DC Solid State Power Controller

Series RD/VD

TELEDYNE RELAYS

28 VDC SSPC 2 TO 25 AMP

Part Number*	Relay Description
RD46CF	Solid State Relay 28 Vdc, 2A Power Controller
RD46CK	Solid State Relay 28 Vdc, 5A Power Controller
RD46CL	Solid State Relay 28 Vdc, 7.5A Power Controller
VD46CM	Solid State Relay 28 Vdc, 10A Power Controller
VD46CN	Solid State Relay 28 Vdc, 15A Power Controller
VD46CQ	Solid State Relay 28 Vdc, 25A Power Controller

* The Y suffix denotes parameters tested to MIL-R-28750 specifications. The W suffix denotes parameters tested to Teledyne specifications.

ELECTRICAL SPECIFICATIONS

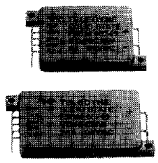
(-55°C TO +105°C CASE TEMPERATURE)

INPUT (CONTROL) SPECIFICATION

	Min	Max	Units
Bias Voltage Range	4.5	5.5	Vdc
Bias Current @ V_{BIAS} = 5 Vdc		45	mA
Turn-On Voltage	2.0		Vdc
Turn-Off Voltage		0.8	Vdc
Control Current @ $V_{CONTROL}$ = 5 Vdc		100	µA

OUTPUT (LOAD) SPECIFICATION

(V_{BIAS} = 5 Vdc, V_{LOAD} (Rated) = 28 Vdc)		Min	Max	Units
Continuous Load Current	RD46CF		2	A
	RD46CK		5	
	RD46CL		7.5	
	VD46CM		10	
	VD46CN		15	
	VD46CQ		25	
Leakage Current V_{LOAD} = 28 Vdc	RD46CF		100	µA
	RD46CK		200	
	RD46CL		300	
	VD46CM		400	
	VD46CN		500	
	VD46CQ		700	



FEATURES

- Temperature-independent current rating and overload protection
- Surge tolerant short circuit protection
- Optical isolation
- Output capable of sourcing and sinking current
- Extremely low ON-resistance
- Flow and Trip status
- TTL and CMOS compatible control
- Meets 28 Vdc surge and spike requirements of MIL-STD-704A

DESCRIPTION

These state-of-the-art solid state power controllers (SSPC) are designed for use in Power Controller applications. The relays utilize the latest technology to provide a low ON-resistance output with complete short circuit and current overload protection. In addition, status output lines for trip and flow are provided to monitor the load and provide a built-in-test (BIT) feature. The control circuit is TTL and CMOS compatible and is optically isolated from the output (load) circuit. This optical isolation allows the output to source or sink current to the load (high or low side switching).

The integrated short circuit and overload protection provides complete protection for both the relay and the system wiring. This feature not only provides protection should a short or overload occur while the relay output is on, but also if the relay is switched into a short. The output can be reset by recycling the control. The relay's trip levels and output (load) current ratings are maintained over the full operating temperature range. The trip current is inversely proportional to time, thus preventing false tripping due to current surges.

The optically isolated status lines provide direct feedback of the output state. The trip status line changes state if the relay output has automatically turned off due to a current overload or short circuit condition. The flow status line turns on if the output (load) current is greater than 10% of the rated output current. A system test (or BIT) can be accomplished by monitoring the status lines and the state of the control line as shown in the truth table.

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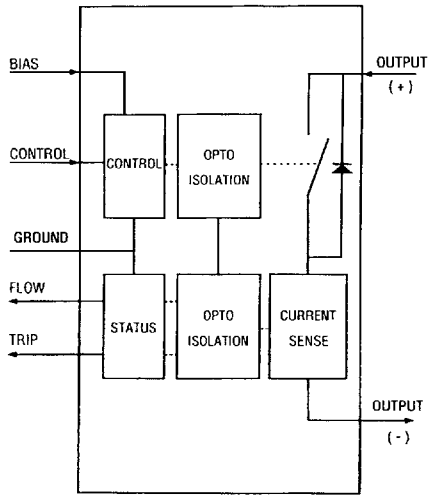
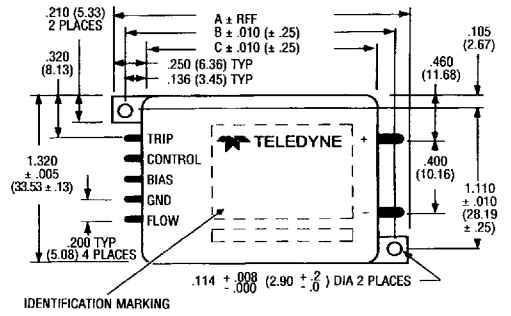
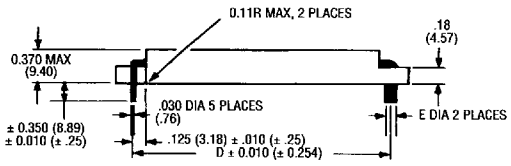
BLOCK DIAGRAM



MECHANICAL SPECIFICATIONS





XXX = INCHES
(xxx) = MILLIMETERS

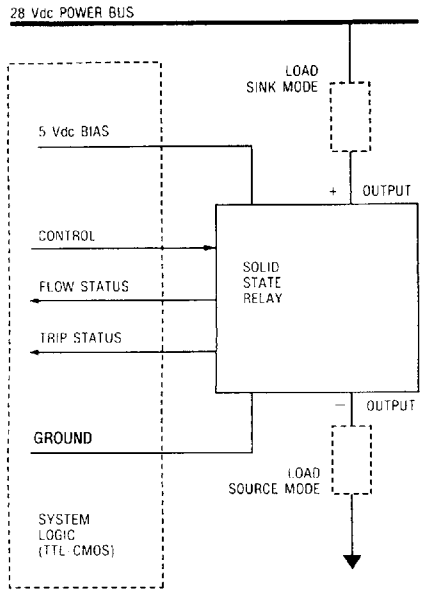
xx = ±.01 (±.25)
xxx = ± .003 (±.08)

	RD46CK RD46CK RD46CL	VD46CM	VD46CN VD46CQ
DIM. "A"	2.245 (57.02	2.690 (68.33)	2.690(68.33)
DIM "B"	2.017 (51.23)	2.462 (62.54)	2.462 (62.54)
DIM "C"	1.745 (44.32)	2.190 (55.63)	2.190 (55.63)
DIM "D"	1.995 (50.67)	2.44 (62.00)	2.48 (62.99)
DIM "E"	0.040 (1.020)	0.060 (1.52)	0.080 (2.03)
WEIGHT	60 Gm max.	70 gm. max	70 gm max.

OUTPUT (LOAD) SPECIFICATION (Cont)

(V_{BIAS} = 5 Vdc, V_{LOAD} (Rated) = 28 Vdc)		Min	Max	Units
Load Voltage		10	60	Vdc
Surge Voltage - MIL-STD-704A, 5 sec			80	Vdc
Transient Voltage - MIL-STD-704A, 10µsec			±600	Vpk
ON Resistance	RD46CF		0.170	Ohms
	RD46CK		0.084	
	RD46CL		0.058	
	VD46CM		0.045	
	VD46CN		0.035	
	VD46CQ		0.030	
Turn-On Delay Time			0.7	ms
Rise Time			0.3	ms
Turn-Off Delay Time			0.7	ms
Fall Time			0.3	ms
dV/dt		100		V/µs
Overload Current (See Figure 3)			1900	%
Trip Reset Time		50		ms
Output Capacitance	RD46CF		1200	pF
	RD46CK		2000	
	RD46CL		2800	
	VD46CM		3500	
	VD46CN		4300	
	VD46CQ		5900	
Input to Output Capacitance			30	pF
Dielectric Strength		750		Vac
Insulation Resistance (@ 500 Vdc)		10^9		Ohm
Junction Temperature at I max			110	°C
Maximum Junction Temperature			150	°C
Thermal Trip Temperature (Case)			150	°C
Thermal Resistance (Junction to Case)	R_{SERIES}		0.65	°C/W
	V_{SERIES}		0.20	
Thermal Resistance (Junction to Ambient)	R_{SERIES}		15	°C/W
	V_{SERIES}		15	

SPECIFICATIONS ARE SUBJECT TO CHANGE WITHOUT NOTICE



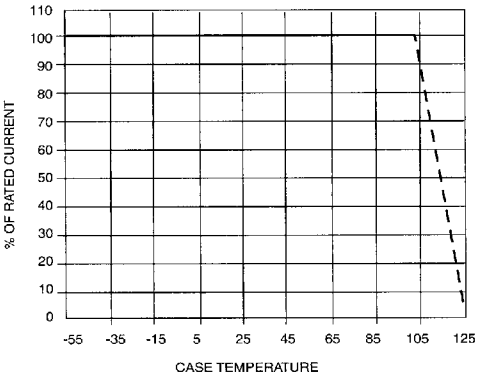
WIRING DIAGRAM
FIGURE 1

ENVIRONMENTAL SPECIFICATIONS

Temperature Range	Operating	-55°C to +105°C
	Storage	-55°C to +125°C
Vibration		30 g, 10 to 2000 Hz
Constant Acceleration		5000 g
Shock		100 g, 6 ms pulse

STATUS CHARACTERISTICS

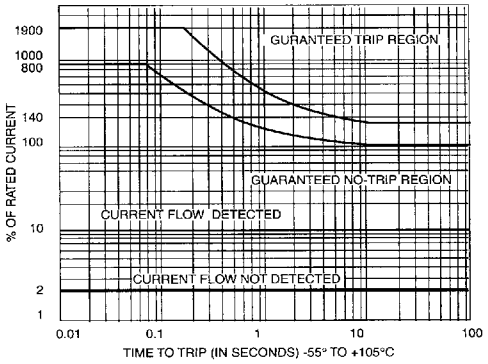
	Min	Max	Units
V_{STATUS} (L) at I_{STATUS} = 4.0 mA		0.4	Vdc
V_{STATUS} (H) at I_{STATUS} = -4.0 mA, Vcc = 5.0V	3.7		Vdc
Flow Status Response Time		3	ms
Trip Status Response Time		1	ms



LOAD CURRENT DERATING CURVE
FIGURE 2

STATUS TRUTH TABLE

Control Voltage	Flow Status	Trip Status	System Status
Low	Low	Low	No Bias
Low	Low	High	Non-Applicable Condition
Low	High	Low	Non-Applicable Condition
Low	High	High	Relay Off
High	Low	Low	Non-Applicable Condition
High	Low	High	Relay On
High	High	Low	Output Tripped Off Overload or Short



TRIP CURRENT VS TIME
FIGURE 3

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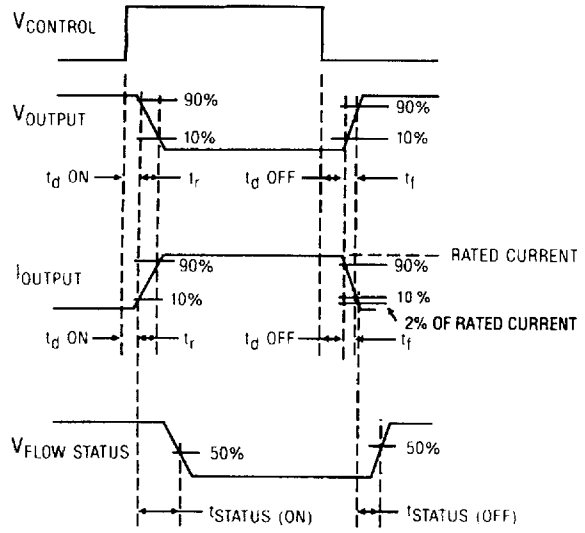
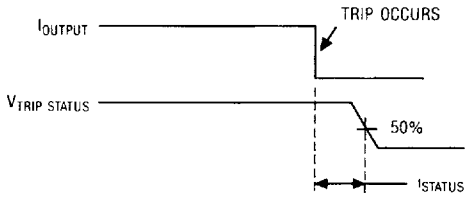


OUTPUT AND FLOW STATUS TIMING
FIGURE 4



TRIP STATUS TIMING
FIGURE 5

APPLICATION INFORMATION

The RD and VD series solid state power controller (SSPC) are designed for power control applications. They are capable of switching power as well as providing complete circuit and self-protection. These SSPCs are ideally suited as a replacement for a mechanical contactor and circuit breaker combination.

Typical applications include:

- Load management systems
- Circuit protection device
- Power Switching
- Load monitoring systems
- Replacement for mechanical/thermal circuit breakers
- Replacement for Remote Power Controllers
- Replacement for mechanical power relays/contactors
- Replacement for Remote Controlled Circuit Breakers

The wiring diagram in Figure 1 shows a typical connection of the relay in a solid state power controller application. Power can be switched to the load from either the 28 Vdc bus or ground, depending upon where the load is connected. Since the 28 Vdc power is normally applied to the output through a load, the circuit wiring, as well as the relay itself, is fully protected by the integrated short circuit/overload protection built into the relay. This feature is only present with a two terminal output, such as on these Solid State Relays.

To control the relay, a bias voltage is applied between the bias and ground pins. This is typically a standard 5 Vdc TTL supply. The control and status lines are referenced to the ground pin and are fully TTL and CMOS compatible. Typically, the relay would interface with system logic, such as a load management center or a remote terminal of a data bus system. A logic high on the control pin will turn the relay output on and a logic low will turn the relay output off. Toggling the control from high to low and back to high will reset the relay output in the event that the short circuit or current overload trip has been activated. The flow status line will indicate a logic low when the output (load) current exceeds 10% of the rated current and a logic high when the output current is less than 2% of the rated current. The trip status line will indicate a logic low should the relay output automatically turn off due to a short circuit or current overload condition. It will remain low until the output is reset by pulling the control line low for a minimum of 50 ms. The trip status line is normally high when the trip circuit has not been activated. The timing relationships for the status lines are shown in Figures 4 and 5.

The trip curve in Figure 3 shows the relationship between current and time for an overload condition. For a short circuit or very high current overload conditions, the time to trip is extremely short. For a lower current overload, such as those encountered with inrush currents, this response time is longer. This allows the relay to handle inrush currents without tripping. Unlike current limiter type trip circuits, these relays use a current sense circuit which does not require the relay to dissipate excessive power and heat prior to tripping. Also, the trip circuit used in these relays does not exhibit oscillations that current limit type circuits often have prior to trip. The predetermined trip levels have been set to provide circuit wiring protection in event of overloads and shorts. This level is significantly less than the I^2t ratings for standard wire gauges.

The state-of-the-art technology incorporated into these relays allows a tight tolerance on the trip current. This feature allows for consistent trip levels over the entire operating temperature range. This 'flat trip' characteristic means that the output rating is not temperature dependent, as shown in Figure 2. In addition to the 'flat trip' characteristic, these relays incorporate true short circuit protection and are not damaged by a direct short, thus allowing for unlimited rupture current. Unlike other circuit protection/power control devices, these relays are not damaged by the true short circuits that can occur in real systems.

DC Solid State Power Controller

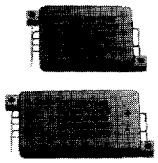
Series RD/VD

TELEDYNE RELAYS

270 VDC SSPC 1 TO 10 AMP

Part Number*	Relay Description
RD46KD	Solid State Relay 270 Vdc, 1A Power Controller
RD46KF	Solid State Relay 270 Vdc, 2A Power Controller
RD46KK	Solid State Relay 270Vdc, 5A Power Controller
VD46KL	Solid State Relay 270 Vdc, 7.5A Power Controller
VD46KM	Solid State Relay 270 Vdc, 10A Power Controller

* The Y suffix denotes parameters tested to MIL-R-28750 specifications. The W suffix denotes parameters tested to Teledyne specifications.



ELECTRICAL SPECIFICATIONS

(-55°C TO +105°C CASE TEMPERATURE)

INPUT (CONTROL) SPECIFICATION

	Min	Max	Units
Bias Voltage Range	4.5	5.5	Vdc
Bias Current at V_{BIAS} = 5 Vdc		45	mA
Turn-On Voltage	2.0		Vdc
Turn-Off Voltage		0.8	Vdc
Control Current at $V_{CONTROL}$ = 5 Vdc		100	µA

OUTPUT (LOAD) SPECIFICATION

		Min	Max	Units
(V_{BIAS} = 5 Vdc, V_{LOAD} (Rated) = 270 Vdc)				
Continuous Load Current	RD46KD		1	A
	RD46KF		2	
	VD46KK		5	
	VD46KL		7.5	
	VD46KM		10	
Leakage Current V_{LOAD} = 270 Vdc	RD46KD		100	µA
	RD46KF		200	
	VD46KK		500	
	VD46KL		700	
	VD46KM		700	
Load Voltage		60	300	Vdc
Surge Voltage - MIL-STD-704A, 5 sec		470		Vdc

FEATURES

- Temperature-independent current rating and overload protection
- Surge tolerant short circuit protection
- Optical isolation
- Output capable of sourcing and sinking current
- Extremely low ON-resistance
- Flow and Trip status
- TTL and CMOS compatible control
- Meets 270 Vdc surge and spike requirements of MIL-STD-704A

DESCRIPTION

These state-of-the-art solid state power controller (SSPC) are designed for use in Power Controller applications. The relays utilize the latest technology to provide a low ON-resistance output with complete short circuit and current overload protection. In addition, status output lines for trip and flow are provided to monitor the load and provide a built-in-test (BIT) feature. The control circuit is TTL and CMOS compatible and is optically isolated from the output (load) circuit. This optical isolation allows the output to source or sink current to the load (high or low side switching).

The integrated short circuit and overload protection provides complete protection for both the relay and the system wiring. This feature not only provides protection should a short or overload occur while the relay output is on, but also if the relay is switched into a short. The output can be reset by recycling the control. The relay's trip levels and output (load) current ratings are maintained over the full operating temperature range. The trip current is inversely proportional to time, thus preventing false tripping due to current surges.

The optically isolated status lines provide direct feedback of the output state. The trip status line changes state if the relay output has automatically turned off due to a current overload or short circuit condition. The flow status line turns on if the output (load) current is greater than 10% of the rated output current. A system test (or BIT) can be accomplished by monitoring the status lines and the state of the control line as shown in

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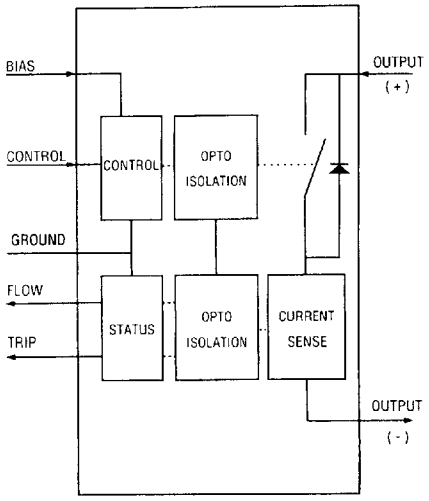
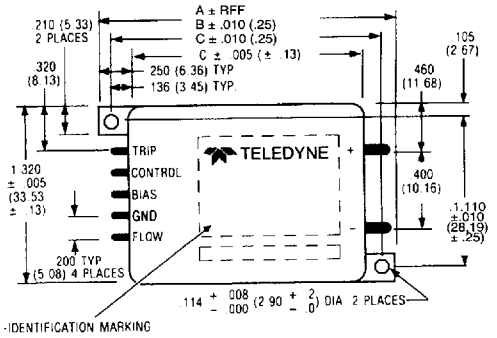
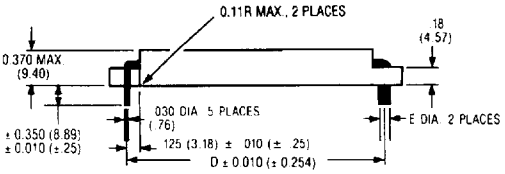
BLOCK DIAGRAM



MECHANICAL SPECIFICATIONS





XXX = INCHES
(xxx) = MILLIMETERS

xx = ±.01 (±.25)
xxx = ± .003 (±.08)

	RD46KD RD46KF	VD46KK	VD46KL VD46KM
DIM. "A"	2.245 (57.02	2.690 (68.33)	2.690(68.33)
DIM "B"	2.017 (51.23)	2.462 (62.54)	2.462 (62.54)
DIM "C"	1.745 (44.32)	2.190 (55.63)	2.190 (55.63)
DIM "D"	1.995 (50.67)	2.44 (62.00)	2.48 (62.99)
DIM "E"	0.040 (1.020)	0.040 (1.02)	0.080 (2.03)
WEIGHT	60 Gm max.	70 gm. max	70 gm max.

OUTPUT (LOAD) SPECIFICATION

		Min	Max	Units
Transient Voltage - MIL-STD-704A, 10µsec			±600	Vpk
ON Resistance	RD46KD		0.80	Ohms
	RD46KF		0.40	
	VD46KK		0.16	
	VD46KL		0.12	
	VD46KM		0.12	
Turn-On Delay Time			0.7	ms
Rise Time			0.3	ms
Turn-Off Delay Time			0.7	ms
Fall Time			0.3	ms
dV/dt		100		V/µs
Rupture Current		unlimited		
Overload Current (See Figure 3)			1900	%
Trip Reset Time		50		ms
Output Capacitance	RD46KD		600	pF
	RD46KF		1200	
	VD46KK		3000	
	VD46KL		4200	
	VD46KM		4200	
Input to Output Capacitance			30	pF
Dielectric Strength		1200		Vac
Insulation Resistance (@ 500 Vdc)		10^9		Ohm
Junction Temperature at I max			110	°C
Maximum Junction Temperature			150	°C
Thermal Resistance (Junction to Case)	R_{SERIES}		0.60	°C/W
	V_{SERIES}		0.20	
Thermal Resistance (Junction to Ambient)	R_{SERIES}		20	°C/W
	V_{SERIES}		15	

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SPECIFICATIONS ARE SUBJECT TO CHANGE WITHOUT NOTICE

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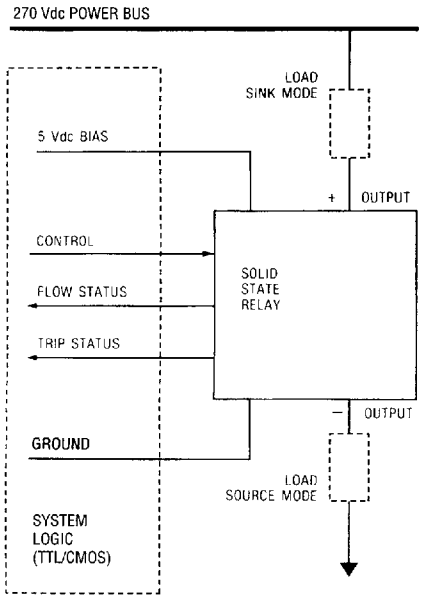
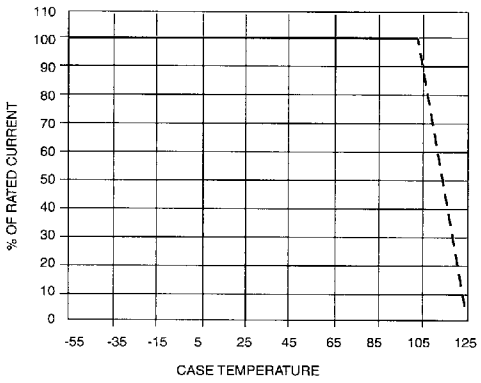
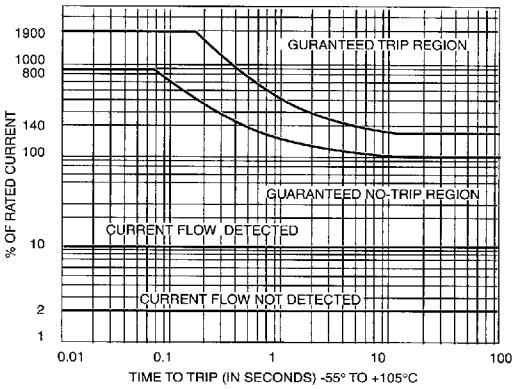


WIRING DIAGRAM
FIGURE 1



LOAD CURRENT DERATING CURVE
FIGURE 2



TRIP CURRENT VS TIME
FIGURE 3

ENVIRONMENTAL SPECIFICATIONS

Temperature Range	Operating	-55°C to +105°C
	Storage	-55°C to +125°C
Vibration		30 g, 10 to 2000 Hz
Constant Acceleration		5000 g
Shock		100 g, 6 ms pulse

STATUS CHARACTERISTICS

	Min	Max	Units
V_{STATUS} (L) at I_{STATUS} = 4.0 mA		0.4	Vdc
V_{STATUS} (H) at I_{STATUS} = -4.0 mA, Vcc = 5.0V	3.7		Vdc
Flow Status Response Time		3	ms
Trip Status Response Time		1	ms

STATUS TRUTH TABLE

Control Voltage	Flow Status	Trip Status	System Status
Low	Low	Low	No Bias
Low	Low	High	Non-Applicable Condition
Low	High	Low	Non-Applicable Condition
Low	High	High	Relay Off
High	Low	Low	Non-Applicable Condition
High	Low	High	Relay On
High	High	Low	Output Tripped Off Overload or Short
High	High	High	Load Circuit Open or Current Less Than 10%

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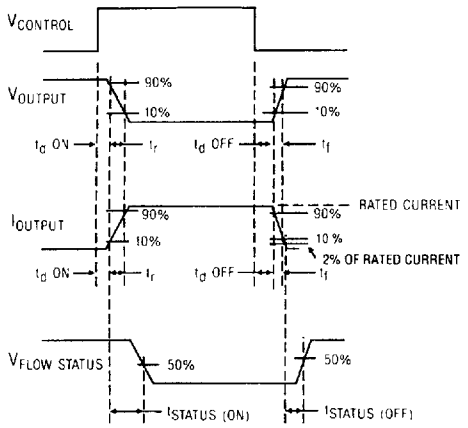
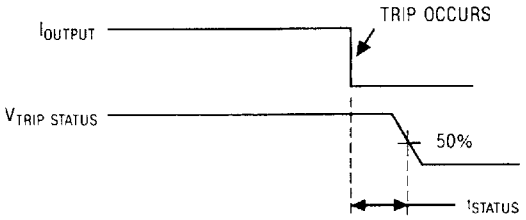


OUTPUT AND FLOW STATUS TIMING
FIGURE 4



TRIP STATUS TIMING
FIGURE 5

APPLICATION INFORMATION

The RD and VD series solid state power controller (SSPC) are designed for power control applications. They are capable of switching power as well as providing complete circuit and self-protection. These SSPCs are ideally suited as a replacement for a mechanical contactor and circuit breaker combination.

Typical applications include:

- Load management systems
- Circuit protection device
- Power Switching
- Load monitoring systems
- Replacement for mechanical/thermal circuit breakers
- Replacement for Remote Power Controllers
- Replacement for mechanical power relays/contactors
- Replacement for Remote Controlled Circuit Breakers

The wiring diagram in Figure 1 shows a typical connection of the relay in a solid state power controller application. Power can be switched to the load from either the 270 Vdc bus or ground, depending upon where the load is connected. Since the 270 Vdc power is normally applied to the output through a load, the circuit wiring, as well as the relay itself, is fully protected by the integrated short circuit/overload protection built into the relay. This feature is only present with a two terminal output, such as on these Solid State Relays.

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To control the relay, a bias voltage is applied between the bias and ground pins. This is typically a standard 5 Vdc TTL supply. The control and status lines are referenced to the ground pin and are fully TTL and CMOS compatible. Typically, the relay would interface with system logic, such as a load management center or a remote terminal of a data bus system. A logic high on the control pin will turn the relay output on and a logic low will turn the relay output off. Toggling the control from high to low and back to high will reset the relay output in the event that the short circuit or current overload trip has been activated. The flow status line will indicate a logic low when the output (load) current exceeds 10% of the rated current and a logic high when the output current is less than 2% of the rated current. The trip status line will indicate a logic low should the relay output automatically turn off due to a short circuit or current overload condition. It will remain low until the output is reset by pulling the control line low for a minimum of 50 ms. The trip status line is normally high when the trip circuit has not been activated. The timing relationships for the status lines are shown in Figures 4 and 5.

The trip curve in Figure 3 shows the relationship between current and time for an overload condition. For a short circuit or very high current overload conditions, the time to trip is extremely short. For a lower current overload, such as those encountered with inrush currents, this response time is longer. This allows the relay to handle inrush currents without tripping. Unlike current limiter type trip circuits, these relays use a current sense circuit which does not require the relay to dissipate excessive power and heat prior to tripping. Also, the trip circuit used in these relays does not exhibit oscillations that current limit type circuits often have prior to trip. The predetermined trip levels have been set to provide circuit wiring protection in event of overloads and shorts. This level is significantly less than the I^2t ratings for standard wire gauges.

The state-of-the-art technology incorporated into these relays allows a tight tolerance on the trip current. This feature allows for consistent trip levels over the entire operating temperature range. This 'flat trip' characteristic means that the output rating is not temperature dependent, as shown in Figure 2. In addition to the 'flat trip' characteristic, these relays incorporate true short circuit protection and are not damaged by a direct short, thus allowing for unlimited rupture current. Unlike other circuit protection/power control devices, these relays are not damaged by the true short circuits that can occur in real systems.