POWER-IO

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SSR Heat Sinks

DIN rail solid state relays
0.1 - 100 amp capability

Solid state relays, SCR thyristors, solid state contactors, mosfet based solid state relays, din rail relays, din rail heat sinks and other automation I/O products

Power-io™ provides advanced products for power control applications, using customized igbt designs, mosfets, or solid state switching technology:

- Large inventory of I/O modules and DIN rail solid state relay products.
- Specializing in SSR, SCR, mosfet, IGBT, alternistor and I/O products
- Advanced Maximum Surge Survival™ technology for 3 layers of surge protection
- Fourth generation of advanced DCB direct copper bonding technology + optimized thermal engineering + customized SCR die selection = superior thermal performance
- Power control, heater contactors, solid state motor starters, lighting contactors, robotics, PLC interface i/o, and network i/o. Industrially hardened for commercial, military FCS, aerospace, test equipment, transportation, HVAC & other applications
- Custom control engineering for sophisticated electrical power switching applications
- Industry leading SCR diagnostics with an Alert output in the C Family products
- High speed, high reliability, rugged industrial design, no moving parts
- *Ultra precise* zero crossing for reduced EMI, without the cost of external filters
- Manufactured in the USA, Canada, or Mexico. Shipped worldwide.
- No "minimum order" requirements; credit cards & government P-Cards accepted
- Smallest installed size = more amps per square inch.

Power-io, Inc. 537 Braemar Ave. Naperville, IL 60563-1372 USA Tel: +1 630 717 7335 Sitemap
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New solid state relays, solid state contactors, or din rail io modules.

[Fast shipping capability]

Need it fast? Contact us for FedEx, UPS, DHL, courier, freight forwarder, or other shipping methods. -- Jan 18, 2010

[New state laws restricting or prohibiting mercury relays]

More states ban mercury. Power-io supplies solid state relays that can replace many types of mercury contactors or mercury displacement relays. The applications include: industrial heater contactors, motor starters, highway lighting contactors, stadium lighting systems, food cooking control systems, and more. -- Oct 28, 2009

[I2T fuses and fuse holders]

Solid state contactors and other thyristor-based products are usually protected by I2T fuses. Power-io stocks a variety of I2T fuses that are often used with our products. This includes fuse and fuse holders: I2T fuses or fuses with L bracket tabs: L-Bracket 63FE or 100FE. -- May 25, 2009

Carbon footprint reductions

Power-io has an active program to reduce or recycle the amount of paper products used, recycle shipping containers, and has completely eliminated the purchasing of any new plastic "peanuts". We are involved in customer projects including: US DOE Solar Decathlon 2009 Solarhouse -- MST.edu; California solar array disconnects; solar panel positioning systems; solar/battery invertors; wind turbine control systems; vehicle hydro gas; and more. -- March 1, 2009

[Mercury contactor recycling]

Power-io manufactures solid state relays and contactors that are often used to replace mercury contactors. Mercury contactors (also called: mercury relays, MDR, or mercury displacement relays) are restricted or prohibited in many states in the USA, and in many countries throughout the world, due to 40-100+ grams of mercury inside each one. Bethleham Apparatus provides an EPA approved way of legally disposing of small quantities of mercury contactors. Visit: Mercury recycling kit -- Dec 19, 2008 (Power-io is NOT affliated with Bethleham Appartus.)

[CDD-1V300 Family of high amperage, dc switching, IGBTs]

Power-io manufactures custom solid state switching products for unique applications. For DC installations, we offer DC switching of loads from 200-600 amps, or momentary loads up to 1000 amps DC. The control input board has a standard high speed capability of up to 2 kHz PWM frequency. Visit: DC contactors for custom applications -- Sept 5, 2008

[Dual IGBTs (or back-to-back IGBTs) for high speed switching of an AC load]

The Power-io HDD-6V15 is a completely packaged IGBT module that includes a high speed 15 kHz control input circuit. Normally this product is used to switch DC loads such as solar array panels, vehicle applications, and hydrogen-generating fuel cells. When you install 2 IGBTs in a back-to-back configuration, you can achieve extremely high speed switching of an AC sinewave. Visit: dual IGBT application example -- Aug 1, 2008

[Distributed power control + temperature / process control + communications]

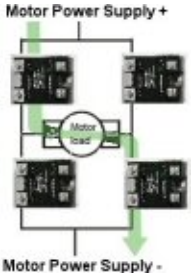
The Power-io C Family of solid state contactors provides a distributed control architecture where you can place the control capability directly on-the-machine. With high density power switching capability from 1-100 amps, Power-io has solid state contactors for most industrial applications. Combine that with distributed temperature or process controllers, and you can build a control system that reduces installation costs and wiring costs while increasing single-zone integrity. Visit: Power-io and distributed controllers -- July 11, 2008

Custom heat sinks for multi-zone applications

Power-io heat sinks are available in custom sizes for multi-zone applications. For high density mosfet or IGBT installations, aluminum extrusion heat sinks can be cut to your specifications. The "6 Pack" shown here permits 6 solid state relays to be installed on a 22 inch extrusion. 6-pack-- April 14, 2008

Green Power-io. Recycle, reuse, reduce waste.

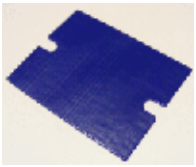
Power-io will meet its internal 2007 environmental goal of reducing paper and packaging waste by 12%. In addition, no new foam "peanuts" have been purchased for the last 2 years. For customer applications: 1) Power-io continues as an environmentally friendly alternative to mercury relays for electrical switching, 2) Power-io is a supplier to many wind or solar power installations, and 3) Power-io is a supplier to alternative transportation applications. -- Nov 27, 2007



H Bridge using 4 solid state relays for reversible VDC loads

For reversible DC motors, reverse polarity DC charging systems, and some solar cell applications; you can use 4 Power-io solid state relays. The Power-io HDD relays are used in pairs to control clockwise vs counter clockwise performance. Additional information is at: H Bridge application -- Oct 18, 2007

Solid state relay thermal pads



The Power-io thermal transfer pads replace thermal grease for use with solid state relays. The dry, die-cut pads provide the optimized amount of high performance thermal grease without any mess or installation delays. The thermal impedance is rated at 0.009 °C-in²/W, which is outstanding. Additional information is at: Solid state relay thermal pads -- Sept 4, 2007

Distributed power control + temperature / process control + communications

The Power-io C Family of solid state contactors, along with control modules from Gefran, allow on-the-machine distributed control capability. A 4 zone temperature/process controller connects to 4 zones of Power-io power control for a modular, distributed architecture that requires less than 1 cubic foot per 4 zones. That's 4 thermocouples, 4 PID control zones, 4 CTs, 4 100 amp power zones, and more, per foot! Interconnected by Modbus, Ethernet, DeviceNet or CANopen, these control zones provide a powerful and flexible control platform for industrial automation. For more information, visit: Distributed control made easy -- Aug 10, 2007

New, improved, analog input 3 phase solid state contactor

The popular DMA3 solid state contactor has been improved. The heat sink has been extended forward by 0.9 inches (23 mm) resulting in an 11% improvement in thermal performance. The DMA3 accepts an analog 4-20mA control input OR a potentiometer input; and provides a electrically clean, high speed, zero-crossing output for electric heaters, resistive heater coils, food cookers, pizza ovens, and other heater applications. The 4-20mA input is directly compatible with PID controllers or PLCs. Please visit: DMA3 data page -- June 7, 2007

New, improved 3 phase solid state contactor

The popular DDA3 solid state contactor has been improved. The heat sink has been extended forward by 0.9 inches (23 mm) resulting in an 11% improvement in thermal performance. This change provides a heat sink with better capability in industrial applications and warm environments. This improvement is being phased in on new orders starting in late May for DC control inputs, and in late June for AC control inputs. Please visit: DDA3-6V75T-H data page -- May 25, 2007

IO Modules -- In stock for fast delivery

The IO modules provide a solid state switching output in a tiny DIN rail package. Activated by a PLC, TTL signal, SCADA system, or controller; the IO modules offer 4000 volt isolation and a fused 3 amp output. IO-OAC modules supply an AC switched output. IO-ODC modules supply a DC switched output. I/O module applications or buy IO modules -- Feb 14, 2007

Wireless Survey

Power-io invites you to participate in the SP100 Wireless Standard user survey. This online survey is to reflect your priorities and requirements as a "user" for the SP100 Wireless Standard. Pls visit: http://www.surveymonkey.com/s.asp?u=73812924482 to participate. -- Jan 30, 2007

[New DC switching solid state relays]

The new HDD-2V25 is used for switching any voltage from 0-200 VDC and any amperage up to 25 amps maximum. These solid state relays use Power-io's high speed 15 khz switching speed for precision performance from simple applications to complete PWM installations. Applications include automatic test equipment, DC inductive loads, UMV drones, and more. -- Nov 16, 2006

[New state laws restricting or prohibiting mercury relays]

Power-io supplies solid state relays that can replace many types of mercury contactors or mercury displacement relays. The applications include: industrial heater contactors, motor starters, highway lighting contactors, stadium lighting systems, food cooking control systems, and more. State laws and penalities increase. -- Aug 25, 2006

[C Family -- Solid State Contactors -- ALERT Output feature]

The C Family of solid state contactors is now is available with an ALERT output. For use with PLCs, PCs, SCADA systems, or controllers, the ALERT output activates if a SCR fails "ON", fails "OFF", the external fuse is "Open", the external load is "Open", or if a thermal problem exists. In addition, the ALERT output monitors the fault conditions that occur upon machine start-up when some of these conditions may not be apparent.

Two individual power channels OR as a 2 pole contactor. Up to 100 amps per pole. Jan 7, 2006

[DC switching solid state relays -- fastest, coolest, more amps]

The DC switching solid state relay family has been expanded to include a 0-60VDC range at up to 75 amps. This additional model is used for 12 and 24 VDC switching such as test equipment, drone vehicle applications, robotic equipment, solar cell energy systems, battery back-up systems, and more. The HDD-06V75 offers the same high speed switching capability, at 15 KHz, that is an exclusive Power-io capability for high performance PWM applications over a variety of voltage and amperage ranges. High speed turn-on and turn-off capability offers precise performance AND it reduces thermal rise. December 1, 2005

[Ultra Power Cooler™ Heat Sink for multiple applications]

The Ultra Power Heat Sink is now available in several customized configurations. Standard options include: single SSR layout, dual SSR layout, extended lengths from 6 - 36 inches, and customer-specific modifications. The massive cooling capability is beneficial with higher amperage SSRs, IGBT modules, or very warm installations. August 24, 2005

[New -- C Family -- Solid State Contactors]

Most rugged, smallest installed size, cost effective -- the new C Family of solid state contactors represent the easiest replacement for mercury or electromechanical contactors. The small width of just 3.1 inches provides 2 power switching channels of up to 100 amps per channel. Install it as a 2 pole contactor, 2 individual poles, or gang units together for multi-pole applications with high power switching every 1.6 inches! The C Family is ideal for applications including: industrial heater contactors, 2-leg break heater contactors, high inrush motor starters, DOT lighting contactors, stadium lighting systems, three phase contactor installations, and more. May 18, 2005

[New -- Ultra Power Cooler™ Heat Sink]

Solid state relays are semiconductor devices that generate heat in proportion to the quantity of amps being switched. Heat sinks capture that thermal rise and dissipate it. Heat sinks are rated by a °C/W number that represents: "for every watt of heat generated, the solid state relay will increase by x°C". For example: if you put 30 watts of heat on a 3°C/W heat sink, the solid state relay's internal SCR dies will rise 90°C (194°F) above the ambient temperature. The new, 80 mm (3.15 inches) wide Ultra Power Cooler heat sink provides a 0.2°C/W rating that makes it ideal for high amperage solid state relays, high ambient temperature areas, or high density installations. Power-io manufactures a variety of heat sinks for industrial, military, or commercial installations. February 16, 2005

[New -- 90 and 125 amp solid state relays]

The popular H family of solid state relays has been expanded with two new high current models offering 90 and 125 amp AC switching outputs. The higher amperage models are ideal for high inrush loads or higher amperage switching. When used at lower amperage switching, such as 20-75 amps, these new models offer cooler performance while ensuring a higher margin of safety against amperage inrush problems. Both models have the Maximum Surge Survival™ circuit for outstanding performance and long life in industrial, laboratory, military, or appliance installations. The models use a precision zero crossing method for the lowest possible EMI (noise) without additional filters or other add-ons. Low noise is an international CE requirement as well as a requirement for medical, test equipment, or other precision applications. January 9, 2005

Electronica Show -- Munich, Germany

Power-io will be exhibiting at the Electronica Show in Munich, Germany, on November 9-12. We are located in the open-air north/south area, #A5, Stand 529. Our local distributor, Sinus Electronic, will be happy to assist with details about solid state contactors, SSRs, and related I/O products. November 6, 2004

[Solid state relays, pre-assembled for fast installations]

Power-io now offers custom solid state relay assemblies. The "Tower of Power" shown here uses 6 solid state relays that provide up to 50 amps of switching per SSR. For multi-zone applications, several towers can be quickly installed, decreasing the local installation time and cost. In addition to multi-zone applications, Power-io can provide:

- individual SSR + heat sink;
- SSR + MOV + heat sink;
- SSRs + fuses + heat sinks;
- 3 phase terminal block + many SSRs + fuses + wire harness;
- custom length heat sinks or custom aluminum extrusions;
- and other combinations.

The Power-io design layout and assembly labor is performed in the USA so rapid delivery of prototype quantities is standard policy. Contact us with your specific requirements. July 2, 2004

[50 amp contactor -- small size and built-in fuse saves time and money]

For switching up to 50 amps, the DDA-6V50 and DAA-6V50 offer a small size and big savings. The universal solid state contactor can switch any voltage from 48-660 volts AC; is activated by a 4-28 vdc signal (model DDA) or 100-280 vac signal (model DAA); and includes a built-in I^2T fuse and fuse holder. LED indicators show: green = control input on, red = fuse failed, and red = over-temperature problem, contactor requested to turn off until the problem clears. Finger safe terminals and din rail mounting means fast installations, reducing your costs and downtime. May 6, 2004

[DC switching solid state relay -- faster, cooler, more rugged]

For switching 1-40 amps of DC power, the HDD family is ideal for switching DC loads, DC servos, or DC robotics. The relays are tested at 15,000 on/off cycles per second for fast response to command signals. With a control input requirement of just 4-32vdc and 6-10mA, the relays are compatible with standard TTL logic systems, PLCs, PCs, or customized control systems. The solid state relays have no parts to wear out and they are immune to mechanical contact bounce. High speed applications include: robotic control, CNC motor positioning, PWM pulse width modulated dc motors, and X-Y positioning motors using high acceleration, low-inertia, precision start/stop capabilities. Other applications include: DC vending machine motors, battery back-up systems, automotive or truck applications, drone vehicles, and racing boat control (trim, pumps, fuel management). The green LED provides quick, input status indication. March 29, 2004

[Real POWER in the palm of your hand]

For switching up to 100 amps of power, the Power-IO solid state contactor is an ideal unit to replace mechanical or mercury contactors. For heater applications, motor starter applications or general power switching; Power-IO provides a wide variety of products to fulfill these requirements. In addition, Power-IO does custom power engineering so if you need a particular feature, amperage, voltage, frequency, or diagnostics capability, contact us for further information. February 24, 2004

DeviceNet
Ethernet
Profibus
Network I/O

[Convert network i/o into power i/o](#)

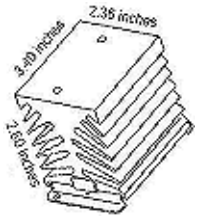
There are hundreds of network i/o, fieldbus i/o, or home automation i/o products. Power-IO provides the ability to convert those i/o nodes into power switching nodes that are rated for 0.1 to 100 amps. In addition, the 4000 volt isolation of every Power-io point ensures better safety for personnel and machinery while reducing ground loops. January 31, 2004

[Din rail i/o modules](#)

Din rail i/o modules provide 4000 volt isolated inputs and 4000 isolated outputs in an industry-leading ultra high density package. The input modules accept a wide range of Vac or Vdc inputs. The output modules provide a fused output that is rated up to 3 amps for switching Vac or Vdc loads. Ideal for PLC isolation, PC automation, or fieldbus interface applications. November 16, 2003

[Solid state motor starters](#)

Power-IO supplies solid state motor starters that are capable of turning on industrial motors up to 2 HP single phase, or up to 5 HP three phase. The solid state motor starter uses the precise, zero-crossing and Maximum Surge Survival features that are standard in the Power-IO "H" family of hockey puck size, solid state relays. In addition, Power-IO can provide the units pre-assembled onto an optimized heat sink, including an additional motor starter MOV and a clear, finger-safe protective cover. October 2, 2003



[Din rail, heat sinks for "H" hockey puck installations](#)

The universal heat sinks are able to be din rail mounted or panel mounted. These heat sinks are specifically engineered to provide optimum performance while occupying an absolute minimum of space inside your electrical cabinet. Designed for single SSR installations, or for multiple SSRs by using the "6 pack" model. In addition, we can extrude custom length heat sinks that match your unique requirements. September 14, 2003

[New, three phase, solid state relay for din rail or panel mounting.](#)

Edge-to-edge, the "D" (Din Rail) family provides more amps per square inch. This product line provides for 25 amps and 35 amps per leg for three phase power control. Including all of the latest international requirements, this product family requires NO SPACE between relays (on the same din rail) for cooling -- an industry improvement that reduces your panel requirements by 30-60% compared to other din-rail, solid state relay products. August 24, 2003

[New, international ready, din rail solid state relay.](#)

Edge-to-edge, the mini "D" (Din Rail) family provides more amps per square inch. This includes models for 25 amps and 40 amps; the new Maximum Surge Survival™ technology; the latest international specifications including the A1, A2, L1, T1 terminal markings; a green LED for control input status; the latest CE specification EN 60947-4-3; and NO need for external filters in order to meet the CE noise specifications. Installation-friendly: less than 1.4 inches wide (25 amp unit) or 2.4 inches wide (40 amp unit), with finger-safe caged terminals and a universal mounting bracket for Din Rail mounting or panel mounting. The new "D" design requires NO SPACE between relays for cooling -- an industry improvement that reduces your panel requirements by 30-60% compared to other din-rail, solid state relay products. Typical in stock inventory is at: inventory. July 21, 2003

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Solid state relay, SSR, SCR, and solid state contactor experience.

The management team at POWER-IO™ have over 60 years of combined experience with industrial automation, lighting control, power control, and power switching applications. POWER-IO was formed in order to expand the use of solid state power switching (ssr, scr, igbt, mosfet, or microprocessor supervised solid state contactor) technology in automation applications from 0.1 amp up to hundreds of amps. In addition, POWER-IO can offer specific, custom designed products that incorporate power switching as one of the primary elements of the product.

The POWER-IO technology is based upon the following core competencies:

- scr design knowledge directly at the silicon wafer creation stage
- use of oversized dies for stronger amperage surge capability
- ceramic pcb assembly, sometimes called dcb or dbc bonding capability
- thermal transfer optimization that results in better thermal efficiencies than are typical in the industry
- design of custom heatsinks that results in the outstanding performance in industrial or commercial environments
- The trademarked Maximum Surge Survival™ technology -- an advanced method of using 3 protective levels to minimize damage from voltage surges
- custom interfaces for vac control inputs, vdc control inputs, 4-20mA inputs, Modbus communications, DeviceNet multi-drop communications and more.
- current limited vdc input requirements of the POWER-IO products mean that they can interface to PLC or PC based control systems.
- indepth industry experience to resolve technical questions quickly, accurately, and fully

POWER-IO also has a history of designing customized products and completing the testing procedures at UL, CSA, and CE, in a rapid fashion.

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Power-io products -- solid state relays, solid state contactors, motor starters and I/O modules

"IO" family of solid state I/O Modules: monitor AC or DC as inputs, or generate 0.1 - 3 amp outputs. Smallest size, fused outputs, 4000 volt isolation. Compatible with PLCs, PCs, TTL, and most controllers:

Input Modules
Output Modules

"H" Family of hockey puck solid state relays for applications from 1-125 amps. These relays include a clear safety cover and the Maximum Surge Survival™ technology:

1-125 amp, AC or DC activated solid state relays for switching AC loads
1-75 amp, DC activated solid state relays for switching DC loads
SSR heat sinks, thermal transfer pads, MOVs, parts, pre-installed options
I2T fuses, semiconductor fuses and din rail fuse holders

"C" Family of din rail contactors for applications up to 100 amps. Two pole switching or individual single poles; smallest installed size; highest inrush capability; Maximum Surge Survival™ technology; and flow through wiring. The universal, modular design replaces mechanical, mercury or lighting contactors in industrial, municipal, or military applications. *Ultra rugged, high density, cost effective.*

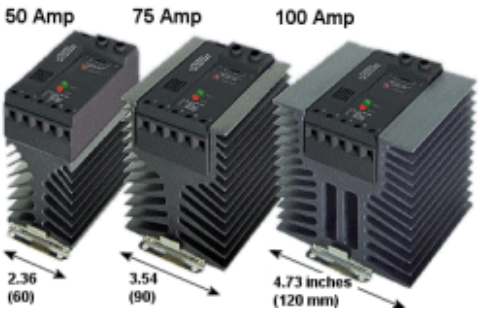
up to 100 amp per pole, AC activated
up to 100 amp per pole, DC activated, + diagnostics feedback output

Mini "D" Family of din rail relays for applications from 1-40 amps. The Mini "D" family includes: an integral heatsink, recessed finger-safe terminals, and the Maximum Surge Survival™ technology:

25 and 40 amp, AC or DC activated
25 and 40 amp, analog 4-20mA activated
Potentiometer input, pot input, manual station, manual % power controller

Three phase "D" Family of din rail relays for applications from 1-35 amps per leg. Ideal for switching 2 or 3 legs of a three phase load (delta, star, or wye loads).

1-35 amps, two or three legs, AC or DC activated
1-35 amps, two or three legs, analog 4-20mA activated
Potentiometer input, pot input, manual station, manual % power controller



"D" Family of din rail relays for single phase applications up to 100 amps. These models include: large power terminals for 3-8 AWG wires; a built-in replaceable I²T fuse; and 2 diagnostic red LEDs for fuse open and over-temperature shutdown.

up to 50 amp, 75 amp, or 100 amp contactor; AC or DC activated

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Additional information:

Application Notes:

- How to maximize your SSR application -- avoid over-voltage, over-amperage, and over-temperature
- Heat sink information, fusing, MOVs, etc.
- Glossary: Mechanical, mercury, solid state relays, SCRs, and phase angle terminology

Catalog. Color, printer friendly, PDF of the Power-IO web site products -- Jan, 2008:

- Hints:
- 1: Your computer's PRINT key = prints entire catalog. This is over 100 pages.
- 2: OR Select: FILE, PRINT, PAGES x-x = prints selected pages only
- 3: OR SAVE to your hard drive or laptop for offline viewing later
- 4: OR SAVE to your hard drive, and use the full Adobe Acrobat program to extract pages x-x for storage with your project details
- 5: The catalog has active links. You can easily navigate the catalog by clicking links, paths, etc.

Data Bulletins PDFs (optimized for internet speed -- text based with minimal color):

- H-Family of hockey puck solid state relays. From 1-125 amps, from 24-660 volt.
- H-Family of hockey puck solid state relays. From 1-75 amps, from 24-660 volt.
- HDD-Family of DC switching solid state relays. From 1-40 amps, from 0-200 VDC.
- I^2T fuses and fuse blocks for solid state applications

Support information:

- UL file (link to UL.com) for Power-io products
- CSA files (link to CSA) for Power-io products

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Ssr, scr, i/o, ss relays and solid state relays can be purchased on-line with confidence at Power-IO. In addition, we are looking to expand our worldwide distribution program. Contact: sales@power-io.com for further information.

Easy online shopping:

- To add items to your cart, click the BUY button that is next to a product's part number.
- To delete items from your cart, set the quantity to 0 (zero).
- Then you can recalculate the amount, continue shopping, or proceed to the payment area.
- We will list what you are buying, ask for your shipping and billing information, and process your order.
- MasterCard or Visa will convert your credit card purchase into your local currency. Please check with your credit card company to see what minor charge they have for this conversion. In addition, many credit card companies also offer: free rebate programs, free warranty extensions, and other free services.
- At any time, you can view what is in your cart by clicking the View Cart button at the top of the page.
- We add a shipping charge for standard, ground shipping costs to USA locations. For Fed Ex Air, international shipments, or other special shipping requests, the shipping charge and duties would be additional. Many international customers supply us their freight forwarder information or shipping account number and that organization can handle all of the shipping and duty questions.

For your security, we use the following online procedures: we record the IP address of the computer that you are using during the purchase, we only accept your credit card number when you enter it on our SSL secured page, and we encrypt the credit card number. In addition, we accept purchase orders or wire transfers from established customers.

If you do NOT prefer to post your credit card number, you can still use our online ordering program. After completing your selection of products, PRINT the page that includes your part numbers and shipping address. You can then fax or telephone that information to our company. We are happy to assist you over the telephone.

We reserve the right to correct errors. We will contact you with our findings.

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Solid state relays have no moving parts so there is no mechanical reason why they should fail. However, traditional solid state relays (and other modern electronics) may be damaged by three local installation reasons -- over voltage power surges, over current due to inrush or improper fusing, and over temperature due to poor thermal dissipation. If you plan for these three situations, you will remove the vast majority of solid state relay failures.

Over voltage power surges

In ALL industrial applications, the local factory power is fluctuating in voltage due to starting and stopping of nearby drives (inductive fly back surges), inductive loads, noisy mechanical or mercury contactors (non-zero cross switching of medium amperage loads), e-stop and other machine stop conditions without proper filters, local phase angle control, and more. This creates a variety of voltage surges on the same (normally unfiltered) power line that directly feeds to the solid state relays and the loads. The Power-IO families of SSRs set the new standard for solid state switching due to the Maximum Surge Survival™ technology. This results in a SSR or solid state contactor that is 10-12 times more bullet-proof to over voltage power surges than other units in the market place. This is a triple-layer approach to surge survival based upon the cumulative effect of attenuate + block + control the activation. The Maximum Surge Survival feature adds: 1) a strong internal attenuator to reduce the peak voltage surge from a short duration, extremely high spike to a longer duration, less destructive, voltage bump; 2) then it adds a strong blocking voltage barrier at 800 volts (for 330 volt rated products) or 1200-1400 volts (for 660 volt rated products); 3) then it adds a pass through circuit that protects the SSR die from the destructive "punch through" that happens during a momentary voltage surge. With-in a sinewave or two, the SSR recovers from the pass-through and then continues to operate. These three layers supply a triple-layer barrier to avoiding voltage surge related product failure. These three layers represent: soften the surge; block what remains; and if is still is a massive surge, then control the turn-on so the SSR will return to normal operation at the next zero crossing mark. If the application is subjected to constant repetition of voltage surges, you can also add a MOV across the power terminals of the POWER-IO SSR. This will act as a fourth layer of surge protection, if you wish, and it is highly recommended for motor starting applications. Voltage surges are always one of the hardest problems to locate in an installation, whether it is industrial or residential, so it is to your advantage to anticipate them in advance.

Over current

The Power-io products (H, C, and D families) uses over-sized internal components so it can absorb short term amperage inrush fluctuations such as when used with tungsten loads or similar high inrush loads. For example: both the 25 amp and the 40 amp D units can be properly protected by a 50 amp I^2T fuse, due to the over-sized internal design. The new CE testing (the new CE EN60947-4-3, effective 2002 for new products) requires solid state relay survival testing under a variety of 20% over-amperage switching into a 0.8 power factor inductive load. Power-IO's D families din rail relays and the H family of hockey puck relays meet all of the requirements of CE EN60947-4-3 without any filters or other external, add-on devices. Please be aware, even though we test the product at 20% over the rated amperage (such as 60 amp loads on a 50 amp SSR), you should ALWAYS design your installation so that you do NOT exceed 80% of a SSR's ampacity during normal operation, at 40°C. Many local electrical codes, circuit breaker companies, wire suppliers, and fuse companies also recommend that the installations always be designed to run at no greater than 80% of any component's rating, and additionally derated based upon local installation temperatures. This 80% rule helps to anticipate resistance changes, amperage fluctuations, and it is an excellent recommendation to ensure long life of all of the components in an installation.

Over temperature

POWER-IO's C and D families are available as manufactured on an optimized heat sink. First, POWER-IO uses a customized ceramic direct copper bonding technique resulting in the absolute minimum thermal resistance from the SSR die to the heat sink. The SCR die is bonded to the thinnest ceramic substrate that is mechanically strong enough for the application. This substrate electrically isolates the SCR from the aluminum heat sink while permitting the thermal rise to dissipate and spread to the copper subplate and then the aluminum heat sink. These substrates are x-rayed with an electron microscope to ensure that we have a void free assembly. Then, we use a new heat sink design that is specifically engineered to maximize exposed aluminum surface area, thermal draw down channeling, heat flow patterns, and the chimney effect. This is why the popular POWER-IO products that have an integrated heat sink can be installed with NO space between units on the same horizontal din rail. This means that they stand up better to installations where the ambient temperature is warm. Please note -- all POWER-IO units are rated to operate in an environment of 40°C without any derating compared to competitive units that may be rated only at 20 or 25°C and need to be de-rated at 40°C. In addition, most other brands of solid state relays require AT LEAST one inch between horizontal units on the same din rail or else they need additional temperature derating up to another 50% reduction in ampacity. The POWER-IO products use a highly efficient design so they typically generate less than 1 watt (25 amp units) or 1.2 watts (40-100 amp units) per amp switched. This compares to other units that might generate 50% - 75% more heat. The POWER-IO product line works harder -- runs cooler -- needs less installation space. The more information on the POWER-IO products, click on solid state relay products.

In addition to avoiding over-voltage, over-current, and over-temperature situations; it is expected that the POWER-IO product should be installed only by qualified personnel, in accordance with all electrical and safety regulations. Naturally, any electrical product can stop functioning at any time, so all installations must be designed in such a way that they use all external fail-safe methods to ensure a safe shut down capability.

Power-io 537 Braemar Avenue Naperville, IL 60563 USA
Sales telephone: +1 630 717 7335 | Legal | Privacy | Trademarks | © 2003-2007, POWER-IO
New solid state relays | Company | Solid state relays and i/o | SSR library | Sales | View cart | Contact

Legal

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The products that are designed, manufactured, or sold by POWER-IO are intended to be installed and serviced by trained personnel. In addition, there are local, national, factory, and other regulations (sometimes referred to as the NEC, National Electrical Code, OSHA, or equivalent) that must be strictly followed during the installation and use of any POWER-IO product. Failure to follow all of these regulations can result in downtime, damage, injury, or death.

POWER-IO products can (as is possible with any electronic product) fail without warning. For this reason, POWER-IO can not recommend, condone or warrant any application of our products that could cause harm or injury, in any manner, to any person, equipment, or facility upon such failure of the product. For your safety and to protect the equipment from damage in the event of failure, it might be necessary to insert some type of upper-limit device (such as: thermal) in series with the relay's output to cause discontinuance of current to the load. In addition, it might be necessary to design your application so that an alarm condition will shut down the relay's output to cause discontinuance of current to the load. Additionally, it is advisable to have a mechanical disconnect in the load circuit for service purposes. Caution: the heat sinks are capable of being over 100°C (212°F) when they are operating correctly in an installation. This could cause burns. Always completely de-energize a POWER-IO product and let it cool down before touching the unit. All heat sinks must be installed on a vertical metal surface with unrestricted air flow that flows up, through the fins, and out the top of the heat sink. Mounting the heat sink on a horizontal surface, or limiting the air flow due to other components being installed nearby, will severely decrease the ability for the heat sink to perform as specified. This could cause failures. Always disconnect the electrical power before touching the POWER-IO product or the load, otherwise, an electrical shock hazard may exist. Failure to do this may result in electrocution or death. POWER-IO products are intended for use where access is limited to qualified, trained, service personnel. POWER-IO products are not intended for use in explosive atmospheres. There may be additional applications that are not recommended. Contact us for further information. CE installation category is Class 3 or lower. Please contact our company if you have any doubts or questions as to whether these cautions apply to your application.

Warranty: POWER-IO warrants its products for a period of 2 years from the date of manufacture to be free from defects in both workmanship and materials. POWER-IO assumes no risk or liability for results of the use in combination with any electrical or electronic components, circuits, systems, assemblies, or suitability of any product for use in any circuit or assembly. Purchaser's rights under this warranty shall consist solely of POWER-IO having to repair or replace, free of charge, FOB factory, any qualified, returned item. In no event will POWER-IO be liable for any expressed or implied warranty as to the merchantability, fitness, description, or for special or consequential damages, or for delay in performance of this warranty. The warranty is voided for any product that has been abused, installed improperly, or used incorrectly. Examples of abuse may include: failing to provide the required air flow; failing to design the application to remain with-in 80% of the stated capacity of the POWER-IO product during operation at a given ambient temperature; failing to properly connect and torque the wires; exposure to water, corrosive environments, conductive atmospheres, explosive atmospheres, condensing environments; exposure to amperage, voltage, or voltage surges that are outside of the stated capacity of the POWER-IO product; exposure to voltage surges from nearby equipment; failing to install the product in accordance with ALL local electrical codes, plant safety codes, and UL/cUL/CSA policies; and failing to fuse the product in accordance with POWER-IO's requirements AND in accordance with any and all local electrical codes or electrical requirements. There are other examples of abuse, improper installation, or improper use that have not been listed here.

For a copy of POWER-IO's standard Terms and Conditions, as a .pdf file, click here. For a copy of POWER-IO's return policy click here. For a copy of the Equal Opportunity Policy, click here.

POWER IO LLC
STANDARD TERMS AND CONDITIONS OF SALE WITHIN THE UNITED STATES

Naming Convention: POWER IO LLC shall hereinafter be referred to and legally referenced as "POWER-IO" For purposes of the Terms and Conditions, POWER IO shall hereby be referenced as "Seller". General Information: Sale of the equipment or services by the Seller is expressly conditioned upon the terms and conditions set forth below. This document constitutes the entire sales contract between Seller and Purchaser. Seller expressly rejects any different or additional terms or conditions previously or hereafter proposed by Purchaser unless agreed to in writing by an authorized representative of Seller. ACCEPTANCE OF THE EQUIPMENT OR SERVICES BY PURCHASER SHALL CONSTITUTE AGREEMENT TO ALL PROVISIONS HEREOF.

WARRANTY: SELLER EXPRESSLY WARRANTS THE PRODUCTS MANUFACTURED BY IT AS MEETING THE APPLICABLE SELLER PRODUCT SPECIFICATIONS. EXCEPT AS SET FORTH HEREIN, SELLER MAKES NO OTHER WARRANTIES EITHER EXPRESS OR IMPLIED (INCLUDING, WITHOUT LIMITATION WARRANTIES AS TO MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE). BUYER RETAINS RESPONSIBILITY FOR THE APPLICATION AND FUNCTIONAL ADEQUACY OF THE OFFERING. IN ADDITION, THE FOLLOWING SHALL CONSTITUTE THE EXCLUSIVE REMEDIES FOR ANY BREACH BY SELLER OF ITS WARRANTIES.

Seller warrants to Purchaser that the equipment to be delivered hereunder will be free from defects in material or workmanship for such period after shipment by Seller as defined in POWER-IO's warranty policy available by calling, emailing, writing or online at:

Phone: 630 717 7335
Fax: 630 839 5996
Email: info@power-io.com
Internet: www.power-io.com
537 Braemar Ave
Naperville, IL 60563

If the equipment delivered hereunder does not meet the foregoing warranty, Purchaser shall promptly notify Seller who shall thereupon replace or repair, free of charge, provided the defective product, component, or part thereof is returned to the nearest authorized Seller repair facility within the time-frame specified in the applicable warranty term from date of shipment, transportation charges prepaid by Purchaser. The cost to diagnose defects at the job site, if required, shall be paid by Purchaser. Any product or component, or part thereof so replaced or repaired shall be warranted by Seller for the remainder of the original warranty period or the applicable repair warranty, whichever is longer. Any and all such replacements or repairs necessitated by inadequate preventative maintenance, or by normal wear and usage, or by the fault of Purchaser or power sources supplied by others, or by attack and deterioration under unsuitable environmental conditions shall be for the account of Purchaser. Seller shall not be obligated to pay any costs or charges including "back charges" incurred by Purchaser or

any other party except as may be agreed upon in writing in advance by Seller.

The liability of Seller under this warranty, whether the claim is based on contract or negligence, shall not in any case exceed the cost of correcting defects in the equipment or of supplying replacement equipment as herein provided and upon the expiration of the warranty period all such liability shall terminate. The foregoing warranty is exclusive and in lieu of all other warranties (except as to title), whether written, oral, implied or statutory.

PATENTS: Seller shall defend Purchaser and pay any award of damages assessed against Purchaser in any suit or proceeding so far as same is based on any claim that the equipment, hardware or software products, or any part thereof furnished hereunder (except for such products basically of Purchaser's specifications) shall in design or construction infringe any patent of the country of its manufacture, provided Purchaser gives Seller prompt notice in writing of such claim and permits Seller to contest same through its counsel or, at its option, to settle by securing for Purchaser the right to continue to use such products or by modifying them to avoid infringement, or by reclaiming them and reimbursing Purchaser the sum paid therefore; and provided Purchaser gives Seller all necessary authority and assistance, at the expense of Seller, to enable Seller to do so. The financial limit of such Indemnification shall not exceed the Contract Price. This indemnity shall not apply to cases where the claimed infringement is a result of (i.) Buyer's detailed specifications, (ii.) parts supplied or designated by Buyer, (iii.) modification of the goods, by someone other than your business, or (iv.) combination of your business' products with other products, the combination of which is alleged to be infringing.

INDEMNITY: Seller agrees to indemnify and save harmless Purchaser only against liability imposed on Purchaser by law with respect to bodily injury or property damage to the extent such liability results from the performance of Seller under this contract. Seller does not agree to indemnify and save Purchaser harmless except as set forth herein. Purchaser agrees to indemnify and save harmless Seller for all loss, cost, or damage incurred by Seller as a result of Purchaser's or third party's misuse or misapplication of Seller-supplied products.

LIMITATION OF LIABILITY: Seller's liability on any claim of any kind, including negligence, for any loss or damage arising out of, connected with, or resulting from this sales contract or the performance or breach thereof, or from the design, manufacture, sales, delivery, resale, installation, repair, operation or use of any equipment covered by or furnished under this agreement shall in no case exceed the purchase price of the equipment which gives rise to the claim. IN NO EVENT, WHETHER AS A RESULT OF BREACH OF CONTRACT OR WARRANTY OR NEGLIGENCE, SHALL SELLER BE LIABLE FOR SPECIAL OR CONSEQUENTIAL DAMAGES INCLUDING, BUT NOT LIMITED TO, LOSS OF PROFITS OR REVENUE, LOSS OF USE OF EQUIPMENT OR ANY OTHER EQUIPMENT, COST OF CAPITAL, COST OF SUBSTITUTE EQUIPMENT, FACILITIES OR SERVICES, DOWNTIME COSTS, OR CLAIMS OF CUSTOMERS OF PURCHASER FOR SUCH DAMAGES EVEN IF SELLER HAS BEEN INFORMED OF THE POSSIBILITY OF SUCH DAMAGE OR LOSS BY PURCHASER OR ANY THIRD

PARTY.

PRICE AND ACCEPTANCE OF ORDERS: Prices stated in orders are binding upon Seller for 30 days from the date hereof. Prices on all equipment shipped more than 30 days hereafter may be increased if necessary to cover increased costs of labor and material incurred by Seller. Orders placed with sales representatives are subject to acceptance by Seller in Naperville, Illinois. This acknowledgment constitutes such acceptance and is a sales contract made in Illinois.

PAYMENTS: The purchase price stated herein shall be due and payable within 30 days after shipment of the equipment. If shipment is delayed by Purchaser, Seller's invoice shall be rendered on the date when Seller is prepared to make shipment. Equipment held for Purchaser shall be at the risk and expense of Purchaser. PAST DUE ACCOUNTS WILL BEAR A FINANCE CHARGE OF 1-1/2 % PER MONTH ON THE UNPAID BALANCE, WHICH CORRESPONDS TO AN 18% ANNUAL PERCENTAGE RATE. Buyer is prohibited from and shall not set off invoiced amounts or any portion thereof against sums that are due or may become due to Seller, its parent, affiliates, subsidiaries or other divisions or units.

SALES, DUTIES, FEES, EXPORT: Unless otherwise stated in the offering, all prices are quoted in United States currency. In addition to the price specified in this sales contract the amount of any present or future sales, use, excise or other similar taxes or other charges applicable to the sale or use of the equipment (including, but not limited to any duties, charges, now existing or hereafter imposed by Government authorities upon equipment or services quoted by Seller, or upon the production, sale, distribution, delivery, import or export thereof, or upon other features related thereto) shall be paid by Purchaser, or in lieu thereof Purchaser shall provide Seller with a tax-exempt certificate acceptable to the taxing authorities. Unless Seller agrees to be the "exporter of record" when exporting products from the United States, Purchaser shall be responsible for meeting export/re-export requirements. Purchaser agrees to comply in full with U.S. export licensing requirements and restrictions with regard to export of Goods.

PACKING AND SHIPPING: Prices are stated exclusive of packing and shipping charges. All prices are Ex-works Shipping Point unless otherwise agreed upon in writing by Seller. Delivery at such point to common carrier or postal authorities shall constitute delivery to Purchaser, who shall thereafter be responsible for delays, loss or damage in transit, although Seller will assist Purchaser in processing claims.

DELIVERY: Title to all products EXCLUDING SOFTWARE, and risk of loss or damage shall pass upon delivery by Seller to the possession of the carrier, unless specified otherwise in writing by Seller. Any claims for loss or damage after risk of loss has passed shall be filed by Purchaser with the carrier. Seller shall not be liable for loss or damage from delay in delivery or failure to manufacture. Delivery dates are approximate and are based on prompt receipt by Seller at its factory of all necessary information including final agreement on detailed specifications, on such date or with such lead times as may be specified by Seller. If delivery is delayed at the request of, or due to acts or omissions by

Purchaser, Seller shall have the right to store the goods at a place of its own choice for Purchaser's account and risk and to invoice Purchaser in accordance with the original contractual terms and for such storage charges incurred as a result of the delay.

INSPECTION AND ACCEPTANCE: Purchaser shall upon delivery of Products inspect and either accept or reject such Products within a reasonable period not to exceed thirty (30) calendar days of delivery (the "Acceptance Period"). In the event that Products do not comply with this Agreement, Purchaser shall promptly notify Seller and provide a specific written explanation of the basis for rejection. Purchaser shall be deemed to have accepted any Product delivered hereunder and to have waived any right to reject in the event that Seller does not receive such notice of rejection within the Acceptance Period. Seller shall be afforded a reasonable opportunity to repair or replace non-conforming Product at Seller's option. After the initial delivery provided for in the "Delivery" clause, the risk of loss or damage to all Products in transit shall be borne by the Party initiating the transportation of such Products; provided, if Seller reasonably determines that the Product originally shipped complied with this Agreement, then all expenses related to the improper rejection are the responsibility of Purchaser.

DELAYS/ FORCE MAJEURE: Shipping dates stated are approximate. Neither party shall be considered in default in performance of obligations hereunder to the extent that performance of such obligations, or any of them, is affected by an event of Force Majeure. Force Majeure shall include, but not be limited to, hostilities, restraint of rulers or peoples, revolution, civil commotion, terrorist acts, strike, epidemic, accident, fire, flood, wind, earthquake, explosion, blockade, or embargo, lack of or failure of transportation facilities or any law, proclamation, regulation or ordinance, demand or requirement of any Government or Governmental agency having or claiming to have jurisdiction over the work or with respect to materials purchased for the work, or over the parties hereto, or any Act of God, or other act of Government, or any cause whether of the same or different nature existing or future, which is beyond the control and without the fault or negligence of the parties hereto.

RESALE: If Purchaser is reselling the equipment, Purchaser agrees to furnish its purchasers copies of the Standard Terms and Conditions of Sale, and Seller agrees to make copies available upon request. In all events and regardless of whether Purchaser complies with this provision, the rights of such purchasers shall be determined under the provisions hereof entitled "Warranty," "Patents" and "Limitation of Liability."

ASSIGNMENT: Neither Party shall assign this Agreement or any portion thereof without the advance, written consent of the other Party, which consent shall not be unreasonably withheld. Notwithstanding the forgoing, Seller may assign this Agreement in the event of a merger, consolidation or reorganization or in connection with the sale of all or substantially all of the assets of the business of Seller to which this Agreement relates.

LICENSE GRANT: All software programs which are embodied in human readable source form or machine readable object form and which include, but are not limited to, programs having a series of instructions, statements and data, and related materials provided by

Seller are the property of Seller and/or others and are subject to the terms set forth in this License, in which Purchaser is provided solely with a personal, nonexclusive and perpetual (except for breach by Purchaser) license to use such programs solely for their internal business purposes in the country in which the software was furnished and for execution on the system for which it was provided.

COPYRIGHT AND TITLE: No title to the intellectual property in the software programs or material is transferred to Purchaser under this license. All software and its copyrights are owned by Seller and/or its suppliers. The software is protected by United States copyright laws and international treaty provisions. Therefore, Purchaser must treat the software like any other copyrighted material (e.g., a book or musical recording) except that Purchaser may make copies of the programs for use only with the system for which such programs were acquired. Purchaser must reproduce and include the copyright notice on any backup copy. The written materials and firmware may not be copied.

RESTRICTED USE: Purchaser shall not export or re-export the programs or material without the appropriate United States and Foreign government licenses. Purchaser agrees not to reverse engineer, de-compile, or disassemble the Software. Purchaser may not rent or lease the Software to any third parties, but may transfer the Software and written materials on a permanent basis provided no copies are retained and the recipient agrees to the terms of this Software License. Storage media, which Purchaser received from Seller may contain certain Software for which Seller has not accepted an order from Purchaser for a Software License. If Purchaser desires to license this Software, Purchaser must obtain the appropriate Software License from Seller.

CANCELLATION: Purchaser may cancel its order by written notice, provided Purchaser pays cancellation charges in accordance with Seller's Cancellation Policy in effect at the time an order is placed. This policy is available by calling, writing or online at POWER-IO.

SCOPE CHANGES: All changes affecting the equipment configuration or otherwise affecting the scope of the order are to be documented in writing for approval and authorization to incorporate such changes into the order. All changes authorized by Purchaser are binding only if accepted in writing by Seller, and may result in price, delivery and/or condition changes. Pricing of changes shall be based on the then current prices. If an extension of delivery is required beyond the original schedule, escalation shall be as agreed.

ARBITRATION: The parties agree that any controversy, claim or dispute arising out of this Agreement, shall be determined by arbitration in the domicile of the Seller, before a sole arbitrator. The arbitration shall be administered by the American Arbitration Association ("AAA") pursuant to its Commercial Rules and Supplementary Procedures for Large, Complex Disputes. The arbitrator shall not be an officer, employee, director, or affiliate of either Party or of its affiliates. If the Parties are unable to agree on an arbitrator within 30 days of the filing of the Demand for Arbitration, an arbitrator shall be selected pursuant to the rules and procedures of the AAA.

APPLICABLE LAW: The validity, construction, and interpretation of any agreement relating to service provided by Seller, and the rights and duties of the parties thereto, shall be governed by the laws of the Commonwealth of Illinois.

MISCELLANEOUS: This Agreement incorporates certain policies and provisions by reference. These articles and clauses apply as if they were set forth in their entirety. All orders are subject to the applicable POWER-IO Sales Policies in effect at the time an order is placed. These Policies are available by calling, emailing, writing or online at POWER-IO.

Any offering or contract of which these conditions are a part constitutes the final, complete and exclusive statement of representations made by Seller, and Seller shall not be bound by any representations, promise or inducement of any kind unless set forth herein nor shall Seller be bound to any representations made herein except to the designated recipient of any offering or contractual commitment. No waiver, alteration or modification of any of the provisions herein or of the provisions of any contract arising herefrom shall be binding on Seller unless modified in writing and signed by Purchaser and Seller.

Sales Order Cancellations

Order cancellations must be received in writing (email, fax or mail) and are subject to a 33% cancellation fee. If the order has shipped from the manufacturing facility, or from one of our stocking locations, it cannot be cancelled.

Product Returns

Generally, all purchases of any Power-io product are considered final.

- Any consideration of a product return must be reviewed and approved by senior management from Power-io.
- Any product that is custom made, custom marked, or custom assembled will not be considered for return.
- Product that is older than 2 months from date of manufacture, will not be considered for return. Product that is under 2 months old, if it is allowed to be returned, will be subject to a minimum restocking fee of at least 33%.
- All requests for return must be made in writing and include a list of products to be returned along with model numbers, serial numbers, and original order information.
- All products returned must brand new, unused, and in their original packaging.
- Product that is not of the current firmware and software version cannot be returned. Non-standard product cannot be returned.
- Products that have been made obsolete cannot be returned. Any product returned to Power-io must be accompanied by a Return Materials Authorization (RMA) number issued by the Sales Department. Product returned to Seller without an RMA will not be processed for any reason.

AFFIRMATIVE ACTION PROGRAMS

For Minorities, Women, and Disabled Individuals

Power-io, Inc.

January 1, 2008 - Dec 31, 2008

DESCRIPTION OF ORGANIZATION

Power-Io, Inc. manufactures or sells electrical products.

DEFINITIONS OF TERMS USED IN THIS AAP

Individual with a Disability: any person who has a physical, sensory, or mental impairment which “materially” (Illinois) or “substantially” (Federal) limits one or more major life activity or has a record of or is regarded as having such an impairment. "Individual with a Disability" does not include an alcohol or drug abuser whose current use of alcohol or drugs renders that individual a direct threat to property or to the safety of others.

American Indian or Alaska Native - a person having origins in any of the original peoples of North and South America (including Central America), and who maintains tribal affiliation or community attachment.

Asian - A person having origins in any of the original peoples of the Far East, Southeast Asia, or the Indian subcontinent including, for example, Cambodia, China, India, Japan, Korea, Malaysia, Pakistan, the Philippine Islands, Thailand, and Vietnam.

Black or African American - A person having origins in any of the black racial groups of Africa.

Hispanic or Latino - A person of Cuban, Mexican, Puerto Rican, South or Central American, or other Spanish culture or origin, regardless of race.

Native Hawaiian or Other Pacific Islander - A person having origins in any of the original peoples of Hawaii, Guam, Samoa, or other Pacific Islands.

White - A person having origins in any of the original peoples of Europe, the Middle East, or North Africa.

Minority – Any person who identifies as being American Indian or Alaska Native, Asian, Black or African American, Hispanic or Latino, Native Hawaiian or Other Pacific Islander, or in any combination of these identifiers, or someone who identifies as White and as any of the other identifiers.

Job Groups: Although companies are not limited to using these broad job groups as the only means of analyzing their workforce, we use the following as guidelines:

Managers and Administrators: Occupations requiring administrative personnel who set broad policies, exercise overall responsibility for execution of these policies, and direct

individual departments or special phases of an organization's operations. Includes: officials, executives, middle management, plant managers, department managers, superintendents, salaried supervisors who are members of management, purchasing agents and buyers. First line supervisors, unless specifically listed under officials and managers or craft (skilled), who engage in the same activities as the employees they supervise should be reported in the same job category.

Professionals and Technicians: Professionals are considered to be persons working in occupations requiring either college graduation or experience of such kind and amount as to provide a comparable background. Technicians are those whose work requires a combination of basic scientific knowledge and manual skills which can be obtained through about two years of post high school education, such as is offered in many technical schools and community colleges, or through equivalent on-the-job training.

Sales Workers: Occupations engaged wholly or primarily in direct selling. Includes: advertising agents and sales agents, insurance agents and brokers, real estate agents and brokers, sales agents and sales clerks, grocery clerks, cashiers/checkers.

Office and Clerical: All clerical work regardless of the level of difficulty, where the activities are predominantly non-manual, though some manual work not directly involved with altering or transporting the products is included. Includes: bookkeepers, collectors, messengers, office helpers, office machine operators, shipping and receiving clerks, stenographers, typists, secretaries, and telephone operators.

Skilled Crafts: Manual workers of a relatively high skill level, having a thorough and comprehensive knowledge of the process involved in their work. They exercise considerable independent judgment and usually receive an extensive period of training. Includes: building trades, hourly paid foremen and lead-workers who are not members of management, mechanics and repairmen, skilled machinery occupations, electricians. Exclude learners and helpers of craft workers (apprentices).

Operatives: (Semi-skilled): Workers who operate machines or processing equipment or perform other factory-type duties of an intermediate skill level which can be mastered in a few weeks and requires only limited training. Includes: apprentices, operatives, attendants, delivery and route drivers, truck and tractor drivers, dressmakers, weavers, welders. Include craft apprentices in such fields as auto mechanics, printing, metalwork, carpentry, plumbing and other building trades.

Laborers: (Unskilled): Workers in manual occupations which generally require no special training. They perform elementary duties which may be learned in a few days and which require the application of little or no independent judgment. Includes: garage laborers, car washers, gardeners, lumber workers, laborers performing lifting, digging, mixing and loading.

Service Workers: Workers in both protective and nonprotective service occupations. Includes: attendants, clean-up workers, janitors, guards, police, fire fighters, waiters and waitresses.

Underutilization: The Illinois Department of Human Rights defines underutilization as being present in a job group if the number of women or minorities in a job group is less than what would be expected based on the availability percentage we have adopted for this analysis. We use a “whole person rule,” so that any fractional underutilization is rounded down to the nearest whole number. Declaration of underutilization does not

indicate that discrimination has occurred in a company; rather it is a term used within this plan document to enable our company to apply good faith efforts to ensure equal opportunity.

EQUAL EMPLOYMENT OPPORTUNITY POLICY

This is to affirm Power-Io, Inc.policy of providing Equal Opportunity to all employees and applicants for employment in accordance with all applicable Equal Employment Opportunity/Affirmative Action laws, directives and regulations of Federal, State and Local governing bodies or agencies thereof.

Our organization will not discriminate against or harass any employee or applicant for employment because of race, color, creed, religion, national origin, sex, sexual orientation, disability, age, marital status, membership or activity in a local human rights commission, or status with regard to public assistance.

We will take Affirmative Action to ensure that all employment practices are free of such discrimination. Such employment practices include, but are not limited to, the following: hiring, upgrading, demotion, transfer, recruitment or recruitment advertising, selection, layoff, disciplinary action, termination, rates of pay or other forms of compensation, and selection for training, including apprenticeship. We will provide reasonable accommodation to applicants and employees with disabilities.

Power-Io, Inc. will evaluate the performance of its management and supervisory personnel on the basis of their involvement in achieving these Affirmative Action objectives as well as other established criteria. In addition, all other employees are expected to perform their job responsibilities in a manner that supports equal employment opportunity for all.

I have appointed myself to manage the Equal Employment Opportunity Program. This person's responsibilities will include monitoring all Equal Employment Opportunity activities and reporting the effectiveness of this Affirmative Action Program, as required by Federal, State and Local agencies. I will receive and review reports on the progress of the program. Any employee or applicant may inspect our Affirmative Action Program during normal business hours by contacting the EEO Coordinator.

If any employee or applicant for employment believes he or she has been treated in a way that violates this policy, they should contact either any other representative of management, including me. Responsible parties will investigate allegations of discrimination or harassment as confidentially and promptly as possible, and we will take appropriate action in response to these investigations.

John Walsh

1/1/2008

ASSIGNMENT OF RESPONSIBILITY FOR AFFIRMATIVE ACTION PROGRAM

John Walsh is designated as EEO/AA coordinator to monitor all employment activity to ensure that our EEO/AA policies are being carried out. The EEO/AA coordinator will be given the necessary top management support and staffing to fulfill the duties of the position. Those duties include, but are not limited to, the following:

1. Develop our EEO/AA policy statement and Affirmative Action Plan/Program, so that it is consistent with our policies, and so that it establishes our affirmative action goals and objectives.
2. Implement the Affirmative Action Plan/Program including internal and external dissemination of our EEO/AA policies and plan.
3. Conduct and/or coordinate EEO/AA training and orientation.
4. Ensure that our managers and supervisors understand it is their responsibility to take action to prevent the harassment of employees and applicants for employment.
5. Ensure that all minority, female, and disabled employees are provided equal opportunity as it relates to organization-sponsored training programs, recreational/social activities, benefit plans, pay and other working conditions.
6. Implement and maintain EEO audit, reporting, and record-keeping systems in order to measure the effectiveness of our Affirmative Action Plan/Program and to determine whether our goals and objectives have been attained.
7. Coordinate the implementation of necessary affirmative action to meet compliance requirements and goals.
8. Serve as liaison between our organization and relevant governmental enforcement agencies.
9. Coordinate the recruitment and employment of women, minorities, and people with disabilities, and coordinate the recruitment and utilization of businesses owned by women, minorities, and people with disabilities.
10. Coordinate employee and company support of community action programs that may lead to the full employment of women, minorities, and people with disabilities.
11. Receive, investigate, and attempt to resolve all EEO complaints.
12. Keep management informed of the latest developments in the area of EEO.

DISSEMINATION OF AFFIRMATIVE ACTION POLICY AND PLAN

A. Internal Dissemination

1. Our policy statement and non-discrimination posters will be permanently posted and conspicuously displayed in areas available to employees and applicants for employment
2. Our EEO/AA policy statement will be communicated to our employees in the same manner that other major personnel policies or decisions are communicated.
3. Our EEO/AA policies will be included in our policy manual or employee handbook and in any collective bargaining agreements.
4. Our policy will be made available to all employees including part-time, temporary or seasonal employees.
5. We will review our EEO/AA policies at least once a year with all of our employees and management.

B. External Dissemination

1. As needed, we will notify all subcontractors, vendors, and suppliers of our EEO/AA policy and project goals, requiring supportive action on their part.
2. We will notify all recruitment sources, employment agencies, and labor unions of our EEO/AA policies, and we will encourage them to assist us in achieving our affirmative action objectives by actively recruiting and referring women, minorities, and people with disabilities.
3. We will include the statement "Equal Opportunity Employer" or "Affirmative Action Employer" on advertisements recruiting employees, on employment applications, and on our company's website, if we post job opportunities on our website.

INTERNAL AUDIT AND REPORTING SYSTEMS

Our EEO Coordinator has the responsibility for implementing and monitoring our affirmative action programs. Department heads, managers, and supervisors are responsible for providing the EEO Coordinator with information and/or statistical data as necessary to measure our good faith efforts to implement our programs.

At least annually, internal audit reports will be prepared in table format and dated. Data collected for these reports will include applicant flow, new hires, promotions, transfers, and terminations (voluntary and involuntary) by job group. Figures for each personnel process must show a breakdown by sex, minority classification, and disability status. Reports will be disseminated to appropriate levels of management, and any problem areas will be addressed as promptly as possible.

External reports will be submitted to government agencies, like the Illinois Department of Human Rights, as required.

WORKFORCE ANALYSIS

AVAILABILITY/UTILIZATION/UNDERUTILIZATION ANALYSIS

GOALS AND TIMETABLES

We will make a good faith effort to meet construction goals as described by government agencies, whether we are a prime or subcontractor.

PROBLEM AREA IDENTIFICATION

Power-Io, Inc.periodically conducts an in-depth analysis of its total employment process to determine whether and where impediments to equal employment opportunity may exist. We evaluated:

1. Workforce composition by job group: We have identified no underutilization of women or minorities in our current workforce. We will continue to monitor our workforce composition to ensure that no problems arise.
2. Personnel activity: We routinely conduct adverse impact analyses using the "Eighty Percent Test" or other statistical methods to analyze our personnel activities, including applicant flow, hires, promotions, terminations and other personnel actions, to determine if there are selection disparities between men and women, minorities and nonminorities (and within specific racial groups, if appropriate), or disabled and nondisabled applicants or employees. If any tests are used as a part of our selection process, we have determined that these tests are job-related and are validated. We have taken corrective action to remove any barriers to hiring or retaining women, people of color, or people with disabilities.
3. Compensation system: We routinely review our compensation system, including rates of pay and bonuses, to determine whether there are gender, race, ethnicity, or disability-based disparities. If any disparities are identified, we take prompt action to resolve the disparity. In offering employment to individuals with disabilities, we will not reduce the amount of compensation offered because of any disability income, pension, or other benefit the applicant or employee receives from another source.
4. Personnel procedures: We routinely review all of our personnel procedures and processes, including selection, recruitment, referral, transfers and promotions, seniority provisions and apprenticeship programs (if applicable), and company-sponsored training programs or other activities to determine if all employees or applicants are fairly considered.
5. Any other areas that might impact the success of our Affirmative Action Program: We continually analyze any other areas that may impact our success, such as accessibility of our facility to the available workforce, the attitude of our current

workforce towards EEO, proper posting of our EEO policy and required governmental posters, proper notification of our subcontractors or vendors, and retention of records in accordance with applicable law. We take prompt action to remedy any problems in these areas through training of staff or other methods.

ACTION-ORIENTED PROGRAMS:

Measures To Facilitate Implementation of Equal Employment Opportunity Policy and Affirmative Action Programs for Women, Minorities, and People with Disabilities

Selection Process

We will evaluate our selection process using an adverse impact analysis to determine if our requirements screen out a disproportionate number of minorities, women, or people with disabilities. All personnel involved in the recruitment, screening, selection, promotion, disciplinary, and related processes will be carefully selected and trained to ensure that there is a commitment to the affirmative action program and its implementation.

Schedule for Review of Job Requirements: We will annually review all physical and mental job requirements to ensure that these requirements do not tend to screen out qualified individuals with disabilities. We will determine whether these requirements are job-related and are consistent with business necessity and the safe performance of the job, and we will remove any physical or mental requirements that do not meet these criteria. Any job descriptions or requirements changed after review will be distributed to all relevant employees, particularly those involved in the selection process and supervision of employees.

Pre-Employment Medical Examination: If we require medical examinations or inquiries as a part of our selection process, all exams or inquiries will be conducted after a conditional offer of employment. Only job-related medical examinations and inquiries will be conducted, and the results of these examinations or inquiries will not be used to screen out qualified individuals with disabilities. Information obtained in response to such inquiries or examinations will be kept confidential except that (a) supervisors and managers may be informed regarding restrictions on the work or duties of individuals with disabilities and regarding accommodations, (b) first aid and safety personnel may be informed, where and to the extent appropriate, if the condition might require emergency treatment, and (c) officials, employees, representatives, or agents of the MN Department of Human Rights or local human rights agencies investigating compliance with the act or local human rights ordinances will be informed if they request such information.

Accommodations to Physical and Mental Limitations of Employees

We will make reasonable accommodations to the physical and mental limitations of an employee or applicant unless such an accommodation would impose an undue hardship on the conduct of the business.

Recruitment of Employees

1. All solicitation or advertisements for employees will state that applicants will receive consideration for employment regardless of their race, color, creed, religion, national origin, sex, sexual orientation, disability, age, marital status, or status with regard to public assistance. When needed, to help address underutilization, help wanted advertising will also be placed in news media oriented towards women or minorities. Copies of advertisements for employees will be kept on file for review by enforcement agencies.
2. When we place help-wanted advertisements, we will not indicate a preference, limitation, or specification based on sex, age, national origin, or other protected characteristic, unless that characteristic is a bona fide occupational qualification for a particular job. We will not allow any employment agency with which we work to express any such limitation on our behalf, and we will require that these agencies share our commitment to EEO.
3. All positions for which we post or advertise externally will be listed with State of Minnesota Workforce Centers, America's Job Bank, or similar governmental agencies.
4. As necessary to ensure that potential candidates are aware of job openings, we will contact community organizations focused on the employment of women, minorities, and people with disabilities (including state vocational rehabilitation agencies or facilities, sheltered workshops, college placement offices, education agencies, or labor organizations). We will keep documentation of all contacts made and responses received, whether formal or informal. We will make every effort to give these agencies a reasonable amount of time to locate and refer applicants.
5. We will carry out active recruiting programs at relevant technical schools and colleges, where applicable.
6. We will encourage present minority, female, and disabled employees to recruit other employees.
7. *Consideration of minorities and women not currently in the workforce:* We will take additional steps to encourage the employment of women, minorities, and people with disabilities who are not currently in the workforce, such as providing part-time employment, internships, or summer employment.

Training Programs

Minority, female, and disabled employees will be afforded a full opportunity and will be

encouraged to participate in all organization sponsored educational and training programs.

We will seek the inclusion of qualified minority, female, and disabled employees in any apprenticeship program in which we participate.

Promotion Process

Our promotion process has been developed and documented and only legitimate qualifications are considered in our promotion decisions. We conduct adverse impact analyses to ensure that women, minorities, and employees with disabilities are promoted at rates substantially similar to those of men, nonminorities, and employees without disabilities.

Termination Process

We use progressive discipline before terminating employees, where appropriate. All employees are made aware of our discipline process. We conduct adverse impact analyses to ensure that women, minorities, and employees with disabilities do not leave our company at rates substantially dissimilar to those of men, nonminorities, and employees without disabilities.

Religion and National Origin Discrimination and Accommodation for Religious Observance and Practice

As a part of our commitment to Equal Employment Opportunity for all, we have made a specific effort to ensure that national origin and religion are not factors in recruitment, selection, promotion, transfer, termination, or participation in training. The following activities are undertaken to ensure religion and national origin are not used as a basis for employment decisions:

1. Recruitment resources are informed of our commitment to provide equal employment opportunity without regard to national origin or religion.
2. Our employees are informed of our policy and their duty to provide equal opportunity without regard to national origin or religion.
3. Employment practices exist and are reviewed to ensure that we implement equal employment opportunity without regard to national origin or religion.
4. The religious observances and practices of our employees are accommodated, except where the requested accommodation would cause undue hardship on the conduct of our business.
5. We do not discriminate against any qualified applicant or employee because of race, color, creed, disability, age, sex, sexual orientation, marital status, or status with regard to public assistance in implementing the policy concerning non-discrimination

based on national origin or religion.

Sex Discrimination Guidelines

We incorporate the following commitments into this AAP to ensure that all laws related to the prohibition of discrimination based on sex are followed:

1. Employment opportunities and conditions of employment are not related to the sex of any applicant or employee. Salaries are not related to or based upon sex.
2. Women are encouraged to attend all training programs that can facilitate their chances for promotion, and to apply for all positions for which they are qualified.
3. We do not deny employment to women or men with young children and do not penalize, in conditions of employment, women or men who require time away from work for parental leave.
4. Appropriate physical facilities are provided to both sexes.

Prevention of Harassment and Discrimination

Our company has developed policies prohibiting the harassment of or discrimination against any employee because of any characteristic protected under civil rights laws. We distribute these policies routinely to current employees and incorporate these policies as a part of new employee orientation. Employees are aware of contact persons to report any violation of these policies.

ANTI-HARASSMENT POLICY

As a part of our commitment to equal opportunity, Power-Io, Inc. has adopted an anti-harassment policy. Any employee who engages in harassment on the basis of race, color, creed, religion, national origin, sex, sexual orientation, marital status, status with regard to public assistance, membership or activity in a local human rights commission, disability, age, or other legally protected characteristics; any employee who permits employees under his/her supervision to engage in such harassment; or any employee who retaliates or permits retaliation against an employee who reports such harassment is guilty of misconduct and shall be subject to remedial action which may include the imposition of discipline or termination of employment.

Examples of harassment may include derogatory comments regarding a person's race, color, religion, or other protected characteristics, sexually explicit or other offensive images (whether printed or displayed on a computer), and jokes that are based on stereotypes of particular races, sexual orientations, ages, religions, or other protected characteristics.

Sexual Harassment is prohibited and includes any unwelcome sexual advance, request for sexual favor and other verbal or physical conduct of a sexual nature when:

Submission to such conduct is made, either explicitly or implicitly, as a term or condition of employment;

Submission to or rejection of such conduct is used as a factor in any employment decision affecting any individual; or

Such conduct has the purpose or effect of unreasonably interfering with any

employee's work performance or creating an intimidating, hostile or offensive working environment.

Although the intent of the person engaging in the conduct may be harmless or even friendly, it is the welcomeness of the conduct by the recipient that is relevant to whether the conduct is harassment. Given the difficulty of judging whether the conduct is welcome or unwelcome in particular situations, the company prohibits all employees from engaging in any conduct of a sexual nature or amounting to harassment based on any protected category in the work setting.

This policy applies to everyone, including managers. No retaliation or intimidation directed towards anyone who makes a complaint will be tolerated.

If you believe you have been a victim of harassment, take the following steps:

Discuss the matter with your supervisor or manager.

If, for any reason, you would prefer not to speak to your supervisor (for example, if you believe your supervisor to be the source of or a party to the harassment), you may talk to any other member of management or the EEO Coordinator.

The company will investigate and attempt to resolve your complaint promptly. If, for any reason, you believe this has not occurred within a reasonable period of time, refer the problem to any other manager in the company, up to and including the CEO of Power-Io, Inc.

PROBLEM RESOLUTION POLICY

In any organization, dissatisfaction may arise because an employee does not know, understand, or agree with certain policy interpretations or management decisions. Such dissatisfactions are commonly referred to as grievances. At Power-Io, Inc., we believe that if any employee has a grievance concerning his/her wages, hours of work, or other terms or conditions of employment, the matter should receive consideration of all concerned.

An employee who feels aggrieved is urged to take the matter up immediately with his/her supervisor. Your supervisor is required to investigate your grievance and provide you a response or decision within a reasonable period of time. This investigation may consist of, but is not limited to, gathering information from other employees involved, reviewing company policy, and any other action necessary to become familiar with the situation.

If you are not satisfied with the response/decision from your immediate supervisor, you are encouraged to go to the next level of supervision, both orally and in writing. This next level of supervision will also have a reasonable period of time in which to investigate the issue and respond to you in writing.

If, after these steps are taken, you believe inadequate action has been taken to resolve your complaint, contact John Walsh. It is the policy of this organization to respond to any reasonable complaint and take the necessary actions to settle the issue.

There will be no adverse action taken against a complaining employee as a result of making the complaint, regardless of the outcome of the investigation.

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Solid state relays
0.01 - 75 amp capability

"D" din rail solid state relays
0.1 - 100 amp capability

Solid state relays, solid state contactors, IGBT based solid-state relay switching and other automation I/O products

With over 75 years of control experience, Power-io provides advanced products for power control applications, using customized mosfets or solid state relay technology:

- Solid state relays, SCR, mosfet, or alternistor designs using customized scr dies and thermal transfer technology
- Custom engineered Maximum Surge Survival™ technology for 3 layers of voltage surge protection
- Advanced, fourth generation of DCB direct copper bonding technology + optimized thermal engineering + oversized SCR die selection = excellent thermal performance
- Meets the CE EN60947-4-3 international specification for industrial solid state switching products. This specification demands a higher level of testing than earlier specifications.
- International terminal designations, internationally accepted green LED for input status indication, international UL, CSA and CE marked
- Custom control engineering for sophisticated electrical switching applications
- Smallest installed size -- more amps per square inch of installation area
- Manufactured in North America and shipped throughout the world.
- The "H" family of familiar Hockey puck size products permit fast replacements when upgrading from older style solid state relays.
- The "D" Din rail family offers power switching from 0.1 to 100 amps in an integrated design including: a universal installation bracket, universal voltage range up to 660 volts, and finger safe wire terminals.
- The "I/O" family provides the smallest input or output modules for PLC, PC, or automation systems.
- 100% tested products and published test results at 40°C

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DIN rail Power i/o
0.1 - 100 amp capability

Power i/o supplies solid state relays and other automation I/O products

Power i/o provides advanced products for power control applications in industrial, commercial and military installations:

- Specializing in SSR, SCR, mosfet, IGBT, alternistor and I/O products
- Advanced Maximum Surge Survival™ technology for 3 layers of surge protection
- Power control, heater contactors, solid state motor starters, lighting contactors, robotics, PLC interface i/o, and network i/o. Industrially hardened for commercial, military FCS, aerospace, test equipment, transportation, HVAC & other applications
- Custom control engineering for sophisticated electrical power switching applications
- High speed, high reliability, rugged industrial design, no moving parts
- *Ultra precise* zero crossing for reduced EMI, without the cost of external filters
- Manufactured in the USA, Canada, and Mexico. Shipped worldwide.
- No "minimum order" requirements; credit cards and government P-Cards accepted.
- Smallest installed size = more amps per square inch.

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Power-io Site Map

Power-io Homepage

Last updated: 2008, January 4

/ 17 pages

- Solid state relays, din rail relay & Power-io ssr contactors
- Solid state relays, din rail relay & Power-io ssr contactors
- New ssr, scr, solid state relays and igbt products.
- Solid state relays and solid-state contactors from Power-io.
- Solid state relays, ssr, and i/o products
- Solid state contactors and i/o modules.
- Ssr, scr, i/o, igbt, ss relays and solid state relays can be purchased on-line at power-io.
- Ssr, scr, solid state relays and igbt products from Power-io.
- http://www.power-io.com/sitemap.htm
- Power-io RoHS information
- Legal documentation for ssr, scr, solid state relays and igbt products.
- Privacy of ssr, solid state relays and scr applications.
- Ssr, scr, solid state relays and igbt trademarks.
- Solid state relays, ssr and solid-state relay accessories.
- Powerio scr contactors, solid state relays, & ssr relays
- Power i/o solid state relays
- http://www.power-io.com/urllist.txt

legal/ 2 pages

- http://www.power-io.com/legal/poweriotandc.pdf
- http://www.power-io.com/legal/return-policy.htm

appnotes/ 6 pages

- H Bridge reversing motor mosfets
- Solid state contactor or SSR heat sink.
- Heat sink designs for solid state relays
- Solid state contactor glossary of terminology
- Dual Mosfet installation
- http://www.power-io.com/library/appnotes/alert-wiring.pdf

catalog/ 2 pages

- http://www.power-io.com/library/catalog/catalog.pdf
- http://www.power-io.com/library/catalog/catalog-a4.pdf

crossref/ 13 pages

- Solid state relays, ssr and solid-state relay parts
- Scr power controls and ssr power controllers
- Crydom solid state relays cross reference
- Solid state contactor and din rail contactors
- Sprecher and Schub solid state contactor and din rail contactors
- Oac modules, odc modules and din rail i/o modules.
- Solid state contactors
- Solid state contactors
- Solid state relays, ssr and solid-state relay parts
- Solid state relays, ssr and solid-state relay parts
- Magnecraft solid state relays from Magnecraft/Struthers-Dunn
- Gordos solid state relays, ssr and solid-state relay parts
- Continental solid state relay

databulletin/ 6 pages

- http://www.power-io.com/library/databulletin/h-family.pdf
- http://www.power-io.com/library/databulletin/h-family-75.pdf
- http://www.power-io.com/library/databulletin/hdd-family.pdf
- http://www.power-io.com/library/databulletin/fuse-data-bulletin.pdf
- http://www.power-io.com/library/databulletin/c-family-dc.pdf
- http://www.power-io.com/library/databulletin/c-family-ac.pdf

drawings/ 5 pages

- 3 phase contactors
- DC switching solid state relay
- Heatsinks, custom heat sink sizes, and heatsink din rail clips.
- AC switching solid state relay
- 4-20 analog input contactor

photos/ 8 pages

- Din rail solid state relays, ssr, scr, and solid-state relay modules.
- IO modules, i/o, and din rail i-o for IAC, OAC, IDC, and IOC.
- Solid state relays, ss relays, scr, and solid-state relay modules.
- 50, 75, 100 amp solid state contactors
- IO modules, i/o, and din rail i-o for IAC, OAC, IDC, and ODC.
- IO modules, i/o, and din rail i-o for IAC, OAC, IDC, and ODC.
- Din rail solid state relays, ssr, scr, and solid-state relay modules.
- Din rail ssr power controllers

new/ 9 pages

- Mercury contactors and mercury relay replacement
- Thermal pad or thermal grease applications.
- 4 zone controller and solid state relay
- Oac, odc, idc, and iac din rail i/o modules
- 100 amp solid state contactor
- Power-io turns network i/o into real power.
- Solid state motor starters
- 3 phase solid state relays, three phase ssr
- New ssr, scr, solid state relays and igbt products.

products/ 18 pages

- Three phase solid state contactor
- Three phase solid state contactor
- Din rail OAC and ODC i/o output modules
- Solid state relays, ssr, dc relay contactors
- C Family solid state contactor
- Heat sink, ssr heatsinks, and thermal pads
- C Family solid state contactor
- Solid state relays, ssr, and scr relay i/o
- 50, 75, 100 amp solid state contactor
- Din rail IAC and IDC input i/o modules
- I2T fuses, semiconductor fuses and i2t fuse holders
- 25 amp single phase solid state contactor
- 4-20 mA input solid state contactor
- Manual station, variac, or potentiometer input control
- Manual station, variac, or potentiometer input control
- Din-rail i/o module schmatics
- DC switching solid state relay
- Heat sink, ssr heatsinks, and thermal pads

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July, 2009

This Power-io document is an update to the RoHS document that was previously posted at Power-io.com. New sections have been added at the bottom, along with the date of the new supporting documentation.

This information is applicable to part numbers: HAA-xxxx, HDA-xxxx, HDD-xxxx, DAA-xxxx, DDA-xxxx, IO-Oxx-xxx, and CZ2H-xxxx. Contact Power-io if you have questions about a particular part number.

Environmental Responsibility in Relation to the WEEE and RoHS Directives

Power-io is committed to complying with and, where appropriate, exceeding all Regulatory and Corporate requirements for the Protection of the Environment and the Communities in which we operate. Proactive areas include:

- Identify, monitor and minimize the impact on the environment associated with the manufacture and use of our products.
- Design products that minimize the use of resources and can easily be reused, recycles or disposed of in a safe manner.
- Openly communicate our environmental policy and performance with our suppliers and customers.

EU Directive 2002/95/EC Restriction of Hazardous Substances (RoHS)

Power-io manufactures equipment falling into category 9 (as defined by Annex 1B of EU Directive 2002/96/EC) and we are currently outside the scope of this Directive. We are, however, taking a proactive approach to this legislation by identifying and minimizing the use of any substances covered by the RoHS Directive prior to any legal requirement.

EU Directive 2002/96/EC Waste of Electrical and Electronic Equipment (WEEE)

Power-io is currently evaluating the proposed National Laws and we are reviewing the various methods for compliance. A working Group has been set up to advise on changes to design procedures to make our products more readily reused, recycled or disposed of in a safe and economical manner.

Commission Decision of 21 October, 2005

The Annex to Directive 2002/95/EC is amended to include the use of lead in high melting temperature solders. The use of lead is permitted in these applications. Power-io uses a small quantity of these high temperature solders in some of the products. See: http://www.dti.gov.uk/sustainability/weee/RoHS_Exemptions_October2005.pdf. Even though Power-io is outside the scope of the RoHS directive and is not subject to RoHS, efforts will continue to minimize any substances covered by the RoHS Directive. (As of 2006, the link shown above is no longer active at the DTI web site.)

DTI RoHS Regulations, Government Guidance Notes. June, 2006

The following document summarizes the guidance as on June, 2006: http://www.dti.gov.uk/files/file31606.pdf. In the Annex for exemptions, page 18, Section 7, paragraph 2, the following statement is shown: "The high melting temperature type solder exemption has been introduced to allow the use of lead in solders for specific applications (such as in power semiconductor package manufacturing), for which viable lead-free alternatives have not yet been identified." Please review the entire 27 page document for more information about this topic.

Applications Exemption

In addition to hardware exemption status, there are specific application exemptions. These include: large scale industrial tool applications, national security applications, military applications, and other applications. The DTI document provides a flow chart to assist with these topics. Visit: http://www.dti.gov.uk/files/file31606.pdf

DTI RoHS Regulations, Government Guidance Notes. Jan, 2007

The following document summarizes the guidance as on January, 2007: http://www.dti.gov.uk/files/file37219.pdf. In the Annex for exemptions, page 18, Section 7, paragraph 2, the following statement is shown: "The high melting temperature type solder exemption has been introduced to allow the use of lead in solders for specific applications (such as in power semiconductor package manufacturing), for which viable lead-free alternatives have not yet been identified." Please review the entire 27 page document for more information about this topic.

BERR RoHS Regulations, Government Guidance Notes. Oct, 2008

The following document summarizes the guidance as of July, 2008: BERR Dept for Business Enterprise & Regulatory Reform -- RoHS Regulations: Government Guidance Notes. In the Annex for exemptions, page 19, Section 7, paragraph 2, the following statement is shown: "The high melting temperature type solder exemption has been introduced to allow the use of lead in solders for specific applications (such as in power semiconductor package manufacturing), for which viable lead-free alternatives have not yet been identified." Please review the entire 32 page document for more information about this topic.

Europa, EUR-Lex search engine. July, 2009

The following link connects you to the latest directive updates:

- http://eur-lex.europa.eu/RECH_naturel.do
- Click: All legislation

- Enter year: 2002
- Enter number: 95

BERR | Department for Business Enterprise & Regulatory Reform

ROHS REGULATIONS

Government Guidance Notes

JULY 2008

URN 08/1061

Government Guidance Notes

SI 2008 No. 37

This Guide is intended to assist those placing electrical and electronic equipment on the UK market to understand the application of The Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment Regulations 2006 (referred to hereafter as "The RoHS Regulations"). It aims to explain the Regulations as interpreted by the Department for Business, Enterprise & Regulatory Reform (BERR).

The Regulations themselves should always be read and understood, as they constitute the law. This Guide is informative, but has no legal authority.

You should refer to the Regulations themselves for a full statement of the legal requirements and in the case of any doubt take independent advice, including your own legal advice. The Regulations may be revised from time to time, so users should take care to keep themselves informed. In this regard, information may be obtained from BERR's Sustainable Development & Regulation Directorate. Details of contacts for further information are given on page 13.

Contents

RoHS - the law in brief

1. The Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment Regulations 2008[1] ("the RoHS Regulations") implemented the provisions of the European Parliament and Council Directive on the Restrictions of the use of certain Hazardous Substances in electrical and electronic equipment[2] ("the RoHS Directive"), as amended.

2. The RoHS Regulations have banned the putting on the UK market of new Electrical and Electronic Equipment (EEE) containing more than the permitted levels of lead, cadmium, mercury, hexavalent chromium and both polybrominated biphenyl (PBB) and polybrominated diphenyl ether (PBDE) flame retardants since 1 July 2006. There are a number of exempted applications for these substances.

3. Since 1 July 2006, manufacturers have needed to ensure that their products - and the components and subassemblies of such products - comply with the requirements of the Regulations by the relevant date in order to be put on the Single Market. The Regulations have also had an impact on those who import EEE into the European Union on a professional basis, those who export to other Member States and those who rebrand other manufacturers' EEE as their own.

4. These Regulations do not affect the application of existing legal requirements for EEE, including those regarding safety, the protection of health, existing transport requirements or provisions on hazardous waste. In other words, existing legislation on EEE and hazardous substances must also be complied with.

Entry into force

5. The Regulations came into force on **1 February 2008**, but replace similar Regulations[3] that came into force on 1 July 2006.

Requirements

6. The main requirement of the RoHS Regulations is that from 1 July 2006 a producer (as defined in the Regulations) may not put new EEE containing lead, mercury, cadmium, hexavalent chromium, polybrominated biphenyls (PBB) and polybrominated diphenyl ethers (PBDE), in amounts exceeding the established maximum concentration values, on the market. Certain applications (listed in Annex C and referred to in Regulation 5) are exempt and there is also an exemption for spare parts for the repair of equipment that had been put on the market before 1 July 2006. The Regulations also do not apply to the re-use of equipment that was put on the market before the same date.

7. Producers must be able to demonstrate compliance by submitting technical documentation or other information to the enforcement authority on request and must retain such documentation for a period of four years after the EEE is placed on the market.

Enforcement

8. Responsibility for the enforcement of the RoHS Regulations lies with the Secretary of State for Business, Enterprise & Regulatory Reform, who has appointed

[1] SI 2008 No. 37.
[2] Directive 2002/95/EC of 27 January 2003, (OJ No. L37, 13.2.2003, p. 19).
[3] The RoHS Regulations 2006, (SI 2006 No. 1463).

the National Weights and Measures Laboratory (NWML), an executive agency of the Department for Innovation, Universities and Skills (DIUS), to act on his behalf.

RoHS Regulations

Scope

9. The RoHS Regulations apply to all EEE containing hazardous substances put on the market in the UK on or after 1 July 2006, which falls into any of the eight broad categories listed in Annex A. Annex A also includes indicative (but not exhaustive) examples of products under each of the categories. The Regulations specify a voltage range within which the products in the eight categories must fall in order to come within the scope. This is up to and including 1,000 volts AC or up to and including 1,500 volts DC.

10. The eight broad categories mentioned above reflect eight of the ten categories in Annex 1 of the Waste Electrical and Electronic Equipment (WEEE) Directive.[4] In addition, the RoHS Regulations apply both to electric light bulbs and to household luminaires.

11. The two categories of the WEEE Directive **not** included within the scope of the RoHS Regulations are Medical Devices and Monitoring & Control Instruments. Please note, however, that Article 6 of the RoHS Directive places an obligation on the European Commission to present proposals for including EEE falling within those two categories within the scope of the RoHS Directive, once scientific and technical evidence has demonstrated that such proposals are feasible. In this respect, the Commission asked independent consultants to undertake a study to review the current position. The results of that study were published by the Commission in July 2006 and are likely to lead to the presentation of proposals for negotiation by Member States towards the end of 2008.

Assessing products to see if they are included in the scope

12. For many products, the decision on whether they are included within the scope of these Regulations should be reasonably straightforward. However there are a number of products (particularly in specialised or industrial sectors), where there may be significant areas of doubt and uncertainty.

13. An example of a 'decision tree' that could be used by producers to help determine whether their products might come within the scope of the RoHS Regulations can be found at Annex B, but it may be necessary to seek independent advice to come to a final decision.

General guidance on the types of products that may be outside the scope of the Regulations

14. Given that the scope of the RoHS Directive is drawn from that of the WEEE Directive it is BERR's view that certain provisions in the WEEE Directive may apply to EEE within the RoHS Directive so as to limit its scope. There is, however, no express provision in the RoHS Directive to this effect.

15. The guidance that follows uses some of the criteria for assessing "grey area" products (those whose inclusion within the scope of the RoHS Directive is in doubt) that have been discussed in the Technical Adaptation Committee (TAC) of Member States and reflects the Commission's non-legally binding Frequently Asked

[4] Directive 2002/96/EC of 27 January 2003, (OJ No. L37, 13.2.2003, p. 24).

Questions document on the WEEE and RoHS Directives[5]. It should be noted that this guidance represents BERR's view and, as with all EC Directives, a definitive view may only be obtained through the courts. Producers must rely on their own legal advice on all questions of scope.

i. *EEE intended to protect national security and/or for military purposes*

On the basis that there is an express exemption from the categories of Annex 1A of the WEEE Directive in relation to EEE intended specifically to protect national security and/or for military purposes, it is the view of BERR and the Commission that equipment connected with the protection of the essential security interests of Member States and to arms, munitions and war material may, accordingly, be considered to be exempt from the provisions of the RoHS Directive. It should be noted, however, that this exemption would not apply to any equipment that is used to protect national security and/or has a military purpose, but is not designed exclusively for these purposes.

ii. *Products where electricity is not the main power source*

Many products contain electrical and electronic components, either for additional functionality or as peripheral parts. A simple example could be a combustion engine with an electronic ignition. The definition of EEE in the Regulations extends only to those products that are dependent on electric currents or electromagnetic fields to work properly, meaning that it is the primary power source. When the electric current is switched off, the product cannot fulfil its main function. If electricity is used only for control or support functions, the product could be considered to be outside the scope of these Regulations. In the above example the combustion engine would be considered to be outside that scope.

iii. *Products where the electrical or electronic components are not needed to fulfil the primary function*

This is related to, but not always the same as the above situation. Some products, particularly toys and novelty items contain an electrical or electronic element that gives added value to the product. Often there are similar products on the market fulfilling the same function, but without these components. Examples might include musical greetings cards or soft toys with electronic components, which still fulfil their primary function without their electronic components and could be considered to be outside the scope of these Regulations.

iv. *Electrical and electronic equipment that is part of another type of equipment*

The WEEE Directive excludes EEE that is part of another type of equipment that does not fall within the scope of the Directive. On the basis that EEE under RoHS is defined in identical terms, it is the view of BERR and the Commission's Legal Services that such an exclusion extends to EEE under the RoHS Directive and, consequently, to the RoHS Regulations. Examples of such equipment would be lighting or entertainment equipment for use in vehicles, trains or aircraft. This type of equipment would be excluded as it is designed to be part of a product that falls outside the scope of the Directive.

[5] European Commission's *Frequently Asked Questions on the RoHS and WEEE Directives* published May 2005 and mostly recently revised August 2006. This can be downloaded from http://ec.europa.eu/environment/waste/weee/index_en.htm

Equipment that is part of another type of equipment or system is considered to be outside the scope of the Directive where it does not have a direct function outside the other item of equipment or system and that other item of equipment or system is itself outside the scope of the Directive.

Equipment may also be part of a fixed installation. A "fixed installation" may be a combination of several pieces of equipment, systems, products and/or components (or parts) assembled and/or erected by a professional assembler or installer at a given place to operate together in an expected environment and to perform a specific task, but not intended to be placed on the market as a single functional or commercial unit.

In such a case, the elements of a system that are not discernible EEE products in their own right or that do not have a direct function away from the installation are excluded from the scope of the Regulations.

v. *Batteries*

The RoHS Directive restricts the use of the named hazardous substances in new electrical and electronic equipment, but in the view of the European Commission does not apply to batteries. This includes batteries that are permanently fixed into the product, as well as disposable batteries. Under the treatment requirements of the WEEE Regulations, batteries must be removed from any separately collected waste electrical and electronic equipment. A new European Commission Directive (adopted in September 2006) will introduce further requirements on battery manufacturers. The Batteries & Accumulators and Waste Batteries & Accumulators Directive[6] will restrict the use of certain materials in most types of batteries put on the market and will include provisions requiring their easy removal from equipment. The Directive will also introduce treatment and recycling obligations, alongside collection targets. Member States are required to transpose the text of the Directive into national legislation by 26 September 2008.

Exemptions

16. The RoHS Regulations do not apply: -

- To large-scale stationary industrial tools. (This is a machine or system, consisting of a combination of equipment, systems, products and/or components installed by professionals, each of which is designed, manufactured and intended to be used only in fixed industrial applications.)

- To spare parts for the repair of EEE that was placed on the market before 1 July 2006. It should be noted that, following discussions in the TAC, the European Commission and Member States have agreed that this exemption extends to parts that expand the capacity of and/or upgrade EEE placed on the market before that date provided the EEE concerned is not put on the market as a new product.

- To the reuse of EEE that was placed on the EU market before 1 July 2006.

- To the specific applications of lead, mercury, cadmium, hexavalent chromium and PBDE set out in the Annex to the RoHS Directive, as amended by seven

[6] Directive 2006/66/EC of 6 September 2006, (OJ No. L266, 26.9.2006, p.1).

Commission Decisions[7]. These specific applications are explained in more detail in Annex C of these Guidance Notes.

Possible future exemptions

17. Since the RoHS Directive was published in February 2003, the European Commission has received many requests from industry for exemptions of additional specific applications of the hazardous substances. These requests extend the list in the original Annex to the Directive, once they have been agreed and adopted as Commission Decisions.

18. The Commission has already reviewed many of the requests and, as a consequence, has published the seven separate Commission Decisions that are listed in the footnote to paragraph 16 above. The Commission continues to receive and review even more requests for exemptions and it is likely that some of these will be included within proposals for new Commission Decisions later in 2008.

19. These current Regulations incorporate both those exemptions which have already been adopted and any further exemptions which may be agreed[8] while they remain in force, as the Department has taken advantage of new provisions so as to refer to the exempt applications listed in the RoHS Directive Annex "as amended from time to time". While this has removed the need for further amendments to the UK Regulations each and every time new exemptions are agreed, Annex C of these Guidance Notes will be amended and reissued whenever a new exemption is agreed

Definitions

20. The definitions of "**electrical and electronic equipment**" and "**hazardous substances**" can be found within the RoHS Regulations.

21. The definition of "**producer**" can also be found within the RoHS Regulations, but it should be noted that whoever exclusively provides financing under or pursuant to any finance agreement shall not be deemed to be a producer unless he also acts as a producer within the meaning of sub points (i) to (iii) of that definition.

22. "**Put on the market**" is not defined in the Regulations or in the Directive, but it is being interpreted in the same way as the term 'placing on the market', which is defined in the European Commission's *"Guide to the implementation of directives based on the New Approach and the Global Approach"* [9] (commonly referred to as the "Blue Book"). This says that 'placing on the market' is the initial action of making a product available for the first time on the Community market, with a view to distribution or use in the Community.

23. A product is placed on the Community market when it is made available for the first time. This is considered to take place when a product is transferred from the

[7] Commission Decisions 2005/717/EC of 13 October 2005, (OJ No. L271, 15.10.2005, p.48); 2005/747/EC of 21 October 2005, (OJ No. L280, 25.10.2005, p.18); 2006/310/EC of 21 April 2006, (OJ No. L115, 28.4.2006, p.38); 2006/690/EC, 2006/691/EC & 2006/692/EC (OJ No. L283, 14.10.2006, pages 47, 48 and 50) and 2008/385/EC (OJ No. L136, 24.5.2008, p. 9). The exemption formally given by point 2 of Commission Decision 2005/717/EC for "DecaBDE in polymeric applications" was annulled by a judgment of the European Court of Justice with effect from 30 June 2008, (for further detail see OJ No. C116, 9.5.2008, p. 2).

[8] Adopted and published as Commission Decisions in the EC Official Journal.

[9] The *Guide to the implementation of directives based on the New Approach and the Global Approach* can be downloaded from http://ec.europa.eu/enterprise/newapproach/legislation/guide/index.htm

stage of manufacture with the intention of distribution or use on the Community market. Thus, imports for own use are also considered as being placed on the market at the moment they enter the Community. Moreover, the concept of placing on the market refers to each individual product, not to a type of product, and whether it was manufactured as an individual unit or in a series.

24. The transfer of the product takes place either from the manufacturer, or the manufacturer's authorised representative in the Community, to the importer established in the Community or to the person responsible for distributing the product on the Community market. The distribution chain can also be the commercial chain of the manufacturer or the authorised representative. The transfer may also take place directly from the manufacturer, or authorized representative in the Community, to the final consumer or user.

25. The product is considered to be transferred either when the physical hand-over or the transfer of ownership has taken place. This transfer can be for payment or free of charge, and it can be based on any type of legal instrument. Thus, a transfer of a product is considered to have taken place, for instance, in the circumstances of sale, loan, hire, leasing and gift.

Maximum Concentration Values

26. For the purposes of the RoHS Regulations, a maximum concentration value of up to 0.1% by weight in homogeneous materials for lead, mercury, hexavalent chromium, PBB and PBDE and of up to 0.01% by weight in homogenous materials for cadmium will be permitted in the manufacture of new EEE. These values were established through the adoption of a Commission Decision on 18 August 2005.[10]

27. "**Homogeneous material**" means a material that cannot be mechanically disjointed into different materials.

28. The term "**homogeneous**" is understood as "of uniform composition throughout", so examples of "homogeneous materials" would be individual types of plastics, ceramics, glass, metals, alloys, paper, board, resins and coatings.

29. The term "**mechanically disjointed**" means that the materials can, in principle, be separated by mechanical actions such as unscrewing, cutting, crushing, grinding and abrasive processes.

30. Using these interpretations, a plastic cover (for example) would be a 'homogeneous material' if it consisted exclusively of one type of plastic that was not coated with or had attached to it (or inside it) any other kinds of materials. In this case, the maximum concentration values of the RoHS Regulations would apply to the plastic.

31. On the other hand, an electric cable that consisted of metal wires surrounded by non-metallic insulation materials would be an example of something that is not 'homogeneous material' because mechanical processes could separate the different materials. In this case the maximum concentration values of the RoHS Regulations would apply to each of the separated materials individually.

32. A semi-conductor package (as a final example) would contain many homogeneous materials, which include the plastic moulding material, the tin-

[10] Commission Decision 2005/618/EC of 18 August 2005, (OJ No. L214, 19.08.2005, p.65).

electroplating coatings on the lead frame, the lead frame alloy and the gold-bonding wires.

Compliance

33. Producers must demonstrate compliance with the Regulations by providing the enforcement authority (on request) with satisfactory evidence of such compliance in the form of relevant technical documentation or information. The UK has adopted self-declaration as the basis of the compliance regime. The enforcement authority is undertaking market surveillance activities to detect non-compliant products and is also conducting tests for this purpose.

34. There is no prescribed method to demonstrate compliance or marking requirements. There are also no registration obligations, but producers may wish to consider the role that both materials declarations and component or material analysis could play.

Materials declarations

35. Producers of EEE could obtain an assurance from their suppliers that any materials, components, assemblies or equipment provided do not contain more than the permitted level of any of the six restricted substances, except where the application of any of those substances comes within the scope of the RoHS Regulations' exempted applications. Producers are required to keep appropriate records for a period of up to four years after the particular EEE product was put on the market.

36. A variety of materials declarations for suppliers are being developed by industry at the moment. Some finished or end product manufacturers have already started to publish such data on their websites.

Producer analysis

37. Producers of EEE to be placed on the UK market may wish to undertake (or ask a third party to undertake) their own analysis of the components or materials that they use in their products. This action may be undertaken either to verify supplier declarations or to establish the presence or otherwise of the restricted substances in those cases where no declaration is available. It may also be undertaken if there are doubts over the reliability of declarations.

38. Producers or third parties may employ any suitable analytical technique in order to establish that their products comply with the maximum concentration values of the six restricted substances. The criteria for analysis will depend on the quantity of product put onto the market (less for small producers than for large producers), the relationship with suppliers, the risk of a banned substance being present, and the potential impact of that substance on the environment. Producers must ensure that they understand and take into account any limitations of the analytical technique they use.

39. At Annex D, you will find an example of a flow chart that has been designed to clarify the compliance process and could help producers determine when analysis of components might be advisable.

Enforcement

40. It is the duty of the National Weights and Measures Laboratory, acting on behalf of the Secretary of State for Business, Enterprise & Regulatory Reform, to enforce these Regulations.

41. Various powers of enforcement are available, including: -

- Making test purchases.
- Requiring the production of compliance documentation and other information which may provide evidence as to whether or not the Regulations have been complied with in a particular case or class of cases.
- Inspecting processes and performing analytical tests.
- Issuing a compliance notice requiring certain action to be taken.
- Issuing an enforcement notice requiring non-compliant goods to be withdrawn from the market or prohibiting or restricting the placing of non-compliant goods on the market.

Offences and Penalties

42. The RoHS Regulations introduced the following offences:

i. Contravening or failing to comply with the prohibition on hazardous substances in the RoHS Regulations, or with an enforcement notice, could result in those held responsible facing a fine up to the statutory maximum (currently £5,000) on summary conviction or an unlimited fine on conviction on indictment.

ii. Those failing to submit compliance documentation at the request of the enforcement authority may be liable on summary conviction to a fine up to level five on the standard scale (currently £5,000).

iii. Procedural offences (obstruction of an enforcement officer, providing false or misleading information to the enforcement authority) are also punishable on summary conviction by a fine up to level five on the standard scale.

43. As an alternative, or in addition, to any of the above penalties, the court may, in certain circumstances, make an order requiring a person convicted of the offences referred to in paragraph 42 (i) and (ii) above to remedy the matters which have given rise to the commission of the offence. In addition, the court may order a person convicted of the offences referred to in paragraph 42 (i) above to reimburse the enforcement authority's costs of investigating the offence.

44. The defence of 'due diligence' is available where a person can show he took all reasonable steps and exercised all due diligence to avoid committing an offence. This may include reference to an act or default of, or reliance on information given by, a third party, in which case it must be accompanied by such information identifying the third party, as is information in the possession of the defendant.

45. The Regulations also provide for the 'liability of persons other than the principle offender', including a provision that where a company or other body corporate commits an offence, those concerned in its management and responsible

(consciously or by negligence) for the commission of the offence, may also be prosecuted as individuals.

Contact points for further information

Department for Business, Enterprise & Regulatory Reform
Eco-design and Product Regulation Unit
Sustainable Development & Regulation Directorate
1 Victoria Street
London SW1H 0ET

Tel: +44 (0) 20 7215 5000

Email: **sustainability@berr.gsi.gov.uk**

Website: **www.berr.gov.uk/sectors/sustainability**

The National Weights & Measures Laboratory's RoHS Enforcement Team
– a Government service working with electrical and electronic equipment manufacturers to deliver compliance with the RoHS Directive in the UK

RoHS Enforcement Team
NWML
Stanton Avenue
Teddington
TW11 0JZ

Tel: +44 (0) 20 8943 7227

Email: **rohs@nwml.gov.uk**

Website: **www.rohs.gov.uk**

Envirowise Telephone Helpline

0800 585 794 (UK calls only)

Website: **www.envirowise.gov.uk**

This Helpline is a telephone enquiry service, funded by the Government, providing a comprehensive information and signposting service for firms seeking advice on a wide range of environmental issues that may affect their business.

Annex A

Categories of electrical and electronic equipment covered by the RoHS Regulations

1. **Large household appliances**

   (Such as large cooling appliances; refrigerators; freezers; other large appliances used for refrigeration, conservation and storage of food; washing machines; clothes dryers; dish washing machines; cooking; electric stoves; electric hot plates; microwaves; other large appliances used for cooking and other processing of food; electric heating appliances; electric radiators; other large appliances for heating rooms, beds, seating furniture; electric fans; air conditioner appliances; other fanning, exhaust ventilation and conditioning equipment)

2. **Small household appliances**

   (Such as vacuum cleaners; carpet sweepers; other appliances for cleaning; appliances used for sewing, knitting, weaving and other processing for textiles; irons and other appliances for ironing, mangling and other care of clothing; toasters; fryers; grinders, coffee machines and equipment for opening or sealing of containers or packages; electric knives; appliances for hair-cutting, hair drying, tooth brushing, shaving, massage and other body care appliances; clocks, watches and equipment for the purpose of measuring, indicating or registering time; scales)

3. **IT and telecommunications equipment**

   (Such as centralised data processing; mainframes; minicomputers; printer units; personal computing; personal computers, including the CPU, mouse and keyboard; laptop computers, including the CPU, mouse and keyboard; notebook computers; notepad computers; printers; copying equipment; electrical and electronic typewriters; pocket and desk calculators; other products and equipment for the collection, storage, processing, presentation or communication of information by electronic means; user terminals and systems; facsimile; telex; telephones; pay telephones; cordless telephones; cellular telephones; answering systems; other products or equipment of transmitting sound, images or other information by telecommunications)

4. **Consumer equipment**

   (Such as radio sets; television sets; video cameras; video recorders; hi-fi recorders; audio amplifiers; musical instruments; other products or equipment for the purpose of recording or reproducing sound or images, including signals or other technologies for the distribution of sound and image than by telecommunications)

5. **Lighting equipment, (including electric light bulbs and household luminaires)**

   (Such as luminaires for fluorescent lamps; straight fluorescent lamps; compact fluorescent lamps; high intensity discharge lamps, including pressure sodium lamps and metal halide lamps; low pressure sodium lamps; other lighting equipment for the purpose of spreading or controlling light)

6. **Electrical and electronic tools (with the exception of large-scale stationary industrial tools)**

   (Such as drills; saws; sewing machines; equipment for turning, milling, sanding, grinding, sawing; cutting; shearing; drilling; making holes; punching; folding; bending or similar processing of wood, metal and other materials; tools for riveting, nailing or screwing or removing rivets, nails, screws or similar uses; tools for welding, soldering or similar use; equipment for spraying, spreading, dispersing or other treatment of liquid or gaseous substances by other means; tools for mowing or other gardening activities)

7. **Toys, leisure and sports equipment**

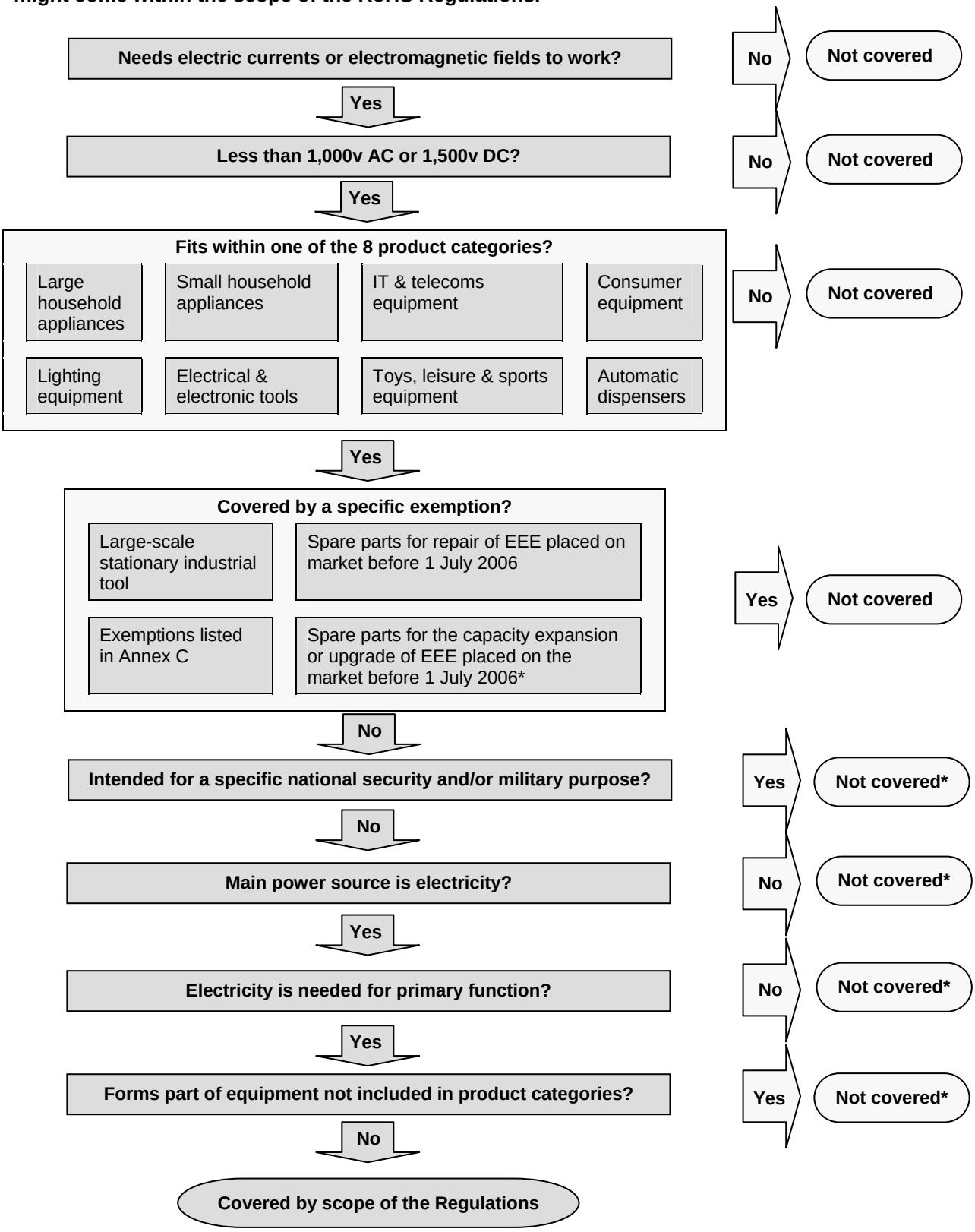
   (Such as electric trains or car racing sets; hand-held video game consoles; video games; computers for biking, diving, running, rowing, etc.; sports equipment with electric or electronic components; coin slot machines)

8. **Automatic dispensers**

   (Such as automatic dispensers for hot drinks; automatic dispensers for hot or cold bottles or cans; automatic dispensers for solid products; automatic dispensers for money; all appliances which deliver automatically all kind of products)

Annex B

A 'decision tree' that could be used by producers to decide whether or not a product might come within the scope of the RoHS Regulations.



*While these exclusions are not expressly provided for in the Directive, it is the BERR view that they apply. It should be noted, however, that a definitive legal interpretation is only available from the court. Producers should rely on independent legal advice on compliance.

Annex C

Guidance on the specific applications of lead, mercury, cadmium, hexavalent chromium and PBDE that are exempt from the requirements of the RoHS Regulations: -

1. **Mercury in compact fluorescent lamps not exceeding 5 mg per lamp.**

   A compact fluorescent lamp (CFL) is usually defined as a single-ended fluorescent lamp with a bent discharge tube of small diameter, of around 10-16 mm, to form a very compact unit. These lamps can be either integral, whereby the lamp and ballast are combined (also known as self-ballasted or self-supporting), or pin-based.

   For the purpose of this exemption, CFLs can contain no more than 5 mg of mercury per lamp.

2. **Mercury in straight fluorescent lamps for general purposes not exceeding:**
   - **10 mg in halophosphate lamps**
   - **5 mg in triphosphate lamps with a normal lifetime**
   - **8 mg in triphosphate lamps with a long lifetime.**

   A straight, or linear, fluorescent lamp is a fluorescent lamp of straight tubular form and bi-pin electrical connections at either end.

   The colour properties of straight fluorescent lamps are determined by the phosphors used to coat the inside of the tube. Halophospate and triphospate are examples of such fluorescent materials.

   Straight fluorescent lamps for general purpose can be defined as lamps used for general lighting solutions, in contrast to lamps used for special purposes (see item 3 below).

3. **Mercury in straight fluorescent lamps for special purposes.**

   Examples of such lamps are LCD back light lamps, disinfection lamps, medical/therapy lamps, pet care lamps (e.g. aquaria lamps), lamps with special components (e.g. integrated reflectors or external protection sleeves), lamps with special ignition features (e.g. designed for low temperatures), long length lamps (length > 1800mm) and amalgam lamps.

   In this context, there is no restriction on the quantity of mercury in these lamps.

4. **Mercury in other lamps not specifically mentioned in this Annex.**

   Examples of other lamps containing mercury are high intensity discharge (HID) lamps (e.g. sodium lamps and metal halide lamps), circular fluorescent lamps and U-shaped fluorescent lamps.
   In this context, there is no restriction on the quantity of mercury in these lamps.

5. **Lead in glass of cathode ray tubes, electronic components and fluorescent tubes.**

   Lead, or more specifically lead oxide, is often used in glass for electrical and electronic equipment to obtain specific characteristics, such as radiation protection (CRTs, medical applications), filtering (photography, image processing) and strengthening purposes (e.g. production of fluorescent tubes). This exemption has been introduced because viable alternatives for these applications have not yet been identified.

   For clarity, the exemption applies to lead as a constituent in the glass used in cathode ray tubes, lead as a constituent in the glass used in electronic components and lead as a constituent in the glass used in fluorescent tubes.

6. **Lead as an alloying element in steel containing up to 0.35% lead by weight, aluminium containing up to 0.4% lead by weight and as a copper alloy containing up to 4% lead by weight.**

   Lead is often used as an alloying element to obtain specific properties of a metal alloy. This exemption applies to the use of lead in steel up to 0.35% by weight, in aluminium up to 0.4% by weight and in copper alloys up to 4% by weight. In the context of this exemption, 'percentage by weight' has to be interpreted as 'the percentage of lead per homogeneous material per discreet part'. For example, if the steel housing of a computer consists of two separate parts, each part can contain up to 0.35% lead by weight of that part.

7. **Lead in high melting temperature type solders (i.e. lead based alloys containing 85% by weight or more lead).**

   For the purposes of applications 7, 8 and 9 in this Annex, it is useful to clarify the term 'solder'. In these Guidance Notes, 'solder' is defined as "alloys used to create metallurgical bonds between two or more metal surfaces to achieve an electrical and/or physical connection". In this context, the term 'solder' also includes all materials that become part of the final solder joint, including solder finishes on components or printed circuit boards.

   The high melting temperature type solder exemption has been introduced to allow the use of lead in solders for specific applications (such as in power semiconductor package manufacturing), for which viable lead-free alternatives have not yet been identified. This exemption is permitted as there are no alternative alloys with similar melting point and which are ductile. The high electrical conductivity and unique mechanical properties of such a high melting point tin-lead alloy make the material malleable and better able to withstand both temperature and physical stress. Such properties ensure fewer defects during manufacturing and high reliability throughout the life of the component, thereby also resulting in fewer components going into the waste stream.

8. **Lead in solders for servers, storage and storage array systems, network infrastructure equipment for switching, signalling, transmission as well as network management for telecommunication.**

   See definition of 'solder' given for application 7 above.

This exemption has been introduced to allow the use of lead in solders for professional, high reliability applications, such as servers and network infrastructure equipment, for which viable lead-free alternatives have not yet been identified.

In this context, a '**server**' is seen as a computer that meets one of the technology criteria that are set out in section (a) below, and the functional criteria set out in section (b) below.

(a) Technology criteria for a server

1) Designed and placed on the market as a Class A product as per EN55022:1994 under the EMC Directive 89/336/EEC (intended primarily for use in the professional environment) and designed and capable of having a single or dual processor capability (one or more sockets on board); or
2) Designed and placed on the market as a Class B product (intended primarily for use in the domestic environment) as per EN55022:1994 under the EMC Directive 89/336/EEC and designed and capable of having at least dual processor capability (two sockets on board).

(b) Functional design criteria for a server

1) Designed and capable of operating in a mission-critical, high-reliability, high-availability application in which use may be 24 hours per day and 7 days per week, and unscheduled downtime is extremely low (minutes per year).

   Examples of typical server functions are the provision of network infrastructure, gateway or switching services, the hosting and management of data on behalf of multiple users, or the running of server-capable operating systems (e.g. as for a web server).

It is BERR's view that this exemption is viewed as applying to lead in the solder of the whole of the computer and its components including processors, memory boards, power converters, power supplies, enclosed housings, modular power subsystems and adapter cards. It would also seem to apply to the lead in the solder of the components that are integrated into the whole computer or that are sold separately for use in an exempt server. The lead in the solder of cable assemblies, and all connectors and connector assemblies used to provide interconnections for the server, would also be covered by this exemption.

It should be noted that this exemption is not viewed as applying to parts or components that are peripheral to the server, nor does it apply to parts or components when they are used other than in an exempt server.

For the purpose of the RoHS Regulations, a **'storage or storage array system'** is viewed as any storage device or subsystem that meets one of the following criteria:

1) Designed and placed on the market as a Class A product as per EN55022:1994 under the EMC Directive 89/336/EEC; or

2) Designed and placed on the market as a Class B product as per EN55022:1994 under the EMC Directive 89/336/EEC and designed to meet one of the following two criteria: -

a) Any storage device capable of accepting direct or switched input from more than one computer, for example fibre channel and SCSI devices, or

b) Any storage fabric or switching device for interconnecting storage devices to server products.

It is BERR's view that this exemption is viewed as applying to the whole of the device or subsystem and their components including processors, memory boards, power converters, power supplies, enclosed housings, modular power subsystems and adapter cards. It would also seem to apply to the components that are integrated into the whole storage or storage array system or that are sold separately for use in an exempt storage or storage array system. Cables and cable assemblies, and all connectors and connector assemblies used to provide interconnections for the storage or storage array system, would also be covered by this exemption.

It should be noted that this exemption does not apply to parts or components that are peripheral to the storage or storage array system, nor does it apply to parts or components when they are used other than in an exempt storage or storage array system.

For the purpose of the RoHS Regulations, **'network infrastructure equipment for telecommunication purposes'** is viewed by BERR as equipment meeting one of the two following criteria:

1) Any system used for routing, switching, signalling, transmission, or network management or network security; or
2) Any system which can simultaneously enable more than one end user terminating equipment to connect to a network.

It is also any such system in a network, except for end user terminating equipment such as voice terminals and facsimile machines.

This would include all servers, power suppliers, display devices and similar electronic units that are incorporated into network infrastructure equipment. It would also include all cables and cable assemblies, and all connectors and connector assemblies used to provide interconnections for network infrastructure equipment but is not intended to include desktop or notebook computers, telephones, fax machines or consumer – type modems or switches etc.

9. Lead in electronic ceramic parts (e.g. piezoelectronic devices).

Ceramic materials are used in a variety of electronic devices including capacitors, insulators, piezoelectrics, magnets and integrated circuit packages. Some of these ceramic materials contain lead, for example lead zirconate titanate and lead magnesium niobate. The specific chemical composition and manufacturing process of these materials determine their electrical parameters, such as dielectric constant and the dissipation that is essential for the functioning of the component in which they are used. Hence, lead used in the ceramic parts of electronic components in electrical and electronic equipment is exempt from these Regulations.

10. Cadmium and its compounds in electrical contacts and cadmium plating except for applications banned under Directive 91/338/EEC (OJ No. L 186, 12 July 1991, p. 59) amending Directive 76/769/EEC (OJ No. L262, 27 September 1976, p. 201) relating to restrictions on the marketing and use of certain dangerous substances and preparations.

Directive 91/338/EEC amending Directive 76/769/EEC relating to restrictions on the marketing and use of certain dangerous substances and preparations, gives the following definition of cadmium plating: “Within the meaning of this Directive, ‘cadmium plating’ means any deposit or coating of metallic cadmium on a metallic surface.” This definition is seen as applying for the purpose of the RoHS Regulations.

Subsequently, the Marketing and Use Directive (as amended) bans the use of cadmium plating in a variety of product sectors.

As a result, in this context cadmium plating is viewed as being permitted for electrical contacts in all the WEEE categories to which the RoHS Regulations apply except for products manufactured in the household goods and central heating and air conditioning plant sectors because the latter are restricted by the Marketing & Use Directive. However, that Directive does allow the use of cadmium plating for “electrical contacts in any sector of use, on account of the reliability required of the apparatus on which they are installed.”

11. Hexavalent chromium as an anti-corrosion of the carbon steel cooling system in absorption refrigerators.

As absorption cooling works on several different types of energy sources such as gas, kerosene, batteries or electricity, absorption fridges are often used in recreational vehicles (e.g. motor homes and caravans) or remote places where electricity is not available. Another typical application is for minibars in hotel rooms as these fridges are virtually noiseless.

The applied heat and use of a water-ammonia mixture results in a corrosive environment that warrants the use of hexavalent chromium. This exemption has been introduced, since viable alternatives for this specific application have so far not been identified.

12. Lead in lead-bronze bearing shells and bushes.

Lead-bronze bearing shells and bushes are used, amongst others, in compressors for stationary refrigeration and air conditioning equipment. Typical characteristics of such compressors include a long design life (over 50,000 hours for residential applications and over 100,000 for commercial applications) and a hermetic sealing to prevent refrigerant leakage and ensure reliable, uninterrupted operation without service for up to 15 years. Combined with the unique technical aspects of the refrigeration cycle (dry-starts, miscibility of the lubricant, repeated condensing and boiling, etc.), the bearings need excellent self-lubrication properties to meet the high durability and reliability requirements. Due to its lubricious nature, the use of lead as a bearing constituent is critical in these applications. This exemption has been introduced because so far no suitable alternative has been identified, although other materials have been extensively tested.

13. Lead used in compliant pin connector systems.

Compliant pin contacts are used to attach connectors or components to a double-sided printed circuit board. This connector system avoids the need for soldering during manufacturing, thereby avoiding the overheating of components and damaging the integrity of the connectors and board material and allows separation for repair. Such pins are coated with a tin-lead alloy to ensure good electrical conductivity, maintain sufficient spring-back force and facilitate insertion of the pins into the boards. The use of tin-lead also reduces the risk of tin whiskers, which may affect reliability.

This exemption has been introduced because suitable alternatives to the tin-lead alloy have not yet been identified.

14. Lead as a coating material for the thermal conduction module c-ring.

A thermal conduction module c-ring serves a specific purpose in the manufacturing of high performance electronic modules. Such modules are the key components of a mainframe central processing unit and typically contain multiple chips. The c-ring functions as a hermetical seal, continuously dissipating heat and preventing oxidation of solder joints.

While substitutes for lead in this application have been investigated, no feasible alternative has so far been identified.

15. Lead and cadmium in optical and filter glass.

Lead and cadmium are used in optical glass and filter glass to obtain specific properties and meet quality standards, for a wide variety of applications including in the photo industry (e.g. camera lenses), in projectors, scanners, printers and copiers.

This exemption has been introduced because suitable alternatives for many of these applications have not yet been identified.

16. Lead in solders consisting of more than two elements for the connection between the pins and the package of microprocessors with a lead content of more than 80% and less than 85% by weight.

Microprocessors are mounted onto boards or substrates by way of a socket. Such sockets require that a large number of pins (up to 950) are mounted onto the microprocessor for completing the necessary electrical connections. The high customer quality demands for these products mean that such packages are extensively tested, which necessitates high adhesion strength of the pins. This is even more critical at higher pin counts and the application of lead in the proportions specified in this exemption is essential to achieve the necessary properties.

Substitute materials without lead are used by some manufacturers but for high pin counts, the development of alternatives before 1 July 2006 would create significant quantities of waste. This exemption has been introduced to allow for the development of alternative designs without generating excessive amounts of waste.

17. Lead in solders to complete a viable electrical connection between semiconductor die and carrier within integrated circuit Flip Chip packages.

Flip chips are attached to their packages or PCBs using very small solder bumps and many types use solder bumps containing lead. Lead is used for two main reasons. Its ductility reduces the risk of damage to brittle parts of flip chip circuitry. Lead also protects against the possibility of thermal fatigue, which results from cyclic temperature changes and is not well understood with lead-free solders. High melting point solder bumps are attached using solder containing typically 37 – 40% lead to the package because this combination has a high resistance to a phenomenon called "electromigration" which in higher power flip chip packages would otherwise cause premature failure of the device. The solder connections to the chip are known as level 1 and level 1 flip-chip connections may contain lead. The external solder connections between packages and PCB known as level 2 are excluded from this exemption as viable alternatives have been developed.

18. Lead in linear incandescent lamps with silicate coated tubes.

An incandescent lamp generates light using a glowing filament heated to white-hot by an electrical current. This light-giving process is known as incandescence.

A linear incandescent lamp is a tubular filament lamp with pin connectors at either end. The glass is coated on the inside with silicate that contains lead. The lead assists in binding the silicate to the glass.

In this context there is no restriction on the use of lead in these lamps.

19. Lead halide as radiant agent in High Intensity Discharge lamps for professional reprography applications.

High Intensity Discharge (HID) lamps produce light by striking an electrical arc across tungsten electrodes housed inside a specially designed inner fused quartz or fused alumina tube. This tube is filled with both gas and metals. The gas aids in the starting of the lamps and the metals produce the light once they are heated to a point of evaporation.

Certain HID lamp types contain lead-iodide (PbI2) as a component in the filling. These lamps are used in professional U.V. applications: the curing, reprography and label printing industries. The lead is used for creating the correct lamp emission spectrum and lamp effectiveness.

In this context there is no restriction on the use of lead halide as a radiant agent in these lamps.

20. Lead as activator in the fluorescent powder (1% lead by weight or less) of discharge lamps when used as sun tanning lamps containing phosphors such as BSP ($BaSi_2O_5$:Pb) as well as when used as speciality lamps for diazo-printing reprography, lithography, insect traps, photochemical and curing processes containing phosphors such as SMS ($(Sr,Ba)_2MgSi_2O_7$:Pb).

Discharge lamps work by sending an electric current through a special gas. Depending on the gas, this either generates light directly or the current generates ultra-violet light, which is converted to visible light by fluorescent powders.

Lead is used as an activator in fluorescent powders for two classes of special fluorescent lamp products: -

1. Sun tanning lamps contain phosphors such as BSP ($BaSi_2O_5$:Pb), with an emission peak of 350 nm; and
2. Certain specialty lamps (applications: diazo-printing reprography, lithography, insect traps, photochemical and curing processes) contain the phosphors such as SMS ($(Sr,Ba)_2MgSi_2O_7$:Pb), generating a broad emission peak centred at 360 nm.

The presence of lead creates the proper lamp emission spectrum and optimum lamp effectiveness.

This exemption applies to the use of lead as an activator in the fluorescent powder of discharge lamps used in the above applications up to 1% by weight.

21. Lead with PbBiSn-Hg and PbInSn-Hg in specific compositions as main amalgam and with PbSn-Hg as auxiliary amalgam in very compact Energy Saving Lamps.

There are two main parts to a compact fluorescent lamp (CFL): the gas-filled tube and the magnetic or electronic ballast. Electrical energy from the ballast flows through the gas in the tube causing it to give off ultraviolet light. The ultraviolet light excites a white phosphor coating on the inside of the tube. This coating then emits a visible light, which is the final product of the CFL.

Very compact Energy Saving Lamps (ESL) with PbBiSn-Hg and PbInSn-Hg in specific compositions as main amalgam and PbSn-Hg as auxiliary amalgam

The substances (both main & auxiliary amalgams) control the Hg-vapour pressure inside small CFLs, stabilizing the light output and lamp effectiveness over a wide temperature range. This makes it possible to replace incandescent lamps by CFLs in a wide range of applications, both indoor and outdoor.

In this context there is no restriction on the use of lead in the form of an amalgam or auxiliary amalgam in these lamps.

22. Lead oxide in glass used for bonding front and rear substrates of flat fluorescent lamps used for Liquid Crystal Displays.

Lead is currently used in the glass panel of Liquid Crystal Display (LCD) screens. Two glass substrates are bonded with high precision by inserting glass spacers in between, to keep the same gap. Lead is used there to prevent overheating of the glass, which would result in image distortion and malfunction. It is found in the form of a solder with a concentration of 70% lead by weight, used to create a safe electrical contact on the plane glass surface. Lead containing glass solder is also used to assemble the flat-panel glass envelope.

In this context there is no restriction on the use of lead in the form of an oxide in the glass.

23. Lead and cadmium in printing inks for the application of enamels on borosilicate glass.

Borosilicate glass items are printed with scales and warnings in order to improve usability and ensure consumer safety. These markings must be permanently readable.

The printing on the glass uses an ink, which is fired and melts together with the glass surface, and contains significant amounts of lead oxide (37-48% by weight) and cadmium oxide (11% by weight). Applications using this process to print onto borosilicate glass include: coffee jugs; water boilers; electric water kettles; lamp covers; laser tubes; ozone tubes; and medical devices.

In this context, there is no restriction on the use of lead and cadmium in the printing inks.

24. Lead as impurity in RIG (rare earth iron garnet) Faraday rotators used for fibre optic communications systems.

Optical isolators are used in high speed fibre optic communication systems to reduce the noise caused by reflectance phenomena. Rare earth iron garnet (RIG) crystal is used in optical isolators in order to maximise noise reduction. RIG crystal is also found in other optical passive devices such as optical circulators, optical attenuators and optical switches that are used for fibre optic communication systems.

The RIG crystals are produced using the Liquid Phase Epitaxy (LPE) method. The lead oxide is used as a solvent (or flux) in crystal growth. The raw materials are melted with the flux. As a result of this process, lead is inevitably found in the RIG crystal as an impurity.

About 5 mg iron garnet crystal is used in each optical passive device, and lead is included as lead oxide. The concentration is about 0.5 to 1% by weight of the crystal.

In this context, there is no restriction on the use of lead as an oxide in the manufacture of rare earth iron garnet crystals for this application.

25. Lead in finishes of fine pitch components other than connectors with a pitch of 0.65 mm or less with NiFe lead frames and lead in finishes of fine pitch components other than connectors with a pitch of 0.65 mm or less with copper lead frames.

The electrical terminations of virtually all electronic components (integrated circuits, memory “chips,” diodes, resistors for example) must be plated with a thin layer of metal to make them capable of being soldered to the printed circuit board. Today, these terminal platings are most commonly comprised of a tin-lead (Sn-Pb) alloy.

One of the main reasons lead is included in the plating is to mitigate the formation and growth of tin “whiskers”. Tin whiskers are electrically conductive, crystalline structures of tin that sometimes grow from surfaces where tin (especially electroplated tin) is used as a final finish.

Tin whiskers have been observed to grow to lengths of several millimetres (mm) and in rare instances to lengths up to 10mm. Numerous electronic system failures have been attributed to short circuits caused by tin whiskers that bridge closely-spaced circuit elements maintained at different electrical potentials.

Lead is used as a whisker suppresser in electroplated Sn coating. The concentration of Pb in the plating alloy is typically below 20%, and the thickness of the plating is only about 10 micrometers.

These tin whiskers can cause functional failure of electronic products once they grow long enough to create short circuits between adjacent electrical terminations. Fine-pitch parts are the most susceptible to such failures because the distance between the conductive leads is small. Modern electronic equipment requires the use of such fine-pitch parts to meet the computation speed and/or small size requirements of the market.

For the purpose of this exemption, fine-pitch components are defined as those with electrical terminations spaced with centres 0.65 mm or less apart. In such parts, the distance between adjacent leads is considerably smaller than the centre-to-centre spacing, and is typically 125 to 300 micrometers.

26. Lead in solders for the soldering to machined through hole discoidal and planar array ceramic multilayer capacitors.

RFI signal line filters are manufactured by soldering axial leads into machined ceramic multi layer through hole devices (discoidal capacitors or planar arrays) and mounting into metal bodies or connector shells.

Due to the novel construction of the capacitor, it is necessary to use ductile solders to make these solder joints so as to prevent the ceramic cracking as a result of tensile stresses generated during the cooling of the assembly.

The solders used contain lead along with other alloys (primarily indium) to maintain the ductility required. These solders are typically 50% lead and 50% indium.

In this context there is no restriction on the use of lead in the form of lead in solders for these components.

27. Lead oxide in plasma display panels (PDPs) and surface conduction electron emitter displays (SED) used in structural elements; notably in the front and rear glass dielectric layer, the bus electrode, the black stripe, the address electrode, the barrier ribs, the seal frit and frit ring as well as in print pastes.

The front substrate consists of the bus electrode and the dielectric layer for the protection of the bus electrodes. The rear substrate consists of the address electrode, the dielectric layer, the barrier rib and fluorescent material. By sealing the front and rear substrates together, a gas (usually Ne-Xe) is injected into the panel. PDPs emit light by producing an ultraviolet ray that excites the fluorescent material. The main substance of PDP material consists of PbO, SiO2, B-2 O3, Al2O3, CaO, TiO2, ZnO, etc.

PbO renders the melting point lower with its presence in the paste and tends to optimize the sintering characteristics of the material.

In this context there is no restriction on the use of lead in the form of PbO in these components.

28. Lead oxide in the glass envelope of Black Light Blue (BLB) lamps.

Black light (also Wood's light) is the common name for a lamp emitting electromagnetic radiation that is almost exclusively in the soft near ultraviolet range, and very little visible light.

BLB lamps produce black light that peaks in the soft ultraviolet at a wavelength of 365 nm, with almost no light in the visible spectrum; they appear deep purple violet to the human eye when operating, and black when turned off. These lamps are used to excite UV-sensitive paints and dyes and for other purposes, especially in special effects, security applications, and medicine.

The amount of PbO in the glass envelope is typically 20 wt%, = 18 wt% Pb.

The lead in the form of PbO is essential for creating the proper lamp emission: optimal optical properties: maximum transmission of UV light, and minimum visible light transmission.

In this context there is no restriction on the use of lead in the form of PbO in these components.

29. Lead alloys as solder for transducers used in high-powered (designated to operate for several hours at acoustic power levels of 125 dB SPL and above) loudspeakers.

Most professional/commercial transducers are designed to operate at high output levels in severe environments. At these high acoustic power levels and severe environmental conditions, the transducer's solder joints are subjected to continuous mechanical and thermal stresses. These extreme stresses are often aggravated by the extreme temperature environments to which fire and military use are frequently subjected.

Alloys containing lead are used as electrical/mechanical solders to attach copper-clad aluminium and copper voice-coils to tinsel wires in electro-acoustic transducers used for commercial and professional fire and security sounders, and other sound applications such as military headsets. The alloys are Sn63Pb37 and Sn60Pb40 with lead content between 37 and 40%.

In this context there is no restriction on the use of lead in the form of alloys as a solder in these transducers.

30. Lead bound in crystal glass as defined in Annex I (Categories 1, 2, 3 and 4) of Council Directive 69/493/EEC[11].

The use of lead in glass leads to a high refractive index (brilliancy), a strong dispersion and a high transmission of the light. Additionally, the use of lead in glass introduces further favourable thermal and mechanical properties in melting, forming, cutting and in post-processing.

[11] Directive 69/493/EEC, (OJ No. L326, 296.12.1969, p.36), as last amended by the 2003 Act of Accession.

In electric and electronic equipment this form of glass is used in pure (colourless) or coloured form for decorative and/or functional purposes, such as lamps, chandeliers, decoration of mobile phone covers, clocks and watches.

According to Council Directive 69/493/EEC, full lead crystal consists at least of 28% lead calculated as lead oxide (therefore >30% lead oxide).

Lead is bonded in the silicate matrix of glass and therefore immobilised and not biologically available. The absolute amount of lead depends on the mass of the article.

In this context there is no restriction on the use of lead bound in crystal glass as defined in Annex I (Categories 1, 2, 3 and 4) of Council Directive 69/493/EEC.

31. Cadmium alloys as electrical/mechanical solder joints to electrical conductors located directly on the voice coil in transducers used in high-powered loudspeakers with sound pressure levels of 100 dB (A) and more

This exemption allows for the use of special high melting point solders that contain about 70% cadmium, to solder the voice-coil wires of a novel design of small and light-weight but high-powered loudspeakers. The loudspeakers that require this exemption are a patented design and operate at close to 300°C and with very high g-forces due to the vibration of the loudspeaker. Few cadmium-free solders have a suitable melting temperature; even so-called high melting point solders which are covered by the exemption mentioned in paragraph 7 above melt at about 300°C. The light-weight design is achieved by the use of aluminium wires and the few cadmium-free solders with a suitably high melting point such as zinc/aluminium are too aggressive and dissolve the aluminium.

32. Lead in soldering materials in mercury free flat fluorescent lamps (which e.g. are used for liquid crystal displays, design or industrial lighting)

This exemption permits the use of lead in the material used to form a gas tight bond for a new type of flat fluorescent lamp that is mercury free and has an unusually long life. Research has not yet identified a material that can form a permanent gas tight bond without lead. Although referred to as a “soldering material”, this is a lead based low melting point glass with ~70% lead oxide which melts on heating the lamp assembly to form the bond and seal the lamp. These lamps can be used as backlights for LCDs, as well as for lighting and other applications. They are thicker than the narrowest types of special straight fluorescent lamps that do need to contain mercury and are used where there is limited space available such as in laptop computers. Lead in these special lamps is already covered by the exemption in paragraph 22 above, but this exemption allows lead in special thin flat lamps but only for LCD.

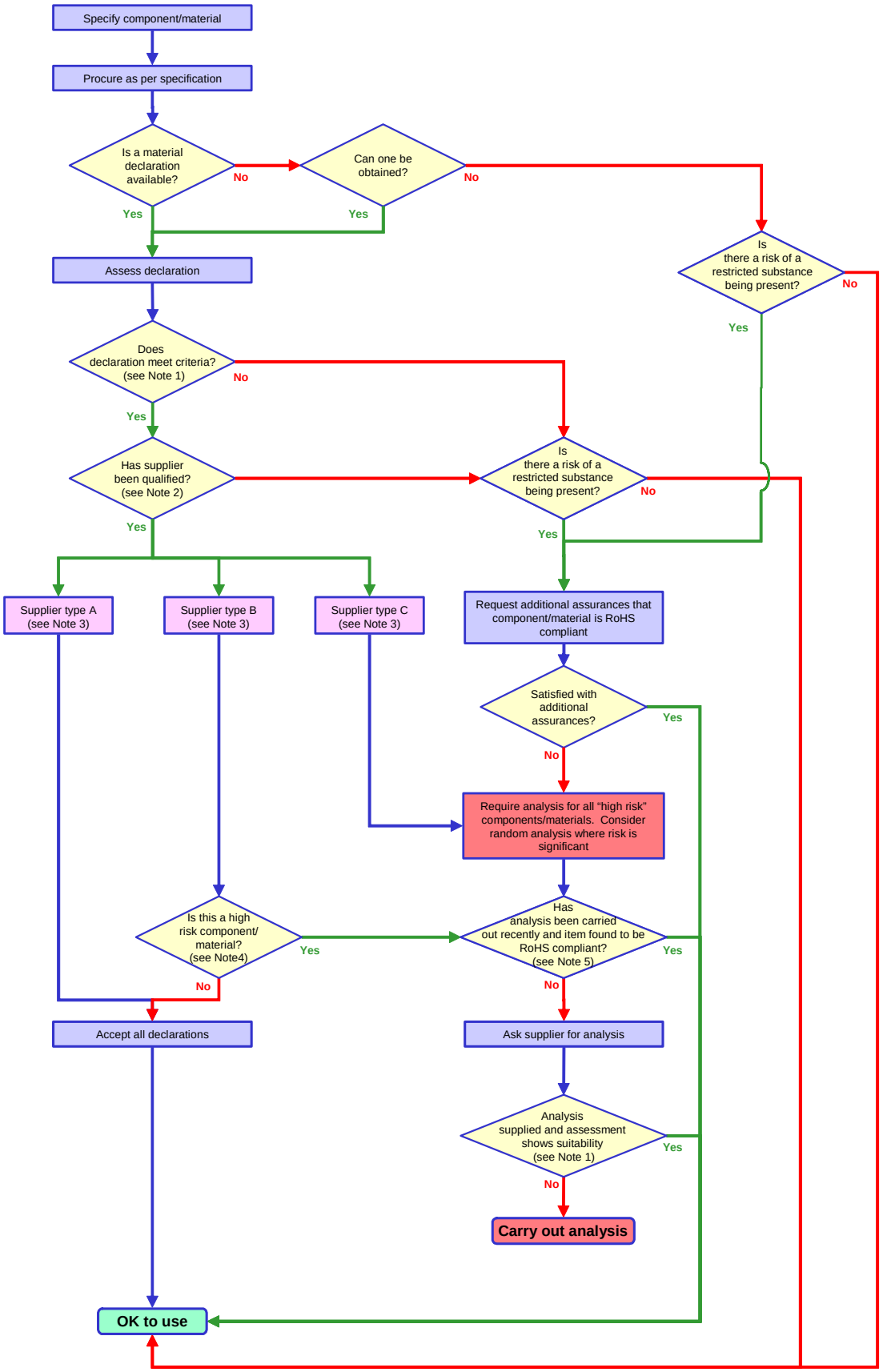
33. Lead oxide in seal frit used for making window assemblies for Argon and Krypton laser tubes

The optical windows of Argon and Krypton lasers are sealed using special glass frit materials that contain lead oxide. Frit seals are made with low melting point glasses in powder form and these form a glass bond when heated to above their melting point. The optical windows and the laser tube are both quartz and only seals made with lead based glass provide the correct combination of properties

that allow the vacuum tight bond to be made and precisely align the windows with a high yield.

Argon and Krypton lasers are used as tools for cutting materials. They are also used for medical applications such as eye surgery although medical lasers are in Category 8 of the WEEE Directive and, therefore, currently outside the scope of the RoHS Directive.

Annex D – An example of a flow chart that might be used as part of an organisation's compliance procedures (see notes on next page).



Notes to accompany the compliance flow chart:

Note 1 - Assessment of materials declarations and suppliers analysis certificates

- Declarations and analysis certificates must be assessed for accuracy. As the forgery of analysis certificates is not unknown, expect to see the following information:
  - Declarations and analysis data based on homogeneous materials
  - A statement that all six RoHS substances are absent and a list of maximum concentration values
  - If an exemption is utilised, a statement to that effect specifying which one this is
  - Supplier name and contact details

Note 2 – Supplier Qualification

- Has the supplier been qualified?
  Most manufacturers will already have a defined process of supplier qualification as part of their quality system. This system needs to be extended to capture information critical to RoHS. This could be based on audit, past experience, etc.

- Supplier audit guidance
  - Aim is to determine if a supplier understands the requirements of the RoHS Regulations and has procedures in place that minimise risk
  - May be carried out in person or remotely
  - Industry accreditations for RoHS may be acceptable although these do not guarantee compliance
  - Any audit should consider how your suppliers assess their suppliers

Note 3 – Supplier Qualification Categorisation

- As an output of the qualification process, suppliers are categorised according to their performance. This example suggests three categories:
  - Type A: supplier has very good understanding of RoHS, comprehensive and effective systems in place to ensure RoHS compliance and carries out selective analysis of high risk components/materials
  - Type B: Supplier has good understanding of RoHS and has a system for ensuring RoHS compliance but may be lacking in some respect, e.g. does not analyse high risk components/materials
  - Type C: Supplier does not understand RoHS requirements or does not have system to ensure compliance and does not check incoming components/materials or declarations

Note 4 – High Risk Components/Materials

- High risk components/materials include the following <u>examples</u>:
  - PVC
  - bright red, orange or yellow plastic
  - ABS
  - aluminium and galvanised steel with a yellow “tint”

Note 5 – Analysis Requirements

- The need for regular analysis depends on the risk of non-compliance as well as the risk to the environment. Therefore components/materials used in large numbers will require more frequent scrutiny (and possibly analysis) than those used in small numbers.
- Due diligence does not expect analysis of every component/material, this would be unreasonable but where there is a risk of non-compliance, the frequency that analysis should be carried out may depend on the potential risk to the environment so that components/materials used in very large numbers would need to be analysed more often than components/materials used in small numbers.

POWER-IO

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Solid state relay or solid state contactor inventory

Inventory of Power-io solid state relays and solid state relay accessories

Part number:		Typically:
HDA-3V25	4-32 vdc input, ac switching solid state relays	In stock
HDA-3V50	4-32 vdc input, ac switching solid state relays	In stock
HDA-3V90	4-32 vdc input, ac switching solid state relays	In stock
HDA-6V50	4-32 vdc input, ac switching solid-state relay	In stock
HDA-6V90	4-32 vdc input, ac switching solid-state relay	In stock
HDA-6V125	4-32 vdc input, ac switching solid-state relay	In stock
HAA-3V25	ac input, ac switching solid state relay	In stock
HAA-3V50	ac input, ac switching solid state relay	In stock
HAA-3V75	ac input, ac switching solid state relay	In stock
HAA-6V50	ac input, ac switching solid-state relay	In stock
HAA-6V75	ac input, ac switching solid-state relay	In stock
		
DAA-6V25	din rail solid state contactors	In stock
DAA-5V25	din rail solid state contactors	In stock
DAA-6V40	din rail solid state contactor	In stock
DAA-5V40	din rail solid state contactor	In stock
DAA-6V50	din rail solid-state contactor	In stock
DDA3-6V75T-H	3 phase, din rail solid state contactor	In stock
DDA-6V75	din-rail solid state power contactors	In stock
DDA-6V100	din-rail solid state power contactors	In stock
DDA-6V25	din-rail solid state contactors	In stock
DDA-6V40	din-rail solid-state contactor	In stock
DDA-6V75	din rail solid-state power contactor	In stock
DMA-6V40	4-20ma din rail solid-state contactor	In stock
FUSE-EXT-14-010	ssr fuses, 10 amp	In stock
FUSE-EXT-14-025	ssr fuses, 25 amp	In stock
FUSE-EXT-14-030	ssr fuses, 30 amp	In stock
FUSE-EXT-14-040	i2t ssr fuses	In stock
FUSE-EXT-14-050	i2t ssr fuses	In stock
FUSE-EXT-22-063	i2t ssr fuses	In stock
FUSE-EXT-22-075	ssr fuses	In stock
FUSE-EXT-22-100	ssr fuses	In stock
FUSE-HLDR-14-01	ssr fuses	In stock
FUSE-HLDR-14-03	ssr fuses	In stock
FUSE-HLDR-22-01	ssr fuses	In stock
FUSE-SEMIBR-100	ssr fuses	In stock
FUSE-SEMIBR-50A	ssr fuses	In stock
FUSE-SEMIBR-63A	ssr fuses	In stock

Solid state relays, ssr and solid-state relay accessories.

FUSE-SEMIBR-75A	ssr fuses	In stock
HDD-1V12	dc switching solid state relays	In stock
HDD-1V20	dc switching solid state relays	In stock
HDD-1V40	dc switching solid-state relays	In stock
I.O.-JUMPER-010	din rail i/o module jumper	In stock
IO-IAC-280-N	din rail i/o input modules	In stock
IO-IAC-280-P	din rail i/o modules	In stock
IO-IDC-028-N	din rail i/o modules	In stock
IO-IDC-028-P	din rail i/o modules	In stock
IO-OAC-280	din rail i/o output modules	In stock
IO-OAC-280-280A	din rail i/o modules	In stock
IO-ODC-60	din rail i/o modules	In stock
THERMAL-PAD-005	solid state relay thermal transfer pad, similar to Dow Corning 340 thermal grease	In stock
THERMAL-PAD-025	thermal transfer pad	In stock
Product Upgrade Recommendations:		Upgrade to Power-io solid state relays:
CSD2410	hockey puck solid state relays	HDA-3V25
CSD2425	hockey puck solid state relays	HDA-3V25
CSD2450	hockey puck solid-state relays	HDA-3V50
CSD2475	hockey puck solid-state relays	HDA-3V90
CSE2410	hockey puck solid state relay	HDA-3V25
CSE2425	hockey puck solid state relay	HDA-3V25
CSE2450	hockey puck solid-state relay	HDA-3V50
CSE2475	hockey puck solid-state relay	HDA-3V90
		Upgrade to Power-io solid state relay:
CWD2410	10 amp hockey puck ssr	HDA-3V25
CWD2410P	hockey puck ssr	HDA-3V25
CWD2410S	hockey puck ssr	HDA-3V25
CWD2425	25 amp hockey puck SSRs	HDA-3V25
CWD2425P	hockey puck SSRs	HDA-3V25
CWD2425S	hockey puck SSRs	HDA-3V25
CWD2450	50 amp hockey puck ssr	HDA-3V50
CWD2450P	hockey puck ssr	HDA-3V50
CWD2450S	hockey puck ssr	HDA-3V50
		Upgrade to Power-io relays:
D1210	solid state relays	HDA-3V25
D1210-B	solid state relays	HDA-3V25
D1225	solid state relay	HDA-3V25
D1225-B	solid state relay	HDA-3V25
D1240	solid-state relay	HDA-3V50
D1240-B	solid-state relay	HDA-3V50
D2410	solid-state relay	HDA-3V25
D2410-B	solid-state relays	HDA-3V25
D24125	solid state relays	HDA-3V25
D2425	solid state relays	HDA-3V25
D2425-B	solid state relays	HDA-3V25
D2450	solid state relais	HDA-3V50
D2450-B	solid state relais	HDA-3V90
D2475	solid-state relais	HDA-3V90
D2475-B	solid-state-relais	HDA-3V90
		Upgrade to Power-io solid state contactors:
RVMA/6V40	din rail, 4-20ma, solid state contactor	DMA-6V40
RVDA/6V25	din rail solid state contactor	DDA-6V25
RVDA/6V40	din rail solid state contactor	DDA-6V40
TD1210	hockey puck solid state relay	HDA-3V25
TD1225	hockey puck solid state relay	HDA-3V25

TD2410	hockey puck solid state relay	HDA-3V25
TD2420Q	hockey puck solid state relay	HDA-3V25
TD2425	hockey puck solid state relay	HDA-3V25
AC51	ac51 contactor, ac-51 solid state contactors	DDA-6V40 DAA-6V40
AC53	ac53 contactor, ac-53 solid state contactors, ac53 three phase contactor	DDA3-6V75T-H DAA3-6V75T-H

The information above is a guideline only and is subject to change or correction. Please examine all specification parameters to confirm the proper product for your application. Note: the Power-io specifications are based upon test results at 40°C (104°C) which is the modern, industrial requirement. Other brands of solid state relays may have test results at 25°C (77°F) which is the older standard, and those products may require significant specification derating when used at 40°C.

Other cross references: many standard solid state relays, Cii ssr, Invensys solid state relay, Crydom solid-state relays, Din rail contactors, Sprecher and Schuh solid state relays, oac modules, odc modules, din rail io

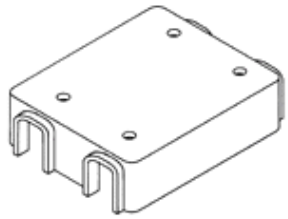
POWER-IO

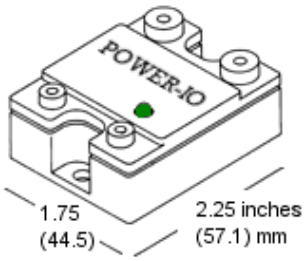
Product information as saved in the www.power-io.com library.
You may save, or print, a copy for your personal use.

Solid state relays and solid state relay heat sinks

1-125 amp solid state relays
up to 330 volts or 660 volts AC switching
Individual solid state relay hockey pucks or pre-assembled onto heat sinks

- Third generation Maximum Surge Survival™ technology for superior performance
- Internal, SCR thyristors and fourth generation DCB Direct Copper Bonding thermal optimization provide longer life than other solid state relays
- Optically isolated for 4000 volt isolation
- International green LED input status indicator and terminal numbers (L1, T1, A1, A2)
- Clear safety cover included
- 800 volt blocking voltage in the 3V models (very high voltage surge blocking)
- 1200 volt blocking voltage in the 6V models (highest voltage surge blocking)
- Ultra-Precise zero voltage turn-on to eliminate EMI noise, without the need for CE filters
- Engineered internal snubber circuit for robust performance
- Highest surge capability with the trademarked triple layer design feature to: attenuate surges AND then block surges AND then control the pass-through.
- UL recognized, CSA, CE EN 60947-4-3 (the newest and most difficult international CE specification), all models up to 75 amps.
- 76-125 amps = approvals pending. Note: the power terminals on "hockey puck" solid state relays are rated for one or two 8 AWG wires which limits the amperage. For larger wire installations, please visit the C Family of products.
- See the data bulletins for complete specifications: 1-75 amp models, 90-125 amp models, or the new C Family DC control input models or AC control input models.





Part Numbers:		Pre-installed* on:		
		Good Heat Sink	Better Heat Sink	Best* Heat Sink
DC Control Input:		Heatsk-Din-1.6	Heatsk-Din-1.0	Ultra Power Cooler™
HDA-3V25 up to 25A, 24-330V max, 4-32 VDC activated	BUY	BUY		
HDA-3V50 up to 50A, 24-330V max, 4-32 VDC activated	BUY	BUY	BUY	
HDA-3V75 up to 75A, 24-330V max, 4-32 VDC activated	BUY		BUY	BUY
HDA-6V50 up to 50A, 24-660V max, 4-32 VDC activated	BUY	BUY	BUY	
HDA-6V75 up to 75A, 24-660V max, 4-32 VDC activated	BUY		BUY	BUY
HDA-6V125 up to 125A, 24-660V max, 4-32 VDC activated. Hint: if you are buying more than one unit, it is more cost effective to buy the dual channel: Power-io's CZ2H-IAC2, shown below.	BUY			BUY
* Upgrade to: CZ2H-IDC2 as an alternative to the HDA-6V125. Two channels of up to 100A continuous on each, 24-575V max, 4-32 VDC activated. The C family is a complete assembly using large 2-8 AWG power connections, built-in additional surge survivability, SCR ALERT Alarm and more. Highest installation density. More information is online at: Power-io's C Family of solid state contactors				BUY
AC Control Input:				
HAA-3V25 up to 25A, 24-330V max, 100-280 VAC activated	BUY	BUY		

HAA-3V50 up to 50A, 24-330V max, 100-280 VAC activated	BUY	BUY	BUY	
HAA-3V75 up to 75A, 24-330V max, 100-280 VAC activated	BUY		BUY	BUY
HAA-6V50 up to 50A, 24-660V max, 100-280 VAC activated	BUY	BUY	BUY	
HAA-6V75 up to 75A, 24-660V max, 100-280 VAC activated	BUY		BUY	BUY
HAA-6V125* up to 125A, 24-660V max, 100-280 VAC activated. Hint: if you are buying more than one unit, it is more cost effective to buy the dual channel: Power-io's CZ2H-IAC2, shown below.	BUY			BUY
* Upgrade to: CZ2H-IAC2 as an alternative to the HAA-6V125. Two channels of up to 100A continuous on each, 24-575V max, 100-280 VAC activated. The C family is a complete assembly using large 2-8 AWG power connections, built-in additional surge survivability, and more. Highest installation density, only 1.6 inches per channel. More information is online at: Power-io's C Family of solid state contactors				BUY

* Pre-installed = Solid state relay + thermal transfer pad + 2 mounting screws + torqued to 20-25 inch pounds + the heat sink shown. For the fastest on site installations, using the pre-assembled packages is beneficial. Power-io can design other assemblies, contact us with your specifications. The Ultra Power Cooler™ is a small footprint, thermally engineered, fan assisted heat sink. Please provide 120 vac, 9 watts, power for the fan.

Purchase heat sinks, thermal pads, pre-installation options separately: Parts page
Heat sink descriptions, multi-zone heat sinks, MOV options, and more.

- For a printable copy of the data bulletin including the complete, in-depth product specifications, engineering details, and thermal calculations: solid state relay data bulletin for 1-75 amp models or solid state relay data bulletin for 1-125 amp models or Power-io's C Family of solid state contactors.
- For full dimensional information and label examples: Power-io solid state relay dimensions and labels
- For a zoomed in photo of the product: Solid state relay and the solid state relay cover
- It is important to anticipate three installation conditions: avoid over-amperage, over-voltage (surges), or over-temperature. See: solid-state-relay-extended-life.htm

Power-IO™

H Family of Solid State Relays
Up to 75 Amps
Up to 330 Vac or 660 Vac switched

- **Maximum Surge Survival**™ technology for triple-layer surge protection
- Internal, oversized components + advanced direct copper bonding capability = increased reliability, less thermal rise, and longer life
- Optically isolated for 4000 volt isolation
- Green LED indicating input status
- International terminal markings (L1, T1, A1, A2)
- 800 volt transient blocking voltage (in the 3V models)
- 1200 volt transient blocking voltage (in the 6V models)
- Precise zero voltage turn-on for low EMI (noise) without the need for CE filters or other external components
- Internal, rugged, snubber circuit for robust performance on all models
- Clear safety cover included
- All parameters are at 40°C, as required by the latest CE EN60947-4-3, which is the industrial SSR specification (toughest specification).

Model Numbers	DC Control input	HDA-3V25	HDA-3V50	HDA-3V75	HDA-6V50	HDA-6V75
	AC Control input	HAA-3V25	HAA-3V50	HAA-3V75	HAA-6V50	HAA-6V75

Items marked in green are engineering enhancements that typically lead the industry resulting in better, long term performance.

Output Specifications (All shown at 40°C, per CE EN60947-4-3, and tested by UL or CSA, on appropriate heat sinks)

Operating Voltage (47-63 Hz) [Vrms}	24-330	24-330	24-330	24-660	24-660
Max Load Current [Arms] with heat sink	25	50	75	50	75
Min Load Current [Arms]	0.10	0.10	0.15	0.10	0.15
Transient Overvoltage [Vpk]	800	800	800	1200	1200
Max Surge Current for 16.7ms [Apk]	250	625	1300	625	1300
Max On-State Voltage Drop @ Rated Current [Vpk]	1.6	1.5	1.4	1.5	1.4
Thermal Resistance Junction to Case [°C/W]	0.97	0.34	0.18	0.34	0.18
Max I^2T for fusing (8.3 msec) [A^2sec]	260	1620	7010	1620	7010
Max. Off-State Leakage @ Rated Voltage [mArms]	5	10	10	10	10
Min Off-State dv/dt @ Max Rated Voltage [V/µsec]	>750	>1000	>1500	>1000	>1500
Max Turn-On Time	1/2 sinewave (HDA), 1 sinewave (HAA) max imbalance = 1/2 sinewave				
Max Turn-Off Time	1/2 sinewave (HDA), 1 sinewave (HAA) max imbalance = 1/2 sinewave				

Input Specifications (All shown at -40°C to +85°C)

Control Voltage Range	DC Control: 4-32 Vdc. AC Control: 100-280 Vac, 60 Hz				
Min Turn-Off Voltage (HDA DC control models)	1 VDC/0.02mA.				
Min Turn-Off Voltage (HAA AC control models)	20 Vrms/2mA (> than most PLC's triac leakage = eliminates false activation)				
HAA models can be activated by triac output PLCs, PID controllers, etc. typically WITHOUT the extra burden resistor.					
Control inputs are **current limited** (consistent mA) and include the green "input status" LED requirements					
HDA -Nominal Input Current Regulation @ 4-32 Vdc	8 mA	5 mA	5 mA	5 mA	5 mA
HAA -Nominal Input Impedance of 10K @ 120 Vac	12 mA	12 mA	12 mA	12 mA	12 mA
HAA -Nominal Input Impedance of 10K @ 240 Vac	20 mA	20 mA	20 mA	20 mA	20 mA

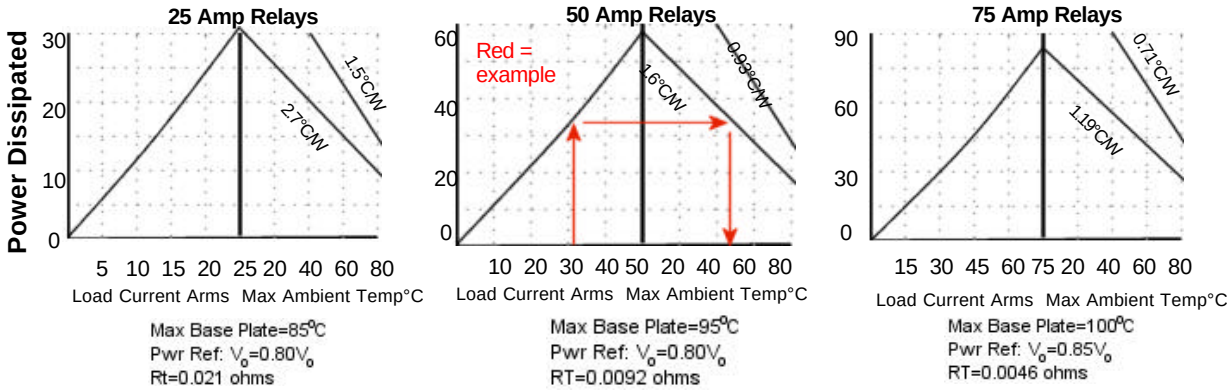
General Specifications

Dielectric Strength: Input / Output / Base	4000 Vrms
Ambient Operating Temperature Range	-40°C to 85°C, when used with an appropriate heat sink and air flow
Ambient Storage Temperature Range	-40°C to 125°C
Terminals	Four screws and saddle clamps provided, unmounted
Screw torque:	6-32 Screws 10 inch lbs.; 8-32 screws 20 inch lbs.
Safety Cover	Clear, snap on, with 4 holes for multi-meter test probes
Shipping	4.2 oz (130.6 g) weight typical. Box = 3.5x2x1.5 inches (87.5x50x37.5 mm)

Power-IO™

H Family of Solid State Relays
Up to 75 Amps
Up to 330 Vac or 660 Vac switched

Heat sink calculations. The left side of the graph shows the total power dissipated as watts of heat, when the relay is in the "on" state. The right side of the graph shows how different heat sinks will "typically" dissipate this heat when in different ambient temperature applications, where unrestricted air is permitted to flow up and through the heat sink. Between the relay and the heat sink, you should install: a Power-IO thermal transfer pad, OR a 0.002 thick layer of Dow Corning™ 340 thermal transfer compound, OR an equivalent thermal transfer gel.



Math calculations, in place of the chart information:
1) Power dissipation (heat generated) for a Power-IO solid state relay:

$(0.9 \times Irms \times V_o)$ + (Irms² x Rt) = Watts of Heat

For example: Use a HDA-6V50 (50 amp relay) for a 31 amp application:
(0.9 x 31Amps x 0.80) + (31Amps² x 0.0092 ohms) = 31.16 watts of heat

2) What size heat sink do I need?:

(Max Base Plate Temp - Max Ambient Temp) / Watts Dissipated = ___°C/W

For example: For the solid state relay in example 1 above,
(95°C max base plate - 45°C at your industrial installation) / 31.16 watts = 1.6°C/W
You need a heat sink that is rated 1.6 °C/W or **LOWER**. The Power-IO 1.6°C/W heat sink would be a good choice or the 1.0°C/W heat sink would offer even better performance. Our calculations include the thermal junctions between the relay, the thermal compound, and the heat sink. We also use a conservative 115°C max for the heat sink which is 10°C below the theoretical 125°C limit.

Precautions:
The products that are designed, manufactured, or sold by POWER-IO are intended to be installed or serviced by electrically trained personnel. In addition, there are local, national, factory, and other regulations (sometimes referred to as the NEC, National Electrical Code, OSHA, or equivalent) that must be strictly followed during the installation and use of any POWER-IO product. Failure to follow all of these regulations can result in downtime, damage, injury, or death. It is important that the customer anticipate the temperature requirements of the product. To ensure the longest possible life, it is customary that the electrical design not exceed 80% of the max amperage for relays, circuit breakers, fuses, wiring and other electronic components in an installation, when at full operating temperature. Power-IO warrants its products for a period of 2 years from the date of manufacture to be free from defects in both workmanship and materials. See www.power-io.com for further information.

Power-IO, Inc. 537 Braemar Avenue Naperville, IL 60563 USA Tel: 630-717-7335 www.power-io.com
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Power-IO™

H Family of Solid State Relays
1-125 Amps
up to 330 Vac or 660 Vac switched

- **Maximum Surge Survival**™ technology for triple-layer surge protection
- Internal, oversized components + advanced direct copper bonding capability = increased reliability, less thermal rise, and longer life
- Optically isolated for 4000 volt isolation
- International green input status LED
- International terminal markings (L1, T1, A1, A2)
- 800 volt transient blocking voltage (in the 3V models)
- 1200 volt transient blocking voltage (in the 6V models)
- Precise zero voltage turn-on for low EMI (noise) without the need for CE filters or other external components
- Internal, rugged, snubber circuit for robust performance on all models
- Clear safety cover included
- All parameters are at 40°C, as required by the latest CE EN60947-4-3, which is the industrial SSR specification (toughest specification).
- New 90 -125 amp models. Ultra high inrush capability and rugged performance for industrial, commercial or laboratory applications.

1-75 amps
76 -125 amps, approvals pending

Model Numbers	DC Control input	HDA-3V25	HDA-3V50	HDA-3V90	HDA-6V50	HDA-6V90	HDA-6V125
	AC Control input	HAA-3V25	HAA-3V50	HAA-3V90	HAA-6V50	HAA-6V90	HAA-6V125

Items marked in green are engineering enhancements that typically lead the industry resulting in better, long term performance.

Output Specifications (All shown at **40°C**, per CE EN60947-4-3, and tested on appropriate heat sinks)

Operating Voltage (47-63 Hz) [Vrms}	24-330	24-330	24-330	24-660	24-660	24-660
Max Load Current [Arms] with heat sink	25	50	90	50	90	125
Min Load Current [Arms]	0.10	0.10	0.15	0.10	0.15	0.15
Transient Overvoltage [Vpk]	800	800	800	1200	1200	1200
Max Surge Current for 16.7ms [Apk]	250	625	1500	625	1500	1800
Max On-State Voltage Drop @ Rated Current [Vpk]	1.6	1.5	1.3	1.5	1.3	1.3
Thermal Resistance Junction to Case [°C/W]	0.97	0.34	0.14	0.34	0.14	0.11
Max I^2T for fusing (8.3 msec) [A^2sec]	260	1620	11250	1620	11250	16000
Max. Off-State Leakage @ Rated Voltage [mArms]	5	10	10	10	10	10
Min Off-State dv/dt @ Max Rated Voltage [V/µsec]	>750	>2000	>3000	>2000	>3000	>3000
Max Turn-On Time	1/2 sinewave (HDA), 1 sinewave (HAA), max imbalance = 1/2 sinewave					
Max Turn-Off Time	1/2 sinewave (HDA), 1 sinewave (HAA), max imbalance = 1/2 sinewave					

Input Specifications (All shown at -40°C to +85°C)

Control Voltage Range	DC Control: 4-32 Vdc. AC Control: 100-280 Vac, 47 - 63 Hz					
Min Turn-Off Voltage (HDA DC control models)	1 VDC / 0.02mA.					
Min Turn-Off Voltage (HAA AC control models)	20 Vrms / 2mA (> than most PLC's triac leakage = eliminates false activation)					
HAA models can be activated by triac output PLCs, PID controllers, etc. typically WITHOUT the extra burden resistor.						
Control inputs are **current limited** (consistent mA) and include the green "input status" LED requirements						
HDA -Nominal Input Current Regulation @ 4-32 Vdc	8 mA	5 mA	5 mA	5 mA	5 mA	5 mA
HAA -Nominal Input Impedance of 10K @ 120 Vac	12 mA	12 mA	12 mA	12 mA	12 mA	12 mA
HAA -Nominal Input Impedance of 12K @ 240 Vac	20 mA	20 mA	20 mA	20 mA	20 mA	20 mA

General Specifications

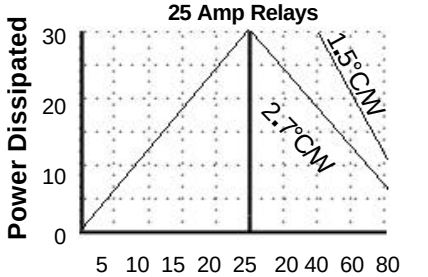
Dielectric Strength: Input / Output / Base	4000 Vrms
Ambient Operating Temperature Range	-40°C to 85°C, when used with an appropriate heat sink and air flow
Ambient Storage Temperature Range	-40°C to 125°C
Terminals	Four screws and saddle clamps provided, unmounted
Screw torque:	6-32 screws 10 inch lbs (1.13 N.m); 8-32 screws 20 inch lbs (2.26 N.m).
Max wire size (copper wire only)	Output: 2 of 8 AWG (3.88 mm) Input: 2 of 12 AWG (2.5 mm)
Safety Cover	IP20, clear, snap on, with 4 holes for multi-meter test probes
Shipping	4.2 oz (130.6 g) weight typical. Box = 3.5x2x1.5 inches (87.5x50x37.5 mm)

Power-IO™

H Family of Solid State Relays
1-125 Amps
up to 330 Vac or 660 Vac switched

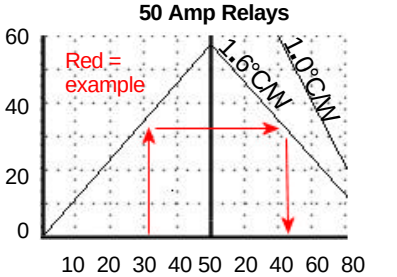
Heat sink calculations. The graph on the left shows the total power dissipated as watts of heat, when the relay is in the "on" state. The graph on the right shows how different heat sinks will "typically" dissipate this heat when in different ambient temperature applications, where unrestricted air is permitted to flow up and through the heat sink. Between the relay and the heat sink, you should install: a Power-IO thermal transfer pad, OR a 0.002 thick layer of Dow Corning 340™ thermal transfer compound, OR an equivalent thermal transfer gel. The relay should be screwed to the heat sink with a mounting torque of 20-30 in/lbs.

25 Amp Relays



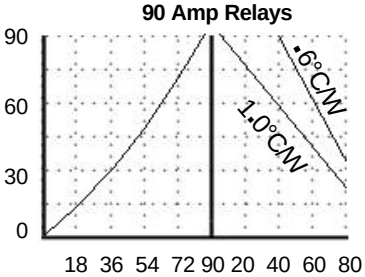
Max Base Plate=85°C
Rt=0.021 ohms Pwr Ref: V_0=0.80V_0

50 Amp Relays



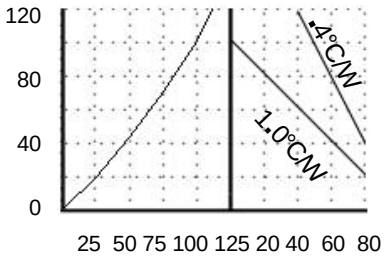
Max Base Plate=95°C
Rt=0.0092 ohms Pwr Ref: V_0=0.80V_0

90 Amp Relays



Max Base Plate=100°C
Rt=0.0039 ohms Pwr Ref: V_0=0.80V_0

125 Amp Relays



Max Base Plate=100°C
Rt=0.0029 ohms Pwr Ref: V_0=0.80V_0

Math calculations, in place of the chart information:
1) Power dissipation (heat generated) for a Power-IO solid state relay:

$(0.9 \times Irms \times V_0) + (Irms^2 \times Rt)$ = watts of heat generated

For example: Use a HDA-6V50 (50 amp relay) for a 31 amp application:
(0.9 x 31Amps x 0.80) + (31Amps² x 0.0092 ohms) = 31.16 watts of heat

2) What size heat sink do I need?:

(Max Base Plate Temp - Max Ambient Temp) / Watts Dissipated = ___°C/W

For example: For the solid state relay in example 1 above,
(95°C max base plate - 45°C industrial installation) / 31.16 watts = 1.6°C/W
You need a heat sink that is rated 1.6 °C/W or LOWER. The Power-IO 1.6°C/W heat sink would be a good choice and the 1.0°C/W heat sink would offer even better performance. Our calculations include the thermal junctions between the relay, the thermal compound, and the heat sink. We also use a conservative 115°C max for the heat sink which is 10°C below the theoretical 125°C limit.

Custom products:
Power-IO is also able to produce solid state relays for other amperage ranges, control inputs, line frequencies, or voltage ranges. The relays can be built as pre-assembled packages including heat sinks, thermal pads, and other components. Please contact us for a quotation for custom products.

Precautions:
The products that are designed, manufactured, or sold by POWER-IO are intended to be installed and serviced by trained personnel. In addition, there are local, national, factory, and other regulations (sometimes referred to as the NEC, National Electrical Code, OSHA, or equivalent) that must be strictly followed during the installation and use of any POWER-IO product. Failure to follow all of these regulations can result in downtime, damage, injury, or death. It is important that the customer anticipate the temperature requirements of the product. To ensure the longest possible life, it is customary that the electrical design not exceed 80% of the max amperage for relays, circuit breakers, fuses, wiring and other electronic components in an installation, when at the full operating temperature. Power-IO warrants its products for a period of 2 years from the date of manufacture to be free from defects in both workmanship and materials. See www.power-io.com for further information.

Power-IO 537 Braemar Avenue Naperville, IL 60563 USA Tel: 630-717-7335 www.power-io.com email: sales@power-io.com
Technical support: support@power-io.com ©2005 Power-IO. Specifications subject to change without notice. PN:HDA01/01/2005

POWER-IO

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C Family of Solid State Contactors --
The new standard for industrially hardened, AC-1 and AC-3 solid state contactors

Features

- 2 switching channels for up to 100 amps per leg
- ALERT diagnostics output -- SCR health, SCR problem, load open, external fuse open, broken wire, and thermal problems
- Two independent channels OR install it as a 2 pole contactor
- SMALL -- only 80 mm by 175mm (~3x7 inches)
- Maximum Surge Survival™ technology -- triple layer, voltage surge protection
- Thermally optimized heat sink permits edge-to-edge installations
- Universal installation bracket -- din rail or bolt on
- *REAL POWER* switching channels every 1.6 inches
- Heater contactor, lighting contactor, or motor starter
- Modular design for flexibility in stocking, installing, and maintaining
- Green LEDs for input status, red LEDS for ALERT status
- Built-in snubber circuit and MOVs
- Built in temperature monitor and temperature shutdown
- Precise zero crossing switching -- lowest EMI, lowest noise to nearby electronics
- 4000 volt isolation, 1400 volt blocking voltage, 1650 max amperage for one sinewave
- Industry standard L1, T1, L2, T2, A1, A2, B1, B2 terminal numbers
- High density design permits more amps per square inch of installation area

Part Number

CZ2H-IDC2 Solid State Contactor, 2 channels at up to 100 amps per channel, 575V max, DC control input. Includes heat sink. BUY

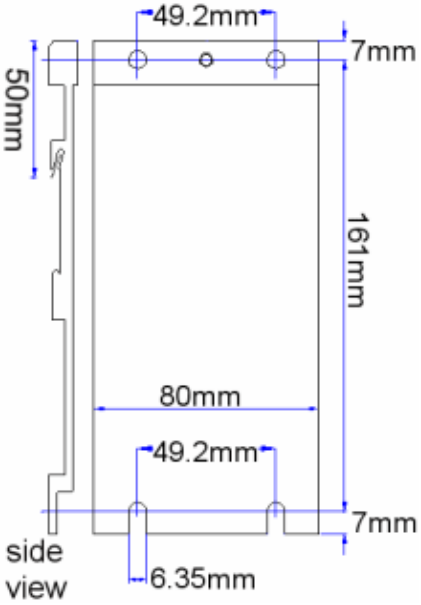
CZ2H-IDC2-A02 Solid State Contactor, 2 channels at up to 100 amps per channel, 575V max, DC control input. Customer to supply own heat sink. Example: for replacement purposes, for large applications (100-500 zones) using a large external heat sink, or military applications when installed directly to the ship or vehicle's frame. BUY

For additional information and complete product specifications, please see the four page: C Family Solid State Contactor Data Bulletin. For simplified wiring information and ALERT wiring information, visit: control input and ALERT wiring. For high amperage inrush applications (motor starters, municipal lighting, stadium lighting, etc.) confirm that the maximum amperage requirements for the load is less than 180 amps for 2 seconds.

Side by Side Power

Part Number	Line Voltage Range (VAC)	Load Current Range (A RMS)	Min Control Voltage & Current Draw	Max Control Voltage & Current Draw
CZ2H-IDC2	24-575	.25-100 per channel	3vdc/2mA	32vdc/2mA
Diagnostics output	The ALERT output will activate upon: SCR #1 failed open or closed, SCR #2 failed open or closed, SCR incapable of switching (OK now, but can not switch when commanded), no incoming power (open fuse), no outbound power (open load), and thermal shutdown. The "incapable of switching ALERT" is a Power-io exclusive feature. For example: a dropped tool momentarily shorts the load during a machine change-over. The machine starts OK and the loads are ON during start up. The ALERT activates because the SCR is damaged and is incapable of future switching as requested. The standard diagnostics range is for a line voltage of 100 - 575 VAC. Contact Power-io for diagnostics outside this voltage range.			
Off-State dv/dt	>3000 v/µs			

Isolation	4000 volts isolation: Line to control input 1; Line to control input 2, Line to base
I²T fuse	100A or less, for example: Bussman FWP-100A22F, or smaller. High inrush loads, motors, incandescent lights, stadium lighting may be able to use higher I²T fuses, under certain circumstances. Contact Power-io before using any I²T fuse greater than 100 amps.
Turn-on time	One sinewave max, max imbalance delay 1/2 sinewave
Turn-off time	One sinewave max, max imbalance delay 1/2 sinewave
Power terminals	Will accept #8- #2 AWG wire. Torque: 40-60 inch lbs.
Control terminals	Will accept #24- #12 AWG wire. Torque: 7-9 inch lbs.



Power-IO™

C Family of Solid State Contactors
Up to 100 Amps per channel
Up to 575 Vac switched
DC Control Inputs

- New, high density POWER-IO, up to 100 amps every 1.6 inches
- 2 power channels for: 2 independent single phase loads, 2-leg break single phase loads, or 2-leg break delta loads
- Multiple C family units can be installed edge-to-edge for highly efficient use of your panel space.
- Advanced diagnostics and ALERT output
- For 3 leg break 3 phase applications, achieve up to 100 amp switching on each leg in less than a 7x7x7 inch cube.
- Replaces DC activated contactors
- Fourth generation **Maximum Surge Survival**™ technology for triple-layer surge protection and long life
- Optically isolated for 4000 volt isolation
- International green input status LED for each channel
- Red LEDS for problem conditions
- International terminal markings
- 1400 volt transient blocking voltage
- The integral Ultra Power Cooler™ heat sink offers optimum thermal performance in a minimum space
- Precise zero voltage turn-on for low EMI (noise)
- Internal, oversized components + advanced direct copper bonding capability = increased reliability, less thermal rise, and longer life
- Internal, rugged, snubber circuit and internal power MOVs for robust performance on all channels

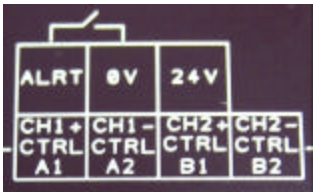
The C family is a **modular, intelligent power controller** that is designed to easily integrate into existing control systems. With flow-though power wiring and an overall, “installed width requirement” of only 80 mm (3.15 inches), you have 2 power switching channels in less width than a typical 2 pole contactor. Large power terminals accept up to a 2 AWG wire while protecting your operators from exposed power connections. The 2 power channels offer 4000 volt optical isolation from each other, from each control input, and from the aluminum base. By inserting a single jumper wire, both control channels can be activated from a single control input for use in many delta load applications.

The internal diagnostic circuit monitors the conditions regarding the health of the contactor. An ALERT output is generated whenever a problem occurs so the control system can take preventative measures immediately.

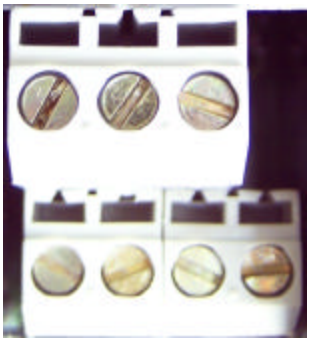
The C family has a universal mounting bracket for DIN rail or bolt-on installations. The integral Ultra Power Cooler™ heat sink is fan assisted in order to achieve maximum performance, even when installed in tightly packed electrical cabinets or warm industrial environments. When multiple C family contactors are installed on the same horizontal DIN rail, there is NO need to leave space between products for cooling purposes. The industry-standard 24 VDC fan is part of an internal temperature monitoring system that activates the fan as needed and provides a thermal shutdown of the inputs in case of excessive temperatures.

For applications requiring a heat sink outside of the electrical enclosure, the Ultra Power Cooler heat sink can be installed outside the cabinet, directly behind the Power-IO’s modular contactor unit. This split contactor installation method is often used in applications that require completely sealed electrical enclosures such as food processing facilities, PVC plastic manufacturing facilities, or medical applications. As an alternative, different external heat sinks can be custom designed for an application. In these cases, the maximum amperage capability of the C family will be de-rated accordingly.

Control Input Wiring:



For DC control input signals, the bottom four position terminal block accepts the control input #1 and control input #2. These accept any control signal between 4-32 VDC and greater than 2 mA. The low mA requirement is very beneficial with smaller control systems, PLCs, and USB outputs from a PC based control system. Terminals A1 and A2 are the control inputs for Channel 1 (L1 and T1 switching). Terminals B1 and B2 are the control inputs for Channel 2 (L2 and T2 switching).



The upper 3 position terminal block is used for the 24 VDC power supply connection and the ALERT output. The diagnostics are always active, even when the two control inputs are "off". The ALERT output can be used independently or connected in parallel with other C Family units. The ALERT can be connected to a Power-IO HDA "hockey puck" relay or connected to a Power-IO I/O module for use in any PLC or PC based application.

For 3 phase applications or any other "simultaneous 2 leg switching application", you can install external jumper wires so control #1 and control #2 activate and deactivate at the same time.

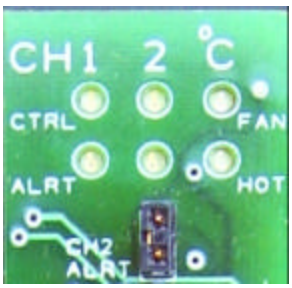
The fan is activated by an internal temperature measurement circuit, as needed. In case of thermal overload, the inputs will be disabled and a red LED will illuminate until the condition is corrected.

Internal Construction:

The safety cover should ONLY be removed by Power-IO trained and authorized personnel.

The control input board is field replaceable as an IDC2 (Input DC, 2 Channel), IAC2, and other input combinations. The fan wiring is factory installed to the mid-board, 2 position connector. The DC activated fan is a standard 80mm size fan.

The red MOVs are standard but they can be removed for 600 VAC Canadian installations.



6 Diagnostic LEDS and jumper:

- Channel 1 control input "on": GREEN
- Channel 2 control input "on": GREEN
- Temperature measurement requests fan "on": GREEN
- Channel 1 Alert: RED
- Channel 2 Alert: RED
- Hot, unit in thermal shutdown : RED

ALERT conditions:

The Alert output will become active based up:

- Channel 1 SCR failed in "ON" mode, or failed in "OFF" mode, or incapable of switching in the future
- Channel 2 SCR failed in "ON" mode, or failed in "OFF" mode, or incapable of switching in the future
- Open external fuse, tripped circuit breaker, or open load, even when the SCR is in "OFF" state*
- Shorted SCR detection, even when the SCR is in the "ON" state*
- Thermal shutdown, control input #1 and #2 automatically turned off

*For example: on machine start-up, all SCRs might be requested to be "ON". If a machine failure damages the SCR, the diagnostics alert will activate because the SCR is not capable of turning "OFF". Power-IO's exclusive diagnostics circuit monitors the status of the unit — immediate and future health capability.

Model Numbers	DC Control input	CZ2H-IDC2
Number of Power Switching Channels		2

Output Specifications (All shown at **40°C**)

Operating Voltage (47-63 Hz) [Vrms}	24-575 volts switched
Max Load Current [Arms]	100 amps/channel
Min Load Current [Arms]	0.25 amps
Maximum Motor Starter Size, Single Phase *	30 FLA, such as: 7.5HP@230vac, 12HP @460vac,
Maximum Motor Starter Size, 3 Phase, Using 2 of CZ2H Models *	30 FLA / Leg such as: 10HP @230vac, 25HP @460vac
* Confirm The Maximum Motor Inrush, <180 Amps for 2 Seconds	
Transient Overvoltage [Vpk]	1400 volts
Max Surge Current for 16.7ms [Apk]	1650 amps
Max On-State Voltage Drop @ Rated Current [Vpk]	1.2
Max I^2T Per Channel (8.3 msec) [A^2sec]	22,678 A^2sec
Max I^2T for Fusing Per Channel (10 msec) [A^2sec]	11,200 A^2sec
Max. Off-State Leakage @ Rated Voltage [mArms]	15mA
Min Off-State dv/dt @ Max Rated Voltage [V/µsec] *	>3000
* High dv/dt values = better false triggering protection	
Max Turn-On Time	1 sinewave, max imbalance = 1/2 sinewave
Max Turn-Off Time	1 sinewave, max imbalance = 1/2 sinewave
Recommended I^2T fuse (AC-1, resistive loads)*	Finger safe: FUSE-KIT-22-100, or stand alone: FWP-125A
* Contact Power-io for I^2T fuses for AC-3, high inrush, or inductive loads	

Input Specifications (All shown at -40°C to +85°C)

DC Control Input Voltage Range	3-32 VDC, 2mA each
Min Turn-Off Voltage	1 VDC / 0.5mA
Control inputs are **current limited** (consistent mA) and include the green "input status" LED requirements	
Input Thermal Shutdown Temperature	105C Typical
Input Thermal Shutdown Recovery Temperature	90C Typical

Alert Output Specifications

Open Collector	32 V Max, -8mA max
Onstate Saturation Voltage (Vdrop)	<2 volts
Compatible with Power-IO Products Such As:	Models HDA, HDD, DDA, IO-IDC, IO-ODC, or IO-OAC

External Power Supply Specifications

	Standard 24 VDC Power Supplies +/- 15%
For Example: www.power-io.com/products/powersupply.htm	This 75 watt unit is ideal for up to 25 CZ2H contactors

Fan Specifications (Premium, Dual Ball Bearing Fan)

Standard Fan Voltage Requirement *	24 VDC +/- 15%, 100mA
* contact Power-io for other voltage fans	
Size	Industry Standard, 80 x 80 x 20mm, Field Replaceable
L 10 rating	60,000 hours, 40 degrees C intake temperature
MTBF	300,000 hours

General Specifications

Dielectric Strength: Inputs-Output 1-Output 2-Base	4000 Vrms
Dielectric Strength: Inputs 1-Input 2-Power Supply	2500 Vrms
Ambient Operating Temperature Range	-40°C to 85°C, when used with unrestricted air flow
Ambient Storage Temperature Range	-40°C to 125°C
Power Terminal Wire Size (Copper Wire Only)	2-8 AWG, torque to 40-60 in/lbs
Control Input or Fan Wire Size	12-24 AWG, torque to 7-9 in/lbs
RoHS Compliance Information, by weight	<0.1% lead, 0% mercury, 0% cadmium, 0% hexavalent chromium, 0% PBB, 0% PBDE
Shipping	6.3 lbs weight typical.

Power-IO™

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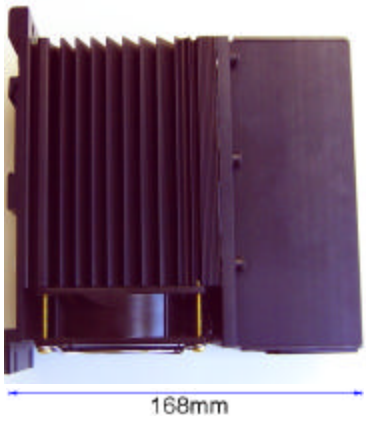
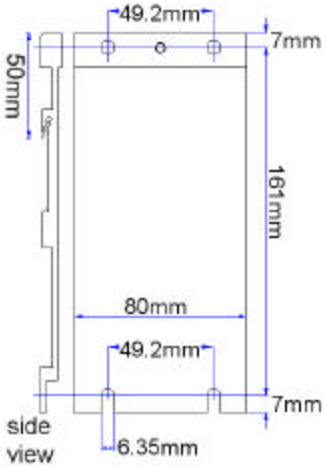
Up to 100 Amps per channel
Up to 575 Vac switched

Recommended mounting:





For surface mounting installations: drill and tap for # 10 screws

For standard 35mm din rail installations: firmly attach the din rail to the sub-plate every 100-150mm..

Leave a minimum of 25mm (one inch) above and below the unit for air circulation. If multiple C Family units are installed next to each other, the horizontal spacing requirement is zero for those units, as shown in the first picture.

FAQ answers:

1) The power switching channels are totally independent. They do not have to be wired to any particular phase.
2) The power switching channels can switch 2 independent single phase loads, 2 legs of a single phase load, 2 leg delta loads, resistive heaters, motors, municipal lighting and similar products.
3) The power connection terminals are standard copper T&B electrical connectors for 2-8 AWG wire. The wire should be prepared in accordance with all recommendations from Thomas and Betts. Only use copper wire for connections.
4) All systems require fuses or circuit breakers in accordance with local electrical codes. In addition, an I^2T fuse is a special, high speed semiconductor fuse that protects the solid state contactor.

Custom products:
Power-IO is also able to produce solid state relays for other amperage ranges, control inputs, line frequencies, or voltage ranges. The relays can be built as pre-assembled packages including heat sinks, thermal pads, and other components. Please contact us for a quotation for custom products.

Precautions:
The products that are designed, manufactured, or sold by POWER-IO are intended to be installed and serviced by trained personnel. In addition, there are local, national, factory, and other regulations (sometimes referred to as the National Electrical Code, NEC, OSHA, or equivalent) that must be strictly followed during the installation and use of any POWER-IO product. Failure to follow all of these regulations can result in downtime, damage, injury, or death. It is important that the customer anticipate the temperature requirements of the product. To ensure the longest possible life, it is customary that the electrical design not exceed 80% of the max amperage for relays, circuit breakers, fuses, wiring and other electronic components in an installation, when at the full operating temperature. Power-IO warrants its products for a period of 2 years from the date of manufacture to be free from defects in both workmanship and materials. See www.power-io.com for further information.

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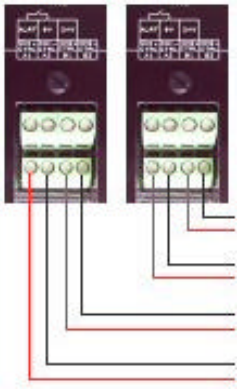
Technical support: support@power-io.com ©2006 Power-IO. Specifications subject to change without notice. PN:C-DC-112006

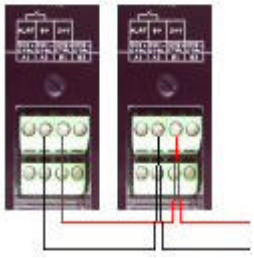
C Family ALERT wiring information

The ALERT output as used in the C Family of products can be used as follows. In each example, typically 1 to 16 of the CZ2H-IDC2 units can have the ALERT outputs wired as shown. The wiring should be done in a way to minimize exposure to electrically noisy environments. The 24 VDC power supply that is being used with the C Family installation should also be used with the ALERT wiring. This power supply should be wired to the PLC card in accordance with their instructions.

When the switched product is a Power-io solid state relay or I/O module, the + of the 24 VDC power supply is wired to the + control input of the Power-io solid state relay or I/O.



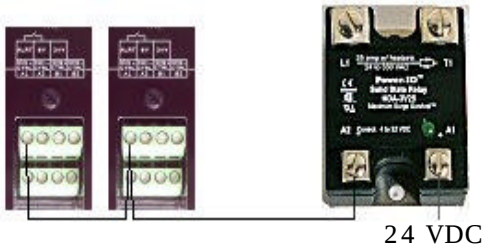
Zone 4, control inputs
Zone 3, control inputs
Zone 2, control inputs
Zone 1, control inputs



24 VDC
power supply

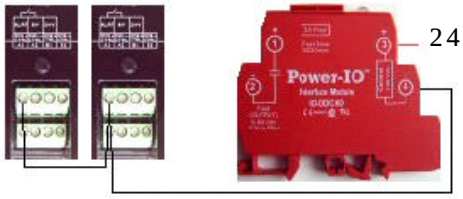
1-16 Power-io ALERTs

A standard PLC input card where the input is set to PULL UP. Power-io's ALERT output will pull down when an ALERT condition happens. Some PLCs will call the ALERT output a "PLC sinking input signal".



24 VDC +

A Power-io HDA-3V25 solid state relay. When an ALERT condition happens, the green LED on the HDA-3V25 will illuminate and a solid state "contact closure" will occur between L1 and T1.



24 VDC +

A Power-io IO module such as:
IO-OAC (Output AC — AC switched output)
IO-ODC (Output DC — DC switched output)
IO-IDC (Input DC, Isolated input to a PLC; available as –Positive or –Negative; similar to normally open or normally closed)

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POWER-IO

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Features

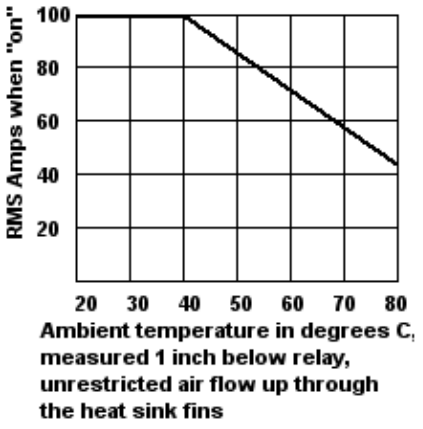
- 2 switching channels for up to 100 amps per leg
- Two independent channels OR install it as a 2 pole contactor
- SMALL -- only 80 mm by 175mm (~3x7 inches)
- Maximum Surge Survival™ technology -- triple layer, voltage surge protection
- Thermally optimized heat sink permits edge-to-edge installations
- Universal installation bracket -- din rail or bolt on
- *REAL POWER* switching channels every 1.6 inches
- Fast, easy replacement for mercury contactors -- same size, same wiring
- Heater contactor, lighting contactor, or motor starter
- Modular design for flexibility in stocking, installing, and maintaining
- Green LEDs for input status
- Built-in snubber circuit and MOVs
- Built in temperature monitor and temperature shutdown
- Precise zero crossing switching -- lowest EMI, lowest noise to nearby electronics
- 4000 volt isolation, 1400 volt blocking voltage, 1650 max amperage for one sinewave
- Industry standard L1, T1, L2, T2, A1, A2, B1, B2 terminal numbers
- High density design permits more amps per square inch of installation area

Part Numbers

CZ2H-IAC2 Solid State Contactor, 2 channels at up to 100 amps per channel, 575V max, AC control input. Includes heat sink. BUY

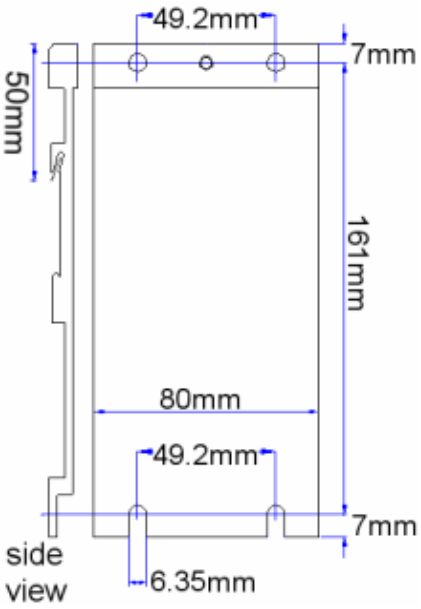
CZ2H-IAC2-A02 Solid State Contactor, 2 channels at up to 100 amps per channel, 575V max, AC control input. Customer to supply own heat sink. Example: for replacement purposes, for large applications (100-500 zones) using a large external heat sink, or military applications when installed directly to the ship or vehicle's frame. BUY

For additional information and complete product specifications, please see the four page: C Family Solid State Contactor Data Bulletin For high inrush applications, confirm the maximum amperage requirements for the load.



Part Number	Line Voltage Range (VAC)	Load Current Range (A RMS)	Min Control Voltage & Current Draw	Max Control Voltage & Current Draw
CZ2H-IAC2	24-575	.25-100 per channel	100VAC/7mA	280VAC/13.3mA
AC activated control inputs typically do NOT need a burden resistor when activated by a triac output controller or triac output PLC.				
Off-State dv/dt	>3000 v/µs			
Isolation	4000 volts isolation: Line to control input 1; Line to control input 2, Line to base			
I^2T fuse	100A or less, for example: Bussman FWP-100A22F, or smaller. High inrush loads, motors, incandescent lights, stadium lighting may be able to use higher I^2T fuses, under certain circumstances. Contact Power-io before using any I^2T fuse greater than 100 amps.			

Turn-on time	One sinewave max, max imbalance delay 1/2 sinewave
Turn-off time	One sinewave max, max imbalance delay 1/2 sinewave
Power terminals	Will accept #8- #2 AWG wire. Torque: 40-60 inch lbs.
Control terminals	Will accept #24- #12 AWG wire. Torque: 7-9 inch lbs.



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- Internal, oversized components + advanced direct copper bonding capability = increased reliability, less thermal rise, and longer life
- The integral Ultra Power Cooler™ heat sink offers optimum thermal performance in a minimum space
- Optically isolated for 4000 volt isolation
- International green input status LED for each channel
- International terminal markings
- 1400 volt transient blocking voltage
- Precise zero voltage turn-on for low EMI (noise)
- Internal, rugged, snubber circuit and internal power MOVs for robust performance on all channels

The C family is a modular solid state power controller that is designed to easily replace mercury or electro-mechanical contactors in applications from 50-100 amps per leg. With flow-though power wiring and an overall, “installed width requirement” of only 80 mm (3.15 inches), you have 2 power switching channels in less width than a typical 2 pole contactor. Large power terminals accept up to a 2 AWG wire while protecting your operators from exposed power connections. The 2 power channels offer 4000 volt optical isolation from each other, from each control input, and from the aluminum base. By inserting a single jumper wire, both control channels can be activated from a single control input for use in many DPST applications or 3 phase delta load applications.

The C family has a universal mounting bracket for DIN rail or bolt-on installations. The integral Ultra Power Cooler™ heat sink is fan assisted in order to achieve maximum performance, even when installed in tightly packed electrical cabinets or warm industrial environments. When multiple C family contactors are installed on the same horizontal DIN rail, there is NO need to leave space between products for cooling purposes. The industry-standard 120 VAC fan is also available in other voltages, contact Power-IO for more information.

For applications requiring a heat sink outside of the electrical enclosure, the Ultra Power Cooler heat sink can be installed outside the cabinet, directly behind the Power-IO’s modular contactor unit. This split contactor installation method is often used in applications that require completely sealed electrical enclosures such as food processing facilities, PVC plastic manufacturing facilities, or medical applications. As an alternative, different external heat sinks can be custom designed for an application. In these cases, the maximum amperage capability of the C family will be de-rated accordingly.

Control Input Wiring:

For AC control input signals, the four position terminal block accepts the fan power, control input #1, control input #2, and the neutral connection. For American installations, the default fan voltage is 120 VAC. Other fan voltages are available upon special request. The control input range is 100-264 VAC. For simplicity, the control inputs and the fan input should be the same voltage. For 3 phase applications or any other "simultaneous 2 leg switching application", you can install a jumper so control #1 and control #2 activate and deactivate at the same time. The fan should be wired as always ON. If the fan power is disabled or if the internal thermal measurement circuit senses an over-temperature problem, the unit will automatically disable control input #1 and #2 until the warm condition is corrected.

Internal Construction:

The safety cover should ONLY be removed by Power-IO trained and authorized personnel.

The control input board is field replaceable as an IAC2 (Input AC, 2 Channel), IDC2, and other input combinations. The fan wiring is factory installed to the mid-board, 2 position connector. American 120 VAC fans or European 240 VAC fans would be connected to this screw connection.

The red MOVs are standard but they can be factory removed for switching 600 VAC, such as for Canadian installations.

Diagnostic LEDS and board label:

The IAC2 board has three LEDS at the top edge. These represent:

- Channel 1 control input "on": GREEN
- Channel 2 control input "on": GREEN
- HOT, unit in thermal shutdown : RED

The red LED will flicker momentarily when the IAC2 control input board is first powered as a diagnostic confirmation that the fan input power is present.

Model Numbers	AC Control input	CZ2H-IAC2
Number of Power Switching Channels		2

Output Specifications (All shown at **40°C**)

Operating Voltage (47-63 Hz) [Vrms}	24-575 volts switched
Max Load Current [Arms]	100 amps/channel
Min Load Current [Arms]	0.25 amps
Maximum Motor Starter Size, Single Phase *	30 FLA, such as: 7.5HP@230vac, 12HP @460vac,
Maximum Motor Starter Size, 3 Phase, Using 2 of CZ2H Models*	30 FLA / Leg such as: 10HP @230vac, 25HP @460vac
* Confirm The Maximum Motor Inrush, <180 Amps for 2 Seconds	
Transient Overvoltage [Vpk]	1400 volts
Max Surge Current for 16.7ms [Apk]	1650 amps
Max On-State Voltage Drop @ Rated Current [Vpk]	1.2
Max I^2T Per Channel (8.3 msec) [A^2sec]	22,678 A^2sec
Max I^2T for Fusing Per Channel (10 msec) [A^2sec]	11,200 A^2sec
Max. Off-State Leakage @ Rated Voltage [mArms]	15mA
Min Off-State dv/dt @ Max Rated Voltage [V/µsec] *	>3000
* High dv/dt values = better false triggering protection	
Max Turn-On Time	1 sinewave, max imbalance = 1/2 sinewave
Max Turn-Off Time	1 sinewave, max imbalance = 1/2 sinewave
Recommended I^2T fuse (AC-1, resistive loads)*	Finger safe: FUSE-KIT-22-100, or stand alone: FWP-125A
* Contact Power-io for I^2T fuses for AC-3, high inrush, or inductive loads	

Input Specifications (All shown at -40°C to +85°C)

AC Control Input Voltage Range	100-280 Vac, 47 - 63 Hz
Min Turn-Off Voltage *	40 Vrms / 2mA
* > than most PLC's triac leakage = eliminates false activation	
* C family contactors can be activated by triac output PLCs, PID controllers, etc. typically WITHOUT the extra burden resistor.	
Nominal Input Impedance of 18K @ 120 Vac	6.7 mA
Input Thermal Shutdown Temperature	105C Typical
Input Thermal Shutdown Recovery Temperature	90C Typical

Fan Specifications (Premium, Dual Ball Bearing Fan)

Standard Fan Voltage Requirement *	120 VAC +/- 15%, 9 watts
* contact Power-io for other voltage fans	
Size	Industry Standard, 80mm x 20mm, Field Replaceable
L 10 rating	60,000 hours, 40 degrees C intake temperature
MTBF	300,000 hours

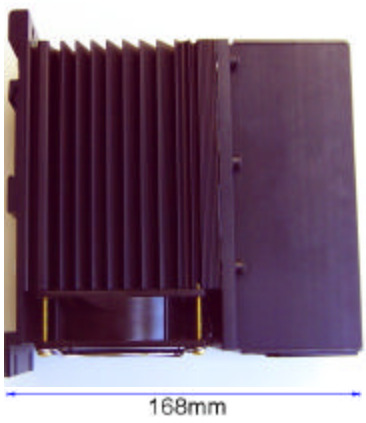
General Specifications

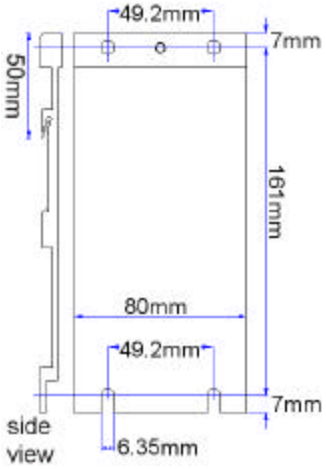
Dielectric Strength: Inputs-Output 1-Output 2-Base	4000 Vrms
Ambient Operating Temperature Range	-40°C to 85°C, when used with unrestricted air flow
Ambient Storage Temperature Range	-40°C to 125°C
Power Terminal Wire Size (Copper Wire Only)	2-8 AWG, torque to 40-60 in/lbs
Control Input or Fan Wire Size	12-24 AWG, torque to 7-9 in/lbs
RoHS Compliance Information, by weight	<0.1% lead, 0% mercury, 0% cadmium, 0% hexavalent chromium, 0% PBB, 0% PBDE
Shipping	6.3 lbs weight typical.

Power-IO™

C Family of Solid State Contactors
Up to 100 Amps per channel
Up to 575 Vac switched

Recommended mounting:





For surface mounting installations: drill and tap for # 10 screws

For standard 35mm din rail installations: firmly attach the din rail to the sub-plate every 100-150mm..

Leave a minimum of 25mm (one inch) above and below the unit for air circulation. If multiple C Family units are installed next to each other, the horizontal spacing requirement is zero for those units, as shown in the first picture.

FAQ answers:

1) The power switching channels are totally independent. They do not have to be wired to any particular phase. They do not have to be in phase with the fan power or the control input power.
2) The power switching channels can switch 2 independent single phase loads, 2 legs of a single phase load, 2 leg delta loads, resistive heaters, motors, and similar products.
3) The power connection terminals are standard copper T&B electrical connectors for 2-8 AWG wire. The wire should be prepared in accordance with all recommendations from Thomas and Betts. Only use copper wire for connections.
4) All systems require fuses or circuit breakers in accordance with local electrical codes. In addition, an I^2T fuse is a special, high speed semiconductor protection fuse that protects the solid state contactor.

Custom products:
Power-IO is also able to produce solid state relays for other amperage ranges, control inputs, line frequencies, or voltage ranges. The relays can be built as pre-assembled packages including heat sinks, thermal pads, and other components. Please contact us for a quotation for custom products.

Precautions:
The products that are designed, manufactured, or sold by POWER-IO are intended to be installed and serviced by trained personnel. In addition, there are local, national, factory, and other regulations (sometimes referred to as the National Electrical Code, NEC, OSHA, or equivalent) that must be strictly followed during the installation and use of any POWER-IO product. Failure to follow all of these regulations can result in downtime, damage, injury, or death. It is important that the customer anticipate the temperature requirements of the product. To ensure the longest possible life, it is customary that the electrical design not exceed 80% of the max amperage for relays, circuit breakers, fuses, wiring and other electronic components in an installation, when at the full operating temperature. Power-IO warrants its products for a period of 2 years from the date of manufacture to be free from defects in both workmanship and materials. See www.power-io.com for further information.

Power-IO 537 Braemar Avenue Naperville, IL 60563 USA Tel: 630-717-7335 www.power-io.com email: sales@power-io.com
Technical support: support@power-io.com ©2006 Power-IO. Specifications subject to change without notice. PN:C-AC-112006

POWER-IO

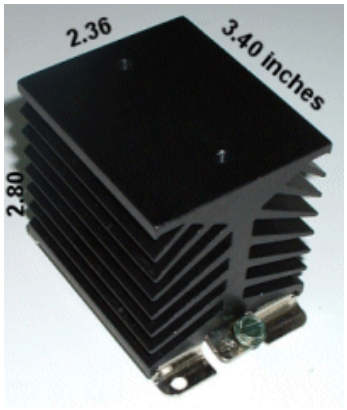
Product information as saved in the www.power-io.com library.
You may save, or print, a copy for your personal use.

As your ambient temperature increases or as your amperage increases, the use of a properly sized heatsink is necessary. Hint: the smaller the "heat sink rating" number, the better the heatsink is at capturing and dissipating the heat. The Power-io heatsinks are the outstanding choice for most applications because they:

- use the least amount of sub-plate mounting space,
- extend the heat sink forward for the best air flow, optimized thermal dissipation flow channels, and surface area exposure
- occupy about the same side-to-side physical space as mercury or mechanical contactors so new or retrofit installations are easy
- use an universal mounting bracket -- they can be din rail mounted for fast installations without the need for drilling and tapping pre-aligned hole patterns or they can be attached with a standard bolt.

Please note: our documented DIN heat ratings are based upon the conservative estimate of being installed in "still air and clipped onto a din rail". Your actual performance will be better than our ratings if: 1) the DIN heatsinks are screwed to a metal subplate (which provides additional heatsinking capability) and/or 2) if there is any airflow in your installation, such as fan cooling. You must use a thermal conduction grease (such as Dow Corning 340™) or a Power-io Thermal Pad in order to achieve the proper heat sinking capability between the SSR and the heatsinks shown below.

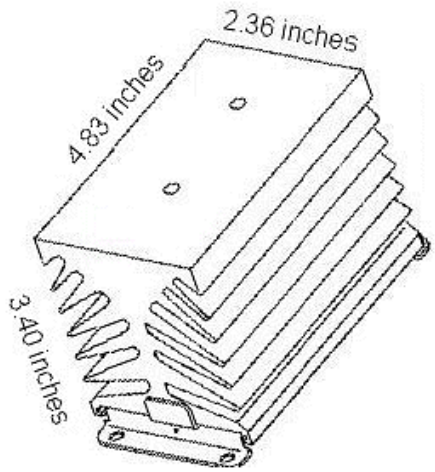
Hint: Solid state relays are semiconductor devices that generate heat in proportion to the quantity of amps being switched. Heat sinks capture that thermal rise and dissipate it. Heat sinks are rated by a °C/W number that represents: for every watt of heat generated, the solid state relay will increase by x°C. For example: if you put 30 watts of heat on a 2°C/W heat sink, the solid state relay's internal SCR dies will rise 60°C (30 x 2°C) above the ambient temperature. Therefore, the lower the °C/W rating, the more aggressively the heat sink captures and dissipates the heat. See our Power-IO data bulletins (AC switching SSR) or (DC switching SSR) for thermal charts for your particular application. It is important that you use a properly sized heat sink or else the SSR product will be permanently damaged.



HEATSK-DIN-1.6

Perfect size -- smallest outside dimensions while providing optimized heatsink capability. Uses about the same panel space as the just the SSR while providing the proper heatsink capability that is required for the majority of "typical" 5 - 40 amp applications.

- W: 2.36 inches H: 3.4 D: 2.8
- Two 8-32 tapped holes for relay mounting
- Attaches to a standard 35mm din rail OR it can be screw mounted to your electrical enclosure.
- Heat dissipation rating: 1.6°C/W
- Best value and smallest size for many 5-40 amp applications.
- Heat sink dimensions -- drawing
- BUY



HEATSK-DIN-1.0

Compact size -- small width dimensions while providing optimized heatsink capability. An engineering-optimized design uses the minimum amount of installation space while providing the proper heatsink capability that is required for the majority of "typical" 25 - 60 amp applications.

- Width: 2.36 inches H: 4.83 D: 3.4
- Two 8-32 tapped holes for relay mounting
- Clips to a 35mm din rail OR it can be screw mounted to your electrical enclosure (four 0.187 mounting holes)
- Heat dissipation rating: 1.0°C/W
- Performance engineered for thermal efficiency = best value and smallest size for many 25-60 amp applications
- Heat sink dimensions -- drawing
- BUY

Only 3.15 inches (80mm) wide

Ultra Power Cooler™ (Trademark of POWER-IO) At 0.2°C/W, this heat sink is the work horse -- any amperage application, at almost any ambient temperature, in any high density installation!

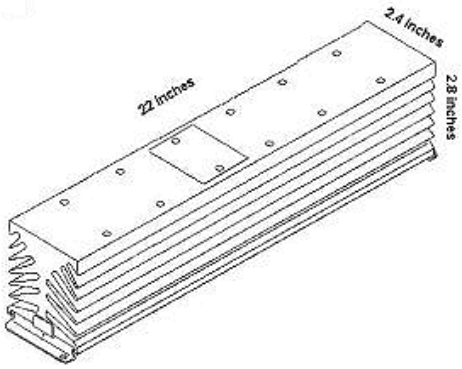
The Ultra Power Cooler is a fan assisted heat sink design. This permits better heat dissipation, while still occupying a very small installation area. Ideal for the higher amperage SSRs, custom SSR or IGBT applications, warm ambient temperature installations, or high density installations that have restricted free air flow.

- Width: 3.15 inches H: 6.50 D: 4.0
- Two 8-32 tapped holes for relay mounting (order relay separately)
- Clips to a 35mm din rail OR it can be screw mounted to your electrical enclosure (four mounting holes)
- Heat dissipation rating: 0.2°C/W
- Install edge-to-edge on a din rail with NO space between them.
- Industry standard, 80mm AC Fan requires 120 VAC at 9 watts
- Industry standard, 80mm DC Fan requires 24 VDC at 100mA
- UPC heat sink dimensions -- drawing and photos
- BUY AC fan model
- BUY DC fan model

Ultra Power Cooler™ Install multiple solid state relays, mosfets, or Power-io IGBT modules and still have excellent cooling in a small footprint.

- Width: 3.15 inches H: 6.50 D: 4.0
- Four 8-32 tapped holes for twin relay mounting (order relays separately)
- Heat dissipation rating: 0.4°C/W per relay
- Custom lengths, custom hole patterns, just ask!
- UPC heat sink dimensions -- drawing and photos
- BUY AC fan model
- BUY DC fan model

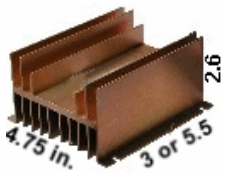
HEATSK-3PK-1.2 or HEATSK-6PK-1.2
(3 or 6 zones at 1.2 °C/W per zone)



The "6 Pack" or the "3 Pack" have a small width dimension while providing excellent heatsink capability. While only 2.4 inches wide and 22 inches high (6 Pack) or 11 inches (3 Pack), these multi-zone heat sinks can be populated with several of the "H" hockey puck relays. Ideal for: several single phase zones, three phase zones, and similar applications.

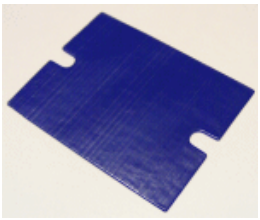
- Width: 2.4 inches H: 22 D: 2.8 for HEATSK-6PK-1.2
- Width: 2.4 inches H: 11 D: 2.8 for HEATSK-3PK-1.2
- Twelve (or six) 8-32 tapped holes for relay mounting
- Can be screw mounted to your electrical enclosure (0.187 mounting holes)
- Heat dissipation rating: 1.2°C/W per location. The thermal rating is better than 1.2°C/W, if some locations are not populated.
- Performance engineered for thermal efficiency
- 6 pack drawing and photos
- HEATSK-6PK-1.2 BUY
- HEATSK-3PK-1.2 BUY

Traditional SSR Heat Sink



The traditional heat sink designs are still available for applications where there is a very large area for the installation. The HEATSK-1.5-SM is 4.75 inches wide and 3 inches long. It is rated at 1.5°C/W which is for typical 5-40 amp applications. The HEATSK-1.0-SM is 4.75 inches wide and 5.5 inches long. It is rated at 1.0°C/W which is for typical 25-60 amp applications. Both heatsinks are attached by screws to the electrical cabinet.

- Heat sink dimensions -- drawing
- BUY 3 inch long, 1.5°C/W, 5-40 amps
- BUY 5.5 inch long, 1.0°C/W, 30-60 amps



Thermal Transfer Pad

This high performance dry pad looks like a piece of black aluminum foil. It is sandwiched between the relay and the heat sink. When the relay is activated, the relay's heat changes the dry pad into the optimal amount of thermal grease. Quick, easy, clean. Just the "right amount" to ensure the best thermal transfer characteristics. When installing the thermal pad, ensure that you fully tighten the two installation screws. Recommended torque: 20 - 25 inch pounds.

- BUY THERMAL-PAD (1 piece)
- BUY THERMAL-PAD-005 (5 pieces)

Mounting Screws (relay to heat sink)

The recommended mounting screws are two 8-32 x 3/8 long screws. We typically use phillips head screws but customers can use other screw head styles that match your local installation equipment. Our part number is: SCRW,8/32X3/8PH (pair of: screws, 8-32, 3/8 inch long, phillips head)

- BUY

MOVs

A MOV adds a fourth layer of voltage surge survival to our trademarked Maximum Surge Survival™ design. The MOV is beneficial if the application is exposed to a high quantity of repetitive AC surges, or to very high amplitude AC surges. A MOV is strongly encouraged on Power-IO motor starters since a motor's coil is a large voltage surge generator (inductive flyback). By design, the Maximum Surge Survival circuit offers the first three strong layers of defense, so the MOV is considered additional protection.

- BUY MOV for 24-265Vac loads
- BUY MOV for 120-575Vac loads

Pre-installed labor

If you wish, we can pre-assemble exactly what you order. First, order your relay, MOV (if desired), and heat sink. This service is a single line item that will: add one thermal pad, add a pair of installation screws, assemble the unit, and torque the installation screws to 20-25 inch pounds. The cost is per SSR.

- BUY

Return to the solid state relays for AC loads or solid state relays for DC loads or Power-io home

Power-IO™

HDD Family of Solid State Relays
Up to 75 Amps
Up to 600 Vdc switched

- Internal, oversized components + advanced metalized ceramic design = increased reliability, less thermal rise, and longer life
- Green LED that indicates input status for fast, visual diagnostics
- Optically isolated for 1500 volt isolation and 2100 volt peak
- **15 kHz, FAST** switching times for superior, consistent performance
- High immunity to voltage transients
- Directly compatible with PLCs, PCs, and most controllers
- Clear, IP20 finger-safe, snap on cover included
- Ideal for activating robotics, PWM loads, test equipment, DC servos, drone vehicle accessories, battery powered products, ATM motors, H Bridge, battery back-up systems, and alternative energy applications
- All parameters shown are at 40°C, a factory-hardened specification
- IGBT model HDD-6V15 for 0-600 Vdc applications
- Ultra low leakage HDD-2V14 for automatic test equipment applications

Model Numbers	HDD-06V75	HDD-1V20	HDD-1V40	HDD-2V14*	HDD-2V25	HDD-6V15

Items marked in green are engineering enhancements that typically lead the industry resulting in better, long term performance.

Output Specifications (All shown at 40°C, which is the typical industrial requirement, on appropriate heat sinks)

Operating Voltage, Vdc, Most Switched Loads	0-60	0-100	0-100	0-200	0-200	0-600
Operating Voltage, Motors or Highly Inductive Loads	0-30	0-50	0-50	0-100	0-100	0-300
Max Load Current [Continuous Arms] W/ Proper Heat Sink	75	20	40	14	25	15
Min Load Current [Arms]	0	0	0	0	0	0
Max Surge Current, Non-Repetitive	350	60	120	42	75	60
Max On-State Voltage Drop, Vdc @ Rated Current**	1.1	1.5	1.5	2.1	1.9	2.2
Thermal Resistance Junction to Case [°C/W]	0.55	1.0	0.55	1	0.55	1
Max. Off-State Leakage @ Rated Voltage @50°C (Max)	1mA	2mA	2mA	25µamp	2mA	600µamp
On-State Resistance, Max, Ohm @ Current Output*	0.02	0.069	0.034	0.15	0.075	IGBT
Internal switching component	mosfet	mosfet	mosfet	mosfet	mosfet	IGBT
Max Turn-On Time, Control Input >8VDC, Line >8VDC	25µsec	25µsec	25µsec	150µsec*	25µsec	25µsec
Max Turn-Off Time, Control Input >8VDC, Line >8VDC	25µsecond					

** at 40°C base plate temperature. At higher base plate temperatures, consult factory. Always use a properly sized heat sink!

High Speed On/Off Frequency Test: 100% of relays tested at 15Khz @50% duty cycle @10V control input. This is a PWM of 33 µsecond "on", 33 µsec "off", 33 µsec "on"….

*HDD-2V14 is tested at a slower turn ON speed and has a smaller leakage current when OFF.

Input Specifications (All shown at -40°C to +85°C)

Control Voltage Range	4-32 Vdc, with a green LED to indicate input status	
Min Turn-On Voltage and Current (-40°C to 25°C)	4.25 Vdc / 10mA	4 Vdc / 10mA
Min Turn-On Voltage and Current (25°C to 85°C)	4.25 Vdc / 10mA	3.75 Vdc/10mA
Max Turn-On Voltage and Current	32 Vdc / 20mA	
Max Turn-Off Voltage	1 Vdc	

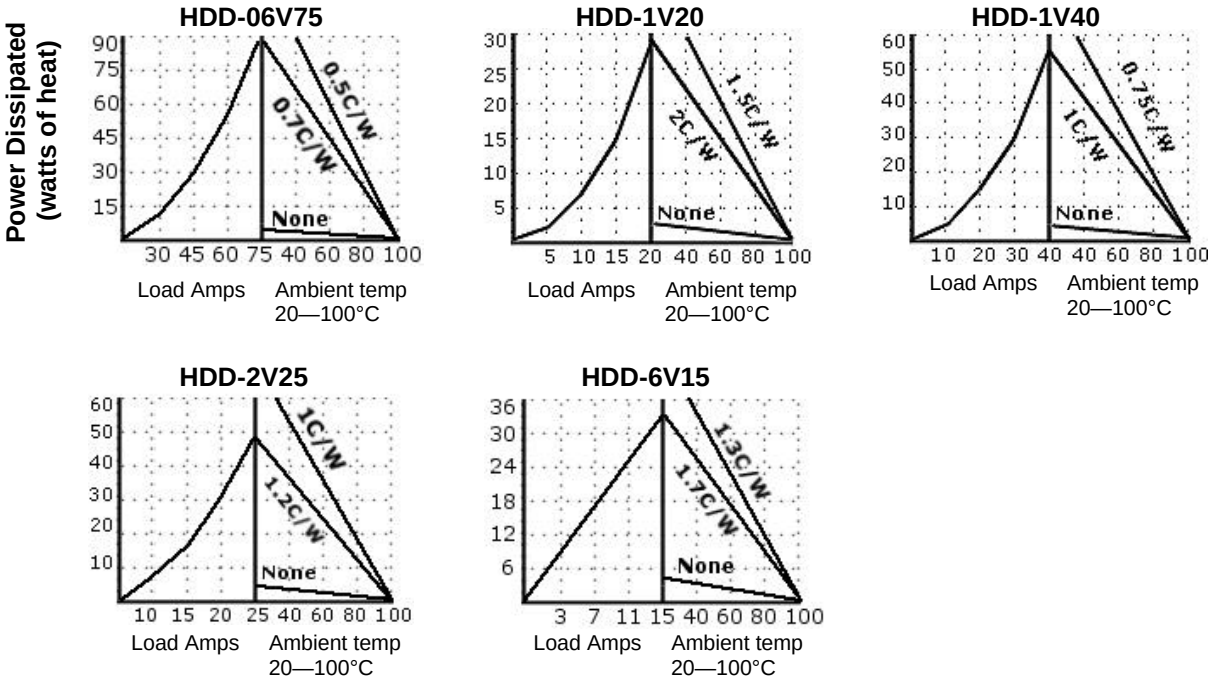
General Specifications

Dielectric Strength: Input / Output / Base Plate	1500 Vrms, 2100 Vpk
Input To Output Capacitance	8pf
Ambient Operating Temperature Range	-40°C to 85°C when used with an appropriate heat sink and air flow
Ambient Storage Temperature Range	-40°C to 125°C
Terminals	Four screws and saddle clamps provided, unmounted
Screw torque:	Control: 6-32 Screws 10 inch lbs.; Power: 8-32 screws 20 inch lbs.
Safety Cover	Clear, snap on, with 4 holes for multi-meter test probes
Shipping weight and size:	4.2 oz (130.6 g) typical. Box = 3.5x2x1.5 inches (87.5x50x37.5 mm)

Power-IO™

HDD Family of Solid State Relays
Up to 75 Amps
Up to 600 Vdc switched

Heat sink calculations. The graph on the left shows the total power dissipated as watts of heat, when the relay is in the "on" state. The graph on the right shows how different heat sinks will "typically" dissipate this heat when in different ambient temperature applications, where unrestricted air is permitted to flow up and through the heat sink. As shown in the graphs, if you use no heat sink, the product must be de-rated to less than 5 amps.



Math calculations, in place of the chart information:

Thermal rise — Mosfet Based Models HDD-06Vxx—HDD-2Vxx:
Power dissipation (heat generated) for a Power-IO solid state relay for a Vdc switching application:

Amps squared x "on-state resistance max ohms"

For example: for a HDD-1V20 that is switching a 12 amp load: 12 x 12 x .069 = 9.94 watts (heat) power dissipation.

Thermal rise — IGBT Based Model HDD-6V15:
Power dissipation (heat generated) for a Power-IO solid state relay for a Vdc switching application using IGBTs:

Amps x 2.2

For example: a HDD-6V15 that is switching a 5 amp load. 5 x 2.2 = 11 watts (heat) power dissipation.

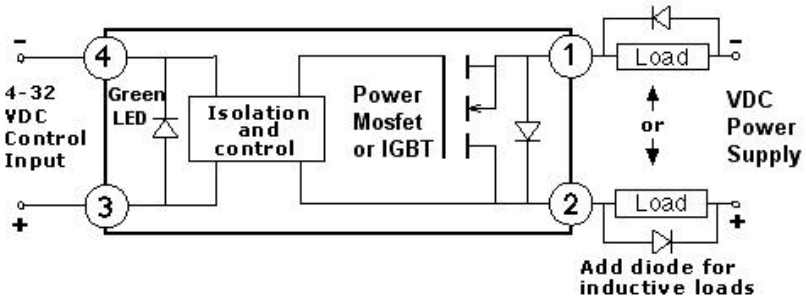
Recommended heat sink size:

(100 - ambient °C temperature) / (watts of power dissipation x 1.4)

For example: for a HDD-1V20 that is switching 12 amps in a 40°C warm electrical enclosure in a factory: (100 - 40°C) / (9.94 watts x 1.4) = 4.31
The required heat sink should be rated as 4.31°C/W or a SMALLER °C/W. The smaller the °C/W rating, the better the heat sink is at dissipating the heat. A 4°C/W heat sink would be good, and a 3°C/W or a 2°C/W would be better. Always use an adequate heat sink. Consult the www.power-io.com website for several high performance heat sinks.

Power-IO™

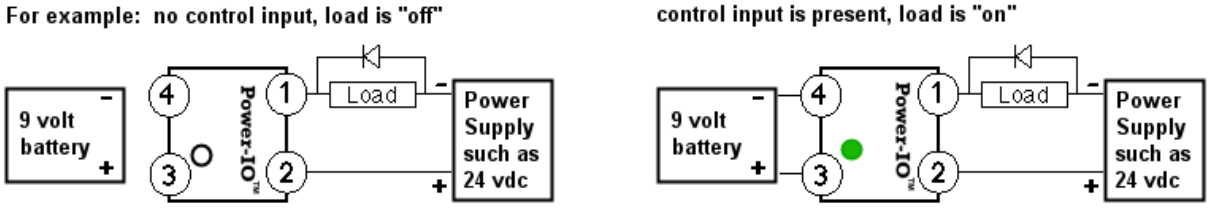
HDD Family of Solid State Relays
Up to 75 Amps
Up to 600 Vdc switched



Installation instructions:
The relay should be installed on a heat sink using a Power-IO thermal pad or Dow Corning 340™ thermal transfer grease. The heat sink installation screws should be torqued to 20-25 inch pounds to ensure a firm thermal connection between the relay and the heat sink. The heat sink should be installed so that the unrestricted air flows up and through the heat sink's fins. When using the relay to activate inductive DC loads (most DC loads are somewhat inductive), always use a fast recovery diode that has a PIV rating greater than the VDC line voltage. For example: a recommended diode is a 2-3 amp diode, with a 600-800V reverse voltage, at 75ns (Power-IO PN: HDD_DIODE). This can be purchased from Power-IO or from other electrical suppliers. The purpose of the external diode is to minimize damage from the momentary EMF voltage surges that occur when an inductive load is turned OFF.

The maximum amperage and voltage of the solid state relay is shown in the part number and the data bulletin. Avoid amperage or voltage surges that exceed these values.

The solid state relay can be quickly tested by using a 9 volt battery as the control input signal on screw terminals 3 and 4. The Power-IO green "input status" LED will illuminate, and your load should turn ON.



Precautions:
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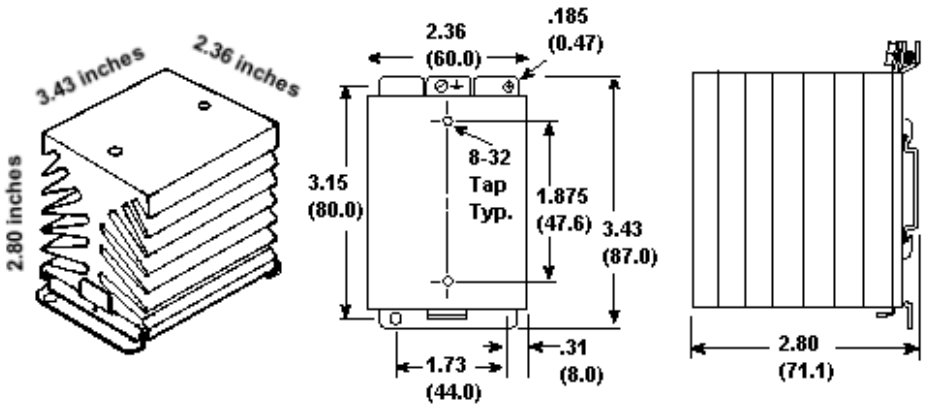
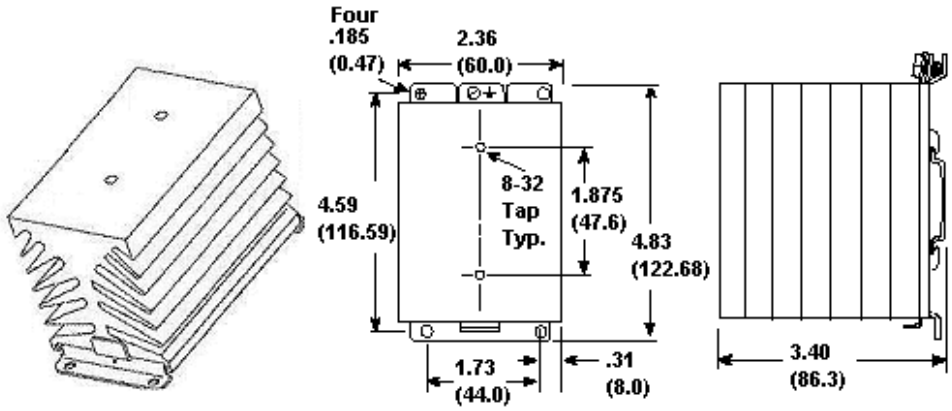
Heat sinks

High performance heat sinks or traditional heatsinks

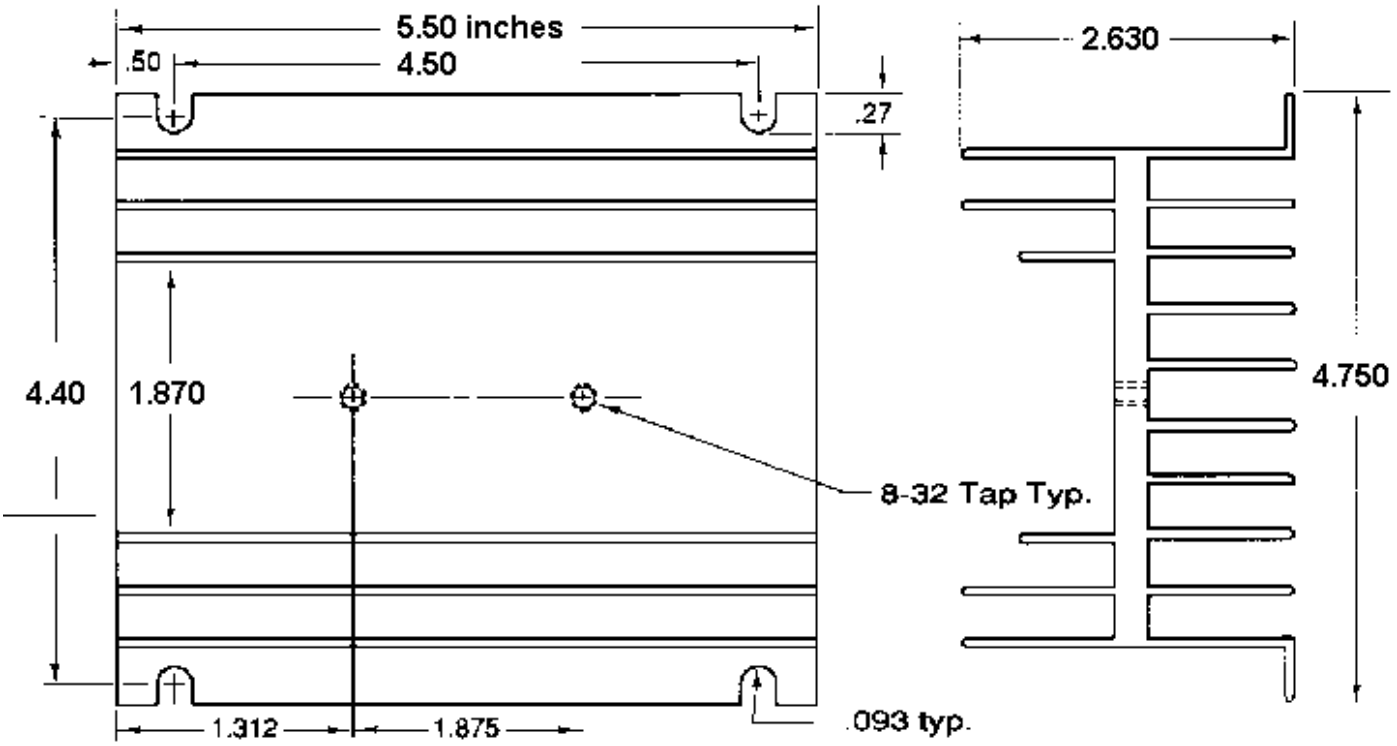
HEATSK-DIN-1.6 heat sink for many 5-40 amp applications:



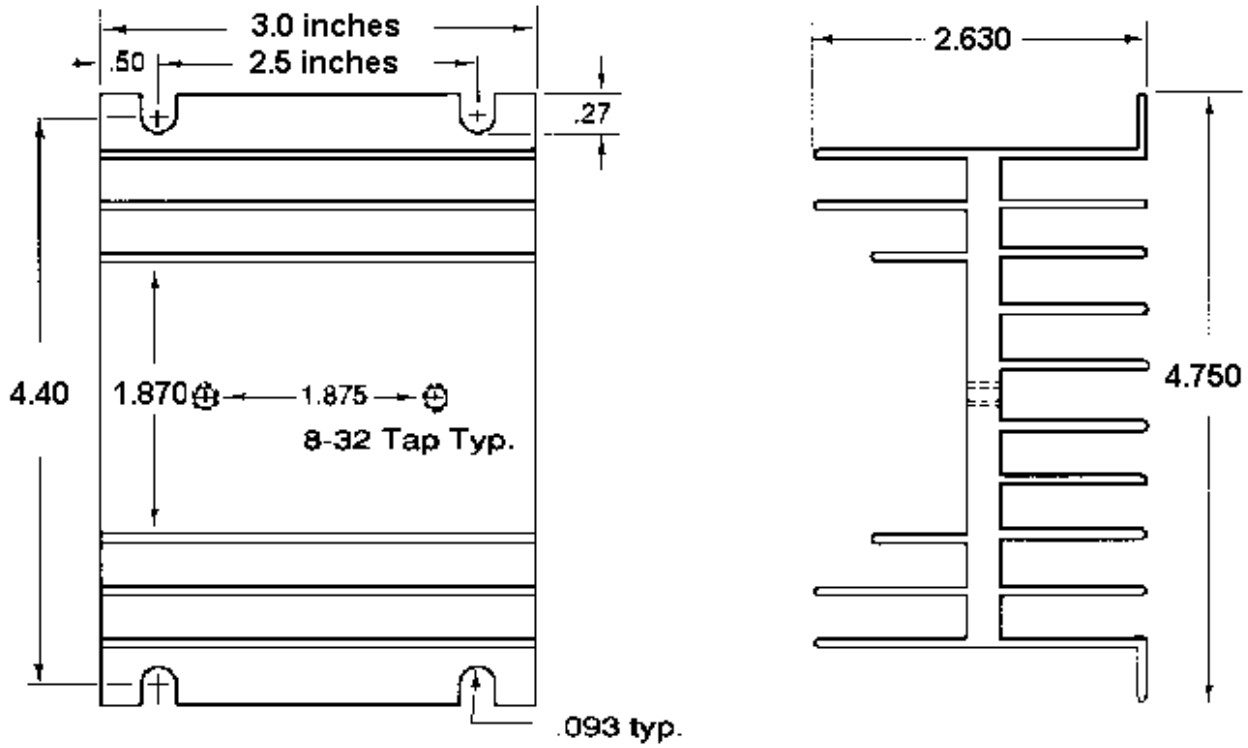
HEATSK-DIN-1.0 heat sink for many 30-60 amp applications:



Traditional HEATSK-1.0-SM heat sink for many 30-60 amp applications. This is a larger footprint heat sink that was used for bolt on applications only:



Traditional HEATSK-1.5-SM heat sink for many 5-40 amp applications. This is a larger footprint heat sink that was used for bolt on applications only:



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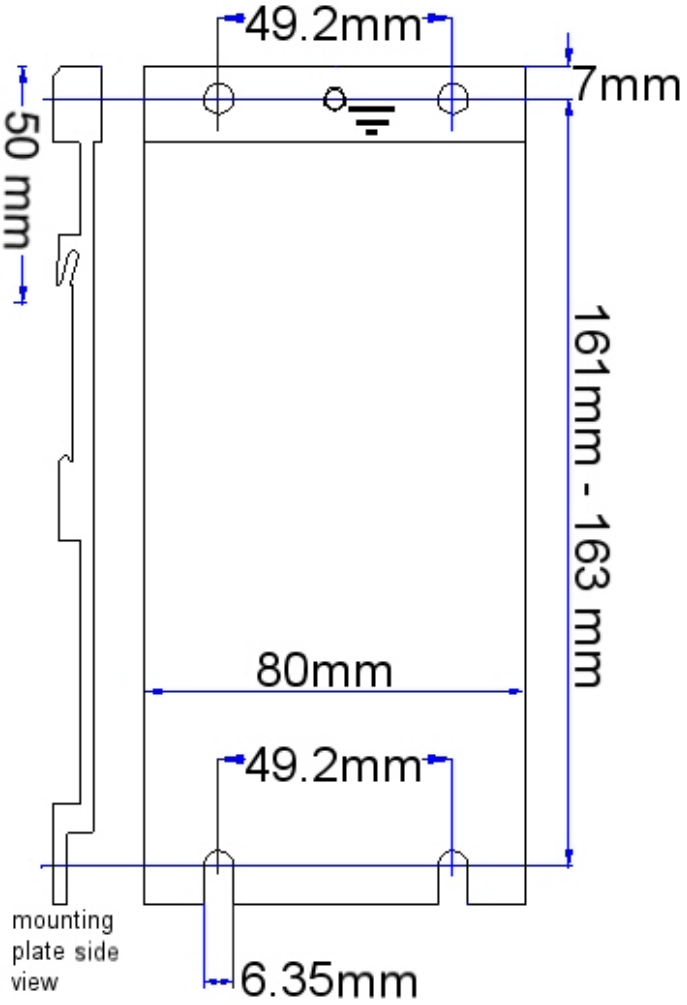
Bottom view

Top view



Quick template using an American dollar bill

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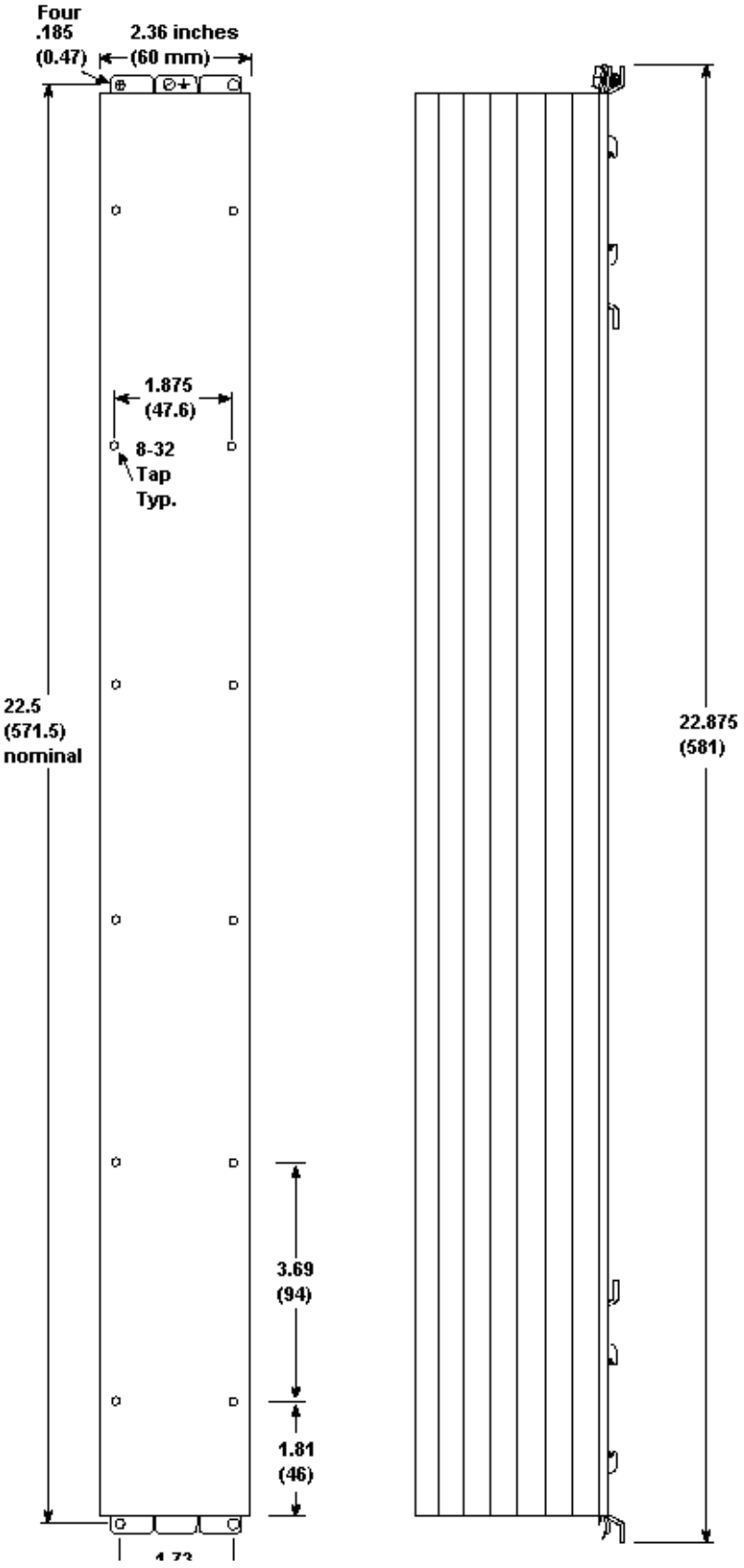
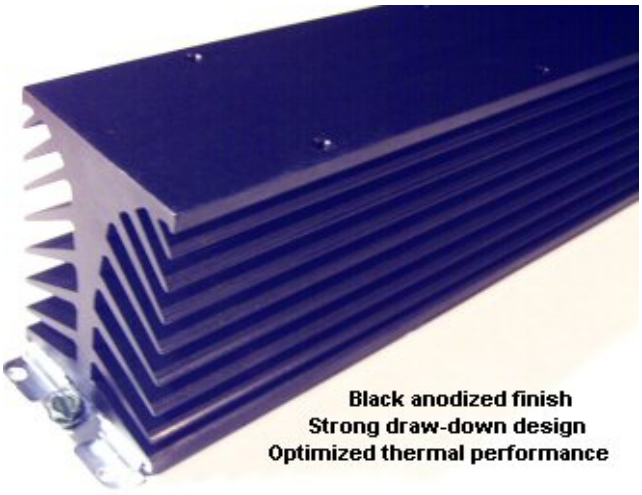
Power-io heat sinks for multi-zone applications

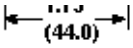




Eight "6-packs" with Power-io's HDD-6V15 IGBT hockey pucks = high speed PWM switching of 600 VDC and up to 720 total amps in a 30 x 23 inch area.

A "6 pack" uses a 22 inch aluminum extrusion, that is drilled and tapped for 6 solid state relays, every 3.7 inches. A "3 pack" uses an 11 inch aluminum extrusion that is drilled and tapped for 3 solid state relays. Some customers will drill and tap unique hole patterns for large amperage modules or other components.

There are some applications where the solid state



relays are installed inside an aluminum electrical enclosure and the heatsink is installed outside the enclosure. In this way, the heat sink removes the warm air and dissipates it to the fresh air.

Return to the Power-io heat sink page.

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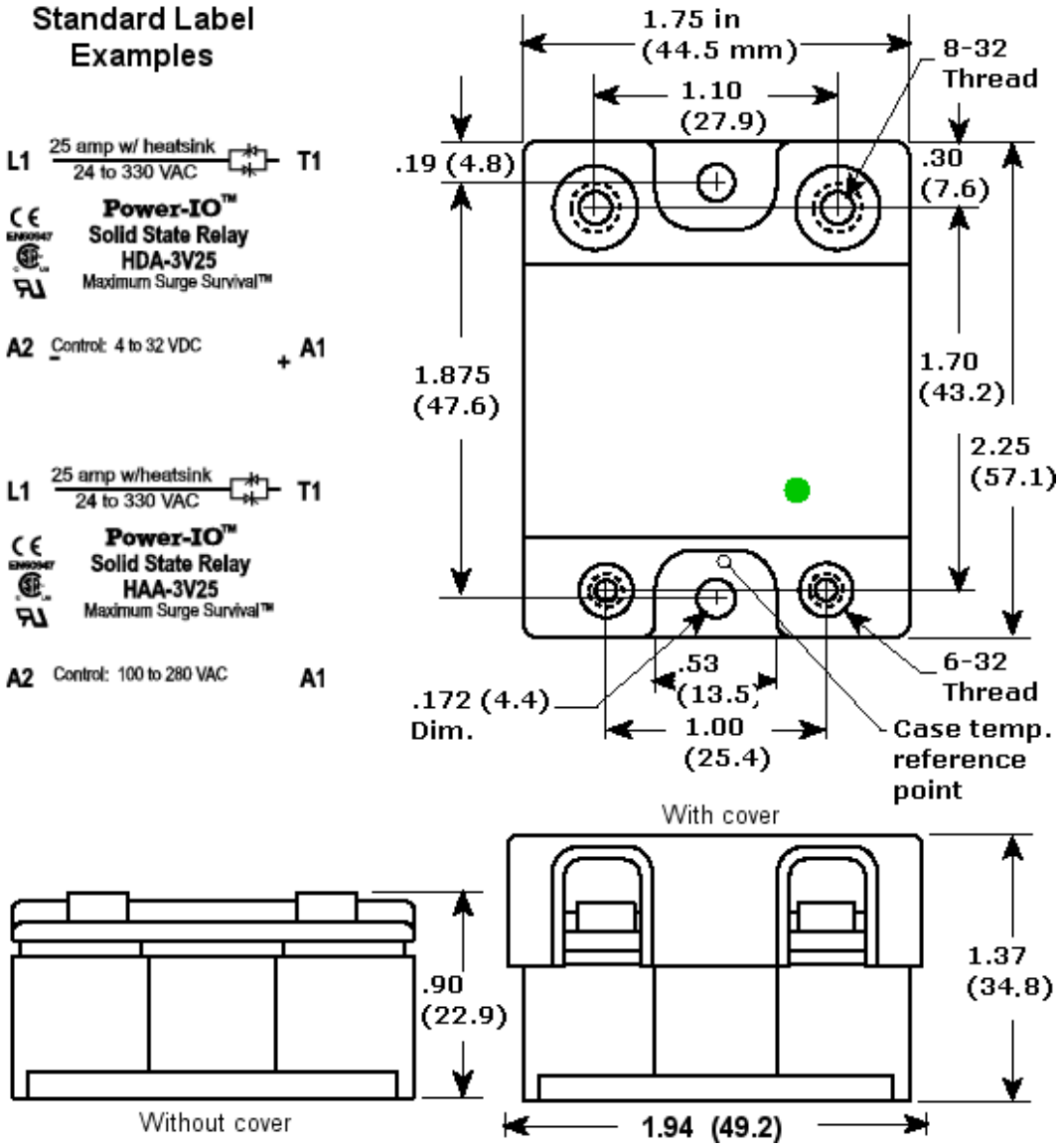
AC switching solid state relay



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Solid state relays

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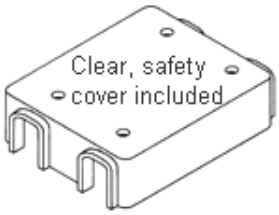
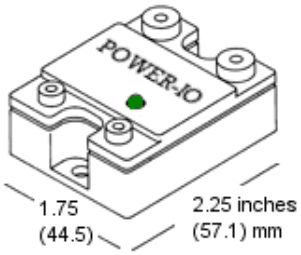
Solid state relays for DC load switching

Up to 75 amp solid state relays, up to 600 volts DC loads switched
Individual solid state relay hockey pucks or pre-assembled onto heat sinks

POWER-IO also does custom designed solid state relays, multi-zone ssr units, custom input ranges for solid state relays, and more. Additional models include: solid state relays for AC loads, AC switching solid state relay + heat sink + din rail mounting, and other solid state relay products.

- Internal, oversized mosfets + advanced metalized ceramic design = increased reliability, less thermal rise, and longer life
- Internal, IGBT design in the 600 volt rated model HDD-6V15
- International green LED that indicates input status for fast, visual diagnostics
- Optically isolated for 1500 volts and 2100 Vpk
- 15kHz FAST switching times for superior, consistent performance
- Ideal for activating robotics, DC servos, PWM dc loads, drone vehicle accessories, automated test equipment, DC vending machine motors, automobile accessories, battery powered lighting, battery back-up applications, and similar DC applications.
- All parameters shown are at 40°C, a factory-hardened specification
- Versatile high side or low side switching of the load
- When used with inductive VDC motors, make sure that the relay is at least twice the motor's voltage. (Example: a 48 vdc motor needs a 100 volt relay)
- Do you require custom features, special labels, military specifications, custom platings, unique performance curves? Contact Power-io directly.





Standard Part Numbers

HDD-06V75 up to 60VDC max, up to 75A, 4-32 VDC activated BUY
HDD-1V20 up to 100VDC max, up to 20A, 4-32 VDC activated BUY
HDD-1V40 up to 100VDC max, up to 40A, 4-32 VDC activated BUY
HDD-2V25 up to 200VDC max, up to 25A, 4-32 VDC activated BUY
HDD-6V15 up to 600VDC max, up to 15A, 4-32 VDC activated BUY
COVR-SAFETY-000 Spare, clear safety cover BUY
HDD_DIODE A high speed diode to install across the inductive load BUY

Pre-assembled units: Some popular choices for the solid state relay, mounted on a properly sized heat sink, including a safety cover, thermal pad and properly torqued installation screws.

HDD-06V75-HS1.0 HDD-06V75 on a HEATSK-DIN-1.0 heat sink BUY
HDD-1V20-HS1.6 HDD-1V20 on a HEATSK-DIN-1.6 heat sink BUY
HDD-1V40-HS1.0 HDD-1V40 on a HEATSK-DIN-1.0 heat sink BUY
HDD-2V25-HS1.0 HDD-2V25 on a HEATSK-DIN-1.0 heat sink BUY
HDD-6V15-HS1.0 HDD-6V15 on a HEATSK-DIN-1.0 heat sink BUY

Purchase heat sinks, thermal pads, pre-installation options separately Parts page

Factory custom models. Please consult the Power-io factory for the latest information:

HDD-2V14 up to 200VDC max, up to 14A, 4-32 VDC activated BUY
Custom feature: 25 microamp leakage during turn OFF. Example: ultra high speed turn OFF for automatic test equipment applications.

HDD-8V15 up to 800VDC max, up to 15A, 4-32 VDC activated BUY
Custom feature: new, high voltage family. Example: solar panels, transportation applications. In prototype stage.

Specifications	HDD-06V75	HDD-1V20	HDD-1V40	HDD-2V25	HDD-6V15
Voltage range of output	0-60 VDC	0-100 VDC	0-100 VDC	0-200 VDC	0-600 VDC

Input					
Min turn-on voltage/current	4 VDC / 10 mA				
Max turn-on voltage/current	32 VDC / 20 mA				
Min turn-off voltage	1 VDC				
Output					
Amps output, continuous, with proper heat sink	75 amps	20 amps	40 amps	25 amps	15 amps
Max on-state voltage drop at current output at 40°C base plate temperature	1.5 VDC	1.5 VDC	1.5 VDC	1.9 VDC	1.9 VDC
Current surge, non-repetitive	225 A peak	60 A peak	120 A peak	75 A peak	45 A peak
On state resistance max at current output at 40°C base plate temperature	0.020 ohm	0.069 ohm	0.034 ohm	0.075 ohm	IGBT
Thermal resistance (Tj=115°C)	0.55 °C/W	1.0 °C/W	0.55 °C/W	0.55 °C/W	1.0 °C/W
Leakage at 50°C	1 mA	2 mA	2 mA	2 mA	600 µamp
Max turn-on output time, control input at >8VDC, DC Line at >8VDC	25 µsecond				
Max turn-off output time	25 µsecond				
High frequency switching test ©2004 Power-io's high speed test results	100% of relays are tested at 15 kHz, @ 50% duty cycle, @ 10V or greater control input, and @ 10 volt or greater dc load. This generates a PWM switching speed of 33 microseconds "on" and 33 microseconds "off" or 15,000 ons and offs per second.				
General					
Dielectric strength (input-output-base plate)	1500 Vrms, 2100 Vpk				
Capacitance input to output	8 pf				
Ambient operating temperature range	-40 to +85°C. Amperage derating curve decreases from full amperage at 40°C to zero amperage at 100°C when a proper heat sink and air flow pattern are in use. Design your application so that you do not exceed 80% of the max amperage at a given temperature in order to anticipate load variations.				
Inductive load protection diode -- recommended for all inductive loads, even "slightly" inductive loads	All inductive DC loads require a high speed protective diode across the load. Two recommended choices are: ● a 2 amp On Semi, DO-41 package, 600V reverse voltage, 75ns ● a 3 amp Fairchild, DO-201AD package, 800V reverse voltage, 75ns This diode is available at: BUY				

Related information regarding the HDD product line:

1. For a printable copy of the in-depth 3 page data bulletin including the complete specifications, please visit: hdd-family.pdf
2. For the product schematic, wiring terminal locations, how to quickly test the HDD, label examples, and more; visit: hdd-dimension-wiring
3. For an overview of Pulse Width Modulation (PWM) and how it is used; visit: pwm-description
4. Need more amperage? Use two HDD relays in parallel: dual-mosfet-switching
5. How to build a H Bridge for dc motor reversing. This also applies to other loads that reverse the polarization of the load, such as some alternative energy applications: h-bridge
6. How to test for high speed testing? A customer has recommended: picoscope3000. Power-io provides this information only as an example of a high speed, PC based, scope.
7. How to use a negative control signal, such as -12 VDC? Connect ZERO to terminal 3+, connect -12VDC to terminal 4-. That is viewed as a 12 VDC differential, and it will work fine. You still need >10mA for high speed turn ON/OFF/ON/OFF PWM.
8. How to use dual IGBTs for 15 kHz switching of an AC load. Visit: dual-igbt-application

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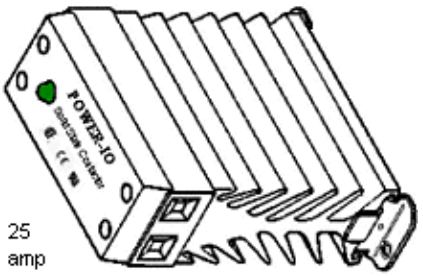
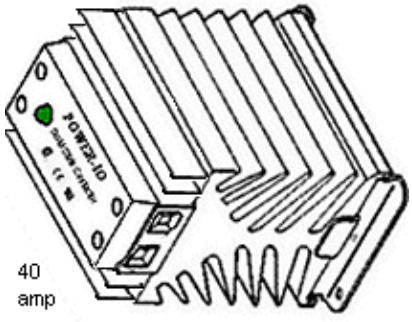
Single phase, 25 or 40 amp, din rail contactor

Features

- Maximum Surge Survival™ technology -- triple layer, voltage surge protection
- Green LED for input status
- Thermally optimized heat sink permits edge-to-edge installations on a horizontal din rail
- Built-in snubber circuit
- Zero crossing activation -- low EMI, low noise to nearby electronics
- Internal 50A thyristors for high inrush capability
- 4000 volt isolation, 1400 blocking voltage
- 1000 volt / microsecond immunity
- Highest thermal efficiency -- less than 1.0 watt dissipated per amp switched (25 amp model) or less than 1.2 watts (40 amp model)
- CE, UL recognized, CSA
- Industry standard A1, A2, L1, T1 terminal numbers
- High density design permits more amps per square inch





Part Number

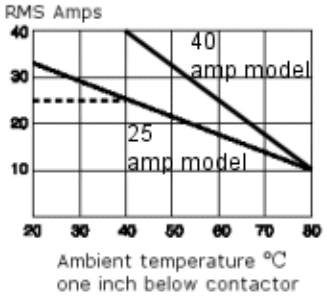
DDA-6V25 25A, 660V max, 4-32 VDC activated BUY

DDA-6V40 40A, 660V max, 4-32 VDC activated BUY

DAA-6V25 25A, 660V max, 100-280 VAC activated BUY

DAA-6V40 40A, 660V max, 100-280 VAC activated BUY

Derating Curve

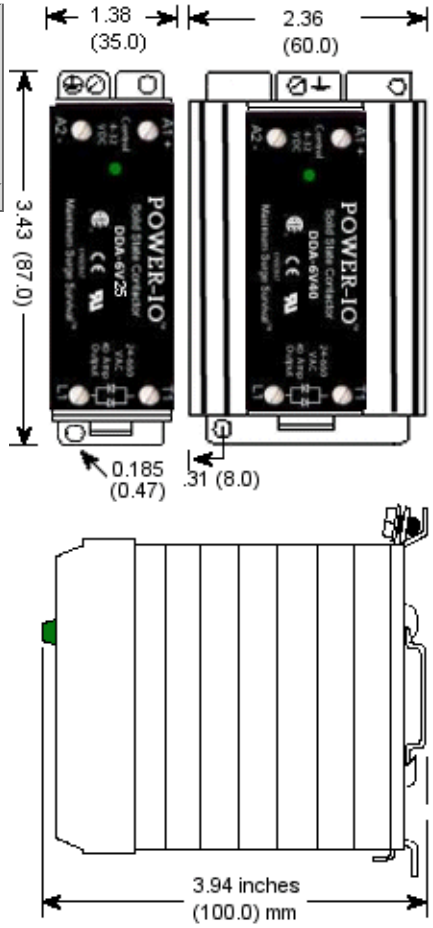


Specifications

Part Number	Line Voltage Range (VAC)	Load Current Range (A RMS)	Min Control Voltage & Current Draw	Max Control Voltage & Current Draw	Must Release Voltage
DC activated					
DDA-6V25	24-660	.10-25	4VDC/3.5mA	32VDC/8mA	1 VDC
DDA-6V40	24-660	.10-40	4VDC/3.5mA	32VDC/8mA	1 VDC
AC activated*					
DAA-6V25	24-660	.10-25	100VAC/9mA	280VAC/25mA	20VDC/2MA
DAA-6V40	24-660	.10-40	100VAC/9mA	280VAC/25mA	20VDC/2MA
* Typically, does NOT need a burden resistor when activated by a triac output controller.					

Off-State dv/dt	1000 v/µs
Isolation	4000 volts
I^2T fuse	50A or less, for example: Bussman FWP50A14F, FWC32A10F, FWC20A10F. Ferraz B093910, M330015, K330013. See: I2T fuse and fuse holders
Turn-on time	<8.3 ms at 60hz
Turn-off time	<8.3 ms at 60hz

Internal MOV	The 5V model uses an internal MOV that is similar to the Littelfuse Harris V575 LA80B Metal Oxide Varistor. The use of MOVs is encouraged in situations where there are frequent voltage surges such as motor starter applications. For example: for motor starters, you can use a DDA-6V25 AND an external MOV_V575LA80B (click to buy) OR you can purchase a DDA-5V25, and the MOV will be inside the unit. Contact Power-io for price and availability of this custom variation.
Terminals	Will accept #24-#10 AWG wire. Torque: 7-9 inch lbs.



Zoomed in product picture

Three, din rail solid state contactors and their labels

Schematic of the internal design

Din rail contactor schematic

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I²T fuses for solid state relays

We recommend fuse protection through the use of properly selected I2t fusing (semiconductor fuses). Devices such as circuit breakers and general purpose fuses, while sufficient and necessary for load and installation protection, do not provide adequate protection for the semiconductor device.

Part Numbers

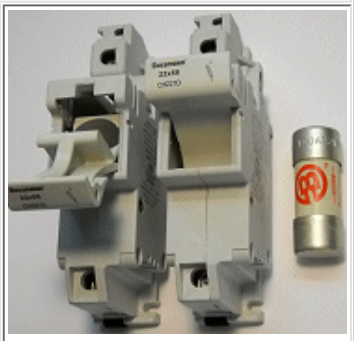
The part number shows the physical size of the fuse (14 mm or 22 mm diameter) and the amperage of the fuse. The FUSE-HLDR fuse holders are finger safe, din rail units.

Ferrule style fuses: (to be installed in the finger safe fuse block listed below)

FUSE-EXT-14-25 I²T Fuse, 14 mm x 51 mm, 25 amp BUY
FUSE-EXT-14-30 I²T Fuse, 14 mm x 51 mm, 30 amp BUY
FUSE-EXT-14-40 I²T Fuse, 14 mm x 51 mm, 40 amp BUY
FUSE-EXT-22-80 I²T Fuse, 22 mm x 58 mm, 80 amp BUY
FUSE-EXT-22-100 I²T Fuse, 22 mm x 58 mm, 100 amp BUY

Din Rail, Finger-Safe, Fuse Blocks for Ferrule Style Fuses:

FUSE-HLDR-14-01 Fuse holder, 14 mm, 1 position BUY
FUSE-HLDR-22-01 Fuse holder, 22 mm, 1 position BUY
FUSE-HLDR-14-03 Fuse holder, 14 mm, 3 position BUY



Finger-Safe Fuse Blocks and ferrule style fuse

L Bracket Style Fuses (installs inside the DDA-6V50, DDA-6V75, DDA-100 or DAA-6V50, DAA-6V75, DAA-6V100)

FUSE-SEMIBR-35A I²T Fuse, L bracket style, 35 amp BUY
FUSE-SEMIBR-63A I²T Fuse, L bracket style, 63 amp BUY
FUSE-SEMIBR-100 I²T Fuse, L bracket style, 100 amp BUY

L Bracket Fuse

Large I²T Fuses and Terminal Blocks:

100 Amp I2T FUSE BUY
175 Amp I2T FUSE BUY
Free Standing Thermal Block for Large Fuses BUY

Large 125-200 Amp Fuses

Large Fuse Holders

For a printable copy of the data bulletin including the complete specifications: I²T fuses, fuse blocks and I2T fuse accessories

Power-IO™

I²T Fuses and Fuse Holders

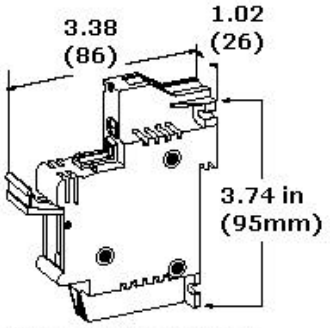
for Solid State Contactors, Solid State Relays and SCRs

For protection of solid state contactors, solid state relays or SCRs; a high speed I²T semiconductor fuse is used. I²T fuses clear within half of a sinewave to protect the solid state contactor, solid state relay, or SCR from damage from momentary, high amplitude current spikes such as short circuits.

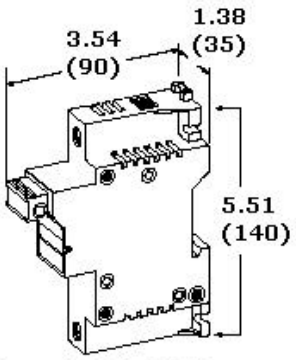
Features of the Power-IO I²T fuse and fuse holders:

- Din rail mounting clip for quick installations
- IP-20 finger-safe design
- Uses the international size standards — 10, 14, or 22 mm diameter fuses

All applications should be designed to not exceed 80% of the rating of a fuse. Additional fuse derating may be required if the fuse is installed in warm environments. I²T fuses are classified as supplemental protection of the solid state switching product. They are not approved for branch circuit protection. All installations must have appropriate branch circuit protection that meets local electrical codes.



14 mm (0.55 in.) Holder



22 mm (0.87 in.) Holder

Amps	Part Number	Fuse Diameter
	KIT = FUSE & HOLDER	
10	FUSE-KIT-14-010	14 mm
25	FUSE-KIT-14-025	14
3 of 30	FUSE-KIT-14-330	3 phase
40	FUSE-KIT-14-040	14
50	FUSE-KIT-14-050	14
63	FUSE-KIT-22-063	22
75	FUSE-KIT-22-075	22
100	FUSE-KIT-22-100	22
	SPARE FUSES	
10	FUSE-EXT-14-010	14
25	FUSE-EXT-14-025	14
30	FUSE-EXT-14-030	14
40	FUSE-EXT-14-040	14
50	FUSE-EXT-14-050	14
75	FUSE-EXT-22-075	22
100	FUSE-EXT-22-100	22
63	FUSE-SEMIBR-63A	For internal installation in DDA/6V50
100	FUSE-SEMIBR-100	For internal installation in DDA/6V75-100
*	BUSBAR (for DDA, DAA)	Then use FUSE-KIT-22-100
	FUSE HOLDERS	
	FUSE-HLDR-14-01	14
	FUSE-HLDR-22-01	22
3 phase	FUSE-HLDR-14-03	3 of 14 mm
	FUSE-3HANDLE-00	Handle (gang 3)

* Due to local electrical codes or due to thermal stress on the fuse, some customers may choose to install the bus bar inside the 100 amp contactor and then use the external 100 fuse kit.

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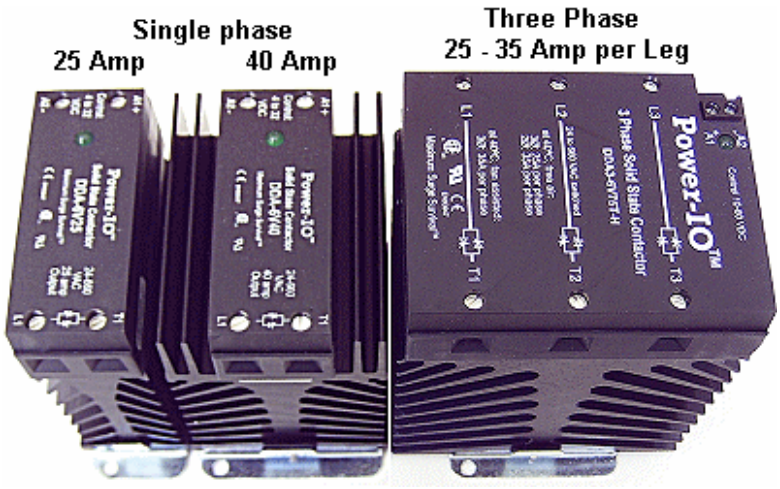
For a close up photo of the din clip, click here



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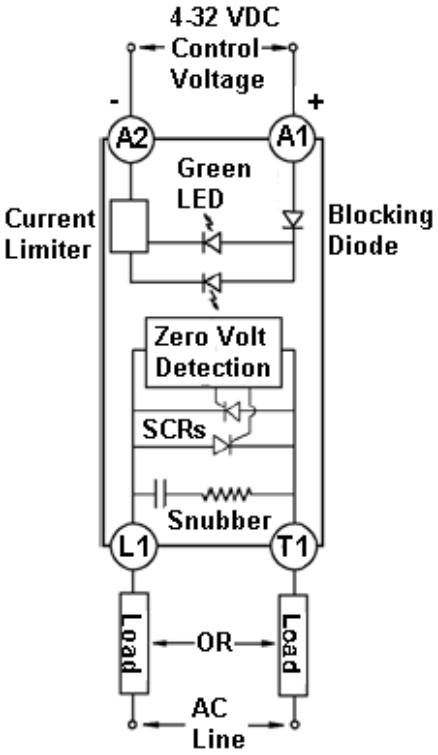
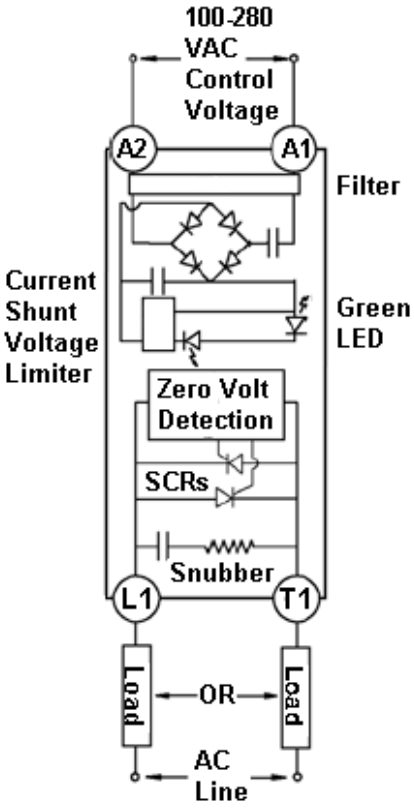
The DDA-6V25 and DDA-6V40 are activated by a 4-32 VDC signal:



The DAA-6V25 and DAA-6V40 are activated by a 100-280 VAC signal:



Return to the DDA and DAA solid state contactors page.

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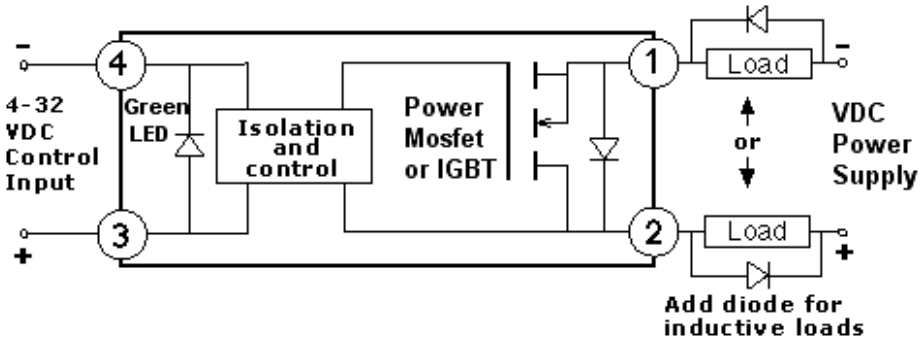
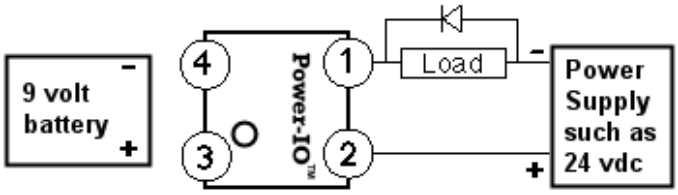
DC output solid state relay



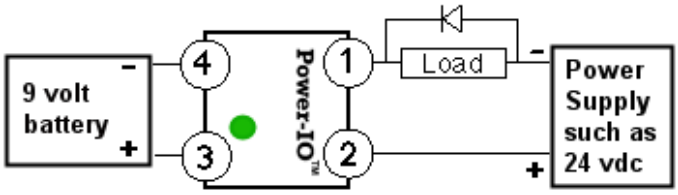
The diode is required to prevent EMF problems from inductive loads. Almost all loads are inductive so it recommended that you install the diode as shown above. Please install a fast recovery diode that has a PIV rating greater than the line voltage VDC. A suitable diode is available for purchase on the HDD product page. The HDD product is capable of switching the + OR -, which some people might call "high side switching" vs "low side switching".

You can quickly test a HDD solid state relay by using a standard 9 volt battery as the control input. Note the power supply + (terminal 2) and - (terminal 1) locations. If you mis-wire the power supply connections, the solid state relay will always appear ON.

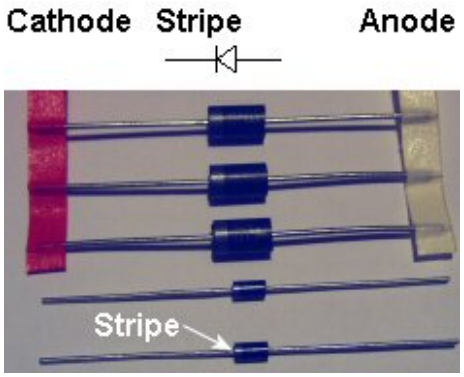
For example: no control input, load is "off"

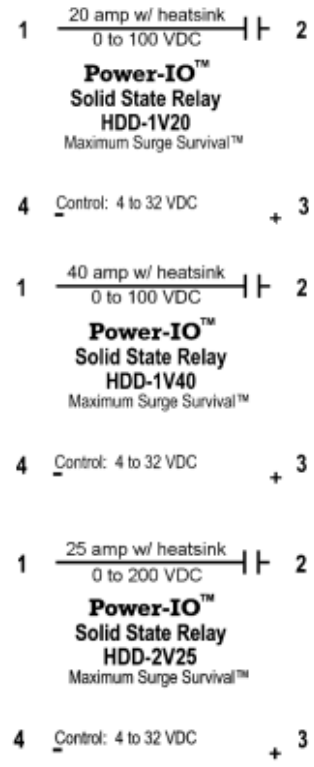


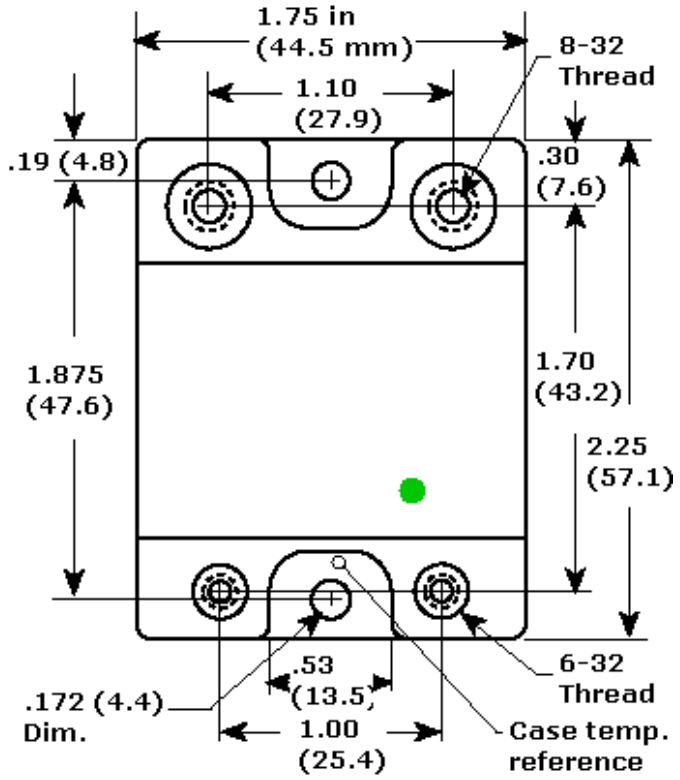
control input is present, load is "on"



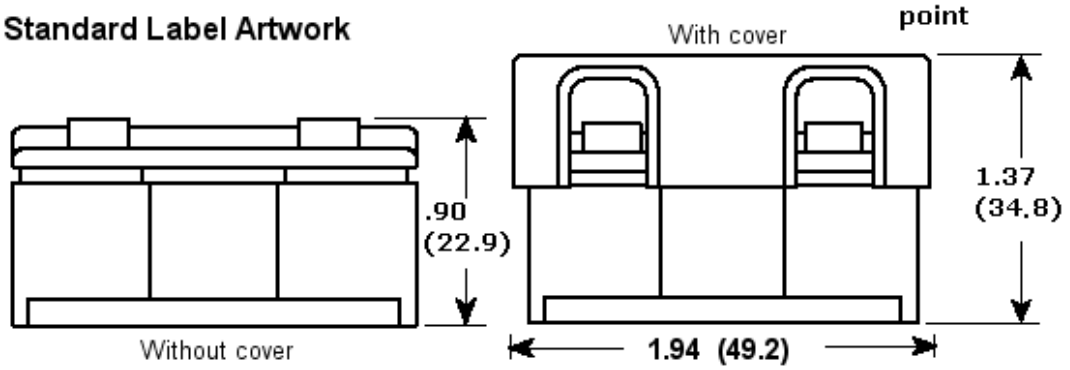
The diode has the stripe on the cathode side.







Standard Label Artwork



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Introduction to Pulse Width Modulation (PWM)

Pulse Width Modulation (PWM) is a technique of creating high speed digital pulses that have a variable amount of ON time vs OFF time within each pulse. This results in the ability to control a final load in a fashion that is similar to analog control resolution with digital control outputs. The Power-io HDD family of products is capable of achieving PWM speeds up to 15 kHz.

The following article by Michael Barr provides an overview of the technology.
http://www.netrino.com/Publications/Glossary/PWM.php
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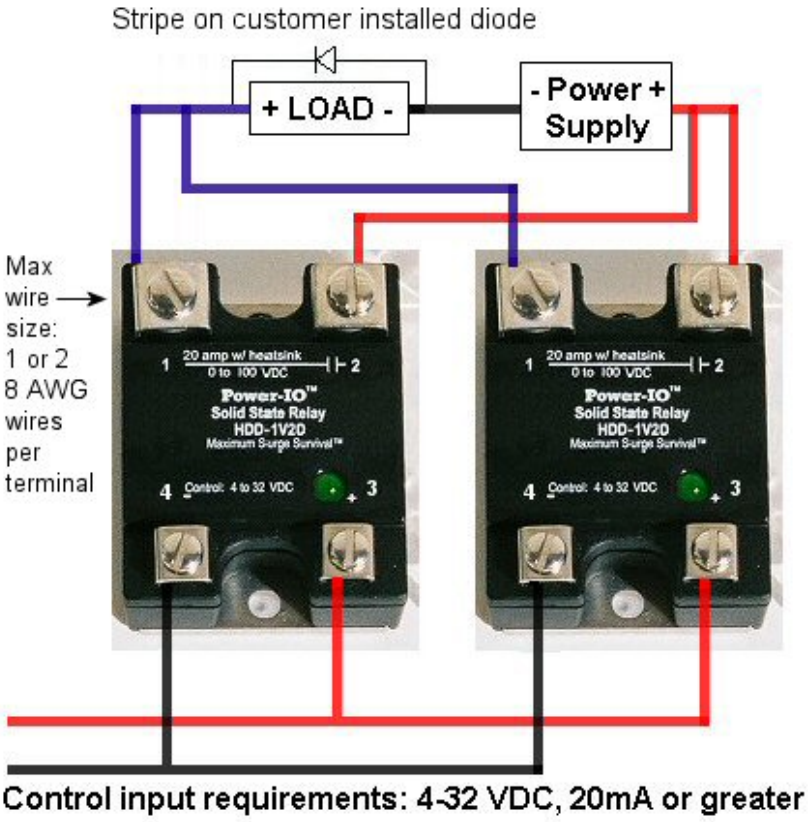
Dual Mosfet installation

Power-io's DC switching products, and only the dc switching products, can be used in parallel in order to switch twice the amperage. Using two HDD family of products can be used together in order switch larger loads than a single relay.



Return to the DC switching solid state relay page (HDD Family)

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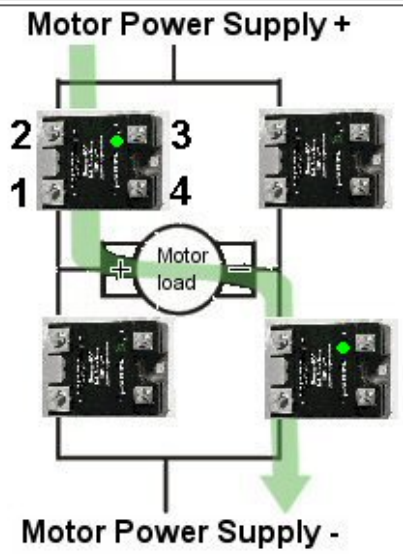
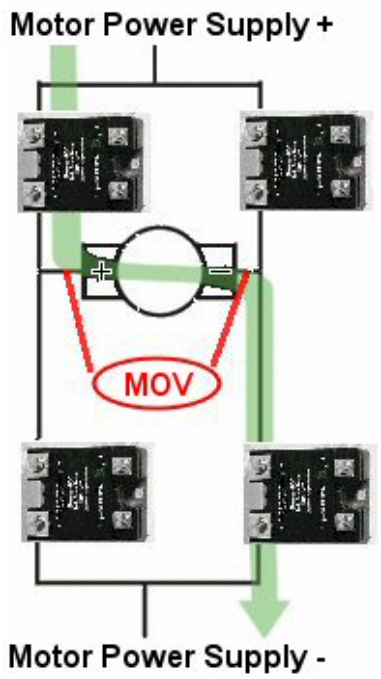


Example: how to make an H Bridge for a reversing VDC motor application or alternative energy application:

First you make an H bridge with 4 Power-io units. Power-io terminals 1 and 2 = the power terminals for the motor connections. Polarity is important. Terminal 2 is towards the positive power supply and terminal 1 is towards the negative power supply.

Use a HDD product where the voltage rating is at least twice the motor's rating. For example: a HDD-06V75 is rated for 60 volts DC so it would be a good choice for a 12 volt or 24 volt motor. Determine the maximum amperage inrush required for the motor and make sure that it is with-in the capability of the Power-io unit. The HDD-06V75 is rated for 75 amps when on a properly sized heat sink.



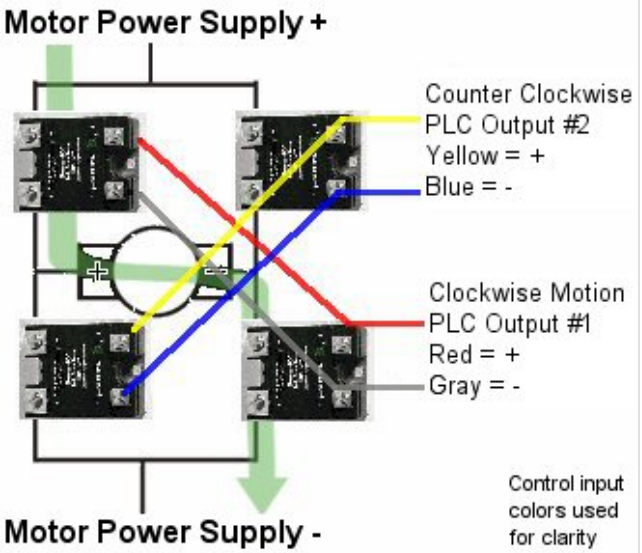
When the motor (inductive load) is turned off, there is a large voltage surge. You can not use a diode to suppress this due to reversing polarity of the installation. Therefore, use an MOV across the motor. One supplier of MOVs is: littelfuse.com

For example, if using a 12 or 24 VDC motor, the MOV should 1) be rated higher than the load, 2) have a clamping voltage approximately equal or lower than the Power-io solid state relay rating, and 3) be a large disk size. For this example, part number V36ZA70 or V36ZA80 might be a good choice. The exact part number should be selected by your engineering department.

ZA Varistor Series — Littelfuse

PART NUMBER	MODEL SIZE DISC DIA. (mm)	MAXIMUM RATING (85°C) CONTINUOUS V_{RMS} (V)	CONTINUOUS V_{DC} (V)	TRANSIENT ENERGY 10 x 1000µs W_{TM} (J)	TRANSIENT PEAK CURRENT 8 x 20µs I_{TM} (A)	SPECIFICATIONS (25°C) VARISTOR VOLTAGE AT 1mA DC TEST CURRENT V_{NOM} MIN (V)	V_{NOM} MAX (V)	MAXIMUM CLAMPING VOLTAGE 8 x 20µs V_C (V)	I_{PK} (A)
		$V_{M(AC)}$	$V_{M(DC)}$						
V33ZA05	5	20	26	0.3	100	29.5	38	65	1
V33ZA1	7	20	26	1.2	250	29.5	36.5	65	2.5
V33ZA2	10	20	26	3	500	29.5	36.5	65	5
V33ZA5	14	20	26	6	1000	29.5	36.5	65	10
V33ZA70	3 20	21	27	150	2000	29.5	36.5	58	20
V36ZA80	20	23	31	160	2000	32	40	63	20

1 2



The control inputs are wired as shown. The inputs can be generated from a PLC, other controller, or a three position switch. The three states are: clockwise, counter clockwise, and no input. It is important to permit the motor to come to a stop before reversing direction.

H Bridges are used with reversible VDC motors, VDC linear positioning actuators, some charging/discharging battery applications, some solar cell applications, solar cell positioning systems, and more.

Caution: if you turn ON all of the relays at the same time, you will short out your power supply and you will damage the solid state relays. Only turn ON the pair for clockwise rotation or for counter clockwise rotation.

The above information is a description of an H Bridge concept. Your installation may have additional considerations that are not discussed here. Return to the DC switching solid state relay page (HDD Family)

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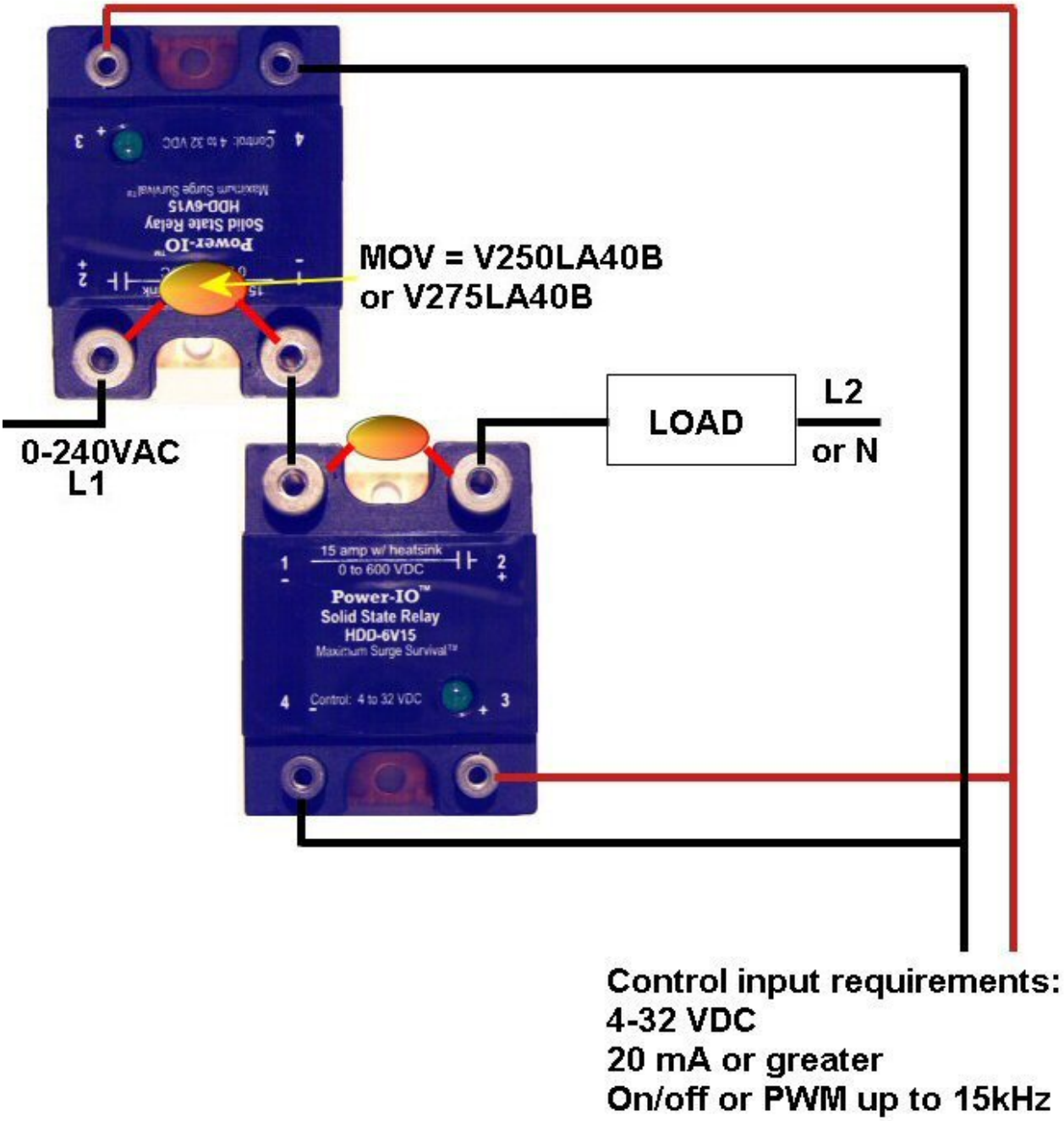
For high speed switching of an 120 VAC or 240 VAC load, you can use dual IGBTs as shown below. The IGBTs are wired back-to-back so each one is controlling a half sine wave. By having one control input, you can trigger for any time period. The Power-io product is the HDD-6V15. Each requires a MOV, such as a V250LA40B for voltage surge reduction.



For more information, please visit: HDD-6V15 IGBT modules and IGBT heat sinks.

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Invensys, Barber-Colman, Eurotherm, Ciirelays, Ci Relays, Ciicontrols, or Continental Industries cross reference list for solid state relays

Power-io solid state relay products:

- International terminal numbers (L1, T1, A1, A2)
- GREEN input status LED
- Rugged internal design and 4th generation DCB
- Most common models are in stock for rapid shipment
- Available individually or pre-assembled onto heat sinks
- Custom multi-zone assemblies
- SSR motor starters available with pre-installed matching MOV

			Upgrade to Power-io solid state relays:	
ssda-3v10	ssda/3v10/a02	ssda/10a/330v/ldc/cover	hda-3v25	4-32 vdc input, solid state relays
ssda-3v25	ssda/3v25/a02	ssda/25a/330v/ldc/cover	hda-3v25	4-32 vdc input, solid state relays
ssda-3v50	ssda/3v50/a02	ssda/50a/330v/ldc/cover	hda-3v50	4-32 vdc input, solid state relays
ssda-3v75	ssda/3v75/a02	ssda/75a/330v/ldc/cover	hda-3v50	4-32 vdc input, solid state relays
ssda-6v50	ssda/6v50/a02	ssda/50a/660v/ldc/cover	hda-6v50	4-32 vdc input, solid state relays
ssda-6v75	ssda/6v75/a02	ssda/75a/660v/ldc/cover	hda-6v75	4-32 vdc input, solid state relays
ssaa-3v10	ssaa/3v10/a02	ssaa/10a/330v/ldc/cover	haa-3v25	100-280 vac input, ssr
ssaa-3v25	ssaa/3v25/a02	ssaa/25a/330v/ldc/cover	haa-3v25	100-280 vac input, ssr
ssaa-3v50	ssaa/3v50/a02	ssaa/50a/330v/ldc/cover	haa-3v50	100-280 vac input, ssr
ssaa-3v75	ssaa/3v75/a02	ssaa/75a/330v/ldc/cover	haa-3v75	100-280 vac input, ssr
ssaa-6v50	ssaa/6v50/a02	ssaa/50a/660v/ldc/cover	haa-6v50	100-280 vac input, ssr
ssaa-6v75	ssaa/6v75/a02	ssaa/75a/660v/ldc/cover	haa-6v75	100-280 vac input, ssr
			Detailed photo of the Power-io solid state relay:	
svda-3v10	svda/3v10/a02	ssda-330-10-0e0	hda-3v25	4-32 vdc ssr relays
svda/3v25/ao2	svda/3v25/a02	ssda-330-25-0e0	hda-3v25	4-32 vdc ssr relays
svda-3v50	svda/3v50/a02	ssda-330-40-0e0	hda-3v50	4-32 vdc ssr relays
svda/3v50/ao2	svda/3v50/a02	ssda-330-50-0e0	hda-3v50	4-32 vdc ssr relays
svda/3v75/ao2	svda/3v75/a02	ssda-330-75-0e0	hda-3v75	4-32 vdc ssr relays
svda/6v50/ao2	svda/6v50/a02	ssda-660-50-0e0	hda-6v50	4-32 vdc ssr relays
svda/6v75/ao2	svda/6v75/a02	ssda-660-75-0e0	hda-6v75	4-32 vdc ssr relays
svaa/3v10/ao2	svaa/3v10/a02	ssaa-330-10-0e0	haa-3v25	100-280 vac ssr relay
svaa/3v25/ao2	svaa/3v25/a02	ssaa-330-25-0e0	haa-3v25	100-280 vac ssr relay
svaa/3v50/ao2	svaa/3v50/a02	ssaa-330-50-0e0	haa-3v50	100-280 vac ssr relay
svaa/3v75/ao2	svaa/3v75/a02	ssaa-330-75-0e0	haa-3v75	100-280 vac ssr relay
svaa/6v50/ao2	svaa/6v50/a02	ssaa-660-50-0e0	haa-6v50	100-280 vac ssr relay
svaa/6v75/ao2	svaa/6v75/a02	ssaa-660-75-0e0	haa-6v75	100-280 vac ssr relay
			Upgrade to Power-io solid state relays:	
s505-osj610-000		rlda-240/15-000	hda-3v25	4-32 vdc ssr relay
s505-osj625-000		rp03-24/280-04a	hda-3v25	4-32 vdc ssr relay
s505-osj640-000			hda-3v50	4-32 vdc ssr relay
s505-osj675-000			hda-3v75	4-32 vdc ssr relay
s505-osj610-009	s505-osj625-009	rlaa-240/15-00a	haa-3v25	100-280 vac ssr relay
s505-osj640-009			haa-3v50	100-280 vac solid state relay
s505-osj675-009			haa-3v75	100-280 vac solid-state relay
			Upgrade to Power-io dc switching solid state relays:	
rsdc-dc-108-000	rsdd/8a/100v/ldc	rsdc-dc-108-0e0	hdd-1v20	4-32 vdc, dc output, mosfet relay
rsdc-dc-112-000	rsdd/12a/100v/ldc	rsdc-dc-112-0e0	hdd-1v20	4-32 vdc, dc output ssr relay
rsdc-dc-120-000	rsdd/20a/100v/ldc	rsdc-dc-120-0e0	hdd-1v20	dc input, dc output ssr relay
rsdc-dc-140-000	rsdd/40a/100v/ldc	rsdc-dc-140-0e0	hdd-1v40	dc input, dc output ssr relay

The information above is a guideline only and is subject to change or correction. Please examine all specification parameters to confirm the proper product for your application.

Other cross references: many standard relays, dc activated 50, 75, 100 contactors, ac activated 50, 75, 100 contactors, Invensys, Crydom, Din rail contactors

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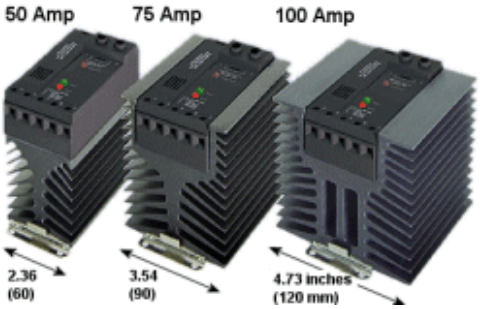

Power-io solid state contactors, dc activated

- Up to 50, 75, or 100 amps switched
- International terminal numbers, CE, UL, CSA
- Oversized internal SCRs for extended life
- Universal, upgrade model
- Switches any voltage from 48-660 VAC, 50 or 60 Hz
- Activated by any dc signal from 4-28 VDC at 6-9 mA = compatible with most PLCs, controllers, TTL systems, or PC based control packages

Cross reference list

			Upgrade to Power-io solid state contactors:	Description:
rsda-660-50-100	rsda-660-50-1d0	rsda-660-50-1e0	DDA-6V50	Up to 50 amps, sometimes called :
rsda-660-50-1d0	rsda/660/50/1eo	rsda-660-50-b00	DDA-6V50	ssr power controller,
rsda-660-50-ieo	rsda-660-50-ie0	rsda-660-50-ido	DDA-6V50	solid state contactor,
rsda/660/50/1e0	rsda/660/50/ieo	rsda/660/50/ie0	DDA-6V50	thyristor power controller,
g3pb-245b-vd	rsda-660-50	rsda/660/50	DDA-6V50	ssr power controls,
SSRINT660DC50	ssrint-660dc50		DDA-6V50	ssr solid state contactors.
			Upgrade to Power-io solid state contactors:	
rsda-660-75-100	rsda-660-75-1d0	rsda-660-75-1e0	DDA-6V75	Up to 75 amps, sometimes called :
rsda-660-75-1do	rsda/660/75/1eo	rsda-660-75-b00	DDA-6V75	ssr power controller,
rsda-660-75-ieo	rsda-660-75-ie0	rsda-660-75-ido	DDA-6V75	solid state contactor,
rsda/660/75/1e0	rsda/660/75/ieo	rsda/660/75/ie0	DDA-6V75	thyristor power controller,
rsda-660-75	rsda/660/75	rsda-660-75-be0	DDA-6V75	ssr power controls,
SSRINT660DC75	ssrint-660dc75	rsda-660-75-beo	DDA-6V75	ssr solid state contactors.
			Upgrade to Power-io solid state contactors:	
rsda-660-100-100	rsda-660-100-1d0	rsda-660-100-1e0	DDA-6V100	Up to 100 amps, sometimes called :
rsda-660-100-1do	rsda/660/100/1eo	rsda-660-100-b00	DDA-6V100	ssr power controller,
rsda-660-100-ieo	rsda-660-100-ie0	rsda-660-100-ido	DDA-6V100	solid state contactor,
rsda/660/100/1e0	rsda/660/100/ieo	rsda/660/100/ie0	DDA-6V100	thyristor power controller,
rsda-660100-100	rsda-660100-1d0	rsda-660100-1e0	DDA-6V100	ssr power controls,
rsda-660100-1do	rsda/660100/1eo	rsda-660100-b00	DDA-6V100	ssr solid state contactors,
rsda-660100-ieo	rsda-660100-ie0	rsda-660100-ido	DDA-6V100	solid state starter,
rsda-660100-be0	rsda-660100-beo	rsda-660100-boo	DDA-6V100	solid state motor starter,
rsda-660-100	rsda/660/100	rsda-660-100-be0	DDA-6V100	PLC solid state contactors,
SSRINT660DC100	ssrint-660dc100	rsda-660-100-beo	DDA-6V100	solid-state relæer
Visit the Power-io 50, 75, or 100 solid state contactors page for more detailed specifications, photos, or further information.				

The information above is a guideline only and is subject to change or correction. Please examine all specification parameters to confirm the proper product for your application.

Other cross references: many standard relays, ac activated solid state contactors, Din rail contactors

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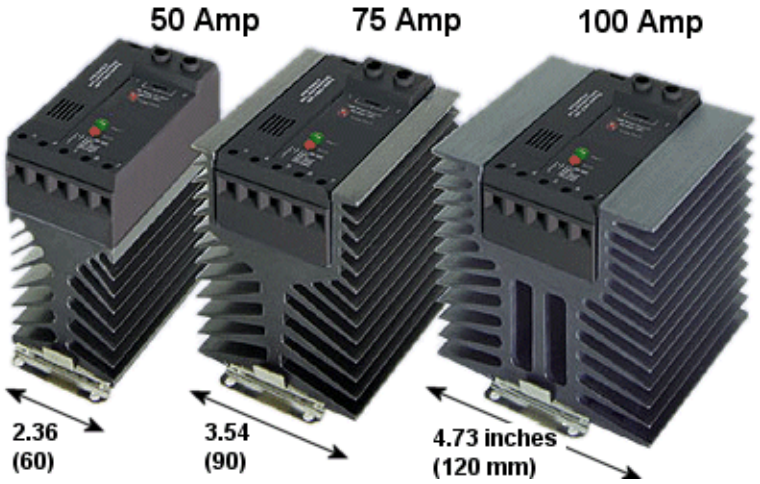
Single phase, up to 50, 75, 100 amp, din rail contactor

Features

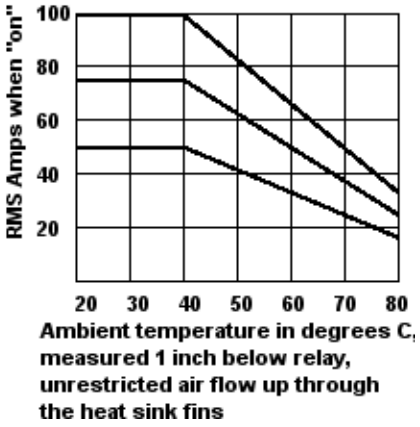
- For larger amperage applications
- I²T fuse is built-in, replaceable, and it has a fuse failure LED
- Automatic shutdown on over-temperature situations
- Universal mounting bracket for din rail or bolt-on applications
- Zero crossing activation -- low EMI, low noise to nearby electronics
- Internal, oversized thyristors for high inrush capability
- 1200 volt peak blocking voltage
- UL recognized, CSA, CE



Part Number

DDA-6V50 up to 50A, 660V max, 4-28 VDC activated BUY
DDA-6V75 up to 75A, 660V max, 4-28 VDC activated BUY
DDA-6V100 up to 100A, 660V max, 4-28 VDC activated BUY

DAA-6V50 up to 50A, 660V max, 100-280 VAC activated BUY
DAA-6V75 up to 75A, 660V max, 100-280 VAC activated BUY
DAA-6V100 up to 100A, 660V max, 100-280 VAC activated BUY

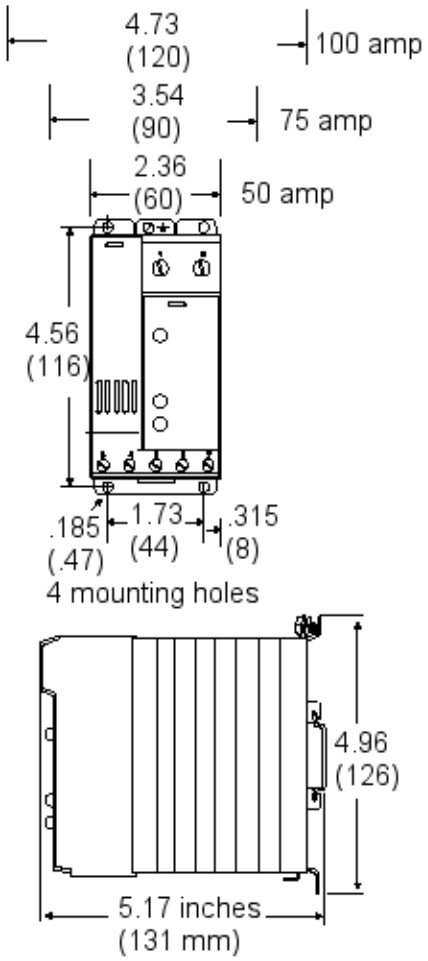


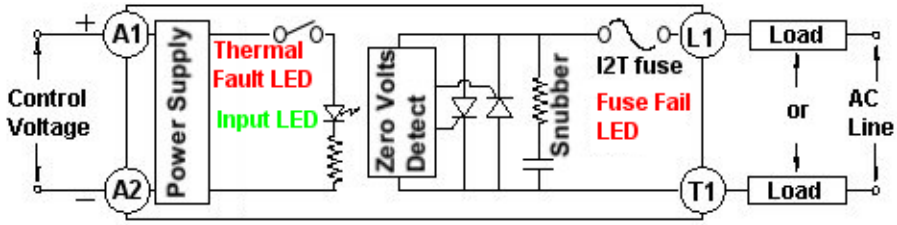
Ambient temperature in degrees C, measured 1 inch below relay, unrestricted air flow up through the heat sink fins

Specifications

Part Number	Line Voltage Range (VAC)	Load Current Range (A RMS)	Min Control Voltage & Current Draw	Max Control Voltage & Current Draw	Must Release Voltage
DC activated					
DDA-6V50	48-660	.10-50	4VDC/6mA	28VDC/9mA	1 VDC
DDA-6V75	48-660	.10-75	4VDC/6mA	28VDC/9mA	1 VDC
DDA-6V100	48-660	.10-100	4VDC/6mA	28VDC/9mA	1 VDC
AC activated					
DAA-6V50	48-660	.10-50	100VAC/5mA	280VAC/15mA	20VAC
DAA-6V75	48-660	.10-75	100VAC/5mA	280VAC/15mA	20VAC
DAA-6V100	48-660	.10-100	100VAC/5mA	280VAC/15mA	20VAC
Isolation	4000 volts				
I²T fuse	For 50 amp model: 63A or less, for example: Bussman FE63. For 75 or 100 amp model: 100A or less, for example: Bussman FE100. For installations >75 amps, or in warm installations, an external I²T fuse and fuse block can be used and a Power-io bus bar can be inserted in place of the internal fuse. See our fuse bulletin.pdf for additional fuse information.				
Turn-on time	<8.3 ms at 60hz				
Turn-off time	<8.3 ms at 60hz				
Control Terminals	Will accept #24-#10 AWG wire. Torque: 7-9 inch lbs.				

Power Terminals	Will accept #8-#3 AWG wire. Torque: 40 inch lbs.
Installation	Leave a minimum of one inch below and 4 inches above these contactors for air ventilation. Leave one inch horizontally between units for air ventilation.





Zoomed in photo: 50, 75, 100 amp solid state contactors

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The universal mounting bracket permits either din rail mounting or panel mounting by using 4 screws. Terminals L1 and T1 accept 8 to 3 AWG copper wire and should be torqued to 40 inch pounds. Terminals 3/A1 and 4/A2 are the normal control input terminals. Terminals 5, 6, and 7 are for custom designed inputs or special features.

The 50 amp model is shown here. The 75 and 100 amp models use the same design and they use heat sinks that are slightly wider than the 50 amp heat sink.

This photo has the 2 safety covers removed. The empty space on the right side is to

permit custom designed features as requested by customer specifications. Contact Power-io if you have special requirements, such as: different input ranges, time delayed features, special diagnostics, and more. The internal I^2T fuse can be easily changed. On the 100 amp models, some customers may prefer to substitute a Power-io copper bus bar for the fuse. This permits the installation to use an external 100 amp fuse and fuse holder. If your electrical installation is warm, this helps to reduce nuisance fuse tripping since I^2T fuses clear (open) more easily when they are warm.

Return to: Din rail solid state contactors 50, 75, 100 amp

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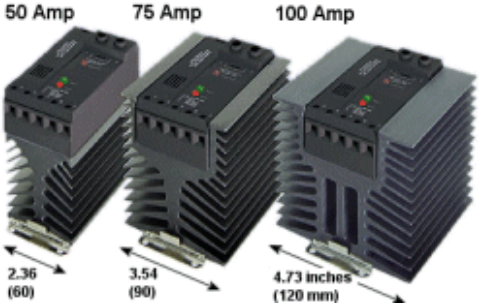

Power-io solid state contactors, ac activated

- Up to 50, 75, or 100 amps switched
- International terminal numbers, CE, UL, CSA
- Oversized internal SCRs for extended life
- Universal, upgrade model
- Switches any voltage from 48-660 VAC, 50 or 60 Hz
- Activated by any ac signal from 100 - 280 VAC = compatible with most PLCs, AC output controllers, or mechanical controls. Universal replacement for many mercury contactors or mercury displacement relays (better performance, longer life, no toxic mercury disposal problems).

Cross reference list

			Upgrade to Power-io solid state contactors:	Description:
rsaa-660-50-100	rsaa-660-50-1d0	rsaa-660-50-1e0	DAA-6V50	Up to 50 amps, sometimes called :
rsaa-660-50-1d0	rsaa/660/50/1eo	rsaa-660-50-b00	DAA-6V50	ssr power controller,
rsaa-660-50-ieo	rsaa-660-50-ie0	rsaa-660-50-ido	DAA-6V50	solid state contactor,
rsaa/660/50/1e0	rsaa/660/50/ieo	rsaa/660/50/ie0	DAA-6V50	thyristor power controller,
g3pb-245b-va	rsaa-660-50	rsaa/660/50	DAA-6V50	ssr power controls,
SSRINT660AC50	ssrint-660ac50		DAA-6V50	ssr solid state contactors.
			Upgrade to Power-io solid state contactors:	
rsaa-660-75-100	rsaa-660-75-1d0	rsaa-660-75-1e0	DAA-6V75	Up to 75 amps, sometimes called :
rsaa-660-75-1do	rsaa/660/75/1eo	rsaa-660-75-b00	DAA-6V75	ssr power controller,
rsaa-660-75-ieo	rsaa-660-75-ie0	rsaa-660-75-ido	DAA-6V75	solid state contactor,
rsaa/660/75/1e0	rsaa/660/75/ieo	rsaa/660/75/ie0	DAA-6V75	thyristor power controller,
rsaa-660-75	rsaa/660/75	rsaa-660-75-be0	DAA-6V75	ssr power controls,
SSRINT660AC75	ssrint-660ac75	rsaa-660-75-beo	DAA-6V75	ssr solid state contactors.
			Upgrade to Power-io solid state contactors:	
rsaa-660-100-100	rsaa-660-100-1d0	rsaa-660-100-1e0	DAA-6V100	Up to 100 amps, sometimes called :
rsaa-660-100-1do	rsaa/660/100/1eo	rsaa-660-100-b00	DAA-6V100	ssr power controller,
rsaa-660-100-ieo	rsaa-660-100-ie0	rsaa-660-100-ido	DAA-6V100	solid state contactor,
rsaa/660/100/1e0	rsaa/660/100/ieo	rsaa/660/100/ie0	DAA-6V100	thyristor power controller,
rsaa-660100-100	rsaa-660100-1d0	rsaa-660100-1e0	DAA-6V100	ssr power controls,
rsaa-660100-1do	rsaa/660100/1eo	rsaa-660100-b00	DAA-6V100	ssr solid state contactors,
rsaa-660100-ieo	rsaa-660100-ie0	rsaa-660100-ido	DAA-6V100	solid state starter,
rsaa-660100-be0	rsaa-660100-beo	rsaa-660100-boo	DAA-6V100	solid state motor starter,
rsaa-660-100	rsaa/660/100	rsaa-660-100-be0	DAA-6V100	PLC solid state contactors,
SSRINT660AC100	ssrint-660ac100	rsaa-660-100-beo	DAA-6V100	solid-state relæer
Visit the Power-io 50, 75, or 100 solid state contactors page for more detailed specifications, photos, or further information.				

The information above is a guideline only and is subject to change or correction. Please examine all specification parameters to confirm the proper product for your application.

Other cross references: many standard relays, dc activated contactors, Din rail contactors

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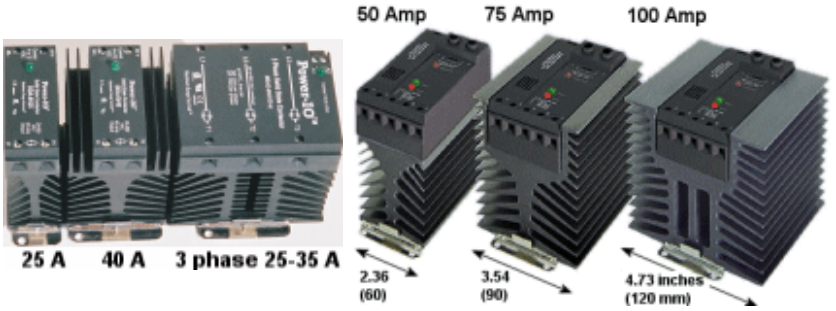
Power-io solid state contactors: ac, dc, or analog 4-20mA control inputs



- Up to 25, 40, 50, 75, 100 amps switched single phase or 25-35 amps three phase
- International terminal numbers
- International green LED
- CE, UL, CSA
- Oversized internal SCRs for extended life
- Universal, upgrade model
- Switches any voltage from 48-660 VAC
- Compatible with most PLCs, controllers, TTL systems, or PC based control packages

Solid state contactors cross reference

			Upgrade to Power-io din rail solid state contactors:	Description:
rsda/3v25	rsda/3v25/a02	rsda-660-25-1e0	dda-6v25	dc input solid state contactor
rsda/3v40	rsda/3v40/a02	rsda-660-40-1e0	dda-6v40	dc input solid state contactor
rsda-660-25-1eo	rsda-660-25-1d0	rsda-660-25-1do	dda-6v25	dc input solid-state contactor
rvda/3v25	rvda/3v25/a02	rvda/6v25/a02	dda-6v25	vdc input solid state contactors
rvda/3v40	rvda/3v40/a02	rvda/6v40/a02	dda-6v25	vdc input solid-state contactors
rsda-660-40-1eo	rsda-660-40-1d0	rsda-660-40-1do	dda-6v40	vdc input solid-state contactors
rsda/5v25	rsda/5v25/a02	rvda/5v25	dda-5v25	solid state contactors with MOV
rsda/5v40	rsda/5v40/a02	rvda/5v40	dda-5v40	solid state contactors with MOV
			Upgrade to Power-io din rail solid state contactors:	
rsda/6v25	rsda/6v25/a02	rsda/6v25/ao2	dda-6v25	660v solid state contactor
rsda/6v40	rsda/6v40/a02	rsda/6v40/ao2	dda-6v40	660v solid state contactor
rvda/6v25	rvda/6v25/a02	rsda/25a/500v/ldc	dda-6v25	din rail solid state contactor
rvda/6v40	rvda/6v40/a02	rsda/32a/500v/ldc	dda-6v40	dinrail solid state contactor
rsda/25a/500v/hdc	rsda/32a/500v/hdc	rsda/40a/500v/ldc	dda-6v40	dinrail solid state contactor
rsda/6v50	rsda/6v50/a02	rsda/40a/500v/hdc	dda-6v50	din rail solid state contactors
rsda-660-50-100	rsda-660-50-1e0	rsda-660-50-b00	dda-6v50	50 amp ssr power controller
rsda/660/50/100	rsda/660/50/1e0	rsda/660/50/b00	dda-6v50	50 amp ssr power controller
rsda-660-75-100	rsda-660-75-1e0	rsda-660-75-b00	dda-6v75	75 amp ssr power controller
rsda/660/75/100	rsda/660/75/1e0	rsda/660/75/b00	dda-6v75	75 amp ssr power controller
rsda-660100-100	rsda-660100-1e0	rsda-660100-b00	dda-6v100	100 amp ssr power controller
rsda/660100/be0	rsda/660100/1e0	rsda/660100/b00	dda-6v100	100 amp ssr power controller
			Upgrade to Power-io din rail solid state contactors:	
rsaa/3v25	rsaa/3v25/a02	rsaa-660-25-1e0	daa-6v25	ac input solid state contactor
rvaa/3v25	rvaa/3v25/a02	rvaa/3v25/ao2	daa-6v25	ac input solid state contactor
rsaa/3v40	rsaa/3v40/a02	rsaa-660-40-1e0	daa-6v40	ac input solid state contactor
rvaa/3v40	rvaa/3v40/a02	rvaa/3v40/ao2	daa-6v40	ac input solid state contactor
rsaa-660-25-1eo	rsaa-660-25-1d0	rsaa-660-25-1do	daa-6v25	ac input solid-state contactors
rsaa-660-40-1eo	rsaa-660-40-1d0	rsaa-660-40-1do	daa-6v40	ac input solid-state contactors
rsaa/5v25	rsaa/5v25/a02		daa-5v25	solid state contactors with MOV
rsaa/5v40	rsaa/5v40/a02		daa-5v40	solid state contactors with MOV
			Upgrade to Power-io din rail solid state contactors:	
rsaa/6v25	rvaa/6v25	rsda-660-25-1d0	daa-6v25	660v solid state contactors
rsaa/6v40	rvaa/6v40	rsda-660-40-1d0	daa-6v40	660v solid state contactors
rsaa/6v50	rsaa/6v50/a02		daa-6v50	660v solid state contactors
rsaa-660-50-100	rsaa-660-50-1e0	rsaa-660-50-b00	daa-6v50	50A scr power controls
rsaa-660-75-100	rsaa-660-75-1e0	rsaa-660-75-b00	daa-6v75	75A scr power controls
rsaa-660100-100	rsaa-660100-1e0	rsaa-660100-b00	daa-6v100	100A scr power controls

			Upgrade to Power-io din rail 4-20 mA solid state contactors:	
rvma/5v25	rvma/5v25/a02		dma-6v25	4-20 mA input solid state contactor
rvma/6v25	rvma/6v25/a02		dma-6v25	4-20 mA input solid state contactors
rvma/5v40	rvma/5v40/a02		dma-6v40	4-20 input solid-state contactor
rvma/6v40	rvma/6v40/a02		dma-6v40	4-20 input solid state contactors
			Upgrade to Power-io din rail 3 phase solid state contactors:	
rvd3/5v75t/h	rvd3/5v75t/h/a2	rsda-660-30-3d2	dda3-5v75t-h	3 phase solid state contactors
rvd3/6v75t/h	rvd3/6v75t/h/a2	rsda-660-30-3d1	dda3-6v75t-h	three phase solid state contactor
rvd3/5v75t/l	rvd3/5v75t/l/a2		dda3-5v75t-l	3 phase solid state contactors
rvd3/6v75t/l	rvd3/6v75t/l/a2	rs3da/30a/500v/ldc	dda3-6v75t-l	three phase solid state contactor
rsda-660-30-3d0	rsda-660-30-3do	rs3da/30a/500v/hdc	dda3-6v75t-l	three phase solid state contactors
rva3/5v75t/h	rva3/5v75t/h/a2	rsaa-660-30-3d2	daa3-5v75t-h	3 phase solid state contactors
rva3/6v75t/h	rva3/6v75t/h/a2	rs3aa/30a/500v/hac	daa3-6v75t-h	three phase ssc
rsaa-660-30-3d0	rsaa-660-30-3do		daa3-6v75t-h	three phase ssc
rvm3/5v75t	rvm3/5v75t/a2		dma3-5v75t	analog input ssr power controller
rvm3/6v75t	rvm3/6v75t/a2		dma3-6v75t	analog input scr power controllers
			Upgrade to Power-io din rail i/o modules:	
io-e-oac-r0-280	io-e-oac-ro-280	Other oac modules	io-oac-280	io module
io-e-odc-r0-060	io-e-odc-ro-060	Other odc modules	io-odc-60	i-o modules

The information above is a guideline only and is subject to change or correction. Please examine all specification parameters to confirm the proper product for your application.

Other cross references: many standard relays, dc activated 50, 75, 100 contactors, ac activated 50, 75, 100 contactors, Invensys, Eurotherm, Crydom, recorders

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OAC & ODC modules for AC or DC i/o outputs

Features

- Highest density din rail i/o -- only 0.3 inches wide
- LED for logic status
- Industry standard color coded
- Optically isolated
- Rugged -- internal 15 amp circuit for high inrush capability
- TTL compatible
- 4000 volt isolation
- Front, replaceable 3 amp fuse
- CE EN60950, UL recognized, CSA
- High density design permits more outputs per din rail location
- The quickest way to install: small, fused output, isolated, i/o terminal blocks.

Part Numbers

Red case color: DC output

IO - ODC - 60 DC logic input = switched DC output BUY

Black case color: AC output

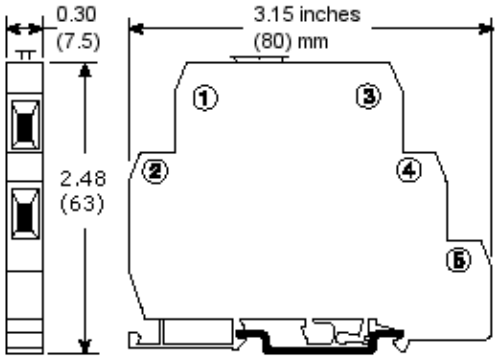
IO - OAC - 280 DC logic input = switched AC output BUY

IO - OAC - 280 - 280A AC logic input = switched AC output BUY

Accessories

IO - JUMPER - 010 Ten position jumper strip BUY

HDD_DIODE A high speed diode to install across the inductive load, if switched by an IO-ODC-60 or IO-ODC-60-LL BUY



Customized models: contact the Power-io factory for specific details before ordering. If you require special features, contact us.

IO - ODC - 60 - LL DC logic input = DC switched output non-standard, special ultra-low leakage model, consult factory before ordering. Only used when the DC load is susceptible to false triggering such as some direct-microprocessor input circuits. (It is more common to use a standard IO-IDC-028-P module when used to trigger a microprocessor input.)

IO - ODC - 60 - Custom Fusing DC logic input = DC switched output non-standard, different fusing models using lower amperage fuses OR no fuse. The no fuse option is used by high G force mobile equipment where the vibration was excessive, deep sea submersible robotic equipment, and other applications where fuse replacement wasn't a practical consideration. The fuse was replaced by a soldered-in bus bar.

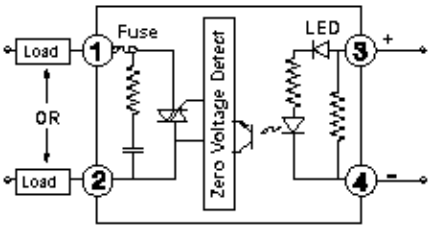
Specifications

Part Number	Logic (input) Voltage Range	Logic (input) Impedance (Rc) Ohm	Field (output) Voltage Range	Field (output) Current Range @ 45°C	Turn On/Turn Off Time Max	Output Leakage Current @ Max Field Voltage	Field (output) Voltage drop@ Max Current Output
AC output, black case color							
IO-OAC-280	4-28 VDC	1,500	12-280 VAC	0.10 - 3 amp*	<8.6 ms @ 60Hz	5 mA	1.65
IO-OAC-280-280A	90-280 VAC	40,000	12-280 VAC	0.10 - 3 amp*	<8.6 ms @ 60Hz	5 mA	1.65
DC output, red case color							
IO-ODC-60	4-28 VDC	1,500	5-60 VDC	0 - 3 amp*	40 µs On, 40 µs Off,	1 mA	1
IO-ODC-60-LL	4-28 VDC	1,500	5-60 VDC	0 - 3 amp*	50 µs On, 100 µs Off,	100 µA	1

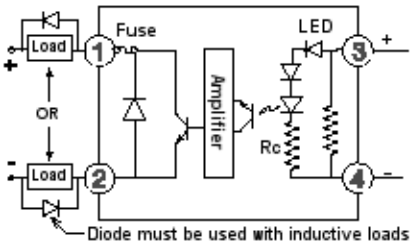
*Temperature	0-70°C operating temperature. The 3 amp maximum amperage output is only achieved when there is <45°C air surrounding all sides of the module. For example: leave 0.30 inches of space between each module on a din rail. Derate the modules if the ambient air temperature is higher and/or if the modules are tightly stacked together. For warm environments or higher amperage applications, use the "D" family of Power-IO. The D family is approximately: the same height on the din rail; the same terminal locations (AC switch on one side, logic input on the other); for 1-25 amp switching.
Isolation	4000 volts isolation to logic on all part numbers
ODC current requirements	The input current draw for 4 - 28 vdc logic activated ODC modules = (V - 1)/1500. For example: if your microprocessor controller generates a 12 VDC signal, then (12 Vdc - 1) / 1500 = 7.33 mA current requirements
LED purpose and color	The green LED represents when a control input is present on terminals 3 and 4. If the LED is red, you have the incorrect + and - polarity on the control inputs (only applies to vdc control inputs).
PWM outputs	The IO-ODC-60 has a high speed output. However, when used in PWM applications, the recommended maximum PWM speed is 1-2 kHz. For applications requiring PWM speeds of up to 15kHz, we recommend the HDD products as shown at: HDD DC switching solid state relays
Terminals	Will accept #24-#10 AWG wire. Torque: 5-7 inch lbs.
Fuse	3 amp, 5x20mm fast fuse. Field replaceable, standard Cooper Bussmann glass fuse.

Representative Schematics

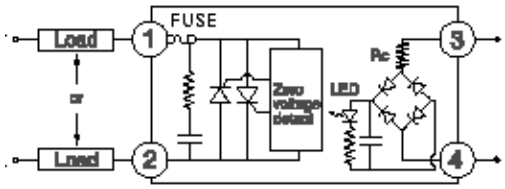
IO-OAC-280 : A DC logic input on terminals 3 and 4 = an AC switch will occur between terminals 1 and 2.



IO-ODC-60 and IO-ODC-60-LL : A DC logic input on terminals 3 and 4 = a DC switch will occur between terminals 1 and 2.



IO-OAC-280-280A : An AC logic input on terminals 3 and 4 = an AC switch will occur between terminals 1 and 2.



Zoomed in product pictures

Four color coded I/O modules and the labels on the sides
OAC or ODC higher resolution wiring schmatic

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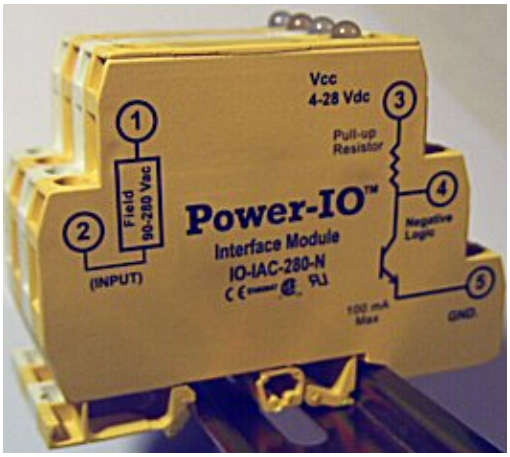
Din rail IAC & IDC modules for AC or DC i/o inputs

Features

- Highest density din rail i/o -- only 0.3 inches wide
- LED for input status
- Industry standard color coded
- Permits multiple, different input devices to be daisy-chained as a single input into a PLC or control system
- Optically isolated
- TTL compatible
- 4000 volt isolation
- CE EN60950, UL recognized, CSA
- High density design permits more inputs per din rail installation
- Positive or negative logic output (similar to "normally open" vs "normally closed")
- Single input integrity. Install 1-1000 and each input is completely independent.



Part Numbers

Yellow case color: AC input

IO - IAC - 280 - P AC input = Positive output BUY

IO - IAC - 280 - N AC input = Negative output BUY

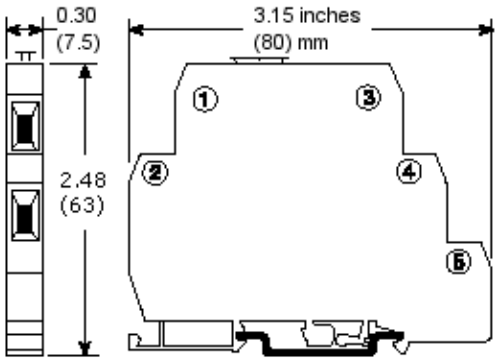
White case color: DC input

IO - IDC - 028 - P DC input = Positive output BUY

IO - IDC - 028 - N DC input = Negative output BUY

Accessories

IO - JUMPER - 010 Ten position jumper strip BUY



IAC, AC input wiring examples: how to wire and test the IAC modules with an AC input source and a 9 volt battery

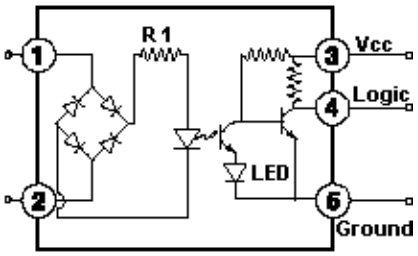
IDC, DC input wiring examples: how to wire and test the IDC modules with two 9 volt batteries

Specifications

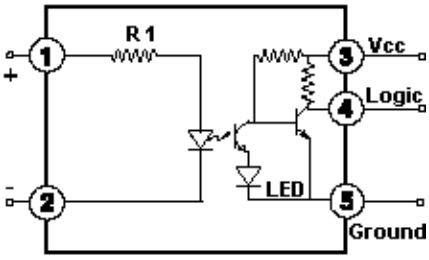
Part Number	Field (input) Voltage Range	Logic	Logic (Output) Voltage Range	Max Load Current mA	Turn On Time Max	Turn Off Time Max	Logic (output) voltage drop@100mA load VDC
AC activated, yellow case color							
IO - IAC - 280 - P	90-280 VAC	Positive	4-28 VDC	100	20 ms	20 ms	0.5
IO - IAC - 280 - N	90-280 VAC	Negative	4-28 VDC	100	20 ms	20 ms	0.5
DC activated, white case color							
IO - IDC - 028 - P	4-28 VDC	Positive	4-28 VDC	100	30 µs	60 µs	0.5
IO - IDC - 028 - N	4-28 VDC	Negative	4-28 VDC	100	30 µs	60 µs	0.5
Temperature	0-70°C operating temperature						
Isolation	4000 volts isolation to logic on all part numbers						
Terminals	Will accept #24-#10 AWG wire. Torque: 5-7 inch lbs.						

Schematics

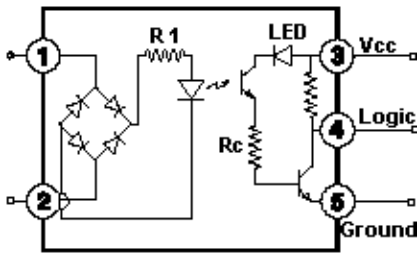
IO-IAC-280-P : An AC field input on terminals 1 and 2 = the voltage of terminal 4 will change from ground (terminal 5) to vcc (terminal 3)



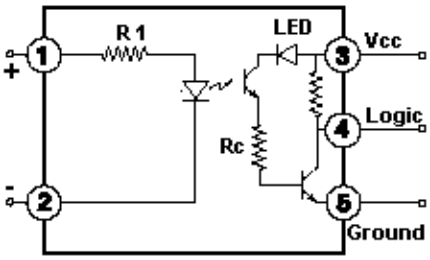
IO-IDC-028-P : A DC field input on terminals 1 and 2 = the voltage of terminal 4 will change from ground (terminal 5) to vcc (terminal 3)



IO-IAC-280-N : An AC field input on terminals 1 and 2 = the voltage of terminal 4 will change from vcc (terminal 3) to ground (terminal 5)



IO-IDC-028-N : A DC field input on terminals 1 and 2 = the voltage of terminal 4 will change from vcc (terminal 3) to ground (terminal 5)



Zoomed in product picture

Four color coded I/O modules and the labels on the sides

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How to quickly test a Power-io IO-IAC Module, using a AC Source, a 9 volt battery and a meter.

IO-IAC-280-N or -P generates a logic signal on terminal 4 that is often wired to a PLC's input. The PLC's power supply is wired to terminals 3 and 5.

The "-N" model produces a logic signal that is negative compared to the input. (If a field device input exists, no output exists). The "-P" model produces a logic signal that is positive compared to the input. (If a field device input exists, an output exists).

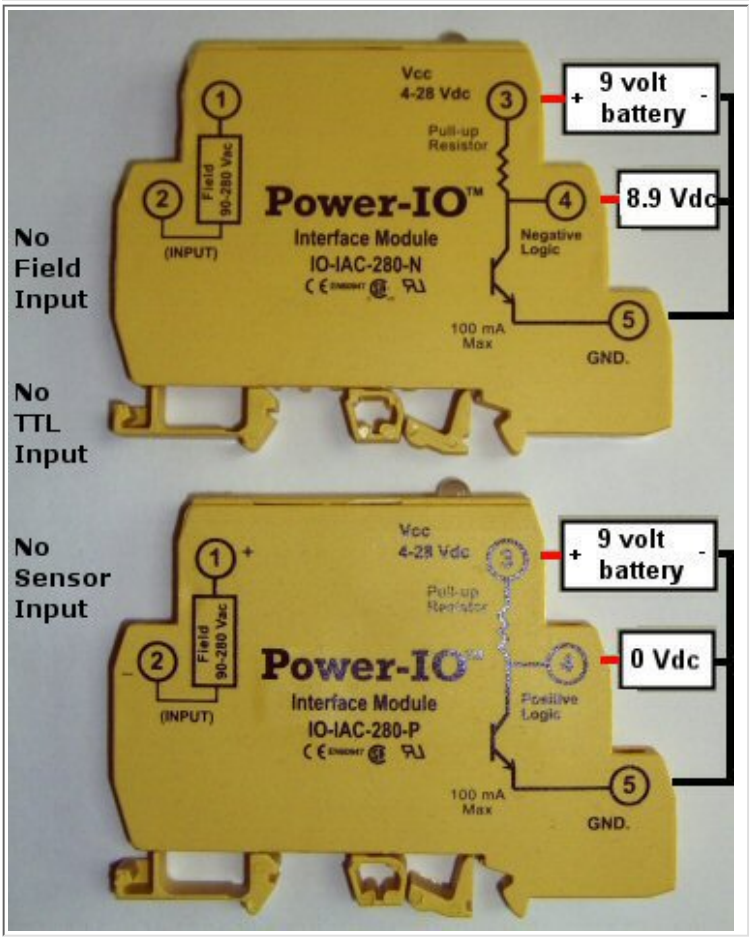
When terminal 4 is at 0 volts, it can be used as a sinking signal, at up to 100mA. This is the most common way of using the I/O module. When terminal 4 is "high", then it can be used as a sourcing signal but the mA capability will be limited to a few mA maximum.

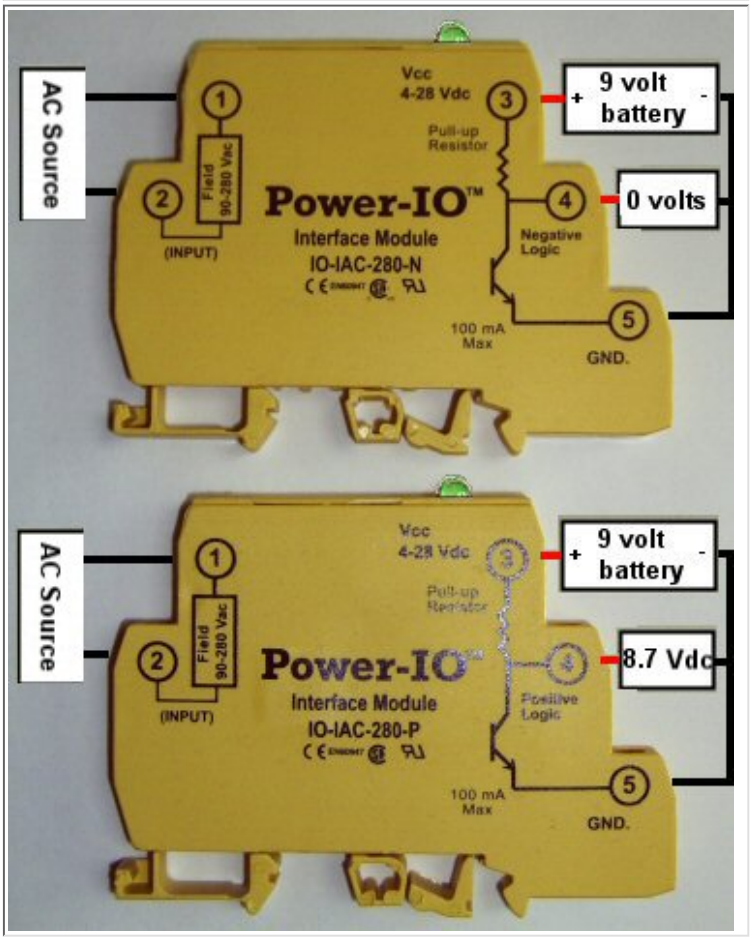
When a control input signal is present on terminals 1 and 2, the logic signal on terminal 4 changes state, and a green LED activates.

If the LED is ever red in color, the + and - polarity is probably mis-wired at terminals 3 and 5.

Sourcing? Sinking? Here is a quick example of using a sinking signal from an IO module to activate an external product: appnotes/io-module-sinking-example.htm

Sourcing? Sinking? Here is a quick explanation from the internet: http://www.patchn.com

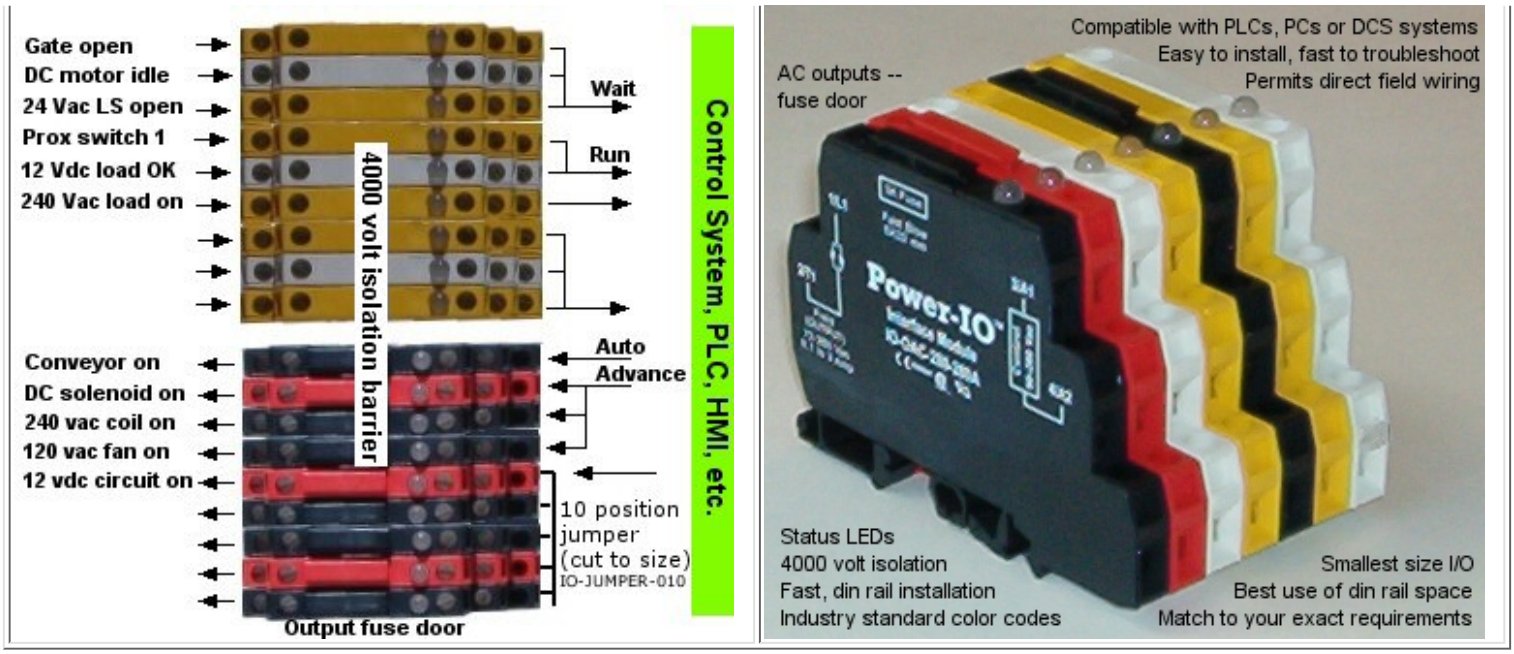




When installed in your application, the Power-io IO modules might be used like this:

The modules can be intermixed as input IO modules and output IO modules:

IO modules, i/o, and din rail i-o for IAC, OAC, IDC, and ODC.



Examples of how to use a variety of IO modules in an application: I/O modules

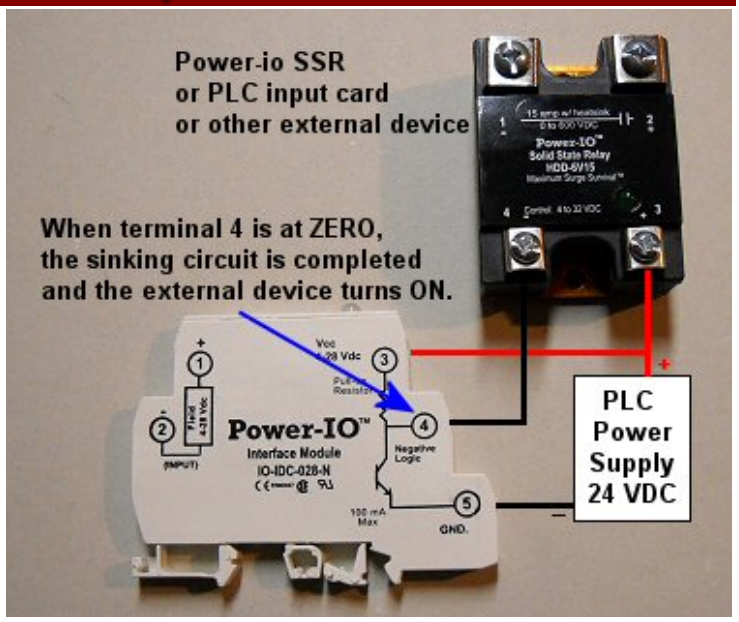
Return to: IAC and IDC input modules or OAC and ODC output modules

Power-io I/O Modules example:

Terminal 4 on the I/O module is typically wired to a PLC's input card, or other product, that is expected to see a "sinking" signal, or pull-down signal.

When terminal 4 is at zero, the circuit is completed, and the external device turns ON.

The Power-io I/O modules can sink up to 100mA.



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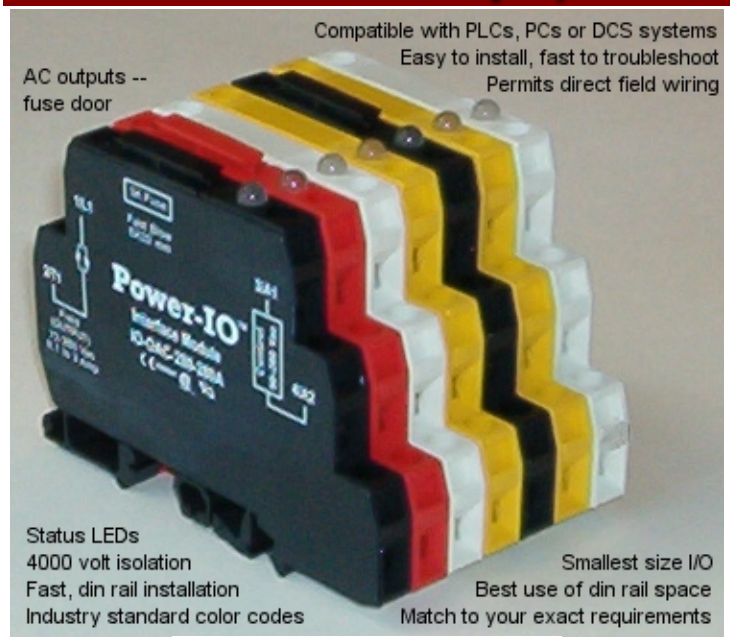


Side - to - side
Looks like a standard terminal block while providing robust i/o capability

Din Rail I/O Modules

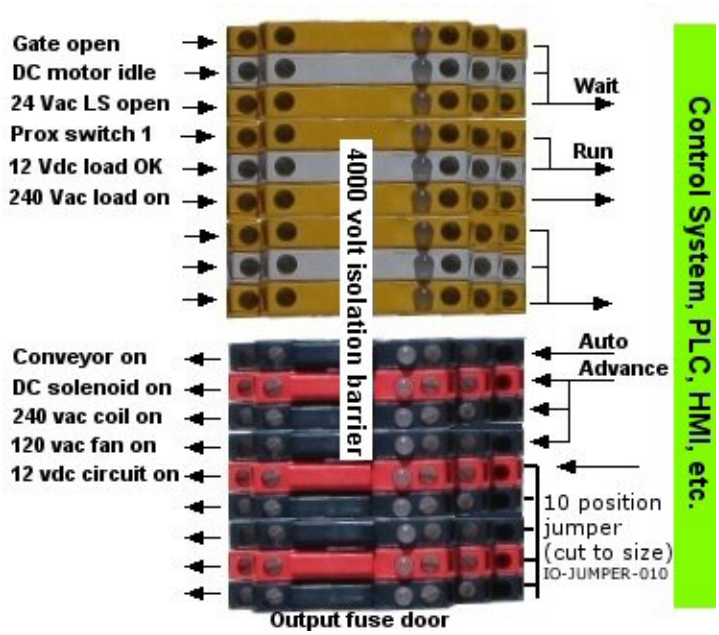
The Power-IO modules lead the industry in cost effective, small size, industrially hardened i/o units. With a width of just 0.30 inches (7.5 mm), the i/o modules represent the smallest, discrete input/output modules for the majority of industrial, laboratory, or automation requirements. All modules provide 4000 volt isolation and finger safe terminals. All modules are solid state so there are no moving parts to ever wear out.

I/O modules are available in 4 color coded models:

- Black OAC modules (Output, AC) perform just like a solid state relay. You provide a dc or ac control signal, and the OAC module creates a 1-3 amp switched AC output for 12-280Vac loads. A field replaceable 3 amp fuse is accessible from the front.
- Red ODC modules provide a 1-3 amp switched DC output for 5-60Vdc loads. A 3 amp fuse is accessible from the front.
- Yellow IAC modules accept 90-280 AC input signals and provide an isolated input to an automation system. IAC modules are available as positive or negative logic (similar to normally open vs normally closed).
- White IDC modules accept 4-28 DC input signals and provide an isolated input to an automation system. IDC modules are available as positive or negative logic (similar to normally open vs normally closed).

Examples of use include:

- PLC interface -- i/o modules provide an easy terminal to wire to; up to 4-8 times greater isolation per point for better human safety and better machine protection; and a low cost replacement cost. (It is easier to replace a fuse in the I/O module, or a complete i/o module, than it is to replace a multi point PLC output card and then re-booting the PLC.)
- Process controller interface -- many controllers provide low power vdc logic outputs that can use i/o modules to activate AC alarm lights, 1-3 amp solenoids, and other AC or DC devices.
- Computer interface -- most microprocessor based controllers can only sense or generate low level TTL (0/5 vdc) signals. The Power-io modules can sense, or switch, high level ac or dc signals.
- Network interface -- there are hundreds of DeviceNet, USB, ProfiBus, Ethernet, or remote I/O blocks that are network connected and then generate multiple logic outputs. I/O modules (1-3 amps) or Power-IO "D" family (1-100 amps) turn those network I/O ports into power I/O ports.
- Isolation -- whether your application is a four point home automation system or a 4000 point factory automation cell, the Power-IO isolation barrier ensures that your system is protected from damage from external devices and from ground loops. Each point is 4000 volt isolated from other points or from the PLC/PC control system.



For more information regarding Power-IO's family of din rail i/o modules, please visit:

OAC or ODC Output modules for AC or DC switching
IDC or IAC Input modules for inputs into automation systems

Full product specifications, pricing, and online ordering capabilities are available on those pages.

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How to quickly test a Power-io IO-IDC Module, using two 9 volt batteries and a meter.

IO-IDC-028-N or -P generates a logic signal on terminal 4 that is often wired to a PLC's input. The PLC's power supply is wired to terminals 3 and 5.

The "-N" model produces a logic signal that is negative compared to the input. (If a field device input exists, no output exists). The "-P" model produces a logic signal that is positive compared to the input. (If a field device input exists, an output exists).

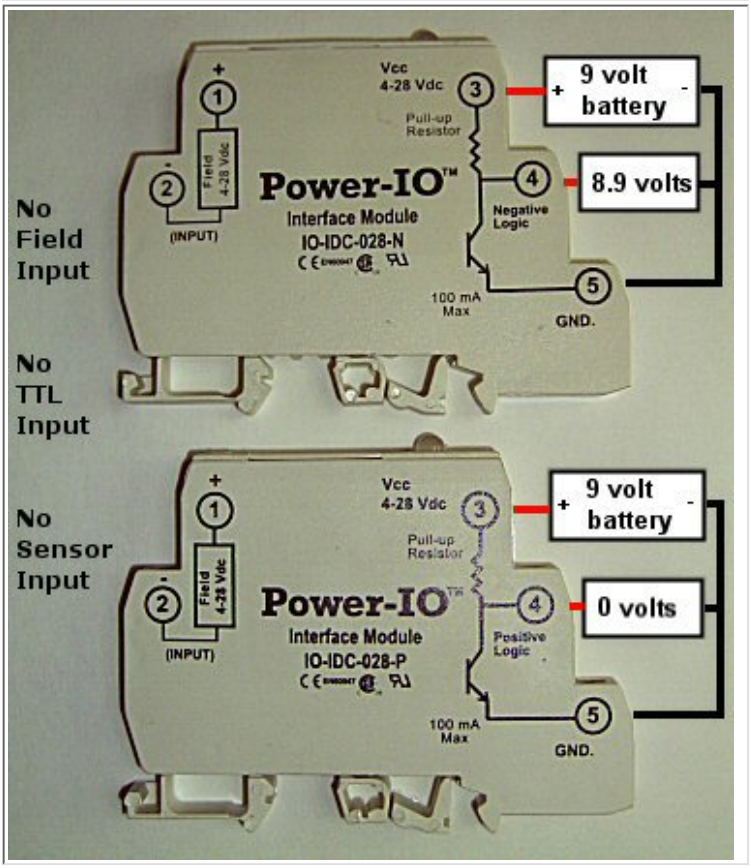
When terminal 4 is at 0 volts, it can be used as a sinking signal, at up to 100mA. This is the most common way of using the I/O module. When terminal 4 is "high", then it can be used as a sourcing signal but the mA capability will be limited to a few mA maximum.

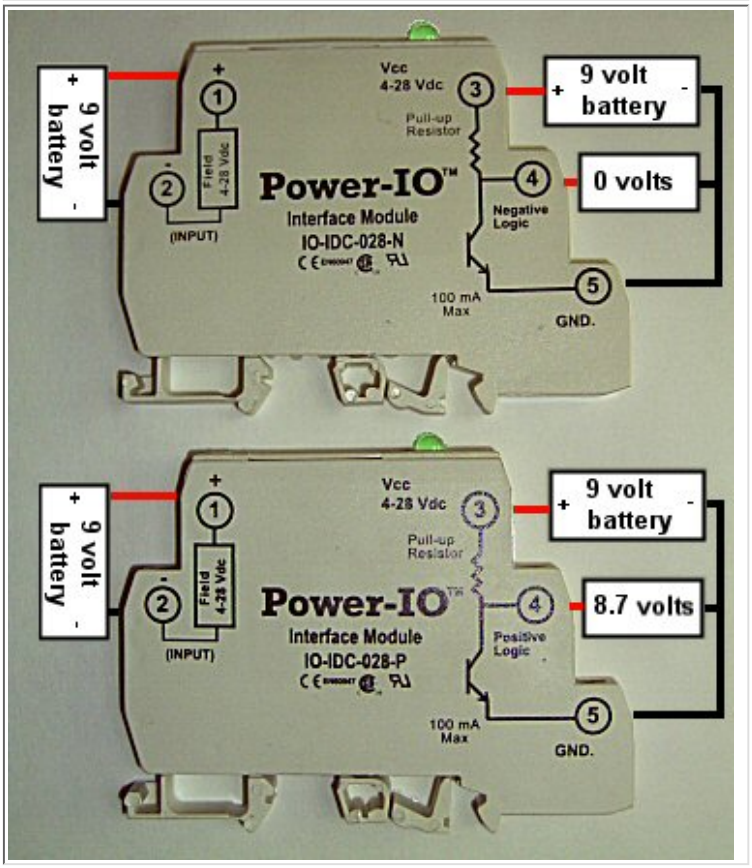
When a control input signal is present on terminals 1 and 2, the logic signal on terminal 4 changes state, and a green LED activates.

If the LED is ever red in color, the + and - polarity is probably mis-wired at terminals 3 and 5.

Sourcing? Sinking? Here is a quick example of using a sinking signal from an IO module to activate an external product: appnotes/io-module-sinking-example.htm

Sourcing? Sinking? Here is a quick explanation from the internet: http://www.patchn.com

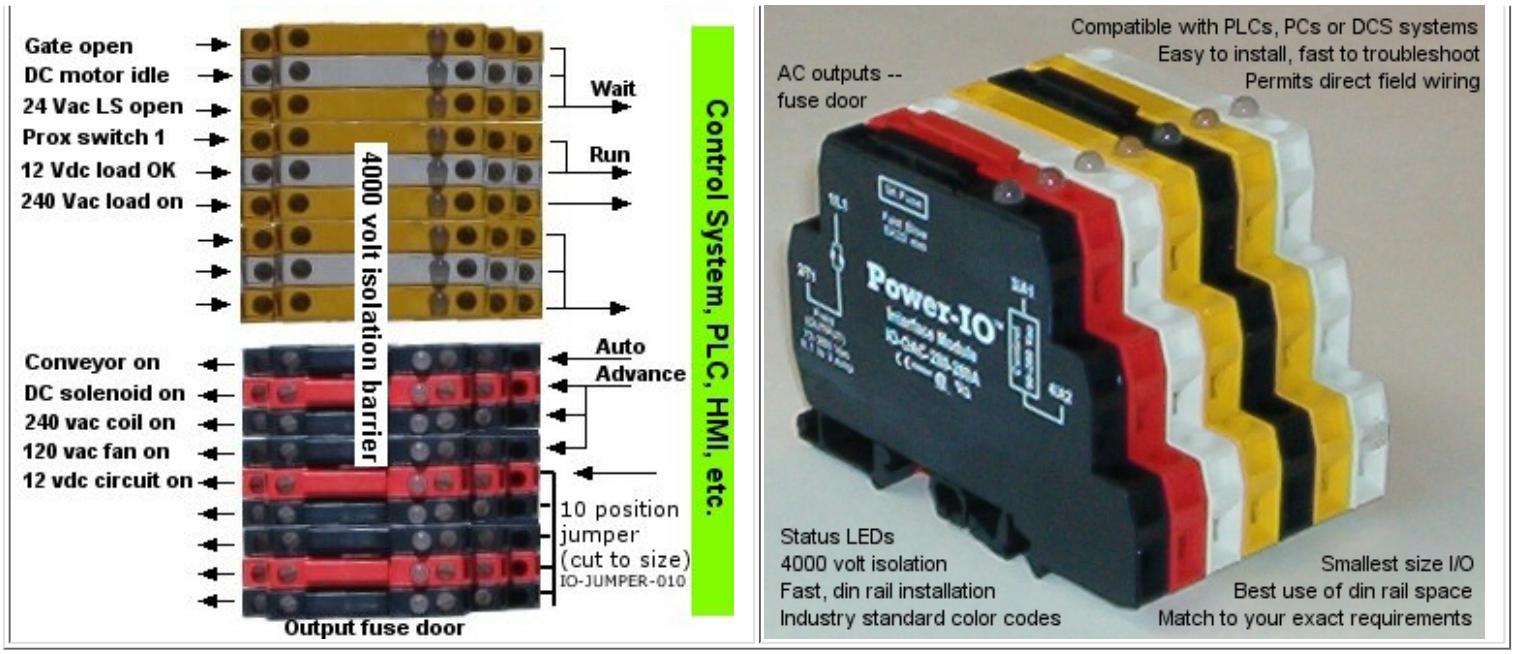




When installed in your application, the Power-io IO modules might be used like this:

The modules can be intermixed as input IO modules and output IO modules:

IO modules, i/o, and din rail i-o for IAC, OAC, IDC, and ODC.



Examples of how to use a variety of IO modules in an application: I/O modules

Return to: IAC and IDC input modules or OAC and ODC output modules

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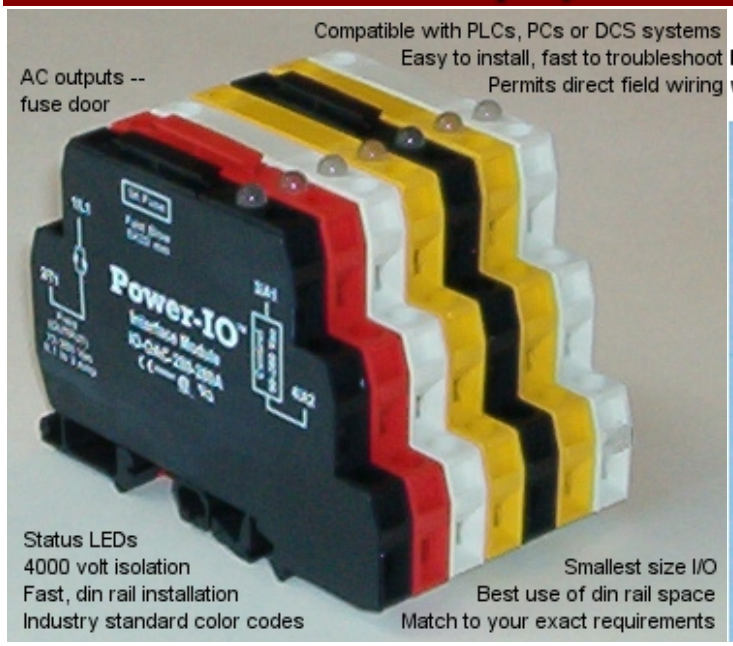
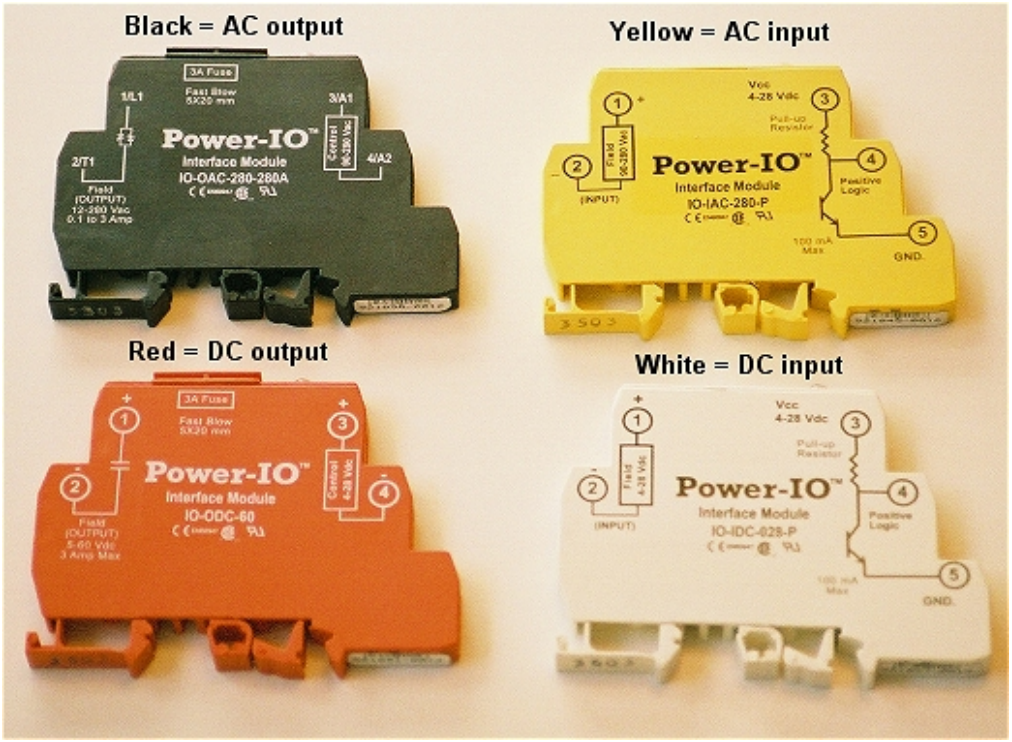
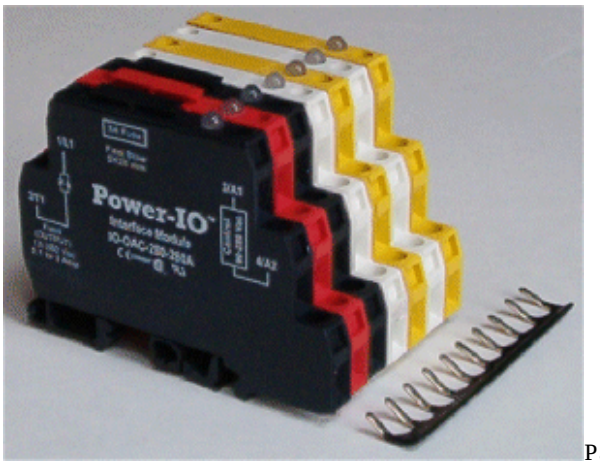


Side - to - side
Looks like a standard terminal block while providing robust i/o capability



IO modules, i/o, and din rail i-o for IAC, OAC, IDC, and IOC.



Part number: IO-JUMPER-010

Examples of how to use a variety of IO modules in an application: I/O modules

Return to: IAC and IDC input modules or OAC and ODC output modules

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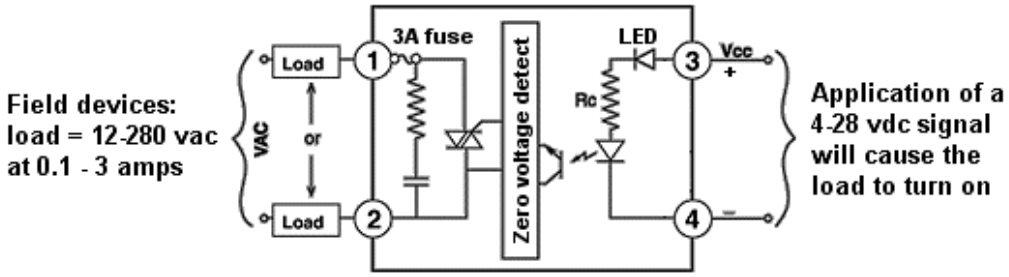
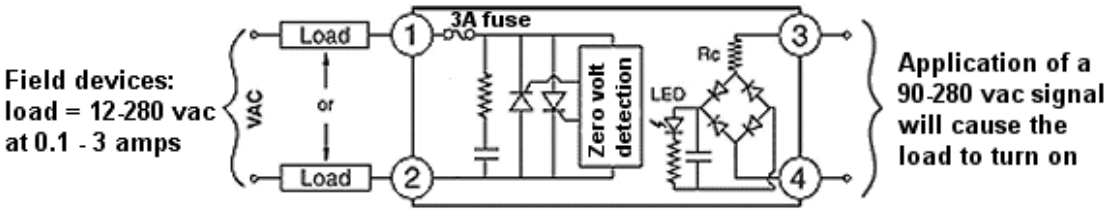
Din rail i/o module schmatics:

- IO modules provide 4000 voltage isolation between the input circuit and the load circuit
- Replaceable fuse is a standard 3 amp glass fuse
- Load amperage is up to 3 amps when the entire module is surrounded by ambient air that is less than 45°C. Some customers will install their higher amperage IO modules with 0.25 inches between the modules for airflow. At warmer ambient temperatures and/or if the modules are stacked tightly together, please derate the output capability.

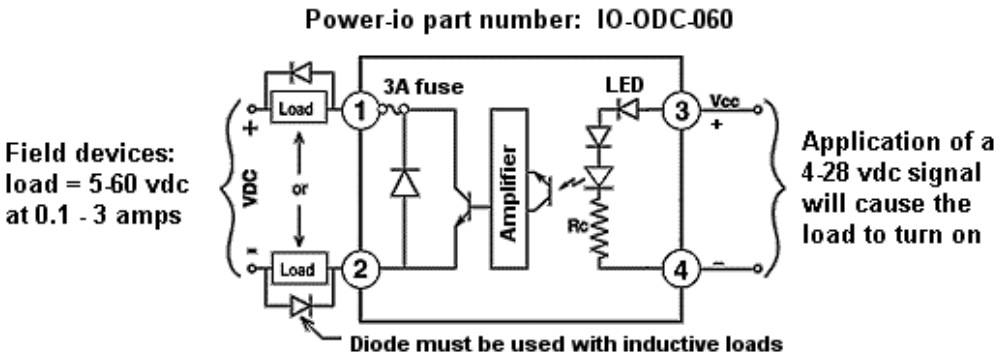
Power-io part number: IO-OAC-280



Power-io part number: IO-OAC-280-280A



Power-io part number: IO-ODC-060



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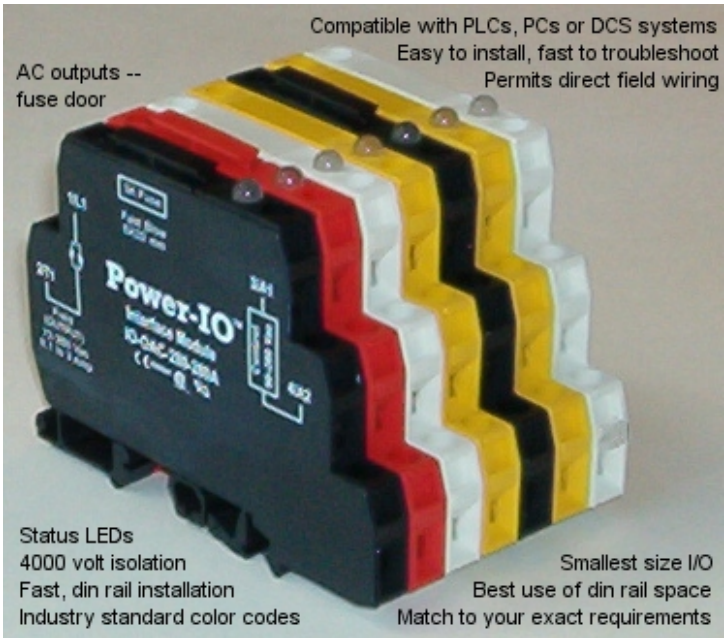
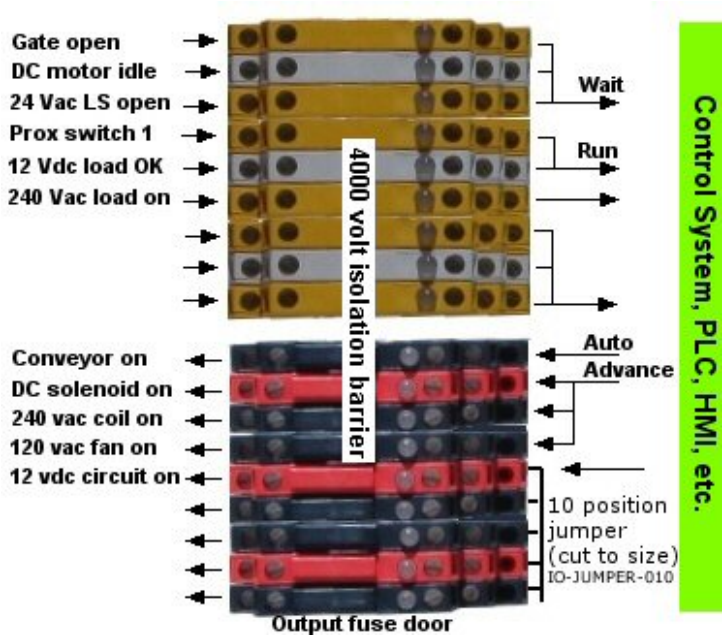
OAC or ODC modules for din rail io module applications, PLC outputs, isolated outputs, or fused outputs





				Update to Power-io din rail io modules:	Black or red output modules
i.o.-oac-ro-280	i.o.-oac-r0-280	io-oac-ro-280	io-oac-r0-280	io-oac-280	din rail io module -- output to AC loads. oac modules
dr-io-oac-ro-280	dr-io-oac-r0-280	io/oac/ro/280		io-oac-280	din rail io module -- output to AC loads. oac module
i.o.-oac-ra-280	io-oac-ra-280	dr-io-oac-ra-280	io/oac/ra/280	io-oac-280-280a	din rail io module -- output to AC loads. oac modules
i.o.-odc-ro-060	i.o.-odc-r0-060	io-odc-ro-060	io-odc-r0-060	io-odc-60	din rail io module -- output to DC loads. odc modules, standard din rail io modules
dr-io-odc-ro-060	dr-io-odc-r0-060	io/odc/ro/060	io-odc-ro-60	io-odc-60	din rail io module -- output to DC loads. odc module, standard din rail io module
i.o.-odc-rl-060	i.o.-odc-rl-60	io-odc-rl-060	io-odc-rl-60	io-odc-60-ll	din rail io module -- output to DC loads. odc modules, ultra low leakage for high parallel wiring
dr-io-odc-rl-060	dr-io-odc-rl-60			io-odc-60-LL	din rail io module -- output to DC loads. odc modules, ultra low leakage for high parallel wiring
					Yellow or white input modules
i.o.-iac-ro-280	i.o.-iac-r0-280	dr-io-iac-ro-280	dr-io-iac-r0-280	io-iac-280-n	din rail io module -- AC input to PLCs, etc. iac modules
i.o.-iac+ro-280	i.o.-iac+r0-280	dr-io-iac+ro-280	dr-io-iac+r0-280	io-iac-280-p	din rail io module -- AC input to PLCs, etc. iac module
i.o.-idc-ro-280	i.o.-idc-r0-280	dr-io-idc-ro-280	dr-io-idc-r0-280	io-idc-280-n	din rail io module -- DC input to PLCs, etc. idc modules
i.o.-idc+ro-280	i.o.-idc+r0-280	dr-io-idc+ro-280	dr-io-idc+r0-280	io-idc-280-p	din rail io module -- DC input to PLCs, etc. idc module

The information above is a guideline only and is subject to change or correction. Please examine all specification parameters to confirm the proper product for your application.

Other cross references: many standard relays, Gordos, din rail contactors, dc activated din rail contactors

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Gordos hockey puck ssr cross reference

				Update to Power-io solid state relays:	Updating to the Power-io product= higher temperature testing (40C vs 25C) Green LED and cover are standard Maximum Surge Survival <tm> technology
Gordos	84134001	84134011		haa-3v25	solid state relay, green led, cover
Gordos	84134021	84134031		haa-3v75	solid state relay, green led, cover
Gordos	84134000	84134010		hda-3v25	solid state relay, green led, cover
Gordos	84134020	84134030		hda-3v75	solid state relay, green led, cover
Gordos	84130150	84130100	84130158	daa-6v25	solid state relay, green led, cover
Gordos	84130152	84130102	84130118	daa-6v25	solid state relay, green led, cover
Gordos	84130101	84130103	84130116	dda-6v25	solid state relay, green led, cover

The information above is a guideline only and is subject to change or correction. Please examine all specification parameters to confirm the proper product for your application.

Other cross references: many standard relays, Magnecraft, din rail contactors, dc activated din rail contactors

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Magnecraft or Struthers-dunn ssr cross reference

				Update to Power-io solid state relays:	Updating to the Power-io product= higher temperature testing (40C vs 25C) Green LED and cover are standard Maximum Surge Survival <tm> technology
Magnecraft	w6210asx-1	w6225asx-1	70s2-03-b-25-s	haa-3v25	solid state relay, green led, cover
Magnecraft	w6240asx-1	w6250asx-1	w6275asx-1	haa-3v75	solid state relay, green led, cover
w6410asx-1	w6425asx-1	w6440asx-1	w6450asx-1	haa-6v50	solid state relay, green led, cover
Magnecraft	w6475asx-1			haa-6v75	solid state relay, green led, cover
Magnecraft & Struthers-Dunn	w6210dsx-1	w6220dsx-1	70s2-04-c-12-s	hda-3v25	solid state relay, green led, cover
Magnecraft / Struthers-Dunn	w6240dsx-1	w6250dsx-1	w6275dsx-1	hda-3v75	solid state relay, green led, cover
Magnecraft Struthers-Dunn	w6410dsx-1	w6425dsx-1	w6440dsx-1	hda-6v50	solid state relay, green led, cover
Magnecraft Struthers Dunn	w6450dsx-1	w6475dsx-1		hda-6v75	solid state relay, green led, cover
Magnecraft Struthers Dunn	w6212ddx-1	w6225ddx-1	w6240ddx-1	hdd-1v40	solid state relay, green led, cover

The information above is a guideline only and is subject to change or correction. Please examine all specification parameters to confirm the proper product for your application.

Other cross references: many standard relays, Gordos, din rail contactors, dc activated din rail contactors

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Invensys, Barber-Colman, Eurotherm or Continental Industries cross reference list

			Upgrade to Power-io:	Description:
ssda-3v10	ssda/3v10/a02	ssda/10a/330v/ldc/cover	hda-3v25	ssr power controller
ssda-3v25	ssda/3v25/a02	ssda/25a/330v/ldc/cover	hda-3v25	ssr power controller
ssda-3v50	ssda/3v50/a02	ssda/50a/330v/ldc/cover	hda-3v50	ssr power controller
ssda-3v75	ssda/3v75/a02	ssda/75a/330v/ldc/cover	hda-3v50	ssr power controller
ssda-6v50	ssda/6v50/a02	ssda/50a/660v/ldc/cover	hda-6v50	ssr power controller
ssda-6v75	ssda/6v75/a02	ssda/75a/660v/ldc/cover	hda-6v75	ssr power controller
ssaa-3v10	ssaa/3v10/a02	ssaa/10a/330v/ldc/cover	haa-3v25	ssr power controller
ssaa-3v25	ssaa/3v25/a02	ssaa/25a/330v/ldc/cover	haa-3v25	ssr power controller
ssaa-3v50	ssaa/3v50/a02	ssaa/50a/330v/ldc/cover	haa-3v50	ssr power controller
ssaa-3v75	ssaa/3v75/a02	ssaa/75a/330v/ldc/cover	haa-3v75	ssr power controller
ssaa-6v50	ssaa/6v50/a02	ssaa/50a/660v/ldc/cover	haa-6v50	ssr power controller
ssaa-6v75	ssaa/6v75/a02	ssaa/75a/660v/ldc/cover	haa-6v75	ssr power controller
			Upgrade to Power-io:	
svda-3v10	svda/3v10/a02	ssda-330-10-0e0	hda-3v25	ssr power controllers
svda-3v25	svda/3v25/a02	ssda-330-25-0e0	hda-3v25	ssr power controllers
svda-3v50	svda/3v50/a02	ssda-330-40-0e0	hda-3v50	ssr power controllers
svda-3v50	svda/3v50/a02	ssda-330-50-0e0	hda-3v50	ssr power controllers
svda-3v75	svda/3v75/a02	ssda-330-75-0e0	hda-3v75	ssr power controllers
svda-6v50	svda/6v50/a02	ssda-660-50-0e0	hda-6v50	ssr power controllers
svda-6v75	svda/6v75/a02	ssda-660-75-0e0	hda-6v75	ssr power controllers
svaa-3v10	svaa/3v10/a02	ssaa-330-10-0e0	haa-3v25	ssr power controllers
svaa-3v25	svaa/3v25/a02	ssaa-330-25-0e0	haa-3v25	ssr power controllers
svaa-3v50	svaa/3v50/a02	ssaa-330-50-0e0	haa-3v50	ssr power controllers
svaa-3v75	svaa/3v75/a02	ssaa-330-75-0e0	haa-3v75	ssr power controllers
svaa-6v50	svaa/6v50/a02	ssaa-660-50-0e0	haa-6v50	ssr power controllers
svaa-6v75	svaa/6v75/a02	ssaa-660-75-0e0	haa-6v75	ssr power controllers
			Upgrade to Power-io:	
s505-osj610-000		rlda-240/15-000	hda-3v25	scr power controller
s505-osj625-000		rp03-24/280-04a	hda-3v25	scr power controller
s505-osj640-000			hda-3v50	scr power controller
s505-osj675-000			hda-3v75	scr power controller
s505-osj610-009		rlaa-240/15-00a	haa-3v25	scr power controller
s505-osj625-009			haa-3v25	scr power controller
s505-osj640-009			haa-3v50	scr power controller
s505-osj675-009			haa-3v75	scr power controller
			Upgrade to Power-io:	
rsdc-dc-108-000	rsdd/8a/100v/ldc	rsdc-dc-108-0e0	hdd-1v20	mosfet power controller
rsdc-dc-112-000	rsdd/12a/100v/ldc	rsdc-dc-112-0e0	hdd-1v20	mosfet power controller
rsdc-dc-120-000	rsdd/20a/100v/ldc	rsdc-dc-120-0e0	hdd-1v20	mosfet power controller
rsdc-dc-140-000	rsdd/40a/100v/ldc	rsdc-dc-140-0e0	hdd-1v40	mosfet power controller

The information above is a guideline only and is subject to change or correction. Please examine all specification parameters to confirm the proper product for your application.

Other cross references: many standard relays, Invensys, Eurotherm, Crydom, Din rail contactors, Continental

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Crydom solid state relays cross reference for Crydom hockey puck relays or din rail relays

				Update to Power-io	Updating to the Power-io product = higher temperature testing (40C vs 25C) higher density on a din rail better dv/dt ratings	
Crydom	ckrd2410	ckrd4810	hpf240d20	dda-6v25	din rail solid state contactor, integral heat sink, rated 25 amps at 40C	
Crydom	ckrd2420	ckrd4820	hpf480d20	dda-6v25	25 amp din rail solid state contactor	
Crydom	ckrd2430	ckrd4830	hpf240d30	dda-6v40	40 amp din rail solid state contactor	
Crydom	ckra2410	ckra4810	hpf480d30	daa-6v25	ac input din rail solid state contactor	
Crydom	ckra2420	ckra4820		daa-6v25	din rail solid state contactor	
Crydom	ckra2430	ckra4830		daa-6v40	din rail solid state contactor	
Crydom	ckrd2410p	ckrd4810p		dda-6v25	din rail solid state contactor	
Crydom	ckrd2420p	ckrd4820p		dda-6v25	din rail solid state contactor	
Crydom	ckrd2430p	ckrd4830p		dda-6v40	din rail solid state contactor	
Crydom	ckra2410p	ckra4810p		daa-6v25	din rail solid state contactor	
Crydom	ckra2420p	ckra4820p		daa-6v25	din rail solid state contactor	
Crydom	ckra2430p	ckra4830p		daa-6v40	din rail solid state contactor	
				Update to Power-io solid state contactors		
Crydom	cmd2425	cmd4825	cmd6025	dda-6v25	solid state contactors	
Crydom	cmd2450	cmd4850	cmd6050	dda-6v50	50 amp solid state contactors	
Crydom	cmd2475	cmd4875	cmd6075	dda-6v75	75 amp solid state contactors	
Crydom	cmd2490	cmd4890	cmd6090	dda-6v100	100 amp solid state contactors	
Crydom	cma2425	cma4825	cma6025	daa-6v25	solid state contactors	
Crydom	cma2450	cma4850	cma6050	daa-6v50	solid state contactors	
Crydom	cma2475	cma4875	cma6075	daa-6v75	solid state contactors	
Crydom	cma2490	cma4890	cma6090	daa-6v100	solid state contactors	
Crydom	cmra2425p	cmra4525p	cmra6025p	daa-6v25	solid state contactors	
Crydom	cmd2425p	cmd4825p	cmd6025p	dda-6v25	solid state contactors	
Crydom	cmd2450p	cmd4850p	cmd6050p	dda-6v50	solid state contactors	
Crydom	cmd2475p	cmd4875p	cmd6075p	dda-6v75	solid state contactors	
Crydom	cmd2490p	cmd4890p	cmd6090p	dda-6v100	solid state contactors	
Crydom	cma2425p	cma4825p	cma6025p	daa-6v25	solid state contactors	
Crydom	cma2450p	cma4850p	cma6050p	daa-6v50	solid state contactors	
Crydom	cma2475p	cma4875p	cma6075p	daa-6v75	solid state contactors	
Crydom	cma2490p	cma4890p	cma6090p	daa-6v100	solid state contactors	
				Update to Power-io solid state contactors		
Crydom	cmrd2425	cmrd4525	cmrd6025	dda-6v25	ssc power controls	
Crydom	cmrd2435	cmrd4535	cmrd6035	dda-6v40	ssc power controls	
Crydom	cmrd2445	cmrd4545	cmrd6045	dda-6v50	ssc power controls	
Crydom	cmrd2455	cmrd4555	cmrd6055	dda-6v75	ssc power controls	
Crydom	cmra2425	cmra4525	cmra6025	daa-6v25	ssc power controls	
Crydom	cmra2435	cmra4535	cmra6035	daa-6v40	ssc power controls	
Crydom	cmra2445	cmra4545	cmra6045	daa-6v50	ssc power controls	
Crydom	cmra2455	cmra4555	cmra6055	daa-6v75	ssc power controls	
Crydom	cmrd2425p	cmrd4525p	cmrd6025p	dda-6v25	scr power controls	
Crydom	cmrd2435p	cmrd4535p	cmrd6035p	dda-6v40	scr power controls	
Crydom	cmrd2445p	cmrd4545p	cmrd6045p	dda-6v50	scr power controls	
Crydom	cmrd2455p	cmrd4555p	cmrd6055p	dda-6v75	scr power controls	
Crydom	cmra2435p	cmra4535p	cmra6035p	daa-6v40	scr power controls	

Crydom	cmra2445p	cmra4545p	cmra6045p	daa-6v50	scr power controls	
Crydom	cmra2455p	cmra4555p	cmra6055p	daa-6v75	scr power controls	
				Update to Power-io solid state relays:		
Crydom	d1210	d1225	d1225-p	hda-3v25	dc input, ac switching ssr	
Crydom	d2410	d2425	d2425-p	hda-3v25	ac switching ssr	
Crydom	d2450	cwd2450	d2450-p	hda-3v50	ac switching ssr	
Crydom	a1210	a1225	a1225	haa-3v25	ac input, ac switching ssr	
Crydom	a2410	a2425	a2425-p	haa-3v25	ac switching ssr	
Crydom	a2450	cwd2450	a2450-p	haa-3v50	ac switching ssr	
Crydom	d1d12	d1d12L	d1d07	hdd-1v12	dc input, dc switching ssr	
Crydom	d1d20	did20	d1d20L	hdd-1v20	dc in dc out ssr	
Crydom	d1d40	did40	d1d4L	hdd-1v40	mosfet based dc switching ssr	
Additional Crydom solid state relays cross reference list						

The information above is a guideline only and is subject to change or correction. Please examine all specification parameters to confirm the proper product for your application.

Other cross references: Crydom SSR list, many standard relays, Invensys, Din rail contactors

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Crydom hockey puck ssr cross reference

				Update to Power-io solid state relays:	Updating to the Power-io product= higher temperature testing (40C vs 25C) Green LED and cover are standard Maximum Surge Survival <tm> technology
Crydom	A1210	A1225	A1225-P	haa-3v25	solid state relay, green led, cover
Crydom	A2410	A2425	A2425-P	haa-3v25	solid state relay, green led, cover
Crydom	A1240	A2450	A2450-P	haa-3v50	solid state relay, green led, cover
Crydom	A2475	A2475-P		haa-3v75	solid state relay, green led, cover
Crydom	D1210	D1225	D1225-P	hda-3v25	solid state relay, green led, cover
Crydom	D2410	D2425	D2425-P	hda-3v25	solid state relay, green led, cover
Crydom	D1240	D2450	D2450-P	hda-3v50	solid state relay, green led, cover
Crydom	A2475	A2475-P		hda-3v75	solid state relay, green led, cover
Crydom	A4812	A4825	A4850	haa-6v50	solid state relay, green led, cover
Crydom	HA4812	HA4825	HA4850	haa-6v50	solid state relay, green led, cover
Crydom	HA6025	HA6050		haa-6v50	solid state relay, green led, cover
Crydom	A4875	A4812-H	HA4875	haa-6v75	solid state relay, green led, cover
Crydom	D4812	D4825	D4850	hda-6v50	solid state relay, green led, cover
Crydom	HD4812	HD4825	HD4850	hda-6v50	solid state relay, green led, cover
Crydom	HD6025	HD6050		hda-6v50	solid state relay, green led, cover
Crydom	D4875	D4875-H	HD4875	hda-6v75	solid state relay, green led, cover
				Update to Power-io solid state relays:	
Crydom	CWD2410	CWD2425	CWD2425S	hda-3v25	solid state relays, green led, cover
Crydom	CWD2450	CWD2450S		hda-3v50	solid state relays, green led, cover
Crydom	CWA2410	CWA2425	CWA2425S	haa-3v25	solid state relays, green led, cover
Crydom	CWA2450	CWA2450S		haa-3v50	solid state relays, green led, cover
Crydom	CWD4810	CWD4825	CWD4850	hda-6v50	solid state relays, green led, cover
Crydom	CWA4810	CWA4825	CWA4850	haa-6v50	solid state relays, green led, cover
				Update to Power-io solid state relays:	

The information above is a guideline only and is subject to change or correction. Please examine all specification parameters to confirm the proper product for your application.

Other cross references: many standard relays, Invensys, Eurotherm, Crydom, din rail contactors, dc activated din rail contactors

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Single phase solid state relays

Marked: Continental, Continental relays, CI, CII, ciicontrols, ciicontinental, or Continental Mesa AZ	Marked: Eurotherm, Barber-Colman, Invensys, or Foxboro	Upgrade to Power-io for international terminals numbers, international green led, latest heat sink improvements, and more.
RSAA-660-25-1D0	RVAA/5V25	DAA-6V25
RSAA-660-40-1D0	RVAA/5V40	DAA-6V40
RSDA-660-25-1D0	RVDA/5V25	DDA-6V25
RSDA-660-40-1D0	RVDA/5V40	DDA-6V40
RVAA/3V25	330 V 25 Amp Din Rail SSR AC Input / AC Output	DAA-6V25
RVAA/3V40	330 V 40 Amp Din Rail SSR AC Input / AC Output	DAA-6V40
RVAA/5V25	560 V 25 Amp Din Rail SSR AC Input / AC Output with MOV	DAA-6V25
RVAA/5V40	560 V 40 Amp Din Rail SSR AC Input / AC Output with MOV	DAA-6V40
RVAA/6V25	660 V 25 Amp Din Rail SSR AC Input / AC Output	DAA-6V25
RVAA/6V40	660 V 40 Amp Din Rail SSR AC Input / AC Output	DAA-6V40
RVDA/3V25	330 V 25 Amp Din Rail SSR DC Input / AC Output	DDA-6V25
RVDA/3V40	330 V 40 Amp Din Rail SSR DC Input / AC Output	DDA-6V40
RVDA/5V25	560 V 25 Amp Din Rail SSR DC Input / AC Output with MOV	DDA-6V25
RVDA/5V40	560 V/40 Amp Din Rail SSR DC Input / AC Output with MOV	DDA-6V40
RVDA/6V25	660 V 25 Amp Din Rail SSR DC Input / AC Output	DDA-6V25
RVDA/6V40	660 V 40 Amp Din Rail SSR DC Input / AC Output	DDA-6V40

Three phase solid state relays

RSAA-660-30-3D0	RVA3/6V75T/H	DDA3-6V75T-H
RSDA-660-30-3D0	RVD3/6V75T/L	DDA3-6V75T-H
RVA3/6V75T/H	660V 75 Amp/AC Input/Rail SSR/3 Phase	DDA3-6V75T-H

RVD3/6V75T/L	660V 75 Amp/DC Input/Rail SSR/3 Phase	DDA3-6V75T-H
4-20 mA analog input solid state relays		
RVMA/5V25	560 V 25 Amp Din Rail SSR 4-20mA Input / AC Output with MOV	DMA-6V25
RVMA/5V40	560 V 40 Amp Din Rail SSR 4-20mA Input / AC Output with MOV	DMA-6V40
RVMA/6V25	660 V 25 Amp Din Rail SSR 4-20 mA Input / AC Output	DMA-6V25
RVMA/6V40	660 V 40 Amp Din Rail SSR 4-20 mA Input / AC Output	DMA-6V40
Links to other cross reference charts: cii-continental, or continental solid state relay.		

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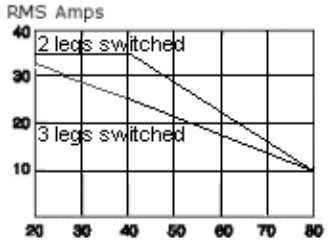
Three phase, 25 or 35 amps per leg, din rail contactor

Features

- Maximum Surge Survival™ technology -- triple layer, voltage surge protection
- Green LED for input status
- Thermally optimized heat sink permits edge-to-edge installations on a din rail
- Built-in snubber circuit
- Zero crossing activation -- low EMI, low noise to nearby electronics
- Internal 50A SCR thyristors for high inrush capability
- 4000 volt isolation, 1400Vpk blocking voltage
- 1000 volt / microsecond immunity
- Highest thermal efficiency -- less than 1.2 watts per amp switched, per leg
- CE, UL recognized, CSA
- Industry standard A1, A2, L1, T1, L2, T2, L3, T3 terminal numbers
- High density design permits more amps per square inch
- 3Ø = 25 amps per leg, 2Ø using L1/T1 and L3/T3 = 35 amps per leg.
- Optional: 3 internal MOVs for a fourth layer of surge survival

Derating Curve



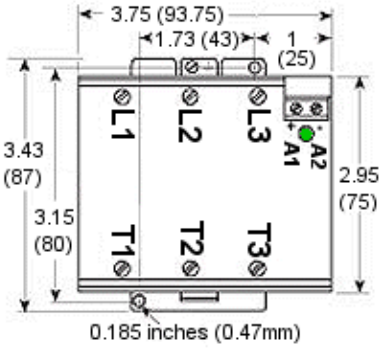
Part Numbers

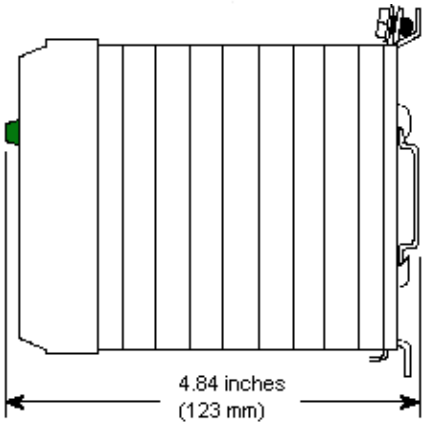
DDA3-6V75T-H up to 75 amps TOTAL; 25A on three legs or 35A on 2 legs; 660V max, 10-60 VDC activated BUY

DDA3-5V75T-H up to 75 amps TOTAL; 25A on three legs or 35A on 2 legs; 570V max, three internal MOVs, 10-60 VDC activated BUY

DAA3-6V75T-H up to 75 amps TOTAL; 25A on three legs or 35A on 2 legs; 660V max, 100-280 VAC activated BUY

DAA3-5V75T-H up to 75 amps TOTAL; 25A on three legs or 35A on 2 legs; 570V max, three internal MOVs, 100-280 VAC activated BUY





Specifications

Part Number	Line Voltage Range (VAC)	Load Current Range (A RMS)	Min Control Voltage & Current Draw	Max Control Voltage & Current Draw	Must Release Voltage
DC activated					
DDA3-6V75T-H	24-660	.10-25 (3 leg) or 35 (2 leg)	10VDC/3.5mA	60VDC/6mA	1 VDC
DDA3-5V75T-H	24-660	.10-25 (3 leg) or 35 (2 leg)	10VDC/3.5mA	60VDC/6mA	1 VDC
AC activated*					
DAA3-6V75T-H	24-660	.10-25 (3 leg) or 35 (2 leg)	100VAC/25mA	280VAC/25mA	20VDC/2MA

DAA3-5V75T-H	24-660	.10-25 (3 leg) or 35 (2 leg)	100VAC/25mA	280VAC/25mA	20VDC/2MA
* Typically, does NOT need a burden resistor when activated by a triac output controller.					

Internal MOVs	The 5V models use three internal MOVs that are similar to the Littelfuse Harris V575 LA80B Metal Oxide Varistors. The use of MOVs is encouraged in situations where there are frequent voltage surges such as near motor starter applications.
Installation	The DDA3 can be installed on a din rail or directly on a metal panel. The heat sink must be installed so the air flows up and through the fins.
Off-State dv/dt	1000 v/µs
Isolation	4000 volts isolation
I^2T fuse	50A or less, for example: Bussman FWP50A14F, FWC32A10F, FWC20A10F. Ferraz Shawmut B093910, M330015, K330013
Turn-on time	<8.3 ms at 60hz
Turn-off time	<8.3 ms at 60hz
Power terminals	Will accept #24-#10 AWG wire. Torque: 7-9 inch lbs.
Control terminals	Will accept #24-#14 AWG wire. Torque: 4 inch lbs.
Terminology	The word "leg" refers to a switched AC power line. A three phase application may use 3 switched lines or 2 switched lines.
Motor starter	When used as a motor starter, use the "5V" feature in order to include the internal MOVs. The Power-io contactor can be typically be used for: <10 FLA amps per phase, 3 HP for most 208/230 volt motors, 7.5 HP for most 460 volt motors.

Additional information

Close up photo of: three, din rail solid state contactors and their labels

Wiring examples of various 3 phase loads: 3 phase contactor wiring

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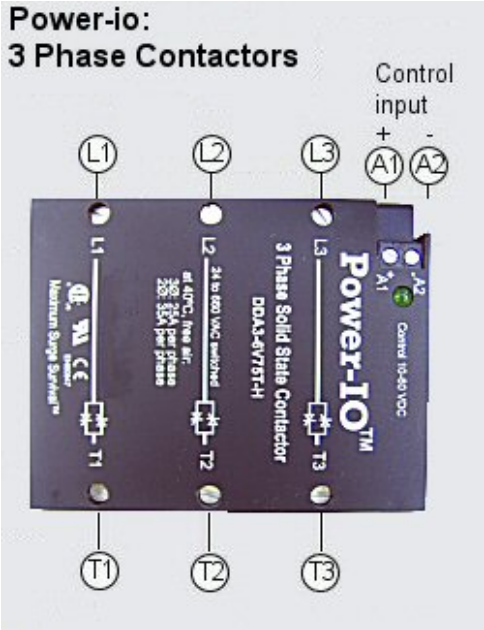
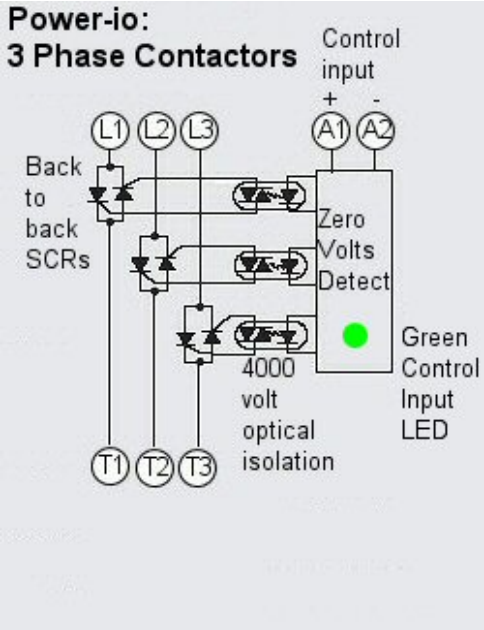
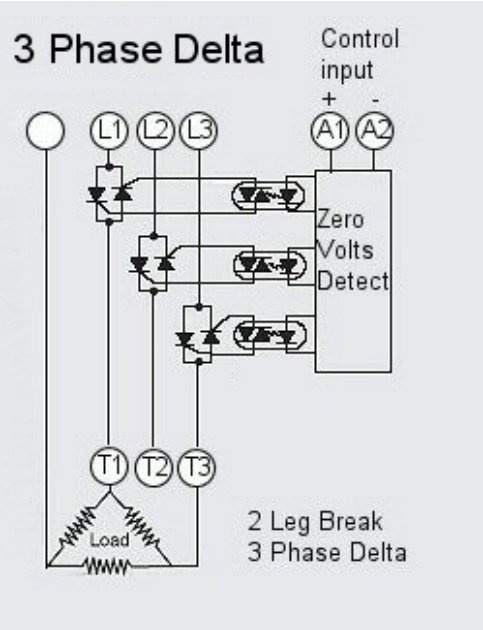
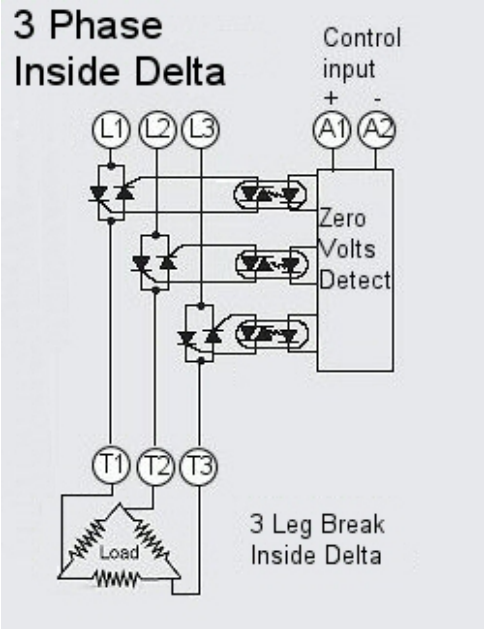
3 phase contactor wiring examples:

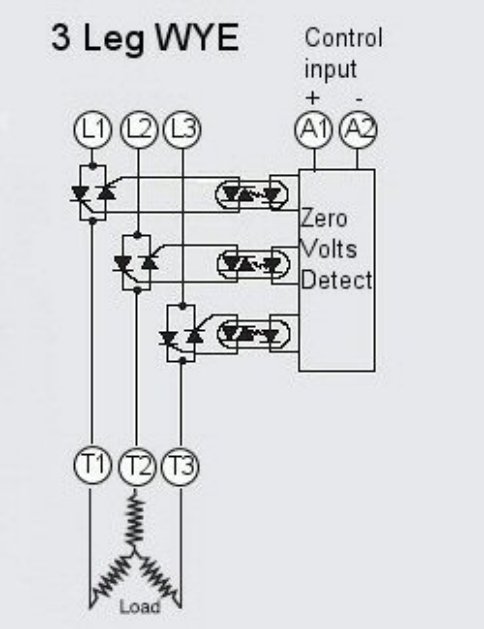
Wiring examples for 3 phase solid state contactors as used in 3 phase delta, 3 phase wye or similar applications. Please consult your local electrical code for specific information about your installation.

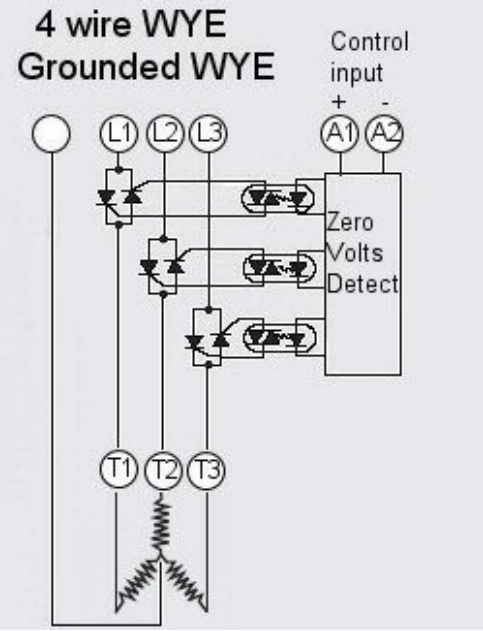


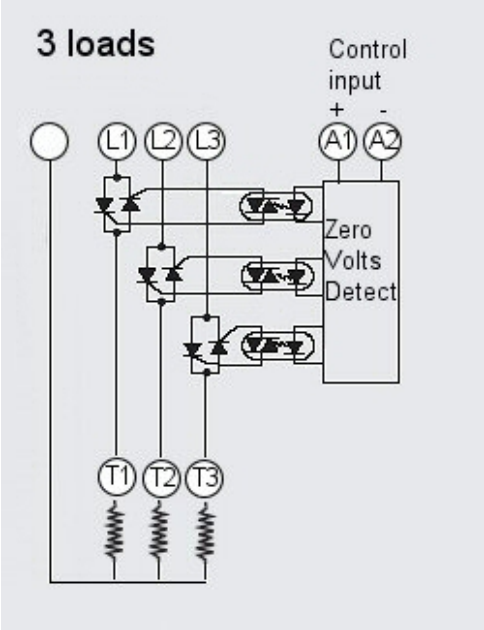


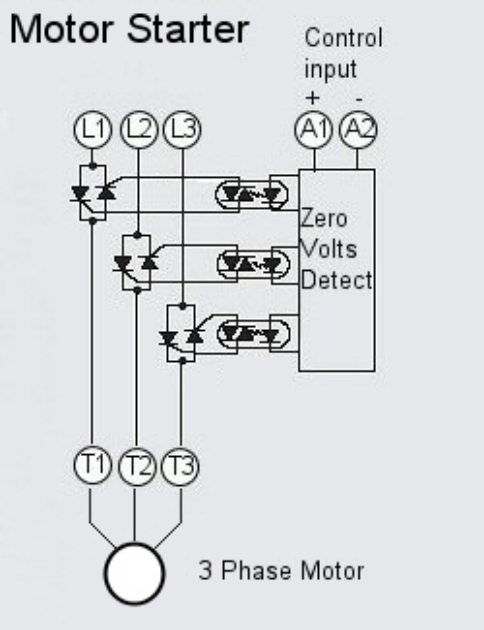


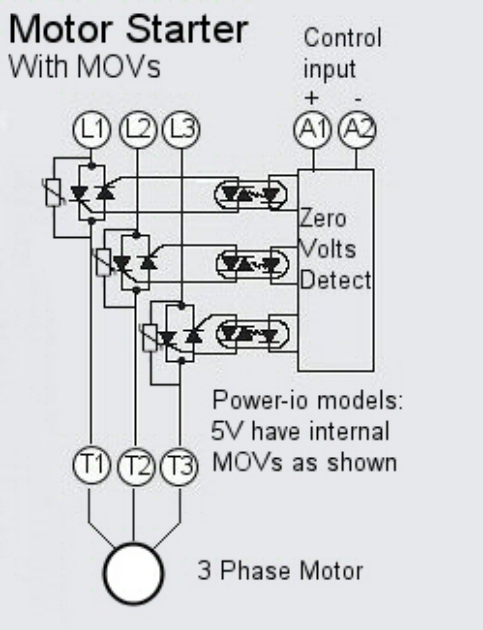












Return to: AC or DC activated 3 phase contactors or analog 4-20mA input, 3 phase contactor

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4-20mA activated, three phase, 25 or 35 amps per leg, din rail contactor

- Accepts a 4-20mA analog process input and provides a high speed, time proportional AC output (TPO)
- Permits a PLC, PC, DCS or other control system to supply a TPO without any software programming or intensive CPU calculations of variable on time vs off time.
- Output cycle time ("ON" time + "OFF" time) = approximately 0.5 second at 50%. Output resolution is one half of one sinewave (8.3 msec for 60 hz applications).

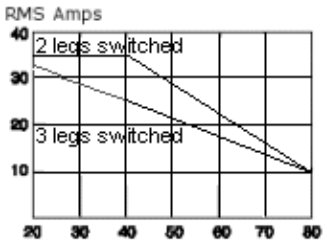
For example, when the POWER-IO unit is used to control an electric heater, band heater, heat sealing bar, etc:
4mA = 0% = heater is off
12mA = 50% = heater is ON for 250 msec, OFF for 250 msec, ON for 250 msec...
16mA = 75% = heater is ON for 375 msec, Off for 125 msec, ON for 375 msec...
20mA = 100% = heater is ON
Note: Rapid pulsing of the heaters provides the most precise temperature control, PLUS it dramatically increases the life of the heaters due to a reduction in the thermal stress of expansion and contraction. Since the contactor is switching at the zero crossing mark of a sinewave, there is no electrical noise that might interfere with nearby electronics. Also, since the calculated ON or OFF time period is measured in half sine waves, the contactor will automatically adjust the total cycle time in order to maintain the best ratio of ON/OFF to match your control input.

Three phase, 25 or 35 amps per leg, din rail contactor

Features

- Maximum Surge Survival™ technology -- triple layer, voltage surge protection
- Green LED for input status
- Thermally optimized heat sink permits edge-to-edge installations on a din rail
- Built-in snubber circuit
- Zero crossing activation -- low EMI, low noise to nearby electronics
- Internal 50A thyristors for high inrush capability
- 4000 volt isolation, 1400Vpk blocking voltage
- 1000 volt / microsecond immunity
- Highest thermal efficiency -- less than 1.2 watts per amp switched, per leg
- CE, UL recognized, CSA
- Industry standard A1, A2, L1, T1, L2, T2, L3, T3 terminal numbers
- High density design permits more amps per square inch
- 3Ø = 25 amps per leg, 2Ø using L1/T1 and L3/T3 = 35 amps per leg.
- Optional: 3 internal MOVs for a fourth layer of surge survival (models "5V")

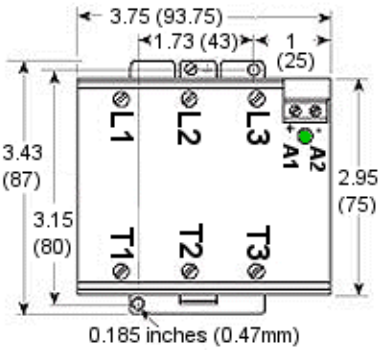
Derating Curve



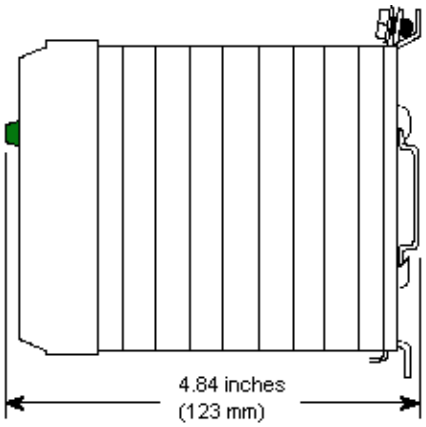
Part Numbers

DMA3-6V75T up to 75 amps TOTAL; 25A on three legs or 35A on 2 legs; 660V max, 4-20mA analog input activated BUY

DMA3-5V75T up to 75 amps TOTAL; 25A on three legs or 35A on 2 legs; 575V max; 3 internal MOVs; 4-20mA analog input activated. Non-standard model -- consult factory for price and availability.



Specifications



Part Number	Line Voltage Range (VAC)	Load Current Range (A RMS)	Max Voltage Drop @ 20mA
4-20mA analog input activated			
DMA3-6V75T	24-660	.10-25 (3 leg) or 35 (2 leg)	10 VDC
DMA3-5V75T	24-575	.10-25 (3 leg) or 35 (2 leg)	10 VDC
Installation	The DMA3 can be installed on a din rail or directly on a metal panel. The heat sink must be installed so the air flows up and through the fins.		
Off-State dv/dt	1000 v/µs		
Isolation	4000 volts isolation		
I^2T fuse	50A or less, for example: Bussman FWP50A14F, FWC32A10F, FWC20A10F. Ferraz B093910, M330015, K330013		
Example of control	0% = heater or load is "off" 50% = heater "on" 250 mseconds, "off" 250 msec, "on" 250 msec... 75% = "on" 375 msec, "off" 125msec, "on" 375 msec.... 85% = "on" 425 msec, "off" 75msec, "on" 425 msec.... 100% = heater "on"		
Turn-on time	<8.3 ms at 60hz		
Turn-off time	<8.3 ms at 60hz		
Power terminals	Will accept #24-#10 AWG wire. Torque: 7-9 inch lbs.		
Control terminals	Will accept #24-#14 AWG wire. Torque: 4 inch lbs.		
Internal MOVs	The "5V" models have three internal MOVs installed providing a fourth layer of surge survivial. Using the MOVs limits the product to applications from 48 - 575 volts.		
Terminology	The word "leg" refers to a switched AC power line. A three phase application may use 3 switched lines or 2 switched lines.		

Additional information

Close up photo of: three, din rail solid state contactors and their labels

Wiring examples of various 3 phase loads: 3 phase contactor wiring

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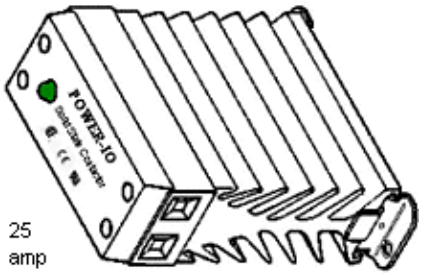
4-20mA activated, single phase, 25 or 40 amp, din rail contactor

- Accepts a 4-20mA analog process input and provides a high speed, time proportional AC output (TPO)
- Permits a PLC, PC, DCS or other control system to supply a TPO without any software programming or intensive CPU calculations of variable on time vs off time.
- Output cycle time ("ON" time + "OFF" time) = approximately 0.5 second at 50%. Output resolution is one half of one sinewave (8.3 msec for 60 hz applications).

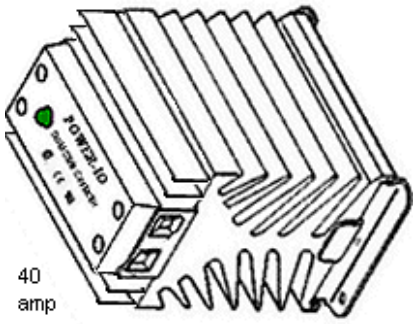
For example, when the POWER-IO unit is used to control an electric heater, band heater, heat sealing bar, etc:
4mA = 0% = heater is OFF
12mA = 50% = heater is ON for 250 msec, OFF for 250 msec, ON for 1/4 second, OFF for 1/4 second...
16mA = 75% = heater is ON for 375 msec, OFF for 125 msec, ON for 375 msec...
17.5mA = 84.375% = heater is ON for 422 msec, OFF for 88 msec, ON for 422 msec...
20mA = 100% = heater is ON
Note: This rapid pulsing of the heaters provides the most precise temperature control, PLUS it dramatically increases the life of the heaters due to a reduction in the thermal stress of expansion and contraction. Since the contactor is switching at the zero crossing mark of a sinewave, there is no electrical noise that might interfere with nearby electronics. Also, since the calculated ON or OFF time period is measured in half sine waves, the contactor will automatically adjust the total cycle time in order to maintain the best ratio of ON/OFF to match your control input.

Features

- Maximum Surge Survival™ technology -- triple layer, voltage surge protection
- Green LED for input status
- Thermally optimized heat sink permits edge-to-edge installations on a din rail
- Built-in snubber circuit
- Zero crossing activation -- low EMI, low noise to nearby electronics
- Internal 50A thyristors for high inrush capability
- 4000 volt isolation, 1400 blocking voltage
- 1000 volt per microsecond immunity
- Highest thermal efficiency -- less than 1.2 watts dissipated per amp switched.
- UL, CSA, CE
- Industry standard A1, A2, L1, T1 terminal numbers
- High density design permits more amps per square inch



25 amp



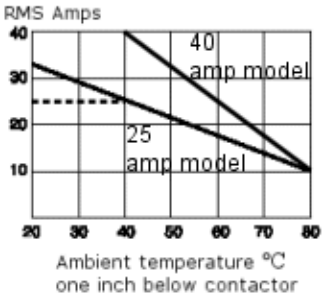
40 amp

Part Number

DMA-6V25 25A, 660V max, 4-20 mA analog input activated BUY

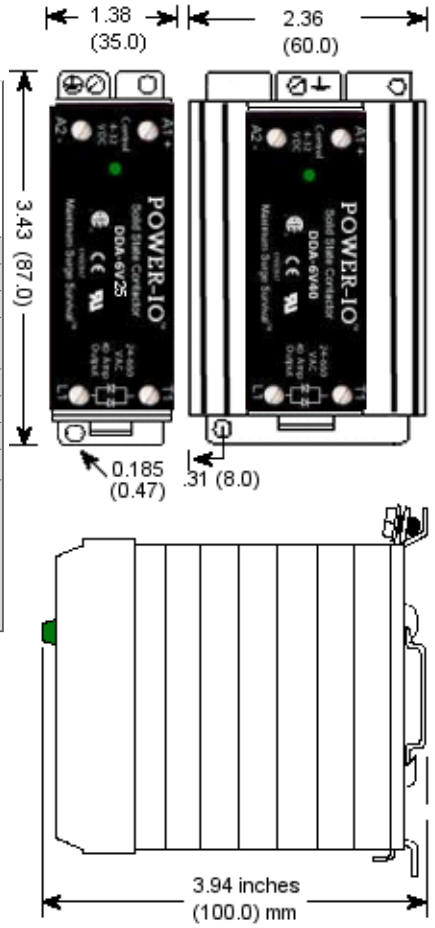
DMA-6V40 40A, 660V max, 4-20 mA analog input activated BUY

Derating Curve



Specifications

Part Number	Line Voltage Range (VAC)	Load Current Range (A RMS)	Max Voltage Drop at 20mA
DMA-6V25	24-660	.10-25	6VDC
DMA-6V40	24-660	.10-40	6VDC
Off-State dv/dt	1000 v/µs		
Isolation	4000 volts		
I^2T fuse	50A or less, for example: Bussman FWP-50A14F, FWP-40A14F, FWP-30A14F. Ferraz B093910, M330015, K330013		
Turn-on time	<8.3 ms at 60hz		
Turn-off time	<8.3 ms at 60hz		
Terminals	Will accept #24-#10 AWG wire. Torque: 7-9 inch lbs.		
FAQs			
Multiple units	Can one 4-20mA output from a PLC activate several units? Yes, determine the compliance of the 4-20mA such as 20 volts. Power-io has a 6 volt drop. So, you could activate 3 units when wired in series (not parallel). OR, your PLC may say 20mA into a 1K max load resistance. 20mA*1K = 20 volts compliance. OR, Ohm's law: 6V (drop) / .020 (mA) = 300 ohm per Power-io unit.		



Zoomed in product picture

Three, din rail solid state contactors and their labels

Schematic of the internal design

4-20 input contactor schematic

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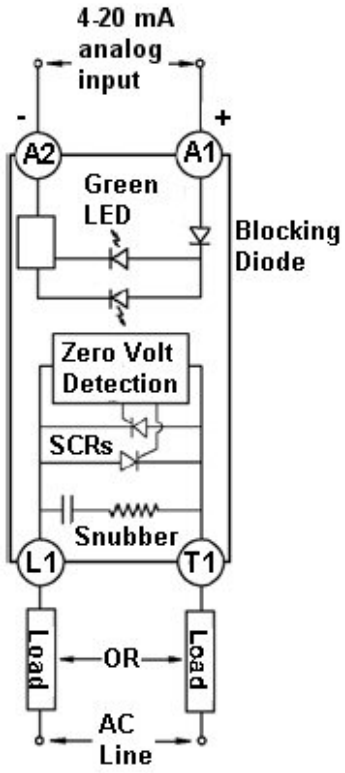
4-20 mA input contactor:



Return to: [4-20 mA solid state contactor]

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Solid state contactors cross reference

				Upgrade to Power-io solid state relays:
Sprecher + Schuh	sr7-sh05gz25		solid state triac	HDA-3v25
Sprecher + Schuh	sr7-sh05ga12		solid state relay	HAA-3v25
Sprecher + Schuh	sr7-sh05ga22		solid state relay	HAA-3v25
Sprecher & Schuh	sr7-sh10gz25		solid state triac	HDA-3v25
Sprecher & Schuh	sr7-sh10ga12		solid state relay	HAA-3v25
Sprecher & Schuh	sr7-sh10ga22		solid state relay	HAA-3v25
Sprecher and Schuh	sr7-sh10hz25		solid state triac	HDA-6v50
Sprecher and Schuh	sr7-sh25gz25		solid state relay	HDA-3v25
Sprecher and Schuh	sr7-sh25ga12		solid state relay	HAA-3v25
Sprecher and Schuh	sr7-sh25ga22		solid state relay	HAA-3v25
Sprecher and Schuh	sr7-sh25hz25		solid state triac	HDA-6v50
Sprecher and Schuh	sr7-sh40gz25		solid state relay	HDA-3v50
ssusa	sr7-sh40ga12		solid state relay	HAA-3v50
ssusa	sr7-sh40ga22		solid state relay	HAA-3v50
ssusa	sr7-sh40hz25		solid state triac	HDA-6v50
				Upgrade to Power-io solid state relays:
sas3-50-1d			ssr	HDA-3v50
sas3-75-1d			ssr	HDA-3v75
sas3-50-1			ac input ssr	HAA-3v50
sas3-75-1			ac input ssr	HAA-3v75
sas6-50-1d			ssr	HDA-6v50
sas6-75-1d			ssr	HDA-6v75
sas6-50-1			ac input ssr	HAA-6v50
sas6-75-1			ac input ssr	HAA-6v75
				Upgrade to Power-io solid state relays:
sr7-a15ab1	sr7-a15bb1	sr7-a15cb1	din rail solid state relay	DDA-6V25
sr7-a15aa1	sr7-a15ba1	sr7-a15ca1	din rail solid state relay	DAA-6V25
sr7-a30ab1	sr7-a30bb1	sr7-a30cb1	din rail solid state relays	DDA-6V40
sr7-a30aa1	sr7-a30ba1	sr7-a30ca1	din rail solid state relays	DAA-6V40
sr7-a50ab1	sr7-a50bb1	sr7-a50cb1	din rail solid state relay	DDA-6V50
sr7-a50aa1	sr7-a50ba1	sr7-a50ca1	din rail solid state relay	DAA-6V50
				Upgrade to Power-io solid state relays:
sr7-a15ab2	sr7-a15bb2	sr7-a15cb2	two leg ssr	DDA3-6v75T-H
sr7-a15aa2	sr7-a15ba2	sr7-a15ca2	two leg ssr	DAA3-6v75T-H
sr7-a30ab2	sr7-a30bb2	sr7-a30cb2	two leg 30 amp ssr	DDA3-6v75T-H
sr7-a30aa2	sr7-a30ba2	sr7-a30ca2	two leg 30 amp ssr	DAA3-6v75T-H
sr7-a50ab2	sr7-a50bb2	sr7-a50cb2	two leg ssr	DDA3-6v75T-H or two DDA-6V50
sr7-a50aa2	sr7-a50ba2	sr7-a50ca2	two leg ssr	DAA3-6v75T-H or two DAA-6V50
sr7-a10ab3	sr7-a10bb3	sr7-a10cb3	three leg ssr	DDA3-6v75T-H
sr7-a10aa3	sr7-a10ba3	sr7-a10ca3	three leg ssr	DAA3-6v75T-H
sr7-a20ab3	sr7-a20bb3	sr7-a20cb3	three leg ssr	DDA3-6v75T-H
sr7-a20aa3	sr7-a20ba3	sr7-a20ca3	three leg ssr	DAA3-6v75T-H
				Upgrade to Power-io solid state relays:
sar6-25-1d			contactors	DDA-6V25
sar6-40-1d			contactors	DDA-6V40
sar6-25-1			contactors	DAA-6V25
sar6-40-1			contactors	DAA-6V40
sar6-25-ma			contactors	DMA-6V25
sar6-40-ma			contactors	DMA-6V40
				Upgrade to Power-io solid state relays:
sar6-50-1d			contactors	DDA-6V50
sar6-75-1d			contactors	DDA-6V75
sar6-100-1d			contactors	DDA-6V100
sar6-50-1			contactors	DAA-6V50
sar6-75-1			contactors	DAA-6V75
sar6-100-1			contactors	DAA-6V100
				Upgrade to Power-io solid state relays:
sar6-30-3d			contactors	DDA3-6V75T-H
sar6-30-3			contactors	DAA3-6V75T-H

The information above is a guideline only and is subject to change or correction. Please examine all specification parameters to confirm the proper product for your application.

Other cross references: many standard relays, Invensys, Eurotherm, Crydom, Gordos, Magnecraft, Struthers-Dunn. Return to Powerio

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				Upgrade to:	
				Power-io solid state relays	
Crouzet	84137011	84134011	ga5-6a25	haa-3v25	solid state relay
Crouzet	84137021	84134021		haa-3v50	solid state relay
Crouzet	84137031	84134031		haa-3v75	solid state relay
Crouzet	84137010	84134010	ga5-6d25	hda-3v25	solid state relay
Crouzet	84137020	84134020		hda-3v50	solid state relay
Crouzet	84137030	84134030		hda-3v75	solid state relay
Crouzet	84137111	84134111		haa-6v50	solid state relays
Crouzet	84137121	84134121		haa-6v50	solid state relays
Crouzet	84137131	84134131		haa-6v75	solid state relays
Crouzet	84137110	84134110		hda-6v50	solid state relays
Crouzet	84137120	84134120		hda-6v50	solid state relays
Crouzet	84137130	84134130		hda-6v75	solid state relays
				Upgrade to:	
				Power-io solid state relays	
Gordos	84137011	84134011	ga5-6a25	haa-3v25	solid state relay
Gordos	84137021	84134021		haa-3v50	solid state relay
Gordos	84137031	84134031		haa-3v75	solid state relay
Gordos	84137010	84134010	ga5-6d25	hda-3v25	solid state relay
Gordos relays	84137020	84134020		hda-3v50	solid state relay
Gordos relays	84137030	84134030		hda-3v75	solid state relay
Gordos solid state relays	84137111	84134111		haa-6v50	solid state relays
Gordos solid state relays	84137121	84134121		haa-6v50	solid state relays
Gordos Serelac	84137131	84134131		haa-6v75	solid state relays
Gordos Seralac	84137110	84134110		hda-6v50	solid state relays
Gordos Crouzet	84137120	84134120		hda-6v50	solid state relays
Gordos Crouzet	84137130	84134130		hda-6v75	solid state relays

The information above is a guideline only and is subject to change or correction. Please examine all specification parameters to confirm the proper product for your application.

Other cross references: many standard relays, Invensys, Crydom, Din rail contactors

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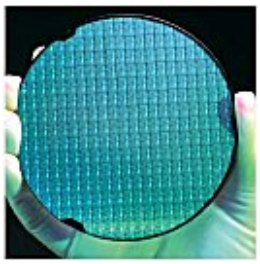
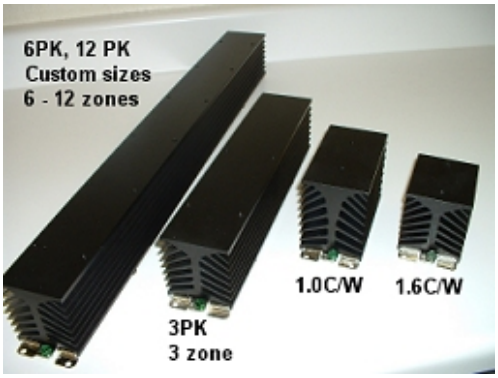


HEAT SINKS FOR SOLID STATE RELAY, SCR, and IGBT APPLICATIONS

The switching device inside a modern solid state relay starts as a multi-layer structure of P and N layers grown on a silicon wafer. These become the thyristor dies that are used inside a Power-io solid state relay. The dies are available in different sizes in order to accommodate different amperage capabilities. For example, a die that is approximately 0.25 x 0.25 inches may be the size for a 50 amp application and 0.5 x 0.4 inches might be 125 amps. All solid state relays develop heat as a result of a forward voltage drop through the junction of the die at a rate of approximately 1.2°C per amp that is being switched. Beyond a point, heat will require a lowering (or derating) of the load current that can be handled by the solid state relay.



Heatsinks are used to create a method of removing heat away from the relay, thus allowing higher current operation. Adequate heat sinks, including consideration of air temperature and air flow, are essential to the proper operation of a solid state relay (SSR, SCR, thyristor or IGBT package). It is necessary that the user provide an effective means of removing heat from the package. The importance of using a proper heat sink cannot be overstressed, since it directly affects the maximum usable load current and/or maximum allowable ambient temperature. Lack of attention to this detail can result in improper switching (lockup) or even total destruction of the solid state relay. Up to 90% of the problems with solid state relays are directly related to heat. POWER-IO has created several customer-specific heatsink designs where overall size, fin geometry, fin angle / spacing, and draw-down geometry were optimized.

With loads of less than 2-4 amperes, cooling by free flowing convection or forced air currents around the unit is usually sufficient. Loads greater than 4 Amps will require heat sinks. SSR units are to be mounted to some heat sinking metal surface, material heat conductivity should be kept in mind. Heat sinks are approximately equivalent, in heat dissipation, to a sheet of aluminum 1/8" thick by the dimensions shown below:

12" X 12" = 288 square inches of exposed surface area = approximately 2.1°C per watt thermal rise (2.1 C/W)
15" X 15" = 450 square inches = approximately 1.5 degrees C per watt thermal rise (1.5 C/W)
18" X 18" = 648 square inches = approximately 1.0 degree C per watt thermal rise (1.0 C/W)

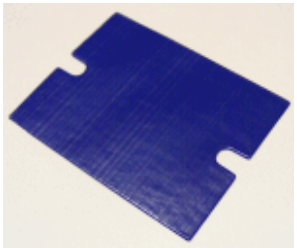
(Hint: the lower the C/W rating, the better the heat sink is at dissipating the heat, given proper ventilation and ambient temperature. For example: if a solid state relay generates 45 watts of heat, on a 2.1 C/W heat sink, that relay's internal dies will increase 94.5°C above the ambient temperature. If the ambient is 40°C, the internal die temperature may be 134.5°C.) The maximum permitted temperature for the thyristor die is typically 125°C but 115°C is often used as an additional margin of safety. If air flow is restricted by near by products, or if the ambient air in the enclosure is warmer, of if the solid state relay is not firmly attached to the heat sink, then additional amperage de-rating will be required.

Heat Sink Material:

The best materials for a heat sink are: gold, silver, copper, or aluminum. For industrial applications, aluminum is the most cost effective material. We typically apply a black anodized finish which provides additional radiant heating dissipation. In comparison to aluminum, twice the amount of steel and four times the amount of stainless steel would be needed to achieve the same effect. Solid state relays should never be mounted in an enclosed area without proper air flow. Units should also never be mounted to a plastic base or to painted surfaces. The heat sink should be positioned with the fins in a vertical position with an unimpeded air flow, up and through the finned heat sink. The interface between the solid state relay and the heat sink must be a flat, clean, bare (non-painted) surface that is free of oxidation.

DCB -- Direct copper bonding:

The internal thyristor dies are usually soldered to a copper surface on a ceramic substrate. The thin ceramic substrate permits the thyristor's heat to past to the heat sink, while the soft solder surface reduce thermal fatique surrounding the thyristor die area. There is a significant investment in years of Power-io engineering and experience regarding how to create the best DCB assemblies.

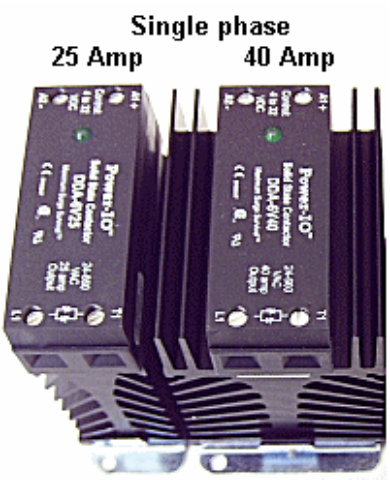


Thermal Pads

Silicone thermal transfer grease should be placed on the metal base of the solid state relay before mounting to a metal surface. Heat transfer is affected by the thickness of the thermal compound, uniformity of application and how firmly the relay is attached to the heatsink. We suggest an evenly applied 0.002" thick layer of Dow Corning 340™, or equivalent, and torque of 10 inch-pounds on both of the SSR mounting screws. Note that a thicker layer of thermal compound actually decreases heat transmission. If a dry thermal pad is used, then the mounting screws should be torqued to 20-30 inch-pounds. The black Power-io thermal pad, shown here, provides an optimized layer of high performance thermal compound in a dry pad.

Precautions:

Care must be taken when mounting multiple SSRs in a confined area. SSRs should be mounted on individual heatsinks whenever possible. Panel mount SSRs should never be operated without proper heat sinking or in free air as they will THERMALLY SELF DESTRUCT UNDER LOAD. A simple rule-of-thumb for monitoring temperature is to slip a thermocouple under a mounting screw. If the base temperature does not exceed 45 °C under normal operating conditions, the SSR is operating in an optimal thermal environment. If this temperature is exceeded the relay's current handling ability must either be thermally improved by the use of a heatsink, or greater air flow must be provided over the device through the use of a fan. ANY moving air in an installation, greatly improves the thermal transfer from the heatsink to the air. If the actual internal SSR device ever achieves an internal temperature of 115 to 125°C, it will be permanently destroyed. Therefore, the desired engineering requirement is to provide a slow heat-rise internal SSR, and then to provide a heat sinking capability that draws the internal heat rise away at a fast rate to ensure that the internal dies do not exceed these temperatures. Thermal problems are cumulative, irreversible, and destructive.



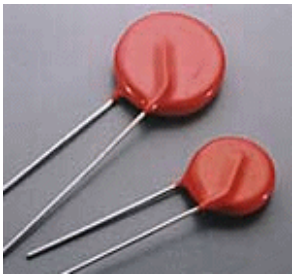
Examples of complete solid state relay assemblies

Some cases may require the selection of a higher current output SSR and thermally derating the device accordingly. POWER-IO has specialized in designing SSR packages that optimize the amps vs. thermal rise application. By using a variety of SSR die sizes and copper bonding techniques, we have created packages that generate significantly less thermal rise than is seen in similar packages.

Remember that the heat sink removes the heat from the Solid State Relay and transfers that heat to the air in the electrical enclosure. In turn, this air must circulate and transfer its heat to the outside ambient. Providing vents and/or forced ventilation is a good way to accomplish this. Heatsinks should always have at least one inch below them, so air can enter the finned heat sink area. Heatsinks should always have empty space above them so the warm air can exit the heat sink area. If horizontal, plastic, wiring trays are used above the heat sink (such as Panduit™ wiring trays), then the empty space should be greater than the depth of the plastic tray. For example, if you use 4 inch deep wiring trays, leave >4 inches of empty space above the relay. All Power-IO Solid State Relays are capable of running at full rated power (with proper heatsink), however it is strongly suggested that they be used at no more than 80% capacity, at a given temperature, in order to provide a safety margin in case of higher than expected voltage, temperature, dirt on the heatsink, poor air flow, etc. Local electrical codes often require that any design remain below 80% maximum capacity for relays, fuses, wire, circuit breakers, etc, at a given temperature. Caution: Power-IO follows the new international CE testing standard (CE EN60947) that requires testing at 40°C. Other brands of SSRs may follow the older standards that tested at 20 or 25°C. Therefore, some of these other brands may be severely under-rated for your application.

PROTECTIVE MEASURES / ELECTRICAL NOISE

SSRs generally do not fail due to electrical noise, unless they happen to mis-trigger during a point in the line cycle when an excessivly high current surge might occur. Usually, a malfunction due to noise is only temporary, such as turning on when the SSR should be off, and vice-versa. By its very nature, noise is difficult to define, being generated by the randomness of contact bounce and arcing motor commutators, etc. Noise, more properly defined as ElectroMagnetic Interference (EMI), affects the SSR by feeding signals into the sensitive parts of the circuit, such as the SCR. A built-in snubber RC network across the output is effective in reducing sensitivity to noise, especially at lower frequencies.



MOVs

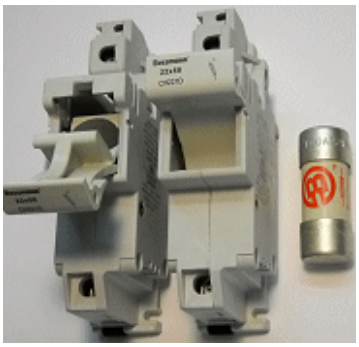
The metal oxide varistor was developed about the same time as the SSR and has subsequently become a trustworthy companion of the SSR, providing much needed protection in some of its more hostile environments. An MOV can be used as follows: across the incoming line to supress external transients before they enter the system; across the load to supress load generated transients; or more frequently, across the SSR to protect it from all transient sources (from L1 to T1). In the latter case, the MOV can be conveniently mounted to the same SSR output terminals as the load wiring. An MOV can be used effectively across such loads as transformers and switching power supplies where spikes too fast to be absorbed by the transformer itself may be fed back into the primary (SSR load) winding. Used within its ratings, the MOV will most likely outlive its associated equipment and provide low cost protective insurance for the SSR. However, an MOV will "wear out" over time if it is constantly exposed to transients. This is why Power-io's Maximum Surge Survival™ technology PLUS an MOV is beneficial since the MOV has three additional surge layers to decrease the transients, thus

limiting the quantity and magnitude of the transcients that the MOV is exposed to. Using an MOV is highly recommended when the SSR is used as a motor starter OR if nearby motor starting and stopping occurs on the same power line that the SSR is on. For a picture of the proper installation of a MOV under our finger-safe protective cover, see: motor starters. There are several manufacturers of MOVs including Littlefuse Harris

SURGE RATINGS

There are very few completely surgeless SSR loads. Next to improper heatsinking, surge current is one of the most common causes of SSR failure. Overstress of this type can also seriously impair the life of the SSR. Therefore, in a new application, it would be wise to carefully examine the surge characteristic of the load and then select a device that can adequately handle the inrush as well as the steady state condition, while also meeting the lifetime requirements. In addition to the actual surge ratings given for SSR's, the rate of rise of surge current (di/dt) is also a factor in AC thyristor types. Exceeding its value may result in destruction of the device. As a guide, the amperes-per-microsecond (di/dt) withstand capabilities are typically in the order of their single cycle surge ratings. The highest surge current rating of an SSR is typically 10 times the steady-state RMS value, and it is given as the maximum peak current for one line cycle. It should be noted that a surge of this magnitude is allowable a limited number of times, such as only 100 times during the SSR's lifetime. Furthermore, control of conduction may be momentarily lost due to a surge. This means that it may not be possible to turn off the SSR by removal of control power both during and immediately after the surge. The output thyristor must regain its blocking capability and the junction temperature allowed to return to its steady state value before reapplication of the surge current, which may take several seconds. It should be noted that the preceding cautionary notes apply only to the extreme limits where the SSR should not be designed to operate anyway. Generally, DC switching SSRs do not have an overcurrent surge capability, since the output transistors are usually rated for continuous operation at their maximum capacity. The tendency is for the DC SSR to cut off (current limit), thus impeding the flow of excessive current. However, the resultant overdissipation may destroy the relay if the surge is prolonged.

I²T FUSING



Fast, "Semiconductor Fuses" are the only reliable way to protect solid state relays. They are also referred to as current-limiting fuses, providing extremely fast opening (about 2 msec) while restricting let-through current far below the fault current that could destroy the semiconductor. This type of fuse tends to be expensive, but it does provide a means of fully protecting SSRs against rapid rise, high current overloads where survival of the SSR is of prime importance. An I²T fuse rating (ampere-squared seconds) is useful in aiding in the proper design of SSR fusing. This rating is the bench mark for an SSRs ability to handle a shorted output condition. Power-io advocates SSR protection through the use of a properly selected I²T (semiconductor) fuse. Devices such as electromechanical circuit breakers and slow blow fuses cannot react quickly enough to protect the SSR in a shorted condition and are not recommended for SSR protection!!! Fast blow type fuses may be appropriate for some applications. Every SSR has an I²T rating (see SSR specifications on this web site). The procedure is to select a fuse with an I²T let-through rating that is less than the I²T capability of the solid state relay for the same duration. I²T relates directly to the published fuse characteristics. System designers who are considering using I²T fuses should consult a good technical manual dealing with the application of these fuses when designing their systems (i.e. Cooper Bussman's semiconductor fuse catalog). For wiring protection and installation protection, you must continue to use standard circuit breakers or standard fuses in accordance with local electrical codes.

SSR APPLICATIONS

Solid State Relays (SSRs) cannot always be applied in exactly the same way as Electromechanical (EMRs) and when such is the case, caution should be taken.

Inductive Loads

While most solid state relay loads, even lamps, include some inductance, its effect with resistive loads is usually negligible. Only those loads that utilize magnetics to perform their function, such as transformers, chokes (windings), or coils are likely to have any significant influence on SSR operation. These loads can create large current surges and the SSR should be derated accordingly. ***Please call Technical Support for additional Suggestions.

Transformer Switching

Extremely high current surges are commonly associated with transformers, especially those with a penchant for saturation. The zero voltage turn on feature of standard SSRs can increase this possibility and might require that special precautions be taken. The zero current turn off characteristic of SSRs, while minimizing the problem, will not prevent it. From the practical and economic standpoint, the best choice may still be a standard SSR, overrated to withstand huge surges. ***Please call Technical Support for additional Suggestions.

Motor Switching

Dynamic loads such as motors and solenoids, etc., can create special problems for solid state relays. High initial surge current is drawn because their stationary impedance is usually very low. As a motor rotates, it develops a back EMF that reduces the flow of current. This same back EMF can also add to the applied line voltage and create 'overvoltage' conditions during turn off. Most of the surge reducing techniques discussed earlier can also be applied to motors. It should be noted that overvoltage caused by capacitive voltage doubling or back EMF from the motor cannot be effectively dealt with by adding voltage-transient suppressors. Suppressors such as Metal Oxide Varistors (MOVs) are typically designed for brief high voltage spikes and may be destroyed by sustained high energy conduction. It is therefore important that SSRs are chosen to withstand the highest expected sustained voltage excursion. ***Please call Power-io's Technical Support for additional Suggestions.

Lamp Switching

The inrush current characteristic of incandescent (tungsten filament) lamps is somewhat similar to the surge characteristic of the thyristors used in AC SSR outputs, making them a good match. The typical ten times steady state ratings which apply to both from a cold start allow many SSRs to switch lamps with current ratings close to their own steady state ratings. CAUTION: Using SSRs for driving mercury, fluorescent, or HID lamps should be avoided. If they must be used, the SSR must be severly derated and thoroughly tested in the specific application.

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New, solid state motor starter.

The "H" (hockey puck size, solid state relay) family provides a precise zero-crossing motor starter. By starting and stopping the control of a motor at the zero-crossing mark, electronic noise is greatly reduced. This may be beneficial if there are nearby PLCs, computers, micro-processor based equipment, or other devices that may be impacted by electronic noise spikes. All motor applications require that the solid state relay be chosen based upon the maximum inrush surge of the motor. This is frequently about 6-8 times the amperage that is required once the motor is running. Your motor supplier can tell you this number. By its design, a Power-IO solid state relay is an ideal way to control a motor due to the ability to absorb short term amperage surges, in addition to its trademarked Maximum Surge Survival™ design for voltage surge protection. The clear finger-safe cover permits an additional motor starter MOV to be placed directly across the solid state relay's output, for a fourth layer of voltage surge protection. The size and shape of the plastic safety cover means that the MOV can be easily inserted without any additional heat shrink tubing or other time consuming requirements.

The Power-IO solid state relay is available as either 100-280 VAC activated or 4-32 VDC activated. A green LED indicates the status of the control input signal. Due to the low, current limited, control input requirements; three of the Power-IO units can be easily used for a three phase motor application. For example: when used with PLCs or computerized control systems, less than 5 mA is required when the DC logic control signal is wired in series to three HDA-6V75 solid state relays (three units, wired in series: the control signal requirement is 12 vdc at 3.5 mA min total).

The Power-IO solid state relays and heat sinks can be purchased individually or they can be purchased pre-assembled as shown in the picture. For three phase applications, three single phase units can be used OR three Power-IO relays can be installed on our new, triple zone, HEATSK-3PK. The HEATSK-3 PK provides for three phase control in a tiny 7 inch by 2.4 inch footprint. For more information on the "H" family of solid state relays, including the Maximum Surge Survival features, the robust 1200 Vpk transient over voltage peak protection, or superior dv/dt performance, please visit H Family general specifications or H Family detailed specifications in .pdf format.

To purchase online:

- 4-32 VDC activated, motor starter assembly (using a HDA-6V75, HEATSK-DIN-1.0, MOV575, and thermal pad). For single phase motor applications up to 2 HP. Confirm with your motor supplier for the maximum amperage requirements: BUY
- 100-280 VAC activated, motor starter assembly (using a HAA-6V75, HEATSK-DIN-1.0, MOV575, and thermal pad). For single phase motor applications up to 2 HP. Confirm with your motor supplier for the maximum amperage requirements: BUY

Other sizes and configurations can be manufactured as required.

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There are several types of electrical switching products. From low cost to high performance, each method serves a part of the market.

Mechanical relays or mechanical contactors: The cost of a mechanical relay or mechanical contactor is influenced by amperage and usage. As these increase, so does the price. A mechanical product typically has two ratings: the number of mechanical cycles (a high number) and the number of electrical cycles (a low number). Therefore, mechanical products should be used when the final device is activated infrequently. Mechanical relays are seldom used for heater applications since the cycle time is too slow and the overall product life is often too short. A mechanical device turns on or off when the coil is energized which can result in noise spikes or surges since this is not at the zero crossing point. An ideal cycle time for a mechanical device is often 30-120 seconds or more; and a total on/off cycle life of 50,000 - 250,000 cycles. Some applications (PLC controlled, PC controlled, or sharing the powerline with other nearby computers) will require snubbers across the control terminals to help to suppress the frequent voltage surges upon opening at the non-zero point.

Mercury contactors or mercury displacement relays (MDR): A mercury contactor uses a pool of mercury, inside a glass sealed tube, to electrically connect the two contacts. This pool may be more than 100 grams of mercury for a single contactor. Since mercury is a cancer causing agent and is banned in many states, countries, or industries; there are restrictions on shipping, storing, or cleaning up if a contactor should leak or explode. A mercury contactor is not a zero crossing device so there will be noise spikes or surges that may affect nearby electrical products or PLCs. An ideal on/off cycle time for a mercury contactor is often 10-20 seconds and 3-8 million overall cycles. Mercury contactors were used frequently for industrial heater control of resistive heaters in the 1960-2000 time period. When used 24 hours a day in a heater application, there may be 3 million on/off cycles in a single year. Therefore, the mercury contactors might be replaced many times during the life of the machine. Information about the legally required elimination of mercury contactors is online at several locations. Worldwide elimination of mercury is being required by RoHS regulations, state laws, food industries, environmentalist groups, and more.

Solid state relays (SSR): The SSR products are usually packaged in the familiar cube shape and are frequently referred to as "hockey puck relays". SSRs can use internal triacs, or the better SSRs will use internal SCRs (a pair of silicon controlled recifiers). Power-io only uses internal SCRs. SSRs turn on and off at the zero crossing mark on a sinewave so electrical surges and noise spikes are greatly reduced. Since there are no moving parts in a SSR, they can be cycled on and off many times per second. SSRs can be an ideal product if you pay attention to the three important application items. Those are: avoid over voltage (surges), over current, and over temperature. For further information, visit: Solid state relay -- extended life and optimum performance.

Power-io has designed several unique features into our SSR family as part of our Maximum Surge Survival™ technology. An ideal cycle time for a SSR is often as fast as 0.2 - 2 seconds and virtually an unlimited number of cycles. SSRs are used frequently for industrial control of resistive heaters, motor starters (due to excellent short term amperage surge capability), PC based control applications (due to minimum control signal input requirements), on/off lighting applications (zero crossing extends the life of the lamp) and other general purpose switching applications. When used for heater control, the fast on/off cycles provide excellent temperature control and this dramatically improves the heater life due to a reduction in thermal shock. For example: at 25% heater demand, this may mean 0.05 seconds on, 0.15 seconds off, 0.05 on, ... This is actually 3 sinewaves on, 9 sinewaves off, 3 on, 9 off, ... Since you are switching full sinewaves, starting at the zero crossing mark and ending at the zero crossing mark, there is no noise generated and the power is permitted to start at zero and then ramp up. The heater stabilizes at a temperature range and does not fluctuate, thus reducing thermal stress and, therefore, increasing the heater's life. For information on Power-IO's SSR products, please visit the "H" hockey puck products at: solid state relay products

Solid state contactors (SSC): When an industrially hardened SSR is assembled onto a properly sized heat sink, the final product is frequently called a solid state contactor. Power-IO uses over-sized internal SCRs (often 20-100% oversized), on a DCB (Direct Copper Bonded ceramic/copper assembly) attached to a thermally optimized heat sink design, finger-safe screw terminations, and an universal mounting bracket. Installation size is minimized by our industry-leading capability that permits you to install the product with NO spaces between products on the same din rail. Therefore, the Power-IO "D" din rail family offers the smallest installed product in the industry. As a finished contactor, the product provides the fastest and most convenient way to install a complete solid state switching product. For more information, please visit: solid-state relays

For electric heater control, solid state contactors are typically used with PLCs, PCs, network I/O, or PID controllers that generate the on/off pulsing vac or vdc control signal. This may be called a time proportional output, TPO, or pulse wave modulation. When used with some PLCs, it may be easier to reduce programming time by using an analog output so Power-IO also has solid state contactors that accept a 4-20mA analog control signal that then gets converted into the appropriate zero crossing output. (4mA=off, 12mA=50%, 16.8mA=80%. 20mA=full on). These have a part number starting with DMA (Din rail, Milliamp input). Visit: 4-20 mA input single phase or three phase solid state relays

"Intelligent" solid state contactor: The solid state contactors can have additional functions added for diagnostics and/or communications. The "C Family" contactors have the ability to create an output based upon: SCR problems, load open, fuse open, and thermal problems. In addition, they have the Power-io exclusive feature of monitoring the SCR's health status independent of the control input which is beneficial during machine start-ups. Intelligent contactors are one of the fastest growing segments of power control since they integrate into larger installations, un-staffed applications, and remote monitored applications for on/off power control or on/off motor control. More information is at C Family intelligent solid state contactors.

Two back-to-back SCRs are the actual switching circuit between the line and the load.

"Zero Crossing" Silicon Controlled Recifier (SCR): The Power-IO solid state relays and solid state contactors use internal zero crossing silicon controlled rectifiers and are sometimes called SCR products, SCR power controllers, SCR power packs, or thyristors. The exclusive way that we activate and deactivate the zero crossing is extremely precise, leading to an exceptionally clean, noise free control mode. When activated by a vac control signal, we typically do NOT need burden resistors on the control input. Power-IO products are usually for applications from 1-100 amps. There are other SCR vendors who concentrate in SCR applications up to 5000 amps.

"Phase Angle" Silicon Controlled Recifier (SCR): A minority of the heater applications use transformer coupled loads or low cold resistance loads. Your heater manufacturer will point out that these loads (such as silicon carbide heaters or moly disilicide heaters) require phase angle SCR control plus current limiting, automatic recalculation and correction for voltage fluctuations, partial load imbalance, and/or other features. These units are typically much more expensive but may be required for applications such as molecular beam epitaxy equipment in semi-conductor fab facilities. Phase angle control means the the electrical power is on for part of each sinewave. This permits precise control, but chopping every sinewave creates electrical noise that may impact nearby equipment. For European applications or any country where CE regulations are used, phase angle power controllers usually require customized noise filters that may be as expensive as the phase angle controller that they are attached to.

Insulated Gate Bipolar Transistor (IGBT): An IGBT can be turned on AND off anywhere within an AC sinewave. This also provides precise control capability, as well as the ability to add performace features for a particular application. Power-IO designs customized IGBT products for specific customer applications. For DC applications, the Power-io HDD-6V15 is an off-the-shelf IGBT with our exclusive fast turn ON/OFF gating control circuit. IGBT solid state relays

Mosfet Solid State Relay: When switching DC loads, the internal device inside the solid state relay is a mosfet semiconductor (up to 200 vdc or an IGBT up to 600 vdc). Power-io has a worldwide exclusive technology that permits the rapid 15Khz switching times for 0-600 vdc applications. Rapid switching is required for PWM dc servo control, automated test equipment applications, and other applications where the need is for instanteous ON or OFF control. Mosfet solid state relays are also used for vehicle or drone applications in order to avoid contact bounce or other mechanical problems that are associated with electro-mechanical relays. Most dc loads are somewhat inductive, so it is recommended that you install a diode across the load to avoid EMF problems. For more information visit: mosfet solid state relays

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Click map for NEMA's mercury information.

Mercury contactors, mercury relays, mercury displacement relays and similar mercury switching products are banned in many states. Power-io provides solid state relays that can be used in place of these mercury relays.

Depending on where your installation is located, the use of mercury contactors or mercury displacement relays may be restricted or totally banned for new installations. Please contact your local EPA office, the local NEMA association (National Electrical Manufacturers Association), or other local agencies to determine the exact prohibitions in your area. The following are examples of some new state laws that may apply:

Illinois Public Act 093-0964 "With some exceptions; the selling, distribution, or offer to sell or distribute mercury electrical switches and relays is prohibited, beginning July 1, 2007." ... "The deadline for requesting an exemption from the switch and relay sales ban has passed. Manufacturers of mercury-containing electrical switches, relays, or products containing mercury electrical switches or relays that did not request an exemption before the deadline cannot sell these products in Illinois after July 1, 2007." http://www.epa.state.il.us/mercury/mercury-illinois.html or Illinois eliminates mercury contactors, mercury relays, and mercury switches. PDF

Vermont bans mercury relays effective January, 2007: http://www.nema.org/gov/env_conscious_design/mercury/vt.cfm

California bans mercury relays effective July 1, 2006: http://www.nema.org/gov/env_conscious_design/mercury/ca.cfm

Maine bans mercury relays effective July 1, 2006: http://janus.state.me.us/legis/statutes/38/title38sec1661-C.html

New York bans mercury relays effective January, 2008: http://www.nema.org/gov/env_conscious_design/mercury/ny.cfm

Rhode Island bans any mercury >1 gram effective Jan 1, 2006 (a mercury contactor can have over 100 grams of mercury): http://www.nema.org/gov/env_conscious_design/mercury/ri.cfm

Louisiana bans all products with greater than 1 gram of mercury as of July 1, 2008: http://www.nema.org/gov/env_conscious_design/mercury/Louisiana.cfm

Replacement options for mercury contactors include:

Dual single pole or two pole contactors for heater control, small motor control, municipal lighting, stadium lighting, highway lighting systems, and more. "C" Family of din rail contactors for applications up to 100 amps.

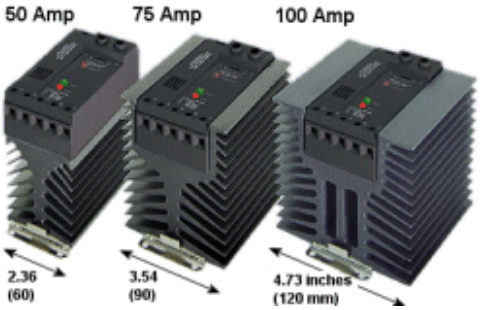
- up to 100 amp per pole, AC activated
- up to 100 amp per pole, DC activated, + diagnostics feedback output

Single pole contactors for smaller amperage applications. Mini "D" Family of din rail relays for applications from 1-40 amps. The Mini "D" family includes: an integral heatsink, recessed terminals, a finger-safe design, and the Maximum Surge Survival™ technology:

- 25 and 40 amp, AC or DC activated
- 25 and 40 amp, analog 4-20mA activated
- Potentiometer input, pot input, manual station, manual % power controller

Three phase contactors. "D" Family of din rail relays for applications from 1-35 amps per leg. Ideal for switching 2 or 3 legs of a three phase load (delta, star, or wye).

- 1-35 amps, two or three legs, AC or DC activated
- 1-35 amps, two or three legs, analog 4-20mA activated
- Potentiometer input, pot input, manual station, manual % power controller



Medium amperage, single pole applications. "D" Family of din rail relays for applications up to 100 amps, single phase. These models include: large power terminals for 3-8 AWG wires, a built-in replaceable I²T fuse, and diagnostic LEDs for fuse open or over-temperature.

up to 50 amp, 75 amp, 100 amp; AC or DC activated, contactor

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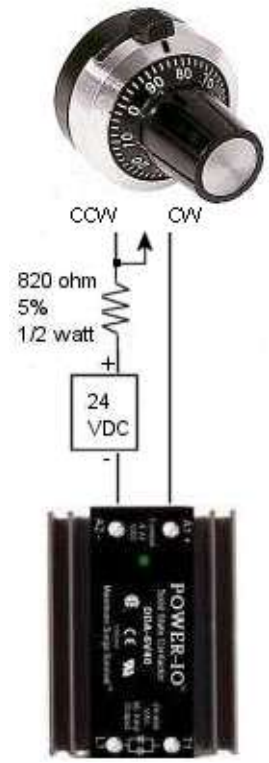
Potentiometer input, 25 or 40 amp, din rail power controller

Features



- Allows a customer to dial in a request from 0% to 100% power.
- Accepts a standard potentiometer input and provides a high speed, time proportional AC output (TPO). That is a zero-crossing, "no electronic noise", power control signal that is ideal for resistive heaters, heat sealing bars, injection molding nozzle zones, simple cookers, etc.
- Output cycle time ("ON" time + "OFF" time) = approximately 0.5 second at 50%. Output resolution is one half of one sinewave (8.3 msec for 60 hz applications).

Note: Rapid pulsing of the heaters provides the most precise temperature control, PLUS it dramatically increases the life of the heaters due to a reduction in the thermal stress of expansion and contraction.

- A standard 0-5k potentiometer can be mounted anywhere on the machine.
- Any standard 24 volt DC power supply can be used, such as your existing PLC power supply.
- A 820 ohm, 5%, 1/2 watt resistor is installed in series.
- A green LED shows input status on the power controller
- Zero crossing activation -- low EMI, low noise to nearby electronics
- Available for the 25 amp DMA-6V25 or 40 amp DMA-6V40
- UL, CSA, CE

Part Number

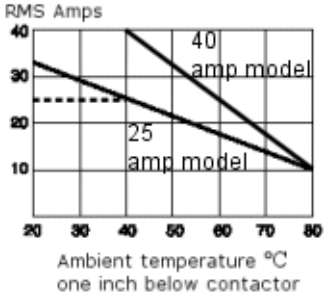
Customer to supply the 0-5k pot, resistor, and 24 VDC power supply.

DMA-6V25 up to 25 amps, 660V max, analog input activated BUY

DMA-6V40 up to 40 amps, 660V max, analog input activated BUY

(As an alternative, you could also use this combination: a 1500 ohm pot; a 270 ohm, 5%, 1/4 watt resistor; 24 vdc power supply, and a DMA-6V__ solid state contactor.)

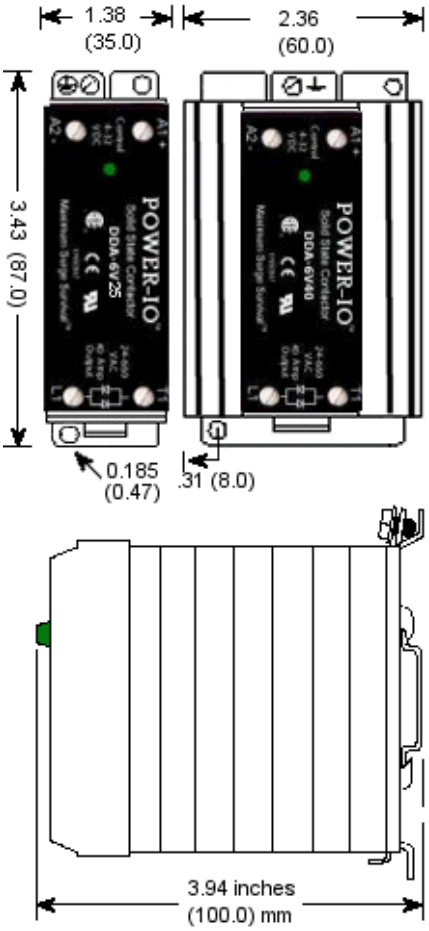
Derating Curve



Specifications

Part Number	Line Voltage Range (VAC)	Load Current Range (A RMS)	Max Voltage Drop at 20mA
DC activated			
DMA-6V25	24-660	.10-25	6VDC
DMA-6V40	24-660	.10-40	6VDC
Off-State dv/dt	1000 v/µs		
Isolation	4000 volts		
I^2T fuse	50A or less, for example: Bussman FWP50A14F, FWC32A10F, FWC20A10F. Ferraz Shawmut B093910, M330015, K330013		

Example of control	0% = heater or load is "off" 50% = heater "on" 250 mseconds, "off" 250 msec, "on" 250 msec... 75% = "on" 375 msec, "off" 125msec, "on" 375 msec.... 85% = "on" 425 msec, "off" 75msec, "on" 425 msec.... 100% = heater "on" Since the contactor is switching at the zero crossing mark of a sinewave, there is no electrical noise that might interfere with nearby electronics. Also, since the calculated ON or OFF time period is measured in half sine waves, the contactor will automatically adjust the total cycle time in order to maintain the best ratio of ON/OFF to match your control input.
Turn-on time	<8.3 msec at 60hz
Turn-off time	<8.3 msec at 60hz
Terminals	Will accept #24-#10 AWG wire. Torque: 7-9 inch lbs.



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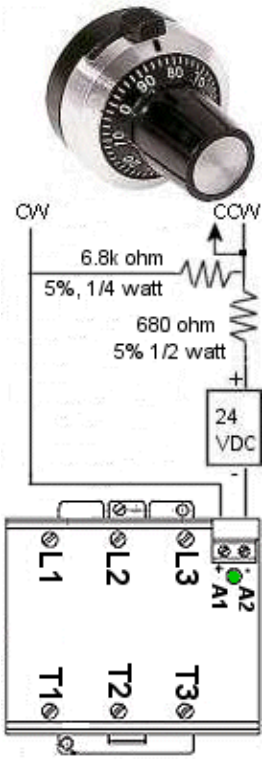
Potentiometer input, 25 or 35 amp, 3 phase din rail power controller



Features

- Allows a customer to dial in a request from 0% to 100% power.
- Accepts a standard potentiometer input and provides a high speed, time proportional AC output (TPO). That is a zero-crossing, "no electronic noise", power control signal that is ideal for resistive heaters, heat sealing bars, injection molding nozzle zones, simple cookers, etc.
- Output cycle time ("ON" time + "OFF" time) = approximately 0.5 second at 50%. Output resolution is one half of one sinewave (8.3 msec for 60 hz applications).

Note: Rapid pulsing of the heaters provides the most precise temperature control, PLUS it dramatically increases the life of the heaters due to a reduction in the thermal stress of expansion and contraction.

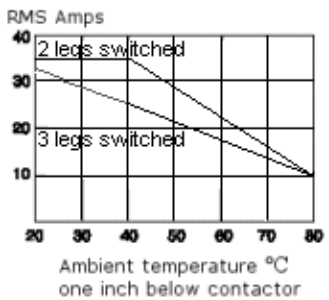
- A standard 0-5k potentiometer can be mounted anywhere on the machine.
- Any standard 24 volt DC power supply can be used, such as your existing PLC power supply.
- A 680 ohm, 5%, 1/2 watt resistor is installed in series.
- A 6.8k ohm, resistor is installed in parallel.
- A green LED shows input status on the power controller
- Zero crossing activation -- low EMI, low noise to nearby electronics
- Available for the DMA3-6V75T, three phase solid state contactor
- UL, CSA, CE

Three phase, 25 or 35 amps per leg, din rail contactor

Features

- Maximum Surge Survival™ technology -- triple layer, voltage surge protection
- Green LED for input status
- Thermally optimized heat sink permits edge-to-edge installations on a din rail
- Built-in snubber circuit
- Zero crossing activation -- low EMI, low noise to nearby electronics
- Internal 50A thyristors for high inrush capability
- 4000 volt isolation, 1400Vpk blocking voltage
- 1000 volt / microsecond immunity
- Highest thermal efficiency -- less than 1.2 watts per amp switched, per leg
- CE, UL recognized, CSA
- Industry standard A1, A2, L1, T1, L2, T2, L3, T3 terminal numbers
- High density design permits more amps per square inch
- 3Ø = 25 amps per leg, 2Ø using L1/T1 and L3/T3 = 35 amps per leg.
- Optional: 3 internal MOVs for a fourth layer of surge survival

Derating Curve

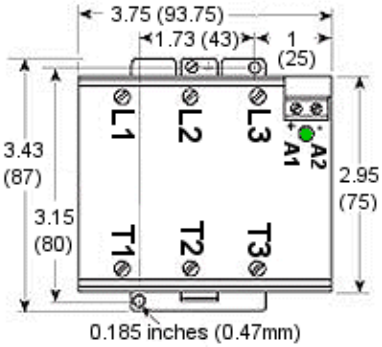


Part Numbers

Customer to supply the 0-5k pot, resistors, and 24 VDC power supply.

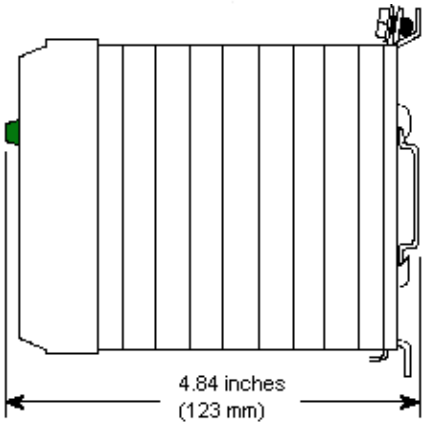
DMA3-6V75T up to 75 amps TOTAL; 25A on three legs or 35A on 2 legs; 660V max, 4-20mA analog input activated BUY

DMA3-5V75T up to 75 amps TOTAL; 25A on three legs or 35A on 2 legs; 575V max; 3 internal MOVs; 4-20mA analog input activated. Non-standard model -- consult factory for price and availability.



Specifications

Part Number	Line Voltage Range (VAC)	Load Current Range (A RMS)	Max Voltage Drop @ 20mA
4-20mA analog input activated			
DMA3-6V75T	24-660	.10-25 (3 leg) or 35 (2 leg)	10 VDC
DMA3-5V75T	24-575	.10-25 (3 leg) or 35 (2 leg)	10 VDC
Installation	The DMA3 can be installed on a din rail or directly on a metal panel. The heat sink must be installed so the air flows up and through the fins.		
Off-State dv/dt	1000 v/µs		
Isolation	4000 volts isolation		
I^2T fuse	50A or less, for example: Bussman FWP50A14F, FWC32A10F, FWC20A10F. Ferraz Shawmut B093910, M330015, K330013		
Example of control	0% = heater or load is "off" 50% = heater "on" 250 mseconds, "off" 250 msec, "on" 250 msec... 75% = "on" 375 msec, "off" 125msec, "on" 375 msec.... 85% = "on" 425 msec, "off" 75msec, "on" 425 msec.... 100% = heater "on" Since the contactor is switching at the zero crossing mark of a sinewave, there is no electrical noise that might interfere with nearby electronics. Also, since the calculated ON or OFF time period is measured in half sine waves, the contactor will automatically adjust the total cycle time in order to maintain the best ratio of ON/OFF to match your control input.		
Turn-on time	<8.3 ms at 60hz		
Turn-off time	<8.3 ms at 60hz		
Power terminals	Will accept #24-#10 AWG wire. Torque: 7-9 inch lbs.		
Control terminals	Will accept #24-#14 AWG wire. Torque: 4 inch lbs.		
Internal MOVs	The "5V" models have three internal MOVs installed providing a fourth layer of surge survivial. Using the MOVs limits the product to applications from 48 - 575 volts.		
Terminology	The word "leg" refers to a switched AC power line. A three phase application may use 3 switched lines or 2 switched lines.		



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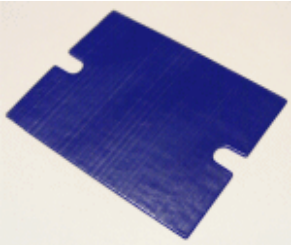
Thermal pad or thermal grease applications.



Between the solid state relay and the heat sink surface, you should apply a thermal transfer compound -- commonly referred to as a thermal pad, thermal grease, Dow Corning 340, Silver Artic, or equivalent. The purpose of this compound is to improve the heat transfer capability between the two surfaces. Using too much, too little, or too inconsistent of an amount will reduce the thermal transfer process. Also, using any adhesives will degrade the thermal transfer process. The ideal application is the smallest amount of compound that provides 100% coverage of the entire mating area between the solid state relay and the heat sink with no voids, air gaps, build-up, or run-out.

Power-io provides an optimized dry thermal pad. This pad is black in color and is die-cut for use with solid state relays or our C Family solid state contactors. It consists of a 0.002 aluminum surface (aluminum is an excellent thermal conductor) covered with a 0.00045 layer of dry thermal transfer material of each side. This phase change material will soften when exposed to the solid state relay's heat and it will have a 15% thermal expansion. The softened thermal pad can be easily removed if a solid state relay is replaced at an installation site. A new thermal pad should always be used when a relay is replaced.

The thermal impedance is rated at 0.009 °C-in²/W at 80psi, ASTM D5470 mounting pressure (or 0.058 °C-cm²/W at 551.6 KPa, ASTM D5470). The "very low °C-in²/W at high installation pressure" is the best thermal transfer pad that Power-io is aware of for use with our products. The thermal pad is slightly larger than a standard Power-io solid state relay, which is 2.25 inches high by 1.75 inches wide.

For purchasing the thermal pad, please visit the accessories page at: http://www.power-io.com/products/heatsinks.htm

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Cost effective distributed control -- PID, heater control, diagnostics, and networking

Product application example: Build a distributed control system, 4 zones at a time, by using the Power-io and Gefran products.

The one-inch wide Gefran module is a 4 zone, distributed control module, which is directly compatible with Modbus, DeviceNet, Ethernet, CANopen, and other control networks. This module is connected to standard Power-io solid state contactors such as the intelligent C Family products shown here. This permits cost effective control systems to be installed on a machine as close as possible to each process zone. This provides: reduced wiring costs, on-the-machine control zones, and a modular design philosophy for easy machine expansion or modification.

- 4 universal process inputs for thermocouple, RTD, or analog inputs
- 4 independent PID control loops
- 4 solid state contactor channels at up to 100 amps each (4 independent single phase zones). Three phase switching is also available.
- 4 CT (current transformer) inputs for amperage monitoring
- 4 configurable secondary outputs -- cooling channels or alarm outputs
- 2 configurable relay outputs
- 2 configurable digital inputs
- Installs on DIN rail or panel mounted
- Small -- only 8 inches wide by 7 inches high when installed as shown.
- High density -- only 14 square inches for each 100 amp complete control loop!

- Each solid state contactor has a diagnostics ALERT output for: SCR fault ON, SCR fault OFF, inbound power failed (open fuse), outbound power failed (open load, open wiring), or thermal problems.
- One standard communications port per Gefran module using Modbus RTU
- Optional additional communications port for Fieldbus: Profibus DP, CANopen, DeviceNet, Modbus RTU, Ethernet Modbus TCP

For additional information about each component, please visit: Power-io C Family contactors and Gefran 4 zone control module

Example pricing:

1) As shown in picture: 4 single phase contactor zones, 4 zone Gefran module, Modbus comms = $1629.00 total.

2) Same as above, add additional comms for Ethernet, DeviceNet, or CANopen = $1859 total.

3) Same as #2, add 2-leg break 3 phase delta contactor zones = $2809 total.

Power-io can also quote and supply the external sensors, CTs, fuses, and other process control accessories.

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Real power in the palm of your hand

The Power-io solid state contactor family and the solid state motor starter family provide 50, 75, or 100 amps of power switching capability while using 12 to 23 square inches of panel space. The 100 amp unit, shown here, is only 4.7 inches wide (120mm). This makes it an ideal size to replace many mechanical or mercury contactors. The solid state contactor also benefits you in the following ways:

- No moving parts or contacts to ever wear out
- No mercury which is regulated or prohibited in many countries, or in food handling applications, or in several states in the USA.
- Precise turn on and turn off exactly at the zero crossing mark = clean, noise free electrical power control.
- Rapid control cycles = improved heater life when used for electrical heater applications such as plastics machinery, food processing ovens, furnaces, duct heaters, immersion heaters, and drying equipment.

The 50 amp model is only 2.4 inches wide (60mm) and the 75 amp model is 3.5 inches wide (90mm). All models are CSA and UL recognized, and CE marked to the CE EN60947-4-3 specification. This is the modern CE specification that requires testing at 40°C. This specification is a dramatic upgrade from the older specifications that tested solid state contactors at only 25°C (room temperature).

For more information about these models, please visit: www.power-io.com/products/dda5075100.htm

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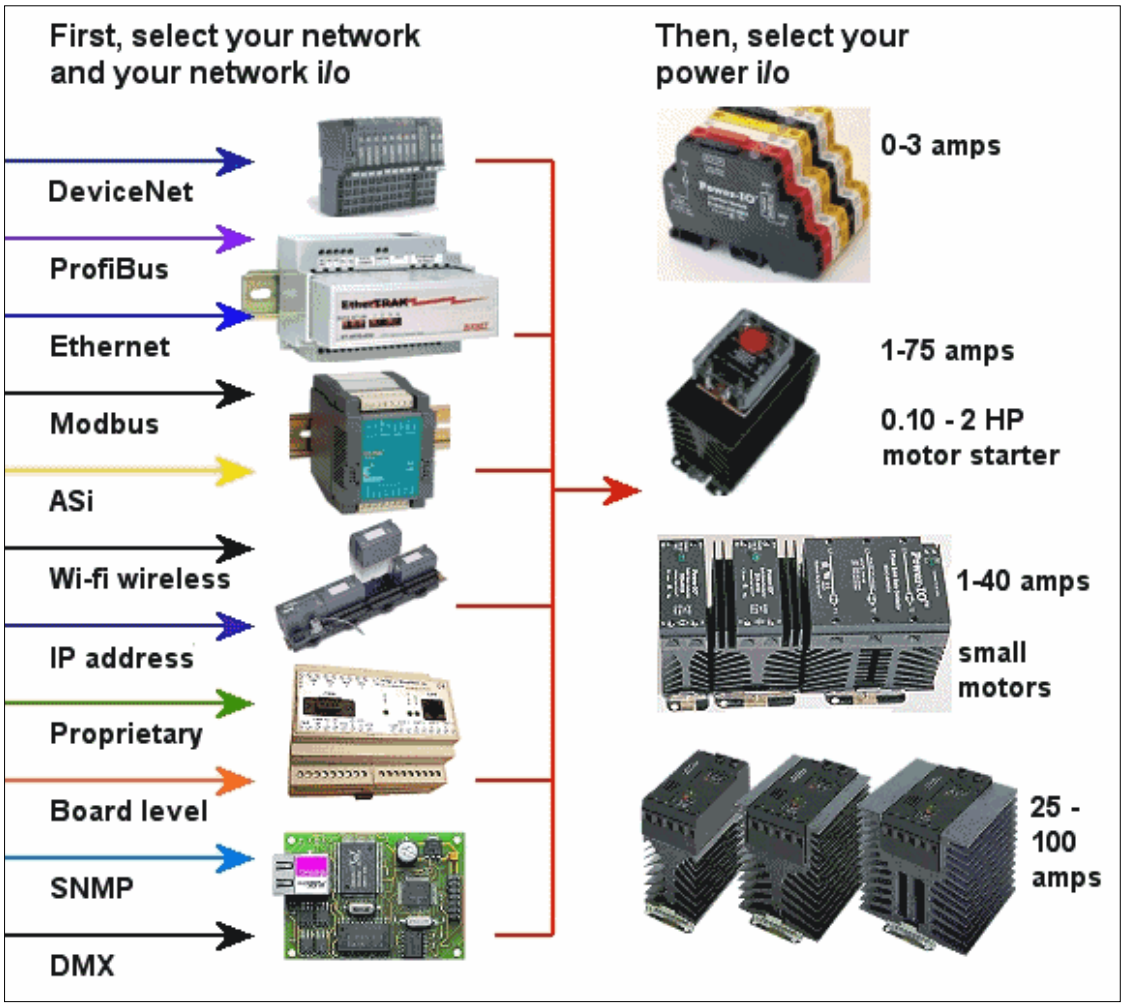
The bus stops here -- turn fieldbus i/o into power i/o

There are many fieldbus systems or automation systems consisting of communications and network I/O devices. Here is how you convert network I/O into power I/O.

These pictures include: Allen-Bradley Point I/O, Sixnet IO, Action I/O, National Instruments FieldPoint I/O, IPIO, and PicoServ IO. All of these are directly compatible with the Power-IO family of products.

These are many other companies who also manufacture excellent network I/O products. The pictures that are shown here are for example only. All trademarks are the property of their respective owners.



Power-io leads the industry in these network applications for the following reasons:

- Power-io's "ultra low current-input requirement" (3 - 9 mA) means that the network product, PLC or PC's control signal can activate one or more units without any problems.
- The I/O modules offer the industry's best flexibility since you can install exactly what you need. Install 1 or 100 without wasting any space or without any concerns about a shared mother-board failing.
- The small SSRs provide a variety of amperage and voltage choices to match your needs.
- The din rail units can be installed edge-to-edge on the same din rail, without de-rating, for the highest density installations in the industry.
- The high amperage 50, 75, or 100 amp din rail units include a built-in, replaceable I^2T fuse, resulting in faster installations that require less panel space.
- 4000 volt isolation between input, output, or adjacent points ensures a high level of safety for personnel or machinery, while reducing ground loop problems.

For more information regarding Power-IO's family of i/o products, please visit:

Power-io products page

Full product specifications, pricing, and online ordering capabilities are available on those pages.

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New, 3 phase solid state contactor.

Edge-to-edge, the "D" (Din Rail) family continues to provide more amps per square inch of installation space. The new three phase solid state contactor (sometimes called a 3 phase solid state relay, 3Ø ssr, or 3Ø solid-state relay) provides three switched legs of power control in a width of just 1.2 inches per leg, when installed on a din rail. Since the D family can be installed edge-to-edge on the same din rail, with no required air gaps between units, you receive maximum space utilization inside your electrical cabinet.

In addition, the new D family uses the latest international specifications including the A1, A2 control input markings; L1, T1, L2, T2, L3, T3 power terminal markings; a green LED for control input status; the latest CE specification EN 60947-4; and NO need for external filters in order to meet the CE noise specifications. The control input circuit can be ordered as a 10-60 VDC input with a low 8mA requirement; or as a 100-280 VAC input; or as a 4-20mA analog input where 4mA= off, 12mA = 50% pulsing, 16 = 75% pulsing, and 20mA = full on.

The complete part number might look like: DDA3 - 6V75T - H that stands for:

- Din-rail mounted, universal installation bracket for din rail or panel mount installations
- DC activated, AC activated, 4-20 Milliamp activated or potentiometer activated using the M model.
- AC switched output,
- 3 separate "back-to-back scr thyristor channels" installed,
- 660 volts max AC switched output. The "6" model is the universal model -- any voltage from 24 - 660 vac, with a blocking voltage of 15% - 75% more rugged than other solid state relays. This provides the maximum in your inventory flexibility, the maximum in blocking voltage specifications, and the maximum in UL / CSA / CE requirements.
- 75T Total amps switching capability when at 40°C, when packed body-to-body. This represents 25 amps per leg if 3 legs switched (25 x 3), 35 amps per leg if two legs switched (35 x 2), or 35 amps per leg for three legs IF a fan is connected to the fan mounting holes on the bottom of the heat sink.
- H special options as required.

The new "D" family uses a performance-engineered heat sink and thermal transfer technology. Due to this, the D family can be installed on a din-rail with ZERO inches between relays (on the same din rail) for cooling purposes ! Edge-to-edge, the D family provides more amps per square inch than other brands of industrially hardened, solid state relays. This means that it stands up better to installations where the ambient temperature is warm. Please note -- all D units are rated to operate in an environment of 40°C (104°F) without any derating compared to other units that may be rated only at 20 or 25°C and need to be de-rated at 40°C. The new CE standard EN60947-4 requires that all new solid state relays must meet their specifications at 40°C. The D family uses a highly efficient design so it generates less than 1.2 watts per amp switched. This compares to other units that might generate 50-75% more heat per amp switched. The D family works harder -- runs cooler -- requires less installation space.

For more information, please visit:

- Three phase solid state contactor, activated by a dc or ac signal, PLC, or controller
- Three phase solid state contactor, activated by a 4-20mA analog signal
- Three phase solid state contactor, activated by a pot, potentiometer, similar to a variac control system

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New, smaller installation requirements.

Edge-to-edge, the "D" (Din Rail) family provides more amps per square inch. POWER-IO was the leader in the development of an integrated solid state relay and heat sink as a single, thermally efficient unit. This product line was expanded to include models for 25 amps and 40 amps. POWER-IO now continues this leadership with the new Maximum Surge Survival™ technology that adds the triple layer of surge shielding to this family. Installation-friendly: less than 1.25 inches wide (25 amp unit) or 2.4 inches wide (40 amp unit), with finger-safe caged terminals and a universal mounting bracket for Din Rail mounting or bolt-on mounting. The new "D" design requires only 0.18 inches between relays for cooling -- an industry improvement that reduces your panel requirements by 30-60% compared to other din-rail, solid state relay products.

In addition, the new D family uses the latest international specifications including the A1, A2, L1, T1 terminal markings; a green LED for control input status; the latest CE specification EN 60947-4; and NO need for external filters in order to meet the CE noise specifications.

The complete part number might look like: DDA - 6V25 that stands for:

- Din-rail mounted, universal installation bracket for din rail or bolt-on installations
- DC activated, AC activated, 4-20 Milliamp activated or potentiometer activated using the M model.
- AC switched output,
- 660 volts max AC switched output. The "6" model is the universal model -- any voltage from 24 - 660 vac, with a blocking voltage of 15% - 75% more rugged than other solid state relays. This provides the maximum in your inventory flexibility, the maximum in blocking voltage specifications, and the maximum in UL / CSA / CE requirements.
- 25 or 40 amps switching capability when at 40°C, when packed body-to-body. This compares to other brands of solid state relays ot SSRs that require at least one or two inches of air space between relays. POWER-IO offers more amps per installed inch.

The new "D" family uses a performance-engineered heat sink and thermal transfer technology. Due to this, the D family can be installed on a din-rail with only 0.18 inches between relays for cooling purposes! Edge-to-edge, the D family provides more amps per square inch than other brands of industrially hardened, solid state relays. This means that it stands up better to installations where the ambient temperature is warm. Please note -- all D units are rated to operate in an environment of 40°C (104°F) without any derating compared to other units that may be rated only at 20 or 25°C and need to be de-rated at 40°C. The new CE standard EN60947-4 requires that all new solid state relays must meet their specifications at 40°C. The D family uses a highly efficient design so it generates less than 1 watt (25 amp units) or less than 1.2 watts (40 amp unit) per amp switched. This compares to other units that might generate 50-75% more heat per amp switched. The D family works harder -- runs cooler.

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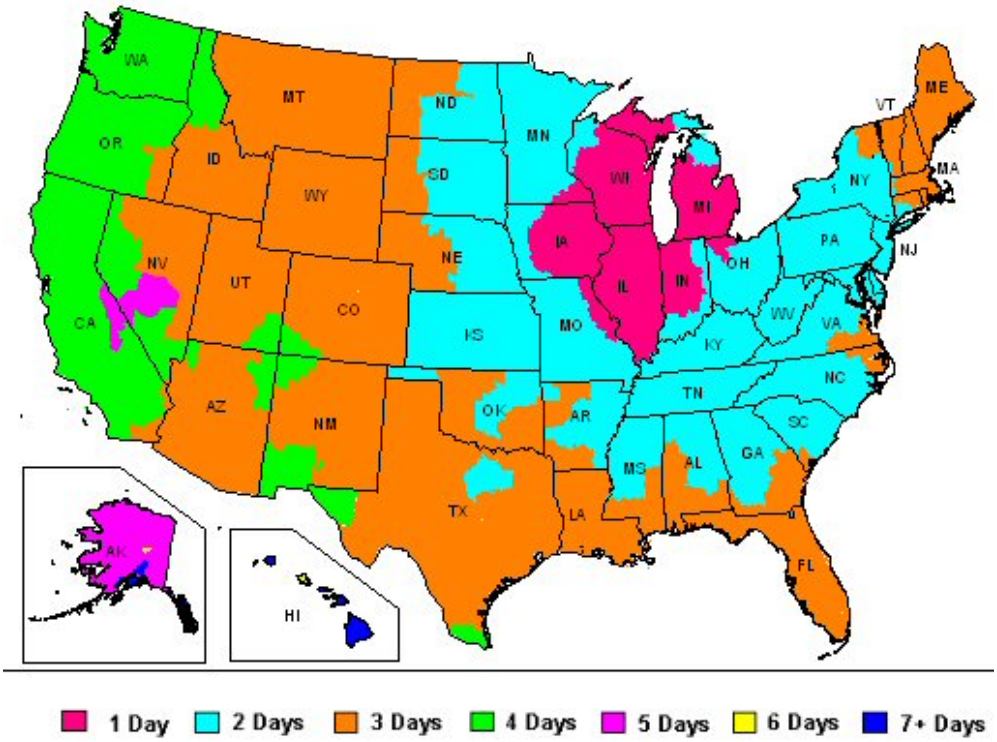
Fast shipping capability for solid state relay products

FedEx Ground shipping time, for Power-io.



Fast delivery --

Power-io ships products by FedEx, UPS, DHL, the US Postal Service, or by international freight forwarding companies. Our primary shipping method is FedEx Ground with a 5:00 PM cut-off time, and FedEx Air with a 6:00 PM cut-off time.

UPS has a 4:30 PM cut-off time for most packages.

If you have emergency shipping requirements, please contact us for other options. Power-io is less than 1 hour away from Chicago's International Airport (ORD), where we have sent couriers directly to DHL's or FedEx's hub, as late as 9 PM.

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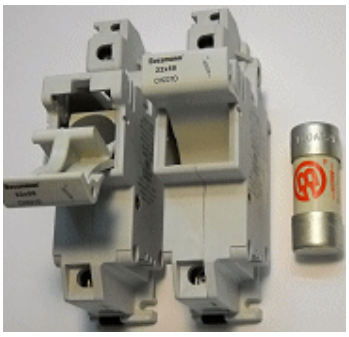
FWP-175A Fuses

I²T fuses for solid state relays

We recommend fuse protection through the use of properly selected I2t fusing (semiconductor fuses). Devices such as circuit breakers and general purpose fuses, while sufficient and necessary for load and installation protection, do not provide adequate protection for the semiconductor device.



Finger-Safe Fuse Blocks and ferrule style fuse

Part Numbers

The part number shows the physical size of the fuse (14 mm or 22 mm diameter) and the amperage of the fuse. The FUSE-HLDR fuse holders are finger safe, din rail units.

Ferrule style fuses: (installs inside the finger safe fuse block shown below)

FUSE-EXT-14-25 I²T Fuse, 14 mm x 51 mm, 25 amp BUY

FUSE-EXT-14-30 I²T Fuse, 14 mm x 51 mm, 30 amp BUY

FUSE-EXT-14-40 I²T Fuse, 14 mm x 51 mm, 40 amp BUY

FUSE-EXT-22-80 I²T Fuse, 22 mm x 58 mm, 80 amp BUY

FUSE-EXT-22-100 I²T Fuse, 22 mm x 58 mm, 100 amp BUY

L Bracket Fuse

Finger-Safe Fuse Blocks for Ferrule Style Fuses:

FUSE-HLDR-14-01 Fuse holder, 14 mm, 1 position BUY

FUSE-HLDR-22-01 Fuse holder, 22 mm, 1 position BUY

FUSE-HLDR-14-03 Fuse holder, 14 mm, 3 position BUY

L Bracket Style Fuses (installs inside the DDA-6V50, DDA-6V75, DDA-100 or DAA-6V50, DAA-6V75, DAA-6V100)

FUSE-SEMIBR-63A I²T Fuse, L bracket style, 63 amp BUY

FUSE-SEMIBR-100 I²T Fuse, L bracket style, 100 amp BUY

Large 125-200 Amp Fuses

Large I²T Fuses and Terminal Blocks:

100 Amp I2T FUSE -- FWP-100B BUY

175 Amp I2T FUSE -- FWP-175A BUY

Free Standing Thermal Block for Large Fuses BUY

Large Fuse Holders

For a printable copy of the data bulletin including the complete specifications: I²T fuses, fuse blocks and I2T fuse accessories

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I²T fuses for solid state relays

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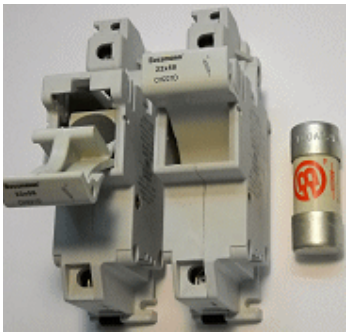

Finger-Safe Fuse Blocks and ferrule style fuse

Part Numbers

The part number shows the physical size of the fuse (14 mm or 22 mm diameter) and the amperage of the fuse. The FUSE-HLDR fuse holders are finger safe, din rail units.

Ferrule style fuses: (installs inside the finger safe fuse block shown below)

FUSE-EXT-14-25 I²T Fuse, 14 mm x 51 mm, 25 amp BUY
FUSE-EXT-14-30 I²T Fuse, 14 mm x 51 mm, 30 amp BUY
FUSE-EXT-14-40 I²T Fuse, 14 mm x 51 mm, 40 amp BUY
FUSE-EXT-22-80 I²T Fuse, 22 mm x 58 mm, 80 amp BUY
FUSE-EXT-22-100 I²T Fuse, 22 mm x 58 mm, 100 amp BUY

L Bracket Fuse

Finger-Safe Fuse Blocks for Ferrule Style Fuses:

FUSE-HLDR-14-01 Fuse holder, 14 mm, 1 position BUY
FUSE-HLDR-22-01 Fuse holder, 22 mm, 1 position BUY
FUSE-HLDR-14-03 Fuse holder, 14 mm, 3 position BUY

L Bracket Style Fuses (installs inside the DDA-6V50, DDA-6V75, DDA-100 or DAA-6V50, DAA-6V75, DAA-6V100)

FUSE-SEMIBR-63A I²T Fuse, L bracket style, 63 amp BUY
FUSE-SEMIBR-100 I²T Fuse, L bracket style, 100 amp BUY

Large 125-200 Amp Fuses

Large I²T Fuses and Terminal Blocks:

100 Amp I2T FUSE -- FWP-100B BUY
175 Amp I2T FUSE -- FWP-175A BUY
Free Standing Thermal Block for Large Fuses BUY

Large Fuse Holders

For a printable copy of the data bulletin including the complete specifications: I²T fuses, fuse blocks and I2T fuse accessories

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I²T fuses for solid state relays

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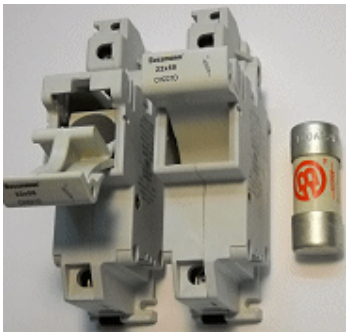

Finger-Safe Fuse Blocks and ferrule style fuse

Part Numbers

The part number shows the physical size of the fuse (14 mm or 22 mm diameter) and the amperage of the fuse. The FUSE-HLDR fuse holders are finger safe, din rail units.

Ferrule style fuses: (installs inside the finger safe fuse block shown below)

FUSE-EXT-14-25, marked FWP-25A14Fa Bussmann, I²T Fuse, 14 mm x 51 mm, 25 amp BUY

FUSE-EXT-14-30, marked FWP-30A14Fa Bussmann, I²T Fuse, 14 mm x 51 mm, 30 amp BUY

FUSE-EXT-14-40, marked FWP-40A14Fa Bussmann, I²T Fuse, 14 mm x 51 mm, 40 amp BUY

FUSE-EXT-22-80, marked FWP-80A22F Bussmann, I²T Fuse, 22 mm x 58 mm, 80 amp BUY

FUSE-EXT-22-100, marked FWP-100A22F Bussmann, I²T Fuse, 22 mm x 58 mm, 100 amp BUY

L Bracket Fuse

Finger-Safe Fuse Blocks for Ferrule Style Fuses:

FUSE-HLDR-14-01, marked CH141D Bussmann, Fuse holder, 14 mm, 1 position BUY

FUSE-HLDR-22-01, marked CH221D Bussmann, Fuse holder, 22 mm, 1 position BUY

FUSE-HLDR-14-03, marked CH143D Bussmann, Fuse holder, 14 mm, 3 position BUY

L Bracket Style Fuses (installs inside the DDA-6V50, DDA-6V75, DDA-100 or DAA-6V50, DAA-6V75, DAA-6V100). Marked 63FE or 100FE.

FUSE-SEMIBR-63A, marked 63FE Bussmann, I²T Fuse, L bracket style, 63 amp BUY

FUSE-SEMIBR-100, marked 100FE Bussmann, I²T Fuse, L bracket style, 100 amp BUY

Large 125-200 Amp Fuses

Large I²T Fuses and Terminal Blocks:

100 Amp I2T FUSE -- FWP-100B BUY

175 Amp I2T FUSE -- FWP-175A BUY

Free Standing Thermal Block for Large Fuses BUY

Large Fuse Holders

For a printable copy of the data bulletin including the complete specifications: I²T fuses, fuse blocks and I2T fuse accessories

POWER-IO

Product information as saved in the www.power-io.com library.
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DC contactors for custom VDC switching applications

Power-io designs and builds custom contactors such as high amperage dc contactors. By using a high speed control input design, IGBT technology, engineered heat sinks, and large power connectors; we can manufacture low-to-medium volume products for custom applications. These designs can be stand alone, or they can incorporate diagnostics as part of a total control package.

The CDD-1V300 family can switch any voltage from 0-100 VDC and any amperage up to 300-450 amps continuous. This design can withstand momentary start-up inrush of up to 1000 amps and can switch up to 600 amps for 10 seconds.

- The stand alone control input board is powered by a standard 24 VDC power supply.
- Control input: 4-32 VDC and less than 5 mA
- Diagnostic LEDs for control input status and power supply status
- Dual fan heat sinks are built in.
- Internal temperature monitoring circuit and auto-shut down at 100C.
- Small -- only 8 x 8 x 8 inches

With the safety cover removed:

- Large power connectors can be torqued to specification for your exact wire size
- Control input board has a standard PWM speed of 2 kHz and can be customized for other speeds or capabilities
- The modular control input section was designed for expansion and it can support up to 2 additional PCBs for customer-specified features or network communications
- Optional 48 VDC power supply input for use in military applications or battery backed-up applications
- Dual Ultra Power Cooler™ (trademark of Power-io) heat sinks

For additional information about custom design capability; high speed DC switching; or high amperage mosfet, IGBT, or thyristors; please contact our factory.

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Power-io provides distributed "on-the-machine" control blocks that can reduce wiring costs and installation time.

In example #1, the Power-io C Family of solid state contactors provide solid state switching for heater control applications. With up to 100 amps of switching, every 1.6 inches on the din rail; Power-io provides high density power control for industrial applications. In addition, each Power-io contactor provides a diagnostics alarm output that indicates: SCR failed in ON mode, SCR failed in OFF mode, incoming power failure (blown fuse, open breaker), outbound power failure (open load, broken wire), or SCR thermal problems (auto shut-down).

In this example, the Power-io units are part of a temperature control system by Ascon. The Delta modules that are shown are individual temperature control zones using a distributed architecture that permits fast and easy expansion. The modules can be connected to a local HMI and/or to a PLC for total line control applications. A wide variety of Delta modules provide standard, off-the-shelf, solutions.

In example #2, the control system from Ascon provides greater flexibility. The Sigma modules continue to provide an expandable architecture that is directly compatible with industry standard fieldbus products. In addition, the SigmaPac main CPU module has an on-board 32 bit ARM processor permiting you to customize the control system to more closely match your exact requirements. The SigmaPac main module also stores a copy of each module's operating parameters so that a replacement module can instantly reconfigure itself to the exact parameters that were previously in use.

The Power-io diagnostic output can be tightly integrated into a control strategy that might include logic interlocks, time based functions, and other PLC functions.

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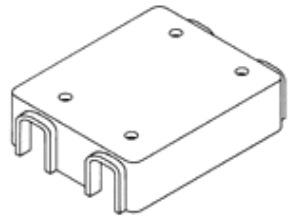
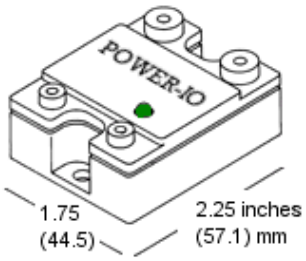
Solid state relay

1-125 amp solid state relay
up to 330 volts or 660 volts AC switching
Individual solid state relay hockey pucks or pre-assembled onto heat sinks

- Internal, SCR thyristors and fourth generation DCB Direct Copper Bonding thermal optimization provide longer life than other solid state relay products
- Third generation Maximum Surge Survival™ technology for superior performance
- 4000 volt optically isolation
- International green LED input status indicator and terminal numbers (L1, T1, A1, A2)
- Clear safety cover included
- 800 volt blocking voltage in the 3V models (very high voltage surge blocking)
- 1200 volt blocking voltage in the 6V models (highest voltage surge blocking)
- Ultra-Precise zero voltage turn-on to eliminate EMI noise, without the need for CE filters
- Highest surge capability with the trademarked triple layer design feature to: attenuate surges AND then block surges AND then control the pass-through.
- UL recognized, CSA, CE EN 60947-4-3 (the newest and most difficult international CE specification), all models up to 75 amps.
- 76-125 amps = approvals pending. Note: the power terminals on "hockey puck" solid state relays are rated for one or two 8 AWG wires which limits the amperage. For larger wire installations, please visit the C Family of products.
- See the data bulletins for complete specifications: 1-75 amp models, 90-125 amp models, or the new C Family DC control input models or AC control input models.





Part Numbers:		Pre-installed* on:		
		Good Heat Sink	Better Heat Sink	Best* Heat Sink
DC Control Input:		Heatsk-Din-1.6	Heatsk-Din-1.0	Ultra Power Cooler™
HDA-3V25 up to 25A, 24-330V max, 4-32 VDC activated	BUY	BUY		
HDA-3V50 up to 50A, 24-330V max, 4-32 VDC activated	BUY	BUY	BUY	
HDA-3V75 up to 75A, 24-330V max, 4-32 VDC activated	BUY		BUY	BUY
HDA-6V50 up to 50A, 24-660V max, 4-32 VDC activated	BUY	BUY	BUY	
HDA-6V75 up to 75A, 24-660V max, 4-32 VDC activated	BUY		BUY	BUY
HDA-6V125 up to 125A, 24-660V max, 4-32 VDC activated. Hint: if you are buying more than one unit, it is more cost effective to buy the dual channel: Power-io's CZ2H-IAC2, shown below.	BUY			BUY
* Upgrade to: CZ2H-IDC2 as an alternative to the HDA-6V125. Two channels of up to 100A continuous on each, 24-575V max, 4-32 VDC activated. The C family is a complete assembly using large 2-8 AWG power connections, built-in additional surge survivability, SCR ALERT Alarm and more. Highest installation density. More information is online at: Power-io's C Family of solid state contactors				BUY
AC Control Input:				
HAA-3V25 up to 25A, 24-330V max, 100-280 VAC activated	BUY	BUY		

HAA-3V50 up to 50A, 24-330V max, 100-280 VAC activated	BUY	BUY	BUY	
HAA-3V75 up to 75A, 24-330V max, 100-280 VAC activated	BUY		BUY	BUY
HAA-6V50 up to 50A, 24-660V max, 100-280 VAC activated	BUY	BUY	BUY	
HAA-6V75 up to 75A, 24-660V max, 100-280 VAC activated	BUY		BUY	BUY
HAA-6V125* up to 125A, 24-660V max, 100-280 VAC activated. Hint: if you are buying more than one unit, it is more cost effective to buy the dual channel: Power-io's CZ2H-IAC2, shown below.	BUY			BUY
* Upgrade to: CZ2H-IAC2 as an alternative to the HAA-6V125. Two channels of up to 100A continuous on each, 24-575V max, 100-280 VAC activated. The C family is a complete assembly using large 2-8 AWG power connections, built-in additional surge survivability, and more. Highest installation density, only 1.6 inches per channel. More information is online at: Power-io's C Family of solid state contactors				BUY

* Pre-installed = Solid state relay + thermal transfer pad + 2 mounting screws + torqued to 20-25 inch pounds + the heat sink shown. For the fastest on site installations, using the pre-assembled packages is beneficial. Power-io can design other assemblies, contact us with your specifications. The Ultra Power Cooler™ is a small footprint, thermally engineered, fan assisted heat sink. Please provide 120 vac, 9 watts, power for the fan.

Purchase heat sinks, thermal pads, pre-installation options separately: Parts page
Heat sink descriptions, multi-zone heat sinks, MOV options, and more.

- For a printable copy of the data bulletin including the complete, in-depth product specifications, engineering details, and thermal calculations: solid state relay data bulletin for 1-75 amp models or solid state relay data bulletin for 1-125 amp models or Power-io's C Family of solid state contactors.
- For full dimensional information and label examples: Power-io solid state relay dimensions and labels
- For a zoomed in photo of the product: Solid state relay and the solid state relay cover
- It is important to anticipate three installation conditions: avoid over-amperage, over-voltage (surges), or over-temperature. See: solid-state-relay-extended-life.htm