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# Single-Channel: 6N135, 6N136, HCPL2503, HCPL4502 Dual-Channel: HCPL2530, HCPL2531 High Speed Transistor Optocouplers

## Features

- High speed –1 MBit/s
- Superior CMR – 10kV/μs
- Dual-Channel HCPL2530/HCPL2531
- 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

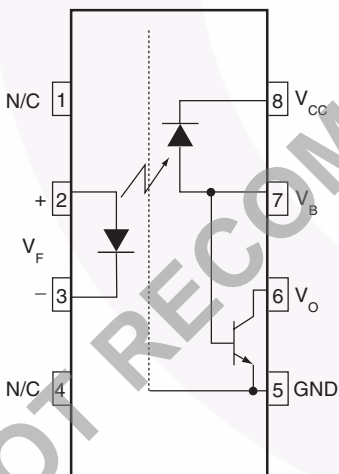
## Description

The HCPL4502, HCPL2503, 6N135, 6N136, HCPL2530 and HCPL2531 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.

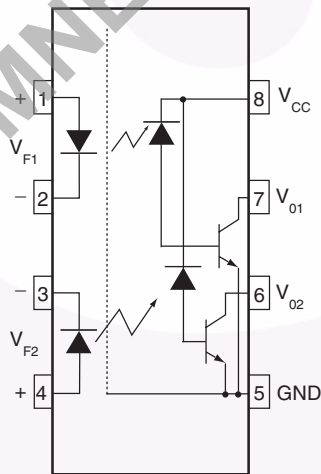
An internal noise shield provides superior common mode rejection of 10kV/μs. An improved package allows superior insulation permitting a 480V working voltage compared to industry standard of 220V.

## Schematics



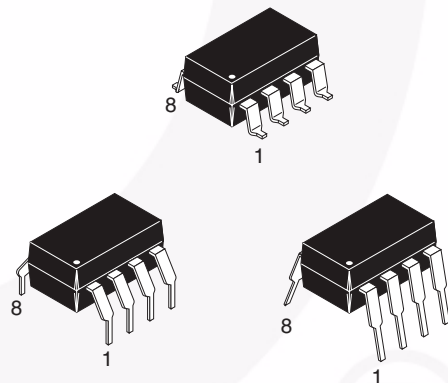
6N135, 6N136, HCPL2503, HCPL4502

Pin 7 is not connected in Part Number HCPL4502



HCPL2530/HCPL2531

## Package Outlines



**Absolute Maximum Ratings** ( $T_A = 25^\circ\text{C}$  unless otherwise specified)

Stresses exceeding the absolute maximum ratings may damage the device. The device may not function or be operable above the recommended operating conditions and stressing the parts to these levels is not recommended. In addition, extended exposure to stresses above the recommended operating conditions may affect device reliability. The absolute maximum ratings are stress ratings only.

Symbol	Parameter	Condition	Value	Units
$T_{STG}$	Storage Temperature		-55 to +125	$^\circ\text{C}$
$T_{OPR}$	Operating Temperature		-55 to +100	$^\circ\text{C}$
$T_{SOL}$	Lead Solder Temperature		260 for 10 sec	$^\circ\text{C}$
<b>EMITTER</b>				
$I_F$ (avg)	DC/Average Forward Input Current Each Channel <sup>(1)</sup>		25	mA
$I_F$ (pk)	Peak Forward Input Current Each Channel <sup>(2)</sup>	50% duty cycle, 1ms P.W.	50	mA
$I_F$ (trans)	Peak Transient Input Current Each Channel	$\leq 1\mu\text{s}$ P.W., 300pps	1.0	A
$V_R$	Reverse Input Voltage Each Channel		5	V
$P_D$	Input Power Dissipation Each Channel	6N135/6N136 and HCPL2503/4502	100	mW
		HCPL-2530/253 <sup>(3)</sup>	45	
<b>DETECTOR</b>				
$I_O$ (avg)	Average Output Current Each Channel		8	mA
$I_O$ (pk)	Peak Output Current Each Channel		16	mA
$V_{EBR}$	Emitter-Base Reverse Voltage	6N135, 6N136 and HCPL2503 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	6N135, 6N136 and HCPL2503 only	5	mA
PD	Output Power Dissipation Each Channel	6N135, 6N136, HCPL2503, HCPL4502 <sup>(4)</sup>	100	mW
		HCPL2530, HCPL2531	35	mW

**Notes:**

1. Derate linearly above  $70^\circ\text{C}$  free-air temperature at a rate of  $0.8\text{mA}/^\circ\text{C}$ .
2. Derate linearly above  $70^\circ\text{C}$  free-air temperature at a rate of  $1.6\text{mA}/^\circ\text{C}$ .
3. Derate linearly above  $70^\circ\text{C}$  free-air temperature at a rate of  $0.9\text{mW}/^\circ\text{C}$ .
4. Derate linearly above  $70^\circ\text{C}$  free-air temperature at a rate of  $2.0\text{mW}/^\circ\text{C}$ .

**Electrical Characteristics** ( $T_A = 0$  to  $70^\circ\text{C}$  Unless otherwise specified)**Individual Component Characteristics**

Symbol	Parameter	Test Conditions	Device	Min.	Typ.*	Max.	Unit
<b>EMITTER</b>							
$V_F$	Input Forward Voltage	$I_F = 16\text{mA}$ , $T_A = 25^\circ\text{C}$			1.45	1.7	V
		$I_F = 16\text{mA}$				1.8	
$B_{VR}$	Input Reverse Breakdown Voltage	$I_R = 10\ \mu\text{A}$		5.0			V
$\Delta V_F/\Delta T_A$	Temperature Coefficient of Forward Voltage	$I_F = 16\text{mA}$			-1.6		mV/ $^\circ\text{C}$
<b>DETECTOR</b>							
$I_{OH}$	Logic High Output Current	$I_F = 0\text{mA}$ , $V_O = V_{CC} = 5.5\text{V}$ , $T_A = 25^\circ\text{C}$	All		0.001	0.5	$\mu\text{A}$
		$I_F = 0\text{mA}$ , $V_O = V_{CC} = 15\text{V}$ , $T_A = 25^\circ\text{C}$	6N135 6N136 HCPL4502 HCPL2503		0.005	1	
		$I_F = 0\text{mA}$ , $V_O = V_{CC} = 15\text{V}$	All			50	
$I_{CCL}$	Logic Low Supply Current	$I_F = 16\text{mA}$ , $V_O = \text{Open}$ , $V_{CC} = 15\text{V}$	6N135 6N136 HCPL4502 HCPL2503		120	200	$\mu\text{A}$
		$I_{F1} = I_{F2} = 16\text{mA}$ , $V_O = \text{Open}$ , $V_{CC} = 15\text{V}$	HCPL2530 HCPL2531		200	400	
$I_{CCH}$	Logic High Supply Current	$I_F = 0\text{mA}$ , $V_O = \text{Open}$ , $V_{CC} = 15\text{V}$ , $T_A = 25^\circ\text{C}$	6N135 6N136 HCPL4502 HCPL2503			1	$\mu\text{A}$
		$I_F = 0\text{mA}$ , $V_O = \text{Open}$ , $V_{CC} = 15\text{V}$	6N135 6N136 HCPL4502 HCPL2503			2	
		$I_F = 0\text{mA}$ , $V_O = \text{Open}$ , $V_{CC} = 15\text{V}$	HCPL2530 HCPL2531		0.02	4	

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

**Electrical Characteristics** (Continued) ( $T_A = 0$  to  $70^\circ\text{C}$  unless otherwise specified)**Transfer Characteristics**

Symbol	Parameter	Test Conditions	Device	Min.	Typ.*	Max.	Unit	
<b>COUPLED</b>								
CTR	Current Transfer Ratio <sup>(5)</sup>	$I_F = 16\text{mA}$ , $V_O = 0.4\text{V}$ , $V_{CC} = 4.5\text{V}$ , $T_A = 25^\circ\text{C}$	6N135 HCPL2530	7	18	50	%	
			6N136 HCPL4502 HCPL2531	19	27	50	%	
			HCPL2503	12	27		%	
		$I_F = 16\text{mA}$ , $V_{CC} = 4.5\text{V}$	$V_{OL} = 0.4\text{V}$	6N135	5	21		%
			$V_{OL} = 0.5\text{V}$	HCPL2530				
			$V_{OL} = 0.4\text{V}$	6N136 HCPL4502	15	30		%
			$V_{OL} = 0.5\text{V}$	HCPL2531				
$V_{OL} = 0.4\text{V}$	HCPL2503	9	30		%			
$V_{OL}$	Logic LOW Output Voltage	$I_F = 16\text{mA}$ , $I_O = 1.1\text{mA}$ , $V_{CC} = 4.5\text{V}$ , $T_A = 25^\circ\text{C}$	6N135		0.18	0.4	V	
			HCPL2530		0.18	0.5		
		$I_F = 16\text{mA}$ , $I_O = 3\text{mA}$ , $V_{CC} = 4.5\text{V}$ , $T_A = 25^\circ\text{C}$	6N136 HCPL2503		0.25	0.4		
		HCPL2531		0.25	0.5			
		$I_F = 16\text{mA}$ , $I_O = 0.8\text{mA}$ , $V_{CC} = 4.5\text{V}$	6N135 HCPL2530			0.5		
$I_F = 16\text{mA}$ , $I_O = 2.4\text{mA}$ , $V_{CC} = 4.5\text{V}$	HCPL4502 HCPL2531			0.5				

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

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%.

**Electrical Characteristics** (Continued) ( $T_A = 0$  to  $70^\circ\text{C}$  unless otherwise specified)**Switching Characteristics** ( $V_{CC} = 5\text{V}$ )

Symbol	Parameter	Test Conditions	Device	Min.	Typ.*	Max.	Unit
$T_{PHL}$	Propagation Delay Time to Logic LOW	$T_A = 25^\circ\text{C}$ , $R_L = 4.1\text{k}\Omega$ , $I_F = 16\text{mA}^{(6)}$ (Fig. 7)	6N135 HCPL2530		0.45	1.5	$\mu\text{s}$
		$R_L = 1.9\text{k}\Omega$ , $I_F = 16\text{mA}$ , $T_A = 25^\circ\text{C}^{(7)}$ (Fig. 7)	6N136 HCPL4502 HCPL2503 HCPL2531		0.45	0.8	$\mu\text{s}$
		$R_L = 4.1\text{k}\Omega$ , $I_F = 16\text{mA}^{(6)}$ (Fig. 7)	6N135 HCPL2530			2.0	$\mu\text{s}$
		$R_L = 1.9\text{k}\Omega$ , $I_F = 16\text{mA}^{(7)}$ (Fig. 7)	6N136 HCPL4502 HCPL2503 HCPL2531			1.0	$\mu\text{s}$
$T_{PLH}$	Propagation Delay Time to Logic HIGH	$T_A = 25^\circ\text{C}$ , ( $R_L = 4.1\text{k}\Omega$ , $I_F = 16\text{mA}^{(6)}$ ) (Fig. 7)	6N135 HCPL2530		0.5	1.5	$\mu\text{s}$
		$R_L = 1.9\text{k}\Omega$ , $I_F = 16\text{mA}^{(7)}$ (Fig. 7) $T_A = 25^\circ\text{C}$	6N136 HCPL4502 HCPL2503 HCPL2531		0.3	0.8	$\mu\text{s}$
		$R_L = 4.1\text{k}\Omega$ , $I_F = 16\text{mA}^{(6)}$ (Fig. 7)	6N135 HCPL2530			2.0	$\mu\text{s}$
		$R_L = 1.9\text{k}\Omega$ , $I_F = 16\text{mA}^{(7)}$ (Fig. 7)	6N136 HCPL4502 HCPL2503 HCPL2531			1.0	$\mu\text{s}$
$ICM_{HI}$	Common Mode Transient Immunity at Logic High	$I_F = 0\text{mA}$ , $V_{CM} = 10\text{V}_{P-P}$ , $R_L = 4.1\text{k}\Omega$ , $T_A = 25^\circ\text{C}^{(8)}$ (Fig. 8)	6N135 HCPL2530		10,000		$\text{V}/\mu\text{s}$
		$I_F = 0\text{mA}$ , $V_{CM} = 10\text{V}_{P-P}$ , $R_L = 1.9\text{k}\Omega$ , $T_A = 25^\circ\text{C}^{(8)}$ (Fig. 8)	6N136 HCPL4502 HCPL2503 HCPL2531		10,000		$\text{V}/\mu\text{s}$
$ICM_{LI}$	Common Mode Transient Immunity at Logic Low	$I_F = 16\text{mA}$ , $V_{CM} = 10\text{V}_{P-P}$ , $R_L = 4.1\text{k}\Omega$ , $T_A = 25^\circ\text{C}^{(8)}$ (Fig. 8)	6N135 HCPL2530		10,000		$\text{V}/\mu\text{s}$
		$I_F = 16\text{mA}$ , $V_{CM} = 10\text{V}_{P-P}$ , $R_L = 1.9\text{k}\Omega^{(8)}$ (Fig. 8)	6N136 HCPL4502 HCPL2503 HCPL2531		10,000		$\text{V}/\mu\text{s}$

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

- The  $4.1\text{k}\Omega$  load represents 1 LSTTL unit load of  $0.36\text{mA}$  and  $6.1\text{k}\Omega$  pull-up resistor.
- The  $1.9\text{k}\Omega$  load represents 1 TTL unit load of  $1.6\text{mA}$  and  $5.6\text{k}\Omega$  pull-up resistor.
- 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.,  $V_O > 2.0\text{V}$ ). 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.,  $V_O < 0.8\text{V}$ ).

**Electrical Characteristics** (Continued) ( $T_A = 0$  to  $70^\circ\text{C}$  unless otherwise specified)**Isolation Characteristics** ( $T_A = 0$  to  $70^\circ\text{C}$  Unless otherwise specified)

Symbol	Characteristics	Test Conditions	Min	Typ**	Max	Unit
$I_{I-O}$	Input-Output Insulation Leakage Current	Relative humidity = 45%, $T_A = 25^\circ\text{C}$ , $t = 5\text{s}$ , $V_{I-O} = 3000\text{VDC}^{(9)}$			1.0	$\mu\text{A}$
$V_{ISO}$	Withstand Insulation Test Voltage	$RH \leq 50\%$ , $T_A = 25^\circ\text{C}$ , $I_{I-O} \leq 2\mu\text{A}$ , $t = 1\text{min.}^{(9)}$	2500			$V_{RMS}$
$R_{I-O}$	Resistance (Input to Output)	$V_{I-O} = 500\text{VDC}^{(9)}$		$10^{12}$		$\Omega$
$C_{I-O}$	Capacitance (Input to Output)	$f = 1\text{MHz}^{(9)}$		0.6		pF
HFE	DC Current Gain	$I_O = 3\text{mA}$ , $V_O = 5\text{V}^{(9)}$		150		
$I_{I-I}$	Input-Input Insulation Leakage Current	$RH \leq 45\%$ , $V_{I-I} = 500\text{VDC}^{(10)}$ $t = 5\text{s}$ , (HCPL2530/2531 only)		0.005		$\mu\text{A}$
$R_{I-I}$	Input-Input Resistance	$V_{I-I} = 500\text{VDC}^{(10)}$ (HCPL2530/2531 only)		$10^{11}$		$\Omega$
$C_{I-I}$	Input-Input Capacitance	$f = 1\text{MHz}^{(10)}$ (HCPL2530/2531 only)		0.03		pF

**Notes:**

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.



## Typical Performance Curves

Fig. 1 Normalized CTR vs. Forward Current

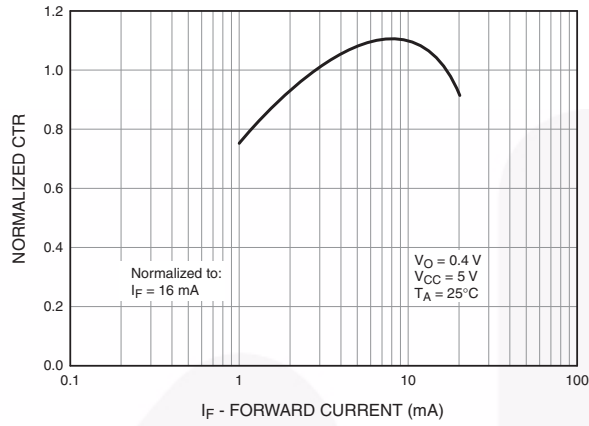


Fig. 2 Normalized CTR vs. Temperature

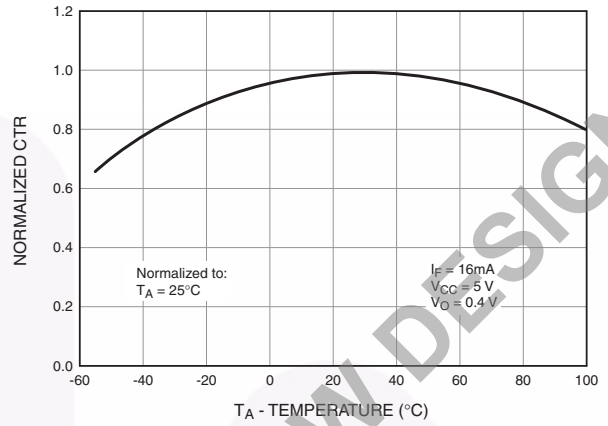


Fig. 3 Output Current vs. Output Voltage

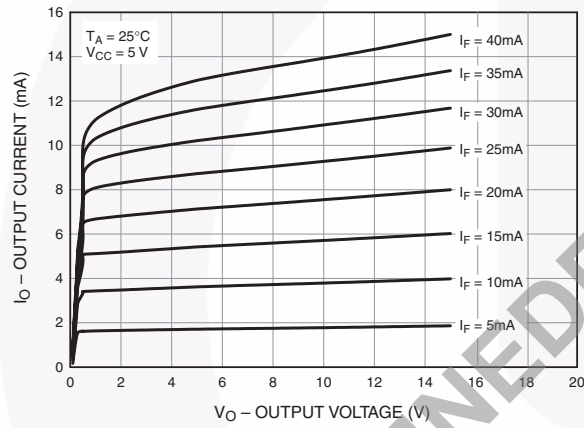


Fig. 4 Logic High Output Current vs. Temperature

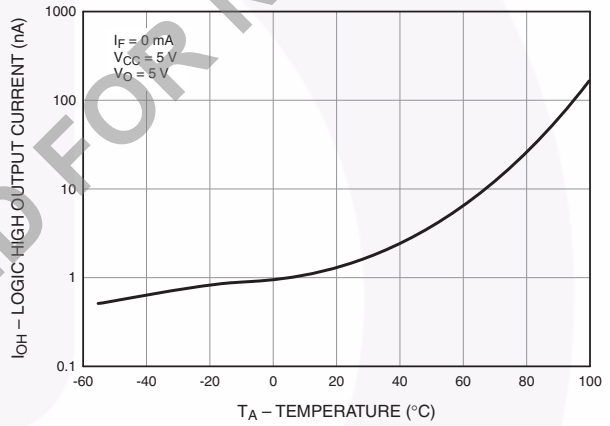


Fig. 5 Propagation Delay vs. Temperature

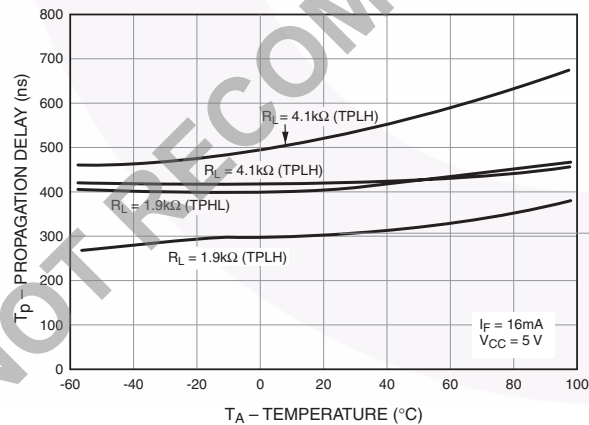
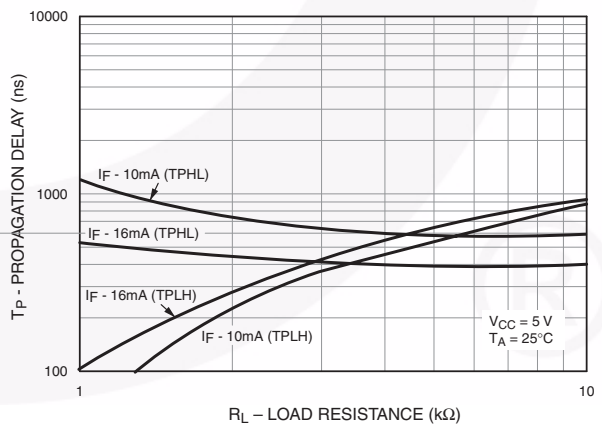
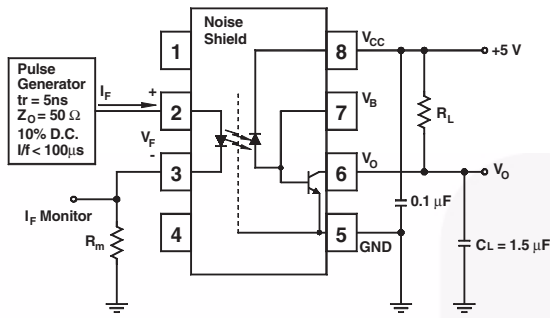


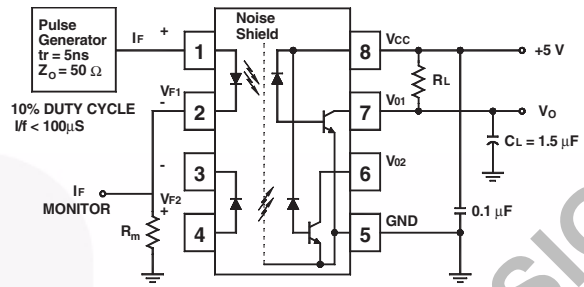
Fig. 6 Propagation Delay vs. Load Resistance



### Test Circuits



Test Circuit for 6N135, 6N136, HCPL-2503 and HCPL-4502



Test Circuit for HCPL-2530 and HCPL-2531

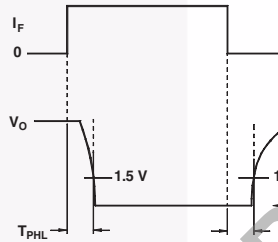
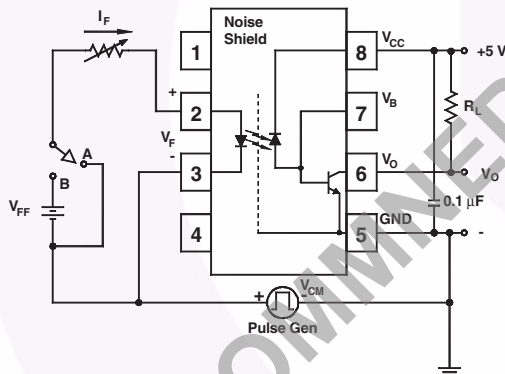
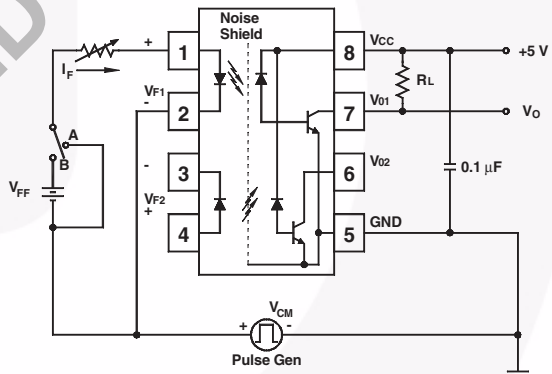


Fig. 7 Switching Time Test Circuit



Test Circuit for 6N135, 6N136, HCPL-2503 and HCPL-4502



Test Circuit for HCPL-2530 and HCPL-2531

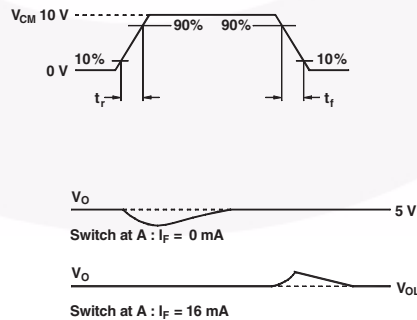
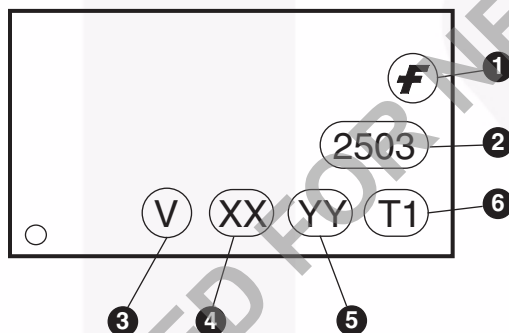


Fig. 8 Common Mode Immunity Test Circuit

### Ordering Information

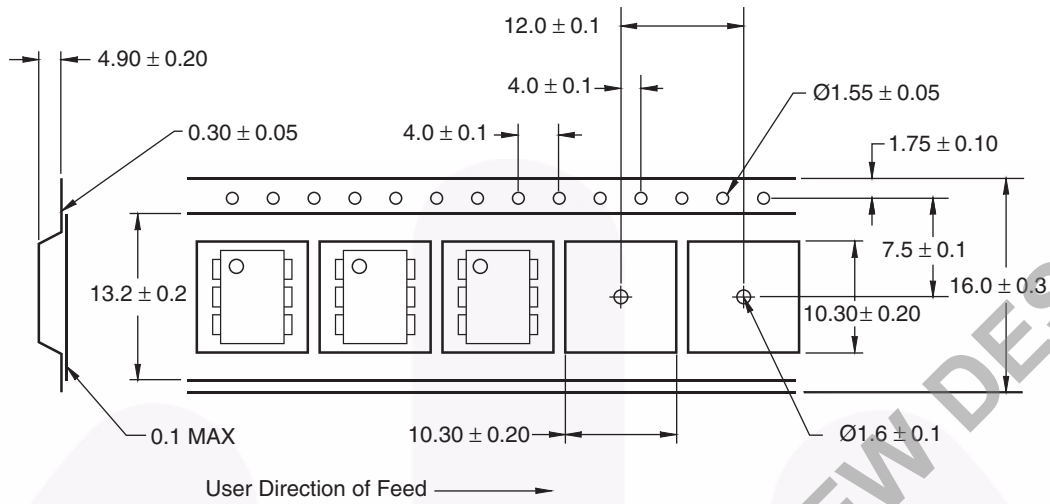
Option	Example Part Number	Description
S	6N135S	Surface Mount Lead Bend
SD	6N135SD	Surface Mount; Tape and reel
W	6N135W	0.4" Lead Spacing
V	6N135V	VDE0884
WV	6N135WV	VDE0884; 0.4" lead spacing
SV	6N135SV	VDE0884; surface mount
SDV	6N135SDV	VDE0884; surface mount; tape and reel

### Marking Information

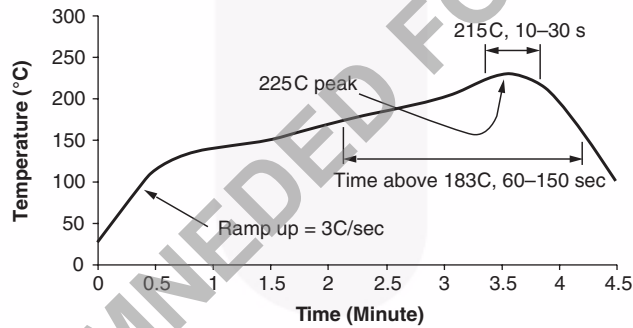


Definitions	
1	Fairchild logo
2	Device number
3	VDE mark (Note: Only appears on parts ordered with VDE option – See order entry table)
4	Two digit year code, e.g., '03'
5	Two digit work week ranging from '01' to '53'
6	Assembly package code

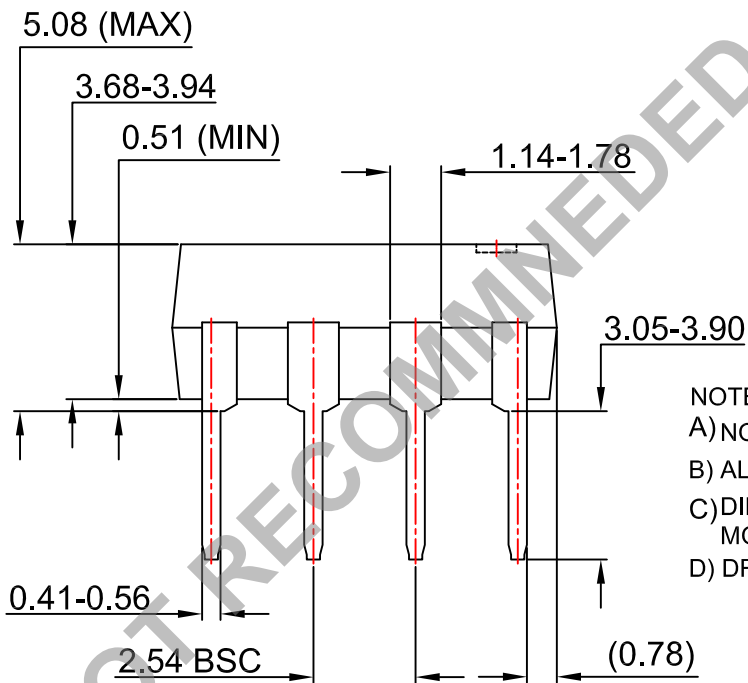
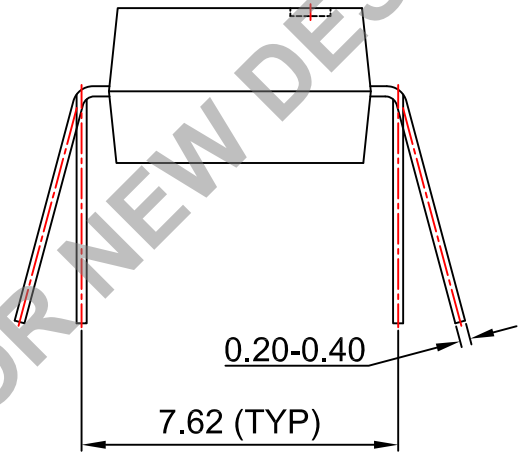
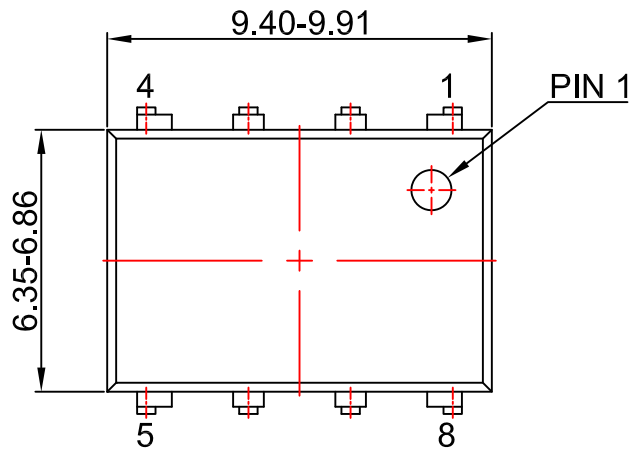
### Tape Specifications



### Reflow Profile



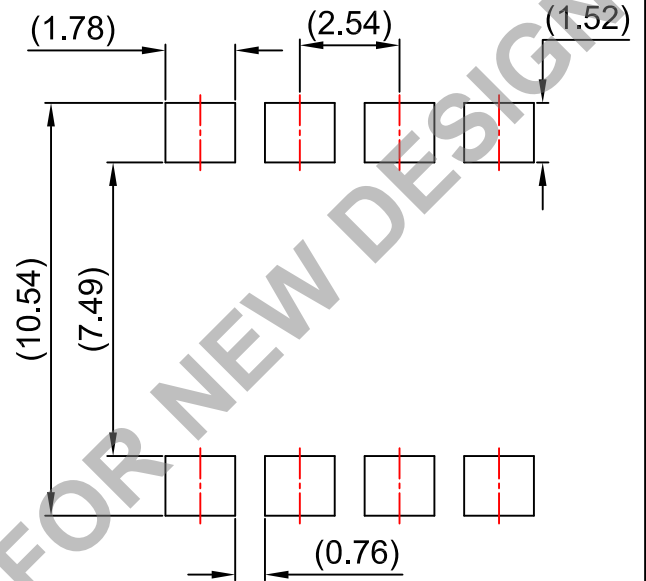
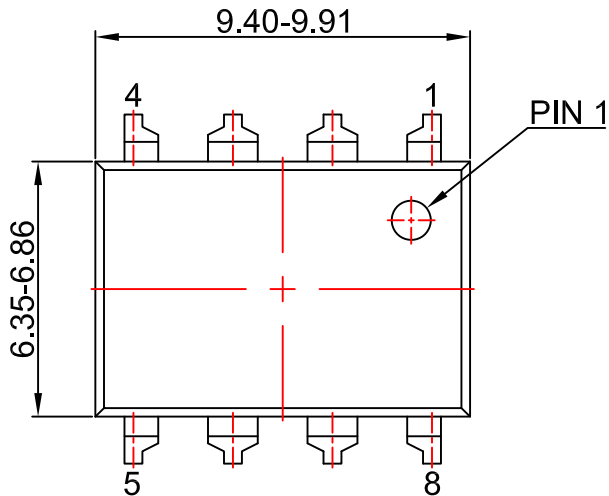
- Peak reflow temperature: 225C (package surface temperature)
- Time of temperature higher than 183C for 60–150 seconds
- One time soldering reflow is recommended



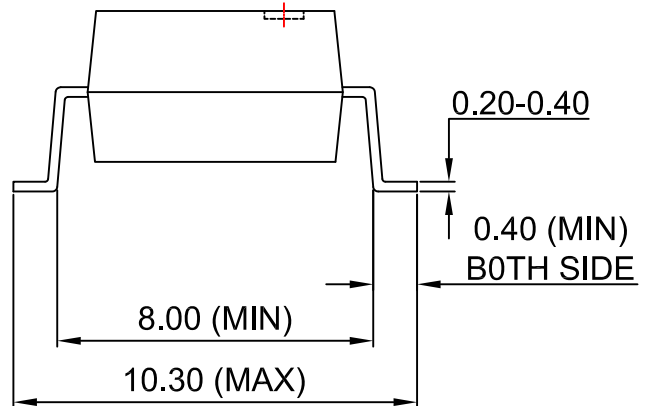
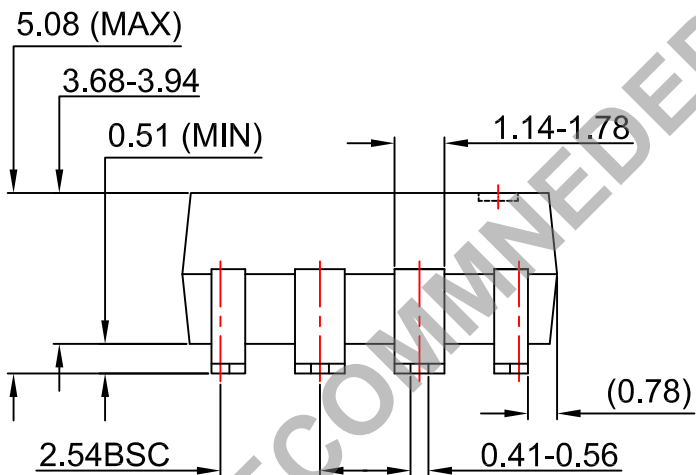
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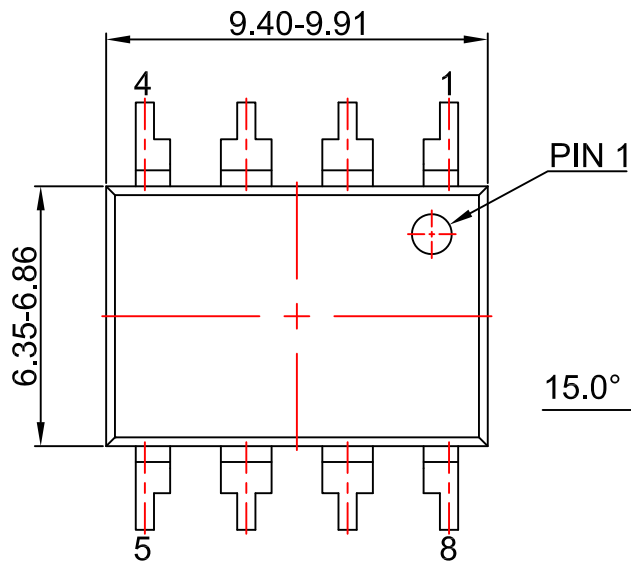
LAND PATTERN RECOMMENDATION



NOTES:

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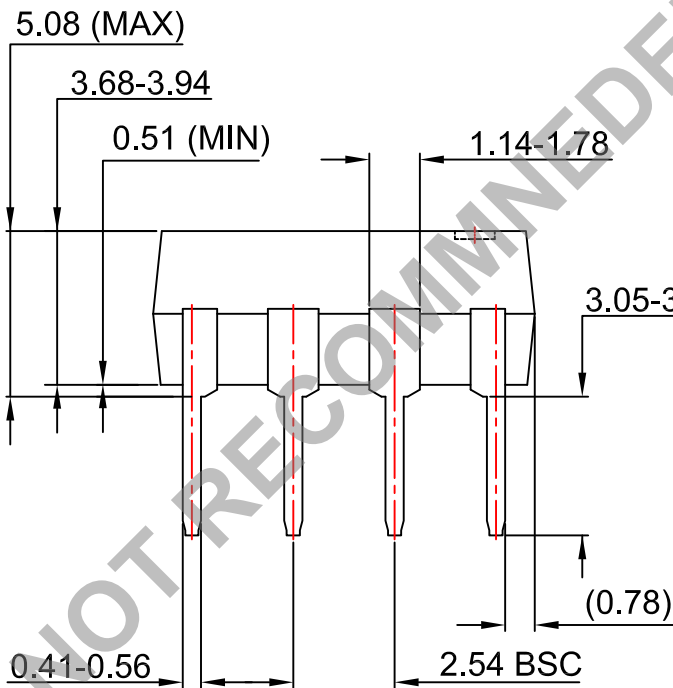


PIN 1

15.0° (MAX)

10.16 (TYP)


0.20-0.40



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