SOLID STATE OPTRONICS



SMJ1309

2 Form C
100V / 500mΩ
MOSFET Output Solid State Relay

Description

The SMJ1309 is a 2 Form C relay in one compact 16 pin SOIC package. It is designed to replace electro-mechanical relays in automotive component testing equipment. Input control is configured for 2 Form C functionality and provides for “break before make” switching. Each output pole has a low resistance of 500mΩ (TYP) and high blocking voltage of 100V (MAX).

The SMJ1309 comes standard in a compact 16 pin SOIC package making it ideal for high-density board applications.

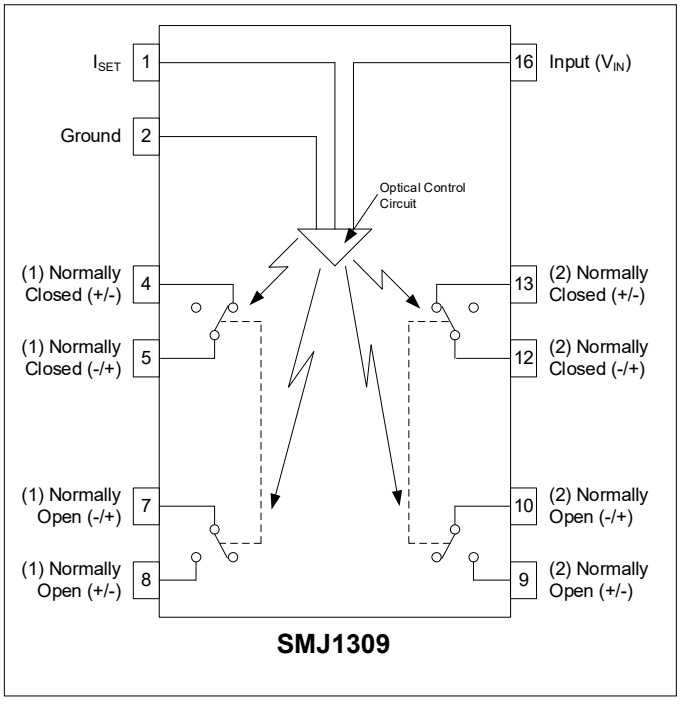
Features

- Low On Resistance (500mΩ TYP)
- Low Output Capacitance (18pF TYP @ 25V)
- Low Output Leakage (1nA MAX @ 80V)
- 750mA Maximum Continuous Load Current
- Isolation Voltage ($500V_{RMS}$)
- 2 Form C with Break Before Make Switching
- Long Life / High Reliability
- RoHS / Pb-Free / REACH Compliant

Applications

- EMR Replacement
- Automatic Test Equipment
- Data Acquisition
- Medical Equipment
- Battery Monitoring
- Safety Systems

Schematic Diagram



SMJ1309

Absolute Maximum Ratings

The values indicated are absolute stress ratings. Functional operation of the device is not implied at these or any conditions in excess of those defined in electrical characteristics section of this document. Exposure to absolute Maximum Ratings may cause permanent damage to the device and may adversely affect reliability.

Storage Temperature .....-55 to +125°C
Operating Temperature .....-40 to +85°C
Continuous Input Current.....40mA
Transient Input Current 400mA
Reverse Input Control Voltage 5V
Input Power Dissipation.....40mW
Output Power Dissipation 600mW
Solder Temperature – Wave (10sec).....260°C
Solder Temperature – IR Reflow (10sec).....260°C

Ordering Information

Part Number	Description
SMJ1309	16 pin SOIC, (45/Tube)
SMJ1309-TR	16 pin SOIC, Tape and Reel (1000/Reel)

NOTES: Suffixes listed above are not included in marking on device for part number identification

© 2021 Solid State Optronics • San José, CA
www.ssousa.com • +1.408.293.4600

SMJ1309 /TR
Rev 04 (23-JUL-2021)
009313

Electrical Characteristics, T_A = 25°C (unless otherwise specified)

Parameter	Symbol	Min.	Typ.	Max.	Units	Test Conditions
Input Specifications						
Control Voltage	V_{CC}	4.5	-	16	V	-
Input Control Low Level	$V_{In(Low)}$	-	-	0.5	V	-
Input Control High Level[1]	$V_{In(High)}$	-	Pull-up to Vcc	-	V	-
Control Current[2]	I_{SET}	-	5	-	mA	-
V_{In} Driver Transition Time	-	-	-	5	µS	-
Output Specifications (Same for both NO and NC poles)						
Blocking Voltage	V_B	100	-	-	V	-
Continuous Load Current	I_O	-	-	750	mA	-
On Resistance	R_{ON}	-	500	750	mΩ	I_O=750mA
Leakage Current	I_{Oleak}	-	-	100	nA	V_O=100V
		-	-	1		V_O=80V
Output Capacitance	C_{OUT}	-	75	-	pF	V_O=0, f=1MHz
		-	18	-		V_O=25, f=1MHz
		-	12	-		V_O=60, f=1MHz
Coupled Specifications						
Turn-On Time	T_{ON}	-	1	3	mS	-
Turn-Off Time	T_{OFF}	-	0.05	-	mS	-
Input to Output Capacitance	C_S	-	0.6	-	pF	V=0, f=1MHz
Contact Transient Ratio	-	2,000	7,000	0	V/µS	dV = 50V
Isolation Specifications						
Isolation Voltage	V_{ISO}	500	-	-	V_{RMS}	RH ≤ 50%, t=1min
Input-Output Resistance	R_{I-O}	-	10^{12}	-	Ω	RH ≤ 50%, V_{I-O} = 500V_{DC}

NOTES:

1. Input Control High Level is controlled by the pull-up resistor (R_P) to V_{CC}. For more details, reference the Connection Diagram found on page 4

2. Control Current is referred to as "I_{SET}" in the connection diagram found on page 4. Reference Note 4 found there for more details

© 2021 Solid State Optronics • San José, CA

SMJ1309 Performance & Characteristics Plots, T_A = 25°C (unless otherwise specified)

Figure 1: *Typical On-Resistance Distribution* (N = 100, T_a = 25ºC)

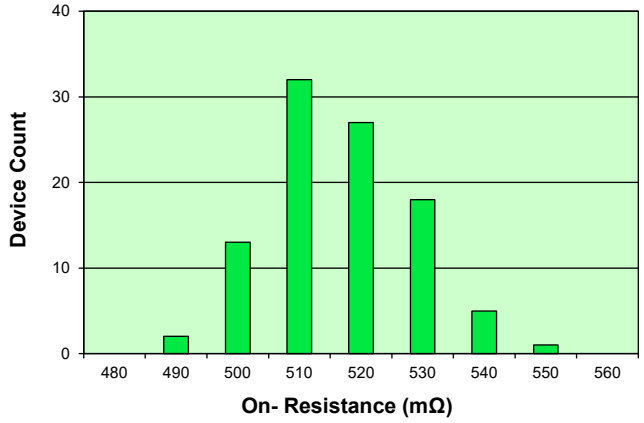


Figure 2: *Typical Blocking Voltage Distribution* (N = 100, Ta = 25ºC)

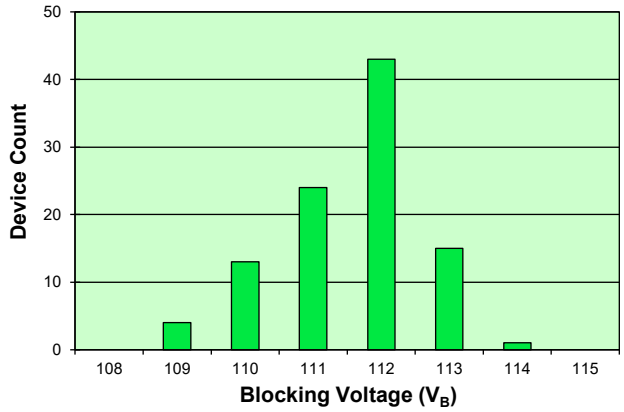


Figure 3: *Typical Output Leakage Current Distribution* (N = 100, T_a = 25ºC)

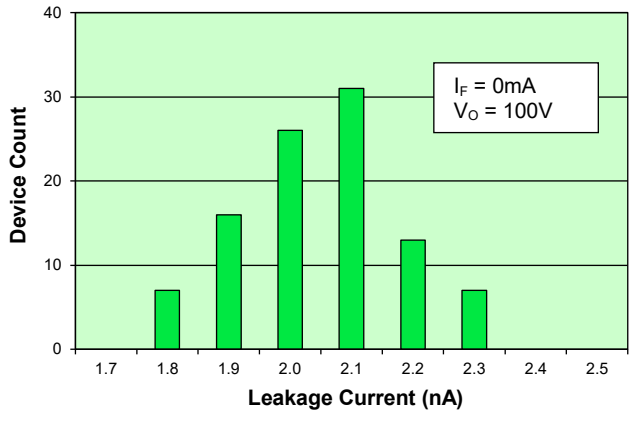
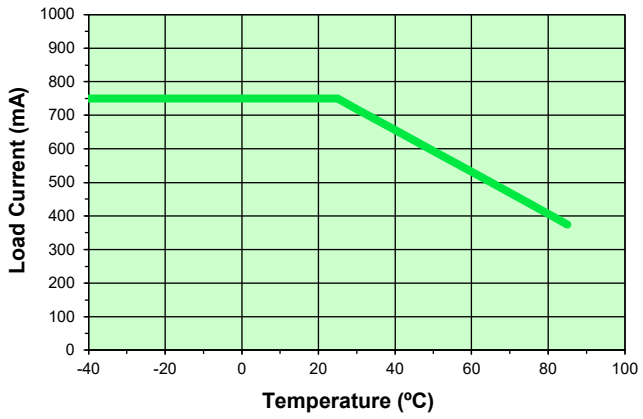
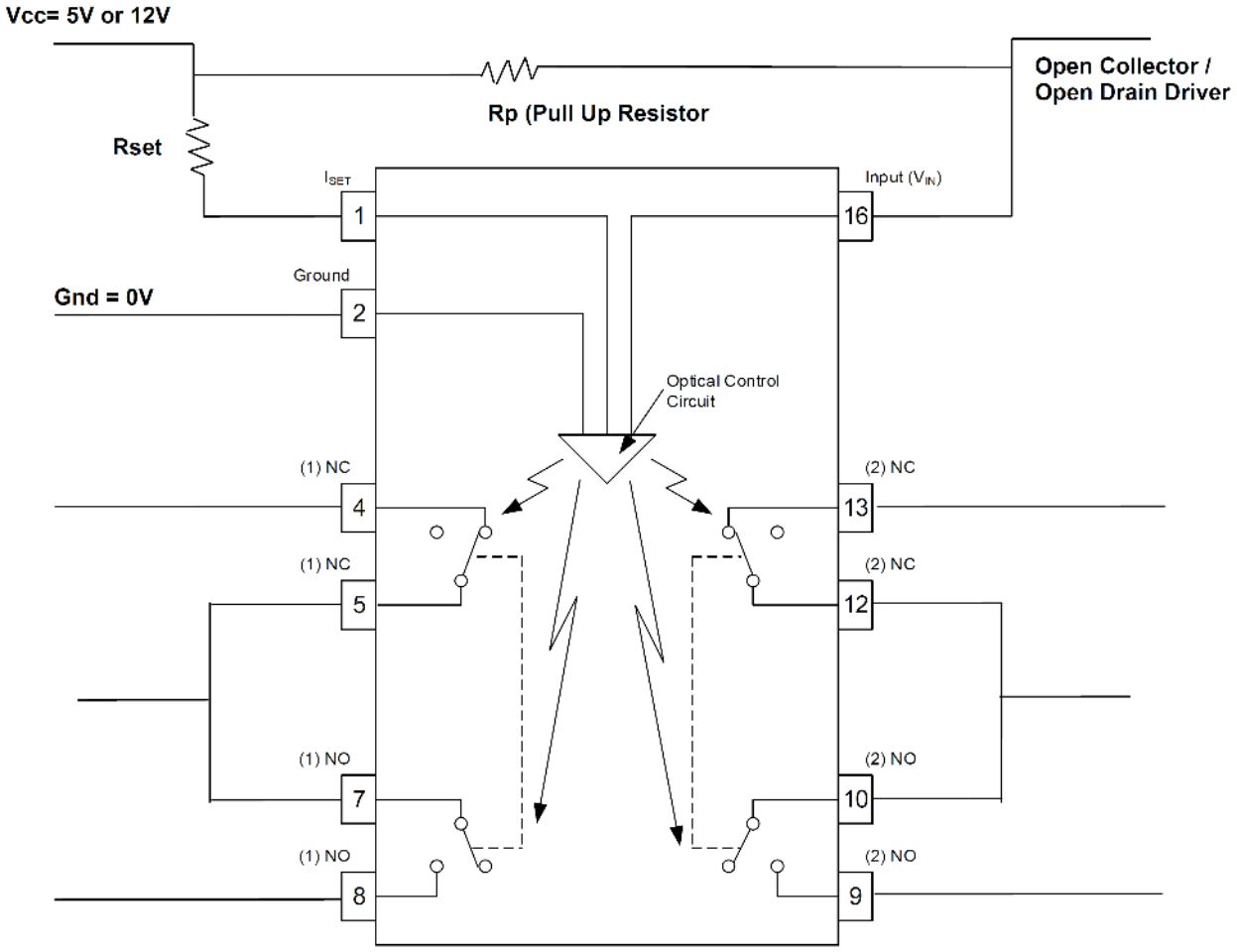


Figure 4: *Maximum Load Current vs. Temperature*



SMJ1309 Recommended Output Connections and Components



Notes

1) SSO recommends a Pull Up Resistor (Rp) to V_{CC} with a value of 10kΩ or less
2) NO (Normally Open) contacts between pins 7&8 and 9&10 are defined as OPEN when the Open Collector is open and pin 16 is pulled up with the Pull Up Resistor (R_P). These contacts will CLOSE when the Open Collector driver pulls pin 16 to ground (below 0.5V). The NC (Normally Closed) contacts between pins 4&5 and 12&13 operate in an inverse manner
3) The Open Collector Transition Time should be less than 5μS for proper performance
4) I_{SET} (Control Current as found in Parameters on Page 2) is used to set the internal photo drive current. SSO recommends an Iset value of 5mA for optimal device performance. Rset can be calculated for Vcc of either 5V or 12V. Assume a voltage drop of 2.1V for the Optical Control Circuit and Rset values for a 5mA Iset become:

Rset (@5Vcc)	=	(Vcc-Vopticalcircuit) / (target Iset)	Rset (@12Vcc)	=	(Vcc-Vopticalcircuit) / (target Iset)
	=	(5V-2.1V) / (0.005A)		=	(12V-2.1V) / (0.005A)
	=	2.9 / 0.005		=	9.9 / 0.005
Rset (@5Vcc)	**=**	**580 ohms**	**Rset (@12Vcc)**	**=**	**1980 ohms**

The above calculations are for power supplies with acceptable tolerances of ±10%. If tolerances go beyond this range calculate Rset values based on the lowest voltage in the tolerance range

5) The same V_{CC} value should be used for both R_{set} (as calculated above) and the pull-up resistor (R_P) used with V_{IN} (pin 16) discussed in Note 1
6) Pins 5&7 and similarly pins 10&12 can be connected externally forming a common point, in effect the common point of the Form C relay

© 2021 Solid State Optronics • San José, CA

SMJ1309 Solder Temperature Profile Recommendations

(1) *Infrared Reflow*:

Refer to the following figure as an example of an optimal temperature profile for single occurrence infrared reflow. Soldering process should not exceed temperature or time limits expressed herein. Surface temperature of device package should not exceed 250ºC:

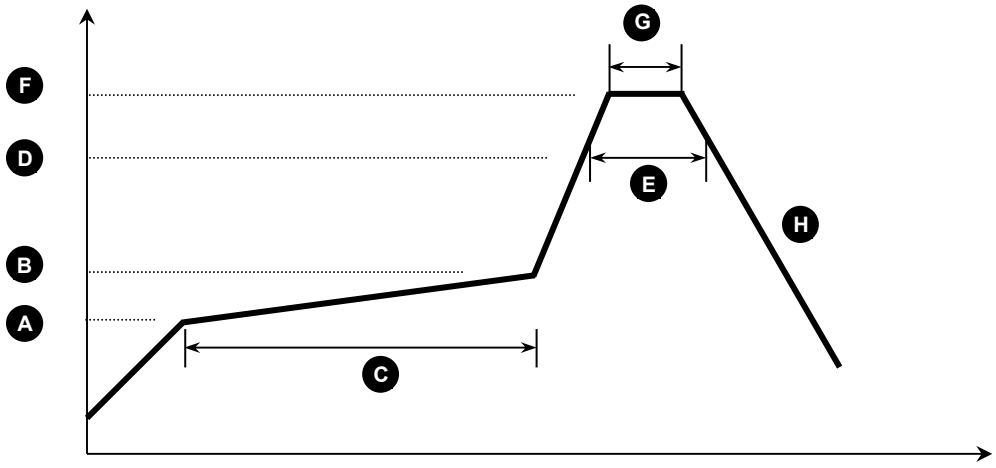


Figure 1

Process Step	Description	Parameter
A	Preheat Start Temperature (ºC)	150ºC
B	Preheat Finish Temperature (ºC)	180ºC
C	Preheat Time (s)	90 - 120s
D	Melting Temperature (ºC)	230ºC
E	Time above Melting Temperature (s)	30s
F	Peak Temperature, at Terminal (ºC)	260ºC
G	Dwell Time at Peak Temperature (s)	10s
H	Cool-down (ºC/s)	<6ºC/s

(2) *Wave Solder*:

Maximum Temperature:	260ºC (at terminal)
Maximum Time:	10s
Pre-heating:	100 - 150ºC (30 - 90s)
Single Occurrence	

(3) *Hand Solder*:

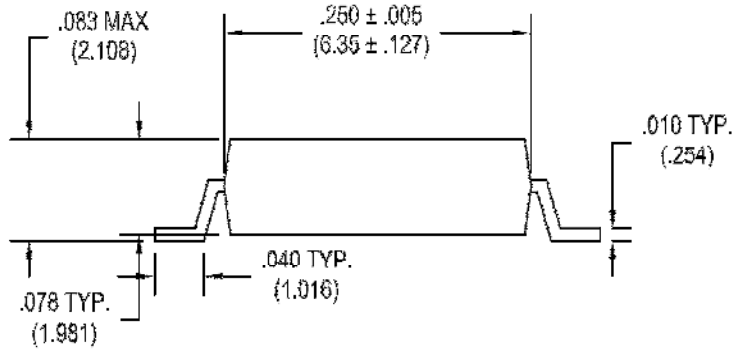
Maximum Temperature:	350ºC (at tip of soldering iron)
Maximum Time:	3s
Single Occurrence	

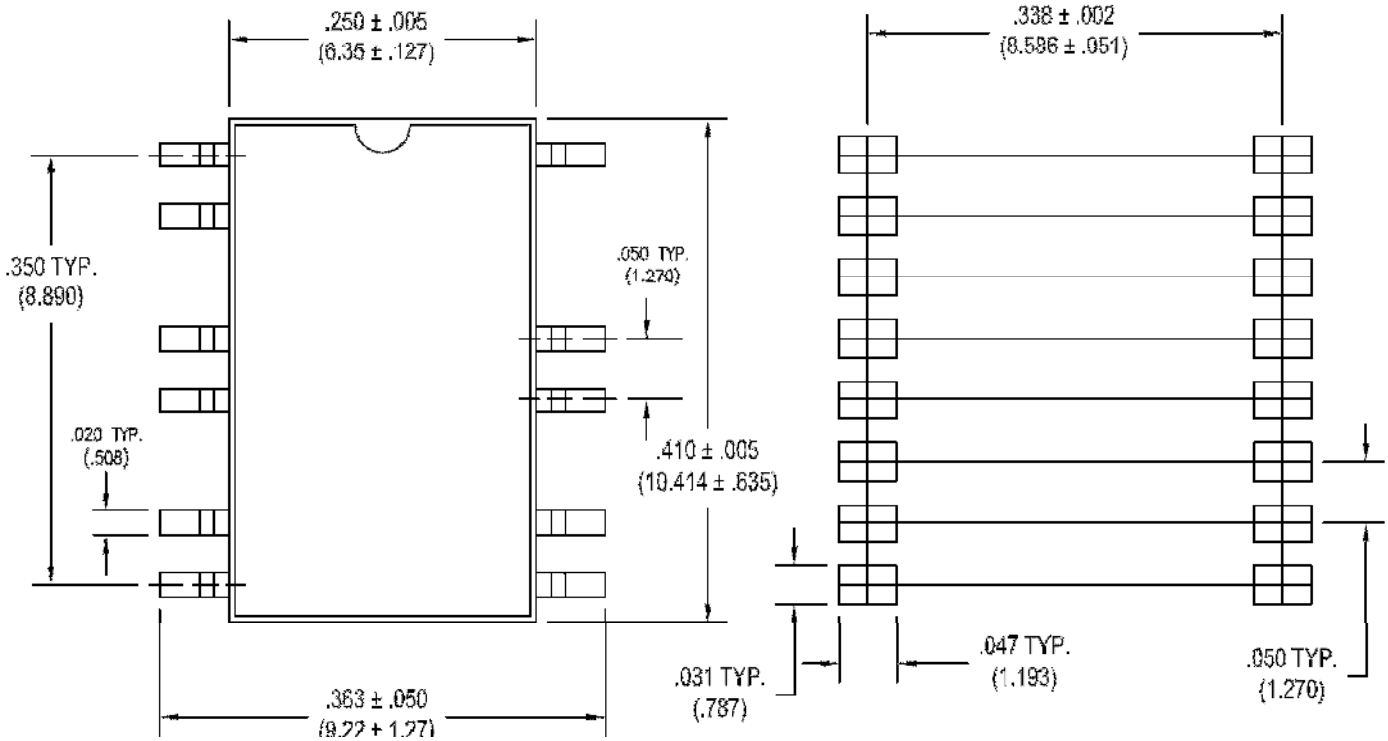
© 2021 Solid State Optronics • San José, CA

SMJ1309 Package Dimensions

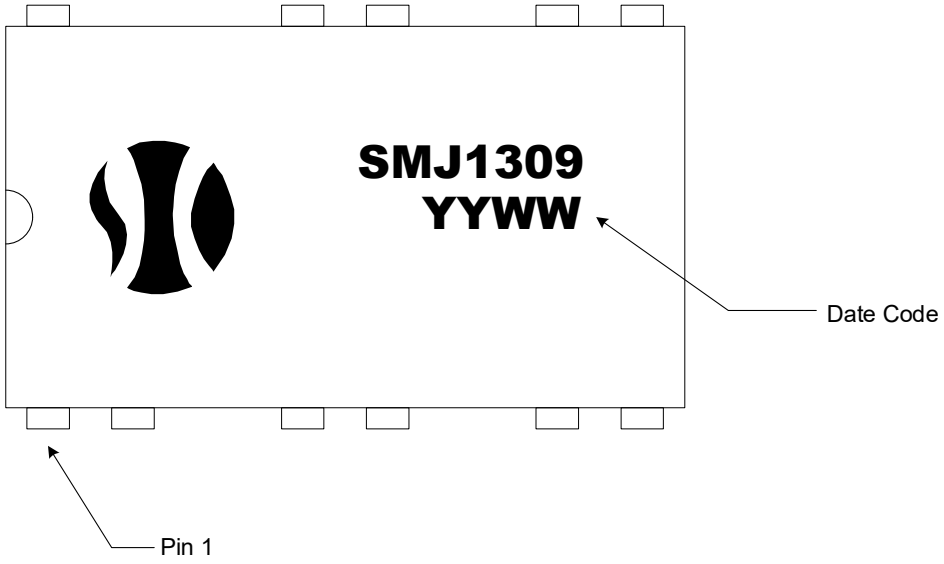
16 PIN SOIC

Note: *All dimensions in inches ["] with millimeters in parenthesis ()*





SMJ1309 Package Marking



SMJ1309 Package Weights

Device	Single Unit	Full Tube (45pcs)	Full Pouch (10 tubes)	Full Reel (1000pcs)
SMJ1309	0.35	33	350	-
SMJ1309-TR	0.35	-	-	850

Note: *All weights above are in GRAMS, and include packaging materials where applicable*

DISCLAIMER

Solid State Optronics (SSO) makes no warranties or representations with regards to the completeness and accuracy of this document. SSO reserves the right to make changes to product description, specifications at any time without further notices.
SSO shall not assume any liability arising out of the application or use of any product or circuit described herein. Neither circuit patent licenses nor indemnity are expressed or implied.
Except as specified in SSO's Standard Terms & Conditions, SSO disclaims liability for consequential or other damage, and we make no other warranty, expressed or implied, including merchantability and fitness for particular use.

LIFE SUPPORT POLICY

SSO does not authorize use of its devices in life support applications wherein failure or malfunction of a device may lead to personal injury or death. Users of SSO devices in life support applications assume all risks of such use and agree to indemnify SSO against any and all damages resulting from such use. Life support devices are defined as devices or systems which, (a) are intended for surgical implant into the body, or (b) support or sustain life, and (c) whose failure to perform when used properly in accordance with instructions for use can be reasonably expected to result in significant injury to the user, or (d) a critical component of a life support device or system whose failure can be reasonably expected to cause failure of the life support device or system, or to affect its safety or effectiveness.

© 2021 Solid State Optronics • San José, CA