600 Volt Class Transformers

FEDERAL PACIFIC

UL LISTED

ISO9001 Registered

Table of Contents - 600 Volt Class Transformers

Full Load Current Ratings

KVA Rating	Full Load Current (Amperes)			
	120 V	240 V	480 V	600 V
.050	0.42	0.21	0.1	0.08
.075	0.63	0.31	0.16	0.13
.100	0.83	0.42	0.21	0.17
.150	1.25	0.63	0.31	0.25
.250	2.08	1.04	0.52	0.42
.500	4.17	2.08	1.04	0.83
.750	6.25	3.13	1.56	1.25
1	8.33	4.17	2.08	1.67
1.5	12.5	6.25	3.13	2.5
2	16.7	8.33	4.17	3.33
3	25	12.5	6.25	5
5	41.7	20.8	10.4	8.33
7.5	62.5	31.3	15.6	12.5
10	83.3	41.7	20.8	16.7
15	125	62.5	31.2	25
25	208	104	52	41.7
37.5	312	156	78.1	62.5
50	417	208	104	83.3
75	625	312	156	125
100	833	417	208	167
167	1392	696	348	278
333	2775	1387	694	555

KVA Rating	Full Load Current (Amperes)			
	208 V	240 V	480 V	600 V
3	8.33	7.22	3.61	2.89
6	16.6	14.4	7.22	5.77
9	25	21.6	10.8	8.66
15	41.6	36.1	18	14.4
25	69.4	60.1	30.1	24.1
30	83.3	72.2	36.1	28.9
37.5	104	90.2	45.1	36.1
45	125	108	54.1	43.3
50	139	120	60.1	48.1
60	166	144	72.2	57.7
75	208	180	90.2	72.2
100	278	241	120	96.2
112.5	312	271	135	108
150	416	361	180	144
225	625	541	271	217
300	833	722	361	289
400	1110	962	481	385
500	1388	1203	601	481
750	2082	1804	902	722
1000	2776	2406	1203	962

$$\text{Single-Phase KVA} = \frac{\text{Volts x Load Amperes}}{1000}$$

$$\text{Three-Phase KVA} = \frac{\text{Volts x Load Amperes x 1.73}}{1000}$$

General Information

What is a Transformer?

A transformer is an electrical apparatus designed to convert alternating voltage from one voltage level to another. Transformers are completely static devices without continuously moving mechanical parts, which, by electromagnetic induction, transform electrical energy from one or more circuits to one or more other circuits at the same frequency.

In most cases, transformers change the voltage from an incoming source to its outgoing load. Transformers can be used to increase (step up) or decrease (step down) voltages. Sometimes transformers do not change voltages; that is, they are not used for step up or step down purposes. These transformers are called **isolation** transformers.

Electric power is always distributed over a wide area by means of alternating current. Direct current is not used for several reasons, the most important being that it cannot be changed from one voltage level to another without expensive conversion equipment. Alternating current however can be simply changed to any convenient voltage by the use of transformers.

Description

Federal Pacific dry-type transformers rated 600 volts and below are available in a wide variety of types and ratings to provide reliable and versatile electrical distribution for lighting and power loads in industrial and commercial applications.

Ratings in the 600V class are available from .050 through 333 KVA in single-phase configurations and from 3 through 1500 KVA in three-phase. All standard primary and secondary voltage ratings are provided to match load requirements to the distribution system.

The air cooled dry-type construction requires no special vaults for installation. The units may be located in almost any indoor location convenient to the load being served. Most transformers are also available for outdoor installations. Maintenance requires only periodic inspection of cable connections and removal of any dust accumulation.

Industry Standards

Federal Pacific dry-type transformers are UL Listed and are designed, tested, and manufactured in accordance with applicable industry standards:

- UL-506 & UL 1561
- ANSI C57.12
- NEMA ST-20, TP1
- CSA # C22.2 No. 47
- CUL
- EPACT 2005 (TP-1 & TSL-2)

Tested Performance

Ratio Test is performed on rated voltage connection and tap connections to assure proper turns ratio on all connections.

Polarity Test and phase relation tests are made to ensure proper polarity and marking because of their importance in paralleling or banking two or more transformers.

No-load (excitation) Loss Test determines the losses of a transformer which is excited at rated voltage and frequency, but which is not supplying a load. Transformer excitation loss consists mainly of the iron loss in the transformer core.

Load Loss Test determines the amount of losses in the transformer when carrying full rated load. These losses consist primarily of I^2R losses in the primary and secondary winding and ensure that specifications of the transformer design are met.

Excitation Current Test determines the current necessary to maintain transformer excitation.

Resistance Test is performed on the transformer windings and is used to determine I^2R loss.

Impedance Test is made to insure that transformer design standards are attained.

Dielectric Test (applied and induced potential) checks the insulation and workmanship to demonstrate that the transformer has been designed and manufactured to meet the insulation tests required by the standards.

Applied Potential Tests are made by impressing between windings and between each winding and ground, a low frequency voltage.

Induced Potential Tests call for over-exciting the transformer by applying between the terminals on one winding a voltage of twice the normal voltage developed in the winding for a period of 7200 cycles.

Primary Taps

All Federal Pacific three-phase transformers and most single-phase models are provided with taps in the primary winding to compensate for input voltage variations. The taps will provide a range of voltage adjustment above and/or below the nominal voltage rating of the transformer. The available quantity, location, and percentage of the tap connections are shown in the transformer listings. All transformers are furnished with a nameplate showing the terminal and tap arrangements.

Selection and Application Considerations

Selection Steps

- Determine the system supply voltage available (primary voltage).
- Determine the required load voltage rating (secondary voltage).
- Determine the KVA rating of the load. (If the load rating is given only in amperes, the proper KVA size of the transformer can be selected from the charts on page 12.) The KVA capacity of the transformer must equal or be greater than the load rating.
- Select a transformer model from the listings on the following pages.

Connections

Many single-phase transformers are provided with a series multiple winding construction and a dual voltage primary or secondary identification (i.e. 240 x 480 to 120/240). These transformers will have two windings on the primary or secondary that can be connected either in series for the higher voltage or in parallel for the lower voltage. Transformers with voltage ratings containing an "x" can only be connected for one or the other of the two voltages. On those units with voltage ratings separated by a "slant", the windings can be connected to provide either or both voltages (three wire operation).

Three-phase transformers are provided with a delta primary for three wire input and either a wye secondary for four wire output or a delta secondary for three wire output. Transformers with 240 volt delta secondaries may have a 120 volt single-phase lighting tap as a standard feature. Maximum single-phase 120 volt load should not exceed 10% of the three-phase KVA rating. The load should also be balanced at 5% maximum between terminals X1 to X4 and 5% between terminals X2 to X4. The three-phase KVA must also be reduced by 30% of the nameplate rating. For example, a 45 KVA transformer can have a 4.5 KVA maximum single-phase, 120 volt load. Of that 4.5 KVA, 2.25 KVA must be loaded between X1 - X4 and 2.25 KVA must be loaded between X2 - X4. The three-phase KVA rating must be reduced to 31.5 KVA.

Preferred 3-Phase Connections

(Applies to 600 volt and medium volt ratings)

For two winding transformers:
The preferred winding connections are: Delta-Wye, Delta-Delta and Wye-Delta. For all of the above connections a three-legged core construction will be employed.

For a Wye-Wye connection Federal Pacific recommends that a four-legged or five-legged core be employed.

For auto-transformers:
Federal Pacific recommends using a Wye-Wye connection to minimize cost. Precautions to avoidunbalanced phase loading conditions should be undertaken.

Sound Levels

A humming sound is an inherent characteristic of transformers due to the vibration caused by alternating flux in the magnetic core. Sound levels will vary according to transformer size. Attention to installation methods can help reduce any objectionable noise.

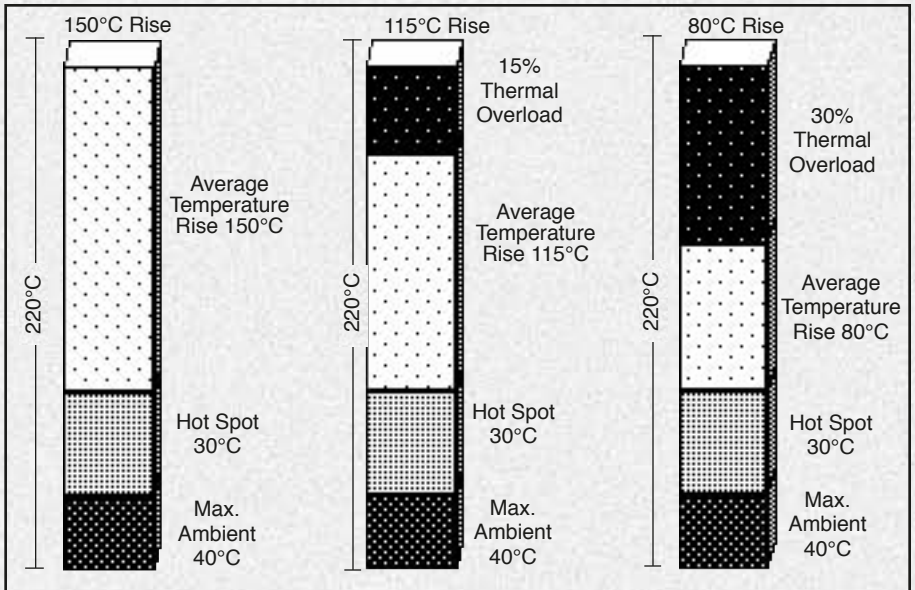
When possible, locate the transformer in an area where the ambient sound will be equal to or greater than the transformer sound level. Avoid locating units in corners. Make connections with flexible conduits and couplings to prevent transmitting vibration to other equipment. Larger units should be installed on flexible mountings to isolate the transformer from the building structure.

Federal Pacific transformers are designed, built, and comply with NEMA maximum sound level requirements as measured in accordance with NEMA ST-20 and IEEE C57.12.01.

Sound Level in Decibels	
kVA 150° C Rise K-1	NEMA ST-20 Average
0-9	40
10-50	45
51-150	50
151-300	55
301-500	60
501-700	62
701-1000	64

Temperature

Insulation system limiting temperatures for FH Style dry-type transformers are classified by industry standards based on a 40°C ambient, 25°C ambient for FB Styles.



Definition of Average Temperature Rise

Selection and Application Considerations

Altitude

Standard self-cooled dry-type transformers are designed for operation with normal temperature rise at altitudes up to 3300 ft. above sea level. The transformer rated KVA should be reduced by 0.3% for each 330 ft. the transformer is installed above 3300 ft.

Polarity

Transformer polarity is an indication of the direction of current flow through the high voltage terminals with respect to the direction of current flow through the low voltage terminals at any given instant in the alternating cycle.

Primary and secondary terminals are said to have the same (or additive) polarity when, at a given instant, the current enters the primary terminal in question and leaves the secondary terminal in question in the same direction as though the two terminals formed a continuous circuit.

Single-phase transformers rated 600 volts and below normally have additive polarity.

The polarity of a three-phase transformer is fixed by the internal connections between phases. It is usually designated by means of a vector diagram showing the angular displacement of the windings and a sketch showing the markings of the terminals.

Angular Displacement

The angular displacement of a three-phase transformer is the time angle expressed in degrees between the line-to-neutral voltage of a specified high voltage terminal and the line-to-neutral voltage of a specified low voltage terminal.

The angular displacement between the high voltage and low voltage terminal voltages of three-phase transformers with delta-delta connections is zero degrees.

The angular displacement for three-phase transformers with delta-wye connections is 30 degrees with the low voltage lagging the high voltage.

Parallel Operation

Transformers with the same KVA ratings can be connected in parallel if required conditions are met. Single-phase transformers must have the same voltage rating, tap settings and frequency rating. Plus, the impedance values of the transformers must be within 7.5% of each other. When paralleling three-phase transformers, the same conditions would apply and, in addition, the angular displacement of the transformers must be the same.

Transformer Banking

Three single-phase transformers can be properly connected to supply a three-phase load. The single-phase units can be used in a three-phase bank with delta connected primary and wye or delta connected secondary. The equivalent three-phase capacity would be three times the nameplate rating of each single-phase transformer. For example, three 15 KVA single-phase transformers will, when properly banked, accommodate a 45 KVA three-phase load.

Balanced Loading

Single-phase loads connected to the secondary of a transformer must be distributed so as not to overload any one winding of the transformer.

Single-phase transformers generally have two winding secondaries that can be connected for 120/240 volt three wire operation. When so arranged, care must be taken when connecting 120 volt loads to assure that the total connected load on each secondary winding does not exceed one-half the nameplate KVA rating.

When connecting single-phase loads on a three-phase transformer, each phase must be considered as a single-phase transformer. The single-phase loading on each phase of a three-phase transformer must not exceed one-third of the nameplate KVA rating. For example, a 45 KVA three-phase transformer with a 208Y/120 Volt secondary should not have any 120 volt single-phase loads distributed such that more than 15 KVA of single-phase load is applied to any one phase.

Transformer Protection (Reference N.E.C. Article 450)

Transformers - 600 Volts or Less Primary Protection Only

If secondary protection is not provided, a transformer must be protected by an individual overcurrent device on the primary side. The primary overcurrent device must be rated: No more than 125% of the rated primary current or the next higher standard device rating (for primary currents of 9 amperes or more); no more than 167% of the rated primary current (for 2 amperes to 9 amperes); and no more than 300 % of the rated primary current (for ratings less than 2 amperes). An individual transformer primary protective device is not necessary where the primary circuit overcurrent protective device provides the required protection.

Primary & Secondary Protection

If the transformer secondary is protected by an overcurrent protective device rated no more than 125% of the transformer rated secondary current (or the next higher standard rating device), an individual primary protective device is not required provided the primary feeder circuit overcurrent device is rated no more than 250% of the transformer rated primary current.

Selection and Application Considerations

For Reverse Feed (Back feed), or Step-Up Operation Only

Step-down transformers may be reverse fed for step-up operation to increase voltage. This means that the incoming power is connected to the low voltage (X's) and the load is connected to the high voltage (H's). If the low voltage is wye, the X0 terminal must **NOT** be connected in any way. Likewise, if the low voltage is a delta with a 120 volt lighting tap (high-leg), the X4 terminal must **NOT** be connected in any way.

CAUTION: Much higher than normal inrush currents may occur with reverse feed operation and may cause nuisance fuse blowing or breaker tripping. For this reason, fuses and breakers with time-delay characteristics must be used.

If a breaker is used for incoming over-current protection, it must be a thermal-magnetic type breaker, not a magnetic-only type breaker.

Type FB Transformers

Non-Ventilated • Indoor / Outdoor

Single-Phase: .050 to 15 KVA
Three-Phase: 3 to 15 KVA

Construction

The Type FB dry-type transformer is a totally enclosed, compound filled transformer. The core and coil assembly is embedded in a polyester resin compound which provides a solid insulation. The embedding compound has an extremely high heat transfer rate which permits a design of minimum size and weight. The compound-filled assembly is completely encased in a sturdy steel housing and cannot be damaged by dust, moisture, or adverse atmospheric conditions.

- Intentionally designed for a low enclosure temperature rise, **no** UL-506 special markings are needed to indicate clearance between the enclosure and adjacent surfaces.
- Type FB transformers are made in a temperature class based on a 25°C ambient, 115°C rise, 180°C insulation system.
- Sound level problems are negligible with Type FB transformers because the core and coils are rigidly encased in the polyester resin which is mechanically strong and acts as sound deadening material. Average sound levels are consistently below NEMA standards.
- A large wiring compartment with knockouts permits fast wiring connections. Compartment temperatures can attain temperatures reaching 90°C; therefore 90°C cable should be used.
- All units are supplied with flexible cable leads marked with easy identification, and are supplied with wall-mounting brackets to reduce installation time.

Application

Federal Pacific UL & CUL Listed Type FB dry-type transformers can be used in industrial, commercial, institutional, and residential installations for economical, efficient distribution of power.

Typical loads served include tanning beds, motors, lighting, heating, ranges, air conditioners, exhaust fans, control circuits, appliances, and portable tools. Other applications are found in pumping stations, mining and shipboard distribution systems.

Type FB units are ideal for dusty industrial areas and are suitable for **Indoor / Outdoor** applications.

Single-Phase
.050 to 3 KVA

Single-Phase
5 KVA to 15 KVA

Three-Phase
3 KVA to 15 KVA

Type FH Transformers

Ventilated
Single-Phase: 15 to 167 KVA
Three-Phase: 7.5 to 1000 KVA

Construction
The Type FH line of ventilated dry-type transformers incorporates wire and/or strip wound coils in a barrel wound configuration. Horizontal and vertical spacers are strategically positioned in the windings to brace the winding layers and allow maximum ventilation. The electrical grade core steel is arranged in a construction designed to accommodate the coils.

Vibration Dampening System
The core and coil assembly is anchored to the enclosure through a vibration dampening system to reduce noise levels. Units through 600 KVA are provided with neoprene isolating pads while larger units are furnished with three layer rubber and cork pads. A flexible grounding conductor is installed between the core and coil assembly and the transformer enclosure.

Rugged Enclosure
Enclosures are rigidly braced and covers are fastened with slotted hex head screws for ease of removal. A rugged steel base supported by mounting feet opened outward provides safe handling with a fork lift and easy attachment to mounting pad.

Wiring Compartments
Front accessible wiring compartments are approved for 90°C cable. Terminals are sized to carry the full current capacity of the transformers.

UL Listed 220 °C Insulation System
To attain UL listing, it was necessary to complete an accelerated aging test as specified by Underwriters Laboratories, Inc.

This insulation system was subjected to a series of exposures to heat, vibration, moisture, and dielectric tests. As a proven system this insulation system has received from Underwriters Laboratories, Inc. a recognized 220°C continuous rating. This total temperature of 220°C is derived from the average conductor temperature rise of 150°C, hotspot temperature gradient of 30°C, and an ambient temperature of 30°C.

The major components that allow for this 220°C rating are Nomex®† paper, resin-glass laminates, silicon rubber, and polyester varnish. This combination of materials and the care taken in construction and workmanship, not only give Federal Pacific Type FH Transformers a long operating life, but helps insure their quiet operation.

Versatile Performance
The design features of the Federal Pacific Type FH family of UL Listed transformers assures versatile, economical, and reliable distribution of power. All transformers are fully tested to insure trouble-free installation and operation. The unique combination of ratings makes the FH family suitable for a wide variety of applications.

† *Dupont T.M.*

Typical Ventilated Dry-Type Transformer Construction

Optional Temperature Rise Transformers

Energy Saving Optional Temperature Rises

Transformers are specifically designed for optimum performance on systems with a continuous high loading factor. The units feature either 80°C or 115°C temperature rise utilizing a 220°C insulation system which provides extended life and inherent overload capability (15% for 115°C and 30% for 80°C.) The transformers provide lower losses and minimize operating costs. The amount of savings will depend on loading factors and local energy costs. (See page 27 for single-phase model listings and 32-37 for three-phase model listings.)

Electrostatically Shielded Transformers

Electrostatically shielded transformers are designed to protect primary systems from unwanted high-frequency signals generated by loads connected to the transformers secondary.

While all transformers with separate primary and secondary windings isolate the load circuits, transients and electrical noise can be transmitted through the interwinding capacitance of the transformer.

These disturbances may have a detrimental effect on sensitive electronic equipment and can cause improper operation. Electrostatic shielding brings these unwanted signals to ground thus preventing the electrical disturbances from being transmitted to the load circuits.

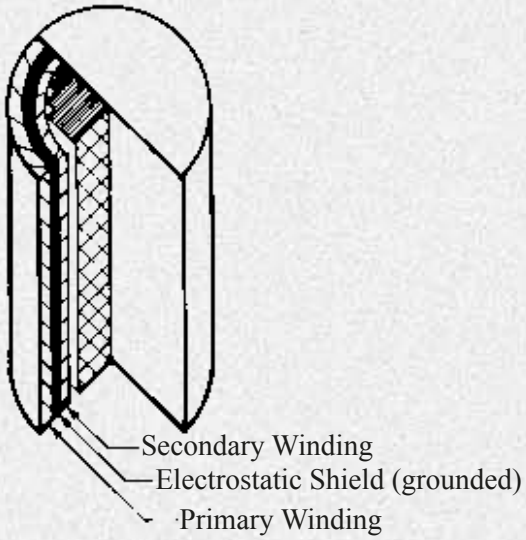
Federal Pacific UL Listed electrostatically shielded transformers provide all the quality features of the transformer plus an electrostatic shield consisting of a single turn, full height, copper or aluminum strip placed between the primary and secondary windings with a lead run to the transformer ground.

Applications

Electronic products ranging from solid state control relays to complex medical equipment are susceptible to malfunction due to transient disturbances in the power supply.

Typical applications would include:

- Hospital Operating Rooms
- X-Ray Equipment
- Computer Installations
- Data Processing
- Instrumentation
- Programmable Controllers



Cutaway Sketch, Shielded Transformer Winding

Energy Efficient Transformers

15 kVA through 1000 kVA

Federal Pacific's Energy Efficient Transformers are designed to meet the guidelines offered by the National Electrical Manufacturers Association (NEMA) Standard TP-1-2002 and EPACT 2005.

The NEMA guidelines require low voltage (600 V or less) isolation-type distribution transformers 15 kVA and above to have efficiency ratings as set forth in the NEMA Standard "Guide for Determining Energy Efficiency for Distribution Transformers".

This guideline considers the Total Ownership Cost (TOC) method where loading is defined as being 35% of nameplate at a temperature of 75° C.

The Key Product Criteria as defined in Table 1 (below) for Industrial Transformers (Single and Three-Phase) relates the required efficiency level by kVA.

Federal Pacific "Energy Efficient Transformers" are in compliance with NEMA TP-2 and TP-3. TP-2 outlines acceptable test methods and efficiency measurement requirements and TP-3 provides acceptable labeling.

Standards and Certifications

All Federal Pacific dry-type transformers are built and tested to applicable Industry Standards of ANSI, NEMA and IEEE.

TABLE 1*

NEMA Class 1 Efficiency Levels for Dry-Type Distribution Transformers

Single Phase		Three Phase	
kVA	**Efficiency Level (%)**	**kVA**	**Efficiency Level (%)**
15	97.7	15	97.0
25	98.0	30	97.5
37	98.2	45	97.7
50	98.3	75	98.0
75	98.5	112.5	98.2
100	98.6	150	98.3
157	98.7	225	98.5
250	98.8	300	98.6
333	98.9	500	98.7
		750	98.8
		1000	98.9

*Efficiencies shown at 35% load and 75°C as defined by NEMA Standard TP-1-2002

Type FB Buck-Boost Transformers

Application

The Type FB Insulating and Buck-Boost Transformer has four separate windings, two windings in the primary and two windings in the secondary. The unit is designed for use as an isolating transformer or as an auto-transformer. As an autotransformer the unit can be connected to Buck (decrease) or Boost (increase) a supply voltage. When connected in either the Buck or Boost mode, the unit is no longer an isolating transformer but is an autotransformer.

Autotransformers are more economical and physically smaller than equivalent two-winding transformers designed to carry the same load. They will perform the same function as two-winding transformers with the exception of isolating two circuits. Since autotransformers may transmit line disturbances directly, they may be prohibited in some areas by local building codes. Before applying them, care should be taken to assure that they are acceptable according to local code.

Note: Three autotransformers are not used in closed delta connections as they introduce into the circuit a phase shift.

As isolating transformers, these units can accommodate a high voltage of 120x240 volts (SB12N and SB16N series) or 240x480 volts (SB24N series.) For the units with two 12 volt secondaries, the low voltage output can be 12 volts, 24 volts, or 3-wire 24/12 volts. For the units with two 16 volt secondaries, the output voltages can be 16 volts, 32 volts, or 3-wire 32/16 volts. For the units with two 24 volt secondaries, the output voltages can be 24 volts, 48 volts, or 3 wire 48/24 volts.

Operation

Electrical and electronic equipment is designed to operate on a standard supply voltage. When the supply voltage is constantly too high or too low, (usually greater than ± 5%), the equipment may fail to operate at maximum efficiency. A Buck-Boost transformer is a simple and economical means of correcting this off-standard voltage up to ± 20%. A Buck-Boost transformer will NOT, however, stabilize a fluctuating voltage.

Buck-Boost transformers are suitable for use in a three-phase autotransformer bank in either direction to supply 3-wire loads. They are also suitable for use in a three-phase autotransformer bank which provides a neutral return for unbalanced current. They are not suitable for use in a three-phase autotransformer bank to supply a 4-wire load when the source is only a 3-wire circuit, having no neutral.

Selection

To select the proper transformer for Buck-Boost applications, determine:

1. Input Line Voltage- the voltage that you want to buck (decrease) or boost (increase). This can be found by measuring the supply line voltage with a voltmeter.

2. Output Load Voltage- the voltage at which your equipment is designed to operate. This is listed on the nameplate of the load equipment.

3. Load KVA or Load Amps- you do not need to know both - one or the other is sufficient for selection purposes. This information usually can be found on the nameplate of the equipment that you want to operate.

4. Number of Phases- single- or three-phase line and load should match because a transformer is not capable of converting single-phase to three-phase. It is, however, a common application to make a single-phase transformer connection from a three-phase supply by use of one leg of the three-phase supply circuit. Care must always be taken not to overload the leg of the three-phase supply. This is particularly true in a Buck-Boost application because the supply must provide the load KVA, not just the nameplate rating of the Buck-Boost transformer.

5. Frequency- the supply line frequency must be the same as the frequency of the equipment to be operated - either 50 or 60 hertz.

Six Step Selection

1. Choose the selection table with the correct number of phases. Tables I, III and V for single-phase applications and Tables II, IV and VI for three-phase applications. Tables I and II are for 120x240-12/24 volt units, tables III and IV are for 120x240-16/32 volt units and tables V and VI are for 240x480-24/48 volt units.

2. Line/Load voltage combinations are listed across the top of the selection table. Use the boosting or bucking columns where appropriate.

3. Follow the selected column down until you find either the load KVA or load amps of your application. If you do not find the exact value, go on to the next highest rating.

4. Follow across the table to the far left-hand side to find the catalog number of the transformer you need.

5. Follow the column of your line/load voltage to the bottom to find the connection diagram for this application. NOTE: Connection diagrams show low voltage and high voltage connection terminals. Either can be input or output depending on buck or boost application.

6. In the case of three-phase loads, two (open Delta) or three (Wye) single-phase transformers are required as indicated in the "quantity required" line at the bottom of Table II, IV or VI. Select depending on whether a Wye connected bank of three transformers with a neutral is required or whether an open Delta connected bank of two transformers for a Delta connected load will be suitable.

For line/load voltages not listed on table, use the pair listed on the table that is slightly above your application for reference. Then apply the first formula at the bottom of the page to determine "New" output voltage. The new KVA rating can be found using the second formula.

For more buck-boost combinations and connections go to our Buck-Boost Program Selector at ***www.federalpacific.com/bbcalc.xls***.

Buck-Boost Technical Data

Type FB: 115° C Rise • 180° C Insulation System • Non-Ventilated • Indoor/Outdoor

Type	KVA	Catalog Number	Taps	Approximate Enclosure Dimension - Inches			Aprox. Total Lbs.	Weather Shield	Wiring Diagram †	Wall Mount Bracket
				H	W	D				
120 x 240 - 12/24 Volts, 60 Hz, No Taps										
FB	0.050	SB12N.050F	No Taps	8.25	3.25	4.25	8	N/R	10A	N/A
	0.100	SB12N.100F	No Taps	8.25	3.25	4.25	10	N/R	10A	N/A
	0.150	SB12N.150F	No Taps	9.25	4	5	14	N/R	10A	N/A
	0.250	SB12N.250F	No Taps	9.25	4	5	15	N/R	10A	N/A
	0.500	SB12N.500F	No Taps	11.25	5.25	6.5	21	N/R	10A	N/A
	0.750	SB12N.750F	No Taps	11.25	5.25	6.5	25	N/R	10A	N/A
	1	SB12N1F	No Taps	11.25	5.25	6.5	28	N/R	10A	N/A
	1.5	SB12N1.5F	No Taps	13.25	6.25	7.75	45	N/R	10A	N/A
	2	SB12N2F	No Taps	13.25	6.25	7.75	50	N/R	10A	N/A
	3	SB12N3F	No Taps	13.25	6.25	7.75	60	N/R	10A	N/A
	5	SB12N5F	No Taps	15	10.187	10.625	110	N/R	10A	N/A
120 x 240 - 16/32 Volts, 60 Hz, No Taps										
FB	0.050	SB16N.050F	No Taps	8.25	3.25	4.25	8	N/R	10A	N/A
	0.100	SB16N.100F	No Taps	8.25	3.25	4.25	10	N/R	10A	N/A
	0.150	SB16N.150F	No Taps	9.25	4	5	14	N/R	10A	N/A
	0.250	SB16N.250F	No Taps	9.25	4	5	15	N/R	10A	N/A
	0.500	SB16N.500F	No Taps	11.25	5.25	6.5	21	N/R	10A	N/A
	0.750	SB16N.750F	No Taps	11.25	5.25	6.5	25	N/R	10A	N/A
	1	SB16N1F	No Taps	11.25	5.25	6.5	28	N/R	10A	N/A
	1.5	SB16N1.5F	No Taps	13.25	6.25	7.75	45	N/R	10A	N/A
	2	SB16N2F	No Taps	13.25	6.25	7.75	50	N/R	10A	N/A
	3	SB16N3F	No Taps	13.25	6.25	7.75	60	N/R	10A	N/A
	5	SB16N5F	No Taps	15	10.187	10.625	110	N/R	10A	N/A
240 x 480 - 24/48 Volts, 60 Hz, No Taps										
FB	0.050	SB24N.050F	No Taps	8.25	3.25	4.25	8	N/R	10A	N/A
	0.100	SB24N.100F	No Taps	8.25	3.25	4.25	10	N/R	10A	N/A
	0.150	SB24N.150F	No Taps	9.25	4	5	14	N/R	10A	N/A
	0.250	SB24N.250F	No Taps	9.25	4	5	15	N/R	10A	N/A
	0.500	SB24N.500F	No Taps	11.25	5.25	6.5	21	N/R	10A	N/A
	0.750	SB24N.750F	No Taps	11.25	5.25	6.5	25	N/R	10A	N/A
	1	SB24N1F	No Taps	11.25	5.25	6.5	28	N/R	10A	N/A
	1.5	SB24N1.5F	No Taps	13.25	6.25	7.75	45	N/R	10A	N/A
	2	SB24N2F	No Taps	13.25	6.25	7.75	50	N/R	10A	N/A
	3	SB24N3F	No Taps	13.25	6.25	7.75	60	N/R	10A	N/A
	5	SB24N5F	No Taps	15	10.187	10.625	110	N/R	10A	N/A

† Connection diagram when used as an isolation transformer

N/R - Not Required

Buck-Boost Selection Tables

120 x 240 Volts Primary - 12/24 Volts Secondary • Buck - Boost Dry-Type Transformers

AMPS = Load Amps
KVA = Load Circuit KVA

Single-Phase

TABLE I

Catalog Number		BOOSTING								BUCKING					
	Line-Voltage	96	100	105	109	189	208	218	220	125	132	229	245	250	252
	Load Voltage	115	120	116	120	208	229	240	242	114	120	208	223	227	240
SB12N.050F	KVA	0.24	0.25	0.48	0.50	0.43	0.48	0.50	0.50	0.52	0.55	0.48	0.51	0.52	1.05
	AMPS	2.08	2.08	4.17	4.17	2.08	2.08	2.08	2.08	4.58	4.58	2.29	2.29	2.29	4.38
SB12N.100F	KVA	0.48	0.50	0.96	1.00	0.87	0.95	1.00	1.01	1.04	1.10	0.95	1.02	1.04	2.10
	AMPS	4.17	4.17	8.33	8.33	4.17	4.17	4.17	4.17	9.17	9.17	4.58	4.58	4.58	8.75
SB12N.150F	KVA	0.72	0.75	1.44	1.50	1.30	1.43	1.50	1.51	1.56	1.65	1.43	1.53	1.56	3.15
	AMPS	6.25	6.25	12.50	12.50	6.25	6.25	6.25	6.25	13.75	13.75	6.87	6.87	6.87	13.13
SB12N.250F	KVA	1.20	1.25	2.41	2.50	2.17	2.38	2.50	2.52	2.60	2.75	2.39	2.55	2.60	5.25
	AMPS	10.42	10.42	20.83	20.83	10.42	10.42	10.42	10.42	22.92	22.92	11.46	11.46	11.46	21.88
SB12N.500F	KVA	2.40	2.50	4.81	5.00	4.33	4.77	5.00	5.04	5.21	5.50	4.77	5.10	5.21	10.50
	AMPS	20.83	20.83	41.67	41.67	20.83	20.83	20.83	20.83	45.83	45.83	22.92	22.92	22.92	43.75
SB12N.750F	KVA	3.60	3.75	7.22	7.49	6.5	7.15	7.49	7.56	7.81	8.25	7.16	7.66	7.81	15.75
	AMPS	31.25	31.25	62.50	62.50	31.25	31.25	31.25	31.25	68.75	68.75	34.37	34.37	34.37	65.63
SB12N1F	KVA	4.80	5.00	9.63	9.99	8.66	9.53	9.99	10.08	10.42	11.00	9.54	10.21	10.42	21.00
	AMPS	41.67	41.67	83.33	83.33	41.67	41.67	41.67	41.67	91.67	91.67	45.83	45.83	45.83	87.50
SB12N1.5F	KVA	7.20	7.5	14.44	14.99	12.99	14.30	14.99	15.13	15.62	16.50	14.31	15.31	15.62	31.50
	AMPS	62.50	62.50	125.00	125.00	62.50	62.50	62.50	62.50	137.50	137.50	68.75	68.75	68.75	131.25
SB12N2F	KVA	9.60	10.00	19.25	19.98	17.32	19.07	19.98	20.17	20.83	22.00	19.08	20.42	20.83	42.00
	AMPS	83.33	83.33	166.67	166.67	83.33	83.33	83.33	83.33	183.33	183.33	91.67	91.67	91.67	175.00
SB12N3F	KVA	14.40	15.00	28.88	29.98	25.99	28.60	29.98	30.25	31.25	33.00	28.62	30.62	31.25	63.00
	AMPS	125.00	125.00	250.00	250.00	125.00	125.00	125.00	125.00	275.00	275.00	137.50	137.50	137.50	262.50
SB12N5F	KVA	24.00	25.00	48.13	49.96	43.31	47.67	49.96	50.42	52.08	55.00	47.71	51.04	52.08	105.00
	AMPS	208.33	208.33	416.67	416.67	208.33	208.33	208.33	208.33	458.33	458.33	229.17	229.17	229.17	437.50
*DIAGRAM		B	B	A	A	D	D	D	D	A	A	D	D	D	C

Three-Phase

TABLE II

Catalog Number		BOOSTING									BUCKING				
	Line Voltage	189Y/109	195Y/113	200Y/115	208Y/120	416Y/240	416Y/240	189	208	220	218	229	250	255	264
	Load Voltage	208Y/120	234Y/135	240Y/139	229Y/132	458Y/264	437Y/252	208	229	242	208	208	227	232	240
SB12N.050F	KVA	1.50	0.84	0.87	1.65	1.65	3.15	0.75	0.83	0.87	1.57	0.83	0.90	0.92	0.95
	AMPS	4.17	2.08	2.08	4.17	2.08	4.17	2.08	2.08	2.08	4.38	2.29	2.29	2.29	2.29
SB12N.100F	KVA	3.00	1.69	1.73	3.30	3.30	6.30	1.50	1.65	1.75	3.15	1.65	1.80	1.84	1.91
	AMPS	8.33	4.17	4.17	8.33	4.17	8.33	4.17	4.17	4.17	8.75	4.58	4.58	4.58	4.58
SB12N.150F	KVA	4.5	2.53	2.60	4.95	4.95	9.46	2.25	2.48	2.62	4.72	2.48	2.71	2.76	2.86
	AMPS	12.50	6.25	6.25	12.50	6.25	12.50	6.25	6.25	6.25	13.13	6.87	6.87	6.88	6.88
SB12N.250F	KVA	7.50	4.22	4.33	8.26	8.26	15.76	3.75	4.13	4.37	7.87	4.13	4.51	4.60	4.76
	AMPS	20.83	10.42	10.42	20.83	10.42	20.83	10.42	10.42	10.42	21.88	11.46	11.46	11.46	11.46
SB12N.500F	KVA	15.00	8.44	8.66	16.51	16.51	31.52	7.50	8.26	8.73	15.73	8.26	9.02	9.20	9.53
	AMPS	41.67	20.83	20.83	41.67	20.83	41.67	20.83	20.83	20.83	43.75	22.92	22.92	22.92	22.92
SB12N.750F	KVA	22.51	12.67	12.99	24.77	24.77	47.28	11.25	12.38	13.10	23.60	12.39	13.53	13.80	14.29
	1AMPS	62.50	31.25	31.25	62.50	31.25	62.50	31.25	31.25	31.25	65.63	34.37	34.37	34.37	34.38
SB12N1F	KVA	30.01	16.89	17.32	33.02	33.02	63.05	15.00	16.51	17.46	31.47	16.53	18.04	18.40	19.05
	AMPS	83.33	41.67	41.67	83.33	41.67	83.33	41.67	41.67	41.67	87.50	45.83	45.83	45.83	45.83
SB12N1.5F	KVA	45.01	25.66	25.98	49.54	49.54	94.57	22.51	24.77	26.20	47.20	24.79	27.06	27.60	28.58
	AMPS	125.00	62.50	62.50	125.00	62.50	125.00	62.50	62.50	62.50	131.25	68.75	68.75	68.75	68.75
SB12N2F	KVA	60.02	33.77	34.64	66.05	66.05	126.09	30.01	33.02	34.93	62.93	33.05	36.08	36.81	38.11
	AMPS	166.67	83.33	83.33	166.67	83.33	166.67	83.33	83.33	83.33	175.00	91.67	91.67	91.67	91.67
SB12N3F	KVA	90.02	50.66	51.96	99.07	99.07	189.14	45.01	49.54	52.39	94.40	49.58	54.13	55.21	57.16
	AMPS	250.00	125.00	125.00	250.00	125.00	250.00	125.00	125.00	125.00	262.50	137.50	137.50	137.50	137.50
SB12N5F	KVA	150.04	84.44	86.60	165.12	165.12	315.23	75.02	82.56	87.32	157.33	82.63	90.21	92.02	95.26
	AMPS	416.67	208.33	208.33	416.67	208.33	416.67	208.33	208.33	208.33	437.50	229.17	229.17	229.17	229.17
No. of Transformers		3	3	3	3	3	3	2	2	2	2	2	2	2	2
*DIAGRAM		F	E	E	F	J	K	G	G	G	H	G	G	G	G

* See Pages 59 - 63

Output voltage for lower input voltage can be found by: $\frac{\text{Rated Output Voltage}}{\text{Rated Input Voltage}}$ x Input Actual Voltage = Output New Voltage.

Output KVA available at reduced input voltage can be found by: $\frac{\text{Actual Input Voltage}}{\text{Rated Input Voltage}}$ x Output KVA = New KVA Rating.

Buck-Boost Selection Tables

120 x 240 Volts Primary - 16/32 Volts Secondary • Buck - Boost Dry-Type Transformers

AMPS = Load Amps
KVA = LoadCircuit KVA

600 Volt Class

Single-Phase

TABLE III

Catalog Number		BOOSTING								BUCKING					
	Line Voltage	95	100	105	208	215	215	220	225	135	240	240	245	250	255
	Load Voltage	120	113	119	236	244	229	235	240	120	212	225	230	234	239
SB16N.050F	KVA	0.19	0.35	0.37	0.37	0.38	0.72	0.73	0.75	0.42	0.38	0.75	0.77	0.78	0.80
	AMPS	1.56	3.13	3.13	1.56	1.56	3.12	3.13	3.12	3.54	1.77	3.33	3.33	3.33	3.33
SB16N.100F	KVA	0.38	0.71	0.74	0.74	0.76	1.43	1.47	1.50	0.84	0.75	1.50	1.53	1.56	1.59
	AMPS	3.13	6.25	6.25	3.13	3.13	6.25	6.25	6.25	7.08	3.54	6.67	6.67	6.67	6.67
SB16N.150F	KVA	0.56	1.06	1.12	1.11	1.14	2.15	2.20	2.25	1.27	1.13	2.25	2.30	2.34	2.39
	AMPS	4.69	9.38	9.38	4.69	4.69	9.37	9.37	9.37	10.63	5.31	10.00	10.00	10.00	10.00
SB16N.250F	KVA	0.94	1.77	1.86	1.84	1.90	3.58	3.67	3.75	2.11	1.88	3.75	3.83	3.91	3.98
	AMPS	7.81	15.63	15.63	7.81	7.81	15.62	15.62	15.62	17.71	8.85	16.67	16.67	16.67	16.67
SB16N.500F	KVA	1.88	3.54	3.72	3.68	3.81	7.17	7.33	7.50	4.22	3.75	7.50	7.66	7.81	7.97
	AMPS	15.63	31.25	31.25	15.63	15.63	31.25	31.25	31.25	35.42	17.71	33.33	33.33	33.33	33.33
SB16N.750F	KVA	2.82	5.31	5.58	5.53	5.71	10.75	11.00	11.25	6.33	5.63	11.25	11.48	11.72	11.95
	AMPS	23.44	46.88	46.88	23.44	23.44	46.87	46.87	46.87	53.13	26.56	50.00	50.00	50.00	50.00
SB16N1F	KVA	3.76	7.08	7.44	7.37	7.61	14.33	14.67	15.00	8.44	7.50	15.00	15.31	15.62	15.94
	AMPS	31.25	62.50	62.50	31.25	31.25	62.50	62.50	62.50	70.83	35.42	66.67	66.67	66.67	66.67
SB16N1.5F	KVA	5.64	10.63	11.16	11.05	11.42	21.50	22.00	22.50	12.66	11.25	22.50	22.97	23.44	23.91
	AMPS	46.88	93.75	93.75	46.88	46.88	93.75	93.75	93.75	106.25	53.13	100.00	100.00	100.00	100.00
SB16N2F	KVA	7.52	14.71	14.88	14.73	15.23	28.67	29.33	30.00	16.88	15.00	30.00	30.62	31.25	31.87
	AMPS	62.50	125.00	125.00	62.50	62.50	125.00	125.00	125.00	141.67	70.83	133.33	133.33	133.33	133.33
SB16N3F	KVA	11.28	21.25	22.31	22.10	22.84	43.00	44.00	45.00	25.31	22.50	45.00	45.94	46.87	47.81
	AMPS	93.75	187.50	187.50	93.75	93.75	187.50	187.50	187.50	212.50	106.25	200.00	200.00	200.00	200.00
SB16N5F	KVA	18.80	35.42	37.19	36.83	38.07	71.67	73.33	75.00	42.19	37.50	75.00	76.56	78.12	79.69
	AMPS	156.25	312.50	312.50	156.25	156.25	312.50	312.50	312.50	354.17	177.08	333.33	333.33	333.33	333.33
*DIAGRAM		B	A	A	D	D	C	C	C	A	D	C	C	C	C

Three-Phase

TABLE IV

Catalog Number		BOOSTING					BUCKING					
	Line Voltage	183Y/106	208Y/120	195	208	225	240	245	250	256	265	272
	Load Voltage	208Y/120	236Y/136	208	236	240	208	230	234	240	234	240
SB16N.050F	KVA	1.12	1.28	1.13	0.64	1.30	0.56	1.33	1.35	1.39	0.72	0.74
	AMPS	3.13	3.13	3.12	1.56	3.12	1.56	3.33	3.33	3.33	1.77	1.77
SB16N.100F	KVA	2.25	2.55	2.25	1.28	2.60	1.13	2.65	2.71	2.77	1.43	1.47
	AMPS	6.25	6.25	6.25	3.13	6.25	3.13	6.67	6.67	6.67	3.54	3.54
SB16N.150F	KVA	3.37	3.83	3.38	1.91	3.90	1.69	3.98	4.06	4.16	2.15	2.21
	AMPS	9.38	9.38	9.37	4.69	9.37	4.69	10.00	10.00	10.00	5.31	5.31
SB16N.250F	KVA	5.61	6.38	5.63	3.19	6.50	2.81	6.63	6.77	6.93	3.59	3.68
	AMPS	15.63	15.62	15.62	7.81	15.62	7.81	16.67	16.67	16.67	8.85	8.85
SB16N.500F	KVA	11.23	12.76	11.26	6.38	12.99	5.63	13.26	13.53	13.86	7.17	7.36
	AMPS	31.25	31.25	31.25	15.63	31.25	15.63	33.33	33.33	33.33	17.71	17.71
SB16N.750F	KVA	16.84	19.14	16.89	9.58	19.49	8.44	19.89	20.30	20.78	10.76	11.04
	1AMPS	46.88	46.88	46.87	23.44	46.87	23.44	50.00	50.00	50.00	26.56	26.56
SB16N1F	KVA	22.45	25.52	22.52	12.76	25.98	11.26	26.52	27.06	27.71	14.34	14.72
	AMPS	62.50	62.50	62.50	31.25	62.50	31.25	66.67	66.67	66.67	35.42	35.42
SB16N1.5F	KVA	33.68	38.28	33.77	19.14	38.97	16.89	39.78	40.59	41.57	21.52	22.08
	AMPS	93.75	93.75	93.75	46.88	93.75	46.88	100.00	100.00	100.00	53.13	53.13
SB16N2F	KVA	44.90	51.04	45.03	25.52	51.96	22.52	53.04	54.13	55.43	28.69	29.44
	AMPS	125.00	125.00	125.00	62.50	125.00	62.50	133.33	133.33	133.33	70.83	70.83
SB16N3F	KVA	67.36	76.56	67.55	38.28	77.94	33.77	79.57	81.19	83.14	43.03	44.17
	AMPS	187.50	187.50	187.50	93.75	187.50	93.75	200.00	200.00	200.00	106.25	106.25
SB16N5F	KVA	112.26	127.59	112.58	63.80	129.90	56.29	132.61	135.32	138.56	71.72	73.61
	AMPS	312.50	312.50	312.50	156.25	312.50	156.25	333.33	333.33	333.33	177.08	177.08
No. of Transformers		3	3	2	2	2	2	2	2	2	2	2
*DIAGRAM		F	F	H	G	H	L	H	H	H	G	G

* See Pages 59 - 63

Output voltage for lower input voltage can be found by: $\frac{\text{Rated Output Voltage}}{\text{Rated Input Voltage}}$ x Input Actual Voltage = Output New Voltage.

Output KVA available at reduced input voltage can be found by: $\frac{\text{Actual Input Voltage}}{\text{Rated Input Voltage}}$ x Output KVA = New KVA Rating.

Buck-Boost Selection Tables

240 x 480 Volts Primary - 24/48 Volts Secondary • Buck - Boost Dry-Type Transformers

AMPS = Load Amps
KVA = Load Circuit KVA

Single-Phase

TABLE V

Catalog Number		BOOSTING									BUCKING				
	Line-Voltage	230	380	416	425	430	435	440	450	460	132	277	480	480	504
	Load Voltage	276	418	458	468	473	457	462	495	483	126	231	436	457	480
SB24N.050F	KVA	0.29	0.44	0.48	0.49	0.49	0.95	0.96	0.52	1.01	0.28	0.29	0.50	1.00	1.05
	AMPS	1.04	1.04	1.04	1.04	1.04	2.08	2.08	1.04	2.08	2.19	1.25	1.15	2.19	2.19
SB24N.100F	KVA	0.58	0.87	0.95	0.97	0.99	1.90	1.93	1.03	2.01	0.55	0.58	1.00	2.00	2.10
	AMPS	2.08	2.08	2.08	2.08	2.08	4.17	4.17	2.08	4.17	4.38	2.50	2.29	4.38	4.38
SB24N.150F	KVA	0.86	1.31	1.43	1.46	1.48	2.85	2.89	1.55	3.02	0.83	0.87	1.50	3.00	3.15
	AMPS	3.13	3.13	3.13	3.13	3.13	6.25	6.25	3.13	6.25	6.56	3.75	3.44	6.56	6.56
SB24N.250F	KVA	1.44	2.18	2.38	2.43	2.46	4.76	4.81	2.58	5.03	1.38	1.44	2.50	5.00	5.25
	AMPS	5.21	5.21	5.21	5.21	5.21	10.42	10.42	5.21	10.42	10.94	6.25	5.73	10.94	10.94
SB24N.500F	KVA	2.88	4.35	4.77	4.87	4.93	9.52	9.63	5.16	10.06	2.75	2.89	5.00	10.00	10.50
	AMPS	10.42	10.42	10.42	10.42	10.42	20.83	20.83	10.42	20.83	21.88	12.50	11.46	21.88	21.88
SB24N.750F	KVA	4.31	6.53	7.15	7.30	7.39	14.27	14.44	7.73	15.09	4.13	4.33	7.50	15.00	15.75
	AMPS	15.63	15.63	15.62	15.63	15.63	31.25	31.25	15.63	31.25	32.81	18.75	17.19	32.81	32.81
SB24N1F	KVA	5.75	8.71	9.53	9.74	9.85	19.03	19.25	10.31	20.13	5.50	5.77	10.00	20.00	21.00
	AMPS	20.83	20.83	20.83	20.83	20.83	41.67	41.67	20.83	41.67	43.75	25.00	22.92	43.75	43.75
SB24N1.5F	KVA	8.63	13.06	14.30	14.61	14.78	28.55	28.88	15.47	30.19	8.25	8.66	15.00	30.00	31.50
	AMPS	31.25	31.25	31.25	31.25	31.25	62.50	62.50	31.25	62.50	65.63	37.50	34.37	65.63	65.63
SB24N2F	KVA	11.50	17.42	19.07	19.48	19.71	38.06	38.50	20.63	40.25	11.00	11.54	20.00	40.00	42.00
	AMPS	41.67	41.67	41.67	41.67	41.67	83.33	83.33	41.67	83.33	87.50	50.00	45.83	87.50	87.50
SB24N3F	KVA	17.25	26.13	28.60	29.22	29.56	57.09	57.75	30.94	60.38	16.50	17.31	30.00	60.00	63.00
	AMPS	62.50	62.50	62.50	62.50	62.50	125.00	125.00	62.50	125.00	131.25	75.00	68.75	131.25	131.25
SB24N5F	KVA	28.75	43.54	47.67	48.70	49.27	95.16	96.25	51.56	100.63	27.50	28.85	50.00	100.00	105.00
	AMPS	104.17	104.17	104.17	104.17	104.17	208.33	208.33	104.17	208.33	218.75	125.00	114.58	218.75	218.75
*DIAGRAM		B	D	D	D	D	C	C	D	C	C	B	D	C	C

Three-Phase

TABLE VI

Catalog Number		BOOSTING								BUCKING							
	Line Voltage	399Y/230	380	430	440	460	460	480	480	440	440	460	460	480	480	500	500
	Load Voltage	480Y/277	418	473	462	506	483	528	504	400	419	438	418	457	436	455	476
SB24N.050F	KVA	0.86	0.75	0.85	1.67	0.91	1.74	0.95	1.82	0.79	1.59	1.66	0.83	1.73	0.87	0.90	1.80
	AMPS	1.04	1.04	1.04	2.08	1.04	2.08	1.04	2.08	1.15	2.19	2.19	1.15	2.19	1.15	1.15	2.19
SB24N.100F	KVA	1.73	1.51	1.71	3.33	1.83	3.49	1.91	3.64	1.59	3.18	3.32	1.66	3.46	1.73	1.80	3.61
	AMPS	2.08	2.08	2.08	4.17	2.08	4.17	2.08	4.17	2.29	4.38	4.38	2.29	4.38	2.29	2.29	4.38
SB24N.150F	KVA	2.59	2.26	2.56	5.00	2.74	5.23	2.86	5.46	2.38	4.76	4.98	2.49	5.20	2.60	2.71	5.41
	AMPS	3.13	3.13	3.13	6.25	3.13	6.25	3.13	6.25	3.44	6.56	6.56	3.44	6.56	3.44	3.44	6.56
SB24N.250F	KVA	4.32	3.77	4.27	8.34	4.56	8.71	4.76	9.09	3.97	7.94	8.30	4.15	8.66	4.33	4.51	9.02
	AMPS	5.21	5.21	5.21	10.42	5.21	10.42	5.21	10.42	5.73	10.94	10.94	5.73	10.94	5.73	5.73	10.94
SB24N.500F	KVA	8.64	7.54	8.53	16.67	9.13	17.43	9.53	18.19	7.94	15.88	16.60	8.30	17.32	8.66	9.02	18.04
	AMPS	10.42	10.42	10.42	20.83	10.42	20.83	10.42	20.83	11.46	21.88	21.88	11.46	21.88	11.46	11.46	21.88
SB24N.750F	KVA	12.96	11.31	12.80	25.01	13.69	26.14	14.29	27.28	11.91	23.82	24.90	12.45	25.98	12.99	13.53	27.06
	1AMPS	15.62	15.63	15.63	31.25	15.63	31.25	15.63	31.25	17.19	32.81	32.81	17.19	32.81	17.19	17.19	32.81
SB24N1F	KVA	17.28	15.08	17.07	33.34	18.26	34.86	19.05	36.37	15.88	31.75	33.20	16.60	34.64	17.32	18.04	36.08
	AMPS	20.83	20.83	20.83	41.67	20.83	41.67	20.83	41.67	22.92	43.75	43.75	22.92	43.75	22.92	22.92	43.75
SB24N1.5F	KVA	25.92	22.62	25.60	50.01	27.39	52.29	28.58	54.56	23.82	47.63	49.80	24.90	51.96	25.98	27.06	54.13
	AMPS	31.25	31.25	31.25	62.50	31.25	62.50	31.25	62.50	34.38	65.63	65.63	34.38	65.63	34.37	34.37	65.63
SB24N2F	KVA	34.55	30.17	34.14	66.68	36.52	69.72	38.11	72.75	31.75	63.51	66.40	33.20	69.28	34.64	36.08	72.17
	AMPS	41.67	41.67	41.67	83.33	41.67	83.33	41.67	83.33	45.83	87.50	87.50	45.83	87.50	45.83	45.83	87.50
SB24N3F	KVA	51.83	45.25	51.20	100.03	54.78	104.57	57.16	109.12	47.63	95.26	99.59	49.80	103.92	51.96	54.13	108.25
	AMPS	62.50	62.50	62.50	125.00	62.50	125.00	62.50	125.00	68.75	131.25	131.25	68.75	131.25	68.75	68.75	131.25
SB24N5F	KVA	86.39	75.42	85.34	166.71	91.29	174.29	95.26	181.87	79.39	158.77	165.99	82.99	173.21	86.60	90.21	180.42
	AMPS	104.17	104.17	104.17	208.33	104.17	208.33	104.17	208.33	114.58	218.75	218.75	114.58	218.75	114.58	114.58	218.75
No. of Transformers		3	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
*DIAGRAM		E	G	G	H	G	H	G	H	G	H	H	G	H	G	G	H

* See Pages 59 - 63

Output voltage for lower input voltage can be found by: $\frac{\text{Rated Output Voltage}}{\text{Rated Input Voltage}}$ x Input Actual Voltage = Output New Voltage.

Output KVA available at reduced input voltage can be found by: $\frac{\text{Actual Input Voltage}}{\text{Rated Input Voltage}}$ x Output KVA = New KVA Rating.

Single-Phase General Purpose Technical Data

Type FB: 115°C Rise • 180°C Insulation System • Non-Ventilated • Indoor/Outdoor
Type FH: 150°C Rise • 220°C Insulation System • Indoor Ventilated • Floor Mounted

Type	KVA	Catalog Number	Taps	Approximate Enclosure Dimensions - Inches			Aprox. Wt. in Lbs.	Weather Shield[1]	Wiring Diagram	Wall Mount Bracket
				H	W	D				
120 x 240 - 120/240 Volts, 60 Hz, No Taps										
FB	1	SE120N1F	No Taps	11.25	5.25	6.5	28	N/R	5	N/A
	1.5	SE120N1.5F	No Taps	13.25	6.25	7.75	45	N/R	5	N/A
	2	SE120N2F	No Taps	13.25	6.25	7.75	50	N/R	5	N/A
	3	SE120N3F	No Taps	13.25	6.25	7.75	60	N/R	5	N/A
	5	SE120N5F	No Taps	15	10.187	10.625	110	N/R	5	N/A
	7.5	SE120N7.5F	No Taps	15	10.187	10.625	150	N/R	5	N/A
	10	SE120N10F	No Taps	17	13.187	13.125	175	N/R	5	N/A
	15	SE120N15F	No Taps	17	13.187	13.125	270	N/R	5	N/A
208 - 120/240 Volts, 60 Hz										
FB	1	SE201D1F	-2 x 5%	11.25	5.25	6.5	28	N/R	6	N/A
	1.5	SE201D1.5F	-2 x 5%	13.25	6.25	7.75	45	N/R	6	N/A
	2	SE201D2F	-2 x 5%	13.25	6.25	7.75	50	N/R	6	N/A
	3	SE201D3F	-2 x 5%	13.25	6.25	7.75	60	N/R	6	N/A
	5	SE201D5F	-2 x 5%	15	10.187	10.625	110	N/R	6	N/A
	7.5	SE201D7.5F	-2 x 5%	15	10.187	10.625	150	N/R	6	N/A
	10	SE201D10F	-2 x 5%	17	13.187	13.125	175	N/R	6	N/A
	15	SE201D15F	-2 x 5%	17	13.187	13.125	270	N/R	6	N/A
240 X 480 - 120/240 Volts, 60 Hz										
FB	0.050	SE2N.050F	No Taps	8.25	3.25	4.25	8	N/R	1	N/A
	0.075	SE2N.075.F	No Taps	8.25	3.25	4.25	9	N/R	1	N/A
	0.100	SE2N.100F	No Taps	8.25	3.25	4.25	10	N/R	1	N/A
	0.150	SE2N.150F	No Taps	9.25	4	5	14	N/R	1	N/A
	0.250	SE2N.250F	No Taps	9.25	4	5	15	N/R	1	N/A
	0.500	SE2N.500F	No Taps	11.25	5.25	6.5	21	N/R	1	N/A
	0.750	SE2N.750F	No Taps	11.25	5.25	6.5	25	N/R	1	N/A
	1	SE2N1F	No Taps	11.25	5.25	6.5	28	N/R	1	N/A
	1.5	SE2N1.5F	No Taps	13.25	6.25	7.75	45	N/R	1	N/A
	2	SE2N2F	No Taps	13.25	6.25	7.75	50	N/R	1	N/A
	3	SE2N3FS	No Taps	13.25	6.25	7.75	60	N/R	10	N/A
	3	SE2T3F	+2, -4 x 2.5%	13.25	6.25	7.75	60	N/R	8	N/A
	5	SE2N5FS	No Taps	15	10.187	10.625	110	N/R	10	N/A
	5	SE2T5F	+2, -4 x 2.5%	15	10.187	10.625	110	N/R	8	N/A
	7.5	SE2N7.5F	No Taps	15	10.187	10.625	150	N/R	1	N/A
	7.5	SE2T7.5F	+2, -4 x 2.5%	15	10.187	10.625	150	N/R	8	N/A
	10	SE2N10F	No Taps	17	13.187	13.125	175	N/R	1	N/A
	10	SE2T10F	+2, -4 x 2.5%	17	13.187	13.125	175	N/R	8	N/A
	15	SE2N15F	No Taps	17	13.187	13.125	270	N/R	1	N/A
	15	SE2T15F	+2, -4 x 2.5%	17	13.187	13.125	270	N/R	8	N/A
FH	15	S2T15E[2]	+2, -4 x 2.5%	33	16.625	18.375	170	WS-3	9	WMB-3
	25	S2T25E[2]	+2, -4 x 2.5%	33	16.625	18.375	195	WS-3	9	WMB-3
	37.5	S2T37E[2]	+2, -4 x 2.5%	37	22.375	19.875	270	WS-4	9	WMB-3
	50	S2T50E[2]	+2, -4 x 2.5%	37	22.375	19.875	300	WS-4	9	WMB-3
	75	S2T75E[2]	+2, -4 x 2.5%	45.5	24.75	20	450	WS-5	9	WMB-4
	100	S2T100E[2]	+2, -4 x 2.5%	52	25.375	23	820	WS-7	9	WMB-4
	167	S2T167E[2]	+2, -4 x 2.5%	60	33.375	26	1070	WS-9	9	NONE

[1]All transformer catalog numbers shown are in a NEMA 2 enclosure, which covers all the requirements of NEMA 1 by offering a degree of protection against the ingress of falling dirt and dripping liquid. The addition of a weather shield kit converts the indoor NEMA 2 transformer to an outdoor NEMA 3R.

[2] Can be furnished with CSA EEV label in compliance with CSA C802.2-06.

N/R - Not Required

Single-Phase General Purpose Technical Data

Type FB: 115°C Rise • 180°C Insulation System • Non-Ventilated • Indoor/Outdoor
Type FH: 150°C Rise • 220°C Insulation System • Indoor Ventilated • Floor Mounted

Type	KVA	Catalog Number	Taps	Approximate Enclosure Dimensions - Inches			Aprox. Wt. in Lbs.	Weather Shield[1]	Wiring Diagram	Wall Mount Bracket
				H	W	D				
277 - 120/240 Volts, 60 Hz										
FB	1	SE271D1F	-2 x 5%	11.25	5.25	6.5	28	N/R	7	N/A
	1.5	SE271D1.5F	-2 x 5%	13.25	6.25	7.75	45	N/R	7	N/A
	2	SE271D2F	-2 x 5%	13.25	6.25	7.75	50	N/R	7	N/A
	3	SE271D3F	-2 x 5%	13.25	6.25	7.75	60	N/R	7	N/A
	5	SE271D5F	-2 x 5%	15	10.187	10.625	110	N/R	7	N/A
	7.5	SE271D7.5F	-2 x 5%	15	10.187	10.625	150	N/R	7	N/A
	10	SE271D10F	-2 x 5%	17	13.187	13.125	175	N/R	7	N/A
	15	SE271D15F	-2 x 5%	17	13.187	13.125	270	N/R	7	N/A
480- 120 x 240 Volts, 60 Hz										
FB	1	SE481D1F	-2 x 5%	11.25	5.25	6.5	28	N/R	2	N/A
	1.5	SE481D1.5F	-2 x 5%	13.25	6.25	7.75	45	N/R	2	N/A
	2	SE481D2F	-2 x 5%	13.25	6.25	7.75	50	N/R	2	N/A
	3	SE481D3F	-2 x 5%	13.25	6.25	7.75	60	N/R	2	N/A
	5	SE481D5F	-2 x 5%	15	10.187	10.625	110	N/R	2	N/A
	7.5	SE481D7.5F	-2 x 5%	15	10.187	10.625	150	N/R	2	N/A
	10	SE481D10F	-2 x 5%	17	13.187	13.125	175	N/R	2	N/A
	15	SE481D15F	-2 x 5%	17	13.187	13.125	270	N/R	2	N/A
600 - 120/240 Volts, 60 Hz, Electrostatically Shielded										
FB	1	SE61D1FS	-2 x 5%	11.25	5.25	6.5	28	N/R	3	N/A
	1.5	SE61D1.5FS	-2 x 5%	13.25	6.25	7.75	45	N/R	3	N/A
	2	SE61D2FS	-2 x 5%	13.25	6.25	7.75	50	N/R	3	N/A
	3	SE61D3FS	-2 x 5%	13.25	6.25	7.75	60	N/R	3	N/A
	5	SE61D5FS	-2 x 5%	15	10.187	10.625	110	N/R	3	N/A
FB	7.5	SE61D7.5FS	-2 x 5%	15	10.187	10.625	150	N/R	3	N/A
	10	SE61D10FS	-2 x 5%	17	13.187	13.125	175	N/R	3	N/A
	15	SE61G15FS	-4 x 2.5%	17	13.187	13.125	270	N/R	4	N/A
FH	15	S61T15SE[2]	+2, -4 x 2.5%	33	16.625	18.375	170	WS-3	11	WMB-3
	25	S61T25SE[2]	+2, -4 x 2.5%	33	16.625	18.375	195	WS-3	11	WMB-3
	37.5	S61T37SE[2]	+2, -4 x 2.5%	37	22.375	19.875	300	WS-4	11	WMB-3
	50	S61T50SE[2]	+2, -4 x 2.5%	37	22.375	19.875	300	WS-4	11	WMB-3
	75	S61T75SE[2]	+2, -4 x 2.5%	45.5	24.75	20	450	WS-5	11	WMB-4
	100	S61T100SE[2]	+2, -4 x 2.5%	52	25.375	23	820	WS-7	11	WMB-4
	167	S61T167SE[2]	+2, -4 x 2.5%	60	33.375	26	1070	WS-9	11	NONE
600 - 120/240 Volts, 60 Hz, Electrostatically Shielded Copper										
FH	`5	S61T15CSE[2]	+2, -4 x 2.5%	33	16.625	18.375	210	WS-3	11	WMB-3
	25	S61T25CSE[2]	+2, -4 x 2.5%	33	16.625	18.375	260	WS-3	11	WMB-3
	37.5	S61T37CSE[2]	+2, -4 x 2.5%	37	22.375	19.875	400	WS-4	11	WMB-3
	50	S61T50CSE[2]	+2, -4 x 2.5%	37	22.375	19.875	330	WS-4	11	WMB-3

[1]All transformer catalog numbers shown are in a NEMA 2 enclosure, which covers all the requirements of NEMA 1 by offering a degree of protection against the ingress of falling dirt and dripping liquid. The addition of a weather shield kit converts the indoor NEMA 2 transformer to an outdoor NEMA 3R.

[2] Can be furnished with CSA EEV label in compliance with CSA C802.2-06.

N/R - Not Required

Single-Phase Optional Temperature Rise Technical Data

Type FH: 115°C and 80°C Rise • 180°C Insulation System
Indoor Ventilated • Floor Mounted

Type	KVA	Catalog Number	Taps	Approximate Enclosure Dimensions - Inches			Aprox. Wt. in Lbs.	Weather Shield[1]	Wiring Diagram	Wall Mount Bracket
				H	W	D				
115° C Rise, 240 x 480 - 120/240 Volts, 60 Hz										
FH	15	S2T15FE	+2, -4 x 2.5%	33	16.625	18.375	170	WS-3	9	WMB-3
	25	S2T25FE	+2, -4 x 2.5%	37	22.375	19.875	270	WS-4	9	WMB-3
	37.5	S2T37FE	+2, -4 x 2.5%	37	22.375	19.875	270	WS-4	9	WMB-3
	50	S2T50FE	+2, -4 x 2.5%	45.5	24.75	20	450	WS-5	9	WMB-4
	75	S2T75FE	+2, -4 x 2.5%	52	25.375	23	610	WS-7	9	WMB-4
	100	S2T100FE	+2, -4 x 2.5%	60	33.375	26	1070	WS-9	9	NONE
	167	S2T167FE	+2, -4 x 2.5%	60	33.375	26	1090	WS-9	9	NONE
80° C Rise, 240 x 480 - 120/240 Volts, 60 Hz										
FH	15	S2T15BE	+2, -4 x 2.5%	33	16.625	18.375	195	WS-3	9	WMB-3
	25	S2T25BE	+2, -4 x 2.5%	37	22.375	19.875	270	WS-4	9	WMB-3
	37.5	S2T37BE	+2, -4 x 2.5%	37	22.375	19.875	300	WS-4	9	WMB-3
	50	S2T50BE	+2, -4 x 2.5%	45.5	24.75	20	450	WS-5	9	WMB-4
	75	S2T75BE	+2, -4 x 2.5%	52	25.375	23	820	WS-7	9	WMB-4
	100	S2T100BE	+2, -4 x 2.5%	60	33.375	26	1070	WS-9	9	NONE

[1]All transformer catalog numbers shown are in a NEMA 2 enclosure, which covers all the requirements of NEMA 1 by offering a degree of protection against the ingress of falling dirt and dripping liquid. The addition of a weather shield kit converts the indoor NEMA 2 transformer to an outdoor NEMA 3R.

Three-Phase General Purpose Technical Data

Type FB: 115°C Rise • 180°C Insulation System • Non-Ventilated • Indoor/Outdoor
Type FH: 150°C Rise • 220°C Insulation System • Indoor Ventilated • Floor Mounted

Type	KVA	Catalog Number	Taps	Approximate Enclosure Dimensions - Inches			Aprox. Wt. in Lbs.	Weather Shield[1]	Wiring Diagram	Wall Mount Bracket
				H	W	D				
208 - 208Y/120 Volts, 60 Hz, Electrostatically Shielded										
FH	15	T202H15SE	+2, -2 x 2.5%	29	17.125	19.375	210	WS-2	19	WMB-3
	30	T202H30SE	+2, -2 x 2.5%	34	22.375	19.875	370	WS-4	19	WMB-3
	45	T202H45SE	+2, -2 x 2.5%	34	22.375	19.875	400	WS-4	19	WMB-3
	75	T202H75SE	+2, -2 x 2.5%	37	26	19.875	575	WS-18A	19	WMB-4
	112.5	T202H112SE	+2, -2 x 2.5%	43	28.5	23.5	760	WS-18	19	WMB-4
	150	T202H150SE	+2, -2 x 2.5%	46	32	28	1180	WS-10B	19A	NONE
	225	T202J225SE	+2, -2 x 3%	51	36	30.5	1520	WS-12A	19B	NONE
	300	T202L300SE	+2, -2 x 3.5%	63	46.5	30.875	1630	WS-14	19C	NONE
	500	T202E500SE	+1, -1 x 5%	72.75	53.375	36.875	2335	WS-16	19E	NONE
208 - 480Y/277 Volts, 60 Hz										
FH	15	T204H15E	+2, -2 x 2.5%	29	17.125	19.375	210	WS-2	23	WMB-3
	30	T204H30E	+2, -2 x 2.5%	34	22.375	19.875	370	WS-4	23	WMB-3
	45	T204H45E	+2, -2 x 2.5%	34	22.375	19.875	400	WS-4	23	WMB-3
	75	T204H75E	+2, -2 x 2.5%	37	26	19.875	575	WS-18A	23	WMB-4
	112.5	T204H112E	+2, -2 x 2.5%	43	28.5	23.5	760	WS-18	23	WMB-4
	150	T204H150E	+2, -2 x 2.5%	46	32	28	1180	WS-10B	23A	NONE
	225	T204J225E	+2, -2 x 3%	51	36	30.5	1520	WS-12A	23B	NONE
	300	T204L300E	+2, -2 x 3.5%	63	46.5	30.875	1630	WS-14	23C	NONE
	500	T204E500E	+1, -1 x 5%	72.75	53.375	36.875	2335	WS-16	23E	NONE
	750	T204E750E	+1, -1 x 5%	76.75	53.375	44.375	3280	NONE	23E	NONE
240 - 208Y/120 Volts, 60 Hz, Electrostatically Shielded										
FB	3	TE242D3FS	-2 x 5%	12.062	12.125	8.375	95	N/R	12	N/A
	6	TE242D6FS	-2 x 5%	14.562	20.125	10.625	225	N/R	12	N/A
	9	TE242D9FS	-2 x 5%	14.562	20.125	10.625	270	N/R	12	N/A
	15	TE242D15FS	-2 x 5%	16.062	21.125	15.125	435	N/R	12	N/A
FH	15	T242T15SE[2]	+2, -4 x 2.5%	29	17.125	19.375	210	WS-2	26	WMB-3
	30	T242T30SE[2]	+2, -4 x 2.5%	34	22.375	19.875	370	WS-4	26	WMB-3
	45	T242T45SE	+2, -4 x 2.5%	34	22.375	19.875	400	WS-4	26	WMB-3
	75	T242T75SE[2]	+2, -4 x 2.5%	37	26	19.875	575	WS-18A	26	WMB-4
	112.5	T242T112SE	+2, -4 x 2.5%	43	28.5	23.5	760	WS-18	26	WMB-4
	150	T242T150SE	+2, -4 x 2.5%	46	32	28	1180	WS-10B	26A	NONE
	225	T242J225SE	+2, -2 x 3%	51	36	30.5	1520	WS-12A	26B	NONE
	300	T242L300SE	+2, -2 x 3.5%	63	46.5	30.875	1630	WS-14	26C	NONE
	500	T242B500SE	+1, -1 x 4%	72.75	53.375	36.875	2335	WS-16	26D	NONE

[1]All transformer catalog numbers shown are in a NEMA 2 enclosure, which covers all the requirements of NEMA 1 by offering a degree of protection against the ingress of falling dirt and dripping liquid. The addition of a weather shield kit converts the indoor NEMA 2 transformer to an outdoor NEMA 3R.

[2] Can be furnished with CSA EEV label in compliance with CSA C802.2-06.

N/R - Not Required

Three-Phase General Purpose Technical Data

Type FB: 115°C Rise • 180°C Insulation System • Non-Ventilated • Indoor/Outdoor
Type FH: 150°C Rise • 220°C Insulation System • Indoor Ventilated • Floor Mounted

Type	KVA	Catalog Number	Taps	Approximate Enclosure Dimensions - Inches			Aprox. Wt. in Lbs.	Weather Shield[1]	Wiring Diagram	Wall Mount Bracket
				H	W	D				
480 - 208Y/120 Volts, 60 Hz										
FB	3	TE4D3F	-2 x 5%	12.062	12.125	8.375	95	N/R	13	N/A
	6	TE4D6F	-2 x 5%	14.562	20.125	10.625	225	N/R	13	N/A
	9	TE4D9F	-2 x 5%	14.562	20.125	10.625	270	N/R	13	N/A
	15	TE4D15F	-2 x 5%	16.062	21.125	15.125	435	N/R	13	N/A
FH	15	T4T15E[2]	+2, -4 x 2.5%	29	17.125	19.375	210	WS-2	22	WMB-3
	30	T4T30E[2]	+2, -4 x 2.5%	34	22.375	19.875	370	WS-4	22	WMB-3
	45	T4T45E[2]	+2, -4 x 2.5%	34	22.375	19.875	400	WS-4	22	WMB-3
	75	T4T75E[2]	+2, -4 x 2.5%	37	26	19.875	575	WS-18A	22	WMB-4
	112.5	T4T112E[2]	+2, -4 x 2.5%	43	28.5	23.5	760	WS-18	22	WMB-4
	150	T4T150E[2]	+2, -4 x 2.5%	46	32	28	1180	WS-10B	22A	NONE
	225	T4T225E[2]	+2, -4 x 2.5%	51	36	30.5	1520	WS-12A	22A	NONE
	300	T4T300E	+2, -4 x 2.5%	63	46.5	30.875	1630	WS-14	22A	NONE
	500	T4T500E	+2, -4 x 2.5%	72.75	53.375	36.875	2335	WS-16	22A	NONE
	750	T4T750E	+2, -4 x 2.5%	76.75	53.375	44.375	3280	NONE	22A	NONE
	1000	T4J1000E	+2, -2 x 3%	80	61	44.375	4450	NONE	22B	NONE
480 - 208Y/120 Volts, 60 Hz, Electrostatically Shielded										
FB	3	TE4D3FS	-2 x 5%	12.062	12.125	8.375	95	N/R	15	N/A
	6	TE4D6FS	-2 x 5%	14.562	20.125	10.625	225	N/R	15	N/A
	9	TE4D9FS	-2 x 5%	14.562	20.125	10.625	270	N/R	15	N/A
	15	TE4D15FS	-2 x 5%	16.062	21.125	15.125	435	N/R	15	N/A
FH	15	T4T15SE[2]	+2, -4 x 2.5%	29	17.125	19.375	210	WS-2	18	WMB-3
	30	T4T30SE[2]	+2, -4 x 2.5%	34	22.375	19.875	370	WS-4	18	WMB-3
	45	T4T45SE[2]	+2, -4 x 2.5%	34	22.375	19.875	400	WS-4	18	WMB-3
	75	T4T75SE[2]	+2, -4 x 2.5%	37	26	19.875	575	WS-18A	18	WMB-4
	112.5	T4T112SE[2]	+2, -4 x 2.5%	43	28.5	23.5	760	WS-18	18	WMB-4
	150	T4T150SE[2]	+2, -4 x 2.5%	46	32	28	1180	WS-10B	18A	NONE
	225	T4T225SE[2]	+2, -4 x 2.5%	51	36	30.5	1520	WS-12A	18A	NONE
	300	T4T300SE[2]	+2, -4 x 2.5%	63	46.5	30.875	1630	WS-14	18A	NONE
	500	T4T500SE[2]	+2, -4 x 2.5%	72.75	53.375	36.875	2335	WS-16	18A	NONE
	750	T4T750SE	+2, -4 x 2.5%	76.75	53.375	44.375	3280	NONE	18A	NONE
	1000	T4J1000SE	+2, -2 x 3%	80	61	44.375	4450	NONE	18B	NONE
480 - 208Y/120 Volts, 60 Hz, Electrostatically Shielded, Copper										
FH	15	T4T15CSE[2]	+2, -4 x 2.5%	29	17.125	19.375	240	WS-2	22	WMB-3
	30	T4T30CSE[2]	+2, -4 x 2.5%	34	22.375	19.875	410	WS-4	22	WMB-3
	45	T4T45CSE[2]	+2, -4 x 2.5%	34	22.375	19.875	460	WS-4	22	WMB-3
	75	T4T75CSE[2]	+2, -4 x 2.5%	37	26	19.875	645	WS-18A	22	WMB-4
	112.5	T4T112CSE[2]	+2, -4 x 2.5%	43	28.5	23.5	855	WS-18	22	WMB-4
	150	T4T150CSE[2]	+2, -4 x 2.5%	46	32	28	1330	WS-10B	22A	NONE
	225	T4T225CSE[2]	+2, -4 x 2.5%	51	36	30.5	1750	WS-12A	22A	NONE
	300	T4T300CSE[2]	+2, -4 x 2.5%	63	46.5	30.875	1830	WS-14	22A	NONE
	500	T4T500CSE[2]	+2, -4 x 2.5%	72.75	53.375	36.875	2700	WS-16	22A	NONE
	750	T4T750CSE	+2, -4 x 2.5%	76.75	53.375	44.375	3800	NONE	18A	NONE
	1000	T4J1000CSE	+2, -2 x 3%	80	61	44.375	4895	NONE	18B	NONE

[1]All transformer catalog numbers shown are in a NEMA 2 enclosure, which covers all the requirements of NEMA 1 by offering a degree of protection against the ingress of falling dirt and dripping liquid. The addition of a weather shield kit converts the indoor NEMA 2 transformer to an outdoor NEMA 3R.

[2] Can be furnished with CSA EEV label in compliance with CSA C802.2-06.

N/R - Not Required

Three-Phase General Purpose Technical Data

Type FB: 115°C Rise • 180°C Insulation System • Non-Ventilated • Indoor/Outdoor
Type FH: 150°C Rise • 220°C Insulation System • Indoor Ventilated • Floor Mounted

Type	KVA	Catalog Number	Taps	Approximate Enclosure Dimensions - Inches			Aprox. Wt. in Lbs.	Weather Shield[1]	Wiring Diagram	Wall Mount Bracket
				H	W	D				
480 - 240 Volts, 60 Hz										
FB	3	TE482D3F	-2 x 5%	12.062	12.125	8.375	95	N/R	14	N/A
	6	TE482D6F	-2 x 5%	14.562	20.125	10.625	225	N/R	14	N/A
	9	TE482D9F	-2 x 5%	14.562	20.125	10.625	270	N/R	14	N/A
	15	TE482D15F	-2 x 5%	16.062	21.125	15.125	435	N/R	14	N/A
480 - 240 Volts, Electrostatically Shielded										
FB	3	TE482D3FS	-2 x 5%	12.062	12.125	8.375	95	N/R	16	N/A
	6	TE482D6FS	-2 x 5%	14.562	20.125	10.625	225	N/R	16	N/A
	9	TE482D9FS	-2 x 5%	14.562	20.125	10.625	270	N/R	16	N/A
	15	TE482D15FS	-2 x 5%	16.062	21.125	15.125	435	N/R	16	N/A
480 - 240/120 Volts - LT (Lighting Tap), 60 Hz										
FH	15	T43T15E[2]	+2, -4 x 2.5%	29	17.125	19.375	210	WS-2	21	WMB-3
	30	T43T30E[2]	+2, -4 x 2.5%	34	22.375	19.875	370	WS-4	21	WMB-3
	45	T43T45E[2]	+2, -4 x 2.5%	34	22.375	19.875	400	WS-4	21	WMB-3
	75	T43T75E[2]	+2, -4 x 2.5%	37	26	19.875	575	WS-18A	21	WMB-4
	112.5	T43T112E[2]	+2, -4 x 2.5%	43	28.5	23.5	760	WS-18	21	WMB-4
	150	T43T150E[2]	+2, -4 x 2.5%	46	32	28	1180	WS-10B	21A	NONE
	225	T43T225E[2]	+2, -4 x 2.5%	51	36	30.5	1520	WS-12A	21A	NONE
	300	T43T300E[2]	+2, -4 x 2.5%	63	46.5	30.875	1630	WS-14	21A	NONE
	500	T43T500E[2]	+2, -4 x 2.5%	72.75	53.375	36.875	2335	WS-16	21A	NONE
	750	T43T750E	+2, -4 x 2.5%	76.75	53.375	44.375	3280	NONE	21A	NONE
480 - 240/120 Volts - LT (Lighting Tap), 60 Hz, Electrostatically Shielded										
FH	15	T43T15SE	+2, -4 x 2.5%	29	17.125	19.375	210	WS-2	17	WMB-3
	30	T43T30SE	+2, -4 x 2.5%	34	22.375	19.875	370	WS-4	17	WMB-3
	45	T43T45SE[2]	+2, -4 x 2.5%	34	22.375	19.875	400	WS-4	17	WMB-3
	75	T43T75SE[2]	+2, -4 x 2.5%	37	26	19.875	575	WS-18A	17	WMB-4
	112.5	T43T112SE	+2, -4 x 2.5%	43	28.5	23.5	760	WS-18	17	WMB-4
	150	T43T150SE[2]	+2, -4 x 2.5%	46	32	28	1180	WS-10B	17A	NONE
	225	T43T225SE	+2, -4 x 2.5%	51	36	30.5	1520	WS-12A	17A	NONE
	300	T43T300SE	+2, -4 x 2.5%	63	46.5	30.875	1630	WS-14	17A	NONE
	500	T43T500SE	+2, -4 x 2.5%	72.75	53.375	36.875	2335	WS-16	17A	NONE
	750	T43T750SE	+2, -4 x 2.5%	76.75	53.375	44.375	3280	NONE	17A	NONE

[1]All transformer catalog numbers shown are in a NEMA 2 enclosure, which covers all the requirements of NEMA 1 by offering a degree of protection against the ingress of falling dirt and dripping liquid. The addition of a weather shield kit converts the indoor NEMA 2 transformer to an outdoor NEMA 3R.

[2] Can be furnished with CSA EEV label in compliance with CSA C802.2-06.

N/R - Not Required

Three-Phase General Purpose Technical Data

Type FH: 150°C Rise • 220°C Insulation System • Indoor Ventilated • Floor Mounted

Type	KVA	Catalog Number	Taps	Approximate Enclosure Dimensions - Inches			Aprox. Wt. in Lbs.	Weather Shield[1]	Wiring Diagram	Wall Mount Bracket
				H	W	D				
480 - 480Y/277 Volts, 60 Hz										
FH	15	T484T15E	+2, -4 x 2.5%	29	17.125	19.375	210	WS-2	20	WMB-3
	30	T484T30E[2]	+2, -4 x 2.5%	34	22.375	19.875	370	WS-4	20	WMB-3
	45	T484T45E[2]	+2, -4 x 2.5%	34	22.375	19.875	400	WS-4	20	WMB-3
	75	T484T75E[2]	+2, -4 x 2.5%	37	26	19.875	575	WS-18A	20	WMB-4
	112.5	T484T112E	+2, -4 x 2.5%	43	28.5	23.5	760	WS-18	20	WMB-4
	150	T484T150E	+2, -4 x 2.5%	46	32	28	1180	WS-10B	20A	NONE
	225	T484T225E	+2, -4 x 2.5%	51	36	30.5	1520	WS-12A	20A	NONE
	300	T484T300E	+2, -4 x 2.5%	63	46.5	30.875	1630	WS-14	20A	NONE
	500	T484T500E	+2, -4 x 2.5%	72.75	53.375	36.875	2335	WS-16	20A	NONE
	750	T484T750E	+2, -4 x 2.5%	76.75	53.375	44.375	3280	NONE	20A	NONE
600 - 208Y/120 Volts, 60 Hz, Electrostatically Shielded										
FH	15	T6T15SE[2]	+2, -4 x 2.5%	29	17.125	19.375	210	WS-2	24	WMB-3
	30	T6T30SE[2]	+2, -4 x 2.5%	34	22.375	19.875	370	WS-4	24	WMB-3
	45	T6T45SE[2]	+2, -4 x 2.5%	34	22.375	19.875	400	WS-4	24	WMB-3
	75	T6T75SE[2]	+2, -4 x 2.5%	37	26	19.875	575	WS-18A	24	WMB-4
	112.5	T6T112SE[2]	+2, -4 x 2.5%	43	28.5	23.5	760	WS-18	24	WMB-4
	150	T6T150SE[2]	+2, -4 x 2.5%	46	32	28	1180	WS-10B	24A	NONE
	225	T6T225SE	+2, -4 x 2.5%	51	36	30.5	1520	WS-12A	24A	NONE
	300	T6T300SE	+2, -4 x 2.5%	63	46.5	30.875	1630	WS-14	24A	NONE
	500	T6T500SE	+2, -4 x 2.5%	72.75	53.375	36.875	2335	WS-16	24A	NONE
600 - 208Y/120 Volts, 60 Hz, Electrostatically Shielded Copper										
FH	15	T6T15CSE[2]	+2, -4 x 2.5%	29	17.125	19.375	240	WS-2	24	WMB-3
	30	T6T30CSE[2]	+2, -4 x 2.5%	34	22.375	19.875	410	WS-4	24	WMB-3
	45	T6T45CSE[2]	+2, -4 x 2.5%	34	22.375	19.875	460	WS-4	24	WMB-3
	50	T6T50CSE[2]	+2, -4 x 2.5%	37	26	19.875	665	WS-18A	24	WMB-4
	75	T6T75CSE[2]	+2, -4 x 2.5%	37	26	19.875	645	WS-18A	24	WMB-4
	112.5	T6T112CSE[2]	+2, -4 x 2.5%	43	28.5	23.5	855	WS-18	24	WMB-4
	150	T6T150CSE	+2, -4 x 2.5%	46	32	28	1330	WS-10B	24A	NONE

[1]All transformer catalog numbers shown are in a NEMA 2 enclosure, which covers all the requirements of NEMA 1 by offering a degree of protection against the ingress of falling dirt and dripping liquid. The addition of a weather shield kit converts the indoor NEMA 2 transformer to an outdoor NEMA 3R.

[2] Can be furnished with CSA EEV label in compliance with CSA C802.2-06.

N/R - Not Required

Three-Phase Optional Temperature Rise Technical Data

Type FH: 115°C Rise • 220°C Insulation System • Indoor Ventilated • Floor Mounted

Type	KVA	Catalog Number	Taps	Approximate Enclosure Dimensions - Inches			Aprox. Wt. in Lbs.	Weather Shield[1]	Wiring Diagram	Wall Mount Bracket
				H	W	D				
208 - 208Y/120 Volts, 60 Hz, Electrostatically Shielded										
FH	15	T202H15FSE	+2, -2 x 2.5%	34	22.375	19.875	370	WS-4	19	WMB-3
	30	T202H30FSE	+2, -2 x 2.5%	34	22.375	19.875	370	WS-4	19	WMB-3
	45	T202H45FSE	+2, -2 x 2.5%	37	26	19.875	575	WS-18A	19	WMB-4
	75	T202H75FSE	+2, -2 x 2.5%	43	28.5	23.5	760	WS-18	19	WMB-4
	112.5	T202H112FSE	+2, -2 x 2.5%	46	32	28	1180	WS-10B	19A	NONE
	150	T202J150FSE	+2, -2 x 3%	51	36	30.5	1520	WS-12A	19B	NONE
	225	T202L225FSE	+2, -2 x 3.5%	63	46.5	30.875	1630	WS-14	19C	NONE
	300	T202B300FSE	+1, -1 x 4%	72.75	53.375	36.875	2070	WS-16	19D	NONE
208 - 480Y/277 Volts, 60 Hz, Electrostatically Shielded										
FH	15	T204H15FSE	+2, -2 x 2.5%	34	22.375	19.875	370	WS-4	23	WMB-3
	30	T204H30FSE	+2, -2 x 2.5%	34	22.375	19.875	370	WS-4	23	WMB-3
	45	T204H45FSE	+2, -2 x 2.5%	34	22.375	19.875	400	WS-4	23	WMB-3
	75	T204H75FSE	+2, -2 x 2.5%	43	28.5	23.5	760	WS-18	23	WMB-4
	112.5	T204H112FSE	+2, -2 x 2.5%	46	32	28	1180	WS-10B	23A	NONE
	150	T204J150FSE	+2, -2 x 3%	51	36	30.5	1520	WS-12A	23B	NONE
	225	T204L225FSE	+2, -2 x 3.5%	63	46.5	30.875	1630	WS-14	23C	NONE
	300	T204B300FSE	+1, -1 x 4%	72.75	53.375	36.875	2070	WS-16	23D	NONE
	500	T204E500FSE	+1, -1 x 5%	72.75	53.375	36.875	2800	WS-16	23E	NONE
240 - 208Y/120 Volts, 60 Hz, Electrostatically Shielded										
FH	15	T242T15FSE	+2, -4 x 2.5%	34	22.375	19.875	370	WS-4	26	WMB-3
	30	T242T30FSE	+2, -4 x 2.5%	34	22.375	19.875	370	WS-4	26	WMB-3
	45	T242T45FSE	+2, -4 x 2.5%	37	26	19.875	575	WS-18A	26	WMB-4
	75	T242T75FSE	+2, -4 x 2.5%	43	28.5	23.5	760	WS-18	26	WMB-4
	112.5	T242T112FSE	+2, -4 x 2.5%	46	32	28	1180	WS-10B	26A	NONE
	150	T242J150FSE	+2, -2 x 3%	51	36	30.5	1520	WS-12A	26B	NONE
	225	T242L225FSE	+2, -2 x 3.5%	63	46.5	30.875	1630	WS-14	26C	NONE
	300	T242B300FSE	+1, -1 x 4%	72.75	53.375	36.875	2070	WS-16	26D	NONE
480 - 208Y/120 Volts, 60 Hz, Aluminum										
FH	15	T4T15FE	+2, -4 x 2.5%	34	22.375	19.875	370	WS-4	22	WMB-3
	30	T4T30FE	+2, -4 x 2.5%	34	22.375	19.875	370	WS-4	22	WMB-3
	45	T4T45FE	+2, -4 x 2.5%	37	26	19.875	575	WS-18A	22	WMB-4
	75	T4T75FE	+2, -4 x 2.5%	43	28.5	23.5	760	WS-18	22	WMB-4
	112.5	T4T112FE	+2, -4 x 2.5%	46	32	28	1180	WS-10B	22A	NONE
	150	T4T150FE	+2, -4 x 2.5%	51	36	30.5	1520	WS-12A	22A	NONE
	225	T4T225FE	+2, -4 x 2.5%	63	46.5	30.875	1630	WS-14	22A	NONE
	300	T4T300FE	+2, -4 x 2.5%	72.75	53.375	36.875	2070	WS-16	22A	NONE
	500	T4T500FE	+2, -4 x 2.5%	72.75	53.375	36.875	2800	WS-16	22A	NONE

[1]All transformer catalog numbers shown are in a NEMA 2 enclosure, which covers all the requirements of NEMA 1 by offering a degree of protection against the ingress of falling dirt and dripping liquid. The addition of a weather shield kit converts the indoor NEMA 2 transformer to an outdoor NEMA 3R.

Three-Phase Optional Temperature Rise Technical Data

Type FH: 115°C Rise • 220°C Insulation System • Indoor Ventilated • Floor Mounted

Type	KVA	Catalog Number	Taps	Approximate Enclosure Dimensions - Inches			Aprox. Wt. in Lbs.	Weather Shield[1]	Wiring Diagram	Wall Mount Bracket
				H	W	D				
480 - 208Y/120 Volts, 60 Hz, Electrostatically Shielded										
FH	15	T4T15FSE	+2, -4 x 2.5%	34	22.375	19.875	370	WS-4	18	WMB-3
	30	T4T30FSE	+2, -4 x 2.5%	34	22.375	19.875	370	WS-4	18	WMB-3
	45	T4T45FSE	+2, -4 x 2.5%	37	26	19.875	575	WS-18A	18	WMB-4
	75	T4T75FSE	+2, -4 x 2.5%	43	28.5	23.5	760	WS-18	18	WMB-4
	112.5	T4T112FSE	+2, -4 x 2.5%	46	32	28	1180	WS-10B	18A	NONE
	150	T4T150FSE	+2, -4 x 2.5%	51	36	30.5	1520	WS-12A	18A	NONE
	225	T4T225FSE	+2, -4 x 2.5%	63	46.5	30.875	1630	WS-14	18A	NONE
	300	T4T300FSE	+2, -4 x 2.5%	72.75	53.375	36.875	2070	WS-16	18A	NONE
	500	T4T500FSE	+2, -4 x 2.5%	72.75	53.375	36.875	2800	WS-16	18A	NONE
480 - 208Y/120 Volts, 60 Hz, Electrostatically Shielded Copper										
FH	15	T4T15FCSE	+2, -4 x 2.5%	29	17.125	19.375	240	WS-2	22	WMB-3
	30	T4T30FCSE	+2, -4 x 2.5%	34	22.375	19.875	410	WS-4	22	WMB-3
	45	T4T45FCSE	+2, -4 x 2.5%	37	26	19.875	645	WS-18A	22	WMB-4
	75	T4T75FCSE	+2, -4 x 2.5%	43	28.5	23.5	855	WS-18	22	WMB-4
	112.5	T4T112FCSE	+2, -4 x 2.5%	46	32	28	1330	WS-10B	22A	NONE
	150	T4T150FCSE	+2, -4 x 2.5%	51	36	30.5	1750	WS-12A	22A	NONE
	225	T4T225FCSE	+2, -4 x 2.5%	63	46.5	30.875	1830	WS-14	22A	NONE
	300	T4T300FCSE	+2, -4 x 2.5%	72.75	53.375	36.875	2170	WS-16	22A	NONE
	500	T4T500FCSE	+2, -4 x 2.5%	72.75	53.375	36.875	2880	WS-16	22A	NONE
480 - 240/120 Volts, LT (Lighting Tap), 60 Hz										
FH	15	T43T15FE	+2, -4 x 2.5%	34	22.375	19.875	370	WS-4	21	WMB-3
	30	T43T30FE	+2, -4 x 2.5%	34	22.375	19.875	370	WS-4	21	WMB-3
	45	T43T45FE	+2, -4 x 2.5%	37	26	19.875	575	WS-18A	21	WMB-4
	75	T43T75FE	+2, -4 x 2.5%	43	28.5	23.5	760	WS-18	21	WMB-4
	112	T43T112FE	+2, -4 x 2.5%	46	32	28	1180	WS-10B	21A	NONE
	150	T43T150FE	+2, -4 x 2.5%	51	36	30.5	1520	WS-12A	21A	NONE
	225	T43T225FE	+2, -4 x 2.5%	63	46.5	30.875	1630	WS-14	21A	NONE
	300	T43T300FE	+2, -4 x 2.5%	72.75	53.375	36.875	2335	WS-16	21A	NONE
	500	T43T500FE	+2, -4 x 2.5%	72.75	53.375	36.875	2800	WS-16	21A	NONE
480 - 240/120 Volts, LT (Lighting Tap), 60 Hz, Electrostatically Shielded										
FH	15	T43T15FSE	+2, -4 x 2.5%	34	22.375	19.875	370	WS-4	17	WMB-3
	30	T43T30FSE	+2, -4 x 2.5%	34	22.375	19.875	370	WS-4	17	WMB-3
	45	T43T45FSE	+2, -4 x 2.5%	37	26	19.875	575	WS-18A	17	WMB-4
	75	T43T75FSE	+2, -4 x 2.5%	43	28.5	23.5	760	WS-18	17	WMB-4
	112.5	T43T112FSE	+2, -4 x 2.5%	46	32	28	1180	WS-10B	17A	NONE
	150	T43T150FSE	+2, -4 x 2.5%	51	36	30.5	1520	WS-12A	17A	NONE
	225	T43T225FSE	+2, -4 x 2.5%	63	46.5	30.875	1630	WS-14	17A	NONE
	300	T43T300FSE	+2, -4 x 2.5%	72.75	53.375	36.875	2070	WS-16	17A	NONE

[1]All transformer catalog numbers shown are in a NEMA 2 enclosure, which covers all the requirements of NEMA 1 by offering a degree of protection against the ingress of falling dirt and dripping liquid. The addition of a weather shield kit converts the indoor NEMA 2 transformer to an outdoor NEMA 3R.

Three-Phase Optional Temperature Rise Technical Data

Type FH: 115°C Rise • 220°C Insulation System • Indoor Ventilated • Floor Mounted

Type	KVA	Catalog Number	Taps	Approximate Enclosure Dimensions - Inches			Aprox. Wt. in Lbs.	Weather Shield[1]	Wiring Diagram	Wall Mount Bracket
				H	W	D				
480 - 480Y/277 Volts, 60 Hz										
FH	15	T484T15FE	+2, -4 x 2.5%	34	22.375	19.875	370	WS-4	20	WMB-3
	30	T484T30FE	+2, -4 x 2.5%	34	22.375	19.875	370	WS-4	20	WMB-3
	45	T484T45FE	+2, -4 x 2.5%	37	26	19.875	575	WS-18A	20	WMB-4
	75	T484T75FE	+2, -4 x 2.5%	43	28.5	23.5	760	WS-18	20	WMB-4
	112.5	T484T112FE	+2, -4 x 2.5%	46	32	28	1180	WS-10B	20A	NONE
	150	T484T150FE	+2, -4 x 2.5%	51	36	30.5	1520	WS-12A	20A	NONE
	225	T484T225FE	+2, -4 x 2.5%	63	46.5	30.875	1630	WS-14	20A	NONE
	300	T484T300FE	+2, -4 x 2.5%	72.75	53.375	36.875	2070	WS-16	20A	NONE
	500	T484T500FE	+2, -4 x 2.5%	72.75	53.375	36.875	2800	WS-16	20A	NONE
600 - 208Y/120 Volts, 60 Hz, Electrostatically Shielded										
FH	15	T6T15FSE	+2, -4 x 2.5%	34	22.375	19.875	370	WS-4	24	WMB-3
	30	T6T30FSE	+2, -4 x 2.5%	34	22.375	19.875	370	WS-4	24	WMB-3
	45	T6T45FSE	+2, -4 x 2.5%	37	26	19.875	575	WS-18A	24	WMB-4
	75	T6T75FSE	+2, -4 x 2.5%	43	28.5	23.5	760	WS-18	24	WMB-4
	112.5	T6T112FSE	+2, -4 x 2.5%	46	32	28	1180	WS-10B	24A	NONE
	150	T6T150FSE	+2, -4 x 2.5%	51	36	30.5	1520	WS-12A	24A	NONE
	225	T6T225FSE	+2, -4 x 2.5%	63	46.5	30.875	1630	WS-14	24A	NONE
	300	T6T300FSE	+2, -4 x 2.5%	72.75	53.375	36.875	2070	WS-16	24A	NONE

[1]All transformer catalog numbers shown are in a NEMA 2 enclosure, which covers all the requirements of NEMA 1 by offering a degree of protection against the ingress of falling dirt and dripping liquid. The addition of a weather shield kit converts the indoor NEMA 2 transformer to an outdoor NEMA 3R.

Three-Phase Optional Temperature Rise Technical Data

Type FH: 80°C Rise • 220°C Insulation System • Indoor Ventilated • Floor Mounted

Type	KVA	Catalog Number	Taps	Approximate Enclosure Dimensions - Inches			Aprox. Wt. in Lbs.	Weather Shield [1]	Wiring Diagram	Wall Mount Bracket
				H	W	D				
208 - 208Y/120 Volts, 60 Hz, Electrostatically Shielded										
FH	15	T202H15BSE	+2, -2 x 2.5%	34	22.375	19.875	370	WS-4	19	WMB-3
	30	T202H30BSE	+2, -2 x 2.5%	34	22.375	19.875	400	WS-4	19	WMB-3
	45	T202H45BSE	+2, -2 x 2.5%	37	26	19.875	575	WS-18A	19	WMB-4
	75	T202H75BSE	+2, -2 x 2.5%	43	28.5	23.5	760	WS-18	19	WMB-4
	112.5	T202J112BSE	+2, -2 x 3%	46	32	28	1180	WS-10B	19B	NONE
	150	T202J150BSE	+2, -2 x 3%	51	36	30.5	1520	WS-12A	19B	NONE
	225	T202B225BSE	+1, -1 x 4%	63	46.5	30.875	1630	WS-14	19D	NONE
	300	T202B300BSE	+1, -1 x 4%	72.75	53.375	36.875	2335	WS-16	19D	NONE
208 - 480Y/277 Volts, 60 Hz										
FH	15	T204H15BE	+2, -2 x 2.5%	34	22.375	19.875	370	WS-4	23	WMB-3
	30	T204H30BE	+2, -2 x 2.5%	34	22.375	19.875	400	WS-4	23	WMB-3
	45	T204H45BE	+2, -2 x 2.5%	37	26	19.875	575	WS-18A	23	WMB-4
	75	T204H75BE	+2, -2 x 2.5%	43	28.5	23.5	760	WS-18	23	WMB-4
	112.5	T204J112BE	+2, -2 x 3%	46	32	28	1180	WS-10B	23B	NONE
	150	T204J150BE	+2, -2 x 3%	51	36	30.5	1520	WS-12A	23B	NONE
	225	T204B225BE	+1, -1 x 5%	63	46.5	30.875	1630	WS-14	23D	NONE
	300	T204B300BE	+1, -1 x 5%	72.75	53.375	36.875	2335	WS-16	23D	NONE
	500	T204E500BE	+1, -1 x 5%	76.75	53.375	44.375	3280	NONE	23E	NONE
240 - 208Y/120 Volts, 60 Hz, Electrostatically Shielded										
FH	15	T242T15BSE	+2, -4 x 2.5%	34	22.375	19.875	370	WS-4	26	WMB-3
	30	T242T30BSE	+2, -4 x 2.5%	34	22.375	19.875	400	WS-4	26	WMB-3
	45	T242T45BSE	+2, -4 x 2.5%	37	26	19.875	575	WS-18A	26	WMB-4
	75	T242T75BSE	+2, -4 x 2.5%	43	28.5	23.5	760	WS-18	26	WMB-4
	112.5	T242T112BSE	+2, -4 x 2.5%	46	32	28	1180	WS-10B	26A	NONE
	150	T242J150BSE	+2, -2 x 3%	51	36	30.5	1520	WS-12A	26B	NONE
	225	T242B225BSE	+1, -1 x 4%	63	46.5	30.875	1630	WS-14	26D	NONE
	300	T242B300BSE	+1, -1 x 4%	72.75	53.375	36.875	2335	WS-16	26D	NONE
480 - 208Y/120 Volts, 60 Hz										
FH	15	T4T15BE	+2, -4 x 2.5%	34	22.375	19.875	370	WS-4	22	WMB-3
	30	T4T30BE	+2, -4 x 2.5%	34	22.375	19.875	400	WS-4	22	WMB-3
	45	T4T45BE	+2, -4 x 2.5%	37	26	19.875	575	WS-18A	22	WMB-4
	75	T4T75BE	+2, -4 x 2.5%	43	28.5	23.5	760	WS-18	22	WMB-4
	112.5	T4T112BE	+2, -4 x 2.5%	46	32	28	1180	WS-10B	22A	NONE
	150	T4T150BE	+2, -4 x 2.5%	51	36	30.5	1520	WS-12A	22A	NONE
	225	T4T225BE	+2, -4 x 2.5%	63	46.5	30.875	1630	WS-14	22A	NONE
	300	T4T300BE	+2, -4 x 2.5%	72.75	53.375	36.875	2335	WS-16	22A	NONE
	500	T4T500BE	+2, -4 x 2.5%	76.75	53.375	44.375	3280	NONE	22A	NONE

[1]All transformer catalog numbers shown are in a NEMA 2 enclosure, which covers all the requirements of NEMA 1 by offering a degree of protection against the ingress of falling dirt and dripping liquid. The addition of a weather shield kit converts the indoor NEMA 2 transformer to an outdoor NEMA 3R.

Three-Phase Optional Temperature Rise Technical Data

Type FH: 80°C Rise • 220°C Insulation System • Indoor Ventilated • Floor Mounted

Type	KVA	Catalog Number	Taps	Approximate Enclosure Dimensions - Inches			Aprox. Wt. in Lbs.	Weather Shield [1]	Wiring Diagram	Wall Mount Bracket
				H	W	D				
480 - 208Y/120 Volts, 60 Hz, Electrostatically Shielded										
FH	15	T4T15BSE	+2, -4 x 2.5%	34	22.375	19.875	370	WS-4	18	WMB-3
	30	T4T30BSE	+2, -4 x 2.5%	34	22.375	19.875	400	WS-4	18	WMB-3
	45	T4T45BSE	+2, -4 x 2.5%	37	26	19.875	575	WS-18A	18	WMB-4
	75	T4T75BSE	+2, -4 x 2.5%	43	28.5	23.5	760	WS-18	18	WMB-4
	112.5	T4T112BSE	+2, -4 x 2.5%	46	32	28	1180	WS-10B	18A	NONE
	150	T4T150BSE	+2, -4 x 2.5%	51	36	30.5	1520	WS-12A	18A	NONE
	225	T4T225BSE	+2, -4 x 2.5%	63	46.5	30.875	1630	WS-14	18A	NONE
	300	T4T300BSE	+2, -4 x 2.5%	72.75	53.375	36.875	2335	WS-16	18A	NONE
	500	T4T500BSE	+2, -4 x 2.5%	76.75	53.375	44.375	3280	NONE	18A	NONE
480 - 208Y/120 Volts, 60 Hz, Electrostatically Shielded Copper										
FH	15	T4T15BCSE	+2, -4 x 2.5%	34	22.375	19.875	410	WS-4	18	WMB-3
	30	T4T30BCSE	+2, -4 x 2.5%	34	22.375	19.875	460	WS-4	18	WMB-3
	45	T4T45BCSE	+2, -4 x 2.5%	37	26	19.875	645	WS-18A	18	WMB-4
	75	T54T75BCSE	+2, -4 x 2.5%	43	28.5	23.5	855	WS-18	18	WMB-4
	112.5	T4T112BCSE	+2, -4 x 2.5%	46	32	28	1330	WS-10B	18A	NONE
	150	T4T150BCSE	+2, -4 x 2.5%	51	36	30.5	1750	WS-12A	18A	NONE
	225	T4T225BCSE	+2, -4 x 2.5%	63	46.5	30.875	1830	WS-14	18A	NONE
	300	T4T300BCSE	+2, -4 x 2.5%	72.75	53.375	36.875	2700	WS-16	18A	NONE
	500	T4J500BCSE	+2, -2 x 3%	CONSULT FACTORY						NONE
480 - 240/120 Volts, LT (Lighting Tap), 60 Hz										
FH	15	T43T15BE	+2, -4 x 2.5%	34	22.375	19.875	370	WS-4	21	WMB-3
	30	T43T30BE	+2, -4 x 2.5%	34	22.375	19.875	400	WS-4	21	WMB-3
	45	T43T45BE	+2, -4 x 2.5%	37	26	19.875	575	WS-18A	21	WMB-4
	75	T43T75BE	+2, -4 x 2.5%	43	28.5	23.5	760	WS-18	21	WMB-4
	112.5	T43T112BE	+2, -4 x 2.5%	46	32	28	1180	WS-10B	21A	NONE
	150	T43T150BE	+2, -4 x 2.5%	51	36	30.5	1520	WS-12A	21A	NONE
	225	T43T225BE	+2, -4 x 2.5%	63	46.5	30.875	1630	WS-14	21A	NONE
	300	T43T300BE	+2, -4 x 2.5%	72.75	53.375	36.875	2335	WS-16	21A	NONE
480 - 240/120 Volts, LT (Lighting Tap), 60 Hz, Electrostatically Shielded										
FH	15	T43T15BSE	+2, -4 x 2.5%	34	22.375	19.875	370	WS-4	17	WMB-3
	30	T43T30BSE	+2, -4 x 2.5%	34	22.375	19.875	400	WS-4	17	WMB-3
	45	T43T45BSE	+2, -4 x 2.5%	37	26	19.875	575	WS-18A	17	WMB-4
	75	T43T75BSE	+2, -4 x 2.5%	43	28.5	23.5	760	WS-18	17	WMB-4
	112.5	T43T112BSE	+2, -4 x 2.5%	46	32	28	1180	WS-10B	17A	NONE
	150	T43T150BSE	+2, -4 x 2.5%	51	36	30.5	1520	WS-12A	17A	NONE
	225	T43T225BSE	+2, -4 x 2.5%	63	46.5	30.875	1630	WS-14	17A	NONE
	300	T43T300BSE	+2, -4 x 2.5%	72.75	53.375	36.875	2335	WS-16	17A	NONE

[1]All transformer catalog numbers shown are in a NEMA 2 enclosure, which covers all the requirements of NEMA 1 by offering a degree of protection against the ingress of falling dirt and dripping liquid. The addition of a weather shield kit converts the indoor NEMA 2 transformer to an outdoor NEMA 3R.

Three-Phase Optional Temperature Rise Technical Data

Type FH: 80°C Rise • 220°C Insulation System • Indoor Ventilated • Floor Mounted

Type	KVA	Catalog Number	Taps	Approximate Enclosure Dimensions - Inches			Aprox. Wt. in Lbs.	Weather Shield [1]	Wiring Diagram	Wall Mount Bracket
				H	W	D				
480 - 480Y/277 Volts, 60 Hz										
FH	15	T484T15BE	+2, -4 x 2.5%	34	22.375	19.875	370	WS-4	20	WMB-3
	30	T484T30BE	+2, -4 x 2.5%	34	22.375	19.875	400	WS-4	20	WMB-3
	45	T484T45BE	+2, -4 x 2.5%	37	26	19.875	575	WS-18A	20	WMB-4
	75	T484T75BE	+2, -4 x 2.5%	43	28.5	23.5	760	WS-18	20	WMB-4
	112.5	T484T112BE	+2, -4 x 2.5%	46	32	28	1180	WS-10B	20A	NONE
	150	T484T150BE	+2, -4 x 2.5%	51	36	30.5	1520	WS-12A	20A	NONE
	225	T484T225BE	+2, -4 x 2.5%	63	46.5	30.875	1630	WS-14	20A	NONE
	300	T484T300BE	+2, -4 x 2.5%	72.75	53.375	36.875	2335	WS-16	20A	NONE
	500	T484T500BE	+2, -4 x 2.5%	76.75	53.375	44.375	3280	NONE	20A	NONE
600 - 208Y/120 Volts, 60 Hz, Electrostatically Shielded										
FH	15	T6T15BSE	+2, -4 x 2.5%	34	22.375	19.875	370	WS-4	24	WMB-3
	30	T6T30BSE	+2, -4 x 2.5%	34	22.375	19.875	400	WS-4	24	WMB-3
	45	T6T45BSE	+2, -4 x 2.5%	37	26	19.875	575	WS-18A	24	WMB-4
	75	T6T75BSE	+2, -4 x 2.5%	43	28.5	23.5	760	WS-18	24	WMB-4
	112.5	T6T112BSE	+2, -4 x 2.5%	46	32	28	1180	WS-10B	24A	NONE
	150	T6T150BSE	+2, -4 x 2.5%	51	36	30.5	1520	WS-12A	24A	NONE
	225	T6T225BSE	+2, -4 x 2.5%	63	46.5	30.875	1630	WS-14	24A	NONE
	300	T6T300BSE	+2, -4 x 2.5%	72.75	53.375	36.875	2335	WS-16	24A	NONE

[1]All transformer catalog numbers shown are in a NEMA 2 enclosure, which covers all the requirements of NEMA 1 by offering a degree of protection against the ingress of falling dirt and dripping liquid. The addition of a weather shield kit converts the indoor NEMA 2 transformer to an outdoor NEMA 3R.

Three-Phase General Purpose Technical Data

Type FH: 150°C Rise • 220°C Insulation System • Indoor Ventilated • Floor Mounted

Type	KVA	Catalog Number	Taps[3]	Approximate Enclosure Dimensions - Inches			Aprox. Wt. in Lbs.	Weather Shield [1]	Wiring Diagram	Wall Mount Bracket
				H	W	D				
480/440/420 - 220Y/127 Volts, 60 Hz										
FH	15	T422X15E	504, 492, 480, 468, 456, 440, 442, 420	29	17.125	19.375	210	WS-2	28	WMB-3
	30	T422X30E[2]	504, 492, 480, 468, 456, 440, 442, 420	34	22.375	19.875	370	WS-4	28	WMB-3
	45	T422X45E[2]	504, 492, 480, 468, 456, 440, 442, 420	34	22.375	19.875	400	WS-4	28	WMB-3
	75	T422X75E[2]	504, 492, 480, 468, 456, 440, 442, 420	37	26	19.875	575	WS-18A	28	WMB-4
	112	T422X112E	504, 492, 480, 468, 456, 440, 442, 420	43	28.5	23.5	760	WS-18	28	WMB-4
	150	T422X150E	504, 492, 480, 468, 456, 440, 442, 420	46	32	28	1180	WS-10B	29	NONE

[1]All transformer catalog numbers shown are in a NEMA 2 enclosure, which covers all the requirements of NEMA 1 by offering a degree of protection against the ingress of falling dirt and dripping liquid. The addition of a weather shield kit converts the indoor NEMA 2 transformer to an outdoor NEMA 3R.

[2] Can be furnished with CSA EEV label in compliance with CSA C802.2-06.

[3] Voltages shown closely represent the actual tap voltage on each rating, but may vary by 0.4% on the larger KVAs having fewer turns that do not allow these exact tap voltages.

Type FH Motor Drive Isolation Transformers

Type FH motor drive isolation transformers are designed to meet the requirements of SCR controlled variable speed motor drives. They are specifically constructed to withstand the mechanical forces associated with SCR drive duty cycles and to isolate the line from most SCR generated voltage spikes and transient feedback. Similarly, the two-winding construction also aids in reducing some types of line transients that can cause misfiring of the SCR's.

The units are UL Listed and incorporate all the features of the FH transformer line. The transformers can also be supplied as core and coil units with UL component recognition.

Delta-wye designs are available for all commonly used primary and secondary voltages. All units include primary taps consisting of one 5% FCAN and one 5% FCBN.

7.5 KVA - 220 KVA

275 KVA - 750 KVA

Three-Phase Motor Drive Isolation Transformer Technical Data

Type FH: 150°C Rise • 220° C Insulation System • Indoor Ventilated • Floor Mounted

HV TAPS: 1 -5% FCAN, 1-5% FCBN

Motor HP	KVA	Voltages - Primary-Delta, Secondary - Wye, 60 Hz				Approximate Dimensions - Inches			Wt. In Lbs.	Weather Shield
		230Δ - 230Y/133	230Δ - 460Y/266	460Δ - 230Y/133	460Δ- 460Y/266	H	W	D		
3 & 5	7.5	7.5AEMD	7.5AFMD	7.5CEMD	7.5CFMD	29	17.125	19.375	145	WS-2
7.5	11	11AEMD	11AFMD	11CEMD	11CFMD	29	17.125	19.375	160	WS-2
10	15	15AEMD	15AFMD	15CEMD	15CFMD	29	17.125	19.375	185	WS-2
15	20	20AEMD	20AFMD	20CEMD	20CFMD	34	22.375	19.875	285	WS-4
20	27	27AEMD	27AFMD	27CEMD	27CFMD	34	22.375	19.875	320	WS-4
25	34	34AEMD	34AFMD	34CEMD	34CFMD	34	22.375	19.875	320	WS-4
30	40	40AEMD	40AFMD	40CEMD	40CFMD	34	22.375	19.875	340	WS-4
40	51	51AEMD	51AFMD	51CEMD	51CFMD	34	22.375	19.875	380	WS-4
50	63	63AEMD	63AFMD	63CEMD	63CFMD	37	26	19.875	485	WS-18A
60	75	75AEMD	75AFMD	75CEMD	75CFMD	37	26	19.875	485	WS-18A
75	93	93AEMD	93AFMD	93CEMD	93CFMD	43	28.5	23.5	665	WS-18
100	118	118AEMD	118AFMD	118CEMD	118CFMD	43	28.5	23.5	675	WS-18
125	145	145AEMD	145AFMD	145CEMD	145CFMD	46	32	28	915	WS-10B
150	175	175AEMD	175AFMD	175CEMD	175CFMD	51	36	30.5	1450	WS-12A
200	220	220AEMD	220AFMD	220CEMD	220CFMD	51	36	30.5	1520	WS-12A
250	275	275AEMD	275AFMD	275CEMD	275CFMD	55.25	44.375	27.25	1450	NONE
300	330	330AEMD	330AFMD	330CEMD	330CFMD	60.5	50.375	34.25	1720	NONE
400	440	440AEMD	440AFMD	440CEMD	440CFMD	60.5	50.375	34.25	2085	NONE
500	550	550AEMD	550AFMD	550CEMD	550CFMD	72	53.375	44.375	2750	NONE
600	660	660AEMD	660AFMD	660CEMD	660CFMD	72	53.375	44.375	3100	NONE
700	750	750AEMD	750AFMD	750CEMD	750CFMD	76.75	53.375	44.375	3150	NONE

Type FH: 150°C Rise • 220° C Insulation System • Indoor Ventilated • Floor Mounted

HV TAPS: 1 -5% FCAN, 1-5% FCBN

Motor HP	KVA	Voltages - Primary-Delta, Secondary - Wye, 60 Hz					Approximate Dimensions - Inches			Wt. In Lbs.	Weather Shield
		230Δ - 575Y/332	460Δ - 575Y/332	575Δ - 230Y/133	575Δ -460Y/266	575Δ -575Y/332	H	W	D		
3 & 5	7.5	7.5AHMD	7.5CHMD	7.5DEMD	7.5DFMD	7.5DHMD	29	17.125	19.375	145	WS-2
7.5	11	11AHMD	11CHMD	11DEMD	11DFMD	11DHMD	29	17.125	19.375	160	WS-2
10	15	15AHMD	15CHMD	15DEMD	15DFMD	15DHMD	29	17.125	19.375	185	WS-2
15	20	20AHMD	20CHMD	20DEMD	20DFMD	20DHMD	34	22.375	19.875	285	WS-4
20	27	27AHMD	27CHMD	27DEMD	27DFMD	27DHMD	34	22.375	19.875	320	WS-4
25	34	34AHMD	34CHMD	34DEMD	34DFMD	34DHMD	34	22.375	19.875	320	WS-4
30	40	40AHMD	40CHMD	40DEMD	40DFMD	40DHMD	34	22.375	19.875	340	WS-4
40	51	51AHMD	51CHMD	51DEMD	51DFMD	51DHMD	34	22.375	19.875	380	WS-42
50	63	63AHMD	63CHMD	63DEMD	63DFMD	63DHMD	37	26	19.875	485	WS-18A
60	75	75AHMD	75CHMD	75DEMD	75DFMD	75DHMD	37	26	19.875	485	WS-18A
75	93	93AHMD	93CHMD	93DEMD	93DFMD	93DHMD	43	28.5	23.5	665	WS-18
100	118	118AHMD	118CHMD	118DEMD	118DFMD	118DHMD	43	28.5	23.5	675	WS-18
125	145	145AHMD	145CHMD	145DEMD	145DFMD	145DHMD	46	32	28	915	WS-10B
150	175	175AHMD	175CHMD	175DEMD	175DFMD	175DHMD	51	36	30.5	1450	WS-12A
200	220	220AHMD	220CHMD	220DEMD	220DFMD	220DHMD	51	36	30.5	1520	WS-12A
250	275	275AHMD	275CHMD	275DEMD	275DFMD	275DHMD	55.25	44.375	27.25	1450	NONE
300	330	330AHMD	330CHMD	330DEMD	330DFMD	330DHMD	60.5	50.375	34.25	1720	NONE
400	440	440AHMD	440CHMD	440DEMD	440DFMD	440DHMD	60.5	50.375	34.25	2085	NONE
500	550	550AHMD	550CHMD	550DEMD	550DFMD	550DHMD	72	53.375	44.375	2750	NONE
600	660	660AHMD	660CHMD	660DEMD	660DFMD	660DHMD	72	53.375	44.375	3100	NONE
700	750	750AHMD	750CHMD	750DEMD	750DFMD	750DHMD	76.75	53.375	44.375	3150	NONE

K-Factor Dry Type Transformers - Type FHK

Application

With today's modern electronic, electrical components and circuitry constantly changing, the demand is forced upon the electrical power industry to produce and supply a clean source of electrical energy.

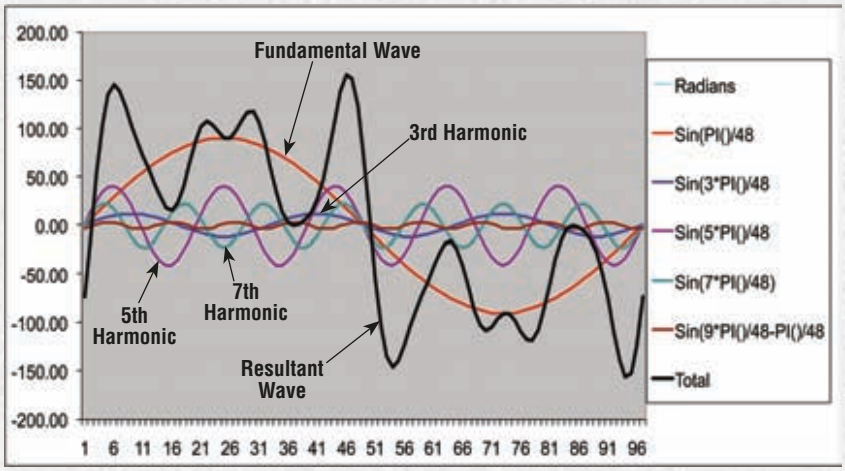
The Problem

The extensive utilization of solid state power conversion technologies has created new problems for the power industry and power engineer designer. This technology, called Switch Mode Power Supply (SMPS), consists of various types of solid state switching elements. These switching elements are solid state devices such as: SCR's, DIAC's, transistors and capacitors. These switching devices are in computers, copy machines, fax machines, tele-communications equipment, solid-state drives and controls, energy-efficient lighting ballasts, and numerous types of DC-Power Loads. These solid state elements continuously switch on and off producing non-linear or non-sinusoidal wave shapes in the current supplied from the energy source.

While a linear load uses current from the AC source continuously over the sinusoidal cycle, a non-linear load (such as the SMPS) uses current in large pulses from the AC source which creates harmonic distortion. These non-linear current pulses may exceed the nameplate ampere rating of the power source and may cause transformers to run hotter than expected, even when these transformers are supplying less than 50% of their rated nameplate capacity.

With non-linear loads, overloaded neutrals are also showing up in three-phase panel boards serving single-phase loads. In some cases the neutral conductor carries 180 Hertz currents, rather than 60 Hertz currents. This phenomenon is called triplen harmonics. Triplens are multiples of three, which do not cancel but are additive in the neutral conductor.

Figure 1
Distorted 3rd and 5th Resultant Harmonic Waveform



(Non-linear loads can produce additive 3rd order harmonic currents which may create overloaded neutral conductors.)

What Are Harmonics

As defined by ANSI/IEEE Std. 519 latest edition.

Harmonic

Harmonic components are represented by a periodic wave having a frequency that is an integral multiple of the fundamental frequency.

In other words, harmonics are voltages or currents at frequencies that are integer multiples of the fundamental (60 Hz) frequency, e.g. 120 Hz, 180 Hz, 240 Hz, 300 Hz, etc. Harmonics are designated by their harmonic number, or multiple of the fundamental frequency. Thus, a harmonic with a frequency of 180 Hz (three times the 60 Hz fundamental Frequency) is called the 3rd harmonic.

Harmonics superimpose themselves on the fundamental waveform, distorting it and changing its magnitude. For instance, when a sine wave voltage source is applied to a non-linear load connected from phase-to-neutral on a 3-phase, 4-wire wye circuit, the load itself will draw a current wave made up of the 60 Hz fundamental frequency of the voltage source plus 3rd and higher order odd harmonic (multiples of the 60 Hz fundamental frequency), which are all generated by the non-linear load. **Figure 1** shows the resultants of a distorted 3rd and 5th harmonic waveform. It is not uncommon for portions of an industrial power system to have 15 to 25% of Total Harmonic Distortion (THD). THD is calculated as the **square root of the sum of the squares** of all harmonics, divided by the normal 60 hertz value as shown in **Equation 1**.

Equation 1

$$THD = \frac{[(I_{RMS_{60}})^2+(I_{RMS_{180}})^2+\ldots+(I_{RMS_N})^2]^{1/2}}{[(I_{RMS_{60}})^2]^{1/2}}$$

This yields a root-mean-square (RMS) value of distortion as a percentage of the fundamental 60 hertz waveform.

Therefore, THD is the percent of odd harmonics (3rd, 5th, 7th, ..., 25th, ...) present in the load which can affect the transformer. This condition is called a "Non-Linear Load" or "Non-Sinusoidal Load".

For dry type transformers, to determine what amount of harmonic content is present, a "K" factor calculation is made instead of using the THD formula.

The total amount of harmonics will determine the percentage of non-linear load, which can be specified with the following typical examples:

Transformers shall be sized to account for harmonic non-linear loads of 50% minimum (K-4), 100% (K-13), 125% (K-20), 150% (K-30).

The neutral connection shall be sized at 200% of the current rating of the phase connections.

The conductors of the transformer winding shall be sized to handle circulation of 3rd harmonic current and not exceed the rated temperature rise.

Transformers shall be capable of operating within the specified temperature rise while supplying 100% of the 60 Hertz fundamental rated current values plus the following harmonics as calculated by ANSI/IEEE 57.110-1998.

(A) 50% Non-Linear Load (K-4 Rating)

16.7% of the rated current at the 3rd Harmonic
10.0% of the rated current at the 5th Harmonic
7.1% of the rated current at the 7th Harmonic
5.6% of the rated current at the 9th Harmonic

Beyond the 9th Harmonic the percentages of the fundamental current through the 25th Harmonic shall be equal to the reciprocal of the odd harmonic number involved times 0.5

The FP Type FHK4 series transformer is designed for 100% linear load plus 50% non-linear load which can operate at a total I_h (pu)^2 h^2 K-factor load value of 4.0. See **Table 1**.

(B) 100% Non-Linear Load (K-13 Rating)

33.3% of the rated current at the 3rd harmonic
20.0% of the rated current at the 5th harmonic
14.3% of the rated current at the 7th harmonic
11.1% of the rated current at the 9th harmonic

Beyond the 9th Harmonic the percentages of the fundamental current through the 25th Harmonic shall be equal to the reciprocal of the odd harmonic number involved times 1.0

The FP Type FHK13 series transformer is designed for 100% linear load plus 100% non-linear load which can operate at a total (I_h (pu)$^2h^2$) K-factor load value of 13.0. See **Table 1**.

(C) 125% Non-Linear Load (K-20 Rating)

41.7% of the rated current at the 3rd harmonic
25.0% of the rated current at the 5th harmonic
17.9% of the rated current at the 7th harmonic
13.9% of the rated current at the 9th harmonic

Beyond the 9th Harmonic the percentages of the fundamental current through the 25th Harmonic shall be equal to the reciprocal of the odd harmonic number involved times 1.25

The FP Type FHK20 series transformer is designed for 100%linear load plus 125% non-linear load which can operate at a total (I_h(pu)$^2h^2$) K-factor load value of 20. See **Table 1**.

(D) 150% Non-Linear Load (K-30 Rating)

50.0% of the rated current at the 3rd harmonic
30.0% of the rated current at the 5th harmonic
21.4% of the rated current at the 7th harmonic
16.7% of the rated current at the 9th harmonic

Beyond the 9th Harmonic the percentages of the fundamental current through the 25th Harmonic shall be equal to the reciprocal of the odd harmonic number involved times 1.50

The FP Type FHK30 series transformer is designed for 100%linear load plus 150% non-linear load which can operate at a total (I_h(pu)$^2h^2$) K-factor load value of 30. See **Table 1**.

Note: *In these examples the amount of non-linear load specified, the percentage of fundamental current, and the percentage of harmonic factor are arbitrary values; actual values may vary. (Consult FP factory for your specific application or current values for each harmonic.)*

Table 1 Examples of K-Factor Loads

	K-4			K-13			K-20			K-30		
Harmonic (h)	Current (I_h)	I_h (pu)	I_h (pu) $^2h^2$	Current (I_h)	I_h (pu)	I_h (pu) $^2h^2$	Current (I_h)	I_h (pu)	I_h (pu) $^2h^2$	Current (I_h)	I_h (pu)	I_h (pu) $^2h^2$
1	00.000%	1.000	1.000	100.000%	1.000	1.000	100.000%	1.000	1.000	100.000%	1.000	1.000
3	16.667%	0.167	0.250	33.333%	0.333	1.000	41.667%	0.417	1.563	50.000%	0.500	2.250
5	10.000%	0.100	0.250	20.000%	0.200	1.000	25.000%	0.250	1.563	30.000%	0.300	2.250
7	7.143%	0.071	0.250	14.286%	0.143	1.000	17.857%	0.179	1.563	21.429%	0.214	2.250
9	5.556%	0.056	0.250	11.111%	0.111	1.000	13.889%	0.139	1.563	16.667%	0.167	2.250
11	4.545%	0.045	0.250	9.091%	0.091	1.000	11.364%	0.114	1.563	13.636%	0.136	2.250
13	3.846%	0.038	0.250	7.692%	0.077	1.000	9.615%	0.096	1.563	11.538%	0.115	2.250
15	3.333%	0.033	0.250	6.667%	0.067	1.000	8.333%	0.083	1.563	10.000%	0.100	2.250
17	2.941%	0.029	0.250	5.882%	0.059	1.000	7.353%	0.074	1.563	8.824%	0.088	2.250
19	2.632%	0.026	0.250	5.263%	0.053	1.000	6.569%	0.066	1.563	7.895%	0.079	2.250
21	2.381%	0.024	0.250	4.762%	0.048	1.000	5.952%	0.060	1.563	7.143%	0.071	2.250
23	2.174%	0.022	0.250	4.348%	0.043	1.000	5.435%	0.054	1.563	6.522%	0.065	2.250
25	2.000%	0.020	0.250	4.000%	0.040	1.000	5.000%	0.050	1.563	6.000%	0.060	2.250

K-Factor Transformer Ratings

The K-Factor rating assigned to a transformer and marked on the transformer case in accordance with the listing of Underwriters Laboratories, is an index of the transformer's ability to supply harmonic content in its load current while remaining within its operating temperature limits. A specific K-factor rating indicates that a transformer can supply its rated KVA load output to a load of specified amount of harmonic content. At present, industry literature and commentary refers to a limited number of K-factor ratings: K-1, K-4, K-9, K-13, K-20, K-30, K-40. In theory, a transformer could be designed for other K-factor ratings in-between those values, as well as for higher values. The commonly referenced ratings calculated according to ANSI/IEEE C57.110-1998 are as follows:

K-1: This is the rating of any conventional transformer that has been designed to handle only the heating effects of eddy currents and other losses resulting from 60 Hertz, sine-wave current loading on the transformer. Such a unit may or may not be designed to handle the increased heating of harmonics in its load current.

K-4: A transformer with this rating has been designed to supply rated KVA, without overheating, to a load made-up of 100% of the normal 60 Hertz, sine-wave, fundamental current plus: 16% of the fundamental as 3rd harmonic current; 10% of the fundamental as 5th; 7% of the fundamental as 7th; 5.5% of the fundamental as 9th; and smaller percentages through the 25th harmonic. The "4" indicates its ability to accommodate four times the eddy current losses of a K-1 transformer.

K-9: A K-9 transformer can accommodate 163% of the harmonic loading of a K-4 rated transformer.

K-13: A K-13 transformer can accommodate 200% of the harmonic loading of a K-4 rated transformer.

K-20, K-30, K-40: The higher number of each of these K-factor ratings indicates ability to handle successively larger amounts of harmonic load content without overheating.

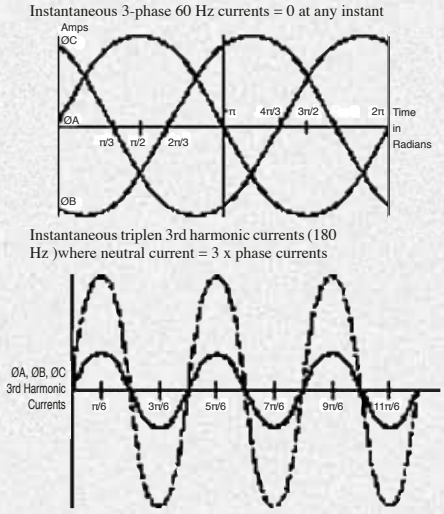
Table 1 Gives examples of K-factor loads.

Triplen Harmonics

Triplen harmonic currents are phase currents which flow from each of the phases into the fourth wire neutral and have frequencies in integer multiples of three times the 60 hertz base frequency (180Hz, 360Hz, 540Hz, etc). At each of these third multiple triplen frequencies, these triplen phase currents are in phase with each other and when flowing in the neutral as zero sequence currents, are equal to three times their RMS phase values. See ***Figure 2***.

In a 3-phase, 4-wire system, single-phase line-to-neutral currents flow in each phase conductor and return in the common neutral. Since the three 60 hertz currents are separated by 120°, when balanced they cancel each other. The measured resultant current is equal to zero. See ***Figure 2.***

Figure 2
Development of Triplen Harmonic Current



At any given instant, the 60 Hertz currents on the three-phase legs have a vector resultant of zero and cancel in the neutral. But, the third (and other odd triplen harmonics) on the phase legs are in phase and become additive in the neutral.

Theory also states that for even harmonics, starting with the second order, when balanced the even harmonic will cancel in the common neutral.

Other odd harmonics add in the common neutral, but their magnitude is considerably less than triplens. The RMS value of the total current is the square root of the RMS value of the individual currents squared. As shown in ***Equation 2***.

Equation 2

$$I_{Total} = \sqrt{I^2_{60Hz} + I^2_{180Hz} + I^2_{300Hz} + I^2_{420Hz} + \ldots}$$

where I = RMS

The UL Approach for Transformers Supplying Non-Sinusoidal Loads

A. A transformer intended for use with loads drawing non-sinusoidal currents shall be marked "Suitable for non-sinusoidal current load with K-factor not to exceed x. (x= 4, 9, 13, 20, 30, 40 or 50)

B. Formulas to determine eddy losses and total losses where the transformer load losses (P_{LL}) are to be determined as follows:

$$P_{LL} = P_{DC}(1 + K(P_{EC}))$$

where:

P_{DC} = the total I^2R losses

K= the K-factor rating at the transformer (4, 9, 13, 20, 30, 40 or 50)

P_{EC}= assumed eddy current losses calculated as follows:

$\frac{P_{AC} - P_{DC}}{P_{DC}}$ for transformers rated 300 KVA or less, and

$\frac{C\,(P_{AC} - P_{DC})}{P_{DC\text{-}I}}$ For transformers rated more than 300 KVA

in which:

P_{AC} = the impedance loss

C= 0.7 for transformers having a turn ratio greater than 4:1 and having one or more windings with a current rating greater than 1000 amperes, or C=0.6 for all other transformers

$P_{DC\text{-}I}$ = the I^2R losses for the inner winding

The impedance losses and the I^2R losses shall be determined in accordance with the Test Code for Dry Type Distribution and Power Transformers, ANSI/IEEE C57.12.91.

DC Components of Load Current

As Stated in ANSI/IEEE C57.110-1998.

Harmonic load currents may be accompanied by DC components in the load current which are frequently caused by the loss of a diode in a rectifier circuit. A DC component of load current will increase the transformer core loss slightly, and may increase the magnetizing current and audible sound level .

Relatively small DC components (up to the RMS magnitude of the transformer excitation current at rated voltage) are expected to have no significant effect on the load carrying capability of a transformer determined by this recommended practice. Higher DC load current components may adversely affect transformer capability and must be corrected by the user.

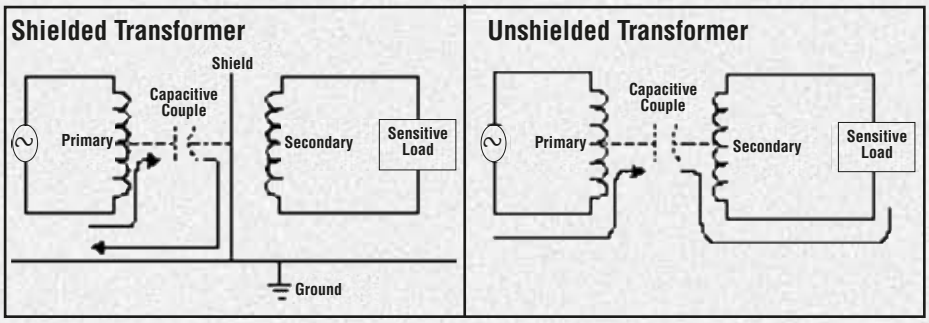
Harmonic currents flowing through transformer leakage impedance and through system impedance may also produce some small harmonic distortion in the voltage waveform at the transformer terminals. Such voltage harmonics may cause extra harmonic losses in the transformer core. However, operating experience has indicated that core temperature rise usually will not be the limiting parameter for determination of safe magnitudes of nonsinusoidal load currents.

Shielded Transformers

Electrostatically Shielded Transformers suppress common mode noise by introducing a grounded shield between its primary and secondary windings. The grounded shield provides a low impedance path to ground by capacitive coupling which prevents unwanted high frequency signals contained in the source voltage from reaching the transformer secondary.

The grounded shield between the primary and secondary windings is called an electrostatic shield. This shield does not perform any function with regard to harmonic current or voltage distortion wave forms. However the shield is extremely valuable in protecting sensitive equipment from common-mode electrical noise and transients generated on the line side of the transformer.

The ratio of the common mode noise attenuation (CMA) on the input to that of the output of the transformer is expressed in decibels as shown in **Equation 3**. An isolation transformer with an electrostatic shield can have a ratio of input noise voltage (V_{IN}) to output noise voltage (V_{OUT}) within the range of 10:1 to 1000:1 or even higher.



Test Circuit

Equation 3

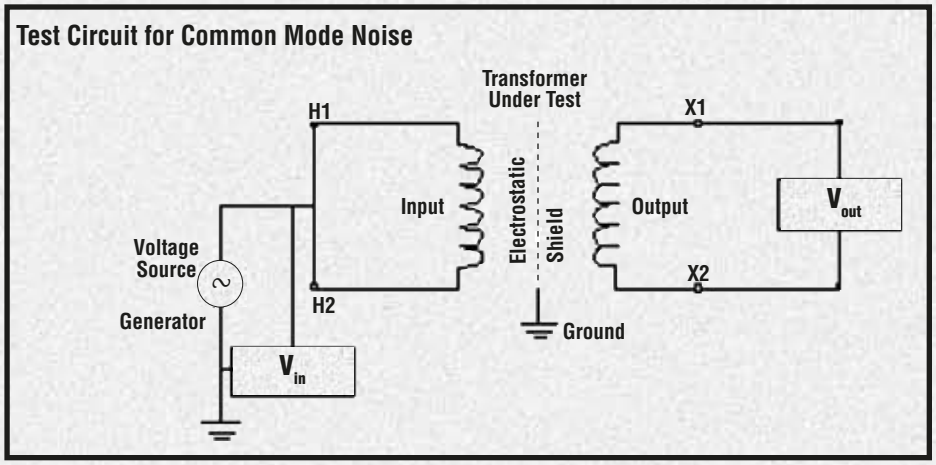
$$CMA = 20 \text{ Log}_{10} \left[\frac{V_{IN}}{V_{OUT}} \right] dB$$

Using a Numerical Example

V_{IN} = 100.0 V at 40 kHz

V_{OUT} = 0.06 V at 40 kHz

$$CMA = 20 \text{ Log}_{10} \left[\frac{100.0 V_{IN}}{0.06 V_{OUT}} \right] = 64.4 \text{ dB}$$

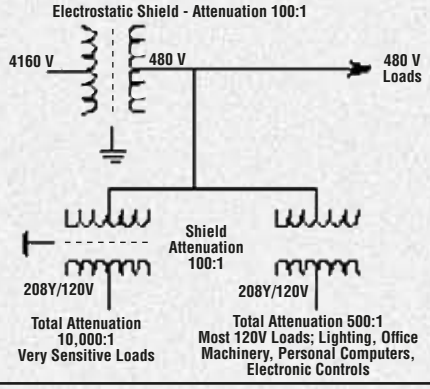


Federal Pacific Type DIT Drive Isolation Transformers are designed to meet the requirements of SCR controlled, variable speed motor drives. They are specifically constructed to withstand the mechanical forces associated with SCR drive duty cycles and to isolate the source voltage circuit from low frequency noise generated from SCR voltage spikes and transient feedback. Whereas the electrostatic shielded transformer attenuates higher frequency noise in the 10 kHz - 100 kHz range.

Multiplying Effect of Cascading Shielded Transformers

Having the presence of an upline transformer with an electrostatic shield may mean that other shielded transformers would not be required in the system. However, if a shielded transformer feeds another shielded transformer, there is an effect of the attenuation ratio multiplying as shown in **Figure 3**. If the attenuation ratio is 100:1 in each of the transformers, the total attenuation will be 100x100=10,000:1. Obviously, cascading inherently multiplies the attenuation effectiveness of shielded transformers. The term cascading means that two or more transformers are connected in series on the same system.

Figure 3



One line diagram shows system with shielded upline transformer and the attenuation ratios for various combinations with downline transformers. In most systems, only one shielded upline transformer is required.

Estimating K-Factor Loads

For the most part, each designer or installer must make his/her own decision regarding what K-factor to assign to any load or load category. The following table is intended to assist in that determination by presenting what we believe are realistic, yet conservative, K-factors for a number of loads and load categories based on their relative harmonic producing capabilities.

Calculating K-Factor Loads

1. List the KVA value for each load category to be supplied. Next, assign an I_{LK} value that corresponds to the relative level of harmonics drawn by each type of load. See Table 2.

2. Multiply the KVA of each load times the I_{LK} rating that corresponds to the assigned K-factor rating. This result is an indexed KVA-I_{LK} value:

   KVA x I_{LK}=KVA -I_{LK}

3. Tabulate the total connected load KVA for all load categories to be supplied.

4. Next, add-up the KVA-I_{LK} values for all loads or load categories to be supplied by the transformer.

5. Divide the grand total KVA-I_{LK} value by the total KVA load to be supplied. This will give an average I_{LK} for that combination of loads. (Total KVA-I_{LK}) ÷ (Total KVA) = average I_{LK}

6. From Table 3, find the K-factor rating whose I_{LK} is equal to or greater than the calculated I_{LK}.

   Corresponding to this I_{LK} is the K-factor of the transformer required.

Table 2

Load	Typical K-Factor	Typical I_{LK}
Incandescent Lighting	K-1	0.00
Electric Resistance Heating	K-1	0.00
Motors (without solid state drives)	K-1	0.00
Control Transformers/Electromagnetic Control Devices	K-1	0.00
Motor-Generators (without solid state drives)	K-1	0.00
Distribution Transformers	K-1	0.00
Electric-Discharge Lighting	K-4	25.82
UPS w/Optional Input Filter	K-4	25.82
Welders	K-4	25.82
Induction Heating Equipment	K-4	25.82
PLCs and Solid State Controls	K-4	25.82
Telecommunications Equipment (e.g. PBX)	K-13	57.74
UPS without Input Filtering	K-13	57.74
Multiwire Receptacle Circuits in General Care Areas of Health Care Facilities, Classrooms of Schools, etc	K-13	57.74
Multiwire Receptacle Circuits Supplying Inspection or Testing Equipment on an Assembly or Production Line	K-13	57.74
Main-Frame Computer Loads	K-20	80.94
Solid State Motor Drives (variable speed drives)	K-20	80.94
Multiwire Receptacle Circuits in Critical Care, Operating and Recovery Room Areas in Hospitals	K-20	80.94
Multiwire Receptacle Circuits in Industrial, Medical and Educational Laboratories	K-30	123.54
Multiwire Receptacle Circuits in Commercial Office Spaces	K-30	123.54
Small Main Frames (mini and micro)	K-30	123.54
Other Loads Identified as Producing Very High Amounts of Harmonics	K-40	208.17

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Table 3 Index of Load K-ratings

K-factor	K-1	K-4	K-9	K-13	K-20	K-30	K- 40
I_{LK}	0.0	25.82	44.72	57.74	80.94	123.54	208.17

Examples:

Problem 1

Calculate the overall K-factor for several non-linear loads.

Load Category	KVA Load	x	I_{LK}	=	KVA-I_{LK} Value
Discharge lighting	7.0	x	25.82	=	180.74
Receptacle circuits	2.0	x	123.54	=	247.08
Main frame computers	5.0	x	80.94	=	404.70
Motor w/drive	0.5	x	80.94	=	40.47
Motor w/o drive	1.5	x	0.00	=	0.00
Totals	16.0				872.99

Total KVA -I_{LK} / Total KVA=average I_{LK}

872.99/16 = 54.56 = average I_{LK}

From Table 3, the nearest K-factor greater than or equal to the average I_{LK} of 54.56 is K-13 with an I_{LK} of 57.74.

Problem 2

Calculate the amount of additional K-30 load that can be handled by a 25KVA, K-13 transformer with 9KVA of spare capacity.

1. Determine the available spare K-13 KVA-I_{LK}, using the I_{LK} that corresponds to the transformer's K-factor rating.

spare KVA x I_{LK} = spare KVA-I_{LK}

9 x 57.74 = 519.66 spare KVA-I_{LK}

2. Divide the spare KVA-I_{LK} by the Index of Load K-rating for the load to be supplied.

The I_{LK} for a K-30 load is 123.54

spare KVA-I_{LK} / new load I_{LK} @ K-30 =maximum additional KVA

519.66 / 123.54 = 4.2 KVA maximum additional KVA

3. Therefore, an additional 4.2 KVA of K-30 load could be added to this transformer. This additional loading represents the absolute maximum non-linear loading for that transformer.

For a transformer already partially loaded, any additional KVA loading must take into consideration the K-factor of each of the new loads to be added.

Guide Specification for 600 Volt Class Ventilated Dry Type Transformer Non-Linear, Non-Sinusoidal Loads

1. Transformer shall be UL 1561 listed, type "FHK". And be a Federal Pacific type FHK or approved equal.

2. Transformer shall be designed to supply rated current at 100% linear load plus carry the percent of non-linear odd order load up to the 25th harmonic as listed in **Table 4**.

Table 4
K-Factor Load Relationship

K Factor	% Linear Load	Plus	% Non Linear Load
4	100%	+	50% (1/h)
13	100%	+	100% (1/h)
20	100%	+	125% (1/h)
30	100%	+	150% (1/h)

where h = 3 through 25 for odd harmonics

3. The transformer shall be three-phase with the fundamental frequency rating of 60 hertz.

4. Primary winding shall be delta connected and secondary winding shall be wye connected.

5. The transformer windings and terminals shall be aluminum. (Copper option is readily available; please specify)

6. The primary shall have two 2.5% full capacity taps above rated voltage and four 2.5% full capacity taps below rated voltage tap.

7. The temperature rise at the rated voltage and rated K-Factor load shall not exceed 150°C when measured by the resistance method as listed in ANSI/IEEE C57.12.91 with a 220°C UL Component Recognition Insulation System. (Optional: 115°C and 80°C temperature rise K-1 through K-20 units available; please specify.)

8. Transformers designed to accomodate additional heating effect of non-linear loads.

9. The secondary neutral shall be 2x (twice) the ampacity of the secondary phase conductors for triplens and unbalanced single phase loads.

10. The Basic Impulse Level of all windings shall be 10 KV.

11. The enclosure shall be rated NEMA-1. (Optional: NEMA-3R units available.)

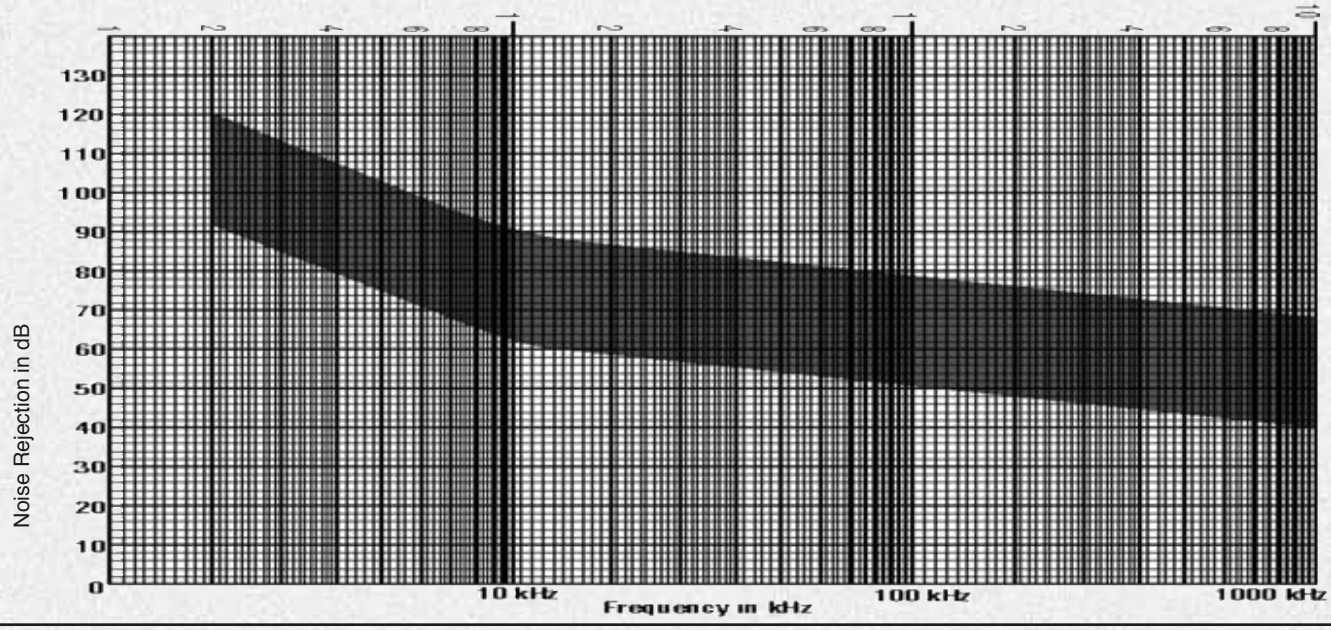
12. Optional: A full electrical width electrostatic shield shall be placed between the primary and secondary windings of each coil. With the shield grounded to a common point and the transformer connected under normal loaded conditions the attenuation of common mode line noise and transients shall be similar to values in Figure 4.

13. The average audible sound level shall comply with NEMA ST-20:
10 to 50 KVA - 45 dB
51 to 150 KVA - 50 dB
151 to 300 KVA - 55 dB
301 to 500 KVA - 60 dB
501 to 700 KVA - 62 dB
701 to 1000 KVA - 64 dB
1001 to 1500 KVA - 65 dB
1501 to 2000 KVA - 66 dB
Note: Lower sound levels may be desirable for critical areas such as hospitals, schools or office areas. Contact your local FP Representative for specific recommendations.

References:
ANSI/IEEE C57.110-1986, Recommended Practice to Establish Transformer Capability when Supplying Non-Sinusoidal Load Currents
ANSI/IEEE STD 519-1981, IEEE Guide to Harmonic Control and Reactive Compensation of Static Power Converters

McPartland, Brian J.

Figure 4. Typical Common Mode Noise Rejection Curve



FPT Type FHK • K-Factor Dry-Type Transformers

K-Factor Rated • 80° C Rise • Three-Phase • K4

Type	KVA	Catalog Number	Taps	Approximate Enclosure Dimensions - Inches			Aprox. Wt. in Lbs.	Weather Shield[1]	Wiring Diagram	Wall Mount Bracket
				H	W	D				
480 - 208Y/120, 60 Hz										
FHK	15	T4T15BK4E	+2, -4 x 2.5%	34	22.375	19.875	370	WS-4	22	WMB-3
	30	T4T30BK4E	+2, -4 x 2.5%	34	22.375	19.875	400	WS-4	22	WMB-3
	45	T4T45BK4E	+2, -4 x 2.5%	37	26	19.875	575	WS-18A	22	WMB-4
	75	T4T75BK4E	+2, -4 x 2.5%	43	28.5	23.5	760	WS-18	22	WMB-4
	112.5	T4T112BK4E	+2, -4 x 2.5%	51	36	30.5	1520	WS-12A	22A	NONE
	150	T4T150BK4E	+2, -4 x 2.5%	63	46.5	30.875	1630	WS-14	22A	NONE
	225	T4T225BK4E	CONSULT FACTORY							
	300	T4T300BK4E								
	500	T4T500BK4E								
480 - 208Y/120, 60 Hz, Electrostatically Shielded										
FHK	15	T4T15BSK4E	+2, -4 x 2.5%	34	22.375	19.875	370	WS-4	18	WMB-3
	30	T4T30BSK4E	+2, -4 x 2.5%	34	22.375	19.875	400	WS-4	18	WMB-3
	45	T4T45BSK4E	+2, -4 x 2.5%	37	26	19.875	575	WS-18A	18	WMB-4
	75	T4T75BSK4E	+2, -4 x 2.5%	43	28.5	23.5	760	WS-18	18	WMB-4
	112.5	T4T112BSK4E	+2, -4 x 2.5%	51	36	30.5	1520	WS-12A	18A	NONE
	150	T4T150BSK4E	+2, -4 x 2.5%	63	46.5	30.875	1630	WS-14	18A	NONE
	225	T4T225BSK4E	CONSULT FACTORY							
	300	T4T300BSK4E								
	500	T4J500BSK4E								
480 - 208Y/120, 60 Hz, Electrostatically Shielded, Copper										
FHK	15	T4T15BCSK4E	+2, -4 x 2.5%	34	22.375	19.875	410	WS-4	18	WMB-3
	30	T4T30BCSK4E	+2, -4 x 2.5%	34	22.375	19.875	460	WS-4	18	WMB-3
	45	T4T45BCSK4E	+2, -4 x 2.5%	37	26	19.875	645	WS-18A	18	WMB-4
	75	T4T75BCSK4E	+2, -4 x 2.5%	43	28.5	23.5	855	WS-18	18A	WMB-4
	112.5	T4T112BCSK4E	+2, -4 x 2.5%	51	36	30.5	1750	WS-12A	18A	NONE
	150	T4T150BCSK4E	+2, -4 x 2.5%	63	46.5	30.875	1830	WS-14	18A	NONE
	225	T4T225BCSK4E	CONSULT FACTORY							
	300	T4T300BCSK4E								
480 - 240/120, LT (Lighting Tap), 60 Hz										
FHK	15	T43T15BK4E	+2, -4 x 2.5%	29	17.125	19.375	210	WS-2	21	WMB-3
	30	T43T30BK4E	+2, -4 x 2.5%	34	22.375	19.875	400	WS-4	21	WMB-3
	45	T43T45BK4E	+2, -4 x 2.5%	37	26	19.875	575	WS-18A	21	WMB-4
	75	T43T75BK4E	+2, -4 x 2.5%	43	28.5	23.5	760	WS-18	21	WMB-4
	112.5	T43T112BK4E	+2, -4 x 2.5%	51	36	30.5	1520	WS-12A	21A	NONE
	150	T43T150BK4E	+2, -4 x 2.5%	63	46.5	30.875	1630	WS-14	21A	NONE
	225	T43T225BK4E	CONSULT FACTORY							
	300	T43T300BK4E								
480 - 240/120, LT (Lighting Tap), 60 Hz, Electrostatically Shielded										
FHK	15	T43T15BSK4E	+2, -4 x 2.5%	29	17.125	19.375	210	WS-2	17	WMB-3
	30	T43T30BSK4E	+2, -4 x 2.5%	34	22.375	19.875	400	WS-4	17	WMB-3
	45	T43T45BSK4E	+2, -4 x 2.5%	37	26	19.875	575	WS-18A	17	WMB-4
	75	T43T75BSK4E	+2, -4 x 2.5%	43	28.5	23.5	760	WS-18	17	WMB-4
	112.5	T43T112BSK4E	+2, -4 x 2.5%	51	36	30.5	1520	WS-12A	17A	NONE

[1]All transformer catalog numbers shown are in a NEMA 2 enclosure, which covers all the requirements of NEMA 1 by offering a degree of protection against the ingress of falling dirt and dripping liquid. The addition of a weather shield kit converts the indoor NEMA 2 transformer to an outdoor NEMA 3R.

FPT Type FHK • K-Factor Dry-Type Transformers

K-Factor Rated • 115° C Rise • Three-Phase • K4

Type	KVA	Catalog Number	Taps	Approximate Dimensions - Inches			Aprox. Wt. in Lbs.	Weather Shield[1]	Wiring Diagram	Wall Mount Bracket
				H	W	D				
480 - 208Y/120, 60 Hz										
FHK	15	T4T15FK4E	+2, -4 x 2.5%	34	22.375	19.875	370	WS-4	22	WMB-3
	30	T4T30FK4E	+2, -4 x 2.5%	34	22.375	19.875	400	WS-4	22	WMB-3
	45	T4T45FK4E	+2, -4 x 2.5%	37	26	19.875	575	WS-18A	22	WMB-4
	75	T4T75FK4E	+2, -4 x 2.5%	43	28.5	23.5	760	WS-18	22	WMB-4
	112.5	T4T112FK4E	+2, -4 x 2.5%	46	32	28	1180	WS-10B	22A	NONE
	150	T4T150FK4E	+2, -4 x 2.5%	51	36	30.5	1520	WS-12A	22A	NONE
	225	T4T225FK4E	+2, -4 x 2.5%	63	46.5	30.875	1630	WS-14	22A	NONE
	300	T4T300FK4E	+2, -4 x 2.5%	72.75	53.375	36.875	2335	WS-16	22A	NONE
	500	T4T500FK4E	CONSULT FACTORY							
480 - 208Y/120, 60 Hz, Electrostatically Shielded										
FHK	15	T4T15FSK4E	+2, -4 x 2.5%	34	22.375	19.875	370	WS-4	18	WMB-3
	30	T4T30FSK4E	+2, -4 x 2.5%	34	22.375	19.875	400	WS-4	18	WMB-3
	45	T4T45FSK4E	+2, -4 x 2.5%	37	26	19.875	575	WS-18A	18	WMB-4
	75	T4T75FSK4E	+2, -4 x 2.5%	43	28.5	23.5	760	WS-18	18	WMB-4
	112.5	T4T112FSK4E	+2, -4 x 2.5%	46	32	28	1180	WS-10B	18A	NONE
	150	T4T150FSK4E	+2, -4 x 2.5%	51	36	30.5	1520	WS-12A	18A	NONE
	225	T4T225FSK4E	+2, -4 x 2.5%	63	46.5	30.875	1630	WS-14	18A	NONE
	300	T4T300FSK4E	+2, -4 x 2.5%	72.75	53.375	36.875	2335	WS-16	18A	NONE
	500	T4T500FSK4E	+2, -4 x 2.5%	CONSULT FACTORY						
480 - 208Y/120, 60 Hz, Electrostatically Shielded, Copper										
FHK	15	T4T15FCSK4E	+2, -4 x 2.5%	29	17.125	19.375	240	WS-2	18	WMB-3
	30	T4T30FCSK4E	+2, -4 x 2.5%	34	22.375	19.875	410	WS-4	18	WMB-3
	45	T4T45FCSK4E	+2, -4 x 2.5%	37	26	19.875	645	WS-18A	18	WMB-4
	75	T4T75FCSK4E	+2, -4 x 2.5%	43	28.5	23.5	855	WS-18	18	WMB-4
	112.5	T4T112FCSK4E	+2, -4 x 2.5%	46	32	28	1330	WS-10B	18A	NONE
	150	T4T150FCSK4E	+2, -4 x 2.5%	51	36	30.5	1750	WS-12A	18A	NONE
	225	T4T225FCSK4E	+2, -4 x 2.5%	63	46.5	30.875	1830	WS-14	18A	NONE
	300	T4T300FCSK4E	+2, -4 x 2.5%	72.75	53.375	36.875	2700	WS-16	18A	NONE
480 - 240/120, LT (Lighting Tap), 60 Hz										
FHK	15	T43T15FK4E	+2, -4 x 2.5%	34	22.375	19.875	370	WS-4	21	WMB-3
	30	T43T30FK4E	+2, -4 x 2.5%	34	22.375	19.875	400	WS-4	21	WMB-3
	45	T43T45FK4E	+2, -4 x 2.5%	37	26	19.875	575	WS-18A	21	WMB-4
	75	T43T75FK4E	+2, -4 x 2.5%	43	28.5	23.5	760	WS-18	21	WMB-4
	112.5	T43T112FK4E	+2, -4 x 2.5%	46	32	28	1180	WS-10B	21A	NONE
	150	T43T150FK4E	+2, -4 x 2.5%	51	36	30.5	1520	WS-12A	21A	NONE
	225	T43T225FK4E	+2, -4 x 2.5%	63	46.5	30.875	1630	WS-14	21A	NONE
	300	T43T300FK4E	+2, -4 x 2.5%	72.75	53.375	36.875	2335	WS-16	21A	NONE
480 - 240/120, LT (Lighting Tap), 60 Hz, Electrostatically Shielded										
FHK	15	T43T15FSK4E	+2, -4 x 2.5%	34	22.375	19.875	370	WS-4	17	WMB-3
	30	T43T30FSK4E	+2, -4 x 2.5%	34	22.375	19.875	400	WS-4	17	WMB-3
	45	T43T45FSK4E	+2, -4 x 2.5%	37	26	19.875	575	WS-18A	17	WMB-4
	75	T43T75FSK4E	+2, -4 x 2.5%	43	28.5	23.5	760	WS-18	17	WMB-4
	112.5	T43T112FSK4E	+2, -4 x 2.5%	46	32	28	1180	WS-10B	17A	NONE
	150	T43T150FSK4E	+2, -4 x 2.5%	51	36	30.5	1520	WS-12A	17A	NONE

[1]All transformer catalog numbers shown are in a NEMA 2 enclosure, which covers all the requirements of NEMA 1 by offering a degree of protection against the ingress of falling dirt and dripping liquid. The addition of a weather shield kit converts the indoor NEMA 2 transformer to an outdoor NEMA 3R.

FPT Type FHK • K-Factor Dry-Type Transformers

K-Factor Rated • 150° C Rise • Three-Phase • K4

Type	KVA	Catalog Number	Taps	Approximate Dimensions - Inches			Aprox. Wt. in Lbs.	Weather Shield[1]	Wiring Diagram	Wall Mount Bracket
				H	W	D				
480 - 208Y/120, 60 Hz										
FHK	15	T4T15K4E	+2, -4 x 2.5%	29	17.125	19.375	210	WS-2	22	WMB-3
	30	T4T30K4E	+2, -4 x 2.5%	34	22.375	19.875	370	WS-4	22	WMB-3
	45	T4T45K4E	+2, -4 x 2.5%	37	26	19.875	575	WS-18A	22	WMB-4
	75	T4T75K4E	+2, -4 x 2.5%	37	26	19.875	575	WS-18A	22	WMB-4
	112.5	T4T112K4E	+2, -4 x 2.5%	46	32	28	1180	WS-10B	22A	NONE
	150	T4T150K4E	+2, -4 x 2.5%	46	32	28	1180	WS-10B	22A	NONE
	225	T4T225K4E	+2, -4 x 2.5%	63	46.5	30.875	1630	WS-14	22A	NONE
	300	T4T300K4E	+2, -4 x 2.5%	63	46.5	30.875	1630	WS-14	22A	NONE
	500	T4T500K4E	+2, -4 x 2.5%	76.75	53.375	44.375	3280	NONE	22A	NONE
	750	T4T750K4E	CONSULT FACTORY							
480 - 208Y/120, 60 Hz, Electrostatically Shielded										
FHK	15	T4T15SK4E	+2, -4 x 2.5%	29	17.125	19.375	210	WS-2	18	WMB-3
	30	T4T30SK4E	+2, -4 x 2.5%	34	22.375	19.875	370	WS-4	18	WMB-3
	45	T4T45SK4E	+2, -4 x 2.5%	37	26	19.875	575	WS-18A	18	WMB-4
	75	T4T75SK4E	+2, -4 x 2.5%	37	26	19.875	575	WS-18A	18	WMB-4
	112.5	T4T112SK4E	+2, -4 x 2.5%	46	32	28	1180	WS-10B	18A	NONE
	150	T4T150SK4E	+2, -4 x 2.5%	46	32	28	1180	WS-10B	18A	NONE
	225	T4T225SK4E	+2, -4 x 2.5%	63	46.5	30.875	1630	WS-14	18A	NONE
	300	T4T300SK4E	+2, -4 x 2.5%	63	46.5	30.875	1630	WS-14	18A	NONE
	500	T4T500SK4E	+2, -4 x 2.5%	76.75	53.375	44.375	3280	NONE	18A	NONE
	750	T4T750SK4E	CONSULT FACTORY							
480 - 208Y/120, 60 Hz, Electrostatically Shielded, Copper										
FHK	15	T4T15CSK4E	+2, -4 x 2.5%	29	17.125	19.375	240	WS-2	18	WMB-3
	30	T4T30CSK4E	+2, -4 x 2.5%	34	22.375	19.875	410	WS-4	18	WMB-3
	45	T4T45CSK4E	+2, -4 x 2.5%	34	22.375	19.875	460	WS-4	18	WMB-3
	75	T4T75CSK4E	+2, -4 x 2.5%	37	26	19.875	645	WS-18A	18	WMB-4
	112.5	T4T112CSK4E	+2, -4 x 2.5%	46	32	28	1330	WS-10B	18A	NONE
	150	T4T150CSK4E	+2, -4 x 2.5%	46	32	28	1330	WS-10B	18A	NONE
	225	T4T225CSK4E	+2, -4 x 2.5%	63	46.5	30.875	1830	WS-14	18A	NONE
	300	T4T300CSK4E	+2, -4 x 2.5%	63	46.5	30.875	1830	WS-14	18A	NONE
	500	T4T500CSK4E	CONSULT FACTORY							
480 - 240/120, LT (Lighting Tap), 60 Hz										
FHK	15	T43T15K4E	+2, -4 x 2.5%	29	17.125	19.375	210	WS-2	21	WMB-3
	30	T43T30K4E	+2, -4 x 2.5%	34	22.375	19.875	370	WS-4	21	WMB-3
	45	T43T45K4E	+2, -4 x 2.5%	37	26	19.875	575	WS-18A	21	WMB-4
	75	T43T75K4E	+2, -4 x 2.5%	37	26	19.875	575	WS-18A	21	WMB-4
	112.5	T43T112K4E	+2, -4 x 2.5%	46	32	28	1180	WS-10B	21A	NONE
	150	T43T150K4E	+2, -4 x 2.5%	46	32	28	1180	WS-10B	21A	NONE
	225	T43T225K4E	+2, -4 x 2.5%	63	46.5	30.875	1630	WS-14	21A	NONE
	300	T43T300K4E	+2, -4 x 2.5%	63	46.5	30.875	1630	WS-14	21A	NONE
480 - 240/120, LT (Lighting Tap), 60 Hz, Electrostatically Shielded										
FHK	15	T43T15SK4E	+2, -4 x 2.5%	29	17.125	19.375	210	WS-2	17	WMB-3
	30	T43T30SK4E	+2, -4 x 2.5%	34	22.375	19.875	370	WS-4	17	WMB-3
	45	T43T45SK4E	+2, -4 x 2.5%	37	26	19.875	575	WS-18A	17	WMB-4
	75	T43T75SK4E	+2, -4 x 2.5%	37	26	19.875	575	WS-18A	17	WMB-4
	112.5	T43T112SK4E	+2, -4 x 2.5%	46	32	28	1180	WS-10B	17A	NONE
	150	T43T150SK4E	+2, -4 x 2.5%	46	32	28	1180	WS-10B	17A	NONE

[1]All transformer catalog numbers shown are in a NEMA 2 enclosure, which covers all the requirements of NEMA 1 by offering a degree of protection against the ingress of falling dirt and dripping liquid. The addition of a weather shield kit converts the indoor NEMA 2 transformer to an outdoor NEMA 3R.

FPT Type FHK • K-Factor Dry-Type Transformers

K-Factor Rated • 80° C Rise • Three-Phase • K13

Type	KVA	Catalog Number	Taps	Approximate Dimensions - Inches			Aprox. Wt. in Lbs.	Weather Shield[1]	Wiring Diagram	Wall Mount Bracket
				H	W	D				
480 - 208Y/120, 60 Hz										
FHK	15	T4T15BK13E	+2, -4 x 2.5%	34	22.375	19.875	370	WS-4	22	WMB-3
	30	T4T30BK13E	+2, -4 x 2.5%	37	26	19.875	575	WS-18A	22	WMB-4
	45	T4T45BK13E	+2, -4 x 2.5%	37	26	19.875	575	WS-18A	22	WMB-4
	75	T4T75BK13E	+2, -4 x 2.5%	46	32	28	1180	WS-10B	22A	NONE
	112.5	T4T112BK13E	CONSULT FACTORY							
	150	T4T150BK13E	+2, -4 x 2.5%	63	46.5	30.875	1630	WS-14	22A	NONE
	225	T4T225BK13E	CONSULT FACTORY							
	300	T4T300BK13E								
480 - 208Y/120, 60 Hz, Electrostatically Shielded										
FHK	15	T4T15BSK13E	+2, -4 x 2.5%	34	22.375	19.875	370	WS-4	18	WMB-3
	30	T4T30BSK13E	+2, -4 x 2.5%	37	26	19.875	575	WS-18A	18	WMB-4
	45	T4T45BSK13E	+2, -4 x 2.5%	37	26	19.875	575	WS-18A	18	WMB-4
	75	T4T75BSK13E	+2, -4 x 2.5%	46	32	28	1180	WS-10B	18A	NONE
	112.5	T4T112BSK13E	CONSULT FACTORY							
	150	T4T150BSK13E	+2, -4 x 2.5%	63	46.5	30.875	1630	WS-14	18A	NONE
	225	T4T225BSK13E	CONSULT FACTORY							
	300	T4T300BSK13E								
480 - 208Y/120, 60 Hz, Electrostatically Shielded, Copper										
FHK	15	T4T15BCSK13E	+2, -4 x 2.5%	34	22.375	19.875	410	WS-4	18	WMB-3
	30	T4T30BCSK13E	+2, -4 x 2.5%	34	22.375	19.875	460	WS-4	18	WMB-3
	45	T4T45BCSK13E	+2, -4 x 2.5%	37	26	19.875	645	WS-18A	18	WMB-4
	75	T4T75BCSK13E	+2, -4 x 2.5%	46	32	28	1330	WS-10B	18A	NONE
	112.5	T4T112BCSK13E	+2, -4 x 2.5%	51	36	30.5	1750	WS-12A	18A	NONE
	150	T4T150BCSK13E	+2, -4 x 2.5%	63	46.5	30.875	1830	WS-14	18A	NONE
	225	T4T225BCSK13E	CONSULT FACTORY							
	300	T4T300BCSK13E								
480 - 240/120, LT (Lighting Tap), 60 Hz										
FHK	15	T43T15BK13E	+2, -4 x 2.5%	34	22.375	19.875	370	WS-4	21	WMB-3
	30	T43T30BK13E	+2, -4 x 2.5%	37	26	19.875	575	WS-18A	21	WMB-4
	45	T43T45BK13E	+2, -4 x 2.5%	43	28.5	23.5	760	WS-18	21	WMB-4
	75	T43T75BK13E	+2, -4 x 2.5%	46	32	28	1180	WS-10B	21A	NONE
	112.5	T43T112BK13E	CONSULT FACTORY							
	150	T43T150BK13E	+2, -4 x 2.5%	63	46.5	30.875	1630	WS-14	21A	NONE
	225	T43T225BK13E	CONSULT FACTORY							
480 - 240/120, LT (Lighting Tap), 60 Hz, Electrostatically Shielded										
FHK	15	T43T15BSK13E	+2, -4 x 2.5%	34	22.375	19.875	370	WS-4	17	WMB-3
	30	T43T30BSK13E	+2, -4 x 2.5%	37	26	19.875	575	WS-18A	17	WMB-4
	45	T43T45BSK13E	+2, -4 x 2.5%	43	28.5	23.5	760	WS-18	17	WMB-4
	75	T43T75BSK13E	+2, -4 x 2.5%	46	32	28	1180	WS-10B	17A	NONE
	112.5	T43T112BSK13E	CONSULT FACTORY							

[1]All transformer catalog numbers shown are in a NEMA 2 enclosure, which covers all the requirements of NEMA 1 by offering a degree of protection against the ingress of falling dirt and dripping liquid. The addition of a weather shield kit converts the indoor NEMA 2 transformer to an outdoor NEMA 3R.

FPT Type FHK • K-Factor Dry-Type Transformers

K-Factor Rated • 115° C Rise • Three-Phase • K13

Type	KVA	Catalog Number	Taps	Approximate Dimensions - Inches			Aprox. Wt. in Lbs.	Weather Shield[1]	Wiring Diagram	Wall Mount Bracket
				H	W	D				
480 - 208Y/120, 60 Hz, Electrostatically Shielded										
FHK	15	T4T15FSK13E	+2, -4 x 2.5%	34	22.375	19.875	370	WS-4	18	WMB-3
	30	T4T30FSK13E	+2, -4 x 2.5%	34	22.375	19.875	400	WS-4	18	WMB-3
	45	T4T45FSK13E	+2, -4 x 2.5%	37	26	19.875	575	WS-18A	18	WMB-4
	75	T4T75FSK13E	+2, -4 x 2.5%	43	28.5	23.5	760	WS-18	18	WMB-4
	112.5	T4T112FSK13E	+2, -4 x 2.5%	46	32	28	1180	WS-10B	18A	NONE
	150	T4T150FSK13E	+2, -4 x 2.5%	63	46.5	30.875	1630	WS-14	18A	NONE
	225	T4T225FSK13E	+2, -4 x 2.5%	63	46.5	30.875	1630	WS-14	18A	NONE
	300	T4T300FSK13E	+2, -4 x 2.5%	72.75	53.375	36.875	2335	WS-16	18A	NONE
	500	T4T500FSK13E	CONSULT FACTORY							
480 - 208Y/120, 60 Hz, Electrostatically Shielded, Copper										
FHK	15	T4T15FCSK13E	+2, -4 x 2.5%	34	22.375	19.875	410	WS-4	18	WMB-3
	30	T4T30FCSK13E	+2, -4 x 2.5%	34	22.375	19.875	410	WS-4	18	WMB-3
	45	T4T45FCSK13E	+2, -4 x 2.5%	37	26	19.875	645	WS-18A	18	WMB-4
	75	T4T75FCSK13E	+2, -4 x 2.5%	43	28.5	23.5	855	WS-18	18	WMB-4
	112.5	T4T112FCSK13E	+2, -4 x 2.5%	46	32	28	1330	WS-10B	18A	NONE
	150	T4T150FCSK13E	+2, -4 x 2.5%	51	36	30.5	1750	WS-12A	18A	NONE
	225	T4T225FCSK13E	CONSULT FACTORY							
	300	T4T300FCSK13E								
480 - 240/120, LT (Lighting Tap), 60 Hz										
FHK	15	T43T15FK13E	+2, -4 x 2.5%	34	22.375	19.875	370	WS-4	21	WMB-3
	30	T43T30FK13E	+2, -4 x 2.5%	34	22.375	19.875	400	WS-4	21	WMB-3
	45	T43T45FK13E	+2, -4 x 2.5%	37	26	19.875	575	WS-18A	21	WMB-4
	75	T43T75FK13E	+2, -4 x 2.5%	43	28.5	23.5	760	WS-18	21	WMB-4
	112.5	T4T3112FK13E	+2, -4 x 2.5%	46	32	28	1180	WS-10B	21A	NONE
	150	T43T150FK13E	+2, -4 x 2.5%	63	46.5	30.875	1630	WS-14	21A	NONE
	225	T43T225FK13E	+2, -4 x 2.5%	63	46.5	30.875	1630	WS-14	21A	NONE
	300	T43T300FK13E	+2, -4 x 2.5%	72.75	53.375	36.875	2335	WS-16	21A	NONE
480 - 240/120, LT (Lighting Tap), 60 Hz, Electrostatically Shielded										
FHK	15	T43T15FSK13E	+2, -4 x 2.5%	34	22.375	19.875	370	WS-4	17	WMB-3
	30	T43T30FSK13E	+2, -4 x 2.5%	34	22.375	19.875	400	WS-4	17	WMB-3
	45	T43T45FSK13E	+2, -4 x 2.5%	37	26	19.875	575	WS-18A	17	WMB-4
	75	T43T75FSK13E	+2, -4 x 2.5%	43	28.5	23.5	760	WS-18	17	WMB-4
	112.5	T43T112FSK13E	+2, -4 x 2.5%	46	32	28	1180	WS-10B	17A	NONE
	150	T43T150FSK13E	+2, -4 x 2.5%	63	46.5	30.875	1630	WS-14	17A	NONE

[1]All transformer catalog numbers shown are in a NEMA 2 enclosure, which covers all the requirements of NEMA 1 by offering a degree of protection against the ingress of falling dirt and dripping liquid. The addition of a weather shield kit converts the indoor NEMA 2 transformer to an outdoor NEMA 3R.

FPT Type FHK • K-Factor Dry-Type Transformers

K-Factor Rated • 150° C Rise • Three-Phase • K13

Type	KVA	Catalog Number	Taps	Approximate Dimensions - Inches			Aprox. Wt. in Lbs.	Weather Shield[1]	Wiring Diagram	Wall Mount Bracket
				H	W	D				
480 - 208Y/120, 60 Hz										
FHK	15	T4T15K13E	+2, -4 x 2.5%	29	17.125	19.375	210	WS-2	22	WMB-3
	30	T4T30K13E	+2, -4 x 2.5%	34	22.375	19.875	370	WS-4	22	WMB-3
	45	T4T45K13E	+2, -4 x 2.5%	37	26	19.875	575	WS-18A	22	WMB-4
	75	T4T75K13E	+2, -4 x 2.5%	37	26	19.875	575	WS-18A	22	WMB-4
	112.5	T4T112K13E	+2, -4 x 2.5%	46	32	28	1180	WS-10B	22A	NONE
	150	T4T150K13E	+2, -4 x 2.5%	51	36	30.5	1520	WS-12A	22A	NONE
	225	T4T225K13E	+2, -4 x 2.5%	63	46.5	30.875	1630	WS-14	22A	NONE
	300	T4T300K13E	+2, -4 x 2.5%	72.75	53.375	36.875	2070	WS-16	22A	NONE
	500	T4T500K13E	CONSULT FACTORY							
480 - 208Y/120, 60 Hz, Electrostatically Shielded										
FHK	15	T4T15SK13E	+2, -4 x 2.5%	29	17.125	19.375	210	WS-2	18	WMB-3
	30	T4T30SK13E	+2, -4 x 2.5%	34	22.375	19.875	370	WS-4	18	WMB-3
	45	T4T45SK13E	+2, -4 x 2.5%	37	26	19.875	575	WS-18A	18	WMB-4
	75	T4T75SK13E	+2, -4 x 2.5%	37	26	19.875	575	WS-18A	18	WMB-4
	112.5	T4T112SK13E	+2, -4 x 2.5%	46	32	28	1180	WS-10B	18A	NONE
	150	T4T150SK13E	+2, -4 x 2.5%	51	36	30.5	1520	WS-12A	18A	NONE
	225	T4T225SK13E	+2, -4 x 2.5%	63	46.5	30.875	1630	WS-14	18A	NONE
	300	T4T300SK13E	+2, -4 x 2.5%	72.75	53.375	36.875	2070	WS-16	18A	NONE
	500	T4T500SK13E	CONSULT FACTORY							
480 - 208Y/120, 60 Hz, Electrostatically Shielded, Copper										
FHK	15	T4T15CSK13E	+2, -4 x 2.5%	29	17.125	19.375	240	WS-2	18	WMB-3
	30	T4T30CSK13E	+2, -4 x 2.5%	34	22.375	19.875	410	WS-4	18	WMB-4
	45	T4T45CSK13E	+2, -4 x 2.5%	37	26	19.875	645	WS-18A	18	WMB-4
	75	T4T75CSK13E	+2, -4 x 2.5%	37	26	19.875	645	WS-18A	18	WMB-4
	112.5	T4T112CSK13E	+2, -4 x 2.5%	46	32	28	1330	WS-10B	18A	NONE
	150	T4T150CSK13E	+2, -4 x 2.5%	51	36	30.5	1750	WS-12A	18A	NONE
	225	T4T225CSK13E	+2, -4 x 2.5%	63	46.5	30.875	1830	WS-14	18A	NONE
	300	T4T300CSK13E	+2, -4 x 2.5%	72.75	53.375	36.875	2170	WS-16	18A	NONE
480 - 240/120, LT (Lighting Tap), 60 Hz										
FHK	15	T43T15K13E	+2, -4 x 2.5%	29	17.125	19.375	210	WS-2	21	WMB-3
	30	T43T30K13E	+2, -4 x 2.5%	34	22.375	19.875	370	WS-4	21	WMB-3
	45	T43T45K13E	+2, -4 x 2.5%	37	26	19.875	575	WS-18A	21	WMB-4
	75	T43T75K13E	+2, -4 x 2.5%	37	26	19.875	575	WS-18A	21	WMB-4
	112.5	T43T112K13E	+2, -4 x 2.5%	46	32	28	1180	WS-10B	21A	NONE
	150	T43T150K13E	+2, -4 x 2.5%	51	36	30.5	1520	WS-12A	21A	NONE
	225	T43T225K13E	+2, -4 x 2.5%	63	46.5	30.875	1630	WS-14	21A	NONE
	300	T43T300K13E	+2, -4 x 2.5%	72.75	53.375	36.875	2070	WS-16	21A	NONE
480 - 240/120, LT (Lighting Tap), 60 Hz, Electrostatically Shielded										
FHK	15	T43T15SK13E	+2, -4 x 2.5%	29	17.125	19.375	210	WS-2	17	WMB-3
	30	T43T30SK13E	+2, -4 x 2.5%	34	22.375	19.875	370	WS-4	17	WMB-3
	45	T43T45SK13E	+2, -4 x 2.5%	37	26	19.875	575	WS-18A	17	WMB-4
	75	T43T75SK13E	+2, -4 x 2.5%	37	26	19.875	575	WS-18A	17	WMB-4
	112.5	T43T112SK13E	+2, -4 x 2.5%	46	32	28	1180	WS-10B	17A	NONE
	150	T43T150SK13E	+2, -4 x 2.5%	51	36	30.5	1520	WS-12A	17A	NONE

[1]All transformer catalog numbers shown are in a NEMA 2 enclosure, which covers all the requirements of NEMA 1 by offering a degree of protection against the ingress of falling dirt and dripping liquid. The addition of a weather shield kit converts the indoor NEMA 2 transformer to an outdoor NEMA 3R.

FPT Type FHK • K-Factor Dry-Type Transformers

K-Factor Rated • 80° C Rise • Three-Phase • K20

Type	KVA	Catalog Number	Taps	Approximate Dimensions - Inches			Aprox. Wt. in Lbs.	Weather Shield[1]	Wiring Diagram	Wall Mount Bracket
				H	W	D				
480 - 208Y/120, 60 Hz										
FHK	15	T4T15BK20E	+2, -4 x 2.5%	34	22.375	19.875	370	WS-4	22	WMB-3
	30	T4T30BK20E	+2, -4 x 2.5%	37	26	19.875	575	WS-18A	22	WMB-4
	45	T4T45BK20E	+2, -4 x 2.5%	37	26	19.875	575	WS-18A	22	WMB-4
	75	T4T75BK20E	+2, -4 x 2.5%	46	32	28	1180	WS-10B	22A	NONE
	112.5	T4T112BK20E								
	150	T4T150BK20E	+2, -4 x 2.5%	63	46.5	30.875	1630	WS-14	22A	NONE
	225	T4T225BK20E	CONTACT FACTORY							
	300	T4T300BK20E								
480 - 208Y/120, 60 Hz, Electrostatically Shielded										
FHK	15	T4T15BSK20E	+2, -4 x 2.5%	34	22.375	19.875	370	WS-4	18	WMB-3
	30	T4T30BSK20E	+2, -4 x 2.5%	37	26	19.875	575	WS-18A	18	WMB-4
	45	T4T45BSK20E	+2, -4 x 2.5%	37	26	19.875	575	WS-18A	18	WMB-4
	75	T4T75BSK20E	+2, -4 x 2.5%	46	32	28	1180	WS-10B	18A	NONE
	112.5	T4T112BSK20E								
	150	T4T150BSK20E	+2, -4 x 2.5%	63	46.5	30.875	1630	WS-14	18A	NONE
	225	T4T225BSK20E	CONSULT FACTORY							
	300	T4T300BSK20E								
480 - 208Y/120, 60 Hz, Electrostatically Shielded, Copper										
FHK	15	T4T15BCSK20E	+2, -4 x 2.5%	34	22.375	19.875	410	WS-4	18	WMB-3
	30	T4T30BCSK20E	+2, -4 x 2.5%	34	22.375	19.875	460	WS-4	18	WMB-3
	45	T4T45BCSK20E	+2, -4 x 2.5%	37	26	19.875	645	WS-18A	18	WMB-4
	75	T4T75BCSK20E	+2, -4 x 2.5%	46	32	28	1330	WS-10B	18A	NONE
	112.5	T4T112BCSK20E	CONSULT FACTORY							
	150	T4T150BCSK20E								
	225	T4T225BCSK20E								

[1]All transformer catalog numbers shown are in a NEMA 2 enclosure, which covers all the requirements of NEMA 1 by offering a degree of protection against the ingress of falling dirt and dripping liquid. The addition of a weather shield kit converts the indoor NEMA 2 transformer to an outdoor NEMA 3R.

FPT Type FHK • K-Factor Dry-Type Transformers

K-Factor Rated • 115° C Rise • Three-Phase • K20

Type	KVA	Catalog Number	Taps	Approximate Dimensions - Inches			Aprox. Wt. in Lbs.	Weather Shield[1]	Wiring Diagram	Wall Mount Bracket
				H	W	D				
480 - 208Y/120, 60 Hz										
FHK	15	T4T15FK20E	+2, -4 x 2.5%	34	22.375	19.875	370	WS-4	22	WMB-3
	30	T4T30FK20E	+2, -4 x 2.5%	34	22.375	19.875	400	WS-4	22	WMB-3
	45	T4T45FK20E	+2, -4 x 2.5%	37	26	19.875	575	WS-18A	22	WMB-4
	75	T4T75FK20E	+2, -4 x 2.5%	43	28.5	23.5	760	WS-18	22	WMB-4
	112.5	T4T112FK20E	+2, -4 x 2.5%	51	36	30.5	1520	WS-12A	22A	NONE
	150	T4T150FK20E	+2, -4 x 2.5%	63	46.5	30.875	1630	WS-14	22A	NONE
	225	T4T225FK20E	CONSULT FACTORY							
	300	T4T300FK20E								
480 - 208Y/120, 60 Hz, Electrostatically Shielded										
FHK	15	T4T15FSK20E	+2, -4 x 2.5%	34	22.375	19.875	370	WS-4	18	WMB-3
	30	T4T30FSK20E	+2, -4 x 2.5%	34	22.375	19.875	400	WS-4	18	WMB-3
	45	T4T45FSK20E	+2, -4 x 2.5%	37	26	19.875	575	WS-18A	18	WMB-4
	75	T4T75FSK20E	+2, -4 x 2.5%	43	28.5	23.5	760	WS-18	18	WMB-4
	112.5	T4T112FSK20E	+2, -4 x 2.5%	51	36	30.5	1520	WS-12A	18A	NONE
	150	T4T150FSK20E	+2, -4 x 2.5%	63	46.5	30.875	1630	WS-14	18A	NONE
	225	T4T225FSK20E	CONSULT FACTORY							
	300	T4T300FSK20E								
480 - 208Y/120, 60 Hz, Electrostatically Shielded, Copper										
FHK	15	T4T15FCSK20E	+2, -4 x 2.5%	34	22.375	19.875	410	WS-4	18	WMB-3
	30	T4T30FCSK20E	+2, -4 x 2.5%	34	22.375	19.875	410	WS-4	18	WMB-3
	45	T4T45FCSK20E	+2, -4 x 2.5%	37	26	19.875	645	WS-18A	18	WMB-4
	75	T4T75FCSK20E	+2, -4 x 2.5%	43	28.5	23.5	855	WS-18	18	WMB-4
	112.5	T4T112FCSK20E	+2, -4 x 2.5%	46	32	28	1330	WS-10B	18A	NONE
	150	T4T150FCSK20E	CONSULT FACTORY							
	225	T4T225FCSK20E								
	300	T4T300FCSK20E								

[1]All transformer catalog numbers shown are in a NEMA 2 enclosure, which covers all the requirements of NEMA 1 by offering a degree of protection against the ingress of falling dirt and dripping liquid. The addition of a weather shield kit converts the indoor NEMA 2 transformer to an outdoor NEMA 3R.

FPT Type FHK • K-Factor Dry-Type Transformers

K-Factor Rated • 150° C Rise • Three-Phase • K20

Type	KVA	Catalog Number	Taps	Approximate Dimensions - Inches			Aprox. Wt. in Lbs.	Weather Shield[1]	Wiring Diagram	Wall Mount Bracket
				H	W	D				
480 - 208Y/120, 60 Hz										
FHK	15	T4T15K20E	+2, -4 x 2.5%	29	17.125	19.375	210	WS-2	22	WMB-3
	30	T4T30K20E	+2, -4 x 2.5%	34	22.375	19.875	370	WS-4	22	WMB-3
	45	T4T45K20E	+2, -4 x 2.5%	37	26	19.875	575	WS-18A	22	WMB-4
	75	T4T75K20E	+2, -4 x 2.5%	37	26	19.875	575	WS-18A	22	WMB-4
	112.5	T4T112K20E	+2, -4 x 2.5%	46	32	28	1180	WS-10B	22A	NONE
	150	T4T150K20E	+2, -4 x 2.5%	63	46.5	60.875	1630	WS-14	22A	NONE
	225	T4T225K20E	+2, -4 x 2.5%	63	46.5	30.875	1630	WS-14	22A	NONE
	300	T4T300K20E	+2, -4 x 2.5%	72.75	53.375	36.875	2335	WS-16	22A	NONE
	500	T4T500K20E	CONSULT FACTORY							
480 - 208Y/120, 60 Hz, Electrostatically Shielded										
FHK	15	T4T15SK20E	+2, -4 x 2.5%	29	17.125	19.375	210	WS-2	18	WMB-3
	30	T4T30SK20E	+2, -4 x 2.5%	34	22.375	19.875	370	WS-4	18	WMB-3
	45	T4T45SK20E	+2, -4 x 2.5%	37	26	19.875	575	WS-18A	18	WMB-4
	75	T4T75SK20E	+2, -4 x 2.5%	37	26	19.875	575	WS-18A	18	WMB-4
	112.5	T4T112SK20E	+2, -4 x 2.5%	46	32	28	1180	WS-10B	18A	NONE
	150	T4T150SK20E	+2, -4 x 2.5%	63	46.5	30.875	1630	WS-14	18A	NONE
	225	T4T225SK20E	+2, -4 x 2.5%	63	46.5	30.875	1630	WS-14	18A	NONE
	300	T4T300SK20E	+2, -4 x 2.5%	72.75	53.375	36.875	2335	WS-16	18A	NONE
	500	T4T500SK20E	CONSULT FACTORY							
480 - 208Y/120, 60 Hz, Electrostatically Shielded, Copper										
FHK	15	T4T15CSK20E	+2, -4 x 2.5%	29	17.125	19.375	240	WS-2	18	WMB-3
	30	T4T30CSK20E	+2, -4 x 2.5%	34	22.375	19.875	410	WS-4	18	WMB-3
	45	T4T45CSK20E	+2, -4 x 2.5%	37	26	19.875	645	WS-18A	18	WMB-4
	75	T4T75CSK20E	+2, -4 x 2.5%	37	26	19.875	645	WS-18A	18	WMB-4
	112.5	T4T112CSK20E	+2, -4 x 2.5%	46	32	28	1330	WS-10B	18A	NONE
	150	T4T150CSK20E	+2, -4 x 2.5%	51	36	30.5	1750	WS-12A	18A	NONE
	225	T4T225CSK20E	CONSULT FACTORY							
	300	T4T300CSK20E								

[1]All transformer catalog numbers shown are in a NEMA 2 enclosure, which covers all the requirements of NEMA 1 by offering a degree of protection against the ingress of falling dirt and dripping liquid. The addition of a weather shield kit converts the indoor NEMA 2 transformer to an outdoor NEMA 3R.

Accessories

Terminal Lug Kits for Type FH Transformers

Catalog Number	KVA Sizes	Terminal Lug Quantity	Lug Cable Range	Quantity Cables Per Lug	Hardware Quantity - Bolt Size	Aprox. Weight in Pounds
50400	15 - 25 1Ø 15-25 -30-37-1/2 3Ø	7	#14 - 1/0	1	(7) - 1/4 - 20 x 1"	1
50401	37 1/2 - 50 1Ø 45-50-60-75 3Ø	3 7	#14 - 1/0 #6 - 250MCM	1 1	(3) - 1/4 - 20 x 1" (7) - 5/16 - 18 x 1 1/2"	3
50402	75-100 1Ø 100-112-150 3Ø	6 6	#6 - 350MCM #6 - 350MCM	2 1	(6) - 1/2 - 13 x 2" (3) - 5/16 - 18 x 1 1/2" (6) - 3/8 - 16 x 1 1/2"	6
50403*	225 3Ø	3 4	#4 - 500MCM #2 - 600MCM	1 2	(3) - 3/8 - 16 x 1 1/2" (4) - 1/2 - 13 x 2"	6
50404*	300 3Ø	3 12	#6 - 350MCM #4 - 500MCM	2 1	(3) - 1/2 - 13 x 2" (9) - 3/8 - 16 x 2"	8
50405*	400-500 3Ø	16 3	300-800MCM #2 - 600MCM	1 2	(13) - 1/2 - 13 x 2 1/2"	15

Notes:
1. Screw type lugs suitable for aluminum or copper conductor.
*2. Catalog numbers 50403, 50404, and 50405 to be used with transformer voltages of 480-208Y/120 or 480 - 240/120 LT only.

Weather Shield Kits for Type FH Indoor Ventilated Transformers

Catalog Number	Overhang Extension (2 top & 2 bottom)	Approximate Weight in Pounds	Catalog Number	Overhang Extension (2 top & 2 bottom)	Approximate Weight in Pounds
WS-2	2 - 1/16 inches each side	10	**WS-10A**	2 - 1/16 inches each side	16
WS-3	2 - 1/16 inches each side	10	**WS-10B**	2 - 1/16 inches each side	16
WS-4	2 - 1/16 inches each side	15	**WS-12**	2 - 1/16 inches each side	22
WS-5	2 - 1/16 inches each side	15	**WS-12A**	2 - 1/16 inches each side	20
WS-6	2 - 1/16 inches each side	16	**WS-14**	2 - 1/16 inches each side	28
WS-7	2 - 1/16 inches each side	16	**WS-16**	2 - 1/16 inches each side	35
WS-8	2 - 1/16 inches each side	17	**WS-18**	2 - 1/16 inches each side	15
WS-9	2 - 1/16 inches each side	18	**WS-18A**	2 - 1/16 inches each side	12
WS-10	2 - 1/16 inches each side	20			

WEATHERSHIELD NOTE: Weathershield catalog numbers are listed in the technical data sections for each product. Addition of a weathershield kit converts the transformer from NEMA 2 to NEMA 3R - UL listed product.

Wall Mount Brackets

Catalog Number	Type	Approximate Weight in Pounds	Use With . . .
WMB-3	Indoor/Outdoor	24	Wall mount bracket catalog numbers are listed in technical data sections for each product.
WMB-4	Indoor/Outdoor	60	

Primary Fuse Kit

Catalog Number	Approximate Weight in Pounds	Use With . . .
FPFK-1	1	Industrial Control Transformers

Specification Guide

Lighting and Power Transformers 600 Volts and Below

Furnish and install single-phase and three-phase general purpose dry type transformers of the two winding type, self-cooled, with ratings as indicated on the electrical plans.

All transformers shall be constructed and rated in accordance with Underwriters Laboratories, Inc. Standard 506 or 1561as applicable, ANSI Standard C57, NEMA Standard ST-20 and the National Electrical Code.

Type FB

Transformers smaller than 15 KVA shall be totally enclosed non-ventilated with core and coil assemblies completely encapsulated in a polyester resin compound to provide a moisture-proof, shock-resistant, high dielectric seal.

Transformers shall be insulated with 180°C insulation system with 115°C rise.

Cores shall be constructed from non-aging electrical steels.

The case shall be constructed in accordance with UL specifications and shall include a wiring compartment to accommodate cable connections. All units shall be supplied with flexible cable leads marked for easy identification. Case design shall include knockouts and wall mounting brackets. All external surfaces shall be provided with a durable ANSI 61 light gray paint finish. Three-phase transformers shall include NEMA standard tap arrangements and all units shall have sound levels in accordance with NEMA standards.

Transformers shall be Federal Pacific Transformer Company Type FB or approved equal.

Type FH

Transformers rated 15 KVA and larger shall be a ventilated dry type with a UL listed 220°C insulation system. Units shall be designed to operate with a rated maximum temperature rise of 150°C (115°C) (80°C).

Cores shall be constructed from non-aging electrical steels. Core laminations shall be tightly clamped with formed steel angles. The complete core and coil assembly shall be coated with non-hygroscopic thermo-setting varnish to provide a high dielectric flame retardant seal.

Core and coil assemblies shall be braced to provide short circuit ratings as defined in ANSI and NEMA standards. The complete assembly shall be installed on vibration dampening pads to reduce noise and securely bolted to the enclosure base. A flexible grounding conductor shall be installed between the core and coil assembly and the transformer enclosure.

Enclosures shall be of heavy gauge steel, ventilated construction, finished with ANSI 61 light gray paint. All units shall be provided with suitable lifting means. Front and rear covers shall be removable to provide access to the terminal compartment. Terminals shall be fully sized to carry the transformer full load current and shall be arranged to accept required UL listed cable connectors. Units installed outdoors shall have a UL listed type 3R outdoor enclosure.

All units shall be supplied with NEMA standard taps in the high voltage windings.

Sound levels shall not exceed the following:

0 to 9 KVA	40 db
10 to 50 KVA	45 db
51 to 150 KVA	50 db
151 to 300 KVA	55 db
301 to 500 KVA	60 db
501 to 700 KVA	62 db
701 to 1000 KVA	64 db

Each transformer shall have a securely attached nameplate providing complete electrical ratings, wiring diagram, tap connections and catalog number.

Transformers shall be Federal Pacific Type FH or approved equal.

For K-Factor specifications, please refer to page 45.

Buck-Boost Connection Diagram

Single-Phase

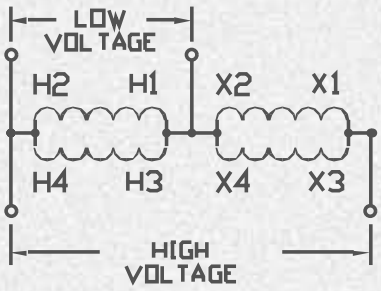


FIGURE A

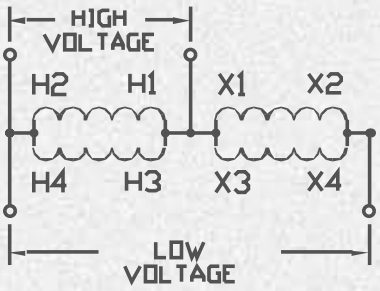


FIGURE A1

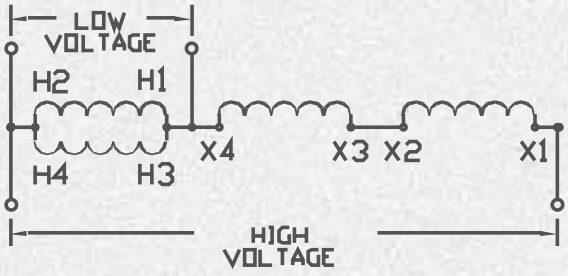


FIGURE B

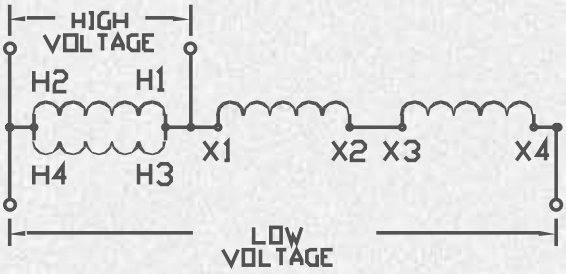


FIGURE B1

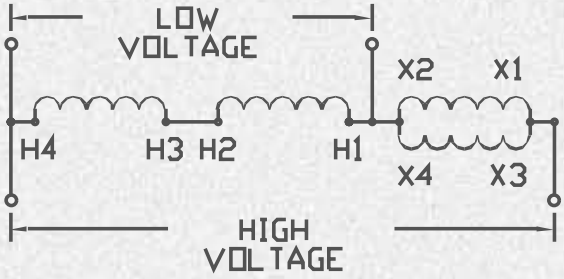


FIGURE C

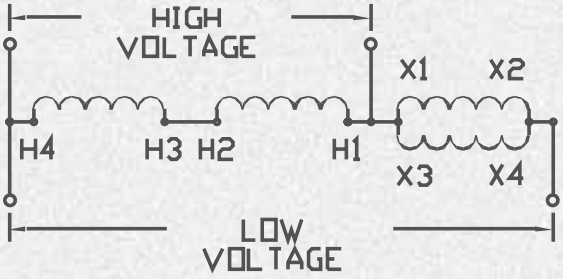


FIGURE C1

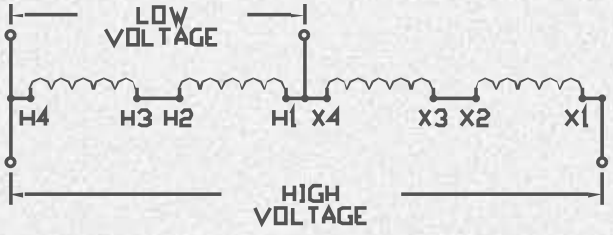


FIGURE D

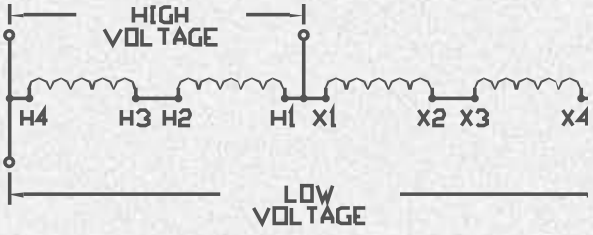


FIGURE D1

Buck-Boost Connection Diagram

Three-Phase Open Delta

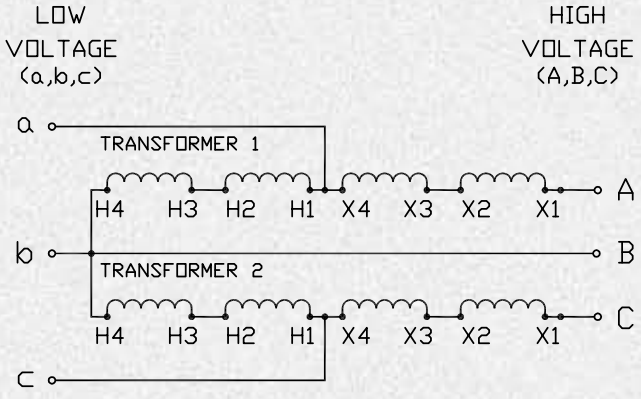


FIGURE G

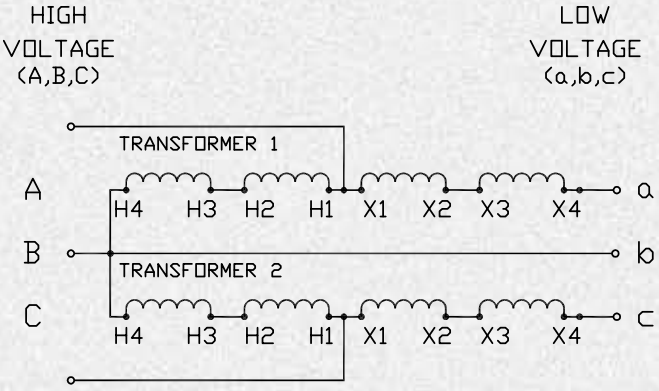


FIGURE L

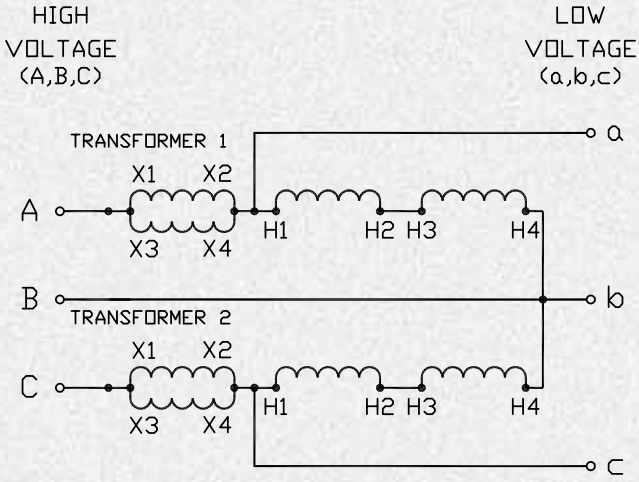


FIGURE H

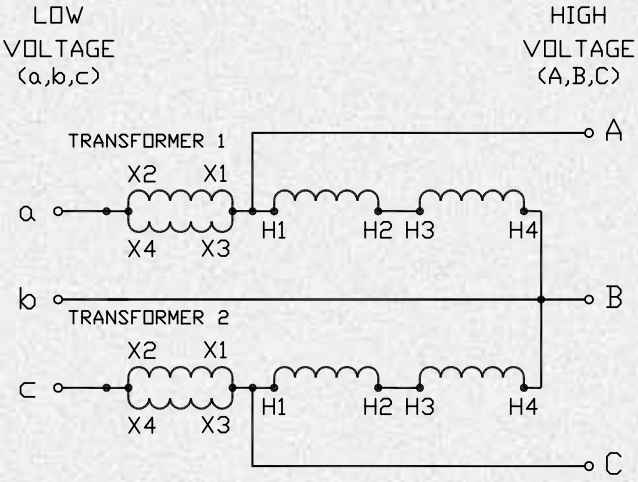


FIGURE H1

Buck-Boost Connection Diagram

Three-Phase Open Delta

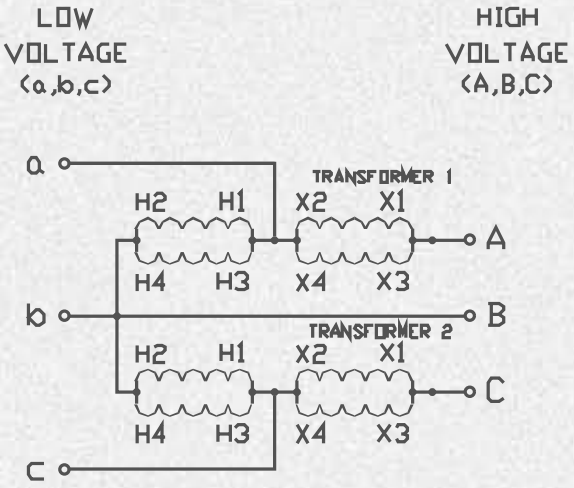


FIGURE M

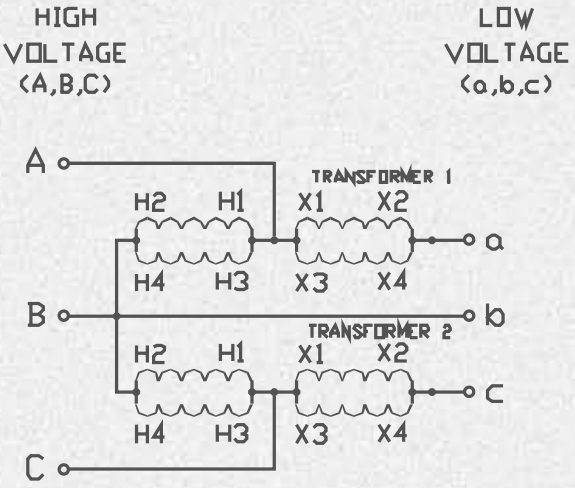


FIGURE M1

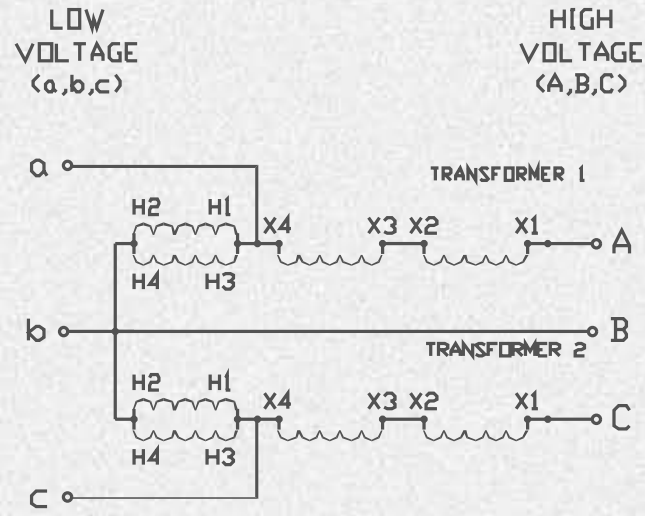


FIGURE N

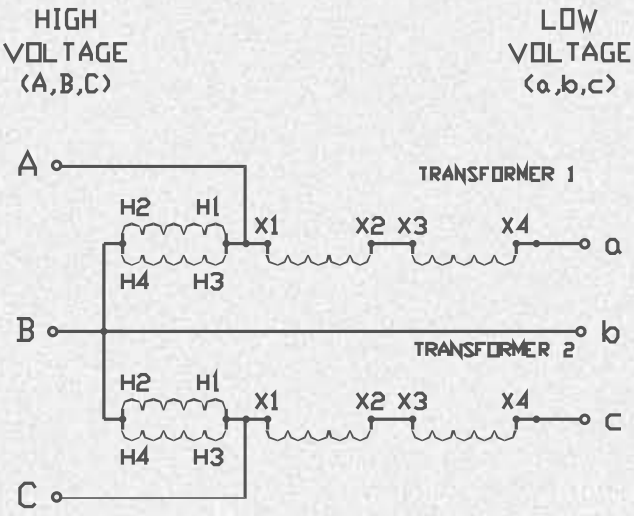


FIGURE N1

Buck-Boost Connection Diagram

Three-Phase WYE

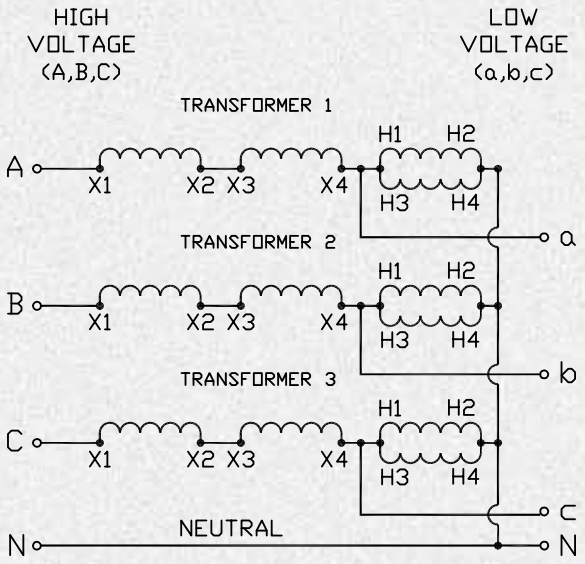


FIGURE E

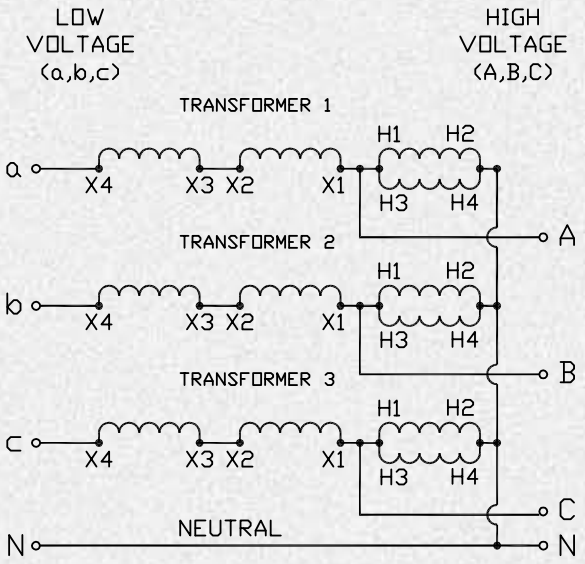


FIGURE E1

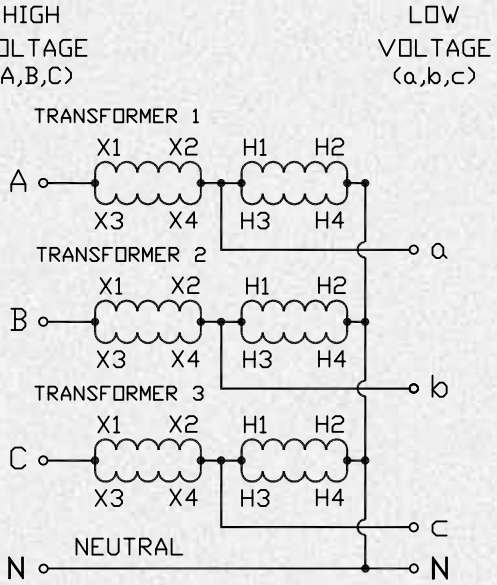


FIGURE F

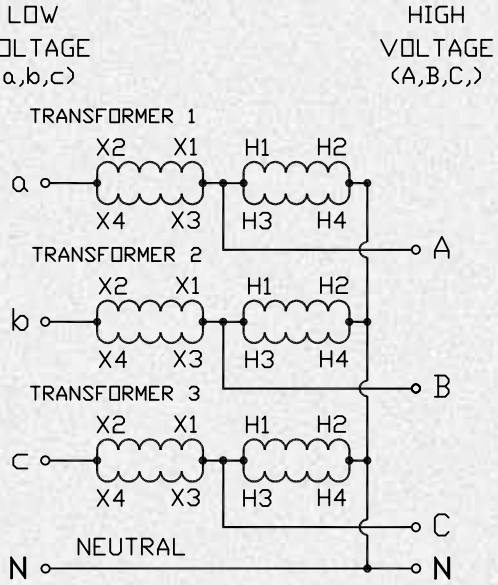


FIGURE F1

Buck-Boost Connection Diagram

Three-Phase WYE

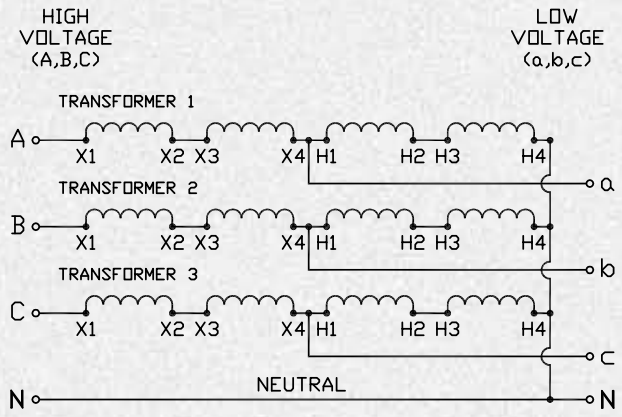


FIGURE J

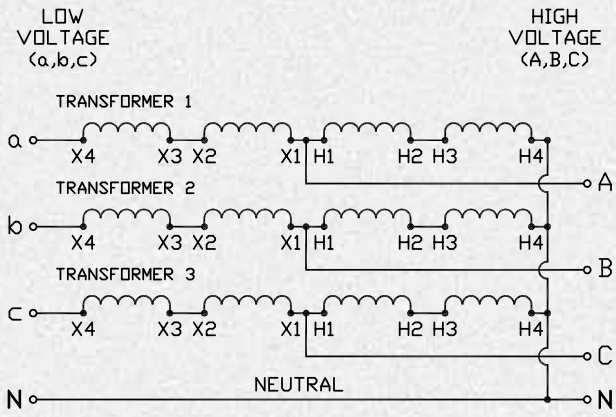


FIGURE J1

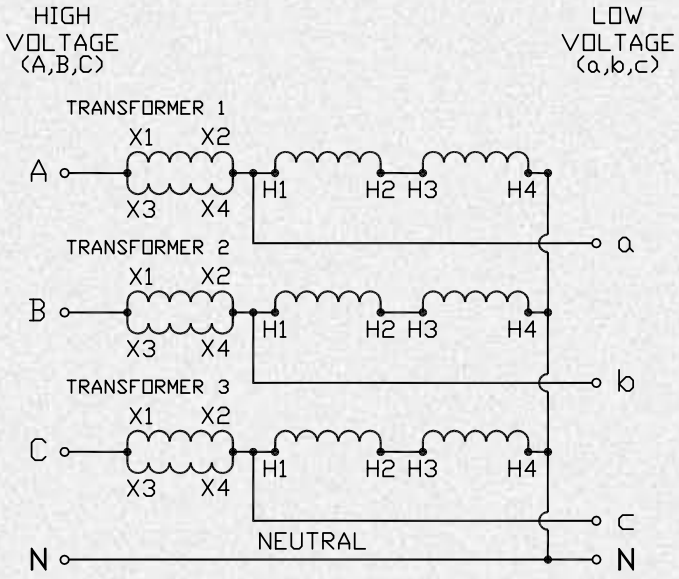


FIGURE K

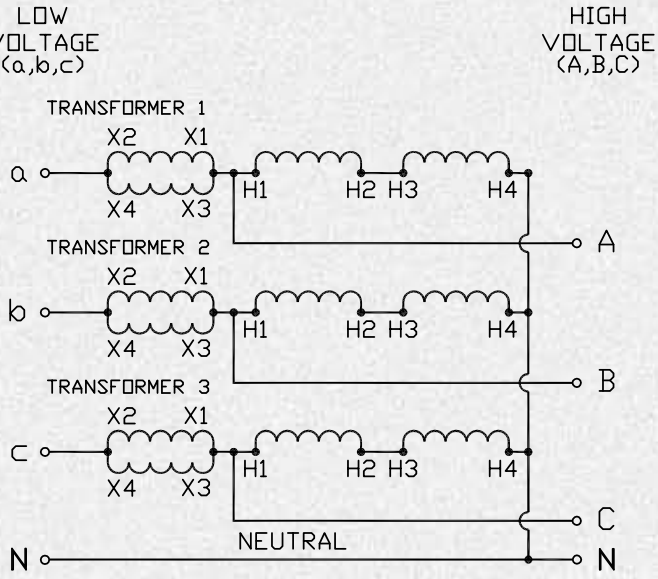


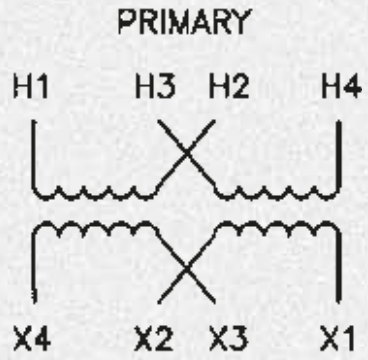
FIGURE K1

Wiring Diagrams

Single-Phase

Diagram #1

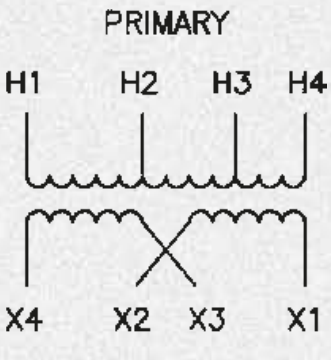
PRIMARY VOLTAGE	SECONDARY VOLTAGE	TAPS
240 x 480	120/240	NONE



VOLTS	CONNECTIONS	LINE LEADS
480	H2 - H3	H1, H4
240	H1 - H3, H2 - H4	H1, H4
240	X2 - X3	X1, X4
240/120	X2 - X3	X1, X2, X4
120	X1 - X3, X2 - X4	X1, X4

Diagram #2

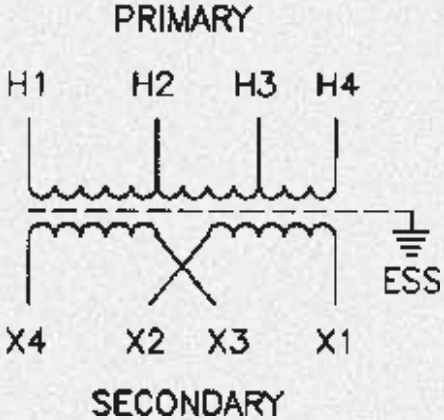
PRIMARY VOLTAGE	SECONDARY VOLTAGE	TAPS
480	120/240	2-5% FCBN



VOLTS	CONNECTIONS	LINE LEADS
480		H1, H4
456		H1, H3
432		H1, H2
240	X2-X3	X1, X4
240/120	X2-X3	X1, X2, X4
120	X1-X3, X2-X4	X1, X4

Diagram #3

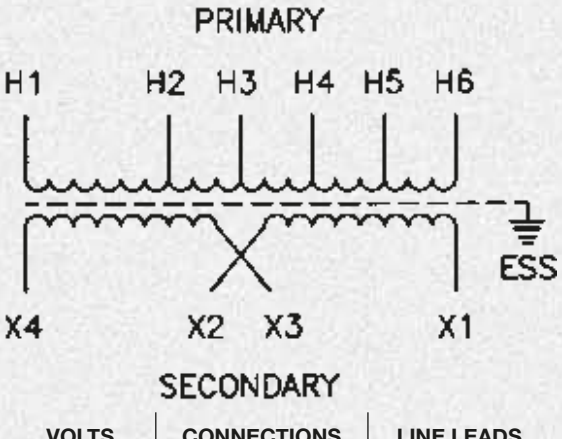
PRIMARY VOLTAGE	SECONDARY VOLTAGE	TAPS
600	120/240	2-5% FCBN



VOLTS	CONNECTIONS	LINE LEADS
600		H1, H4
570		H1, H3
540		H1, H2
240	X2-X3	X1, X4
240/120	X2-X3	X1, X2, X4
120	X1-X3, X2-X4	X1, X4

Diagram #4

PRIMARY VOLTAGE	SECONDARY VOLTAGE	TAPS
600	120/240	4 - 2 1/2% FCBN



VOLTS	CONNECTIONS	LINE LEADS
600		H1, H6
585		H1, H5
570		H1, H4
555		H1, H3
540		H1, H2
240	X2-X3	X1, X4
240/120	X2-X3	X1, X2, X4
120	X1-X3, X2-X4	X1, X4

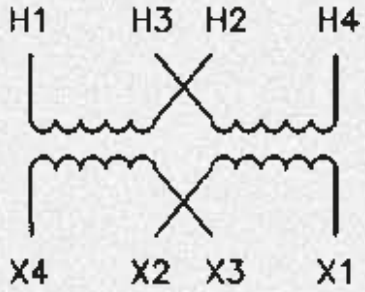
Wiring Diagrams

Single-Phase

Diagram #5

PRIMARY VOLTAGE	SECONDARY VOLTAGE	TAPS
120 x 240	120/240	NONE

PRIMARY



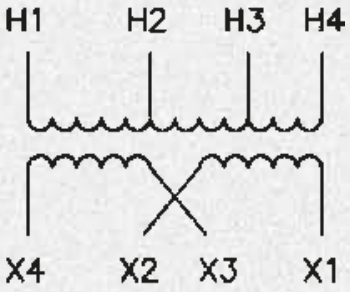
SECONDARY

VOLTS	CONNECTIONS	LINE LEADS
240	H2-H3	H1, H4
120	H1-H3, H2-H4	H1, H4
240	X2-X3	X1, X4
240/120	X2-X3	X1, X2, X4
120	X1-X3, X2-X4	X1, X4

Diagram #6

PRIMARY VOLTAGE	SECONDARY VOLTAGE	TAPS
208	120/240	2-5% FCBN

PRIMARY



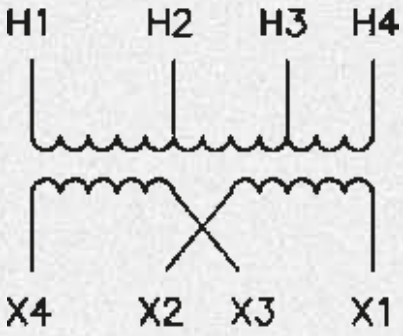
SECONDARY

VOLTS	CONNECTIONS	LINE LEADS
208		H1, H4
198		H1, H3
187		H1, H2
240	X2-X3	X1, X4
240/120	X2-X3	X1, X2, X4
120	X1-X3, X2-X4	X1, X4

Diagram #7

PRIMARY VOLTAGE	SECONDARY VOLTAGE	TAPS
277	120/240	2-5% FCBN

PRIMARY



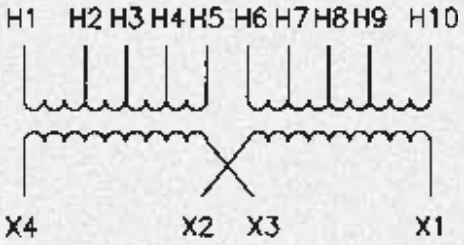
SECONDARY

VOLTS	CONNECTIONS	LINE LEADS
277		H1, H4
263		H1, H3
249		H1, H2
240	X2-X3	X1, X4
240/120	X2-X3	X1, X2, X4
120	X1-X3, X2-X4	X1, X4

Diagram #8

PRIMARY VOLTAGE	SECONDARY VOLTAGE	TAPS
240 x 480	120/240	2 - 2 1/2% FCAN & 4 - 2 1/2% FCBN

PRIMARY



SECONDARY

VOLTS	CONNECTIONS	LINE LEADS
252	H1-H6, H10-H5	H1, H10
240	H1-H7, H10-H4	H1, H10
228	H1-H8, H10-H3	H1, H10
216	H1-H9, H10-H2	H1, H10
504	H5-H6	H1, H10
492	H5-H7	H1, H10
480	H4-H7	H1, H10
468	H4-H8	H1, H10
456	H3-H8	H1, H10
444	H3-H9	H1, H10
432	H2-H9	H1, H10
240	X2-X3	X1, X4
240/120	X2-X3	X1, X2, X4
120	X1-X3, X2-X4	X1, X4

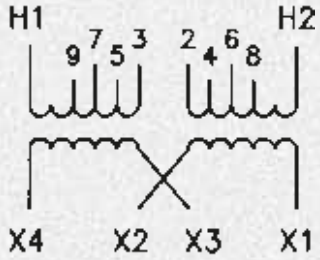
Wiring Diagrams

Single-Phase

Diagram #9

PRIMARY VOLTAGE	SECONDARY VOLTAGE	TAPS
240 x 480	120/240	2 - 2 1/2% FCAN & 4 - 2 1/2% FCBN

PRIMARY



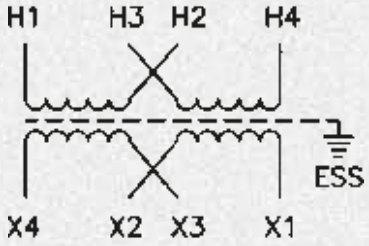
SECONDARY

VOLTS	CONNECTIONS	LINE LEADS
504	2 TO 3	H1, H2
492	3 TO 4	H1, H2
480	4 TO 5	H1, H2
468	5 TO 6	H1, H2
456	6 TO 7	H1, H2
444	7 TO 8	H1, H2
432	8 TO 9	H1, H2
252	2 TO H1, 3 TO H2	H1, H2
240	4 TO H1, 5 TO H2	H1, H2
228	6 TO H1, 7 TO H2	H1, H2
216	8 TO H1, 9 TO H2	H1, H2
240	X2 TO X3	X1, X4
240/120	X2 TO X3	X1, X2, X4
120	X1 TO X3, X2 TO X4	X1, X4

Diagram #10

PRIMARY VOLTAGE	SECONDARY VOLTAGE	TAPS
240 x 480	120/240	NONE

PRIMARY



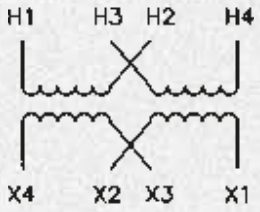
SECONDARY

VOLTS	CONNECTIONS	LINE LEADS
480	H2-H3	H1, H4
240	H1-H3, H2-H4	H1, H4
240	X2-X3	X1, X4
240/120	X2-X3	X1, X2, X4
120	X1-X3, X2-X4	X1, X4

Diagram #10A

	PRIMARY VOLTAGE	SECONDARY VOLTAGE	TAPS
(A)	120 x 240	12/24	NONE
(B)	120 x 240	16/32	NONE
(C)	240 x 480	24/48	NONE

PRIMARY



SECONDARY

(A)

VOLTS	CONNECTIONS	LINE LEADS
240	H2-H3	H1, H4
120	H1-H3, H2-H4	H1, H4
24	X2-X3	X1, X4
12	X1-X3, X2-X4	X1, X4

(B)

VOLTS	CONNECTIONS	LINE LEADS
240	H2-H3	H1, H4
120	H1-H3, H2-H4	H1, H4
32	X2-X3	X1, X4
16	X1-X3, X2-X4	X1, X4

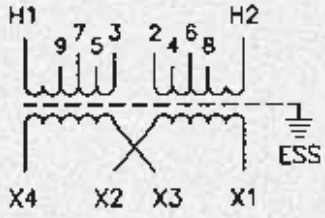
(C)

VOLTS	CONNECTIONS	LINE LEADS
480	H2-H3	H1, H4
240	H1-H3, H2-H4	H1, H4
48	X2-X3	X1, X4
24	X1-X3, X2-X4	X1, X4

Diagram #11

PRIMARY VOLTAGE	SECONDARY VOLTAGE	TAPS
600	120/240	2 - 2 1/2% FCAN & 4 - 2 1/2% FCBN

PRIMARY



SECONDARY

VOLTS	CONNECTIONS	LINE LEADS
630	2 TO 3	H1, H2
615	3 TO 4	H1, H2
600	4 TO 5	H1, H2
585	5 TO 6	H1, H2
570	6 TO 7	H1, H2
555	7 TO 8	H1, H2
540	8 TO 9	H1, H2
240	X2 TO X3	X1, X4
240/120	X2 TO X3	X1, X2, X4
120	X1 TO X3, X2 TO X4	X1, X4

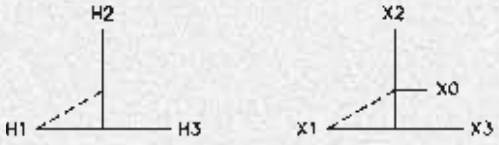
Wiring Diagrams

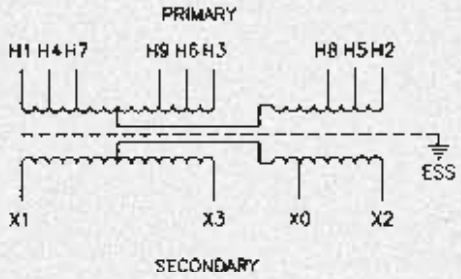
Three-Phase

Diagram #12

PRIMARY VOLTAGE	SECONDARY VOLTAGE	TAPS
240Δ	208Y/120	2-5% FCBN

Ø DEGREE ANGULAR DISPLACEMENT



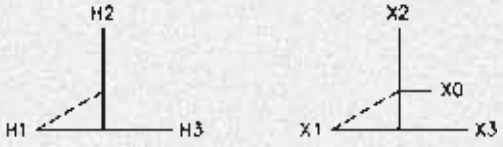


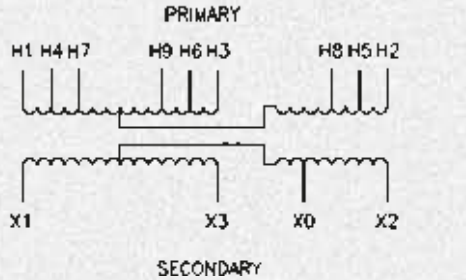
VOLTS	CONNECTIONS	LINE LEADS
240		H1, H2, H3
228		H4, H5, H6
216		H7, H8, H9
208Y/120		X0, X1, X2, X3

Diagram #13

PRIMARY VOLTAGE	SECONDARY VOLTAGE	TAPS
480Δ	208Y/120	2-5% FCBN

Ø DEGREE ANGULAR DISPLACEMENT



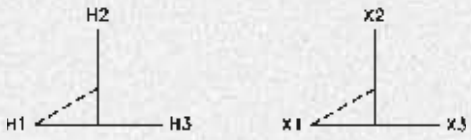


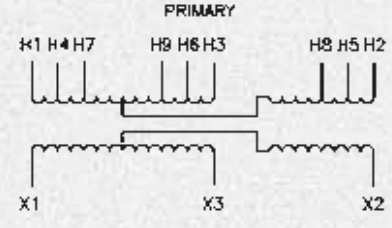
VOLTS	CONNECTIONS	LINE LEADS
480		H1, H2, H3
456		H4, H5, H6
432		H7, H8, H9
208Y/120		X0, X1, X2, X3

Diagram #14

PRIMARY VOLTAGE	SECONDARY VOLTAGE	TAPS
480Δ	240Δ	2-5% FCBN

Ø DEGREE ANGULAR DISPLACEMENT



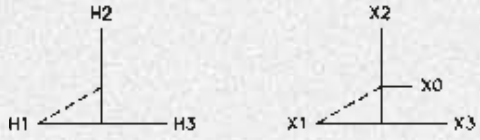


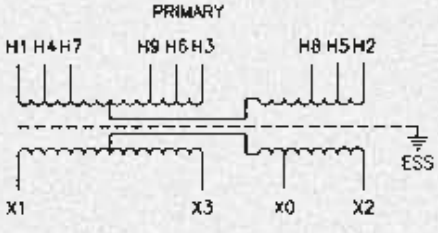
VOLTS	CONNECTIONS	LINE LEADS
480		H1, H2, H3
456		H4, H5, H6
432		H7, H8, H9
240		X1, X2, X3

Diagram #15

PRIMARY VOLTAGE	SECONDARY VOLTAGE	TAPS
480Δ	208Y/120	2-5% FCBN

Ø DEGREE ANGULAR DISPLACEMENT



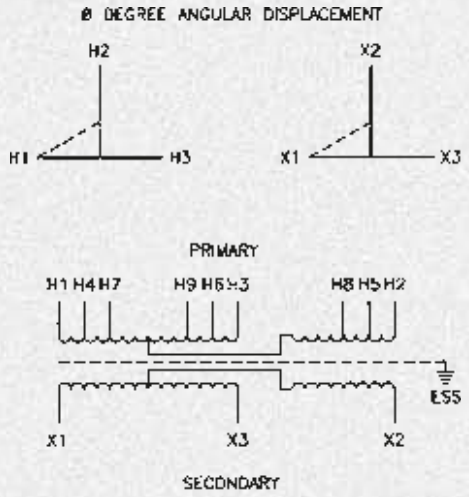


VOLTS	CONNECTIONS	LINE LEADS
480		H1, H2, H3
456		H4, H5, H6
432		H7, H8, H9
208Y/120		X0, X1, X2, X3

Wiring Diagrams

Diagram #16

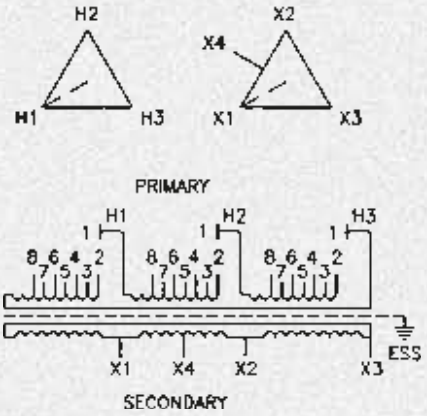
PRIMARY VOLTAGE	SECONDARY VOLTAGE	TAPS
480Δ	240	2-5% FCBN



VOLTS	CONNECTIONS	LINE LEADS
480		H1, H2, H3
456		H4, H5, H6
432		H7, H8, H9
240		X1, X2, X3

Diagram #17

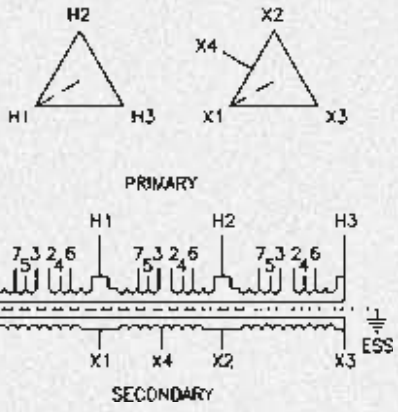
PRIMARY VOLTAGE	SECONDARY VOLTAGE	TAPS
480Δ	240Δ/120 LT	2-2 1/2% FCAN & 4-2 1/2% FCBN



VOLTS	CONNECTIONS	LINE LEADS
504	1 TO 2	H1, H2, H3
492	1 TO 3	H1, H2, H3
480	1 TO 4	H1, H2, H3
468	1 TO 5	H1, H2, H3
456	1 TO 6	H1, H2, H3
444	1 TO 7	H1, H2, H3
432	1 TO 8	H1, H2, H3
240		X1, X2, X3

Diagram #17A

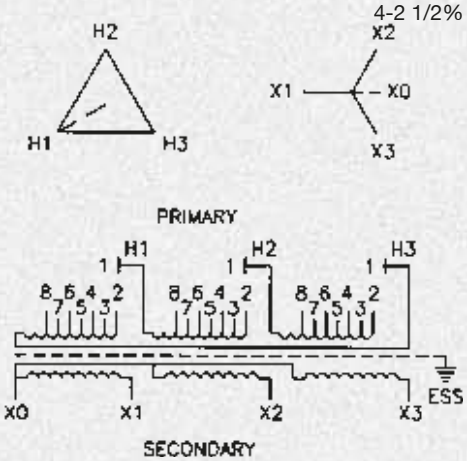
PRIMARY VOLTAGE	SECONDARY VOLTAGE	TAPS
480Δ	240Δ/120 LT	2-2 1/2% FCAN & 4-2 1/2% FCBN



VOLTS	CONNECTIONS	LINE LEADS
504	2 TO 3	H1, H2, H3
492	2 TO 5	H1, H2, H3
480	3 TO 4	H1, H2, H3
468	4 TO 5	H1, H2, H3
456	5 TO 6	H1, H2, H3
444	4 TO 7	H1, H2, H3
432	6 TO 7	H1, H2, H3
240		X1, X2, X3

Diagram #18

PRIMARY VOLTAGE	SECONDARY VOLTAGE	TAPS
480Δ	208Y/120	2-2 1/2% FCAN & 4-2 1/2% FCBN



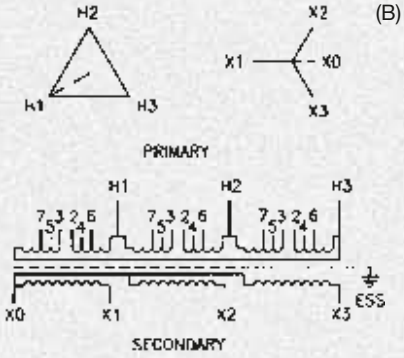
VOLTS	CONNECTIONS	LINE LEADS
504	1 TO 2	H1, H2, H3
492	1 TO 3	H1, H2, H3
480	1 TO 4	H1, H2, H3
468	1 TO 5	H1, H2, H3
456	1 TO 6	H1, H2, H3
444	1 TO 7	H1, H2, H3
432	1 TO 8	H1, H2, H3
208Y/120		X0, X1, X2, X3

Wiring Diagrams

Three-Phase

Diagram #18A - 18B

PRIMARY VOLTAGE	SECONDARY VOLTAGE	TAPS
480Δ	208Y/120	(A) 2-2 1/2% FCAN & 4-2 1/2% FCBN (B) 2-3% FCAN & 2-3% FCBN



(A)

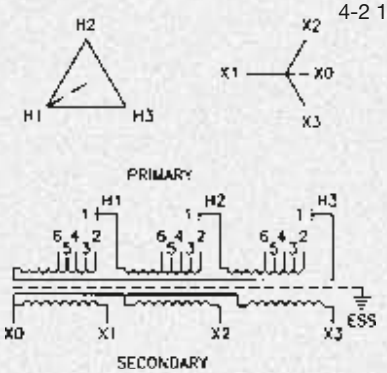
VOLTS	CONNECTIONS	LINE LEADS
504	2 TO 3	H1, H2, H3
492	2 TO 5	H1, H2, H3
480	3 TO 4	H1, H2, H3
468	4 TO 5	H1, H2, H3
456	5 TO 6	H1, H2, H3
444	4 TO 7	H1, H2, H3
432	6 TO 7	H1, H2, H3
208Y/120		X0, X1, X2, X3

(B)

VOLTS	CONNECTIONS	LINE LEADS
509	2 TO 3	H1, H2, H3
494	2 TO 5	H1, H2, H3
480	3 TO 4	H1, H2, H3
466	4 TO 5	H1, H2, H3
451	5 TO 6	H1, H2, H3
208Y/120		X0, X1, X2, X3

Diagram #19

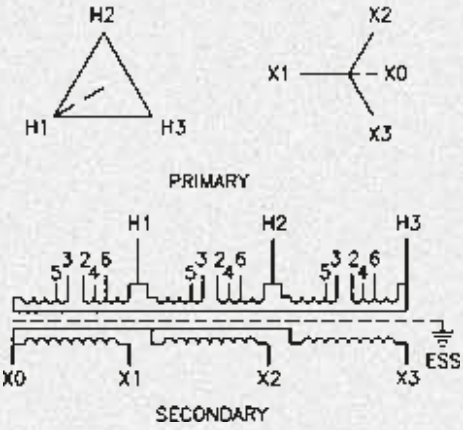
PRIMARY VOLTAGE	SECONDARY VOLTAGE	TAPS
208Δ	208Y/120	2-2 1/2% FCAN & 4-2 1/2% FCBN



VOLTS	CONNECTIONS	LINE LEADS
218	1 TO 2	H1, H2, H3
213	1 TO 3	H1, H2, H3
208	1 TO 4	H1, H2, H3
203	1 TO 5	H1, H2, H3
198	1 TO 6	H1, H2, H3
208Y/120		X0, X1, X2, X3

Diagram #19A - 19E

PRIMARY VOLTAGE	SECONDARY VOLTAGE	TAPS
208Δ	208Y/120	(A) 2-2 1/2% FCAN & 4-2 1/2% FCBN (B) 2-3% FCAN & 2-3% FCBN (C) 2-3 1/2% FCAN & 2-3 1/2% FCBN (D) 1-4% FCAN & 1-4% FBCN (E) 1-5% FCAN & 1-5% FCBN



(A)

VOLTS	CONNECTIONS	LINE LEADS
218	2 TO 3	H1, H2, H3
213	2 TO 5	H1, H2, H3
208	3 TO 4	H1, H2, H3
203	4 TO 5	H1, H2, H3
198	5 TO 6	H1, H2, H3
208Y/120		X0, X1, X2, X3

(B)

VOLTS	CONNECTIONS	LINE LEADS
220	2 TO 3	H1, H2, H3
214	2 TO 5	H1, H2, H3
208	3 TO 4	H1, H2, H3
202	4 TO 5	H1, H2, H3
196	5 TO 6	H1, H2, H3
208Y/120		X0, X1, X2, X3

(C)

VOLTS	CONNECTIONS	LINE LEADS
223	2 TO 3	H1, H2, H3
215	2 TO 5	H1, H2, H3
208	3 TO 4	H1, H2, H3
201	4 TO 5	H1, H2, H3
193	5 TO 6	H1, H2, H3
208Y/120		X0, X1, X2, X3

(D)

VOLTS	CONNECTIONS	LINE LEADS
216	2 TO 3	H1, H2, H3
208	3 TO 4	H1, H2, H3
200	4 TO 5	H1, H2, H3
208Y/120		X0, X1, X2, X3

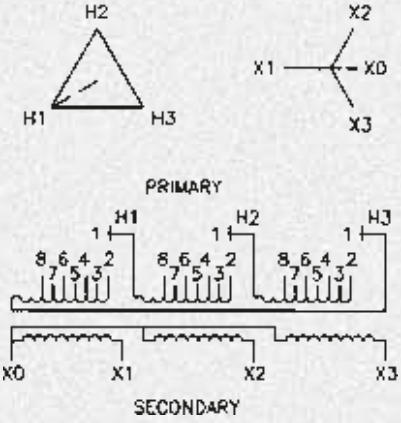
(E)

VOLTS	CONNECTIONS	LINE LEADS
218	2 TO 3	H1, H2, H3
208	3 TO 4	H1, H2, H3
198	4 TO 5	H1, H2, H3
208Y/120		X0, X1, X2, X3

Wiring Diagrams

Diagram #20

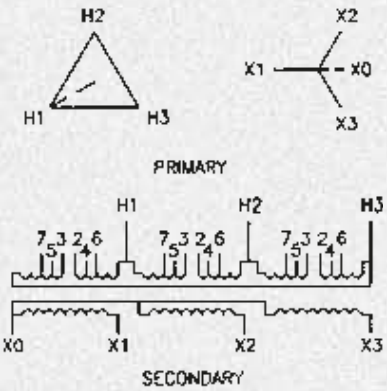
PRIMARY VOLTAGE	SECONDARY VOLTAGE	TAPS
480Δ	480Y/277	2-2 1/2% FCAN & 4-2 1/2% FCBN



VOLTS	CONNECTIONS	LINE LEADS
504	1 TO 2	H1, H2, H3
492	1 TO 3	H1, H2, H3
480	1 TO 4	H1, H2, H3
468	1 TO 5	H1, H2, H3
456	1 TO 6	H1, H2, H3
444	1 TO 7	H1, H2, H3
432	1 TO 8	H1, H2, H3
408Y/277		X0, X1, X2, X3

Diagram #20A

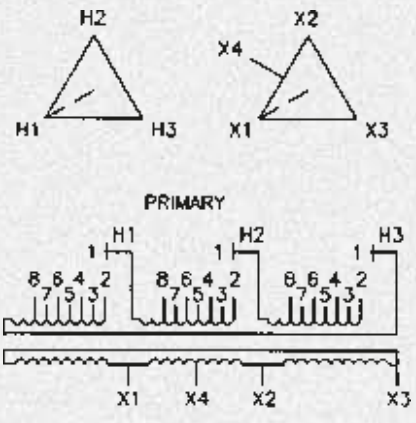
PRIMARY VOLTAGE	SECONDARY VOLTAGE	TAPS
480Δ	480Y/277	2-2 1/2% FCAN & 4-2 1/2% FCBN



VOLTS	CONNECTIONS	LINE LEADS
504	2 TO 3	H1, H2, H3
492	2 TO 5	H1, H2, H3
480	3 TO 4	H1, H2, H3
468	4 TO 5	H1, H2, H3
456	5 TO 6	H1, H2, H3
444	4 TO 7	H1, H2, H3
432	6 TO 7	H1, H2, H3
408Y/277		X0, X1, X2, X3

Diagram #21

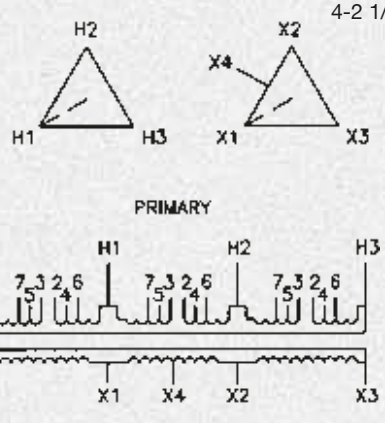
PRIMARY VOLTAGE	SECONDARY VOLTAGE	TAPS
480Δ	240Δ/120 LT	2-2 1/2% FCAN & 4-2 1/2% FCBN



VOLTS	CONNECTIONS	LINE LEADS
504	1 TO 2	H1, H2, H3
492	1 TO 3	H1, H2, H3
480	1 TO 4	H1, H2, H3
468	1 TO 5	H1, H2, H3
456	1 TO 6	H1, H2, H3
444	1 TO 7	H1, H2, H3
432	1 TO 8	H1, H2, H3
240		X1, X2, X3

Diagram #21A

PRIMARY VOLTAGE	SECONDARY VOLTAGE	TAPS
480Δ	240Δ/120 LT	2-2 1/2% FCAN & 4-2 1/2% FCBN

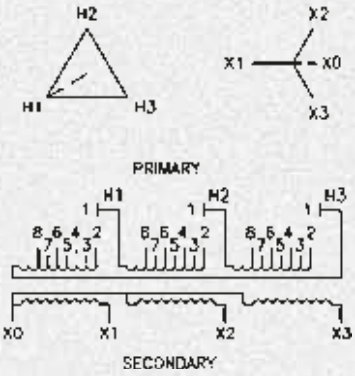


VOLTS	CONNECTIONS	LINE LEADS
504	2 TO 3	H1, H2, H3
492	2 TO 5	H1, H2, H3
480	3 TO 4	H1, H2, H3
468	4 TO 5	H1, H2, H3
456	5 TO 6	H1, H2, H3
444	4 TO 7	H1, H2, H3
432	6 TO 7	H1, H2, H3
240		X1, X2, X3

Wiring Diagrams

Diagram #22

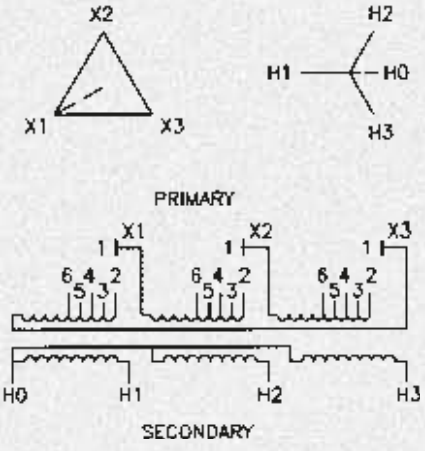
PRIMARY VOLTAGE	SECONDARY VOLTAGE	TAPS
480Δ	208Y/120	2-2 1/2% FCAN & 4-2 1/2% FCBN



VOLTS	CONNECTIONS	LINE LEADS
504	1 TO 2	H1, H2, H3
492	1 TO 3	H1, H2, H3
480	1 TO 4	H1, H2, H3
468	1 TO 5	H1, H2, H3
456	1 TO 6	H1, H2, H3
444	1 TO 7	H1, H2, H3
432	1 TO 8	H1, H2, H3
208Y/120		X0, X1, X2, X3

Diagram #23

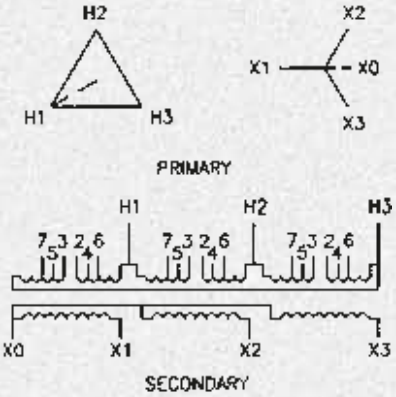
PRIMARY VOLTAGE	SECONDARY VOLTAGE	TAPS
208Δ	480Y/277	2-2 1/2% FCAN & 2-2 1/2% FCBN



VOLTS	CONNECTIONS	LINE LEADS
218	1 TO 2	X1, X2, X3
213	1 TO 3	X1, X2, X3
208	1 TO 4	X1, X2, X3
203	1 TO 5	X1, X2, X3
198	1 TO 6	X1, X2, X3
408Y/277		H0, H1, H2, H3

Diagram #22A - 22B

PRIMARY VOLTAGE	SECONDARY VOLTAGE	TAPS
480Δ	208Y/120	(A) 2-2 1/2% FCAN & 4-2 1/2% FCBN (B) 2-3% FCAN & 2-3% FCBN



(A)

VOLTS	CONNECTIONS	LINE LEADS
504	2 TO 3	H1, H2, H3
492	2 TO 5	H1, H2, H3
480	3 TO 4	H1, H2, H3
468	4 TO 5	H1, H2, H3
456	5 TO 6	H1, H2, H3
444	4 TO 7	H1, H2, H3
432	6 TO 7	H1, H2, H3
208Y/120		X0, X1, X2, X3

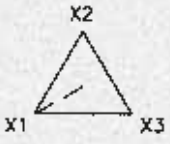
(B)

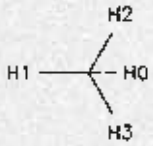
VOLTS	CONNECTIONS	LINE LEADS
509	2 TO 3	H1, H2, H3
494	2 TO 5	H1, H2, H3
480	3 TO 4	H1, H2, H3
466	4 TO 5	H1, H2, H3
451	5 TO 6	H1, H2, H3
208Y/120		X0, X1, X2, X3

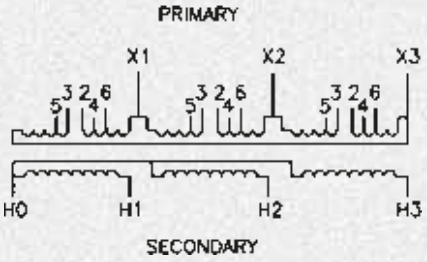
Wiring Diagrams

Diagram #23A-23E

PRIMARY VOLTAGE	SECONDARY VOLTAGE	TAPS
208Δ	480Y/277	(A) 2-2 1/2% FCAN & 2-2 1/2% FCBN (B) 2-3% FCAN & 2-3% FCBN (C) 2-3 1/2% FCAN & 2-3 1/2% FCBN (D) 1-4% FCAN & 1-4% FCBN (E) 1-5% FCAN & 1-5% FCBN







(A)

VOLTS	CONNECTIONS	LINE LEADS
218	2 TO 3	X1, X2, X3
213	2 TO 5	X1, X2, X3
208	3 TO 4	X1, X2, X3
203	4 TO 5	X1, X2, X3
198	5 TO 6	X1, X2, X3
480Y/277		H0, H1, H2, H3

(B)

VOLTS	CONNECTIONS	LINE LEADS
220	2 TO 3	X1, X2, X3
214	2 TO 5	X1, X2, X3
208	3 TO 4	X1, X2, X3
202	4 TO 5	X1, X2, X3
196	5 TO 6	X1, X2, X3
480Y/277		H0, H1, H2, H3

(C)

VOLTS	CONNECTIONS	LINE LEADS
223	2 TO 3	X1, X2, X3
215	2 TO 5	X1, X2, X3
208	3 TO 4	X1, X2, X3
201	4 TO 5	X1, X2, X3
193	5 TO 6	X1, X2, X3
480Y/277		H0, H1, H2, H3

(D)

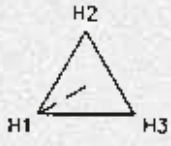
VOLTS	CONNECTIONS	LINE LEADS
216	2 TO 3	X1, X2, X3
208	3 TO 4	X1, X2, X3
200	4 TO 5	X1, X2, X3
480Y/277		H0, H1, H2, H3

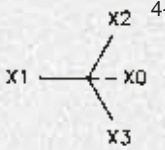
(E)

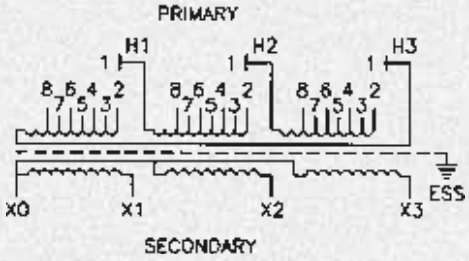
VOLTS	CONNECTIONS	LINE LEADS
218	2 TO 3	X1, X2, X3
208	3 TO 4	X1, X2, X3
198	4 TO 5	X1, X2, X3
480Y/277		H0, H1, H2, H3

Diagram #24

PRIMARY VOLTAGE	SECONDARY VOLTAGE	TAPS
600Δ	208Y/120	2-2 1/2% FCAN & 4-2 1/2% FCBN



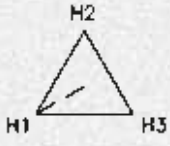


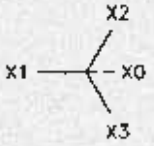


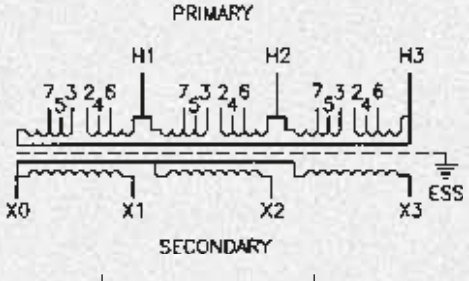
VOLTS	CONNECTIONS	LINE LEADS
630	1 TO 2	H1, H2, H3
615	1 TO 3	H1, H2, H3
600	1 TO 4	H1, H2, H3
585	1 TO 5	H1, H2, H3
570	1 TO 6	H1, H2, H3
555	1 TO 7	H1, H2, H3
540	1 TO 8	H1, H2, H3
208Y/120		X0, X1, X2, X3

Diagram #24A

PRIMARY VOLTAGE	SECONDARY VOLTAGE	TAPS
600Δ	208Y/120	2-2 1/2% FCAN & 4-2 1/2% FCBN







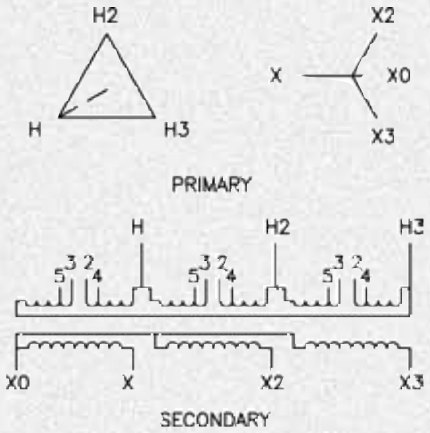
VOLTS	CONNECTIONS	LINE LEADS
630	2 TO 3	H1, H2, H3
615	2 TO 5	H1, H2, H3
600	3 TO 4	H1, H2, H3
585	4 TO 5	H1, H2, H3
570	5 TO 6	H1, H2, H3
555	4 TO 7	H1, H2, H3
540	6 TO 7	H1, H2, H3
208Y/120		X0, X1, X2, X3

Wiring Diagrams

Three-Phase

Diagram #25

PRIMARY VOLTAGE	SECONDARY VOLTAGE	TAPS
460	230Y/133	+1, -1 x 5%
460	460Y/266	+1, -1 x 5%



A

VOLTS	CONNECTIONS	LINE LEADS
242	2 TO 3	H1, H2, H3
230	3 TO 4	H1, H2, H3
219	4 TO 5	H1, H2, H3
230Y/133		X0, X1, X2, X3

B

VOLTS	CONNECTIONS	LINE LEADS
483	2 TO 3	H1, H2, H3
460	3 TO 4	H1, H2, H3
437	4 TO 5	H1, H2, H3
230Y/133		X0, X1, X2, X3

C

VOLTS	CONNECTIONS	LINE LEADS
483	2 TO 3	H1, H2, H3
460	3 TO 4	H1, H2, H3
437	4 TO 5	H1, H2, H3
460Y/266		X0, X1, X2, X3

D

VOLTS	CONNECTIONS	LINE LEADS
604	2 TO 3	H1, H2, H3
575	3 TO 4	H1, H2, H3
546	4 TO 5	H1, H2, H3
460Y/266		X0, X1, X2, X3

E

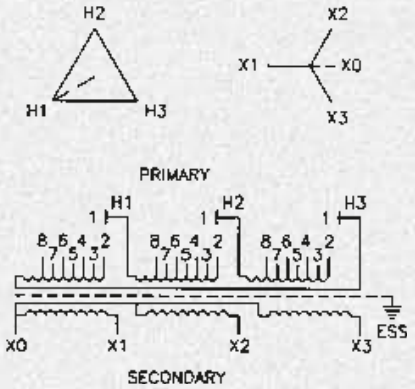
VOLTS	CONNECTIONS	LINE LEADS
604	2 TO 3	H1, H2, H3
575	3 TO 4	H1, H2, H3
546	4 TO 5	H1, H2, H3
575Y/332		X0, X1, X2, X3

F

VOLTS	CONNECTIONS	LINE LEADS
604	2 TO 3	H1, H2, H3
575	3 TO 4	H1, H2, H3
546	4 TO 5	H1, H2, H3
230Y/133		X0, X1, X2, X3

Diagram #26

PRIMARY VOLTAGE	SECONDARY VOLTAGE	TAPS
240Δ	208Y/120	2-2 1/2% FCAN & 4-2 1/2% FCBN

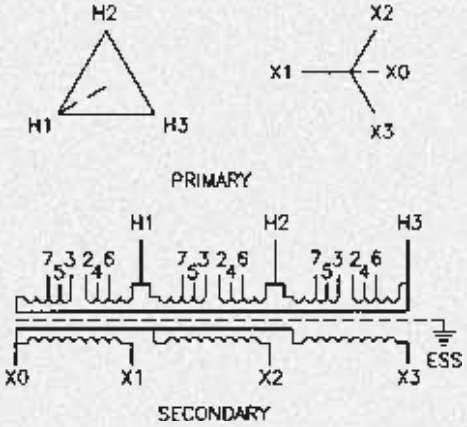


VOLTS	CONNECTIONS	LINE LEADS
252	1 TO 2	H1, H2, H3
246	1 TO 3	H1, H2, H3
240	1 TO 4	H1, H2, H3
234	1 TO 5	H1, H2, H3
228	1 TO 6	H1, H2, H3
222	1 TO 7	H1, H2, H3
216	1 TO 8	H1, H2, H3
208Y/120		X0, X1, X2, X3

Wiring Diagrams

Diagram #26A - 26D

PRIMARY VOLTAGE	SECONDARY VOLTAGE	TAPS
240Δ	208Y/277	(A) 2-2 1/2% FCAN & 4-2 1/2% FCBN (B) 2-3% FCAN & 2-3% FCBN (C) 2-3 1/2% FCAN & 2-3 1/2% FCBN (D) 1-4% FCAN & 1-4% FBCN



(A)

VOLTS	CONNECTIONS	LINE LEADS
252	2 TO 3	H1, H2, H3
246	2 TO 5	H1, H2, H3
240	3 TO 4	H1, H2, H3
234	4 TO 5	H1, H2, H3
228	5 TO 6	H1, H2, H3
222	4 TO 7	H1, H2, H3
216	6 TO 7	H1, H2, H3
208Y/120		X0, X1, X2, X3

(B)

VOLTS	CONNECTIONS	LINE LEADS
254	2 TO 3	H1, H2, H3
247	2 TO 5	H1, H2, H3
240	3 TO 4	H1, H2, H3
233	4 TO 5	H1, H2, H3
226	5 TO 6	H1, H2, H3
208Y/120		X0, X1, X2, X3

(C)

VOLTS	CONNECTIONS	LINE LEADS
256	2 TO 3	H1, H2, H3
248	2 TO 5	H1, H2, H3
240	3 TO 4	H1, H2, H3
232	4 TO 5	H1, H2, H3
224	5 TO 6	H1, H2, H3
208Y/120		X0, X1, X2, X3

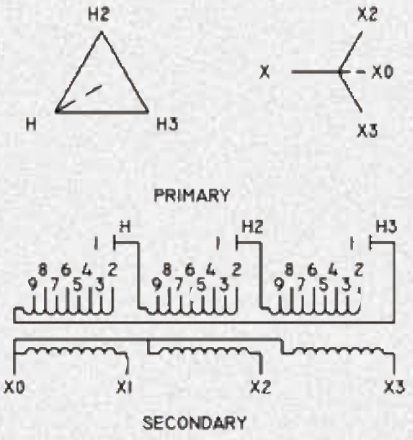
(D)

VOLTS	CONNECTIONS	LINE LEADS
250	2 TO 3	H1, H2, H3
240	3 TO 4	H1, H2, H3
230	4 TO 5	H1, H2, H3
208Y/120		X0, X1, X2, X3

Diagram #27

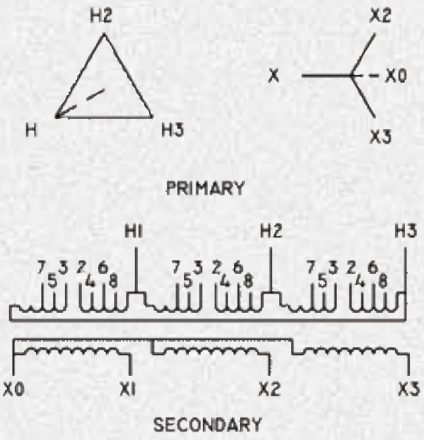
Not Used

Diagram #28



VOLTS	CONNECTIONS	LINE LEADS
504	1 TO 2	H1, H2, H3
492	1 TO 3	H1, H2, H3
480	1 TO 4	H1, H2, H3
468	1 TO 5	H1, H2, H3
456	1 TO 6	H1, H2, H3
440	1 TO 7	H1, H2, H3
432	1 TO 8	H1, H2, H3
420	1 TO 9	H1, H2, H3
220Y/127		X0, X1, X2, X3

Diagram #29



VOLTS	CONNECTIONS	LINE LEADS
504	2 TO 3	H1, H2, H3
492	2 TO 5	H1, H2, H3
480	3 TO 4	H1, H2, H3
468	4 TO 5	H1, H2, H3
456	5 TO 6	H1, H2, H3
440	4 TO 7	H1, H2, H3
428	6 TO 7	H1, H2, H3
420	7 TO 8	H1, H2, H3
220Y/127		X0, X1, X2, X3