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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

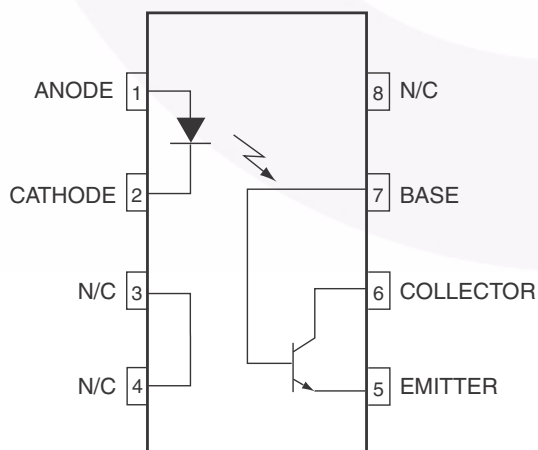


Figure 1. Schematic

## Package Outline

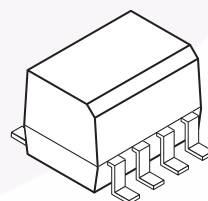


Figure 2. Package Outline

## 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 MOC216M, MOC217M	$I_F = 1\text{ mA}$		1.07	1.3	V
	MOC205M, MOC206M, MOC207M 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 MOC205M, MOC206M, MOC207M	$I_C = 100\text{ }\mu\text{A}$	70	100		V
	MOC211M, MOC212M, MOC213M, 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 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 MOC205M, MOC206M, MOC207M 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	$I_C = 2\text{ mA}, V_{CC} = 10\text{ V},$ $R_L = 100\text{ }\Omega$ (Figure 12)		7.5		$\mu\text{s}$
$t_{off}$	Turn-Off Time	$I_C = 2\text{ mA}, V_{CC} = 10\text{ V},$ $R_L = 100\text{ }\Omega$ (Figure 12)		5.7		$\mu\text{s}$
$t_r$	Rise Time	$I_C = 2\text{ mA}, V_{CC} = 10\text{ V},$ $R_L = 100\text{ }\Omega$ (Figure 12)		3.2		$\mu\text{s}$
$t_f$	Fall Time	$I_C = 2\text{ mA}, V_{CC} = 10\text{ V},$ $R_L = 100\text{ }\Omega$ (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

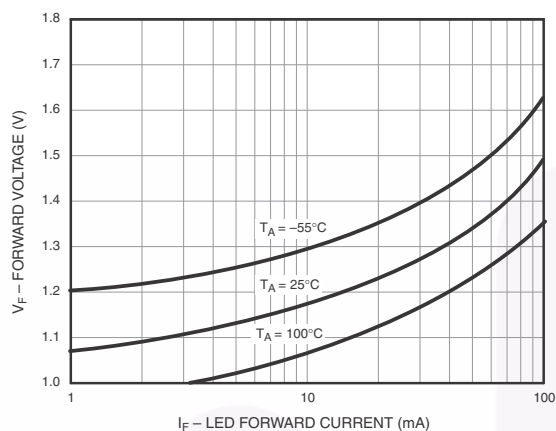


Figure 3. LED Forward Voltage vs. Forward Current

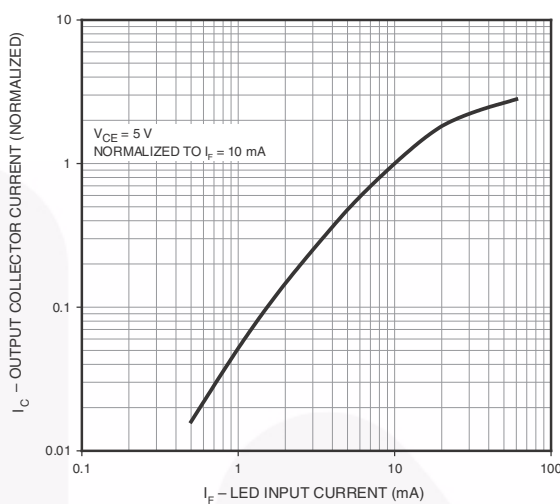


Figure 4. Output Current vs. Input Current

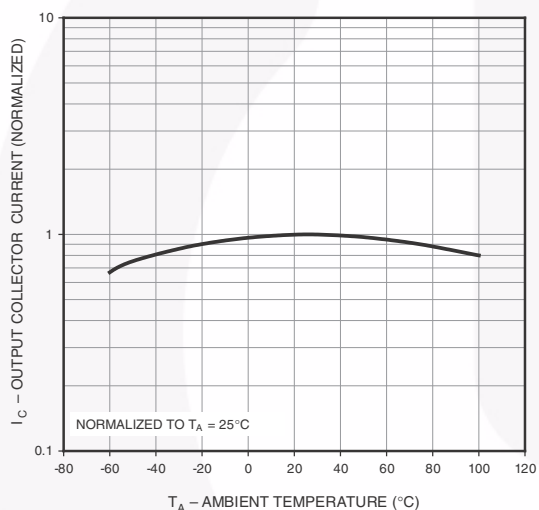


Figure 5. Output Current vs. Ambient Temperature

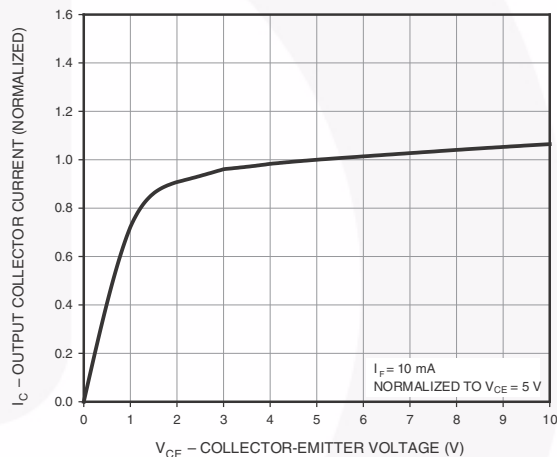


Figure 6. Output Current vs. Collector-Emitter Voltage

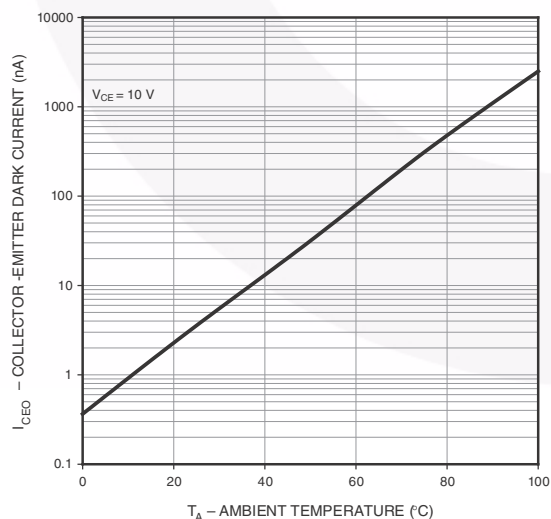


Figure 7. Dark Current vs. Ambient Temperature

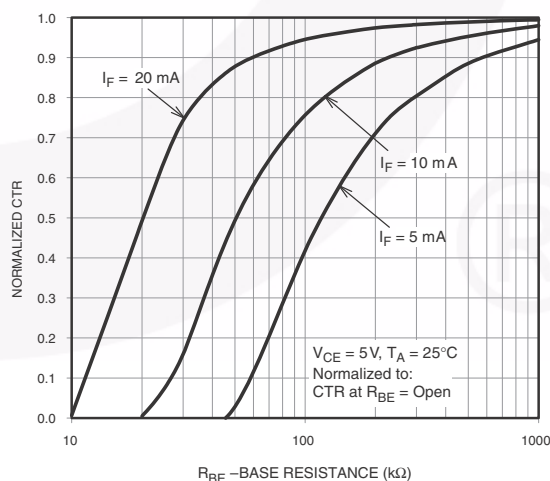


Figure 8. CTR vs.  $R_{BE}$  (Unsaturated)

# Typical Performance Curves (Continued)

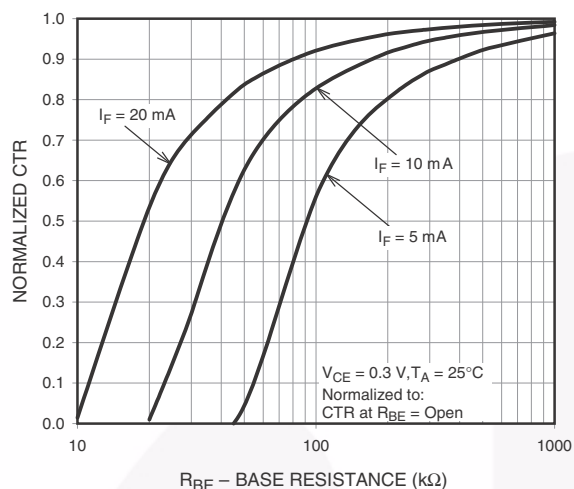


Figure 9. CTR vs.  $R_{BE}$  (Saturated)

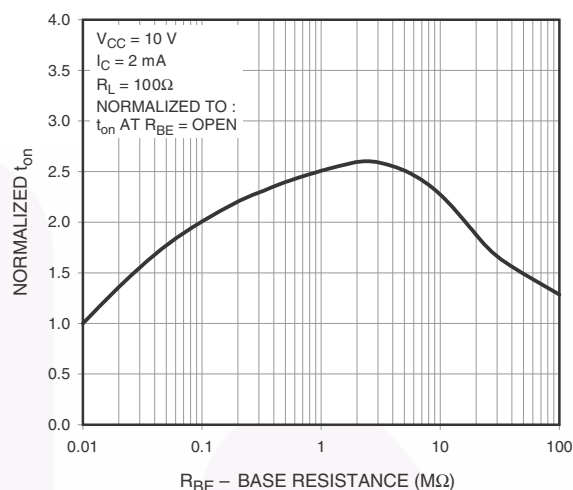


Figure 10. Normalized  $t_{on}$  vs.  $R_{BE}$

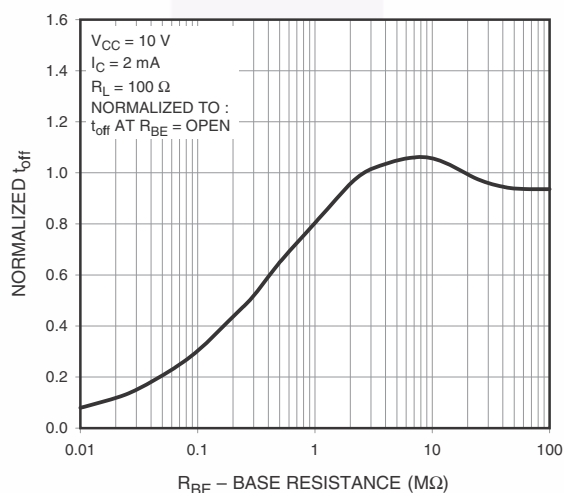


Figure 11. Normalized  $t_{off}$  vs.  $R_{BE}$

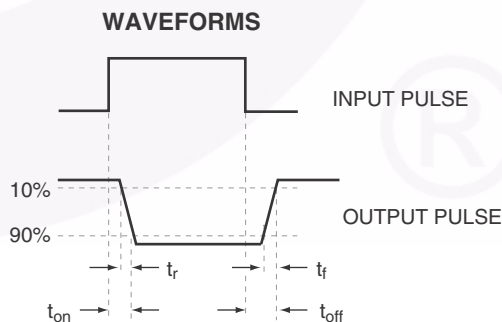
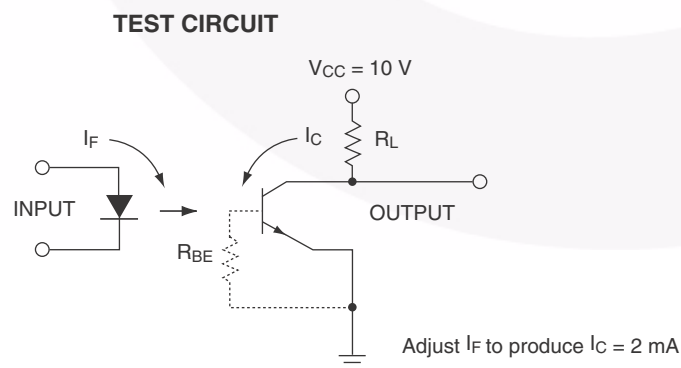


Figure 12. Switching Time Test Circuit and Waveforms



## Reflow Profile

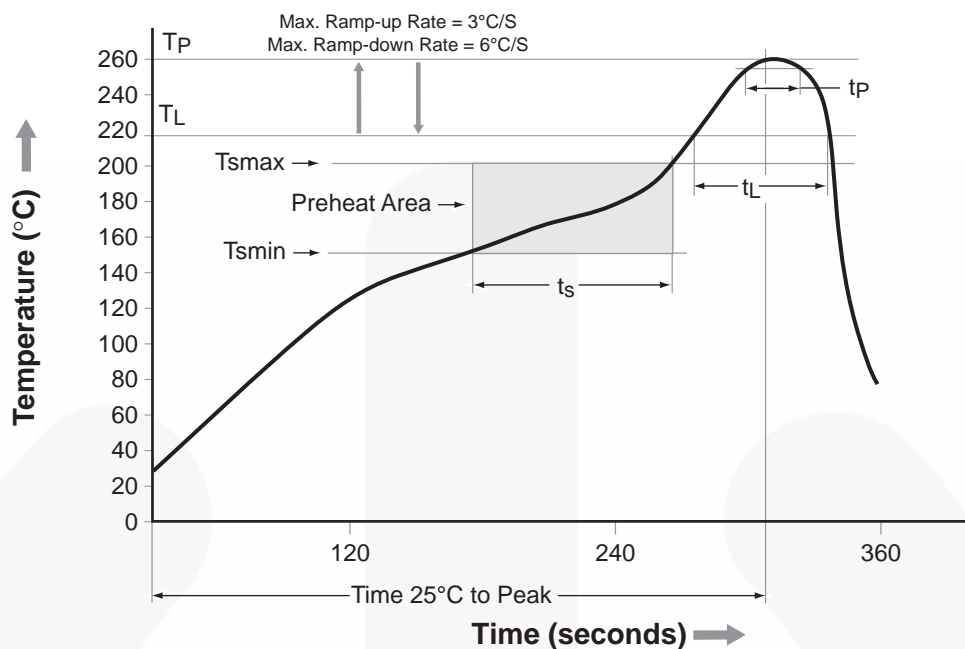


Figure 13. Reflow Profile

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

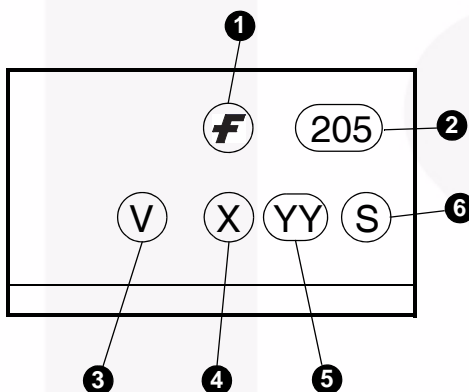


Figure 14. Top Mark

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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