BULLETIN 803B

CRYDOM COMPANY

SERIES 1-DC

MOSFET Output Solid-State Relay

7.0 Thru 40 Amp 100-500 VDC Output

- **Advanced Semiconductor Technology**
- **Low On-State Resistance**
- **Paralleling Capability**
- **High Surge Ratings**
- **Compatible with most Logic Systems**
- **Wide Control Range**

General Description

Crydom Series 1 DC solid-state relays incorporate power MOSFETs as output devices in the original Crydom package. This DC relay takes full advantage of the power efficient, low on-state resistance of MOSFETs together with their established features such as freedom from second breakdown, fast switching, ease of paralleling and temperature stability.

The output switching capability of these relays is 7 amps through 40 amps at 100 Vdc, and 7 through 12 amps at voltages up to 500 Vdc. The (SPST, normally open) output has 2500 VRMS of isolation from the mounting base and input circuit.

The input can be driven from most logic circuits, requiring less than 1.6 mA at 5 Vdc. The dc control signal activates a 50 KHz oscillator which is transformer coupled to the output circuit (Figure 1).

Built with the quality and experience of the world's leading manufacturer of solid-state relays, incorporating the latest in power MOSFET technology, these solid-state relays will provide long, consistent and reliable service.

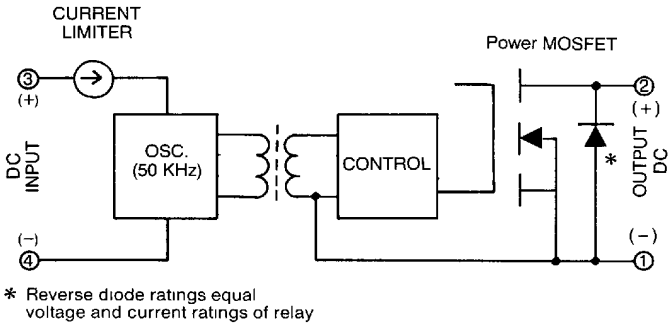
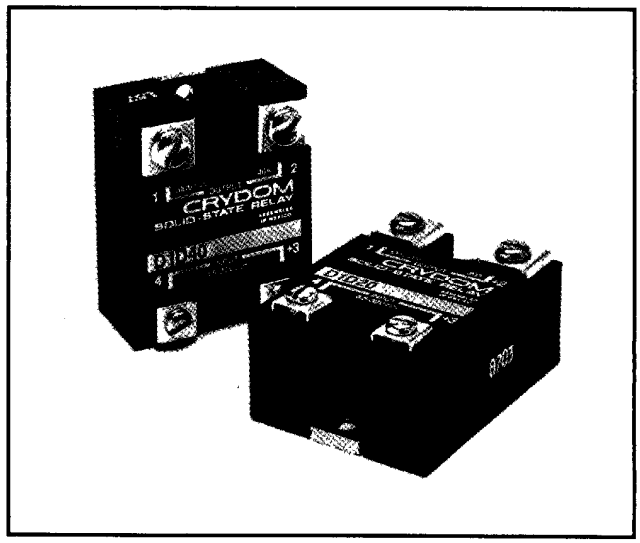


Figure 1. DC SSR Schematic



Part Identification

Model Number	Output Voltage Range (Vdc)	Output Current (Adc)
D1D07*	0-100	7
D1D12*	0-100	12
D1D20*	0-100	20
D1D40*	0-100	40
D2D07	0-200	7
D2D12	0-200	12
D4D07	0-400	7
D4D12	0-400	12
D5D07	0-500	7
D5D10	0-500	10

*Available with internal transient voltage suppression . . . "Z" suffix. Output voltage range is reduced to 0-80 VDC.

Crydom Series 1 MOSFET DC Power Relays

Electrical Specifications (25° unless otherwise specified)

OUTPUT CHARACTERISTICS		MODEL NUMBERS										UNITS
		D1D07	D1D12	D1D20	D1D40	D2D07	D2D12	D4D07	D4D12	D5D07	D5D10	
Operating Voltage Range		0-100				0-200		0-400		0-500		Vdc
Max. Load Current ①		7	12	20	40	7	12	7	12	7	10	Adc
Min. Load Current		20				20		20		20		mAdc
Max. Surge Current 10 ms ②		15	28	42	106	22	27	17	36	19	29	Adc
F.W. Rect. Current		10	17	28	57	10	17	10	17	10	14	A peak
Max. On-State Voltage @ Rated Current ③		2.0	1.6	2.1	2.1	2.0	2.8	4.2	4.2	5.7	5.5	Vdc
Thermal Resistance, ($R_{\theta JC}$) ④		2.2	1.34	1.06	0.83	1.5	1.06	1.06	0.8	1.0	0.8	°C/W
Power Dissipation @ Rated Current ③		14	19	41	85	14	34	29	50	40	55	Watts
Max. On-State Resistance @ Rated Current ③		0.29	0.13	0.10	0.05	0.29	0.23	0.6	0.35	0.8	0.55	Ohms
Max. Off-State Leakage Curr. @ Rated Voltage	Tj=125°C	4.0	8.0	12.0	12.0	4.0	12.0	12.0	12.0	8.0	12.0	mA
	Tj=25°C	0.1	0.2	0.3	0.3	0.1	0.3	0.3	0.3	0.2	0.3	

INPUT CHARACTERISTICS		ALL MODELS	UNITS
Control Voltage Range		3.5-32	Vdc
Max. Reverse Voltage		-1.0	Vdc
Max. Turn-On Voltage ⑤		3.5	Vdc
Min. Turn-Off Voltage ⑤		1.0	Vdc
Min. Input Impedance		1,000	Ohms
Max. Input Current	5 Vdc	1.6	mA
	32 Vdc	28	
Max. Turn-On Time (T_d+T_r)		100	μsec
Max. Turn-Off Time (T_d+T_f)		1.0	msec

GENERAL CHARACTERISTICS		ALL MODELS	UNITS
Min. Dielectric Strength (60Hz) ⑥		2,500	Vrms
Min. Insulation Resist. (500 Vdc) ⑥		10^9	Ohms
Max. Capacitance Inp/Out		50	pf
Ambient Temperature Range	Oper.	-30 to 80	°C
	Stor.	-40 to 125	

GENERAL NOTES
① See figures 5 thru 14.
② See figures 2 and 3.
③ Case temperature T_c=80°C.
④ Junction temperature T_j (max.)=125°C, (D1D40=150°C)
⑤ Over temperature range -30°C≤T_A≤80°C
⑥ Dielectric and insulation resistance measured between input and output, and both to baseplate.

Data and specifications subject to change without notice.

Surge Characteristics

The curves in figures 2 and 3 apply to a nonrepetitive uniform amplitude surge of a given time and peak current, preceded by an off-state and followed by any rated load condition. The junction temperature must be allowed to fall below 80°C before reapplication of surge.

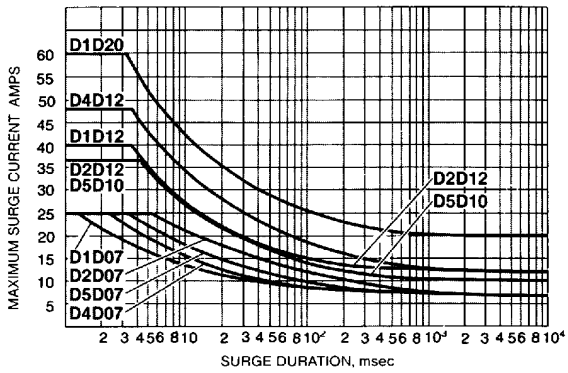


Figure 2. Maximum Surge Current vs. Duration

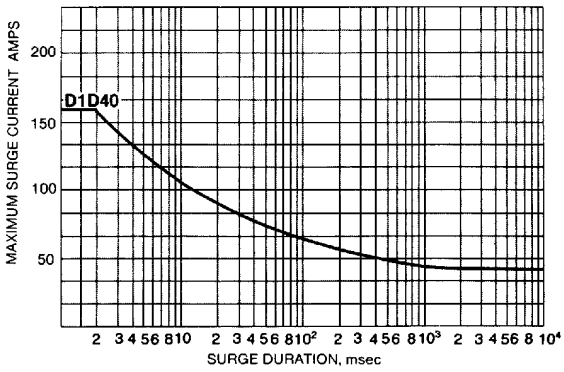


Figure 3. Maximum Surge Current vs. Duration

Thermal Characteristics

A major consideration in the use of solid-state relays is the thermal design. It is essential that the user provide adequate heat sinking for the application.

Referring to figures 5 through 14 the left halves show power dissipation versus load current. The right halves are families of curves which are used in selecting the required heatsink to maintain a maximum case temperature for a given ambient. It is important to note that the thermal resistance values (°C/W) shown include both case-to-heatsink interface ($R_{\theta CS}$) as well as the heatsink-to-ambient thermal resistance ($R_{\theta SA}$). Thus, when selecting a heatsink, the value of ($R_{\theta CS}$) must be subtracted from the number indicated by the curve in order to determine the required heatsink-to-ambient thermal resistance ($R_{\theta SA}$).

As a point of information, if the SSR is firmly mounted on a smooth heatsink surface using thermally conductive grease, the value of ($R_{\theta CS}$) (case-to-heatsink interface) will typically be 0.1°C/W or less. Examples of how the curves are used are explained below in conjunction with figure 7.

Example

If a current of 15A is required for a D1D20 in an ambient of 55°C, the necessary heatsink, plus interface, thermal resistance of 2.0°C/W may be determined by following the route DCAB (Figure 7). Additional information of power dissipation and case temperature can be found by extending line CB to points E and F where the values of 23W and 101°C are read.

This information can be used in heatsink selection from manufacturer's dissipation versus thermal resistance curves such as that shown in figure 4. The thermal resistance of the curve at 23 watts is 1.75°C/W, which with 0.1°C/W added for $R_{\theta CS}$ (1.85°C/W) is better than the 2.0°C/W required in the above example and thus suitable for this application.

By referring again to figure 7 and extending line C, B to the approximate value of 1.85°C/W, this heatsink would allow operation at a maximum ambient of 60°C instead of 55°C.

Confirmation of proper heatsink selection can be achieved by actual temperature measurement under worst case conditions. The measurement can be taken on the metal baseplate in the area of the mounting screw, and should not exceed the maximum allowable case temperature shown in graphs.

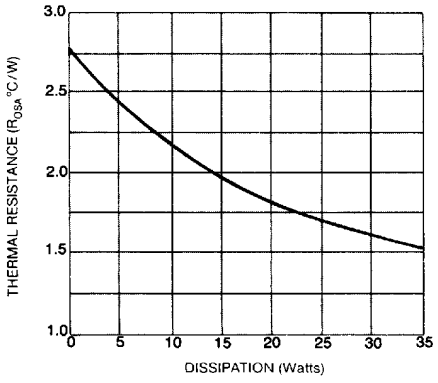


Figure 4. Typical Heat Sink Characteristic (Crydom P/N HS-2)

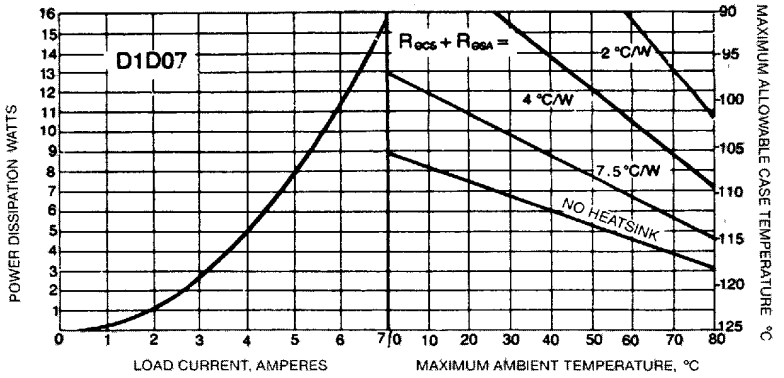


Figure 5. Thermal Derating Curves: 7 Amp, 100 Vdc

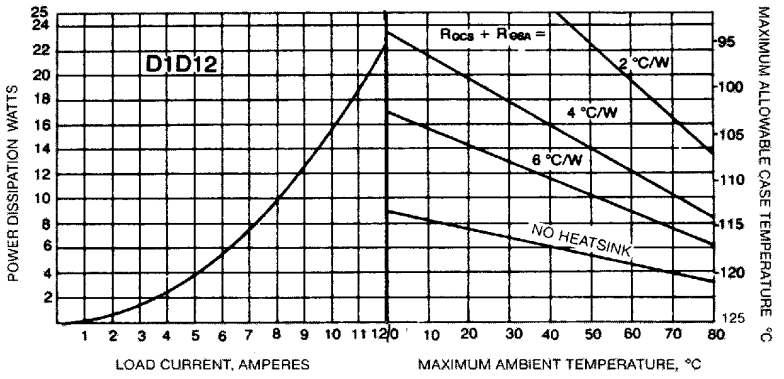


Figure 6. Thermal Derating Curves: 12 Amp, 100 Vdc

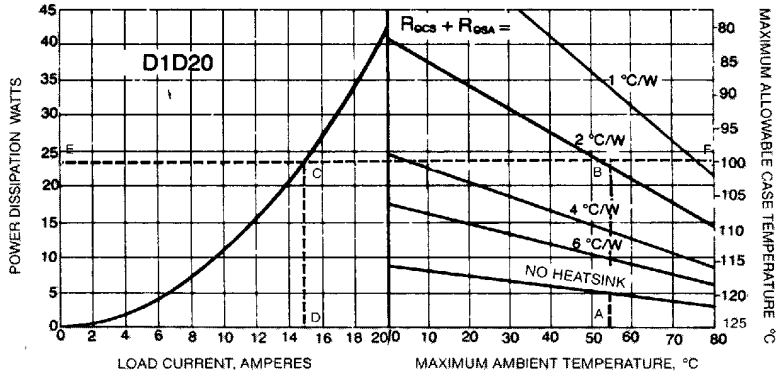


Figure 7. Thermal Derating Curves: 20 Amp, 100 Vdc

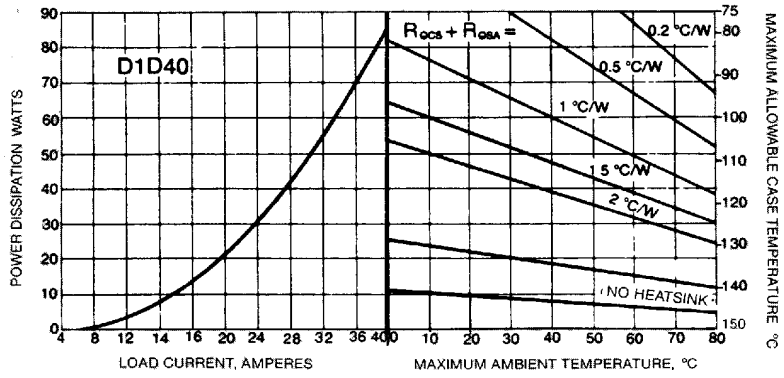


Figure 8. Thermal Derating Curves: 40 Amp, 100 Vdc

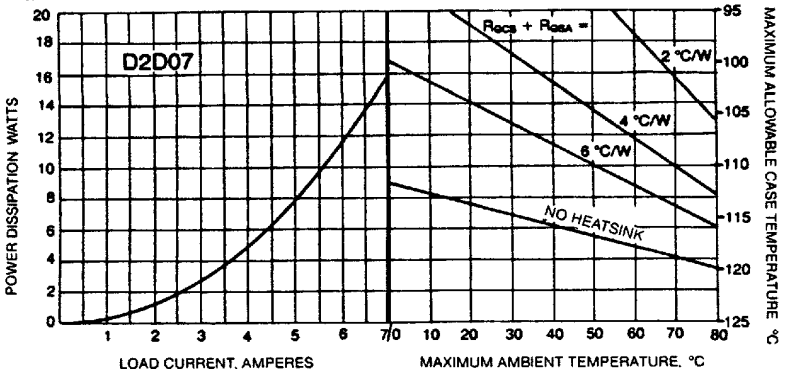


Figure 9. Thermal Derating Curves: 7 Amp, 200 Vdc

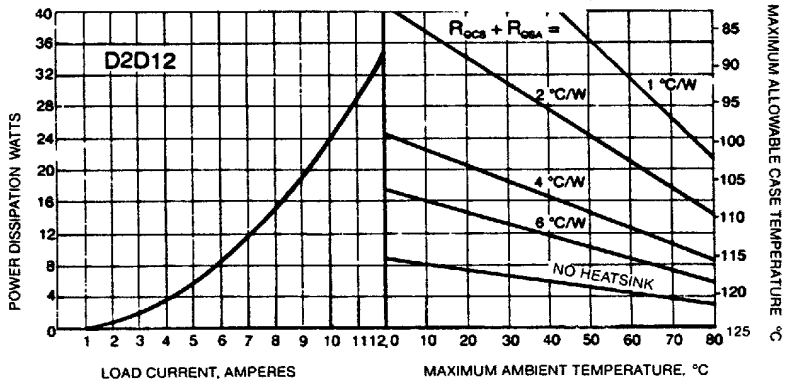


Figure 10. Thermal Derating Curves: 12 Amp, 200 Vdc

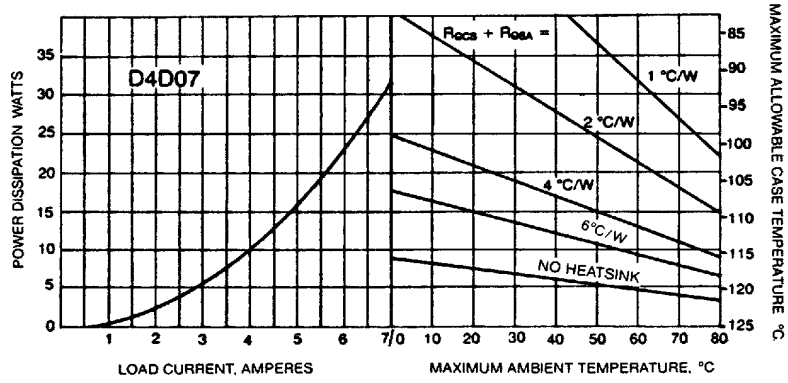


Figure 11. Thermal Derating Curves: 7 Amp, 400 Vdc

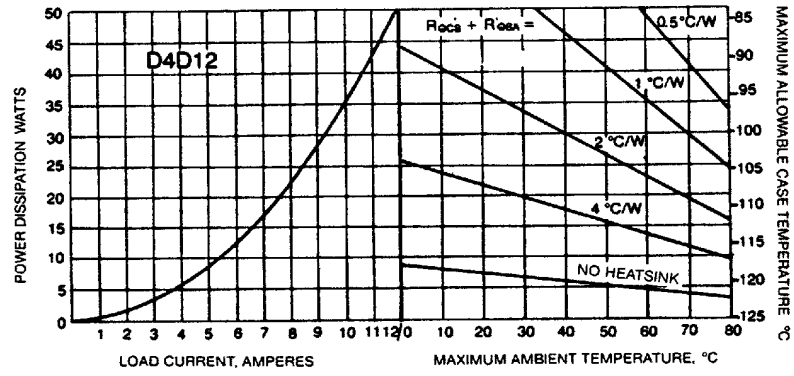


Figure 12. Thermal Derating Curves: 12 Amp, 400 Vdc

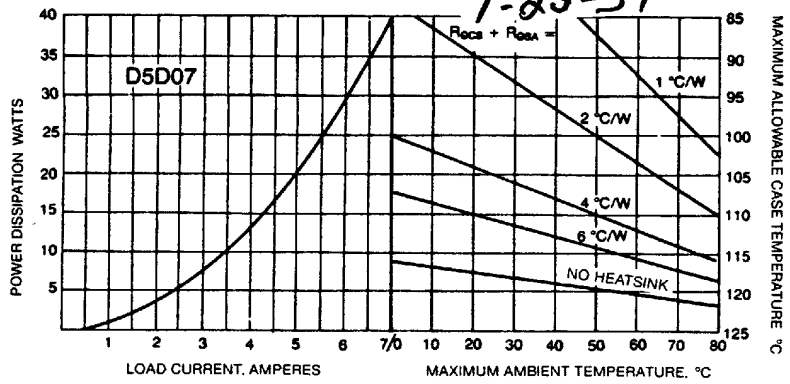


Figure 13. Thermal Derating Curves: 7 Amp, 500 Vdc

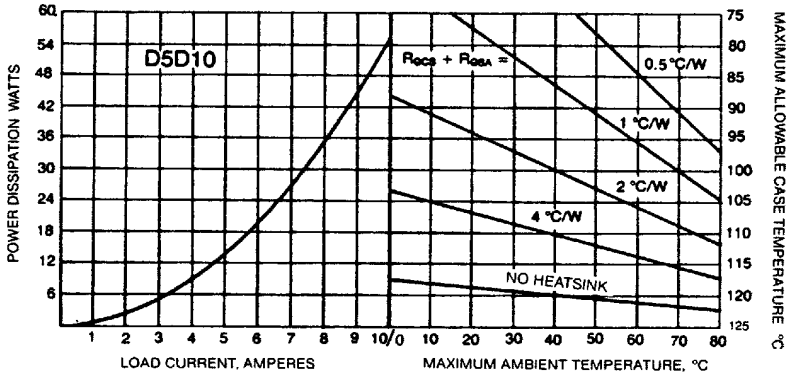
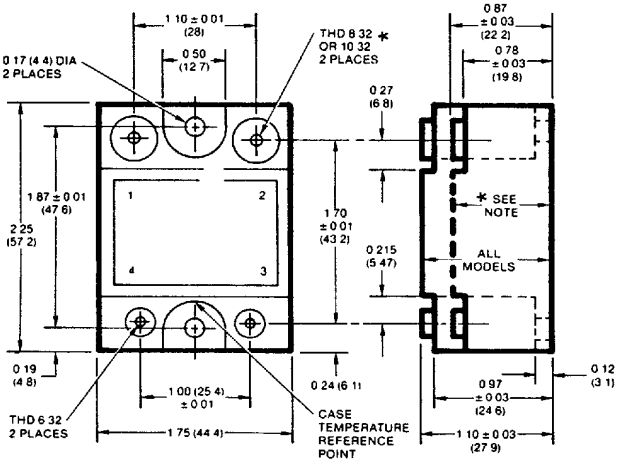


Figure 14. Thermal Derating Curves: 10 Amp, 500 Vdc

Mechanical Specifications

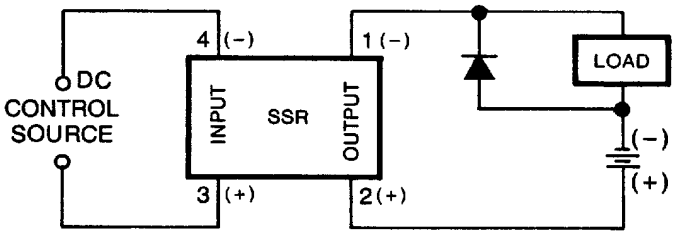
Weight: 5 oz. Max.
Case Material: Fire retardant polyester
Encapsulant: Alumina filled epoxy
Case Color: Black
Base Plate: Aluminum, nickel-plated
Terminals: Tin-plated Brass. Nickel-plated screws & saddle clamps supplied unmounted
Tolerances: ±0.02 (0.50) (unless otherwise noted)
Dimensions: Inches (mm)



* Some models, prior to early 1985 may have the shorter dimension and #8-32 output terminals.

Wiring Diagram

Input and output polarity must be observed.
Inductive loads must be diode suppressed.



Transient Protection

All loads are inductive, even ones that are not so labeled. An inductive load will produce harmful transient voltages when it is turned off. The more perfect the switch, the larger the transient voltages; the MOSFET output is so nearly an ideal switch that the transient voltages produced by seemingly "non-inductive" loads can cause damage if not suppressed.

The diode used should be of the fast-recovery type with a reverse voltage rating at least equal to the supply voltage.

Examples of fast-recovery diodes that may be used for transient suppression:

RELAY MODELS	IR DIODES	GE DIODES
All D1---	30DF1	A115A
All D2---	30DF2	A115B
All D4---		A115D
All D5---		A115E

These diodes will be suitable for most applications. For fast repetition rates consult factory for further information (AP3151-1037)

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