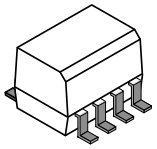
High Speed Transistor Optocouplers

Single Channel:
HCPL0453, HCPL0500, HCPL0501
Dual Channel:
HCPL0531, HCPL0534

HCPL0453, HCPL0500, HCPL0501, HCPL0531, HCPL0534



SOIC8
CASE 751DZ

Description

The HCPL05XX, and HCPL04XX optocouplers consist of an AlGaAs LED optically coupled to a high speed photo−detector transistor housed in a compact 8−pin small outline package.

A separate connection for the bias of the photodiode improves the speed by several orders of magnitude over conventional phototransistor optocouplers by reducing the base−collector capacitance of the input transistor. The HCPL04XX devices do not have the base bonded out to a lead for additional noise margin. The HCPL053X devices have two channels per package for optimum mounting density.

Features

- High Speed − 1 MBit/s
- 15 kV/μs Minimum Commone Mode Transient Immunity at V_{CM} = 1500 V (HCPL0453/0534)
- Open Collector Output
- Guaranteed Performance Over Temperature: 0°C to 70°C
- U.L. Recognized (File # E90700)
- VDE0884 Recognized (File # 136616)
  - Approval Pending for HCPL0531/0453
  - Ordering Option V, e.g., HCPL0500V
- BSI Recognized (File # 8661, 8662)
  - HCPL0500/0501 only

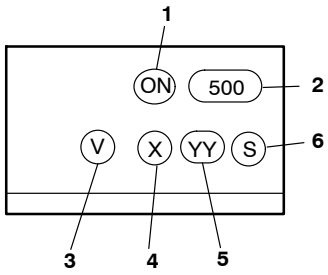
Applications

- Line Receivers
- Pulse Transformer Replacement
- Output Interface to CMOS−LSTTL−TTL
- Wide Bandwidth Analog Coupling

TRUTH TABLE (Positive Logic)

LED	V_O
ON	LOW
OFF	HIGH

MARKING DIAGRAM



1. ON = **onsemi** Logo
2. 500 = Device Number
3. V = VDE mark indicates DIN EN/IEC60747−5−5 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 8 of this data sheet.

© Semiconductor Components Industries, LLC, 2020

SAFETY AND INSULATION RATINGS (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		55/100/21
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	V_{peak}
	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	V_{peak}
V_{IORM}	Maximum Working Insulation Voltage	565	V_{peak}
V_{IOTM}	Highest Allowable Over−Voltage	4000	V_{peak}
	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.

SCHEMATICS

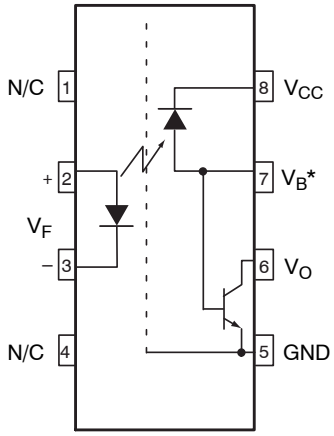


Figure 1. Single−channel Circuit Schematics (HCPL0500, HCPL0501 *Base Not Connected for HCPL0453)

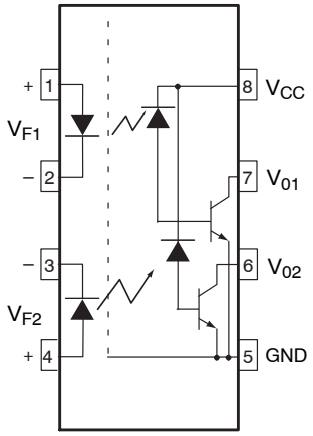


Figure 2. Dual−channel Circuit Schematics (HCPL0531, HCPL0534)

ABSOLUTE MAXIMUM RATINGS (T_A = 25°C unless otherwise specified)

Symbol	Parameter	Value	Units
T_{STG}	Storage Temperature	−40 to +125	°C
T_{OPR}	Operating Temperature	−40 to +85	°C
	Reflow Temperature Profile (Refer to page 8)		
EMITTER			
I_F (avg)	DC/Average Forward Input Current	25	mA
I_F (pk)	Peak Forward Input Current (50% duty cycle, 1 ms P.W.)	50	mA
I_F (trans)	Peak Transient Input Current (t ≤ 1 μs P.W., 300 pps)	1.0	A
V_R	Reverse Input Voltage	5.0	V
P_D	Input Power Dissipation	45	mW
DETECTOR			
I_O (avg)	Average Output Current (Pin 6)	8	mA
I_O (pk)	Peak Output Current	16	mA
V_{EBR}	Emitter−Base Reverse Voltage (HCPL0500/0501 only)	5	V
V_{CC}	Supply Voltage	−0.5 to 30	V
V_O	Output Voltage	−0.5 to 20	V
I_B	Base Current (HCPL0500/0501 only)	5	mA
P_D	Output Power Dissipation	100	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.

ELECTRICAL CHARACTERISTICS (T_A = 0°C to 70°C unless otherwise specified)

INDIVIDUAL COMPONENT CHARACTERISTICS

Symbol	Parameter	Test Conditions	Device	Min.	Typ.*	Max.	Unit
EMITTER							
V_F	Input Forward Voltage	I_F = 16 mA, T_A = 25°C	All		1.45	1.7	V
		I_F = 16 mA				1.8	
BV_R	Input Reverse Breakdown Voltage	I_R = 10 μA	All	5.0			V
$\Delta V_F / \Delta T_A$	Temperature Coefficient of Forward Voltage	I_F = 16 mA	All		−1.6		mV/°C
DETECTOR							
I_{OH}	Logic High Output Current	I_F = 0 mA, V_O = V_{CC} = 5.5 V, T_A = 25°C	All		0.001	0.5	μA
		I_F = 0 mA, V_O = V_{CC} = 15 V, T_A = 25°C	All		0.005	1	
		I_F = 0 mA, V_O = V_{CC} = 15 V	All			50	
I_{CCL}	Logic Low Supply Current	I_F = 16 mA, V_O = Open, V_{CC} = 15 V	HCPL0453/ 0500/1		120	200	μA
			HCPL0531/4			400	
I_{CCH}	Logic High Supply Current	I_F = 0 mA, V_O = Open, V_{CC} = 15 V, T_A = 25°C	All		0.01	1	μA
		I_F = 0 mA, V_O = Open, V_{CC} = 15 V	HCPL0453/ 0500/1			2	
			HCPL0531/4			4	

TRANSFER CHARACTERISTICS

Symbol	Parameter	Test Conditions	Device	Min.	Typ.*	Max.	Unit
COUPLED							
CTR	Current Transfer Ratio (Note 2)	I_F = 16 mA, V_O = 0.4 V, V_{CC} = 4.5 V, T_A = 25°C	HCPL0500	7	27	50	%
			HCPL0453	19	27	50	
			HCPL0501/0531				
		I_F = 16 mA, V_O = 0.5 V, V_{CC} = 4.5 V	HCPL0500	5	30		
			HCPL0453	15	30		
			HCPL0501/0534				
V_{OL}	Logic Low Output Voltage	I_F = 16 mA, I_O = 1.1 mA, V_{CC} = 4.5 V, T_A = 25°C	HCPL0500		0.18	0.4	V
		I_F = 16 mA, I_O = 3 mA, V_{CC} = 4.5 V, T_A = 25°C	HCPL0453		0.25	0.4	
			HCPL0501/0531/4				
		I_F = 16 mA, I_O = 0.8 mA, V_{CC} = 4.5 V	HCPL0500		0.13	0.5	
		I_F = 16 mA, I_O = 2.4 mA, V_{CC} = 4.5 V	HCPL0453		0.23	0.5	
			HCPL0501/0531/4				

*All typicals at T_A = 25°C

ELECTRICAL CHARACTERISTICS (CONTINUED) (T_A = 0°C to 70°C unless otherwise specified)

SWITCHING CHARACTERISTICS (TV_{CC} = 5 V)

Symbol	Parameter	Test Conditions	Device	Min.	Typ.*	Max.	Unit
T_{PHL}	Propagation Delay Time to Logic LOW	T_A = 25°C, R_L = 4.1 kΩ, I_F = 16 mA (Note 3) (Fig. 9)	HCPL0500		0.45	1.5	μs
		R_L = 1.9 kΩ, I_F = 16 mA, T_A = 25°C (Note 4) (Fig. 9)	HCPL0453		0.45	0.8	
			HCPL0501/0531/4				
		R_L = 4.1 kΩ, I_F = 16 mA (Note 3) (Fig. 9)	HCPL0500			2.0	
		R_L = 1.9 kΩ, I_F = 16 mA (Note 4) (Fig. 9)	HCPL0453			1.0	
			HCPL0501/0531/4				
T_{PLH}	Propagation Delay Time to Logic HIGH	T_A = 25°C, R_L = 4.1 kΩ, I_F = 16 mA (Note 3) (Fig. 9)	HCPL0500		0.5	1.5	μs
		R_L = 1.9 kΩ, I_F = 16 mA, T_A = 25°C (Note 4) (Fig. 9)	HCPL0453		0.3	0.8	
			HCPL0501/0531/4				
		R_L = 4.1 kΩ, I_F = 16 mA (Note 3) (Fig. 9)	HCPL0500			2.0	
		R_L = 1.9 kΩ, I_F = 16 mA (Note 4) (Fig. 9)	HCPL0453			1.0	
			HCPL0501/0531/4				
$\|CM_H\|$	Common Mode Transient Immunity at Logic HIGH	I_F = 0 mA, V_{CM} = 10 V_{P-P}, R_L = 4.1 kΩ, T_A = 25°C (Note 5) (Fig. 10)	HCPL0500	1,000	10,000		V/μs
		I_F = 0 mA, V_{CM} = 10 V_{P-P}, R_L = 1.9 kΩ T_A = 25°C (Note 5) (Fig. 10)	HCPL0501/31	1,000	10,000		
			HCPL0534	15,000	40,000		
		I_F = 0 mA, V_{CM} = 1500 V_{P-P}, R_L = 1.9 kΩ, T_A = 25°C (Note 5) (Fig. 10)	HCPL0453	15,000	40,000		
$\|CM_L\|$	Common Mode Transient Immunity at Logic LOW	I_F = 16 mA, V_{CM} = 10 V_{P-P}, R_L = 4.1 kΩ, T_A = 25°C (Note 5) (Fig. 10)	HCPL0500	1,000	10,000		V/μs
		I_F = 16 mA, V_{CM} = 10 V_{P-P}, R_L = 1.9 kΩ (Note 5) (Fig. 10)	HCPL0501/31	1,000	10,000		
			HCPL0534	15,000	40,000		
		I_F = 16 mA, T_A = 25°C, V_{CM} = 1500 V_{P-P}, R_L = 1.9 kΩ (Note 5) (Fig. 10)	HCPL0453	15,000	40,000		

ISOLATION CHARACTERISTICS

Symbol	Characteristics	Test Conditions	Min.	Typ.*	Max.	Unit
V_{ISO}	Input−Output Isolation Voltage	f = 60 Hz, t = 1.0 min., $I_{I-O} \le 2$ μA (Notes 6, 7)	2500			Vac_{RMS}
R_{ISO}	Isolation Resistance	V_{I-O} = 500 V (Note 6)	10^{11}			
C_{ISO}	Isolation Capacitance	V_{I-O} = 0 V, f = 1.0 MHz (Note 6)		0.2		pF

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.

*All typicals at T_A = 25°C

2. Current Transfer Ratio is designed as a ratio of output collector current, I_O, to the forward LED input current, I_F, times 100%.
3. The 4.1 kΩ load represents 1 LSTTL unit load of 0.36 mA and 6.1 kΩ pull−up resistor.
4. The 1.9 kΩ load represents 1 TTL unit load of 1.6 mA and 5.6 kΩ pull−up resistor.
5. Common mode transient immunity in logic high level is the maximum tolerable (positive) dV_{cm}/dt on the leading edge of the common mode pulse signal V_{CM}, to assure that the output will remain in a logic high state (i.e., V_O > 2.0 V). Common mode transient immunity in logic low level is the maximum tolerable (negative) dV_{cm}/dt on the trailing edge of the common mode pulse signal, V_{CM}, to assure that the output will remain in a logic low state (i.e., V_O < 0.8 V).
6. Device is considered a two terminal device: Pins 1, 2, 3 and 4 are shorted together and Pins 5, 6, 7 and 8 are shorted together.
7. 2500 VAC RMS for 1 minute duration is equivalent to 3000 VAC RMS for 1 second duration.

TYPICAL PERFORMANCE CURVES

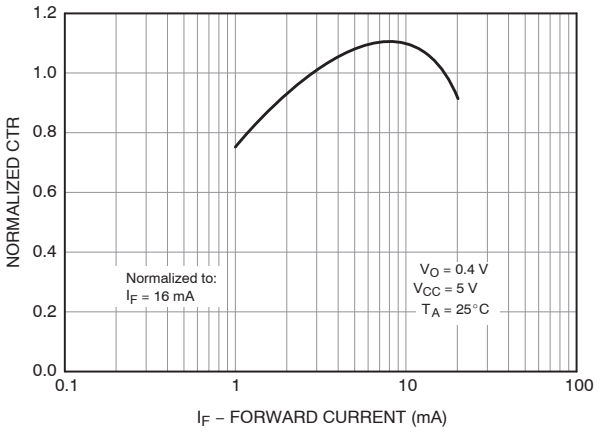


Figure 3. Normalized CTR vs. Forward Current

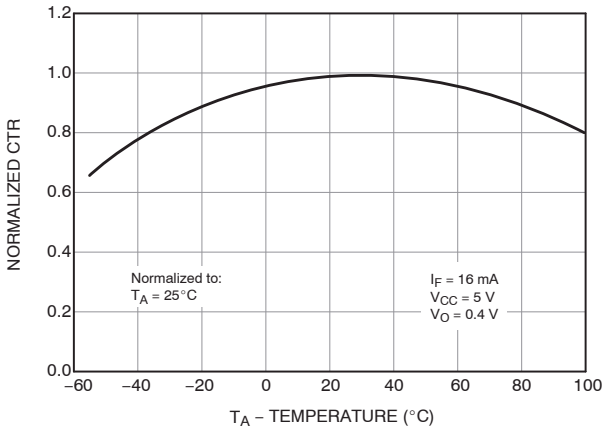


Figure 4. Normalized CTR vs. Temperature

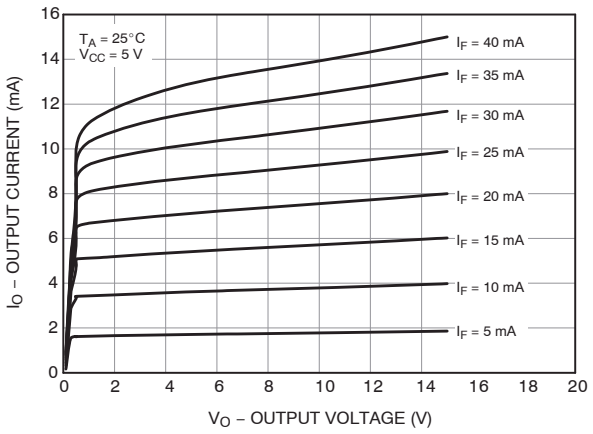


Figure 5. Output Current vs. Output Voltage

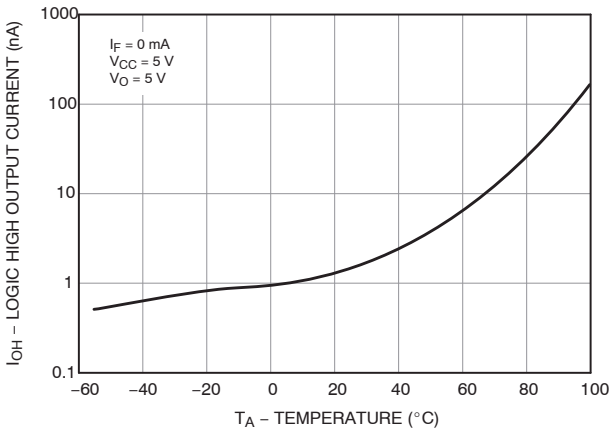


Figure 6. Logic High Output Current vs. Temperature

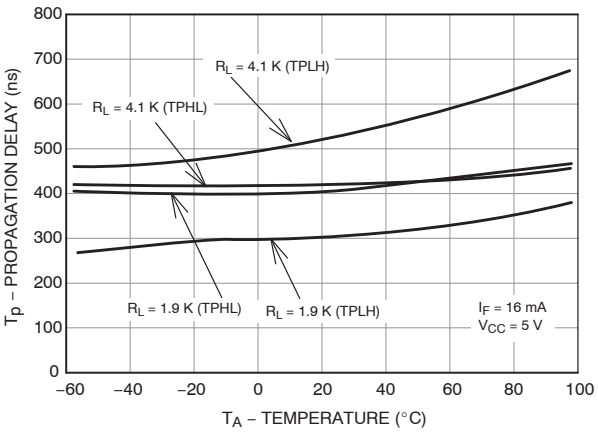


Figure 7. Propagation Delay vs. Temperature

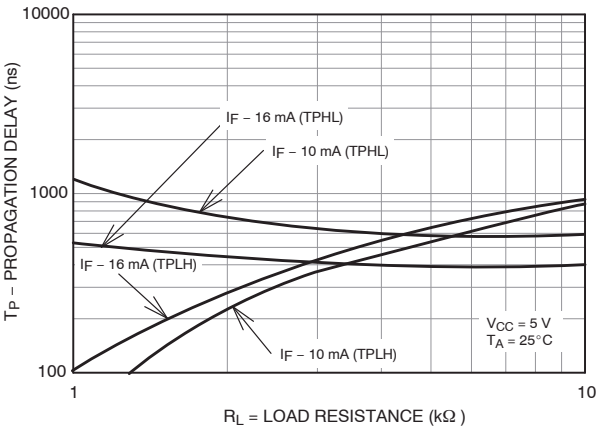
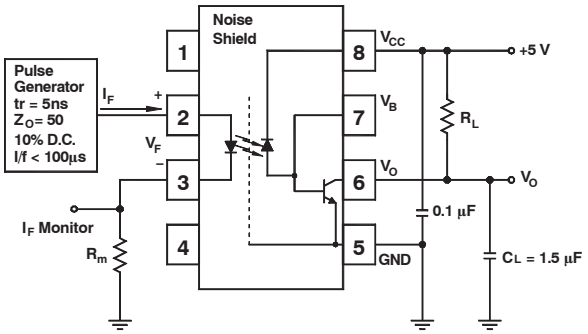
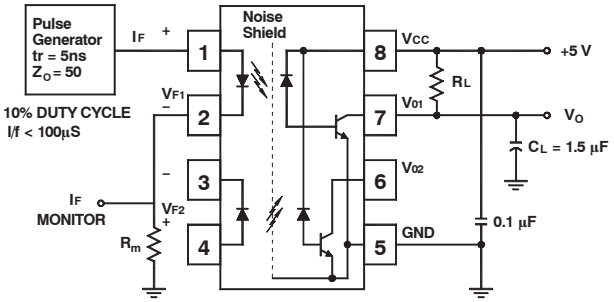


Figure 8. Propagation Delay vs. Load Resistance



Test Circuit for HCPL0453, HCPL0500 and HCPL0501



Test Circuit for HCPL0531 and HCPL0534

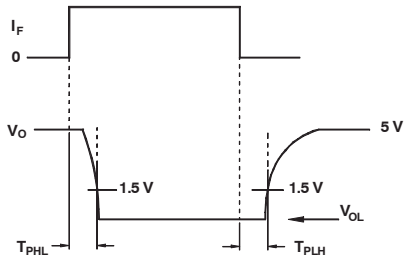
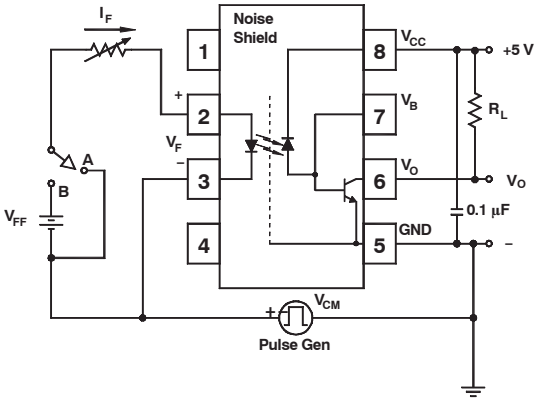
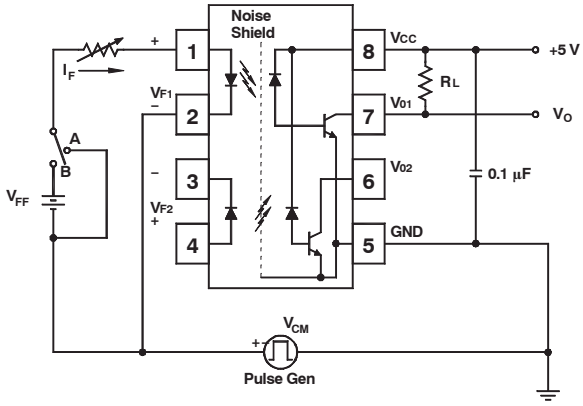


Figure 9. Switching Time Test Circuit



Test Circuit for HCPL0453, HCPL0500 and HCPL0501



Test Circuit for HCPL0531 and HCPL0534

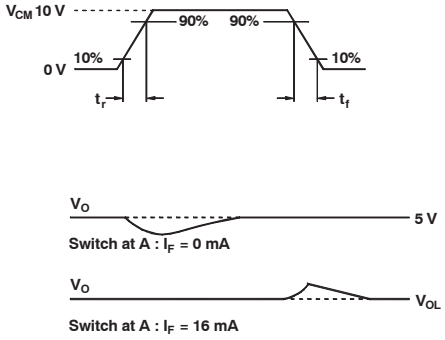


Figure 10. Common Mode Immunity Test Circuit

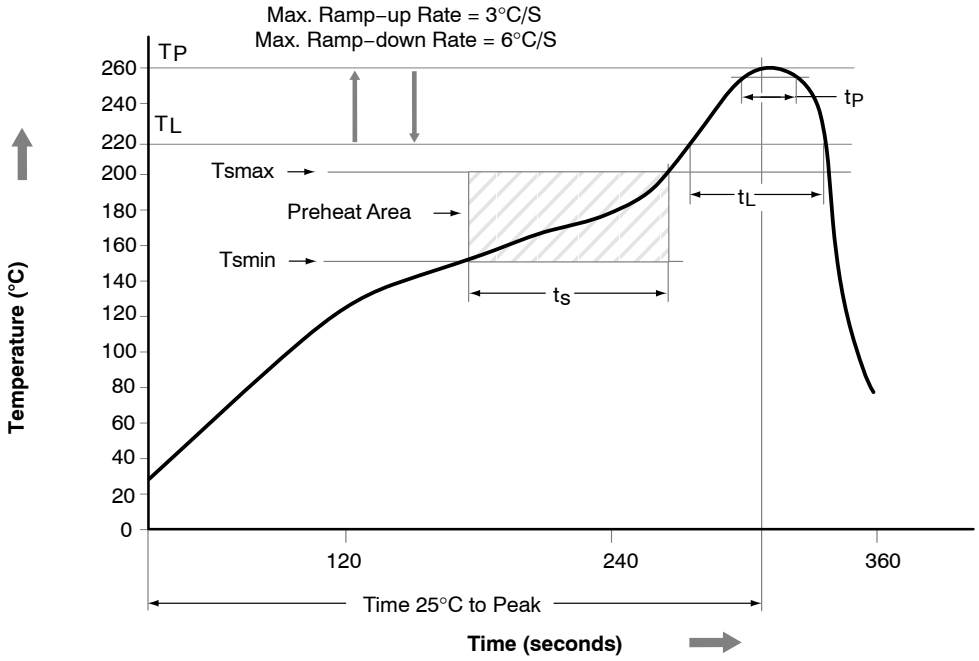
ORDERING INFORMATION

Part Nr./ Option (Note 8)	Order Entry Identifier	Package	Description	Packing Method†
HCPL0xxx**V**	V	SOIC8	VDE 0884 (approval pending for HCPL0531 & HCPL0534)	Tube (3000 Units)
HCPL0xxx**R2**	R2	SOIC8		Tape and Reel (2500 Units)
HCPL0xxx**R2V**	R2V	SOIC8	VDE 0884 (approval pending for HCPL0531 & HCPL0534)	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.

8. The product orderable part number system listed in this table also applies to the HCPL0453, HCPL0500, HCPL0501, HCPL0531 and HCPL0534 product.

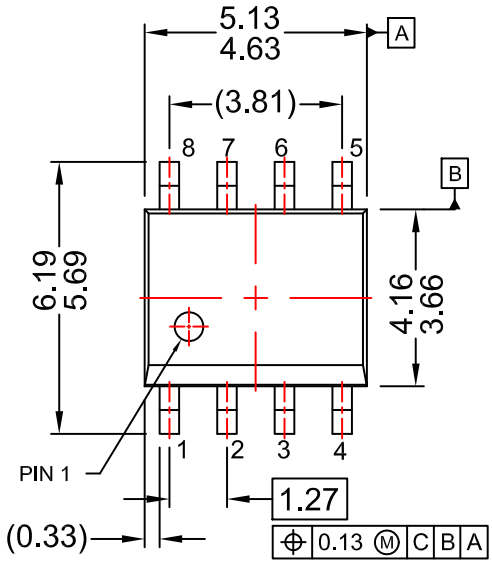
REFLOW PROFILE

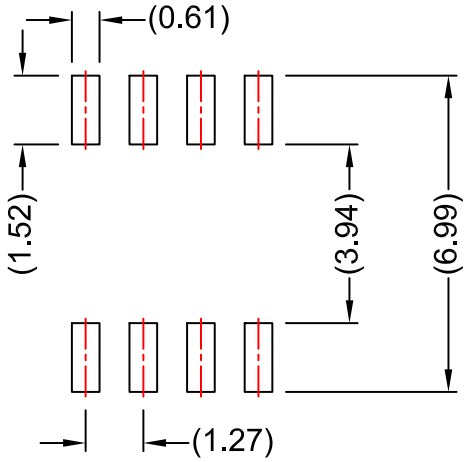


Profile Freature	Pb−Free Assembly Profile
Temperature Min. (Tsmin)	150°C
Temperature Max. (Tsmax)	200°C
Time (t_S) from (Tsmin to Tsmax)	60−120 seconds
Ramp−up Rate (t_L to t_P)	3°C/second max.
Liquidous Temperature (T_L)	217°C
Time (t_L) Maintained Above (T_L)	60−150 seconds
Peak Body Package Temperature	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.

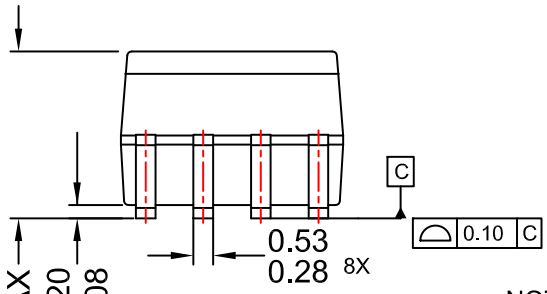
SOIC8
CASE 751DZ
ISSUE O

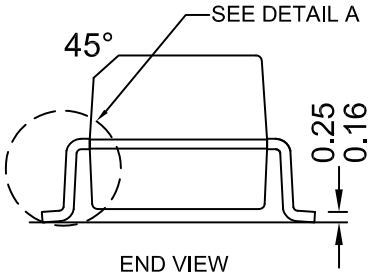
DATE 30 SEP 2016



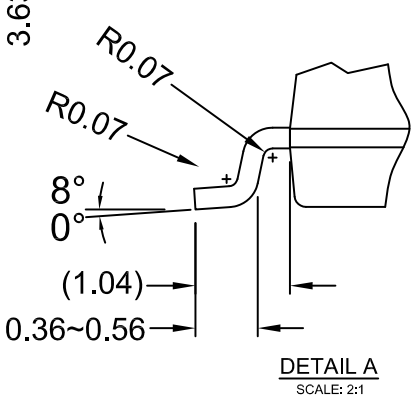


LAND PATTERN RECOMMENDATION





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.

DOCUMENT NUMBER:	**98AON13733G**	Electronic versions are uncontrolled except when accessed directly from the Document Repository. Printed versions are uncontrolled except when stamped "CONTROLLED COPY" in red.	
DESCRIPTION:	**SOIC8**		**PAGE 1 OF 1**

ON Semiconductor and ON are trademarks of Semiconductor Components Industries, LLC dba ON Semiconductor or its subsidiaries in the United States and/or other countries. ON Semiconductor reserves the right to make changes without further notice to any products herein. ON Semiconductor makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does ON Semiconductor assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. ON Semiconductor does not convey any license under its patent rights nor the rights of others.

© Semiconductor Components Industries, LLC, 2019

onsemi, , and other names, marks, and brands are registered and/or common law trademarks of Semiconductor Components Industries, LLC dba "**onsemi**" or its affiliates and/or subsidiaries in the United States and/or other countries. **onsemi** owns the rights to a number of patents, trademarks, copyrights, trade secrets, and other intellectual property. A listing of **onsemi**'s product/patent coverage may be accessed at www.onsemi.com/site/pdf/Patent−Marking.pdf. **onsemi** reserves the right to make changes at any time to any products or information herein, without notice. The information herein is provided "as−is" and **onsemi** makes no warranty, representation or guarantee regarding the accuracy of the information, product features, availability, functionality, or suitability of its products for any particular purpose, nor does **onsemi** assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. Buyer is responsible for its products and applications using **onsemi** products, including compliance with all laws, regulations and safety requirements or standards, regardless of any support or applications information provided by **onsemi**. "Typical" parameters which may be provided in **onsemi** data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. **onsemi** does not convey any license under any of its intellectual property rights nor the rights of others. **onsemi** products are not designed, intended, or authorized for use as a critical component in life support systems or any FDA Class 3 medical devices or medical devices with a same or similar classification in a foreign jurisdiction or any devices intended for implantation in the human body. Should Buyer purchase or use **onsemi** products for any such unintended or unauthorized application, Buyer shall indemnify and hold **onsemi** and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that **onsemi** was negligent regarding the design or manufacture of the part. **onsemi** is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner.

ADDITIONAL INFORMATION

TECHNICAL PUBLICATIONS:
Technical Library: www.onsemi.com/design/resources/technical−documentation
onsemi Website: www.onsemi.com

ONLINE SUPPORT: www.onsemi.com/support
For additional information, please contact your local Sales Representative at www.onsemi.com/support/sales