

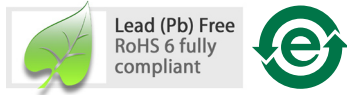
# ASSR-1611

## High Current, 1 Form A, Solid State Relay (MOSFET)

(60V/2.5A/0.1Ω)



### Data Sheet



#### Description

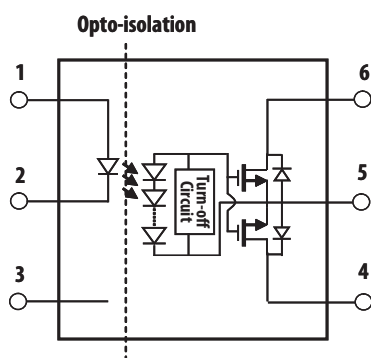
The ASSR-1611 is specifically designed for high current applications, commonly found in the industrial equipments. The relay is a solid-state replacement for single-pole, normally-open, (1 Form A) electromechanical relays.

The ASSR-1611 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 5mA through the input LED. The relay turns off (contact opens) with an input voltage of 0.8V or less.

The ASSR-1611 connection A, as shown in the schematic, allows the relay to switch either ac or dc loads. The connection B, with its advantages of reduced on-resistance and higher output current, allows the relays to switch dc loads only.

The electrical and switching characteristics are specified over the temperature range of -40°C to +85°C.

#### Functional Diagram



#### Truth Table

| LED | Output |
|-----|--------|
| Off | Open   |
| On  | Close  |

#### Features

- Compact Solid-State Bi-directional Signal Switch
- Single Channel Normally-off Single-Pole-Single-Throw (SPST) Relay
- 60V Output Withstand Voltage
- 2.5A or 5A Current Rating
- Low Input Current: CMOS Compatibility
- Low On-Resistance: 20mΩ Typical for DC-only, 65mΩ Typical for AC/DC
- High Speed Switching: 3.2ms (T<sub>on</sub>), 0.1ms (T<sub>off</sub>) Typical
- High Transient Immunity: >1kV/μs
- High Input-to-Output Insulation Voltage
  - (Safety and Regulatory Approvals)
    - UL recognized - 3750 V<sub>RMS</sub> and 5000 V<sub>RMS</sub>\* for 1 min per UL1577
    - CSA Component Acceptance
      - \*5000 V<sub>RMS</sub>/1 Minute rating is for Option X21 only.

#### Applications

- Industrial Controls
- Factory Automation
- Data Acquisition
- Measuring Instrument
- Medical System
- Security System
- 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-1611 is UL Recognized with 3750 V<sub>RMS</sub> and 5000 V<sub>RMS</sub> (option X21) for 1 minute per UL1577 and is approved under CSA Components Acceptance Notice #5, File CA 88324

| Part Number | Option         |              | Surface Mount | Gullwing | Tape & Reel | UL 5000 VRMS/<br>1 Minute Rating | Quantity            |
|-------------|----------------|--------------|---------------|----------|-------------|----------------------------------|---------------------|
|             | RoHS Compliant | Package      |               |          |             |                                  |                     |
| ASSR-1611   | -001E          | 300mil DIP-6 |               |          |             |                                  | 50 units per tube   |
|             | -021E          |              |               |          |             | X                                |                     |
|             | -301E          |              | X             | X        |             |                                  |                     |
|             | -321E          |              | X             | X        |             | X                                | 1000 units per reel |
|             | -501E          |              | X             | X        | X           |                                  |                     |
|             | -521E          |              | X             | X        | X           | X                                |                     |

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:

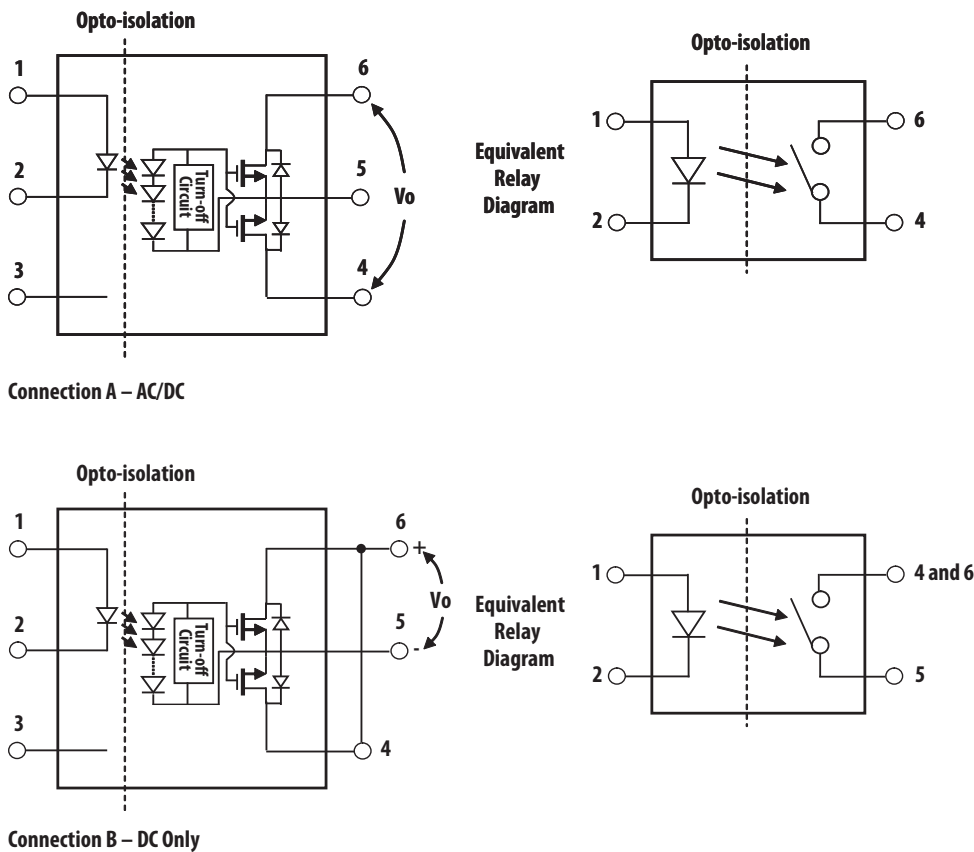
ASSR-1611-501E to order product of 300mil DIP-6 Gull Wing Surface Mount package in Tape and Reel packaging and RoHS Compliant.

Example 2:

ASSR-1611-021E to order product of 300mil DIP-6 package in tube packaging, RoHS Compliant and UL 5000V<sub>RMS</sub> 1 Minute rating.

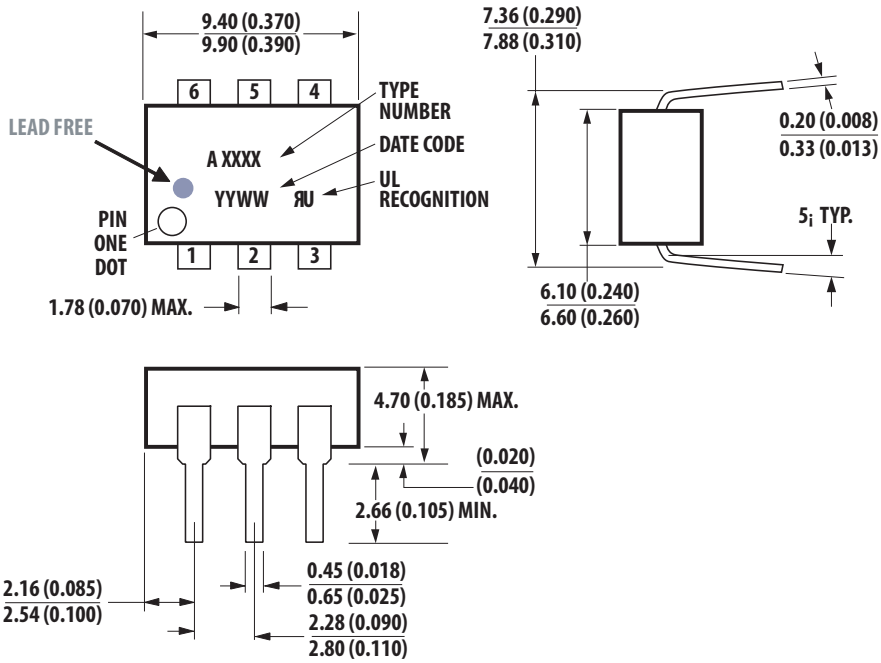
## Schematic

ASSR-1611



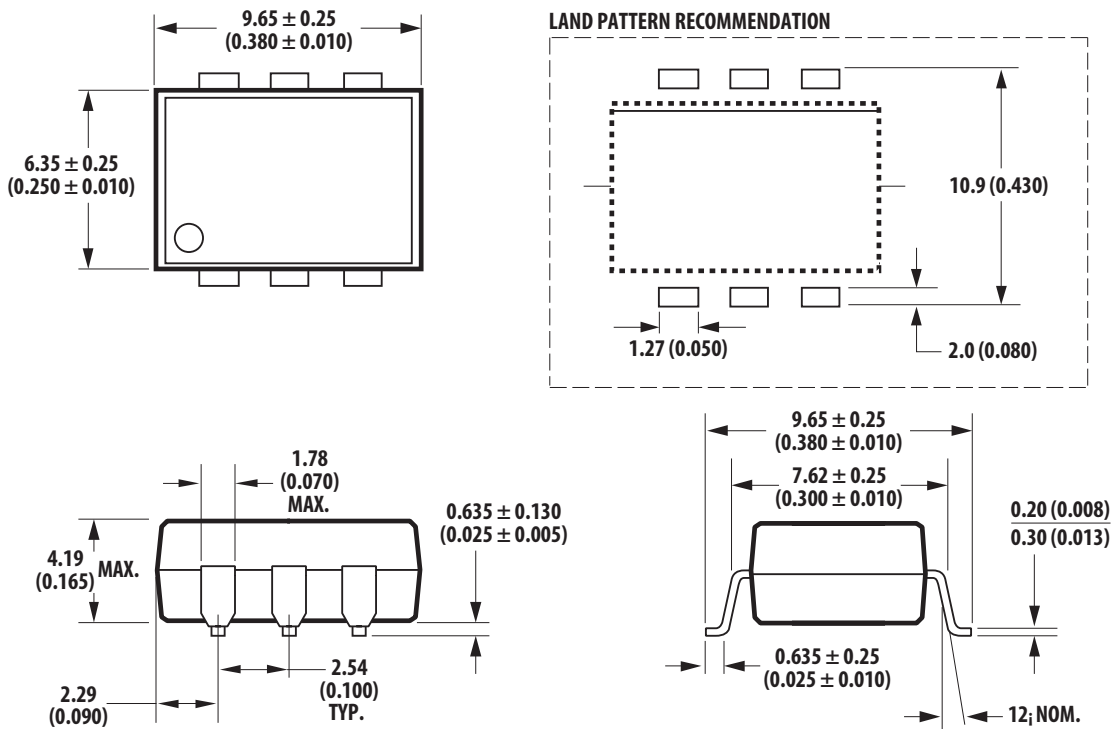
## Package Outline Drawings

### ASSR-1611 6-Pin DIP Package



DIMENSIONS IN MILLIMETERS AND (INCHES).

### ASSR-1611 6-Pin DIP Package with Gull Wing Surface Mount Option 300



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

## Solder Reflow Temperature Profile

Recommended reflow condition as per JEDEC Standard, J-STD-020 (latest revision). Non-Halide Flux should be used.

## Regulatory Information

The ASSR-1611 is approved by the following organizations:

### UL

Approved under UL 1577, component recognition program up to  $V_{ISO} = 3750 V_{RMS}$  and  $5000 V_{RMS}$  (option x21).

Approved under CSA Component Acceptance Notice #5.

## Insulation and Safety Related Specifications

| Parameter   | Symbol | ASSR-1611 | 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 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                       | sec   |      |   |
| Input Current   | Average      | $I_F$ | 25                       | mA    |      |   |
|   | Surge        |       | 50                       | mA    |      |   |
|   | Transient    |       | 1000                     | mA    |      |   |
| Reversed Input Voltage  | $V_R$        |       | 5                        | V     |      |   |
| Input Power Dissipation   | $P_{IN}$     |       | 40                       | mW    |      |   |
| Output Power Dissipation  | Connection A | $P_O$ | 625                      | mW    |      |   |
|   | Connection B |       | 880                      | mW    |      |   |
| Average Output Current<br>( $T_A=25^\circ\text{C}$ , $T_C \leq 100^\circ\text{C}$ ) | Connection A | $I_O$ | 2.5                      | A     | 1    |   |
|   | Connection B |       | 5                        | A     | 1    |   |
| Output Voltage<br>( $T_A=25^\circ\text{C}$ )  | Connection A | $V_O$ | -60                      | 60    | V    | 2 |
|   | Connection B |       | 0                        | 60    | V    |   |
| Solder Reflow Temperature Profile   |              |       | See Lead Free IR Profile |       |      |   |

## Recommended Operating Conditions

| Parameter             | Symbol       | Min. | Max. | Units | Note |
|-----------------------|--------------|------|------|-------|------|
| Input Current (ON)    | $I_{F(ON)}$  | 5    | 20   | mA    |      |
| Input Voltage (OFF)   | $V_{F(OFF)}$ | 0    | 0.8  | V     |      |
| Operating Temperature | $T_A$        | -40  | +85  | °C    |      |

## Package Characteristics

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

| Parameter                                | Sym.      | Min. | Typ.      | Max. | Units     | Conditions   | Note |
|--|-----------|------|-----------|------|-----------|--|------|
| Input-Output Momentary Withstand Voltage | $V_{ISO}$ | 3750 |           |      | $V_{RMS}$ | $RH \leq 50\%$ , $t=1\text{min}$ , $T_A=25^\circ\text{C}$              | 3, 4 |
|  |           | 5000 |           |      |           | $RH \leq 50\%$ , $t=1\text{min}$ , $T_A=25^\circ\text{C}$ , option X21 |      |
| Input-Output Resistance                  | $R_{I-O}$ |      | $10^{14}$ |      | $\Omega$  | $V_{I-O}=500\text{Vdc}$  |      |
| Input-Output Capacitance                 | $C_{I-O}$ |      | 0.8       |      | pF        | $V_{I-O}=0\text{Vdc}$ , $f=1\text{MHz}$                                | 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)} $ | 60         | 68    |       | V             | $V_F=0.8\text{V}$ , $I_O=250\mu\text{A}$ , $T_A=25^{\circ}\text{C}$                           | 3     |      |
|                                 |                | 55         |       |       | V             | $V_F=0.8\text{V}$ , $I_O=250\mu\text{A}$  | 3     |      |
| Output Leakage Current          | $I_{O(OFF)}$   |            | 0.01  | 0.1   | $\mu\text{A}$ | $V_F=0.8\text{V}$ , $V_O=60\text{V}$ , $T_A=25^{\circ}\text{C}$                               | 5     |      |
|                                 |                |            |       | 5     | $\mu\text{A}$ | $V_F=0.8\text{V}$ , $V_O=55\text{V}$  | 4     |      |
| Output Off-Capacitance          | $C_{(OFF)}$    |            | 1400  |       | pF            | $V_F=0.8\text{V}$ , $V_O=0\text{V}$ , $f=1\text{MHz}$   | 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   | 1.7   | V             | $I_F=5\text{mA}$  | 7, 8  |      |
| Output On-resistance            | Connection A   | $R_{(ON)}$ | 0.065 | 0.1   | $\Omega$      | $I_F=5\text{mA}$ , $I_O=2.5\text{A}$ ,<br>Pulse $\leq 30\text{ms}$ , $T_A=25^{\circ}\text{C}$ | 9, 10 | 5    |
|                                 | Connection B   |            | 0.02  | 0.035 | $\Omega$      |   | 11    |      |

## 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                     | $T_{ON}$      |      | 3.2       | 5.0  | ms                      | $I_F=5\text{mA}$ , $I_O=1.0\text{A}$ , $T_A=25^{\circ}\text{C}$  | 12, 13 |      |
|                                  |               |      |           | 10.0 | ms                      | $I_F=5\text{mA}$ , $I_O=1.0\text{A}$   |        |      |
|                                  |               |      | 1.6       | 2.5  | ms                      | $I_F=10\text{mA}$ , $I_O=1.0\text{A}$ , $T_A=25^{\circ}\text{C}$   | 12, 14 |      |
|                                  |               |      |           | 5.0  | ms                      | $I_F=10\text{mA}$ , $I_O=1.0\text{A}$  |        |      |
| Turn Off Time                    | $T_{OFF}$     |      | 0.1       | 0.5  | ms                      | $I_F=5\text{mA}$ , $I_O=1.0\text{A}$ , $T_A=25^{\circ}\text{C}$  | 15, 16 |      |
|                                  |               |      |           | 1    | ms                      | $I_F=5\text{mA}$ , $I_O=1.0\text{A}$   |        |      |
|                                  |               |      | 0.06      | 0.2  | ms                      | $I_F=10\text{mA}$ , $I_O=1.0\text{A}$ , $T_A=25^{\circ}\text{C}$   | 15, 17 |      |
|                                  |               |      |           | 0.5  | ms                      | $I_F=10\text{mA}$ , $I_O=1.0\text{A}$  |        |      |
| Output Transient Rejection       | $dV_O/dt$     | 1    | 7         |      | $\text{kV}/\mu\text{s}$ | $\Delta V_O=60\text{V}$ , $R_M \geq 1\text{M}\Omega$ ,<br>$C_M=1000\text{pF}$ , $T_A=25^{\circ}\text{C}$                     |        | 6    |
| Input-Output Transient Rejection | $dV_{I-O}/dt$ | 1    | $\geq 10$ |      | $\text{kV}/\mu\text{s}$ | $V_{DD}=5\text{V}$ , $\Delta V_{I-O}=1000\text{V}$ ,<br>$R_L=1\text{k}\Omega$ , $C_L=25\text{pF}$ , $T_A=25^{\circ}\text{C}$ |        | 6    |

Notes:

- For derating, refer to Figure 1 and 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.
- Device is considered as a two terminal device: pins 1, 2, and 3 shorted together and pins 5, 6, and 7 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 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.
- For the transient rejection measurements, refer to Avago whitepaper, AV01-0610EN, "Solid State Relay Transient Immunity".

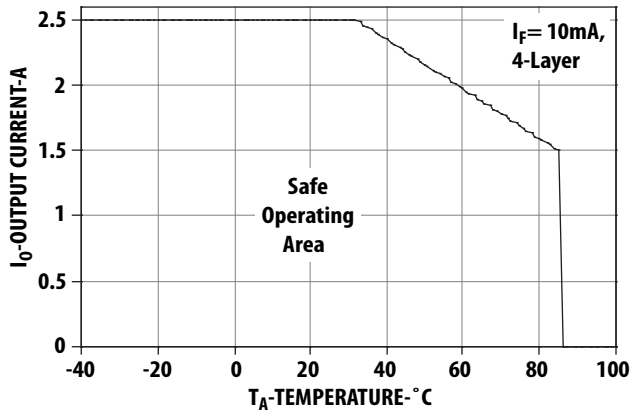


Figure 1. Maximum Output Current rating vs Ambient Temperature (AC/DC Connection)

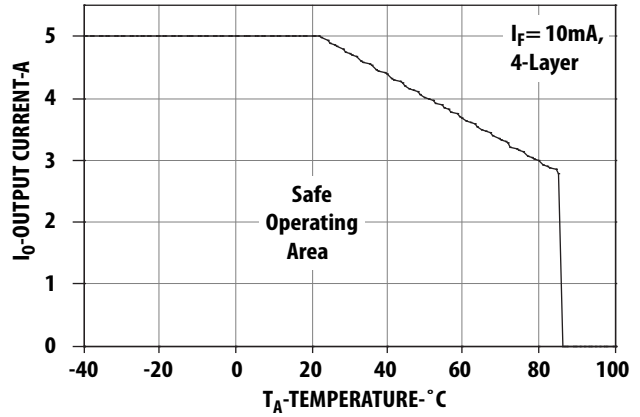


Figure 2. Maximum Output Current rating vs Ambient Temperature (DC Connection)

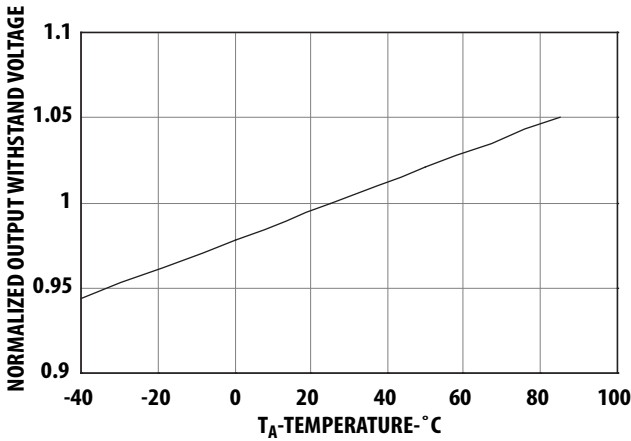


Figure 3. Normalized Typical Output Withstand Voltage vs Ambient Temperature

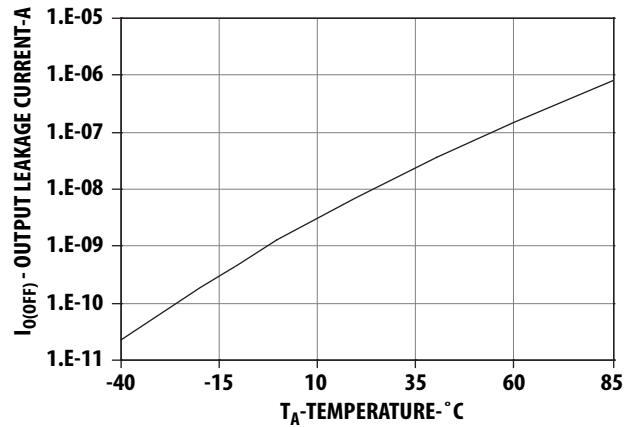


Figure 4. Typical Output Leakage vs Ambient Temperature

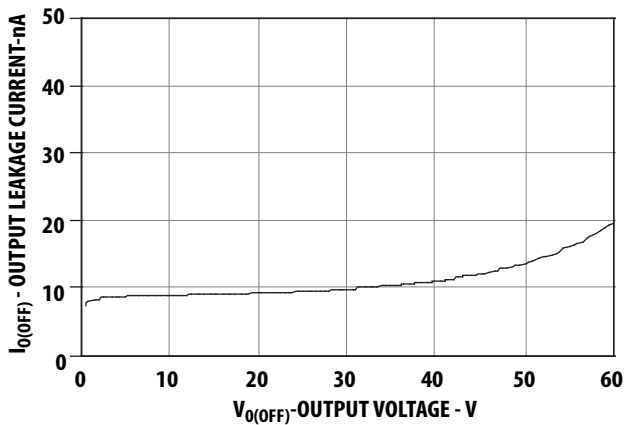


Figure 5. Typical Output Leakage vs Output Voltage

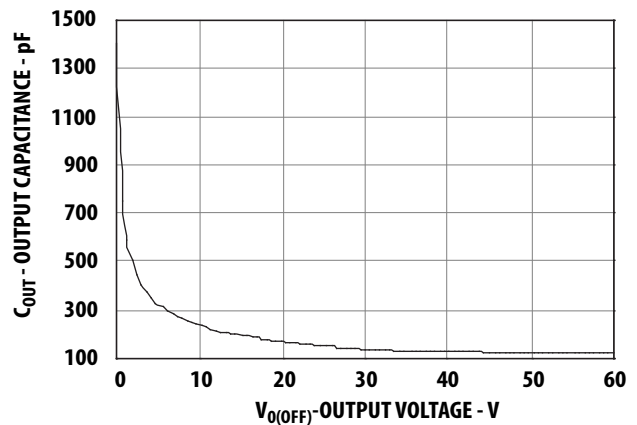


Figure 6. Typical Output Capacitance vs Output Voltage

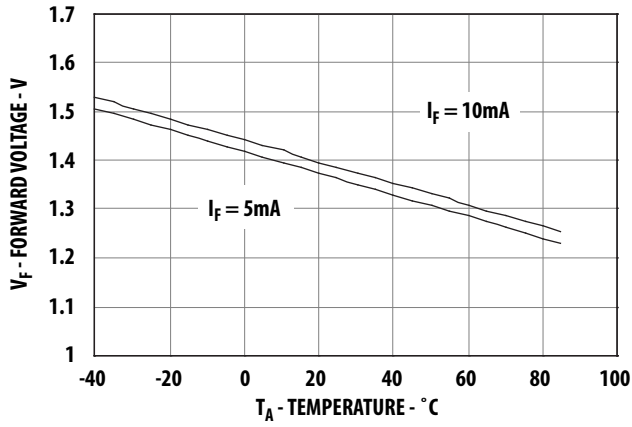


Figure 7. Typical Forward Voltage vs Temperature

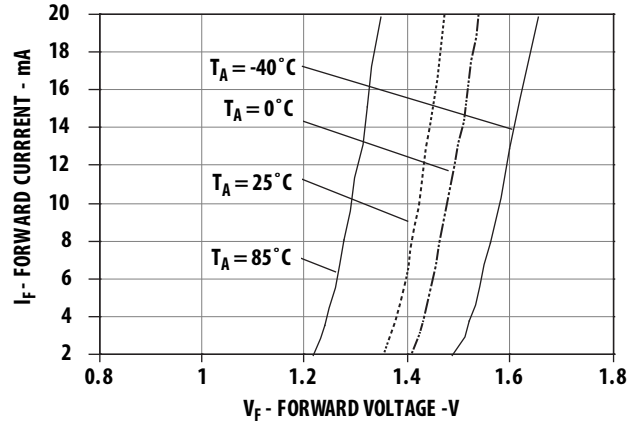


Figure 8. Typical Forward Current vs Forward Voltage over Temperature

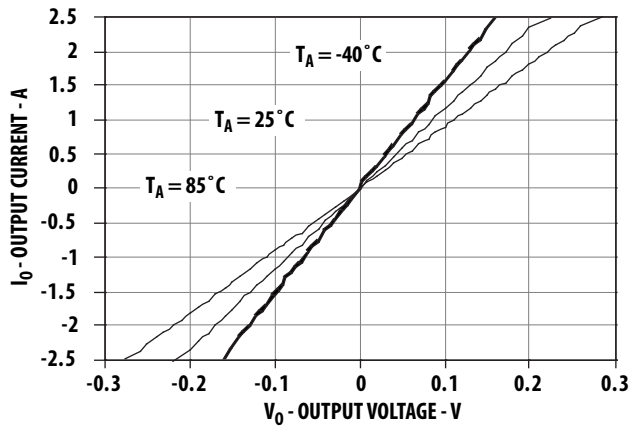


Figure 9. Typical Output Current vs Typical Output Voltage over Temperature

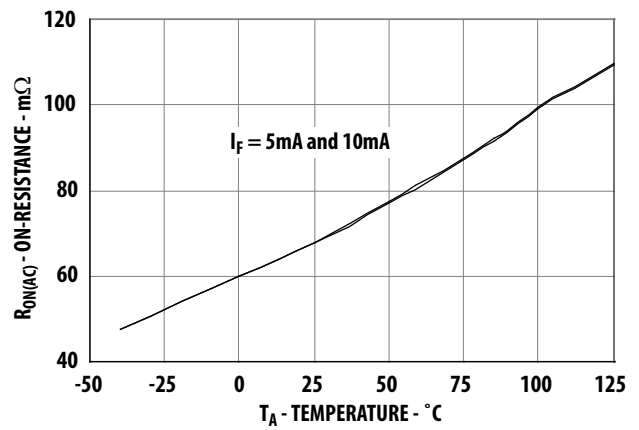


Figure 10. Typical Ron (AC/DC Connection) vs Temperature

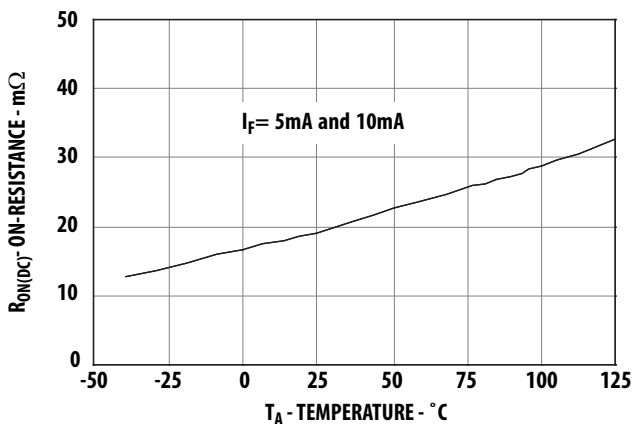


Figure 11. Typical Ron (DC Connection) vs Temperature

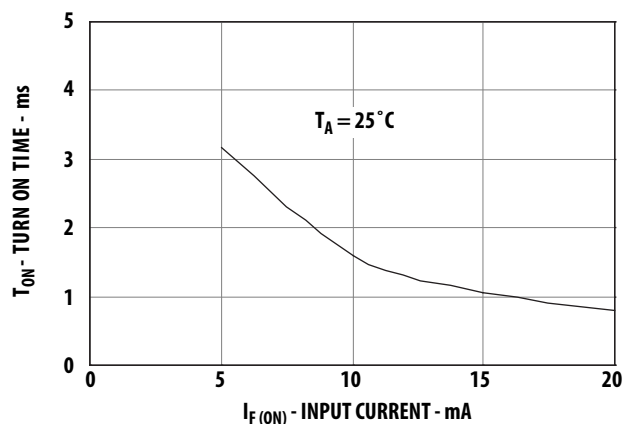


Figure 12. Typical Turn On Time vs Input Current

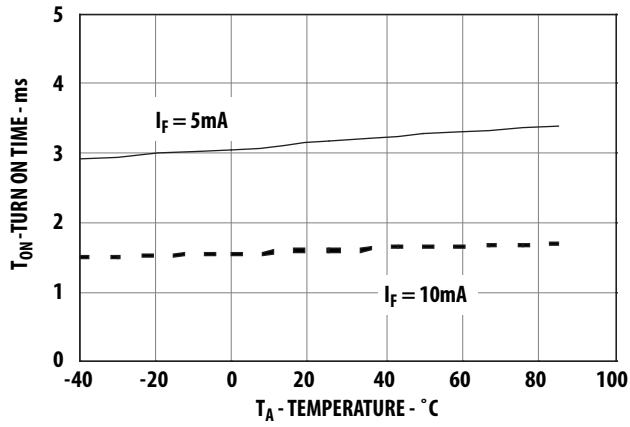


Figure 13. Typical Turn On Time vs Ambient Temperature

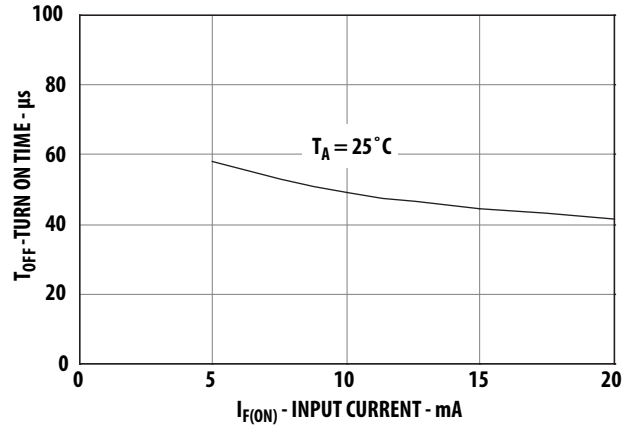


Figure 14. Typical Turn Off Time vs Input Current

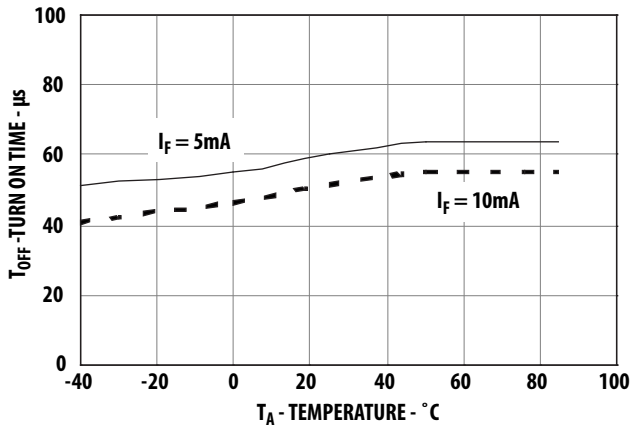


Figure 15. Typical Turn Off Time vs Ambient Temperature

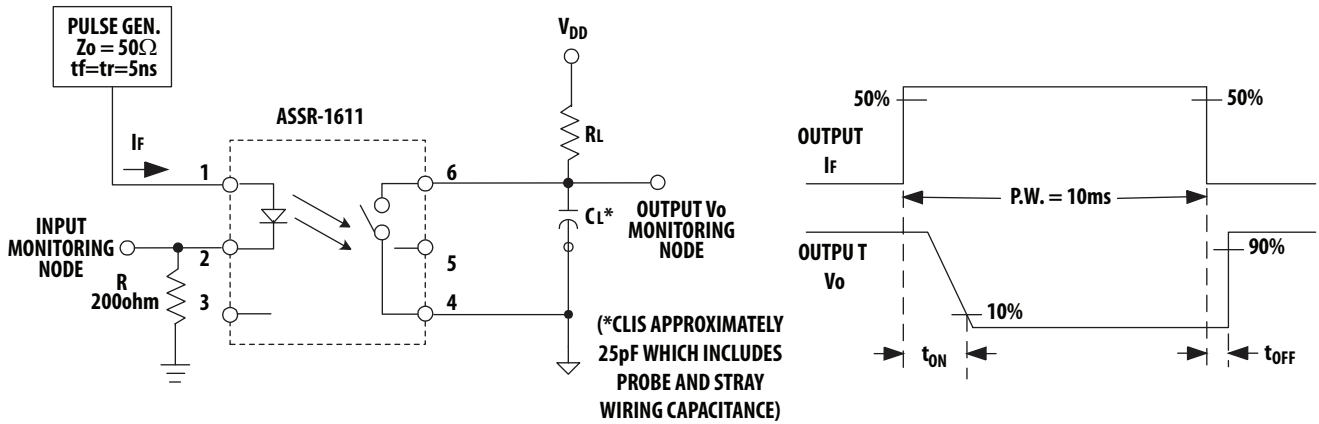
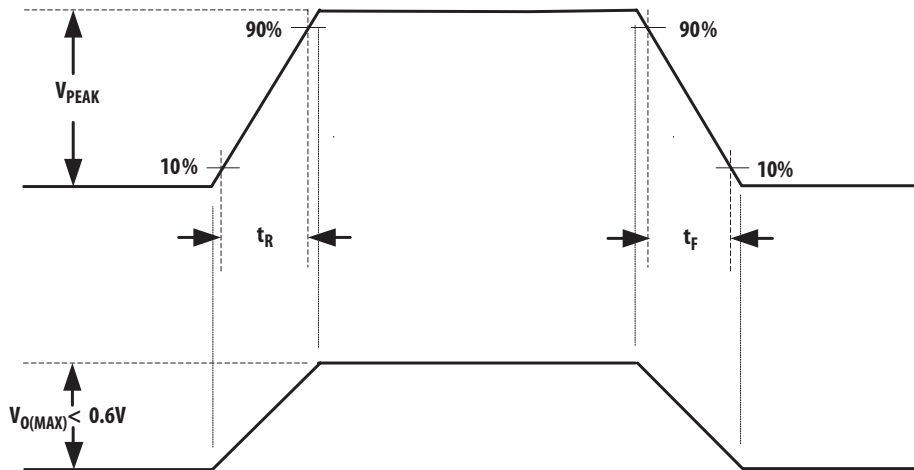
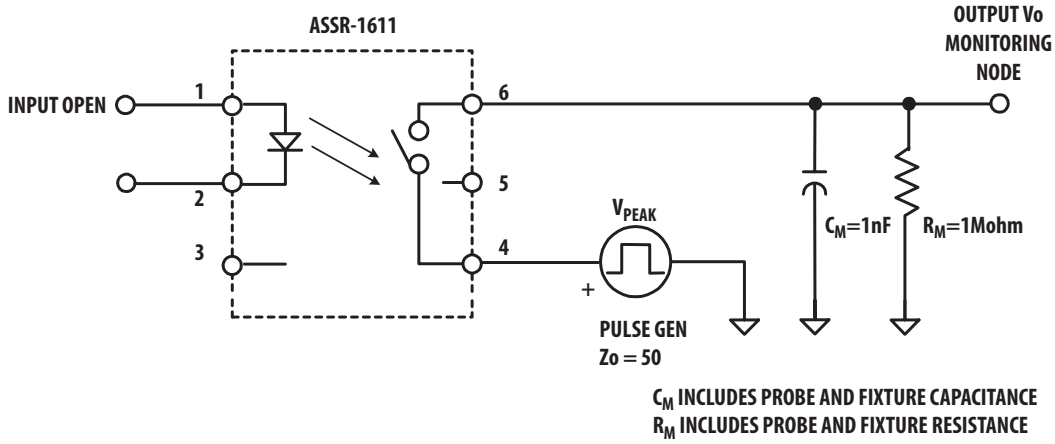


Figure 16. Switching Circuit



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

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

Figure 17. Output Transient Rejection Test Circuit

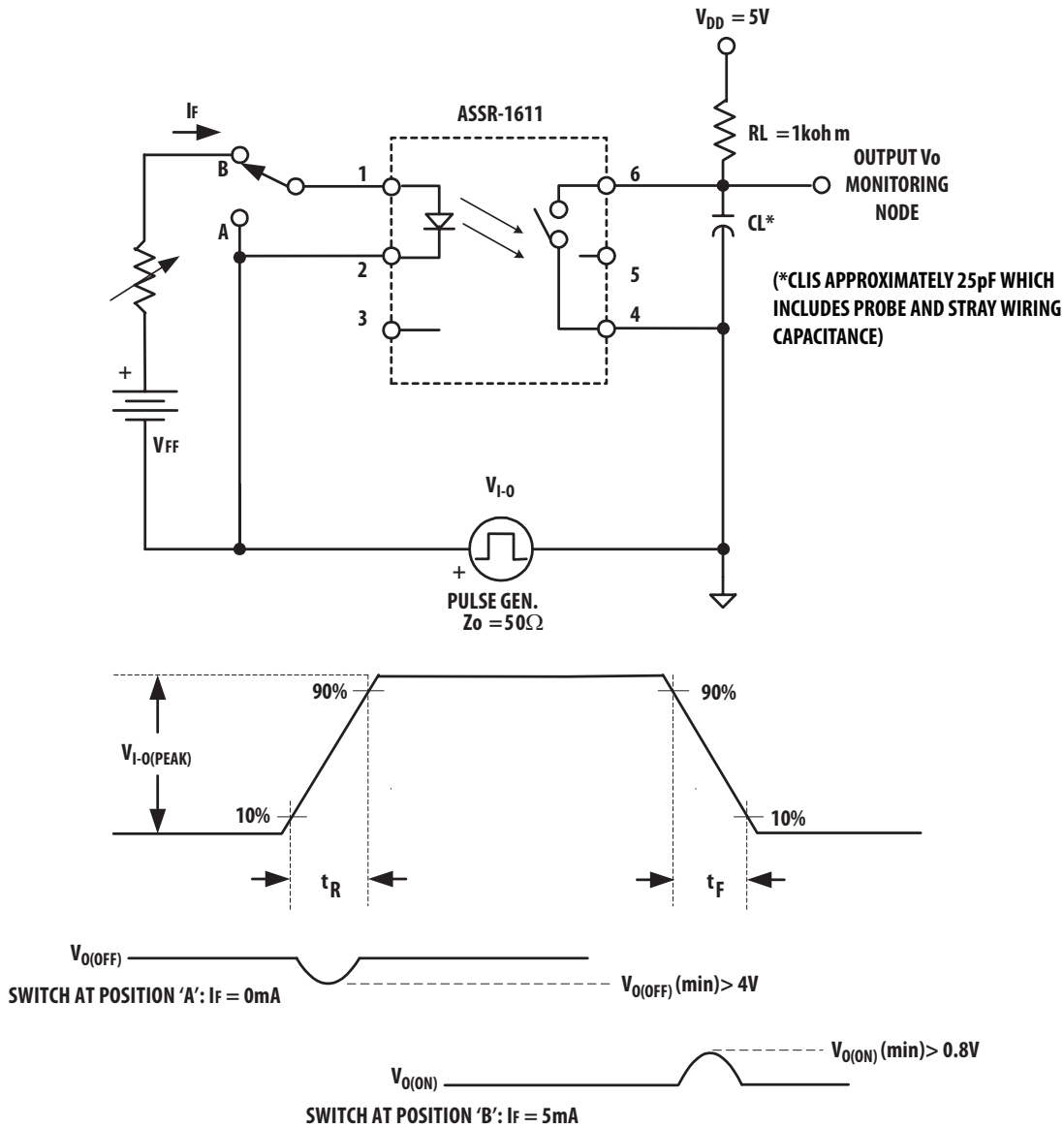


Figure 18. Input-Output Transient Rejection Test Circuit

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