

# ASSR-322R

Low C x R, Form A, Solid State Relay (250V/8.5Ω/60pF)



## Data Sheet



Lead (Pb) Free  
RoHS 6 fully  
compliant

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

### Description

The ASSR-322R is specifically designed for fast switching applications, commonly found in the test and measurement systems. The low C x R and low output off-state leakage current provide higher system throughput and reduce system errors.

The dual channel configuration of ASSR-322R is equivalent to 2 Form A Electromechanical Relays (EMR). One channel of the relay 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.

ASSR-322R is available in 8-pin DIP and Gull Wing Surface Mount packages. Their electrical and switching characteristics are specified over the temperature range of -40°C to +85°C.

### Applications

- Automatic Test Equipment
- Data Acquisition System
- Measuring Instrument
- EMR / Reed Relay Replacement

### Features

- Compact Solid-State Bi-directional Signal Switch
- Dual Channel Normally-off Single-Pole-Single-Throw (SPST) Relay
- 250V Output Withstand Voltage
- 0.2A Current Rating
- Low Input Current: CMOS Compatibility
- Low C x R: 340pF•Ω typical
- Low Output Off-state Leakage Current: 30pA typical
- Fast Speed Switching: 0.2ms (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

*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.

| Part number | Option         | Package          | Surface Mount | Gull Wing | Tape & Reel | Quantity            |
|-------------|----------------|------------------|---------------|-----------|-------------|---------------------|
|             | RoHS Compliant |                  |               |           |             |                     |
| ASSR-322R   | -002E          | 300 mil<br>DIP-8 | X             | X         | X           | 50 units per tube   |
|             | -302E          |                  |               |           |             | 50 units per tube   |
|             | -502E          |                  |               |           |             | 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.

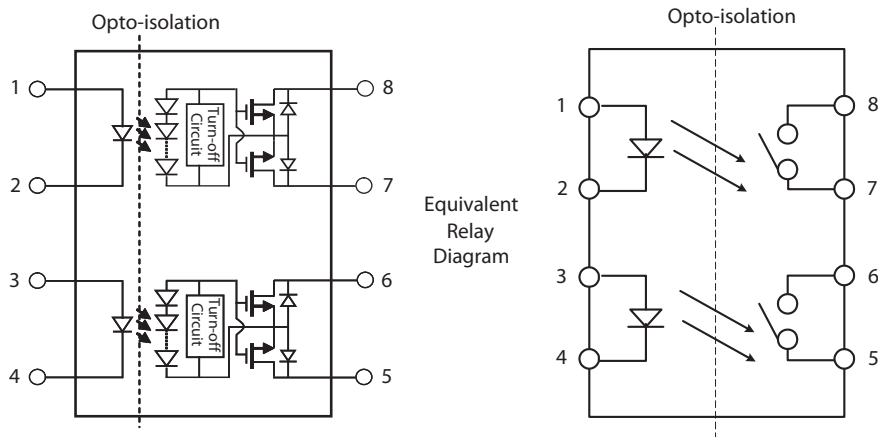
Example 1:

ASSR-322R-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.

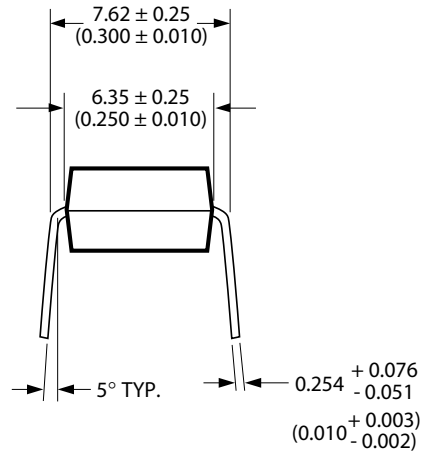
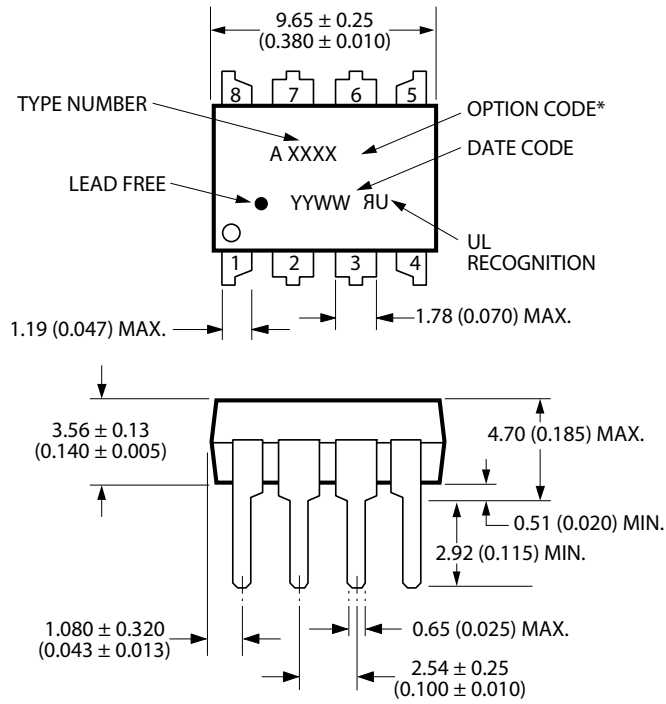
## Schematic

### ASSR-322R



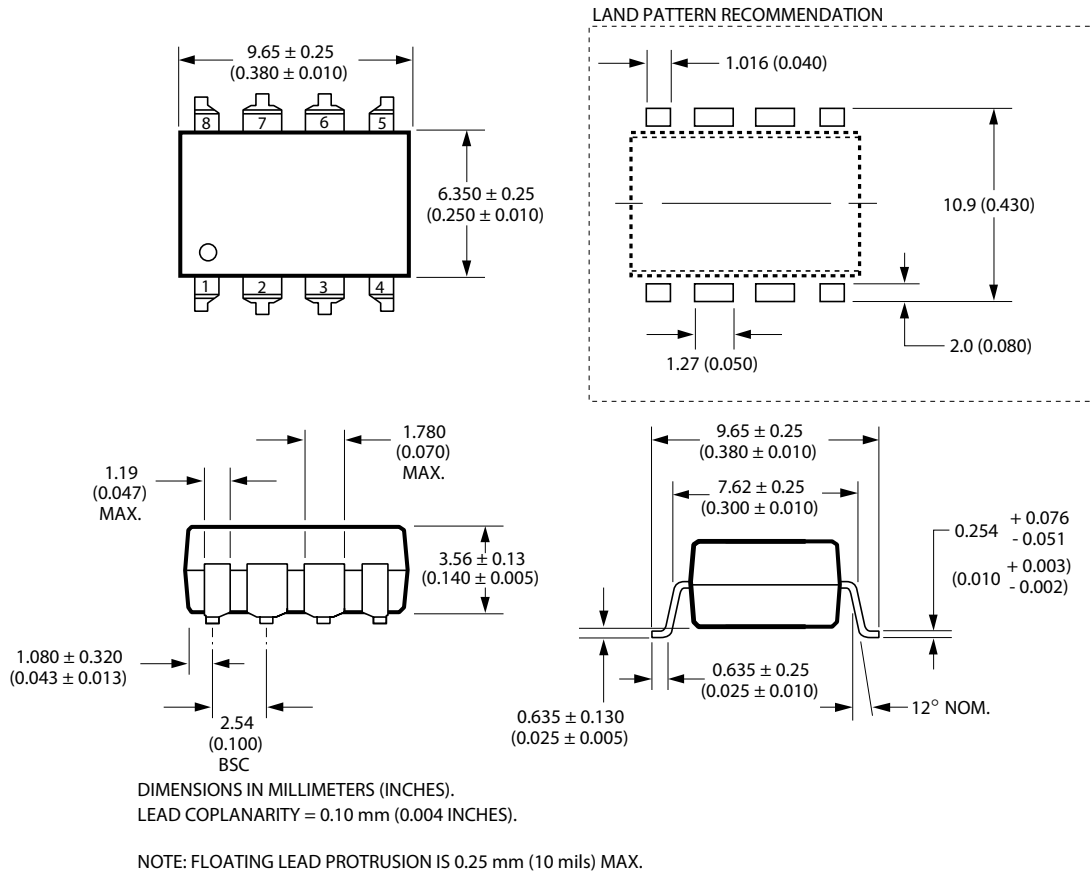
# Package Outline Drawings

## ASSR-322R 8-Pin DIP Package

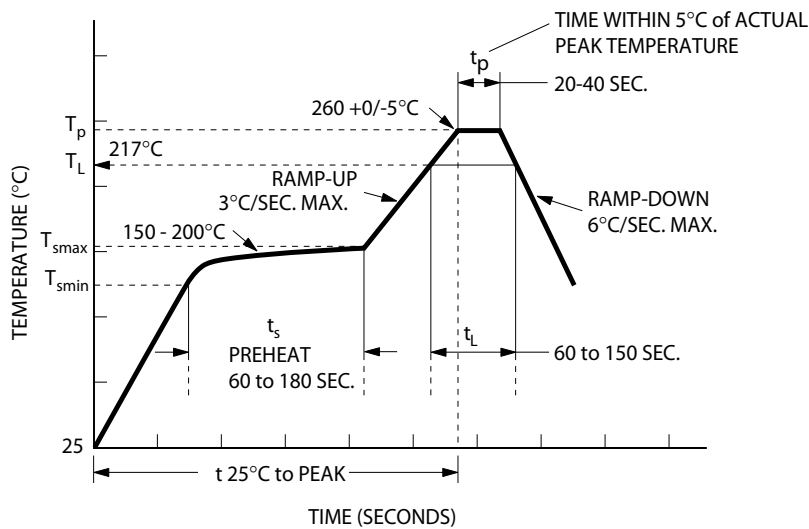


DIMENSIONS IN MILLIMETERS AND (INCHES).  
 OPTION NUMBERS 300 AND 500 NOT MARKED.

## ASSR-322R 8-Pin DIP Package with Gull Wing Surface Mount Option 300



## 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-322R is approved by the following organizations:

### UL

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

### CSA

Approved under CSA Component Acceptance Notice #5.

## Insulation and Safety Related Specifications

| Parameter   | Symbol | ASSR-322R | Units | Conditions   |
|---|--------|-----------|-------|--|
| Minimum External Air Gap (Clearance)              | L(101) | 7.1       | mm    | Measured from input terminals to output terminals, shortest distance through air.  |
| Minimum External Tracking (Creepage)              | L(102) | 7.4       | mm    | Measured from input terminals to output terminals, shortest distance path along body.  |
| Minimum Internal Plastic Gap (Internal Clearance) |        | 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       | V     | DIN IEC 112/VDE 0303 Part 1  |
| Isolation Group (DIN VDE0109)                     |        | IIIa      |       | Material Group (DIN VDE0109)   |

## 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  | $T_J$                         |                          | 150              | °C      |      |
| Lead Soldering Cycle  | Temperature<br>Time           |                          | 260<br>10        | °C<br>s |      |
| Input Current   | Average<br>Surge<br>Transient | $I_F$                    | 25<br>50<br>1000 | mA      |      |
| Reversed Input Voltage  | $V_R$                         |                          | 5                | V       |      |
| Input Power Dissipation   | $P_{IN}$                      |                          | 80               | mW      |      |
| Output Power Dissipation  | $P_O$                         |                          | 680              | mW      |      |
| Average Output Current<br>( $T_A = 25^\circ\text{C}$ , $T_C \leq 100^\circ\text{C}$ ) | $I_O$                         |                          | 0.2              | A       | 1    |
| Output Voltage ( $T_A = 25^\circ\text{C}$ )   | $V_O$                         | -250                     | 250              | V       |      |
| 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    | 2    |
| Input Voltage (OFF)   | $V_{F(OFF)}$ | 0    | 0.8  | V     |      |
| Operating Temperature | $T_A$        | -40  | +85  | °C    |      |

## Package Characteristics

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

| Parameter                                | Sym.      | Min. | Typ.      | Max. | Units    | Conditions                             | Fig. | Note |
|--|-----------|------|-----------|------|----------|--|------|------|
| Input-Output Momentary Withstand Voltage | $V_{ISO}$ | 3750 |           |      | Vrms     | RH $\leq$ 50%,<br>t = 1 min            |      | 3, 4 |
| Input-Output Resistance                  | $R_{I-O}$ |      | $10^{12}$ |      | $\Omega$ | $V_{I-O} = 500\text{ Vdc}$             |      |      |
| Input-Output Capacitance                 | $C_{I-O}$ |      | 0.8       |      | pF       | f = 1 MHz;<br>$V_{I-O} = 0\text{ Vdc}$ |      | 3    |

## Electrical Specifications (DC)

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

| Parameter                       | Sym.           | Min. | Typ. | Max. | Units         | Conditions   | Fig. | Note |
|---------------------------------|----------------|------|------|------|---------------|--|------|------|
| Output Withstand Voltage        | $ V_{O(OFF)} $ | 250  | 280  |      | V             | $V_F = 0.8\text{V}$ , $I_O = 250\ \mu\text{A}$ ,<br>$T_A = 25^\circ\text{C}$                       |      |      |
|                                 |                | 230  |      |      | V             | $V_F = 0.8\text{V}$ , $I_O = 250\ \mu\text{A}$   | 3    |      |
| Output Leakage Current          | $I_{O(OFF)}$   |      | 0.03 | 1    | nA            | $V_F = 0.8\text{V}$ , $V_O = 250\text{V}$ ,<br>$T_A = 25^\circ\text{C}$                            |      | 5    |
|                                 |                |      |      | 1    | $\mu\text{A}$ | $V_F = 0.8\text{V}$ , $V_O = 250\text{V}$  | 4    | 5    |
| Output Off-Capacitance          | $C_{(OFF)}$    |      | 45   | 60   | pF            | $V_F = 0.8\text{V}$ , $V_O = 0\text{V}$ , Freq=1<br>MHz  | 5    |      |
| Output Offset Voltage           | $ V_{(OS)} $   |      | 1    |      | $\mu\text{V}$ | $I_F = 5\text{mA}$ , $I_O = 0\text{mA}$  |      |      |
| 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             | $I_F = 5\text{mA}$   | 6, 7 |      |
| Output On-resistance            | $R_{(ON)}$     |      | 7.5  | 8.5  | $\Omega$      | $I_F = 5\text{mA}$ , $I_O = 200\text{mA}$ ,<br>Pulse $\leq 30\text{ms}$ , $T_A = 25^\circ\text{C}$ | 8, 9 | 6    |

## Switching Specifications (AC)

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

| Parameter                        | Sym.          | Min. | Typ.      | Max. | Units             | Conditions  | Fig.   | Note |
|----------------------------------|---------------|------|-----------|------|-------------------|---|--------|------|
| Turn On Time                     | $T_{ON}$      |      | 0.25      | 0.5  | ms                | $I_F = 5\text{mA}$ , $I_O = 200\text{mA}$ ,<br>$T_A = 25^{\circ}\text{C}$ | 10, 14 |      |
|                                  |               |      |           |      | 1.0               | ms  |        |      |
| Turn Off Time                    | $T_{OFF}$     |      | 0.02      | 0.2  | ms                | $I_F = 5\text{mA}$ , $I_O = 200\text{mA}$ ,<br>$T_A = 25^{\circ}\text{C}$ | 12, 14 |      |
|                                  |               |      |           |      | 0.5               | ms  |        |      |
| Output Transient Rejection       | $dV_O/dt$     | 1    | 7         |      | kV/ $\mu\text{s}$ | $\Delta V_O = 250\text{V}$ , $T_A = 25^{\circ}\text{C}$                   | 15     |      |
| Input-Output Transient Rejection | $dV_{I-O}/dt$ | 1    | $\geq 10$ |      | kV/ $\mu\text{s}$ | $\Delta V_{I-O} = 1000\text{V}$ ,<br>$T_A = 25^{\circ}\text{C}$           | 16     |      |

Notes:

- For derating, refer to Figure 1 and 2.
- Threshold to switch device is  $I_F \geq 0.5\text{mA}$ , however, for qualified device performance over temperature range, it is recommended to operate at  $I_F = 5\text{mA}$ . Refer to application information in next section of this datasheet.
- Device is considered as a two terminal device: pins 1, 2, 3 and 4 shorted together and pins 5, 6, 7 and 8 shorted together.
- 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."
- The PCB design and environmental conditions are taken into consideration when measuring the  $I_{O(OFF)}$  performance.
- During the pulsed  $R_{(ON)}$  measurement ( $I_O$  duration  $\leq 30\text{ms}$ ), ambient ( $T_A$ ) and case temperature ( $T_C$ ) are equal.

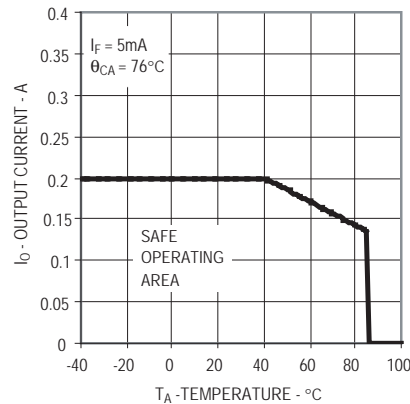


Figure 1. Maximum Average Output Current Rating vs Ambient Temperature

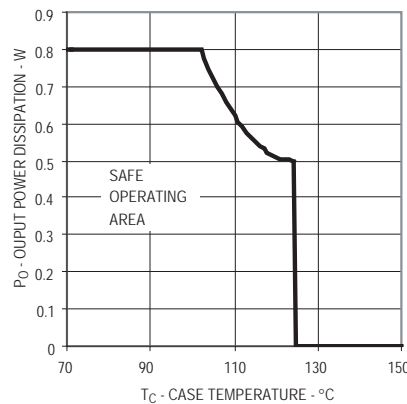


Figure 2. Output Power Derating vs Case Temperature

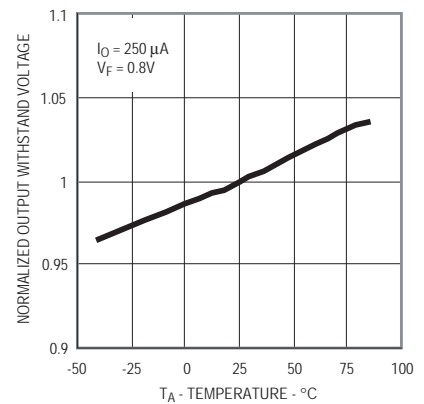
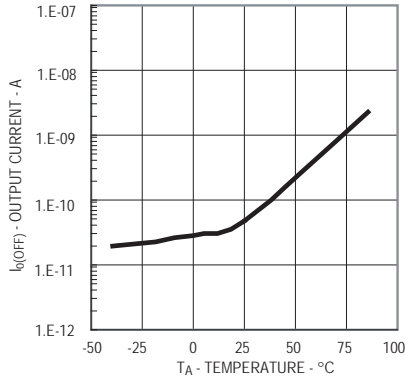
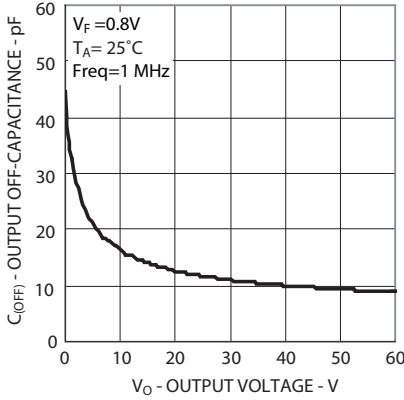


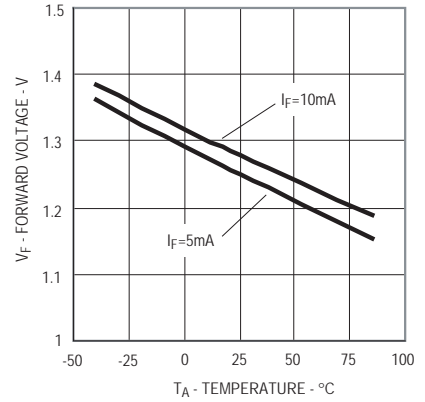
Figure 3. Normalized Typical Output Withstand Voltage vs. Temperature



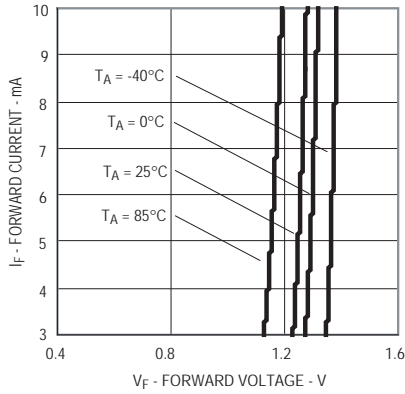
**Figure 4. Typical Output Leakage Current vs. Temperature**



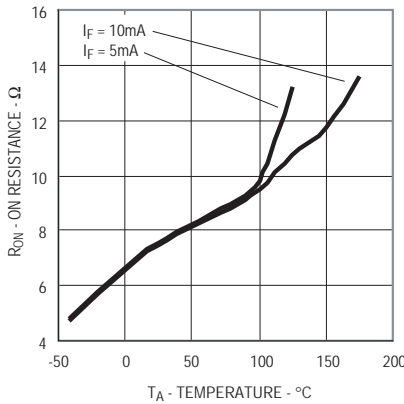
**Figure 5. Typical Output Off-Capacitance vs. Output Voltage**



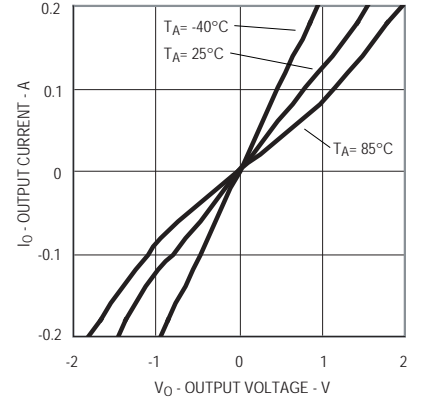
**Figure 6. Typical Forward Voltage vs. Temperature**



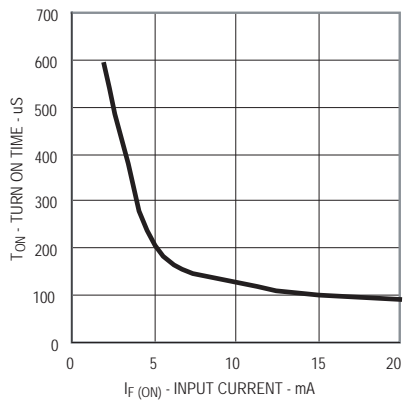
**Figure 7. Typical Forward Current vs. Forward Voltage**



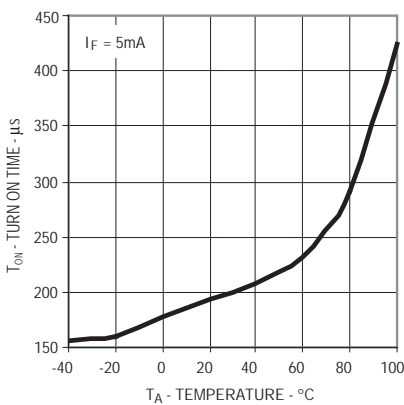
**Figure 8. Typical On Resistance vs. Temperature**



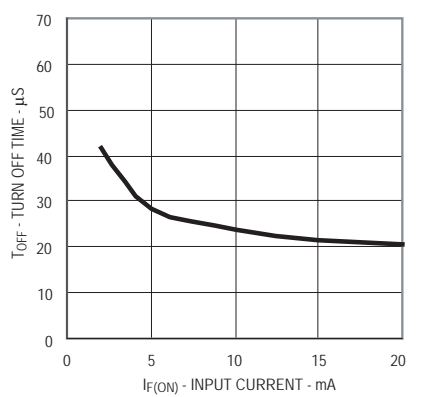
**Figure 9. Typical Output Current vs. Output Voltage**



**Figure 10. Typical Turn On Time vs. Input Current**



**Figure 11. Typical Turn On Time vs. Temperature**



**Figure 12. Typical Turn Off Time vs. Input Current**



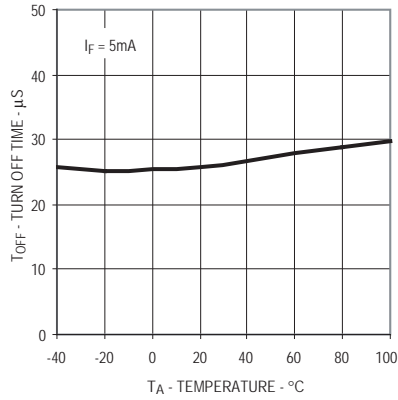


Figure 13. Typical Turn Off Time vs. Temperature

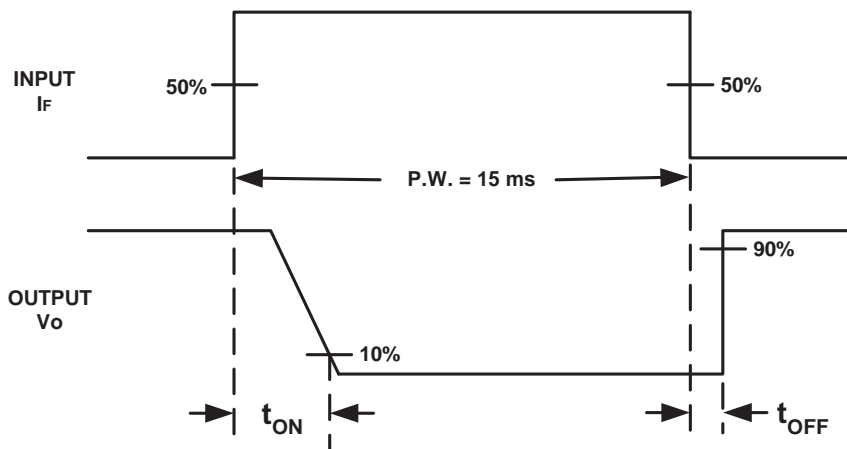
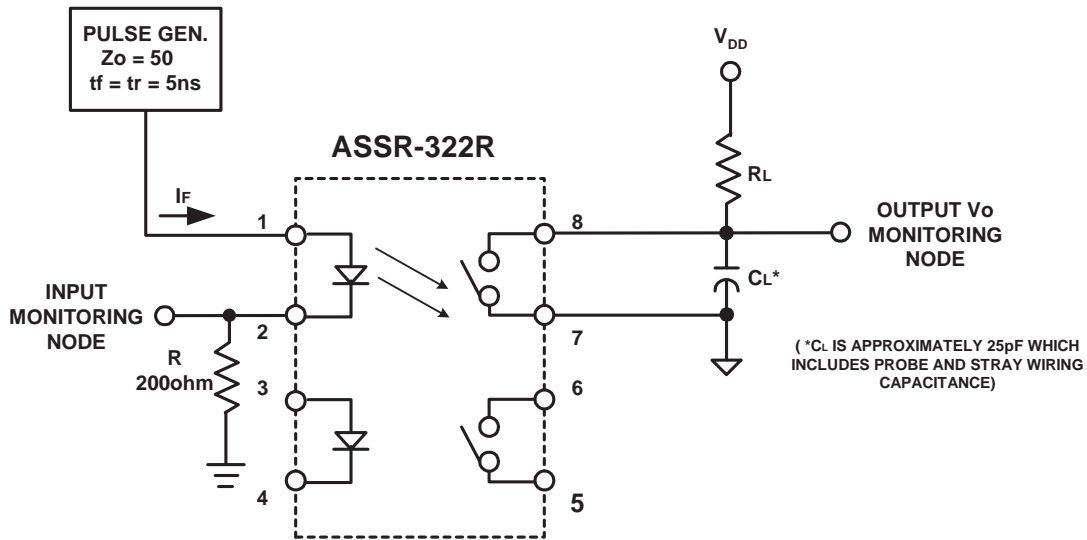
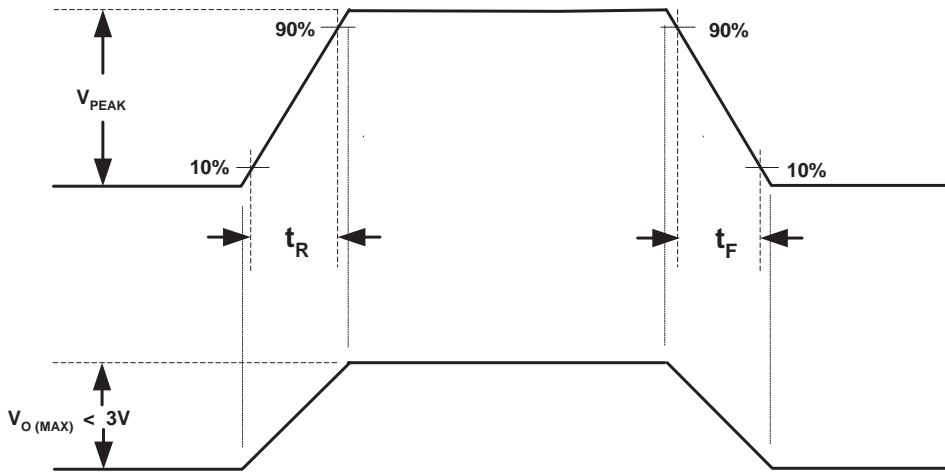
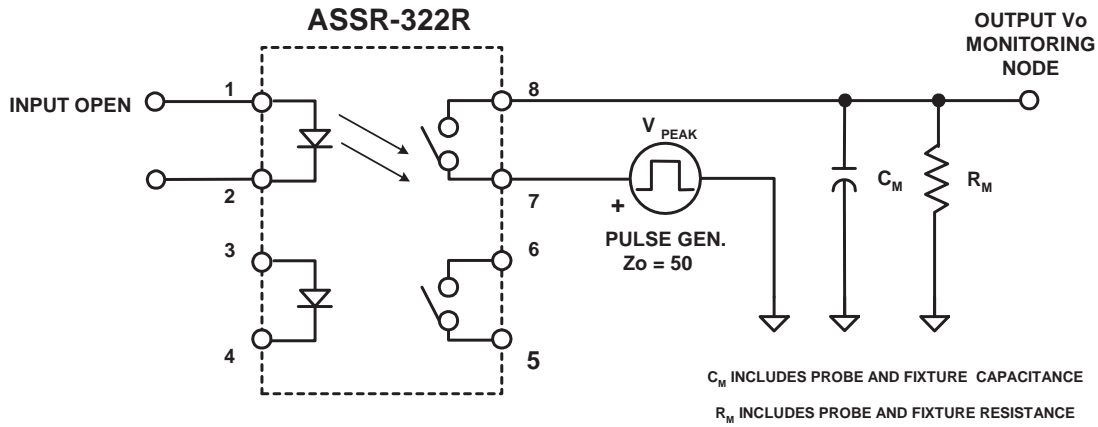


Figure. 14 Switching Test Circuit for TON, TOFF



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

OVER SHOOT ON  $V_{PEAK}$  IS TO BE 10%

Figure. 15. Output Transient Rejection Test Circuit

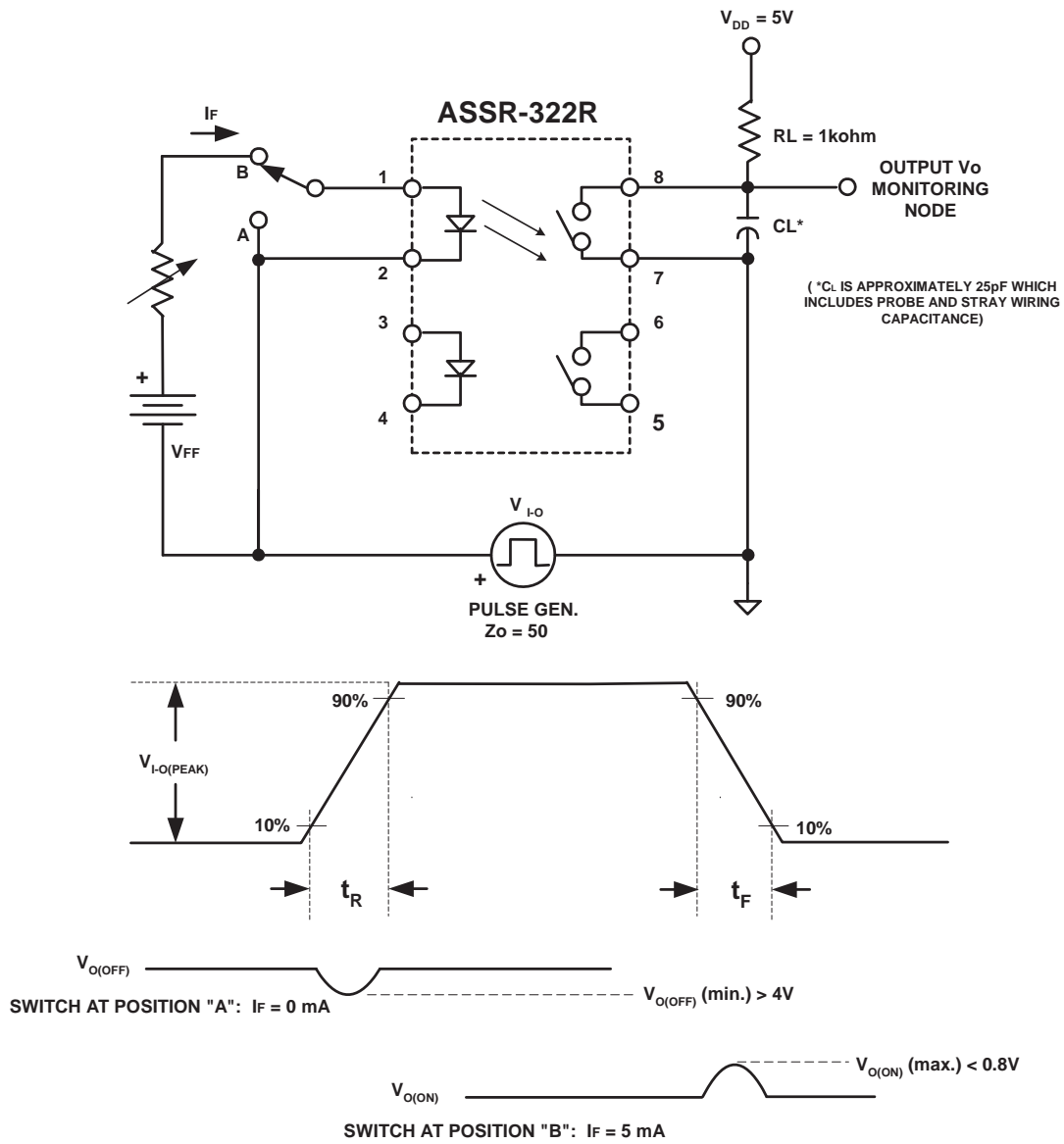


Figure 16. Input-Output Transient Rejection Test Circuit

## 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 ( $I_o=200\text{mA}$ ) is applied to the output pins. The use of a pulsed signal ( $\leq 30\text{ms}$ ) 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.

Derating curves are shown in Figures 1 and 2. Figure 1 specifies the maximum average output current allowable for a given ambient temperature. Figure 2 specifies the output power dissipation allowable for a given case temperature. Above a case temperature  $102^\circ\text{C}$ , the maximum allowable output current and power dissipation are related by the expression  $R_{ss}=P_o(\text{max})/(I_o(\text{max}))^2$  from which  $R_{ss}$  can be calculated. Staying within the safe area assures that the steady state MOSFET junction temperature remains less than  $150^\circ\text{C}$ .

### Turn On Time and Turn Off Time Variation

The ASSR-322R 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 10 and 12. The changes of the turn on and turn off time with ambient temperature are also shown in Figures 11 and 13.

For product information and a complete list of distributors, please go to our web site:

[www.avagotech.com](http://www.avagotech.com)

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