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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

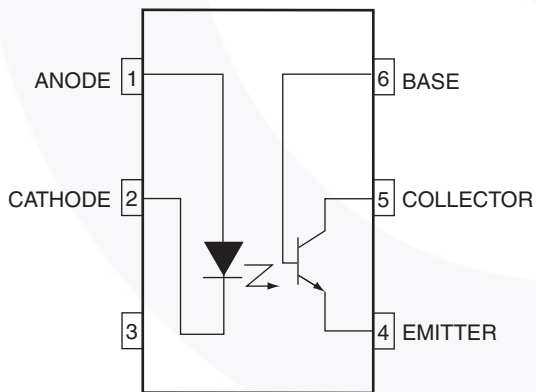


Figure 1. Schematic

Package Outlines

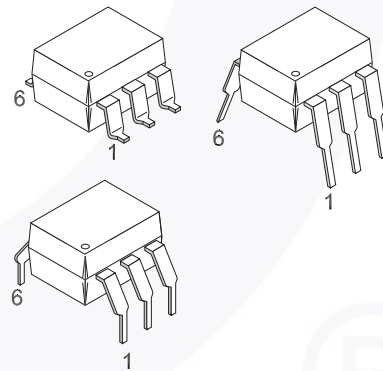


Figure 2. Package Outlines

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 _{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 μs 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°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} = ∞ | I _F = 1.0 mA, V _{CC} = 5.0 V | MCT5211M | 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} = ∞ | I _F = 1.0 mA, V _{CC} = 5.0 V | MCT5211M | 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) x 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) time 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:

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

Typical Performance Curves

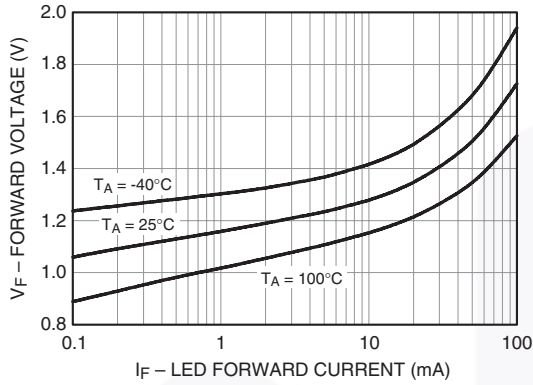


Figure 3. LED Forward Voltage vs. Forward Current

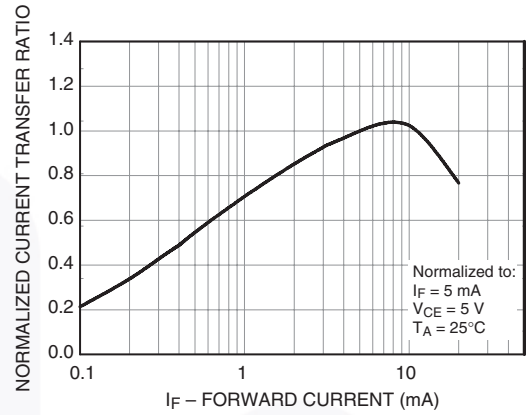


Figure 4. Normalized Current Transfer Ratio vs. Forward Current

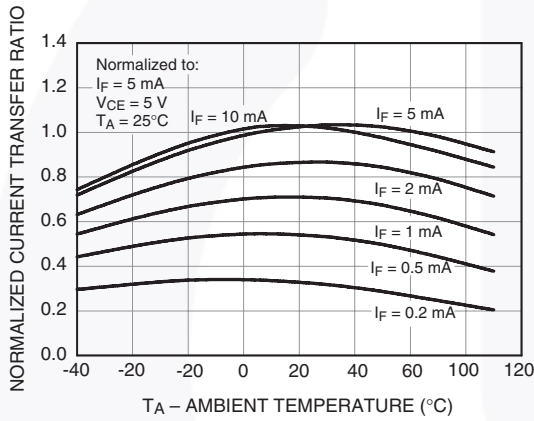


Figure 5. Normalized CTR vs. Temperature

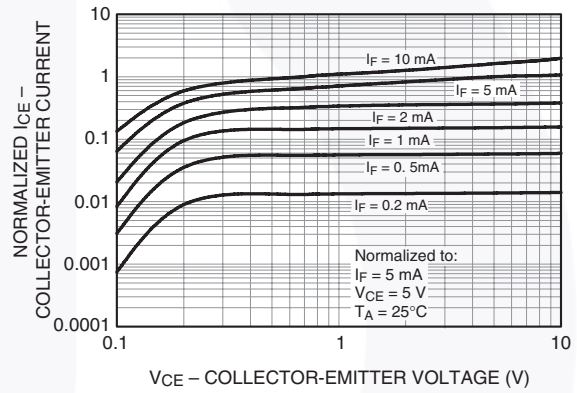


Figure 6. Normalized Collector vs. Collector-Emitter Voltage

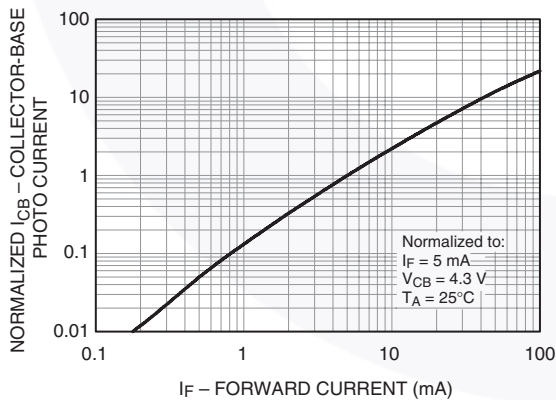


Figure 7. Normalized Collector Base Photocurrent Ratio vs. Forward Current

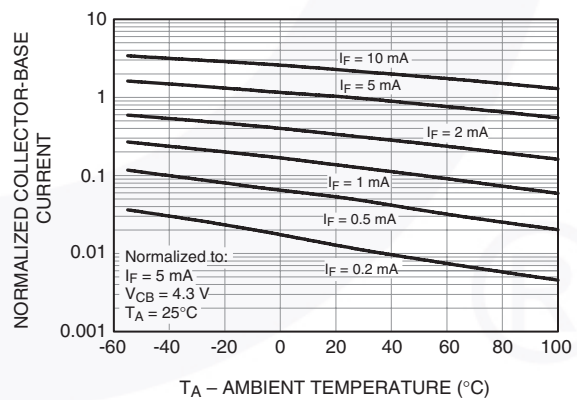


Figure 8. Normalized Collector-Base Current vs. Temperature

Typical Performance Curves (Continued)

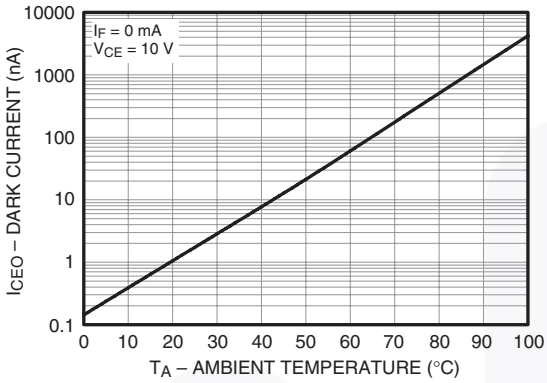


Figure 9. Collector-Emitter Dark Current vs. Ambient Temperature

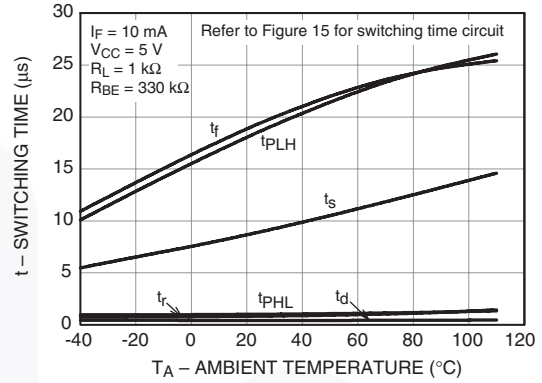


Figure 10. Switching Time vs. Ambient Temperature

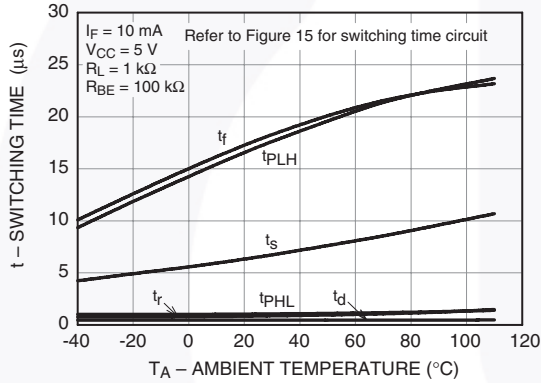


Figure 11. Switching Time vs. Ambient Temperature

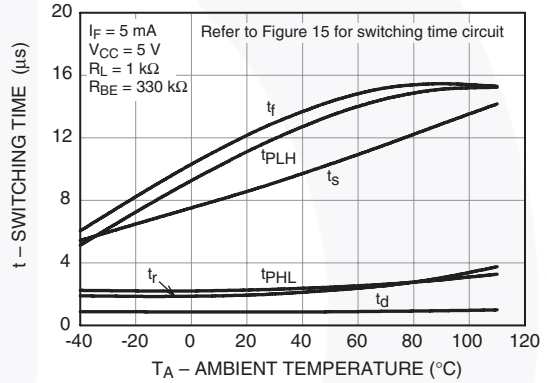


Figure 12. Switching Time vs. Ambient Temperature

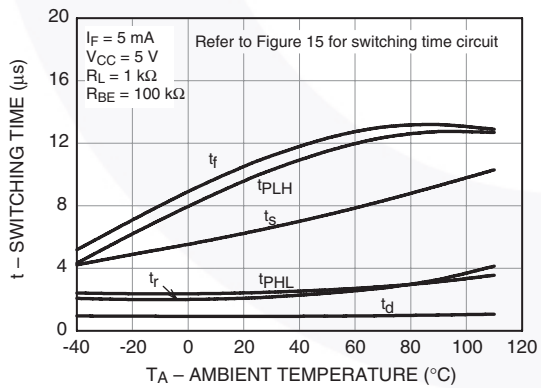


Figure 13. Switching Time vs. Ambient Temperature

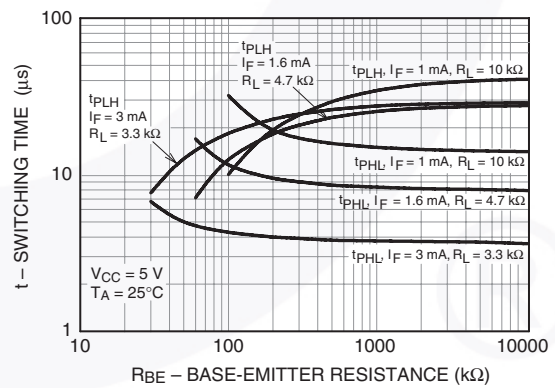


Figure 14. Switching Time vs. Base-Emitter Resistance

Switching Time Test Circuits and Waveforms

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

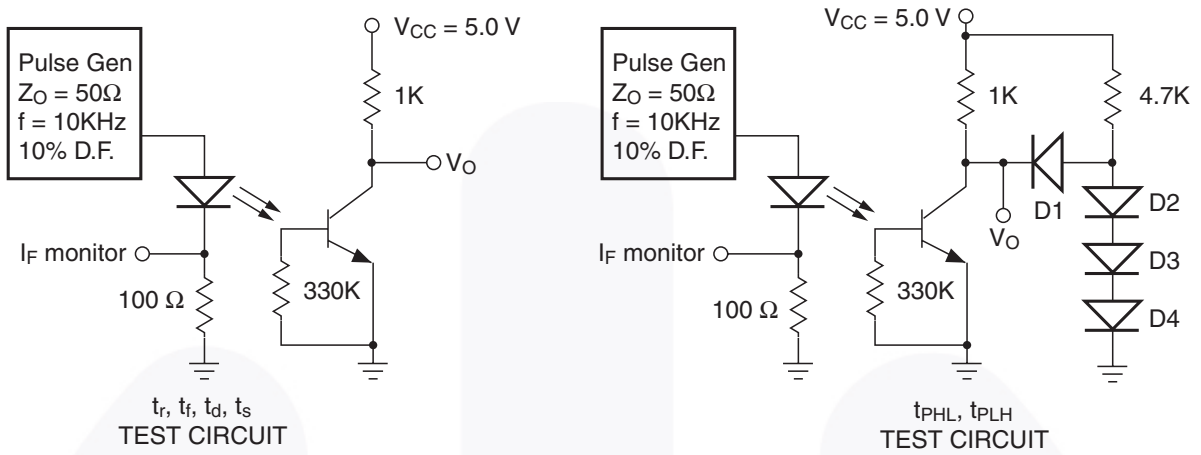


Figure 15. Switching Time Test Circuits

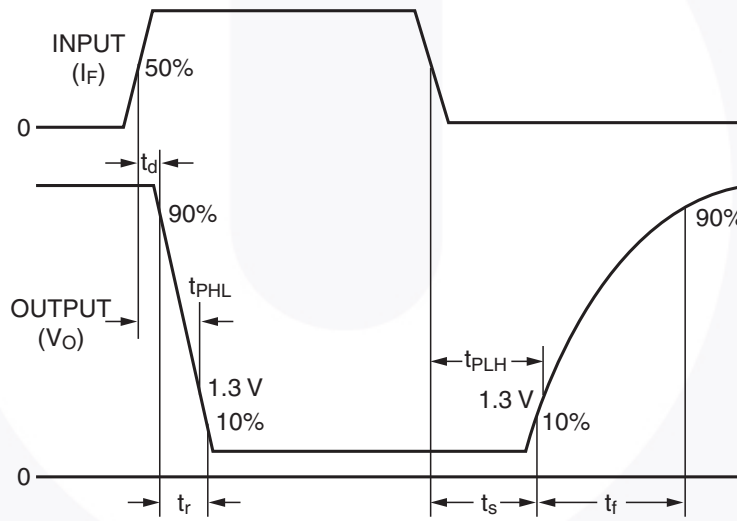


Figure 16. Switching Time Waveforms

Reflow Profile

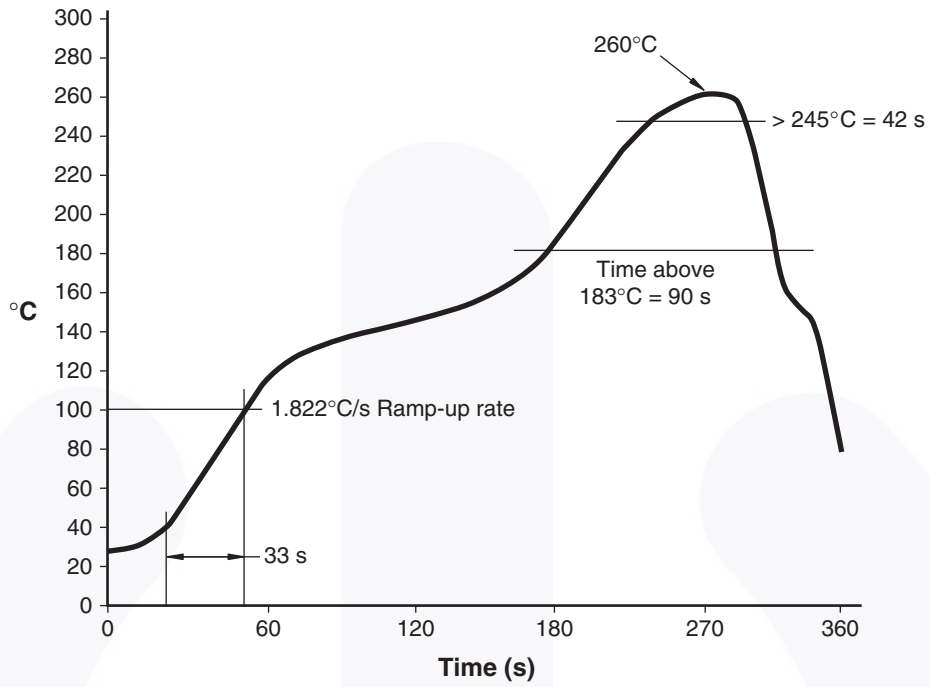


Figure 17. Reflow Profile



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

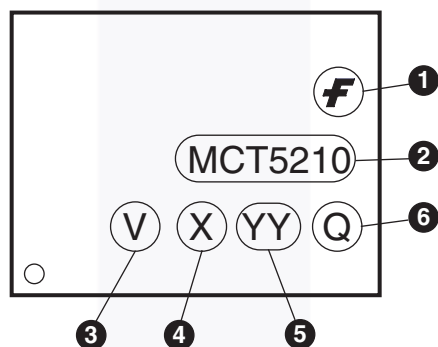
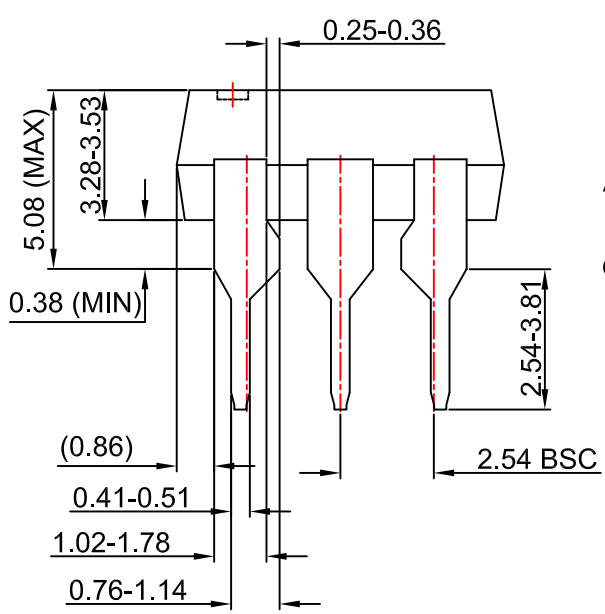
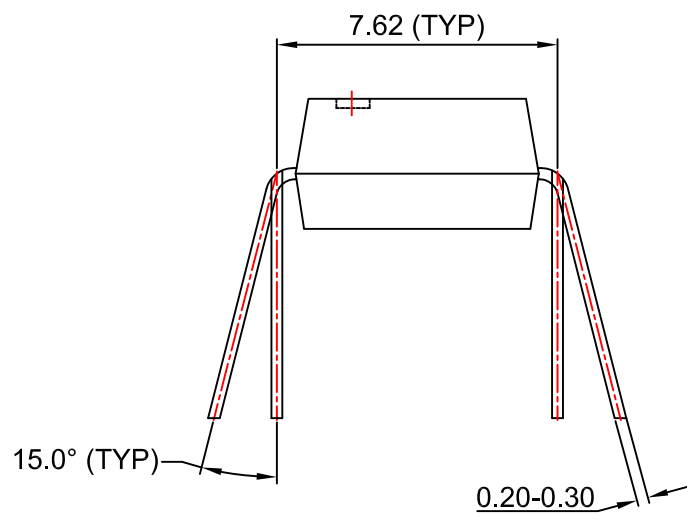
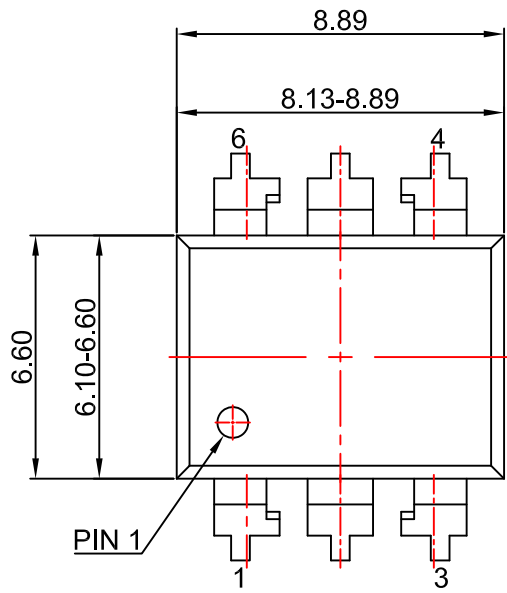


Figure 18. Top Mark

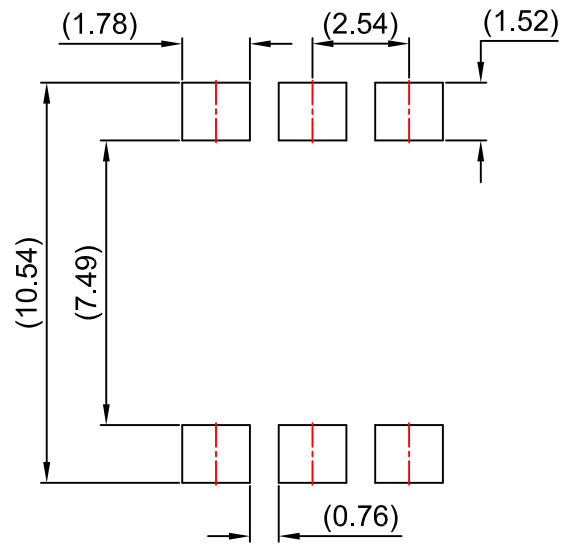
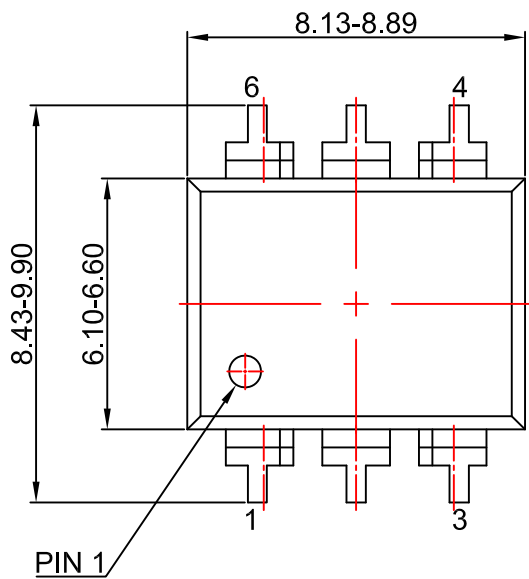
Table 1. Top Mark Definitions

| | |
|---|---|
| 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 |

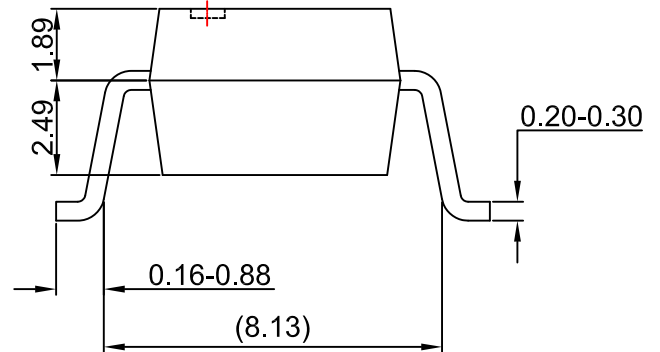
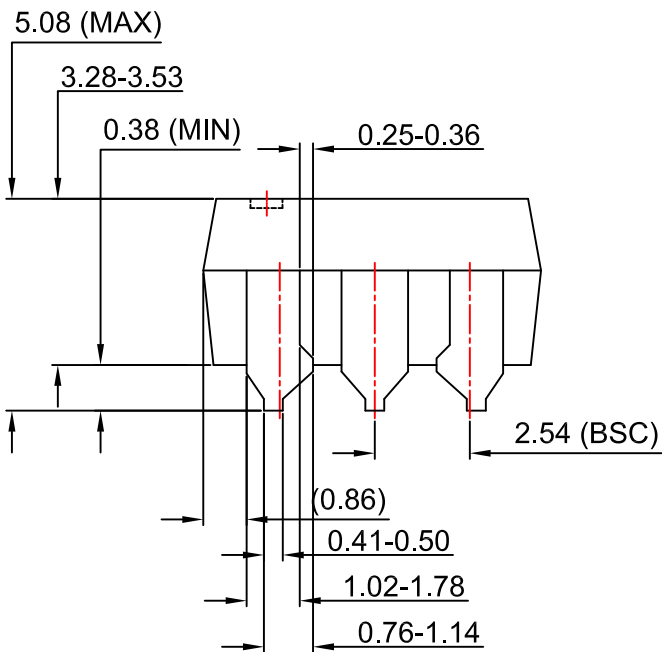


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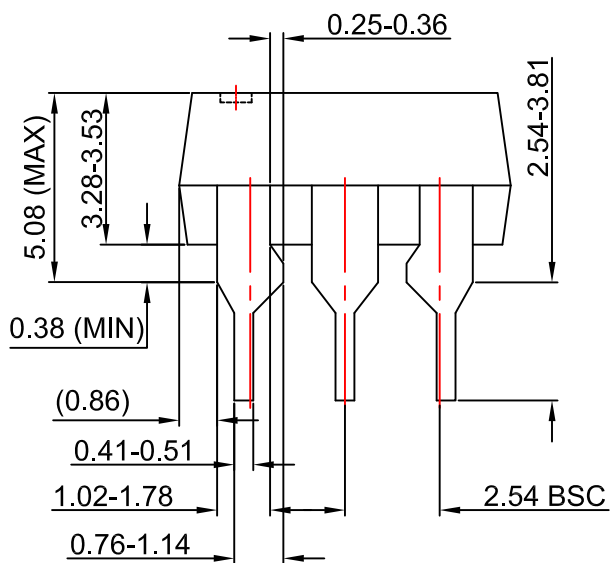
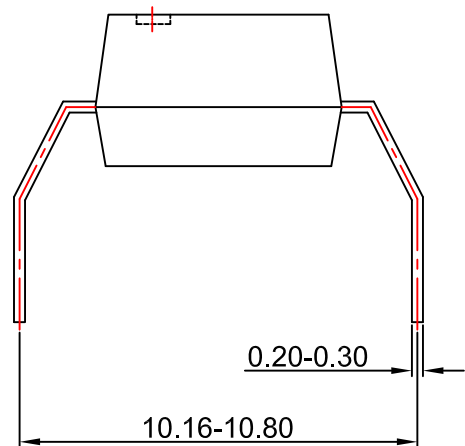
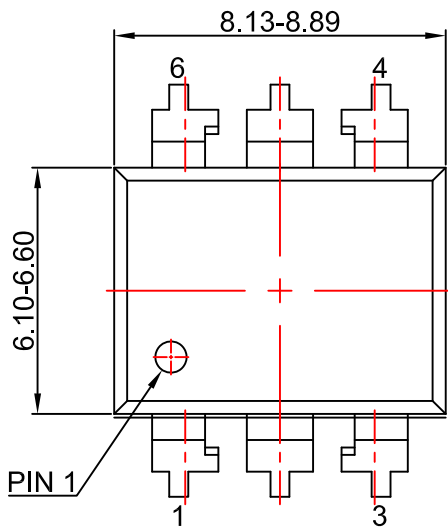
LAND PATTERN RECOMMENDATION



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