



October 2008

# Single-Channel: 6N135M, 6N136M, HCPL2503M, HCPL4502M, HCPL4503M Dual-Channel: HCPL2530M, HCPL2531M High Speed Transistor Optocouplers

## Features

- High speed –1 MBit/s
- Superior CMR – 10kV/μs
- Dual-Channel HCPL2530M, HCPL2531M (Preliminary)
- CTR guaranteed 0–70°C
- U.L. recognized (File # E90700, Vol. 2)
- 5,000Vrms (1 minute) isolation rating
- Superior CMR of 15,000V/μs min. (HCPL4503M)
- >8mm creepage and clearance (option T)
- No base connection for improved noise immunity (HCPL4502M, HCPL4503M)

## Applications

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

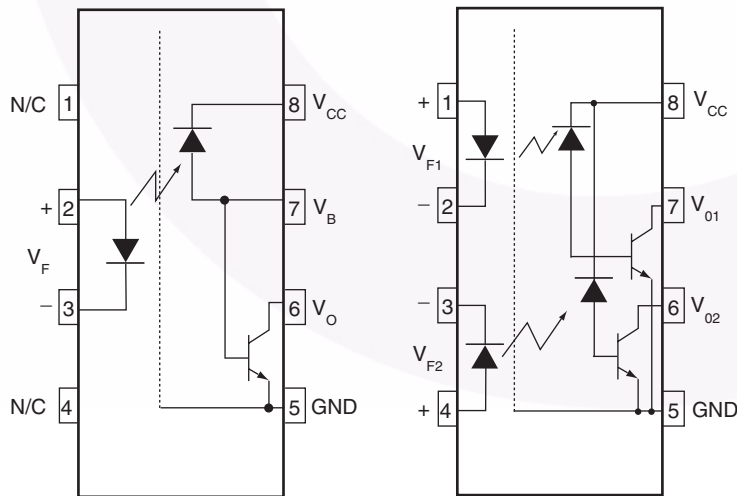
## Description

The HCPL4502M, HCPL4503M, HCPL2503M, 6N135M, 6N136M, HCPL2530M and HCPL2531M 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 up to 50,000V/μs.

## Schematics

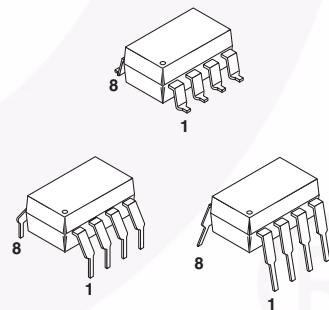


6N135M, 6N136M, HCPL2503M,  
HCPL4502M, HCPL4503M

HCPL2530M/HCPL2531M

Pin 7 is not connected in  
HCPL4502M and HCPL4503M

## Package Outlines



Single-Channel: 6N135M, 6N136M, HCPL2503M, HCPL4502M, HCPL4503M  
Dual-Channel: HCPL2530M, HCPL2531M — High Speed Transistor Optocouplers

**PRELIMINARY**

**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		-40 to +125	$^\circ\text{C}$
$T_{OPR}$	Operating Temperature		-40 to +100	$^\circ\text{C}$
$T_{SOL}$	Lead Solder Temperature (Wave)		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	6N135M, 6N136M, HCPL2503M, HCPL4502M, HCPL4503M	100	mW
		HCPL2530M, HCPL2531M <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	6N135M, 6N136M and HCPL2503M 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	6N135M, 6N136M and HCPL2503M only	5	mA
PD	Output Power Dissipation Each Channel	6N135M, 6N136M, HCPL2503M, HCPL4502M, HCPL4503M <sup>(4)</sup>	100	mW
		HCPL2530M, HCPL2531M	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  $2.0\text{ mW}/^\circ\text{C}$ .

Single-Channel: 6N135M, 6N136M, HCPL2503M, HCPL4502M, HCPL4503M  
Dual-Channel: HCPL2530M, HCPL2531M — High Speed Transistor Optocouplers

**PRELIMINARY**

**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	$I_F = 16\text{mA}$ , $T_A = 25^\circ\text{C}$	All		1.45	1.7	V
		$I_F = 16\text{mA}$	All			1.8	
$B_{VR}$	Input Reverse Breakdown Voltage	$I_R = 10\ \mu\text{A}$	All	5.0			V
$\Delta V_F/\Delta T_A$	Temperature Coefficient of Forward Voltage	$I_F = 16\text{mA}$	All		-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		0.003	0.5	$\mu\text{A}$
		$I_F = 0\text{mA}$ , $V_O = V_{CC} = 15\text{V}$ , $T_A = 25^\circ\text{C}$	6N135M 6N136M HCPL4502M HCPL4503M HCPL2503M		0.005	1	
		$I_F = 0\text{mA}$ , $V_O = V_{CC} = 15\text{V}$	All			50	
$I_{CCL}$	Logic Low Supply Current	$I_F = 16\text{mA}$ , $V_O = \text{Open}$ , $V_{CC} = 15\text{V}$	6N135M 6N136M HCPL4502M HCPL4503M HCPL2503M		145	200	$\mu\text{A}$
		$I_{F1} = I_{F2} = 16\text{mA}$ , $V_O = \text{Open}$ , $V_{CC} = 15\text{V}$	HCPL2530M HCPL2531M		250	400	
$I_{CCH}$	Logic High Supply Current	$I_F = 0\text{mA}$ , $V_O = \text{Open}$ , $V_{CC} = 15\text{V}$ , $T_A = 25^\circ\text{C}$	6N135M 6N136M HCPL4502M HCPL4503M HCPL2503M			1	$\mu\text{A}$
		$I_F = 0\text{mA}$ , $V_O = \text{Open}$ , $V_{CC} = 15\text{V}$	6N135M 6N136M HCPL4502M HCPL4503M HCPL2503M			2	
		$I_F = 0\text{mA}$ , $V_O = \text{Open}$ , $V_{CC} = 15\text{V}$	HCPL2530M HCPL2531M		0.02	4	

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

Single-Channel: 6N135M, 6N136M, HCPL2503M, HCPL4502M, HCPL4503M  
Dual-Channel: HCPL2530M, HCPL2531M — High Speed Transistor Optocouplers

**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>	$I_F = 16\text{mA}, V_O = 0.4\text{V}, V_{CC} = 4.5\text{V}, T_A = 25^\circ\text{C}$	6N135M HCPL2530M	7	18	50	%		
			6N136M HCPL4502M HCPL4503M HCPL2531M	19	30	50	%		
			HCPL2503M	12	27		%		
		$I_F = 16\text{mA}, V_{CC} = 4.5\text{V}$	$V_{OL} = 0.4\text{V}$	6N135M	5	21			%
			$V_{OL} = 0.5\text{V}$	HCPL2530M					
			$V_{OL} = 0.4\text{V}$	6N136M HCPL4502M HCPL4503M	15	30			%
			$V_{OL} = 0.5\text{V}$	HCPL2531M					
$V_{OL} = 0.4\text{V}$	HCPL2503M	9	30			%			
$V_{OL}$	Logic LOW Output Voltage	$I_F = 16\text{mA}, I_O = 1.1\text{mA}, V_{CC} = 4.5\text{V}, T_A = 25^\circ\text{C}$	6N135M		0.10	0.4	V		
			HCPL2530M		0.10	0.5			
		$I_F = 16\text{mA}, I_O = 3\text{mA}, V_{CC} = 4.5\text{V}, T_A = 25^\circ\text{C}$	6N136M HCPL2503M HCPL4503M		0.15	0.4			
			HCPL2531M		0.15	0.5			
		$I_F = 16\text{mA}, I_O = 0.8\text{mA}, V_{CC} = 4.5\text{V}$	6N135M HCPL2530M			0.5			
$I_F = 16\text{mA}, I_O = 2.4\text{mA}, V_{CC} = 4.5\text{V}$	HCPL4502M HCPL4503M HCPL2531M			0.5					

\*All Typical 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%.

**PRELIMINARY**

**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)	6N135M HCPL2530M		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)	6N136M HCPL4502M HCPL4503M HCPL2503M HCPL2531M		0.45	0.8	$\mu\text{s}$
		$R_L = 4.1\text{k}\Omega$ , $I_F = 16\text{mA}^{(6)}$ (Fig. 7)	6N135M HCPL2530M			2.0	$\mu\text{s}$
		$R_L = 1.9\text{k}\Omega$ , $I_F = 16\text{mA}^{(7)}$ (Fig. 7)	6N136M HCPL4502M HCPL4503M HCPL2503M HCPL2531M			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)	6N135M HCPL2530M		0.5	1.5	$\mu\text{s}$
		$R_L = 1.9\text{k}\Omega$ , $I_F = 16\text{mA}^{(7)}$ (Fig. 7) $T_A = 25^\circ\text{C}$	6N136M HCPL4502M HCPL4503M HCPL2503M HCPL2531M		0.3	0.8	$\mu\text{s}$
		$R_L = 4.1\text{k}\Omega$ , $I_F = 16\text{mA}^{(6)}$ (Fig. 7)	6N135M HCPL2530M			2.0	$\mu\text{s}$
		$R_L = 1.9\text{k}\Omega$ , $I_F = 16\text{mA}^{(7)}$ (Fig. 7)	6N136M HCPL4502M HCPL4503M HCPL2503M HCPL2531M			1.0	$\mu\text{s}$
$ICM_{HI}$	Common Mode Transient Immunity at Logic High	$I_F = 0\text{mA}$ , $V_{CM} = 10V_{P-P}$ , $R_L = 4.1\text{k}\Omega$ , $T_A = 25^\circ\text{C}^{(8)}$ (Fig. 8)	6N135M HCPL2530M		10,000		$\text{V}/\mu\text{s}$
		$I_F = 0\text{mA}$ , $V_{CM} = 10V_{P-P}$ , $R_L = 1.9\text{k}\Omega$ , $T_A = 25^\circ\text{C}^{(8)}$ (Fig. 8)	6N136M HCPL4502M HCPL2503M HCPL2531M		10,000		$\text{V}/\mu\text{s}$
		$I_F = 0\text{mA}$ , $V_{CM} = 1,500V_{P-P}$ , $R_L = 1.9\text{k}\Omega$ , $T_A = 25^\circ\text{C}^{(8)}$ (Fig. 8)	HCPL4503M	15,000	30,000		
$ICM_{LI}$	Common Mode Transient Immunity at Logic Low	$I_F = 16\text{mA}$ , $V_{CM} = 10V_{P-P}$ , $R_L = 4.1\text{k}\Omega$ , $T_A = 25^\circ\text{C}^{(8)}$ (Fig. 8)	6N135M HCPL2530M		10,000		$\text{V}/\mu\text{s}$
		$I_F = 16\text{mA}$ , $V_{CM} = 10V_{P-P}$ , $R_L = 1.9\text{k}\Omega^{(8)}$ (Fig. 8)	6N136M HCPL4502M HCPL2503M HCPL2531M		10,000		$\text{V}/\mu\text{s}$
		$I_F = 0\text{mA}$ , $V_{CM} = 1,500V_{P-P}$ , $R_L = 1.9\text{k}\Omega$ , $T_A = 25^\circ\text{C}^{(8)}$ (Fig. 8)	HCPL4503M	15,000	30,000		

\*\* 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.,  $V_O < 0.8\text{V}$ ).

Single-Channel: 6N135M, 6N136M, HCPL2503M, HCPL4502M, HCPL4503M  
Dual-Channel: HCPL2530M, HCPL2531M — High Speed Transistor Optocouplers

**PRELIMINARY**

**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
$V_{ISO}$	Withstand Insulation Test Voltage	$RH \leq 50\%$ , $T_A = 25^\circ\text{C}$ , $I_{I-O} \leq 10\mu\text{A}$ , $t = 1 \text{ min.}$ , $f = 50\text{Hz}^{(9)(11)}$	5,000			$V_{RMS}$
$R_{I-O}$	Resistance (Input to Output)	$V_{I-O} = 500\text{VDC}^{(9)}$		$10^{11}$		$\Omega$
$C_{I-O}$	Capacitance (Input to Output)	$f = 1\text{MHz}$ , $V_{I-O} = 0\text{V}^{(9)}$		1		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	$RH \leq 45\%$ , $V_{I-I} = 500\text{VDC}^{(10)}$ $t = 5 \text{ s}$ , (HCPL2530M/2531M only)		0.005		$\mu\text{A}$
$R_{I-I}$	Input-Input Resistance	$V_{I-I} = 500 \text{ VDC}^{(10)}$ (HCPL2530M/2531M only)		$10^{11}$		$\Omega$
$C_{I-I}$	Input-Input Capacitance	$f = 1\text{MHz}^{(10)}$ (HCPL2530M/2531M 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.
11. 5,000Vrms for 1 minute duration is equivalent to 6,000Vrms for 1 second duration.

Single-Channel: 6N135M, 6N136M, HCPL2503M, HCPL4502M, HCPL4503M  
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## Typical Performance Curves

Fig. 1 Normalized CTR vs. Forward Current

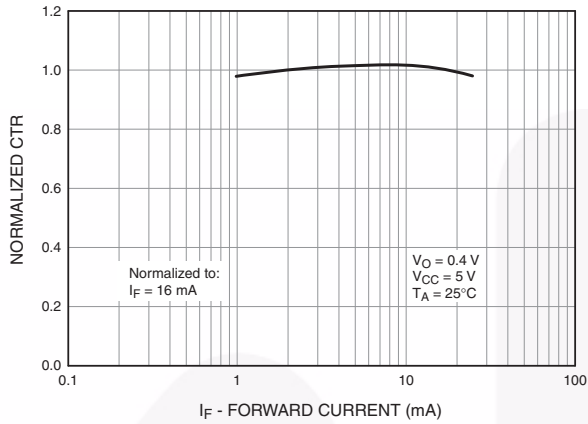


Fig. 2 Normalized CTR vs. Temperature

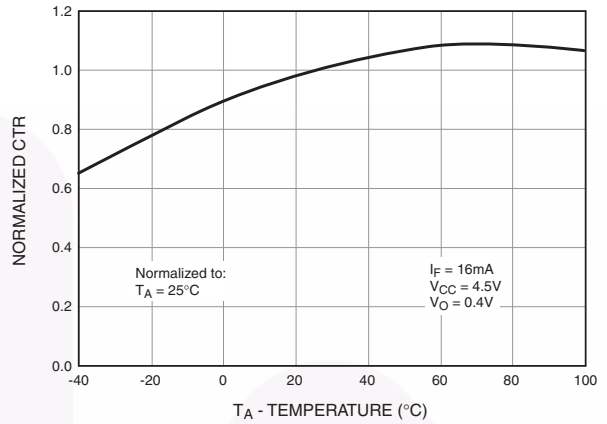


Fig. 3 Output Current vs. Output Voltage

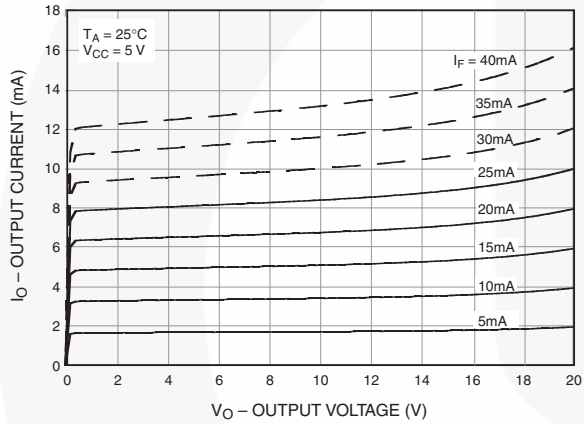


Fig. 4 Logic High Output Current vs. Temperature

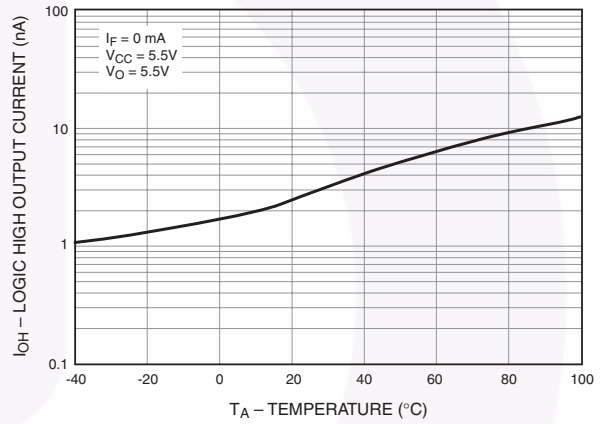


Fig. 5 Propagation Delay vs. Temperature

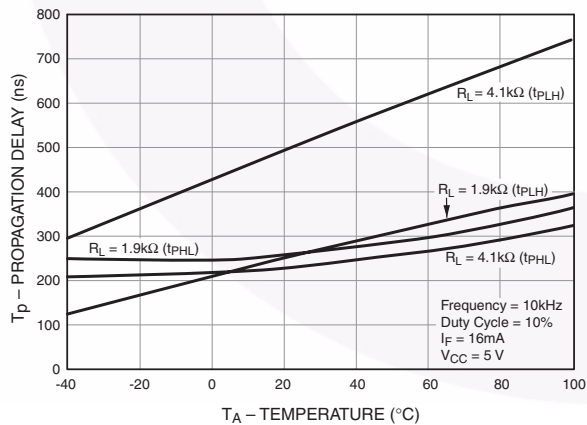
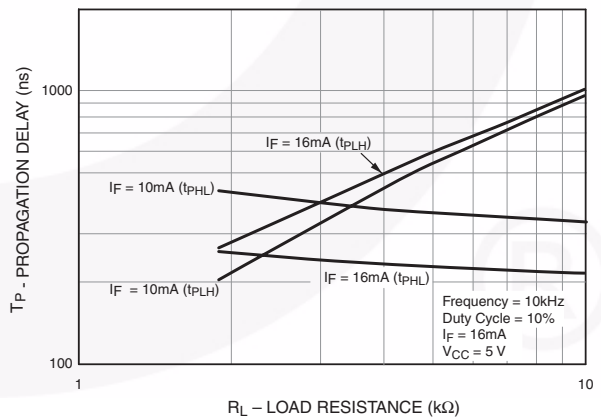
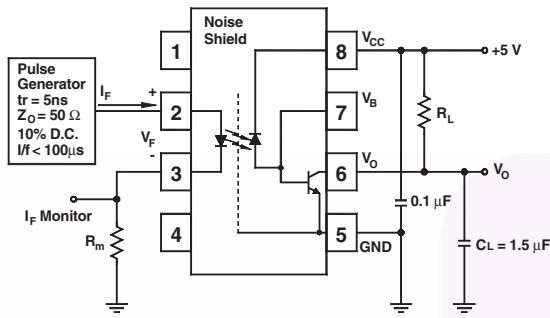


Fig. 6 Propagation Delay vs. Load Resistance

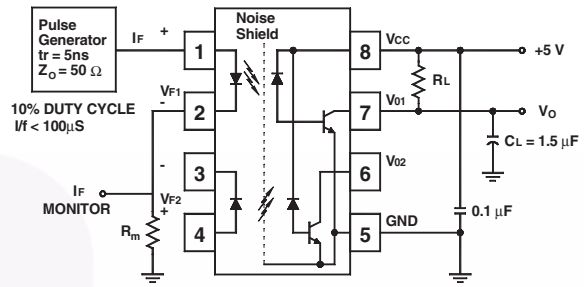


Single-Channel: 6N135M, 6N136M, HCPL2503M, HCPL4502M, HCPL4503M  
 Dual-Channel: HCPL2530M, HCPL2531M — High Speed Transistor Optocouplers

Test Circuits



Test Circuit for 6N135M, 6N136M, HCPL2503M, HCPL4502M and HCPL4503M



Test Circuit for HCPL2530M and HCPL2531M

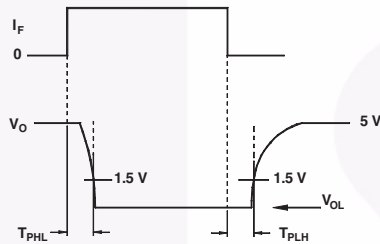
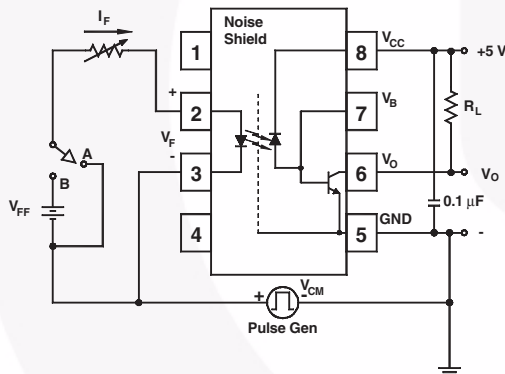
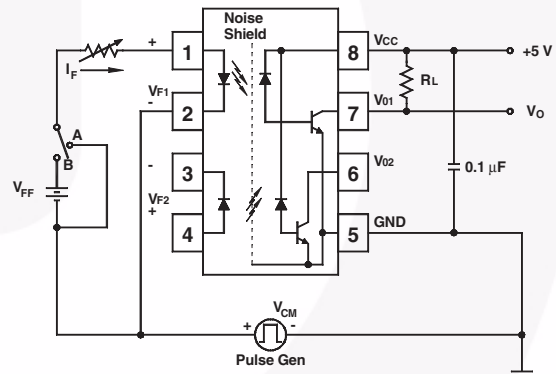


Fig. 7 Switching Time Test Circuit



Test Circuit for 6N135M, 6N136M, HCPL2503M, HCPL4502M and HCPL4503M



Test Circuit for HCPL2530M and HCPL2531M

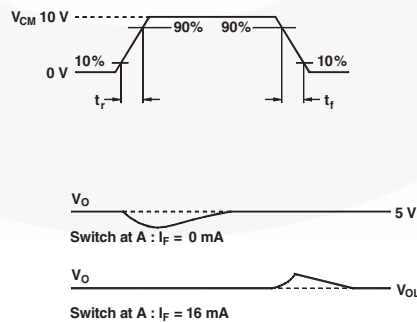
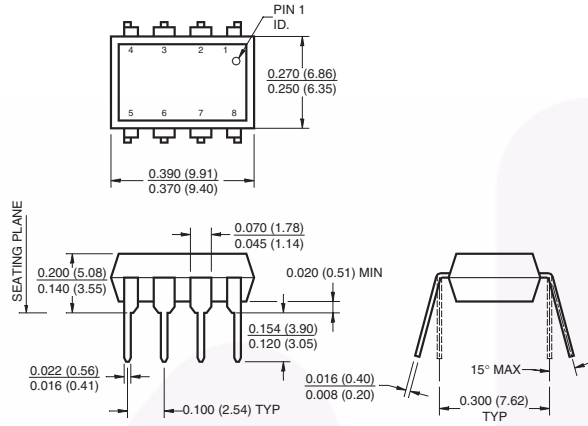


Fig. 8 Common Mode Immunity Test Circuit

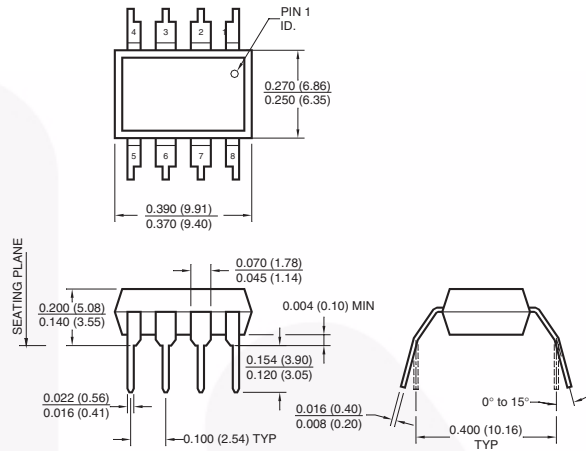


## Package Dimensions

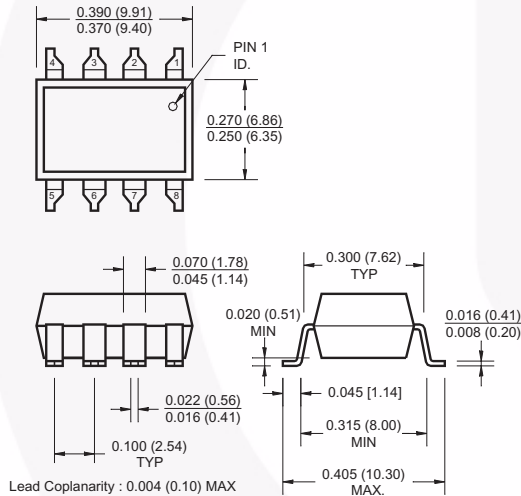
### Through Hole



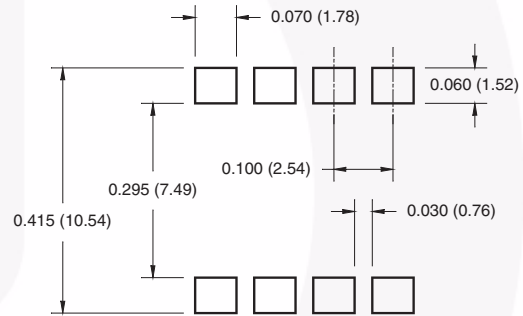
### 0.4" Lead Spacing



### Surface Mount



### 8-Pin DIP – Land Pattern (option S)



**Note:**

All dimensions are in inches (millimeters)

Package drawings are provided as a service to customers considering Fairchild components. Drawings may change in any manner without notice. Please note the revision and/or date on the drawing and contact a Fairchild Semiconductor representative to verify or obtain the most recent revision. Package specifications do not expand the terms of Fairchild's worldwide terms and conditions, specifically the warranty therein, which covers Fairchild products.

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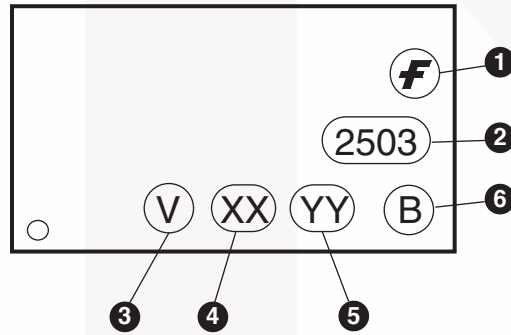
<http://www.fairchildsemi.com/packaging/>

Single-Channel: 6N135M, 6N136M, HCPL2503M, HCPL4502M, HCPL4503M  
 Dual-Channel: HCPL2530M, HCPL2531M — High Speed Transistor Optocouplers

### Ordering Information

Option	Example Part Number	Description
No option	6N135M	Standard through hole lead form
S	6N135SM	Surface mount lead bend
SD	6N135SDM	Surface mount; tape and reel
T	6N135TM	0.4" lead spacing
V	6N135VM	IEC60747-5-2 (approval pending)
TV	6N135TVM	IEC60747-5-2 (approval pending); 0.4" lead spacing
SV	6N135SVM	IEC60747-5-2 (approval pending); surface mount
SDV	6N135SDVM	IEC60747-5-2 (approval pending); surface mount; tape and reel

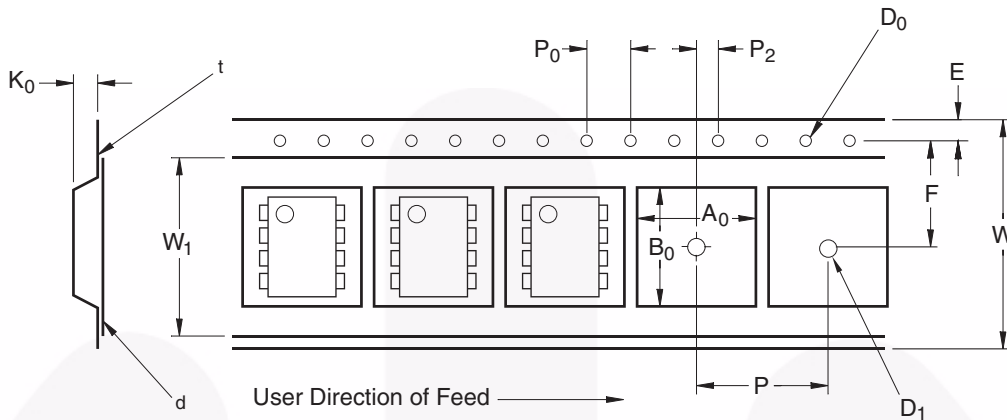
### Marking Information



Definitions	
1	Fairchild logo
2	Device number
3	IEC60747-5-2 mark (Note: Only appears on parts ordered with this option – See order entry table)
4	Two digit year code, e.g., '08'
5	Two digit work week ranging from '01' to '53'
6	Assembly package code

Single-Channel: 6N135M, 6N136M, HCPL2503M, HCPL4502M, HCPL4503M  
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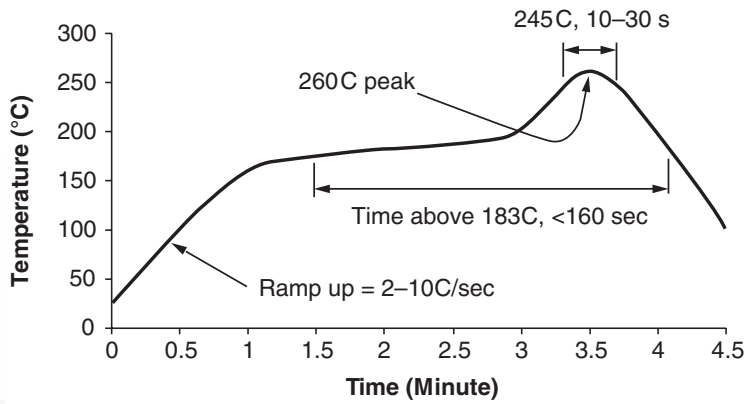
### Carrier Tape Specifications



Symbol	Description	Dimension in mm
W	Tape Width	16.0 ± 0.3
t	Tape Thickness	0.30 ± 0.05
P <sub>0</sub>	Sprocket Hole Pitch	4.0 ± 0.1
D <sub>0</sub>	Sprocket Hole Diameter	1.55 ± 0.05
E	Sprocket Hole Location	1.75 ± 0.10
F	Pocket Location	7.5 ± 0.1
P <sub>2</sub>		2.0 ± 0.1
P	Pocket Pitch	12.0 ± 0.1
A <sub>0</sub>	Pocket Dimensions	10.30 ± 0.20
B <sub>0</sub>		10.30 ± 0.20
K <sub>0</sub>		4.90 ± 0.20
W <sub>1</sub>	Cover Tape Width	13.2 ± 0.2
d	Cover Tape Thickness	0.1 max
	Max. Component Rotation or Tilt	10°
R	Min. Bending Radius	30

Single-Channel: 6N135M, 6N136M, HCPL2503M, HCPL4502M, HCPL4503M  
 Dual-Channel: HCPL2530M, HCPL2531M — High Speed Transistor Optocouplers

### Reflow Profile



- Peak reflow temperature: 260C (package surface temperature)
- Time of temperature higher than 183C for 160 seconds or less
- One time soldering reflow is recommended






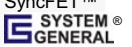
Single-Channel: 6N135M, 6N136M, HCPL2503M, HCPL4502M, HCPL4503M  
Dual-Channel: HCPL2530M, HCPL2531M — High Speed Transistor Optocouplers





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**Definition of Terms**

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