ASSR-7300

Extreme Temperature, Hermetically Sealed, Optically Isolated Solid State Relay 60V/0.6Ω, –55˚C to +175˚C

Data Sheet

Description

The ASSR-7300 is a single-channel, isolated Solid State Relay (SSR) constructed in an eight-pin, hermetic, dual-inline, ceramic package that is capable of operation from -55˚C to +175˚C. Each device contains an AlGaAs light emitting diode optically coupled to a photovoltaic diode stack, which drives two discrete power MOSFETs. The device operates as a solid-state replacement for single pole, normally open (1 Form A) relays used for general-purpose switching of signals and loads in high temperature applications.

Comprehensive reliability testing is performed on the ASSR-7300. Product lifetimes at extended operating temperature are obtained using high temperature operating life (HTOL). HTOL is performed to JEDEC JESD22-A108. A minimum of three wafer fab and assembly lots are processed through HTOL at the maximum operating temperature. Predicted lifetime at maximum operating temperature on the ASSR-7300 is 1000 hours.

The devices feature logic level input control and very low output on-resistance, making them suitable for both ac and dc loads. Connection A, as shown in the Functional Diagram, allows the device to switch either ac or dc loads. Connection B, with the polarity and pin configuration as shown, allows the device to switch dc loads only. The advantage of Connection B is that the on-resistance is significantly reduced, and the output current capability increases by a factor of two.

The devices are convenient replacements for mechanical and solid state relays where high component reliability with standard footprint lead configuration is desirable. Devices may be purchased with a variety of lead bend and plating options.

Part Numbers and Options

ASSR-7300, ASSR-7300-200, ASSR-7300-300

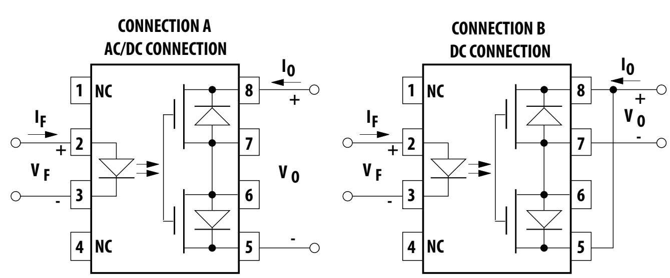
Features

- Compact solid-state bidirectional switch
- Performance guaranteed over –55°C to +175°C
- Hermetically sealed 8-pin dual in-line package
- Small size and weight
- 1500 Vdc withstand test voltage
- High transient immunity
- Connection A: 0.8A, 1.2Ω
- Connection B: 1.6A, 0.6Ω

Applications

- Down hole and directional drilling
- Extreme temperature operation
- Harsh industrial environments
- 28/48VDC load drivers
- AC/DC electromechanical relay replacement

Functional Diagrams



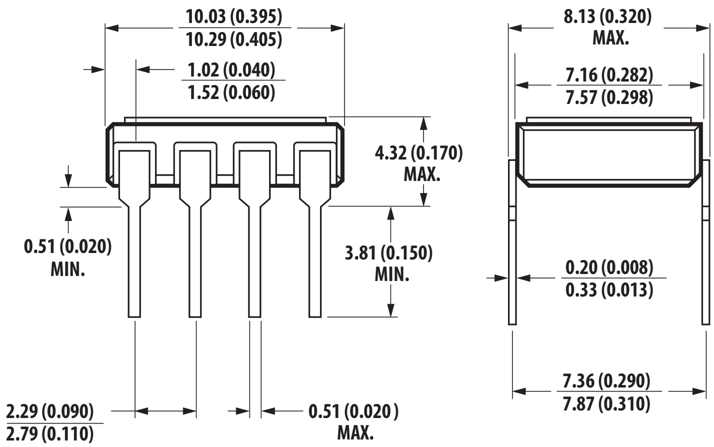
TRUTH TABLE

INPUT	OUTPUT
H	CLOSED
L	OPEN

CAUTION It is advised that normal static precautions be taken in handling and assembly of this component to prevent damage and/or degradation which may be induced by ESD.

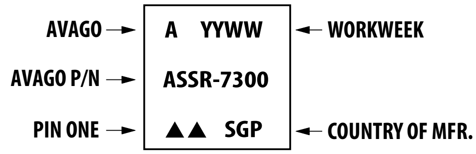
Package Information

Outline Drawing – 8-pin DIP Through Hole



NOTE: DIMENSIONS IN MILLIMETERS (INCHES).

Device Marking



Thermal Resistance

Maximum Output MOSFET Junction to Case θ_{JC} = 15°C/W.

ESD Classification

MIL-STD-883, Method 3015 .... ▲▲, Class 2

Absolute Maximum Ratings

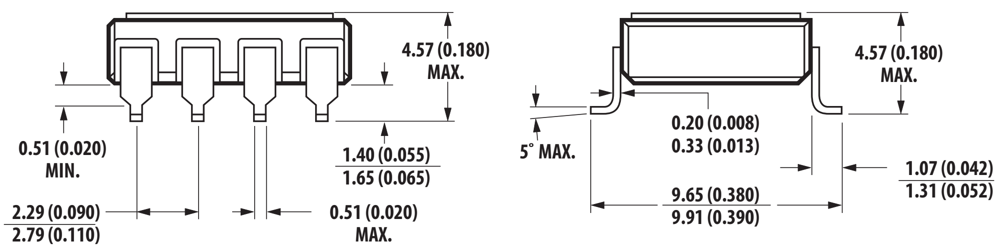
Parameter	Symbol	Min	Max	Unit	Note
Storage Temperature Range	T_S	–65	+150	°C	
Operating Ambient Temperature	T_A	–55	+175	°C	
Junction Temperature	T_J	—	+200	°C	
Operating Case Temperature	T_C	—	+200	°C	a
Lead Solder Temperature		260 °C for 10 seconds		°C	
Average Input Current	I_F	—	25	mA	
Peak Repetitive Input Current (Pulse Width < 100 ms; duty cycle < 50%)	I_{FPK}	—	50	mA	
Peak Surge Input Current (Pulse Width < 0.2 ms; duty cycle < 0.1%)	$I_{FPK\ surge}$	—	100	mA	
Reverse Input Voltage	V_R	—	5	V	
Average Output Current (see Figure 2) Connection A Connection B	I_O	 — —	 0.8 1.6	 A A	
Single Shot Output Current (see Figure 3) Connection A (Pulse width < 10 ms) Connection B (Pulse width < 10 ms)	$I_{OPK\ surge}$	 — —	 5.0 10.0	 A A	
Output Voltage Connection A Connection B	V_O	 –60 0	 60 60	 V V	

a. Maximum junction to case thermal resistance for the device is 15°C/W, where case temperature, T_C, is measured at the center of the package bottom.

Recommended Operating Conditions

Parameter	Symbol	Min	Max	Unit
Input Current (on)	$I_{F(ON)}$	10	20	mA
Input Voltage (off)	$V_{F(OFF)}$	0	0.6	V
Operating Temperature	T_A	–55	+175	°C

Hermetic Optocoupler Options

Option	Description
ASSR-7300[a]	Through-hole gold lead devices. See Outline Drawing – 8-pin DIP Through Hole.
ASSR-7300-200[b]	Through-hole solder-dipped lead devices, rather than gold plated.
ASSR-7300-300[b]	Surface-mountable hermetic optocoupler with leads cut and bent for gull wing assembly.  Dimensions in millimeters (inches).

a. Gold Plate lead finish: Maximum gold thickness of leads is <100 micro-inches. Typical is 60 to 90 micro-inches.

b. Solder lead finish: Sn63/Pb37.

Electrical Specifications

T_A = –55°C to +175°C, unless otherwise specified.

Parameter	Symbol	Test Conditions	Min	Typ[a]	Max	Unit	Fig	Notes
Output Withstand Voltage	$\|V_{O(OFF)}\|$	V_F = 0.6V, I_O = 150 µA	60	—	—	V	4	
Output On-Resistance Connection A	$R_{(ON)}$	I_F = 20 mA, I_O = 800 mA, (pulse duration ≤ 30 ms)	—	—	1.2	Ω	5, 6	b
Output On-Resistance Connection B	$R_{(ON)}$	I_F = 20 mA, I_O = 1.6A, (pulse duration ≤ 30 ms)	—	—	0.6	Ω	5, 6	b
Output Leakage Current	$I_{O(OFF)}$	V_F = 0.6V, V_O = 60V	—	10^{-4}	150	µA	7	
Input Forward Voltage	V_F	I_F = 20 mA	1.0	1.45	1.85	V	8	
Input Reverse Breakdown Voltage	V_R	I_R = 100 µA	5.0	—	—	V		
Input-Output Insulation	I_{I-O}	RH ≤ 65%, t = 5s, V_{I-O} = 1500 Vdc, T_A = 25°C	—	—	1.0	µA		c, d
Turn On Time	t_{ON}	I_F = 20 mA, V_{DD} = 28V, I_O = 800 mA	—	0.5	6.0	ms	1, 9, 10, 11	
Turn Off Time	t_{OFF}	I_F = 20 mA, V_{DD} = 28V, I_O = 800 mA	—	0.03	0.25	ms	1, 9, 12, 13	
Output Transient Rejection	$\left\|\frac{dVo}{dt}\right\|$	V_{PEAK} = 50V, CM = 1000 pF, C_L = 15 pF, R_M ≥ 1 MΩ	1000	—	—	V/µs	15	
Input-Output Transient Rejection	$\left\|\frac{dVio}{dt}\right\|$	V_{DD} = 5V, $V_{I-O(PEAK)}$ = 50V, R_L = 20 kΩ, C_L = 15 pF	500	—	—	V/µs	16	

a. Typical at 25°C.

b. During the pulsed R_{ON} measurement (I_O duration <30 ms), ambient (T_A) and case temperature (T_C) are equal.

c. Device considered a two terminal device: pins 1 through 4 shorted together and pins 5 through 8 shorted together.

d. This is a momentary withstand test, not an operating condition.

Typical Characteristics

All typical values are at T_A = 25°C, $I_{F(ON)}$ = 20 mA, $V_{F(OFF)}$ = 0.6V unless otherwise specified.

Parameter	Symbol	Test Conditions	Typ	Unit	Fig	Notes
Output Off-Capacitance	$C_{O(OFF)}$	V_O = 28V, f = 1 MHz	145	pF	14	
Output Offset Voltage	$\|V_{OS}\|$	I_F = 20 mA, I_O = 0 mA	2	µV	17	a
Input Diode Temperature Coefficient	$\Delta V_F/\Delta T_A$	I_F = 20 mA	–1.85	mV/°C		
Input Capacitance	C_{IN}	V_F = 0V, f = 1MHz	20	pF		b
Input-Output Capacitance	C_{I-O}	V_{I-O} = 0V, f = 1 MHz	1.5	pF		c
Input-Output Resistance	R_{I-O}	V_{I-O} = 500V, t = 60s	10^{13}	Ω		c

a. 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).

b. Zero-bias capacitance measured between the LED anode and cathode.

c. Device considered a two terminal device: pins 1 through 4 shorted together and pins 5 through 8 shorted together.

Performance

Figure 1 Recommended Input Circuit

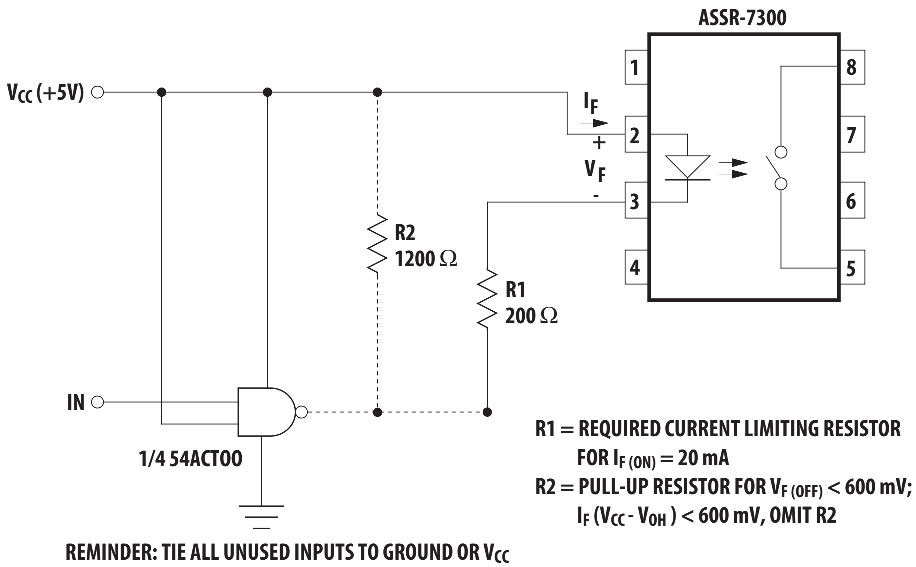


Figure 2 Maximum Average Output Current Rating vs. Ambient Temperature

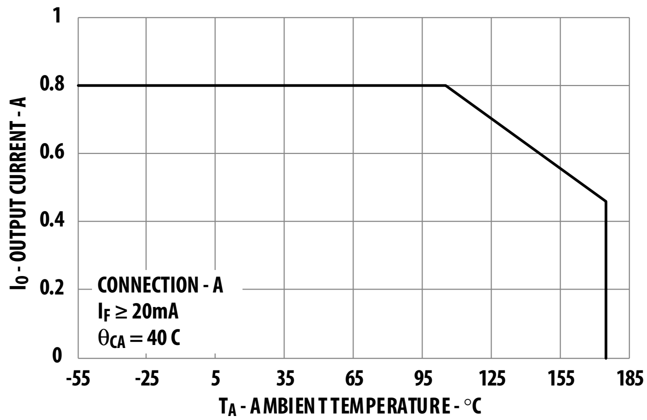


Figure 3 Single Shot (non-repetitive) Output Current vs. Pulse Duration

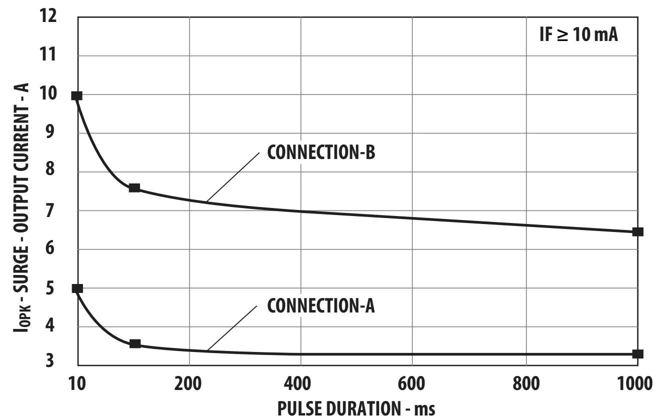


Figure 4 Normalized Typical Output Withstand Voltage vs. Temperature

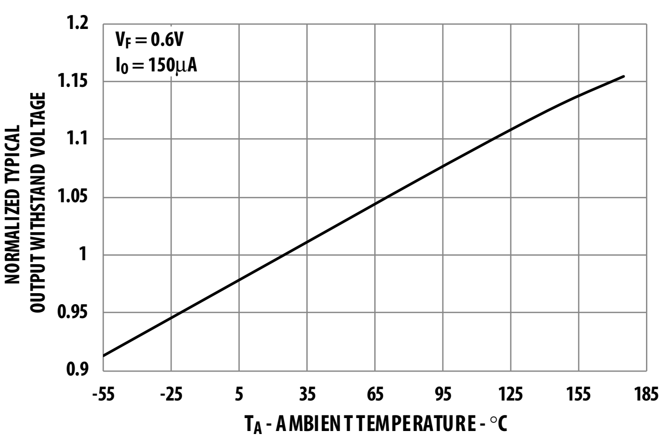


Figure 5 Normalized Typical Output Resistance vs. Temperature

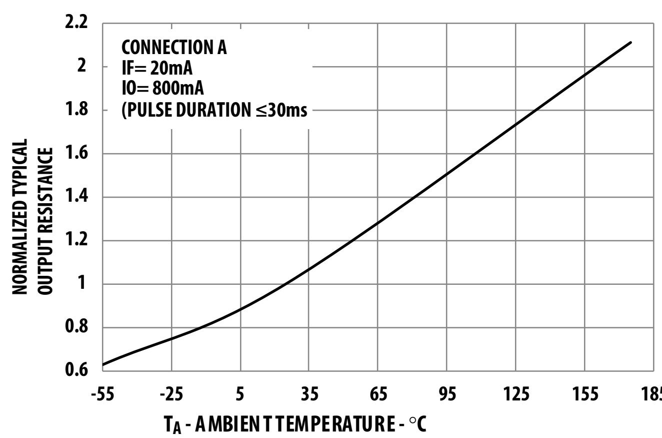


Figure 6 Typical On State Output I-V Characteristics

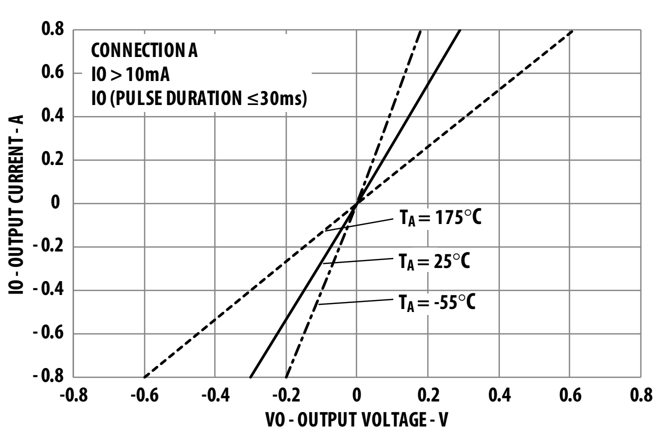


Figure 7 Typical Output Leakage Current vs. Temperature

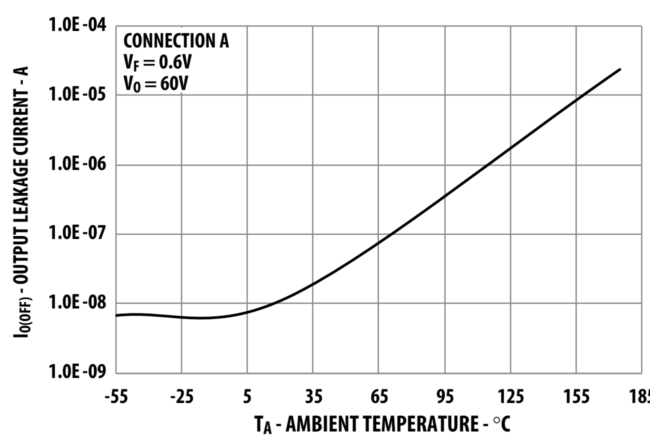


Figure 8 Typical Input Forward Current vs. Input Forward Voltage

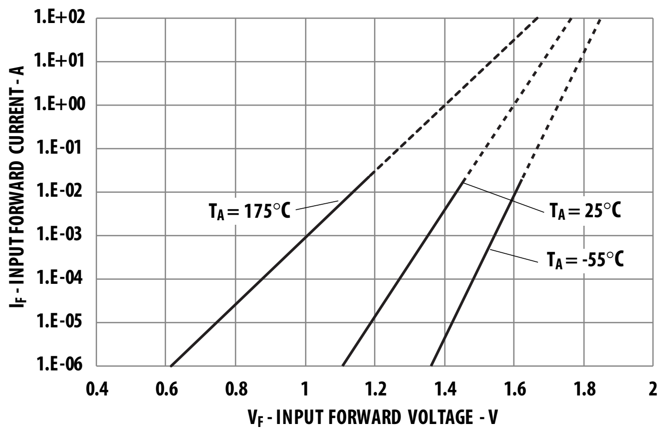


Figure 9 Switching Test Circuit for t_{ON}, t_{OFF}

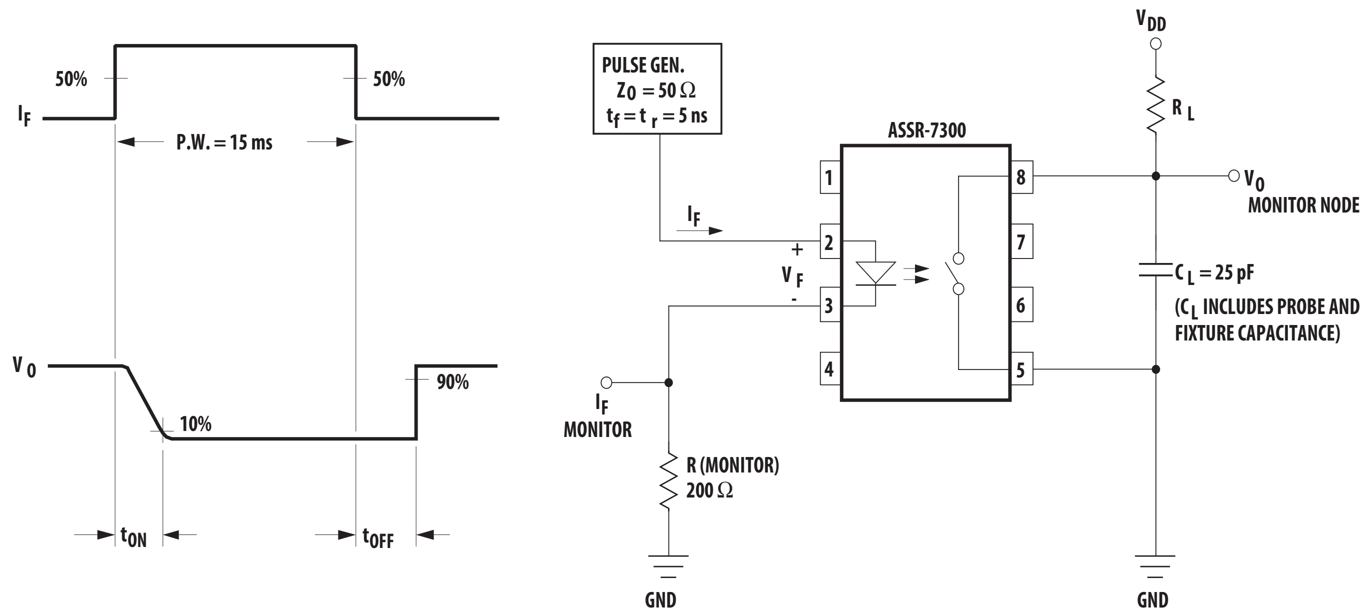


Figure 10 Typical Turn On Time vs. Temperature

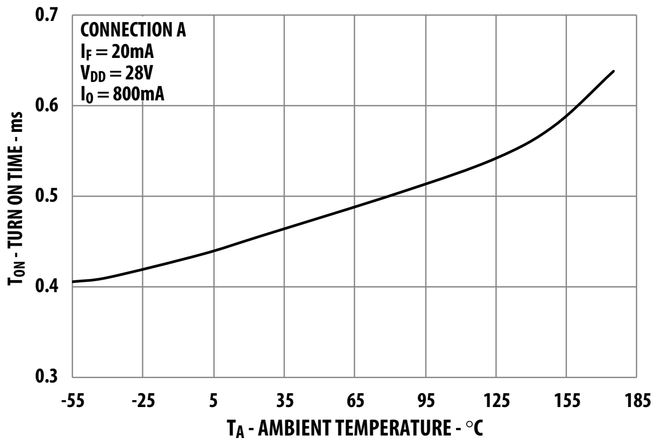


Figure 11 Typical Turn On Time vs. Input Current

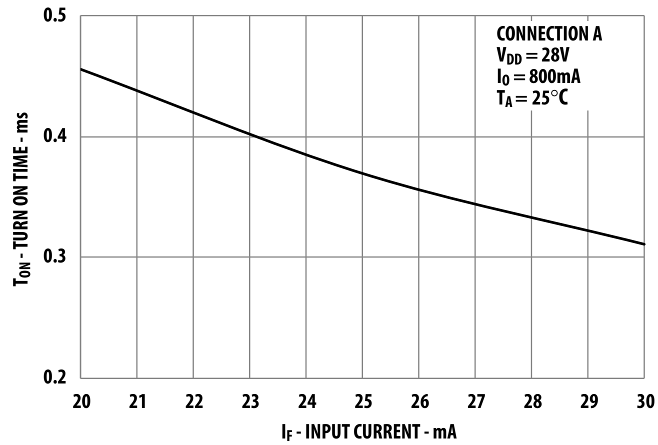


Figure 12 Typical Turn Off Time vs. Temperature

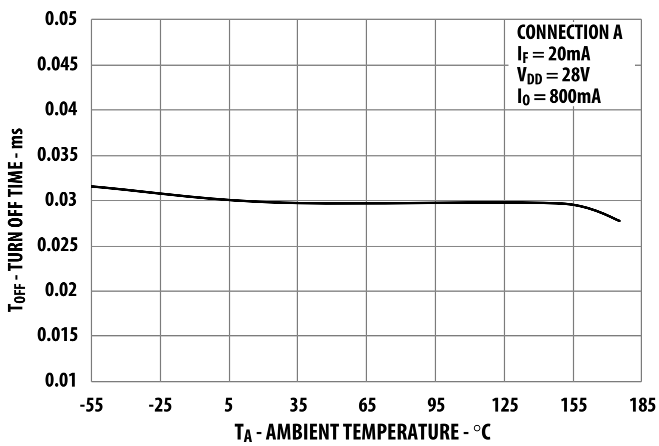


Figure 13 Typical Turn Off Time vs. Input Current

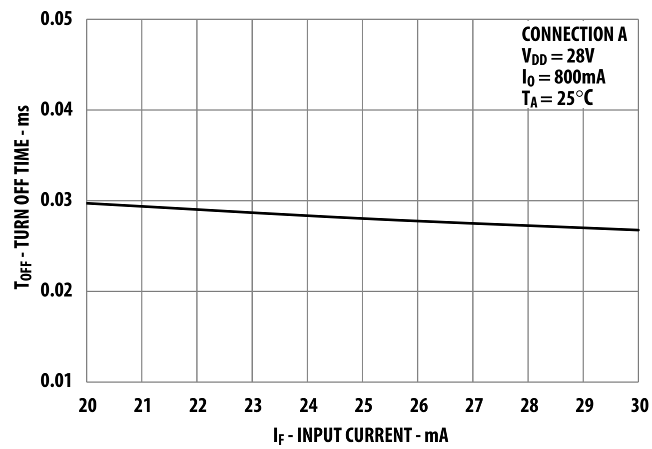


Figure 14 Typical Output Off Capacitance vs. Output Voltage

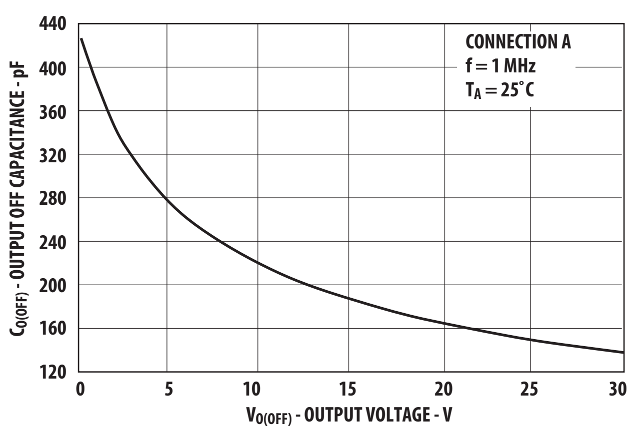


Figure 15 Output Transient Rejection Test Circuit

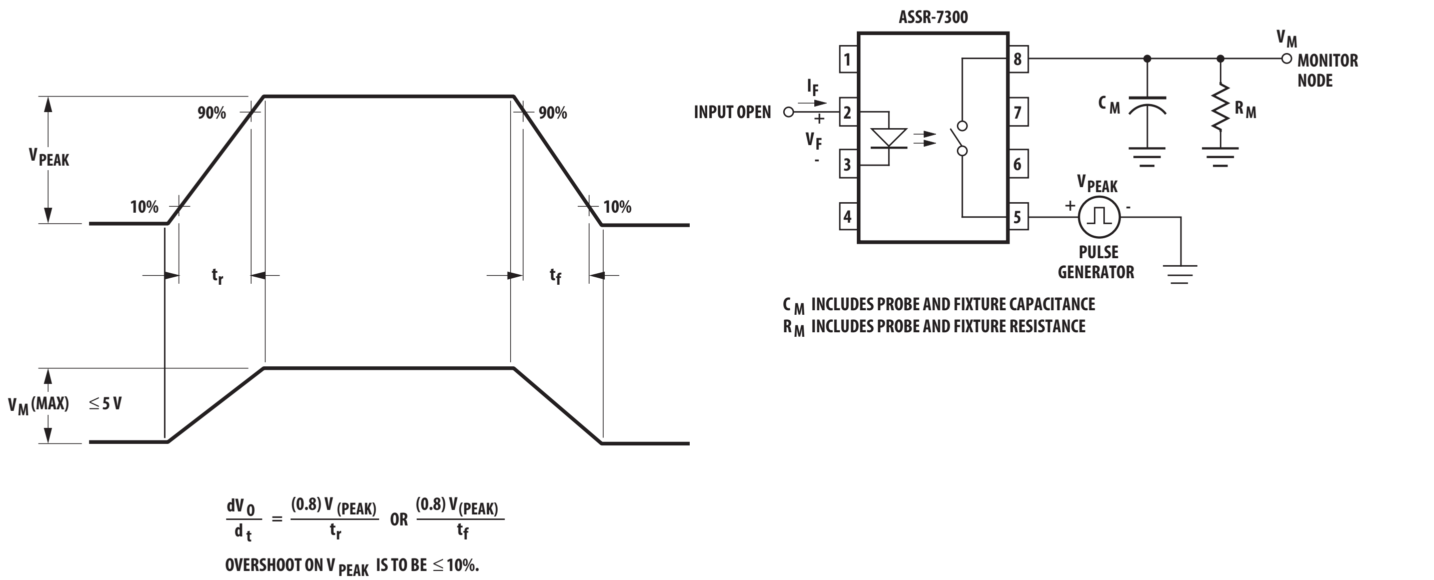


Figure 16 Input-Output Transient Rejection Test Circuit

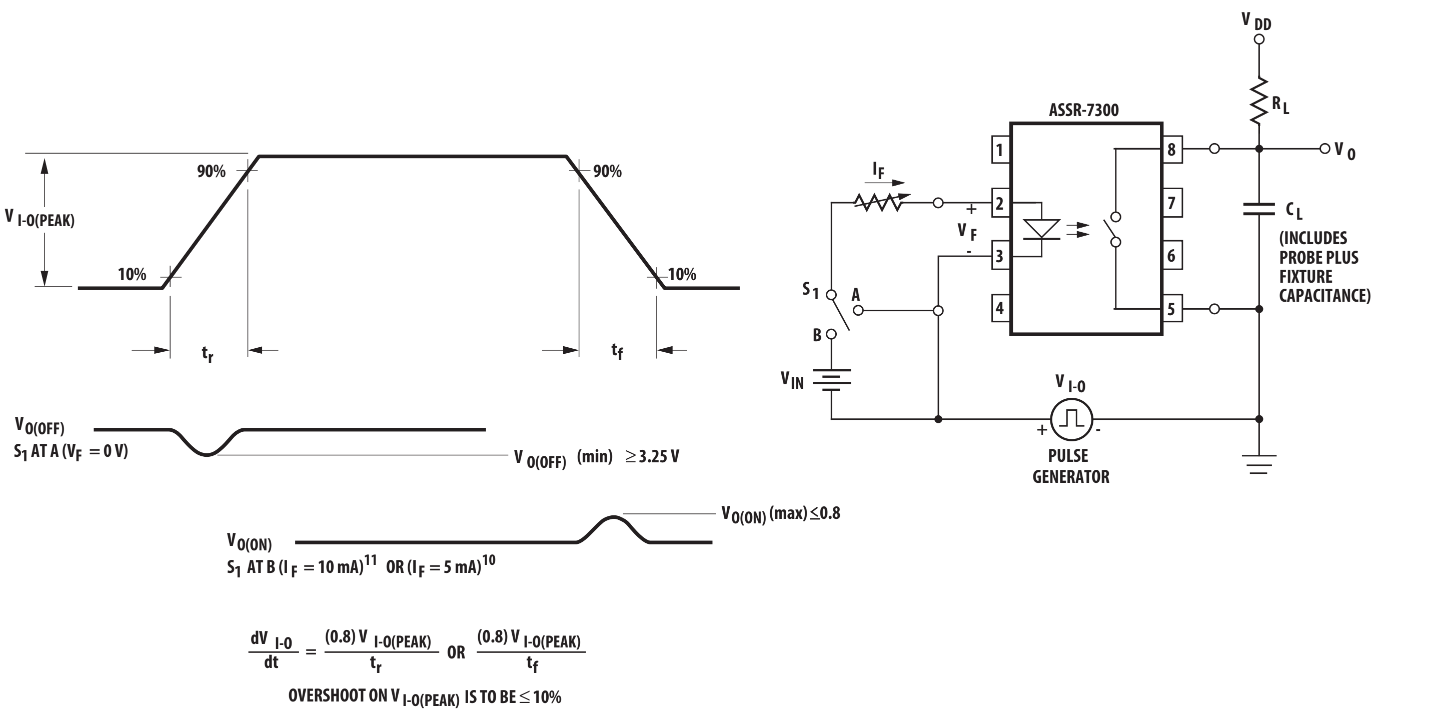


Figure 17 Voltage Offset Test Setup

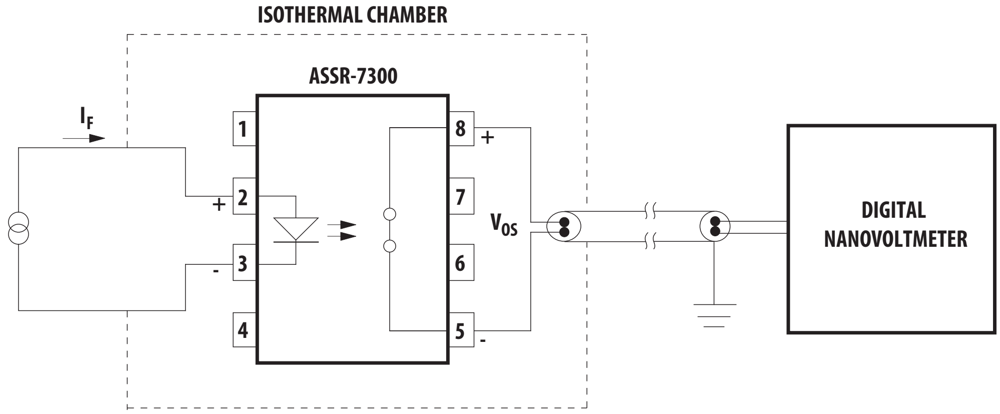


Figure 18 Burn-In Circuit

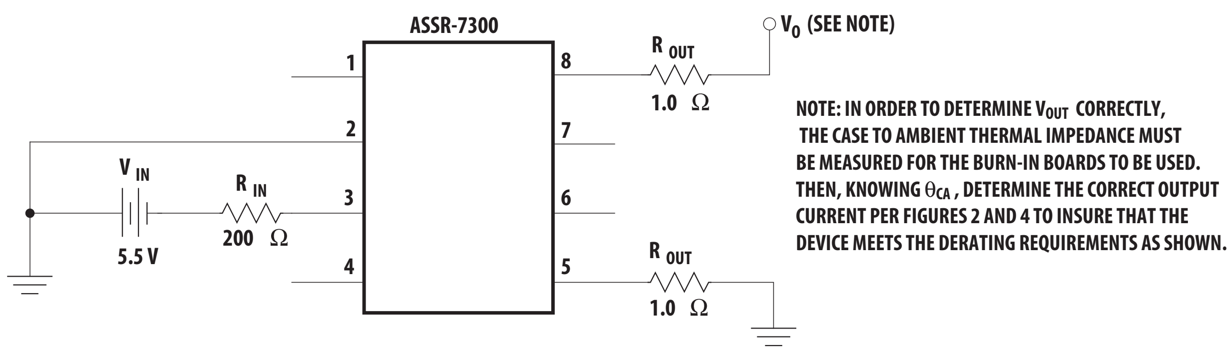
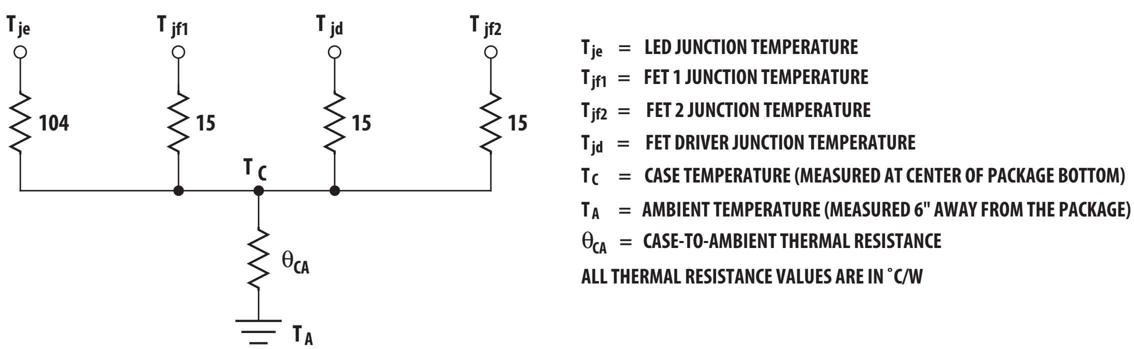


Figure 19 Thermal Model



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