

# 6-Pin General Purpose Phototransistor Optocouplers

## 4N25M, 4N26M, 4N27M, 4N28M, 4N35M, 4N36M, 4N37M

### Description

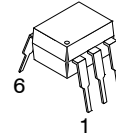
The general purpose optocouplers consist of a gallium arsenide infrared emitting diode driving a silicon phototransistor in a standard plastic 6-pin dual-in-line package.

### Features

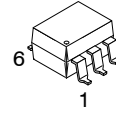
- Minimum Current Transfer Ratio at  $I_F = 10 \text{ mA}$ ,  $V_{CE} = 10 \text{ V}$ :
  - ◆ 10% for 4N27M and 4N28M
  - ◆ 20% for 4N25M and 4N26M
  - ◆ 100% for 4N35M and 4N36M and 4N37M
- Safety and Regulatory Approvals:
  - ◆ UL1577, 4,170 VAC<sub>RMS</sub> for 1 Minute
  - ◆ DIN-EN/IEC60747-5-5, 850 V Peak Working Insulation Voltage

### Applications

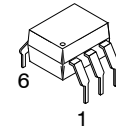
- Power Supply Regulators
- Digital Logic Inputs
- Microprocessor Inputs



PDIP6  
CASE 646BX

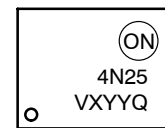


PDIP6  
S SUFFIX  
CASE 646BY



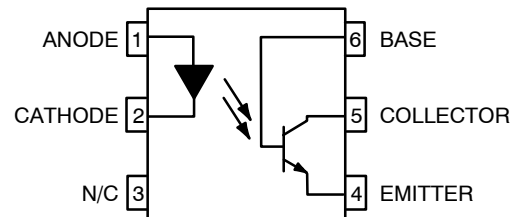
PDIP6  
T SUFFIX  
CASE 646BZ

### MARKING DIAGRAM



- ON = Logo
- 4N25 = Specific Device Code
- V = DIN EN/IEC60747-5-5 Option (only appears on component ordered with this option)
- X = One-Digit Year Code
- YY = Digit Work Week
- Q = Assembly Package Code

### SCHEMATIC



### ORDERING INFORMATION

See detailed ordering and shipping information on page 8 of this data sheet.

## 4N25M, 4N26M, 4N27M, 4N28M, 4N35M, 4N36M, 4N37M

**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.

## 4N25M, 4N26M, 4N27M, 4N28M, 4N35M, 4N36M, 4N37M

### ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Max	Unit
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#### TOTAL DEVICE

T <sub>STG</sub>	Storage Temperature	-40 to +125	°C
T <sub>OPR</sub>	Operating Temperature	-40 to +100	°C
T <sub>J</sub>	Junction Temperature	-40 to +125	°C
T <sub>SOL</sub>	Lead Solder Temperature	260 for 10 seconds	°C
P <sub>D</sub>	Total Device Power Dissipation @ T <sub>A</sub> = 25°C	270	mW
	Derate Above 25°C	2.94	mW/°C

#### EMITTER

I <sub>F</sub>	DC / Average Forward Input Current	60	mA
V <sub>R</sub>	Reverse Input Voltage	6	V
I <sub>F(pk)</sub>	Forward Current – Peak (300 μs, 2% Duty Cycle)	3	A
P <sub>D</sub>	LED Power Dissipation @ T <sub>A</sub> = 25°C	120	mW
	Derate Above 25°C	1.41	mW/°C

#### DETECTOR

V <sub>CEO</sub>	Collector-to-Emitter Voltage	30	V
V <sub>CBO</sub>	Collector-to-Base Voltage	70	V
V <sub>ECO</sub>	Emitter-to-Collector Voltage	7	V
P <sub>D</sub>	Detector Power Dissipation @ T <sub>A</sub> = 25°C	150	mW
	Derate Above 25°C	1.76	mW/°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.

## 4N25M, 4N26M, 4N27M, 4N28M, 4N35M, 4N36M, 4N37M

### ELECTRICAL CHARACTERISTICS – INDIVIDUAL COMPONENT CHARACTERISTICS

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

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
<b>EMITTER</b>						
$V_F$	Input Forward Voltage	$I_F = 10\text{ mA}$	–	1.18	1.50	V
$I_R$	Reverse Leakage Current	$V_R = 6.0\text{ V}$	–	0.001	10	$\mu\text{A}$

### DETECTOR

$BV_{CEO}$	Collector-to-Emitter Breakdown Voltage	$I_C = 1.0\text{ mA}, I_F = 0$	30	100	–	V
$BV_{CBO}$	Collector-to-Base Breakdown Voltage	$I_C = 100\ \mu\text{A}, I_F = 0$	70	120	–	V
$BV_{ECO}$	Emitter-to-Collector Breakdown Voltage	$I_E = 100\ \mu\text{A}, I_F = 0$	7	10	–	V
$I_{CEO}$	Collector-to-Emitter Dark Current	$V_{CE} = 10\text{ V}, I_F = 0$	–	1	50	nA
$I_{CBO}$	Collector-to-Base Dark Current	$V_{CB} = 10\text{ V}$	–	–	20	nA
$C_{CE}$	Capacitance	$V_{CE} = 0\text{ V}, f = 1\text{ MHz}$	–	8	–	pF

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.

### ELECTRICAL CHARACTERISTICS – TRANSFER CHARACTERISTICS ( $T_A = 25^\circ\text{C}$ unless otherwise noted)

Symbol	Parameter	Test Conditions	Device	Min	Typ	Max	Unit
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#### DC CHARACTERISTICS

CTR	Current Transfer Ratio, Collector-to-Emitter	$I_F = 10\text{ mA}, V_{CE} = 10\text{ V}$	4N35M, 4N36M, 4N37M	100	–	–	%
			4N25M, 4N26M	20	–	–	
			4N27M, 4N28M	10	–	–	
		$I_F = 10\text{ mA}, V_{CE} = 10\text{ V}, T_A = -55^\circ\text{C}$	4N35M, 4N36M, 4N37M	40	–	–	
		$I_F = 10\text{ mA}, V_{CE} = 10\text{ V}, T_A = +100^\circ\text{C}$	4N35M, 4N36M, 4N37M	40	–	–	
$V_{CE(SAT)}$	Collector-to-Emitter Saturation Voltage	$I_C = 2\text{ mA}, I_F = 50\text{ mA}$	4N25M, 4N26M, 4N27M, 4N28M	–	–	0.5	V
		$I_C = 0.5\text{ mA}, I_F = 10\text{ mA}$	4N35M, 4N36M, 4N37M	–	–	0.3	

#### AC CHARACTERISTIC

$T_{ON}$	Non-Saturated Turn-on Time	$I_F = 10\text{ mA}, V_{CC} = 10\text{ V}, R_L = 100\ \Omega$ (Figure 11)	4N25M, 4N26M, 4N27M, 4N28M	–	2	–	$\mu\text{s}$
		$I_C = 2\text{ mA}, V_{CC} = 10\text{ V}, R_L = 100\ \Omega$ (Figure 11)	4N35M, 4N36M, 4N37M	–	2	10	
$T_{OFF}$	Turn-off Time	$I_F = 10\text{ mA}, V_{CC} = 10\text{ V}, R_L = 100\ \Omega$ (Figure 11)	4N25M, 4N26M, 4N27M, 4N28M	–	2	–	$\mu\text{s}$
		$I_C = 2\text{ mA}, V_{CC} = 10\text{ V}, R_L = 100\ \Omega$ (Figure 11)	4N35M, 4N36M, 4N37M	–	2	10	

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.

### ELECTRICAL CHARACTERISTICS – ISOLATION CHARACTERISTICS ( $T_A = 25^\circ\text{C}$ unless otherwise noted)

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
$V_{ISO}$	Input-Output Isolation Voltage	$t = 1\text{ Minute}$	4170	–	–	$V_{AC_{RMS}}$
$C_{ISO}$	Isolation Capacitance	$V_{I-O} = 0\text{ V}, f = 1\text{ MHz}$	–	0.2	–	pF
$R_{ISO}$	Isolation Resistance	$V_{I-O} = \pm 500\text{ VDC}, T_A = 25^\circ\text{C}$	$10^{11}$	–	–	$\Omega$

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.

TYPICAL PERFORMANCE CURVES

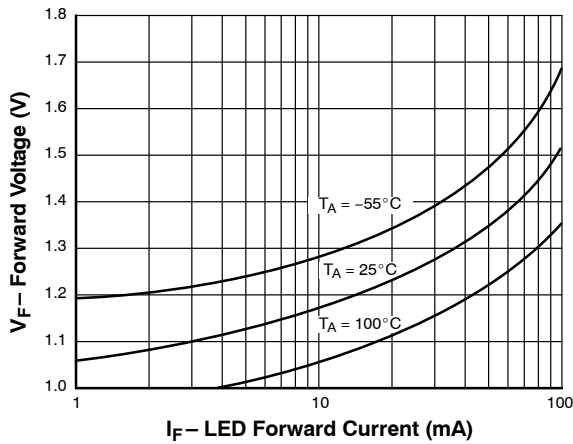


Figure 1. LED Forward Voltage vs. Forward Current

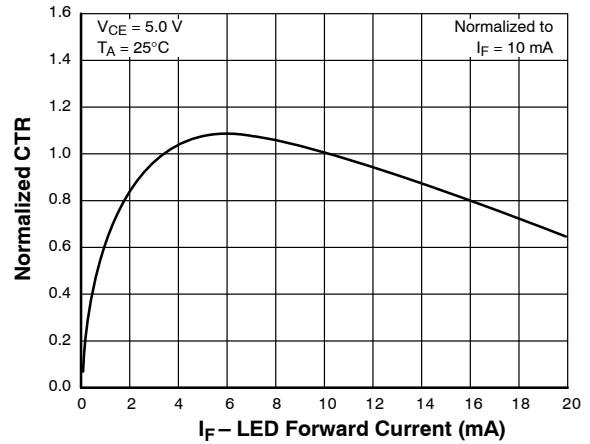


Figure 2. Normalized CTR vs. Forward Current

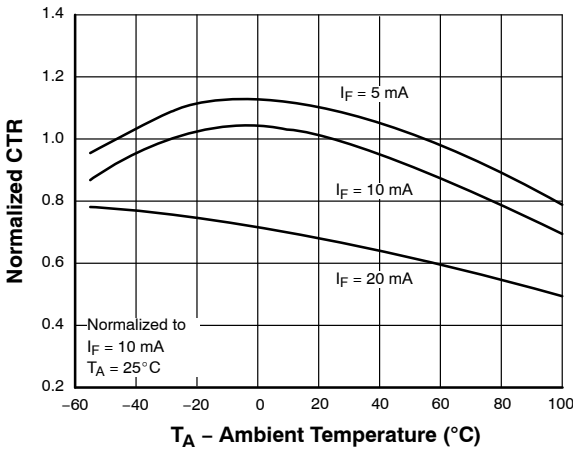


Figure 3. Normalized CTR vs. Ambient Temperature

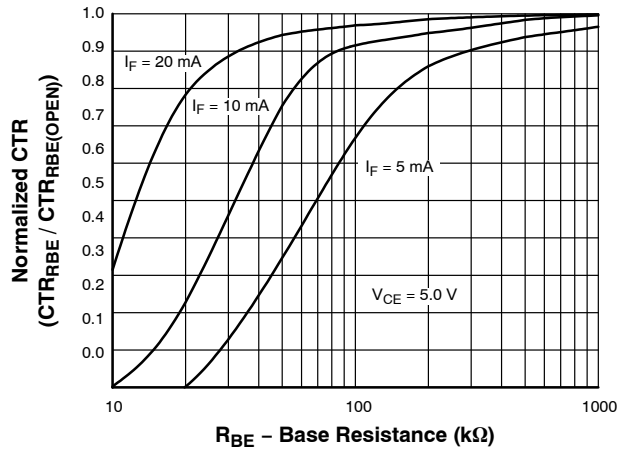


Figure 4. CTR vs. RBE (Unsaturated)

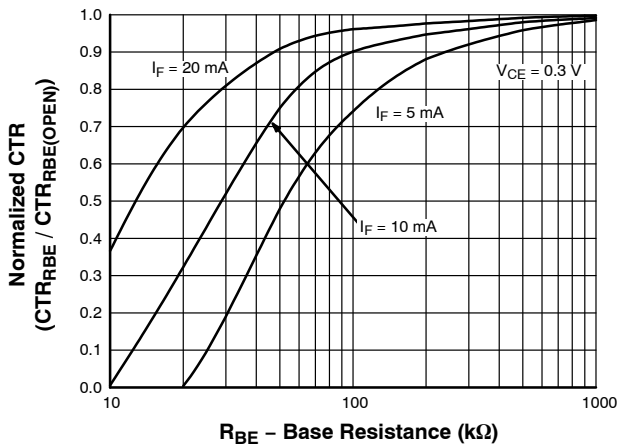


Figure 5. CTR vs. RBE (Saturated)

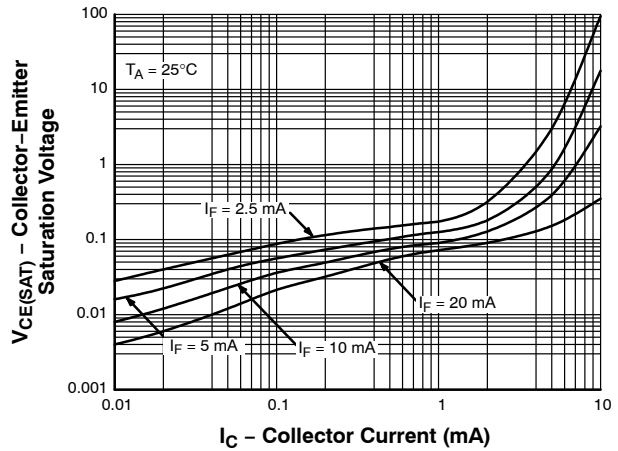


Figure 6. Collector-Emitter Saturation Voltage vs. Collector Current

# 4N25M, 4N26M, 4N27M, 4N28M, 4N35M, 4N36M, 4N37M

## TYPICAL PERFORMANCE CURVES (continued)

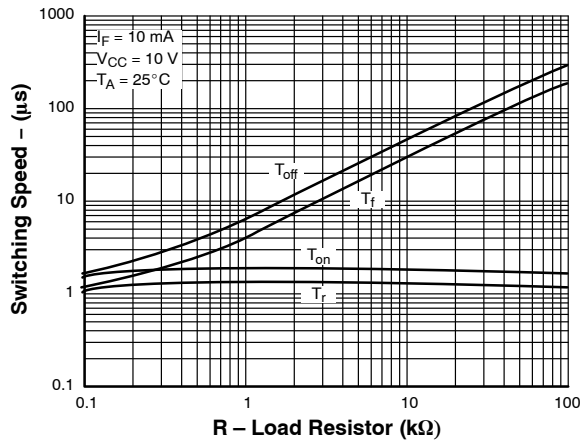


Figure 7. Switching Speed vs. Load Resistor

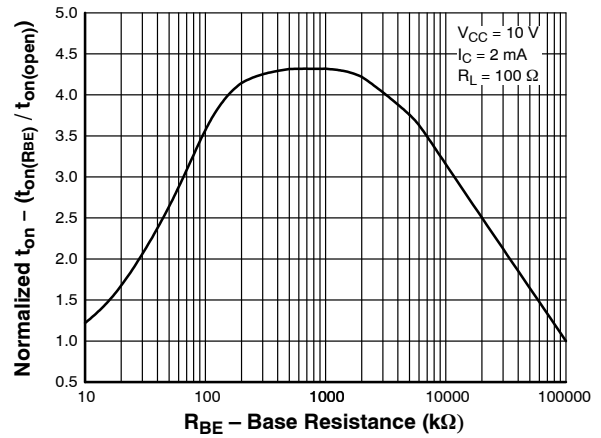


Figure 8. Normalized  $t_{on}$  vs.  $R_{BE}$

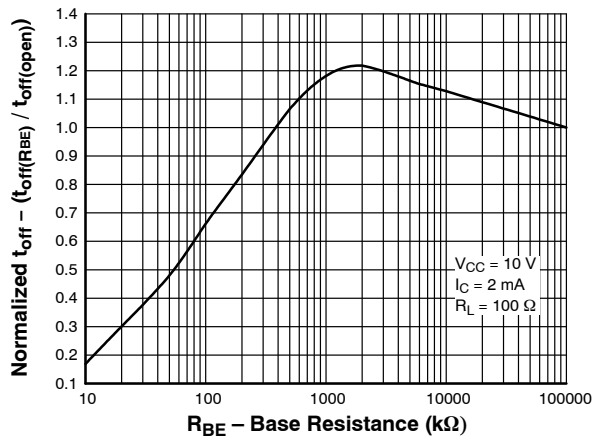


Figure 9. Normalized  $t_{off}$  vs.  $R_{BE}$

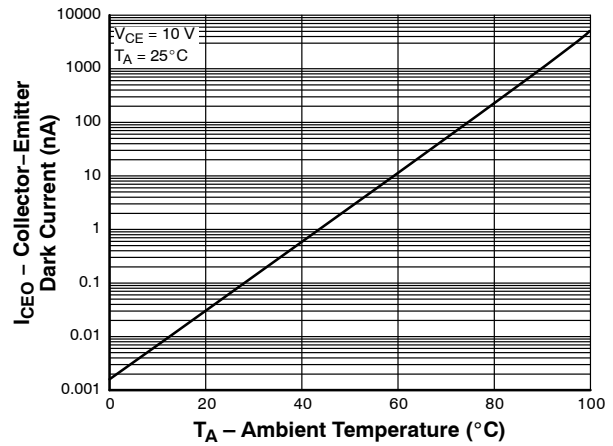


Figure 10. Dark Current vs. Ambient Temperature

## SWITCHING TIME TEST CIRCUIT AND WAVEFORMS

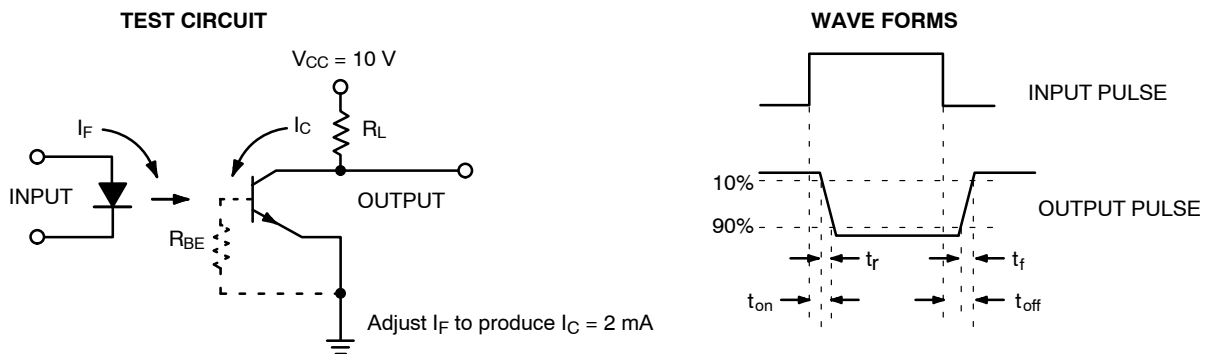
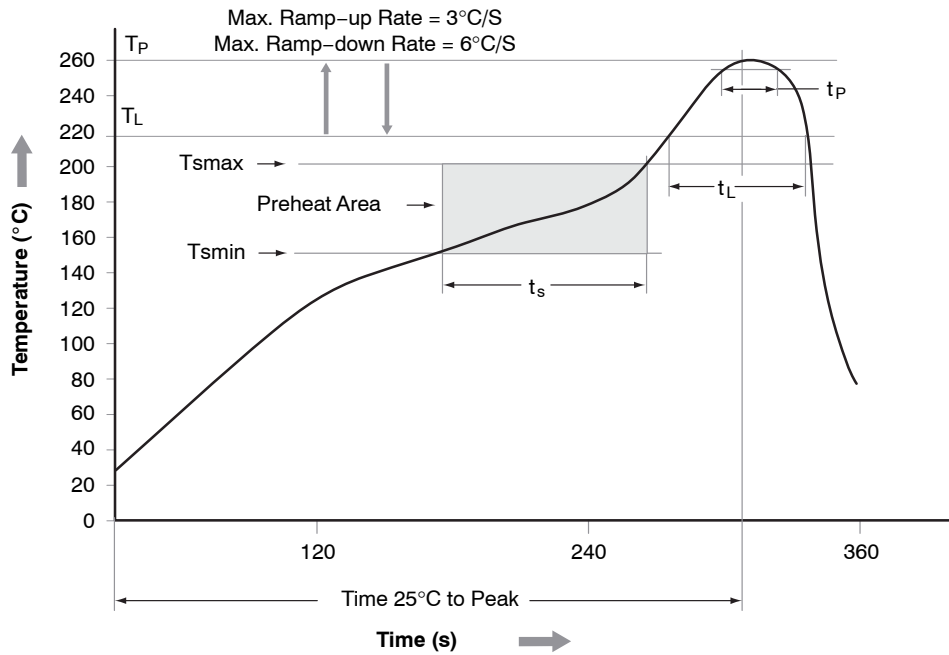


Figure 11. Switching Time Test Circuit and Waveform

REFLOW PROFILE



Profile Feature	Pb-Free Assembly Profile
Temperature Min. (Tsmín)	150°C
Temperature Max. (Tsmáx)	200°C
Time (ts) from (Tsmín to Tsmáx)	60–120 seconds
Ramp-up Rate (tL to tp)	3°C/second max.
Liquidous Temperature (TL)	217°C
Time (tL) Maintained Above (TL)	60–150 seconds
Peak Body Package Temperature	260°C +0°C / -5°C
Time (tp) within 5°C of 260°C	30 seconds
Ramp-down Rate (TP to TL)	6°C/second max.
Time 25°C to Peak Temperature	8 minutes max.

Figure 12. Reflow Profile

## 4N25M, 4N26M, 4N27M, 4N28M, 4N35M, 4N36M, 4N37M

### ORDERING INFORMATION (Note 2)

Part Number	Package	Shipping <sup>†</sup>
4N25M	DIP 6-Pin	50 Units / Tube
4N25SM	SMT 6-Pin (Lead Bend)	50 Units / Tube
4N25SR2M	SMT 6-Pin (Lead Bend)	1000 Units / Tape & Reel
4N25VM	DIP 6-Pin, DIN EN/IEC60747-5-5 Option	50 Units / Tube
4N25SVM	SMT 6-Pin (Lead Bend), DIN EN/IEC60747-5-5 Option	50 Units / Tube
4N25SR2VM	SMT 6-Pin (Lead Bend), DIN EN/IEC60747-5-5 Option	1000 Units / Tape & Reel
4N25TVM	DIP 6-Pin, 0.4" Lead Spacing, DIN EN/IEC60747-5-5 Option	50 Units / Tube

<sup>†</sup>For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

2. The product orderable part number system listed in this table also applies to the 4N26M, 4N27M, 4N28M, 4N35M, 4N36M, and 4N37M devices.



# MECHANICAL CASE OUTLINE

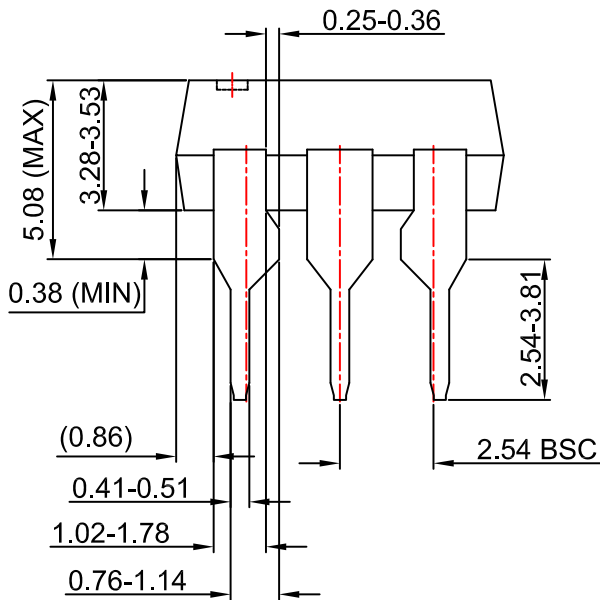
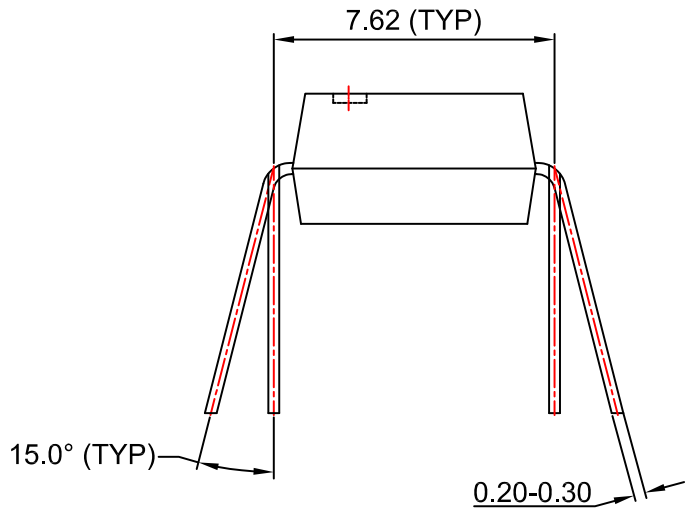
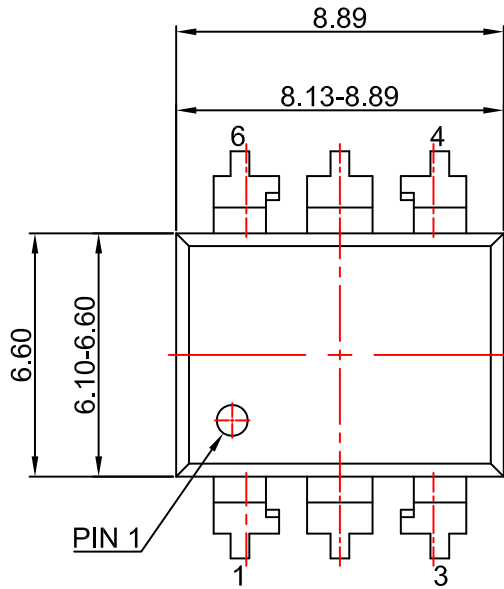
## PACKAGE DIMENSIONS

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PDIP6 8.51x6.35, 2.54P  
CASE 646BX  
ISSUE O

DATE 31 JUL 2016



NOTES:

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# MECHANICAL CASE OUTLINE

## PACKAGE DIMENSIONS

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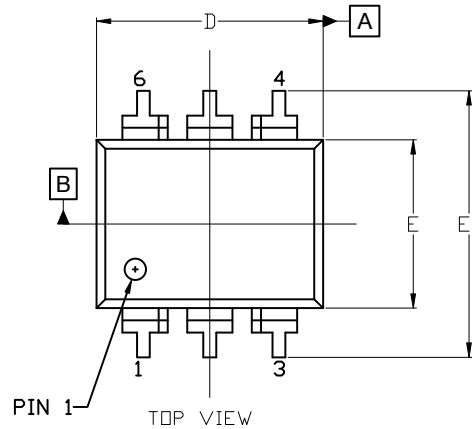


### PDIP6 8.51x6.35, 2.54P

#### CASE 646BY

#### ISSUE A

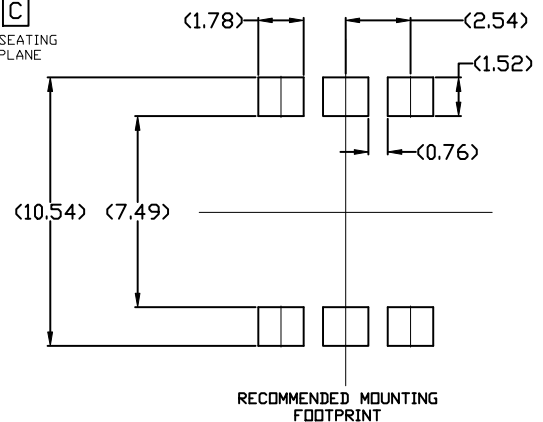
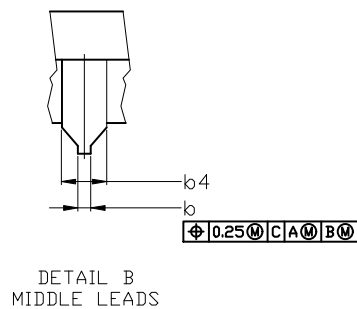
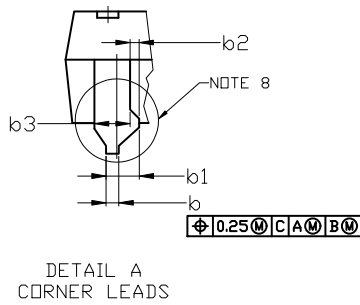
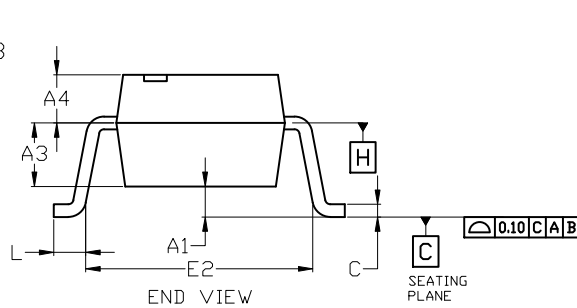
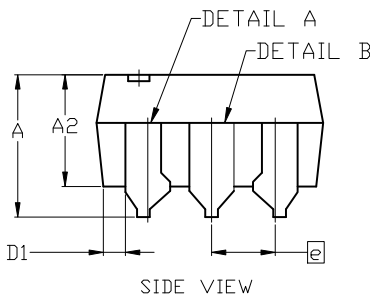
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**NOTES:**

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.

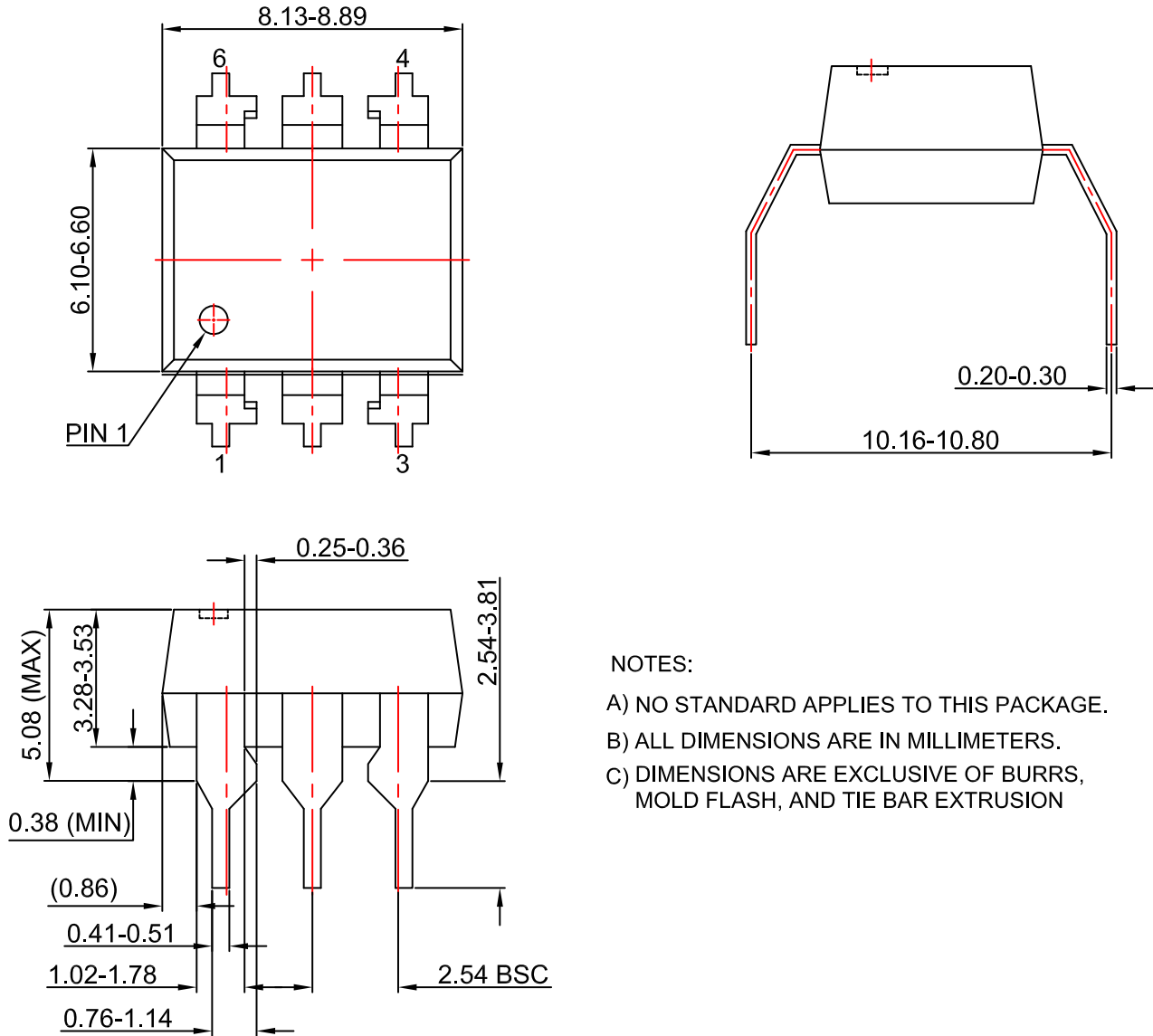
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**MECHANICAL CASE OUTLINE**  
**PACKAGE DIMENSIONS**

PDIP6 8.51x6.35, 2.54P  
CASE 646BZ  
ISSUE O

DATE 31 JUL 2016



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