

Invensys Electric/Electronics Products Catalog



invensys®

Design innovation with uncompromised reliability

General Information

Invensys Building Systems

Invensys Building Systems is part of the Invensys Controls family with a long tradition of global leadership in building controls technology. We offer the most extensive line of controls and components available to today's market, including: valve bodies, valve assemblies, actuation devices and sensors, as well as interfaces, and automated systems that link these products and other building systems together.

With many patents awarded for our product designs, Invensys offers the most innovative line of state-of-the-art HVAC control systems and devices in the industry. Superior engineering, combined with ISO 9001 certification and six-sigma lean manufacturing, ensures that our products conform to the highest standards of internationally recognized quality, providing solid performance, unsurpassed value, and exceptional reliability for our customers.

Through OEM's, Distributors, and a world-wide network of Field Offices, Invensys Building Systems is a single source for all building control needs. Consult www.invensysbuildings.com (choose Contact Us, and click on the Office Locator) for your nearest Invensys distributor.

Invensys Building Systems Electric and Electronic Products

Building on the heritage of the Barber-Colman, Robertshaw, and Erie™ electric and electronic control product families, Invensys Building Systems offers a complete range of products, including: electromechanical and electronic thermostats, sensors, DuraDrive® and EconoDrive™ valve and damper actuators, Erie PopTop™ zone valves, Erie Boiler Boss® controls, the System 8000 family of controllers and sensors, plus a wide range of accessories to provide all the electrical and electronic control components needed for the installation and maintenance of complete systems.

Organization and Index Systems

The Invensys Building Systems Electric/Electronic Products Catalog is organized alphanumerically by product number. For a brief description of the model numbering system, consult the **Part Numbering System** chart on the following page. A **Subject Index** follows and a **Model Number Index**. The **Subject Index** is used when you know what subject you are looking for, but are not sure of the specific model number of a specific product. The **Model Number Index** mirrors the organization of the catalog and is used when you know the specific model number.

Other Invensys Building Systems Product Catalogs

Invensys Building Systems also offers a complete range of valves and pneumatic products in addition to its electric/electronic products. These are covered in separate catalogs - see the back cover for further information. Electronic versions of all catalogs are also available on a CD.

Visit Us on the Web

Be sure and visit us at www.invensysbuildings.com. You'll find electronic versions of all our catalogs, a complete list of field offices, training information, and links to more information about Invensys Building Systems and Invensys plc.

All specifications are nominal and may change as design improvements are introduced. Invensys shall not be liable for damages resulting from misapplication or misuse of its products.

Manufactured Parts Numbering System

Primary Designation (First Letter)

A	Accessories
H	Humidity
P	Pressure
S	Switch or Step Controller
V	Valve
C	Controller or Controlled Device
M	Motor (Actuator)
R	Receiver-Controller or P.E. Switch

Alpha Prefix Combinations

AD	accessory, electronic or electronic control package
AE	accessory, electric
AH	accessory, humidity
AK	pneumatic relay or positioner
AKR	accessory, pneumatic replacement
AKS	accessory, pneumatic
AL	accessory, pneumatic or E.P. relays
AM	accessory, motor
AP	accessory, pressure
ASP	accessory, electronic
AT	accessory, thermostat
AV	accessory, valve
C	cover, 2" x 2" pneumatic thermostats
CC	controller/controlled device, electronic
CN	multi-purpose bridge, electronic
CP	controller/controlled device, electronic
CT	cover, 2" x 2" pneumatic thermostats
H	humidistat or humidity transmitter, pneumatic
HC	humidity, two-position (three-wire), electric
HKS	humidity or enthalpy

	transmitter, pneumatic
HS	humidity sensor, electronic
HSP	humidity transmitter, electronic
HTSP	humidity/temperature transmitter, electronic
M	motor, pneumatic, with or without positioner
MA	motor, two-position, spring return, electric
MC	motor, two-position (three-wire), electric
MCS	accessories, modular control systems (PNEUMODULAR®)
ME	motor
MF	motor, floating, proportional
MK	motor, pneumatic
MK4	motor, pneumatic with positive positioner
MM	motor, modular
MMC	control card, modular motor
MMR	replacement motor, modular
MP	motor, proportional, electric or electronic
MS	motor, proportional, electronic
MU	motor, proportional, temp., electric or electronic
N	thermostat, accessories
P	pressure or differential pressure transmitter, or receiver-controller, pneumatic
PC	pressure, two-position (three-wire), electric
PCP	PNEUMODULAR control panels
PF	pressure, floating, electric
PKSR	differential water pressure or air velocity transmitters, pneumatic
PP	pressure, proportional, electric or pneumatic
R	electric power relays, pneumatic relays, P.E. switches, and VAV controllers
RKS	receiver-controller, pneumatic

RKSR	receiver-controller, pneumatic replacement
S	switch, pneumatic
SLC	controller, solid-state
SP	step controller, proportional, electric, pneumatic, or electronic
T	thermostat or transmitter, pneumatic
TA	thermostat, two-position, electric
TC	thermostat, two-position, electric
TF	thermostat, floating
THC	enthalpy controller, electric
THCR	enthalpy controller, electric replacement
TK	thermostat, pneumatic
TKR	thermostat, pneumatic replacement
TKS	temperature transmitters, pneumatic
TOOL	calibration fixtures, kits, and tools
TP	thermostat, proportional, electric or electronic
TR	thermostat, pneumatic replacement
TS	temperature sensor, electronic
TSP	temperature transmitter, electronic
VA	valve, two-position, spring return, electric
VB	valve body
VC	valve, two-position (three-wire), electric
VK	valve, pneumatic
VK4	valve, pneumatic with positive positioner
VM	valve, modular motor
VP	valve, proportional, electric or electronic
VS	valve, electronic

Subject Index

Accessories

500 Ohm Resistor	340
Accessory Kit	343
Adapter Plate	317, 374
Angle Damper Clip	326
Bracket	342
Celsius Set Point Dial	318
Damper Rod	326
Damper Shaft Position Indicator/Stroke Limiter	340
Dial Stop Pins	356
Differential Pressure Pick-ups	368
Digital Indicator	350
Duplex Unit Sub-Base	361
Enclosure	322
Expansion Relay	367
Heavy Duty Connecting Link	332
High/Low Signal Selector	321
Legend Plates	362
Metric Conduit Adaptor	345
Modulation Interface	339
Mounting Plates	317
Outdoor Bulb Shield	357
Pilot Light Assembly	368
Position Selector - Manual/Minimum	321
Remote Setpoint Adjusters	351, 352
Rotation Limiter	337
Sequencing, Paralleling, Reversing Module	319
Signal Adapter	320
Single Unit Sub-Base	360
Span Adjustment	338
Static Pressure Probe	348, 349
Terminal Block	366
Thermostat Covers and Inserts	353
Thermostat Guard	316, 363, 364, 365
Universal Clamp	341
Universal Shaft Extension	336
V-Bolt Kit	337
V-Clamp Assembly	336
Wall Plate	315
Warmer/Cooler Set Point Dial	318
Weather Shield	335, 342

Actuator Drives

1 to 15 Vdc Input Electronic Actuator Drive	66
2 to 15 Vdc Input Electronic Actuator Drive	52
4 to 20 mA Input Electronic Actuator Drive	57, 60
Electronic Actuator Drive	55

Actuators

Control Module Card	130
Electric/Electronic Gear Train Modular Actuators	133
Electronic Gear Train Economizer Actuator	196
Electronic Hydraulic Actuator	145

Electronic Positive Positioning Actuator	152
Electronic Positive Positioning Hydraulic Actuator	148
Erie Spring Return Floating & Proportional Actuator	14
Erie Two-Position Damper Actuator	1
Floating Hydraulic Actuator	19, 21, 92, 213, 216
Floating Valve Actuator	95, 98
Non-Spring Return DuraDrive Floating Actuator	107, 111
Non-Spring Return DuraDrive Modulating Actuator	175, 178
Non-Spring Return DuraDrive Proportional Actuator	187
Non-Spring Return DuraDrive Three Position Actuator	109
Non-Spring Return EconoDrive Floating Actuator	120
Non-Spring Return EconoDrive Proportional Actuator	181
Non-Spring Return Floating & Proportional Actuator	16
Non-Spring Return EconoDrive Floating Actuator	114
Proportional Actuators	159, 162
Proportional or Floating Actuators	155
Proportional Valve Actuator	163
Reversible and Proportional Electric Actuators	137
Spring Return DuraDrive Floating Actuator	101, 104, 123
Spring Return DuraDrive Proportional Actuator	166, 172, 189
Spring Return DuraDrive Two-Position Actuator	79, 83
Spring Return DuraDrive Two-Position Actuator	85
Spring Return DuraDrive™ Floating Actuator	104
Spring Return EconoDrive Floating Actuator	117
Spring Return EconoDrive Proportional Actuator	184
Spring Return EconoDrive Two-Position Actuator	74
Spring Return Two-Position Actuator	11
Two-Position Actuators	76
Two-Position, Non-Spring Return Actuators	90
Two-Position, Oil-Submerged Actuators	71

Bulb Wells

Bulb Well	357, 358
High Pressure Brass Well	358
Immersion Well	356

Control Modules

Control Module Card	127
Control Modules	136

Controllers

BB1200 Universal Reset Control	19
BB3000 Injection Mixing Pump Control	21
BB3600 Three-Way Mixing Valve Control	23
Erie Multi-Zone Circulator Control Relay	216
Erie Two Zone Hydro-Air Relay	313
Erie Universal Control Relay	213
Erie Zone Valve Control Center	310
Fan Speed Controller	35, 375
Proportional Pressure Controllers	205
Proportional Temperature Controller (Less Sensor)	209

Subject Index

Proportional Temperature Controller with Sensor	211
Room/Discharge Low Limit Temperature Controller	274
Single/Dual Output Room Temperature Controllers	270
System 8000 Chiller Controller	42
System 8000 Eight-Stage Sequencer Controller	32
System 8000 Four-Step Sequence Controller	27
System 8000 Six Stage Programmable Controllers	45, 48
System 8000 Two-Input Controller/Relay	29
System 8000 Two-Input Temperature or Humidity Controller	37, 40
Two-Position Electric Controller	69
Two-Position Enthalpy Controller	266

Crank Arms

Crank Arms	325
Heavy Duty Crank Arm	332
Motor Crank Arm Kit	327

Enclosures

Control Cabinets	10
Power Relay Enclosure	324

Kits

Accessory Kit	343, 344
Bracket Kit	329
Capacitor Kit	324
Cover Kits	355
Crank Arm Kit	337, 341, 342
Damper Shaft Kits	317
Gasket Cover Kit	331
Lock Cover Screw Kit	355
NEMA 4 Rated Gasket Cover Kit	332
Position Indication Kit	322
Replacement Weather Resistant Kit	328
Set Point Dial Stop Kit	318

Linkage

Damper Linkage Kit	338
--------------------------	-----

Linkages

Actuator/Valve Linkage	347
Ball Joint Linkage Connector	326
Damper Linkage Kits	327
Straight Linkage Connector	325

Mounting

Angle Mounting Bracket	329
Anti-Rotation Bracket	344, 347
Base Mounting Plate	335
Damper Actuator Mounting Adaptor	333, 347
Duct Mounting Kit	357
Liquid Line or Tank Mounting Kit	357
Manual Override Crank	345, 347
Mounting Base Dual	359
Mounting Base Single	359
Mounting Box	315
Mounting Bracket	331, 366, 369
Mounting Bracket Kit	348
Mounting Plate	369
Mounting Ring	315, 316
Multiple Actuator Mounting Bracket	334
Panel Mounting Adaptor	323
Slotted L Mounting Bracket	346
Universal Mounting Bracket	333, 334, 346
Universal Mounting Clamp	343
Universal Mounting Clamps	345
Vinyl Mounting Track	323

Positioners

Positioner	373
Positioners	340

Potentiometers

Potentiometer	330
---------------------	-----

Power Supply

Power Supply	18
--------------------	----

Relays

Actuator Mount Time Delay Relay	331
Paralleling Relay	8
Power Relays	325
System 8000 Controlled Relays	25

Resistors

Precision Resistor	374
Resistor Kits	323

Subject Index

Sensor

Outside Air Sensor	369
Thermistor	369

Sensors

Adjustable Wall Sensor	277
Electronic Room Temperature Sensor	292
Remote Balco Temperature Sensors	288
Remote Platinum Temperature Sensors	286
Remote Sensor	318
Remote Thermistor Temperature Sensors	282
Room Sensor	278
Room Temperature Sensor, Remote Setpoint	290

Switches

Auxiliary Four-Step Switch	330
Auxiliary Two-Step Switch	329
Floating Differential Pressure Switch	202
Floating Pressure Air Flow Switch	203
Pneumatic-Electric Pressure Switch	198
Seasonal Changeover Switch	4
Toggle Switch	367
Two-Position Air Flow Pressure Switch	200

Thermometers

Dial Thermometers	276
-------------------------	-----

Thermostat/Controller

Digital, 3-Wire Floating Thermostat/Controller	229
Digital, Proportional Thermostat/Controller	236, 239
Erie Digital, On/Off Thermostat	220
Erie Non-Digital Proportional Thermostat/Controller	233
Erie Non-Digital, Electronic On/Off Thermostat/Controller	226
Erie Non-Digital, On/Off Low/Line Voltage Thermostat/Controller	223

Thermostats

Electric Proportional Room Thermostats	268
High/Low Temperature Thermostats	244
Low Temperature Thermostats	263
Single Bulb Thermostats	253
Single Stage, Multi-Stage, and Heat Pump Digital Thermostats	246

Strap-on Changeover Thermostat	258
Strap-on Thermostat	259
Two-Position Electric Duplex Room Thermostats	248, 255
Two-Position Electric Room Thermostat, Heating	241
Two-Position, Single & Dual Bulb Thermostats	260

Tools

Auxiliary Switch Adjustment	371
Bellows Compressor	372
Calibration Kit	373
Calibration Wrench	371
Cam Adjustment Wrench	372
Contact Burnishing Tool	371
Pneumatic Thermostat Calibration Kit	372
Positioner	373
Precision Resistor	374
Setpoint Calibration Tool	374
Spanner Head Bit	371
Spanner Head Driver with Bit	371
Wrench	373

Transducers

Duct Pressure Transducer	306
Electronic to Pneumatic Transducer	62, 64
Pressure Transducer	207, 304
Static & Differential Pressure Transducer	308

Transformers

Transformer/Cover Kit	328
Transformers	6

Transmitters

Combination Humidity Transmitters/Temperature Sensors ... 301	
Electronic Humidity Transmitters	298, 301
Humidity/Temperature Transmitters	298
Remote 4 to 20 mAdc Temperature Transmitters	296
Room 4 to 20 mAdc Temperature Transmitters with Platinum Sensors	294
Temperature Transmitters	370

Subject Index

Model Number Index

Model	Page	Model	Page	Model	Page
Numerics		680-243-5	4	AG23B02A	11
10-22	315	680-243-6	4	AG23D020	11
10-48	315	A		AG23D02A	11
10-53	316	AD-8101	319	AG23T020	11
10-58	316	AD-812x	320, 321	AG23T02A	11
10-62	316	AD-8301	321	AG24T020	12
10-82-48	317	AD-8817	322	AG24U020	12
10-82-SS	317	AD-8953	323	AH	11
20-715	316	AD-8954	323	AH13A020	12
453-52	317	AD-8969-101	323	AH13A02A	12
453-69	317	AD-8969-102	323	AH13B020	12
453H	1	AD-8969-10x	323	AH13B02A	12
453H0034GA00	1	AD-8969-202	324	AH13D020	12
453H0034GB00	1	AD-8969-621	324	AH13D02A	12
453H0034GU00	1	AD-89xx	322	AH13T020	12
453H0038GA00	1	AE-201	6	AH13T02A	12
453H0038GA01	1	AE-207-120	6	AH13U020	12
453H0038GB00	1	AE-207-277	6	AH13U02A	12
453H0038GB01	1	AE-300	324	AH14A020	12
453H0038GU00	1	AE-304	325	AH14A02A	12
453H0038GU01	1	AE-314	325	AH14B020	12
453H0074GA00	1	AE-504	8	AH14B02A	12
453H0074GB00	1	AE-629	10	AH14D020	12
453H0074GU00	1	AE-630	10	AH14D02A	12
453H0077GA00	1	AE-631	10	AH14T020	12
453H0077GA01	2	AE-632	10	AH14U020	12
453H0077GB00	2	AE-662-501	10	AH23A020	12
453H0077GB01	2	AE-662-502	10	AH23A02A	12
453H0077GU00	2	AE-662-503	10	AH23B020	12
453L	1	AEM-8120-005	6	AH23B02A	12
453L0034GA00	1	AEM-8120-010	6	AH23U020	12
453L0034GB00	1	AEM-8240-005	6	AH23U02A	12
453L0034GU00	1	AEM-8240-010	6	AH24A020	12
453L0038GA00	2	AG	11	AH24A02A	12
453L0038GA01	2	AG13A01A	11	AH24B020	12
453L0038GB00	2	AG13A020	11	AH24B02A	12
453L0038GB01	2	AG13A02A	11	AH24D020	12
453L0038GU00	2	AG13B020	11	AH24D02A	12
453L0038GU01	2	AG13B02A	11	AH24T020	12
453L0074GA00	2	AG13D020	11	AH24U020	12
453L0074GB00	2	AG13D02A	11	AH24U02A	12
453L0074GU00	2	AG13T020	11	AM-111	325
453L0077GA00	2	AG13T02A	11	AM-112	325
453L0077GA01	2	AG13U020	11	AM-113	325
453L0077GB00	2	AG13U02A	11	AM-115	325
453L0077GB01	2	AG14A020	11	AM-116	325
453L0077GU00	2	AG14A02A	11	AM-122	325
453L0077GU01	2	AG14B020	11	AM-123	326
453R	1	AG14B02A	11	AM-125	326
453R0077GA00	2	AG14D020	11	AM-125-048	326
453R0077GB00	2	AG14D02A	11	AM-125-600	326
453R0077GU00	2	AG14T020	11	AM-132	326
6-371	315	AG14U020	11	AM-161	327
65170	318	AG14U02A	11	AM-161-1	327
65345	317	AG23A01A	11	AM-161-3	327
65410	318	AG23A020	11	AM-230	327
65671	318	AG23A02A	11	AM-231	328
65860	318	AG23B020	11	AM-232	328

Model Number Index

Model	Page	Model	Page	Model	Page
AM-237	329	AP-305	349	AT-8258-101	351
AM-301	329	AP33A000	16	AT-82xx	351
AM-321	329	ASP-8111	350	AT-8435	351
AM-332	330	ASP-8112	350	AT-8522	351
AM-341	330	ASP-8121	350	AT-8901	351
AM-345	331	ASP-8131	350	B	
AM-348	331	ASP-81xx	350	BB1200	19
AM-363	331	ASP-8311-120	18	BB3000	21
AM-369	332	ASP-8311-240	18	BB3600	23
AM-392	332	AT-10	353	BYZP-145	366
AM-394	332	AT-101	355	BYZP-146	366
AM-601	333	AT-104	356	BYZP-252	366
AM-671	333	AT-1103	363	BYZP-253	366
AM-672	334	AT-1104	364	BYZP-269-2	366
AM-673	334	AT-1105	364	BYZP-xxx	366
AM-674	335	AT-1155	364	C	
AM-675	335	AT-1163	363	CC-8102	25
AM-676	336	AT-1165	365	CC-8102-024	25
AM-686	336	AT13A00T	14	CC-8103	25
AM-687	336	AT-1x Series	353	CC-8103-240	25
AM-688	336	AT-201	356	CC-8104	27
AM-689	337	AT-203	356	CC-8111-024	29
AM-690	337	AT-206	356	CC-8111-120	29
AM-691	337	AT-208	357	CC-8111-240	29
AM-692	337	AT-209	357	CC-8118-120	32
AM-693	338	AT-211	357	CP-5341	35
AM-703	338	AT-215	357	CP-8102	37
AM-704	339	AT-219	358	CP-8102-116	37
AM-705	340	AT-225	358	CP-8122	40
AM-706	340	AT-226	358	CP-8142-024	42
AM-708	340	AT23A00T	14	CP-8161-333	45
AM-709	340	AT-2x Series	353	CP-8161-433	45
AM-710	341	AT33A000	16	CP-8261-333	48
AM-711	341	AT33A00T	16	CP-8261-702	48
AM-712	341	AT-504	359	CP-8301-024	52
AM-713	342	AT-505	359	CP-8301-120	52
AM-714	342	AT-546	359	CP-8301-240	52
AM-715	342	AT-602	360	CP-8391-456	55
AM-717	343	AT-603	360	CP-8391-716	57
AM-726	343	AT-607	361	CP-8391-910	60
AM-727	343	AT-608	361	CP-8391-913	60
AM-728	344	AT-609	362	CP-8511-024	62
AM-751	344	AT-61	353	CP-8551	64
AM-752	344	AT-70	353	CP-8552	64
AM-753	345, 346	AT-80	355	CP-9301	66
AM-754	345	AT-8122	351	CP-9301-456	66
AM-755	345, 347	AT-8122-420	352	CP-9302	66
AM-756	345	AT-8155	351	CP-9302-702	66
AM-759	346	AT-8158	351	CYZP-105	367
AM-760	346	AT-81xx	351	CYZP-11	367
AM-761	347	AT-8222-101	351	CYZP-268	367
AM-762	347	AT-8222-102	352	CYZP-346	367
AM-764	347	AT-8222-201	352	CYZP-347	367
AM-770	347	AT-8222-202	352	CYZP-427	367
AM-771	348	AT-8222-203	352	E	
AP13A000	14	AT-8222-205	352	EXP10	367
AP23A000	14	AT-8222-206	352	EYZP-504-1	368
AP-302	348	AT-8222-xxx	352		

Model Number Index

Model	Page	Model	Page	Model	Page
EYZP-504-2	368	MA51-7203	86	MF41-7073	101
EYZP-504-3	368	MA-5210	76	MF41-7073-502	101
EYZP-721	368	MA-5210-500	76	MF41-7153	101
EYZP-722-1	368	MA-5211	76	MF41-7153-502	101
EYZP-722-2	368	MA-5211-500	76	MF4D-6043-100	114
EYZP-722-3	368	MA-5213	76	MF4D-6083-100	114
EYZP-722-4	368	MA-5213-500	76	MF4D-7033-100	117
EYZP-722-5	368	MA-5330	76	MF4D-8033-100	117
EYZP-xxx	368	MA-5333	76	MF4E-60430-100	120
H		MA5-419	71	MF4E-60830-100	120
HC-101	69	MA5-419-500	71	MF51-7103-000	123
HC-201	69	MA61-7200	86	MF51-7103-100	123
M		MA61-7201	86	MF51-7203	123
MA-305	71	MA61-7203	86	MF-5413	92
MA-305-500	71	MA6-305	72	MF-5413-500	92
MA-318	71	MA6-305-500	72	MF-5433	92
MA-318-500	71	MA6-318	72	MF-5513	92
MA-405	71	MA6-318-500	72	MF-5513-500	92
MA-405-500	71	MA6-405	72	MF-5533	92
MA40-7040	79	MA6-405-500	72	MF61-7203	123
MA40-7040-501	79	MA6-416	72	MF-63103	98
MA40-7041	79	MA6-416-500	72	MF-63103-500	98
MA40-7041-501	79	MA6-418	72	MF-63123	98
MA40-7043	79	MA6-418-500	72	MF-63123-201	98
MA40-7043-501	79	MA6-419	72	MF-63123-500	98
MA40-7170	83	MA6-419-500	72	MFC-420	127
MA40-7171	83	MA7-419	72	MFC-8000	130
MA40-7173	83	MA7-419-500	72	MM-400	133
MA-416	71	MA8-318	72	MM-400-002	133
MA-416-500	71	MA8-318-500	72	MM-500	133
MA41-7070	79	MA8-416	72	MM-500-002	133
MA41-7070-502	79	MA8-416-500	72	MMC-401	136
MA41-7071	79	MA8-418	72	MMC-420	136
MA41-7071-502	79	MA8-418-500	72	MMC-421	136
MA41-7073	79	MA8-419	72	MMC-468	136
MA41-7073-502	79	MA8-419-500	72	MMC-8000	136
MA41-7150	79	MC-351	90	MMC-90	136
MA41-7150-502	79	MC-421	90	MMR-400	133
MA41-7151	79	MC-431	90	MMR-400-002	133
MA41-7151-502	79	MC-4311	90	MMR-500	133
MA41-7153	79	MC5-4311	90	MMR-500-002	133
MA41-7153-502	79	MF-22203	95	MP-2113-500	139
MA-418	71	MF-22303	95	MP-2130-500	139
MA-418-500	71	MF-22323	95	MP-2150-500	139
MA-419	71	MF-23203	95	MP-2151-500	139
MA-419-500	71	MF-23303	95	MP-361	137
MA4D-7030-000	74	MF-23323	95	MP-361-600	137
MA4D-7031-000	74	MF40-7043	101	MP-361-691	137
MA4D-7033-100	74	MF40-7043-501	101	MP-367	137
MA4D-8030-000	74	MF40-7173	104	MP-371	137
MA4D-8031-000	74	MF41-6043	107	MP-371-600	137
MA4D-8033-100	74	MF41-6043-502	107	MP-371-691	137
MA51-7100	85	MF41-6043-510	107	MP-377	137
MA51-7101	85	MF41-6083	107	MP-379	137
MA51-7103-000	85	MF41-6083-502	107	MP-381	137
MA51-7103-100	85	MF41-6083-510	107	MP-382	137
MA51-7200	86	MF41-6153	109	MP-387	137
MA51-7201	86	MF41-6343	111	MP-389	137

Model Number Index

Model	Page	Model	Page	Model	Page
MP-421	138	MPR-5613	159	MS51-7103-130	190
MP-422	138	MPR-5630	159	MS51-7103-140	190
MP-423	138	MPR-5633	159	MS51-7103-150	190
MP-424	138	MPR-5713	162	MS51-7103-160	190
MP-451	138	MR-461-691	138	MS51-7203	190
MP-452	138	MS-22353	163	MS51-7203-040	190
MP-453	138	MS40-7043	166	MS61-7203	190
MP-454	138	MS40-7043-501	166	MS61-7203-040	190
MP-461-600	138	MS40-7043-MP	166	MS61-7203-050	190
MP-465	138	MS40-7043-MP5	166	MS-7203-050	190
MP-470	138	MS40-7170	172	MU-12313	196
MP-4701	139	MS40-7171	172	MU-12313-100	196
MP-471-600	138	MS40-7173	172	N	
MP-471-691	138	MS41-6043	175	N1-51	368
MP-475	138	MS41-6043-502	175	N1-52	368
MP-480	138	MS41-6043-520	175	N1-53	368
MP-481	138	MS41-6043-522	175	N5-52	369
MP-481-600	138	MS41-6083	175	N5-53	369
MP-481-691	138	MS41-6083-502	175	O	
MP-483	138	MS41-6083-520	175	OAS-1	369
MP-485	138	MS41-6083-522	175	P	
MP-4851	139	MS41-6153	178	PC-110	198
MP-486	138	MS41-6153-502	178	PC-131	198
MP-495	138	MS41-6340	187	PC-132	198
MP-5210	145	MS41-6341	187	PC-151	198
MP-5210-500	145	MS41-6343	187	PC-301	200
MP-5211	145	MS41-7073	166	PF-126	202
MP-5211-500	145	MS41-7073-502	166	PF-305	203
MP-5213	145	MS41-7153	166	PF-306	203
MP-5213-500	145	MS41-7153-502	166	PF-307	203
MP-5230	145	MS4D-6043-100	181	PF-308	203
MP-5233	145	MS4D-6043-120	181	PP-221	205
MP5-381	137	MS4D-6043-130	181	PP-222	205
MP-5410	148	MS4D-6043-150	181	PP-223	205
MP-5411	148	MS4D-6043-160	181	PP-224	205
MP-5413	148	MS4D-6083-100	181	PP-225	205
MP-5430	148	MS4D-6083-120	181	PP-226	205
MP-5433	148	MS4D-6083-130	181	PP-8311-024-0-0-1	207
MP5-4651	139	MS4D-6083-150	181	PP-8311-120-0-0-1	207
MP5-4751	139	MS4D-6083-160	181	S	
MP5-483	138	MS4D-7033-100	184	SENS-10K	369
MP5-4851	139	MS4D-7033-120	184	SLC-8112	209
MP-5510	152	MS4D-7033-130	184	SLC-8113	209
MP-5511	152	MS4D-7033-150	184	SLC-8114	209
MP-5513	152	MS4D-7033-160	184	SLC-8322	211
MP-5530	152	MS4D-8033-100	184	SLC-8323	211
MP-5533	152	MS4D-8033-120	184	SLC-8324	211
MP6-4xx	139	MS4D-8033-130	184	SLC-8332	211
MP7-3xx	139	MS4D-8033-150	184	SLC-8333	211
MP7-4xx	139	MS4D-8033-160	184	SR100	213
MP-9713	155	MS51-7103-000	190	SR201	216
MP-9750	155	MS51-7103-020	190	SR201AT	216
MP-9810	155	MS51-7103-030	190	SR201B	216
MP-9830	155	MS51-7103-040	190	SR301	216
MP-9910	155	MS51-7103-050	190	SR301AT	216
MP-9xxx Series	155	MS51-7103-060	190	SR301B	216
MPR-5610	159	MS51-7103-100	190	SR601	216
MPR-5611	159	MS51-7103-120	190		

Model Number Index

Model	Page	Model	Page	Model	Page
SR601AT	216	TA-3432	244	TC-4122	260
SR601B	216	TA-3433	244	TC-4123	260
ST100AT	213	TA-3434	244	TC-4151	260
SYZE-102	367	TA-3441	244	TC-4152	260
SYZE-189	367	TB-155-10	226	TC-4166	260
SYZE-212	367	TB-155-15	226	TC-4211	260
SYZE-255	367	TB-158-1	229	TC-4221	260
SYZE-271	367	TB-158-15	229	TC-4222	260
SYZE-293	367	TB-158-17	229	TC-4223	260
SYZE-300	367	TB-158-18	229	TC-4251	260
SYZE-52	367	TB-158-2	229	TC-4252	260
SYZE-74	367	TB-158-3	229	TC-4266	260
SYZE-75	367	TB-158-7	229	TC-5231	263
T		TB-167-1	233	TC-5232	263
T158	229	TB-170-9	239	TC-5241	263
T168	236	TC-1101	249	TC-5242	263
T170	239	TC-1101-116	249	TC97-M	246
T200	220	TC-1101-500	249	TC97-MHP	246
T201	220	TC-1102	249	TC-97-S	246
T201-FP	220	TC-1102-116	249	TC97-SHP	246
T204	220	TC-1102-500	249	TC98-M	246
T205	220	TC-1102-602	249	TC98-MHP	246
T205-FP	220	TC-1103	249	TC98-S	246
T207	220	TC-1103-116	249	TF-1111	249
T207-FP	220	TC-1103-500	249	TF-1111-116	249
T511	223	TC-114	248	THC-2	266
T511F	223	TC-1151	255	THC-3	266
T513	223	TC-1151-116	255	THCR-4	266
T513F	223	TC-1161	255	TOOL-11	371
TA-1101	241	TC-1161-116	255	TOOL-110	373
TA-1101-116	241	TC-1161-479	255	TOOL-111	373
TA-1101-602	241	TC-1161-530	255	TOOL-112	373
TA-1101-770	241	TC-1161-531	255	TOOL-113	373
TA-1102	241	TC-1191	249	TOOL-115	373
TA-1102-116	241	TC-1191-116	249	TOOL-11X	373
TA-1102-602	241	TC-1191-500	249	TOOL-12	371
TA-1102-770	241	TC-1191-602	249	TOOL-13	371
TA-1501	241	TC-186	248	TOOL-14	371
TA-1501-116	241	TC-187	248	TOOL-15	371
TA-1501-770	241	TC-187-116	248	TOOL-16	372
TA-155-10	226	TC-188	248	TOOL-201	373
TA-155-17	226	TC-188-116	248	TOOL-202	373
TA-155-18	226	TC-195	248	TOOL-203	374
TA-158-1	229	TC-199	248	TOOL-204	374
TA-158-2	229	TC-202	253	TOOL-205	374
TA-167-1	233	TC-252	253	TOOL-207	374
TA-167-3	233	TC-271	253	TOOL-23	372
TA-168-1	236	TC-282	253	TOOL-95-1	372
TA-168-2	236	TC-282-20	253	TP	270
TA-168-3	236	TC-288	253	TP-1011	268
TA-168-4	236	TC-2931	258	TP-1031	268
TA-168-5	236	TC-2942	258	TP-8101	270
TA-168-6	236	TC-2974	259	TP-8101-116	270
TA-168-7	236	TC-4111	260	TP-8102	270
TA-168-8	236	TC-4111-020	260	TP-8102	270
TA-168-9	236	TC-4112	260	TP-8102-116	270
TA-170-16	239	TC-4115	260	TP-8121	270
TA-170-18	239	TC-4121	260	TP-8121	270

Model Number Index

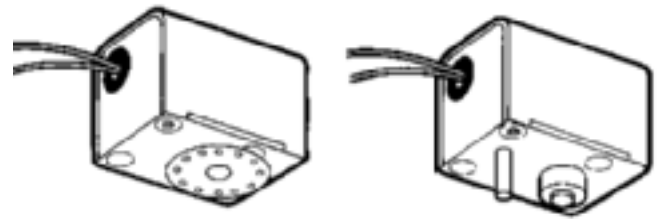
Model	Page	Model	Page
TP-8124	270	TS-8811	290
TP-8124	270	TS-8811-116	290
TP-8232	274	TSMN-57011-850	292
TP-8232-116	274	TSMN-58011	292
TS-291	276	TSMN-81011	292
TS-292	276	TSP-8101	370
TS-293	276	TSP-8101-103	370
TS-294	276	TSP-8111	370
TS-5191	277	TSP-8111-103	370
TS-57011	278	TSP-84152	294
TS-57011-850	278	TSP-84252	294
TS-57031	278	TSP-84553	296
TS-57031-850	278	TSP-84654	296
TS-5711	278	TSP-84656	296
TS-5711-850	278	TSP-84704	296
TS-5721	282	TSP-84804	296
TS-5721-101	282	TSP-84957	296
TS-5721-102	282	TSP-85552	296
TS-5721-110	282	TSP-85554	296
TS-5721-850	283	TSP-85555	296
TS-5721-851	283	TSP-85557	296
TS-5721-852	283	TSP-85653	296
TS-5721-853	283	TSP-85703	296
TS-5721-854	283	TSP-85803	296
TS-5721-901	282	TSP-85956	296
TS-5722-851	283		
TS-5722-852	283	V	
TS-5722-853	283	VER-PHx-07-S	304
TS-5722-901	282	VER-PHx-08-S	304
TS-5751	282	VER-PHx-09-S	304
TS-5751-850	283	VER-PxDLx-01S	306
TS-5771	282	VER-PxDLx-02S	306
TS-5771-850	283	VER-PxDx-015	306
TS-58011	279	VER-PxDxx-025	306
TS-58011-770	279	VER-PxpLx-01S	308
TS-5811	279	VER-PxpLxx-02S	308
TS-5821	286	VER-Pxpxx-01S	308
TS-5821-101	286	VER-PxPxx-02S	308
TS-5821-110	286	VL500	310
TS-5851	286		
TS-5871	286	W	
TS-8101	279	WA300	313
TS-81011	279	WP500	374
TS-81031	279		
TS-81031-770	279		
TS-8111	279		
TS-8111-116	279		
TS-8131	288		
TS-8201	288		
TS-8201-106	288		
TS-8201-110	288		
TS-8204	288		
TS-8261	288		
TS-8281	288		
TS-8281-101	288		
TS-8405	288		
TS-8422	288		
TS-8501	288		

Erie™ Two-Position Damper Actuator

The 453L light duty damper actuators are designed for a variety of two-position, spring return, damper applications. They are suitable for up to 125 in² (806 cm²) of balanced damper. The 453L uses a two-wire thermostat control. Linkage hardware must be supplied by the end user.

The 453H medium duty damper actuators are designed for a variety of two-position, spring return damper applications. They are suitable for up to 250 in² (1,613 cm²) of balanced damper. The 453H uses a two-wire thermostat control. Linkage hardware must be supplied by the end user.

The 453R medium duty non-spring return damper actuators are designed for two-position, motor open and motor closed, damper applications. They are suitable for up to 500 in² (3,225 cm²) of balanced damper. The 453R uses a three-wire thermostat control. Linkage hardware must be supplied by the end user.



Linkage Drive

Direct Drive



Features:

- Available with end switch.
- Linkage or direct drive available.
- Hysteresis synchronous motor with a “lost motion” drive to protect the gear train from closing shock.

Model Chart									
Model No.	Description	Voltage Vac	Drive Direction of Rotation ^a	Torque Rating in.-oz.				Stroke Speed in Seconds	
				Motor Driven		Spring Return		Motor Driven	Spring Return
				0°	84°	0°	84°		
453H0034GA00	Linkage Drive	24	CCW	55	35	35	55	27 @ 60 Hz 32 @ 50 Hz	8 @ 50/60 Hz
453H0034GB00		120							
453H0034GU00		230							
453H0038GA00		24							
453H0038GA01	Linkage Drive with End Switch	120	CW	55	35	35	55	27 @ 60 Hz 32 @ 50 Hz	8 @ 50/60 Hz
453H0038GB00	Linkage Drive								
453H0038GB01	Linkage Drive with End Switch								
453H0038GU00	Linkage Drive								
453H0038GU01	Linkage Drive with End Switch	230							
453H0074GA00	Direct Drive	24	CCW	45	25	17	25	18 @ 60 Hz 22 @ 50 Hz	6 @ 50/60 Hz
453H0074GB00		120							
453H0074GU00		230							
453L0034GA00		24							
453L0034GB00	Linkage Drive	120	CCW	45	25	17	25	18 @ 60 Hz 22 @ 50 Hz	6 @ 50/60 Hz
453L0034GU00		230							
453H0077GA00		24							

^a Drive direction as viewed from the bottom of the actuator.

453L, 453H, 453R Series

Model Chart (Continued)

Model No.	Description	Voltage Vac	Drive Direction of Rotation ^a	Torque Rating in.-oz.				Stroke Speed in Seconds	
				Motor Driven		Spring Return		Motor Driven	Spring Return
				0°	84°	0°	84°		
453H0077GA01	Direct Drive with End Switch	24	CCW	55	35	35	55	27 @ 60 Hz 32 @ 50 Hz	8 @ 50/60 Hz
453H0077GB00	Direct Drive	120							
453H0077GB01	Direct Drive with End Switch								
453H0077GU00	Direct Drive	230							
453L0038GA00			CW	45	25	17	25	18 @ 60 Hz 22 @ 50 Hz	6 @ 50/60 Hz
453L0038GA01	Linkage Drive with End Switch	24							
453L0038GB00	Linkage Drive								
453L0038GB01	Linkage Drive with End Switch	120							
453L0038GU00	Linkage Drive								
453L0038GU01	Linkage Drive with End Switch	230							
453L0074GA00	Direct Drive	24	CCW	45	25	17	25	18 @ 60 Hz 22 @ 50 Hz	6 @ 50/60 Hz
453L0074GB00		120							
453L0074GU00		230							
453L0077GA00		24	CW						
453L0077GA01	Direct Drive with End Switch								
453L0077GB00	Direct Drive	120							
453L0077GB01	Direct Drive with End Switch								
453L0077GU00	Direct Drive	230							
453L0077GU01	Direct Drive with End Switch								
453R0077GA00	Direct Drive 3-wire Control	24	—	150	150	—	—	37 @ 60 Hz 45 @ 50 Hz	Non-Spring Return
453R0077GB00		120							
453R0077GU00		240							

^a Drive direction as viewed from the bottom of the actuator.

Specifications

Inputs

Control signal	SPST for spring return, SPDT for non-spring return.
Power	24 Vac @ 50/60 Hz; 110/120 Vac @ 50/60 Hz; 220/230 Vac @ 50/60 Hz. 453L, 453R: 6.5 W, 7 VA. 453H: 6.5W, 10 VA. End switch: 10 Amps @ 120 Vac.

Outputs

Motor Type	Synchronous AC.
Mechanical	Direction of rotation: CW or CCW rotation. Maximum close-off torque: See Model Chart.

Environment

Ambient temperature limits	Shipping and storage: -40 to 169°F (-40 to 71°C). Operating: 0 to 120°F (-17 to 49°C).
Humidity	Non-condensing.
Locations	NEMA Type 1.

Agency Listings

UL	File #E37601.
CSA	File #LR19535 listed, CE compliant.

General Instructions Refer to F-27028.

Accessories

Model No.	Description
453-52	6 to 12 in. damper shaft extension kit.
453-69	12 to 20 in. damper shaft extension kit.
453-239	5/16 to 1/2 in. shaft adaptor.

Typical Applications

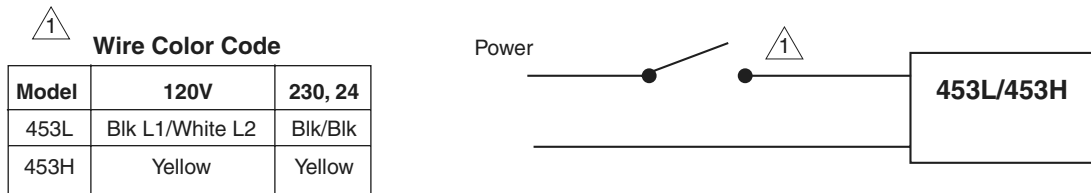


Figure 1 Typical Wiring Diagram, 453L/453H Models.

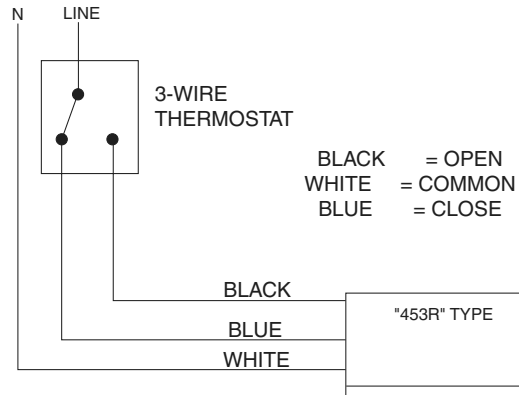


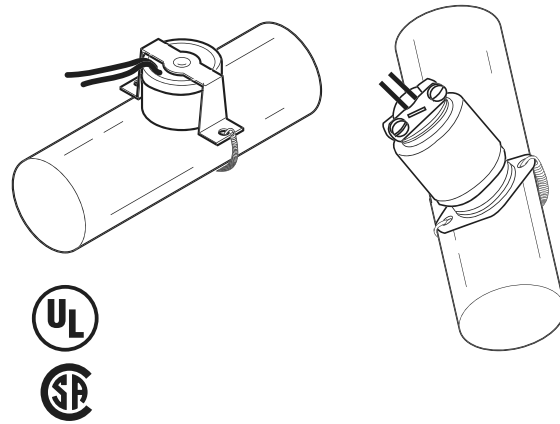
Figure 2 453R with Three-Wire Thermostat.

680 Series

Erie™ Seasonal Changeover Switch

The 680 series low or line voltage changeover switches are designed to switch a thermostat from heating to cooling based on a change in supply water temperature. The 680 series switches can be mounted on 5/8 in. or 7/8 in. O.D. copper tube or iron pipe.

Both models are easily mounted to the supply piping with a simple spring clip included with the thermostat. Each thermostat also includes the necessary wire nuts and strain relief bushing.



Features:

- Add-on switch for seasonal change over.
- Includes all necessary parts for installation.
- Snap acting SPDT.

Model Chart					
Model No.	Voltage	Inductive		Resistive Amps	Description
		FLA	LRA		
680-243-5	120	5.8	34.8	10	Standard changeover switch
	240	2.9	17.4	5	
680-243-6	120	10.0	60.0	25	Includes a conduit connection
	240	5.0	30.0	25	

See TC-2931/2942 for other models.

Specifications	
Inputs	
Connections	Color coded leads, 36 in (914 mm).
Outputs	
Mechanical	Changeover temperature range: Below 65 ±5°F white and blue (cool) make, above 83 ±5°F white and black (heat) make.
Environment	
Ambient temperature limits	Shipping and storage: -20 to 176°F (-29 to 80°C). Operating: 220°F (104°C) fluid at ambient temperature of 125°F (52°C)
Locations	NEMA Type 1.
Agency Listings	
UL Listed	UL-873, Underwriters Laboratories Listed (File #E29653).
CSA	Canadian Standards File #LR10281.
General Instructions	Refer to F-26932.

Typical Applications

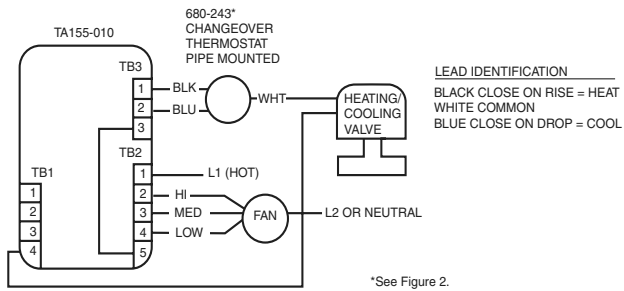


Figure 1 Typical Wiring.

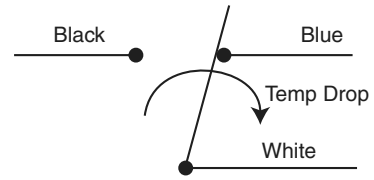


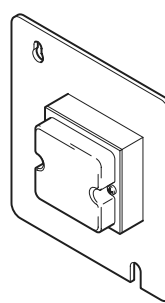
Figure 2 Switch Action on Temperature Drop.

Transformers

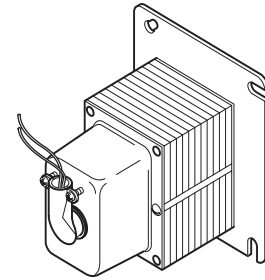
These transformers supply low voltage power for operating control equipment. The AEM-8120 series provides low voltage power sources from 50 to 100 Va, and are the only recommended transformers for use with the System 8000 Series Controller.

Features:

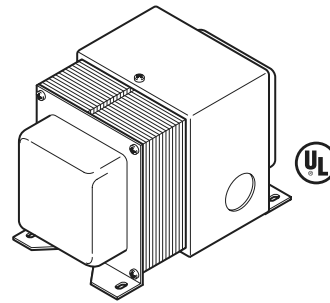
- Many varieties for use with specific requirements.
- Ratings that meet requirements for Invensys electrical products.
- Agency approval, AEM-8120 and AEM-8240 transformers are UL listed.



AE-207-120
AE-207-277



AE-201



AEM-8120-005
AEM-8240-005
AEM-8120-010
AEM-8240-010

Model Chart

Description.					
Model No.	Capacity VA	Primary Voltage	Hz	Secondary Voltage	Fig. No.
AE-201	50	120	50/60	24	1
AE-207-120	20	120			2
AE-207-277		277			2
AEM-8120-005	50	120			3
AEM-8240-005		240			
AEM-8120-010	100	120			
AEM-8240-010		240			

Dimensions.

Model No.	Dimensions in. (mm)				
	A	B	C	D	E
AE-201	4-3/8 (111)	—	—	—	—
AE-207-120	—				
AE-207-277	—				
AEM-8120-005	5-1/2 (140)	4-3/8 (111)	3-15/16 (100)	3-1/8 (80)	3-1/2 (89)
AEM-8240-005					
AEM-8120-010	5-15/16 (151)	4-11/16 (119)			
AEM-8240-010					

AE-20X Series, AEM-8120 Series, AEM-8240 Series

Specifications

Electrical ratings	Refer to Description Model Chart.
Secondary connections	
AE-201	Flexible conduit fitting.
AE-207 series	Color coded leads.
Locations	NEMA Type 1.
Mounting	Primarily in control centers in conjunction with disconnect switch and overload circuit breaker. AE-201 is provided with a plate on the primary side for mounting on standard 4 in. outlet box. AE-207 series are provided with plate for mounting on standard 4 in. outlet box.
Dimensions	Refer to Dimensions Model Chart, Figure 1, Figure 2, and Figure 3.
Agency Listing	AEM models — UL Listed.
General Instructions	AEM-8xxx: Refer to F-21670.

Typical Applications

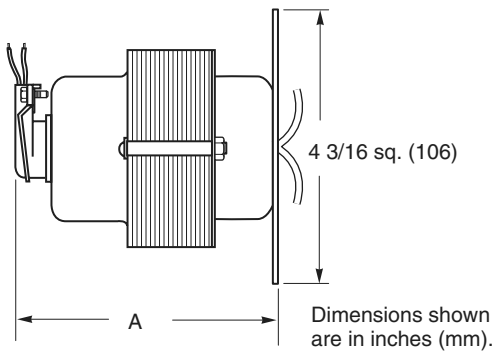


Figure 1 Mounting Dimensions AE-201.

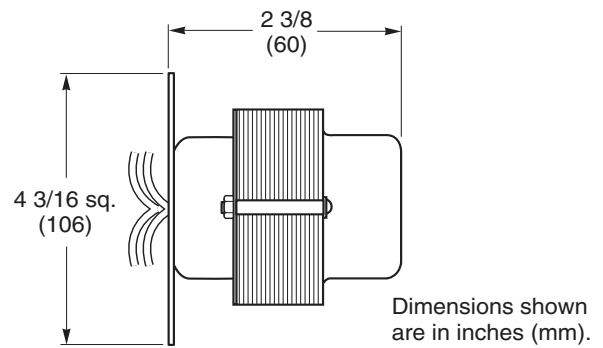


Figure 2 Mounting Dimensions AE-207-xxx.

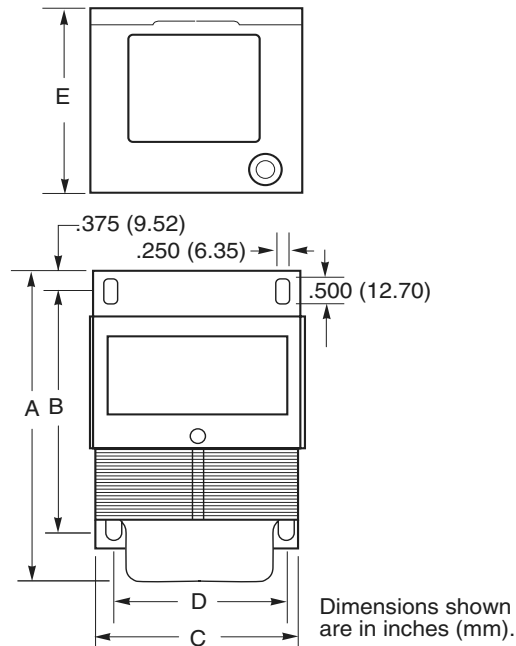


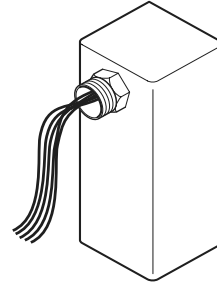
Figure 3 Mounting Dimensions AEM-8120 Series and AEM-8240 Series.

Paralleling Relay

Paralleling relay for controlling or manually positioning MP type proportional gear train actuators from a potentiometer (slidewire).

Features:

- Provides interface between a 100 to 1000 Ω potentiometer and a gear train actuator.
- Mounts directly to the gear train actuator.



Model Chart				
Model No.	Transmitting Potentiometer Requirements			Actuators Controlled by AE-504
	Max. Ω	Watts per AE-504	Max. No. of AE-504s per Potentiometer	
AE-504	100 ^a to 135	1.5	3	MP-300, 400, 2000, 4000, 9700 Series, MP-9810 ^b , 9830 ^b , 9910 ^b
	136 to 1000	3	1	

^a Actuator equipped with AM-332 potentiometer kit.

^b Requires AM-345.

Specifications	
Inputs	
Signal	100 to 1000 Ω potentiometer. Up to 3 actuators, each equipped with an AE-504, can be operated from an AM-332 or a 135 Ω slidewire.
Power	24 Vac, 50/60 Hz, 5 VA, normally supplied from an actuator. Line voltage actuator must have built-in transformer.
Impedance	50 Ω at 0 Vac, 350 Ω at 12 Vac.
Environment	
Ambient temperature limits	Shipping and storage: -40 to 140°F (-40 to 60°C). Operating: 30 to 135°F (-1 to 57°C).
Humidity	5 to 95% RH, non-condensing.
Locations	NEMA Type 1.
Case	Epoxy.
Connections	Six 8 in. (203 mm) color coded leads.
Mounting	Panel mounted with adhesive pads provided. Unit is supplied with 1/2 in. threaded connector and mounting nut for direct mounting to actuator.
Dimensions	3-1/2 H x 2 W x 2 D in. (89 x 51 x 51 mm).
General Instructions	Refer to F-16524.

Typical Applications

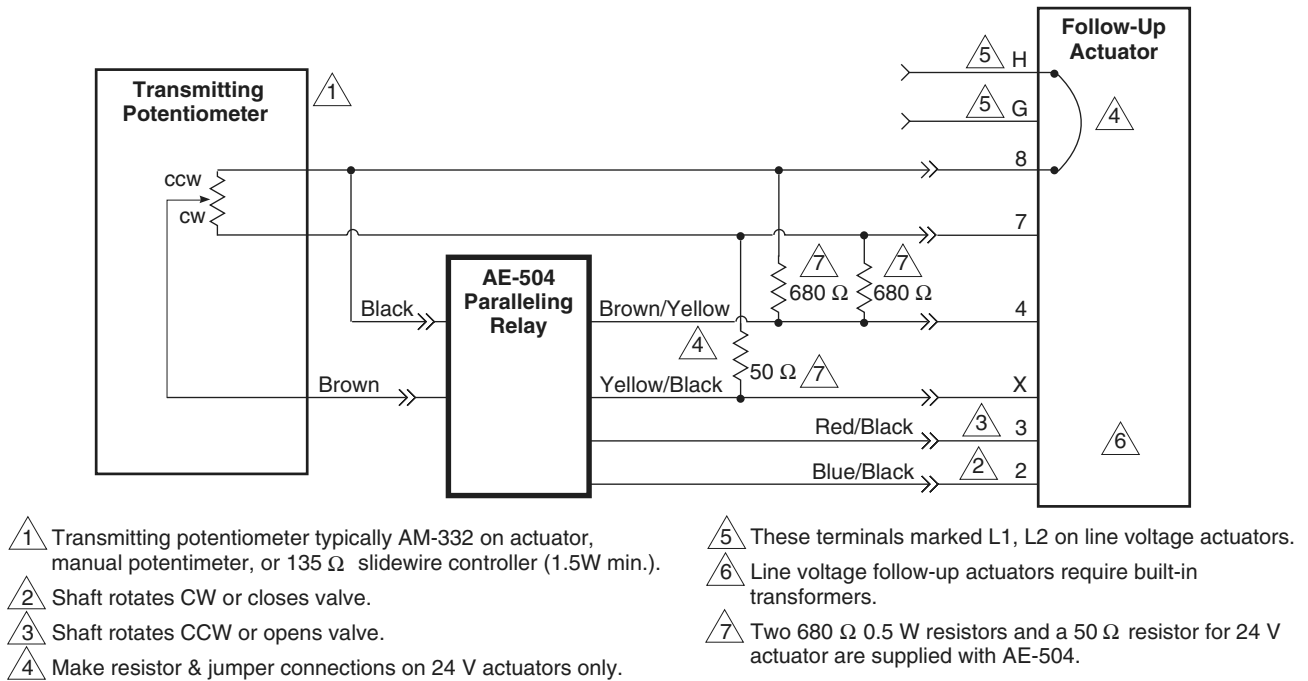


Figure 1 Wiring for AE-504.

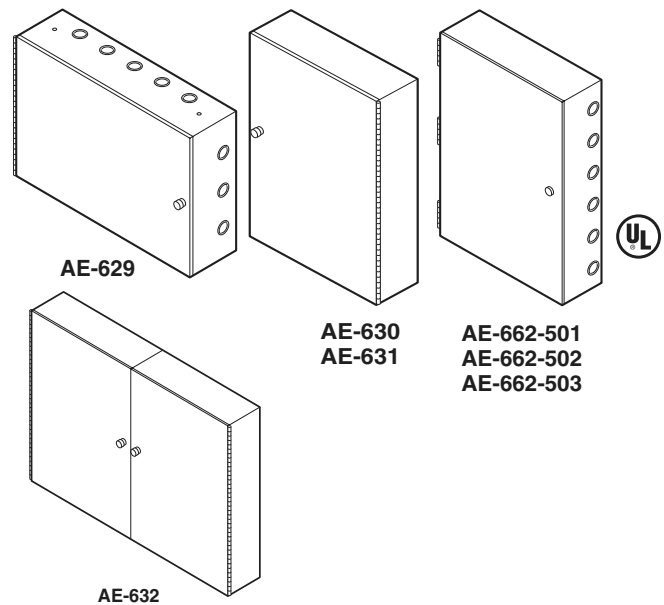
AE-600 Series

Control Cabinets

Control cabinets for mounting of electric, electronic, and pneumatic controls.

Features:

- New lock design for AE-629, 630, 631, and 632 improves locking ability.
- Available subpanels for certain cabinets for easy equipment mounting.
- AE-662 Series UL listed.



Model Chart							
Model No.	Door		Steel Gauge	Subpanel	Finish	Knockouts	Dimensions in. (mm)
	Type	Opening					
AE-629	Single, continuously hinged	Right or left-handed	18	AE-630-101 16 GA perforated 14-1/2 x 20 in.	Beige paint	For 3/4 in. conduit, two on each side	24 W x 16 H x 7 D (610 x 406 x 178)
AE-630				AE-631-101 22-1/2 x 28 in.			16 W x 24 H x 7 D (406 x 610 x 178)
AE-631				Obtain locally, one or two subpanels may be used			24 W x 32 H x 7 D (610 x 813 x 178)
AE-632	Double, continuously hinged	Right and left-handed	16	42 W x 36 H x 7 D (1067 x 914 x 178)			
AE-662-501	Single, three hinges	Left-handed	14	16 gage, perforated for #8 Type A sheet metal screws, flanged, included	White paint	Five on top & bottom, six on each side for 3/4 in. or 1 in. conduit. Eight 3/8 in. dia. on top & bottom, ten on each side for 3/8 in. bulkhead barbed pneumatic fittings	24 W x 30 H x 7-1/2 D (610 x 762 x 191)
AE-662-502				16 gage, solid, flanged, included			
AE-662-503				None, mounting studs for subpanel not provided			

Specifications

Construction	
Doors	Locking type, supplied with keys, rigidly supported. The doors are easily removed for protection on job site installation or mounting of components. Refer to Model Chart.
Steel gauge	Refer to Model Chart.
Knockouts	Aligned so that a short nipple may be used to couple the panels. Refer to Model Chart.
Appearance	Refer to Model Chart.
Locations	NEMA Type 1.
Mounting	Four extruded mounting holes 1/4 in. (6 mm).
Dimensions	Refer to Model Chart.
Agency Listing	AE-662-xxx — UL Listed.
General Instructions	Refer to F-15609.

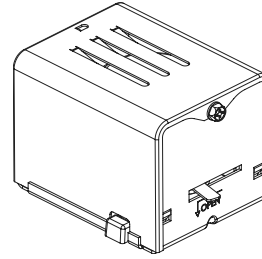
Erie™ Spring Return Two-Position Actuator

The PopTop™ series valve bodies and actuators provide easy installation for a variety of heating and cooling applications.

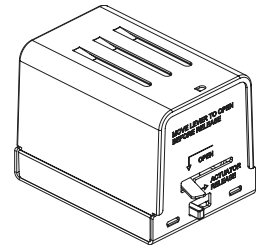
The valve's actuator can be installed after the valve body has been installed onto the fan coil, baseboard or air handler.

Features:

- Synchronous motor drive with spring return.
- Variety of voltages available.
- Mounts directly onto the body without the need for linkages or calibration.
- Manual override lever on normally closed actuators.



**AHxx Series
High Close-off**



**AGxx Series
General Close-off**

Model Chart								
General Close-Off, 2-Position, Power (Open or Close): 9 to 11 Seconds; Spring Return (Open or Close): 4 to 5 Seconds								
Model No.	Volts AC	Electrical Position	Temperature Range F (C)	End Of Travel Switch	Wiring			
AG13A01A	24	Normally Closed	32 to 200°F (Fluid) @ 104°F (Ambient) (0 to 93°C @ 40°C)	Yes	Terminal Block			
AG13A020	24			No				
AG13A02A	24			Yes				
AG13B020	120			No				
AG13B02A	120			Yes				
AG13D020	208			No				
AG13D02A	208			Yes				
AG13T020	277			No				
AG13T02A	277			Yes				
AG13U020	230			No				
AG13U02A	230			Yes				
AG14A020	24			Normally Open (can only be used on 2-way valve)		32 to 250°F (Fluid) @ 169°F (Ambient) (0 to 121°C @ 76°C)	No	18 in. Leads
AG14A02A	24						Yes	
AG14B020	120						No	
AG14B02A	120						Yes	
AG14D020	208						No	
AG14D02A	208						Yes	
AG14T020	277						No	
AG14U020	230	No						
AG14U02A	230	Yes						
AG23A01A	24	Normally Open (can only be used on 2-way valve)	32 to 200°F (Fluid) @ 104°F (Ambient) (0 to 93°C @ 40°C)		Yes		Terminal Block	
AG23A020	24				No			
AG23A02A	24				Yes			
AG23B020	120				No			
AG23B02A	120				Yes			
AG23D020	208				No			
AG23D02A	208				Yes			
AG23T020	277				No			
AG23T02A	277	Yes						

AGxx, AHxx Series

Model Chart (Continued)					
Model No.	Volts AC	Electrical Position	Temperature Range F (C)	End Of Travel Switch	Wiring
AG24T020	277	Normally Open	32 to 250°F (Fluid) @ 169° (0 to 121° @ 76°)	No	18 in. Leads
AG24U020	230			No	
High Close Off, 2-Position, Power (Open or Close): 13 to 18 Seconds; Spring Return (Open or Close): 4 to 5 Seconds					
AH13A020	24	Normally Closed	32 to 200°F (Fluid) @ 104°F (Ambient) (0 to 93°C @ 40°C)	No	18 in. Leads
AH13A02A	24			Yes	
AH13B020	120			No	
AH13B02A	120			Yes	
AH13D020	208			No	
AH13D02A	208			Yes	
AH13T020	277			No	
AH13T02A	277			Yes	
AH13U020	230			No	
AH13U02A	230		Yes		
AH14A020	24		32 to 250°F (Fluid) @ 169°F (Ambient) (0 to 121°C @ 76°C)	No	
AH14A02A	24			Yes	
AH14B020	120			No	
AH14B02A	120			Yes	
AH14D020	208			No	
AH14D02A	208			Yes	
AH14T020	277			No	
AH14U020	230			No	
AH23A020	24	Normally Open (can only be used on 2-way valve)		32 to 200°F (Fluid) @ 104°F (Ambient) (0 to 93°C @ 40°C)	No
AH23A02A	24		Yes		
AH23B020	120		No		
AH23B02A	120		Yes		
AH23U020	230		No		
AH23U02A	230		Yes		
AH24A020	24		32 to 250°F (Fluid) @ 169°F (Ambient) (0 to 121°C @ 76°C)	No	
AH24A02A	24			Yes	
AH24B020	120			No	
AH24B02A	120			Yes	
AH24D020	208			No	
AH24D02A	208			Yes	
AH24T020	277			No	
AH24U020	230			No	
AH24U02A	230			Yes	

Specifications

Inputs	
Control signal	On/off, 2 position SPST, spring return.
Power	6.5 watts 7.5 VA @ 50/60 Hz.
End Switch	24-240 Vac/101 mA minimum to 5A maximum and 90-30 Vdc@ 100 mA maximum.
Outputs	
Motor Type	Hysteresis synchronous.
Mechanical	Control action: 2-way accepts N.O or N.C. actuator, 3-way N.C. (piping determines N.O./N.C. status of flow to coil.) Timing:
Environment	
Ambient temperature limits	Refer to Model Chart.
Humidity	5 to 95% RH, non-condensing.
Agency Listings	Actuator only: CUL #MH25807, CE compliant, C-Tick Declaration (N2223). Actuator/Valve Assembly: UL #Mp916, CE Compliant.
European Community	EMC Directive (89/336/EEC). Low Voltage Directive (72/23/EEC).
General Instructions	Refer to F-27384 Valve Catalog, Zone Valve section.

Typical Applications

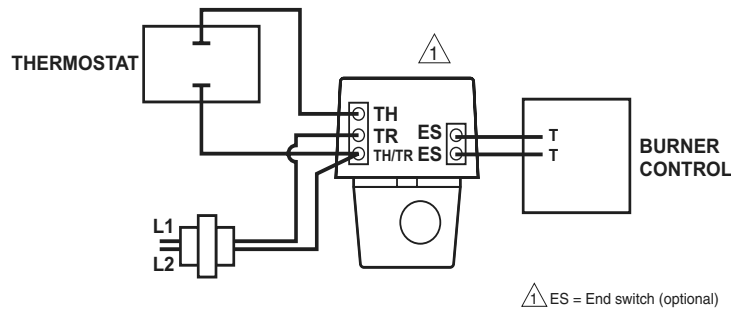


Figure 1 Typical Wiring/Erie Terminal Block.

Invensys - Erie Wire Leads

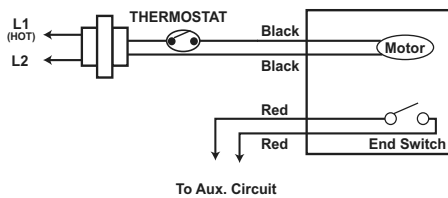
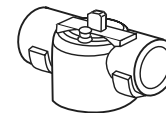
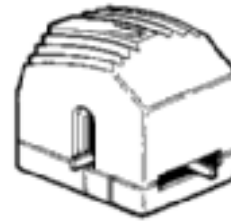


Figure 2 Typical Wiring of a PopTop with Wire Leads.

Erie™ Spring Return Floating & Proportional Actuators

The AP series proportional and AT series floating PopTop™ actuators incorporate equal percentage flow characteristics. The floating and proportional actuators are designed to be used on the 1/2 to 1-1/4 in. VM series valves for precise temperature control of fluid flow in heating or cooling applications. See valve section for details.



Zone Valve

Features:

- Floating model is compatible with any 24 Vac three-wire signal.
- Proportional model compatible with any 0 to 10 Vdc or 4 to 20 mA controller.
- Spring return logic is only for emergency power loss.
- Microprocessor controlled (proportional only).
- Magnetic clutch to maximize the life of the motor and gear train.
- Manual operating lever/position indicator facilitates field setup.
- Easy to use lever terminal blocks.
- Returns actuator to normal position when power is lost for more than 2 seconds.
- Actuator can be installed after valve body.
- Refer to F-27384, Invensys Valve Catalog for compatible 1/2 to 1-1/4 in.c VM Series two or three way zone valves.

Model Chart				
Model No.	Electrical Position	Input Impedance	Control Signal	Wiring
AT13A00T	N.C.	Open/close 3.9 kΩ	24 Vac, three wire floating	Refer to Figure 1
AT23A00T	N.O. ^a			
AP13A000	N.C.	Voltage 200 kΩ; Current 300 Ω	0 to 10 Vdc, or 4 to 20 mA or 0 to 5 Vdc, 5 to 10 Vdc	Refer to Figure 2
AP23A000	N.O. ^a			

^a Cannot be used on 3-way valve. Use N.C. and pipe with open port to coil.

Specifications

Inputs	
Control signal	Refer to Model Chart.
	Impedance: Refer to Model Chart.
Power	10 VA required for power-up, max running 68 mA (1.6 VA).
Outputs	
Motor Type	Synchronous.
Mechanical	Control action: AP series: Direct acting, field selectable reverse acting. Nominal valve stroke: 2 minutes 30 seconds @ 60 Hz; 3 minutes @ 50 Hz.
Environment	
Ambient temperature limits	Operating: 32 to 125°F (0 to 52°C).
Humidity	5 to 95% RH, non-condensing.

Specifications (Continued)

Agency Listings	CE compliant.
European Community	EMC Directive (89/336/EEC). Low Voltage Directive (72/23/EEC).
General Instructions	Refer to F-27384, Invensys Valve Catalog for compatible 1/2 to 1-1/4 in. VM Series two or three-way zone valves.

Typical Applications

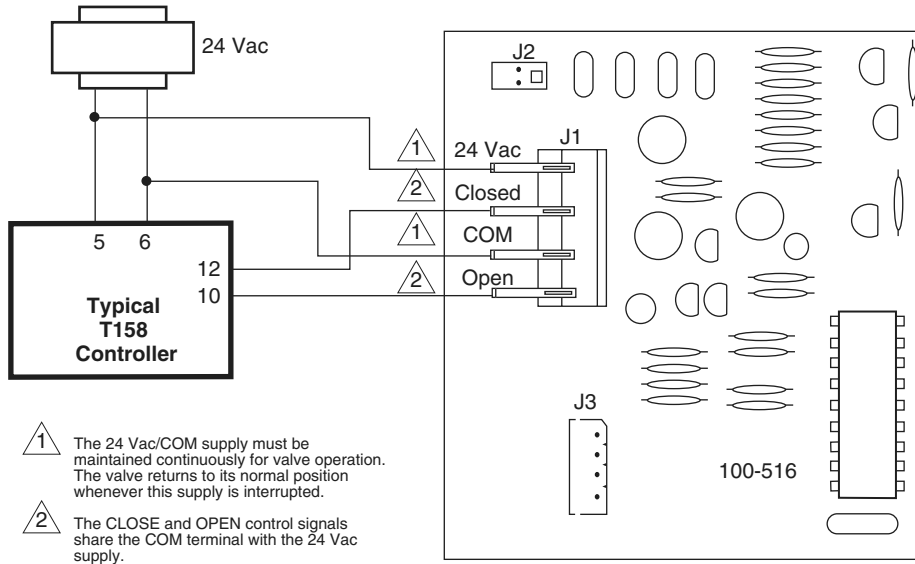


Figure 1 Typical Wiring of Three-Wire Floating Spring Return Valves with Time-Out.

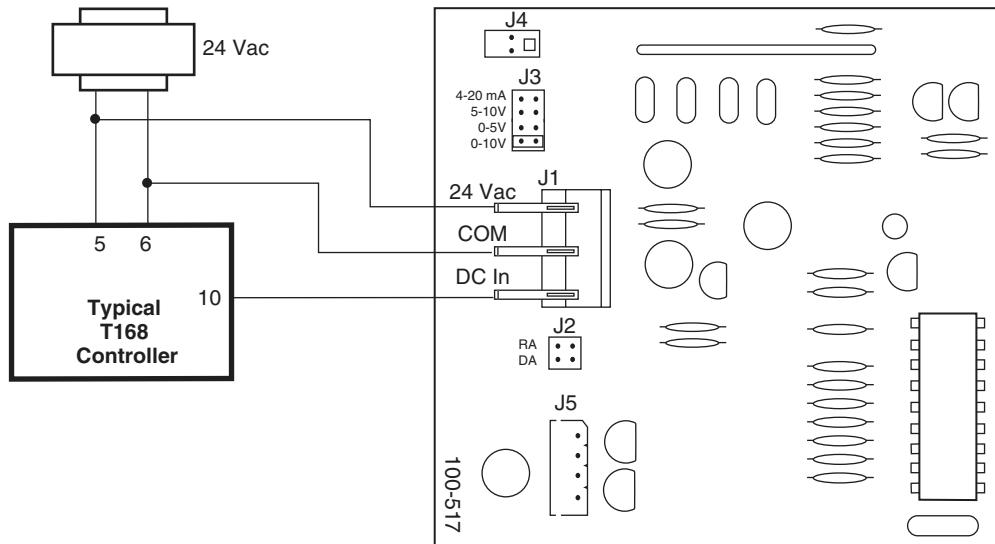


Figure 2 Typical Wiring of Three-Wire Proportional Spring Return Valves.

Erie™ Non-Spring Return Floating & Proportional Actuators

The AP series proportional and AT series floating PopTop™ actuators are designed to work with the 1/2 to 1-1/4 in. VM series valves for precise temperature control of fluid flow in heating or cooling applications.



Features:

- Floating model is compatible with any 24 Vac three-wire signal as long as 3 minute timeout logic resides in the controller or on the valve.
- Microprocessor controlled (proportional only).
- Magnetic clutch to maximize the life of the motor and gear train.
- Manual operating lever/position indicator facilitates field setup.
- Easy to use lever terminal blocks.
- Actuator can be installed after valve body.
- Refer to F-27384, Invensys Valve Catalog, Zone Valve Section for correct applications.

Model Chart					
Model No.	Maximum Current/Power Requirements at 24 Vac mA (VA)	Control Signal	Timeout	Timing (min:sec)	
				60 Hz	50 Hz
AT33A000	40 mA (1.0 VA)	24 Vac, three wire floating.	No	Maximum 2:30	Maximum 3:00
AT33A00T	50 mA (1.2 VA)	24 Vac, three wire floating.	Yes		—
AP33A000	65 mA (1.6 VA)	0 to 10 Vdc, or 4 to 20 mA field selectable	Not Applicable	2:30 + 15 sec. recalibration time	3:00 + 18 sec. recalibration time ^a

^a Recalibration of zero: Every time the valve closes it resets the zero position. Every 10 days it resets its zero position.

Specifications	
Inputs	
Control signal	Refer to Model Chart. Impedance: Open/close 3.9 K, voltage 200 k Ω, current 300 Ω.
Power	24 Vac 50/60 Hz.
Outputs	
Motor Type	Synchronous.
Mechanical	Control Action: AP series: Direct Acting, field selectable reverse acting. Timing: Refer to Model Chart.
Environment	
Ambient temperature limits	Operating: 32 to 125°F (0 to 52°C).
Humidity	5 to 95% RH, non-condensing.
Agency Listings	CE compliant.
European Community	EMC Directive (89/336/EEC). Low Voltage Directive (72/23/EEC).
General Instructions	Refer to F-27013. Refer to F-27384, Invensys Valve Catalog, Zone Valve section, for correct applications.

Typical Applications

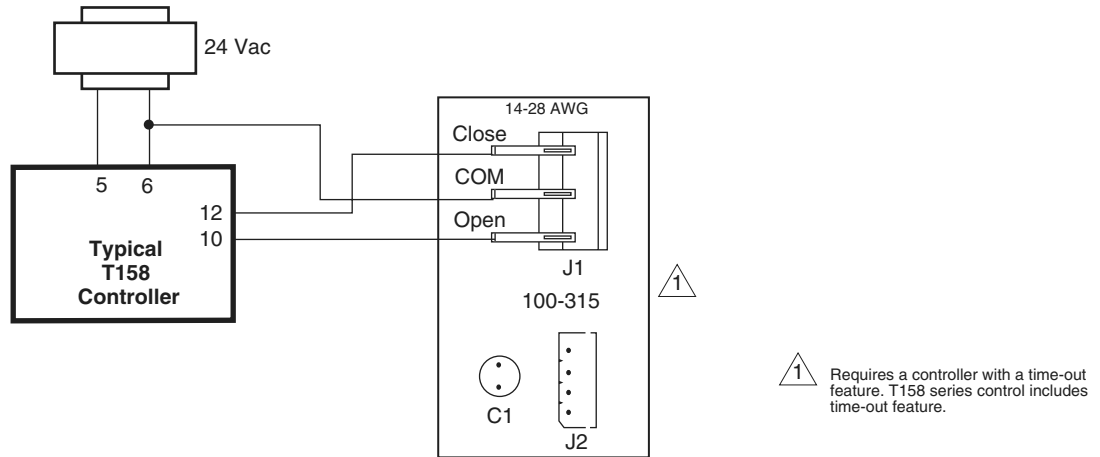


Figure 1 Typical Wiring of Three-Wire Floating Non-Spring Return Valves (AT33A000).

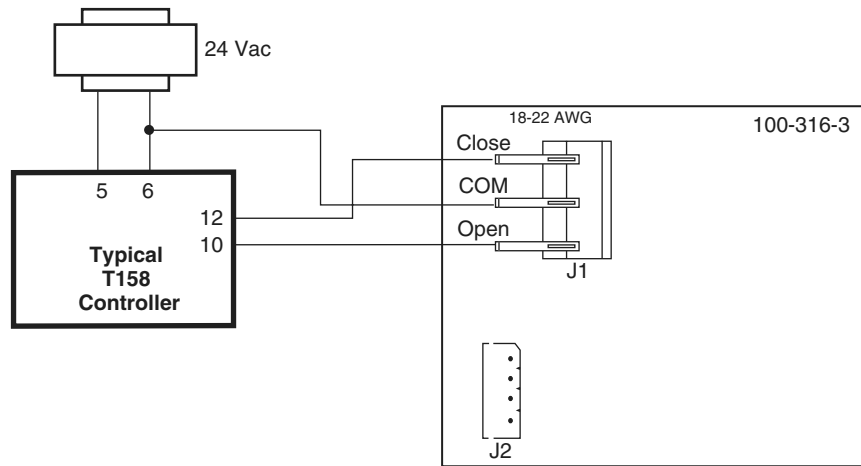


Figure 2 Typical Wiring of Three-Wire Floating Non-Spring Return Valves with Time-Out (AT33A00T).

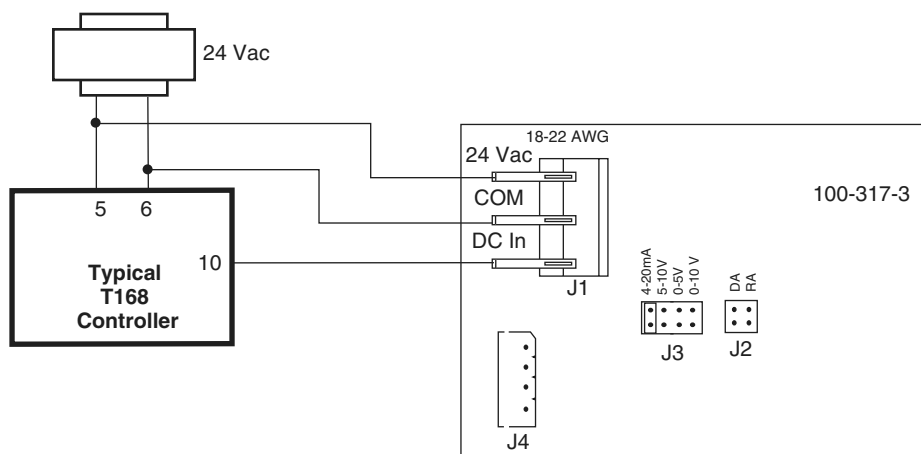


Figure 3 Typical Wiring of Three-Wire Proportional Non-Spring Return Valves (AP33A000).

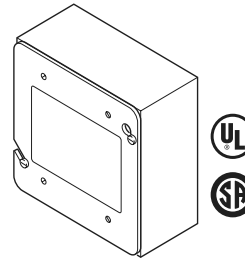
ASP-8311 Series

Power Supply

Provides 20 or 24 Vdc power supply for up to six HSP-8xxx, VER-Hx, or TSP-8xxxx Transmitters. ASP-8311 series power supplies can be used for System 8000 applications where added capacity is required.

Features:

- UL and CSA listed units available in ASP-8311 Series.
- Capacity rating selected to prevent damage to hardware if misapplied.
- Dual voltage capability to meet all applications.
- Isolated output.



Model Chart					
Model No.	Input Voltage	Enclosure Provided	Output	UL	CSA
ASP-8311-120	120 Vac	Yes	20 or 24 Vdc selectable	Listed	Certified
ASP-8311-240	240 Vac				

Specifications	
DC power supplies available	Selectable 150 mA maximum, 20 Vdc or 24 Vdc. Full wave isolated. Output is short circuit protected.
Power requirements	
120 Vac	60 Hz, 13 watts; 50 Hz, 26 watts.
240 Vac	60 Hz, 13 watts; 50 Hz, 26 watts.
Environment	
Ambient temperature limits	Shipping and storage: -40 to 160°F (-40 to 71°C). Operating: 40 to 140°F (4 to 60°C).
Humidity	5 to 95% RH, non-condensing.
Locations	NEMA Type 1.
Connections	Coded pigtail leads.
Dimensions	4-11/16 H x 4-11/16 W x 2-1/8 D in. (119 x 119 x 54 mm).
Agency Listing	UL, CSA.
General Instructions	Refer to F-24283.

Typical Applications

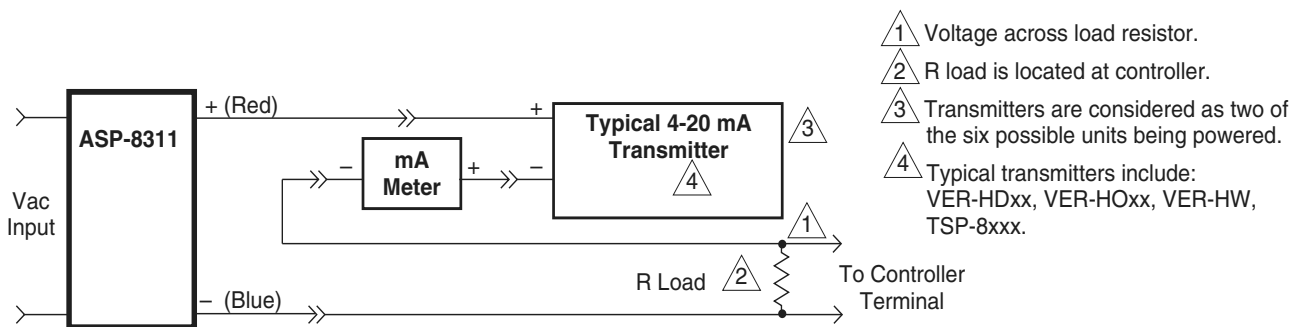
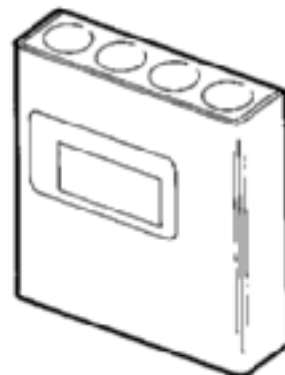


Figure 1 Checkout of ASP-8311 Power Supply.

Erie™ Universal Reset Control

The Boiler Boss® BB1200 series universal reset control is used to control boiler water temperature applications. The supply water temperature is automatically adjusted up or down based on outside air temperature. As the outside air gets colder the BB1200 raises the hot water supply temperature through its dry contact output. As the outside air gets warmer the BB1200 provides a lower water temperature based on its control range. This is not a boiler operating control.



Features:

- Boiler water temperature reset.
- Warm weather shutdown.
- Domestic hot water priority.
- Boiler low limit.
- Boiler supply and outdoor air sensors (OAS-1).
- LED display for boiler temperature and system settings.
- Burner LED.
- Three reset ratios.
- Test mode.

Model Chart

Model No.	Description
BB1200	Refer to Specifications.

Specifications

Inputs

Power input	24 Vac, class 2, 0.25 amps maximum (6 VA) @ 50/60 Hz.
Thermostat input	24 Vac, 60 mA dry contacts.
Priority zone input	10 DC, 2 mA dry contacts.
Temperature sensors	100kΩ @ 77°F (25°C) (Thermistor). Two OAS-1 included.

Outputs

Electrical	Burner output (dry contacts): 24 Vac pilot duty class 2, 75 VA maximum.
Mechanical	Boiler temperature range: 90 to 230°F (32 to 110°C).
Operating differential:	15 or 25 F degrees (8 or 14 C degrees).

Environment

Ambient temperature limits	Operating: 20 to 120°F (-29 to 49°C). Shipping and storage: -40 to 140°F (-40 to 60°C)
Humidity	85% RH, non-condensing.
Locations	NEMA Type 1.

Control Ranges

Outdoor temperature	-50 to 80°F (-45 to 27°C).
Boiler temperature	90 to 230°F (32 to 110°C).
Operating differential	15 or 25°F (-9 to -4°C).

General Instructions	Refer to F-27014.
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BB1200

Accessories

Model No.	Description
OAS-2	Extension cable 50 ft, for use with OAS-1.

Typical Applications

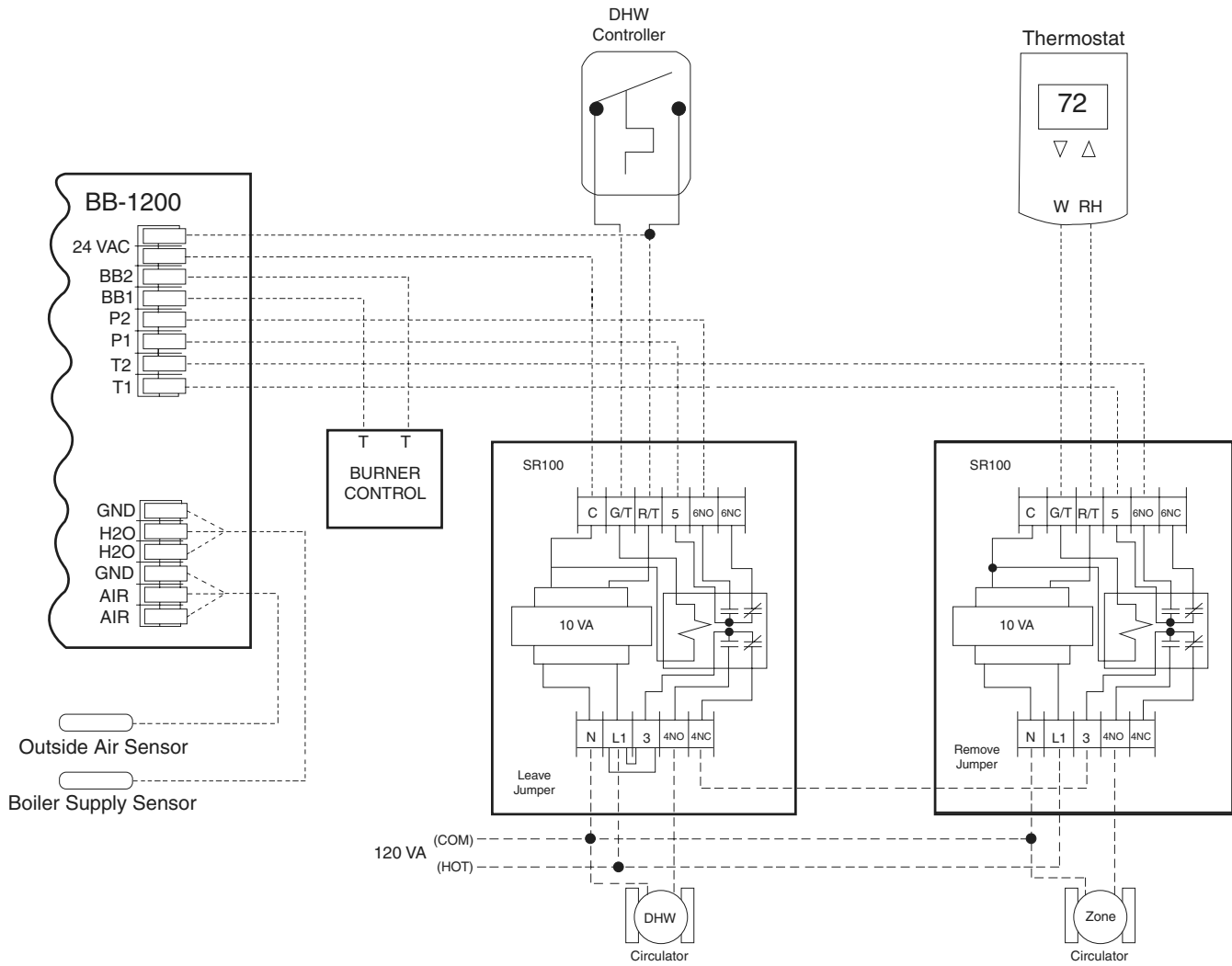


Figure 1 Typical Wiring for Boiler Boss 1200 Series With Two SR100 Relays Including Domestic Hot Water Priority.

Erie™ Injection Mixing Pump Control

The Boiler Boss® BB3000 injection pump mixing control with outdoor reset provides closed loop control of water temperature in the secondary (radiant) loop of a primary/secondary heating system.

The Boiler Boss BB3000 also protects against boiler condensation by monitoring and anticipating the boiler return water temperature.

The outdoor air and loop temperatures are displayed continuously, along with the secondary loop setpoint and pump speed.



Features:

- Built-in transformer and relays.
- Sure start pump control.
- Real application data inputs.
- LED display for temperatures and settings.
- Raises or lowers secondary loop temperature based on changes in outside air.
- Boiler low temperature protection and short-cycle protection.

Model Chart

Model No.	Description
BB3000	Refer to Specifications.

Specifications

Inputs

Power input	Switch selectable 115/230 Vac +10% -15% @ 50/60 Hz, 5 A.
Connections	See Figure 1 - Typical Wiring.
Priority zone input	Dry contact closure, 24 Vac @ 8 mA.
Heat demand	Dry contact closure, 24 Vac @ 8 mA.
Three temperature sensors	10kΩ thermistors, -60° to 220°F (-51° to 104°C). SENS-10K (3) included with unit.
Internal transformer	24 Vac, 5 VA. Not available for external loads except as specified.
Fuse (F1)	250 V, 5 A slow blow.
Circulator fuse (F2)	250 V, 10 A slow blow.

Outputs

Electrical	Boiler control signal, Normally open relay (dry contacts for class 2 circuit only) 24 Vac, 75 VA pilot duty.
	Injection pump, Phase controlled triac at line voltage, maximum of 1/6 HP @ 115/230 Vac.
	Secondary circulator, Normally open relay maximum 1/3 HP @ 115 Vac. Maximum 1/2 HP @ 230 Vac.

Environment

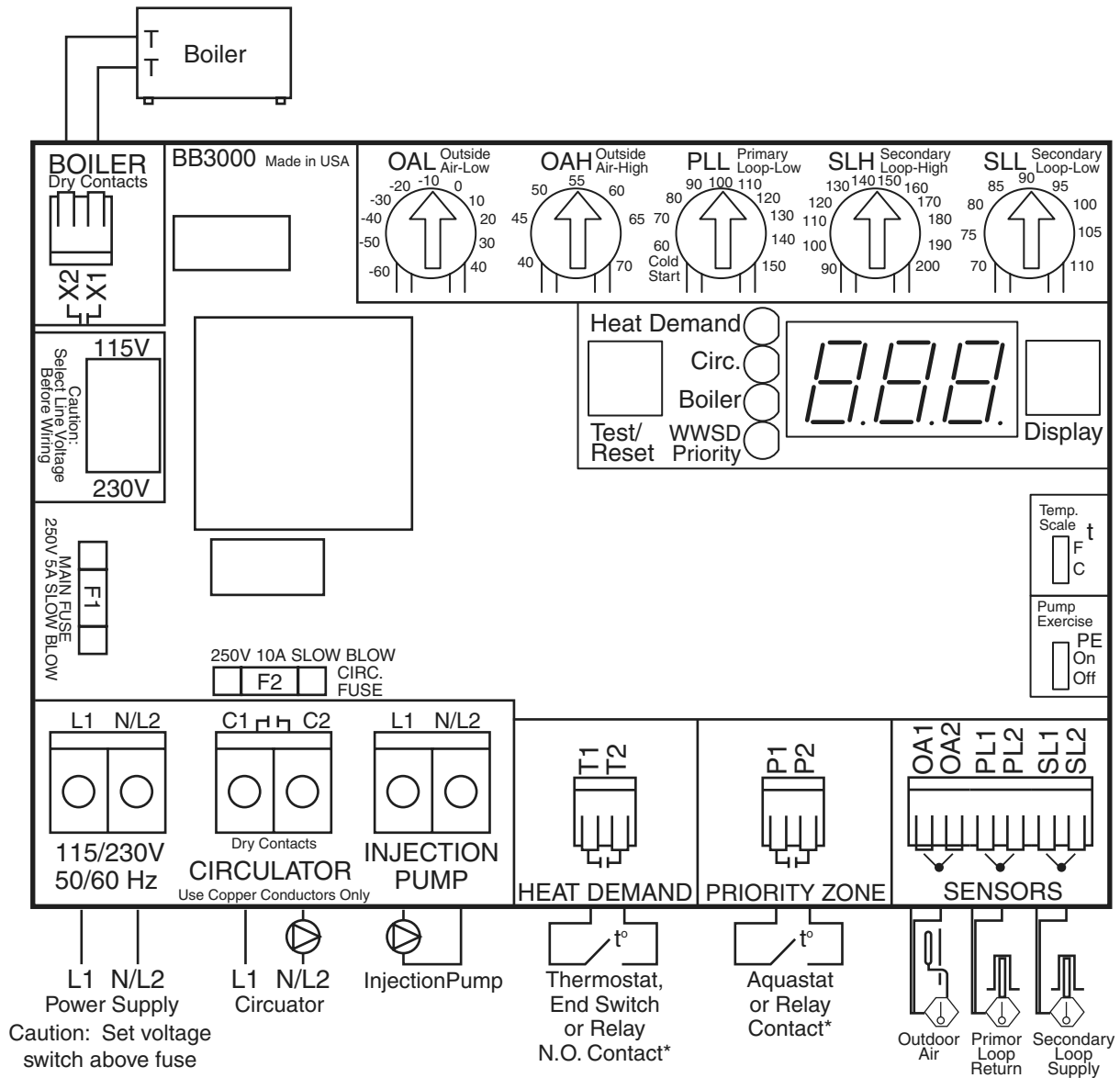
Ambient temperature limits	Shipping and storage: -20° to 140°F (-29° to 60°C) Operating: 40° to 104°F (4° to 40°C). 95% RH, non-condensing.
Locations	NEMA Type 1.
Agency Listings	UL 873. CUL C22.2 #24-93
U.S. Patent	#6,062,485.
General Instructions	Refer to F-27030.

BB3000

Accessories

Model No.	Description
40-8-68	F1 Fuse
40-8-69	F2 Fuse
SENS-10K	Three 10K thermistor sensors. OA, PRI, SEC.

Typical Applications



*Do not use triac, dry contact required.

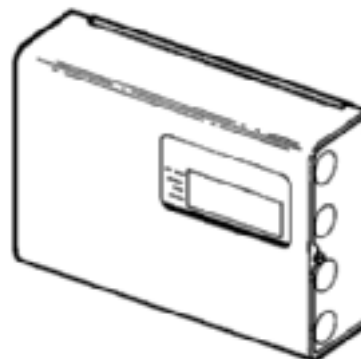
Figure 1 Typical Wiring Boiler Boss® BB3000 Series (see F-27030 for detailed applications).

Erie™ Three-Way Mixing Valve Control

The Boiler Boss® BB3600 mixing valve control with outdoor reset provides closed loop control of water temperature in the secondary (radiant) loop of a heating system using a proportional control three-way mixing valve.

The Boiler Boss® BB3600 protects against boiler condensation by monitoring and anticipating the boiler return water temperature.

A continuously scrolling display shows the outdoor air, loop temperatures, secondary loop setpoint and valve signal value.



Features:

- Built-in transformer and relays.
- Real application data inputs.
- LED display for temperature settings.
- Raises or lowers secondary loop temperature based on changes in outside air.
- Boiler low temperature protection and short-cycle protection.
- Controls a modulating valve with either a 0-10 V or 4-20 mA signal.

Model Chart

Model No.	Description
BB3600	Refer to Specifications.

Specifications

Inputs

Power input	120 Vac +10% -15% @ 50/60 Hz, 20 VA.
Connections	Power: 120 Vac. Control: 24 Vac.
Heat demand	Dry contact closure, 24 Vac supplied.
Three temperature sensors	10k thermistors, -60 to 220°F (-51 to 104°C). SENS-10K included with unit.
Internal transformer	24 Vac, 25 VA. Not available for external loads except as specified.
Fuse	250 V, 15 A slow blow.

Outputs

Electrical	Boiler control signal: Normally open relay (dry contacts for class 2 circuit only) 24 Vac, 75 VA pilot duty. Proportional valve supply: 24 Vac, 10 VA. Proportional valve control signal: 0-10 Vdc into 500Ω minimum, direct or reverse acting. 4-20 mA into 300Ω maximum, direct or reverse acting. Secondary circulator: Normally open relay, 1/3 @ 120 Vac.
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Environment

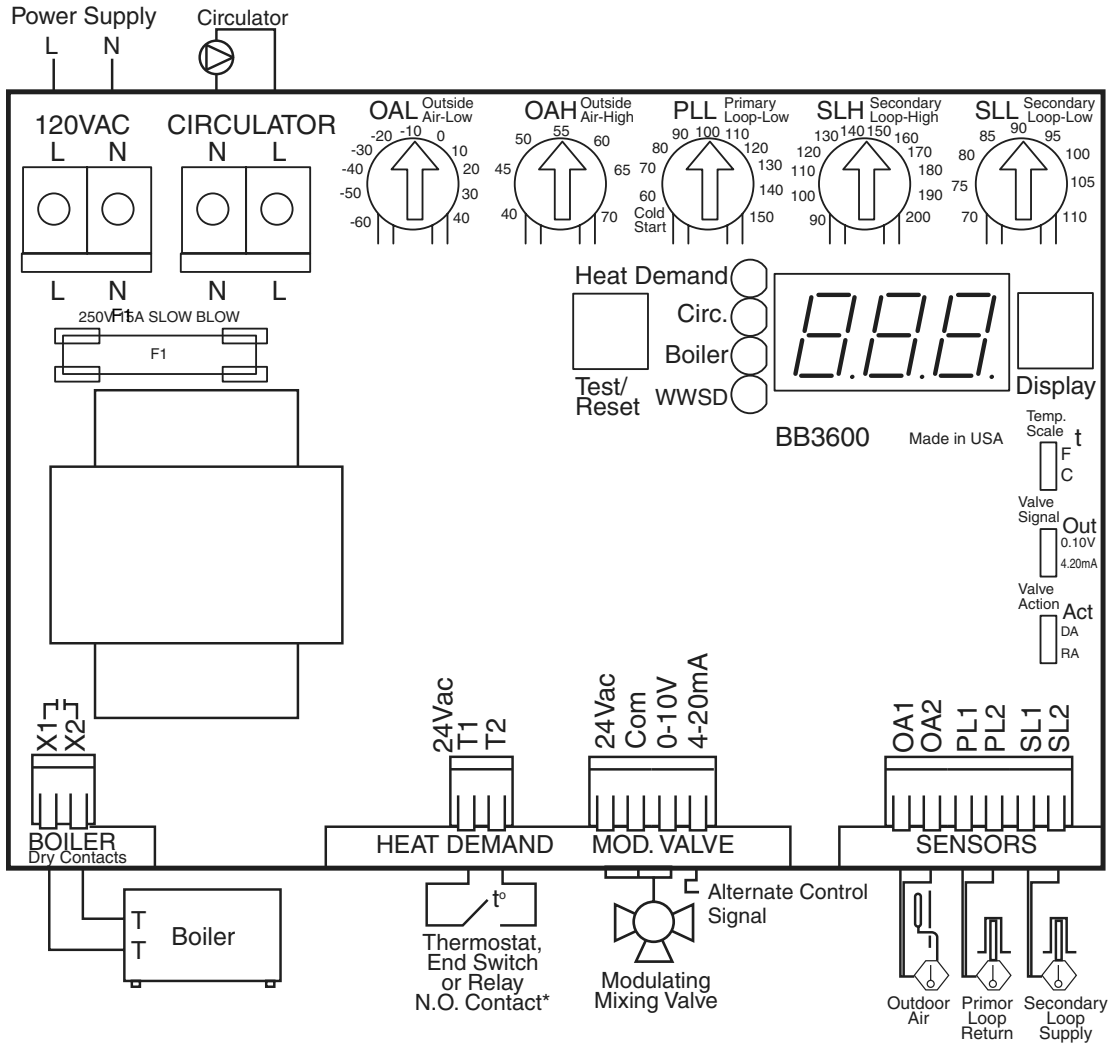
Ambient temperature limits	Shipping and storage: -20 to 140°F (-29 to 60°C). Operating: 40 to 104°F (4 to 40°C).
Humidity	95% RH, non-condensing.
Locations	NEMA Type 1.
Agency Listing	UL/CUL File #E9429. FCC tested to comply with FCC Part 15, subpart B.
General Instructions	Refer to F-27031.

BB3600

Accessories

Model No.	Description
40-8-44	F1 Fuse
SENS-10K	Three 10K thermistor sensors, OA, PRI, SEC.

Typical Applications



*Do not use triac, dry contact required.

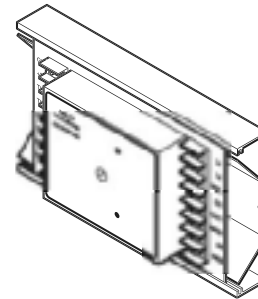
Figure 1 Basic Wiring Boiler Boss® BB3600 Series (see F-27031 for detailed applications).

System 8000 Controlled Relays

Electronic controlled relays are offered in dual, or dual with one having heat anticipation for time proportional control of electric heat.

Features:

- Stages individually adjustable.
- Large selection of operational differentials available.
- Uses standard track mounting.
- Can accommodate two individual inputs.



Model Chart							
Model No.	Input Signals	Description	Power Requirements Vac (50/60 Hz) (+10/-15%)	Relay			
				Relay 1 Dropout	Deadband (Differential)	Pull-in	Relay 2 (CC-8103 Only) Time Proportioning
CC-8102	1 or 2	2 relays	120	Adjustable 2 to 12 Vdc (input signal); factory set 6 Vdc	Jumper selectable 1/2, 1, 2, 4 Vdc ^a (input signal); factory set 1 Vdc	Pull-in equals dropout plus deadband	Adjustable 2 to 12 Vdc (input signal) factory set to drop out at 8 Vdc
CC-8102-024 ^b			24				
CC-8103		2 relays, 1 time proportioning	120	Adjustable 2 to 12 Vdc (input signal); factory set 10 Vdc			Non-adjustable 6 VDC input: 1 00% duty cycle 7.5 Vdc input: 50% duty cycle 9 Vdc input: 0% duty cycle
CC-8103-240			240				

^a 1.5, 2.5, 3, 3.5, 4.5, 5, 5.5, 6, 6.5, 7, 7.5 Vdc differentials can be obtained with an AD-8969-901 (order separately).

^b Not CSA certified.

Specifications	
Input signals	One or two 2 to 15 Vdc input signals.
Relay	SPDT. Refer to Electrical Rating per Relay Table for electrical ratings.
Power requirements	Refer to Model Chart.
Power consumption	2.4 VA.
Power supply available	20 Vdc, 35 mA; filtered and regulated.
Environment	
Ambient temperature limits	Shipping and storage: -40 to 140°F (-40 to 60°C). Operating: 40 to 135°F (4 to 57°C).
Humidity	5 to 95% RH, non-condensing.
Locations	NEMA Type 1.
Connections	Coded screw terminals for 12 to 20 AWG.
Cover	Aluminum.
Mounting	Unit is provided with plastic track for panel mounting. AD-8912 enclosure can be ordered separately for remote installations.
Dimensions	3-7/8 H x 7-1/2 W x 2-1/2 D in. (98 x 191 x 63).
Agency Listings	CC-8102 and CC-8103: UL Recognized CSA. CC-8102-024: UL Recognized.
General Instructions	Refer to F-14966.

CC-810X Series

Electrical Rating per Relay.

Contact Rating	24 Vac	120 Vac	240 Vac
Amps (continuous)	—	1	0.5
Amps (inrush)	—	10	5
Pilot duty sealed (VA)	25	125	125
Pilot duty inrush (VA)	250	1250	1250

Accessories

Model No.	Description
AD-8969-901	Extended relay differential jumper.
AD-8912	Enclosure, 12 in. (305 mm).
TOOL-201	Calibration kit for System 8000.

Typical Applications

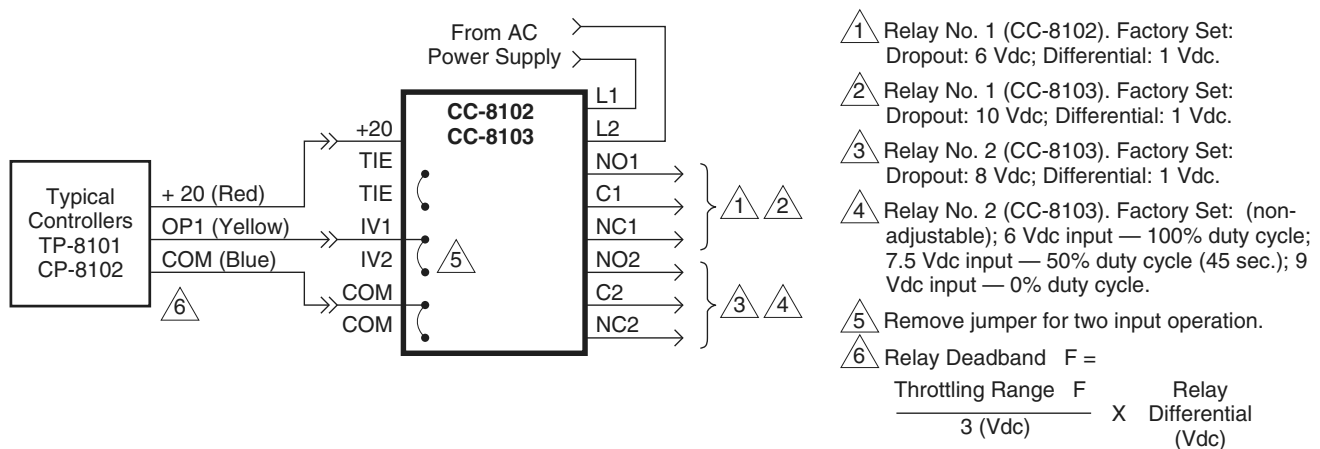
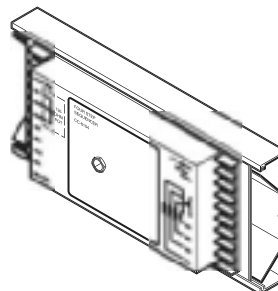


Figure 1 Typical Wiring Diagram for CC-810x.

System 8000 Four-Step Sequence Controller

This controller operates up to four external AC power handling relays or loads in heating, ventilating and air conditioning systems. A second unit can be sequenced to provide up to eight steps.



Features:

- Usable with competitive 135 Ω slidewire controllers.
- Accepts 2 to 15 volt power demand EMS signals.
- Self-contained built in controller.
- Solid state switching output.
- Standard track mounting.

Model Chart	
Model No.	Description
CC-8104	Refer to Specifications.

Specifications	
Construction	Self-contained package with an amplifier.
Sensors	
Balco	1000 ohm, requires remote setpoint adjuster (except TS-8111) AT-8100 (order separately).
Slidewire	135 ohm.
Input signals	6 to 9 Vdc or 11 to 14 Vdc from a controller.
Power demand override	Contact closure or proportional 2 to 15 Vdc control signal.
Throttling range	3 or 6°F (2 or 3°C), 9°F (5°C) can be obtained by the use of AD-8969-901 (order separately). Additional ranges obtainable through selection of resistors (not included).
Staged sequencing	35 second delay between stages and return to cold start on power interruption. For electrical ratings refer to Maximum Electric Ratings Table.
Control output voltage	2 to 15 Vdc is available for sequencing up to two System 8000 controlled devices.
Action	Factory set for reverse acting, but can be made direct acting.
Power requirements	24 Vac 50/60 Hz at 13 VA plus VA of each stage, maximum 100 VA.
Power supplies available	
6.2 Vdc (5.8 to 6.6 Vdc)	7 mA. ^a
20 Vdc (18.5 to 21 Vdc)	50 mA. ^a
Environment	
Ambient temperature limits	Shipping and storage: -40 to 140°F (-40 to 60°C). Operating: 40 to 125°F (4 to 52°C).
Humidity	5 to 95% RH, non-condensing.
Locations	NEMA Type 1.
Connections	Coded screw terminals for 16 to 20 AWG.
Cover	Aluminum.
Mounting	In any position. Unit is provided with a section of plastic track for panel installation.
Dimensions	4 H x 9-1/2 W x 2-1/2 D in. (102 x 241 x 63 mm).
General Instructions	Refer to F-15809.

^a These regulated and filtered power supplies must not be connected to +20 (red) or +6.2 of other power supplies.

CC-8104

Maximum Electrical Rating per Output Stage 24 Vac^a.

Amps	VA Pilot Duty
0.9 (continuous)	22 (sealed)
9 (inrush)	220 (inrush)

^a Minimum load amps: 0.1.

Accessories

Model No.	Description
AD-8969-201	Offset resistor kit: 5, 10, 15 and 20°F.
AD-8969-301	1 K, ±1%, WW resistor kit.
AD-8969-901	Extended throttling range jumper.
AT-8100	Remote setpoint adjuster.
TOOL-201	Calibration kit for System 8000.
TS-8000	1000 ohm Balco sensors.

Typical Applications

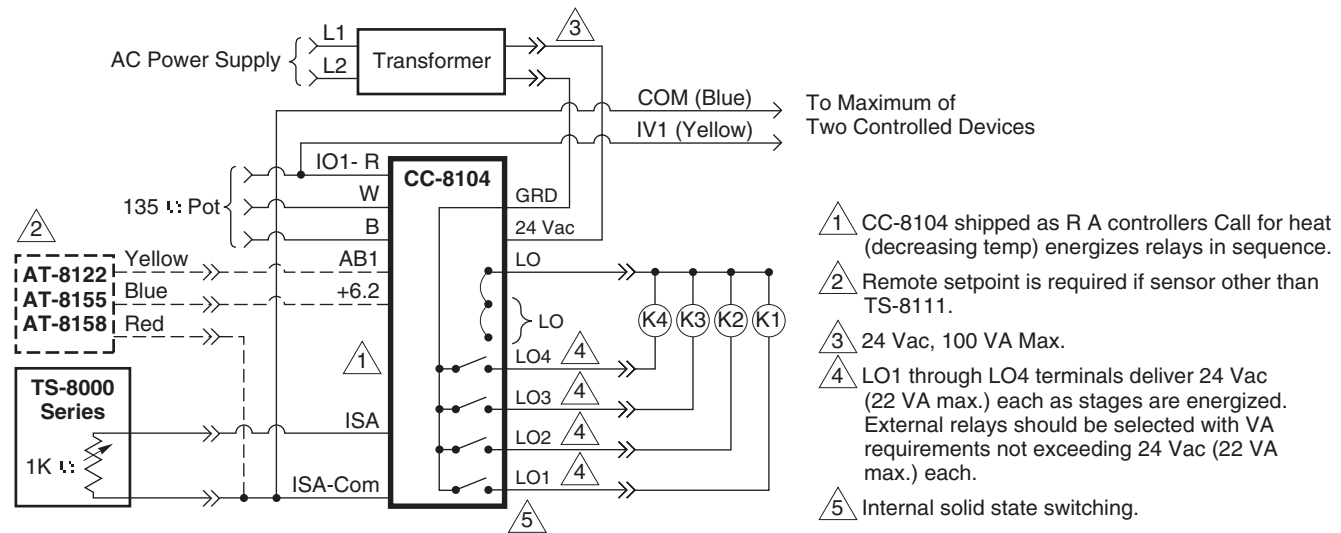


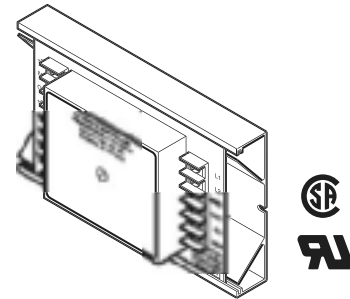
Figure 1 Typical Wiring Diagram for CC-8104.

System 8000 Two-Input Controller/Relay

Two-input electronic controller with proportional output and a single state relay output for single input, differential and reset control in HVAC systems.

Features:

- True differential on-off controller.
- Dual capability as proportional 2 to 15 Vdc signal and individual relay output.
- Self contained built in dual input controller.
- Standard track mounting.



Model Chart								
Model No.	Power Requirements (50/60 Hz) 4 VA	Dial Adjustable Functions				Pin Selectable Functions		
		Setpoint A ^a °F (°C)	Setpoint B ^a °F (°C)	Differential Range	Relay Dropout	Throttling Range ^b (J4 Jumper)	Authority Ratio ^c (J3 Jumper)	Relay Differential ^d (J5 Jumper)
CC-8111-024	24	41 to 95 (5 to 35)	41 to 95 (5 to 35)	1 to 54 F° Std. by added res.1 to 400 F°	2 to 12 Vdc (IV1 to COM) Factory set 6 Vdc	3,6, or 9 F° ^e (1.6, 3.4 or 5 C°) ^e Factory set 3 F°	0.5 0.75 1.0 15.0 Aux. Factory set 1	0.5 1.0 2.0 4.0 Vdc (IV1 to COM) Factory set 1
CC-8111-120	120							
CC-8111-240	240							

^a Units dual marked in °F and °C. For reset control, set setpoint "B" at zero reset point. Set setpoint "A" at control point desired with no reset action from sensor "B".

^b For 3 Vdc output change.

^c Number of degrees change at sensor "B" required to reset sensor "A" one degree. Example: 15:1 means a 15°F change at sensor "B" to reset sensor "A" 1°F.

^d 1.5, 2.5, 3, 3.5, 4.5, 5, 5.5, 6, 6.5, 7, 7.5 Vdc differentials can be obtained with an AD-8969-901 (ordered separately).

^e 9 F° (5 C°) can be obtained with AD-8969-901 (ordered separately).

Specifications

Sensors	
Balco	1000 ohm single or dual sensor input. Three sensor input by the use of CN-8101 multipurpose bridge.
Slidewire	135 ohm.
Controller input signal	1 to 15 Vdc.
Reset control or differential control	Requires dual 1000 ohm inputs.
Action	
Input A	Factory set for direct acting, but can be made reverse acting.
Input B	Factory set for reverse acting, but can be made direct acting.
Throttling range	Refer to Model Chart.
Relay output	SPDT has adjustable dropouts and selectable differential. Refer to Model Chart.
Control output	2 to 15 Vdc, 10 mA maximum, factory calibrated for 7.5 Vdc output with sensor at setpoint temperature.
Power requirements	Refer to Model Chart.
Power supplies available	
6.2 Vdc	4 mA. These regulated and filtered power supplies must not be connected to +20 (red) or +6.2 of other supplies.
20 Vdc	35 mA. These regulated and filtered power supplies must not be connected to +20 (red) or +6.2 of other supplies.

CC-8111-xxx Series

Specifications (Continued)

Environment

Ambient temperature limits	Shipping and storage: -40 to 160°F (-40 to 71°C). Operating: 40 to 140°F (4 to 60°C).
Humidity	5 to 95% RH, non-condensing.
Locations	NEMA Type 1.
Connections	Coded screw terminals for 14 to 20 AWG.
Cover	Aluminum.
Mounting	Unit is provided with a plastic track for panel installation.
Dimensions	4 H x 7-1/2 W x 2-1/2 D in. (102 x 191 x 63 mm).
Agency Listings	UL Recognized, CSA.
General Instructions	Refer to F-17192.

Relay deadband

$$\text{Relay Deadband } F = \frac{\text{ThrottlingRange } F}{3(V_{dc})} \times \text{Relay Differential}(V_{dc})$$

Electrical Rating.

Contact Rating	24 Vac	120 Vac	240 Vac
Amps (continuous)	—	1	0.5
Amps (inrush)	—	10	5
Pilot Duty Sealed (VA)	25	125	125
Pilot Duty Inrush (VA)	250	1250	1250

Accessories

Model No.	Description
AD-8122	Signal adaptor for outputs (direct acting, direct acting).
AD-8123	Signal adaptor for outputs (direct acting, reverse acting).
AD-8124	Signal adaptor for outputs (direct acting, reverse acting).
AD-8912	Enclosure, 12 in. (305 mm).
AD-8969-201	Offset resistor kit: 5, 10, 15, and 20°F.
AD-8969-901	Extended throttling range jumper.
AT-8122	Remote setpoint adjuster, dual scale 20 to 120°F (-6 to 49°C).
AT-8155	Remote setpoint adjuster, dual scale 50 to 250°F (10 to 120°C).
AT-8158	Remote setpoint adjuster, dual scale 55 to 85°F (13 to 29°C).
AT-8435	Remote setpoint adjuster, dual scale 50 to 450°F (10 to 232°C) for use with TS-8204 only.
TS-8101	Room sensor.
TS-8111	Room sensor with setpoint.
TS-8131	Room button type sensor.
TS-8201	Duct/immersion sensor.
TS-8204	High temperature duct/immersion sensor requires AT-8435 remote setpoint for all applications except differential control.
TS-8261	Light fixture sensor.
TS-8405	Averaging sensor, 5 ft. (1.5 m).
TS-8422	Averaging sensor, 22 ft. (6.7 m).
TS-8501	Outdoor sensor.
TOOL-201	Calibration kit for System 8000.

Typical Applications

Single Input.

Input	Bridge and Input Action	Internal Connections	Sensor Connection
A	Direct acting	J1 to COM, J2 disconnect and tape	ISA and +6.2
	Reverse acting	J1 to +6.2, J2 disconnect and tape	ISA and COM

Dual Input.

Input A Action	Sensor A Between	J1 to Pin	Reset Action of Input B	J2 to Pin	Sensor B Between
Direct acting ^a	+6.2 and ISA	COM	Direct reset ^a	+6.2	ISB-COM
			Reverse reset	COM	ISB-+6.2
Reverse acting	ISA and COM	+6.2	Direct reset	COM	ISB-+6.2
			Reverse reset	+6.2	ISB-COM

^a Factory set.

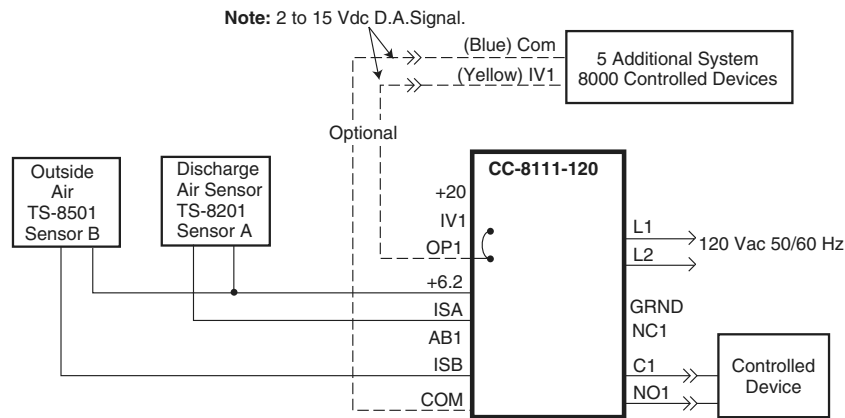


Figure 1 Discharge Temperature Control with Outdoor Air Reset.

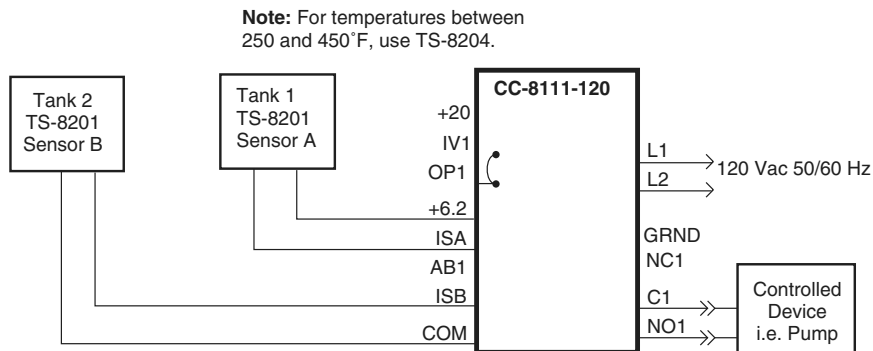


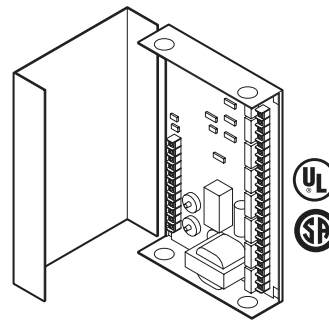
Figure 2 Tank Differential Temperature Control.

System 8000 Eight-Stage Sequencer Controller

This controller is an electronic linear sequencer for sequencing external low or line voltage contactors or other loads. This unit also has a 2-15 Vdc proportional output for use with other controlled devices.

Features:

- Dual sensing input capability.
- 2 to 15 volt control signal for additional functions.
- Can be adapted to competitive 135 Ω controllers.
- Power demand input for load shedding ability.
- Proportioning output signal to afford proportional control between on-off stages.
- Self-contained UL/CSA approved wiring package.



Model Chart			
Model No.	Power Requirements Vac 11 VA 50/60 H	Staging	Stages Available by Multi-Unit Operation
CC-8118-120	120	Linear eight stage heat or cool ("first on, last off")	48 Parallel 24 Sequence

Specifications	
Sensors	
Balco	1000 ohm single or dual sensor input. Three sensor input by the use of CN-8101 multipurpose bridge.
Slidewire	135 ohm.
Inputs	
Power demand	2 to 15 Vdc from a power monitor.
1 to 15 Vdc	Unit operates at 2 to 5, 6 to 9, 10 to 13 Vdc.
Control dial range	
Setpoints "A" and "B"	20 to 120°F (-6 to 49°C).
Action	Direct, factory set, or reverse; change by pin selection.
Throttling range	Dial adjustable 2 to 10 F degrees (1.1 or 5.5 C degrees), factory set 3 F degrees (1.6 C degrees), dual marked. 12 to 40 F degrees available by the addition of resistors.
Authority ratio	Dial adjustable 0.5:1 to 25:1.
Staged sequencing relay outputs	
Linear ("first on", "last off")	Eight SPDT has adjustable dropouts and selectable differential.
Time delay between stages	Standard 10 seconds, resistor selectable 5 to 60 seconds. Return to cold start on power interruption.

Specifications (Continued)

Control output voltage	
Control of System 8000 devices	2 to 15 Vdc paralleling or sequencing five additional System 8000 devices. Factory calibrated for 7.5 Vdc with sensor at setpoint temperature.
Proportional control of electric heat	6 to 9 Vdc between each HTG relay outputs.
Power requirements	Refer to Model Chart.
Power supplies available	
6.2 Vdc, 4 mA	These regulated and filtered power supplies must not be connected to +20 (red) or +6.2 of other supplies.
20 Vdc, 35 mA	
Environment	
Ambient temperature limits	Shipping and storage: -40 to 160°F (-40 to 71°C). Operating: 40 to 140°F (4 to 60°C).
Humidity	5 to 95% RH, non-condensing.
Locations	NEMA Type 1.
Connections	
Control	Coded screw terminals for 14 to 20 AWG.
Power	Color coded pigtails.
Case	Metal with four 1/2 to 3/4 in. conduit knockouts, two on each end.
Mounting	Inside location near the controlled equipment using the four keyhole slots.
Dimensions	10-3/8 H x 7-1/4 W x 3-1/8 D in. (263 x 184 x 79 mm).
Agency Listings	UL Listed, CUL.
General Instructions	Refer to F-17219.

Accessories

Model No.	Description
AD-8969-201	Offset resistor kit; 5, 10, 15, and 20°F.
AT-8122	Remote setpoint adjuster, dual scale 20 to 120°F (-6 to 49°C).
AT-8155	Remote setpoint adjuster, dual scale 50 to 250°F (10 to 120°C).
AT-8158	Remote setpoint adjuster, dual scale 55 to 85°F (13 to 29°C).
CC-8102	Electronic relays for additional stages for linear sequencers.
TS-8101	Room sensor.
TS-8111	Room sensor with setpoint.
TS-8131	Room button type sensor.
TS-8201	Duct/immersion sensor.
TS-8261	Light fixture sensor.
TS-8405	Averaging sensor, 5 ft. (1.5 m).
TS-8422	Averaging sensor, 22 ft. (6.7 m).
TS-8501	Outdoor sensor.
TS-8601	Selective ratio discharge sensor.
TOOL-201	Calibration kit for System 8000.

Typical Applications

Relay Contact Electrical Ratings.

Volts AC 50/60 Hz	Contact	Va Rating	Inrush VA
120	N.O.	125	1250
	N.C.	67	670
24	N.O.	25	250
	N.C.	13	130

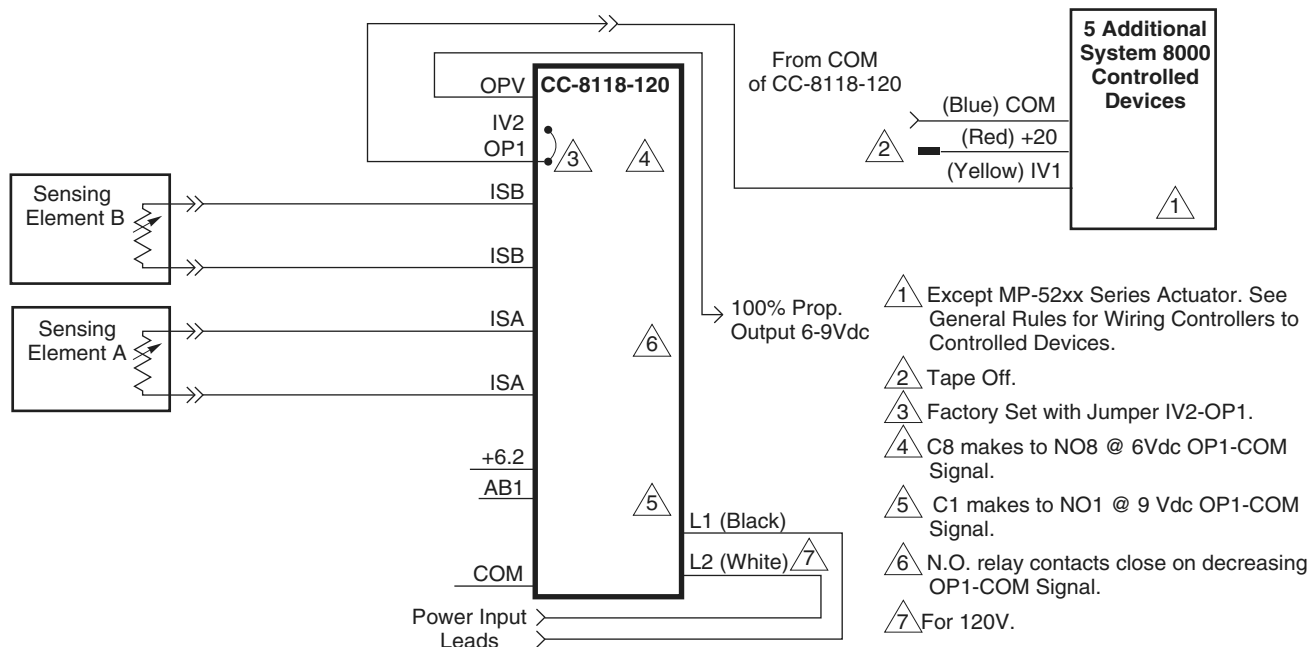
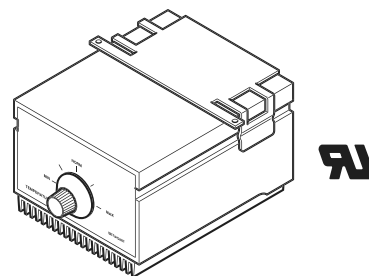


Figure 1 Typical Application.

Fan Speed Controller

An electronic motor speed controller for use with shaded pole and permanent split capacitor type motors without integral starting switches and starting windings, up to 120 Vac with a maximum of 5 amps running current. Used in heating and/or cooling applications.



Features:

- Adjustable minimum cutoff speed setting to match specific motor characteristics.
- Direct and reverse action through summer/winter selection.
- Sensor supplied and designed for convenient surface mounting on fan coil units.
- Automatic summer/winter changeover thermostat for sensing fluid temperature available.

Model Chart	
Model No.	Description
CP-5341	Refer to Specifications.

Specifications	
Setpoint dial range	Dial marked "Minimum-Normal-Maximum" (55 to 85°F approximately).
Sensor	Supplied with a medallion sensor (TS-5181) for unit mounting. TS-5191 adjustable wall sensor (order separately) for applications requiring remote sensing and setpoint.
Automatic summer/winter changeover	TC-2931-205 changeover thermostat with plug-in connector (order separately).
Throttling range	Adjustable 2 to 12 F degrees (1 to 7 C degrees), factory set at 2 F degrees (1 C degrees).
Output voltage	From minimum fan speed cutoff to 105 Vac.
Minimum fan speed cutoff	Factory set at 65 Vac, adjustable 65 to 105 Vac.
Environment	
Ambient temperature limits	Shipping and storage: -40 to 160°F (-40 to 71°C). Operating: 35 to 135°F (2 to 57°C).
Humidity	5 to 95% RH, non-condensing.
Locations	NEMA Type 1.
Connections	
Sensor	3 ft. (0.9 m) of two-conductor cable with plug-in type connections. Note: TC-2931-205 has 3 ft. (0.9 m) cable which cannot be extended.
Power	Color coded 3 ft. (0.91 m) three-conductor cord.
Case	Bakelite.
Mounting	Should be surface mounted in a vertical position with mounting bracket provided. Medallion sensor supplied with controller requires 17/64 in. dia. mounting hole.
Dimensions	3 H x 4-1/16 W x 5 D in. (76 x 103 x 127 mm).
Agency Listing	UL Recognized.
General Instructions	Refer to F-15094.

Accessories	
Model No.	Description
TC-2931-205	Changeover thermostat.
TS-5191	Adjustable wall sensor.

Typical Applications

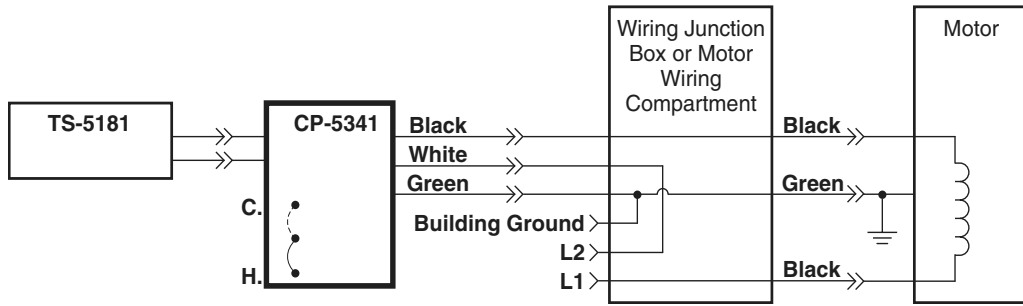
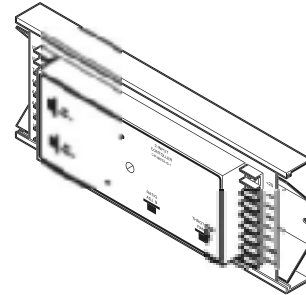


Figure 1 Typical Installation Wiring.

System 8000 Two-Input Temperature or Humidity Controller

This two-input temperature or humidity controller provides heating, cooling, humidification, or dehumidification control in HVAC systems.



Features:

- Individual setpoints for each input element.
- Self contained package incorporating two bridges and amplifiers.
- One input element has a 0.5 to 1 through 25:1 ratio adjustment.
- Accommodates all temperature/humidity System 8000 devices.
- Temperature setpoint ranges can be customized with remote setpoint assemblies.
- Standard System 8000 track mounting.

Model Chart			
Model No.	Control Dial Range Setpoint "A"	Control ^a Dial Range Setpoint "B"	Throttling Range for 3 Vdc Output Change
CP-8102	20 to 120°F	20 to 120°F	Adjustable 2 to 10 F° by dial ^b
CP-8102-116	-6 to 48°C	-6 to 48°C	Adjustable 1 to 6 C° by dial ^b

^a For reset control, set setpoint "B" at zero reset point and setpoint "A" at control point desired with no reset action from sensor "B".

^b 15, 25, 40, and 60°F by pin selection (use J9 jumper). With the use of AD-8969-901 (order separately), the following T.R.'s can be obtained: 55, 65, 75, 85, 100, 115, 125, and 140°F (13, 18, 24, 29, 38, 46, 52, and 60°C).

Specifications	
Sensors	
Temperature	TS-8xxx one or two; three sensors through a CN-8101.
Humidity	HS-8x01, VER-HDxx-MSx, VER-HOxx-MSx, VER-HxWx-MA.
Control action	Direct (D.A.) or reverse (R.A.) selectable by jumper. Factory set D.A.
Authority ratio adjustment	0.5:1 to 25:1, adjustable by dial.
Control output voltage	1 to 15 Vdc, 10 mA maximum. Unit factory calibrated for 7.5 Vdc output with sensor at setpoint temperature.
Power requirements	20 Vdc (-1.5, +1), 23 mA.
Power supply available	6.2 Vdc, 7 mA maximum. Regulated and filtered power supply must not be connected to +6.2 of other supplies.
Remote setpoints	Order separately AT-8122, AT-8155 or AT-8158.
Setpoints, ratio and throttling potentiometers	Visible and accessible without removing controller cover.

CP-8102, CP-8102-116

Specifications (Continued)

Typical controlled devices	Maximum of six System 8000.
CC-8100	Series relays.
MF-63123	Floating valve actuator.
MFC-8000	Control module card for MF-62123 actuator.
MM/MMR-400 Series	Modular actuators w/MMC-8000 control module.
MM/MMR-500 Series	Modular actuators w/MMC-8000 control module.
MP-300-600 Series	Actuators.
MP-400-600 Series	Actuators.
MP-5000 Series	Actuators.
MS-1233 Series	Damper actuators.
MS4D-x0x3-030	Actuators.
MS40-7043-MP	Actuators.
MS40-7043-MP5	Actuators.
MS51-7103-030	Actuators.
MS51-7103-040	Actuators.
SP-40000 Series	Step controllers.
Environment	
Ambient temperature limits	Shipping and storage: -40 to 160°F (-40 to 71°C). Operating: 40 to 135°F (4.4 to 57°C).
Humidity	5 to 95% RH, non-condensing.
Locations	NEMA Type 1.
Connections	Coded screw terminals for 14 to 20 AWG.
Cover	Aluminum.
Mounting	Unit is provided with plastic track for panel mounting. AD-8912 enclosure can be ordered separately for remote installations.
Dimensions	4 H x 11 W x 2-1/2 D in. (102 x 279 x 64 mm).
General Instructions	Refer to F-14969.

Accessories

Model No.	Description
AD-8122	Signal adaptor for dual outputs (two direct acting).
AD-8123	Signal adaptor for dual outputs (one direct, one reverse acting).
AD-8124	Signal adaptor for dual outputs (one reverse, one direct acting).
AD-8912	Enclosure, 12 in. (305 mm).
AD-8969-201	Offset resistor kit: 5, 10, 15 and 20°F
AD-8969-901	Extended throttling range jumper.
AT-8122	Remote setpoint adjuster, dual scale 20 to 120°F (-6 to 49°C).
AT-8155	Remote setpoint adjuster dual scale 50 to 250°F (10 to 121°C).
AT-8158	Remote setpoint adjuster, dual scale 55 to 85°F (13 to 29°C).
AT-8222-101	Setpoint scale for humidity 20 to 100%.
AT-8435	Remote setpoint adjuster, dual scale 50 to 450°F (10 to 232°C) for use with TS-8204 only.
CN-8101	Multi-purpose bridge.
TOOL-201	Calibration kit for System 8000.

Typical Applications

Jumper Connections.

Controller Function	Jumper Connections Required	
	Bridge "A"	Bridge "B"
Direct acting ^a	J4 to JC6 J3 to JC5	J5 to JC5 J6 to JC6
Reverse acting	J4 to JC5 J3 to JC6	J5 to JC6 J6 to JC5
Internal setpoint active ^a	J1 to JC1	J2 to JC3
Internal setpoint inactive for remote setpoint	J1 to JC2	J2 to JC4
Disable Bridge "B" for single sensor input	Remove jumper from AB2 to AB3	

^a As supplied from factory.

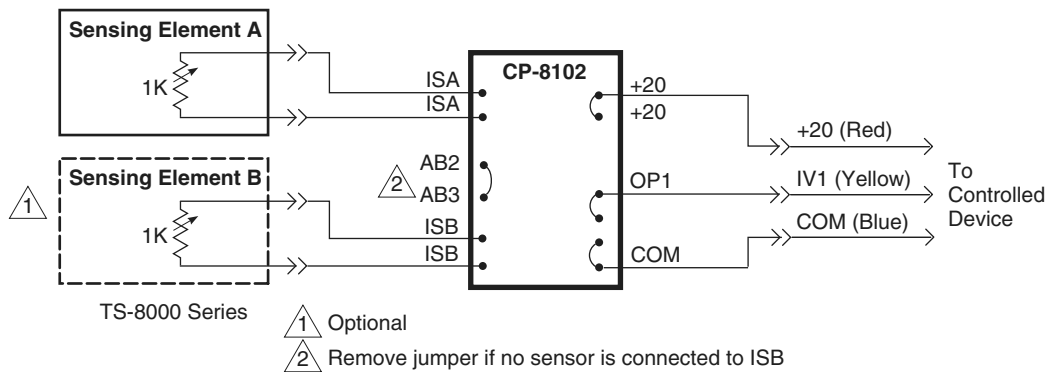
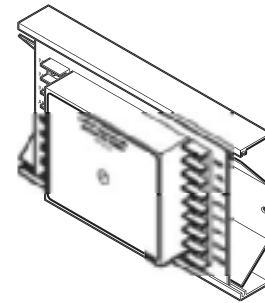


Figure 1 Typical Temperature Control Wiring.

System 8000 Two-Input Temperature or Humidity Controller

This controller provides precision control for mixed air dampers, heating and cooling valves, make up air units, chillers, laboratories, computer rooms, test chambers, and other applications.



Features:

- System 8000 two input controller.
- Automatic reset action.
- Control signal inversion capability.
- High signal selection.
- Ramp up and ramp down operation.
- Anti wind-up capability.

Model Chart	
Model No.	Description
CP-8122	Refer to Specifications.

Specifications

Sensors	
Temperature	TS-8000 series one or two; three sensors through a CN-8101 multi-purpose bridge.
Humidity	HS-8x01, VER-HDxx-MSx, VER-HOxx-MSx, VER-HxWx-MA.
Setpoint adjusters	SPA and SPB, 41 to 95°F (5 to 35°C).
Remote setpoints	Order separately AT-8122, AT-8155, or AT-8158.
Throttling range	10 F degrees (5 C degrees) factory set, 20 and 30 F degrees (11 and 17 C degrees) pin selectable.
Authority ratio adjustment	Factory set 1:1, pin selectable 0.5, 0.75, 15:1, others available.
Bridge action	Factory set, "A", D.A. (direct acting), "B" R.A. (reverse acting), can be made reverse acting.
Auxiliary bridge input	For remote setpoint adjusters, night setback, etc.
Control amplifier output voltage (OP1)	2 to 15 Vdc. Unit factory calibrated for 7.5 Vdc output with sensor at setpoint temperature.
Integral action time	Dial adjustable 0.3 to 3 repeats per minute.
Integral action limiter	Limits output signal from integral action section to 2 Vdc above input signal in ramp up mode or 2 Vdc below input signal in ramp down mode.
Anti-wind-up or down	On system startup, normal proportional control signal from OP2 until the input voltage to IV1 is less than 7.5 Vdc (anti-wind-up) or greater than 7.5 Vdc (anti-wind-down), at which point integral action is initiated.
Signal inversion	Adjustable at SPC from 5.5 Vdc above or below the input signal at IV2.
Softstart	On system startup.
Time	Adjustable 3 to 60 minutes for 3 Vdc output change.
Start point	Adjustable 0 to 15 Vdc.
Restart	Momentary contact closure between RST and COM restarts ramp function.
Power requirements	20 Vdc, 40 mA +2 mA per System 8000 controlled device.
Power supply available	6.2 Vdc 4 mA maximum. This regulated and filtered power supply must not be connected to +6.2 or red lead of other supplies.
Calibration potentiometers	Internal.
Number of controlled devices	Maximum of six System 8000.

Specifications (Continued)

Typical controlled devices	
CC-8100 Series	Relays.
MF-63123	Floating valve actuator.
MFC-8000	Control module card for MF-62123 actuator.
MM/MMR-400 Series	Modular motor with MMC-8000 control module.
MM/MMR-500 Series	Modular motor with MMC-8000 control module.
MP-300-600 Series	Actuators.
MP-400-600 Series	Actuators.
MP-5000 Series	Actuators.
MS-1233 Series	Damper actuators.
MS4D-x0x3-030	Actuators.
MS40-7043-MP	Actuators.
MS40-7043-MP5	Actuators.
MS51-7103-030	Actuators.
MS51-7103-040	Actuators.
SP-40000 Series	Step controllers.
Environment	
Ambient temperature limits	Shipping and storage: -40 to 160°F (-40 to 71°C). Operating: 40 to 140°F (4 to 60°C).
Humidity	5 to 95% RH, non-condensing.
Locations	NEMA Type 1 indoor only.
Connections	Coded screw terminals.
Cover	Aluminum.
Mounting	Unit provided with plastic track for panel mounting. AD-8912 enclosure can be ordered separately for remote installations.
Dimensions	4 H x 7-1/2 W x 2-1/2 D in. (102 x 191 x 64 mm).
General Instructions	Refer to F-18503.

Accessories

Model No.	Description
AD-8912	Enclosure, 12 in. (305 mm).
AD-8969-201	Offset resistor kit: 5, 10, 15 and 20°F (-15, -12, -9 and -7°C).
AD-8969-901	Extended throttling range jumper.
AT-8122	Remote setpoint adjuster, dual scale 20 to 120°F (-6 to 49°C).
AT-8155	Remote setpoint adjuster, dual scale 50 to 250°F (10 to 121°C).
AT-8158	Remote setpoint adjuster, dual scale 55 to 85°F (13 to 29°C).
AT-8435	Remote setpoint adjuster, dual scale 50 to 450°F (10 to 232°C) for use with TS-8204 only.
TOOL-201	Calibration kit for System 8000.

Typical Applications

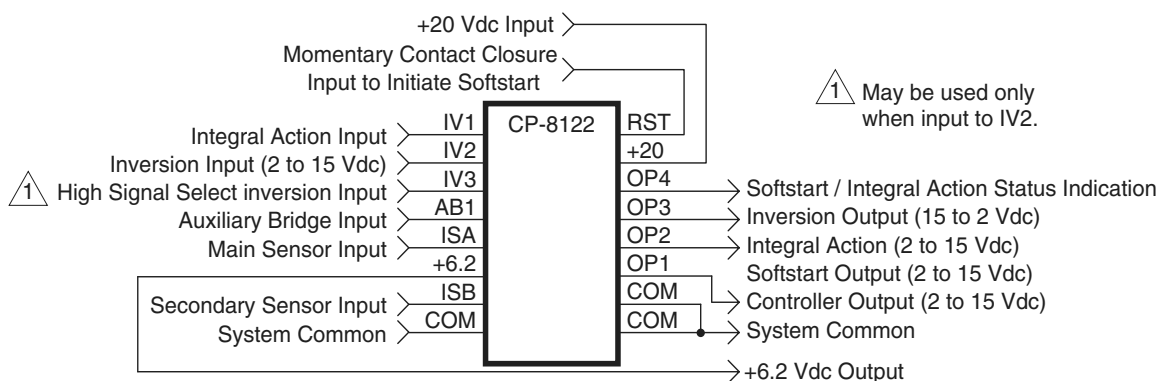


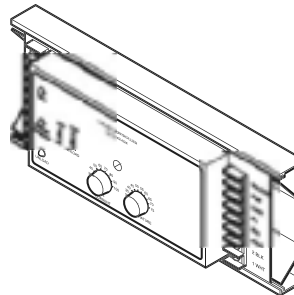
Figure 1 Input/Output Connections.

System 8000 Chiller Controller

This chiller controller provides electronic control for centrifugal chillers with electric or hydraulic loading vane actuators.

Features:

- System 8000 two input controller design.
- Precise zero droop control action.
- Auto ramp-up of chiller designed into unit.
- Motor current limit action for start-up.
- Standard auto/manual control switches.
- LED indication of control action.
- Standard System 8000 track mounting.
- Excellent retrofit package for competitive hardware.



Model Chart				
Model No.	Relay Contact Electrical Rating			
	Vac 50/60 Hz	Contact	VA Rating	Inrush VA
CP-8142-024	120/240	N.O. or N.C.	125	1250
	24		25	250

Specifications

Inputs	
Sensors	TS-8000 (1000 ohm Balco), 1 or 2 required.
Current transformer	0.5 or 5 Vac.
Power demand control	15 to 2 Vdc (IV1), 10 to 2 Vdc (IV2).
Momentary contact closure	Ramp-up reset (3 sec. min.).
Auxiliary voltage	Remote temperature setpoint adjuster 2 to 15 Vdc (IO1).
Outputs	
Relays	Two SPST time proportioned. Both factory set normally open (N.O.). Refer to Model Chart for contact ratings.
Control voltage	Temperature: 2 to 15 Vdc (IO1). Current indication: 0 to 10 Vdc (OP2).
Field Adjustments	
Temperature	Chilled water supply setpoint (SPA): 35 to 70°F (2 to 21°C).
	Chilled water return setpoint (SPB): 35 to 70°F (2 to 21°C).
	Return water reset ratio: By jumper.
	Sensitivity: By jumper.
Motor current	Maximum percent motor current: 30 to 100%.
	Ramp-up start point: 0 to 100%.
	Ramp-up time: 2 to 45 minutes.
Pulse rate adjustment	Repeats per minute for corrective action on loading vane actuator.
Relay load and unload contact adjustment	Either or both may be set normally closed.
Power requirements	24 Vac 50/60 Hz, 6 VA.
Power supplies available	+20 Vdc, 35 mA; +6.2 Vdc, 4 mA.

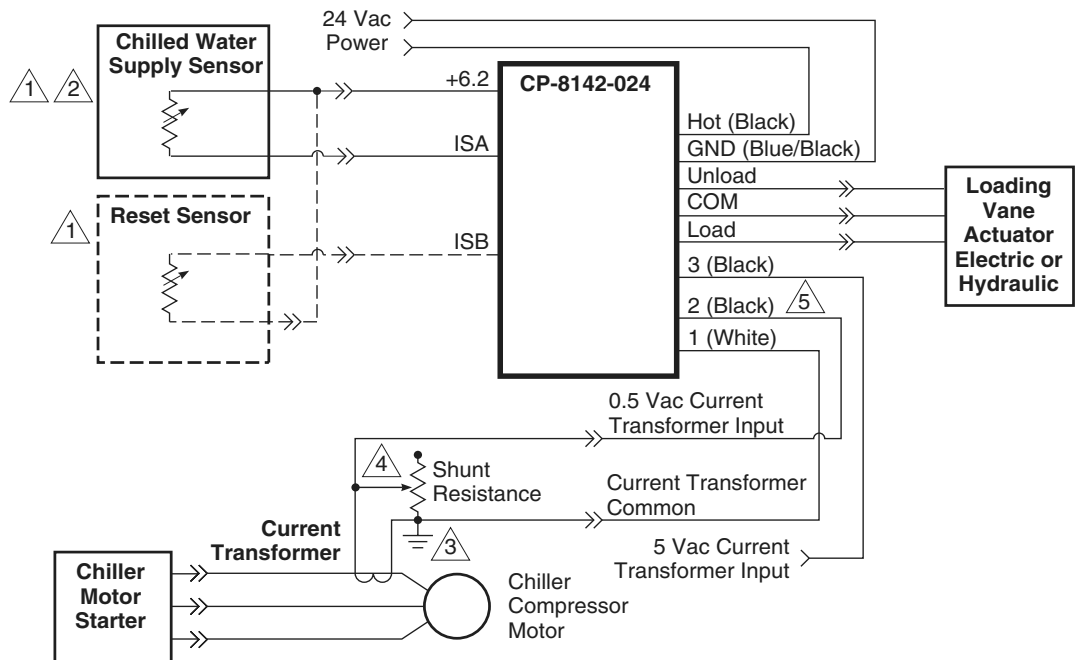
Specifications (Continued)

Environment	
Ambient temperature limits	Shipping and storage: -40 to 160°F (-40 to 71°C). Operating: 40 to 125°F (4 to 60°C).
Humidity	5 to 95% RH, non-condensing.
Locations	NEMA Type 1.
Wiring connections	
Control	Coded screw terminals for 14 to 20 AWG.
Power	Color coded pigtails, 10 in. (254 mm).
Cover	Aluminum.
Mounting	Unit is provided with a section of plastic track for panel mounting.
Dimensions	3-7/8 H x 11 W x 3-1/4 D in. (98 x 279 x 83 mm).
General Instructions	Refer to F-17983.

Accessories

Model No.	Description
AD-8301	Minimum positioner.
ASP-584	Indicating meter 0 to 100%.
AT-215	Immersion well.
AT-8522	Remote setpoint adjuster, dual scale 30 to 80°F (1 to 26°C).
TS-8201	Immersion sensor.

Typical Applications



- △1 TS-8000 Series 1000 Balco Temp. Sensor.
- △2 Supply and return water sensors must be installed in an appropriate well filled with M-500 temperature conductive silicon grease.
- △3 Ground at Current Transformer only. Use a common ground when one transformer powers the CP-8142-024 and the loading valves for hydraulic vane control.
- △4 Adjust for 0.5 Volts full load.

△5 Terminal	Input Vac
2	0.5
3	5

Figure 1 Typical Wiring Diagram.

CP-8142-024

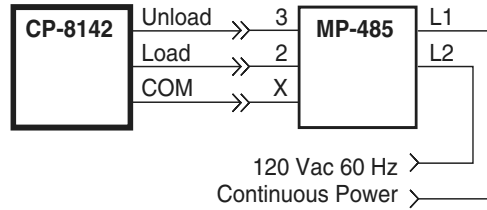


Figure 2 Connections to an Electric Vane Actuator.

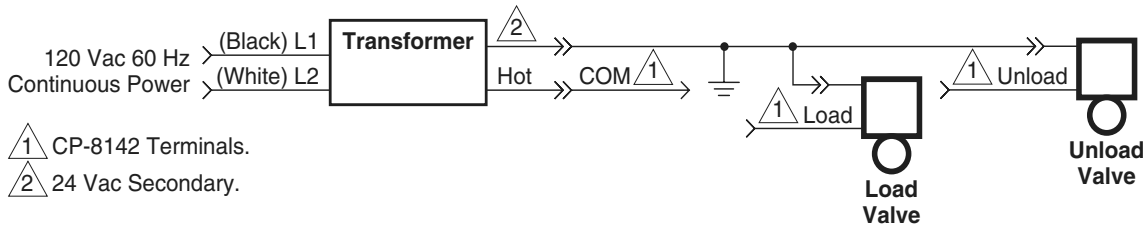


Figure 3 Connections to Hydraulically Controlled Vane Valves.

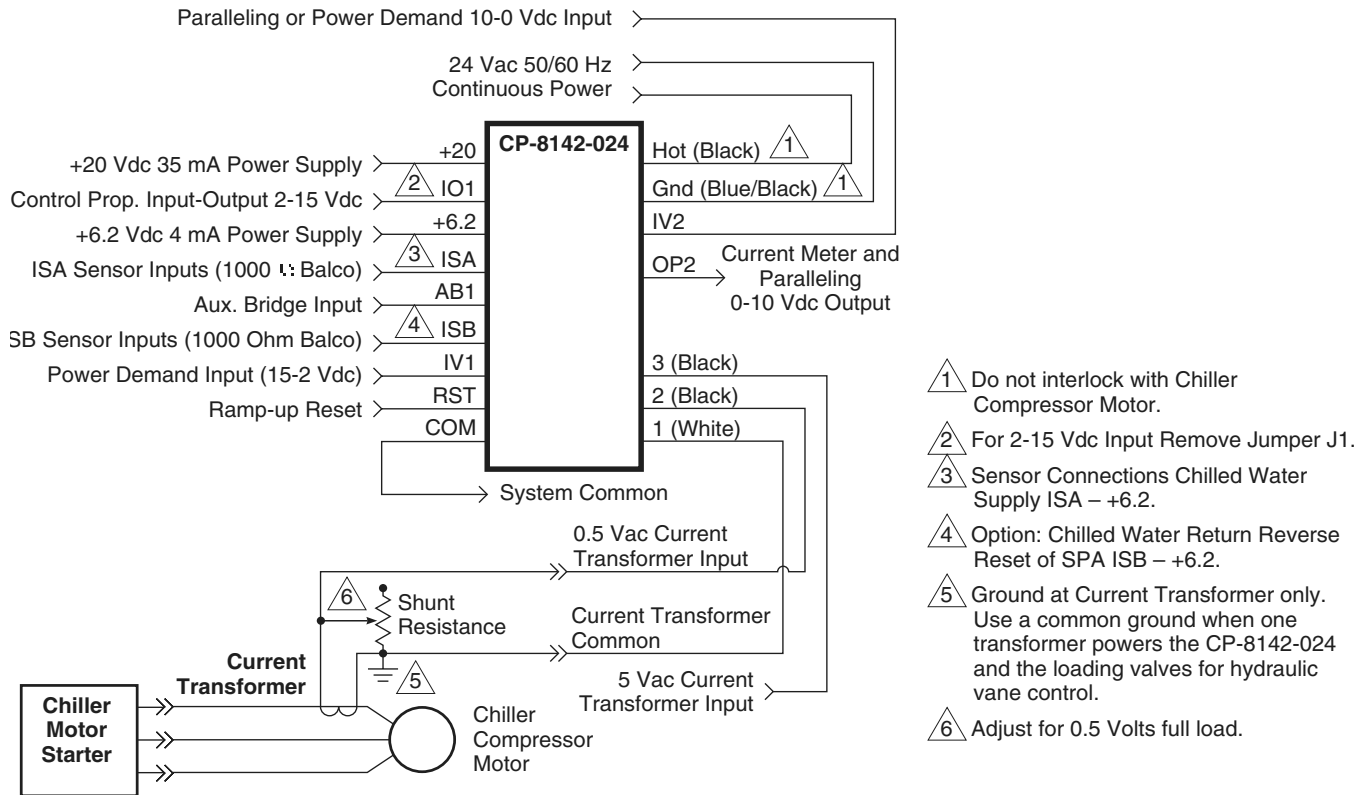
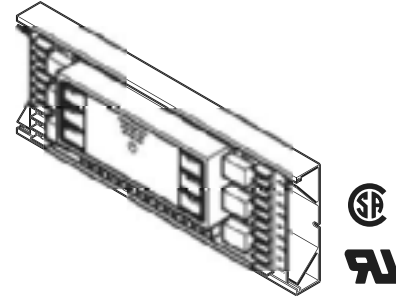


Figure 4 CP-8142-024 Terminal Designations.

System 8000 Six Stage Programmable Controllers

Electronic six stage programmable controller with proportional output for heating, cooling and mixed air. The six stages can be programmed for heating, cooling and fan operation.



Features:

- Six stages of control, any heat-cool combination programmable.
- Two individual heat-cool setpoints.
- Two input System 8000 controllers.
- Automatic integrated mixed air control cycle.
- Slave operation to add additional control stages.
- Setpoints can be remotely controlled.
- Enthalpy input signal capability.

Model Chart Description.

Model No.	Heating			Cooling		
	Setpoint (SPA)	Throttling (TRA) ^a	Output (IO1)	Setpoint (SPB)	Throttling (TRB) ^a	Output (IO2)
CP-8161-333	45 to 75°F (7 to 24)°C	2 to 10 F° Factory set 3 F°	2 to 15 Vdc Factory set reverse acting, Field changeable direct acting	70 to 100°F (21 to 38)°C	2 to 10 F° Factory set 3 F°	2 to 15 Vdc direct acting only
CP-8161-433	None	None	^b	None	None	^b

^a For 3 Vdc output change.

^b IO1 and IO2 become inputs on CP-8161-433.

Mixed Air and /Relay Outputs Table.

Model No.	Mixed Air ^a				Relay (6) Outputs	
	Low Limit Setpoint ^b	Minimum Position	Mixed Air	Output (OP3)	Pull-In Voltage (Vdc)	Differential
CP-8161-333	41 to 95 °F (5 to 35°C) 10 °F (5°C) ^c fixed T.R.	0 to 100% Factory set 25%	Factory calibrated for 9 Vdc when IO2 cooling signal is 6 Vdc	5 to 12 Vdc direct acting only	5.5	0.5 Vdc fixed
CP-8161-433					6.5	
	7					
	7.5					
	8					
	8.5					
	9					

^a Mixed air override is either accomplished from first or second stage cooling, or by outside enthalpy or temperature thermostats (purchased separately).

^b Can be used as separate mixed air controller or mixed air low limit in conjunction with cooling output ramp (then throttling range of mixed air would be the same as cooling ramp).

^c For 3 Vdc output change.

CP-8161-333, CP-8161-433 (Slave)

Relay Contact Ratings.

Volts AC 50/60 Hz	Contact	Va Rating	Inrush VA
120/240	N.O.	125	1250
	N.C.	67	670
24	N.O.	25	250
	N.C.	13	130

Specifications

Sequenced control	Staged and/or proportional heating, proportional control of outside and return (mixed air) damper, staged and/or proportional cooling. Heating and cooling cannot operate simultaneously.
Single sensor control	Heating, cooling, and ventilation with individual heating and cooling setpoints.
Unit fan	May be programmed to cycle in the unoccupied mode.
Relay output	Six relays can be programmed for heating, cooling or fan operation. Operational voltage level by dual-in-line switches.
Mixed air sensor (optional)	The controller can provide a separate mixed air control, or limit control in conjunction with proportional cooling output ramp.
Cold start	On power failure.
Control output voltage	Refer to Description Model Chart and Mixed Air and /Relay Outputs Model Chart.
Power requirements	24 Vac, 10 VA.
Power supplies available	6.2 Vdc, 4 mA; 20 Vdc, 35 mA. These regulated and filtered power supplies must not be connected to +20, +6.2 or red lead of other supplies.
Environment	
Ambient temperature limits	Shipping and storage: -40 to 160°F (-40 to 71°C). Operating: 0 to 140°F (-18 to 60°C).
Humidity	5 to 95% RH, non-condensing.
Locations	NEMA Type 1.
Connections	Coded screw terminals.
Cover	Aluminum.
Mounting	Unit is provided with plastic track for panel mounting.
Dimensions	3-7/8 H x 12 W x 2-3/4 D in. (98 x 305 x 70 mm).
Agency Listings	UL Recognized, CSA.
General Instructions	Refer to F-18096.

Accessories

Model No.	Description
AD-8969-201	Offset resistor kit; 5, 10, 15, and 20°F.
AT-8122	Remote setpoint adjuster, dual scale 20 to 120°F (-6 to 49°C).
AT-8155	Remote setpoint adjuster, dual scale 50 to 250°F (10 to 120°C).
AT-8158	Remote setpoint adjuster, dual scale 55 to 85°F (13 to 29°C).
AT-8258-101	Night setback scale for AT-8158.
TC-4111	Bulb thermostat.
THC-2	Enthalpy controller.
TS-8101	Room sensor.
TS-8131	Room button-type sensor.
TS-8201	Duct/immersion sensor.
TS-8261	Light fixture sensor.
TS-8405	Averaging sensor, 5 ft. (1.5 m).
TS-8422	Averaging sensor, 22 ft. (6.7 m).
TS-8501	Outdoor sensor.
TS-8601	Selective ratio discharge sensor.
TSP-8101-103	Temperature transmitter.
TOOL-201	Calibration kit for System 8000.

Typical Applications

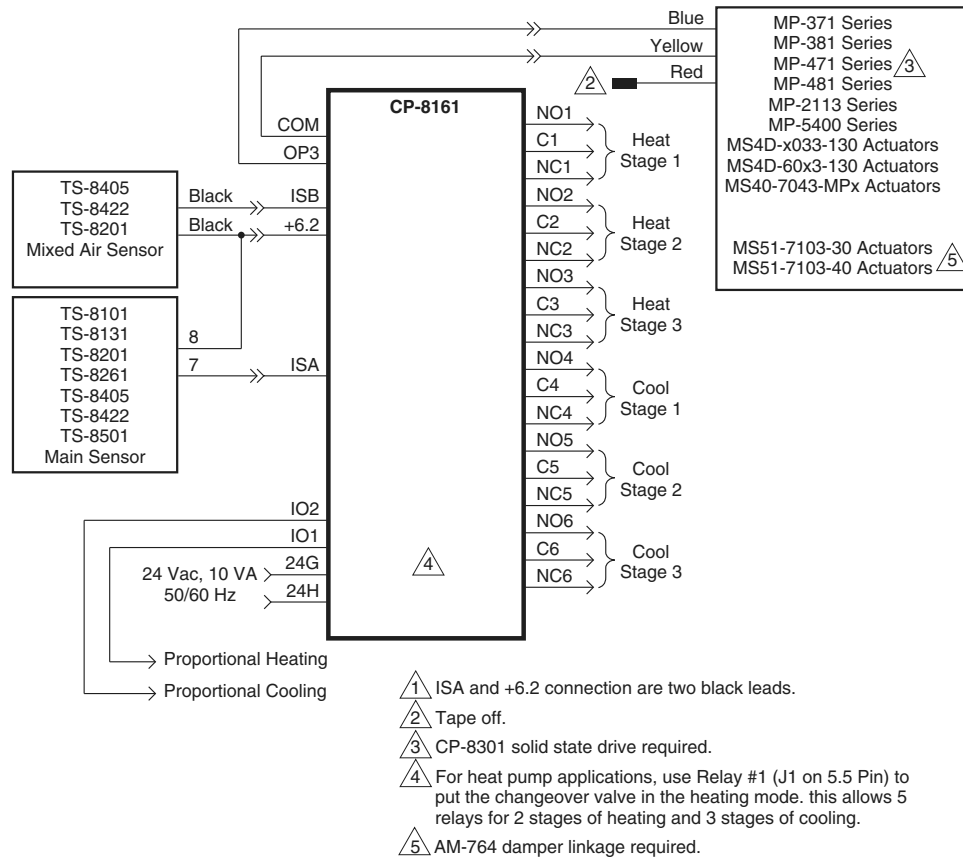


Figure 1 CP-8161-xxx 3-Heat/3-Cool/Mixed Air (Showing Program as Shipped from Factory).

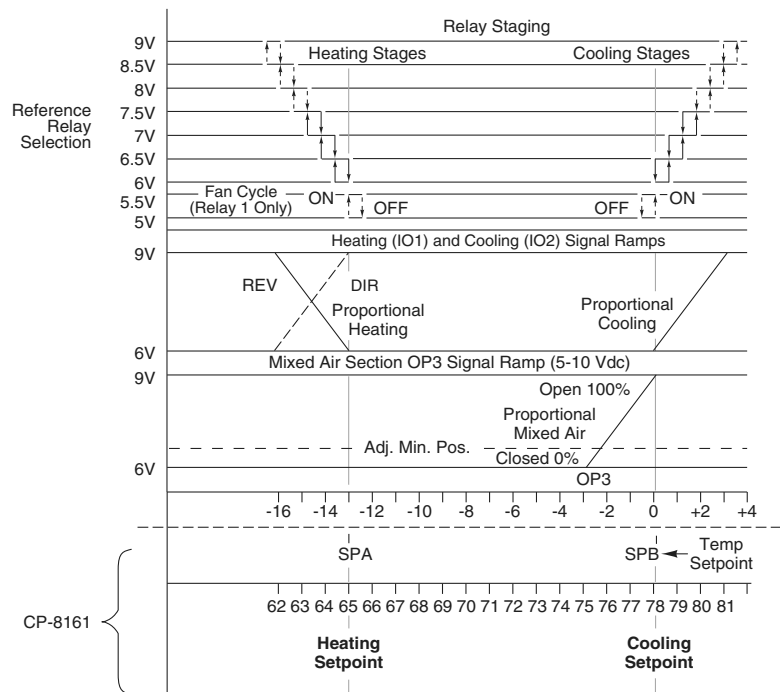


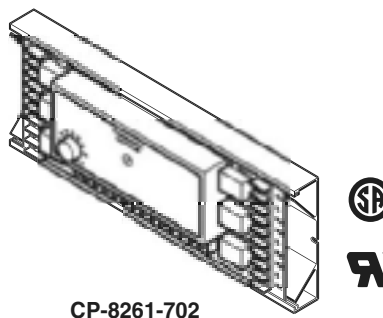
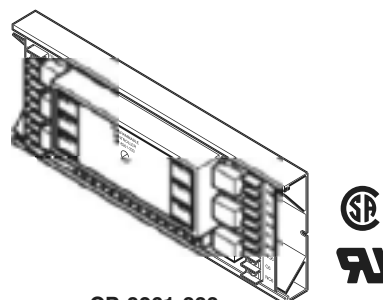
Figure 2 CP-8161-xxx Programmable Controller Sequence of Operation.

System 8000 Six Stage Programmable Controllers

The six stage electronic programmable controllers provide proportional control of outside and return (mixed air) dampers in sequence with staged heating and cooling equipment. Programming of the heating and cooling stages and relay assignment of heating and/or cooling plus operating level are accomplished by dual-in-line package (DIP) switches. Proportional heating and cooling outputs are available for valves or electric heat coils. The six stages can be programmed for heating, cooling, humidification, night setback, and fan operation.

Features:

- Six stages of control, any heat-cool combination programmable.
- One setpoint for heat/cool with adjustable deadband between heating and cooling.
- Two input System 8000 controllers.
- Automatic integrated mixed air control cycle.
- Slave operation to add additional control stages.
- Setpoints can be remotely controlled.
- Enthalpy input signal capability.



Model Chart

Description.

Model No.	Setpoint Range (SPB)		Nullband Range (SPA)	Mixed Air Low Limit Setpoint (SPC)	Throttling Range Adjustments		
					Heating (TRA)	Cooling (TRB)	Mixed Air
CP-8261-333	Internal	55 to 85°F (13 to 29°C)	2 to 14°F (1 to 8°C) Factory set for 3°F (2°C)	41 to 95°F (5 to 35°C)	2 to 10 F° (1 to 5 C°) Factory set for 3 F° (2 C°)	2 to 10 F° (1 to 5 C°) Factory set 3 F° (2 C°)	10 F° (5 C°) fixed
CP-8261-702	External						

Proportional Outputs and Output Relays.

Model No.	Proportional Outputs			Staged Heat and/or Cool Output Relays
	Heating (IO1)	Cooling (IO2)	Mixed Air (OP3)	
CP-8261-333	2 to 15 Vdc direct acting or 15 to 2 Vdc reverse acting (jumper select)	2 to 15 Vdc direct acting <i>only</i>	5 to 10 Vdc direct acting <i>only</i>	0 to 6 relays DIP switch selectable for any combination of heat and/or cool
CP-8261-702				

Specifications	
Sequenced control	Staged and/or proportional heating, proportional control of outside and return (mixed air) damper, staged and/or proportional cooling. Heating and cooling cannot operate simultaneously.
Single Setpoint (SPB)	55 to 85°F (13 to 29°C). Heating, cooling, and ventilation are controlled from a single sensor and a single setpoint.
Nullband Adjustment (SPA)	2 to 14°F (0 to 8°C); factory set at 3°F (2°C). Provides for separating the heating and ventilation/cooling.
Mixed Air Low Limit Setpoint (SPC)	41 to 95°F (5 to 35°C).
Relay rating	24/120 Vac, 1 amp. 240 Vac, 0.5 amp inductive. Refer to the Relay Contact Ratings Model Chart.
Adjustments, minimum position	Minimum mixed air damper position (0 to 100%) factory set at 25%. For other adjustments refer to the Description Model Chart and Proportional Outputs and Output Relays Model Chart.
Unit fan	May be programmed to cycle in the unoccupied mode.
Relay output	Six relays can be programmed for heating, cooling, or fan operation. Operational voltage level by dual-in-line switches.
Mixed air sensor (optional)	The controller can provide a separate mixed air control, or limit control in conjunction with proportional cooling output ramp.
Cold start	On power failure.
Control output voltage	Refer to the Description Model Chart and Proportional Outputs and Output Relays Model Chart.
Power requirements	24 Vac, 10 VA.
Rectifier type	Half wave, not isolated.
Power supplies available	6.2 Vdc, 4 mA; 20 Vdc, 35 mA. These regulated and filtered power supplies must not be connected to +20, +6.2 or red lead of other supplies.
Environment	
Ambient temperature limits	Shipping and storage: -40 to 160°F (-40 to 71°C). Operating: 0 to 140°F (-18 to 60°C).
Humidity	5 to 95% RH, non-condensing.
Locations	NEMA Type 1.
Connections	Coded screw terminals.
Cover	Aluminum.
Mounting	Unit is provided with plastic track for panel mounting.
Dimensions	3-7/8 H x 12 W x 2-3/4 D in. (98 x 305 x 70 mm).
Agency Listing	UL Recognized.
General Instructions	Refer to F-23832.

CP-8261-333, CP-8261-702

Relay Contact Ratings.

Volts AC 50/60 Hz	Contact	Va Rating	Inrush VA
120/240	N.O.	125	1250
	N.C.	67	670
24	N.O.	25	250
	N.C.	13	130

Accessories

Model No.	Description
AD-8969-201	Offset resistor kit; 5, 10, 15, and 20°F.
AT-8122	Remote setpoint adjuster, dual scale 20 to 120°F (-6 to 49°C).
AT-8155	Remote setpoint adjuster, dual scale 50 to 250°F (10 to 120°C).
AT-8158	Remote setpoint adjuster, dual scale 55 to 85°F (13 to 29°C).
AT-8258-101	Night setback scale for AT-8158.
CP-8161-433	Slave.
TC-4111	Bulb thermostat.
THC-2	Enthalpy controller.
TS-8101	Room sensor.
TS-8131	Room button-type sensor.
TS-8201	Duct/immersion sensor.
TS-8261	Light fixture sensor.
TS-8405	Averaging sensor, 5 ft. (1.5 m).
TS-8422	Averaging sensor, 22 ft. (6.7 m).
TS-8501	Outdoor sensor.
TS-8601	Selective ratio discharge sensor.
TSP-8101-103	Temperature transmitter.
TOOL-201	Calibration kit for System 8000.

Typical Applications

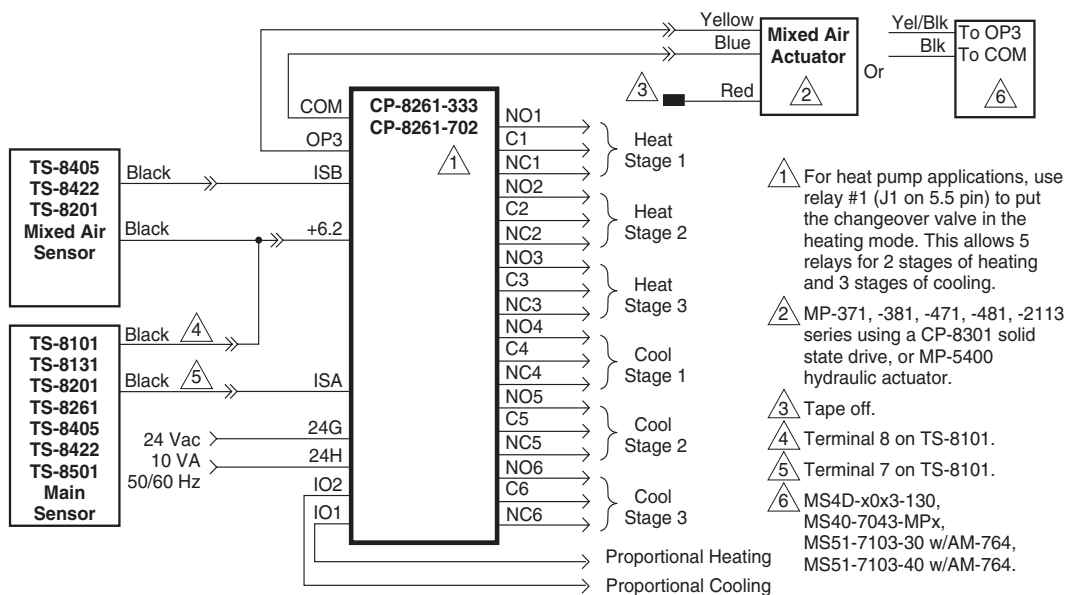


Figure 1 CP-8261-xxx3-Heat/3-Cool/Mixed Air (Showing Program as Shipped from Factory).

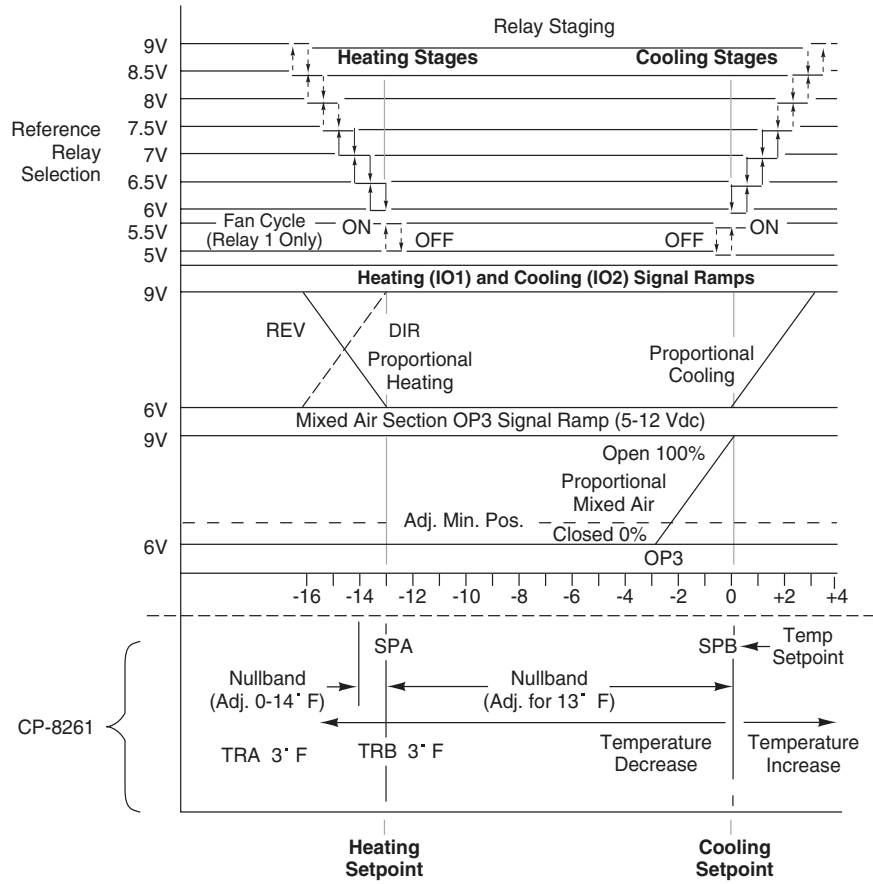


Figure 2 CP-8261-xxx Programmable Controller Sequence of Operation.

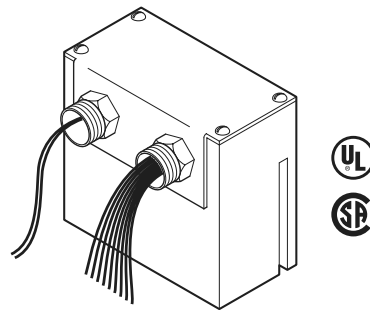
CP-8301-xxx Series

2 to 15 Vdc Input Electronic Actuator Drive

The CP-8301-xxx Series electronic actuator drive is designed to process a variable 2 to 15 Vdc signal from a controller to provide proportional control of an electric gear train actuator.

Features:

- Mounts directly onto Invensys proportional, electric, gear train actuators.
- 24, 120, and 240 Vac models available.
- Color-coded pigtail leads.



Model Chart				
Model No.	Power Requirement Vac, 4.8 VA 50/60 Hz (+10/-15%)	Power Supply ^a	Start Point of Actuator	Span
CP-8301-024	24	20 Vdc, 50 mA regulated and filtered.	Adjustable from 2 to 12 Vdc input. Factory set at 6 Vdc.	Fixed at 3 Vdc for full actuator stroke.
CP-8301-120	120			
CP-8301-240	240			

^a The power supply must not be connected to +20 (red) of other supplies.

Typical Actuators.

Actuator Series	Power		Torque		Stroke Degrees	Spring Return
	Vac 60 Hz	Amp	Lb-in.	N-m		
MP-2113-500	24	2.2	50	5.6	180	—
MP-361		2.5				220
MP-371			0.5	50		
MP-381		120				0.5
MP-465 ^a	90		0.95	450	50.8	
MP-475 ^a		180				0.9
MP-483 ^a	24		4.0	800	90	
MP-485 ^a		120				0.9
MP-486 ^a	24		4.0	800	90	
MP-495 ^a		120				0.9
MP-9713	24		4.0	800	90	
MP-9750 ^a		120				0.9

^a **CAUTION:** Remove red and blue transformer wires from terminals 7 and 8 of actuator and tape.

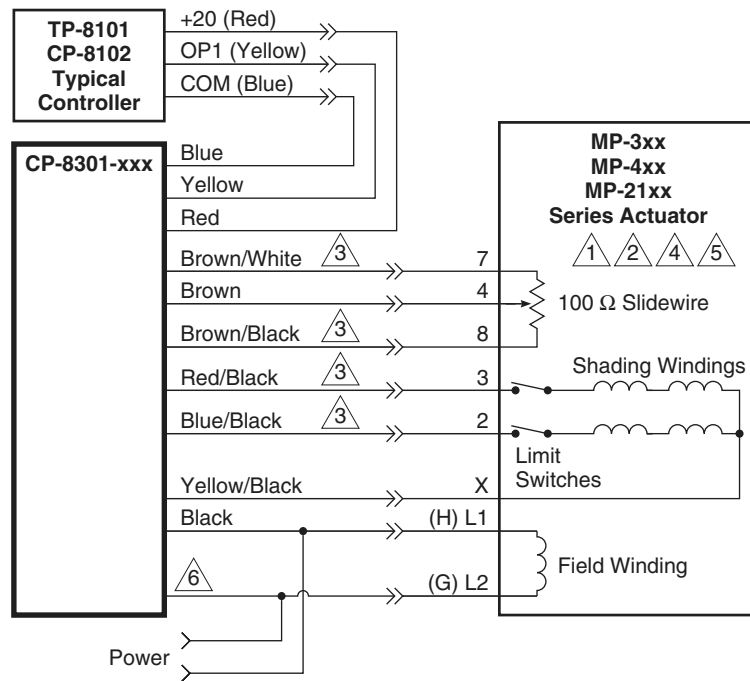
Specifications

Inputs	
Control signal	Range: 2 to 15 Vdc. Span: refer to Model Chart. Start point: refer to Model Chart.
Power requirements	Refer to Model Chart.
Power supplies	Refer to Model Chart.
Outputs	
Connections	Color coded pigtail leads.
Mounting	Directly to an actuator.
Case	Bakelite.
Environment	
Ambient temperature limits	Shipping and storage: -40 to 140° F (-40 to 60°C). Operating: -40 to 140° F (-40 to 60°C).
Humidity	5 to 95% RH, non-condensing.
Locations	NEMA Type 1.
Dimensions	4 H x 4 W x 3-1/4 D in.(102 x 102 x 83 mm).
Agency Listings	
UL 873	Underwriters Laboratories (File #E9429 Category Temperature-Indicating and Regulating Equipment.
CSA	Canadian Standards C22.2 No. 24-93.
General Instructions	Refer to F-14940.

Accessories

Model No.	Description
TOOL-201	Calibration kit for System 8000.

Typical Applications



- 1 For actuator with internal transformers. Disconnect red and blue leads from actuator terminals 7 and 8 and tape off.
- 2 Diagram Shown; Increasing input causes CW actuator rotation. All references to the direction of rotation are determined by looking at the actuator output shaft.
- 3 For CCW rotation with an increasing input signal, reverse the wires to terminals 7 & 8 and 2 & 3.
- 4 CP-8301-024 can be used with the following electric actuators: MP-361, 371, 381, 2113-500 and 9713. CP-8301-120 can be used with the following electric actuators: MP-465, 475, 483, 485, 486, 2150-500, and 9750.
- 5 CP-8301-240 can be used with 240 Vac electric actuators. (Available as a standard option.)
- 6

Part No.	Vac.	Color
CP-8301-120	120	White
CP-8301-024	24	Black/Blue
CP-8301-240	240	White/Blue

Figure 1 Typical CP-8301-xxx Used On Actuator with Same Voltage as the Drive.

CP-8301-xxx Series

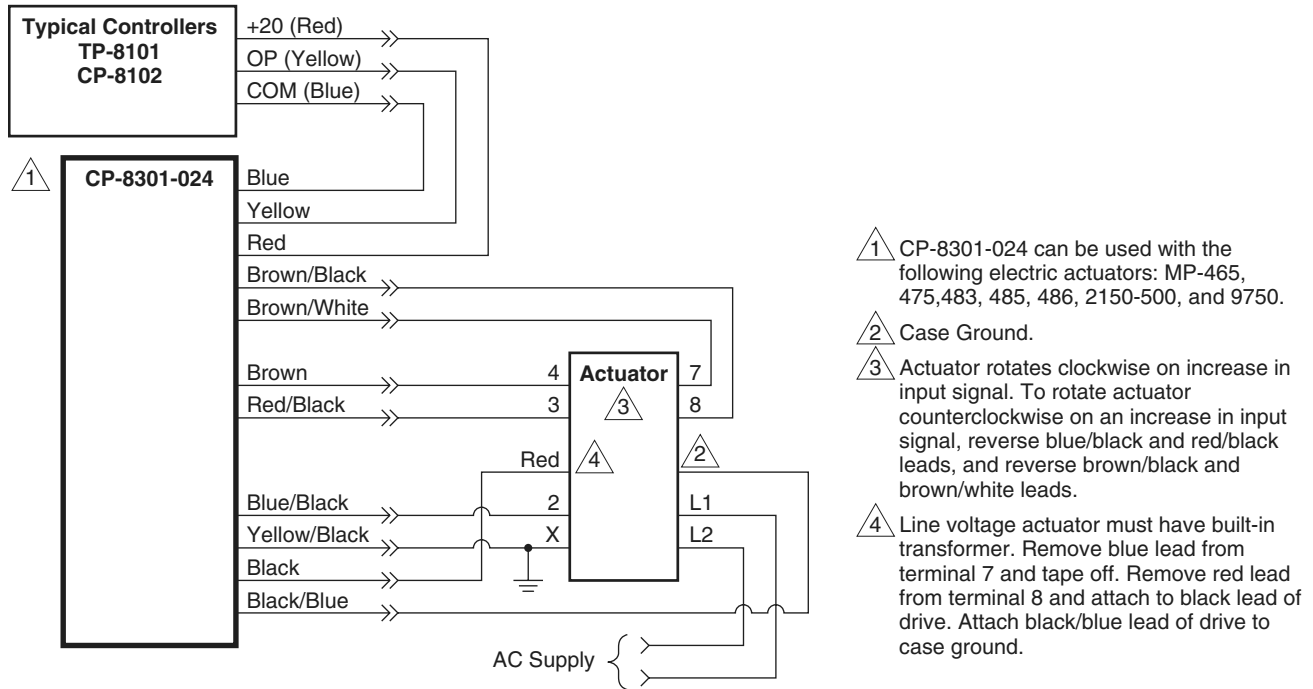


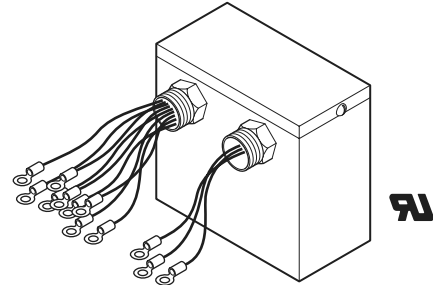
Figure 2 Typical CP-8301-024 on 120 or 240 Vac Actuators with Built-in Transformer.

Electronic Actuator Drive

This drive provides proportional control of an electric gear train actuator from a variable voltage DC signal produced by a controller.

Features:

- Variable Vdc signal acceptance and proportional drive of certain MP-400, MP-4000, MP-2100, and MP-9000 series actuators.
- Rugged aluminum case.
- Direct actuator mount model.
- Adjustable start point, span, and hysteresis.
- Driving capability of up to three actuator drives by typical controller.



Model Chart

Mounting and Field Wiring Connections.

Model No.	Input Signal Range	Voltage 50/60 Hz	Operating Span	Start Point	Impedance	Field Wiring Connections
CP-8391-456	0 to 10 Vdc factory set Field adjustable 1 to 5, 2 to 10, 5.5 to 9.5, 2 to 18.5, and 10 to 20 Vdc	120 Vac or 240 Vac	10 Vdc factory set Field adjustable 3.5 to 16.5 Vdc	0 Vdc factory set Field adjustable -5.5 to 10 Vdc	19K Ω Other input impedances obtained by adding series and/or parallel resistors.	Color coded pigtail leads.

Typical Actuators.

Actuator Series	Volts (60 Hz)	Torque		Stroke (Deg.)	Spring Return
		Lb.-in.	N-m		
MP-465 ^{ab}	120	50	5.6	180	CW
MP-475 ^{ab}					CCW
MP-483 ^{ab}		220	24.9	180	—
MP-485 ^{ab}					
MP-486 ^{ab}					
MP-495 ^{ab}		450	50.8	90	—
MP-9750 ^{ab}					
MP-9810		800	90.4	180	—
MP-9830					
MP-9910					
MP-4851 ^{ab}	240	220	24.9	180	—

^a CP-9301 drive may be an alternative solution.

^b **CAUTION:** Remove red and blue transformer wires from terminals 7 and 8 of actuator and tape.

Specifications

Electronic Actuator Drive inputs

Compatible with variable Vdc input signal	Grounding: Either or both input wires grounded will not cause damage.
	Maximum: 40 Vdc.
	Isolation: Optically.
Power	Requirements: 120 or 240 Vac, $\pm 10\%$, with fixed input signal offset of $\pm 1\%$ maximum. 24 Vac units not available.
	Consumption: 3.5 VA at 120 or 240 Vac, 50 or 60 Hz.
Connections	CP-8391-456 mounts directly to the actuator.

Electronic Actuator Drive outputs

Electrical	Refer to Typical Actuators Model Chart for triac output compatible actuators.
Environment	
Ambient temperature limits	Shipping and storage: -40 to 140°F (-40 to 60°C). Operating: -13 to 140°F (-25 to 60°C).
Humidity	5 to 95% RH, non-condensing.
Locations	NEMA Type 1.
Dimensions	
CP-8391-456	4-1/16 W x 4-5/8 H x 3-3/8 D in. (103 x 118 x 86 mm).
Agency Listing	UL Recognized.
General Instructions	Refer to F-24190.

Typical Applications

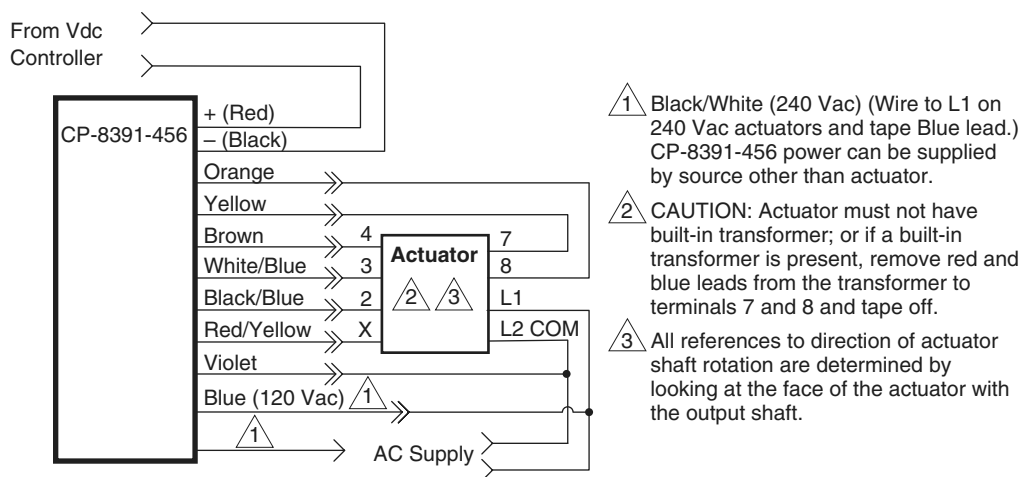
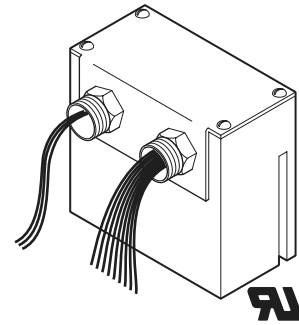


Figure 1 Typical Wiring Diagram, CP-8391-456 to MP-4xx and MP-21xx Series and MP-9750 Actuators, Increasing Input Signal, CCW Actuator Rotation.

4 to 20 mA Input Electronic Actuator Drive

The CP-8391-716 Series electronic actuator drive is designed to process a variable 4 to 20 mA_{dc} signal from a controller to provide proportional control of an electric gear train actuator.



Features:

- Mounts directly onto Invensys proportional, electric, gear train actuators.
- 4 to 20 mA_{dc} operating range. with 250 Ω impedance with field adjustable ranges of 2 through 7, 2 through 12, 7 through 12, 4 through 12, and 12 through 20 mA_{dc}.
- 120 or 240 Vac applications.
- Color-coded pigtail leads.

Model Chart	
Model No.	Description
CP-8391-716	Refer to Specifications.

Typical Actuators.

Actuator Series	Power		Torque		Stroke Degrees	Spring Return
	Vac 60 Hz	Amp	Lb-in.	N-m		
MP-2130-500 ^{a b}	120	0.5	50	5.6	90	—
MP-2150-500 ^{a b}					180	
MP-465 ^{a b}		0.5	50	5.6	90	CW
MP-475 ^{a b}						CCW
MP-483 ^{a b}		0.5	220	24.9	180	—
MP-485 ^{a b}						
MP-486 ^{a b}		0.95	450	50.8	180	—
MP-495 ^{a b}						
MP-9750 ^{a b}		0.9	800	90	90	—
MP-9830 ^c						
MP-9910 ^c		1.8	1300	146.9	90	—
					1600	

^a **CAUTION:** Remove red and blue transformer wires from terminals 7 and 8 of actuator and tape.

^b CP-9302 drive may be an alternative solution.

^c NOTE: Some MP-9xxx will require two X6880 mounting extensions.

CP-8391-716 Series

Specifications

Inputs	
Control signal	Range: 4 to 20 mAdc, non-adjustable. Span: Adjustable 4 to 16 mAdc. Start point: Adjustable from 2 to 16 mAdc. Impedance: 250 Ω.
	Grounding: Either input wire can be grounded and will not cause damage, provided the electric gear train actuator is ungrounded. Hysteresis: 3 to 5% of 16 mAdc span, nonadjustable. (Hysteresis is the difference in input signal between that signal which will drive the actuator shaft one way and the signal which will drive it the other way.)
Power requirements	120 or 240 Vac ±10%, fixed input signal offset ±1% maximum.
Power consumption	3.5 Va.
Linearity	0.15% of actuator rotation.
Outputs	To control windings of gear train actuators, see "Typical Actuators."
Connections	Color coded pigtail leads.
Mounting	Directly to an actuator. The upright position is preferred, but other positions are acceptable.
Case	Bakelite.
Environment	
Ambient temperature limits	Shipping and storage: -40 to 140° F (-40 to 60°C). Operating: -13 to 140° F (-25 to 60°C).
Humidity	5 to 95% RH, non-condensing.
Vibration	1G maximum in any plane.
Dimensions	4 H x 4 W x 3-1/4 D in.(102 x 102 x 83 mm).
Agency Listing	UL Recognized.
General Instructions	Refer to F-21220.

Typical Applications

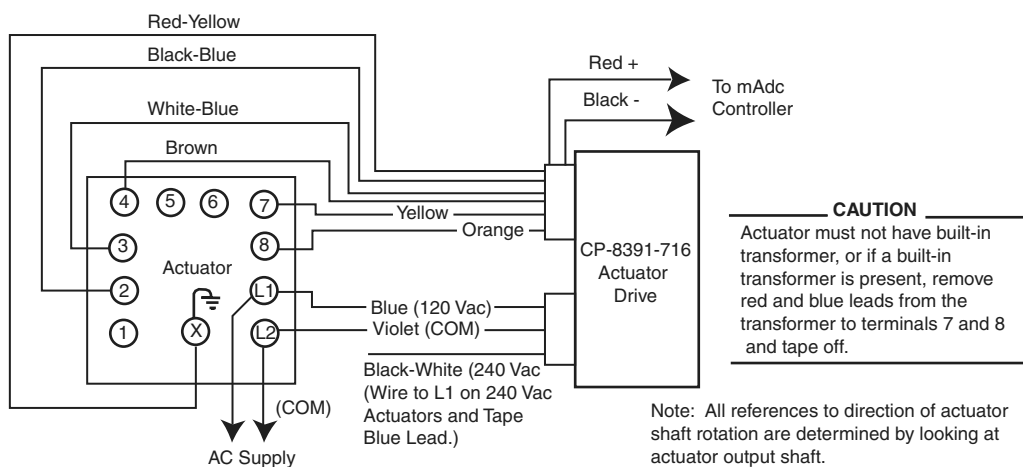


Figure 1 Typical Wiring Diagram, CP-8391-716 to MP-4xx and MP-21xx Series and MP-9750 Actuators, Increasing Input Signal, CCW Actuator Rotation.

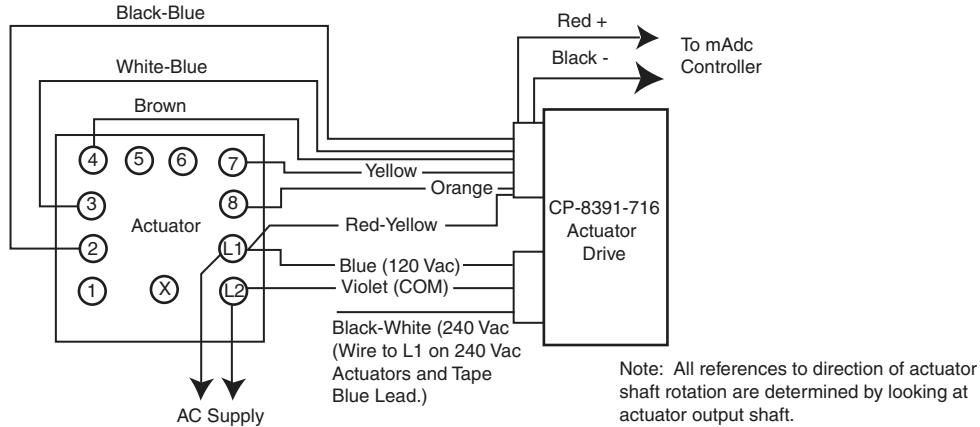


Figure 2 Installation Wiring Diagram, CP-8391-716 to MP-98xx and MP-99xx Series Actuators, Increasing Input Signal, CCW Actuator Rotation.

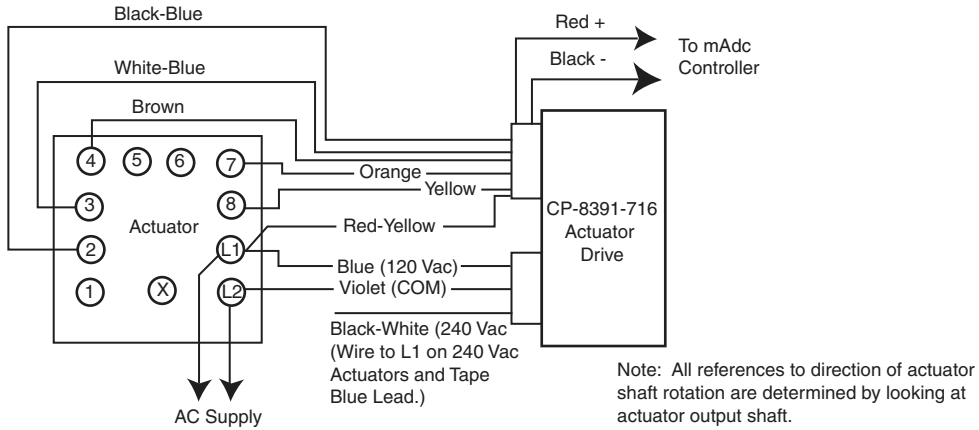


Figure 3 Installation Wiring Diagram, CP-8391-716 to MP-98xx and MP-99xx Series Actuators, Increasing Input Signal, CW Actuator Rotation.

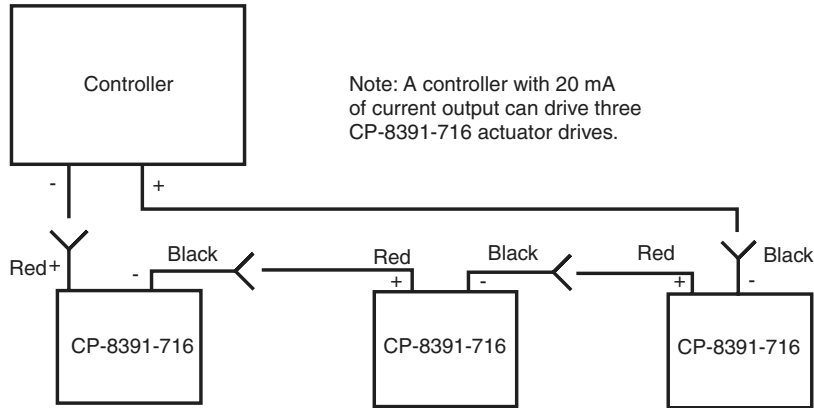


Figure 4 Wiring for Typical Series Application.

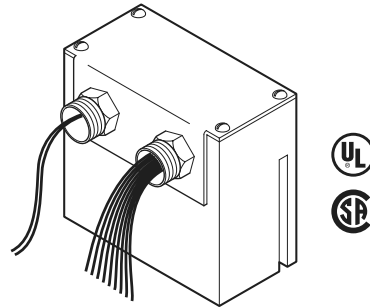
CP-8391-91x Series

4 to 20 mA Input Electronic Actuator Drive

The CP-8391-910 Series electronic actuator drive is designed to process a variable 4 to 20 mAdc signal from a controller to provide proportional control of an electric gear train actuator.

Features:

- Mounts directly onto Invensys proportional, electric, gear train actuators.
- Fixed 4 to 20 mAdc operating range. with 250 Ω impedance.
- 24 and 120 Vac models available.
- Color-coded pigtail leads.



Model Chart				
Model No.	Power Requirement Vac, 50/60 Hz (+10/-15%)	Power Consumption	Start Point of Actuator	Span
CP-8391-910	120	4.8 VA	Factory set at 4 mAdc non-adjustable.	Fixed at 16 mAdc for full actuator stroke.
CP-8391-913	24			

Typical Actuators.

Actuator Series	Power		Torque		Stroke Degrees	Spring Return
	Vac 60 Hz	Amp	Lb-in.	N-m		
MP-2113-500 ^a	24	2.2	50	5.6	180	—
MP-361 ^a		2.5				—
MP-371 ^a			—	CCW		
MP-381 ^a		—	—			
MP-465 ^{a b}	120	0.5	50	5.6	90	CW
MP-475 ^{a b}			220	24.9		—
MP-483 ^{a b}						—
MP-485 ^{a b}		0.95	450	50.8	180	—
MP-486 ^{a b}						
MP-495 ^{a b}		—				
MP-9713	24	4.0	800	90		
MP-9750 ^a	120	0.9				

^a CP-9301 may be an alternative solution.

^b **CAUTION:** Remove red and blue transformer wires from terminals 7 and 8 of actuator and tape.

Specifications

Inputs

	Range: 4 to 20 mAdc, non-adjustable. Span: 16 mAdc. Start point: 4 mAdc. Impedance: 250 Ω.
Control signal	Grounding: Either input wire can be grounded and will not cause damage, provided the electric gear train actuator is ungrounded. Hysteresis: 6 to 9% of 16 mAdc span, nonadjustable. (Hysteresis is the difference in input signal between that signal which will drive the actuator shaft one way and the signal which will drive it the other way.)
Power requirements	Refer to Model Chart.
Power Consumption	Refer to Model Chart.
Linearity	0.15% of 16 mAdc span.
Outputs	To control windings of gear train actuators, see "Typical Actuators."
Connections	Color coded pigtail leads.
Mounting	Directly to an actuator. The upright position is preferred, but other positions are acceptable.
Case	Bakelite.
Environment	
Ambient temperature limits	Shipping and storage: -40 to 140° F (-40 to 60°C). Operating: -40 to 140° F (-40 to 60°C).
Humidity	5 to 95% RH, non-condensing.
Vibration	1G maximum in any plane.
Dimensions	4 H x 4 W x 3-1/4 D in. (102 x 102 x 83 mm).
Agency Listing	
UL 873	Underwriters Laboratories (File #E9429 Category Temperature-Indicating and Regulating Equipment.
CSA	Canadian Standards C22.2 No. 24-93.
General Instructions	Refer to F-22453.

Typical Applications

- 1 For actuator with internal transformers. Disconnect red and blue leads from actuator terminals 7 and 8 and tape off.
- 2 Diagram Shown; Increasing input causes CCW actuator rotation. All references to the direction of rotation are determined by looking at the actuator output shaft.
- 3 For CW rotation with an increasing input signal, reverse the wires to terminals 7 & 8 and 2 & 3.

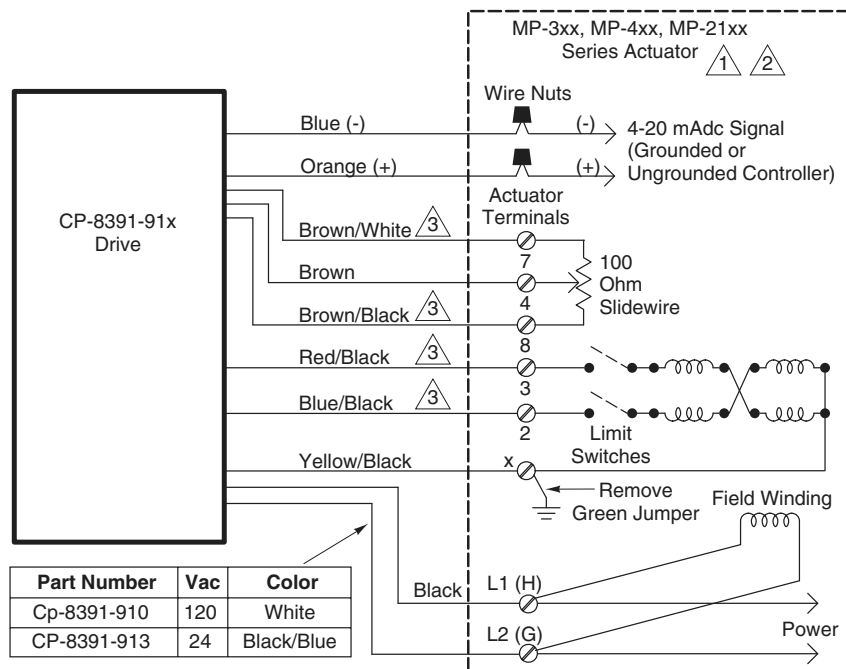


Figure 1 Typical CP-8391-91x Used On Actuator.

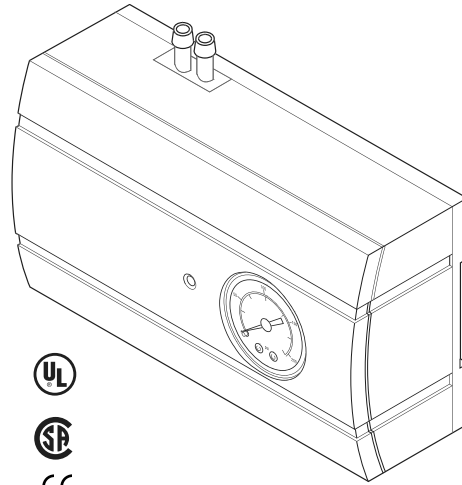
CP-8511-xxx Series

Electronic to Pneumatic Transducer

The CP-8511 transducer receives a variable electronic input signal and produces a 3 to 15 psig (21 to 103 kPa) pneumatic output signal to position pneumatic damper and valve actuators in HVAC systems.

Features:

- Durable enclosure with easily accessible wiring terminations.
- Panel or DIN rail mounting for quick, snap-on installation.
- High accuracy with low hysteresis.
- Long-term driftless operation with high repeatability.
- Low air consumption and large air flow capacity.
- Field selectable input ranges.
- Integral +20 Vdc power output for auxiliary components.
- Factory installed branch pressure gauge
- Integral auto/manual override feature with indication.
- BAS indication of auto/manual override.



Model Chart					
Model No. ^a	Field Selectable Input Range	Input Impedance Ohms	Output Range	Field Selectable Action ^b	Power Requirements
CP-8511-024	4 to 20 mA ^c	250	3 to 15 psig ^d (21 to 103 kPa)	D.A. or R.A.	20 to 30 Vac, 24 to 30 Vdc, 3.8 W
	1 to 5 mA	1000			
	6 to 9 V	> 10,000			
	1 to 5 V				
	0 to 10 V				
	1 to 11 V				
	2 to 10 V				

^a CAUTION: This product contains a half-wave rectifier power supply and must not be powered off transformers used to power other devices utilizing non-isolated full-wave rectifier power supplies. Refer to EN206 F-26363.

^b D.A. = Direct acting, branch pressure rises as input increases.
R.A. = Reverse acting, branch pressure falls as input increases.

^c Factory configured as 4 to 20 mA_{dc}.

^d A maximum of 18 psig output is available when the zero potentiometer is increased to 6 psig.

Specifications	
Inputs	Refer to Model Chart.
Adjustments	
Calibration	Potentiometer for adjusting mid-range branch pressure.
Action	By pin selection, refer to Model Chart.
Power requirements	Refer to Model Chart.
Power supply	Requires 20 to 30 Vac, 50/60 Hz, or 24 to 30 Vdc power supply, 3.8 watts maximum.
Rectifier type	Half wave, not isolated.
Air supply required	20 psig (138 kPa) nominal, 30 psig (207 kPa) maximum. Clean, dry, oil free air required (reference EN-123, F-22516).

Specifications (Continued)

Air consumption for sizing air compressor	Maximum 0.012 scfm (5.66 ml/s).
Air capacity for sizing air mains	550 scim (150.24 ml/s).
Air connections	Male barbed fittings for flexible 1/4" O.D. pneumatic tubing.
Wiring connections	Screw terminals for use with 16 to 22 AWG wire.
Outputs	3 to 15 psig (21 to 103 kPa).
Maximum pneumatic output	1 to 18 psig (7 to 124 kPa).
Action	Refer to Model Chart.
Output air capacity & pressure	515 scim (141 mL/s) with a 20 psig (138 kPa) supply.
Operating characteristics	
Linearity	±1% of span @ 75°F (24°C).
Hysteresis	0.75% of span @ 75°F (24°C).
Adjustments	Field adjustable zero potentiometer.
Auxiliary power supply	+20 Vdc @ 50 mA (maximum).
Auto/manual feedback	Isolated open collector output transistor.
Auto/manual status	Green LED.
Pressure gauge accuracy	Within 2% of total scale range in middle portion of scale and 3% elsewhere (ANSI Class B).
Environment	
Ambient temperature limits	Shipping and storage: -40 to 160°F (-40 to 71°C). Operating: 32 to 140°F (0 to 60°C).
Humidity	5 to 95% RH, non-condensing.
Locations	NEMA Type 1.
Mounting	Upright position. Unit is provided with section of plastic track for panel mounting. AD-8912 enclosure can be ordered separately for remote installations.
Dimensions	4-1/4 H x 5 W x 2-5/32 D in. (108 x 127 x 55 mm).
Agency Listings	
UL	UL-873, Underwriters Laboratories.
European Community	EMC Directive (89/336/EEC). Emissions (EN50081-1). Immunity (EN61000-6-2).
CSA	Canadian Standards C22.2 No. 24-93.
General Instructions	Refer to F-26205.

Accessories

Model No.	Description
K-335	In-line air filter.
P-610	35 mm DIN rail (1-3/8 W x 36 L x 3/10 H in.).

Typical Applications

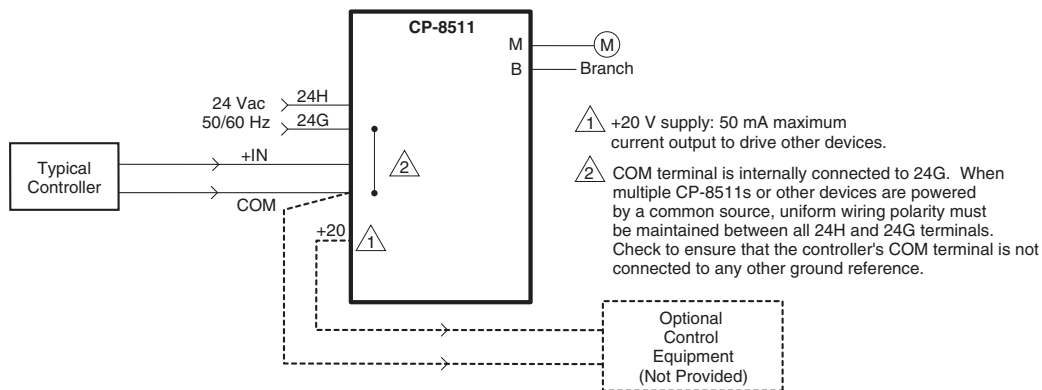


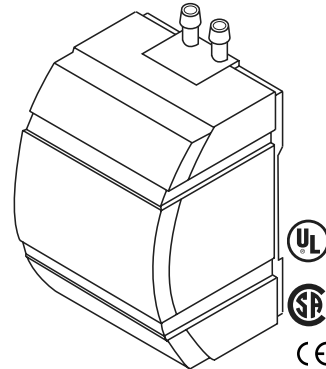
Figure 1 Typical CP-8511 Wiring with Optional +20 Vdc Supply.

Electronic to Pneumatic Transducer

The CP-8551 and CP-8552 transducers receive a variable electronic input signal and produce a 3 to 15 psig (21 to 103 kPa) pneumatic output signal to position pneumatic damper and valve actuators in HVAC systems.

Features:

- Durable enclosure with easily accessible wiring terminations.
- Panel or DIN rail mounting for quick, snap-on installation.
- Two-wire loop powered or three-wire voltage input.
- High accuracy with low hysteresis.
- Long-term driftless operation with high repeatability.
- Low air consumption and large air flow capacity.
- Control input protection from short circuit or reverse polarity.



Model Chart			
Model No. ^a	Input Signal	Input Impedance Ohms	Power Requirements
CP-8551	4 to 20 mA	550 maximum, 400 minimum	None
CP-8552	4 to 20 mA	550 maximum, 400 minimum, 4 to 20 mA input, >10,000 Vac input	None
	6 to 9 Vdc, 0 to 10 Vdc		20 to 30 Vac, 24 to 30 Vdc, 3.9 VA, 1.6 W

^a CAUTION: This product contains a half-wave rectifier power supply and must not be powered off transformers used to power other devices utilizing non-isolated full-wave rectifier power supplies. Refer to EN206 F-26363.

Specifications	
Input signal	Refer to Model Chart.
Rectifier type	Half wave, not isolated.
Input range adjustment	CP-8551: Fixed, 16 mAdc. CP-8552: Jumper selectable. Refer to Model Chart.
Power supply	0 to 10 and 6 to 9 V: Requires 20 to 30 Vac, 3.9 VA (CP-8552), 50/60 Hz, or 24 to 30 Vdc power supply, 1.6 watts maximum.
Air supply required	20 psig (138 kPa) nominal, 30 psig (207 kPa) maximum. Clean, dry, oil free air required (reference EN-123, F-22516).
Air consumption for sizing air compressor	Maximum 0.012 scfm (5.66 ml/s) at 20 psig (138 kPa) supply.
Air capacity for sizing air mains	Minimum 550 scim (150.24 mL/s).
Air connections	Male barbed fittings for flexible 1/4" O.D. pneumatic tubing.
Wiring connections	Screw terminals for 16 to 22 AWG wire.
Output signal	3 to 15 psig (21 to 103 kPa) nominal, direct acting.
Adjustments	CP-8551: None. CP-8552: 4 to 20 mA range, none; 0 to 10 and 6 to 9 V range, adjustable start point and span potentiometers.
Maximum pneumatic output	1 to 18 psig (7 to 124 kPa).
Maximum air capacity	515 scim (141 ml/s) maximum with a 20 psig (138 kPa) supply.
Operating characteristics	
Linearity	±1% of span at 75°F (24°C).
Hysteresis	0.75% of span at 75°F (24°C).

Specifications (Continued)

Environment	
Ambient temperature limits	Shipping and storage: -40 to 160°F (-40 to 71°C). Operating: 32 to 140°F (0 to 60°C).
Humidity	5 to 95% RH, non-condensing.
Locations	NEMA Type 1.
Dimensions	4-1/4 H x 2-13/16 W x 2-5/32 D in. (108 x 71 x 55 mm)
Agency Listings	
UL 873	Underwriters Laboratories (File #E9429 Category Temperature-Indicating and Regulating Equipment).
CUL	Canadian Standards C22.2 No. 24-93.
European Community	EMC Directive (89/336/EEC). Emissions (EN50081-1). Immunity (EN61000-6-2).
General Instructions	Refer to F-26159.

Accessories

Model No.	Description
AL-3x2	Pressure gauge.
K-335	In-line air filter.
B-371	Branch tee.
M-127	90° drop ear elbow.
M-636	4 in. T and B wire tie.
P-610	35 mm DIN rail (1-3/8 W x 36 L x 3/10 H in.)

Typical Applications

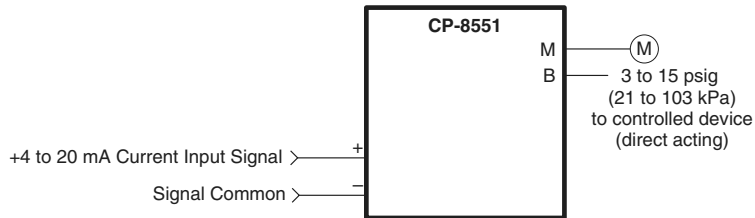


Figure 1 CP-8551 Typical Wiring.

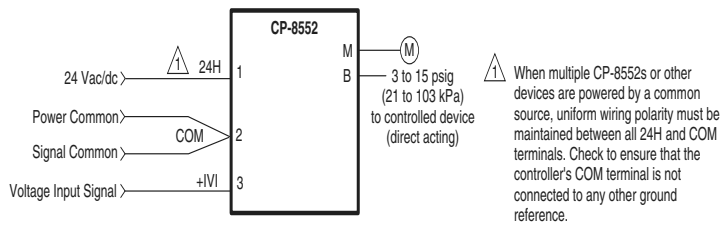


Figure 2 CP-8552 Typical Wiring for Voltage Input.

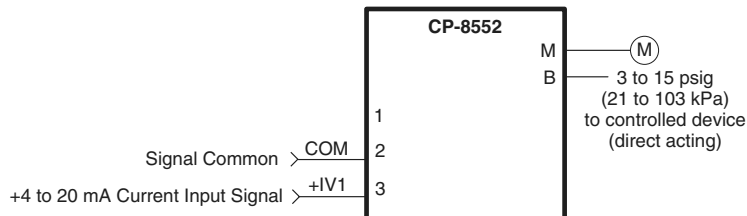


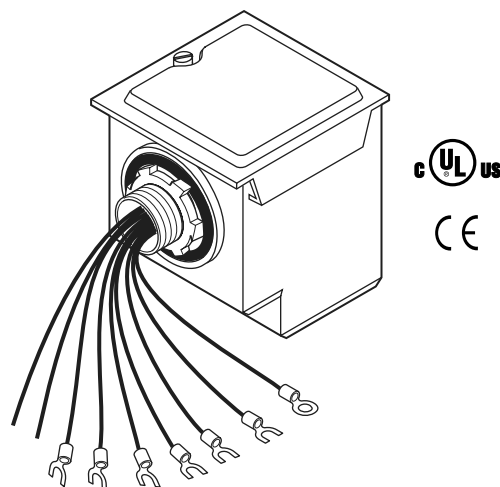
Figure 3 CP-8552 Typical Wiring for Current Input.

Electronic Actuator Drive

The CP-9301 and CP-9302 electronic actuator drives process a variable input signal from a controller to provide proportional control of an electric gear train actuator. The CP-9301 is preset at the factory for voltage input. The CP-9302 is factory preset for current input and has additional wiring for connection to an override switch, for those applications requiring an external override of the input signal. These drives are equipped with built-in jumpers and adjustable potentiometers, so that the type of input signal, deadband, input span, and start point may be reset in the field when necessary.

Features:

- Mounts directly onto Invensys proportional, electric, gear train actuators.
- Power is supplied directly from the actuator.
- Jumpers for selecting either voltage or current input, as well as 3% or 5% deadband.
- Adjustable span and start point potentiometers.



Model Chart									
Part Number	Input Signal Override	Factory Jumper Settings				Jumper Settings		Potentiometer Adjustment Ranges	
		Input Signal	Deadband	Start Point	Input Span	Input Signal	Deadband	Input Span	Start Point
CP-9301	Not Available	Voltage (6 to 9 Vdc)	3% of Input Span	6 Vdc	3 Vdc	Voltage or Current	3% or 5% of Input Span	3.0 to 16.5 Vdc or 8 to 16 mAdc	0 to 10 Vdc or 2 to 16 mAdc
CP-9301-456		Voltage (0 to 10 Vdc)		0 Vdc	10 Vdc				
CP-9302	Available (Use is Optional)	Current (4 to 20 mAdc)	5% of Input Span	4 mAdc	16 mAdc				
CP-9302-702									

Typical Actuators.

Actuator Series	Power		Torque		Stroke Degrees	Spring Return	Internal Transformer ^a
	Vac 60 Hz	Amp	Lb-in.	N-m			
MP-2113-500	24	2.2	50	5.6	180	—	No
MP-361	24	2.5	50	5.6	180	CW	No
MP-371	24	2.5	50	5.6	180	CCW	No
MP-381	24	2.5	220	24.9	180	—	No
MP-9713	24	4.0	800	90.3	180	—	No
MP-465	120	0.5	50	5.6	180	CW	Yes
MP-475	120	0.5	50	5.6	180	CCW	No
MP-483	120	0.5	220	24.9	90	—	Yes
MP-485	120	0.5	220	24.9	180	—	Yes
MP-495	120	0.95	450	50.8	180	—	Yes
MP-9750	120	0.9	800	90.3	180	—	Yes
MP-4651	240	0.25	50	5.6	180	CW	Yes
MP-4851	240	0.25	220	24.9	180	—	Yes

^a Units with a "-2" suffix, e.g. MP-xxxx-xxx-2-x, include a built-in transformer (used for Microtherm[®] or with AE-504) with secondary leads wired externally to terminals 7 (Blue, 12 Vac) and 8 (Red, 24 Vac) of the actuator.
Caution: When using the CP-9301 or CP-9302 with actuators containing an internal transformer, disconnect and tape off the red and blue leads before installing and powering the device. Failure to do so can result in damage to the actuator drive.
 Note: Models prior to "-2" suffix had transformer wired directly to potentiometer. To disconnect the transformer, remove the back plate of the actuator, then disconnect and tape the transformer leads.

Specifications	
Mounting	Directly to an actuator. The drive may be mounted on either the left or right side of the actuator, in a conduit opening adjacent to the low voltage wiring compartment.
Case	Injection molded plastic with stamped aluminum cover.
Inputs - Voltage and Current	
Input	Refer to Model Chart.
Input Span Adjustment	Refer to Model Chart.
Start Point Adjustment	Refer to Model Chart.
Input Impedance	
Voltage Input	Greater than 10,000 ohms.
Current Input	250 ohms.
Power Supply	Power shall be supplied directly from the shading coil windings provided on the shaded pole reversible motor of the gear train actuator (less than 30 Vac).
Outputs	
Connections	Color-coded leads with crimped screw terminal connectors. Purge override (input signal override) leads are color-coded pigtails.
Shading Coil Triac Output	1.2 A RMS.
Deadband	Refer to Model Chart.
Environment	
Ambient temperature limits	
Shipping & Storage	-40 to 160 °F (-40 to 71 °C).
Operating	-40 to 136 °F (-40 to 58 °C).
Humidity	5 to 95% RH, non-condensing.
Locations	NEMA Type 4; IEC IP56.
Agency Listings	
UL Listed	UL 873 (File #E9429 Category Temperature Indicating and Regulating Equipment).
CUL	Canadian Standards C22.2 No. 24-93.
European Community	EMC Directive 89/336/EEC.
General Instructions	Refer to F-26563.

CP-9301-xxx Series, CP-9302-xxx Series

Typical Applications

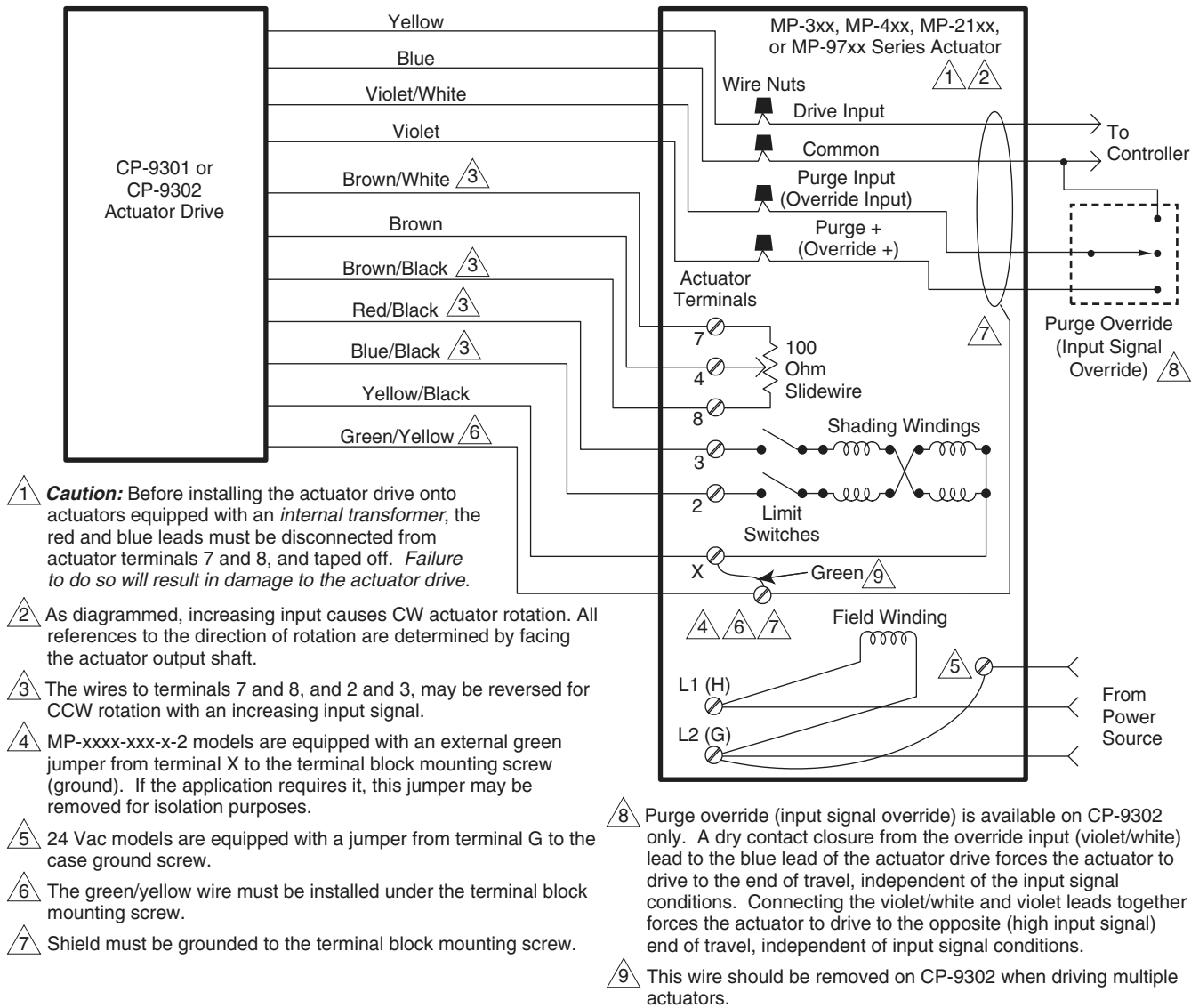


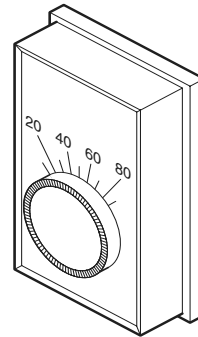
Figure 1 Service Application Wiring Diagram.

Two-Position Electric Controller

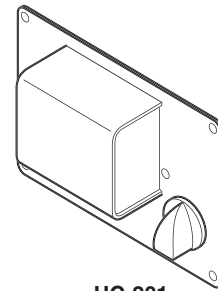
These controllers provide low or line voltage on-off single stage control of humidifiers, dehumidifiers, valves, solenoid valves, compressors, relays, etc.

Features:

- SPDT switching for humidification/dehumidification.
- Agency listed room and duct units.
- Long life nylon elements.
- Standard locking feature.



HC-101



HC-201



Model Chart

Description.

Model No.	Description	Scale Range % RH	Differential % RH
			Switch
HC-101	Room	10 to 90	5
HC-201	Duct	15 to 95	

Maximum Electrical Ratings.

Model No.	AC Volt 50/60 Hz	FLA	LRA	Resistive Amps	Pilot Duty VA
HC-101	24	—	—	8	60
HC-201	240	3.6	21.6		345
	120	7.2	43.2		

Specifications

Control dial settings	Refer to Description Model Chart.
Humidity sensing element	Nylon ribbon.
Differential	Refer to Description Model Chart.
Environment	
Ambient temperature limits	Operating: 40 to 125°F (4 to 52°C). Shipping and Storage: -40 to 140°F (-40 to 60°C).
Humidity	5 to 95% RH non-condensing.
Locations	NEMA Type 1.
Electrical Switch	One snap-acting SPDT.
Ratings	Refer to Maximum Electrical Ratings Model Chart.
Connections	Color coded wire leads.
Mounting	
HC-101	Flush or surface switch boxes or, for 24 V only, directly to wall.
HC-201	In any position on the outside surface of return air duct.
Dimensions	HC-101: 4-3/8 H x 2-7/8 W x 1-5/8 D in. (111 x 73 x 41 mm). HC-201: 4-3/4 H x 6-1/2 W x 3-1/2 D in. (121 x 165 x 89 mm).
Cover	HC-1xx: Plastic. HC-2xx: Metal. CH21-1: Metal.
Agency Listings	HC-101 and HC-201: UL. HC2-101 and HC-201: CSA.
General Instructions	HC-101: Refer to F-15143. HC-201: Refer to F-24213.

HC-101 Series, HC-201

Accessories

Model No.	Description
Accessories for HC-101 only	
AT-504	Aux. mounting base.
AT-505	Wall box cover plate.
AT-546	Aux. mounting base.
AT-1104	Cast guard.
AT-1155	Plastic guard.
AT-1165	Plastic guard.

Typical Applications

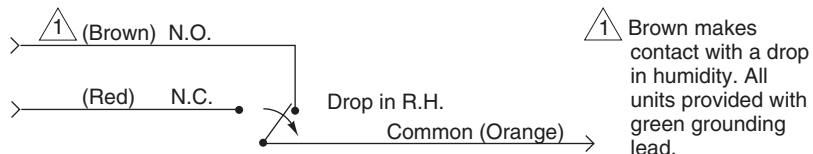


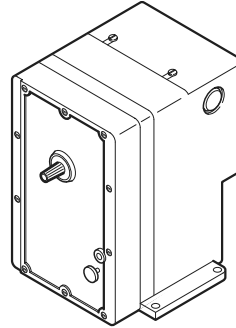
Figure 2 HC-101, and HC-201 Switch Action and Terminal Identification.

Two-Position, Oil-Submerged Actuators

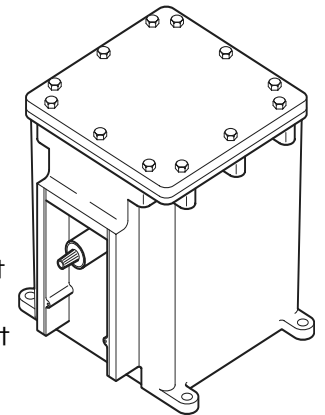
These actuators provide two-position operation of dampers, valves, and other equipment requiring the return to normal position upon power interruption.

Features:

- SPST controller.
- Spring return.
- 24, 120, 208, and 240 Vac models.
- SPDT auxiliary switch if actuator part number suffix is "-500."
- Rugged die cast aluminum.
- Oil immersed motor and gear train.
- Models for hazardous locations are only available as a factory enclosure/actuator assemblies.
- NEMA 4 with optional watertight conduit connectors, field supplied.



MA-3xx, MA5-318,
MA-4xx, MA5-418
(Standard)



MA6-3xx, MA8-3xx,
MA6-4xx, MA8-4xx, MA7-4xx
† Hazardous Locations

Model Chart								
Model No.	Power Supply		Aux. ^a Switch	Input (Watts)	Va Running/Holding	Rated Torque lb-in. (N-m)	Application and Mounting	Shaft Rotation
	Vac	Hz						
MA-305	24	60	No	25	56/56	16 (1.8)	Damper actuators. Upright position preferred.	CW 180° when power is applied.
MA-305-500	24		Yes		48/48			
MA-405	120		No					
MA-405-500	120		Yes					
MA-318	24		No	70 Running 25 Holding	92/32	60 (6.8)	Damper and valve actuators. Output shaft horizontal.	CW 170° when power is applied.
MA-318-500	24		Yes		104/38			
MA-416	208		No					
MA-416-500	208		Yes		108/42			
MA-418	120		No					
MA-418-500	120		Yes					
MA-419	240		No		120/39			
MA-419-500	240		Yes					
MA5-419	240		50	No				
MA5-419-500	240			Yes				

^a 2 FLA, 12 LRA at 24/120 Vac; 1 FLA, 6 LRA 2 240 Vac.

† Models for hazardous locations are only available as factory enclosure/actuator assemblies.

MA-3XX Series, MA-4XX Series

Part Numbers for Hazardous Location Applications^{a b}.

Model No.	Damper Actuator Part Numbers for Hazardous Locations	Valve Actuator Part Numbers for Hazardous Locations
MA-305	MA6-305	—
MA-305-500	MA6-305-500	—
MA-405	MA6-405	—
MA-405-500	MA6-405-500	—
MA-318	MA6-318	MA8-318
MA-318-500	MA6-318-500	MA8-318-500
MA-416	MA6-416	MA8-416
MA-416-500	MA6-416-500	MA8-416-500
MA-418	MA6-418	MA8-418
MA-418-500	MA6-418-500	MA8-418-500
MA-419	MA6-419	MA8-419
MA-419-500	MA6-419-500	MA8-419-500
MA5-419	MA7-419	MA7-419
MA5-419-500	MA7-419-500	MA7-419-500

^a Class 1, Groups C and D, and Class 2, Groups E, F and G, hazardous locations. Ref. EN-56-2, F-18451.

^b Models for hazardous locations are only available as factory enclosure/actuator assemblies.

Specifications

Control circuit	Two wire.
Spring return	CCW to original position when actuator is de-energized.
Auxiliary switch (-500 models)	SPDT makes (or breaks) circuit at powered end of stroke (fixed).
Nominal damper area	Actuator sizing should be done in accordance with damper manufacturer's specifications.
Environment	
Ambient temperature limits	Shipping and storage: -40 to 136°F (-40 to 58°C). Operating: -40 to 136° (-40 to 58°C).
Humidity	5 to 95% RH, non-condensing.
Locations	NEMA 4 ^a .
Connections	Coded screw terminals.
Case	Die cast aluminum with two 1/2 in. conduit openings.
Mounting	Allow 6 in. (152 mm) clearance above the actuator wiring compartment. Refer to Model Chart for additional data.
Dimensions	
Base actuators	5-3/4 H x 5-3/8 W x 6-9/16 D in. (146 x 136 x 167 mm).
Hazardous location actuators	8-7/8 H x 8-1/2 W x 10-5/8 D in. (225 x 216 x 167 mm).
No load timing^b at 75°F (24°C)	20 seconds.
Agency Listings	
UL 873	File E9429 Temperature Indicating and Regulating Equipment.
CSA	C22.2 No. 24 File LR 3728.
General Instructions	Refer to F-06491.

^a When used with gasket (provided) and water-tight conduit connectors (not provided).

^b Spring return timing with full load opposing spring approximately 60 seconds.

Accessories

Model No.	Description
Damper linkage.	
AM-111	Crank arm for 5/16 in. diameter damper shaft.
AM-112	Crank arm for 3/8 in. diameter damper shaft.
AM-113	Crank arm for actuator or 1/2 in. diameter damper shaft.
AM-115	Crank arm for 7/16 in. diameter damper shaft.
AM-116	Splined crank arm for actuator.
AM-122	Linkage connector straight type.
AM-123	Damper clip.
AM-125	5/16 in. diameter x 20 in. damper rod.
AM-125-048	5/16 in. diameter x 48 in. damper rod.
AM-132	Ball joint connector.
AM-161	Damper linkage kit.
AM-161-1	Damper linkage kit.
AM-301	90 degree mounting bracket (except MA6, MA7, MA8-xxx).
Valve linkage for 60 lb-in. (6.8 N-m) actuators only (except MA7, MA8-xxx).	
AV-29 and AV-300	2-1/2 and 3 in. VB-9323.
AV-391	1/2 to 2 in. VB-7xxx and 1/2 to 1-1/4 in. discontinued VB-9xxx.
AV-392	1-1/2 and 2 in. VB-92X3 or VB-93X3.
AV-395	2-1/2 to 4 in. VB-92X3 or VB-9313.
Valve Only (To be used with 60 lb-in. (6.8 N-m) MA7-xxx and MA8-xxx hazardous location actuators only)	
NYBA-37	Stem extension for 1/2 to 2 in. VB-7xxx and 1/2 to 1-1/4 in. discontinued VB-9xxx, for actuators assembled in hazardous locations enclosure (use with AV-391 linkage kit).
NYBA-61	Mounting bracket for hazardous locations enclosure (use with AV-391 linkage kit).

Typical Applications

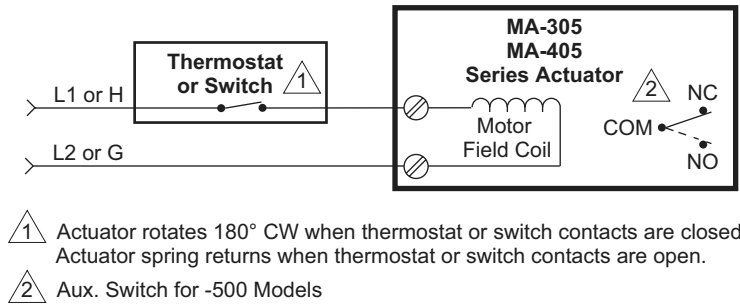


Figure 1 Wiring for MA-305 and 405 Series.

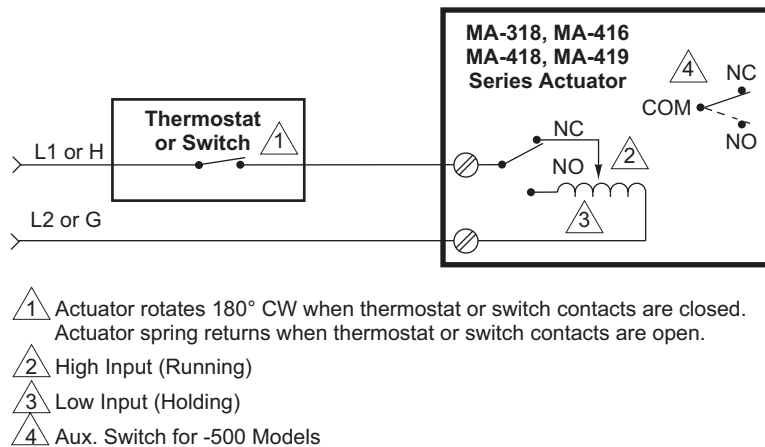


Figure 2 Wiring for MA-318, 416, 418, and 419 Series.

MA4D-xxxx Series

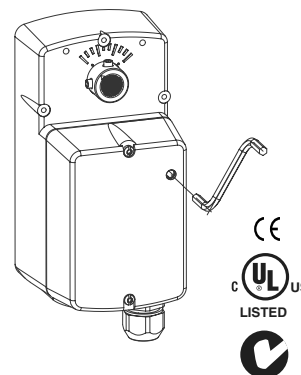
Spring Return EconoDrive™ Two-Position Actuator

EconoDrive overshaft actuators are designed to provide an economical and reliable solution for many overshaft damper and ball valve requirements. All products accommodate shaft sizes up to 1/2 in. (13 mm) in diameter.

Spring return models provide 30 in-lb (3.4 N-m) of torque.

Features:

- Controlled by SPST controller.
- 30 in-lb (3.4 N-m) of torque.
- Polymer housing rated for NEMA 2/IP54.
- Overload protection throughout stroke.
- Compact size to allow installation in limited space.
- Manual override to allow positioning of dampers and valves.
- Directly mounts to 1/2 to 3 in. ball valves.
- Polymer housing rated for plenum use.



Model Chart										
Part No.	Rotation	Control Signal	Voltage	Wiring System	Actuator Power Input				Approximate Timing ^a in Sec. @ 70°F (21°C)	
					Running		Holding			
					50/60 Hz		DC Amps	50/60 Hz	Powered	Spring Return (CCW)
					VA	W		W		
MA4D-7033-100	CCW	2 Position SPST	24 VAC ± 20% or 20-30 Vdc	Plenum Cable	5.1	3.6	0.14	1.3	56	23
MA4D-7030-000			120 Vac ± 10% 50/60 Hz	Appliance Wire	7.8	5.0	--	2.5		
MA4D-7031-000			230 Vac ± 10% 50/60 Hz		7.2	5.2	--	2.4		
MA4D-8033-100	CW	2 Position SPST	24 VAC ± 20% or 20-30 Vdc	Plenum Cable	5.1	3.6	0.14	1.3		
MA4D-8030-000			120 Vac ± 10% 50/60 Hz	Appliance Wire	7.8	5.0	--	2.5		
MA4D-8031-000			230 Vac ± 10% 50/60 Hz		7.2	5.2	--	2.4		

^a Timing is measured with no load applied to actuator.

Specifications

Inputs	
Control signal	Two-Position SPST.
Power	See Model Chart. All 24 Vac circuits are Class 2. All circuits 30 Vac and above are Class 1.
Connections	3 ft (91 cm) appliance or plenum cables, enclosure accepts 1/2 in. (13 mm) conduit connector. For M20 Metric conduit, use AM-756 adapter. 24 Volt models: 10 ft. plenum cable.
Outputs	
Mechanical	Timing: See Model Chart. Travel: 93° nominal. Manual Override: Allows positioning of damper or valve using manual crank.
Environment	
Ambient temperature limits	Shipping and Storage: -40 to 160°F (-40 to 71°C). Operating: -22 to 140°F (-30 to 60°C).
Humidity	15 to 95% RH, non-condensing.
Locations	NEMA 1, NEMA 2, UL Type 2 (IEC IP54) with customer supplied water tight conduit connectors. Enclosure is air plenum rated.
Dimensions	7-7/8 H x 3-1/2 W x 3-1/2 D in. (200 x 89 x 89 mm).
Agency Listings	
UL 873	Underwriters Laboratories (File #E9429 Category Temperature-Indicating and Regulating Equipment).
CUL	UL Listed for use in Canada by Underwriters Laboratories. Canadian Standards C22.2 No. 24-93.
European Community	EMC Directive (89/336/EEC). Low Voltage Directive (72/23/EEC). This product fits in Installation Category (Overvoltage Category) II per EN 61010-1.
Australia	This product meets requirements to bear the C-Tick Mark according to the terms specified by the Communications Authority under the Radiocommunications Act 1992.
General Instructions	Refer to F-27170.

Accessories

Model No.	Description
AM-714	Weathershield kit.
AM-756	Metric conduit adapter M20 x 1.5 to 1/2 in. NPT.
AM-771	Crank arm and bracket kit.
AM-772	Bracket for reverse mounting.

Typical Applications

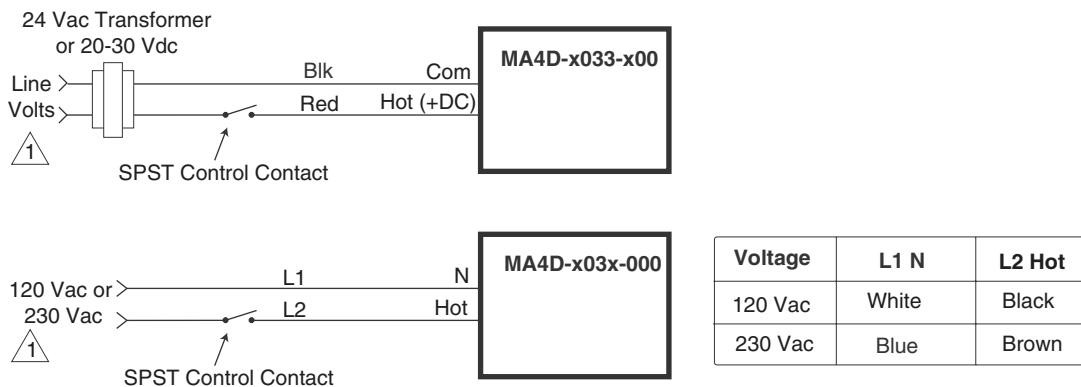


Figure 1 Typical Wiring Diagrams for Two Position Actuators.

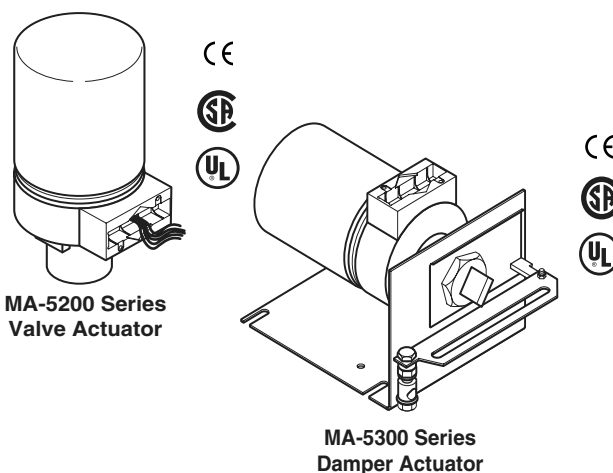
MA-5200 Series, MA-5300 Series

Two-Position Actuators

These actuators are used for electric two-position control of globe valves and dampers which require a return to the normal position upon power interruption.

Features:

- Two-position actuators controlled by an SPST controller.
- Spring return.
- Available 24, 120, and 240 Vac models.
- An actuator with the part number suffix "-500" has a built-in, adjustable, SPDT auxiliary switch.
- Available damper models with linkage or base models that require separate damper or valve linkage.
- Die cast lower housing with 1/2 in. conduit opening and painted steel upper housing.
- Hydraulic actuator with oil-immersed motor and pump.



Model Chart

Damper Actuators.

Model No.	Actuator Power Input			Timing in Seconds at 72°F (22°C)		Damper Output Torque Rating
	AC Voltage (±10%)	50/60 Hz		To Extend (No Load Stroke)	Retract on Power Loss	
		Watts	VA			
MA-5330	120	10	16.8	60	15	20 lb-in.
MA-5333	24	8.8	15.6			

Valve Actuators. Also for Damper Actuators with Field Assembled Damper Linkages.

Model No.	Actuator Power Input			10 Amps Aux Switch	Timing in Seconds at 72°F (22°C)		Required Linkage ^a		Damper Output Torque Rating
	AC Voltage (+10/-15%)	50/60 Hz			To Extend (No Load Stroke)	Retract on Power Loss	Damper	Valve	
		Watts	VA						
MA-5210	120	10	16.8	No	60	15	AM-601	AV-601 AV-7600-1	20 lb-in.
MA-5210-500				Yes					
MA-5211	240	10	19.2	No	60	15	AM-601	AV-601 AV-7600-1	20 lb-in.
MA-5211-500				Yes					
MA-5213	24	10	15.6	No	60	15	AM-601	AV-601 AV-7600-1	20 lb-in.
MA-5213-500				Yes					

^a Damper models are provided with factory-installed damper linkages. Only base models require separately-ordered linkages.

Specifications

Actuator inputs

Control circuit	Two wire, SPST.
Power input	Refer to Model Chart.
Connections	Color-coded 4 ft. (1.2 m) leads.

Specifications (Continued)

Actuator outputs

Electrical	Auxiliary switch (MA-5xxx-500), 10 amps, 120/240 Vdc adjustable SPDT, factory set to close the N.C. contact at the retracted end of stroke.
Mechanical	Stroke damper: Approximately 2 in. (51 mm) from fully retracted to fully extended (includes AM-601 linkage). Stroke valve: Approximately 9/16 in. (14.3 mm) from fully retracted to fully extended.
Nominal damper area	Actuator sizing should be done in accordance with damper manufacturer's specifications.
Environment	
Ambient temperature limits	Shipping and storage: -40 to 140°F (-40 to 60°C). Operating, damper: 0 to 140°F (-18 to 60°C). Operating, valve: Refer to Restrictions on Maximum Ambient Temperature for Valve Actuators Table.
Humidity	5 to 95% RH, non-condensing.
Location	NEMA Type 1.
Dimensions	6-3/4 H x 3-23/32 W x 3-1/4 Dia. in. (171 x 94 x 83 mm).
Agency Listings	
UL 873	File #E9429 Category Temperature-Indicating and Regulating Equipment.
CSA	Canadian Standard C22.2 #24-93.
European Community	EMN Directive (89/336/EEC) Low Voltage Directive (72/23/EEC).
General Instructions	Refer to F-15070.

Restrictions on Maximum Ambient Temperature for Valve Actuators.

Maximum Temperature of Media in the Valve Body (Check Rating of the Valve) °F (°C)	Maximum Ambient Temperature of MA-521X Series	
	AV-7600-1 (Only) °F (°C)	AV-7600-1 and AV-601 °F (°C)
366 (186)	90 (32)	90 (32)
340 (171)	100 (38)	100 (38)
281 (138)	115 (46)	140 (46) ^a
181 (83)	140 (60) ^a	140 (60) ^a
80 (26)	140 (60) ^a	140 (60) ^a

^a Maximum ambient temperature of the actuator must never exceed 140°F (60°C).

Accessories

Model No.	Description
Damper Linkages	
AM-111	Crank arm for 5/16 in. diameter damper shaft.
AM-112	Crank arm for 3/8 in. diameter damper shaft.
AM-113	Crank arm for 1/2 in. diameter damper shaft.
AM-115	Crank arm for 7/16 in. diameter damper shaft.
AM-122	Linkage connector straight type.
AM-123	Damper clip.
AM-125	5/16 diameter x 20 in. damper rod.
AM-125-048	5/16 diameter x 48 in. damper rod.
AM-132	Ball joint connector.
AM-161-3	Damper linkage kit.
AM-601	Device includes mounting bracket, damper linkage with spring, and AM-122 straight connector. Required to modify MA-521X series) valve actuators into 2 in. (51 mm) stroke damper actuators.
AM-602	Spacer.
Valve Linkages	
AV-600	Valve linkage for VB-7xxx to 2 in. and discontinued VB-9xxx valves to 1-1/4 in.
AV-601	Valve linkage extension for hot water and steam applications; use with AV-600.
AV-7600-1	Valve linkage for VB-7xxx valves with booster springs.
TOOLS (factory-available)	
TOOL-12	Wrench for adjustment of auxiliary switch.
TOOL-19	Spring compression tool for AV-600.

MA-5200 Series, MA-5300 Series

Typical Applications

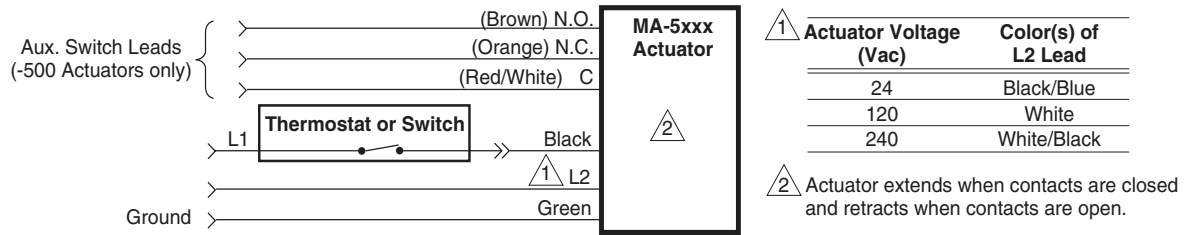


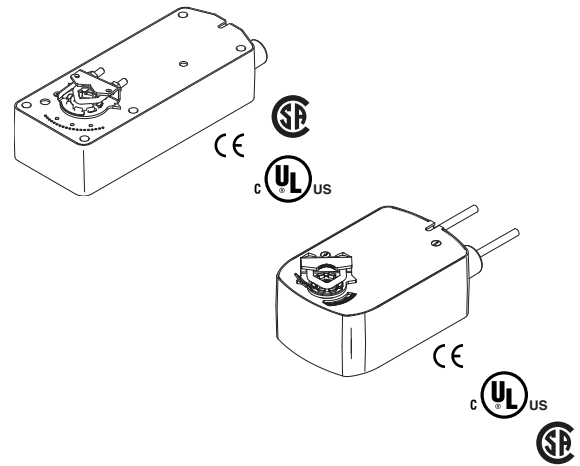
Figure 1 Wiring for MA-5xxx Series Actuators.

Spring Return DuraDrive® Two-Position Actuator

For spring return applications that require two-position control of dampers and valves in HVAC system.

Features:

- 35 lb.-in. (4 N-m), 60 lb.-in (7 N-m), 133 lb.-in (15 N-m).
- On-off control.
- Rugged die cast housings rated for NEMA 2/IP54.
- Overload protection throughout rotation.
- Optional built-in auxiliary switch to provide for interfacing or signaling.
- Provides 95° of rotation.
- Visual position indicator provided.
- Rotation limiting available.
- MA41 series manual override.



Model Chart														
Part Number	Actuator Power Input								Auxiliary Switch	Approximate Timing in Seconds @ 70° (21°C) ^a		Output Torque Rating lb-in (N-m) ^b		Manual Override
	Voltage	VA		Watts				Powered		Spring Return	Minimum	Maximum Stall		
		50 Hz	60 Hz	Running		DC Amps	Holding							
				50 Hz	60 Hz		50 Hz						60 Hz	
MA41-7153	24 Vac ± 20% 22-30 Vdc	9.8	9.7	7.5	7.5	0.29	2.8	2.8	No	<190	<30	133 (15)	350 (40)	Yes
MA41-7153-502				Two ^c										
MA41-7150	120 Vac ± 10%	11.7	10.0	8.8	8.4	—	5.0	3.6	No					
MA41-7150-502				Two ^c										
MA41-7151	230 Vac ± 10%	15.5	10.6	9.5	8.5	—	4.6	3.3	No					
MA41-7151-502				Two ^c										
MA41-7073	24 Vac ± 20% 22-30 Vdc	4.8	4.8	3.2	3.2	0.13	0.8	0.8	No					
MA41-7073-502				Two ^c										
MA41-7070	120 Vac ± 10%	10.7	5.6	4.2	3.6	—	2.0	1.2	No					
MA41-7070-502				Two ^c										
MA41-7071	230 Vac ± 10%	17.0	8.0	5.1	4.0	—	2.7	1.4	No					
MA41-7071-502				Two ^c										
MA40-7043	24 Vac ± 20% 22-30 Vdc	4.4	4.4	2.9	2.9	0.11	0.8	0.8	No					
MA40-7043-501				One ^d										
MA40-7040	120 Vac ± 10%	6.4	4.3	3.8	3.4	—	1.6	1.2	No					
MA40-7040-501				One ^d										
MA40-7041	230 Vac ± 10%	5.8	4.6	4.1	3.9	—	1.5	1.2	No					
MA40-7041-501				One ^d										

^a Timing was measured with no load applied to the actuator.
^b De-rating is required at low temperatures.
^c One adjustable from 25 to 85° rotation and one set to operate @ 5° fixed.
^d One adjustable from 0 to 95° rotation (0 to 1 scale).

MA40-704x Series, MA41-707x Series, and MA41-715x Series

Specifications	
Inputs	
Control signal	On-off SPST contacts or Triacs (500 mA).
Power	Refer to Model Chart.
Connections	3 ft. (0.9 m) long, appliance cable, 1/2 in. conduit connectors. For M20 Metric conduit, use AM-756 adaptor.
Outputs	
Motor Type	MA40-704x, MA41-707x: Brush. MA41-715x: Brushless DC.
Electrical	MA40-7043-501: One auxiliary switch available, SPDT 6A resistive @ 24 Vac, adjustable 0 to 95° (0 to 1 scale). UL listed, switch meets VDE requirements for 6 (1.5)A, 24 Vac. MA40-7040-501 or MA40-7041-50: One auxiliary switch available, SPDT 6A resistive @ 240 Vac, adjustable 0 to 95° (0 to 1 scale). UL listed, switch meets VDE requirements for 6 (1.5)A, 24 Vac. MA41-715x-502 or MA41-707x-502: Two auxiliary switches available, SPDT 7A resistive @ 250 Vac, one fixed @ 5 ° and one adjustable 25 to 85°. UL Listed, meets VDE requirements for 7 (2.5)A, 250 Vac.
Mechanical	Direction of rotation: CW or CCW rotation is available through reverse mounting. Shaft clamp: Direct coupled using a through hole output hub. MA40-704x: Up to 5/8 in. round, 1/2 in. square shafts. MA41-71xx: Up to 3/4 in. round, 1/2 in. square shafts. See Accessories for larger shaft options. Position Indicator: MA40-704x: Visual indicator, 0 to 1 (0 is the spring return position). MA41-707x, MA41-715x: Pointer (-5 to 90°) and scale are provided for position indication (-5 is normal or spring return position).
Environment	
Ambient Temperature limits	Shipping and storage: -40 to 160°F (-40 to 71°C). Operating: -22 to 140°F (-30 to 60°C).
Humidity	5 to 95% RH, non-condensing.
Locations	MA40-704x: NEMA 2 (IEC 1P54) no restrictions. MA41-707x: NEMA 1 (IEC IP30), NEMA 2 (IEC IP54) with conduit in the down position. MA41-715x: NEMA 1 (IEC IP30), NEMA 2 (IEC IP54) with conduit in the down position.
Dimensions	MA41-707x, MA41-715x: 10-1/2 H x 4 W x 3-1/2 D in. (287 x 100 x 89 mm). MA40-704x: 6-51/64 H x 4 W x 3-1/2 D in. (68 x 100 x 89 mm).
Agency Listings	
UL	UL-873, Underwriters Laboratories Listed (File #E9429 Category Temperature-Indicating and Regulating Equipment).
European Community	EMC Directive (89/336/EEC). Low Voltage Directive (72/23/EEC).
CUL	Canadian Standards C22.2 No. 24-93.
Australia	This product meets requirements to bear the C-Tick mark according to the terms specified by the Communications Authority under the Radio Communications Act 1992.
General Instructions	Refer to F-26642.

MA40-704x Series, MA41-707x Series, and MA41-715x Series

Accessories

Model No.	Description
MA41-707x, MA41-715x	
AM-671 ^{abcd}	Mounting bracket.
AM-672 ^{abcd}	Mounting bracket.
AM-673 ^a	Mounting bracket.
AM-674	Weather shield.
AM-675	Weather shield base.
AM-676	Universal shaft extension, approximately 9-1/2 in. long (242 mm) for use on 3/8 to 11/16 in. (10 to 17 mm) round shafts, 3/8 to 9/16 in. square shafts. (AM-753 clamps required).
AM-686	Position indicator.
AM-687	V-clamp for 1.05 in. round shafts.
AM-688	Replacement universal clamp.
AM-689	Rotation limiter.
AM-690	Crank arm.
AM-691	Crank arm.
AM-692	V-bolt.
AM-693 ^{ef}	Crank arm kit.
AM-714	Weather shield.
AM-756	Metric conduit adaptor M20 x 1.5 to 1/2 in. NPT (two per package).
AM-758	Universal short "U" mounting bracket.
AM-759	Universal Long "U" mounting bracket.
AM-760	Universal slotted "L" mounting bracket.
AM-761	Replacement 7-inch anti-rotation bracket.
AM-762	Replacement 9-inch anti-rotation bracket.
AM-763	1/8 inch hex crank for manual override.
AV-602	Vx-7xxx 1/2 to 2 in. valve linkage.
AV-607	Vx-9xxx 2-1/2 to 4 in. valve linkage.
MA40-704x	
AM-673	Mounting bracket.
AM-674	Weather shield.
AM-675	Weather shield base.
AM-676	Universal shaft extension, approximately 9-1/2 in. long (242 mm) for use on 3/8 to 11/16 in. (10 to 17 mm) round shafts, 3/8 to 9/16 in. square shafts. (AM-753 clamps required).
AM-709	Position indicator and stroke limiter.
AM-710	V-clamp for 3/4 in. round shafts.
AM-711	Crank arm adaptor kit.
AM-712 ^e	Crank arm adaptor kit
AM-713 ^e	Bracket.
AM-714	Weather shield
AM-715 ^e	Crank arm adaptor kit.
AM-717	Replacement universal clamp
AM-756	Metric conduit adapter
AM-761	Replacement 7-inch anti-rotation bracket.
AM-762	Replacement 9-inch anti-rotation bracket.
AV-605	Vx-7xxx 1/2 to 2 in. valve linkage.

^a Drill appropriate mounting holes where needed.

^b AM-693 crank arm kit required.

^c Cannot be used with Mx41-634x or Mx40-717x series actuators.

^d The large "C"-shaped clamps included in AM-693 crank arm kit are required for mounting the actuator. Drill appropriate mounting holes where needed.

^e Use the self-tapping screws and flat washers provided in kit to mount actuator.

^f AM-692 V-bolt kit required.

MA40-704x Series, MA41-707x Series, and MA41-715x Series

Typical Applications

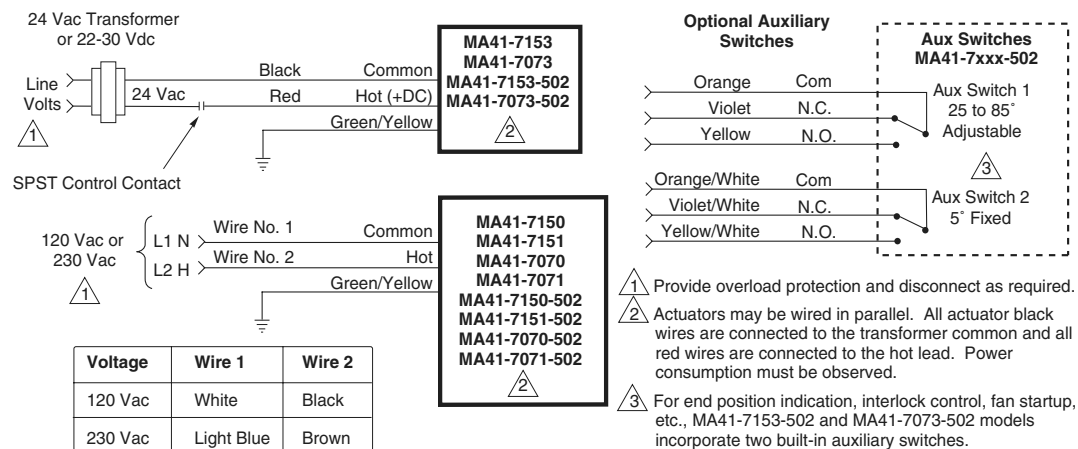


Figure 1 Typical Wiring Diagram for 24, 120, or 240 Vac Basic and Double Auxiliary Switch Models.

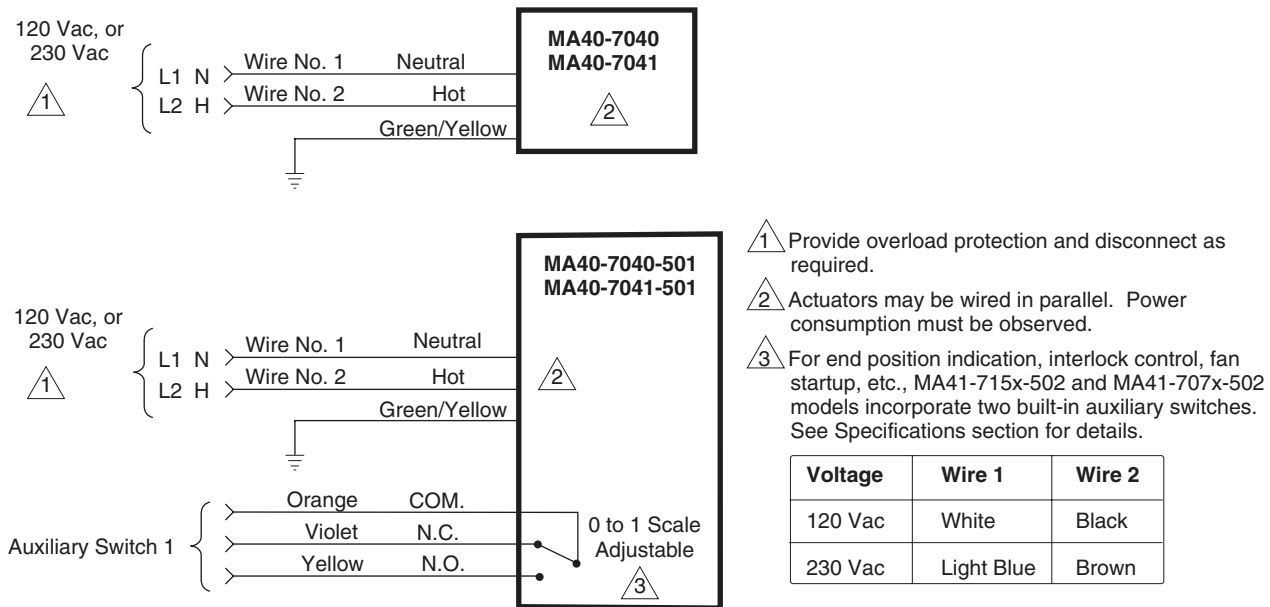


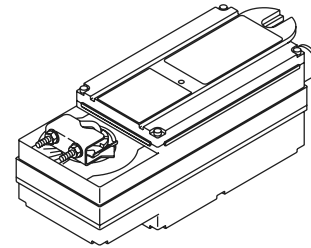
Figure 2 Typical Wiring Diagram for 120 Vac or 230 Vac Basic and Single Auxiliary Switch Models.

Spring Return DuraDrive® Two-Position Actuator

For spring return applications that require two position control of dampers and valves in HVAC systems.

Features:

- 150 lb.-in. (17 N-m) rated torque.
- On-off control.
- NEMA Type 4 housing (IEC IP56).
- Custom automatic current sensing motor control provides extended reliability and repeatable timing.
- Direct coupled to the damper shaft with dual industrial hardened universal mounting clamps.
- Accurate 93° travel digitally controlled.
- Integral position indication scale.
- Rugged die-cast housing.
- Oil immersed gear train provides continuous lubrication.
- Rated for operating temperature up to 140°F.
- Can be double mounted to accommodate high torque applications.
- 100% duty cycle.



Model Chart											
Damper Actuators											
Model No.	Shaft Size ^a	Stroke	Actuator Power Input				SPDT Auxiliary Switches	Approximate Timing in Seconds @ 70°F (21°C) with No Load		Output Torque Rating lb.-in. (N-m)	
			Voltage	Running		Holding		Powered	Spring Return	Minimum ^b	Maximum Stall
				50/60 Hz	50/60 Hz	50/60 Hz					
			W	VA	W						
MA40-7173	3/8 to 1/2 in. round or square	93° ± 1°	24 Vac ± 20%	5.4	9.6	4.1	No	<145	150 (17)	450 (51)	
MA40-7170 ^c			120 Vac ± 10%	7.2	11.4	9.4					
MA40-7171			240 Vac ± 10%	7.4	11.8	9.5					

^a Optional AM-753 damper shaft mounting clamps for 5/8 in. square or 3/4 to 1 in. round shafts.

^b De-rating required for spring return actuators at low temperatures.

^c The CE directive is not applicable to this model.

Valve Actuator plus Linkage.

Model No. ^a	Linkage (Included)	Voltage 50/60 Hz	Running		Holding Watts	SPDT Aux. Switches
			Watts	VA		
MA40-7173-200	AV-602	24 Vac ± 20%	5.4	9.6	4.1	No
MA40-7170-200		120 Vac ± 10%	7.2	11.4	9.4	
MA40-7171-200		240 Vac ± 10%	7.4	11.8	9.5	
MA40-7173-220	AV-607	24 Vac ± 20%	5.4	9.6	4.1	
MA40-7170-220		120 Vac ± 10%	7.2	11.4	9.4	
MA40-7171-220		240 Vac ± 10%	7.4	11.8	9.5	
MA40-7173-230	AV-609	24 Vac ± 20%	5.4	9.6	4.1	
MA40-7170-230		120 Vac ± 10%	7.2	11.4	9.4	
MA40-7171-230		240 Vac ± 10%	7.4	11.8	9.5	

^a Refer to Valve Catalog, F-27384 for correct applications.

MA40-717x Series

Specifications

Inputs	
Control signal	On-off SPST control contacts or Triacs (500 mA) rated.
Power	Refer to Model Chart.
Connections	2 ft (61 cm) long appliance cable & 1/2 in. conduit connectors.
Outputs	
Motor Type	Brushless DC.
Mechanical	Direction of rotation: CW or CCW rotation is available through reverse mounting. Dual shaft clamps: Direct coupled using a through hole output hub.
Environment	
Ambient temperature limits	Shipping and storage: -40 to 160°F (-40 to 71°C). Operating: -25 to 140°F (-32 to 60°C).
Humidity	5 to 95% RH, non-condensing.
Locations	NEMA 1, NEMA 4 (IEC IP56) with customer supplied water tight connector.
Agency Listings	
UL	UL-873, Underwriters Laboratories Listed (File #9429 Category Temperature-Indicating and Regulating Equipment).
European Community	EMC Directive (89/336/EEC). Low Voltage Directive (72/23/EEC). Not applicable to MA40-7170.
CSA	Canadian Standards C22.2 No. 4-93.
Australia	This product meets requirements to bear the C-Tick mark according to the terms specified by the Communications Authority under the Radio Communications Act 1992.
General Instructions	
	Refer to F-26742.

Accessories

Model No.	Description
AM-674	Weather shield.
AM-676	Universal shaft extension, approximately 9-1/2 in. long (242 mm) for use on 3/8 to 11/16 in. (10 to 17 mm) round shafts, 3/8 to 9/16 in. square shafts. (AM-753 clamps required).
AM-751	Standard anti-rotation bracket 9 in. long x 13/16 in. wide (229 x 21 mm), included with actuator.
AM-752	Optional anti-rotation bracket 4 in. long x 1-11/16 in. wide (102 x 43 mm), for narrow spaces.
AM-753	Optional damper shaft mounting clamps for 5/8 in. square shaft, 3/4 in. and 1 in. round shafts (two per package).
AM-754	Standard universal mounting clamps for 3/8 to 1/2 in. (10 to 13 mm) round and square shafts, two included with actuator.
AM-756	Metric conduit adaptor M20 x 1.5 to 1/2 in. NPT (two per package).
AV-602	Vx-7xxx 1-1/2 to 2 in. valve linkage.
AV-607	Vx-9xxx 2-1/2 to 4 in. valve linkage.

Typical Applications

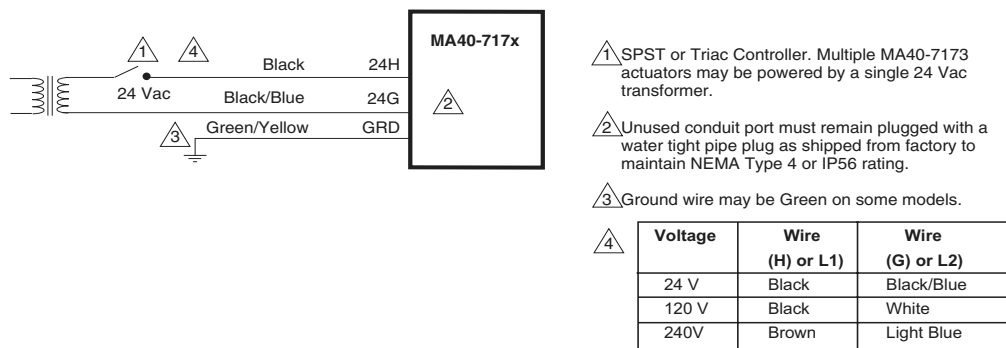


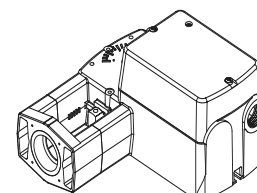
Figure 1 Typical Wiring Diagram for MA40-717x.

Spring Return DuraDrive® Two-Position Actuator

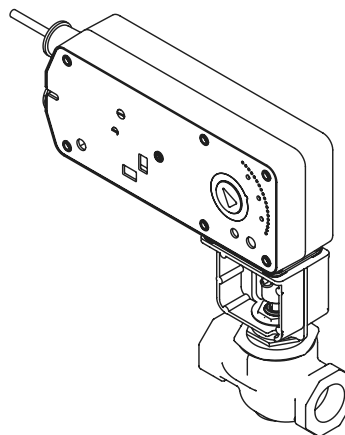
DuraDrive Linear Actuators are designed to mount directly onto two-way or three-way globe valves without the use of linkages. They provide linear travel to operate valves from 1/2 to 2 in. VB-7xxx valves and discontinued 1/2 to 1-1/4 in. VB-9xxx valves, 2-1/2 to 4 in. VB-9xxx valves and VB-8xxx 2-1/2 to 5 in. valves in chilled water, hot water and steam applications up to 366°F (186°C). Linear spring return actuators provide control of valves in HVAC systems.

Features:

- Two position models controlled by SPST controller.
- 105 lb_f (467 N) with 1/2 in. (13 mm) nominal linear stroke, 220 lb_f (979 N) with 5/8 in. (16 mm) or 1-1/16 (27 mm) linear stroke.
- 24 Vac, 120 Vac, and 230 Vac models.
- Rugged die-cast or polymer housings rated for up to NEMA 2/IP54.
- Polymer housing rated for plenum use.
- Overload protection throughout stroke.
- Automatically sets input span to match valve travel.
- Compact size to allow installation in limited space.
- Manual override to allow positioning of valve and preload.
- Spring return operation, stem up.
- Direct mount to valves without separate linkage.



Mx51-710x



Model Chart															
Part No.	Control Action	Voltage	Actuator Power Input						Linear Stroke Inches	Approximate Stroke Timing in Seconds @ 70°F (21°C)		Output Force Rating lb. (Newton)		Valve Size	
			Running				Holding			Powered	Spring Return	Min.	Max. Stall		
			50 Hz		60 Hz		DC Amps	50/60 Hz							
			VA	W	VA	W				W					
MA51-7103-000	Two Position SPST	24 Vac ±20% 20-30 Vdc	5.3	4.1	5.3	4.1	0.15	1.2	1/2 in. nominal	44 ^a	19 ^a	105	215	1/2 to 2 in.	
MA51-7103-100			5.3	4.1	5.3	4.1	0.15	1.2							
MA51-7100		120 Vac ±10% 50/60 Hz	7.9	6.2	7.9	6.2	N/A	2.1							
MA51-7101		230 Vac ±10% 50/60 Hz	7.4	5.4	7.4	5.4	N/A	2.1							

^a Timing was measured with the actuator mounted on a VB-7xxx valve.

MA51-7x0x Series, MA61-720x Series

Model Chart(Continued)

Part No.	Control Action	Actuator Power Input							Linear Stroke Inches	Approximate Stroke Timing in Seconds @ 70°F (21°C)		Output Force Rating lb. (Newton)		Valve Size
		Voltage	Running					Holding		Powered	Spring Return	Min.	Max. Stall	
			50 Hz		60 Hz		DC Amps	50/60 Hz						
			VA	W	VA	W		W						
MA51-7203	2 Position	24 Vac ±20% 22-30 Vdc	9.8	7.5	9.7	7.5	.29	2.8	5/8	<100 ^a	<35 ^a	220 (979)	495 (2202)	1-1/4 to 2 in. ^b
MA51-7200		120 Vac ±10%	11.7	8.8	10.0	8.4	N/A	3.6/5.0						
MA51-7201		230 Vac ±10%	15.5	9.5	10.6	8.5	N/A	4.6/3.3						
MA61-7203		24 Vac ±20% 22-30 Vdc	9.8	7.5	9.7	7.5	.29	2.8	1-1/16	<190 ^a	<40 ^a	220 (979)	495 (2202)	2-1/2 to 4 or 5 in. ^c
MA61-7200		120 Vac ±10%	11.7	8.8	10.0	8.4	N/A	3.6/5.0						
MA61-7201		230 Vac ±10%	15.5	9.5	10.6	8.5	N/A	4.6/3.3						

^a Timing was measured with no load applied to the actuator.

^b Current VB-7xxx Series valves and discontinued VB-9xxx Series valves (1-1/4 in. only).

^c Current VB-9xxx Series valves (2-1/2 to 4 in.), current VB-8xxx (2-1/2 to 5 in.) Series valves, and discontinued VB-9xxx (1-1/2 to 2 in.) Series valves.

Specifications

Inputs

Control signal	On-off spring return, SPST control contacts or Triacs (500 mA rated).
Power	24 Vac ± 20%, Class 2, 22 to 30 Vdc, 120 Vac ± 10%, 230 Vac ± 10%, 50/60 Hz. All 24 Vac circuits are Class 2. All circuits 30 Vac and above are Class 1.
Connections	Models with -0xx have 3 ft. (91 cm) appliance wire connections. Models with -1xx have 3 ft. (91 cm) plenum wire connections. Enclosure accepts 1/2 in. (13 mm) conduit connectors. For M20 Metric connector, use AM-756 adaptor.

Outputs

Mechanical	Motor Type: Brushless DC. Linear Stroke: MA51-720x: 5/8 in. (16 mm). MA61-720x: 1-1/16 in. (27 mm). MA51-710x: 1/2 in. (13 mm) nominal. Approximate Stroke Timing: See Model Chart. Manual Override: Allows positioning of valve and preload using manual crank.
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Environment

MA51-7x0x Series, MA61-720x Series

Ambient temperature limits

Shipping and Storage: -40 to 160°F (-40 to 71°C).
 Operating: MA51-720x/MA61-720x: 0 to 140°F (-18 to 60°C). MA51-710x: -22 to 140°F (-30 to 60°C).
 Temperature Restrictions: For maximum ambient 140°F (60°C) the maximum allowable fluid temperature should not exceed valve rating. See F-27252 Selection Guide for specific ratings.

Actuator	Max. Allowable Ambient @ Max. Fluid Temperatures	Valve Body
MA51-720x	140°F (60°C) @ 281°F (138°C)	VB-721x, 722x
	120°F (49°C) @ 300°F (149°C)	VB-73xx
	100°F (38°C) @ 340°F (171°C)	VB-725x, 726x
	90°F (32°C) @ 366°F (186°C)	VB-727x, 728x
MA61-720x	140°F (60°C) @ 300°F (149°C)	2-1/2 to 4 in. VB-931x
MA61-720x	140°F (60°C) @ 281°F (138°C)	2-1/2 to 4 in. VB-92xx, 2-1/2 to 5 in. VB-8xxx

Humidity	MAx1-72xx: 15 to 95% RH, non-condensing. MA51-710x: 5 to 95% RH, non-condensing.
Locations	NEMA 1. NEMA 2 (enclosure is air plenum rated), UL Type 2 (IEC IP54) with customer supplied water tight conduit connections.

Specifications (Continued)

Dimensions	MA51-71xx: 6-5/16 H x 6-49/64 W x 3-1/2 D in. (160 x 170 x 89 mm). MA51-72xx: 7 H x 9-1/4 W x 2-33/64 D in. (178 x 235 x 64 mm). MA61-720x: 9-1/2 H x 11-1/8 W x 2-33/64 D in. (241 x 283 x 64 mm).
Agency Listings	
UL 873	Underwriters Laboratories (File #E9429 Category Temperature-Indicating and Regulating Equipment).
CUL	UL Listed for use in Canada by Underwriters Laboratories. Canadian Standards C22-2 No. 24-93.
European Community	EMC Directive (89/336/EEC). Low Voltage Directive (72/23/EEC).
Australia	This product meets requirements to bear the C-Tick Mark according to the terms specified by the Communications Authority under the Radio Communications Act 1992.
General Instructions	Refer to F-27169 and F-27120.

MA51-7x0x Series, MA61-720x Series

Valve Size Chart.

Valve Body Part Number	P Code	Size inches	Close-Off Pressure PSI ^a			Required Retrofit Kit
			MA51-710x	MA51-720x	MA61-720x	
VB-721X-000-4-P VB-7253-000-4-P VB-7273-000-4-P	1, 2,3 or 4	1/2	250			
	5 or 6	3/4	200			
	7 or 8	1	150			
	9	1-1/4	90	150		
	10	1-1/2	60	100		
	11	2	32	65		
VB-722X-000-4-P VB-7263-000-4-P VB-7283-000-4-P	1,2,3 or 4	1/2	250			
	5 or 6	3/4	200			
	7 or 8	1	90			
	9	1-1/4	60	150		
	10	1-1/2	35	100		
	11	2	20	65		
VB-731X-000-4-P	2 or 4	1/2	250			
	6	3/4	200			
	7 or 8	1	90			
	9	1-1/4	60	150		
	10	1-1/2	35	100		
	11	2	20	65		
VB-732X-000-4-P	4	1/2	250			
	6	3/4	250			
	7 or 8	1	250			
	9	1-1/4	250	250		
	10	1-1/2	250	250		
	11	2	250	250		
VB-8213-000-5-P VB-8223-000-5-P	12	2-1/2			125	
	13	3			125	
	14	4			125	
	15	5			125	
VB-8303-000-5-P	12	2-1/2			35	
	13	3			35	
	14	4			35	
	15	5			35	
VB-921X-000-4-P VB-9253-000-4-P VB-9273-000-4-P	1,2,3 or 4	1/2	250			
	5 or 6	3/4	200			
	7 or 8	1	150			
	9	1-1/4	90	150		
	10	1-1/2			100	AM-733 or AM-734 ^b
	11	2			65	AM-733 or AM-734 ^b
VB-922X-000-4-P VB-9263-000-4-P VB-9283-000-4-P	1, 2, 3, or 4	1/2	250			
	5 or 6	3/4	200			
	7 or 8	1	90			
	9	1-1/4	60	150		
	10	1-1/2			100	AM-733 or AM-734 ^b
	11	2			65	AM-733 or AM-734 ^b

^a Note: Maximum valve differential operating pressures MUST be observed. Please consult our Valve Products Catalog F-27384 to assure the operating differential for your application is followed.

^b Use AM-733 with valves with date codes after 9404. Use AM-734 with valves with date codes before 9404.

Valve Compatibility Table, Continued..

Valve Body Part Number	P Code	Size inches	Close-Off Pressure PSI ^a			Required Retrofit Kit
			MA51-710x	MA51-720x	MA61-720x	
VB-931X-000-4-P	2 or 4	1/2	250			
	6	3/4	200			
	7 or 8	1	90			
	9	1-1/4	60	150		
	10	1-1/2			65	AM-733 or AM-734 ^b
	11	2			65	AM-733 or AM-734 ^b
VB-9323-000-4-P	2 or 4	1/2	250			
	6	3/4	250			
	7 or 8	1	250			
	9	1-1/4	250	250		
	10	1-1/2			250	AM-733 or AM-734 ^b
	11	2			250	AM-733 or AM-734 ^b
VB-92X3-000-X-P VB-9313-000-X-P	12	2-1/2			33	
	13	3			22	
	14	4			12	

MA51-7x0x Series, MA61-720x Series

^a Note: Maximum valve differential operating pressures MUST be observed. Please consult our Valve Products Catalog F-27384 to assure the operating differential for your application is followed.

Accessories

Model No.	Description
MA51-72xx, MA61-72xx	
AM-731	Mounting kit - Mx51 - 720x (included with actuator).
AM-732	Mounting kit - Mx61 - 720x (included with actuator).
AM-733	Retrofit kit - discontinued VB-9xxx 1-1/2 to 2 in. valves after 9404 date code.
AM-734	Retrofit kit 1 - discontinued VB-9xxx - 1/2 to 2 in. valves prior to 9404 date code.
AM-756	Metric conduit adapter M20 x 1.5 to 1/2 in. NPT.
AM-763	1/8 in. Hex crank for manual override.
MA51-710x	
AM-756	Metric conduit adapter M20 x 1.5 to 1/2 in. NPT.
AM-770	Replacement valve linkage parts kit.
AM-764	Linkage kit for damper applications.

Typical Applications

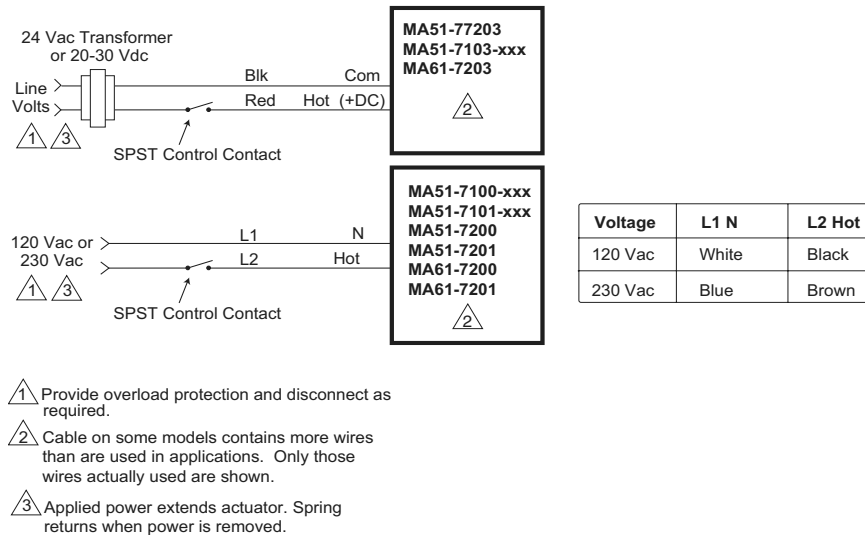


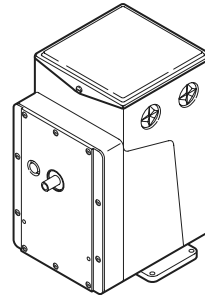
Figure 1 Typical Wiring Diagrams for Two Position Actuators.

Two-Position, Non-Spring Return Actuators

This actuator provides two-position operation of dampers or valves in heating, ventilating, and air conditioning systems, and similar applications where return-to-normal position is not required.

Features:

- Two-position actuators controlled by SPDT controller.
- Non-spring return.
- 24, 120, and 240 Vac models available.
- SPDT auxiliary switch is standard.
- Rugged die cast aluminum housings.
- Oil immersed motor and gear train.



Model Chart						
Model No.	Input				No Load Timing (sec/180°)	Rated Torque lb-in. (N-m)
	Volts	Hz	Watts	VA Rating		
MC-351	24	60	28	53	70	220 (25)
MC-421	120	60	50	96	20	175 (19)
MC-431	120	60	50	96	30	220 (25)
MC-4311	240	60	50	96	30	220 (25)
MC5-4311 ^a	240	50	50	96	36	220 (25)

^a No CSA on MC5-4311.

Specifications	
Control Circuit	Three wire, SPDT snap-acting switch provided by a thermostat, pressure switch, or relay.
Shaft Rotation	Unidirectional clockwise 180° when power is applied.
Auxiliary Switch	Adjustable SPDT is standard. Factory set to make (or break) at mid-stroke.
Nominal Damper Ares	Actuator sizing should be done in accordance with damper manufacturer's specifications.
Environment	
Ambient temperature limits	Shipping and storage: -40 to 136°F (-40 to 58°C). Operating: -40 to 136°F (-40 to 58°C).
Humidity	5 to 95% RH, non-condensing.
Locations	NEMA Type 1. NEMA 4 with AM-363.
Connections	Coded screw terminals.
Case	Die cast aluminum with two 1/2 in. conduit knock-outs on each side.
Mounting	Allow 6 in. (152 mm) clearance above the actuator wiring compartment.
Dampers	Any position.
Valves	In any upright position with actuator above the center line of the valve body.
Dimensions	7 H x 5-3/8 W x 6-5/16 D in. (178 x 137 x 160 mm).
Options	Hazardous locations: specify MC6-431, MC6-4311 (60 Hz), MC7-4311 (50 Hz).
General Instructions	Refer to F-08366.

Adjustable Auxiliary Switch SPDT Rating Amps.

Type	120 V	240 V
Running	5.8	2.9
Locked Rotor	34.8	17.4
Non-Inductive	12.0	6.0

Accessories

Model No.	Description
Damper linkage accessories	
AM-111	Crank arm for 5/16 in. (7.9 mm) diameter damper shaft.
AM-112	Crank arm for 3/8 in. (9.5 mm) diameter damper shaft.
AM-113	Crank arm for actuator or 1/2 in. (12.7 mm) diameter damper shaft.
AM-115	Crank arm for 7/16 in. (11.1 mm) diameter damper shaft.
AM-116	Splined crank arm for actuator.
AM-122	Linkage connector straight type.
AM-123	Damper clip.
AM-125	5/16 in. (7.9 mm) diameter x 20 in. (508 mm) damper rod.
AM-125-048	5/16 in. (7.9 mm) diameter x 48 in. (1,219.2 mm) damper rod.
AM-132	Ball joint connector.
AM-161	Damper linkage kit.
AM-161-1	Damper linkage kit.
AM-301	90 degree mounting bracket.
Miscellaneous actuator accessories	
AM-321	Two step switch kit.
AM-341	Four step switch kit.
AM-363	NEMA 4 gasket kit.
Valve linkage accessories	
AV-30 & AV-300	Valve linkage for 2-1/2 in. & 3 in. VB-9323.
AV-352	Valve linkage for 2-1/2 in. to 6 in. VB-9213, 2-1/2 in. through 6 in. VB-9313, 4 in. through 6 in. VB-9323.
AV-393	Valve linkage for 1/2 to 2 in. VB-7xxx and 1/2 in. to 1-1/4 in. discontinued VB-92x3, or VB-93x3.
AV-394	Valve linkage for 1-1/2 in. and 2 in. VB-92X3, or VB-93x3
AV-396	Valve linkage for 2-1/2 in. to 4 in. VB-9213, and VB-9313.

Typical Applications

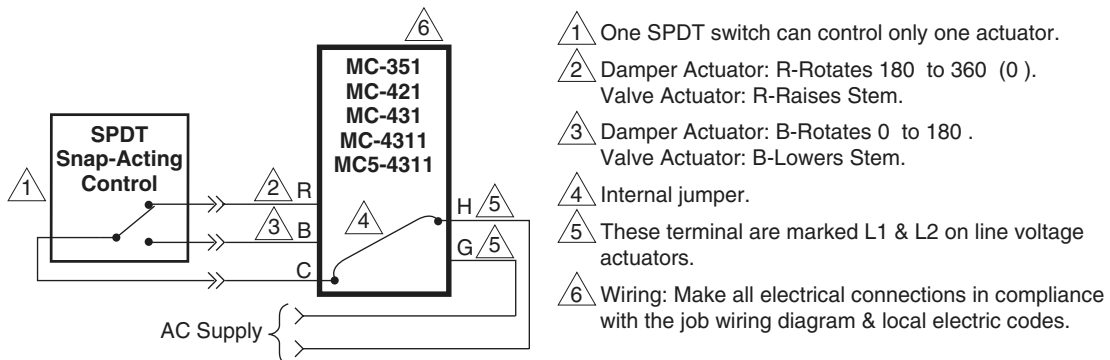


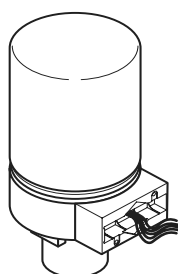
Figure 1 Typical Wiring.

Floating Hydraulic Actuator

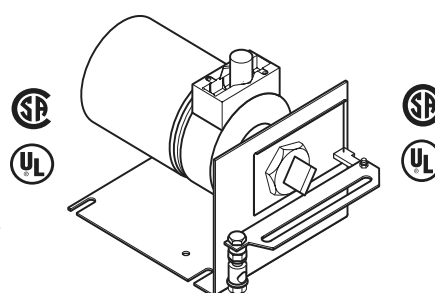
These hydraulic spring return actuators provide floating control of hydronic heating and cooling globe valves or dampers.

Features:

- Floating actuators controlled by SPDT center off floating controllers or DDC controllers with 2 SPST (drive open, hold, drive close) outputs.
- Spring return.
- All models 24 Vac 50/60 Hz. Optional AM-610 transformer available for 120, 208, or 240 Vac.
- Adjustable SPDT auxiliary switch on -500 models.
- Models available with potentiometer position feedback.
- Damper models or base models that require damper or valve linkage.
- Die cast lower housing with 1/2 in. conduit opening and painted steel upper housing.
- Hydraulic actuator with oil immersed motor and pump.



MF-5x13 Series Valve Actuator



MF-5x33 Series Damper Actuator

Model Chart

Damper Actuators.

Model No.	Actuator Power Input				Feedback 15K Ω Potentiometer	Aux Switch	Timing in Seconds at 75°F No Load Stroke		Approx. Damper Output Torque Rating Lb-in. (N-m)	
	Voltage (+10/-15%)	60 Hz		50 Hz			To Extend	To Retract		
		Watts	VA	Watts						VA
MF-5433	24	11.8	21.6	13.3	26.4	No	65	57	20 (2.3)	
MF-5533						Yes				

Valve and Damper Actuators.

Model No.	Feedback 15K Ω Potentiometer	Aux Switch	Timing in Seconds at 75°F No Load Stroke		Required Linkage	
			To Extend	To Retract	Damper	Valve
MF-5413	No	No	65	57	20 lb-in. torque AM-601	AV-7600 ^a
MF-5413-500		Yes				
MF-5513	Yes	No	65	57	20 lb-in. torque AM-601	AV-7600 ^a
MF-5513-500		Yes				

^a May require AV-601. Refer to Restrictions on Maximum Ambient Temperature for Valve Actuators Table.

Valve Actuator Power Input.

Model No.	Actuator Power Input				
	Voltage (+10/-15%)	60 Hz		50 Hz	
		Watts	VA	Watts	VA
MF-5413	24	11.8	21.6	13.3	26.4
MF-5413-500					
MF-5513					
MF-5513-500					

Specifications

Inputs

Control signal	SPDT Center Off Floating Control Output or 2 SPST Control Contacts: Minimum rating of 1 A at 24 Vac, inductive load. Refer to Figure 1. Triacs: DDC controller output must be able to switch 1 A inductive load (200 V minimum).
Power req.	Refer to Damper Actuators Model Chart and Valve Actuator Power Input Model Chart.
Connections	Color coded 4 ft. (1.2 m) leads. All 24 Vac circuits are Class 2.

Outputs

Electrical	Auxiliary switch (-500 models): SPDT externally adjustable over actuator stroke of 9/16 in. Factory setting N.C. contact makes at 1/8 in. from retracted end to full retracted end of stroke. Auxiliary switch rating: 120/240 Vac, 50/60 Hz, 10 amp, 1/4 hp. Pilot duty rating; 24 VA at 24 Vac; 120 VA at 120/208/240 Vac.
	Actuator position feedback signals: Refer to Damper Actuators Model Chart and Valve Actuators Model Chart.
	Stroke Damper: Approximately 2 in. (51 mm) at full stroke. Refer to Damper Actuators Model Chart for models.
	Stroke Valve: Approximately 9/16 in. (14.3 mm) available at full stroke. Refer to Valve Actuators Model Chart for models.
Mechanical	Nominal damper area: Actuator sizing should be done in accordance with damper manufacturer's specifications. Drift: Actuator movement in hold mode. Damper: 0.08 in./hr. max. (2 mm/hr.). Valve: 0.02 in./hr. max. (0.5 mm/hr.).

Environment

Ambient temperature limits	Shipping and storage: -40 to 160°F (-40 to 71°C). Damper: -20 to 140°F (-29 to 60°C). Valve: Refer to Restrictions on Maximum Ambient Temperature for Valve Actuators Table.
Humidity	5 to 95% RH, non-condensing.
Locations	NEMA Type 1.

Dimensions 6-3/4 H x 3-23/32 W x 3-1/4 D in. (171 x 94 x 83 mm). Actuator only.

Agency Listings

UL	Underwriters Laboratories (File #E9429 Category Temperature-Indicating and Regulating Equipment).
CSA	Canadian Standards C22.2 No. 24-93.

General Instructions Refer to F-24696.

Restrictions on Maximum Ambient Temperature for Valve Actuators.

Maximum Temperature of Media in the Valve Body (Check Rating of the Valve)	Maximum Ambient Temperature of MF-5xxx Series	
	AV-7600-1 Only for Chilled Water Applications	AV-7600-1 and AV-601
366°F (180°C)	Do not use	88°F (31°C)
340°F (171°C)		93°F (34°C)
281°F (138°C)		103°F (39°C)
181°F (83°C)		120°F (48°C)
140°F (60°C)	140°F (60°C)	140°F (60°C)
80°F (26°C)		

MF-5x13 Series, MF-5x33 Series

Accessories

Model No.	Description
Common	
AM-610	Nipple-mounted transformer 120/208/240 Vac 50/60 Hz 40 VA (for mounting on conduit box).
Damper Only	
AM-111	Crank arm for 5/16 in. diameter damper shaft.
AM-112	Crank arm for 3/8 in. diameter damper shaft.
AM-113	Crank arm for 1/2 in. diameter damper shaft.
AM-115	Crank arm for 7/16 in. diameter damper shaft.
AM-122	Linkage connector straight type.
AM-123	Damper clip.
AM-125	5/16 in. diameter x 20 in. damper rod.
AM-125-048	5/16 in. diameter x 48 in. damper rod.
AM-132	Ball joint connector.
AM-161-3	Damper linkage kit.
AM-601	Device includes mounting bracket, damper linkage with spring and AM-122 straight connector. Required to modify MF-5x13 series valve actuators into 2 in. (51 mm) stroke damper actuators.
Valve Only	
AV-7600-1	Valve linkage for VB-7xxx valves.
AV-600	Valve linkage for VB-7xxx and discontinued VB-9xxx 1/2 to 2 in.
AV-601	Valve linkage extension for hot water and steam applications; requires AV-600.
TOOLS	
TOOL-12	Wrench for adjustment of auxiliary switch.
TOOL-19	Spring compression tool for AV-600.

Typical Applications

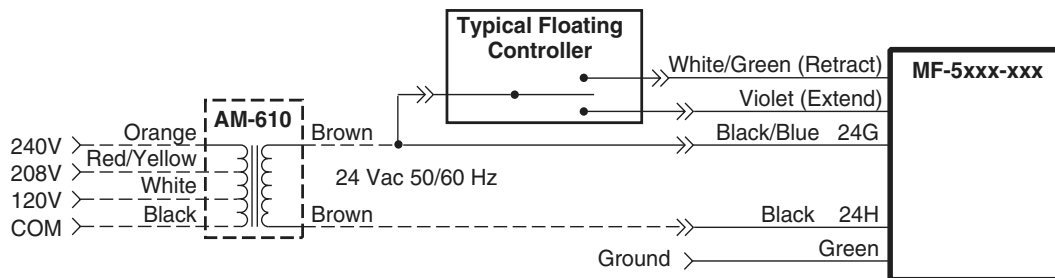


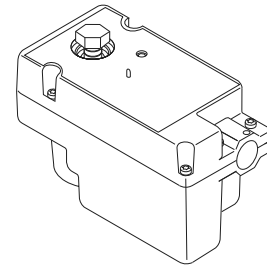
Figure 1 Basic Wiring Diagram.

Floating Valve Actuator

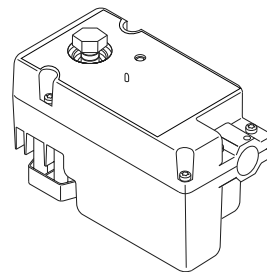
The MF-22xx3 and MF-23xx3 series floating valve actuators are non-spring return actuators used with floating DDC controllers and standard 1/2 to 2 in. two-way and three-way globe valve bodies for control of heating and cooling coils. Typical applications include VAV terminals with reheat coils, fans coil units, and unit ventilators. Certain models are thermally isolated for use with chilled fluids.

Features:

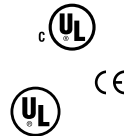
- Floating actuator controlled by DDC controller with contact or Triac output or SPDT center off controller (drive open-hold-drive closed).
- MF-22xx3 has 45 pounds (200 newtons) of output force with automatic load limit for self-adjusting travel and long motor life.
- MF-23xx3 has 80 pounds (355 newtons) of output force at low line voltage and requires DDC controller with time-out feature.
- Synchronous motor for consistent timing.
- Manual override with automatic release.
- Optional feedback potentiometer available for precision control or position indication.
- Integral linkage for all standard 1/2 to 2 in. Invensys two-way stem-up open and three-way valve bodies for a wide variety of applications.
- Compact size for application flexibility.
- Rugged construction with die cast housing.



MF-22203
MF-23203



MF-223x3
MF-233x3



Model Chart										
Model No.	Application	Output Force	Actuator Power Input			Feedback	Typical Timing in Sec. @ 75°F for 1/2" Stroke		Max. Stroke in in. (mm)	
			Voltage (+20%, -15%)	Hz	VA		15K ¼ Pot.	60 Hz		50Hz
MF-22203	Hot Water ^a Steam	45 lb (200 newtons)	24 (Class 2 Power Supply)	50	60	1.5	No	126. ±30 sec.	151 ±30 sec.	9/16 (14.3)
MF-22303	Chilled/Hot Water Steam						No			
MF-22323							Yes			
MF-23203 ^b	Hot Water ^a Steam	80 lb. (355 newtons)	24 (Class 2 Power Supply)	50	60	1.5	No	126. ±30 sec.	151 ±30 sec.	9/16 (14.3)
MF-23303 ^b	Chilled/Hot Water Steam						No			
MF-23323 ^b							Yes			

^a Do not use in chilled water applications.
^b Requires DDC control with timeout feature

MF-2xxx3 Series

Specifications

Inputs	
Control signal	SPDT Center Off (Floating) Control Contacts or Two SPST Control Contacts, minimum rating of 250 mA at 24 Vac inductive load. MF-23xx3 models require a controller with a timeout feature.
Power	Two Triacs: DDC output must be able to switch 250 mA (24 VA) inductive load (150 Vac minimum).
Connections	4 foot (1.2 M) color coded 18 AWG, plenum cable rated for UL.
Outputs	
Position feedback signal	15k ohm nominal potentiometer. Refer to Model Chart. Connections: 4 foot (1.2 m) color coded 18 AWG, plenum cable rated for UL.
Mechanical	Force: See Model Chart. Stroke: Up to 9/16" (14.3 mm) maximum, self-adjusting. Timing: Refer to Model Chart.
Manual Operator	Allows actuator to be manually set at any position upon loss of power. Releases automatically when power is restored.
Environment	
Ambient temperature limits	Shipping and storage: -40 to 160°F (-40 to 71°C). Operating: See "Restrictions on Ambient Temperature for Valve Actuators" for minimum and maximum temperatures.
Fluid Temperature Limits	Refer to "Restrictions on Ambient Temperature for Valve Actuators."
Humidity	5 to 95% RH, non-condensing. Refer to "Restrictions on Ambient Temperature for Valve Actuators" for dew point temperature.
Locations	NEMA Type 1.
Enclosure Protection Class	Designed to meet IP31 Class, according to EN 60529, BS EN 60529.
Agency Listings	
UL 873	Underwriters Laboratories (File # E9429 Category Temperature-Indicating and Regulating Equipment).
CUL	Certified for use in Canada by Underwriters Laboratories. Canadian Standard C22.2 No. 24-93.
European Community	EMC Directive (89/336/EEC). Low Voltage Directive (72/23/EEC).
Dimensions	3-5/16 H x 3 W x 5-9/16 D in. (84 x 76 x 141 mm).
General Instructions	Refer to F-26264 and F-26572.

Restrictions on Ambient Temperature for Valve Actuators.

Model No.	Temperature of Media in the Valve Body (Check Rating of the Valve)		Maximum Actuator Ambient Temperature	Dew Point Temperature
	Minimum	Maximum		
MF-2x203	70°F (21°C)	281°F (138°C)	115°F (46°C)	Non-condensing ^a
		220°F (104°C)	140°F (60°C)	
MF-2x303	40°F (4°C)	281°F (138°C)	115°F (46°C)	88°F Dew Point maximum with 40°F fluid (31°C Dew Point maximum with 4°C fluid) ^b
MF-2x323		220°F (104°C)	140°F (60°C)	

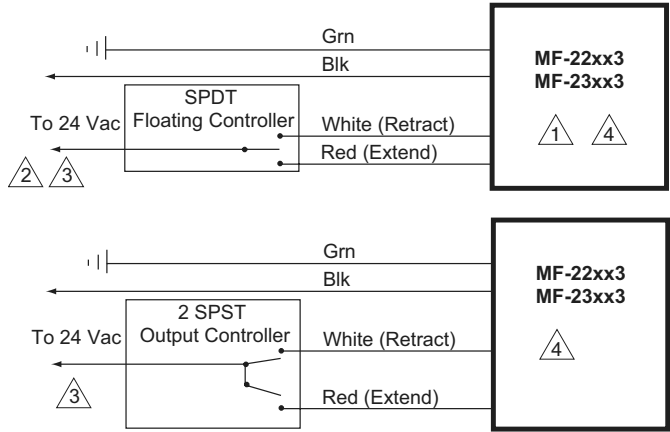
^a Do not use MF-2X203 models in chilled water applications.

^b The dew point temperature cannot be more than 48°F (26.7°C) above the fluid temperature.

Accessories

Model No.	Description
AV-641	Valve linkage kit (replacement parts only, order separately, see F-26588).
AV-642	Four-way valve linkage kit for Controlli valve bodies (see F-26261).
AV-644	Valve linkage kit (included with MF-22xx3 actuator) (see F-26264).
FRAC-255	Metric male 20 mm conduit fitting (m20 x 1.5 - 8g) 11 mm nominal thread length.
FRAC-259	MF-20000/MS-20000 male conduit fitting.

Typical Applications



CAUTION: Each actuator must have its own separate controller output or relay.

- 1 Provide overload protection and disconnect as required.
- 2 Two-position 3-wire control is possible by use of a form-C controller output (MF-22xx3 series).
- 3 Actuator retract wire may be White/Green on some models.
- 4 CAUTION MF-23xx3 models: The controller drive circuit must be disabled after 3 minutes or less

Figure 1 Basic Wiring Diagrams with SPDT Floating Control or Two SPST Control Contacts.

Power and Control Wiring Color Codes.

Connections	Lead	Description	Wire Codes
			Color Only ^a (Current Models)
Actuator	Earth	Earth Ground	Green
	24 ^b	24 Vac	Black
	Extend	Extend	Red
	Retract	Retract	White
Potentiometer	Pot. Retract	15K Feedback - Retract	Orange
	Pot. Wiper	15K Feedback - Wiper	Blue
	Pot. Extend	15K Feedback - Extend	Brown

^a Refer to F-26264 and F-26572 for wiring information on units manufactured prior to date code 991X (e.g. 9919, 9918, etc.).

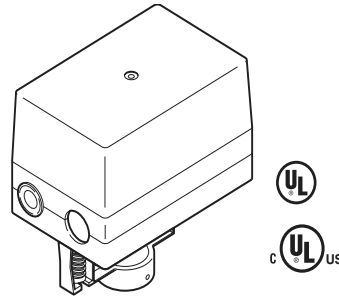
^b Black 24 Vac terminal can be connected to either side of the 24 Vac power.

Floating Valve Actuator

This valve actuator is a non-spring return actuator compatible with floating and optional proportional controllers.

Features:

- Floating actuator controlled by SPDT floating controller (drive open-hold-drive closed) or a DDC controller with equivalent control action (contact or triac).
- Optional control module cards for proportional control (MF-63123 only): MFC-8000 for Vdc and MFC-420 for 4 to 20 mA_{dc}.
- 210 lbs minimum output force with automatic load limit.
- Wide operating ambient range of 0 to 140°F (-18 to 60°C).
- Synchronous motor assures accurate stroke timing.
- MF-63123 series available with position feedback potentiometer.
- Self-adjusting travel and position feedback potentiometer mechanisms.
- Manual override operation with automatic release.
- Adjustable SPDT auxiliary switch on -500 models.
- Rugged construction: Die cast housing, double thread 1/2 in. dia. stainless steel jackscrew, roller thrust bearings, and all metal gear train.
- Integral linkage for 1/2 to 2 in. VB-7xxx and VB-9xxx 1/2 to 1-1/4 in. valves. Optional linkage for 2-1/2 to 5 in. VB-8xxx valves, 2-1/2 to 4 in. VB-931x and discontinued 1-1/2 to 4 in. VB-9xxx (except VB-9323 2-1/2 to 4 in.).



Model Chart						
Model No.	Actuator Power Input				Feedback 15K Ω Pot.	Aux. Switch
	Voltage (+10%/ -15%)	Hz	VA	Watts		
MF-63103	24 Vac	50/60	6	7	No	No
MF-63103-500					Yes	Yes
MF-63123 ^a					Yes	No
MF-63123-201 ^b					No	Yes
MF-63123-500 ^a					Yes	

^a Feedback potentiometer cannot be used when MFC control module card is installed

^b MF-63123 with MFC-8000 0 to 10 Vdc reverse action factory set.

Specifications

Inputs	
Control signal	SPDT floating control contacts or 2 SPDT control contacts: Minimum rating of 1/2 amp at 24 Vac inductive load.
Power	Triacs: DDC controller must be able to switch 1/2 amp inductive load (200 Vac minimum).
Connections	Coded screw terminals.

Specifications (Continued)

Outputs

Electrical	Auxiliary switch (-500 models): SPDT, adjustable over actuator stroke of 1 in. The N.C. contact is factory set to make contact at 3/8 in. from the fully extended position.
	Rating: 1 amp at 24 Vac, 50/60 Hz. Pilot duty rating; 24 VA at 24 Vac.
	Connections: Color coded leads for auxiliary switch, terminal block for control.
Position feedback signal	Refer to Model Chart (cannot be used when MFC control module card is installed).
	Connections: Coded screw terminals.
Mechanical	Force: 210 lbs (935 N) minimum and 270 lbs (1202 N) maximum with automatic load limit.
	Stroke: Up to maximum of 1 in. self adjusting.
	Timing: 2 minutes per in. at 60 Hz; 2 minutes, 24 seconds per in. at 50 Hz.
Environment	
Ambient temperature limits	Shipping and storage: -40 to 160°F (-20 to 71°C). Operating: 0 to 140°F (-18 to 60°C). Refer to Valve section for further information.
Humidity	5 to 95% RH, non-condensing.
Locations	NEMA Type 1.
Dimensions	6 H x 5-5/8 W x 3-5/8 D in. (152 x 143 x 92 mm).
Agency Listings	
UL 873	File #E9429.
CUL	#C22.2 No. 24-93.
General Instructions	Refer to F-24732.

Accessories

Model No.	Description
MFC-420	Control module card for 4 to 20 mAdc (for MF-63123 only, order separately).
MFC-8000	Control module card for Vdc (for MF-63123 only, order separately).
Valve Linkage	
AV-672	Linkage for 2-1/2 to 4 in. VB-9000 valves, except VB-9323, 2-1/2 to 5 in. VB-8xx3 (order separately).
AV-673	Linkage for 1/2 to 2 in. Johnson Controls VB-3754, VB-3924, and VB-4324 valves.
AV-674	Linkage for 1/2 to 3 in. Honeywell V5011F, V5011G, and V5013F valves.
AV-608	Linkage adapter kit for discontinued VB-9xxx 1-1/2 and 2 in.

Typical Applications

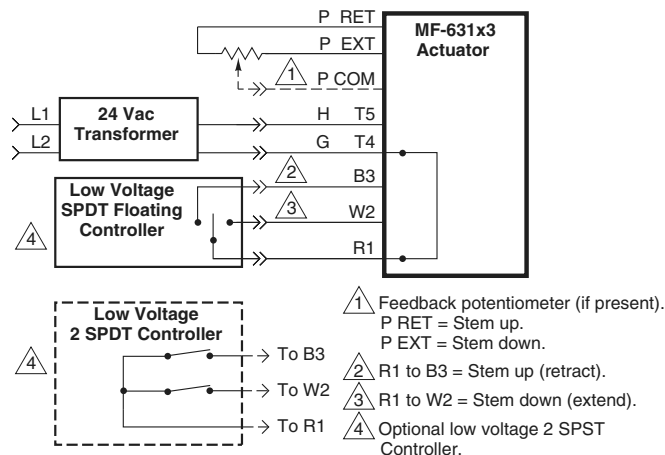
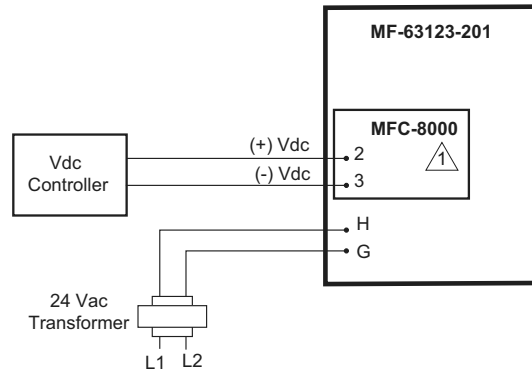


Figure 1 Basic Actuator: Wiring Diagram with SPDT Floating Controller.

MF-631x3 Series



Figure 2 Auxiliary Switch Models MF-631x3-500.




 Factory installed in actuator. Set for 0 to 10 Vdc control signal, reverse action. Consult MFC-8000 General Instructions, F-25124 for further information.

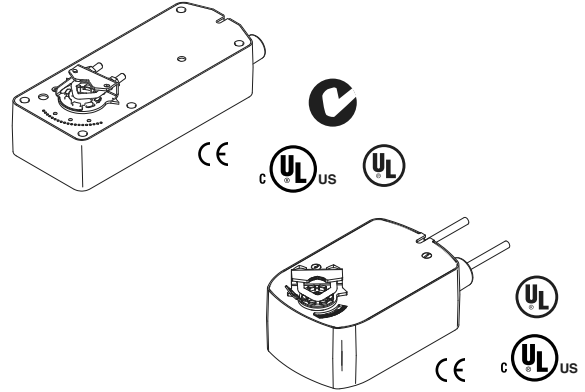
Figure 3 Basic Wiring Diagram for MF-63123-201.

Spring Return DuraDrive® Floating Actuator

For spring return applications that require floating control of dampers and valves in HVAC system.

Features:

- 35 lb.-in. (4 N-m), 60 lb.-in (7 N-m), 133 lb.-in (15 N-m).
- Direct mount to round or square damper shaft.
- Overload protection throughout rotation.
- True mechanical clockwise or counterclockwise spring return operation for positive close-off in airtight applications.
- Visual position indicator.
- Rotation limiting available.
- MF41-7xxx manual override models.



Model Chart																
Model No.	Shaft Size	Stroke	Actuator Power Input								SPDT Auxiliary Switches	Approximate Timing in Seconds @ 70°F (21°C) with No Load		Output Torque Rating lb.-in. (N-m)		Manual Override
			Voltage	Running				Holding		Powered		Spring Return	Min. ^a	Max. Stall		
				50 Hz		60 Hz		DC Amps	50 Hz						60 Hz	
				VA	W	VA	W									
MF40-7043 ^b	5/8" Dia. 1/2" Sq.	95° ± 5° maximum, adjustable from 40 to 95° with an integral mechanical stop.	24 Vac ± 20%	5.9	4.4	5.9	4.4	.17	2.9	2.9	No	<130	<25	35 (4)	120 (14)	No
MF40-7043-501 ^b				One ^c												
MF41-7073	3/4" Dia. 1/2" Sq.	95° ± 5° maximum, adjustable from 30 to 95° with AM-689 rotation limiter.	22 to 30 Vdc	6.2	4.8	6.2	4.8	.18	2.8	2.8	No	<195	<30	60 (7)	160 (18)	Yes
MF41-7073-502				Two ^d												
MF41-7153				No	<190	<30	133 (15)	300 (34)								
MF41-7153-502	Two ^d															

^a De-rating required for spring return actuators at low temperatures.
^b With plenum-rated cable.
^c One adjustable from 0 to 95° rotation (0 to 1 scale).
^d One adjustable from 25 to 85° rotation and one set to operate @ 5° fixed.

Specifications

Inputs	
Control signal	Floating point control, 24 Vac.
Power	Refer to Model Chart.
Connections	MF40-7073 and MF40-7153: 3 ft. (0.9 m) long, appliance cable, 1/2 in. conduit connectors. For M20 metric conduit, use AM-756 adapter. MF40-7043: 3 ft. (91 cm) plenum-rated cables. 1/2 in. conduit connectors. For M20 metric conduit, use AM-756 adapter.

MF40-7043 Series, MF41-7073 Series, MF41-7153 Series

Specifications (Continued)

Outputs

Motor Type	Brushless DC.
Electrical	<p>One auxiliary switch available with MF40-7043-501, SPDT 6A resistive @ 24 Vac, adjustable 0 to 95° (0 to 1 scale). UL Listed, switch meets VDC requirements for 6 (1.5)A, 24 Vac.</p> <p>Two auxiliary switch available with MF40-7153-501 or MF40-7073-502, SPDT 7A resistive @ 24 Vac, one fixed @ 5° and one adjustable 0 to 95°. UL Listed, switch meets VDC requirements for 6 (1.5)A, 24 Vac.</p> <p>Position feedback voltage "AO": 2 to 10 Vdc (maximum 0.5 mA) output signal for position feedback or operation of up to four slave actuators.</p> <p>Control mode: Switch provided for selection of direct acting or reverse acting control mode on proportional models.</p> <p>Timing: Refer to Model Chart.</p>
Mechanical	<p>Output torque rating: Refer to Model Chart.</p> <p>Position Indicator: MF40-704X: Visual indicator, 0 to 1 (0 is the spring return position). MF40-707X, MF40-715X: Pointer (-5 to 90°) and scale are provided for position indication (-5 is normal or spring return position).</p> <p>Stroke: Refer to Model Chart.</p>
Environment	
Ambient Temperature limits	<p>Shipping and storage: -40 to 160°F (-40 to 71°C).</p> <p>Operating: -22 to 140°F (-30 to 60°C).</p>
Humidity	5 to 95% RH, non-condensing.
Locations	<p>MF40-704X: NEMA 2 (IEC 1P54).</p> <p>MF40-707X: NEMA 1, NEMA 2 (IEC IP54) with conduit in the down position.</p> <p>MF40-715X: NEMA 1, NEMA 2 (IEC IP54) with conduit in the down position.</p>
Dimensions	<p>MF40-7043: 6-51/64 H x 4 W x 3-1/2 D in. (170 x 100 x 90 mm).</p> <p>MF41-7xxx: 10-1/2 H x 4 W x 3-1/2 D in. (270 x 100 x 90 mm).</p>
Agency Listings	
UL	UL-873, Underwriters Laboratories Listed (File #9429 Category: Temperature-Indicating and Regulating Equipment).
European Community	EMC Directive (89/336/EEC). Low Voltage Directive (72/23/EEC).
CSA	Canadian Standards C22.2 No. 4-93.
Australia	This product meets requirements to bear the C-Tick mark according to the terms specified by the Communications Authority under the Radio Communications Act 1992.
General Instructions	Refer to F-26644.

Accessories

Model No.	Description
MF40-7043, MF40-7073, MF40-7153	
AM-673 ^a	Mounting bracket.
AM-674	Weather shield.
AM-675	Weather shield base.
AM-676	Universal shaft extension, approximately 9-1/2 in. long (242 mm) for use on 3/8 to 11/16 in. (10 to 17 mm) round shafts, 3/8 to 9/16 in. square shafts. (AM-753 clamps required).
AM-756	Metric conduit adaptor M20 x 1.5 to 1/2 in. NPT (two per package).
AM-714	Weather shield.
MF40-7073, MF40-7153	
AM-671 ^{abcd}	Mounting bracket.
AM-672 ^{abcd}	Mounting bracket.
AM-686	Position indicator.
AM-687	V-clamp.
AM-689	Rotation limiter.
AM-690	Crank arm.
AM-691	Crank arm.
AM-692	V-bolt.
AM-693 ^{ef}	Crank arm kit.
AV-602	Valve linkage for VB-7xxx 1 to 2 in.
AV-607	Valve linkage VB-9xxx 2-1/2 to 4 in.
MF40-7043	
AM-709	Position indicator and stroke limiter.
AM-710	V-clamp.
AM-711	Crank arm adaptor kit.
AM-712 ^e	Crank arm adaptor kit.
AM-713 ^e	Bracket.
AM-715 ^e	Crank arm adaptor kit.
AV-605	Valve linkage for VB-7xxx.

^a Drill appropriate mounting holes where needed.

^b AM-693 crank arm kit required.

^c Cannot be used with Mx40-634x or Mx40-717x series actuators.

^d The large "C"-shaped clamps included in AM-693 crank arm kit are required for mounting the actuator. Drill appropriate mounting holes where needed.

^e Use the self-tapping screws and flat washers provided in kit to mount actuator.

^f AM-692 V-bolt kit required.

Typical Applications

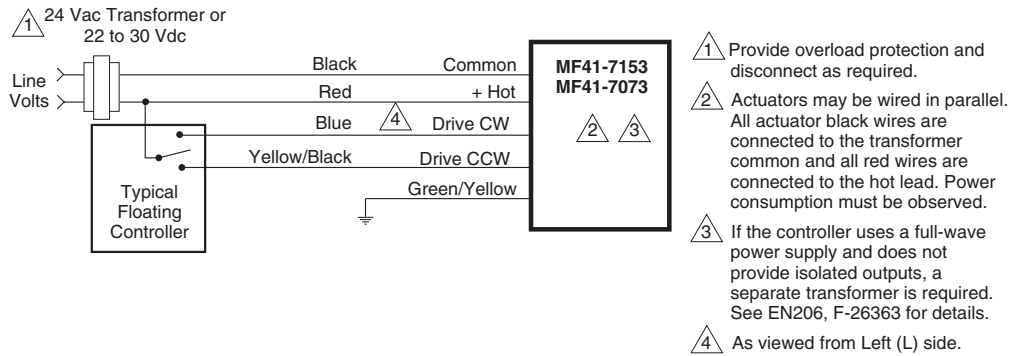


Figure 1 Typical Wiring Diagram For Floating Actuator.

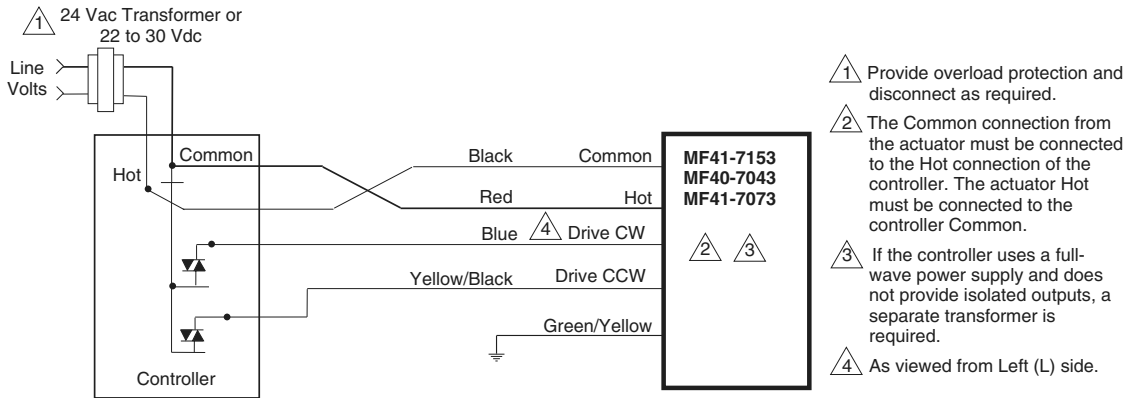


Figure 2 Typical Wiring Diagram with Triac Sink.

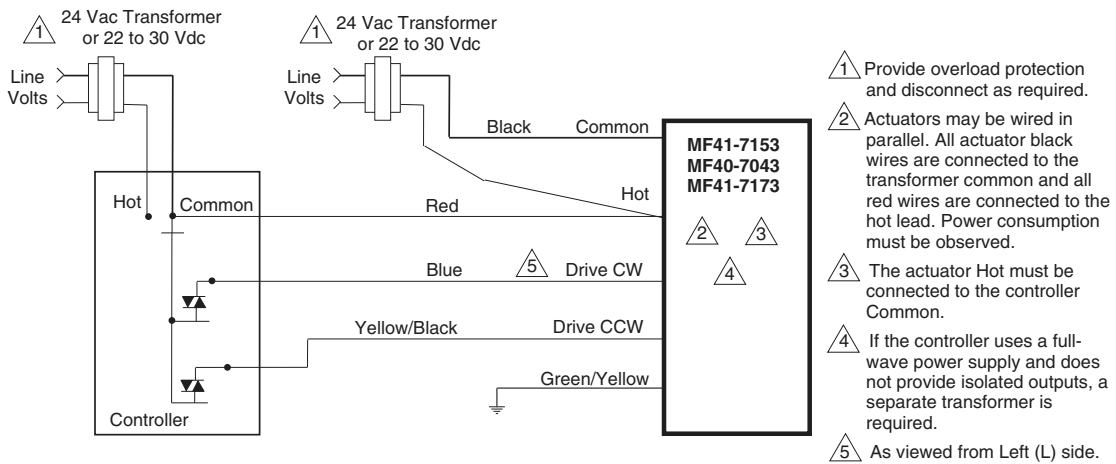


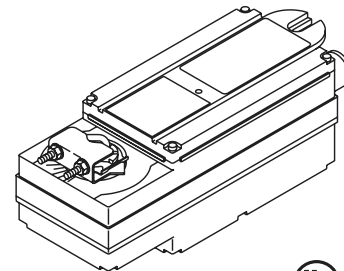
Figure 3 Typical Wiring Diagram with Triac Sink and Separate Transformers.

Spring Return DuraDrive® Floating Actuator

For spring return applications that require floating control of dampers and valves in HVAC system.

Features:

- 150 lb.-in. (17 N-m) rated torque.
- Direct mount to round or square damper shaft.
- Overload protection throughout rotation.
- True mechanical clockwise or counterclockwise spring return operation for positive close-off in tight seal damper applications.
- Visual position indicator.
- Oil immersed gear train provides continuous lubrication.
- NEMA 4 housing (IEC IP56).
- Automatic current sensing motor control provides extended reliability and repeatable timing.



Model Chart										
Damper Actuators										
Model No.	Damper Shaft Size ^a	Actuator Power Input				SPDT Auxiliary Switches	Approximate Timing in Seconds @ 70°F (21°C) with No Load		Output Torque Rating lb.-in. (N-m)	
		Voltage	Watts	VA			Powered	Spring Return	Minimum ^b	Maximum Stall
				Running	Holding					
MF40-7173	3/8 to 1/2 in. round or square	24 Vac ± 20%	5.5	10	4.3	No	<145	150 (17)	450 (51)	

^a Optional AM-753 damper shaft mounting clamps for 5/8 in. square or 3/4 to 1 in. round shafts.

^b De-rating required for spring return actuators at low temperatures.

Valve Actuator plus Linkages.

Model No. ^a	Linkage (included)	Voltage 50/60 Hz	Running		Holding VA	SPDT Aux. Switches
			W	VA		
MF40-7173-200	AV-602	24 Vac ± 20%	5.5	10	4.3	No
MF40-7173-220	AV-607					
MF40-7173-230	AV-609					

^a Refer to Valve Catalog, F-27384, for correct applications.

Specifications

Inputs

Control signal	SPDT Floating point control, Triacs (500 mA rated), or 2 SPST contacts.
Power	Refer to Model Chart.
Connections	1/2 in. conduit ports for separation of Class 1 and Class 2 circuits. Power: Appliance cable.

Specifications (Continued)**Outputs**

Motor Type	Brushless DC.
Mechanical	Direction of rotation: CW or CCW rotation is available through reverse mounting. Dual shaft clamp: Direct coupled using a through hole output hub. Stroke: Electronically limited to $93^{\circ} \pm 1^{\circ}$.
Environment	
Ambient Temperature limits	Shipping and storage: -40 to 160°F (-40 to 71°C). Operating: -25 to 140°F (-32 to 60°C).
Humidity	5 to 95% RH, non-condensing.
Locations	NEMA 1, NEMA 4 (IEC IP56) with customer supplied water tight connector.
Dimensions	10-27/32 H x 4 W x 4 D in. (280 x 100 x 100 mm).
Agency Listings	
UL	UL-873, Underwriters Laboratories Listed (File #9429 Category: Temperature-Indicating and Regulating Equipment.)
European Community	EMC Directive (89/336/EEC). Low Voltage Directive (72/23/EEC).
CUL	Canadian Standards C22.2 No. 4-93.
Australia	This product meets requirements to bear the C-Tick mark according to the terms specified by the Communications Authority under the Radio Communications Act 1992.
General Instructions	Refer to F-26749.

Accessories

Model No.	Description
AM-674	Weather shield.
AM-676	Universal shaft extension, approximately 9-1/2 in. long (242 mm) for use on 3/8 to 1 1/16 in. (10 to 17 mm) round shafts, 3/8 to 9/16 in. square shafts. (AM-753 clamps required).
AM-751	Standard anti-rotation bracket 9 in. long x 1 3/16 in. wide (229 x 21 mm), included with actuator.
AM-752	Optional anti-rotation bracket 4 in. long x 1-11/16 in. wide (102 x 43 mm), for narrow spaces.
AM-753	Damper shaft mounting clamps for 5/8 in. square shaft, 3/4 in. and 1 in. round shafts (two per package).
AM-754	Standard universal mounting clamps for 3/8 to 1/2 in. (10 to 13 mm) round and square shafts, two included with actuator.
AM-756	Metric conduit adaptor M20 x 1.5 to 1/2 in. NPT (two per package).
AV-602	Valve linkage for VB-7xxx 1-1/2 to 2 in.
AV-607	Valve linkage for VB-9xxx 2-1/2 to 4 in.

Typical Applications

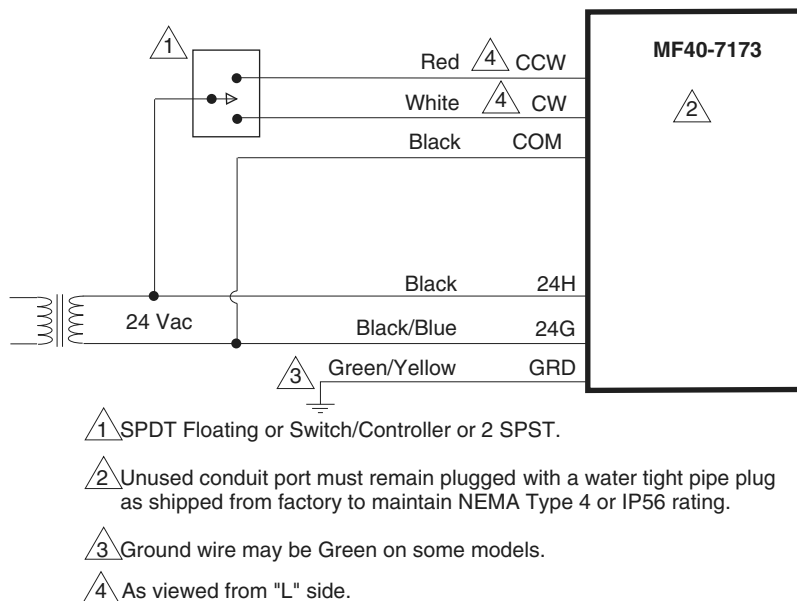


Figure 1 Typical SPDT Controller Wiring Diagram.

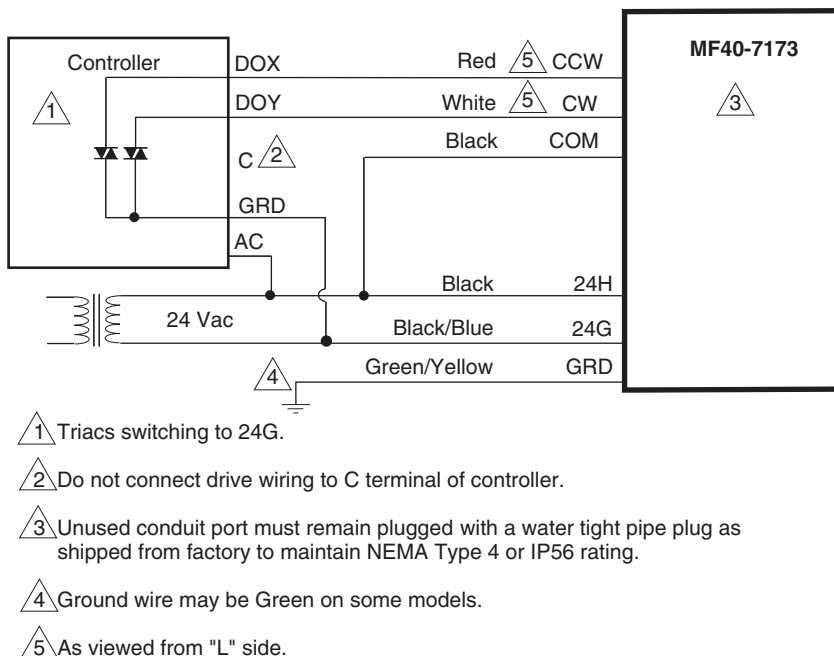


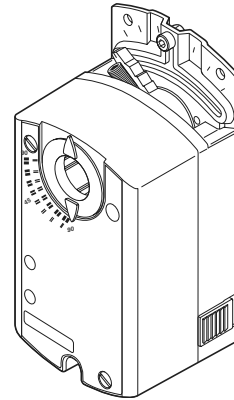
Figure 2 Typical Triacs Switching to 24G Wiring Diagram of Actuator.

Non-Spring Return DuraDrive® Floating Actuator

The DuraDrive direct coupled 24 Vac non-spring return rotary electric actuators are designed for three-position (floating) control of dampers.

Features:

- Compact, lightweight design.
- Manual override.
- Factory pre-positioned at 5° from 0 to assure damper or valve close-off.
- Plenum cabling.
- Feedback potentiometer models available.
- cUL and UL listed; plenum versions also CE certified.
- Independently adjustable dual auxiliary switches available.



Model Chart								
Damper Actuators.								
Model No.	Shaft Size	Actuator Power Input		With Potentiometer	SPDT Auxiliary Switches	Approximate Timing in Seconds @ 70°F (21°C) with No Load		Output Torque Rating lb.-in. (N-m) Minimum
		Voltage	VA Running			50 Hz	60 HZ	
						MF41-6043	3/8 to 5/8 in. dia.	24 VAC +20%-15%
MF41-6043-510	Yes	No						
MF41-6043-502	No	Two						
MF41-6083	1/4 to 1/2 in. sq.	24 VAC +20%-15%	2.3	No	No	150	125	70 (8)
MF41-6083-510				Yes	No			
MF41-6083-502				No	Two			

Valve Actuator plus Linkages.

Model No. ^a	Linkage (included)	Voltage 50/60 Hz	Running VA	SPDT Aux. Switches
MF41-6043-200	AV-603	24 Vac + 20% -15%	2.3	No
MF41-6043-202				Yes
MF41-6083-200				No
MF41-6083-202				Yes

^a Refer to Valve Catalog, F-27384, for correct applications.

Specifications

Inputs

Control signal	Floating three position control, 24 Vac.
Power	24 Vac +20/-15% 50/60 Hz. Power Consumption: 2.3 VA MF41-6083: 24 Vac +20/-10% at 90 to 130°F (32 to 55°C) ambient.
Connections	3 ft. (0.9 m) long, 18 AWG leads, plenum-rated.

Outputs

MF41-60xx-510: Feedback potentiometer: 0 to 1000Ω < 10 mA.
MF41-60xx-502: Auxiliary switch contact rating, AC rating: 24 Vac, 4A Resistive, 2A Inductive. DC Rating: 12 to 30 Vdc, DC 2A.
Switching Hysteresis: 2°

MF41-60xx Series

Specifications (Continued)

Environment

Ambient temperature limits	Shipping and Storage: -40 to 158°F (-40 to 70°C). Operating: -25 to 130°F (-32 to 55°C).
Humidity	5 to 95% RH, non-condensing.
Locations	NEMA 2, IP54 to EN60529.
Dimensions	5-7/16 H x 2-3/4 W x 2-3/8 D in. (140 x 70x 60 mm).
Agency Listings	
UL	UL-873, Underwriters Laboratories.
European Community	EMC Directive (89/336/EEC). Emissions (EN50081-1). Immunity (EN50082-2).
CUL	Canadian Standards C22.2 No. 24-93.
General Instructions	Refer to F-27213.

Accessories

Model No.	Description
AM-726	Rotary to linear bracket.
AM-727	Rotary to linear crank arm adaptor
AM-728	Conduit adaptor.
AM-729	3/8 in. shaft adaptor.
AV-603	Valve linkage for VB-7xxx 1/2 to 2 in.

Typical Applications

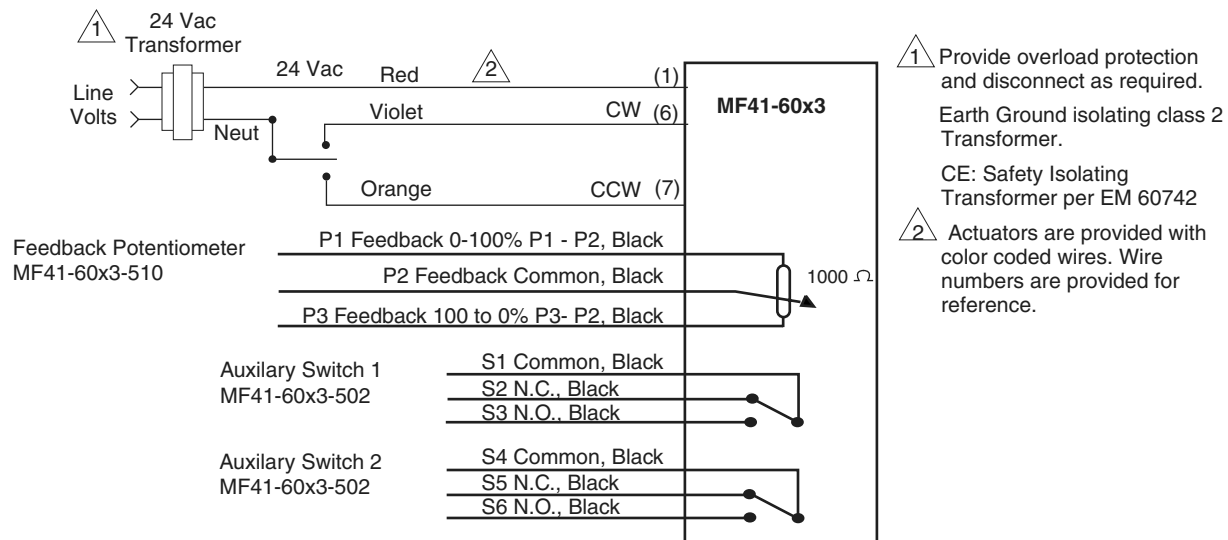


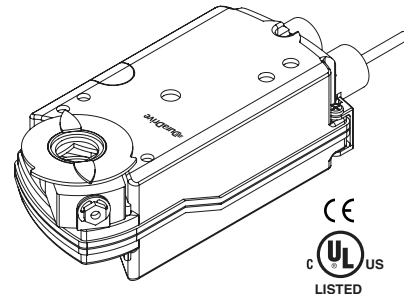
Figure 1 Typical Wiring Diagram for MF41-60x3-2xx Floating Actuators.

Non-Spring Return DuraDrive® Three Position Actuator

The DuraDrive direct-coupled, 24 Vac, non-spring return electronic actuator is designed for three-position control of building HVAC dampers.

Features:

- Synchronous motor technology with stall protection.
- Unique self-centering shaft coupling.
- Manual override.
- 133 lb-in (15 Nm) torque.
- Factory pre-positioned at 5° from 0 to assure damper or valve close-off.
- Mechanical range adjustment capabilities.
- Offset and span adjustment models available.
- Built-in 1/2-inch conduit connection.



Model Chart									
Damper Actuators.									
Model No.	Shaft Size	Motor Type	Power Input @ 50/60 Hz			SPDT Auxiliary Switches	Approximate Timing in Seconds @ 70°F (21°C) with No Load		Output Torque Rating lb-in (Nm)
			Voltage	Running			50 Hz	60 Hz	
				VA	W				
MF41-6153	1/4 to 3/4 in. dia. 1/4 to 1/2 in.sq.	Synchronous	24 Vac + 20% - 15%	3	3	No	150	125	133 lb-in (15 Nm)

Valve Actuator plus Linkages.

Model No. ^a	Linkage (included)	Voltage 50/60 Hz	Running		SPDT Aux. Switches
			W	VA	
MF41-6153-200	AV-605	24 Vac ± 20%	3	3	No
MF41-6153-220	AV-607				

^a Refer to Valve Catalog, F-27384, for correct applications.

Specifications	
Inputs	
Control signal	Floating three position control, 24 Vac.
Power	All 24 Vac circuits are Class 2. 24 Vac +20/-15% @ 50/60 Hz. Running VA: 3 @ 3 W.
Connections	3 ft. (0.9 m) long, 18 AWG leads.
Electrical	Timing: 150 seconds @ 50 Hz; 125 seconds @ 60 Hz.
Mechanical	Output torque rating: 133 lb-in. (15 N-m).
	Stroke: Normal angle of rotation is 90°, limited to a maximum of 95°. Field adjustable to limit travel on either end of stroke.
	Position indicator: Adjustable pointer is provided for position indication.

MF41-6153 Series

Specifications (Continued)

Environment	
Ambient temperature limits	Operation: -25 to 130°F (-32 to 55°C) Storage: -40 to 158°F (-40 to 70°C).
Humidity	5 to 95% RH, non-condensing.
Locations	NEMA Type 1, IP54 According to EN 60 529.
Dimensions	
	8-3/8 H x 3-1/4 W x 2-2/3 D in. (210 x 80 x 70 mm).
Agency Listings	
UL	UL-873, Underwriters Laboratories.
European Community	EMC Directive (89/336/EEC). Emissions (EN50081-1). Immunity (EN61000-6-2).
CUL	Canadian Standards C22.2 No. 24-93.
General Instructions	
	Refer to F-27215.

Accessories

Model No.	Description
AV-605	Valve linkage for VB-7xxx 1-1/2 to 2 in.
AV-607	Valve linkage for VB-9xxx 2-1/2 to 4 in.

Typical Applications

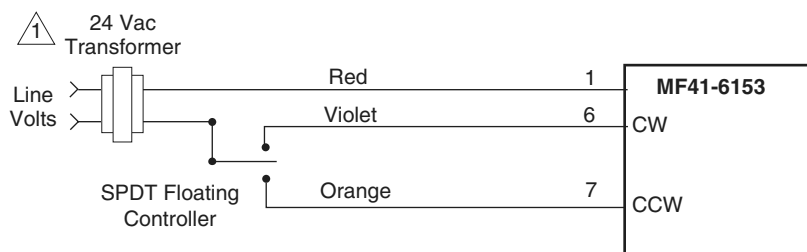


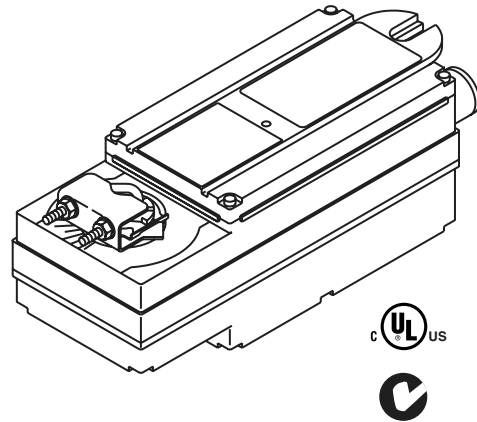
Figure 1 Typical Wiring Diagram for MF41-6153 Floating Actuators.

Non-Spring Return DuraDrive® Floating Actuator

For non-spring return applications that require floating control of dampers and valves in HVAC systems.

Features:

- Direct mount to round or square damper shaft.
- 300 lb.-in. (34 N-m) torque rating.
- Overload protection throughout rotation.
- Oil immersed gear train provides continuous lubrication.
- NEMA 4 housing (IEC IP56).
- Manual override to allow positioning for installation and manual operation.
- Provide floating point control (drive open-hold-drive closed).



Model Chart									
Damper Actuators.									
Model No.	Damper Shaft Size ^a	Actuator Power Input				SPDT Auxiliary Switches	Approximate Timing in Seconds @ 70°F (21°C) with No Load	Output Torque Rating lb.-in. (N-m)	
		Voltage 5-/60 Hz	Watts	VA				Minimum	Maximum Stall
				Running	Holding				
				VA	W				
MF41-6343	3/8 to 1/2 in. round or square	24 Vac ± 20%	3.8	7.1	3.6	No	<145	300 (34)	600 (68)

^a Optional AM-753 damper shaft mounting clamps for 5/8 in. square or 3/4 to 1 in. round shafts.

Valve Actuator plus Linkages.

Model No. ^a	Linkage (included)	Voltage 50/60 Hz	Running		Holding VA	SPDT Aux. Switches
			W	VA		
MF41-6343-230	AV-609	24 Vac ± 20%	3.8	7.1	3.6	No

^a Refer to Valve Catalog, F-27384, for correct applications.

Specifications

Inputs

Control signal	SPDT floating control input, triacs (500 mA rated) or 2 SPST contacts.
Power	Refer to Model Chart. All 24 Vac circuits are Class 2.
Connections	24 in. (61 cm) appliance cables. Conduit connector for M20 metric conduit use AM-756 adapter.

Outputs

Motor Type	Brushless DC.
Mechanical	Direction of rotation: CW or CCW rotation is available through reverse mounting. Dual shaft clamp: Direct coupled using a through hole output hub. 3/8 to 1/2 in. round or square shafts standard. Position indicator: Pointer and scale numbered from 0 to 95°. Stroke 93° ± 1°. See Accessories for larger shaft sizes.

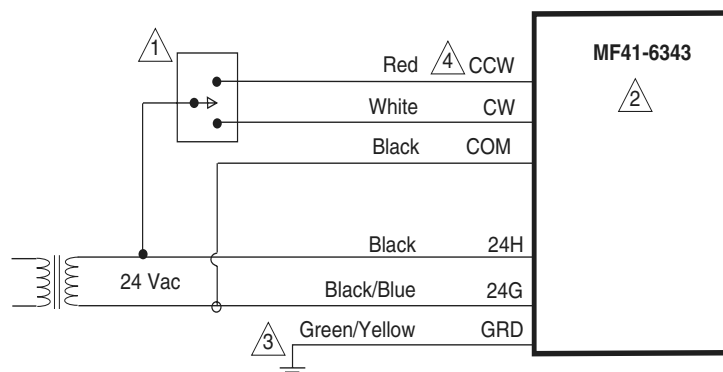
Specifications (Continued)

Environment	
Ambient Temperature limits	Shipping and Storage: -40 to 160°F (-40 to 71°C). Operation: -25 to 140°F (-32 to 60°C).
Humidity	5 to 95% RH, non-condensing.
Locations	NEMA 1, NEMA 4 (IEC IP56) with customer supplied water tight connectors.
Agency Listings	
UL	UL-873, Underwriters Laboratories Listed (File #9429 Category: Temperature-Indicating and Regulating Equipment).
European Community	EMC Directive (89/336/EEC). Low Voltage Directive (72/23/EEC).
CUL	Canadian Standards C22.2 No. 4-93.
Australia	This product meets requirements to bear the C-Tick mark according to the terms specified by the Communications Authority under the Radio Communications Act 1992.
General Instructions	Refer to F-26744.

Accessories

Model No.	Description
AM-674	Weather shield.
AM-676	Universal shaft extension, approximately 9-1/2 in. long (242 mm) for use on 3/8 to 11/16 in. (10 to 17 mm) round shafts, 3/8 to 9/16 in. square shafts. (AM-753 clamps required).
AM-751	Standard anti-rotation bracket 9 in. long x 13/16 in. wide (229 x 21 mm), included with actuator.
AM-752	Optional anti-rotation bracket 4 in. long x 1-11/16 in. wide (102 x 43 mm), for narrow spaces.
AM-753	Damper shaft mounting clamps for 5/8 in. square shaft, 3/4 in. and 1 in. round shafts (two per package).
AM-754	Standard universal mounting clamps for 3/8 to 1/2 in. (10 to 13 mm) round and square shafts, two included with actuator.
AM-755	Manual override crank.
AM-756	Metric conduit adaptor M20 x 1.5 to 1/2 in. NPT (two per package).
AV-609	Valve linkage for VB-9xxx 5 and 6 in.

Typical Applications



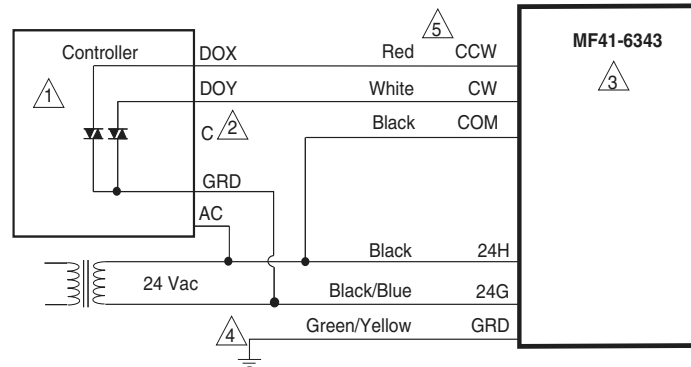
① SPDT Floating or Switch/Controller or 2 SPST.

② Unused conduit port must remain plugged with a water tight pipe plug as shipped from factory to maintain NEMA Type 4 or IP56 rating.

③ Ground wire may be Green on some models.

④ As viewed from Left (L) side.

Figure 1 Typical SPDT Controller Wiring Diagram.



- 1 Triacs switching to 24G.
- 2 Do not connect drive wiring to C terminal of controller.
- 3 Unused conduit port must remain plugged with a water tight pipe plug as shipped from factory to maintain NEMA Type 4 or IP56 rating.
- 4 Ground wire may be Green on some models.
- 5 As viewed from Left (L) side.

Figure 2 Typical Triacs Switching to 24G Wiring Diagram of Actuator.

MF4D-60x3 Series

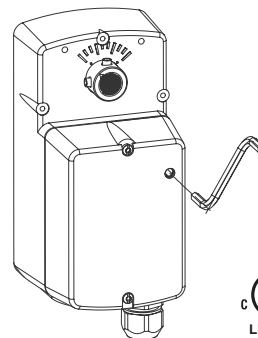
Non-Spring Return EconoDrive™ Floating Actuator

EconoDrive overshaft actuators are designed to provide an economical and reliable solution for many overshaft damper and ball valve requirements. All products accommodate shaft sizes up to 1/2 in. (13 mm) in diameter.

Non-spring return models provide either 35 in-lb (4 N-m) or 70 in-lb (8 N-m) in proportional control.

Features:

- Floating models controlled by SPDT floating controllers.
- Non-spring return models supply 35 in-lb (4 N-m) or 70 in-lb (8 N-m) of torque.
- Polymer housing rated for NEMA 2/IP54 and for plenum use.
- Overload protection throughout stroke.
- Automatically adjust the input span to match the damper/valve travel.
- Compact size to allow installation in limited space.
- Manual override to allow positioning of dampers and valves.
- Directly mounts to 1/2 to 3 in. ball valves.



Model Chart									
Model No.	Torque in-lb (N-m)	Control Signal	Voltage	Wiring System	Actuator Power Input				Approximate Timing ^a in Seconds @ 70°F (21°C)
					Running			Holding	
					50/60 Hz		DC Amps	50/60 Hz	
					VA	W		W	
MF4D-6043-100	35 (4)	Floating	24 VAC +/-20% or 20-30 Vdc	Plenum Cable	4.4	2.7	0.1	1.7	85
MF4D-6083-100	70 (8)				5.9	3.6	0.13	1.6	

^a Timing was measured with no load applied to actuator.

Specifications	
Inputs	
Control signal	Floating.
Power	See Model Chart. All 24 Vac circuits are Class 2. Half wave device.
Connections	10 ft. plenum cables, enclosure accepts 1/2 in. (13 mm) conduit connector. For M20 Metric conduit, use AM-756 adapter.
Outputs	
Electrical	A 2 to 10 Vdc feedback signal can supply up to 0.5 mA to operate up to four additional slave actuators. Timing: See Model Chart.
Mechanical	Travel: 93° nominal. Manual Override: Allows positioning of damper or valve using manual crank.

Specifications (Continued)

Environment	
Ambient temperature limits	Shipping and Storage: -40 to 160°F (-40 to 71°C). Operating: -22 to 140°F (-30 to 60°C).
Humidity	15 to 95% RH, non-condensing.
Locations	NEMA 1, NEMA 2, UL Type 2 (IEC IP54) with customer supplied water tight conduit connectors. Enclosure is air plenum rated.
Agency Listings	
UL 873	Underwriters Laboratories (File #E9429 Category Temperature-Indicating and Regulating Equipment).
CUL	UL Listed for use in Canada by Underwriters Laboratories. Canadian Standards C22.2 No. 24-93.
European Community	EMC Directive (89/336/EEC), Low Voltage Directive (72/23/EEC). This product fits in Installation Category (Overvoltage Category) II per EN 61010-1.
Australia	This product meets requirements to bear the C-Tick Mark according to the terms specified by the Communications Authority under the Radiocommunications Act 1992.
General Instructions	Refer to F-27170.

Accessories

Model No.	Description
AM-714	Weathershield kit.
AM-756	Metric conduit adapter M20 x 1.5 to 1/2 in. NPT.
AM-771	Crank arm and bracket kit.
AM-772	Bracket for reverse mounting.

Typical Applications

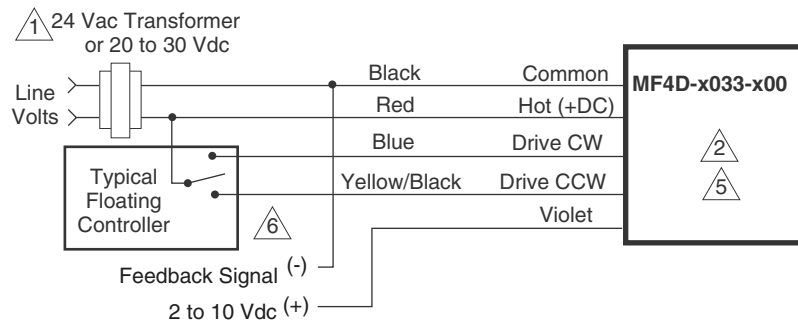


Figure 1 Floating Point Control.

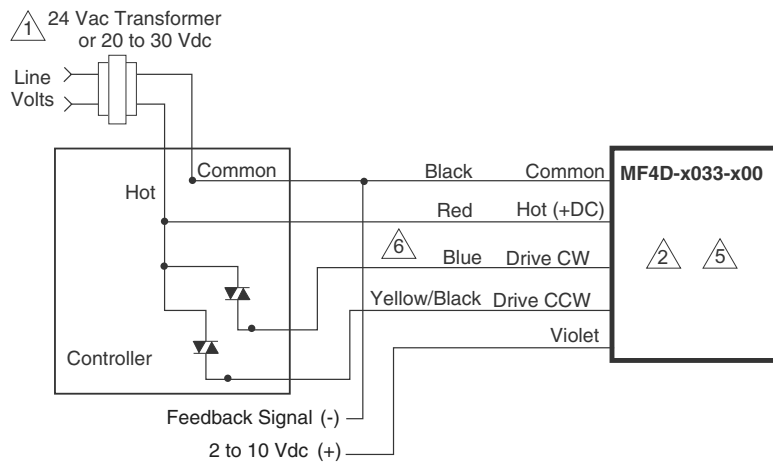


Figure 2 Triac Source.

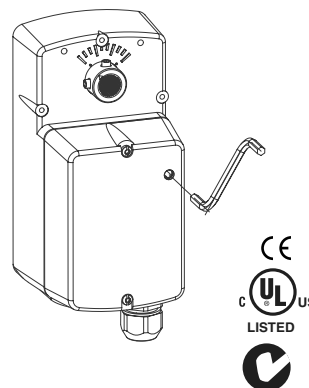
Spring Return EconoDrive™ Floating Actuator

EconoDrive overshaft actuators are designed to provide an economical and reliable solution for many overshaft damper and ball valve requirements. All products accommodate shaft sizes up to 1/2 in. (13 mm) in diameter.

Spring return models provide 30 in-lb (3.4 N-m) of torque.

Features:

- Controlled by SPDT floating controllers.
- 30 in-lb (3.4 N-m) of torque.
- Polymer housing rated for NEMA 2/IP54 rated for plenum use.
- Overload protection throughout stroke.
- Automatically adjust the input span to match the damper/valve travel.
- Compact size to allow installation in limited space.
- Manual override to allow positioning of dampers and valves.
- Directly mounted to 1/2 to 3 in. ball valves.



Model Chart										
Part No.	Rotation	Control Signal	Voltage	Wiring System	Actuator Power Input				Approximate Timing ^a in Sec. @ 70°F (21°C)	
					Running			Holding	Powered	Spring Return (CCW)
					50/60 Hz		DC Amps	50/60 Hz		
					VA	W		W		
MF4D-7033-100	CCW	Floating	24 VAC +/-20% or 20-30 Vdc	Plenum Cable	6.8	4.2	0.15	1.9	85	21
MF4D-8033-100	CW									

^a Timing was measured with no load applied to actuator.

Specifications	
Inputs	
Control signal	Floating.
Power	See Model Chart. All 24 Vac circuits are Class 2. Half wave device.
Connections	10 ft plenum cables, enclosure accepts 1/2 in. (13 mm) conduit connector. For M20 Metric conduit, use AM-756 adapter.
Outputs	
Electrical	Position Feedback Voltage: 2 to 10 Vdc feedback signal. The feedback signal can supply up to 0.5 mA to operate up to four additional slave actuators.
Mechanical	Timing: See Model Chart.
	Travel: 93° nominal.
	Manual Override: Allows positioning of damper or valve using manual crank.

MF4D-x033 Series

Specifications (Continued)

Environment	
Ambient temperature limits	Shipping and Storage: -40 to 160°F (-40 to 71°C). Operating: -22 to 140°F (-30 to 60°C).
Humidity	15 to 95% RH, non-condensing.
Locations	NEMA 1, NEMA 2, UL Type 2 (IEC IP54) with customer supplied water tight conduit connectors. Enclosure is air plenum rated.
Agency Listings	
UL 873	Underwriters Laboratories (File #E9429 Category Temperature-Indicating and Regulating Equipment).
CUL	UL Listed for use in Canada by Underwriters Laboratories. Canadian Standards C22.2 No. 24-93.
European Community	EMC Directive (89/336/EEC). Low Voltage Directive (72/23/EEC). This product fits in Installation Category (Overvoltage Category) II per EN 61010-1.
Australia	This product meets requirements to bear the C-Tick Mark according to the terms specified by the Communications Authority under the Radiocommunications Act 1992.
General Instructions	Refer to F-27170.

Accessories

Model No.	Description
AM-714	Weathershield Kit.
AM-756	Metric conduit adapter M20 x 1.5 to 1/2 in. NPT.
AM-771	Crank arm and bracket kit.
AM-772	Bracket for reverse mounting.

Typical Applications

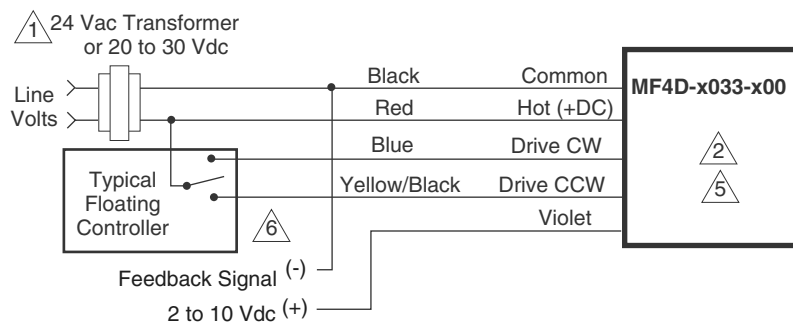


Figure 1 Floating Point Control.

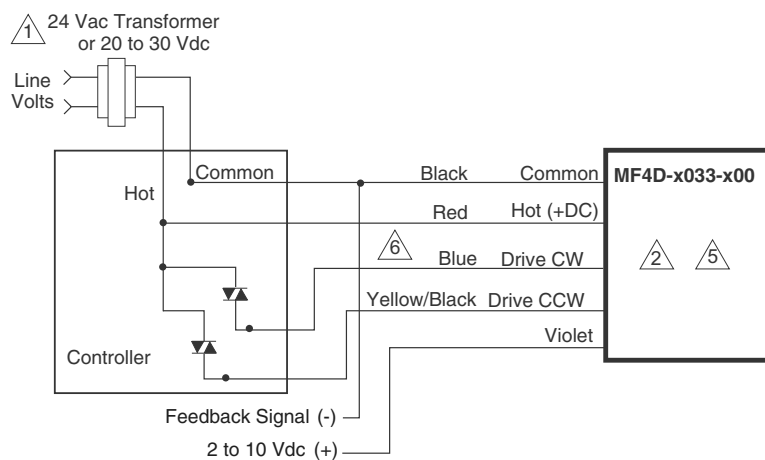


Figure 2 Triac Source.

See notes on next page.

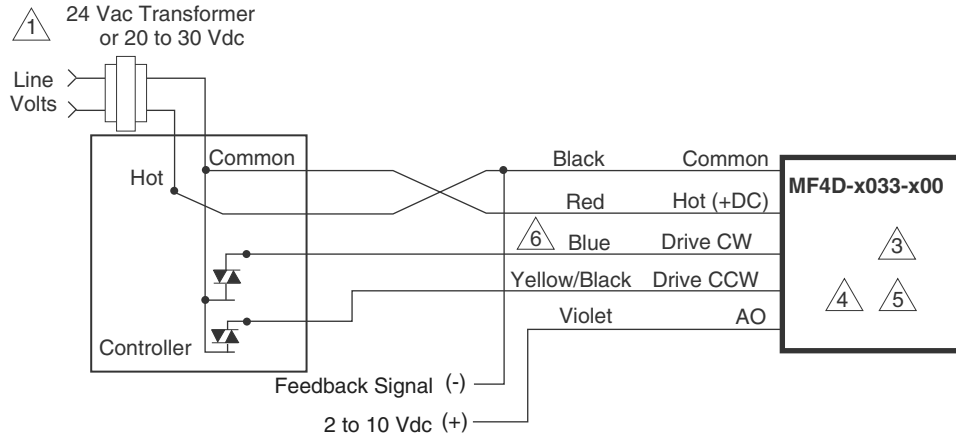


Figure 3 Triac Sink.

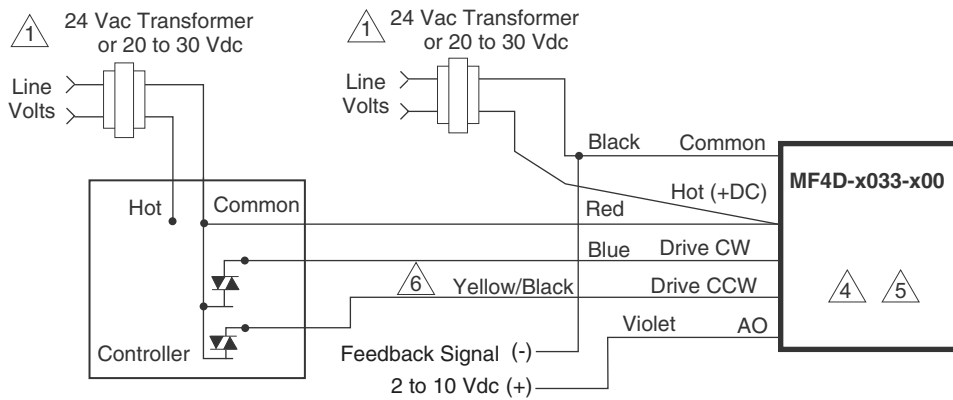


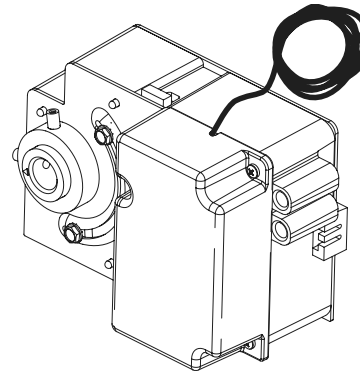
Figure 4 Triac Sink With Separate Transformers.

- 1 Provide overload protection and disconnect as required.
- 2 Actuators may be wired in parallel. All actuator black wires are connected to the transformer Common and all red wires are connected to the Hot lead. Power consumption must be observed.
- 3 The Common connection from the actuator must be connected to the Hot connection of the controller. The actuator Hot must be connected to the controller Common.
- 4 If the controller uses a full-wave power supply and does not provide isolated outputs, a separate transformer is required. See EN206, F-26363.
- 5 Cable on some models contains more wires than are used in applications. Only those wires actually used are shown.
- 6 CW/CCW drive direction is as viewed from the top (removable cover) side.

MF4E-60x3x Series

Non-Spring Return EconoDrive™ Floating Actuator

The MF4E-6043x series 35 lb-in. (3.3 N-m) and MF4E-6083x series 70 lb-in. (6.6 N-m) non-spring return, direct-coupled actuators provide affordable floating control for dampers and rotary valves. They are suitable for use with single pole, double throw (SPDT) floating thermostats or Direct Digital Control (DDC) systems.



Features:

- Visual position indicator.
- Adjustable stroke limit in both clockwise (CW) and counterclockwise (CCW) directions.
- Magnetic coupling prevents overload at any stroke.
- 35 and 70 lb-in. (4 and 8 N-m) torque models.
- Provides 95° rotation (stroke).
- Direct mount on 1/2 in. diameter shafts (3/8 in. shafts with use of an adapter).
- Manual override for free shaft rotation to any position, 0° to 95°.
- Can be mounted in any position.
- Rated for use in plenums.
- Rugged design for extended actuator life.
- Integral strain relief for integral 10 foot plenum rated cable.
- Synchronous motor provides consistent timing.

Model Chart							
Model	Actuator Power Input				Typical Timing in Seconds for 90° Stroke at 70°F (21°C) ^a		Output Torque Rating lb-in. (N-m)
	Voltage	Running		Watts	50 Hz	60 Hz	
		50 Hz	60 Hz				
MF4E-60430-100	24 Vac +20%/-15%	2.0	2.0	2.0	108	90	35 (4)
MF4E-60830-100							70 (8)

^a Timing is measured with no load applied to the actuator.

Specifications

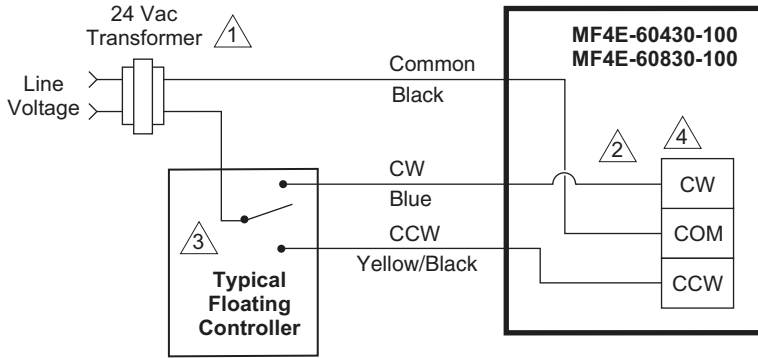
Inputs	
Control signal	Floating control, 24 Vac +20%/-15%.
Power Input	See Model Chart. All 24 Vac circuits are Class 2.
Electrical Connections	10 ft plenum rated cable.
Outputs	
Mechanical	Stroke: 95° ± 3° of rotation. Stroke limit is adjustable 0° to 95° in both clockwise (CW) and counterclockwise (CCW) directions.
	Manual Override: Allows free shaft rotation to any position from 0° to 95°.
	Mounting: Mounts directly onto a 1/2 in. (13 mm) round shaft. Two mounting screws allows mounting onto the shaft in any position. Minimum 2 in. (51 mm) shaft length required. Mounting onto a 3/8 in. (9.5 mm) diameter shaft requires an AM-135 adapter kit.
	Actuator Timing for 90° Stroke: See Model Chart.
	Torque Ratings: See Model Chart.
	Position Indicator: Visual indicator.
Nominal Damper Area: Actuator sizing should be done in accordance with the damper manufacturer's recommendations for the given flow condition.	
Direction of Rotation: Clockwise (CW) or counterclockwise (CCW) rotation.	
Environment	
Ambient temperature limits	Shipping and Storage: -40 to 160°F (-40 to 71°C). Operating: -22 to 140°F (-30 to 60°C).
Humidity	5 to 95% RH, non-condensing.
Locations	NEMA 1 (IEC IP30).
Dimensions	4-5/32 L x 3-17/32 W x 2-3/4 D in. (110 x 90 x 70 mm).
Agency Listings	
UL 873	Underwriters Laboratories (File # E9429) Category Temperature-Indicating and Regulating Equipment. Plenum rated.
CUL	UL Listed for use in Canada by Underwriters Laboratories. Canadian Standards C22.2 No. 24-93.
European Community	EN 61326.
Australia	This product meets requirements to bear the C-Tick Mark.
General Instructions	Refer to F-27108.

Accessories

Model No.	Description
AM-135	3/8 in. (9.5 mm) shaft adapter.
AM-675	Base mounting plate (used with AM-714).
AM-714	Weather shield.
AM-769	Terminal cover guard.

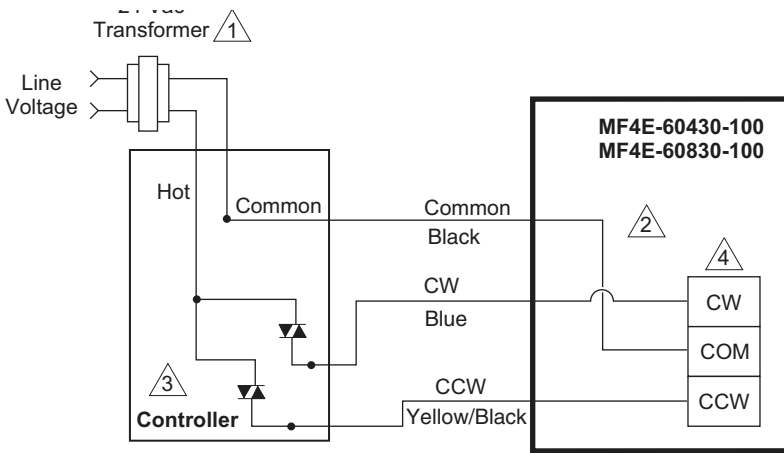
MF4E-60x3x Series

Typical Applications



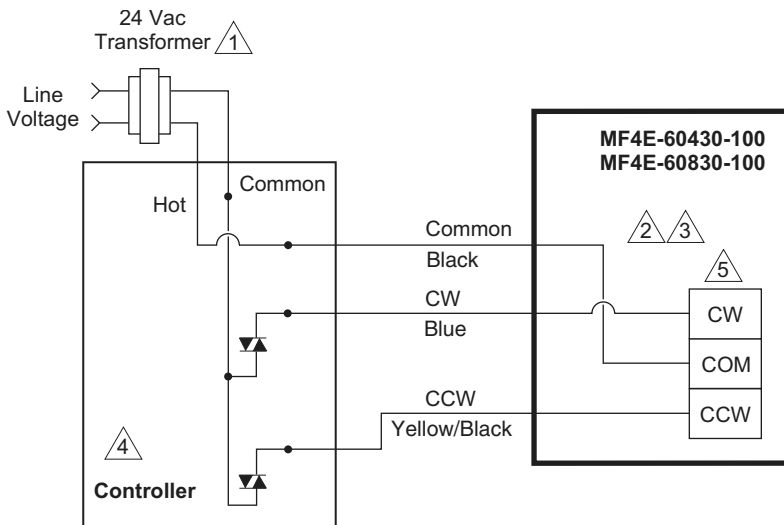
- 1 Provide overload protection and a disconnect as required.
- 2 Actuators may be wired in parallel only if they have the same rotational speed (stroke timing). When doing so, be sure to observe power consumption limits.
- 3 To increase actuator life, design the system with a time-out feature that removes power from the actuator between uses. For example, such a device may stop controller output after powering the actuator in one direction for 3 minutes or more.
- 4 CW/CCW drive direction is as viewed from the top of the actuator.

Figure 1 Floating Point Control Wiring Diagram.



- 1 Provide overload protection and a disconnect as required.
- 2 Actuators may be wired in parallel only if they have the same rotational speed (stroke timing). When doing so, be sure to observe power consumption limits.
- 3 To increase actuator life, design the system with a time-out feature that removes power from the actuator between uses. For example, such a device may stop controller output after powering the actuator in one direction for 3 minutes or more.
- 4 CW/CCW drive direction is as viewed from the top of the actuator.

Figure 2 Triac Source Wiring Diagram.

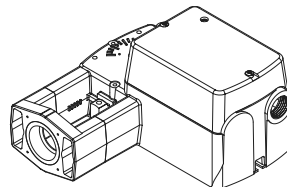


- 1 Provide overload protection and a disconnect as required.
- 2 Actuators may be wired in parallel only if they have the same rotational speed (stroke timing). When doing so, be sure to observe power consumption limits.
- 3 The Common connection from the actuator must be connected to the Hot connection of the controller.
- 4 To increase actuator life, design the system with a time-out feature that removes power from the actuator between uses. For example, such a device may stop controller output after powering the actuator in one direction for 3 minutes or more.
- 5 CW/CCW drive direction is as viewed from the top of the actuator.

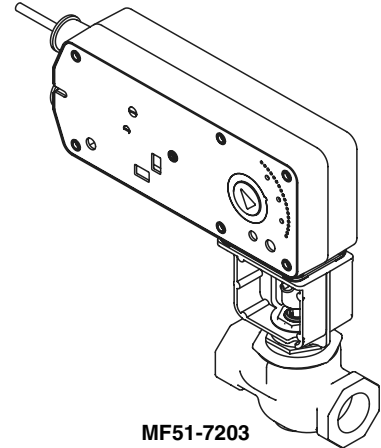
Figure 3 Triac Sink Wiring Diagram.

Spring Return DuraDrive® Floating Actuator

DuraDrive Linear Actuators are designed to mount directly onto two-way or three-way globe valves without the use of linkages. They provide linear travel to operate globe valves from 1/2 to 2 in. VB-7xxx valves and discontinued 1/2 to 1-1/4 in. VB-9xxx valves, 2-12/ to 4-inch VB-9xxx valves, and 2-1/2 to 5-in VB-8xxx valves in chilled water, hot water and steam applications up to 366°F (186°C). Linear spring return actuators provide floating control of valves in HVAC systems.



MF51-7103



MF51-7203



Features:

- Floating models controlled by SPDT floating controllers.
- 105 lbf (467 N) with 1/2 in.(13 mm) nominal linear stroke. 220 lbf (979 N) with 5/8-in. (16 mm) or 1-1/16-in. (27m mm) linear stroke.
- 24 Vac, 120 Vac, and 230 Vac models.
- Rugged die-cast or polymer housings rated for up to NEMA 2/IP54 rated for plenum use.
- Polymer housing rated for plenum use.
- Overload protection throughout stroke.
- Automatically sets input span to match valve travel.
- Compact size to allow installation in limited space.
- Manual override to allow positioning of valve and preload.
- Spring return stem up operation.
- Direct mount to valves without separate linkage.

Model Chart															
Part No.	Control Action	Actuator Power Input							Linear Stroke Inches	Approximate Stroke Timing in Seconds @ 70°F (21°C) ^a		Output Force Rating lb. (Newton)		Valve Size	
		Voltage	Running				DC Amps	Holding		Powered	Spring Return	Min.	Max. Stall		
			50 Hz		60 Hz										50/60 Hz
			VA	W	VA	W									
MF51-7103-000 ^b	Floating	24 Vac ±20% 20-30 Vdc	6.9	4.7	6.9	4.7	0.16	2.1	1/2 in. nominal	60	16	105	215	1/2 to 2 in.	
MF51-7103-100 ^c															
MF51-7203		24 Vac ±20% 22-30 Vdc	9.8	7.7	9.7	7.7	.30	3.3	5/8	<100	<35	220 (979)	495 (2202)	1-1/4 to 2 in. ^d	
MF61-7203		24 Vac ±20% 22-30 Vdc												1-1/16	<190

^a Timing was measured with the actuator mounted on a VB-7xxx Series valve.
^b Appliance wire leads.
^c Plenum wire leads.
^d Current VB-7xxx Series valves and discontinued VB-9xxx Series valves (1-1/4 in. only).
^e Current VB-9xxx Series valves (2-1/2 to 4 in.), current VB-8xxx (2-1/2 to 5 in.) Series valves, and discontinued VB-9xxx (1-1/2 to 2 in.) Series valves.

MF51-7x03 Series, MF61-7203

Specifications

Inputs	
Control signal	See Model Chart for actuator models and control type.
Power	See Model Chart. All 24 Vac circuits are Class 2. All circuits 30 Vac and above are Class 1. Half wave device.
Connections	Models with -0xx have 3 ft. (91 cm) appliance wire connections. Models with -1xx have 3 ft. (91 cm) plenum wire connections. Enclosure accepts 1/2 in. (13 mm) conduit connectors. For M20 Metric connector, use AM-756 adaptor.
Outputs	
Electrical	MF51-7103 only: Position Feedback Voltage: The actuators have a 2 to10 Vdc position feedback signal.
Mechanical	Linear Stroke: MF51-7xxx: 1/2 in. (13 mm) nominal. MF61-7xxx: 1-1/6 in. (27 mm). Approximate Stroke Timing: See Model Chart. Manual Override: Allows positioning of valve and preload using manual crank.
Environment	
Ambient temperature limits	Shipping and Storage: MF51-7103: -40 to 160°F (-40 to 71°C). MF51-720x and MF61-720x: -40 to 180°F (-40 to 82°C) Operating: MF51-7103: -22 to 140°F (-30 to 60°C). MF51-720x and MF61-720x: 0 to 140°F (-18 to 60°C). Temperature Restrictions: For maximum ambient 140°F (60°C) the maximum allowable fluid temperature should not exceed valve rating. See F-27252 Selection Guide for specific ratings.
Humidity	MF51-7xxx: 5 to 95% RH, non-condensing. MF51-720x and MF61-720x: 15 to 95% RH, non-condensing.
Locations	NEMA 1. NEMA 2 (enclosure is air plenum rated), UL Type 2 (IEC IP54) with customer supplied water tight conduit connections.
Dimensions	MF51-71xx: 6-5/16 H x 6-49/64 W x 3-1/2 D in. (160 x 170 x 90 mm). MF51-72xx: 7 H x 10-5/8 W x 2-9/16 D in. (178 x 270 x 65 mm). MF61-72xx: 9-9/16 H x 10-5/8 W x 2-9/16 D in. (243 x 270 x 65 mm).
Agency Listings	
UL 873	Underwriters Laboratories (File #E9429 Category Temperature-Indicating and Regulating Equipment).
CUL	UL Listed for use in Canada by Underwriters Laboratories. Canadian Standards C22-2 No. 24-93
European Community	EMC Directive (89/336/EEC). Low Voltage Directive (72/23/EEC).
Australia	This product meets requirements to bear the C-Tick Mark according to the terms specified by the Communications Authority under the Radio Communications Act 1992.
General Instructions	Refer to F-27169 and F-27120.

Accessories

Model No.	Description
MF51-71xx	
AM-756	Metric conduit adapter M20 x 1.5 to 1/2 in. NPT.
AM-764	Linkage kit for damper applications.
AM-770	Replacement valve linkage parts kit.
MF51-72xx and MF61-72xx	
AM-731	Mounting kit - Mx51-720x (included with actuator).
AM-732	Mounting kit - Mx61-720x (included with actuator).
AM-733	Retro fit kit - discontinued VB-9xxx 1-1/2 to 2 in. valves after 9404 date code.
AM-734	Retro fit kit - discontinued VB-9xxx -1/2 to 2 in. valves prior to 9404 date code.
AM-756	Metric conduit adapter M20 x 1.5 to 1/2 in. NPT.
AM-763	1/8 in. Hex crank for manual override.

Valve Size Chart.

Valve Body Part Number	P Code	Size inches	Close-Off Pressure PSI ^a			Required Retrofit Kit
			MF51-710x	MF51-720x	MF61-720x	
VB-721X-000-4-P VB-7253-000-4-P VB-7273-000-4-P	1, 2,3 or 4	1/2	250			
	5 or 6	3/4	200			
	7 or 8	1	150			
	9	1-1/4	90	150		
	10	1-1/2	60	100		
	11	2	32	65		
VB-722X-000-4-P VB-7263-000-4-P VB-7283-000-4-P	1,2,3 or 4	1/2	250			
	5 or 6	3/4	200			
	7 or 8	1	90			
	9	1-1/4	60	150		
	10	1-1/2	35	100		
	11	2	20	65		
VB-731X-000-4-P	2 or 4	1/2	250			
	6	3/4	200			
	7 or 8	1	90			
	9	1-1/4	60	150		
	10	1-1/2	35	100		
	11	2	20	65		
VB-732X-000-4-P	4	1/2	250			
	6	3/4	250			
	7 or 8	1	250			
	9	1-1/4	250	250		
	10	1-1/2	250	250		
	11	2	250	250		
VB-8213-000-5-P VB-8223-000-5-P	12	2-1/2			125	
	13	3			125	
	14	4			125	
	15	5			125	
VB-8303-000-5-P	12	2-1/2			35	
	13	3			35	
	14	4			35	
	15	5			35	
VB-921X-000-4-P VB-9253-000-4-P VB-9273-000-4-P	1,2,3 or 4	1/2	250			
	5 or 6	3/4	200			
	7 or 8	1	150			
	9	1-1/4	90	150		
	10	1-1/2			100	AM-733 or AM-734 ^b
	11	2			65	AM-733 or AM-734 ^b
VB-922X-000-4-P VB-9263-000-4-P VB-9283-000-4-P	1, 2, 3, or 4	1/2	250			
	5 or 6	3/4	200			
	7 or 8	1	90			
	9	1-1/4	60	150		
	10	1-1/2			100	AM-733 or AM-734 ^b
	11	2			65	AM-733 or AM-734 ^b
VB-931X-000-4-P	2 or 4	1/2	250			
	6	3/4	200			
	7 or 8	1	90			
	9	1-1/4	60	150		
	10	1-1/2			65	AM-733 or AM-734 ^b
	11	2			65	AM-733 or AM-734 ^b
VB-9323-000-4-P	2 or 4	1/2	250			
	6	3/4	250			
	7 or 8	1	250			
	9	1-1/4	250	250		
	10	1-1/2			250	AM-733 or AM-734 ^b
	11	2			250	AM-733 or AM-734 ^b
VB-92X3-000-X-P VB-9313-000-X-P	12	2-1/2			33	
	13	3			22	
	14	4			12	

^a Note: Maximum valve differential operating pressures MUST be observed. Please consult our Valve Products Catalog F-27384 to assure the operating differential for your application is followed.

^b Use AM-733 with valves with date codes after 9404. Use AM-734 with valves with date codes before 9404.

Typical Applications

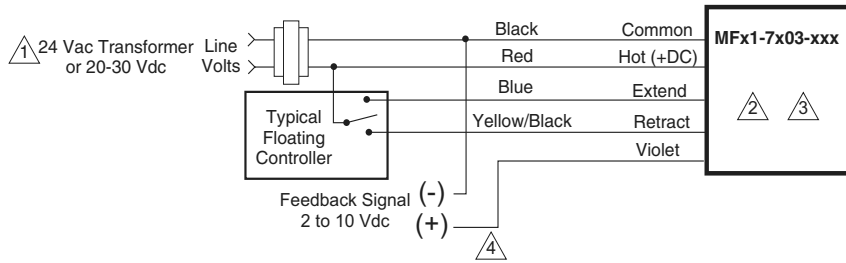


Figure 1 Floating Point Control.

- 1 Provide overload protection and disconnect as required. If controller uses a full wave power supply and does not provide isolated outputs, a separate transformer must be used.
- 2 Actuators may be wired in parallel. All actuator black wires are connected to the transformer common and all red wires are connected to the hot lead. Power consumption must be observed.
- 3 Cable on some models contains more wires than are used in applications. Only those wires actually used are shown.
- 4 Feedback only available on MF51-7103 models.

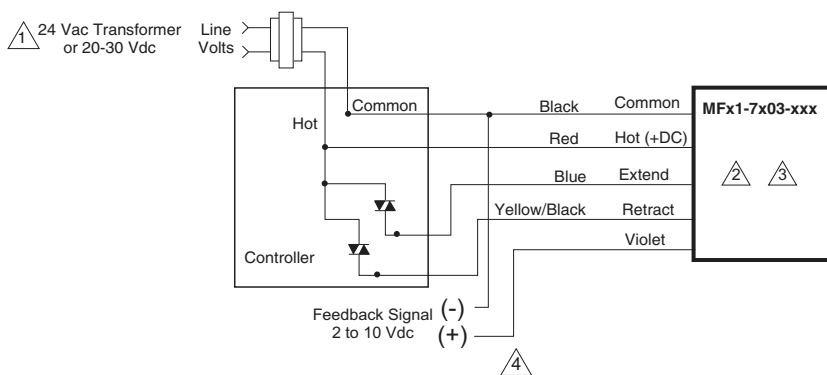


Figure 2 Triac Source.

- 1 Provide overload protection and disconnect as required. If controller uses a full wave power supply and does not provide isolated outputs, a separate transformer must be used.
- 2 Actuators may be wired in parallel. All actuator black wires are connected to the transformer common and all red wires are connected to the hot lead. Power consumption must be observed.
- 3 Cable on some models contains more wires than are used in applications. Only those wires actually used are shown.
- 4 Feedback only available on MF51-7103 models.

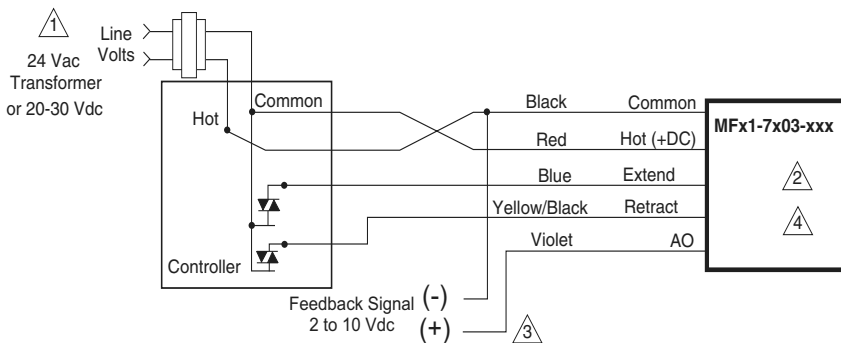


Figure 3 Triac Sink.

- 1 Provide overload protection and disconnect as required. If controller uses a full wave power supply and does not provide isolated outputs, a separate transformer must be used.
- 2 The Common connection from the actuator must be connected to the Hot connection of the controller. The actuator Hot must be connected to the controller Common.
- 3 Feedback only available on MF51-7103 models.
- 4 Cable on some models contains more wires than are used in applications. Only those wires actually used are shown.

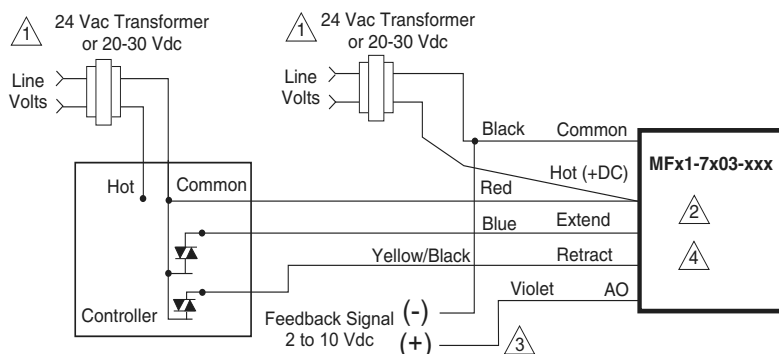


Figure 4 Triac Sink With Separate Transformers.

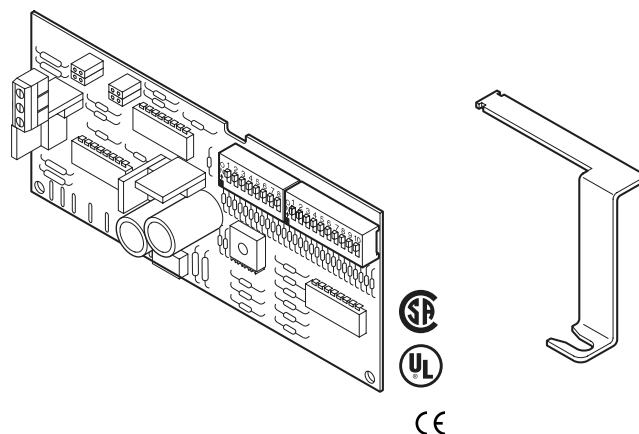
- 1 Provide overload protection and disconnect as required. If controller uses a full wave power supply and does not provide isolated outputs, a separate transformer must be used.
- 2 Actuators may be wired in parallel. All actuator black wires are connected to the transformer common and all red wires are connected to the hot lead. Power consumption must be observed.
- 3 Feedback only available on MF51-7103 models.
- 4 Cable on some models contains more wires than are used in applications. Only those wires actually used are shown.

Control Module Card

This Control Module Card is designed as a plug-in module for the MF-63123 Floating Valve Actuator. The MFC-420 card allows the actuator to accept proportional mA_{dc} signals.

Features:

- Acceptance of all commonly used proportional mA_{dc} input signals.
- Factory set for 4 to 20 mA_{dc} applications.
- Switch selectable control input signal extend point and span for quick, accurate field setup.
- Control module plugs into MF-63123 actuator for quick, easy installation.
- Field selectable 100 Ω or 250 Ω impedance.



Model Chart					
Model No.	Power Input				Actuator Part Number
	Voltage (+20%/-15%)	Hz	Amps	Watts	
MFC-420	24 (Class 2 Power Supply)	50	0.085	1.2	MF-63123
		60	0.080	1.1	MF-63123-500

Specifications

Inputs	
Control signal	Factory setting: 4 to 20 mA _{dc} field configurable reverse or direct acting.
	Maximum input signal: 25 mA _{dc} to maintain specified performance.
	Operating span: 4 to 16 mA _{dc} adjustable by DIP switch.
	Start point: 2 to 16 mA _{dc} adjustable by DIP switch.
	Hysteresis: factory setting, 2.1% of span (16 mA _{dc} control signal input span). Hysteresis is switch selectable using positions 9 and 10 of the 10 position DIP switch.
Power requirements	Impedance: Field selectable to either 100 Ω to 250 Ω (circuit performance is not affected by changing configuration).
	Refer to Model Chart.
Connections	Control module to actuator: Uses the pin connections on the actuator circuit board to interface with control module.
	Field wiring for control signal: Uses the screw terminals on the circuit board and accepts 14 to 20 gage wire.
Outputs	
Electrical	Control module plugs into MF-63123 Actuator.
Timing	Refer to MF-63123 Actuator General Instructions, F-24732."
Environment	
Ambient temperature limits	Shipping and storage: -40 to 160°F (-40 to 71°C). Operating: 0 to 140°F (-17.78 to 60°C).
Humidity	5 to 95% RH, non-condensing.
Locations	NEMA Type 1 (when mounted in MF-63123).
Dimensions	1-7/8 H x 4-9/16 W x 4/5 D in. (47.6 x 115.9 x 20.6 mm).
General Instructions	Refer to F-25125.

MFC-420

Specifications (Continued)

Agency Listings

UL	File E9429 Temperature Indicating and Regulating Equipment.
CUL	Canadian Standard C22.2 #24-93
European Community	EMC Directive (89/336/EEC).

Typical Applications

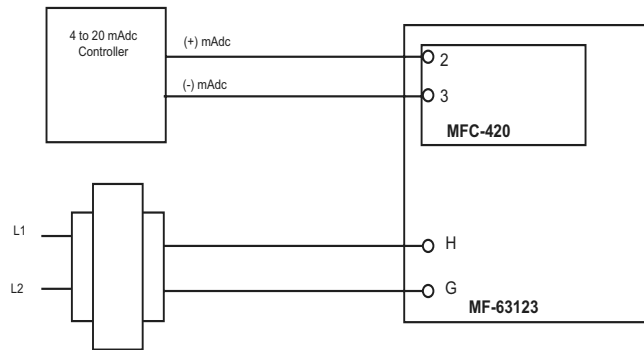


Figure 1 Typical Wiring Diagram for MF-63123 with MFC-420.

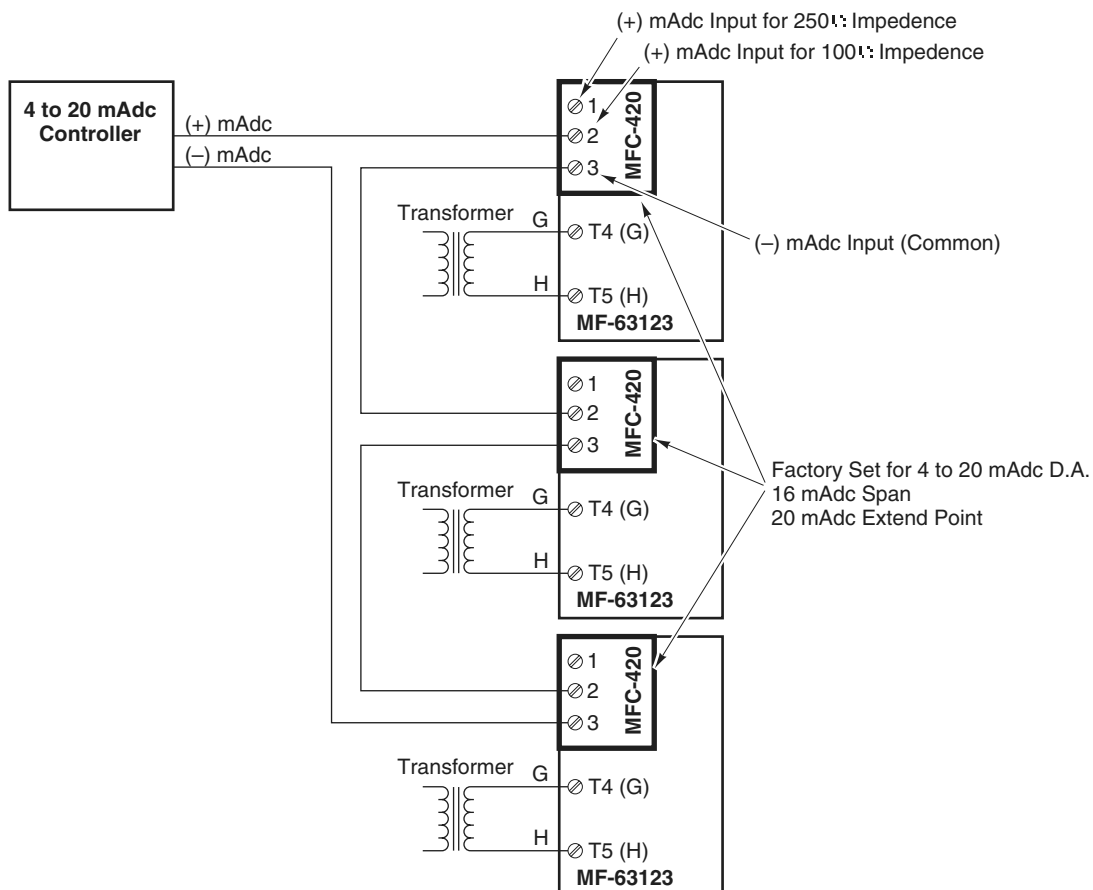


Figure 2 MF-63123 with MFC-420 Wiring for Three Units Operating in Unison.

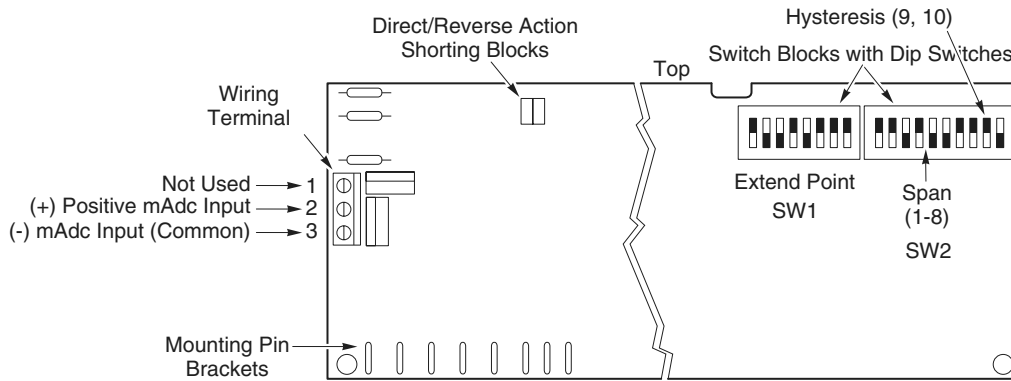
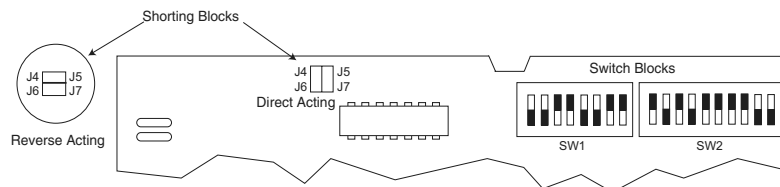


Figure 3 MFC-420 Control Module Switch and Adjustment Locations. Showing Wiring Designations and Typical Factory Settings for Switches and Shorting Blocks.



Note: Extend point is the current required to drive an actuator to fully extended position. This is set at SW1. SW2 switches 1 thru 8 determine span. Switches 9 and 10 set hysteresis.

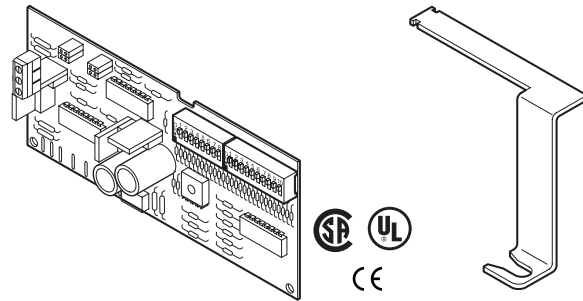
Figure 4 MFC-420 Control Module Shorting Block and Program Switch Block.

Control Module Card

This card acts as a plug-in module for the MF-63123 Floating Valve Actuator. It allows the actuator to accept proportional voltage Vdc signals.

Features:

- Acceptance of all commonly used proportional Vdc input signals (0 to 10 Vdc and 6 to 9 Vdc).
- Factory set at 6 to 9 Vdc for System 8000 applications.
- Switch-selectable control input signal extend point and span for quick, accurate field setup.
- MF-63123 actuator plug-in for quick, easy installation.
- Field-selectable for direct or reverse action, for maximum application flexibility.



Model Chart					
Model No.	Power Input				Actuator Part Number
	Voltage (+20%/ -15%)	Hz	Amps	Watts	
MFC-8000	24 (Class 2 Power Supply)	50	0.085	1.2	MF-63123
		60	0.080	1.1	MF-63123-500

Specifications	
Inputs	
Control signal	Factory setting: 6 to 9 Vdc, field configurable reverse or direct acting.
	Maximum input signal: 22 Vdc to maintain specified performance. 30 Vdc to avoid component damage.
	Operating span: 2 to 10 Vdc adjustable by DIP switch.
	Start point: 0 to 12 Vdc adjustable by DIP switch.
Power required	Hysteresis: Hysteresis switch settings selectable using 9 and 10 of the 10-position DIP switch. Refer to General Instructions. Factory setting: 2.3% of span (3 Vdc control signal input span). Adjustable: hysteresis switch selection settings for control signal input spans. Refer to General Instructions.
	Impedance: Minimum of 10k Ω.
Connections	Refer to Model Chart.
	Control module to actuator: Uses the pin connections on the actuator circuit board to interface with control module.
Outputs	Field wiring for control signal: Uses the screw terminals on the circuit board and accepts 14 to 20 gage wire.
Electrical	Control module plugs into MF-63123 Actuator.
Timing	Refer to MF-63123 Actuator General Instructions, F-24732.
Environment	
Ambient temperature limits	Shipping and storage: -40 to 160°F (-40 to 71°C). Operating: 0 to 140°F (-17.78 to 60°C).
Humidity	5 to 95% RH, non-condensing.
Locations	NEMA Type 1 (When mounted in MF-63123).
Dimensions	1-7/8 H x 4-9/16 L x 4-13/16 D in. (47.6 x 115.9 x 20.6 mm).
General Instructions	Refer to F-25124.

Specifications (Continued)

Agency Listings

UL	File E9429 Temperature Indicating and Regulating Equipment.
CUL	Canadian Standard C22.2 #24-93
European Community	EMC Directive (89/336/EEC).

Typical Applications

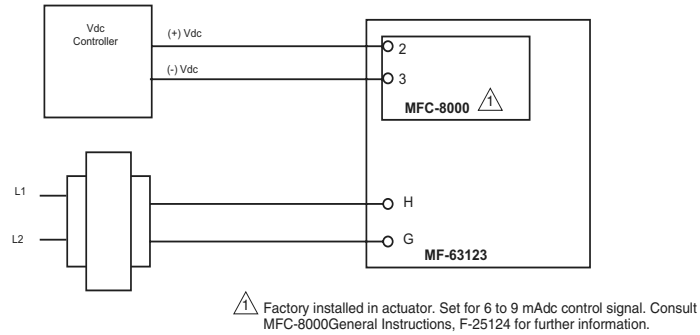
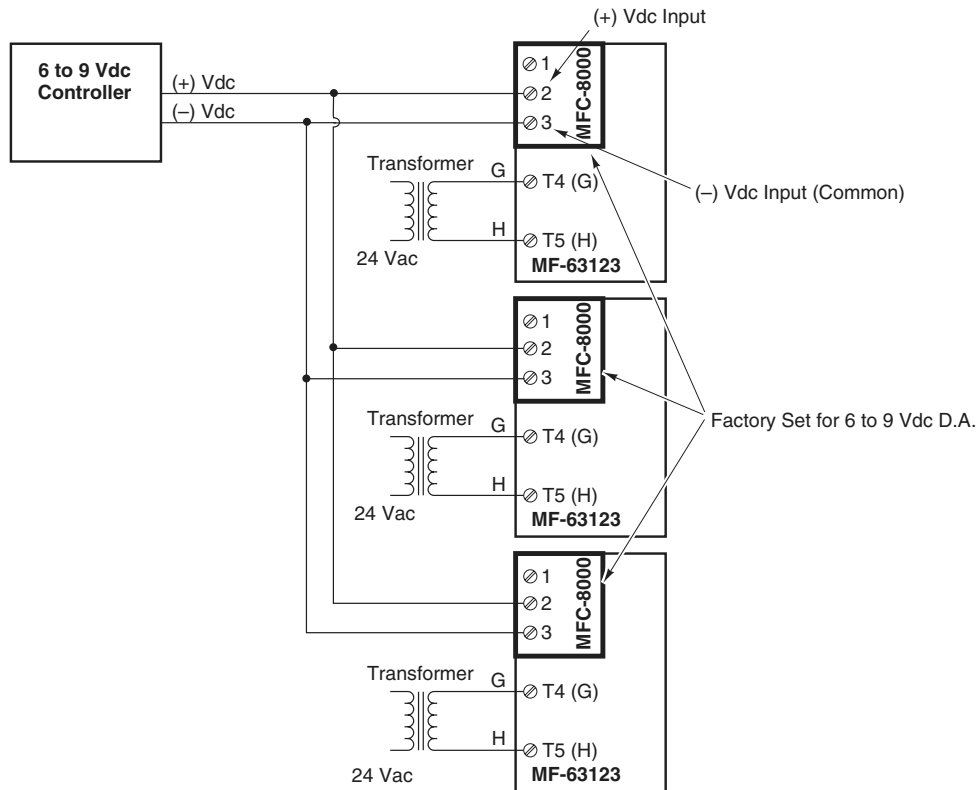


Figure 1 Typical Wiring Diagram for MF-63123 with MFC-8000.



Notes:

1. A separate transformer is required for each actuator.
2. Unison operation of the actuators is shown. Connect the (+) Vdc controller signal to terminal 2 on the MFC-8000.
3. For sequence operation of the actuators, change the span and extend point settings of the MFC-8000. For example, set the span and extend point of actuator #1 for .25 to 3.25 Vdc (.25 Vdc extend point and 3 Vdc span) set span and extend point of actuator #2 for 3.5 to 6.5 Vdc (6.5 extend point and 3 Vdc span) and set span and extend point actuator #3 for 6.75 to 9.75 Vdc (.75 extend point and 3 Vdc span).

Figure 2 MF-63123 and MFC-8000 Wiring for Three Units Operating in Unison and/or Sequence.

MFC-8000

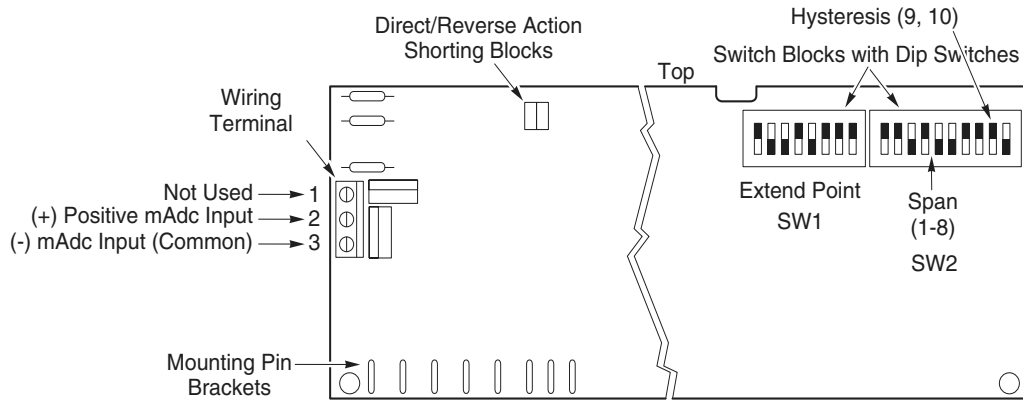


Figure 3 MFC-8000 Control Module Switch and Adjustment Locations Showing Wiring Designations, Typical Factory Switch, and Shorting Block Settings.

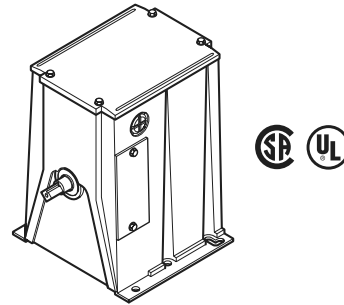
Note: Extend point is the voltage required to drive an actuator to fully extended position. This is set at SW1. SW2 switches 1 thru 8 determine span. SW2 switches set hysteresis (9 and 10).

Electric/Electronic Gear Train Modular Actuators

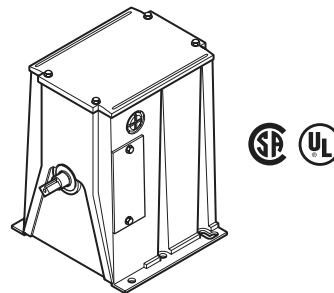
For operation of air control dampers and water valves in HVAC systems. The modular actuators are designed to be used with MMC-Series control modules.

Features:

- 50 lb-in. spring return and 150 lb-in. non-spring return models featuring the Invensys patented load sensing feature.
- All models accept MMC plug-in control module cards for a wide variety of input signals.
- A true universal replacement motor. Fits competitive valve and damper linkages, and auxiliary switch/potentiometer kits.
- UL 94-5V flame-rated housing with heavy duty load bearings and permanent gear train lubrication.
- All models feature an integral NEMA 3R weather resistant enclosure.
- Models available with two auxiliary switches.
- MMR-series actuators replace specific Honeywell and Johnson actuators.
- Optional control modules allow various input signals.



MM-400



MM-500

Model Chart																	
Model No.	Duty Cycle Rating	Motor Power Input				Aux Switch	Shaft Rotation Timing (160° shaft rotation at 75°F (24°C))		Shaft Rotation		Output Torque lb.-in. (N-m)						
		Voltage (+10/-15%)	Hz		VA		Drive Time (Sec.)	Spring Return Time (Sec.)	Energized	Power Loss	Rated	Limit					
MM-400	50%	24 Vac	50	60	23	No	50 (±5)	No spring return	CW or CCW	No action	150 (16.9)	180 (20.3)					
MMR-400						Two											
MM-400-002						No	55 (±5)	42 (±5)	CW	CCW	50 (5.6)	65 (7.3)					
MMR-400-002													Two				
MM-500						50%	24 Vac	50	60	23	No	55 (±5)	42 (±5)	CW	CCW	50 (5.6)	65 (7.3)
MMR-500											Two						
MM-500-002											No	55 (±5)	42 (±5)	CW	CCW	50 (5.6)	65 (7.3)
MMR-500-002																	
MM-500-002	No	55 (±5)	42 (±5)	CW	CCW						50 (5.6)	65 (7.3)					
MMR-500-002													Two				

MM-400 Series, MM-500 Series, MMR-400 Series, MMR-500 Series

Specifications

Optional MMC series control modules

	The MMC series control module determines the control signal (order separately).
Control signal	MMC-90: 135 Ω slidewire.
	MMC-401: TS-5721-102 temperature sensor. The economizer module can only be used with the MM-500 series actuator.
	MMC-420: 4 to 20 mAdc.
	MMC-421: 2 to 20 mAdc.
	MMC-468: Two position SPST or SPDT.
	MMC-8000: 0 to 20 mAdc or 0 to 20 Vdc.
Power req.	24 Vac Class 2 (+10/-15%) 50/60 Hz power supply required.
Connections	Control: 1/4 in. quick-connect (spade lug) terminals.
	Auxiliary switch: Screw terminals.
Modular actuator outputs	
Output shaft	Description: Dual 3/8 in. (9.5 mm) square shafts with 3/64 x 3/16 in. (1.2 x 4.8 mm) keyways and #8-32 1/2 in. (12.7 mm) tapped hole in each end of shaft.
	Rotation: Shaft rotation as viewed from the front of the motor. The front of the motors defined as the left end when facing the auxiliary switches adjustments.
	Nominal Damper Area: Actuator sizing should be done in accordance with damper manufacturer's specifications.
Dead weight load	200 lb. (90.9 kg) either end.
Shaft rotation	Factory set at maximum 160°. Adjustable to 75, 90, or 110°.
Factory setting	Shaft position for shipping is set at the full CCW position.
Environment	
Ambient temperature limits	Shipping and storage: -40 to 160°F (-40 to 71°C).
	Operating: MMR/MM-400/500, -40 to 140°F (-40 to 60°C); MMR/MM-400/500 with AM-231. Transformer Kit, -40 to 130°F (-40 to 54°C).
Humidity	5 to 95% RH, non-condensing.
Vibration	Maximum 1 G in any plane.
Locations	NEMA Type1 when mounted in any position; NEMA 3R when mounted in vertical position up only, AM-232 gasket kit (factory installed) and Appleton ST-50 flexible metal conduit connection with STG-50 gasket field installed.
Construction	Housing: Glass reinforced thermoplastic (PET) UL-94-5V flame rated housing material to meet UL-465 requirements for air plenum mounting, plated steel base. One (1) 1/2 in. conduit knock-out on two sides of housing.
Dimensions	7-1/2 H x 5-9/16 W x 5-5/8 D in. (184 x 141 x 143 mm).
General Instructions	Refer to F-23347.

MM-400 Series, MM-500 Series, MMR-400 Series, MMR-500 Series

Accessories

Model No.	Description
Common	
AD-8961-407	Parallel resistor kit for MM series.
AD-8961-408	W973 interface kit for MM series.
AM-231	Transformer kit (if power voltage is not 24 Vac).
AM-232	Weather resistance kit (factory installed).
AV-632	Adaptor kit (for mounting motor to Honeywell and Johnson valve linkage).
Damper Only	
AM-111	Damper crank arm for 5/16 in. (7.9 mm) damper shaft.
AM-112	Damper crank arm for 3/8 in. (9.5 mm) damper shaft.
AM-113	Damper crank arm for 1/2 in. (12.7 mm) damper shaft.
AM-115	Damper crank arm for 7/16 in. (11.1 mm) damper shaft.
AM-122	Linkage connector, straight type.
AM-123	Damper clip.
AM-125	5/16 (7.9 mm) diameter x 20 in. (508 mm) damper rod.
AM-125-048	5/16 (7.9 mm) diameter x 48 in. (1219 mm) damper rod.
AM-132	Ball joint connector.
AM-230	Motor crank arm.
AM-234	Damper linkage kit.
AM-235	Multiple damper linkage kit.
AM-301	90° angle mounting bracket.
Valve Only	
AV-630	Valve linkage (for mounting to Barber-Colman VB-7xxx and VB-9000 series valves).
TOOLS	
TOOL-16	Cam adjustment wrench (for -002 models only).

MMC Series

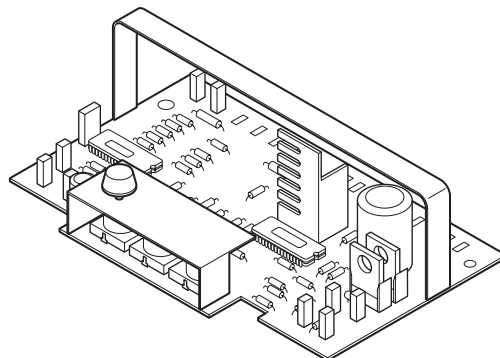
Control Module

For MM, MMR 400 and 500 series actuators.

These plug in control modules are used with the MM-400, MM-500, MMR-400, and MMR-500 Series actuators.

Features:

- Plugs into the MM, and MMR actuators.
- Accepts various control signals.
- Johnson and Honeywell interface models.
- Economizer control models.



Model Chart												
Model No.	Competitor Interface	Control Signals		Adjustments								
		Analog AI	Digital DI	Start Point	Span	Throttling Range	Mix Air Set Point	Minimum Position	Electrical/Mot or Stroke	Complete Application Information		
MMC-90 ^a	Honeywell/Johnson	135 ohm 0 to 7 mA _d c	SPST or SPDT	—	—	—	—	Yes ^b	Yes	F-23350		
MMC-401 ^c		10K Thermistor	Yes			2 to 20 F ^o	40 to 65°F	0 to 50%	No	F-23493		
MMC-420		4 to 20 mA	Yes			—	—	—	Yes	F-23786		
MMC-468 ^a	Honeywell/Johnson	—	SPST or SPDT	Adjustable	2 to 20 mA	—	—	—	No	F-23349		
MMC-421		4 to 20 mA	—						—	—	Yes	F-24160
MMC-8000 ^a	Johnson	4 to 20 mA/ 6 to 9 V _d c	—						2 to 20 mA/ 1 to 20 V _d c	—	—	Yes

^a Refer to Complete Application Information column for details.

^b Remote minimum positioner optional.

^c Economizer Control.

Specifications	
Power requirements	24 Vac +10/-15%, 50/60 Hz, 3.9 VA.
Power supply available	MMC-420 and MMC-8000 only: 20 V _d c ±1 V _d c, 35 mA (regulated and filtered power supply that cannot be paralleled with another supply).
Environment	
Ambient temperature limits	Shipping and storage: -40 to 160°F (-40 to 71°C). Operating: -40 to 140°F (-40 to 60°C).
Humidity	5 to 95% RH, non-condensing.
Locations	Mounted in MM or MMR series of actuators.
Dimensions	1-1/8 H x 3-1/2 W x 2-1/2 D in. (29 x 89 x 64 mm).

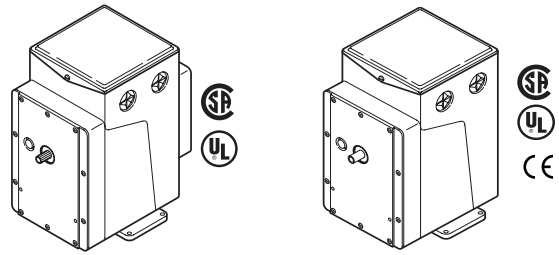
Accessories	
Model No.	Description
AM-236-300	Remote minimum positioner.
TS-5721-102	Thermistor (MMC-401 only).
TC-4115	Outside air thermostat (MMC-401).
THCR-4	Enthalpy controller (MMC-401).

Reversible and Proportional Electric Actuators

The MP Series Actuators are used for two-position, floating, and proportional control of dampers, valves, and program switches in heating, ventilation, and air conditioning applications or similar applications.

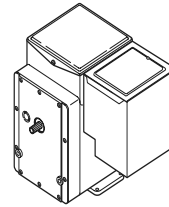
Features:

- Proportional actuators with built-in feedback potentiometers.
- Spring return and non-spring return models available.
- 24 Vac, 120 Vac, and 240 Vac models are available.
- Die cast housings with four 1/2 in. conduit openings.
- Oil-immersed motor and gear train.



Typical Spring Return

Typical Non-Spring Return



Typical -6XX Suffix
(CP-8301-XXX Installed,
CP-9301-XXX or
CP-9302-91X Installed)

Typical -691 or -692 Suffix
(CP-9301-XXX or
CP-9302-91X Installed)

Model Chart

MP-3xx Series.

Model No.	Application	Solid State Drive CP-8301-xxx CP-9301 CP-9302	Power Requirements			Output Shaft				Aux. Switch	Built-in Transformer ^a
			Volts	Hz	Amps	Torque lb.-in. (N-m)	Timing Seconds (No Load)	Degrees of Rotation	Spring Return		
MP-361	Proportional	Available	24	60	2.5	50 (5.6)	90	180 (Adj. ^b)	CW	SPDT	—
MP-361-600 ^c		CP-8301-024 Included									
MP-361-691 ^d		CP-9301 Included									
MP-367	Sequencing	—								SPST	
MP-371	Proportional	Available									
MP-371-600 ^c		CP-8301-024 Included									
MP-371-691 ^d		CP-9301 Included									
MP-377	Sequencing	—			None						
MP-379	Five position	—									
MP-381	Proportional	Available				2.2	220 (24.9)	130 to 1300 (Adj.)	180 (Adj. ^b)	No	
MP-382											
MP-387			Sequencing	None							
MP-389			Five position								
MP5-381	Proportional	Available	50	2.5	130	156	SPDT				

^a Units with a “-2” suffix, e.g. MP-xxxx-xxx-2-x, include a built-in transformer (used for Microtherm or with AE-504) with secondary loads wired externally to terminals seven and eight of the actuator. Red (24 Vac) to terminal eight and Blue (12 Vac) to terminal seven. When these actuators are used with controllers other than Microtherm or AE-504, disconnect the Red and Blue leads and tape off. Note: Models prior to “-2” suffix had transformer wired directly to potentiometer. To disconnect the transformer, remove the back plate of the actuator, disconnect, and tape the transformer leads.

^b Rotation adjustable 45 to 320°. Caution: On actuators with proportional input signals changing the rotation will affect the control, since the internal feedback potentiometer’s travel is fixed.

^c Integral solid state drive CP-8301 accepts 6-9 Vdc voltage with 20 Vdc power supply included.

^d Integral solid state drive CP-9301 accepts 6-9 Vdc voltage.

MP-3xx Series, MP-4xx Series, MP-2xxx Series, and MP-4xxx Series

MP-4xx Series

Model No.	Application	Solid State Drive CP-9301 CP-9302	Power Requirements			Output Shaft				Aux. Switch	Built-in Transformer ^a		
			Volts	Hz	Amps	Torque lb.-in. (N-m)	Timing Seconds (No Load)	Degrees of Rotation	Spring Return				
MP-421	Proportional	Available	120	60	0.65	60 (6.8)	25	180 (Adj. ^b)	No	SPDT	—		
MP-422							25 to 250 (Adj.)						
MP-423							13	90 (Adj. ^b)					
MP-424							13 to 130 (Adj.)						
MP-451						80	180 (Adj. ^b)						
MP-452						80 to 800 (Adj.)							
MP-453						40	90 (Adj. ^b)						
MP-454						40 to 400 (Adj.)							
MP-461-600	refer to footnote ^c	CP-8301-120 Included			120	60	0.5	50 (5.6)	90	180 (Adj. ^b)	CW	None	Yes
MR-461-691		CP-9301											
MP-465	Proportional	Available											
MP-470	Five position	—											
MP-471-600	refer to footnote ^c	CP-8301-120 Included	0.5	50 (5.6)			90	180 (non-Adj.)	CCW	SPDT	—		
MP-471-691		CP-9301 Included											
MP-475	Proportional	Available											
MP-480	Five position	—											
MP-481	Proportional	Available	0.5	50 (5.6)			90	180 (non-Adj.)	CCW	SPDT	—		
MP-481-600	refer to footnote ^c	CP-8301-120 Included											
MP-481-691 ^c		CP-9301 Included											
MP-483	Proportional	Available											
MP-485													
MP-486													
MP-495													
MP5-483			—										
MP-483	Proportional	Available	120	60	0.95	450 (50.9)	130	90 (Adj. ^b)	No	SPDT	Yes		
MP-485												65	
MP-486												130	
MP-495												130 to 1300 (Adj.)	
MP5-483												220 (24.9)	78

^a Units with a "-2" suffix, e.g. MP-xxxx-xxx-2-x, include a built-in transformer (used for Microtherm or with AE-504) with secondary loads wired externally to terminals seven and eight of the actuator. Red (24 Vac) to terminal eight and Blue (12 Vac) to terminal seven. When these actuators are used with controllers other than Microtherm or AE-504, disconnect the Red and Blue leads and tape off. Note: Models prior to "-2" suffix had transformer wired directly to potentiometer. To disconnect the transformer, remove the back plate of the actuator, disconnect, and tape the transformer leads.

^b Rotation adjustable 45 to 320°. Caution: On actuators with proportional input signals changing the rotation will affect the control, since the internal feedback potentiometer's travel is fixed.

^c 6 to 9V proportional.

MP-3xx Series, MP-4xx Series, MP-2xxx Series, and MP-4xxx Series

MP-2xxx Series.

Model No.	Application	Solid State Drive CP-9301 CP-9302	Power Requirements			Output Shaft				Aux. Switch	Built-in Transformer ^a
			Volts	Hz	Amps	Torque lb.-in. (N-m)	Timing Seconds (No Load)	Degrees of Rotation	Spring Return		
MP-2113-500	Proportional	Available	24	60	2.2	50 (5.6)	25	180 (non-Adj.)	No	SPDT	—
MP-2130-500			120		0.5			90 (non-Adj.)			Yes
MP-2150-500			240		0.22			180 (non-Adj.)			
MP-2151-500											

^a Units with a "-2" suffix, e.g. MP-xxxx-xxx-2-x, include a built-in transformer (used for Microtherm or with AE-504) with secondary loads wired externally to terminals seven and eight of the actuator. Red (24 Vac) to terminal eight and Blue (12 Vac) to terminal seven. When these actuators are used with controllers other than Microtherm or AE-504, disconnect the Red and Blue leads and tape off. Note: Models prior to "-2" suffix had transformer wired directly to potentiometer. To disconnect the transformer, remove the back plate of the actuator, disconnect, and tape the transformer leads.

MP-4xxx Series.

Model No.	Application	Solid State Drive CP-9301 CP-9302	Power Requirements			Output Shaft				Aux. Switch	Built-in Transformer ^a
			Volts	Hz	Amps	Torque lb.-in. (N-m)	Timing Seconds (No Load)	Degrees of Rotation	Spring Return		
MP5-4651	Proportional	Available	240	50	0.25	50 (5.6)	108	180 (Adj. ^b)	CW	SPDT	Yes
MP-4701	Five position	—		60			90	180 (non-Adj.)	CCW	None	
MP5-4751	Proportional	Available		50			108				
MP-4851				60		220 (24.9)	130	180 (Adj. ^b)	No	SPDT	
MP5-4851				50		156					

^a Units with a "-2" suffix, e.g. MP-xxxx-xxx-2-x, include a built-in transformer (used for Microtherm or with AE-504) with secondary loads wired externally to terminals seven and eight of the actuator. Red (24 Vac) to terminal eight and Blue (12 Vac) to terminal seven. When these actuators are used with controllers other than Microtherm or AE-504, disconnect the Red and Blue leads and tape off. Note: Models prior to "-2" suffix had transformer wired directly to potentiometer. To disconnect the transformer, remove the back plate of the actuator, disconnect, and tape the transformer leads.

^b Rotation adjustable 45 to 320°. Caution: On actuators with proportional input signals changing the rotation will affect the control, since the internal feedback potentiometer's travel is fixed.

Part Numbers for Hazardous Locations Applications.

Hazardous Locations ^a	Hz	Listing
MP6-4xx	60	UL Listed and CSA Certified
MP7-3xx, MP7-4xx	50	

^a Class 1, Groups C and D, and Class 2, Groups E, F, and G Hazardous Locations; Ref. EN-56-2.

MP-3xx Series, MP-4xx Series, MP-2xxx Series, and MP-4xxx Series

Specifications	
Input Control signals	Refer to the Model Charts for input control signal capability versus specific actuator models.
Floating	Requires one Single Pole Double Throw (SPDT) switch with floating (center off) position rated at 0.9 amps at 24 Vac or two Single Pole Single Throw (SPST) switches rated at 0.9 amps at 24 Vac.
Two-position	SPDT: Requires snap acting switch rated at 0.9 amps at 24 Vac. SPST: Can be used with certain spring return actuators. Switch must be rated to handle actuator power requirements.
Microtherm®	Proportional electrical system with the following typical controllers: PP-22x Series, TP-1xx Series, TP-2xx Series, TP-3xx Series, TP-4xx Series, TP-1xxx Series, and TP-1xxxx Series. Standard: Control of a single actuator. Sequencing: Control of two actuators in sequence. Five-position: Used typically for adjustable minimum position (five positions) of an economizer actuator.
Slidewire and paralleling	Requires AE-504 paralleling relay. AE-504 accepts 100 Ω to 1000 Ω slidewires.
Voltage Vdc (System 8000)	Requires CP-8301-xxx or CP-9301-xxx Series of solid state actuator drives. Refer to the Model Charts.
Current mAdc	Requires CP-9302-xxx Series of solid state actuator drives. Refer to the Model Charts.
Connections	
MP-3xx, 4xx, 2xxx, 4xxx	Coded screw terminals.
Models -600 Suffix	Coded screw terminals except for input signal which are color coded pigtailed.
Power Requirements	Refer to the Model Charts to determine power requirements.
Torque	Refer to the Model Charts to determine the actuator torque rating.
Nominal damper area	Actuator sizing should be done in accordance with damper manufacturer's specifications.
Spring return	Refer to the Model Charts for models that are spring return.
Environment	
Ambient temperature limits	Shipping and storage: -40 to 160°F (-40 to 71°C). Operating: -40 to 136°F (-40 to 58°C).
Humidity	5 to 95% RH, non-condensing.
Locations	NEMA 1. NEMA 4 for non-spring return actuators with AM-363.
Dimensions	
MP-3xx, 4xx, 2xxx, 4xxx	7 H x 5-3/8 W x 6-5/16 D in. (178 x 136 x 160 mm) NSR.
Models -600 Suffix	7 H x 5-3/8 W x 8-1/8 D in. (178 x 136 x 206 mm) SR plus actuator drive housing.
Agency Listings	
UL 873	File E9429 Temperature Indicating and Regulating Equipment.
CUL	Canadian Standard #LR 3728.
European Community	EMC Directive 89/336/EEC and 92/31 EEC. Low voltage Directive 72/23EEC. Units with a "-xxx-x-2" suffix identify models that are in compliance with CE. Example: MP-xxxx-xxx-x-2.
General Instructions	Refer to F-15479.

MP-3xx Series, MP-4xx Series, MP-2xxx Series, and MP-4xxx Series

Accessories

Model No.	Description
Damper linkage accessories	
AM-111	Crank arm for 5/16 in. (7.9 mm) diameter damper shaft.
AM-112	Crank arm for 3/8 in. (9.5 mm) diameter damper shaft.
AM-113	Crank arm for 1/2 in. (12.7 mm) diameter damper shaft.
AM-115	Crank arm for 7/16 in. (11.1 mm) diameter damper shaft.
AM-116	Splined crank arm for actuator.
AM-122	Linkage connector, straight type.
AM-123	Damper clip.
AM-125	5/16 x 20 in. (7.9 mm x 0.5 m) damper rod.
AM-125-048	5/16 x 48 in. (7.9 mm x 1.2 m) damper rod.
AM-132	Ball joint connector.
AM-161	Damper linkage kit.
AM-161-1	Damper linkage kit.
AM-301	90 degree mounting bracket.
Miscellaneous actuator accessories	
AM-321	Two step switch kit.
AM-332	Potentiometer kit.
AM-341	Four step switch kit.
AM-342	Two step switch and potentiometer kit.
AM-363	NEMA 4 gasket kit for non-spring return actuators only.
CP-8301	Electronic drive, voltage input 1 to 20 Vdc.
CP-9301	Electronic drive, voltage input 6 to 9 Vdc.
CP-9302	Electronic drive, voltage input 4 to 20 mAdc.
TOOL-201	Calibration kit for System 8000.
TOOL-209	135 Ω slidewire calibration kit.
Valve linkage for 50 lb.-in. minimum, 180° actuator.	
AV-391	Valve linkage for 1/2 to 2 in. VB-7XXX and 1/2 to 1-1/4 in. discontinued VB-9XXX.
AV-392	Valve linkage for 1-1/2 and 2 in. discontinued VB-9XXX.
AV-395	Valve linkage for 2-1/2 to 4 in. VB-9213 or VB-9313.
Valve linkage for 130 lb.-in. minimum, 180° actuator.	
AV-352	Valve linkage for 2-1/2 to 6 in VB-9213 or VB-9313, 4 to 6 in. VB-9323.
AV-393	Valve linkage for 1/2 to 2 in. VB-7XXX and 1/2 to 1-1/4 in. discontinued VB-9XXX.
AV-394	Valve linkage for 1-1/2 and 2 in. discontinued VB-9XXX.
AV-396	Valve linkage for 2-1/2 to 4 in. VB-9213 or VB-9313.

Typical Applications

- 1 Terminals 1, 5, & 6 are used for built-in auxiliary switch.
- 2 Rotates CW or Lowers Valve Stem.
- 3 Rotates CCW or Raises Valve Stem.
- 4 These terminal are marked L1 & L2 on line voltage actuators.
- 5 Remove green wire to unground actuator.
- 6 SPDT Neutral Off Switch may be used on manual positioning applications.
- 7 Switch control circuit is 0.5 amp at approx. 24 Vac on either low or line voltage actuators.
- 8 Install under cover of actuator.

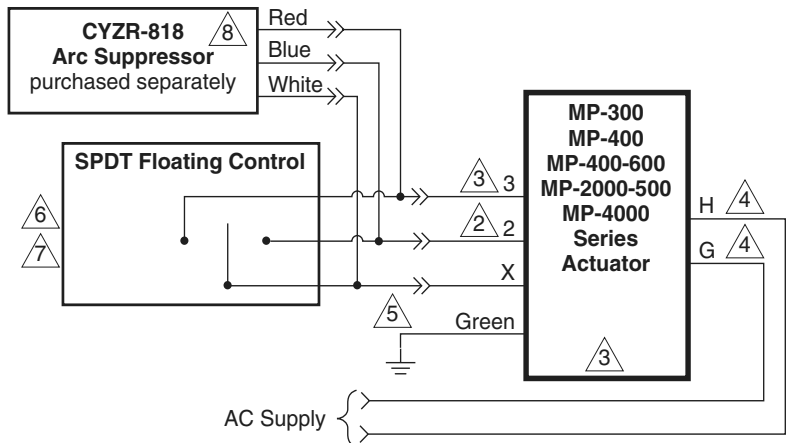


Figure 1 Typical Reversible Floating Wiring.

MP-3xx Series, MP-4xx Series, MP-2xxx Series, and MP-4xxx Series

Max. Amp Rating	120V	240V
Running	5.8	2.9
Locked Rotor	34.8	17.4
Non-inductive	12	6

Terminal Identification: ①, ⑤, ⑥

Cam Action Factory Setting: CCW, CW

Figure 2 Adjustable Auxiliary Switch SPDT.

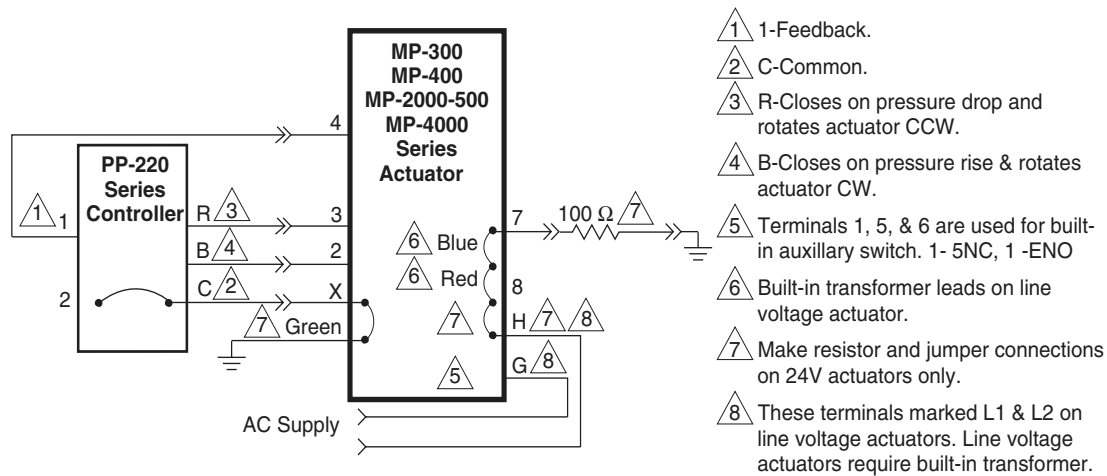


Figure 3 Typical PP-2xx Wiring.

MP-3xx Series, MP-4xx Series, MP-2xxx Series, and MP-4xxx Series

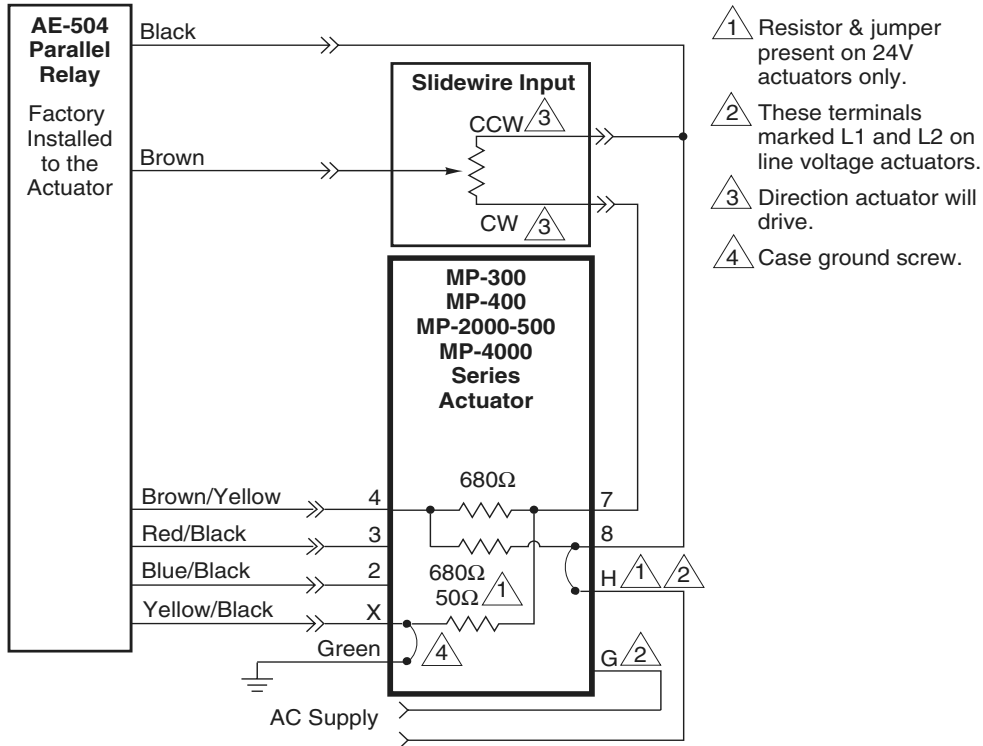


Figure 4 Typical for Proportional Slidewire.

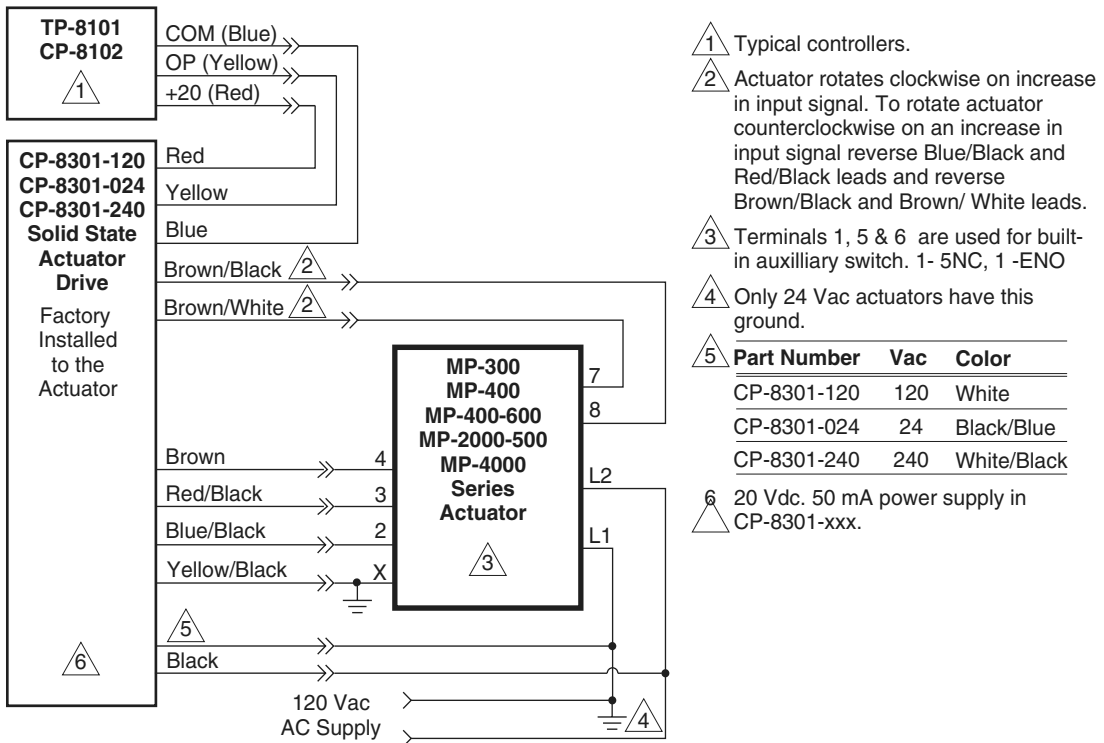


Figure 5 Typical Proportional Electronic — Voltage.
Wiring for MP-461-600, MP-471-600, MP-481-600.

MP-3xx Series, MP-4xx Series, MP-2xxx Series, and MP-4xxx Series

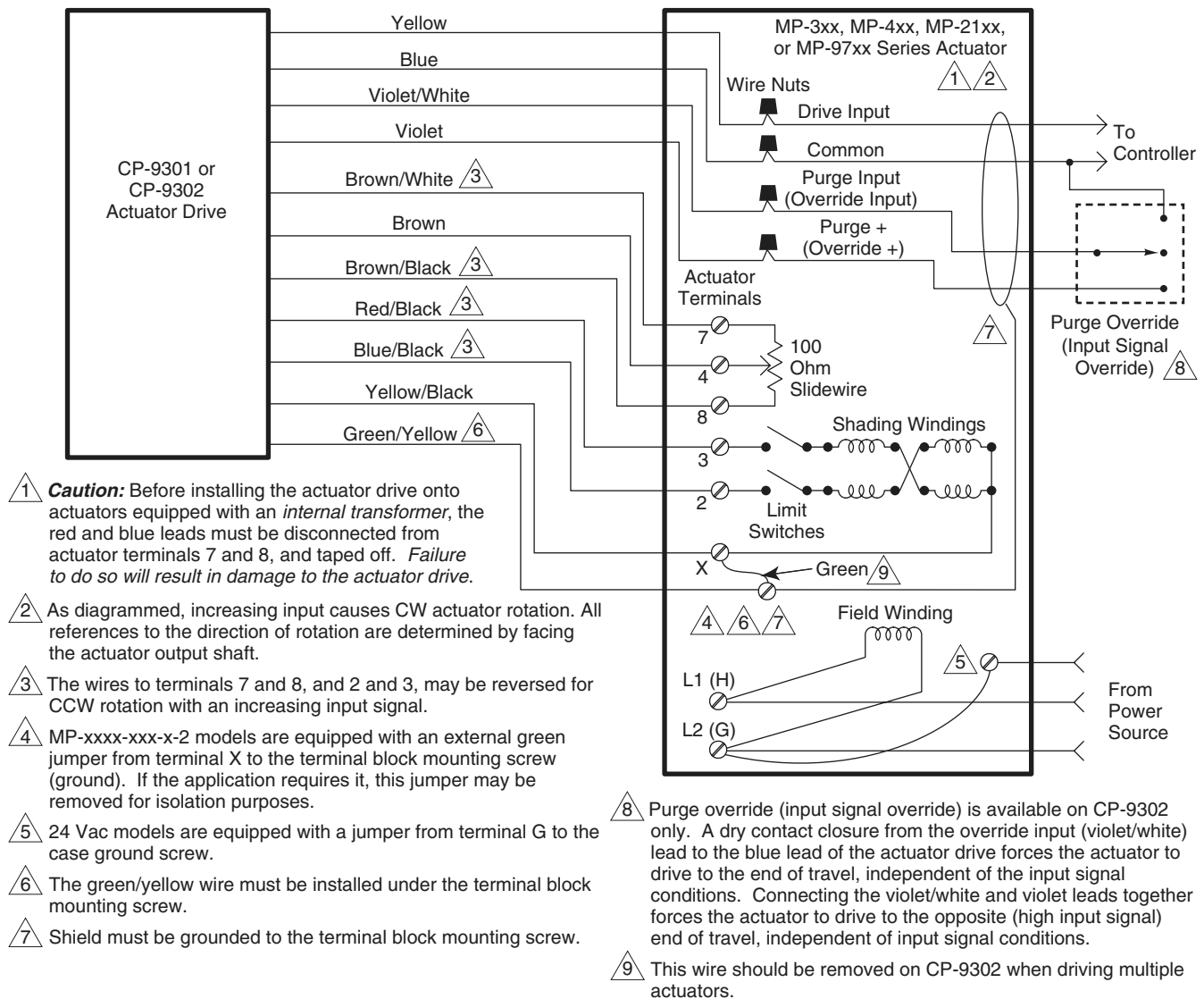


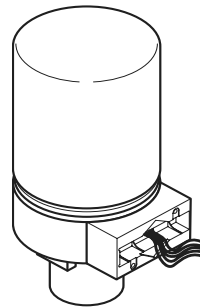
Figure 6 Typical Proportional Electronic - Current/Voltage Wiring for CP-930x to MP-3xx, MP-4xx, and MP-21xxx Series Actuators.

Electronic Hydraulic Actuator

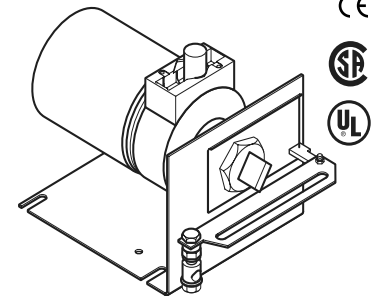
These actuators provide electronic proportional control of dampers, valves, or program switches requiring the return to normal position upon power interruption.

Features:

- Compatibility with 2 to 15 Vdc System 8000 input signals.
- Proportional control by variable Vdc input signal.
- Spring return.
- Fixed 3 Vdc operating span.
- Non-adjustable start point and non-positive positioning. Typically, one actuator is controlled from one Vdc output signal.
- 10,000 Ω or greater input impedance.
- 24, 120, and, 240 Vac models.
- Damper models with linkage or base models requiring separate damper or valve linkage available.
- Die cast lower housing with 1/2 in. (12.7 mm) conduit opening and painted steel upper housing.
- Hydraulic actuator with oil-immersed motor, transducer, and pump.



MP-521X
Valve Actuator



MP-523X
Damper Actuator



Model Chart

Damper Actuators.

Model No.	Actuator Power Input			Timing in Seconds at 72°F (22°C)			Torque Rating lb-in. (N-m)
	Voltage (±10%)	50/60 Hz		No Load Stroke		Retract on Power Loss	
		Watts	VA	To Extend	To Retract		
MP-5230	120	10	18	60	40	15	1.86 (0.21)
MP-5233	24						

Valve Actuators. Also for Damper Actuators with Field Assembled Damper Linkages.

Model No.	Actuator Power Input			10 Amps ^a Aux Switch	Timing in Seconds @ 72°F (22°C)			Required Linkage	
	Voltage (±10%)	50/60 Hz			No Load Stroke		Retract on Power Loss	Damper	Valve
		Watts	VA		To Extend	To Retract			
MP-5210	120	10	18	No	60	40	15	AM-601	AV-600 or AV-7600-1 AV-601 ^b
MP-5210-500				Yes					
MP-5211	240	10	18	No	60	40	15	AM-601	AV-600 or AV-7600-1 AV-601 ^b
MP-5211-500				Yes					
MP-5213	24	10	18	No	60	40	15	AM-601	AV-600 or AV-7600-1 AV-601 ^b
MP-5213-500				Yes					

^a Common of switch in series with AC power supply to the motor. Therefore, the switch must be wired to control the same voltage as the actuator itself.

^b May be required for steam, hot or chilled water. Refer to Maximum Allowable Ambient Air Temperature for Valve Actuators.

MP-52xx Series

Maximum Allowable Ambient Air Temperature for Valve Actuators.

Temperature of Media in the Valve Body (Check the Rating of the Valve) °F (°C)	Maximum Allowable Ambient Air Temperature of MP-52xx Series	
	AV-600 or AV-7600-1 Only for Chilled Water Applications °F (°C)	AV-600 or AV-7600-1 with AV-601 Extension °F (°C)
366 (180)	90 (32)	90 (32)
340 (171)	100 (38)	100 (38)
281 (138)	115 (46)	140 (60)
181 (83)	140 (60)	
80 (26)		

CAUTION: Avoid condensation which can facilitate corrosion. With 40°F (4°C) water, the maximum allowable ambient dew point temperature is 68°F (20°C). Piping insulation must not stop drainage at actuator mounting nut. Do not use hydraulic actuators with fluid temperatures below 40°F (4°C).

Specifications

Actuator inputs

Compatible with	2 to 15 Vdc from System 8000 controllers. Operating span: Approximately 3 Vdc fixed on damper. See F26235-2 for valves. Start point: Approximately 6 Vdc fixed. See F-26235-2 for valves. Impedance: 10,000 Ω or greater.
Power input	Refer to Damper Actuator Model Chart, and Valve Actuator Model Chart.
Connections	Color coded 4 ft. (1.2 m) leads.

Actuator outputs

Electrical	Internal power supply: 20 Vdc, 25 mA. Auxiliary switch (MP-52XX-500): 10 amps, 120/240 Vdc adjustable SPDT, factory set to close N.C. contact at retracted end of stroke.
Mechanical	Stroke, Damper: Approximately 2 in. (51 mm) over a nominal 6 Vdc (fully retracted) to 9 Vdc (fully extended) input range. Includes AM-601 linkage. Stroke, Valve: Approximately 9/16 in. (14 mm) over a nominal 6 Vdc (fully retracted) to 9 Vdc (fully extended) input range. Nominal damper area: Actuator sizing should be done in accordance with damper manufacturer's specifications.

Environment

Ambient temperature limits	Shipping and handling: -40 to 140°F (-40 to 60°C). Operating: -20 to 140°F (-29 to 60°C) for damper actuators. For valve actuators, refer to Maximum Allowable Ambient Air Temperature for Valve Actuators.
Humidity	5 to 95% RH, non-condensing.
Location	NEMA Type 1.
Dimensions	6-3/4 H x 3-1/4 W in. (171 x 83 mm).

Agency Listings

UL	File E9429 Temperature Indicating and Regulating Equipment.
CUL	Canadian Standard C22.2 #24-93.
European Community	EMC Directive 89/336/EEC, Low Voltage Directive 72/23/EEC.
General Instructions	Refer to F-24789.

Accessories

Model No.	Description
Damper Only	
AM-111	Crank arm for 5/16 in. (7.9 mm) diameter damper shaft.
AM-112	Crank arm for 3/8 in. (9.5 mm) diameter damper shaft.
AM-113	Crank arm for 1/2 in. (12.7 mm) diameter damper shaft.
AM-115	Crank arm for 7/16 in. (11.1 mm) diameter damper shaft.
AM-122	Linkage connector straight type.
AM-123	Damper clip.
AM-125	5/16 in. (7.9 mm) diameter x 20 in. (508 mm) damper rod.
AM-125-048	5/16 in. (7.9 mm) diameter x 48 in. (1,219.2 mm) damper rod.
AM-132	Ball joint connector.
AM-161-3	Damper linkage kit.
AM-601	Required to modify valve actuators into 2 in. (50.8 mm) stroke damper actuators. Device includes mounting bracket, damper linkage with spring, and AM-122 straight connector.
AM-602	Spacer.
Valve Only	
AV-600	Valve linkage 1/2 to 2 in. VB-7xxx and discontinued VB-9xxx valves.
AV-601	Valve linkage extension for hot water and steam applications. Use with AV-7600.
AV-7600-1	Valve linkage for VB-7XXX.
TOOLS (factory available)	
TOOL-12	Wrench for adjustment of auxiliary switch.
TOOL-19	Spring compression tool for AV-600.
TOOL-202	Manual positioner.

Typical Applications

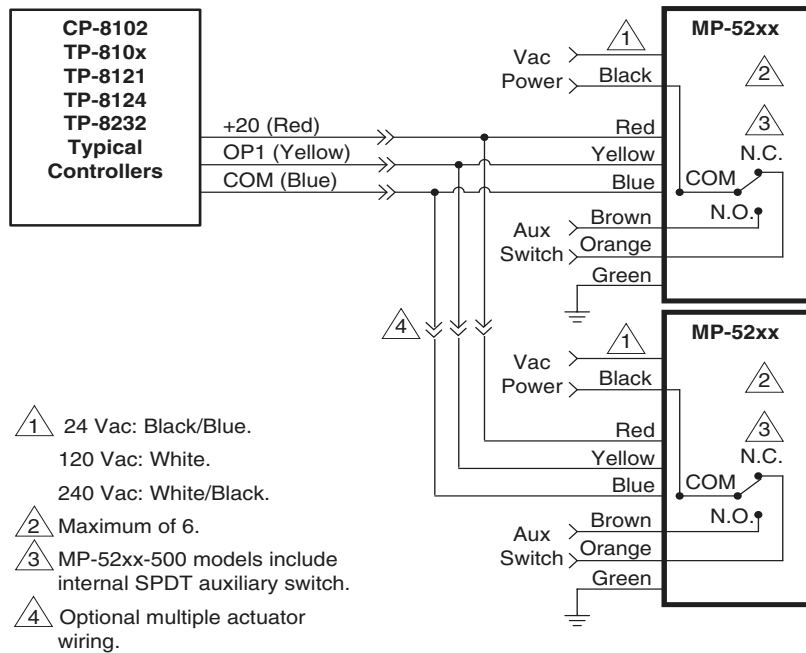


Figure 1 Typical Control Wiring for up to Six MP-52xx Series Actuators to Controllers Requiring External 20 Vdc Power Supply.

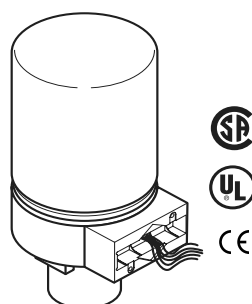
MP-54xx Series

Electronic Positive Positioning Hydraulic Actuator

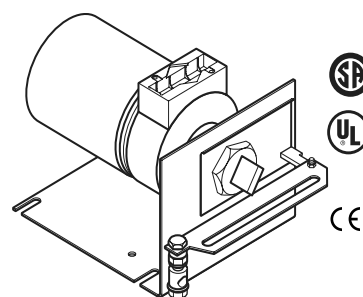
These actuators provide electronic proportional control of dampers, valves, or program switches requiring the return to normal position upon power interruption.

Features:

- Proportional control by variable Vdc input signal.
- Compatibility with 2 to 15 Vdc System 8000 input signals.
- Spring return.
- Fixed 3 Vdc operating span.
- Adjustable 2 to 12 Vdc start point for paralleling or sequencing of actuators.
- 10,000 Ω or greater input impedance.
- 24 Vac, 120 Vac, and 240 Vac models.
- Damper models with linkage or base models that require separate damper or valve linkage.
- Die cast lower housing with 1/2 in. conduit opening and painted steel upper housing.
- Hydraulic actuator with oil immersed motor, transducer, and pump.



MP-5410 Series
Valve Actuator



MP-5430 Series
Damper Actuator

Model Chart

Damper Actuators.

Model No.	Actuator Power Input			Positive Positioner ^a	Timing in Seconds at 72°F (22°C)			Torque Rating lb-in. (N-m)
	AC Voltage +10/-15%	50/60 Hz			No Load Stroke		Retract on Power Loss	
		Watts	VA		To Extend	To Retract		
MP-5430	120	18	10	Yes	60	30	15	15 (1.69)
MP-5433	240							

^a Internal feedback circuitry provides positive positioning of the damper in relation to the controller signal.

Valve Actuators. Also for Damper Actuators with Field Assembled Damper Linkages.

Model No.	Actuator Power Input			Positive Positioner ^a	Timing in Seconds at 72°F (22°C)			Required Linkage	
	AC Voltage +10/-15%	50/60 Hz			No Load Stroke		Retract on Power Loss	Damper	Valve
		Watts	Amps		To Extend	To Retract			
MP-5410	120	18	10	Yes	60	30	15	AM-601 ^b	AV-600 or AV-7600-1 AV-601 ^c
MP-5411	240								
MP-5413	24								

^a Internal feedback circuitry provides positive positioning of valve stem in relation to control signal.

^b With the installation of the AM-601 damper linkage, these valve actuators become functionally the same as the damper actuators listed under Damper Actuators.

^c May be required for steam and hot water. Refer to Maximum Allowable Ambient Temperature for the Valve Actuator.

Maximum Allowable Ambient Air Temperature for Valve Actuators.

Temperature of Media in the Valve Body (Check the Rating of the Valve) °F (°C)	Maximum Allowable Ambient Air Temperature of MP-541x Series	
	AV-600 ^a or AV-7600-1 ^b Only for Chilled Water Applications °F (°C)	AV-600 ^a or AV-7600-1 ^b with AV-601 Extension °F (°C)
366 (180)	Do Not Use	88 (31)
340 (171)		93 (34)
281 (138)		103 (39)
181 (83)		120 (48)
80 (26)	140 (60) ^c	140 (60) ^c

^a For detailed valve linkage installation instructions, refer to AV-600 Hydraulic Actuator Valve Linkage Kit General Instructions, F-26279.

^b For detailed valve linkage installation instructions, refer to AV-7600 Hydraulic Actuator Valve Linkage Kit General Instructions, F-26235.

^c Maximum allowable ambient temperature of the actuator.

CAUTION: Avoid condensation which can facilitate corrosion. With 40°F (4°C) water, the maximum allowable ambient dew point temperature is 68°F (20°C). Piping insulation must not stop drainage at actuator mounting nut. Do not use Hydraulic Actuators with fluid temperatures below 40°F (4°C).

Specifications

Inputs	Compatible with 2 to 15 Vdc from System 8000 controllers.
Operating span	Approximately 3 Vdc fixed.
Start point	Adjustable 2 to 12 Vdc. Factory set at 6 Vdc. Impedance 10,000 Ω or greater.
Power	Refer to Damper Actuators Table and Valve Actuators Table.
Connections	Color-coded 4 ft (1.2 m) leads.
Outputs	
Electrical	Internal Power Supply: 20 Vdc, 25 mA.
Mechanical	Stroke, Damper: Approximately 2 in. (51 mm) over a nominal 6 Vdc (fully retracted) to 9 Vdc (fully extended) input range (includes AM-601 linkage). Stroke, Valve: Approximately 9/16 in. (14 mm) over a nominal 6 Vdc (fully retracted) to 9 Vdc (fully extended) input range. Nominal Damper Area: Actuator sizing should be done in accordance with damper manufacturer's specifications.
Environmental	
Ambient temperature limits	Operating: -20 to 140°F (-29 to 60°C). Damper: -20 to 140°F (-29 to 60°C). Valve: Refer to Maximum Allowable Ambient Air Temperature for Valve Actuators.
Humidity	5 to 95% RH, non-condensing.
Location	NEMA Type 1.
Dimensions	6-3/4 H x 3-23/32 W x 3-1/4 D in. (171 x 18 x 83 mm).
Agency Listings	
UL	UL873 File E9429 Temperature Indicating and Regulating Equipment.
CUL	Canadian Standard (File #LR3728).
European Community	EMC Directive 89/336/EEC, Low Voltage Directive 72/23/EEC.
General Instructions	Refer to F-24788.

MP-54xx Series

Accessories

Model No.	Description
Damper only	
AM-111	Crank arm for 5/16 in. diameter damper shaft.
AM-112	Crank arm for 3/8 in. diameter damper shaft.
AM-113	Crank arm for 1/2 in. diameter damper shaft.
AM-115	Crank arm for 7/16 in. diameter damper shaft.
AM-122	Linkage connector straight type.
AM-123	Damper clip.
AM-125	5/16 in. diameter x 20 in. damper rod.
AM-125-048	5/16 in. diameter x 48 in. damper rod.
AM-132	Ball joint connector.
AM-161-3	Damper linkage kit.
AM-601	Device includes mounting bracket, damper linkage with spring, and AM-122 straight connector. Required to modify actuators into 2 in. (50.8 mm) stroke damper actuators.
Valve only	
AV-600	Valve linkage 1/2 to 2 in. VB-7xxx and discontinued VB-9xxx valves.
AV-601	Valve linkage extension for hot water and steam applications. Use with AV-7600-1.
AV-7600-1	Valve linkage for VB-7xxx.
TOOLS (factory available)	
TOOL-12	Wrench for adjustment of auxiliary switch.
TOOL-19	Spring compression tool for AV-600.
TOOL-37	1-5/8 in. open end wrench.
TOOL-202	Manual positioner.

Typical Applications

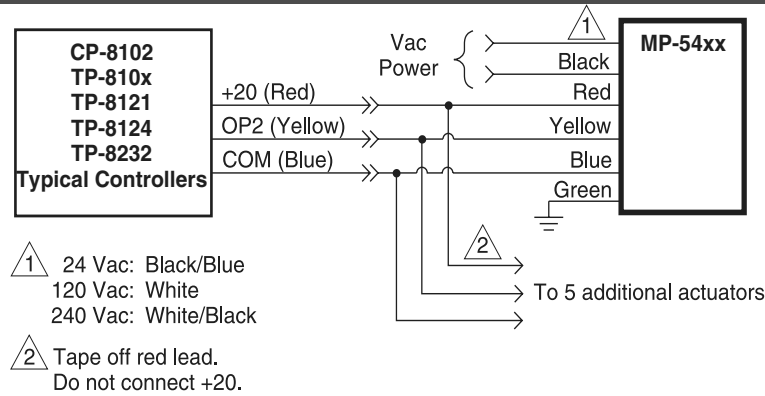


Figure 1 Typical Control Wiring for up to Six MP-54xx Series Actuators to Controllers Requiring External 20 Vdc Power Supply.

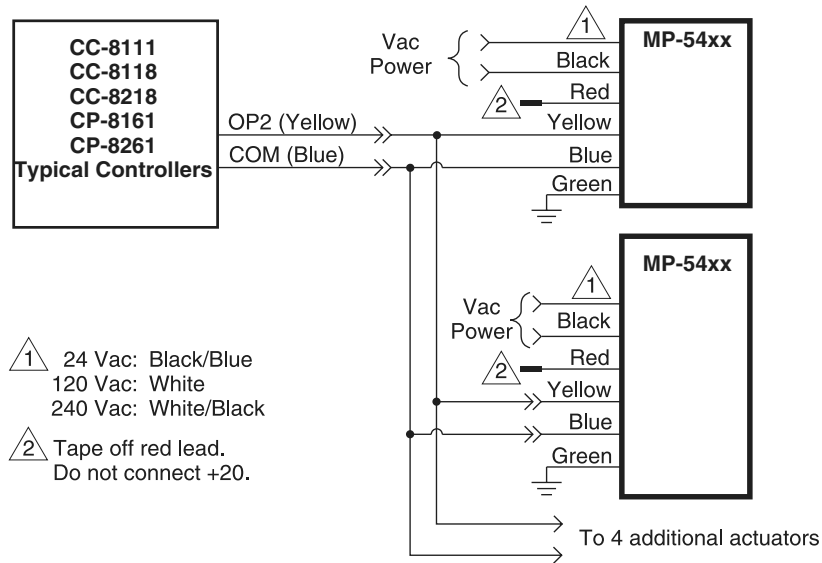


Figure 2 Typical Control Wiring for Up to Six MP-54xx Series Actuators to Controllers Having Internal 20 Vdc Power Supply.

Note:

1. When applied with most DDC controllers, the actuator's 20 Vdc supply (red to blue) is not required.
2. When this actuator is used with a DDC controller, it is important to program the controller's output to provide a minimum control span of 4.5 to 11.5 Vdc to assure full travel to each end of the actuator stroke.

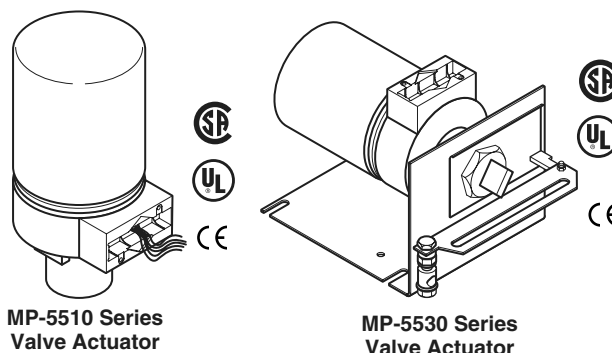
MP-55xx Series

Electronic Positive Positioning Actuator

The MP-5500 Series Actuators are for the electronic proportional control of dampers, valves, or program switches which require the return to normal position upon power interruption. This series is compatible with 0 to 10 Vdc input signals.

Features:

- Proportional actuators controlled by variable Vdc input signal.
- Spring return.
- Fixed 10 Vdc operating span.
- 10,000 ohms or greater input impedance.
- 24 Vac, 120 Vac, and 240 Vac models.
- Available in damper models with linkage or base models that require separate damper or valve linkage.
- Die cast lower housing with 1/2 in. conduit opening and painted steel upper housing.
- Hydraulic actuator with oil-immersed motor, transducer, and pump.



Model Chart

Damper Actuators.

Model No.	Actuator Power Input			Positive Positioner ^a	Timing in Seconds at 72°F (22°C)			Torque Rating lb-in. (N-m)
	AC Voltage +10/-15%	50/60 Hz			No Load Stroke		Retract on Power Loss	
		Watts	VA		To Extend	To Retract		
MP-5530	120	10	18	Yes	60	30	15	15 (1.69)
MP-5533	24							

^a Internal feedback circuitry provides positive positioning of the damper in relation to the controller signal.

Valve Actuators. Also for Damper Actuators with Field Assembled Damper Linkages.

Model No.	Actuator Power Input			Positive Positioner ^a	Timing in Seconds at 72°F (22°C)			Required Linkage	
	AC Voltage +10/-15%	50/60 Hz			No Load Stroke		Retract on Power Loss	Damper	Valve
		Watts	VA		To Extend	To Retract			
MP-5510	120	10	18	Yes	60	30	15	AM-601 ^b	AV-600 or AV-7600-1 AV-601 ^c
MP-5511	240								
MP-5513	24								

^a Internal feedback circuitry provides positive positioning of valve stem in relation to control signal.

^b With the installation of the AM-601 damper linkage, these valve actuators become functionally the same as the damper actuators listed under Damper Actuators. Refer to Damper Actuators for the torque rating.

^c May be required for steam and hot water. Refer to Maximum Allowable Ambient Temperature for the Valve Actuator.

Maximum Allowable Ambient Air Temperature for Valve Actuators.

Temperature of Media in the Valve Body ^a (Check the Rating of the Valve) °F (°C)	Maximum Allowable Ambient Air Temperature of MP-55xx Series	
	AV-600 Only for Chilled Water Applications °F (°C)	AV-600 and AV-601 °F (°C)
366(180)	Do Not Use	88 (31)
340 (171)		93 (34)
281 (138)		103 (39)
181 (83)		120 (48)
80 (26)	140 (60)	140 (60)

^a Maximum allowable ambient temperature of the actuator 140 F (60 C), minimum -20 F (-29 C). Refer to the Valve section for further information.

Specifications

Inputs	Compatible with 0 to 10 Vdc input signals.
Operating span	Approximately 10 Vdc fixed.
Start point	Approximately 0.5 Vdc fixed.
Impedance	10,000 ohms or greater.
Power input	Refer to Damper Actuators Model Chart and Valve Actuators Model Chart.
Connections	Color-coded 4 ft (1.2 m) leads.
Electrical Outputs	Internal Power Supply: 20 Vdc, 25 mA.
Mechanical Outputs	
Stroke	Damper: Approximately 2 in. (51 mm) over a nominal 0 Vdc (fully retracted) to 10 Vdc (fully extended) input range (includes AM-601 linkage). Valve: Approximately 1/2 in. (12.7 mm) over a nominal 0 Vdc (fully retracted) to 10 Vdc (fully extended) input range. With increased input, the actuator continues to extend to a nominal 9/16 inc. (14.3 mm).
Nominal Damper Area	Actuator sizing should be done in accordance with damper manufacturer's specifications.
Environmental	
Ambient temperature limits	Shipping and storage: -40 to 140°F (-40 to 60°C). Operating, Damper: -20 to 140°F (-29 to 60°C). Operating Valve: Refer to Maximum Allowable Ambient Air Temperature for Valve Actuators.
Humidity	5 to 95% RH, non-condensing.
Location	NEMA Type 1.
Dimensions	6-3/4 H x 3-23/32 W x 3-1/4 D in. (171 x 18 x 83 mm).
Agency Listings	
UL 873	File E9429 Temperature Indicating and Regulating Equipment.
CUL	Canadian Standard (File #LR3728)
European Community	MP-5513 and MP-5533 only: EMC Directive 89/336/EEC.
General Instructions	Refer to F-25856.

MP-55xx Series

Accessories

Model No.	Description
Damper only	
AM-111	Crank arm for 5/16 in. diameter damper shaft.
AM-112	Crank arm for 3/8 in. diameter damper shaft.
AM-113	Crank arm for 1/2 in. diameter damper shaft.
AM-115	Crank arm for 7/16 in. diameter damper shaft.
AM-122	Linkage connector straight type.
AM-123	Damper clip.
AM-125	5/16 in. diameter x 20 in. damper rod.
AM-125-048	5/16 in. diameter x 48 in. damper rod.
AM-132	Ball joint connector.
AM-161-3	Damper linkage kit.
AM-601	Device includes mounting bracket, damper linkage with spring, and AM-122 straight connector. Required to modify actuators into 2 in. (50.8 mm) stroke damper actuators.
Valve only	
AV-600	Valve linkage 1/2 to 2 in. VB-7xxx and discontinued VB-9xxx valves.
AV-601	Valve linkage extension for hot water and steam applications. Use with AV-7600.
AV-7600-1	Valve linkage for VB-7XXX.
TOOLS (factory available)	
TOOL-12	Wrench for adjustment of auxiliary switch.
TOOL-19	Spring compression tool for AV-600.
TOOL-37	1-5/8 in. open end wrench.
TOOL-202	Manual positioner.

Typical Applications

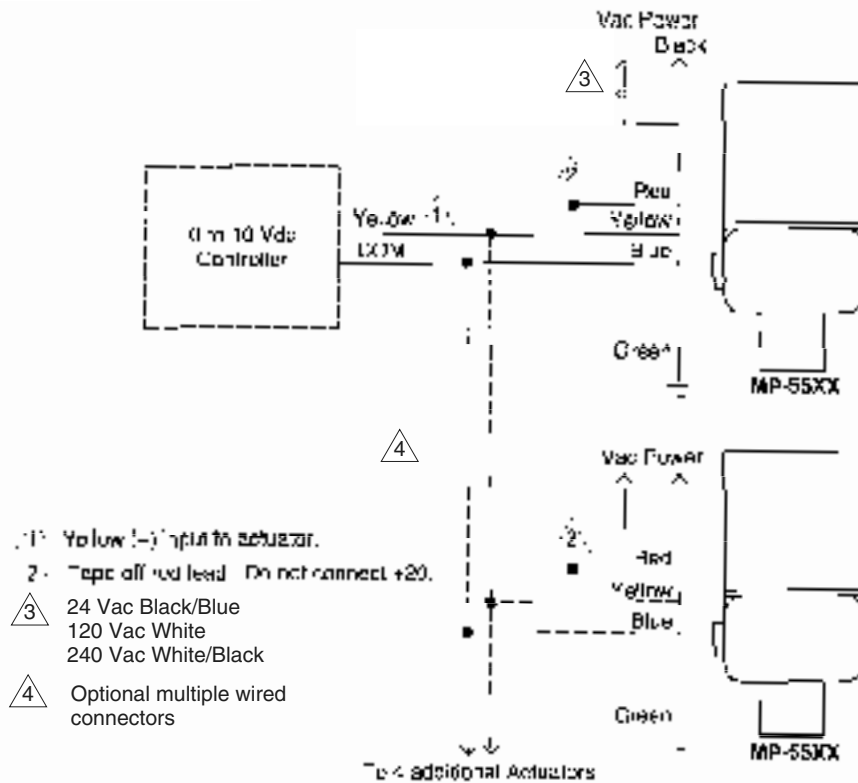


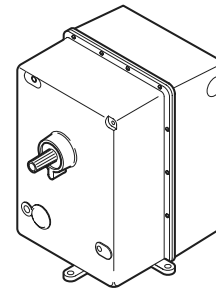
Figure 1 Typical Control Wiring for Up to Six MP-5500 Series Actuators to Controllers That Do Not Require 20 Vdc Power from the Actuator.

Proportional or Floating Actuators

These actuators provide control of heavy dampers, large valves, and other high torque applications in heating, ventilating, air conditioning, and similar applications which do not require return to a normal position.

Features:

- High torque proportional gear train actuators accept the following signals:
 - 100 to 1,000 Ω slidewire (requires AE-504).
 - SPDT floating or snap-acting controller.
 - Variable Vdc .
 - Variable mAdc.
- Torques to 1,600 lb-in.
- Available in 24 and 120 Vac models.
- Standard SPDT auxiliary switch.
- Rugged die cast aluminum housings.
- Oil immersed motor and gear train.



MP-9710 and MP-9750 only

Model Chart							
Model No.	Control		Input	Torque Lb-in. ^a	Timing Sec.	Stroke	Misc.
	Type	Amp Rating					
MP-9713 ^b	1, 2	4.0 at 24 Vac	24 Vac, 60 Hz, 4.0 A	800	135	180°	—
MP-9750 ^b	1, 2	0.9 at 120 Vac	120 Vac, 60 Hz, 0.9 A	800	135	180°	Built-in Trans. ^c
MP-9810	3, 4	1.8 at 120 Vac	120 Vac, 60 Hz, 1.8 A	1300	115	180°	—
MP-9830	3, 4	1.8 at 120 Vac	120 Vac, 60 Hz, 1.8 A	1300	60	90°	—
MP-9910	3, 4	1.8 at 120 Vac	120 Vac, 60 Hz, 1.8 A	1600	145	180°	—

^a 1 lb-in. = 0.113 N-m.

^b UL Listed.

^c Note: MP-9750-xxx-2-x includes a built-in transformer with secondary leads wired externally to terminals 7 and 8 — Red (24 Vac) to 8 and Blue (12 Vac) to 7.

MP-9xxx Series

Actuator Drive Compatibility

Actuators	Actuator Drives Input Type				
	Vdc	Vdc	mA	Vdc/mA	mA/Vdc
Actuator Model	CP-8301-xxx ^a	CP-8391-456 ^a	CP-8391-716 ^a	CP-9301	CP-9302
MP-9610	—	X	X	—	—
MP-9713	X	—	—	X	X
MP-9750	X	X	X	X	X
MP-9810	—	X	X	—	—
MP-9830	—	X	X	—	—
MP-9910	—	X	X	—	—

^a May require close nipple conduit extensions for mounting x-6680.

Specifications

Control circuit	Requires SPDT switch with neutral (floating) or two-position and proportional. Refer to Figure 1 for ratings.
Shaft rotation	Reversible proportional can stop at any point in the stroke.

Specifications (Continued)

Auxiliary switch	Adjustable SPDT snap-acting. Factory set to close one contact and open the other at end of CW stroke. Refer to Figure 1.
Environment	
Ambient temperature limits	Shipping: -40 to 130°F (-40 to 54°C). Operating: -40 to 130°F (-40 to 54°C).
Humidity	5 to 95% RH.
Locations	NEMA Type 1 (NEMA 4 with AM-369).
Connections	Coded screw terminals.
Case	Die cast aluminum with two 1/2 in. conduit knockouts on each side.
Mounting	
Dampers	Upright preferred.
Valves	Upright with actuator above the center line of the valve body.
Dimensions	9-9/16 H x 9-1/2 W x 10-1/2 D in. (243 x 241 x 267 mm).
Agency Listing	MP-9713 and MP-9750 only: UL Listed.
General Instructions	Refer to F-11331.

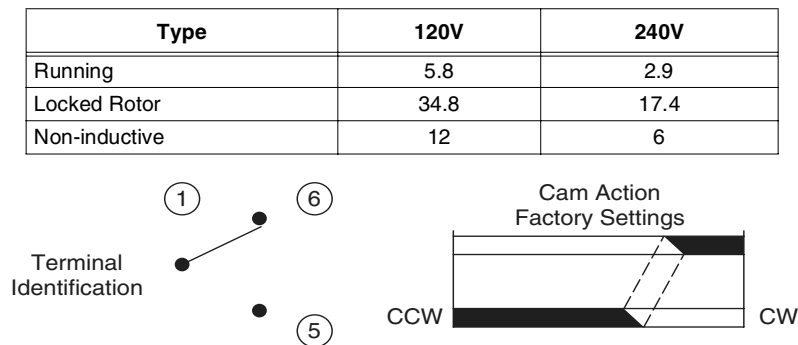


Figure 1 Adjustable Auxiliary Switch SPDT Rating Amps.

Accessories

Model No.	Description
Damper Linkage Accessories	
AE-504	100 to 1000 Ω input actuator drive.
AM-321	Two step switch kit.
AM-332	100 Ω single potentiometer.
AM-341	Four step switch kit.
AM-342	Two step switch and potentiometer kit.
AM-345	Actuator mount, time delay relay for MP-9810, MP-9830 and MP-9910, field modified for panel mounting.
AM-369	NEMA 4 gasket kit. ^a
AM-392	Crank arm for actuator, 1/2 in. slot provides for adjustable radius from 1 in. (25 mm) to 5 in. (127 mm), zinc plated.
AM-394	Connecting link, two (2) 1/2 in. dia. threaded rods with turnbuckle and two (2) 1/2 in. dia. ball joint connectors, adjustable from 15-3/4 to 24-3/4 in.
CYZR-818-3	Arc suppressor.

^a Back cover plate prevents the use of other accessory kits.

Typical Applications

- 1 SPDT Neutral Off Switch may be used on manual positioning applications.
- 2 Switch control circuit is 0.9 amp at approx. 24 Vac on either low or line voltage actuators.
- 3 Terminals 1,5,& 6 are used for built-in auxiliary switch.
- 4 Rotates CW or valve stem down.
- 5 Rotates CCW or valve stem up.
- 6 These terminal are marked L1 & L2 on line voltage actuators.
- 7 External green Jumper from X to case ground on MP-xxxx-xxx-x-2 models only.

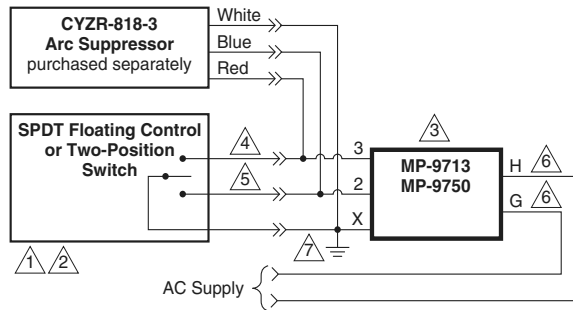
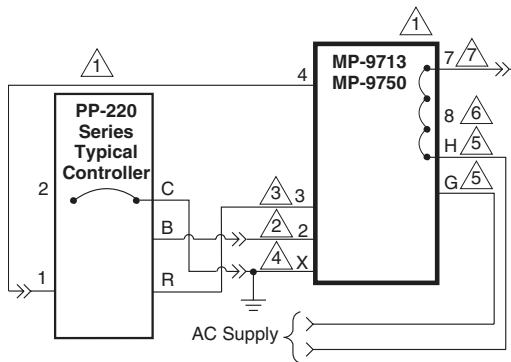


Figure 2 Typical Reversible Floating or Two-Position.



- 1 Terminals 1, 5, & 6 are used for built-in auxiliary switch. R-Closes on pressure drop and rotates actuator CCW. B-Closes on pressure rise & rotates actuator CW. C-Common. 1 -Feedback.
- 2 Rotates CW or valve stem down.
- 3 Rotates CWW or valve stem up.
- 4 External green jumper X to case ground on MP-xxxx-xxx-x-2 Models only.
- 5 These terminals marked L1 & L2 on line voltage actuators. Line voltage actuators require built-in transformer.
- 6 Built-in transformer leads on line voltage actuator.
- 7 Make resistor and jump connection on 24V actuators only.

Figure 3 Typical Proportional Electric.

MP-9xxx Series

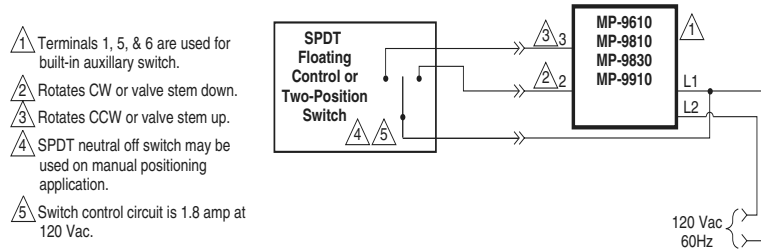


Figure 4 Typical Reversible Floating or Two-Position.

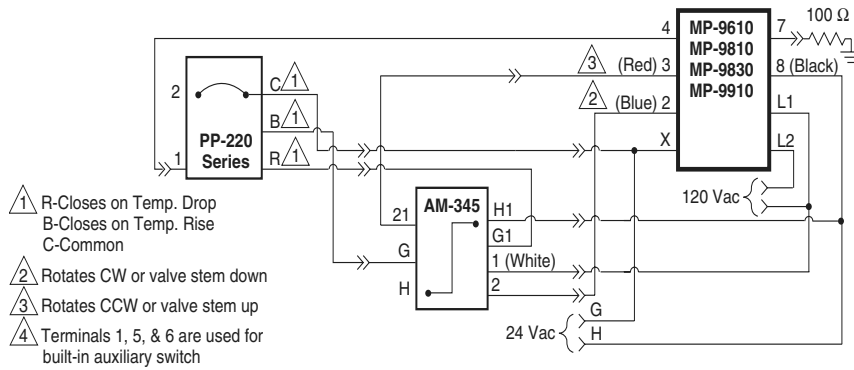


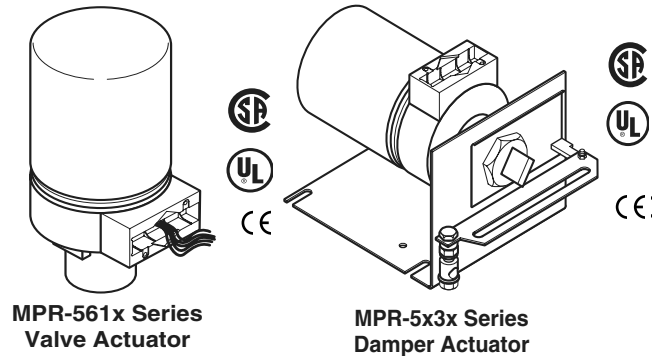
Figure 5 Typical Proportional Electric.

Proportional Actuators

These actuators provide electronic proportional control of dampers and valves requiring return to normal position upon power interruption. They are compatible with controllers generating 4 to 20 mA input signals.

Features:

- Spring return.
- 24, 120, and 240 Vac models available.
- Damper models with linkage or base models requiring separate damper or valve linkage available.
- Die cast lower housing with 1/2 in. conduit opening and painted steel upper housing.
- Hydraulic actuator with oil-immersed motor, transducer, and pump.
- Proportional actuators controlled by a variable mAdc input signal.
- 82.5 Ω input impedance.
- Adjustable actuator startpoint.



Model Chart

Valve (Basic) Actuators.

Model No. ^a	Actuator Power Input		Timing in Seconds @ 72°F (22°C)				Required Linkages		Input Signal
	AC Voltage (±10%)	50/60 Hz		No Load Stroke		Retract on Power Loss	Valve Applications	Damper Applications ^b	
		Watts	VA	Extend	Retract				
MPR-5610	120	10	18	60	30	15	AV-600 AV-601 ^c	AM-601	Compatible with 4 to 20 mA
MPR-5611	240								
MPR-5613	24								

^a These MPR-5x1x series valve actuators are compatible with VB-7xxx 1/2 to 2 in. valve bodies.
^b The MPR-5x1x series actuators are basic models which may be equipped for damper applications with the installation of an AM-601 linkage.
^c May be required for steam and hot water. Refer to General Instructions.

Damper Actuators.

Model No. ^a	Actuator Power Input		Timing in Seconds @ 72°F (22°C)				Input Signal
	AC Voltage (+10/-15%)	50/60 Hz		No Load Stroke		Retract on Power Loss	
		Watts	VA	Extend	Retract		
MPR-5630	120	10	18	60	30	15	Compatible with 4 to 20 mA
MPR-5633	24						

^a Damper models (MPR-5x3x) provided with factory-installed damper linkages. Only base models (MPR-5x1x) require separately ordered linkages.

MPR-5600 Series

Specifications

Actuator inputs

Control circuit	MPR-561x and -563x series: Two-wire. 4 to 20 mA.
Input impedance	82.5 Ω for 40 to 20 mA input.
Power input	Refer to Valve (Basic) Actuators Model Chart and Damper Actuators Model Chart.
Connections	Color coded 4 ft. (1.2 m) leads.

Actuator outputs

Electrical	Position signals: Internal feedback circuitry provides positive positioning of the damper in relation to the controller signal. Startpoint adjustment: Adjustable potentiometer provides manual adjustment of the actuator startpoint.
Mechanical	Stroke damper: Approximately 2 in. (51 mm) from fully retracted to fully extended (includes AM-601 linkage). Valve: Approximately 9/16 in. (14 mm) from fully retracted to fully extended. Nominal damper area: Actuator sizing should be done in accordance with damper manufacturer's specifications. Proportional output torque rating of 15 lb-in. (1.7 N-m), available throughout the entire stroke, based on the lowest force available under normal operation, the spring return stroke, or at a minimum (-10%) supply voltage.

Environment

Ambient temperature limits	Shipping and storage: -40 to 140°F (-40 to 60°C). Damper: -20 to 140°F (-29 to 60°C).
Humidity	5 to 95% RH, non-condensing.
Location	NEMA Type 1.

Dimensions

MPR-5x1x series	6 -3/4 H x 3 -1/4 D in. (171 x 83 mm).
MPR-5x3x series	10 H x 4 -1/4 W x 9 -1/2 D in. (254 x 108 x 241 mm).

Timing in Seconds at 72°F (22°C)

No load stroke	Extend: 60. Retract: 30.
Retract on power loss	15.

Agency Listings

UL 873	Underwriters Laboratories File E9429 Category Temperature-Indicating and Regulating Equipment.
CUL	Certified for use in Canada by Underwriters Laboratories. Canadian Standard C22.2 No. 24-93.
European Community	EMN Directive (89/336/EEC). Low Voltage Directive (72/23/EEC).

General Instructions

	Refer to F-23576.
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Accessories

Model No.	Description
Damper Linkages	
AM-111	Crank arm for 5/16 in. (7.9 mm) diameter damper shaft.
AM-112	Crank arm for 3/8 in. (9.5 mm) diameter damper shaft.
AM-113	Crank arm for 1/2 in. (12.7 mm) diameter damper shaft.
AM-115	Crank arm for 7/16 in. (11.1 mm) diameter damper shaft.
AM-122	Linkage connector straight type.
AM-123	Damper clip.
AM-125	5/16 in. diameter x 20 in. (7.9 x 508 mm) damper rod.
AM-125-048	5/16 in. diameter x 48 in. (7.9 x 1,219 mm) damper rod.
AM-132	Ball joint connector.
AM-161-3	Damper linkage kit.
AM-601	Device includes mounting bracket, damper linkage with spring, and AM-122 straight connector. Required to modify (MPR-5x1x series) valve actuators into 2 in. (51 mm) stroke damper actuators.
AM-602	Spacer.
Valve Linkages and Valves	
AV-600	Valve linkage for 1/2 to 2 in. VB-7xxx and discontinued VB-9xxx valves.
AV-601	Valve linkage extension for hot water and steam applications. Use with AV-7600-1.
AV-7600-1	Valve linkage for VB-7xxx.
Tools (factory available)	
TOOL-19	Spring compression tool for AV-600.
TOOL-209	135 Ω and 0 to 7 mA manual positioner.

Restrictions on Maximum Ambient Temperature for Valve Actuators.

Maximum Temperature of Media in the Valve Body (Check Rating of the Valve) °F (°C)	Maximum Ambient Temperature of MPR-561x and MPR-573x Series.	
	AV-600 (only) °F (°C)	AV-600 and AV-601 °F (°C)
366 (186)	Do Not Use	88 (31) ^a
340 (171)		93 (34)
281 (138)		103 (39) ^b
181 (83)		120 (48) ^b
80 (26)		140 (60) ^b

^a Minimum allowable ambient temperature of the actuators is -20°F (-29°C).

^b Maximum allowable ambient temperature of the actuator must never exceed 140°F (60°C).

Typical Applications

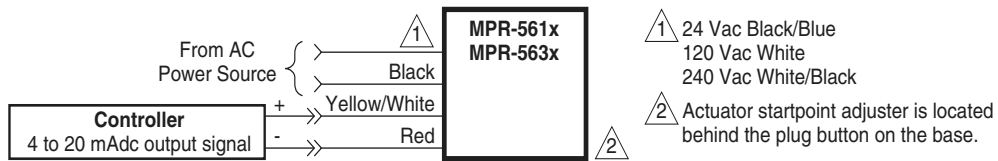


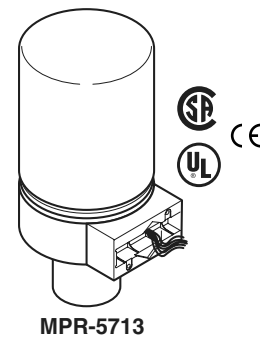
Figure 1 Wiring Diagram 4 to 20 mAdc Controllers.

Proportional Actuators

The MPR-5713 actuator provides electronic proportional control of dampers and valves which require a return to the normal position upon power interruption. The actuator is compatible with 135 ohm slidewire controllers (Series 90).

Features:

- Spring return.
- Available in damper models or base models that require damper or valve linkage.
- Die cast lower housing with 1/2 in. conduit opening and painted steel upper housing.
- Hydraulic actuator with oil-immersed motor, transducer, and pump.
- Proportional actuators controlled by a controller with a 135 ohm slidewire output.



Model Chart									
Model No.	Actuator Power Input			Timing in Seconds at 72°F (22°C)			Required Linkages (Applications)		Input Signal
	AC Voltage (±10%)	50/60 Hz		No Load Stroke		Retract on Power Loss	Valve	Damper ^a	
		Watts	Amps	Extend	Retract				
MPR-5713	24	10	18	60	30	15	AV-7600-1 or AV-600 AV-601 ^b	AM-601	Compatible with 135 Ω Slidewire (Series 90)

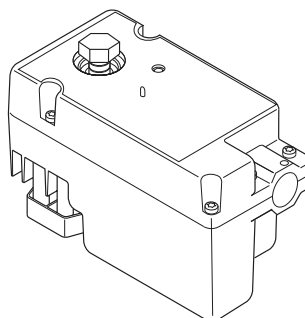
^a The MPR-5713 actuator basic model may be equipped for damper applications with the installation of an AM-601 linkage.

^b May be required for steam and hot water. Refer to "Valve" section in this catalog.

Specifications	
Actuator inputs	
Control circuit	MPR-5713: Three-wire 135 Ω slidewire.
Power input	Refer to Model Chart.
Connections	Color-coded 4 ft. (1.2 m) leads.
Actuator outputs	
Electrical	Position signals: Internal feedback circuitry provides positive positioning of the damper in relation to the controller signal.
Mechanical	Stroke Valve: Approximately 9/16 in. (14 mm) from fully retracted to fully extended. Output torque rating: The proportional output torque rating of 15 lb-in. (1.7 N-m) is available throughout the entire stroke and is based on the lowest force available under normal operation, the spring return stroke, or at a minimum (-10%) supply voltage.
Environment	
Ambient temperature limits	Shipping and storage: -40 to 140°F (-40 to 60°C).
Humidity	5 to 95% RH, non-condensing.
Location	NEMA Type 1.
Dimensions	6-3/4 H x 3-1/4 dia in. (171 x 83 mm).
Agency Listings	
UL 873	Underwriters Laboratories File E9429 Category Temperature-Indicating and Regulating Equipment.
CUL	Certified for use in Canada by Underwriters Laboratories. Canadian Standard C22.2 No. 24-93.
European Community	EMN Directive (89/336/EEC). Low Voltage Directive (72/23/EEC).
General Instructions	Refer to F-23576.

Proportional Valve Actuator

The MS-22353 proportional valve actuator is a non-spring return actuator used with proportional 2 to 10 Vdc or 4 to 20 mA controllers and 1/2 to 1-1/4 in. two-way and three-way globe valve bodies for control of heating and cooling coils. Typical applications include VAV terminals with reheat coils, fan coil units, and unit ventilators.



Features:

- Proportional non-spring return actuator controlled by 2 to 10 Vdc or 4 to 20 mA.
- 45 pounds (200 newtons) of output force with automatic load limit for self-adjusting travel and long motor life.
- Synchronous motor for consistent timing.
- Manual override with automatic release.
- 2 to 10 Vdc actuator position feedback signal.
- Integral linkage for all standard 1/2 to 1 1/4 in. two-way stem-up open and three-way valve bodies for a wide variety of applications.
- Compact size for application flexibility.
- Rugged construction with die cast housing.
- 100% input impedance for the 4 to 20 mA input.

Model Chart

Model No.	Application	Actuator Power Input			Feedback	Typical Timing in Sec. @ 75°F for 1/2" Stroke		Max. Stroke in in. (mm)	
		Voltage (+20%, -15%)	Hz	VA		2 to 10 Vdc ^a	60 Hz		50Hz
MS-22353	Chilled/Hot Water/Steam ^b	24 (Class 2 Power Supply)	50	60	4	Yes	126	151	9/16 (14.3)

^a Running or manually adjusting the actuator before it is mounted to a valve changes the potentiometer setting and could also cause damage.

^b Refer to "Restrictions on Ambient Temperature for Valve Actuators," for maximum allowable temperature.

Specifications

Inputs

Control Signal	2 to 10 Vdc or 4 to 20 mA: Proportional control signals (fixed span and start point). Input Impedance: 100KΩ minimum for voltage input. 100Ω for current input.
Power	Refer to Model Chart.
Connections	4 foot (1.2 M) color coded 18 AWG, plenum cable rated for UL.

Outputs

Position feedback signal	2 to 10 Vdc non-adjustable. Connections: 4 foot (1.2 m) color coded 18 AWG, plenum cable rated for UL.
Mechanical	Force: 45 pounds (200 N) minimum with automatic load limit. Stroke: Up to 9/16 in. (14.3 mm) maximum, self-adjusting. Timing: Refer to Model Chart.
Manual Operator	Allows actuator to be manually set at any position upon loss of power. Releases automatically when power is restored.

Specifications (Continued)

Environment

Ambient temperature limits	Shipping and storage: -40 to 160°F (-40 to 71°C). Operating: Minimum 40°F (4°C). Refer to "Restrictions on Ambient Temperature for Valve Actuators" for maximum temperatures.
Fluid Temperature Limits	Refer to "Restrictions on Ambient Temperature for Valve Actuators."
Humidity	5 to 95% RH, non-condensing. Refer to "Restrictions on Ambient Temperature for Valve Actuators" for dew point temperature.
Locations	NEMA Type 1.
Enclosure Protection Class	Designed to meet IP31 Class, according to EN 60529, BS EN 60529.
Agency Listings	
UL 873	Underwriters Laboratories Listed (File # E9429 Category Temperature-Indicating and Regulating Equipment).
CUL	Certified for use in Canada by Underwriters Laboratories. Canadian Standard C22.2 No. 24-93.
European Community	EMC Directive (89/336/EEC). Low Voltage Directive (72/23/EEC).
Dimensions	3-5/16 H x 3 W x 5-9/16 D in. (84 x 76 x 141 mm).
General Instructions	Refer to F-26263.

Restrictions on Ambient Temperature for Valve Actuators.

Model No.	Temperature of Media in the Valve Body (Check Rating of the Valve)		Maximum Actuator Ambient Temperature	Dew Point Temperature ^a
	Minimum	Maximum		
MS-22353	40°F (4°C)	281°F (138°C)	115°F (46°C)	88°F Dew Point maximum with 40°F fluid (31°C Dew Point maximum with 4°C fluid) ^b
		220°F (104°C)	140°F (60°C)	

^a Dew point temperature applies only to chilled water applications.

^b The dew point temperature cannot be more than 48°F (26.7°C) above the fluid temperature.

Accessories

Model No.	Description
AV-642	Four-way valve linkage kit for Controlli valve bodies.
AV-644	Valve linkage kit (included with MS-22353 actuator).
FRAC-255	Metric male 20 mm conduit fitting (m20 x 1.5 - 8g) 11 mm nominal thread length.
FRAC-259	MF-20000/MS-20000 male conduit fitting.

Typical Applications

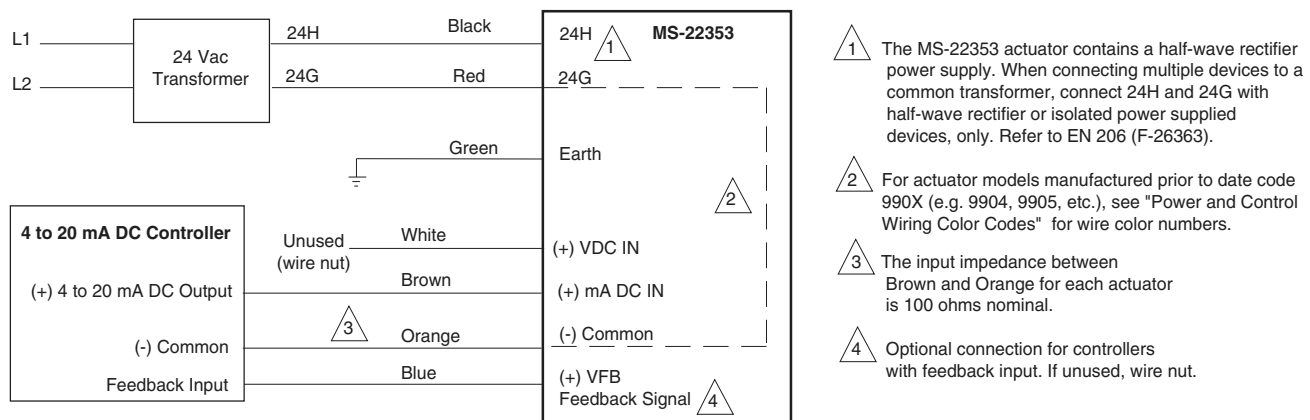
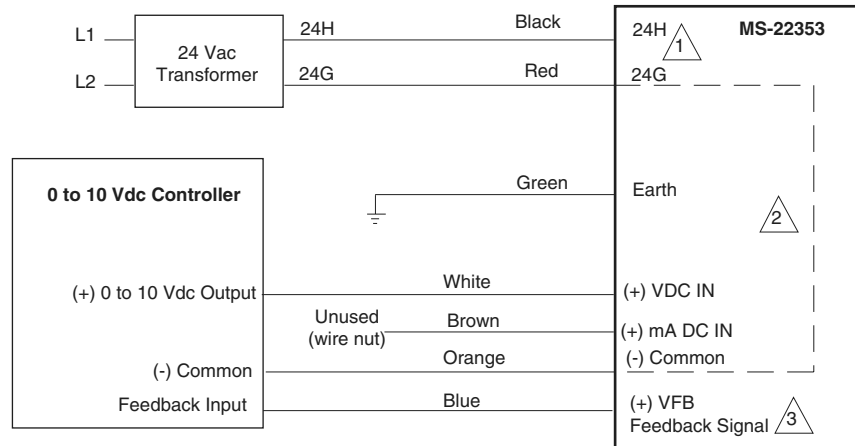


Figure 1 Wiring Diagram for 4 to 20 mA DC Proportional Control.



- 1 The MS-22353 actuator contains a half-wave rectifier power supply. When connecting multiple devices to a common transformer connect 24H and 24G with half-wave rectifier or isolated power supplied devices, only. Refer to EN 206 (F-26363).
- 2 For actuator models manufactured prior to date code 990X (e.g. 9904, 9905, etc.), see "Power and Control Wiring Color Codes" for wire color numbers.
- 3 Optional connection for controllers with feedback input. If unused, wire nut.

Figure 2 Wiring Diagram for 2 to 10 Vdc Proportional Control.

Power and Control Wiring Color Codes.

	Actuator Label	Description	Wire Codes	
			Color Only (Current Models)	Colors with Numbers (Older Models ^a)
Actuator Power	Earth	Earth Ground	Green	Green (—)
	24 H	24 Vac	Black	Black (1)
	24 G	24 Vac	Red	Red ^b (2)
Proportional Control Signals	+ VDC (IN)	2 to 10 Vdc Input	White	White/Green (3)
	- COMMON	DC Common Ground	Orange	White/Orange (4)
	+ mADC (IN)	4 to 20 mADC Input	Brown	White/Brown (6)
Feedback Control Signal	+ VFB	Actuator Feedback	Blue	White/Blue (5)

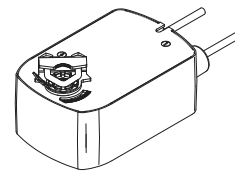
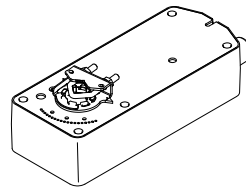
^a Actuator models manufactured prior to date code 991X (e.g. 9910, 9911, etc.) have multi-color, numbered wires.
^b Actuator extend wire may be violet on some models.

Spring Return DuraDrive® Proportional Actuator

For spring return applications that require proportional modulation control of dampers and valves in HVAC systems.

Features:

- Proportional models controlled by 6-9 Vdc, 2-10 Vdc or 4-20 mA with the addition of a 500 ohm resistor.
- 35 lb.-in. (4 N-m), 60 lb.-in (7 N-m), 133 lb.-in (15 N-m).
- Direct mount to round or square damper shaft.
- Overload protection throughout rotation.
- True mechanical clockwise or counterclockwise spring return operation for positive close-off in airtight applications.
- Visual position indicator.
- Direct acting or reverse acting control mode available on proportional models.
- Rotation limiting available.
- Rugged die-cast housing.
- MS40-7043: plenum rated cables.
- MS41-7xxx equipped with manual override.



Model Chart																
Model No.	Output Torque Rating lb.-in. (N-m)		Stroke	Power Input						Approximate Timing in Seconds @ 70°F (21°C) ^a		SPDT Auxiliary Switches	Shaft Size	Auxiliary Power Supply	Input	
				Voltage	Running		DC Amps	Holding 50/60 Hz	Powered	Spring Return						
	50 Hz VA	60 Hz W			60 Hz VA	60 Hz W										
MS40-7043 ^c	35 (4)	120 (14)	95° ± 5° maximum, adjustable from 40 to 95° with mechanical stop	24 Vac ± 20% 22-30 Vdc	5.6	4.2	5.6	4.2	.15	2.4	<130	<25	No	5/8 in. dia. 1/2 in. sq.	None	2-10 Vdc or 4-20 mA w/500 Ω
MS40-7043-501 ^c					One ^d											
MS40-7043-MP					No											
MS40-7043-MP5					One ^d											
MS41-7073	60 (7)	160 (18)	95° ± 5° maximum, adjustable from 30 to 95° with AM-689 rotation limiter	24 Vac ± 20% 22-30 Vdc	5.8	4.6	5.8	4.6	.17	2.3	<195	<30	No	3/4 in. dia. 1/2 in. sq.	None	2-10 Vdc or 4-20 mA w/500 Ω
MS41-7073-502					Two ^e											
MS41-7153					No											
MS41-7153-502	133 (15)	300 (34)			9.8	7.4	9.7	7.4	.28	2.9	<190	<30	Two ^e			

^a Timing was measured with no load applied to the actuator.
^b De-rating required for spring return actuators at low temperatures.
^c With plenum-rated cable.
^d One adjustable from 0 to 95° rotation (0 to 1 scale).
^e One adjustable from 25 to 85° rotation and one set to operate @ 5° fixed.

Specifications	
Inputs	
Control signal	Proportional, 6 to 9 Vdc, 2 to 10 Vdc, or 4 to 20 mA with 500 ohm resistor.
Power	All 24 Vac circuits are Class 2. Refer to Model Chart for AC and DC ratings. Half wave device.
Connections	MS41-7073, MS41-7153: 3 ft. (0.9 m) long, appliance cables, 1/2 in. conduit connectors. For M20 metric conduit, use AM-756 adaptor. MS40-7043: 3 ft. (0.9 m) long, plenum-rated cables, 1/2 in. conduit connectors. For M20 metric conduit, use AM-756 adaptor. MS40-7043: 3 ft. (0.9 mm) plenum rated cable.
Outputs	
Motor Type	Brushless DC.
Electrical	Internal Power Supply: 20 Vdc, 25 mA. Control Mode: Switch provided for selection of direct acting or reverse acting control mode.
Mechanical	Position Indicator: MS40-7043: Visual indicator, 0 to 1 (0 is the spring return position). MS41-7073, MS41-7153: Pointer (-5 to 90°) and scale are provided for position indication (-5 is normal or spring return position). Direction of rotation: CW or CCW rotation is available through reversible mounting. Damper shaft clamp: Direct coupled using a through hole output hub.
Environment	
Temperature limits	Shipping and storage: -40 to 160°F (-40 to 71°C) ambient. Operating: -22 to 140°F (-30 to 60°C).
Humidity	5 to 95% RH, non-condensing.
Locations	NEMA 1, NEMA 2 (IEC IP54) with conduit in the down position.
Agency Listings	
UL	UL-873, Underwriters Laboratories Listed (File #9429 Category: Temperature-Indicating and Regulating Equipment).
European Community	EMC Directive (89/336/EEC). Low Voltage Directive (72/23/EEC).
CSA	Canadian Standards C22.2 No. 4-93.
Australia	This product meets requirements to bear the C-Tick mark according to the terms specified by the Communications Authority under the Radio Communications Act 1992.
General Instructions	Refer to F-26645.

MS40-7043, MS41-7073, MS41-7153

Accessories

Model No.	Description
MS40-7043, MS41-7073, MS41-7153	
AM-673 ^a	Mounting bracket.
AM-674	Weather shield.
AM-675	Weather shield base.
AM-676	Universal shaft extension, approximately 9-1/2" long (242 mm) for use on 3/8" to 11/16" (10 to 17 mm) round shafts, 3/8" to 9/16" square shafts. (AM-753 clamps required).
AM-703	Span adjustment.
AM-704	Modulating interface.
AM-705	Positioner.
AM-706	Positioner.
AM-707	Digital indication.
AM-708	500 ohm resistor.
AM-756	Metric conduit adaptor M20 x 1.5 to 1/2" NPT (two per package).
AM-714	Weather shield.
AM-715 ^f	Crank arm adaptor kit.
AM-762	Replacement 9-inch anti-rotation bracket
MS41-7073, MS41-7153	
AM-671 ^{abcd}	Mounting bracket.
AM-672 ^{abcd}	Mounting bracket.
AM-686	Position indicator.
AM-687	V-clamp.
AM-688	Replacement universal clamp
AM-689	Rotation limiter.
AM-690	Crank arm.
AM-691	Crank arm.
AM-692	V-bolt.
AM-693 ^{ef}	Crank arm kit.
AM-758	Universal short "U" mounting bracket
AM-759	Universal long "U" mounting bracket
AM-760	Universal slotted "L" mounting bracket
VA-602	Vx-7xxx 1 to 2 in. valve linkage.
VA-607	Vx-9xxx 2-1/2 to 4 in. valve linkage.
MS40-7043	
AM-709	Position indicator and stroke limiter.
AM-710	V-clamp.
AM-711	Crank arm adaptor kit.
AM-712 ^f	Crank arm adaptor kit.
AM-713 ^f	Bracket.
AM-717	Replacement universal clamp
AM-761	Replacement 7-inch anti-rotation bracket
AV-605	Vx-7xxx 1/2 to 2 in. valve linkage.

^a Drill appropriate mounting holes where needed.

^b AM-693 crank arm kit required.

^c Cannot be used with Mx41-634x or Mx40-717x series actuators.

^d The large "C"-shaped clamps included in AM-693 crank arm kit are required for mounting the actuator.

^e AM-692 V-bolt kit required.

^f Use the self-tapping screws and flat washers provided in kit to mount actuator.

Typical Applications

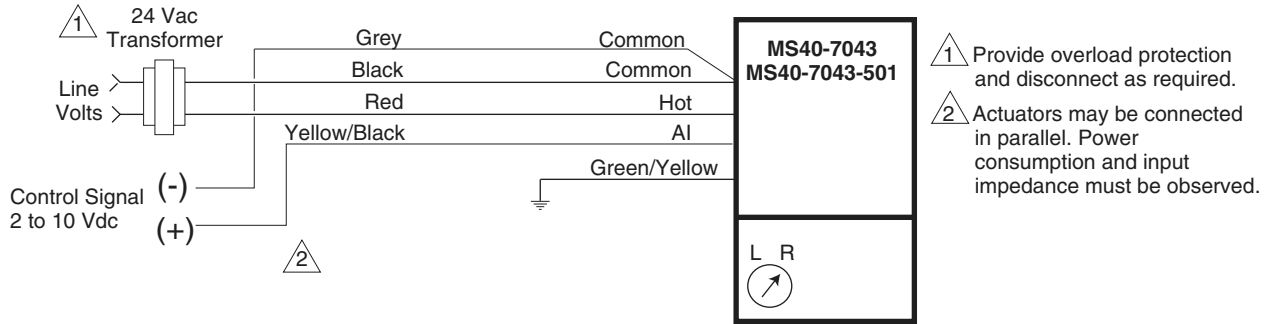


Figure 1 2 to 10 Vdc Control of MS40-7043 and MS40-7043-501 Actuator.

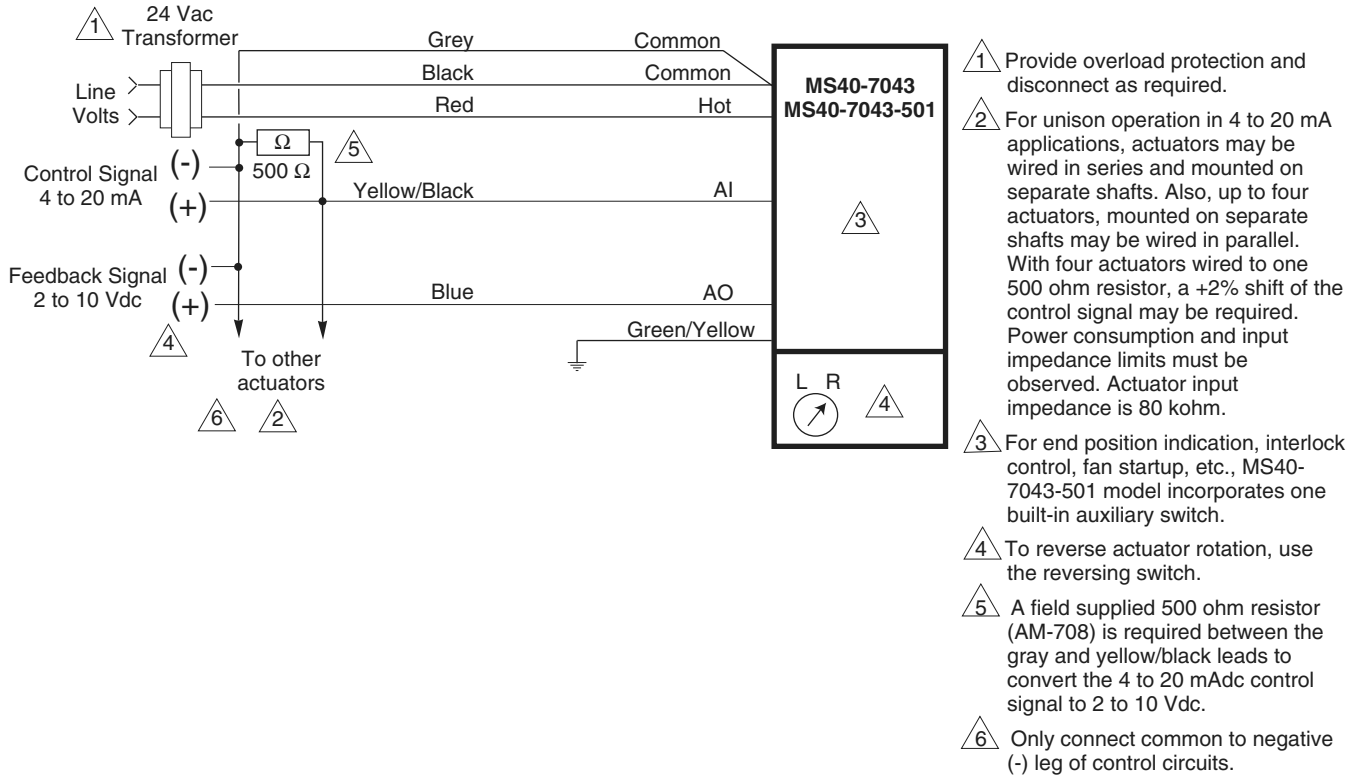


Figure 2 4 to 20 mA Control of MS40-7043 and MS40-7043-501 with 2 to 10 Vdc Feedback Control.

MS40-7043, MS41-7073, MS41-7153

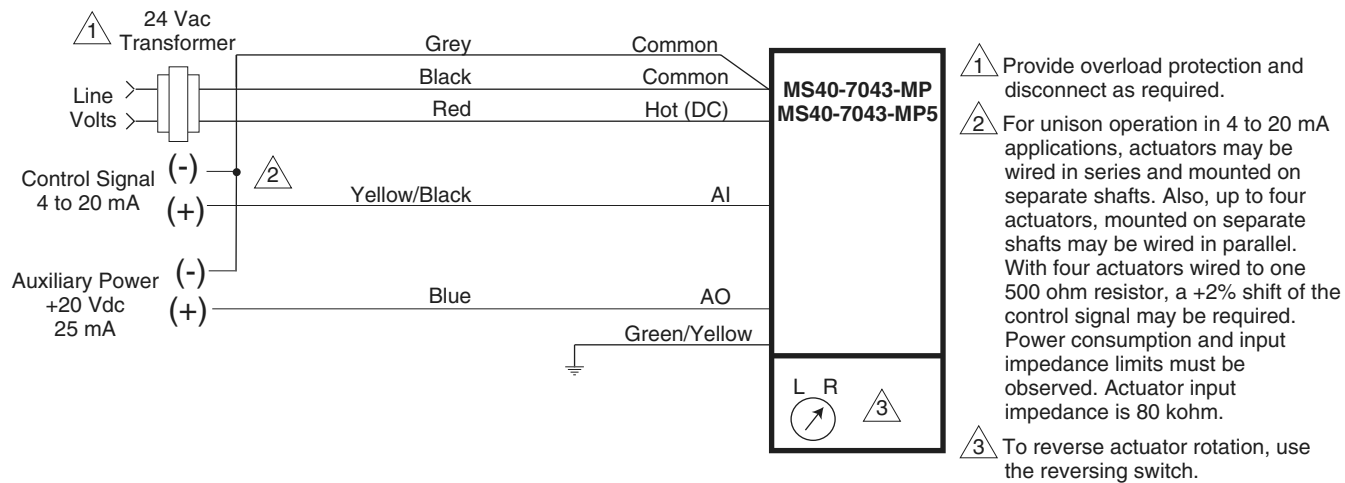


Figure 3 6 to 9 Vdc Proportional Control with 20 Vdc Power Output.

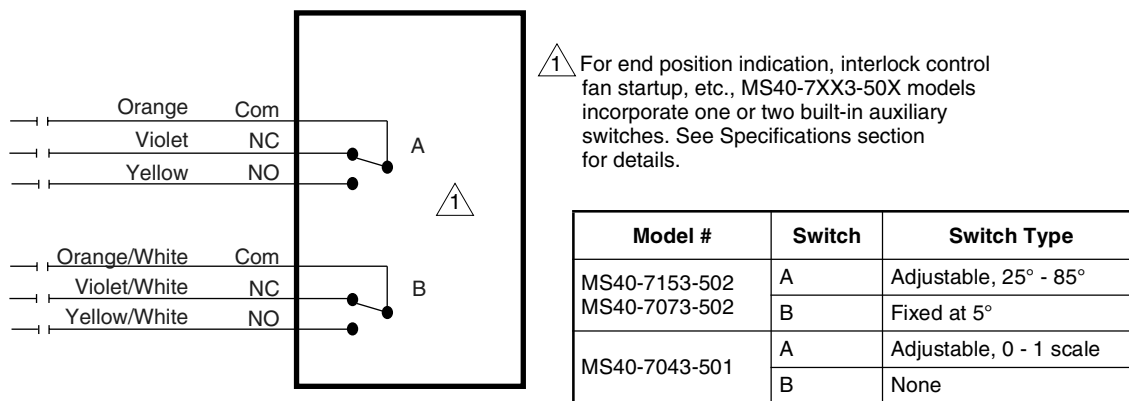


Figure 4 Optional Auxiliary Switches.

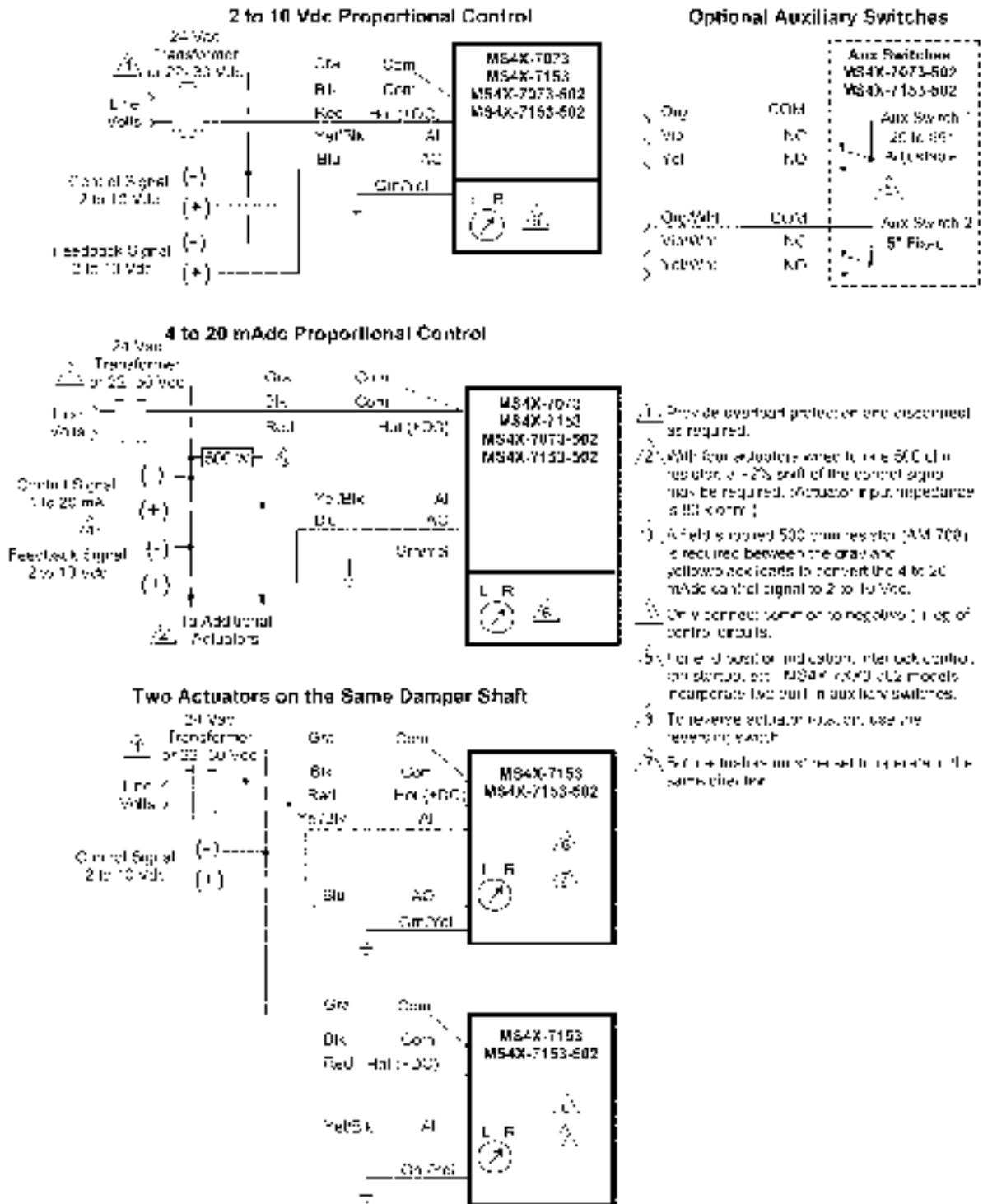


Figure 5 Typical Wiring Diagrams for Proportional Control 24 Vac Basic and Double Auxiliary Switch Models.

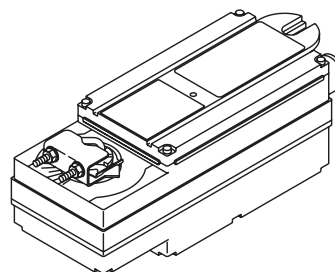
MS40-717x Series

Spring Return DuraDrive® Proportional Actuator

For spring return applications that require proportional modulation control of dampers and valves in HVAC systems.

Features:

- 150 lb.-in. (17 N-m) rated torque.
- Direct mount to round or square damper shaft.
- Overload protection throughout rotation.
- True mechanical clockwise or counterclockwise spring return operation for positive close-off in airtight applications.
- Oil immersed gear train provides continuous lubrication.
- NEMA 4 housing (IEC IP56).
- Automatic current sensing motor control provides extended reliability and repeatable timing.
- Visual position indicator.
- Provide proportional control compatible with 2 to 10 Vdc or 4 to 20 mA dc with intergrated resistor.



Model Chart

Damper Actuators.

Model No.	Output Torque Rating lb.-in. (N-m)		Actuator Power Input 50/60 Hz.					SPDT Auxiliary Switches	Approximate Timing in Seconds @ 70°F (21°C) with No Load		Shaft Size
			Voltage	Watts	Stroke	VA			Powered	Spring Return	
	Minimum ^a	Maximum Stall				Running	Holding				
MS40-7173	150 (17)	450 (51)	24 Vac ± 20%	7.1	93° ± 1°	9.4	5.4	No	<145	1.05 in. dia. 5/8 in. sq.	
MS40-7170 ^b			120 Vac ± 10%	7.1		11.1	9.1				
MS40-7171			240 Vac ± 10%	7.2		11.8	10.1				

^a De-rating required for spring return actuators at low temperatures.

^b The CE directive is not applicable to this model.

Valve Actuator/Linkages.

Model No.	Linkage (Included) ^a	Actuator Power Input 50/60 Hz.				SPDT Auxiliary Switches
		Voltage	Watts	VA		
				Running	Holding	
MS40-7173-200	AV-602	24 Vac ± 20%	7.1	9.4	5.4	No
MS40-7170-200 ^b		120 Vac ± 10%	7.1	11.1	9.1	
MS40-7171-200		240 Vac ± 10%	7.2	11.8	10.1	
MS40-7173-220	AV-607	24 Vac ± 20%	7.1	9.4	5.4	
MS40-7170-220		120 Vac ± 10%	7.1	11.1	9.1	
MS40-7171-220		240 Vac ± 10%	7.2	11.8	10.1	

^a AV-602: Use with 1-1/4 to 2 in. globe valves. AV-607: Use with 2-1/2 to 4 in. globe valves.

^b The CE directive is not applicable to this model.

Specifications

Inputs	
Control signal	Proportional, 2 to 10 Vdc or 4 to 20 mA dc with integral 500 ohm resistor.
Power	Refer to Model Chart.
Connections	2 ft. (0.6 m) appliance cables, 1/2 in. conduit connector. For M20 metric conduit, use AM-756 adaptor.
Outputs	
Motor Type	Brushless DC.
Mechanical	Direction of rotation: CW or CCW rotation is available through reverse mounting.
	Dual shaft clamp: Direct coupled using a through hole output hub.
	Position indicator: Pointer and scale are provided for position indication (0° is the normal, or spring return position).
	Stroke: 93° ± 1°
Environment	
Ambient Temperature limits	Shipping and storage: -40 to 160°F (-40 to 71°C). Operating: -25 to 140°F (-32 to 60°C).
Humidity	5 to 95% RH, non-condensing.
Locations	NEMA 1, NEMA 4 (IEC IP56) with customer supplied water tight connector.
Dimensions	10-27/32 H x 4 W x 4 D in. (275 x 102 x 102 mm).
Agency Listings	
UL	UL-873, Underwriters Laboratories Listed (File #E9429 Category: Temperature-Indicating and Regulating Equipment).
European Community	EMC Directive (89/336/EEC). Low Voltage Directive (72/23/EEC).
CSA	Canadian Standards C22.2 No. 4-93.
Australia	This product meets requirements to bear the C-Tick mark according to the terms specified by the Communications Authority under the Radio Communications Act 1992.
General Instructions	Refer to F-26748 and F-27384.

Accessories

Model No.	Description
AM-674	Weather shield.
AM-676	Universal shaft extension, approximately 9-1/2 in. long (242 mm) for use on 3/8 to 1 1/16 in. (10 to 17 mm) round shafts, 3/8 to 9/16 in. square shafts. AM-753 clamps required).
AM-703	Span adjustment.
AM-704	Modulating interface.
AM-705	Positioner.
AM-706	Positioner.
AM-707	Digital indication.
AM-751	Standard anti-rotation bracket 9 in. long x 1 3/16 in. wide (229 x 21 mm), included with actuator.
AM-752	Optional anti-rotation bracket 4 in. long x 1-11/16 in. wide (102 x 43 mm), for narrow spaces.
AM-753	Damper shaft mounting clamps for 5/8 in. square shaft, 3/4 in. and 1 in. round shafts (two per package).
AM-754	Standard universal mounting clamps for 3/8 to 1/2 in. (10 to 13 mm) round and square shafts, two included with actuator.
AV-602	Vx-7xxx 1/2 to 2 in. valve linkage.
AV-607	Vx-9xxx 2-1/2 to 4 in. valve linkage.
M-756	Metric conduit adaptor M20 x 1.5 to 1/2 in. NPT (two per package).

MS40-717x Series

Typical Applications

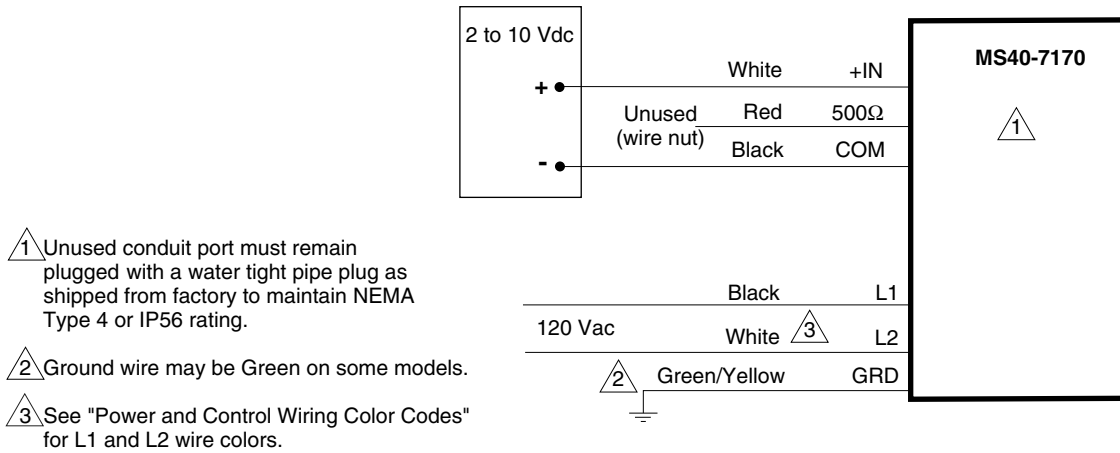


Figure 1 Typical MS40-7170 2 to 10 Vdc Wiring Diagram (120 Vac).

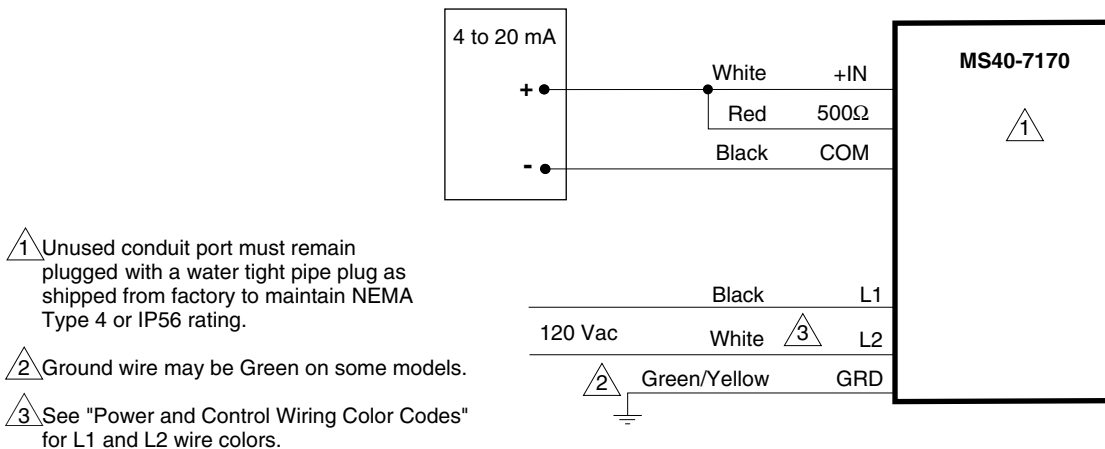


Figure 2 Typical MS40-7170 4 to 20 mA Wiring Diagram (120 Vac).

Power and Control Wiring Color Codes.

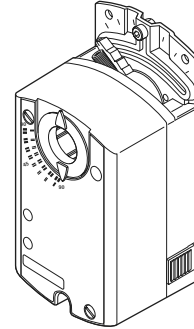
Model	Lead	Color	Voltage
MS40-7171	L1	Brown	240V
	L2	Light Blue	240V
MS40-7173	L1	Black	24 V H
	L2	Black/Blue	24 V G

Non-Spring Return DuraDrive® Modulating Actuator

The DuraDrive direct coupled 24 Vac non-spring return rotary electric actuators are designed for modulating control of dampers.

Features:

- Compact, lightweight design.
- Self-adapting capability for maximum flexibility in damper positioning.
- Manual override.
- 5° offset from 0° as shipped from factory.
- Offset and slope (zero and span) adjustment models available.
- Independently adjustable dual auxiliary switches available.
- CUL and UL listed; CE certified.
- 0 to 10 Vdc feedback output.



Model Chart

Damper Actuators.

Model No.	Output Torque Rating lb.-in. (N-m)	Actuator Power Input		Slope/Offset Adjustable (Zero Span)	SPDT Auxiliary Switches	Approximate Timing in Seconds @ 70°F (21°C) with No Load		Shaft Size			
		Voltage	VA			50 Hz	60 Hz				
	Running VA										
MS41-6043	35 (4)	24 VAC +20%-15%	3.3	None	None	108	90	3/8" to 5/8" dia. 1/4" to 1/2" sq. 9/16" hex			
MS41-6043-520				Yes	None						
MS41-6043-522				Yes	Two						
MS41-6043-502				None	Two						
MS41-6083	70 (8)			24 VAC +20%-15%	3.3	None	None		150	125	3/8" to 5/8" dia. 1/4" to 1/2" sq. 9/16" hex
MS41-6083-520						Yes	None				
MS41-6083-522						Yes	Two				
MS41-6083-502						None	Two				

Valve Actuator/Linkages.

Model No. ^a	Linkage (Included)	Actuator Power Input 50/60 Hz.		SPDT Auxiliary Switches
		Voltage	VA Running	
MS41-6043-200	AV-603	24 Vac + 20% - 15%	3.3	No
MS41-6043-202				Yes
MS41-6083-200				No
MS41-6083-202				Yes

^a Refer to Valve Catalog, F-27384 for correct applications.

MS41-60xx Series

Specifications

Inputs	
Control signal	MS41-60x3: Proportional, 0 to 10 Vdc; input resistance 100K Ω . Control signal adjustment available with MS41-60x3-522 and MS41-60x3-522. Start point (offset): 0 and 50 Vdc (factory setting = 0 Vdc) Span 2 to 30 Vdc.
Power	24 Vac, +20%-15%, rated Class 2, Class III per EN60730. MS41-6083: 24 Vac +20%/-10% at 90 to 130°F (32 to 55°C) ambient. Half wave device.
Connections	3 ft. (0.9 m) long, 18 AWG leads, plenum-rated.
Outputs	
Electrical	Output voltage: 0 to 10 Vdc.
	Maximum output current: 1 mA.
	MS41-60xx-502 auxiliary switch contact rating: AC Rating: 24 Vac, 4A Resistive, 2A Inductive. DC Rating: 12 to 30 Vdc, DC 2A.
	Switching hysteresis: 2°. Switch range: Switch A: 0 to 90° range in 5° intervals; Recommended range usage: 0 to 45°; Factory setting: 5°. Switch B: 0 to 90° range in 5° intervals; Recommended range usage: 45 to 90°; Factory setting: 85°.
	Timing: See Model Chart.
Mechanical	Output torque rating: MS41-6043 , 35 lb-in. (4 N-m); MS41-6083 , 70 lb-in. (8 N-m).
	Stroke: Normal angle of rotation is 90°, limited to a maximum of 95°. Field adjustable to limit travel on either end of stroke. MS41-60x3-52x have adjustable start point and span. Position indicator: Adjustable pointer is provided for position indication.
Environment	
Ambient temperature limits	Shipping and Storage: -40 to 158°F (-40 to 70°C). Operating: -25 to 130°F (-32 to 55°C).
Humidity	5 to 95% RH, non-condensing.
Locations	NEMA 2, IP54 to EN60529.
Dimensions	5-7/16 H x 2-3/4 W x 2-3/8 D in. (138 x 70 x 60 mm).
Agency Listings	
UL	UL-873, Underwriters Laboratories.
European Community	EMC Directive (89/336/EEC). Emissions (EN50081-1). Immunity (EN50082-2).
CUL	Canadian Standards C22.2 No. 24-93.
General Instructions	Refer to F-27214.

Accessories

Model No.	Description
AM-726	Rotary to linear bracket.
AM-727	Rotary to linear crank arm adaptor.
AM-728	Conduit adaptor.
AM-729	3/8 in. shaft adapter.
AV-603	1/2 to 2 in. Vx-7xxx valve linkage.

Typical Applications

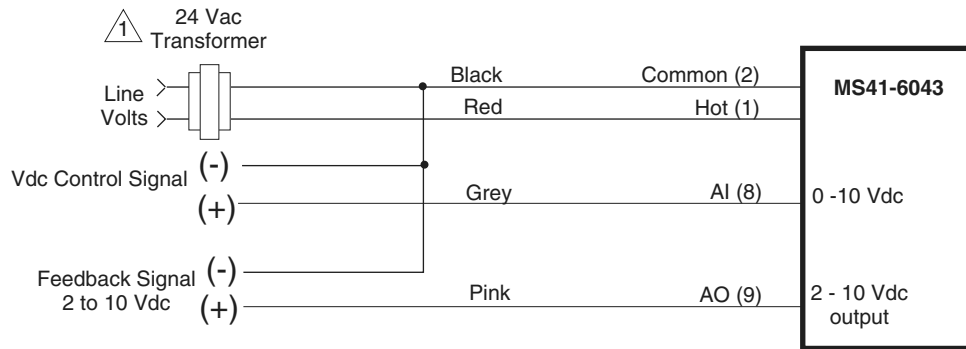


Figure 1 Typical Wiring for Proportional Control, 24 Vac, 0-10 Vdc Input.

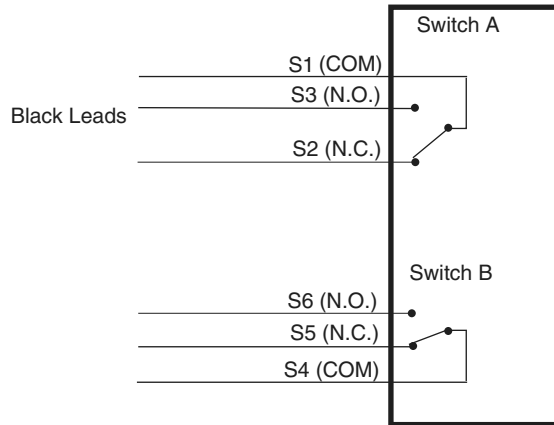


Figure 2 Typical Wiring for Auxiliary Switch Models MS41-60x3-502, -522, or -202.

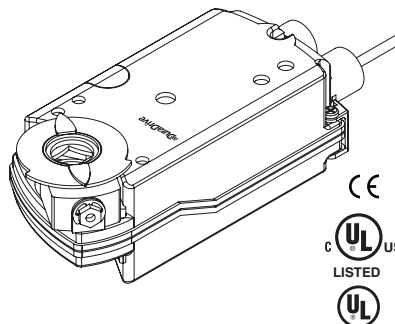
MS41-6153 Series

Non-Spring Return DuraDrive® Modulating Actuator

The DuraDrive direct-coupled, 24 Vac, non-spring return electronic actuator is designed for modulating control of building HVAC dampers.

Features:

- Synchronous motor technology with stall protection.
- Unique self-centering shaft coupling.
- Manual override.
- 133 lb-in (15 N-m) torque.
- 5° offset from 0° as shipped from factory.
- Mechanical range adjustment capabilities.
- Models with independently adjustable, dual auxiliary switches available.
- Built-in 1/2-in. conduit connection.
- UL and cUL listed, CE certified.
- 0 to 10 (factory set) or 2 to 10 Vdc input field selectable.
- 0 to 10 Vdc feedback output.



Model Chart

Damper Actuators.

Model No.	Output Torque Rating lb.-in. (N-m)	Power Input @ 50/60 Hz					SPDT Auxiliary Switches	Approximate Timing in Seconds @ 70°F (21°C) with No Load		Shaft Size
		Voltage	VA					50 Hz	60 Hz	
			Running		Holding					
			VA	W	VA	W				
MS41-6153	133 lb-in (15 N-m)	24 Vac ± 20%	5	4	1	1	No	150	125	1/4 to 3/4 in. dia. 1/4 to 1/2 in. sq.
MS41-6153-502							2			

Valve Actuator/Linkages.

Model No. ^a	Linkage (Included)	Actuator Power Input 50/60 Hz.			SPDT Auxiliary Switches
		Voltage	VA Running	Watts	
MS41-6153-200	AV-605	24 Vac ± 20%	5	4	No
MS41-6153-202					Yes
MS41-6153-220	AV-607				No
MS41-6153-222					Yes

^a Refer to Valve Catalog, F-27384 for correct applications.

Specifications

Inputs

Control signal	0 to 10 Vdc (factory set) or 2 to 10 Vdc input field selectable (max. 34 Vdc). Resistance: > 100K ohms.
Power	All 24 Vac circuits are Class 2. 24 Vac +20/-15% @ 50/60 Hz. Running VA: 5 @ 4 W, Holding VA: 1.2 @ 1 W. Half wave device.
Connections	3 ft. (0.9 m) long, 18 AWG leads.

Specifications (Continued)

Outputs	
	Position output signal wires 9 and 2.
Output voltage:	0 to 10 Vdc.
Maximum output current:	± 1 mA
Electrical	
	Dual auxiliary switches available on MS41-6153-502.
	Switch contact rating: 6A resistive, 2A inductive.
	Switch voltage: 24 Vac.
	Switching hysteresis: 2.
	Switch range: Switch A: 0 to 90° range in 5° intervals; Recommended range usage: 0 to 45°; Factory setting: 5°. Switch B: 0 to 90° range in 5° intervals; Recommended range usage: 45 to 90°; Factory setting: 85°.
	Timing: 150 seconds @ 50 Hz. 125 seconds @ 60 Hz.
Mechanical	
	Output torque rating: 133 lb-in. (15 N-m).
	Stroke: Normal angle of rotation is 90°, limited to a maximum of 95°. Field adjustable to limit travel on either end of stroke.
	Position indicator: Adjustable pointer is provided for position indication.
Environment	
Ambient temperature limits	Operation: -25 to 130°F (-32 to 55°C). Storage and transport: -40 to 158°F (-40 to 70°C).
Humidity	5 to 95% RH, non-condensing.
Locations	NEMA Type 1, IP54 according to EN 60 529.
Dimensions	8-3/8 H x 3-1/4 W x 2-2/3 D in. (213 x 83 x 68 mm).
Agency Listings	
UL	UL-873, Underwriters Laboratories. UL Listed to UL 60730.
European Community	EMC Directive (89/336/EEC). Emissions (EN50081-1). Immunity (EN61000-6-2).
CUL	Canadian Standards C22.2 No. 24-93.
General Instructions	Refer to F-27215.

Accessories

Model No.	Description
AM-674	Weather shield.
AM-675	Mounting base for weather shield.
AM-703	Span adjustment module.
AM-704	Pulse to 2 to 10 Vdc converter.
AM-705	Remote positioner surface mount for 0 to 10 Vdc control.
AM-706	Remote positioner flush mount for 0 to 10 Vdc control.
AM-726	Linear conversion kit with mounting bracket.
AM-727	Linear conversion kit.

MS41-6153 Series

Typical Applications

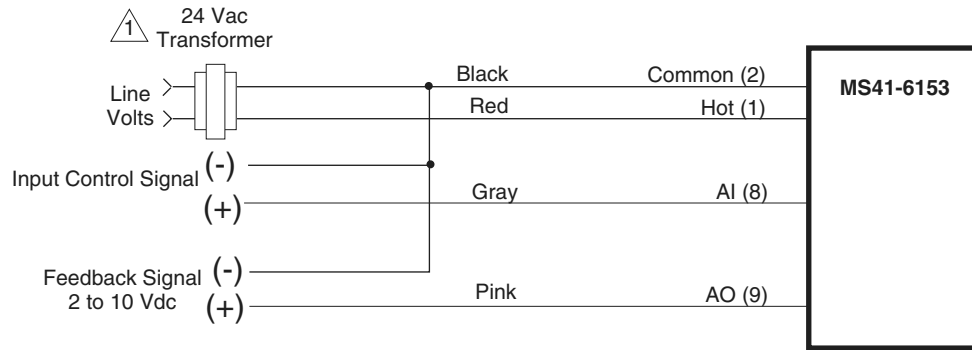


Figure 1 Typical Wiring for Proportional Control 24 Vac, 0-10 Vdc Input Standard.

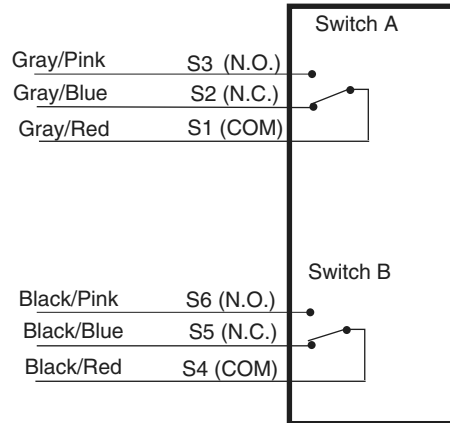


Figure 2 Typical Wiring for Auxiliary Switch Models MS41-6153-502, -505, or -222.

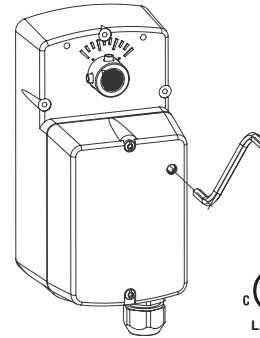
Non-Spring Return EconoDrive™ Proportional Actuator

EconoDrive overshaft actuators are designed to provide an economical and reliable solution for many overshaft damper and ball valve requirements. All products accommodate shaft sizes up to 1/2 in. (13 mm) in diameter.

Non-spring return models provide either 35 in-lb (4 N-m) or 70 in-lb (8 N-m) in proportional control.

Features:

- Proportional models controlled by 0 to 3 Vdc, 6 to 9 Vdc, 0 to 10 Vdc, 2 to 10 Vdc or 4 to 20 mAdc. Control function direct/reverse action is jumper selectable.
- Non-spring return models supply 35 in-lb (4 N-m) or 70 in-lb (8 N-m) of torque.
- Polymer housing rated for NEMA 2/IP54.
- Overload protection throughout stroke.
- Automatically adjust the input span to match the damper/valve travel.
- Compact size to allow installation in limited space.
- Manual override to allow positioning of dampers and valves.
- Directly mounts to 1/2 to 3 in. ball valves.
- Polymer housing rated for plenum use.



Model Chart										
Model No.	Torque in-lb (N-m)	Control Signal	Voltage	Wiring System	Actuator Power Input				Approximate Timing ^a in Seconds @ 70°F (21°C)	
					Running			Holding		
					50/60 Hz		DC Amps	50/60 Hz		
					VA	W		W		
MS4D-6043-100	35 (4)	2 to 10 Vdc Proportional	24 VAC +/-20% or 20-30 Vdc	Plenum Cable	4.2	2.2	0.08	1.2	85	
MS4D-6043-120		0 to 3 Vdc Proportional		Plenum Cable						
MS4D-6043-130		6 to 9 Vdc Proportional		Plenum Cable						
MS4D-6043-150		0 to 10 Vdc Proportional		Plenum Cable						
MS4D-6043-160		4 to 20 mAdc Proportional		Plenum Cable						
MS4D-6083-100	70 (8)	2 to 10 Vdc Proportional		Plenum Cable	5.2	2.7	0.10	1.4		85
MS4D-6083-120		0 to 3 Vdc Proportional		Plenum Cable						
MS4D-6083-130		6 to 9 Vdc Proportional		Plenum Cable						
MS4D-6083-150		0 to 10 Vdc Proportional		Plenum Cable						
MS4D-6083-160		4 to 20 mAdc Proportional		Plenum Cable						

^a Timing was measured with no load applied to actuator.

MS4D-60x3 Series

Specifications

Inputs	
Control signal	See Model Chart for actuator models and control types.
Power	See Model Chart. All 24 Vac circuits are Class 2. Half wave device.
Connections	10 ft. plenum cables, enclosure accepts 1/2 in. (13 mm) conduit connector. For M20 Metric conduit, use AM-756 adapter.
Outputs	
Electrical	Position Feedback Voltage: For voltage ranges, the feedback signal is the same range as the input signal. The 4 to 20 mA current range has a 2 to 10 Vdc feedback signal. The feedback signal can supply to 0.5 mA to operate up to four additional slave actuators.
	Timing: See Model Chart.
Mechanical	Travel: 93° nominal.
	Manual Override: Allows positioning of damper or valve using manual crank.
	RA/DA Jumper: Permits reverse acting/direct acting control.
Environment	
Ambient temperature limits	Shipping and Storage: -40 to 160°F (-40 to 71°C). Operating: -22 to 140°F (-30 to 60°C).
Humidity	15 to 95% RH, non-condensing.
Locations	NEMA 1, NEMA 2, UL Type 2 (IEC IP54) with customer supplied water tight conduit connectors. Enclosure is air plenum rated.
Dimensions	7-7/8 H x 3-1/2 W x 3-1/2 D in. (200 x 89 x 89 mm).
Agency Listings	
UL 873	Underwriters Laboratories (File #E9429 Category Temperature-Indicating and Regulating Equipment).
CUL	UL Listed for use in Canada by Underwriters Laboratories. Canadian Standards C22.2 No. 24-93.
European Community	EMC Directive (89/336/EEC), Low Voltage Directive (72/23/EEC). This product fits in Installation Category (Overvoltage Category) II per EN 61010-1.
Australia	This product meets requirements to bear the C-Tick Mark according to the terms specified by the Communications Authority under the Radiocommunications Act 1992.
General Instructions	Refer to F-27170.

Accessories

Model No.	Description
AM-703	Input rescaling module, adjust signals to 2-10 Vac, zero and span adjust.
AM-704	Interface, pulse width modulation (PWM).
AM-705	Positioner (NEMA 4 housing).
AM-706	Min and/or manual positioner for flush panel mount.
AM-708	500 Ω resistor to convert 4 to 20 mA to 2 to 10 Vdc control signal.
AM-714	Weathershield Kit.
AM-756	Metric conduit adapter M20 x 1.5 to 1/2 in. NPT.
AM-771	Crank arm and bracket kit.
AM-772	Bracket for reverse mounting.

Typical Applications

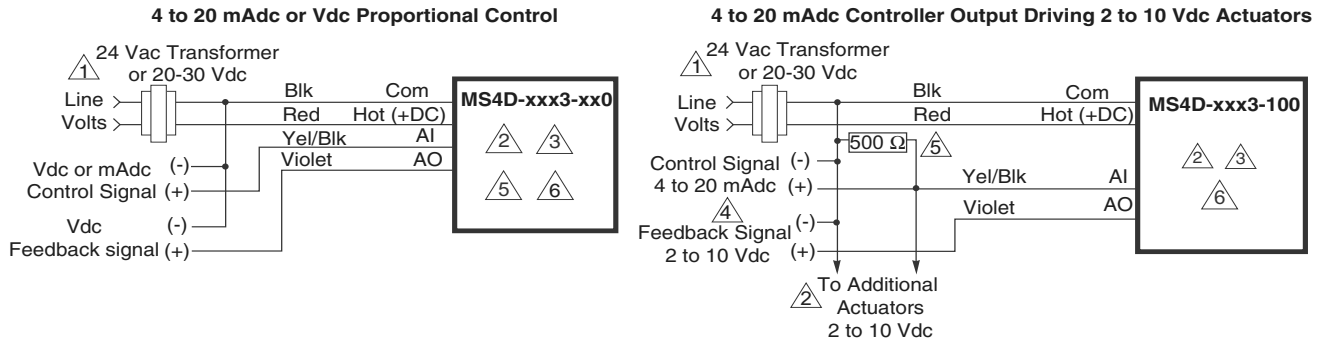


Figure 1 Typical Wiring Diagrams for Proportional Control 24 Vac Basic Models.

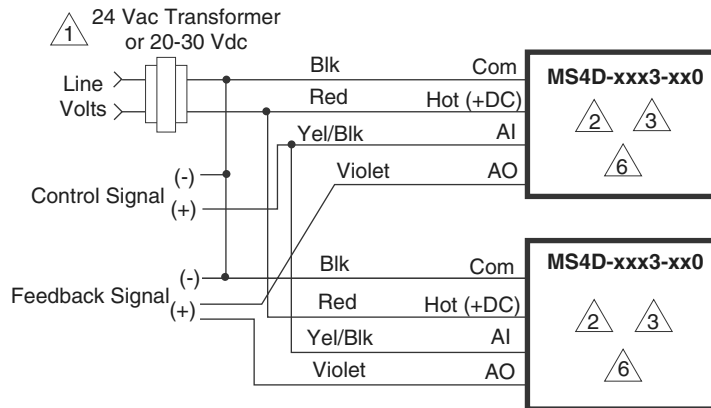


Figure 2 Typical Wiring Diagrams for Proportional Control 24 Vac Models Wired in Parallel.

- 1 Provide overload protection and disconnect as required.
- 2 Actuators may be wired in parallel. All actuator black wires are connected to the transformer Common and all red wires are connected to the Hot lead. Power consumption must be observed.
- 3 If the controller uses a full-wave power supply and does not provide isolated outputs, a separate transformer is required.
- 4 A field-supplied 500 ohm resistor (AM-708) is required for this application.
- 5 On MS4D-xxx3-x60 (4-20 mAdc) models a 500 resistor is incorporated in the product. Do not use an external resistor.
- 6 Cable on some models contains more wires than are used in applications. Only those wires actually used are shown.

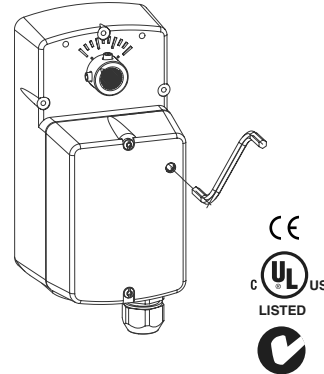
Spring Return EconoDrive™ Proportional Actuator

EconoDrive overshaft actuators are designed to provide an economical and reliable solution for many overshaft damper and ball valve requirements. All products accommodate shaft sizes up to 1/2 in. (13 mm) in diameter.

Spring return models provide 30 in-lb (3.4 N-m) of torque.

Features:

- Controlled by 0 to 3 Vdc, 6 to 9 Vdc, 0 to 10 Vdc, 2 to 10 Vdc or 4 to 20 mAdc. Control function direct/reverse action is jumper selectable.
- 30 in-lb (3.4 N-m) of torque.
- Polymer housing rated for NEMA 2/IP54.
- Overload protection throughout stroke.
- Proportional models automatically adjust the input span to match the damper/valve travel.
- Compact size to allow installation in limited space.
- Manual override to allow positioning of dampers and valves.
- Directly mounts to 1/2 to 3 in. ball valves.
- Polymer housing rated for plenum use.



Model Chart										
Part No.	Rotation	Control Signal	Voltage	Wiring System	Actuator Power Input				Approximate Timing ^a in Sec. @ 70°F (21°C)	
					Running		Holding		Powered	Spring Return (CCW)
					50/60 Hz		DC Amps	50/60 Hz		
					VA	W		W		
MS4D-7033-100	CCW	2 to 10 Vdc Proportional	24 VAC ± 20% or 20-30 Vdc	Plenum Cable	6.1	3.4	0.12	1.4	85	21
MS4D-7033-120		0 to 3 Vdc Proportional								
MS4D-7033-130		6 to 9 Vdc Proportional								
MS4D-7033-150		0 to 10 Vdc Proportional								
MS4D-7033-160		4 to 20 mAdc Proportional								
MS4D-8033-100	CW	2 to 10 Vdc Proportional								
MS4D-8033-120		0 to 3 Vdc Proportional								
MS4D-8033-130		6 to 9 Vdc Proportional								
MS4D-8033-150		0 to 10 Vdc Proportional								
MS4D-8033-160		4 to 20 mAdc Proportional								

^a Timing was measured with no load applied to actuator.

Specifications

Inputs

Control signal	See Model Chart for actuator models and control types.
Power	See Model Chart. All 24 Vac circuits are Class 2. Half wave device.
Connections	10 ft. plenum cables, enclosure accepts 1/2 in. (13 mm) conduit connector. For M20 Metric conduit, use AM-756 adapter.

Outputs

Electrical	Position Feedback Voltage: For voltage ranges, the feedback signal is the same range as the input signal. The 4 to 20 mA current range has a 2 to 10 Vdc feedback signal. The feedback signal can supply up to 0.5 mA to operate up to four additional slave actuators.
Mechanical	Timing: See Model Chart.
	Travel: 93° nominal.
	Manual Override: Allows positioning of damper or valve using manual crank. RA/DA Jumper: Permits reverse acting/direct acting control.

Environment

Ambient temperature limits	Shipping and Storage: -40 to 160°F (-40 to 71°C). Operating: -22 to 140°F (-30 to 60°C).
Humidity	15 to 95% RH, non-condensing.
Locations	NEMA 1, NEMA 2, UL Type 2 (IEC IP54) with customer supplied water tight conduit connectors. Enclosure is air plenum rated..
Dimensions	7-7/8 H x 3-1/2 W x 3-1/2 D in. (200 x 89 x 89 mm).

Agency Listings

UL 873	Underwriters Laboratories (File #E9429 Category Temperature-Indicating and Regulating Equipment).
CUL	UL Listed for use in Canada by Underwriters Laboratories. Canadian Standards C22.2 No. 24-93.
European Community	EMC Directive (89/336/EEC). Low Voltage Directive (72/23/EEC). This product fits in Installation Category (Overvoltage Category) II per EN 61010-1.
Australia	This product meets requirements to bear the C-Tick Mark according to the terms specified by the Communications Authority under the Radiocommunications Act 1992.

General Instructions

Refer to F-27170.

Accessories

Model No.	Description
AM-703	Input rescaling module, adjust signals to 2-10 Vac, zero and span adjust.
AM-704	Interface, pulse width modulation (PWM).
AM-705	Positioner (NEMA 4 housing).
AM-706	Min and/or manual positioner for flush panel mount.
AM-708	500 Ω Resistor for 4 to 20 mA control signal.
AM-714	Weathershield Kit.
AM-756	Metric conduit adapter M20 x 1.5 to 1/2 in. NPT..
AM-771	Crank arm and bracket kit.
AM-772	Bracket for reverse mounting.

Typical Applications

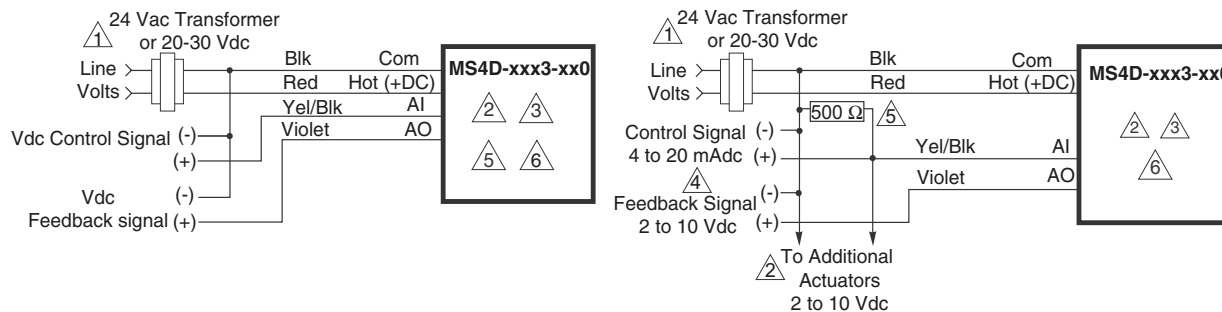


Figure 1 Typical Wiring Diagrams for Proportional Control 24 Vac Basic Models.

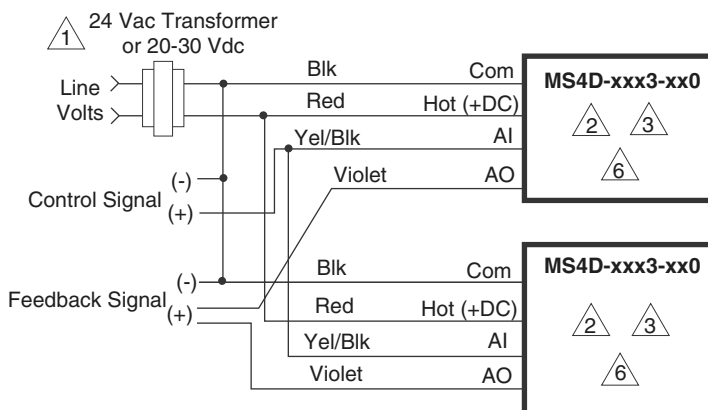


Figure 2 Typical Wiring Diagrams for Proportional Control 24 Vac Models Wired In Parallel.

- 1 Provide overload protection and disconnect as required.
- 2 Actuators may be wired in parallel. All actuator black wires are connected to the transformer Common and all red wires are connected to the Hot lead. Power consumption must be observed.
- 3 If the controller uses a full-wave power supply and does not provide isolated outputs, a separate transformer is required.

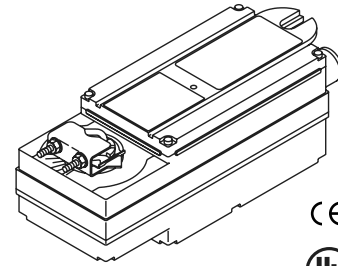
- 4 A field-supplied 500 ohm resistor (AM-708) is required for this application.
- 5 On MS4D-xxx3-x60 (4-20 mA) models a 500 resistor is incorporated in the product. Do not use an external resistor.
- 6 Cable on some models contains more wires than are used in applications. Only those wires actually used are shown.

Non-Spring Return DuraDrive® Proportional Actuator

For non-spring return applications that require proportional modulation control of dampers and valves in HVAC systems.

Features:

- Direct mount to round or square damper shaft.
- 300 lb.-in (34 N-m) rated torque.
- Overload protection throughout rotation.
- Oil immersed gear train provides continuous lubrication.
- NEMA 4 housing (IEC IP56).
- Manual override to allow positioning for installation and manual operation.
- Automatic current sensing motor control provides extended reliability and repeatable timing.
- Proportional control compatible with 2 to 10 Vdc or 4 to 20 mAdc with integrated resistor.



Model Chart

Damper Actuators.

Model No.	Output Torque Rating lb.-in. (N-m)		Power Input @ 50/60 Hz				SPDT Auxiliary Switches	Approximate Timing in Seconds @ 70°F (21°C) with No Load	Shaft Size
	Minimum	Maximum Stall	Voltage	VA	Watts				
					Running	Holding			
MS41-6343	300 (34)	600 (68)	24 Vac ± 20%	8	10	NA	No	<145	1/2 to 1 in. diameter 1/2 to 5/8 in. square
MS41-6340 ^a			120 Vac ± 10%						
MS41-6341			240 Vac ± 10%						

^a The CE directive is not applicable to this model.

Valve Actuator/Linkages.

Model No.	Linkage (Included) ^a	Actuator Power Input 50/60 Hz.				SPDT Auxiliary Switches
		Voltage	VA	Watts		
				Running	Holding	
MS41-6043-200	AV-609	24 Vac ± 20%	8	10	N/A	No

^a AV-609: Use with 5 and 6 in. VB-9xxx and 6 in. VB-8xxx globe valves.

Specifications

Inputs

Control signal	Proportional, 2 to 10 Vdc or 4 to 20 mAdc with intergral 500 ohm resistor.
Power	Refer to Model Chart.
Connections	2 ft. (0.6 m) appliance cable. 1/2 in. conduit connectors. For M20 metric conduit, use AM-756 adaptor.

Outputs

Motor Type	Brushless DC.
Mechanical	Direction of rotation: CW or CCW rotation is available through reverse mounting. Dual shaft clamp: Direct coupled using a through hole output hub for 3/8 to 1/2 in. round included. Position indicator: Pointer and scale.

MS41-634x Series

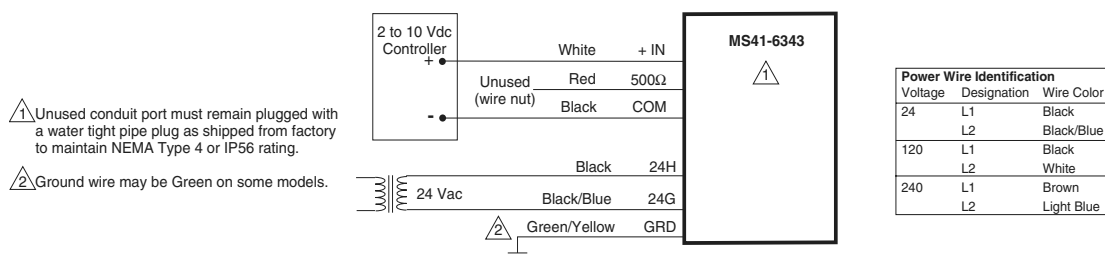
Specifications (Continued)

Environment	
Temperature limits	Shipping and Storage: -40 to 160°F (-40 to 71°C) ambient. Operating: -25 to 140°F (-32 to 60°C).
Humidity	5 to 95% RH, non-condensing.
Locations	NEMA 1, NEMA 4 (IEC IP56) with customer supplied water tight connectors.
Dimensions	10-27/32 H x 4 W x 4 D in. (275 x 102 x 102 mm).
Agency Listings	
UL	UL-873, Underwriters Laboratories Listed (File #E9429 category: Temperature-Indicating and Regulating Equipment.)
European Community	EMC Directive (89/336/EEC). Low Voltage Directive (72/23/EEC).
CSA	Canadian Standards C22.2 No. 24-93.
Australia	This product meets requirements to bear the C-Tick mark according to the terms specified by the Communications Authority under the Radio Communications Act 1992.
General Instructions	Refer to F-26745.

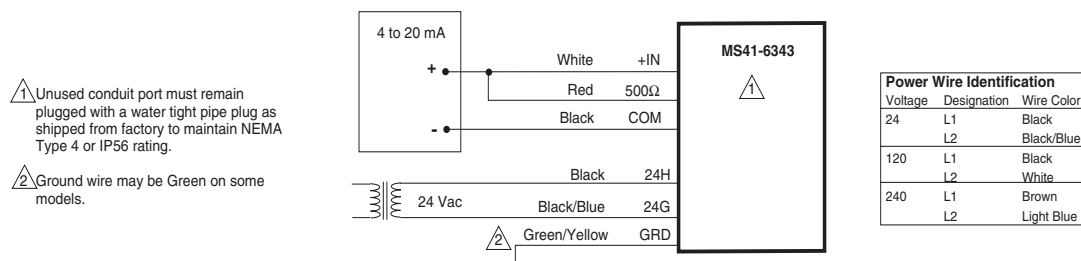
Accessories

Model No.	Description
AM-676	Universal shaft extension, approximately 9-1/2 in. long (242 mm) for use on 3/8 to 11/16 in. (10 to 17 mm) round shafts, 3/8 to 9/16 in. square shafts. (AM-753 clamps required).
AM-703	Span adjustment module mA/Vdc input to 2 to 10 Vdc output.
AM-704	Modulating interface pulse to 2 to 10 Vdc control.
AM-705	Positioner for 0 to 10 Vdc control.
AM-706	Positioner for 0 to 10 Vdc control.
AM-751	Standard anti-rotation bracket 9 in. long x 13/16 in. wide (229 x 21 mm), included with actuator.
AM-752	Optional anti-rotation bracket 4 in. long x 1-11/16 in. wide (102 x 43 mm), for narrow spaces.
AM-753	Damper shaft mounting clamps for 5/8 in. square shaft, 3/4 in. and 1 in. round shafts (two per package).
AM-754	Standard universal mounting clamps for 3/8 in. to 1/2 in. (10 to 13 mm) round and square shafts, two included with actuator.
AM-755	Manual override crank.
AM-756	Metric conduit adaptor M20 x 1.5 to 1/2 in. NPT (two per package).
AV-609	5 and 6 in. Vx-9xxx valve linkage or 6 in VX-8000.

Typical Applications



**Figure 1 Typical Wiring Diagram for 2 to 10 Vdc Controller with a 24 Vac Actuator
(See Power Wiring Identification for 120 or 240 V Power).**



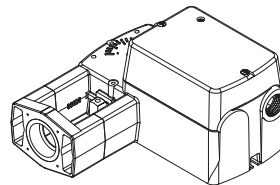
**Figure 2 Typical Wiring Diagram for 4 to 20 mA Controller with a 24 Vac Actuator
(See Power Wiring Identification for 120 or 240 V Power).**

Spring Return DuraDrive® Proportional Actuator

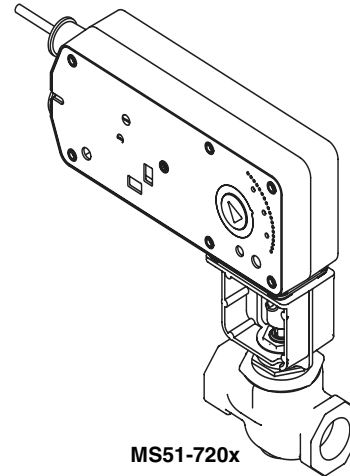
DuraDrive Linear Actuators are designed to mount directly onto two-way or three-way globe valves without the use of linkages. They provide linear travel to operate globe valves from 1/2 to 2 in. VB-7xxx valves, discontinued 1/2 to 1-1/4 in. VB-9xxx valves, 2-1/2 to 4 in. VB-9xxx valves, and 2-1/2 to 5 in. VB-8xxx valves in chilled water, hot water and steam applications up to 366°F (186°C). Linear spring return actuators provide control of valves in HVAC systems.

Features:

- Proportional models controlled by 0 to 3 Vdc, 6 to 9 Vdc, 0 to 10 Vdc, 0 to 20 mAdc, 2 to 0 Vdc, or 4 to 20 mAdc. Control function direct/reverse action is jumper selectable.
- 105 lbf (467 N) with 1/2 in. (13 mm) nominal linear stroke. 220 lbf (979 N) with 5/8 in. (16 mm) or 1-1/6 in. (27 mm) linear stroke.
- Rugged die cast or polymer housings rated for up to NEMA 2/IP54.
- Polymer housing rated for plenum use.
- Overload protection throughout stroke.
- Automatically sets input span to match valve travel.
- Compact size to allow installation in limited space.
- Manual override to allow positioning of valve and preload.
- Spring return operation to valve stem up position.
- Direct mount to valves without separate linkage.



MS51-7103



MS51-720x



MS51-7103 Series, MSx1-7203 Series

Model Chart														
Part No.	Control Action	Actuator Power Input							Linear Stroke Inches	Approximate Timing in Seconds @ 70°F (21°C) ^a		Output Force Rating lb.-in. (N-m)		Valve Size inches
		Voltage	Running				Holding			Powered	Spring Return	Min.	Max. Stall	
			50 Hz		60 Hz		DC Amps	50/60 Hz						
			VA	W	VA	W								
MS51-7103-000 ^b	2 to 10 Vdc Proportional ^c	24 Vac ± 20% 20 to 30 Vdc	6.6	4.2	6.6	4.2	0.14	1.5	1/2 in. nominal	60	16	105	215	1/2 to 2
MS51-7103-100 ^b														
MS51-7103-020 ^b	0 to 3 Vdc Proportional													
MS51-7103-120 ^b														
MS51-7103-030 ^b	6 to 9 Vdc Proportional													
MS51-7103-130 ^b														
MS51-7103-040 ^{b,d}														
MS51-7103-140 ^{b,d}	0 to 10 Vdc Proportional													
MS51-7103-050 ^b														
MS51-7103-150 ^b														
MS51-7103-060 ^b														
MS51-7103-160 ^b	4 to 20 mAdc													
MS51-7203	2 to 10 Vdc	24 Vac ± 20% 22 to 30 Vdc	9.8	7.4	9.7	7.4	.28	2.9	5/8	<100	<35	220 (919)	495 (2202)	1-1/4 to 2 ^e
MS51-7203-040 ^f	6-9 Vdc													
MS51-7203-050	0-10 Vdc													
MS61-7203	2 to 10 Vdc								1-1/16	<190	<40	2-1/2 to 4 or 5 ^g		
MS61-7203-040 ^f	6-9 Vdc													
MS61-7203-050	0-10 Vdc													

- ^a Timing was measured with no load applied to the actuator.
- ^b Proportional (MS) models shipped with RA/DA jumper set for DA (actuator extends with increasing signal).
- ^c 4 to 20 mAdc with AM-708 500 ohm field-installed resistor.
- ^d Has 20 Vdc 25 mA power supply for System 8000 applications.
- ^e Current VB-7xxx Series valves and discontinued VB-9xxx Series valves (1-1/4 in. only).
- ^f 20 Vdc 25 mA power supply included (replaces position feedback wires).
- ^g Current VB-9xxx Series valves (2-1/2 to 4 in.), current VB-8xxx (2 to 5 in.) Series valves, and discontinued VB-9xxx (1-1/2 to 2 in.) Series valves.

Specifications

Inputs	
Control signal	See Model Chart for actuator models and control type.
Power	See Model Chart. All 24 Vac circuits are Class 2. All circuits 30 Vac and above are Class 1. Half wave device.
Connections	Models with -0xx have 3 ft. (91 cm) appliance wire connections. Models with -1xx have 3 ft. (91 cm) plenum wire connections. Enclosure accepts 1/2 in. (13 mm) conduit connectors. For M20 Metric connector, use AM-756 adaptor.
Outputs	
Electrical	Position Feedback Voltage: For voltage ranges, the feedback signal is the same range as the input signal. The 4 to 20 mAdc current input range have a 2 to 10 Vdc position feedback signal. The position feedback signal can supply up to 0.5 mAdc to operate up to four additional slave actuators. The MS51-7103-040 and -140, MS51-7203-040, MS61-7203-040 do not have feedback.
Mechanical	Linear Stroke: See Model Chart. Approximate Stroke Timing: See Model Chart. Manual Override: Allows positioning of valve and preload using manual crank.
Environment	
Ambient temperature limits	Shipping and Storage: -40 to 160°F (-40 to 71°C). MS51-720x and MS61-720x: -40 to 180°F (-40 to 82°C). Operating: -22 to 140°F (-30 to 60°C). MS51-720x and MS61-720x: 0 to 140°F (-18 to 60°C) Temperature Restrictions: For maximum ambient 140°F (60°C) the maximum allowable fluid temperature should not exceed valve rating. See F-27252 Selection Guide for specific ratings.
Humidity	MS51-7103: 5 to 95% RH, non-condensing. MS51-7203 and MS61-7203: 15 to 95% RH, non-condensing.
Locations	NEMA 1. NEMA 2 (enclosure is air plenum rated), UL Type 2 (IEC IP54) with customer supplied water tight conduit connections.
Dimensions	MS51-7103: 6-5/16 H x 6-49/64 W x 3-1/2 D in. (160 x 172 x 89 mm). MS51-7203: 7 H x 10-5/8 W x 2-9/16 D in. (178 x 270 x 65 mm). MS61-7203: 9-9/16 H x 10-5/8 W x 2-9/16 D in. (243 x 270 x 65 mm).
Agency Listings	
UL 873	Underwriters Laboratories (File #E9429 Category Temperature-Indicating and Regulating Equipment).
CUL	UL Listed for use in Canada by Underwriters Laboratories. Canadian Standards C22-2 No. 24-93
European Community	EMC Directive (89/336/EEC). Low Voltage Directive (72/23/EEC).
Australia	This product meets requirements to bear the C-Tick Mark according to the terms specified by the Communications Authority under the Radio Communications Act 1992.
General Instructions	Refer to F-27169 and F-27120.

Accessories

Model No.	Description
AM-703	Input rescaling module, adjust signals to 2 to 10 Vac, zero and span adjust.
AM-704	Interface, pulse width modulation (PWM).
AM-705	Positioner (NEMA 4 housing).
AM-706	Min and/or manual positioner for flush panel mount.
AM-708	500 ohm resistor for 4 to 20 mA control signal.
AM-756	Metric conduit adapter M20 x 1.5 to 1/2 in. NPT.
MS51-7103	
AM-764	Linkage kit for damper applications.
AM-770	Replacement valve linkage parts kit.
MS51-71xx, MS51-72xx, and MS61-72xx	
AM-731	Mounting kit - MS51-720x (stem extension, lock washer, jam nut, connecting pin; included with actuator).
AM-732	Mounting kit - MS61-720x (stem extension, lock washer, jam nut, connecting pin; included with actuator).
AM-733	Retrofit kit - discontinued VB-9xxx 1-1/2 to 2 in. valves after 9404 date code.
AM-734	Retrofit kit - discontinued VB-9xxx 1-1/2 to 2 in. valves prior to 9404 date code.
AM-756	Metric conduit adaptor M20 x 1.5 to 1/2 in. NPT.
AM-763	1/8 in. Hex crank for manual override.

MS51-7103 Series, MSx1-7203 Series

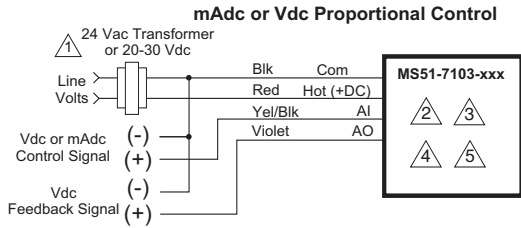
Valve Size Chart.

Valve Body Part Number	P Code	Size inches	Close-Off Pressure PSI ^a			Required Retrofit Kit
			MS51-710x	MS51-720x	MS61-720x	
VB-721X-000-4-P VB-7253-000-4-P VB-7273-000-4-P	1, 2,3 or 4	1/2	250			
	5 or 6	3/4	200			
	7 or 8	1	150			
	9	1-1/4	90	150		
	10	1-1/2	60	100		
	11	2	32	65		
VB-722X-000-4-P VB-7263-000-4-P VB-7283-000-4-P	1,2,3 or 4	1/2	250			
	5 or 6	3/4	200			
	7 or 8	1	90			
	9	1-1/4	60	150		
	10	1-1/2	35	100		
	11	2	20	65		
VB-731X-000-4-P	2 or 4	1/2	250			
	6	3/4	200			
	7 or 8	1	90			
	9	1-1/4	60	150		
	10	1-1/2	35	100		
	11	2	20	65		
VB-732X-000-4-P	4	1/2	250			
	6	3/4	250			
	7 or 8	1	250			
	9	1-1/4	250	250		
	10	1-1/2	250	250		
	11	2	250	250		
VB-8213-000-5-P VB-8223-000-5-P	12	2-1/2			125	
	13	3			125	
	14	4			125	
	15	5			125	
VB-8303-000-5-P	12	2-1/2			35	
	13	3			35	
	14	4			35	
	15	5			35	
VB-921X-000-4-P VB-9253-000-4-P VB-9273-000-4-P	1,2,3 or 4	1/2	250			
	5 or 6	3/4	200			
	7 or 8	1	150			
	9	1-1/4	90	150		
	10	1-1/2			100	AM-733 or AM-734 ^b
	11	2			65	AM-733 or AM-734 ^b
VB-922X-000-4-P VB-9263-000-4-P VB-9283-000-4-P	1, 2, 3, or 4	1/2	250			
	5 or 6	3/4	200			
	7 or 8	1	90			
	9	1-1/4	60	150		
	10	1-1/2			100	AM-733 or AM-734 ^b
	11	2			65	AM-733 or AM-734 ^b
VB-931X-000-4-P	2 or 4	1/2	250			
	6	3/4	200			
	7 or 8	1	90			
	9	1-1/4	60	150		
	10	1-1/2			65	AM-733 or AM-734 ^b
	11	2			65	AM-733 or AM-734 ^b
VB-9323-000-4-P	2 or 4	1/2	250			
	6	3/4	250			
	7 or 8	1	250			
	9	1-1/4	250	250		
	10	1-1/2			250	AM-733 or AM-734 ^b
	11	2			250	AM-733 or AM-734 ^b
VB-92X3-000-X-P VB-9313-000-X-P	12	2-1/2			33	
	13	3			22	
	14	4			12	

^a Note: Maximum valve differential operating pressures MUST be observed. Please consult our Valve Products Catalog F-27384 to assure the operating differential for your application is followed.

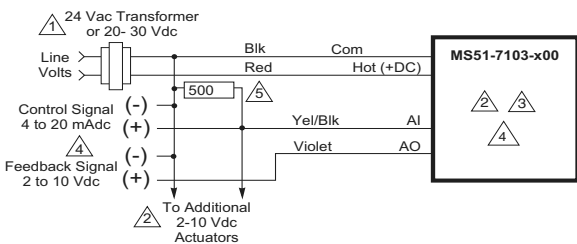
^b Use AM-733 with valves with date codes after 9404. Use AM-734 with valves with date codes before 9404.

Typical Applications



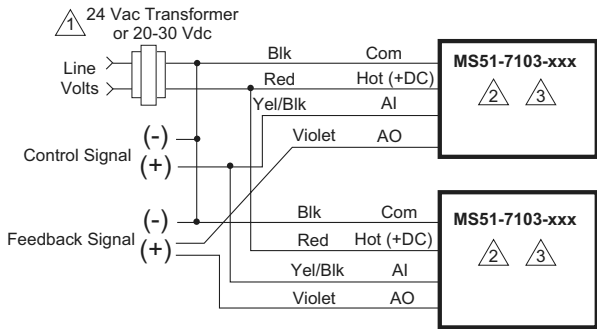
- 1 Provide overload protection and disconnect as required.
- 2 Actuators may be wired in parallel. All actuator black wires are connected to the transformer common and all red wires are connected to the hot lead. Power consumption must be observed.
- 3 If the controller uses a full-wave power supply and does not provide isolated outputs, a separate transformer is required.
- 4 On MS51-7103-x60 (4-20 mAdc) models a 500 ohm resistor is incorporated in the product. Do not use an external resistor.
- 5 Cable on some models contains more wires than are used in applications. Only those wires actually used are shown.

Figure 1 Vdc Proportional Control.



- 1 Provide overload protection and disconnect as required.
- 2 Actuators may be wired in parallel. All actuator black wires are connected to the transformer common and all red wires are connected to the hot lead. Power consumption must be observed.
- 3 If the controller uses a full-wave power supply and does not provide isolated outputs, a separate transformer is required.
- 4 Cable on some models contains more wires than are used in applications. Only those wires actually used are shown.
- 5 AM-708 load resistor to convert signal to 2 to 10 Vdc.

Figure 2 4 to 20 mAdc with 2 to 10 Vdc Actuators.



- 1 Provide overload protection and disconnect as required.
- 2 Actuators may be wired in parallel. All actuator black wires are connected to the transformer common and all red wires are connected to the hot lead. Power consumption must be observed.
- 3 Cable on some models contains more wires than are used in applications. Only those wires actually used are shown.

Figure 3 Proportional Control 24 Vdc Models Wired in Parallel.

MS51-7103 Series, MSx1-7203 Series

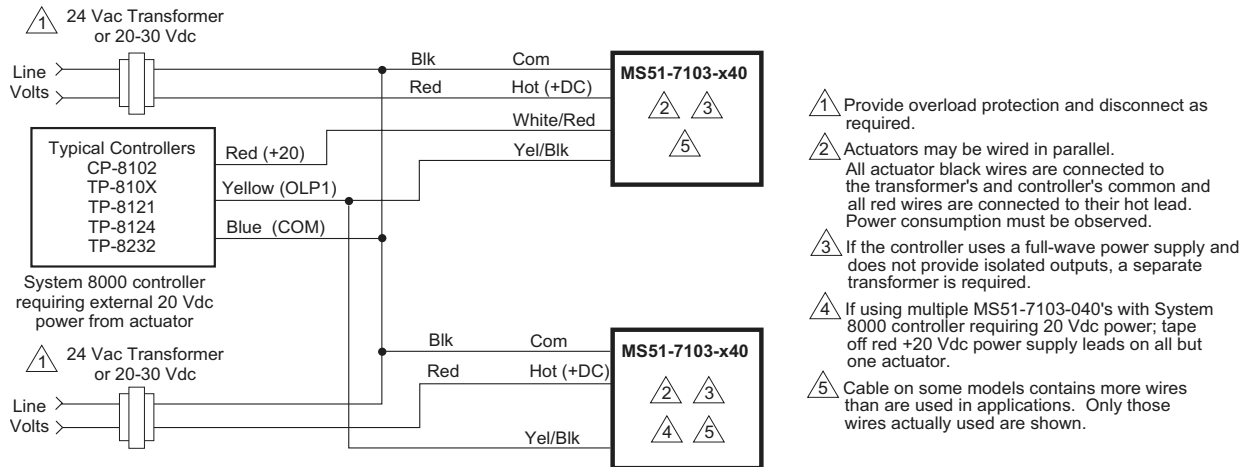


Figure 4 Two MS51-7103-x40 to System 8000 Controllers Requiring External 20 Vdc Power from Actuator.

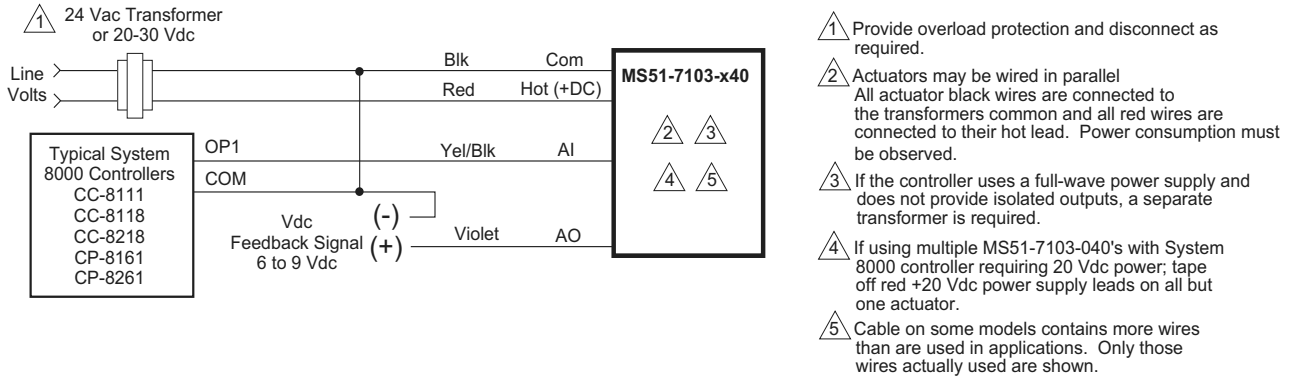


Figure 5 MS51-7103-x40 to Controllers Not Requiring External 20 Vdc Power from Actuator.

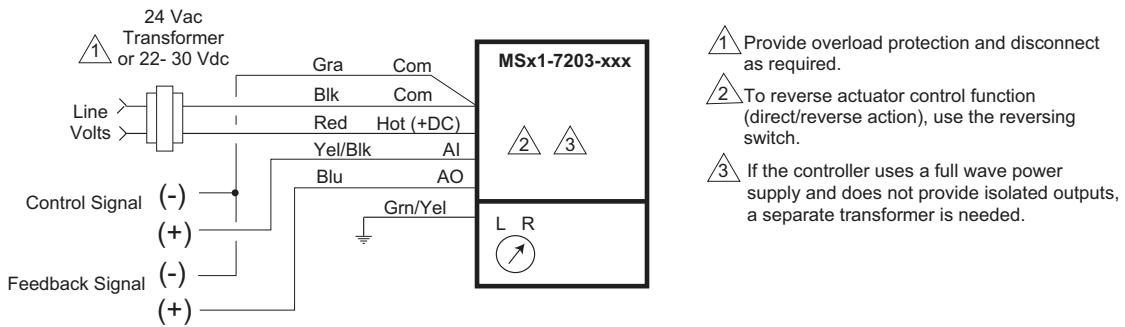


Figure 6 Typical Wiring Diagram for 4 to 20 mAdc Proportional Control.

MS51-7103 Series, MSx1-7203 Series

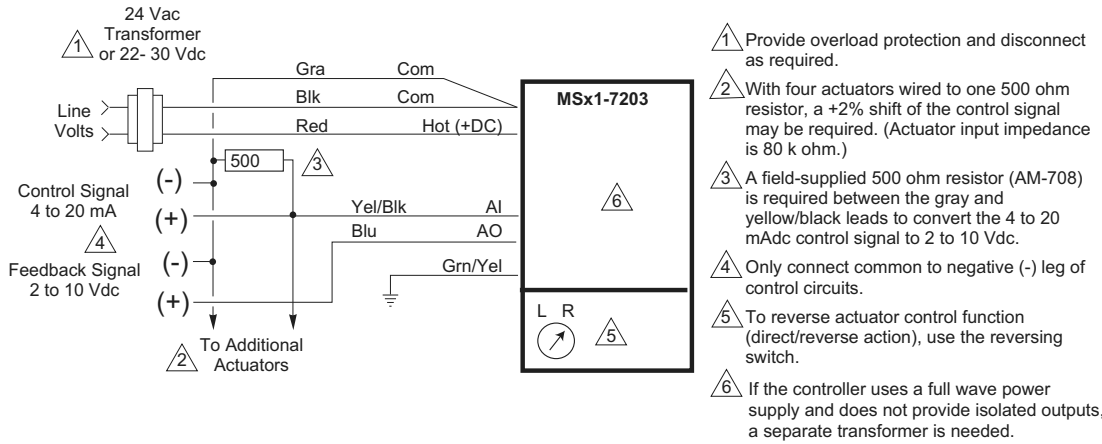


Figure 7 Typical Wiring Diagrams for Proportional Control 4 to 20 mA Converted to 2 to 10 Vdc Basic Models.

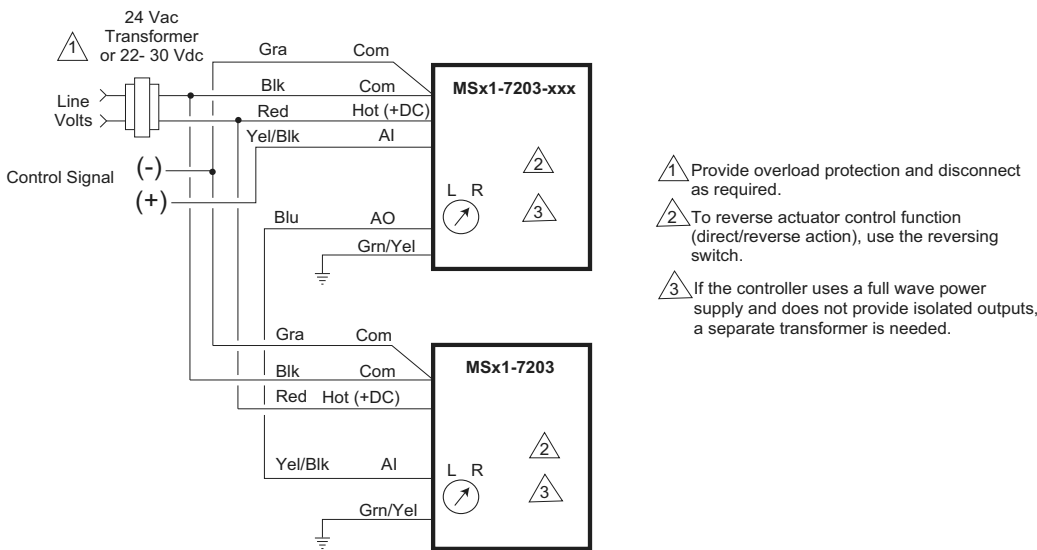


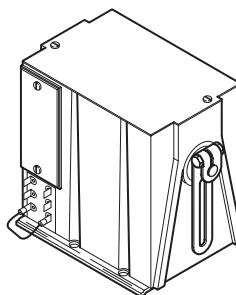
Figure 8 Typical Wiring Diagrams for Proportional Control 2 to 10 Vdc Models Wired in Parallel.

Electronic Gear Train Economizer Actuator

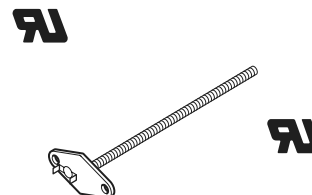
This actuator provides modulating operation of dampers and other equipment which require the return to normal position upon power interruption. Adjustable minimum position control 0 to 90°. Replaces Honeywell M-7415A and functionally replaces White-Rodgers 3420-4.

Features:

- Proportional damper economizer actuator with built-in controller.
- Adjustable mixed air setpoint, throttling range, minimum positions, and travel.
- Spring return.



MU-12313



Thermistor Sensor
(Shipped with actuator.)

Model Chart					
Model No.	Description	Watts		VA	
		Running	Holding	Running	Holding
MU-12313	Round output shaft	14.4	9.6	14.2	9.2
MU-12313-100	Square output shaft				

Specifications	
Control circuit	Two-wire.
Mixed or discharge air sensor	Thermistor (8 in. long) with 1/4 in. male quick connectors and integral mounting flange; 10K Ω at 77°F (25°C), negative temperature coefficient. Supplied with actuator.
MA (Mixed Air) setpoint	Dial adjustable 40 to 65°F (4 to 18°C); factory set at 55°F (18°C).
Throttling range	Factory set. Refer to Throttling Ranges Table.
Power supply	24 Vac, Class 2 (+10, -15% for 0 to 90° travel; +10, -10% for 90 to 180° travel), 60 Hz 24 Vac, Class 2 (+10, -10%), 50 Hz.
Torque	
Rated	25 lb-in. (2.8 N-m).
Limit	40 lb-in. (4.5 N-m) under stall conditions.
Nominal Damper Area	Actuator sizing should be done in accordance with damper manufacturer's specifications.
Shaft output	Dual output; either shaft can be used if torque limit is not exceeded.
Environment	
Shaft rotation	CCW when power is applied. (The front of the actuator is defined as the right end when facing the field wiring terminals.) Maximum shaft rotation field adjustable 75°, 90°, 110°, 160°, 180°; factory set 90°. When used with 50 Hz power supply, rotation is limited to 75° or 90° adjustments.
Minimum position	Factory set 22°. Dial adjustable 0 to 90°.
Timing	
Powered	28 sec/90°.
Spring return	18 sec/90°.
Environment	
Ambient temperature limits	Shipping and storage: -40 to 160°F (-40 to 71°C). Operating: -40 to 140°F (-40 to 60°C).
Humidity	5 to 95% RH, non-condensing.
Locations	NEMA Type 1 (NEMA 3R with AM-219 installed and mounted in vertical position).
Vibration	Maximum 1G in any plane.
Wiring connections	Side mounted #6 self tapping screw 1/4 in. tab.

Specifications (Continued)

Case	Glass reinforced thermoplastic (PET) cover, plated steel case.
Mounting	Any position. Five 9/32 in. (7.1 mm) mounting holes provided.
Crank arm for actuator	AM-112 included with actuator. 3/8 in. (9.5 mm) slot provides for adjustable radius from 7/8 in. (22 mm) to 3-1/8 in. (79 mm).
Dimensions	5-1/2 H x 5 W x 7-9/32 D in. (140 x 127 x 185 mm). 3/8 in. (9.5 mm) shaft diameter.
General Instructions	Refer to F-22174.

Throttling Ranges^a

Degree Rotation	T.R. as Factory Supplied F°(C°)	T.R. with Jumper J1 Removed F° (C°)
75	7 (3.8)	3.5 (1.9)
90	8 (4.4)	4 (2.2)
110	10 (5.5)	5 (2.8)
160	14 (7.2)	7 (3.8)
180	16 (8.9)	8 (4.4)

^a Number of degrees change required at the sensor in order to produce the maximum rotation of the actuator output shaft.

Accessories

Model No.	Description
Damper Linkage Accessories	
AD-931-105	Min positioner.
AM-111	Crank arm for 5/16 in. diameter damper shaft.
AM-112	Crank arm for 3/8 in. diameter damper or MU-12313 actuator shaft.
AM-113	Crank arm for MU-12313 or 1/2 in. diameter damper shaft.
AM-115	Crank arm for 7/16 in. diameter damper shaft.
AM-122	Linkage connector straight type.
AM-123	Damper clip.
AM-125	5/16 in. diameter x 20 in. damper rod.
AM-125-048	5/16 in. diameter x 48 in. damper rod.
AM-132	Ball joint connector.
AM-219	Conduit cover kit.
AM-230	Crank arm for MU-12313-100.
AM-301	90° mounting bracket.
BDHE-55	Thermistor sensor.

Typical Applications

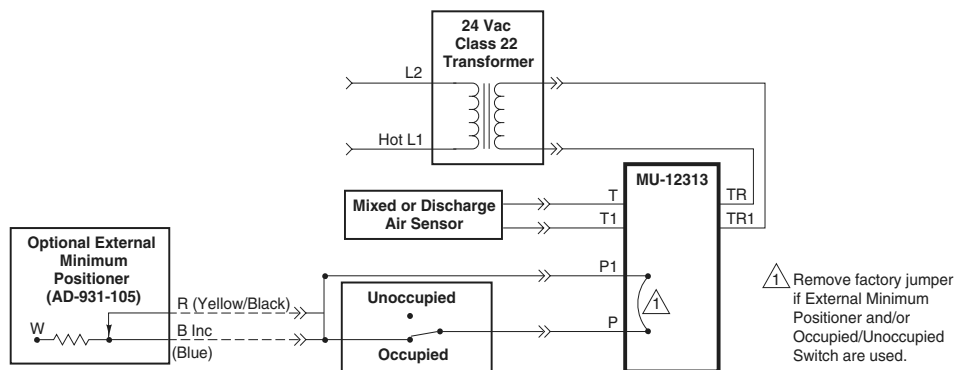


Figure 1 Typical Wiring for MU-12313.

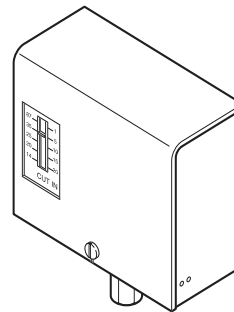
PC-1XX Series

Pneumatic-Electric Pressure Switch

For on-off control of electrical devices such as air compressors, fans, pilot lights, etc., by the use of a predetermined air pressure signal.

Features:

- One, two, and three switch models to meet a variety of applications.
- One and two switch models have adjustable setpoints.
- Indication scales on one and two switch units.
- Agency approved.



PC-110

Model Chart									
Model No.	Mounting	Switch Action	Scale Range psig (kPa)		Differential psig (kPa)		Ambient Temp Limits °F (°C)	Max. Press. Input psig (kPa)	Dimensions (H x W x D) in. (mm)
PC-110	Surface or track	SPDT makes N.O. contact to common on pressure increase	1 to 20 (7 to 138)		1 to 5 (7 to 34) Adjustable factory set at 2 (14)		-40 to 150 (-40 to 118)	50 (345)	3-1/2 x 3-1/8 x 2-1/8 (89 x 79 x 54)
PC-131	Surface	DPST opens on pressure rise	3 to 30 (21 to 207)		1-1/2 to 20 (10 to 138) Adjustable		32 to 140 (0 to 78)		4-1/4 x 4 x 2-9/32 (108 x 102 x 58)
PC-132		DPST opens on pressure drop						4-1/4 x 4 x 2-9/32 (108 x 102 x 58)	
PC-151	Surface	3 SPST opens on pressure rise	Sw.	Open	Sw.	Fixed	32 to 140 (0 to 78)	150 (1034)	3-1/4 x 5-3/8 x 3-1/2 (83 x 137 x 89)
			1	6 (41)	1	3 (21)			
			2 & 3	18 (124)	2 & 3	0.5 (3)			

Electrical Ratings.

Model No.	Volts (Vac)	FLA Amps	LRA Amps	Non-Ind. Amps	Pilot Duty VA
PC-110	24	—	—	16	100
	120	13.8	82.8		650
	208	9.6	57.6	9.6	750
	240	8.3	49.8	8.3	
	277	—	—	7.2	—
PC-131 ^a PC-132	120	12	72	12	125 at 120/600 Vac
	208				
	240				
	277	—	—		
PC-151	120	6	36	6	125 at 24/277 Vac
	208/240	3	18	3	
	277	—	—	2.6	

^a The only parts available to Uni-Line.

Specifications

Diaphragm	Non-metallic, positioned by air pressure changes to actuate switches.
Environment	
Humidity	5 to 95% RH, non-condensing.
Locations	NEMA Type 1.
Connections	
Air	1/8 in. FNPT. Except PC-131 and PC-132 1/8 in. male NPT.
Electrical	Coded screw terminals.
Electrical ratings	Refer to Electrical Ratings Table.

Accessories

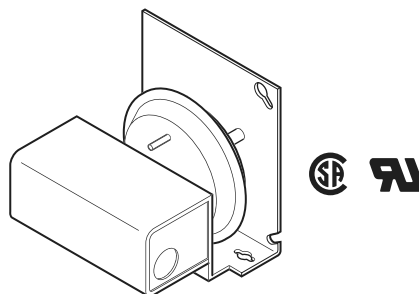
Model No.	Description
For PC-110 only	
AD-8953	Track.
AK-52582	Bracket for mounting PC-110 to track.

Two-Position Air Flow Pressure Switch

This switch provides low or line voltage control of pressure for air and non-combustible gases. It controls static pressure, total pressure, or differential total pressure.

Features:

- High/low pressure taps.
- Adjustable from 0.07 to 1 in. (1.8 to 25.4 mm) W.C.
- Universal mounting.
- Agency approved.



Model Chart	
Model No.	Description
PC-301	Refer to Specifications.

Specifications	
Setpoint	
Factory setting	0.07 in. (1.8 mm) W.C.
Field adjustment	0.07 to 1 in. (1.8 to 25.4 mm) W.C.
Sensing element	Neoprene diaphragm.
Differential	0.04 in. (1 mm) W.C. at minimum setpoint to 0.1 in. (3 mm) W.C. at maximum setpoint.
Environment	
Ambient temperature limits	Shipping and storage: -40 to 140°F (-40 to 60°C). Operating: 35 to 140°F (2 to 60°C).
Humidity	5 to 95% RH, non-condensing.
Locations	NEMA Type 1.
Maximum pressure	12 in. (305 mm) W.C.
Electrical switch	
Type	Snap action SPDT.
Ratings	Refer to Maximum Electrical Switch Ratings Table.
Connections	Refer to Figure 1.
Wiring	Coded screw terminals.
High pressure taps	One barbed fitting for 3/8 in. O.D. plastic tubing.
Low pressure taps	One barbed fitting for 1/4 in. O.D. plastic tubing.
Case	All metal with 1/2 in. conduit opening.
Mounting	In vertical position on any surface free of vibration.
Dimensions	6-3/8 H x 4-3/4 W x 4-3/8 D in. (162 x 121 x 111 mm).
General Instructions	Refer to F-16160.

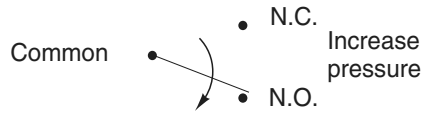
Maximum Electrical Switch Ratings.

Vac	Full Load Amps	Locked Rotor Amps	Pilot Duty (VA)	Non-Inductive Amps
24 V	—	—	60	—
120 V	6.25	37.5	300	
240 V	3.1	18.6		
277 V	2.7	16.2		10

Accessories

Model No.	Description
AP-302	Duct static pressure sensing tip for pressure 1 in. (25.4 mm) W.C. and up.
AP-305	Duct static pressure sensing tip for pressure 0.01 in. (0.3 mm) W.C. and up.
AT-208	Duct mounting bracket for probes other than AP-302 and AP-305.

Typical Applications



N.O. makes on increase of pressure.

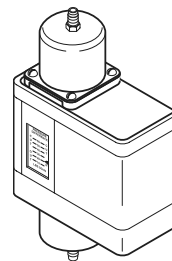
Figure 1 Switch Action for PC-301 Switch.

Floating Differential Pressure Switch

For use with reversible electric actuated valves, actuators, or sequence controllers for control of steam, air, gas, or liquid pressure differential.

Features:

- Adjustable setpoint.
- Usable on steam, air, gas, or liquid.
- Floating action for MP-gear train actuators.



Model Chart	
Model No.	Description
PF-126	Refer to Specifications.

Specifications	
Control range	8 to 60 psi (57 to 414 kPa). Graduated scale and external adjustment screw.
Sensing elements	High and low pressure bellows with opposing spring mechanism.
Differential	2 psi (14 kPa) fixed.
Maximum static pressure	180 psi (1241 kPa).
Environment	
Ambient temperature limits	Shipping and storage: -40 to 140°F (-40 to 60°C). Operating: 35 to 140°F (0 to 60°C).
Humidity	5 to 95% RH, non-condensing.
Locations	NEMA Type 1.
Electrical switch	
Ratings	1.0 amps at 24 Vac, 60 Hz.
Connections	
Electrical	Coded screw terminals.
Pressure connectors	Two 1/4 in. male flare.
Case	All metal with 1/2 in. conduit opening.
Mounting	In any position.
Dimensions	7-7/8 H x 4 W x 2 D in. (200 x 102 x 51 mm).
General Instructions	Refer to F-11384.

Typical Applications

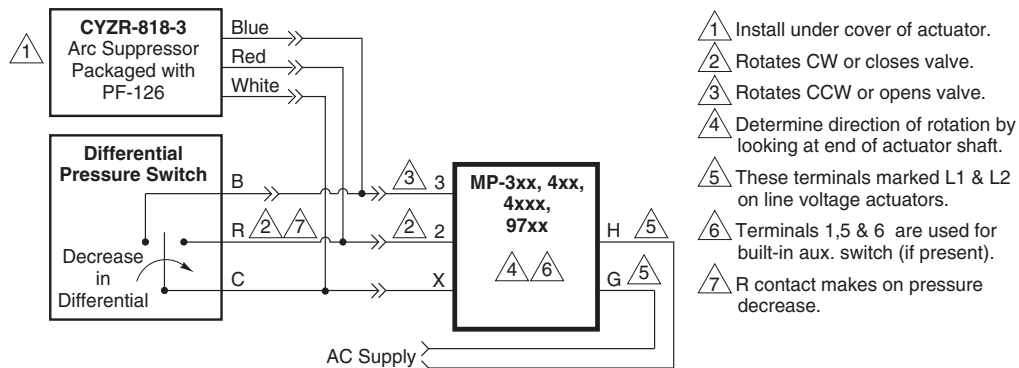


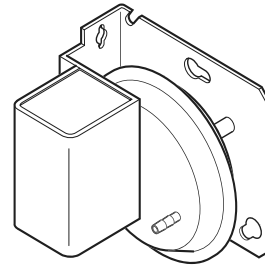
Figure 1 Switch Action and Typical Wiring.

Floating Pressure Air Flow Switch

These switches are used with reversible electric actuators to control differential pressures, low static pressures, or air velocities in duct systems.

Features:

- Low static control for ± 0.5 in. control unit.
- Built-in arc suppression.
- Liquid level control usability.
- Highly reliable product.
- Universal mounting.



Model Chart				
Model No.	Differential Pressure Setpoint Range in. (mm) of Water	Adjustable Null Span ^a		Velocity Range fpm (m/s) 70°F (21°C) Air
		At Minimum Setpoint in. (mm) of Water	At Maximum Setpoint in. (mm) of Water	
PF-305	-0.5 to +0.5 (-12.7 to +12.7)	0.06 to 0.14 (1.5 to 3.5)	0.07 to 0.14 (1.8 to 3.5)	400 to 2800 (2 to 14)
PF-306	0.2 to 1.3 (5.1 to 33)	0.05 to 0.13 (1.3 to 3.3)	0.13 to 0.28 (3.3 to 7.1)	1800 to 4600 (9 to 23)
PF-307	1.1 to 3.5 (27.9 to 88.9)	0.06 to 0.17 (1.5 to 4.3)	0.11 to 0.31 (2.8 to 7.9)	4200 to 7500 (21 to 38)
PF-308	3.2 to 10 (81.3 to 254)	0.12 to 0.4 (3.0 to 10.2)	0.24 to 0.8 (6.1 to 20.3)	7200 to 14000 (37 to 71)

^a Minimum null is with 0.005 in. (0.13 mm) contact gap. Maximum null is with 0.025 in. (0.63 mm) contact gap.

Specifications	
Differential pressure setpoint range	Refer to Model Chart.
Sensing element	Silicone rubber coated polyester diaphragm.
Adjustable null span	Refer to Model Chart.
Maximum pressure	
Differential	12 in. (305 mm).
Input	28 in. (711 mm).
Environment	
Ambient temperature limits	Shipping and storage: -40 to 140°F (-40 to 60°C). Operating: 35 to 140°F (0 to 60°C).
Humidity	5 to 95% RH, non-condensing.
Locations	NEMA Type 1.
Electrical switch	
Type	Floating SPDT. Integral arc suppression.
Ratings	1.0 amps at 24Vac
Connections	Refer to Figure 1.
Wiring	Coded screw terminals.
Air pressure taps	Barbed fittings for 3/8 in. O.D. plastic tubing, one high and one low.
Case	All metal with 1/2 in. conduit opening.
Mounting	In vertical position on any surface free of vibration.
Dimensions	5-1/8 H x 4-3/4 W x 4-3/8 D in. (130 x 121 x 111 mm).
General Instructions	Refer to F-17492.

PF-30x Series

Accessories

Model No.

AP-302
 AP-305
 AT-208
 N1-81
 N1-52
 N1-53

Description

Duct static pressure sensing tip for pressure 1 in. (25.4 mm) W.C. and up.
 Duct static pressure sensing tip for pressure below 1 in. (25.4 mm) water.
 Duct mounting bracket for probes other than AP-302 and AP-305.
 Velocity pressure probe, 3 in.
 Velocity pressure probe, 6 in.
 Velocity pressure probe, 9 in.

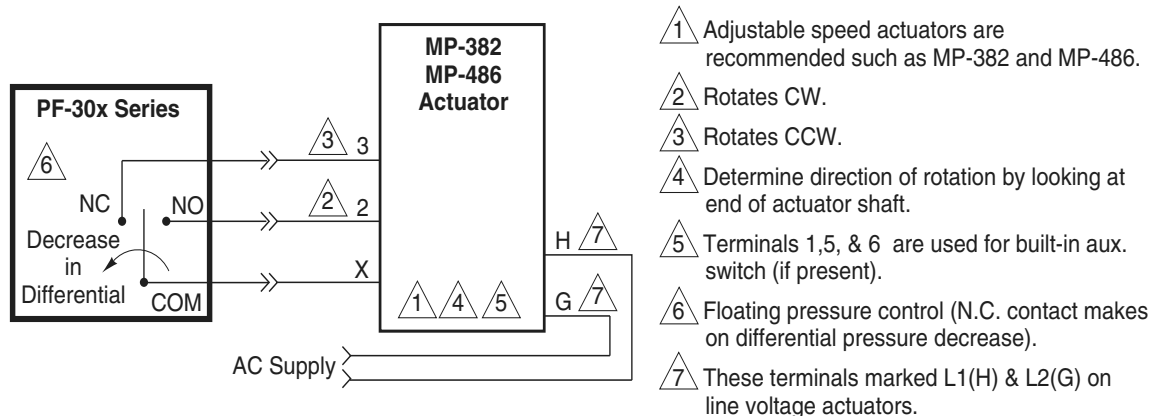
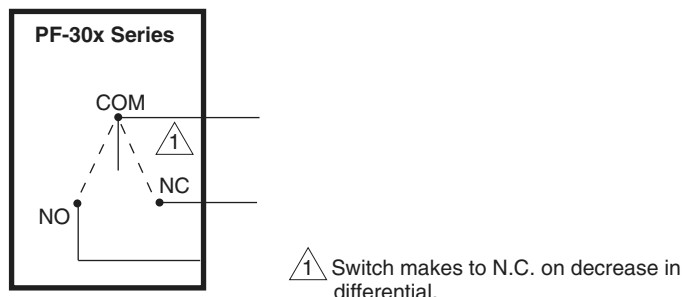


Figure 1 Switch Action and Typical Connections for PF-305 Switch.



Model No.	Com Term	N.C. Term (CCW)	N.O. Term (CW)
MF40-6043	24N	Orange	Violet
MF41-6153			
MF41-6343	24H	Red	White
MF40-7173			
MF51-7103*	24H	Blue	Yellow/Black
MF61-7203*			
MF4D-6043-100	24H	Yellow/Black	Blue
MF4D-6083-100			
MF4E-60430-100	24H	Yellow/Black	Blue
MF4E-60830-100			
MF40-7043	24H	Yellow	Blue
MF41-7073			
MF41-7153			

*Linear actuator Blue retracts, Yellow/Black extends.
 For complete wiring details for these actuators, refer to their general instructions document.

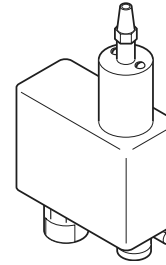
Figure 2 Switch Action and Typical Connections for PF-30x With Other Actuators.

Proportional Pressure Controllers

For the proportional pressure control of steam, air, gases, or liquids.

Features:

- Usable on steam, air, and water.
- Built in arc suppression.
- Adjustable throttling range.
- Locking feature for setpoint.



Model Chart			
Model No.	Control Knob Range (psig)	Throttling Range (psig)	
		Factory set at	Adj. between
PP-221	20 in. Hg. Vac to 10 psig	1	1 to 3
PP-222	0 to 20		
PP-223	10 to 60	2-1/2	2-1/2 to 7-1/2
PP-224	50 to 150	5	5 to 15
PP-225	100 to 250	7-1/2	7-1/2 to 22-1/2
PP-226	216 to 360		

Specifications	
Control range	Refer to Model Chart. Graduated adjusting knob with recessed locking screw.
Pressure element	Stainless steel cartridge type.
Differential	Approximately 2-1/2% of total range.
Maximum bellows pressure	400 psig (2758 kPa).
Environment	
Ambient temperature limits	Shipping and storage: -40 to 140°F (-40 to 60°C). Operating: 35 to 140°F (2 to 60°C).
Humidity	5 to 95% RH, non-condensing.
Locations	NEMA Type 1.
Electrical Switch	SPDT with silver contacts and proportional solenoid.
Ratings	1.0 amps at 24 Vac, 60 Hz.
Connections	
Electrical	Coded screw terminals.
Pressure connection	Flared fitting for 1/4 in. tubing.
Case	All metal with 1/2 in. conduit opening.
Mounting	On any flat vertical surface free of vibration.
Dimensions	9 H x 5-1/4 W x 2-5/16 D in. (229 x 133 x 59 mm).
General Instructions	Refer to F-11526.

Typical Applications

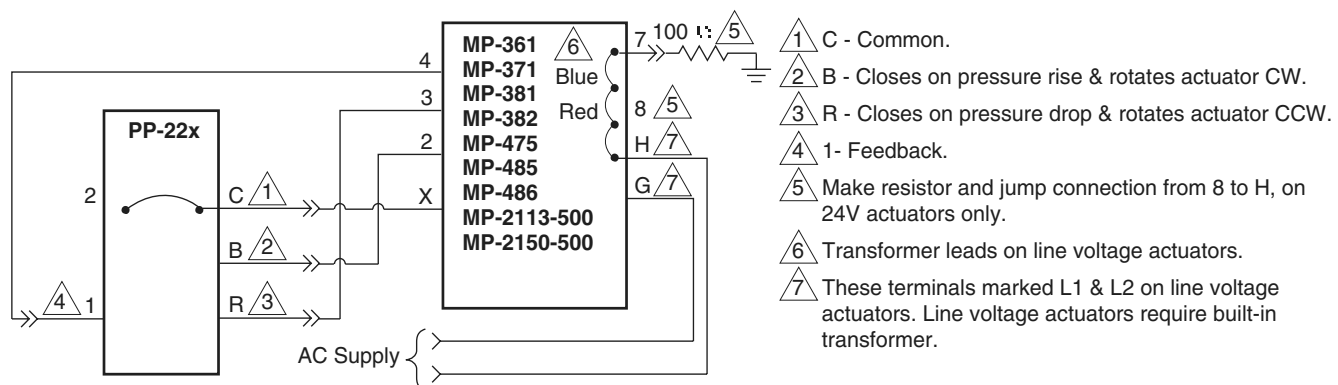
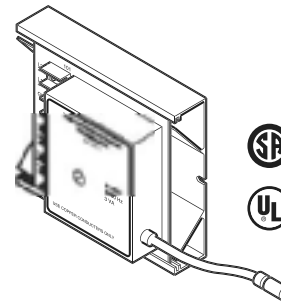


Figure 1 Switch Action and Typical Wiring.

Pressure Transducer

This transducer converts a 3 to 15 psig (21 to 103 kPa) or a 0 to 20 psig (0 to 137 kPa) pneumatic input signal to a proportional 4 to 20 mAdc or 1 to 5 Vdc electronic output signal.



Features:

- 4 to 20 mAdc load capability to 625 Ω maximum.
- Dual outputs for 4 to 20 mAdc and 1 to 5 Vdc.
- 3 to 15 psig factory calibrated.
- Does not consume any air.
- Can be calibrated for 0 to 20 psig.
- Requires less panel spaces than former model.

Model Chart				
Model No. ^a	Transducer Power Input			
	Voltage	Hz		VA
PP-8311-024-0-0-1	24 Vac (±15%)	50	60	2.5
PP-8311-120-0-0-1	120 Vac (+10/-15%)			4.0

^a CAUTION: This product contains a half-wave rectifier power supply and must not be powered off transformers used to power other devices utilizing non-isolated full-wave rectifier power supplies.

Specifications

Inputs	
Signal	Factory setting: 3 to 15 psig (21 to 103 kPa). Adjustable to: 0 to 20 psig (0 to 137 kPa) by recalibration.
Load impedance capability	4 to 20 mA output 625 Ω maximum 1 to 5 volts output, 1,000 Ω minimum.
Maximum supply air pressure	30 psig (207 kPa).
Operating characteristics	Linearity: ±0.75% of span. Hysteresis: ±0.25% of span.
Air consumption	None.
Connections	Coded screw terminals and one barbed fitting for 1/4 in. O.D. plastic tubing.
Outputs	
Electrical	Output signal: 4 to 20 mAdc and 1 to 5 Vdc. Supply voltage: Refer to Model Chart.
Mechanical	Action: Direct acting output rises as input increases.
Adjustments	Refer to Figure 1.
Environment	
Ambient temperature limits	Shipping and handling: -40 to 160°F (-40 to 71°C). Operating: 40 to 140°F (4 to 60°C).
Temperature stability	Typically ±0.03% of output span per °F between 40 and 140°F.
Humidity	5 to 95%, non-condensing.
Location	NEMA Type 1.
Dimensions	3-7/8 H x 5 W in. (98 x 127 mm).
Agency Listing	UL File E71385. CUL.
General Instructions	Refer to F-20091.

PP-8311 Series

Accessories

Model No.	Description
TOOL-95-1	Pneumatic calibration tool kit.

Typical Applications

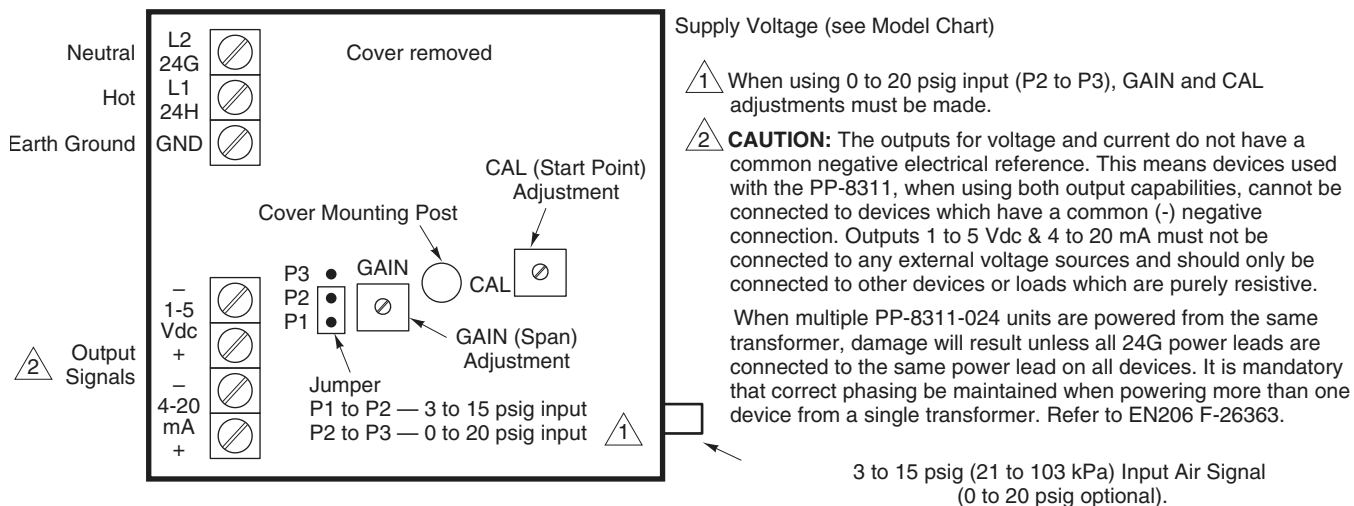


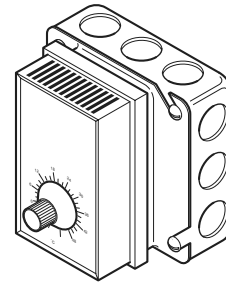
Figure 1 PP-8311 Series Pressure Transducer Terminal Designations Shown with Cover Removed.

Proportional Temperature Controller (Less Sensor)

Electronic temperature controller for single loop control of media in ducts, tanks, and liquid lines.

Features:

- Dual sensor capability.
- Optional reset sensor.
- Direct acting, reverse acting, pin selectable.
- System 8000 compatible.
- 100°F spans.
- Reset ratios switch selectable.



SLC-811x Series

Model Chart			
Model No.	Setpoint Dial Range	Sensor Connections ^a	Control Connections ^a
SLC-8112	0 to 100°F (-18 to 38°C) ^b	Use standard System 8000 sensors.	Red, yellow and blue pigtail leads provided for low voltage connection to System 8000 controlled devices.
SLC-8113	60 to 160°F (16 to 71°C) ^b	Two black pigtail leads provided for primary sensor (typically TS-8201 TS-8405, or TS-8422).	
SLC-8114	120 to 220°F (49 to 104°C) ^b	Two white pigtail leads provided for optional reset sensor (typically TS-8501).	

^a Terminate all pigtail leads in 4 x 4 electrical box provided.

^b °C insert included with controller.

For additional information on System 8000 wiring, refer to General Rules for Wiring Controllers to Controlled Devices.

Specifications	
Construction	Self-contained proportional temperature controller with integral setpoint for use with remotely located System 8000, 1000 Ω Balco sensors.
Setpoint dial range	Refer to Model Chart.
Throttling range	Pin selectable (3, 8, 12 or 20°F); factory set at 8°F for 3 Vdc output change.
Power requirements	20 Vdc (+1.0, -1.5), 13 mA.
Output voltage	2 to 15 Vdc direct acting; field changeable to 15 to 2 Vdc reverse acting. Calibrated at 7.5 Vdc when dial setting matches temperature sensed by integral sensor.
Controlled devices	Maximum of six System 8000 devices or two MP-5210 actuators.
Selectable reset ratio	Selectable on a prewired DIP switch for 0.7:1, 1:1, 1.5:1 or 15:1 (0.7:1 equivalent to 1:1.5 ratio).
Control and sensor connections	Refer to Model Chart.
Environment	
Ambient temperature limits	Shipping and storage: -40 to 160°F (-40 to 71°C). Operating: 40 to 140°F (4.4 to 60°C).
Humidity	5 to 95% RH, non-condensing.
Locations	NEMA Type 1.
Cover	Beige colored plastic with brushed bronze metal insert.
Mounting	Controller installed on 4 x 4 electrical box for mounting directly on wall or inside a panel (enclosure).
Dimensions	4-3/8 H x 4-1/8 W x 4-1/2 D in. (111 x 105 x 114 mm).
General Instructions	Refer to F-23322.

SLC-811x Series

Accessories

Model No.	Description
AD-8122	Signal adaptor for dual outputs (two direct acting).
AD-8123	Signal adaptor for dual outputs (one direct, one reverse acting).
AD-8124	Signal adaptor for dual outputs (one reverse, one direct acting).
AT-226	Brass bulb well.
TS-8201	Duct/immersion sensor.
TS-8405	Averaging sensor 5 ft. (1.5 m).
TS-8422	Averaging sensor 22 ft. (6.7 m).
TS-8501	Outdoor air sensor.

Typical Applications

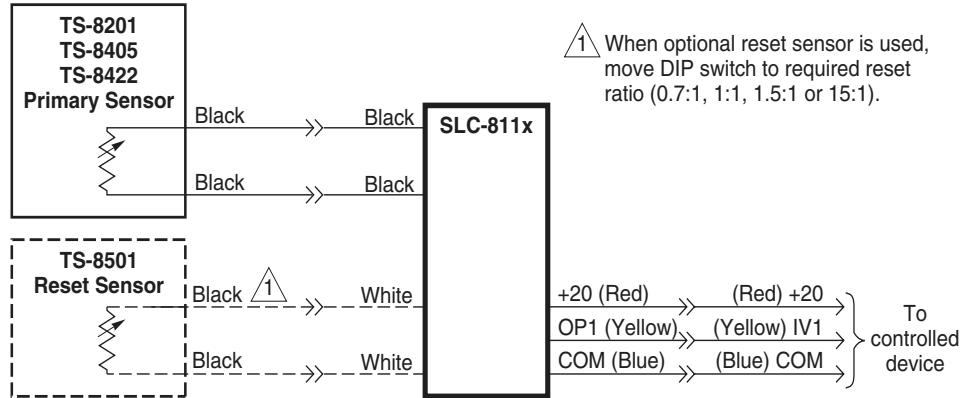


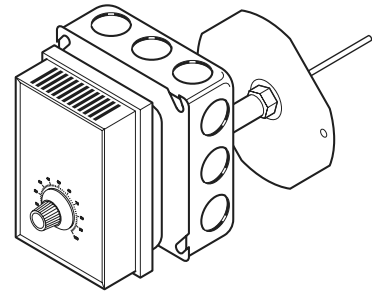
Figure 1 Typical Wiring Diagram.

Proportional Temperature Controller with Sensor

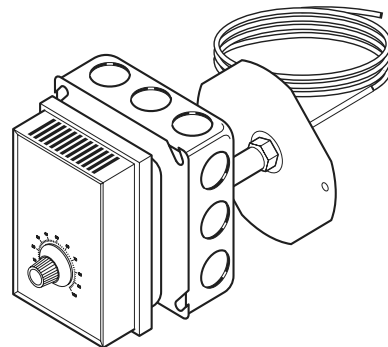
Electronic temperature controller for single loop control of media in ducts, tanks, and liquid lines.

Features:

- Dual sensor capability.
- Optional reset sensor.
- Direct acting, reverse acting, pin selectable.
- System 8000 compatibility.
- Span of 100°F.
- Switch selectable reset ratios.



SLC-832x
Duct/Immersion



SLC-833x
Duct Averaging

Model Chart		
Model No.	Type	Setpoint Dial Range °F (°C)
SLC-8322	Duct/immersion with probe sensor	0 to 100 (-18 to 38)
SLC-8323 ^a		60 to 160 (16 to 71)
SLC-8324 ^a		120 to 220 (49 to 104)
SLC-8332 ^a	Duct with averaging sensor	0 to 100 (-18 to 38)
SLC-8333 ^a		60 to 160 (16 to 71)

^a °C insert included with controller.

SLC-832x, SLC-833x

Specifications	
Power requirements	20 Vdc (+1.0, -1.5), 13 mA.
Output voltage	2 to 15 Vdc direct acting; field changeable to 15 to 2 Vdc reverse acting. Calibrated at 7.5 Vdc when dial setting matches temperature sensed by integral sensor.
Environment	
Ambient temperature limits	Shipping and storage: -40 to 160°F (-40 to 71°C). Operating: 40 to 140°F (4 to 60°C).
Humidity	5 to 95% RH, non-condensing.
Locations	NEMA Type 1.
Construction	Self-contained proportional temperature controller with integral setpoint and sensing element. Optional reset sensor available.
Setpoint dial range	Refer to Model Chart.
Throttling range	Pin selectable (3, 8, 12 or 20 F degrees); factory set at 8 F degrees for 3 Vdc output change.
Controlled devices	Maximum of six System 8000 devices.
Selectable reset ratio	All units provided with a selectable reset ratio on a prewired DIP switch for 0.7:1, 1:1, 1.5:1, or 15:1 (0.7:1 equivalent to 1:1.5).
Sensing element	1000 Ω Balco, refer to Model Chart.
Cover	Beige colored plastic with brushed bronze metal insert.
Mounting	
Duct	Mounting plate provided; 2-1/2 in. (64 mm) standoff provides clearance if required.
Immersion (SLC-832X only)	Install controller directly to an AT-226 bulb well (order separately).
Dimensions	
Controller	4-3/8 H x 4-1/8 W x 4-1/2 D in. (111 x 105 x 114 mm).
Sensor insertion length	SLC-832X: 6 in. (152 mm). SLC-833X: 5 ft. (1.5 m).
Connections	
	Refer to Typical Applications.
To optional reset ratio sensor	All units are provided with two white pigtail leads for connection to optional reset sensor (typically TS-8501). Terminate all pigtail leads in the 4 x 4 electrical box provided. For additional information on System 8000 wiring, refer to F-22985.
General Instructions	Refer to F-22985.

Accessories	
Model No.	Description
AD-8122	Signal adaptor for dual outputs (two direct acting).
AD-8123	Signal adaptor for dual outputs (one direct, one reverse acting).
AD-8124	Signal adaptor for dual outputs (one reverse, one direct acting).
AT-226	Brass bulb well.
TS-8501	Outdoor air sensor.

Typical Applications

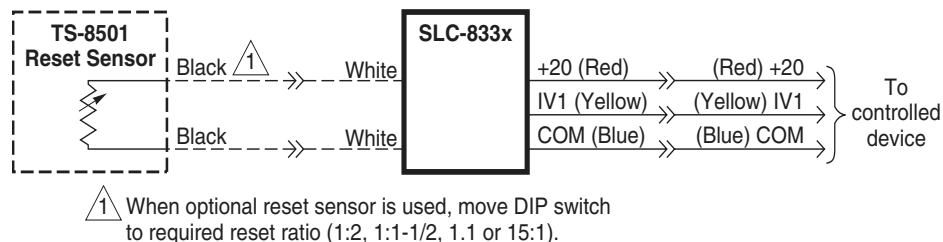


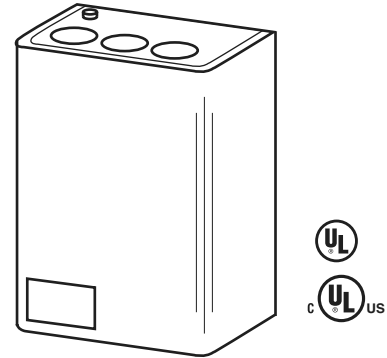
Figure 1 Typical Wiring Diagram.

Erie™ Universal Control Relay

The SR100 series zone control relay incorporates a double pole/double throw relay to control a circulator and a boiler operating control in a single zone hydronic heating system.

Features:

- Field replaceable relay.
- High capacity 10 VA transformer.
- Large terminal connections.
- Common 24 Vac transformer terminal.
- Optional auto-test function to test system operation.



Model Chart	
Model No	Description
SR100	Single zone relay.
ST100AT	Single zone relay with auto-test.

Specifications	
Inputs	
Power input	120 Vac @ 50/60 Hz.
Thermostat	Thermostatic anticipator setting: 0.07 amps @ 24 Vac.
Outputs	
Electrical	Relay rating: 1/3 HP @ 120 Vac, Full load: 10.0 amps, Locked rotor: 43.2 amps (3, 4NO, 4NC). Resistive: 10.0 amps.
Environment	
Ambient temperature limits	Shipping and storage: -20 to 140°F (-29 to 60°C) Operating: maximum of 120°F (49°C).
Humidity	85% non-condensing RH.
Locations	NEMA Type 1.
Dimensions	4-1/8 x 2-7/8 x 5-1/8 inches (105 x 73 x 130 mm).
Agency Listing	UL File #E9429. CUL.
General Instructions	Refer to F-27018.

Accessories	
Model No.	Description
EXP10	Replacement relay.

Typical Applications

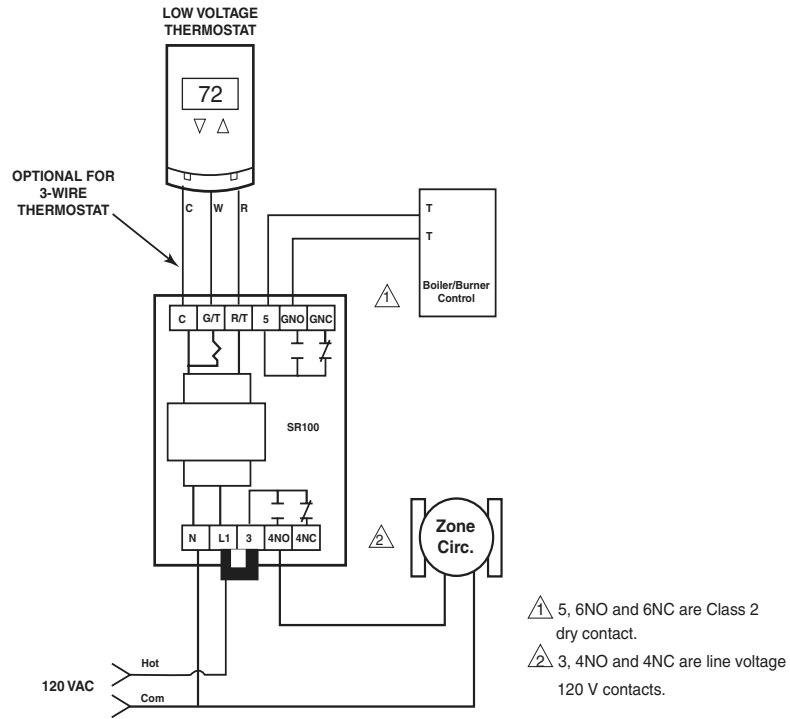


Figure 1 SR100 Relay Typical Wiring.

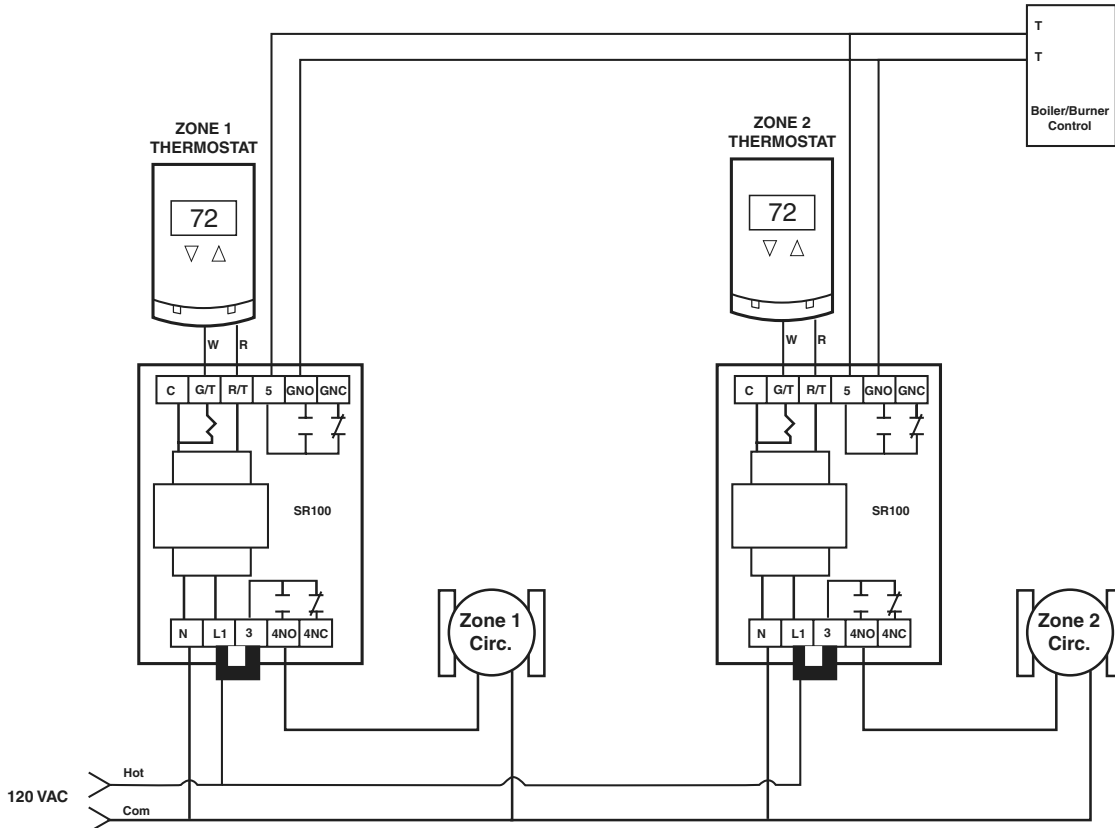


Figure 2 Multiple Zoning Using SR100 Relays.

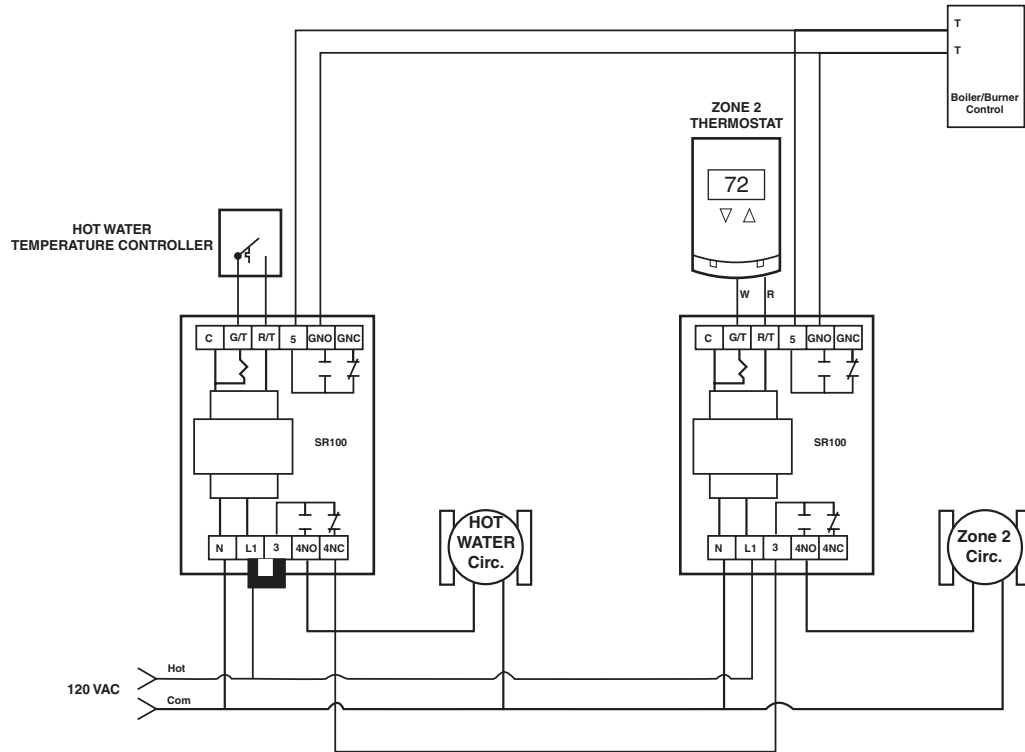


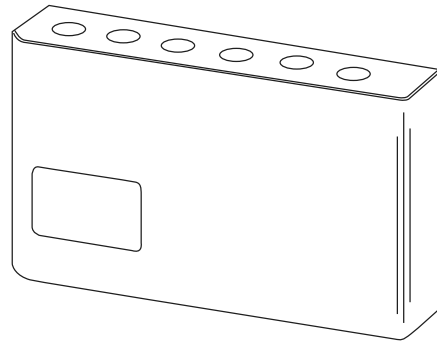
Figure 3 SR100 Series With Domestic Hot Water Priority.

Erie™ Multi-Zone Circulator Control Relay

The SR multiple-zone series control relays incorporate up to six double pole/single throw relays (SR601/601AT) providing control of up to six circulators and a boiler operating control in a multi-zone hydronic heating system. Field selectable priority for zone 1 eliminates the need for additional relays to provide domestic hot water priority.

Features:

- Field selectable priority zone.
- Sealed contact double pole/single throw relays.
- Field replaceable relays.
- High capacity transformer.
- LED status window.
- Zone expansion up to 10 amps of total switched line voltage.
- Common 24 Vac transformer terminal.



Model Chart			
Model No	Description	Priority Plus	Dimensions in. (mm)
SR201	2 zone relay with Priority Plus. ^a	Yes	5-18 x 2-15/16 x 12-5/16 (130 x 75 x 312)
SR201B	2 zone relay with Priority. ^b	No	
SR201AT	2 zone relay with auto-test.	Yes	
SR301	3 zone relay with Priority Plus. ^a	Yes	
SR301B	3 zone relay with Priority. ^b	No	
SR301AT	3 zone relay with auto-test and Priority Plus. ^a	Yes	
SR601	4 zone expandable to 6 zone relay with Priority Plus. ^a	Yes	8 x 2-7/8 x 12-3/8 (213 x 73 x 314)
SR601B	4 zone expandable to 6 zone relay with Priority. ^b	No	
SR601AT	4 zone expandable to 6 zone relay with auto-test and Priority Plus. ^a	Yes	

^a In addition to priority only logic, Priority Plus allows non-priority heating zones to be locked out for up to one hour on a call for priority domestic hot water heating.

^b Priority only logic locks out non-priority heating zones indefinitely.

Specifications	
Inputs	
Power input	120 Vac @ 50/60 Hz.
Thermostat	Thermostatic anticipator setting: Set to actual current draw of system @ 24 Vac.
Outputs	
Electrical	Relay rating: 1/3 HP @ 120 Vac, Full load: 10.0 amps, Locked rotor: 43.2 amps, Resistive: 10.0 amps.
Environment	
Ambient temperature limits	Operating: maximum of 110°F (43°C).
Humidity	85% non-condensing RH.
Locations	NEMA Type 1.
Dimensions	Refer to Model Chart.
Agency Listing	UL File E9429. CUL Canadian Standard C22.2 #23-93.
General Instructions	Refer to F-27019.

Accessories

Model No.	Description
EXP10	Replacement relay.
T155 Series	Thermostats.
T200 Series	Thermostats.
T500 Series	Thermostats.
TA-1xx Series	Thermostats.
TC-1xx Series	Thermostats.

Typical Applications

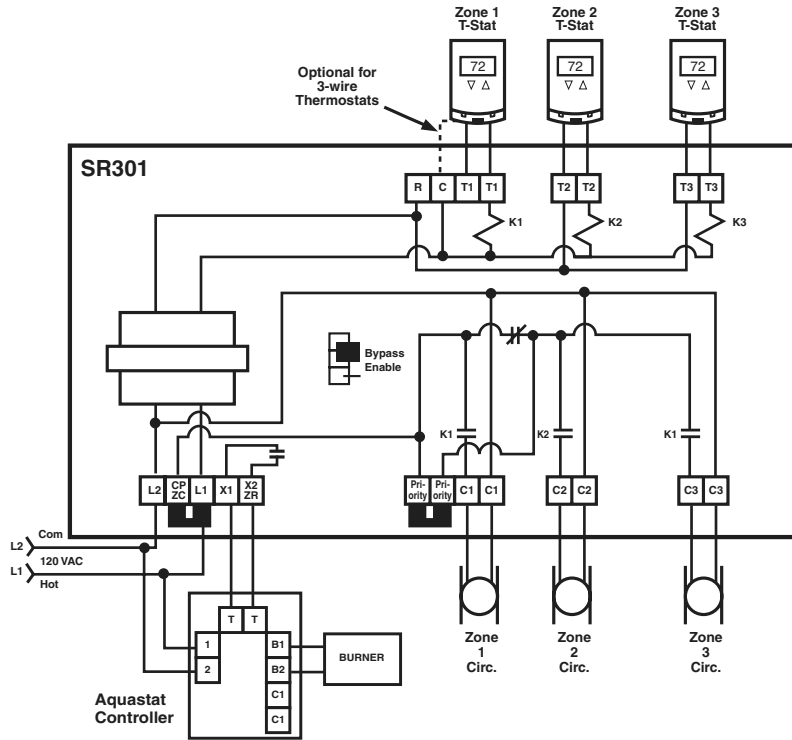


Figure 1 Typical Wiring SR301 - Boiler Controller.

SR201/301/601 Series

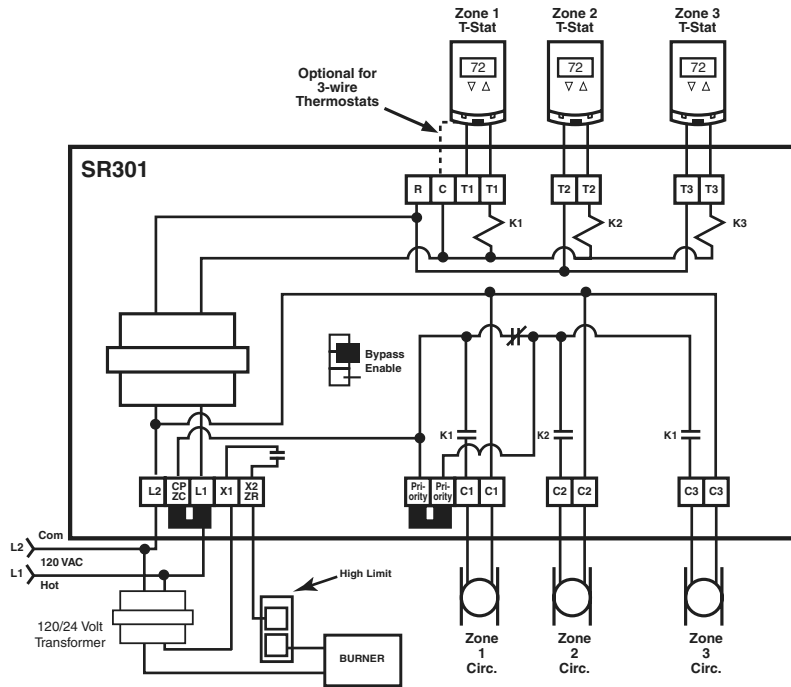
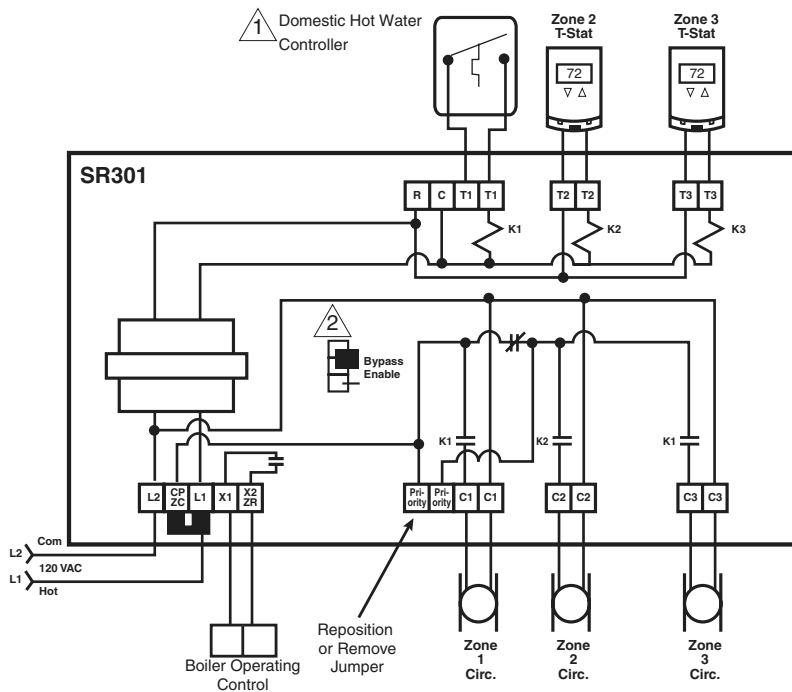


Figure 2 Typical Wiring SR301 - 24 VAC High Limit and Gas Valve.



① DHW Controller must provide dry contacts.

② For Priority Plus, place Bypass/Enable jumper on Enable.

Figure 3 Typical Wiring SR201, SR301, and SR601 - Domestic Hot Water Priority.

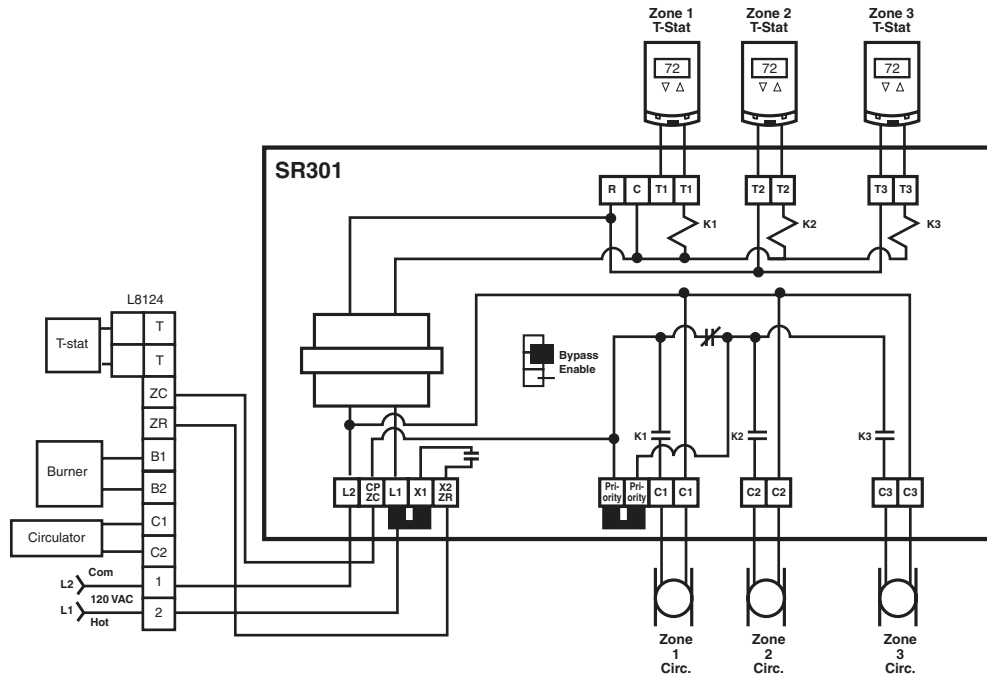


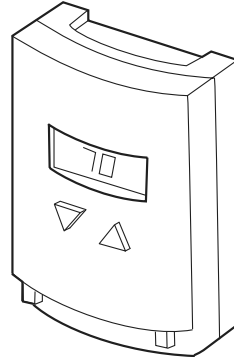
Figure 4 Typical Wiring SR301 - Tankless Coil Application.

T200 Series

Erie™ Digital, On/Off Thermostat

T200 series thermostats provide temperature control on a variety of heating, cooling and single stage heat pump applications.

The large LCD window displays room temperature including 1/5th of a degree increments indicated by a series of up to 5 dashes. The system heat output cycles on a 1 or 2F degree field selectable differential. The cool output differential is fixed at 2F degrees. The setpoint is displayed and changed by pressing one of the setpoint buttons up or down. Installation is simplified by having all of the field wires mounted to the separate wall plate.



Features:

- LCD window display, °F standard, °C configurable.
- Jumper selectable 5 minute time delay for heating and cooling application.
- Mechanical contact for low limit protection (optional).
- Base adaptor plate standard.

Model Chart						
Model No.	Control Outputs	Fan Control ^a	System Switch ^a	Changeover	Mechanical Contact	B & O Terminals
T201	Heating Only	None	Heat/Off	None	No	No
T201-FP ^b	Heating Only	None	Heat/Off	None	Yes	No
T204	Cooling Only	On/Auto	Cool/Off	None	No	No
T205	Cooling & Heating	On/Auto	Cool/Off/Heat	Manual	No	No
T205-FP ^b	Cooling & Heating	On/Auto	Cool/Off/Heat	Manual	Yes	No
T207	Cooling & Heating	On/Auto	Cool/Off/Heat	Manual	No	Yes
T207-FP ^b	Cooling & Heating	On/Auto	Cool/Off/Heat	Manual	Yes	Yes

^a Fan switch operates independent of system switch unless relays are added.

^b Low limit protection, at 40°F the thermostat mechanically latches heat with output.

Specifications

Inputs	
Power input	20 to 32 Vac, 75 mA to 1.2 amps (power-stealing thermostat, 75 mA required at all times. 250Ω, 5 watt resistor may be needed).
Outputs	
Electrical	Battery: Setpoint backup Energizer 357 or similar (battery included). 1.2 A inductive load max. Setpoint range: 50 to 86°F (10 to 35°C).
Control ranges	Operating differential: Heating 1 or 2 F degrees field selectable, (0.6 or 1.1 C degrees), Cooling 2 F degrees (1.1 C degrees).
Mechanical	Material: Rigid vinyl. Finish: Off-white.
Environment	
Ambient temperature limits	Shipping and storage: -4 to 125°F (-20 to 52°C). Operating: 40 to 125°F (5 to 53°C).
Humidity	95% non-condensing.
Locations	NEMA Type 1.
Dimensions	
	Thermostat: 4 H x 2-1/2 W inches (102 x 64 mm). Thermostat base and adaptor plate: 4-3/4 H x 4-1/4 W inches (121 x 108 mm).
Agency Listing	None.
General Instructions	Refer to F-27027.

Typical Applications

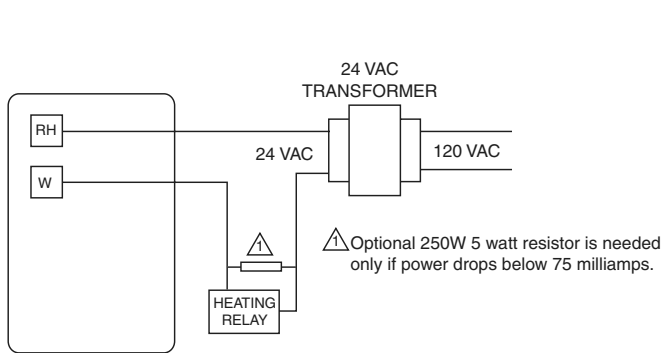


Figure 1 T201 Wiring to Heating System With Single Transformer.

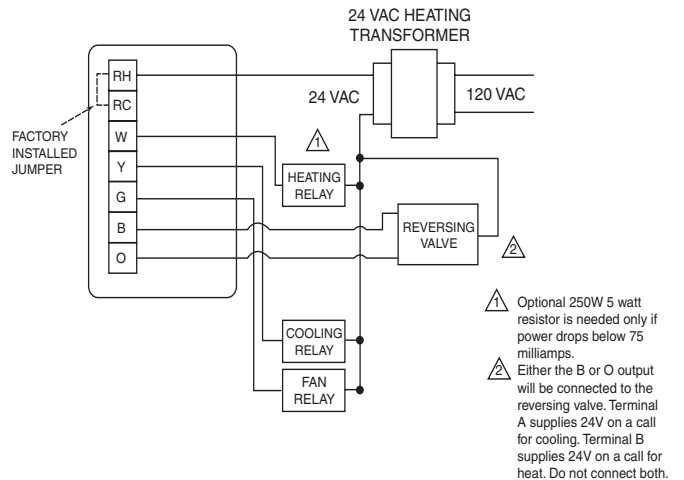


Figure 2 T207 Wiring to Heating/Cooling System With Single Transformer and Reversing Valve.

T200 Series

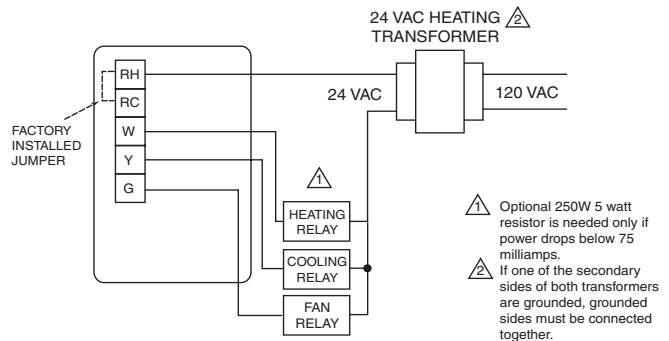
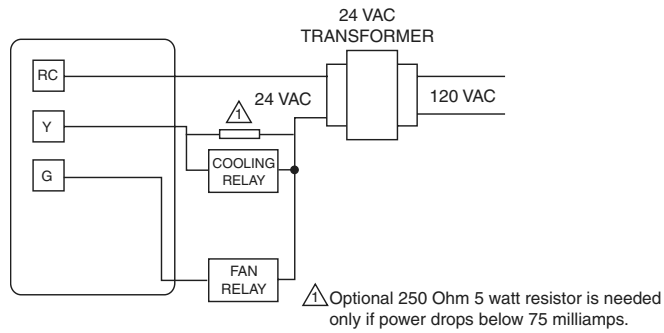
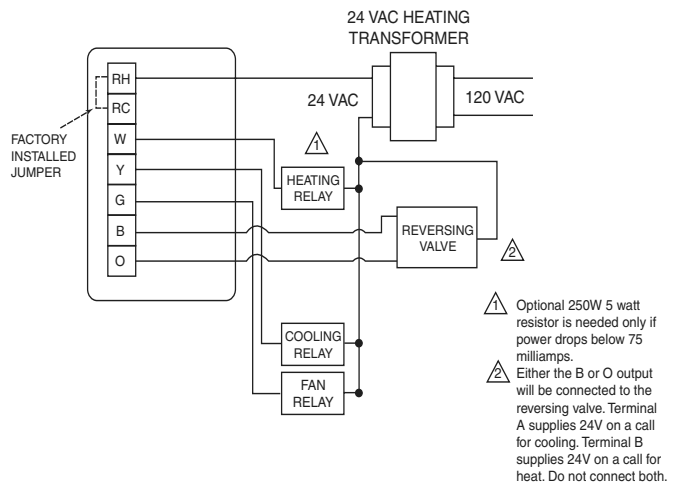
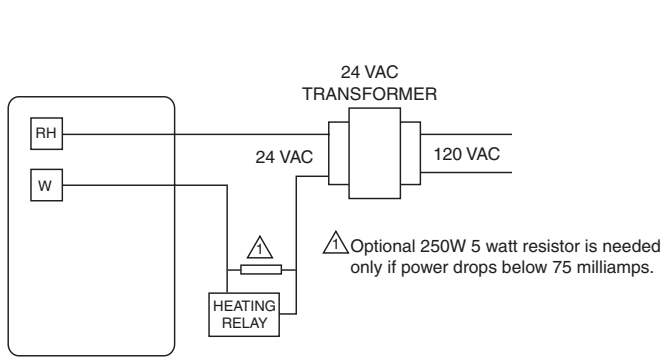


Figure 3 T204 Wiring to Cooling System With Single Transformer.

Figure 4 T205 Wiring To Heating/Cooling System With Single Transformer.

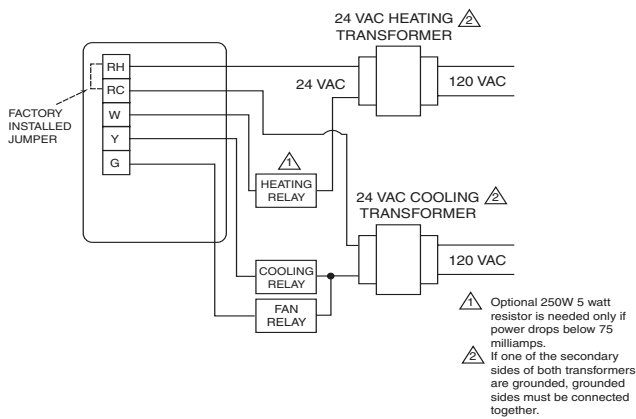


Figure 5 T205 Wiring To Heating/Cooling System With Dual Transformer.

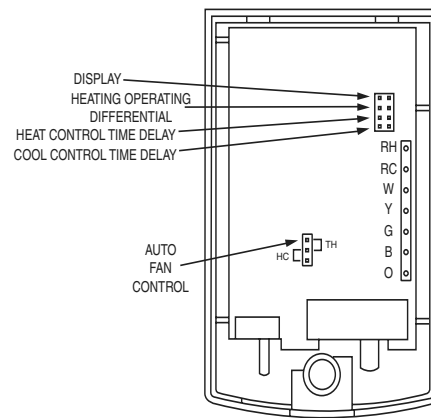


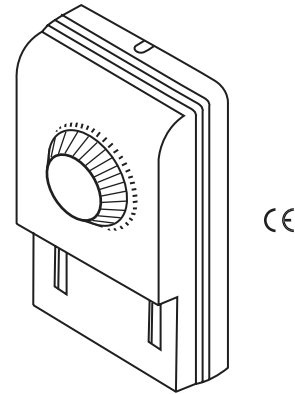
Figure 6 Terminal Identification.

Erie™ Non-Digital, On/Off Low/Line Voltage Thermostat/Controller

The T500 series thermostats are available in four basic models for low and line voltage control of valves, relays, and fan motors in fan coil and packaged units for commercial, industrial, and residential installations.

Features:

- Set point dial stop (optional).
- Bellows type sensor for constant and close temperature differential.
- System and fan switches.
- Fahrenheit and celsius models.



Model Chart				
Model No.	Outputs	Dial	Fan Control	System Switches
T511	Two-pipe	Celsius	3-Speed	On/Off
T511F	Two-pipe	Fahrenheit	3-Speed	On/Off
T513	Four-pipe	Celsius	3-Speed	Heat/Off/Cool
T513F	Four-pipe	Fahrenheit	3-Speed	Heat/Off/Cool

Specifications	
Inputs	
Power req.	24 to 240 Vac @ 50/60 Hz.
Connections	Power: Up to 18 AWG wire.
	Control: Up to 18 AWG wire.
Outputs	
Electrical	Switch rating (heating): 6 amp resistive, 1.5 amp inductive. 24 to 240 Vac 50/60 Hz.
	Switch rating (cooling): 6 amp resistive, 1 amp inductive. 24 to 240 Vac 50/60 Hz.
	Fan switch rating: 6 amp resistive, 3 amp inductive. 24 to 240 Vac 50/60 Hz.
Control ranges	Setpoint adjustment range: 50 to 85°F (10 to 30°C).
	Operating differential: 2 F degrees (1.1 C degrees).
Mechanical	Material: Molded ABS.
	Finish: Bone white.
Environment	
Ambient temperature limits	Shipping and storage: -30 to 130°F (-34 to 55°C). Operating: 32 to 130°F (0 to 55°C).
Humidity	Non-condensing.
Locations	NEMA Type 1.
Dimensions	5-1/5 H x 3-1/4 W x 1-3/4 D in. (132 x 82 x 45 mm).
Agency Listing	CE compliant.
General Instructions	Refer to F-27029.

T500 Series

Accessories

Model No.
WP500
680-243
PIN 500

Description
5-1/2 x 5-1/2" (140 x 140 mm) adapter plate.
Auto seasonal changeover switch.
Dial stop pin.

Typical Applications

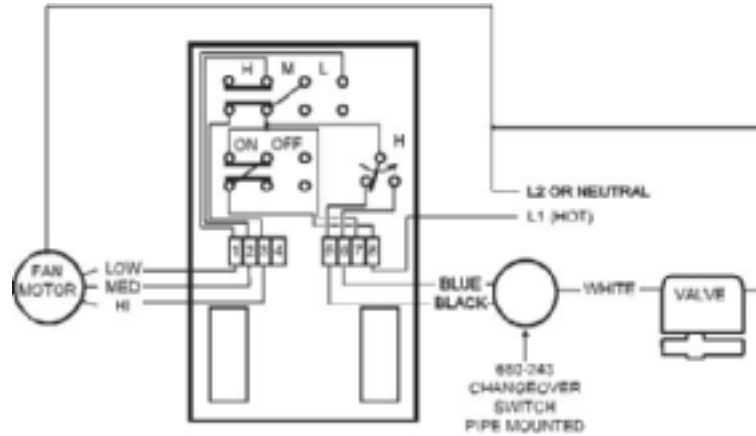


Figure 1 T511/T511F, 2-Pipe Heating & Cooling With Changeover Switch.

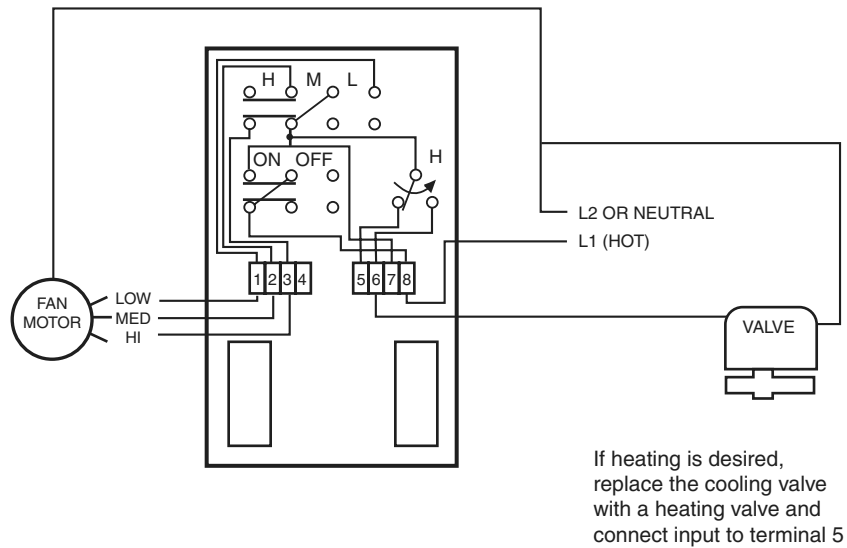


Figure 2 T511/T511F, 2-Pipe Cooling.

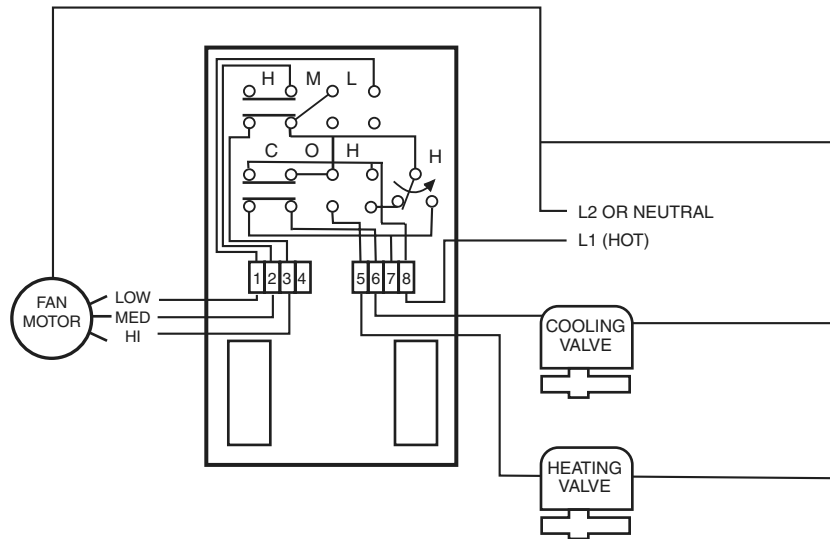


Figure 3 T513/T513F, 4-Pipe Heating/Cooling.

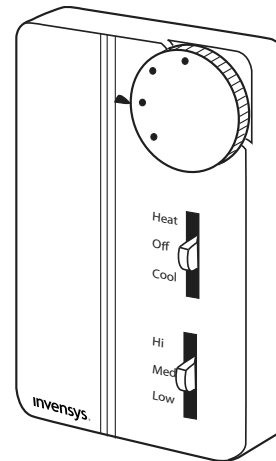
TA-155 Series, TB-155 Series

Erie™ Non-Digital, Electronic On/Off Thermostat/Controller

The T155 series thermostat provides on/off control for low voltage and line voltage control of valves, relays and fan motors. Applications include two-pipe and four-pipe fan coil units, air handling units, and heating and cooling applications.

Features:

- Manual or automatic changeover models.
- Line voltage 3-speed fan control.
- Continuous or cycling fan operation (cycling fan operation requires additional relay or relays).
- Handles all supply voltages from 24 to 277 Vac at 50/60 Hz (fan and system voltage must be the same).



Model Chart					
Model No.	Heat/Cool Outputs	Deadband	Changeover	Fan Control	System Switches
TA-155-10	Dual	N/A	Manual	Hi-Med-Lo	Heat-Off-Cool
TA-155-17	Single	0°F	External ^a	Hi-Med-Lo	On-Off
TA-155-18	Single	0°F	External ^a	None	None
TB-155-10	Dual	4 F° (2.2 C°)	Automatic ^b	Hi-Med-Lo	On-Off
TB-155-15	Dual	4 F° (2.2 C°)	Automatic ^b	None	None

^a Models with 0°F deadband must use a 680-243 changeover thermostat or equal for heating/cooling applications. Not required for heating only or cooling only applications.

^b Auto changeover models have 4°F degree deadband between heating and cooling.

Outputs.

Fan Switch Rating. ^a (TB2 - 2, 3, 4) ^b					H/C Outputs (TB3 - 1, 2)
Voltage	Inductive		Resistive Amps	Pilot Duty	Pilot Duty
	FLA	LRA			
24	N/A	N/A	N/A	24 VA	10 VA
120	5.8	34.8	6.0	125 VA	20 VA
240	2.9	17.4	5.0		
277	2.4	14.4	4.2		

^a Fan and system must share same voltage.

^b TB2 and TB3 refer to terminal blocks. Refer to Figures-1 through 7.

Specifications

Inputs

Power input	24 to 277 Vac @ 50/60 Hz, full wave device.
Power consumption	0.88 watts at maximum.
Connections	Power: Up to 14 AWG wire.
	Control: Up to 14 AWG wire.

Outputs

Electrical	Thermostatic heat/cool output switch ratings: 10 VA @ 24 Vac, Pilot duty 20 VA @ 120 - 277 Vac. Full wave device.
Control ranges	Operating differential: 1 F degree (0.6 C degree).
	Changeover deadband (TB155 only): 4 F degrees (2.2 C degrees).
	Setpoint adjustment range: 50 to 90°F (10 to 32°C).
Mechanical	Material: Rigid vinyl.
	Finish: Cool gray.

Environment

Ambient temperature limits	Shipping and storage: -30 to 130°F (-34 to 55°C). Operating: 32 to 130°F (0 to 55°C).
Humidity	Maximum 95% con-condensing.
Locations	NEMA Type 1.

Dimensions 4-1/2 H x 2-3/4 W x 1 D inches (114 x 79 x 25 mm).

Agency Listings CE compliant.

UL File #E50023.

CUL File #E50023.

General Instructions Refer to F-27022.

Accessories

Model No.	Description.
680-243	Auto seasonal changeover switch.
65345	4-3/4 x 4-3/4" adapter plate.
65170	Warmer/cooler set point dial.
65410	Celsius set point dial, 10 to 34°C.
65821	TA/TB 155 blank cover (no Invensys logo).
65860	Set point dial stop kit.

Typical Applications

CAUTION: All models, output terminals voltage will be the same as the input voltage to the thermostat. If the thermostat is powered with 120Vac terminal block-1 terminals 1, 2, 3, and 4, terminal block 2-terminals 1, 2, 3, 4 and 5 and terminal block 3-terminals 1, 2 and 3 will all have 120 Vac.

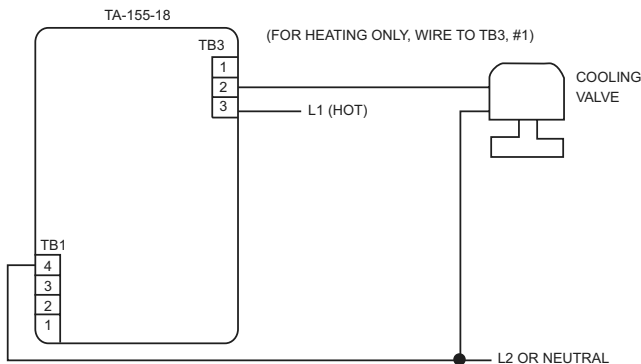


Figure 1 Typical 2-Pipe Cooling or Heating Only. No Fan Connections. Cooling Shown.

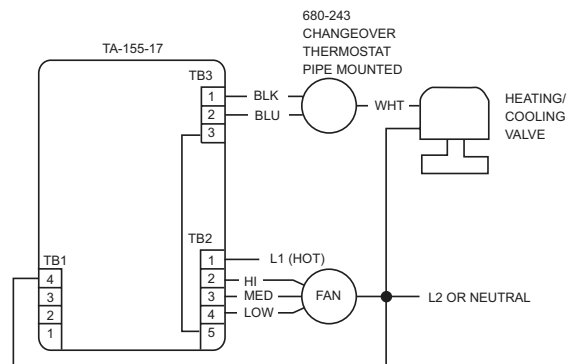


Figure 2 Typical 2-Pipe Heating/Cooling/Continuous Fan with System Switch off, Fan is Off.

TA-155 Series, TB-155 Series

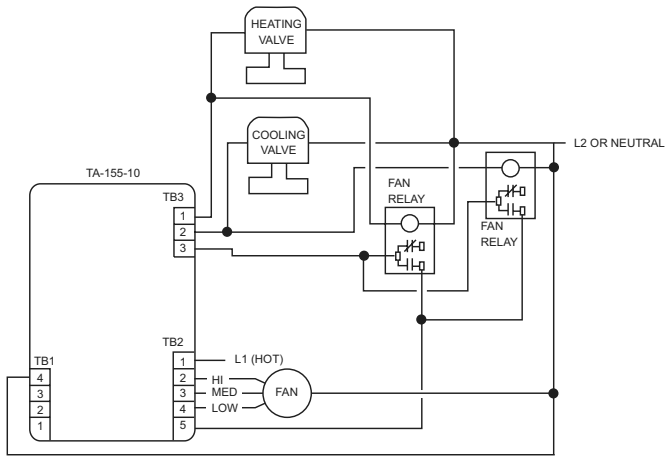


Figure 3 Typical 4-Pipe Heating/Cooling Fan Cycles with Demand for Heating or Cooling. With System Switch Off, Fan is Off.

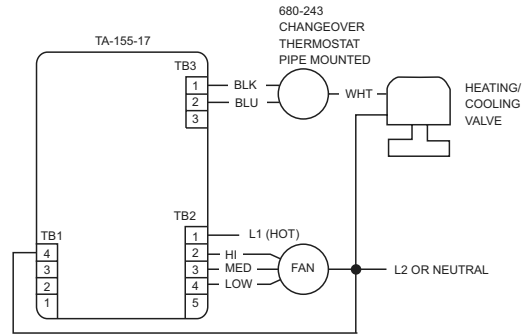


Figure 4 Typical 2-Pipe Heating/Cooling Fan Runs with System Switch On or Off.

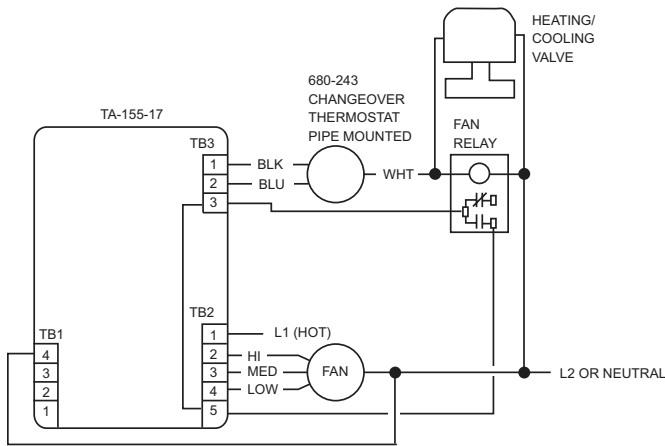


Figure 5 Typical 2-Pipe Heating/Cooling Fan Cycles with Demand for Heating or Cooling. With System Switch Off, Fan is Off.

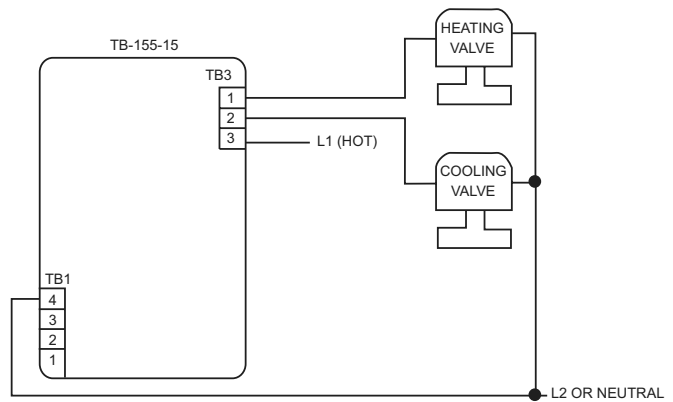


Figure 6 Typical 4-Pipe Heating/Cooling. No Fan Connections.

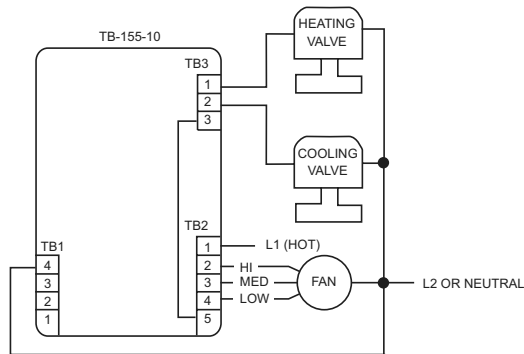
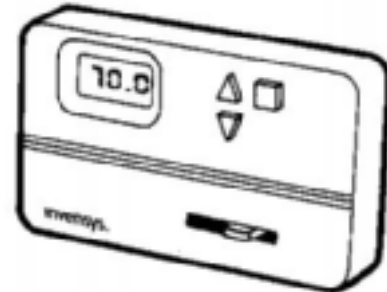


Figure 7 Typical 4-Pipe Heating/Cooling Fan Runs Continuously with System Switch On. With System Switch Off, Fan is Off.

Erie™ Digital, 3-Wire Floating Thermostat/Controller

The T158 series microprocessor based thermostat/controller with digital display provides 3-wire floating, on/off control, or a combination of 3-wire floating and on/off control. This series controls a variety of two-pipe and four-pipe fan coil units, air handling units, and various heating and cooling applications.

The microprocessor combines a proportional plus intergral control algorithm with advanced adaptive logic. This provides control without the need for tuning or calibration the control algorithm in the field.



Features:

- Heating and cooling outputs are individually configurable for 3-wire floating or on/off control in the normally open or normally closed modes.
- Line voltage continuous 3-speed fan control.
- Manual or automatic changeover.
- Remote setback capability from a time clock or facility management system.
- Time out feature. Drive signal stops after 3 mins (max) on.
- Fahrenheit or Celsius display capability.
- Built-in purge cycle assists the controller to determine if the controlling agent is providing heating or cooling.
- Microprocessor eliminates the necessity for tuning or calibration.
- Display can be calibrated to within ±5F degrees (2.5C degrees).

Model Chart							
Model No. ^{abc}	Heat/Cool Outputs	Control Signal Options	Fan Control ^d	Demand Output	Remote Sensor ^e	Setback	System Switches
TA-158-1	Dual	6	None	Yes	Yes	Yes	Off-Auto-Heat-Cool
TA-158-2	Dual	6	Off-Hi-Med-Lo		Yes	Yes	Off-Auto-Heat-Cool
TB-158-1	Dual	1, 2, 3, 5, 6	None	Available	Yes	Yes	Off-Auto-Heat-Cool
TB-158-2	Dual	1, 2, 3, 4, 5, 6	Off-Hi-Med-Lo		Yes	Yes	Off-Auto-Heat-Cool
TB-158-3	Single	5	Off-Hi-Med-Lo	No	Yes	Yes	Off-Heat/Off-Cool
TB-158-7	Single	5	None		Yes	Yes	None
TB-158-15	Single	5	None		Yes	Yes	Off-Heat/Off-Cool
TB-158-17	Dual	1, 2, 3, 4, 5, 6	Off/On	Available	Yes	Yes	Off-Auto-Heat-Cool
TB-158-18	Single	5	On/Off		Yes	Yes	Off-Heat/Off-Cool

1. 3-wire floating single stage cooling and 3-wire floating single stage heating.
2. 3-wire floating cooling and two stage on/off heating.
3. Single stage on/off cooling, on/off fan control, and 3-wire floating single stage heating.
4. On/off single stage cooling, on/off single stage heating and fan control.
5. 3-wire floating single stage cooling or single stage heating.
6. On/off single stage cooling, on/off single stage heating.

^a Do not use with actuators in which the motor is driven by DC voltage.
^b Do not use with actuators which have position memory on power loss.
^c Actuator must full stroke open or closed in 1 to 3 minutes.
^d Fan "Off" disables unit including display.
^e Remote sensor ordered separately.

TA-158 Series, TB-158 Series

Outputs.

Fan Switch Rating, Terminals 1 - 4					Control Outputs
Voltage	Inductive		Resistive Amps	Pilot Duty	Terminals 7, 10, 11, 12, 13, and 14
	FLA	LRA			
24	N/A	N/A	N/A	24 VA	10 VA
120	5.8	34.8	6.0	125 VA	N/A
240	2.9	17.4	5.0	125 VA	
277	2.4	14.4	4.2	125 VA	

Specifications

Inputs

Power input 20 to 28 Vac, nominal 24 VA. Full wave device.

Power consumption 25 mA maximum at 24 Vac.

Connections Power: Up to 14 AWG wire.

Control: Up to 14 AWG wire.

Outputs

Electrical Thermostatic switch ratings: 10 VA @ 24 Vac.

System switch rating: 10 VA @ 24 Vac.

Control ranges Display range: 32 to 99°F (0 to 37°C).

Proportional band: 2 F degrees (1.1 C degrees).

Changeover deadband: 3 F degrees (1.6 C degrees).

Setpoint adjustment range: 50 to 90°F (10 to 32°C).

Mechanical Material: Rigid vinyl.

Finish: Cool gray.

Environment

Ambient temperature limits Shipping and storage: -30 to 130°F (-34 to 55°C).
Operating: 32 to 130°F (0 to 55°C).

Humidity Maximum 95% non-condensing.

Locations NEMA Type 1.

Dimensions 2-3/4 H x 4-1/2 W x 1-1/8 D inches (79 x 114 x 28 mm).

Agency Listings UL/CUL Recognized, CE compliant.

General Instructions Refer to F-27041.

Accessories

Model No.	Description.
65345	4-3/4 x 4-3/4" adapter plate.
65821	Solid blank cover
68671	Remote sensor, 60" leads 10k Ω @ 77°F (25°C).
680-243-5	36" changeover switch with clamp.
680-234-6	36" changeover switch with conduit connector.

Typical Applications

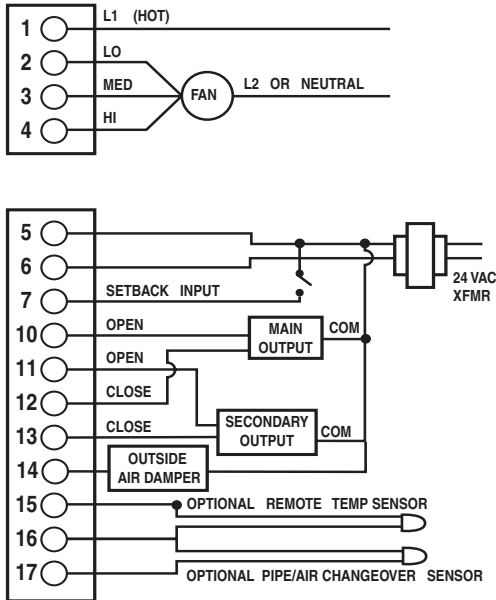


Figure 1 Typical Wiring for 3-Wire Floating Control (Four Pipe).

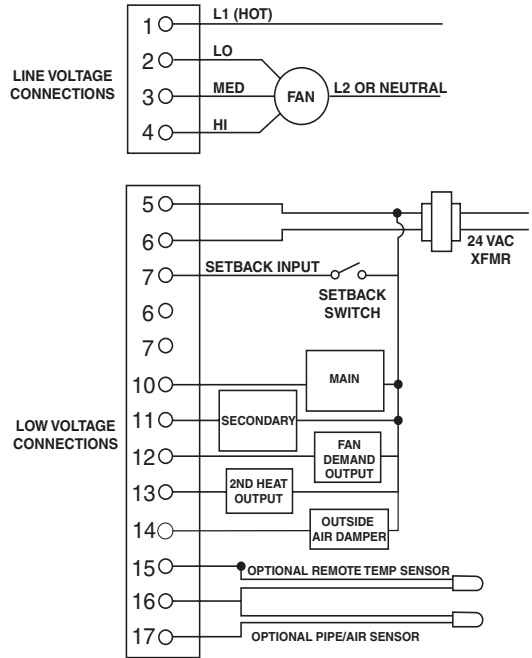


Figure 2 Typical Wiring for On/Off Control (Four Pipe).

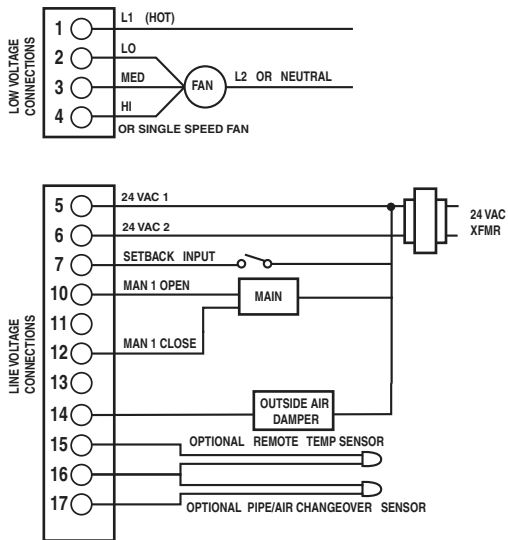


Figure 3 Typical Wiring for 3-Wire Valve Configuration (Two Pipe) Heating - Cooling With Changeover Pipe Thermostat (JP4 Jumper Installed).

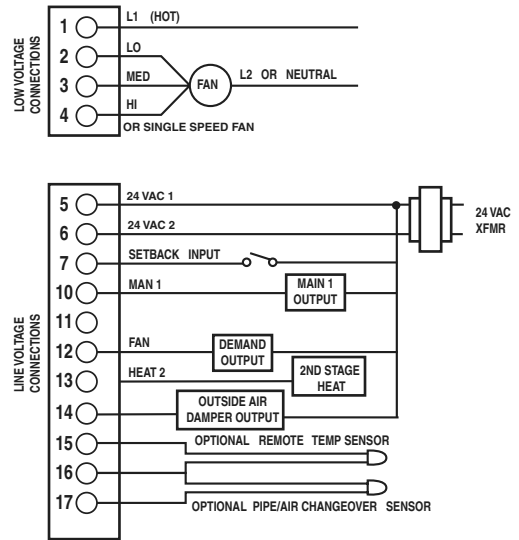


Figure 4 Typical Wiring for On/Off Output Configuration (Two Pipe) Heating - Cooling With Changeover Pipe Thermostat (JP4 Jumper Installed).

TA-158 Series, TB-158 Series

T158 Terminal Function and Model Table.

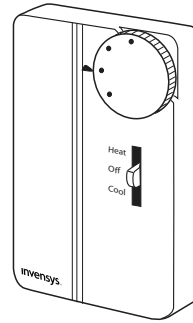
		TA-158		TB-158						
Model Number		-1	-2	-1	-2	-3	-7	-15	-17	-18
Terminal Function										
Line Voltage Fan Terminals										
1	L1 Fan Hot	—	X	—	X	X	—	—	X	X
2	L2 Lo Fan	—	X	—	X	X	—	—	—	—
3	L2 Med Fan	—	X	—	X	X	—	—	—	—
4	L2 Hi or Single Speed Fan	—	X	—	X	X	—	—	X	X
Low Voltage Terminals										
5	24 Vac input	X	X	X	X	X	X	X	X	X
6	24 Vac input	X	X	X	X	X	X	X	X	X
7	Setback	X	X	X	X	X	X	X	X	X
10	Main Out (1 open) 24 Vac	X	X	X	X	X	X	X	X	X
11	Secondary Out (1 open) 24 Vac	X	X	X	X	—	—	—	X	—
12	Main (2 closed) or Demand Out 24 Vac	X	X	X	X	X	X	X	X	X
13	Secondary Out (2 closed) or 2nd Stage Heating 24 Vac	—	—	X	X	—	—	—	X	—
14	Outside Air Damper 24 Vac	—	X	—	X	X	—	—	X	X
15	Remote Temperature Sensor Optional	X	X	X	X	X	X	X	X	X
16	Common Optional Sensors	X	X	X	X	X	X	X	X	X
17	Changeover Sensor Optional	X	X	X	X	X	X	X	X	X

Erie™ Non-Digital, Proportional Thermostat/Controller

The T167 series microprocessor based thermostat/controller provides 0-10 Vdc control. This series controls a variety of two-pipe and four-pipe fan coil units, air handling units, unitary equipment, and various heating and cooling applications.

Features:

- 0-10 Vdc heat and/or cool outputs.
- Fahrenheit standard. Optional Celsius setpoint dial.



Model Chart			
Model	Heat/Cool Outputs	Fan Control	System Switches
TA-167-1 ^a	Dual	None	None
TA-167-3			Heat, Off, Cool
TB-167-1			None

^a Model has no deadband between heating and cooling. If using as a heat/cool control an optional changeover thermostat (680-243-x) is required.

Specifications

Inputs	
Power input	20 to 28 Vac, nominal 24 Vac, full wave device.
Power consumption	25 mA maximum at 24 Vac.
Connections	Power: Up to 14 AWG wire.
	Control: Up to 14 AWG wire.
Outputs	
Electrical	Heat and cool output rating: 0-10 Vdc 1000 Ω minimum. Full wave device.
Control ranges	Proportional band: 2 F degrees (1.1 C degrees).
	Setpoint adjustment range: 50 to 90°F (10 to 32°C).
Mechanical	Material: Rigid vinyl.
	Finish: Cool gray.
Environment	
Ambient temperature limits	Shipping and storage: -20 to 120°F (-29 to 49°C).
	Operating: 0 to 120°F (-18 to 49°C).
Humidity	Maximum 95% non-condensing.
Locations	NEMA Type 1.
Dimensions	4-1/2 H x 2-3/4 W x 1 D inches (114 x 79 x 25 mm).
Agency Listings	UL/CUL Listed File #E50023, CE compliant. Except TA167-001, TB167-001.
General Instructions	Refer to F-27024.

TA-167 Series, TB-167 Series

Accessories

Model No.	Description.
65-821	Solid blank cover.
680-243-5	Changeover switch with clamp and 36 in. leads.
680-243-6	Changeover switch with conduit connector and 36 in. leads.
65170	Warmer/cooler set point dial.
65345	4-3/4" x 4-3/4" adapter plate.
65410	Celsius set point dial, 10 to 34°C.
65860	Set point dial stop kit.
68671	Remote sensor, 60" leads 10k Ω @ 77°F (25°C).

Typical Applications

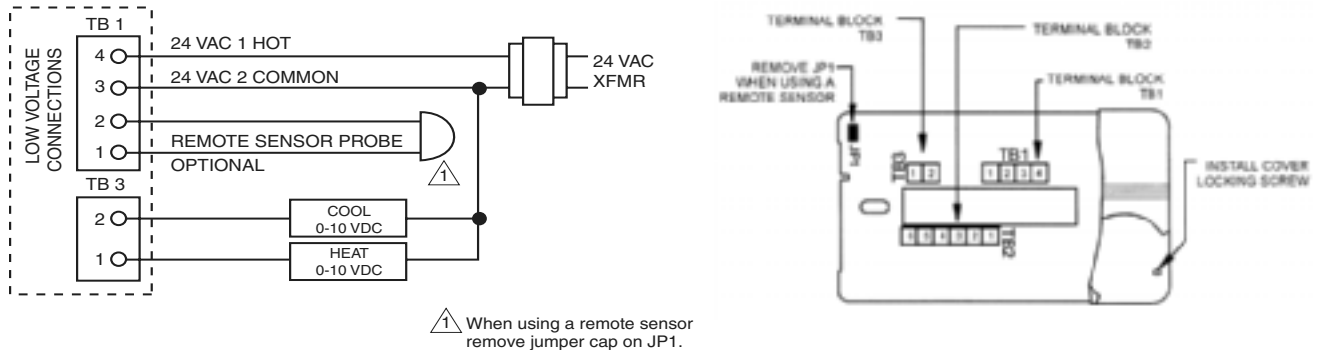


Figure 1 Typical Wiring.

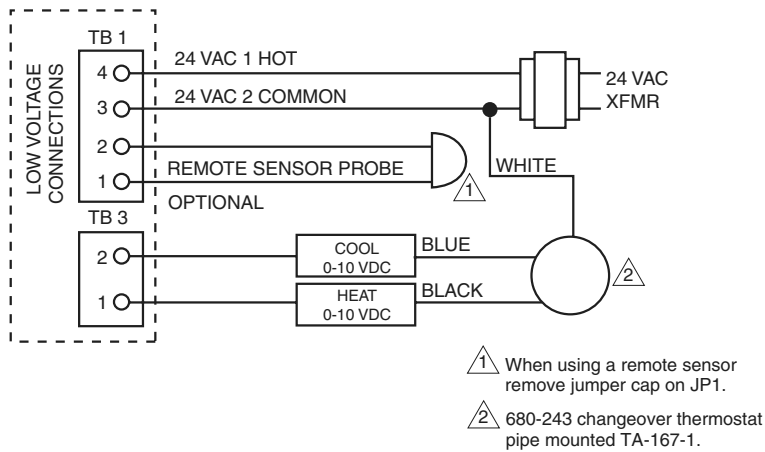
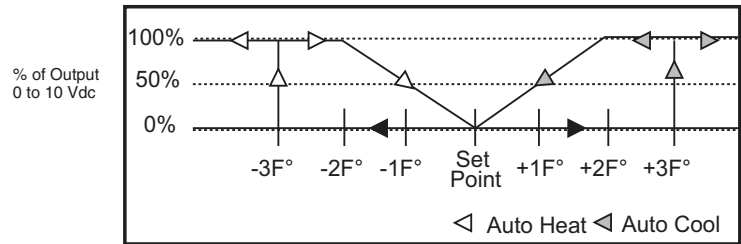


Figure 2 Typical Wiring for TA-167-1 for Optional Heat/Cool Auto Changeover Applications.



Proportional Output Signal Operation: At 3 F degrees from setpoint either the heat or cool output signal goes to 10 Vdc, based on ambient temperature being above or below setpoint. As the ambient temperature starts to move closer to setpoint the output signal remains at 10 Vdc until ambient temperature is within 2 F degrees of setpoint. Then the output signal starts to modulate, as the ambient temperature comes closer to setpoint, the output signal decreases. Then the output signal will modulate up or down based on the ambient temperature and this modulation will continue until setpoint is achieved, at which point the output will be 0 Vdc.

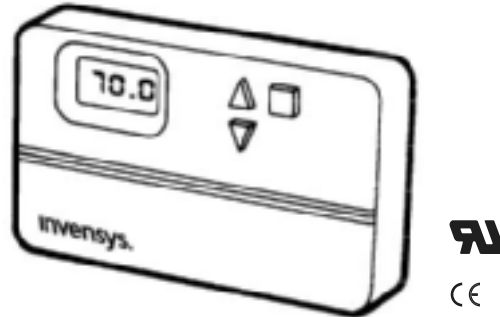
Figure 3 TB-167 Output Profile.

TA-168 Series

Erie™ Digital, Proportional Thermostat/Controller

The T168 series microprocessor based thermostat/controller provides 0-10 Vdc or 4-20 mA control. This series controls variety of two-pipe and four-pipe fan coil units, air handling units, and various heating and cooling applications.

The microprocessor combines a proportional plus integral control algorithm with advanced adaptive logic. This provides control without the need for tuning or calibration the control algorithm in the field.



Features:

- 0-10 Vdc or 4-20 mA heat and cool outputs.
- Low voltage fan cycling operation with demand output.
- Remote setback capability from a time clock or facility management system.
- Auxiliary heat function.
- Remote and/or seasonal changeover sensor optional.
- Fahrenheit or Celsius display capability.
- In two pipe mode a built-in purge cycle assists the controller to determine if the controlling agent is providing heating or cooling.
- Line voltage continuous on/off or 3-speed fan control.

Model Chart						
Model No.	Heat/Cool Outputs	Fan Control ^a	Demand Output	Configurable 2-Position Auxiliary Heat Output	Setback	System Modes
TA-168-1	Dual	None	No	Yes	Yes	Off-Auto-Heat-Cool
TA-168-2	Dual	Off-Hi-Med-Lo	Yes		Yes	Off-Auto-Heat-Cool
TA-168-3	Single	Off-Hi-Med-Lo	Yes		Yes	Off-Heat/Off-Cool
TA-168-4	Single	None	No		Yes	Off-Heat/Off-Cool
TA-168-5	Single	None	Yes		Yes	Off-Heat/Off-Cool
TA-168-6	Dual	None	Yes		Yes	Off-Auto-Heat-Cool
TA-168-7	Single	Off/On	Yes		Yes	Off-Heat/Off-Cool
TA-168-8	Dual	Off/On	Yes		Yes	Off-Auto-Heat-Cool
TA-168-9	Single	None	No		Yes	None

^a Fan "Off" disables unit including display.

Outputs.

Fan Switch Rating, Terminals 1 - 4					Control Output
Voltage	Inductive		Resistive Amps	Pilot Duty	Terminals 7, 12, 13, and 14
	FLA	LRA			
24	N/A	N/A	N/A	24 VA	10 VA
120	5.8	34.8	6.0	125 VA	N/A
240	2.9	17.4	5.0	125 VA	
277	2.4	14.4	4.2	125 VA	

Specifications

Inputs

Power input	20 to 28 Vac, nominal 24 Vac. Full wave device.
Power Consumption	25 mA maximum at 24 Vac.

Outputs

Electrical	Demand and aux. heat: 10 VA @ 24 Vac. Electrical connections: Terminal strip with screw-down terminals.
Control signals	0 to 10 Vdc 1000 Ω minimum. 4 to 20 mA 100 - 600 Ω.
Control ranges	Setpoint adjustment range: 50 to 90°F (10 to 32°C)
	Display range: 32 to 99°F (0 to 37°C).
	Proportional band: 2 F degrees (1.1 C degrees). Changeover deadband: 3 F degrees (1.6 C degrees)
Mechanical	Material: Rigid vinyl. Finish: Cool gray.

Environment

Ambient temperature limits	Shipping and storage: -30 to 130°F (-34 to 55°C). Operating: 32 to 130°F (0 to 55°C).
Humidity	Maximum 95% non-condensing.
Locations	NEMA Type 1.
Dimensions	2-3/4 H x 4-1/2 W x 1-1/8 D inches (79 x 114 x 28 mm).
Agency Listings	UL Recognized, CE compliant.
General Instructions	Refer to F-27025.

Accessories

Model No.	Description.
680-243-5	36" Changeover switch with clamp.
680-234-6	36" Changeover switch with conduit connector.
65345	4-3/4 x 4-3/4" adapter plate.
65821	Blank cover.
68671	Remote changeover sensor, 60 in. leads 10K Ω @ 77°F (25°C).

Typical Applications

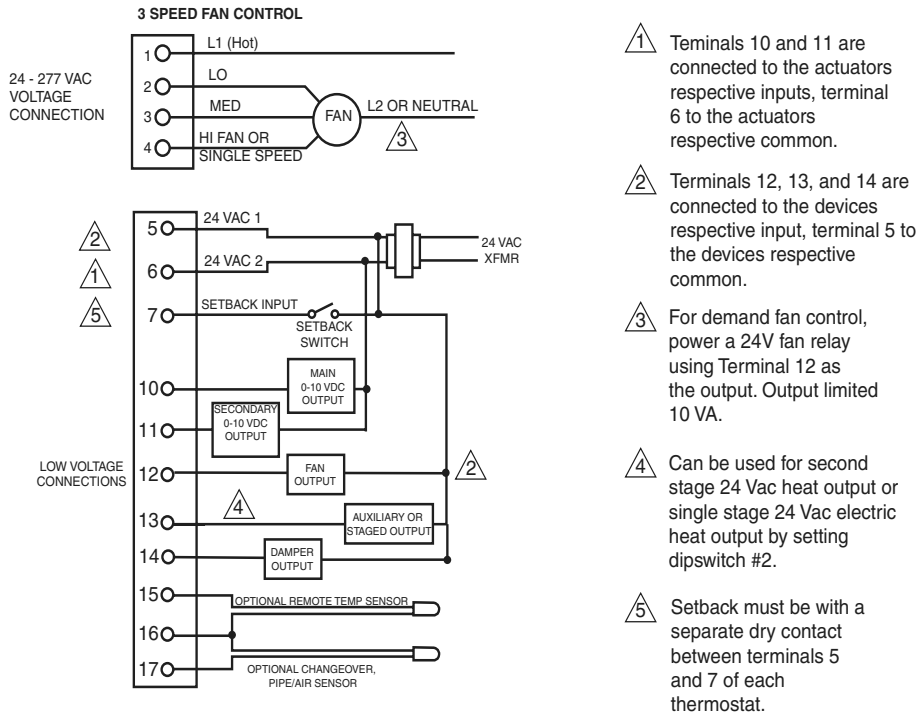


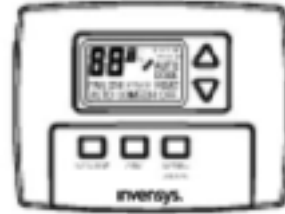
Figure 1 Typical Wiring for Proportional Control.

T168 Terminal Function and Model Table.

Model Number		TA-168									
		-1	-2	-3	-4	-5	-6	-7	-8	-9	
Terminal Function											
Line Voltage Fan Terminals											
1	L1 Fan Hot	—	X	X	—	—	—	X	X	—	
2	L2 Lo Fan	—	X	X	—	—	—	—	—	—	
3	L2 Med Fan	—	X	X	—	—	—	—	—	—	
4	L2 Hi or Single Speed Fan	—	X	X	—	—	—	X	X	—	
Low Voltage Terminals											
5	24 Vac input	X	X	X	X	X	X	X	X	X	
6	24 Vac input	X	X	X	X	X	X	X	X	X	
7	Setback	X	X	X	X	X	X	X	X	X	
10	Main Output Signal	X	X	X	X	X	X	X	X	X	
11	Secondary Output Signal	X	X	—	—	—	X	—	X	—	
12	Demand Output 24 Vac	—	X	X	—	X	X	X	X	—	
13	Auxiliary or Staged Heat 24 Vac	X	X	X	X	X	X	X	X	X	
14	Damper Output 24 Vac	—	X	X	—	—	—	X	X	—	
15	Remote Temperature Sensor Optional	X	X	X	X	X	X	X	X	X	
16	Common Optional Sensors	X	X	X	X	X	X	X	X	X	
17	Changeover Sensor Optional	X	X	X	X	X	X	X	X	X	

Erie™ Digital, Proportional Thermostat/Controller

The T170 series microprocessor based stand-alone controller supplies line or low voltage relay control of heat, cool, outside air and fan. Designed for 1 heat, 1 cool, on/off vent damper and fan speed control applications.



Features:

- 1H/1C and on-off vent damper.
- Fan switch auto/on/off.
- Fan control manual, staged, or auto.
- 24-277 Vac power.
- Large backlit ADA compliant display/buttons.
- Remote sensor optional.
- Changover sensor option.
- 2/4 pipe operation.
- Setback from occupancy, clock or BMS.
- Temperature °F or °C display.
- Keypad lockout.

Model Chart

Model No.	Heat/Cool Outputs	Remote Sensor Optional	Fan Control	Fan Speed Button	System Modes
TA-170-16	Dual	Yes	3-Speed Manual	Yes	Off-Auto-Heat-Cool
TA-170-18			Single Speed	None	Off-Auto-Heat-Cool
TB-170-9			3-Speed Staged	None	Off-Auto-Heat-Cool

Fan Switch Rating.

Voltage Vac	Inductive		Resistive Amps	Pilot Duty
	FLA	LRA		
24	N/A	N/A	N/A	24 VA
120	5.8	34.8	6.0	125 VA
240	2.9	17.4	5.0	125 VA
277	2.4	14.4	4.2	125 VA

Combined load current not to exceed 20 amps.

TA-170 Series, TB-170 Series

Specifications

Inputs	
Power input	24 to 277 Vac @ 50/60 Hz ±10%.
Power Consumption	45 mA.
Connections	Five inch 18 ga pigtails.
Outputs	
Relays	H/C/Damper relays and up to three fan relays based on model. See switch rating table for capacity.
Deadband	3 F degrees (1.6 C degrees).
Control	Proportional plus integral.
Set Point Range	50 to 90°F (10 to 32°C).
Housing	Vinyl plastic white.
Environment	
Ambient temperature limits	130°F (-34°C) maximum. Operating: 32 to 130°F (0 to 55°C).
Humidity	Maximum 95% non-condensing.
Dimensions	5.8 W x 4.4 H x 1.4 D inches (147 x 112 x 35 mm).
Agency Listings	CE, UL, CUL File # E50023.

Accessories

Model No.	Description.
680-243-5	36" Changeover switch with clamp.
680-234-6	36" Changeover switch with conduit connector.
68671	Remote sensor.
SA200-001	Occupancy sensor, ceiling mount.
SB200-001	Occupancy sensor, wall mount.
SE200-001	Door switch.

Typical Applications

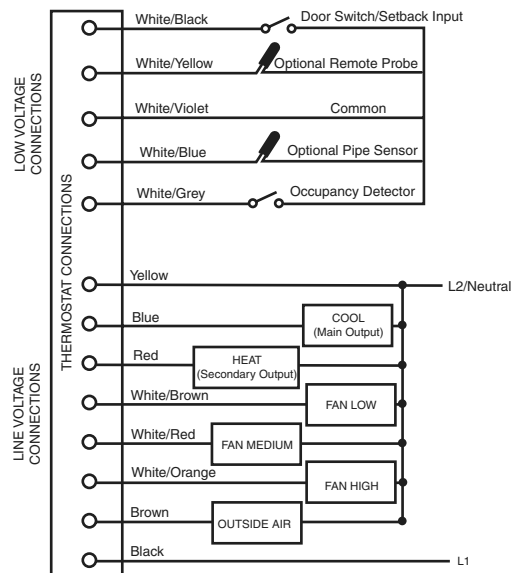


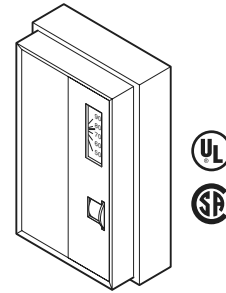
Figure 1 Typical Wiring for Proportional Control.

Two-Position Electric Room Thermostat, Heating

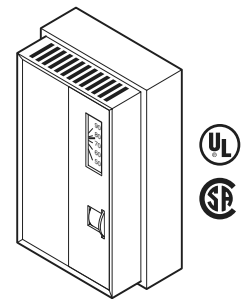
For on-off control of electric heaters, actuators, relays, unit heater motors, high input motor starter coils, and motor pull-up coils.

Features:

- Separate units for °C and °F.
- 2F degrees differential.
- Dial stop pins to limit dial range.
- Lock cover screw kits available.
- Agency approval.
- Switch bases AT-602 and AT-603 available for custom applications.



TA-1101
TA-1102



TA-1501

Model Chart								
Model No.	Application	Setpoint Dial Range	Differential F° (C°)	Night Depression (24V) 10 F°	Electrical Switch Refer to Maximum Electrical Ratings Table	Connections in. (mm)	Cover	Dimensions H x W x D in. (mm)
TA-1101	Unit heater motors, electrical heater, high input motor starter coils	55 to 85°F ^a	2 (1)	No	Snap action SPST with heavy duty contacts	Coded screw terminals	Beige plastic with two inserts standard	4-3/8 x 2-3/4 x 1-5/8 (111 x 70 x 43)
TA-1101-116		13 to 19°C ^a		Yes				
TA-1101-602		55 to 85°F						
TA-1101-770 ^b			45 to 75°F ^a	No				
TA-1102			7 to 23°C ^a					
TA-1102-116			45 to 75°F	Yes	Snap action SPST with heavy duty contacts	Coded screw terminals	Beige plastic with two inserts standard	
TA-1102-602								
TA-1102-770 ^b			2 (1)					
TA-1501	On-off control with heat anticipation for low current devices such as actuators, relays, and motor pull-up coils	55 to 85°F ^a	2 (1) maximum	No	Snap action SPST	Color coded 6 (152) leads	Beige plastic with two inserts standard	4-3/8 x 2-3/4 x 1-5/8 (111 x 70 x 43)
TA-1501-116		13 to 29°C ^a						
TA-1501-770 ^b		55 to 85°F ^a						

^a Two dial stop pins included to limit setpoint range.

^b Covers, Robertshaw named.

TA-110X Series, TA-1501 Series

Maximum Electrical Ratings.

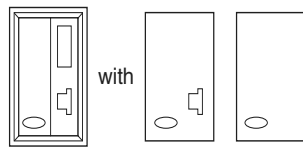
Model No.	Full Load Amps		Locked Rotor Amps		Non-Inductive Amps			Pilot Duty VA	
	24/120 Vac	240 Vac	24/120 Vac	240 Vac	120 Vac	240 Vac	277 Vac	24 Vac	120/240 Vac
TA-1101 Series	7.2	3.6	44	22	7.5	7.5	7	68	340
TA-1102 Series									
TA-1501 Series	1	1	6	6	—	—	—	—	—
TA-1501-116									
TA-1501-770									

STANDARD

TA-1x0x^a

TA-1x0x-116^a

TA-1x01-602 10 F degree night depression, 24V



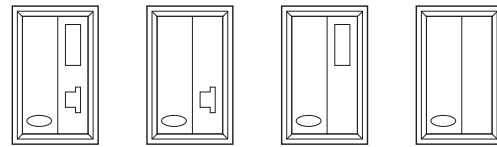
Standard

Insert

Insert

^a5/64" Allen screw used to secure cover.

Figure 1 Standard Covers.



F TA-1x0x-399 -400 -403^a -404^a
C TA-1x0x-398 -410 -413^a -414^a

^a5/64" Allen screw used to secure cover.

Figure 2 Options, covers for quantities of 24 or more each part number. Add dash-number (-xxx) suffix to base part number for desired option. For metal covers, specify TA2-1x0x-xxx.

Specifications

Sensing Element	Bimetal.
Mounting	Flush or 2 x 4 wall box, or directly on wall (24V only).
Locations	NEMA Type 1.
Agency Listing	UL. TA-110x-602: UL, CUL.
General Instructions	TA-110x: Refer to F-09961. TA-1501: Refer to F-18787.

Accessories

Model No.	Description
AT-101	Lock cover kit.
AT-104	Dial stop pins (NOTE: Pins included with each unit.)
AT-504	Mounting base.
AT-505	Surface mounting base.
AT-546	Auxiliary mounting plate.
AT-602	Selector switch sub-base DP4T.
AT-603	Selector switch sub-base one DP4T, one DPDT.
AT-1103	Wire guard.
AT-1104	Cast aluminum guard.
AT-1155	Plastic guard.
AT-1165	Plastic guard with base.
TOOL-11	Calibration wrench.
TOOL-13	Contact burnishing tool.

Typical Applications

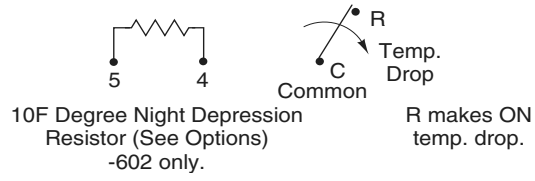


Figure 3 TA-110x Switch Action and Terminal Identification.

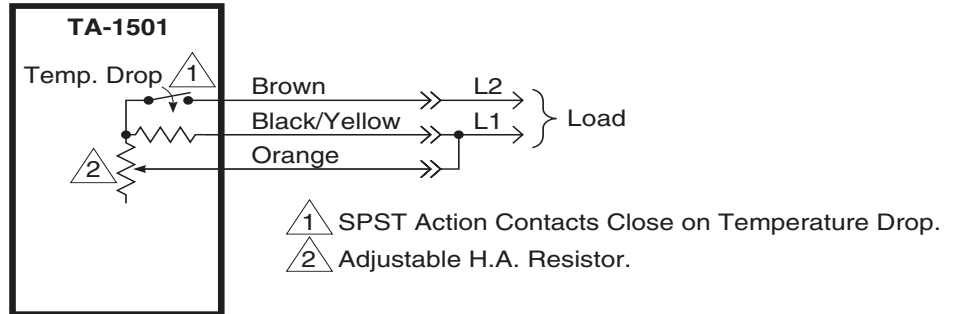


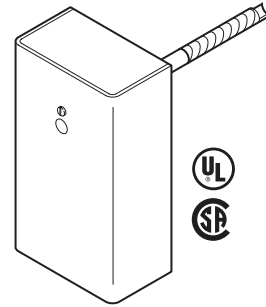
Figure 4 TA-1501 Switch Action and Lead Identification.

High/Low Temperature Thermostats

For line voltage on-off control of media temperatures in ducts, tanks, liquid lines, pipes, etc.

Features:

- Dual marked °F and °C scale.
- 5 and 10F degrees differential.
- Locking screw standard.
- Agency approval.
- Manual reset standard.



Model Chart				
Model No.	Device Type	Functional Setpoint Dial Range °F (°C) ^a	Differential °F (°C)	Switch Type
TA-3432	High temp manual reset	75 to 135 (23 to 57)	Fixed ^b 10 (5)	SPST opens on temp rise
TA-3433		100 to 160 (38 to 71)	Fixed ^b 5 (3)	
TA-3434		120 to 240 (49 to 116)	Fixed ^b 10 (5)	
TA-3441	Low temp manual reset	35 to 59 (1.7 to 15)	Fixed ^c 5 (2)	SPST opens on temp drop

^a Units dual marked °F and °C.

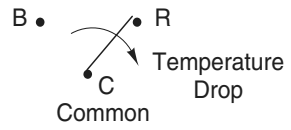
^b Reset cannot be accomplished until the sensed temperature is at least 5°F (3°C) below setpoint.

^c Reset cannot be accomplished until the sensed temperature is at least 5°F (3°C) above setpoint.

Note: Bulb well required for liquid service.

Specifications	
Setpoint dial range	Refer to Model Chart.
Sensing element	Helical bimetal.
Differential	Refer to Model Chart.
Environment	
Ambient temperature limits	Shipping and operating: 100°F (55°C) above or below dial range.
Locations	NEMA Type 1.
Electrical switch	Refer to Model Chart.
Voltage	120 and 240 Vac.
Current	
Full Load	16 Amps at 120 Vac, 8 Amps at 240 Vac.
Locked Rotor	96 Amps at 120 Vac, 48 Amps at 240 Vac.
Pilot Duty	720 VA.
Connections	Coded terminals.
Cover	Beige painted steel case with 1/2 in. conduit opening.
Mounting	In any position on any surface not subject to excessive vibration. For immersion mounting, bulb well is required.
Dimensions	
Case	5-3/8 H x 3-1/2 W x 1-7/8 D in. (136 x 89 x 48 mm).
Element	1/2 D x 7-1/2 insertion length, overall length 9-3/8 in. (131 x 191 x 238 mm).
Agency Listing	UL, CUL.
General Instructions	Refer to F-11302.

Typical Applications



TA-343x opens circuit on rise of temperature above set point.
TA-3441 opens circuit on drop of temperature below set point.

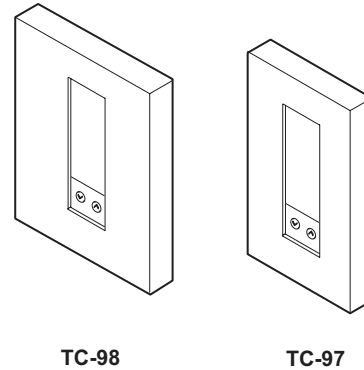
Figure 1 Switch Action and Terminal Identification.

Single Stage, Multi-Stage, and Heat Pump Digital Thermostats

Designed for both commercial and residential needs, the TC97 and TC98 series thermostats handle single stage, multi-stage, and heat pump applications. They also provide short cycle protection during normal operation.

Features:

- Slim, contemporary design.
- Automatic changeover.
- Memory retention (battery not required).
- Easy-to-read LCD display with informative icons.
- On/auto fan operation.
- Electronic keyboard lockout.
- Selectable Celsius/Fahrenheit operation.
- 1-hour temporary override.
- Relay outputs.
- 2 F degrees minimum heat/cool separation.
- Minimum on/off times (2 or 4 min. selectable).
- Short cycle protection.
- Optional remote indoor and outdoor sensors.
- The TC98 series thermostats have the following unique features:
 - 7-day schedule programming with a copy feature.
 - 2 or 4 events per day schedule.
 - 12- or 24-hour clock.
 - Continuous override (hold).
 - Smart fan ventilation option for ventilation requirements.



Model Chart					
Model No.	Description	Heat/Cool Stages	7-Day Schedule Programming	2 or 4 Events per Day Selectable	Dimensions In. (mm) H x W x D
TC97-S	Single stage	1 heat/1 cool	No	No	4-1/2 x 4 x 7/8 (114 x 102x 22)
TC97-SHP	Single compressor heat pump without auxiliary heat				
TC97-MHP	Heat pump—2 compressors with auxiliary heat	2 heat/1 cool 3 heat/2 cool			
TC97-M	Multi-stage	1 heat/2 cool 2 heat/1 cool 2 heat/2 cool			
TC98-S	Single stage	1 heat/1 cool	Yes	Yes	4-1/2 x 5 x 7/8 (114 x 127 x 22)
TC98-MHP	Heat pump—2 compressors with auxiliary heat or single compressor without auxiliary heat	1 heat/1 cool 2 heat/1 cool 3 heat/2 cool			
TC98-M	Multi-stage	1 heat/2 cool 2 heat/1 cool 2 heat/2 cool			

Specifications	
Control Range	
Heating	38 to 88°F (5 to 30°C).
Cooling	60 to 108°F (16 to 40°C).
Minimum Deadband	2 F degrees (1 C degree) between heating and cooling.
Shipping and Storage Temperature	-40 to 124°F (-40 to 48°C).
Operating Temperature	28 to 124°F (0 to 48°C).
Humidity	5 to 85% RH, non-condensing.
Wiring Terminals	Terminal block in wall plate. AWG #14 maximum.
Power Supply	24 Vac nominal 20 to 30 Vac, 50/60 Hz.
Relay Outputs	Form A (SPST, normally open) relay commons are internally connected.
AC Rating	0.05 to 0.75 amp (continuous) at 24 Vac.
DC Rating	0 to 0.75 amp (continuous) at 24 Vdc.
Display	
Range	
Room Temperature Input	28 to 124°F (0 to 48°C).
Outdoor Air Temperature Measurement	-40 to 124°F (-40 to 48°C).
Units	°F or °C.
Control Accuracy	±1 F degree at 68°F (±0.5 C degrees at 20°C).
Mounting	Flush.
Locations	NEMA Type 1.
General Instructions	TC97-SHP: Refer to F-26403. TC97-M: Refer to F-26404. TC97-MHP: Refer to F-26405. TC98-xxx: Refer to F-26406.

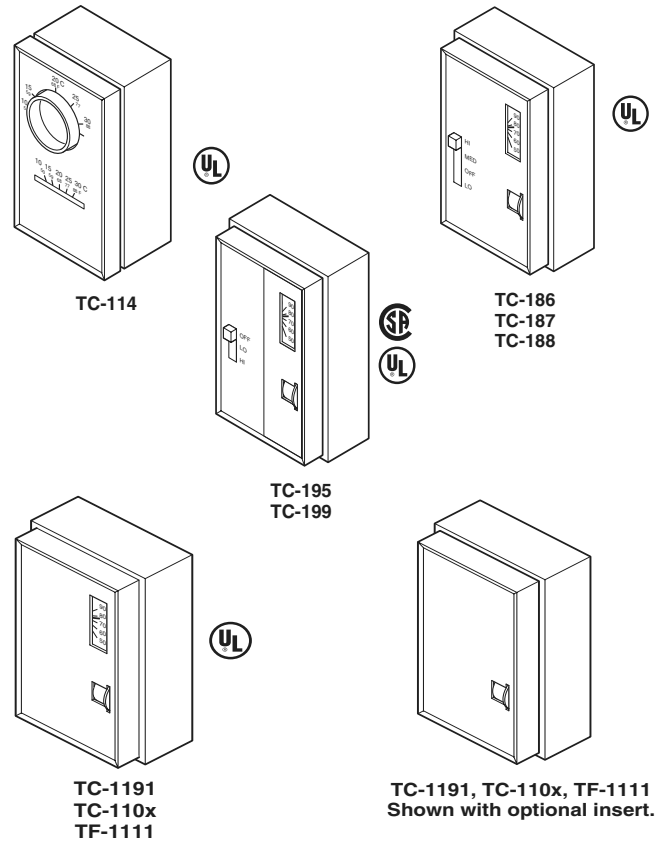
Accessories	
Model No.	Description
WXU-10-528	Indoor air sensor (Robertsshaw labeled)
WXU-10-529	Outdoor air sensor.
WXU-10-546	Add-A-Wire (allows 5-wire thermostats to be connected to 4-wire).

Two-Position Electric Duplex Room Thermostats

These thermostats provide on-off control of heating/cooling systems.

Features:

- Separate units for °C and °F.
- All units except TC-114.
 - Parallel heat and/or cooling anticipation capability.
 - Dial stop pins to limit range.
 - Lock cover screw/sets available.
 - Agency approval.
 - Switch bases AT-602 and AT-603 available for custom applications.
- TC-18x and TC-19x.
 - Fan switch option standard.



Model Chart								
Model No.	Application	Setpoint Dial Range	Differential F Degrees (C Degrees)	Electrical Switch Refer to Electrical Ratings Table	Connections	Cover	Dimensions In. (mm) H x W x D	Agency Listing
TC-114	On/off control of unit heaters or motors.	50 to 90°F (10 to 32°C) Dual marked	Heat, 2 (1.1) Cool, 4 (1.7°)	SPDT snap action	Screw terminals	Beige plastic with metal brushed bronze insert	4-3/4 x 2-3/4 x 2-3/4 (121 x 70 x 70)	UL
TC-186 ^a TC-187 ^a TC-188 ^a TC-187-116 ^a TC-188-116 ^a	Sequenced on-off control of line voltage fan coil or zone valves on heating and cooling systems.	55 to 85 °F 13 to 29°C	Heat, 2 Neutral, 2 Cool, 2 Heat, (1.1) Neutral, (1.1) Cool, (1.1)	SPDT zero energy band (neutral center)	Coded screw terminals and color-coded 6 in. leads		Beige metal with metal brushed bronze insert	
TC-195 ^a TC-199 ^a	On-off control of line voltage fan coil or zone valves on heating and cooling systems.	55 to 85 °F (13 to 29°C)	1.5 (0.8) Heat, 2 (1.1) Cool, 2 (1.1) Neutral, 2 (1.1)	SPDT snap action SPDT zero energy band (neutral center)				

^a Models offer fan speed control.

TC-1xx Series, TC-11xx Series, TF-1111 Series

Model Chart (Continued)								
Model No.	Application	Setpoint Dial Range	Differential F Degrees (C Degrees)	Electrical Switch Refer to Electrical Ratings Table	Connections	Cover	Dimensions In. (mm) H x W x D	Agency Listing
TC-1101	Low or line voltage on-off control of fan coils, fans, motor starters, contactors, two-position electric actuators.	55 to 85°F	2 (1.1)	SPDT snap action	Color-coded 6 in. leads	Beige plastic as standard	4-3/8 x 2-7/8 x 1-5/8 (111 x 73 x 41)	UL
TC-1101-116		13 to 29°C	1 C° (1.8 F°)					—
TC-1101-500 ^a		55 to 85°F	2 (1.1)					—
TC-1102		45 to 75°F	2 (1.1)					UL
TC-1102-116		7 to 23°C	1 C° (1.8 F°)					—
TC-1102-500 ^a		45 to 75°F	2 (1.1)					—
TC-1102-602 ^b		75 to 105°F						UL
TC-1103			24 to 40°C					1 C° (1.8 F°)
TC-1103-500 ^a		75 to 105°F	2 (1.1)					—
TC-1191	Low or line voltage on-off control of heat/cool systems such as 3 or 4 pipe unitary.	55 to 85°F	Heat, 2 (1.1) Cool, 2 (1.1) Neutral, 2 (1.1)	SPDT (neutral center)			UL	
TC-1191-116		13 to 29°C						
TC-1191-500 ^a		55 to 85°F						
TC-1191-602 ^b								
TF-1111	Floating control of one MF-1233 series actuator.	55 to 85°F	4 (2.2)	SPDT floating off 0.160 FLA @ 24 Vac			—	
TF-1111-116	13 to 29°C	(2)						

^a Heat anticipation model.

^b 10 F degree night depression model.

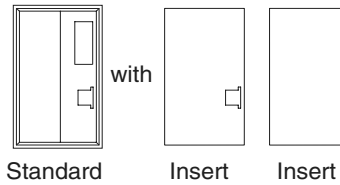
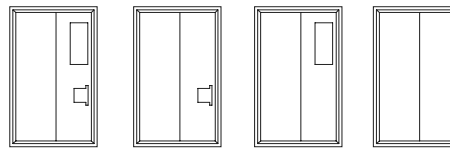


Figure 1 Standard Covers.



	F TC-1xxx-399	-400	-403††	-404††
	C TC-1xxx-398	-410	-413††	-414††

††5/64" Allen screw used to secure cover.

**Figure 2 Options (for quantities of 24 or more each number)
Add dash number (-xxx) suffix to base [part number of desired option].
For metal covers, specify TC2-11xx. No cover option for TC-1xx.**

TC-1xx Series, TC-11xx Series, TF-1111 Series

Specifications

Anticipators Thermostats mounted on concrete walls or surfaces that change temperature slowly, have reduced response to changes in air temperature. Response is further delayed by guards that restrict air flow to the thermostat. Anticipators are required (parallel for cooling, series or parallel for heating) for any of these conditions and in spaces intended for continuous occupancy; i.e., hotel guest rooms and offices.

Anticipation

TC-18x Series	Cooling is fixed.
TF-1111 Series	Heating and cooling; factory-installed resistors are sized for 0.16 FLA @ 24 Vac maximum.

Fan switch

TC-18x Series	Marking: Low-Off ^a -Med-High.
TC-19x Series	Marking: Off-Lo-Hi ^a . Construction: Integral two-pole three-position.

Sensing element

Bimetal.

Mounting

Flush or 2 x 4 wall box.

Locations

NEMA Type 1.

General Instructions

TC-18x: Refer to F-20044.
TC-19x: Refer to F-15688.
TC-110x: Refer to F-18785.
TC-119x: Refer to F-18781.
TF-1111-xxx: Refer to F-21666.

^a Off position de-energizes thermostat and fan.

Electrical Ratings.

Model No.	Fan Switch			Thermostat Contacts							
	Volts (AC)	Full Load Amps	Locked Amps	Volts (AC)	Full Load Amps	Locked Rotor Amps	Pilot Duty (VA)	Non-Inductive Amps			
TC-114	—	—	—	120/240	9.8/8	58.8/48	—	22			
TC-186	24	6	36	24	4.4	26	40	—			
TC-187	120			240			120		3	18	125
TC-187-116											
TC-187-770											
TC-188	240	3	18	240	3	18	125				
TC-188-116											
TC-188-770											
TC-195	120/240	6/3	36/18	120/240	3/1.5	18/9	48	120V 3 A 240V 1.5 A			
TC-195-770											
TC-199					1.0/0.5	6/3		120V 1 A 240V .5 A			
TC-199-770											
TC-1101	—	—	—	24/120/240	Heat, 4.4/4.4/2.2 Cool, 3.0/3.0/1.5	Heat 26.4/26.4/13.2 Cool, 18/18/9	40/210/210	—			
TC-1101-116											
TC-1101-500											
TC-1101-700											
TC-1102											
TC-1102-116											
TC-1102-500											
TC-1102-602											
TC-1102-770											
TC-1103											
TC-1103-116											
TC-1103-500											
TC-1103-770											

TC-1xx Series, TC-11xx Series, TF-1111 Series

Electrical Ratings (Continued).

Model No.	Fan Switch			Thermostat Contacts				
	Volts (AC)	Full Load Amps	Locked Amps	Volts (AC)	Full Load Amps	Locked Rotor Amps	Pilot Duty (VA)	Non-Inductive Amps
TC-1191	—	—	—	24/120/240	Heat, 4.4/4.4/2.2 Cool, 3.0/3.0/1.5	Heat 26.4/26.4/13.2 Cool, 18/18/9	40/210/210	—
TC-1191-116								
TC-1191-500								
TC-1191-602								
TC-1191-770								
TF-1111	—	—	—	24	0.16 at 24 Vac	—	—	—
TF-1111-116								
TF-1111-770								

Accessories

Model No.	Description
AT-61 Series	Brushed bronze cover plates.
AT-101	Lock cover kit.
AT-104	Dial stop pins (pins included with each unit).
AT-504	Plaster hole cover kit (small).
AT-505	Surface mounting base.
AT-546	Auxiliary mounting plate.
AT-602	Selector switch sub-base DP4T.
AT-603	Selector switch sub-base one DP4T, one DPDT.
AT-1103	Wire guard.
AT-1104	Cast aluminum guard.
AT-1105	Plastic guard, 3-7/8 H x 3-1/2 W x 2-1/2 D in..
AT-1155	Plastic guard, 6-1/4 H x 5-1/2 W x 3-1/4 D in..
AT-1165	Plastic guard 8 H x 5-1/2 W x 3-1/2 D in.
TOOL-11	Calibration wrench.
TOOL-13	Contact burnishing tool.

Typical Applications

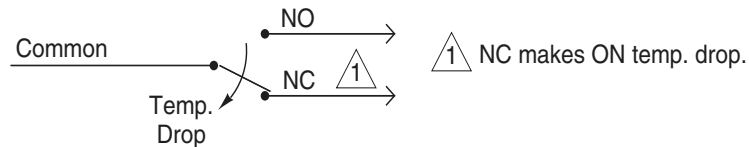


Figure 1 TC-114 Switch Action and Lead Identification.

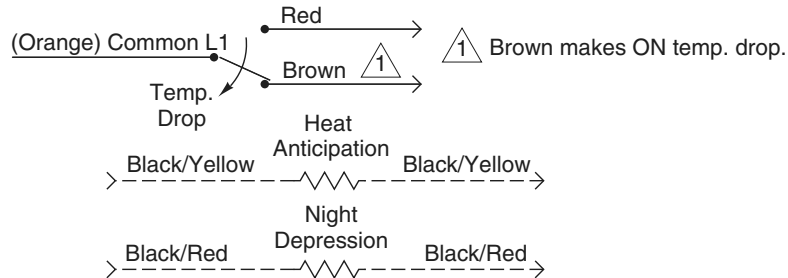


Figure 2 TC-110x Series Switch Action and Lead Identification.

TC-1xx Series, TC-11xx Series, TF-1111 Series

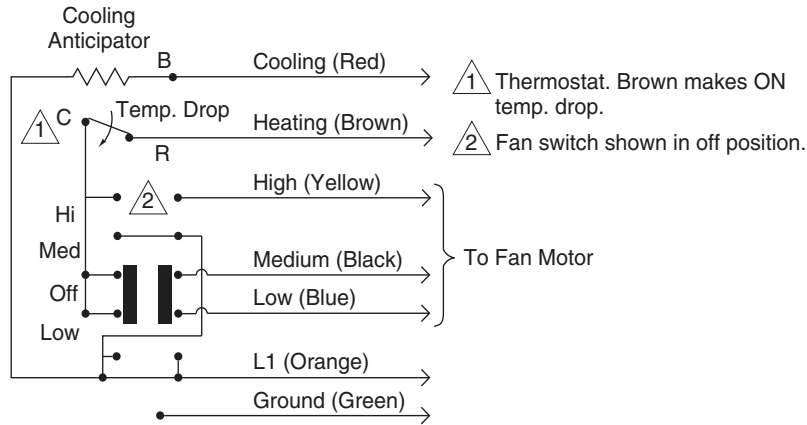


Figure 3 TC-18x Series Switch Action and Terminal Identification.

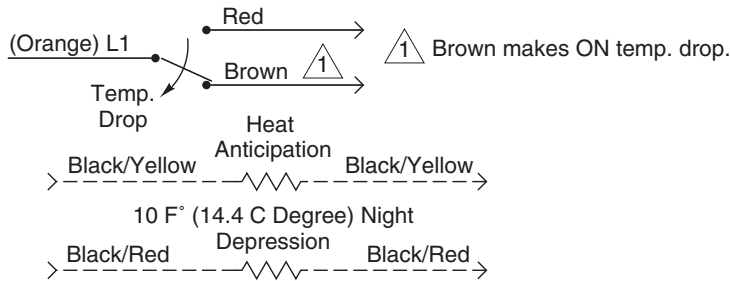


Figure 4 TC-1191 Switch Action and Lead Identification.

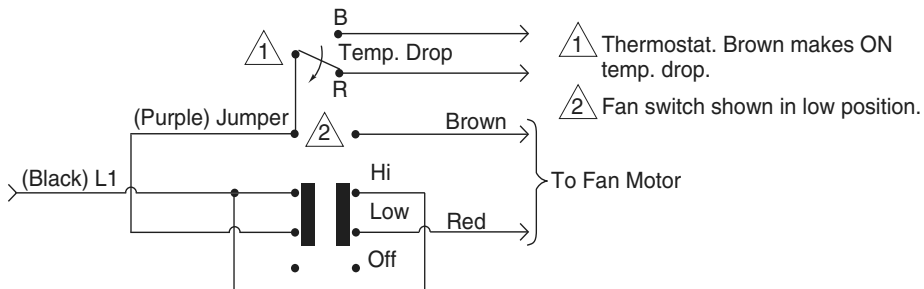


Figure 5 TC-19x Series Switch Action and Terminal/Lead Identification.

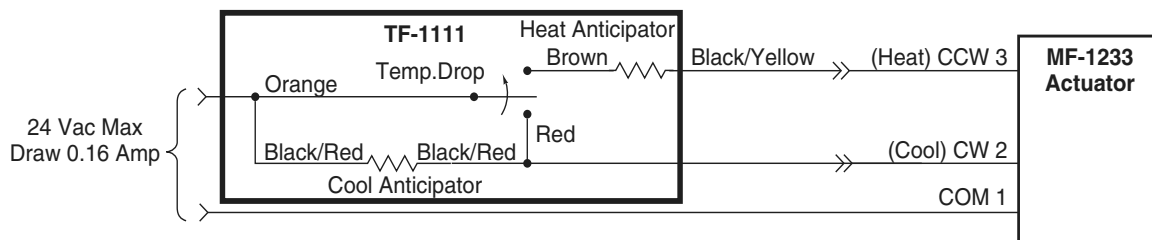


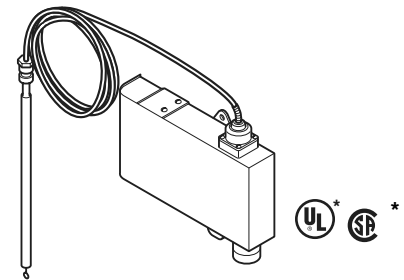
Figure 6 TF-1111 Switch Action and Typical Wiring.

Single Bulb Thermostats

These units are used for on-off control of media temperature in ducts, tanks, etc.

Features:

- Mechanism enclosed in rugged die cast case with metal cover.
- Large coded terminals.
- Liquid-filled thermal element actuates one snap-acting SPDT per stage.
- Setpoint adjustment knob is clearly marked and has recessed locking screw.
- Copper thermal element is suitable for either immersion or duct mounting.
- Explosion proof housing available on one and two stage models.



*Only TC-202, TC-252, and TC-271 are UL and CUL Listed.

Model Chart										
Model No.	Description	Capillary ft. (m)	Setpoint Adjustment Range ^a °F (°C)	Volts	Switch Ratings (AC only) ^b 50/60 Hz				Thermal Differential F°(C°)	
					FLA Amps	LRA Amps	Resistive Amps	Pilot Duty (VA)	Factory Set	Adjustable
TC-202	Single stage heating or cooling	6 (1.8) copper	10 to 90 (-12 to 32)	120 240	—	—	12 6	125 125	2 (1.1)	1 to 15 (0.55 to 8.3)
TC-252	Two stage heating or cooling	6 (1.8) copper	10 to 90 (-12 to 32)							
TC-271	Two stage heating or cooling	10 (3) armored	0 to 160 (-17 to 71)						2 (1.1) per stage	2 to 7 (1 to 4) per stage
TC-282	Three stage heating or cooling	6 (1.8) copper	10 to 90 (-12 to 32)	24	3.8	22.8	15	26	3 (1.66) between stages	0 to 20 (0 to 11) between high and low stage
TC-282-20		20 (6) copper		120	3.8	22.8	15	125		
TC-288	Four stage cooling only	6 (1.8) copper		277	—	—	15	—		

^a Celsius scale is available as an option. Specify -216 suffix.

^b 1600 VA maximum load.

Specifications	
Setpoint adjustment range	Setpoint dial marked in °F. Refer to Model Chart for specific range.
Sensing element	Liquid filled thermal element.
Electrical switch	One snap-acting SPDT per stage.
Ratings	Refer to Model Chart.
Connections	Coded terminals.
Case	Rugged die cast with metal cover. Half inch conduit openings at top and bottom.
Ambient temperature limits	
Case	-40 to 140°F (-40 to 60°C).
Bulb	230°F (110°C).
Output	Switch action is adjustable. Refer to Model Chart.
Dimensions	
Case	Single or two stage: 5-3/4 H x 5-1/4 W x 1-7/8 D in. (146 x 133 x 48 mm). Three or four stage: 5-3/4 H x 7-1/8 W x 1-7/8 D in. (146 x 181 x 48 mm).
Thermal element	3/8 dia. x 9-1/2 L in. (9.5 x 241 mm).
Options	Available in °C.
Hazardous locations	Specify TC6-2Xx.
Agency Listing	TC-202, 252, 271: UL, CUL.
General Instructions	Refer to F-18783.

TC-200 Series

Accessories

Model No.	Description
AT-201	Copper bulb well (order separately).
AT-203	Stainless steel bulb well (order separately).
AT-208	Bulb duct mounting kit (order separately).
AT-211	Outside bulb shield (order separately).

Typical Applications

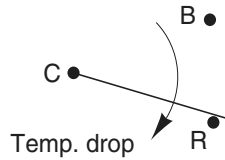


Figure 1 Typical of TC-202, Single Stage.

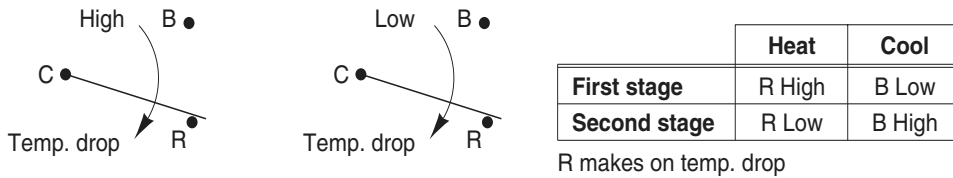


Figure 2 Typical of TC-252 and TC-271, Two Stage.

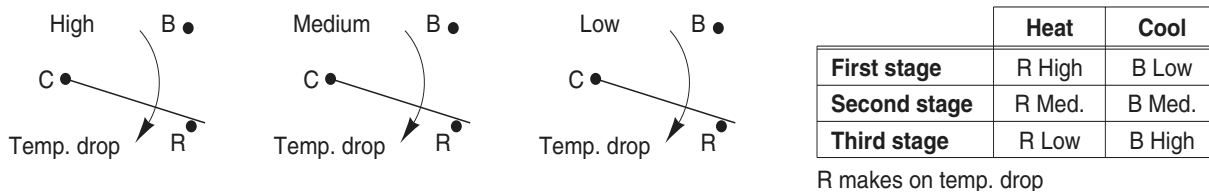
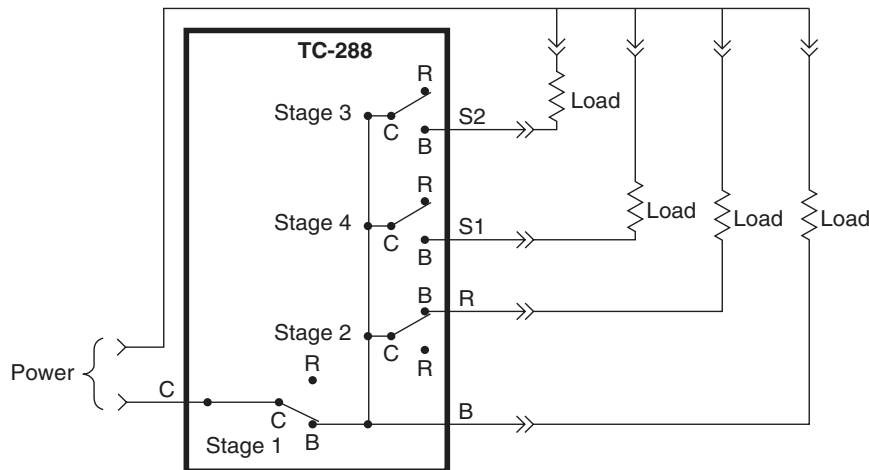


Figure 3 Typical of TC-282, Three Stage.



C is common of a single pole, double-throw switch.
 B closes on rise in temperature (call for cooling).
 R contact, present in switch but not wired, closes on a drop in temperature (call for Heat).

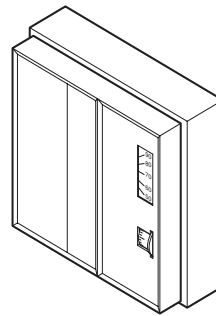
Figure 4 Typical of TC-288, Four Stage Cooling.

Two-Position Electric Duplex Room Thermostats

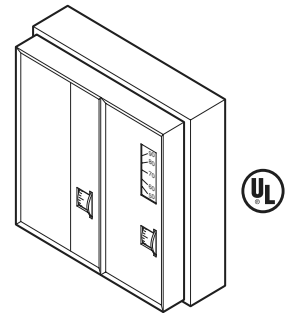
These thermostats provide temperature control for on-off applications requiring two individually adjustable thermostats under one cover. Typical applications include, day/night control, night and warm-up control, summer/winter and other energy conserving systems.

Features:

- Fixed switch differential.
- Dial stop pins to limit dial range.
- Lock cover screw kits available.
- Agency approval.
- Unit marked in °F or C°.
- Switch bases AT-607 and AT-608 available for custom applications.



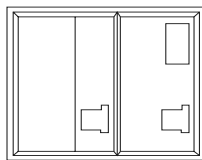
TC-1151 Series



TC-1161 Series

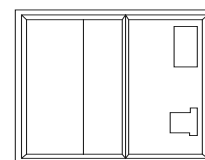
Model Chart											
Model No.	Dial Scale °F (°C)		Thermo meter	Electrical Ratings							
	Left Side	Right Side		Full Load Amps		Locked Rotor Amps		Current Rating (amps)	Voltage	Pilot Duty VA	Thermostat Switch Action
				24/120	240	24/120	240				
TC-1151	—	55 to 85	Yes	3	1.5	18	9	—	—	28 at 24 Vac 140 at 120/240 Vac	Two Stage 2 SPDT
TC-1151-116	—	13 to 29									2 SPDT
TC-1161	55 to 85	55 to 85									
TC-1161-116	13 to 29	13 to 29									
TC-1161-479	75 to 105	45 to 75	No	—	—	—	—	0.41	24 Vac	—	2 SPST
TC-1161-530 ^a	75 to 105							0.082	120 Vac		
TC-1161-531 ^a											

^a 3F degree cooling and heating anticipation. Heat anticipation should be used when system differential varies from specified thermostat differential. Wide system differential may be due to thermostat guards, material on which the thermostat is mounted, location of thermostat, etc.



Standard

TC-1161 Standard Model

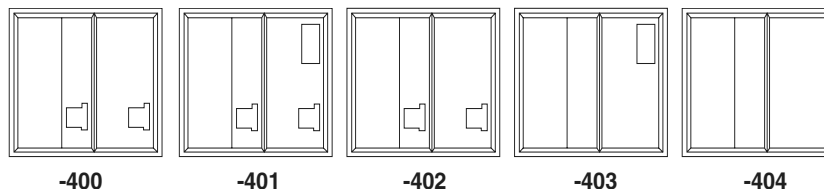


Standard

TC-1151 Standard Models

Figure 1 Standard Covers.

TC-1151 Series, TC-1161 Series



**Figure 2 Options for Quantities of 24 or more of each part number.
Add dash number to base part number for desired option.**

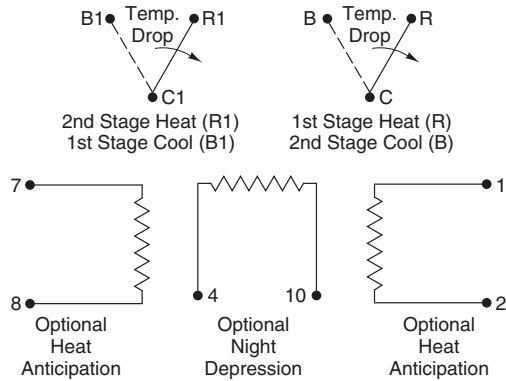
Specifications

Setpoint dial range	See Description Model Chart.
Sensing element	Bimetal.
Differential	Switching: 2 F degrees (1.1 C degrees). Staging: Adjustable 2 to 10 F degrees (1.1 to 5.6 C degrees), factory adjusted between 2 and 4 F degrees.
Environment	
Ambient temperature limits	Shipping: -40 to 160°F (-40 to 71°C). Operating: 40 to 140°F (4 to 60°C).
Humidity	5 to 95% RH, non-condensing.
Locations	NEMA Type 1.
Electrical ratings	See Model Chart.
Connections	Coded screw terminals.
Cover	Plastic.
Mounting	Flush on single or 2-gang switch box or 4 x 4 in. (102 x 102 mm) surface box or directly to wall (24 Vac only).
Dimensions	4-3/8 H x 4-3/4 W x 1-5/8 D in. (111 x 121 x 41 mm).
Agency Listing	UL.
General Instructions	TC-115: Refer to F-18782. TC-1161: Refer to F-16290.

Accessories

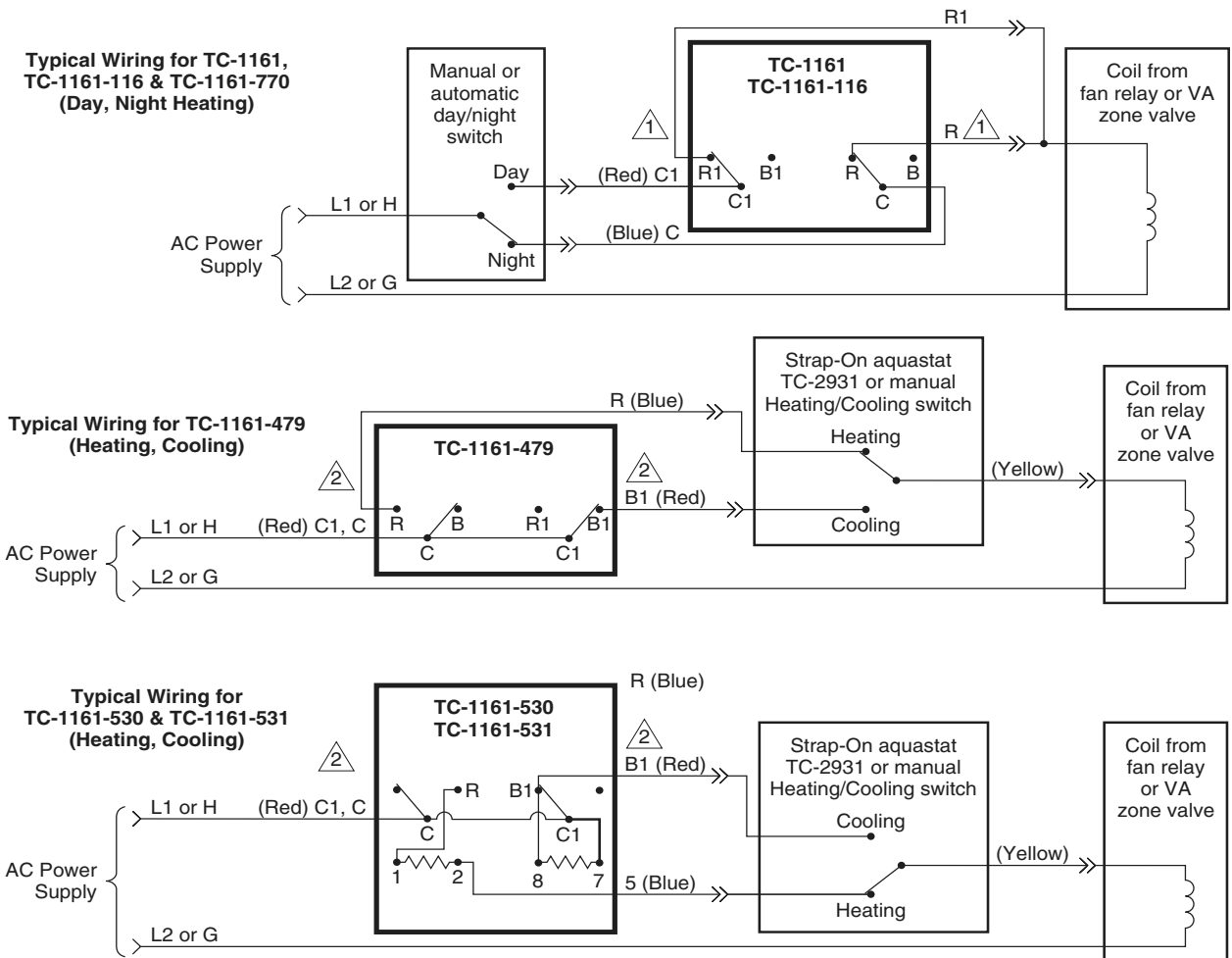
Model No.	Description
AT-101	Lock cover kit (2 required per thermostat).
AT-104	Dial stop pins (note: pins included with each unit).
AT-546	Auxiliary mounting plate
AT-607	Selector switch sub-base DP4T.
AT-608	Selector switch sub-base one DP4T, one DPDT.
AT-1155	Plastic guard for TC-1161 series.
AT-1163	Plastic guard for TC-1151 series.
AT-1165	Plastic guard.
TOOL-11	Calibration wrench.
TOOL-13	Contact burnishing tool.

Typical Applications



Note: Thermostat is designed for either heat or cool applications, not heat and cool.

Figure 3 TC-1151 Series Switch Action and Lead Identification.



1 "R" and "R1" close on temperature drop. "B" and "B1" close on temperature rise.
 2 "R" closes on temperature drop. "B1" closes on temperature rise.

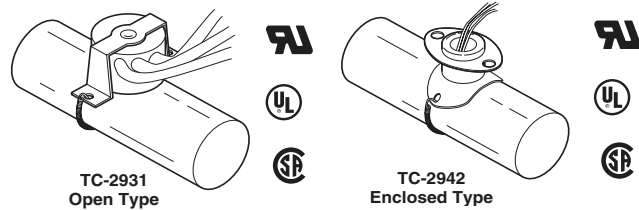
Figure 4 Typical Wiring Diagrams.

Strap-on Changeover Thermostat

This thermostat provides summer-winter changeover in hydronic heating-cooling systems.

Features:

- Fixed control point. No adjustment required.

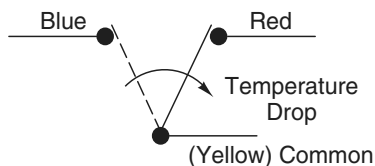


Model Chart							
Model No.	Type	Switch Ratings (AC only)				Blue-Yellow Close on Rise °F (°C)	Red-Yellow Close on Drop °F (°C)
		Vac	FLA (amps)	LRA (amps)	Pilot Duty (VA)		
TC-2931	Strap-on	120	5.8	34.8	125	82 (28)	67 (19)
TC-2942	Strap-on enclosed ^a	240	2.9	17.4			

^a Has 1/2 in. (12.7 mm) conduit adaptor.

Specifications	
Setpoint	75°F (24°C) approximately, fixed.
Sensing element	Bimetal.
Differential	15 F degrees (8 C degrees) fixed.
Ambient temperature limits	
TC-2931	Shipping: -40 to 167°F (-40 to 75°C). Operating: -40 to 167°F (-40 to 75°C).
TC-2942	Shipping: -40 to 220°F (-40 to 104°C). Operating: -40 to 220°F (-40 to 104°C).
Minimum hot water temperature	90°F (32°C).
Maximum chilled water temperature	60°F (16°C).
Electrical switch	Snap acting SPDT with silver contacts.
Ratings	Refer to Model Chart.
Sensing element	Bimetal disc.
Connections	
TC-2931	Three color coded 16 gage leads 3 ft. (914 mm) long.
TC-2942	Three color coded 16 gage leads 3 ft. (914 mm) long with 1/2 in. (12.7 mm) conduit adaptor.
Case	Hermetically sealed steel.
Mounting	On up to 1-1/2 in. (51 mm) pipe with mounting springs provided.
Dimensions	2 in. dia. x 1-1/2 H in. (51 x 38 mm).
Agency Listing	UL, CSA approved.
General Instructions	Refer to F-12720.

Typical Applications



Red makes ON temperature drop

Figure 1 Typical Lead Connections TC-2931.

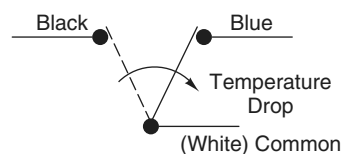


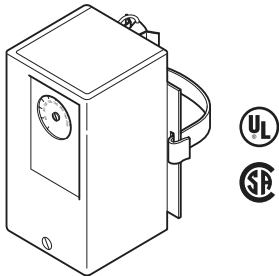
Figure 2 Typical Lead Connections TS-2942.

Strap-on Thermostat

This thermostat provides hot water unit heater control and summer-winter changeover. May be used as either an open high control or an open low control.

Features:

- Available lock cover and concealed setpoint kit.
- Adjustable setpoint.

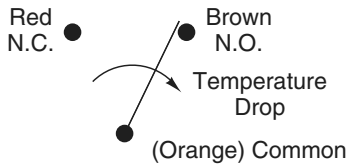


Model Chart					
Model No.	Voltage (Vac)	Full Load Amps	Locked Rotor Amps	Pilot Duty (VA)	Non-inductive (amps)
TC-2974	120	9.8	58.8	360	22
	240	8	48.8		

Specifications	
Setpoint adjustment range	50 to 210°F (10 to 99°C), graduated external setpoint adjustment marked in °F on one side and °C on the other.
Sensing element	Liquid-filled copper.
Differential	10 F degrees (5.5 C degrees) fixed.
Ambient temperature limits	
Case	Storage: -40 to 160°F (-40 to 71°C). Operating: -40 to 140°F (-40 to 60°C).
Bulb	260°F (127°C) maximum.
Locations	NEMA Type 1.
Electrical Switch	Heavy duty snap-acting SPDT.
Ratings	Refer to Model Chart.
Connections	Coded screw terminals.
Case	Steel with 1/2 in. to 3/4 in. conduit opening on bottom.
Mounting	On up to 4 in. O.D pipe with metal strap and spring provided.
Dimensions	4-5/8 H x 2-1/4 W x 2-5/8 D in. (117 x 57 x 67 mm)
Agency Listing	UL, CSA.
General Instructions	Refer to F-16441.

Accessories	
Model No. AT-210	Description Concealed adjustment plate.

Typical Applications



Brown makes ON temperature drop

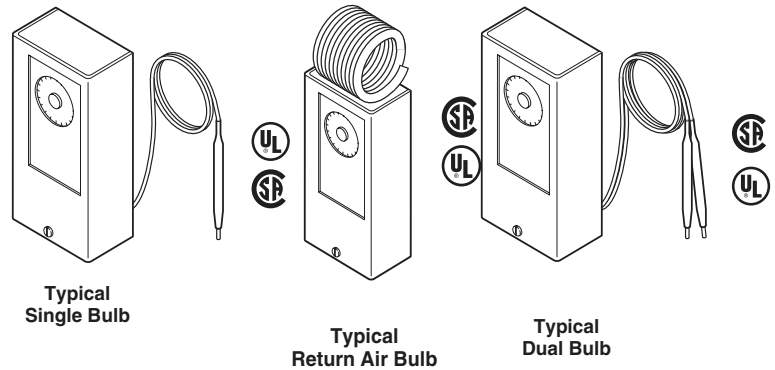
Figure 1 TC-2974 Switch Action and Screw Terminal Identification.

Two-Position, Single & Dual Bulb Thermostats

For on-off control of media temperature in ducts, tanks, liquid lines, etc.

Features:

- Heating or cooling applications.
- Adjustable differential on all except TC-4166.
- 1/2 in. conduit connections.
- Agency approval.
- Duct/immersion/outside mounting kits available.
- Concealed adjustment plate.



Model Chart					
Model No.	Type	Dual ^a Bulb Ratio	Dimensions		
			Capillary Copper ft. (m)	Bulb Copper in. (mm)	
TC-4111	Single stage, single bulb	—	8 (2.4)	3/8 x 4 (9.5 x 102)	
TC-4111-020			20 (6)		
TC-4112			8 (2.4)		
TC-4115 ^b			10 (3) Armored		
TC-4121					
TC-4122					
TC-4123					
TC-4151	Single stage, dual bulb	1:1-1/2 ^c	30 (9) Each bulb	Indoor	Outdoor
TC-4152		1:1		3/8 x 4 (9.5 x 102)	3/8 x 5-1/2 (9.5 x 140)
TC-4166	Single stage, return air bulb	—	None	Coiled 2-1/2 x 2 (64 x 51)	
TC-4211	Two stage, single bulb	—	8 (2.4)	3/8 x 4 (9.5 x 102)	
TC-4221			10 (3) Armored		
TC-4222					
TC-4223					
TC-4251	Two stage, dual bulb	1:1-1/2 ^c	30 (9) Each bulb	Indoor	Outdoor
TC-4252		1:1		3/8 x 4 (9.5 x 102)	3/8 x 5-1/2 (9.5 x 140)
TC-4266	Two stage, return air bulb	—	None	Coiled 2-1/2 x 2 (64 x 51)	

^a First number of reset ratio typically indicates outdoor air temperature change required to increase the setpoint by the second number.

^b Refer to Electrical Ratings Table.

^c For 1-1/2:1 ratio, reverse bulbs and use extra dial supplied with unit.

Differential, Setpoint Adjustment, and Safe Bulb Temperature Ranges.

Model No.	Differential F° (C°)	Setpoint Adjustment Range °F (°C)	Safe Bulb Temperature Range °F (°C)
TC-4111	Factory set 3 (2), adj. 3 to 16 (2 to 9)	-40 to 120 (-40 to 49)	-40 to 170 (-40 to 77)
TC-4111-020			
TC-4112		100 to 260 (38 to 127)	-40 to 310 (-40 to 154)
TC-4115		-40 to 120 (-40 to 49)	-40 to 170 (-40 to 77)
TC-4121		100 to 260 (38 to 127)	-40 to 310 (-40 to 154)
TC-4122		190 to 350 (88 to 176)	-40 to 400 (-40 to 204)
TC-4123			
TC-4151	Factory set 3 (2), adj. 1-1/2 to 10 (1 to 5)	70 to 120 (21 to 49)	Total of indoor and outdoor temperatures must not exceed 280 (138)
TC-4152	Factory set 3 (2), adj. 3 to 16 (2 to 9)		
TC-4166	Fixed 2 (1)	50 to 90 (10 to 32)	-40 to 145 (-40 to 63)
TC-4211	Per stage fixed 3 (2), between stages set 3 (2), adj. 2 to 10 (1 to 5)	-40 to 120 (-40 to 49)	-40 to 170 (-40 to 77)
TC-4221			
TC-4222		100 to 260 (38 to 127)	-40 to 310 (-40 to 154)
TC-4223		190 to 350 (88 to 176)	-40 to 400 (-40 to 204)
TC-4251	Per stage fixed 3 (2), between stages set 3 (2), adj. 1.5 to 6.5 (1 to 4)	70 to 120 (21 to 149)	Total of indoor and outdoor temperatures must not exceed 280 (138)
TC-4252	Per stage fixed 3 (2), between stages set 3 (2), adj. 2 to 10 (1 to 5)		
TC-4266	Each stage fixed 2 (1), between stages set 3 (2), adj. 1 to 5 (0.5 to 3)	50 to 90 (10 to 32)	-40 to 145 (-40 to 63)

Specifications

Setpoint dial range	Dial plate is marked as °F on one side and °C on the other. Refer to Differential, Setpoint Adjustment, and Safe Bulb Temperature Ranges Model Chart for specific ranges.
Sensing element	Liquid filled copper.
Differential	Refer to Differential, Setpoint Adjustment, and Safe Bulb Temperature Ranges Model Chart.
Dual bulb units	One bulb senses the controlled media; the second bulb senses the outside air temperature. The temperature of the controlled media increases as outside air temperature decreases.
Ambient temperature limits	
Case	Shipping: -40 to 160°F (-40 to 71°C). Operating: -40 to 150°F (-40 to 65°C) except return air bulb unit, -40 to 140°F (-40 to 60°C).
Bulb	Refer to Differential, Setpoint Adjustment, and Safe Bulb Temperature Ranges Model Chart.
Electrical switch	Snap action SPDT, one per stage.
Ratings	Refer to Electrical Ratings Table.
Connections	Coded screw terminals.
Cover	All metal with 1/2 to 3/4 in. conduit openings.
Case Locations	NEMA Type 1.
Mounting	Case can be mounted in any position. Refer to Accessories for bulb mounting kits, order separately.
Dimensions	
Case	4-5/8 H x 2-1/4 W x 2 D in. (117 x 57 x 51 mm).
Element and Capillary	Refer to Description Model Chart.
Agency Listing	UL, CUL.
General Instructions	Refer to F-18895.

TC-4100 Series, TC-4200 Series

Electrical Ratings (Except TC-4115^a).

Switch Rating (50/60 Hz)	24 V	120 V	240 V
Full Load Amps	16	16	8.0
Locked Rotor Amps	96	96	48.0
Pilot Duty VA	60	360	360
Non-Inductive Amps (Resistive)			
Single Stage	22	22	22
Two Stage	16	16	8.0

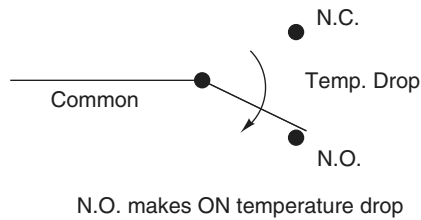
^a TC-4115 for System 8000 and applications requiring less than one (1) amp. Electrical Rating: 1.0 amp at 24 Vac; 0.25 amp at 24 Vdc.

Accessories

Model No.	Description
AT-201	Copper bulb well requires AT-209.
AT-203	Stainless steel bulb well requires AT-209.
AT-206	Copper bulb well.
AT-208	Duct mounting kit
AT-209	Bulb mounting kit.
AT-210	Concealed adjustment plate.
AT-211	Outdoor bulb shield.

Typical Applications

Typical Single Stage



Typical Two Stage

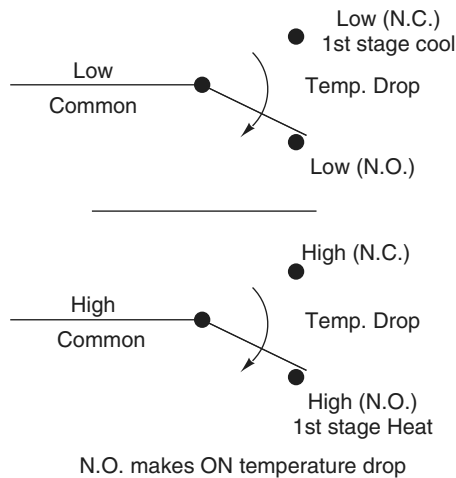


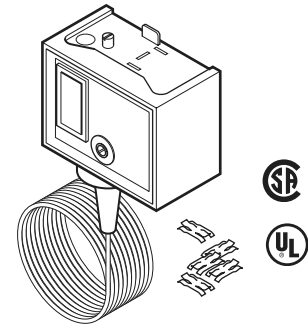
Figure 1 Switch Action and Terminal Identification.

Low Temperature Thermostats

The TC-5231, TC-5232, and TC-5241 low temperature thermostats are used to control temperature in air conditioning or refrigeration systems.

Features:

- 20 ft. (6.1 m) element senses temperature over a large area. Control responds to coldest one-foot section of the sensor.
- Adjustable setpoint with 5 F degrees (3 C degrees) fixed differential.
- SPST, SPDT and DPST versions.
- Capillary mounting clips provided.



Model Chart															
Model No.	Setpoint Range	Device Type	Electrical Switch	Voltage Vac	Full Load Amps	Locked Rotor Amps	Pilot Duty (VA)	Non-Inductive Amps							
TC-5231	35 to 60°F (1.7 to 1.5°C)	Low temp auto reset	SPDT ^a	24 ^b	—	—	100	16							
				120	17	102	720	24							
				208											
				240 ^c											
TC-5232			277	—	—	—	—	—	—	7.2					
										DPST ^d	24 ^b	—	—	100	16
											120	24	144	125	24
											208				
240 ^c															
TC-5241	277	—	—	—	—	—	—	7.2							
								SPDT ^a	24 ^b	—	—	100	16		
									120	17	102	720	24		
									208						
240 ^c															
TC-5242	15 to 55°F (-9.4 to 12.8°C)	Low temp manual reset ^e	1-SPST Main N.C. 1-SPST Aux N.O.	120	16	96	125	—							
				208	9.2	55.2									
				240 ^c	8	48									
				277	—	—		7.2							
				120	6	36	6								
				208	3.4	20.4									
				240 ^c	3	18									
				277	—	—									

^a Do not exceed pilot duty rating on one side of switch.
^b Less than 0.5 Amp is not recommended.
^c Full load and locked rotor ratings are suitable for hermetic compressors only.
^d Limit two separate circuit loads with common return to <5885 VA. Only one load may be a motor load.
^e Reset cannot be accomplished until the sensed temperature is at least 5°F above setpoint.

TC-5231 Series, TC-5232, TC-5241 Series

DC Ratings for TX-5232 Only.

Volts	FLA ^a	LRA ^a	NIA ^a	PD VA ^a
120	4.6	46	3	57.5
240	2.3	23	0.5	57.5
600	—	—	—	57.5

- ^a FLA — Full Load Amps.
 LRA — Locked Rotor Amps.
 NIA — Non-Inductive Amps.
 PDVA — Pilot Duty VA.

Specifications	
Setpoint dial range	Dual marked 35 to 60°F (1.7 to 15.5°C). TC-5242: 15 to 55°F (-9.4 to 12.8°C).
Sensing element	Vapor pressure type, copper construction.
Response	To lowest temperature sensed by any one-foot section of its element. Altitude causes the control to operate approximately 1°F colder per 1000 ft. of elevation.
Differential	5 F degrees (3 C degrees) fixed.
Electrical switch	Refer to Model Chart.
Ratings	Refer to Model Chart.
Connections	Coded screw terminals.
Mounting	In any position on any surface not subject to excessive vibration.
Housing	Molded gray PVC plastic cover with a zinc-plated steel main enclosure with a 1/2 in. conduit opening. TC-5242: painted steel housing.
Environment	
Ambient temperature limits	Shipping: -40 to 150°F (-40 to 66°C). Operating: Must be 5°F (3°C) above setpoint to a maximum of 150°F (66°C) at case. Thermal sensing element: 300°F (149°C).
Humidity	Enclosure: 5 to 95% RH, non-condensing. Thermal sensing element: 0 to 100% RH.
Locations	NEMA Type 1.
Dimensions	
Case	2-45/64 H x 3-1/2 max. W x 2 max. D in. (69 x 89 x 51 mm). TC-5242: 3-1/4 H x 4 L x 2 D in. (83 x 101 x 51 mm)
Element	3/32 in. O.D. x 20 ft. length (2.4 mm x 6.1 m). TC-5242 1/8 in. O.D. x 20 ft. length. (3.2 mm x 6.1 m).
Agency Listings	
UL 873	Underwriters Laboratories Inc. listed (File # E9429 Category Temperature-indicating and Regulating Equipment).
CSA	Certified for use in Canada by Underwriters Laboratories. Canadian standards C22.2 No. 24-93.
General Instructions	Refer to F-25911.

Typical Applications

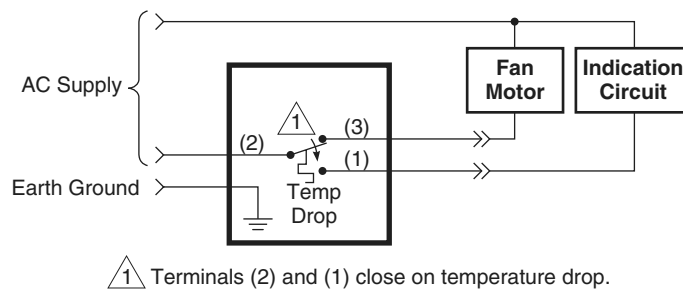


Figure 1 TC-5231 or TC-5241 Switch Action and Terminal Identification.

TC-5231 Series, TC-5232, TC-5241 Series

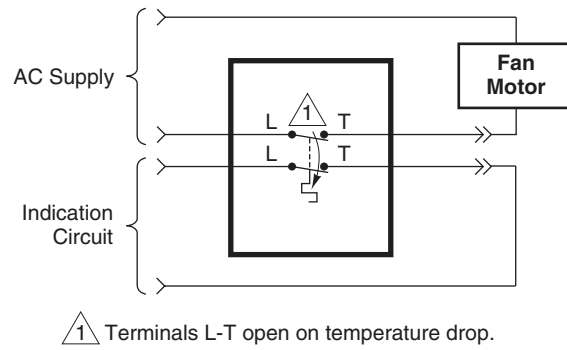


Figure 2 TC-5232 Switch Action and Terminal Identification.

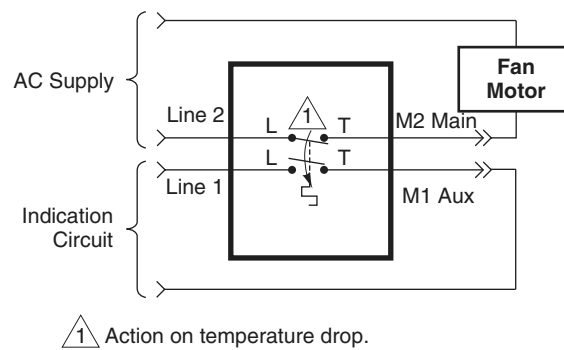


Figure 3 TC-5242 Switch Action and Terminal Identification Manual Reset.

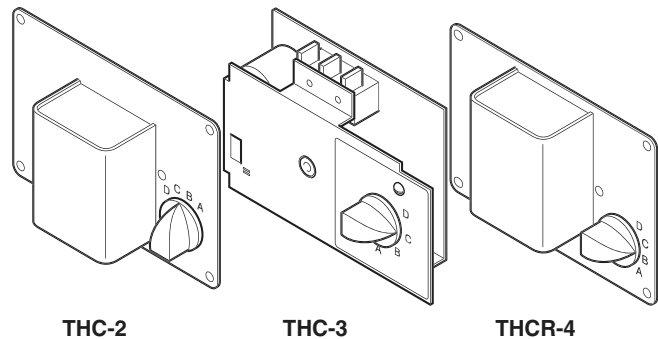
THC-2, THC-3, THCR-4

Two-Position Enthalpy Controller

This controller provides on-off (two-position) low voltage control of the amount of air brought into the cooling system with respect to the “total heat” (enthalpy) of the outside air. THC-3 and THCR-4 controllers replace Honeywell H250A series.

Features:

- Direct acting and reverse acting applications from all units.
- Long life nylon element.
- 1/2 in. conduit units available.
- Competitive replacement units listed.
- Fail safe design.



Model Chart						
Model No.	Control Settings					Replaces Honeywell
	Dial Setting	10% RH	20% RH	50% RH	80% RH	
THC-2	A	88°F (31°C)	—	83°F (28°C)	74°F (23°C)	—
	B	83°F (28°C)		78°F (26°C)	70°F (21°C)	
	C	78°F (26°C)		73°F (23°C)	64°F (18°C)	
	D	73°F (23°C)		68°F (20°C)	59°F (15°C)	
THC-3	A	—	78°F (26°C)	73°F (23°C)	68°F (20°C)	—
	B		73°F (23°C)	68°F (20°C)	63°F (17°C)	
	C		68°F (20°C)	63°F (17°C)	59°F (15°C)	
	D		62°F (17°C)	58°F (14°C)	53°F (12°C)	
THCR-4	A	—	78°F (26°C)	73°F (23°C)	68°F (20°C)	H205A-1012 H205A-1061
	B		73°F (23°C)	68°F (20°C)	63°F (17°C)	
	C		68°F (20°C)	63°F (17°C)	59°F (15°C)	
	D		62°F (17°C)	58°F (14°C)	53°F (12°C)	

Specifications	
Control dial settings	Refer to Model Chart. Intermediate settings are available.
Sensing elements	
Humidity	Nylon ribbon. (Controller will function as a dry bulb control if the nylon element should fail.)
Temperature	Bimetal.
Differentials	8% RH (approximately) and 2F degrees (1C degrees).
Environment	
Ambient temperature limits	Shipping and storage: -40 to 150°F (-40 to 65°C). Operating: 40 to 150°F (4 to 65°C).
Humidity	5 to 95% RH, non-condensing.
Locations	NEMA Type 1, Indoor only.
Electrical switch	Snap acting SPDT will run the outdoor air damper to the minimum position whenever the total heat in the outdoor air renders it unsuitable for cooling.
Rating	100 mA to 2.5 amps at 24 Vac.

Specifications (Continued)

Connections	
THC-2, THCR-4	Three 6 in. (150 mm) color coded leads.
THC-3	Three 1/4 in. male quick connect (spade lug) terminals.
Cover	
	All metal; THC-2 and THCR-4 with 1/2 in. conduit opening.
Mounting	
	In any position where it is exposed to freely circulating outdoor air.
Dimensions	
THC-2, THCR-4	4-3/4 H x 6-1/2 W x 3-1/2 D in. (121 x 165 x 89 mm).
THC-3	3-1/2 H x 5-1/8 W x 1-1/8 D in. (89 x 130 x 29 mm).
General Instructions	
	Refer to F-20009.

Typical Applications

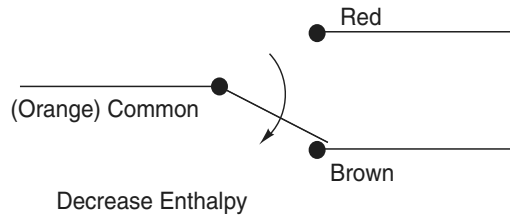


Figure 1 THC-2, THCR-4 Switch Action and Lead Identification.

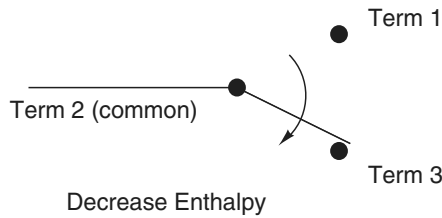
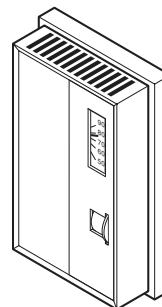


Figure 2 THC-3 Switch Action and Terminal Identification.

Electric Proportional Room Thermostats

For proportional temperature control of electric actuated valves, damper actuators, and sequence controllers.



Features:

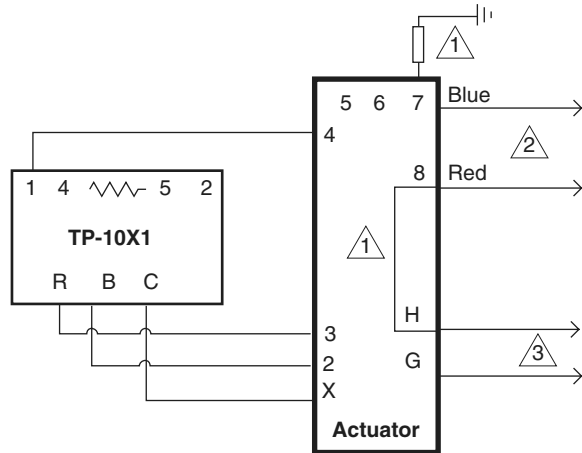
- Proportional control of MP actuators.
- Night set back (TP-1011).
- Concealed adjustments to eliminate tampering optional.
- Accepts actuator feedback for precise control.
- Temperature indication.
- Direct actuator control without interface devices.

Model Chart				
Model No.	Typical Application	Night Set Back	Control Range	Throttling Range
TP-1011	General Purpose	10°F (-12°C)	55 to 85°F (12.7 to 29°C)	4°F (2.4°C)
TP-1031	Cooling	—		

Specifications	
Control range	
Setpoint range	55 to 85°F (13 to 29°C).
Throttling range	4 F degrees (2.4 C degrees).
Night setback	TP-1011 only: 10°F (5.5°C).
Electrical	
Switch rating	24 Vac 1 amp.
Environment	
Ambient temperature limits	Shipping and storage: -40 to 160°F (-40 to 71°C). Operating: 40 to 140°F (4.4 to 60°C).
Construction	Metal base with plastic cover.
Locations	NEMA Type 1.
Dimensions	4-3/8 H x 2-3/4 W x 1-5/8 D in. (111 x 70 x 41 mm).

Accessories	
Model No.	Description
AT-101	Lock cover kit.
AT-104	Dial stop pins.
AT-136	Title plates (day, night, heat, cool).
AT-504	Plaster hole cover kit (small).
AT-505	Surface mounting base.
AT-546	Auxiliary mounting plate.
AT-602	Selector switch sub-base DP4T.
AT-603	Selector switch sub-base one DP4T, one DPDT.
AT-1103	Wire guard.
AT-1104	Cast aluminum guard.
AT-1105	Plastic guard.
AT-1155	Plastic guard.
AT-1165	Plastic guard.
TOOL-11	Calibration wrench.
TOOL-13	Contact burnishing tool.

Typical Applications

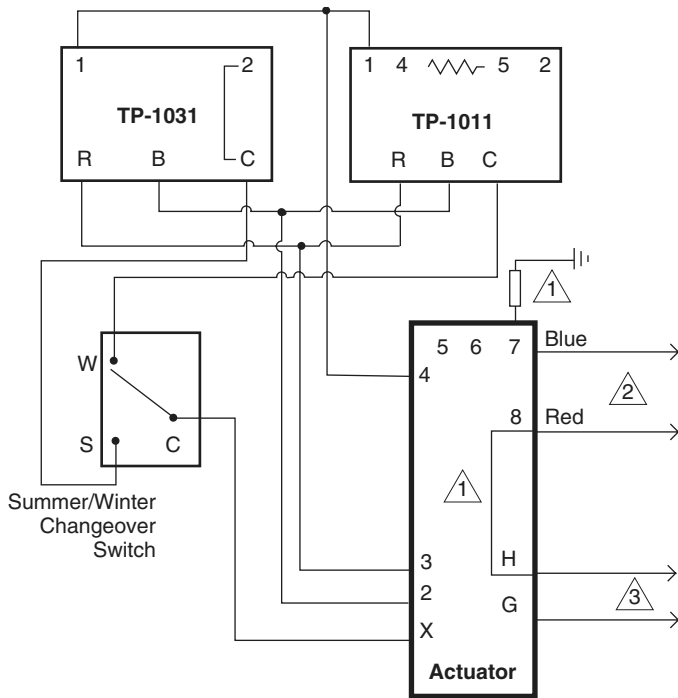


- ① Make 100 ohm resistor and jumper connections on 24 V actuators only.
- ② Transformer leads on line voltage actuators only.
- ③ Marked L1 and L2 on line voltage actuators. Built-in transformer required.

- R Closes on temperature drop (rise for TP-1031 and rotates actuator CCW).
- B Closes on temperature rise (drop for TP-1031) and rotates actuator CW.
- C Common
- 1 Feedback
- 4 & 5 10 degrees F, 24 Vac night depression resistor on TP-1011.

Typical Actuators:
 MP-361, MP-371, MP-381, MP-382
 MP-475, MP-485, MP-486
 MP-2113-600, MP-2150-500

Figure 1 Typical Wiring for TP-1011 (Heating) and TP-1031 (Cooling).



- ① Make 100 ohm resistor and jumper connections on 24 V actuators only.
- ② Transformer leads on line voltage actuators only.
- ③ Marked L1 and L2 on line voltage actuators. Built-in transformer required.

- R Closes on temperature drop (rise for TP-1031 and rotates actuator CCW).
- B Closes on temperature rise (drop for TP-1031) and rotates actuator CW.
- C Common
- 1 Feedback
- 4 & 5 10 degrees F, 24 Vac night depression resistor on TP-1011.

Typical Actuators:
 MP-361, MP-371, MP-381, MP-382
 MP-475, MP-485, MP-486
 MP-2113-600, MP-2150-500

Figure 2 Typical Wiring of TP-10x1s for Summer/Winter.

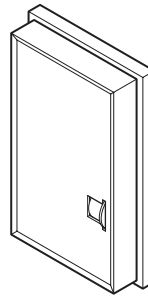
TP-8101, TP-8102, TP-8121, TP-8124

Single/Dual Output Room Temperature Controllers

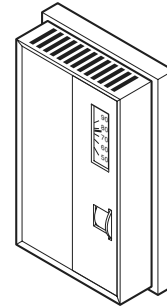
These temperature controllers are used in heating and air conditioning systems.

Features:

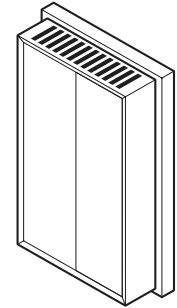
- Dual output adapters for TP-8101 and TP-8102.
- TP-8124 meets ASHRA 90-75 DOE requirements.
- Heating and cooling cannot operate simultaneously.
- Heating/cooling deadband obtained by adjustable dual setpoints and throttling range.
- Concealed adjustments to eliminate occupant tampering.



TP-810X



TP-810X



TP-8121
TP-8124

Model Chart						
Model No.	Control Dial Range		Description	Throttling Range for 3 Vdc Output Change	Power Requirements	Output Voltage
	Temp.	Null-band				
TP-8101	55 to 85°F	—	Single setpoint with single output signal room controller	2, 3, 6 and 20 F°; factory set 3 F° by jumper/pins	20 Vdc (-1.5/+1) 13mA	2 to 15 Vdc or 15 to 2 Vdc ^a
TP-8101-116	13 to 29°C					
TP-8102	45 to 75°F					
TP-8102-116	17 to 24°C					
TP-8121	55 to 85°F	2 to 14°F (1.1 to 8°C); factory set at 3 (1.7)	Single setpoint with dual output signal room controller	Heating & cooling 2 to 10 F°, independently adj; factory set 3 F°	20 Vdc (-1.5/-1) 23 mA	Heat (OP1) 2 to 15 Vdc or 15 to 2 Vdc ^b ; cool (OP2) 2 to 15 Vdc
TP-8124 TP-8124-770	Dual Scale Heating 45 to 75°F Cooling 70 to 100°F	Difference between heating & cooling setpoints	Dual setpoints and dual output signals with deadband between heating and cooling room controller			

^a Units factory calibrated for 7.5 Vdc output with sensor at setpoint temperature providing a 6 to 9 Vdc output signal over the selected throttling range..

^b Units factory calibrated for 6 Vdc (R.A. HTG), 9 Vdc (D.A. HTG) and 6 Vdc (D.A. CLG) with sensor at setpoint temperature.

Power Supply, Wiring, Control Action, and Number of Controlled Devices.

Model No.	Power Supply	Wiring	Control Action	Number of Controlled Devices
TP-8101	6.2 Vdc 2.2 mA max.	Three color coded pigtail leads, terminals; for options refer to Figure 4.	Factory set direct acting jumper terminal 4 to 5; for reverse acting jumper terminal 4 to 3	Six System 8000 devices or two MP-5200 series actuators
TP-8101-116				
TP-8102				
TP-8102-116				
TP-8121	—	Coded terminals; refer to Figure 5 and Figure 6.	Heating factory set reverse acting, jumper J7 to pin B for direct acting; cooling direct acting only	Six System 8000 devices or two MP-5200 series actuators in both heating and cooling
TP-8124 TP-8124-770				

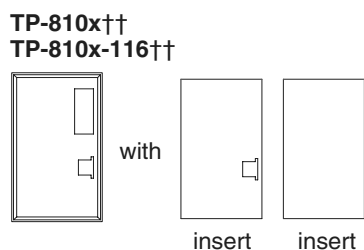


Figure 1 Standard Cover with Inserts.

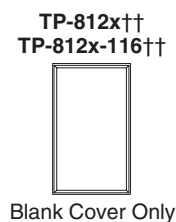


Figure 2 Blank Cover Only.



††5/64 in. Allen screw used to secure cover.

Figure 3 Options for Quantities of 24 or More of Each Part Number.

Specifications	
Construction	Self-contained room controller with a 1000 Ω Balco sensing element with single or dual output(s).
Ambient temperature limits	Shipping and storage: -40 to 160°F (-40 to 71°C). Operating: 40 to 140°F (4.4 to 60°C).
Connections	Coded screw terminals. T-8101 and TP-8102 have 6 in. color coded pigtailed in addition to coded screw terminals.
Cover	Beige colored plastic.
Locations	NEMA Type 1.
Mounting	Panel assembly order AD-8953 mounting track separately.
Dimensions	4-3/8 H x 2-3/4 W x 1-5/8 D in. (111 x 70 x 41 mm).
General Instructions	Refer to F-18097. TP-8121, 8124: Refer to F-22615.

Accessories	
Model No.	Description
AT-504	Plaster hole cover kit (small).
AT-505	Surface mounting base.
AT-546	Auxiliary mounting plate.
AT-1103	Wire guard.
AT-1104	Cast aluminum guard.
AT-1155	Plastic guard.
AT-1165	Plastic guard.
TP-810x only	
AD-8122	Signal adaptor for dual outputs (two direct acting).
AD-8123	Signal adaptor for dual outputs (one direct, one reverse acting).
AD-8124	Signal adaptor for dual outputs (one reverse, one direct acting).
AD-8953	Mounting track.
AD-8969-201	Offset resistor kit; 5, 10, 15 and 20°F.
AD-8969-901	Extended throttling range jumper.
AT-61 Series	Brushed bronze cover plates.
AT-101	Lock cover kit.
AT-104	Dial stop pins.
AT-602	Selector switch sub-base DP4T.
AT-603	Selector switch sub-base DP4T, one DPDT.
AT-8122	Remote setpoint adjuster, dual scale 20 to 120°F (-6 to 49°C).
AT-8155	Remote setpoint adjuster, dual scale 50 to 250°F (10 to 121°C).
AT-8158	Remote setpoint adjuster, dual scale 55 to 85°F (13 to 29°C).
TS-8131	Room button type sensor.
TS-8201	Duct/immersion sensor.
TS-8261	Light fixture sensor.
TS-8405	5 ft. (1.5 m) averaging sensor.
TS-8422	22 ft. (6.7 m) averaging sensor.
TS-8601	Selective ratio discharge sensor.

Typical Applications

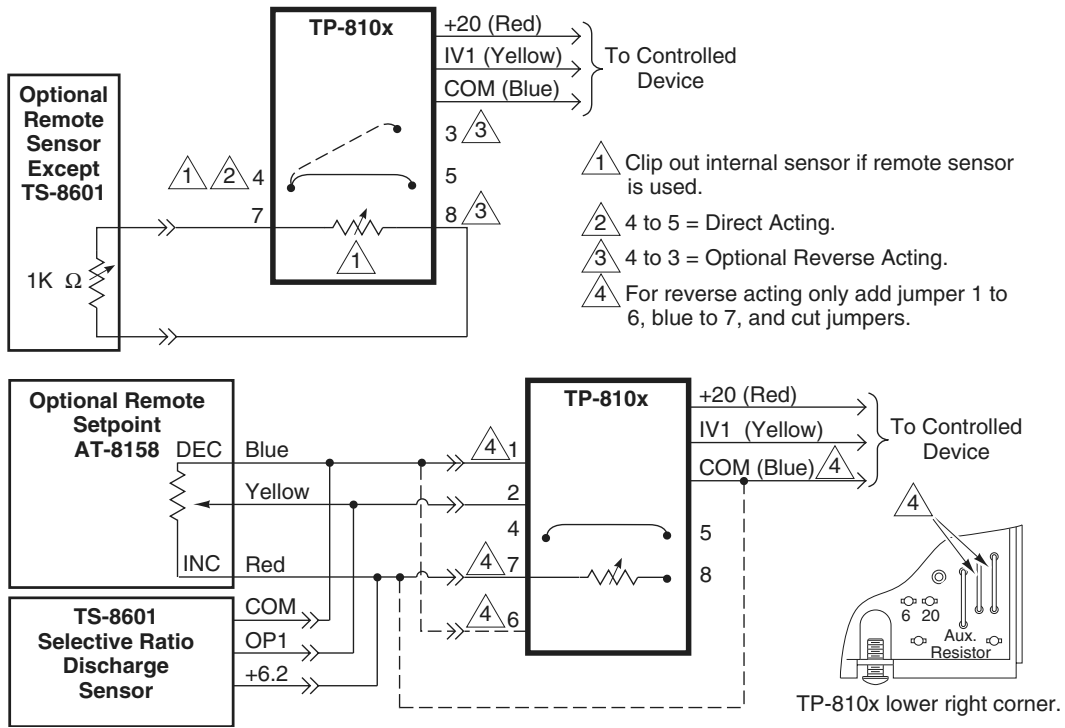


Figure 4 TP-810x Terminals and Typical Wiring.

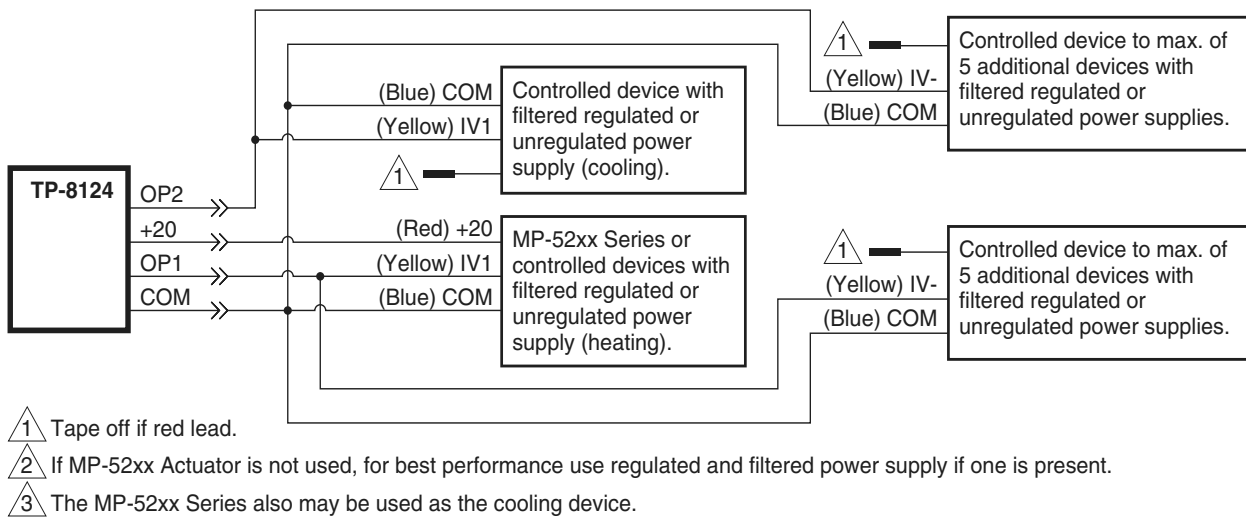


Figure 5 TP-8124 Typical Wiring with One MP-52xx Actuator.

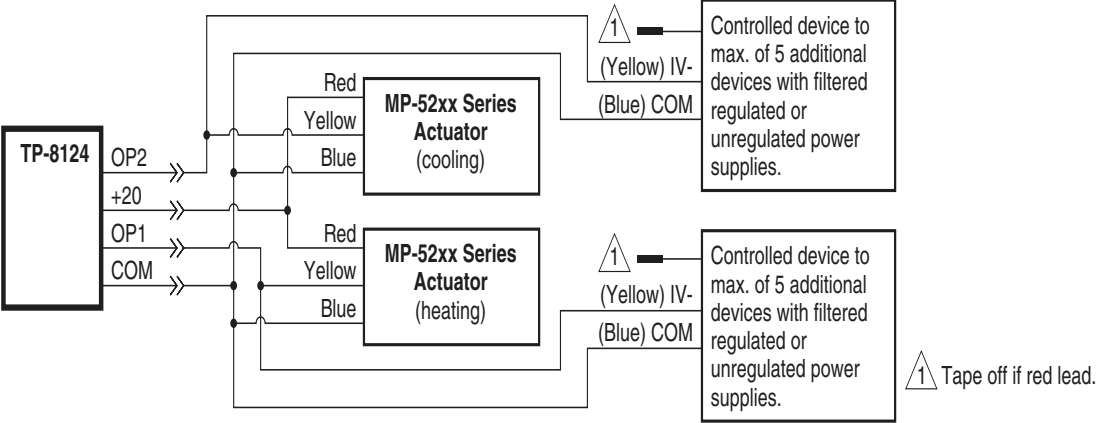


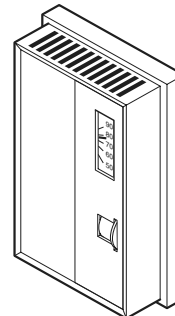
Figure 6 TP-8124 Typical Wiring with Two MP-52xx Actuators.

Room/Discharge Low Limit Temperature Controller

These electronic room and low limit supply air temperature controllers are used in heating and air conditioning systems.

Features:

- Low cost replacement for unit vent packages.
- System 8000 compatible for control functions.
- Individual supply air setpoint with concealed adjustments eliminate occupant tampering.
- Day/night input capability.
- Remote setpoint input.



TP-8232

Model Chart				
Model No.	Setpoint Dials		Throttling Range ^a Adjustments	
	Room	Supply ^b	Room	Supply ^c
TP-8232	55 to 85°F	45 to 75°F (7 to 24°C)	1 to 9°F	1 to 9°F
TP-8232-116	13 to 29°C	7 to 24°C (45 to 75°F)		

^a Throttling range (T.R.) is defined as °F (°C) change at the temperature sensor in order to cause a 6 to 9 Vdc controller output signal change.

^b Units marked setpoints °F (°C).

^c F marked setpoints only; 1 to 9°F (1 to 5°C).

Specifications	
Construction	Self-contained room controller with a 1000 Ω Balco sensing element.
Control dial range	Refer to Model Chart.
Throttling range	Refer to Model Chart.
Power requirements	20, (+1, -1.5) Vdc; 25 mA.
Output voltage	2 to 15 Vdc, direct acting only.
Power supply available	6.2 Vdc, 4 mA max.
Controlled devices	Maximum of six System 8000 (10 mA maximum).
Environment	
Ambient temperature limits	Shipping and storage: -40 to 160°F (-40 to 71°C). Operating: 40 to 140°F (4.4 to 60°C).
Humidity	5 to 95% RH, non-condensing.
Locations	NEMA Type 1.
Connections	Coded screw terminals and color coded wire leads.
Cover	Beige colored plastic.
Mounting	Wall. Panel, order AD-8951 mounting assembly.
Dimensions	4-3/8 H x 2-7/8 W x 1-5/8 D in. (111 x 73 x 41 mm).
General Instructions	Refer to F-19057.

Accessories

Model No.	Description
AD-8969-201	Offset resistor.
AT-101	Lock cover kit.
AT-104	Dial stop pins.
AT-504	Plaster hole cover kit (small).
AT-505	Surface mounting base.
AT-546	Auxiliary mounting plate.
AT-1103	Wire guard.
AT-1104	Cast aluminum guard.
AT-1155	Plastic guard, 6-1/4 H x 5-1/2 W x 3-1/4 D in.
AT-1165	Plastic guard, 8 H x 5-1/2 W x 3-1/2 D in.
AT-8122	Remote setpoint adjuster, dual scale 20 to 120°F (-6 to 49°C).
AT-8155	Remote setpoint adjuster, dual scale 50 to 250°F (10 to 121°C).
AT-8158	Remote setpoint adjuster, dual scale 55 to 85°F (13 to 29°C).
TS-8131	Room button type sensor.
TS-8201	Duct/immersion sensor.
TS-8261	Light fixture sensor.
TS-8405	Averaging sensor, 5 ft. (1.5 m).
TS-8422	Averaging sensor, 22 ft. (6.7 m).
TOOL-82	Allen wrench for room setpoint calibration, 5/64 in.
TOOL-201	Calibration kit for System 8000.

Typical Applications

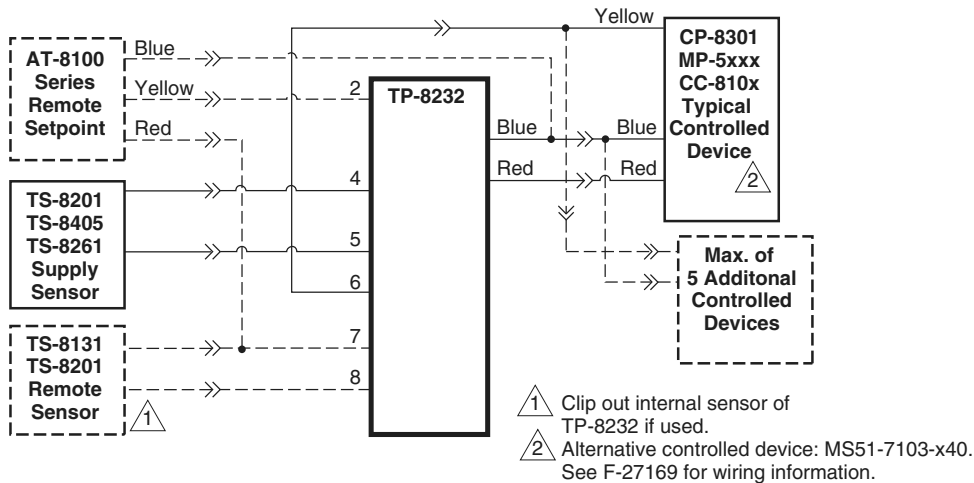


Figure 7 Typical Wiring Diagram — Direct Acting Output Only.

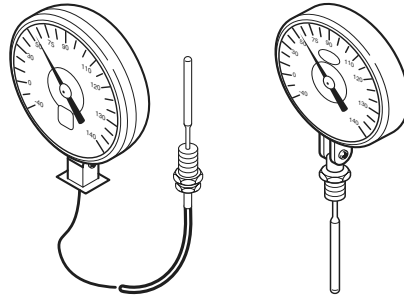
TS-29x Series

Dial Thermometers

Dial thermometers for continuous visual indication of temperature in ducts, pipes and tanks.

Features:

- Large dial readout.
- Corrosion resistant.
- Universal mounting availability.



Model Chart					
Model No.	Type	Scale ^a Range °F (°C)	Dimensions		
			Capillary ft. (m)	Bulb in. (mm)	Dial in. (mm)
TS-291	Direct mounting	-40 to 150 (-40 to 65)	—	4-3/4 x 7/16 (95 x 11) 1-1/2 (38) extension	3-1/2 (89)
TS-292		30 to 240 (0 to 115)			
TS-293	Remote mounting	-40 to 150 (-40 to 65)	6 (1.8)	5-3/8 x 7/16 (136 x 11)	
TS-294		30 to 240 (0 to 115)			

^a Scales dual marked in °F and °C.

Specifications

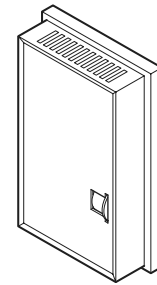
Construction	
Case	Chrome-plated brass.
Lens	Crown type unbreakable acrylic.
Connection	Watertight 1/2 in. MNPT.
Mounting	In any position. Case can be rotated 150°.
Dimensions	Refer to Model Chart.

Accessories

Model No.	Description
AT-219	Bulb well (refer to "Accessories" section in this catalog).

Adjustable Wall Sensor

This sensor provides electronic sensing of room temperature through a wall mounted device. It is designed for use with the CP-5341 Fan Speed Controller.



Features:

- Remote setpoint and control of CP-5341.
- Available with lock cover screw kits.
- Dial stop pins limit dial range.

Model Chart	
Model No.	Description
TS-5191	Refer to Specifications.

Specifications	
Sensing element	Thermistor.
Control dial	Marked “cooler/warmer” with approximate range of 55 to 85°F (13 to 29°C).
Ambient temperature limits	Shipping and storage: -40 to 160°F (-40 to 71°C). Operating -40 to 135°F (-40 to 57°C).
Connections	Coded screw terminals.
Cover	Beige plastic.
Locations	NEMA Type 1.
Mounting	Wall.
Dimensions	4-3/8 H x 2-3/4 W x 1-5/8 D in. (111 x 70 x 43 mm).
General Instructions	Refer to F-23768.

Accessories	
Model No.	Description
AT-101	Lock cover kit.
AT-104	Dial stop pins.
AT-504	Plaster hole cover kit (small).
AT-505	Surface mounting base.
AT-546	Auxiliary mounting plate.
AT-602	Selector switch sub-base DP4T.
AT-603	Selector switch sub-base one DP4T, one DPDT.
AT-1103	Wire guard.
AT-1104	Cast aluminum guard.
AT-1155	Plastic guard, 6-1/4 H x 5-1/2 W x 3-1/4 D in.
AT-1165	Plastic guard, 8 H x 5-1/2 W x 3-1/2 D in.

Typical Applications

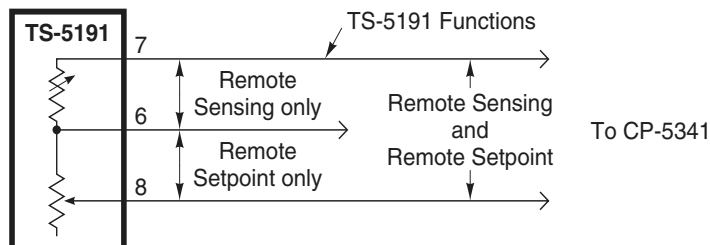


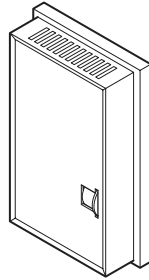
Figure 1 Installation Wiring Diagram of Optional TS-5191.

Room Sensor

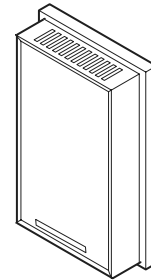
Platinum Balco and Thermistor Electronic Room Sensors for Wall Mount Locations.

Features:

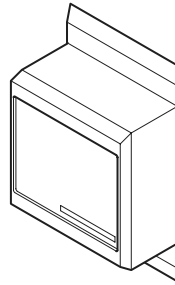
- High accuracy.
- Wide choice of styles.
- Industry standard elements.



TS-8111
TS-8111-116



TS-5711
TS-5711-850
TS-5811
TS-8101



TS-57011
TS-57011-850
TS-58011
TS-81011



TS-57031
TS-57031-850
TS-58031
TS-81031

Model Chart					
Model No.	Sensor Type	Max. Error Over 100°F (55.6°C) Span	Temperature Coefficient of Resistance	Operating Range	Refer to Complete Applications
TS-5711	10K Ω Thermistor @ 77°F (25°C)	± 0.36°F (0.2°C)	See Temperature vs Resistance Table	40 to 140°F (4 to 60°C)	F-21732
TS-57011					F-22932
TS-57031					
TS-5711-850	10K Ω Thermistor @ W/11K Ω Shunt				F-23837
TS-57011-850					
TS-57031-850					

Model Chart (Continued)					
Model No.	Sensor Type	Max. Error Over 100°F (55.6°C) Span	Temperature Coefficient of Resistance	Operating Range	Refer to Complete Applications
TS-5811	1K Ω Thin Film Platinum @ 32°F (0°C)	± 1.08°F (0.6°C)	2.12 Ω Per °F ^a (3.85°C)	40 to 140°F (4 to 60°C)	F-23405
TS-58011					F-22932
TS-58011-770					F-23770
TS-8101	1K Ω Balco @ 70°F (21°C)	± 0.1%	2.2 Ω Per °F (0.5°C) @ 70°F		F-22633
TS-81011					
TS-81031					F-22785
TS-81031-770					
TS-8111*	1K Ω when control dial is set to sensed temp				
TS-8111-116*					F-22633

* Resistance value with sensed air and setpoint equal will be 1000 ohm. Resistance will change as sensed air moves from setpoint. As temperature rises, resistance rises.

^a Meets TCR and Class b tolerance requirement of DIN #43760 and IEC #751

Temperature Versus Resistance.

Temperature °F (°C)	Nominal Resistance Values, ohms			
	10K Ω Thermistor	10K Ω Thermistor with/11K Shunt	1K Ω Platinum	1K Ω Balco
	TS-5711 TS-57011 TS-57031	TS-5711-850 TS-57011-850 TS-57031-850	TS-5811 TS-58011 TS-58031-770	TS-8101 TS-81011 TS-81031 TS-81031-770 TS-8111 TS-8111-116
40 (4)	24,550	7596	1017.0	935.9
50 (10)	18,790	6938	1039.0	956.9
68 (20)	12,260	5798	1077.9	995.6
77 (25)	10,000	5238	1097.3	1015.4
86 (30)	8194	4696	1116.7	1035.4
104 (40)	5592	3707	1155.4	1076.2
122 (50)	3893	2875	1194.0	1118.0
140 (60)	2760	2206	1232.4	1160.9

TS-5xxx, TS-8xxx Series

Specifications

Environment

Ambient temperature limits	Shipping and storage: -40 to 160°F (-40 to 71°C). Operating 40 to 140°F (4 to 60°C).
Humidity	5 to 95% RH non-condensing.
Locations	NEMA Type 1.
Connections	Coded screw terminals or wire leads.

Cover

TS-5811, TS-5711, TS-5711-850, TS-81x1	Beige plastic.
TS-58011, TS-57011, TS-57011-850, TS-81011	Shadow white plastic.
TS-58031, TS-57031, TS-57031-850, TS-81031	Grey plastic.

Mounting Wall: TS-57031, TS-58031 TS-81031 mullion.

Dimensions

TS-5811, TS-5711-xxx, TS-81x1-xxx	4-3/8 H x 2-3/4 W x 1-5/8 D in. (111 x 70 x 43 mm).
TS-58011, TS-57011-xxx, TS-81011	4-13/16 H x 3-1/4 W x 1-31/64 D in. (122 x 83 x 38 mm)
TS-58031, TS-57031-xxx, TS-81031	2 H x 2 W x 1-1/4 D in. (51 x 51 x 32)

Accessories

Model No.	Description
TS-5711, TS-5811, TS-81x1	
AT-61 Series	Brushed bronze cover plates.
AT-101	Lock cover kit.
AT-104	Dial stop pin.
AT-504	Plaster hole cover kit (small).
AT-505	Surface mounting plate.
AT-546	Auxiliary mounting plate.
AT-602	Selector switch sub-base DP4T.
AT-1103	Wire guard.
AT-1104	Cast aluminum guard.
AT-1155	Plastic guard.
AT-1165	Plastic guard.
TS-5x01	
AT-8801	Mounting plate.
TS-xx011	
AD-8969-951	Wall plates (six per package).
AD-8969-952	Base plates (six per package).
AT-80	Replacement cover kit.
TS-81031	
6-371	Mounting ring.
10-11	Mounting ring.
10-22	Mounting box.
10-48	Wall plate.
10-53	Thermostat guard.
10-58	Mounting ring.
TS-57031-xxx, TS-58031, TS-81031	
N2-4	Cover screw wrench.

Typical Applications

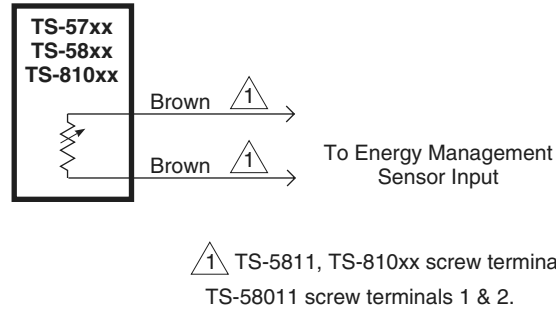


Figure 1 Typical Wiring Diagram for TS-5700, TS-5800, and TS-810xx Series Sensors.

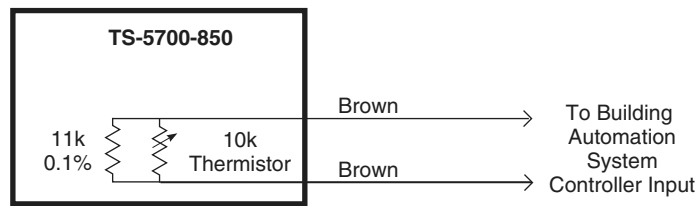


Figure 2 Typical Wiring Diagram for TS-5700-850 Series Sensors.

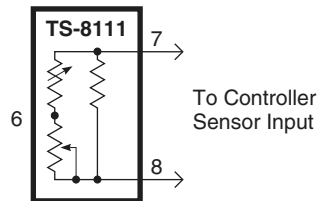


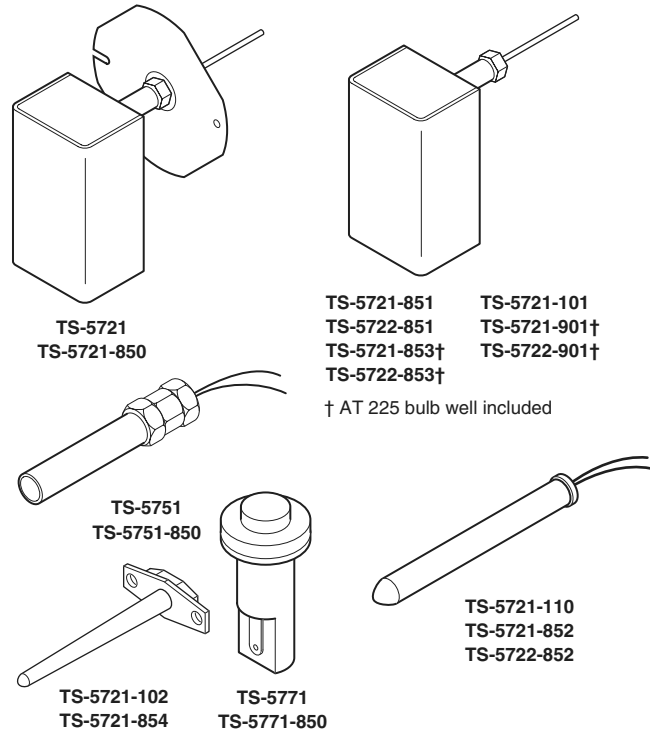
Figure 3 Typical Wiring Diagram for TS-8111 Sensors.

Remote Thermistor Temperature Sensors

Electronic thermistor sensing of temperature at remote room locations, ducts, liquid lines, tanks, outdoor air, etc. for use with microprocessor-based energy management systems.

Features:

- High accuracy.
- Low drift.
- Wide choice of styles.
- TS-57xx-85x units have shunt resistor included.
- Duct/immersion models.
- Outdoor air models.



Model Chart

Used with Microprocessor-Based System.

Model No.	Description	Mounting Connection	Dimensions in. (mm)		Wiring Connections
			Element Dia. x L	Wiring Enclosure	
TS-5721	Duct/immersion ^a	Plate 1/4 in. NPT ^a	1/4 x 8 (6 x 203)	3-1/2 H x 2-1/4 W x 2-1/4 D (89 x 57 x 57) with 2-1/2 (64) extension to element. 1/2 in. knockouts (top & bottom)	12 in. (305 mm)
TS-5721-101	Immersion ^b	1/4 in. NPT nut ^b	1/4 x 4 (6 x 102)		
TS-5721-901 TS-5722-901	Immersion	1/4 in. NPT nut ^c	1/4 x 4 (6 x 102)		
TS-5721-110	Strap-on	Nylon wire tie ^d	1/4 x 2-1/4 (6 x 57)	None	
TS-5721-102	Duct	Plate	5/16 x 7-3/4 (8 x 197)	None (can be mounted in a NEMA standard 5-16-1984 handy box)	1/4 in. spade connections (2 female conn. provided)
TS-5751	Outdoor	1/2 in. conduit	1-1/8 x 5 (29 x 127)	None	3 ft. (0.9 m) brown pigtail leads
TS-5771	Unitary ^e	17/32 in. (13.5 mm) dia. mtg. hole ^e	3/4 x 1-1/4 (19 x 32)	None	1/4 in. spade connectors (2 female conn. provided)

^a Immersion requires AT-226 bulb well.

^b Immersion requires AT-225 bulb well.

^c AT-225 bulb well included.

^d Factory supplied 2-1/2 x 2 in. (64 x 51 mm) foam insulation tape and 30 in. (762 mm) nylon wire tie for 1-1/2 to 8 in. (38 to 203 mm) dia. pipes.

^e For mounting through fan coil of unit ventilator cabinet of similar application. Ambient humidity limits, 5 to 95% RH, non-condensing.

Models with 11K Ohm Shunt Resistor.

Model No.	Description	Mounting Connection	Dimensions in. (mm)		Wiring Connections
			Element Dia. x L	Wiring Enclosure	
TS-5721-850	Duct/immersion ^a	Plate 1/4 in. NPT ^a	1/4 x 8 (6 x 203)	3-1/2 H x 2-1/4 W x 2-1/4 D (89 x 57 x 57) with 2-1/2 (64) extension to element. 1/2 in. knockouts (top & bottom)	12 in. (305 mm)
TS-5721-851 TS-5722-851	Immersion ^b	1/4 in. NPT nut ^b	1/4 x 4 (6 x 102)		
TS-5721-853 TS-5722-853	Immersion	1/4 in. NPT nut ^c	1/4 x 4 (6 x 102)		
TS-5721-852 TS-5722-852	Strap-on	Nylon wire tie ^d	1/4 x 2-1/4 (6 x 57)		
TS-5721-854	Duct	Plate	5/16 x 7-3/4 (8 x 197)	None (can be mounted in a NEMA standard 5-16-1984 handy box)	1/4 in. spade connections (2 female conn. provided)
TS-5751-850	Outdoor	1/2 in. conduit	1-1/8 x 5 (29 x 127)	None	3 ft. (0.9 m) brown pigtail leads
TS-5771-850	Unitary ^e	17/32 in. (13.5 mm) dia. mtg. hole ^e	3/4 x 1-1/4 (19 x 32)	None	1/4 in. spade connectors (2 female conn. provided)

^a Immersion requires AT-226 bulb well

^b Immersion requires AT-225 bulb well.

^c AT-225 bulb well included.

^d Factory supplied 2-1/2 x 2 in. (64 x 51 mm) foam insulation tape and 30 in. (762 mm) nylon wire tie for 1-1/2 to 8 in. (38 to 203 mm) dia. pipes.

^e For mounting through fan coil of unit ventilator cabinet of similar application. Ambient humidity limits, 5 to 95% RH, non-condensing.

Specifications

Sensing element

TS-5700 series	Thermistor resistance, 10,000 Ω (TS-5721-XXX) or 30,000 Ω (TS-5722-XXX series only) at 77°F (25°C).
TS-5700-850 series	Thermistor resistance, 10,000 Ω (TS-5721-85X) or 30,000 Ω TS-5722-85X series only) at 77°F (25°C) shunted with an 11k Ω 0.1% resistor.
32 to 158°F (0 to 70°C)	Error: ±0.36 F degrees (±0.2 C degrees) maximum. Drift/year: 0.045 F degrees (0.025 C degrees), maximum.
Over operating temperature limits	Error: ±0.76 F degrees (±0.4 2C degrees) maximum, except ±0.36 F degrees (±0.2 C degrees) maximum for TS-5771 series. Drift/year: 0.09 F degrees (0.05 C degrees), maximum.
Nominal resistance values	Refer to Temperature vs. Resistance Table.
General Instructions	Refer to F-21733 and F-23838.

TS-5700 Series, TS-5700-850 Series

Ambient Temperature Limits °F (°C).

Part Number	Shipping & Storage	Operating Span
TS-5721	-40 to 250 (-40 to 121)	-40 to 250 (-40 to 121)
TS-5721-101		
TS-5721-110		
TS-5721-901		
TS-5721-850	-40 to 160 (-40 to 71)	-40 to 140 (-40 to 60)
TS-5721-851		
TS-5721-852		
TS-5721-853		
TS-5721-102		
TS-5721-854		
TS-5722-901	-40 to 250 (-40 to 121)	85 to 250 (29 to 121)
TS-5722-851	-40 to 160 (-40 to 71)	
TS-5722-852		
TS-5722-853		
TS-5751	-40 to 220 (-40 to 104)	-40 to 140 (-40 to 60)
TS-5751-850	-40 to 160 (-40 to 71)	
TS-5771		
TS-5771-850		

Temperature vs. Resistance.

Nominal Resistance Values (in 1000 Ω)				
Temp °F (°C)	TS-5721 TS-5721-101 TS-5721-102 TS-5721-110 TS-5721-901 TS-5751 TS-5771	TS-5721-850 TS-5721-851 TS-5721-852 TS-5721-853 TS-5721-854 TS-5751-850 TS-5771-850	TS-5722-901	TS-5722-851 TS-5722-852 TS-5722-853
-40 (-40)	239.8	10.517	—	—
-22 (-30)	135.2	10.172	—	—
-4 (-20)	78.91	9.654	—	—
14 (-10)	47.54	8.933	—	—
32 (0)	29.94	8.044	—	—
50 (10)	18.79	6.938	—	—
68 (20)	12.26	5.798	—	—
77 (25)	10.00	5.238	30.00	8.049
86 (30)	8.194	4.696	24.582	7.599
104 (40)	5.592	3.875	16.776	6.644
122 (50)	3.893	3.707	11.679	5.665
140 (60)	2.760	2.206	8.280	4.724
158 (70)	1.990	1.685	5.970	3.870
176 (80)	1.458	1.287	4.734	3.180
194 (90)	1.084	0.986	3.252	2.510
212 (100)	0.816	0.760	2.448	2.002
230 (110)	0.623	0.590	1.869	1.598
248 (120)	0.482	0.462	1.446	1.278

Accessories

Model No.
AT-226
AT-225

Description
Brass bulb well for TS-5721 and TS-5721-850.
Stainless steel bulb well for TS-5721-101, TS-5721-851, and TS-5722-851.

Typical Applications

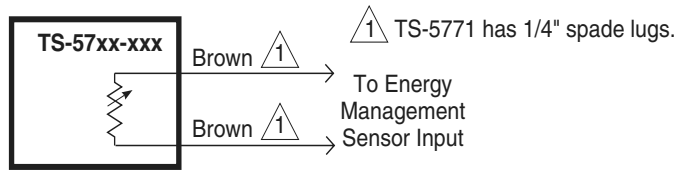


Figure 1 TS-57xx Series Sensor Connections.

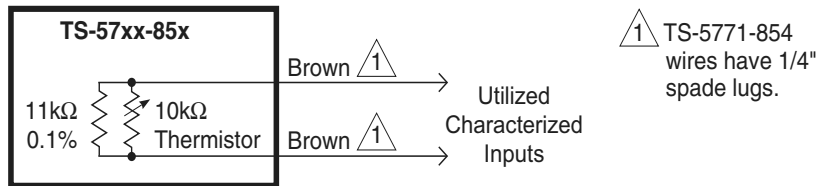


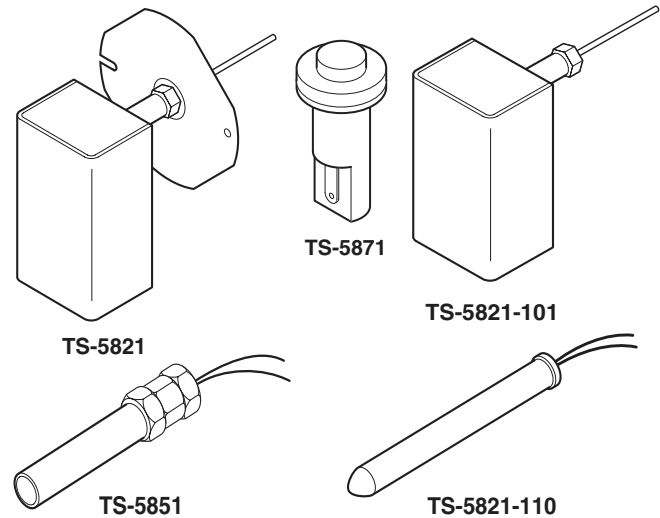
Figure 2 TS-57xx-85x Series with 11K Shunt Sensor Connections.

Remote Platinum Temperature Sensors

These electronic devices provide remote temperature sensing at sites such as room locations, ducts, liquid lines, tanks, outdoor air, and others.

Features:

- DIN class 43760 platinum elements.
- $\pm 0.12\%$ error at 32°F (0°C).
- Pure metal providing long term stability.
- Universally accepted measured technology.
- Extremely linear capability.



Model Chart					
Model No.	Description	Mounting Connection	Dimensions in. (mm)		Wiring Connections
			Element	Wiring Enclosure	
TS-5821	Duct/immersion ^a	Plate 1/4 in. (6.3 mm) NPT ^a	1/4 D x 8 L (6.3 x 203.2)	3-1/2 H x 2-1/4 W x 2-1/4 D (88.9 x 57.1 x 57.1) with 2-1/2 (63) extension to element 1/2 (12.7) knockouts (top & bottom)	12 in. (304.8 mm) grey pigtail leads
TS-5821-101	Immersion ^b	1/4 in. (6 mm) NPT nut ^b	1/4 D x 4 L (6 x 102)		
TS-5821-110	Strap-on	Nylon wire tie ^c	1/4 D x 2-1/4 L (6 x 57)	None	
TS-5851	Outdoor	1/2 in. (13 mm) conduit	1-1/8 D x 5 L (29 x 127)		1/4 in. (6.3 mm) spade connections (2 female connectors provided)
TS-5871	Unitary ^d	17/32 in. (13.5 mm) dia. mtg. hole ^d	3/4 D x 1-1/4 L (19 x 32)		

^a Immersion requires AT-226 bulb well.

^b Immersion requires AT-225 bulb well.

^c Factory supplied, 2-1/2 x 2 in. (63.5 x 50.8 mm) foam insulation tape and 30 in. (762 mm) nylon wire tie for 1-1/2 through 8 in. (38.1 through 203.2 mm) diameter pipes.

^d For mounting through fan coil of unit ventilator cabinet or similar application. Ambient humidity limits, 5 to 95% RH, non-condensing.

Specifications	
Sensing element	Platinum RTD, 1000 Ω at 0°C.
Maximum error	-40 to 250°F (-40 to 121°C), $\pm 1.6^\circ\text{F}$ (1.0°C) over 290°F (161°C) span.
Ambient temperature limits °F (°C)	
TS-5821, TS-5821-101, TS-5821-110	Shipping and storage: -40 to 250 (-40 to 121). Operating: -40 to 250 (-40 to 121).
TS-5851	Shipping and storage: -40 to 220 (-40 to 104). Operating: -40 to 140 (-40 to 60).
TS-5871	Shipping and storage: -40 to 160 (-40 to 71). Operating: 40 to 140 (4 to 60).
Nominal Resistance Values	Refer to Temperature vs. Resistance Table.
General Instructions	Refer to F-23404.

Temperature vs. Resistance

Temperature °F (°C)	Nominal Resistance Values in Ω
	TS-5821, TS-5821-101, TS-5821-110, TS-5851, TS-5871
-40 (-40)	842.7
-22 (-30)	882.2
- 4 (-20)	921.6
14 (-10)	960.9
32 (0)	1000
50 (10)	1039
68 (20)	1077.9
77 (25)	1097.3
86 (30)	1116.7
104 (40)	1155.4
122 (50)	1194
140 (60)	1232.4
158 (70)	1270.7
176 (80)	1308.9
194 (90)	1347
212 (100)	1385
230 (110)	1422.9
248 (120)	1460.6

Accessories

Model No.

AT-211
AT-226
AT-225

Description

Sun shield for TS-5851.
Brass bulb well for TS-5X21.
Stainless steel bulb well for TS-5X21-101.

Typical Applications

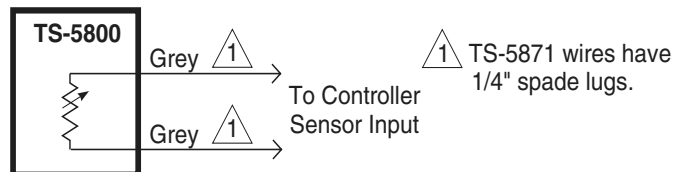


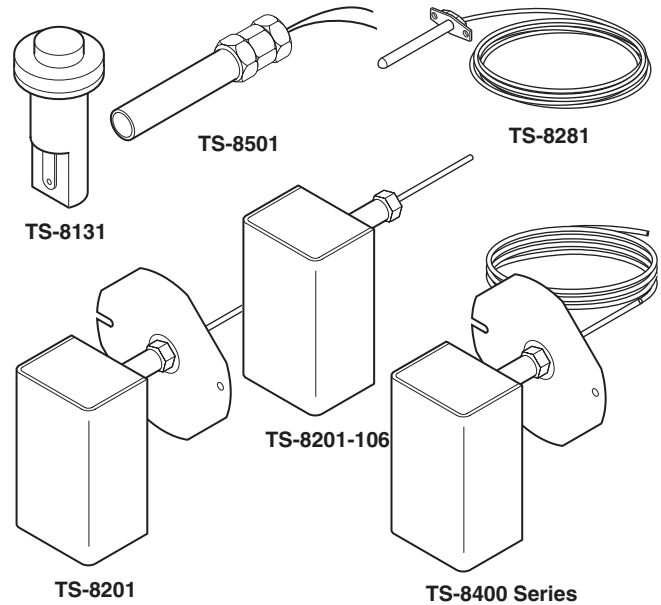
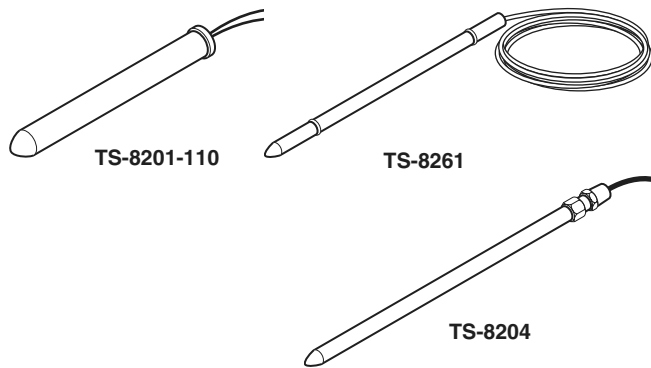
Figure 1 TS-5800 Series Sensor Connections.

Remote Balco Temperature Sensors

These temperature sensors provide electronic sensing of temperature at remote room locations, ducts, plenum chambers, liquid lines, tanks, outdoor air, etc.

Features:

- Accuracy of $\pm 0.1\%$ on all but averaging elements and high temperature.
- System 8000 compatibility.
- Usable over wide temperature range.
- Meets all system applications requirements.



Model Chart						
Model No.	Description	Mounting Connection	Dimensions in. (mm)		Wiring connections	
			Element	Enclosure		
TS-8131	Unitary ^a	17/32 in. (13.5 mm) dia. mtg. hole	3/4 dia. x 1-1/4 L (19 x 32)	None	1/4 in. spade connections	
TS-8201	Duct/immersion ^b	Plate, 1/4 in. NPT ^b	1/4 dia. x 8 L (6 x 203)	3-1/2 H x 2-1/4 W x 2-1/4 D (89 x 57 x 57) with 2-1/2 (64) extension to element; 1/2 in. knockouts (top & bottom)	12 in. (305 mm) black pigtail leads	
TS-8201-106	Immersion ^c	1/4 in. NPT nut ^c	1/4 dia. x 4 L (6 x 102)	3-1/2 H x 2-1/4 W x 2-1/4 D (89 x 57 x 57) with 2-1/2 (64) extension to element; 1/2 in. knockouts (top & bottom)	12 in. (305 mm) black pigtail leads	
TS-8405	Averaging (duct)	Plate	5 ft. (1.5 m) L			
TS-8422			22 ft. (6.7 m) L			
TS-8201-110	Strap-on	Nylon wire tie ^d	1/4 dia. x 2-1/4 L (6 x 57)	None	16 in. (401 mm) yellow pigtail leads	
TS-8204	Duct/immersion ^b	1/4 in. NPT nut ^b ; AT-208 included	1/4 dia. x 8 L (6 x 203)			
TS-8261	Comb. light fixtures & ceiling diffuser	None	1/4 dia. x 8-1/8 L (6 x 206)			
TS-8281	Duct	Plate	5/16 dia x 3-5/8 L (7.9 x 92)			
TS-8281-101						6 ft. (1.8 m) (1) red, (1) black shielded & jacketed plenum rated cable
TS-8501	Outdoor	1/2 in. conduit	1-1/8 dia. x 5 L (29 x 127)			3 ft. (0.9 m) black pigtail leads

^a For mounting through fan coil of unit ventilator cabinet or similar application.

^b Immersion requires AT-226 bulb well.

^c Immersion requires AT-225 bulb well.

^d Factory supplied. 2-1/2 x 2 in. (64 x 51 mm) foam insulation tape and 30 in. (762 mm) nylon tie for 1-1/2 through 8 in. (33 through 203 mm) dia. pipes.

Specifications

Sensing element

Balco resistance	1000 Ω \pm 1% at 70°F (20°C).
TS-8405, TS-8422	\pm 1% at 70°F (20°C). Changes 2.2 Ω per 1°F (0.5°C) at 70°F (21°C).
TS-8204 only	1657 Ω \pm 0.1% at 300°F (149°C); changes 2.5 Ω per 1°F (0.5°C) at 300°F (149°C).

General Instructions Refer to F-22668, F-22575.

Ambient Temperature Limits °F (°C).

Part Number	Shipping and Storage	Operating
TS-8131 ^a	-40 to 160 (-40 to 71)	40 to 140 (4 to 60)
TS-8261 ^a		
TS-8281 Series ^a		
TS-8201	-40 to 250 (-40 to 121)	-40 to 250 (-40 to 121)
TS-8201-106		
TS-8201-110		
TS-8405	-40 to 220 (-40 to 104)	-40 to 220 (-40 to 104)
TS-8422		
TS-8501		
TS-8204	-40 to 400 (-40 to 204)	200 to 400 (93 to 204)

^a Humidity, 5 to 95% RH, non-condensing.

Accessories

Model No.	Description
AT-208	Duct mounting kit for TS-8201-105 (included with TS-8204).
AT-226	Brass bulb well for TS-8201 or TS-8204.
AT-225	Stainless steel bulb well for TS-8201-106.
AT-8435	Remote setpoint adjuster, dual scale 200 to 400°F (93 to 204°C); required for all TS-8204 applications except differential control.

Typical Applications

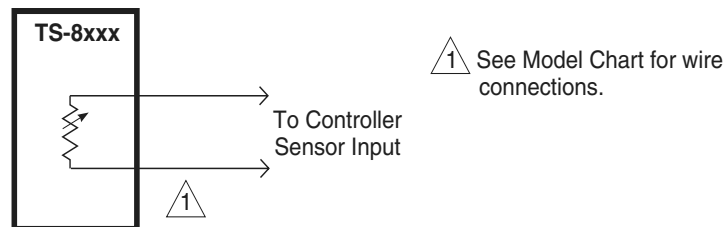


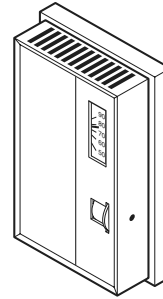
Figure 1 TS-8xxx Series Sensor Connections.

Room Temperature Sensor, Remote Setpoint

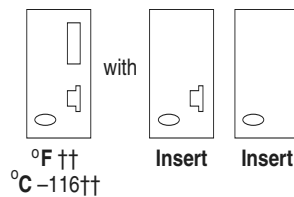
Electronic sensing of room temperature at wall locations for use with Energy Management Systems (EMS) using Balco inputs.

Features:

- EMS adaptable.
- System 8000 compatible.
- High accuracy 0.1% sensing element.
- Dial stop pins to limit dial range.
- Lock cover screw kit available.

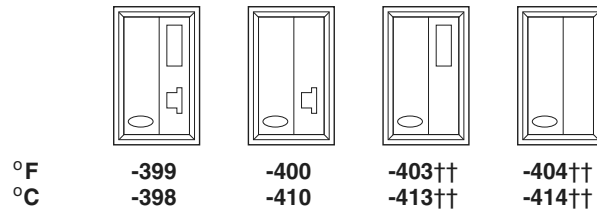


Model Chart	
Model No.	Description
TS-8811	Refer to Specifications.
TS-8811-116	



†† 5/64 in. Allen screw used to secure cover.

Figure 1 Standard Covers.



†† 5/64 in. Allen screw used to secure cover.

**Figure 2 Optional Covers (for quantities of 24 or more of each part number).
Add dash number (-xxx suffix to base part number for desired option).**

Specifications

Sensing element	Temperature sensitive Balco element. 1000 Ω ±0.1% at 70°F (21°C); changes 2.2 Ω per 1°F (0.5°C) at 70°F (21°C).
Remote setpoint dial range	55 to 85°F or 13 to 29°C, with resistance change equal to sensor resistance change.
Environment	
Ambient temperature limits	Shipping and storage: -40 to 160°F (-40 to 71°C). Operating: 40 to 140°F (4 to 60°C).
Humidity	5 to 95% RH, non-condensing.
Locations	NEMA Type 1.
Connections	Coded screw terminals.
Cover	Beige plastic.
Mounting	Wall.
Dimensions	4-3/8 H x 2-3/4 W x 1-5/8 D in. (111 x 70 x 43 mm).
General Instructions	Refer to F-23849.

Accessories

Model No.	Description
AT-61 Series	Brushed bronze cover plates.
AT-101	Lock cover kit.
AT-104	Dial stop pins.
AT-504	Plaster hole cover kit (small).
AT-505	Surface mounting base.
AT-546	Auxiliary mounting plate.
AT-602	Selector switch sub-base DP4T.
AT-1103	Wire guard.
AT-1104	Cast aluminum guard.
AT-1155	Plastic guard, 6-1/4 H x 5-1/2 W x 3-1/4 D in.
AT-1165	Plastic guard, 8 H x 5-1/2 W x 3-1/2 D in.

Typical Applications

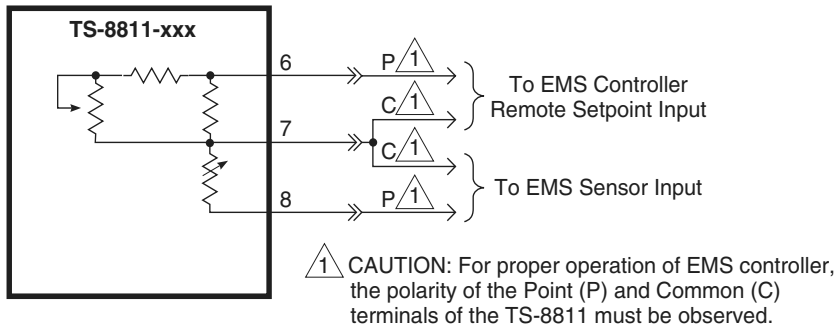


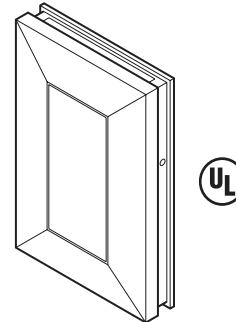
Figure 3 Sensor Wiring.

Electronic Room Temperature Sensor

The Electronic Room Temperature Sensor is a resistance-temperature device (RTD) that provides electronic sensing of room temperature at wall locations.

Features:

- Available in four models: one containing a Balco sensor, one with a platinum sensor, one with a thermistor sensor, and one with a thermistor that includes an 11K shunt resistor.
- Contemporary, low-profile packaging.
- Easy installed base plate and electronic assembly
- High-impact cover.
- Suitable for direct-wall, 2 x 4 electrical box, 1/4 DIN electrical box, and surface box mounting.
- Sensor package may be painted or papered for customization.
- Optional factory applied customer marking



Model Chart

Description.

Model No.	Sensor Type	Max. Error Over 100°F	Resistance Change	Operating Temperature
TSMN-57011	Thermistor, 10 K Ω at 77°F (25°C)	± 0.36°F (0.2°C)	See "Temperature Versus Resistance" chart	-40 to 250°F (-40 to 121°C)
TSMN-57011-850	Thermistor, 10 K Ω at 77°F (25°C), with 11 K Ω ± 0.1% shunt resistor			
TSMN-58011	Platinum, Class B thin film, 1000 Ω ± 0.1% at 32°F (0 °C).	± 1.08°F (0.6°C)	2.12 Ω/°F (3.85 Ω/°C)	-40 to 240°F (-40 to 116°C)
TSMN-81011	Balco, 1000 Ω ± 0.1% at 70°F (21.1°C)	±1.2°F (0.66°C)	2.2 Ω/°F (0.5 Ω/°C)	-40 to 250°F (-40 to 121°C)

Temperature Versus Resistance.

Temperature °F (°C)	Nominal Resistance Value			
	TSMN-57011 10K Ω 77°F (25°C)	TSMN-57011-850 10K Ω 77°F (25°C) w/11K Ω Shunt	TSMN-58011 1K Ω Platinum .00385 ohm/ohm/°C	TSMN-81011 1K Ω Balco
40 (4)	24543	7596	1017.0	935.9
50 (10)	18780	6938	1039.0	956.9
68 (20)	12263	5798	1077.9	995.6
77 (25)	10000	5238	1097.3	1015.4
86 (30)	8194	4696	1116.7	1035.4
104 (40)	5592	3707	1155.4	1076.2
122 (50)	3893	2875	1194.0	1118.0
140 (60)	2760	2206	1232.4	1160.9

Specifications

Sensing element	Refer to Model chart.
Environment	
Ambient temperature limits	Shipping and storage: -40 to 160°F (-40 to 71°C). Operating: Refer to Model Chart.
Humidity	5 to 95% RH, non-condensing.
Locations	NEMA Type 1.
Mounting	Direct-wall, 2 x 4 electrical box, 1/4 DIN, and surface box.
Dimensions	4-3/4 H x 3-1/16 W x 13/16 D in. (121 x 78 x 21 mm).
Agency Listing	UL

Accessories

Model No.	Description
AT-1104	Cast aluminum guard.
AT-1155	Plastic guard.
AT-1163	Wire guard with steel base plate.
MNA-STAT-1	Replacement sensor covers (qty. 12).
MNA-STAT-2	Designer inserts, may be painted (qty. 25).
MN-AP	7 x 5.25. in. wall adaptor plate, cloud white.

Typical Applications

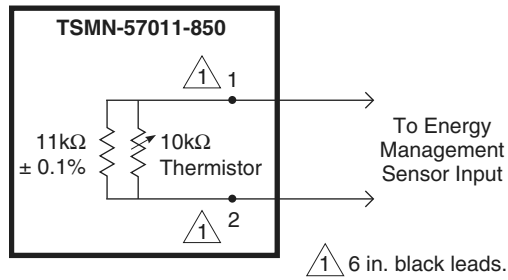


Figure 1 TSMN-57011-850 Sensor Wiring.

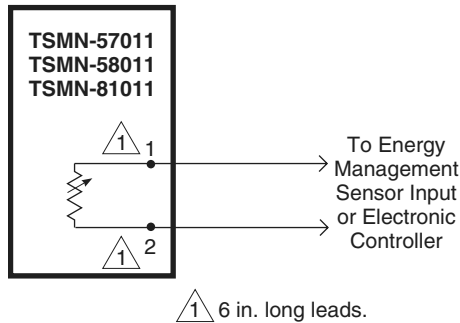


Figure 2 TSMN-58011 and TSMN-81011 Sensor Wiring.

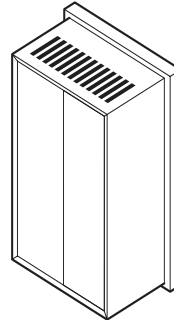
TSP-84xxx Series

Room 4 to 20 mAdc Temperature Transmitters with Platinum Sensors

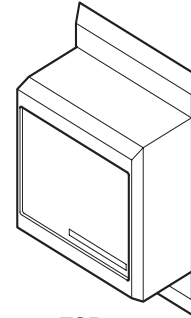
These transmitters use platinum electronic sensors to control room temperature from a wall location. The sensed temperature is converted to a rapid response 4 to 20 mAdc output signal for microprocessor-based energy management systems.

Features:

- Two wire 4 to 20 mA current loop.
- Adaptability to System 8000 controllers.
- Class A DIN platinum high accuracy elements
- Low electrical noise transmission.
- Highly accurate current amplifier linearity of $\pm 0.01\%$ of span.
- Adaptability to energy management systems.
- Short circuit protection.



TSP-84152



TSP-84252

Model Chart		
Model No.	Cover Color	Output Signal mAdc at °F (°C)
TSP-84152	Beige	20 at 100 (38)
TSP-84252	Shadow white	12 at 75 (24) 4 at 50 (10)

Specifications	
Signal output	Variable 4 to 20 mAdc for linear signal. Refer to Model Chart.
Span	16 mAdc (non-adjustable).
Current limit	30 mAdc.
Linearity	$\pm 0.01\%$ of span.
Hysteresis (deadband)	0%.
Short circuit duration	Continuous.
Response time	400 microsec. at full load.
Load resistance	25 through 900 Ω , dependent on power supply voltage. Refer to Figure 2.
Sensing element	Thin film platinum, DIN Class A.
Resistance	1000 $\Omega \pm 0.1\%$ at 32°F (0°C).
Resistance change	2.14 Ω per °F (3.85 Ω per °C).
Power requirements	12 Vdc (min.) to 30 Vdc (max.).
System performance	
Element and transmitter	Maximum error 0.8% of span.

Specifications (Continued)

Environment	
Ambient temperature limits	Shipping and storage: -40 to 140°F (-40 to 60°C). Operating: 50 to 100°F (10 to 38°C).
Humidity	5 to 95% RH, non-condensing.
Locations	NEMA Type 1.
Connections	Coded screw terminals.
Cover	Plastic, no thermometer.
Mounting	Vertical, wall; TSP-84252 and TSP-85251 plenum rated.
Dimensions	
TSP-84152	4-3/8 H x 2-3/4 W x 1-5/8 D in. (111 x 70 x 43 mm).
TSP-84252	4-13/16 H x 3-1/4 W x 1-31/64 D in. (122 x 83 x 38 mm).
General Instructions	Refer to F-24171.

Accessories

Model No.	Description
ASP-83X1 Series	Power supply.
AT-505	Surface mounting base (TSP-84152 series only).
AT-1103	Wire guard.
AT-1104	Cast aluminum guard (TSP-84152 series only).
AT-1105	Plastic guard (TSP-84152 series only).
AT-8801	Non-flush 2 x 4 box adapter (TSP-84252 Series only).
N2-4	Cover screw wrench.

Typical Applications

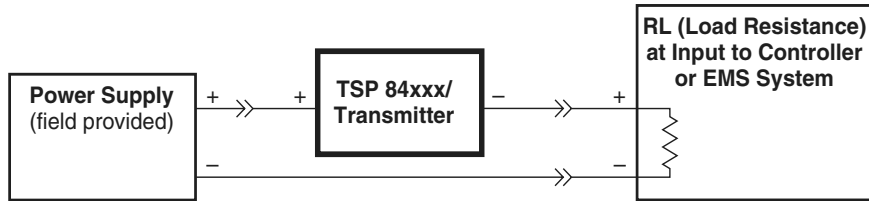


Figure 1 Typical System Wiring.

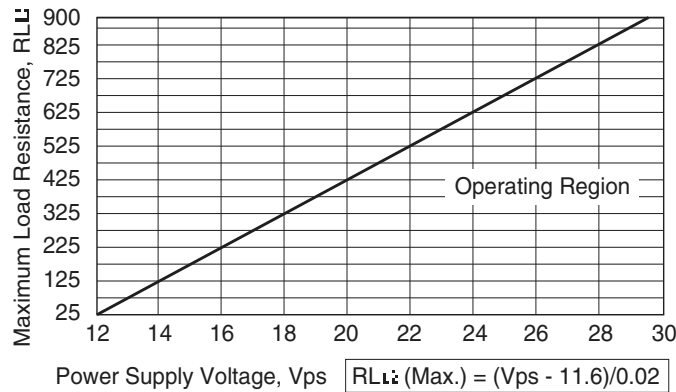


Figure 2 Maximum Load Resistance vs. Power Supply Voltage.

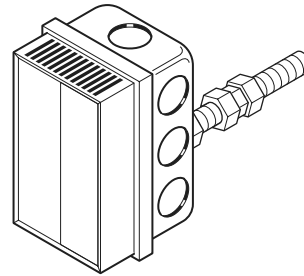
TSP-84x04, TSP-84x5x, TSP-85x03, & TSP-85x5x Series

Remote 4 to 20 mAdc Temperature Transmitters

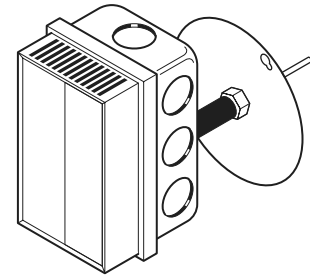
These remote, electronic temperature transmitters with integral sensors accurately measure and transmit temperature readings to the input of an Energy Management System (EMS).

Features:

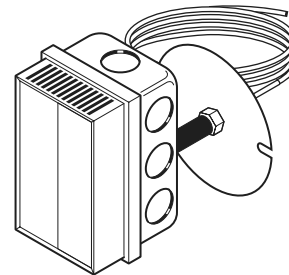
- Two wire 4 to 20 mA current loop.
- Adaptable to System 8000 controllers.
- Utilizes Class A DIN platinum high accuracy elements on all except averaging modules (Balco element).
- Low electrical noise transmission.
- High accuracy current amplifier linearity $\pm 0.01\%$ of span.
- Adaptable to energy management systems.
- Short circuit protected.



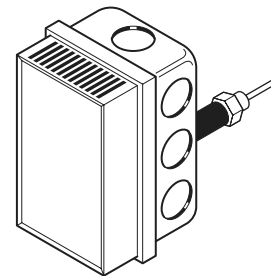
TSP-84957
TSP-85956



TSP-84654
TSP-84656
TSP-85653



TSP-84704
TSP-84804
TSP-85703
TSP-85803



TSP-84553
TSP-85552
TSP-85554
TSP-85555
TSP-85557

Model Chart			
Model No.	Description	Ambient Temperature Operating Limits °F (°C)	Sensor Length in. (mm)
TSP-84553 ^a	Chilled water immersion	30 to 80 (-1 to 27)	4 in. (102 mm)
TSP-84654 ^a	Duct/immersion	0 to 200 (-17 to 93)	6 in. (152 mm)
TSP-84656 ^a		40 to 240 (4 to 116)	
TSP-85552 ^a	Immersion	30 to 130 (-1 to 54)	4 in. (102 mm)
TSP-85554 ^a		30 to 240 (-1 to 116)	
TSP-85555 ^a		100 to 250 (38 to 121)	
TSP-85557 ^a		200 to 500 (93 to 260)	
TSP-85703	Duct averaging ^b	40 to 140 (4 to 60)	5 ft. (152 cm)
TSP-85803			22 ft. (671 cm)
TSP-84704		30 to 130 (-1 to 54)	5 ft. (152 cm)
TSP-84804			22 ft. (671 cm)
TSP-85653	Duct/probe	40 to 140 (4 to 60)	6 in. (152 mm)
TSP-85956	Air outdoor	-30 to 130 (-35 to 54)	4 in. (102 mm)
TSP-84957		-40 to 160 (-40 to 71)	

^a Immersion service requires a bulb well. See Accessories for correct application.

^b Balco element.

TSP-84x04, TSP-84x5x, TSP-85x03, & TSP-85x5x Series

Specifications

Construction	Self-contained temperature transmitter employing a platinum sensing element, 1000 Ω (±0.1%) at 32°F (0°C). Duct averaging models TSP-84704, TSP-84804, TSP-85703 and TSP-85803 employ Balco sensing element, 1000 Ω ±1.0% at 70°F (21°C). All models are housed in a sturdy plastic enclosure.
Output signal	Variable 4 to 20 mA _{dc} for linear signal. High temperature = 20 mA _{dc} , mid-range temperature = 12 mA _{dc} , and low temperature = 4 mA _{dc} .
Span	16 mA _{dc} (non-adjustable).
Current limit	30 mA _{dc} .
Linearity	0.01% of span.
Hysteresis (deadband)	0%.
Short circuit duration	Continuous.
Response time	400 microsec at full load.
Load resistance	25 through 900 Ω, dependent on power supply voltage. Refer to Figure 1.
Sensing element	Duct averaging elements are ±1.8% of span.
Resistance change	Platinum: 2.14 Ω per F degree (3.85 Ω per C degree). Balco sensor: 2.2 Ω per F degree (1.22 Ω per C degree) at 70°F (21°C).
Power requirements	12 V _{dc} (min.) to 30 V _{dc} (max.).
System performance	
Element and transmitter	Maximum error 0.8% of span.
Environment	
Ambient temperature limits	Shipping and storage: -40 to 140°F (-40 to 60°C). Operating: electronic trans. assembly, 40 to 140°F (5 to 60°C); sensor, refer to Model Chart.
Humidity	5 to 95% RH, non-condensing.
Locations	NEMA Type 1.
Connections	Coded screw terminals.
Cover	Beige plastic.
Dimensions	4-3/8 H x 2-7/8 W x 3-5/8 D in. (112 x 73 x 92 mm).
General Instructions	Refer to F-24101.

Accessories

Model No.	Description
AT-215	Stainless steel 6 in. bulb well insertion length, 7 in. overall length.
AT-226	Brass bulb well (required with immersion type sensors), 5.25 in. insertion length, 6.25 in. overall length.
AT-225	Stainless steel bulb well (required with immersion type sensors), 4 in. insertion length, 4-13/16 overall length.
N2-4	Cover screw wrench.

Typical Applications

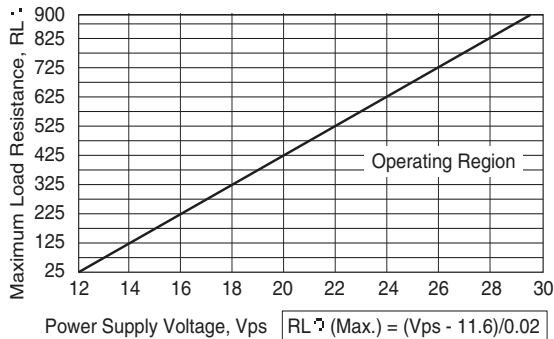


Figure 1 Maximum Load Resistance vs. Power Supply Voltage.

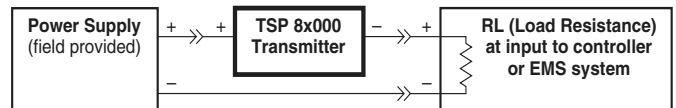


Figure 2 Typical Wiring Diagram.

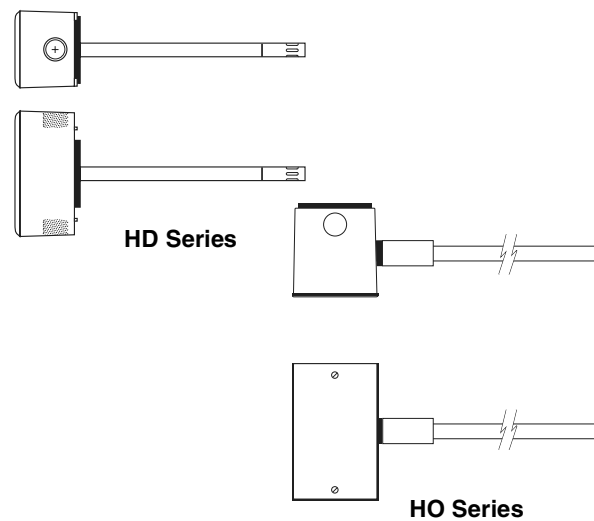
Electronic Humidity and Humidity/Temperature Transmitters

Electronic humidity transmitters VER-HD are used for duct applications requiring humidity and/or temperature indication and/or humidity control.

Electronic humidity transmitters VER-HO are used for outside air applications requiring humidity and/or temperature indication and/or control.

Features:

- Microprocessor profile sensor with on-board nonvolatile memory.
- Accuracy ± 2 or 3% RH models.
- Multi-point digital calibration.
- Outputs 4 to 20 mA, 0 to 5 or 0 to 10 Vdc.
- Field replaceable RH element, no recalibration required.
- Optional resistive temperature sensor models.



Model Chart			
Model No.	Description	Temperature Sensor	Humidity Output Signal ^a
Duct			
VER-HD2xMSx	0 to 100 % RH $\pm 2\%$	—	4 to 20 mA
VER-HD3xMSx	0 to 100% RH $\pm 3\%$		
VER-HD2xVSx	0 to 100 % RH $\pm 2\%$		0 to 5 or 0 to 10 Vdc
VER-HD3xVSx	0 to 100% RH $\pm 3\%$		
VER-HD2xMSTC	0 to 100 % RH $\pm 2\%$	1 K Platinum	4 to 20 mA
VER-HD3xMSTC	0 to 100% RH $\pm 3\%$	Thermistor 10 K, w/11K Shunt	
VER-HD2xMSTK	0 to 100 % RH $\pm 2\%$		
VER-HD3xMSTK	0 to 100% RH $\pm 3\%$		
VER-HD2xVSTC	0 to 100 % RH $\pm 2\%$	1 K Platinum	0 to 5 or 0 to 10 Vdc
VER-HD3xVSTC	0 to 100% RH $\pm 3\%$	Thermistor 10 K, w/11K Shunt	
VER-HD2xVSTK	0 to 100 % RH $\pm 2\%$		
VER-HD3xVSTK	0 to 100% RH $\pm 3\%$		
Outside Air			
VER-HO2xMSx	0 to 100 % RH $\pm 2\%$	—	4 to 20 mA
VER-HO3xMSx	0 to 100% RH $\pm 3\%$		
VER-HO2xVSx	0 to 100 % RH $\pm 2\%$		0 to 5 or 0 to 10 Vdc
VER-HO3xVSx	0 to 100% RH $\pm 3\%$		
VER-HO2xMSTC	0 to 100 % RH $\pm 2\%$	1 K Platinum	4 to 20 mA
VER-HO3xMSTC	0 to 100% RH $\pm 3\%$	Thermistor 10 K, w/11K Shunt	
VER-HO2xMSTK	0 to 100 % RH $\pm 2\%$		
VER-HO3xMSTK	0 to 100% RH $\pm 3\%$		
VER-HO2xVSTC	0 to 100 % RH $\pm 2\%$	1 K Platinum	0 to 5 or 0 to 10 Vdc
VER-HO3xVSTC	0 to 100% RH $\pm 3\%$	Thermistor 10 K, w/11K Shunt	
VER-HO2xVSTK	0 to 100 % RH $\pm 2\%$		
VER-HO3xVSTK	0 to 100% RH $\pm 3\%$		

^a RH output signal from the factory, field selectable.

Specifications

Sensing element	
RH sensing element	Thin-film capacitive, digitally profiled.
Temperature element	10K thermistor with 11K shunt or 1K platinum. 385 1000 ohms @0°C.
Accuracy	
RH	± 2% or ± 3% at 10 to 90%.
Stability	± 1% at 68°F for two years.
Operating range	0 to 100% RH.
Temperature coefficient	0.1% RH below 25°C, -0.1% RH above 25°C.
Inputs	
4 to 20 mA	Two-wire 12 to 24 Vdc 30 mA. Minimum 750 ohm max loop resistance.
Vdc	0 to 5 or 0 to 10 Vdc, 12 to 24 Vdc or 24 Vac. 15 mA minimum. 24 Vac is a half wave device. Refer to EN 206 (F-26363) for wiring.
Output	
RH 4 to 20 mA	Two-wire non-polarity sensitive.
RH 0 to 5 or 0 to 10 Vdc	Three-wire observe polarity.
Temperature	10K with 11K shunt thermistor or 1K platinum or 10K thermistor.
Environment	
Ambient temperature limits	Shipping and storage: -58 to 185°F (-50 to 85°C). Operating: -58 to 122°F (-50 to 50°C).
Humidity	0 to 100% non-condensing.
Locations	NEMA 4.
Housing	Die-cast body, 304SS probe, PVC solar shield on outside models.
Mounting	HD models are duct-mounted, HO models are outside mount.
Dimensions	HD: 4-19/32 H x 2-27/32 W x 2 D in. (117 x 72 x 51 mm). HO: 4-19/32 H x 2-13/16 W x 2-5/16 D (117 x 71 x 52 mm).

Typical Applications

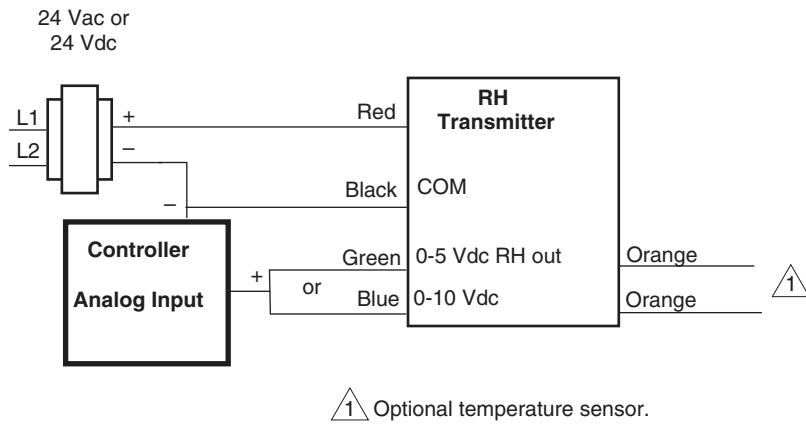
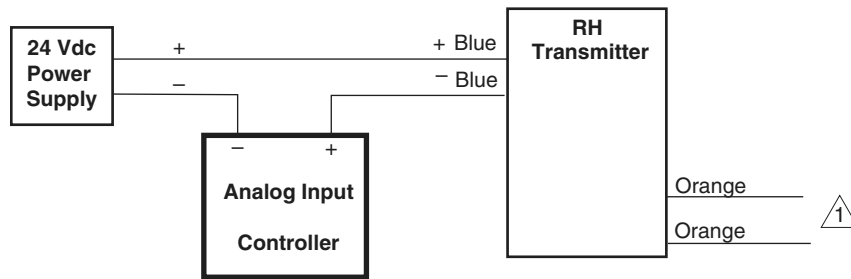


Figure 1 Typical Wiring for Three-Wire 0 to 5 or 0 to 10 Vdc Mode.

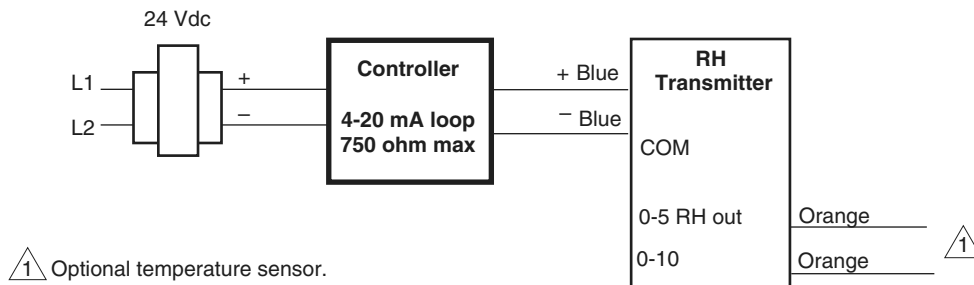
VER-HD Series, VER-HO Series



△ 1 Optional temperature sensor.

Note: 4-20 mA models humidity and temperature are not polarity sensitive. 0-5/0-10 RH transmitter models must observe polarity.

Figure 2 Typical Wiring for 4 to 20 mA External 12 to 24 Vdc.



△ 1 Optional temperature sensor.

Figure 3 Typical Wiring for 4 to 20 mA Power Supply.

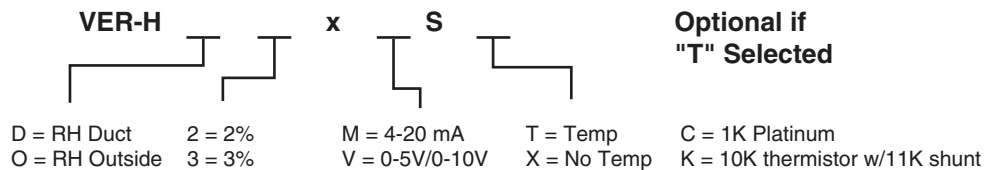


Figure 4 Model Information.

Resistance Curves.

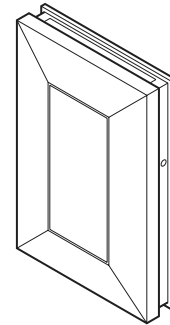
°C	°F	1000 Platinum .385	10K Thermistor w/11K Shunt
-20	-04	921.60	9.654
-10	14	960.86	8.933
0	32	1000.00	8.044
10	50	1039.03	6.938
20	68	1077.94	5.798
25	77	1097.35	5.238
30	86	1116.73	4.696
40	104	1155.41	3.875

Electronic Humidity and Combination Humidity Transmitters/Temperature Sensors

VER-HxW room unit electronic humidity transmitters are used in applications requiring humidity and temperature indication and/or control.

Features:

- Microprocessor profile sensor with on-board nonvolatile memory.
- Accuracy ± 2 or 3% RH models.
- Multi-point digital calibration.
- Field selectable 4 to 20 mA or 0 to 5/0 to 10 Vdc.
- Field replaceable RH element, no recalibration required.
- Optional temperature sensor.



Model Chart		
Model No.	Description	Humidity Output Signal ^a
VER-HW2-M	0 to 100 % RH $\pm 2\%$	4 to 20 mA
VER-HW3-M	0 to 100% RH $\pm 3\%$	
VER-HW2-V	0 to 100 % RH $\pm 2\%$	0 to 5 or 0 to 10 Vdc
VER-HW3-V	0 to 100% RH $\pm 3\%$	
VER-HW2M2	0 to 100 % RH $\pm 2\%$ plus 10K thermistor temp sensor	4 to 20 mA
VER-HW3M2	0 to 100% RH $\pm 3\%$ plus 10K thermistor temp sensor	
VER-HW2V2	0 to 100 % RH $\pm 2\%$ plus 10K thermistor temp sensor	0 to 5 or 0 to 10 Vdc
VER-HW3V2	0 to 100% RH $\pm 3\%$ plus 10K thermistor temp sensor	
VER-HW2M3	0 to 100 % RH $\pm 2\%$ plus 10K thermistor w/11k shunt	4 to 20 mA
VER-HW3M3	0 to 100% RH $\pm 3\%$ plus 10K thermistor w/11k shunt	
VER-HW2V3	0 to 100 % RH $\pm 2\%$ plus 10K thermistor w/11k shunt	0 to 5 or 0 to 10 Vdc
VER-HW3V3	0 to 100% RH $\pm 3\%$ plus 10K thermistor w/11k shunt	

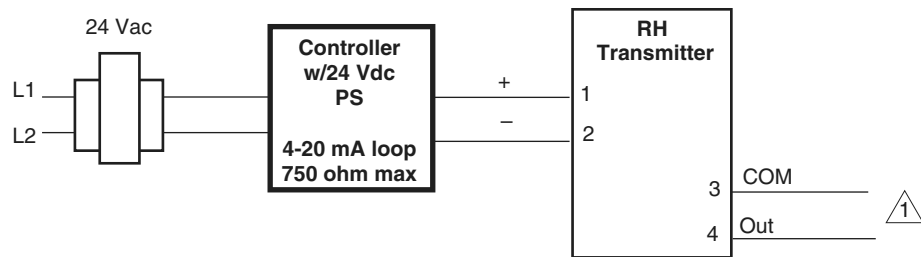
^a Output signal is field selectable.

VER-HW Series

Specifications

Sensing element	
RH sensing element	Thin-film capacitive, digitally profiled.
Temperature element	Optional 1K platinum, 10K thermistor, or 10K thermistor with 11K shunt.
Accuracy	
RH	± 2% or ± 3% at 10 to 90%.
Stability	± 1% at 68°F for two years.
Operating range	0 to 100% RH.
Temperature coefficient	± 0.1% RH °C over 0 to 60 °C.
Inputs	
4 to 20 mA	Two-wire 12 to 24 Vdc 30 mA. Minimum 750 ohm max loop resistance.
Vdc	0 to 5 or 0 to 10 Vdc, 12 to 24 Vdc or 24 Vac. 15 mA minimum. 24 Vac is a half wave device. Refer to EN 206 (F-26363) for wiring.
Output	
RH 4 to 20 mA	Two-wire non-polarity sensitive.
RH 0 to 5 or 0 to 10 Vdc	Three-wire observe polarity.
Temperature	Optional 10K , 10K thermistor with 11K shunt, or 1K platinum.
Environment	
Ambient temperature limits	Shipping and storage: -58 to 185°F (-50 to 85°C). Operating: -58 to 122°F (-50 to 50°C).
Humidity	0 to 100% non-condensing.
Locations	Wall NEMA 1.
Wall housing	High impact ABS plastic, plenum rated UL 945va. White.
Mounting	Inside wall.
Dimensions	4-3/4 H x 3-1/8 x 15/16 D in. (121 x 79 x 24 mm).

Typical Applications



 Optional temperature sensor.

Figure 1 Typical Wiring for 4 to 20 mA Output with Internal Power Supply.

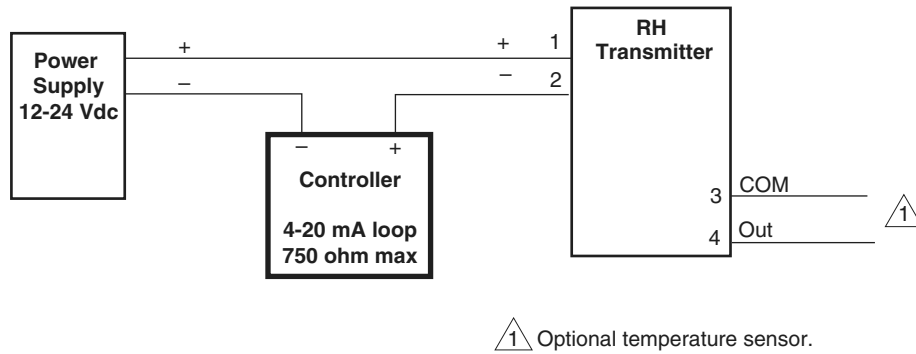


Figure 2 Typical Wiring for 4 to 20 mA External 12 to 24 Vdc Power Supply.

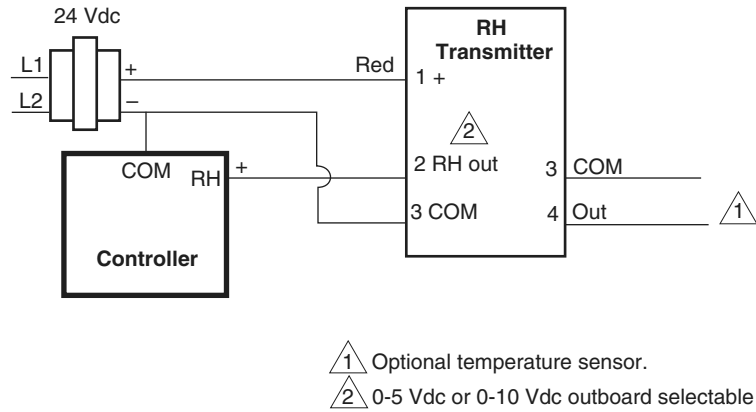


Figure 3 Typical Wiring for Three-Wire 0 to 5 or 0 to 10 Vdc Mode.

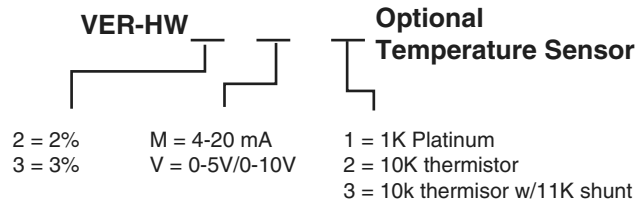


Figure 4 Model Information.

Resistance Curves.

°C	°F	1K Platinum	10K Thermistor	10K Thermistor w/11K Shunt
-20	-04	921.60	78.910	9.654
-10	14	960.86	47.540	8.933
0	32	1000.00	29.490	8.044
10	50	1039.03	18.780	6.938
20	68	1077.94	12.260	5.798
25	77	1097.35	10.000	5.238
30	86	1116.73	8.184	4.696
40	104	1155.41	5.592	3.875

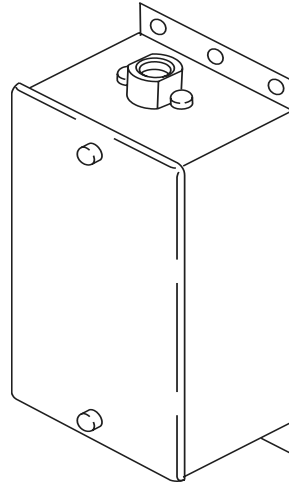
VER-PHx Series

Pressure Transducer

The VER-PHx Series Pressure Transducer is used for the proportional pressure control and/or monitoring pressure of steam (steam siphon required), air, gases, or liquids. Microprocessor based for improved accuracy and reliability.

Features:

- $\pm 1\%$ accuracy (including linearity, hysteresis, and repeatability).
- Micromachined silicon pressure sensor.
- Up to 200% overpressure without zero shift.
- Over 500% burst pressure.
- Up to three field selectable pressure ranges in a single unit.
- Short circuit and reverse polarity protected.



Model Chart			
Model No. ^a	Range (psig)	Input Supply	Output Supply
VER-PHx-07-S	0 to 25 / 0 to 50 / 0 to 100	24 Vac nominal 12 to 30 Vdc	4 to 20 mA, 0 to 5 Vdc or 0 to 10 Vdc Each field selectable
VER-PHx-08-S	0 to 62.5 / 0 to 125 / 0 to 250		
VER-PHx-09-S	0 to 125 / 0 to 250 / 0 to 500		

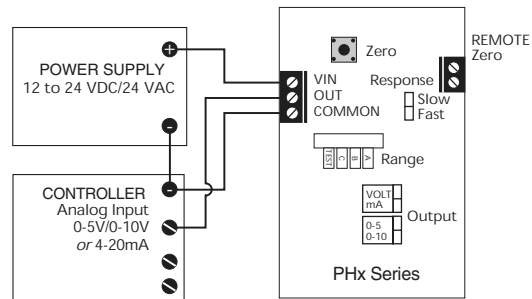
^a CAUTION: This product contains a half-wave rectifier power supply and must not be powered off transformers used to power other devices utilizing non-isolated full-wave rectifier power supplies.

Specifications	
Inputs	
Media compatible	Liquid/gases compatible to 17-4 PH stainless steel.
Supply voltage	± 15 or 24 Vac nominal. 70 mA 24 Vdc $\pm 15\%$ 40 mA.
Load impedance capability	600 Ω minimum.
Maximum supply air pressure	200% of the range.
Operating characteristics	Accuracy: $\pm 1\%$ FS (included linearity, hysteresis, and repeatability).
Long term stability	$\pm 0.25\%$.
Connections	1/4 inch NPT (Male). Unpluggable screw terminal block for use with maximum 12 AWG wire.
Outputs	
Electrical	
Signal	3-wire transmitter, 0 to 5 Vdc or 0 to 10 Vdc, 4 to 20 mA,.
DC power supply rectifier type	Half-wave. (Refer to previous Caution). EN206, F-26363.
Environment	
Ambient temperature limits	Shipping and handling: -4 to 185°F (-20 to 85°C). Operating: -4 to 185°F (-20 to 85°C). Temperature compensated 32 to 122°F (0 to 50°C).
Humidity	10 to 90%, non-condensing.
Location	NEMA Type 1.
Dimensions	5 H x 2-1/2 W x 2-1/4 D in. (127 x 64 x 58 mm).

Accessories

Model No.	Description
TOOL-95-1	Pneumatic calibration tool kit.

Typical Applications



MODEL	RANGE psig		
	A	B	C
07-S	25	50	100
08-S	62.5	125	250
09-S	125	250	500

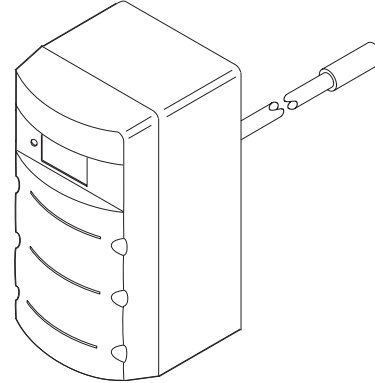
Figure 1 Typical Wiring for mA Output Pressure Transducers.

Duct Pressure Transducer

The VER-PxD Series Duct Pressure Transducer is used to monitor and control building static pressure and duct static pressure. Microprocessor based for high accuracy and reliability.

Features:

- $\pm 1\%$ accuracy (including linearity, hysteresis, and repeatability).
- Advanced ceramic capacitance sensor.
- Duct pressure transducer and static pressure tip integrated as one unit.
- Up to three PSID overpressure without zero shift.
- Up to four field selectable ranges available in a single unit.
- 24 Vac/dc nominal supply voltage.
- Short circuit and reverse polarity protected.
- Conforms to EMC standards EN50082-1/ EN55014/EN60730-1.
- LCD display models.



Model Chart				
Model No. ^a	Range (inches WC) ^b	Input Supply	Output Supply	Display
VER-PxDxx-015	0 to .1 / 0 to .25 / 0 to -5 / 0 to 1.0	24 Vac/dc nominal	Field selectable, 3-wire (0 to 5 Vdc or 0 to 10 Vdc) 2-wire loop mA (4 to 20 mA)	No
VER-PxDxx-025	0 to 1.0 / 0 to 2.5 / 0 to 5.0 / 0 to 10			
VER-PxDLx-01S	0 to .1 / 0 to .25 / 0 to .5 / 0 to 1.0			
VER-PxDLx-02S	0 to 1.0 / 0 to 2.5 / 0 to 5.0 / 0 to 10.0			Yes

^a CAUTION: This product contains a half-wave rectifier power supply and must not be powered off transformers used to power other devices utilizing non-isolated full-wave rectifier power supplies.

^b Ranges may be unidirectional, as shown, or bidirectional field selectable.

Specifications	
Inputs	
Media compatible	Clean dry air or any inert gas.
Load impedance capability	600 ohm minimum.
Proof pressure	3 PSID. Burst pressure 5 psid.
Operating characteristics	Accuracy: $\pm 1\%$ FS (included linearity and hysteresis).
Outputs	
Electrical	
Signal	4 to 20 mA, 2-wire. 0 to 5 Vdc or 0 to 10 Vdc, 3-wire.
Supply voltage	24 Vac/dc nominal. $\pm 15\%$. 9 mA draw (AC), 4 mA draw (DC).
DC power supply rectifier type	Half-wave. (Refer to previous Caution). EN206. F-26363.
Connections	Cage clamp terminal block.
Environment	
Ambient temperature limits	Shipping and handling: -30 to 140°F (0 to 60°C). Operating: 32 to 140°F (0 to 60°C).
Humidity	10 to 90%, non-condensing.
Location	Meets UL 94 VO.
Dimensions	4.49 H x 3.3 W x 2.136 D in. probe (114 x 84 x 54 mm) 7.938 in. (202 mm).
Agency Listings	Conformance: EMC EN 50081-1, EN 50082-1, EN 61000-4-4, EN 61000-4-5, EN 61000-4-3, ENV 50402, EN 61000-4-6.

Accessories

Model No.	Description
TOOL-95-1	Pneumatic calibration tool kit.

Typical Applications

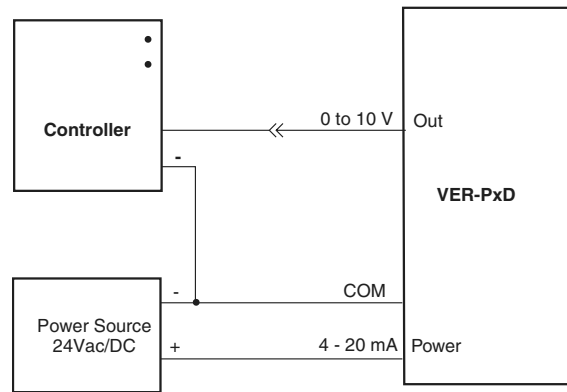


Figure 1 Typical Wiring for VER-PxD Series Three Wire Vdc Output.

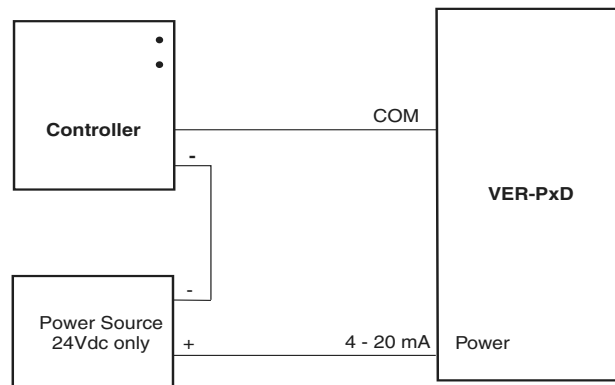


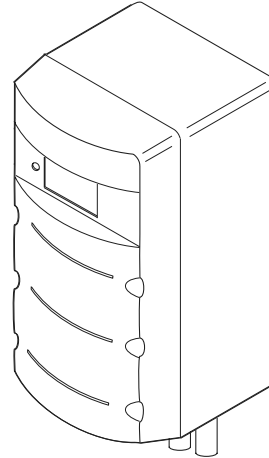
Figure 2 Typical Wiring for VER-PxD Series Two Wire mA Output.

Static & Differential Pressure Transducer

The VER-PxP Series Static and Differential Pressure Transducer is used to monitor and control building static pressure, air flow, and filter pressure drop. Microprocessor based for increased accuracy and reliability.

Features:

- $\pm 1\%$ accuracy (including linearity, hysteresis, and repeatability).
- Advanced ceramic capacitance sensor.
- As low as 0.1" W.C.
- Up to three PSID overpressure without zero shift.
- Up to sixteen field selectable ranges over two models.
- Field selectable output versions, 4 to 20 mA two-wire or three-wire 0 to 5 Vdc/0 to 10 Vdc.
- Short circuit and reverse polarity protected.
- Conforms to EMC standards EN50082-1/ EN55014/EN60730-1.
- 24 Vac/DC nominal supply voltage.
- Optional display.



Model Chart				
Model No. ^a	Range (in. W.C.) ^b	Input Supply	Output Supply	LCD Display
VER-PxPxx-01S	0 to 0.1/0 to .25/0 to 0.5/0 to 1.0	24 Vac/dc nominal $\pm 15\%$	2-wire, loop powered 4 to 20 mA or 3-wire 0 to 5 V/0 to 10 V	No
VER-PxPLx-01S				Yes
VER-PxPxx-02S	0 to 1.0/0 to 2.5/0 to 5.0/0 to 10			No
VER-PxPLx-02S				Yes

^a CAUTION: This product contains a half-wave rectifier power supply and must not be powered off transformers used to power other devices utilizing non-isolated full-wave rectifier power supplies.

^b Ranges may be unidirectional, as shown above, or bidirectional. Field selectable.

Specifications

Inputs

Media compatible	Clean dry air or any inert gas.
Load impedance capability	600 ohm minimum.
Proof pressure	3 PSID. Burst 5 PSID.
Operating characteristics	Accuracy: $\pm 1\%$ FS includes: linearity, hysteresis, and repeatability.
Air consumption	None.
Connections	1/8 inch brass hose barb fitting air connections. Cage clamp terminal block electrical connections.

Outputs

Electrical

Signal	4 to 20 mA, 2-wire. 0 to 5 Vdc or 0 to 10 Vdc, 3-wire.
Supply voltage	24 Vac/dc nominal $\pm 15\%$. 9 mA draw (AC), 4 mA draw (DC).
DC power supply rectifier type	Half-wave. (Refer to previous Caution). EN206. F-26363.

Environment

Ambient temperature limits	Shipping and handling: -32 to 140°F (0 to 60°C). Operating: 32 to 140°F (0 to 60°C).
Humidity	10 to 90%, non-condensing.
Location	Plenum rated UL 94. Meets UL94 VO.

Dimensions	4.49 H x 3.3 W x 2.14 D in. (114 x 84 x 54 mm).
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Accessories

Model No.	Description
N1-5x	Differential pressure pickups (series).

Typical Applications

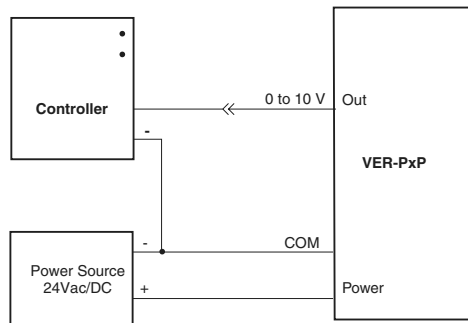


Figure 1 Typical Wiring for VER-PxP Series, Three Wire Vdc Output.

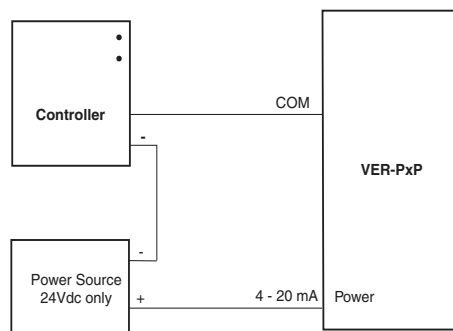


Figure 2 Typical Wiring for VER-PxP Series, Two-Wire mA Output.

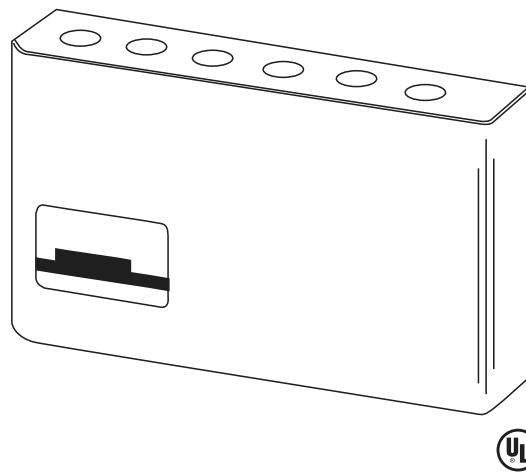
Erie™ Zone Valve Control Center

The VL500 zone control system provides control of up to five zone valves, 7 VA or less per valve, a circulator and boiler control in a multi-zone hydronic heating system.

Field selectable priority for zone 1 eliminates the need for additional relays to provide domestic hot water priority. Additional zones can be added.

Features:

- Field selectable Priority Plus™ zone.
- Unlimited zone expansion. Maximum load on any serially linked VL500 slave module should not exceed 58 VA.
- Field replaceable relays.
- LED status window.
- Common 24 Vac transformer terminal provides compatibility with electronic thermostats.
- Field replaceable fuse.



Model Chart	
Model No.	Description
VL500	Refer to Specifications.

Specifications	
Inputs	
Power input	120 Vac @ 50/60 Hz, 90 VA.
Connections	See Figure 1 - Typical Wiring.
Outputs	
Electrical	Thermostatic anticipator setting: 0.05 amps plus load current.
	Transformer: 24 Vac, 75 VA (maximum load 58 VA).
	Valve: 24 Vac, 0.9 A per output not to exceed 2.7 A total.
	Boiler relay: Dry contacts.
	Fuse ratings: F1 (24 Vac): 3.2 A, 125 V slow blow; F2 (120 Vac): 10 A, 250 V slow blow.
Environment	
Ambient temperature limits	Operating: 32 to 104°F (0 to 40°C).
Humidity	Up to 85% non-condensing.
Locations	NEMA Type 1.
Dimensions	8 H x 12-3/8 W x 2-7/8 D inches (203 x 314 x 73 mm).
Agency Listing	UL: Listed (file #E37601).
General Instructions	Refer to F-27020.

Accessories	
Model No.	Description
40-8-47	F1 fuse (3.2 A / 250V Slo-Blow).
40-8-66	F2 fuse (10 A / 250V Slo-Blow).

Typical Applications

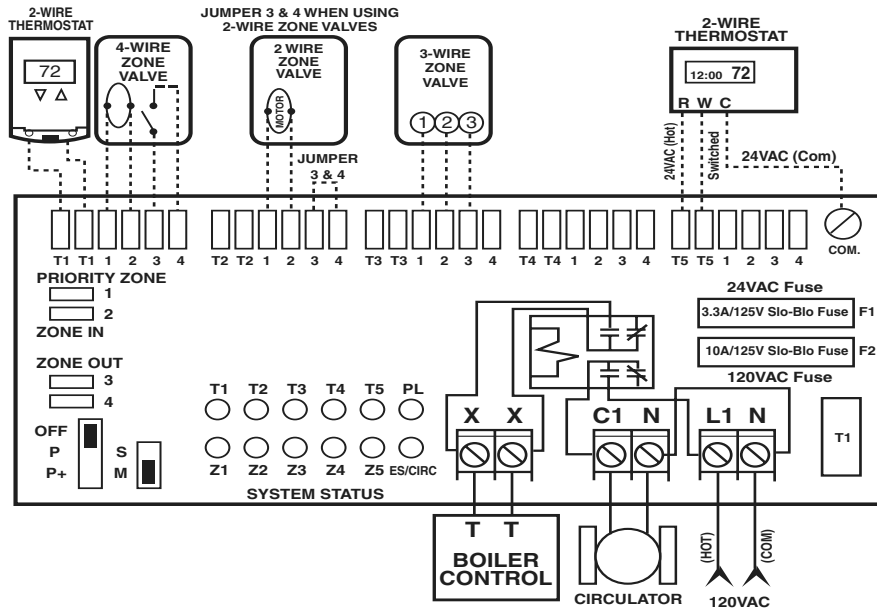


Figure 1 Typical Wiring.

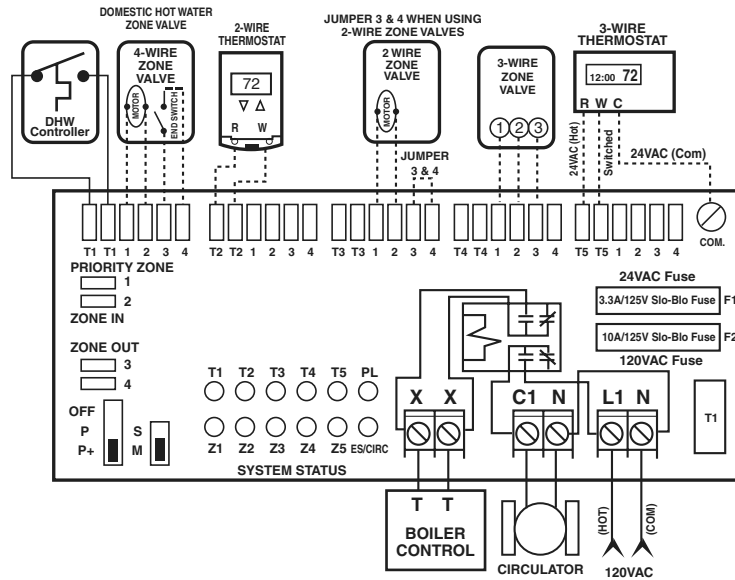


Figure 2 Typical Wiring VL500 Series with Domestic Hot Water Priority Zone, Boiler Controller and Circulator.

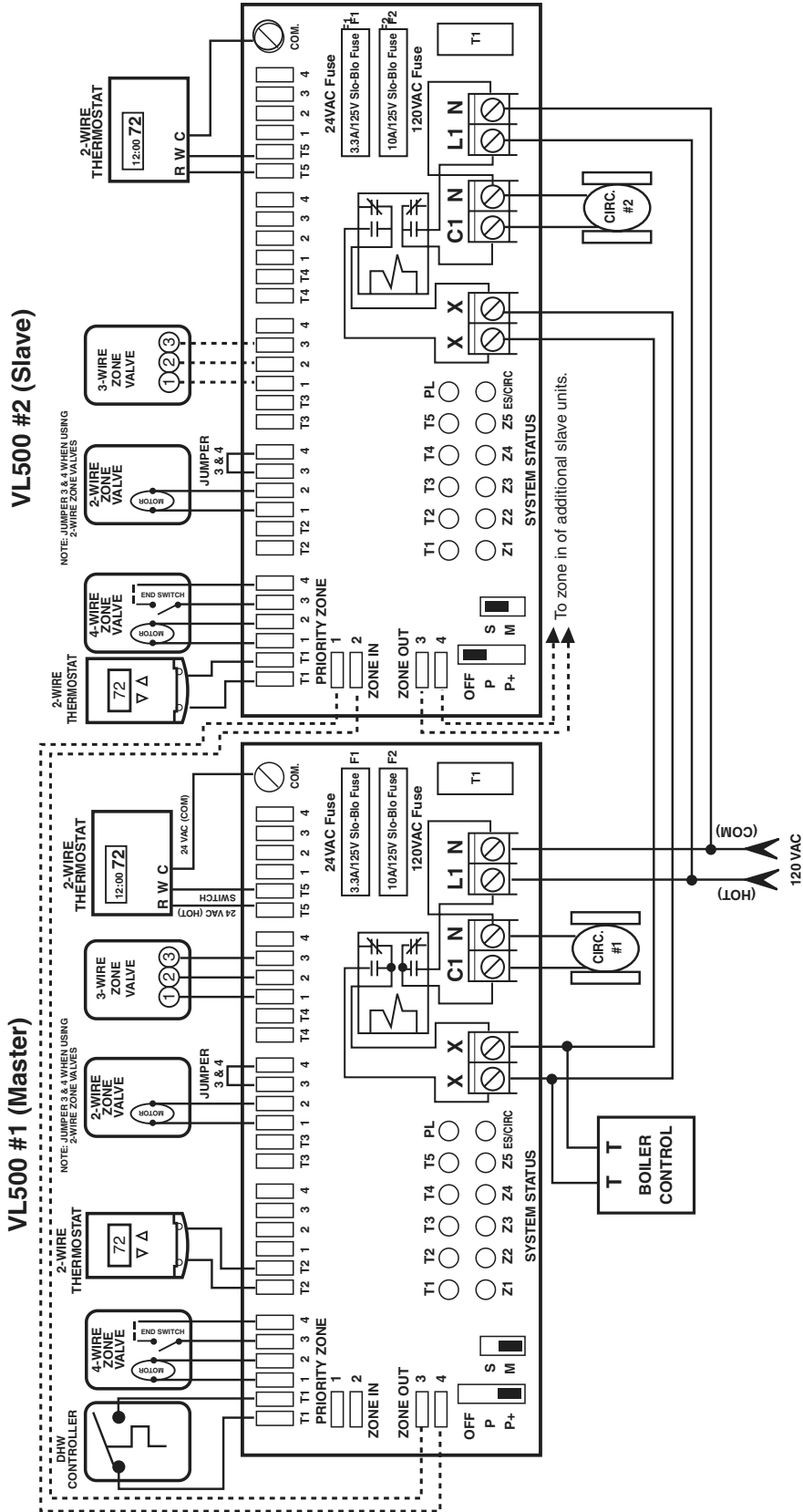
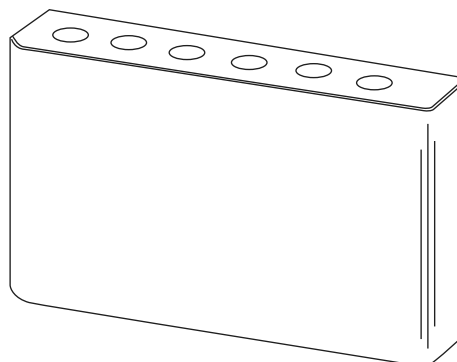


Figure 3 Two VL500 series with Domestic Hot Water Priority, Nine Heating Zones, Boiler and Circulator.

Erie™ Two Zone Hydro-Air Relay

The WA300 hydro-air control relay incorporates double pole/single throw relays to provide control for up to two hydro-air systems including two air handlers/AC controller, two system heating circulators, one boiler/burner circulator, and one domestic hot water controller. Domestic hot water priority zone eliminates the need for additional relays to provide domestic hot water for indirect fired hot water tanks. The thermostats used with the WA300 must power the fan on when the heat output is powered.



Features:

- Capable of controlling two hydro-air systems in one relay package.
- Selectable fan delay of 90 to 180 seconds in heat mode.
- Common 24 Vac transformer terminal provides compatibility with electronic thermostats.
- Field replaceable circulator relays.
- Large terminal connections.
- Expandable up to 4 zones with the addition of a second WA300.

Model Chart

Model No.	Description
WA300	Refer to Specifications.

Accessories

Model No.	Description
EXP10	Replacement plug in relay.

Specifications

Inputs	
Power input	Circulators: 120 Vac @ 50/60 Hz. Fan centers: 24 Vac @ 50/60 Hz.
Connections	See Figure 1 - Typical Wiring.
Outputs	
Electrical	Thermostatic anticipator setting: Set to actual current draw of system @ 24 Vac. Circulator relay rating: Full load: 7.2 amps; Locked rotor: 43.2 amps; Resistive: 7.4 amps. Fan center switch rating: 1 amp @ 24 Vac.
Environment	
Ambient temperature limits	Operating: 120°F (49°C) maximum.
Humidity	5 to 95% RH, non-condensing.
Locations	NEMA Type 1.
Dimensions	5-1/8 H x 12-5/16 W x 2-15/16 D inches (130 x 312 x 75 mm).
General Instructions	Refer to F-27021.

Typical Applications

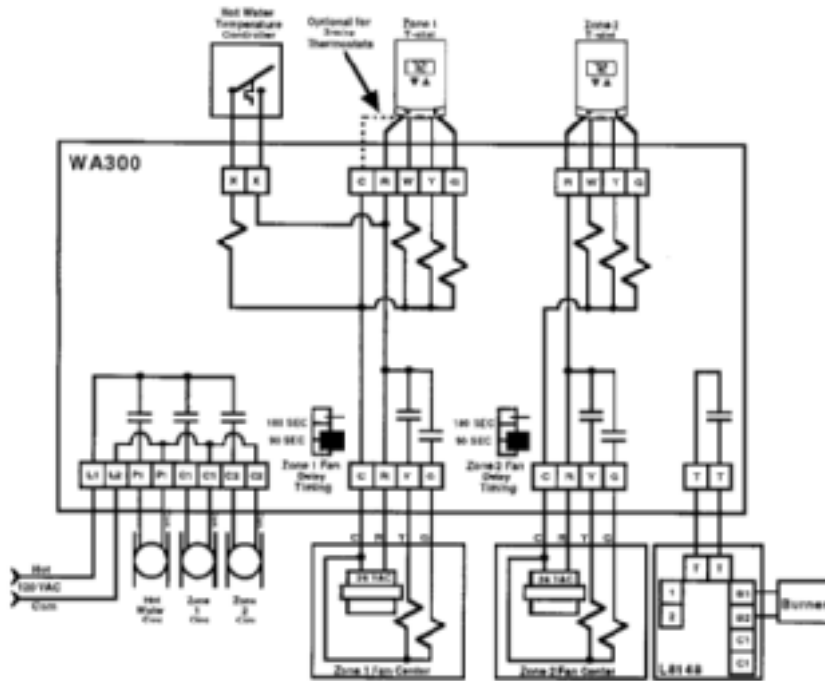


Figure 1 Typical Wiring WA300 -Boiler Controller and Two Fan Centers With Domestic Hot Water Priority.

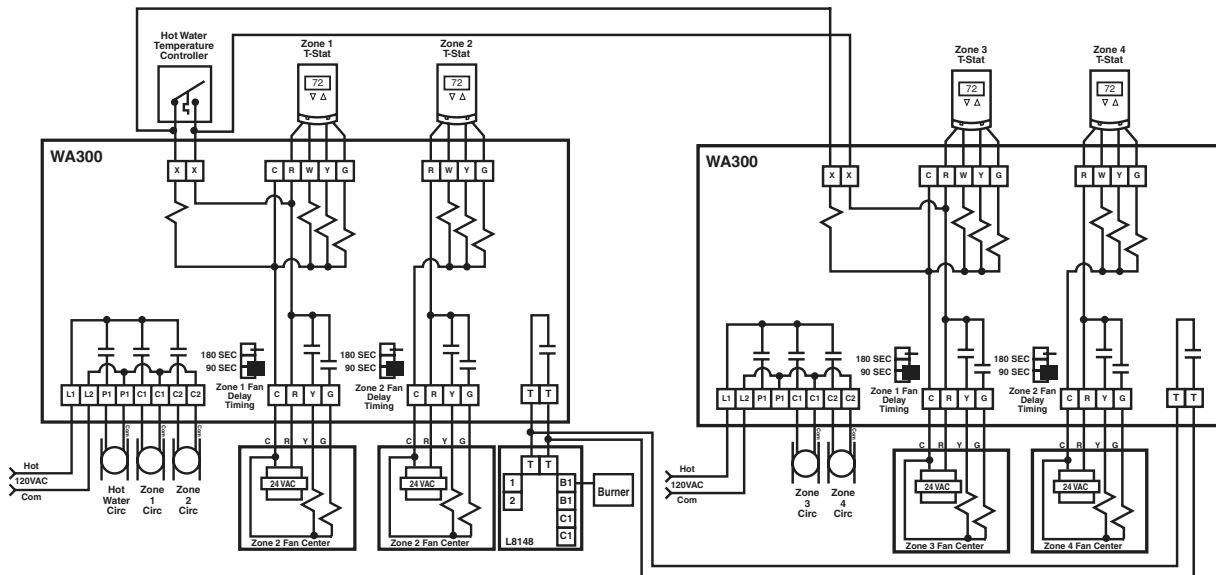


Figure 2 Four Zone Hydro-Air System with Domestic Hot Water Priority Using Two WA300s.

Application

2 X 2 Sensor Installation.

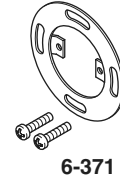
Description

Steel mounting ring for mounting sensors mounting head. Includes two #6 flat head screws.

Specifications

- For use with:
 - TS-57031.
 - TS-58031.
 - TS-81031.

6-371 (20-642)
Mounting Ring



Application

2 X 2 Sensor Installation Wall Box.

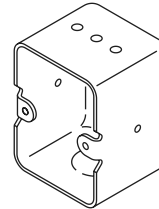
Description

Plain deep mounting box 2-1/2 H x 1-7/8 W x 1-3/4 D in., 1/2 in. conduit knockout, for use with 2 x 2 in. sensors and 10-77 (or 10-78) plate.

Specifications

- For use with:
 - TS-57031.
 - TS-58031.
 - TS-81031.

10-22
Mounting Box



Application

2 X 2 Sensor Wall Plate.

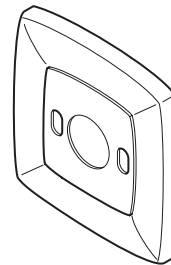
Description

Lexan wall plate to cover 10-47. This plate will accept 2 x 2 in. devices.

Specifications

- Grey plastic.
- For use with:
 - TS-57031.
 - TS-58031.
 - TS-81031.

10-48 (20-758)
Wall Plate



Accessories and Tools

Application

2 X 2 Sensor Guard.

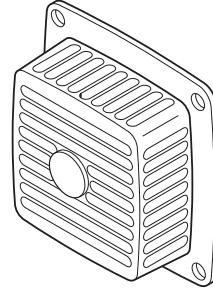
Description

5-3/16 in. sq. cast metal guard. Will fit over 2 x 2 in. sensors.

Specifications

- For use with:
 - TS-57031.
 - TS-58031.
 - TS-81031.

10-53 (20-707)
Thermostat Guard



Application

2 X 2 Sensor Mounting Ring.

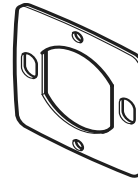
Description

Stamped metal mounting ring for use with 2 x 2 in. devices. Used with N5-52 for drywall mounting.

Specifications

- For use with:
 - TS-57031.
 - TS-58031.
 - TS-81031.

10-58 (20-711)
Mounting Ring



Application

2 X 2 Sensor Guard.

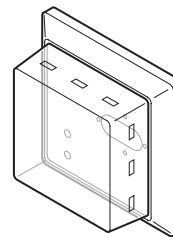
Description

Molded Lexan guard for 2 x 2 in. devices. Clear front, satin-chrome enamel base.

Specifications

- For use with:
 - TS-57031.
 - TS-58031.
 - TS-81031.

10-62 (20-715)
Thermostat Guard



Application

2 X 2 Sensor Installation Mounting Plate.

Description

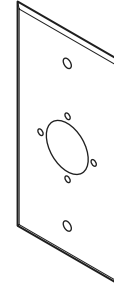
10-82-SS: Sensor mounting plate provides 2 x 2 in. device mounting to a 2 x 4 in. vertical or horizontal outlet box. Includes two wing bolt screws. Color: stainless steel.

10-82-48: Sensor mounting plate provides 2 x 2 in. device mounting to a 2 x 4 in. vertical or horizontal outlet box. Includes two wing bolt screws. Color: Euro-white.

Specifications

- For use with:
 - TS-57031.
 - TS-58031.
 - TS-81031.

**10-82-SS, 10-82-48
Mounting Plates**



Application

Erie™

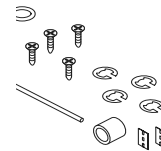
Damper shaft kit may be used with 453 Erie direct drive damper actuator. Kit includes shaft, four lockwasher, two 5/16 in. steel washer, four screws, two push-on speed nuts, and two nylon bearings.

Specifications

- 6 to 12 in. (152 x 305 mm) long.

453-52

Damper Shaft Kit



Application

Erie™

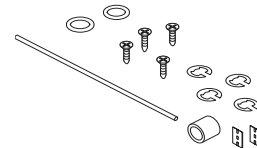
Damper shaft kit may be used with 453 Erie direct drive damper actuator. Kit includes shaft, four lockwasher, two 5/16 in. steel washer, four screws, two push-on speed nuts, and two nylon bearings.

Specifications

- 12 to 20 in. (305 x 508 mm) long.

453-69

Damper Shaft Kit



Application

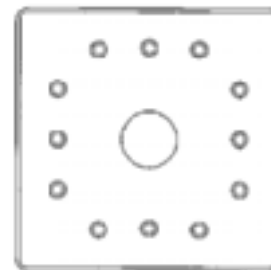
Erie™

Allows T155, T158, T167, T168 to be mounted to a 4 X 4 in. electrical box.

Specifications

- Dimensions: 4-3/4 X 4-3/4 in. (121 x 121 mm).
- Color: Cool grey.

**65345
Adapter Plate**



Accessories and Tools

Application

Erie™

Set point dial for use with T155, T167.

65410

Celsius Set Point Dial

Specifications

- Setpoint: 10 to 39°C.



Application

Erie™

Set point dial for use with T155, T167.

65170

Warmer/Cooler Set Point Dial



Application

Erie™

Sensor for use with T158, T167, T168. May be used as either a remote sensor or a changeover sensor. For both functions two separate sensors are required.

65671

Remote Sensor

Specifications

- 60 inch leads, 10 k Ω @ 77°F (25°C).



Application

Erie™

For use with T155, T167.

65860

Set Point Dial Stop Kit



Application

System 8000

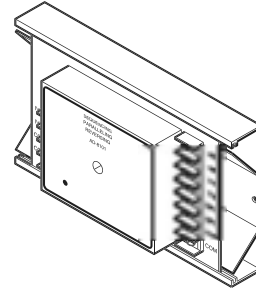
Module provides sequencing, reversing, or parallel operation for up to 12 System 8000 controlled devices in HVAC systems. The module sequences two non-positive positioning devices or three positive positioning devices.

Specifications

- Operation: Receives 1 to 15 Vdc output from a controller for parallel, sequencing, or reversing operation of up to 12 controlled devices. For reversing, the output of the module is reversed with the output of the controller, i.e., a 1 to 15 Vdc output from the controller provides a 15 to 1 Vdc output from the module.
- Adjustment: Potentiometer is adjustable without removing the cover to provide ± 5 Vdc change in output of module with respect to the output of the controller.
- Power requirements: 20 Vdc, 10mA.
- Mounting: Provided with plastic track for panel mounting. AD-8912 enclosure can be ordered separately for remote installations.
- Dimensions: 4 H x 7-1/2 W x 2-1/2 D in. (102 x 191 x 63 mm).
- Accessories:
 - AD-8912, 12 in. (305 mm) enclosure.
 - TOOL-201, Calibration kit for System 8000.
- Refer to F-14963 for complete applications.

AD-8101

Sequencing, Paralleling, Reversing Module



Application

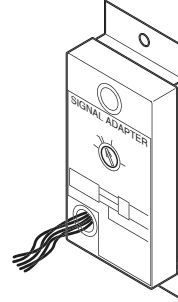
System 8000

This signal adapter for dual output sequence control offers a one to two signal amplifier and a reversing module with one to two signal amplification. The adapter is usable with other System 8000 controllers. Compact design permits mounting on the back of the TP-8101 thermostat. The color coding is compatible with Series 8000 devices. The output with adjustable span conforms with ASHRAE 90-75 Standards. The adapter produces gains of two from TP-8101.

Specifications

- Operation: Unit produces two 6 to 9 Vdc output signals from a controller's single 1 to 15 Vdc input signal. The two outputs make it possible to sequence two controlled devices from one controller. Typically, one output controls heating and the other controls cooling.
- Outputs:
 - AD-8122, Two direct acting.
 - AD-8123, One direct and one reverse acting.
 - AD-8124, One reverse and one direct acting.
- Mounting: Units mount on the back of a TP-81xx room controller. For panel mounting, order separately AD-8953 mounting rack, or use screws (not included).
- Dimensions: 3-3/4 H x 1-1/2 W x 5/8 D in. (95 x 38 x 16 mm).
- Accessories:
 - AD-8953, Mounting rack.
 - TOOL-201, Calibration kit for System 8000.
- Refer to F-16770 for complete applications.

AD-812x Signal Adapter



Application

System 8000

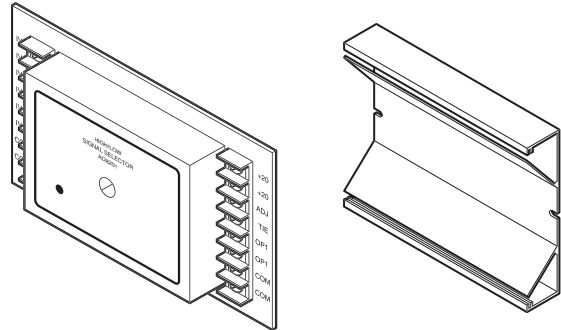
This signal selector offers selection of either the highest or lowest signal from up to six zones. One model can be used for either high or low signal selections. The selector has the capability to drive up to 12 System 8000 controlled devices. It has System 8000 compatible terminology. The AD-8201 offsets input to output adjustment. Standard trade mounting.

Specifications

- Input to Output Ratio: Factory calibrated for a 1:1 ratio. Output adjustable ± 4 Vdc with respect to the input signal.
- Outputs: Signal is equal to either the highest or lowest input signal. Selector pins change the unit from a high to a low signal selector.
- Power requirements: 20 Vdc, 10mA.
- Mounting: Panel mounted to a track section. AD-8912 enclosure ordered separately for remote installations.
- Dimensions: 4 H x 7-1/2 W x 2-1/2 D in. (101.6 x 190.5 x 63.5 mm).
- Accessories:
 - AD-8912, 12 in. (308.4 mm) enclosure.
 - TOOL-201, Calibration kit for System 8000.
- Refer to F-14963 for complete applications.

AD-8201

High/Low Signal Selector



Application

System 8000

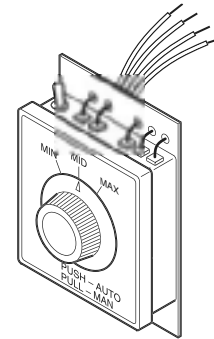
This selector provides high voltage, manual, or minimum selection for controlled devices. The selector has the capability to drive up to 5 System 8000 controlled devices. AD-8301 has automatic high signal select in minimum position operation. Universal mounting capability with selected hardware. Track mounting with AD-8954.

Specifications

- Operation:
 - Manual positioner: Produces a 6 to 9 Vdc swing with the pointer between minimum and maximum markings when the knob is pulled out. CCW to CW rotation produces 1 to 15 Vdc.
 - Minimum positioner: Produces a 6 to 9 Vdc minimum position signal by adjusting the pointer between the minimum to maximum markings when the knob is pushed in. CCW to CW rotation produces 1 to 15 Vdc minimum output. Output to the controlled device equals the controller output but is not less than the minimum established by the positioner.
- Mounting: Surface, but can be mounted on AD-8954 for panel mounting. AD-8954 can snap into an AD-8953 mounting track.
- Dimensions: Plate is 2-1/16 H x 1-7/8 W in. (52 x 48 mm). Allow 1-1/2 in. (38 mm) depth behind plate for mounting. Requires a 3/8 in. (9.5 mm) diameter mounting hole.
- Accessories:
 - AD-8953, Mounting track (requires AD-8954).
 - AD-8954, Panel mounting bracket.
- Refer to F-25795 for complete applications.

AD-8301

Position Selector - Manual/Minimum



Accessories and Tools

Application

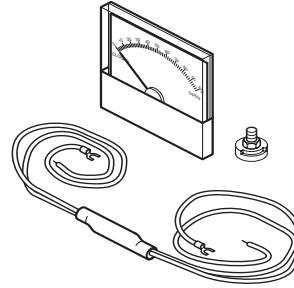
Position indication kit for MP-300, MP-400, MP-2000, MP-4000 and MP-9700 Series gear train actuators.

Specifications

- Kit:
 - Converter: AC/DC.
 - Calibration potentiometer: 10K, 2W.
 - Indication meter: 0 to 100% (Open/Closed), 0 to 10 Vdc, 1000 Ω .
- Operation: Meter shows position of actuator shaft rotation, closed % to open 100%.
- Input: 100 Ω actuator potentiometer.
- Power requirements: 24 Vac.
- Ambient temperature limits:
 - Shipping and storage: -40 to 160°F (-40 to 71°C).
 - Operating: 40 to 140°F (4 to 60°C).
- Connections: Color coded wire leads, screw terminals and lug terminals.
- Mounting: Panel.
- Dimensions:
 - Meter: 2-3/4 H x 3-1/4 W x 1-1/8 D in. (70 x 83 x 29 mm).
 - AC/DC converter: 3 L x 1 W in. (76 x 25 mm).
 - Calibration potentiometer: 1-1/8 H x 1-1/8 Dia. in. (29 x 29 mm).
- Refer to F-21063 for complete applications.

AD-8817

Position Indication Kit



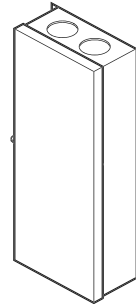
Application

This enclosure is used for remote mounting of certain electronic devices. There are conduit knockouts top and bottom for convenient installation. Appropriate spacers are supplied for easy assembly. AD-89xx aids the stand-alone application of System 8000 devices.

Specifications

- Connections: Two 1/2 in. knockouts provided on each end of enclosure.
- Locations: NEMA Type 1.
- Mounting: Wall.
- Dimensions:
 - AD-8905: 5-1/8 H x 5 L x 3 D in. (102 x 127 x 76 mm).
 - AD-8912: 5-1/8 H x 12 L x 3 D in. (102 x 305 x 76 mm).
- Refer to F-19482 for complete applications.

**AD-89xx
Enclosure**



Application

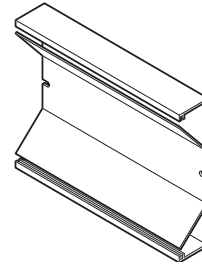
Vinyl mounting track for cabinet mounting of devices.

Specifications

- Dimensions: 3-3/4 in. W x 4 ft. L (95 mm x 1.2 m).

AD-8953

Vinyl Mounting Track



Application

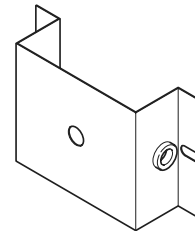
Panel mounting adaptor, adapts AD-8301 or AT-8xxx remote setpoint adjusters.

Specifications

- Mounting: Can snap into AD-8953 mounting track.
- Dimensions: 3-3/4 H x 2-1/8 W x 1-1/4 D in. (95 x 54 x 32 mm).

AD-8954

Panel Mounting Adaptor



Application

AD-8969-101
Output loading of System 8000 controllers.

AD-8969-102
Interfacing a 6 to 9 Vdc external control signal to System 8000 controllers.

Specifications

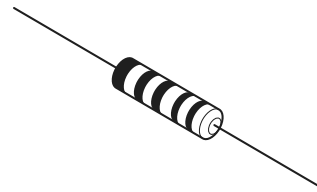
AD-8969-101

- 10,000 Ω (10K), $\pm 10\%$ tolerance, 1/2 watt, carbon resistor.
- Number in kit: 12.

AD-8969-102

- 3,300,000 Ω (3.3 meg), $\pm 5\%$ tolerance, 1/2 watt, carbon resistor.
- Number in kit: 12.

AD-8969-10x Series Resistor Kits



Accessories and Tools

Application

AD-8969-202

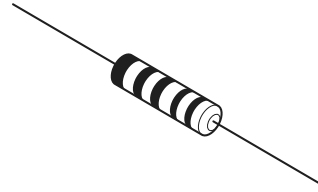
Converting and interfacing a 4 to 20 mA dc external signal to 1 to 5 V dc signal.

Specifications

AD-8969-202

- 250 Ω , $\pm 1\%$ tolerance, 1/2 watt, temperature coefficient (TC) of 25 PPM/ $^{\circ}\text{C}$ metal film resistor.
- Number in kit: six.
- Refer to F-21279 for complete applications.

AD-8969-202 Series Resistor Kit



Application

Used for electrical and magnetic noise by-passing to ground.

Specifications

- 470 Pico Farad (PF), +10% tolerance, 1000 (1K) volts direct current working (VDCW) ceramic capacitor.
- Number in kit: 12.

AD-8969-621 Capacitor Kit



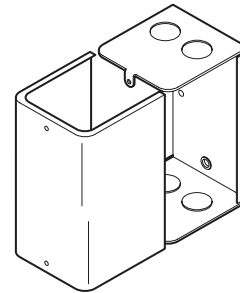
Application

Enclosure for the AE-3XX Series power relays to be used when stand alone units are required.

Specifications

- Locations: NEMA Type 1.
- Dimensions: 5-5/16 H x 3-3/8 W x 3-1/16 D in. (135 x 86 x 78 mm).
- Four 1/2 in. knockout tabs.

AE-300 Power Relay Enclosure



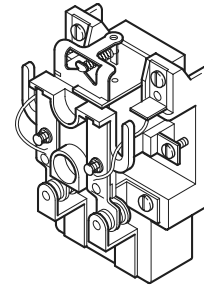
Application

This relay connects power to control equipment. The AE-3xx can be panel mounted or stand alone with AE-300 enclosure. One unit (DPDT) is universally adaptable to most applications.

Specifications

- Electrical switch: DPDT clapper type.
- Connections: Screw terminals.
- Coil power requirements: 9.8 VA.
- UL Listed.
- Dimensions: 3-3/8 H x 2-17/32 W x 2-1/2 D in. (86 x 64 x 64 mm).
- Accessories: AE-300, Power relay enclosure.

AE-304, AE-314 Power Relays



AE-3X4
Power Relay



Application

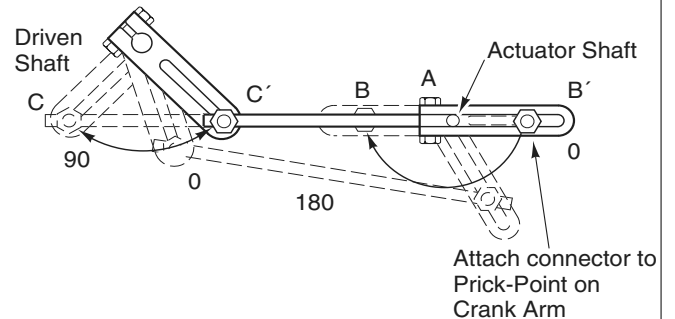
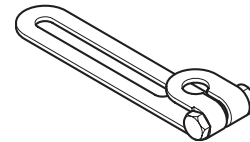
Crank arms for damper or splined actuator shafts.

Specifications

- 3/8 in. (10 mm) slot provides for adjustable radius from 7/8 in. (22 mm) min. to 3-1/8 in. (79 mm) max.
- Plated.
- AM-111 for 5/16 in. dia. shaft.
- AM-112 for 3/8 in. dia. shaft.
- AM-113 for 1/2 in. dia. shaft.
- AM-115 for 7/16 in. dia. shaft.
- AM-116 splined for 1/2 in. dia. actuator shaft.
- May be used with:
 - AM-122 Straight linkage connector.
 - AM-132 Ball joint linkage connector.

AM-111, AM-112, AM-113, AM-115, AM-116

Crank Arms



Application

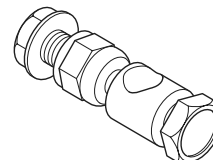
Straight linkage connector used for linking parallel shafts.

Specifications

- Plated — 5/16 in. (8 mm) diameter hole.

AM-122

Straight Linkage Connector



Accessories and Tools

Application

Angle damper plated clip for attaching connector to damper blade.

Specifications

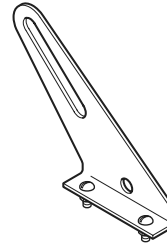
- Use AM-122 or AM-132 connectors in 3/8 in. (10 mm) slot.

Accessories

AM-122 Straight linkage connector.

AM-132 Ball joint linkage connector.

AM-123 Angle Damper Clip



Application

Damper rod.

Specifications

AM-125

- Plated 5/16 dia. x 20 in. (8 mm x 0.5 m).
- Maximum load for damper rod 173 lbs. (769 N).

AM-125-048

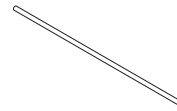
- Plated 5/16 dia x 48 in. (8 mm x 1.2 m).
- Maximum load for damper rods 30 lbs (133 N).

AM-125-600

- Pkg. of five 5/16 in. dia. x 10 ft. (8 mm x 3 m).
- Not plated.

AM-125, AM-125-048, AM-125-600

Damper Rod



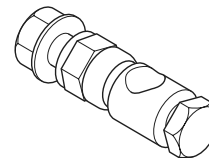
Application

Ball joint linkage connector used for linking nonparallel shafts.

Specifications

- Plated connector with 5/16 in. (8 mm) diameter hole.

AM-132 Ball Joint Linkage Connector



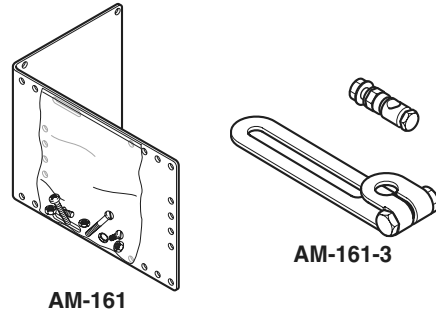
Application

Damper linkage kits eliminate the need to order all the necessary linkage parts separately.

Specifications

- Description: Kits consist of two to five pieces of prepackaged hardware.
- Order AM-125-xxx damper rod separately.

AM-161, AM-161-1, AM-161-3 Damper Linkage Kits



Model No.	Hardware Supplied					Where Used
	Damper Linkage		Actuator Linkage		Actuator Bracket	
	1/2 in. Dia. Crank Arm	Balljoint Linkage Connector	Actuator Crank Arm	Balljoint Linkage Connector		
AM-161	AM-113	AM-132	AM-116	AM-132	AM-301	MA-300, 400 series; MC-300, 400, 4000 series; MP-300, 400, 2000, 4000 series
AM-161-1	AM-113	AM-132	AM-116	AM-132	—	
AM-161-3	AM-113	AM-132	—	—	—	MK-31xx, MK-44xx, MP-523x, MP-543x, MPR-5xxx.

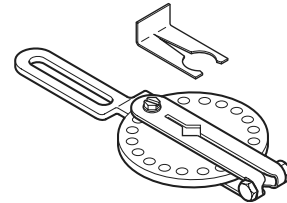
Application

For connecting MM and MMR-400/500 Series modular actuators to dampers.

Specifications

- Kit contains:
 - One AM-230 motor crank arm assembly for connecting to square shafts of MM & MMR-400/500 Series modular actuator.
 - One shaft retainer clip.
- Refer to F-23377 for complete applications.

AM-230 Motor Crank Arm Kit



Accessories and Tools

Application

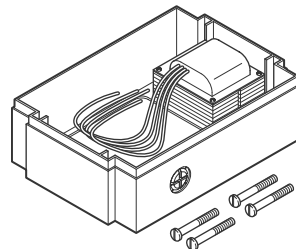
For connecting MM and MMR-400/500 Series modular actuators to 120, 208, or 240 Vac power sources.

Specifications

- Power supply:
 - Primary: 120/208/240 Vac (+10, -15%), 50/60 Hz. For maximum reliability and operating life, use at nominal primary voltage.
 - Secondary: 24 Vac.
 - VA: 40.
- Ambient temperature limits:
 - Shipping and storage: -40 to 160°F (-40 to 71°C).
 - Operating: -40 to 130°F (-40 to 54°C).
- Humidity: 5 to 95% RH, non-condensing.
- Locations: NEMA Type 1 (NEMA 3R with AM-232 gasket kit installed on modular actuator).
- Connections:
 - Primary: 8 in. (203 mm) color coded pigtail leads.
 - Secondary: 8 in. (203 mm) brown pigtail leads with 1/4 in. quick-connect (spade lug) terminals.
 - Housing: Glass-reinforced thermoplastic (PET). UL-94-5V flame-rated housing material to meet UL-465 requirements for air plenum mounting.
 - Mounting: To top of modular actuator housing. Four screws provided to secure kit to modular motor housing. Weather resistant cover gasket kit included.
 - Dimensions: 1-15/16 H x 5-11/16 W x 4 D in. (49 x 144 x 102 mm).
- Refer to F-23353 for complete applications.

AM-231

Transformer/Cover Kit (if power 120, 208, or 240 Vac)



Application

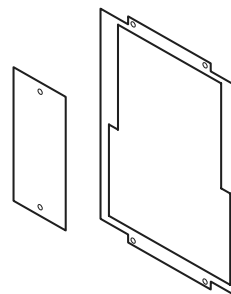
For providing a replacement NEMA 3R weather resistant kit for MM and MMR-400/500 Series modular actuators.

Specifications

- Kit contains:
 - One top cover gasket.
 - One internal switch cover gasket.
- Gasket material: 1/16 in. (1.6 mm) thick closed cell Neoprene.
- Mounting: Modular housing must be mounted vertically — top up — and weather resistant conduit connectors are required for NEMA 3R rating.
- Dimensions:
 - Top cover gasket: 5-1/2 x 3-13/16 in. (140 x 97 mm).
 - Internal switch cover gaskets: 3-5/8 x 1-21/32 in. (92 x 42 mm).
- Refer to F-23481 for complete applications.

AM-232

Replacement Weather Resistant Kit

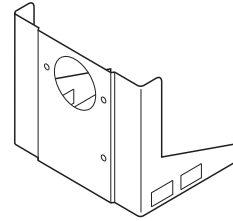


Application

AM-237 kit is used to mount Honeywell Q607 auxiliary switch and Q181A auxiliary potentiometer kits to MM or MMR-400/500 modular actuators when AV-631 linkage is used.

Specifications

- Refer to F-23503 for complete applications.



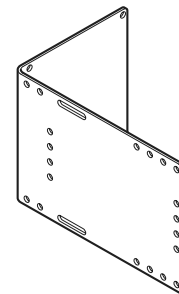
AM-237 Bracket Kit

Application

90° angle mounting bracket for all oil-submerged gear train damper actuators (except MP-9000), MK-71X1 and MK-38X1 pneumatic actuators, MM/MMR-400 and 500 electric/electronic gear train actuators and ME/MU-12313 damper economizer actuators.

Specifications

- Material: 3/16 in. painted steel.
- Punch sizes: 27, 1/4 in. (6.4 mm) dia.; one 1/2 in. (12.7 mm) dia. hole; two 1/2 x 1 in. (12.7 x 25.4 mm) slots.
- Dimensions: 7-3/8 H x 5-1/2 W x 5-7/8 D in. (187 x 140 x 149 mm).



AM-301 Angle Mounting Bracket

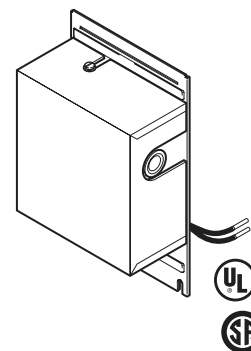
Application

Auxiliary two-step switches for multiple step control of compressors, pumps, auxiliary control of relays, indicating circuits and similar applications. Use with MC and MP oil-submerged gear train actuators or AM-348 mounting bracket.

Specifications

- Electrical switch: Two snap-action SPDT. Setting of each switch is adjustable using the wrench included. Differential of each switch is adjustable (minimum differential is 9°).
 - Ratings: Refer to table.
- Connections: Coded screw terminals.
- Case: Aluminum 1/2 in. conduit knockouts on right and left hand sides.
- Mounting: To back of actuator, or AM-348.
- Dimensions: 4-3/16 H x 4 W x 2 D in. (106 x 120 x 51 mm).
- Refer to F-09240 for complete applications.

Note: If installed on NEMA4 actuator the assembly will no longer be NEMA4.



AM-321 Auxiliary Two-Step Switch

Full Load Amps		Locked Rotor Amps		Non-Inductive Amps		Max. Total Load Not to Exceed
120 Vac	240 Vac	120 Vac	240 Vac	120 Vac	240 Vac	
5.8	2.9	34.8	17.4	15	7.5	2000 VA

Accessories and Tools

Application

Single potentiometer for use in position indicating applications or in paralleling actuators. For use with MP oil-submerged gear train actuator or AM-348 mounting bracket.

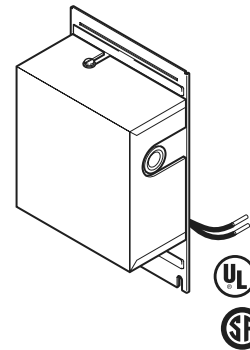
Specifications

- Construction: Spring-loaded friction-driven copper wiper arm with a contact that rides on a uniformly wound wire resistance card.
- Resistance card:
 - Resistance: 100 Ω ; use with a power supply not to exceed 25 Vac.
 - Electrical capacity: 3 watts.
- Connections: Coded screw terminals.
- Case: Aluminum. 1/2 in. conduit knockouts on right and left hand sides.
- Mounting: To back of actuator, or AM-348.
- Dimensions: 4-3/16 H x 4 W x 2 D in. (106 x 102 x 51 mm).
- May be used with: AE-504 Paralleling relay (required for paralleling applications).
- Refer to F-09240 for complete applications.

Note: If installed on NEMA4 actuator the assembly will no longer be NEMA4.

AM-332

Potentiometer



Application

Auxiliary four-step switches for multiple step control of compressors, pumps, auxiliary control of relays, indicating circuits and similar applications. Use with MC and MP oil-submerged gear train actuators or AM-348 mounting bracket.

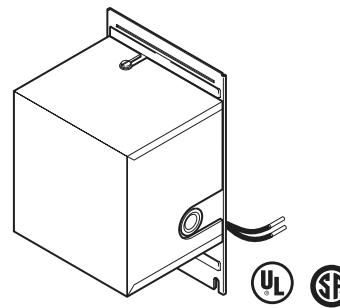
Specifications

- Electrical switch: Four snap-action SPDT. Setting of each switch is adjustable using the wrench included. Differential of each switch is adjustable (minimum differential is 9°).
 - Ratings: Refer to table.
- Connections: Coded screw terminals.
- Case: Aluminum. 1/2 in. conduit knockouts on right and left hand sides.
- Mounting: To back of actuator, or AM-348.
- Dimensions: 4-3/16 H x 4 W x 3-7/16 D in. (106 x 102 x 87 mm).
- Refer to F-09240 for complete applications.

Note: If installed on NEMA4 actuator the assembly will no longer be NEMA4.

AM-341

Auxiliary Four-Step Switch



Full Load Amps		Locked Rotor Amps		Non-Inductive Amps		Max. Total Load Not to Exceed
120 Vac	240 Vac	120 Vac	240 Vac	120 Vac	240 Vac	
5.8	2.9	34.8	17.4	15	7.5	2000 VA

Application

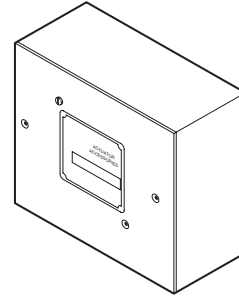
Time delay relay used with CP-8301-xxx and CP-8391-91x solid state drives to control MP-98xx and MP-99xx actuators.

Specifications

- Electrical Switch: Two SPDT relays having separate electronic 3 to 5 second time delay circuits.
 - Coil power requirements: 5 VA at 24 Vac.
 - 120 Vac: 5.
 - 240 Vac: 2.5
- Connections: Color coded leads.
- Case: Metal
- Locations: NEMA Type 1.
- Mounting: To back of actuator, field modified for panel mounting.
- Dimensions: 4-5/8 H x 5-5/8 W x 2-3/8 D in. (117 x 143 x 60 mm).
- Refer to F-11331 for complete applications.

AM-345

Actuator Mount Time Delay Relay



Application

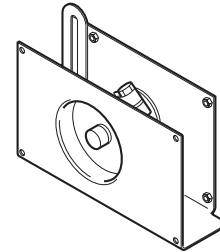
Mounting bracket to be used with auxiliary switches AM-321 and AM-341 or potentiometer kits AM-332 and AM-342.

Specifications

- Mounting: Typically, the crank arm provided on mounting bracket is linked to a damper shaft.
- Dimensions: 3-3/8 H x 5 W x 2-3/16 D in. (86 x 127 x 55 mm).
- Refer to F-10538 for complete applications.

AM-348

Mounting Bracket



Application

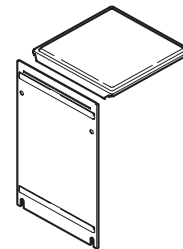
The NEMA4 rated gasket cover kit is designed to provide the internal components of non-spring return oil-submerged gear train actuators with a degree of protection against wind-blown dust, rain, and hose directed water. The kit is designed to be used on MC and MP-3xx, 4xx, 2xxx, and 4xxx actuators.

Specifications

- Construction: Top and back gasketed aluminum covers.
- Note:** Back cover plate prevents the use of other accessory kits.
- Kit contains:
 - One top cover plate.
 - One back cover plate.
 - Five screws.
- Dimensions:
 - Top cover: 4-1/8 W x 4-1/8 D in. (105 x 105 mm).
 - Back cover: 4-1/8 W x 6-3/4 H in. (105 x 171 mm).
- Refer to F-25598 for complete applications.

AM-363

Gasket Cover Kit



Accessories and Tools

Application

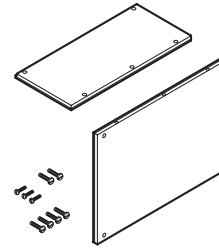
The NEMA 4 rated gasket cover kit is designed to provide the internal components MC and MP-9000 Series actuators with a degree of protection against wind-blown dust, rain and hose directed water.

Specifications

- Construction: Top and back gasketed aluminum covers.
- Kit contains:
 - One top cover plate.
 - One back cover plate.
 - Four #6-32 top cover plate screws.
 - Five #8-32 back cover plate screws.
- Dimensions:
 - Top cover: 6-5/8 W x 3-7/8 D in. (168.3 x 98.4 mm).
 - Back cover: 6-7/8 W x 5 H in. (174.6 x 127 mm).
- Refer to F-25600 for complete applications.

AM-369

NEMA 4 Rated Gasket Cover Kit



Application

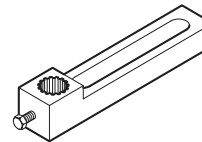
Crank arm for MP-9000 Series actuators.

Specifications

- 1/2 in. slot provides for adjustable radius from 1 to 5 in. (25 to 127 mm).
- Plated.
- Splined crank arm fits actuator output splined shaft.

AM-392

Heavy Duty Crank Arm



Application

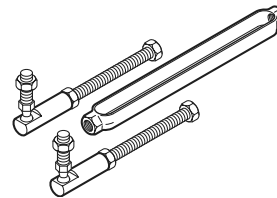
Connecting link for MK-7xxx and Mx-9xxx actuators.

Specifications

- Two 1/2 in. dia. threaded rods with turnbuckle.
- Two 1/2 in. dia. ball joint connectors.
- Adjustable from 15-3/4 to 24-3/4 in. (400 to 629 mm).
- MK-7xxx: Refer to F-16791 for complete applications.
- Mx-9xxx: Refer to F-11331 for complete applications.

AM-394

Heavy Duty Connecting Link



Application

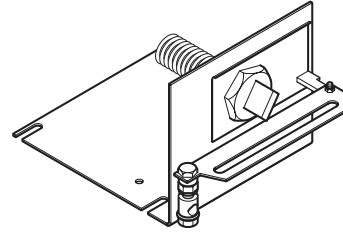
Required to modify Mx-5xxx and Mxx-5xxx hydraulic actuators for damper applications with 2 in. (51 mm) stroke.

Specifications

- Device includes:
 - Mounting bracket.
 - Damper linkage with spring.
 - AM-122 straight connector.
 - Spring loader fixture.

AM-601

Damper Actuator Mounting Adaptor



Application

DuraDrive

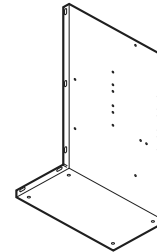
The AM-671 universal mounting bracket with side flange is designed to provide a mounting surface for an actuator when the actuator cannot be mounted directly to the damper shaft and no proper mounting surface is available.

Specifications

- To be used with the following damper actuators:
 - MA40-704x.
 - MF40-704x.
 - MS40-704x.
 - MA4x-707x.
 - MF4x-707x.
 - MS4x-707x.
 - MA4x-715x.
 - MF4x-715x.
 - MS4x-715x.
- Material: 12 gauge galvanized steel.
- Dimensions: 11 W x 17 H x 6-1/4 D in. (279 x 432 x 159 mm).
- May be installed inside or outside the duct mounting, to the ductwork, or directly to the damper assembly.
- May also be mounted to suitable surface other than the duct.
- Refer to F-25096 for complete applications.

AM-671

Universal Mounting Bracket



Accessories and Tools

Application

DuraDrive

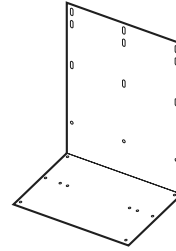
The AM-672 universal mounting bracket is designed to provide a mounting surface for an actuator when the actuator cannot be mounted directly to the damper shaft and no proper mounting surface is available.

Specifications

- To be used with the following damper actuators:
 - MA40-704x.
 - MF40-704x.
 - MS40-704x.
 - MA4x-707x.
 - MF4x-707x.
 - MS4x-707x.
 - MA4x-715x.
 - MF4x-715x.
 - MS4x-715x.
- Material: 12 gauge galvanized steel.
- Dimensions: 10-1/4 W x 13 H x 6-1/8 D in. (260 x 330 x 156 mm).
- May be installed inside or outside the duct mounting, to the ductwork, or directly to the damper assembly.
- May also be mounted to suitable surface other than the duct.
- Refer to F-25096 for complete applications.

AM-672

Universal Mounting Bracket



Application

DuraDrive

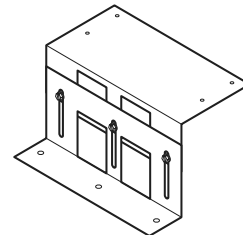
The AM-673 multiple actuator mounting bracket makes it possible to mount two of the actuators onto one damper shaft when more torque is required.

Specifications

- To be used with the following damper actuators:
 - MA4x-707x.
 - MF4x-707x.
 - MS4x-707x.
 - MA4x-715x.
 - MF4x-715x.
 - MS4x-715x.
- Material: 12 gauge galvanized steel.
- Dimensions: 7 W x 3-3/8 max. H x 5-3/4 D in. (178 x 86 x 146 mm).
- Allows the mounting of two damper actuators onto one damper shaft.
- Refer to F-25096 for complete applications.

AM-673

Multiple Actuator Mounting Bracket



Application

DuraDrive

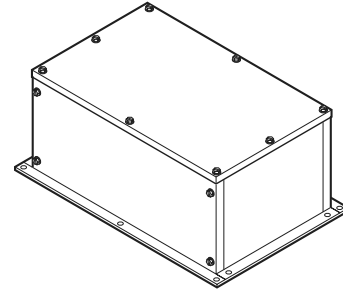
The AM-674 weather shield provides moderate weather protection for damper actuators which are mounted outdoors. While this weather shield provides effective, moderate, weather protection it is not designed as a water-tight enclosure.

Specifications

- Material: 16 gage galvanized steel.
- Provides weather protection for the following actuators:
 - MX40-704x.
 - MX41-707x.
 - MX41-715x.
 - MX40-717x.
 - MF41-6043.
 - MS41-6043.
 - MF41-6083.
 - MS41-6083.
 - MF41-6153.
 - MS41-6153.
 - MF41-6343.
 - MS41-634x.
 - MS50-E2x01.
 - MS50-H2x01.
- Dimensions: 9-1/2 W x 14 3/8 L x 6 D in.
(241 x 365 x 152 mm).
- Refer to F-25097 for complete applications.

AM-674

Weather Shield



Application

DuraDrive

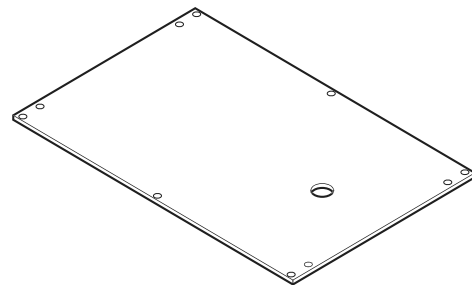
The AM-675 base mounting plate is used with the AM-674 weather shield if a suitable mounting surface for the weather shield is not present.

Specifications

- Material: 12 gage galvanized steel.
- Provides weather protection for the following actuators:
 - Mx40-704x.
 - Mx41-707x.
 - Mx41-715x.
 - Mx40-717x.
 - MF41-6043.
 - MS41-6043.
 - MF41-6083.
 - MS41-6083.
 - MF41-6153.
 - MS41-6153.
 - MF41-6343.
 - MS41-634x.
 - MS50-E2x01.
 - MS50-H2x01.
- Dimensions: 9-5/16 W x 14-5/16 H in. (237 x 364 mm).
- New drill holes required where needed for appropriate DuraDrive actuator mounting.
- Refer to F-25097 for complete applications.

AM-675

Base Mounting Plate



Accessories and Tools

Application

DuraDrive/EconoDrive

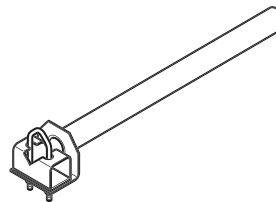
The AM-676 universal shaft extension extends the length of the damper shaft in applications where the damper shaft is too short to reach the damper actuator.

Specifications

- Length: Approximately 9-1/2 in. (13 mm).
- Damper shaft sizes:
 - 3/8 to 11/16 in. (10 to 17 mm) diameter for round shafts.
 - 3/8 to 9/16 in. (10 to 14 mm) square for square shafts.
- AM-710 is required for MA40-704x series, MF40-704x series and MS40-704x series.
- To be used with the following damper actuators:
 - Mx40-704x. MF41-6083.
 - Mx4x-707x. MS41-6083.
 - Mx4x-715x. MF41-6153.
 - Mx40-717x. MS41-6153.
 - MF4x-6043. MF41-6343.
 - MS4x-6043. MS41-634x.
 - MS50-E2x01.
 - MS50-H2x01.
- Refer to F-25098 for complete applications.

AM-676

Universal Shaft Extension



Application

DuraDrive

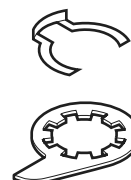
The AM-686 damper position indicator mounts on the actuator to indicate actuator position when the V-bolt indicator is not visible.

Specifications

- Material: Plated steel.
- Mounts on the following actuators:
 - Mx4x-707x.
 - Mx4x-715x.
- Refer to F-25098 for complete applications.

AM-686

Damper Position Indicator



Application

DuraDrive

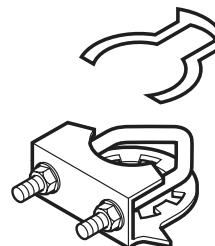
The AM-687 universal clamp assembly is used to replace the standard universal clamp assembly when a larger diameter damper shaft must be gripped, up to 1.05 in dia or up to 5/8 in sq. The AM-688 replacement universal clamp is used to clamp the actuator on shafts up to 3/4 in. dia. or up to 1/2 in. sq. Available to replace lost standard clamps shipped with actuator.

Specifications

- Material: Plated steel.
- Mounts on the following actuators:
 - Mx40-707x.
 - Mx4x-715x.
- Refer to F-25098 for complete applications.

AM-687, AM-688

Universal Clamp Assembly



Application

DuraDrive

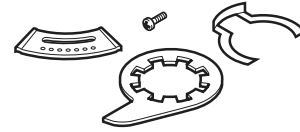
The AM-689 Rotation Limiter is used to limit the angle of rotation of a direct coupled damper actuator in applications where the damper does not have a proper end-stop.

Specifications

- Material: Plated steel.
- Maximum angle allowed: 95°.
- Setting Increments: 5°.
- Actuators: Mx4x-707x and Mx4x-715x.
- Refer to F-25098 for complete applications.

AM-689

Rotation Limiter



Application

DuraDrive

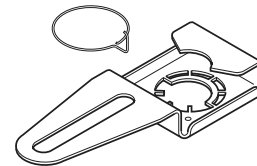
The AM-690 crank arm kit is used in non-direct mounting applications for round shafts. May require AM-692.

Specifications

- Actuators: Mx4x-707x and Mx4x-715x.
- Maximum damper shaft size: 3/4 in. (19 mm).
- Refer to F-25098 for complete applications.

AM-690

Crank Arm Kit



Application

DuraDrive

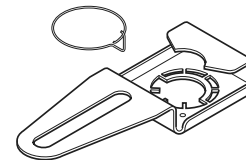
The AM-691 crank arm kit is used in non-direct mounting applications for jack shafts. May require AM-692.

Specifications

- Actuators: Mx4x-707x and Mx4x-715x.
- Maximum damper shaft size: 1.05 in. (27 mm) jackshaft.
- Refer to F-25098 for complete applications.

AM-691

Crank Arm Kit



Application

DuraDrive

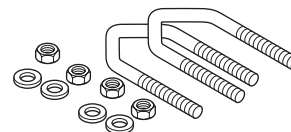
The AM-692 V-bolt kit is used with the AM-690 and AM691 crank arm. The V-bolts in the kit are used for standard and larger diameter damper shafts when crank arm assembly is necessary.

Specifications

- Actuators: Mx4x-707x and Mx4x-715x.
- Parts included in kit:
 - (2) washers.
 - (2) nuts.
 - (2) V-bolts.

AM-692

V-Bolt Kit



Accessories and Tools

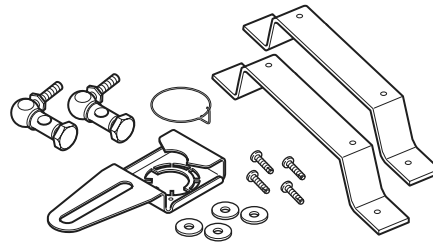
Application

DuraDrive

The AM-693 damper linkage kit provides a mechanical linkage between the damper actuator and the damper shaft when a direct coupling is not possible.

Specifications

- Actuators: Mx4x-707x and Mx4x-715x.
- Parts included in kit:
 - Crank arm with wire clip.
 - "C" mounting brackets (2)
 - Self-tapping metal screws (4).
 - Ball joints (2).
 - Flat washers (4)
- Refer to F-25098 for complete applications.



AM-693

Damper Linkage Kit

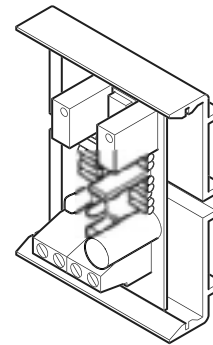
Application

DuraDrive

The AM-703 span adjustment module changes non-standard current and voltage signals into a 2 to 10 Vdc output signal.

Specifications

- Actuators: MS4x-7043, 7073, 7153, 717x, 6083, 6153 and 6343.
- Any Invensys actuators that are half-wave and accept a 2 to 10 Vdc input control signal.
- Supply voltage: 24 Vac/Vdc \pm 15%.
- Input:
 - Zero offset of 0 to 18 Vdc.
 - Span adjustment: Span range of 2.6 to 17 Vdc.
- Will accept 4 to 20 mA signal.
- Connection: Wire terminals, 14 gauge maximum.
- Ambient temperature: -20 to 150°F (-30 to 65°C).
- Humidity: 5 to 95% RH non-condensing.
- Mounting: Snap-Track (provided)
- Dimensions:
 - Board: 1-3/16" x 2-3/16" x 9/16" (30 x 56 x 14 mm)
 - With Snap-Track: 1-7/8" x 2-3/8" x 15/16" (48 x 60 x 24 mm)
- Half wave device.
- Refer to F-26895 for complete applications.



AM-703

Span Adjustment

Application

DuraDrive

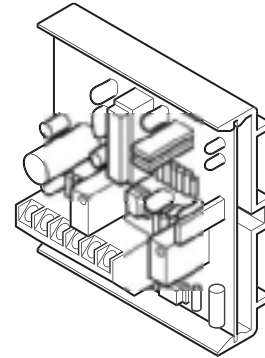
The AM-704 modulation interface converts signal input from a pulse-width modulated input signal to an analog 2 to 10 Vdc signal.

Specifications

- Actuators: MS40-7043, MS4x-7073, MS4x-7153, MS40-717x, MS41-6083, MS41-6153, MS41-6343, and MS4D-xxxx-x00.
- Four input pulse clock rates.
- Optically isolated input signal.
- Linear analog output has 256 steps of resolution.
- Diagnostic LEDs.
- Supply voltage: 24 Vac/Vdc \pm 15%.
- Input:
 - Isolation: Optically isolated (when wired as such).
 - Type: Normal or triac, jumper selectable.
 - Trigger level: 12 to 24 Vac/Vdc or dry contact to com.
 - Time between trigger pulses: 12.5 milliseconds minimum.
 - Impedance: Vac - 500 ohms, Vdc - 10 ohms.
 - Pulse duration/resolution: 4 selectable ranges, in seconds or dry contact or SSR closure \pm 40% of signal increment.
 - Range 1: 0.0235 to 6 seconds/ in 0.0235 sec. increments.
 - Range 2: 0.0196 to 5 seconds/ in 0.0196 sec. increments.
 - Range 3: 0.1 to 25.5 seconds/ in 0.100 sec. increments.
 - Range 4: 0.59 to 2.93 seconds/ in 0.092 sec. increments.
- Output:
 - Voltage: 2 to 10 Vdc.
 - Current: 15 mA max.
 - Accuracy: \pm 2%.
- Electrical connection: Wire terminals, 14 gauge max.
- Ambient temperature: -20 to 150°F (-30 to 65°C).
- Humidity: 5 to 95% RH non-condensing.
- Mounting: Snap-Track (provided)
- Dimensions:
 - Board: 2-3/16" x 2-3/16" x 9/16" (56 x 56 x 14 mm)
 - With Snap-Track: 2-3/8" x 2-1/4" x 15/16" (60 x 57 x 24 mm)
- Refer to F-26895 for complete applications.

AM-704

Modulation Interface



Accessories and Tools

Application

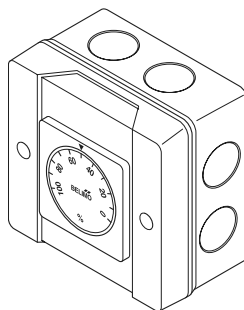
DuraDrive

The AM-705 and AM-706 positioners are used for remotely controlling or setting minimum position of proportional actuators. The AM-705 is for surface mounting. The AM-706 is for flush mounting.

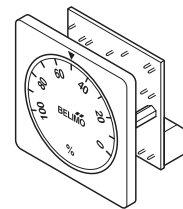
Specifications

- Actuators: MS40-7043, MS4x-7073, MS4x-7153, MS40-717x, MS41-6083, MS41-6153, MS41-6343, and MS4D-xxxx-x00.
- Control range is 0 to 100% of the actuator rotation angle.
- Power supply: 24 Vac \pm 20%, 50/60 Hz, 24 Vdc \pm 10%.
- Control Signal: 0.5 to 10 Vdc, 2 to 10 Vdc (switchable).
- Power output: Up to 10 actuators (1mA max).
- Degree of protection (AM-705 only): NEMA 4 (IP54).
- Connection: Terminals, 14 gauge wire max.
- Humidity: 5 to 95% RH non-condensing.
- Refer to F-26895 for complete applications.
- Half wave device.

AM-705 and AM-706 Positioners



AM-705



AM-706

Application

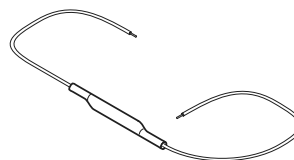
The AM-708 500 ohm resistor converts a 4 to 20 mA signal to a 2 to 10 Vdc signal.

Specifications

- Actuators: MS40-7043, MS41-7073, MS41-7153, MS40-717x, MS41-6083, MS41-6153, MS41-6343, and MS4D-xxxx-x00.
- Wire leads.
- Refer to F-26895 for complete applications.

AM-708

500 Ohm Resistor



Application

DuraDrive

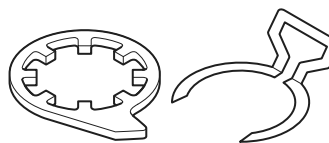
The AM-709 damper shaft position indicator is used in short shaft applications to show the shaft position.

Specifications

- Actuators: Mx40-704x.
- Shaft sizes:
 - Up to 3/4" diameter round shaft
 - Up to 1/2" square for square shaft.
 - Secured to actuator with retaining ring.
- Refer to F-26896 for complete applications.

AM-709

Damper Shaft Position Indicator/Stroke Limiter



Application

DuraDrive

The AM-710 universal clamp is used to clamp the actuator to 3/4" diameter round shafts, 3/8" to 5/8" hex shafts, or 1/2" square shafts. The AM-710 is required whenever the AM-676 shaft extension is used.

Specifications

- Actuators: Mx40-704x.
- Shaft sizes:
 - Up to 3/4" diameter round shafts.
 - 3/8" to 5/8" hex shafts.
 - Up to 1/2" square for square shafts.
 - Secured to actuator with retaining ring.
- Refer to F-26896 for complete applications.

AM-710

Universal Clamp



Application

DuraDrive

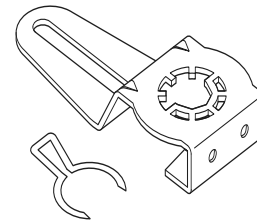
The AM-711 crankarm kit attaches to the actuator and provides a crankarm for non-direct mounting applications.

Specifications

- Actuators: Mx40-704x.
- Refer to F-26896 for complete applications.

AM-711

Crank Arm Kit



Application

DuraDrive

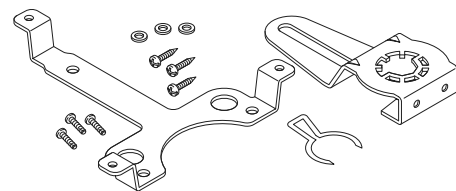
The AM-712 is a crankarm kit that includes the crankarm (AM-711) plus an actuator mounting bracket, three flatwashers, three sheet metal screws, and three self-tapping screws. This kit provides a mechanical linkage between the damper actuator and the damper shaft when a direct couple is not possible.

Specifications

- Actuators: Mx40-704x.
- Refer to F-26896 for complete applications.

AM-712

Crank Arm Kit



Accessories and Tools

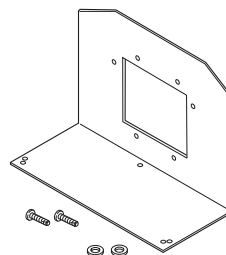
Application

DuraDrive

The AM-713 bracket is a mounting bracket for Honeywell Mod IV M6415-type actuators.

Specifications

- Actuators: Mx40-704x.
- Refer to F-26896 for complete applications.



AM-713 Bracket

Application

DuraDrive

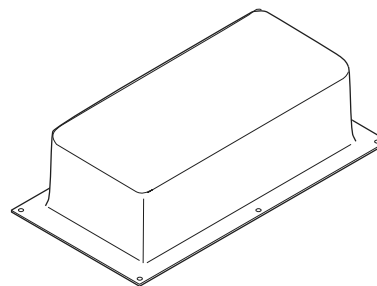
The AM-714 weather shield provides moderate weather protection for damper actuators which are mounted outdoors. While these weather shields provide effective, moderate, weather protection, they are not designed as a water-tight enclosure.

Specifications

- Actuators: Mx40-704x, Mx41-707x, Mx41-715x, Mx4D-xxxx.
- Clear, smoke-tinted polycarbonate.
- Dimensions: 13" x 6" x 9.5" (330 x 152 x 241 mm)

Note: Cannot be used with aux. switch mounted models MF41-6083 series, MS41-6083 series, M41-6153, and MS4x-6153.

- Refer to F-25097 for complete applications.



AM-714 Weather Shield

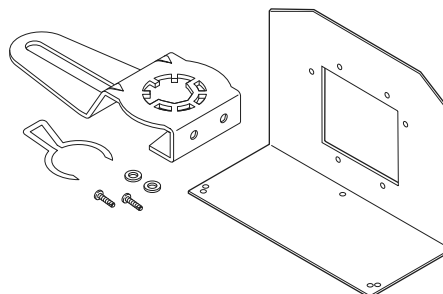
Application

DuraDrive

For non-direct mounting applications. The AM-715 is a crankarm kit that includes the crankarm (AM-711) plus an angled plate mounting bracket, two self-tapping screws, and two flat washers. This kit is used to mount the actuator and provide a crankarm.

Specifications

- Actuators: Mx40-704x.
- Refer to F-26896 for complete applications.



AM-715 Crank Arm Kit

Application

DuraDrive

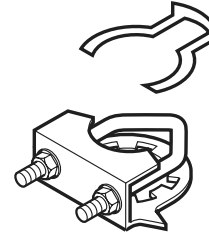
The AM-717 replacement universal clamp is used to clamp the actuator up to 5/8 in. dia. or up to 1/2 in. sq. Available to replace lost standard clamps shipped with actuator.

Specifications

- Refer to F-26896 for complete applications.

AM-717

Universal Clamp



Application

DuraDrive

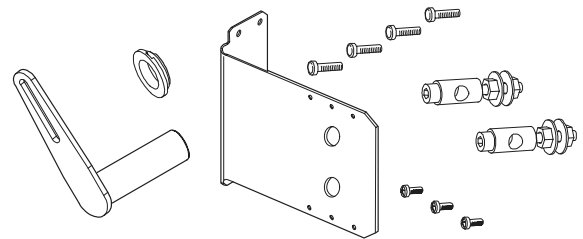
The AM-726 accessory kit provides for changing the actuator rotary motion to linear motion for the MF41-6043, MF41-6083, MS41-6043, MS41-6083 series 35 in.-lb. non-spring return direct coupled damper actuators.

Specifications

- Contains:
 - Swivel clamps (2)
 - Bracket (1)
 - Crank arm (1)
 - Bushing (1)
- Actuators:
 - MF41-6043
 - MS41-6043
 - MF41-6083
 - MS41-6083

AM-726

Accessory Kit



Application

DuraDrive

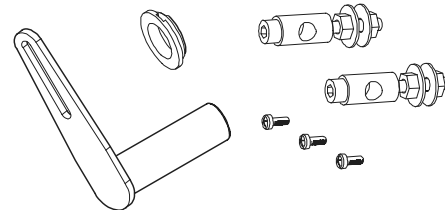
The AM-727 accessory kit provides for changing the actuator rotary motion to linear motion for the MF41-6043, MF41-6083, MS41-6043, and MS41-6083 series 35 in.-lb. non-spring return direct coupled damper actuators.

Specifications

- Contains:
 - Swivel clamps (2)
 - Crank arm (1)
 - Bushing (1)
- Actuators:
 - MF41-6043
 - MS41-6043
 - MF41-6083
 - MS41-6083

AM-727

Accessory Kit



Accessories and Tools

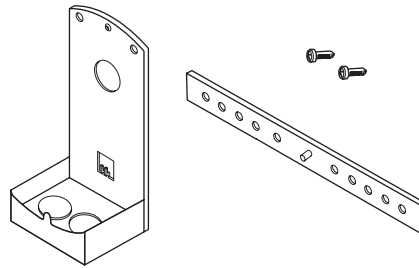
Application

DuraDrive

The AM-728 accessory kit provides a conduit connection for the MF41-6043, MS41-6043, MF41-6083, and MS41-6083 series 35 in.-lb. non-spring return direct coupled damper actuators.

Specifications

- Contains:
 - Adaptor mounting bracket.
 - Conduit adaptor.
 - Mounting screws (2).
- Actuators:
 - MF41-6043
 - MS41-6043
 - MF41-6083
 - MS41-6083
- Refer to F-26802 for complete applications.



AM-728

Accessory Kit

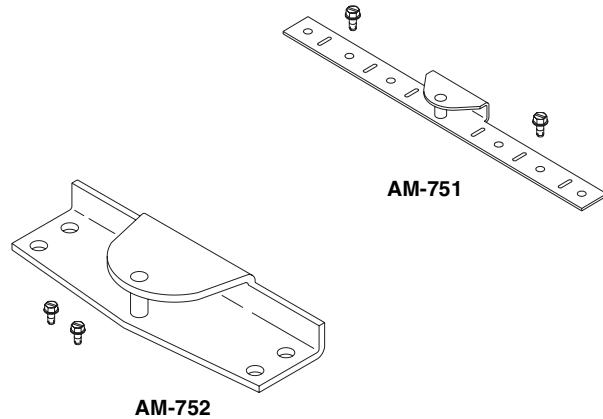
Application

DuraDrive

The AM-751 and AM-752 anti-rotation brackets are used to hold the actuator in position during operation. The AM-752 is for mounting in narrow spaces.

Specifications

- Material: zinc dichromate plated steel.
- Provides a narrow mounting option for the following actuators:
 - MA40-717x.
 - MF40-717x.
 - MS40-717x.
 - MF41-6343.
 - MS41-634x.
 - MS50-H2x01.
 - MS50-E2x01.
- Refer to F-26898 for complete applications.



AM-751 and AM-752

Anti-Rotation Bracket

Application

DuraDrive

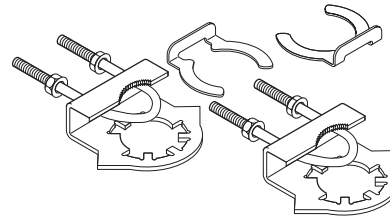
The AM-753 and AM-754 shaft mounting clamps are used to clamp the actuator to the damper shaft. The AM-753 is used for a 5/8" (16 mm) square shaft, or 3/4" to 1" (19 mm to 25 mm) round shaft. Two clamps are in each package. The AM-754 is used for a 3/8" to 1/2" (10 to 13 mm) round and square shaft. Two clamps are in each package.

Specifications

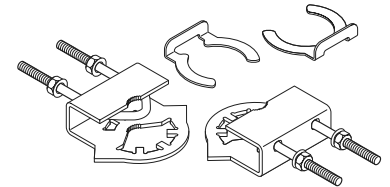
- Material: zinc dichromate plated steel.
- For use with the following actuators:
 - MA40-717x.
 - MF40-717x.
 - MS40-717x.
 - MF41-6343.
 - MS41-634x.
 - MS50-H2x01.
 - MS50-E2x01.
- Refer to F-26898 for complete applications.

AM-753, AM-754

Universal Mounting Clamps



AM-753



AM-754

Application

DuraDrive

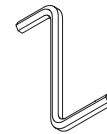
The AM-755 manual override crank is used to manually position the actuator for setup and installation.

Specifications

- For use with the following actuators:
 - MF41-6343
 - MS41-634x
- Refer to F-26898 for complete applications.

AM-755

Manual Override Crank



Application

DuraDrive

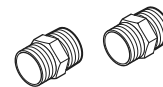
The AM-756 metric conduit adaptor is used with the following actuator series: Mx40-704x, Mx4x-707x, Mx41-715x, Mx41-717x, and Mx41-634x.

Specifications

- Material: zinc plated, low carbon steel.
- Adapts 1/2" NPT threads to M20 threads to connect metric conduit.
- Refer to F-26899 for complete applications.

AM-756

Metric Conduit Adaptor



Accessories and Tools

Application

DuraDrive

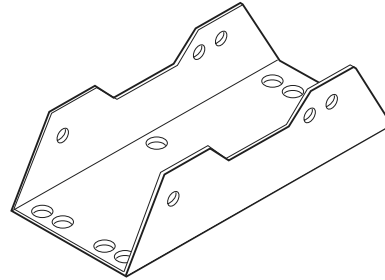
The AM-758 universal mounting bracket is designed to provide a mounting surface for the Mx4x-707x and Mx4x-715x actuators when the actuators cannot be mounted directly to the damper shaft and no proper mounting surface is available. The bracket allows both vertical and horizontal mounting. The bracket requires the AM-690 or AM-691 crankarm kit be used.

Specifications

- Material: 12-gauge galvanized steel.
- May be installed inside or outside the duct, mounting to the duckwork, or directly to the damper assembly.
- When used as a replacement it will place the crankarm in the same relative position as the Honeywell™ Mod IV actuators.
- Refer to F-25096 for complete applications.

AM-758

Universal Mounting Bracket



Application

DuraDrive

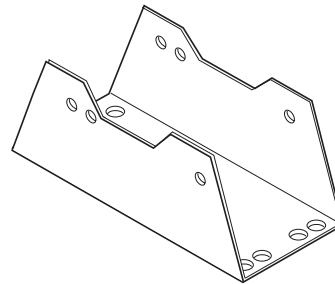
The AM-759 universal mounting bracket is designed to provide a mounting surface for the Mx4x-707x and Mx4x-715x actuators when the actuators cannot be mounted directly to the damper shaft and no proper mounting surface is available. The bracket allows both vertical and horizontal mounting. The bracket requires the AM-690 or AM-691 crankarm kit be used.

Specifications

- Material: 12-gauge galvanized steel.
- May be installed inside or outside the duct, mounting to the duckwork, or directly to the damper assembly.
- When used as a replacement it will place the crankarm in the same relative position as the Honeywell™ Mod III actuators.
- Refer to F-25096 for complete applications.

AM-759

Universal Mounting Bracket



Application

DuraDrive

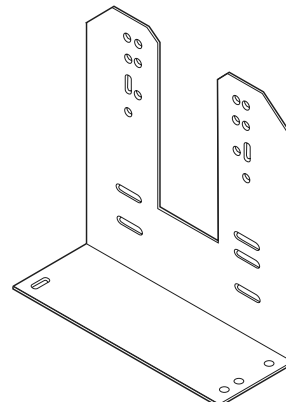
The AM-760 universal mounting brackets are designed to provide a mounting surface for the Mx4x-707x and Mx4x-715x actuators when the actuators cannot be mounted directly to the damper shaft and no proper mounting surface is available. The bracket allows both vertical and horizontal mounting. The bracket requires the AM-690 or AM-691 crankarm kit be used.

Specifications

- Material: 12-gauge galvanized steel.
- May be installed inside or outside the duct, mounting to the duckwork, or directly to the damper assembly.
- Provided with hole patterns to mount the actuators in a horizontal or vertical position.
- Refer to F-25096 for complete applications.

AM-760

Slotted L Mounting Bracket



Application

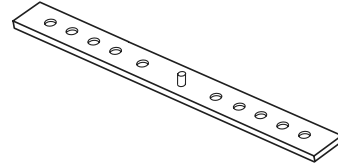
DuraDrive

The AM-761 and AM-762 anti-rotation brackets are used to secure the Mx4x-707x and Mx41-715x actuators and prevent them from rotating around the shaft. Available to replace lost anti-rotation brackets shipped with actuator.

Specifications

- AM-761: 7 inch length.
- AM-762: 9 inch length.
- Refer to F-25098 for complete applications.

AM-761, AM-762 Anti-Rotation Bracket



Application

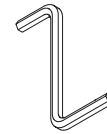
DuraDrive

The AM-763 manual override crank is used to manually position the actuator for setup and installation.

Specifications

- For use with the following actuators:
 - Mx41-707x
 - Mx41-715x

AM-763 Manual Override Crank



Application

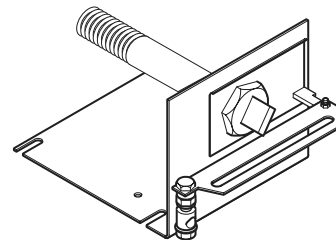
DuraDrive

Required to allow Mx51-7103 actuators to be used for damper applications.

Specifications

- Device includes:
 - Mounting bracket.
 - AM-122 straight connector.

AM-764 Damper Actuator Mounting Adaptor



Application

DuraDrive

The AM-770 is included with each Mx51-7103 as standard.

Specifications

- Replacement linkage kit.
- Fits 1/2 to 2 in. VB-7000 valves with Mx51-7103 mounted.
- Device includes:
 - Connector.
 - Lock nut.
 - Connector pin.
 - Manual crank.

AM-770 Actuator/Valve Linkage



Accessories and Tools

Application

EconoDrive

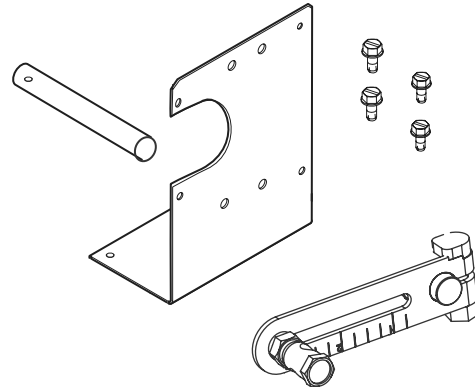
The AM-771 is a mounting bracket designed to provide a mounting surface for an actuator when the actuator cannot be mounted directly to a damper shaft.

Specifications

- For use with the following actuators:
 - Mx4D-60x3-xxx
 - Mx4D-7033-xxx.
 - Mx4D-8033-xxx.
- Kit contains:
 - Bracket.
 - Shaft.
 - Crank arm.
 - Mounting screw.
 - Linkage kit.

AM-771

Mounting Bracket Kit



Application

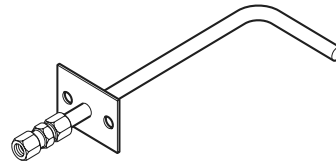
Duct status pressure sensing tips.

Specifications

- Mounting hardware provided.
- 1/4 in. for plastic or copper end fitting.
- Construction: Brass
- Dimensions: Insertion length 4 in. (102 mm); 5 L x 2-1/2 W in. (127 x 64 mm).
- For use with:
 - P323 Series.
 - PC-301.
 - PF-300 Series.
 - PP-1012.
 - PP-3013.
 - PP-3113.
 - PP-8121.
 - PP-8516.
 - PP-8616.
 - PP-8621.
 - PKS-323.
 - R435.
 - R436.
 - VER-PxP
- Refer to F-24002 for complete applications.

AP-302

Static Pressure Probe



Application

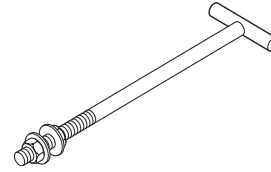
Duct status pressure sensing tips.

Specifications

- Mounting hardware provided.
- 1/8 in. pipe thread end fitting.
- Construction: Brass with S.S. tee end.
- Mounting location: Very low actuating pressure.
- Dimensions: 8-3/4 L x 2-1/2 W in. (222 x 64 mm).
- For use with:
 - P323 Series.
 - PC-301.
 - PF-300 Series.
 - PP-1012.
 - PP-3013.
 - PP-3113.
 - PKS-323.
 - R435.
 - R436.

AP-305

Static Pressure Probe



Accessories and Tools

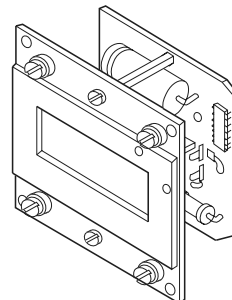
Application

This indicator is a self-contained unit, designed for panel mounting. The unit has a 1/2 in. (13 mm) high, seven segment, light emitting diode (LED) display for temperature, 0 to 100 or 0 to 1000 range digital readouts.

Specifications

- Refer to F-21292 for complete applications.

ASP-81xx Digital Indicator



Model No.	Range	Power Requirements	Input	Accuracy
ASP-8111	-40 to 260 °F or (-40 to 126°C)	24 Vac 4 VA	Any TS-8000 Series (without internal setpoints & TS-8204) 1KΩ Balco sensor.	±2-1/2% over temperature span.
ASP-8121	-40 to 260°F		Accepts a 1 to 11 Vdc signal from either a TSP-8101 (TX1 output) and/or TSP-8111-103 (yellow lead) transmitters.	±1.5°F (0.9°C) between 50 and 100°F (10 and 38°C)
ASP-8112	-40 to 260 °F or (-40 to 126°C)		Any TS-8000 Series (without internal setpoints & TS-8204) 1K Ω Balco sensor.	±2-1/2% over temperature span. ±1.5°F (0.9°C) between 52 and 100°F (11 and 38°C)
ASP-8131	0 to 100 or 0 to 1000 digit display		0 to 10 Vdc, 0.1 mA from auxiliary devices (factory shipped 0 to 1000 digits).	±2 digits

- Accessories for use with ASP-8111:
 - TS-8101, Room sensor.
 - TS-8131, Room button type sensor.
 - TS-8201, Duct/immersion sensor.
 - TS-8261, Light fixture sensor.
 - TS-8405, Averaging sensor, 5 ft. (1.5 m) long.
 - TS-8422, Averaging sensor, 22 ft. (6.7 m) long.
 - TS-8501, Outdoor sensor.
- Accessories for use with ASP-8121:
 - TSP-8101, Transmitter.
 - TSP-8111-103, Indicator.

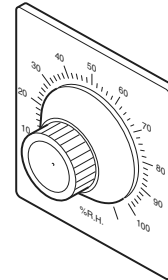
Application

System 8000

Use these adjusters when setpoint is to be remote from the controller or to obtain setpoint range required for the application.

**AT-81xx, AT-82xx, AT-8435, AT-8522,
AT-8901**

Setpoint Adjusters



Specifications

- Universal mounting capability with selected hardware.
- Matches all System 8000 AB1 or AB2 input requirements.
- Universal adaptation of specific applications and/or alternate non-System 8000 devices.
- Surface mounting but can be mounted on AD-8954 for panel mounting. AD-8954 can snap into AD-8953 mounting track.
- Plate Dimensions: 2-1/16 H x 1-7/8 W in. (52 x 48 mm); allow 1-1/2 in. (38 mm) depth behind plate for mounting. Requires a 3/8 in. (9.5 mm) dia. mounting hole.
- Refer to F-25795 for complete applications.
- Accessories:
 - AD-8953, Mounting track (requires AD-8954).
 - AD-8954, Panel mounting bracket.

Model No.	Description	Control Dial Range
AT-8122	Remote setpoint adjuster with scale.	20 to 120°F (6 to 49°C)
AT-8155		50 to 250°F (10 to 21°C)
AT-8158		55 to 85°F (13 to 29°C)
AT-8222-101	Scale for use with AT-8122 (humidity).	20 to 100%
AT-8258-101	Scale for use with AT-8158 (night setback).	Deviation scale $\pm 15^\circ\text{F}$ ($\pm 8^\circ\text{C}$)
AT-8435	Remote setpoint adjuster with scale, for use with TS-8204 only.	200 to 400°F (93 to 204°C)
AT-8522	Remote setpoint adjuster with scale.	30 to 80°F (-1 to 26°C)
AT-8901	Remote setpoint adjuster with scale, for use with PP-8121 or PP-8516.	0 to 100%

Accessories and Tools

Application

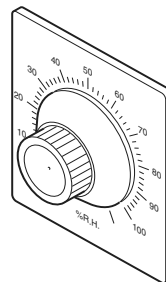
System 8000

The AT-8122-420 remote setpoint adjuster and AT-8222-xxx series dial scales are required when using the TSP-8xxx, VER-HDxx-MSx, VER-HOxx-MSx, VER-HxWx-MA 4 to 20 mA transmitters in association with System 8000 controllers.

Specifications

- Adapts new 4 to 20 mA transmitters to System 8000 controllers.
- Universal mounting capability with appropriate hardware.
- Wires to AB1 input same as other remote setpoint System 8000 devices.
- Ambient temperature limits:
 - Shipping and storage: -40 to 160°F (-40 to 71°C).
 - Operating: 40 to 135°F (4 to 57°C).
- Humidity: 5 to 95% RH, non-condensing.
- Locations: NEMA Type 1.
- Power requirements: 6.2 Vdc, 1.2 mA.
- Connections: Color coded pigtail leads.
- Mounting: Flat surface, but can be mounted on AD-8954 for panel mounting. AD-8954 can snap into AD-8953 mounting track.
- Dimensions: 2-1/16 H x 1-7/8 W in. (52 x 48 mm). Allow 1-1/2 in. (38 mm) depth behind dial scale for mounting. Adjuster requires a 3/8 in. (9.5 mm) dia. mounting hole.
- Refer to F-25795 for complete applications.
- Accessories:
 - AD-8953, Mounting track (requires AD-8954).
 - AD-8954, Panel mounting bracket.

AT-8122-420, AT-8222-xxx Remote Setpoint Adjusters



Model No.	Description	Scale Range Marked	Used with Transmitter
AT-8122-420	Remote setpoint adjuster (Order dial scale separately)	—	TSP-8xxx, VER-HDxx-MSx Series, VER-HOxx-MSx Series, VER-HxWx-MA Series
AT-8222-102	Dial scale used with AT-8122-420 and AT-8222-xxx	0 to 100% RH	HSP-8xxx, HTSP-8xxx Series
AT-8222-201		30 to 80°F (1 to 27°C)	TSP-84553
AT-8222-202		50 to 100°F (10 to 38°C)	TSP-84152, TSP-84252
AT-8222-203		30 to 130°F (1 to 54°C)	TSP-84704, TSP-84804, TSP-85552
AT-8222-205		40 to 240°F (4 to 116°C)	TSP-84656
AT-8222-206		-40 to 160°F (-40 to 71°C)	TSP-84957

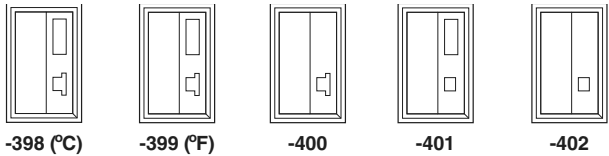
Application

Thermostat covers and inserts.

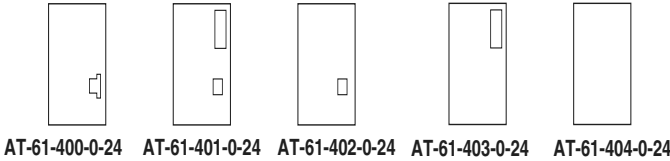
AT-1x Series, AT-2x Series, AT-61, AT-11 through AT-70

Specifications

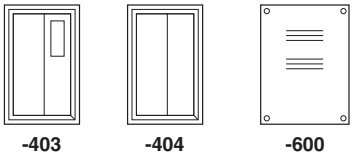
Thermostat Covers and Inserts



-398 (°C) -399 (°F) -400 -401 -402



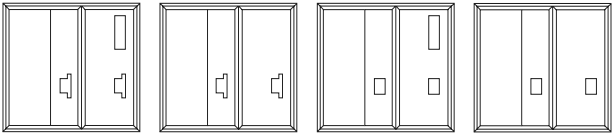
AT-61-400-0-24 AT-61-401-0-24 AT-61-402-0-24 AT-61-403-0-24 AT-61-404-0-24



-403 -404 -600 (AT-11 only)

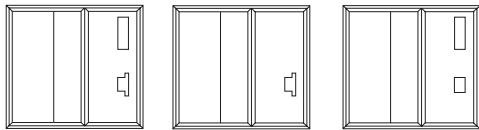
Typical of: AT-61 cover plates (in packages of 24) brushed bronze. Cover plates are typically used to convert a "standard" cover to -4xx cover.

Typical of: AT-11, AT-12, AT-14, AT-21, AT-22, AT-24 covers.

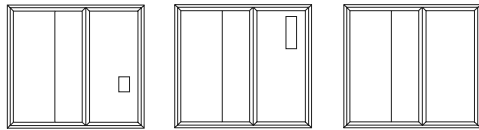


-000 -400 -401 -402

Typical of: AT-16, AT-26 covers.



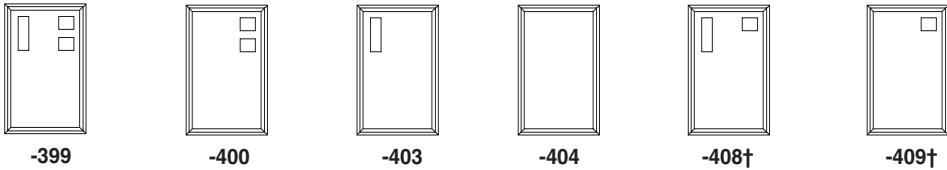
-000 -400 -401



-402 -403 -404

Typical of: AT-15, AT-25 covers.

Typical of: AT-45, AT-46, AT-47, AT-48, AT-49, AT-50, AT-51, AT-52 covers



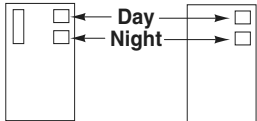
-399 -400 -403 -404 -408† -409†

Typical of: AT-65 cover plates (in packages of 24)* brushed bronze



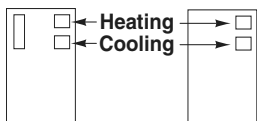
AT-65-399-0-24 AT-65-400-0-24 AT-65-403-0-24 AT-65-404-0-24 AT-65-408-0-24† AT-65-409-0-24†

Typical of: AT-66 cover plates (in packages of 24)* brushed bronze



AT-66-399-0-24 AT-66-400-0-24

Typical of: AT-67 cover plates (in packages of 24)* brushed bronze



AT-67-399-0-24 AT-67-400-0-24

* Cover plates are typically used to convert a "standard" cover to -4xx cover.

† No legend.

AT-1x Series, AT-2x Series, AT-61, AT-11 through AT-70 Thermostat Covers and Inserts (Continued)

Part Number	Standard			-400			-401			-402			-403			-404			-600		
	Plastic Cover	Metal Cover	Plastic Cover	Metal Cover	Plastic Cover	Metal Cover	Plastic Cover ^a	Metal Cover	Plastic Cover	Metal Cover	Plastic Cover	Metal Cover	Plastic Cover ^a	Metal Cover	Plastic Cover	Metal Cover	Plastic Cover	Metal Cover	Plastic Cover ^a	Aspirated Metal Cover	
HC-101-404, HS-8101, HS-8201, HSP-82xx, TKS-5001																					
TA-110x	AT-14	AT-24	AT-14-400	AT-24-400	AT-14-401	AT-24-401		AT-14-402	AT-24-402	AT-14-403			AT-14-404	AT-24-404							
TA-150x, TC-110x, TC-1191, TF-1111	AT-11	AT-21 ^b	AT-11-400	AT-21-400 ^b	AT-11-401	AT-21-401 ^b	AT-61-400-24	AT-11-402	AT-21-402 ^b	AT-11-403	AT-21-403 ^b	AT-61-403-24	AT-11-404	AT-21-404 ^b	AT-61-404-24						
TC-115x	AT-15	AT-25	AT-15-400		AT-15-401			AT-15-402	AT-25-402	AT-15-403			AT-15-404	AT-25-404							
TC-1161	AT16	AT-26	AT-16-400	AT-26-400	AT-16-401			AT-16-402	AT-26-402	AT-15-403			AT-15-404	AT-25-404							
TK-100x, TK-107x, TK-110x, TK-117x	AT-11	AT-21	AT-11-400	AT-21-400	AT-11-401	AT-21-401	AT-61-400-24	AT-11-402	AT-21-402	AT-11-403	AT-21-403	AT-61-403-24	AT-11-404	AT-21-404	AT-61-404-24						AT-11-600
TK-130x, TK-138x	AT-12	AT-22	AT-12-400		AT-12-401		AT-61-400-24	AT-12-402	AT-22-402	AT-12-403	AT-22-403	AT-61-403-24	AT-12-404	AT-22-404	AT-61-404-24						
TK-1601, TK-168x	AT-12	AT-22	AT-12-400	AT-22-400	AT-12-401		AT-61-400-24	AT-12-402	AT-22-402	AT-12-403	AT-22-403	AT-61-403-24	AT-12-404	AT-22-404	AT-61-404-24						
TK-1717, TK-1727, TK-1731, TK-1741	AT-45	AT-49			AT-45-403	AT-49-403	AT-65-4000-24	AT-45-404	AT-49-404			AT-65-404-24						AT-49-409	AT-65-409-24		AT-11-600
TK-1711, TK-1721	AT-46	AT-50			AT-45-403	AT-49-403		AT-45-404	AT-49-404			AT-65-404-24					AT-45-409	AT-65-409-24			
TK-1751, TK-1761	AT-47	AT-51			AT-47-403	AT-51-403		AT-47-404	AT-51-404			AT-65-404-24							AT-65-409-24		
TK-1801, TK-1811	AT-45	AT-49		AT-49-400	AT-45-403	AT-49-403	AT-65-4000-24	AT-45-404	AT-49-404	AT-45-403	AT-49-403	AT-65-403-24	AT-45-404	AT-49-404	AT-65-404-24						AT-11-600
TK-500x, TK-510x	AT-11	AT-21	AT-11-400	AT-21-400	AT-11-401	AT-21-401	AT-61-400-24	AT-11-402	AT-21-402	AT-11-403	AT-21-403	AT-61-403-24	AT-11-404	AT-21-404	AT-61-404-24						
TP-810x	AT-11		AT-11-400		AT-11-401		AT-61-400-24	AT-11-402		AT-11-403		AT-61-403-24	AT-11-404		AT-61-404-24						
TP-812x																					
TS-8101																					
TS-811x	AT-11		AT-11-400		AT-11-401		AT-61-400-24	AT-11-402		AT-11-403		AT-61-403-24	AT-11-404		AT-61-404-24						

^a Cover plates are typically used to convert a "standard" cover into 4xx cover. AT-61-4xx-24 packed in groups of 24; AT-64-4xx-12 packed in groups of 12.

^b **CAUTION:** AT-21 metal covers should only be used on TA-2150x, TC2-110x, TC2-1191.

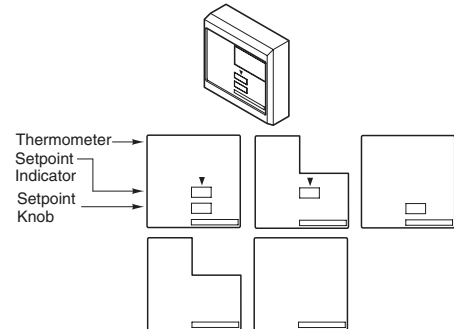
Application

Replacement cover kits.

Specifications

- Kit includes:
 - One shadow white plastic cover.
 - Five cover inserts.
- Where used:
 - TS-57011
 - TS-57011-850
 - TS-58011
 - TS-81011

AT-80 Cover Kits



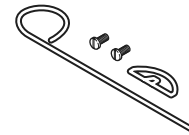
Application

Lock cover screw kit modifies room thermostats to prevent unauthorized tampering of either the dial setting or the internal mechanism.

Specifications

- Electric.
 - All except TA-121, TC-114.
 - Electronic.
 - SLC-800x.
 - TP-810x.
 - TP-812x.
 - TP-8232.
 - TS-5191.
 - TS-5711.
 - TS-5811.
 - TS-8101.
 - TS-811x.
 - TSP-8415x.
 - Pneumatic.
 - All TK-1xxx and TK-5xxx except TK-17xx, TK-18xx.
- Note:** Two kits are required for duplex type thermostats.

AT-101 Lock Cover Screw Kit



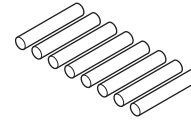
Accessories and Tools

Application

Package of 100 dial stop pins to insert in dial ends to limit the high or low setting of room thermostats.

AT-104

Dial Stop Pins



Specifications

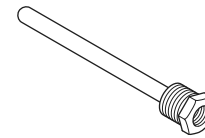
- Electric.
 - All except TA-121, TC-114.
- Electronic.
 - TP-810x.
 - TP-8232.
 - TS-5191.
 - TS-5711.
 - TS-811x.
- Pneumatic.
 - All TK-1xxx and TK-5xxx except TK-17xx, TK-18XX.

Application

Immersion well for use with 3/8 in. (10 mm) temperature bulbs.

AT-201, AT-203, AT-206

Immersion Well



Specifications

- Ambient temperature limits: -40 to 350°F (-40 to 177°C).
- Refer to F-18895 for complete applications.

Model No.	Material	Dimensions						Application Limitations at 250°F (121°C) Fluid Temp.		Used With
		O.D. in. (mm)	Insertion Probe O.D. Max.	Insertion Length in. (mm)	Overall Well Length in. (mm)	Internal Fitting Thread	External Fitting in.	Max. Recom. Velocity FPS (m/s)	Max. Recom. Static Pressure psig (kPa)	
AT-201 ^a	Copper	1/2 (13) ^b	.3750	9-1/2 (241)	10-1/4 (260)	5/8-18	3/4 MNPT	11 (3.3)	250 (1728)	TC-28x, TC-4x1x, TC-4x2x, TC-4x5x, TK-6024, TK-6124, TKS-8000's
AT-203 ^a	Stainless Steel	1/2 (13) ^b	.395	9-1/2 (241)	10-1/2 (267)		3/4 MNPT	20 (6.1)	500 (3448)	Same as AT-201
AT-206	Copper	1/2 (13) ^b	.420	4-1/2 (114)	5-13/16 (148)	—	1/2 MNPT	11 (3.3)	250 (1728)	TC-4x1x, TC-4x2x, TC-4x5x, TK-6024, TK-6124

^a Requires AT-209 for TC-4x1x, TC-4x2x, TC-4x5x, TK-6024, TK-6124.

^b For 3/8 in. (10 mm) diameter bulbs.

Application

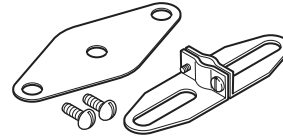
Duct mounting kit for pneumatic and electric temperature bulbs. TS-8201-105, TS-8204 temperature sensors typical.

AT-208

Duct Mounting Kit

Specifications

- Refer to F-18895 for complete applications.



Application

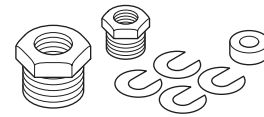
3/4 in. MNPT liquid line or tank mounting kit for TC-4x1x, TC-4x2x, TC-4x5x, TK-6024 or TK-6124 Series bulb thermostats. Bulb well is recommended.

AT-209

Liquid Line or Tank Mounting Kit

Specifications

- Refer to F-18895 for complete applications.



Application

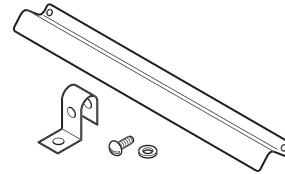
Outdoor bulb shield for mounting bulb to outside wall to protect from damage and foreign matter and direct solar radiation.

AT-211

Outdoor Bulb Shield

Specifications

- Construction: Aluminum.
- Mounting: Two 17/64 in. (7 mm) mounting holes in shield. Kit is furnished with bulb holding clip.
- Dimensions: 2 H x 11-3/4 W x 1-1/8 D in. (51 x 298 x 29 mm).
- Refer to F-18895 for complete applications.



Application

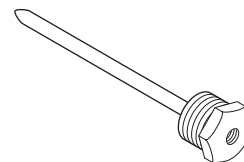
Bulb well for use with insertion into ducts, pipes, and tanks.

AT-215

Bulb Well

Specifications

- Construction: Stainless Steel.
- Connection: 3/4 in. MNPT, external, 1/4 in. FNPT internal.
- Dimensions: 6 in. insertion length (152 mm) nominal.
7 in. overall length (177.8 mm) nominal
9/32 in. tube I.D.



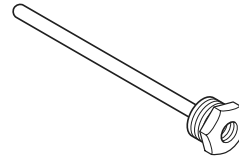
Accessories and Tools

Application

Bulb well for use with TS-290 Series dial thermostats for insertion into ducts, pipes, and tanks.

Specifications

- Construction: Brass
- Connection: 1/2 in. MNPT, external, 5/8-18 UNF internal.
- Dimensions: 9/16 Dia. O.D.
 - 4.6 in. insertion length (116.8 mm) nominal.
 - 6.25 in. overall length (158.8 mm) nominal.
- Will accept a 7/16 in. Dia. bulb element.



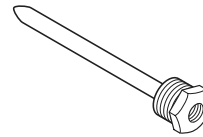
AT-219
Bulb Well

Application

Bulb well for use with TS-572x-101, TS-582x-101, TS-572x-901, TS-8201-106 sensors, and TSP-8xxxx temperature transmitters for insertion into liquid line or tank to allow removal of sensing element without draining the system.

Specifications

- Construction: 316 stainless steel 1/2 in. MNPT external and 1/4 in. FNPT internal thread.
- Maximum velocity: 20 FPS (6 m/s).
- Maximum static pressure: 500 psig (3448 kPa).
- Dimensions: 3/8 O.D 9/32 I.D.
 - 4 in. (102 mm) insertion length nominal.
 - 4-13/16 in. overall length (9.5 x 122) nominal.



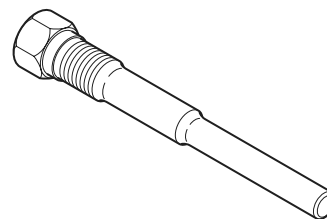
AT-225
Bulb Well

Application

Bulb well for use with 6 in. Tx-xx21 Immersion Sensors. Capable of operating in greater than 500 lb. static pressures and water velocities greater than 20 (FPS) ft. per second.

Specifications

- Temperature: 70/200/400°F.
- Maximum static pressure: 5000 psig.
- Maximum water velocity: 27 ft/sec.
- Overall length: 6.25 in. (158.8 mm) nominal.
 - 4.353 in. insertion length nominal.
- Element mounting: 1/4 in. female NPS internal.
- Well mounting: 3/4 in. male NPT external.
- .281 I.D.
- Material: Brass.



AT-226
High Pressure Brass Well

Application

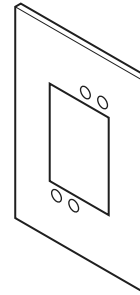
Single room type electric or pneumatic thermostats, sensing elements and electronic controllers or sensing elements. Used to cover a rough plaster hole in the wall. Use with AT-505 sub-base for surface mounting applications.

Specifications

- Color: Beige.
- Dimensions: 5-7/16 H x 3-7/8 W x 3/8 D in. (138 x 98 x 16 mm).

AT-504

Mounting Base Single



Application

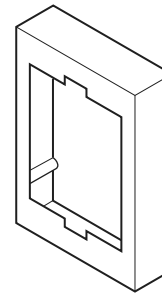
Surface mounting of single room type electric or pneumatic thermostats, sensing elements and electronic controllers or sensing elements. Can be used over AT-504 to facilitate installations where there is no wall box.

Specifications

- For surface mounting, screws field supplied.
- Color: Beige.
- Dimensions: 4-5/8 H x 3-1/8 W x 1 D in. (117 x 79 x 25 mm).

AT-505

Mounting Base Single



Application

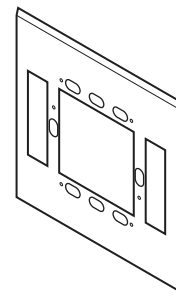
Two single wall type thermostats, controllers or sensing elements for dual function control. Can be installed on a horizontally mounted switch box by mounting an AT-504 on the AT-546.

Specifications

- Color: Beige painted.
- Dimensions: 6-1/4 H x 6-1/4 W x 1/4 D in. (159 x 159 x 6 mm).

AT-546

Mounting Base Dual



Accessories and Tools

Application

Selector switch sub-bases for use with electric room thermostats to provide switching functions such as heating to cooling, day to night control, etc.

Specifications

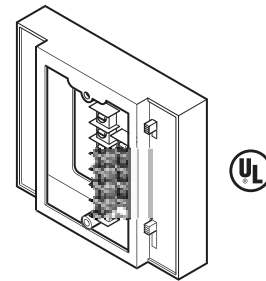
- Legend plates: Blank plate on left side is factory installed.
- Connections: Coded screw terminals.
- Mounting: On flush or surface with box. Directly to the wall for 24V applications.
- Switch positions:
 - AT-602: Lower right DP4T.
 - AT-603: Upper right: DPDT.
 - Lower right: DP4T.
- Use with: All single electric room thermostats except TC-114, TA-121.
- Dimensions: 4-1/2 H x 5-1/8 W x 1-1/4 D in. (114 x 130 x 32 mm).
- Color: Beige.

Total electrical rating of each sub-base switch:

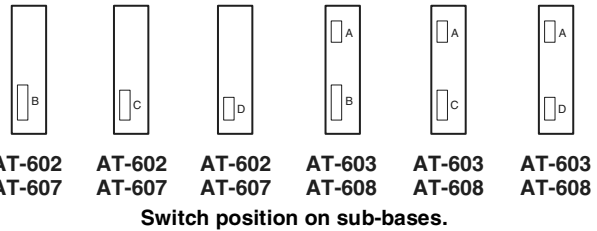
Volts (AC)	Inductive		Non-Inductive Amps	Pilot Duty (VA)
	Full Load Amps	Locked Rotor Amps		
24	5.8	34.8	6	125
120				
240	2.9	17.4	3	

The total load on both poles of a switch must not exceed the total electrical rating.

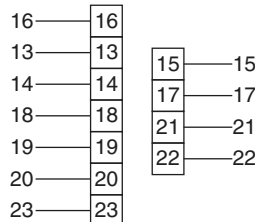
AT-602, AT-603 Single Unit Sub-Base



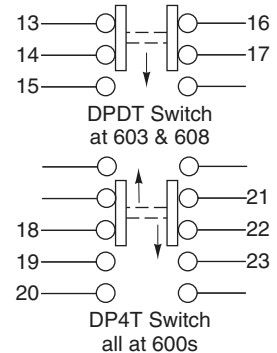
AT-602
AT-603



Terminal Identification



Switch Functions



Symbols: — Terminal — Switch Contact

Note: Switches in the position shown above make three separate usable circuits: 13 to 14, 16 to 17, and 21 to 22.

Terminal and Switch Interconnections.

Application

Selector switch sub-bases for use with electric room thermostats to provide switching functions such as heating to cooling, day to night control, etc.

Specifications

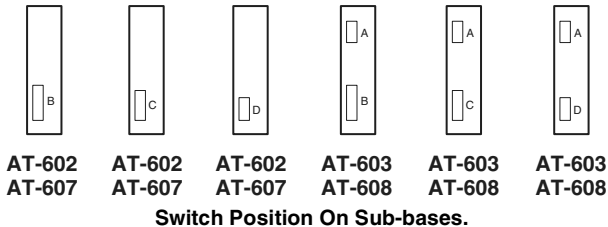
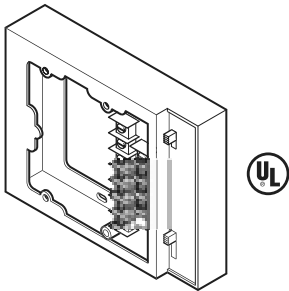
- Connections: Coded screw terminals.
- Mounting: On flush or surface with box. Directly to the wall for 24V applications.
- Switch positions:
 - AT-607: Lower right: DP4T.
 - AT-608: Upper right: DPDT. Lower right: DP4T.
- Use with: All duplex or two-stage electric room thermostats.
- Dimensions: 4-1/2 H x 5-3/4 W x 1-1/4 D in. (114 x 146 x 32 mm).
- Color: Beige.

Total electrical rating of each sub-base switch:

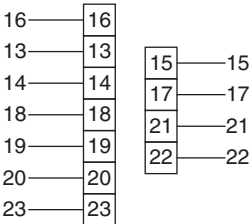
Volts (AC)	Inductive		Non-Inductive Amps	Pilot Duty (VA)
	Full Load Amps	Locked Rotor Amps		
24	5.8	34.8	6	125
120				
240	2.9	17.4	3	

The total load on both poles of a switch must not exceed the total electrical rating.

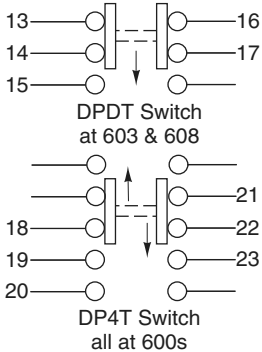
**AT-607, AT-608
Duplex Unit Sub-Base**



Terminal Identification



Switch Functions



Symbols: 16 — Terminal ○ — Switch Contact

Note: Switches in the position shown above make three separate usable circuits: 13 to 14, 16 to 17, and 21 to 22.

Terminal and Switch Interconnections.

Accessories and Tools

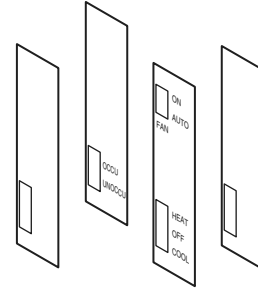
Application

Legend plates for use with AT-600 Series selector switch sub-base.

AT-609 Series Legend Plates

Specifications

- Construction: Brown simulated leather finish with bright letters and self-adhesive backing.



AT-609-xxx Switch Legend Plates

Switch Position	Switch Action	Blank Plates ^a				Plates with Legends																		
		301	350	401	450	202	203	204	205	206	251	252	302	303	304	305	307	351	352	354	402	403	452	453
A	DPDT		X		X						On Off	On Off						On Auto Fan	Heat Cool	On Off Fan			On Auto Fan	On Off Fan
B	DP4T			X	X																Off Heat Auto Cool	Off Low Med High	Off Heat Auto Cool	Off Heat Auto Cool
C	DP3Tb	X	X									Off Low High	Heat Off Cool	On Off Auto	Occu Off Unoc	Off On Auto	Heat Off Cool	Off Low High	Heat Auto Cool					
D	DPDTb					On Off	Occ Unoc	Heat Cool	Night Day	Auto On	Low High	High Low												

^a Special lettering can usually be printed on blank plates by local nameplate engravers if legends do not fit specific application.

^b Legend plate limits travel of DP4T switch to provide DPDT or DP3T.

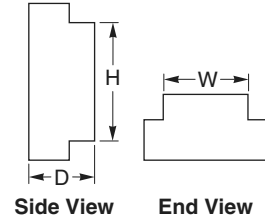
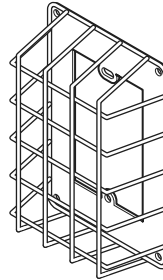
Application

Room thermostat guards protect thermostats from damage and vandalism.

AT-1103, AT-1163 Thermostat Guard

Specifications

- Construction:
 - AT-1103: Wire guard with steel base plate, zinc plated.
 - AT-1163: Guard, zinc plated, with beige steel base.
- Mounting: To standard outlet or directly to the wall.
- Dimensions:
 - AT-1103: 4-1/4 H x 2-7/8 W x 1-5/8 D in. (108 x 67 x 41 mm).
 - AT-1163: 6-1/2 H x 6-5/8 W x 3-1/4 D in. (165 x 168 x 83 mm).
- Refer to F-07930 for complete applications.



Guard/Thermostat Combinations

Model No.	Single Thermostat			Single Humidity, Temperature or Sensing Element			Dual Thermostat
	TA-1101, TA-1102, TA-1501, TC-1100, TP-1011	TA-121, TC-114	HKS-5033, TK-1XXX, TK-5xxx, TKR-1xxx, TKR-5xxx, TKS-5001	TP-8101, TP-8102, TS-5191, TS-5711, TS-5811, TS-8101, TS-811x, TS-8811, TSP-8x15x	TS-57011 Series, TS-81001 Series, TS-90110, TSP-8x351	TP-8124	TC-1151, TC-1161
AT-1103	X		X	X	X	X	
AT-1163	X ^{b, d}	X ^c	X ^d	X ^{b, d}		X ^c	X ^a

^a With or without AT sub-bases.

^b Requires an AT-504 or AT-600 series sub-base.

^c Requires an AT-504 auxiliary mounting base.

^d AT-1163 will accept two single thermostats on an AT-546 auxiliary mounting base.

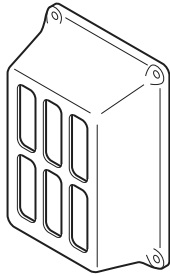
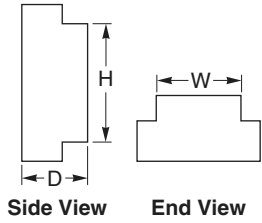
Accessories and Tools

Application
Room thermostat guards protect thermostats from damage and vandalism.

Specifications

- Construction: Cast aluminum guard with steel base plate.
- Mounting: To standard outlet or directly to the wall.
- Dimensions: 4-1/4 H x 3-1/8 W x 1-5/8 D in. (108 x 79 x 41 mm).
- Refer to F-07930 for complete applications.

AT-1104
Thermostat Guard

Guard/Thermostat Combinations

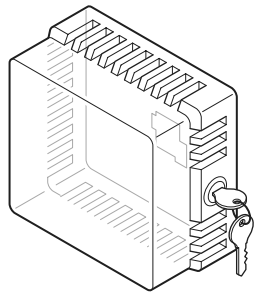
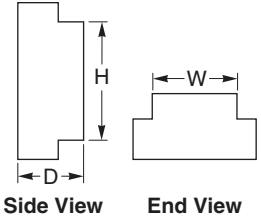
Model No.	Single Thermostat		Single Humidity, Temperature or Sensing Element	
	HC-101, TA-1101, TA-1102, TA-1501, TC-1100 Series	HKS-5033, TK-1xxx, TK-5xxx, TKR-1xxx, TKR-5xxx, TKS-5001	TP-8101, TP-8102, TS-5191, TS-5711, TS-5811, TS-8101, TS-811x, TS-8811, TSP-8x15x	TP-8124
AT-1104	X	X	X	X

Application
Room thermostat guard protects thermostats from damage and vandalism.

Specifications

- Construction: Clear plastic guard with solid and ring base, tumbler type key lock.
- Mounting: To standard outlet or directly to the wall.
- AT-1155 only: Included: Mounting ring for installation over installed thermostats without their removal from the wall.
- Dimensions: AT-1105: 3-7/8 H x 3-1/2 W x 2-1/2 D in. (98 x 89 x 63 mm). AT-1155: 6-1/4 H x 5-1/2 W x 3-1/4 D in. (159 x 140 x 83 mm).
- Refer to F-07930 for complete applications.

AT-1105, AT-1155
Thermostat Guard

Guard/Thermostat Combinations

Model No.	Single Thermostat			Single Humidity, Temperature or Sensing Element			Dual Thermostat
	HC-101, TA-1101, TA-1102, TA-1501, TC-1100 Series, TP-1011, TP-1031	HKS-5033, TK-1xxx, TK-5xxx, TKR-1xxx, TKR-5xxx, TKS-5001	Any 2 x 2 Wall Mounted Device	TP-8101, TP-8102, TS-5191, TS-5711, TS-5811, TS-8101, TS-811x, TS-8811, TSP-8x15x	TS-57011 Series, TS-81001 Series, TS-90110, TSP-8x351	TP-8124	TC-1151, TC-1161
AT-1105	X	X	X	X		X	
AT-1155	X ^a	X	X	X ^a		X	X

^a With or without AT sub-bases.

Application

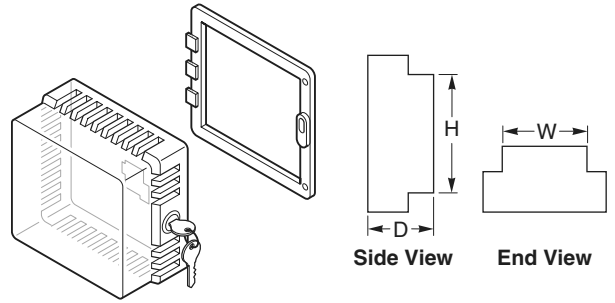
Room thermostat guard protects thermostats from damage and vandalism.

AT-1165

Thermostat Guard

Specifications

- Construction: Clear plastic guard with solid and ring base, tumbler type key lock.
- Mounting: To standard outlet or directly to the wall.
- Included: Mounting ring for installation over installed thermostats without their removal from the wall.
- Dimensions: 8 H x 5-1/2 W x 3-1/2 D in. (203 x 140 x 89 mm).
- Refer to F-07930 for complete applications.



Guard/Thermostat Combinations

Model No.	Single Thermostat				Single Humidity, Temperature or Sensing Element		Dual Thermostat
	HC-101, TA-1101, TA-1102, TA-1501, TC-1100 Series	TA-121, TC-114	HKS-5033, TK-1XXX, TK-5XXX, TKR-1XXX, TKR-5XXX, TKS-5001	Any 2 x 2 Wall Mounted Device	TP-8101, TP-8102, TS-5191, TS-5711, TS-5811, TS-8101, TS-811X, TS-8811, TSP-8X15X	TP-8124	TC-1151, TC-1161
AT-1165	X ^a	X	X	X	X ^a	X	X ^a

^a With or without AT sub-bases.

Accessories and Tools

Application

Electrical component for AE-629 to AE-662 control cabinets.

Specifications

BYZP-145

- 12 circuit terminal block.

BYZP-146

- Marker strip #1 to 12.

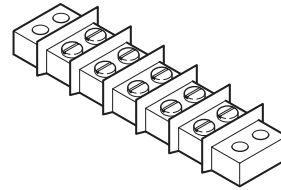
BYZP-252

- Marker strip #13 to 24.

BYZP-253

- Marker strip #25 to 36.

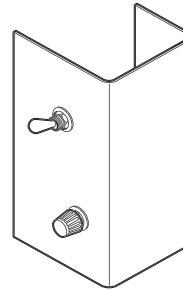
BYZP-xxx Terminal Block



Application

Mounting bracket for circuit breaker and switch.

BYZP-269-2 Mounting Bracket



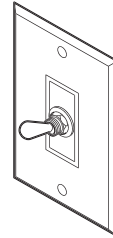
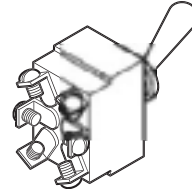
Application

Switches, mounting and position indicating plates for AE-629 to AE-662 control cabinets and standard switch boxes.

CYZP-11 through CYZP-427

SYZE-52 through SYZE-300

Toggle Switch



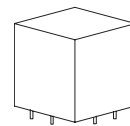
Switch Part No.	Switch Action	AC Rating		Switch Type	Mounting Plate (Flush)	Indicating Plate		
		Amp	Volt			Part No.	Position Markings	Size in. (mm)
CYZP-11	DPDT	10	250	Toggle 2 position	SYZE-52	SYZE-74	On-Off	1-1/8 W x 2-1/6 H (28.6 x 52.4)
CYZP-105	4PDT	5	24			SYZE-75	Summer-Winter	
						SYZE-102	Day-Night	
						SYZE-189	Open-Close	
						SYZE-271	Manual-Auto	
CYZP-268	DPDT (Center Off)	10	250			SYZE-293	Cooler-Warmer	
				SYZE-300	Occupied- Unoccupied			
CYZP-427	4PDT (Center Off)	5	24	Toggle 3 position	SYZE-212	On-Off-Automatic	1-7/8 W x 2-1/16 H (47.6 x 52.4)	
CYZP-346	SPST N.O.	5	125			Push button momentary contact		SYZE-255
CYZP-347	SPST N.C.			Note: All switches fit in standard switch box. 1/2 in. mounting hole required.				

Application

Expansion relay for SR100 to SR601. Replacement for VL500 and WA300.

EXP10

Expansion Relay



Accessories and Tools

Application

Electrical component for AE-629 to AE-662 control cabinets.

EYZP-xxx

Pilot Light Assembly

Specifications

EYZP-504-1.

- Lamp, 24V, 0.073 amp, 1.7 W.

EYZP-504-2.

- Lamp, 120V, 0.025 amp, 3.0 W.

EYZP-504-3.

- Lamp, 48V, 0.053 amp, 2.5 W.

EYZP-721.

- Lamp socket with clip.

EYZP-722-1.

- Lens, red.

EYZP-722-2.

- Lens, green.

EYZP-722-3.

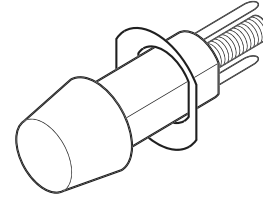
- Lens, amber.

EYZP-722-4.

- Lens, blue.

EYZP-722-5.

- Lens, white.



Application

Used with variable air controllers. Available in three sizes. To sense differential pressure. H port senses total pressure. L port senses static pressure. The difference equals differential pressure.

N1-51, N1-52, N1-53
(21-238, 21-239)

Description

N1-51 — 3 inches.

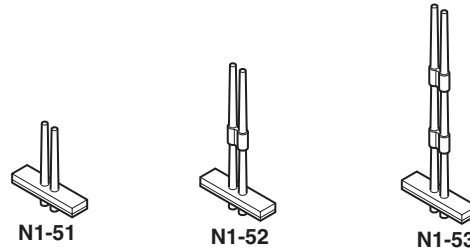
N1-52 — 6 inches.

N1-53 — 9 inches.

Specifications

- For use with:
 - PP-8516.
 - PP-86xx.
 - VER-PxP.

Differential Pressure Pick-ups



Application

2 X 2 Sensor Installation Mounting Plate.

Description

Mounting bracket (for use in mounting sensors). For installation on dry wall construction. Used with 10-58 for drywall mounting.

Specifications

- For use with:
 - TS-57011.
 - TS-58011.
 - TS-81031.

N5-52 (21-068)

Mounting Bracket



Application

2 X 2 Sensor Installation Mounting Plate.

Description

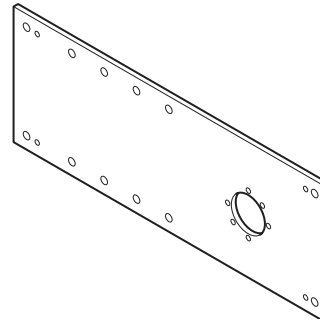
Mounting plate for sensors. Use for dry wall construction. (To be roughed in prior to installation of dry wall.)

Specifications

- For use with:
 - TS-57011.
 - TS-58011.
 - TS-81031.

N5-53 (21-069)

Mounting Plate



Application

Erie™

BB1200 series, 2 sensors (OA and H₂O). Outside air temperature sensor must be used for reset logic and/or warm weather shutdown.

Specifications

- 25 ft. (7.5 m) shielded cable.
- 100K thermistor sensor.
- 1-1/4 L X 3/16 in.(32 x 5 mm) Dia.

OAS-1

Outside Air Sensor



Application

BB3000/BB3600

Thermistor 10K Encapsulated Sensors

Description

Three sensors - OA, PRI, SEC.

Specifications

- .15/.20 inches OD x 3/4 - 1 inch long.
- 12 inch PVC leads.

SENS-10K

Thermistor



Accessories and Tools

Application

System 8000

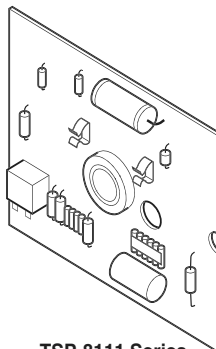
TSP-8101 series electronic temperature transmitters are used for providing signals to 8000 controllers and temperature indication readouts.

TSP-8111 series electronic temperature transmitters are used for providing signals for temperature indication readouts.

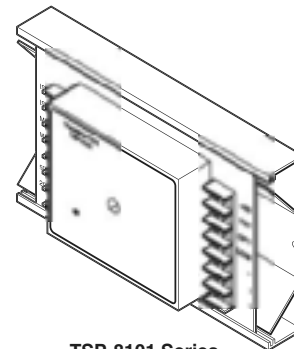
Specifications

Refer to F-15496 for complete applications.

TSP-8101 Series, TSP-8111 Series Temperature Transmitters



TSP-8111 Series



TSP-8101 Series

Description.

Model No.	Output Signal		Power Requirements	Wiring Connections
	Controllers	Indication		
TSP-8101	For single output 8000 controllers. Typically CC-8111-xxx, CP-8102-xxx, CP-8502-xxx, or CP-8x61-333 (AB3 input only).	<u>Meter Readout</u> ASP-500 series ^{a b} (except ASP-584)	20, ±1 Vdc at 13 mA	Coded screw terminals
TSP-8101-103	For controllers with two direct acting outputs. Typically CP-8x61-333 (AB1 & AB2 inputs).	<u>Digital Indication</u> ASP-8121, ASP-8122 ^b		
TSP-8111	—	ASP-500 series ^{a b} (except ASP-584)	20, ±1 Vdc at 12 mA or 24 Vac/24 Vdc ±10% ^c at 20 mA	Color coded pigtail leads
TSP-8111-103	—	ASP-8121 or ASP-8122 digital ^b		

^a Up to six meters can be controlled from one transmitter.

^b With switching, five TSP-81x1 series can control one meter readout or digital indicator.

^c Requires removal of jumper.

Installation.

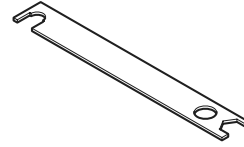
Model No.	Mounting			Dimensions in. (mm)		
	Panel	Track	Remote	H	W	D
TSP-8101	Shipped with vinyl track for panel mounting. Note: Must be mounted in same cabinet as 8000 controller.	—	—	4 (120)	7-1/2 (190)	2-1/2 (63)
TSP-8101-103						
TSP-8111	Direct attachment to meter.	Order separately AD-8952 adaptor plate and AD-8953 track.	—	2-3/8 (60)	3 (76)	2-1/8 (54)
TSP-8111-103	—					

Application

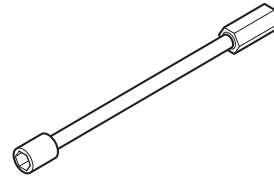
Calibration wrench for 2-position electric room thermostats, electric MU actuators and pneumatic receiver controller.

Specifications

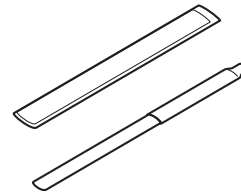
Also included in AL-95.

TOOL-11**Calibration Wrench****Application**

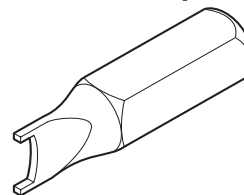
5/32 hex auxiliary switch adjustment for MA and MP-5000 Series actuators.

TOOL-12**Auxiliary Switch Adjustment****Application**

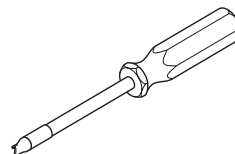
For contact preparation.

TOOL-13**Contact Burnishing Tool****Application**

Spanner head bit for #6 spanner head screws.

TOOL-14**Spanner Head Bit****Application**

Spanner head driver with bit for #6 spanner head screws.

TOOL-15**Spanner Head Driver with Bit**

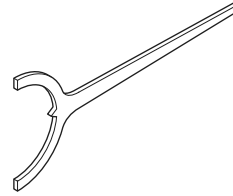
Accessories and Tools

Application

Cam adjustment wrench fo ME-12313 and ME-12313-102 actuators.

TOOL-16

Cam Adjustment Wrench

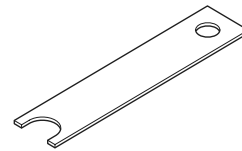


Application

Bellows compressor for remote bulb thermostats.

TOOL-23

Bellows Compressor



Application

Pneumatic calibration tool kit. Calibrates all pneumatic equipment.

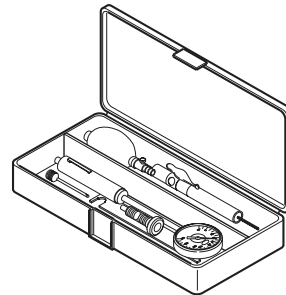
TOOL-95-1

Pneumatic Thermostat Calibration Kit

Specifications

Kit includes:

- MCS-GA, gauge adaptor.
- N2-4, 2 x 2, 1/16 in. hexhead thermostat calibration cover screw wrench.
- Female branch tee (1/4 barb x 1/4 barb x 1/8 in. FPT).
- TOOL-11: calibration wrench.
- TOOL-78: adaptor.
- TOOL-80: changeover wrench.
- TOOL-82: combination wrench.
- TOOL-83: mullion thermostat calibration wrench.
- TOOL-87: needle and adaptor.
- TOOL-110: 3/32 in. hex wrench.
- AL-362: 0 to 30 psi gauge.
- Air line tubing for barbed fitting.
- Air line tubing with compression fitting.
- 3/16 x 4 in. blade screwdriver.



Application

Wrench for removing thermostat backplates and covers.

Specifications

TOOL-110

- 3/32 in. hex wrench.

TOOL-111

- 5/64 in. Allen wrench. Also included in TOOL-96. See also TOOL-82.

TOOL-112

- 7/64 in. Allen wrench. Also included in TOOL-96.

TOOL-113

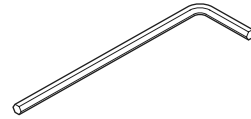
- 0.035 in. Allen wrench.

TOOL-115

- TORX T-8 offset driver for removing back plates of pneumatic room thermostats (TK-1xxx and TK-1xxxx) manufactured after 1-1-81.

TOOL-11x

Wrench



Application

System 8000

Calibration kit for System 8000 Controls.

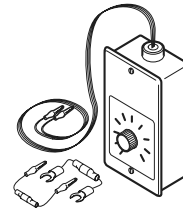
Specifications

Kit includes:

- TOOL-202: Calibration box (manual positioner).
- TOOL-203: Two 1000 Ω \pm 0.1% resistors.
- TOOL-204: 22K Ω \pm 1% resistor.

TOOL-201

Calibration Kit



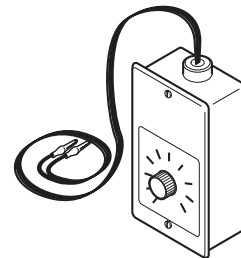
Application

System 8000

Manual positioner with test connections for System 8000 controlled devices.

TOOL-202

Positioner



Accessories and Tools

Application

System 8000

Substitute for temperature element equivalent to 70°F for System 8000 controllers.

Specifications

TOOL-203

- 1000 Ω \pm 0.1% temperature coefficient 20 ppm/°C precision resistor.

TOOL-204

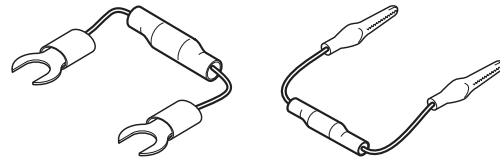
- 22K Ω \pm 1% resistor (substitute for HS-8xxx humidity element equivalent to mid-point of element) for System 8000 controllers.

TOOL-205

- 1 meg. Ω resistor for calibration of TP-8124.

TOOL-203, TOOL-204, TOOL-205

Precision Resistor



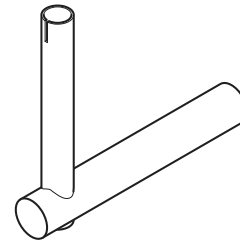
Application

System 8000

Setpoint calibration tool for System 8000.

TOOL-207

Setpoint Calibration Tool



Application

Erie™

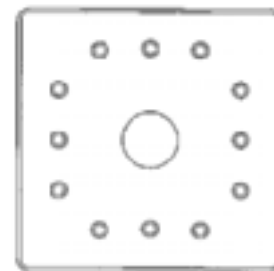
Allows the T500 to be mounted to a 4 X 4 in. electrical box.

Specifications

- Dimensions: 5-1/2 X 5-1/2 in. (140 x 140 mm).
- Color: Bone white.

WP500

Adapter Plate



Enclosure Selection Chart

Enclosure ratings in NEMA and IP terms are similar. Use the following tables to convert from one rating to the other.

NEMA Rating Definitions (Ref. NEMA 250, UL 50, and ANS/UL 50).

NEMA Type	Intended Use and Description	UL Standard UL50 Requirements
1	Indoor use primarily to provide a degree of protection against limited amounts of falling dirt.	Corrosion Protection—5.3 or Rust Resistance—Section 38
2	Indoor use primarily to provide a degree of protection against limited amounts of falling water and dirt.	Corrosion Protection—5.3 or Rust Resistance—Section 38, Drip—Section 31, Gaskets—Section 14 and Gasket Tests—Section 43.
3	Outdoor use primarily to provide a degree of protection against rain, sleet, windblown dust and damage from external ice formation.	Rain—Section 30, Outdoor dust or Hose—Section 32 or 35, Icing—Section 34, Protective Coating—Section 15, Gaskets—Section 14, and Gasket Tests—Section 43.
3R	Outdoor use primarily to provide a degree of protection against rain, sleet, and damage from external ice formation.	Rain—Section 30, Icing—Section 34, Protective Coating—Section 15, Gaskets—Section 14 and Gasket Tests—Section 43.
3S	Outdoor use primarily to provide a degree of protection against rain, sleet, windblown dust and to provide for operation of external mechanisms when ice laden.	Rain—Section 30, Outdoor Dust or Hose—Section 32 or 35, Icing—Section 34, Protective Coating—Section 15, Gaskets—Section 14 and Gasket Tests—Section 43.
4	Indoor or outdoor use primarily to provide a degree of protection against windblown dust and rain, splashing water, hose-directed water and damage from external ice formation.	Hosedown—Section 35, Protective Coating—Section 15, Corrosion Resistance—Section 39, Icing—Section 34, Gaskets—Section 14 and Gasket Tests—Section 43.
4X	Indoor or outdoor use primarily to provide a degree of protection against corrosion, windblown dust and rain, splashing water, hose-directed water, and damage from external ice formation.	Hosedown—Section 35, Protective Coating—Section 15, Corrosion Resistance—Section 39, Icing—Section 34, Gaskets—Section 14 and Gasket Tests—Section 43.

IP Rating Definitions (Ref. IEC 60529 and ANSI/IEC 60529).

1st IP Number		2nd IP Number	
IP	Protection	IP	Protection
0	No protection	0	No protection
1	Protection against solid objects over 50 mm (i.e. accidental touch by hands).	1	Protection against vertically falling drops of water (i.e. condensation).
2	Protection against solid objects over 12 mm (i.e. fingers).	2	Protection against direct sprays of water up to 15° from vertical.
3	Protection against solid objects over 2.5 mm (i.e. tools and wires).	3	Protection against sprays up to 60° from vertical.
4	Protection against solid objects over 1 mm.	4	Protection against water sprayed from all directions (limited ingress permitted).
5	Protection against dust (limited ingress, no harmful deposit).	5	Protection against low pressure jets of water from all directions (limited ingress permitted).
6	Total protection against dust.	6	Protection against strong jets of water.
		7	Protection against the effects of immersion between 15 cm and 1 m.
		8	Protection against long periods of immersion under pressure.

Example IP Rating.

If 1st IP Number is:	And the 2nd IP Number is:	Then the IP Rating is:
2	3	IP23
Provides protection against solid objects.	Provides protection against fluids.	Then this rating provides enclosure protection against penetration of solid objects greater than 12 mm and against water.

Enclosure Type Rating VS IP Rating Cross Reference (Approximate only).

IP ratings do not directly convert to NEMA types

IEC 60529 has no equivalents to NEMA enclosure Types 7, 8, 9, 10, or 11.

Type ratings and IP ratings have the following in common:

- A degree of protection for persons from hazardous components inside the enclosure.
- A degree of protection for equipment inside the enclosure from ingress of solid foreign objects, including dust.
- A degree of protection for equipment inside the enclosure from ingress of water.

NEMA 250 and UL50 type rating documentation defines additional requirements that type-rated enclosures must meet. These include the following:

- Mechanical impact on enclosure walls.
- Gasket aging and oil resistance
- Corrosion resistance
- Door and cover requirements
- Sheet metal gauge construction requirements

NOTE: Electrical enclosures that carry only an IP rating have not been designed to the NEMA rating requirements and therefore cannot be assigned a NEMA rating.

Low Pressure Conversion Chart

Low Pressure Conversion Chart

in/H ₂ O	P.S.I.	in/Hg	mm/H ₂ O	mm/Hg	kg/cm ²	bar	mbar	Pa	kPa
.1	.0036	.0073	2.534	.1863	.0002	.0002	.2482	24.82	.0248
.2	.0072	.0146	5.067	.3726	.0005	.0005	.4964	49.64	.0496
.4	.0144	.0293	10.13	.7452	.0010	.0010	.9928	99.28	.0993
.6	.0216	.0440	15.20	1.118	.0015	.0015	1.489	148.9	.1489
.8	.0289	.0588	20.34	1.496	.0020	.0020	1.992	199.2	.1992
1.0	.0361	.0735	25.41	1.868	.0025	.0025	2.489	248.9	.2489
2	.0722	.1470	50.81	3.736	.0051	.0050	4.978	497.8	.4978
3	.1083	.2205	76.22	5.604	.0076	.0075	7.467	746.7	.7467
4	.1444	.2940	101.62	7.472	.0102	.0099	9.956	995.6	.9956
5	.1804	.3673	127.0	9.335	.0127	.0124	12.44	1244	1.244
6	.2165	.4408	152.4	11.203	.0152	.0149	14.93	1493	1.493
7	.2526	.5143	177.8	13.072	.0178	.0174	17.42	1742	1.742
8	.2887	.5878	203.2	14.940	.0203	.0199	19.90	1990	1.990
9	.3248	.6613	228.6	16.808	.0228	.0224	22.39	2239	2.239
10	.3609	.7348	254.0	18.676	.0254	.0249	24.88	2488	2.488
11	.3970	.8083	279.4	20.544	.0279	.0274	27.37	2737	2.737
12	.4331	.8818	304.8	22.412	.0304	.0298	29.86	2986	2.986
13	.4692	.9553	330.2	24.280	.0330	.0323	32.35	3235	3.235
14	.5053	1.029	355.6	26.148	.0355	.0348	34.84	3484	3.484
15	.5414	1.102	381.0	28.016	.0381	.0373	37.33	3733	3.733
16	.5774	1.176	406.4	29.879	.0406	.0398	39.81	3981	3.981
17	.6136	1.249	431.8	31.752	.0431	.0423	42.31	4231	4.231
18	.6496	1.322	457.2	33.616	.0457	.0448	44.79	4479	4.479
19	.6857	1.396	482.6	35.484	.0482	.0472	47.28	4728	4.728
20	.7218	1.470	508.0	37.352	.0507	.0497	49.77	4977	4.977
21	.7579	1.543	533.4	39.22	.0533	.0522	52.26	5226	5.226
22	.7940	1.616	558.8	41.09	.0558	.0547	54.74	5474	5.474
23	.8301	1.690	584.2	42.96	.0584	.0572	57.23	5723	5.723
24	.8662	1.764	609.6	44.82	.0609	.0597	59.72	5972	5.972
25	.9023	1.837	635.0	46.69	.0634	.0622	62.21	6221	6.221
26	.9384	1.910	660.4	48.56	.0660	.0646	64.70	6470	6.470
27	.9745	1.984	685.8	50.43	.0685	.0671	67.19	6719	6.719
28	1.010	2.056	710.8	52.26	.0710	.0696	69.64	6964	6.964

High Pressure Conversion Chart

High Pressure Conversion Chart

P.S.I.	in/H ₂ O	in/Hg	mm/H ₂ O	mm/Hg	kg/cm ²	bar	mbar	Pa	kPa
1.0	27.71	2.036	703.1	51.75	.0703	.0689	68.95	6895	6.895
1.1	30.45	2.240	773.4	56.89	.0773	.0758	75.84	7584	7.584
1.2	33.22	2.443	843.7	62.06	.0844	.0827	82.74	8274	8.274
1.3	35.98	2.647	914.0	67.23	.0914	.0896	89.63	8963	8.963
1.4	38.75	2.850	984.3	72.40	.0984	.0965	96.52	9652	9.652
1.5	41.52	3.054	1055	77.57	.1055	.1034	103.4	10340	10.34
1.6	44.29	3.258	1125	82.74	.1125	.1103	110.3	11030	11.03
1.7	47.06	3.461	1195	87.92	.1195	.1172	117.2	11720	11.72
1.8	49.82	3.665	1266	93.09	.1266	.1241	124.1	12410	12.41
1.9	52.59	3.868	1336	98.26	.1336	.1310	131.0	13100	13.10
2.0	55.36	4.072	1406	103.4	.1406	.1379	137.9	13790	13.79
2.1	58.13	4.276	1476	108.6	.1476	.1448	144.8	14480	14.48
2.2	60.90	4.479	1547	113.8	.1547	.1517	151.7	15170	15.17
2.3	63.67	4.683	1617	118.9	.1617	.1586	158.6	15860	15.86
2.4	66.43	4.886	1687	124.1	.1687	.1655	165.5	16550	16.55
2.5	69.20	5.090	1758	129.3	.1758	.1724	172.4	17240	17.24
2.6	71.97	5.294	1828	134.5	.1828	.1793	179.3	17930	17.93
2.7	74.74	5.497	1898	139.6	.1898	.1862	186.2	18620	18.62
2.8	77.51	5.701	1969	144.8	.1968	.1930	193.0	19300	19.30
2.9	80.27	5.904	2039	150.0	.2039	.1999	199.9	19990	19.99
3.0	83.04	6.108	2109	155.1	.2109	.2068	206.8	20680	20.68
3.1	85.81	6.312	2180	160.3	.2180	.2137	213.7	21370	21.37
3.2	88.58	6.515	2250	165.5	.2250	.2206	220.6	22060	22.06
3.3	91.35	6.719	2320	170.7	.2320	.2275	227.5	22750	22.75
3.4	94.11	6.922	2390	175.8	.2390	.2344	234.4	23440	23.44
3.5	96.88	7.126	2461	181.0	.2461	.2413	241.3	24130	24.13
3.6	99.65	7.330	2531	186.2	.2531	.2482	248.2	24820	24.82
3.7	102.4	7.533	2601	191.3	.2601	.2551	255.1	25510	25.51
3.8	105.2	7.737	2672	196.5	.2672	.2620	262.0	26200	26.20
3.9	108.0	7.940	2742	201.7	.2742	.2689	268.9	26890	26.89
4.0	110.7	8.144	2812	206.9	.2812	.2758	275.8	27580	27.58
4.1	113.5	8.348	2883	212.0	.2883	.2827	282.7	28270	28.27
4.2	116.3	8.551	2953	217.2	.2953	.2896	289.6	28960	28.96
4.3	119.0	8.775	3023	222.4	.3023	.2965	296.5	29650	29.65
4.4	121.8	8.958	3094	227.5	.3094	.3034	303.4	30403	30.34
4.5	124.6	9.162	3164	232.7	.3164	.3103	310.3	31030	31.03
4.6	127.3	9.366	3234	237.9	.3234	.3172	317.2	31720	31.72
4.7	130.1	9.569	3304	243.1	.3304	.3240	324.0	32400	32.40
4.8	132.9	9.773	3375	248.2	.3375	.3310	331.0	33100	33.10
4.9	135.6	9.976	3445	253.4	.3445	.3378	337.8	33780	33.78
5.0	138.4	10.18	3515	258.6	.3515	.3447	344.7	34470	34.47
5.1	141.2	10.38	3586	263.7	.3586	.3516	351.6	35160	35.16
5.2	143.9	10.59	3656	268.9	.3656	.3585	358.5	35850	35.85
5.3	146.7	10.79	3726	274.1	.3726	.3654	365.4	36540	36.54
5.4	149.5	10.99	3797	279.3	.3797	.3723	372.3	37230	37.23
5.5	152.2	11.20	3867	284.4	.3867	.3792	379.2	37920	37.92
5.6	155.0	11.40	3937	289.6	.3937	.3861	386.1	38610	38.61
5.7	157.8	11.60	4008	294.8	.4007	.3930	393.0	39300	39.30
5.8	160.5	11.81	4078	299.9	.4078	.3999	399.9	39990	39.99
5.9	163.3	12.01	4148	305.1	.4148	.4068	406.8	40680	40.68
6.0	166.1	12.22	4218	310.3	.4218	.4137	413.7	41370	41.37
6.1	168.8	12.42	4289	315.5	.4289	.4206	420.6	42060	42.06
6.2	171.6	12.62	4359	320.6	.4359	.4275	427.5	42750	42.75
6.3	174.4	12.83	4429	325.8	.4429	.4344	434.4	43440	43.44
6.4	177.2	13.03	4500	331.0	.4500	.4413	441.3	44130	44.13
6.5	179.9	13.23	4570	336.1	.4570	.4482	448.2	44820	44.82

High Pressure Conversion Chart

P.S.I.	in/H ₂ O	in/Hg	mm/H ₂ O	mm/Hg	kg/cm ²	bar	mbar	Pa	kPa
6.6	182.7	13.44	4640	341.3	.4640	.4550	455.0	45500	45.50
6.7	185.5	13.84	4711	346.5	.4710	.4619	461.9	46190	46.19
6.8	188.2	13.84	4781	351.7	.4781	.4688	468.8	46880	46.88
6.9	191.0	14.05	4851	356.8	.4851	.4757	475.7	47570	47.57
7.0	193.8	14.25	4922	362.0	.4921	.4826	482.6	48260	48.26
7.1	196.5	14.46	4992	367.2	.4992	.4895	489.5	48950	48.95
7.2	199.3	14.66	5062	372.3	.5062	.4964	496.4	49640	49.64
7.3	202.1	14.86	5132	377.5	.5132	.5033	503.3	50330	50.30
7.4	204.8	15.07	5203	382.7	.5203	.5102	510.2	51020	51.02
7.5	207.6	15.27	5273	387.9	.5273	.5171	517.1	51710	51.71
7.6	210.4	15.47	5343	393.0	.5343	.5240	524.0	52400	52.40
7.8	215.9	15.88	5484	403.4	.5484	.5378	537.8	53780	53.78
8.0	221.4	16.29	5625	413.7	.5625	.5516	551.6	55160	55.16
8.2	227.0	16.70	5765	424.1	.5765	.5654	565.4	56540	56.54
8.4	232.5	17.10	5906	434.4	.5906	.5792	579.2	57920	57.92
8.6	238.0	17.51	6047	444.7	.6046	.5929	592.9	59290	59.29
8.8	243.6	17.92	6187	455.1	.6187	.6067	606.7	60670	60.67
9.0	249.1	18.32	6328	465.4	.6328	.6205	620.5	62050	62.05
9.2	254.7	18.73	6468	475.8	.6468	.6343	634.3	63430	63.43
9.4	260.2	19.14	6609	486.1	.6609	.6481	648.1	64810	64.81
9.6	265.7	19.54	6750	496.5	.6749	.6619	661.9	66190	66.19
9.8	271.3	19.95	6890	506.8	.6890	.6757	675.7	67570	67.57
10.0	276.8	20.36	7031	517.1	.7031	.6895	689.5	68950	68.95
11.0	304.5	22.40	7734	568.9	.7734	.7584	758.4	75840	75.84
12.0	332.2	24.43	8437	620.6	.8437	.8274	827.4	82740	82.74
13.0	359.8	26.47	9140	672.3	.9140	.8963	896.3	89630	89.63
14.0	387.5	28.50	9843	724.0	.9843	.9652	965.2	96250	96.52
14.7	406.9	29.93	10340	760.2	1.033	1.014	1014	101400	101.4
15.0	415.2	30.54	10550	775.7	1.055	1.034	1034	103400	103.4
16.0	442.9	32.58	11250	827.4	1.125	1.103	1103	110300	110.3
17.0	470.6	34.61	11950	879.1	1.195	1.172	1172	117200	117.2
18.0	498.2	36.65	12660	930.9	1.265	1.241	1241	124100	124.1
19.0	525.9	38.68	13360	982.6	1.336	1.310	1310	131000	131.0
20.0	553.6	40.72	14060	1034	1.406	1.379	1379	137900	137.9
21.0	581.3	42.76	14770	1086	1.476	1.448	1448	144800	144.8
22.0	609.0	44.79	15470	1138	1.547	1.519	1517	151700	151.7
23.0	636.7	46.83	16170	1189	1.617	1.586	1586	158600	158.6
24.0	664.3	48.86	16870	1241	1.687	1.655	1655	165500	165.5
25.0	692.0	50.90	17580	1293	1.758	1.725	1724	172400	172.4

Conversion Factors

Note: Conversion factors rounded.

PSI x 27.71 = in. H₂O PSI x .0689 = bar
 PSI 2.036 = in. Hg PSI x 68.95 = mbar
 PSI x 703.1 = mm/H₂O PSI x 6895 = pa
 PSI x 51.75 = mm/Hg PSI x 6.895 = kPa
 PSI x .0703 = kg/cm²

When making conversions, remember that a converted value is no more precise than the original value. Round off the final value to the same number of significant figures as those in the original value.

Multiply	By	To Obtain
Atmospheres (Std.) 760 mm of Mercury at 32°F	14.696	lbs/sq inch
Atmosphere, standard	101.325	kPa
Atmospheres	760	mm of mercury
Atmospheres	29.92	in. of mercury
Atmospheres	33.90	feet of water
Atmospheres	1.0333	kgs/sq cm (kp/cm ²)
Atmospheres	14.70	lbs/sq inch
Atmospheres	1.058	tons/sq ft
Bar	0.98692	Atmospheres
Bar	100	kPa
Bar	14.5038	psi
Btu	0.2520	kilogram-calories
Btu	777.5	foot-lbs
Btu	0.000393	horsepower-hrs.
Btu	0.293	watt-hrs.
Btu, IT	1.055	kJ
Btu • ft/h • ft ² • °F	1.731	W/(m • K)
Btu • in/h • ft ² • °F (thermal conductivity, k)	0.1442	W/(m • K)
Btu/h	0.2931	W
Btu/ft ²	11.36	kJ/m ²
Btu/h • ft ²	3.155	W/m ²
Btu • ft ² • °F (heat transfer coefficient, U)	5.678	W/(m ² • K)
Btu/lb	2.326	kJ/kg
Btu/lb • °F (specific heat c _p)	4.184	kJ/(kg • K)
Btu/min.	12.96	foot-lbs/sec
Btu/min.	0.02356	horsepower
Btu/min.	0.01757	kilowatts
Btu/min.	17.57	watts
Calorie	0.003968	btu
Calorie, gram	4.187	J
Calorie, kilogram (kilocalorie)	4.187	kJ
Centimeters	0.3937	inches
Centimeters	0.03280	feet
Centimeters	0.01	meters
Centimeters	10	millimeters
Centimeters of mercury	0.01316	atmospheres
Centimeters of mercury	0.4461	feet of water
Centimeters of mercury	136.0	kgs/sq meter
Centimeters of mercury	27.85	lbs/sq ft
Centimeters of mercury	0.1934	lbs/sq inch

Multiply	By	To Obtain
Centipoise, dynamic viscosity, μ	1.00	mPa • s
Centistokes, kinematic viscosity, ν	1.00	mm ² /s
CFM	0.000471947	m ³ /s
Clo	0.155	m ² • K/W
Cubic feet	2.832x10 ⁴	cubic cms.
Cubic feet	1728	cubic inches
Cubic feet	0.02832	cubic meters
Cubic feet	0.03704	cubic yards
Cubic feet	7.48052	gallons U.S.
Cubic feet/minute	472.0	cubic cms/sec
Cubic feet/minute	0.1247	gallons/sec.
Cubic foot water	62.4	pounds at 60°F
Cv (Gpm @ 1 psi ΔP)	0.865	Kvs (m ³ /h @ 100 kPaΔP)
Dyne/cm ²	0.100	Pa
EDR hot water (150 Btu/h)	44.0	W
EDR steam (240 Btu/h)	70.3	W
Fuel cost comparison at 100% eff:		
Cents/gallon (no.2 fuel oil)	0.0677	S/GJ
Cents/gallon (no. 6 fuel oil)	0.0632	S/GJ
Cents/gallon (propane)	0.113	S/GJ
Cents/kWh	2.78	S/GJ
Cents/therm	0.0948	S/GJ
Feet	30.48	centimeters
Feet	12	inches
Feet	0.3048	meters
Feet	1/3	yards
Feet of water	0.02950	atmospheres
Feet of water	0.8826	inches of mercury
Feet of water	0.03048	kgs/sq cm
Feet of water	62.43	lbs/sq ft
Feet of water	0.4335	lbs/sq inch
Feet of water	2.99	kPa
Feet/min., fpm	0.00508	m/s
Feet/min.	0.01667	feet/sec
Feet/min	0.01829	kilometers/hr.
Feet/min.	0.3048	meters/min
Feet/min.	0.01136	miles/hr.
Feet ²	0.09290	m ²
Feet ² • h • °F/Btu (thermal resistance, R)	0.176	m ² • K/W
Feet ² /s, kinematic viscosity, ν	92 900	mm ² /s
Feet ³	28.32	L
Feet ³	0.02832	m ³
Feet ³ /h, cfh	7.866	mL/s
Feet ³ /min, cfm	0.4719	L/s
Feet ³ /s, cfs	28.32	L/s
Foot-pounds (ft • lb)	0.001286	btu
Ft • lb _r (torque or moment)	1.36	N m
Ft • lb _r (work)	1.36	J
Ft • lb _r /lb (specific energy)	2.99	J/kg
Ft • lb _r /min (power)	0.0226	W
Gallons	3785	cubic centimeters
Gallons	0.1337	cubic feet
Gallons	231	cubic inches
Gallons	128	fluid ounces
Gallons	3.785	liters

Conversion Factors

Multiply	By	To Obtain
Gallons water	8.35	lbs water at 60°F
Gph	1.05	mL/s
Gpm	0.000063092	m ³ /s
Gpm	0.0631	L/s
Gpm/ft ²	0.6791	L/(s * m ²)
Gpm/ton refrigeration	0.0179	mL/J
Grain (1/7000 lb)	0.0648	g
Gr/gal	17.1	mg/L
Horsepower	42.44	btu/min
Horsepower	33,000	foot-lbs/min
Horsepower	550	foot-lbs/sec
Horsepower	0.7457	kilowatts
Horsepower	745.7	watts
Horsepower (boiler)	33,479	btu/hr.
Horsepower (boiler)	9.803	kilowatts
Horsepower-hours	2547	btu
Horsepower-hours	0.7457	kilowatt-hours
Inches	2,540	centimeters
Inches	25.4	millimeters
Inches	0.0254	meters
Inches	0.0833	foot
Inches of mercury	0.03342	atmospheres
Inches of mercury	1.133	feet of water
Inches of mercury	13.57	inches of water
Inches of mercury	70.73	lbs/sq ft
Inches of mercury	0.4912	lbs/sq inch
Inches of water	0.002458	atmospheres
Inches of water	0.07355	in of mercury
Inches of water	0.5781	ounces/sq inch
Inches of water	5.202	lbs/sq foot
Inches of water	0.03613	lbs/sq inch
Inches of water	248.84	Pa
In/100 ft (thermal expansion)	0.833	mm/m
In * lb _r s (torque or moment)	113	mN * m
In ²	645	mm ²
In ³ (volume)	16.4	mL
In ³ /min (SCIM)	0.273	mL/s
In ³ (section module)	16 400	mm ³
In ⁴ (section moment)	416 200	mm ⁴
Kilowatts	56.92	btu/min
Kilowatts	1.341	horsepower
Kilowatts	1000	watts
Kilowatt-hours	3415	btu
Kilopond (kg force)	9.81	N
Kip (1000 lb _r s)	4.45	kN
Kip/in ² (ksi)	6.895	MPa
Km/h	0.278	m/s
kp ² (kg/cm ²)	14.223	psi
Kvs (m ³ /h @ 100 kPa ΔP)	1.156	Cv (GPM @ 1 psi ΔP)
kWh	3.60	MJ
kWh/1000 cfm	2.12	J/L
Liters	0.2642	gallons
Liters	2.113	pints (liquid)
Liters	1,057	quarts (liquid)
Meters	100	centimeters
Meters	3.281	feet
Meters	39.37	inches

Multiply	By	To Obtain
Meters	1000	millimeters
Meters	1.094	yards
Micron (μm) of mercury (60°F)	133	mPa
Mile	1.61	km
Mile, nautical	1.85	km
Mph	1.61	km/h
Mph	0.447	m/s
Millibar	0.100	kPa
Mm of mercury (60°F)	0.133	kPa
Mm of water (60°F)	9.80	Pa
N-m	8.85	lb-in.
N-m	0.7375	lb-ft.
Ounces (fluid)	1.805	cubic inches
Ounces (fluid)	0.02957	liters
Ounces/sq inch	0.0625	lbs/sq inch
Ounces/sq inch	1.73	inches of water
Ounce (mass, avoirdupois)	28.35	g
Ounce (force of thrust)	0.278	N
Ounce (liquid, US)	29.6	mL
Ounce (avoirdupois) per gallon	7.49	g/L
Perm (permeance)	57.45	ng/(s * m ² * Pa)
Pints	0.4732	liter
Pounds (avoir.)	16	ounces
Lb (mass)	0.4536	kg
Lb (mass)	4.53.6	g
Lb _r (force or thrust)	4.45	N
Lb/ft (uniform load)	1.49	kg/m
Lb m / (ft * h) (dynamic viscosity, μ)	0.413	mPa * s
Lb m / (ft * s) (dynamic viscosity, μ)	1490	mPa * s
Lb _r * sft ² (dynamic viscosity, μ)	47 880	mPa * s
lb-ft. (Torque)	1.356	N-m
lb-in. (Torque)	0.11356	N-m
Lb/min	0.00756	kg/s
Lb/h	0.126	g/s
Lb/h (steam at 212°F)	0.284	kW
Lb _r ft ²	47.9	Pa
Lb/ft ²	4.88	kg/m ²
Lb/ft ³ (density, ρ)	16.0	kg/m ³
Lb/gallon	120	kg/m ³
Pa	.0040186	inches of water
Ppm (by mass)	1.00	mg/kg
Pounds of water	0.01602	cubic feet
Pounds of water	27.68	cubic inches
Pounds of water	0.1198	gallons
Pounds/sq foot	0.01602	feet of water
Pounds/sq foot	0.006945	pounds/sq inch
Pounds/sq inch	0.06804	atmospheres
Pounds/sq inch	2.307	feet of water
Pounds/sq inch	2.036	inches of mercury
Pounds/sq inch	27.68	Inches of water
Pounds/sq inch	6.8948	kPa
Quart (liquid, US)	0.946	L
Square (100 ft ²)	9.29	m ²
Tablespoon (approx.)	15	mL
Teaspoon (approx.)	5	mL
Therm	100,000	btu
Tons (long)	2240	pounds

Electronic/Pneumatic Transducer Conversion Chart

Multiply	By	To Obtain
Ton, refrigeration	12,000	btu/hr.
Ton, refrigeration (12,000 btu/h)	3.517	kW
Torr (1 mm Hg at 0°C)	133	Pa
Tons, (short)	2000	pounds
Watts	3.415	btu
Watts	0.05692	btu/min.
Watts	44.26	foot-pounds/min
Watts	0.7376	foot-pounds/sec
Watts	0.001341	horsepower
Watts	0.001	kilowatts
Watt-hours	3.415	btu-hr.
Watt-hours	2655	foot-pounds
Watt-hours	0.001341	horsepower hrs.
Watt-hours	0.001	kilowatt-hours

Multiply	By	To Obtain
Watt per square foot	10.8	W/m ²
Yd	0.9144	M
Yd ²	0.836	M ²
Yd ³	0.7646	M ³

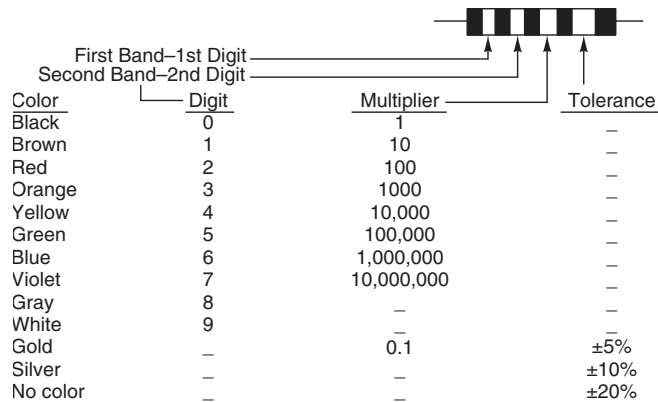
Multiply	By	Add	To Obtain
Temp (°C)	—	273	abs. temp (°K)
Temp (°C)	1.8	32	temp (°F)
Temp (°F)	—	460	abs. temp. (°R)
Temp (°F) -32	.556	—	temp (°C)

Electronic/Pneumatic Transducer Conversion Chart

Output 3-15 P.S.I.	Electronic Input						
	1-5 Amp	4-20 mAmp	1-5 Volts	6-9 Volts	2-10 Volts	0-10 Volts	1-11 Volts
3	1.00	4.00	1.00	6.00	2.00	0.00	1.00
4	1.33	5.33	1.33	6.25	2.67	0.83	1.83
5	1.67	6.67	1.67	6.50	3.33	1.67	2.67
6	2.00	8.00	2.00	6.75	4.00	2.50	3.50
7	2.33	9.33	2.33	7.00	4.67	3.33	4.33
8	2.67	10.67	2.67	7.25	5.33	4.17	5.17
9	3.00	12.00	3.00	7.50	6.00	5.00	6.00
10	3.33	13.33	3.33	7.75	6.67	5.83	6.83
11	3.67	14.67	3.67	8.00	7.33	6.67	7.67
12	4.00	16.00	4.00	8.25	8.00	7.50	8.50
13	4.33	17.33	4.33	8.50	8.67	8.33	9.33
14	4.67	18.67	4.67	8.75	9.33	9.17	10.17
15	5.00	20.00	5.00	9.00	10.00	10.00	11.00

Resistor Coding

COLOR CODE (if application)



Useful Formulas

SYSTEM 8000

Action

Balco between 6.2 and ISA = Direct Action
 1K resistor between ISA and COM

1K resistor between ISA and 6.2 = Reverse Action
 Balco between ISA and COM

Reset Truth Table

If You Need the Reset To Be:	Make the "B" Bridge
Reverse	The same as the "A" Bridge
Direct	Different than the "A" Bridge

$$C.T.R. = \frac{S.T.R. \times 3 \text{ VDC}}{\text{volt span of system}}$$

$$S.T.R. = \frac{C.T.R. \times \text{volt span of system}}{3 \text{ VDC}}$$

Ratio (Reset applications only)

A (T1 max - min) = _____

B (T2 max - min) = _____

$$\frac{B}{A} = \text{Ratio}$$

Typical S.T.R.	Application
2°F	VAV.
3°F	Reheat.
4°F	Dual duct or multizone.
8°F	Hot water temperature from mixing valve.
10°F	Hot water temperature from steam to water converter.
10°F	Mixed air temperature.
5°F	Chilled water.
5°F	DX cooling.
8°F	Hot water coil.

Abbreviations

ACU: Air Conditioning Unit
AHU: Air Handling Unit
ASHRAE: American Society of Heating, Refrigerating, and Air-Conditioning Engineers; 1791 Tullie Circle N.E.; Atlanta, GA 30329.
BTU: British Thermal Unit
C: Common
CCW: Counter Clockwise
CFM: Cubic Feet per Minute
CR: Condensate Return
CW: Clockwise
CWR: Chilled Water Return
CWS: Chilled Water Supply
DDC: Direct Digital Control
D.A.: Discharge Air, Direct Action, Direct Acting
 ΔT : Temperature Differential or Change
DIFF: Differential
DPC: Differential Pressure Controller
DPDT: Double Pole - Double Throw
EA: Exhaust Air
EMS: Energy Management System
EP: Electric - Pneumatic Switch
FA: Fresh Air
GPM: Gallons Per Minute
h: Enthalpy
HVU: Heating and Ventilating Unit
HVAC: Heating, Ventilating, and Air Conditioning
HWR: Hot Water Return
HWS: Hot Water Supply
in. wc: inches of water column
IBS: Invensys Building Systems
mA: Milliamps
M.A.: Mixed Air
N.C.: Normally Closed
N.O.: Normally Open
NEMA: National Electrical Manufacturers Association
O.A.: Outdoor Air
PA: Percent Authority
PB: Proportional Band
PE: Pneumatic Electric switch
PID: Proportional, Integral, Derivative
PPM: Parts Per Million
PSI: Pounds per Square Inch

R: Ratio
R.A.: Return Air, Reverse Action, Reverse Acting
RC: Receiver-Controller
RH: Relative Humidity
RSES: Refrigeration Service Engineer Society, 960 Rand Rd., Des Plaines, IL 60016
SP: Setpoint
SPST: Single Pole - Single Throw
TR: Throttling Range
SS: Steam Supply
TR: Throttling Range
Vac: Volts Alternating Current
VAV: Variable Air Volume
Vdc: Volts Direct Current
VFD: Variable Frequency Drive

Absolute Pressure (PSIA): The sum of both atmospheric pressure (14.7) and gauge pressure (psig). Example: If a pneumatic gauge indicates 8 psig, the absolute pressure will be 22.7 psia (8+14.7).

Action: The direction of magnitude change of the output of a controller with respect to the change in the variable that is being sensed. Example:
 Direct Action (D.A.): Variable increases, output increases.
 Reverse Action (R.A.): Variable increases, output decreases.

Actuator: A device which is mechanically linked to a damper and positions the damper to regulate the flow of air; or is mounted on a valve and repositions the valve to regulate the flow of steam or water. Actuators are sometimes referred to as operators or motors.

Adaptor (System 8000): A device which conditions the signal from a controller and it modifies this signal in some manner before the signal reaches the controlled device thereby accomplishing specific applications such as sequencing, paralleling, minimum position, etc.

AHU (Air Handling Unit): A mechanical system usually consisting of an enclosure housing a supply-air fan (or fans), heating and/or cooling coils, filters, and outdoor air and return air dampers. May include return air fan(s) and relief air damper(s). May deliver air to a single space, to a number of zones, or to numerous constant-volume or variable-volume air terminal units.

Air Conditioning: The process of treating air so as to control simultaneously its temperature, humidity, cleanliness and distribution to meet requirements of the conditioned space.

Air Handling Unit: Refer to AHU.

Analog: A proportional type of signal whose level varies smoothly and continuously in amplitude or frequency.

Auxiliary Device (Pneumatic): A control module which is generally placed between the controller and actuator that modifies the controller signal in some manner before the signal reaches the actuator. Example: Relays and switches.

Glossary

Averaging Element: A sensing device that can extend across the entire duct and sense the average temperature.

Axial Fan: A fan with multiple impeller blades that move air along the length of the fan's axle. Its flanged, heavy-gauge cylindrical enclosure mounts directly into round ductwork.

Boiler: A closed vessel in which fuel is burned to generate steam or to heat water.

Brake Horsepower: The total horsepower applied to the drive shaft of any piece of rotating equipment. The actual power required to drive a fan or pump.

Branch Lines (Pneumatic): The tubing in a pneumatic control system which carries the output signal from controller to auxiliary devices or actuators.

Bridge (System 8000): A device that receives the resistance change from the sensor and produces a low voltage change that is amplified to a higher level which becomes the controller output. Usually a part of the controller or can be a separate module.

Btu (British Thermal Unit): The energy or heat required to raise the temperature of one pound of water 1°F under standard pressure.

Butterfly Valve: A cylindrical flanged-end body with an internal, rotatable disc serving as a fluid flow regulating device.

Bypass Control Damper: A damper mounted inside a duct that provides an alternate path for air to flow.

Calibration Point: The output voltage of a controller when the setpoint and control point are equal.

System 8000: Normally this would be 7.5 Vdc (midpoint of controller output (6 to 9 Vdc)). It may also be midpoint of actuator ranges.

Pneumatic: Normally this would be 8 psig (midpoint of controller output (3 to 13 psig)). It may also be midpoint of actuator ranges: 3-8=5.5, 5-10=7.5, 8-13=10.5, etc.

Cavitation: The phenomenon occurring in a flowing liquid when the pressure falls below the vapor pressure of the liquid, causing the liquid to vaporize and form bubbles. The bubbles in the flowing liquid are carried through the pump or valve inlet to a zone of higher pressure where they suddenly collapse or implode with terrific force.

Centrifugal Fan: A fan housed in a scroll-type housing. Those used in HVAC systems usually have impellers of the airfoil, backward-inclined or backward-curved, or forward-curved type, for different applications. May have a single or double inlet. May or may not have inlet vane damper(s).

CFM (Cubic Feet Per Minute): A rate of air volume delivery. Standard measure for HVAC ducted systems.

Chiller: A machine, usually centrifugal or reciprocating, that chills the water used to cool a building. Heat removed from the water is rejected to a remote air-cooled condensing unit, or to a water-cooled condenser that is usually an integral part of the chiller.

Close-Off: The maximum allowable pressure drop to which a valve may be subjected while fully closed.

Cold Deck: The portion of the duct containing the chilled water coil or DX coil. Generally parallel with a bypass deck or hot deck.

Comfort Zone: The range of temperatures and humidities over which the majority of people feel comfortable. Generally, between 68°F and 79°F and 20% to 60% relative humidity.

Conduction: Heat energy transmitted by direct contact.

Constant Volume Control: Constant volume control systems change the supply air temperature in response to the space load, while maintaining constant air flow.

Control Point: The actual value of the controlled variable which the controller operates to maintain (under any fixed set of conditions).

Controlled Device (C/D): An apparatus that receives the signal from a controller and positions the damper or valve to match the capacity to the load. Example: Motorized damper or valve.

Controller: A device that monitors a controlled variable and changes the position of final control devices (such as valves, dampers, or contacts) to maintain the value of the controlled variable at or near the controller's setpoint.

Convection: Heat that moves from one place to another by means of currents that are set up within some fluid medium, vapor or liquid.

Corrosion Test Coupon: A weighed strip of metal that is suspended in a flowing water stream for a specified time. The corrosion rate is calculated from weight loss during the period of exposure, using procedure ASTM D2688.

Cubic Feet/Minute: A rate of air volume delivery. Standard measure for HVAC ducted systems.

Cv (Flow Coefficient): The flow of water in gallons per minute (at 60°F) that causes a pressure drop of 1 psi across a fully open valve.

Damper: A valve used to regulate the flow of air or some other gas.

DDC (Direct Digital Control): Microprocessor-based control systems that provide direct control of the individual components of an HVAC system without the use of conventional control devices such as thermostats.

Deadband: An area of no change. For example, a point's value must go above or below the deadband to trigger an alarm or control action.

Degree Day, Heating: A unit, based upon temperature and time, used in estimating fuel consumption and specifying nominal heating load of a building in winter. For any one day, when the mean temperature is less than 65°F (18°C), there exist as many degree days as there are Fahrenheit (Celsius) degrees difference in temperature between the mean temperature for the day and 65°F (18°C).

Dew Point: The point at which a given mixture of air and water vapor is saturated.

Differential Pressure Control: A system in which two pressure sensors transmit their respective signals to a controller; the controller, in turn, produces an output to the controlled device that will vary in accordance with the difference of the two sensed pressures.

Differential Pressure Switch: A switch activated by air pressure, often used in supply ducts to detect flow or pressure drop across filters.

Digital: An On/Off or two-position signal.

DIP Switch (Dual In-line Package Switch): A ganged array of switches on a circuit board. Each switch can be set to one of two positions.

Direct Reset: On multiple (typically two) input applications, when a decrease at the second (open loop) sensor causes the controller setpoint to decrease.

Discharge Damper: A damper located directly in the discharge of a fan or duct.

Diverting Valve: A three-way valve which has one inlet, two outlets, and can direct full flow to either outlet or proportion the flow between the two outlets.

Dry-Bulb Temperature: The air temperature as measured by a conventional thermometer.

Dry Contact: A contact closure that does not impose an electronic signal from an outside source. A direct short of normally open contacts.

Duct Fan: An axial flow fan mounted in, or intended for mounting in, a section of duct.

Duty Cycling: An energy management function that reduces consumption by periodically turning off electrical equipment for short intervals during normal operating hours.

Economizer Band: The range of temperatures within which an air handler is in economizer mode.

Economizer Deadband: The range of temperatures between the high end of the economizer band and the first stage of mechanical cooling.

Economizer Mode: A control mode in which outside return and relief dampers are controlled by air temperature to provide the most economical heating and cooling.

Electronic Controls: Using very low voltages (20V or less) and currents for sensing and transmitting.

Energy Management: A number of techniques for reducing a building's energy consumption, while maximizing operating efficiency, all without drastic degradation of comfort.

Engineering Units: The units that a medium is measured in, represented by an abbreviation. Examples include degrees Fahrenheit (DEGF), kilowatts (KW), and feet per minute (FPM).

Enthalpy: For most HVAC applications, a measure of total heat (sensible plus latent) of air, measured above an arbitrary datum. The specific enthalpy of dry air is assigned a value of zero at 0 [degrees] F and U.S. standard atmospheric pressure (29.92 in. mercury), and is measured in Btu per pound of dry air.

E/P (Electric-Pneumatic Switch): An electrically operated air flow switch with normally closed and normally opened inputs which lead to a common output. Also known as solenoid air valve.

Evaporative Cooling: The adiabatic exchange of heat between air and a water spray or wetted surface. The wet bulb temperature of the air remains constant, but the dry bulb is decreased. Example: a swamp cooler.

Exhaust damper: A damper usually associated with an air handling unit. Usually modulates open as the outdoor air damper opens and the return air damper closes. Also called a relief damper.

Finish Point (System 8000): The voltage necessary to drive an actuator to complete its stroke. Example: An actuator with a 6-9 Vdc range, "9" is the finish point.

Finish Point (Pneumatic): The pressure necessary to completely compress the spring of an actuator and cause the actuator to complete its stroke. Example: An actuator with a 5-10 psi spring range, "10" is the finish point.

Floating Control/Action: While definitions vary, floating control is essentially two position control in which the controlled device (i.e., MF-XXXX Actuators) can stop at any point in its stroke at loss of control signal. The controlled device will hold this position until the controller senses another signal to reposition the controlled device.

FPM (Feet Per Minute): A unit of measure to quantify the velocity of air flow.

Freezestat: Refer to Low Temperature Thermostat.

GPM (Gallons Per Minute): A unit of measure to quantify water flow.

Gear Train Actuator: A controlled device that operates dampers or valves by producing a rotary motion as a result of an induction motor driving the output shaft through a series of gears. The motor is driven in either direction and can be stopped at any position so as to obtain proportional control. The electronic actuator drive is necessary to interface the DC signal of the controller and the induction motor.

Heat Pump: A refrigeration machine which is arranged to either heat or cool a building by using heat from the condenser section or by using cooling from the evaporator section.

High Limit: A controller generally located in the return air, that will turn off the fan of air handling units when the temperature increases above setpoint.

Humidity Controller: A device which senses and controls the moisture content of air.

Humidistat: An instrument which measures humidity and controls a device(s) for maintaining a desired humidity.

Hunting: The action of a controller which causes the controlled device to continuously travel from one end of its stroke to the other. Normally associated with proportional control. Hunting is an undesirable condition.

HVAC: Heating, ventilating, and air conditioning.

Glossary

Hydraulic Actuator: A controlled device that operates dampers or valves by producing a linear motion as a result of the fluid pressure developed from a continuously running motor pumping oil through a transducer. As the control signal increases the fluid pressure increases and as the control signal decreases the fluid pressure decreases allowing the spring to retract the output shaft.

Hydronics: The science dealing with the control of and use of water as a heat transfer medium in air conditioning systems.

Hygroscopic: Water absorbing.

IBS: Invensys Building Systems.

Immersion Sensor: A device with an extended element, which can be inserted into a well in order to sense the temperature in liquid lines and tanks.

Infiltration: The uncontrolled inward air leakage through cracks and joints in any building element and around windows and doors of a building, caused by the pressure effects of wind and/or the effect of difference in the indoor and outdoor air density.

Inlet Vane: An attachment to a centrifugal fan that restricts the flow of air into the fan housing. Also used on centrifugal chillers to restrict refrigerant flow.

Integral Control: A control action designed to eliminate/reduce offset in proportional control.

Interface: The point at which a connection is made between two devices so that they can work together. Software interfaces allow the user to interact with a computer. Hardware interfaces are cards, plugs, and other devices that connect hardware with the computer.

in. W.C. (Inches Water Column): A unit of pressure measurement used to measure and control low differential pressures. These pressures include duct static pressure relative to space static pressure, space static pressure relative to that of other spaces or outside atmospheric pressure, and the velocity pressure of air flowing in ducts.

Latent Heat: The amount of heat necessary to change a given quantity of water at 212°F (100°C) from liquid to vapor at constant barometric pressure.

Load Shedding: The turning off of electrical loads to limit peak electrical demand.

Low Limit: A control/application to prevent a sensed variable from falling below a dangerous or undesirable condition.

Low Temperature Thermostat: A duct thermostat with a capillary-type, vapor-filled sensing element installed across a duct. When any given section of the element (usually one foot) falls below setpoint, the thermostat is actuated, usually to stop the supply fan of an air handling unit and close the outdoor air and relief dampers. Available with manual or automatic reset.

Main or Supply Pressure (Pneumatic Controls): The force per unit area (psi) of the compressed air supplied to a controller. It is usually constant at 15 or 20 psig, but may have some other value in special cases.

Make-Up Air: Outdoor air brought into a building for ventilation and/or pressurization.

Make-Up Water: Water supplied to replenish that lost by leaks, evaporation, etc.

Minimum Position: A control sequence in which the controlled device is prevented from moving to the fully closed position even though the signal from the controller is at a value that would cause the controlled device to be fully closed. However, at a total loss of power or signal from the minimum position, the controlled device will typically go to a fail safe position.

I.E. Minimum Position of the outside air damper, for purposes of ventilation may require that a minimum of X% of outside air be introduced to the building when occupied. However, if there is a loss of power or a low limit that could freeze the coil, the outside dampers will close fully.

Mixing Box: A box containing dampers in the hot and cold air stream, mixing the two and delivering the air to a space at a specified temperature.

Mixing Valve: The three-way valve which has two inlets, one outlet, and can direct full flow from either inlet or proportion the flow from the two inlets.

National Electrical Manufacturers Association (NEMA): Defines a product, process, or procedure with reference to one or more of the following: nomenclature, composition, construction, dimensions, tolerances, safety, operating characteristics, performance, quality, rating, testing and the service for which the product is designed.

Night Setback (Heating): An application by which the setpoint is shifted to a lower value during unoccupied hours during the heating season.

Night Setup (Cooling): An application by which the setpoint is shifted to a higher value during unoccupied hours during cooling season.

Normally Closed (N.C.): Applies to the condition of a controlled device which closes when all operating force (control pressure or electric energy) is removed. i.e., power failure.

Normally Open (N.O.): Applies to the condition of a controlled device which is open when all operating force is removed.

Occupied Mode: A control mode used to heat or cool a building when it is occupied.

Offset: The amount of difference between control point and setpoint in a proportional control system.

Packaged Equipment: Off-the-shelf HVAC equipment.

Parallel Fan: For air terminal units, a system in which fans are located outside the primary airstream to allow intermittent fan operation.

Paralleling: A control arrangement in which several controlled devices are operated in unison as the signal from the controller changes. If these controlled devices are actuators they will operate over the same range.

Parameter: Any specific characteristic of a device. When considered together, all the parameters of a device describe its operational and physical characteristics.

P/E (Pneumatic-Electric Switch): An air pressure operated switch in which the contacts are made or broken in order to operate electrical devices in a pneumatic control system.

Peak Load: The maximum electrical or thermal load reached during a period of time.

Percent Authority: The adjustment of a receiver-controller which determines the effect of the reset signal of the secondary transmitter as a percentage of the signal of the primary transmitter.

Pneumatic: Controls powered by low-pressure compressed air.

Positive Positioner: Used where accurate positioning of the controlled device is required. Example: Pneumatic positive positioners provide up to full main air to the actuator for any change in position required by the controller. Positive positioners may also be referred to as pilot positioners.

Positive Positioning: The characteristic of a controlled device in which it has the maximum force available at any point of the stroke.

Pressure Drop: The difference in pressure between two points in a flow system, usually caused by frictional resistance to fluid flow in a conduit, filter, or other flow system.

Pressure Independent VAV: A control technique in which the flow of air (usually through a VAV terminal unit) is maintained essentially at the setpoint of a flow controller regardless of variations (reasonably controlled) in supply duct static pressure.

Proportional Control: A mode of control in which the controlled device may assume any position from fully closed to fully open, depending on the load at any given point in time.

PSIG (Gauge Pressure): The amount of pressure above atmospheric pressure.

Radiation: Heat energy transmitted from one body to another without the need of intervening matter. Moves in waves.

Range: (1) The minimum to maximum setpoint capability of a controller, (2) the minimum to maximum sensing capability of a transmitter, or (3) the start point to finish point of an actuator. Example: Controller - 55 to 85°F
Transmitter - 40 to 240°F
Actuator - 5 to 10 psi

Recovered Energy: Energy utilized which would otherwise be wasted from an energy utilization system.

Reheat: The process by which heat is added to preconditioned (cooled, humidified, etc.) primary air or recirculated room air.

Relative Humidity: The ratio of the amount of moisture that is present in the air to the amount that can be in the air at that temperature.

Relief Damper: A damper usually associated with an air handling unit. Usually modulates open as the outdoor air damper opens and the return air damper closes. Also called an exhaust damper.

Reset: Making use of a second (open loop) sensor whose function is to change the effective/desired setpoint of a controller automatically according to changes in the open loop conditions. Not to be confused with Automatic Reset.

Restrictor: A device which has a minute opening (0.005" or 0.0075") which changes the velocity pressure of the air line to static pressure.

Return Air: Air returning to the heater or conditioner from the heated or conditioned space.

Return Stroke (Pneumatic Actuators): Refers to the retraction of the actuator shaft as a result of the control pressure being less than opposing force of the spring.

Reverse Acting (R.A.): A decrease in the sensed media causes an increase in controller output (and vice-versa).

Reverse Reset: On multiple (typically two) input applications, when a decrease at the second (open loop) sensor causes the controller setpoint to be increased.

Rooftop Unit: Packaged heating/cooling or heating/cooling/ventilating unit designed to be mounted on the roof of a building. May be a small, single-zone unit; a large, complex unit supplying air to many VAV terminals; or anything in between.

RTD (Resistance Temperature Device): An electronic device which sensor temperature. As the temperature sensed changes the resistance changes. Example: Balco.

Run Time: For HVAC equipment, the total hours of actual running time since installation, the last maintenance, or a specified date.

Safety Shutdown: A process or device that prevents equipment from operating manually, such as during maintenance work.

Sensible Heat: The heat which changes the temperature of the air without a change in moisture content. Changes in dry bulb thermometer readings are indicative of changes in sensible heat.

Span: The difference between the start and finish point of range.

Example: Transmitter range 50° to 100° = span of 50°
Voltage Range 6 to 9 Volts = span of 3 volts
Spring Range of 3 to 8 psi = span of 5 psi

Sequencing: A control arrangement in which several actuators move through their stroke in succession as the signal from the controller changes.
Example: Electric; This arrangement is derived by using actuators with different voltage ranges (such as 3 to 6 Vdc and 6 to 9 Vdc) or by the use of a sequencing adaptor.
Pneumatic; This arrangement is derived by using actuators with different spring ranges (such as 3 to 8 psi and 8 to 13 psi) or by the use of a pneumatic relay.

Setpoint: The desired value assigned to a controller.
Example: The setpoint dial on a thermostat indicates the desired occupied condition.

Glossary

Short-Cycling: When equipment is turned on and off at frequent intervals. Normally associated with two-position control. (Short-cycling is an undesirable condition).

SPDT (Single-Point, Double-Throw): An electromechanical switch, which makes one circuit immediately upon breaking the other.

Spring Return: The movement of an actuator as a result of a decreasing voltage signal and therefore the force is supplied by a coiled or compressed spring. Upon a power interruption the spring will drive the actuator to a known position.

Squirrel Cage Fan: See Centrifugal fan.

Staged Heating/Cooling: A temperature control technique in which heating or cooling is turned in stages. For example, the farther away the temperature is from the setpoint, the more stages of heating or cooling are turned on.

Staging: A method of control in which the total capacity of a two-position mode of control application is divided into several levels of capacity so as to match the capacity to the load more evenly.

Stand-Alone: A device, such as a controller or computer, that does not require support from another device or system.

Stand-Alone Operation: Performance independent of direction of any other component in the system.

Start Point (Pneumatic): The pressure necessary to begin compressing the spring of an actuator, therefore, causing the actuator to begin its stroke. Example: An actuator with a 5 to 10 psi spring range, "5" is the start point.

Static Pressure Control: The process of regulating the air pressure inside a duct or a room in relation to a reference pressure. Usually controlled in terms of in. W. C.

Status: The state of a contact input that indicates the position of the field device. Examples include: on/off, stop/run, enable/disable, etc.

Strap-On Thermostat: A Controller designed for mounting on and sensing the temperature of a surface. Example: the surface of a pipe.

Stratification: Layers of air at different temperatures of different velocities flowing through a duct or plenum.

Stroke Length: The linear distance the actuator shaft moves.

Summer/Winter: A combination of a direct acting and a reverse acting thermostat. The term heating/cooling is synonymous.

Supply or Main Pressure (Pneumatic): The force per unit area (psi) of the compressed air supplied to a controller. It is usually constant at 15 to 20 psig, but may have some other value in special cases.

System 8000: This is an analog Electronic Component Controls.

Thermistor: A semiconductor whose resistance is extremely temperature sensitive. Like carbon, thermistors have negative temperature coefficients; that is, their resistance increases as temperature decreases. They are used to compensate for temperature variations in other parts of a circuit and are also used as transducers. Thermistors are not used in System 8000.

Thermostat: An instrument which measures temperature and controls device(s) for maintaining a desired temperature.

Throttling Range (Controller): Throttling range is the change in measured variable (temperature, pressure, liquid level, etc.) required to cause the controller output to vary a pre-defined range. In System 8000 this range is 6 to 9 volts. In Pneumatics, this range may be 3 to 13 psig or 3 to 15 psig.

Throttling Range (System): The amount of change of the variable necessary for the controller to drive the actuator(s) through their complete stroke(s).

Total Pressure: The sum of static and velocity pressure.

Transducer: A device which converts one form of energy into another form of energy.

Transmitter (Pneumatic): A sensor element located remote from the controller which bleeds off branch line air to create a varying pressure signal as input to the controller.

Transmitter (System 8000): A component added to a control system which allows temperature or relative humidity indication.

Tubeaxial Fan: An airfoil (propeller) fan within a cylinder and including driving mechanism supports for belt drive or direct connection.

Two-Position Control: A method of control in which the control device is either 100% open or closed; therefore, the controlled medium is flowing at these respective rates. Also called On-Off control.

VA: Volt ampere.

VAC: Volts alternating current.

Vaneaxial Fan: An airfoil (propeller) fan within a cylinder and equipped with air guide vanes before or after the wheel and including driving mechanism supports for belt drive or direct connection. Blades may have adjustable or controllable pitch.

Variable Air Volume (VAV): A system that controls space temperature by varying the quantity of supply air rather than by varying the temperature of the supply air.

Variable Frequency Drive: A device that varies the voltage to an electric motor to vary the speed of the motor (also called a speed drive.)

VDC: Volts direct current.

Velocity Pressure: The pressure caused by the air being in motion and has a direct relation to the velocity of the air.

Wet-Bulb Temperature: Air temperature as measured by a wet-bulb thermometer and which is lower than dry-bulb temperature (for all cases except when the air is saturated) in inverse proportion to the humidity.

Zone: A space or group of spaces within a building with heating and/or cooling requirements sufficiently similar so that comfort conditions can be maintained throughout by a single controlling device.

Zone Control: A control process in which a building is divided into different areas (zones). Each zone can be controlled independently.

Zoned Reheat: Provides zone or space control for areas of unequal loading and simultaneous heating or cooling of perimeter areas with different exposures. Heat is added as a secondary simultaneous process to preconditioned (cooled, humidified, etc.) primary air or recirculated room air.

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