

# 6-Pin DIP Phototransistor Optocouplers

## H11AG1M

### Description

The H11AG1M device consists of a Gallium–Aluminum– Arsenide IRED emitting diode coupled with a silicon phototransistor in a dual in–line package. This device provides the unique feature of high current transfer ratio at both low output voltage and low input current. This makes it ideal for use in low–power logic circuits, telecommunications equipment and portable electronics isolation applications.

### Features

- High–Efficiency Low–Degradation Liquid Epitaxial IRED
- Logic Level Compatible, Input and Output Currents, with CMOS and LS/TTL
- High DC Current Transfer Ratio at Low Input Currents (as low as 200  $\mu$ A)
- 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

- CMOS Driven Solid State Reliability
- Telephone Ring Detector
- Digital Logic Isolation

### SCHEMATIC

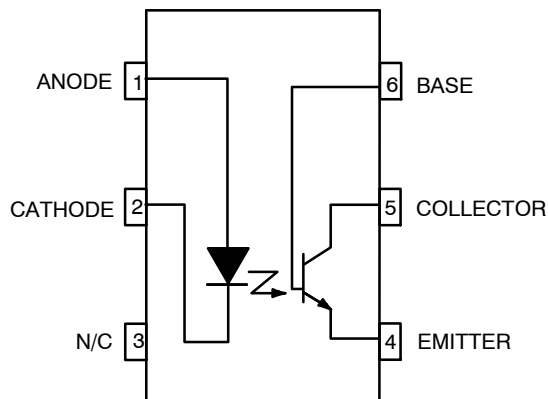
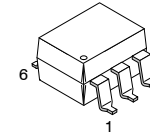
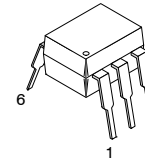


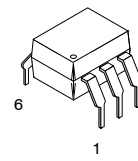
Figure 1. Schematic



PDIP6  
CASE 646BY

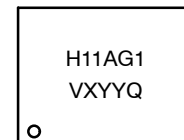


PDIP6  
CASE 646BX



PDIP6  
CASE 646BZ

### MARKING DIAGRAM



H11AG1 = Device Number  
 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

### ORDERING INFORMATION

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

# H11AG1M

## SAFETY AND INSULATION RATINGS

Parameter		Characteristic
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

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.

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

## ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
<b>TOTAL DEVICE</b>			
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 s	°C
P <sub>D</sub>	Total Device Power Dissipation @ 25°C(LED plus detector)	225	mW
	Derate Linearly From 25°C	3.5	mW/°C
<b>EMITTER</b>			
I <sub>F</sub>	Continuous Forward Current	50	mA
V <sub>R</sub>	Reverse Voltage	6.0	W
I <sub>F</sub> (pk)	Forward Current – Peak (1 μs pulse 300 pps)	3.0	A
P <sub>D</sub>	Led Power Dissipation @ T <sub>A</sub> = 25°C	75	mW
	Derate Linearly From 25°C	1.0	mW/°C
<b>DETECTOR</b>			
I <sub>C</sub>	Continuous Collector Current	50	mA
P <sub>D</sub>	Total Power Dissipation @ T <sub>A</sub> = 25°C	150	mW
	Derate Linearly From 25°C	2.0	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.

# H11AG1M

## ELECTRICAL CHARACTERISTICS

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

### INDIVIDUAL COMPONENT CHARACTERISTICS

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

$V_F$	Input Forward Voltage	$I_F = 1\text{ mA}$	–	1.25	1.50	V
$I_R$	Reverse Leakage Current	$V_R = 5\text{ V}$ , $T_A = 25^\circ\text{C}$	–	–	10	$\mu\text{A}$
$C_J$	Capacitance	$V_F = 0\text{ V}$ , $f = 1.0\text{ MHz}$	–	–	100	pF

#### DETECTOR

$BV_{CEO}$	Breakdown Voltage, Collector-to-Emitter	$I_C = 1\text{ mA}$ , $I_F = 0$	30	–	–	V
$BV_{CBO}$	Breakdown Voltage, Collector-to-Base	$I_C = 100\text{ }\mu\text{A}$ , $I_F = 0$	70	–	–	V
$BV_{ECO}$	Breakdown Voltage, Emitter-to-Collector	$I_C = 100\text{ }\mu\text{A}$ , $I_F = 0$	7	–	–	V
$I_{CEO}$	Leakage Current, Collector-to-Emitter	$V_{CE} = 10\text{ V}$ , $I_F = 0$	–	5	10	nA
$C_{CE}$	Capacitance	$V_{CE} = 10\text{ V}$ , $f = 1\text{ MHz}$	–	10	–	pF

### TRANSFER CHARACTERISTICS

Symbol	Characteristics	Test Conditions	Min.	Typ.	Max.	Unit
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#### DC CHARACTERISTICS

CTR	Current Transfer Ratio	$I_F = 1\text{ mA}$ , $V_{CE} = 5\text{ V}$	300	–	–	%
		$I_F = 1\text{ mA}$ , $V_{CE} = 0.6\text{ V}$	100	–	–	%
		$I_F = 0.2\text{ mA}$ , $V_{CE} = 1.5\text{ V}$	100	–	–	%
$V_{CE(SAT)}$	Saturation Voltage	$I_C = 2.0\text{ mA}$ , $I_F = 0.5\text{ mA}$	–	–	0.40	V

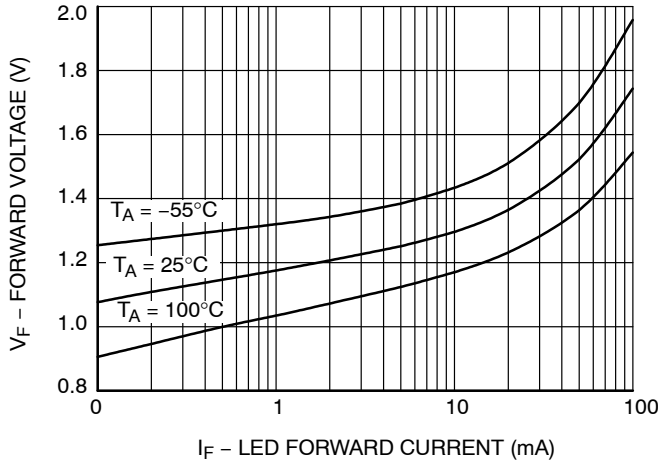
#### AC CHARACTERISTICS (NON-SATURATED SWITCHING TIMES)

$t_{on}$	Turn-On Time	$R_L = 100\text{ }\Omega$ , $I_F = 1\text{ mA}$ , $V_{CC} = 5\text{ V}$	–	5	–	$\mu\text{s}$
$t_{off}$	Turn-Off Time	$R_L = 100\text{ }\Omega$ , $I_F = 1\text{ mA}$ , $V_{CC} = 5\text{ V}$	–	5	–	$\mu\text{s}$

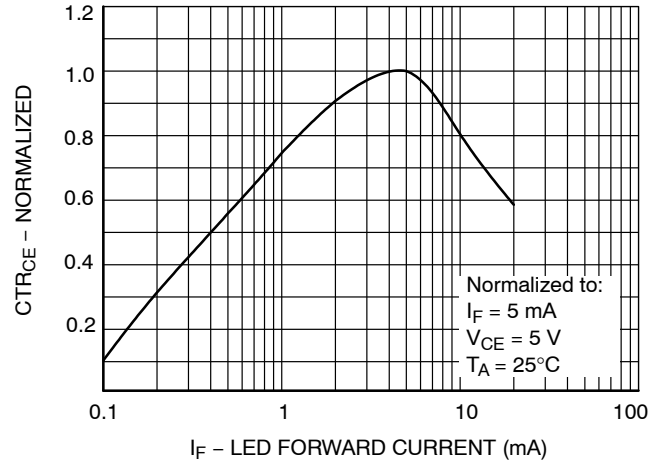
### ISOLATION CHARACTERISTICS

Symbol	Characteristics	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	$V_{I-O} = \pm 500\text{ VDC}$ , $T_A = 25^\circ\text{C}$	$10^{11}$	–	–	$\Omega$

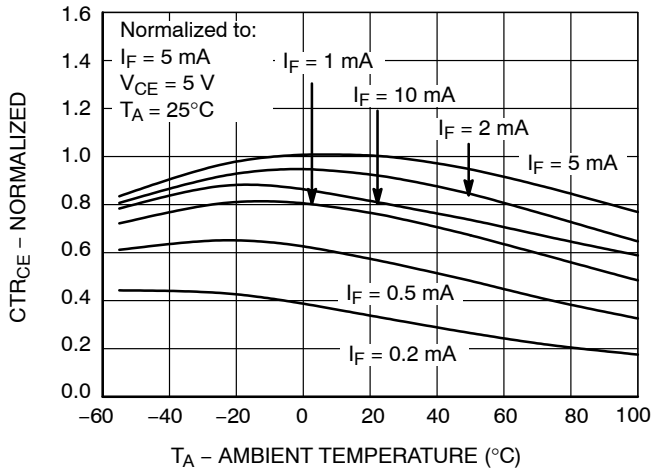
## TYPICAL PERFORMANCE CHARACTERISTICS



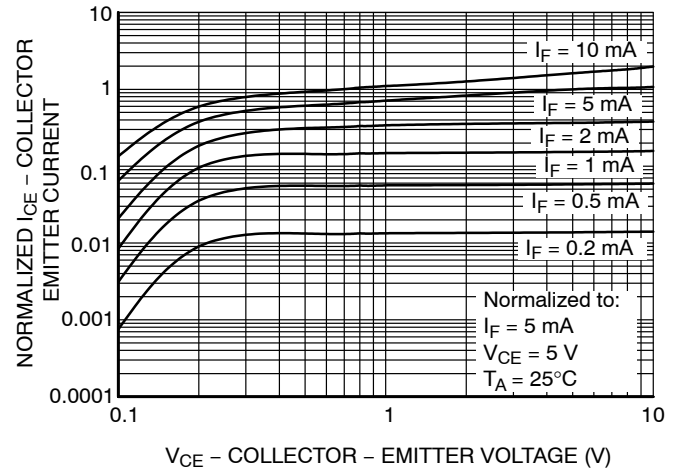
**Figure 2. LED Forward Voltage vs. Forward Current**



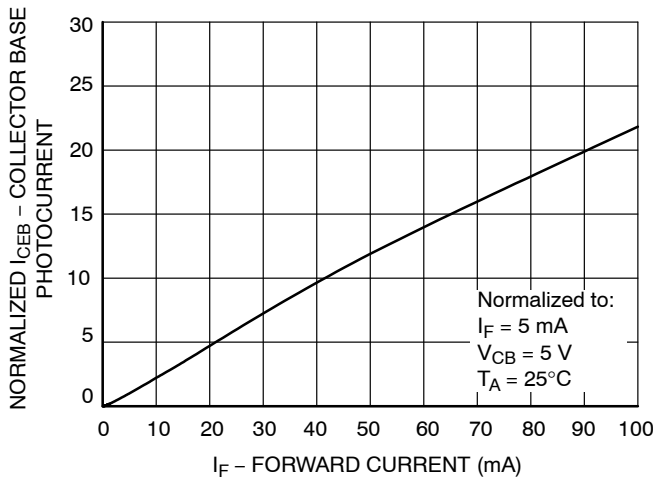
**Figure 3. Normalized Current Transfer Ratio vs. Forward Current**



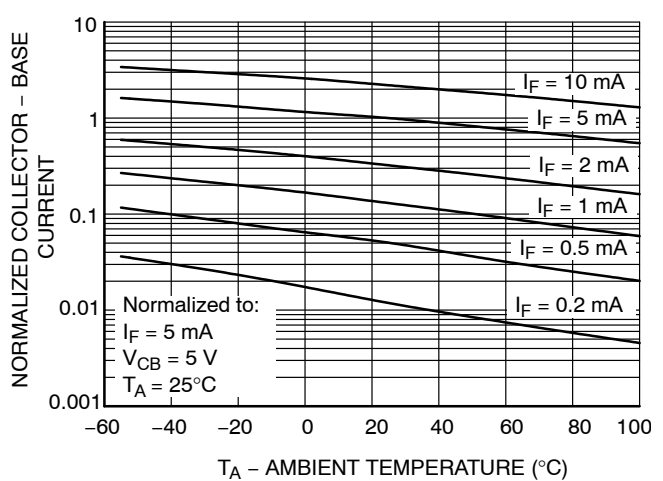
**Figure 4. Normalized CTR vs. Temperature**



**Figure 5. Normalized Collector vs. Collector-Emitter Voltage**



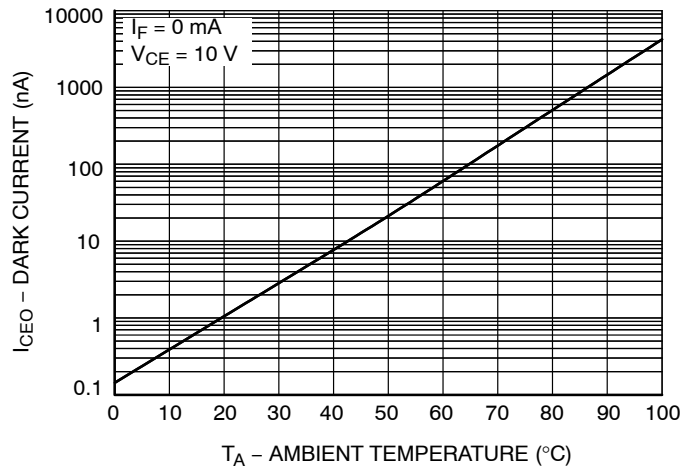
**Figure 6. Normalized Collector-Base Photocurrent Ratio vs. Forward Current**



**Figure 7. Normalized Collector-Base Current vs. Temperature**

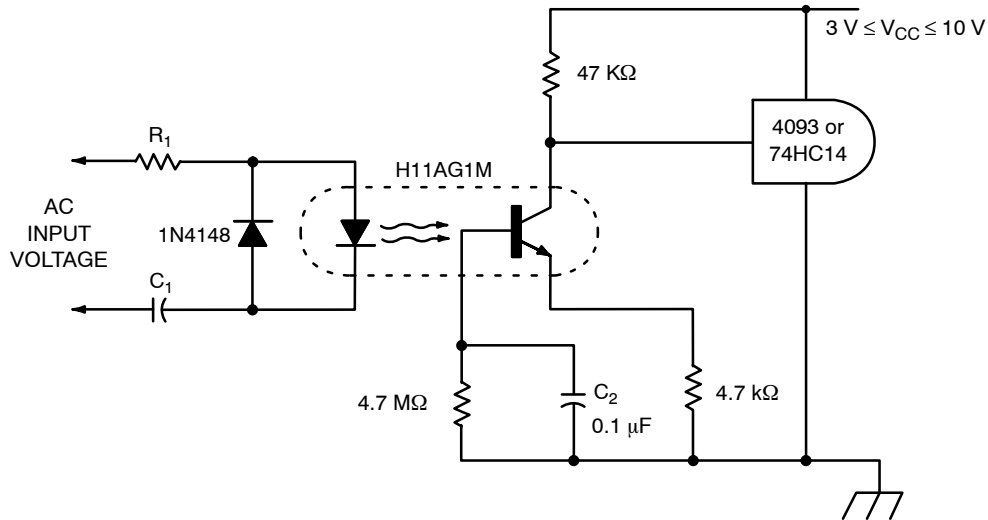
# H11AG1M

## TYPICAL PERFORMANCE CURVES (continued)



**Figure 8. Collector-Emitter Dark Current vs. Ambient Temperature**

## TYPICAL APPLICATION



Input	R1	C1	Z
40 – 90 VAC <sub>RMS</sub> 20 Hz	75 k $\Omega$ 1/10 W	0.1 $\mu\text{F}$ 100 V	109 k $\Omega$
95 – 135 VAC <sub>RMS</sub> 60 Hz	180 k $\Omega$ 1/10 W	12 nF 200 V	285 k $\Omega$
200 – 280 VAC <sub>RMS</sub> 50 / 60 Hz	390 k $\Omega$ 1/4 W	6.80 nF 400 V	550 k $\Omega$

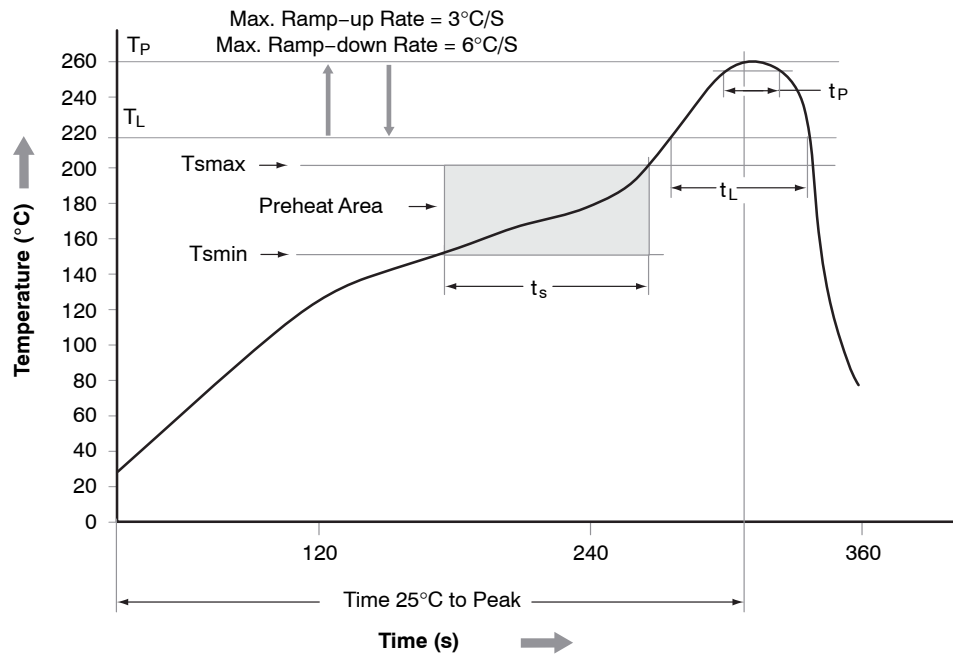
DC component of input voltage is ignored due to  $C_1$

The H11AG1M uses less input power than the neon bulb traditionally used to monitor telephone and line voltages. Additionally response time can be tailored to ignore telephone dial tap, switching transients and other undesired signals by modifying the value of  $C_2$ . The high impedance to line voltage also can simply board layout spacing requirements.

**Figure 9. Telephone Ring Detector / A.C. Line CMOS Input Isolator**

# H11AG1M

## REFLOW PROFILE



Profile Feature	Pb-Free Assembly Profile
Temperature Min. (T <sub>smin</sub> )	150°C
Temperature Max. (T <sub>smax</sub> )	200°C
Time (t <sub>s</sub> ) from (T <sub>smin</sub> to T <sub>smax</sub> )	60–120 seconds
Ramp-up Rate (t <sub>L</sub> to t <sub>P</sub> )	3°C/second max.
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 max.
Time 25°C to Peak Temperature	8 minutes max.

Figure 10. Reflow Profile

# H11AG1M

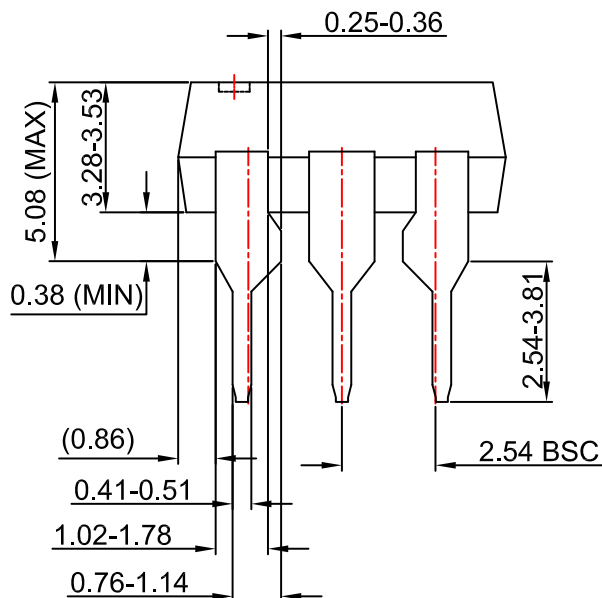
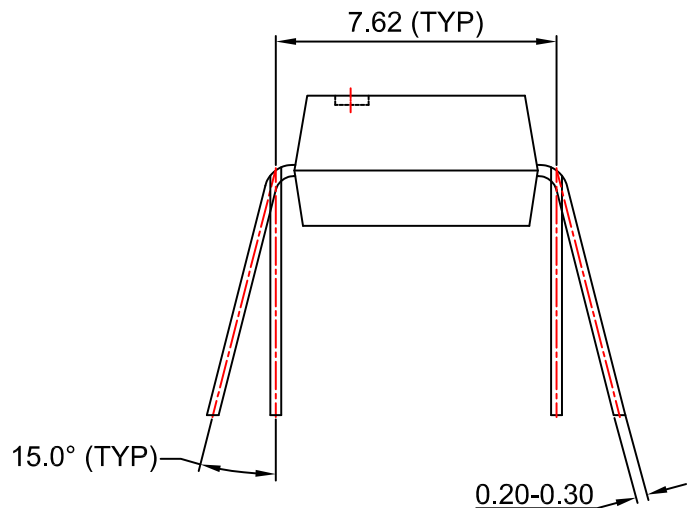
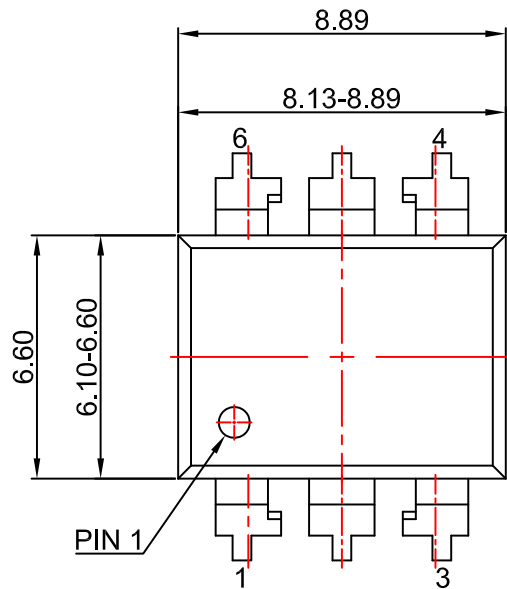
## ORDERING INFORMATION

Part Number	Package	Shipping <sup>†</sup>
H11AG1M	DIP 6-Pin	50 Units / Tube
H11AG1SM	SMT 6-Pin (Lead Bend)	50 Units / Tube
H11AG1SR2M	SMT 6-Pin (Lead Bend)	1000 Units / Tape & Reel
H11AG1VM	DIP 6-Pin, DIN EN/IEC60747-5-5 Option	50 Units / Tube
H11AG1SVM	SMT 6-Pin (Lead Bend), DIN EN/IEC60747-5-5 Option	50 Units / Tube
H11AG1SR2VM	SMT 6-Pin (Lead Bend), DIN EN/IEC60747-5-5 Option	1000 Units / Tape & Reel
H11AG1TVM	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](#).

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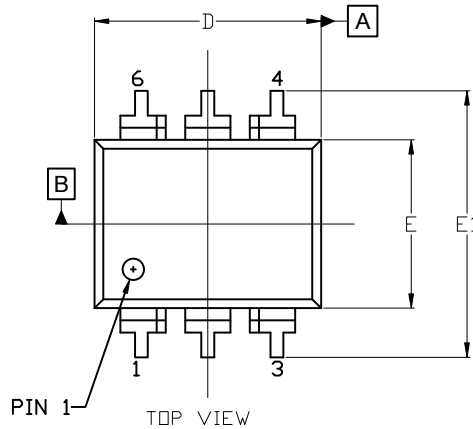
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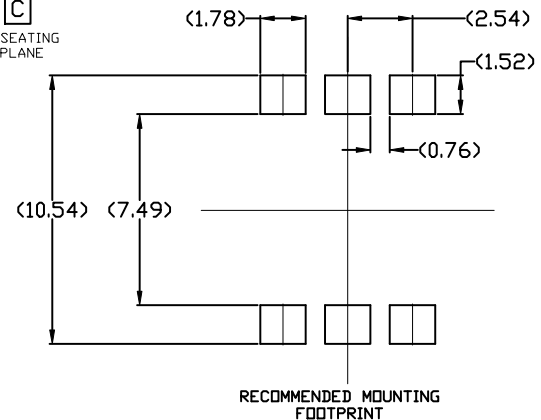
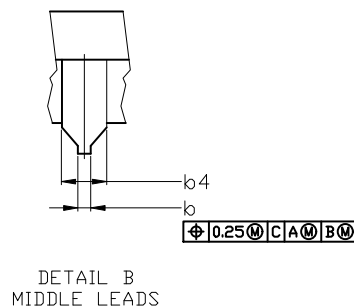
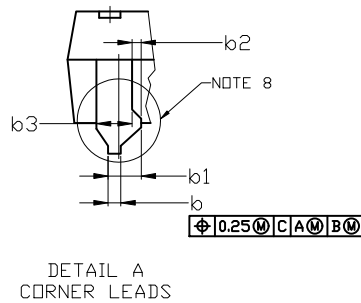
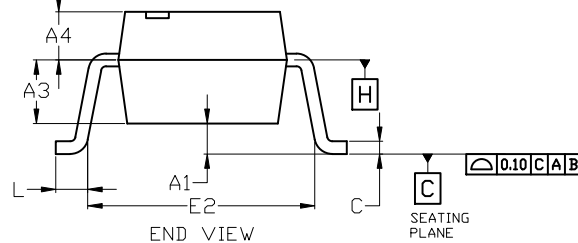
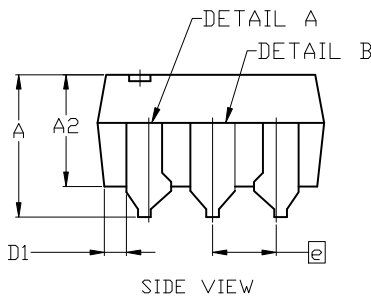
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5. PACKAGE CONTOUR IS OPTIONAL (ROUNDED OR SQUARE CORNERS).
6. CENTER LINE OF CORNER LEADS IS LOCATED BY LOCATING THE CENTER OF FEATURE b2 AND b3.

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



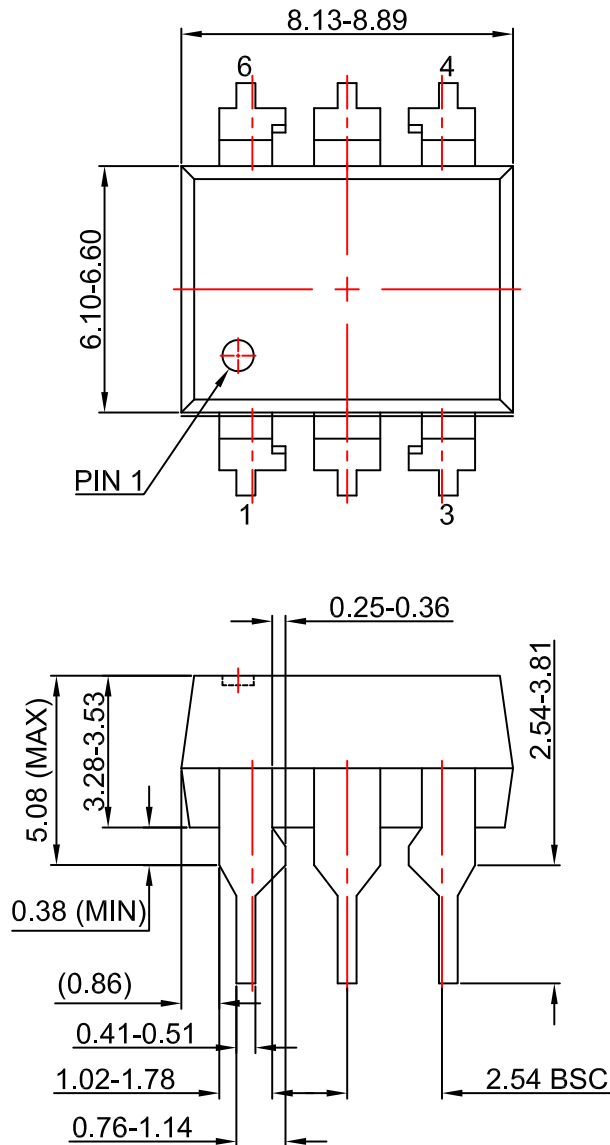
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