i1R Series OR-ing Module Series

3.3-30V or 5-60V Input range
1" x 1" Footprint

The i1R series offers low loss power devices that replace power diodes in applications requiring OR-ing devices for paralleling or redundancy. The i1R series utilizes MOSFET-based circuitry to provide a superior level of performance while minimizing reverse current transients. The compact, shielded design features a low profile and weight that allows for extremely flexible and robust manufacturing processes. The ultra-high efficiency enables the i1R series to achieve much higher usable power densities compared to traditional power diodes.

Features

- Size – 26.3mm x 26.3 mm x 10.1 mm (1.03 in. x 1.03 in. x 0.4 in.)
- Maximum weight 20g (0.71 oz.)
- Through-hole pins 3.68mm (0.145")
- Industry standard package
- Up to 80A of output current with minimal power de-rating
- Wide voltage range
- Fast turn-off during fault conditions
- 5-sided metal case
- ISO Certified manufacturing facilities

Optional Features

- Long 5.59mm (0.220") pin length

Ordering Information:

Product Identifier	Package Size	Platform	Input Voltage	Output Current	Units		Feature Set		RoHS indicator
i	**1**	**R**	**60**	**060**	**A**	**-**	**000**	**-**	**R**
TDK Lambda	1 x 1 inch	i1R	30 – 3.3V to 30V 60 - 5V to 60V	060 – 60A 080 – 80A	Amps		See option table		R=RoHS Compliant

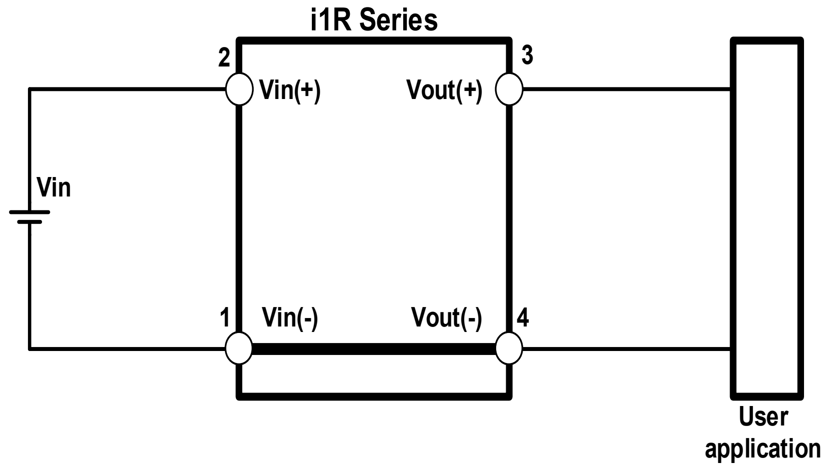
Option Table:

Feature Set	0.145" Pin Length (Default)	0.220" Pin Length
-000	YES	-
-004	-	YES

Product Offering:

Product Code	Input Voltage (V)	Output Current (A)	Maximum Output Power (W)	Efficiency
i1R60060A	5-60	60	3600	99.5%
i1R30080A	3.3-30	80	2400	99.5%

Typical Application Circuit:

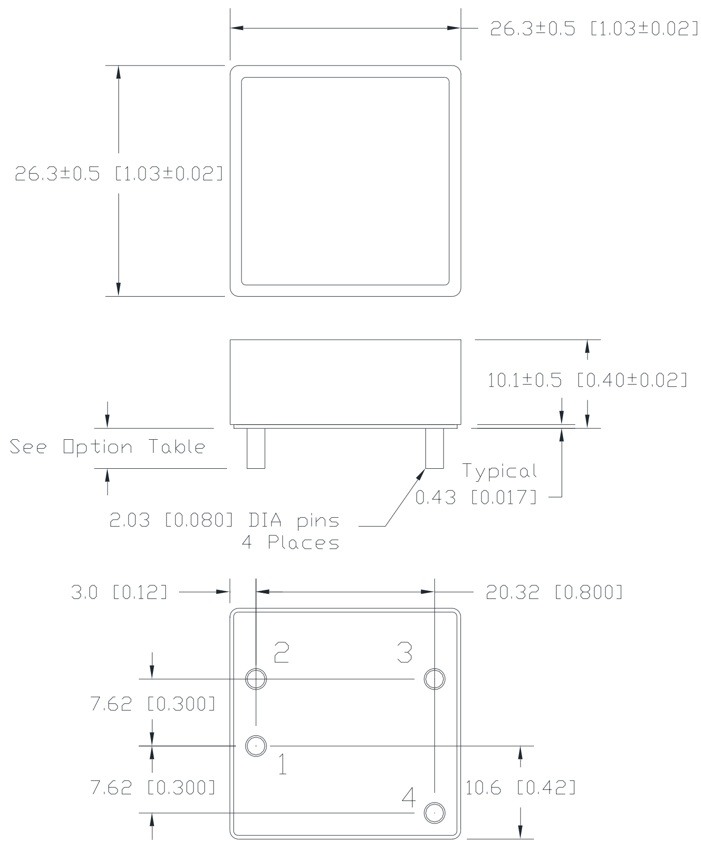


Recommendation

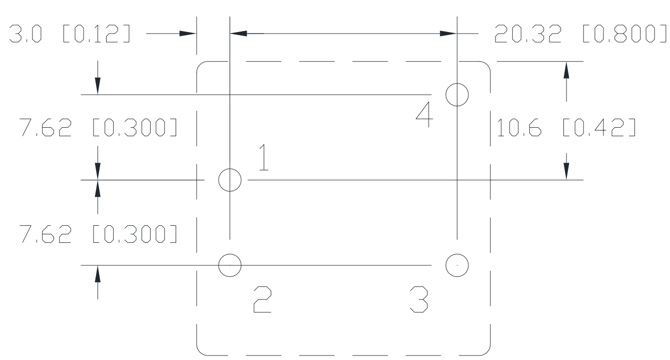
1. Connect Vin(-) and Vout(-) to copper ground plane underneath the i1R module.

Mechanical Specification: (–00x-R product options)

Dimensions are in mm [in]. Unless otherwise specified, tolerances are:
x.x ± 0.5 [0.02] / x.xx ± 0.25 [0.010]



Recommended Hole Pattern



Pin Assignment:

PIN	Function	PIN	Function
1	Vin (-) / GND	3	Vout (+)
2	Vin (+)	4	Vout (-) / GND

Pin base material is copper with tin over nickel plating.

Maximum Weight: 20g (0.71 oz.)

Absolute Maximum Ratings:

Stresses in excess of Absolute Maximum Ratings may cause permanent damage to the device.

Characteristic	Min	Max	Unit	Notes & Conditions
Transient Input Voltage	-24	66	Vdc	i1R60
	-24	36		i1R80
Isolation Voltage	---	---	Vdc	NOT APPLICABLE
Storage Temperature	-55	125	˚C	
Operating Temperature Range (Tcase)	-40	120*	˚C	Measured at the location specified in the thermal measurement figure; absolute maximum temperature varies with operating condition – see curves in the thermal performance section of the data sheet.

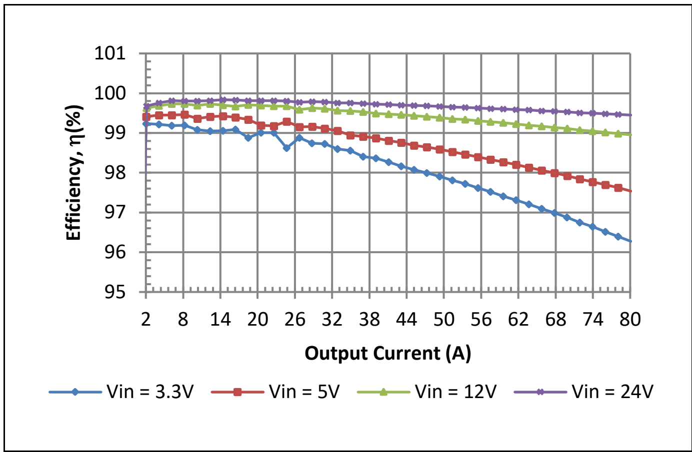
*Engineering estimate

Electrical Characteristics:

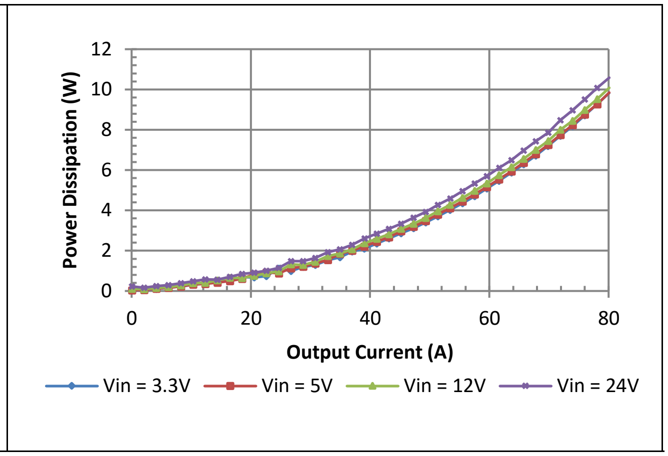
Unless otherwise specified, specifications apply over all rated Input Voltage, Resistive Load and Temperature Conditions.

Characteristic	Min	Typ	Max	Unit	Notes & Conditions
Operating Input Voltage	5	---	60	Vdc	i1R60
	3.3	---	30		i1R80
On Resistance	---	2.5	---	mohm	i1R60, Tc = 25˚C
	---	1.5	---		i1R80, Tc = 25˚C
Output Current	---	---	60	A	i1R60
	---	---	80	A	i1R80
Turn-off Time	---	500	---	ns	(Vin +50mV) < Vo

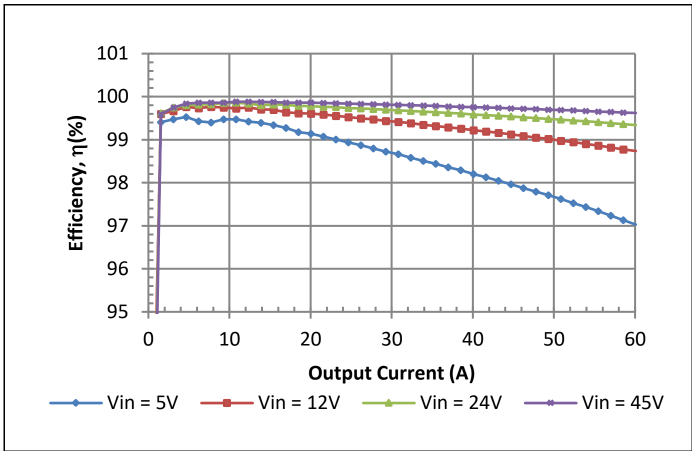
Electrical Characteristics:



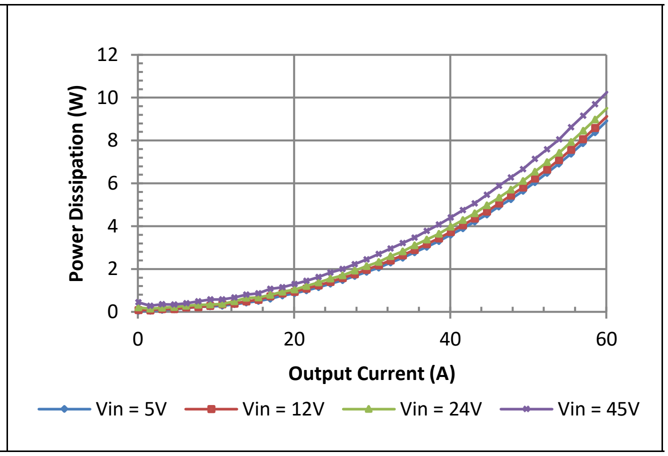
i1R30080A typical operating efficiency.



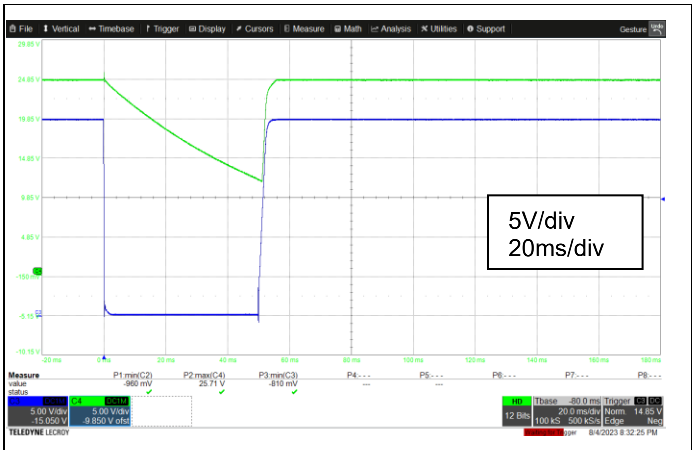
i1R30080A typical power dissipation.



i1R60060A typical operating efficiency.

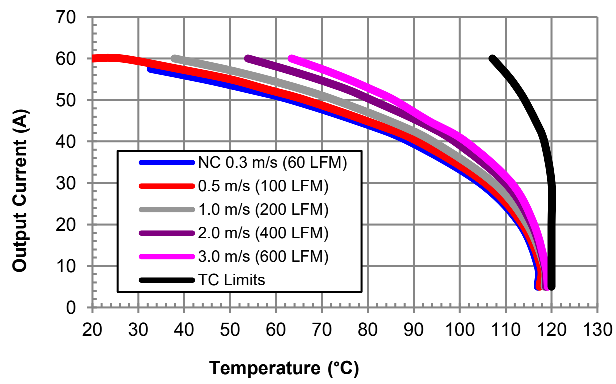


i1R60060A typical power dissipation.

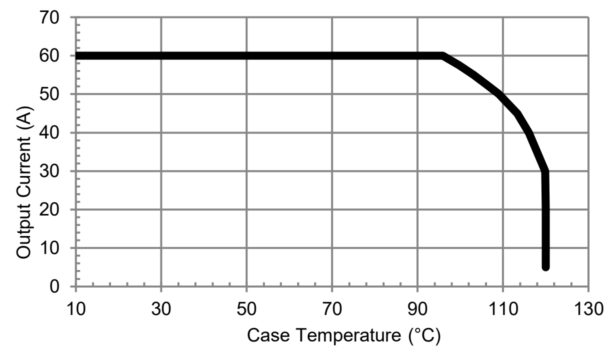


Typical Response to Vin drop w/ 50 ohm load, Cout = 2100uF
Ch3 (blue) = Vin, Ch4 (green) = Vout

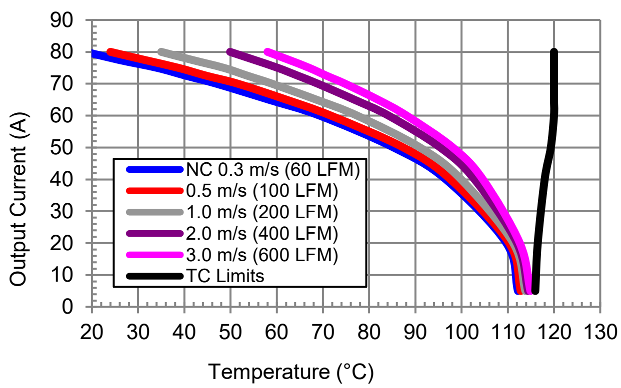
Thermal Performance: **i1R Series**



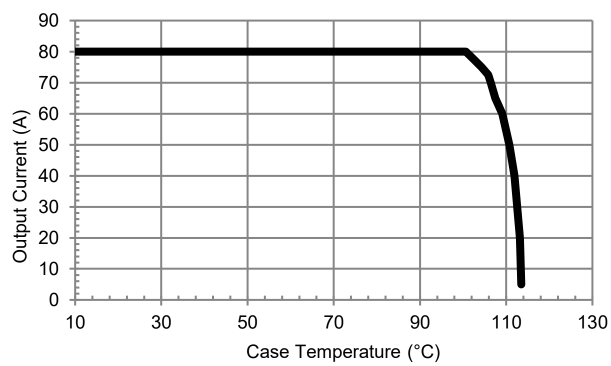
i1R60060A maximum output current vs. ambient temperature for natural convection (60lfm) to 3m/s (600 lfm) with airflow from pin 1 to pin 2.



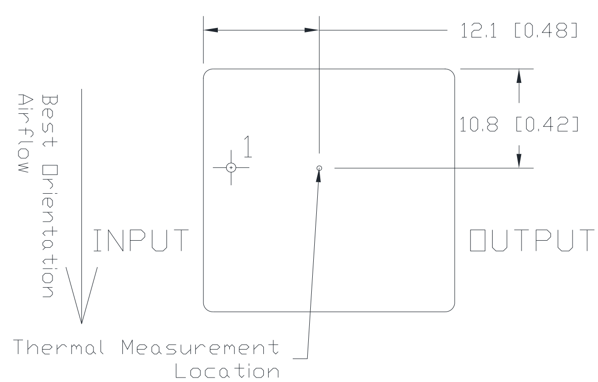
i1R60060A maximum output current vs. case temperature with enclosed environment.



i1R30080A maximum output current vs. ambient temperature for natural convection (60lfm) to 3m/s (600 lfm) with airflow from pin 1 to pin 2.



i1R30080A maximum output current vs. case temperature with enclosed environment.



i1R series thermal measuring location figure

The thermal curves provided are based on measurements made in TDK Lambda's test setup that is described in the Thermal Management section. Due to the large number of variables in system design and the extremely wide operating range of the module. TDK Lambda recommends that the user verify the module's thermal performance in the end application. The critical component should be thermocoupled, monitored and should not exceed the temperature limit specified in the derating curve above. It is critical that the thermocouple be mounted in a manner that gives direct thermal contact or significant measurement errors may result. TDK Lambda can provide modules with a thermocouple pre-mounted to the critical component for system verification tests.

Thermal Management:

An important part of the overall system design process is thermal management; thermal design must be considered at all levels to ensure good reliability and lifetime of the final system. Superior thermal design and the ability to operate in severe application environments are key elements of a robust, reliable power module.

A finite amount of heat must be dissipated from the power module to the surrounding environment. This heat is transferred by the three modes of heat transfer: convection, conduction and radiation. While all three modes of heat transfer are present in every application, convection is the dominant mode of heat transfer in most applications. However, to ensure adequate cooling and proper operation, all three modes should be considered in a final system configuration.

Power modules with an open frame design offer a direct air path to individual power dissipating components. This air path improves convection cooling to the surrounding environment, which reduces areas of heat concentration and resulting hot spots.

For power modules featuring a metal baseplate or enclosed construction, the design provides a low thermal impedance path to key components on the power module, facilitating efficient heat transfer through conduction. This method of heat transfer can be further enhanced by affixing the power module to an external cold plate or system chassis.

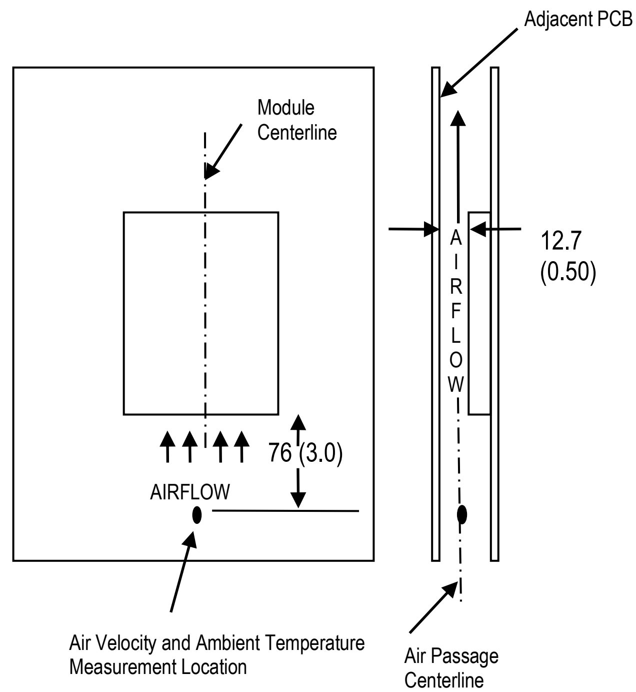
Test Setup (Convection):

The thermal performance data of the power module is based upon measurements obtained from a wind tunnel test with the setup shown in the wind tunnel figure. This thermal test setup replicates the typical thermal environments encountered in many modern electronic systems with distributed power architectures. The electronic equipment in networking, telecom, wireless, and advanced computer systems operate in similar environments and utilize vertically mounted PCBs or circuit cards in cabinet racks.

The power module, as shown in the Wind Tunnel Test Setup figure, is mounted on a printed circuit board (PCB) and is vertically oriented within the wind tunnel. The cross section of the airflow passage is rectangular. The spacing between the top of the module and a parallel facing PCB is kept at a constant (0.5 in). The power module's orientation with respect to the airflow direction can have a significant impact on the module's thermal performance.

Heat transfer by convection can be enhanced by increasing the airflow rate that the power module experiences. The maximum output current of the power module is a function of ambient temperature (Ta) and airflow rate as shown in the thermal performance figures on the thermal performance page for the power module of interest.

The curves in the figures are shown for natural convection through 3 m/s (600 ft/min). The data for the natural convection condition has been collected at 0.3 m/s (60 ft/min) of airflow, which is the typical airflow generated by other heat dissipating components in many of the systems that these types of modules are used in. In the final system configurations, the airflow rate for the natural convection condition can vary due to temperature gradients from other heat dissipating components.



Wind Tunnel Test Setup Figure
(Dimensions are in millimeters and (inches)

Test Setup (Conduction):

The thermal performance of the power module was also evaluated using measurements obtained from testing with the setup shown in the conduction cooling figure. This thermal test setup replicates the thermal configuration encountered by products in many industrial, medical, and avionics systems which utilize circuit cards mounted in clamshells or thermally connected to system enclosures.

For applications where the power module is used in sealed box/cold plate configuration, the dominant mode of heat transfer is conduction cooling. Heat dissipated from the power module is conducted primarily through the cold plate/chassis.

The power module, as shown in the Conduction Cooling Test Setup figure, is mounted on a printed circuit board

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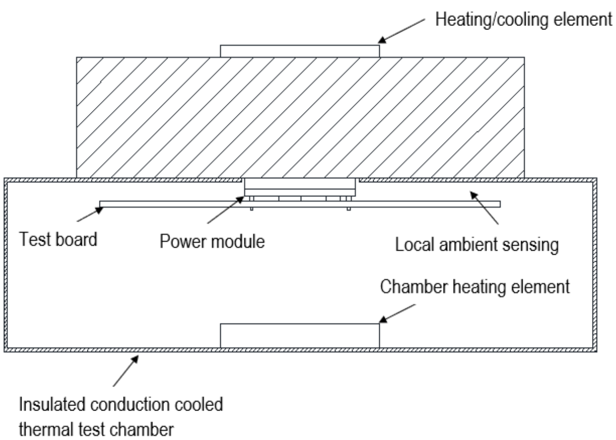
Thermal Management: *(continued)*

(PCB) and is horizontally oriented within an insulated sealed test chamber. The space between the top of the module and the parallel facing large heat sink is filled with a thin gap pad to improve the thermal connection.

On the thermal performance page for the power module of interest, curves are shown with the power module being tested over various line and load conditions with the sealed chamber's internal ambient temperature maintained at 85°C. The power module's case is attached to large heatsink to achieve the targeted case temperature



Conduction Cooling Test Setup

Variables such as the mounting PCB's thickness and copper weight, the power loss of other surrounding components, and the heat transfer capacity of the metal plate can all have a significant impact on the module's thermal performance.

Thermal De-rating:

For proper application of the power module in a given thermal environment, output current de-rating curves are provided as a design guideline on the Thermal Performance section for the power module of interest. The module temperature should be measured in the final system configuration to ensure proper thermal management of the power module. For thermal performance verification, the module temperature should be measured at the location specified on the thermal measurement location figure on the thermal performance page for the power module of interest.

In all conditions, the power module should be operated below the maximum operating temperature shown on the de-rating curve. For improved design margins and enhanced system reliability, the power module may be operated at temperatures below the maximum rated operating temperature.

Operating Information:

Over-Current Protection:

The module acts as a power switch and does not feature internal fusing or over current protection. There is no over temperature shutdown. Users must take care to ensure the module's thermal and current limits are being observed.

Remote On/Off:

The ORing module is always on and does not feature under voltage lockout protection. The module utilizes the voltage at the input pin to power the internal circuitry. Users must take care to avoid operating the unit with input voltages below the specified ratings to avoid overheating and possible damage to internal components.

Reverse Polarity:

The ORing module does not have reverse polarity protection but has capacity to withstand negative input voltages which may appear during transient conditions.

Reverse Current Flow:

The ORing module will turn off the power switch when it detects a reverse current flow through the power switch. Typically, a 50mV drop between output and input pins will be sufficient to deactivate the switch. In the case of a severe fault this off sequence will typically occur in 500nS. During softer faults, the switch will remain on for a longer period. Performance should be evaluated in the end application.

Input Impedance:

The Oring module contains all necessary components. Additional capacitors can be added at input or output but are not required for operation. Depending upon application needs, capacitors will help limit transient voltage deviation when the i1R module transitions between a forward conducting and an off state.

Reliability:

The power modules are designed using TDK Lambda's stringent design guidelines for component derating, product qualification, and design reviews. The MTBF is calculated to be greater than 50 million hours at full output power and Ta = 40˚C using the Telcordia SR-332 calculation method.

Quality:

TDK Lambda's product development process incorporates advanced quality planning tools such as FMEA and Cpk analysis to ensure designs are robust and reliable. All products are assembled at ISO certified assembly plants.

Warranty:

TDK Lambda offers a three-year limited warranty. Complete warranty information is listed on our web site or is available upon request from TDK-Lambda.

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