Power-IO™

HDD-E Family of Solid State Relays
Up to 75 Amps
Up to 900 VDC switched

- **12 - 20 kHz, FAST** switching times for superior PWM performance
- **Ultra Cool Technology**™ trademarked thermal management design
- Green LED that indicates input status for fast, visual diagnostics
- Optically isolated for 2100 VDC peak isolation and 1500 Vrms
- **Maximum Surge Survival**™ = high immunity to voltage transients
- High amperage surge capability
- Directly compatible with PLCs, PCs, and most controllers
- Highly efficient, high-performance internal drive circuit
- Easy turn-ON control requirements, starting at 3 VDC, 10mA
- Mosfet-based models for 0-200 VDC applications
- IGBT-based models for 0-900 VDC applications
- Clear, finger-safe, snap-on cover included
- All parameters shown are at 40°C, a factory-hardened specification
- Ideal for: robotics, PWM loads, test equipment, remote controlled products, DC servos, battery powered products, h-bridges, inverters, vehicles, rail installations, solar, wind turbine, and other alternative energy applications.
- Rugged and light weight — ideal for electric vehicles, rail transit systems or airborne applications
- RoHS compliant; assembled in the USA; shipped worldwide
- CE marked

Power-io also designs customized versions of this product family. This may include: different control input ranges, outputs, custom labels, performance parameters, military specifications, high altitude ratings, high temperature SAE ratings, special plating, higher speed PWM, and more. Contact Power-io for additional information.

The clear safety cover permits a customer-supplied PCB, such as 1.62 x 1.62 inches, to be installed under the clear cover. The PCB can also extend outside the cover. The PCB can sit on two 0.5 high, 8-32, stand-offs. Using an under-the-cover PCB permits fast prototyping of simple logic circuits, communications capability, on-board micro, on-board LCD, or other customer-specific product modifications.

Model Numbers	HDD-06V75E	HDD-1V25E	HDD-1V50E	HDD-2V40E	HDD-6V20E	HDD-9V30E
Output Specifications (All shown at 40°C, which is the typical industrial requirement, when on appropriate heat sinks)						
Operating Voltage, VDC, Most Switched Loads	0-60	0-100	0-100	0-200	0-600	0-900
Operating Voltage, Motors or Highly Inductive Loads	0-30	0-50	0-50	0-100	0-300	0-450
Max Load Current [Continuous Arms] W/ Proper Heat Sink	75	25	50	40	20	30
Min Load Current (Arms)	0	0	0	0	0	0
Max Surge Current, Non-Repetitive [Amps Peak]	450	160	320	130	80	90
Max On-State Voltage Drop, VDC @ Rated Current**	0.75	0.63	0.7	1.4	1.9	2.3
Thermal Resistance Junction to baseplate [°C/W]	0.5	1	0.5	0.5	1	0.4
Max. Off-State Leakage @ Rated Voltage @50°C (Max)	0.1mA	0.1mA	0.1mA	0.1mA	0.5mA	0.5mA
On-State Resistance, Max, Ohm @ Current Output	0.01	0.025	0.014	0.033	IGBT	IGBT
Internal switching component	mosfet	mosfet	mosfet	mosfet	IGBT	IGBT
Control Input						
Min turn-on VDC/mA control signal, LED not visible	3VDC/9mA					
Min turn-on control for full speed and LED visible	4.5VDC/10mA					
Max turn-on voltage/current	32VDC/20mA					
Turn-off voltage	1VDC					
Max turn-on time delay, 4.5V CTRL, >10V switched	20µSec	20µSec	20µSec	20µSec	20µSec	30µSec
Turn On delay, minimum ctrl (typical)	60µSec	60µSec	60µSec	40µSec	40µSec	60µSec
Max turn-off time delay	20µSec	20µSec	20µSec	20µSec	20µSec	30µSec
High Frequency test, >8V Ctrl	20KHz	20KHz	20KHz	20KHz	16KHz *	12KHz *
For highest PWM speed (fast turn ON, no dwell time, fast turn OFF, no dwell time,...), use a strong control signal (>8VDC, >10mA)						
PWM Min ON Time, On > 8V ctrl	25µSec	25µSec	25µSec	25µSec	30µSec *	40µSec *
PWM Min ON Time, On = 4.5V ctrl	100µSec	60µSec	100µSec	100µSec	100µSec	250µSec
PWM Min ON Time, On = 3.5V ctrl	200µSec	125µSec	200µSec	225µSec	300µSec	1000µSec
PWM Min ON Time, On = 3.0V ctrl	400µSec	250µSec	400µSec			
PWM Minimum Off Time, Off < 1V ctrl	25µSec	25µSec	25µSec	25µSec	30µSec *	40µSec *
Over Clock Protection	yes	yes	yes	yes	yes	yes
* Blanking Pulse limited						
General						
Dielectric Strength: Input-Output-Baseplate	2100 Vpk (1500 Vrms)					
Capacitance input to output	8pf					
Ambient operating range	-40°C to 85°C when used with an appropriate heat sink and with unrestricted air flow					
Ambient Storage Temperature Range	-40°C to 125°C					
Terminals	Four screws and saddle clamps, pre-installed					
Screw torque:	Control: 8-32 screws 15 inch lbs.; Power: 8-32 screws 20 to 25 inch lbs.					
Safety Cover	Clear, snap on, with 4 holes for multi-meter test probes					
Shipping weight and size:	3 oz (85 g) typical. Box = 2.5 x 1.9 x 1.5 inches (63.5 x 48 x38 mm) typical					

Application Notes — single-time turn ON, fast turn ON speed, and high speed PWM ON/OFF/ON/OFF
For example, using a HDD-06V75E, program your PWM controller as follows:

1. With a weak control signal (3VDC), the SSR can be turned ON or OFF in 400µSec (400 millionths of a second). The LED may not be visible.
2. With a medium strength control signal (>4.5VDC), the SSR will quickly turn ON in 20 microseconds, it will require 80 microseconds to remain ON, and then can be turned OFF. The LED will be a visible indication of the status of the control signal.
3. With a strong control signal (>8VDC), the SSR can be turned ON in 20 microseconds and can immediately be turned OFF in 20 microseconds, achieving a PWM speed of 20 kHz ON/OFF/ON/OFF.

The control input signal also powers the SSR's internal power supply. Over Clock Protection forces the SSR OFF if the power supply voltage goes too low.

Blanking Pulse is the ability for the SSR to differentiate between noise and a valid load voltage. As the load voltage increases (such as 500-900VDC loads), then the blanking pulse circuit provides a slightly decrease in maximum PWM speed in order to avoid false turn ON/OFF/ON/OFF performance.

Power-io can modify several of these parameters, if your application has unique requirements. Contact us.

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Heat sink calculations. It is important that the solid state relay be installed on a properly sized heat sink, or else it will become damaged. The new HDD-E family was designed for a lower thermal rise, so the heat sink size requirements are minimized.

Math calculations:

Thermal rise — Mosfet Based Models HDD-06VxxE—HDD-2VxxE:
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-06V75E that is switching a 32 amp load:

32 x 32 x 0.01 = 10.24 watts (heat) power dissipation.

Recommended heat sink size:

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

For example: for a HDD-06V75E that is switching 32 amps in a 40°C (104°F) warm electrical enclosure in a factory:

(100 - 40°C) / (10.24 watts x 1.4) = 4.18

The required heat sink should be rated as 4.18C/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 adequate. A 3°C/W or a 2.0°C/W would be better. Always use a properly sized heat sink. Consult the www.power-io.com website for several high performance heat sinks.

Thermal rise — IGBT Based Models HDD-6V20E and HDD-9V30E:
Power dissipation for a Power-IO solid state relay for a VDC switching application using IGBTs:

Amps x "max on-state voltage drop"

For example: for a HDD-6V20E that is switching a 11 amp load.

11 x 1.9 = 20.9 watts (heat) power dissipation.

Assembly examples:

Example part number:
HDD-1V25E-HS2.0

A HDD-1V25E installed on a HEATSK-DIN-2.0 including a Thermal Transfer Pad, or Thermal Grease, and two mounting screws.

This is a 2.0 C/W heat sink and is typical for 4-25 watts of heat dissipation.

Assembly examples:

Example part number:
H__-_____-HS1.0U

A Power-io SSR installed on a HEATSK-DIN-1.0U including a Thermal Transfer Pad, or Thermal Grease, and two mounting screws.

This is a 1.0 C/W heat sink and is typical for 15-43 watts of heat dissipation.

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Auxiliary information:

One safety cover is included. Additional covers are available as part number: **COVR-SAFETY-E**

The power terminals can connect to one or two 8 AWG wires. The terminals can connect to an external wire lug such as BURNDY KPA8CUP for a 6 AWG wire.

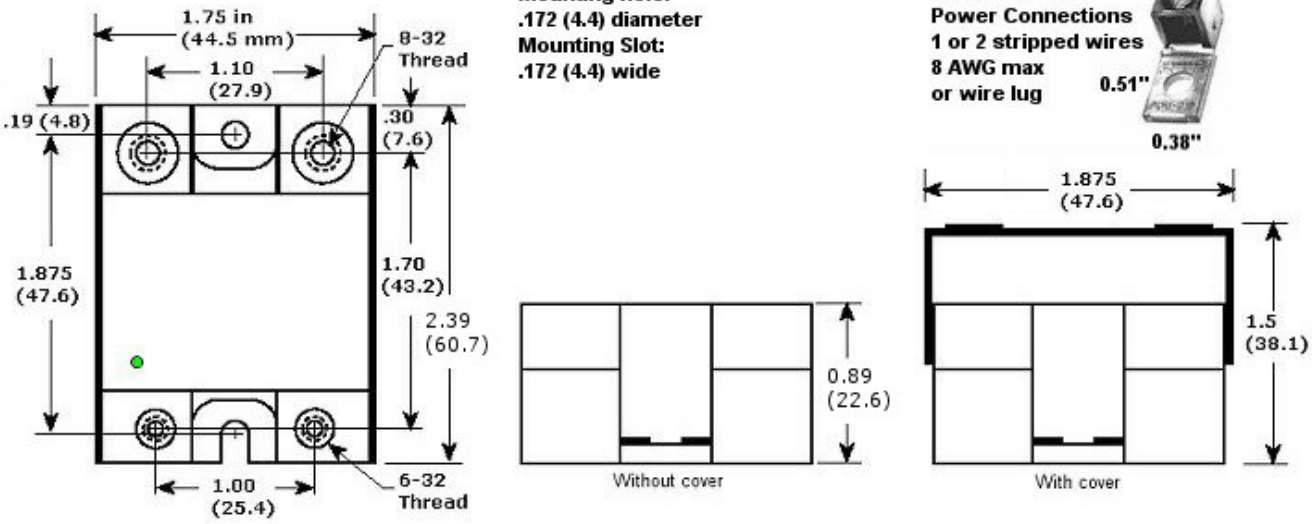
Flyback protection — Diodes or MOVs:

Diodes: A flyback diode is installed across the load to prevent EMF voltage problems from inductive loads. We assume that all loads or wiring have some inductance. The recommended Power-io diodes are fast, 75nsec, and are available as: **HDD_DIODE** for applications < than 600 VDC,, or **HDD_DIODE_1000V4A** for < than 900 VDC.
Install the external diode as shown on the last page of this bulletin. The installation orientation is important. If the wire length to the load is long, install the flyback diode to suppress the load AND the long wire length. Diodes are available from Power-io.

MOVs: For h-bridges, other bi-directional current flow applications, or high PWM speed DC solenoids; you can install a MOV across the load or the Power-io terminals 1 and 2. For assistance in choosing the right MOV part number, see: **http://www.power-io.com/library/appnotes/h-bridge.htm**
For example: **MOV_V33ZA80P** is a typical choice for a 12-24 VDC motor or solenoid. This MOV is available from Power-io.

Mounting screws — SSR to heat sink: For use with Power-io heat sinks, we recommend using a pair of screws, 1/2 inch long. These are available from Power-io. Some heat sinks use 8-32 screws and some use M4 metric screws.

Stand-offs: The control input terminals can use two 8-32, 1/2 inch high, stand-offs for mounting an external PCB. The power terminals can use two 8-32, 3/8 inch high stand-offs.



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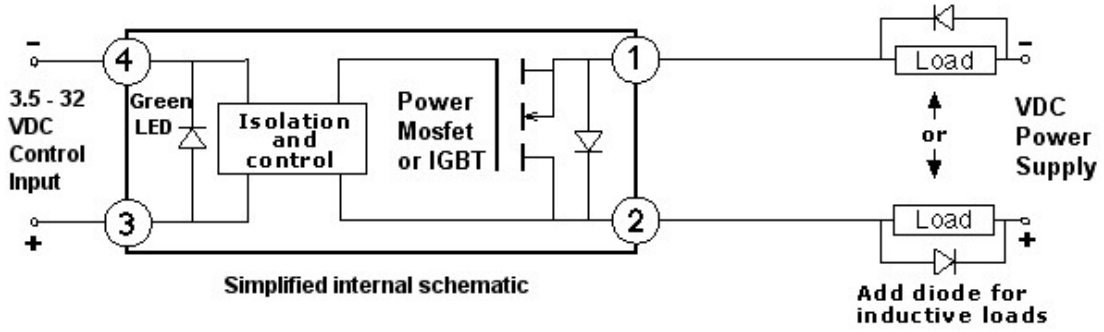
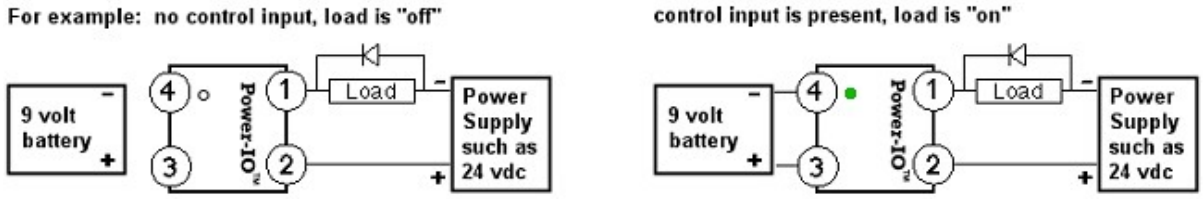


Installation instructions:
The relay should be installed on a heat sink using a Power-IO Thermal Pad or Dow Corning 340™ thermal transfer grease or equivalent. The heat sink installation screws should be tightly torqued to 20-25 inch pounds to ensure a firm thermal connection between the relay and the 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 Power-io part number HDD_DIODE or HDD_DIODE_1000V4A. 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 HDD solid state relay is capable of switching the positive wire or negative wire of the application. This is sometimes called "switching the high side" or "switching the low side". The power supply wiring polarity is important and must be wired as shown above. Otherwise, the HDD will appear ON due to the internal diode. 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 HDD-E solid state relay can be quickly tested with a 9 volt battery and a small load:



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, SAE 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 1 year 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 Specifications subject to change without notice.
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