

# HCPL-2201, HCPL-2202, HCPL-2211, HCPL-2212, HCPL-2231, HCPL-2232, HCPL-0201, HCPL-0211, HCNW2201, HCNW2211

## Very High CMR, Wide $V_{CC}$ Logic Gate Optocouplers

### Description

The Broadcom<sup>®</sup> HCPL-22XX, HCPL-02XX, and HCNW22XX are optically coupled logic gates. The HCPL22XX and HCPL-02XX contain a GaAsP LED while the HCNW22XX contains an AlGaAs LED. The detectors have totem pole output stages and optical receiver input stages with built-in Schmitt triggers to provide logic-compatible waveforms, eliminating the need for additional waveshaping.

A superior internal shield on the HCPL-2211/12, HCPL-0211, HCPL-2232, and HCNW2211 guarantees common mode transient immunity of 10 kV/ $\mu$ s at a common mode voltage of 1000V.

**CAUTION!** Take normal static precautions in handling and assembly of this component to prevent damage, or 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. The components are not AEC-Q100 qualified and are not recommended for automotive applications.

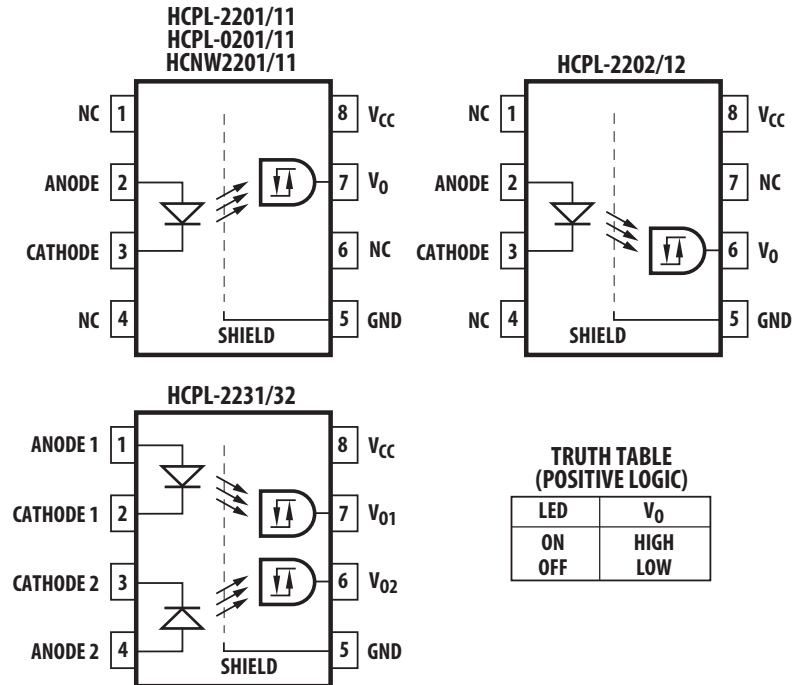
### Features

- 10 kV/ $\mu$ s minimum Common Mode Rejection (CMR) at  $V_{CM} = 1000V$  (HCPL-2211/2212/0211/2232, HCNW2211)
- Wide operating  $V_{CC}$  range: 4.5V to 20V
- 300 ns propagation delay guaranteed over the full temperature range
- 5 Mbd typical signal rate
- Low input current (1.6 mA to 1.8 mA)
- Hysteresis
- Totem pole output (no pull-up resistor required)
- Available in 8-pin DIP, SOIC-8, wide body packages
- Guaranteed performance from  $-40^{\circ}C$  to  $+85^{\circ}C$
- Safety approval
  - UL recognized  $-3750 V_{rms}$  for 1 minute ( $5000 V_{rms}$  for 1 minute for HCNW22XX) per UL1577
  - CSA approved
  - IEC/EN/DIN EN 60747-5-5 approved with  $V_{IORM} = 630 V_{peak}$  (HCPL-2211/2212 Option 060 only) and  $V_{IORM} = 1414 V_{peak}$  (HCNW22XX only)
- MIL-PRF-38534 hermetic version available (HCPL-52XX/62XX)

### Applications

- Isolation of high-speed logic systems
- Computer-peripheral interfaces
- Microprocessor system interfaces
- Ground loop elimination
- Pulse transformer replacement
- High-speed line receiver
- Power control systems

## Functional Diagram



**NOTE:** A 0.1- $\mu$ F bypass capacitor must be connected between pins 5 and 8.

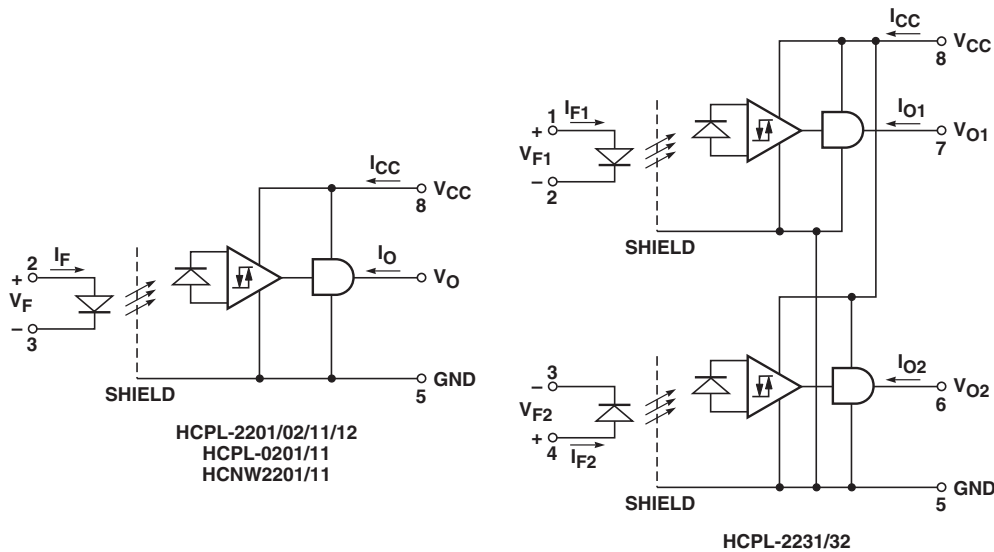
The electrical and switching characteristics of the HCPL-22XX, HCPL-02XX and HCNW22XX are guaranteed from  $-40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$  and a  $V_{CC}$  from 4.5V to 20V. Low  $I_F$  and wide  $V_{CC}$  range allow compatibility with TTL, LSTTL, and CMOS logic and result in lower power consumption compared to other high-speed couplers. Logic signals are transmitted with a typical propagation delay of 150 ns.

## Selection Guide

Minimum CMR Input		On Current (mA)	8-Pin DIP (300 Mil)		Small Outline SO-8	Widebody (400 Mil)	Hermetic
dV/dt (V/ $\mu$ s)	$V_{CM}$ (V)		Single Channel Package	Dual Channel Package	Single Channel Package	Single Channel Package	Single and Dual Channel Packages
1,000	50	1.6	HCPL-2200 <sup>a,b</sup> HCPL-2201 HCPL-2202		HCPL-0201	HCNW2201	
		1.8		HCPL-2231			
2,500	400	1.6	HCPL-2219 <sup>a,b</sup>				
5,000 <sup>c</sup>	300 <sup>c</sup>	1.6	HCPL-2211 HCPL-2212		HCPL-0211	HCNW2211	
		1.8		HCPL-2232			
1,000	50	2.0					HCPL-52XX <sup>b</sup> HCPL-62XX <sup>b</sup>

- a. HCPL-2200/2219 devices include output enable/disable function.
- b. Technical data for the HCPL-2200/2219, HCPL-52XX, and HCPL-62XX are on separate Broadcom publications.
- c. Minimum CMR of 10 kV/ $\mu$ s with  $V_{CM} = 1000V$  can be achieved with input current,  $I_F$ , of 5 mA.

## Schematic



## Ordering Information

HCPL-2201, HCPL-2202, HCPL-2211, HCPL-2212, HCPL-2231, HCPL-2232, HCPL-0201, HCPL-0211 are UL Recognized with 3750 V<sub>rms</sub> for 1 minute per UL1577.

HCNW2201 and HCNW2211 are UL Recognized with 5000 V<sub>rms</sub> for 1 minute per UL1577.

All devices listed above are approved under CSA Component Acceptance Notice #5, File CA 88324.

Part Number	Option		Package	Surface Mount	Gull Wing	Tape & Reel	UL 5000 V <sub>rms</sub> / 1 Minute Rating	IEC/EN/DIN EN 60747-5-5	Quantity
	RoHS Compliant	Non RoHS Compliant							
HCPL-2201	-000E	No option	300 mil DIP-8						50 per tube
HCPL-2202	-300E	#300		X	X				50 per tube
HCPL-2211	-500E	#500		X	X	X			1000 per reel
HCPL-2212	-060E	#060						X	50 per tube
	-360E	#360		X	X			X	50 per tube
	-560E	#560		X	X	X		X	1000 per reel
HCPL-2231	-000E	No option	300 mil DIP-8						50 per tube
HCPL-2232	-300E	#300		X	X				50 per tube
	-500E	#500		X	X	X			1000 per reel
HCPL-0201	-000E	No option	SO-8	X					100 per tube
HCPL-0211	-500E	#500		X		X			1500 per reel
	-060E	#060		X				X	100 per tube
	-560E	#560		X		X		X	1500 per reel
HCNW2201	-000E	No option	400 mil Widebody DIP-8				X	X	42 per tube
HCNW2211	-300E	#300		X	X		X	X	42 per tube
	-500E	#500		X	X	X	X	X	750 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:

HCPL-2202-560E to order product of 300 mil DIP Gull Wing Surface Mount package in Tape and Reel packaging with IEC/EN/DIN EN 60747-5-5 Safety Approval in RoHS compliant.

Example 2:

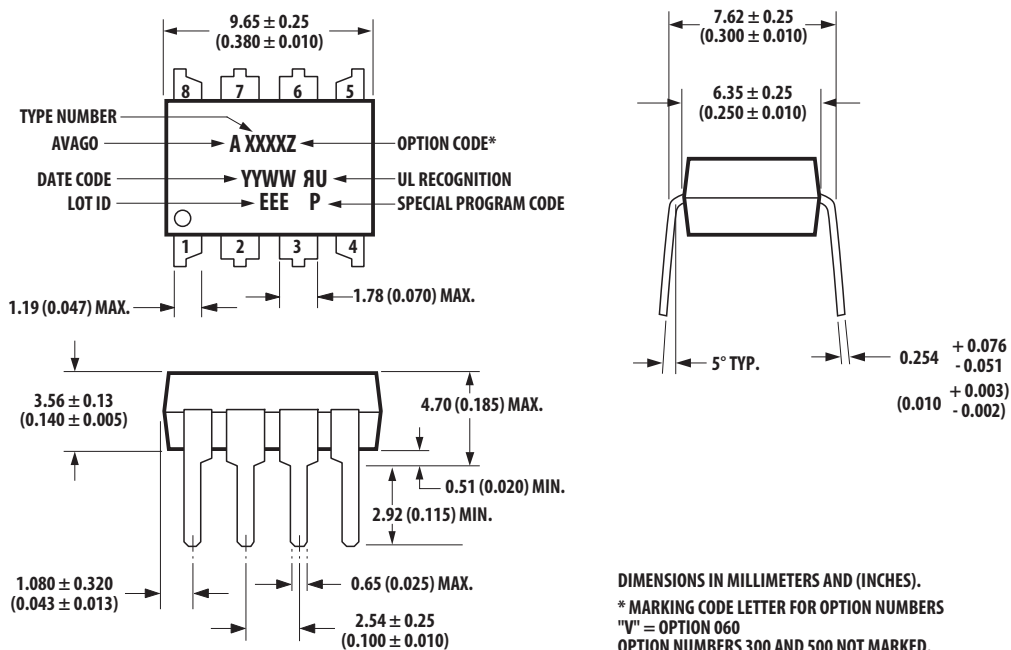
HCPL-2202 to order product of 300 mil DIP package in tube packaging and non-RoHS compliant.

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

**NOTE:** The notation #XXX is used for existing products, while (new) products launched since 15th July 2001 and RoHS compliant option will use -XXXE.

# Package Outline Drawings

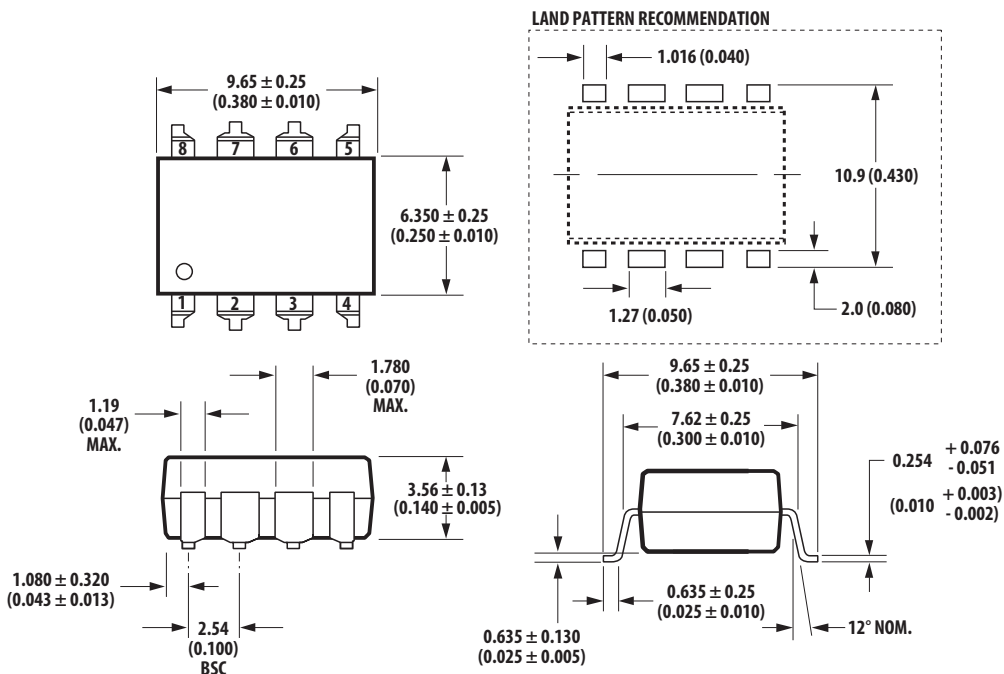
## 8-Pin DIP Package (HCPL-2201/02/11/12/31/32)



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

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

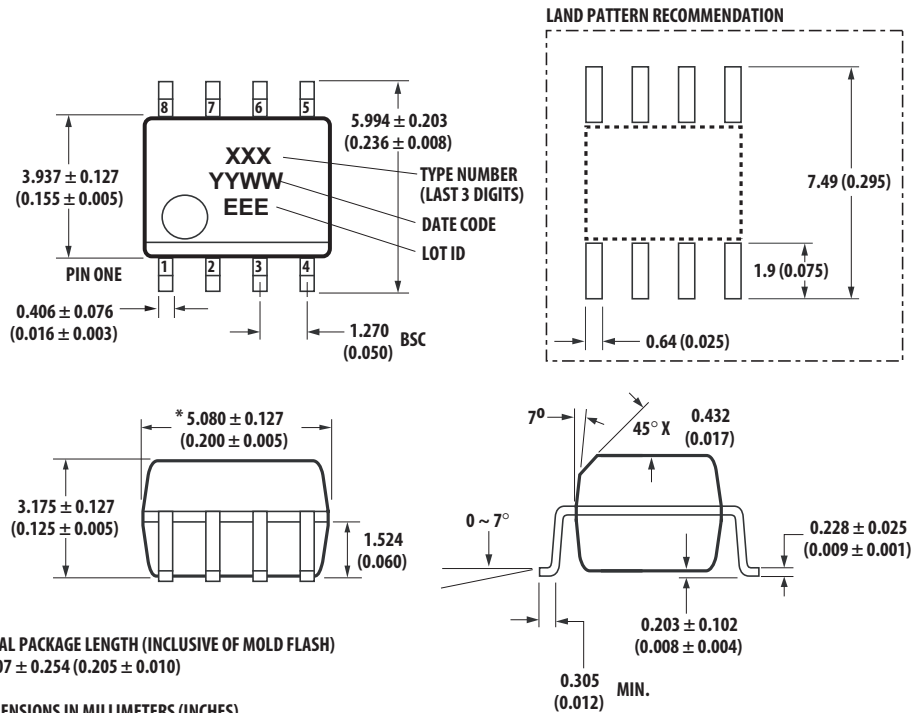
## 8-Pin DIP Package with Gull Wing Surface Mount Option 300 (HCPL-2201/02/11/12/31/32)



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

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

## Small-Outline SO-8 Package (HCPL-0201/11)

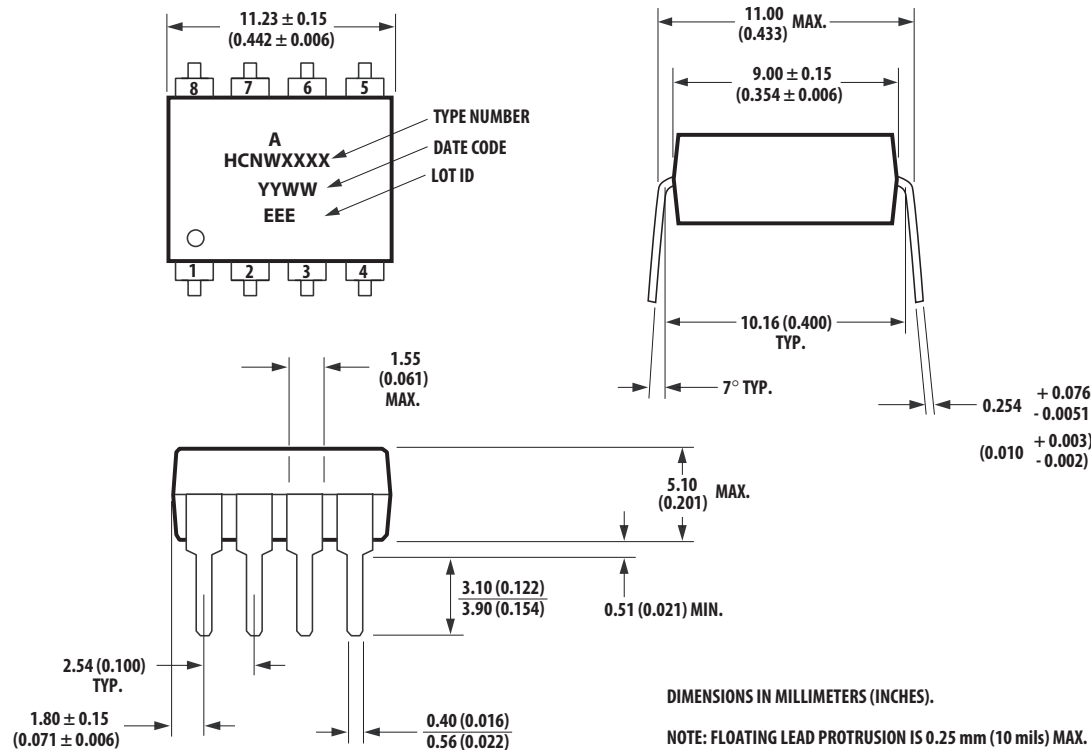


\* TOTAL PACKAGE LENGTH (INCLUSIVE OF MOLD FLASH)  
 5.207 ± 0.254 (0.205 ± 0.010)

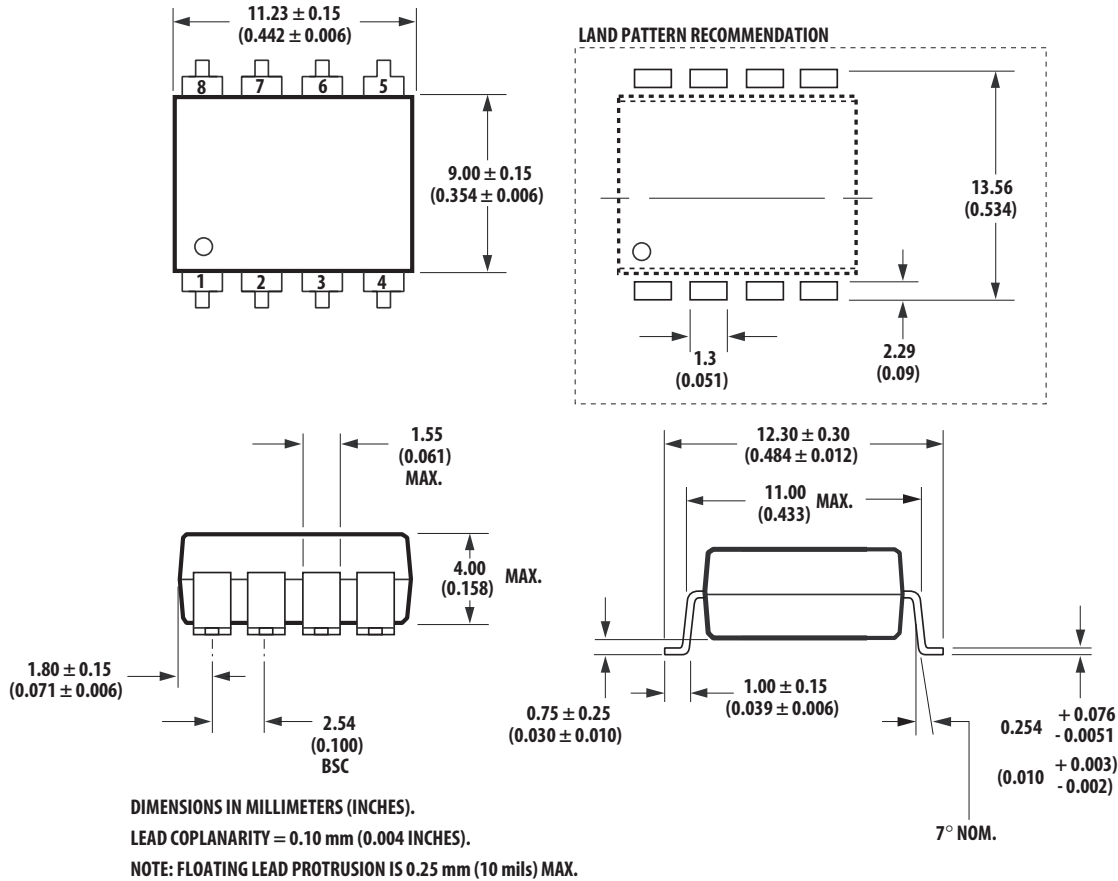
DIMENSIONS IN MILLIMETERS (INCHES).  
 LEAD COPLANARITY = 0.10 mm (0.004 INCHES) MAX.

NOTE: FLOATING LEAD PROTRUSION IS 0.15 mm (6 mils) MAX.

## 8-Pin Widebody DIP Package (HCNW2201/11)



## 8-Pin Widebody DIP Package with Gull Wing Surface Mount Option 300 (HCNW2201/11)



## Solder Reflow Profile

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

## Regulatory Information

The HCPL-22XX/02XX and HCNW22XX have been approved by the following organizations:

- UL** Recognized under UL 1577, Component Recognition Program, File E55361.
- CSA** Approved under CSA Component Acceptance Notice #5, File CA 88324.
- IEC/EN/DIN EN 60747-5-5** (Option 060 and HCNW only.)

## Insulation and Safety Related Specifications

Parameter	Symbol	8-Pin DIP (300 Mil) Value	SO-8 Value	Widebody (400 Mil) Value	Unit	Conditions
Minimum External Air Gap (External Clearance)	L(101)	7.1	4.9	9.6	mm	Measured from input terminals to output terminals, shortest distance through air.
Minimum External Tracking (External Creepage)	L(102)	7.4	4.8	10.0	mm	Measured from input terminals to output terminals, shortest distance path along body.
Minimum Internal Plastic Gap (Internal Clearance)		0.08	0.08	1.0	mm	Through insulation distance, conductor to conductor, usually the direct distance between the photoemitter and photodetector inside the optocoupler cavity.
Minimum Internal Tracking (Internal Creepage)		NA	NA	4.0	mm	Measured from input terminals to output terminals, along internal cavity.
Tracking Resistance (Comparative Tracking Index)	CTI	200	200	200	V	DIN IEC 112/VDE 0303 Part 1.
Isolation Group		IIIa	IIIa	IIIa		Material Group (DIN VDE 0110, 1/89, Table 1).

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



## IEC/EN/DIN EN 60747-5-5 Insulation Characteristics (Option 060)

Description	Symbol	Characteristic		Unit
		HCPL-2201/02/11/12/31/32	HCPL-0201/11	
Installation Classification per DIN VDE 0110, Table 1 For Rated Mains Voltage $\leq 150 V_{rms}$ For Rated Mains Voltage $\leq 300 V_{rms}$ For Rated Mains Voltage $\leq 600 V_{rms}$		I – IV I – IV I – IV	I – IV I – IV I – III	
Climatic Classification		0/70/21	0/70/21	
Pollution Degree (DIN VDE 0110/39)		2	2	
Maximum Working Insulation Voltage	$V_{IORM}$	630	567	$V_{peak}$
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 $< 5 pC$	$V_{PR}$	1181	1063	$V_{peak}$
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 $< 5 pC$	$V_{PR}$	1008	907	$V_{peak}$
Highest Allowable Overvoltage (Transient Overvoltage $t_{ini} = 60s$ )	$V_{IOTM}$	8000	6000	$V_{peak}$
Safety-Limiting Values (Maximum values allowed in the event of a failure, also see <a href="#">Figure 12.</a> )				
Case Temperature	$T_S$	175	150	$^{\circ}C$
Input Current	$I_S, INPUT$	230	230	mA
Output Power	$P_S, OUTPUT$	600	600	mW
Insulation Resistance at $T_S, V_{IO} = 500V$	$R_S$	$\geq 10^9$	$\geq 10^9$	$\Omega$

a. Refer to the front of the optocoupler section of the current catalog, under Product Safety Regulations section IEC/EN/DIN EN 60747-5-5, for a detailed description.

**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.

## IEC/EN/DIN EN 60747-5-5 Insulation Characteristics (HCNW22xx Option 060 ONLY)

Description	Symbol	Characteristic	Unit
Installation Classification per DIN VDE 0110, Table 1 For Rated Mains Voltage $\leq 150 V_{rms}$ For Rated Mains Voltage $\leq 300 V_{rms}$ For Rated Mains Voltage $\leq 600 V_{rms}$ For Rated Mains Voltage $\leq 1000 V_{rms}$		I – IV I – IV I – IV I – III	
Climatic Classification		–40/85/21	
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 $t_m = 1$ sec, Partial Discharge < 5 pC	$V_{PR}$	2651	$V_{peak}$
Input to Output Test Voltage, Method a <sup>a</sup> $V_{IORM} \times 1.6 = V_{PR}$ , Type and Sample Test, $t_m = 1$ 0 sec, Partial Discharge < 5 pC	$V_{PR}$	2262	$V_{peak}$
Highest Allowable Overvoltage <sup>a</sup> (Transient Overvoltage $t_{ini} = 60$ sec)	$V_{IOTM}$	8000	$V_{peak}$
Safety-Limiting Values (Maximum values allowed in the event of a failure, also see <a href="#">Figure 12.</a> ) Case Temperature Input Current Output Power	$T_S$ $I_{S, INPUT}$ $P_{S, OUTPUT}$	150 400 700	$^{\circ}C$ mA mW
Insulation Resistance at $T_S$ , $V_{IO} = 500V$	$R_S$	$\geq 10^9$	$\Omega$

a. Refer to the front of the optocoupler section of the current catalog, under Product Safety Regulations section IEC/EN/DIN EN 60747-5-5, for a detailed description.

**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.	Unit	Note
Storage Temperature	$T_S$	-55	125	°C	
Operating Temperature	$T_A$	-40	85	°C	
Average Forward Input Current	$I_{F(AVG)}$	—	10	mA	a
Peak Transient Input Current ( $\leq 1 \mu s$ Pulse Width, 300 pps) ( $\leq 200 \mu s$ Pulse Width, <1% Duty Cycle)	HCNW22XX	—	1.0	A	a
			40	mA	
Reverse Input Voltage	HCNW22XX	—	5	V	a
			3		
Average Output Current	$I_O$	—	25	mA	a
Supply Voltage	$V_{CC}$	0	20	V	
Output Voltage	$V_O$	-0.5	20	V	a
Total Package Power Dissipation	HCPL-223X	—	210	mW	b
			294		
Output Power Dissipation	$P_O$	See <a href="#">Figure 7</a> .			a
Lead Solder Temperature (Through Hole Parts Only)	HCNW22XX	260°C for 10s, 1.6 mm below seating plane			
		260°C for 10s, up to seating plane			
Solder Reflow Temperature Profile (Surface Mount Parts Only)		See <a href="#">Package Outline Drawings</a> .			

a. Each channel.

b. Derate total package power dissipation,  $P_T$ , linearly above 70°C free-air temperature at a rate of 4.5 mW/°C.

## Recommended Operating Conditions

Parameter	Symbol	Min.	Max.	Unit
Power Supply Voltage	$V_{CC}$	4.5	20	V
Forward Input Current (ON)	HCPL-223X	1.6 <sup>a</sup>	5	mA
		1.8 <sup>b</sup>	—	
Forward Input Voltage (OFF)	$V_{F(OFF)}$	—	0.8	V
Operating Temperature	$T_A$	-40	85	°C
Junction Temperature	$T_J$	-40	125	°C
Fan Out	N	—	4	TTL Loads

a. The initial switching threshold is 1.6 mA or less. It is recommended that 2.2 mA be used to permit at least a 20% LED degradation guardband.

b. The initial switching threshold is 1.8 mA or less. It is recommended that 2.5 mA be used to permit at least a 20% LED degradation guardband.

## Electrical Specifications

$-40^{\circ}\text{C} \leq T_A \leq 85^{\circ}\text{C}$ ,  $4.5\text{V} \leq V_{CC} \leq 20\text{V}$ ,  $1.6\text{ mA} \leq I_{F(\text{ON})}^1 \leq 5\text{ mA}$ ,  $0\text{V} \leq V_{F(\text{OFF})} \leq 0.8\text{V}$ , unless otherwise specified.  
 All Typical at  $T_A = 25^{\circ}\text{C}$ .

Parameter	Sym.	Min.	Typ.	Max.	Unit	Test Conditions	Note	Fig
Logic Low Output Voltage	$V_{OL}$	—	—	0.5	V	$I_{OL} = 6.4\text{ mA}$ (4 TTL Loads)	a, b	1
Logic High Output Voltage ( $V_{OUT} < V_{CC}$ )	$V_{OH}$	2.4	c	—	V	$I_{OH} = -2.6\text{ mA}$	d, b	1
		2.7	—	—		$I_{OH} = -0.4\text{ mA}$		
Output Leakage Current	$I_{OHH}$	—	—	100	$\mu\text{A}$	$V_O = 5.5\text{V}$ ; $I_F = 5\text{ mA}$		1
		—	—	500		$V_O = 20\text{V}$ ; $I_F = 5\text{ mA}$		
Logic Low Supply Current	$I_{CCL}$	—	3.7	6.0	mA	$V_{CC} = 5.5\text{V}$ ; $V_F = 0\text{V}$ , $I_O = \text{Open}$		
		—	4.3	7.0		$V_{CC} = 20\text{V}$ ; $V_F = 0\text{V}$ , $I_O = \text{Open}$		
		—	7.4	12.0		$V_{CC} = 5.5\text{V}$ ; $V_F = 0\text{V}$ , $I_O = \text{Open}$		
		—	8.6	14.0		$V_{CC} = 20\text{V}$ ; $V_F = 0\text{V}$ , $I_O = \text{Open}$		
Logic High Supply Current	$I_{CCH}$	—	2.4	4.0	mA	$V_{CC} = 5.5\text{V}$ ; $I_F = 5\text{ mA}$ , $I_O = \text{Open}$		
		—	2.7	5.0		$V_{CC} = 20\text{V}$ ; $I_F = 5\text{ mA}$ , $I_O = \text{Open}$		
		—	4.8	8.0		$V_{CC} = 5.5\text{V}$ ; $I_F = 5\text{ mA}$ , $I_O = \text{Open}$		
		—	5.4	10.0		$V_{CC} = 20\text{V}$ ; $I_F = 5\text{ mA}$ , $I_O = \text{Open}$		
Logic Low Short Circuit Output Current	$I_{OSL}$	15	—	—	mA	$V_O = V_{CC} = 5.5\text{V}$ ; $V_F = 0\text{V}$		1, 3
		20	—	—		$V_O = V_{CC} = 20\text{V}$ ; $V_F = 0\text{V}$		
Logic High Short Circuit Output Current	$I_{OSH}$	—	—	-10	mA	$V_{CC} = 5.5\text{V}$ ; $V_O = \text{GND}$ ; $I_F = 5\text{ mA}$		1, 3
		—	—	-20		$V_{CC} = 20\text{V}$ ; $V_O = \text{GND}$ ; $I_F = 5\text{ mA}$		
Input Forward Voltage	$V_F$	—	1.5	1.7	V	$T_A = 25^{\circ}\text{C}$ ; $I_F = 5\text{ mA}$	e	1
		—	—	1.85		$I_F = 5\text{ mA}$		
		—	1.5	1.82		$T_A = 25^{\circ}\text{C}$ ; $I_F = 5\text{ mA}$		
		—	—	1.95		$I_F = 5\text{ mA}$		
Input Reverse Breakdown Voltage	$BV_R$	5	—	—	V	$I_R = 10\text{ }\mu\text{A}$		1
		3	—	—		$I_R = 100\text{ }\mu\text{A}$		
Input Diode Temperature Coefficient	$\Delta V_F/\Delta T_A$	—	-1.7	—	mV/ $^{\circ}\text{C}$	$I_F = 5\text{ mA}$		
		—	-1.4	—		$I_F = 5\text{ mA}$		
Input Capacitance	$C_{IN}$	—	60	—	pF	$f = 1\text{ MHz}$ , $V_F = 0\text{V}$	a, e	
		—	70	—		$f = 1\text{ MHz}$ , $V_F = 0\text{V}$		

- Each channel.
- Duration of output short circuit time should not exceed 10 ms.
- Typical  $V_{OH} = V_{CC} - 2.1\text{V}$ .
- Derate total package power dissipation,  $P_T$ , linearly above  $70^{\circ}\text{C}$  free-air temperature at a rate of  $4.5\text{ mW}/^{\circ}\text{C}$ .
- For single devices, input capacitance is measured between pin 2 and pin 3.

1. For HCPL-223X,  $1.8\text{ mA} \leq I_{F(\text{ON})} \leq 5\text{ mA}$ .

## Switching Specifications (AC)

$-40^{\circ}\text{C} \leq T_A \leq 85^{\circ}\text{C}$ ,  $4.5\text{V} \leq V_{CC} \leq 20\text{V}$ ,  $1.6\text{ mA} \leq I_{F(\text{ON})} \leq 5\text{ mA}$ ,  $0\text{V} \leq V_{F(\text{OFF})} \leq 0.8\text{V}$ , unless otherwise specified.  
 All Typical at  $T_A = 25^{\circ}\text{C}$ ,  $V_{CC} = 5\text{V}$ ,  $I_{F(\text{ON})} = 3\text{ mA}$ .

Parameter	Sym.	Min.	Typ.	Max.	Unit	Test Conditions	Fig.	Note
Propagation Delay Time to Logic Low Output Level	$t_{\text{PHL}}$	—	150	—	ns	Without Peaking Capacitor	5, 6	a, b
		—	160	—		HCNW22XX		
		—	150	300		With Peaking Capacitor		
Propagation Delay Time to Logic High Output Level	$t_{\text{PLH}}$	—	110	—	ns	Without Peaking Capacitor	5, 6	a, b
		—	180	—		HCNW22XX		
		—	90	300		With Peaking Capacitor		
Output Rise Time (10% to 90%)	$t_r$	—	30	—	ns		5, 9	a
Output Fall Time (90% to 10%)	$t_f$	—	7	—	ns		5, 9	a

a. Each channel.

b. The  $t_{\text{PLH}}$  propagation delay is measured from the 50% point on the leading edge of the input pulse to the 1.3V point on the leading edge of the output pulse. The  $t_{\text{PHL}}$  propagation delay is measured from the 50% point on the trailing edge of the input pulse to the 1.3V point on the trailing edge of the output pulse.

Parameter	Sym.	Device	Min.	Unit	Test Conditions		Fig.	Note	
Logic High Common Mode Transient Immunity	$ CM_H $	HCPL-2201/02 HCPL-0201 HCPL-2231 HCNW2201	1,000	V/ $\mu\text{s}$	$ V_{\text{CM}}  = 50\text{V}$ , $I_F = 1.6\text{ mA}^a$ ,	$V_{CC} = 5\text{V}$ $T_A = 25^{\circ}\text{C}$	10	b, c	
		HCPL-2211/12 HCPL-0211	5,000	V/ $\mu\text{s}$					$ V_{\text{CM}}  = 300\text{V}$ , $I_F = 1.6\text{ mA}^d$
		HCPL-2232 HCNW2211	10,000	V/ $\mu\text{s}$					$ V_{\text{CM}}  = 1\text{ kV}$ , $I_F = 5.0\text{ mA}$
Logic Low Common Mode Transient Immunity	$ CM_L $	HCPL-2201/02 HCPL-0201 HCPL-2231 HCNW2201	1,000	V/ $\mu\text{s}$	$ V_{\text{CM}}  = 50\text{V}$	$V_F = 0\text{V}$ $V_{CC} = 5\text{V}$ $T_A = 25^{\circ}\text{C}$	10	b, c	
		HCPL-2211/12 HCPL-0211 HCPL-2232 HCNW2211	10,000	V/ $\mu\text{s}$					$ V_{\text{CM}}  = 1\text{ kV}$

a.  $I_F = 1.8\text{ mA}$  for HCPL-2231.

b. Each channel.

c.  $CM_H$  is the maximum slew rate of the common mode voltage that can be sustained with the output voltage in the logic high state,  $V_O > 2.0\text{V}$ .  
 $CM_L$  is the maximum slew rate of the common mode voltage that can be sustained with the output voltage in the logic low state,  $V_O < 0.8\text{V}$ .

d.  $I_F = 1.8\text{ mA}$  for HCPL-2232.

2. For HCPL-223X,  $1.8\text{ mA} \leq I_{F(\text{ON})} \leq 5\text{ mA}$ .

## Package Characteristics

Parameter	Sym.	Min.	Typ.	Max.	Unit	Test Conditions	Fig.	Note
Input-Output Momentary Withstand Voltage <sup>a</sup>		$V_{ISO}$	3750	—	—	$V_{rms}$	RH < 50%, t = 1 min.	b, c
	HCNW22XX		5000	—	—		$T_A = 25^\circ C$	b, d
Input-Output Resistance		$R_{I-O}$	—	$10^{12}$	—	$\Omega$	$V_{I-O} = 500$ Vdc	b
	HCNW22XX		$10^{12}$	$10^{13}$	—		$T_A = 25^\circ C$	
			$10^{11}$	—	—		$T_A = 100^\circ C$	
Input-Output Capacitance		$C_{I-O}$	—	0.6		pF	f = 1 MHz	b
	HCNW22XX		—	0.5	0.6		$T_A = 25^\circ C, V_{I-O} = 0$ Vdc	
Input-Input Insulation Leakage Current		$I_{I-I}$	—	0.005	—	$\mu A$	Relative Humidity = 45%, t = 5s, $V_{I-I} = 500$ V	e
Resistance (Input-Input)		$R_{I-I}$	—	$10^{11}$	—	$\Omega$	$V_{I-I} = 500$ V	e
Capacitance (Input-Input)		$C_{I-I}$	—	0.25	—	pF	f = 1 MHz	e

- The Input-Output Momentary Withstand Voltage is a dielectric voltage rating that should not be interpreted as an input-output continuous voltage rating. For the continuous voltage rating, refer to the IEC/EN/DIN EN 60747-5-5 Insulation Characteristics Table (if applicable), your equipment level safety specification, or the Broadcom Application Note *Optocoupler Input-Output Endurance Voltage*, publication number 5963-2203.
- Device considered a two-terminal device: pins 1, 2, 3, and 4 shorted together and pins 5, 6, 7, and 8 shorted together.
- In accordance with UL 1577, each optocoupler is proof tested by applying an insulation test voltage  $\geq 4500 V_{rms}$  for one second (leakage detection current limit,  $I_{I-O} \leq 5 \mu A$ ). 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 Table, if applicable.
- In accordance with UL 1577, each optocoupler is proof tested by applying an insulation test voltage  $\geq 6000 V_{rms}$  for one second (leakage detection current limit,  $I_{I-O} \leq 5 \mu A$ ). 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 Table.
- For HCPL-2231/32 only. Measured between pins 1 and 2, shorted together, and pins 3 and 4, shorted together.

Figure 1: Typical Logic Low Output Voltage Vs. Temperature

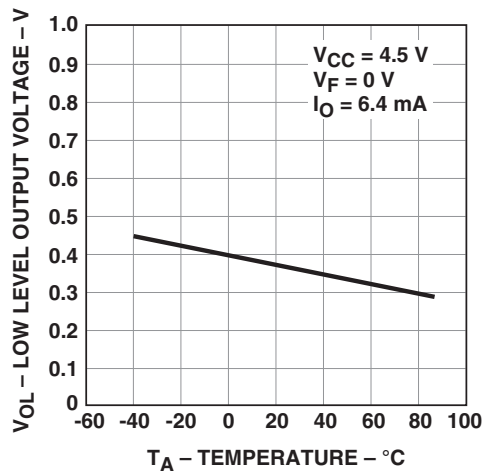


Figure 2: Typical Logic High Output Current vs. Temperature

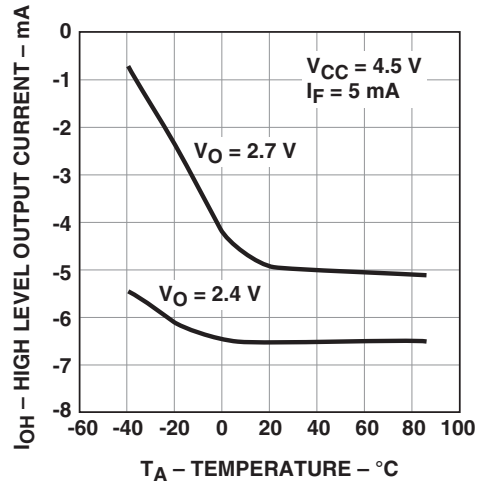


Figure 3: Typical Output Voltage vs. Forward Input Current

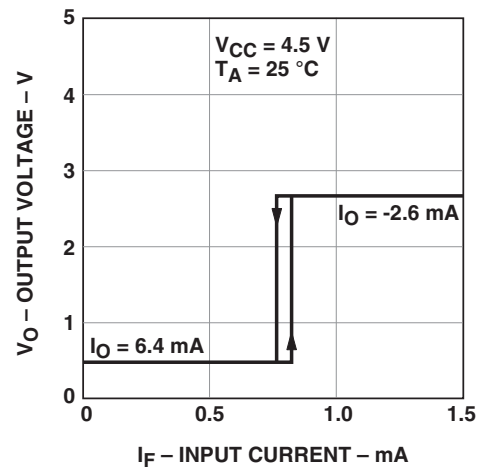


Figure 4: Typical Input Diode Forward Characteristic

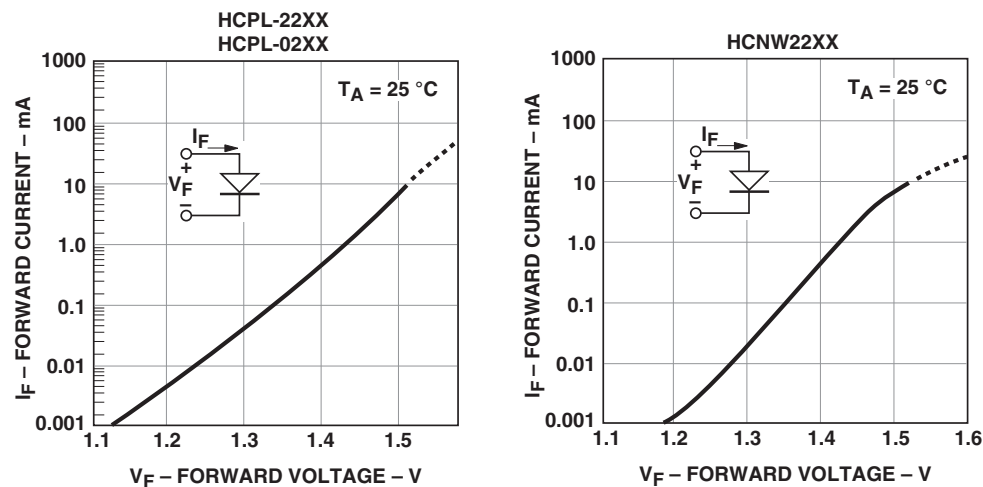
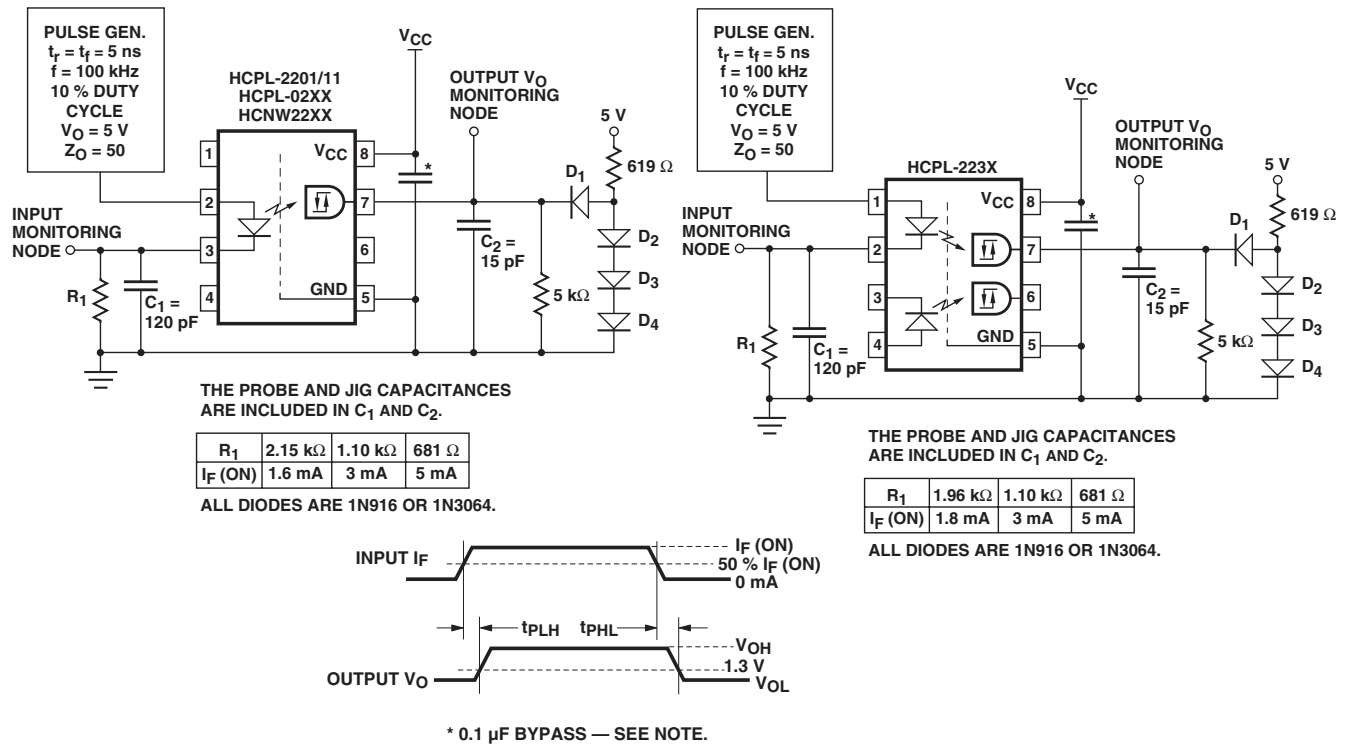


Figure 5: Circuit for  $t_{PLH}$ ,  $t_{PHL}$ ,  $t_r$ ,  $t_f$



NOTE: A 0.1  $\mu$ F bypass capacitor must be connected between pins 5 and 8.

Figure 6: Typical Propagation Delays vs. Temperature

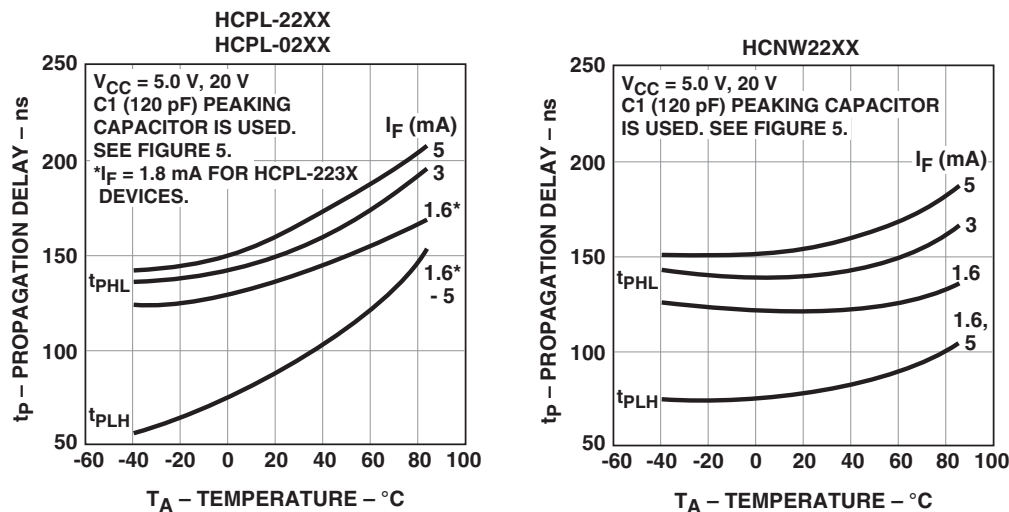




Figure 7: Maximum Output Power per Channel vs. Supply Voltage

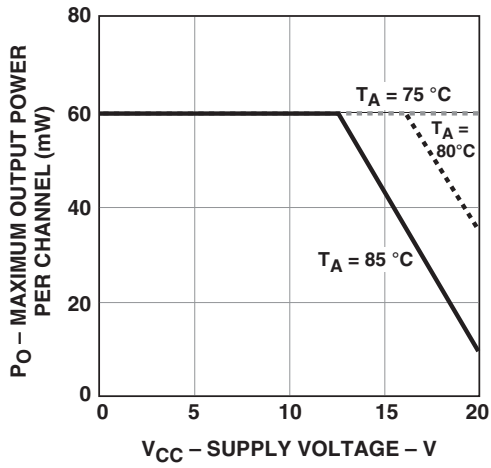


Figure 8: Typical Logic High Output Voltage vs. Supply Voltage

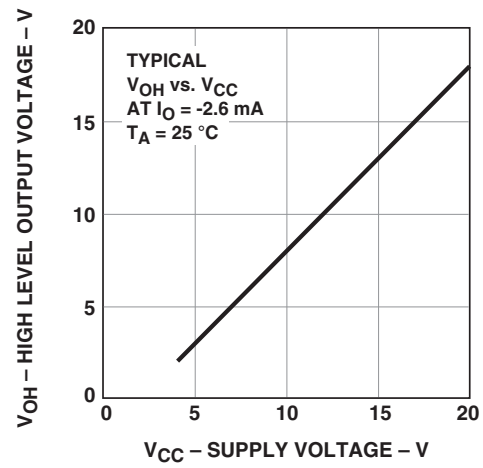


Figure 9: Typical Rise, Fall Time vs. Temperature

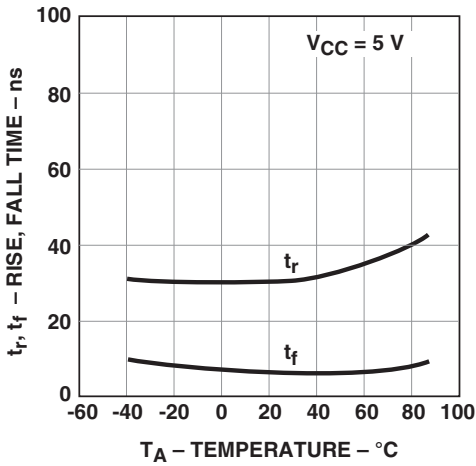
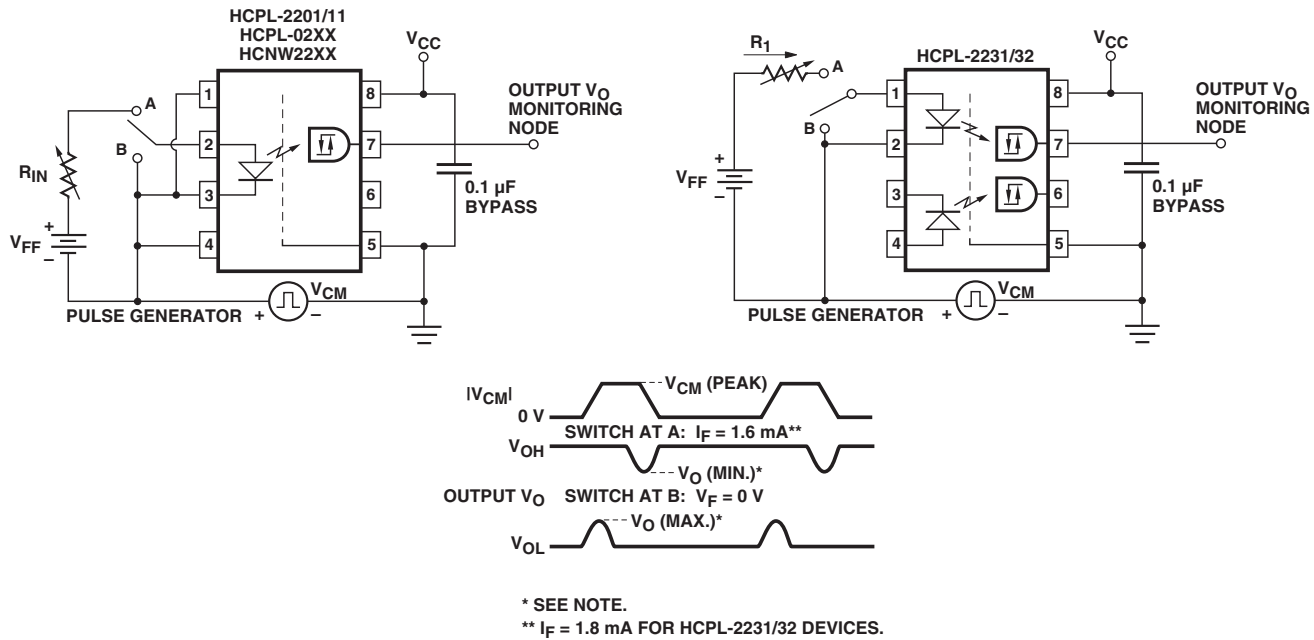


Figure 10: Test Circuit for Common Mode Transient Immunity and Typical Waveforms



**NOTE:**  $CM_H$  is the maximum slew rate of the common mode voltage that can be sustained with the output voltage in the logic high state,  $V_O > 2.0V$ .

$CM_L$  is the maximum slew rate of the common mode voltage that can be sustained with the output voltage in the logic low state,  $V_O < 0.8V$ .

Use of a 0.1- $\mu F$  bypass capacitor connected between pins 5 and 8 is recommended.

Figure 11: Typical Input Threshold Current vs. Temperature

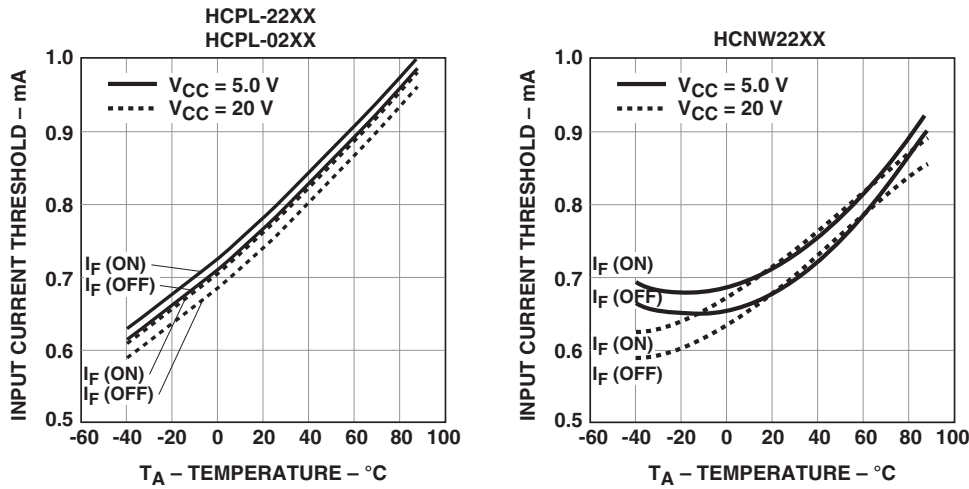


Figure 12: Thermal Derating Curve, Dependence of Safety Limiting Value with Case Temperature per IEC/EN/DIN EN 60747-5-5

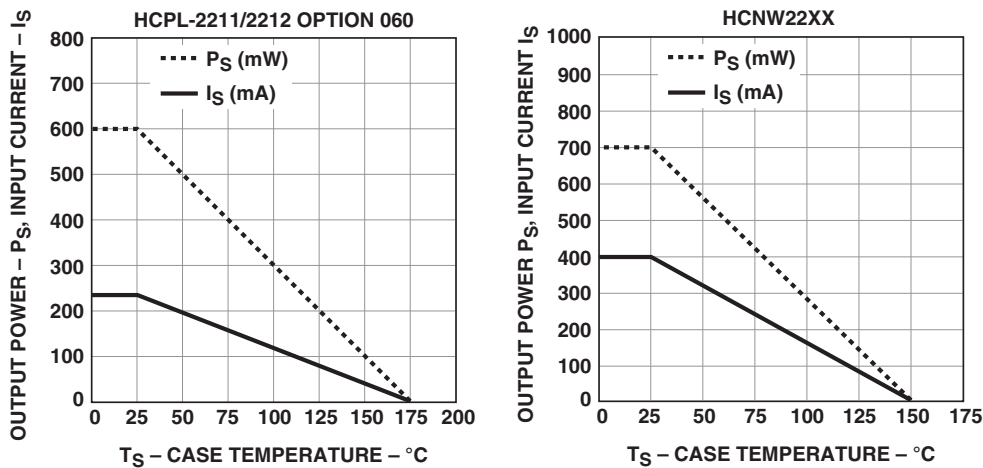


Figure 13: Recommended LSTTL to LSTTL Circuit where 500 ns Propagation Delay Is Sufficient

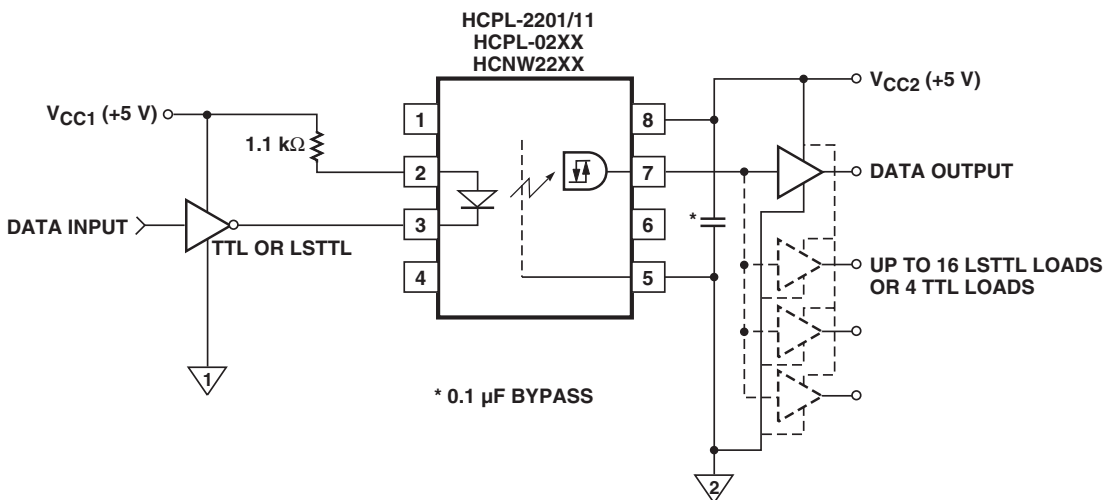


Figure 14: Recommended LSTTL to LSTTL Circuit for Applications Requiring a Maximum Allowable Propagation Delay of 300 ns

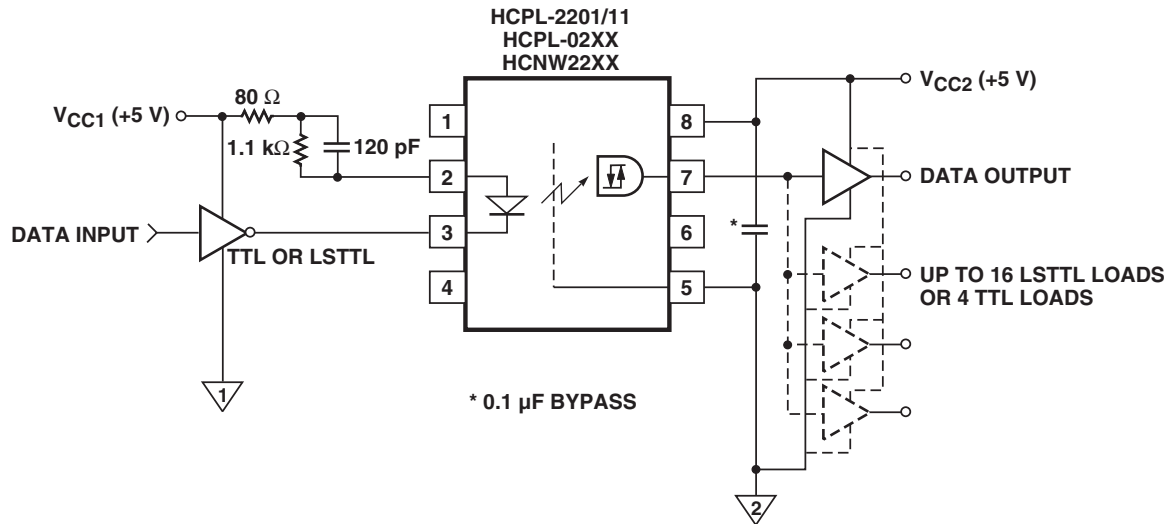


Figure 15: LSTTL to CMOS Interface Circuit

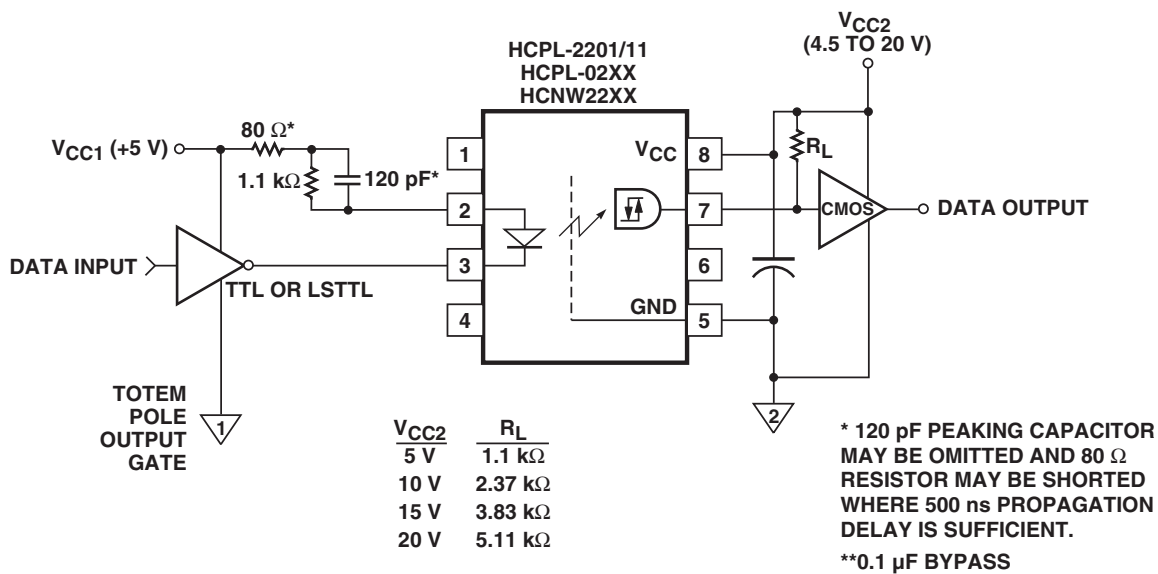


Figure 16: Alternative LED Drive Circuit

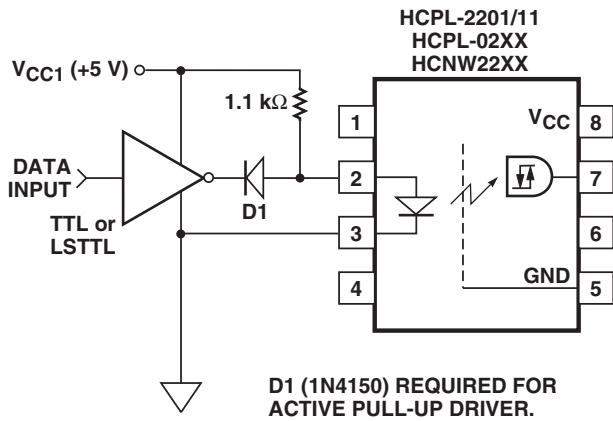
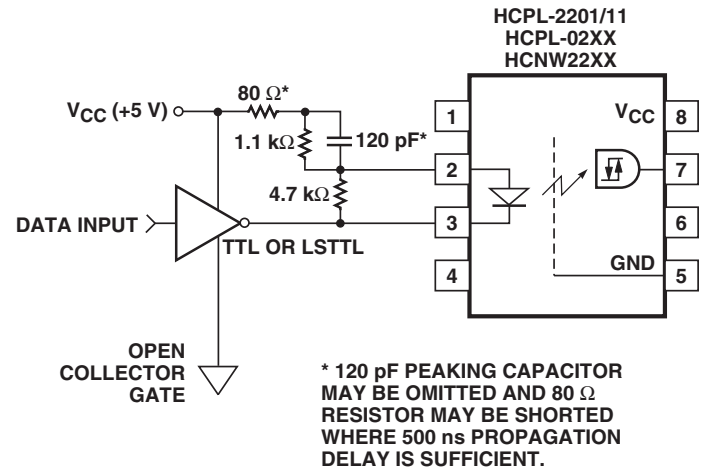


Figure 17: Series LED Drive with Open Collector Gate (4.7 k Resistor Shunts  $I_{OH}$  from the LED)



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