

# 6-Pin General Purpose Phototransistor Optocouplers

## Product Preview **4N35**

### Description

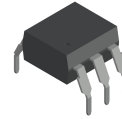
The general purpose optocouplers consist of a gallium arsenide infrared emitting diode driving a silicon phototransistor in a standard plastic 6-pin dual-in-line package.

### Features

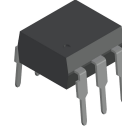
- Minimum Current Transfer Ratio at  $I_F = 10 \text{ mA}$ ,  $V_{CE} = 10 \text{ V}$ :
- 100% for 4N35
- Safety and Regulatory Approvals:
  - ◆ UL1577, 5,000  $V_{AC_{RMS}}$  for 1 Minute
  - ◆ DIN-EN/IEC60747-5-5, 850 V Peak Working Insulation Voltage (Pending)

### Applications

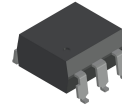
- Power Supply Regulators
- Digital Logic Inputs
- Microprocessor Inputs



PDIP6  
M TYPE  
CASE 646CG



PDIP6  
STD TYPE  
CASE 646CU



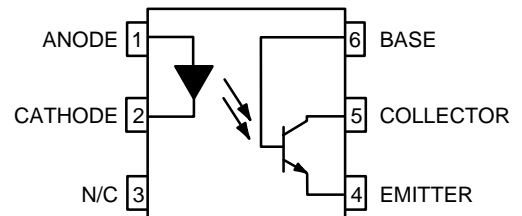
PDIP6  
S TYPE  
CASE 646CV

### MARKING DIAGRAM



- ON = Logo
- 4N35 = 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
- D = Assembly Package Code

### SCHEMATIC



### ORDERING INFORMATION

See detailed ordering and shipping information on page 7 of this data sheet.

This document contains information on a product under development. **onsemi** reserves the right to change or discontinue this product without notice.

## 4N35

**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		55/110/21
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)	≥0.4	mm
T <sub>S</sub>	Case Temperature (Note 1)	175	°C
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.

### ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Max	Unit
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#### TOTAL DEVICE

T <sub>STG</sub>	Storage Temperature	-55 to +125	°C
T <sub>OPR</sub>	Operating Temperature	-55 to +110	°C
T <sub>SOL</sub>	Lead Solder Temperature	260 for 10 seconds	°C
P <sub>D</sub>	Total Device Power Dissipation	200	mW

#### EMITTER

I <sub>F</sub>	DC / Average Forward Input Current	50	mA
V <sub>R</sub>	Reverse Input Voltage	6	V
P <sub>D</sub>	LED Power Dissipation @ T <sub>A</sub> = 25°C	70	mW
	Derate Above 100°C	3.8	mW/°C

#### DETECTOR

V <sub>CEO</sub>	Collector-to-Emitter Voltage	80	V
V <sub>CBO</sub>	Collector-to-Base Voltage	80	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 100°C	9	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.

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

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
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### EMITTER

$V_F$	Input Forward Voltage	$I_F = 10\text{ mA}$	–	1.20	1.50	V
$I_R$	Reverse Leakage Current	$V_R = 6.0\text{ V}$	–	–	10	$\mu\text{A}$
$C_{in}$	Input Capacitance	$V = 0, f = 1\text{ MHz}$	–	30	–	pF

### DETECTOR

$BV_{CEO}$	Collector-to-Emitter Breakdown Voltage	$I_C = 1.0\text{ mA}, I_F = 0$	80	–	–	V
$BV_{CBO}$	Collector-to-Base Breakdown Voltage	$I_C = 0.1\text{ mA}, I_F = 0$	80	–	–	V
$BV_{ECO}$	Emitter-to-Collector Breakdown Voltage	$I_E = 0.1\text{ mA}, I_F = 0$	7	–	–	V
$BV_{EBO}$	Emitter-to-Base Breakdown Voltage	$I_E = 0.1\text{ mA}, I_F = 0$	7	–	–	V
$I_{CEO}$	Collector-to-Emitter Dark Current	$V_{CE} = 10\text{ V}, I_F = 0$	–	–	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	Min	Typ	Max	Unit
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### DC CHARACTERISTICS

CTR	Current Transfer Ratio, Collector-to-Emitter	$I_F = 10\text{ mA}, V_{CE} = 10\text{ V}$	100	–	–	%
$V_{CE(SAT)}$	Collector-to-Emitter Saturation Voltage	$I_C = 0.5\text{ mA}, I_F = 10\text{ mA}$	–	–	0.3	V

### AC CHARACTERISTIC

$T_{on}$	Turn-on Time	$I_C = 2\text{ mA}, V_{CC} = 10\text{ V}, R_L = 100$ (Figure 11)	–	10	12	$\mu\text{s}$
$T_{off}$	Turn-off Time	$I_C = 2\text{ mA}, V_{CC} = 10\text{ V}, R_L = 100$ (Figure 11)	–	9	12	$\mu\text{s}$

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	$t = 1\text{ Minute}$	5000	–	–	$V_{AC_{RMS}}$
$C_{ISO}$	Isolation Capacitance	$V_{I-O} = 0\text{ V}, f = 1\text{ MHz}$	–	0.2	–	pF
$R_{ISO}$	Isolation Resistance	$V_{I-O} = \pm 500\text{ VDC}, T_A = 25^\circ\text{C}$	$10^{11}$	–	–	

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

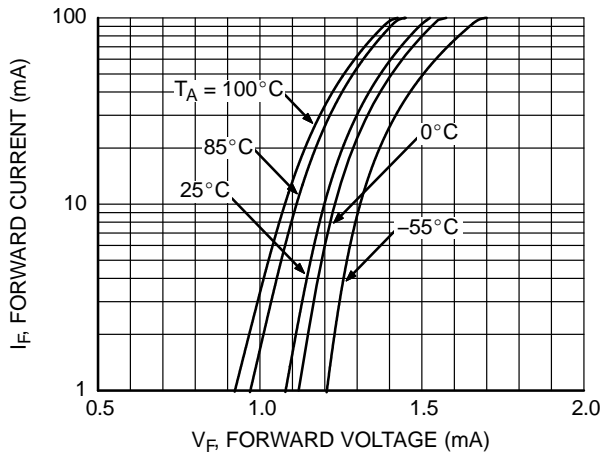


Figure 1. LED Forward Current vs. Forward Voltage

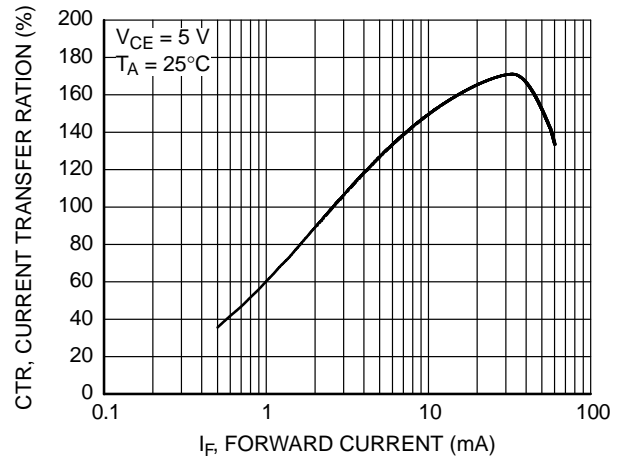


Figure 2. Current Transfer Ratio vs. Forward Current

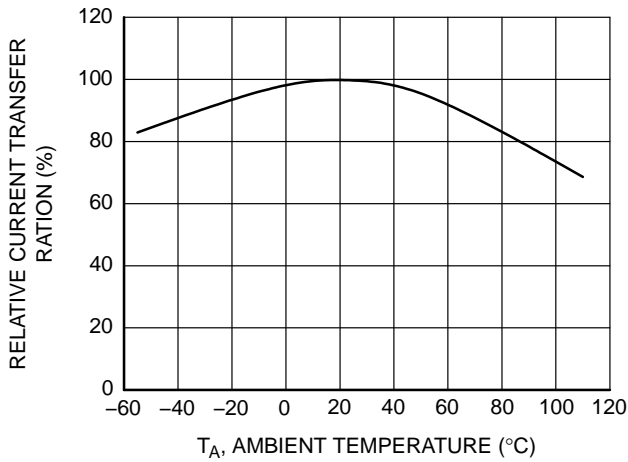


Figure 3. Relative Current Ratio vs. Ambient Temperature

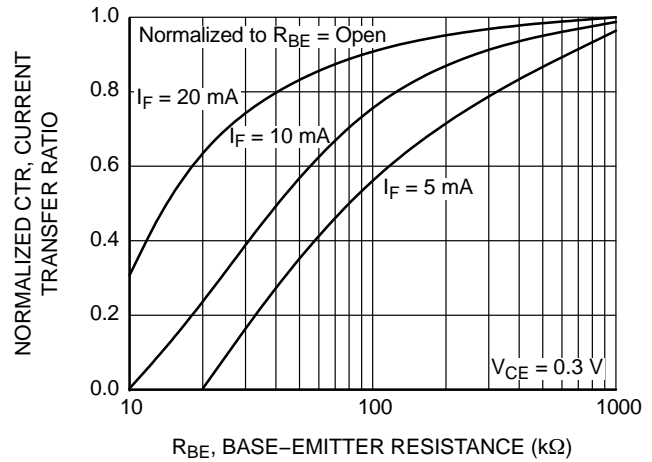


Figure 4. Current Transfer Ratio (Saturated) vs. Base-Emitter Resistance

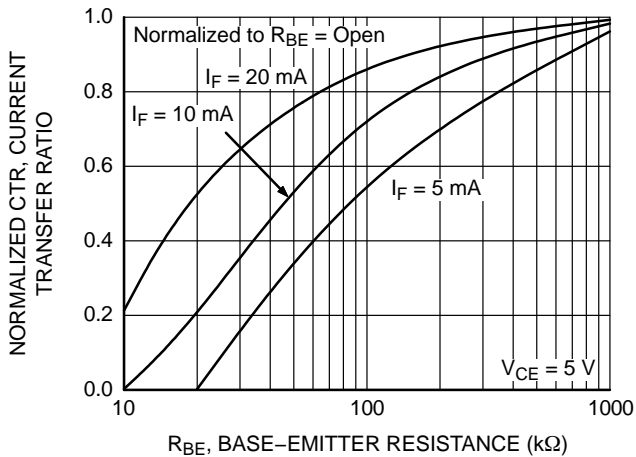


Figure 5. Current Transfer Ratio (Unsatuated) vs. Base-Emitter Resistance

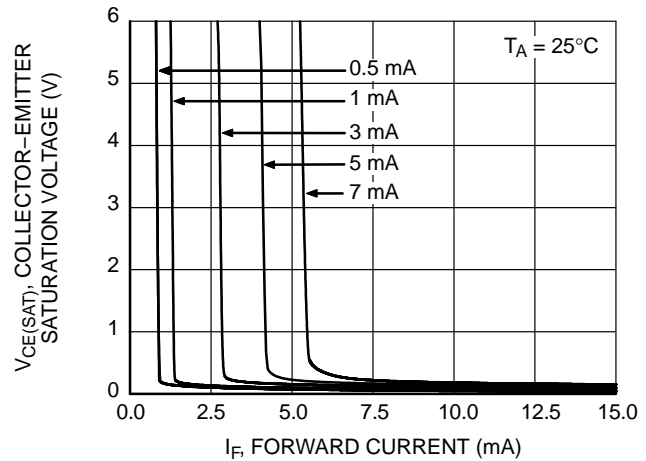


Figure 6. Collector-Emitter Saturation Voltage vs. Forward Current

TYPICAL PERFORMANCE CURVES (continued)

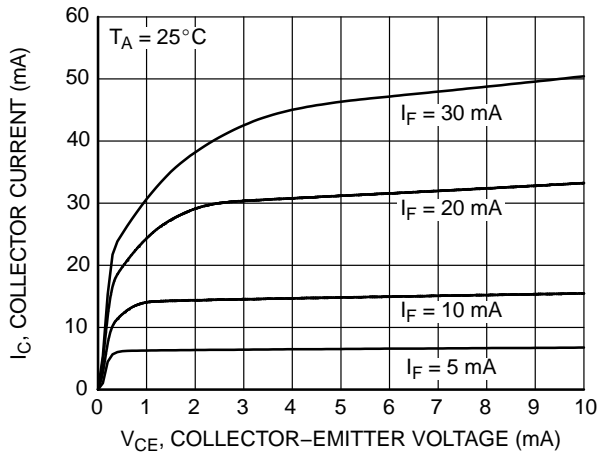


Figure 7. Collector Current vs. Collector-Emitter Voltage

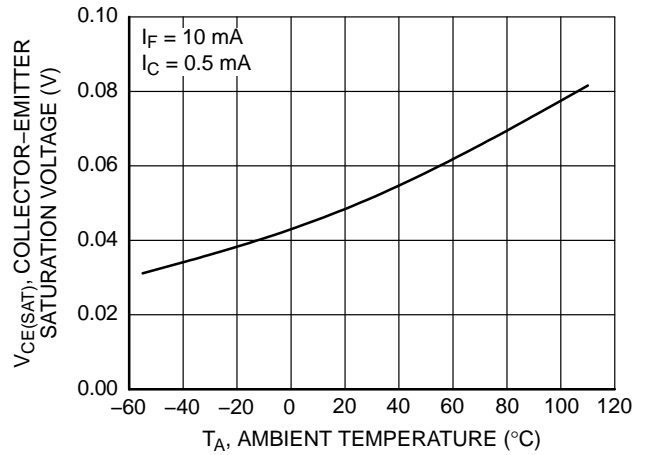


Figure 8. Collector-Emitter Saturation Voltage vs. Ambient Temperature

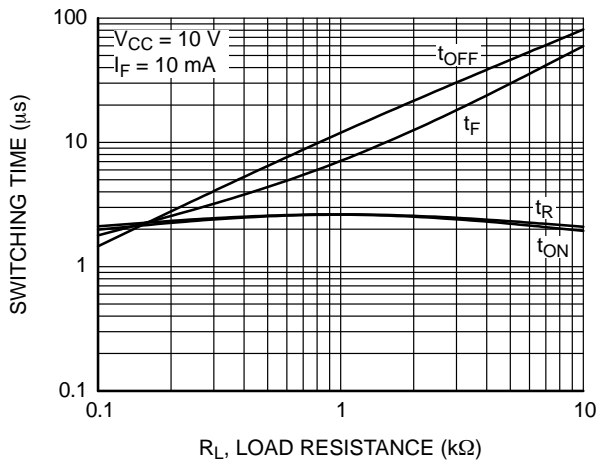


Figure 9. Switching Time vs. Load Resistance

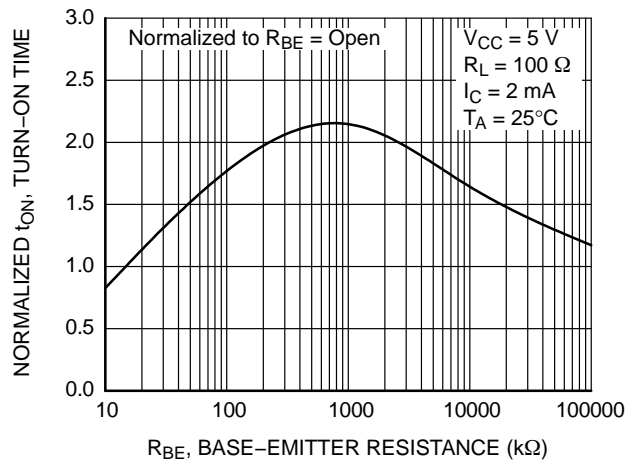


Figure 10. Turn-on Time vs. Base-Emitter Resistance

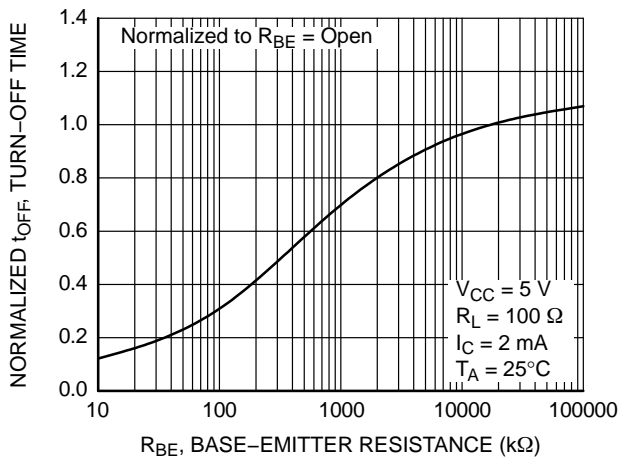


Figure 11. Turn-off Time vs. Base-Emitter Resistance

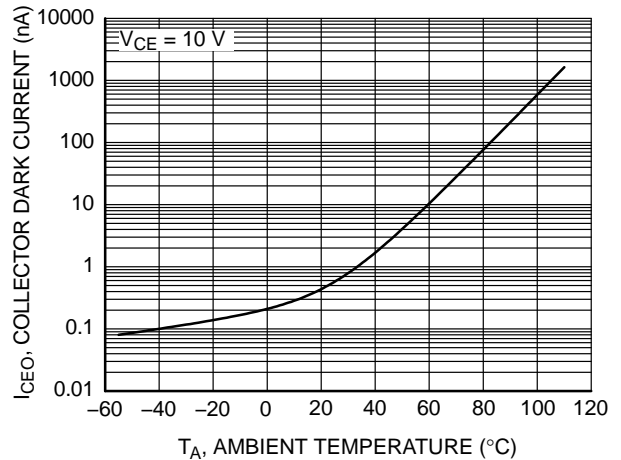


Figure 12. Collector Dark Current vs. Ambient Temperature

TYPICAL PERFORMANCE CURVES (continued)

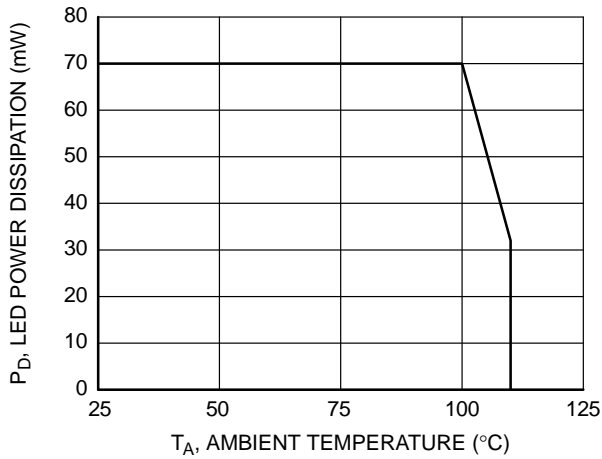


Figure 13. Max Allowable Power Dissipation (LED) vs. Ambient Temperature

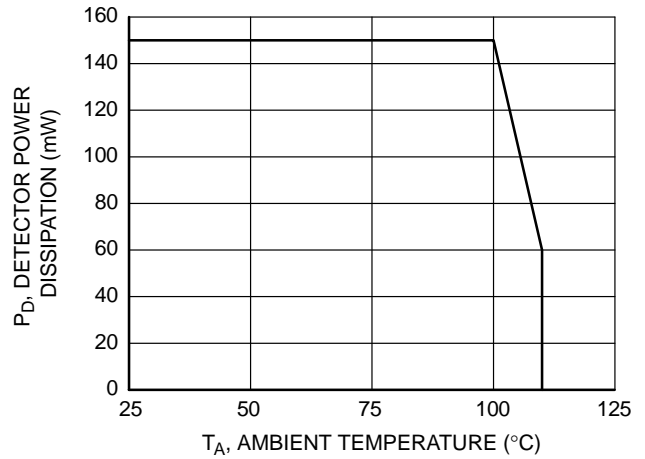


Figure 14. Max Allowable Power Dissipation (Detector) vs. Ambient Temperature

SWITCHING TIME TEST CIRCUIT AND WAVEFORMS

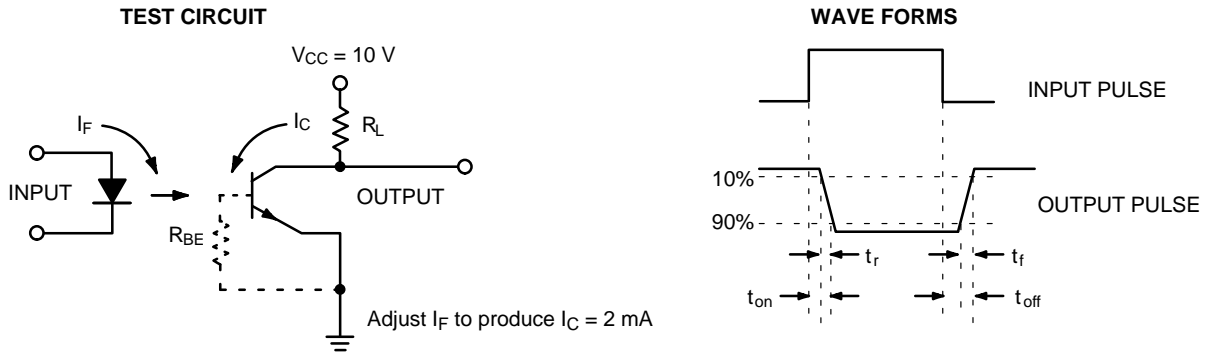
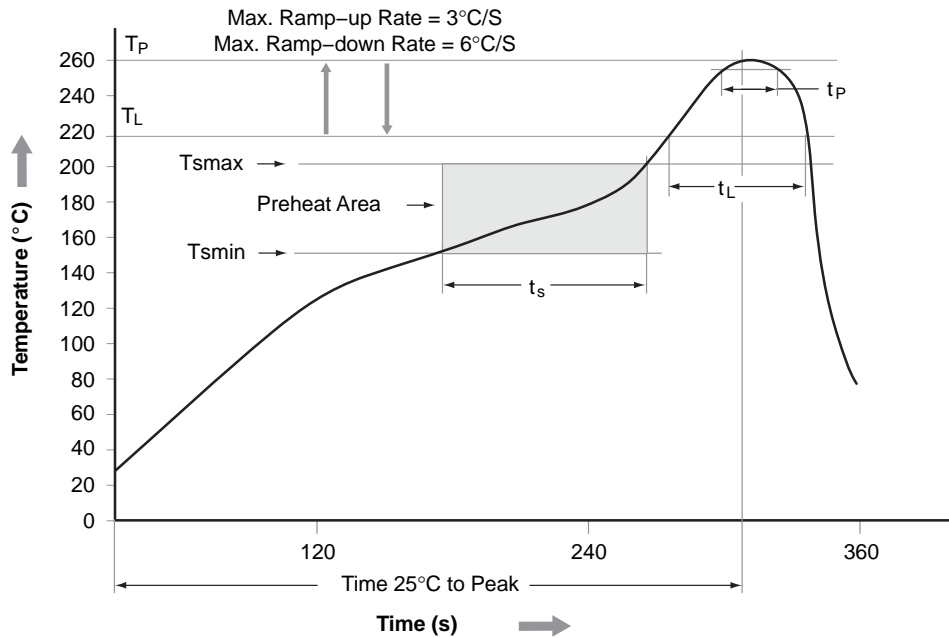


Figure 15. Switching Time Test Circuit and Waveform

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## REFLOW PROFILE



Profile Feature	Pb-Free Assembly Profile
Temperature Min. (Tsmín)	150°C
Temperature Max. (Tsmáx)	200°C
Time ( $t_s$ ) from (Tsmín to Tsmáx)	60–120 seconds
Ramp-up Rate ( $t_L$ to $t_p$ )	3°C/second max.
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 max.
Time 25°C to Peak Temperature	8 minutes max.

Figure 16. Reflow Profile

### ORDERING INFORMATION

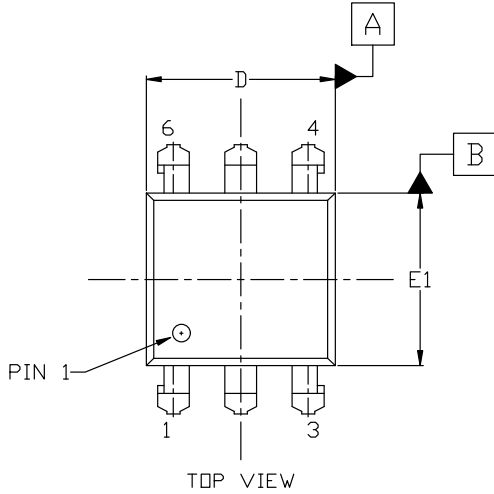
Part Number	Package	Shipping†
4N35	DIP 6-Pin	65 Units / Tube
4N35SR2	SMT 6-Pin (Lead Bend)	1000 Units / Tape & Reel
4N35SR2V	SMT 6-Pin (Lead Bend), DIN EN/IEC60747-5-5 Option	1000 Units / Tape & Reel
4N35TV	DIP 6-Pin, 0.4" Lead Spacing, DIN EN/IEC60747-5-5 Option	65 Units / Tube

†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.

# 4N35

## PACKAGE DIMENSIONS

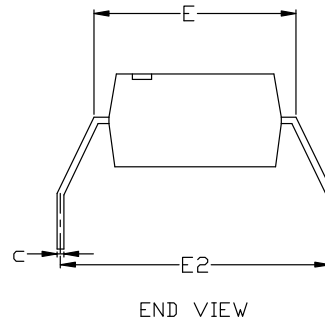
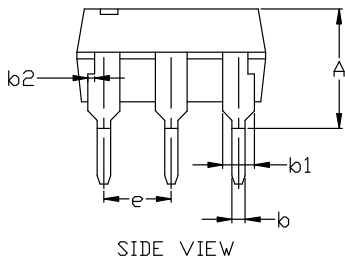
**PDIP6 7.12x6.50, 2.54P (M TYPE)**  
CASE 646CG  
ISSUE O



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
- D) DRAWING FILENAME AND REVISION: MKT-N06Drev4

DIM	MILLIMETERS		
	MIN.	NOM.	MAX.
A	4.20	4.50	4.80
b	0.40	0.50	0.60
b1	1.10	1.20	1.30
b2	0.24	0.25	0.26
c	0.25 REF		
D	6.82	7.12	7.32
E	7.62 TYP		
E1	6.20	6.50	6.80
E2	10.16 TYP		
e	2.54 TYP		

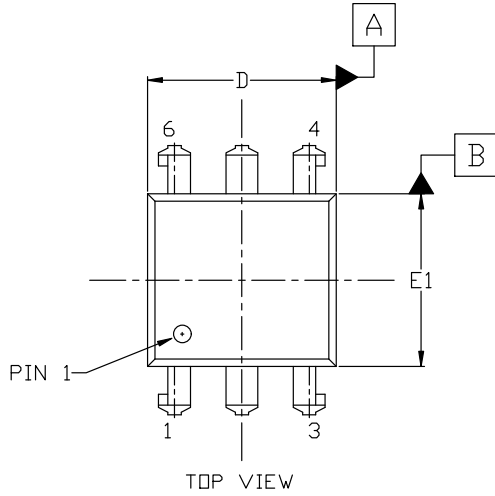




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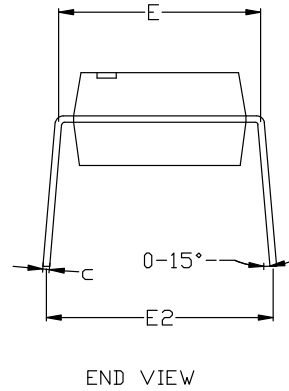
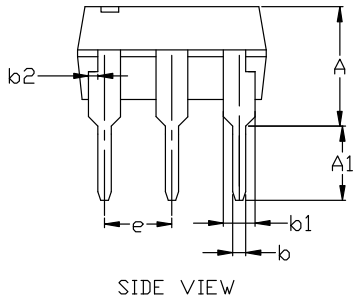
**PDIP6 7.12x6.50, 2.54P (STD TYPE)**  
CASE 646CU  
ISSUE O



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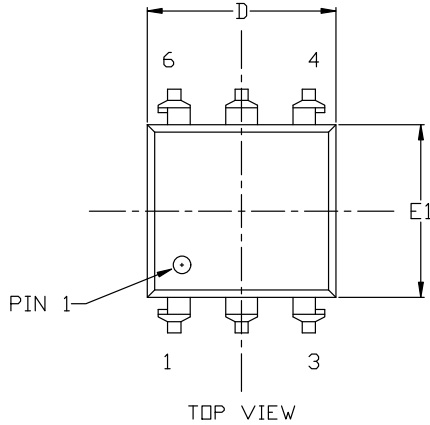
DIM	MILLIMETERS		
	MIN.	NOM.	MAX.
A	4.20	4.50	4.80
A1	2.30	2.80	3.30
b	0.40	0.50	0.60
b1	1.10	1.20	1.30
b2	0.34	0.35	0.36
c	0.25 REF		
D	6.82	7.12	7.32
E	7.62 TYP		
E1	6.20	6.50	6.80
E2	7.62	---	9.50
e	2.54 TYP		



# 4N35

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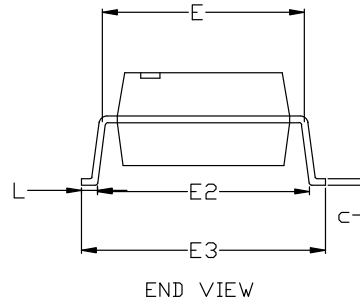
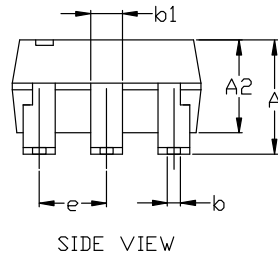
### PDIP6 7.12x6.50, 2.54P (S TYPE) CASE 646CV ISSUE O



#### NOTES:

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DIM	MILLIMETERS		
	MIN.	NOM.	MAX.
A	4.00	4.30	4.60
A2	3.20	3.50	3.80
b	0.40	0.50	0.60
b1	1.10	1.20	1.30
c	0.25 REF		
D	6.82	7.12	7.32
E	7.62 TYP		
E1	6.20	6.50	6.80
E2	8.00	---	---
E3	---	---	10.3
e	2.54 TYP		



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