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April 2015

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

## Features

- High  $CTR_{CE(SAT)}$  Comparable to Darlingtonts
- High Common Mode Transient Rejection: 5 kV/ $\mu$ s
- Data Rates Up to 150 kbits/s (NRZ)
- Safety and Regulatory Approvals:
  - UL1577, 4,170 VAC<sub>RMS</sub> 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

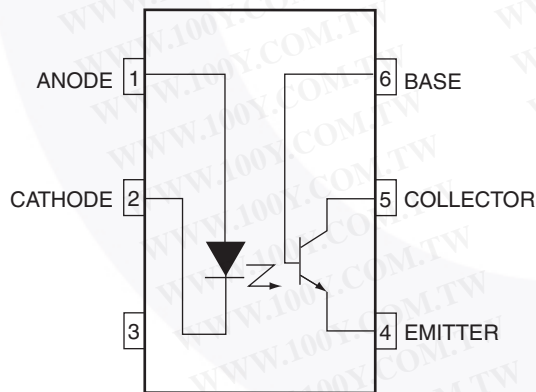


Figure 1. Schematic

## Package Outlines

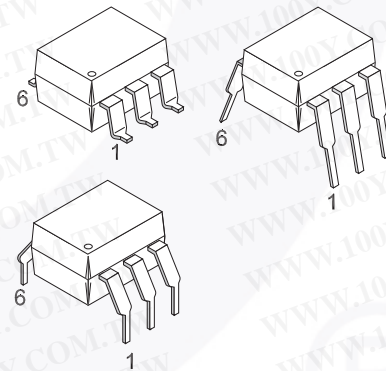


Figure 2. Package Outlines

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

## 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 <sub>RMS</sub>	I–IV
	< 300 V <sub>RMS</sub>	I–IV
Climatic Classification		55/100/21
Pollution Degree (DIN VDE 0110/1.89)		2
Comparative Tracking Index		175

Symbol	Parameter	Value	Unit
V <sub>PR</sub>	Input-to-Output Test Voltage, Method A, V <sub>IORM</sub> × 1.6 = V <sub>PR</sub> , Type and Sample Test with t <sub>m</sub> = 10 s, Partial Discharge < 5 pC	1360	V <sub>peak</sub>
	Input-to-Output Test Voltage, Method B, V <sub>IORM</sub> × 1.875 = V <sub>PR</sub> , 100% Production Test with t <sub>m</sub> = 1 s, Partial Discharge < 5 pC	1594	V <sub>peak</sub>
V <sub>IORM</sub>	Maximum Working Insulation Voltage	850	V <sub>peak</sub>
V <sub>IOTM</sub>	Highest Allowable Over-Voltage	6000	V <sub>peak</sub>
	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 <sub>S</sub>	Case Temperature <sup>(1)</sup>	175	°C
I <sub>S,INPUT</sub>	Input Current <sup>(1)</sup>	350	mA
P <sub>S,OUTPUT</sub>	Output Power <sup>(1)</sup>	800	mW
R <sub>IO</sub>	Insulation Resistance at T <sub>S</sub> , V <sub>IO</sub> = 500 V <sup>(1)</sup>	> 10 <sup>9</sup>	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
<b>TOTAL DEVICE</b>			
T <sub>STG</sub>	Storage Temperature	-40 to +125	°C
T <sub>OPR</sub>	Operating Temperature	-40 to +100	°C
T <sub>J</sub>	Junction Temperature	-40 to +125	°C
T <sub>SOL</sub>	Lead Solder Temperature	260 for 10 seconds	°C
P <sub>D</sub>	Total Device Power Dissipation @ 25°C (LED plus detector)	225	mW
	Derate Linearly From 25°C	3.5	mW/°C
<b>EMITTER</b>			
I <sub>F</sub>	Continuous Forward Current	50	mA
V <sub>R</sub>	Reverse Input Voltage	6	V
I <sub>F(pk)</sub>	Forward Current – Peak (1 μs pulse, 300 pps)	3.0	A
P <sub>D</sub>	LED Power Dissipation @ 25°C	75	mW
	Derate Linearly From 25°C	1.0	mW/°C
<b>DETECTOR</b>			
I <sub>C</sub>	Continuous Collector Current	150	mA
P <sub>D</sub>	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
<b>EMITTER</b>						
$V_F$	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	$I_R = 10\ \mu\text{A}$	6			V
$C_J$	Junction Capacitance	$V_F = 0\text{ V}, f = 1.0\text{ MHz}$		18		pF
<b>DETECTOR</b>						
$BV_{CEO}$	Breakdown Voltage, Collector-to-Emitter	$I_C = 1.0\text{ mA}, I_F = 0$	30	100		V
$BV_{CBO}$	Breakdown Voltage, Collector-to-Base	$I_C = 10\ \mu\text{A}, I_F = 0$	30	120		V
$BV_{EBO}$	Breakdown Voltage, Emitter-to-Base	$I_E = 10\ \mu\text{A}, I_F = 0$	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
<b>DC CHARACTERISTICS</b>							
$CTR_{CE(SAT)}$	Saturated Current Transfer Ratio Collector-to-Emitter <sup>(2)</sup>	$I_F = 3.0\text{ mA}, V_{CE} = 0.4\text{ V}$	MCT5210M	60			%
		$I_F = 1.6\text{ mA}, V_{CE} = 0.4\text{ V}$	MCT5211M	100			%
		$I_F = 1.0\text{ mA}, V_{CE} = 0.4\text{ V}$		75			%
$CTR_{(CE)}$	Current Transfer Ratio Collector-to-Emitter <sup>(2)</sup>	$I_F = 3.0\text{ mA}, V_{CE} = 5.0\text{ V}$	MCT5210M	70			%
		$I_F = 1.6\text{ mA}, V_{CE} = 5.0\text{ V}$	MCT5211M	150			%
		$I_F = 1.0\text{ mA}, V_{CE} = 5.0\text{ V}$		110			%
$CTR_{(CB)}$	Current Transfer Ratio Collector-to-Base <sup>(3)</sup>	$I_F = 3.0\text{ mA}, V_{CE} = 4.3\text{ V}$	MCT5210M	0.2			%
		$I_F = 1.6\text{ mA}, V_{CE} = 4.3\text{ V}$	MCT5211M	0.3			%
		$I_F = 1.0\text{ mA}, V_{CE} = 4.3\text{ V}$		0.25			%
$V_{CE(SAT)}$	Saturation Voltage	$I_F = 3.0\text{ mA}, I_{CE} = 1.8\text{ mA}$	MCT5210M			0.4	V
		$I_F = 1.6\text{ mA}, I_{CE} = 1.6\text{ mA}$	MCT5211M			0.4	V
<b>AC CHARACTERISTICS</b>							
$T_{PHL}$	Propagation Delay HIGH-to-LOW <sup>(4)</sup>	$R_L = 330\ \Omega, R_{BE} = \infty$	$I_F = 3.0\text{ mA}, V_{CC} = 5.0\text{ V}$	MCT5210M	10		$\mu\text{s}$
		$R_L = 3.3\text{ k}\Omega, R_{BE} = 39\text{ k}\Omega$			7		$\mu\text{s}$
		$R_L = 750\ \Omega, R_{BE} = \infty$	$I_F = 1.6\text{ mA}, V_{CC} = 5.0\text{ V}$	MCT5211M	14		$\mu\text{s}$
		$R_L = 4.7\text{ k}\Omega, R_{BE} = 91\text{ k}\Omega$			15		$\mu\text{s}$
		$R_L = 1.5\text{ k}\Omega, R_{BE} = \infty$	$I_F = 1.0\text{ mA}, V_{CC} = 5.0\text{ V}$	MCT5211M	17		$\mu\text{s}$
		$R_L = 10\text{ k}\Omega, R_{BE} = 160\text{ k}\Omega$			24		$\mu\text{s}$
$T_{PLH}$	Propagation Delay LOW-to-HIGH <sup>(5)</sup>	$R_L = 330\ \Omega, R_{BE} = \infty$	$I_F = 3.0\text{ mA}, V_{CC} = 5.0\text{ V}$	MCT5210M	0.4		$\mu\text{s}$
		$R_L = 3.3\text{ k}\Omega, R_{BE} = 39\text{ k}\Omega$			8		$\mu\text{s}$
		$R_L = 750\ \Omega, R_{BE} = \infty$	$I_F = 1.6\text{ mA}, V_{CC} = 5.0\text{ V}$	MCT5211M	2.5		$\mu\text{s}$
		$R_L = 4.7\text{ k}\Omega, R_{BE} = 91\text{ k}\Omega$			11		$\mu\text{s}$
		$R_L = 1.5\text{ k}\Omega, R_{BE} = \infty$	$I_F = 1.0\text{ mA}, V_{CC} = 5.0\text{ V}$	MCT5211M	7		$\mu\text{s}$
		$R_L = 10\text{ k}\Omega, R_{BE} = 160\text{ k}\Omega$			16		$\mu\text{s}$

**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.

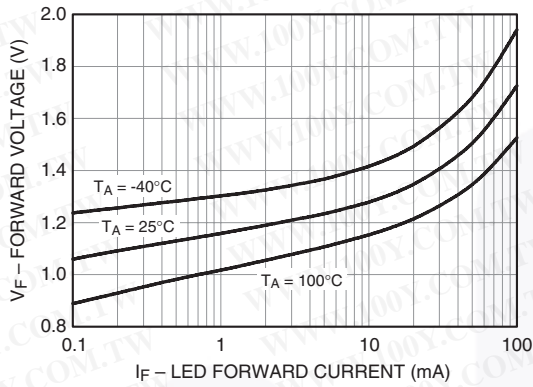
**Electrical Characteristics** (Continued) $T_A = 25^\circ\text{C}$  unless otherwise specified.**Isolation Characteristics**

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

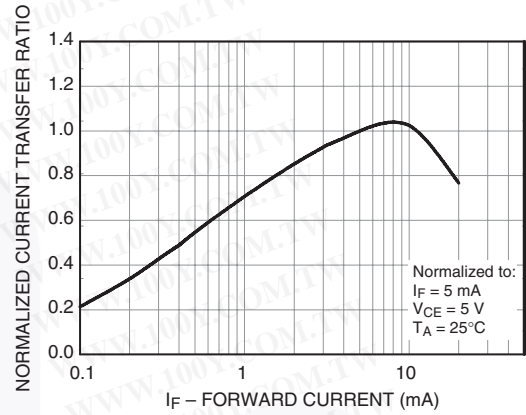
**Notes:**

- Device considered a two terminal device: pins 1, 2, and 3 shorted together and pins 5, 6 and 7 are shorted together.
- $C_{\text{ISO}}$  is the capacitance between the input (pins 1, 2, 3 connected) and the output (pin 4, 5, 6 connected).

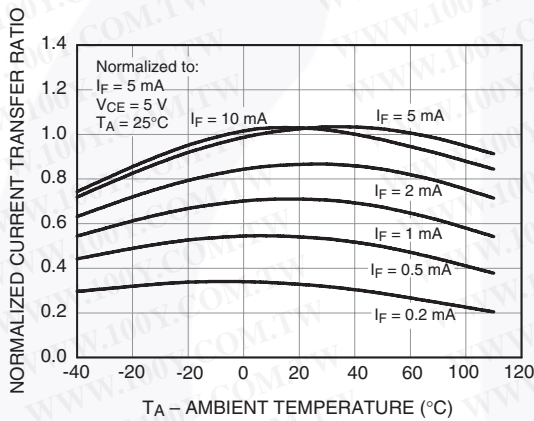
### Typical Performance Curves



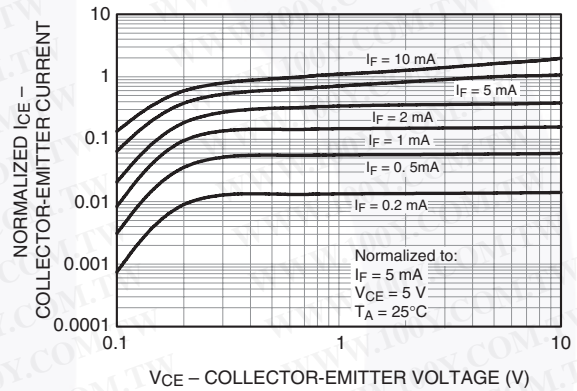
**Figure 3. LED Forward Voltage vs. Forward Current**



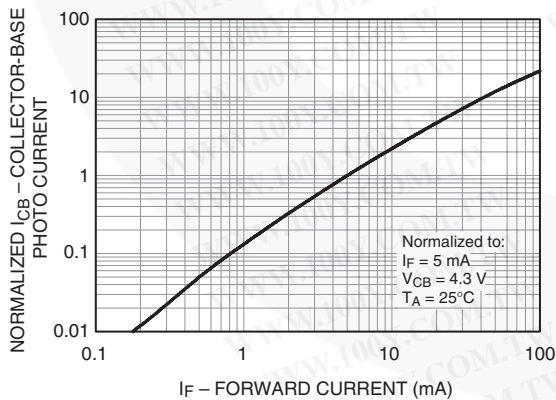
**Figure 4. Normalized Current Transfer Ratio vs. Forward Current**



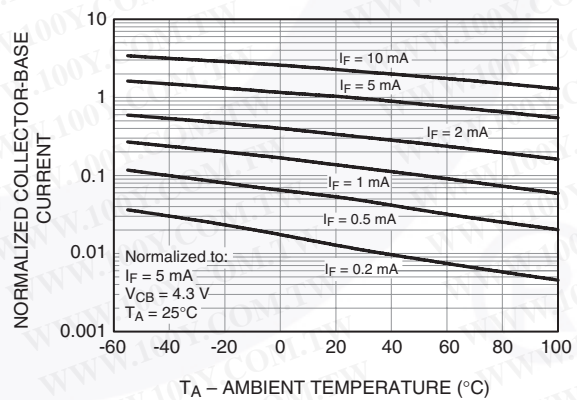
**Figure 5. Normalized CTR vs. Temperature**



**Figure 6. Normalized Collector vs. Collector-Emitter Voltage**



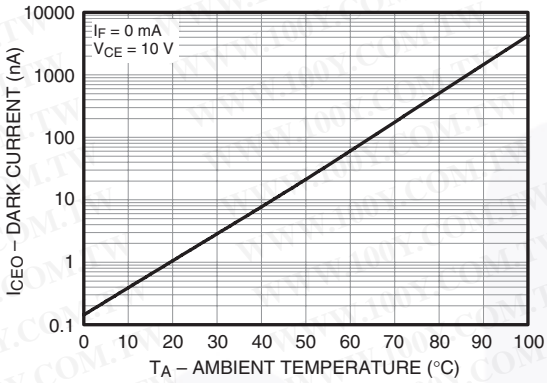
**Figure 7. Normalized Collector Base Photocurrent Ratio vs. Forward Current**



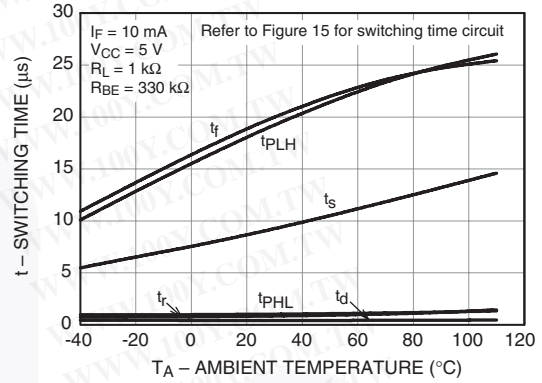
**Figure 8. Normalized Collector-Base Current vs. Temperature**



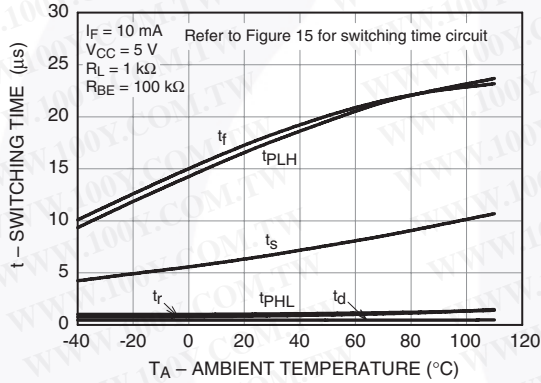
**Typical Performance Curves (Continued)**



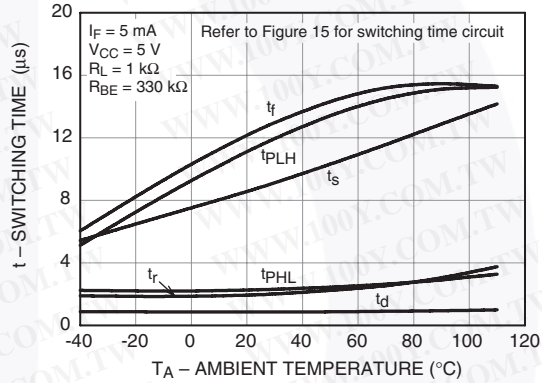
**Figure 9. Collector-Emitter Dark Current vs. Ambient Temperature**



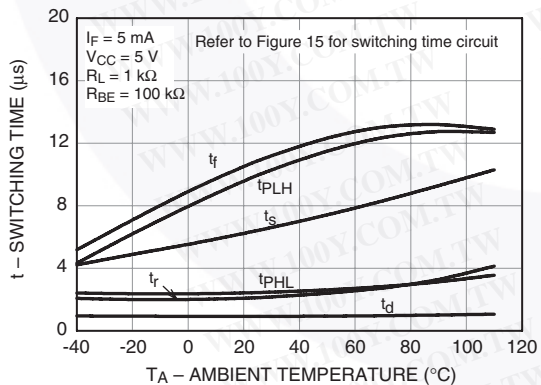
**Figure 10. Switching Time vs. Ambient Temperature**



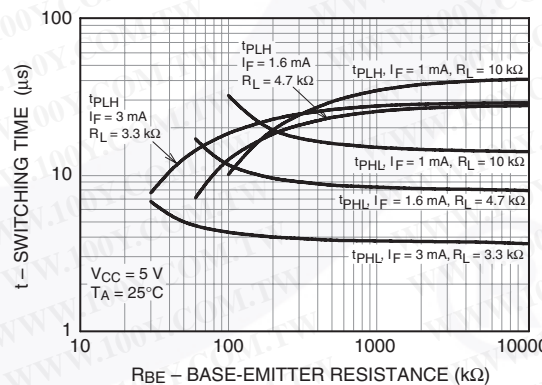
**Figure 11. Switching Time vs. Ambient Temperature**



**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.

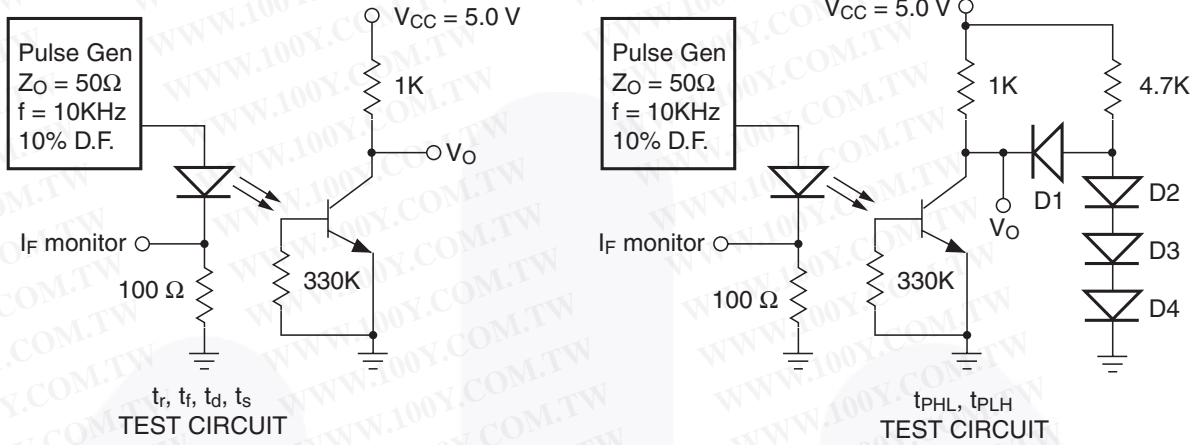


Figure 15. Switching Time Test Circuits

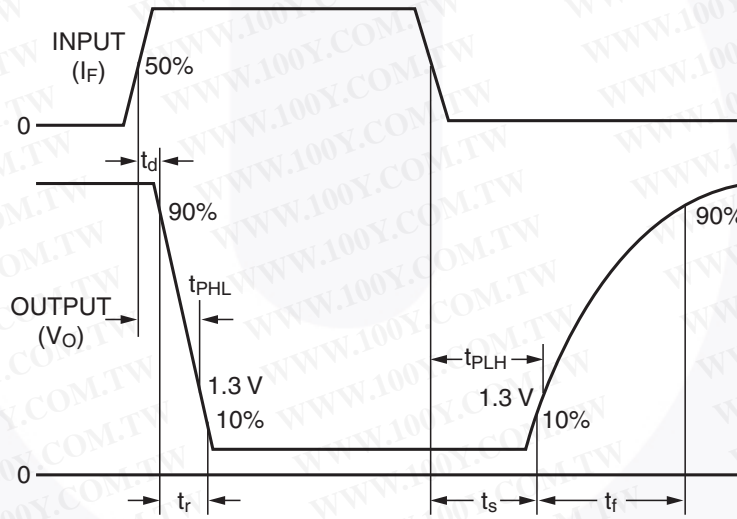


Figure 16. Switching Time Waveforms

### Reflow Profile

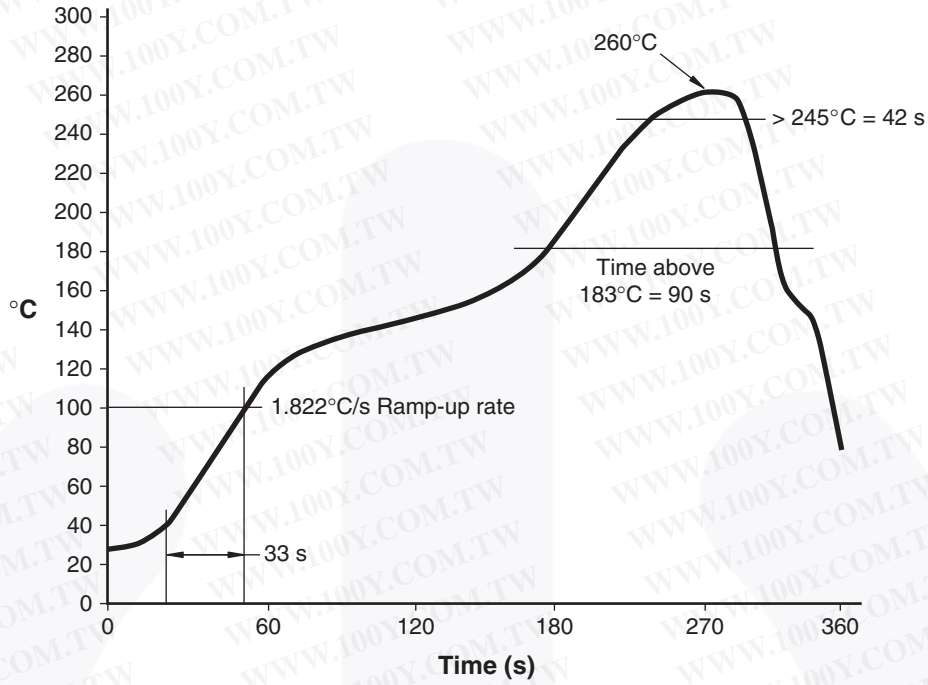


Figure 17. Reflow Profile

## 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

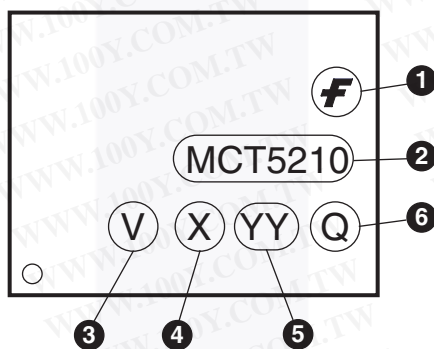
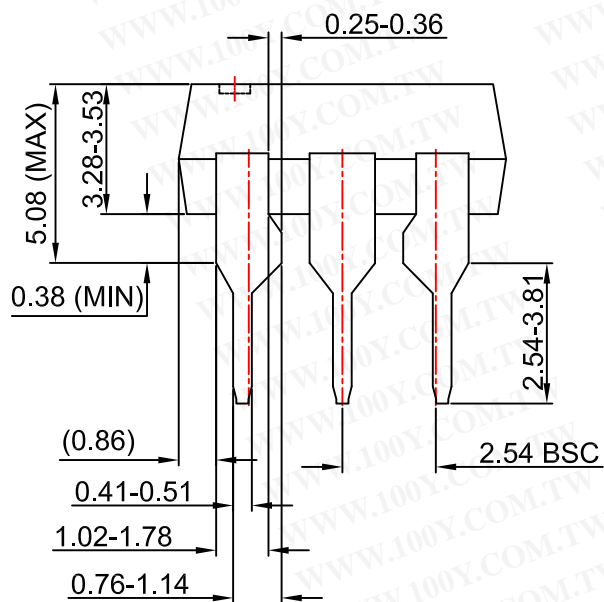
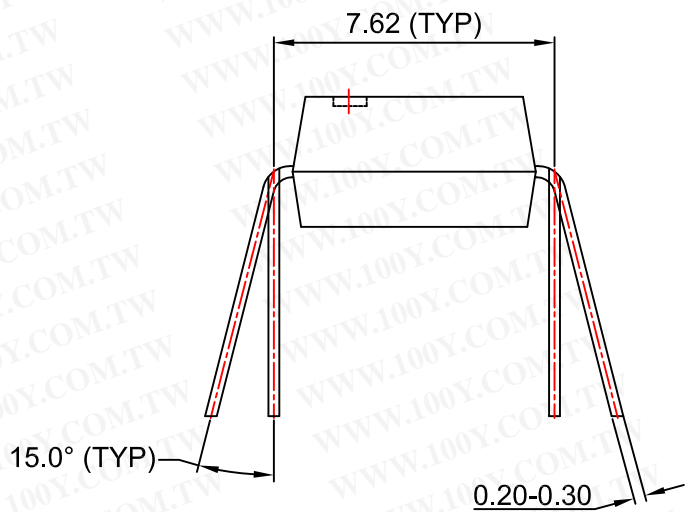
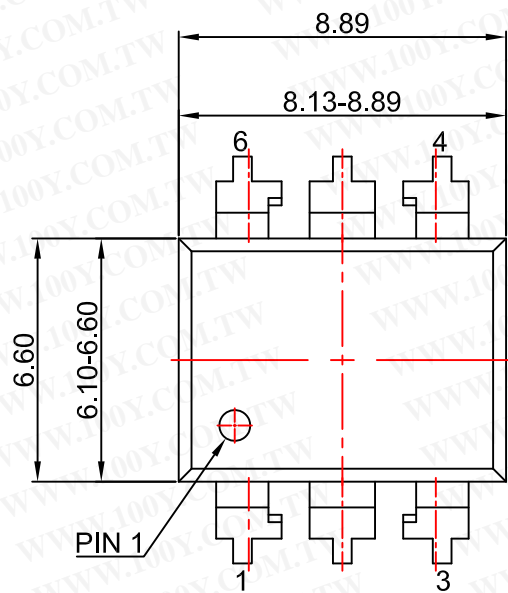


Figure 18. Top Mark

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

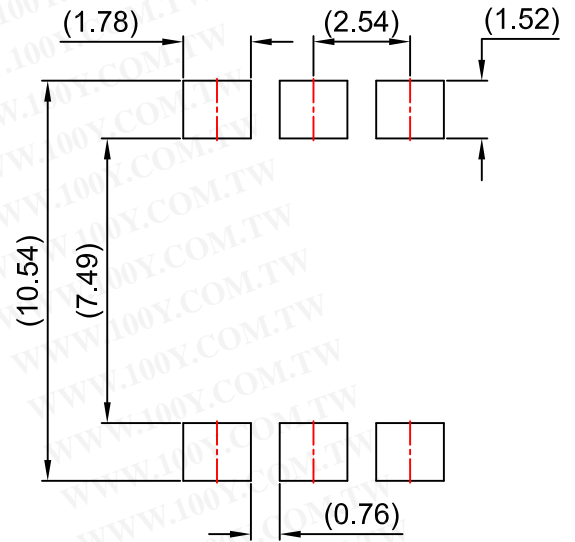
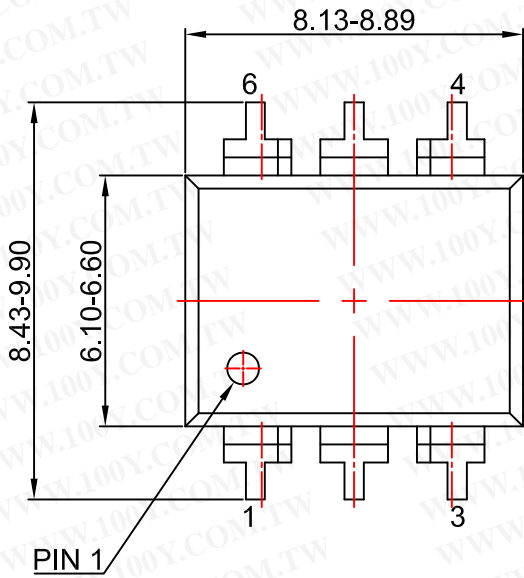




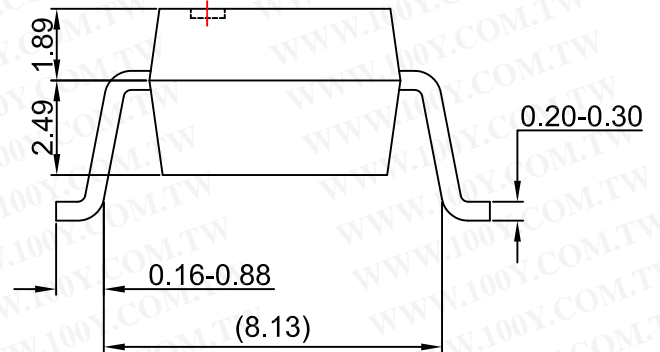
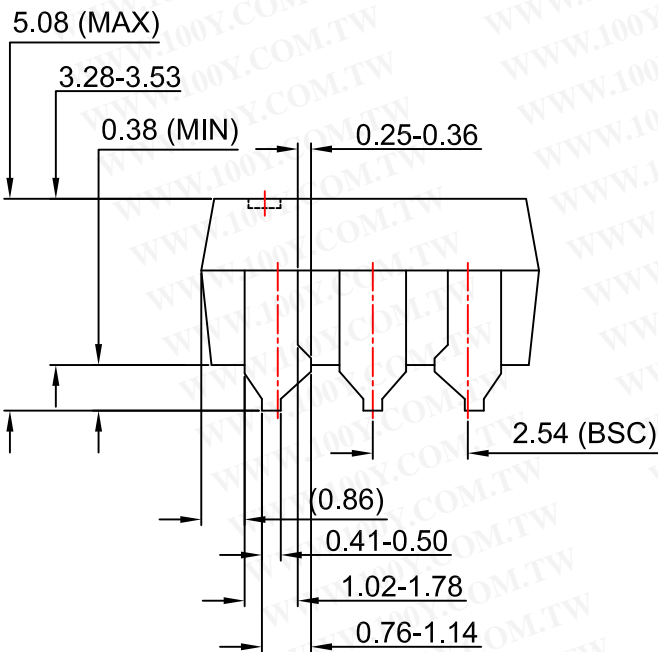
NOTES:

- A) NO STANDARD APPLIES TO THIS PACKAGE.
- B) ALL DIMENSIONS ARE IN MILLIMETERS.
- C) DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH, AND TIE BAR EXTRUSION
- D) DRAWING FILENAME AND REVISION: MKT-N06BREV4.





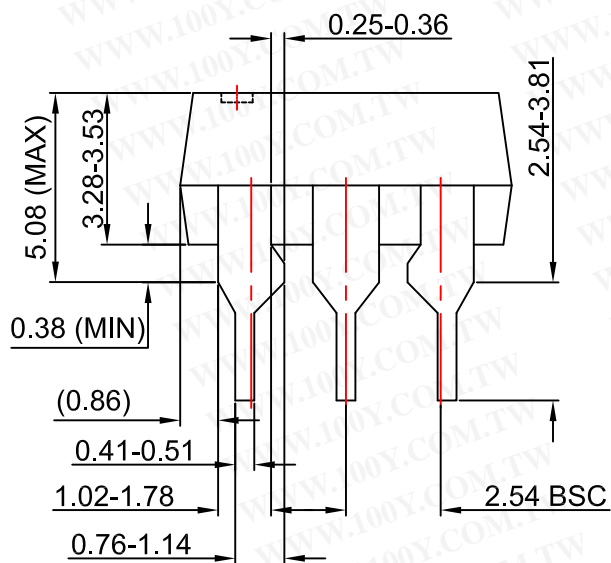
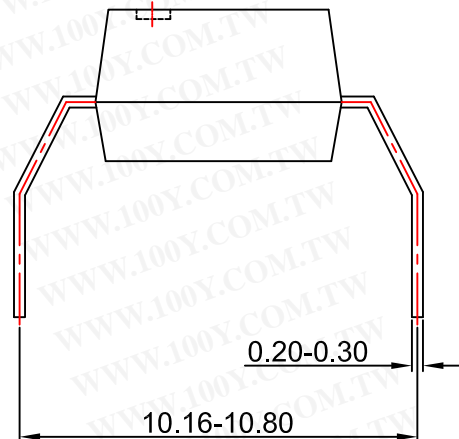
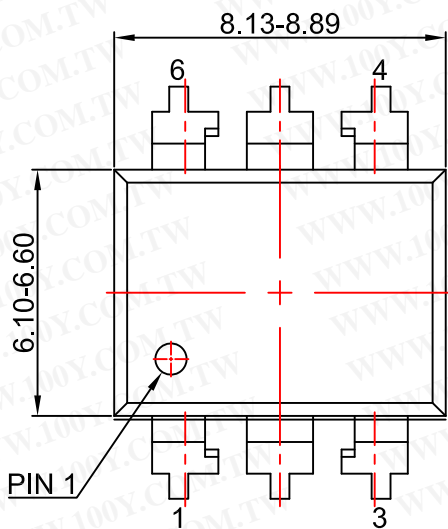
LAND PATTERN RECOMMENDATION



NOTES:

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- D) DRAWING FILENAME AND REVISION : MKT-N06CREV4.





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