

Data Sheet

Description

The ACPL-W611/ACPL-P611 is an optically coupled gate that combines a GaAsP light emitting diode and an integrated high gain photo detector. The output of the detector IC is an open collector Schottky clamped transistor. The internal shield provides a guaranteed common mode transient immunity specification of 10,000 V/ μ s for the ACPL-W611.

This unique design provides maximum AC and DC circuit isolation while achieving TTL compatibility. The optocoupler AC and DC operational parameters are guaranteed from -40°C to $+100^{\circ}\text{C}$, allowing trouble-free system performance.

The ACPL-W611/ACPL-P611 is suitable for high-speed logic interfacing, input/output buffering, as line receivers in environments that conventional line receivers cannot tolerate and are recommended for use in extremely high ground or induced noise environments.

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. The components featured in this data sheet are not to be used in military or aerospace applications or environments.

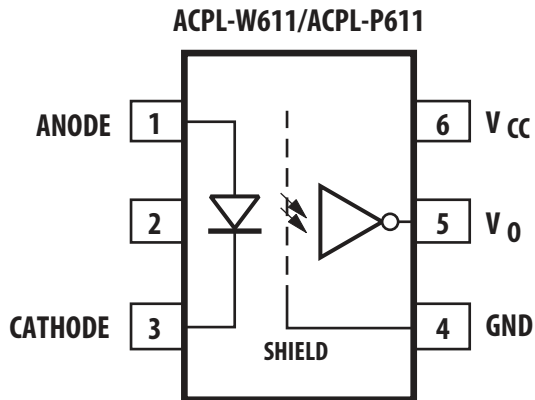
Features

- 10 kV/ μ s minimum Common Mode Rejection (CMR) at $V_{\text{CM}} = 1000\text{V}$
- High speed: 10 MBd typical
- LSTTL/TTL compatible
- Low input current capability: 5 mA
- Guaranteed ac and dc performance over temperature: -40°C to $+100^{\circ}\text{C}$
- Stretched SO-6 package
- Safety Approval:
 - UL Recognized:
5000Vrms for 1 minute for ACPL-W611 and ACPL-P611-020E per UL1577
 - CSA
 - IEC/EN/DIN EN 60747-5-5

Applications

- Isolated line receiver
- Computer-peripheral interfaces
- Microprocessor system interfaces
- Digital isolation for A/D, D/A conversion
- Switching power supply
- Instrument input/output isolation
- Ground loop elimination
- Pulse transformer replacement
- Power transistor isolation in motor drives
- Isolation of high speed logic systems

Functional Diagram

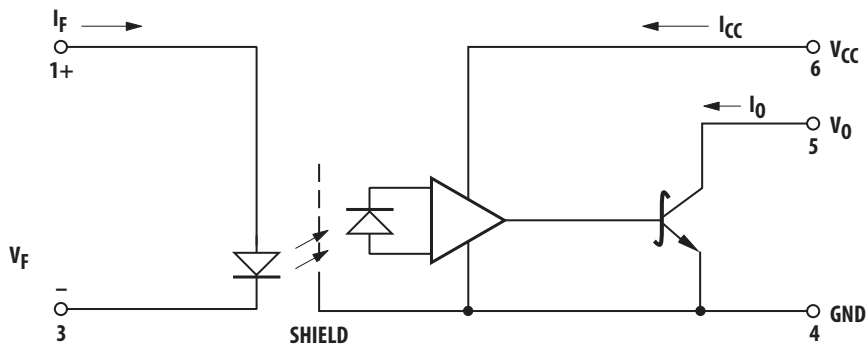


TRUTH TABLE
(POSITIVE LOGIC)

| LED | OUTPUT |
|-----|--------|
| ON | L |
| OFF | H |

NOTE Bypassing of the power supply line is required with a 0.1- μ F ceramic disc capacitor adjacent to each optocoupler. The total lead length between both ends of the capacitor and the isolator pins should not exceed 10 mm.

Schematic Diagram



Ordering Information

ACPL-P611 is UL Recognized with 3750 V_{rms} for 1 minute and ACPL-W611 is UL recognized with 5000 V_{rms} for 1 minute per UL1577. They are approved under CSA Component Acceptance Notice #5, File CA 88324.

| Part Number | Option | Package | Surface Mount | Tape and Reel | UL 5000 Vrms/ 1 Minute Rating | IEC/EN/DIN EN 60747-5-5 | Quantity |
|-------------|-------------------|----------------|---------------|---------------|----------------------------------|----------------------------|---------------|
| | RoHS Compliant | | | | | | |
| ACPL-P611 | -000E | Stretched SO-6 | X | | | | 100 per tube |
| | -020E | | X | | X | | 100 per tube |
| | -060E | | X | | | X | 100 per tube |
| | -500E | | X | X | | | 1000 per reel |
| | -520E | | X | X | X | | 1000 per reel |
| | -560E | | X | X | | X | 1000 per reel |
| ACPL-W611 | -000E | Stretched SO-6 | X | | X | | 100 per tube |
| | -060E | | X | | X | X | 100 per tube |
| | -500E | | X | X | X | | 1000 per reel |
| | -560E | | X | X | X | X | 1000 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. Combination of Option 020 and Option 060 is not available.

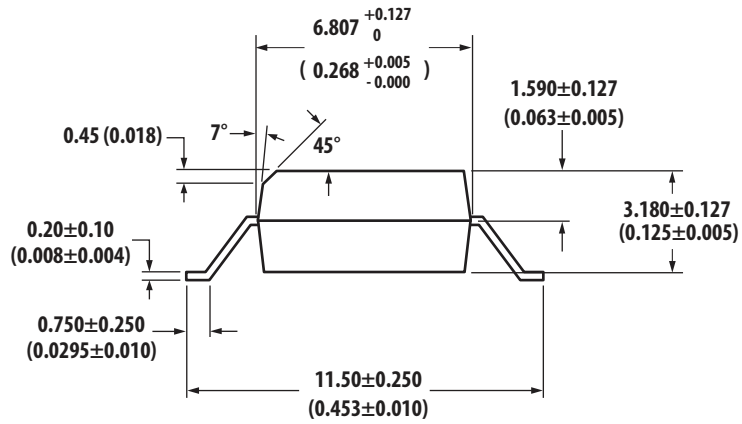
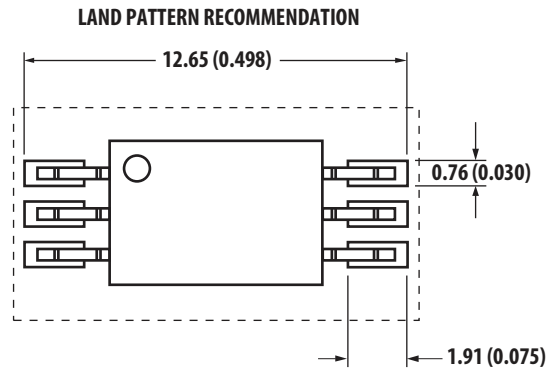
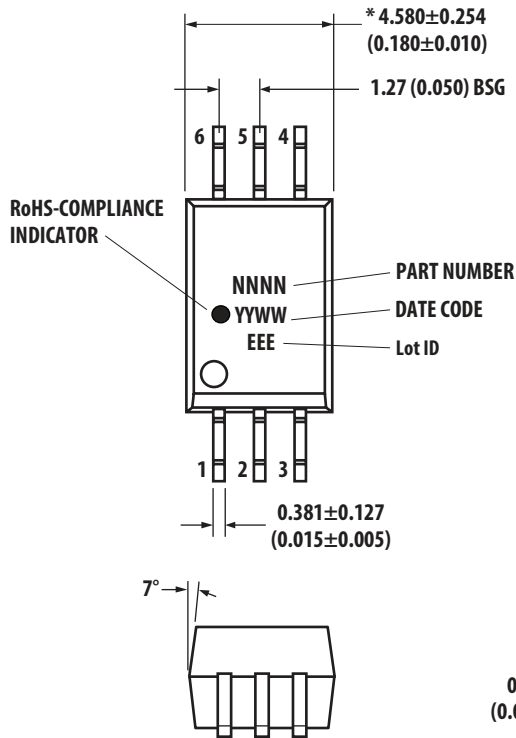
Example 1:

ACPL-P611-500E to order product of Surface Mount Stretched SO-6 package in Tape and Reel packaging with RoHS compliant.

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

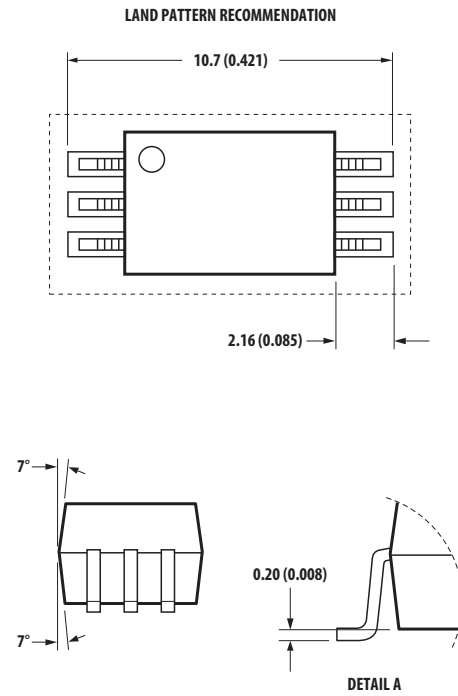
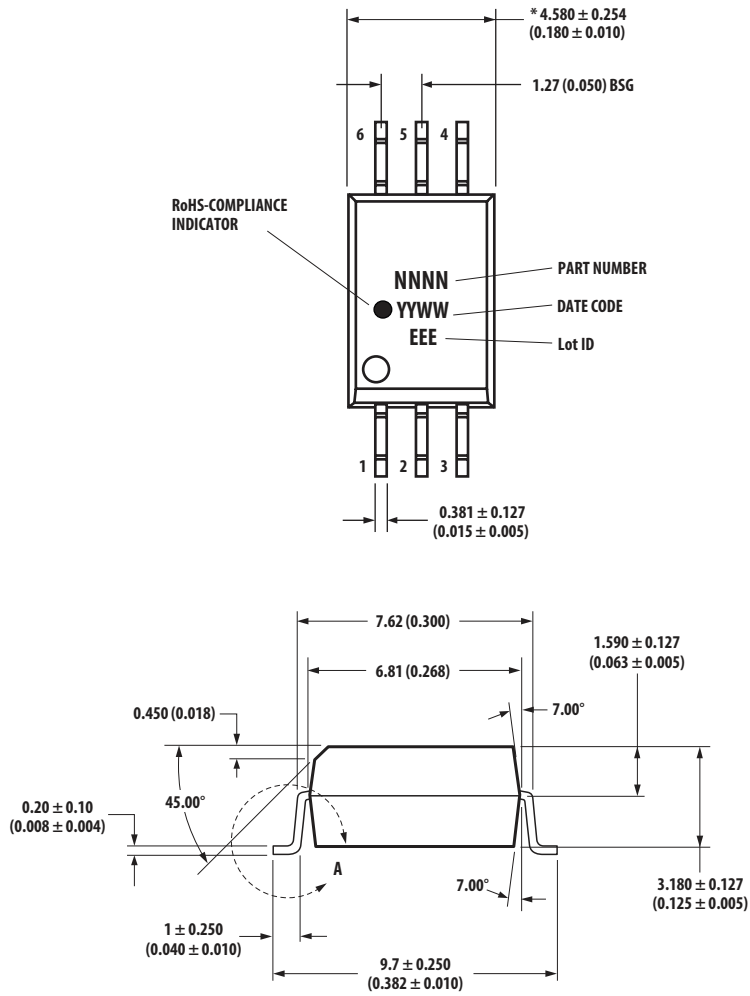
Package Outline Drawings

ACPL-W611 Stretched SO-6 Package



* Total package width (inclusive of mold flash)
4.834 ± 0.254 mm
Dimensions in Millimeters (Inches).
Lead coplanarity = 0.1 mm (0.004 inches).

ACPL-P611 Stretched SO-6 Package



* Total package width (inclusive of mold flash)
 4.834 ± 0.254 mm
 DIMENSIONS IN MILLIMETERS AND (INCHES).
 COPLANARITY = 0.10 mm (0.004 INCHES).

Reflow Soldering Profile

The recommended reflow soldering conditions are per JEDEC Standard J-STD-020 (latest revision). Non-halide flux should be used.

Regulatory Information

The ACPL-W611 and ACPL-P611 is approved/pending approval by the following organizations:

| | |
|--|---|
| IEC/EN/DIN EN 60747-5-5 (Option 060 only) | Approval |
| UL | Approval under UL 1577, component recognition program up to $V_{ISO} = 5000 V_{RMS}$. File E55361. |
| CSA | Approval under CSA Component Acceptance Notice #5, File CA 88324. |

Insulation and Safety-Related Specifications

| Parameter | Symbol | ACPL-P611 | ACPL-W611 | Units | Conditions |
|--|--------|-----------|-----------|-------|--|
| Minimum External Air Gap (External Clearance) | L(101) | 7 | 8 | mm | Measured from input terminals to output terminals, shortest distance through air. |
| Minimum External Tracking (External Creepage) | L(102) | 8 | 8 | 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 | | IIIa | IIIa | | Material Group (DIN VDE 0110, 1/89, Table 1) |

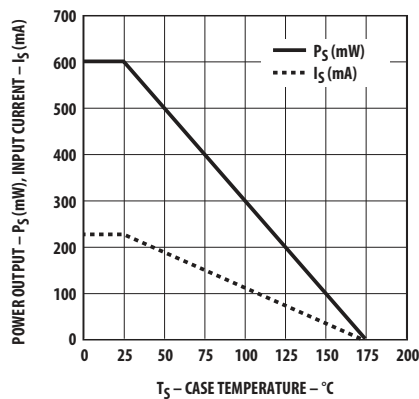
IEC/EN/DIN EN 60747-5-5 Insulation Characteristics (option x60, See Note ^a)

| Description | Symbol | ACPL-P611 | ACPL-W611 | Units |
|---|-----------------|--|--|-------------|
| Installation classification per DIN VDE 0110/39, Table 1 for rated mains voltage $\leq 150 V_{rms}$ for rated mains voltage $\leq 300 V_{rms}$ for rated mains voltage $\leq 600 V_{rms}$ for rated mains voltage $\leq 1000 V_{rms}$ | | I - IV I - IV I - III I - III | I - IV I - IV I - III I - III | |
| Climatic Classification | | 55/100/21 | 55/100/21 | |
| Pollution Degree (DIN VDE 0110/39) | | 2 | 2 | |
| Maximum Working Insulation Voltage | V_{IORM} | 891 | 1140 | V_{peak} |
| Input to Output Test Voltage, Method b ^a $V_{IORM} \times 1.875 = V_{PR}$, 100% Production Test with $t_m=1s$, Partial discharge $< 5 pC$ | V_{PR} | 1671 | 2137 | V_{peak} |
| Input to Output Test Voltage, Method a ^a $V_{IORM} \times 1.6 = V_{PR}$, Type and Sample Test, $t_m=10s$, Partial discharge $< 5 pC$ | V_{PR} | 1426 | 1824 | V_{peak} |
| Highest Allowable Overvoltage (Transient Overvoltage $t_{ini} = 60s$) | V_{IOTM} | 6000 | 8000 | V_{peak} |
| Safety-limiting values - maximum values allowed in the event of a failure. | | | | |
| Case Temperature | T_S | 175 | 175 | $^{\circ}C$ |
| Input Current ^b | $I_{S, INPUT}$ | 230 | 230 | mA |
| Output Power ^b | $P_{S, OUTPUT}$ | 600 | 600 | mW |
| Insulation Resistance at T_S , $V_{IO} = 500V$ | R_S | $>10^9$ | $>10^9$ | Ω |

- a. Refer to the optocoupler section of the Isolation and Control Components Designer's Catalog, under Product Safety Regulations section, (IEC/EN/DIN EN 60747-5-2) for a detailed description of Method a and Method b partial discharge test profiles.
- b. Refer to [Figure 1](#) for dependence of P_S and I_S on ambient temperature.

NOTE These optocouplers are suitable for "safe electrical isolation" only within the safety limit data. Maintenance of the safety data shall be ensured by means of protective circuits.

Figure 1 Power Output vs. Case Temperature



Absolute Maximum Ratings

| Parameter | Symbol | Min. | Max. | Units | Note |
|------------------------------------|--|------|---|-------|------|
| Storage Temperature | T_S | -55 | 125 | °C | |
| Operating Temperature | T_A | -40 | 100 | °C | |
| Average Input Current | $I_{F(AVG)}$ | — | 20 | mA | a |
| Reverse Input Voltage | V_R | — | 5 | V | |
| Input Power Dissipation | P_I | — | 45 | mW | |
| Supply Voltage (1 Minute Maximum) | V_{CC} | — | 7 | V | |
| Output Collector Current | I_O | — | 50 | mA | |
| Output Collector Voltage | V_O | — | 7 | V | |
| Output Collector Power Dissipation | P_O | — | 85 | mW | |
| Lead Solder Temperature | T_{LS} | — | 260°C for 10s, 1.6 mm below seating plane | | |
| Solder Reflow Temperature Profile | See Package Outline Drawings | | | | |

a. Peaking circuits may produce transient input currents up to 50 mA, 50-ns maximum pulse width, provided average current does not exceed 20 mA.

Recommended Operating Conditions

| Parameter | Symbol | Min. | Max. | Units |
|--|----------|------|------|-----------|
| Input Current, Low Level | I_{FL} | 0 | 250 | μA |
| Input Current, High Level | I_{FH} | 5 | 15 | mA |
| Power Supply Voltage | V_{CC} | 4.5 | 5.5 | V |
| Operating Temperature | T_A | -40 | 100 | °C |
| Fan Out (at $R_L = 1\text{ k}\Omega$) | N | — | 5 | TTL Loads |
| Output Pull-up Resistor | R_L | 330 | 4k | Ω |

Electrical Specifications (DC)

Over recommended operating conditions unless otherwise specified. All typicals at $V_{CC} = 5V$, $T_A = 25^\circ C$.

| Parameter | Symbol | Min. | Typ. | Max. | Units | Test Conditions | Figure | Note |
|---------------------------------|---------------------------|------|------|------|----------------|--|----------------|------|
| High Level Output Current | I_{OH} | — | 5.5 | 100 | μA | $V_{CC} = 5.5V$, $V_O = 5.5V$, $I_F = 250 \mu A$ | 2 | |
| Input Threshold Current | I_{TH} | — | 2.0 | 5.0 | mA | $V_{CC} = 5.5V$, $V_O = 0.6V$, $I_{OL} > 13 \text{ mA}$ | 14 | |
| Low Level Output Voltage | V_{OL} | — | 0.35 | 0.6 | V | $V_{CC} = 5.5V$, $I_F = 5 \text{ mA}$, $I_{OL}(\text{Sinking}) = 13 \text{ mA}$ | 3, 5, 6, 14 | |
| High Level Supply Current | I_{CCH} | — | 4 | 7.5 | mA | $V_{CC} = 5.5V$, $I_F = 0 \text{ mA}$, | | |
| Low Level Supply Current | I_{CCL} | — | 6 | 10.5 | mA | $V_{CC} = 5.5V$, $I_F = 10 \text{ mA}$, | | |
| Input Forward Voltage | V_F | 1.4 | 1.5 | 1.75 | V | $T_A = 25^\circ C$, $I_F = 10 \text{ mA}$ | 4 | |
| | | 1.3 | — | 1.8 | | | | |
| Input Reverse Breakdown Voltage | BV_R | 5 | — | — | V | $I_R = 10 \mu A$ | | |
| Input Capacitance | C_{IN} | — | 60 | — | pF | $f = 1 \text{ MHz}$, $V_F = 0V$ | | |
| Input Diode Temperature | $\Delta V_F / \Delta T_A$ | — | -1.6 | — | mV/ $^\circ C$ | $I_F = 10 \text{ mA}$ | 13 | |

Switching Specifications (AC)

Over recommended operating conditions $T_A = -40^\circ C$ to $100^\circ C$, $V_{CC} = 5V$, $I_F = 7.5 \text{ mA}$ unless otherwise specified.

All typicals at $V_{CC} = 5V$, $T_A = 25^\circ C$.

| Parameter | Symbol | Min. | Typ. | Max. | Units | Test Conditions | Figure | Note |
|--|-----------------------|------|------|------|-------------|---|--------|------|
| Propagation Delay Time to High Output Level | t_{PLH} | 20 | 48 | 75 | ns | $T_A = 25^\circ C$, $R_L = 350\Omega$, $C_L = 15 \text{ pF}$ | | a |
| | | — | — | 100 | | $R_L = 350\Omega$, $C_L = 15 \text{ pF}$ | | |
| Propagation Delay Time to Low Output Level | t_{PHL} | 25 | 50 | 75 | ns | $T_A = 25^\circ C$, $R_L = 350\Omega$, $C_L = 15 \text{ pF}$ | | b |
| | | — | — | 100 | | $R_L = 350\Omega$, $C_L = 15 \text{ pF}$ | | |
| Pulse Width Distortion | $ t_{PHL} - t_{PLH} $ | — | 3.5 | 35 | ns | $R_L = 350\Omega$, $C_L = 15 \text{ pF}$ | | c |
| Propagation Delay Skew | t_{PSK} | — | — | 40 | ns | | | c, d |
| Output Rise Time (10%–90%) | t_R | — | 24 | — | ns | | | |
| Output Fall Time (10%–90%) | t_F | — | 10 | — | ns | | | |
| Output High Level Common Mode Transient Immunity | $ CM_H $ | 10 | 15 | — | kV/ μs | $V_{CC} = 5V$, $I_F = 0 \text{ mA}$, $V_{O(MIN)} = 2V$, $R_L = 350\Omega$, $T_A = 25^\circ C$, $V_{CM} = 1000V$ | 8, 10 | e |
| Output Low Level Common Mode Transient Immunity | $ CM_L $ | 10 | 15 | — | kV/ μs | $V_{CC} = 5V$, $I_F = 7.5 \text{ mA}$, $V_{O(MAX)} = 0.8V$, $R_L = 350\Omega$, $T_A = 25^\circ C$, $V_{CM} = 1000V$ | | f, g |

- The t_{PLH} propagation delay is measured from 3.75 mA point on the falling edge of the input pulse to the 1.5-V point on the rising edge of the output pulse.
- The t_{PHL} propagation delay is measured from 3.75 mA point on the rising edge of the input pulse to the 1.5-V point on the falling edge of the output pulse.
- See the application section, "Propagation Delay, Pulse-Width Distortion and Propagation Delay Skew," for more information.
- t_{PSK} is equal to the worst case difference in t_{PHL} and/or t_{PLH} that will be seen between units at any given temperature within the worst case operating condition range.
- CM_H is the maximum tolerable rate of rise of the common mode voltage to assure that the output will remain in a high logic state (that is, $V_{OUT} > 2.0V$).
- CM_L is the maximum tolerable rate of fall of the common mode voltage to assure that the output will remain in a low logic state (that is, $V_{OUT} > 0.8V$).
- For sinusoidal voltages, $(dV_{CM}/dt)_{max} = \pi f_{CM} V_{CM(p-p)}$.

Package Characteristics

All typicals at $T_A = 25^\circ\text{C}$.

| Parameter | Symbol | Device | Min. | Typ. | Max. | Units | Test Conditions | Figure | Note |
|--------------------------|-----------|-----------|------|-----------|------|----------|---|--------|---------|
| Input-Output Insulation | V_{ISO} | ACPL-P611 | 3750 | — | — | Vrms | RH < 50% for 1 min., $T_A = 25^\circ\text{C}$ | | a, b, c |
| | | ACPL-W611 | 5000 | | | | | | |
| Input-Output Resistance | R_{I-O} | | — | 10^{12} | — | Ω | $V_{I-O} = 500\text{V}$ | | a |
| Input-Output Capacitance | C_{I-O} | | — | 0.6 | — | pF | $f = 1\text{ MHz}$, $T_A = 25^\circ\text{C}$ | | a |

- The device considered a two terminal device: pins 1, 2, and 3 shorted together, and pins 4, 5, and 6 shorted together.
- In accordance with UL 1577, for $V_{ISO} = 3750\text{ V}_{rms}$, each optocoupler is proof-tested by applying an insulation test voltage $\geq 4500\text{ V}_{RMS}$ for 1 second (leakage detection current limit, $I_{I-O} \leq 5\ \mu\text{A}$). For $V_{ISO} 5000\text{ V}_{rms}$, each optocoupler is proof-tested by applying an insulation test voltage $\geq 6000\text{ V}_{RMS}$ for 1 second (leakage detection current limit, $I_{I-O} \leq 5\ \mu\text{A}$).
- ACPL- P611 (non -020E, -520E option) is UL Recognized 3750 V_{rms} . The -020E and -520E option is Recognized 5000 V_{rms} .

Figure 2 High Level Output Current vs. Temperature

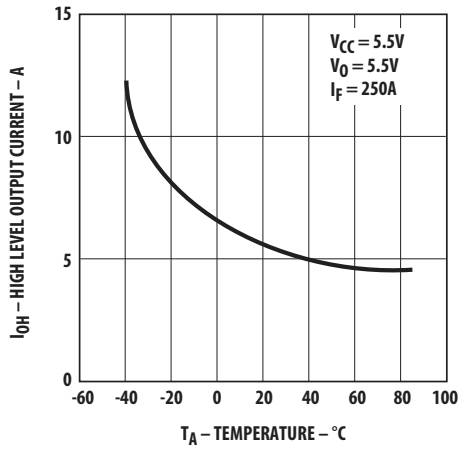


Figure 3 Low Level Output Voltage vs. Temperature

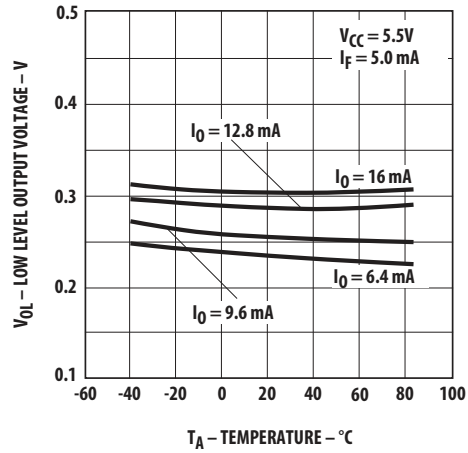


Figure 4 Input Diode Forward Characteristic

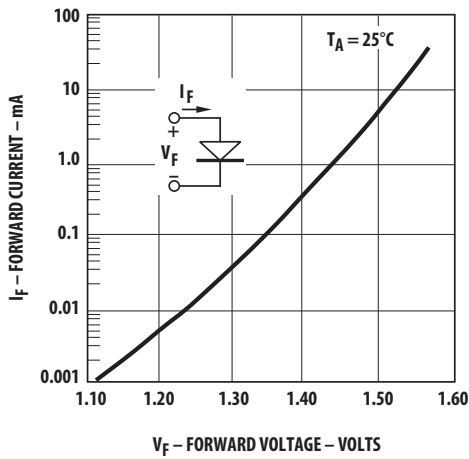


Figure 5 Output Voltage vs. Forward Input Current

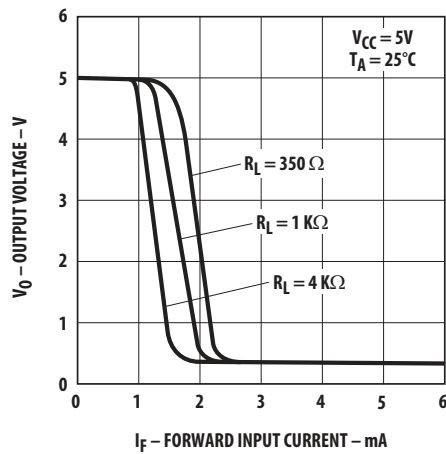


Figure 6 Low Level Output Current vs. Temperature

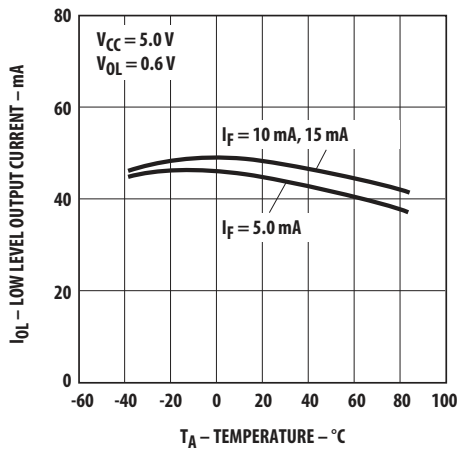


Figure 7 Test Circuit for t_{pHL} and t_{pLH}

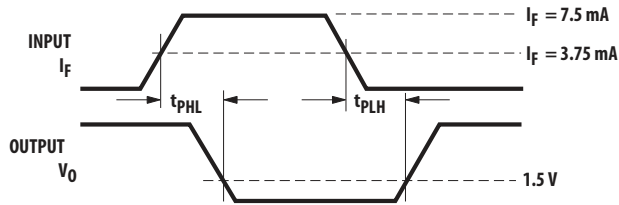
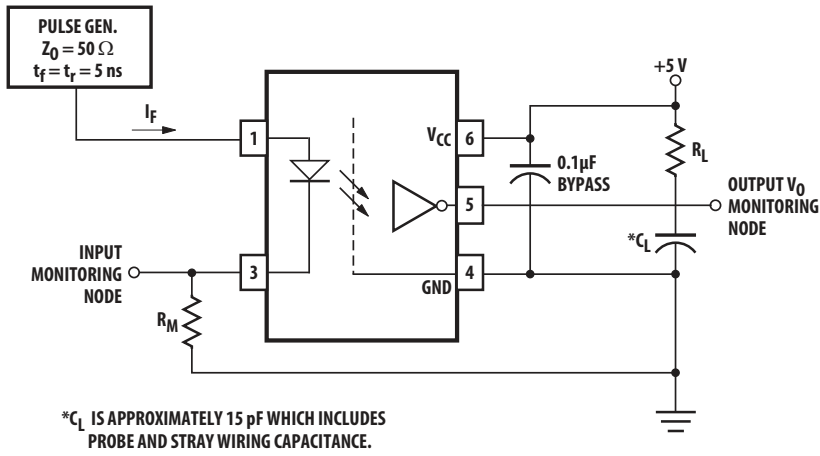


Figure 8 Propagation Delay vs. Temperature

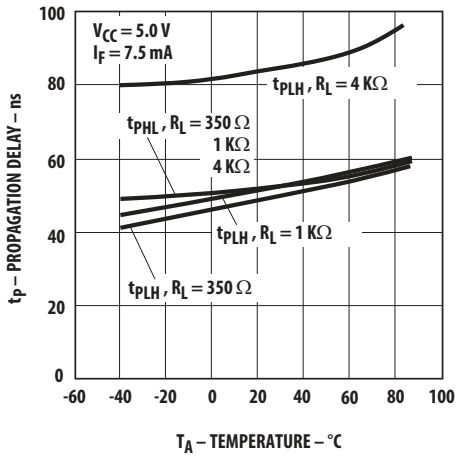


Figure 9 Propagation Delay vs. Pulse Input Current

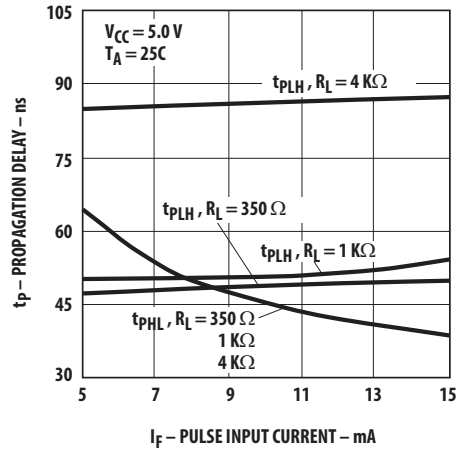


Figure 10 Pulse Width Distortion vs. Temperature

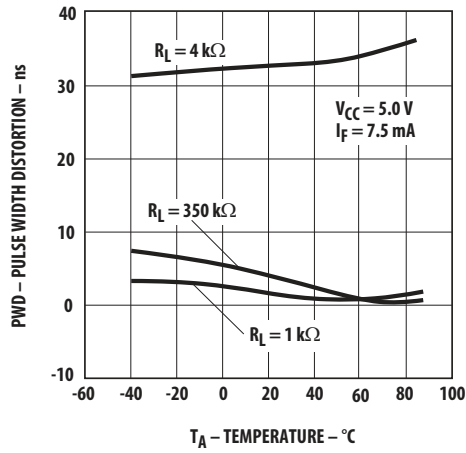


Figure 11 Rise and Fall Time vs. Temperature

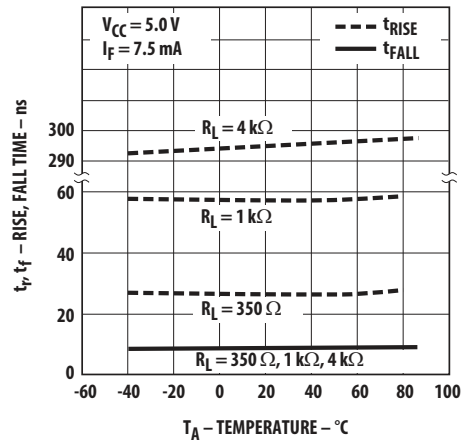


Figure 12 Test Circuit for Common Mode Transient Immunity and Typical Waveforms

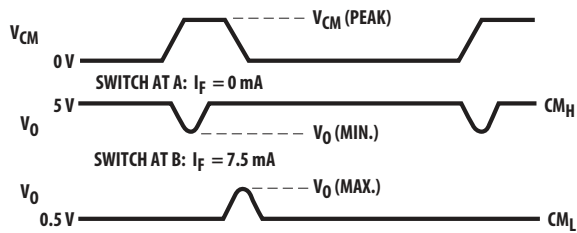
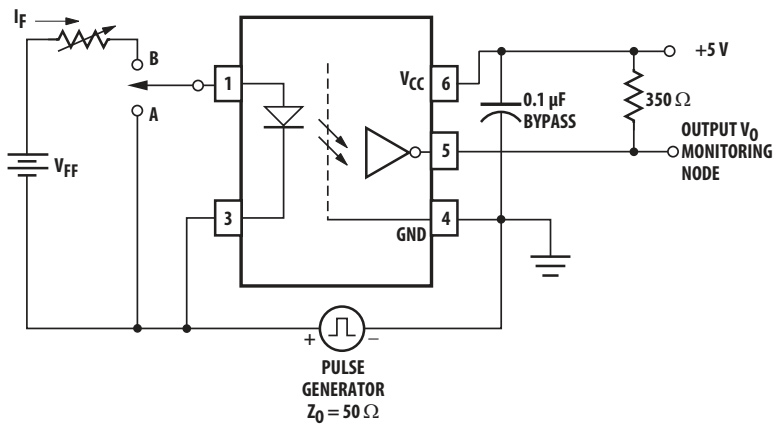


Figure 13 Temperature Coefficient for Forward Voltage vs. Input Current

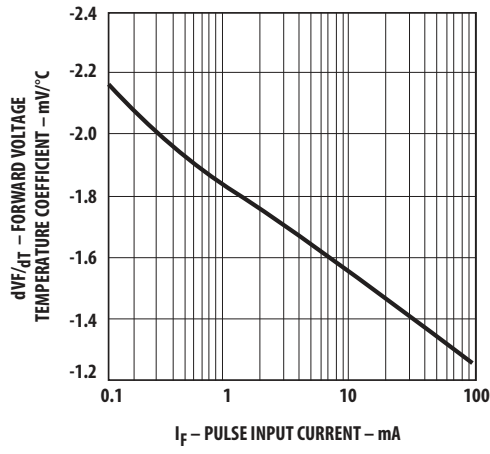
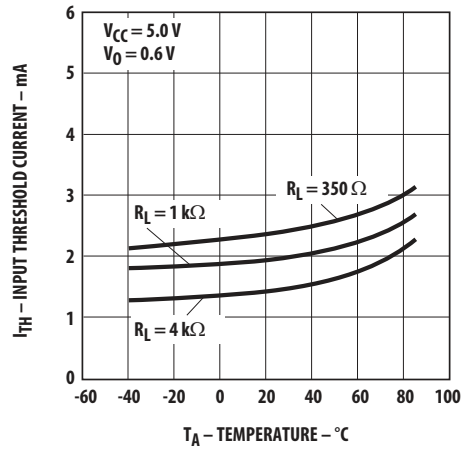


Figure 14 Input Threshold Current vs. Temperature



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