ACNV2601

High Insulation Voltage 10-MBd Digital Optocoupler

Data Sheet

Description

The ACNV2601 is an optically coupled gate that combines an AlGaAs light-emitting diode and an integrated photo detector housed in a widebody package. The distance-through-insulation (DTI) between the emitting diode and photo-detector is at 2 mm. 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 20 kV/µs at V_{cm} = 1500V.

With creepage and clearance of greater than 13 mm, ACNV2601 is designed to provide high isolation voltage (7500 V_{rms}). It can withstand a continuous high working voltage of 2262 V_{peak} and a surge voltage of 12,000 V_{peak}, meeting IEC60747-5-5, UL, and CSA standard for reinforced insulation. ACNV2601 provides the high insulation voltage protection at a high data rate of 10 MBd.

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

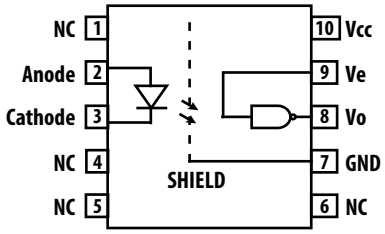
Features

- High voltage insulation with minimum 13-mm creepage and clearance
- 20 kV/µs minimum common mode rejection (CMR) at V_{CM} = 1500V
- High speed: 10 MBd typical
- TTL compatible
- Open collector output
- Guaranteed AC and DC performance over wide temperature: –40°C to +105°C
- Available in 10-pin widebody packages
- Safety approval:
  - Approval at 7500 V_{rms} for 1 minute per UL1577
  - CSA
  - IEC/EN/DIN EN 60747-5-5 with V_{iorm} = 2262 V_{peak}

Applications

- High voltage insulation
- Instrument input/output isolation
- Line receivers
- Ground loop elimination
- Isolation of high-speed logic systems
- Microprocessor system interfaces

Functional Diagram



NOTE A 0.1-µF bypass capacitor must be connected between pins V_{CC} and GND.

Truth Table (Positive Logic)

LED	ENABLE	OUTPUT
On	H	L
Off	H	H
On	L	H
Off	L	H
On	NC	L
Off	NC	H

Ordering Information

ACNV2601 is UL recognized with 7500 V_{rms} for 1 minute per UL1577.

Part Number	Option	Package	Surface Mount	Gull Wing	Tape & Reel	UL 7500 V_{rms}/ 1 Minute Rating	IEC/EN/DIN EN 60747-5-5	Quantity
	RoHS Compliant							
ACNV2601	-000E	500 mil DIP-10				X	X	35 per tube
	-300E		X	X		X	X	35 per tube
	-500E		X	X	X	X	X	500 per reel

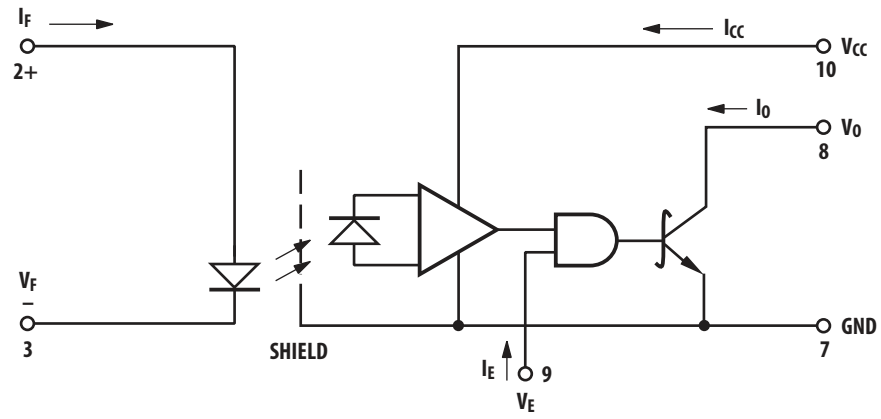
To order, choose a part number from the Part Number column and combine with the desired option from the Option column to form an order entry.

Example 1:

ACNV2601-500E to order product of 500 mil DIP-10 Widebody with Gull Wing Surface Mount package in Tape and Reel packaging with both UL 7500 V_{rms}/1 min and IEC/EN/DIN EN 60747-5-5 Safety Approval in RoHS compliant.

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

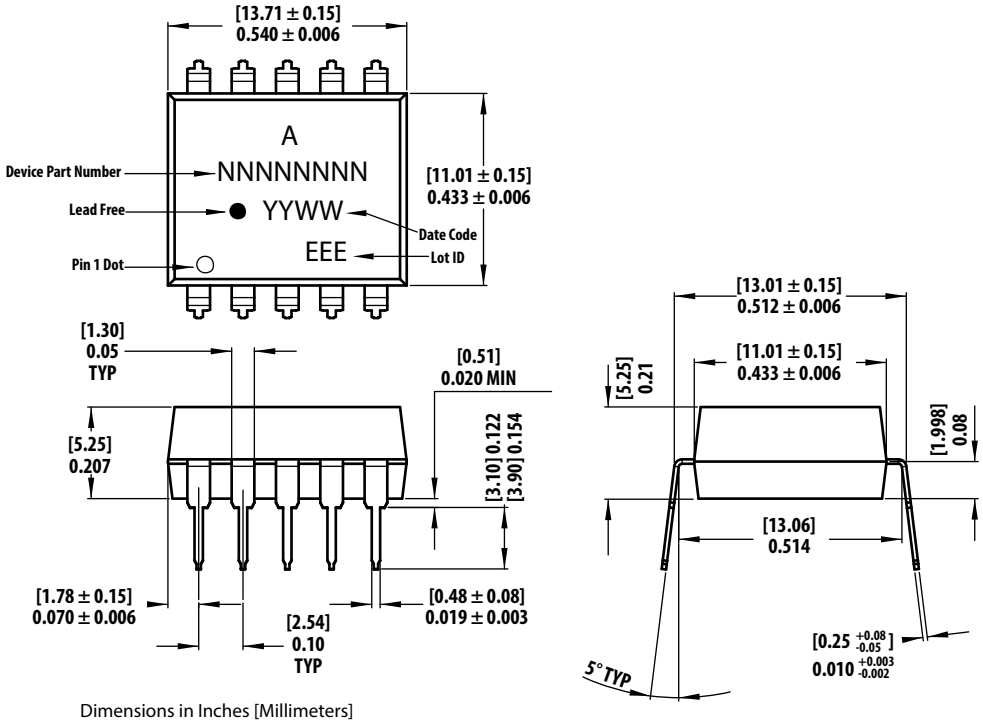
Schematic



NOTE Use of a 0.1-µF bypass capacitor connected between pins of 7 and 10 is recommended.

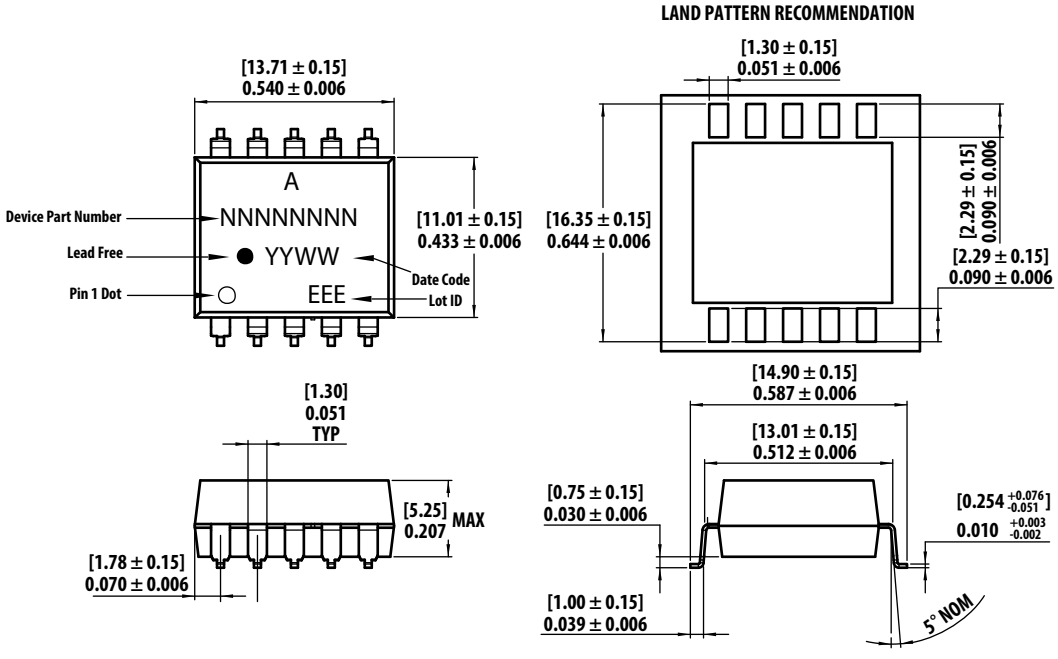
Package Drawings

10-Pin Widebody (500 mils) DIP Package



Dimensions in Inches [Millimeters]

10-Pin Widebody (500 mils) DIP Package with Gull Wing Surface Mount Option 300



Dimension in Inches [Millimeter]

Solder Reflow Profile

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

Insulation and Safety Related Specifications

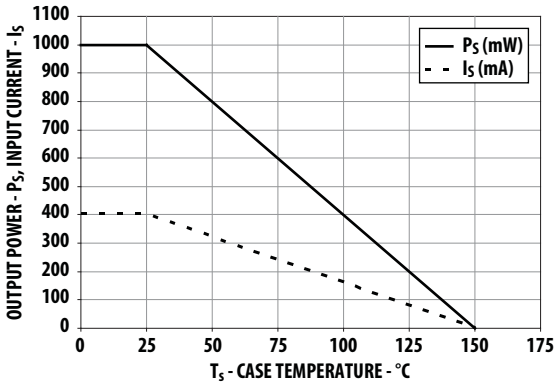
Parameter	Symbol	ACNV2601	Unit	Conditions
Minimum External Air Gap (External Clearance)	L(101)	13	mm	Measured from input terminals to output terminals, shortest distance through air.
Minimum External Tracking (External Creepage)	L(102)	13	mm	Measured from input terminals to output terminals, shortest distance path along body.
Minimum Internal Plastic Gap (Internal Clearance)		2.0	mm	Through insulation distance conductor to conductor, usually the straight line distance thickness between the emitter and detector.
Minimum Internal Tracking (Internal Creepage)		4.6	mm	Measured from input terminals to output terminals, along internal cavity.
Tracking Resistance (Comparative Tracking Index)	CTI	200	V	DIN IEC 112/VDE 0303 Part 1.
Isolation Group		IIIa		Material Group (DIN VDE 0110, 1/89, Table 1).

IEC/EN/DIN EN 60747-5-5 Insulation Characteristics[a]

Description	Symbol	Characteristic	Unit
Installation Classification per DIN VDE 0110/1.89, Table 1			
For Rated Mains Voltage ≤ 600 V_{rms}		I – IV	
For Rated Mains Voltage ≤ 1000 V_{rms}		I – III	
Climatic Classification		55/105/21	
Pollution Degree (DIN VDE 0110/1.89)		2	
Maximum Working Insulation Voltage	V_{IORM}	2262	V_{peak}
Input to Output Test Voltage, Method b[a] V_{IORM} x 1.875 = V_{PR}, 100% Production Test with t_m = 1 sec, Partial Discharge < 5 pC	V_{PR}	4241	V_{peak}
Input to Output Test Voltage, Method a[a] V_{IORM} x 1.6 = V_{PR}, Type and Sample Test, t_m = 10 sec, Partial Discharge < 5 pC	V_{PR}	3619	V_{peak}
Highest Allowable Overvoltage (Transient Overvoltage t_{ini} = 60 sec)	V_{IOTM}	12000	V_{peak}
Safety-Limiting Values — Maximum Values Allowed in the Event of a Failure			
Case Temperature	T_S	150	°C
Input Current[b]	$I_{S, INPUT}$	400	mA
Output Power[b]	$P_{S, OUTPUT}$	1	W
Insulation Resistance at T_S, V_{IO} = 500V	R_S	$>10^9$	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 60747-5-5) for a detailed description of Method a and Method b partial discharge test profiles.

b. Refer to the following figure 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.

Absolute Maximum Ratings

Parameter	Symbol	Min.	Max.	Unit
Storage Temperature	T_S	–55	125	°C
Operating Temperature	T_A	–40	105	°C
Average Input Current	$I_{F(AVG)}$	—	20	mA
Reverse Input Voltage	V_R	—	3	V
Input Power Dissipation	P_I	—	40	mW
Supply Voltage (1 Minute Maximum)	V_{CC}	—	7	V
Enable Input Voltage (Not to exceed V_{CC} by more than 500 mV)	V_E	—	V_{CC} + 0.5	V
Enable Input Current	I_E	—	5	mA
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}	—	245°C for 10 sec, up to seat plane	

Recommended Operating Conditions

Parameter	Symbol	Min.	Max.	Unit	Notes
Input Current, Low Level	I_{FL} [a]	0	250	µA	
Input Current, High Level	I_{FH} [b]	9	16	mA	[c]
Power Supply Voltage	V_{CC}	4.5	5.5	V	
Low Level Enable Voltage	V_{EL}	0	0.8	V	
High Level Enable Voltage	V_{EH}	2.0	V_{CC}	V	
Operating Temperature	T_A	–40	105	°C	
Fan Out (at R_L = 1 kΩ)	N	—	5	TTL Loads	
Output Pull-up Resistor	R_L	330	4k	Ω	

a. The off condition can also be guaranteed by ensuring that V_{FL} 0.8V.

b. The initial switching threshold is 8 mA or less. It is recommended that 9 mA to 16 mA be used for best performance and to permit at least a 20% LED degradation guardband.

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

Electrical Specifications (DC)

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

Parameter	Symbol	Min.	Typ.	Max.	Unit	Test Conditions	Fig.	Notes
High Level Output Current	I_{OH}	—	5.5	100	µA	V_{CC} = 5.5V, V_E = 2.0V V_O = 5.5V, I_{FL} = 250 µA		a
Input Threshold Current	I_{TH}	—	3.5	8	mA	V_{CC} = 5.5V, V_E = 2.0V, V_O = 0.6V, I_{OL} > 13 mA	1, 2	a
Low Level Output Voltage	V_{OL}	—	0.35	0.6	V	V_{CC} = 5.5V, V_E = 2.0V, I_F = 8 mA, $I_{OL(Sinking)}$ = 13 mA	1, 2, 3, 4	a
High Level Supply Current	I_{CCH}	—	7.0	12	mA	V_E = 0.5V; V_{CC} = 5.5 V, I_F = 0 mA		
		—	6.5	—		V_E = V_{CC}; V_{CC} = 5.5 V, I_F = 0 mA		
Low Level Supply Current	I_{CCL}	—	9.0	13	mA	V_E = 0.5V; V_{CC} = 5.5V, I_F = 10 mA		
		—	8.5	—		V_E = V_{CC}; V_{CC} = 5.5V, I_F = 10 mA		
High Level Enable Current	I_{EH}	—	–0.7	—	mA	V_{CC} = 5.5V, V_E = 2.0V		
Low Level Enable Current	I_{EL}	—	–0.9	—	mA	V_{CC} = 5.5V, V_E = 0.5V		
High Level Enable Voltage	V_{EH}	2.0	—	—	mA	V_{CC} = 5.5 V, V_E = 2.0V		a
Low Level Enable Voltage	V_{EL}	—	—	0.8	mA	V_{CC} = 5.5V, V_E = 0.5V		
Input Forward Voltage	V_F	1.25	1.64	1.85	V	T_A = 25°C; I_F = 10 mA	5	
		1.2	—	2.05		I_F = 10 mA		
Input Reverse Breakdown Voltage	BV_R	5	—	—	V	I_R = 100 µA, T_A = 25°C		
Input Capacitance	C_{IN}	—	60	—	pF	f = 1 MHz, V_F = 0V		
Input Diode Temperature Coefficient	$\Delta V_F/\Delta T_A$	—	–1.9	—	mV/°C	I_F = 10 mA		

a. No external pull-up is required for a high logic state on the enable input. If the V_E pin is not used, tying V_E to V_{CC} results in improved CM_R performance

Switching Specifications (AC)

Over recommended temperature (T_A = –40°C to +105°C), V_{CC} = 5V, I_F = 10 mA unless otherwise specified. All typicals are at T_A = 25°C, V_{CC} = 5V.

Parameter	Symbol	Min.	Typ.	Max.	Unit	Test Conditions		Fig.	Notes
Propagation Delay Time to High Output Level	t_{PLH}	30	50	80	ns	T_A = 25°C	R_L = 350Ω, C_L = 15 pF	6, 7, 8	a, b
				120					
Propagation Delay Time to Low Output Level	t_{PHL}	35	55	80	ns	T_A = 25°C			c, b
				120					
Pulse Width Distortion	$\lvert t_{PHL} - t_{PLH} \rvert$	—	5	40	ns	R_L = 350Ω, C_L = 15 pF		6, 7, 8, 9	b
Propagation Delay Skew	t_{psk}	—		50	ns				d, b
Output Rise Time (10% to 90%)	T_r	—	25	—	ns			10	b
Output Fall Time (10% to 90%)	T_f	—	10	—	ns			10	b
Propagation Delay Time of Enable from V_{EH} to V_{EL}	t_{ELH}	—	30	—	ns	R_L = 350Ω, C_L = 15 pF, V_{EL} = 0V, V_{EH} = 3V		11, 12	e
Propagation Delay Time of Enable from V_{EL} to V_{EH}	t_{EHL}	—	20	—	ns	R_L = 350Ω, C_L = 15 pF, V_{EL} = 0V, V_{EH} = 3V		11, 12	f
Output High Level Common Mode Transient Immunity	$\lvert CM_H \rvert$	20	25	—	kV/µs	V_{CC} = 5 V, I_F = 0 mA, $V_{O(MIN)}$ = 2V, R_L = 350Ω, T_A = 25°C, V_{CM} = 1500V		13	g, h, b
Output Low Level Common Mode Transient Immunity	$\lvert CM_L \rvert$	20	25	—	kV/µs	V_{CC} = 5V, I_F = 10 mA, $V_{O(MAX)}$ = 0.8V, R_L = 350Ω, T_A = 25°C, V_{CM} = 1500V			h, i, b

a. The t_{PLH} propagation delay is measured from the 5 mA point on the falling edge of the input pulse to the 1.5V point on the rising edge of the output pulse.

b. No external pull-up is required for a high logic state on the enable input. If the V_E pin is not used, tying V_E to V_{CC} results in improved CM_R performance.

c. The tPHL propagation delay is measured from the 5 mA point on the rising edge of the input pulse to the 1.5V point on the falling edge of the output pulse.

d. t_{PSK} is equal to the worst-case difference in t_{PHL} and/or t_{PLH} that is seen between units at any given temperature and specified test conditions.

e. The t_{ELH} enable propagation delay is measured from the 1.5V point on the falling edge of the enable input pulse to the 1.5V point on the rising edge of the output pulse.

f. The t_{EHL} enable propagation delay is measured from the 1.5V point on the rising edge of the enable input pulse to the 1.5V point on the falling edge of the output pulse.

g. CM_H is the maximum tolerable rate of rise of the common mode voltage to ensure that the output remains in a high logic state (i.e., V_O > 2.0V).

h. For sinusoidal voltages, $(\lvert dV_{CM} \rvert/dt)_{max} = \pi f_{CM} V_{CM(p\text{-}p)}$.

i. CM_L is the maximum tolerable rate of fall of the common mode voltage to ensure that the output remains in a low logic state (i.e., V_O < 0.8V).

Package Characteristics

All typicals are at T_A = 25°C.

Parameter	Symbol	Min.	Typ.	Max.	Unit	Test Conditions	Fig.	Notes
Input-Output Insulation	V_{ISO}	7500	—	—	V_{rms}	RH < 50% for 1 min., T_A = 25°C		a, b
Input-Output Resistance	$R_{I\text{-}O}$	10^{12}	—	—	Ω	$V_{I\text{-}O}$ = 500V		a
Input-Output Capacitance	$C_{I\text{-}O}$	—	0.5	0.6	pF	f = 1 MHz, T_A = 25°C		a

a. Device considered a two-terminal device: pins 1, 2, 3, 4 and 5 shorted together, and pins 6, 7, 8, 9 and 10 shorted together.

b. In accordance with UL1577, each optocoupler is proof tested by applying an insulation test voltage ≥9000 V_{rms} for one second (leakage detection current limit, $I_{I\text{-}O} \leq 5$ µA). This test is performed before the 100% production test for partial discharge (Method b) shown in the IEC/EN/DIN EN 60747-5-5 Insulation Characteristics[a] table, if applicable.

Figure 1 Typical Output Voltage vs. Forward Input Voltage Current

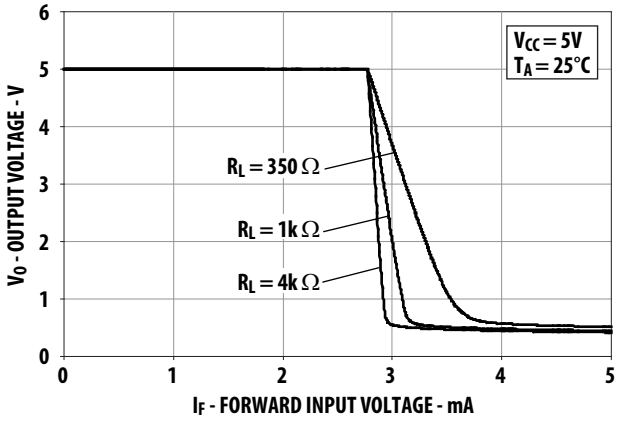


Figure 2 Typical Input Threshold Current vs. Temperature

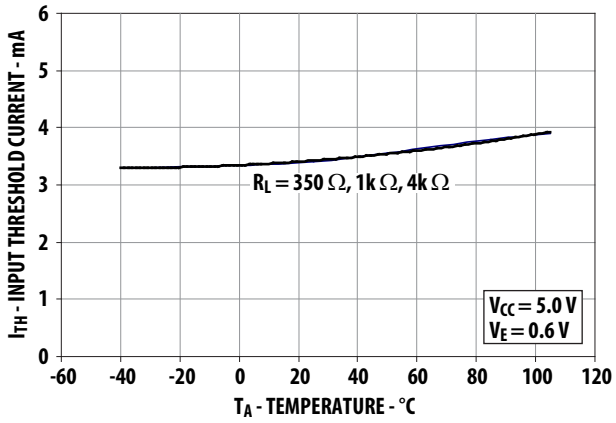


Figure 3 Typical Low Level Output Voltage vs. Temperature

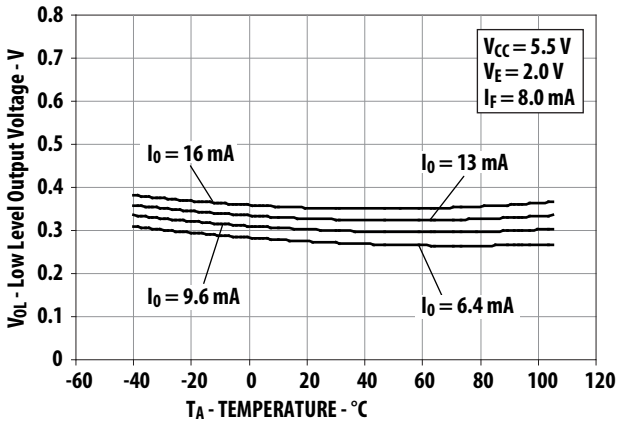


Figure 4 Typical Low Level Output Current vs. Temperature

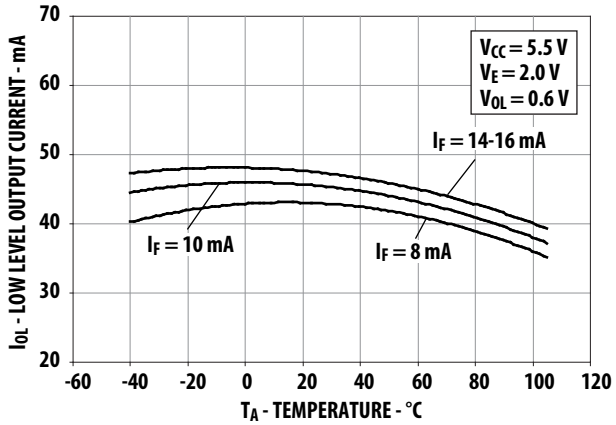


Figure 5 Typical Input Diode Forward Characteristic

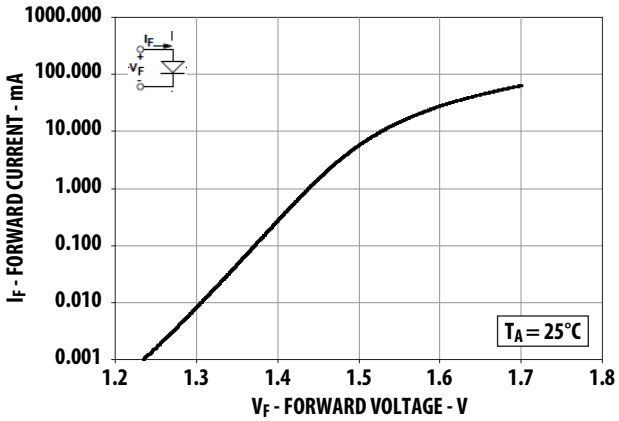


Figure 6 Test Circuit for t_{PHL} and t_{PLH}

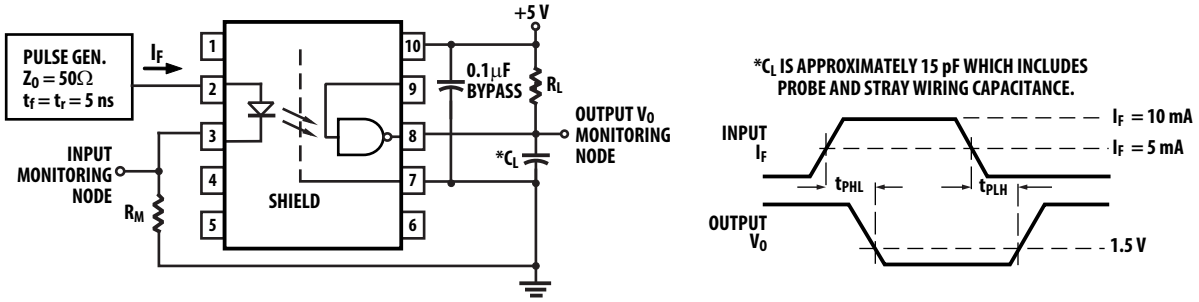


Figure 7 Typical Propagation Delay vs. Temperature

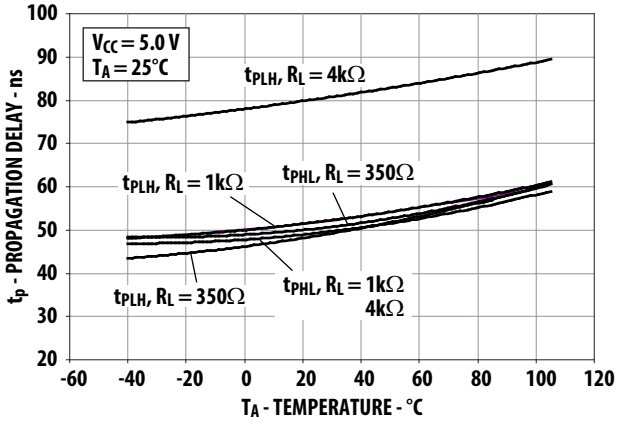


Figure 8 Typical Propagation Delay vs. Pulse Input Current

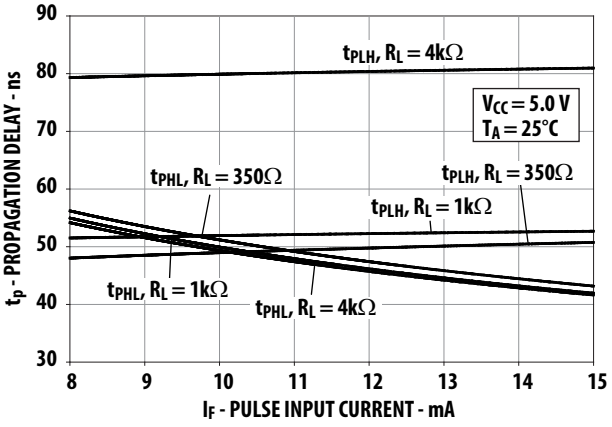


Figure 9 Typical Pulse Width Distortion vs. Temperature

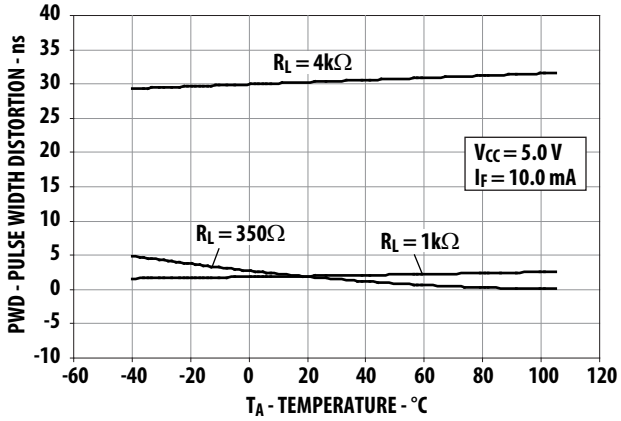


Figure 10 Typical Rise and Fall Time vs. Temperature

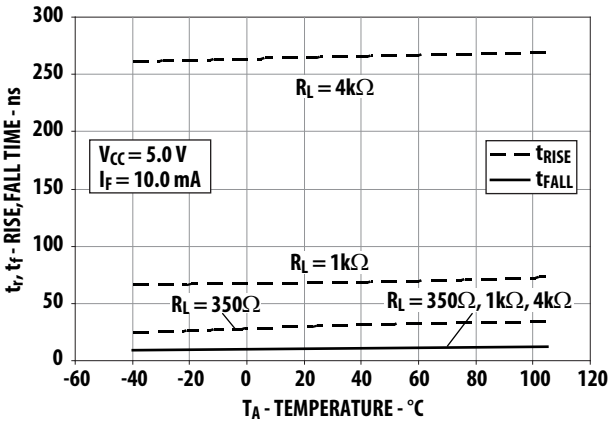


Figure 11 Test Circuit for t_{EHL} and t_{ELH}

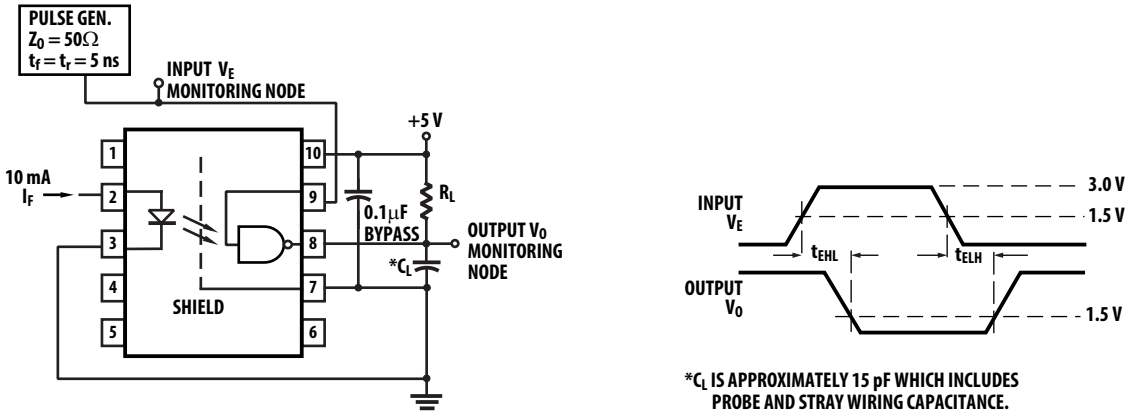


Figure 12 Typical Enable Propagation Delay vs. Temperature

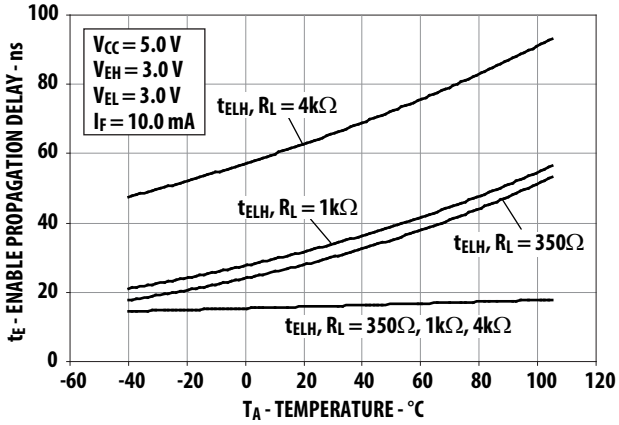


Figure 13 Test Circuit for Common Mode Transient Immunity and Typical Waveforms

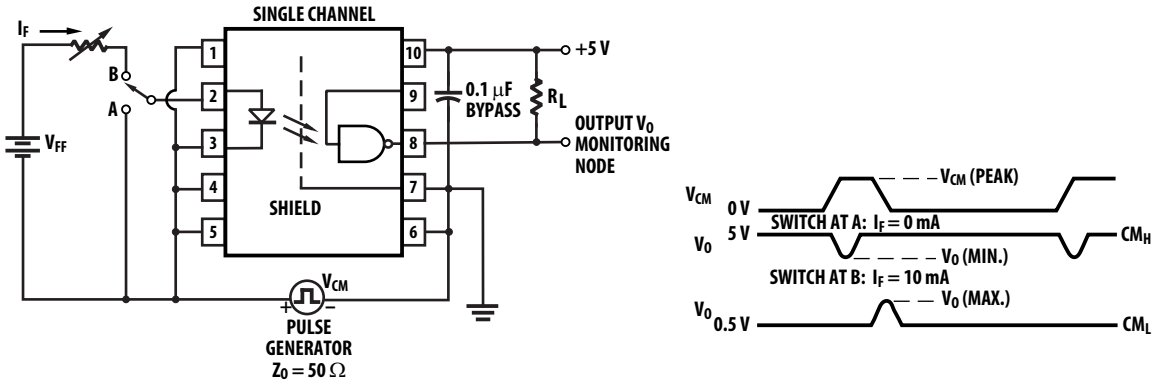
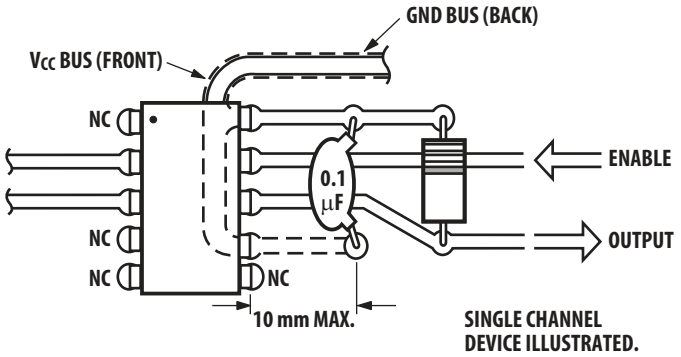


Figure 14 Recommended Printed Circuit Board Layout



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

AV02-2456EN – April 12, 2017