

6-Pin DIP Low Input Current Phototransistor Optocouplers

MCT5210M, MCT5211M

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 LSTT/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 20 kbits/s are possible.

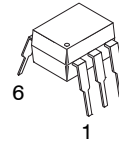
Both can easily interface LSTTL to LSTTL/TTL, and with use of an external base-to-emitter resistor data rates of 100 kbits/s can be achieved.

Features

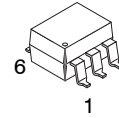
- High CTR_{CE(SAT)} Comparable to Darlington
- High Common Mode Transient Rejection: 5 kV/μs
- Data Rates Up to 150 kbits/s (NRZ)
- Safety and Regulatory Approvals:
 - UL1577; 4,170 VAC_{RMS} for 1 Minute
 - DIN-EN/IEC60747-5-5, 850 V Peak Working Insulation Voltage
- These are Pb-Free Devices

Applications

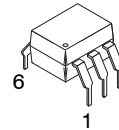
- CMOS to CMOS/LSTTL Logic Isolation
- LSTTL to CMOS/LSTTL Logic Isolation
- RS-232 Line Receiver
- Telephone Ring Detector
- AC Line Voltage Sensing
- Switching Power Supply



PDIP6 8.51x6.35, 2.54P
CASE 646BX

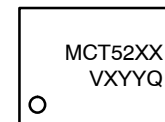


PDIP6 8.51x6.35, 2.54P
CASE 646BY



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CASE 646BZ

MARKING DIAGRAM



MCT52XX = Device Number
XX = 10, 11

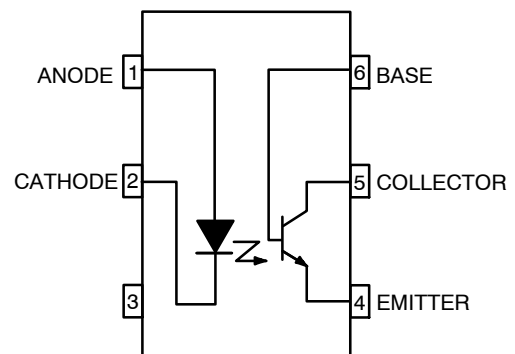
V = DIN EN/IEC60747-5-5 Option (only appears on component ordered with this option)

X = One-Digit Year Code, e.g., '5'

YY = Digit Work Week, Ranging from '01' to '53'

Q = Assembly Package Code

SCHEMATIC



ORDERING INFORMATION

See detailed ordering and shipping information on page 16 of this data sheet.

MCT5210M, MCT5211M

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 (Note 1) | 175 | °C |
| I _{S, INPUT} | Input Current (Note 1) | 350 | mA |
| P _{S, OUTPUT} | Output Power (Note 1) | 800 | mW |
| R _{IO} | Insulation Resistance at T _S , V _{IO} = 500 V (Note 1) | >10 ⁹ | Ω |

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

ABSOLUTE MAXIMUM RATINGS (T_A = 25°C unless otherwise noted)

| Symbol | Parameter | 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 at 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 |

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

MCT5210M, MCT5211M

ELECTRICAL CHARACTERISTICS (T_A = 25°C, unless otherwise noted)

| Symbol | Parameter | Test Conditions | Min | Typ | Max | Unit |
|---|---|--|-----|-------|------|-------|
| INDIVIDUAL COMPONENT CHARACTERISTICS | | | | | | |
| EMITTER | | | | | | |
| V _F | Input Forward Voltage | I _F = 5 mA | – | 1.25 | 1.50 | V |
| $\frac{\Delta V_F}{\Delta T_A}$ | Forward Voltage Temperature Coefficient | I _F = 2 mA | – | –1.75 | – | mV/°C |
| V _R | Reverse Voltage | I _R = 10 µA | 6 | – | – | V |
| C _J | Junction Capacitance | V _F = 0 V, f = 1.0 MHz | – | 18 | – | pF |
| DETECTOR | | | | | | |
| BV _{CEO} | Breakdown Voltage Collector-to-Emitter | I _C = 1.0 mA, I _F = 0 | 30 | 100 | – | V |
| BV _{CBO} | Breakdown Voltage Collector-to-Base | I _C = 10 µA, I _F = 0 | 30 | 120 | – | V |
| BV _{EBO} | Breakdown Voltage Emitter-to-Base | I _E = 10 µA, I _F = 0 | 5 | 10 | – | V |
| I _{CER} | Dark Current, Collector-to-Emitter | V _{CE} = 10 V, I _F = 0, R _{BE} = 1 MΩ | – | 1 | 100 | nA |
| C _{CE} | Capacitance, Collector-to-Emitter | V _{CE} = 0 V, f = 1 MHz | – | 10 | – | pF |
| C _{CB} | Capacitance, Collector-to-Base | V _{CB} = 0 V, f = 1 MHz | – | 80 | – | pF |
| C _{EB} | Capacitance, Emitter-to-Base | V _{EB} = 0 V, f = 1 MHz | – | 15 | – | pF |

ELECTRICAL CHARACTERISTICS (T_A = 25°C, unless otherwise noted) (continued)

| Symbol | Parameter | Test Conditions | Device | Min | Typ | Max | Unit |
|---------------------------------|--|---|----------|------|-----|-----|------|
| TRANSFER CHARACTERISTICS | | | | | | | |
| DC CHARACTERISTICS | | | | | | | |
| CTR _{CE(SAT)} | Saturated Current Transfer Ratio Collector-to-Emitter (Note 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 (Note 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 (Note 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 |

MCT5210M, MCT5211M

ELECTRICAL CHARACTERISTICS (T_A = 25°C, unless otherwise noted) (continued)

| Symbol | Parameter | Test Conditions | | Device | Min | Typ | Max | Unit |
|--------------------------|---|--|---|----------|-----|-----|-----|------|
| TRANSFER CHARACTERISTICS | | | | | | | | |
| AC CHARACTERISTICS | | | | | | | | |
| T _{PHL} | Propagation Delay HIGH-to-LOW (Note 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 (Note 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 |

ELECTRICAL CHARACTERISTICS (T_A = 25°C, unless otherwise noted) (continued)

| Symbol | Parameter | Test Conditions | Min | Typ | Max | Unit |
|----------------------------------|---|---|------------------|------|-----|--------------------|
| ISOLATION CHARACTERISTICS | | | | | | |
| V _{ISO} | Input-Output Isolation Voltage (Note 6) | t = 1 Minute | 4170 | – | – | VAC _{RMS} |
| R _{ISO} | Isolation Resistance (Note 6) | V _{I-O} = ±500 VDC, T _A = 25°C | 10 ¹¹ | – | – | Ω |
| C _{ISO} | Isolation Capacitance (Note 7) | V _{I-O} = 0 V, f = 1 MHz | – | 0.4 | 0.6 | pF |
| CM _H | Common Mode Transient Rejection – Output HIGH | V _{CM} = 50 V _{P-P} , R _L = 750 Ω, I _F = 0 | – | 5000 | – | V/μs |
| CM _L | Common Mode Transient Rejection – Output LOW | V _{CM} = 50 V _{P-P} , R _L = 750 Ω, I _F = 1.6 mA | – | 5000 | – | V/μs |

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

- 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.
- 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

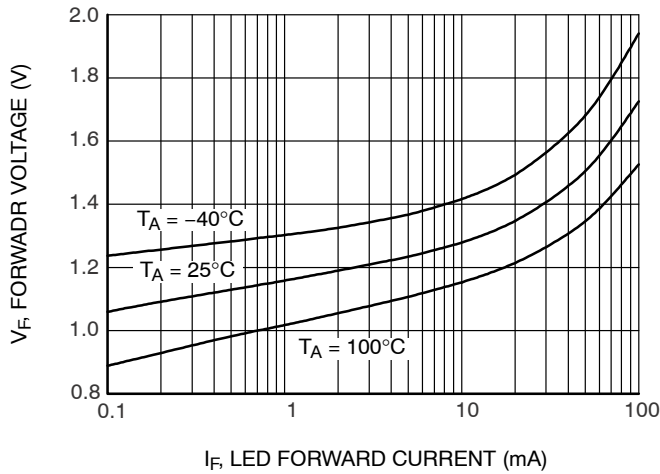


Figure 1. LED Forward Voltage vs. Forward Current

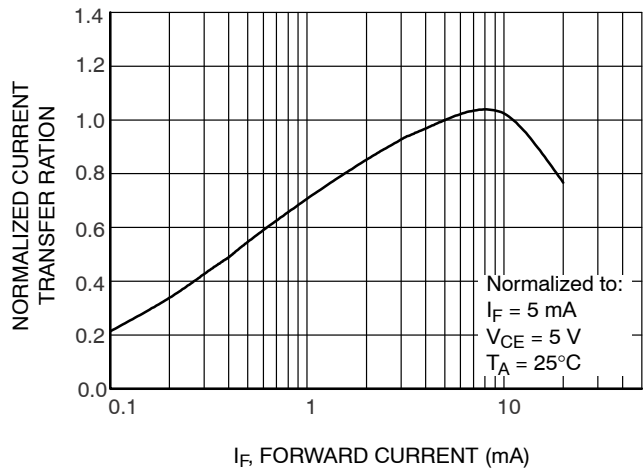


Figure 2. Normalized Current Transfer Ratio vs. Forward Current

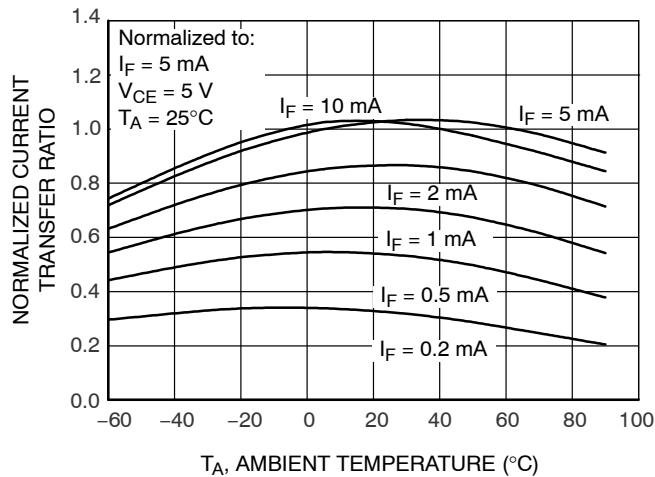


Figure 3. Normalized CTR vs. Temperature

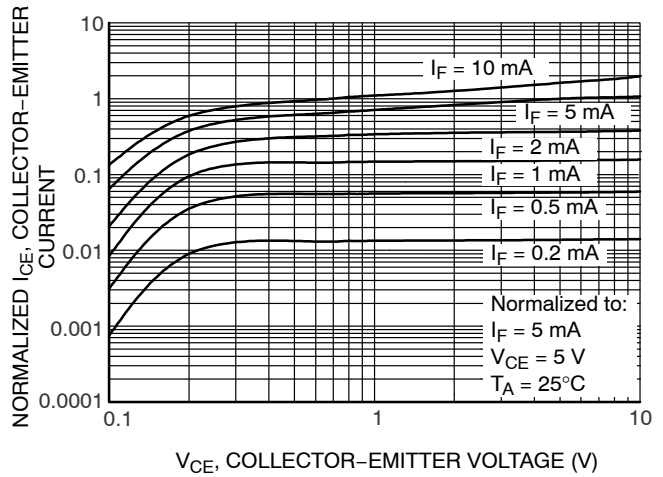


Figure 4. Normalized Collector vs. Collector-Emitter Voltage

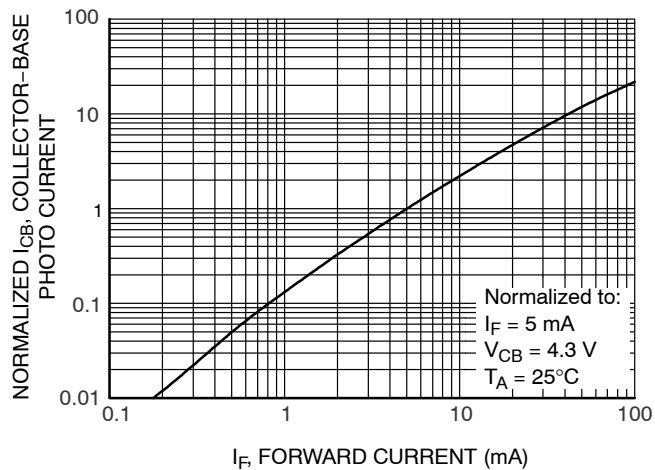


Figure 5. Normalized Collector Base Photocurrent Ratio vs. Forward Current

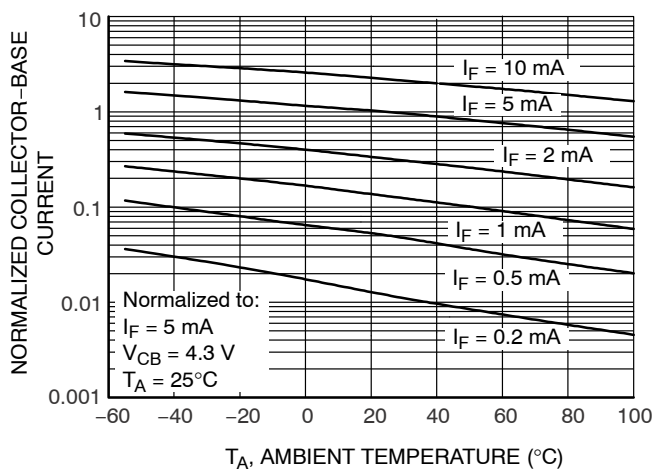


Figure 6. Normalized Collector-Base Current vs. Temperature

TYPICAL PERFORMANCE CURVES (continued)

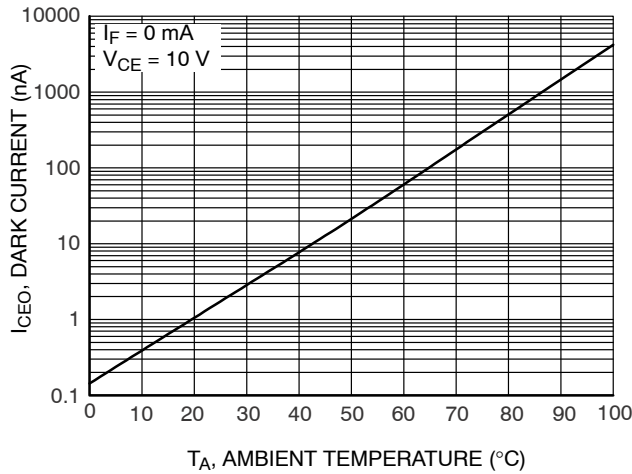


Figure 7. Collector-Emitter Dark Current vs. Ambient Temperature

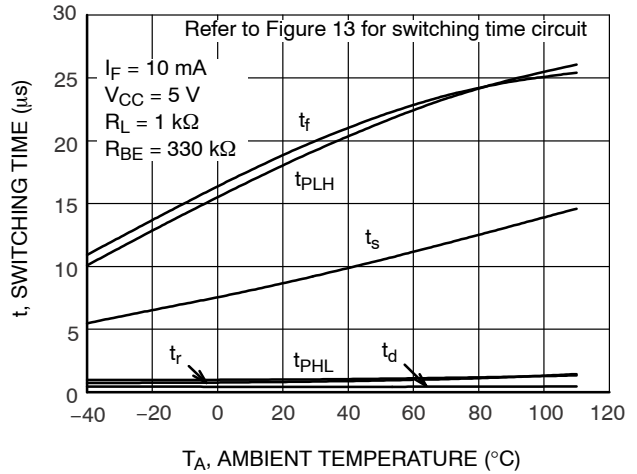


Figure 8. Switching Time vs. Ambient Temperature

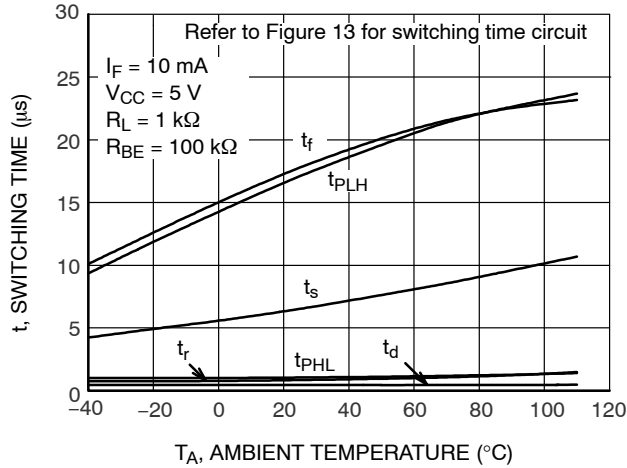


Figure 9. Switching Time vs. Ambient Temperature

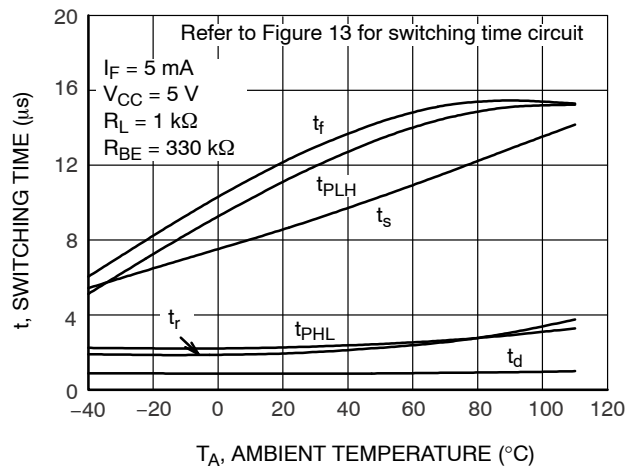


Figure 10. Switching Time vs. Ambient Temperature

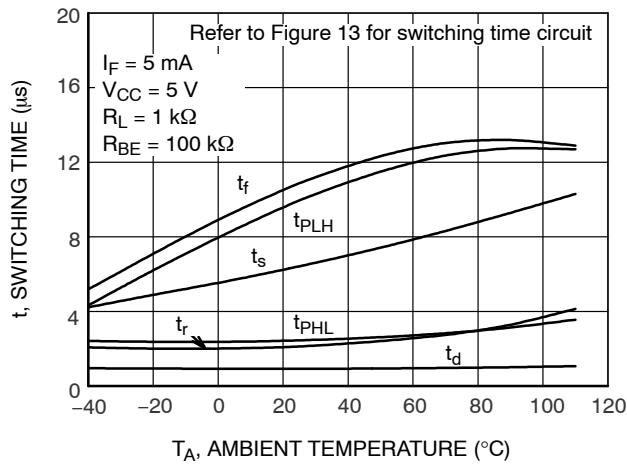


Figure 11. Switching Time vs. Ambient Temperature

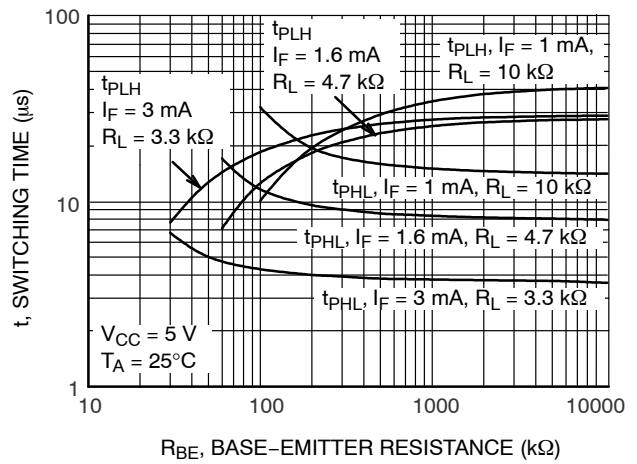


Figure 12. Switching Time vs. Base-Emitter Resistance

MCT5210M, MCT5211M

SWITCHING TIME TEST CIRCUIT AND WAVEFORMS

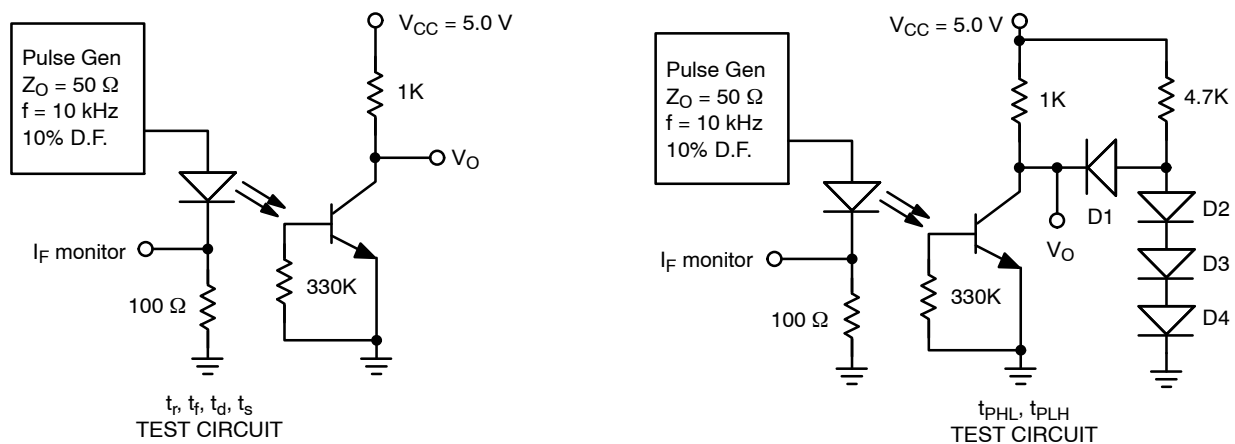


Figure 13. Switching Time Test Circuit

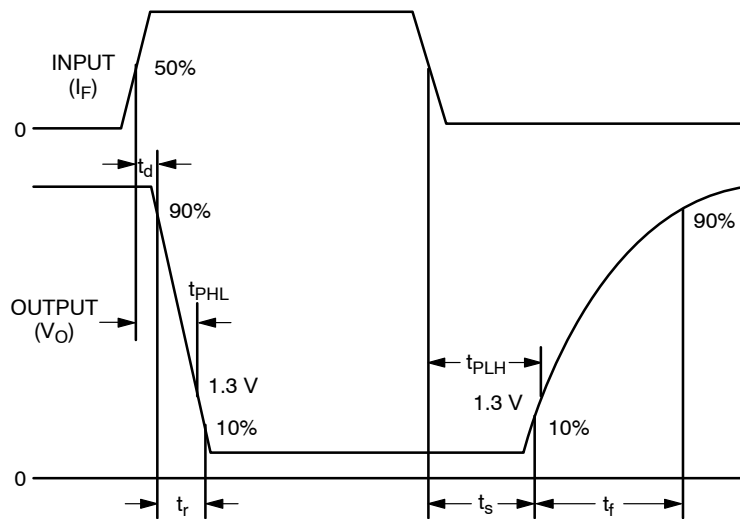


Figure 14. Switching Time Test Circuit

MCT5210M, MCT5211M

REFLOW PROFILE

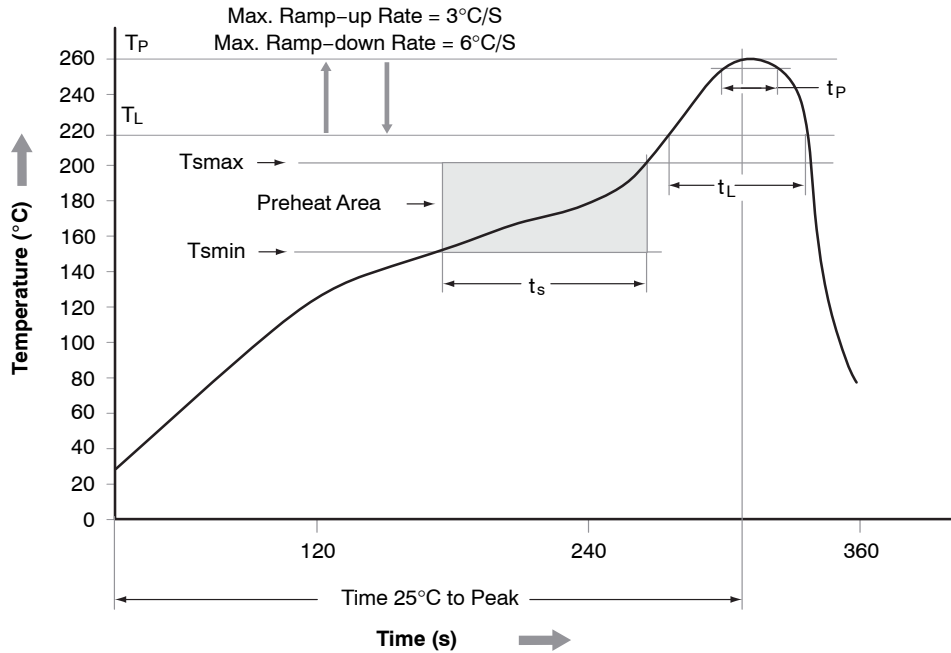


Figure 15. Reflow Profile

Table 1.

| Profile Feature | Pb-Free Assembly Profile |
|--|--------------------------|
| Temperature Minimum (T_{smin}) | 150°C |
| Temperature Maximum (T_{smax}) | 200°C |
| Time (t_s) from (T_{smin} to T_{smax}) | 60 – 120 seconds |
| Ramp-up Rate (t_L to t_p) | 3°C/second maximum |
| Liquidous Temperature (T_L) | 217°C |
| Time (t_L) Maintained Above (T_L) | 60 – 150 seconds |
| Peak Body Package Temperature | 260°C +0°C / -5°C |
| Time (t_p) within 5°C of 260°C | 30 seconds |
| Ramp-down Rate (T_P to T_L) | 6°C/second maximum |
| Time 25°C to Peak Temperature | 8 minutes maximum |

ORDERING INFORMATION (Note 8)

| 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) |

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

MECHANICAL CASE OUTLINE

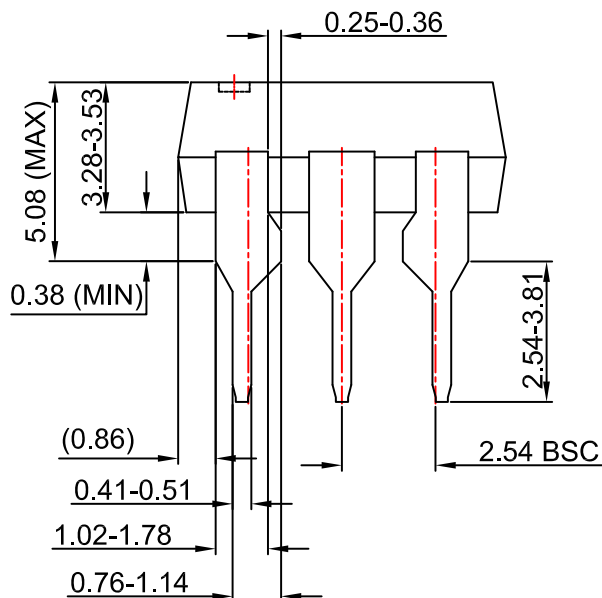
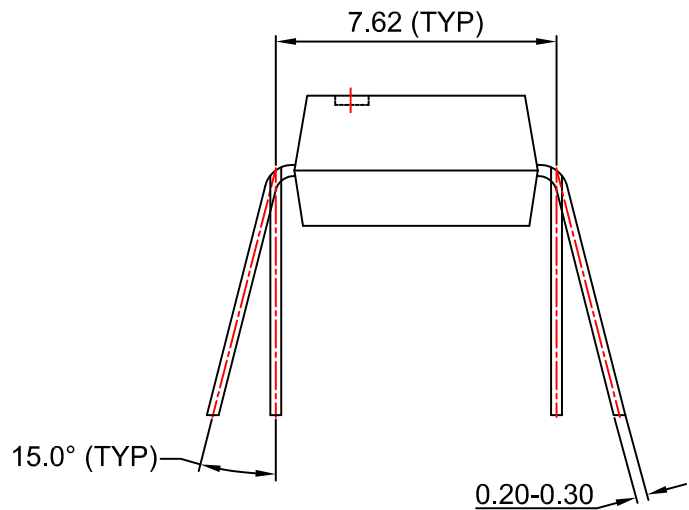
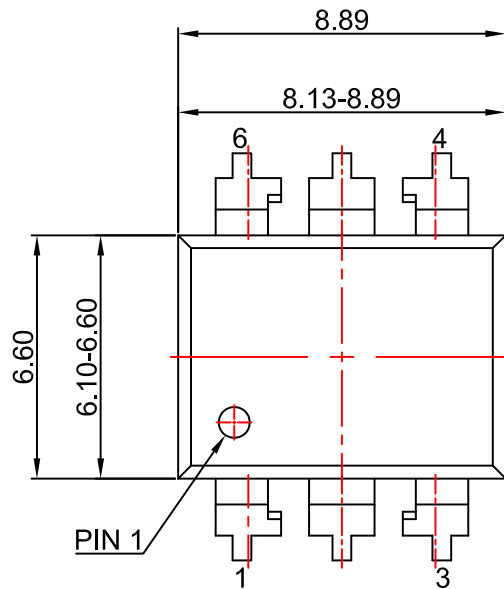
PACKAGE DIMENSIONS

ON Semiconductor®



PDIP6 8.51x6.35, 2.54P
CASE 646BX
ISSUE O

DATE 31 JUL 2016



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

| | | |
|------------------|------------------------|--|
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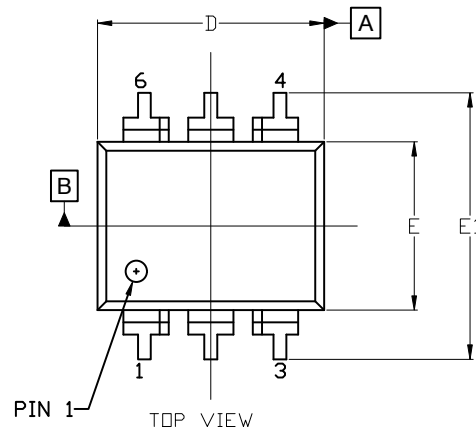
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PDIP6 8.51x6.35, 2.54P

CASE 646BY

ISSUE A

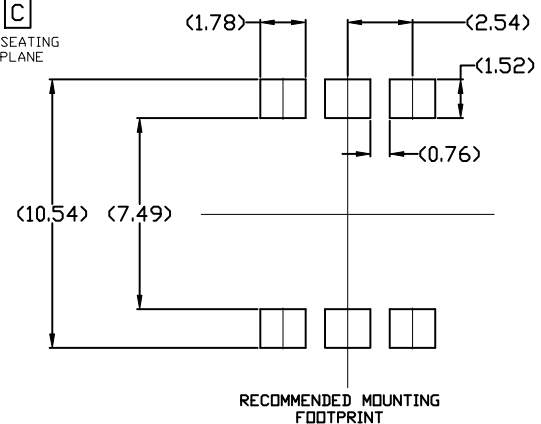
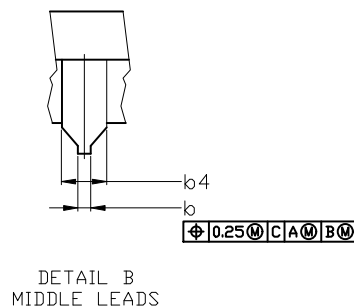
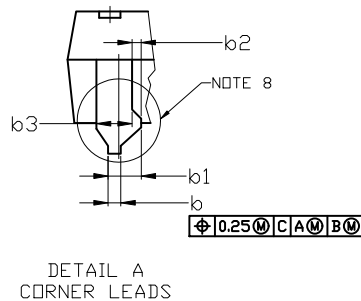
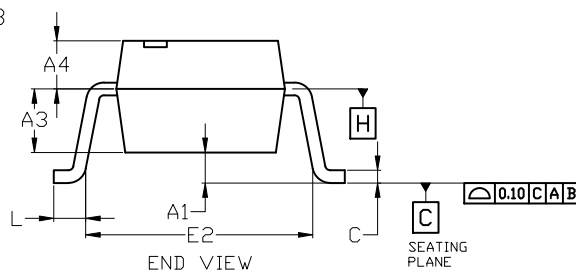
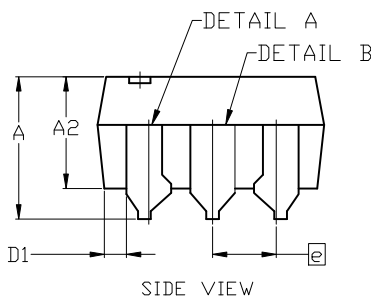
DATE 15 JUL 2019



NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 2009.
2. CONTROLLING DIMENSION: MILLIMETERS
3. DIMENSIONS A, A1, AND L ARE MEASURED WITH THE PACKAGE SEATED.
4. DIMENSIONS D, D1, AND E1 DO NOT INCLUDE MOLD FLASH OR PROTRUSIONS. MOLD FLASH OR PROTRUSIONS ARE NOT TO EXCEED 2.54mm.
5. PACKAGE CONTOUR IS OPTIONAL (ROUNDED OR SQUARE CORNERS).
6. CENTER LINE OF CORNER LEADS IS LOCATED BY LOCATING THE CENTER OF FEATURE b2 AND b3.

| DIM | MILLIMETERS | | |
|-----|-------------|------|------|
| | MIN. | NOM. | MAX. |
| A | --- | --- | 4.80 |
| A1 | 0.38 | --- | --- |
| A2 | 3.28 | 3.40 | 3.53 |
| A3 | 2.49 REF | | |
| A4 | 1.89 REF | | |
| b | 0.41 | 0.46 | 0.51 |
| b1 | 0.76 | 0.92 | 1.14 |
| b2 | 0.25 | 0.28 | 0.36 |
| b3 | 1.02 | 1.40 | 1.78 |
| b4 | 1.778 REF | | |
| c | 0.20 | 0.25 | 0.30 |
| D | 8.13 | 8.51 | 8.89 |
| D1 | 0.86 REF | | |
| E | 6.10 | 6.35 | 6.60 |
| E1 | 8.43 | 9.17 | 9.90 |
| E2 | 8.13 REF | | |
| e | 2.54 BSC | | |
| L | 0.16 | 0.52 | 0.88 |



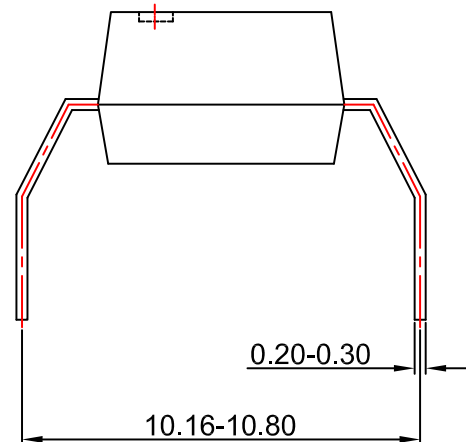
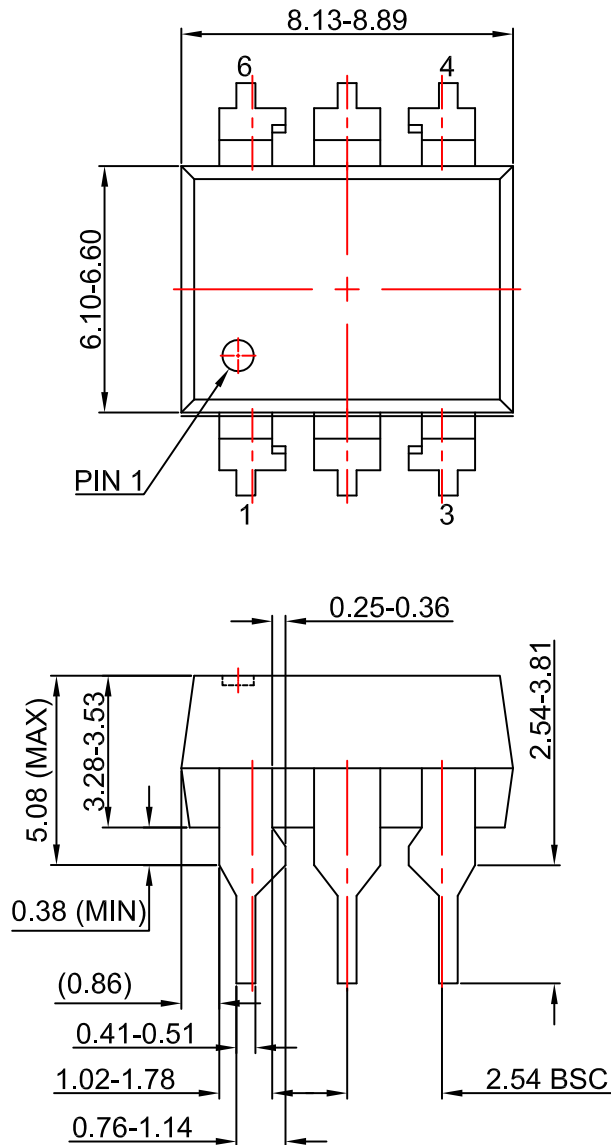
- For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERM/D.

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