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April 2015

MCT5210M, MCT5211M 6-Pin DIP Low Input Current Phototransistor Optocouplers

Features

- High $CTR_{CE(SAT)}$ Comparable to Darlington
- High Common Mode Transient Rejection: 5 kV/ μ s
- Data Rates Up to 150 kbits/s (NRZ)
- Safety and Regulatory Approvals:
 - UL1577, 4,170 VAC_{RMS} for 1 Minute
 - DIN-EN/IEC60747-5-5, 850 V Peak Working Insulation Voltage

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 MCT5210M and MCT5211M devices consist of a high-efficiency AlGaAs infrared emitting diode coupled with an NPN phototransistor in a six-pin dual-in-line package.

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

Both 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

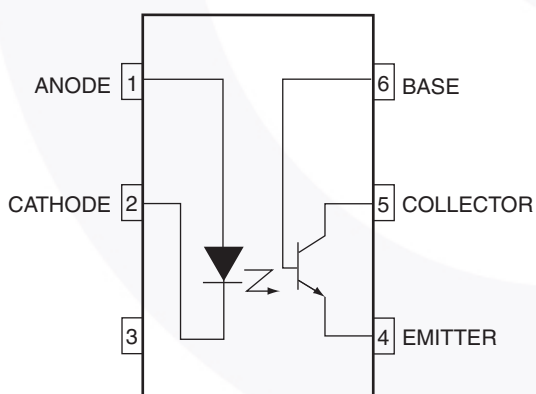


Figure 1. Schematic

Package Outlines

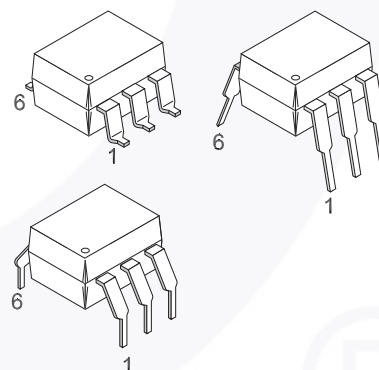


Figure 2. Package Outlines

Safety and Insulation Ratings

As per DIN EN/IEC 60747-5-5, this optocoupler is suitable for “safe electrical insulation” only within the safety limit data. Compliance with the safety ratings shall be ensured by means of protective circuits.

Parameter		Characteristics
Installation Classifications per DIN VDE 0110/1.89 Table 1, For Rated Mains Voltage	< 150 V _{RMS}	I–IV
	< 300 V _{RMS}	I–IV
Climatic Classification		55/100/21
Pollution Degree (DIN VDE 0110/1.89)		2
Comparative Tracking Index		175

Symbol	Parameter	Value	Unit
V _{PR}	Input-to-Output Test Voltage, Method A, V _{IORM} × 1.6 = V _{PR} , Type and Sample Test with t _m = 10 s, Partial Discharge < 5 pC	1360	V _{peak}
	Input-to-Output Test Voltage, Method B, V _{IORM} × 1.875 = V _{PR} , 100% Production Test with t _m = 1 s, Partial Discharge < 5 pC	1594	V _{peak}
V _{IORM}	Maximum Working Insulation Voltage	850	V _{peak}
V _{IOTM}	Highest Allowable Over-Voltage	6000	V _{peak}
	External Creepage	≥ 7	mm
	External Clearance	≥ 7	mm
	External Clearance (for Option TV, 0.4" Lead Spacing)	≥ 10	mm
DTI	Distance Through Insulation (Insulation Thickness)	≥ 0.5	mm
T _S	Case Temperature ⁽¹⁾	175	°C
I _{S,INPUT}	Input Current ⁽¹⁾	350	mA
P _{S,OUTPUT}	Output Power ⁽¹⁾	800	mW
R _{IO}	Insulation Resistance at T _S , V _{IO} = 500 V ⁽¹⁾	> 10 ⁹	Ω

Note:

1. Safety limit values – maximum values allowed in the event of a failure.

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	Unit
TOTAL DEVICE			
T_{STG}	Storage Temperature	-40 to +125	°C
T_{OPR}	Operating Temperature	-40 to +100	°C
T_J	Junction Temperature	-40 to +125	°C
T_{SOL}	Lead Solder Temperature	260 for 10 seconds	°C
P_D	Total Device Power Dissipation @ 25°C (LED plus detector)	225	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 μ s pulse, 300 pps)	3.0	A
P_D	LED Power Dissipation @ 25°C	75	mW
	Derate Linearly From 25°C	1.0	mW/°C
DETECTOR			
I_C	Continuous Collector Current	150	mA
P_D	Detector Power Dissipation @ 25°C	150	mW
	Derate Linearly From 25°C	2.0	mW/°C

Electrical Characteristics

$T_A = 25^\circ\text{C}$ unless otherwise specified.

Individual Component Characteristics

Symbol	Parameters	Test Conditions	Min.	Typ.	Max.	Unit
EMITTER						
V_F	Input Forward Voltage	$I_F = 5\text{ mA}$		1.25	1.50	V
$\frac{\Delta V_F}{\Delta T_A}$	Forward Voltage Temperature Coefficient	$I_F = 2\text{ mA}$		-1.75		mV/°C
V_R	Reverse Voltage	$I_R = 10\text{ }\mu\text{A}$	6			V
C_J	Junction Capacitance	$V_F = 0\text{ V}$, $f = 1.0\text{ MHz}$		18		pF
DETECTOR						
BV_{CEO}	Breakdown Voltage, Collector-to-Emitter	$I_C = 1.0\text{ mA}$, $I_F = 0$	30	100		V
BV_{CBO}	Breakdown Voltage, Collector-to-Base	$I_C = 10\text{ }\mu\text{A}$, $I_F = 0$	30	120		V
BV_{EBO}	Breakdown Voltage, Emitter-to-Base	$I_E = 10\text{ }\mu\text{A}$, $I_F = 0$	5	10		V
I_{CER}	Dark Current, Collector-to-Emitter	$V_{CE} = 10\text{ V}$, $I_F = 0$, $R_{BE} = 1\text{ M}\Omega$		1	100	nA
C_{CE}	Capacitance, Collector-to-Emitter	$V_{CE} = 0$, $f = 1\text{ MHz}$		10		pF
C_{CB}	Capacitance, Collector-to-Base	$V_{CB} = 0$, $f = 1\text{ MHz}$		80		pF
C_{EB}	Capacitance, Emitter-to-Base	$V_{EB} = 0$, $f = 1\text{ MHz}$		15		pF

Electrical Characteristics (Continued) $T_A = 25^\circ\text{C}$ unless otherwise specified.**Transfer Characteristics**

Symbol	Characteristics	Test Conditions		Device	Min.	Typ.	Max.	Unit
DC CHARACTERISTICS								
CTR _{CE(SAT)}	Saturated Current Transfer Ratio Collector-to-Emitter ⁽²⁾	I _F = 3.0 mA, V _{CE} = 0.4 V		MCT5210M	60			%
		I _F = 1.6 mA, V _{CE} = 0.4 V		MCT5211M	100			%
		I _F = 1.0 mA, V _{CE} = 0.4 V			75			%
CTR _(CE)	Current Transfer Ratio Collector-to-Emitter ⁽²⁾	I _F = 3.0 mA, V _{CE} = 5.0 V		MCT5210M	70			%
		I _F = 1.6 mA, V _{CE} = 5.0 V		MCT5211M	150			%
		I _F = 1.0 mA, V _{CE} = 5.0 V			110			%
CTR _(CB)	Current Transfer Ratio Collector-to-Base ⁽³⁾	I _F = 3.0 mA, V _{CE} = 4.3 V		MCT5210M	0.2			%
		I _F = 1.6 mA, V _{CE} = 4.3 V		MCT5211M	0.3			%
		I _F = 1.0 mA, V _{CE} = 4.3 V			0.25			%
V _{CE(SAT)}	Saturation Voltage	I _F = 3.0 mA, I _{CE} = 1.8 mA		MCT5210M			0.4	V
		I _F = 1.6 mA, I _{CE} = 1.6 mA		MCT5211M			0.4	V
AC CHARACTERISTICS								
T _{PHL}	Propagation Delay HIGH-to-LOW ⁽⁴⁾	R _L = 330 Ω, R _{BE} = ∞	I _F = 3.0 mA, V _{CC} = 5.0 V	MCT5210M		10		μs
		R _L = 3.3 kΩ, R _{BE} = 39 kΩ				7		μs
		R _L = 750 Ω, R _{BE} = ∞	I _F = 1.6 mA, V _{CC} = 5.0 V	MCT5211M		14		μs
		R _L = 4.7 kΩ, R _{BE} = 91 kΩ				15		μs
		R _L = 1.5 kΩ, R _{BE} = ∞				17		μs
		R _L = 10 kΩ, R _{BE} = 160 kΩ				24		μs
T _{PLH}	Propagation Delay LOW-to-HIGH ⁽⁵⁾	R _L = 330 Ω, R _{BE} = ∞	I _F = 3.0 mA, V _{CC} = 5.0 V	MCT5210M		0.4		μs
		R _L = 3.3 kΩ, R _{BE} = 39 kΩ				8		μs
		R _L = 750 Ω, R _{BE} = ∞	I _F = 1.6 mA, V _{CC} = 5.0 V	MCT5211M		2.5		μs
		R _L = 4.7 kΩ, R _{BE} = 91 kΩ				11		μs
		R _L = 1.5 kΩ, R _{BE} = ∞				7		μs
		R _L = 10 kΩ, R _{BE} = 160 kΩ				16		μs

Notes:

- DC Current Transfer Ratio (CTR_{CE}) is defined as the transistor collector current (I_{CE}) divided by the input LED current (I_F) $\times 100\%$, at a specified voltage between the collector and emitter (V_{CE}).
- 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) $\times 100\%$.
- Referring to Figure 16 the T_{PHL} propagation delay is measured from the 50% point of the rising edge of the data input pulse to the 1.3 V point on the falling edge of the output pulse.
- Referring to Figure 16 the T_{PLH} propagation delay is measured from the 50% point of the falling edge of data input pulse to the 1.3 V point on the rising edge of the output pulse.

Electrical Characteristics (Continued)

$T_A = 25^\circ\text{C}$ unless otherwise specified.

Isolation Characteristics

Symbol	Characteristic	Test Conditions	Min.	Typ.	Max.	Unit
V_{ISO}	Input-Output Isolation Voltage ⁽⁶⁾	$t = 1 \text{ Minute}$	4170			$V_{\text{AC}_{\text{RMS}}}$
R_{ISO}	Isolation Resistance ⁽⁶⁾	$V_{\text{I-O}} = \pm 500 \text{ VDC}, T_A = 25^\circ\text{C}$	10^{11}			Ω
C_{ISO}	Isolation Capacitance ⁽⁷⁾	$V_{\text{I-O}} = 0 \text{ V}, f = 1 \text{ MHz}$		0.4	0.6	pF
CM_{H}	Common Mode Transient Rejection – Output HIGH	$V_{\text{CM}} = 50 \text{ V}_{\text{P-P}}, R_{\text{L}} = 750 \Omega, I_{\text{F}} = 0$		5000		$\text{V}/\mu\text{s}$
CM_{L}	Common Mode Transient Rejection – Output LOW	$V_{\text{CM}} = 50 \text{ V}_{\text{P-P}}, R_{\text{L}} = 750 \Omega, I_{\text{F}} = 1.6 \text{ mA}$		5000		$\text{V}/\mu\text{s}$

Notes:

6. Device considered a two terminal device: pins 1, 2, and 3 shorted together and pins 5, 6 and 7 are shorted together.

7. C_{ISO} is the capacitance between the input (pins 1, 2, 3 connected) and the output (pin 4, 5, 6 connected).

Typical Performance Curves

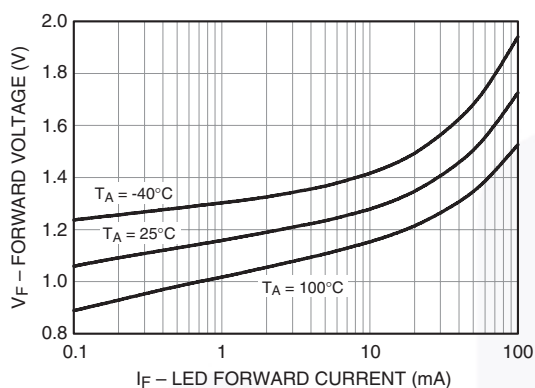


Figure 3. LED Forward Voltage vs. Forward Current

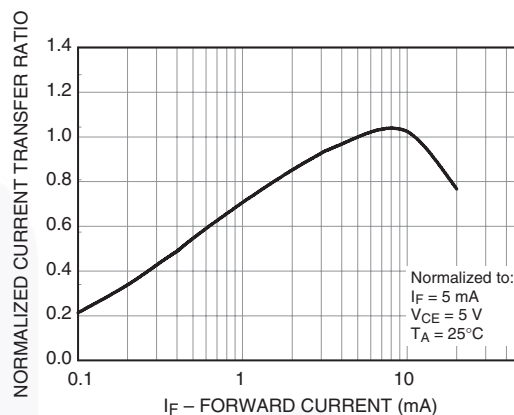


Figure 4. Normalized Current Transfer Ratio vs. Forward Current

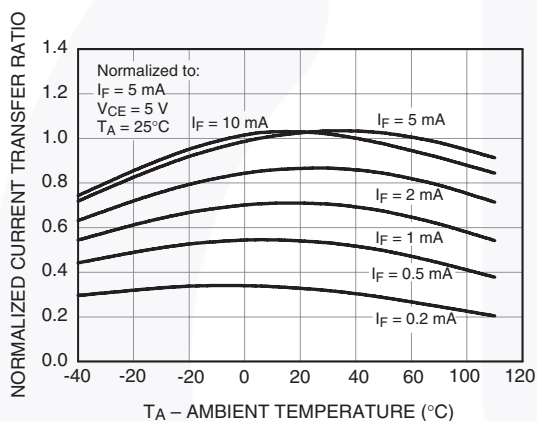


Figure 5. Normalized CTR vs. Temperature

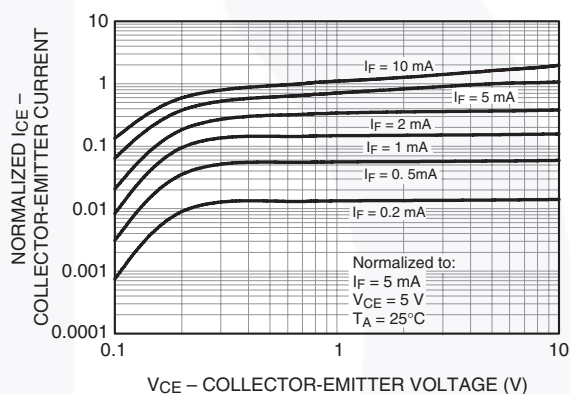


Figure 6. Normalized Collector vs. Collector-Emitter Voltage

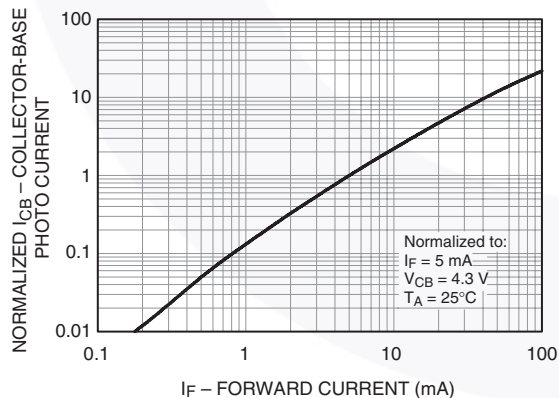


Figure 7. Normalized Collector Base Photocurrent Ratio vs. Forward Current

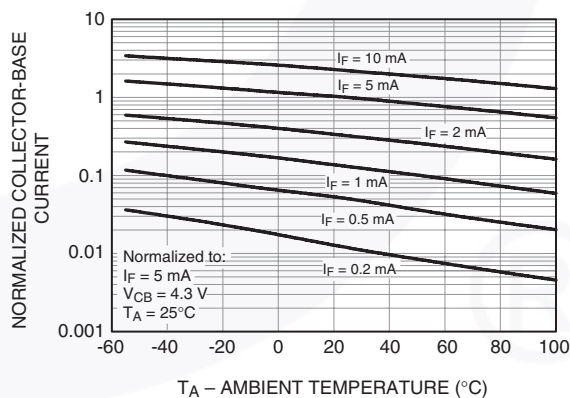


Figure 8. Normalized Collector-Base Current vs. Temperature

Typical Performance Curves (Continued)

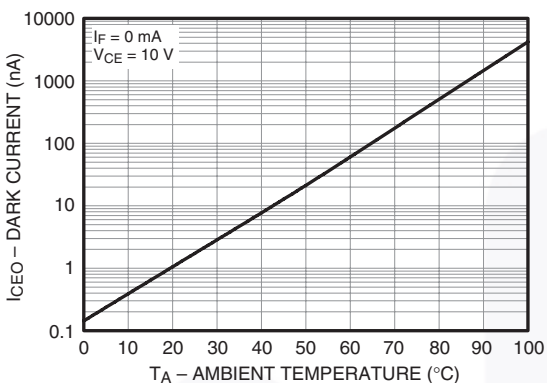


Figure 9. Collector-Emitter Dark Current vs. Ambient Temperature

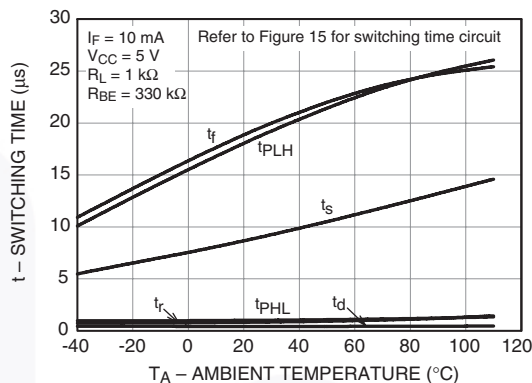


Figure 10. Switching Time vs. Ambient Temperature

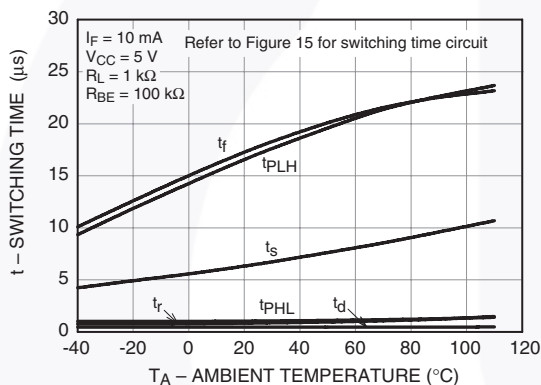


Figure 11. Switching Time vs. Ambient Temperature

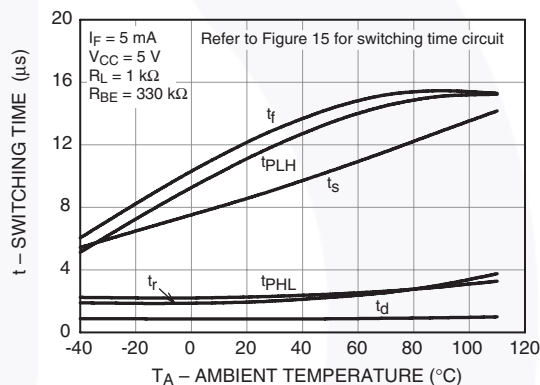


Figure 12. Switching Time vs. Ambient Temperature

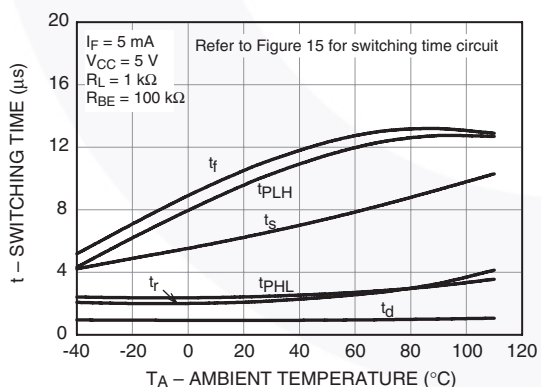


Figure 13. Switching Time vs. Ambient Temperature

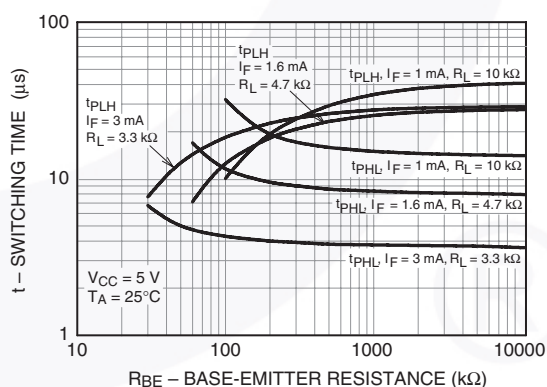


Figure 14. Switching Time vs. Base-Emitter Resistance

Switching Time Test Circuits and Waveforms

$T_A = 25^\circ\text{C}$ unless otherwise specified.

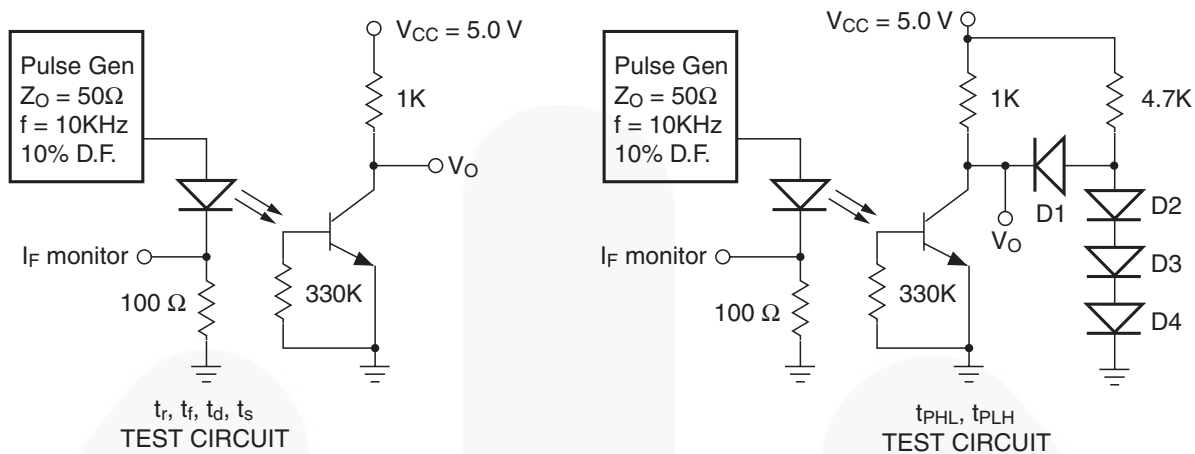


Figure 15. Switching Time Test Circuits

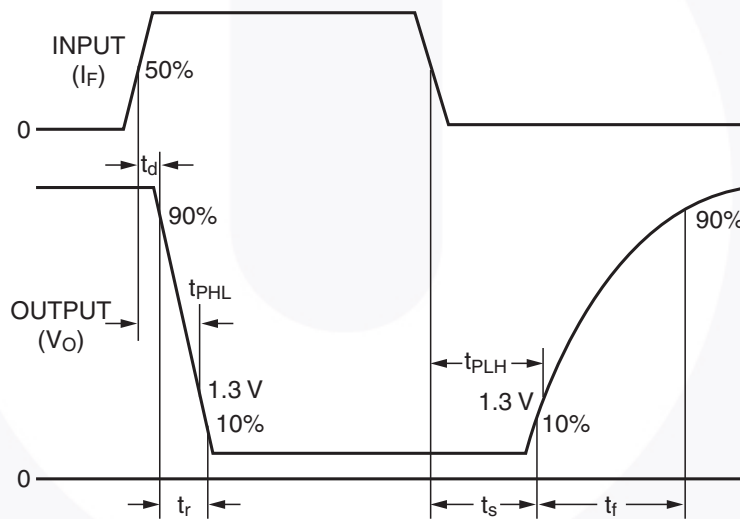


Figure 16. Switching Time Waveforms

Reflow Profile

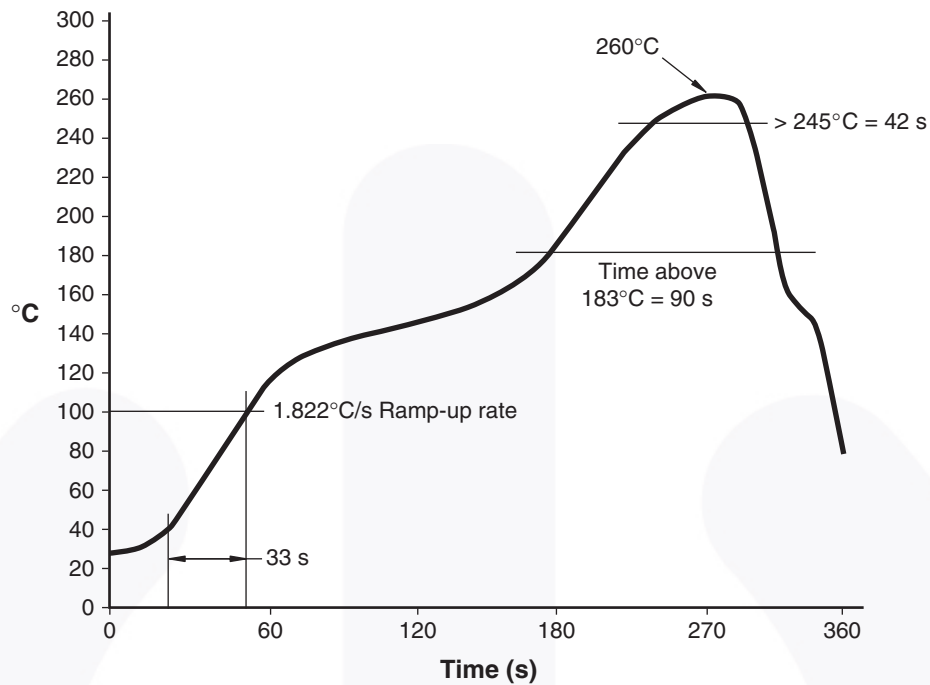


Figure 17. Reflow Profile

Ordering Information

Part Number	Package	Packing Method
MCT5210M	DIP 6-Pin	Tube (50 Units)
MCT5210SM	SMT 6-Pin (Lead Bend)	Tube (50 Units)
MCT5210SR2M	SMT 6-Pin (Lead Bend)	Tape and Reel (1000 Units)
MCT5210VM	DIP 6-Pin, DIN EN/IEC60747-5-5 Option	Tube (50 Units)
MCT5210SVM	SMT 6-Pin (Lead Bend), DIN EN/IEC60747-5-5 Option	Tube (50 Units)
MCT5210SR2VM	SMT 6-Pin (Lead Bend), DIN EN/IEC60747-5-5 Option	Tape and Reel (1000 Units)
MCT5210TVM	DIP 6-Pin, 0.4" Lead Spacing, DIN EN/IEC60747-5-5 Option	Tube (50 Units)

Note:

8. The product orderable part number system listed in this table also applies to the MCT5211M device.

Marking Information

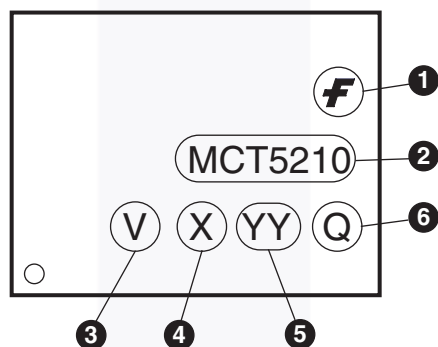
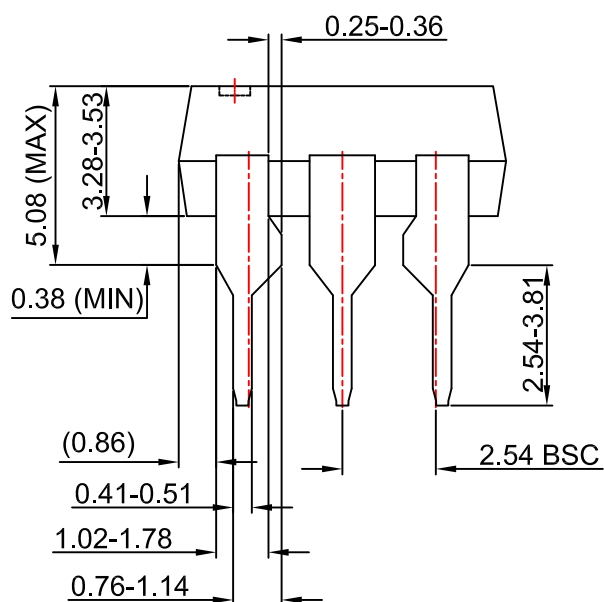
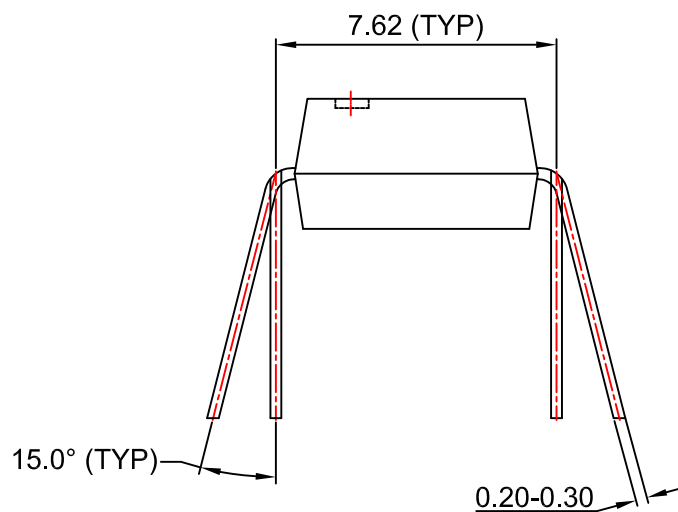
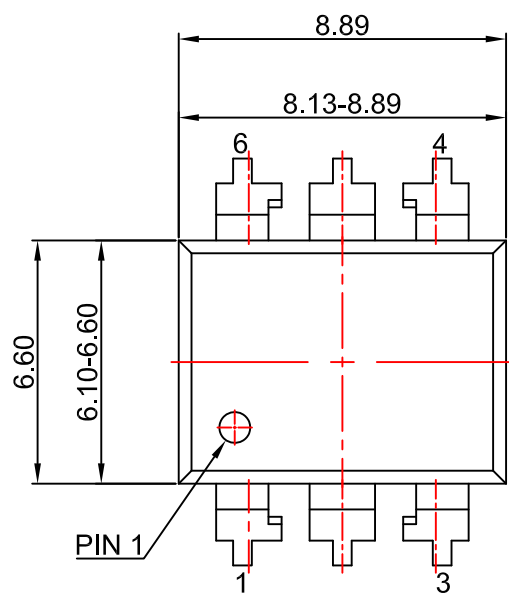


Figure 18. Top Mark

Table 1. Top Mark Definitions

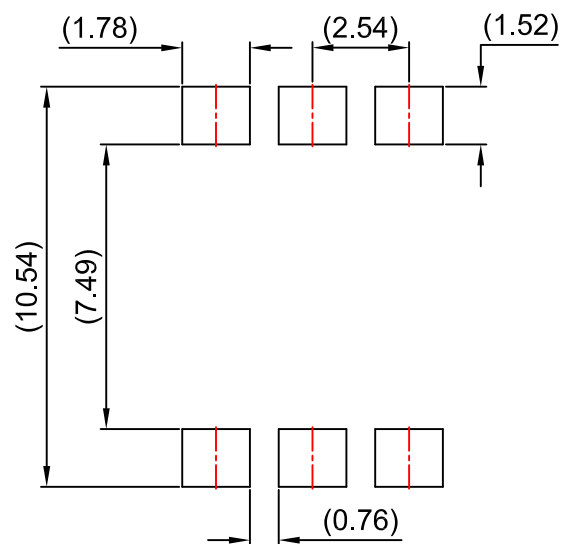
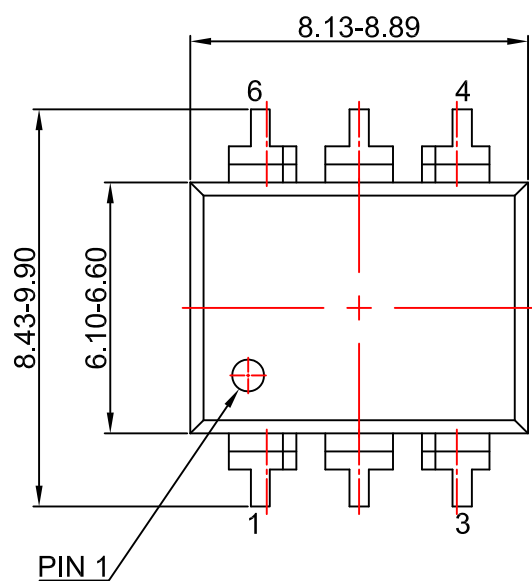
1	Fairchild Logo
2	Device Number
3	DIN EN/IEC60747-5-5 Option (only appears on component ordered with this option)
4	One-Digit Year Code, e.g., "5"
5	Digit Work Week, Ranging from "01" to "53"
6	Assembly Package Code



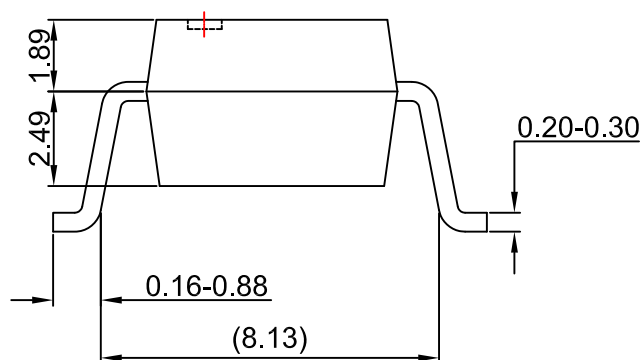
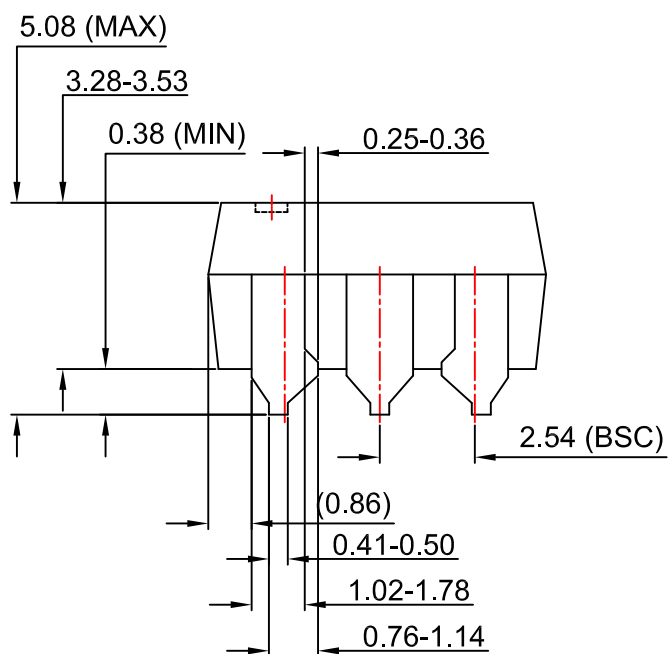
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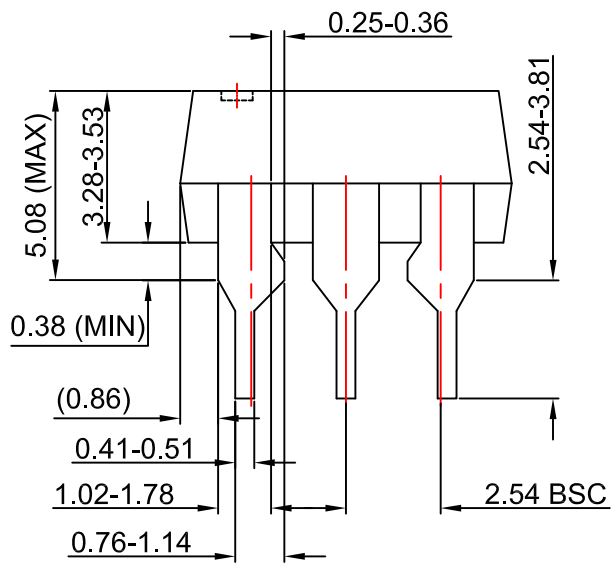
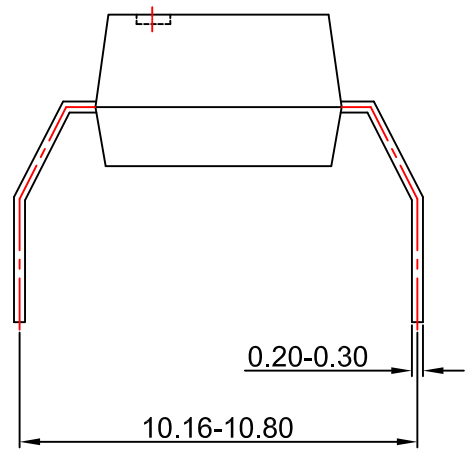
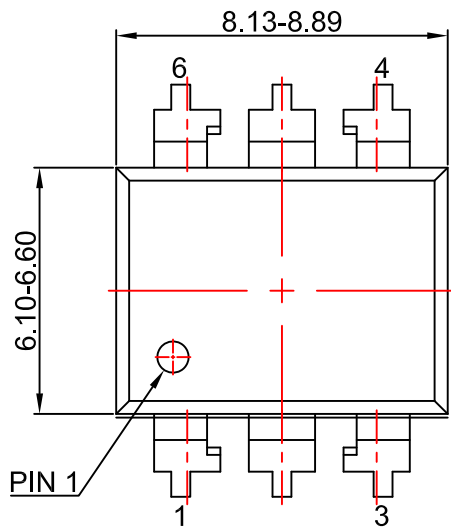
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