FAIRCHILD
SEMICONDUCTOR®

HIGH SPEED TRANSISTOR OPTOCOUPLERS

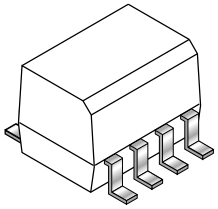
Single Channel: HCPL0452 HCPL0453 HCPL0500 HCPL0501
Dual Channel: HCPL0530 HCPL0531 HCPL0534

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.

FEATURES



- High speed – 1 MBit/s
- 15kV/μs minimum commone 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

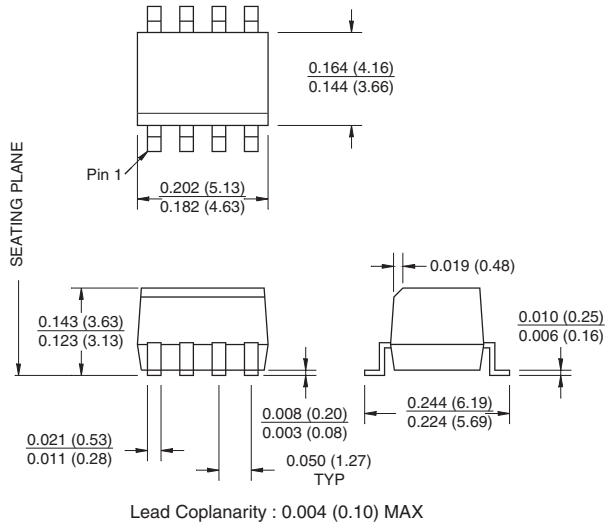
APPLICATIONS

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

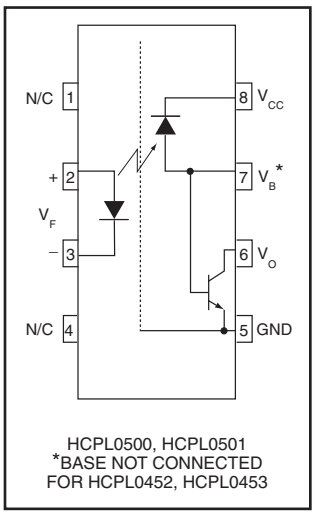
TRUTH TABLE (positive logic)

LED	V_O
ON	LOW
OFF	HIGH

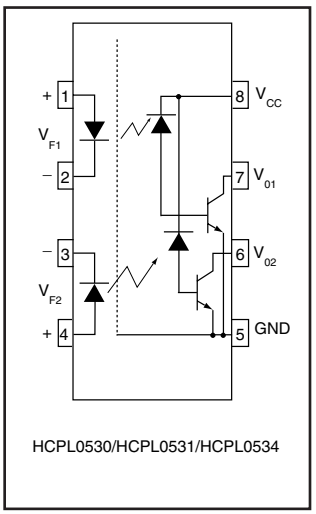
PACKAGE DIMENSIONS



NOTE
All dimensions are in inches (millimeters)



HCPL0500, HCPL0501
*BASE NOT CONNECTED
FOR HCPL0452, HCPL0453



HCPL0530/HCPL0531/HCPL0534

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

ABSOLUTE MAXIMUM RATINGS (T_A = 25°C unless otherwise specified)

Parameter	Symbol	Value	Units
Storage Temperature	T_{STG}	-40 to +125	°C
Operating Temperature	T_{OPR}	-40 to +85	°C
Reflow Temperature Profile (Refer to page 9)			
EMITTER			
DC/Average Forward Input Current	I_F (avg)	25	mA
Peak Forward Input Current (50% duty cycle, 1 ms P.W.)	I_F (pk)	50	mA
Peak Transient Input Current - ([≤1 µs P.W., 300 pps)	I_F (trans)	1.0	A
Reverse Input Voltage	V_R	5	V
Input Power Dissipation	P_D	45	mW
DETECTOR			
Average Output Current (Pin 6)	I_O (avg)	8	mA
Peak Output Current	I_O (pk)	16	mA
Emitter-Base Reverse Voltage (HCPL0500/HCPL0501 only)	V_{EBR}	5	V
Supply Voltage	V_{CC}	-0.5 to 30	V
Output Voltage	V_O	-0.5 to 20	V
Base Current (HCPL0500/HCPL0501 only)	I_B	5	mA
Output power dissipation	P_D	100	mW

ELECTRICAL CHARACTERISTICS (T_A = 0 to 70°C Unless otherwise specified)

INDIVIDUAL COMPONENT CHARACTERISTICS

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

ELECTRICAL CHARACTERISTICS (T_A = 0 to 70°C Unless otherwise specified) (Continued)

INDIVIDUAL COMPONENT CHARACTERISTICS

Parameter	Test Conditions	Symbol	Device	Min	Typ**	Max	Unit
Logic high supply current	(I_F = 0 mA, V_O = Open, V_{CC} = 15 V) (T_A =25°C)	I_{CCH}	All		0.01	1	µA
	(I_F = 0 mA, V_O = Open) (V_{CC} = 15 V)		HCPL0452/3/ 0500/1			2	
			HCPL0530/1/4			4	

TRANSFER CHARACTERISTICS (T_A = 0 to 70°C Unless otherwise specified)

Parameter	Test Conditions	Symbol	Device	Min	Typ**	Max	Unit
COUPLED Current transfer ratio (Note 1)	(I_F = 16 mA, V_O = 0.4 V) (V_{CC} = 4.5 V, T_A =25°C)	CTR	HCPL0500/0530	7	27	50	%
			HCPL0452/3	19	27	50	
			HCPL0501/0531				
	(I_F = 16 mA, V_O = 0.5 V) (V_{CC} = 4.5 V)		HCPL0500	5	30		
			HCPL0452/3	15	30		
			HCPL0501/0534				
Logic low output voltage output voltage	(I_F = 16 mA, I_O = 1.1 mA) (V_{CC} = 4.5 V, T_A =25°C)	V_{OL}	HCPL0500		0.18	0.4	V
			HCPL0530			0.5	
	(I_F = 16 mA, I_O = 3 mA) (V_{CC} = 4.5 V, T_A =25°C)		HCPL0452/3		0.25	0.4	
			HCPL0501/0531/4				
	(I_F = 16 mA, I_O = 0.8 mA) (V_{CC} = 4.5 V)		HCPL0500 HCPL0530		0.13	0.5	
	(I_F = 16 mA, I_O = 2.4 mA) (V_{CC} = 4.5 V)		HCPL0452/3		0.23	0.5	
			HCPL0501/0531/4				

** All typicals at T_A = 25°C

SWITCHING CHARACTERISTICS (T_A = 0 to 70°C unless otherwise specified., V_{CC} = 5 V)

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

ISOLATION CHARACTERISTICS (T_A = 0°C to +70°C Unless otherwise specified.)

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

** All typicals at T_A = 25°C

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

NOTES

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%.
2. The 4.1 kΩ load represents 1 LSTTL unit load of 0.36 mA and 6.1kΩ pull-up resistor.
3. The 1.9 kΩ load represents 1 TTL unit load of 1.6 mA and 5.6 kΩ 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 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, VCM, to assure that the output will remain in a logic low state (i.e., V_O<0.8 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

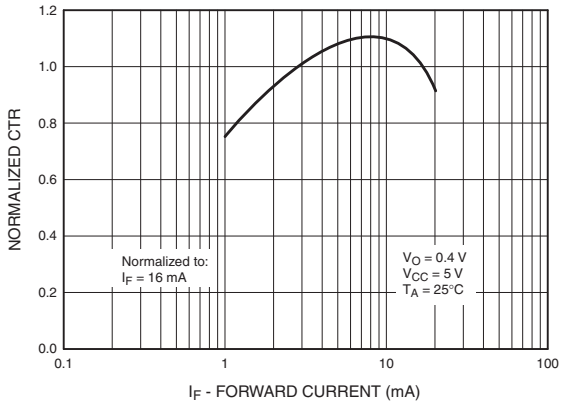


Fig. 2 Normalized CTR vs. Temperature

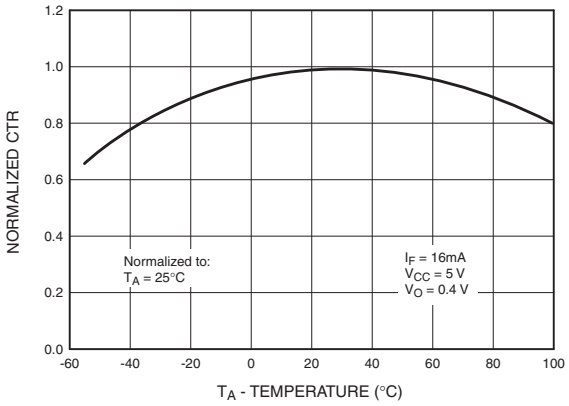


Fig. 3 Output Current vs. Output Voltage

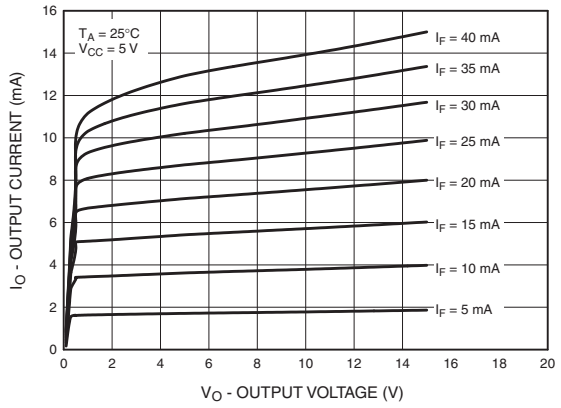


Fig. 4 Logic High Output Current vs. Temperature

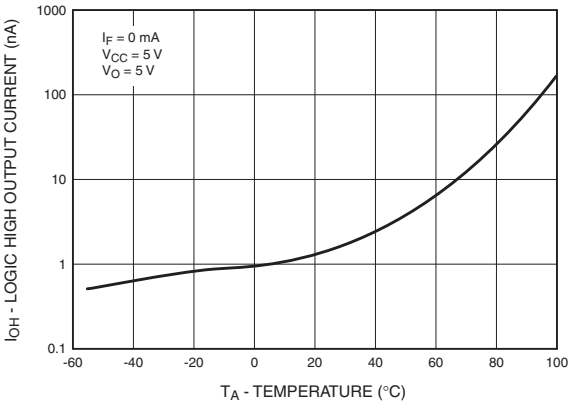


Fig. 5 Propagation Delay vs. Temperature

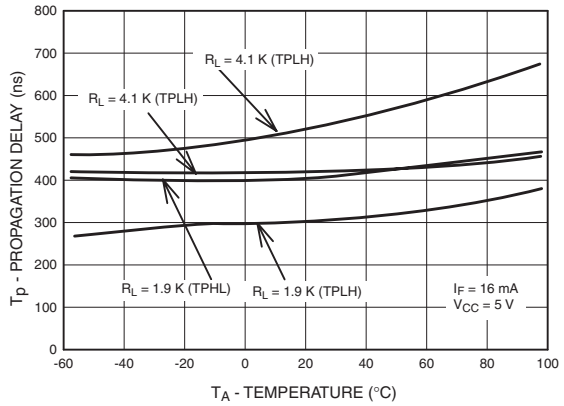
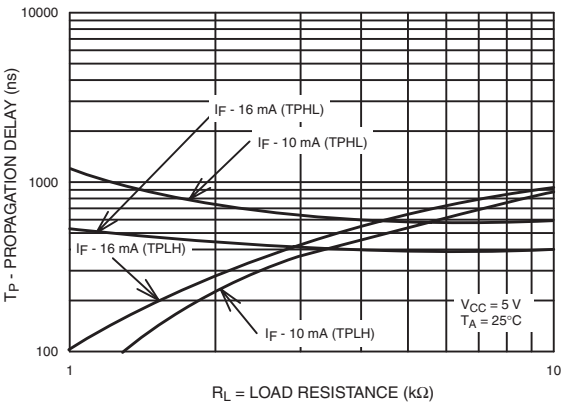
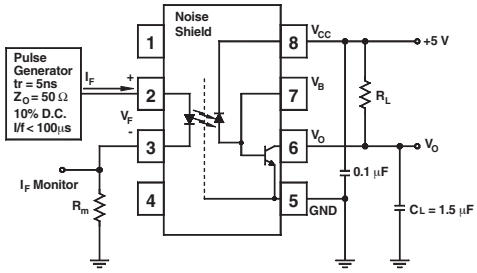
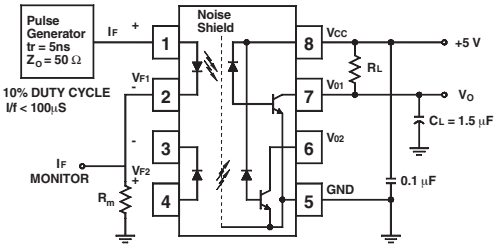


Fig. 6 Propagation Delay vs. Load Resistance





Test Circuit for HCPL0452, HCPL0453, HCPL0500 and HCPL0501



Test Circuit for HCPL0530, HCPL0531 and HCPL0534

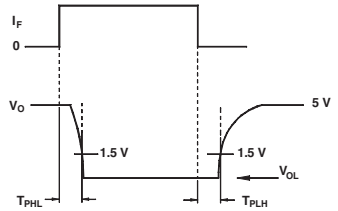
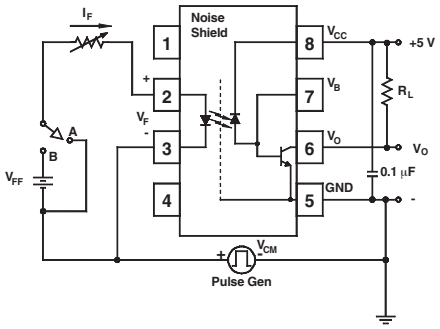
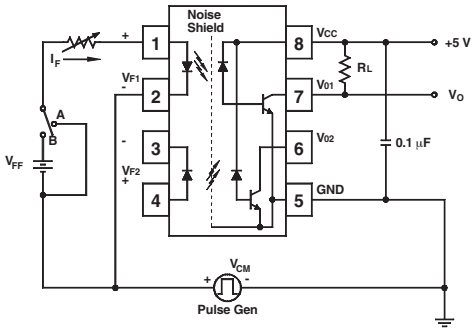


Fig. 7 Switching Time Test Circuit



Test Circuit for HCPL0452, HCPL0453, HCPL0500 and HCPL0501



Test Circuit for HCPL0530, HCPL0531 and HCPL0534

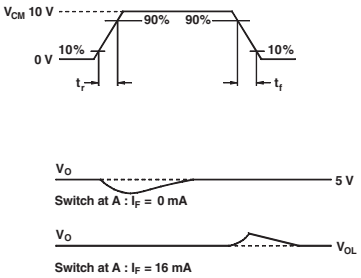


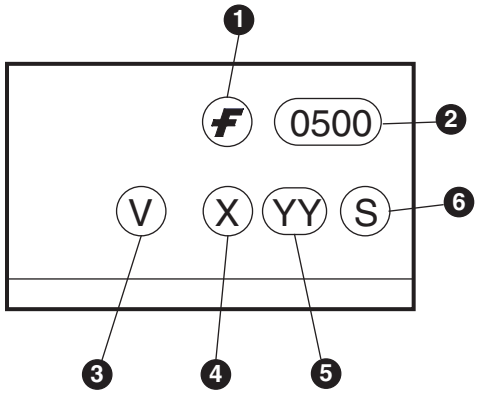
Fig. 8 Common Mode Immunity Test Circuit

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

ORDERING INFORMATION

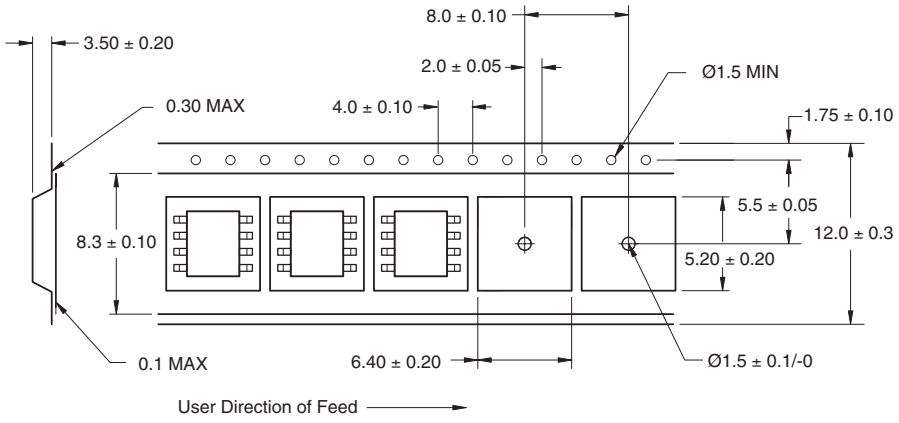
Option	Order Entry Identifier	Description
V	V	VDE 0884 (approval pending for HCPL0530, HCPL0531 & HCPL0534)
R1	R1	Tape and reel (500 units per reel)
R1V	R1V	VDE 0884 (approval pending for HCPL0530, HCPL0531 & HCPL0534), Tape and reel (500 units per reel)
R2	R2	Tape and reel (2500 units per reel)
R2V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

MARKING INFORMATION

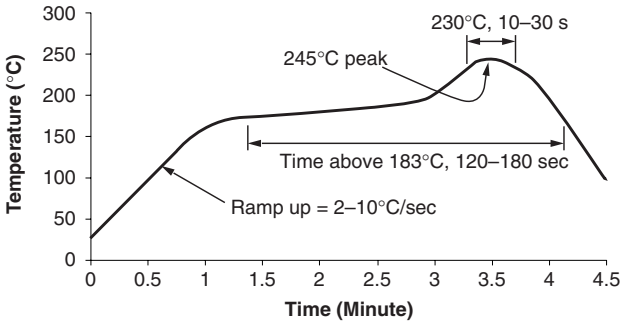


Definitions	
1	Fairchild logo
2	Device number
3	VDE mark (Note: Only appears on parts ordered with VDE option – See order entry table)
4	One digit year code, e.g., ‘3’
5	Two digit work week ranging from ‘01’ to ‘53’
6	Assembly package code

Carrier Tape Specifications



Reflow Profile



- Peak reflow temperature: 245°C (package surface temperature)
- Time of temperature higher than 183°C for 120–180 seconds
- One time soldering reflow is recommended

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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, 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.