



August 2015

# MOC205M, MOC206M, MOC207M, MOC211M, MOC212M, MOC213M, MOC216M, MOC217M 8-pin SOIC Single-Channel Phototransistor Output Optocoupler

## Features

- Closely Matched Current Transfer Ratios
- Minimum  $BV_{CEO}$  of 70 V Guaranteed
  - MOC205M, MOC206M, MOC207M
- Minimum  $BV_{CEO}$  of 30 V Guaranteed
  - MOC211M, MOC212M, MOC213M, MOC216M, MOC217M
- Low LED Input Current Required for Easier Logic Interfacing
  - MOC216M, MOC217M
- Convenient Plastic SOIC-8 Surface Mountable Package Style, with 0.050" Lead Spacing
- Safety and Regulatory Approvals:
  - UL1577, 2,500 VAC<sub>RMS</sub> for 1 Minute
  - DIN-EN/IEC60747-5-5, 565 V Peak Working Insulation Voltage

## Applications

- Feedback Control Circuits
- Interfacing and Coupling Systems of Different Potentials and Impedances
- General Purpose Switching Circuits
- Monitor and Detection Circuits

## Description

These devices consist of a gallium arsenide infrared emitting diode optically coupled to a monolithic silicon phototransistor detector, in a surface mountable, small outline, plastic package. They are ideally suited for high-density applications, and eliminate the need for through-the-board mounting.

## Schematic

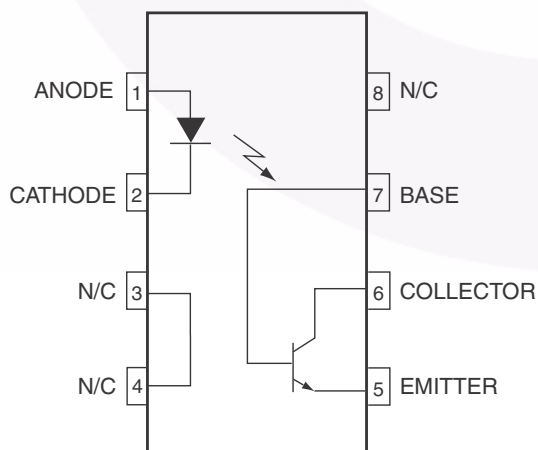


Figure 1. Schematic

## Package Outline

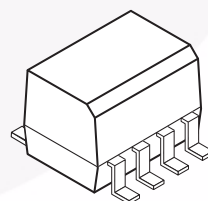


Figure 2. Package Outline

## 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–III           |
| 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  | 904               | 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 | 1060              | V <sub>peak</sub> |
| V <sub>IORM</sub>     | Maximum Working Insulation Voltage                                                                                                                             | 565               | V <sub>peak</sub> |
| V <sub>IOTM</sub>     | Highest Allowable Over-Voltage                                                                                                                                 | 4000              | V <sub>peak</sub> |
|                       | External Creepage                                                                                                                                              | ≥ 4               | mm                |
|                       | External Clearance                                                                                                                                             | ≥ 4               | mm                |
| DTI                   | Distance Through Insulation (Insulation Thickness)                                                                                                             | ≥ 0.4             | mm                |
| T <sub>S</sub>        | Case Temperature <sup>(1)</sup>                                                                                                                                | 150               | °C                |
| I <sub>S,INPUT</sub>  | Input Current <sup>(1)</sup>                                                                                                                                   | 200               | mA                |
| P <sub>S,OUTPUT</sub> | Output Power <sup>(1)</sup>                                                                                                                                    | 300               | 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.  $T_A = 25^\circ\text{C}$  unless otherwise specified.

| Symbol              | Rating                                                    | Value              | Unit                 |
|---------------------|-----------------------------------------------------------|--------------------|----------------------|
| <b>TOTAL DEVICE</b> |                                                           |                    |                      |
| $T_{STG}$           | Storage Temperature                                       | -40 to +125        | $^\circ\text{C}$     |
| $T_A$               | Ambient Operating Temperature                             | -40 to +100        | $^\circ\text{C}$     |
| $T_J$               | Junction Temperature                                      | -40 to +125        | $^\circ\text{C}$     |
| $T_{SOL}$           | Lead Solder Temperature                                   | 260 for 10 seconds | $^\circ\text{C}$     |
| $P_D$               | Total Device Power Dissipation @ $T_A = 25^\circ\text{C}$ | 240                | mW                   |
|                     | Derate above $25^\circ\text{C}$                           | 2.94               | mW/ $^\circ\text{C}$ |
| <b>EMITTER</b>      |                                                           |                    |                      |
| $I_F$               | Continuous Forward Current                                | 60                 | mA                   |
| $I_F(\text{pk})$    | Forward Current – Peak (PW = 100 $\mu\text{s}$ , 120 pps) | 1.0                | A                    |
| $V_R$               | Reverse Voltage                                           | 6.0                | V                    |
| $P_D$               | LED Power Dissipation @ $T_A = 25^\circ\text{C}$          | 90                 | mW                   |
|                     | Derate above $25^\circ\text{C}$                           | 0.8                | mW/ $^\circ\text{C}$ |
| <b>DETECTOR</b>     |                                                           |                    |                      |
| $I_C$               | Continuous Collector Current                              | 150                | mA                   |
| $V_{CEO}$           | Collector-Emitter Voltage                                 | 30                 | V                    |
| $V_{ECO}$           | Emitter-Collector Voltage                                 | 7                  | V                    |
| $P_D$               | Detector Power Dissipation @ $T_A = 25^\circ\text{C}$     | 150                | mW                   |
|                     | Derate above $25^\circ\text{C}$                           | 1.76               | mW/ $^\circ\text{C}$ |

## Electrical Characteristics

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

| Symbol          | Parameter                                                                                      | Test Conditions                                                                     | Min. | Typ.  | Max. | Unit          |
|-----------------|------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|------|-------|------|---------------|
| <b>EMITTER</b>  |                                                                                                |                                                                                     |      |       |      |               |
| $V_F$           | Input Forward Voltage<br>MOC216M, MOC217M                                                      | $I_F = 1\text{ mA}$                                                                 |      | 1.07  | 1.3  | V             |
|                 | MOC205M, MOC206M, MOC207M<br>MOC211M, MOC212M, MOC213M                                         | $I_F = 10\text{ mA}$                                                                |      | 1.15  | 1.5  | V             |
| $I_R$           | Reverse Leakage Current                                                                        | $V_R = 6\text{ V}$                                                                  |      | 0.001 | 100  | $\mu\text{A}$ |
| $C_{IN}$        | Input Capacitance                                                                              |                                                                                     |      | 18    |      | pF            |
| <b>DETECTOR</b> |                                                                                                |                                                                                     |      |       |      |               |
| $I_{CEO1}$      | Collector-Emitter Dark Current                                                                 | $V_{CE} = 10\text{ V}, T_A = 25^\circ\text{C}$                                      |      | 1.0   | 50   | nA            |
| $I_{CEO2}$      |                                                                                                | $V_{CE} = 10\text{ V}, T_A = 100^\circ\text{C}$                                     |      | 1.0   |      | $\mu\text{A}$ |
| $BV_{CEO}$      | Collector-Emitter Breakdown Voltage<br>MOC205M, MOC206M, MOC207M                               | $I_C = 100\text{ }\mu\text{A}$                                                      | 70   | 100   |      | V             |
|                 | MOC211M, MOC212M, MOC213M,<br>MOC216M, MOC217M                                                 | $I_C = 100\text{ }\mu\text{A}$                                                      | 30   | 100   |      | V             |
| $BV_{CBO}$      | Collector-Base Breakdown Voltage                                                               | $I_C = 10\text{ }\mu\text{A}$                                                       | 70   | 120   |      | V             |
| $BV_{ECO}$      | Emitter-Collector Breakdown Voltage                                                            | $I_E = 100\text{ }\mu\text{A}$                                                      | 7    | 10    |      | V             |
| $C_{CE}$        | Collector-Emitter Capacitance                                                                  | $f = 1.0\text{ MHz}, V_{CE} = 0$                                                    |      | 7     |      | pF            |
| <b>COUPLED</b>  |                                                                                                |                                                                                     |      |       |      |               |
| CTR             | Collector-Output Current<br>MOC205M                                                            | $I_F = 10\text{ mA}, V_{CE} = 10\text{ V}$                                          | 40   |       | 80   | %             |
|                 | MOC206M                                                                                        | $I_F = 10\text{ mA}, V_{CE} = 10\text{ V}$                                          | 63   |       | 125  | %             |
|                 | MOC207M                                                                                        | $I_F = 10\text{ mA}, V_{CE} = 10\text{ V}$                                          | 100  |       | 200  | %             |
|                 | MOC211M                                                                                        | $I_F = 10\text{ mA}, V_{CE} = 10\text{ V}$                                          | 20   |       |      | %             |
|                 | MOC212M                                                                                        | $I_F = 10\text{ mA}, V_{CE} = 10\text{ V}$                                          | 50   |       |      | %             |
|                 | MOC213M                                                                                        | $I_F = 10\text{ mA}, V_{CE} = 10\text{ V}$                                          | 100  |       |      | %             |
|                 | MOC216M                                                                                        | $I_F = 1\text{ mA}, V_{CE} = 5\text{ V}$                                            | 50   |       |      | %             |
|                 | MOC217M                                                                                        | $I_F = 1\text{ mA}, V_{CE} = 5\text{ V}$                                            | 100  |       |      | %             |
| $V_{CE(SAT)}$   | Collector-Emitter Saturation Voltage<br>MOC205M, MOC206M, MOC207M<br>MOC211M, MOC212M, MOC213M | $I_C = 2\text{ mA}, I_F = 10\text{ mA}$                                             |      |       | 0.4  | V             |
|                 | MOC216M, MOC217M                                                                               | $I_C = 100\text{ }\mu\text{A}, I_F = 1\text{ mA}$                                   |      |       | 0.4  | V             |
| $t_{on}$        | Turn-On Time                                                                                   | $I_C = 2\text{ mA}, V_{CC} = 10\text{ V},$<br>$R_L = 100\text{ }\Omega$ (Figure 12) |      | 7.5   |      | $\mu\text{s}$ |
| $t_{off}$       | Turn-Off Time                                                                                  | $I_C = 2\text{ mA}, V_{CC} = 10\text{ V},$<br>$R_L = 100\text{ }\Omega$ (Figure 12) |      | 5.7   |      | $\mu\text{s}$ |
| $t_r$           | Rise Time                                                                                      | $I_C = 2\text{ mA}, V_{CC} = 10\text{ V},$<br>$R_L = 100\text{ }\Omega$ (Figure 12) |      | 3.2   |      | $\mu\text{s}$ |
| $t_f$           | Fall Time                                                                                      | $I_C = 2\text{ mA}, V_{CC} = 10\text{ V},$<br>$R_L = 100\text{ }\Omega$ (Figure 12) |      | 4.7   |      | $\mu\text{s}$ |

**Isolation Characteristics**

| Symbol    | Characteristic                 | Test Conditions                                         | Min.      | Typ. | Max. | Unit           |
|-----------|--------------------------------|---------------------------------------------------------|-----------|------|------|----------------|
| $V_{ISO}$ | Input-Output Isolation Voltage | $t = 1 \text{ Minute}$                                  | 2500      |      |      | $V_{AC_{RMS}}$ |
| $C_{ISO}$ | Isolation Capacitance          | $V_{I-O} = 0 \text{ V}, f = 1 \text{ MHz}$              |           | 0.2  |      | pF             |
| $R_{ISO}$ | Isolation Resistance           | $V_{I-O} = \pm 500 \text{ VDC}, T_A = 25^\circ\text{C}$ | $10^{11}$ |      |      | $\Omega$       |

## Typical Performance Curves

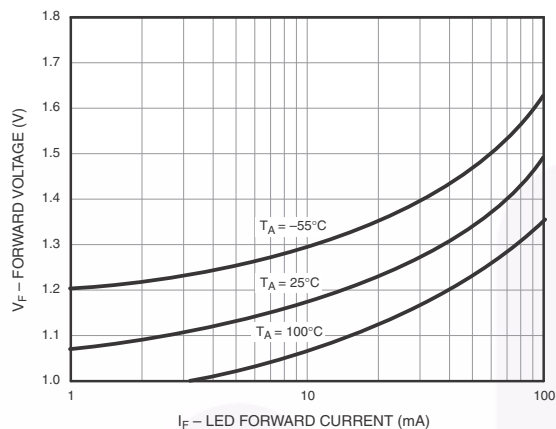


Figure 3. LED Forward Voltage vs. Forward Current

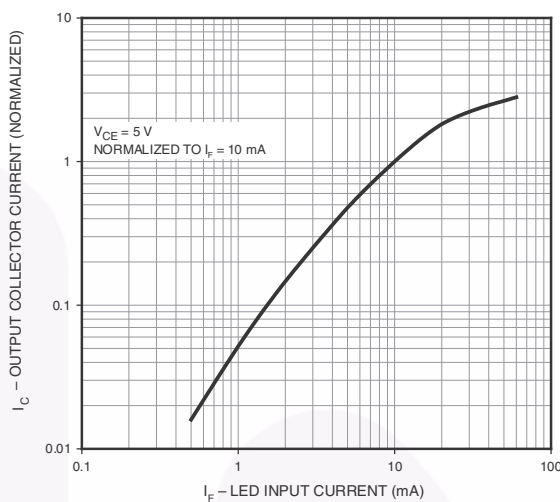


Figure 4. Output Current vs. Input Current

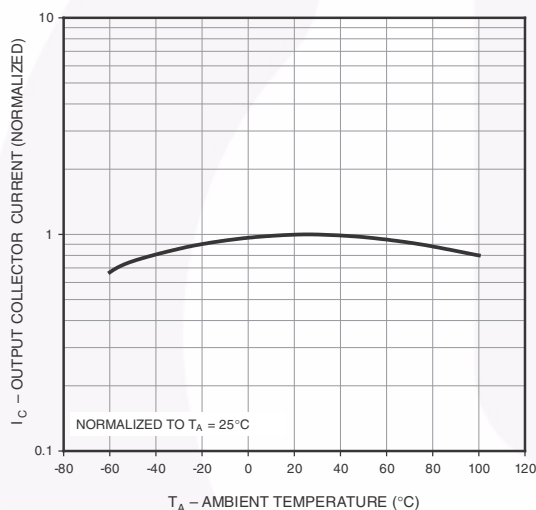


Figure 5. Output Current vs. Ambient Temperature

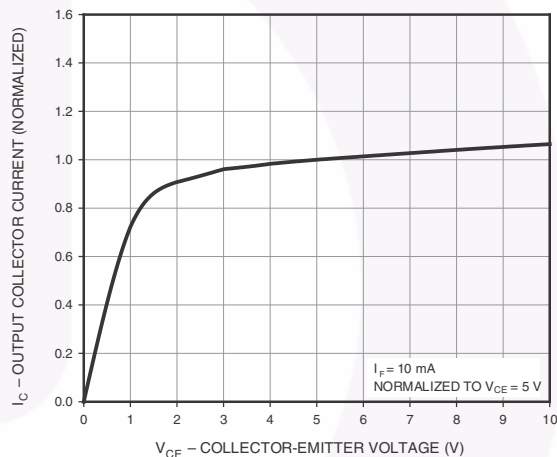


Figure 6. Output Current vs. Collector-Emitter Voltage

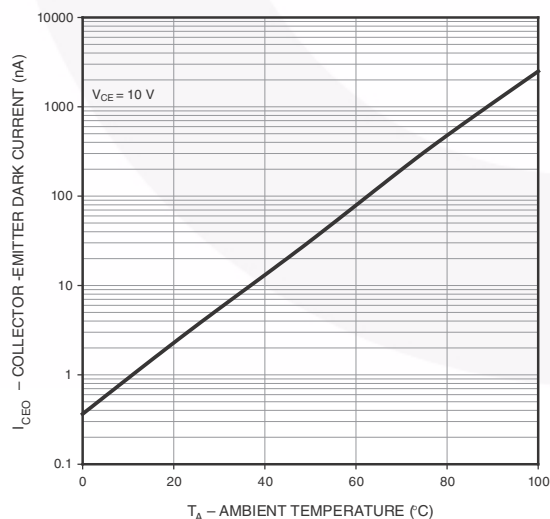


Figure 7. Dark Current vs. Ambient Temperature

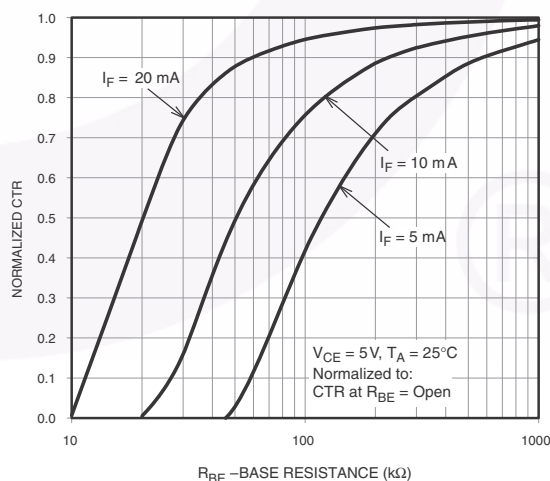


Figure 8. CTR vs.  $R_{BE}$  (Unsaturated)

## Typical Performance Curves (Continued)

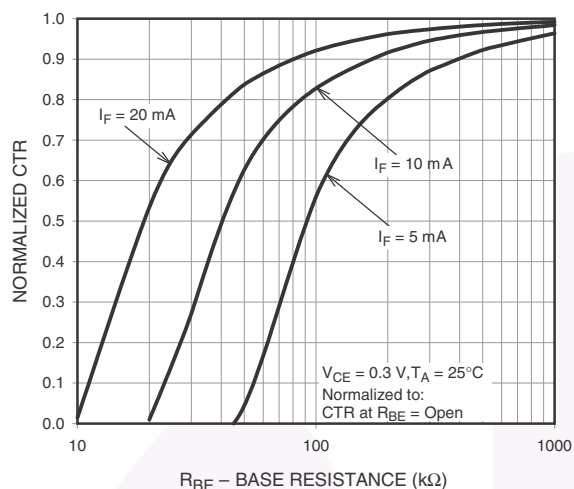


Figure 9. CTR vs.  $R_{BE}$  (Saturated)

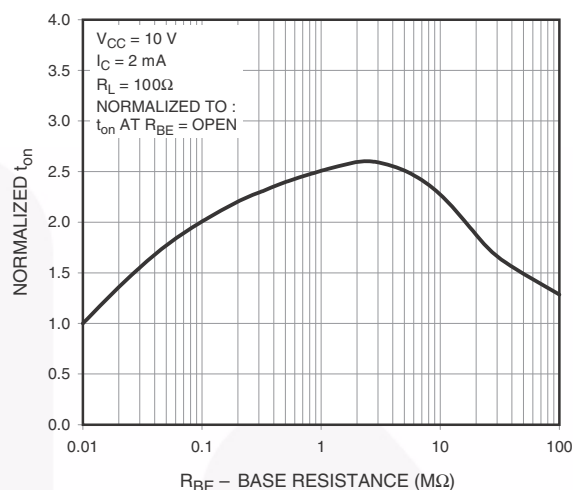


Figure 10. Normalized  $t_{on}$  vs.  $R_{BE}$

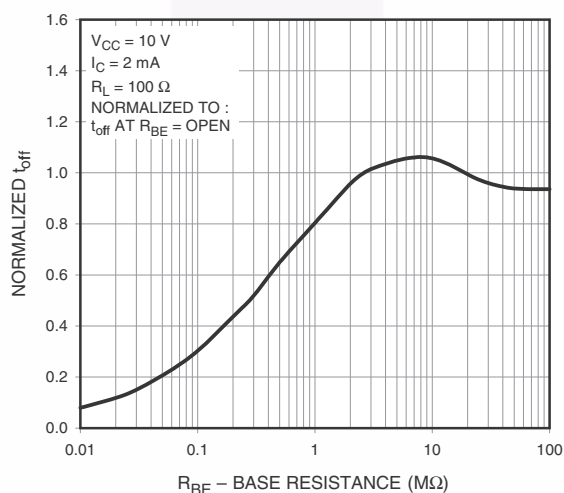


Figure 11. Normalized  $t_{off}$  vs.  $R_{BE}$

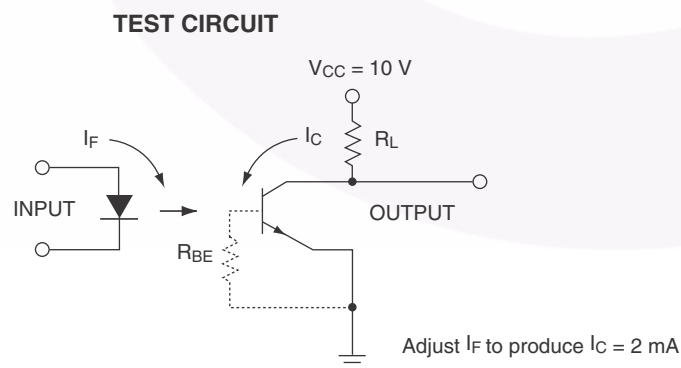


Figure 12. Switching Time Test Circuit and Waveforms

## Reflow Profile

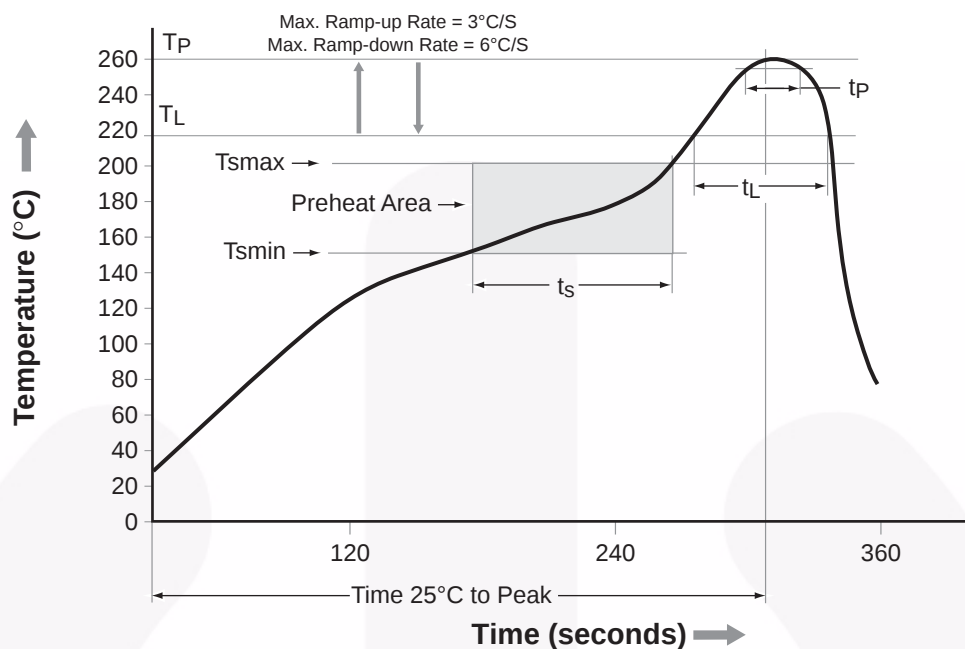


Figure 13. Reflow Profile

| 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<sup>(2)</sup>

| Part Number | Package                                         | Packing Method             |
|-------------|-------------------------------------------------|----------------------------|
| MOC205M     | Small Outline 8-Pin                             | Tube (100 Units)           |
| MOC205R2M   | Small Outline 8-Pin                             | Tape and Reel (2500 Units) |
| MOC205VM    | Small Outline 8-Pin, DIN EN/IEC60747-5-5 Option | Tube (100 Units)           |
| MOC205R2VM  | Small Outline 8-Pin, DIN EN/IEC60747-5-5 Option | Tape and Reel (2500 Units) |

### Note:

2. The product orderable part number system listed in this table also applies to the MOC20XM and MOC21XM products.

## Marking Information

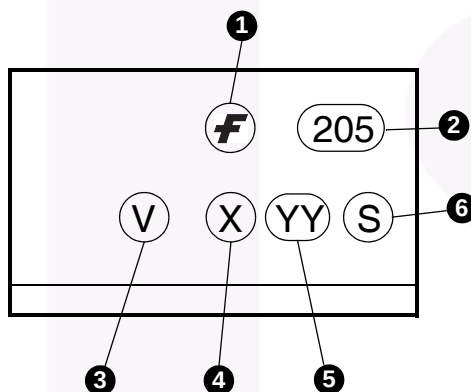


Figure 14. Top Mark

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., "4"                                                  |
| 5 | Digit Work Week, Ranging from "01" to "53"                                      |
| 6 | Assembly Package Code                                                           |





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MicroFET™  
MicroPak™  
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## PRODUCT STATUS DEFINITIONS

### Definition of Terms

| Datasheet Identification | Product Status        | Definition                                                                                                                                                                                          |
|--------------------------|-----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Advance Information      | Formative / In Design | Datasheet contains the design specifications for product development. Specifications may change in any manner without notice.                                                                       |
| Preliminary              | First Production      | Datasheet contains preliminary data; supplementary data will be published at a later date. Fairchild Semiconductor reserves the right to make changes at any time without notice to improve design. |
| No Identification Needed | Full Production       | Datasheet contains final specifications. Fairchild Semiconductor reserves the right to make changes at any time without notice to improve the design.                                               |
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