DATA SHEET, Rev. F

53111 POWER MOSFET OPTOCOUPLER,

90 V/1 Ω, Hermetically Sealed,
DSCC Approved 5962-9314001

HYBRID MICROELECTRONICS
PRODUCTS DIVISION

Features:

- Hermetically Sealed 8-Pin Dual-In-Line package
- Small Size and Weight
- Performance Guaranteed over –55°C to +125°C Ambient Temperature Range
- Compact Solid-state Bi-directional Switch
- AC/DC Signal & Power Switching
- Maximum Average Current
  - AC/DC: 0.8 A
  - DC only: 1.6 A
- Optically coupled
- 1500 VDC Withstand Test Voltage
- High Transient Immunity
- 5 A Output Surge Current
- Shock and Vibration Resistant
- MIL-PRF-38534 Compliant
- Equivalent to HSSR7111

Applications:

- Satellite/Space Systems
- Military/High Reliability Systems
- Standard 28 VDC and 48 VDC Load Driver
- Standard 24 VAC Load Driver
- AC/DC Electromechanical and Solid State Relay Replacement
- I/O Modules

DESCRIPTION

The 53111 is a single channel, hermetically sealed, power MOSFET optocoupler. Low on-resistance of the MOSFET outputs, 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.

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 (1)
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 (2)

RECOMMENDED OPERATING CONDITIONS:

PARAMETER	SYMBOL	MIN	MAX	UNITS
Input Current (on)	$I_{F\ (ON)}$	5	20	mA
Input Voltage (off)	$V_{F\ (OFF)}$	0	0.6	VDC
Operating Temperature	T_A	-55	+125	°C

ELECTRICAL SPECIFICATIONS

T_A = -55°C to +125°C, unless otherwise specified.

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

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

TYPICAL CHARACTERISTICS

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

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

Notes:

1. Maximum junction to case thermal resistance for the device is 15ºC/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 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.

Case outlines	A, B, and C	
Terminal number	Terminal symbol	
	Connection A (AC or DC load)	Conneciton B (DC load only)
1	NC	NC
2	V_{F+}	V_{F+}
3	V_{F-}	V_{F-}
4	NC	NC
5	V_{O-}	V_{O+}
6	NC	NC
7	NC	N_{O-}
8	V_{O+}	V_{O+}

NC = No connection

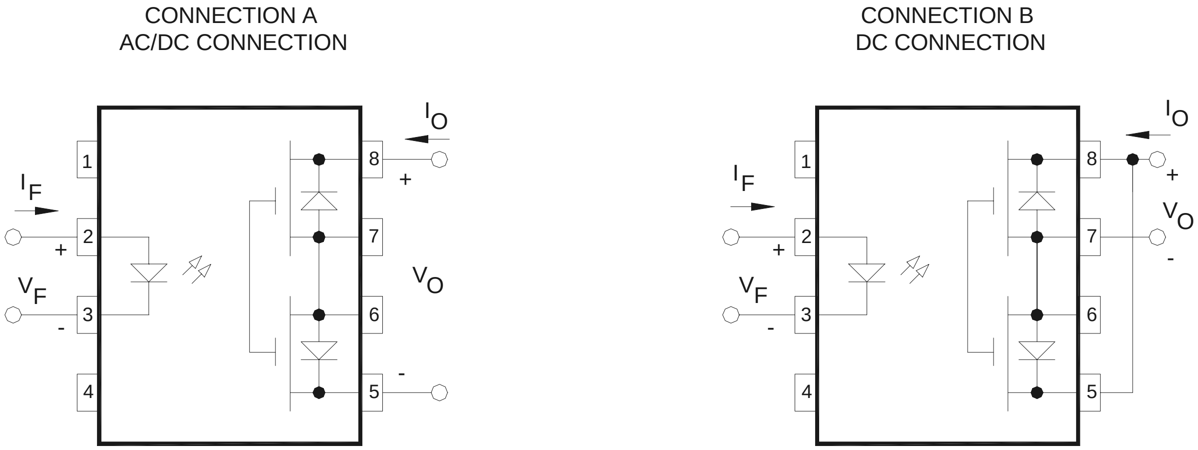


Figure 1 - Terminal Connections

INPUT	OUTPUT
OFF	OFF
ON	ON

Figure 2 - Truth Table

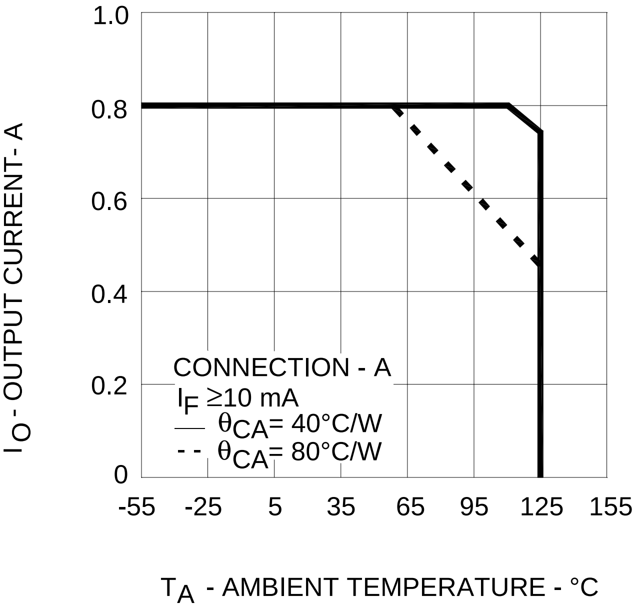


Figure 3. Maximum Average Output Current
Rating vs. Ambient Temperature.

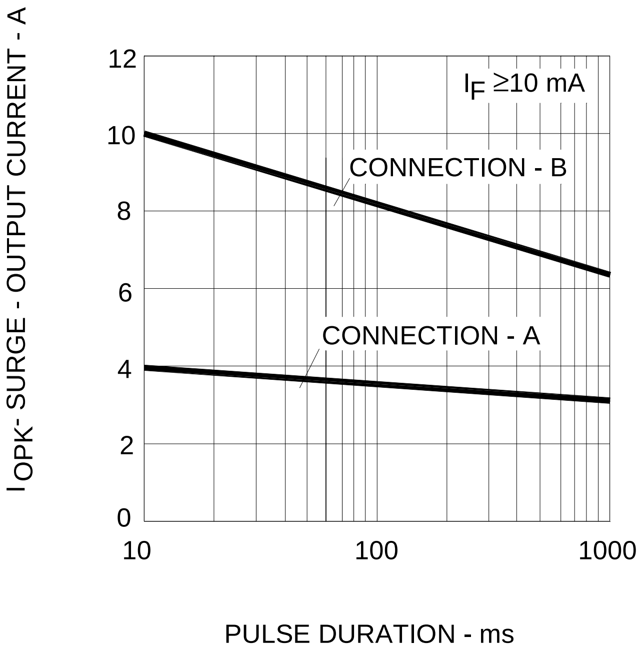


Figure 4. Single Shot (nonrepetitive)
Output Current vs. Pulse Duration.

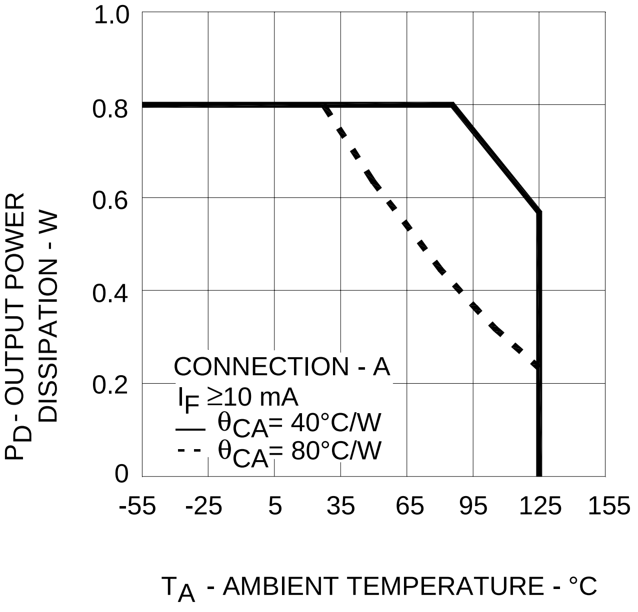
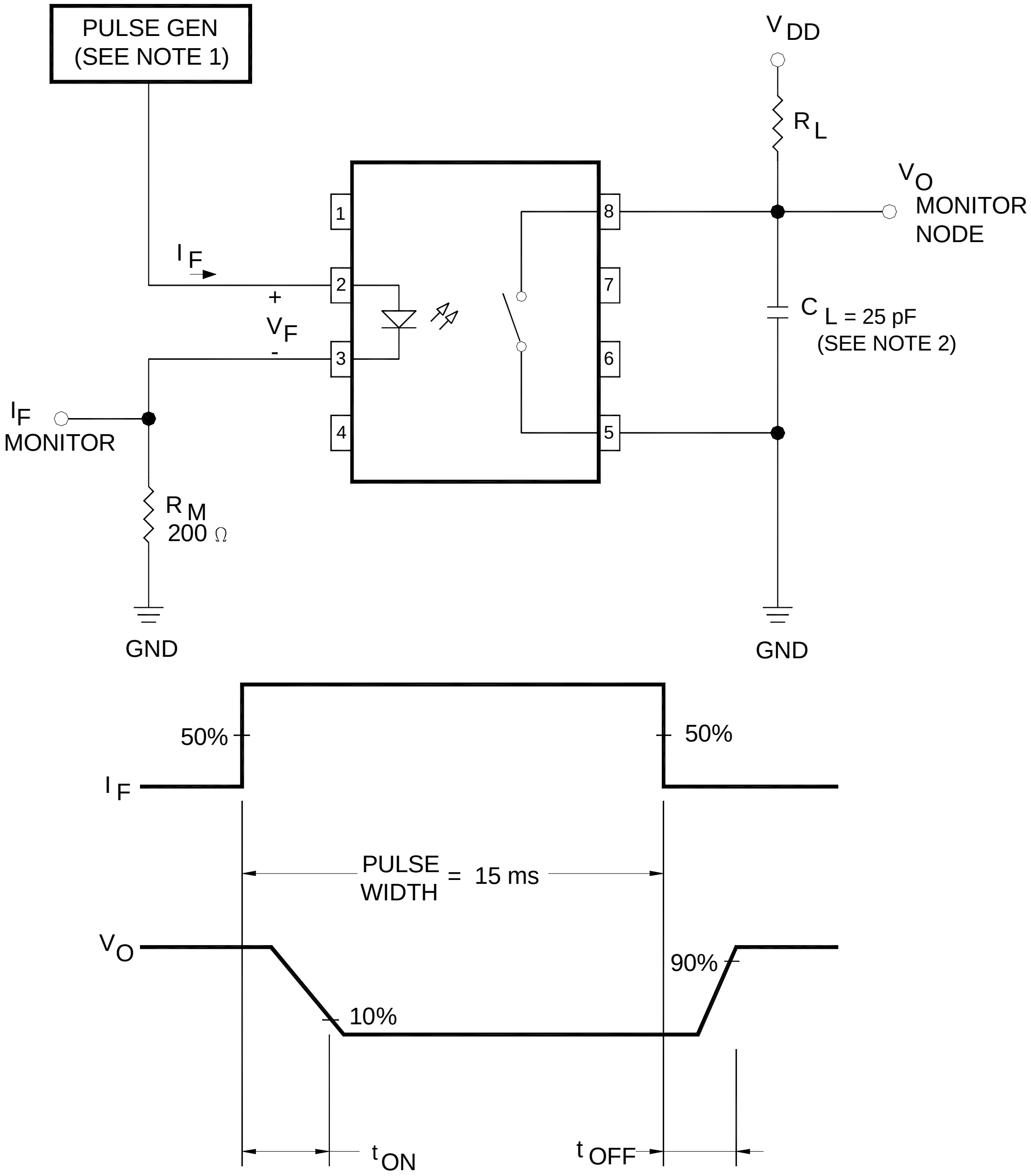


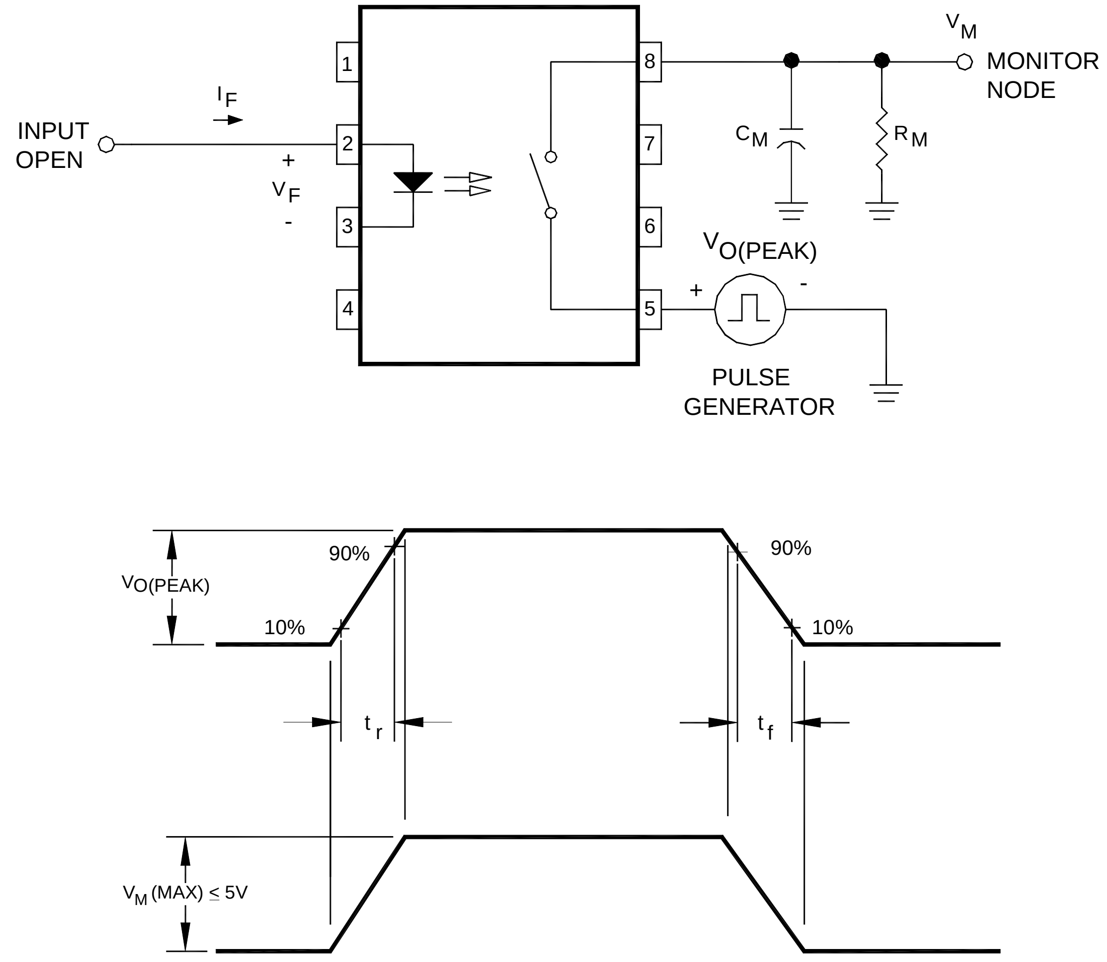
Figure 5. Output Power Rating vs. Ambient Temperature.



NOTES:

1. PULSE GENERATOR HAS THE FOLLOWING CHARACTERISTICS: OUTPUT IMPEDANCE = 50 Ω AND $t_r = t_f = 5.0$ ns.
2. LOAD CAPACITANCE (C_L) INCLUDES PROBE AND JIG CAPACITANCE.

Figure 6. Switching Test Circuit and Waveform.

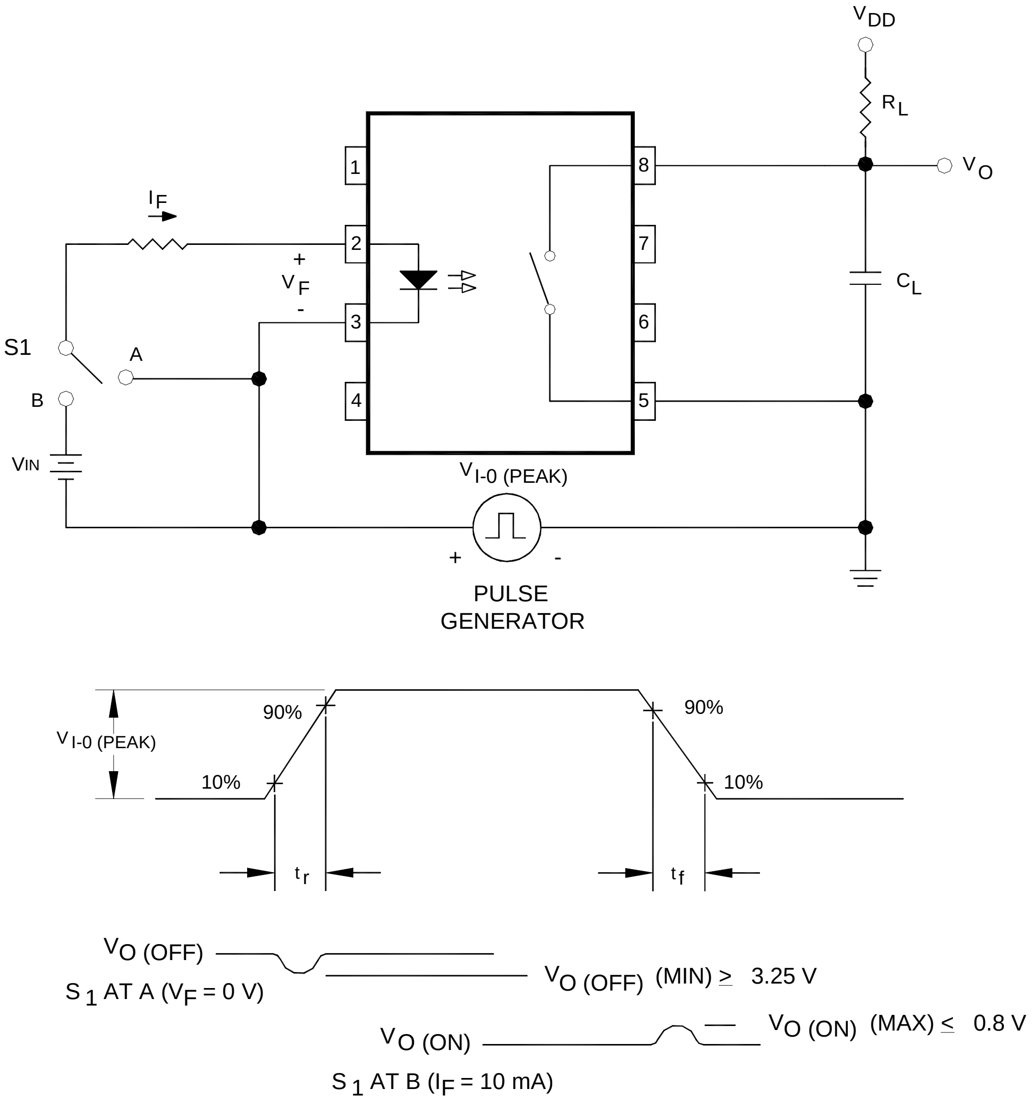


$$\frac{d\,V_O}{d_t} = \frac{(0.8)\,V_O\,(PEAK)}{t_r} \quad \text{OR} \quad \frac{(0.8)\,V_O\,(PEAK)}{t_f}$$

OVERSHOOT ON V_O (PEAK) IS TO BE ≤ 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.



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

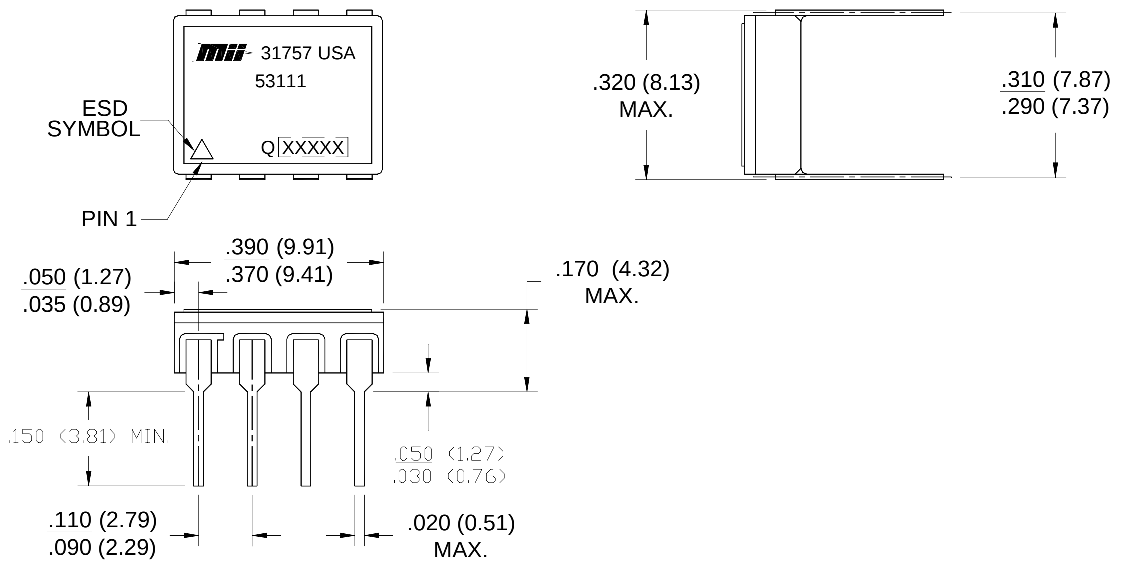
OVERSHOOT ON $V_{I-0\ (PEAK)}$ IS TO BE $\leq$ 10%

NOTES:
1. LOAD CAPACITANCE (C_L)INCLUDES PROBE AND FIXTURE CAPACITANCE.

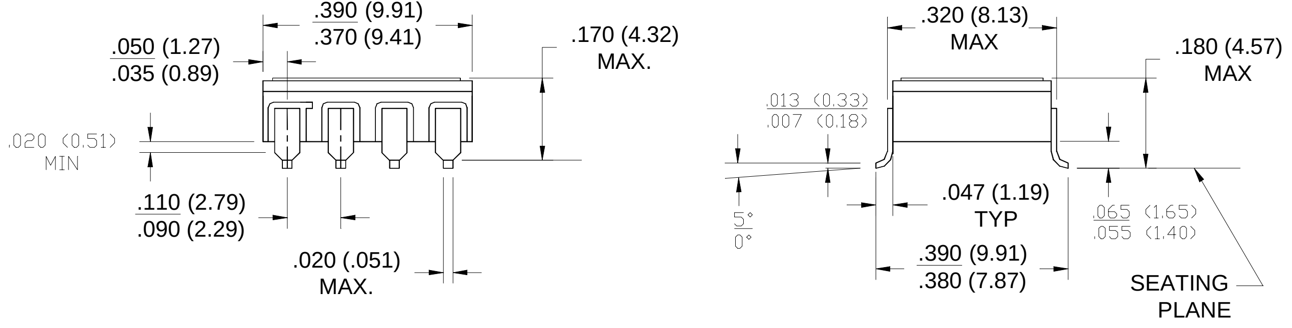
Figure 8. Input-Output Transient Rejection Test Circuit and Waveform.

Case Outlines

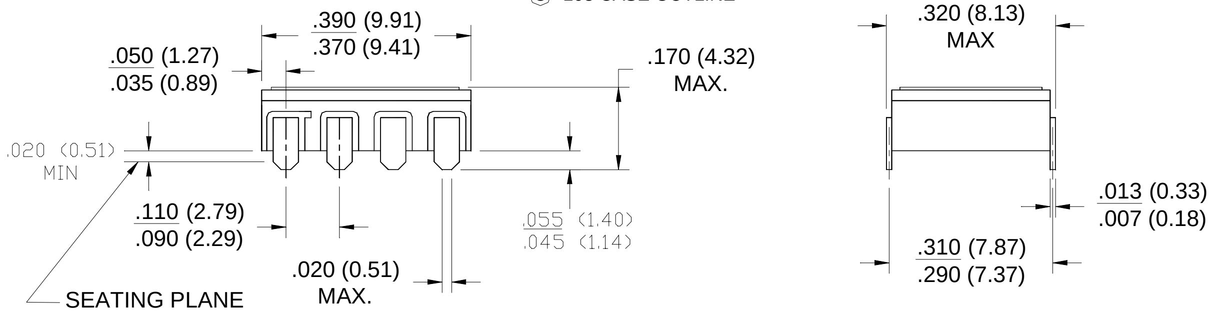
Ⓐ -101 CASE OUTLINE



Ⓑ -102 CASE OUTLINE



Ⓒ -103 CASE OUTLINE



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).