

## ACNU-250L

### 1MBd Optocoupler in 11-mm SSO8 Package

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#### Description

The Broadcom<sup>®</sup> ACNU-250L is a single-channel 1MBd optocoupler in an SSO8 footprint.

This optocoupler uses an insulating layer between the light-emitting diode and an integrated photon detector to provide electrical insulation between input and output. Separate connections for the photodiode bias and output transistor collector increase the speed up to a hundred times over that of a conventional photo-transistor coupler by reducing the base-collector capacitance.

The ACNU-250L is suitable for isolated communication logic interface and control in high-voltage power systems, space-constrained industrial applications, renewable inverters and medical equipments. This package platform features wide 11-mm creepage and 10.5-mm clearance, high insulation voltage of  $V_{iorm} = 1414 V_{peak}$  and compact footprint which is 40% smaller than the 400-mil DIP8 package.

#### Features

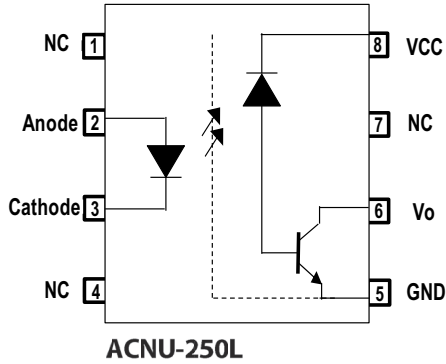
- Wide supply voltage: 3.0V to 24V
- 11-mm creepage, 10.5-mm clearance in a compact SSO8 package
- TTL compatible
- Open-collector output
- 40 kV/ $\mu$ s minimum common-mode rejection at  $V_{CM} = 1500V$
- Guaranteed performance within temperature range:  $-40^{\circ}C$  to  $+105^{\circ}C$
- Worldwide safety approval:
  - UL1577 recognized, 5000 Vrms/1 minute
  - CSA Approval
  - IEC 60747-5-5 Approval for Reinforced Insulation

#### Applications

- Communications interface
- Feedback elements in switching power supplies
- Digital signal isolation for A/D, D/A conversion
- MCU interface
- Renewable energy inverters

**CAUTION!** Take normal static precautions in handling and assembly of this component to prevent damage, degradation, or both that may be induced by ESD. The components featured in this data sheet are not to be used in military or aerospace applications or environments.

## Functional Diagram



## Truth Table

LED	OUTPUT
ON	L
OFF	H

## Ordering Information

ACNU-250L is UL Recognized with 5000  $V_{rms}$  for 1 minute per UL1577.

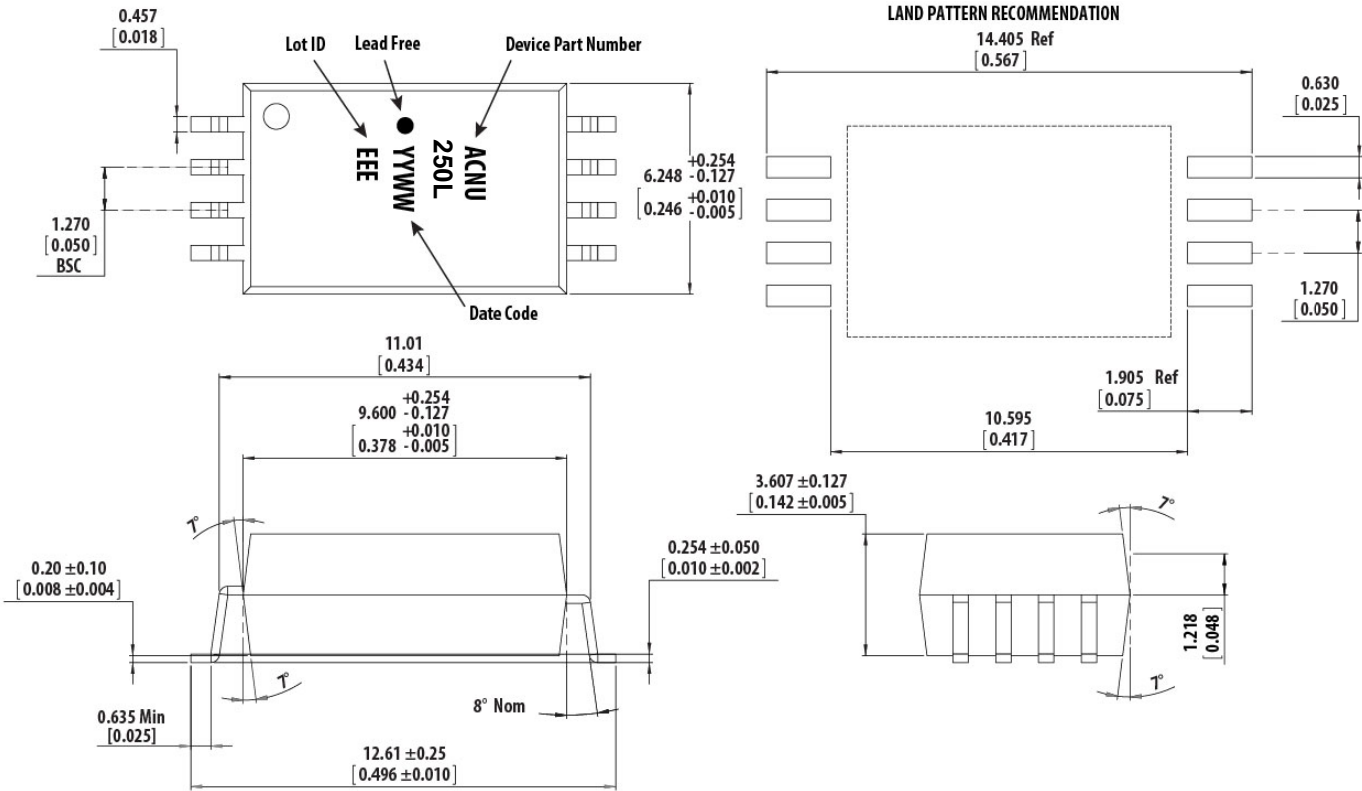
A 0.1- $\mu$ F bypass capacitor must be connected between pins VCC and GND.

Part Number	Option	Package	Surface Mount	Tape and Reel	UL 1577	IEC 60747-5-5	Quantity
	RoHS Compliant						
ACNU-250L	-000E	11mm Stretched SO8	X		X	X	80 per tube
	-500E		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.

# Package Outline Drawing

## ACNU-250L SSO8 Package



Lead Coplanarity = 0.10mm (0.004 inches)  
 Dimensions in mm [inch]  
 Maximum mold flash on each side 0.127mm [0.005]  
 Note: Floating lead protrusion is 0.15mm [0.006] Max if applicable

## Solder Reflow Profile

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

## Regulatory Information

The ACNU-250L is approved by the following organizations.

<b>UL</b>	Approval under UL 1577, component recognition program up to $V_{ISO} = 5000 V_{RMS}$ File E55361.
<b>CSA</b>	Approval under CSA Component Acceptance Notice #5, File CA 88324.
<b>IEC 60747-5-5</b>	Maximum Working Insulation Voltage $V_{iorm} = 1414 V_{peak}$ .

## Insulation and Safety Related Specifications

Parameter	Symbol	ACNU-250L	Units	Conditions
Minimum External Air Gap (External Clearance)	L(101)	10.5	mm	Measured from input terminals to output terminals, shortest distance through air.
Minimum External Tracking (External Creepage)	L(102)	11.0	mm	Measured from input terminals to output terminals, shortest distance path along body.
Minimum Internal Plastic Gap (Internal Clearance)		0.5	mm	Through insulation distance conductor to conductor, usually the straight line distance thickness between the emitter and the detector.
Tracking Resistance (Comparative Tracking Index)	CTI	>300	V	DIN IEC 112/VDE 0303 Part 1
Isolation Group		IIIa		Material Group (DIN VDE 0110, 1/89, Table 1)

## IEC 60747-5-5 Insulation Characteristics

Description	Symbol	Characteristic	Units
Installation Classification per DIN VDE 0110/39, Table 1			
For rated mains voltage $\leq 600 V_{rms}$		I-IV	
For rated mains voltage $\leq 1000 V_{rms}$		I-III	
Climatic Classification		40/105/21	
Pollution Degree (DIN VDE 0110/39)		2	
Maximum Working Insulation Voltage	$V_{IORM}$	1414	$V_{peak}$
Input to Output Test Voltage, Method b <sup>a</sup> $V_{IORM} \times 1.875 = V_{PR}$ , 100% Production Test with $t_m = 1s$ , Partial discharge $< 5 pC$	$V_{PR}$	2652	$V_{peak}$
Input to Output Test Voltage, Method a <sup>a</sup> $V_{IORM} \times 1.6 = V_{PR}$ , Type and Sample Test, $t_m = 10s$ , Partial discharge $< 5 pC$	$V_{PR}$	2262	$V_{peak}$
Highest Allowable Overvoltage (Transient Overvoltage $t_{ni} = 60s$ )	$V_{IOTM}$	8000	$V_{peak}$
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	$P_{S, OUTPUT}$	600	mW
Insulation Resistance at $T_S$ , $V_{IO} = 500 V$	$R_S$	>109	$\Omega$

a. Refer to the optocoupler section of the Isolation and Control Components Designer's Catalog, under Product Safety Regulations section, (IEC 60747-5-5) for a detailed description of Method a and Method b partial discharge test profiles.

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

## Absolute Maximum Ratings

Parameter	Symbol	Min.	Max.	Units
Storage Temperature	$T_S$	-55	125	°C
Operating Temperature	$T_A$	-40	105	°C
Average Forward Input Current	$I_{F(avg)}$	—	20	mA
Peak Forward Input Current (1-ms Pulse Width, 50% Duty Cycle)	$I_{F(peak)}$	—	80	mA
Peak Transient Input Current ( $\leq 1\text{-}\mu\text{s}$ pulse width, $<300\text{ ps}$ )	$I_{F(trans)}$	—	1	A
Reversed Input Voltage	$V_R$	—	5	V
Input Power Dissipation	$P_{IN}$	—	37	mW
Output Power Dissipation	$P_O$	—	100	mW
Output Current	$I_O$	—	12	mA
Supply Voltage	$V_{CC}$	-0.5	30	V
Output Voltage	$V_O$	-0.5	24	V
Lead Solder Temperature	TLS	260°C for 10 seconds, 1.6 mm below seating plane		
Solder Reflow Temperature Profile	Refer to the Solder Reflow Profile section			

## Recommended Operating Conditions

Parameter	Symbol	Min.	Max.	Units
Supply Voltage	$V_{CC}$	3.0	24	V
Input Current, High Level	$I_{FH}$	10	18	mA
Operating Temperature	$T_A$	-40	105	°C
Forward Input Voltage(OFF)	$V_{F(OFF)}$	—	0.8	V

## Electrical Specifications (DC)

Over recommended operating  $T_A = -40^{\circ}\text{C}$  to  $105^{\circ}\text{C}$ , supply voltage ( $3.0\text{V} \leq V_{CC} \leq 24\text{V}$ ) and unless otherwise specified. All typical are at  $T_A = 25^{\circ}\text{C}$ .

Parameter	Symbol	Min.	Typ.	Max.	Units	Conditions			Figure
Current Transfer Ratio	CTR <sup>a</sup>	23	33	53	%	$T_A = 25^{\circ}\text{C}$	$V_O = 0.4\text{V}$	$V_{CC} = 3.3\text{V}$ or $5\text{V}$ $I_F = 12\text{ mA}$	2, 3
		19	—	—	%		$V_O = 0.5\text{V}$		
Logic Low Output Voltage	$V_{OL}$	—	0.2	0.4	V	$T_A = 25^{\circ}\text{C}$	$I_O = 3\text{ mA}$	$V_{CC} = 3.3\text{V}$ or $5\text{V}$ $I_F = 12\text{ mA}$	
		—	0.2	0.5	V		$I_O = 1.6\text{ mA}$		
Logic High Output Current	$I_{OH}$	—	0.014	0.5	$\mu\text{A}$	$T_A = 25^{\circ}\text{C}$	$V_O = V_{CC} = 5.5\text{V}$	$I_F = 0\text{ mA}$	4, 5
		—	0.06	1			$V_O = V_{CC} = 24\text{V}$		
		—	—	80			$V_O = V_{CC} = 24\text{V}$		
Logic Low Supply Current	$I_{CCL}$	—	50	200	$\mu\text{A}$		$I_F = 12\text{ mA}$ , $V_O = \text{open}$ , $V_{CC} = 24\text{V}$		
Logic High Supply Current	$I_{CCH}$	—	0.02	2	$\mu\text{A}$		$I_F = 0\text{ mA}$ , $V_O = \text{open}$ , $V_{CC} = 24\text{V}$		
Input Forward Voltage	$V_F$	—	1.50	1.80	V		$I_F = 12\text{ mA}$		1
Input Reversed Breakdown Voltage	$BV_R$	5	—	—	V		$I_R = 10\text{ }\mu\text{A}$		
Temperature Coefficient of Forward Voltage	$\Delta V_F / \Delta T_A$	—	-1.6	—	$\text{mV}/^{\circ}\text{C}$		$I_F = 12\text{ mA}$		
Input Capacitance	$C_{IN}$	—	77	—	pF		$f = 1\text{ MHz}$ , $V_F = 0$		

a. Current transfer ratio in percent is defined as the ratio of output collector current,  $I_O$ , to the forward LED input current,  $I_F$ , times 100%.

## Switching Specifications

Over recommended operating ( $T_A = -40^\circ\text{C}$  to  $105^\circ\text{C}$ ),  $I_F = 12\text{ mA}$ , ( $3.0\text{V} \leq V_{CC} \leq 24\text{V}$ ), unless otherwise specified.

Parameter	Symbol	Min.	Typ.	Max.	Units	Test Conditions		Figure
Propagation Delay Time to Logic Low at Output	$t_{PHL}$	—	0.3	0.9	$\mu\text{s}$	$T_A = 25^\circ\text{C}$	$V_{CC} = 3.3\text{V}$ , $R_L = 1.0\text{ k}\Omega$	15
		—	—	1.0	$\mu\text{s}$			6
		—	0.3	0.8	$\mu\text{s}$	$T_A = 25^\circ\text{C}$	$V_{CC} = 5.0\text{V}$ , $R_L = 1.6\text{ k}\Omega$	15
		—	—	1.0	$\mu\text{s}$			7
		—	0.7	1.2	$\mu\text{s}$	$T_A = 25^\circ\text{C}$	$V_{CC} = 24\text{V}$ , $R_L = 8.2\text{ k}\Omega$	15
		—	—	1.5	$\mu\text{s}$			8
Propagation Delay Time to Logic High at Output	$t_{PLH}$	—	0.7	1.0	$\mu\text{s}$	$T_A = 25^\circ\text{C}$	$V_{CC} = 3.3\text{ V}$ , $R_L = 1.0\text{ k}\Omega$	15
		—	—	1.4	$\mu\text{s}$			6
		—	0.5	1.0	$\mu\text{s}$	$T_A = 25^\circ\text{C}$	$V_{CC} = 5.0\text{ V}$ , $R_L = 1.6\text{ k}\Omega$	15
		—	—	1.3	$\mu\text{s}$			7
		—	0.4	0.8	$\mu\text{s}$	$T_A = 25^\circ\text{C}$	$V_{CC} = 24\text{V}$ , $R_L = 8.2\text{ k}\Omega$	15
		—	—	1.0	$\mu\text{s}$			8
Propagation Delay Difference Between Any two Parts <sup>a</sup>		—	0.5	0.9	$\mu\text{s}$	$T_A = 25^\circ\text{C}$	$V_{CC} = 3.3\text{V}$ , $R_L = 1.0\text{ k}\Omega$	
		—	0.2	0.6	$\mu\text{s}$	$T_A = 25^\circ\text{C}$	$V_{CC} = 5.0\text{V}$ , $R_L = 1.6\text{ k}\Omega$	
		—	0.3	1.0	$\mu\text{s}$	$T_A = 25^\circ\text{C}$	$V_{CC} = 24\text{V}$ , $R_L = 8.2\text{ k}\Omega$	
Common Mode Transient Immunity at Logic High Output <sup>b</sup>	$ CM_H $	40	—	—	$\text{kV}/\mu\text{s}$	$T_A = 25^\circ\text{C}$	$V_{CM} = 1500\text{V}$ , $I_F = 0\text{ mA}$ , $R_L = 1.0\text{ k}\Omega$ , $V_{CC} = 3.3\text{V}$ or $R_L = 1.6\text{ k}\Omega$ , $V_{CC} = 5\text{V}$	16
Common Mode Transient Immunity at Logic Low Output <sup>c</sup>	$ CM_L $	40	—	—	$\text{kV}/\mu\text{s}$	$T_A = 25^\circ\text{C}$	$V_{CM} = 1500\text{V}$ , $I_F = 12\text{ mA}$ , $R_L = 1.0\text{ k}\Omega$ , $V_{CC} = 3.3\text{V}$ or $R_L = 1.6\text{ k}\Omega$ , $V_{CC} = 5\text{V}$	16

- The difference between  $t_{PLH}$  and  $t_{PHL}$  between any two parts under the same test condition.
- Common transient immunity in a Logic High level is the maximum tolerable (positive)  $dV_{CM}/dt$  on the rising edge of the common mode pulse,  $V_{CM}$ , to assure that the output will remain in a Logic High state.
- Common mode transient immunity in a Logic Low level is the maximum tolerable (negative)  $dV_{CM}/dt$  on the falling edge of the common mode pulse signal,  $V_{CM}$ , to assure that the output will remain in a Logic Low state.

## Package Characteristics

All Typical at  $T_A = 25\text{ C}$ .

Parameter	Symbol	Min.	Typ.	Max.	Units	Test Conditions
Input-Output Momentary Withstand Voltage <sup>a</sup>	$V_{ISO}$	5000	—	—	$V_{rms}$	$RH \leq 50\%$ , $t = 1\text{ minute}$ , $T_A = 25^\circ\text{C}$
Input-Output Resistance <sup>a</sup>	$R_{I-O}$	—	$10^{-14}$	—	$\Omega$	$V_{I-O} = 500\text{ Vdc}$
Input-Output Capacitance <sup>a</sup>	$C_{I-O}$	—	0.6	—	$\text{pF}$	$f = 1\text{ MHz}$ , $T_A = 25^\circ\text{C}$

- The device considered a two terminal device: pins 2 and 3 are shorted together and pins 5, 6, and 8 are shorted together.

Figure 1: Input Current vs. Forward Voltage

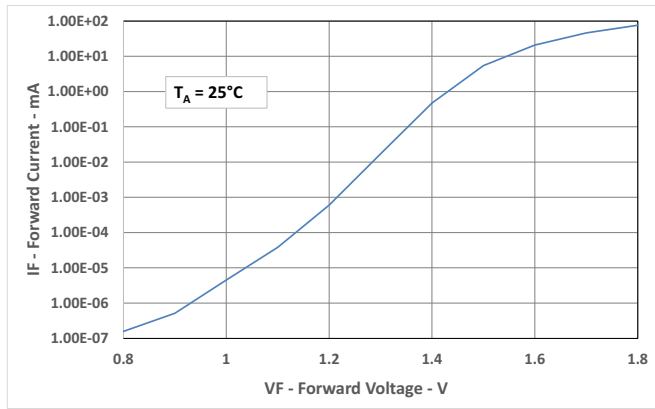


Figure 2: Typical Current Transfer Ratio vs. Temperature, 3.3V

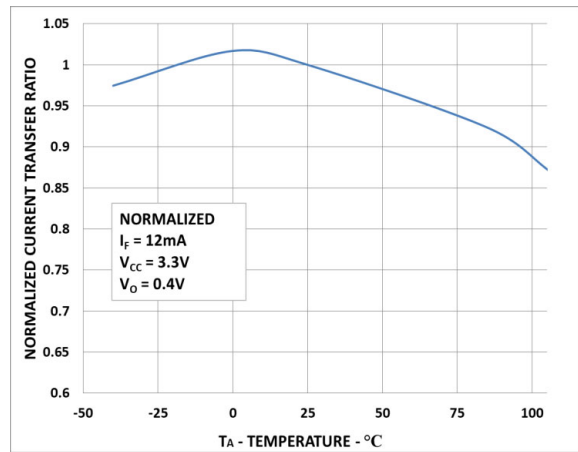


Figure 3: Typical Current Transfer Ratio vs. Temperature, 5.0V

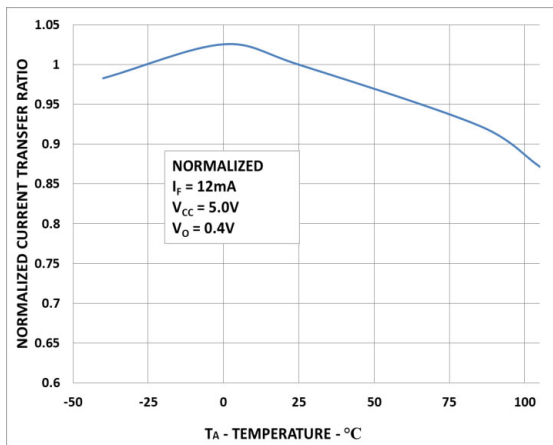


Figure 4: Typical Logic High Output Current vs. Temperature, 3.3V

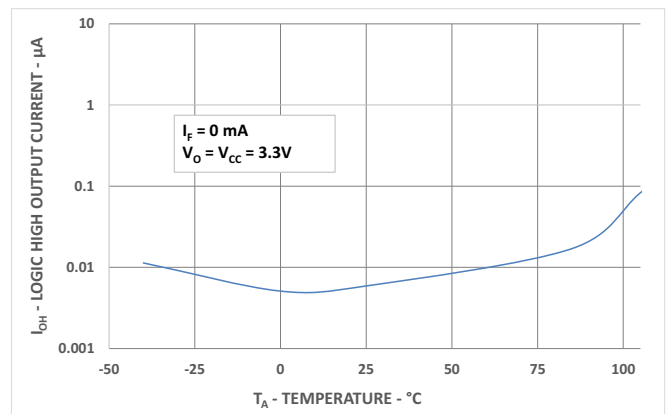


Figure 5: Typical Logic High Output Current vs. Temperature, 5.0V

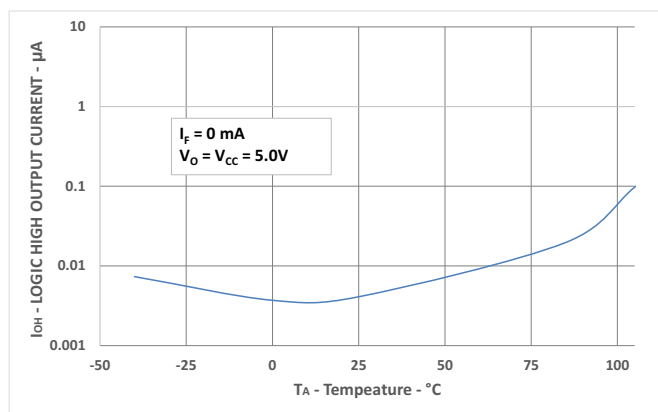


Figure 6: Typical Propagation Delay vs. Temperature, 3.3V

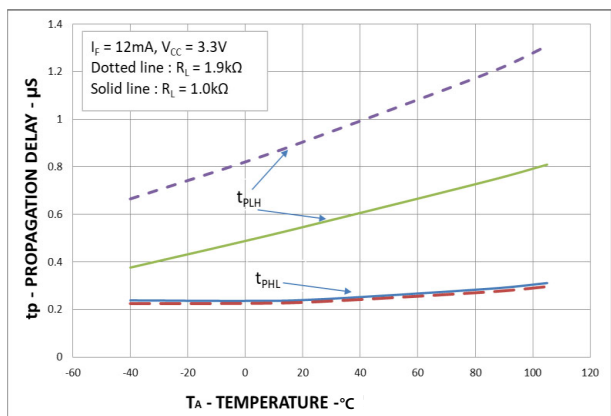




Figure 7: Typical Propagation Delay vs. Temperature, 5.0V

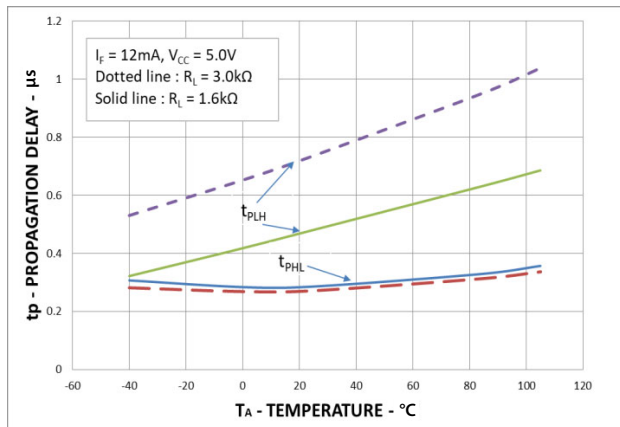


Figure 8: Typical Propagation Delay vs. Temperature, 24V

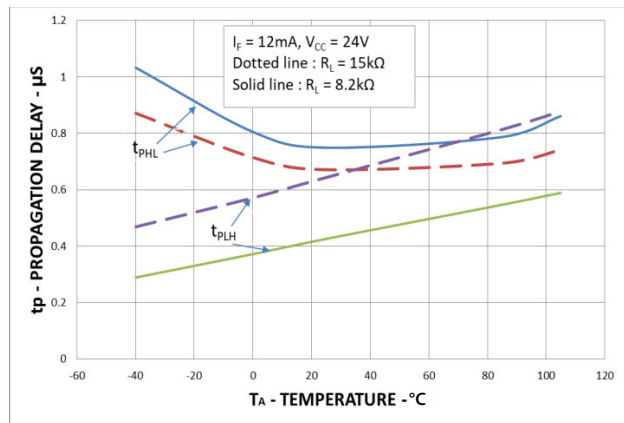


Figure 9: Typical Propagation Delay vs. Load Resistance, 3.3V

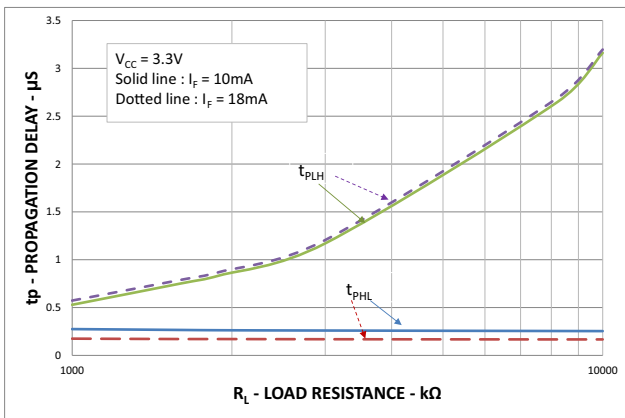


Figure 10: Typical Propagation Delay vs. Load Resistance, 5.0V

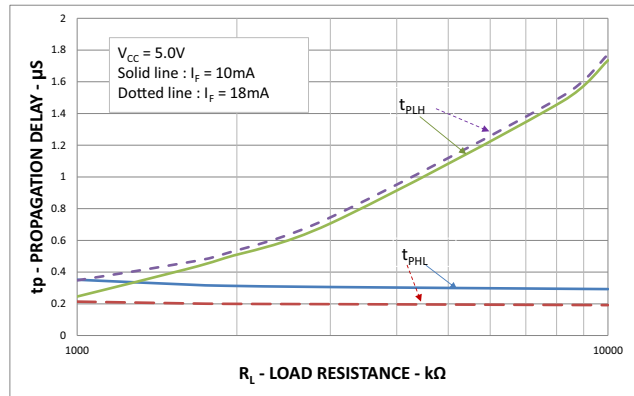


Figure 11: Typical Propagation Delay vs. Supply Voltage

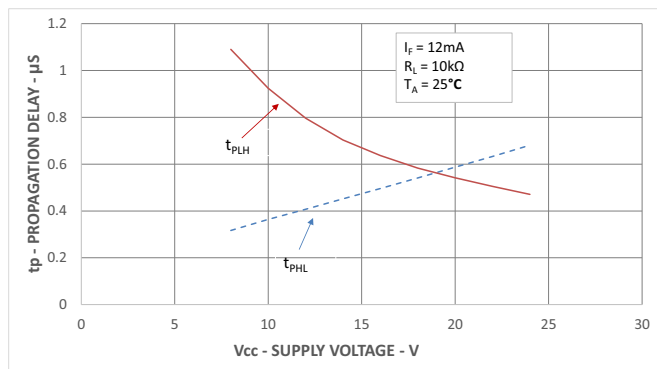


Figure 12: Typical Propagation Delay vs. Input Current

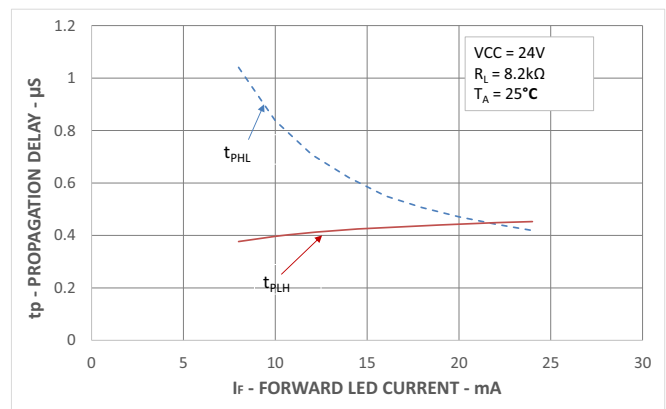


Figure 13: Current Transfer Ratio vs. Input Current

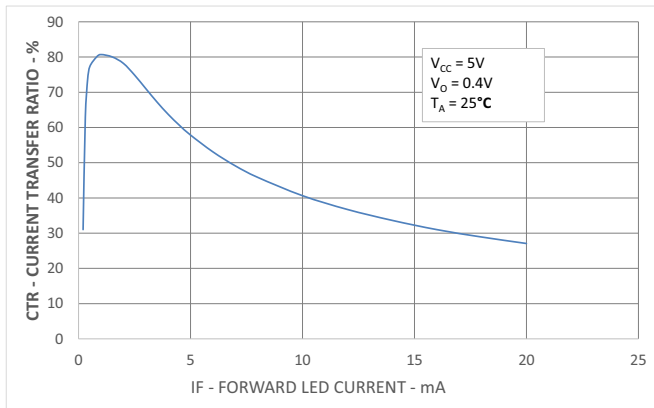


Figure 14: DC Pulse Transfer Characteristic

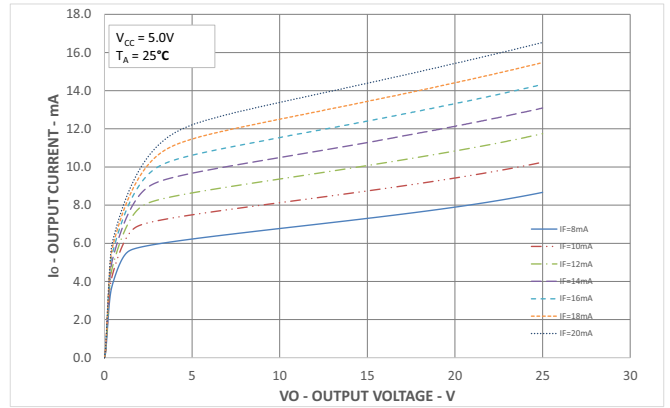


Figure 15: Switching Test Circuits

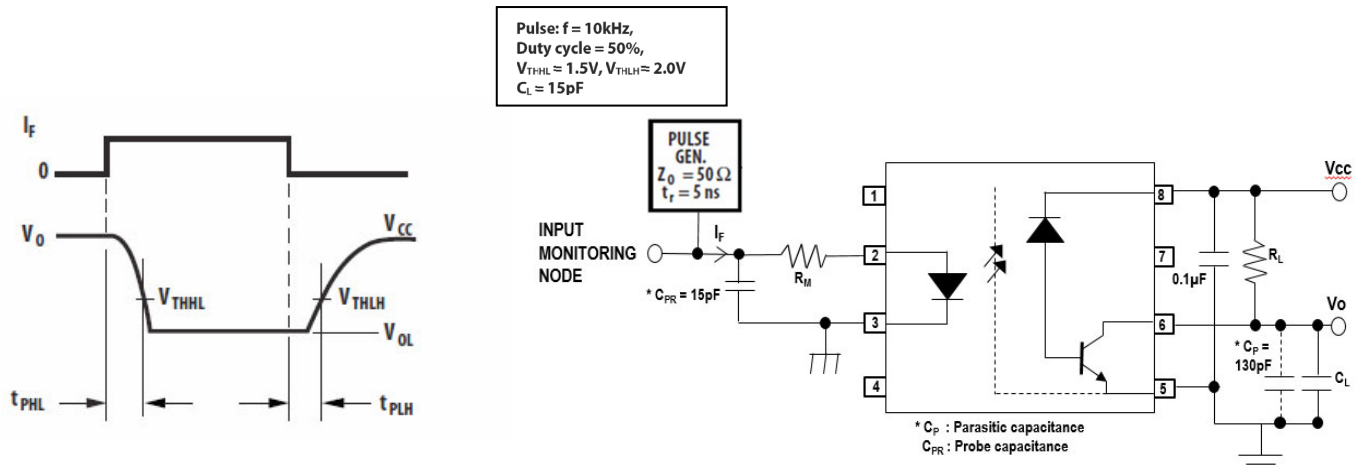
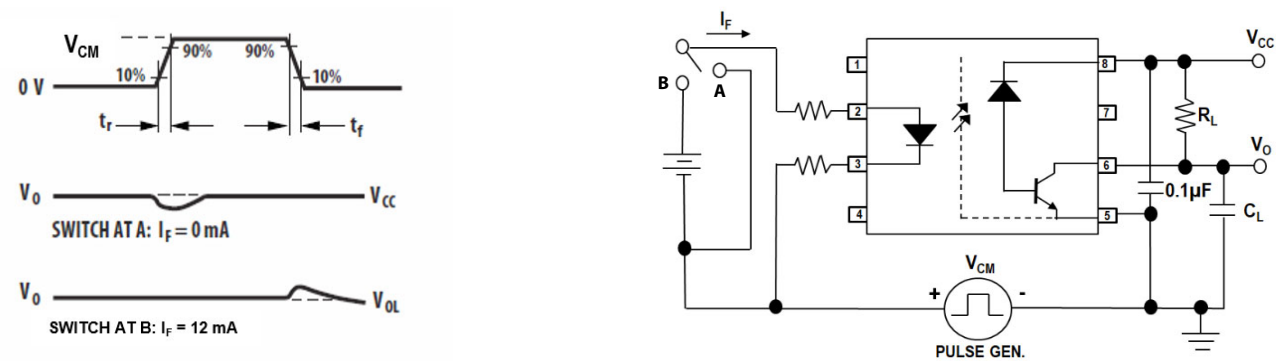


Figure 16: Test Circuit for Transient Immunity and Typical Waveforms



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