ASSR-1510, ASSR-1511, ASSR-1520

High Current, Solid State Relay (Photo MOSFET)
(60V/1.0A/0.5Ω)

Data Sheet

Lead (Pb) Free
RoHS 6 fully compliant

RoHS 6 fully compliant options available;
-xxxE denotes a lead-free product

Description

The ASSR-15XX Series is specifically designed for high current applications, commonly found in the industrial applications.

The ASSR-15XX Series consists of an AlGaAs infrared light-emitting diode (LED) input stage optically coupled to a high-voltage output detector circuit. The detector consists of a high-speed photovoltaic diode array and driver circuitry to switch on/off two discrete high voltage MOSFETs. The relay turns on (contact closes) with a minimum input current of 3mA through the input LED. The relay turns off (contact opens) with an input voltage of 0.8V or less.

The single channel configurations, ASSR-1510 and ASSR-1511, are equivalent to 1 Form A Electromechanical Relays (EMR), and the dual channel configuration, ASSR-1520, is equivalent to 2 Form A EMR. They are available in 4-pin SO, 6-pin DIP, 8-pin DIP and Gull Wing Surface Mount for DIP packages. Their electrical and switching characteristics are specified over the temperature range of -40°C to +85°C.

ASSR-1511 enables AC/DC and DC-only output connections. For DC-only connection, the output current, Io, increases to 2A and the on-resistance, R(ON) reduces to 0.2Ω.

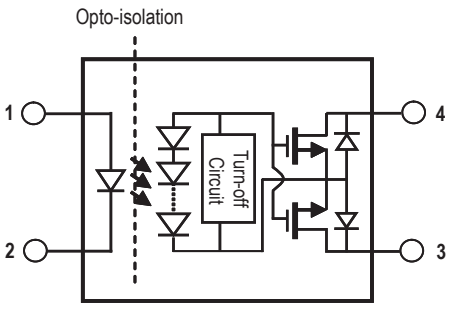
Applications

- Industrial Controls
- Factory Automation
- Data Acquisition System
- Measuring Instrument
- Medical System
- Security System
- EMR / Reed Relay Replacement

Features

- Compact Solid-State Bi-directional Signal Switch
- Single and Dual Channel Normally-off Single-Pole-Single-Throw (SPST) Relay
- 60V Output Withstand Voltage
- 1.0A or 2.0A Current Rating
  (See Schematic for ASSR-1511 Connections A & B)
- Low Input Current: CMOS Compatibility
- Low On-Resistance:
  0.12Ω Typical for DC-only, 0.35Ω Typical for AC/DC
- Very High Output Off-state Impedance:
  10 Teraohms Typical
- High Speed Switching: 0.25ms (Ton), 0.02ms (Toff) Typical
- High Transient Immunity: >1kV/µs
- High Input-to-Output Insulation Voltage
  (Safety and Regulatory Approvals Pending)
  - 3750 Vrms for 1 min per UL1577
  - CSA Component Acceptance

Functional Diagram



Single Channel, SPST Relay,
1 Form A in 4-Pin SO Package

Truth Table

LED	Output
Off	Open
On	Close

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.

Ordering Information

ASSR-xxxx is UL Recognized with 3750 Vrms for 1 minute per UL1577 and is approved under CSA Component Acceptance Notice #5, File CA 88324.

Part number	Option RoHS Compliant	Package	Surface Mount	Gull Wing	Tape & Reel	Quantity
ASSR-1510	-003E	SO-4	X			100 units per tube
	-503E		X		X	1500 units per reel
ASSR-1511	-001E	300mil DIP-6				50 units per tube
	-301E		X	X		50 units per tube
	-501E		X	X	X	1000 units per reel
ASSR-1520	-002E	300 mil DIP-8				50 units per tube
	-302E		X	X		50 units per tube
	-502E		X	X	X	1000 units per reel

To order, choose a part number from the part number column and combine with the desired option from the option column to form an order entry.

Example 1:

ASSR-1511-501E to order product of 300mil DIP-6 Gull Wing Surface Mount package in Tape and Reel packaging and RoHS Compliant.

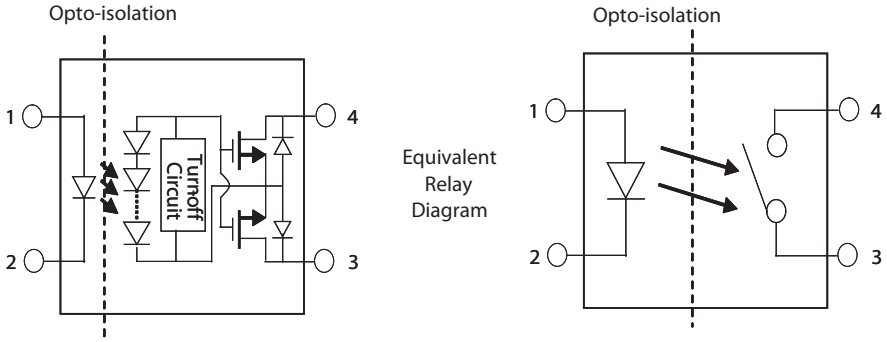
Example 2:

ASSR-1520-002E to order product of 300mil DIP-8 package in tube packaging and RoHS Compliant.

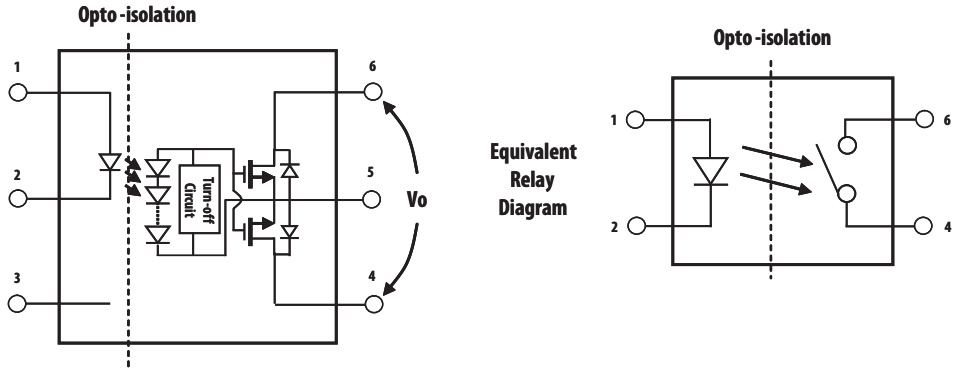
Option datasheets are available. Contact your Avago sales representative or authorized distributor for information.

Schematic

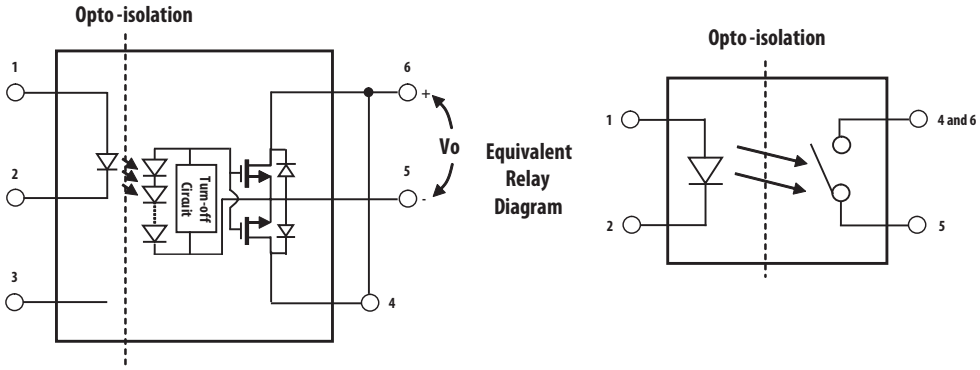
ASSR-1510



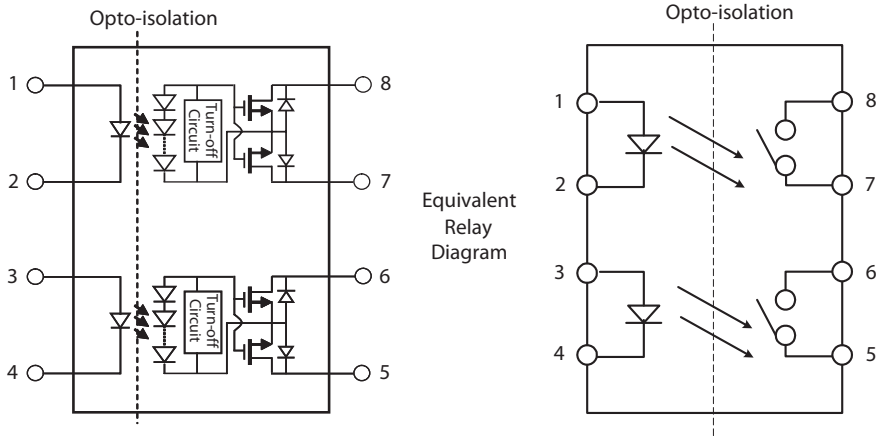
ASSR-1511 Connection A



ASSR-1511 Connection B

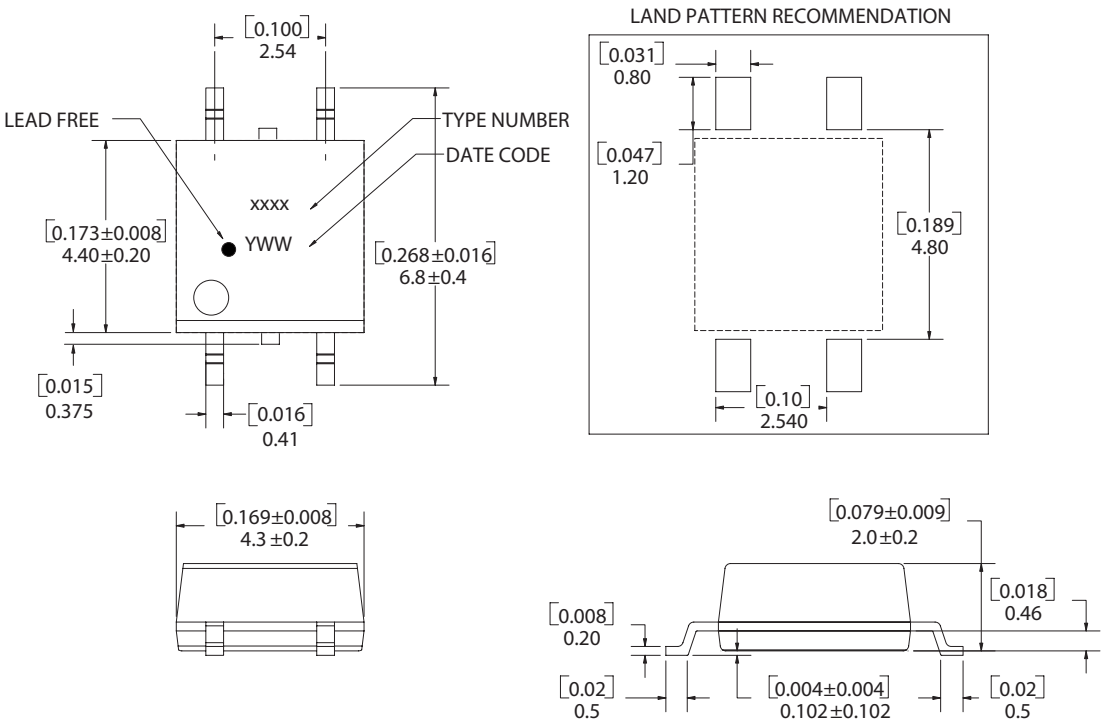


ASSR-1520



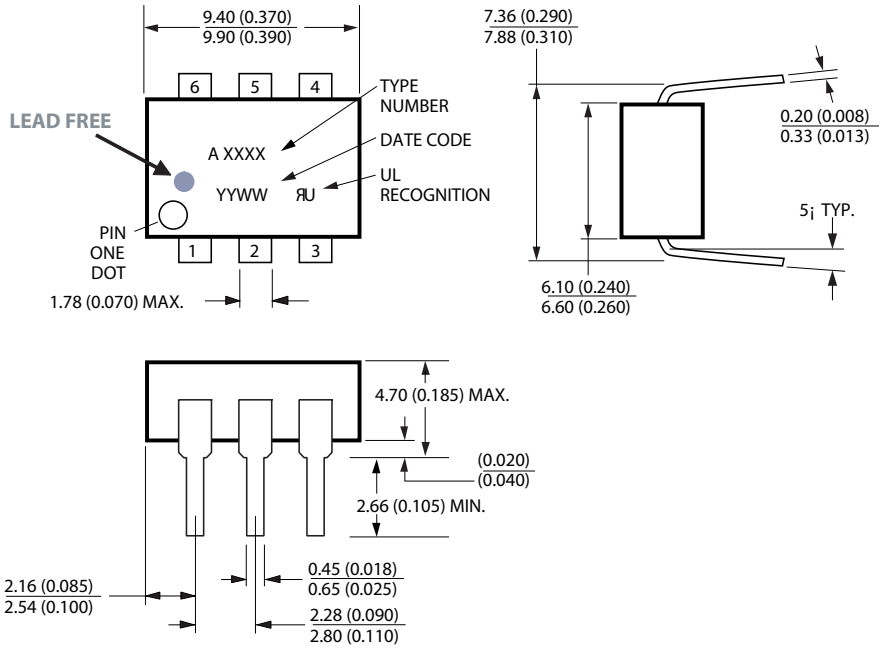
Package Outline Drawings

ASSR-1510 4-Pin Small Outline Package



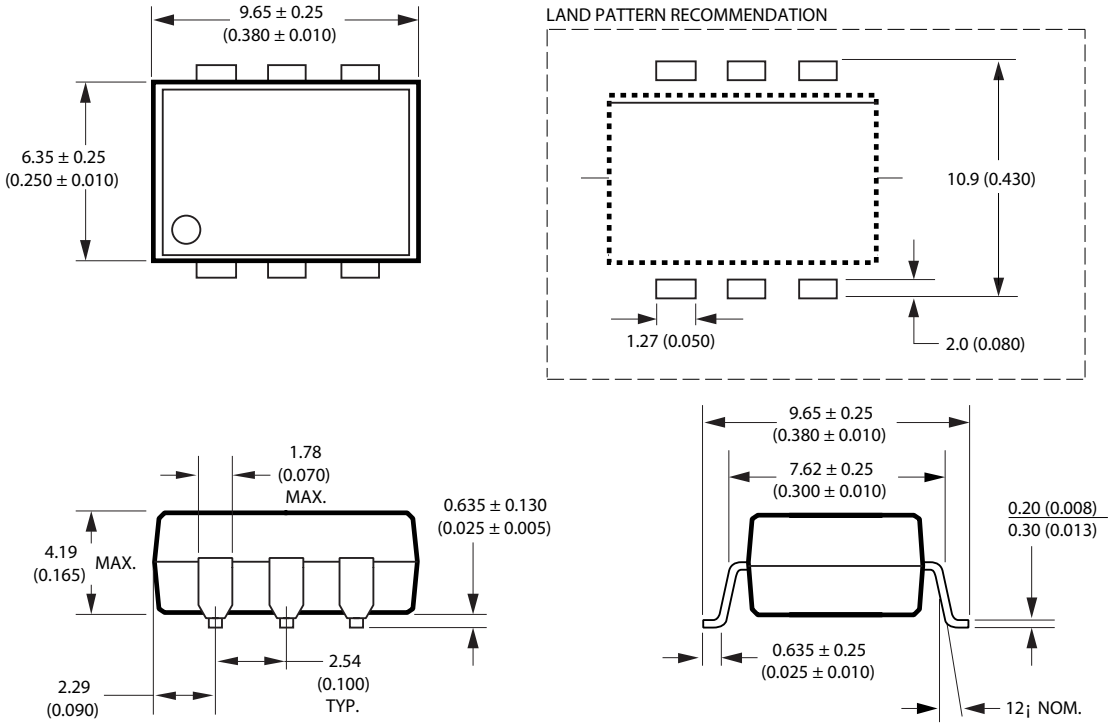
DIMENSIONS IN MILLIMETERS AND [INCHES]
OPTION NUMBER 500 AND UL RECOGNITION NOT MARKED

ASSR-1511 6-Pin DIP Package



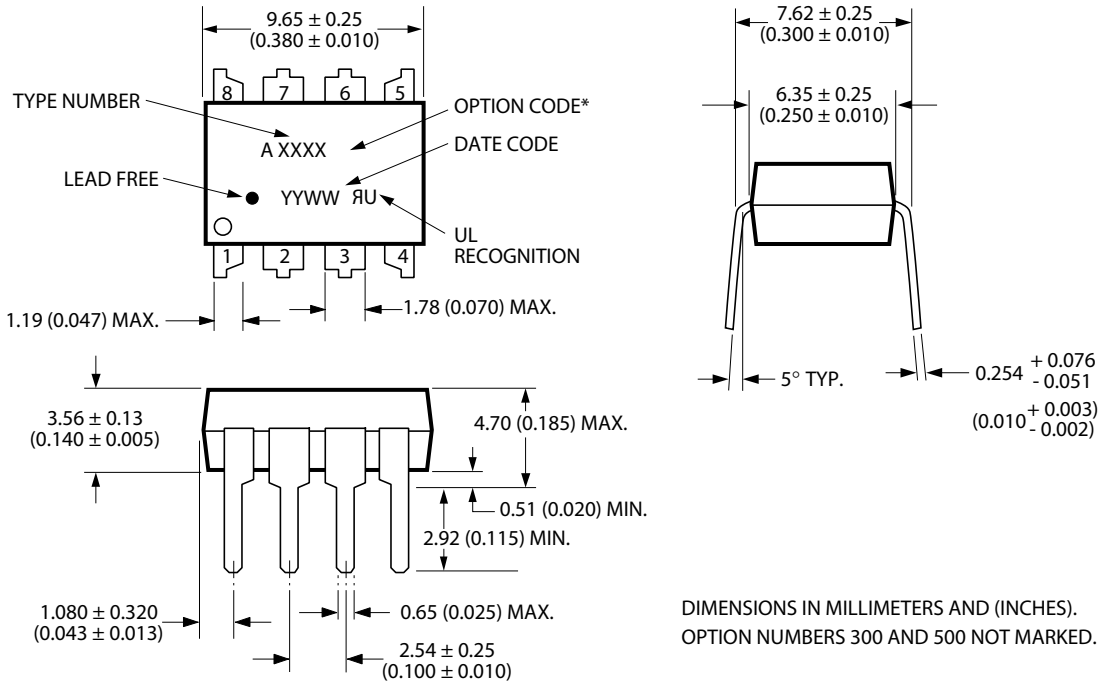
DIMENSIONS IN MILLIMETERS AND (INCHES).

ASSR-1511 6-Pin DIP Package with Gull Wing Surface Mount Option 300



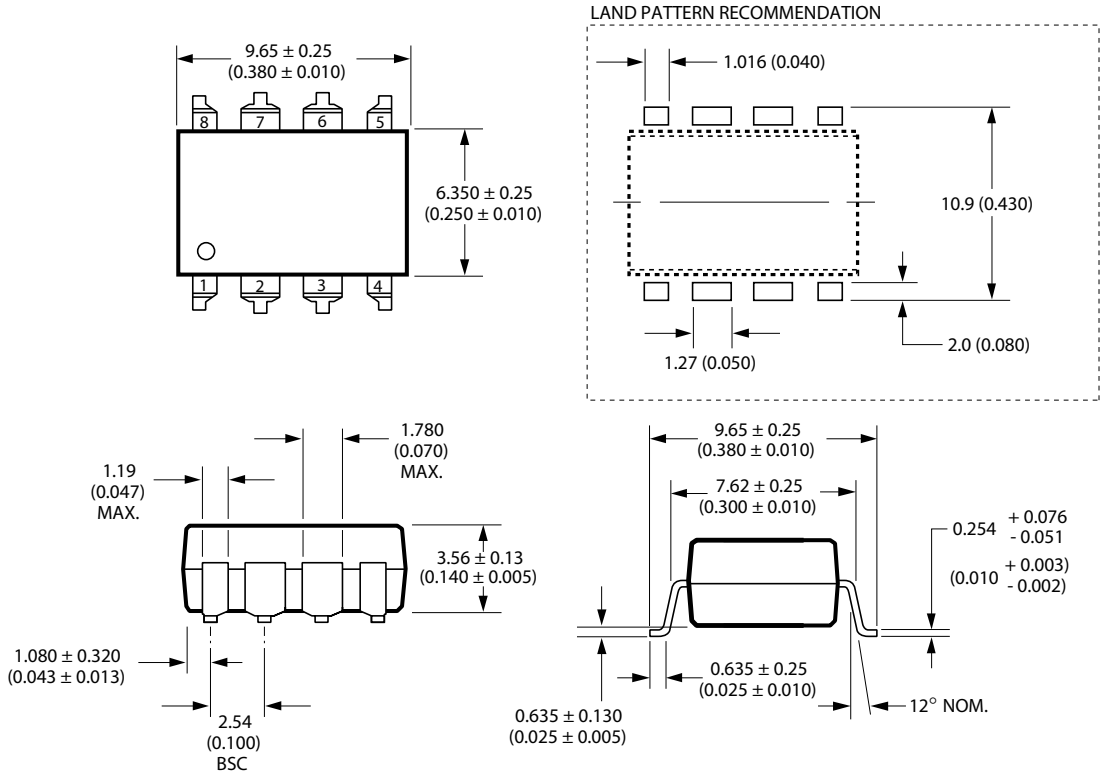
NOTE: FLOATING LEAD PROTRUSION IS 0.25 mm (10 mils) MAX.

ASSR-1520 8-Pin DIP Package



DIMENSIONS IN MILLIMETERS AND (INCHES).
OPTION NUMBERS 300 AND 500 NOT MARKED.

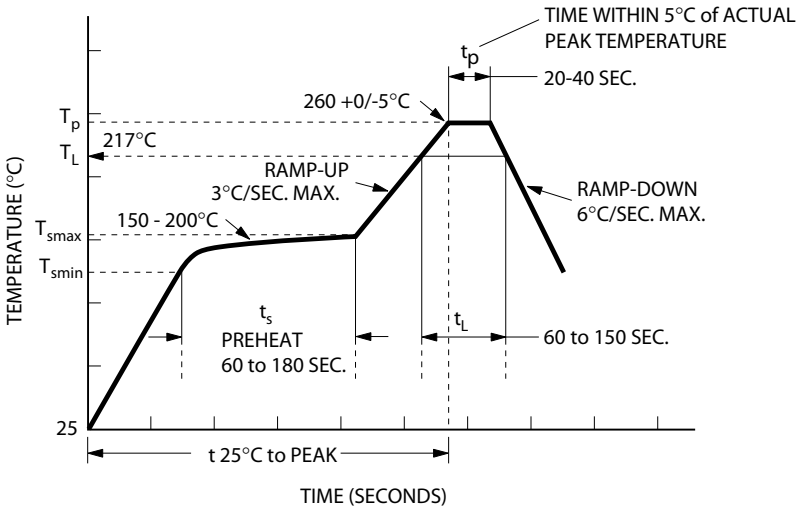
ASSR-1520 8-Pin DIP Package with Gull Wing Surface Mount Option 300



DIMENSIONS IN MILLIMETERS (INCHES).
LEAD COPLANARITY = 0.10 mm (0.004 INCHES).

NOTE: FLOATING LEAD PROTRUSION IS 0.25 mm (10 mils) MAX.

Lead Free IR Profile



NOTES:
THE TIME FROM 25°C to PEAK TEMPERATURE = 8 MINUTES MAX.
T_{smax} = 200°C, T_{smin} = 150°C

Use of non-chlorine-activated fluxes is highly recommended.

Regulatory Information

The ASSR-1510, ASSR-1511 and ASSR-1520 are pending approval by the following organizations:

UL

Pending approval under UL 1577, component recognition program up to V_{ISO} = 3750 V_{RMS}

CSA

Pending approval under CSA Component Acceptance Notice #5.

Insulation and Safety Related Specifications

Parameter	Symbol	ASSR-1510	ASSR-1511 ASSR-1520	Units	Conditions
Minimum External Air Gap (Clearance)	L(101)	4.9	7.1	mm	Measured from input terminals to output terminals, shortest distance through air.
Minimum External Tracking (Creepage)	L(102)	4.9	7.4	mm	Measured from input terminals to output terminals, shortest distance path along body.
Minimum Internal Plastic Gap (Internal Clearance)		0.08	0.08	mm	Through insulation distance conductor to conductor, usually the straight line distance thickness between the emitter and detector.
Tracking Resistance (Comparative Tracking Index)	CTI	175	175	V	DIN IEC 112/VDE 0303 Part 1
Isolation Group (DIN VDE0109)		IIIa	IIIa		Material Group (DIN VDE 0109)

Absolute Maximum Ratings

Parameter		Symbol	Min.	Max.	Units	Note
Storage Temperature		T_S	-55	125	°C	
Operating Temperature		T_A	-40	85	°C	
Junction Temperature		T_J		125	°C	
Lead Soldering Cycle	Temperature			260	°C	
	Time			10	s	
Input Current	Average	I_F		25	mA	
	Surge			50		
	Transient			1000		
Reversed Input Voltage		V_R		5	V	
Input Power Dissipation	ASSR-1510	P_{IN}		40	mW	
	ASSR-1511	P_{IN}		40	mW	
	ASSR-1520	P_{IN}		80	mW	
Output Power Dissipation	ASSR-1510	P_O		500	mW	
	ASSR-1511	P_O		800	mW	
	ASSR-1520	P_O		1000	mW	
Average Output Current ($T_A = 25°C, T_C \leq 100°C$)		I_O		1.0	A	1
	ASSR-1511 Connection B	I_O		2.0	A	
Output Voltage ($T_A = 25°C$)		V_O	-60	60	V	2
	ASSR-1511 Connection B	V_O	0	60	V	2
Solder Reflow Temperature Profile		See Lead Free IR Profile				

Recommended Operating Conditions

Parameter	Symbol	Min.	Max.	Units	Note
Input Current (ON)	$I_{F(ON)}$	3	20	mA	3
Input Voltage (OFF)	$V_{F(OFF)}$	0	0.8	V	
Operating Temperature	T_A	-40	+85	°C	

Package Characteristics

Unless otherwise specified, T_A = 25°C.

Parameter	Sym.	Min.	Typ.	Max.	Units	Conditions	Note
Input-Output Momentary Withstand Voltage	V_{ISO}	3750			Vrms	RH ≤ 50%, t = 1 min	4, 5
Input-Output Resistance	R_{I-O}		10^{12}		Ω	V_{I-O} = 500 Vdc	
Input-Output Capacitance							
ASSR-1510	C_{I-O}		0.4		pF	f = 1 MHz; V_{I-O} = 0 Vdc	4
ASSR-1511	C_{I-O}		0.5		pF	f = 1 MHz; V_{I-O} = 0 Vdc	
ASSR-1520	C_{I-O}		0.8		pF	f = 1 MHz; V_{I-O} = 0 Vdc	

Electrical Specifications (DC)

Over recommended operating T_A = -40°C to 85°C, I_F = 5mA to 10mA, unless otherwise specified.

Parameter	Sym.	Min.	Typ.	Max.	Units	Conditions	Fig.	Note
Output Withstand Voltage	$\|V_{O(OFF)}\|$	60	65		V	V_F =0.8V, I_O=250 μA, T_A=25°C		
		55			V	V_F =0.8V, I_O=250 μA	5	
Output Leakage Current	$I_{O(OFF)}$		0.5	100	nA	V_F =0.8V, V_O=60V, T_A=25°C		
				1	μA	V_F =0.8V, V_O=60V	6	
Output Offset Voltage	$\|V_{(OS)}\|$		1		μV	I_F =5mA, I_O=0mA		
Input Reverse Breakdown Voltage	V_R	5			V	I_R =10 μA		
Input Forward Voltage	V_F	1.1	1.3	1.65	V	I_F =5mA	8, 9	
Output On-resistance	$R_{(ON)}$		0.35	0.5	Ω	I_F =5mA, I_O=1A, Pulse ≤30ms, T_A=25°C	10, 11	6
	ASSR-1511 Connection B $R_{(ON)}$		0.12	0.2	Ω	I_F =5mA, I_O=2A, Pulse ≤30ms, T_A=25°C		

Switching Specifications (AC)

Over recommended operating T_A = -40°C to 85°C, I_F = 5mA to 10mA, unless otherwise specified.

Parameter	Sym.	Min.	Typ.	Max.	Units	Conditions	Fig.	Note
Turn On Time	T_{ON}		0.5	1.0	ms	I_F =5mA, I_O=1A, T_A=25°C	12, 16	
				2.0	ms	I_F =5mA, I_O=1A	13	
			0.25	0.5	ms	I_F =10mA, I_O=1A, T_A=25°C		
				1.0	ms	I_F =10mA, I_O=1A		
Turn Off Time	T_{OFF}		0.03	0.2	ms	I_F =5mA, I_O=1A, T_A=25°C	14, 16	
				0.5	ms	I_F =5mA, I_O=1A	15	
			0.02	0.15	ms	I_F =10mA, I_O=1A, T_A=25°C		
				0.2	ms	I_F =10mA, I_O=1A		
Output Transient Rejection	dV_O/dt	1	7		kV/μs	ΔV_O=60V, T_A=25°C	17	
Input-Output Transient Rejection	dV_{I-O}/dt	1	≥ 10		kV/μs	ΔV_{I-O}=1000V, T_A=25°C	18	

Notes:

1. For derating, refer to Figure 1, 2, 3 and 4.
2. The voltage across the output terminals of the relay should not exceed this rated withstand voltage. Over-voltage protection circuits should be added in some applications to protect against over-voltage transients.
3. Threshold to switch device is $I_F \geq 0.5$mA, however, for qualified device performance over temperature range, it is recommended to operate at I_F =5mA.
4. Device is considered as a two terminal device:
   ASSR-1510 - pin 1, 2 shorted and pin 3, 4 shorted.
   ASSR-1511 - pin 1, 2, 3 shorted and pin 4, 5, 6 shorted.
   ASSR-1520 - pin 1, 2, 3, 4 shorted and pin 5, 6, 7, 8 shorted.
5. The Input-Output Momentary Withstand Voltage is a dielectric voltage rating that should not be interpreted as an input-output continuous voltage rating. For the continuous voltage rating refer to the IEC/EN/DIN EN 60747-5-2 Insulation Characteristics Table (if applicable), your equipment level safety specification, or Avago Technologies Application Note 1074, "Optocoupler Input-Output Endurance Voltage."
6. During the pulsed $R_{(ON)}$ measurement (I_O duration ≤30ms), ambient (T_A) and case temperature (T_C) are equal.

Applications Information

On-Resistance and Derating Curves

The Output On-Resistance, $R_{(ON)}$, specified in this data sheet, is the resistance measured across the output contact when a pulsed current signal (Io=1A) is applied to the output pins. The use of a pulsed signal (≤ 30ms) implies that each junction temperature is equal to the ambient and case temperatures. The steady-state resistance, Rss, on the other hand, is the value of the resistance measured across the output contact when a DC current signal is applied to the output pins for a duration sufficient to reach thermal equilibrium. Rss includes the effects of the temperature rise in the device.

Derating curves are shown in Figures 1, 2, 3 and 4, specifying the maximum output current allowable for a given ambient temperature. The maximum allowable output current and power dissipation are related by the expression Rss=Po(max)/(Io(max))^2 from which Rss can be calculated. Staying within the safe area assures that the steady state MOSFET junction temperature remains less than 125°C.

Turn On Time and Turn Off Time Variation

The ASSR-15xx Series exhibits a very fast turn on and turn off time. Both the turn on and turn off time can be adjusted by choosing proper forward current as depicted in Figures 12 and 14. The changes of the turn on and turn off time with ambient temperature are also shown in Figures 13 and 15.

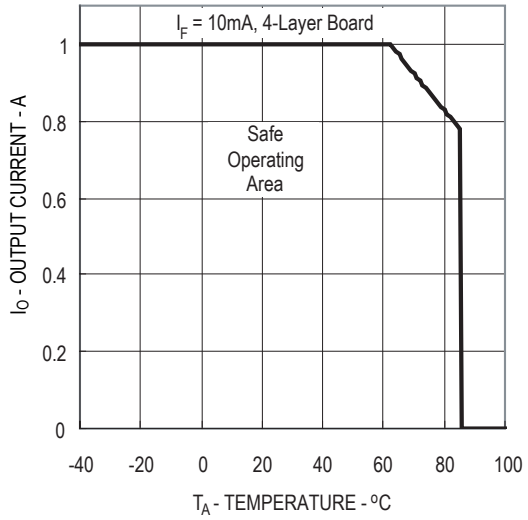


Figure 1. Maximum Output Current Rating vs Ambient Temperature (ASSR-1510-003E)

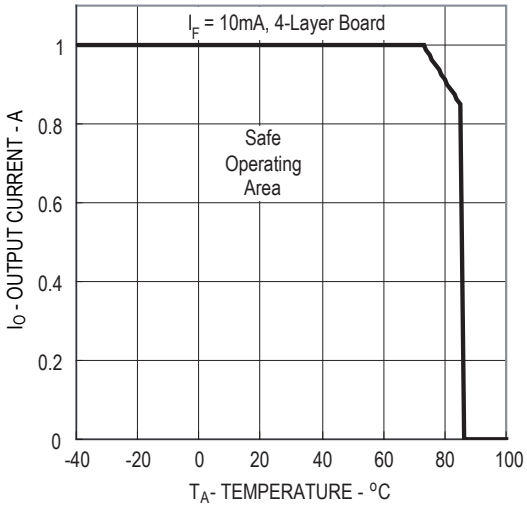


Figure 2. Maximum Output Current Rating vs Ambient Temperature (ASSR-1511-001E)

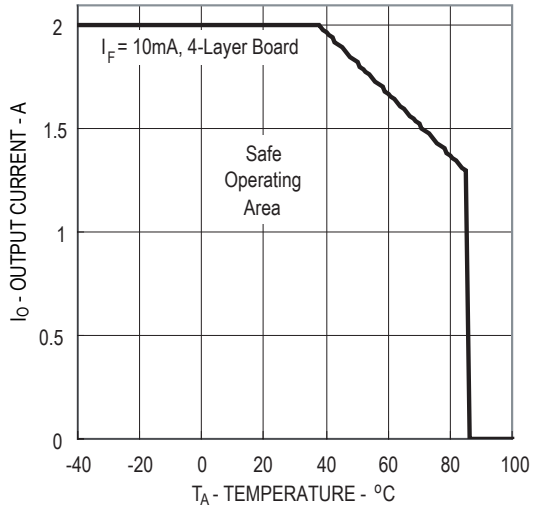


Figure 3. Maximum Output Current Rating vs Ambient Temperature (ASSR-1511-001E DC Connection)

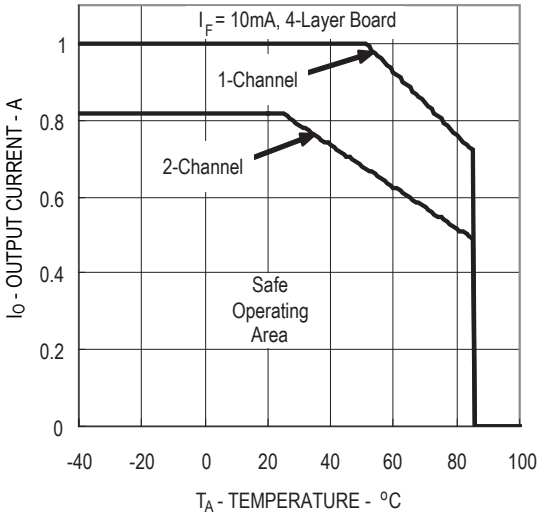


Figure 4. Maximum Output Current Rating vs Ambient Temperature (ASSR-1520-002E)

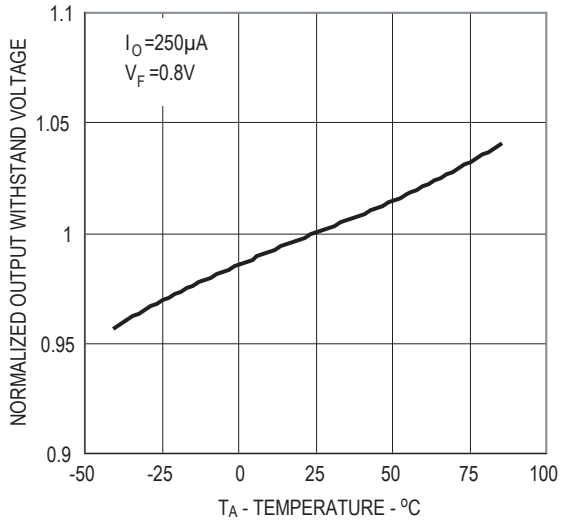


Figure 5. Normalized Typical Output Withstand Voltage vs. Temperature

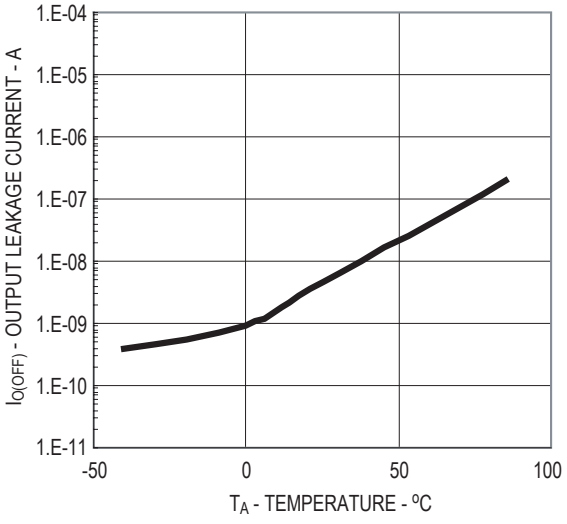


Figure 6. Typical Output Leakage Current vs. Temperature

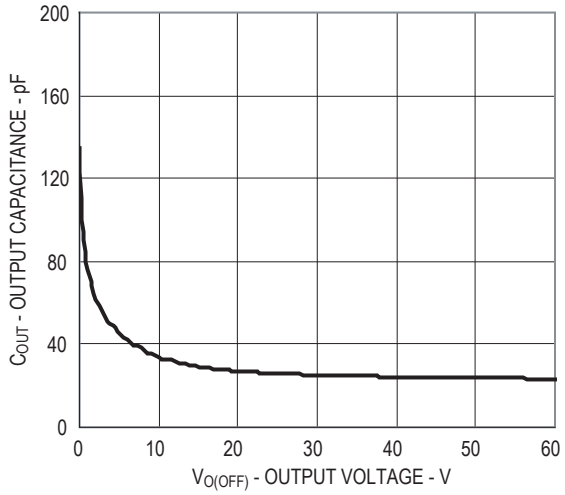


Figure 7. Output Capacitance vs. Output Voltage

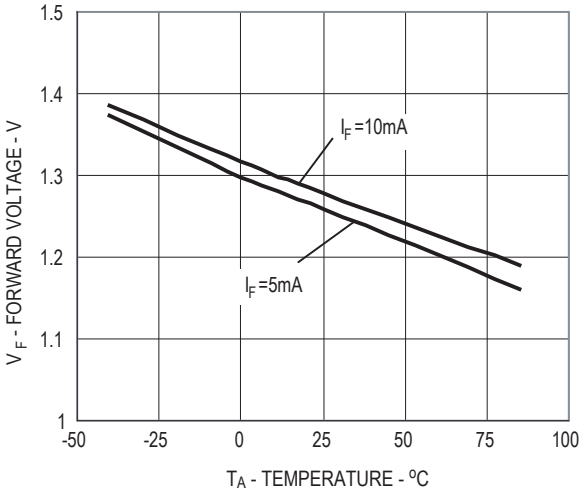


Figure 8. Typical Forward Voltage vs. Temperature

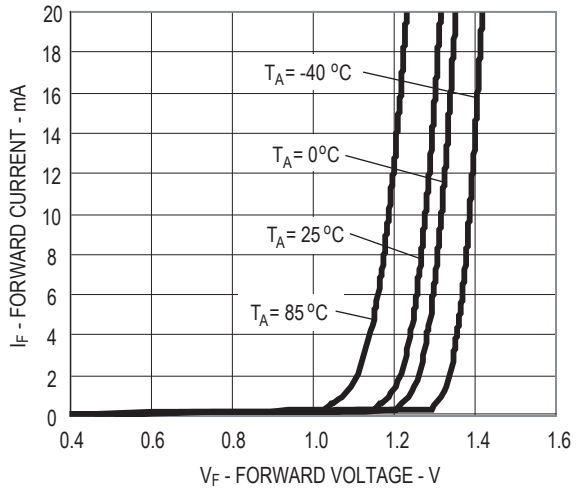


Figure 9. Typical Forward Current vs. Forward Voltage

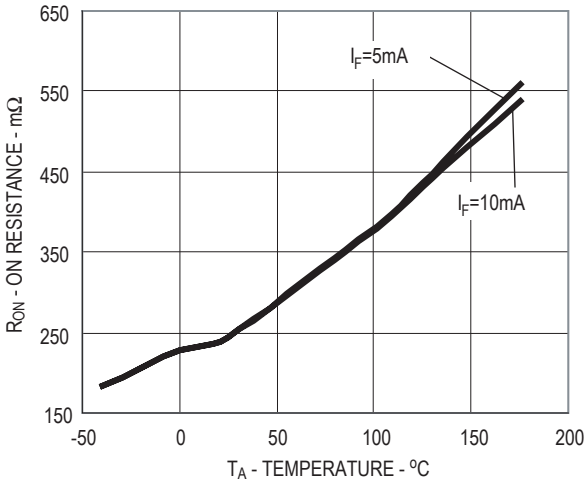


Figure 10. Typical On Resistance vs.Temperature

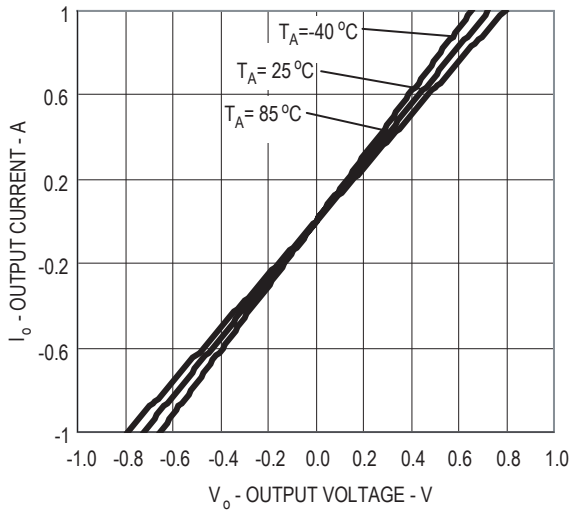


Figure 11. Typical Output Current vs. Output Voltage

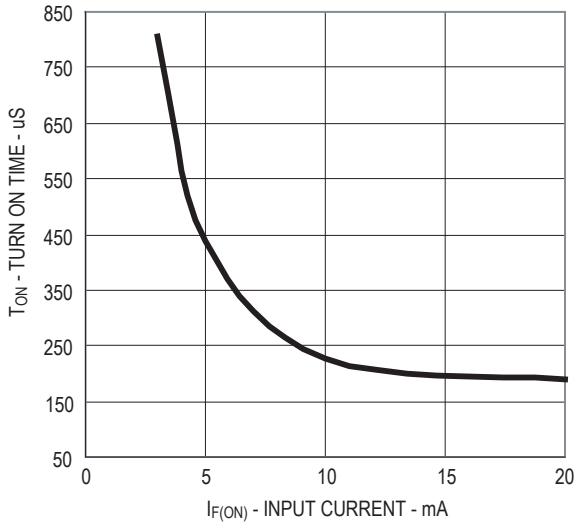


Figure 12. Typical Turn On Time vs. Input Current

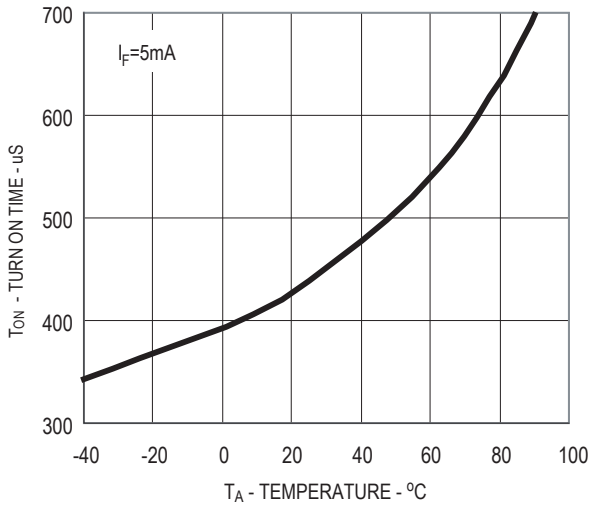


Figure 13. Typical Turn On Time vs. Temperature

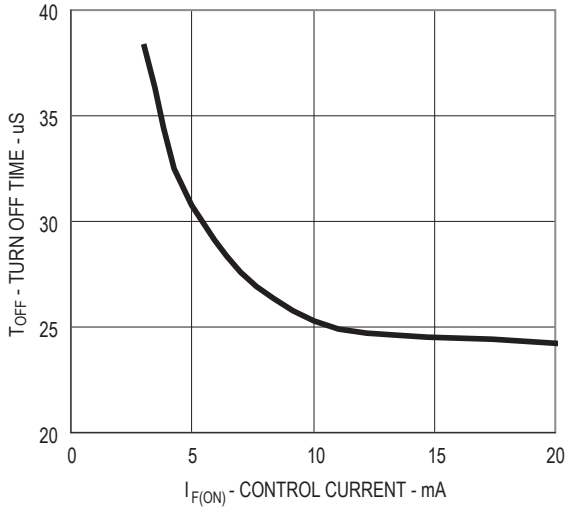


Figure 14. Typical Turn Off Time vs. Input Current

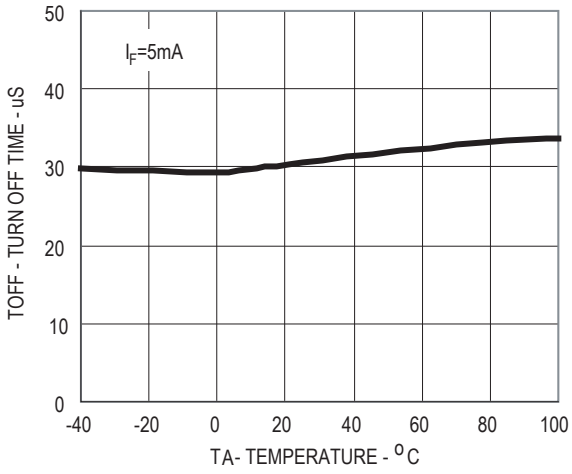


Figure 15. Typical Turn Off Time vs. Temperature

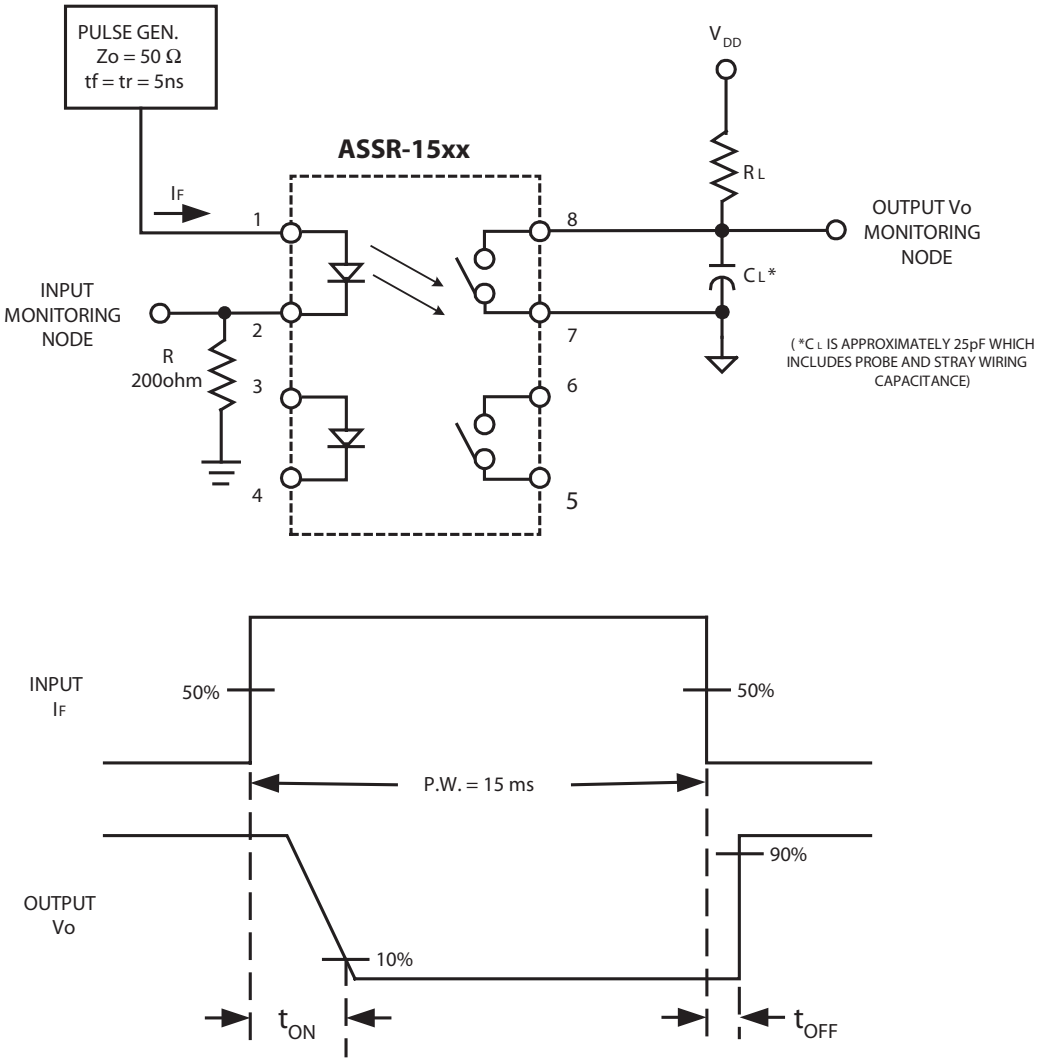
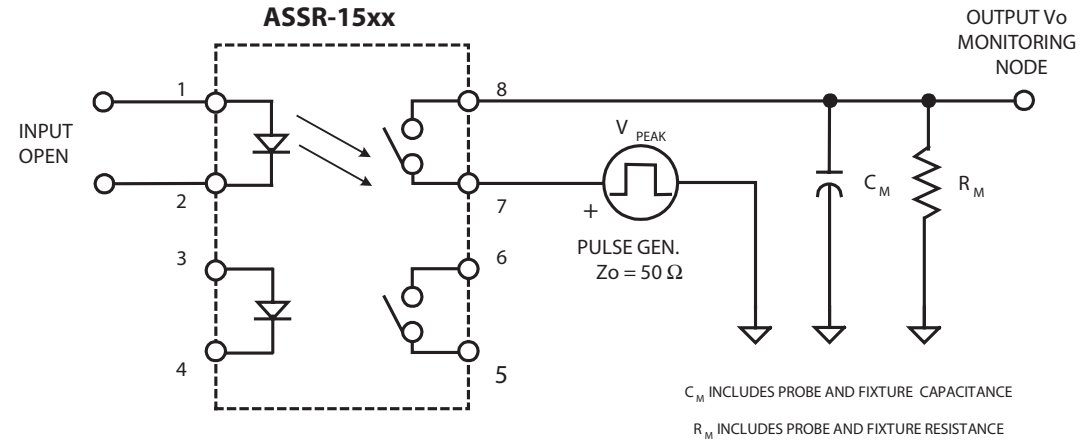
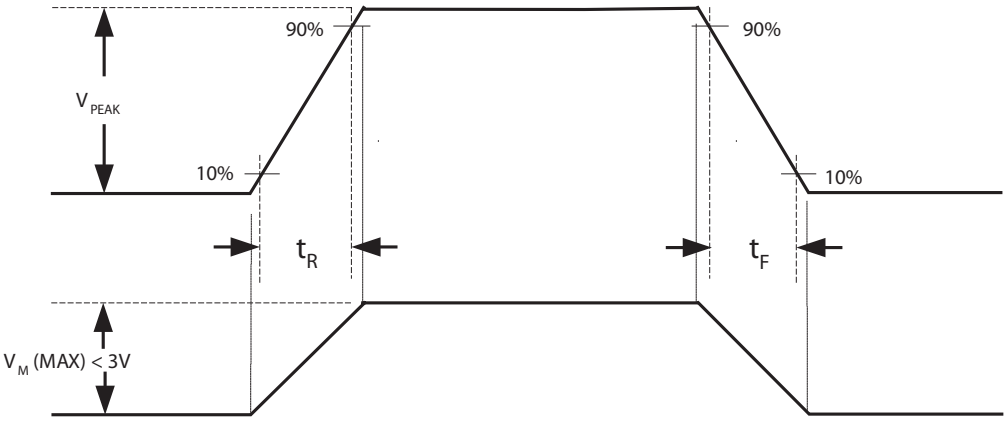


Figure 16. Switching Test circuit for t_{ON} , t_{OFF}





$$\frac{dV_0}{dt} = \frac{(0.8)V_{PEAK}}{t_R} \; OR \; \frac{(0.8)V_{PEAK}}{t_F}$$

OVERSHOOT ON V_{PEAK} IS TO BE ≤ 10%

Figure 17. Output Transient Rejection Test Circuit

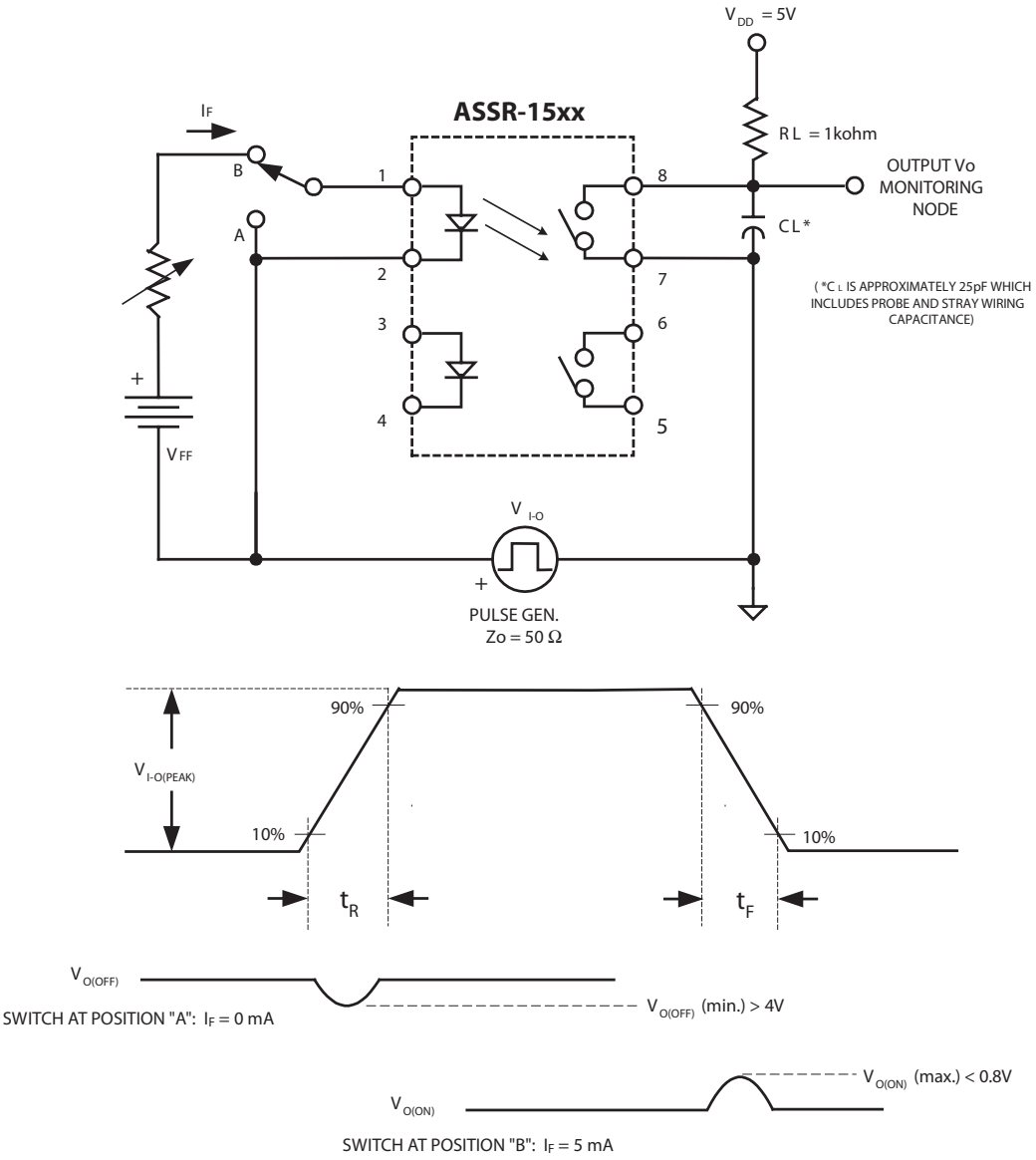


Figure 18. Input - Output Transient Rejection Test Circuit

AV02-0036EN - July 13, 2007