FAIRCHILD SEMICONDUCTOR®

August 2008

HCPL4503M
High Speed Transistor Optocouplers

Features

- V_{ISO} = 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°C to 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

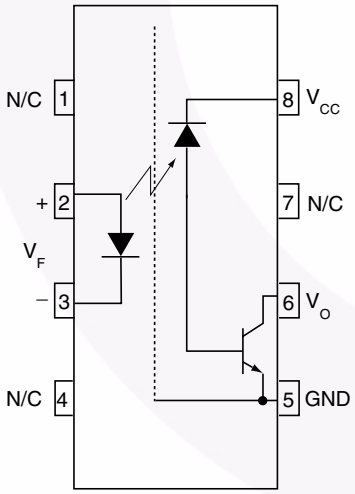
Description

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

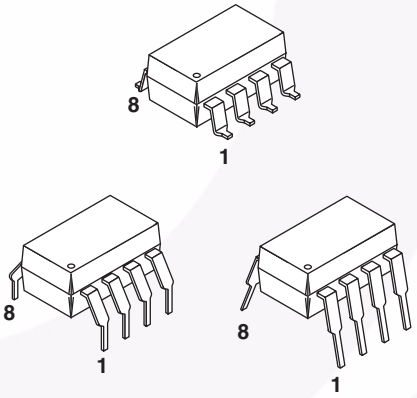
A separate connection for the bias of the photodiode improves the speed by several orders of magnitude over conventional phototransistor optocouplers by reducing the base-collector capacitance of the input transistor. The base of the phototransistor is not bonded out to a pin for improved noise immunity.

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

Schematic



Package Outlines



Absolute Maximum Ratings (T_A = 25°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	Value	Units
T_{STG}	Storage Temperature	-40 to +125	°C
T_{OPR}	Operating Temperature	-40 to +100	°C
T_{SOL}	Lead Solder Temperature	260 for 10 sec	°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 – (≤1µs 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 = 16mA, T_A = 25°C		1.45	1.7	V
		I_F = 16mA			1.8	
B_{VR}	Input Reverse Breakdown Voltage	I_R = 10µA	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		0.001	0.5	µA
		I_F = 0mA, V_O = V_{CC} = 15V, T_A = 25°C		0.005	1	
		I_F = 0mA, V_O = V_{CC} = 15V			50	
I_{CCL}	Logic low supply current	I_F = 16mA, V_O = Open, V_{CC} = 15V		120	200	µA
I_{CCH}	Logic high supply current	I_F = 0mA, V_O = Open, V_{CC} = 15V, T_A = 25°C			1	µA
		I_F = 0mA, V_O = Open, V_{CC} = 15V			2	

*All Typicals at T_A = 25°C

Transfer Characteristics

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

*All Typicals at T_A = 25°C

Note:

1. Current Transfer Ratio is defined as a ratio of output collector current, I_O, to the forward LED input current, I_F, times 100%.

Electrical Characteristics (Continued) (T_A = 0 to 70°C unless otherwise specified)

Switching Characteristics (V_{CC} = 5V)

Symbol	Parameter	Test Conditions	Min.	Typ.*	Max.	Unit
T_{PHL}	Propagation Delay Time to Logic Low	R_L = 1.9kΩ, I_F = 16mA(2) (Fig. 7) T_A = 25°C		0.45	0.8	µs
		R_L = 1.9kΩ, I_F = 16mA(2) (Fig. 7)			1.0	µs
T_{PLH}	Propagation Delay Time to Logic High	R_L = 1.9kΩ, I_F = 16mA(2) (Fig. 7) T_A = 25°C		0.3	0.8	µs
		R_L = 1.9kΩ, I_F = 16mA(2) (Fig. 7)			1.0	µs
$\|CM_H\|$	Common Mode Transient Immunity at Logic High	I_F = 0 mA, V_{CM} = 1,500V_{P-P}, T_A = 25°C, R_L = 1.9kΩ(3)(Fig. 8)	15,000	50,000		V/µs
$\|CM_L\|$	Common Mode Transient Immunity at Logic Low	I_F = 16mA, V_{CM} = 1,500V_{P-P}, R_L = 1.9kΩ(3) (Fig. 8)	15,000	30,000		V/µs

*All Typicals at T_A = 25°C

Isolation Characteristics

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

Notes:

2. The 1.9kΩ load represents 1 TTL unit load of 1.6mA and 5.6kΩ pull-up resistor.
3. 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).
4. 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.

Typical Performance Curves

Fig. 1 Normalized CTR vs. Forward Current

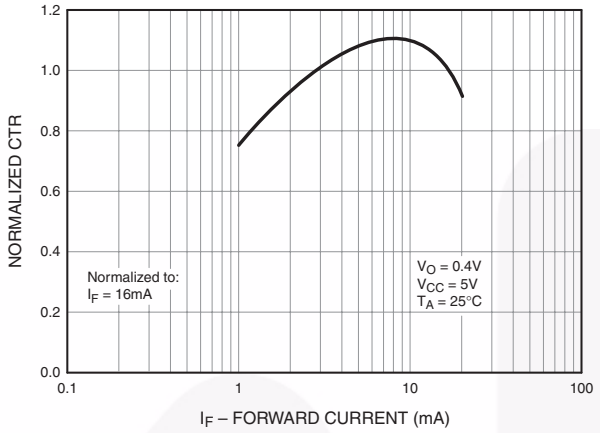


Fig. 2 Normalized CTR vs. Temperature

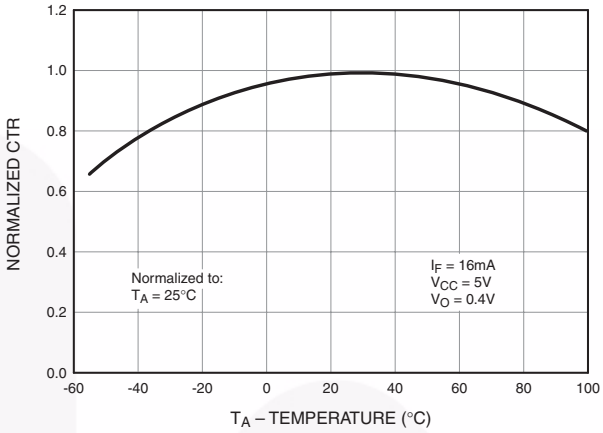


Fig. 3 Output Current vs. Output Voltage

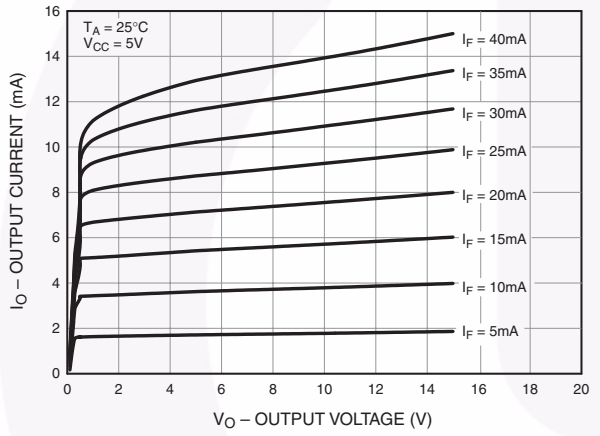


Fig. 4 Logic High Output Current vs. Temperature

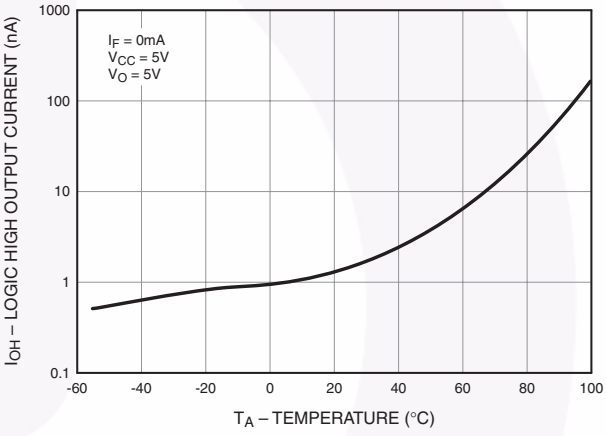


Fig. 5 Propagation Delay vs. Temperature

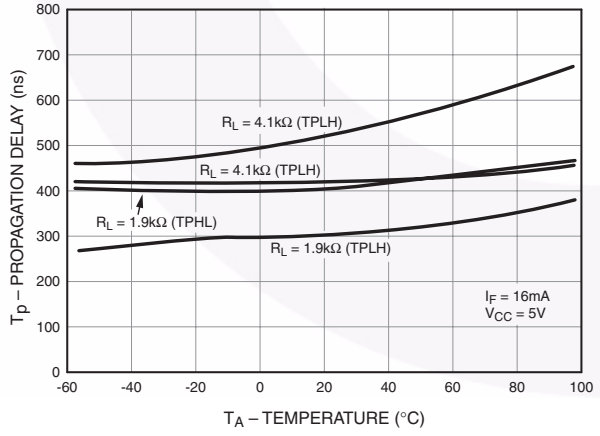
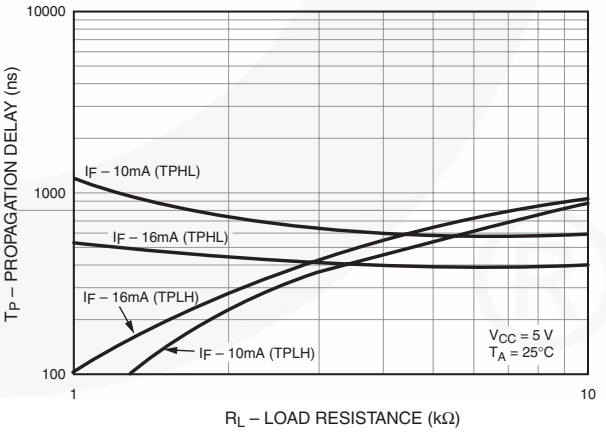


Fig. 6 Propagation Delay vs. Load Resistance



Test Circuits

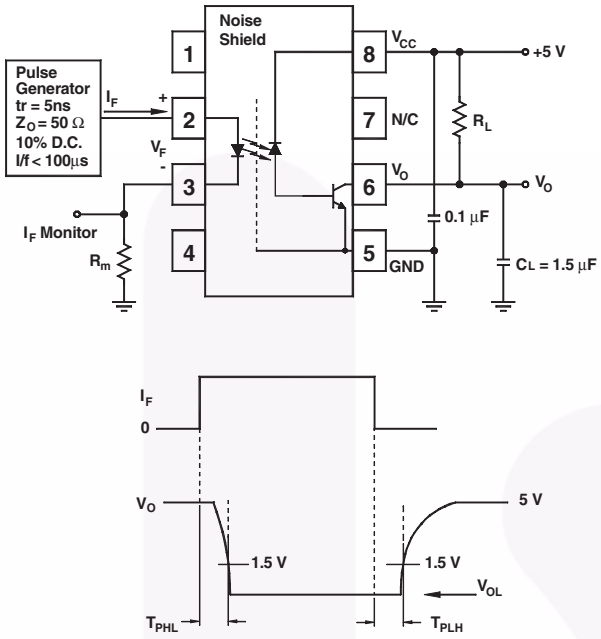


Fig. 7 Switching Time Test Circuit

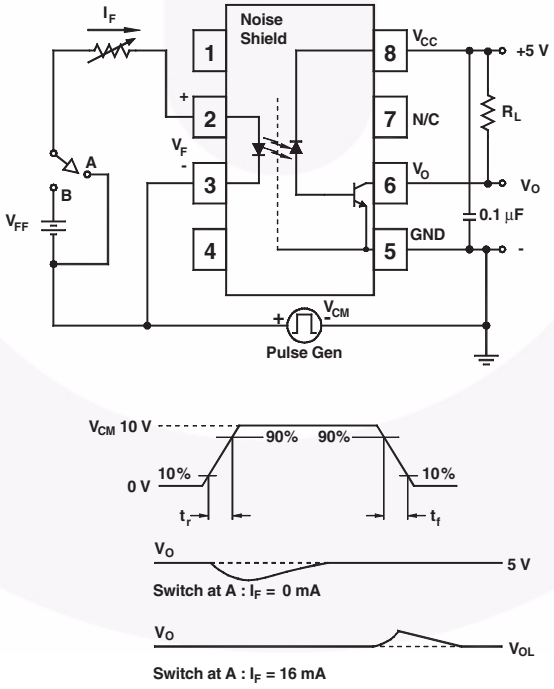
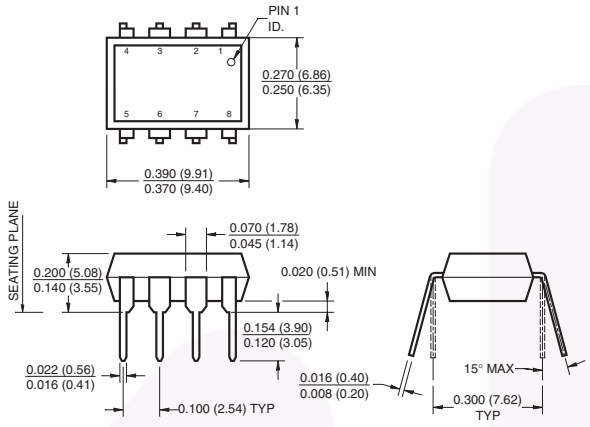


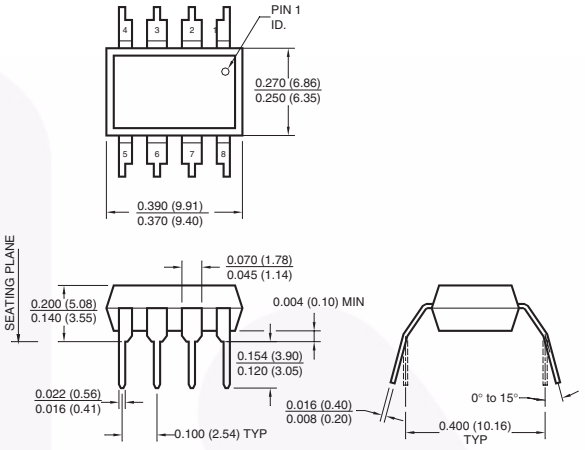
Fig. 8 Common Mode Immunity Test Circuit

Package Dimensions

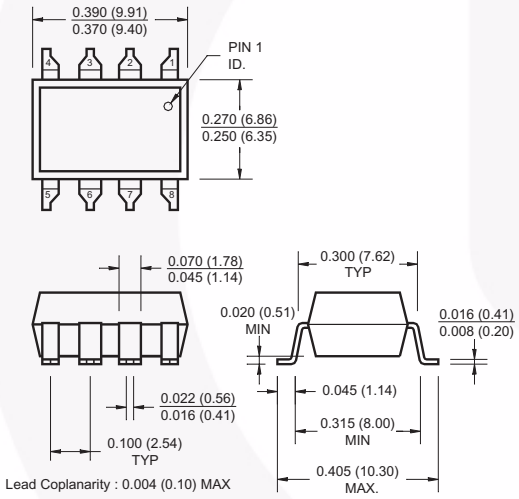
Through Hole



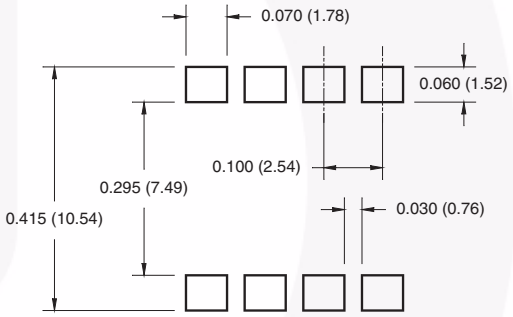
0.4" Lead Spacing



Surface Mount



8-Pin DIP – Land Pattern

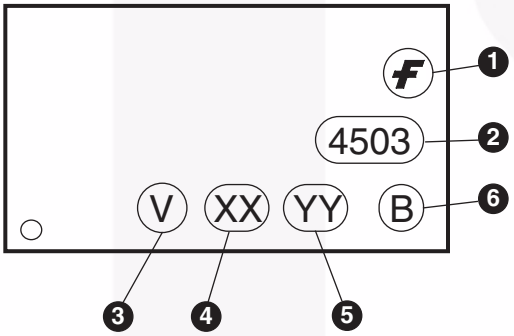


Note:
All dimensions are in inches (millimeters)

Ordering Information

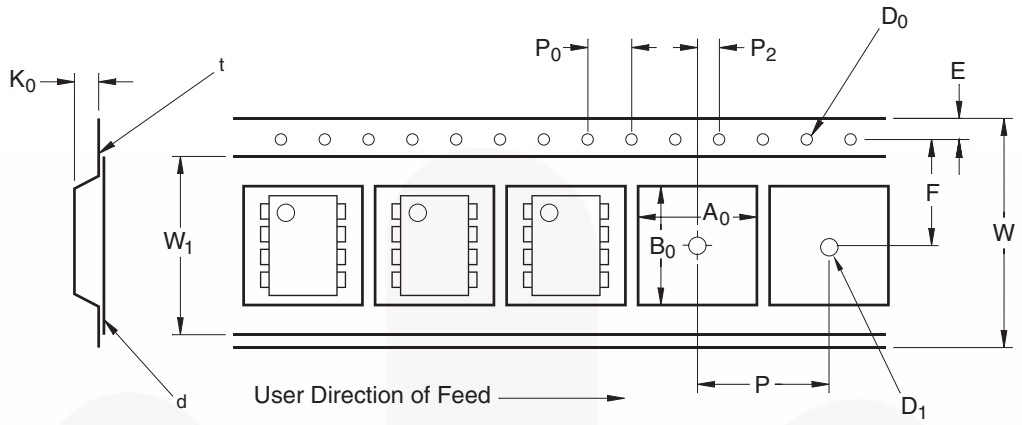
Option	Example Part Number	Description
No Option	HCPL4503M	Standard Through Hole
S	HCPL4503SM	Surface Mount Lead Bend
SD	HCPL4503SDM	Surface Mount; Tape and Reel
T	HCPL4503TM	0.4" Lead Spacing
V	HCPL4503VM	VDE0884
TV	HCPL4503TVM	VDE0884; 0.4” Lead Spacing
SV	HCPL4503SVM	VDE0884; Surface Mount
SDV	HCPL4503SDVM	VDE0884; Surface Mount; Tape and Reel

Marking Information



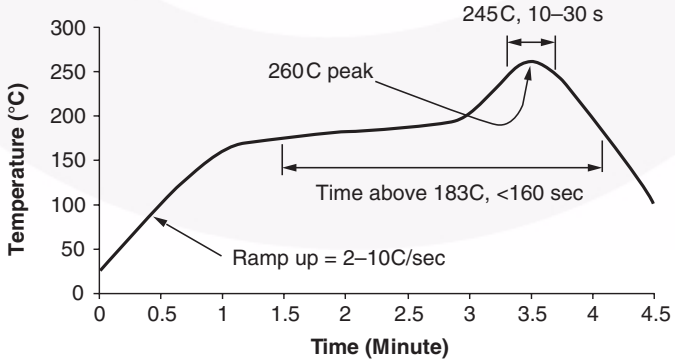
Definitions	
1	Fairchild logo
2	Device number
3	VDE mark (Note: Only appears on parts ordered with VDE option – See order entry table)
4	Two digit year code, e.g., ‘03’
5	Two digit work week ranging from ‘01’ to ‘53’
6	Assembly package code

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



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

FAIRCHILD SEMICONDUCTOR®

TRADEMARKS

The following includes registered and unregistered trademarks and service marks, owned by Fairchild Semiconductor and/or its global subsidiaries, and is not intended to be an exhaustive list of all such trademarks.

Build it Now™
CorePLUS™
CorePOWER™
CROSSVOLT™
CTL™
Current Transfer Logic™
EcoSPARK®
EfficentMax™
EZSWITCH™ *
™
®
Fairchild®
Fairchild Semiconductor®
FACT Quiet Series™
FACT®
FAST®
FastvCore™
FlashWriter® *
FPS™
F-PFS™
FRFET®
Global Power Resource SM
Green FPS™
Green FPS™ e-Series™
GTO™
IntelliMAX™
ISOPLANAR™
MegaBuck™
MICROCOUPLER™
MicroFET™
MicroPak™
MillerDrive™
MotionMax™
Motion-SPM™
OPTOLOGIC®
OPTOPLANAR®
®
PDP SPM™
Power-SPM™
PowerTrench®
Programmable Active Droop™
QFET®
QS™
Quiet Series™
RapidConfigure™
Saving our world, 1mW at a time™
SmartMax™
SMART START™
SPM®
STEALTH™
SuperFET™
SuperSOT™-3
SuperSOT™-6
SuperSOT™-8
SupreMOS™
SyncFET™
SYSTEM ® GENERAL
The Power Franchise®
the power franchise
TinyBoost™
TinyBuck™
TinyLogic®
TINYOPTO™
TinyPower™
TinyPWM™
TinyWire™
µSerDes™
SerDes
UHC®
Ultra FRFET™
UniFET™
VCX™
VisualMax™

* EZSWITCH™ and FlashWriter® are trademarks of System General Corporation, used under license by Fairchild Semiconductor.

DISCLAIMER

FAIRCHILD SEMICONDUCTOR RESERVES THE RIGHT TO MAKE CHANGES WITHOUT FURTHER NOTICE TO ANY PRODUCTS HEREIN TO IMPROVE RELIABILITY, FUNCTION, OR DESIGN. FAIRCHILD DOES NOT ASSUME ANY LIABILITY ARISING OUT OF THE APPLICATION OR USE OF ANY PRODUCT OR CIRCUIT DESCRIBED HEREIN; NEITHER DOES IT CONVEY ANY LICENSE UNDER ITS PATENT RIGHTS, NOR THE RIGHTS OF OTHERS. THESE SPECIFICATIONS DO NOT EXPAND THE TERMS OF FAIRCHILD'S WORLDWIDE TERMS AND CONDITIONS, SPECIFICALLY THE WARRANTY THEREIN, WHICH COVERS THESE PRODUCTS.

LIFE SUPPORT POLICY

FAIRCHILD'S PRODUCTS ARE NOT AUTHORIZED FOR USE AS CRITICAL COMPONENTS IN LIFE SUPPORT DEVICES OR SYSTEMS WITHOUT THE EXPRESS WRITTEN APPROVAL OF FAIRCHILD SEMICONDUCTOR CORPORATION.

As used herein:

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, and (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 a significant injury of the user.
2. A critical component in 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.

ANTI-COUNTERFEITING POLICY

Fairchild Semiconductor Corporation's Anti-Counterfeiting Policy. Fairchild's Anti-Counterfeiting Policy is also stated on our external website, www.fairchildsemi.com, under Sales Support.

Counterfeiting of semiconductor parts is a growing problem in the industry. All manufacturers of semiconductor products are experiencing counterfeiting of their parts. Customers who inadvertently purchase counterfeit parts experience many problems such as loss of brand reputation, substandard performance, failed applications, and increased cost of production and manufacturing delays. Fairchild is taking strong measures to protect ourselves and our customers from the proliferation of counterfeit parts. Fairchild strongly encourages customers to purchase Fairchild parts either directly from Fairchild or from Authorized Fairchild Distributors who are listed by country on our web page cited above. Products customers buy either from Fairchild directly or from Authorized Fairchild Distributors are genuine parts, have full traceability, meet Fairchild's quality standards for handling and storage and provide access to Fairchild's full range of up-to-date technical and product information. Fairchild and our Authorized Distributors will stand behind all warranties and will appropriately address any warranty issues that may arise. Fairchild will not provide any warranty coverage or other assistance for parts bought from Unauthorized Sources. Fairchild is committed to combat this global problem and encourage our customers to do their part in stopping this practice by buying direct or from authorized distributors.

PRODUCT STATUS DEFINITIONS

Definition of Terms

Datasheet Identification	Product Status	Definition
Advance Information	Formative / In Design	Datasheet contains the design specifications for product development. Specifications may change in any manner without notice.
Preliminary	First Production	Datasheet contains preliminary data; 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	Datasheet contains final specifications. Fairchild Semiconductor reserves the right to make changes at any time without notice to improve the design.
Obsolete	Not In Production	Datasheet contains specifications on a product that is discontinued by Fairchild Semiconductor. The datasheet is for reference information only.

Rev. I35