



ON Semiconductor®

MCT2EM, TIL111M, TIL117M 6-Pin General Purpose Phototransistor Optocouplers

Features

- Minimum Current Transfer Ratio at $I_F = 10 \text{ mA}$, $V_{CE} = 10 \text{ V}$:
 - 20% for MCT2EM
 - 50% for TIL117M
- Safety and Regulatory Approvals:
 - UL1577, 4,170 $V_{AC_{RMS}}$ for 1 Minute
 - DIN-EN/IEC60747-5-5, 850 V Peak Working Insulation Voltage

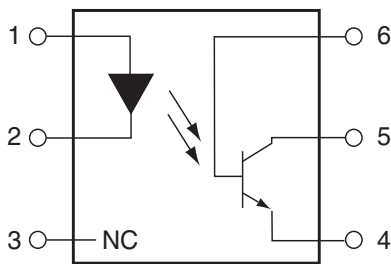
Applications

- Power Supply Regulators
- Digital Logic Inputs
- Microprocessor Inputs

Description

The general purpose optocouplers consist of a gallium arsenide infrared emitting diode driving a silicon phototransistor in a standard plastic six-pin dual-in-line package.

Schematic



- PIN 1. ANODE
- 2. CATHODE
- 3. NO CONNECTION
- 4. EMITTER
- 5. COLLECTOR
- 6. BASE

Figure 1. Schematic

Package Outlines

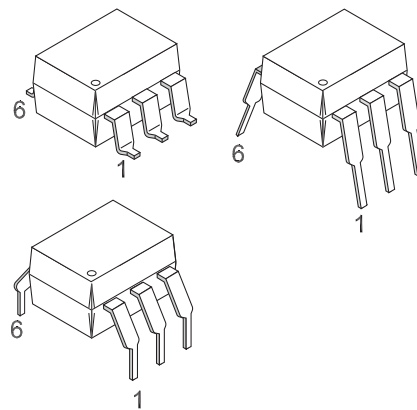


Figure 2. Package Outlines

MCT2EM, TIL111M, TIL117M — 6-Pin General Purpose 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. $T_A = 25^\circ\text{C}$ unless otherwise specified.

| Symbol | Parameter | Device | Value | Unit |
|---------------------|--|-----------------|--------------------|----------------------|
| TOTAL DEVICE | | | | |
| T_{STG} | Storage Temperature | All | -40 to +125 | $^\circ\text{C}$ |
| T_{OPR} | Operating Temperature | All | -40 to +100 | $^\circ\text{C}$ |
| T_J | Junction Temperature | All | -40 to +125 | $^\circ\text{C}$ |
| T_{SOL} | Lead Solder Temperature | All | 260 for 10 seconds | $^\circ\text{C}$ |
| P_D | Total Device Power Dissipation @ $T_A = 25^\circ\text{C}$ | All | 250 | mW |
| | Derate Above 25°C | All | 2.94 | mW/ $^\circ\text{C}$ |
| EMITTER | | | | |
| I_F | DC/Average Forward Input Current | All | 60 | mA |
| V_R | Reverse Input Voltage | TIL111M | 3 | V |
| | | MCT2EM, TIL117M | 6 | V |
| $I_{F(pk)}$ | Forward Current – Peak (300 μs , 2% Duty Cycle) | All | 3 | A |
| P_D | LED Power Dissipation @ $T_A = 25^\circ\text{C}$ | All | 120 | mW |
| | Derate Above 25°C | All | 1.41 | mW/ $^\circ\text{C}$ |
| DETECTOR | | | | |
| V_{CEO} | Collector-to-Emitter Voltage | All | 30 | V |
| V_{CBO} | Collector-to-Base Voltage | All | 70 | V |
| V_{ECO} | Emitter-to-Collector Voltage | All | 7 | V |
| V_{EBO} | Emitter-to-Base Voltage | All | 7 | V |
| P_D | Detector Power Dissipation @ $T_A = 25^\circ\text{C}$ | All | 150 | mW |
| | Derate Above 25°C | All | 1.76 | mW/ $^\circ\text{C}$ |

Electrical Characteristics

TA = 25°C unless otherwise specified.

Individual Component Characteristics

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|-------------------|--|---|------|-------|------|------|
| EMITTER | | | | | | |
| V _F | Input Forward Voltage | I _F = 10 mA | | 1.18 | 1.50 | V |
| I _R | Reverse Leakage Current | V _R = 6.0 V | | 0.001 | 10 | μA |
| DETECTOR | | | | | | |
| BV _{CEO} | Collector-to-Emitter Breakdown Voltage | I _C = 1.0 mA, I _F = 0 | 30 | 100 | | V |
| BV _{CBO} | Collector-to-Base Breakdown Voltage | I _C = 100 μA, I _F = 0 | 70 | 120 | | V |
| BV _{EBO} | Emitter-to-Base Breakdown Voltage | I _E = 10 μA, I _F = 0 | 7 | 10 | | V |
| BV _{ECO} | Emitter-to-Collector Breakdown Voltage | I _E = 100 μA, I _F = 0 | 7 | 10 | | V |
| I _{CEO} | Collector-to-Emitter Dark Current | V _{CE} = 10 V, I _F = 0 | | 1 | 50 | nA |
| I _{CBO} | Collector-to-Base Dark Current | V _{CB} = 10 V | | | 20 | nA |
| C _{CE} | Capacitance | V _{CE} = 0 V, f = 1 MHz | | 8 | | pF |

Transfer Characteristics

| Symbol | Parameter | Test Conditions | Device | Min. | Typ. | Max. | Unit |
|---------------------------|--|--|-----------------|------|------|------|------|
| DC CHARACTERISTICS | | | | | | | |
| CTR | Current Transfer Ratio, Collector-to-Emitter | I _F = 10 mA, V _{CE} = 10 V | MCT2EM | 20 | | | % |
| | | | TIL117M | 50 | | | % |
| V _{CE(SAT)} | Collector-to-Emitter Saturation Voltage | I _C = 2 mA, I _F = 16 mA | MCT2EM, TIL111M | | | 0.4 | V |
| | | I _C = 0.5 mA, I _F = 10 mA | TIL117M | | | 0.4 | V |
| AC CHARACTERISTICS | | | | | | | |
| T _{ON} | Non-Saturated Turn-on Time | I _F = 10 mA, V _{CC} = 10 V, R _L = 100 Ω (Figure 13) | MCT2EM | | 2 | | μs |
| | | I _C = 2 mA, V _{CC} = 10 V, R _L = 100 Ω (Figure 13) | TIL117M | | 2 | 10 | μs |
| T _{OFF} | Turn-off Time | I _F = 10 mA, V _{CC} = 10 V, R _L = 100 Ω (Figure 13) | MCT2EM | | 2 | | μs |
| | | I _C = 2 mA, V _{CC} = 10 V, R _L = 100 Ω (Figure 13) | TIL117M | | 2 | 10 | μs |

Isolation Characteristics

| Symbol | Characteristic | Test Conditions | Min. | Typ. | Max. | Unit |
|------------------|--------------------------------|--|------------------|------|------|----------------------|
| V _{ISO} | Input-Output Isolation Voltage | t = 1 Minute | 4170 | | | V _{AC(RMS)} |
| C _{ISO} | Isolation Capacitance | V _{I-O} = 0 V, f = 1 MHz | | 0.2 | | pF |
| R _{ISO} | Isolation Resistance | V _{I-O} = ±500 VDC, T _A = 25°C | 10 ¹¹ | | | Ω |

Typical Performance Curves

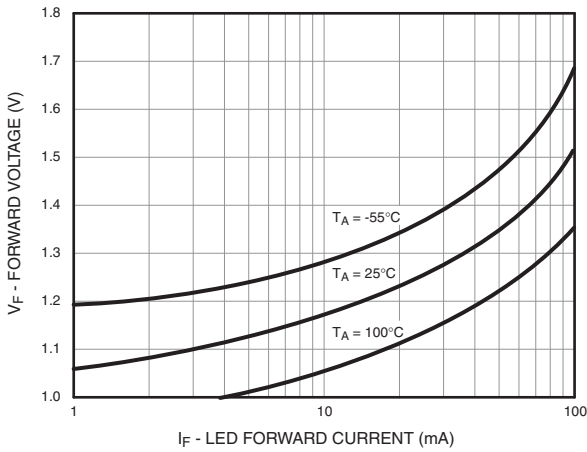


Figure 3. LED Forward Voltage vs. Forward Current

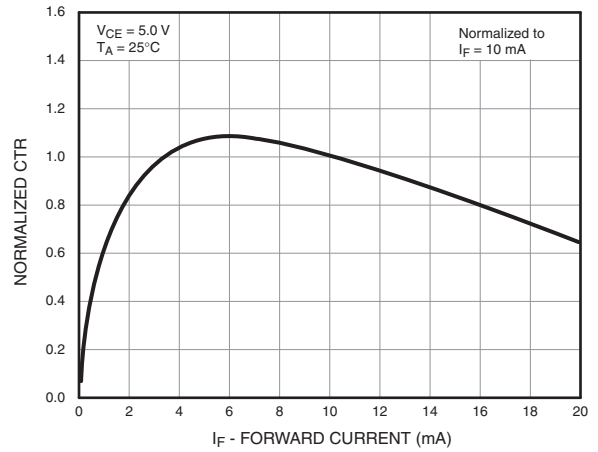


Figure 4. Normalized CTR vs. Forward Current

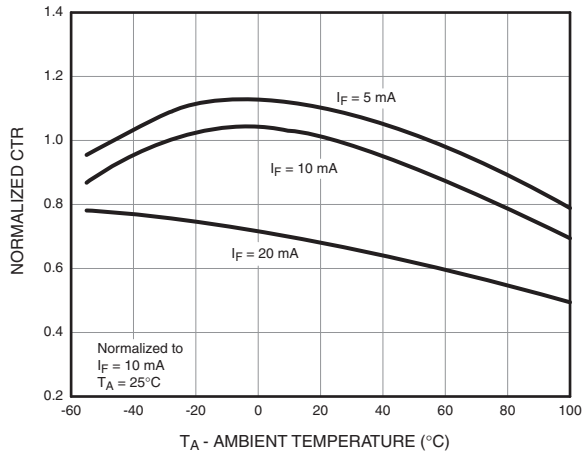


Figure 5. Normalized CTR vs. Ambient Temperature

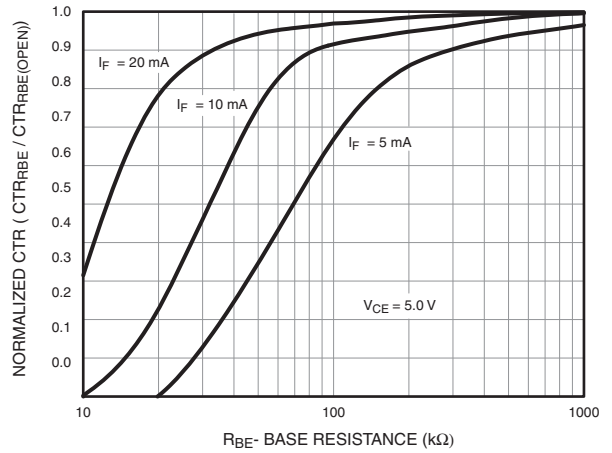


Figure 6. CTR vs. RBE (Unsaturated)

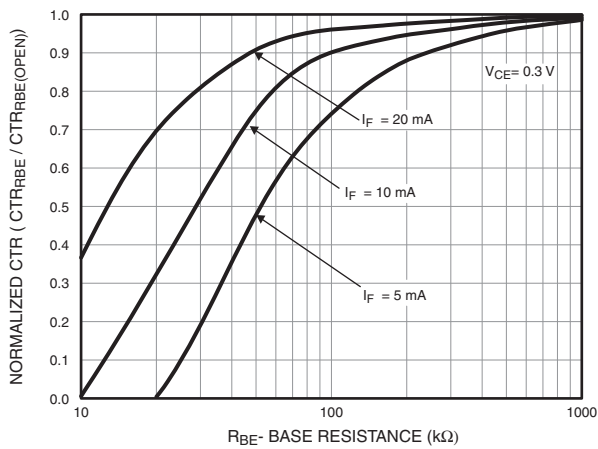


Figure 7. CTR vs. RBE (Saturated)

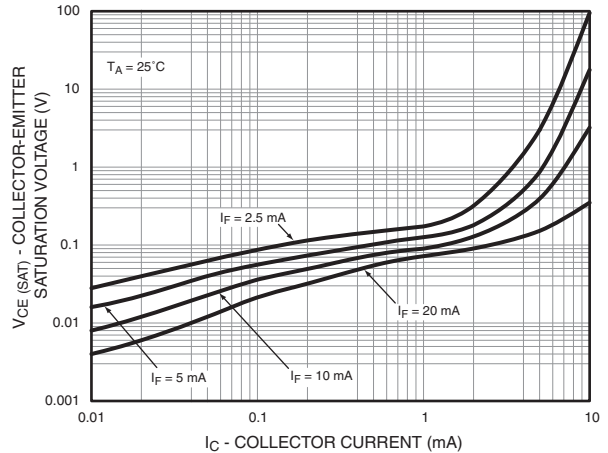


Figure 8. Collector-Emitter Saturation Voltage vs. Collector Current

Typical Performance Curves (Continued)

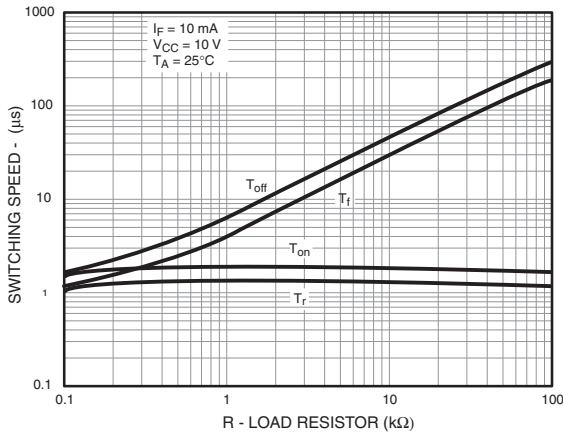


Figure 9. Switching Speed vs. Load Resistor

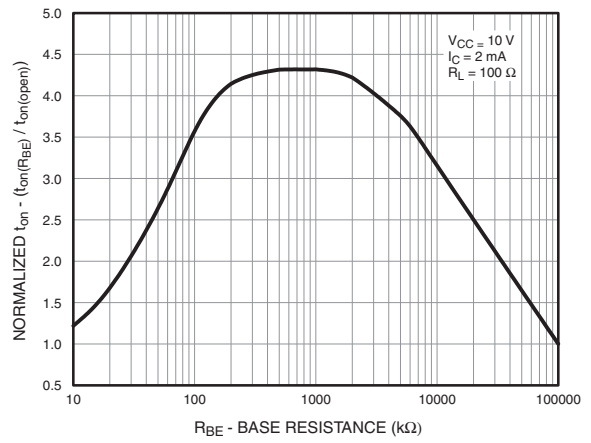


Figure 10. Normalized t_{on} vs. R_{BE}

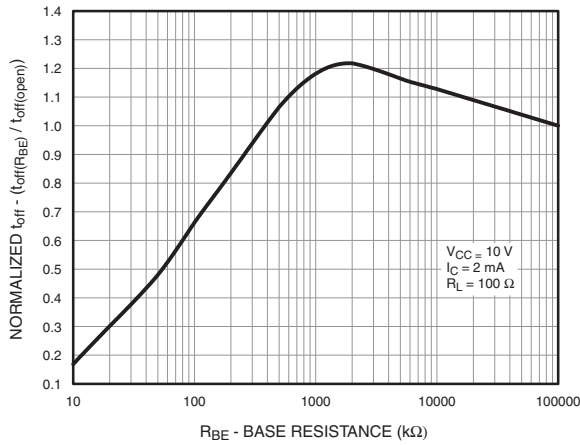


Figure 11. Normalized t_{off} vs. R_{BE}

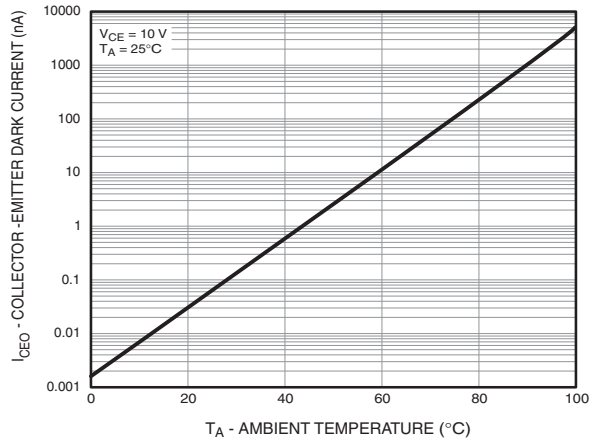


Figure 12. Dark Current vs. Ambient Temperature

Switching Time Test Circuit and Waveforms

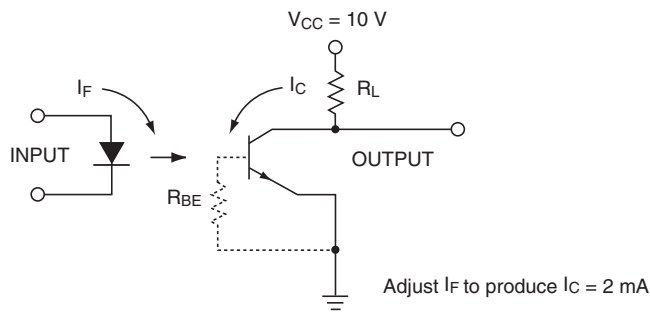


Figure 13. Switching Time Test Circuit and Waveforms

Reflow Profile

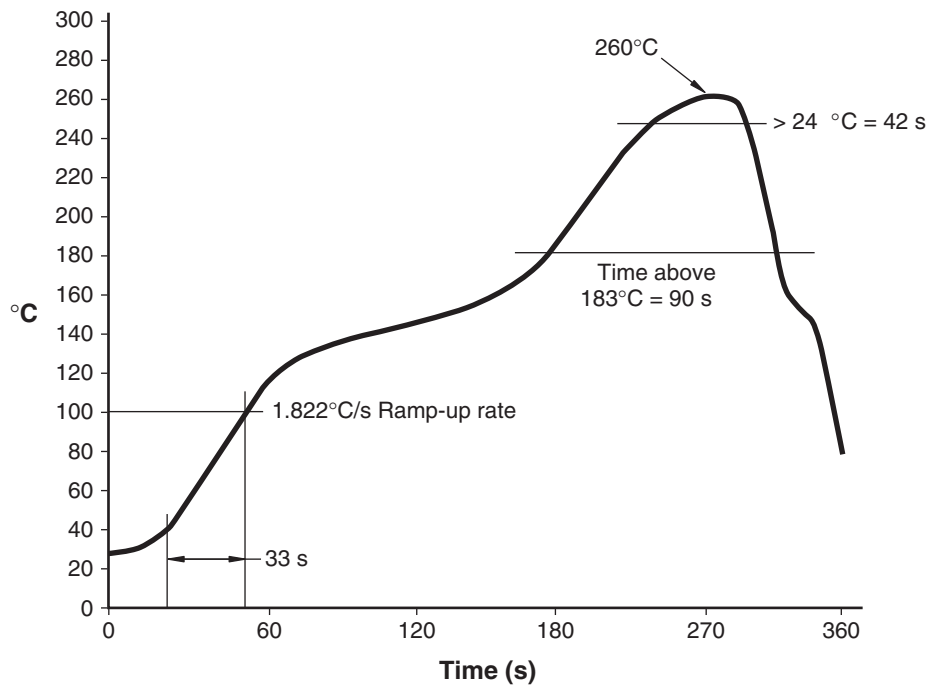


Figure 14. Reflow Profile

Ordering Information

| Part Number | Package | Packing Method |
|-------------|--|----------------------------|
| MCT2EM | DIP 6-Pin | Tube (50 Units) |
| MCT2ESM | SMT 6-Pin (Lead Bend) | Tube (50 Units) |
| MCT2ESR2M | SMT 6-Pin (Lead Bend) | Tape and Reel (1000 Units) |
| MCT2EVM | DIP 6-Pin, DIN EN/IEC60747-5-5 Option | Tube (50 Units) |
| MCT2ESVM | SMT 6-Pin (Lead Bend), DIN EN/IEC60747-5-5 Option | Tube (50 Units) |
| MCT2ESR2VM | SMT 6-Pin (Lead Bend), DIN EN/IEC60747-5-5 Option | Tape and Reel (1000 Units) |
| MCT2ETVM | DIP 6-Pin, 0.4" Lead Spacing, DIN EN/IEC60747-5-5 Option | Tube (50 Units) |

Note:

2. The product orderable part number system listed in this table also applies to the TIL111M and TIL117M devices.

Marking Information

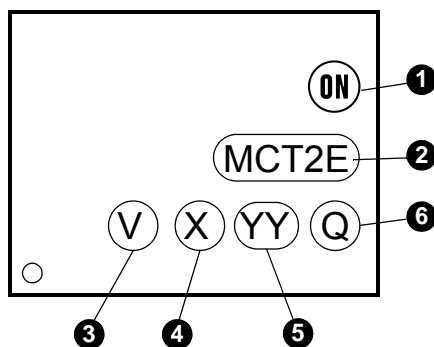


Figure 15. Top Mark

Table 1. Top Mark Definitions

| | |
|---|---|
| 1 | ON Semiconductor 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., "6" |
| 5 | Digit Work Week, Ranging from "01" to "53" |
| 6 | Assembly Package Code |

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