

# MCT2M, MCT2EM, MCT210M, MCT271M Phototransistor Optocouplers

## Features

- UL recognized (File # E90700, Vol. 2)
- IEC60747-5-2 recognized (File # 102497)
  - Add option V (e.g., MCT2VM)

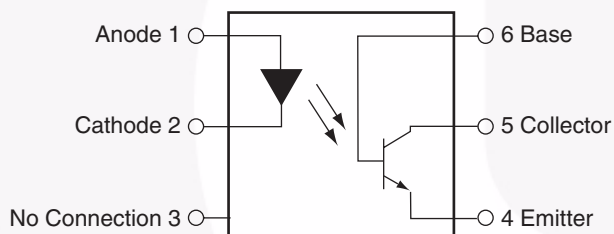
## Applications

- Power supply regulators
- Digital logic inputs
- Microprocessor inputs

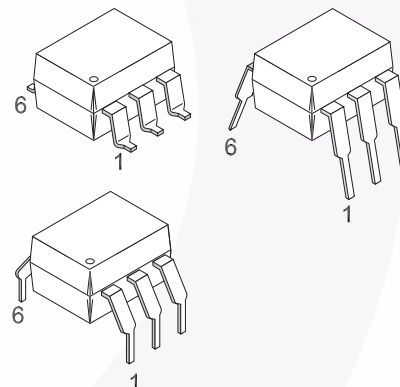
## Description

The MCT2XXM series optoisolators consist of a gallium arsenide infrared emitting diode driving a silicon phototransistor in a 6-pin dual in-line package.

## Schematic



## Package Outlines



## 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	Parameter	Value	Units
TOTAL DEVICE			
T <sub>STG</sub>	Storage Temperature	-40 to +150	°C
T <sub>OPR</sub>	Operating Temperature	-40 to +100	°C
T <sub>SOL</sub>	Lead Solder Temperature	260 for 10 sec	°C
P <sub>D</sub>	Total Device Power Dissipation @ T <sub>A</sub> = 25°C Derate above 25°C	250	mW
		2.94	mW/°C
EMITTER			
I <sub>F</sub>	DC/Average Forward Input Current	60	mA
V <sub>R</sub>	Reverse Input Voltage	3	V
I <sub>F(pk)</sub>	Forward Current – Peak (300μs, 2% Duty Cycle)	3	A
P <sub>D</sub>	LED Power Dissipation @ T <sub>A</sub> = 25°C Derate above 25°C	120	mW
		1.41	mW/°C
DETECTOR			
I <sub>C</sub>	Collector Current	50	mA
V <sub>CEO</sub>	Collector-Emitter Voltage	30	V
P <sub>D</sub>	Detector Power Dissipation @ T <sub>A</sub> = 25°C Derate above 25°C	150	mW
		1.76	mW/°C

**Electrical Characteristics** ( $T_A = 25^\circ\text{C}$  unless otherwise specified)**Individual Component Characteristics**

Symbol	Parameter	Test Conditions	Device	Min.	Typ.*	Max.	Units
EMITTER							
V <sub>F</sub>	Input Forward Voltage	I <sub>F</sub> = 20mA	MCT2M MCT2EM MCT271M		1.25	1.50	V
		T <sub>A</sub> = 0°C–70°C, I <sub>F</sub> = 40mA	MCT210M		1.33		
I <sub>R</sub>	Reverse Leakage Current	V <sub>R</sub> = 3.0V	MCT2M MCT2EM MCT271M		0.001	10	μA
		T <sub>A</sub> = 0°C–70°C, V <sub>R</sub> = 6.0V	MCT210M				
DETECTOR							
BV <sub>CEO</sub>	Collector-Emitter Breakdown Voltage	I <sub>C</sub> = 1.0mA, I <sub>F</sub> = 0	ALL	30	100		V
		T <sub>A</sub> = 0°C–70°C	MCT210M				
BV <sub>CBO</sub>	Collector-Base Breakdown Voltage	I <sub>C</sub> = 10μA, I <sub>F</sub> = 0	MCT2M MCT2EM MCT271M	70	120		V
		T <sub>A</sub> = 0°C–70°C	MCT210M	30			
BV <sub>ECO</sub>	Emitter-Collector Breakdown Voltage	I <sub>E</sub> = 100μA, I <sub>F</sub> = 0	MCT2M MCT2EM MCT271M	7	10		V
		T <sub>A</sub> = 0°C–70°C	MCT210M	6	10		
I <sub>CEO</sub>	Collector-Emitter Dark Current	V <sub>CE</sub> = 10V, I <sub>F</sub> = 0	ALL		1	50	nA
		V <sub>CE</sub> = 5V, T <sub>A</sub> = 0°C–70°C				30	μA
I <sub>CBO</sub>	Collector-Base Dark Current	V <sub>CB</sub> = 10V, I <sub>F</sub> = 0	ALL			20	nA
C <sub>CE</sub>	Capacitance	V <sub>CE</sub> = 0V, f = 1MHz	ALL		8		pF

\*All typical  $T_A = 25^\circ\text{C}$ **Isolation Characteristics**

Symbol	Parameter	Test Conditions	Min	Typ*	Max	Units
$V_{ISO}$	Input-Output Isolation Voltage	$f = 60\text{Hz}$ , $t = 1 \text{ sec.}$	7500			Vac(pk)
$R_{ISO}$	Isolation Resistance	$V_{I-O} = 500 \text{ VDC}$	$10^{11}$			$\Omega$
$C_{ISO}$	Isolation Capacitance			0.2	2	pF

\*All typicals at  $T_A = 25^\circ\text{C}$

**Electrical Characteristics** (Continued) ( $T_A = 25^\circ\text{C}$  unless otherwise specified)**Transfer Characteristics**

Symbol	Parameter	Test Conditions	Device	Min.	Typ.*	Max.	Unit
DC CHARACTERISTICS							
CTR	Output Collector Current	T <sub>A</sub> = 0°C–70°C	MCT210M	150			%
		I <sub>F</sub> = 10mA, V <sub>CE</sub> = 10V	MCT2M MCT2EM	20			
			MCT271M	45		90	
		I <sub>F</sub> = 3.2mA to 32mA, V <sub>CE</sub> = 0.4V, T <sub>A</sub> = 0°C–70°C	MCT210M	50			
V <sub>CE(SAT)</sub>	Collector-Emitter Saturation Voltage	I <sub>C</sub> = 2mA, I <sub>F</sub> = 16mA	MCT2M MCT2EM MCT271M			0.4	V
		I <sub>C</sub> = 16mA, I <sub>F</sub> = 32mA, T <sub>A</sub> = 0°C–70°C	MCT210M				
AC CHARACTERISTICS							
t <sub>on</sub>	AC Characteristic Saturated Turn-on Time from 5V to 0.8V	I <sub>F</sub> = 15mA, V <sub>CC</sub> = 5V, R <sub>L</sub> = 2kΩ, R <sub>B</sub> = Open (Fig. 11)	MCT2M MCT2EM		1.1		μs
		I <sub>F</sub> = 20mA, V <sub>CC</sub> = 5 V, R <sub>L</sub> = 2kΩ, R <sub>B</sub> = 100kΩ) (Fig. 11)	MCT2M MCT2EM		1.3		
t <sub>off</sub>	Saturated Turn-off Time from SAT to 2.0 V	I <sub>F</sub> = 15mA, V <sub>CC</sub> = 5V, R <sub>L</sub> = 2kΩ, R <sub>B</sub> = Open (Fig. 11)	MCT2M MCT2EM		50		μs
		I <sub>F</sub> = 20mA, V <sub>CC</sub> = 5V, R <sub>L</sub> = 2kΩ, R <sub>B</sub> = 100kΩ (Fig. 11)	MCT2M MCT2EM		20		
t <sub>on</sub>	Turn-on Time	I <sub>F</sub> = 10mA, V <sub>CC</sub> = 10V, R <sub>L</sub> = 100Ω	MCT2M MCT2EM		2		μs
t <sub>off</sub>	Turn-off Time	I <sub>F</sub> = 10mA, V <sub>CC</sub> = 10V, R <sub>L</sub> = 100Ω	MCT2M MCT2EM		2		μs
t <sub>r</sub>	Rise Time	I <sub>F</sub> = 10mA, V <sub>CC</sub> = 10V, R <sub>L</sub> = 100Ω	MCT2M MCT2EM		2		μs
t <sub>f</sub>	Fall Time	I <sub>F</sub> = 10mA, V <sub>CC</sub> = 10V, R <sub>L</sub> = 100Ω	MCT2M MCT2EM		1.5		μs
t <sub>on</sub>	Saturated turn-on time	I <sub>F</sub> = 16mA, R <sub>L</sub> = 1.9kΩ, V <sub>CC</sub> = 5V (Fig. 11)	MCT271M		1.0		μs
t <sub>off</sub>	Saturated turn-off time (Approximates a typical TTL interface)				48		μs
t <sub>on</sub>	Saturated turn-on time	I <sub>F</sub> = 16mA, R <sub>L</sub> = 4.7kΩ, V <sub>CC</sub> = 5 V (Fig. 20)	MCT271M		1.0		μs
t <sub>off</sub>	Saturated turn-off time (Approximates a typical low power TTL interface)				98		μs
t <sub>r</sub>	Saturated rise time	I <sub>F</sub> = 16mA, R <sub>L</sub> = 560Ω, V <sub>CC</sub> = 5V) (Fig. 11, 12)	MCT210M		1.0		μs
t <sub>f</sub>	Saturated fall time				11		μs
T <sub>PD (HL)</sub>	Saturated propagation delay – HIGH to LOW	I <sub>F</sub> = 16mA, R <sub>L</sub> = 2.7kΩ (Fig. 11, 12)	MCT210M		1.0		μs
T <sub>PD (LH)</sub>	Saturated propagation delay – LOW to HIGH				50		μs
t <sub>r</sub>	Non-saturated rise time	I <sub>C</sub> = 2mA, V <sub>CC</sub> = 5V, R <sub>L</sub> = 100Ω (Fig. 11)	MCT210M		2		μs
t <sub>f</sub>	Non-saturated fall time				2		μs
t <sub>on</sub>	Non-saturated turn-on time	I <sub>C</sub> = 2mA, V <sub>CC</sub> = 5V, R <sub>L</sub> = 100Ω (Fig. 20)	MCT271M		2	7	μs
t <sub>off</sub>	Non-saturated turn-off time				2	7	μs

\*All typicals at  $T_A = 25^\circ\text{C}$

## Safety and Insulation Ratings

As per IEC 60747-5-2, 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.

Symbol	Parameter	Min.	Typ.	Max.	Unit
	Installation Classifications per DIN VDE 0110/1.89 Table 1				
	For Rated Main Voltage < 150Vrms		I-IV		
	For Rated Main voltage < 300Vrms		I-IV		
	Climatic Classification		55/100/21		
	Pollution Degree (DIN VDE 0110/1.89)		2		
CTI	Comparative Tracking Index	175			
$V_{PR}$	Input to Output Test Voltage, Method b, $V_{IORM} \times 1.875 = V_{PR}$ , 100% Production Test with $t_m = 1$ sec, Partial Discharge < 5pC	1594			$V_{peak}$
	Input to Output Test Voltage, Method a, $V_{IORM} \times 1.5 = V_{PR}$ , Type and Sample Test with $t_m = 60$ sec, Partial Discharge < 5pC	1275			$V_{peak}$
$V_{IORM}$	Max. Working Insulation Voltage	850			$V_{peak}$
$V_{IOTM}$	Highest Allowable Over Voltage	6000			$V_{peak}$
	External Creepage	7			mm
	External Clearance	7			mm
	Insulation Thickness	0.5			mm
RIO	Insulation Resistance at $T_s$ , $V_{IO} = 500V$	$10^9$			$\Omega$

## Typical Performance Curves

Fig. 1 LED Forward Voltage vs. Forward Current

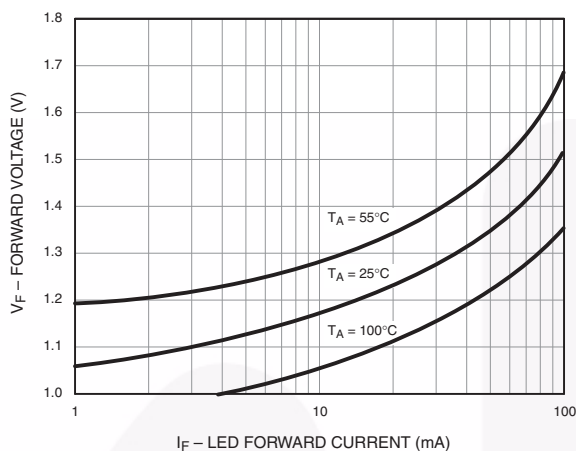


Fig. 2 Normalized CTR vs. Forward Current

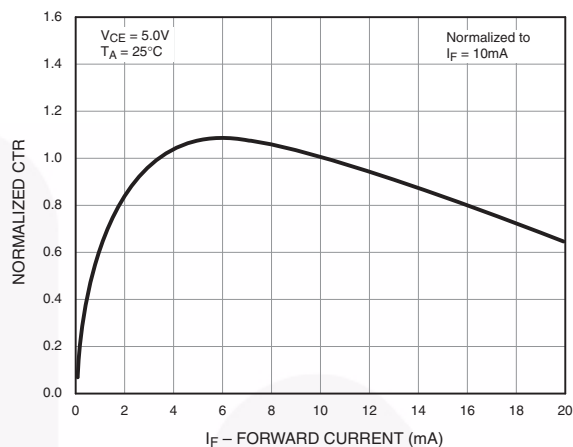


Fig. 3 Normalized CTR vs. Ambient Temperature

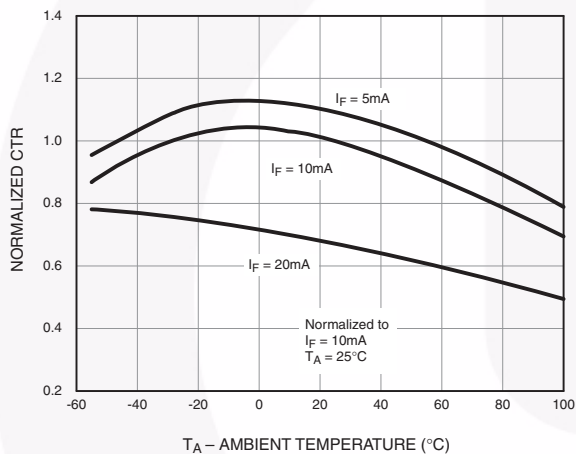


Fig. 4 CTR vs.  $R_{BE}$  (Unsaturated)

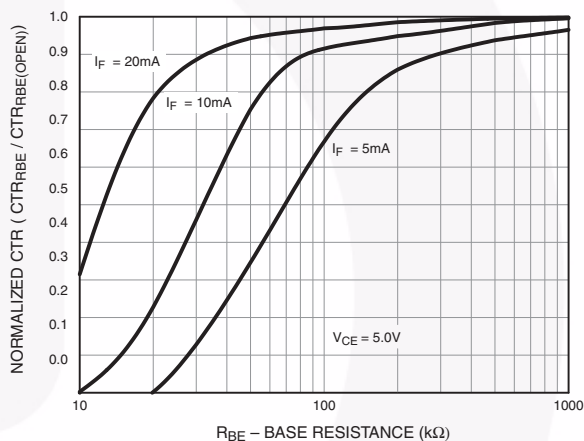


Fig. 5 CTR vs.  $R_{BE}$  (Saturated)

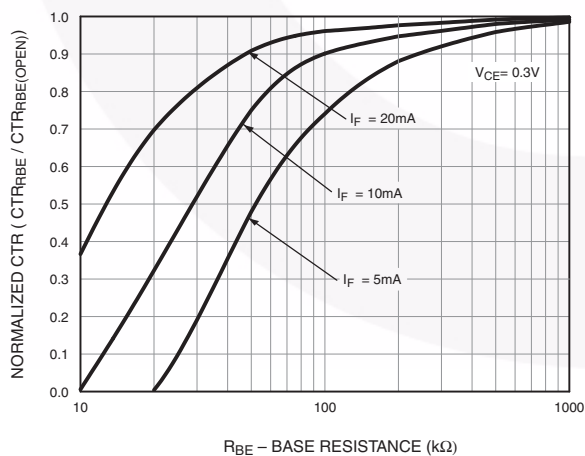
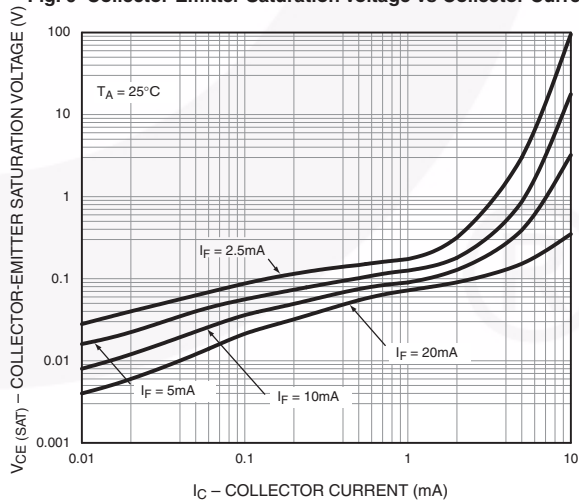


Fig. 6 Collector-Emitter Saturation Voltage vs. Collector Current



## Typical Performance Curves (Continued)

Fig. 7 Switching Speed vs. Load Resistor

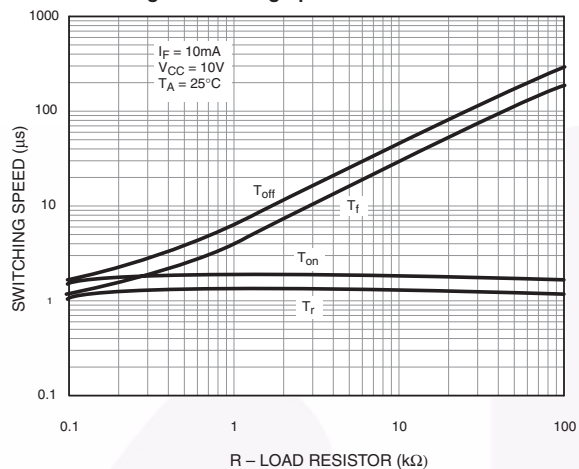


Fig. 8 Normalized  $t_{on}$  vs.  $R_{BE}$

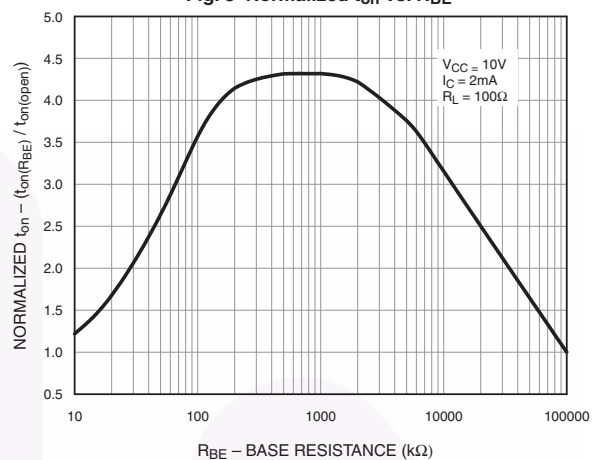


Fig. 9 Normalized  $t_{off}$  vs.  $R_{BE}$

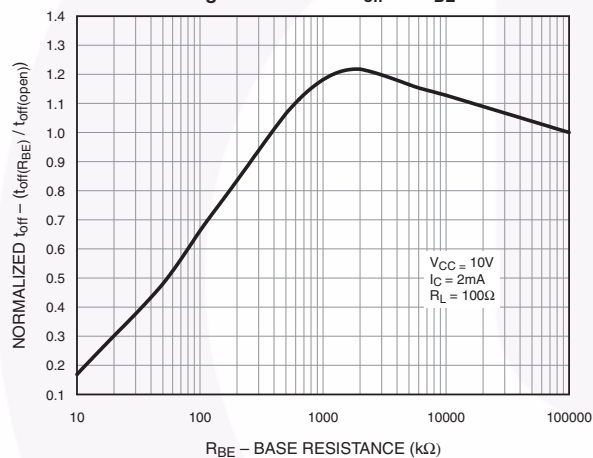
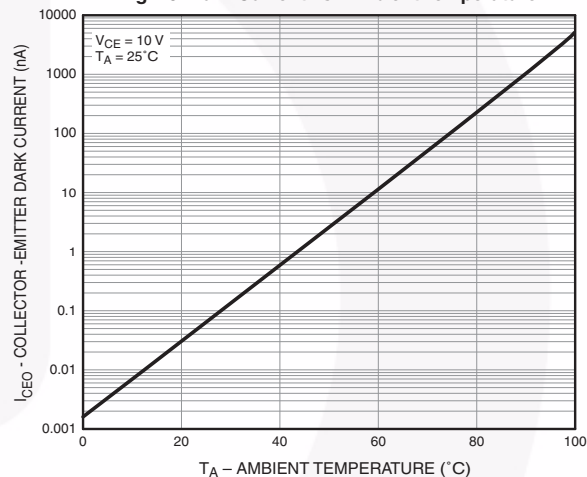


Fig. 10 Dark Current vs. Ambient Temperature



## Typical Electro-Optical Characteristics

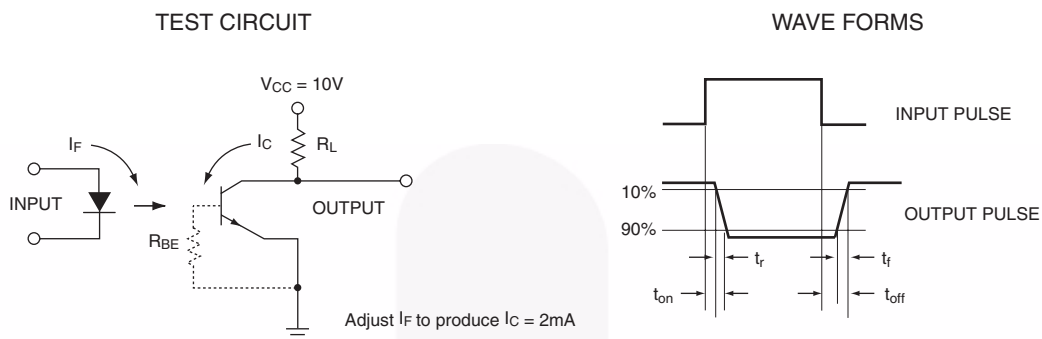


Figure 11. Switching Time Test Circuit and Waveforms

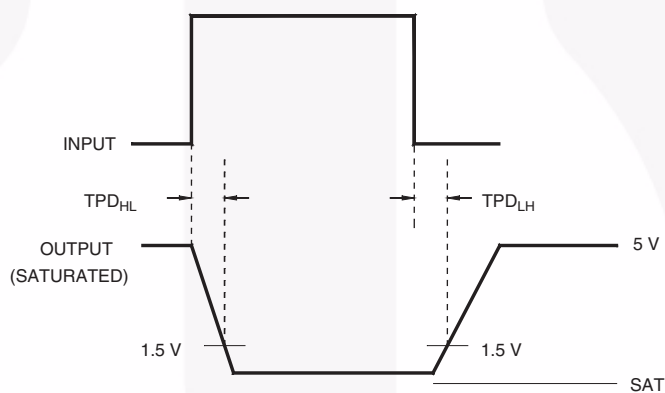


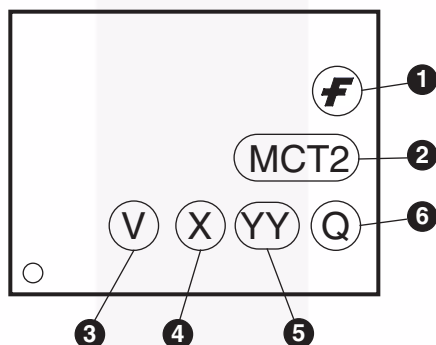
Figure 12. Switching Time Waveforms (MCT210M)



## Ordering Information

Option	Order Entry Identifier (Example)	Description
No suffix	MCT2M	Standard Through Hole Device (50 units per tube)
S	MCT2SM	Surface Mount Lead Bend
SR2	MCT2SR2M	Surface Mount; Tape and Reel (1,000 units per reel)
T	MCT2TM	0.4" Lead Spacing
V	MCT2VM	IEC60747-5-2
TV	MCT2TVM	IEC60747-5-2, 0.4" Lead Spacing
SV	MCT2SVM	IEC60747-5-2, Surface Mount
SR2V	MCT2SR2VM	IEC60747-5-2, Surface Mount, Tape and Reel (1,000 units per reel)

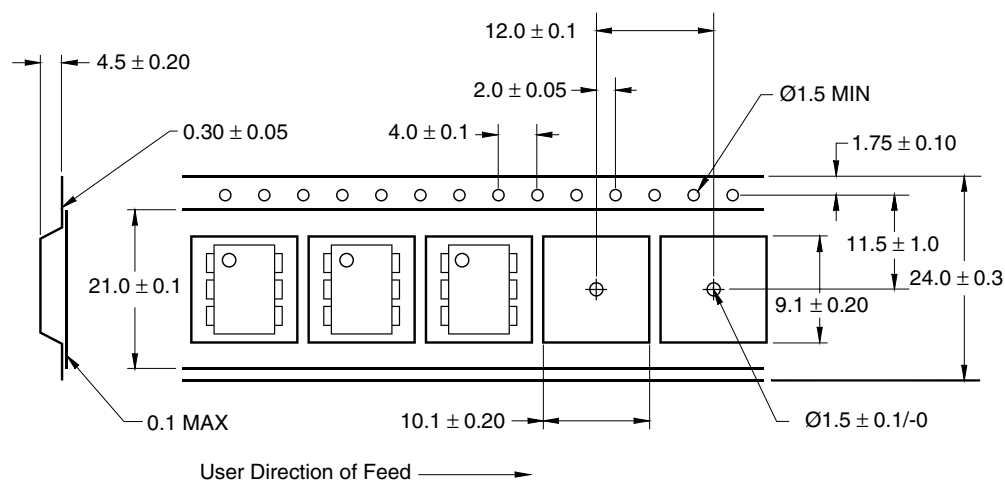
## Marking Information



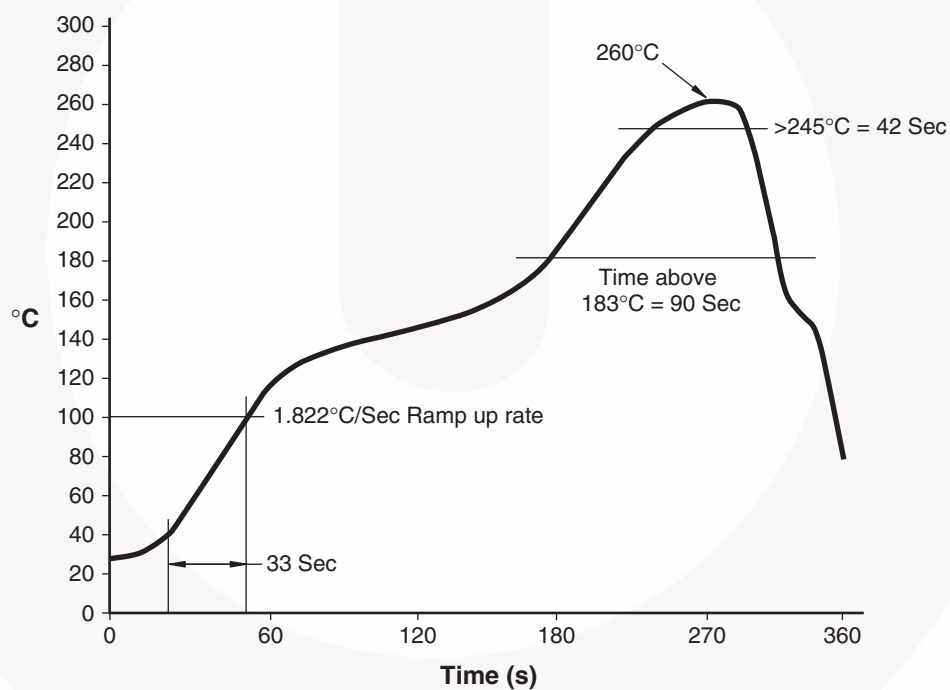
Definitions	
1	Fairchild logo
2	Device number
3	VDE mark (Note: Only appears on parts ordered with VDE option – See order entry table)
4	One digit year code, e.g., '7'
5	Two digit work week ranging from '01' to '53'
6	Assembly package code

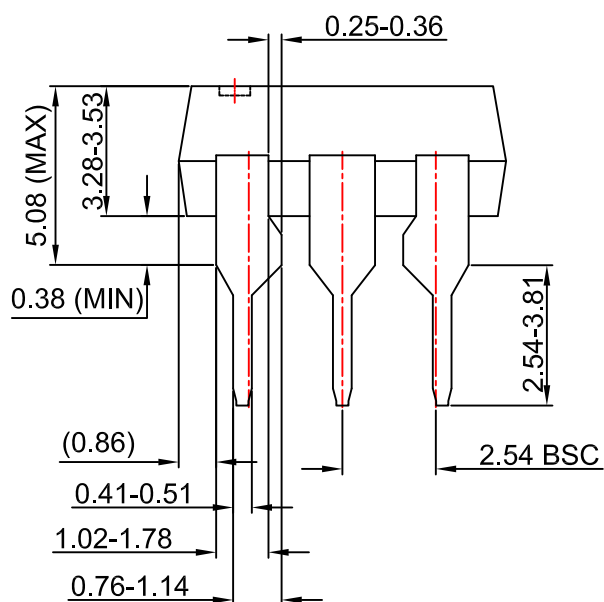
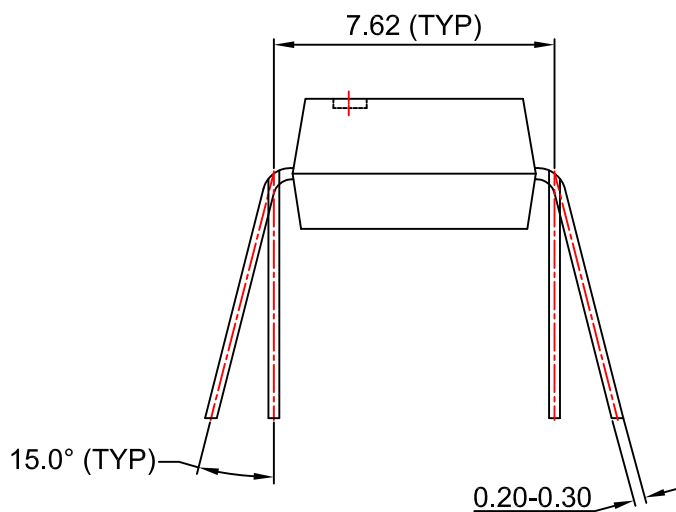
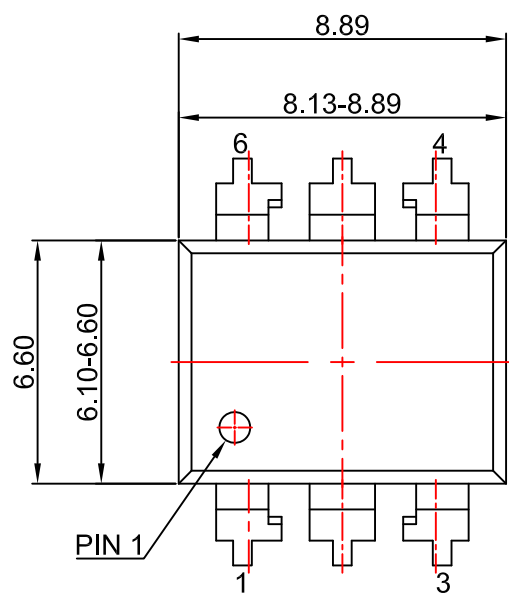
\*Note – Parts that do not have the 'V' option (see definition 3 above) that are marked with date code '325' or earlier are marked in portrait format.

## Carrier Tape Specification



## Reflow Profile

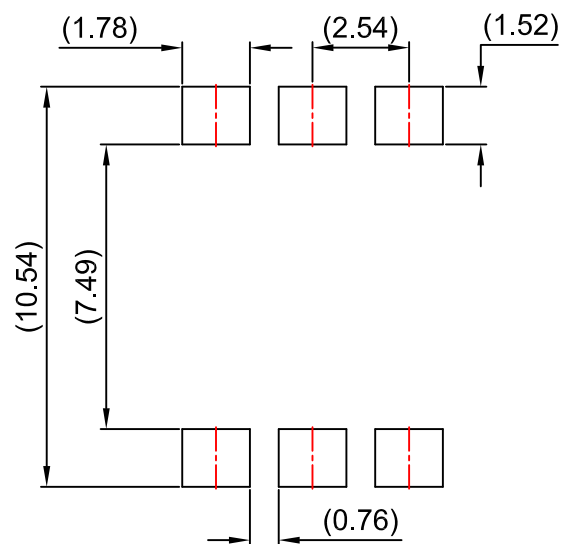
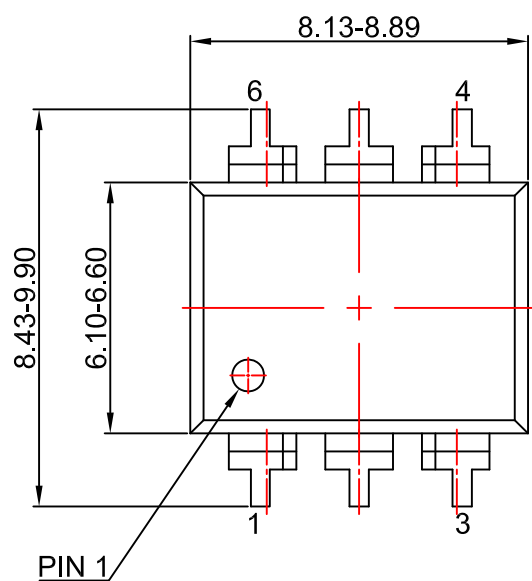




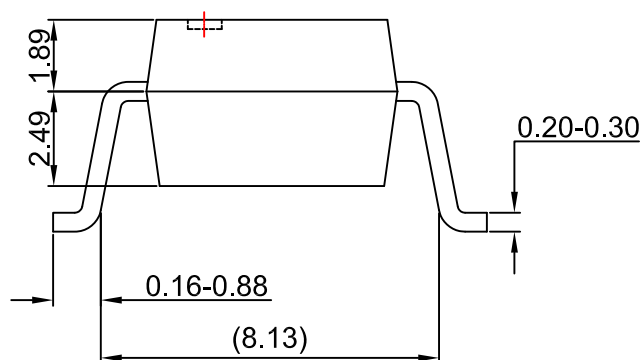
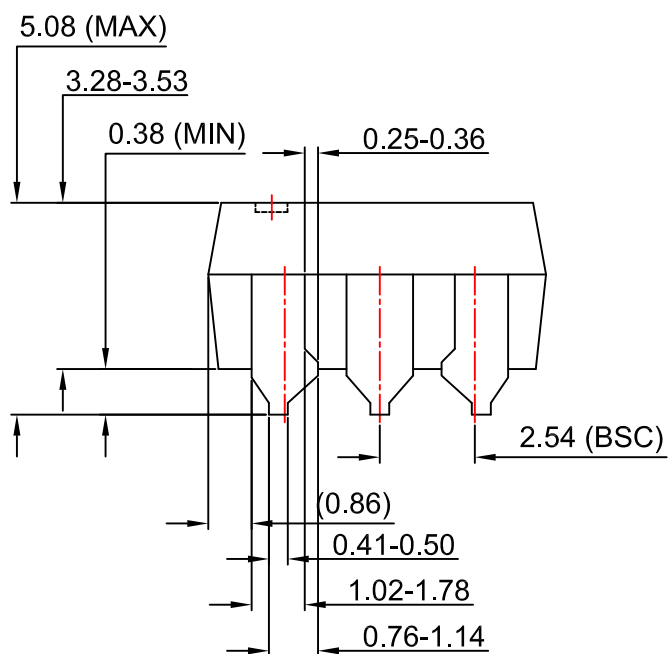
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Datasheet Identification	Product Status	Definition
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No Identification Needed	Full Production	Datasheet contains final specifications. Fairchild Semiconductor reserves the right to make changes at any time without notice to improve the design.
Obsolete	Not In Production	Datasheet contains specifications on a product that is discontinued by Fairchild Semiconductor. The datasheet is for reference information only.

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