LOW INPUT CURRENT PHOTOTRANSISTOR OPTOCOUPLERS

FAIRCHILD SEMICONDUCTOR®

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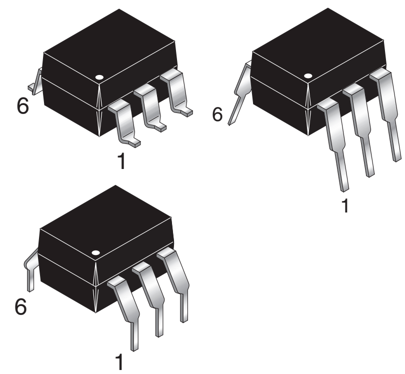
MCT5200 MCT5201 MCT5210 MCT5211

Description

The MCT52XX series consists of a high-efficiency AlGaAs, infrared emitting diode, coupled with an NPN phototransistor in a six pin dual-in-line package.

The MCT52XX is well suited for CMOS to LSTT/TTL interfaces, offering 250% $CTR_{CE(SAT)}$ with 1 mA of LED input current. When an LED input current of 1.6 mA is supplied data rates to 20K bits/s are possible.

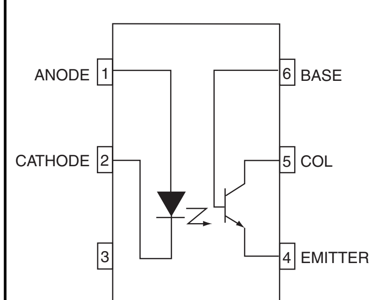
The MCT52XX can easily interface LSTTL to LSTTL/TTL, and with use of an external base to emitter resistor data rates of 100K bits/s can be achieved.



Features

- High $CTR_{CE(SAT)}$ comparable to Darlingtons
- CTR guaranteed 0°C to 70°C
- High common mode transient rejection 5kV/µs
- Data rates up to 150 kbits/s (NRZ)
- Underwriters Laboratory (UL) recognized (file #E90700)
- VDE recognized (file #94766)
  – Add option 300 (e.g., MCT5211.300)

SCHEMATIC



Applications

- CMOS to CMOS/LSTTL logic isolation
- LSTTL to CMOS/LSTTL logic isolation
- RS-232 line receiver
- Telephone ring detector
- AC line voltage sensing
- Switching power supply

Parameters	Symbol	Device	Value	Units
TOTAL DEVICE				
Storage Temperature	T_{STG}	All	-55 to +150	°C
Operating Temperature	T_{OPR}	All	-55 to +100	°C
Lead Solder Temperature	T_{SOL}	All	260 for 10 sec	°C
Total Device Power Dissipation @ 25°C (LED plus detector)	P_D	All	260	mW
Derate Linearly From 25°C			3.5	mW/°C
EMITTER				
Continuous Forward Current	I_F	All	50	mA
Reverse Input Voltage	V_R	All	6	V
Forward Current - Peak (1 µs pulse, 300 pps)	I_F(pk)	All	3.0	A
LED Power Dissipation	P_D	All	75	mW
Derate Linearly From 25°C		All	1.0	mW/°C
DETECTOR				
Continuous Collector Current	I_C	All	150	mA
Detector Power Dissipation	P_D	All	150	mW
Derate Linearly from 25°C		All	2.0	mW/°C

ELECTRICAL CHARACTERISTICS (T_A = 25°C Unless otherwise specified.)

INDIVIDUAL COMPONENT CHARACTERISTICS

Parameters		Test Conditions	Symbol	Device	Min	Typ**	Max	Units
EMITTER								
Input Forward Voltage		(I_F = 5 mA)	V_F	All		1.25	1.5	V
Forward Voltage Temp. Coefficient		(I_F = 2 mA)	$\frac{\Delta V_F}{\Delta T_A}$	All		-1.75		mV/°C
Reverse Voltage		(I_R = 10 µA)	V_R	All	6			V
Junction Capacitance		(V_F = 0 V, f = 1.0 MHz)	C_J	All		18		pF
DETECTOR								
Collector-Emitter Breakdown Voltage		(I_C = 1.0 mA, I_F = 0)	BV_{CEO}	All	30	100		V
Collector-Base Breakdown Voltage		(I_C = 10 µA, I_F = 0)	BV_{CBO}	All	30	120		V
Emitter-Base Breakdown Voltage		(I_C = 10 µA, I_F = 0)	BV_{EBO}	All	5	10		V
Collector-Emitter Dark Current		(V_{CE} = 10V, I_F = 0, R_{BE} = 1MΩ)	I_{CER}	All		1	100	nA
Capacitance	Collector to Emitter	(V_{CE} = 0, f = 1 MHz)	C_{CE}	All		10		pF
	Collector to Base	(V_{CB} = 0, f = 1 MHz)	C_{CB}	All		80		pF
	Emitter to Base	(V_{EB} = 0, f = 1 MHz)	C_{EB}	All		15		pF

ISOLATION CHARACTERISTICS

Characteristic	Test Conditions	Symbol	Device	Min	Typ**	Max	Units
Input-Output Isolation Voltage(10)	(f = 60Hz, t = 1 min.)	V_{ISO}	All	5300			Vac(rms)
Isolation Resistance(10)	V_{I-O} = 500 VDC, T_A = 25°C	R_{ISO}	All	10^{11}			Ω
Isolation Capacitance(9)	V_{I-O} = 0, f = 1 MHz	C_{ISO}	All		0.7		pF
Common Mode Transient Rejection – Output High	V_{CM} = 50 V_{P-P1}, R_L= 750Ω, I_F = 0	CM_H	MCT5210/11		5000		V/µs
	V_{CM} = 50 V_{P-P}, R_L= 1KΩ, I_F = 0		MCT5200/01				
Common Mode Transient Rejection – Output Low	V_{CM} = 50 V_{P-P1}, R_L = 750Ω, I_F =1.6mA	CM_L	MCT5210/11		5000		V/µs
	V_{CM} = 50 V_{P-P1}, R_L= 1KΩ, I_F = 5 mA		MCT5200/01				

**All typical T_A=25°C

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

DC Characteristics	Test Conditions	Symbol	Device	Min	Typ**	Max	Units
Saturated Current Transfer Ratio(1) (Collector to Emitter)	I_F = 10 mA, V_{CE} = 0.4 V	$CTR_{CE(SAT)}$	MCT5200	75			%
	I_F = 5 mA, V_{CE} = 0.4 V		MCT5201	120			
	I_F = 3.0 mA, V_{CE} = 0.4 V		MCT5210	60			
	I_F = 1.6 mA, V_{CE} = 0.4 V		MCT5211	100			
	I_F = 1.0 mA, V_{CE} = 0.4 V			75			
Current Transfer Ratio (Collector to Emitter)(1)	I_F = 3.0 mA, V_{CE} = 5.0 V	$CTR_{(CE)}$	MCT5210	70			%
	I_F = 1.6 mA, V_{CE} = 5.0 V		MCT5211	150			
	I_F = 1.0 mA, V_{CE} = 5.0 V			110			
Current Transfer Ratio Collector to Base(2)	I_F = 10 mA, V_{CB} = 4.3 V	$CTR_{(CB)}$	MCT5200	0.2			%
	I_F = 5 mA, V_{CB} = 4.3 V		MCT5201	0.28			
	I_F = 3.0 mA, V_{CE} = 4.3 V		MCT5210	0.2			
	I_F = 1.6 mA, V_{CE} = 4.3 V		MCT5211	0.3			
	I_F = 1.0 mA, V_{CE} = 4.3 V			0.25			
Saturation Voltage	I_F = 10 mA, I_{CE} = 7.5 mA	$V_{CE(SAT)}$	MCT5200			0.4	V
	I_F = 5 mA, I_{CE} = 6 mA		MCT5201			0.4	
	I_F = 3.0 mA, I_{CE} = 1.8 mA		MCT5210			0.4	
	I_F = 1.6 mA, I_{CE} = 1.6 mA		MCT5211			0.4	
AC Characteristics	**Test Conditions**	**Symbol**	**Device**	**Min**	**Typ**	**Max**	**Units**
Propagation Delay High to Low(3)	R_L = 330 Ω, R_{BE} = ∞; I_F = 3.0 mA	T_{PHL}	MCT5210		10		μs
	R_L = 3.3 kΩ, R_{BE} = 39 kΩ; V_{CC} = 5.0 V				7		
	R_L = 750 Ω, R_{BE} = ∞; I_F = 1.6mA		MCT5211		14		
	R_L = 4.7 kΩ, R_{BE} = 91 kΩ; V_{CC} = 5.0V				15		
	R_L = 1.5 kΩ, R_{BE} = ∞; I_F = 1.0mA				17		
	R_L = 10 kΩ, R_{BE} = 160 kΩ; V_{CC} = 5.0V				24		
	V_{CE} = 0.4V, V_{CC} = 5V, R_L = fig. 13, R_{BE} = 330 kΩ; I_F = 10mA		MCT5200		1.6	12	
	I_F = 5mA		MCT5201		3	30	
Propagation Delay Low to High(4)	R_L = 330 Ω, R_{BE} = ∞; I_F = 3.0 mA	T_{PLH}	MCT5210		0.4		μs
	R_L = 3.3 kΩ, R_{BE} = 39 kΩ; V_{CC} = 5.0 V				8		
	R_L = 750 Ω, R_{BE} = ∞; I_F = 1.6mA		MCT5211		2.5		
	R_L = 4.7 kΩ, R_{BE} = 91 kΩ; V_{CC} = 5.0V				11		
	R_L = 1.5 kΩ, R_{BE} = ∞; I_F = 1.0mA				7		
	R_L = 10 kΩ, R_{BE} = 160 kΩ; V_{CC} = 5.0 V				16		
	V_{CE} = 0.4V, V_{CC} = 5V, R_L = fig. 13, R_{BE} = 330 kΩ; I_F = 10mA		MCT5200		18	20	
	I_F = 5mA		MCT5201		12	13	
Delay Time(5)	V_{CE} = 0.4V, R_{BE} = 330 kΩ, R_L = 1 kΩ, V_{CC} = 5V; I_F = 10mA	t_d	MCT5200		0.5	7	μs
	I_F = 5mA		MCT5201		1.1	15	
Rise Time(6)	V_{CE} = 0.4V, R_{BE} = 330 kΩ, R_L = 1 kΩ, V_{CC} = 5V; I_F = 10mA	t_r	MCT5200		1.3	6	μs
	I_F = 5mA		MCT5201		2.5	20	

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

DC Characteristics	Test Conditions		Symbol	Device	Min	Typ**	Max	Units
Storage Time(7)	V_{CE} = 0.4V, R_{BE} = 330 kΩ, R_L = 1 kΩ, V_{CC} = 5V	I_F = 10mA	t_s	MCT5200		15	18	µs
		I_F = 5mA		MCT5201		10	13	
Fall Time(8)	V_{CE} = 0.4V, R_{BE} = 330 kΩ, R_L = 1 kΩ, V_{CC} = 5V	I_F = 10mA	t_f	MCT5200		16	30	µs
		I_F = 5mA		MCT5201		16	30	

**All typicals at T_A = 25°C

Notes
1. DC Current Transfer Ratio (CTR_{CE}) is defined as the transistor collector current (I_{CE}) divided by the input LED current (I_F) x 100%, at a specified voltage between the collector and emitter (V_{CE}).
2. The collector base Current Transfer Ratio (CTR_{CB}) is defined as the transistor collector base photocurrent(I_{CB}) divided by the input LED current (I_F) time 100%.
3. Referring to Figure 14 the T_{PHL} propagation delay is measured from the 50% point of the rising edge of the data input pulse to the 1.3V point on the falling edge of the output pulse.
4. Referring to Figure 14 the T_{PLH} propagation delay is measured from the 50% point of the falling edge of data input pulse to the 1.3V point on the rising edge of the output pulse.
5. Delay time (t_d) is measured from 50% of rising edge of LED current to 90% of Vo falling edge.
6. Rise time (t_r) is measured from 90% to 10% of Vo falling edge.
7. Storage time (t_s) is measured from 50% of falling edge of LED current to 10% of Vo rising edge.
8. Fall time (t_f) is measured from 10% to 90% of Vo rising edge.
9. C_{ISO} is the capacitance between the input (pins 1, 2, 3 connected) and the output, (pin 4, 5, 6 connected).
10. Device considered a two terminal device: Pins 1, 2, and 3 shorted together, and pins 5, 6 and 7 are shorted together.

TYPICAL PERFORMANCE GRAPHS

Fig. 1 LED Forward Voltage vs. Forward Current

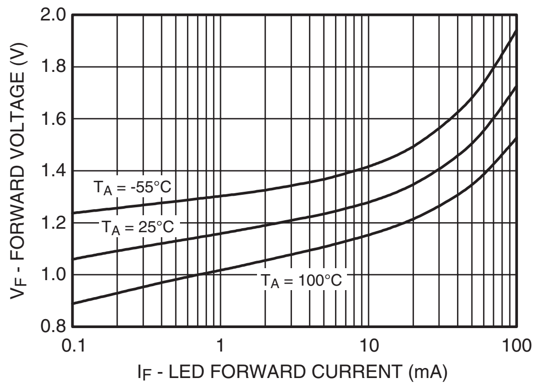


Fig. 2 Normalized Current Transfer Ratio vs. Forward Current

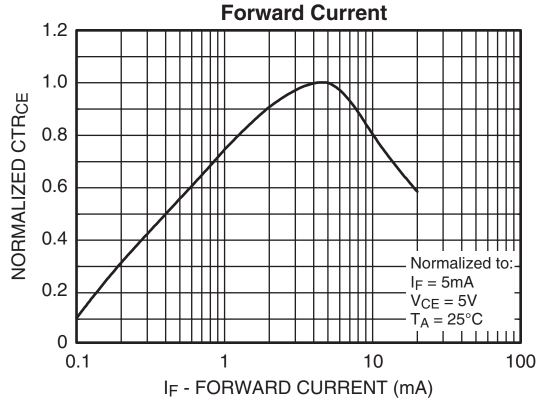


Fig. 3 Normalized CTR vs. Temperature

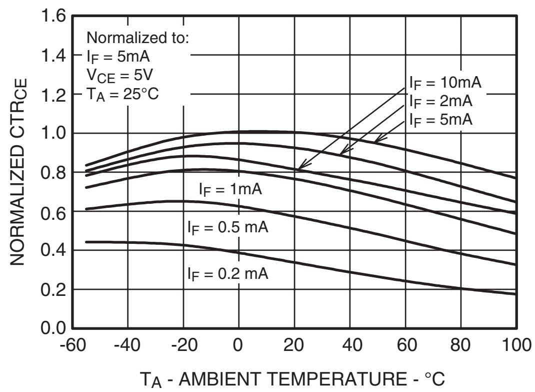


Fig. 4 Normalized Collector vs. Collector - Emitter Voltage

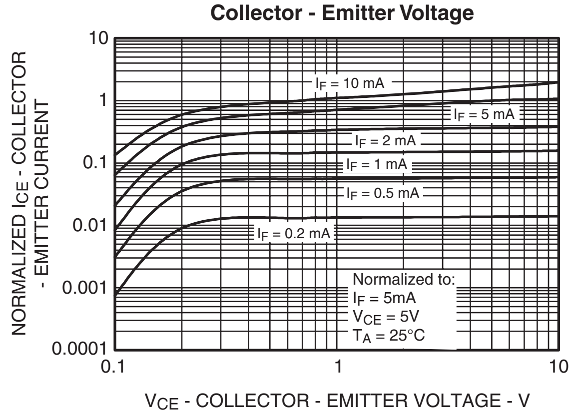


Fig. 5 Normalized Collector Base Photocurrent Ratio vs. Forward Current

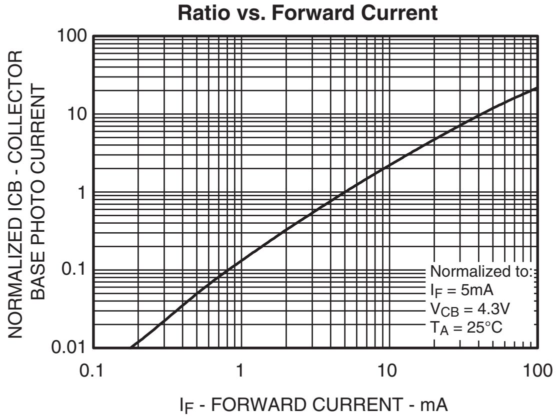
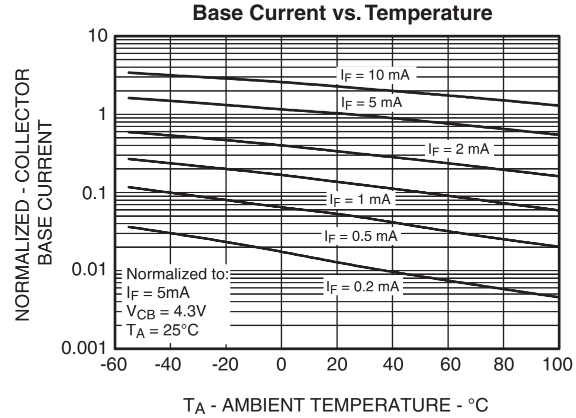


Fig. 6 Normalized Collector - Base Current vs. Temperature



TYPICAL PERFORMANCE GRAPHS (Continued)

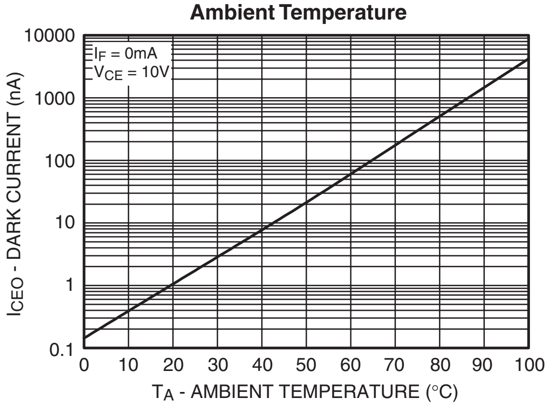


Fig. 7 Collector-Emitter Dark Current vs. Ambient Temperature

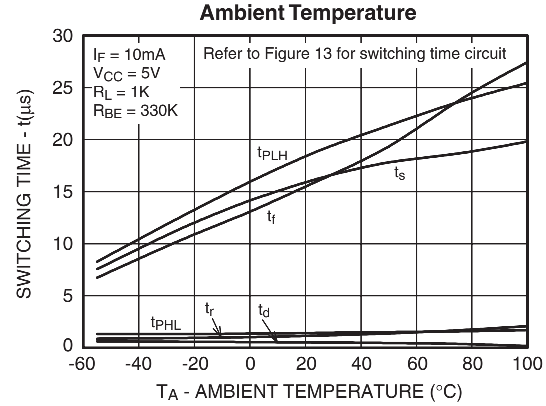


Fig. 8 Switching Time vs. Ambient Temperature

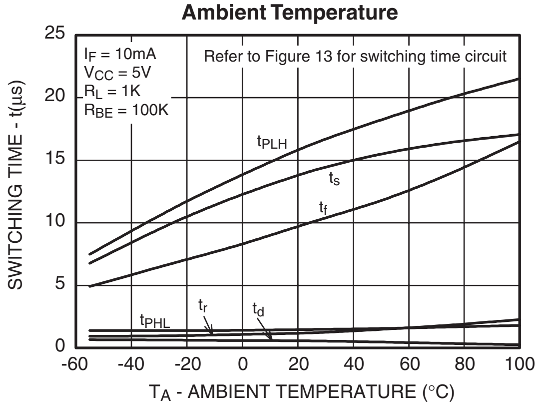


Fig. 9 Switching Time vs. Ambient Temperature

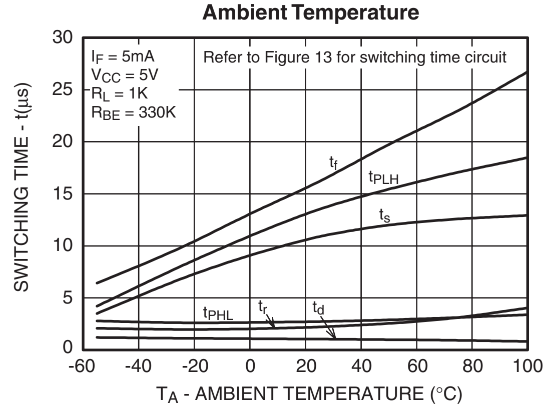


Fig. 10 Switching Time vs. Ambient Temperature

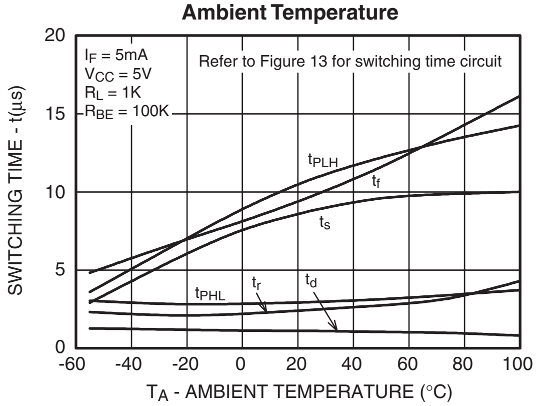


Fig. 11 Switching Time vs. Ambient Temperature

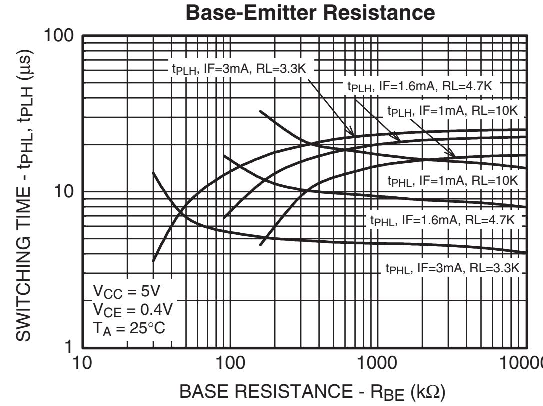


Fig. 12 Turn-on Time vs. Base-Emitter Resistance

TYPICAL ELECTRO-OPTICAL CHARACTERISTICS (TA = 25°C Unless Otherwise Specified)

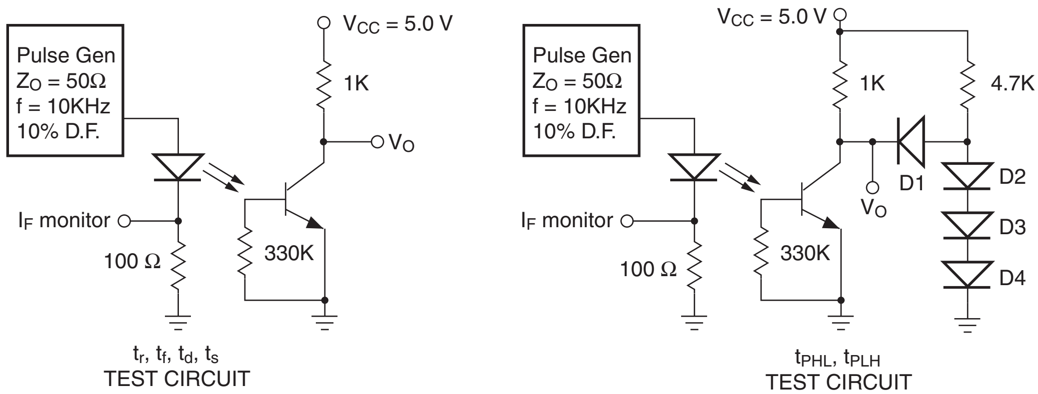


Figure 13.

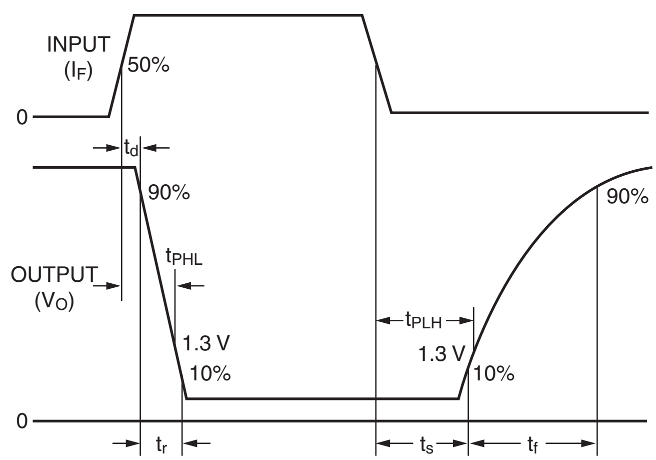
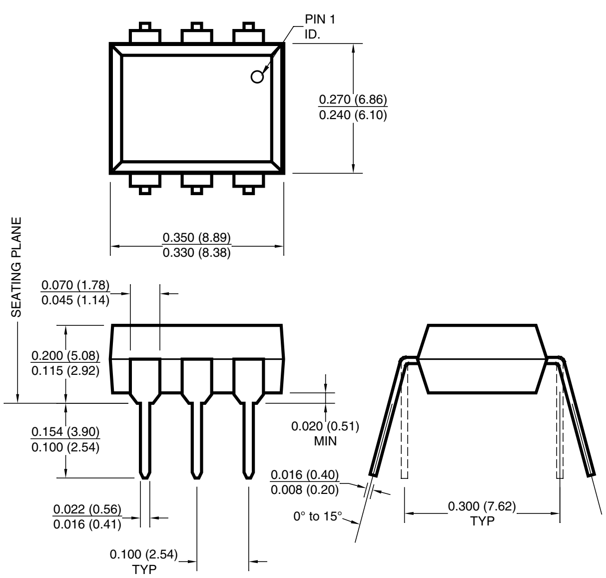
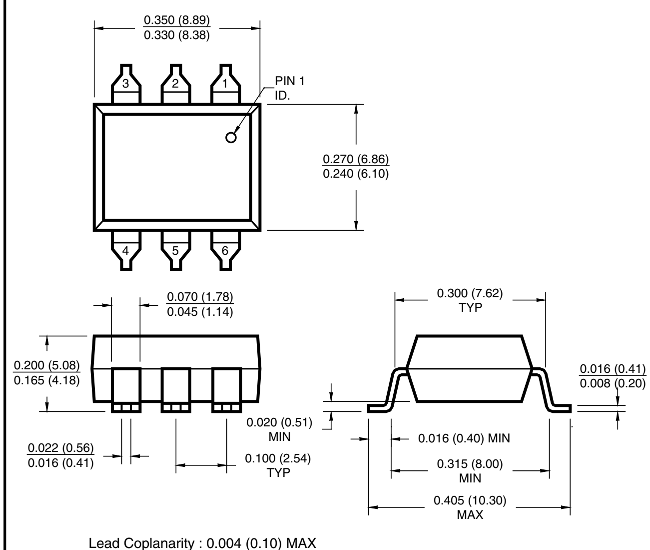


Figure 14. Switching Circuit Waveforms

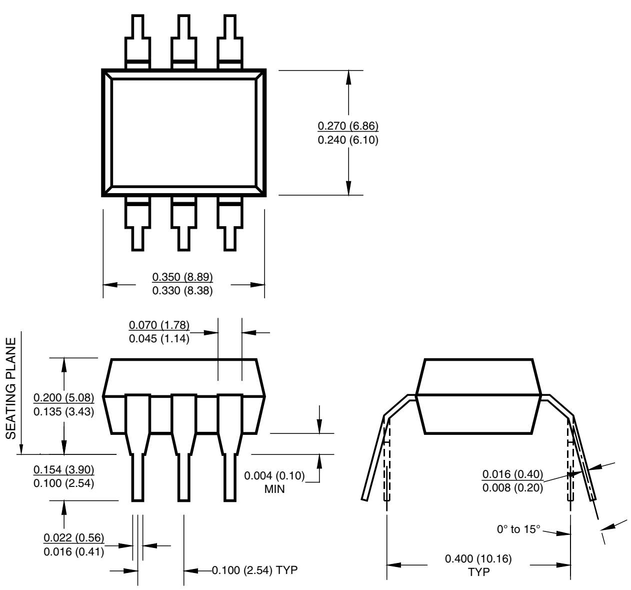
Package Dimensions (Through Hole)



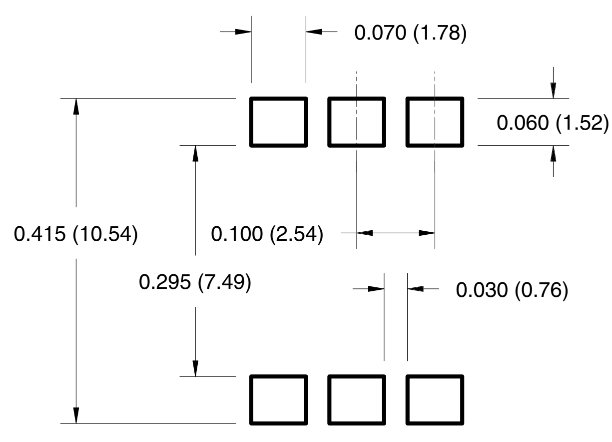
Package Dimensions (Surface Mount)



Package Dimensions (0.4" Lead Spacing)



Recommended Pad Layout for Surface Mount Leadform

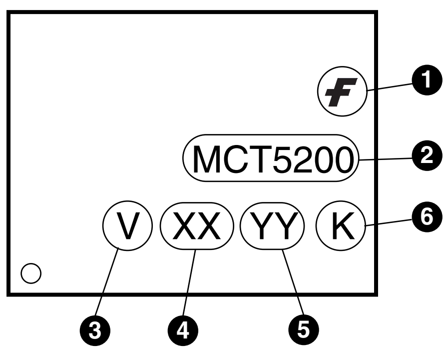


Note
All dimensions are in inches (millimeters)

ORDERING INFORMATION

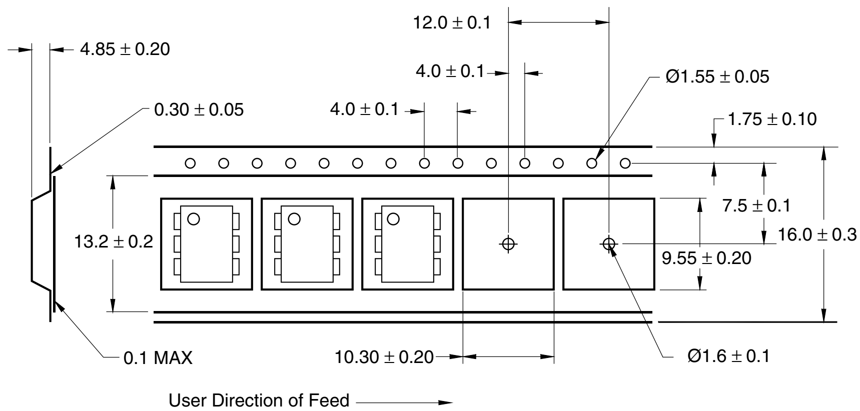
Option	Order Entry Identifier	Description
S	.S	Surface Mount Lead Bend
SD	.SD	Surface Mount; Tape and Reel
W	.W	0.4" Lead Spacing
300	.300	VDE 0884
300W	.300W	VDE 0884, 0.4" Lead Spacing
3S	.3S	VDE 0884, Surface Mount
3SD	.3SD	VDE 0884, Surface Mount, Tape and Reel

MARKING INFORMATION



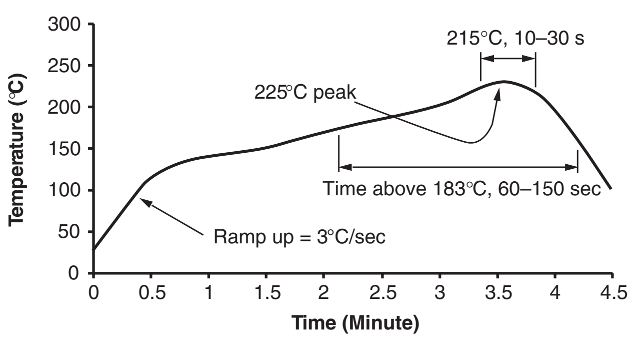
Definitions	
1	Fairchild logo
2	Device number
3	VDE mark (Note: Only appears on parts ordered with VDE option – See order entry table)
4	Two digit year code, e.g., ‘03’
5	Two digit work week ranging from ‘01’ to ‘53’
6	Assembly package code

Carrier Tape Specifications



NOTE
All dimensions are in inches (millimeters)

Reflow Profile (Black Package, No Suffix)



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

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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.