FAIRCHILD™

Is Now Part of

ON Semiconductor®

To learn more about ON Semiconductor, please visit our website at
www.onsemi.com

FAIRCHILD

SEMICONDUCTOR®

August 2008

Single-Channel: 6N135, 6N136, HCPL2503, HCPL4502
Dual-Channel: HCPL2530, HCPL2531
High Speed Transistor Optocouplers

Features

■ High speed –1 MBit/s

■ Superior CMR – 10kV/µs

■ Dual-Channel HCPL2530/HCPL2531

■ 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 HCPL4502, HCPL2503, 6N135, 6N136, HCPL2530 and HCPL2531 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.

Schematics
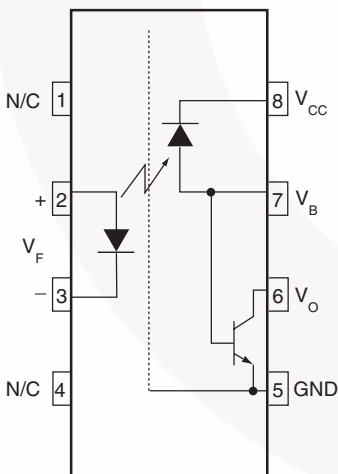
6N135, 6N136, HCPL2503, HCPL4502

Pin 7 is not connected in
Part Number HCPL4502
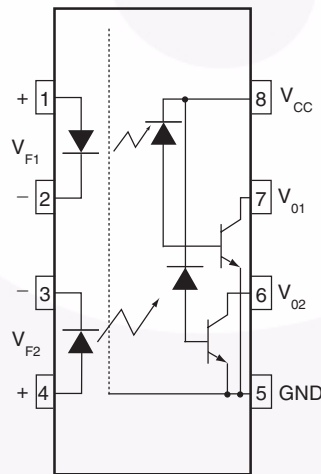
HCPL2530/HCPL2531

Package Outlines
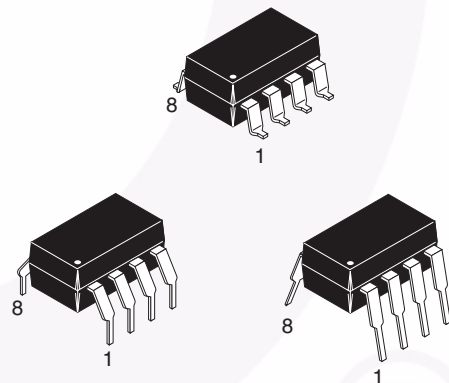
Absolute Maximum Ratings (T$_A$ = 25°C unless otherwise specified)

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	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	≤1µs 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 HCPL2503/4502	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 HCPL2503 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 HCPL2503 only	5	mA
PD	Output Power Dissipation Each Channel	6N135, 6N136, HCPL2503, HCPL4502[4]	100	mW
		HCPL2530, HCPL2531	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 HCPL4502 HCPL2503		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 HCPL4502 HCPL2503		120	200	µA
		I_{F1} = I_{F2} = 16mA, V_O = Open, V_{CC} = 15V	HCPL2530 HCPL2531		200	400	
I_{CCH}	Logic High Supply Current	I_F = 0mA, V_O = Open, V_{CC} = 15V, T_A =25°C	6N135 6N136 HCPL4502 HCPL2503			1	µA
		I_F = 0mA, V_O = Open, V_{CC} = 15V	6N135 6N136 HCPL4502 HCPL2503			2	
		I_F = 0mA, V_O = Open, V_{CC} = 15V	HCPL2530 HCPL2531		0.02	4	

*All Typicals at T_A = 25°C

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

Transfer Characteristics

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 HCPL2530	7	18	50	%
				6N136 HCPL4502 HCPL2531	19	27	50	%
				HCPL2503	12	27		%
		I_F = 16mA, V_{CC} = 4.5V	V_{OL} = 0.4V	6N135	5	21		%
			V_{OL} = 0.5V	HCPL2530				
			V_{OL} = 0.4V	6N136 HCPL4502	15	30		%
			V_{OL} = 0.5V	HCPL2531				
			V_{OL} = 0.4V	HCPL2503	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
				HCPL2530		0.18	0.5	
		I_F = 16mA, I_O = 3mA, V_{CC} = 4.5V, T_A =25°C		6N136 HCPL2503		0.25	0.4	
				HCPL2531		0.25	0.5	
		I_F = 16mA, I_O = 0.8mA, V_{CC} = 4.5V		6N135 HCPL2530			0.5	
		I_F = 16mA, I_O = 2.4mA, V_{CC} = 4.5V		HCPL4502 HCPL2531			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%.

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

Switching Characteristics (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 HCPL2530		0.45	1.5	µs
		R_L = 1.9kΩ, I_F = 16mA, T_A = 25°C[7] (Fig. 7)	6N136 HCPL4502 HCPL2503 HCPL2531		0.45	0.8	µs
		R_L = 4.1kΩ, I_F = 16mA[6] (Fig. 7)	6N135 HCPL2530			2.0	µs
		R_L = 1.9kΩ, I_F = 16mA[7] (Fig. 7)	6N136 HCPL4502 HCPL2503 HCPL2531			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 HCPL2530		0.5	1.5	µs
		R_L = 1.9kΩ, I_F = 16mA[7] (Fig. 7) T_A = 25°C	6N136 HCPL4502 HCPL2503 HCPL2531		0.3	0.8	µs
		R_L = 4.1kΩ, I_F = 16mA[6] (Fig. 7)	6N135 HCPL2530			2.0	µs
		R_L = 1.9kΩ, I_F = 16mA[7] (Fig. 7)	6N136 HCPL4502 HCPL2503 HCPL2531			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 HCPL2530		10,000		V/µs
		I_F = 0mA, V_{CM} = 10V_{P-P}, R_L = 1.9kΩ, T_A = 25°C[8] (Fig. 8)	6N136 HCPL4502 HCPL2503 HCPL2531		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 HCPL2530		10,000		V/µs
		I_F = 16mA, V_{CM} = 10 V_{P-P}, R_L = 1.9kΩ[8] (Fig. 8)	6N136 HCPL4502 HCPL2503 HCPL2531		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).

www.fairchildsemi.com

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

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} ≤ 2µA, 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 = 1MHz[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, (HCPL2530/2531 only)		0.005		µA
R_{I-I}	Input-Input Resistance	V_{I-I} = 500 VDC[10] (HCPL2530/2531 only)		10^{11}		Ω
C_{I-I}	Input-Input Capacitance	f = 1MHz)[10] (HCPL2530/2531 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.

Typical Performance Curves

Fig. 1 Normalized CTR vs. Forward Current

Fig. 2 Normalized CTR vs. Temperature

Fig. 3 Output Current vs. Output Voltage
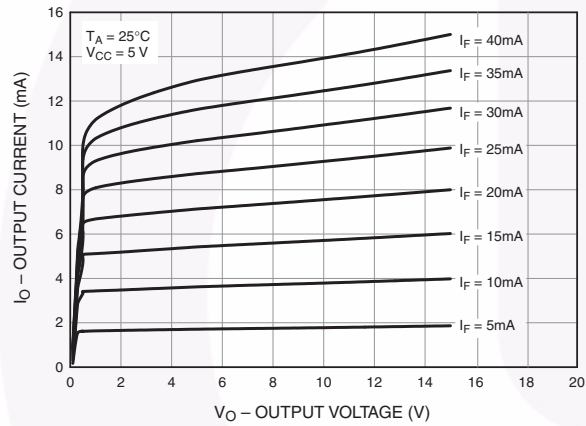
Fig. 4 Logic High Output Current vs. Temperature
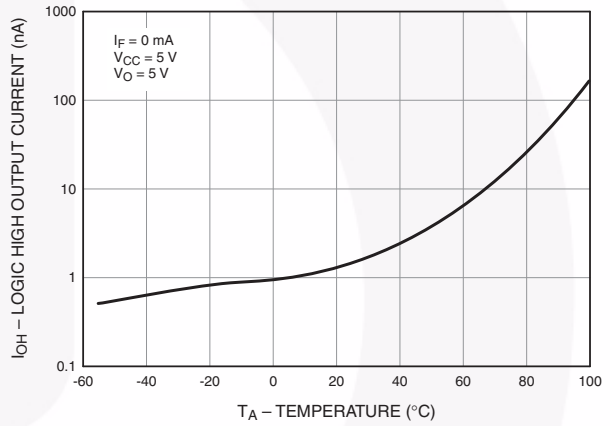
Fig. 5 Propagation Delay vs. Temperature

Fig. 6 Propagation Delay vs. Load Resistance

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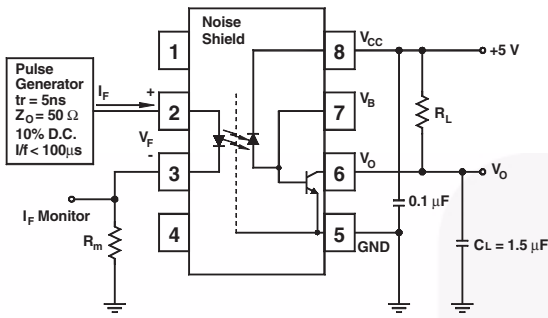
Test Circuit for 6N135, 6N136, HCPL-2503 and HCPL- 4502

Test Circuit for HCPL-2530 and HCPL-2531
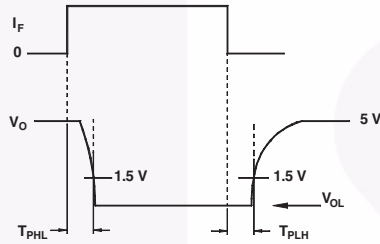
Fig. 7 Switching Time Test Circuit
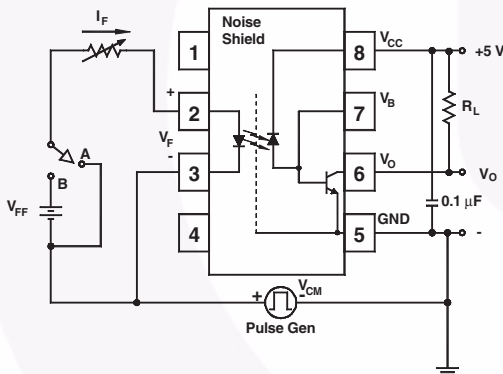
Test Circuit for 6N135, 6N136, HCPL-2503 and HCPL-4502

Test Circuit for HCPL-2530 and HCPL-2531

Switch at A : I_F = 0 mA

Switch at A : I_F = 16 mA
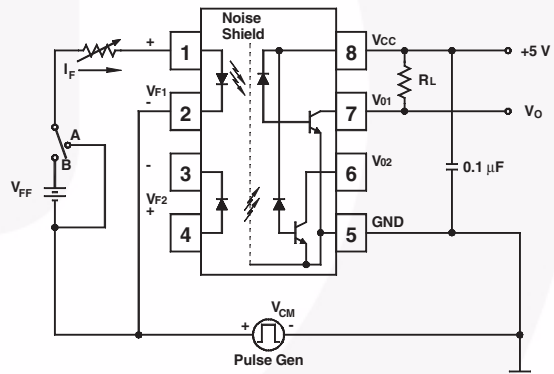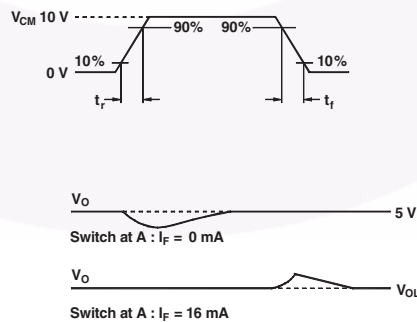
Fig. 8 Common Mode Immunity Test Circuit

Ordering Information

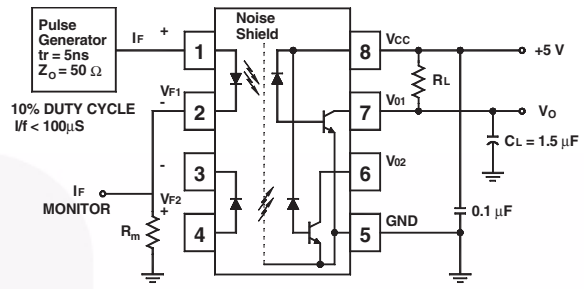| Option	Example Part Number	Description
S	6N135S	Surface Mount Lead Bend
SD	6N135SD	Surface Mount; Tape and reel
W	6N135W	0.4" Lead Spacing
V	6N135V	VDE0884
WV	6N135WV	VDE0884; 0.4" lead spacing
SV	6N135SV	VDE0884; surface mount
SDV	6N135SDV	VDE0884; surface mount; tape and reel

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

Tape Specifications

12.0 ± 0.1

4.0 ± 0.1

Ø1.55 ± 0.05

4.90 ± 0.20

0.30 ± 0.05

4.0 ± 0.1

1.75 ± 0.10

13.2 ± 0.2

7.5 ± 0.1

16.0 ± 0.3

10.30 ± 0.20

0.1 MAX

10.30 ± 0.20

Ø1.6 ± 0.1

User Direction of Feed ⟶

Reflow Profile

215C, 10–30 s

225C peak

Time above 183C, 60–150 sec

Ramp up = 3C/sec

Temperature (°C)

Time (Minute)

- Peak reflow temperature: 225C (package surface temperature)
- Time of temperature higher than 183C for 60–150 seconds
- One time soldering reflow is recommended

9.40-9.91

4   1   PIN 1

6.35-6.86

5   8

0.20-0.40

7.62 (TYP)

5.08 (MAX)

3.68-3.94

0.51 (MIN)

1.14-1.78

3.05-3.90

0.41-0.56

2.54 BSC

(0.78)

NOTES:
A) NO STANDARD APPLIES TO THIS PACKAGE
B) ALL DIMENSIONS ARE IN MILLIMETERS.
C) DIMENSIONS ARE EXCLUSIVE OF BURRS,
    MOLD FLASH, AND TIE BAR EXTRUSION
D) DRAWING FILENAME AND REVSION: MKT-N08GREV7

FAIRCHILD™

9.40-9.91

4   1

PIN 1

6.35-6.86

5   8

(1.78)   (2.54)   (1.52)

(10.54)

(7.49)

(0.76)
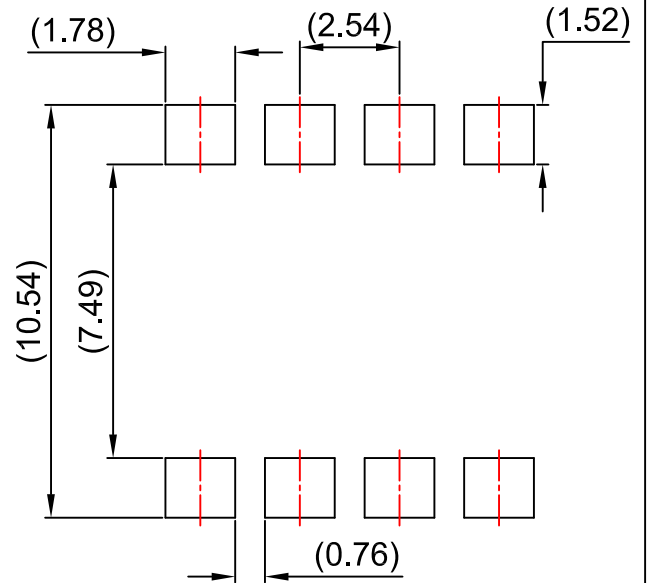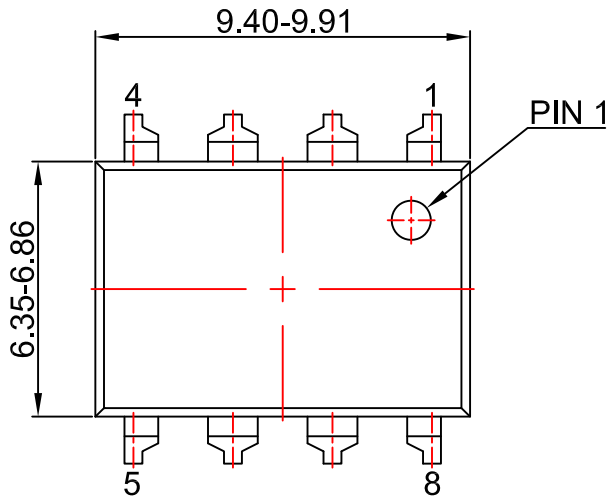
LAND PATTERN RECOMMENDATION

5.08 (MAX)

3.68-3.94

0.51 (MIN)

1.14-1.78

(0.78)

2.54BSC

0.41-0.56

0.20-0.40

0.40 (MIN)
B0TH SIDE

8.00 (MIN)

10.30 (MAX)

NOTES:

A) NO STANDARD APPLIES TO THIS PACKAGE

B) ALL DIMENSIONS ARE IN MILLIMETERS.

C) DIMENSIONS ARE EXCLUSIVE OF BURRS,
   MOLD FLASH, AND TIE BAR EXTRUSION

D) DRAWING FILENAME AND REVSION: MKT-N08Hrev7.

FAIRCHILD.

9.40-9.91

4   1

PIN 1

6.35-6.86

5   8

15.0° (MAX)

10.16 (TYP)

0.20-0.40

5.08 (MAX)

3.68-3.94

0.51 (MIN)

1.14-1.78

3.05-3.90

(0.78)

0.41-0.56

2.54 BSC

NOTES:

A) NO STANDARD APPLIES TO THIS PACKAGE
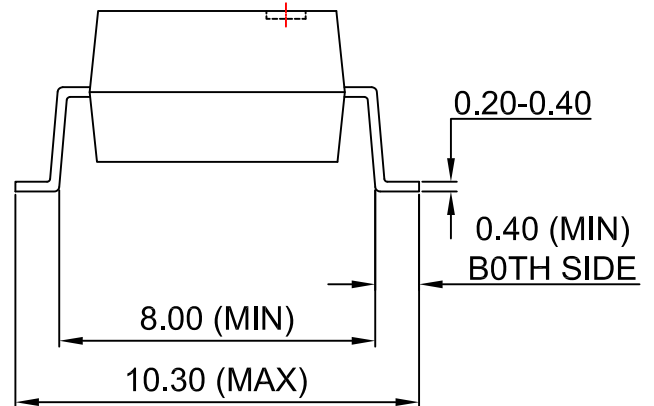
B) ALL DIMENSIONS ARE IN MILLIMETERS.

C) DIMENSIONS ARE EXCLUSIVE OF BURRS,
   MOLD FLASH, AND TIE BAR EXTRUSION

D) DRAWING FILENAME AND REVSION: MKT-N08REV7

FAIRCHILD™

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.

AccuPower™
AttitudeEngine™
Awinda®
AX-CAP®*
BitSiC™
Build it Now™
CorePLUS™
CorePOWER™
CROSSVOLT™
CTL™
Current Transfer Logic™
DEUXPEED®
Dual Cool™
EcoSPARK®
EfficientMax™
ESBC™
𝐹®
Fairchild®
Fairchild Semiconductor®
FACT Quiet Series™
FACT®
FastvCore™
FETBench™
FPS™

F-PFS™
FRFET®
Global Power Resource℠
GreenBridge™
Green FPS™
Green FPS™ e-Series™
G*max*™
GTO™
IntelliMAX™
ISOPLANAR™
Making Small Speakers Sound Louder
    and Better™
MegaBuck™
MICROCOUPLER™
MicroFET™
MicroPak™
MicroPak2™
MillerDrive™
MotionMax™
MotionGrid®
MTi®
MTx®
MVN®
mWSaver®
OptoHiT™
OPTOLOGIC®

OPTOPLANAR®

®

Power Supply WebDesigner™
PowerTrench®
PowerXS™
Programmable Active Droop™
QFET®
QS™
Quiet Series™
RapidConfigure™

™

Saving our world, 1mW/W/kW at a time™
SignalWise™
SmartMax™
SMART START™
Solutions for Your Success™
SPM®
STEALTH™
SuperFET®
SuperSOT™-3
SuperSOT™-6
SuperSOT™-8
SupreMOS®
SyncFET™
Sync-Lock™

SYSTEM GENERAL®*

TinyBoost®
TinyBuck®
TinyCalc™
TinyLogic®
TINYOPTO™
TinyPower™
TinyPWM™
TinyWire™
TranSiC™
TriFault Detect™
TRUECURRENT®*
μSerDes™

UHC®
Ultra FRFET™
UniFET™
VCX™
VisualMax™
VoltagePlus™
XS™
Xsens™
仙童®

* 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. TO OBTAIN THE LATEST, MOST UP-TO-DATE DATASHEET AND PRODUCT INFORMATION, VISIT OUR WEBSITE AT HTTP://WWW.FAIRCHILDSEMI.COM. 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.

AUTHORIZED USE

Unless otherwise specified in this data sheet, this product is a standard commercial product and is not intended for use in applications that require extraordinary levels of quality and reliability. This product may not be used in the following applications, unless specifically approved in writing by a Fairchild officer: (1) automotive or other transportation, (2) military/aerospace, (3) any safety critical application – including life critical medical equipment – where the failure of the Fairchild product reasonably would be expected to result in personal injury, death or property damage. Customer's use of this product is subject to agreement of this Authorized Use policy. In the event of an unauthorized use of Fairchild's product, Fairchild accepts no liability in the event of product failure. In other respects, this product shall be subject to Fairchild's Worldwide Terms and Conditions of Sale, unless a separate agreement has been signed by both Parties.

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 Terms of Use

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. I77