

HCPL0452, HCPL0453, HCPL0500, HCPL0501, HCPL0530, HCPL0531, HCPL0534 High Speed Transistor Optocouplers

Single Channel: HCPL0452 HCPL0453 HCPL0500 HCPL0501
Dual Channel: HCPL0530 HCPL0531 HCPL0534

Features

- High speed – 1 MBit/s
- 15kV/μs minimum common mode transient immunity at $V_{CM} = 1500V$ (HCPL0453/0534)
- Open collector output
- Guaranteed performance over temperature: 0°C to 70°C
- U.L. recognized (File # E90700)
- VDE0884 recognized (file#136616)
 - approval pending for HCPL0530/0531/0453
 - ordering option V, e.g., HCPL0500V
- BSI recognized (file# 8661, 8662)
 - HCPL0452/0500/0501 only

Applications

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

Description

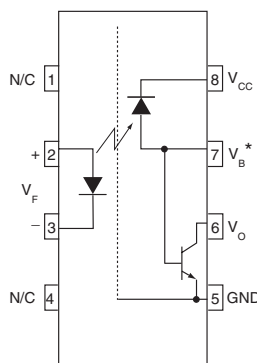
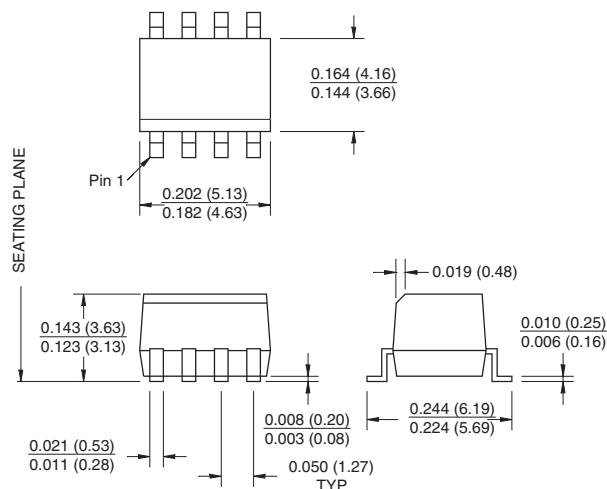
The HCPL05XX, and HCPL04XX optocouplers consist of an AlGaAs LED optically coupled to a high speed photodetector transistor housed in a compact 8-pin small outline package.

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 HCPL04XX devices do not have the base bonded out to a lead for additional noise margin. The HCPL053X devices have two channels per package for optimum mounting density.

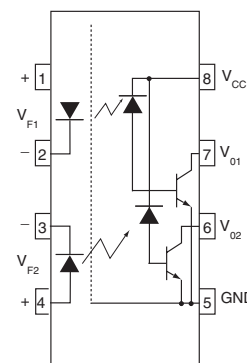
Truth Table (positive Logic)

LED	V _o
ON	LOW
OFF	HIGH

Package Dimensions



HCPL0500, HCPL0501
*BASE NOT CONNECTED
FOR HCPL0452, HCPL0453



HCPL0530/HCPL0531/HCPL0534

NOTE

All dimensions are in inches (millimeters)

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 +85	$^\circ\text{C}$
	Reflow Temperature Profile (Refer to page 9)		
EMITTER			
I_F (avg)	DC/Average Forward Input Current	25	mA
I_F (pk)	Peak Forward Input Current (50% duty cycle, 1 ms P.W.)	50	mA
I_F (trans)	Peak Transient Input Current - ($\leq 1 \mu\text{s}$ P.W., 300 pps)	1.0	A
V_R	Reverse Input Voltage	5	V
P_D	Input Power Dissipation	45	mW
DETECTOR			
I_O (avg)	Average Output Current (Pin 6)	8	mA
I_O (pk)	Peak Output Current	16	mA
V_{EBR}	Emitter-Base Reverse Voltage (HCPL0500/HCPL0501 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 (HCPL0500/HCPL0501 only)	5	mA
P_D	Output power dissipation	100	mW

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

Individual Component Characteristics

Symbol	Parameter	Test Conditions	Device	Min	Typ**	Max	Unit
V_F	EMITTER	$(I_F = 16 \text{ mA}, T_A = 25^\circ\text{C})$	All		1.45	1.7	V
	Input Forward Voltage	$(I_F = 16 \text{ mA})$				1.8	
BV_R	Input Reverse Breakdown Voltage	$(I_R = 10 \mu\text{A})$	All	5.0			V
$(\Delta V_F / \Delta T_A)$	Temperature coefficient of forward voltage	$(I_F = 16 \text{ mA})$	All		-1.6		mV/ $^\circ\text{C}$
I_{OH}	DETECTOR	$(I_F = 0 \text{ mA}, V_O = V_{CC} = 5.5\text{V}, T_A = 25^\circ\text{C})$	All		0.001	0.5	μA
	Logic high output current	$(I_F = 0 \text{ mA}, V_O = V_{CC} = 15 \text{ V}, T_A = 25^\circ\text{C})$	All		0.005	1	
		$(I_F = 0 \text{ mA}, V_O = V_{CC} = 15 \text{ V})$	All			50	
I_{CCL}	Logic low supply current	$(I_F = 16 \text{ mA}, V_O = \text{Open}, V_{CC} = 15 \text{ V})$	HCPL0452/3/0500/1		120	200	μA
			HCPL0530/1/4			400	
I_{CCH}	Logic high supply current	$(I_F = 0 \text{ mA}, V_O = \text{Open}, V_{CC} = 15 \text{ V}, T_A = 25^\circ\text{C})$	All		0.01	1	μA
			HCPL0452/3/0500/1			2	
			HCPL0530/1/4			4	

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

Symbol	Parameter	Test Conditions	Device	Min	Typ**	Max	Unit
CTR	COUPLED	$(I_F = 16 \text{ mA}, V_O = 0.4 \text{ V})$ $(V_{CC} = 4.5 \text{ V}, T_A = 25^\circ\text{C})$	HCPL0500/0530	7	2.7	50	%
			HCPL0452/3	19	27	50	
			HCPL0501/0531				
	Current transfer ratio (Note 1)	$(I_F = 16 \text{ mA}, V_O = 0.5 \text{ V})$ $(V_{CC} = 4.5 \text{ V})$	HCPL0500	5	30		
			HCPL0452/3	15	30		
V_{OL}	Logic low output voltage	$(I_F = 16 \text{ mA}, I_O = 1.1 \text{ mA})$ $(V_{CC} = 4.5 \text{ V}, T_A = 25^\circ\text{C})$	HCPL0500		0.18	0.4	V
			HCPL0530			0.5	
		$(I_F = 16 \text{ mA}, I_O = 3 \text{ mA})$ $(V_{CC} = 4.5 \text{ V}, T_A = 25^\circ\text{C})$	HCPL0452/3		0.25	0.4	
			HCPL0501/0531/4				
		$(I_F = 16 \text{ mA}, I_O = 0.8 \text{ mA})$ $(V_{CC} = 4.5)$	HCPL0500		0.13	0.5	
			HCPL0530				
		$(I_F = 16 \text{ mA}, I_O = 2.4 \text{ mA})$ $(V_{CC} = 4.5)$	HCPL0452/3		0.23	0.5	
			HCPL0501/0531/4				

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

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

Symbol	Parameter	Test Conditions	Device	Min	Typ**	Max	Unit
T_{PHL}	Propagation delay time to logic low	$T_A = 25^\circ\text{C}, (R_L = 4.1 \text{ k}\Omega, I_F = 16 \text{ mA})$ (Note 2) (Fig. 9)	HCPL0500/0530		0.45	1.5	μs
			HCPL0452/3		0.45	0.8	
		HCPL0501/0531/4					
		$(R_L = 1.9 \text{ k}\Omega, I_F = 16 \text{ mA})$ (Note 3) (Fig. 9) $T_A = 25^\circ\text{C}$	HCPL0500/0530			2.0	
			HCPL0452/3			1.0	
T_{PLH}	Propagation delay time to logic high	$T_A = 25^\circ\text{C}, (R_L = 4.1 \text{ k}\Omega, I_F = 16 \text{ mA})$ (Note 2) (Fig. 9)	HCPL0500/0530		0.5	1.5	μs
			HCPL0452/3		0.3	0.8	
		HCPL0501/0531/4					
		$(R_L = 1.9 \text{ k}\Omega, I_F = 16 \text{ mA})$ (Note 3) (Fig. 9) $T_A = 25^\circ\text{C}$	HCPL0500/0530			2.0	
			HCPL0452/3			1.0	
ICM_H	Common mode transient immunity at logic high	$(I_F = 0 \text{ mA}, V_{CM} = 10 \text{ V}_{P-P}, R_L = 4.1 \text{ k}\Omega)$ (Note 4) (Fig. 10) $T_A = 25^\circ\text{C}$	HCPL0500	1,000	10,000		V/ μs
			HCPL0530				
		$(I_F = 0 \text{ mA}, V_{CM} = 10 \text{ V}_{P-P})$ $T_A = 25^\circ\text{C}, (R_L = 1.9 \text{ k}\Omega)$ (Note 4) (Fig. 10)	HCPL0452	1,000	10,000		
			HCPL0501/31				
		$(I_F = 16 \text{ mA}, V_{CM} = 1500 \text{ V}_{P-P}, R_L = 1.9 \text{ k}\Omega,$ $T_A = 25^\circ\text{C})$ (Note 4) (Fig. 10)	HCPL0534	15,000	40,000		
ICM_L	Common mode transient immunity at logic low	$(I_F = 16 \text{ mA}, V_{CM} = 10 \text{ V}_{P-P}, R_L = 4.1 \text{ k}\Omega)$ (Note 4) (Fig. 10) $T_A = 25^\circ\text{C}$	HCPL0500	1,000	10,000		V/ μs
			HCPL0530				
		$(I_F = 16 \text{ mA}, V_{CM} = 10 \text{ V}_{P-P})$ $T_A = 25^\circ\text{C}, (R_L = 1.9 \text{ k}\Omega)$ (Note 4) (Fig. 10)	HCPL0452	1,000	10,000		
			HCPL0501/31				
		$(I_F = 16 \text{ mA}, T_A = 25^\circ\text{C}, V_{CM} = 1500 \text{ V}_{P-P},$ $C_L = 15 \text{ pF})$ (Note 4) (Fig. 10)	HCPL0534	15,000	40,000		
	HCPL0453	15,000	40,000				

Isolation Characteristics ($T_A = 0^\circ\text{C}$ to $+70^\circ\text{C}$ Unless otherwise specified.)

Symbol	Characteristics	Test Conditions	Min	Typ**	Max	Unit
V_{ISO}	Input-Output Isolation Voltage	(note 5, 6) ($f = 60 \text{ Hz}$, $t = 1.0 \text{ min}$) ($I_{I-O} \leq 2 \mu\text{A}$)	2500	—	—	V_{acRMS}
R_{ISO}	Isolation Resistance	(note 5) ($V_{I-O} = 500 \text{ V}$) ⁽⁹⁾	10^{11}	—	—	—
C_{ISO}	Isolation Capacitance	(note 5) ($V_{I-O} = 0$, $f = 1.0 \text{ MHz}$) ⁽⁹⁾	—	0.2	—	pF

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

1. Current Transfer Ratio is designed as a ratio of output collector current, I_O , to the forward LED input current, I_F times 100%.
2. The 4.1 k Ω load represents 1 LSTTL unit load of 0.36 mA and 6.1k Ω pull-up resistor.
3. The 1.9 k Ω load represents 1 TTL unit load of 1.6 mA and 5.6 k Ω pull-up resistor.
4. 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., $V_O < 0.8 \text{ V}$).
5. 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.
6. 2500 VAC RMS for 1 minute duration is equivalent to 3000 VAC RMS for 1 second duration.

Typical Performance Curves

Fig. 1 Normalized CTR vs. Forward Current

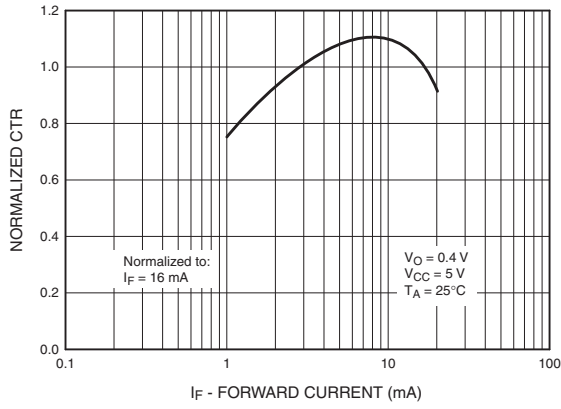


Fig. 2 Normalized CTR vs. Temperature

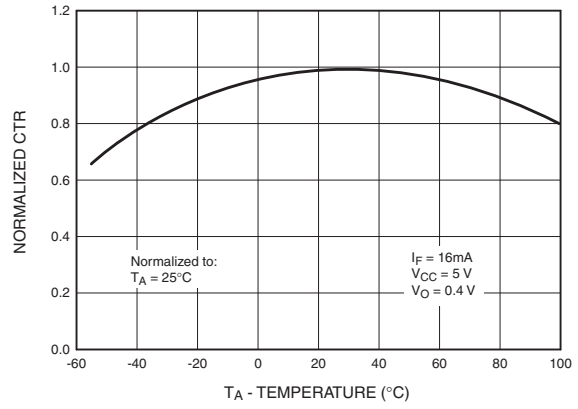


Fig. 3 Output Current vs. Output Voltage

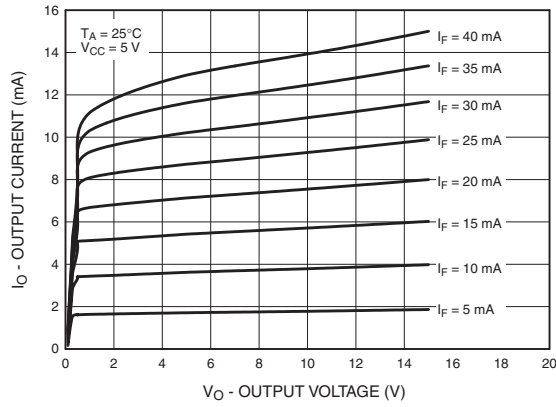


Fig. 4 Logic High Output Current vs. Temperature

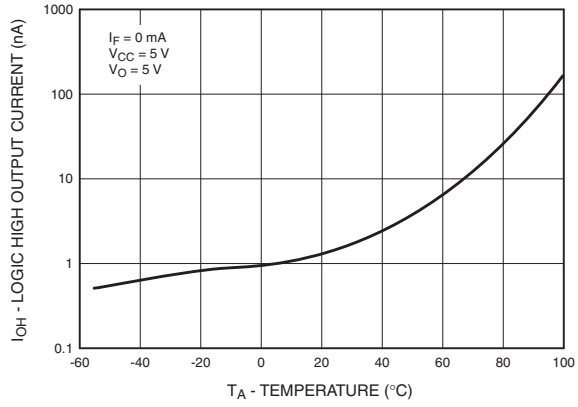


Fig. 5 Propagation Delay vs. Temperature

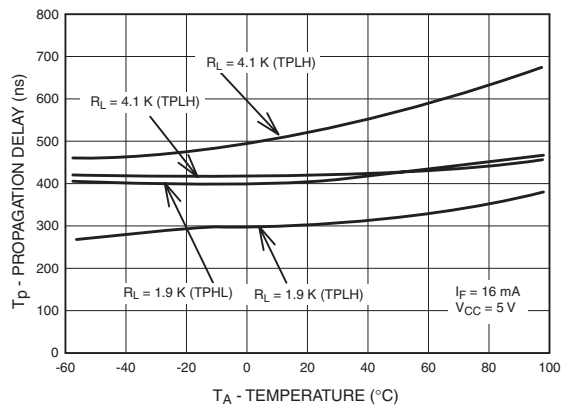
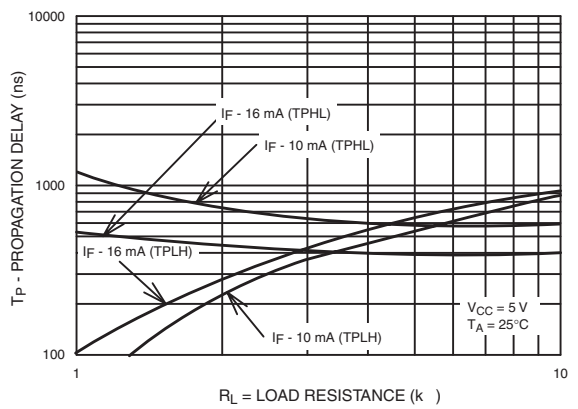


Fig. 6 Propagation Delay vs. Load Resistance



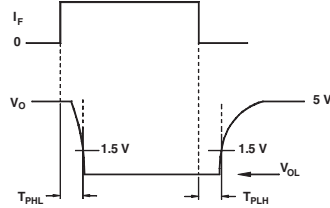
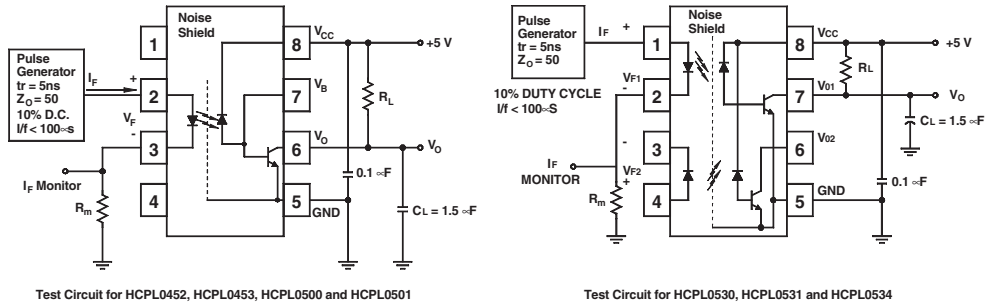


Fig. 7 Switching Time Test Circuit

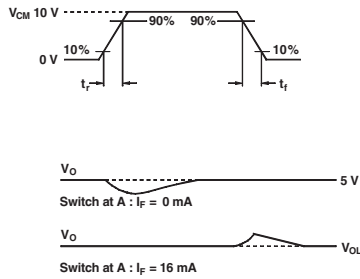
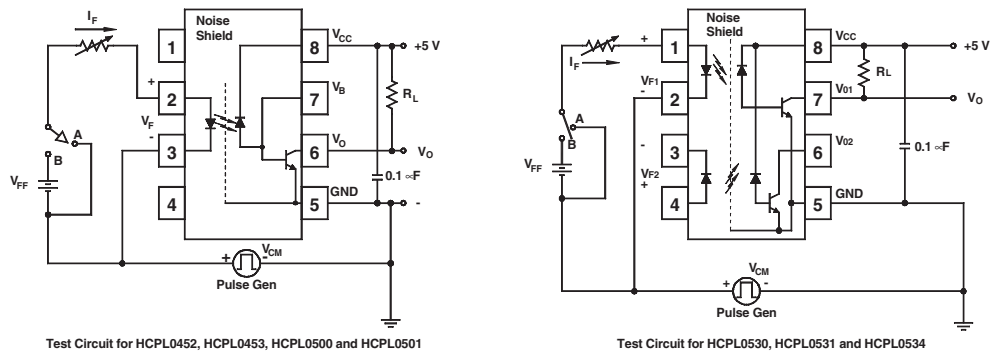
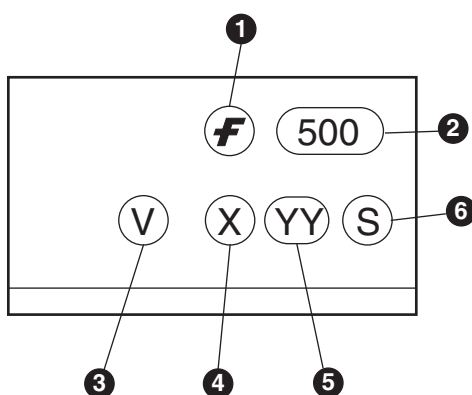


Fig. 8 Common Mode Immunity Test Circuit

Ordering Information

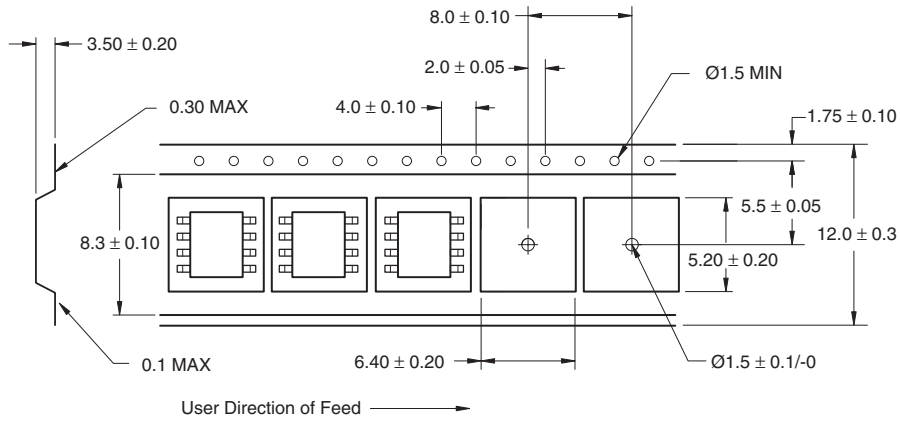
Option	Order Entry Identifier	Description
V	V	VDE 0884 (approval pending for HCPL0530, HCPL0531 & HCPL0534)
R1	R1	Tape and reel (500 units per reel)
R1V	R1V	VDE 0884 (approval pending for HCPL0530, HCPL0531 & HCPL0534), Tape and reel (500 units per reel)
R2	R2	Tape and reel (2500 units per reel)
R2V	R2V	VDE 0884 (approval pending for HCPL0530, HCPL0531 & HCPL0534), Tape and reel (2500 units per reel)

Marking Information

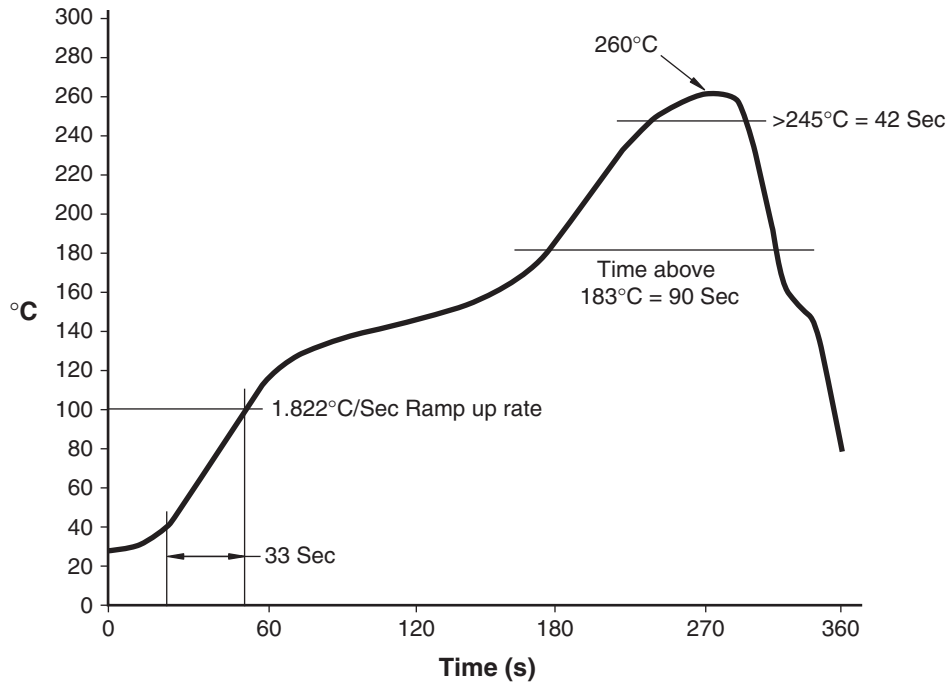


Definitions	
1	Fairchild logo
2	Device number
3	VDE mark (Note: Only appears on parts ordered with VDE option – See order entry table)
4	One digit year code, e.g., '3'
5	Two digit work week ranging from '01' to '53'
6	Assembly package code

Carrier Tape Specifications



Reflow Profile



TRADEMARKS

The following are registered and unregistered trademarks Fairchild Semiconductor owns or is authorized to use and is not intended to be an exhaustive list of all such trademarks.

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

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, 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 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.

Rev. I19