

ACPL-267XL, ACPL-268KL, ACPL-560XL, ACPL-563XL, 5962-08242*



Hermetically Sealed, 3.3V High Speed, High CMR,
Logic Gate Optocouplers

Data Sheet

*See Selection Guide for full matrix of part numbers.

Description

These units are single and dual channel, hermetically sealed optocouplers. The products are capable of operation and storage over the full military temperature range and can be purchased as either standard commercial product or with full MIL-PRF-38534 Class Level H or K testing or from DSCC Drawing 5962-08242. All devices are manufactured and tested on a MIL-PRF-38534 certified line and are included in the DSCC Qualified Manufacturers List QML-38534 for Hybrid Microcircuits.

Truth Table (Positive Logic)

Multichannel Devices

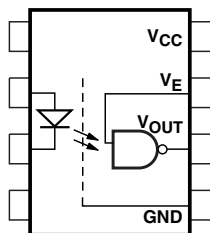
| Input | Output |
|---------|--------|
| On (H) | L |
| Off (L) | H |

Single Channel DIP

| Input | Enable | Output |
|---------|--------|--------|
| On (H) | H | L |
| Off (L) | H | H |
| On (H) | L | H |
| Off (L) | L | H |

Functional Diagram

Multiple channel devices available



The connection of a 0.1 μ F bypass capacitor between V_{CC} and GND is recommended.

Features

- Low power consumption
- 3.3V supply voltages
- Dual marked with device part number and DSCC drawing number
- Manufactured and tested on a MIL-PRF-38534 Certified Line
- QML-38534, Class H and K
- Three hermetically sealed package configurations
- Performance guaranteed over full military temperature range: -55°C to +125°C
- High speed: 10 Mbd typical
- CMR: > 10,000 V/ μ s typical
- 1500 Vdc withstand test voltage
- TTL circuit compatibility
- HCPL-260L/060L/263L/063L function compatibility

Applications

- Military and aerospace
- High reliability systems
- Transportation, medical, and life critical systems
- Line receiver
- Voltage level shifting
- Isolated input line receiver
- Isolated output line driver
- Logic ground isolation
- Harsh industrial environments
- Isolation for computer, communication, and test equipment systems

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.

Each channel contains a GaAsP light emitting diode which is optically coupled to an integrated high speed photon detector. The output of the detector is an open collector Schottky clamped transistor. Internal shields provide a guaranteed common mode transient immunity specification of 1000 V/ μ s. Package styles for these parts are 8 and 16 pin DIP through hole (case outlines P and E respectively). Devices may be purchased with a variety of lead bend and plating options. See Selection Guide Table for details. Standard Microcircuit Drawing (SMD) parts are available for each package and lead style.

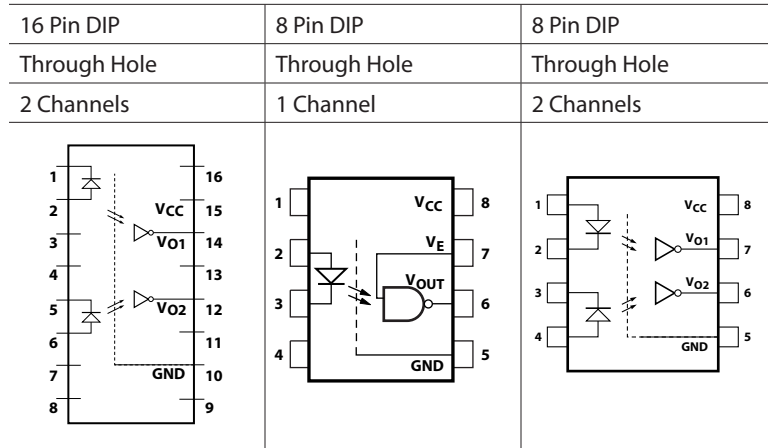
Because the same electrical die (emitters and detectors) are used for each channel of each device listed in this data sheet, absolute maximum ratings, recommended operating conditions, electrical specifications, and performance characteristics shown in the figures are identical for all parts. Occasional exceptions exist due to package variations and limitations, and are as noted. Additionally, the same package assembly processes and materials are used in all devices.

Selection Guide – Package Styles and Lead Configuration Options

| Package | 16 Pin DIP | 8 Pin DIP | 8 Pin DIP |
|-------------------------|--------------|--------------|--------------|
| Lead Style | Through Hole | Through Hole | Through Hole |
| Channels | 2 | 1 | 2 |
| Common Channel Wiring | VCC, GND | None | VCC, GND |
| Withstand Test Voltage | 1500 Vdc | 1500 Vdc | 1500 Vdc |
| Avago Part # & Options | | | |
| Standard Commercial | ACPL-2670L | ACPL-5600L | ACPL-5630L |
| MIL-PRF-38534, Class H | ACPL-2672L | ACPL-5601L | ACPL-5631L |
| MIL-PRF-38534, Class K | ACPL-268KL | ACPL-560KL | ACPL-563KL |
| Standard Lead Finish | Gold Plate | Gold Plate | Gold Plate |
| Solder Dipped* | Option -200 | Option -200 | Option -200 |
| Butt Cut/Gold Plate | Option -100 | Option -100 | Option -100 |
| Gull Wing/Soldered* | Option -300 | Option -300 | Option -300 |
| Class H SMD Part # | | | |
| Prescript for all below | 5962- | 5962- | 5962- |
| Either Gold or Solder | 0824203HEX | 0824201HPX | 0824202HPX |
| Gold Plate | 0824203HEC | 0824201HPC | 0824202HPC |
| Solder Dipped* | 0824203HEA | 0824201HPA | 0824202HPA |
| Butt Cut/Gold Plate | 0824203HUC | 0824201HYC | 0824202HYC |
| Butt Cut/Soldered* | 0824203HUA | 0824201HYA | 0824202HYA |
| Gull Wing/Soldered* | 0824203HTA | 0824201HXA | 0824202HXA |
| Class K SMD Part # | | | |
| Prescript for all below | 5962- | 5962- | 5962- |
| Either Gold or Solder | 0824203KEX | 0824201KPX | 0824202KPX |
| Gold Plate | 0824203KEC | 0824201KPC | 0824202KPC |
| Solder Dipped* | 0824203KEA | 0824201KPA | 0824202KPA |
| Butt Cut/Gold Plate | 0824203KUC | 0824201KYC | 0824202KYC |
| Butt Cut/Soldered* | 0824203KUA | 0824201KYA | 0824202KYA |
| Gull Wing/Soldered* | 0824203KTA | 0824201KXA | 0824202KXA |

* Solder contains lead.

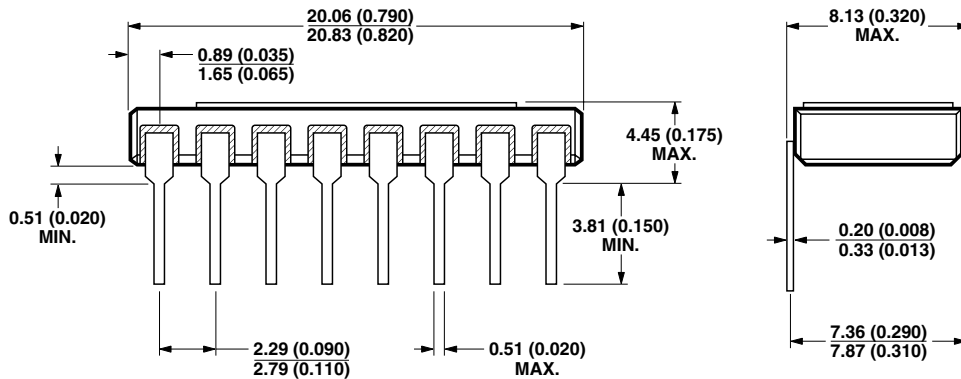
Functional Diagrams



Note: Dual channel devices have common V_{CC} and ground. Single channel DIP has an enable pin 7. All diagrams are “top view.”

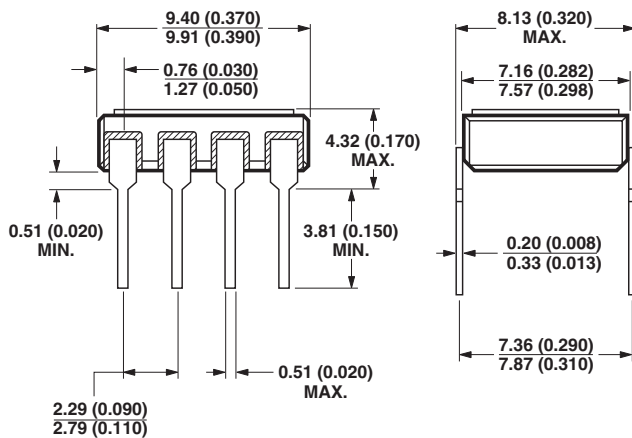
Outline Drawings

16 Pin DIP Through Hole, 2 Channels



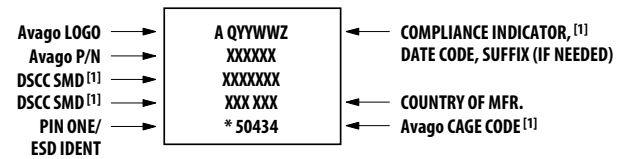
NOTE: DIMENSIONS IN MILLIMETERS (INCHES).

8 Pin DIP Through Hole, 1 and 2 Channels



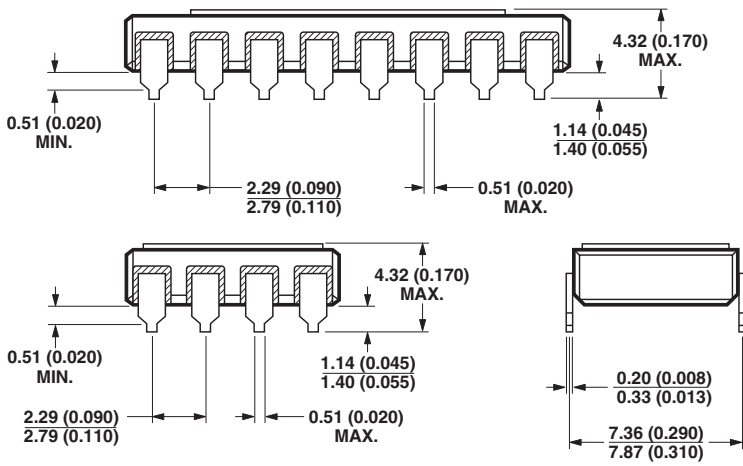
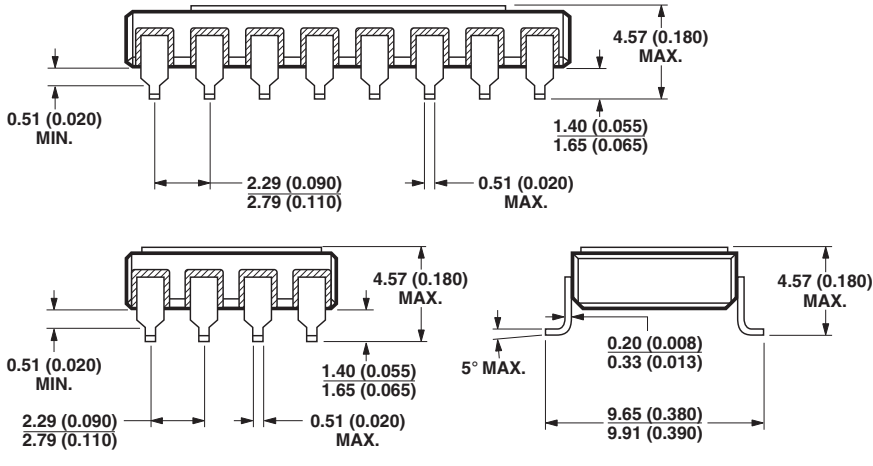
NOTE: DIMENSIONS IN MILLIMETERS (INCHES).

Device Marking



Note 1. Qualified parts only

Hermetic Optocoupler Options

| Option | Description |
|--------|--|
| 100 | <p>Surface mountable hermetic optocoupler with leads trimmed for butt joint assembly. This option is available on standard commercial, class H & class K product in 8 and 16 pin DIP (see drawings below for details).</p>  <p>NOTE: DIMENSIONS IN MILLIMETERS (INCHES).</p> |
| 200 | <p>Lead finish is solder dipped rather than gold plated. This option is available on standard commercial, class H and class K products in 8 and 16 pin DIP. DSCC Drawing part numbers contain provisions for lead finish.</p> |
| 300 | <p>Surface mountable hermetic optocoupler with leads cut and bent for gull wing assembly. This option is available on standard commercial, class H & class K product in 8 and 16 pin DIP (see drawings below for details). This option has solder dipped leads.</p>  <p>NOTE: DIMENSIONS IN MILLIMETERS (INCHES).</p> |

Solder contains lead.

Absolute Maximum Ratings

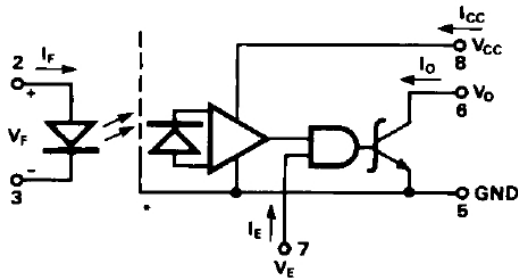
No derating required up to +125°C.

| Parameter | Symbol | Min. | Max. | Units |
|---|---------------|------|----------------|-------|
| Storage Temperature | T_S | -65 | +150 | °C |
| Operating Temperature | T_A | -55 | +125 | °C |
| Case Temperature | T_C | | +170 | °C |
| Junction Temperature | T_J | | +175 | °C |
| Lead Solder Temperature | | | 260 for 10 sec | °C |
| Peak Forward Input Current (each channel, ≤ 1 ms duration) | $I_{F(PEAK)}$ | | 40 | mA |
| Average Input Forward Current (each channel) | $I_{F(AVG)}$ | | 20 | mA |
| Input Power Dissipation (each channel) | | | 35 | mW |
| Reverse Input Voltage (each channel) | V_R | | 5 | V |
| Supply Voltage (1 minute maximum) | V_{CC} | | 7.0 | V |
| Output Current (each channel) | I_O | | 25 | mA |
| Output Voltage (each channel) | V_O | | 7 | V |
| Output Power Dissipation (each channel) | P_O | | 40 | mW |
| Package Power Dissipation (each channel) | P_D | | 200 | mW |

Single Channel Product Only

| | | | | |
|----------------------|-------|--|-----|---|
| Enable Input Voltage | V_E | | 3.6 | V |
|----------------------|-------|--|-----|---|

8 Pin Ceramic DIP Single Channel Schematic



Note enable pin 7. An external 0.01 μ F to 0.1 μ F bypass capacitor must be connected between V_{CC} and ground for each package type.

ESD Classification

MIL-PRF-38534 and MIL-STD-883, Method 3015

| | |
|------------------------------------|------------------|
| ACPL-560L/01L/0KL, 5962-0824201 | (▲B), Class 1B |
| ACPL-5630L/31L/3KL, 5962-0824202 | (▲▲▲A), Class 3A |
| ACPL-2670L/72L/268KL, 5962-0824203 | (▲▲), Class 2 |

Recommended Operating Conditions

| Parameter | Symbol | Min. | Max. | Units |
|---|----------|------|------|---------|
| Input Current, Low Level, Each Channel | I_{FL} | 0 | 250 | μ A |
| Input Current, High Level, Each Channel | I_{FH} | 10 | 20 | mA |
| Supply Voltage, Output | V_{CC} | 3.0 | 3.6 | V |
| Fan Out (TTL Load) Each Channel | N | | 6 | |

Recommended Operating Conditions (cont'd.)

Single Channel Product Only^[10]

| Parameter | Symbol | Min. | Max. | Units |
|---------------------------|----------|------|----------|-------|
| High Level Enable Voltage | V_{EH} | 2.0 | V_{CC} | V |
| Low Level Enable Voltage | V_{EL} | 0 | 0.8 | V |

Electrical Characteristics ($T_A = -55^\circ\text{C}$ to $+125^\circ\text{C}$, unless otherwise specified)

| Parameter | Symbol | Test Conditions | Group A ^[13] Sub-groups | Limits | | | Units | Fig. | Note |
|-----------------------------------|------------------|---|------------------------------------|--------|-------|------|---------------|------|----------|
| | | | | Min. | Typ.* | Max. | | | |
| High Level Output Current | I_{OH} | $V_{CC} = 3.3\text{ V}, V_O = 3.3\text{ V}, I_F = 250\ \mu\text{A}$ | 1, 2, 3 | | 6 | 250 | μA | 1 | 1 |
| Low Level Output Voltage | V_{OL} | $V_{CC} = 3.3\text{ V}, I_F = 10\text{ mA}, I_{OL}(\text{Sinking}) = 10\text{ mA}$ | 1, 2, 3 | | 0.3 | 0.6 | V | 2 | 1, 8 |
| Current Transfer Ratio | $h_F\text{ CTR}$ | $V_O = 0.6\text{ V}, I_F = 10\text{ mA}, V_{CC} = 3.3\text{ V}$ | 1, 2, 3 | 100 | | | % | | 1 |
| Logic High Supply Current | Single Channel | $V_{CC} = 3.3\text{ V}, I_F = 0\text{ mA}$ | 1, 2, 3 | | 5 | 11 | mA | | 1 |
| | Dual Channel | | | | 10 | 22 | mA | | |
| Logic low Supply Current | Single Channel | $V_{CC} = 3.3\text{ V}, I_F = 20\text{ mA}$ | 1, 2, 3 | | 6 | 15 | mA | | 1 |
| | Dual Channel | | | | 12 | 30 | mA | | |
| Input Forward Voltage | V_F | $I_F = 20\text{ mA}$ | 1, 2 | | 1.55 | 1.75 | V | 3 | 1 |
| | | | 3 | | | 1.85 | | | |
| Input Reverse Breakdown Voltage | BV_R | $I_R = 10\ \mu\text{A}$ | 1, 2, 3 | 5 | | | V | | 1 |
| Input-Output Leakage Current | I_{I-O} | $RH \leq 65\%, T_A = 25^\circ\text{C}$ $t = 5\text{ s}, V_{I-O} = 1500\text{ Vdc}$ | 1 | | | 1.0 | μA | | 2, 7 |
| Capacitance Between Input/ Output | C_{I-O} | $f = 1\text{ MHz}, T_C = 25^\circ\text{C}$ | 4 | | 1.0 | 4.0 | pF | | 1, 3, 13 |

*All typical values are at $V_{CC} = 3.3\text{ V}, T_A = 25^\circ\text{C}$.

Electrical Characteristics (cont'd) $T_A = -55^\circ\text{C}$ to $+125^\circ\text{C}$ unless otherwise specified

| Parameter | Symbol | Test Conditions | Group A ^[13] Subgroups | Limits | | | Units | Fig. | Note |
|---|-----------|---|--------------------------------------|--------|--------|------|------------------|---------|-------------|
| | | | | Min. | Typ.* | Max. | | | |
| Propagation Delay Time to High Output Level | t_{PLH} | $V_{CC} = 3.3\text{ V}$, $R_L = 510\ \Omega$, $C_L = 50\text{ pF}$, $I_F = 13\text{ mA}$ | 9 | | 43 | 100 | ns | 4, 5, 6 | 1, 5 |
| | | | 10, 11 | | | 140 | | | |
| Propagation Delay Time to Low Output Level | t_{PHL} | | 9 | | 54 | 100 | ns | | |
| | | | 10, 11 | | | 120 | | | |
| Output Rise Time | t_{LH} | $R_L = 510\ \Omega$, $C_L = 50\text{ pF}$, $I_F = 13\text{ mA}$ | 9, 10, 11 | | 20 | 90 | ns | | 1 |
| Output Fall Time | t_{HL} | | | | 8 | 40 | | | |
| Common Mode Transient Immunity at High Output Level | $ CM_H $ | $V_{CM} = 50\text{ V (PEAK)}$, $V_{CC} = 3.3\text{ V}$, $V_O(\text{min.}) = 2\text{ V}$, $R_L = 510\ \Omega$, $I_F = 0\text{ mA}$ | 9, 10, 11 | 1000 | >10000 | | V/ μs | 7 | 1, 6, 13 |
| Common Mode Transient Immunity at Low Output Level | $ CM_L $ | $V_{CM} = 50\text{ V (PEAK)}$, $V_{CC} = 3.3\text{ V}$, $V_O(\text{max.}) = 0.8\text{ V}$, $R_L = 510\ \Omega$, $I_F = 10\text{ mA}$ | 9, 10, 11 | 1000 | >10000 | | V/ μs | 7 | 1, 6, 13 |

Single Channel Product Only

| | | | | | | | | | |
|------------------------------|----------|---|---------|------|-------|-----|----|--|---|
| Low Level Enable Current | I_{EL} | $V_{CC} = 3.3\text{ V}$, $V_E = 0.5\text{ V}$ | 1, 2, 3 | -2.0 | -0.54 | | mA | | |
| High Level Enable Voltage | V_{EH} | | 1, 2, 3 | 2.0 | | | V | | 9 |
| Low Level Enable Voltage | V_{EL} | | 1, 2, 3 | | | 0.8 | V | | |

*All typical values are at $V_{CC} = 3.3\text{ V}$, $T_A = 25^\circ\text{C}$.

Typical Characteristics, $T_A = 25^\circ\text{C}$, $V_{CC} = 3.3\text{ V}$

| Parameter | Sym. | Typ. | Units | Test Conditions | Fig. | Note |
|--|---------------------------------|-----------|----------------------|---|------|------|
| Input Capacitance | C_{IN} | 60 | pF | $V_F = 0\text{ V}$, $f = 1\text{ MHz}$ | | 1 |
| Input Diode Temperature Coefficient | $\frac{\Delta V_F}{\Delta T_A}$ | -1.5 | mV/ $^\circ\text{C}$ | $I_F = 20\text{ mA}$ | | 1 |
| Resistance (Input-Output) | R_{I-O} | 10^{12} | Ω | $V_{I-O} = 500\text{ V}$ | | 2 |

Single Channel Product Only

| | | | | | | |
|---|-----------|----|----|---|------|-------|
| Propagation Delay Time of Enable from V_{EH} to V_{EL} | t_{ELH} | 32 | ns | $R_L = 510\ \Omega$, $C_L = 50\text{ pF}$ $I_F = 13\text{ mA}$, $V_{EH} = 3\text{ V}$, $V_{EL} = 0\text{ V}$ | 8, 9 | 1, 10 |
| Propagation Delay Time of Enable from V_{EL} to V_{EH} | t_{EHL} | 28 | ns | | | 1, 11 |

Dual Channel Product Only

| | | | | | | |
|--------------------------------|----------|-----------|----------|---|--|---|
| Input-Input Leakage Current | I_{-I} | 0.5 | nA | Relative Humidity $\leq 65\%$ $V_{-I} = 500\text{ V}$, $t = 5\text{ s}$ | | 4 |
| Resistance (Input-Input) | R_{-I} | 10^{12} | Ω | $V_{-I} = 500\text{ V}$ | | 4 |
| Capacitance (Input-Input) | C_{-I} | 0.55 | pF | $f = 1\text{ MHz}$ | | 4 |

Notes:

1. Each channel.
2. All devices are considered two-terminal devices; I_{I-O} is measured between all input leads or terminals shorted together and all output leads or terminals shorted together.
3. Measured between each input pair shorted together and all output connections for that channel shorted together.
4. Measured between adjacent input pairs shorted together for each multichannel device.
5. t_{PHL} propagation delay is measured from the 50% point on the leading edge of the input pulse to the 1.5 V point on the leading edge of the output pulse. The t_{PLH} propagation delay is measured from the 50% point on the trailing edge of the input pulse to the 1.5 V point on the trailing edge of the output pulse.
6. CM_L is the maximum rate of rise of the common mode voltage that can be sustained with the output voltage in the logic low state ($V_O < 0.8$ V). CM_H is the maximum rate of fall of the common mode voltage that can be sustained with the output voltage in the logic high state ($V_O > 2.0$ V).
7. This is a momentary withstand test, not an operating condition.
8. It is essential that a bypass capacitor (0.01 to 0.1 μ F, ceramic) be connected from V_{CC} to ground. Total lead length between both ends of this external capacitor and the isolator connections should not exceed 20 mm.
9. No external pull up is required for a high logic state on the enable input.
10. The t_{ELH} enable propagation delay is measured from the 1.5 V point on the trailing edge of the enable input pulse to the 1.5 V point on the trailing edge of the output pulse.
11. The t_{EHL} enable propagation delay is measured from the 1.5 V point on the leading edge of the enable input pulse to the 1.5 V point on the leading edge of the output pulse.
12. Standard commercial parts receive 100% testing at 25°C (Subgroups 1 and 9). Class H and K parts receive 100% testing at 25, 125, and -55°C (Subgroups 1 and 9, 2 and 10, 3 and 11, respectively).
13. Parameters are tested as part of device initial characterization and after design and process changes. Parameters are guaranteed to limits specified for all lots not specifically tested.

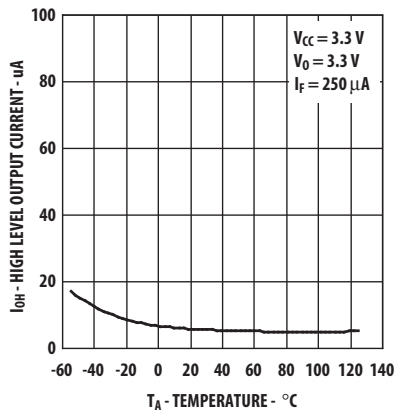


Figure 1. High Level Output Current vs. Temperature.

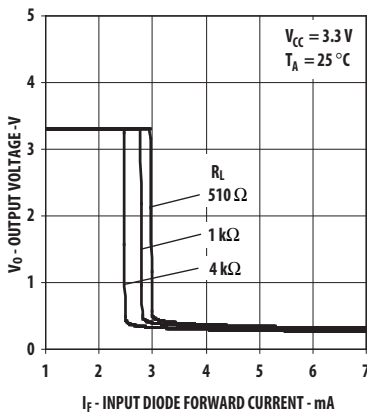


Figure 2. Input-Output Characteristics.

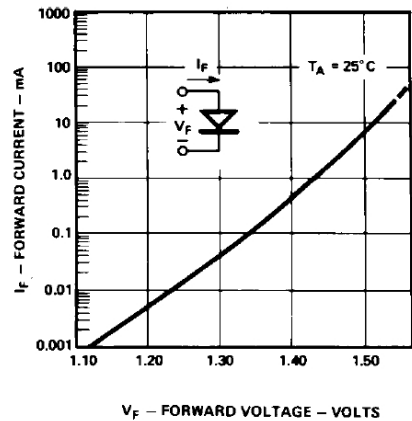


Figure 3. Input Diode Forward Characteristics.

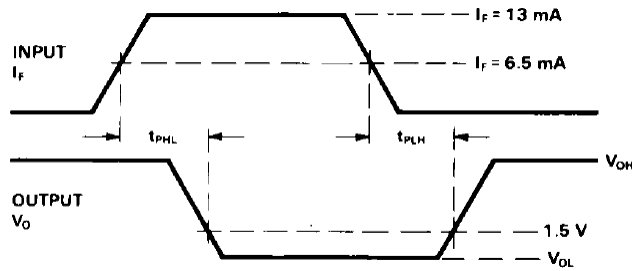
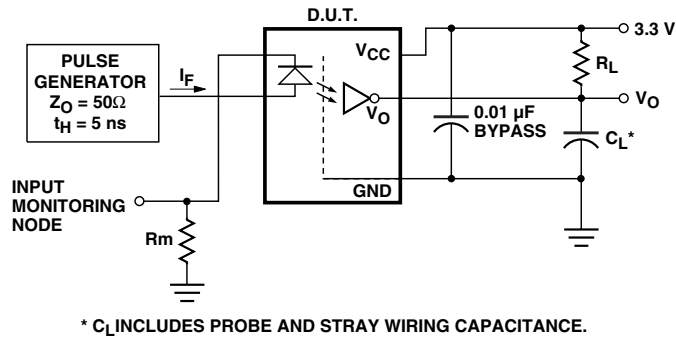


Figure 4. Test Circuit for t_{PHL} and t_{PLH} *

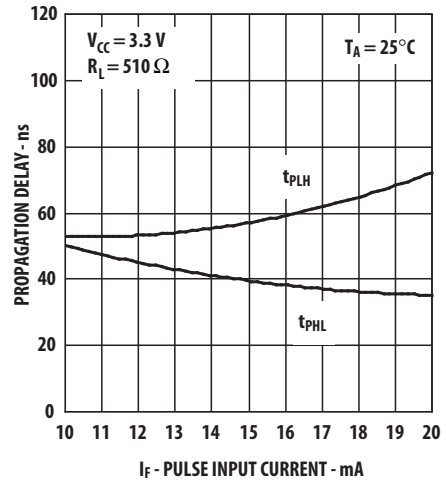


Figure 5. Propagation Delay, t_{PHL} and t_{PLH} vs. Pulse Input Current, I_{FH} .

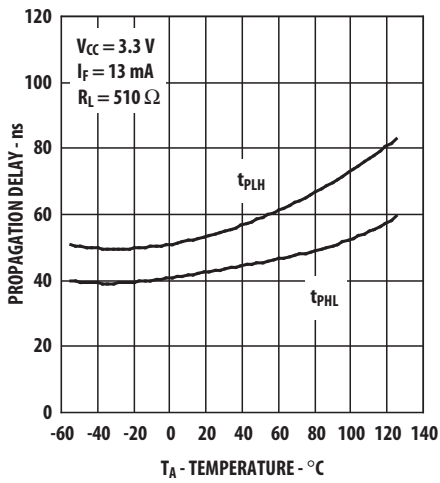


Figure 6. Propagation Delay vs. Temperature.

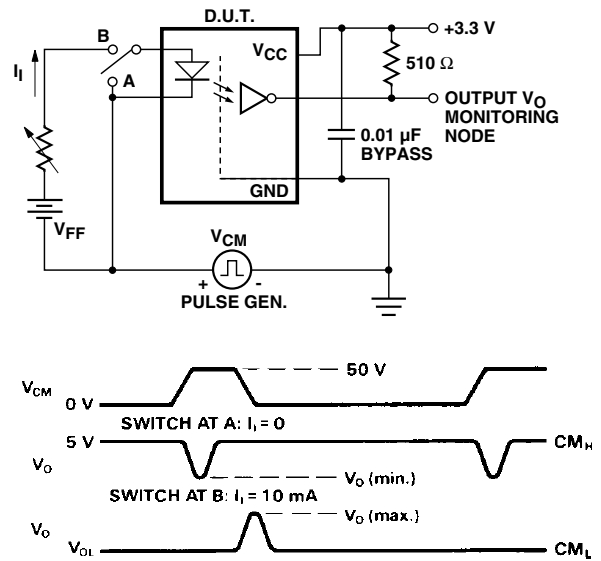


Figure 7. Test Circuit for Common Mode Transient Immunity and Typical Waveforms.

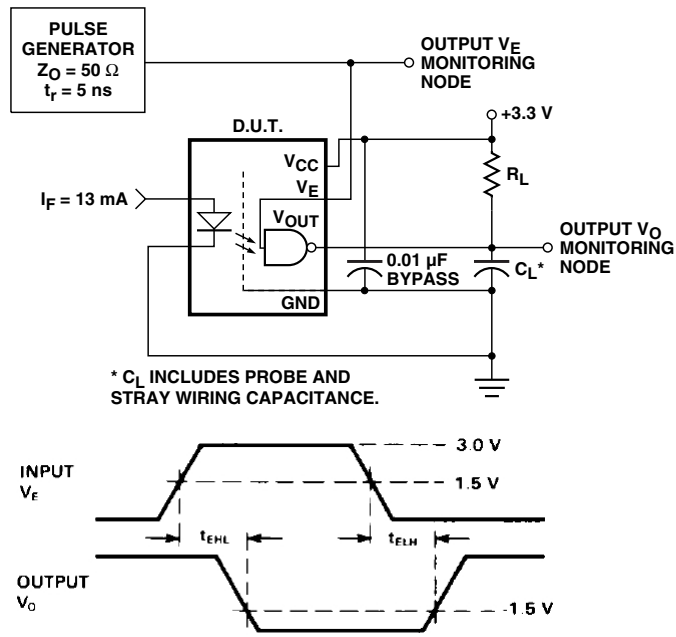


Figure 8. Test Circuit for t_{EHL} and t_{ELH}^*

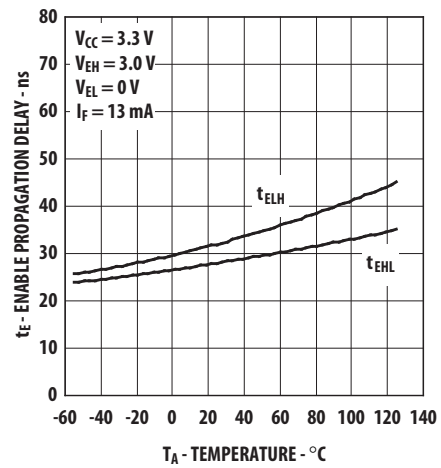


Figure 9. Enable Propagation Delay vs. Temperature.

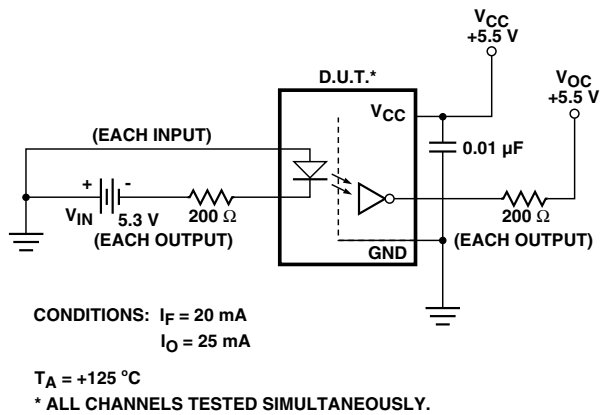


Figure 10. Operating Circuit for Burn-In and Steady State Life Tests.

MIL-PRF-38534 Class H, Class K, and DSCC SMD Test Program

Avago's Hi-Rel Optocouplers are in compliance with MIL-PRF-38534 Classes H and K. Class H and Class K devices are also in compliance with DSCC drawing 5962-08242.

Testing consists of 100% screening and quality conformance inspection to MIL-PRF-38534.

For product information and a complete list of distributors, please go to our website: www.avagotech.com

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