Agilent Technologies

0.5 Amp Output Current IGBT Gate Drive Optocoupler

Technical Data

HCPL-3150 (Single Channel)
HCPL-315J (Dual Channel)

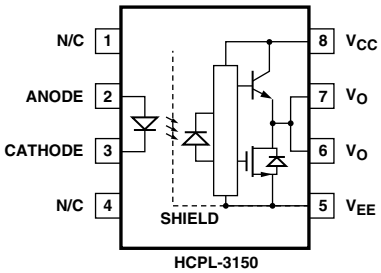
Features

- **0.5 A Minimum Peak Output Current**
- **15 kV/μs Minimum Common Mode Rejection (CMR) at V_{CM} = 1500 V**
- **1.0 V Maximum Low Level Output Voltage (V_{OL}) Eliminates Need for Negative Gate Drive**
- **I_{CC} = 5 mA Maximum Supply Current**
- **Under Voltage Lock-Out Protection (UVLO) with Hysteresis**
- **Wide Operating V_{CC} Range:** 15 to 30 Volts
- **0.5 μs Maximum Propagation Delay**
- **+/– 0.35 μs Maximum Delay Between Devices/Channels**
- **Industrial Temperature Range:** -40°C to 100°C
- **HCPL-315J: Channel One to Channel Two Output Isolation = 1500 Vrms/1 min.**
- **Safety and Regulatory Approval:** UL Recognized (UL1577) 3750 Vrms/1 min. IEC/EN/DIN EN 60747-5-2 Approved V_{IORM} = 630 V_{peak} (HCPL-3150 Option 060 only) V_{IORM} = 891 V_{peak} (HCPL-315J) CSA Certified

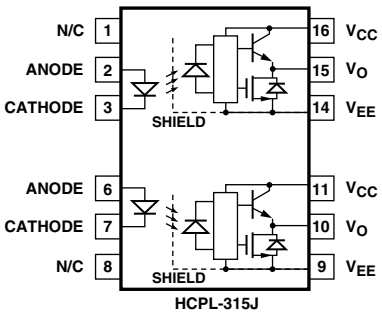
Applications

- **Isolated IGBT/MOSFET Gate Drive**
- **AC and Brushless DC Motor Drives**
- **Industrial Inverters**
- **Switch Mode Power Supplies (SMPS)**
- **Uninterruptable Power Supplies (UPS)**

Functional Diagram



HCPL-3150



HCPL-315J

TRUTH TABLE

LED	V_{CC} - V_{EE} "Positive Going" (i.e., Turn-On)	V_{CC} - V_{EE} "Negative-Going" (i.e., Turn-Off)	V_O
OFF	0 - 30 V	0 - 30 V	LOW
ON	0 - 11 V	0 - 9.5 V	LOW
ON	11 - 13.5 V	9.5 - 12 V	TRANSITION
ON	13.5 - 30 V	12 - 30 V	HIGH

Description

The HCPL-315X consists of a LED optically coupled to an integrated circuit with a power output stage. This optocoupler is ideally suited for driving power IGBTs and MOSFETs used in motor control inverter applications. The high operating voltage range of the output stage provides the drive voltages required by gate controlled devices. The voltage and current supplied by this optocoupler makes it ideally suited for directly driving IGBTs with ratings up to 1200 V/50 A. For IGBTs with higher ratings, the HCPL-3150/315J can be used to drive a discrete power stage which drives the IGBT gate.

A 0.1 μF bypass capacitor must be connected between the V_{CC} and V_{EE} pins for each channel.

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.

Selection Guide: Invertor Gate Drive Optoisolators

Package Type	8-Pin DIP (300 mil)				Widebody (400 mil)	Small Outline SO-16		
Part Number	**HCPL-3150**	**HCPL-3120**	**HCPL-J312**	**HCPL-J314**	**HCNW-3120**	**HCPL-315J**	**HCPL-316J**	**HCPL-314J**
Number of Channels	1	1	1	1	1	2	1	2
IEC/EN/DIN EN 60747-5-2 Approvals	V_{IORM} 630 V_{peak} Option 060		V_{IORM} 891V_{peak}		V_{IORM} 1414 V_{peak}	V_{IORM} 891 V_{peak}		
UL Approval	3750 Vrms/1 min.		3750 Vrms/1 min.		5000 Vrms/1min.	3750 Vrms/1 min.		
Output Peak Current	0.5A	2A	2A	0.4A	2A	0.5A	2A	0.4A
CMR (minimum)	15 kV/µs			10 kV/µs	15 kV/µs			10 kV/µs
UVLO	Yes			No	Yes			No
Fault Status	No						Yes	No

Ordering Information

Specify Part Number followed by Option Number (if desired)

Example
HCPL-315Y#XXXX

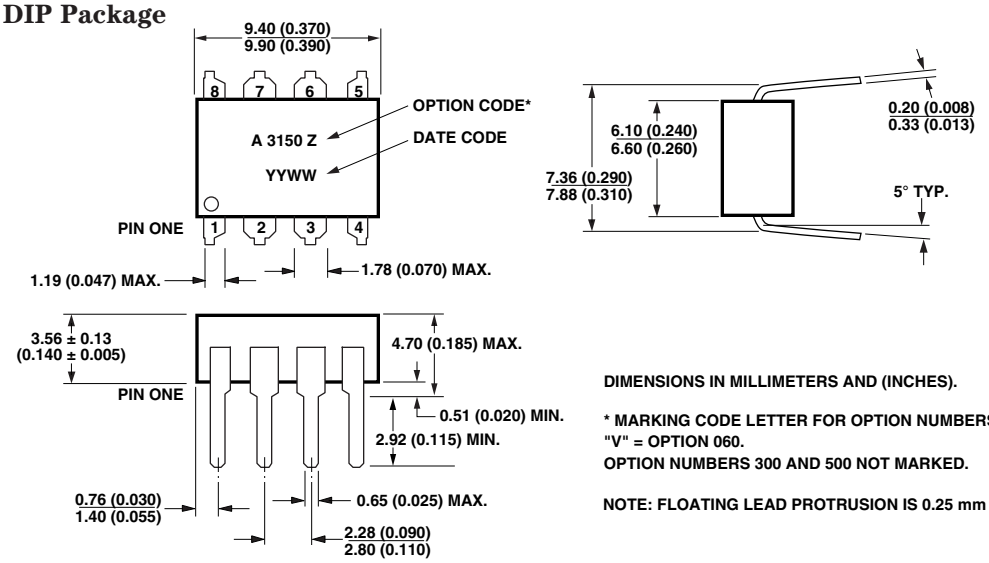
- No Option = Standard DIP package, 50 per tube.
- 060 = IEC/EN/DIN EN 60747-5-2 V_{IORM} = 630 Vpeak Option, 50 per tube. (HCPL-3150 only)
- 300 = Gull Wing Surface Mount Option, 50 per tube. (HCPL-3150 only)
- 500 = Tape and Reel Packaging Option. HCPL-3150; 1000 per reel. HCPL-315J; 850 per reel.
- XXXE = Lead Free Option
- ∅ = Single Channel, 8-pin PDIP.
- J = Dual Channel, SO16.

Option data sheets available. Contact Agilent sales representative or authorized distributor.

Remarks: The notation "#" is used for existing products, while (new) products launched since 15th July 2001 and lead free option will use "–"

Package Outline Drawings

Standard DIP Package



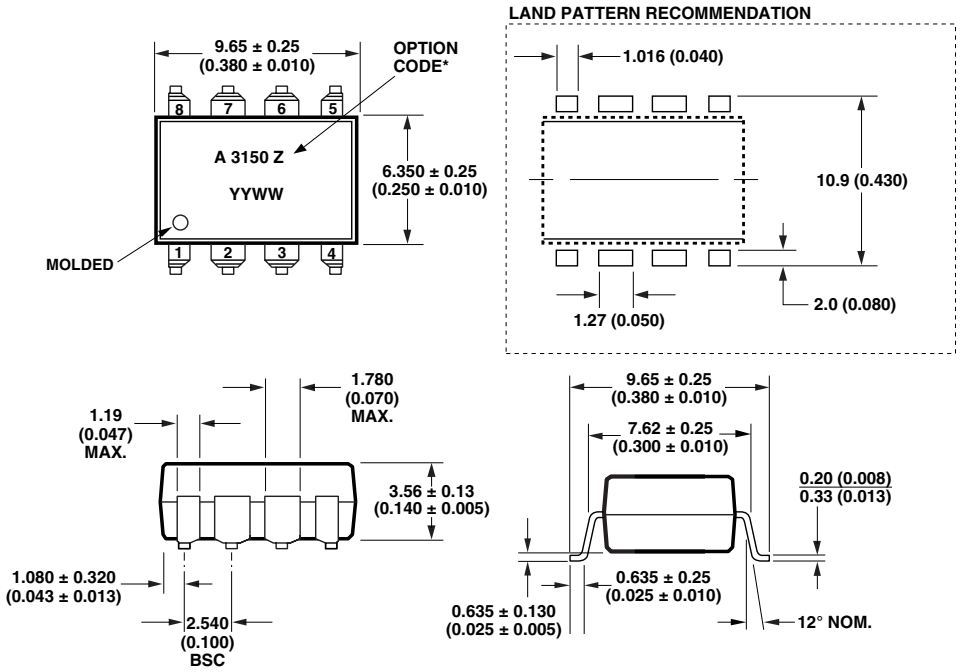
DIMENSIONS IN MILLIMETERS AND (INCHES).

* 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.

Package Outline Drawings

Gull-Wing Surface-Mount Option 300



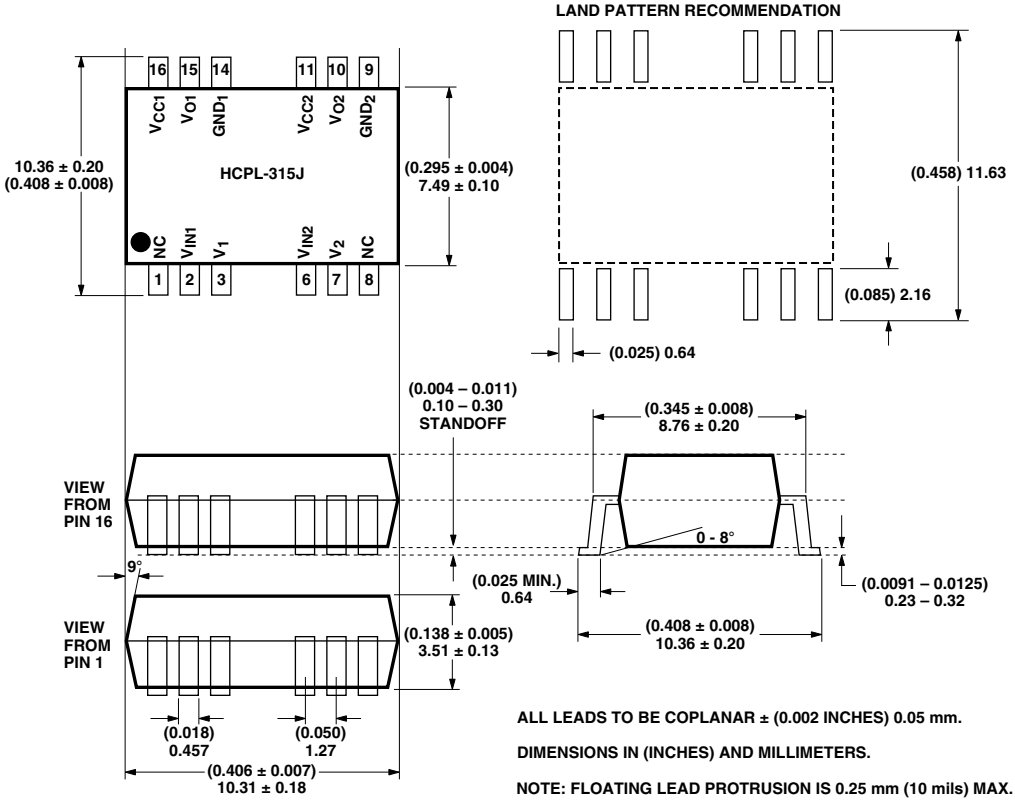
DIMENSIONS IN MILLIMETERS (INCHES).
TOLERANCES (UNLESS OTHERWISE SPECIFIED): xx.xx = 0.01
xx.xxx = 0.005

LEAD COPLANARITY
MAXIMUM: 0.102 (0.004)

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

*MARKING CODE LETTER FOR OPTION NUMBERS.
"V" = OPTION 060.
OPTION NUMBERS 300 AND 500 NOT MARKED.

16 - Lead Surface Mount

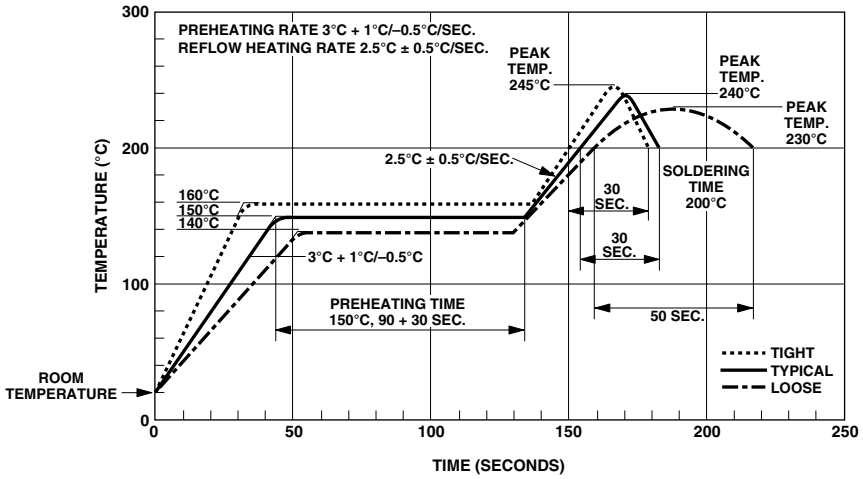


ALL LEADS TO BE COPLANAR ± (0.002 INCHES) 0.05 mm.

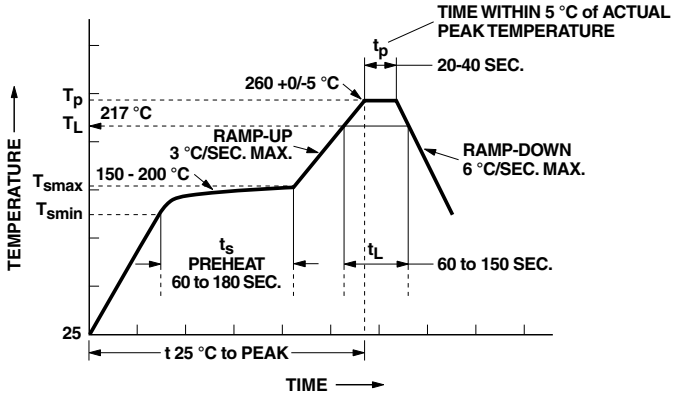
DIMENSIONS IN (INCHES) AND MILLIMETERS.

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

Solder Reflow Thermal Profile



Recommended Pb-Free IR Profile



NOTES:
THE TIME FROM 25 °C to PEAK TEMPERATURE = 8 MINUTES MAX.
T_{smax} = 200 °C, T_{smin} = 150 °C

Regulatory Information

The HCPL-3150 and HCPL-315J 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 60747-5-2

Approved under:
IEC 60747-5-2:1997 + A1:2002
EN 60747-5-2:2001 + A1:2002
DIN EN 60747-5-2 (VDE 0884 Teil 2):2003-01.
(Option 060 and HCPL-315J only)

IEC/EN/DIN EN 60747-5-2 Insulation Characteristics

Description	Symbol	HCPL-3150#060	HCPL-315J**	Unit
Installation classification per DIN VDE 0110/1.89, Table 1 for rated mains voltage ≤ 150 Vrms for rated mains voltage ≤ 300 Vrms for rated mains voltage ≤ 600 Vrms		 I-IV I-III	 I-IV I-III I-II	
Climatic Classification		55/100/21	55/100/21	
Pollution Degree (DIN VDE 0110/1.89)		2	2	
Maximum Working Insulation Voltage	V_{IORM}	630	891	Vpeak
Input to Output Test Voltage, Method b* V_{IORM} x 1.875 = V_{PR}, 100% Production Test with t_m = 1 sec, Partial discharge < 5 pC	V_{PR}	1181	1670	Vpeak
Input to Output Test Voltage, Method a* V_{IORM} x 1.5 = V_{PR}, Type and Sample Test, t_m = 60 sec, Partial discharge < 5 pC	V_{PR}	945	1336	Vpeak
Highest Allowable Overvoltage* (Transient Overvoltage t_{ini} = 10 sec)	V_{IOTM}	6000	6000	Vpeak
Safety-Limiting Values – Maximum Values Allowed in the Event of a Failure, Also See Figure 37, Thermal Derating Curve. Case Temperature Input Current Output Power	 T_S $I_{S, INPUT}$ $P_{S, OUTPUT}$	 175 230 600	 175 400 1200	 °C mA mW
Insulation Resistance at T_S, V_{IO} = 500 V	R_S	≥ 10^9	≥ 10^9	Ω

**Approval Pending.

*Refer to the front of the optocoupler section of the current Catalog, under Product Safety Regulations section IEC/EN/DIN EN 60747-5-2, for a detailed description of Method a and Method b partial discharge test profiles.

Note: Isolation characteristics are guaranteed only within the safety maximum ratings which must be ensured by protective circuits in application.

Insulation and Safety Related Specifications

Parameter	Symbol	HCPL-3150	HCPL-315J	Units	Conditions
Minimum External Air Gap (External Clearance)	L(101)	7.1	8.3	mm	Measured from input terminals to output terminals, shortest distance through air.
Minimum External Tracking (External Creepage)	L(102)	7.4	8.3	mm	Measured from input terminals to output erminals, shortest distance path along body.
Minimum Internal Plastic Gap (Internal Clearance)		0.08	≥ 0.5	mm	Through insulation distance conductor to conductor.
Tracking Resistance (Comparative Tracking Index)	CTI	≥ 175	≥ 175	Volts	DIN IEC 112/VDE 0303 Part 1
Isolation Group		IIIa	IIIa		Material Group (DIN VDE 0110, 1/89, Table 1)

Option 300 - surface mount classification is Class A in accordance wtih CECC 00802.

Absolute Maximum Ratings

Parameter	Symbol	Min.	Max.	Units	Note
Storage Temperature	T_S	-55	125	℃	
Operating Temperature	T_A	-40	100	℃	
Average Input Current	$I_{F(AVG)}$		25	mA	1, 16
Peak Transient Input Current (<1 μs pulse width, 300 pps)	$I_{F(TRAN)}$		1.0	A	
Reverse Input Voltage	V_R		5	Volts	
“High” Peak Output Current	$I_{OH(PEAK)}$		0.6	A	2, 16
“Low” Peak Output Current	$I_{OL(PEAK)}$		0.6	A	2, 16
Supply Voltage	$(V_{CC} - V_{EE})$	0	35	Volts	
Output Voltage	$V_{O(PEAK)}$	0	V_{CC}	Volts	
Output Power Dissipation	P_O		250	mW	3, 16
Total Power Dissipation	P_T		295	mW	4, 16
Lead Solder Temperature	260℃ for 10 sec., 1.6 mm below seating plane				
Solder Reflow Temperature Profile	See Package Outline Drawings Section				

Recommended Operating Conditions

Parameter	Symbol	Min.	Max.	Units
Power Supply Voltage	$(V_{CC} - V_{EE})$	15	30	Volts
Input Current (ON)	$I_{F(ON)}$	7	16	mA
Input Voltage (OFF)	$V_{F(OFF)}$	-3.0	0.8	V
Operating Temperature	T_A	-40	100	℃

Electrical Specifications (DC)

Over recommended operating conditions (T_A = -40 to 100°C, $I_{F(ON)}$ = 7 to 16 mA, $V_{F(OFF)}$ = -3.0 to 0.8 V, V_{CC} = 15 to 30 V, V_{EE} = Ground, each channel) unless otherwise specified.

Parameter	Symbol	Min.	Typ.*	Max.	Units	Test Conditions	Fig.	Note
High Level Output Current	I_{OH}	0.1	0.4		A	V_O = (V_{CC} - 4 V)	2, 3, 17	5
		0.5				V_O = (V_{CC} - 15 V)		2
Low Level Output Current	I_{OL}	0.1	0.6		A	V_O = (V_{EE} + 2.5 V)	5, 6, 18	5
		0.5				V_O = (V_{EE} + 15 V)		2
High Level Output Voltage	V_{OH}	(V_{CC} - 4)	(V_{CC} - 3)		V	I_O = -100 mA	1, 3, 19	6, 7
Low Level Output Voltage	V_{OL}		0.4	1.0	V	I_O = 100 mA	4, 6, 20	
High Level Supply Current	I_{CCH}		2.5	5.0	mA	Output Open, I_F = 7 to 16 mA	7, 8	16
Low Level Supply Current	I_{CCL}		2.7	5.0	mA	Output Open, V_F = -3.0 to +0.8 V		
Threshold Input Current Low to High	I_{FLH}		2.2	5.0	mA	HCPL-3150	I_O = 0 mA, V_O > 5 V	9, 15, 21	
			2.6	6.4		HCPL-315J			
Threshold Input Voltage High to Low	V_{FHL}	0.8			V				
Input Forward Voltage	V_F	1.2	1.5	1.8	V	HCPL-3150	I_F = 10 mA	16	
			1.6	1.95		HCPL-315J			
Temperature Coefficient of Forward Voltage	$\Delta V_F/\Delta T_A$		-1.6		mV/°C	I_F = 10 mA			
Input Reverse Breakdown Voltage	BV_R	5			V	HCPL-3150	I_R = 10 µA		
		3				HCPL-315J	I_R = 10 µA		
Input Capacitance	C_{IN}		70		pF	f = 1 MHz, V_F = 0 V			
UVLO Threshold	V_{UVLO+}	11.0	12.3	13.5	V	V_O > 5 V, I_F = 10 mA	22, 36	
	V_{UVLO-}	9.5	10.7	12.0				
UVLO Hysteresis	$UVLO_{HYS}$		1.6		V			

*All typical values at T_A = 25°C and V_{CC} - V_{EE} = 30 V, unless otherwise noted.

Switching Specifications (AC)

Over recommended operating conditions (T_A = -40 to 100°C, $I_{F(ON)}$ = 7 to 16 mA, $V_{F(OFF)}$ = -3.0 to 0.8 V, V_{CC} = 15 to 30 V, V_{EE} = Ground, each channel) unless otherwise specified.

Parameter	Symbol	Min.	Typ.*	Max.	Units	Test Conditions	Fig.	Note
Propagation Delay Time to High Output Level	t_{PLH}	0.10	0.30	0.50	µs	Rg = 47 Ω, Cg = 3 nF, f = 10 kHz, Duty Cycle = 50%	10, 11, 12, 13, 14, 23	14
Propagation Delay Time to Low Output Level	t_{PHL}	0.10	0.3	0.50	µs			
Pulse Width Distortion	PWD			0.3	µs			15
Propagation Delay Difference Between Any Two Parts or Channels	PDD (t_{PHL} - t_{PLH})	-0.35		0.35	µs		34,35	10
Rise Time	t_r		0.1		µs		23	
Fall Time	t_f		0.1		µs			
UVLO Turn On Delay	$t_{UVLO\ ON}$		0.8		µs	V_O > 5 V, I_F = 10 mA	22	
UVLO Turn Off Delay	$t_{UVLO\ OFF}$		0.6		µs	V_O < 5 V, I_F = 10 mA		
Output High Level Common Mode Transient Immunity	$\|CM_H\|$	15	30		kV/µs	T_A = 25°C, I_F = 10 to 16 mA, V_{CM} = 1500 V, V_{CC} = 30 V	24	11, 12
Output Low Level Common Mode Transient Immunity	$\|CM_L\|$	15	30		kV/µs	T_A = 25°C, V_{CM} = 1500 V, V_F = 0 V, V_{CC} = 30 V		11, 13

Package Characteristics (each channel, unless otherwise specified)

Parameter	Symbol	Device	Min.	Typ.*	Max.	Units	Test Conditions	Fig.	Note
Input-Output Momentary Withstand Voltage**	V_{ISO}	HCPL-3150	3750			Vrms	RH < 50%, t = 1 min., T_A = 25°C		8, 9
		HCPL-315J	3750						
Output-Output Momentary Withstand Voltage**	V_{O-O}	HCPL-315J	1500			Vrms	RH < 50% t = 1 min., T_A = 25°C		17
Resistance (Input - Output)	R_{I-O}			10^{12}		Ω	V_{I-O} = 500 V_{DC}		9
Capacitance (Input - Output)	C_{I-O}	HCPL-3150		0.6		pF	f = 1 MHz		
		HCPL-315J		1.3					
LED-to-Case Thermal Resistance	θ_{LC}	HCPL-3150		391		°C/W	Thermocouple located at center underside of package	28	18
LED-to-Detector Thermal Resistance	θ_{LD}	HCPL-3150		439		°C/W			
Detector-to-Case Thermal Resistance	θ_{DC}	HCPL-3150		119		°C/W			

*All typical values at T_A = 25°C and V_{CC} - V_{EE} = 30 V, unless otherwise noted.
**The Input-Output/Output-Output Momentary Withstand Voltage is a dielectric voltage rating that should not be interpreted as an input-output/output-output continuous voltage rating. For the continuous voltage rating refer to your equipment level safety specification or Agilent Application Note 1074 entitled "Optocoupler Input-Output Endurance Voltage."

Notes:

1. Derate linearly above 70°C free-air temperature at a rate of 0.3 mA/°C.
2. Maximum pulse width = 10 µs, maximum duty cycle = 0.2%. This value is intended to allow for component tolerances for designs with I_O peak minimum = 0.5 A. See Applications section for additional details on limiting I_{OH} peak.
3. Derate linearly above 70°C free-air temperature at a rate of 4.8 mW/°C.
4. Derate linearly above 70°C free-air temperature at a rate of 5.4 mW/°C. The maximum LED junction temperature should not exceed 125°C.
5. Maximum pulse width = 50 µs, maximum duty cycle = 0.5%.
6. In this test V_{OH} is measured with a dc load current. When driving capacitive loads V_{OH} will approach V_{CC} as I_{OH} approaches zero amps.
7. Maximum pulse width = 1 ms, maximum duty cycle = 20%.
8. In accordance with UL1577, each HCPL-3150 optocoupler is proof tested by applying an insulation test voltage ≥ 4500 Vrms (≥ 5000 Vrms for the HCPL-315J) for 1 second (leakage detection current limit, I_{I-O} ≤ 5 µA). This test is performed before the 100% production test for partial discharge (method b) shown in the IEC/EN/DIN EN 60747-5-2 Insulation Characteristics Table, if applicable.
9. Device considered a two-terminal device: pins on input side shorted together and pins on output side shorted together.
10. The difference between t_{PHL} and t_{PLH} between any two parts or channels under the same test condition.
11. Pins 1 and 4 (HCPL-3150) and pins 3 and 4 (HCPL-315J) need to be connected to LED common.
12. Common mode transient immunity in the high state is the maximum tolerable $|dV_{CM}/dt|$ of the common mode pulse, V_{CM}, to assure that the output will remain in the high state (i.e., V_O > 15.0 V).
13. Common mode transient immunity in a low state is the maximum tolerable $|dV_{CM}/dt|$ of the common mode pulse, V_{CM}, to assure that the output will remain in a low state (i.e., V_O < 1.0 V).
14. This load condition approximates the gate load of a 1200 V/25 A IGBT.
15. Pulse Width Distortion (PWD) is defined as $|t_{PHL}-t_{PLH}|$ for any given device.
16. Each channel.
17. Device considered a two terminal device: Channel one output side pins shorted together, and channel two output side pins shorted together.
18. See the thermal model for the HCPL-315J in the application section of this data sheet.