July 2005

FAIRCHILD
SEMICONDUCTOR®

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

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

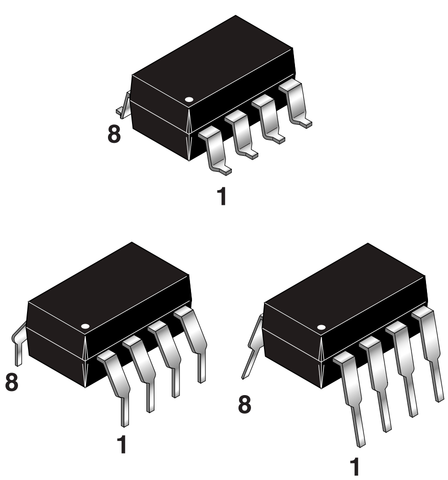
Description

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.

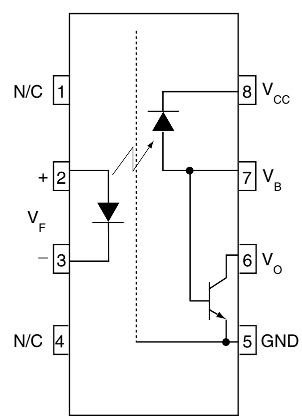
A separate connection for the bias of the photodiode improves the speed by several orders of magnitude over conventional phototransistor optocouplers by reducing the base-collector capacitance of the input transistor.

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.

Package

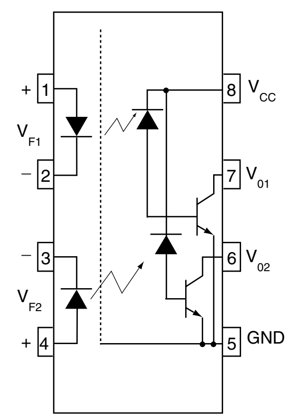


Schematic



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

Pin 7 is not connected in Part Number HCPL-4502



HCPL-2530/HCPL-2531

Absolute Maximum Ratings (T_A = 25°C unless otherwise specified)

Parameter		Symbol	Value	Units
Storage Temperature		T_{STG}	-55 to +125	°C
Operating Temperature		T_{OPR}	-55 to +100	°C
Lead Solder Temperature		T_{SOL}	260 for 10 sec	°C
EMITTER				
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 - (≤1 µs 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
DETECTOR				
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)	PD	100	mW
	(HCPL-2530, HCPL-2531) Each Channel		35	mW

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

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

** All Typicals at T_A = 25°C

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

Parameter	Test Conditions	Symbol	Device	Min	Typ**	Max	Unit
COUPLED Current transfer ratio (Note 5)	(I_F = 16 mA, V_O = 0.4 V) (V_{CC} = 4.5 V, T_A =25°C)	CTR	6N135 HCPL-2530	7	18	50	%
			6N136 HCPL-4502 HCPL-2531	19	27	50	%
			HCPL-2503	12	27		%
	(I_F = 16 mA, V_{CC} = 4.5 V) V_{OL}=0.4V		6N135	5	21		%
	V_{OL}=0.5V		HCPL-2530				
	V_{OL}=0.4V		6N136 HCPL-4502	15	30		%
	V_{OL}=0.5V		HCPL-2531				
	V_{OL}=0.4V		HCPL-2503	9	30		%
Logic low output voltage output voltage	(I_F = 16 mA, I_O = 1.1 mA) (V_{CC} = 4.5 V, T_A =25°C)	V_{OL}	6N135		0.18	0.4	V
			HCPL-2530		0.18	0.5	
	(I_F = 16 mA, I_O = 3 mA) (V_{CC} = 4.5 V, T_A =25°C)		6N136 HCPL-2503		0.25	0.4	
			HCPL-2531		0.25	0.5	
	(I_F = 16 mA, I_O = 0.8 mA) (V_{CC} = 4.5 V)		6N135 HCPL-2530			0.5	
	(I_F = 16 mA, I_O = 2.4 mA) (V_{CC} = 4.5 V)		HCPL-4502 HCPL-2531			0.5	

** All Typicals at T_A = 25°C

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

Parameter	Test Conditions	Symbol	Device	Min	Typ**	Max	Unit
Propagation delay time to logic low	T_A = 25°C, (R_L = 4.1 kΩ, I_F = 16 mA) (Note 6) (Fig. 7)	T_{PHL}	6N135 HCPL-2530		0.45	1.5	µs
	(R_L = 1.9 kΩ, I_F = 16 mA) (Note 7) (Fig. 7) T_A = 25°C		6N136 HCPL-4502 HCPL-2503 HCPL-2531		0.45	0.8	µs
	(R_L = 4.1 kΩ, I_F = 16 mA) (Note 6) (Fig. 7)		6N135 HCPL-2530			2.0	µs
	(R_L = 1.9 kΩ, I_F = 16 mA) (Note 7) (Fig. 7)		6N136 HCPL-4502 HCPL-2503 HCPL-2531			1.0	µs
Propagation delay time to logic high	T_A = 25°C, (R_L = 4.1 kΩ, I_F = 16 mA) (Note 6) (Fig. 7)	T_{PLH}	6N135 HCPL-2530		0.5	1.5	µs
	(R_L = 1.9 kΩ, I_F = 16 mA) (Note 7) (Fig. 7) T_A = 25°C		6N136 HCPL-4502 HCPL-2503 HCPL-2531		0.3	0.8	µs
	(R_L = 4.1 kΩ, I_F = 16 mA) (Note 6) (Fig. 7)		6N135 HCPL-2530			2.0	µs
	(R_L = 1.9 kΩ, I_F = 16 mA) (Note 7) (Fig. 7)		6N136 HCPL-4502 HCPL-2503 HCPL-2531			1.0	µs
Common mode transient immunity at logic high	(I_F = 0 mA, V_{CM} = 10 V_{P-P}, R_L = 4.1 kΩ) (Note 8) (Fig. 8) T_A = 25°C	$\|CM_H\|$	6N135 HCPL-2530		10,000		V/µs
	(I_F = 0 mA, V_{CM} = 10 V_{P-P}) T_A = 25°C, (R_L = 1.9 kΩ) (Note 8) (Fig. 8)		6N136 HCPL-4502 HCPL-2503 HCPL-2531		10,000		V/µs
Common mode transient immunity at logic low	(I_F = 16 mA, V_{CM} = 10 V_{P-P}, R_L = 4.1 kΩ) (Note 8) (Fig. 8) T_A = 25°C	$\|CM_L\|$	6N135 HCPL-2530		10,000		V/µs
	(I_F = 16 mA, V_{CM} = 10 V_{P-P}) (R_L = 1.9 kΩ) (Note 8) (Fig. 8)		6N136 HCPL-4502 HCPL-2503 HCPL-2531		10,000		V/µs

** All Typicals at T_A = 25°C

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

Characteristics	Test Conditions	Symbol	Min	Typ**	Max	Unit
Input-output insulation leakage current	(Relative humidity = 45%) (T_A = 25°C, t = 5 s) (V_{I-O} = 3000 VDC) (Note 9)	I_{I-O}			1.0	µA
Withstand insulation test voltage	(RH ≤ 50%, T_A = 25°C) (Note 9) (t = 1 min.)	V_{ISO}	2500			V_{RMS}
Resistance (input to output)	(Note 9) (V_{I-O} = 500 VDC)	R_{I-O}		10^{12}		Ω
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	(RH ≤ 45%, V_{I-I} = 500 VDC) (Note 10) t = 5 s, (HCPL-2530/2531 only)	I_{I-I}		0.005		µA
Input-Input Resistance	(V_{I-I} = 500 VDC) (Note 10) (HCPL-2530/2531 only)	R_{I-I}		10^{11}		Ω
Input-Input Capacitance	(f = 1 MHz) (Note 10) (HCPL-2530/2531 only)	C_{I-I}		0.03		pF

Notes

1. Derate linearly above 70°C free-air temperature at a rate of 0.8 mA/°C.
2. Derate linearly above 70°C free-air temperature at a rate of 1.6 mA/°C.
3. Derate linearly above 70°C free-air temperature at a rate of 0.9 mW/°C.
4. Derate linearly above 70°C free-air temperature at a rate of 2.0 mW/°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 kΩ load represents 1 LSTTL unit load of 0.36 mA and 6.1kΩ pull-up resistor.
7. The 1.9 kΩ load represents 1 TTL unit load of 1.6 mA and 5.6 kΩ pull-up resistor.
8. 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 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 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.

Fig. 1 Normalized CTR vs. Forward Current

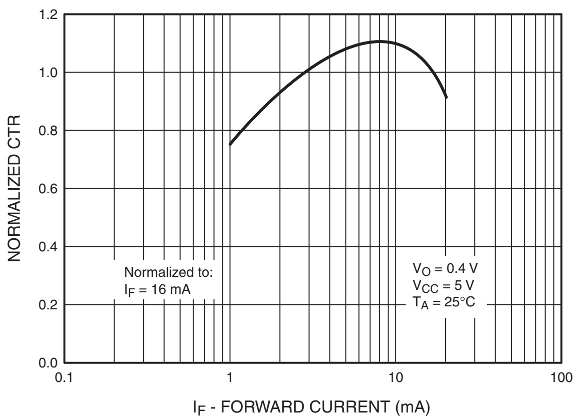


Fig. 2 Normalized CTR vs. Temperature

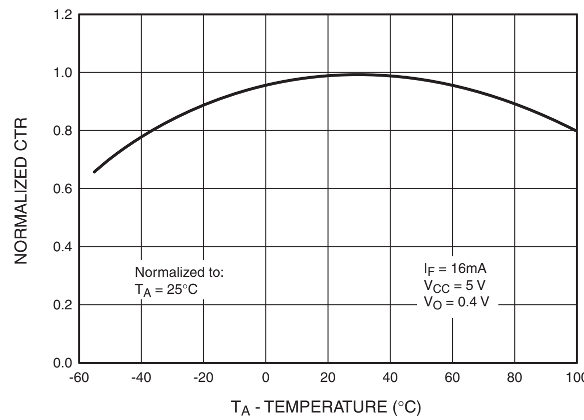


Fig. 3 Output Current vs. Output Voltage

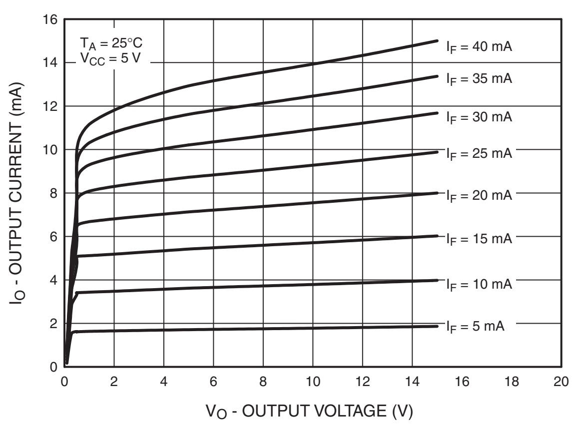


Fig. 4 Logic High Output Current vs. Temperature

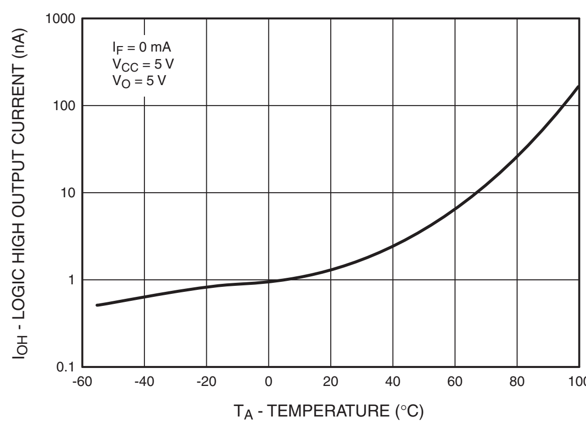


Fig. 5 Propagation Delay vs. Temperature

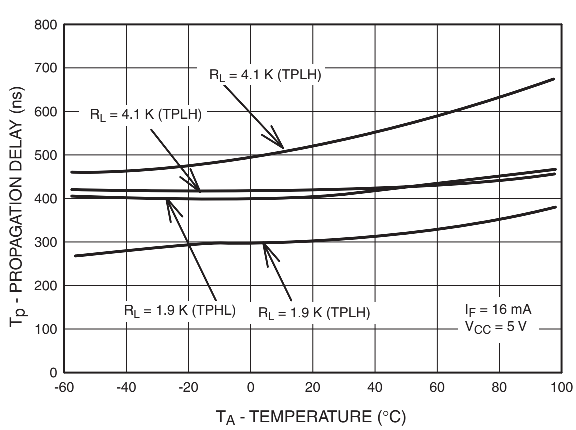
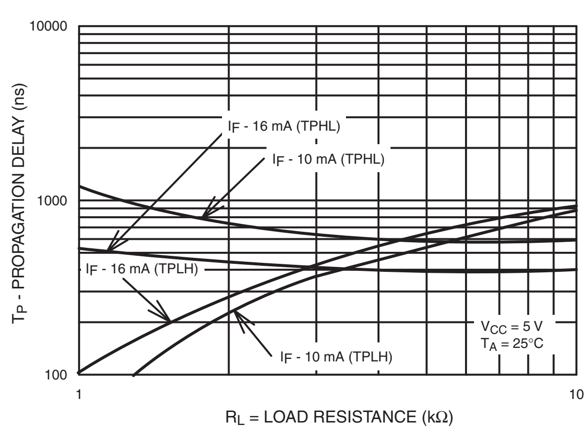
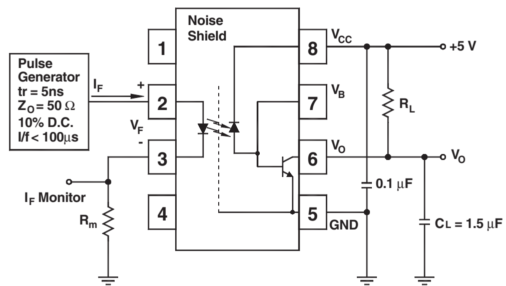
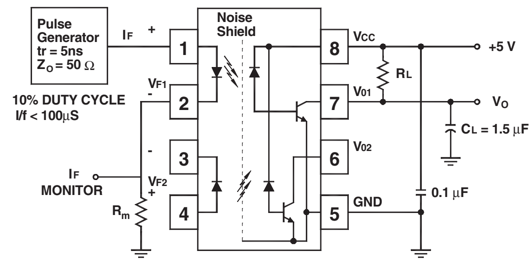


Fig. 6 Propagation Delay vs. Load Resistance





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



Test Circuit for HCPL-2530 and HCPL-2531

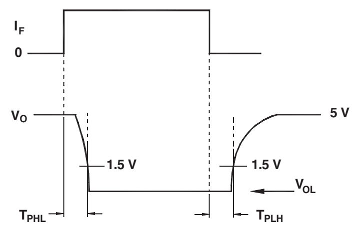
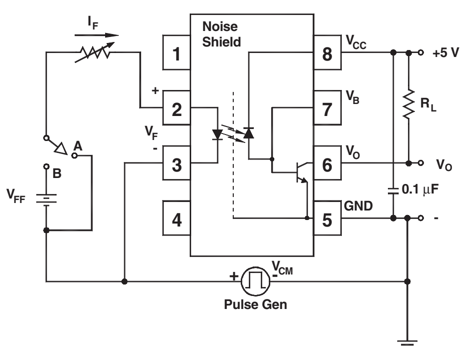
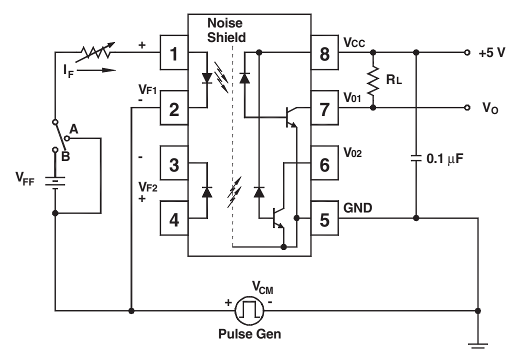


Fig. 7 Switching Time Test Circuit



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



Test Circuit for HCPL-2530 and HCPL-2531

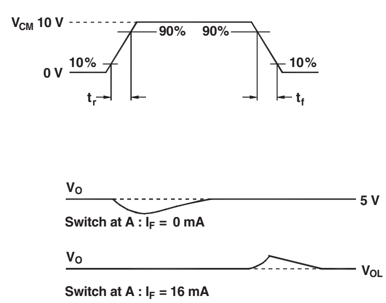
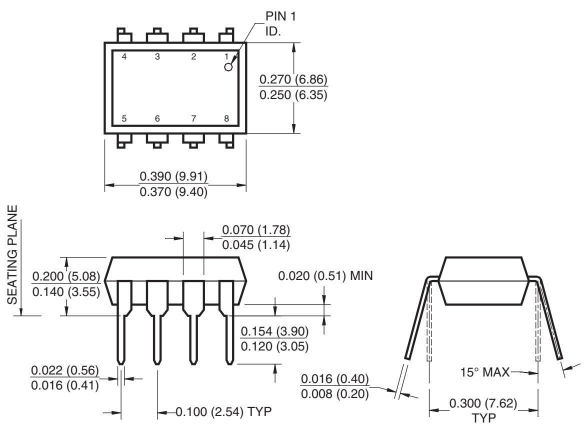
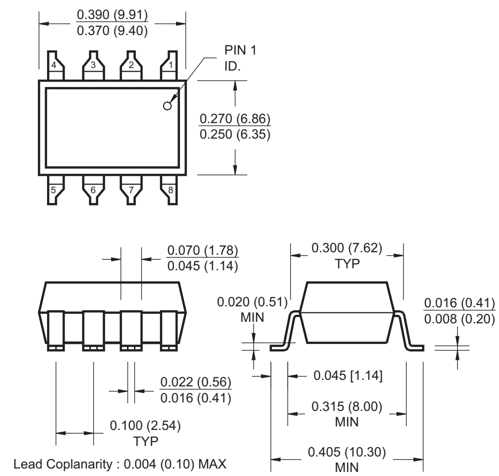


Fig. 8 Common Mode Immunity Test Circuit

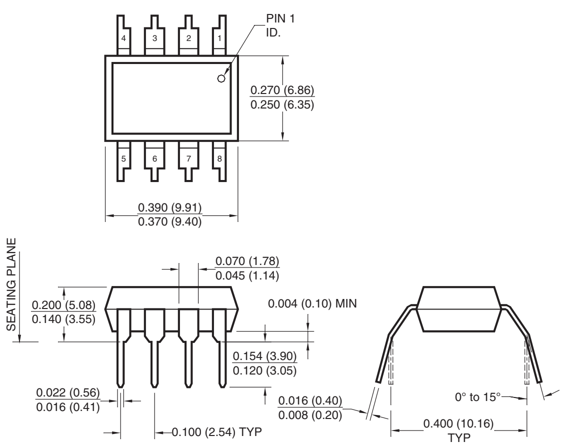
Package Dimensions (Through Hole)



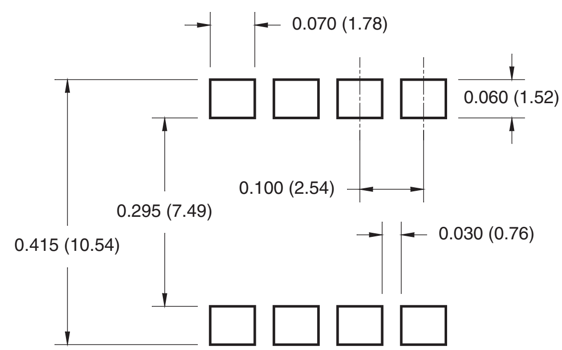
Package Dimensions (Surface Mount)



Package Dimensions (0.4"Lead Spacing)



Recommended Pad Layout for Surface Mount Leadform

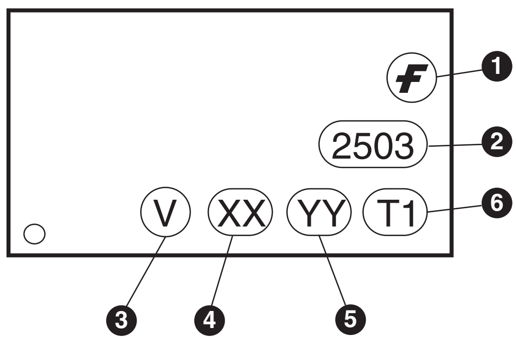


NOTE
All dimensions are in inches (millimeters)

Ordering Information

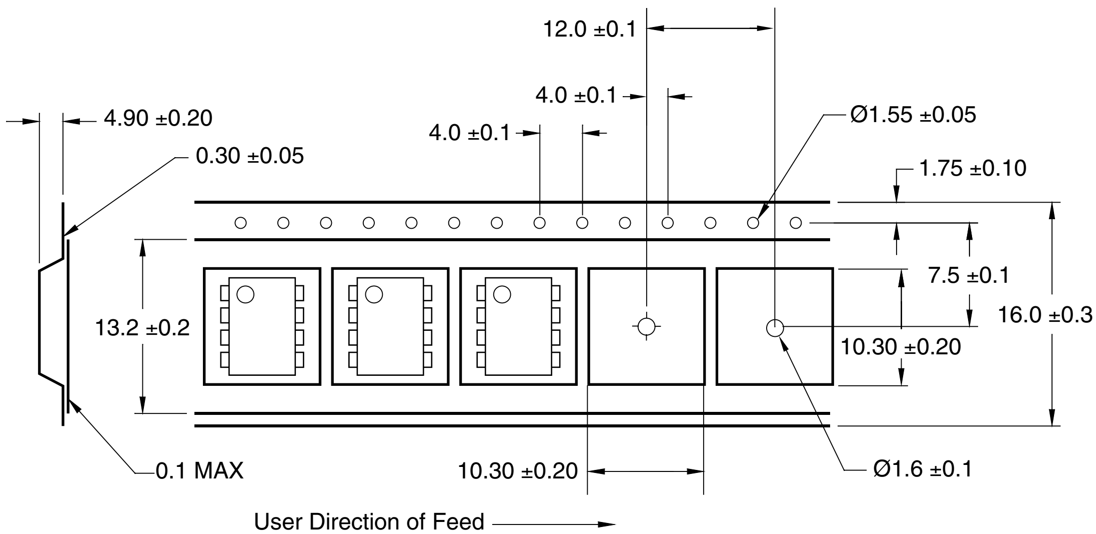
Option	Example Part Number	Description
S	6N135S	Surface Mount Lead Bend
SD	6N135SD	Surface Mount; Tape and reel
W	6N135W	0.4" Lead Spacing
V	6N135V	VDE0884
TV	6N135TV	VDE0884; 0.4” lead spacing
SV	6N135SV	VDE0884; surface mount
SDV	6N135SDV	VDE0884; surface mount; tape and reel

Marking Information

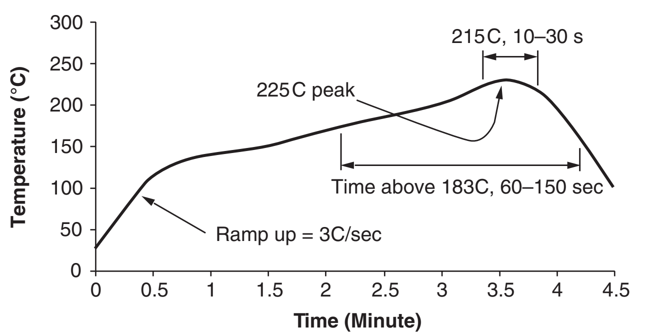


Definitions	
1	Fairchild logo
2	Device number
3	VDE mark (Note: Only appears on parts ordered with VDE option – See order entry table)
4	Two digit year code, e.g., ‘03’
5	Two digit work week ranging from ‘01’ to ‘53’
6	Assembly package code

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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PowerSaver™
PowerTrench®
QFET®
QS™
QT Optoelectronics™
Quiet Series™
RapidConfigure™
RapidConnect™
µSerDes™
SILENT SWITCHER®
SMART START™
SPM™
Stealth™
SuperFET™
SuperSOT™-3
SuperSOT™-6

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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 in order to improve design.
No Identification Needed	Full Production	This datasheet contains final specifications. Fairchild Semiconductor reserves the right to make changes at any time without notice in order to improve design.
Obsolete	Not In Production	This datasheet contains specifications on a product that has been discontinued by Fairchild semiconductor. The datasheet is printed for reference information only.

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