FAIRCHILD
SEMICONDUCTOR®

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

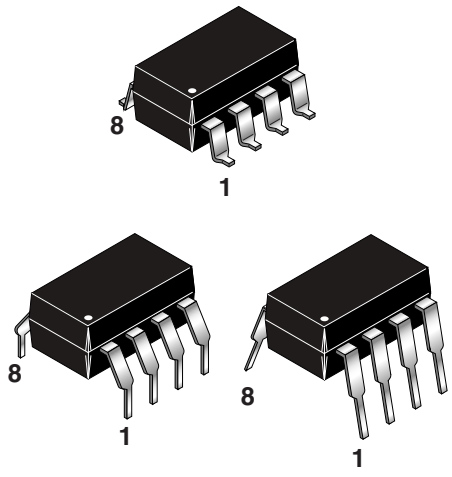
Description

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.

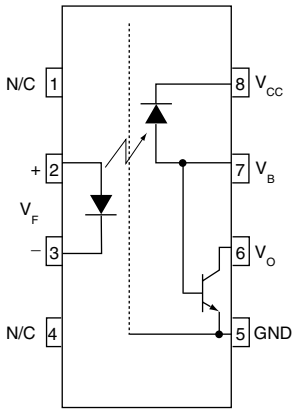
A separate connection for the bias of the photodiode improves the speed by several orders of magnitude over conventional phototransistor optocouplers by reducing the base-collector capacitance of the input transistor.

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

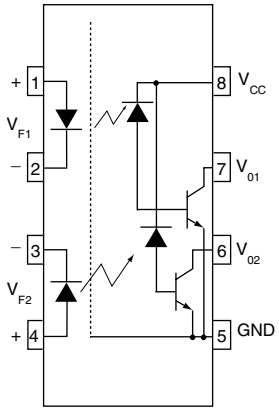


Schematic



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

Pin 7 is not connected in
Part Number HCPL-4502



HCPL-2530/HCPL-2531

Absolute Maximum Ratings (T_A = 25°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 0.8mA/°C.
2. Derate linearly above 70°C free-air temperature at a rate of 1.6mA/°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.

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 = 16mA, T_A =25°C			1.45	1.7	V
		I_F = 16mA				1.8	
B_{VR}	Input Reverse Breakdown Voltage	I_R = 10 µA		5.0			V
$\Delta V_F/\Delta T_A$	Temperature Coefficient of Forward Voltage	I_F = 16mA			-1.6		mV/°C
DETECTOR							
I_{OH}	Logic High Output Current	I_F = 0mA, V_O = V_{CC} = 5.5V, T_A =25°C	All		0.001	0.5	µA
		I_F = 0mA, V_O = V_{CC} = 15V, T_A =25°C	6N135 6N136 HCPL-4502 HCPL-2503		0.005	1	
		I_F = 0mA, V_O = V_{CC} = 15V	All			50	
I_{CCL}	Logic Low Supply Current	I_F = 16mA, V_O = Open, V_{CC} = 15V	6N135 6N136 HCPL-4502 HCPL-2503		120	200	µA
		I_{F1} = I_{F2} = 16mA, V_O = Open, V_{CC} = 15V	HCPL-2530 HCPL-2531		200	400	
I_{CCH}	Logic High Supply Current	I_F = 0mA, V_O = Open, V_{CC} = 15V, T_A =25°C	6N135 6N136 HCPL-4502 HCPL-2503			1	µA
		I_F = 0mA, V_O = Open, V_{CC} = 15V	6N135 6N136 HCPL-4502 HCPL-2503			2	
		I_F = 0mA, V_O = Open, V_{CC} = 15V	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)

Symbol	Parameter	Test Conditions		Device	Min.	Typ.*	Max.	Unit
COUPLED								
CTR	Current Transfer Ratio[5]	I_F = 16mA, V_O = 0.4 V, V_{CC} = 4.5V, T_A =25°C		6N135 HCPL-2530	7	18	50	%
				6N136 HCPL-4502 HCPL-2531	19	27	50	%
				HCPL-2503	12	27		%
		I_F = 16mA, V_{CC} = 4.5V	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		%
V_{OL}	Logic LOW Output Voltage	I_F = 16mA, I_O = 1.1mA, V_{CC} = 4.5V, T_A =25°C		6N135		0.18	0.4	V
				HCPL-2530		0.18	0.5	
		I_F = 16mA, I_O = 3mA, V_{CC} = 4.5V, T_A =25°C		6N136 HCPL-2503		0.25	0.4	
				HCPL-2531		0.25	0.5	
		I_F = 16mA, I_O = 0.8mA, V_{CC} = 4.5V		6N135 HCPL-2530			0.5	
		I_F = 16mA, I_O = 2.4mA, V_{CC} = 4.5V		HCPL-4502 HCPL-2531			0.5	

*All Typicals at T_A = 25°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} = 5V)

Symbol	Parameter	Test Conditions	Device	Min.	Typ.*	Max.	Unit
T_{PHL}	Propagation Delay Time to Logic LOW	T_A = 25°C, R_L = 4.1kΩ, I_F = 16mA(6) (Fig. 7)	6N135 HCPL-2530		0.45	1.5	µs
		R_L = 1.9kΩ, I_F = 16mA, T_A = 25°C(7) (Fig. 7)	6N136 HCPL-4502 HCPL-2503 HCPL-2531		0.45	0.8	µs
		R_L = 4.1kΩ, I_F = 16mA(6) (Fig. 7)	6N135 HCPL-2530			2.0	µs
		R_L = 1.9kΩ, I_F = 16mA(7) (Fig. 7)	6N136 HCPL-4502 HCPL-2503 HCPL-2531			1.0	µs
T_{PLH}	Propagation Delay Time to Logic HIGH	T_A = 25°C, (R_L = 4.1kΩ, I_F = 16mA(6) (Fig. 7)	6N135 HCPL-2530		0.5	1.5	µs
		R_L = 1.9kΩ, I_F = 16mA(7) (Fig. 7) T_A = 25°C	6N136 HCPL-4502 HCPL-2503 HCPL-2531		0.3	0.8	µs
		R_L = 4.1kΩ, I_F = 16mA(6) (Fig. 7)	6N135 HCPL-2530			2.0	µs
		R_L = 1.9kΩ, I_F = 16mA(7) (Fig. 7)	6N136 HCPL-4502 HCPL-2503 HCPL-2531			1.0	µs
$\|CM_H\|$	Common Mode Transient Immunity at Logic High	I_F = 0mA, V_{CM} = 10V_{P-P}, R_L = 4.1kΩ, T_A = 25°C(8) (Fig. 8)	6N135 HCPL-2530		10,000		V/µs
		I_F = 0mA, V_{CM} = 10V_{P-P} R_L = 1.9kΩ, T_A = 25°C(8) (Fig. 8)	6N136 HCPL-4502 HCPL-2503 HCPL-2531		10,000		V/µs
$\|CM_L\|$	Common Mode Transient Immunity at Logic Low	I_F = 16mA, V_{CM} = 10 V_{P-P} R_L = 4.1kΩ, T_A = 25°C(8) (Fig. 8)	6N135 HCPL-2530		10,000		V/µs
		I_F = 16mA, V_{CM} = 10 V_{P-P} R_L = 1.9kΩ(8) (Fig. 8)	6N136 HCPL-4502 HCPL-2503 HCPL-2531		10,000		V/µs

** All Typicals at T_A = 25°C

Notes:

6. The 4.1kΩ load represents 1 LSTTL unit load of 0.36mA and 6.1kΩ pull-up resistor.
7. The 1.9kΩ load represents 1 TTL unit load of 1.6mA and 5.6kΩ 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 > 2.0V). 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 < 0.8V).

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°C, t = 5s, V_{I-O} = 3000 VDC(9)			1.0	µA
V_{ISO}	Withstand Insulation Test Voltage	RH ≤ 50%, T_A = 25°C, I_{I-O} ≤ 2 µA, t = 1 min.(9)	2500			V_{RMS}
R_{I-O}	Resistance (Input to Output)	V_{I-O} = 500VDC(9)		10^{12}		Ω
C_{I-O}	Capacitance (Input to Output)	f = 1 MHz(9)		0.6		pF
HFE	DC Current Gain	I_O = 3mA, V_O = 5V(9)		150		
I_{I-I}	Input-Input Insulation Leakage Current	RH ≤ 45%, V_{I-I} = 500VDC(10) t = 5 s, (HCPL-2530/2531 only)		0.005		µA
R_{I-I}	Input-Input Resistance	V_{I-I} = 500 VDC(10) (HCPL-2530/2531 only)		10^{11}		Ω
C_{I-I}	Input-Input Capacitance	f = 1MHz)(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

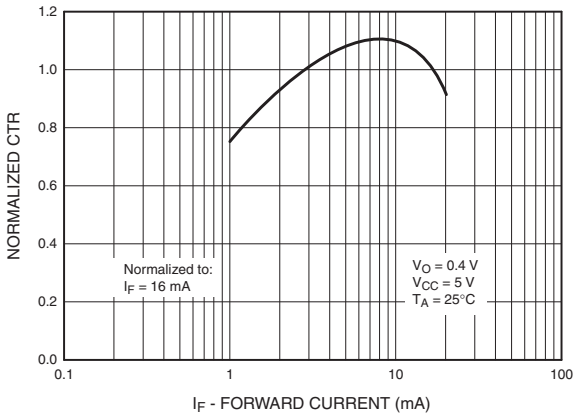


Fig. 2 Normalized CTR vs. Temperature

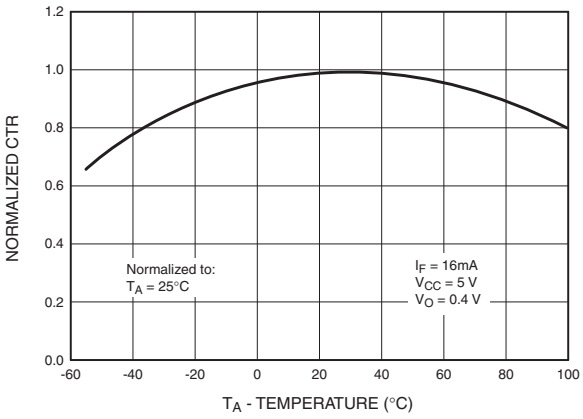


Fig. 3 Output Current vs. Output Voltage

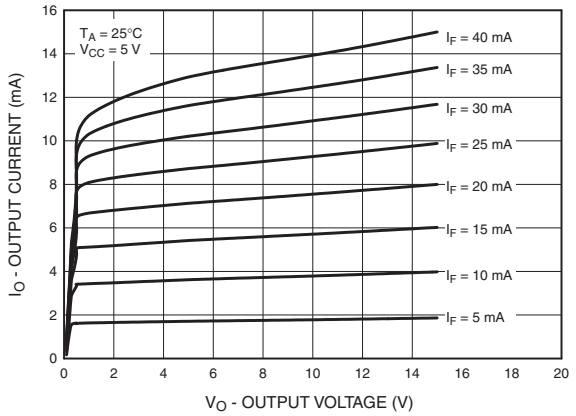


Fig. 4 Logic High Output Current vs. Temperature

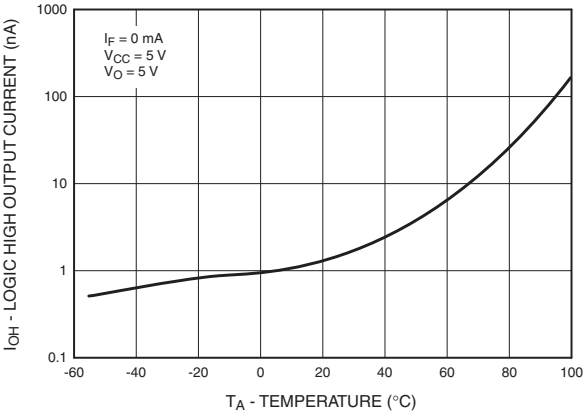


Fig. 5 Propagation Delay vs. Temperature

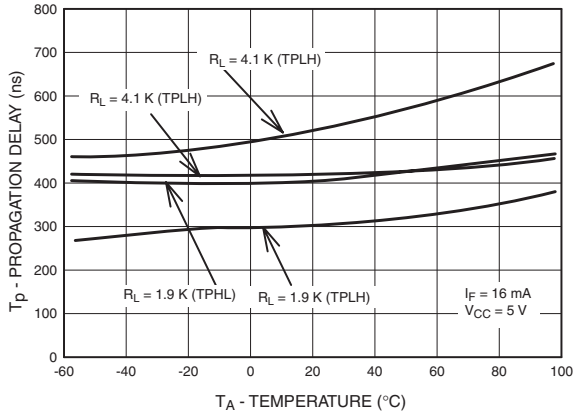
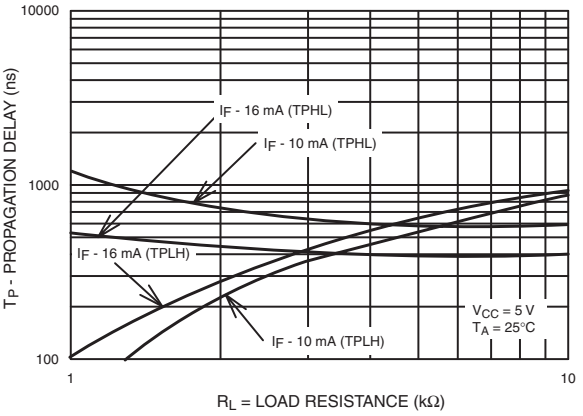
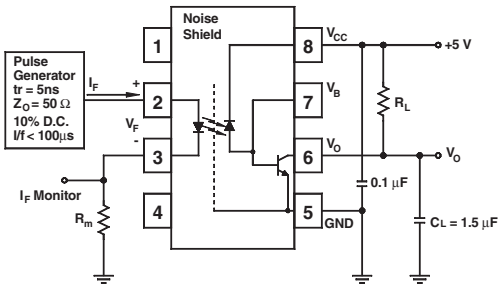
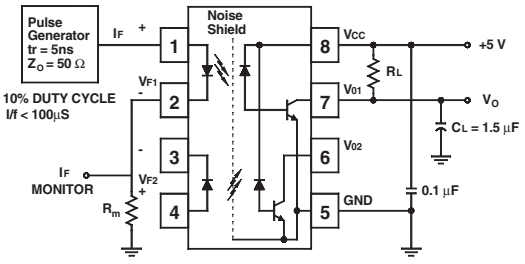


Fig. 6 Propagation Delay vs. Load Resistance





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



Test Circuit for HCPL-2530 and HCPL-2531

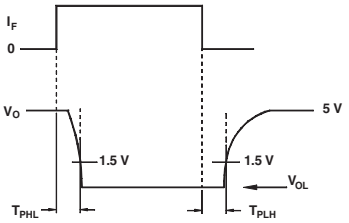
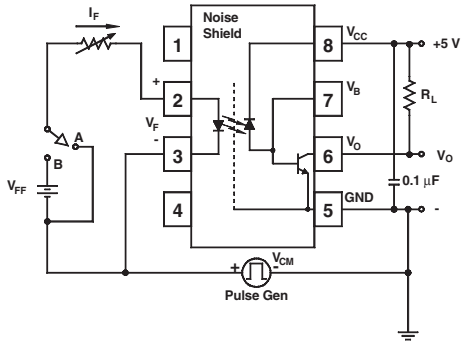
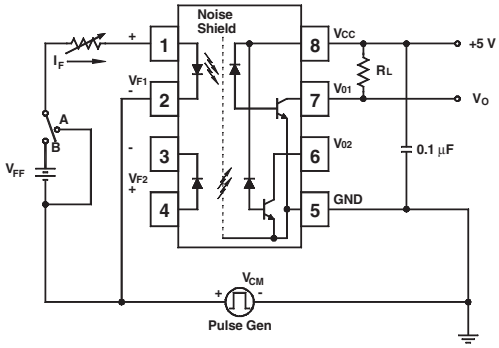


Fig. 7 Switching Time Test Circuit



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



Test Circuit for HCPL-2530 and HCPL-2531

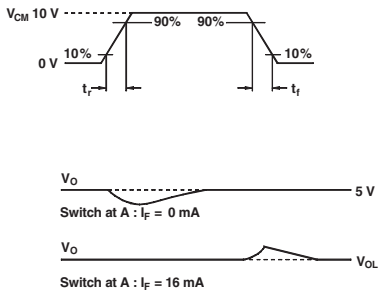
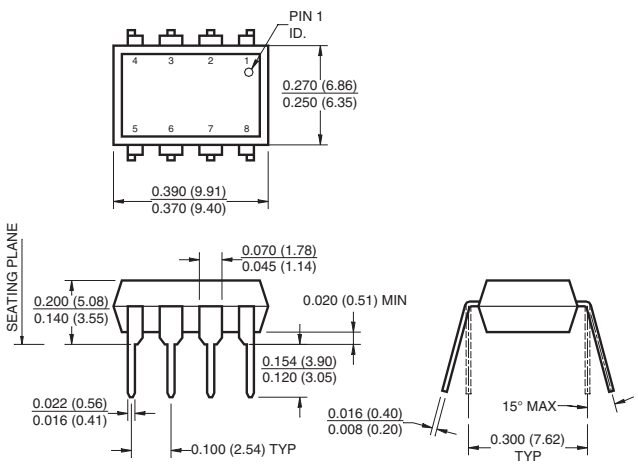


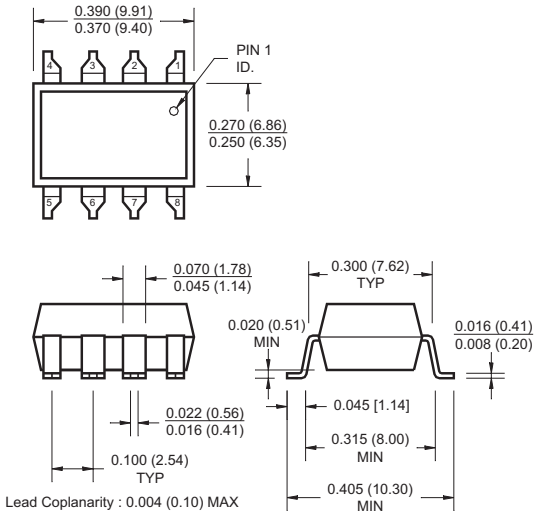
Fig. 8 Common Mode Immunity Test Circuit

Package Dimensions All dimensions are in inches (millimeters)

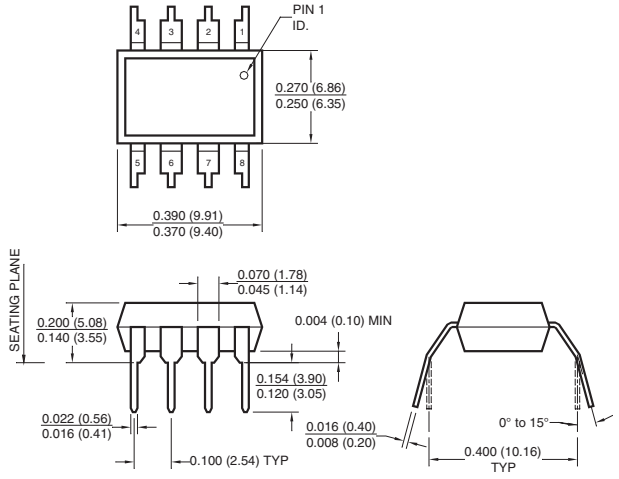
Through Hole



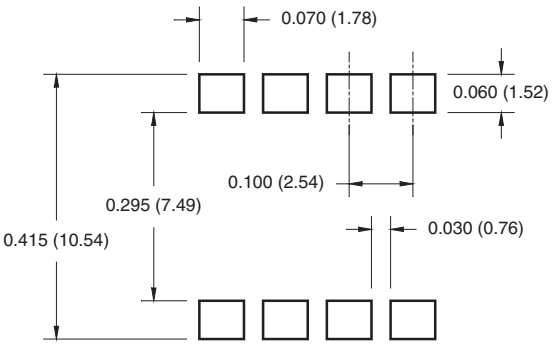
Surface Mount



0.4” Lead Spacing



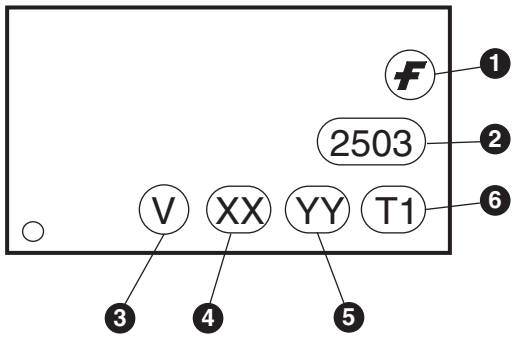
Recommend Pad Layout for Surface Mount Leadform



Ordering Information

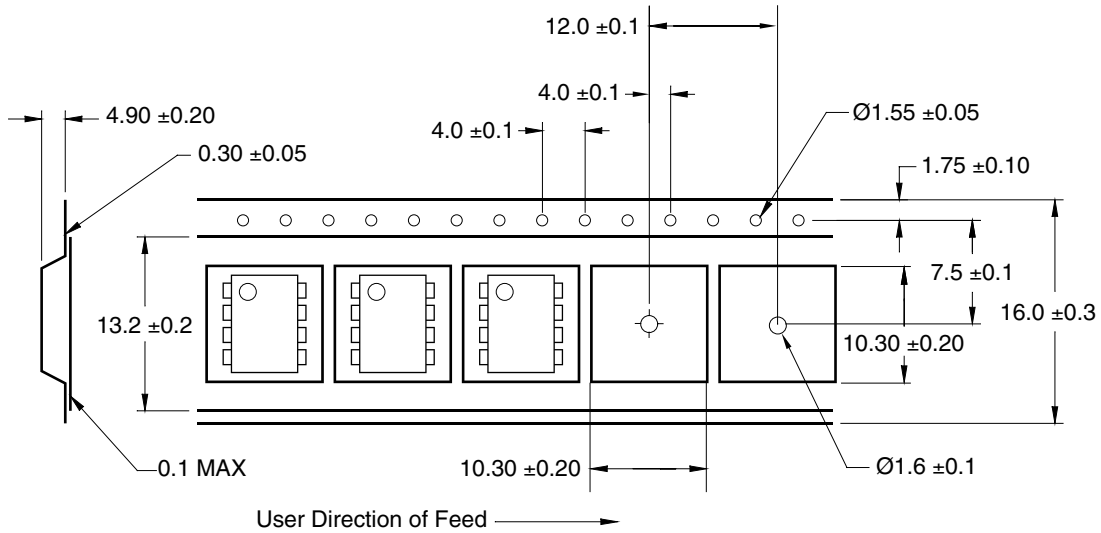
Option	Example Part Number	Description
S	6N135S	Surface Mount Lead Bend
SD	6N135SD	Surface Mount; Tape and reel
W	6N135W	0.4" Lead Spacing
V	6N135V	VDE0884
WV	6N135WV	VDE0884; 0.4” lead spacing
SV	6N135SV	VDE0884; surface mount
SDV	6N135SDV	VDE0884; surface mount; tape and reel

Marking Information

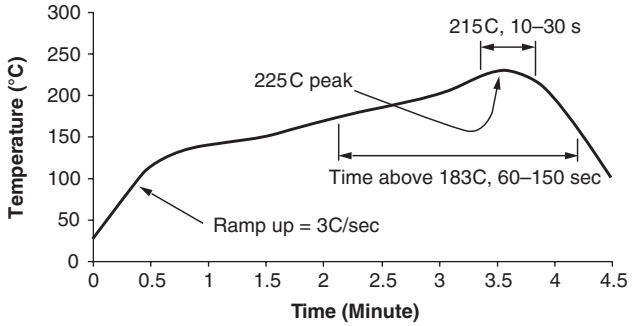


Definitions	
1	Fairchild logo
2	Device number
3	VDE mark (Note: Only appears on parts ordered with VDE option – See order entry table)
4	Two digit year code, e.g., ‘03’
5	Two digit work week ranging from ‘01’ to ‘53’
6	Assembly package code

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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Bottomless™	GTO™	OPTOLOGIC®	SPM™	VCX™
Build it Now™	HiSeC™	OPTOPLANAR™	Stealth™	Wire™
CoolFET™	I^2C™	PACMAN™	SuperFET™	
CROSSVOLT™	*i-Lo*™	POP™	SuperSOT™-3	
DOME™	ImpliedDisconnect™	Power247™	SuperSOT™-6	
EcoSPARK™	IntelliMAX™	PowerEdge™	SuperSOT™-8	
E^2CMOS™	ISOPLANAR™	PowerSaver™	SyncFET™	
EnSigna™	LittleFET™	PowerTrench®	TCM™	
FACT™	MICROCOUPLER™	QFET®	TinyBoost™	
FAST®	MicroFET™	QS™	TinyBuck™	
FASTr™	MicroPak™	QT Optoelectronics™	TinyPWM™	
FPS™	MICROWIRE™	Quiet Series™	TinyPower™	
FRFET™	MSX™	RapidConfigure™	TinyLogic®	
	MSXPro™	RapidConnect™	TINYOPTO™	
Across the board. Around the world.™		µSerDes™	TruTranslation™	
The Power Franchise®		ScalarPump™	UHC™	
Programmable Active Droop™				

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1. Life support devices or systems are devices or systems which, (a) are intended for surgical implant into the body, or (b) support or sustain life, or (c) whose failure to perform when properly used in accordance with instructions for use provided in the labeling, can be reasonably expected to result in significant injury to the user.

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.
No Identification Needed	Full Production	This datasheet contains final specifications. Fairchild Semiconductor reserves the right to make changes at any time without notice to improve design.
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