

# ASSR-1410, ASSR-1411 and ASSR-1420

## General Purpose, Form A, Solid State Relay (Photo MOSFET)

(60V/0.6A/1Ω)



## Data Sheet



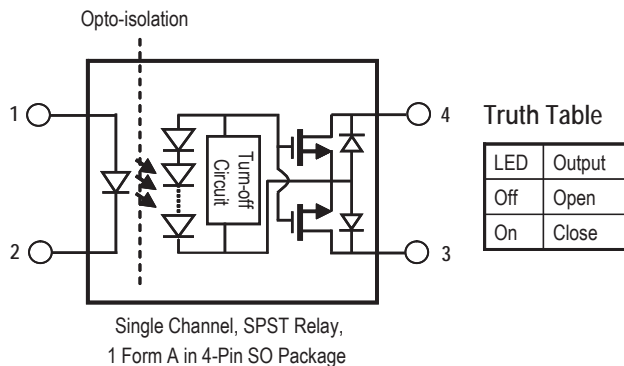
### Description

The ASSR-14XX 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-1410 and ASSR-1411, are equivalent to 1 Form A Electromechanical Relays (EMR), and the dual channel configuration, ASSR-1420, 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. They are used for general purpose switching of signals and low power AC/DC loads.

ASSR-1411 enables AC/DC and DC-only output connections. For DC-only connection, the output current,  $I_o$ , increases to 1.2A and the on-resistance,  $R_{(ON)}$  reduces to 0.5Ω.

### Functional Diagram



### Features

- Compact Solid-State Bi-directional Signal Switch
- Single and Dual Channel Normally-off Single-Pole-Single-Throw (SPST) Relay
- 60V Output Withstand Voltage
- 0.6A or 1.2A Current Rating  
(See Schematic for ASSR-1411 Connection A and B)
- Low Input Current: CMOS Compatibility
- Low On-Resistance:  
0.2 Ω Typical for DC-only,  
0.7 Ω Typical for AC/DC
- Very High Output Off-state Impedance:  
10 Teraohms Typical
- High Speed Switching:  
0.1ms (Ton), 0.02ms (Toff) Typical
- High Transient Immunity: >1kV/μs
- High Input-to-Output Insulation Voltage (Safety and Regulatory Approvals)
  - 3750 Vrms for 1 min per UL1577
  - CSA Component Acceptance

### Applications

- Telecommunication Switching
- Data Communications
- Industrial Controls
- Medical
- Security
- EMR / Reed Relay Replacement

**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-1410   | -003E          | SO-4          | X             |           |             | 100 units per tube  |
|             | -503E          |               | X             |           | X           | 1500 units per reel |
|             | -001E          |               |               |           |             |                     |
| ASSR-1411   | -301E          | 300mil DIP-6  | X             | X         |             | 50 units per tube   |
|             | -501E          |               | X             | X         | X           | 1000 units per reel |
|             | -002E          |               |               |           |             |                     |
| ASSR-1420   | -302E          | 300 mil DIP-8 | X             | X         |             | 50 units per tube   |
|             | -502E          |               | X             | X         | X           | 1000 units per reel |
|             | -001E          |               |               |           |             |                     |

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-1411-501E to order product of 300mil DIP-6 Gull Wing Surface Mount package in Tape and Reel packaging and RoHS Compliant.

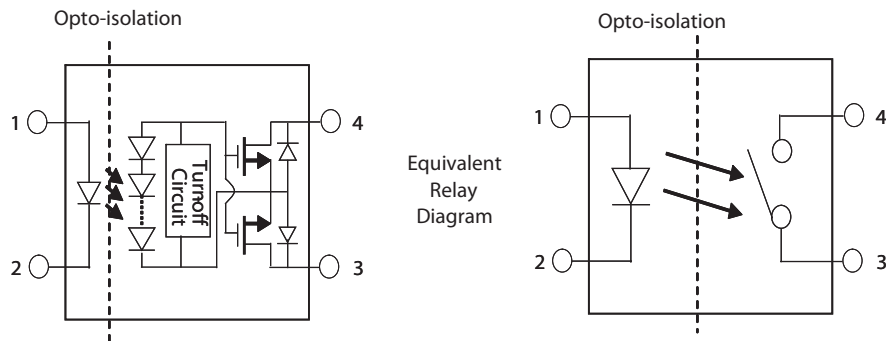
Example 2:

ASSR-1420-002E to order product of 300mil DIP-8 package in tube packaging and RoHS Compliant.

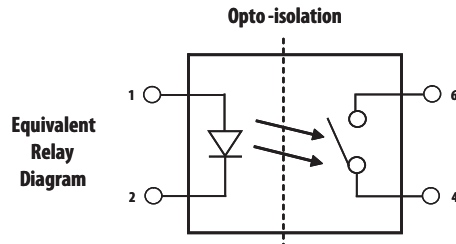
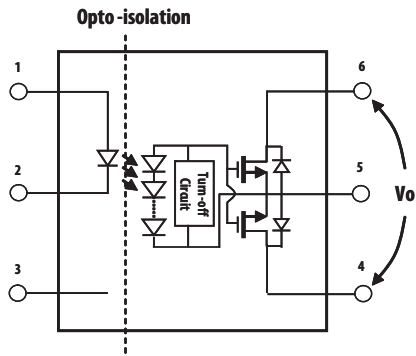
Option datasheets are available. Contact your Avago sales representative or authorized distributor for information.

## Schematic

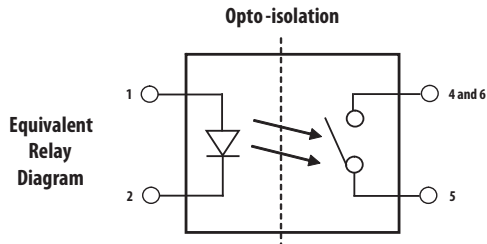
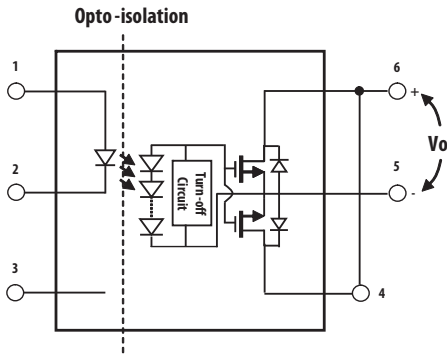
### ASSR-1410



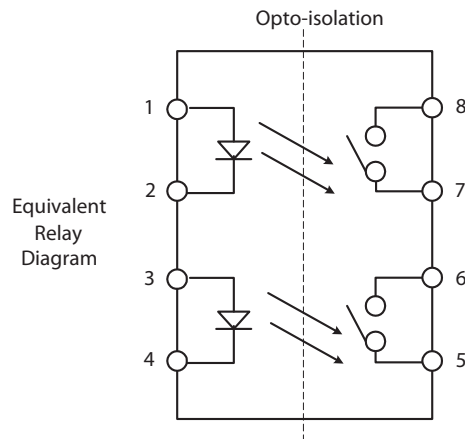
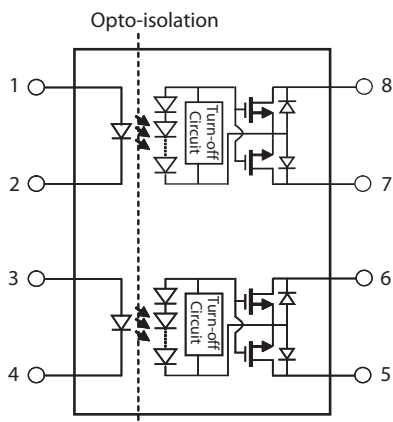
### ASSR-1411 Connection A



### ASSR-1411 Connection B

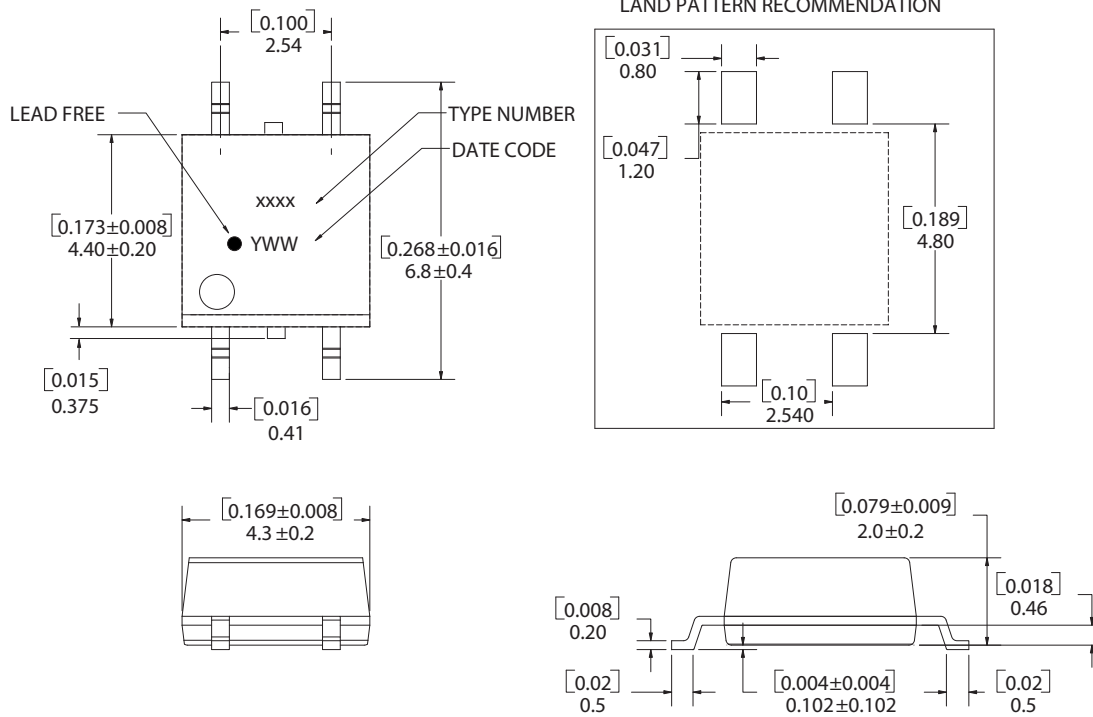


### ASSR-1420



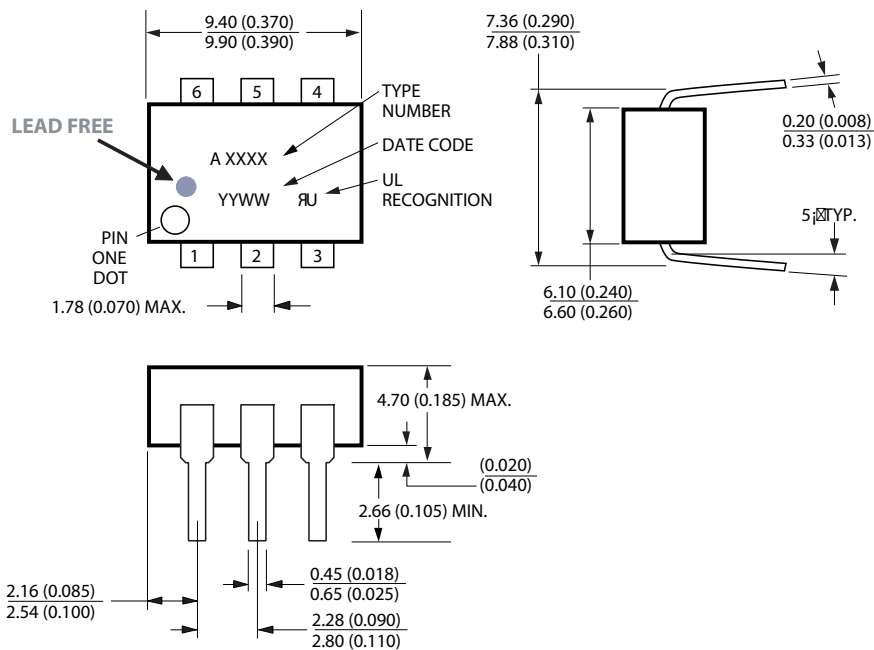
## Package Outline Drawings

### ASSR-1410 4-Pin Small Outline Package



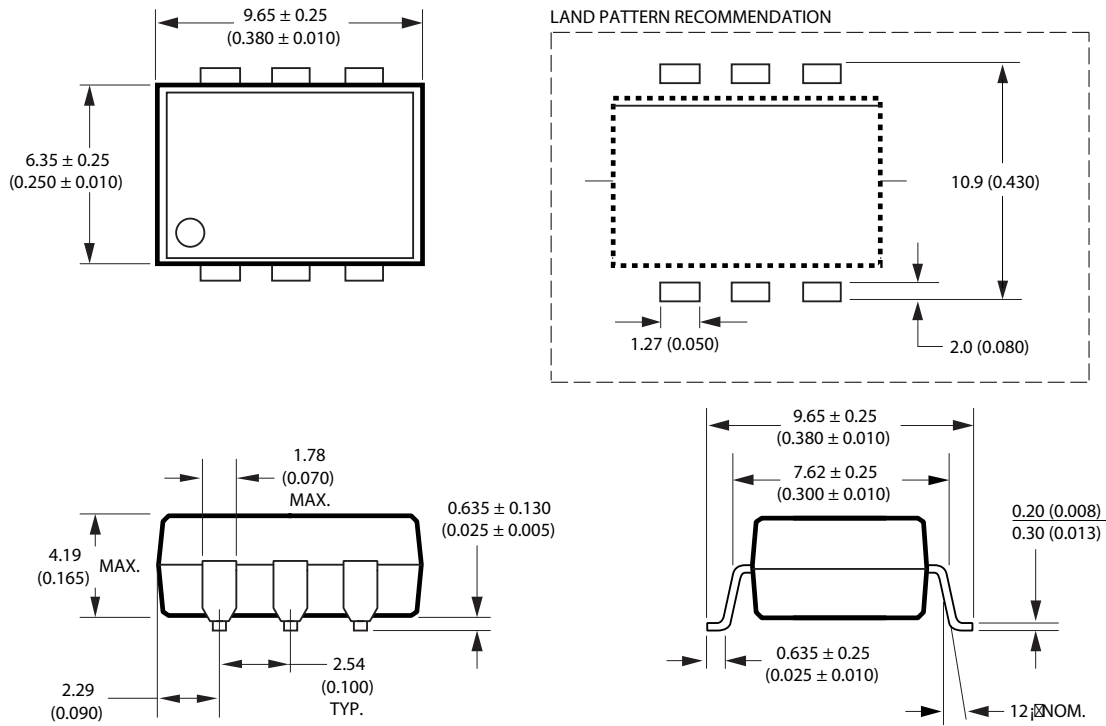
DIMENSIONS IN MILLIMETERS AND [INCHES]  
 OPTION NUMBER 500 AND UL RECOGNITION NOT MARKED

### ASSR-1411 6-Pin DIP Package



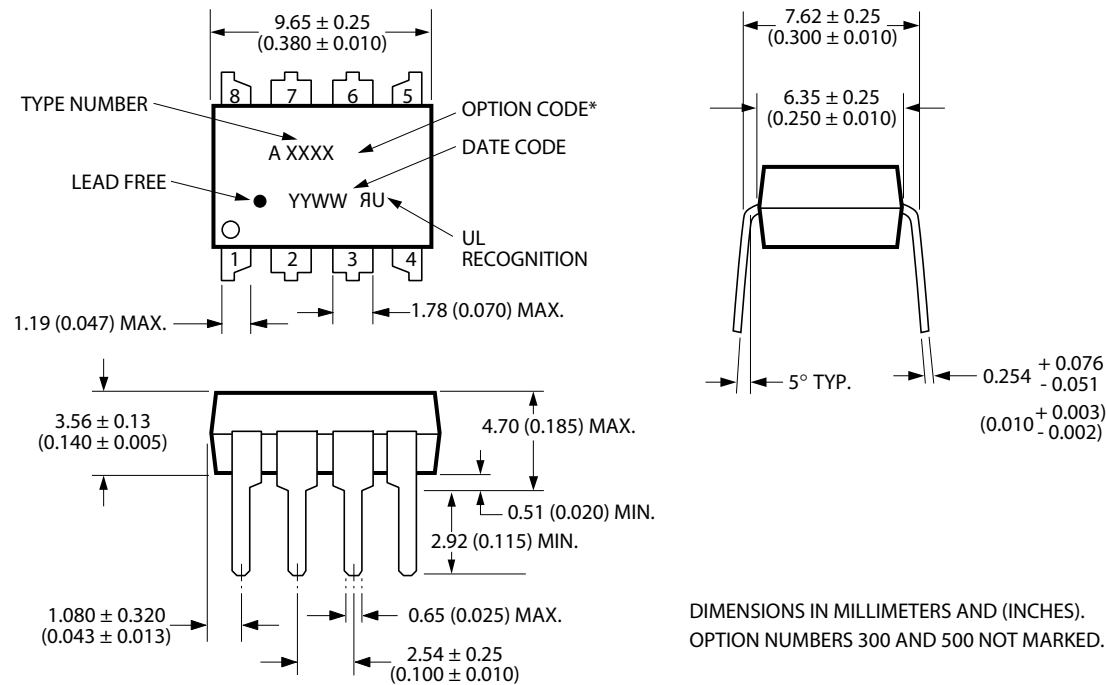
DIMENSIONS IN MILLIMETERS AND (INCHES).

**ASSR-1411 6-Pin DIP Package with Gull Wing Surface Mount Option 300**



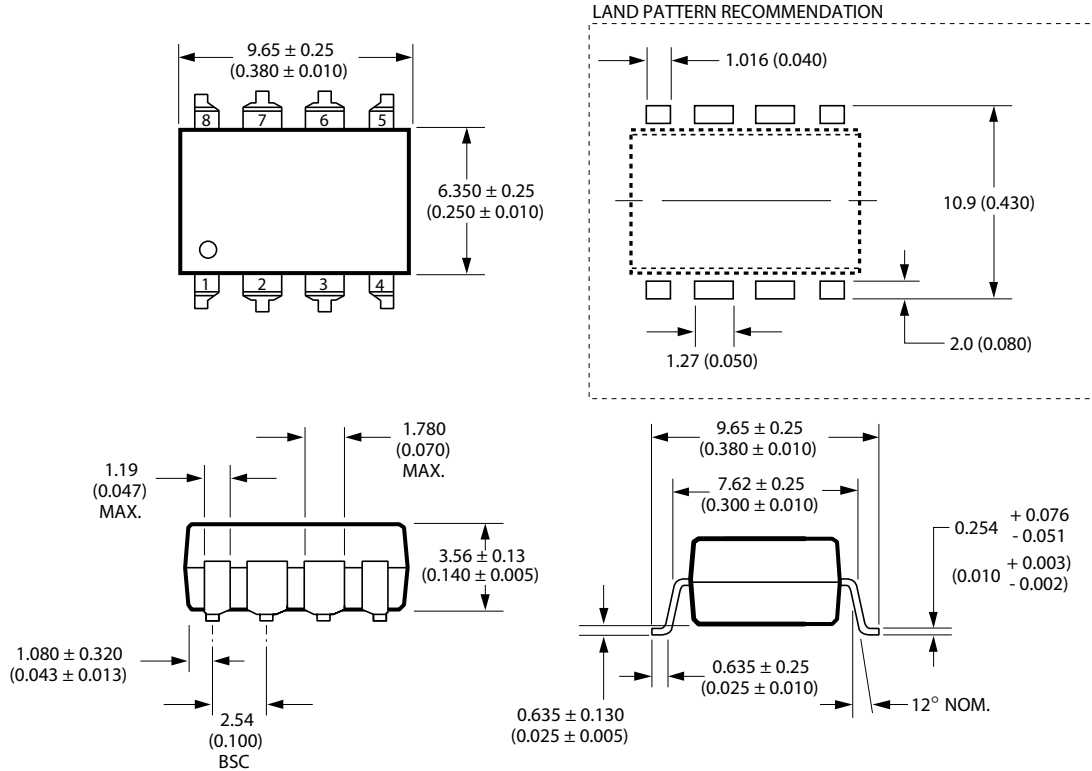
NOTE: FLOATING LEAD PROTRUSION IS 0.25 mm (10 mils) MAX.

**ASSR-1420 8-Pin DIP Package**



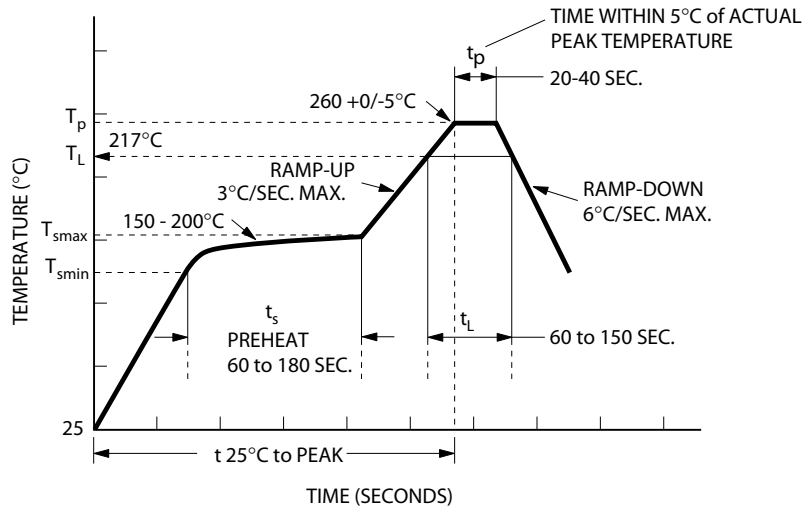
DIMENSIONS IN MILLIMETERS AND (INCHES).  
OPTION NUMBERS 300 AND 500 NOT MARKED.

### ASSR-1420 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.  
 $T_{smax} = 200°C$ ,  $T_{smin} = 150°C$

Non-halide flux should be used.

## Regulatory Information

The ASSR-1410, ASSR-1411 and ASSR-1420 are 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-1411 |           | Units | Conditions   |
|---|--------|-----------|-----------|-------|--|
|   |        | ASSR-1410 | ASSR-1420 |       |  |
| 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-1410                 | $P_{IN}$ | 40   | mW    |      |   |
|   | ASSR-1411                 | $P_{IN}$ | 40   | mW    |      |   |
|   | ASSR-1420                 | $P_{IN}$ | 80   | mW    |      |   |
| Output Power Dissipation  | ASSR-1410                 | $P_O$    | 360  | mW    |      |   |
|   | ASSR-1411                 | $P_O$    | 720  | mW    |      |   |
|   | ASSR-1420                 | $P_O$    | 720  | mW    |      |   |
| Average Output Current<br>( $T_A = 25^\circ\text{C}$ , $T_C \leq 100^\circ\text{C}$ ) |                           | $I_O$    | 0.6  | A     | 1    |   |
|   | ASSR-1411<br>Connection B | $I_O$    | 1.2  | A     |      |   |
| Output Voltage ( $T_A = 25^\circ\text{C}$ )   |                           | $V_O$    | -60  | 60    | V    | 2 |
|   | ASSR-1411<br>Connection B | $V_O$    | 0    | 60    | 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    | 3    |
| Input Voltage (OFF)   | $V_{F(OFF)}$ | 0    | 0.8  | V     |      |
| Operating Temperature | $T_A$        | -40  | +85  | °C    |      |



## Package Characteristics

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

| Parameter                                | Sym.                   | Min. | Typ.      | Max. | Units    | Conditions   | Note |
|--|------------------------|------|-----------|------|----------|--|------|
| Input-Output Momentary Withstand Voltage | $V_{ISO}$              | 3750 |           |      | Vrms     | $RH \leq 50\%$ ,<br>$t = 1 \text{ min}$            | 4, 5 |
| Input-Output Resistance                  | $R_{I-O}$              |      | $10^{12}$ |      | $\Omega$ | $V_{I-O} = 500 \text{ Vdc}$                        |      |
| Input-Output Capacitance                 | ASSR-1410<br>$C_{I-O}$ |      | 0.4       |      | pF       | $f = 1 \text{ MHz}$ ;<br>$V_{I-O} = 0 \text{ Vdc}$ | 4    |
|  | ASSR-1411<br>$C_{I-O}$ |      | 0.5       |      | pF       | $f = 1 \text{ MHz}$ ;<br>$V_{I-O} = 0 \text{ Vdc}$ |      |
|  | ASSR-1420<br>$C_{I-O}$ |      | 0.8       |      | pF       | $f = 1 \text{ MHz}$ ;<br>$V_{I-O} = 0 \text{ Vdc}$ |      |

## 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)} $                          | 60   | 65   |      | V             | $V_F = 0.8\text{V}$ , $I_O = 250 \mu\text{A}$ ,<br>$T_A = 25^\circ\text{C}$                        |       |      |
|                                 |   | 55   |      |      | V             | $V_F = 0.8\text{V}$ , $I_O = 250 \mu\text{A}$  | 5     |      |
| Output Leakage Current          | $I_{O(OFF)}$                            |      | 0.5  | 100  | nA            | $V_F = 0.8\text{V}$ , $V_O = 60\text{V}$ ,<br>$T_A = 25^\circ\text{C}$                             |       |      |
|                                 |   |      |      | 1    | $\mu\text{A}$ | $V_F = 0.8\text{V}$ , $V_O = 60\text{V}$   | 6     |      |
| 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             | $I_F = 5\text{mA}$   | 7, 8  |      |
| Output On-resistance            | $R_{(ON)}$                              |      | 0.7  | 1    | $\Omega$      | $I_F = 5\text{mA}$ , $I_O = 600\text{mA}$ ,<br>Pulse $\leq 30\text{ms}$ , $T_A = 25^\circ\text{C}$ | 9, 10 | 6    |
|                                 | ASSR-1411<br>Connection B<br>$R_{(ON)}$ |      | 0.2  | 0.5  | $\Omega$      | $I_F = 5\text{mA}$ , $I_O = 1.2\text{A}$ ,<br>Pulse $\leq 30\text{ms}$ , $T_A = 25^\circ\text{C}$  |       |      |

## 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                | $I_F = 5\text{mA}$ , $I_O = 600\text{mA}$ ,<br>$T_A = 25^{\circ}\text{C}$  | 11,                                       |      |
|                                  |               |      |           |      | 1.0               | ms   | $I_F = 5\text{mA}$ , $I_O = 600\text{mA}$ | 15   |
|                                  |               |      | 0.1       | 0.25 | ms                | $I_F = 10\text{mA}$ , $I_O = 600\text{mA}$ ,<br>$T_A = 25^{\circ}\text{C}$ |   |      |
|                                  |               |      |           | 0.5  | ms                | $I_F = 10\text{mA}$ , $I_O = 600\text{mA}$                                 |   |      |
| Turn Off Time                    | $T_{OFF}$     |      | 0.02      | 0.2  | ms                | $I_F = 5\text{mA}$ , $I_O = 600\text{mA}$ ,<br>$T_A = 25^{\circ}\text{C}$  | 13,                                       |      |
|                                  |               |      |           |      | 0.5               | ms   | $I_F = 5\text{mA}$ , $I_O = 600\text{mA}$ | 14   |
|                                  |               |      | 0.02      | 0.15 | ms                | $I_F = 10\text{mA}$ , $I_O = 600\text{mA}$ ,<br>$T_A = 25^{\circ}\text{C}$ |   |      |
|                                  |               |      |           | 0.2  | ms                | $I_F = 10\text{mA}$ , $I_O = 600\text{mA}$                                 |   |      |
| Output Transient Rejection       | $dV_O/dt$     | 1    | 7         |      | 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    | $\geq 10$ |      | kV/ $\mu\text{s}$ | $\Delta V_{I-O} = 1000\text{V}$ , $T_A = 25^{\circ}\text{C}$               | 17  |      |

Notes:

- For derating, refer to Figure 1, 2, 3 and 4.
- 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.
- 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  $I_F = 5\text{mA}$ .
- Device is considered as a two terminal device:
  - ASSR-1410 - pin 1, 2 shorted and pin 3, 4 shorted.
  - ASSR-1411 - pin 1, 2, 3 shorted and pin 4, 5, 6 shorted.
  - ASSR-1420 - pin 1, 2, 3, 4 shorted and pin 5, 6, 7, 8 shorted.
- 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."
- During the pulsed  $R_{(ON)}$  measurement ( $I_O$  duration  $\leq 30\text{ms}$ ), ambient ( $T_A$ ) and case temperature ( $T_C$ ) are equal.

## Applications Information

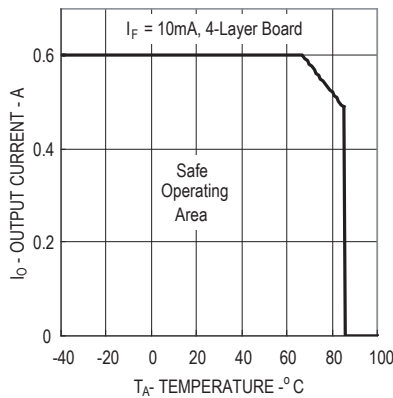
### On-Resistance and Derating Curves

The Output On-Resistance,  $R_{(ON)}$ , specified in this data sheet, is the resistance measured across the output contact when a pulsed current signal ( $I_o=0.6A$ ) is applied to the output pins. The use of a pulsed signal ( $\leq 30ms$ ) 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.

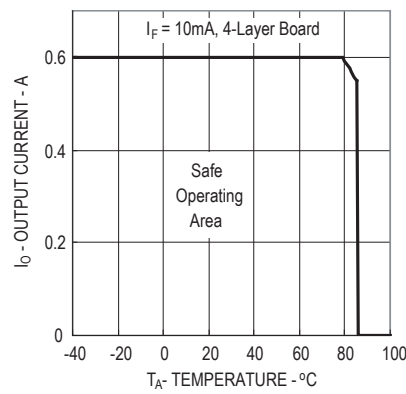
Derating curves are shown in Figures 1, 2, 3 and 4, specifying the maximum output current allowable for a given ambient temperature. The maximum allowable output current and power dissipation are related by the expression  $R_{ss}=P_o(max)/(I_o(max))^2$  from which  $R_{ss}$  can be calculated. Staying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

### Turn On Time and Turn Off Time Variation

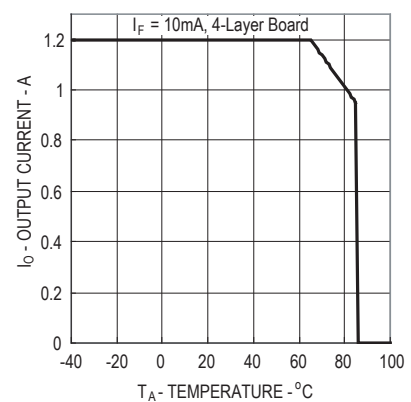
The ASSR-14XX Series exhibits a very fast turn on and turn off time. Both the turn on and turn off time can be adjusted by choosing proper forward current as depicted in Figures 11 and 13. The changes of the turn on and turn off time with ambient temperature are also shown in Figures 12 and 14.



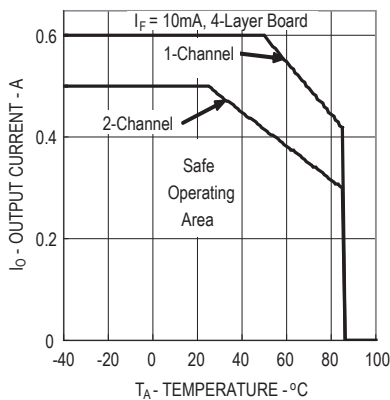
**Figure 1. Maximum Output Current Rating vs Ambient Temperature (ASSR-1410-003E)**



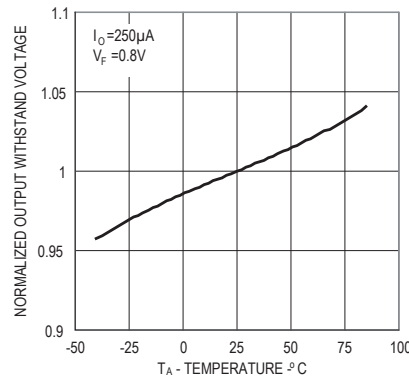
**Figure 2. Maximum Output Current Rating vs Ambient Temperature (ASSR-1411-001E)**



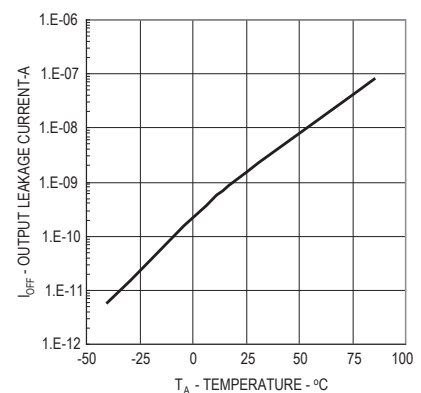
**Figure 3. Maximum Output Current Rating vs Ambient Temperature (ASSR-1411-001E DC Connection)**



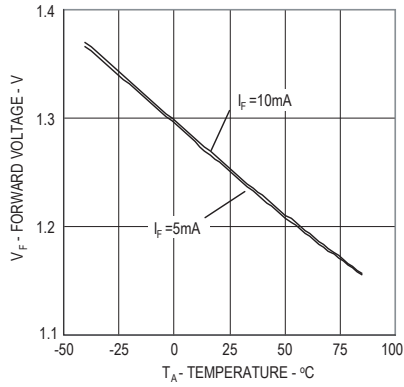
**Figure 4. Maximum Output Current Rating vs Ambient Temperature (ASSR-1420-002E)**



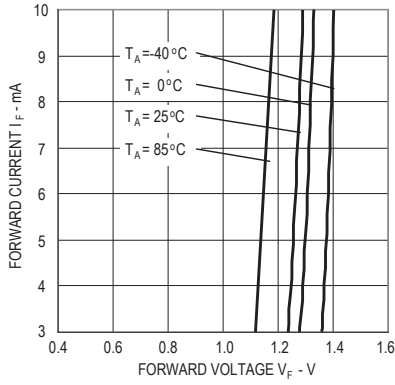
**Figure 5. Normalized Typical Output Withstand Voltage vs. Temperature**



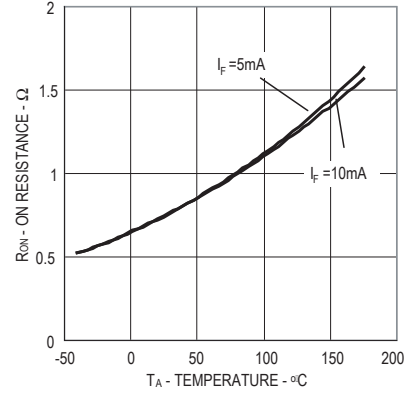
**Figure 6. Typical Output Leakage Current vs. Temperature**



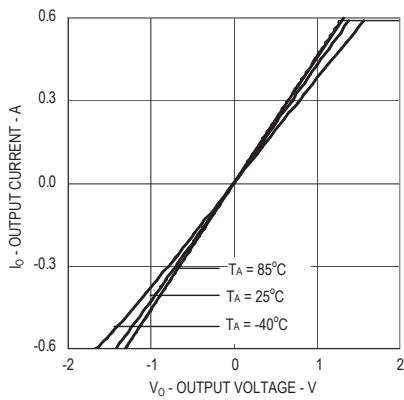
**Figure 7. Typical Forward Voltage vs. Temperature**



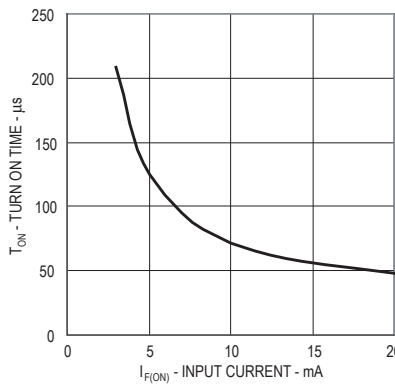
**Figure 8. Typical Forward Current vs. Forward Voltage**



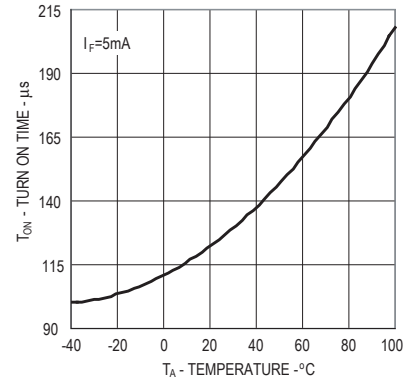
**Figure 9. Typical On Resistance vs. Temperature**



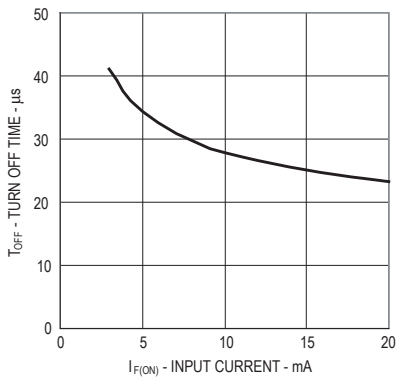
**Figure 10. Typical Output Current vs. Output Voltage**



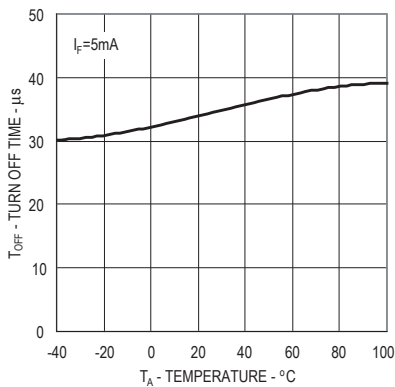
**Figure 11. Typical Turn On Time vs. Input Current**



**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**

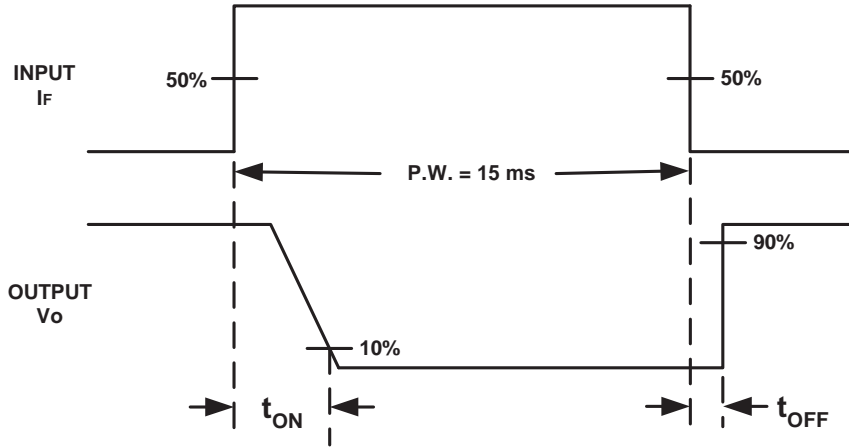
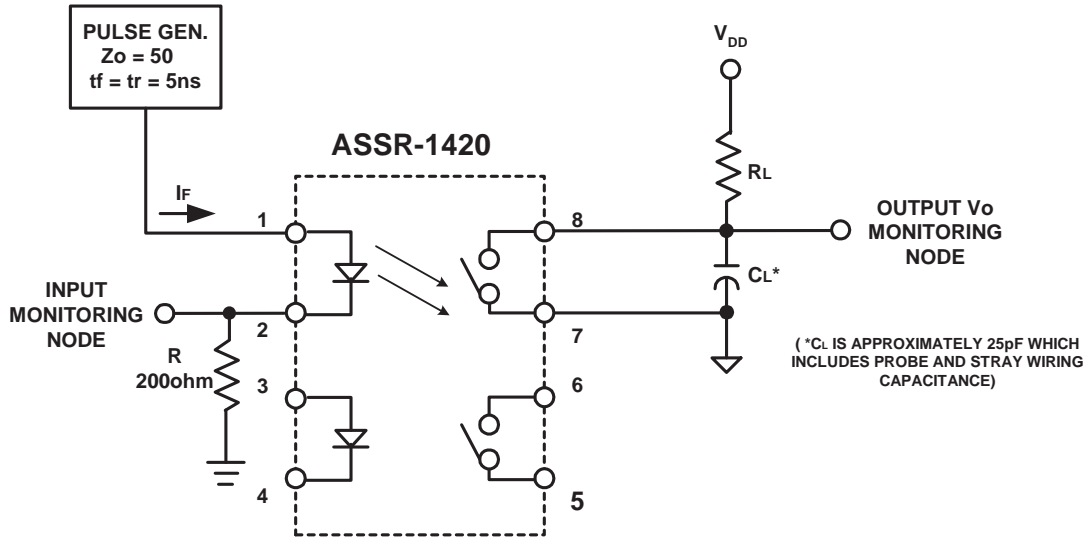
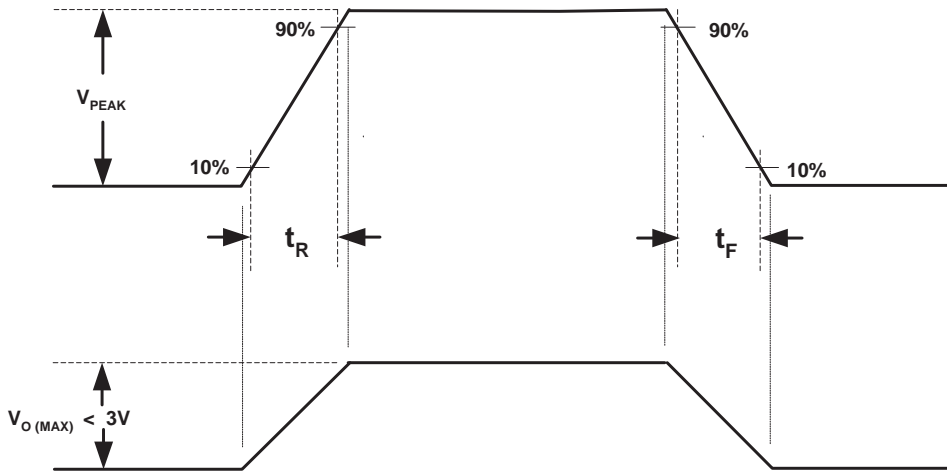
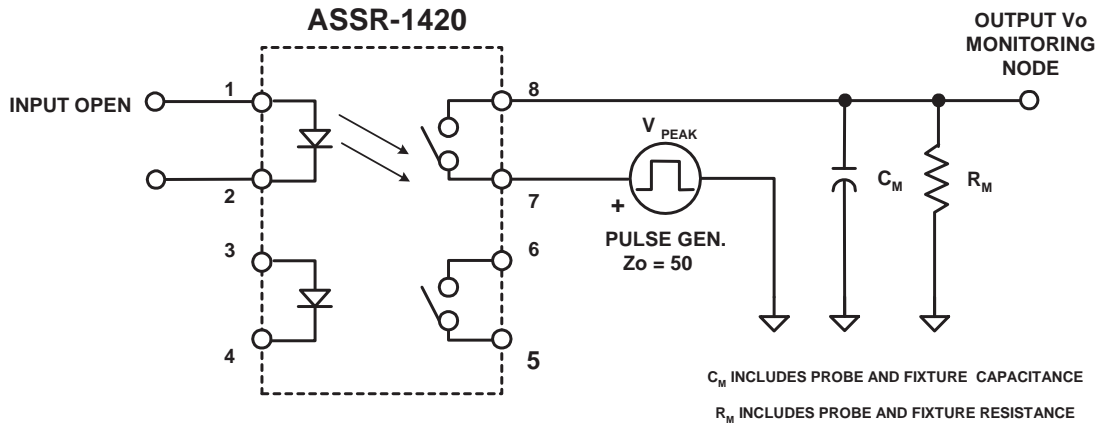


Figure 15. Switching Test circuit for  $t_{ON}$ ,  $t_{OFF}$



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

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

Figure 16. Output Transient Rejection Test Circuit

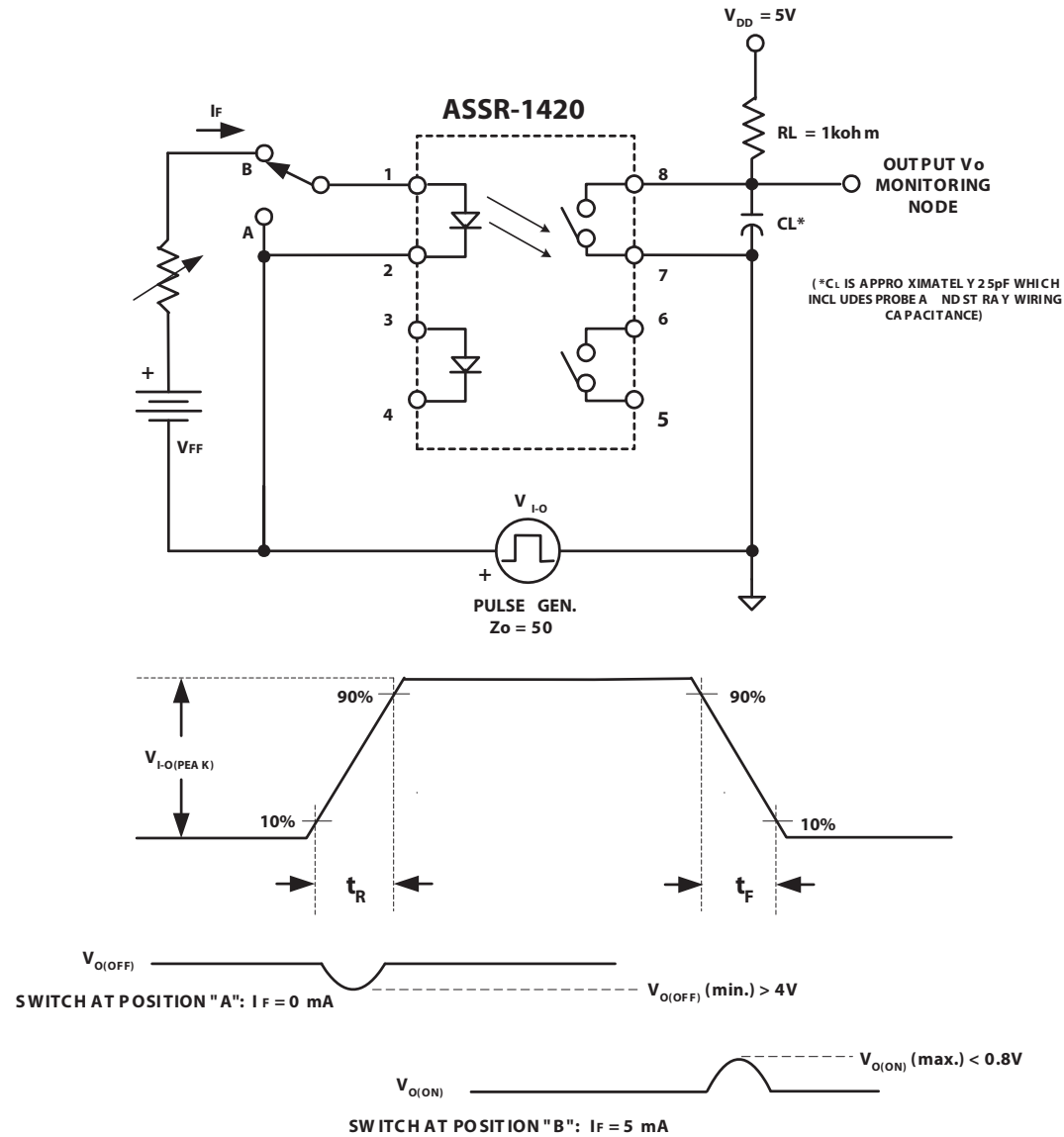


Figure 17. Input - Output Transient Rejection Test Circuit

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Телефон: 8 (812) 309-75-97 (многоканальный)

Факс: 8 (812) 320-03-32

Электронная почта: [ocean@oceanchips.ru](mailto:ocean@oceanchips.ru)

Web: <http://oceanchips.ru/>

Адрес: 198099, г. Санкт-Петербург, ул. Калинина, д. 2, корп. 4, лит. А