

<b>53111</b>	<b>POWER MOSFET OPTOCOUPLER, 90 V/1 Ω, Hermetically Sealed</b> <b>DSCC Approved 5962-9314001, 5962-9314002 and 5962-9314003</b>	

<b>Features:</b> <ul style="list-style-type: none"> <li>• Hermetically Sealed 8-Pin Dual-In-Line package</li> <li>• Small Size and Weight</li> <li>• Options: 5mA or 10mA input forward current</li> <li>• Performance Guaranteed over -55°C to +125°C Ambient Temperature Range</li> <li>• AC/DC Signal &amp; Power Switching</li> <li>• Maximum Average Current AC/DC: 0.8 A DC only: 1.6 A</li> <li>• 1500 VDC Withstand Test Voltage</li> <li>• High Transient Immunity</li> <li>• 5 A Output Surge Current</li> <li>• Shock and Vibration Resistant</li> <li>• MIL-PRF-38534 Compliant</li> </ul>	<b>Applications:</b> <ul style="list-style-type: none"> <li>• Satellite/Space Systems</li> <li>• Military/High Reliability Systems</li> <li>• Standard 28 VDC and 48 VDC Load Driver</li> <li>• Standard 24 VAC Load Driver</li> <li>• AC/DC Electromechanical and Solid State Relay Replacement</li> <li>• I/O Modules</li> </ul>
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## DESCRIPTION

The 53111 is a single channel, hermetically sealed, power MOSFET optocoupler. Low on-resistance of the MOSFET output, combined with 1500 VDC isolation between input and output, makes this optocoupler ideal for solid state relay applications. Operation is specified over the full military temperature range. The part is supplied in an eight-pin, dual-in-line ceramic package, available as COTS, as fully compliant MIL-PRF-38534 Class H device, or with custom screening. Lead options support both through-hole and surface-mount assembly. The part is normally shipped with gold plated leads, but lead finishes per MIL-PRF-38534 are available.

Functionally, the device operates as a single-pole, normally open (1 Form A) solid state relay. The device is actuated by an input current, which can be supplied from standard logic types such as open-collector TTL. The input current biases a light emitting diode that is optically coupled to an integrated photovoltaic diode array. The photovoltaic array powers control circuitry that operates the output MOSFETs.

Optimum switching of either AC or DC loads is provided by a configurable output. For AC loads, connection A in Figure 1 must be used. Connection A will also switch DC loads but connection B, in Figure 1, provides DC-only operation with the advantages of substantial reduction in on-resistance and twice the output current capability as that obtained with connection A.

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**ABSOLUTE MAXIMUM RATINGS**

Storage Temperature Range .....	-65°C to +150°C
Operating Ambient Temperature - $T_A$ .....	-55°C to +125°C
Junction Temperature - $T_J$ .....	150°C
Operating Case Temperature - $T_C$ .....	+145°C <sup>(1)</sup>
Lead Solder Temperature (1.6mm below seating plane).....	260°C for 10s
Average Input Current - $I_F$ .....	20 mA
Peak Repetitive Input Current - $I_{Fpk}$ ... (Pulse Width < 100ms; duty cycle < 50%) .....	40 mA
Peak Surge Input Current - $I_{Fpk}$ surge... (Pulse Width < 0.2ms; duty cycle < 0.1%).....	100 mA
Reverse Input Voltage - $V_R$ .....	5 V
Average Output Current	
Connection A - $I_O$ .....	0.8 A
Connection B - $I_O$ .....	1.6 A
Single Shot Output Current - Figure 4	
Connection A - $I_{Opk}$ surge... (Pulse width < 10ms) .....	5 A
Connection B - $I_{Opk}$ surge... (Pulse width < 10ms) .....	10 A
Output Voltage	
Connection A - $V_O$ .....	-90 V to +90 V
Connection B - $V_O$ .....	0 V to +90 V
Average Output Power Dissipation - Figure 5 .....	800 mW <sup>(2)</sup>

**RECOMMENDED OPERATING CONDITIONS:**

PARAMETER	SYMBOL	DEVICE TYPE	MIN	MAX	UNITS
Input Current (on)	$I_{F(ON)}$	-01	10	20	mA
		-02 / -03	5	20	mA
Input Voltage (off)	$V_{F(OFF)}$	All	0	0.6	VDC
Operating Temperature	$T_A$	All	-55	+125	°C

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**ELECTRICAL SPECIFICATIONS**

$T_A = -55^\circ\text{C}$  to  $+125^\circ\text{C}$ , unless otherwise specified.

Parameter	Sym.	Min.	Typ.*	Max.	Units	Test Conditions	Notes
Output Withstand Voltage	$ V_{O(OFF)} $	90	110		V	$V_F = 0.6\text{ V}$ $I_O = 10\ \mu\text{A}$	
Output On-Resistance (Connection A)	$R_{(ON)}$		0.40	1.0	$\Omega$	$I_F = 10\text{ mA}$ (for -01) $I_F = 5\text{ mA}$ (for -02 / -03) $I_O = 800\text{ mA}$ (pulse duration $\leq 30\text{ ms}$ )	3, Figure 1
Output On-Resistance (Connection B)			0.12	0.25	$\Omega$	$I_F = 10\text{ mA}$ (for -01) $I_F = 5\text{ mA}$ (for -02 / -03) $I_O = 1.6\text{ A}$ (pulse duration $\leq 30\text{ ms}$ )	
Output Leakage Current	$I_{O(OFF)}$		$10^{-4}$	10	$\mu\text{A}$	$V_F = 0.6\text{ V}$ $V_O = 90\text{ V}$	
Input Forward Voltage	$V_F$	1.0	1.24	1.7	V	$I_F = 10\text{ mA}$ (for -01) $I_F = 5\text{ mA}$ (for -02 / -03)	
Input Reverse Breakdown Voltage	$V_R$	5.0			V	$I_R = 100\ \mu\text{A}$	
Input-Output Insulation	$I_{I-O}$			1.0	$\mu\text{A}$	$RH \leq 45\%$ , $t = 5\text{ s}$ $V_{I-O} = 1500\text{ VDC}$ $T_A = 25^\circ\text{C}$	4, 5
Turn-On Time	$t_{ON}$		1.25	6.0	ms	$I_F = 10\text{ mA}$ (for -01) $I_F = 5\text{ mA}$ (for -02 / -03) $V_{DD} = 28\text{ VDC}$ $I_O = 800\text{ mA}$	Figure 6
Turn-Off time	$t_{OFF}$		0.02	0.25	ms	$I_F = 10\text{ mA}$ (for -01) $I_F = 5\text{ mA}$ (for -02 / -03) $V_{DD} = 28\text{ VDC}$ $I_O = 800\text{ mA}$	Figure 6
Output Transient Rejection	$ dV_O/dt $	1000			V/ $\mu\text{s}$	$V_{PEAK} = 50\text{ V}$ $C_M = 1000\text{ pF}$ $C_L = 15\text{ pF}$ $R_M \geq 1\text{ M}\Omega$	Figure 7
Input-Output Transient Rejection	$ dV_{I-O}/dt $	500			V/ $\mu\text{s}$	$V_{DD} = 5\text{ V}$ $V_{I-O(PEAK)} = 50\text{ V}$ $R_L = 20\text{ k}\Omega$ $C_L = 15\text{ pF}$	Figure 8

\* All typical values are at  $T_A = 25^\circ\text{C}$ ,  $I_{F(ON)} = 10\text{ mA}$  (for -01) or  $5\text{ mA}$  (for -02),  $V_{F(OFF)} = 0.6\text{ V}$  unless otherwise specified.

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**TYPICAL CHARACTERISTICS**

All typical values are at  $T_A = 25^\circ\text{C}$ ,  $I_{F(ON)} = 10\text{mA}$ ,  $V_{F(OFF)} = 0.6\text{V}$  unless otherwise specified.

Parameter	Symbol	Test Conditions	Typ.	Units	Notes
Output Off-Capacitance	$C_{O(OFF)}$	$V_O = 28\text{ V}$ $f = 1\text{ MHz}$	145	pF	
Output Offset Voltage	$ V_{OS} $	$I_F = 10\text{ mA}$ $I_O = 0\text{ mA}$	2	$\mu\text{V}$	6
Input Diode Temperature Coefficient	$\Delta V_F / \Delta T_A$	$I_F = 10\text{ mA}$	-1.4	$\text{mV}/^\circ\text{C}$	
Input Capacitance	$C_{IN}$	$V_F = 0\text{ V}$ $f = 1\text{ MHz}$	20	pF	7
Input-Output Capacitance	$C_{I-O}$	$V_{I-O} = 0\text{ V}$ $f = 1\text{ MHz}$	1.5	pF	4
Input-Output Resistance	$R_{I-O}$	$V_{I-O} = 500\text{ V}$ $t = 60\text{ s}$	$10^{13}$	$\Omega$	4

**Notes:**

1. Maximum junction to case thermal resistance for the device is  $15^\circ\text{C}/\text{W}$ , where case temperature,  $T_C$ , is measured at the center of the package bottom.
2. For rating, see Figure 5. The output power  $P_D$  rating curve is obtained when the part is handling the maximum average output current  $I_O$  as shown in Figure 3.
3. During the pulsed  $R_{ON}$  measurement ( $I_O$  duration  $< 30\text{ ms}$ ), ambient ( $T_A$ ) and case temperature ( $T_C$ ) are equal.
4. Pins 2 through 3 shorted together and pins 5 through 8 shorted together.
5. This is a momentary withstand test, not an operating condition.
6.  $V_{OS}$  is a function of  $I_F$  and is defined between pins 5 and 8, with pin 5 as the reference.  $V_{OS}$  must be measured in a stable ambient (free of temperature gradients).
7. Zero-bias capacitance measured between the LED anode and cathode.

**CAUTION:**

Care should be taken not to exceed the maximum output power dissipation, maximum case temperature, and maximum junction temperature when repetitively switching loads.

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Case outlines	P, X, Y, AND Z	
Terminal number	Terminal symbol	
	Connection A (AC or DC load)	Conneciton B (DC load only)
1	NC	NC
2	V <sub>F+</sub>	V <sub>F+</sub>
3	V <sub>F-</sub>	V <sub>F-</sub>
4	NC	NC
5	V <sub>O-</sub>	V <sub>O+</sub>
6	NC	NC
7	NC	N <sub>O-</sub>
8	V <sub>O+</sub>	V <sub>O+</sub>

NC = No connection

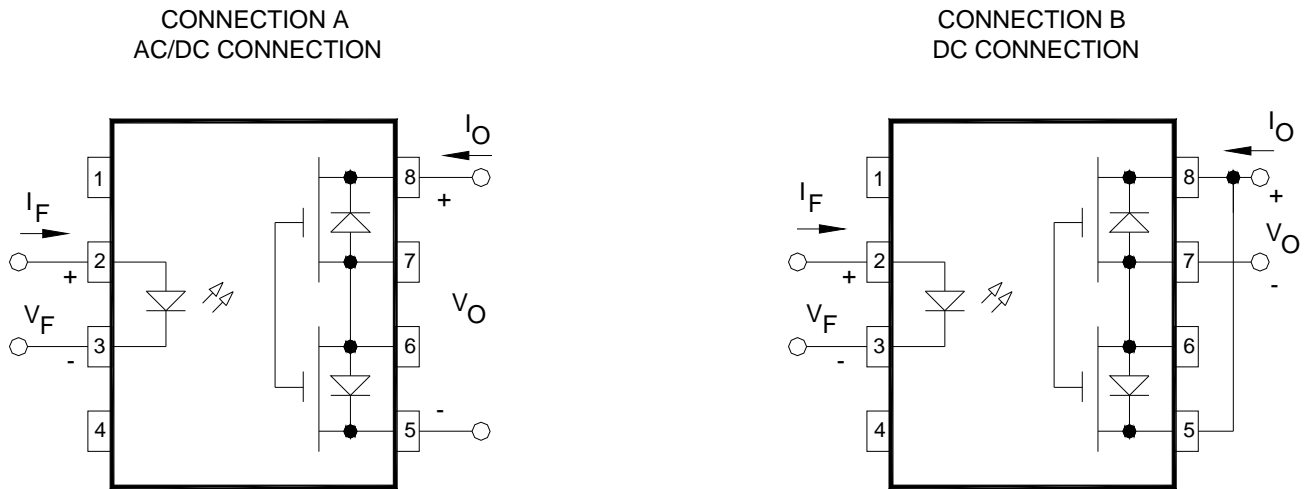


Figure 1 - Terminal Connections

INPUT	OUTPUT
OFF	OFF
ON	ON

Figure 2 - Truth Table

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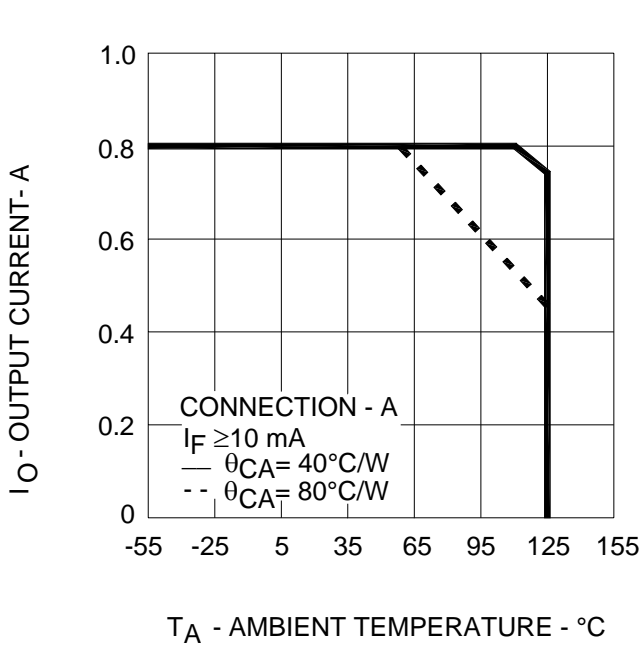


Figure 3. Maximum Average Output Current Rating vs. Ambient Temperature.

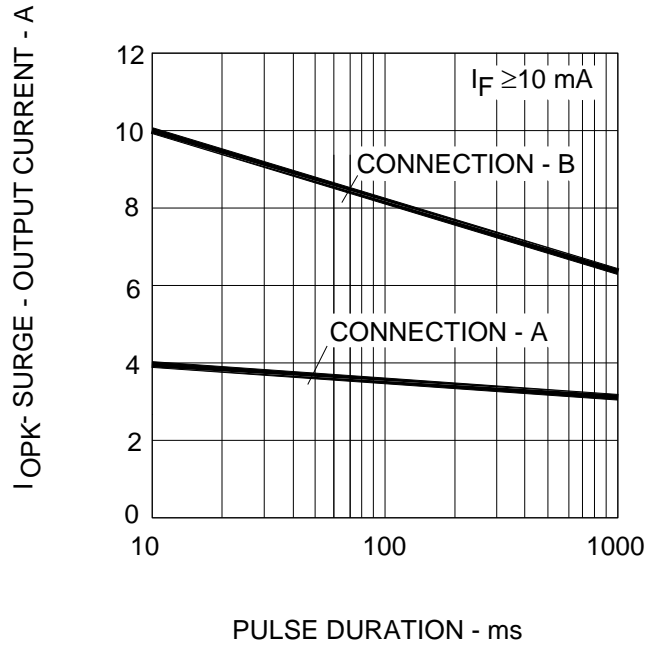


Figure 4. Single Shot (nonrepetitive) Output Current vs. Pulse Duration.

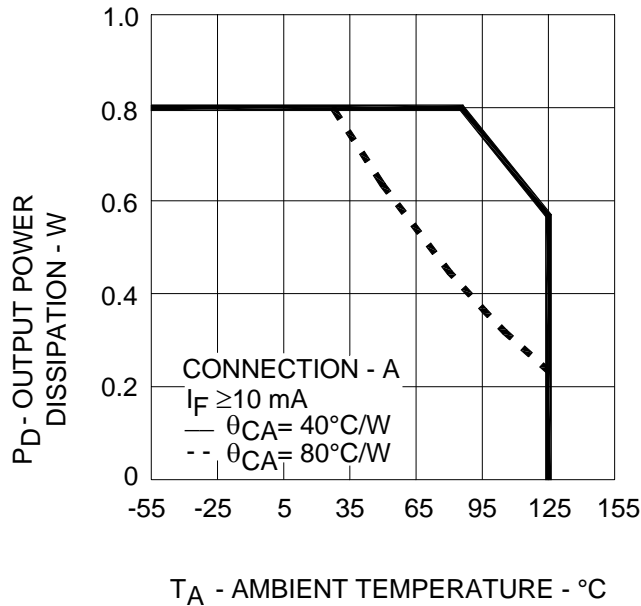
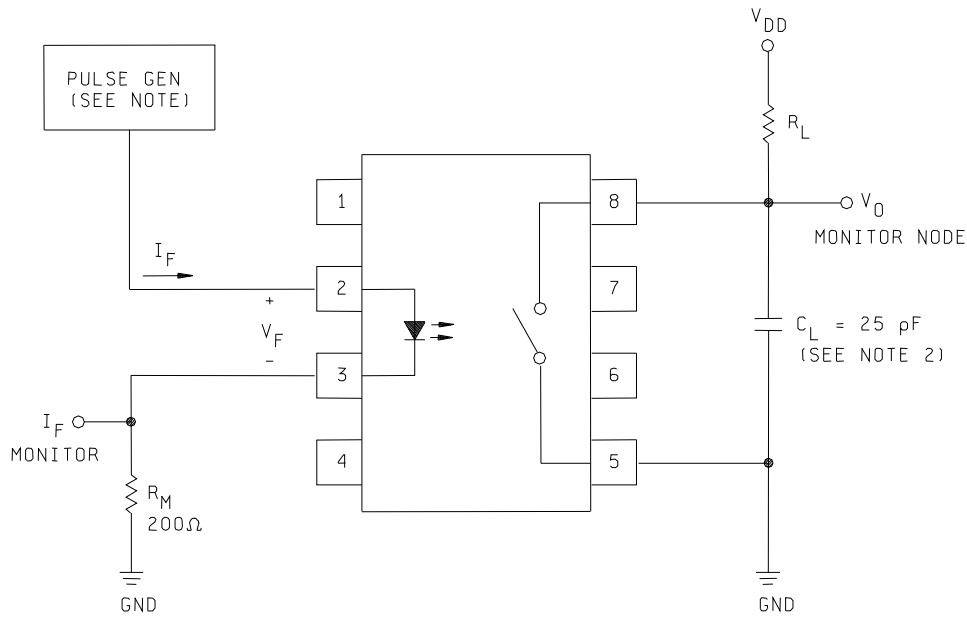


Figure 5. Output Power Rating vs. Ambient Temperature.

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DEVICE TYPES O1 AND O2

DEVICE TYPE O3

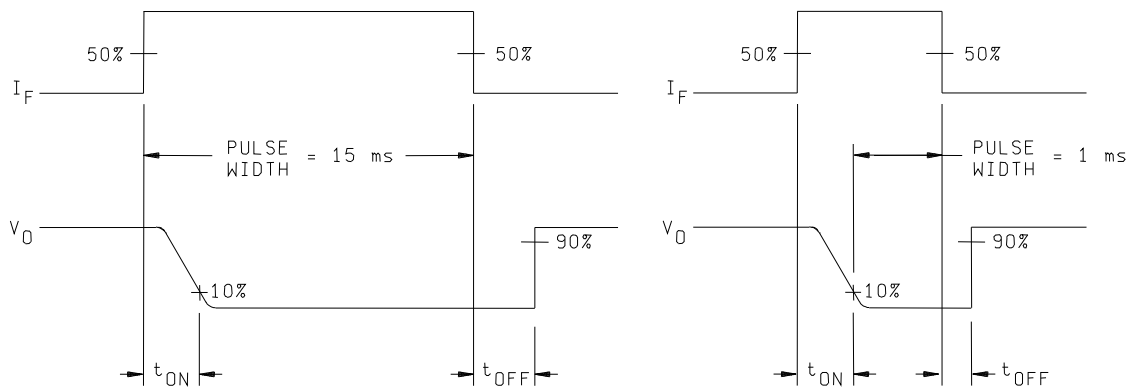
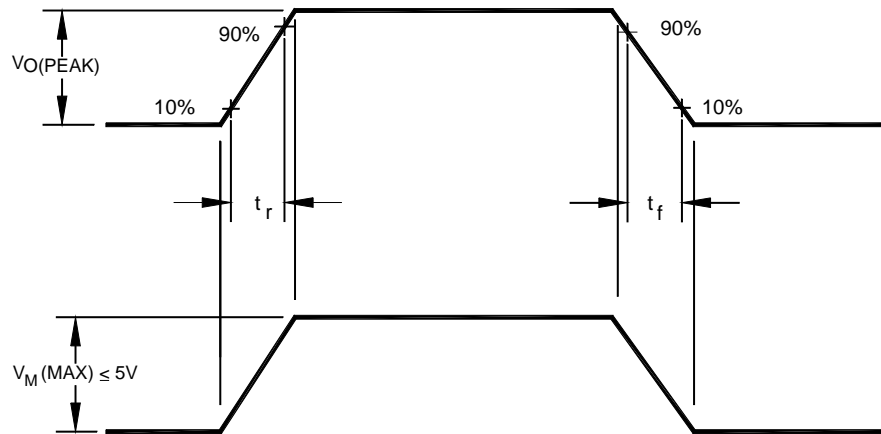
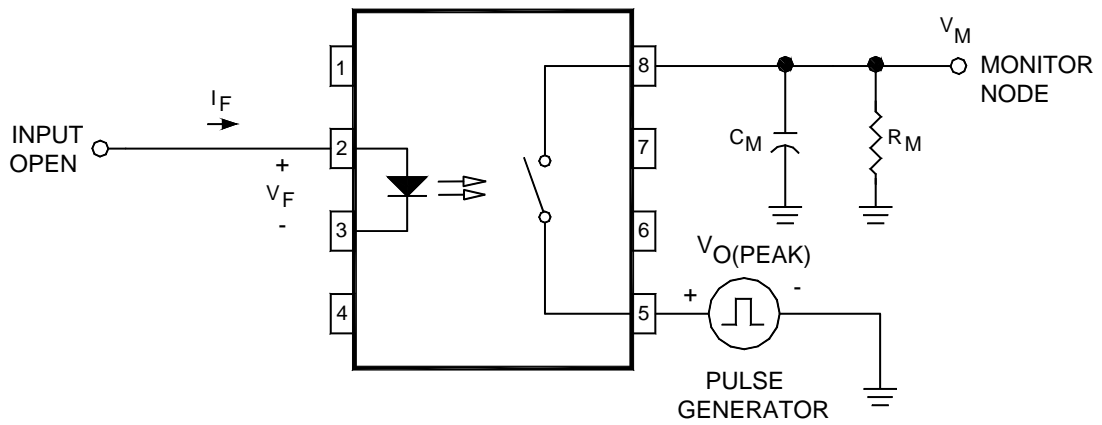


Figure 6. Switching Test Circuit and Waveforms.

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$$\frac{dV_O}{dt} = \frac{(0.8)V_O(PEAK)}{t_r} \quad \text{OR} \quad \frac{(0.8)V_O(PEAK)}{t_f}$$

OVERSHOOT ON  $V_O(PEAK)$  IS TO BE  $\leq 10\%$

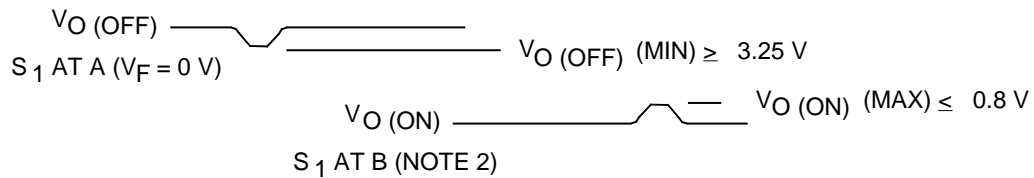
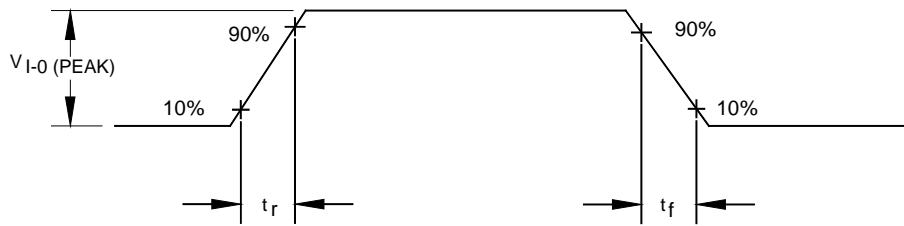
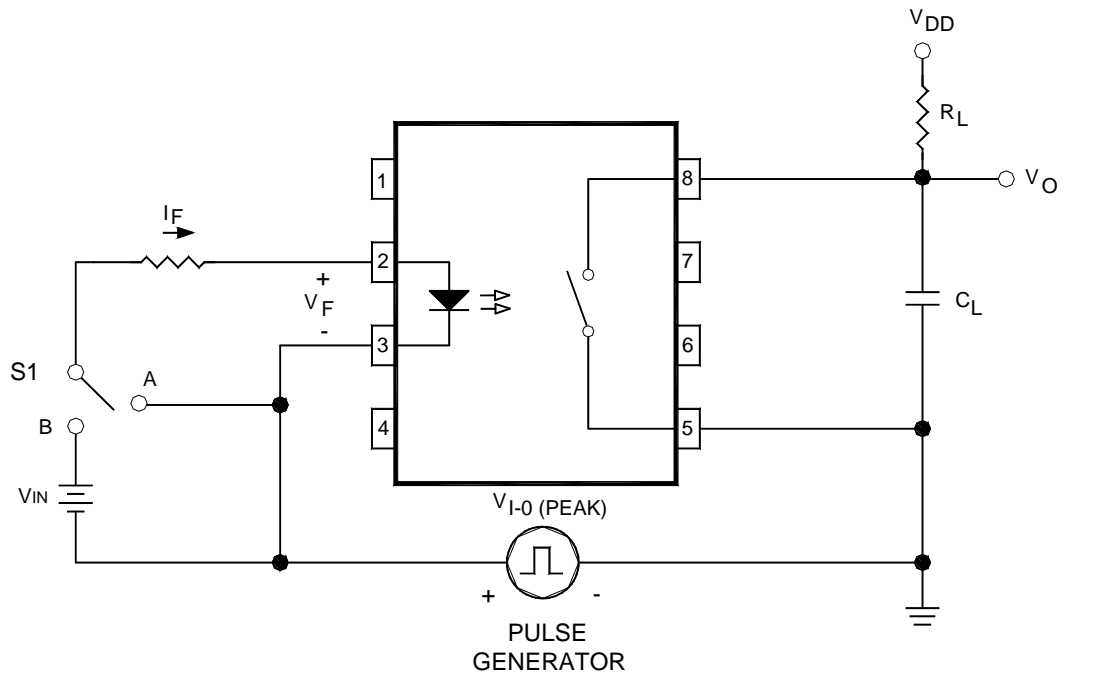
NOTES:

1.  $C_M$  INCLUDES PROBE AND FIXTURE CAPACITANCE.
2.  $R_M$  INCLUDES PROBE AND FIXTURE RESISTANCE.

Figure 7. Output Transient Rejection Test Circuit and Waveform.

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$$\frac{dV_{I-0}}{dt} = \frac{(0.8) V_{I-0} (PEAK)}{t_r} \quad \text{OR} \quad \frac{(0.8) V_{I-0} (PEAK)}{t_f}$$

OVERSHOOT ON  $V_{I-0} (PEAK)$  IS TO BE  $\leq 10\%$

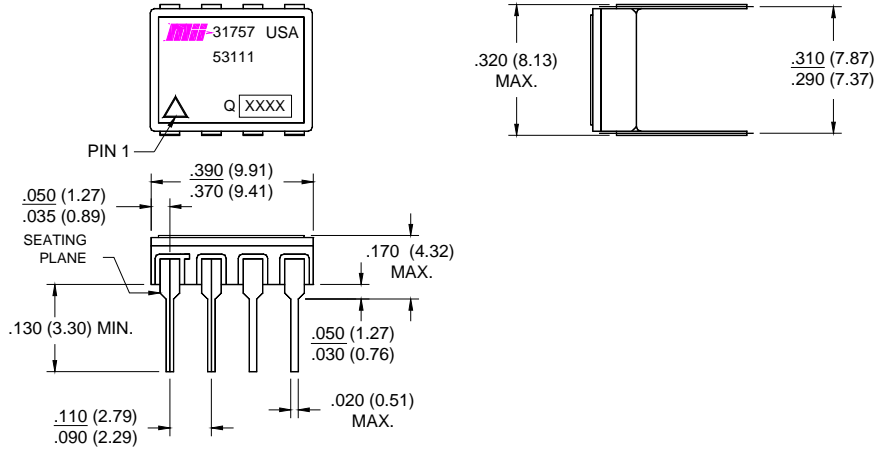
NOTES:

1. LOAD CAPACITANCE ( $C_L$ ) INCLUDES PROBE AND FIXTURE CAPACITANCE.
2. FOR DEVICE TYPE 01,  $I_F = 10\text{mA}$ ,  
FOR DEVICE TYPE 02,  $I_F = 5\text{mA}$ .

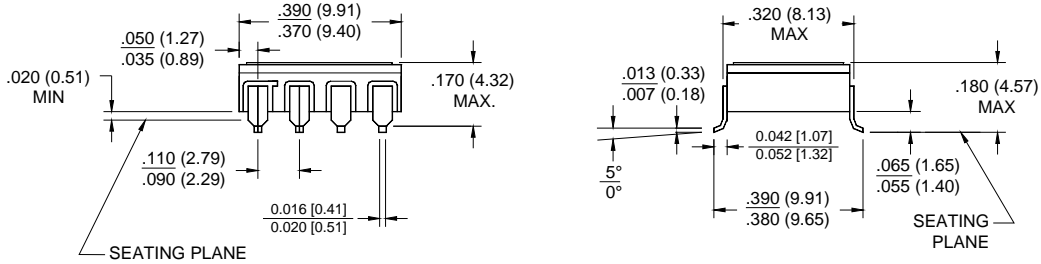
Figure 8. Input-Output Transient Rejection Test Circuit and Waveform.

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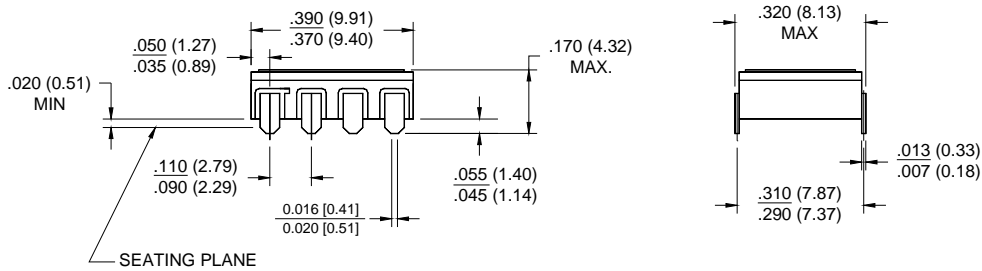
**Case Outline P**



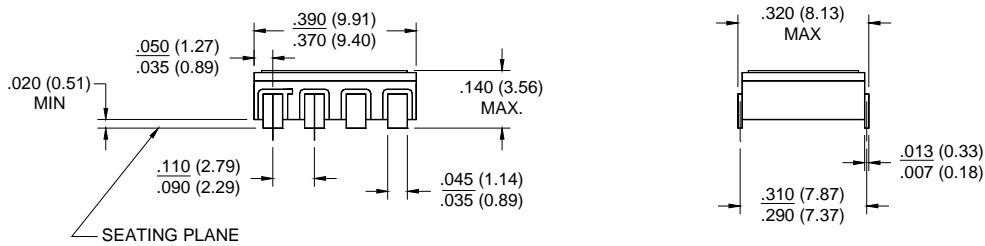
**Case Outline X**



**Case Outline Y**



**Case Outline Z**



- NOTES:
1. PIN 1 IS INDICATED BY THE ESD TRIANGLE MARKED ON THE LID OF THE PACKAGE.
  2. DIMENSIONS ARE IN INCHES, (mm).
  3. METRIC EQUIVALENTS ARE GIVEN FOR GENERAL INFORMATION ONLY.
  4. UNLESS OTHERWISE SPECIFIED, TOLERANCE IS ±.005 (0.13mm).

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**ORDERING GUIDE**

The followings are the cross-reference of Micropac part numbers versus Standard Military PIN. Please contact Micropac for other desired options.

Micropac Part Number	Standard Military Drawing PIN	Case Outline
53111-1PA	5962-9314001HPA	P
53111-1PC	5962-9314001HPC	P
53111-1XA	5962-9314001HXA	X
53111-1XC	5962-9314001HXC	X
53111-1YA	5962-9314001HYA	Y
53111-1YC	5962-9314001HYC	Y
53111-1ZA	5962-9314001HZA	Z
53111-1ZC	5962-9314001HZC	Z
53111-2PA	5962-9314002HPA	P
53111-2PC	5962-9314002HPC	P
53111-2XA	5962-9314002HXA	X
53111-2XC	5962-9314002HXC	X
53111-2YA	5962-9314002HYA	Y
53111-2YC	5962-9314002HYC	Y
53111-2ZA	5962-9314002HZA	Z
53111-2ZC	5962-9314002HZC	Z

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