ACPL-570XL, ACPL-573XL, ACPL-177XL, 5962-08227

Hermetically Sealed 3.3V, Low I_F, Wide V_{CC}, High Gain Optocouplers

AVAGO TECHNOLOGIES

Data Sheet

Description

These devices are single, dual, and quad 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 product or with full MIL-PRF-38534 Class Level H or K testing or from DSCC Drawing 5962-08227. All devices are manufactured and tested on a MIL-PRF-38534 certified line and are included in the DSCC Qualified Products Database Supplemental Information Sheets QPDSIS-38534 as Hybrid Microcircuits.

Each channel contains a GaAsP light emitting diode which is optically coupled to an integrated high gain photon detector. The high gain output stage features an open collector output providing both lower saturation voltage and higher signaling speed than possible with conventional photo-Darlington optocouplers.

The supply voltage can be operated as low as 3.0 V without adversely affecting the parametric performance.

These devices have a 300% minimum CTR at an input current of only 0.5 mA making them ideal for use in low input current applications such as MOS, CMOS, low power logic interfaces or line receivers.

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
- QPDSIS-38534, Class H and K
- Three hermetically sealed package configurations
- Performance guaranteed over full military temperature range: -55°C to +125°C
- Low input current requirement: 0.5 mA
- High current transfer ratio: 1500% typical @ I_F = 0.5 mA
- Low output saturation voltage: 0.11 V typical
- 1500 Vdc withstand test voltage
- HCPL-4701/31, -070A/31 function compatibility

Applications

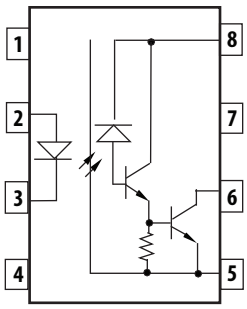
- Military and aerospace
- High reliability systems
- Telephone ring detection
- Microprocessor system interface
- Transportation, medical, and life critical systems
- Isolated input line receiver
- EIA RS-232-C line receiver
- Voltage level shifting
- Isolated input line receiver
- Isolated output line driver
- Logic ground isolation
- Harsh industrial environments
- Current loop receiver
- System test equipment isolation
- Process control input/output isolation

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

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.*

Functional Diagram

Multiple Channel Devices Available



Truth Table

(Positive Logic)

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

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 Military Drawing (SMD) parts are available for each package and lead style.

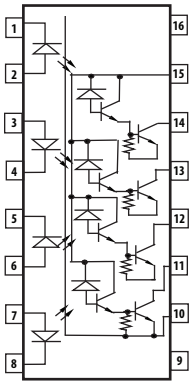
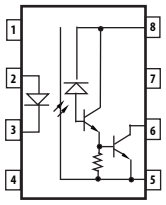
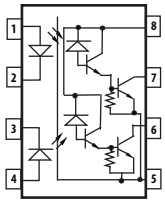
Because the same electrical die (emitters and detectors) are used for each channel of each device listed in this data sheet, absolute maximum ratings, recommended operating conditions, electrical specifications, and performance characteristics shown in the figures are similar for all parts except as noted. Additionally, the same package assembly processes and materials are used in all devices. These similarities justify the use of a common data base for die related reliability.

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	4	1	2
Common Channel Wiring	VCC, GND	None	VCC, GND
Avago Part # & Options			
Commercial	ACPL-1770L	ACPL-5700L	ACPL-5730L
MIL-PRF-38534, Class H	ACPL-1772L	ACPL-5701L	ACPL-5731L
MIL-PRF-38534, Class K	ACPL-177KL	ACPL-570KL	ACPL-573KL
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	0822703HEX	0822701HPX	0822702HPX
Gold Plate	0822703HEC	0822701HPC	0822702HPC
Solder Dipped*	0822703HEA	0822701HPA	0822702HPA
Butt Cut/Gold Plate	0822703HUC	0822701HYC	0822702HYC
Butt Cut/Soldered*	0822703HUA	0822701HYA	0822702HYA
Gull Wing/Soldered*	0822703HTA	0822701HXA	0822702HXA
Class K SMD Part #			
Prescript for all below	5962-	5962-	5962-
Either Gold or Solder	0822703KEX	0822701KPX	0822702KPX
Gold Plate	0822703KEC	0822701KPC	0822702KPC
Solder Dipped*	0822703KEA	0822701KPA	0822702KPA
Butt Cut/Gold Plate	0822703KUC	0822701KYC	0822702KYC
Butt Cut/Soldered*	0822703KUA	0822701KYA	0822702KYA
Gull Wing/Soldered*	0822703KTA	0822701KXA	0822702KXA

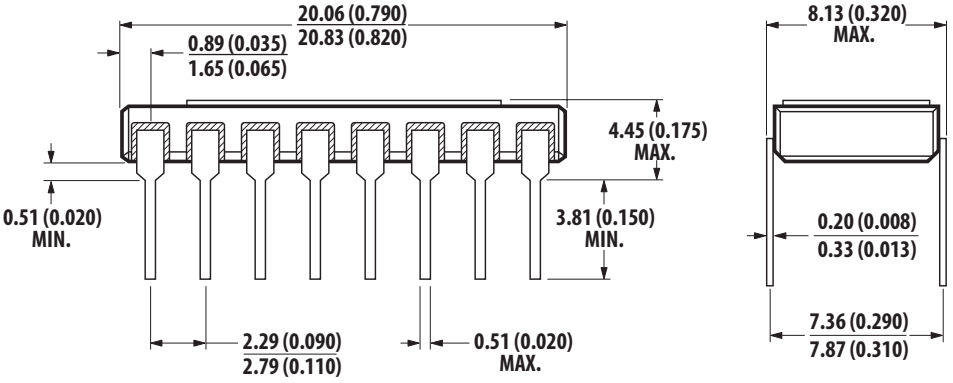
* Solder contains lead.

Functional Diagrams

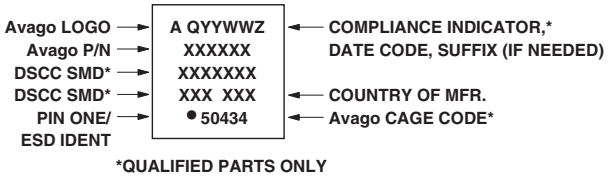
16 pin DIP	8 pin DIP	8 pin DIP
Through Hole	Through Hole	Through Hole
4 Channels	1 Channel	2 Channels
		

Outline Drawings

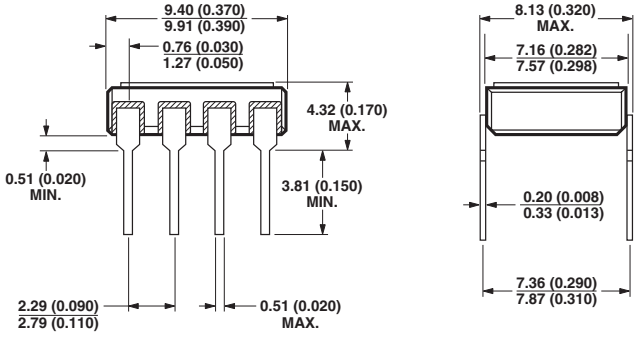
16 Pin DIP Through Hole, 4 Channels



Device Marking



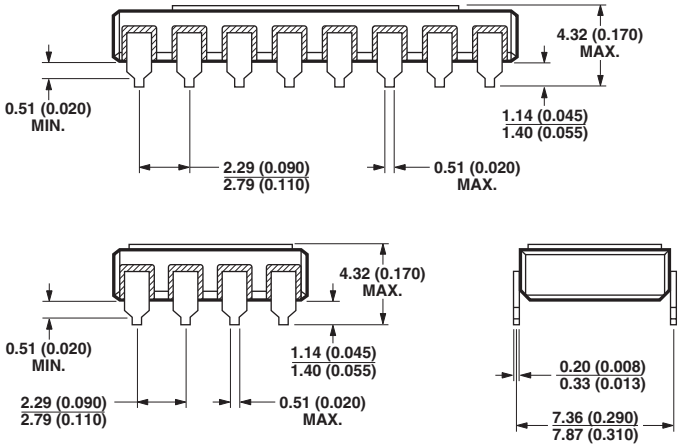
8 Pin DIP Through Hole, 1 and 2 Channel



Note: Dimensions in Millimeters (Inches).

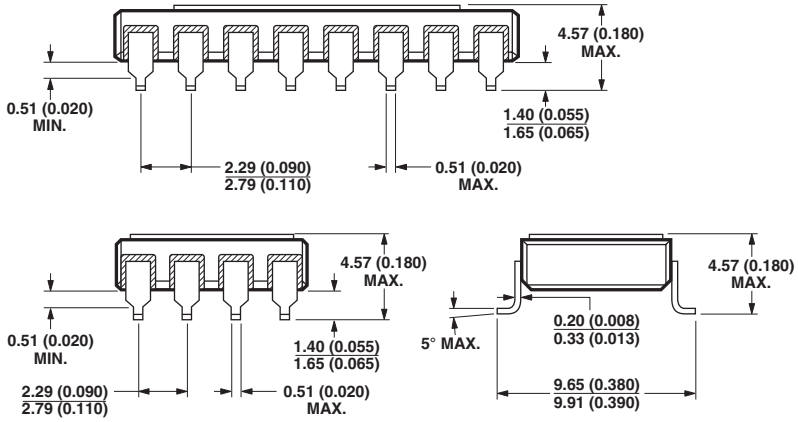
Hermetic Optocoupler Options

Option	Description
100	Surface mountable hermetic optocoupler with leads trimmed for butt joint assembly. This option is available on commercial and hi-rel product in 8 and 16 pin DIP (see drawings below for details).



Note: Dimensions in Millimeters (Inches).

200	Lead finish is solder dipped rather than gold plated. This option is available on commercial and hi-rel product in 8 and 16 pin DIP. DSCC Drawing part numbers contain provisions for lead finish.
300	Surface mountable hermetic optocoupler with leads cut and bent for gull wing assembly. This option is available on commercial and hi-rel product in 8 and 16 pin DIP (see drawings below for details). This option has solder dipped leads.



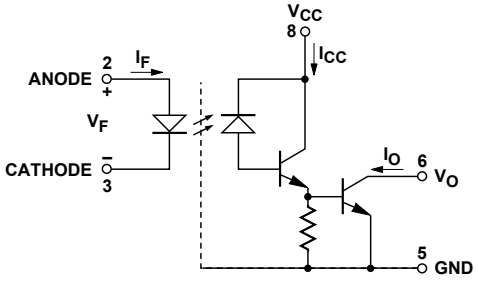
Note: Dimensions in Millimeters (Inches).

Solder contains lead.

Absolute Maximum Ratings

Parameter	Symbol	Min.	Max.	Units	Notes
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	
Output Current (each channel)	I_O		40	mA	
Output Voltage (each channel)	V_O	-0.5	20	V	1
Supply Voltage	V_{CC}	-0.5	20	V	1
Output Power Dissipation (each channel)			50	mW	2
Peak Input Current (each channel, <1 ms duration)			20	mA	
Average Input Current (each channel)	I_F		10	mA	3
Reverse Input Voltage (each channel)	V_R		5	V	
Package Power Dissipation (each channel)	P_D		200	mW	

8 Pin Ceramic DIP Single Channel Schematic



ESD Classification

(MIL-STD-883, Method 3015)

ACPL-5700L/01L/0KL	(▲▲), Class 2
ACPL-5730L/31L/3KL	(▲▲A), Class 3A
ACPL-1770L/2L/KL	(▲▲B), Class 3B

Recommended Operating Conditions

Parameter	Symbol	Min.	Max.	Units
Input Current, Low Level (Each Channel)	$I_{F(OFF)}$		2.0	µA
Input Current, High Level (Each Channel)	$I_{F(ON)}$	0.5	5	mA
Supply Voltage	V_{CC}	3.0	7.0	V
Output Voltage	V_O	3.0	7.0	V

Electrical Characteristics, T_A = -55°C to +125°C, unless otherwise specified

Parameter		Symbol	Test Conditions	Group A[13] Subgroup	Limits			Units	Fig.	Note
					Min.	Typ.*	Max.			
Current Transfer Ratio		CTR	I_F = 0.5 mA, V_O = 0.4 V, V_{CC} = 3.0 V	1, 2, 3	300	1500		%	3	4, 5
			I_F = 1.6 mA, V_O = 0.4 V, V_{CC} = 3.0 V		300	1300				
			I_F =5 mA, V_O = 0.4 V, V_{CC} = 3.0 V		200	800				
Logic Low Output Voltage		V_{OL}	I_F = 0.5 mA, I_{OL} = 1.5 mA, V_{CC} = 3.0 V	1, 2, 3		0.05	0.4	V	2	4
			I_F = 1.6 mA, I_{OL} = 4.8 mA, V_{CC} = 3.0 V			0.06	0.4			4
			I_F =5 mA, I_{OL} = 10 mA, V_{CC} = 3.0 V			0.09	0.4			4
Logic High Output Current		I_{OH}	I_F =2 µA, V_O = 7 V, V_{CC} = 7 V	1, 2, 3		1.0	100	µA		4
		I_{OHX}					100	µA		4, 6
Logic Low Supply Current	Single Channel	I_{CCL}	I_F =1.6 mA, V_{CC} = 7 V	1, 2, 3		0.8	2	mA		
	Dual Channel		I_{F1} =I_{F2} = 1.6 mA, V_{CC} = 7 V			0.8	4		4	
	Quad Channel		I_{F1} = I_{F2} =I_{F3} =I_{F4} =1.6 mA, V_{CC} = 7 V			1.3	4			
Logic High Supply Current	Single Channel	I_{CCH}	I_F =0 mA, V_{CC} = 7 V	1, 2, 3		0.01	20	µA		
	Dual Channel		I_{F1} =I_{F2} = 0 mA, V_{CC} = 7 V				40			
	Quad Channel		I_{F1} = I_{F2} =I_{F3} =I_{F4} =0 mA, V_{CC} = 7 V				40			
Input Forward Voltage		V_F	I_F = 1.6 mA	1, 2, 3	1.0	1.4	1.8	V	1	4
Input Reverse Breakdown Voltage		B_{VR}	I_R = 10 µA	1, 2, 3	5			V		4
Input-Output Insulation Leakage Current		I_{I-O}	≤65% Relative Humidity T_A =25°C, t = 5 s, V_{I-O} = 1500 VDC	1			1.0	µA		7, 12
Capacitance Between Input-Output		C_{I-O}	f = 1 MHz, T_A =25°C	4			4	pF		4, 8, 14

* All typical values are at V_{CC} = 3.3 V, T_A = 25°C.

Electrical Characteristics (cont), T_A = -55°C to +125°C, unless otherwise specified

Parameter	Symbol	Test Conditions	Group A[13] Subgroup	Limits			Units	Fig.	Note
				Min.	Typ.*	Max.			
Propagation Delay Time to Logic Low at Output	t_{PHL}	I_F = 0.5 mA, R_L = 2.2 kΩ, V_{CC} = 3.3 V	9, 10, 11		40	100	µs	5, 6, 7, 8	4
	t_{PHL}	I_F = 1.6 mA, R_L = 680 Ω, V_{CC} = 3.3 V	9, 10, 11		9	30			4
	t_{PHL}	I_F =5 mA, R_L = 330 Ω, V_{CC} = 3.3 V	9		2	5			4
			10, 11			10			
Propagation Delay Time to Logic High at Output	t_{PLH}	I_F = 0.5 mA, R_L = 2.2 kΩ, V_{CC} = 3.3 V	9, 10, 11		10	60	µs	5, 6, 7, 8	4
	t_{PLH}	I_F = 1.6 mA, R_L = 680 Ω, V_{CC} = 3.3 V	9, 10, 11		8	50			4
	t_{PLH}	I_F =5 mA, R_L = 330 Ω, V_{CC} = 3.3 V	9		6	20			4
			10, 11			30			
Common Mode Transient Immunity at Low Output Level	$\|CM_L\|$	V_{CC} = 3.3 V, I_F = 1.6 mA R_L = 680 kΩ $\|V_{CM}\|$= 50 V_{P-P}	9, 10, 11	500	1000		V/µs	9	4, 10 11, 14
Common Mode Transient Immunity at High Output Level	$\|CM_H\|$	V_{CC} = 3.3 V , I_F =0 mA R_L = 680 kΩ $\|V_{CM}\|$= 50 V_{P-P}	9, 10, 11	500	1000		V/µs	9	4, 10 11, 14

* All typical values are at V_{CC} = 3.3 V, T_A = 25°C.

Typical Characteristics, T_A = 25°C

Parameter	Sym.	Typ.	Units	Test Conditions	Note
Input Capacitance	C_{IN}	60	pF	V_F =0 V, f = 1 MHz	4
Input Diode Temperature Coefficient	$\Delta V_F/\Delta T_A$	-1.8	mV/°C	I_F = 1.6 mA	4
Resistance (Input-Output)	R_{I-O}	10^{12}	Ω	V_{I-O} = 500 V	4, 8
Capacitance (Input-Output)	C_{I-O}	2.0	pF	f = 1 MHz	4, 8
Dual and Quad Channel Product Only					
Input-Input Leakage Current	I_{I-I}	0.5	nA	Relative Humidity = ≤65%, V_{I-I} = 500 V, t = 5 s	9
Resistance (Input-Input)	R_{I-I}	10^{12}	Ω	V_{I-I} = 500 V	9
Capacitance (Input-Input)	C_{I-I}	1.0	pF	f = 1 MHz	9

Notes:

1. GND Pin should be the most negative voltage at the detector side. Keeping V_{CC} as low as possible, but greater than 2.0 V, will provide lowest total I_{OH} over temperature.
2. Output power is collector output power plus total supply power for the single channel device. For the dual channel device, output power is collector output power plus one half the total supply power. For the quad channel device, output power is collector output power plus one fourth of total supply power. Derate at 1.66 mW/°C above 110°C.
3. Derate I_F at 0.33 mA/°C above 110°C.
4. Each channel.
5. CURRENT TRANSFER RATIO is defined as the ratio of output collector current, I_O, to the forward LED input current, I_F, times 100%.
6. I_{OHX} is the leakage current resulting from channel to channel optical crosstalk. $I_F = 2$ µA for channel under test. For all other channels, $I_F = 10$ mA.
7. All devices are considered two-terminal devices; measured between all input leads or terminals shorted together and all output leads or terminals shorted together.
8. Measured between each input pair shorted together and all output connections for that channel shorted together.
9. Measured between adjacent input pairs shorted together for each multi-channel device.
10. 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).
11. In applications where dV/dt may exceed 50,000 V/µs (such as a static discharge) a series resistor, R_{CC}, should be included to protect the detector ICs from destructively high surge currents. The recommended value is:

$$R_{CC} = \frac{1\ (V)}{0.15\ I_F\ (mA)}\ k\Omega$$

for single channel;

$$R_{CC} = \frac{1\ (V)}{0.3\ I_F\ (mA)}\ k\Omega$$

for dual channel;

$$R_{CC} = \frac{1\ (V)}{0.6\ I_F\ (mA)}\ k\Omega$$

for quad channel.

12. This is a momentary withstand test, not an operating condition.
13. Standard parts receive 100% testing at 25°C (Subgroups 1 and 9). SMD and 883B parts receive 100% testing at 25,125, and -55°C (Subgroups 1 and 9, 2 and 10, 3 and 11, respectively).
14. Parameters tested as part of device initial characterization and after design and process changes. Parameters guaranteed to limits specified for all lots not specifically tested.

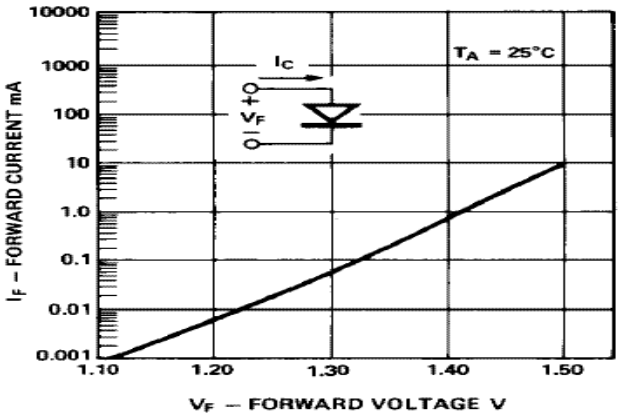


Figure 1. Input Diode Forward Current vs. Forward Voltage.

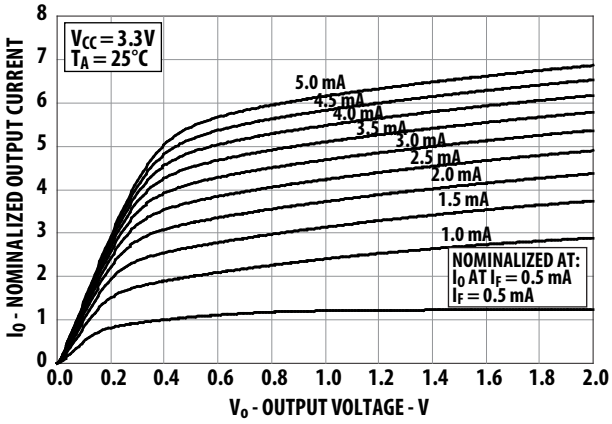


Figure 2. Normalized DC Transfer Characteristics.

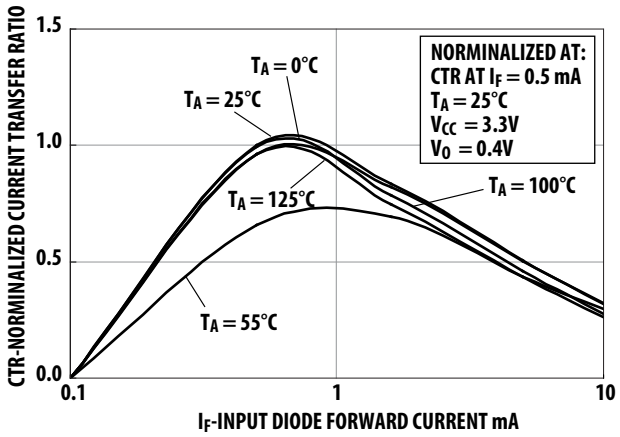


Figure 3. Normalized Current Transfer Ratio vs. Input Diode Forward Current.

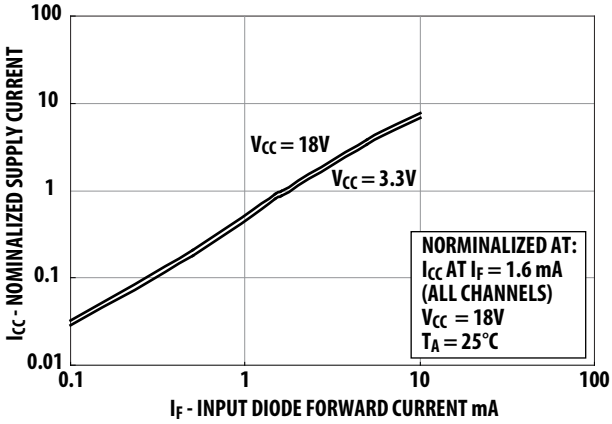


Figure 4. Normalized Supply Current vs. Input Diode Forward Current.

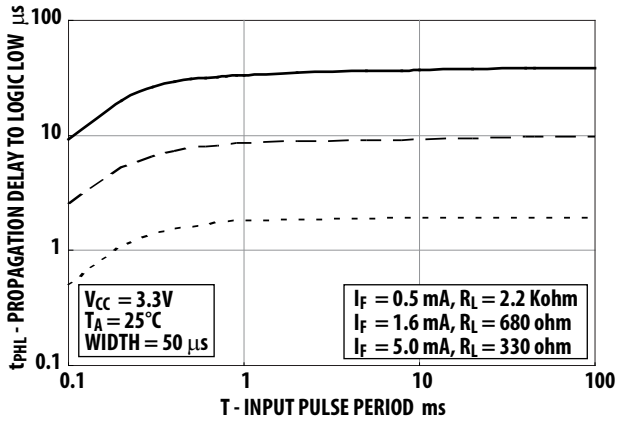


Figure 5. Propagation Delay to Logic Low vs. Input Pulse Period.

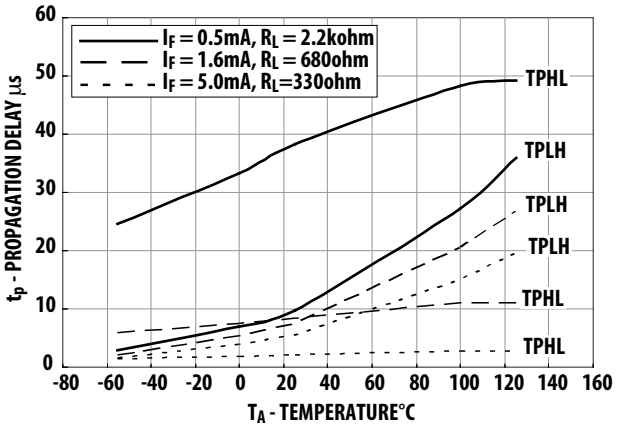


Figure 6. Propagation Delay vs. Temperature.

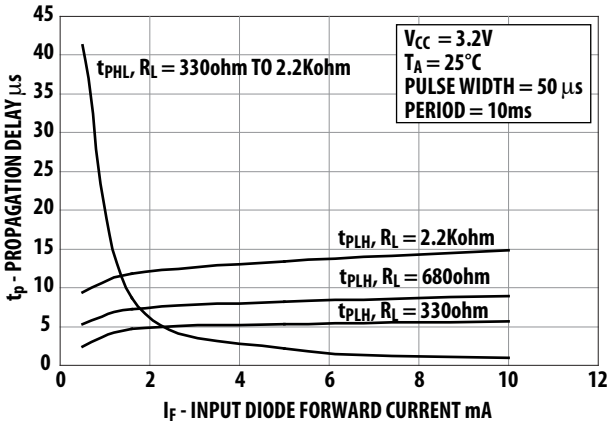
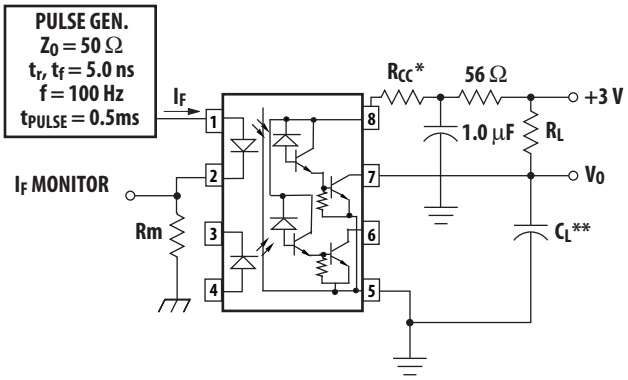


Figure 7. Propagation Delay vs. Input Diode Forward Current.



* SEE NOTE 11
** C_L INCLUDES PROBE AND STRAY WIRING CAPACITANCE.

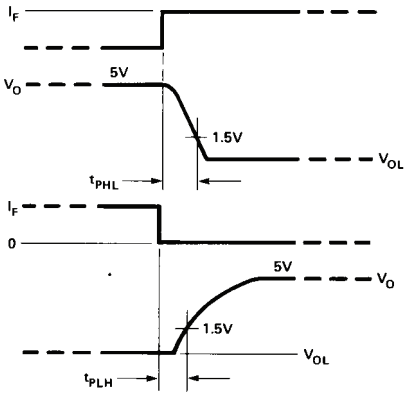
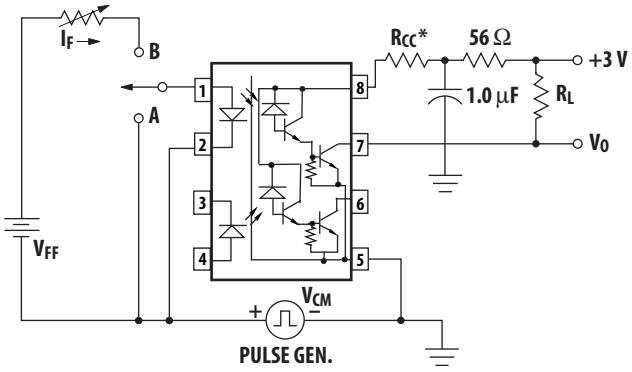


Figure 8. Switching Test Circuit.



* SEE NOTE 11

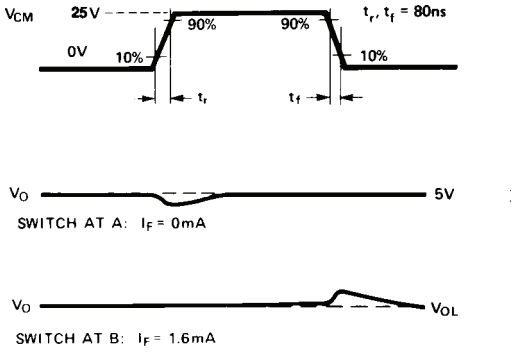


Figure 9. Test Circuit for Transient Immunity and Typical Waveforms.

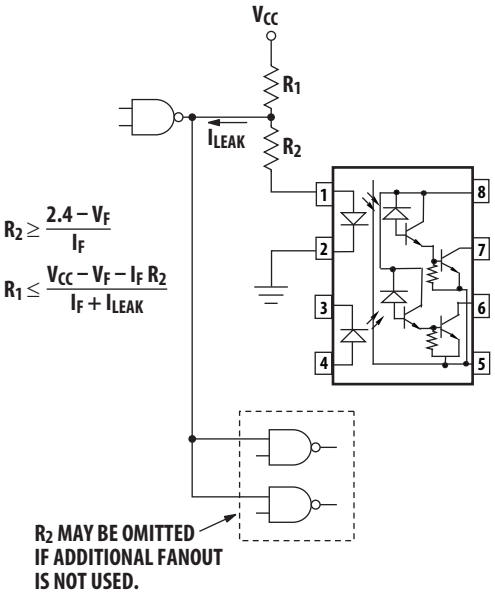
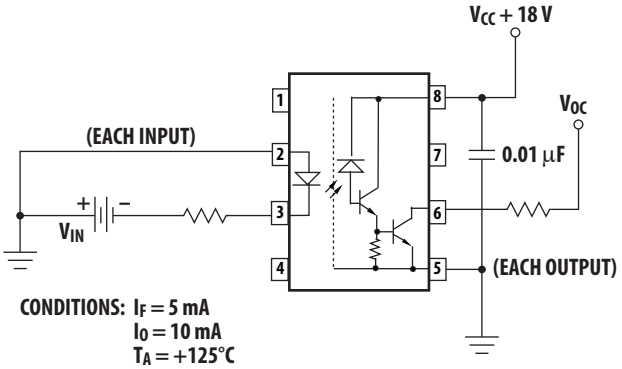


Figure 10. Recommended Drive Circuitry Using TTL Open-Collector Logic.

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

Avago's Hi-Rel Optocouplers are in compliance with MIL-PRF-38534 Class H and K. Class H and Class K devices are also in compliance with DSCC drawing 5962-08227.

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



*** ALL CHANNELS TESTED SIMULTANEOUSLY.**

Figure 11. Operating Circuit for Burn-In and Steady State Life Tests.

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

AV02-1819EN - March 25, 2009