



**THE DATASHEET OF  
6N136W**

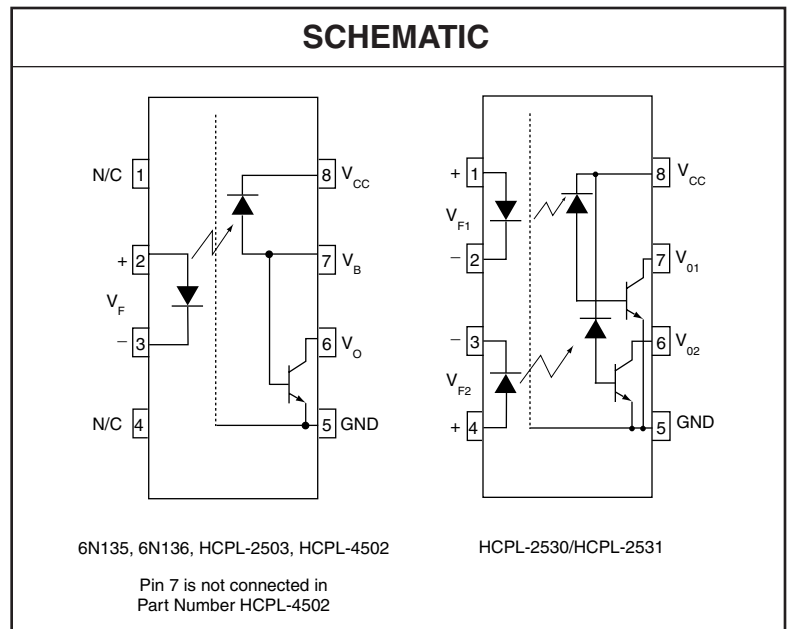
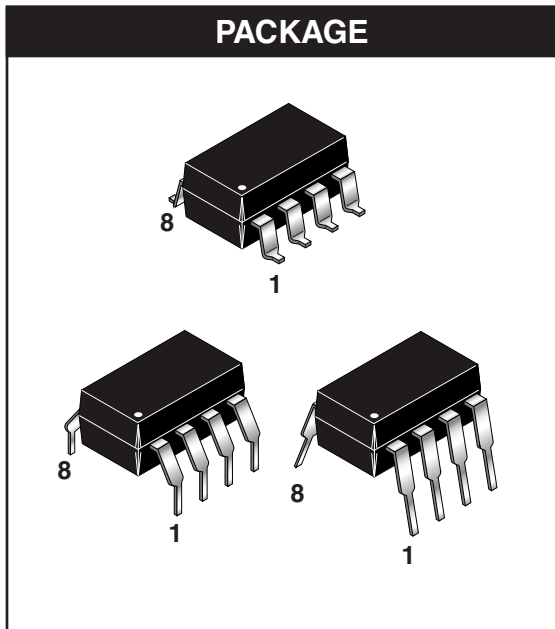


**SINGLE-CHANNEL: 6N135**  
**DUAL-CHANNEL: HCPL-2530**

**6N136**  
**HCPL-2531**

**HCPL-2503**

**HCPL-4502**



**DESCRIPTION**

The HCPL-4502/HCPL-2503, 6N135/6 and HCPL-2530/HCPL-2531 optocouplers consist of an AlGaAs LED optically coupled to a high speed photodetector transistor.

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.

An internal noise shield provides superior common mode rejection of 10kV/μs. An improved package allows superior insulation permitting a 480 V working voltage compared to industry standard of 220 V.

**FEATURES**

- High speed-1 MBit/s
- Superior CMR-10 kV/μs
- Dual-Channel HCPL-2530/HCPL-2531
- Double working voltage-480V RMS
- CTR guaranteed 0-70°C
- U.L. recognized (File # E90700)

**APPLICATIONS**

- Line receivers
- Pulse transformer replacement
- Output interface to CMOS-LSTTL-TTL
- Wide bandwidth analog coupling

**SINGLE-CHANNEL: 6N135**  
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**ABSOLUTE MAXIMUM RATINGS** ( $T_A = 25^\circ\text{C}$  unless otherwise specified)

Parameter	Symbol	Value	Units
Storage Temperature	$T_{STG}$	-55 to +125	$^\circ\text{C}$
Operating Temperature	$T_{OPR}$	-55 to +100	$^\circ\text{C}$
Lead Solder Temperature	$T_{SOL}$	260 for 10 sec	$^\circ\text{C}$
<b>EMITTER</b>			
DC/Average Forward Input Current	Each Channel (Note 1)	$I_F$ (avg)	25 mA
Peak Forward Input Current (50% duty cycle, 1 ms P.W.)	Each Channel (Note 2)	$I_F$ (pk)	50 mA
Peak Transient Input Current - ( $\leq 1 \mu\text{s}$ P.W., 300 pps)	Each Channel	$I_F$ (trans)	1.0 A
Reverse Input Voltage	Each Channel	$V_R$	5 V
Input Power Dissipation	(6N135/6N136 and HCPL-2503/4502) (HCPL-2530/2531) Each Channel (Note 3)	$P_D$	100 45 mW
<b>DETECTOR</b>			
Average Output Current	Each Channel	$I_O$ (avg)	8 mA
Peak Output Current	Each Channel	$I_O$ (pk)	16 mA
Emitter-Base Reverse Voltage	(6N135, 6N136 and HCPL-2503 only)	$V_{EBR}$	5 V
Supply Voltage		$V_{CC}$	-0.5 to 30 V
Output Voltage		$V_O$	-0.5 to 20 V
Base Current	(6N135, 6N136 and HCPL-2503 only)	$I_B$	5 mA
Output power dissipation	(6N135, 6N136, HCPL-2503, HCPL-4502) (Note 4) (HCPL-2530, HCPL-2531) Each Channel	$P_D$	100 35 mW

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**DUAL-CHANNEL: HCPL-2530**

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**ELECTRICAL CHARACTERISTICS** ( $T_A = 0$  to  $70^\circ\text{C}$  Unless otherwise specified)

**INDIVIDUAL COMPONENT CHARACTERISTICS**

Parameter	Test Conditions	Symbol	Device	Min	Typ**	Max	Unit
<b>EMITTER</b> Input Forward Voltage	( $I_F = 16$ mA, $T_A = 25^\circ\text{C}$ )	$V_F$			1.45	1.7	V
	( $I_F = 16$ mA)				1.8		
Input Reverse Breakdown Voltage	( $I_R = 10$ $\mu\text{A}$ )	$B_{VR}$		5.0			V
Temperature coefficient of forward voltage	( $I_F = 16$ mA)	( $\Delta V_F / \Delta T_A$ )			-1.6		mV/ $^\circ\text{C}$
<b>DETECTOR</b> Logic high output current	( $I_F = 0$ mA, $V_O = V_{CC} = 5.5$ V) ( $T_A = 25^\circ\text{C}$ )	$I_{OH}$	All		0.001	0.5	$\mu\text{A}$
	( $I_F = 0$ mA, $V_O = V_{CC} = 15$ V) ( $T_A = 25^\circ\text{C}$ )		6N135 6N136 HCPL-4502 HCPL-2503		0.005	1	
	( $I_F = 0$ mA, $V_O = V_{CC} = 15$ V)		All			50	
Logic low supply current	( $I_F = 16$ mA, $V_O = \text{Open}$ ) ( $V_{CC} = 15$ V)	$I_{CCL}$	6N135 6N136 HCPL-4502 HCPL-2503		120	200	$\mu\text{A}$
	( $I_{F1} = I_{F2} = 16$ mA, $V_O = \text{Open}$ ) ( $V_{CC} = 15$ V)		HCPL-2530 HCPL-2531		200	400	
Logic high supply current	( $I_F = 0$ mA, $V_O = \text{Open}$ , $V_{CC} = 15$ V) ( $T_A = 25^\circ\text{C}$ )	$I_{CCH}$	6N135 6N136 HCPL-4502 HCPL-2503			1	$\mu\text{A}$
	( $I_F = 0$ mA, $V_O = \text{Open}$ ) ( $V_{CC} = 15$ V)		6N135 6N136 HCPL-4502 HCPL-2503			2	
	( $I_F = 0$ mA, $V_O = \text{Open}$ ) ( $V_{CC} = 15$ V)		HCPL-2530 HCPL-2531		0.02	4	

\*\* All Typical at  $T_A = 25^\circ\text{C}$

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**TRANSFER CHARACTERISTICS** ( $T_A = 0$  to  $70^\circ\text{C}$  Unless otherwise specified)

Parameter	Test Conditions	Symbol	Device	Min	Typ**	Max	Unit		
COUPLED  Current transfer ratio (Note 5)	$(I_F = 16 \text{ mA}, V_O = 0.4 \text{ V})$ $(V_{CC} = 4.5 \text{ V}, T_A = 25^\circ\text{C})$	CTR	6N135 HCPL-2530	7	18	50	%		
			6N136 HCPL-4502 HCPL-2531	19	27	50	%		
			HCPL-2503	12	27		%		
	$V_{OL}=0.4\text{V}$ $V_{OL}=0.5\text{V}$		6N135 HCPL-2530	5	21		%		
	$(I_F = 16 \text{ mA}, V_{CC} = 4.5 \text{ V})$ $V_{OL}=0.4\text{V}$ $V_{OL}=0.5\text{V}$ $V_{OL}=0.4\text{V}$							6N136 HCPL-4502 HCPL-2531	15
			HCPL-2503	9	30		%		
	Logic low output voltage output voltage		$(I_F = 16 \text{ mA}, I_O = 1.1 \text{ mA})$ $(V_{CC} = 4.5 \text{ V}, T_A = 25^\circ\text{C})$	V <sub>OL</sub>	6N135		0.18	0.4	V
					HCPL-2530		0.18	0.5	
			6N136 HCPL-2503			0.25	0.4		
			HCPL-2531			0.25	0.5		
$(I_F = 16 \text{ mA}, I_O = 0.8 \text{ mA})$ $(V_{CC} = 4.5 \text{ V})$		6N135 HCPL-2530				0.5			
$(I_F = 16 \text{ mA}, I_O = 2.4 \text{ mA})$ $(V_{CC} = 4.5 \text{ V})$		HCPL-4502 HCPL-2531				0.5			

\*\* All Typicals at  $T_A = 25^\circ\text{C}$

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<b>SWITCHING CHARACTERISTICS</b> ( $T_A = 0$ to $70^\circ\text{C}$ unless otherwise specified., $V_{CC} = 5\text{ V}$ )							
Parameter	Test Conditions	Symbol	Device	Min	Typ**	Max	Unit
Propagation delay time to logic low	$T_A = 25^\circ\text{C}$ , ( $R_L = 4.1\text{ k}\Omega$ , $I_F = 16\text{ mA}$ ) (Note 6) (Fig. 7)	$T_{PHL}$	6N135 HCPL-2530		0.45	1.5	$\mu\text{s}$
	$(R_L = 1.9\text{ k}\Omega$ , $I_F = 16\text{ mA}$ ) (Note 7) (Fig. 7) $T_A = 25^\circ\text{C}$		6N136 HCPL-4502 HCPL-2503 HCPL-2531		0.45	0.8	$\mu\text{s}$
	$(R_L = 4.1\text{ k}\Omega$ , $I_F = 16\text{ mA}$ ) (Note 6) (Fig. 7)		6N135 HCPL-2530			2.0	$\mu\text{s}$
	$(R_L = 1.9\text{ k}\Omega$ , $I_F = 16\text{ mA}$ ) (Note 7) (Fig. 7)		6N136 HCPL-4502 HCPL-2503 HCPL-2531			1.0	$\mu\text{s}$
Propagation delay time to logic high	$T_A = 25^\circ\text{C}$ , ( $R_L = 4.1\text{ k}\Omega$ , $I_F = 16\text{ mA}$ ) (Note 6) (Fig. 7)	$T_{PLH}$	6N135 HCPL-2530		0.5	1.5	$\mu\text{s}$
	$(R_L = 1.9\text{ k}\Omega$ , $I_F = 16\text{ mA}$ ) (Note 7) (Fig. 7) $T_A = 25^\circ\text{C}$		6N136 HCPL-4502 HCPL-2503 HCPL-2531		0.3	0.8	$\mu\text{s}$
	$(R_L = 4.1\text{ k}\Omega$ , $I_F = 16\text{ mA}$ ) (Note 6) (Fig. 7)		6N135 HCPL-2530			2.0	$\mu\text{s}$
	$(R_L = 1.9\text{ k}\Omega$ , $I_F = 16\text{ mA}$ ) (Note 7) (Fig. 7)		6N136 HCPL-4502 HCPL-2503 HCPL-2531			1.0	$\mu\text{s}$
Common mode transient immunity at logic high	$(I_F = 0\text{ mA}$ , $V_{CM} = 10\text{ V}_{P-P}$ , $R_L = 4.1\text{ k}\Omega$ ) (Note 8) (Fig. 8) $T_A = 25^\circ\text{C}$	$ICM_{HI}$	6N135 HCPL-2530		10,000		$\text{V}/\mu\text{s}$
	$(I_F = 0\text{ mA}$ , $V_{CM} = 10\text{ V}_{P-P}$ ) $T_A = 25^\circ\text{C}$ , ( $R_L = 1.9\text{ k}\Omega$ ) (Note 8) (Fig. 8)		6N136 HCPL-4502 HCPL-2503 HCPL-2531		10,000		$\text{V}/\mu\text{s}$
Common mode transient immunity at logic low	$(I_F = 16\text{ mA}$ , $V_{CM} = 10\text{ V}_{P-P}$ , $R_L = 4.1\text{ k}\Omega$ ) (Note 8) (Fig. 8) $T_A = 25^\circ\text{C}$	$ICM_{LI}$	6N135 HCPL-2530		10,000		$\text{V}/\mu\text{s}$
	$(I_F = 16\text{ mA}$ , $V_{CM} = 10\text{ V}_{P-P}$ ) ( $R_L = 1.9\text{ k}\Omega$ ) (Note 8) (Fig. 8)		6N136 HCPL-4502 HCPL-2503 HCPL-2531		10,000		$\text{V}/\mu\text{s}$

\*\* All Typical at  $T_A = 25^\circ\text{C}$

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**DUAL-CHANNEL: HCPL-2530**

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<b>ISOLATION CHARACTERISTICS</b> ( $T_A = 0$ to $70^\circ\text{C}$ Unless otherwise specified)						
<b>Characteristics</b>	<b>Test Conditions</b>	<b>Symbol</b>	<b>Min</b>	<b>Typ**</b>	<b>Max</b>	<b>Unit</b>
Input-output insulation leakage current	(Relative humidity = 45%) ( $T_A = 25^\circ\text{C}$ , $t = 5$ s) ( $V_{I-O} = 3000$ VDC) (Note 9)	$I_{I-O}$			1.0	$\mu\text{A}$
Withstand insulation test voltage	( $\text{RH} \leq 50\%$ , $T_A = 25^\circ\text{C}$ ) (Note 9) ( $t = 1$ min.)	$V_{\text{ISO}}$	2500			$V_{\text{RMS}}$
Resistance (input to output)	(Note 9) ( $V_{I-O} = 500$ VDC)	$R_{I-O}$		$10^{12}$		$\Omega$
Capacitance (input to output)	(Note 9) ( $f = 1$ MHz)	$C_{I-O}$		0.6		pF
DC Current gain	( $I_O = 3$ mA, $V_O = 5$ V)	HFE		150		
Input-Input Insulation leakage current	( $\text{RH} \leq 45\%$ , $V_{I-I} = 500$ VDC) (Note 10) $t = 5$ s, (HCPL-2530/2531 only)	$I_{I-I}$		0.005		$\mu\text{A}$
Input-Input Resistance	( $V_{I-I} = 500$ VDC) (Note 10) (HCPL-2530/2531 only)	$R_{I-I}$		$10^{11}$		$\Omega$
Input-Input Capacitance	( $f = 1$ MHz) (Note 10) (HCPL-2530/2531 only)	$C_{I-I}$		0.03		pF

**Notes**

1. Derate linearly above  $70^\circ\text{C}$  free-air temperature at a rate of  $0.8$  mA/ $^\circ\text{C}$ .
2. Derate linearly above  $70^\circ\text{C}$  free-air temperature at a rate of  $1.6$  mA/ $^\circ\text{C}$ .
3. Derate linearly above  $70^\circ\text{C}$  free-air temperature at a rate of  $0.9$  mW/ $^\circ\text{C}$ .
4. Derate linearly above  $70^\circ\text{C}$  free-air temperature at a rate of  $2.0$  mW/ $^\circ\text{C}$ .
5. Current Transfer Ratio is defined as a ratio of output collector current,  $I_O$ , to the forward LED input current,  $I_F$ , times 100%.
6. The  $4.1$  k $\Omega$  load represents 1 LSTTL unit load of  $0.36$  mA and  $6.1$  k $\Omega$  pull-up resistor.
7. The  $1.9$  k $\Omega$  load represents 1 TTL unit load of  $1.6$  mA and  $5.6$  k $\Omega$  pull-up resistor.
8. Common mode transient immunity in logic high level is the maximum tolerable (positive)  $dV_{\text{cm}}/dt$  on the leading edge of the common mode pulse signal  $V_{\text{CM}}$ , 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)  $dV_{\text{cm}}/dt$  on the trailing edge of the common mode pulse signal,  $V_{\text{CM}}$ , to assure that the output will remain in a logic low state (i.e.,  $V_O < 0.8$  V).
9. 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.
10. Measured between pins 1 and 2 shorted together, and pins 3 and 4 shorted together.

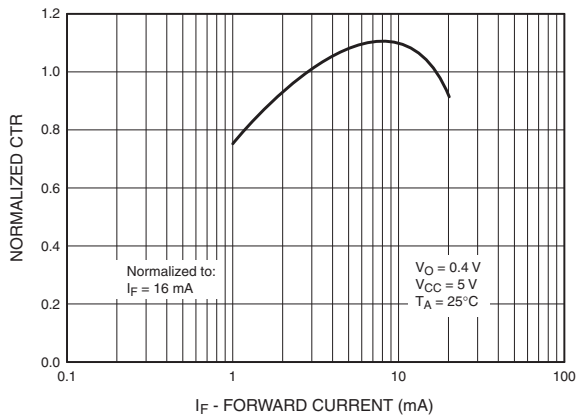
**SINGLE-CHANNEL: 6N135**  
**DUAL-CHANNEL: HCPL-2530**

**6N136**  
**HCPL-2531**

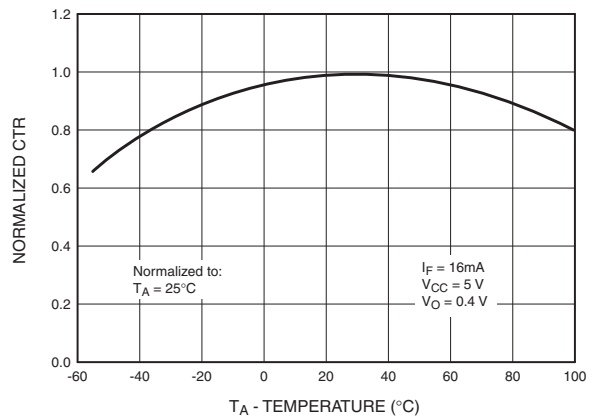
**HCPL-2503**

**HCPL-4502**

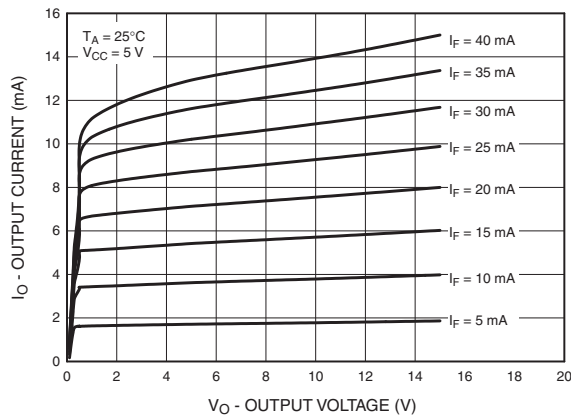
**Fig. 1 Normalized CTR vs. Forward Current**



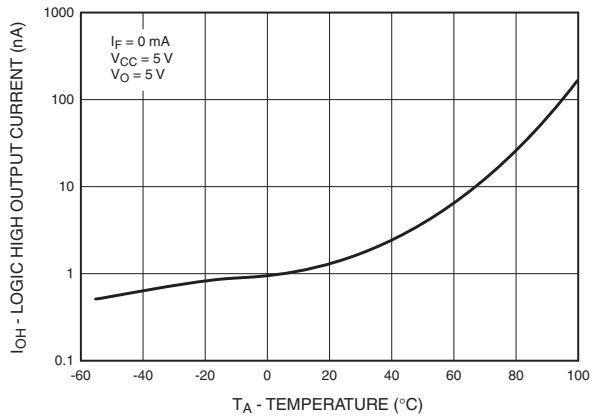
**Fig. 2 Normalized CTR vs. Temperature**



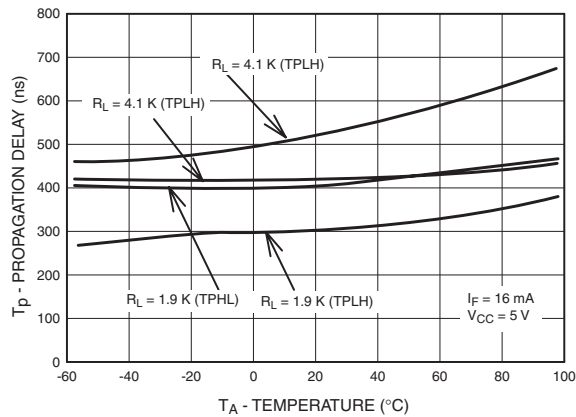
**Fig. 3 Output Current vs. Output Voltage**



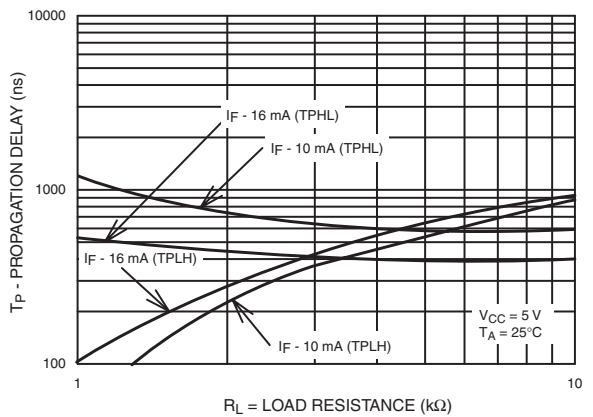
**Fig. 4 Logic High Output Current vs. Temperature**



**Fig. 5 Propagation Delay vs. Temperature**



**Fig. 6 Propagation Delay vs. Load Resistance**

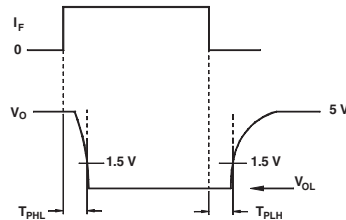
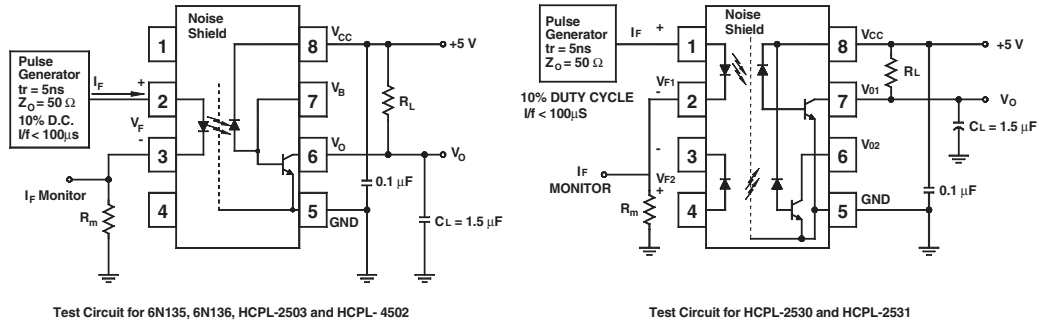


SINGLE-CHANNEL: 6N135  
DUAL-CHANNEL: HCPL-2530

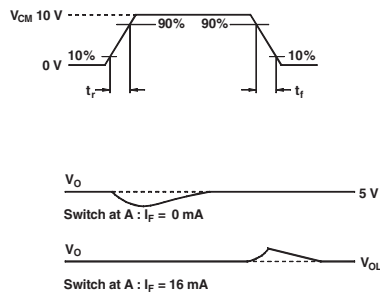
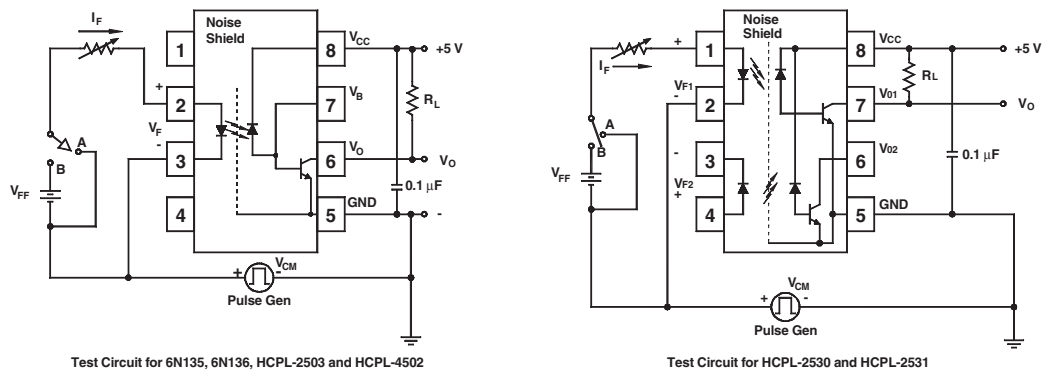
6N136  
HCPL-2531

HCPL-2503

HCPL-4502



**Fig. 7 Switching Time Test Circuit**



**Fig. 8 Common Mode Immunity Test Circuit**

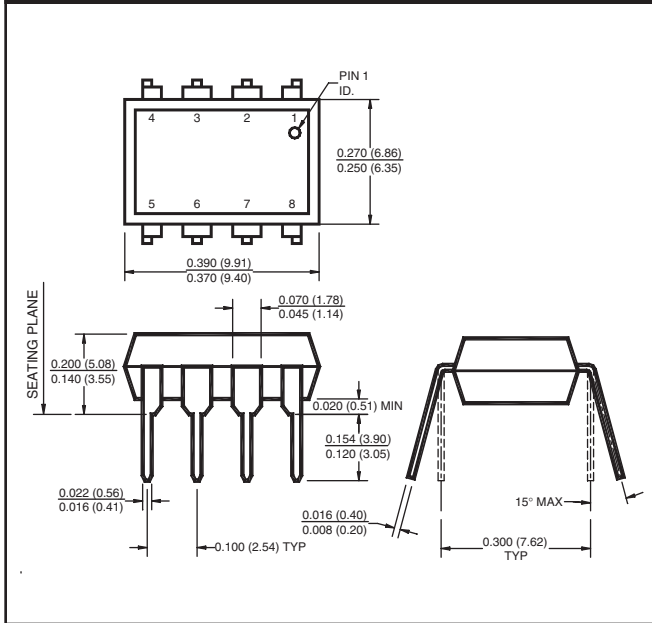
**SINGLE-CHANNEL: 6N135**  
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**6N136**  
**HCPL-2531**

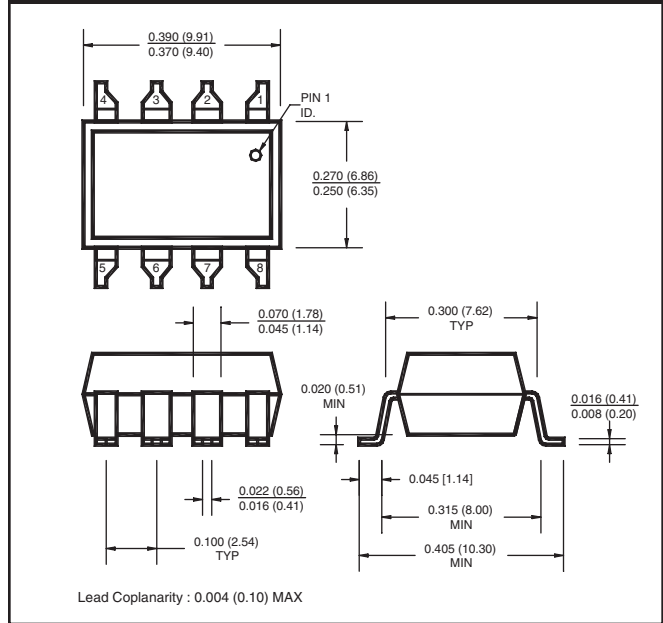
**HCPL-2503**

**HCPL-4502**

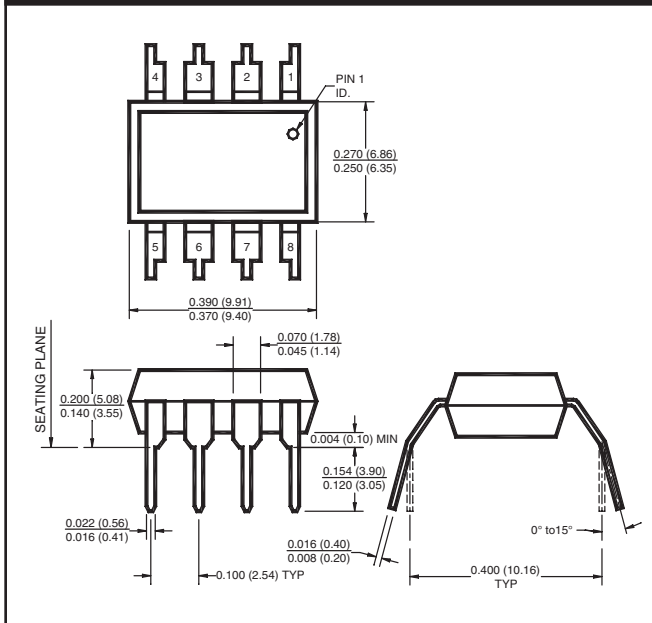
**Package Dimensions (Through Hole)**



**Package Dimensions (Surface Mount)**



**Package Dimensions (0.4" Lead Spacing)**



**NOTE**  
All dimensions are in inches (millimeters)

SINGLE-CHANNEL: 6N135  
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6N136  
HCPL-2531

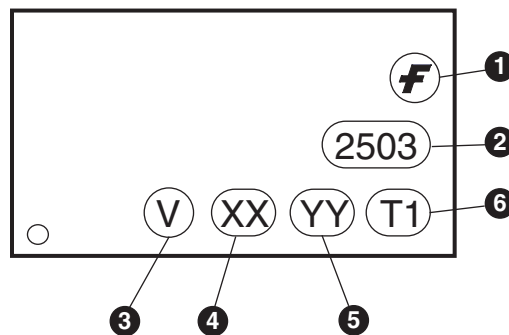
HCPL-2503

HCPL-4502

**ORDERING INFORMATION**

Option	Example Part Number	Description
S	6N135S	Surface Mount Lead Bend
SD	6N135SD	Surface Mount; Tape and reel
T	6N135T	0.4" Lead Spacing
V	6N135V	VDE0884
TV	6N135TV	VDE0884; 0.4" lead spacing
SV	6N135SV	VDE0884; surface mount
SDV	6N135SDV	VDE0884; surface mount; tape and reel

**MARKING INFORMATION**



Definitions	
1	Fairchild logo
2	Device number
3	VDE mark (Note: Only appears on parts ordered with VDE option – See order entry table)
4	Two digit year code, e.g., '03'
5	Two digit work week ranging from '01' to '53'
6	Assembly package code

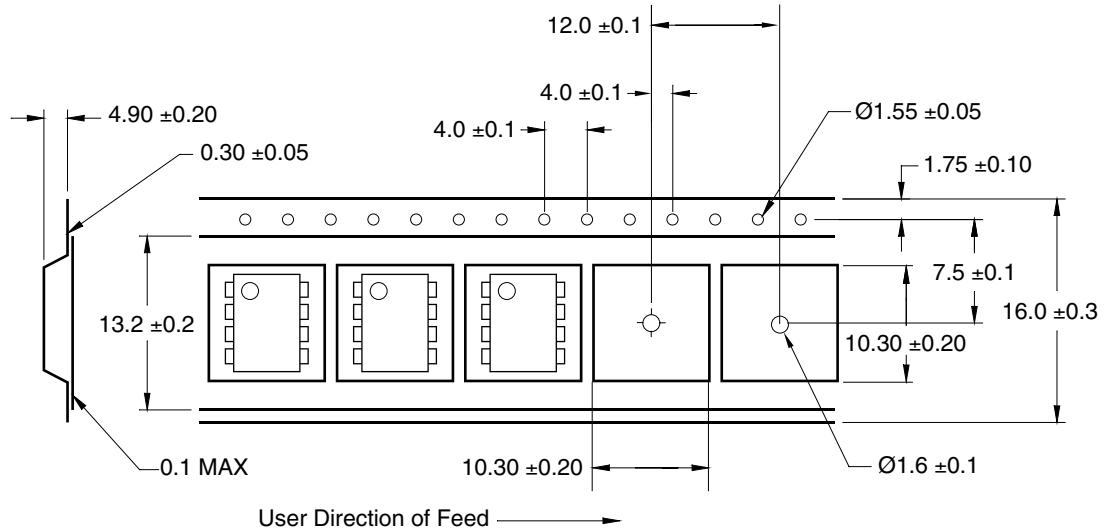
SINGLE-CHANNEL: 6N135  
DUAL-CHANNEL: HCPL-2530

6N136  
HCPL-2531

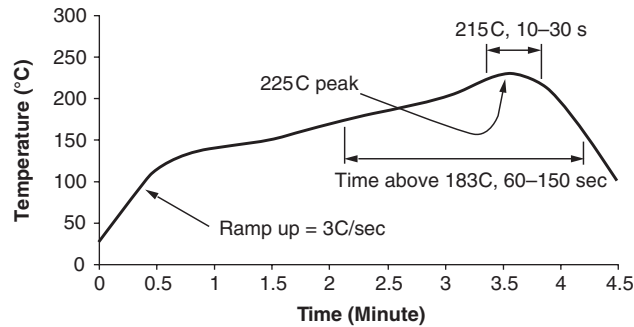
HCPL-2503

HCPL-4502

**Carrier Tape Specifications**



**Reflow Profile**



- Peak reflow temperature: 225C (package surface temperature)
- Time of temperature higher than 183C for 60–150 seconds
- One time soldering reflow is recommended

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