

HCPL4503M High Speed Transistor Optocouplers

Features

- VISO = 5kV RMS is standard for all devices
- High speed – 1MBit/s
- Superior CMR, $CM_H = 50kV/ms$ (typical);
 $CM_L = 30kV/ms$ (typical)
- No base connection for improved noise immunity
- CTR guaranteed 0-70°C
- U.L. recognized (File # E90700, Vol 2)
- VDE approval pending

Applications

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

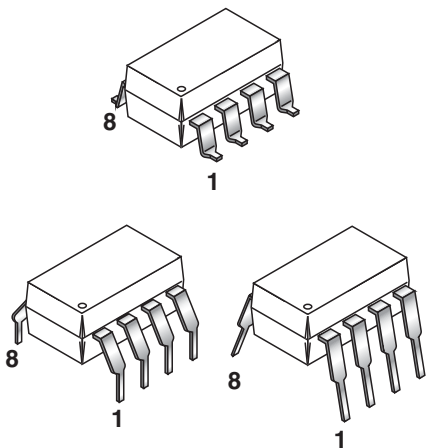
Description

The HCPL4503M optocoupler consists of an AlGaAs LED optically coupled to a high speed photodetector transistor.

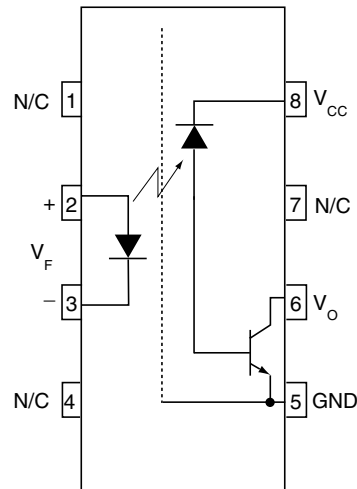
A separate connection for the bias of the photodiode improves the speed by several orders of magnitude over conventional phototransistor optocouplers by reducing the base-collector capacitance of the input transistor. The base of the phototransistor is not bonded out to a pin for improved noise immunity.

An internal noise shield provides superior common mode rejection of 15kV/μs minimum.

Package



Schematic



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

Symbol	Parameter	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	260 for 10 sec	$^\circ\text{C}$
EMITTER			
I_F (avg)	DC/Average Forward Input Current	25	mA
I_F (pk)	Peak Forward Input Current (50% duty cycle, 1ms P.W.)	50	mA
I_F (trans)	Peak Transient Input Current – ($\leq 1\mu\text{s}$ P.W., 300pps)	1.0	A
V_R	Reverse Input Voltage	5	V
P_D	Input Power Dissipation	100	mW
DETECTOR			
I_O (avg)	Average Output Current	8	mA
I_O (pk)	Peak Output Current	16	mA
V_{CC}	Supply Voltage	-0.5 to 30	V
V_O	Output Voltage	-0.5 to 20	V
PD	Output power dissipation	100	mW

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

Individual Component Characteristics

Symbol	Parameter	Test Conditions	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	$I_R = 10\mu\text{A}$	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	$I_F = 0\text{mA}, V_O = V_{CC} = 5.5\text{V}, T_A = 25^\circ\text{C}$		0.001	0.5	μA
		$I_F = 0\text{mA}, V_O = V_{CC} = 15\text{V}, T_A = 25^\circ\text{C}$		0.005	1	
		$I_F = 0\text{mA}, V_O = V_{CC} = 15\text{V}$			50	
I_{CCL}	Logic low supply current	$I_F = 16\text{mA}, V_O = \text{Open}, V_{CC} = 15\text{V}$		120	200	μA
I_{CCH}	Logic high supply current	$I_F = 0\text{mA}, V_O = \text{Open}, V_{CC} = 15\text{V}, T_A = 25^\circ\text{C}$			1	μA
		$I_F = 0\text{mA}, V_O = \text{Open}, V_{CC} = 15\text{V}$			2	

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

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

Symbol	Parameter	Test Conditions	Min.	Typ.**	Max.	Unit
COUPLED						
CTR	Current Transfer Ratio ⁽⁵⁾	$I_F = 16\text{mA}, V_O = 0.4\text{V}, V_{CC} = 4.5\text{V}, T_A = 25^\circ\text{C}^{(1)}$	19	27	50	%
		$I_F = 16\text{mA}, V_{CC} = 4.5\text{V}, V_{OL} = 0.5\text{V}$	15	30		
V_{OL}	Logic low output voltage output voltage	$I_F = 16\text{mA}, I_O = 3\text{mA}, V_{CC} = 4.5\text{V}, T_A = 25^\circ\text{C}$			0.5	V
		$I_F = 16\text{mA}, I_O = 2.4\text{mA}, V_{CC} = 4.5\text{V}$			0.5	

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

Note:

- 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	Min.	Typ.**	Max.	Unit
T_{PHL}	Propagation Delay Time to Logic Low	$R_L = 1.9\text{k}\Omega$, $I_F = 16\text{mA}^{(2)}$ (Fig. 7) $T_A = 25^\circ\text{C}$		0.45	0.8	μs
		$R_L = 1.9\text{k}\Omega$, $I_F = 16\text{mA}^{(2)}$ (Fig. 7)			1.0	μs
T_{PLH}	Propagation Delay Time to Logic High	$R_L = 1.9\text{k}\Omega$, $I_F = 16\text{mA}^{(2)}$ (Fig. 7) $T_A = 25^\circ\text{C}$		0.3	0.8	μs
		$R_L = 1.9\text{k}\Omega$, $I_F = 16\text{mA}^{(2)}$ (Fig. 7)			1.0	μs
ICM_{HI}	Common Mode Transient Immunity at Logic High	$I_F = 0$ mA, $V_{CM} = 1,500\text{V}_{P-P}$, $T_A = 25^\circ\text{C}$, $R_L = 1.9\text{k}\Omega^{(3)}$ (Fig. 8)	15,000	50,000		$\text{V}/\mu\text{s}$
ICM_{LI}	Common Mode Transient Immunity at Logic Low	$I_F = 16\text{mA}$, $V_{CM} = 1,500\text{V}_{P-P}$, $R_L = 1.9\text{k}\Omega^{(3)}$ (Fig. 8)	15,000	30,000		$\text{V}/\mu\text{s}$

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

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%, $T_A = 25^\circ\text{C}$, $t = 5\text{s}$, $V_{I-O} = 3000\text{VDC}^{(4)}$			1.0	μA
V_{ISO}	Withstand Insulation Test Voltage	$RH \leq 50\%$, $T_A = 25^\circ\text{C}$, $I_{I-O} \leq 2\mu\text{A}$, $t = 1$ min. ⁽⁴⁾	5,000			V_{RMS}
R_{I-O}	Resistance (input to output)	$V_{I-O} = 500\text{VDC}$		10^{12}		Ω
C_{I-O}	Capacitance (input to output)	$f = 1\text{MHz}^{(4)}$		0.6		pF

Notes:

- The 1.9 k Ω load represents 1 TTL unit load of 1.6 mA and 5.6 k Ω 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., $V_O < 0.8\text{V}$).
- 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.

Fig. 1 Normalized CTR vs. Forward Current

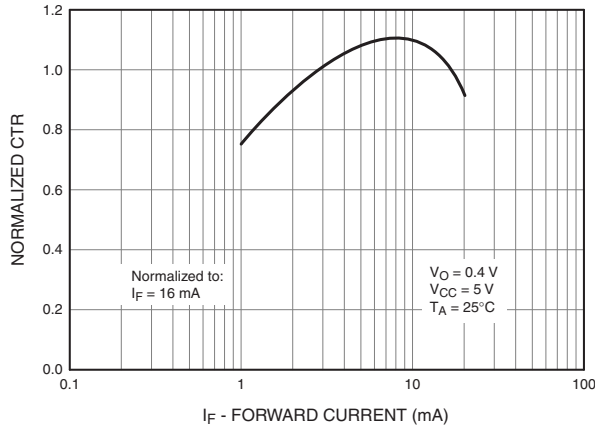


Fig. 2 Normalized CTR vs. Temperature

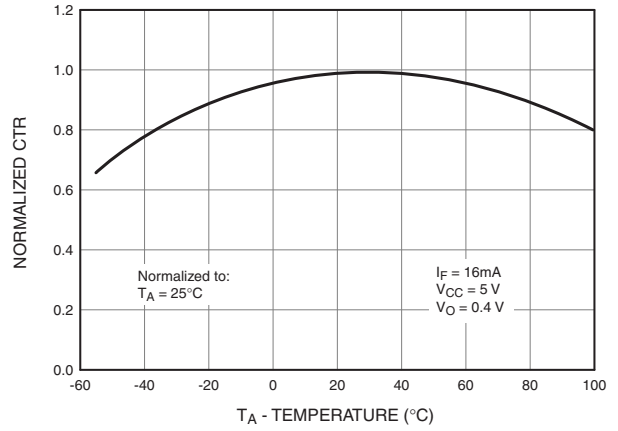


Fig. 3 Output Current vs. Output Voltage

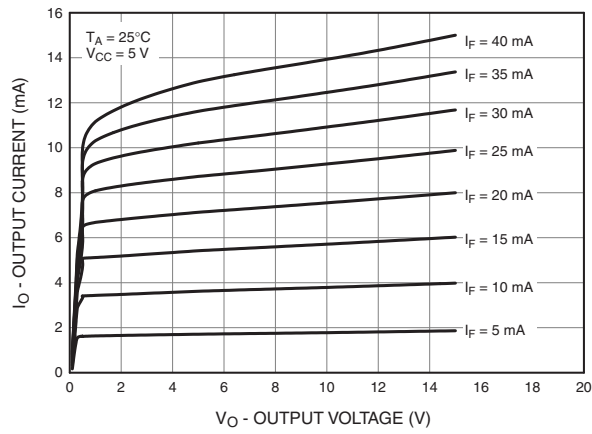


Fig. 4 Logic High Output Current vs. Temperature

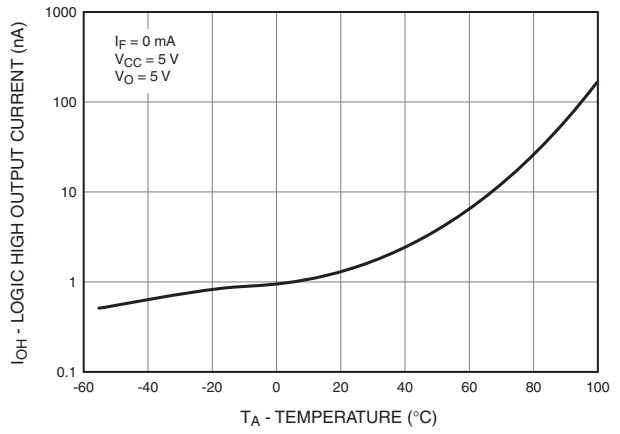


Fig. 5 Propagation Delay vs. Temperature

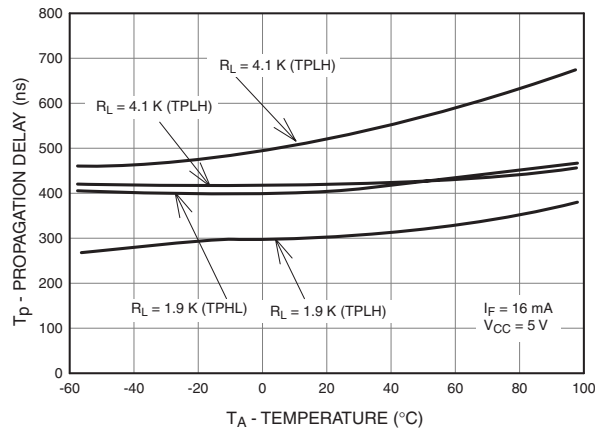


Fig. 6 Propagation Delay vs. Load Resistance

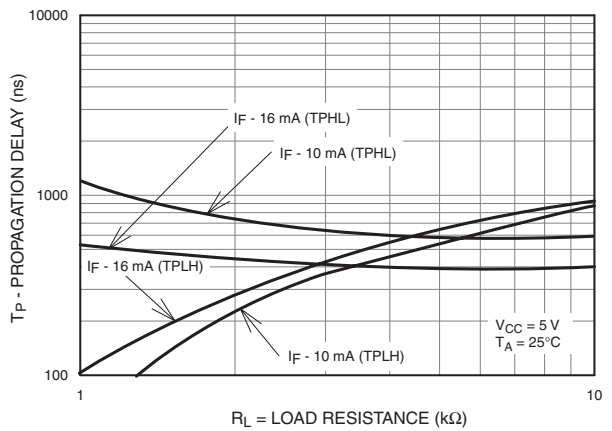


Fig. 7 Switching Time Test Circuit

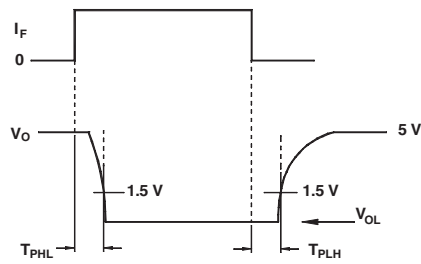
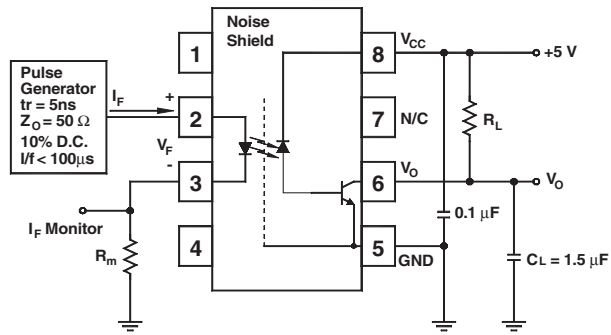
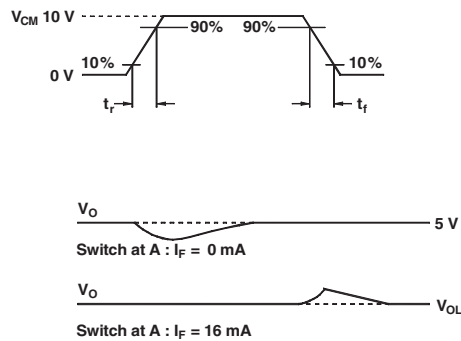
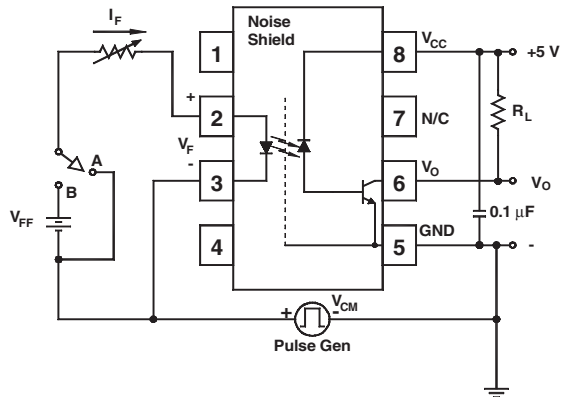
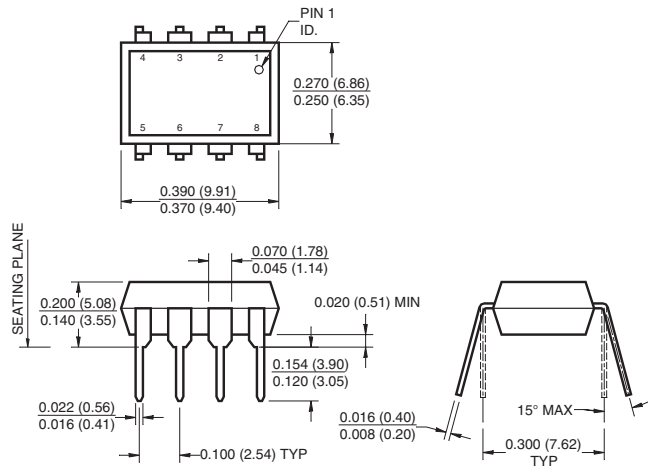


Fig. 8 Common Mode Immunity Test Circuit

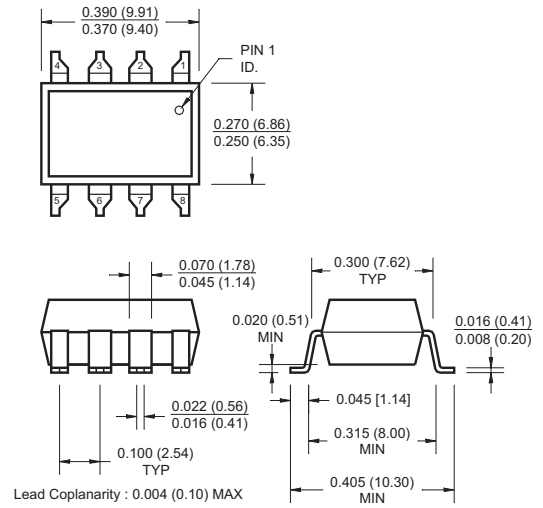


Package Dimensions

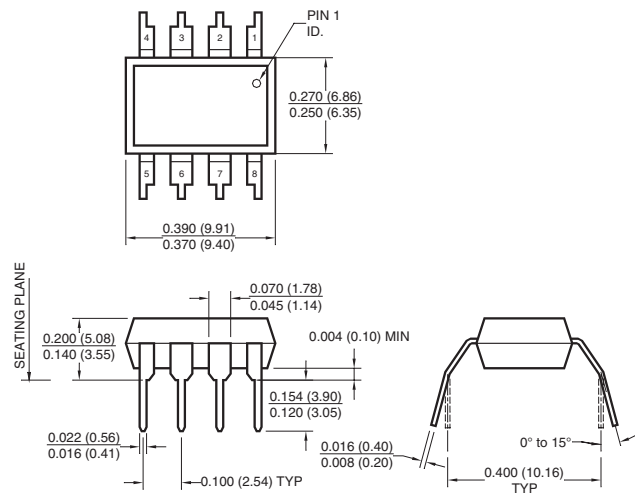
Through Hole



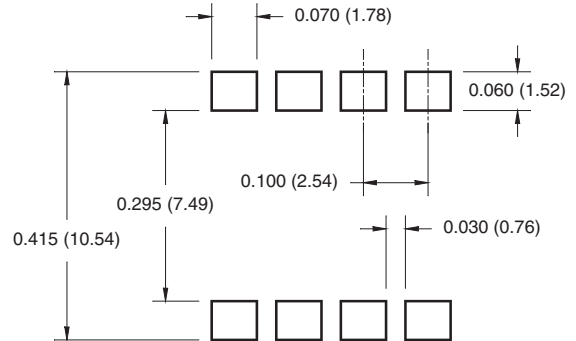
Surface Mount



0.4" Lead Spacing



8-Pin DIP



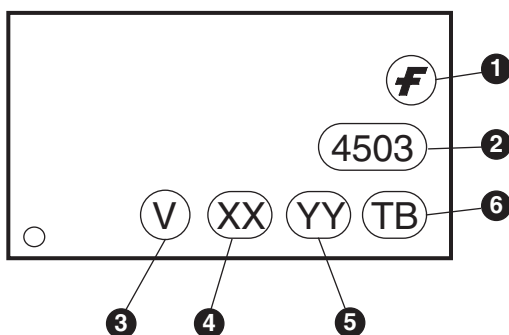
Note:

All dimensions are in inches (millimeters)

Ordering Information

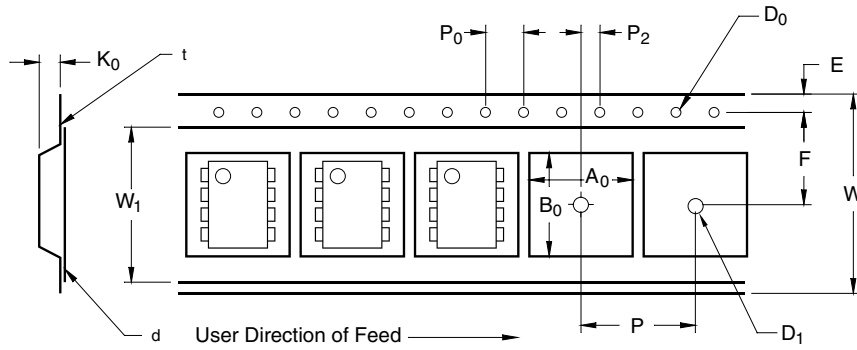
Option	Example Part Number	Description
	HCPL4503M	Standard Through Hole
S	HCPL4503SM	Surface Mount Lead Bend
SD	HCPL4503SDM	Surface Mount; Tape and Reel
T	HCPL4503TM	0.4" Lead Spacing
V	HCPL4503VM	VDE0884
TV	HCPL4503TVM	VDE0884; 0.4" Lead Spacing
SV	HCPL4503SVM	VDE0884; Surface Mount
SDV	HCPL4503SDVM	VDE0884; Surface Mount; Tape and Reel

Marking Information



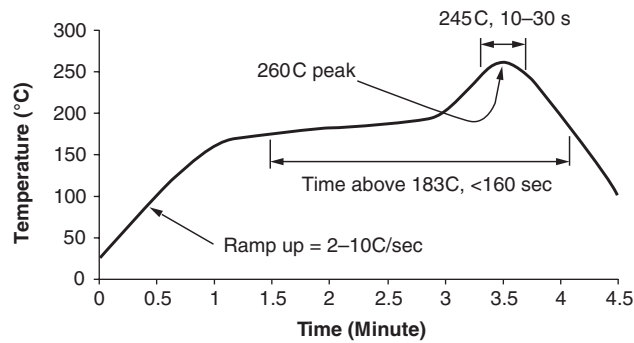
Definitions	
1	Fairchild logo
2	Device number
3	VDE mark (Note: Only appears on parts ordered with VDE option – See order entry table)
4	Two digit year code, e.g., '03'
5	Two digit work week ranging from '01' to '53'
6	Assembly package code

Carrier Tape Specifications



Symbol	Description	Dimension in mm
W	Tape Width	16.0 ± 0.3
t	Tape Thickness	0.30 ± 0.05
P ₀	Sprocket Hole Pitch	4.0 ± 0.1
D ₀	Sprocket Hole Diameter	1.55 ± 0.05
E	Sprocket Hole Location	1.75 ± 0.10
F	Pocket Location	7.5 ± 0.1
P ₂		4.0 ± 0.1
P	Pocket Pitch	12.0 ± 0.1
A ₀	Pocket Dimensions	10.30 ± 0.20
B ₀		10.30 ± 0.20
K ₀		4.90 ± 0.20
W ₁	Cover Tape Width	1.6 ± 0.1
d	Cover Tape Thickness	0.1 max
	Max. Component Rotation or Tilt	10°
R	Min. Bending Radius	30

Reflow Profile



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Build it Now™	HiSeC™	OPTOPLANAR™	Stealth™	Wire™
CoolFET™	I ² C™	PACMAN™	SuperFET™	
CROSSVOLT™	i-Lo™	POP™	SuperSOT™-3	
DOE™	ImpliedDisconnect™	Power247™	SuperSOT™-6	
EcoSPARK™	IntelliMAX™	PowerEdge™	SuperSOT™-8	
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FASTr™	MicroPak™	QT Optoelectronics™	TinyPWM™	
FPS™	MICROWIRE™	Quiet Series™	TinyPower™	
FRFET™	MSX™	RapidConfigure™	TinyLogic®	
	MSXPro™	RapidConnect™	TINYOPTO™	
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Programmable Active Droop™				

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- 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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