

ASSR-1510, ASSR-1511, ASSR-1520, ASSR-1530

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

Description

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

The ASSR-15XX Series consists of an AlGaAs infrared light-emitting diode (LED) input stage that is 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 and off two discrete high-voltage MOSFETs. The relay turns on (contact closes) with a minimum input current of 3 mA 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 configurations, ASSR-1520 and ASSR-1530, are 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 and true surface mount SO-8pin. Their electrical and switching characteristics are specified over the temperature range of -40°C to +85°C.

The ASSR-1511 enables AC/DC and DC-only output connections. For DC-only connections, the output current, I_O , increases to 2A and the on-resistance, $R_{(ON)}$, reduces to 0.2Ω.

Features

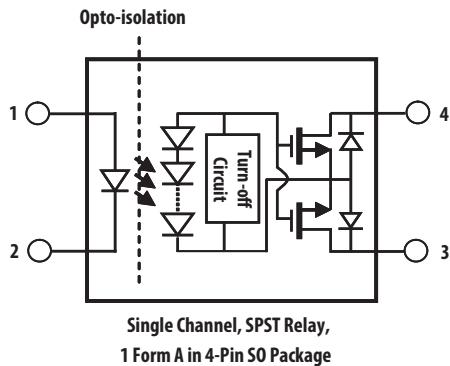
- Compact solid-state bidirectional signal switch
- Single- and dual-channel normally-off Single-Pole-Single-Throw (SPST) relay
- 60V output withstand voltage
- 1.0A or 2.0A current rating (See the schematics for ASSR-1511 connections A and B.)
- Low input current: CMOS compatibility
- Low on-resistance: 0.12Ω typical for DC-only, 0.35Ω typical for AC/DC
- High-speed switching: 0.25 ms (Ton), 0.02 ms (Toff) typical
- High transient immunity: >1 kV/μs
- High input-to-output insulation voltage (safety and regulatory approvals)
 - 3750 Vrms for 1 minute per UL1577
 - CSA component acceptance

Applications

- Industrial controls
- Factory automation
- Data acquisition system
- Measuring instrument
- Medical system
- Security system
- EMR/Reed Relay replacement

CAUTION! It is advised that normal static precautions be taken in the handling and assembly of this component to prevent damage and degradation that may be induced by ESD. The components featured in this data sheet are not to be used in military or aerospace applications or environments. The components are not AEC-Q100 qualified and are not recommended for automotive applications.

Functional Diagram



Truth Table

LED	Output
Off	Open
On	Close

Ordering Information

ASSR-xxxx is UL recognized with 3750 Vrms for 1 minute per UL1577 and is approved under CSA Component Acceptance Notice #5.

Part Number	Option	Package	Surface Mount	Gull Wing	Tape & Reel	Quantity
	RoHS Compliant					
ASSR-1510	-003E	SO-4	X			100 units per tube
	-503E		X		X	1500 units per reel
ASSR-1511	-001E	300 mil 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
ASSR-1530	-005E	SO-8	X			50 units per tube
	-505E		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 300-mil DIP-6 gull wing surface mount package in tape and reel packaging and RoHS compliant.

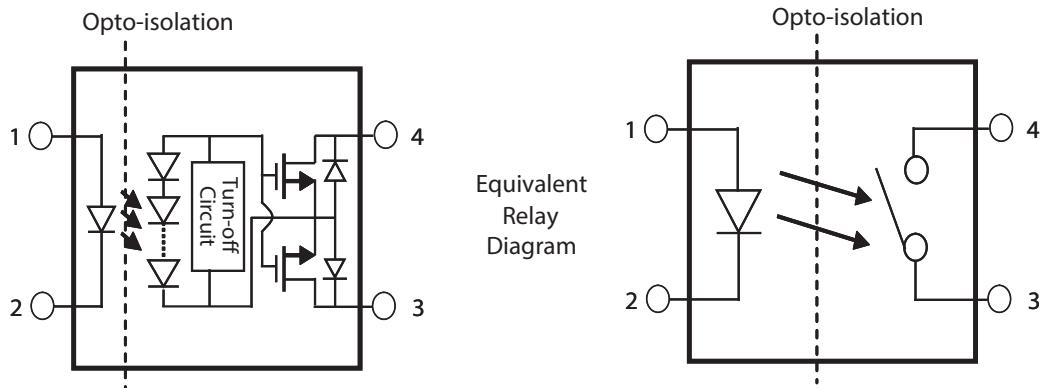
Example 2:

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

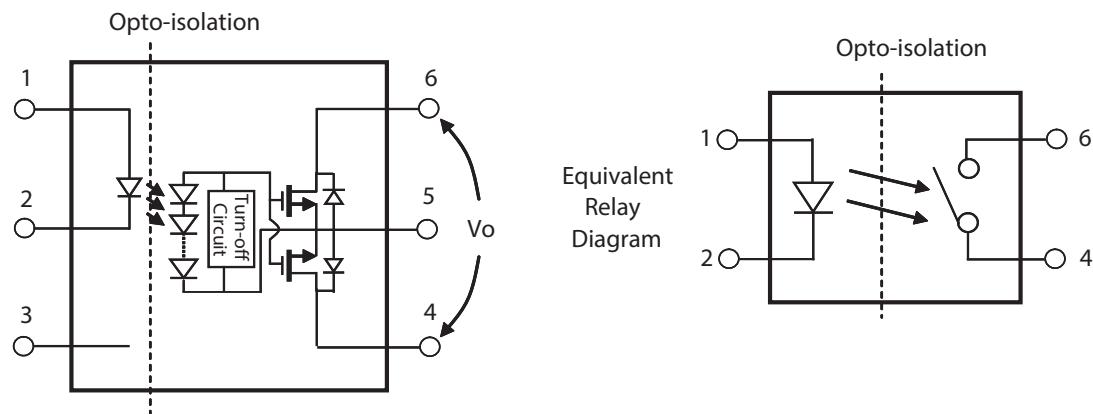
Option data sheets are available. Contact your Broadcom sales representative or authorized distributor for information.

Schematics

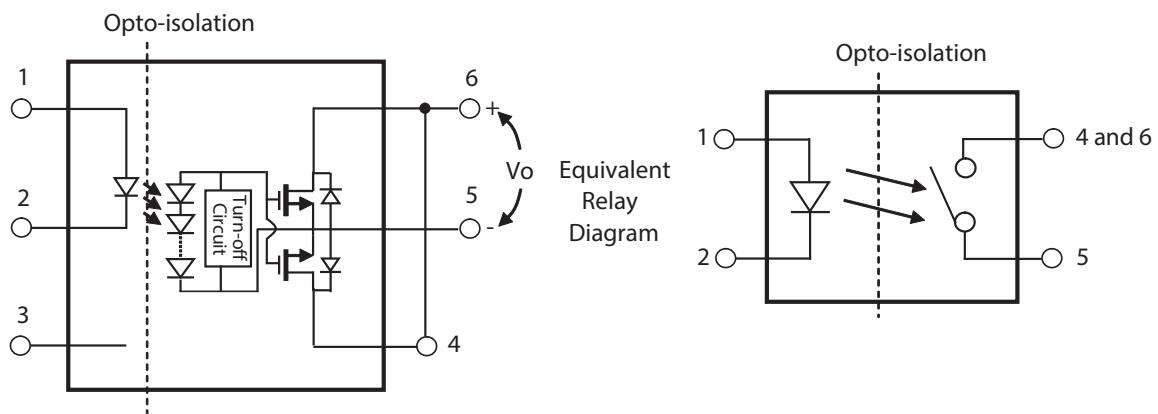
ASSR-1510



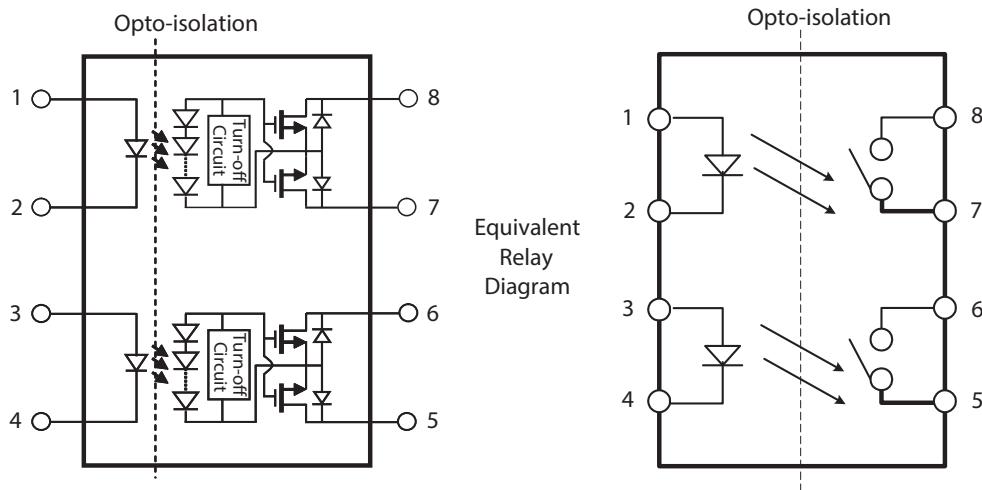
ASSR-1511 Connection A



ASSR-1511 Connection B

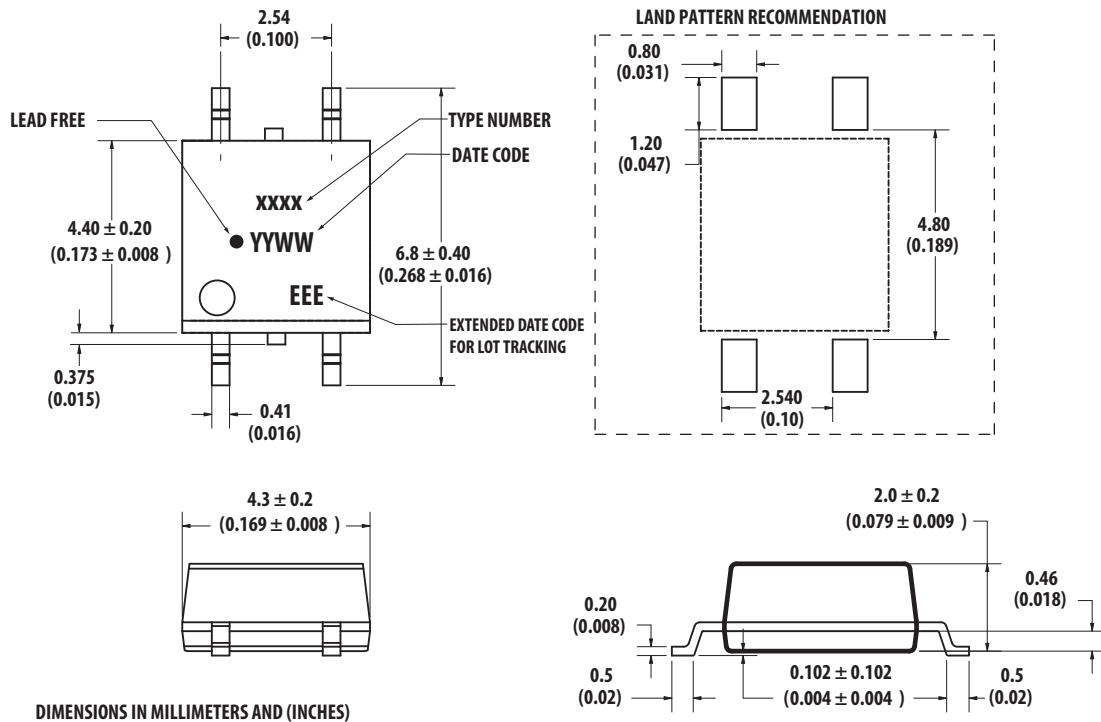


ASSR-1520 and ASSR-1530

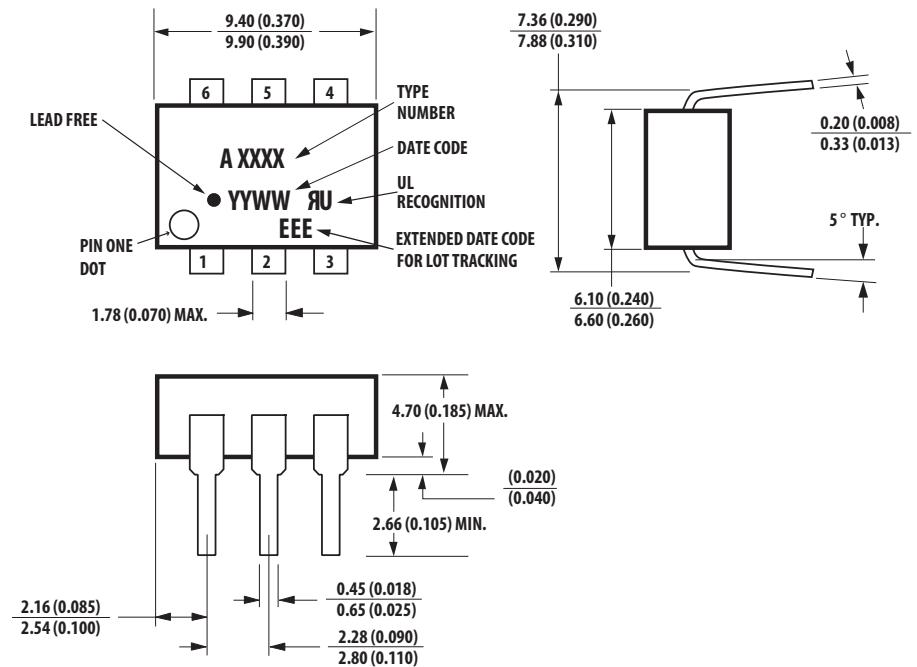


Package Outline Drawings

ASSR-1510 4-Pin Small Outline Package

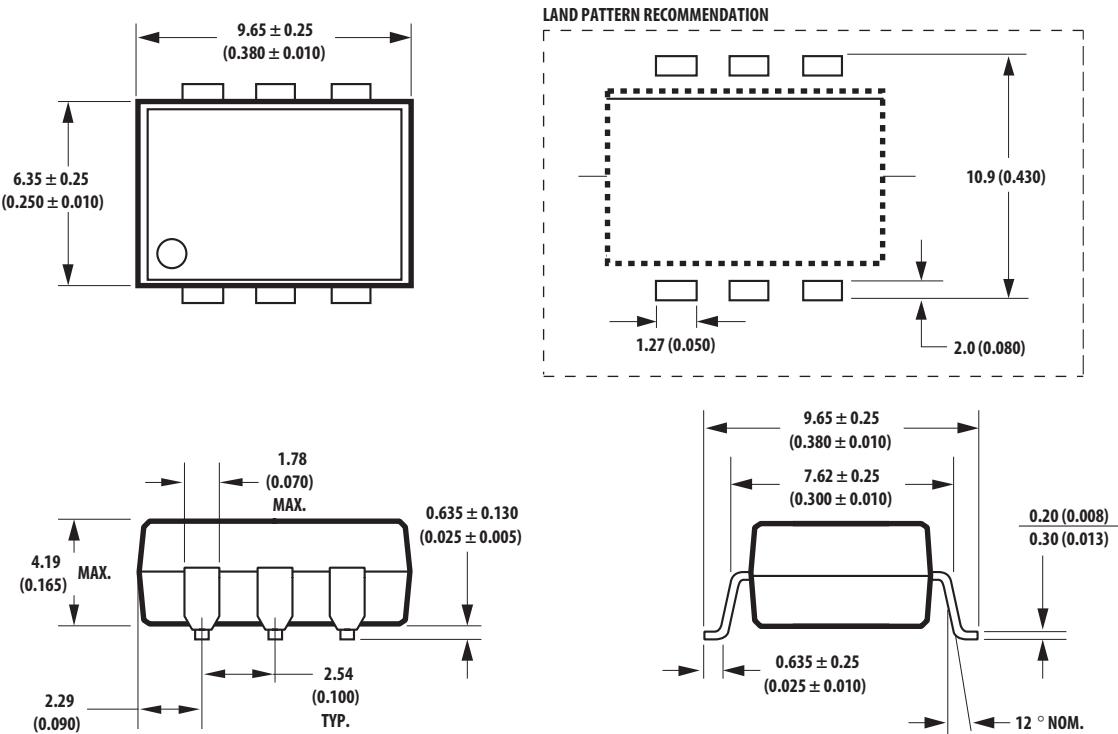


ASSR-1511 6-Pin DIP Package



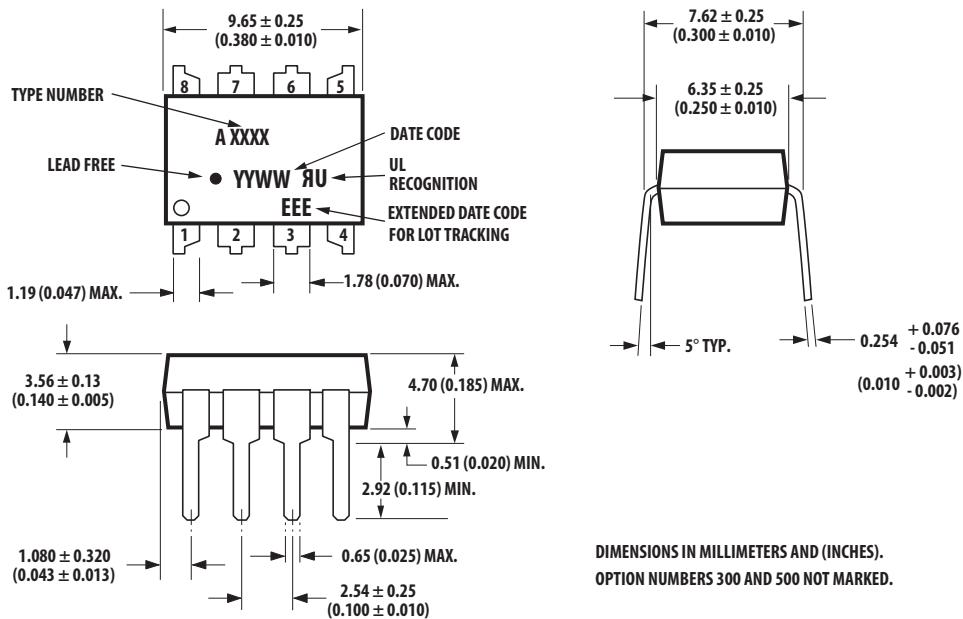
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ASSR-1511 6-Pin DIP Package with Gull Wing Surface Mount Option 300

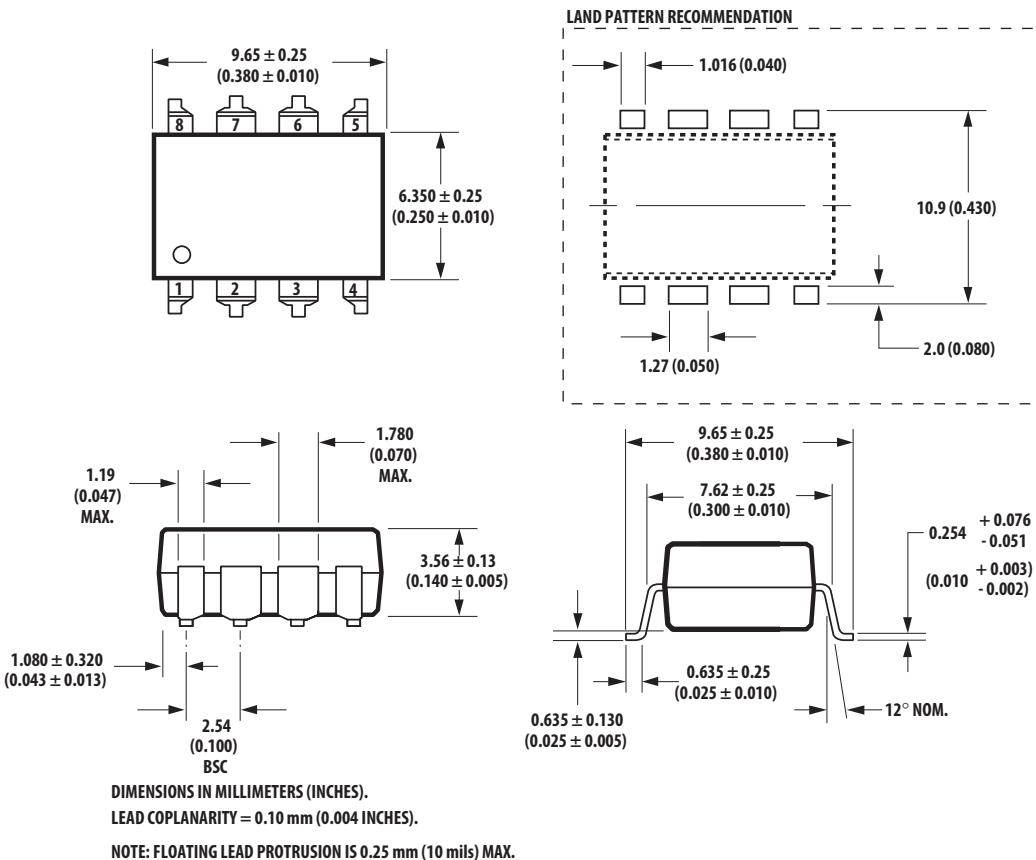


NOTE: FLOATING LEAD PROTRUSION IS 0.25 mm (10 mils) MAX.

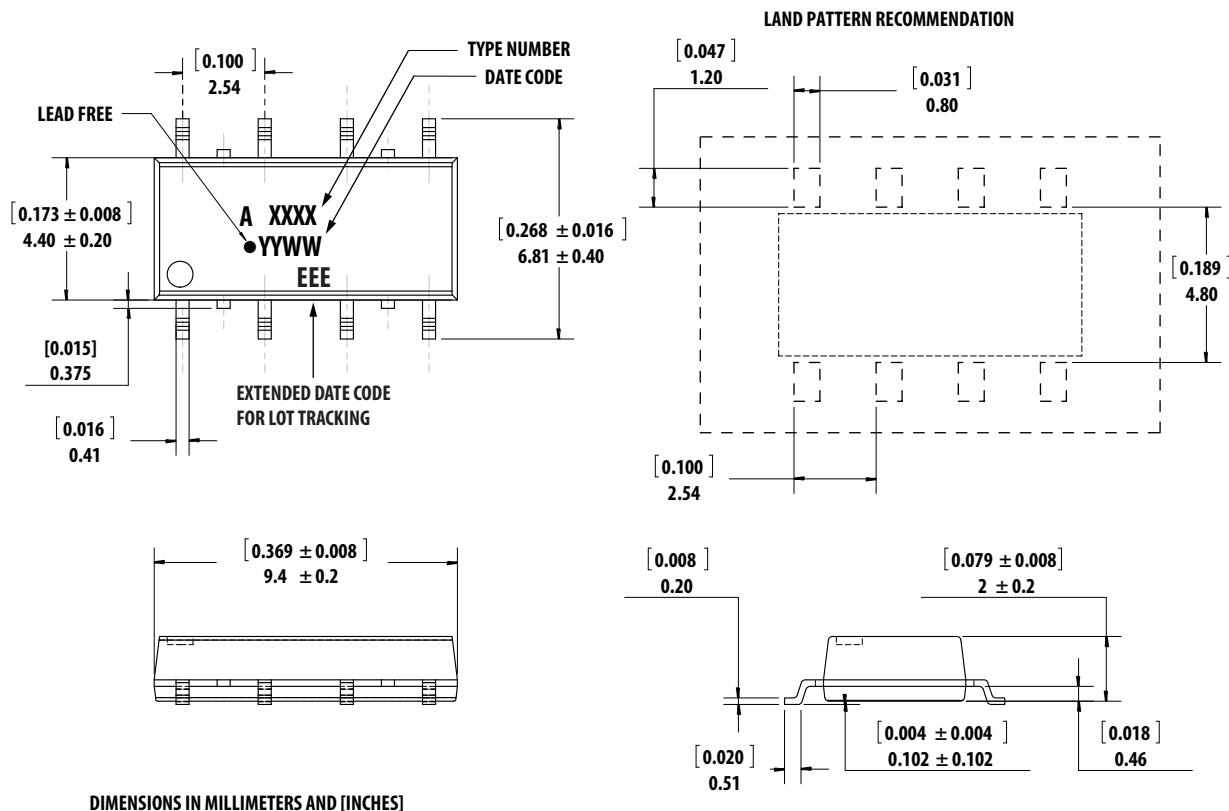
ASSR-1520 8-Pin DIP Package



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



ASSR-1530 8-Pin Surface Mount Package



Solder Reflow Profile

Recommended reflow condition as per JEDEC Standard J-STD-020 (latest revision).

NOTE: Non-halide flux should be used.

Regulatory Information

The ASSR-1510, ASSR-1511, ASSR-1520, and ASSR-1530 are approved by the following organizations:

UL

Approved under UL 1577, component recognition program up to $V_{ISO} = 3750$ Vrms.

CSA

Approved under CSA Component Acceptance Notice #5.

Insulation and Safety Related Specifications

Parameter	Symbol	ASSR-1510	ASSR-1511 ASSR-1520	ASSR-1530	Unit	Conditions
Minimum External Air Gap (Clearance)	L(101)	4.9	7.1	4.9	mm	Measured from input terminals to output terminals, shortest distance through air.
Minimum External Tracking (Creepage)	L(102)	4.9	7.4	4.8	mm	Measured from input terminals to output terminals, shortest distance path along body.
Minimum Internal Plastic Gap (Internal Clearance)	—	0.08	0.08	0.08	mm	Through insulation distance conductor to conductor, usually the straight line distance thickness between the emitter and the detector.
Tracking Resistance (Comparative Tracking Index)	CTI	175	175	175	V	DIN IEC 112/VDE 0303 Part 1.
Isolation Group (DIN VDE0109)	—	IIIa	IIIa	IIIa	—	Material Group (DIN VDE 0109).

Absolute Maximum Ratings

Parameter	Symbol	Min.	Max.	Unit	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	—	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 ASSR-1530	P _{IN}	—	80	mW
Output Power Dissipation	ASSR-1510	P _O	—	500	mW
	ASSR-1511	P _O	—	800	mW
	ASSR-1520 ASSR-1530	P _O	—	700	mW
Average Output Current (T _A = 25°C, T _C ≤ 100°C)	ASSR-1511 Connection A	I _O	—	1.0	A
	ASSR-1511 Connection B	I _O	—	2.0	A

Parameter	Symbol	Min.	Max.	Unit	Note
Output Voltage ($T_A = 25^\circ\text{C}$)	ASSR-1511 Connection A	V_O	-60	60	V
	ASSR-1511 Connection B	V_O	0	60	V
Solder Reflow Temperature Profile		See Solder Reflow Profile .			

- a. For derating, see [Figure 1](#), [Figure 2](#), [Figure 3](#), and [Figure 4](#).
- b. The voltage across the output terminals of the relay should not exceed this rated withstand voltage. Overvoltage protection circuits should be added in some applications to protect against overvoltage transients.

Recommended Operating Conditions

Parameter	Symbol	Min.	Max.	Unit	Note
Input Current (ON)	$I_F(\text{ON})$	3	20	mA	a
Input Voltage (OFF)	$V_F(\text{OFF})$	0	0.8	V	
Operating Temperature	T_A	-40	+85	°C	

- a. The threshold to switch the device is $I_F \geq 0.5$ mA; however, for qualified device performance over the temperature range, it is recommended to operate at $I_F = 5$ mA.

Package Characteristics

Unless otherwise specified, $T_A = 25^\circ\text{C}$.

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions	Note
Input-Output Momentary Withstand Voltage	V_{ISO}	3750	—	—	Vrms	$\text{RH} \leq 50\%$, $t = 1$ min	a, b
Input-Output Resistance	R_{I-O}	—	10^{12}	—	Ω	$V_{I-O} = 500$ Vdc	
Input-Output Capacitance	C_{I-O}	—	0.4	—	pF	$f = 1$ MHz; $V_{I-O} = 0$ Vdc	a
	C_{I-O}	—	0.5	—	pF	$f = 1$ MHz; $V_{I-O} = 0$ Vdc	
	C_{I-O}	—	0.8	—	pF	$f = 1$ MHz; $V_{I-O} = 0$ Vdc	

- a. The device is considered 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 and ASSR-1530 — Pin 1, 2, 3, 4 shorted and pin 5, 6, 7, 8 shorted.
- b. 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 Broadcom Application Note 1074, *Optocoupler Input-Output Endurance Voltage*.

Electrical Specifications (DC)

Over recommended operating $T_A = -40^\circ\text{C}$ to 85°C , $I_F = 5 \text{ mA}$ to 10 mA , unless otherwise specified.

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions	Figure	Note
Output Withstand Voltage	$ V_{O(OFF)} $	60	65	—	V	$V_F = 0.8\text{V}$, $I_O = 250 \mu\text{A}$, $T_A = 25^\circ\text{C}$		
		55	—	—	V	$V_F = 0.8\text{V}$, $I_O = 250 \mu\text{A}$	5	
Output Leakage Current	$I_{O(OFF)}$	—	—	1	μA	$V_F = 0.8\text{V}$, $V_O = 60\text{V}$		
Output Offset Voltage	$ V_{(OS)} $	—	1	—	μV	$I_F = 5 \text{ mA}$, $I_O = 0 \text{ mA}$		
Input Reverse Breakdown Voltage	V_R	5	—	—	V	$I_R = 10 \mu\text{A}$		
Input Forward Voltage	V_F	1.1	1.3	1.65	V	$I_F = 5 \text{ mA}$	7, 8	
Output On-Resistance ASSR-1511 Connection B	$R_{(ON)}$	—	0.2	0.5	Ω	$I_F = 5 \text{ mA}$, $I_O = 1\text{A}$, Pulse $\leq 30 \text{ ms}$, $T_A = 25^\circ\text{C}$	9, 10	a
	$R_{(ON)}$	—	0.1	0.2	Ω	$I_F = 5 \text{ mA}$, $I_O = 2\text{A}$, Pulse $\leq 30 \text{ ms}$, $T_A = 25^\circ\text{C}$		

a. During the pulsed $R_{(ON)}$ measurement (I_O duration $\leq 30 \text{ ms}$), the ambient (T_A) temperature and case temperature (T_C) are equal.

Switching Specifications (AC)

Over recommended operating $T_A = -40^\circ\text{C}$ to 85°C , $I_F = 5 \text{ mA}$ to 10 mA , unless otherwise specified.

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions	Figure	Note
Turn-On Time	T_{ON}	—	0.27	1.0	ms	$I_F = 5 \text{ mA}$, $I_O = 1\text{A}$, $T_A = 25^\circ\text{C}$	11, 15	
		—	—	2.0	ms	$I_F = 5 \text{ mA}$, $I_O = 1\text{A}$	12	
		—	0.13	0.5	ms	$I_F = 10 \text{ mA}$, $I_O = 1\text{A}$, $T_A = 25^\circ\text{C}$		
		—	—	1.0	ms	$I_F = 10 \text{ mA}$, $I_O = 1\text{A}$		
Turn-Off Time	T_{OFF}	—	0.04	0.2	ms	$I_F = 5 \text{ mA}$, $I_O = 1\text{A}$, $T_A = 25^\circ\text{C}$	13, 15	
		—	—	0.5	ms	$I_F = 5 \text{ mA}$, $I_O = 1\text{A}$	14	
		—	0.034	0.15	ms	$I_F = 10 \text{ mA}$, $I_O = 1\text{A}$, $T_A = 25^\circ\text{C}$		
		—	—	0.2	ms	$I_F = 10 \text{ mA}$, $I_O = 1\text{A}$		
Output Transient Rejection	dV_O/dt	1	7	—	$\text{kV}/\mu\text{s}$	$\Delta V_O = 60\text{V}$, $T_A = 25^\circ\text{C}$	16	
Input-Output Transient Rejection	dV_{I-O}/dt	1	≥ 10	—	$\text{kV}/\mu\text{s}$	$\Delta V_{I-O} = 1000\text{V}$, $T_A = 25^\circ\text{C}$	17	

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 ($I_O = 1A$) is applied to the output pins. The use of a pulsed signal (≤ 30 ms) implies that each junction temperature is equal to the ambient and case temperatures. The steady-state resistance, R_{ss} , 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. R_{ss} includes the effects of the temperature rise in the device.

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

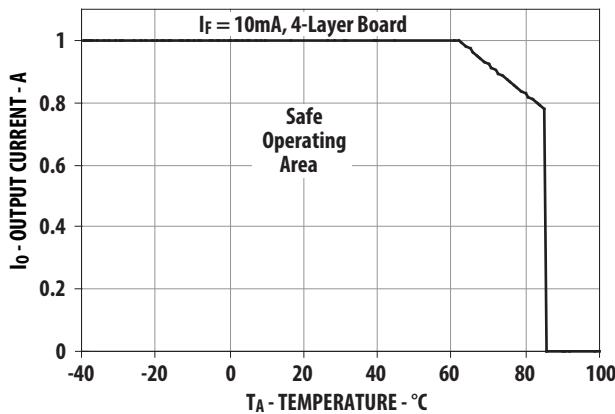
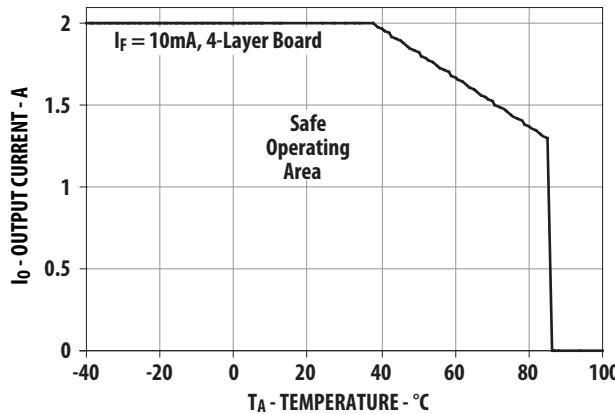


Figure 3: Maximum Output Current Rating vs Ambient Temperature (ASSR-1511-001E DC Connection)



Derating curves are shown in [Figure 1](#), [Figure 2](#), [Figure 3](#), and [Figure 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 $R_{ss} = P_o(\max)/(I_o(\max))^2$ from which R_{ss} can be calculated. Staying within the safe area ensures 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 [Figure 11](#) and [Figure 13](#). The changes of the turn-on and turn-off time with ambient temperature are also shown in [Figure 12](#) and [Figure 14](#).

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

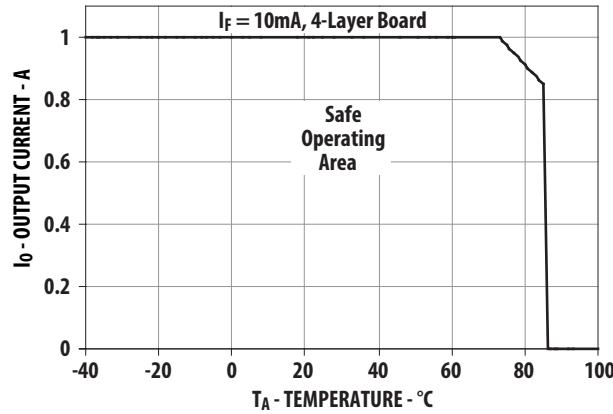


Figure 4: Maximum Output Current Rating vs Ambient Temperature (ASSR-1520-002E and ASSR-1530-005E)

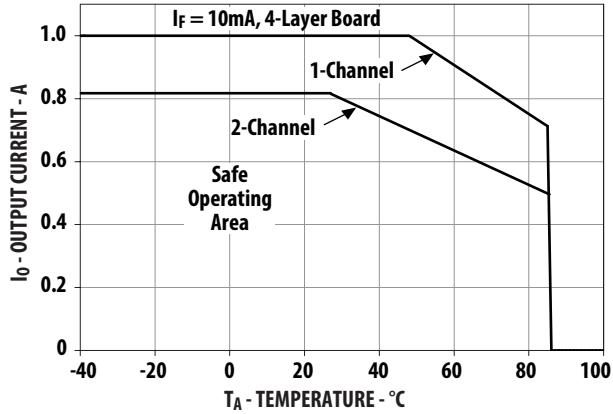


Figure 5: Normalized Typical Output Withstand Voltage vs. Temperature

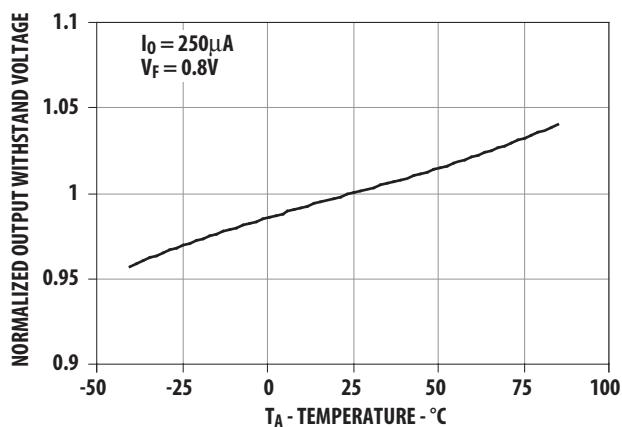


Figure 6: Output Capacitance vs. Output Voltage

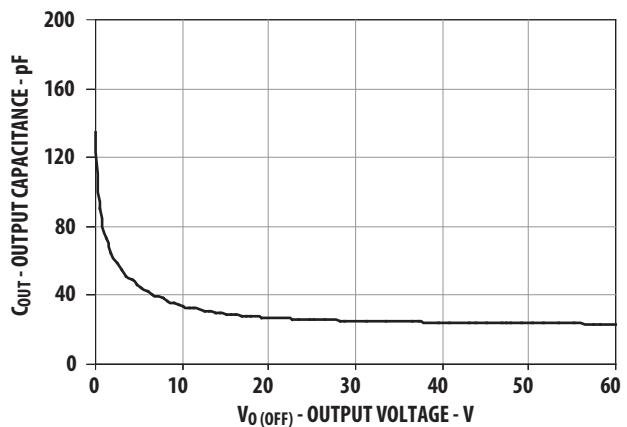


Figure 7: Typical Forward Voltage vs. Temperature

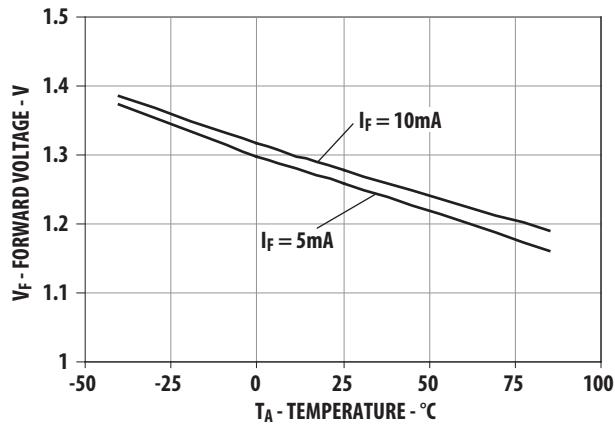


Figure 8: Typical Forward Current vs. Forward Voltage

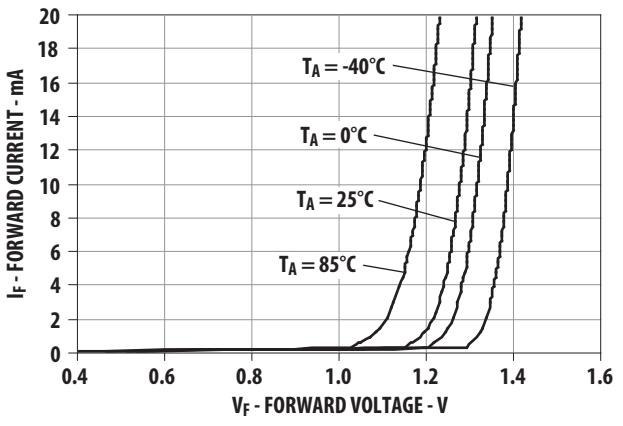


Figure 9: Typical On-Resistance vs. Temperature

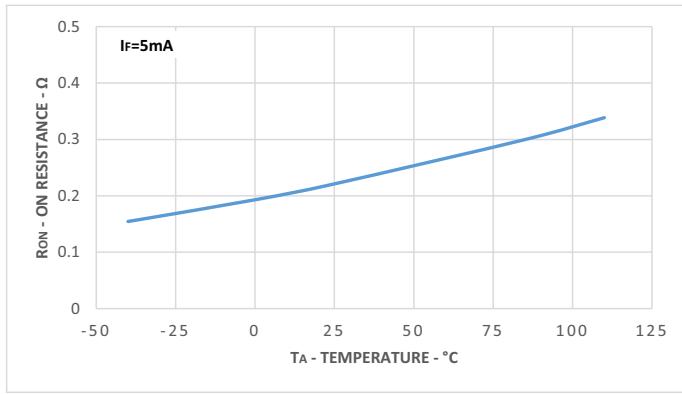


Figure 10: Typical Output Current vs. Output Voltage

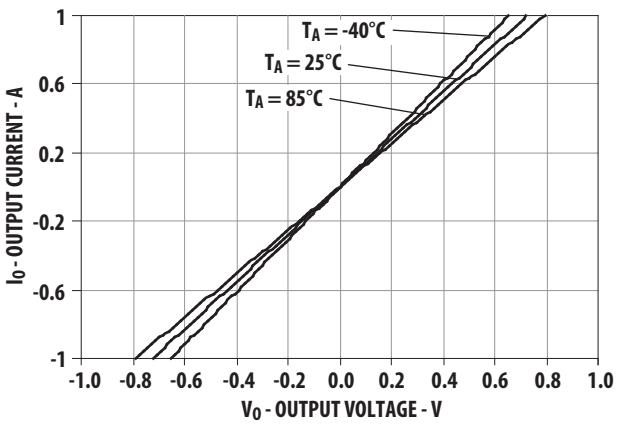


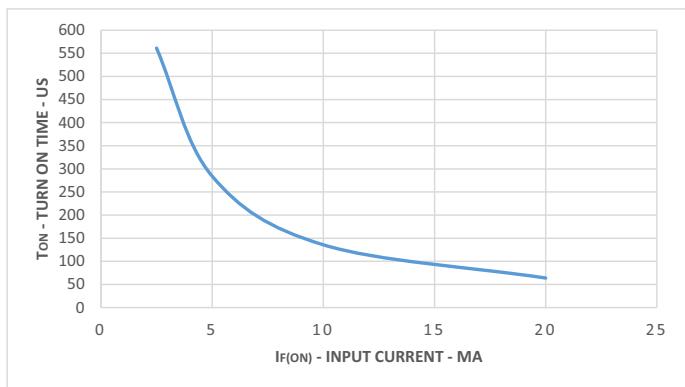
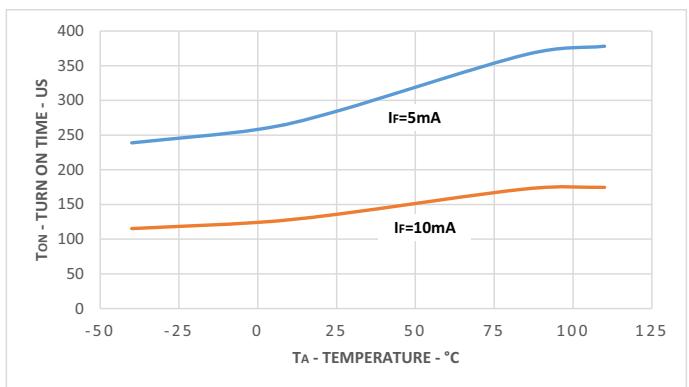
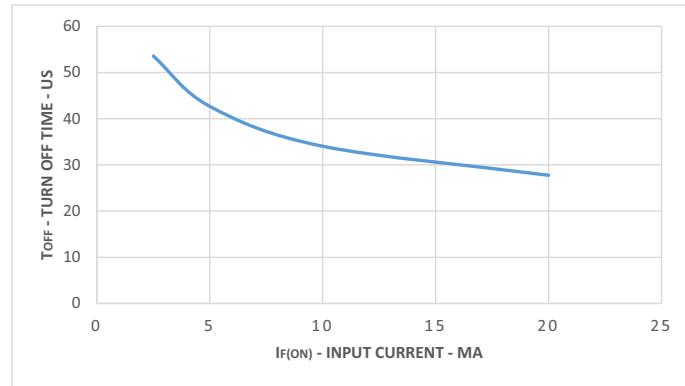
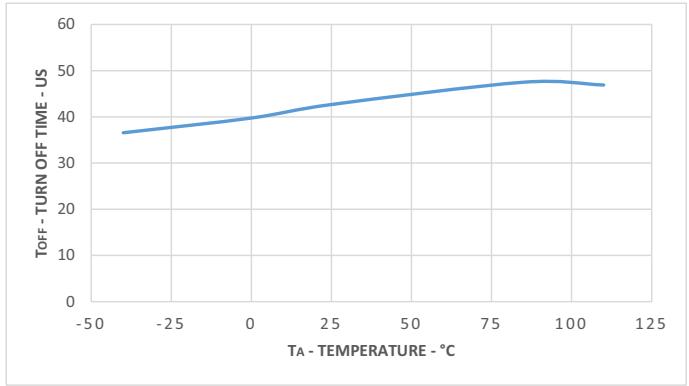
Figure 11: Typical Turn-On Time vs. Input Current**Figure 12: Typical Turn-On Time vs. Temperature****Figure 13: Typical Turn-Off Time vs. Input Current****Figure 14: Typical Turn-Off Time vs. Temperature**

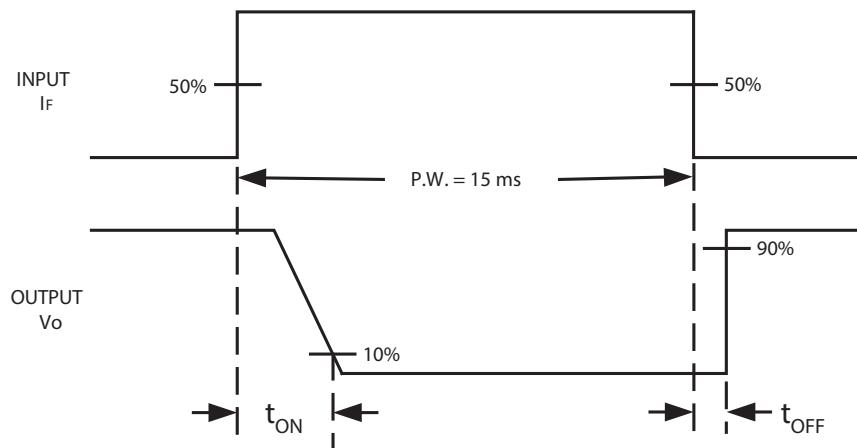
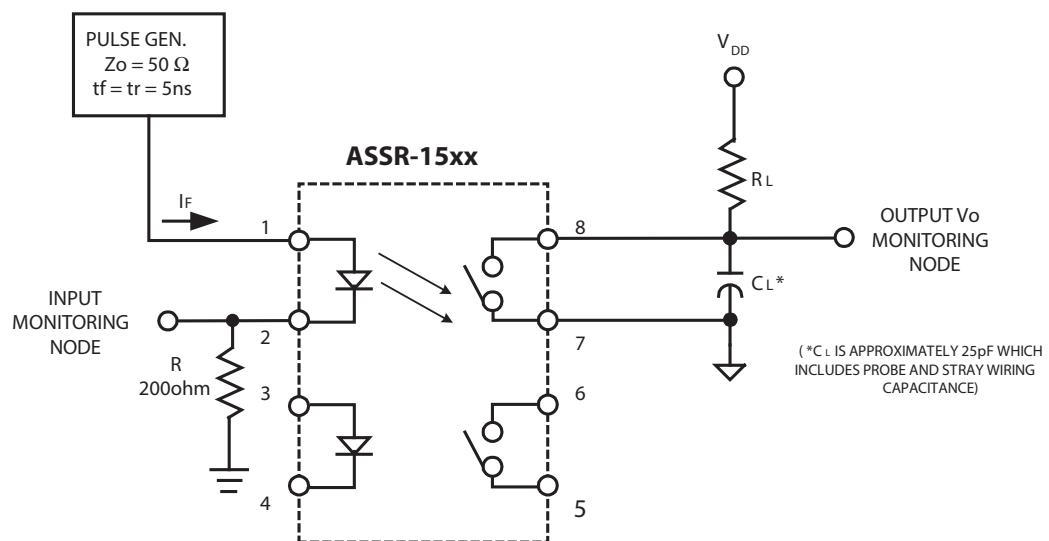
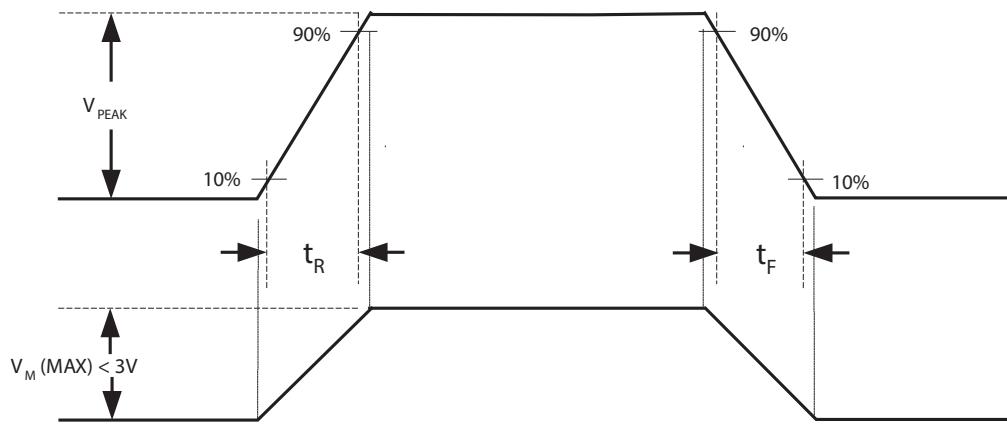
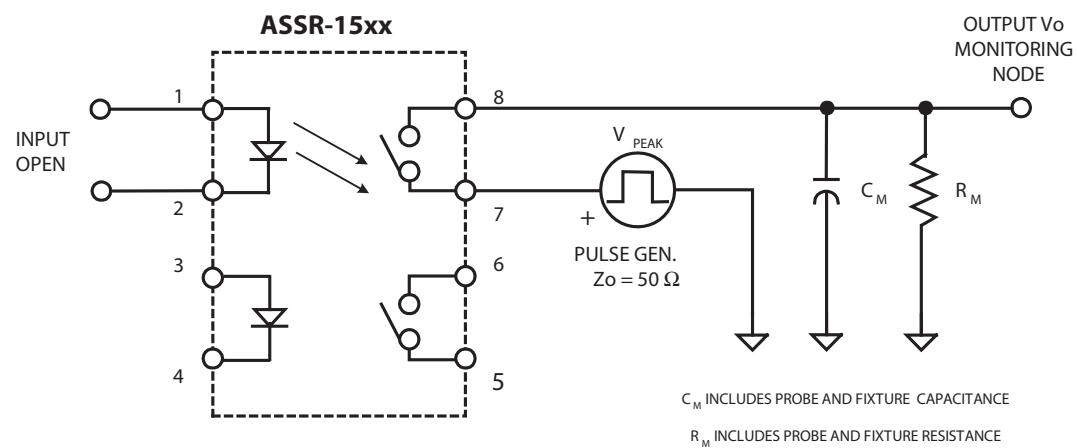
Figure 15: Switching Test Circuit for t_{ON} , t_{OFF} 

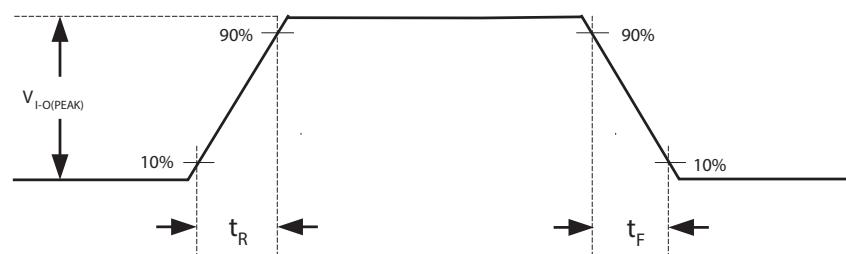
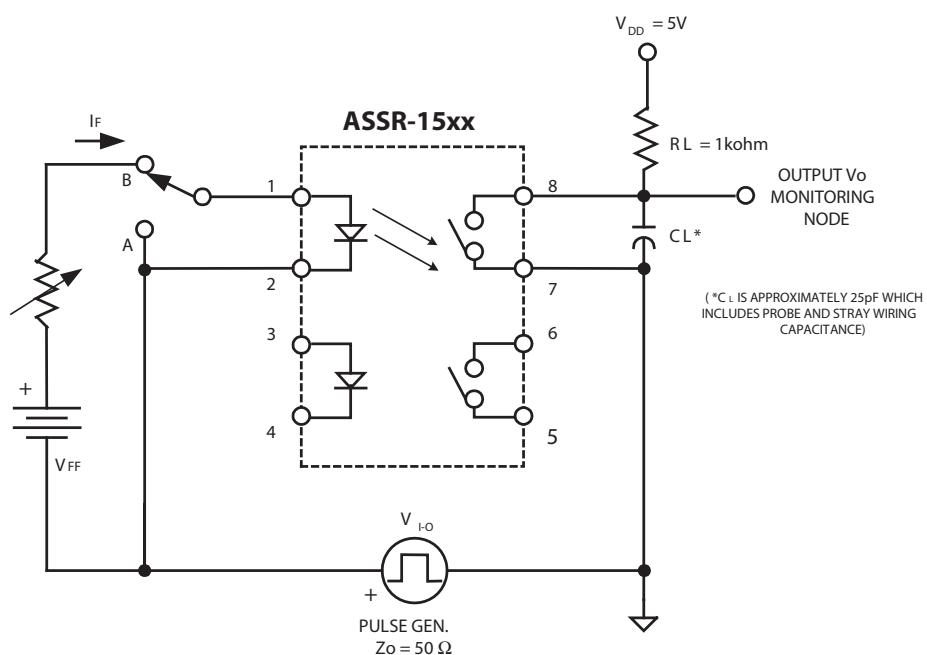
Figure 16: Output Transient Rejection Test Circuit



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

OVERSHOOT ON V_{PEAK} IS TO BE $\leq 10\%$

Figure 17: Input-Output Transient Rejection Test Circuit



SWITCHES AT POSITION 1 AND 2

- $V_{O(OFF)}$ (min.) > 4V

SWITCH AT POSITION "B": $I_L = 5 \text{ mA}$

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