February 2008

MCT5201M, MCT5210M, MCT5211M
Low Input Current Phototransistor Optocouplers

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 150kbits/s (NRZ)
- Underwriters Laboratory (UL) recognized, file #E90700, volume 2
- IEC60747-5-2 approved (ordering option V)

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

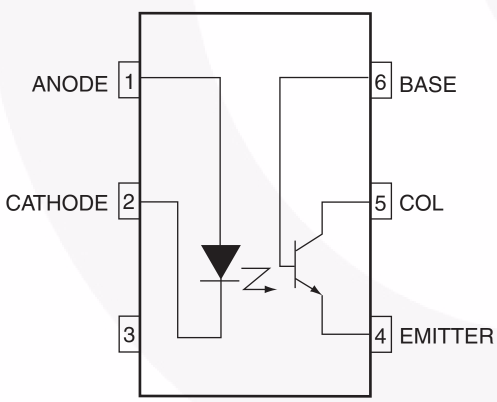
Description

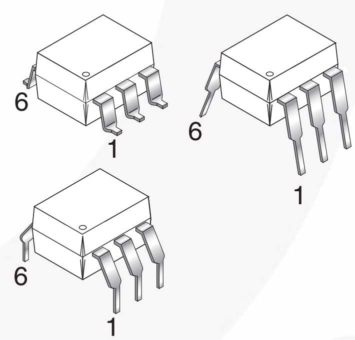
The MCT52XXM series consists of a high-efficiency AlGaAs, infrared emitting diode, coupled with an NPN phototransistor in a six pin dual-in-line package.

The MCT52XXM is well suited for CMOS to LSTT/TTL interfaces, offering 250% $CTR_{CE(SAT)}$ with 1mA of LED input current. When an LED input current of 1.6mA is supplied data rates to 20K bits/s are possible.

The MCT52XXM 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.

Schematic





Absolute Maximum Ratings

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	Parameters	Value	Units
TOTAL DEVICE			
T_{STG}	Storage Temperature	-55 to +150	°C
T_{OPR}	Operating Temperature	-40 to +100	°C
T_{SOL}	Lead Solder Temperature	260 for 10 sec	°C
P_D	Total Device Power Dissipation @ 25°C (LED plus detector)	260	mW
	Derate Linearly From 25°C	3.5	mW/°C
EMITTER			
I_F	Continuous Forward Current	50	mA
V_R	Reverse Input Voltage	6	V
I_F(pk)	Forward Current - Peak (1 µs pulse, 300 pps)	3.0	A
P_D	LED Power Dissipation	75	mW
	Derate Linearly From 25°C	1.0	mW/°C
DETECTOR			
I_C	Continuous Collector Current	150	mA
P_D	Detector Power Dissipation	150	mW
	Derate Linearly from 25°C	2.0	mW/°C

Electrical Characteristics (T_A = 25°C unless otherwise specified)

Individual Component Characteristics

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

Isolation Characteristics

Symbol	Characteristic	Test Conditions	Device	Min.	Typ.*	Max.	Units
V_{ISO}	Input-Output Isolation Voltage(10)	f = 60Hz, t = 1 sec.	All	7500			Vac(peak)
R_{ISO}	Isolation Resistance(10)	V_{I-O} = 500 VDC, T_A = 25°C	All	10^{11}			Ω
C_{ISO}	Isolation Capacitance(9)	V_{I-O} = 0, f = 1 MHz	All		0.4	0.6	pF
CM_H	Common Mode Transient	V_{CM} = 50 V_{P-P1}, R_L= 750Ω, I_F = 0	MCT5210M/11M		5000		V/µs
	Rejection – Output HIGH	V_{CM} = 50 V_{P-P}, R_L= 1KΩ, I_F = 0	MCT5201M				
CM_L	Common Mode Transient	V_{CM} = 50 V_{P-P1}, R_L = 750Ω, I_F =1.6mA	MCT5210M/11M		5000		V/µs
	Rejection – Output LOW	V_{CM} = 50 V_{P-P1}, R_L= 1KΩ, I_F = 5mA	MCT5201M				

*All typical T_A = 25°C

Electrical Characteristics (Continued) (T_A = 25°C unless otherwise specified)

Transfer Characteristics

Symbol	Characteristics	Test Conditions		Device	Min.	Typ.*	Max.	Units
DC CHARACTERISTICS								
$CTR_{CE(SAT)}$	Saturated Current Transfer Ratio(1) (Collector to Emitter)	I_F = 5mA, V_{CE} = 0.4V		MCT5201M	120			%
		I_F = 3.0mA, V_{CE} = 0.4V		MCT5210M	60			
		I_F = 1.6mA, V_{CE} = 0.4V		MCT5211M	100			
		I_F = 1.0mA, V_{CE} = 0.4V			75			
$CTR_{(CE)}$	Current Transfer Ratio (Collector to Emitter)(1)	I_F = 3.0mA, V_{CE} = 5.0V		MCT5210M	70			%
		I_F = 1.6mA, V_{CE} = 5.0V		MCT5211M	150			
		I_F = 1.0mA, V_{CE} = 5.0V			110			
$CTR_{(CB)}$	Current Transfer Ratio Collector to Base(2)	I_F = 5mA, V_{CB} = 4.3V		MCT5201M	0.28			%
		I_F = 3.0mA, V_{CE} = 4.3V		MCT5210M	0.2			
		I_F = 1.6mA, V_{CE} = 4.3V		MCT5211M	0.3			
		I_F = 1.0mA, V_{CE} = 4.3V			0.25			
$V_{CE(SAT)}$	Saturation Voltage	I_F = 5mA, I_{CE} = 6mA		MCT5201M			0.4	V
		I_F = 3.0mA, I_{CE} = 1.8mA		MCT5210M			0.4	
		I_F = 1.6mA, I_{CE} = 1.6mA		MCT5211M			0.4	
AC CHARACTERISTICS								
T_{PHL}	Propagation Delay HIGH-to-LOW(3)	R_L = 330 Ω, R_{BE} = ∞	I_F = 3.0mA, V_{CC} = 5.0V	MCT5210M		10		µs
		R_L = 3.3 kΩ, R_{BE} = 39kΩ				7		
		R_L = 750 Ω, R_{BE} = ∞	I_F = 1.6mA, V_{CC} = 5.0V	MCT5211M		14		
		R_L = 4.7 kΩ, R_{BE} = 91kΩ				15		
		R_L = 1.5 kΩ, R_{BE} = ∞	I_F = 1.0mA, V_{CC} = 5.0V			17		
		R_L = 10 kΩ, R_{BE} = 160kΩ				24		
		V_{CE} = 0.4V, V_{CC} = 5V, R_L = fig. 13, R_{BE} = 330kΩ	I_F = 5mA	MCT5201M		3	30	
T_{PLH}	Propagation Delay LOW-to-HIGH(4)	R_L = 330 Ω, R_{BE} = ∞	I_F = 3.0mA, V_{CC} = 5.0V	MCT5210M		0.4		µs
		R_L = 3.3 kΩ, R_{BE} = 39kΩ				8		
		R_L = 750 Ω, R_{BE} = ∞	I_F = 1.6mA, V_{CC} = 5.0V	MCT5211M		2.5		
		R_L = 4.7 kΩ, R_{BE} = 91kΩ				11		
		R_L = 1.5 kΩ, R_{BE} = ∞	I_F = 1.0mA, V_{CC} = 5.0V			7		
		R_L = 10 kΩ, R_{BE} = 160kΩ				16		
		V_{CE} = 0.4V, V_{CC} = 5V, R_L = fig. 13, R_{BE} = 330kΩ	I_F = 5mA	MCT5201M		12	13	
t_d	Delay Time(5)	V_{CE} = 0.4V, R_{BE} = 330kΩ, R_L = 1 kΩ, V_{CC} = 5V	I_F = 5mA	MCT5201M		1.1	15	µs
t_r	Rise Time(6)	V_{CE} = 0.4V, R_{BE} = 330kΩ, R_L = 1 kΩ, V_{CC} = 5V	I_F = 5mA	MCT5201M		2.5	20	µs
t_s	Storage Time(7)	V_{CE} = 0.4V, R_{BE} = 330 kΩ, R_L = 1 kΩ, V_{CC} = 5V	I_F = 5mA	MCT5201M		10	13	µs
t_f	Fall Time(8)	V_{CE} = 0.4V, R_{BE} = 330 kΩ, R_L = 1 kΩ, V_{CC} = 5V	I_F = 5mA	MCT5201M		16	30	µs

*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 Curves

Fig. 1 LED Forward Voltage vs. Forward Current

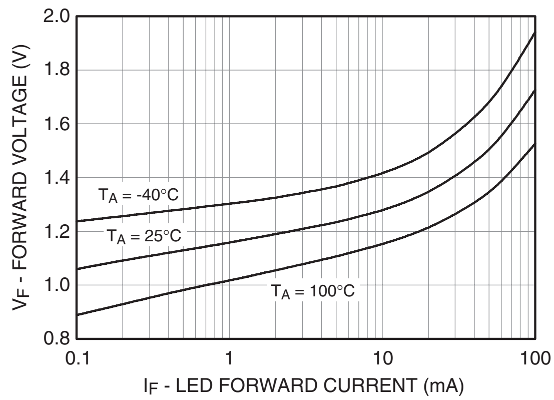


Fig. 2 Normalized Current Transfer Ratio vs. Forward Current

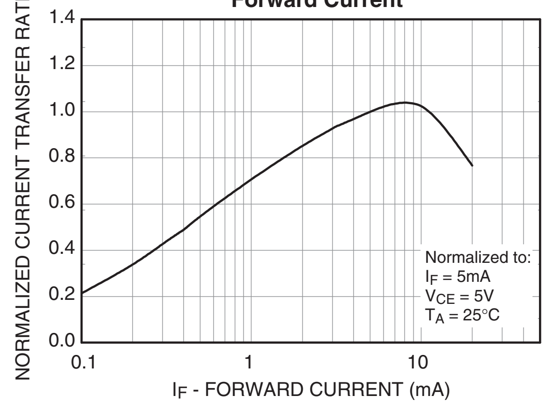


Fig. 3 Normalized CTR vs. Temperature

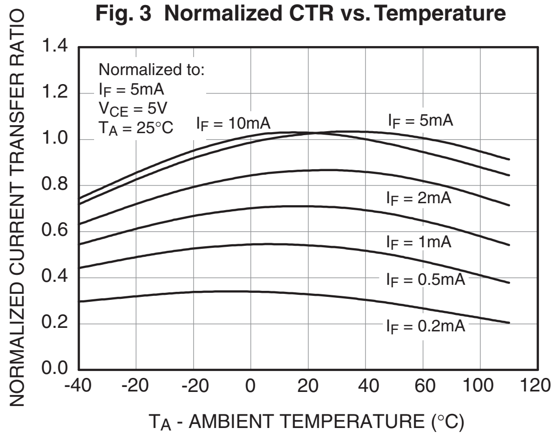


Fig. 4 Normalized Collector vs. Collector - Emitter Voltage

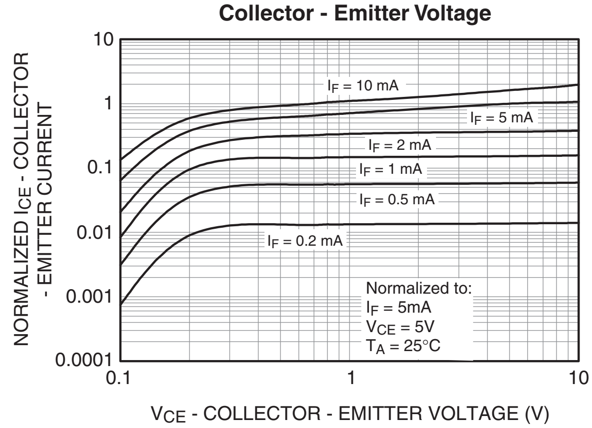


Fig. 5 Normalized Collector Base Photocurrent Ratio vs. Forward Current

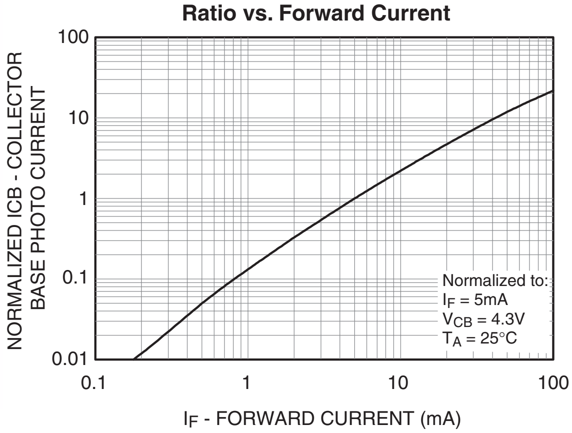
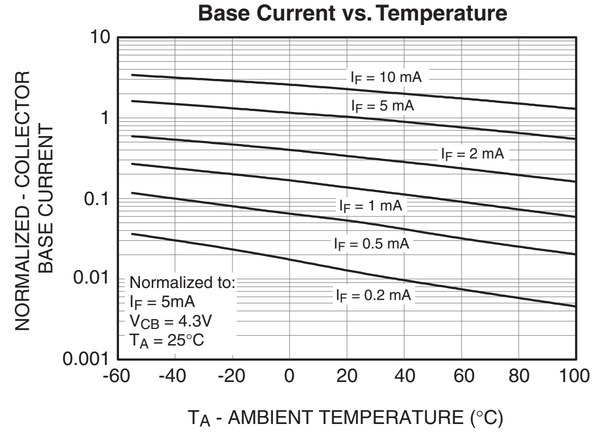


Fig. 6 Normalized Collector - Base Current vs. Temperature



Typical Performance Curves (Continued)

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

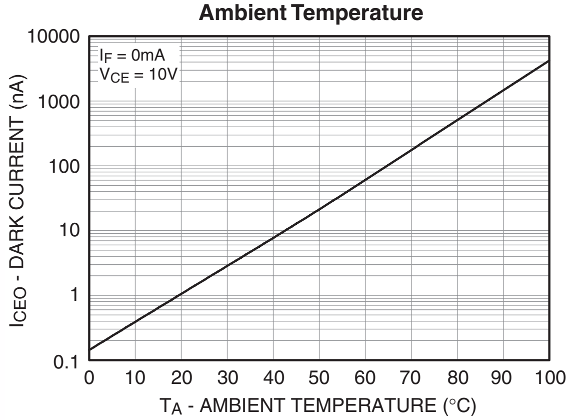


Fig. 8 Switching Time vs. Ambient Temperature

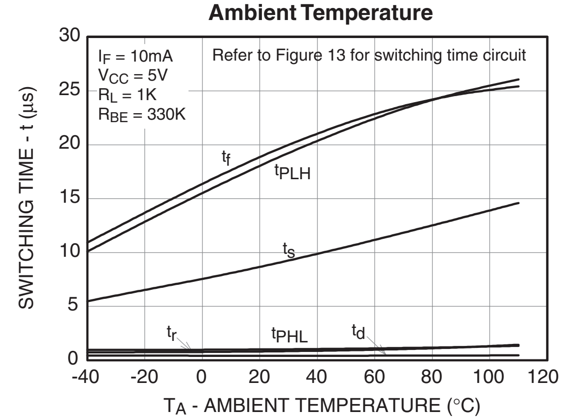


Fig. 9 Switching Time vs. Ambient Temperature

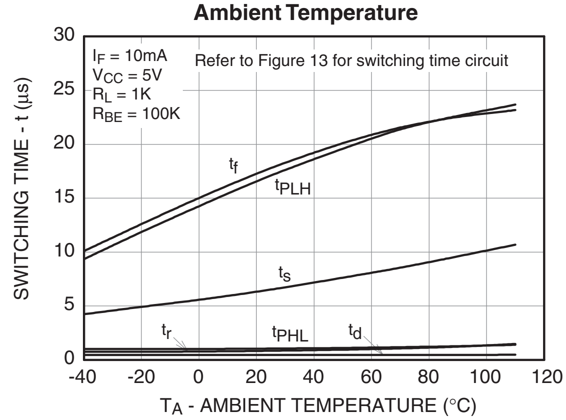


Fig. 10 Switching Time vs. Ambient Temperature

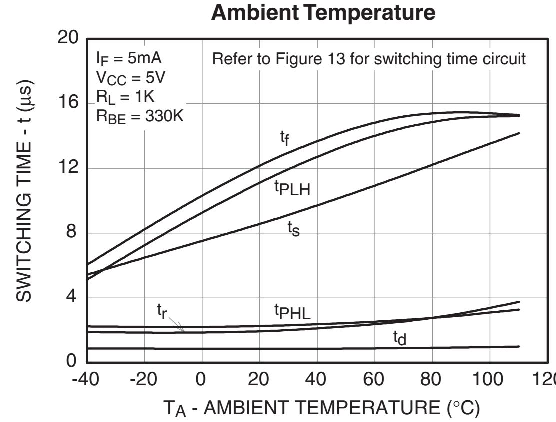


Fig. 11 Switching Time vs. Ambient Temperature

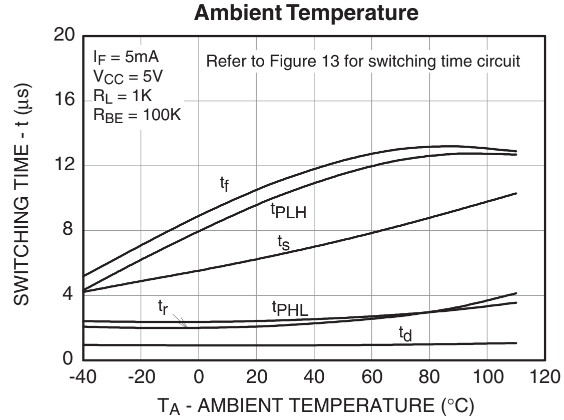
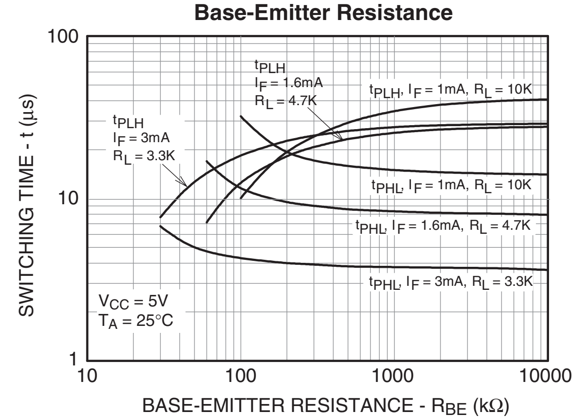


Fig. 12 Switching Time vs. Base-Emitter Resistance



Typical Electro-Optical Characteristics (T_A = 25°C unless otherwise specified

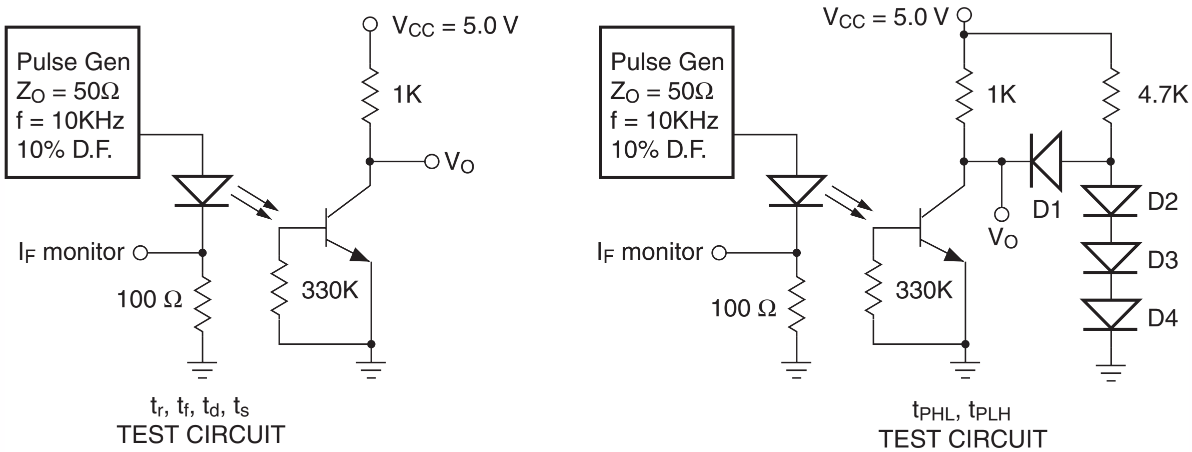


Figure 13.

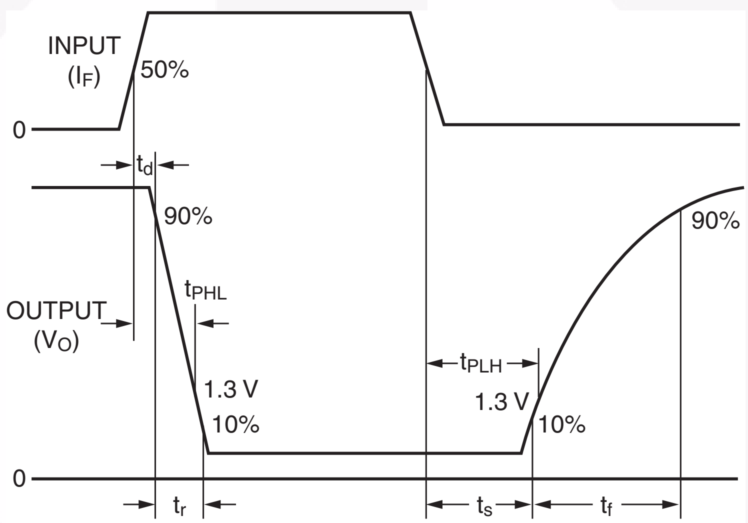
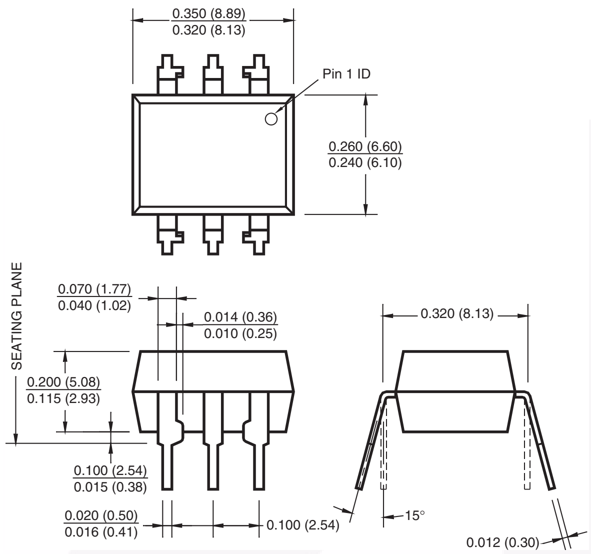


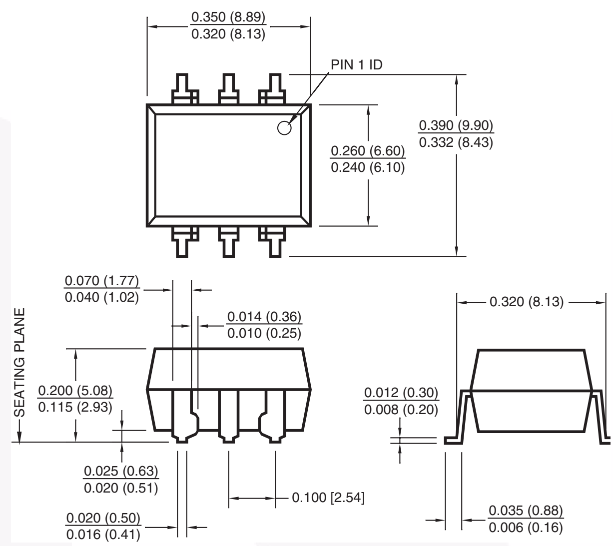
Figure 14. Switching Circuit Waveforms

Package Dimensions

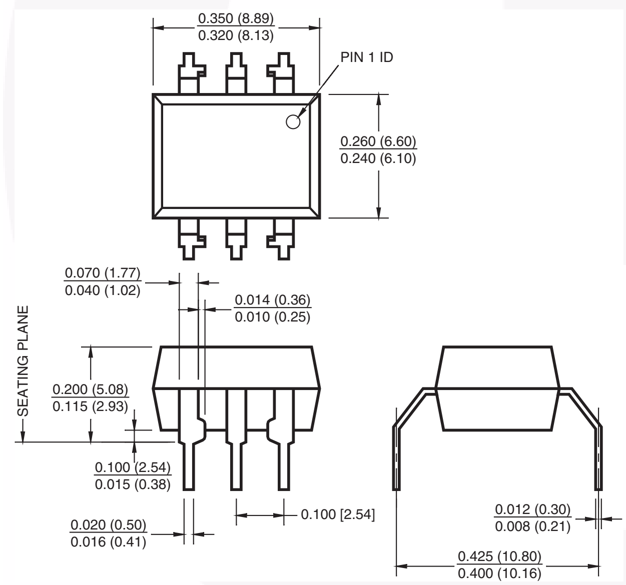
Through Hole



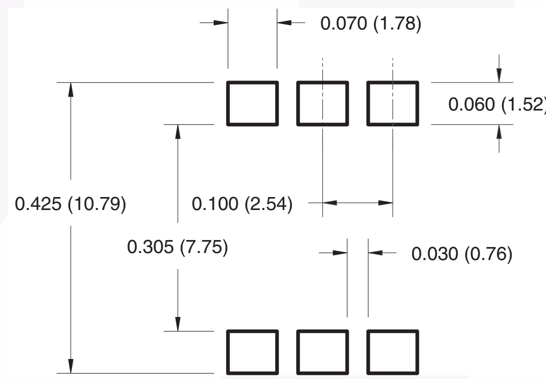
Surface Mount



0.4" Lead Spacing



Recommended Pad Layout for Surface Mount Leadform

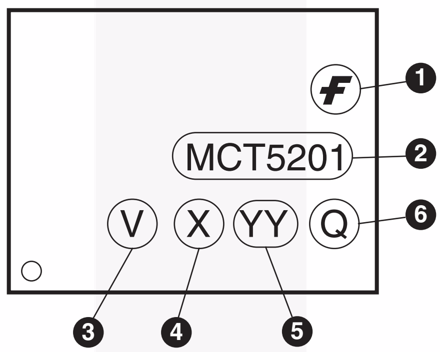


Note:
All dimensions are in inches (millimeters)

Ordering Information

Option	Order Entry Identifier (Example)	Description
No suffix	MCT5201M	Standard Through Hole Device (50 units per tube)
S	MCT5201SM	Surface Mount Lead Bend
SR2	MCT5201SR2M	Surface Mount; Tape and Reel (1,000 units per reel)
T	MCT5201TM	0.4" Lead Spacing
V	MCT5201VM	IEC60747-5-2
TV	MCT5201TVM	IEC60747-5-2, 0.4" Lead Spacing
SV	MCT5201SVM	IEC60747-5-2, Surface Mount
SR2V	MCT5201SR2VM	IEC60747-5-2, Surface Mount, Tape and Reel (1,000 units per reel)

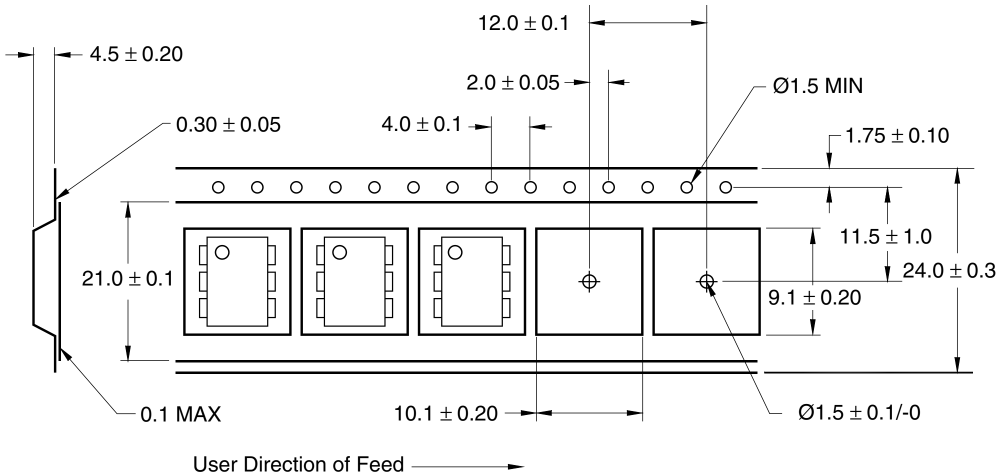
Marking Information



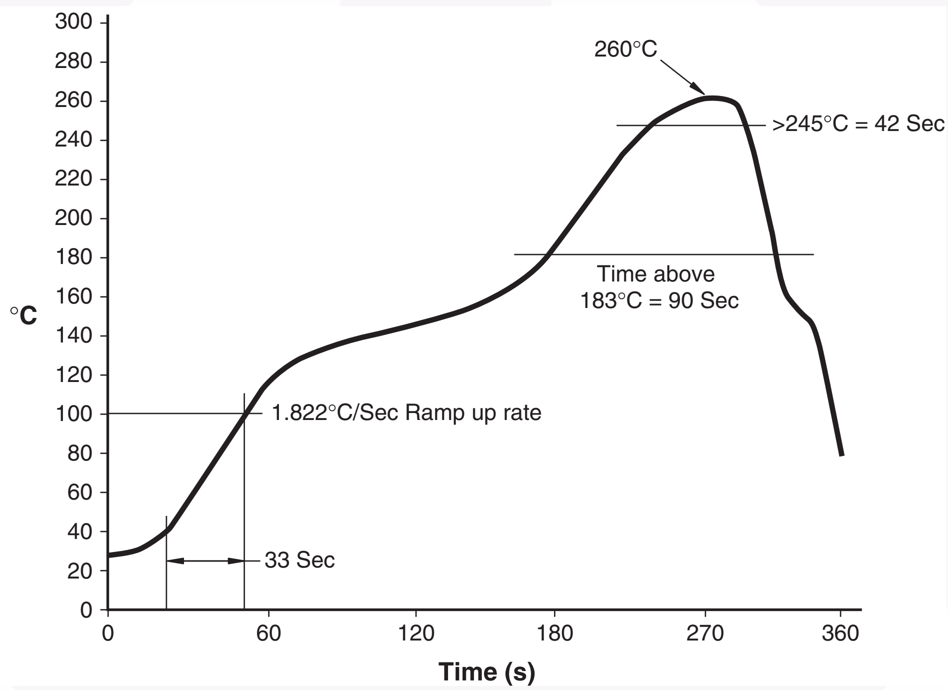
Definitions	
1	Fairchild logo
2	Device number
3	VDE mark (Note: Only appears on parts ordered with VDE option – See order entry table)
4	One digit year code, e.g., ‘7’
5	Two digit work week ranging from ‘01’ to ‘53’
6	Assembly package code

*Note – Parts that do not have the ‘V’ option (see definition 3 above) that are marked with date code ‘325’ or earlier are marked in portrait format.

Carrier Tape Specification



Reflow Profile



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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.

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; 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	This 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	This datasheet contains specifications on a product that has been discontinued by Fairchild Semiconductor. The datasheet is printed for reference information only.

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