

# General Purpose Phototransistor Optocouplers, 6-Pin

## MCT2EM, TIL111M, TIL117M

### Description

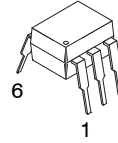
The general purpose optocouplers consist of a gallium arsenide infrared emitting diode driving a silicon photo-transistor in a standard plastic six-pin dual-in-line package.

### Features

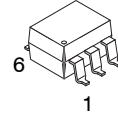
- Minimum Current Transfer Ratio at  $I_F = 10 \text{ mA}$ ,  $V_{CE} = 10 \text{ V}$ 
  - ◆ 20% for MCT2EM
  - ◆ 50% for TIL117M
- Safety and Regulatory Approvals
  - ◆ UL1577, 4,170 VAC<sub>RMS</sub> for 1 Minute
  - ◆ DIN-EN/IEC60747-5-5, 850 V Peak Working Insulation Voltage
- These are Pb-Free Devices

### Applications

- Power Supply Regulators
- Digital Logic Inputs
- Microprocessor Inputs

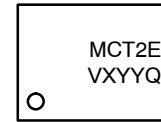


PDIP6 8.51x6.35, 2.54P  
 CASE 646BX



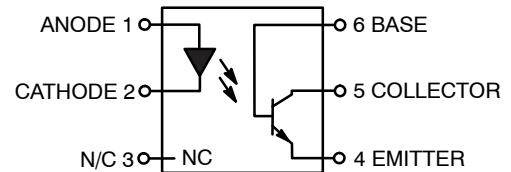
PDIP6 8.51x6.35, 2.54P  
 CASE 646BY

### MARKING DIAGRAM



- MCT2E = Device Number
- 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 7 of this data sheet.

## MCT2EM, TIL111M, TIL117M

**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-IV
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	1360	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	1594	V <sub>peak</sub>
V <sub>IORM</sub>	Maximum Working Insulation Voltage	850	V <sub>peak</sub>
V <sub>IOTM</sub>	Highest Allowable Over-Voltage	6000	V <sub>peak</sub>
	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 <sub>S</sub>	Case Temperature (Note 1)	175	°C
I <sub>S, INPUT</sub>	Input Current (Note 1)	350	mA
P <sub>S, OUTPUT</sub>	Output Power (Note 1)	800	mW
R <sub>IO</sub>	Insulation Resistance at T <sub>S</sub> , V <sub>IO</sub> = 500 V (Note 1)	>10 <sup>9</sup>	Ω

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

## MCT2EM, TIL111M, TIL117M

### ABSOLUTE MAXIMUM RATINGS ( $T_A = 25^\circ\text{C}$ unless otherwise noted)

Symbol	Parameter	Device	Value	Unit
<b>TOTAL DEVICE</b>				
$T_{STG}$	Storage Temperature	All	-40 to +125	$^\circ\text{C}$
$T_{OPR}$	Operating Temperature	All	-40 to +100	$^\circ\text{C}$
$T_J$	Junction Temperature Range	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 at $T_A = 25^\circ\text{C}$	All	250	mW
	Derate Above $25^\circ\text{C}$	All	2.94	$\text{mW}/^\circ\text{C}$
<b>EMITTER</b>				
$I_F$		All	60	mA
$V_R$	Reverse Input Voltage	TIL111M	3	V
		MCT2EM, TIL117M	6	V
$I_F(\text{pk})$	Forward Current – Peak (300 $\mu\text{s}$ , 2% Duty Cycle)	All	3	A
$P_D$	LED Power Dissipation at $T_A = 25^\circ\text{C}$	All	120	mW
	Derate Above $25^\circ\text{C}$	All	1.41	$\text{mW}/^\circ\text{C}$
<b>DETECTOR</b>				
$V_{CEO}$	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 at $T_A = 25^\circ\text{C}$	All	150	mW
	Derate Above $25^\circ\text{C}$	All	1.76	$\text{mW}/^\circ\text{C}$

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.

# MCT2EM, TIL111M, TIL117M

## ELECTRICAL CHARACTERISTICS (T<sub>A</sub> = 25°C, unless otherwise noted)

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
<b>INDIVIDUAL COMPONENT CHARACTERISTICS</b>						
<b>EMITTER</b>						
V <sub>F</sub>	Input Forward Voltage	I <sub>F</sub> = 10 mA	–	1.18	1.50	V
I <sub>R</sub>	Reverse Leakage Current	V <sub>R</sub> = 6.0 V	–	0.001	10	μA
<b>DETECTOR</b>						
BV <sub>CEO</sub>	Collector-to-Emitter Breakdown Voltage	I <sub>C</sub> = 1.0 mA, I <sub>F</sub> = 0	30	100	–	V
BV <sub>CBO</sub>	Collector-to-Base Breakdown Voltage	I <sub>C</sub> = 100 μA, I <sub>F</sub> = 0	70	120	–	V
BV <sub>EBO</sub>	Emitter-to-Base Breakdown Voltage	I <sub>E</sub> = 10 μA, I <sub>F</sub> = 0	7	10	–	V
BV <sub>ECO</sub>	Emitter-to-Collector Breakdown Voltage	I <sub>E</sub> = 100 μA, I <sub>F</sub> = 0	7	10	–	V
I <sub>CEO</sub>	Collector-to-Emitter Dark Current	V <sub>CE</sub> = 10 V, I <sub>F</sub> = 0	–	1	50	nA
I <sub>CBO</sub>	Collector-to-Base Dark Current	V <sub>CB</sub> = 10 V	–	–	20	nA
C <sub>CE</sub>	Capacitance	V <sub>CE</sub> = 0 V, f = 1 MHz	–	8	–	pF

## ELECTRICAL CHARACTERISTICS (T<sub>A</sub> = 25°C, unless otherwise noted) (continued)

Symbol	Parameter	Test Conditions	Device	Min	Typ	Max	Unit
<b>TRANSFER CHARACTERISTICS</b>							
<b>DC CHARACTERISTICS</b>							
CTR	Current Transfer Ratio, Collector-to-Emitter	I <sub>F</sub> = 10 mA, V <sub>CE</sub> = 10 V	MCT2EM	20	–	–	%
			TIL117M	50	–	–	
V <sub>CE(SAT)</sub>	Collector-to-Emitter Saturation Voltage	I <sub>C</sub> = 2 mA, I <sub>F</sub> = 16 mA	MCT2EM, TIL111M	–	–	0.4	V
		I <sub>C</sub> = 0.5 mA, I <sub>F</sub> = 10 mA	TIL117M	–	–	0.4	
<b>AC CHARACTERISTICS</b>							
T <sub>ON</sub>	Non-Saturated Turn-on Time	I <sub>F</sub> = 10 mA, V <sub>CC</sub> = 10 V, R <sub>L</sub> = 100 Ω (Figure 11)	MCT2EM	–	2	–	μs
		I <sub>C</sub> = 2 mA, V <sub>CC</sub> = 10 V, R <sub>L</sub> = 100 Ω (Figure 11)	TIL117M	–	2	10	
T <sub>OFF</sub>	Turn-off Time	I <sub>F</sub> = 10 mA, V <sub>CC</sub> = 10 V, R <sub>L</sub> = 100 Ω (Figure 11)	MCT2EM	–	2	–	μs
		I <sub>F</sub> = 2 mA, V <sub>CC</sub> = 10 V, R <sub>L</sub> = 100 Ω (Figure 11)	TIL117M	–	2	10	

## ELECTRICAL CHARACTERISTICS (T<sub>A</sub> = 25°C, unless otherwise noted) (continued)

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
<b>ISOLATION CHARACTERISTICS</b>						
V <sub>ISO</sub>	Input-Output Isolation Voltage	t = 1 Minute	4170	–	–	V <sub>ACRMS</sub>
C <sub>ISO</sub>	Isolation Capacitance	V <sub>I-O</sub> = 0 V, f = 1 MHz	–	0.2	–	pF
R <sub>ISO</sub>	Isolation Resistance	V <sub>I-O</sub> = ±500 VDC, T <sub>A</sub> = 25°C	10 <sup>11</sup>	–	–	Ω

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.

# MCT2EM, TIL111M, TIL117M

## TYPICAL PERFORMANCE CURVES

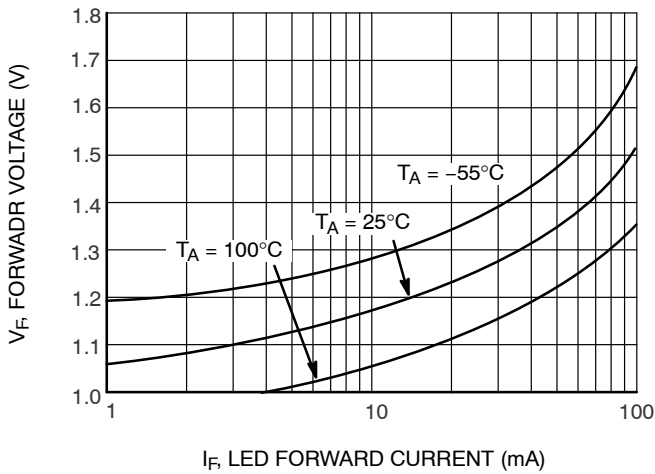


Figure 1. LED Forward Voltage vs. Forward Current

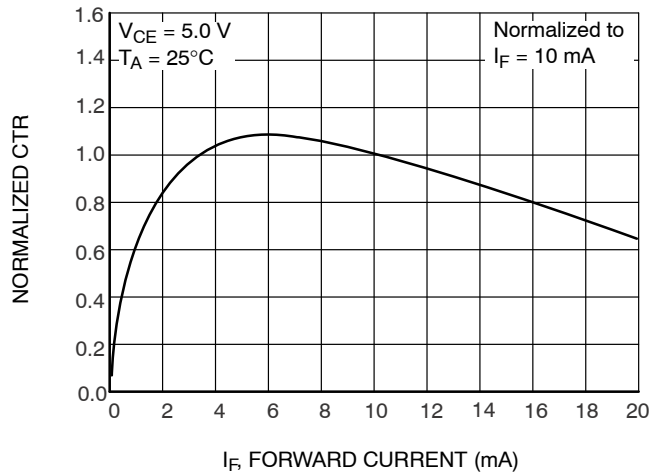


Figure 2. Normalized CTR vs. Forward Current

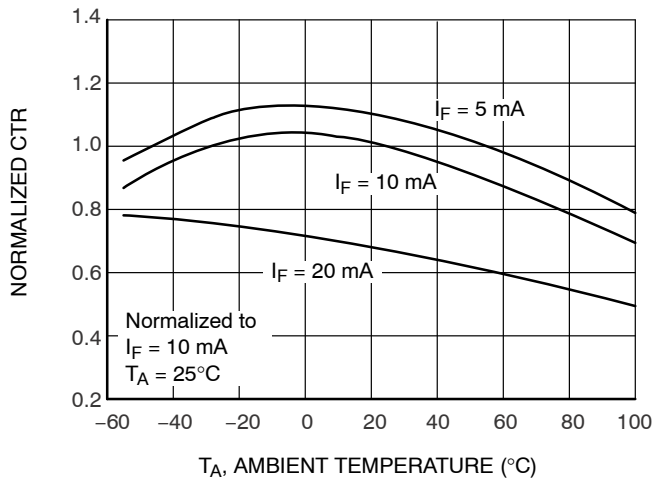


Figure 3. Normalized CTR vs. Ambient Temperature

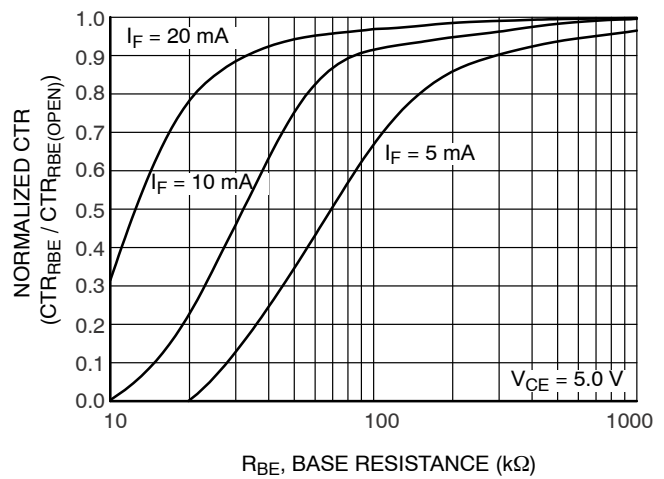


Figure 4. CTR vs. R<sub>BE</sub> (Unsaturated)

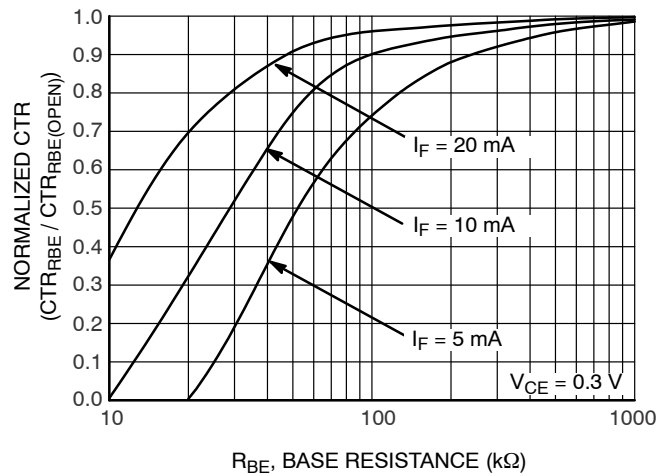


Figure 5. CTR vs. R<sub>BE</sub> (Saturated)

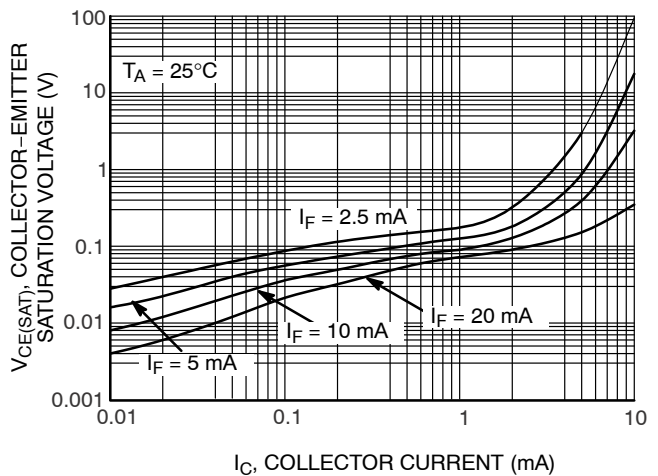


Figure 6. Collector-Emitter Saturation Voltage vs. Collector Current

# MCT2EM, TIL111M, TIL117M

## TYPICAL PERFORMANCE CURVES (continued)

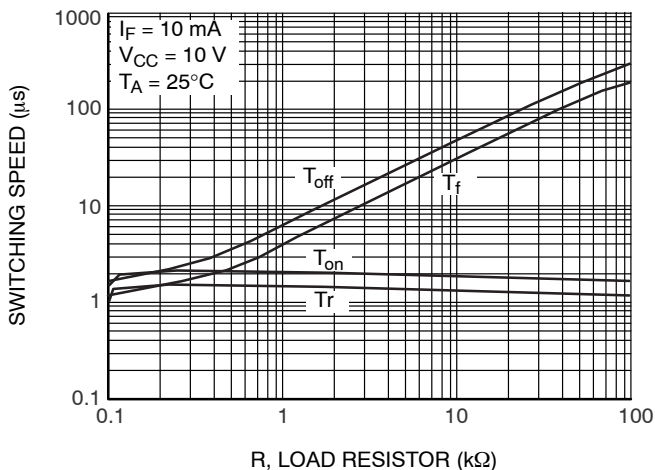


Figure 7. Switching Speed vs. Load Resistor

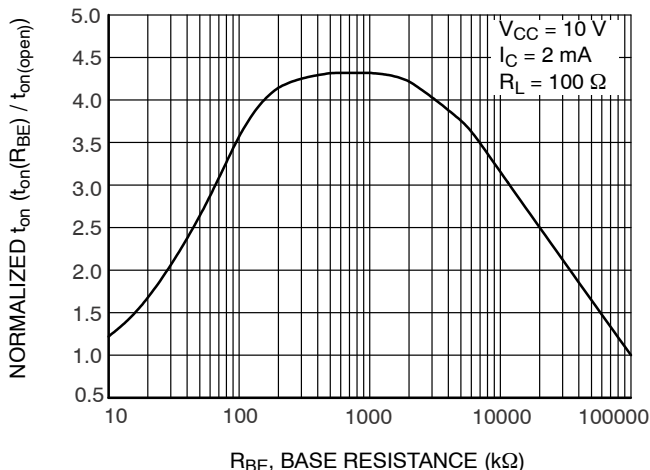


Figure 8. Normalized  $t_{on}$  vs.  $R_{BE}$

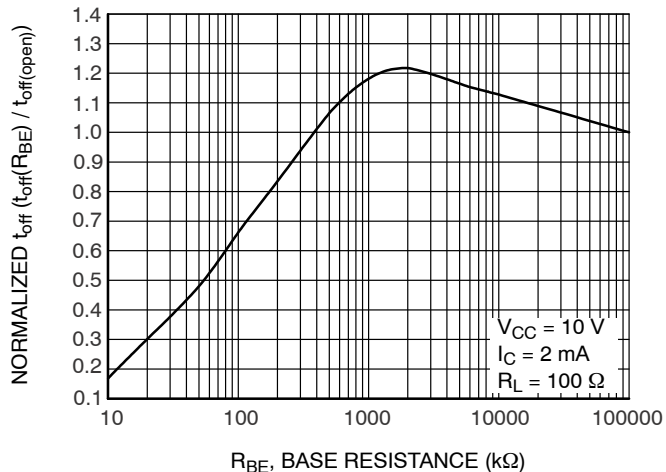


Figure 9. Normalized  $t_{off}$  vs.  $R_{BE}$

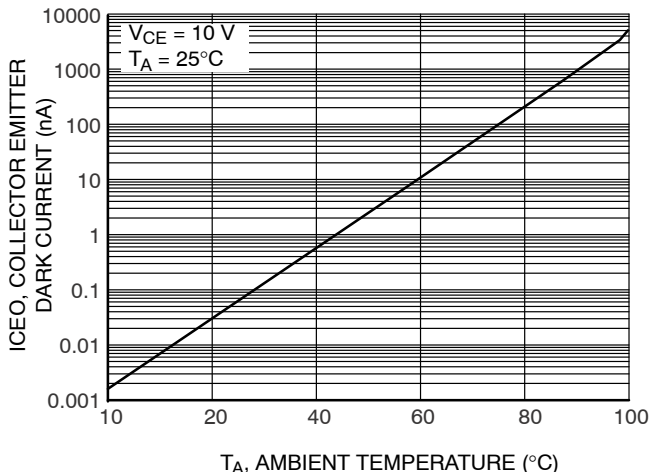


Figure 10. Dark Current vs. Ambient Temperature

### SWITCHING TIME TEST CIRCUIT AND WAVEFORMS

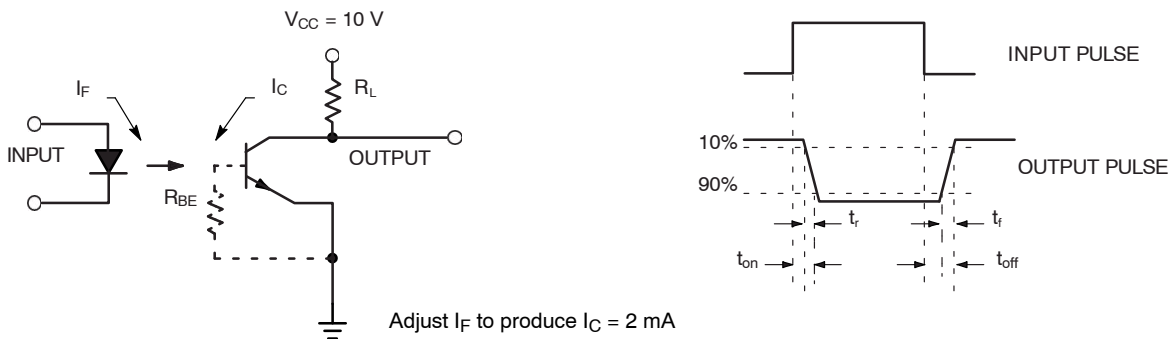


Figure 11. Switching Time Test Circuit and Waveforms

# MCT2EM, TIL111M, TIL117M

## REFLOW PROFILE

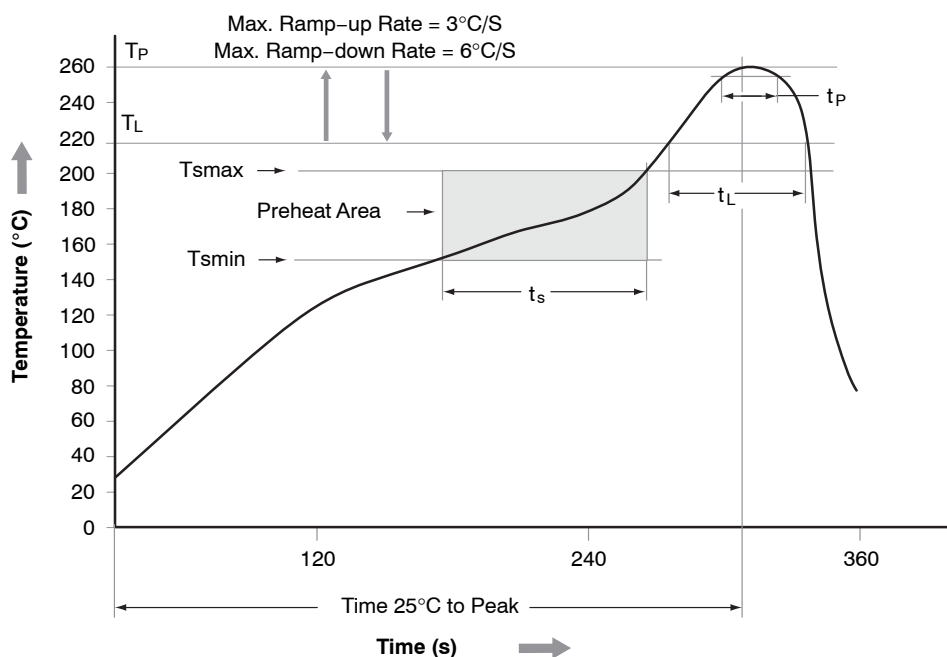


Figure 12. Reflow Profile

Table 1.

Profile Feature	Pb-Free Assembly Profile
Temperature Minimum (T <sub>min</sub> )	150°C
Temperature Maximum (T <sub>max</sub> )	200°C
Time (t <sub>s</sub> ) from (T <sub>min</sub> to T <sub>max</sub> )	60 – 120 seconds
Ramp-up Rate (t <sub>L</sub> to t <sub>p</sub> )	3°C/second maximum
Liquidous Temperature (T <sub>L</sub> )	217°C
Time (t <sub>L</sub> ) Maintained Above (T <sub>L</sub> )	60 – 150 seconds
Peak Body Package Temperature	260°C +0°C / -5°C
Time (t <sub>p</sub> ) within 5°C of 260°C	30 seconds
Ramp-down Rate (T <sub>p</sub> to T <sub>L</sub> )	6°C/second maximum
Time 25°C to Peak Temperature	8 minutes maximum

### ORDERING INFORMATION (Note 2)

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)

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

# MECHANICAL CASE OUTLINE

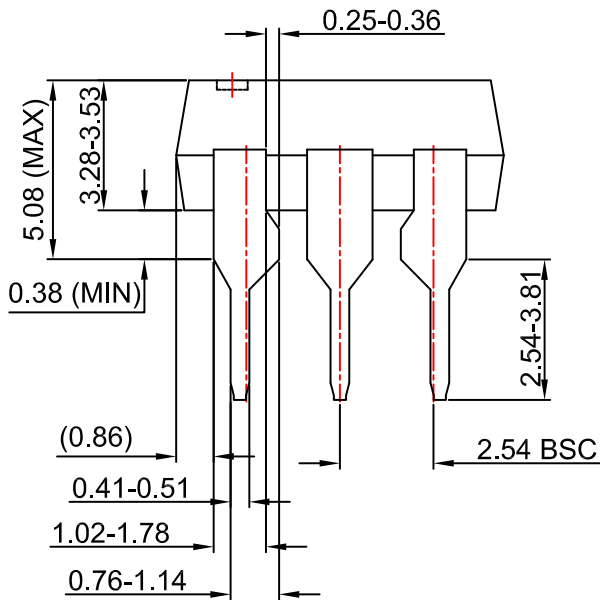
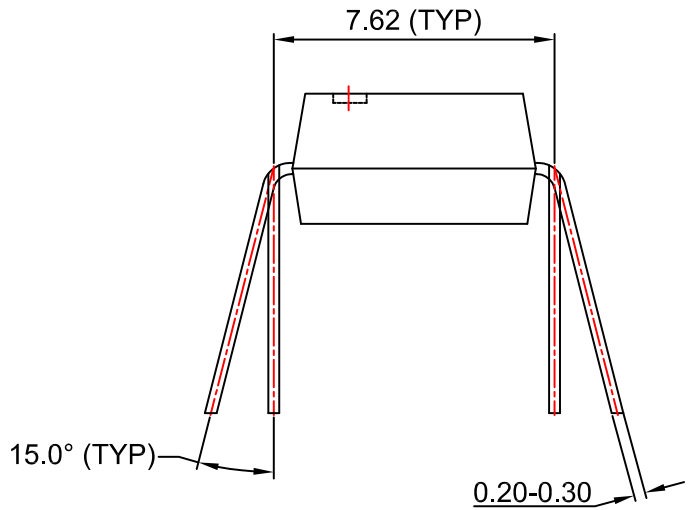
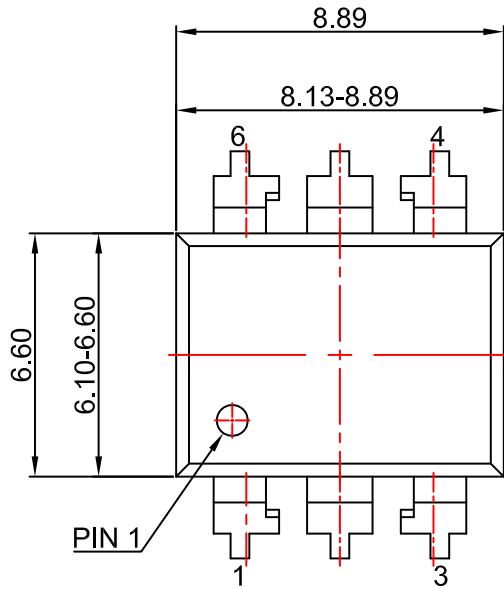
## PACKAGE DIMENSIONS

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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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# MECHANICAL CASE OUTLINE

## PACKAGE DIMENSIONS

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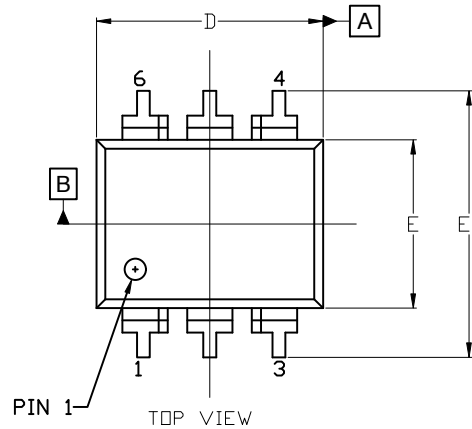


### PDIP6 8.51x6.35, 2.54P

#### CASE 646BY

#### ISSUE A

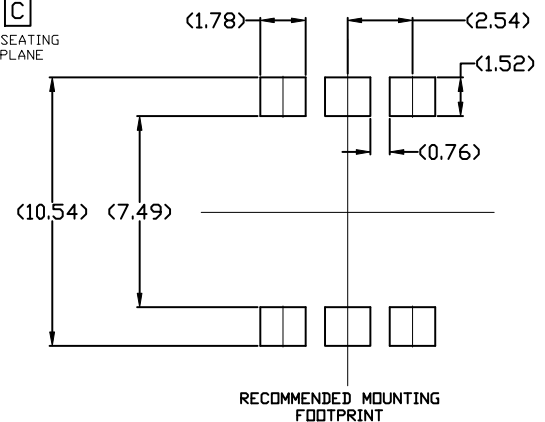
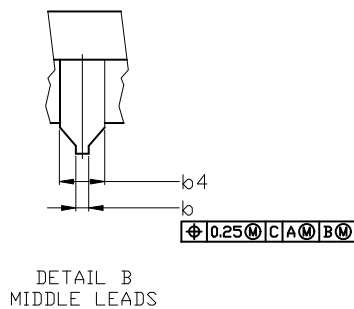
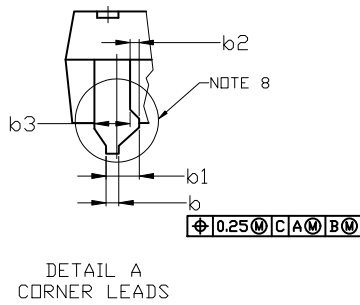
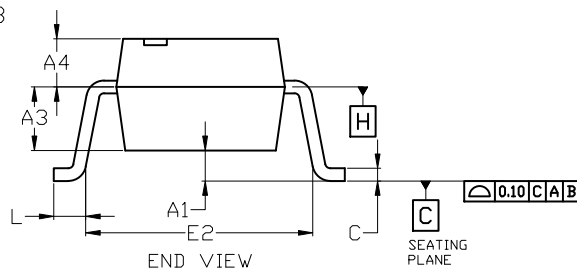
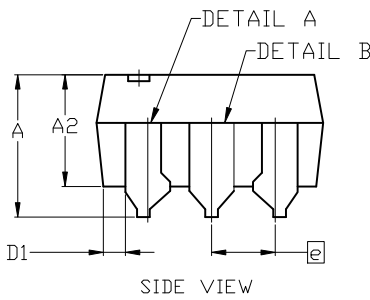
DATE 15 JUL 2019



**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 ARE 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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