



July 2006

Single-Channel: 6N135, 6N136, HCPL-2503, HCPL-4502 Dual-Channel: HCPL-2530, HCPL-2531 High Speed Transistor Optocouplers

Features

- High speed—1MBit/s
- Superior CMR—10kV/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

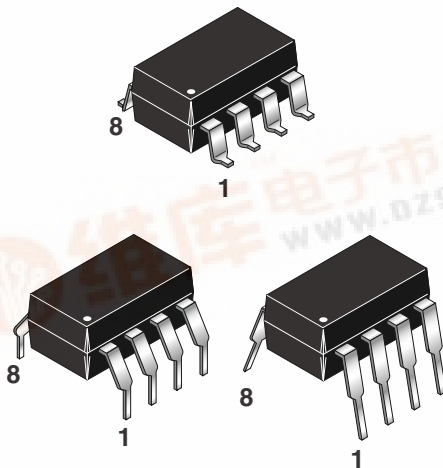
Description

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.

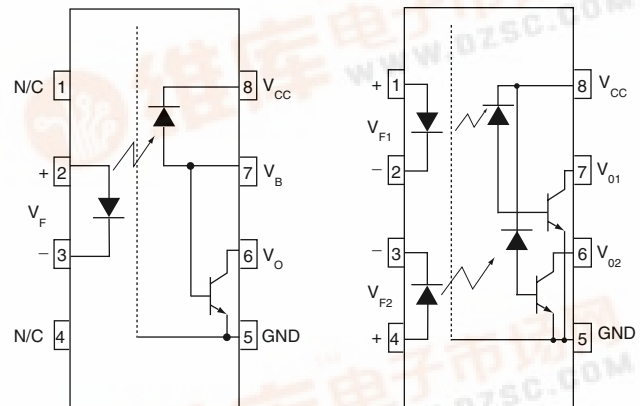
A separate connection for the bias of the photodiode improves the speed by several orders of magnitude over conventional phototransistor optocouplers by reducing the base-collector capacitance of the input transistor.

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

Package



Schematic



6N135, 6N136, HCPL-2503, HCPL-4502

HCPL-2530/HCPL-2531

Pin 7 is not connected in Part Number HCPL-4502

Single-Channel: 6N135, 6N136 , HCPL-2503, HCPL-4502 Dual-Channel: HCPL-2530, HCPL-2531 High Speed Transistor Optocouplers

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

Symbol	Parameter	Condition	Value	Units
T _{STG}	Storage Temperature		-55 to +125	°C
T _{OPR}	Operating Temperature		-55 to +100	°C
T _{SOL}	Lead Solder Temperature		260 for 10 sec	°C
EMITTER				
I _F (avg)	DC/Average Forward Input Current Each Channel ⁽¹⁾		25	mA
I _F (pk)	Peak Forward Input Current Each Channel ⁽²⁾	50% duty cycle, 1ms P.W.	50	mA
I _F (trans)	Peak Transient Input Current Each Channel	≤1 μs 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 HCPL-2503/4502	100	mW
		HCPL-2530/253 ⁽³⁾	45	
DETECTOR				
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 HCPL-2503 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 HCPL-2503 only	5	mA
PD	Output Power Dissipation Each Channel	6N135, 6N136, HCPL-2503, HCPL-4502 ⁽⁴⁾	100	mW
		HCPL-2530, HCPL-2531	35	mW

Notes:

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

Electrical Characteristics ($T_A = 0$ to 70°C Unless otherwise specified)**Individual Component Characteristics**

Symbol	Parameter	Test Conditions	Device	Min.	Typ.*	Max.	Unit
EMITTER							
V_F	Input Forward Voltage	$I_F = 16\text{mA}$, $T_A = 25^\circ\text{C}$			1.45	1.7	V
		$I_F = 16\text{mA}$				1.8	
B_{VR}	Input Reverse Breakdown Voltage	$I_R = 10\text{ }\mu\text{A}$		5.0			V
$\Delta V_F / \Delta T_A$	Temperature Coefficient of Forward Voltage	$I_F = 16\text{mA}$			-1.6		mV/ $^\circ\text{C}$
DETECTOR							
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	μA
		$I_F = 0\text{mA}$, $V_O = V_{CC} = 15\text{V}$, $T_A = 25^\circ\text{C}$	6N135 6N136 HCPL-4502 HCPL-2503		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 HCPL-4502 HCPL-2503		120	200	μA
		$I_{F1} = I_{F2} = 16\text{mA}$, $V_O = \text{Open}$, $V_{CC} = 15\text{V}$	HCPL-2530 HCPL-2531		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 HCPL-4502 HCPL-2503			1	μA
		$I_F = 0\text{mA}$, $V_O = \text{Open}$, $V_{CC} = 15\text{V}$	6N135 6N136 HCPL-4502 HCPL-2503			2	
		$I_F = 0\text{mA}$, $V_O = \text{Open}$, $V_{CC} = 15\text{V}$	HCPL-2530 HCPL-2531		0.02	4	

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

Transfer Characteristics ($T_A = 0$ to 70°C Unless otherwise specified)

Symbol	Parameter	Test Conditions		Device	Min.	Typ.*	Max.	Unit	
COUPLED									
CTR	Current Transfer Ratio ⁽⁵⁾	$I_F = 16\text{mA}$, $V_O = 0.4\text{ V}$, $V_{CC} = 4.5\text{V}$, $T_A = 25^\circ\text{C}$		6N135 HCPL-2530	7	18	50	%	
				6N136 HCPL-4502 HCPL-2531	19	27	50	%	
				HCPL-2503	12	27		%	
		$I_F = 16\text{mA}$, $V_{CC} = 4.5\text{V}$		$V_{OL} = 0.4\text{V}$	6N135	5	21		%
				$V_{OL} = 0.5\text{V}$	HCPL-2530				
				$V_{OL} = 0.4\text{V}$	6N136 HCPL-4502	15	30		%
				$V_{OL} = 0.5\text{V}$	HCPL-2531				
				$V_{OL} = 0.4\text{V}$	HCPL-2503	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	
				HCPL-2530		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 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 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%.

Switching Characteristics ($T_A = 0$ to 70°C unless otherwise specified., $V_{CC} = 5\text{V}$)

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 HCPL-2530		0.45	1.5	μs
		$R_L = 1.9\text{k}\Omega$, $I_F = 16\text{mA}$, $T_A = 25^\circ\text{C}^{(7)}$ (Fig. 7)	6N136 HCPL-4502 HCPL-2503 HCPL-2531		0.45	0.8	μs
		$R_L = 4.1\text{k}\Omega$, $I_F = 16\text{mA}^{(6)}$ (Fig. 7)	6N135 HCPL-2530			2.0	μs
		$R_L = 1.9\text{k}\Omega$, $I_F = 16\text{mA}^{(7)}$ (Fig. 7)	6N136 HCPL-4502 HCPL-2503 HCPL-2531			1.0	μs
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 HCPL-2530		0.5	1.5	μs
		$R_L = 1.9\text{k}\Omega$, $I_F = 16\text{mA}^{(7)}$ (Fig. 7) $T_A = 25^\circ\text{C}$	6N136 HCPL-4502 HCPL-2503 HCPL-2531		0.3	0.8	μs
		$R_L = 4.1\text{k}\Omega$, $I_F = 16\text{mA}^{(6)}$ (Fig. 7)	6N135 HCPL-2530			2.0	μs
		$R_L = 1.9\text{k}\Omega$, $I_F = 16\text{mA}^{(7)}$ (Fig. 7)	6N136 HCPL-4502 HCPL-2503 HCPL-2531			1.0	μs
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)	6N135 HCPL-2530		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)	6N136 HCPL-4502 HCPL-2503 HCPL-2531		10,000		$\text{V}/\mu\text{s}$
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)	6N135 HCPL-2530		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)	6N136 HCPL-4502 HCPL-2503 HCPL-2531		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 0.36mA and $6.1\text{k}\Omega$ pull-up resistor.
- The $1.9\text{k}\Omega$ load represents 1 TTL unit load of 1.6mA 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., $V_O < 0.8\text{V}$).

Isolation Characteristics ($T_A = 0$ to 70°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	μA
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}		Ω
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	$RH \leq 45\%$, $V_{I-I} = 500\text{VDC}^{(10)}$ $t = 5\text{ s}$, (HCPL-2530/2531 only)		0.005		μA
R_{I-I}	Input-Input Resistance	$V_{I-I} = 500\text{ VDC}^{(10)}$ (HCPL-2530/2531 only)		10^{11}		Ω
C_{I-I}	Input-Input Capacitance	$f = 1\text{MHz}^{(10)}$ (HCPL-2530/2531 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.

Fig. 1 Normalized CTR vs. Forward Current

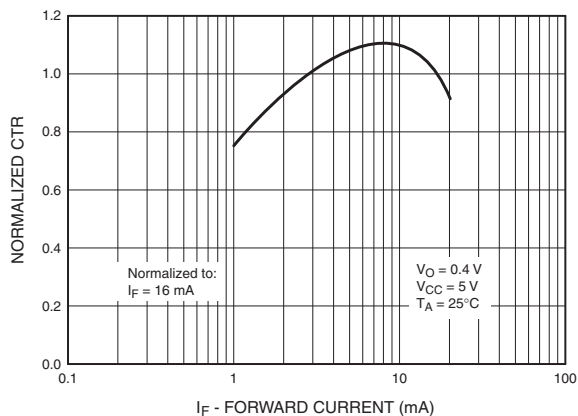


Fig. 2 Normalized CTR vs. Temperature

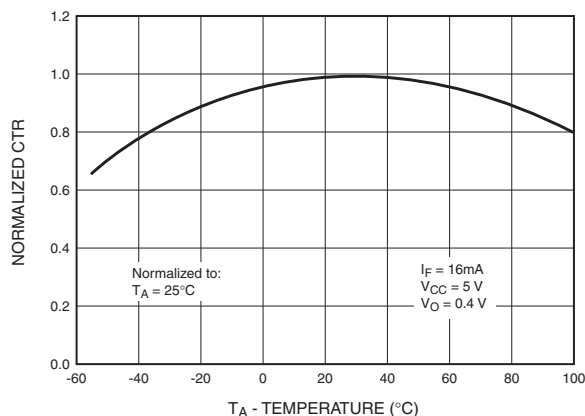


Fig. 3 Output Current vs. Output Voltage

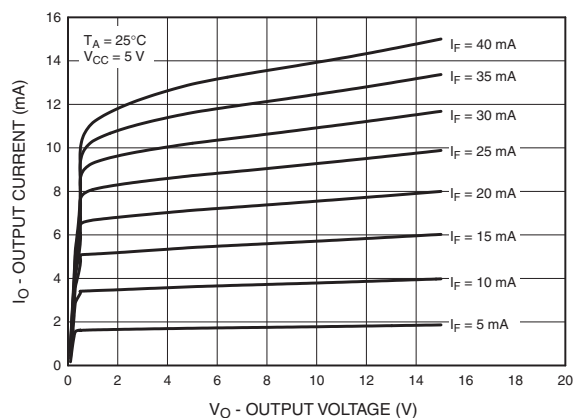


Fig. 4 Logic High Output Current vs. Temperature

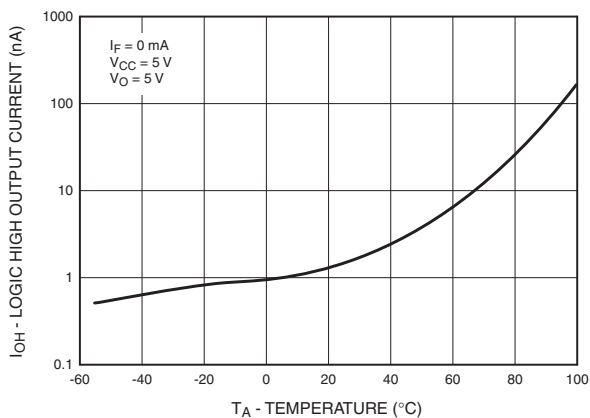


Fig. 5 Propagation Delay vs. Temperature

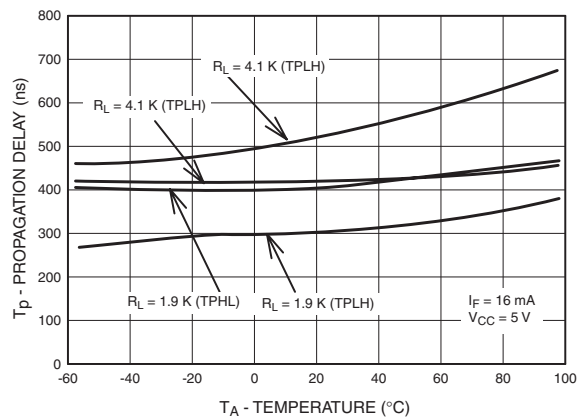
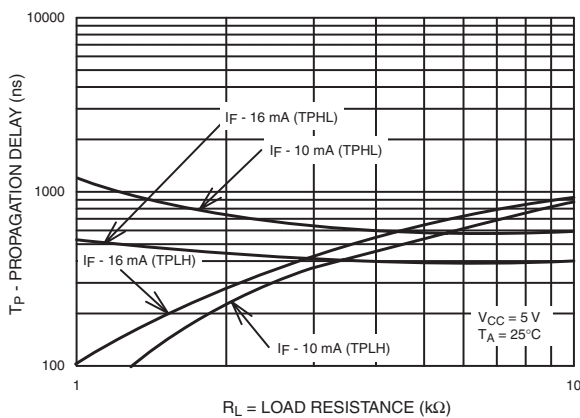


Fig. 6 Propagation Delay vs. Load Resistance



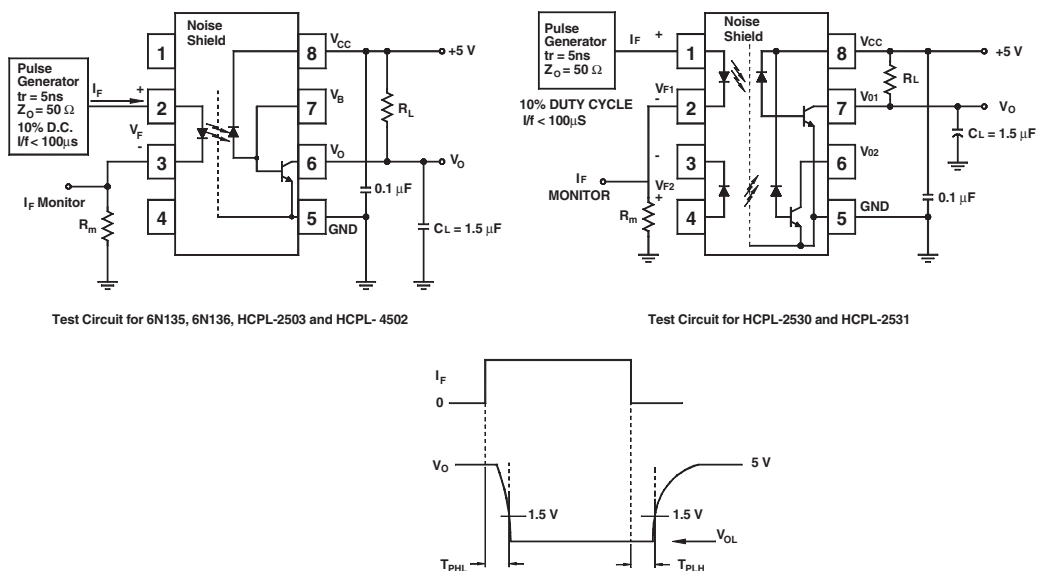


Fig. 7 Switching Time Test Circuit

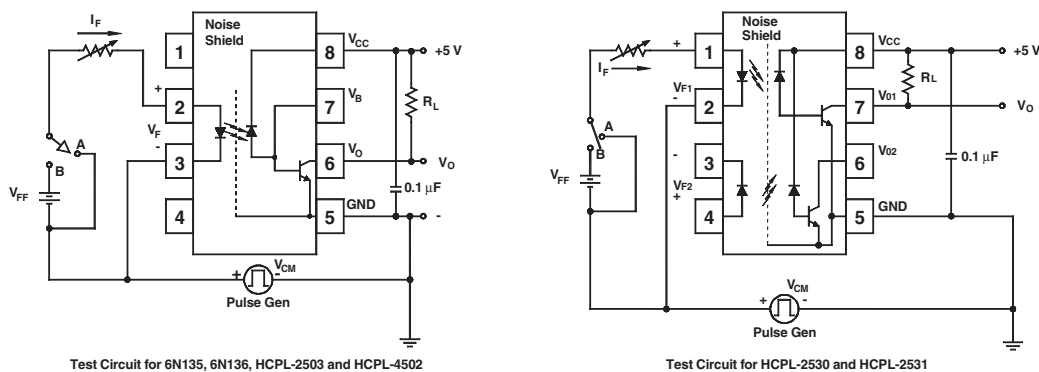
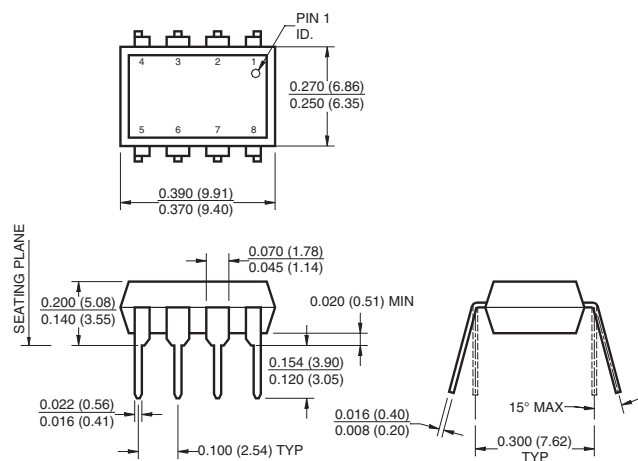


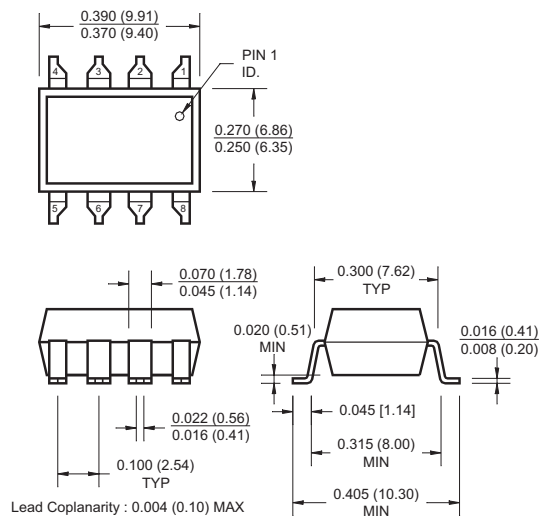
Fig. 8 Common Mode Immunity Test Circuit

Package Dimensions All dimensions are in inches (millimeters)

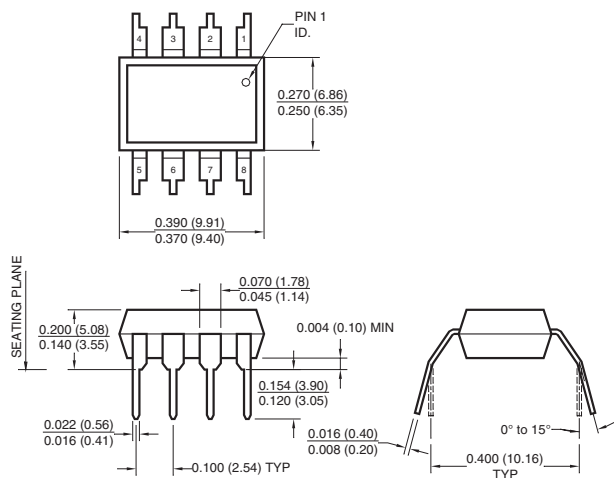
Through Hole



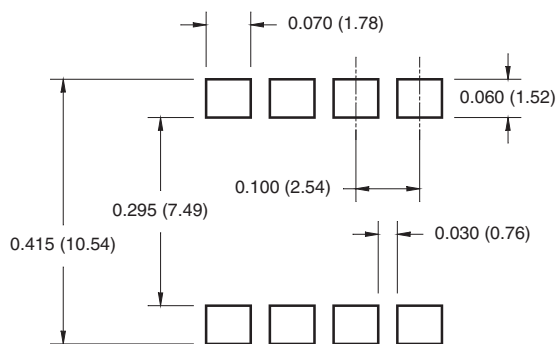
Surface Mount



0.4" Lead Spacing



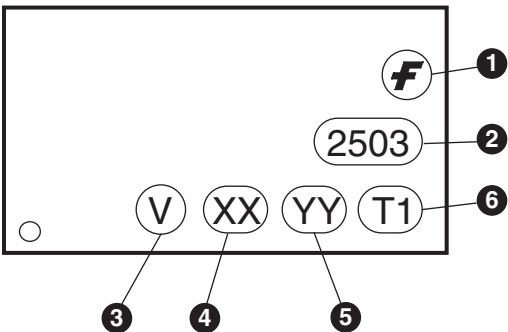
Recommend Pad Layout for Surface Mount Leadform



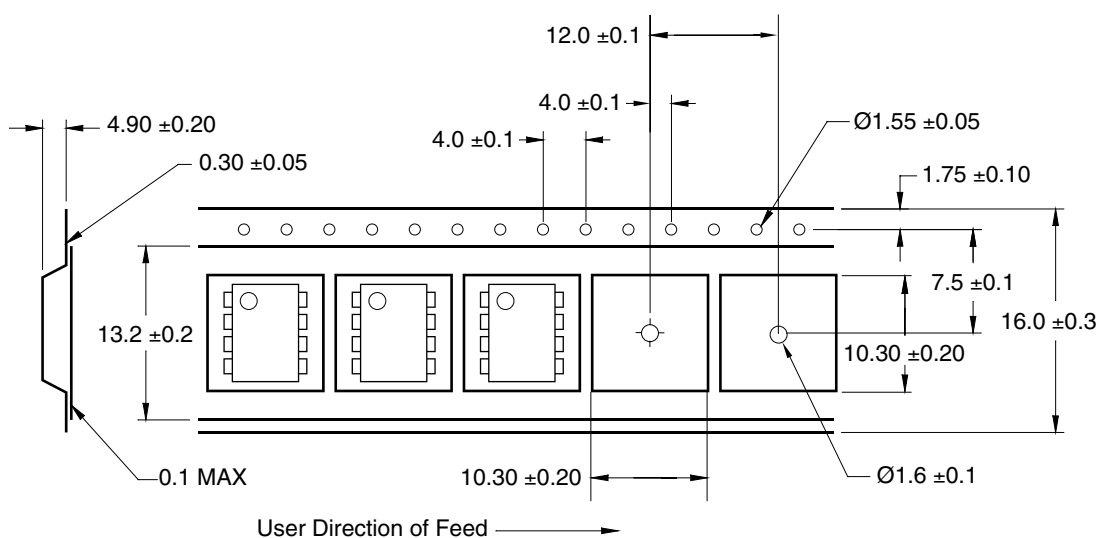
Ordering Information

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



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- Figure 1 is a graph showing Temperature (°C) on the Y-axis (0 to 300) versus Time (Minute) on the X-axis (0 to 4.5). The curve represents the DSC thermogram of polypropylene. Key features labeled include:
- Ramp up = 3C/sec**: Indicated by an arrow pointing to the initial heating phase.
 - 225C peak**: Points to the maximum of the broad endothermic peak.
 - 215C, 10-30 s**: Points to a secondary peak or shoulder.
 - Time above 183C, 60-150 sec**: A horizontal double-headed arrow indicating the duration of the melting process.

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Build it Now TM	HiSeC TM	OPTOPLANAR TM	Stealth TM	Wire TM
CoolFET TM	I ² C TM	PACMAN TM	SuperFET TM	
CROSSVOLT TM	i-Lo TM	POPT TM	SuperSOT TM -3	
DOMET TM	ImpliedDisconnect TM	Power247 TM	SuperSOT TM -6	
EcoSPARK TM	IntelliMAX TM	PowerEdge TM	SuperSOT TM -8	
E ² CMOS TM	ISOPPLANAR TM	PowerSaver TM	SyncFET TM	
EnSigna TM	LittleFET TM	PowerTrench [®]	TCM TM	
FACT TM	MICROCOUPLER TM	QFET [®]	TinyBoost TM	
FAST [®]	MicroFET TM	QS TM	TinyBuck TM	
FAST ^r TM	MicroPak TM	QT Optoelectronics TM	TinyPWM TM	
FPS TM	MICROWIRE TM	Quiet Series TM	TinyPower TM	
FRFET TM	MSX TM	RapidConfigure TM	TinyLogic [®]	
	MSXPro TM	RapidConnect TM	TINYOPTO TM	
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The Power Franchise [®]		ScalarPump TM	UHC TM	
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2. A critical component is any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

PRODUCT STATUS DEFINITIONS

Definition of Terms

Datasheet Identification	Product Status	Definition
Advance Information	Formative or In Design	This datasheet contains the design specifications for product development. Specifications may change in any manner without notice.
Preliminary	First Production	This datasheet contains preliminary data, and supplementary data will be published at a later date. Fairchild Semiconductor reserves the right to make changes at any time without notice to improve design.
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