

# ACPL-4800

## High CMR Intelligent Power Module and Gate Drive Interface Optocoupler

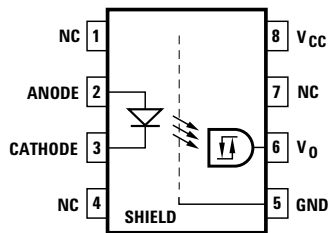


### Datasheet

#### Description

The ACPL-4800 fast speed optocoupler contains a GaAsP LED and photo detector with built-in Schmitt trigger to provide logic-compatible waveforms, eliminating the need for additional wave shaping. The totem pole output eliminates the need for a pull up resistor and allows for direct drive Intelligent Power Module or gate drive.

#### Functional Diagram



TRUTH TABLE  
(POSITIVE LOGIC)

LED	V <sub>O</sub>
ON	HIGH
OFF	LOW

Note: The connection of a 0.1  $\mu$ F bypass capacitor between pins 5 & 8 is recommended.

#### Features

- Performance Specified for Fast IPM Applications over Industrial Temperature Range: -40°C to 100°C
- Wide Operating V<sub>CC</sub> Range: 4.5 to 20 Volts
- Typical Propagation Delays 150 ns
- Minimized Pulse Width Distortion  
PWD = 250 ns
- Propagation Delay Difference  
Min. -100 ns, Max. 250 ns
- 30 kV/ $\mu$ s Minimum Common Mode Transient Immunity at V<sub>CM</sub> = 1000 V
- Hysteresis
- Totem Pole Output (No Pull-up Resistor Required)
- Safety Approval:  
Pending for UL 1577, 3750 Vrms / 1 minute  
Pending for CSA File CA88324, Notice #5  
Pending for IEC/EN/DIN EN 60747-5-2, V<sub>IORM</sub> = 630 Vpeak

#### Applications

- IPM Interface Isolation
- Isolated IGBT/MOSFET Gate Drive
- AC and Brushless DC Servo Motor Drives
- Low Power Inverters
- General Digital Isolation

### Ordering Information

Specify Part Number followed by Option Number (if desired).

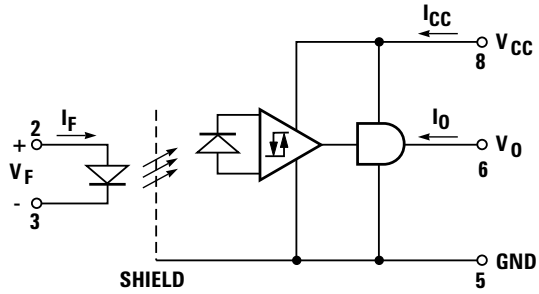
Example:

ACPL-4800-XXX

- 060 = IEC/EN/DIN EN 60747-5-2 Option
- 300 = Gull Wing Lead Option
- 500 = Tape and Reel Packaging Option
- XXXE = Lead-Free Option

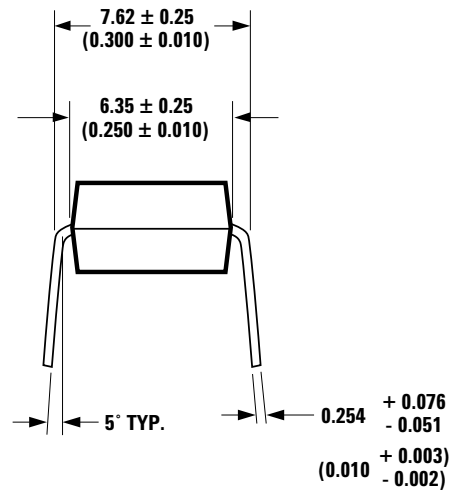
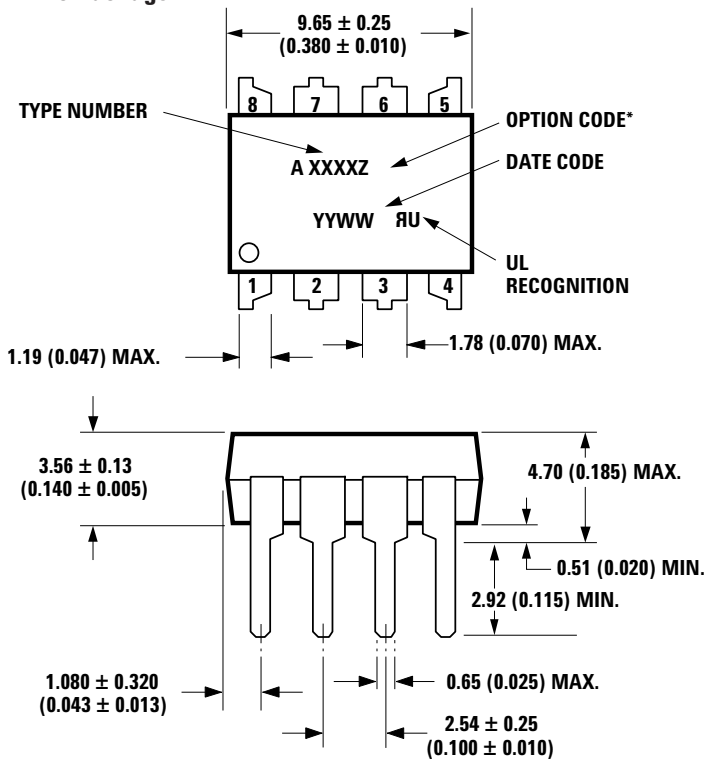
Option data sheets are available. Contact Avago sales representative or authorized distributor for information.

### Schematic



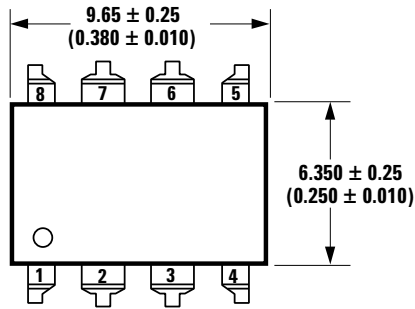
### Package Outline Drawings

#### DIP-8 Package

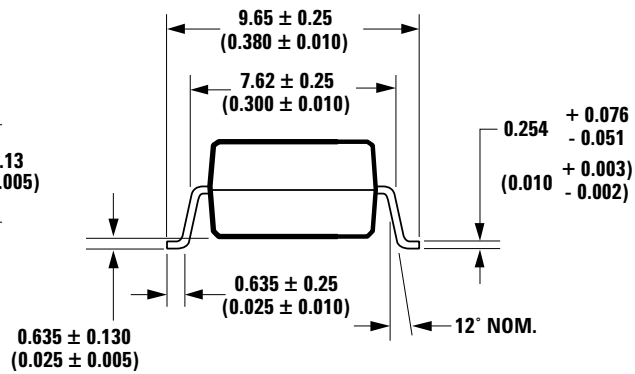
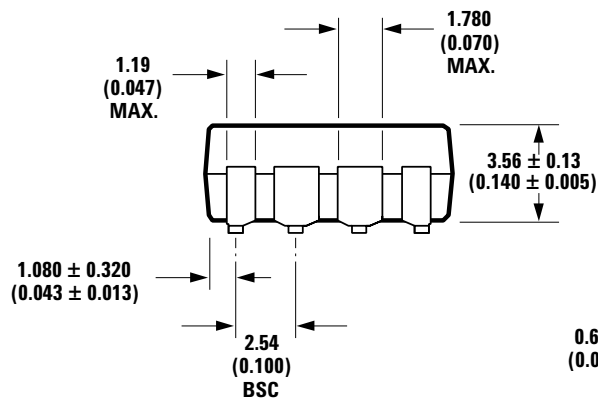
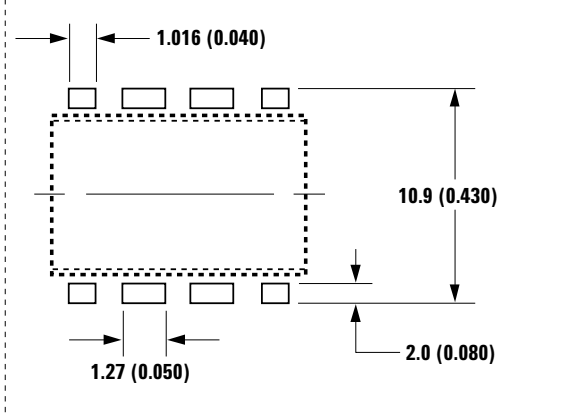


DIMENSIONS IN MILLIMETERS AND (INCHES).  
 \* MARKING CODE LETTER FOR OPTION NUMBERS  
 "V" = OPTION 060  
 OPTION NUMBERS 300 AND 500 NOT MARKED.

**DIP-8 Package with Gull Wing Surface Mount Option 300**



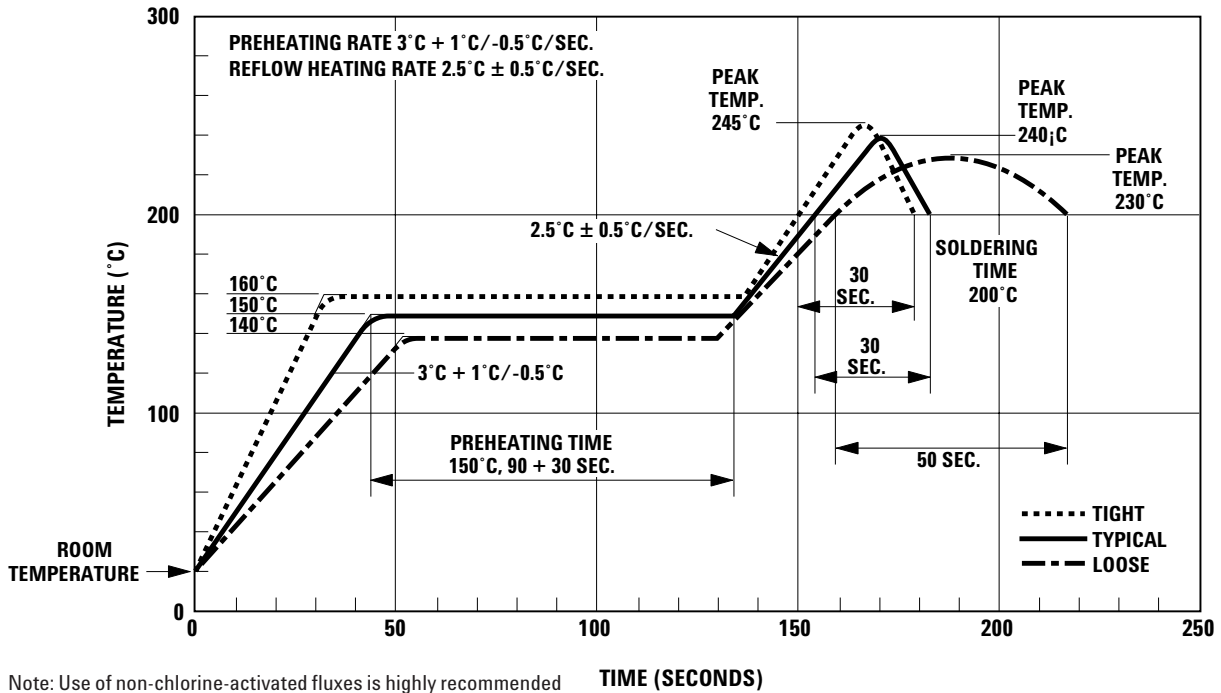
**LAND PATTERN RECOMMENDATION**



**DIMENSIONS IN MILLIMETERS (INCHES).**  
**LEAD COPLANARITY = 0.10 mm (0.004 INCHES).**

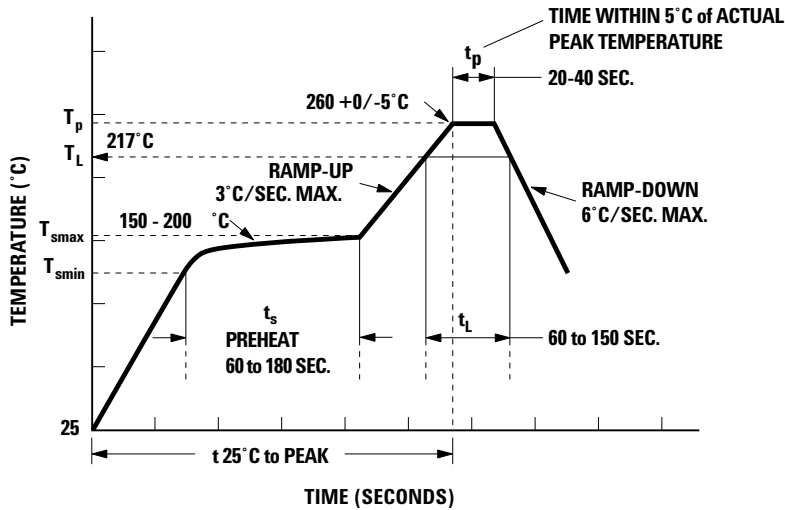
**NOTE: FLOATING LEAD PROTRUSION IS 0.25 mm (10 mils) MAX.**

**Solder Reflow Temperature Profile (Gull Wing Surface Mount Option 300 Parts)**



Note: Use of non-chlorine-activated fluxes is highly recommended

**Recommended Pb-Free IR Profile**



NOTES:  
 THE TIME FROM 25 C to PEAK TEMPERATURE = 8 MINUTES MAX.  
 $T_{smax} = 200^{\circ}\text{C}$ ,  $T_{smin} = 150^{\circ}\text{C}$

**Table 2. Insulation and Safety Related Specifications**

Parameter	Symbol	8-Pin DIP	Unit	Conditions
Minimum External Air Gap (External Clearance)	L(101)	7.1	mm	Measured from input terminals to output terminals, shortest distance through air.
Minimum External Tracking (External 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		Through insulation distance, conductor to conductor, usually the direct distance between the photo emitter and photo detector inside the optocoupler cavity.
Minimum Internal Tracking (Internal Creepage)		NA	mm	Measured from input terminals to output terminals, along internal cavity.
Tracking Resistance (Comparative Tracking Index)	CTI	200	mm	DIN IEC 112/VDE 0303 Part 1
Isolation Group		IIIa		Material Group (DIN VDE 0110, 1/89, Table 1)

Option 300 - surface mount classification is Class A in accordance with CECC 00802.

**Table 3. IEC/EN/DIN EN 60747-5-2 Insulation Characteristics (Option 060)**

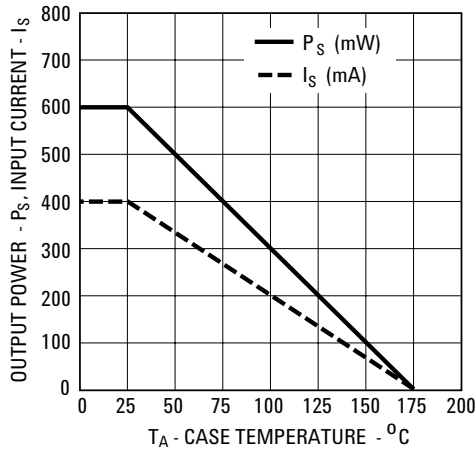
Description	Symbol	Characteristic	Unit
Installation classification per DIN VDE 0110/1.89, Table 1			
for rated mains voltage $\leq 300 V_{rms}$		I-IV	
for rated mains voltage $\leq 450 V_{rms}$		I-III	
Climatic Classification		55/85/21	
Pollution Degree (DIN VDE 0110/1.89)		2	
Maximum Working Insulation Voltage	$V_{IORM}$	630	$V_{peak}$
Input to Output Test Voltage, Method a* $V_{IORM} \times 1.875 = V_{PR}$ , 100% Production Test with $t_m = 1$ sec, Partial discharge $< 5$ pC	$V_{PR}$	1181	$V_{peak}$
Input to Output Test Voltage, Method a* $V_{IORM} \times 1.5 = V_{PR}$ , Type and Sample Test, $t_m = 60$ sec, Partial discharge $< 5$ pC	$V_{PR}$	945	$V_{peak}$
Highest Allowable Over-voltage (Transient Over-voltage $t_{ini} = 10$ sec)	$V_{IOTM}$	6000	$V_{peak}$
Safety-limiting values - maximum values allowed in the event of a failure.			
Case Temperature	$T_S$	175	$^{\circ}C$
Input Current	$I_{S, INPUT}$	230	mA
Output Power (refer to Thermal Derating Curve)	$P_{S, OUTPUT}$	600	mW
Insulation Resistance at $T_S$ , $V_{IO} = 500$ V	$R_S$	$>10^9$	$\Omega$

\* 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.

Note:

Isolation characteristics are guaranteed only within the safety maximum ratings which must be ensured by protective circuits in application.

**Thermal Derating Curve**



**Table 4. Absolute Maximum Rating**

Parameter	Symbol	Min.	Max.	Units	Note
Storage Temperature	T <sub>S</sub>	-55	125	°C	
Operating Temperature	T <sub>A</sub>	-40	100	°C	
Average Forward Input Current	I <sub>F(AVG)</sub>		10	mA	
Peak Transient Input Current ( ≤1 μs Pulse Width, 300 pps) ( ≤200 μs Pulse Width, < 1% Duty Cycle)	I <sub>F(TRAN)</sub>		1.0 40	A mA	
Reverse Input Voltage	V <sub>R</sub>		5	V	
Average Output Current	I <sub>O</sub>		25	mA	
Supply Voltage	V <sub>CC</sub>	0	25	V	
Output Voltage	V <sub>O</sub>	-0.5	25	V	
Total Package Power Dissipation	P <sub>T</sub>		210	mW	1
Lead Solder Temperature (Through Hole Parts Only)		260 °C for 10 sec., 1.6 mm below seating plane			
Solder Reflow Temperature Profile (Surface Mount Parts Only)		See Package Outline Drawings section			

**Table 5. Recommended Operating Conditions**

Parameter	Symbol	Min.	Max.	Units
Power Supply Voltage	V <sub>CC</sub>	4.5	20	V
Forward Input Current (ON)	I <sub>F(ON)</sub>	6	10	mA
Forward Input Voltage (OFF)	V <sub>F(OFF)</sub>	-	0.8	V
Operating Temperature	T <sub>A</sub>	-40	100	C

**Table 6. Electrical Specification**-40°C ≤ T<sub>A</sub> ≤ 100°C, 4.5V ≤ V<sub>CC</sub> ≤ 20V, 6mA ≤ I<sub>F(ON)</sub> ≤ 10 mA, 0V ≤ V<sub>F(OFF)</sub> ≤ 0.8 V, unless otherwise specified.All Typical at T<sub>A</sub> = 25°C. See Note 7.

Parameter	Sym.	Min.	Typ.	Max.	Units	Test Conditions	Fig.	Note
Logic Low Output Voltage	V <sub>OL</sub>			0.5	V	I <sub>OL</sub> = 6.4 mA	1,3	
Logic High Output Voltage	V <sub>OH</sub>	2.4	V <sub>CC</sub> - 1.1V		V	I <sub>OH</sub> = -2.6 mA	2,3,7	
		2.7				I <sub>OH</sub> = -0.4 mA		
Output Leakage Current (V <sub>OUT</sub> = V <sub>CC</sub> +0.5V)	I <sub>OHH</sub>			100	μA	V <sub>CC</sub> = 5 V	I <sub>F</sub> = 10mA	
				500		V <sub>CC</sub> = 20 V		
Logic Low Supply Current	I <sub>CCL</sub>		1.9	3.0	mA	V <sub>CC</sub> = 5.5 V	V <sub>F</sub> = 0 V	
			2.0	3.0		V <sub>CC</sub> = 20 V		I <sub>0</sub> = Open
Logic High Supply Current	I <sub>CCH</sub>		1.5	2.5	mA	V <sub>CC</sub> = 5.5 V	I <sub>F</sub> = 10 mA	
			1.6	2.5		V <sub>CC</sub> = 20 V		I <sub>0</sub> = Open
Logic Low Short Circuit Output Current	I <sub>OSL</sub>	25			mA	V <sub>0</sub> = V <sub>CC</sub> = 5.5 V	V <sub>F</sub> =0V	2
		50				V <sub>0</sub> = V <sub>CC</sub> = 20 V		
Logic High Short Circuit Output Current	I <sub>OSH</sub>			-25	mA	V <sub>CC</sub> = 5.5 V	I <sub>F</sub> =6mA	2
				-50		V <sub>CC</sub> = 20 V		
Input Forward Voltage	V <sub>F</sub>		1.5	1.7	V	T <sub>A</sub> = 25 C	I <sub>F</sub> =6mA	4
				1.85				
Input Reverse Breakdown Voltage	BV <sub>R</sub>	5			V	I <sub>R</sub> = 10 μA		
Input Diode Temperature Coefficient	DV <sub>F</sub> DT <sub>A</sub>		-1.7		mV/°C	I <sub>F</sub> = 6 mA		
Input Capacitance	C <sub>IN</sub>		60		pF	f = 1 MHz, V <sub>F</sub> = 0 V		3

**Table 7. Switching Specifications (AC)**

-40°C ≤ T<sub>A</sub> ≤ 100°C, 4.5V ≤ V<sub>CC</sub> ≤ 20V, 6mA ≤ I<sub>F(ON)</sub> ≤ 10 mA, 0V ≤ V<sub>F(OFF)</sub> ≤ 0.8V.

All Typical at T<sub>A</sub> = 25°C, I<sub>F(ON)</sub> = 6 mA unless otherwise specified.

Parameter	Sym.	Min.	Typ.	Max.	Units	Test Conditions	Fig.	Note
Propagation Delay Time to Logic Low Output Level	t <sub>PHL</sub>		150	350	ns	With Peaking Capacitor	5,6	5
Propagation Delay Time to Logic High Output Level	t <sub>PLH</sub>		110	350	ns	With Peaking Capacitor	5,6	5
Pulse Width Distortion	PWD			250	ns	t <sub>PHL</sub> - t <sub>PLH</sub>		8
Propagation Delay Difference Between Any 2 Parts	PDD	-100		250	ns			10
Output Rise Time (10-90%)	t <sub>r</sub>		16		ns		5,8	
Output Fall Time (90-10%)	t <sub>f</sub>		20		ns		5,8	
Logic High Common Mode Transient Immunity	CM <sub>H</sub>	-30000			V/μs	V <sub>CM</sub>   = 1000 V, I <sub>F</sub> = 6.0 mA, V <sub>CC</sub> = 5 V, T <sub>A</sub> = 25 C	9	6
Logic Low Common Mode Transient Immunity	CM <sub>L</sub>	30000			V/μs	V <sub>CM</sub>   = 1000 V, V <sub>F</sub> = 0 V, V <sub>CC</sub> = 5 V, T <sub>A</sub> = 25 C	9	6

**Table 8. Package Characteristics**

Parameter	Sym.	Min.	Typ.	Max.	Units	Test Conditions	Fig.	Note
Input-Output Momentary Withstand Voltage*	V <sub>ISO</sub>	3750			Vrms	RH < 50%, t = 1 min. T <sub>A</sub> = 25°C		4,7
Input-Output Resistance	R <sub>I-O</sub>		10 <sup>12</sup>		Ω	V <sub>I-O</sub> = 500 Vdc		4
Input-Output Capacitance	C <sub>I-O</sub>		0.6		pF	f = 1 MHz, V <sub>I-O</sub> = 0 Vdc		4

**Notes:**

- Derate total package power dissipation, P<sub>T</sub>, linearly above 70°C free-air temperature at a rate of 4.5 mW/°C.
- Duration of output short circuit time should not exceed 10 ms.
- Input capacitance is measured between pin 2 and pin 3.
- Device considered a two-terminal device: pins 1, 2, 3, and 4 shorted together and pins 5, 6, 7, and 8 shorted together.
- The t<sub>PLH</sub> propagation delay is measured from the 50% point on the leading edge of the input pulse to the 1.3 V point on the leading edge of the output pulse. The t<sub>PHL</sub> propagation delay is measured from the 50% point on the trailing edge of the input pulse to the 1.3 V point on the trailing edge of the output pulse.
- CMH is the maximum slew rate of the common mode voltage that can be sustained with the output voltage in the logic high state, V<sub>O</sub> > 2.0 V. CML is the maximum slew rate of the common mode voltage that can be sustained with the output voltage in the logic low state, V<sub>O</sub> < 0.8 V.
- In accordance with UL 1577, each optocoupler is proof tested by applying an insulation test voltage <sup>3</sup> 4200 V rms for one second (leakage detection current limit, I<sub>I-O</sub> ≤ 5 mA). This test is performed before the 100% production test for partial discharge (Method b) shown in the IEC/EN/DIN EN 60747-5-2 Insulation Characteristics Table, if applicable.
- Pulse Width Distortion (PWD) is defined as |t<sub>PHL</sub> - t<sub>PLH</sub>| for any given device.
- Use of a 0.1 μF bypass capacitor connected between pins 5 and 8 is recommended.
- The difference between t<sub>PLH</sub> and t<sub>PHL</sub> between any two devices under the same test condition.



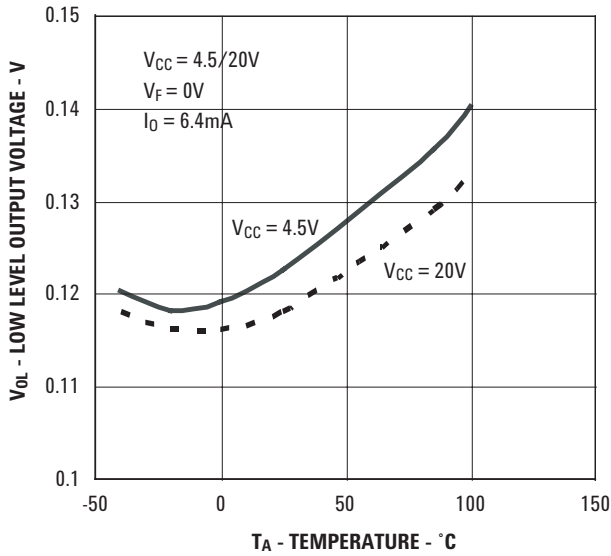


Figure 1. Typical Logic Low Output Voltage vs. Temperature

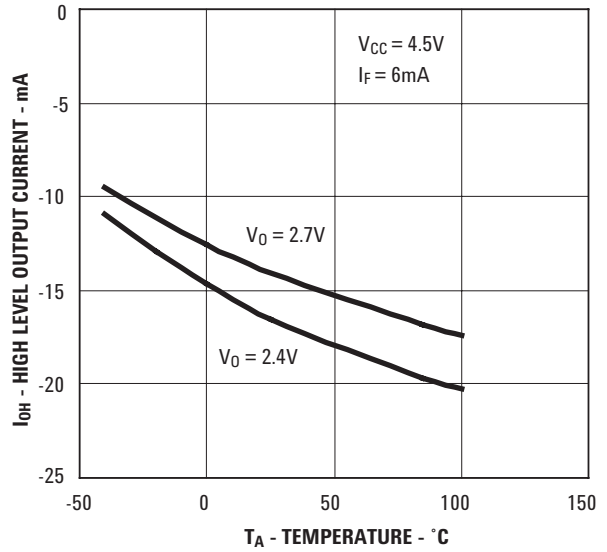


Figure 2. Typical Logic High Output Current vs. Temperature

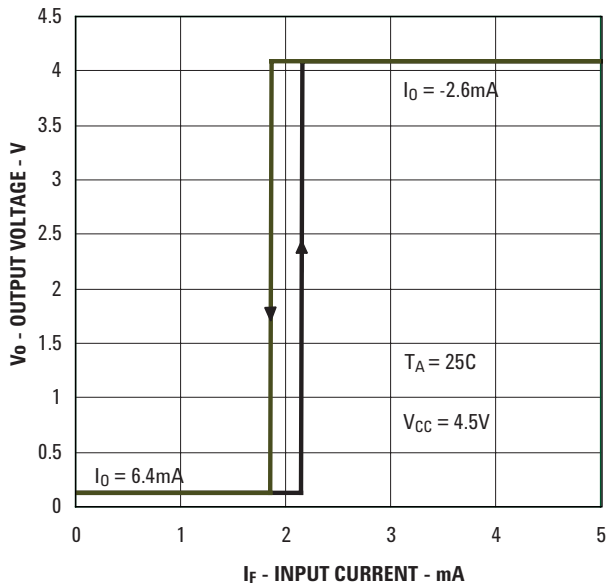


Figure 3. Typical Output Voltage vs. Forward Input Current

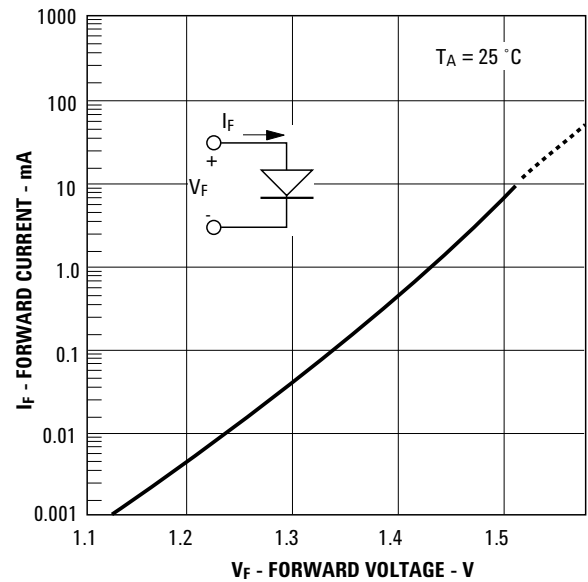


Figure 4. Typical Input Diode Forward Characteristic

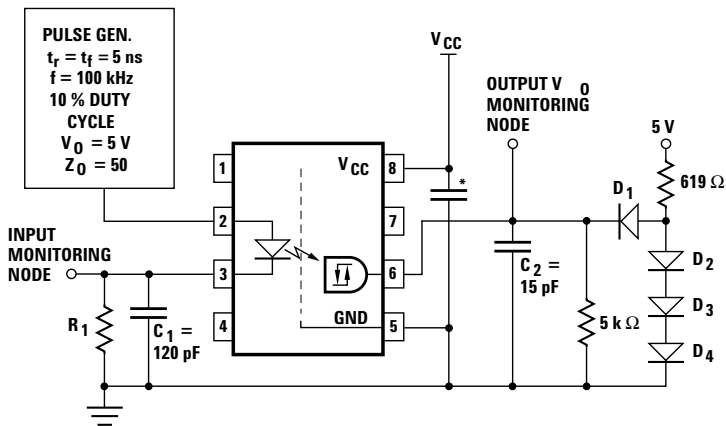
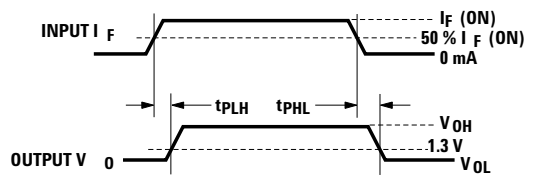


Figure 5. Circuit for  $t_{PLH}$ ,  $t_{PHL}$ ,  $t_r$ ,  $t_f$

THE PROBE AND JIG CAPACITANCES ARE INCLUDED IN C1 AND C2.

$R_1$	1.10 k $\Omega$	681 $\Omega$	330 $\Omega$
$I_F$ (ON)	3 mA	5 mA	10 mA

ALL DIODES ARE 1N916 OR 1N3064.



\* 0.1  $\mu$ F BYPASS  $\bar{N}$  SEE NOTE 9.

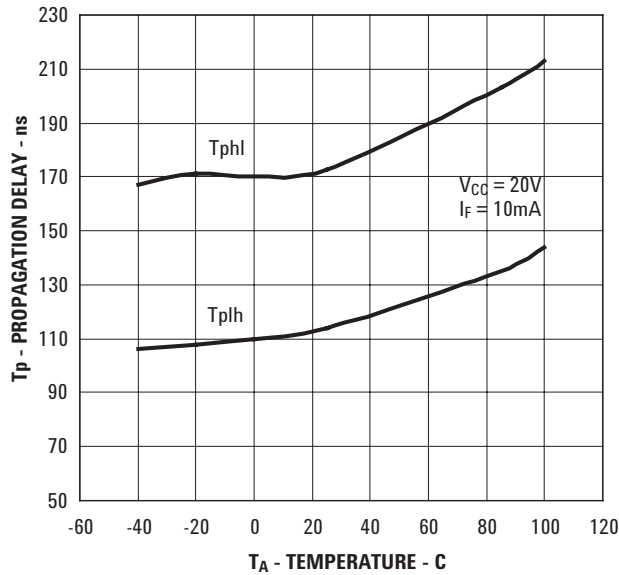


Figure 6. Typical Propagation Delays vs. Temperature.

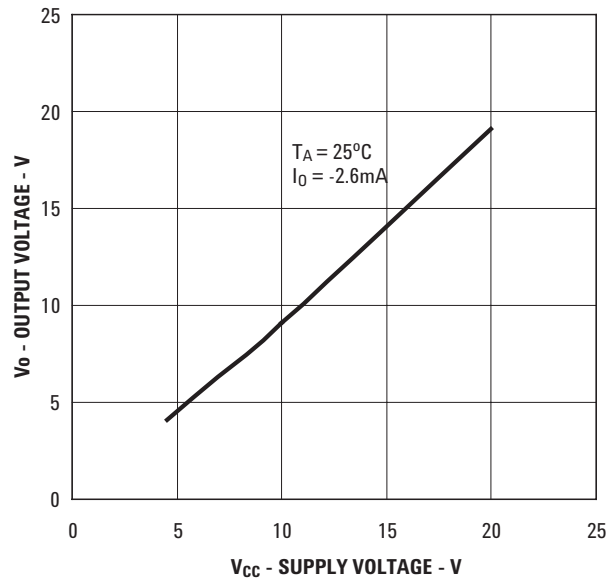


Figure 7. Typical Logic High Output Voltage vs. Supply Voltage

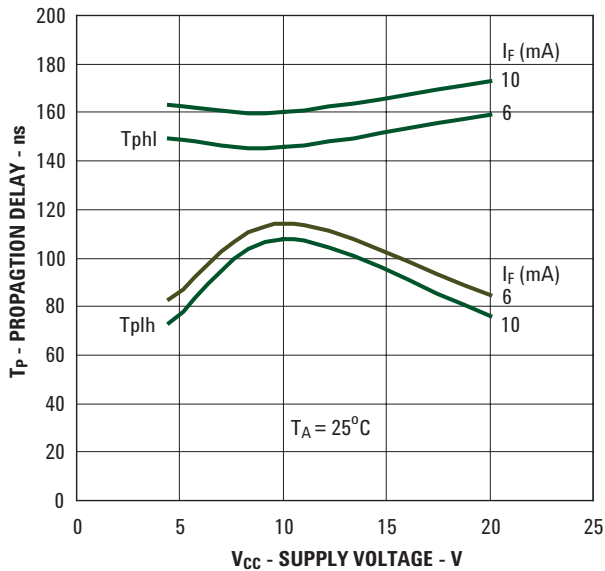


Figure 8. Typical Propagation Delays vs. Supply Voltage

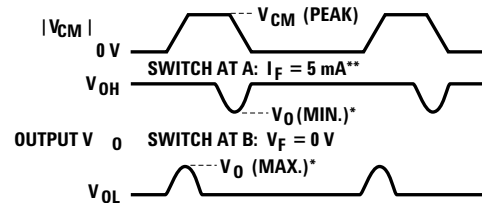
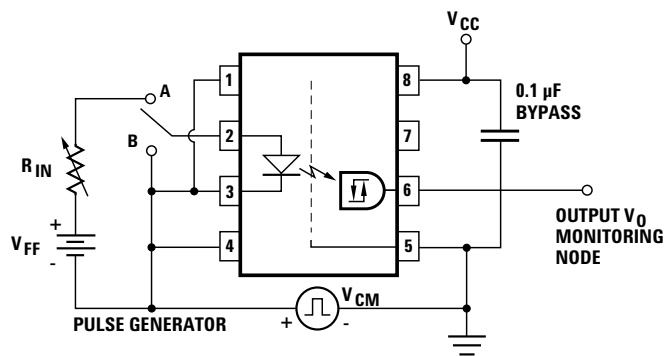


Figure 9. Test Circuit for Common Mode Transient Immunity and Typical Waveforms

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