HCPL0600, HCPL0601, HCPL0611, HCPL0637, HCPL0638, HCPL0639

High Speed-10 MBit/s Logic Gate Optocouplers

Single Channel: HCPL0600, HCPL0601, HCPL0611
Dual Channel: HCPL0637, HCPL0638, HCPL0639

Description

The HCPL06XX optocouplers consist of an AlGaAS LED, optically coupled to a very high speed integrated photo−detector logic gate with a strobable output (single channel devices). The devices are housed in a compact small−outline package. This output features an open collector, thereby permitting wired OR outputs. The HCPL0600, HCPL0601 and HCPL0611 output consists of bipolar transistors on a bipolar process while the HCPL0637, HCPL0638, and HCPL0639 output consists of bipolar transistors on a CMOS process for reduced power consumption. The coupled parameters are guaranteed over the temperature range of −40°C to +85°C. An internal noise shield provides superior common mode rejection.

Features

- Compact SO8 Package
- Very High Speed−10 MBit/s
- Superior CMR
- Logic Gate Output
- Strobable Output (Single Channel Devices)
- Wired OR−open Collector

Safety and Regulatory Approvals

- UL1577, 3750 VAC_{RMS} for 1 min
- DIN EN/IEC60747−5−5, 565 V Peak Working Insulation Voltage

Typical Applications

- Ground Loop Elimination
- LSTTL to TTL, LSTTL or 5−volt CMOS
- Line Receiver, Data Transmission
- Data Multiplexing
- Switching Power Supplies
- Pulse Transformer Replacement
- Computer−peripheral Interface

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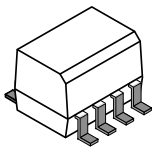
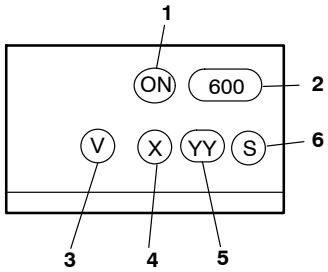


SOIC8
CASE 751DZ

MARKING DIAGRAM



1. ON = ON Semiconductor Logo
2. 600 = Device Number
3. V = VDE mark indicates DIN EN/IEC60747−5−2 approval (Note: Only appears on parts ordered with VDE option − See Ordering Information Table)
4. X = One−Digit Year Code, e.g. ‘3’
5. YY = Two Digit Work Week Ranging from ‘01’ to ‘53’
6. S = Assembly Package Code

ORDERING INFORMATION

See detailed ordering and shipping information on page 13 of this data sheet.

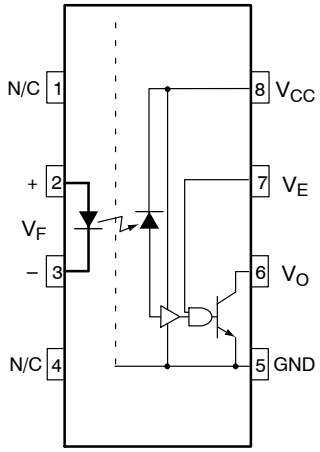


Figure 1. Single−channel Circuit Drawing (HCPL0600, HCPL0601 and HCPL0611)

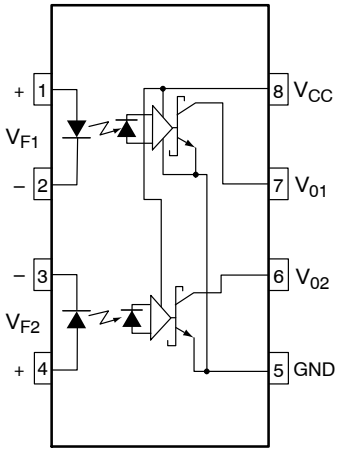


Figure 2. Dual−channel Circuit Drawing (HCPL0637, HCPL0638 and HCPL0639)

TRUTH TABLE (Positive Logic)

Input	Enable	Output
H	H	L
L	H	H
H	L	H
L	L	H
H*	NC*	L*
L*	NC*	H*

*Dual channel devices or single channel devices with pin 7 not connected. A 0.1 μF bypass capacitor must be connected between pins 8 and 5. (See Note 2)

SAFETY AND INSULATIONS RATING

As per DIN EN/IEC 60747−5−5, this optocoupler is suitable for “safe electrical insulation” only within the safety limit data. Compliance with the safety ratings shall be ensured by means of protective circuits.

Parameter		Characteristics
Installation Classifications per DIN VDE 0110/1.89 Table 1, For Rated Mains Voltage	< 150 V_{RMS}	I–IV
	< 300 V_{RMS}	I–III
Climatic Classification		40/85/21
Pollution Degree (DIN VDE 0110/1.89)		2
Comparative Tracking Index		175

Symbol	Parameter	Value	Unit
V_{PR}	Input−to−Output Test Voltage, Method A, V_{IORM} x 1.6 = V_{PR}, Type and Sample Test with t_m = 10 s, Partial Discharge < 5 pC	904	Vpeak
	Input−to−Output Test Voltage, Method B, V_{IORM} x 1.875 = V_{PR}, 100% Production Test with t_m = 1 s, Partial Discharge < 5 pC	1060	Vpeak
V_{IORM}	Maximum Working Insulation Voltage	565	Vpeak
V_{IOTM}	Highest Allowable Over−Voltage	4,000	Vpeak
	External Creepage	≥ 4	mm
	External Clearance	≥ 4	mm
DTI	Distance Through Insulation (Insulation Thickness)	≥ 0.4	mm
T_S	Case Temperature (Note 1)	150	°C
$I_{S,INPUT}$	Input Current (Note 1)	200	mA
$P_{S,OUTPUT}$	Output Power (Note 1)	300	mW
R_{IO}	Insulation Resistance at T_S, V_{IO} = 500 V (Note 1)	> 10^9	Ω

1. Safety limit values − maximum values allowed in the event of a failure.

ABSOLUTE MAXIMUM RATINGS (No Derating Required up to 85°C)

Symbol	Parameter	Value	Units
T_{STG}	Storage Temperature	−40 to +125	°C
T_{OPR}	Operating Temperature	−40 to +85	°C
T_J	Junction Temperature	−40 to +125	°C

EMITTER

I_F	DC/Average Forward Input Current	Each Channel	50	mA
V_E	Enable Input Voltage Not to exceed VCC by more than 500 mV	Single Channel Devices Only	5.5	V
V_R	Reverse Input Voltage	Each Channel	5.0	V
P_I	Power Dissipation	Each Channel	45	mW

DETECTOR

V_{CC} (1 minute max)	Supply Voltage		7.0	V
I_O	Output Current	Each Channel	15	mA
V_O	Output Voltage (each channel)	Each Channel	7.0	V
P_O	Collector Output Power Dissipation	Each Channel	85	mW

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

RECOMMENDED OPERATING CONDITIONS

Symbol	Parameter		Min.	Max.	Units
I_{FL}	Input Current, Low Level		0	250	μA
I_{FH}	Input Current, High Level		*6.3	15	mA
V_{CC}	Supply Voltage, Output		4.5	5.5	V
V_{EL}	Enable Voltage, Low Level	Single Channel only	0	0.8	V
V_{EH}	Enable Voltage, High Level	Single Channel only	2.0	V_{CC}	V
T_A	Operating Temperature		−40	+85	°C
N	Fan Out (TTL load)	Single Channel		8	TTL Loads
		Dual Channel		5	
R_L	Output Pull−up		330	4000	Ω

Functional operation above the stresses listed in the Recommended Operating Ranges is not implied. Extended exposure to stresses beyond the Recommended Operating Ranges limits may affect device reliability.

*6.3 mA is a guard banded value which allows for at least 20% CTR degradation. Initial input current threshold value is 5.0 mA or less.

ELECTRICAL CHARACTERISTICS

(T_A = −40°C TO +85°C UNLESS OTHERWISE SPECIFIED)

INDIVIDUAL COMPONENT CHARACTERISTICS

Symbol	Parameter	Test Conditions		Min.	Typ.*	Max.	Unit
EMITTER							
V_F	Input Forward Voltage	I_F = 10 mA				1.8	V
			T_A = 25°C			1.75	
B_{VR}	Input Reverse Breakdown Voltage	I_R = 10 μA		5.0			V
$\Delta V_F/\Delta T_A$	Input Diode Temperature Coefficient	I_F = 10 mA			−1.5		mV/°C
DETECTOR							
I_{CCH}	High Level Supply Current	I_F = 0 mA, V_E = 0.5 V, V_{CC} = 5.5 V	Single Channel			10	mA
			Dual Channel			15	
I_{CCL}	Low Level Supply Current	I_F = 10 mA, V_E = 0.5 V, V_{CC} = 5.5 V	Single Channel			13	mA
			Dual Channel			21	
I_{EL}	Low Level Enable Current	V_{CC} = 5.5 V, V_E = 0.5 V	Single Channel			−1.6	mA
I_{EH}	High Level Enable Current	V_{CC} = 5.5 V, V_E = 2.0 V	Single Channel			−1.6	mA
V_{EH}	High Level Enable Voltage	V_{CC} = 5.5 V, I_F = 10 mA	Single Channel	2.0			V
V_{EL}	Low Level Enable Voltage	V_{CC} = 5.5 V, I_F = 10 mA (Note 3)	Single Channel			0.8	V

SWITCHING CHARACTERISTICS (T_A = −40°C to +85°C, V_{CC} = 5 V, I_F = 7.5 mA unless otherwise specified)

Symbol	AC Characteristics	Test Conditions		Device	Min.	*	Max.	Unit
T_{PLH}	Propagation Delay Time to Output High Level	R_L = 350 Ω, T_A = 25°C C_L = 15 pF (Note 4) (Fig. 22)		All	20		75	ns
							100	
T_{PHL}	Propagation Delay Time to Output Low Level	R_L = 350 Ω, T_A = 25°C C_L = 15 pF (Note 5) (Fig. 22)		All	25		75	ns
							100	
$\|T_{PHL}-T_{PLH}\|$	Pulse Width Distortion	R_L = 350 Ω, C_L = 15 pF (Fig. 20)		All			35	ns
t_r	Output Rise Time (10–90%)	R_L = 350 Ω, C_L = 15 pF (Note 6) (Fig. 22)		Single Ch		50		ns
				Dual Ch		17		
t_f	Output Fall Time (90–10%)	R_L = 350 Ω, C_L = 15 pF (Note 7) (Fig. 22)		Single Ch		12		ns
				Dual Ch		5		
t_{ELH}	Enable Propagation Delay Time to Output High Level	I_F = 7.5 mA, V_{EH} = 3.5 V, R_L = 350 Ω, C_L = 15 pF (Note 8) (Fig. 23)		HCPL0600 HCPL0601 HCPL0611		20		ns
t_{EHL}	Enable Propagation Delay Time to Output Low Level	I_F = 7.5 mA, V_{EH} = 3.5 V, R_L = 350 Ω, C_L = 15 pF (Note 9) (Fig. 23)		HCPL0600 HCPL0601 HCPL0611		20		ns
$\|CM_H\|$	Common Mode Transient Immunity (at Output High Level)	R_L = 350 Ω, T_A = 25°C, I_F = 0 mA, V_{OH} (Min.) = 2.0 V (Note 10) (Fig. 24, 25)	$\|V_{CM}\|$ = 10 V	HCPL0600 HCPL0637	5,000			V/μs
			$\|V_{CM}\|$ = 50 V	HCPL0601 HCPL0638	10,000			
			$\|V_{CM}\|$ = 1,000 V	HCPL0611	15,000			
				HCPL0639	25,000			
$\|CM_L\|$	Common Mode Transient Immunity (at Output Low Level)	R_L = 350 Ω, T_A = 25°C, I_F = 7.5 mA, V_{OL} (Max.) = 0.8 V (Note 11) (Fig. 24, 25)	$\|V_{CM}\|$ = 10 V	HCPL0600 HCPL0637	5,000			V/μs
			$\|V_{CM}\|$ = 50 V	HCPL0601 HCPL0638	10,000			
			$\|V_{CM}\|$ = 1,000 V	HCPL0611	15,000			
				HCPL0639	25,000			

TRANSFER CHARACTERISTICS (T_A = −40°C to +85°C unless otherwise specified)

Symbol	DC Characteristics	Test Conditions	Min.	Typ.*	Max.	Unit
I_{OH}	High Level Output Current	V_{CC} = 5.5 V, V_O = 5.5 V, I_F = 250 μA, V_E = 2.0 V (Note 3)			100	μA
V_{OL}	Low Level Output Voltage	V_{CC} = 5.5 V, I_F = 5 mA, V_E = 2.0 V, I_{OL} = 13 mA (Note 3)			0.6	V
I_{FT}	Input Threshold Current	V_{CC} = 5.5 V, V_O = 0.6 V, V_E = 2.0 V, I_{OL} = 13 mA			5	mA

*All typical values are at V_{CC} = 5 V, T_A = 25°C.

ISOLATION CHARACTERISTICS (T_A = −40°C to +85°C unless otherwise specified)

Symbol	Characteristics	Test Conditions	Min.	Typ.*	Max.	Unit
I_{I-O}	Input−Output Insulation Leakage Current	Relative humidity = 45%, T_A = 25°C, t = 5 s, V_{I-O} = 3000 VDC (Note 12)			1.0*	μA
V_{ISO}	Withstand Insulation Test Voltage	R_H < 50%, T_A = 25°C, I_{I-O} ≤ 2 μA, t = 1 min. (Note 12)	3750			V_{RMS}
R_{I-O}	Resistance (Input to Output)	V_{I-O} = 500 V (Note 12)		10^{12}		Ω
C_{I-O}	Capacitance (Input to Output)	f = 1 MHz (Note 12)		0.6		pF

*All typical values are at V_{CC} = 5 V, T_A = 25°C.
Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

Notes:

2. The V_{CC} supply to each optoisolator must be bypassed by a 0.1 μF capacitor or larger. This can be either a ceramic or solid tantalum capacitor with good high frequency characteristic and should be connected as close as possible to the package V_{CC} and GND pins of each device.
3. Enable Input − No pull up resistor required as the device has an internal pull up resistor.
4. t_{PLH} − Propagation delay is measured from the 3.75 mA level on the HIGH to LOW transition of the input current pulse to the 1.5 V level on the LOW to HIGH transition of the output voltage pulse.
5. t_{PHL} − Propagation delay is measured from the 3.75 mA level on the LOW to HIGH transition of the input current pulse to the 1.5 V level on the HIGH to LOW transition of the output voltage pulse.
6. t_r − Rise time is measured from the 90% to the 10% levels on the LOW to HIGH transition of the output pulse.
7. t_f − Fall time is measured from the 10% to the 90% levels on the HIGH to LOW transition of the output pulse.
8. t_{ELH} − Enable input propagation delay is measured from the 1.5 V level on the HIGH to LOW transition of the input voltage pulse to the 1.5 V level on the LOW to HIGH transition of the output voltage pulse.
9. t_{EHL} − Enable input propagation delay is measured from the 1.5 V level on the LOW to HIGH transition of the input voltage pulse to the 1.5 V level on the HIGH to LOW transition of the output voltage pulse.
10. CM_H − The maximum tolerable rate of rise of the common mode voltage to ensure the output will remain in the high state (i.e., V_{OUT} > 2.0 V). Measured in volts per microsecond (V/μs).
11. CM_L − The maximum tolerable rate of fall of the common mode voltage to ensure the output will remain in the low output state (i.e., V_{OUT} < 0.8V). Measured in volts per microsecond (V/μs).
12. Device considered a two−terminal device: Pins 1, 2, 3 and 4 shorted together, and Pins 5, 6, 7 and 8 shorted together.

TYPICAL PERFORMANCE CURVES

(HCPL0600, HCPL0601 and HCPL0611 only)

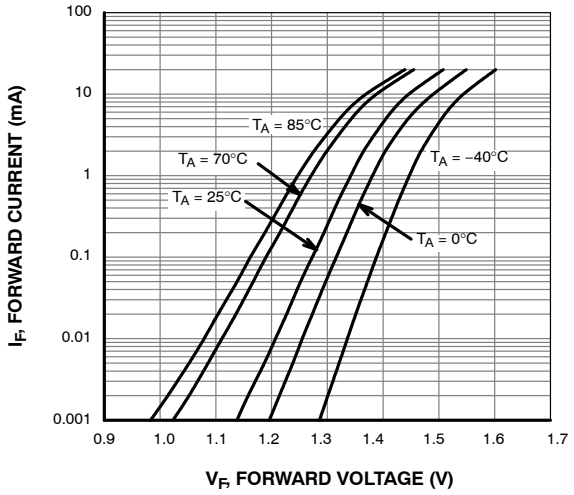


Figure 3. Forward Current vs. Input Forward Voltage

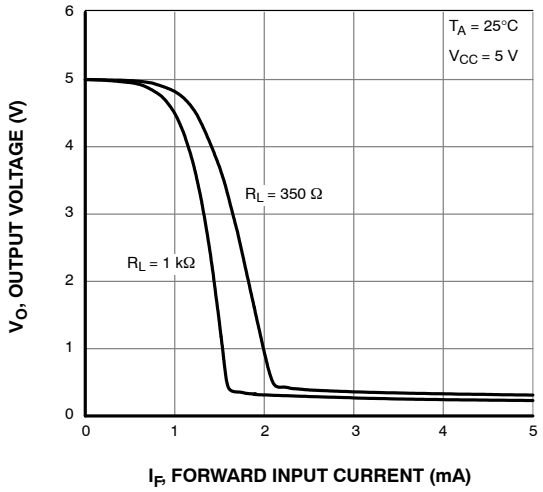


Figure 4. Output Voltage vs. Forward Current

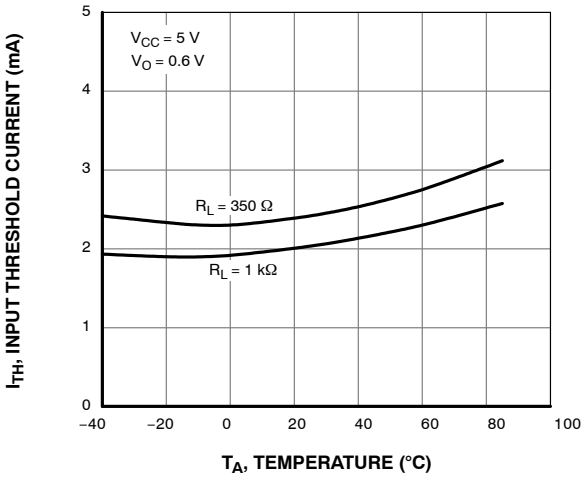


Figure 5. Input Threshold Current vs. Temperature

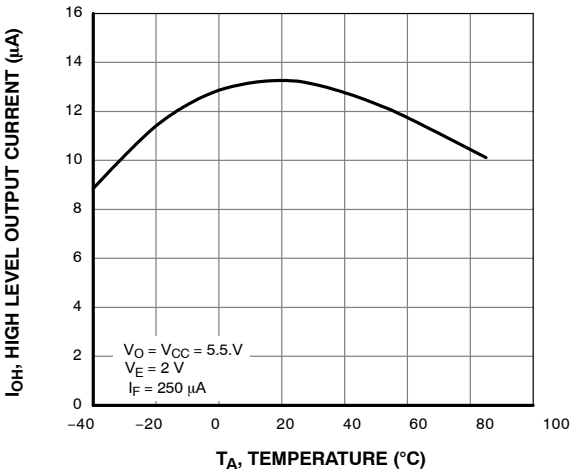


Figure 6. High Level Output Current vs. Temperature

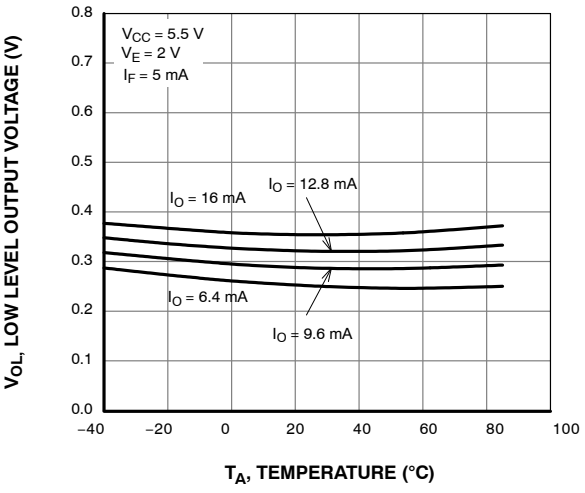


Figure 7. Low Level Output Voltage vs. Temperature

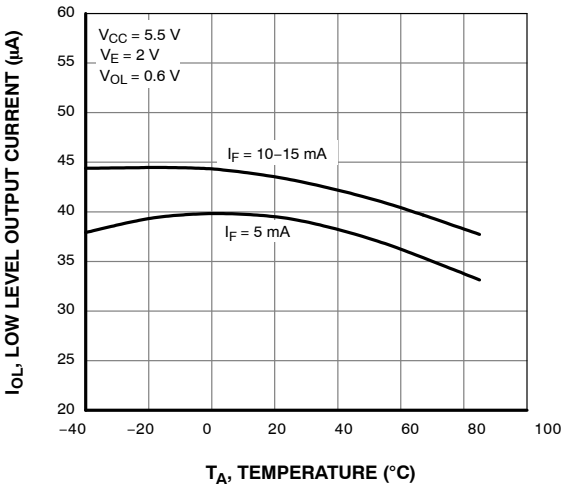


Figure 8. Low Level Output Current vs. Temperature

TYPICAL PERFORMANCE CURVES

(HCPL0600, HCPL0601 and HCPL0611 only)

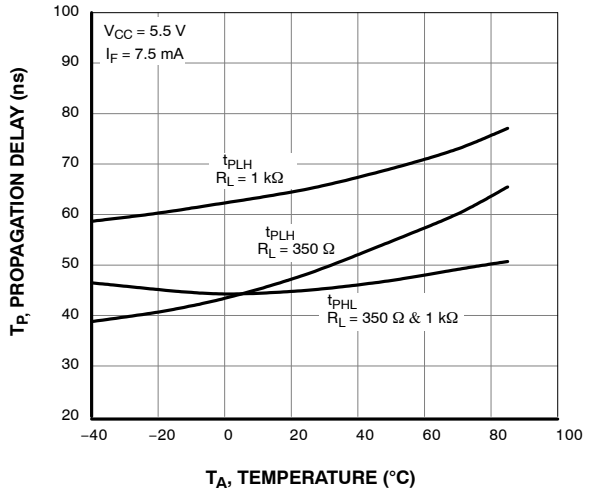


Figure 9. Propagation Delay vs. Temperature

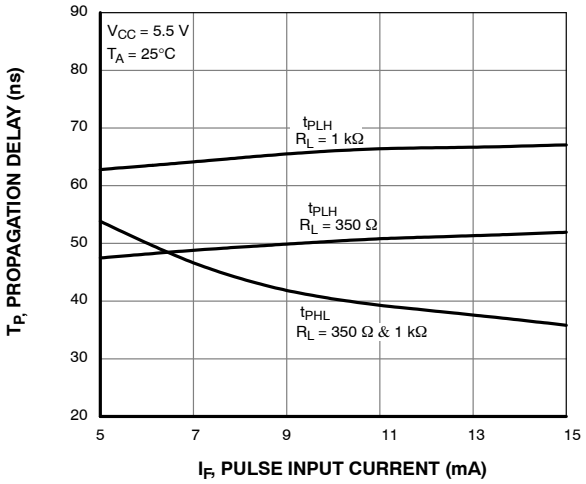


Figure 10. Propagation Delay vs. Pulse Input Current

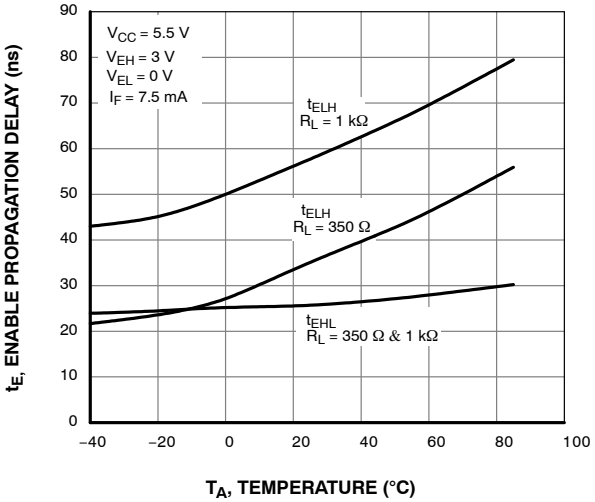


Figure 11. Typical Enable Propagation Delay vs. Temparature

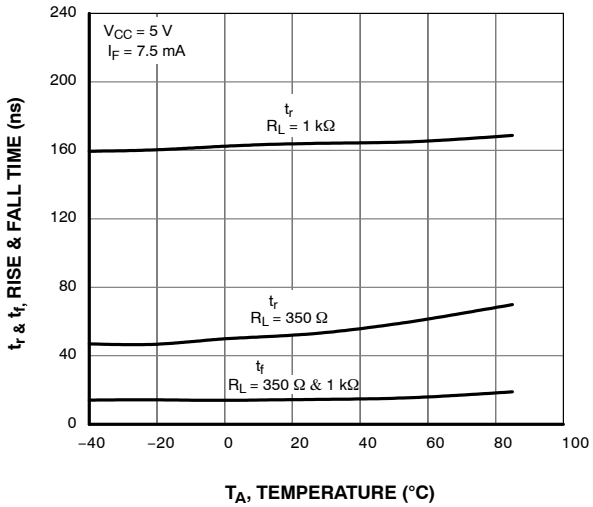


Figure 12. Typical Rise and Fall Time vs. Temperature

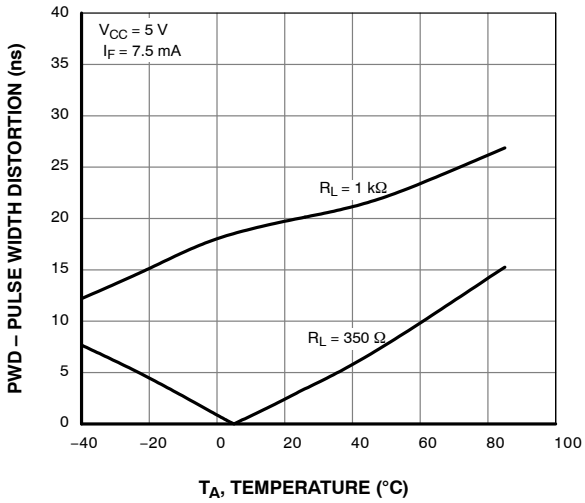


Figure 13. Typical Pulse Width Distortion vs. Temperature

TYPICAL PERFORMANCE CURVES

(HCPL0637, HCPL0638 and HCPL0639 only)

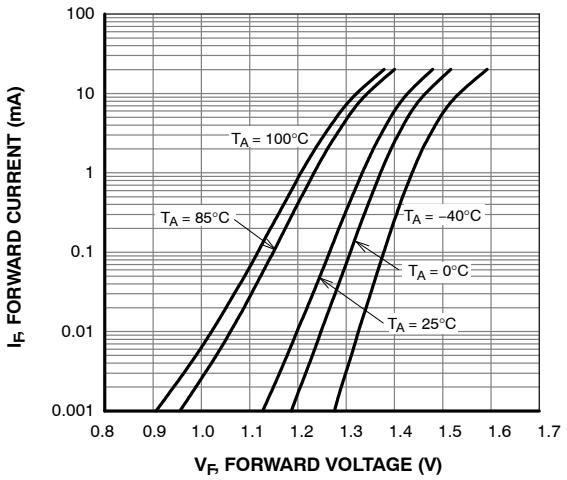


Figure 14. Input Forward Current vs. Forward Voltage

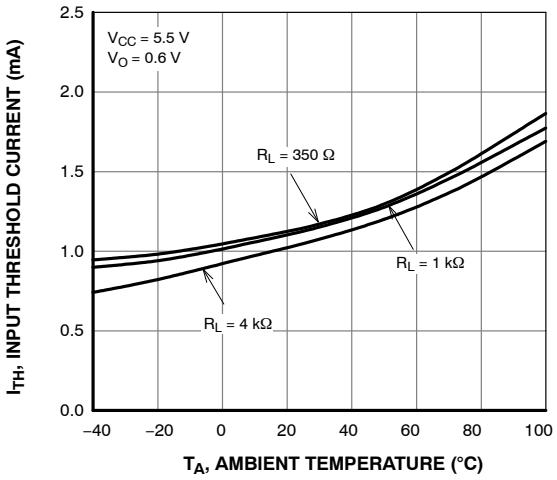


Figure 15. Input Threshold Current vs. Ambient Temperature

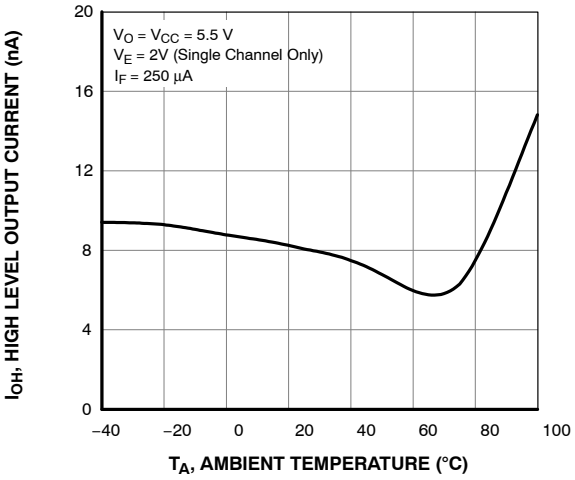


Figure 16. High Level Output Current vs. Ambient Temperature

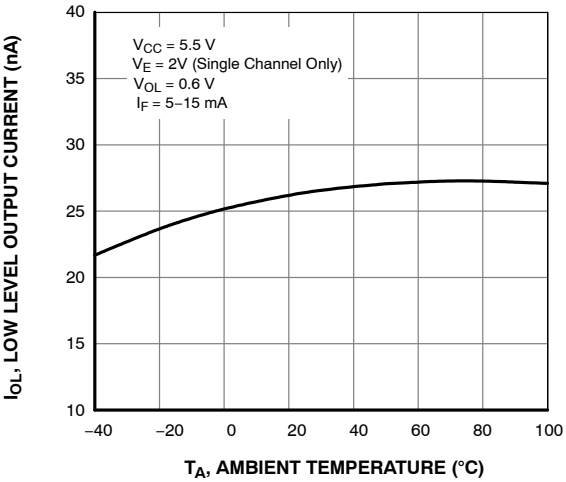


Figure 17. Low Level Output Current vs. Ambient Temperature

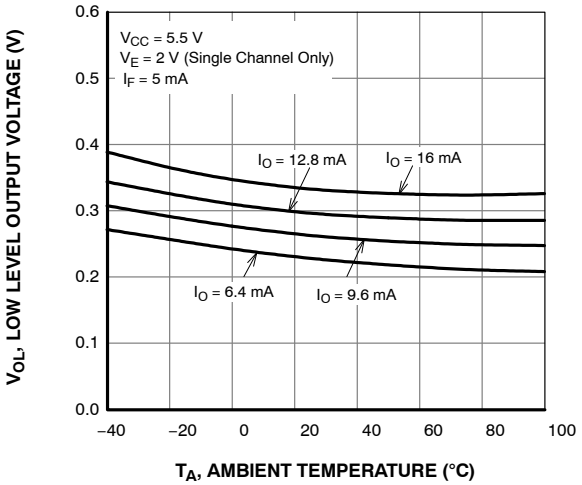


Figure 18. Low Level Output Voltage vs. Ambient Temperature

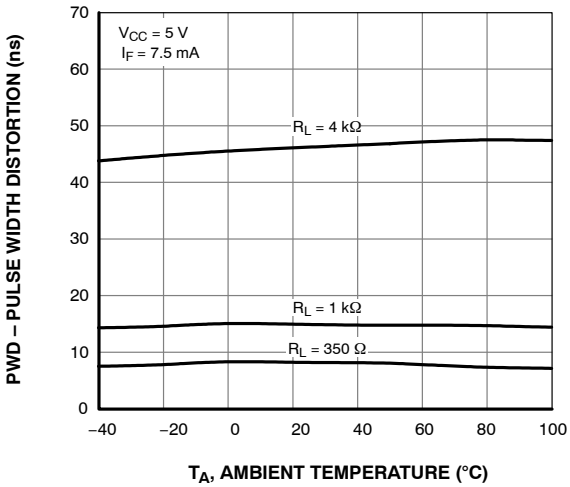


Figure 19. Pulse Width Distortion vs. Ambient Temperature

TYPICAL PERFORMANCE CURVES

(HCPL0637, HCPL0638 and HCPL0639 only)

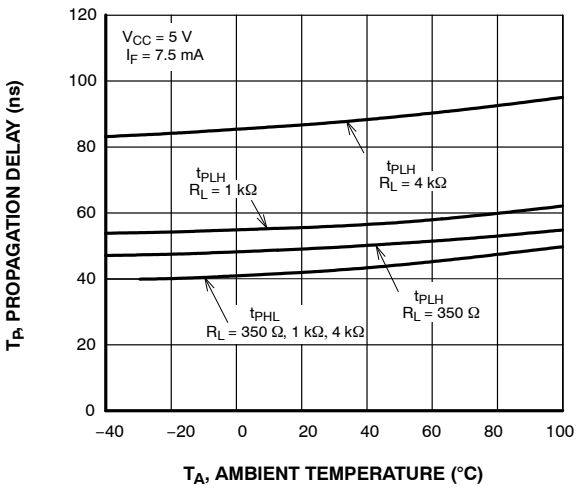


Figure 20. Propagation Delay vs. Ambient Temperature

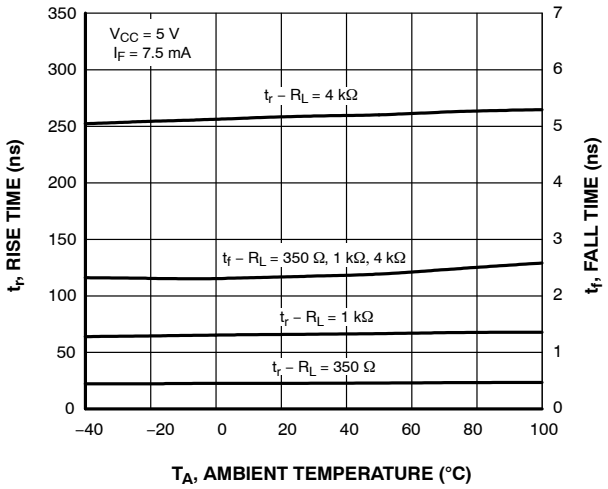


Figure 21. Rise and Fall Times vs. Ambient Temperature

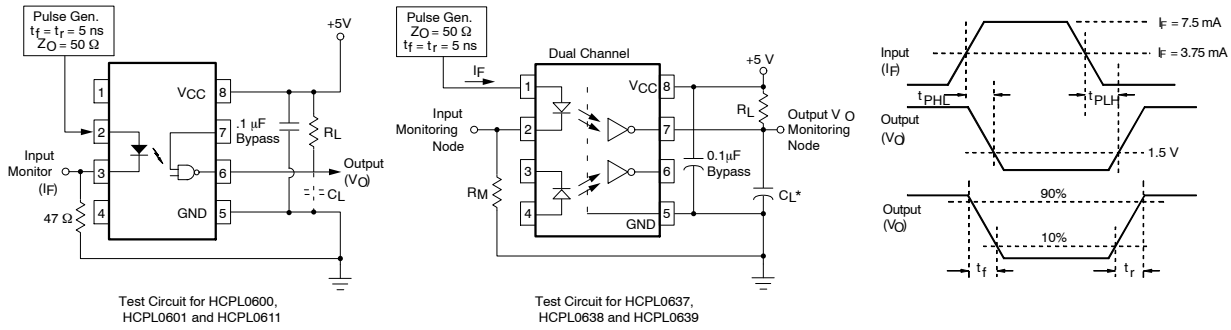


Figure 22. Test Circuit and Waveforms for t_{PLH}, t_{PHL}, t_r and t_f

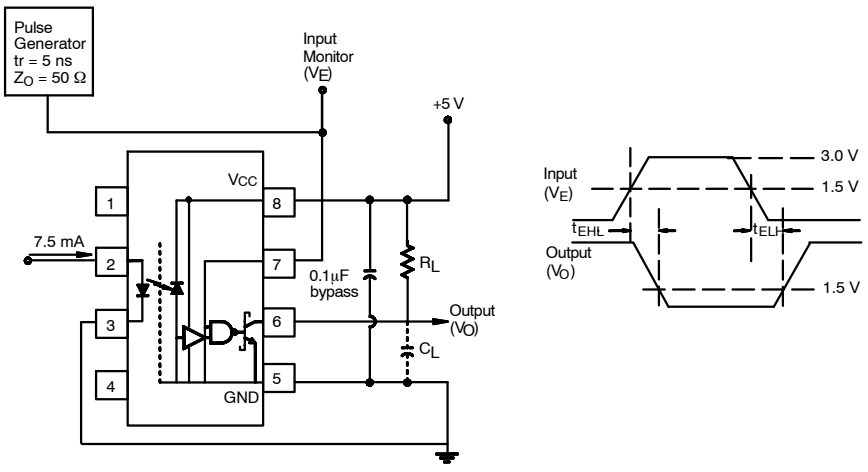


Figure 23. Test Circuit t_{EHL} and t_{ELH}

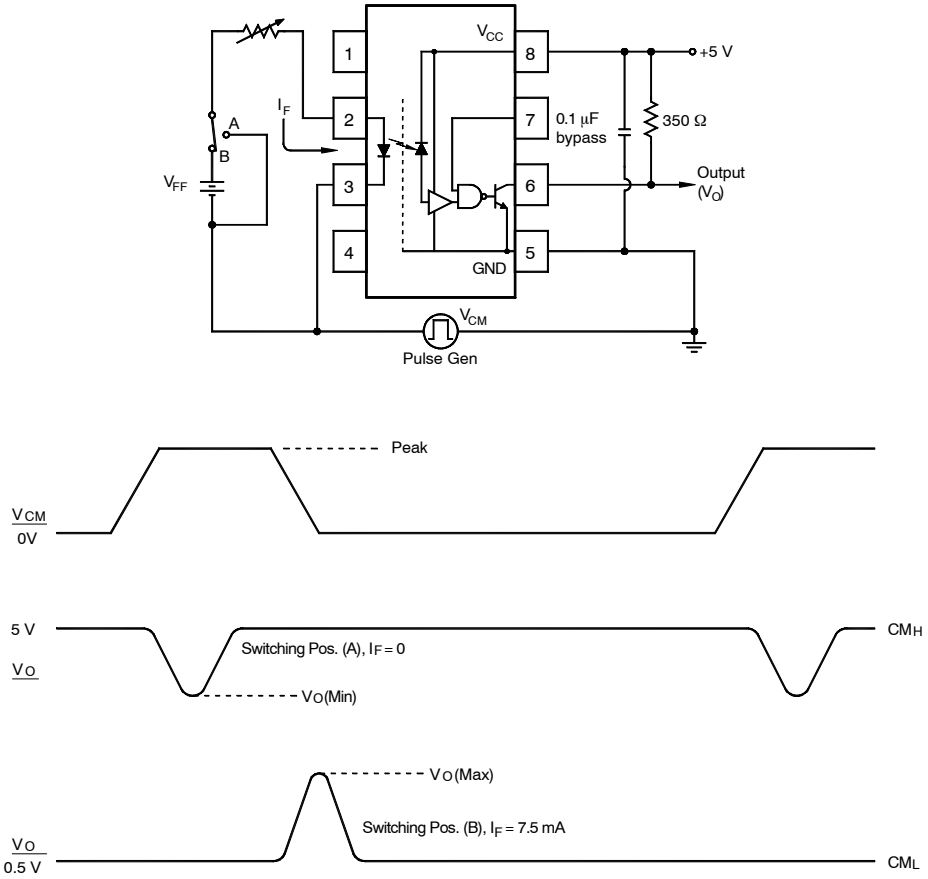


Figure 24. Test Circuit and Waveforms for Common Mode Transient Immunity (HCPL0600, HCPL0601 and HCPL0611)

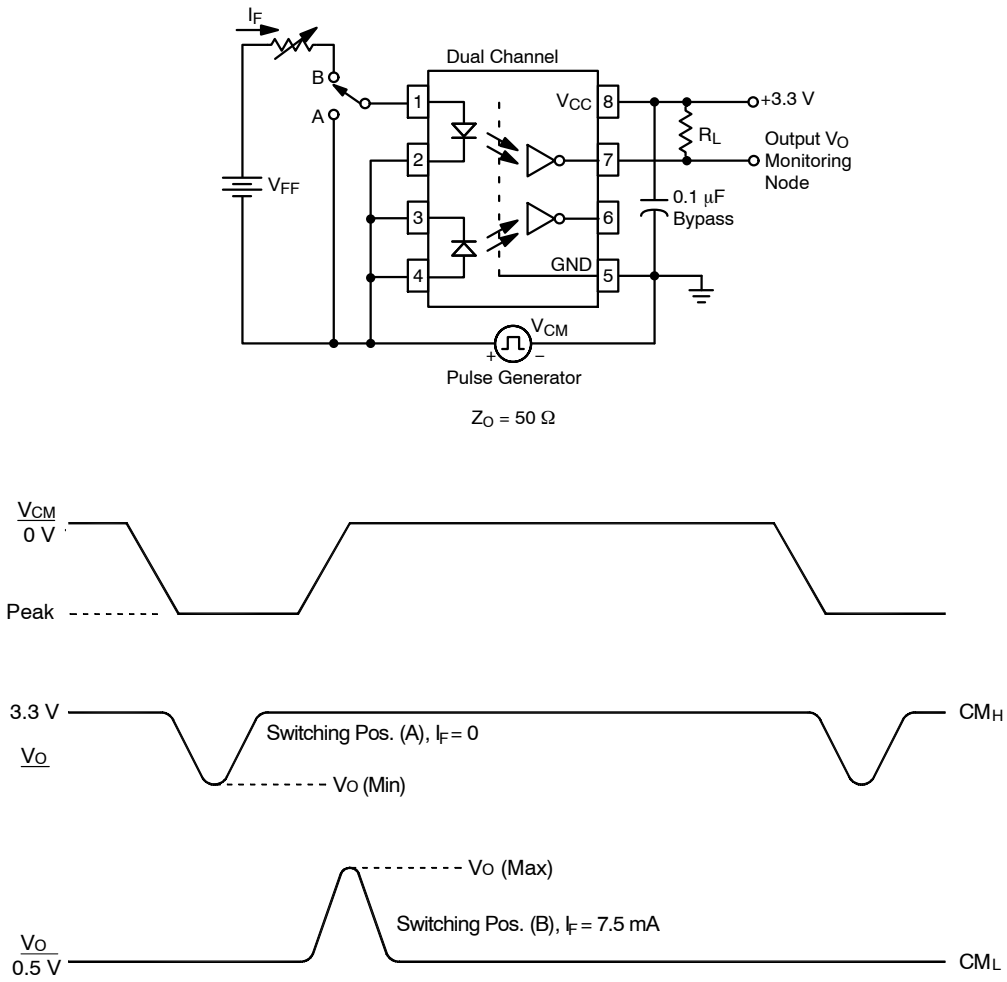


Figure 25. Test Circuit and Waveforms for Common Mode Transient Immunity (HCPL0637, HCPL0638 and HCPL0639)

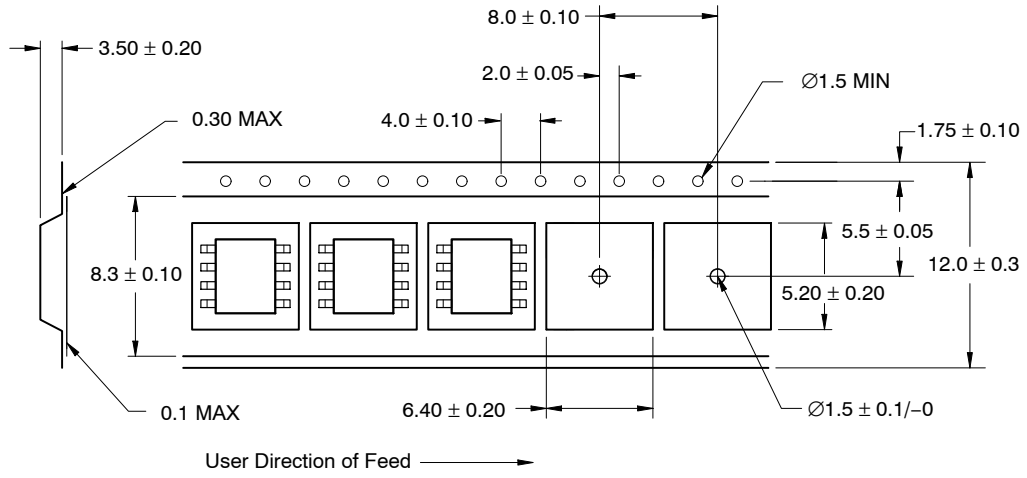
ORDERING INFORMATION

Part Number	Package	Packing Method†
HCPL0600	Small Outline 8−Pin	Tube (50 Units)
HCPL0600R2	Small Outline 8−Pin	Tape and Reel (2500 Units)
HCPL0600V	Small Outline 8−Pin, DIN EN/IEC60747−5−5 Option	Tube (50 Units)
HCPL0600R2V	Small Outline 8−Pin, DIN EN/IEC60747−5−5 Option	Tape and Reel (2500 Units)

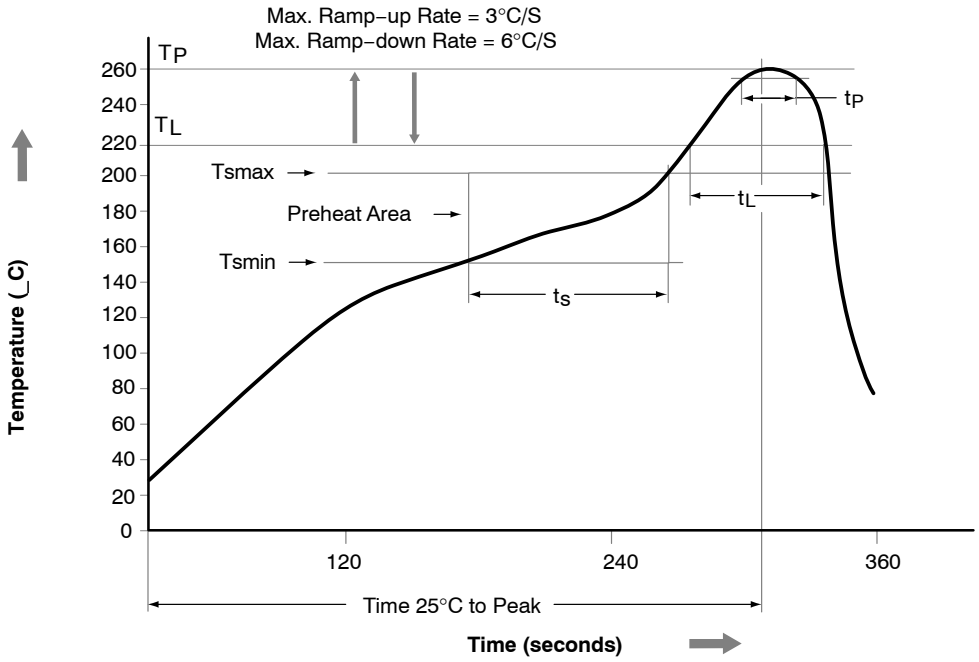
†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

13. The product orderable part number system listed in this table also applies to the HCPL0601, HCPL0611, HCPL0637, HCPL0638 and HCPL0639 product.

CARRIER TAPE SPECIFICATIONS



REFLOW PROFILE



Profile Feature	Pb−Free Assembly Profile
Temperature Min. (Tsmin)	150°C
Temperature Max. (Tsmax)	200°C
Time (t_S) from (Tsmin to Tsmax)	60−120 seconds
Ramp−up Rate (t_L to t_P)	3°C/second max.
Liquidous Temperature (T_L)	217°C
Time (t_L) Maintained Above (T_L)	60−150 seconds
Peak Body Package Temperature	260°C +0°C / −5°C
Time (t_P) within 5°C of 260°C	30 seconds
Ramp−down Rate (T_P to T_L)	6°C/second max.
Time 25°C to Peak Temperature	8 minutes max.

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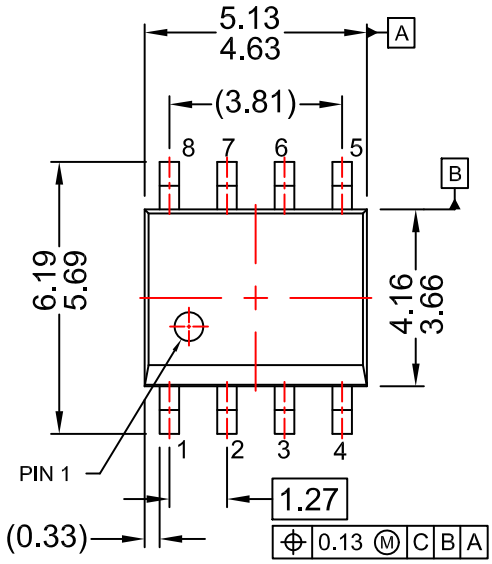
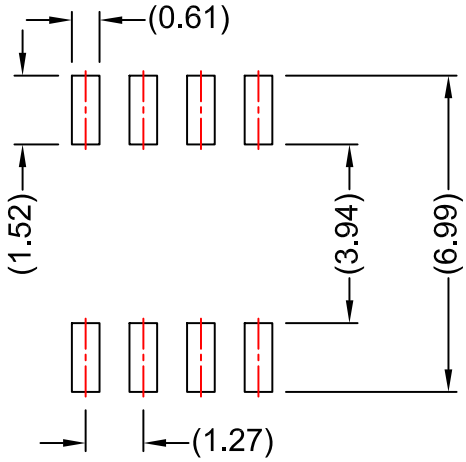
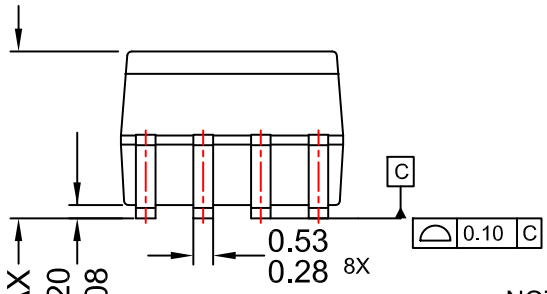
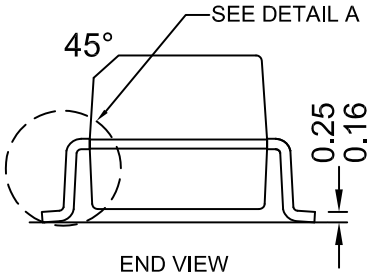


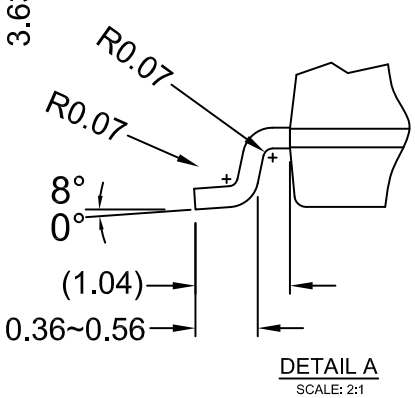


LAND PATTERN RECOMMENDATION





END VIEW



DETAIL A
SCALE: 2:1

NOTES:

A) NO STANDARD APPLIES TO THIS PACKAGE
B) ALL DIMENSIONS ARE IN MILLIMETERS.
C) DIMENSIONS DO NOT INCLUDE MOLD FLASH OR BURRS.
D) LANDPATTERN STANDARD: SOIC127P600X175-8M.

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