



April 2015

# H11AA1M, H11AA4M 6-Pin DIP AC Input Phototransistor Optocouplers

## Features

- Bi-polar Emitter Input
- Built-in Reverse Polarity Input Protection
- 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

- AC Line Monitor
- Unknown Polarity DC Sensor
- Telephone Line Interface

## Description

The H11AA1M and H11AA4M devices consist of two gallium-arsenide infrared emitting diodes connected in inverse parallel driving a single silicon phototransistor output.

## Schematic

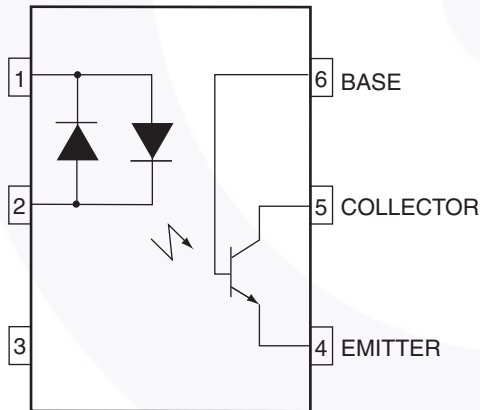


Figure 1. Schematic

## Package Outlines

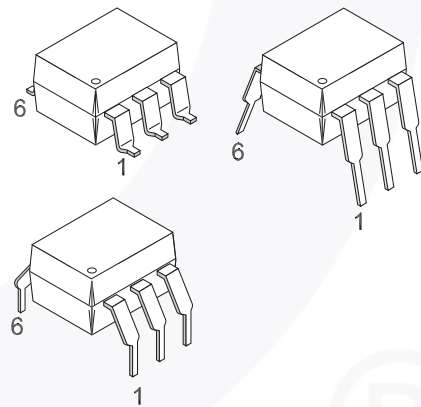


Figure 2. Package Outlines

H11AA1M, H11AA4M — 6-Pin DIP AC Input Phototransistor Optocouplers

## 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 <sup>(1)</sup>	175	°C
I <sub>S,INPUT</sub>	Input Current <sup>(1)</sup>	350	mA
P <sub>S,OUTPUT</sub>	Output Power <sup>(1)</sup>	800	mW
R <sub>IO</sub>	Insulation Resistance at T <sub>S</sub> , V <sub>IO</sub> = 500 V <sup>(1)</sup>	> 10 <sup>9</sup>	Ω

### Note:

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

## 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	Unit
<b>TOTAL DEVICE</b>			
$T_{STG}$	Storage Temperature	-40 to +125	°C
$T_{OPR}$	Operating Temperature	-40 to +100	°C
$T_J$	Junction Temperature	-40 to +125	°C
$T_{SOL}$	Lead Solder Temperature	260 for 10 seconds	°C
$P_D$	Total Device Power Dissipation @ 25°C	270	mW
	Derate Linearly From 25°C	2.94	mW/°C
<b>EMITTER</b>			
$I_F$	Continuous Forward Current	60	mA
$I_F(pk)$	Forward Current – Peak (1 $\mu$ s pulse, 300 pps)	$\pm 1.0$	A
$P_D$	LED Power Dissipation @ 25°C	120	mW
	Derate Linearly From 25°C	1.41	mW/°C
<b>DETECTOR</b>			
$I_C$	Continuous Collector Current	50	mA
$P_D$	Detector Power Dissipation @ 25°C	150	mW
	Derate linearity from 25°C	1.76	mW/°C

## Electrical Characteristics

$T_A = 25^\circ\text{C}$  Unless otherwise specified.

### Individual Component Characteristics

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
<b>EMITTER</b>						
$V_F$	Input Forward Voltage	$I_F = \pm 10\text{ mA}$		1.17	1.50	V
$C_J$	Capacitance	$V_F = 0\text{ V}, f = 1.0\text{ MHz}$		80		pF
<b>DETECTOR</b>						
$BV_{CEO}$	Breakdown Voltage, Collector-to-Emitter	$I_C = 1.0\text{ mA}, I_F = 0$	30	100		V
$BV_{CBO}$	Breakdown Voltage, Collector-to-Base	$I_C = 100\text{ }\mu\text{A}, I_F = 0$	70	120		V
$BV_{EBO}$	Breakdown Voltage, Emitter-to-Base	$I_E = 100\text{ }\mu\text{A}, I_F = 0$	5	10		V
$BV_{ECO}$	Breakdown Voltage, Emitter-to-Collector	$I_E = 100\text{ }\mu\text{A}, I_F = 0$	7	10		V
$I_{CEO}$	Leakage Current, Collector-to-Emitter	$V_{CE} = 10\text{ V}, I_F = 0$		1	50	nA
$C_{CE}$	Capacitance Collector to Emitter	$V_{CE} = 0, f = 1\text{ MHz}$		10		pF
$C_{CB}$	Collector to Base	$V_{CB} = 0, f = 1\text{ MHz}$		80		pF
$C_{EB}$	Emitter to Base	$V_{EB} = 0, f = 1\text{ MHz}$		15		pF

### Transfer Characteristics

Symbol	Characteristics	Test Conditions	Device	Min.	Typ.	Max.	Unit
$CTR_{CE}$	Current Transfer Ratio, Collector-to-Emitter	$I_F = \pm 10\text{ mA}, V_{CE} = 10\text{ V}$	H11AA1M	20			%
			H11AA4M	100			%
	Current Transfer Ratio, Symmetry	$I_F = \pm 10\text{ mA}, V_{CE} = 10\text{ V}$ (Figure 13)	All	0.33		3.00	
$V_{CE(SAT)}$	Saturation Voltage, Collector-to-Emitter	$I_F = \pm 10\text{ mA}, I_{CE} = 0.5\text{ mA}$	All			0.40	V

### Isolation Characteristics

Symbol	Characteristic	Test Conditions	Min.	Typ.	Max.	Unit
$V_{ISO}$	Input-Output Isolation Voltage	$t = 1\text{ Minute}$	4170			$V_{AC(RMS)}$
$C_{ISO}$	Isolation Capacitance	$V_{I-O} = 0\text{ V}, f = 1\text{ MHz}$		0.7		pF
$R_{ISO}$	Isolation Resistance	$V_{I-O} = \pm 500\text{ VDC}, T_A = 25^\circ\text{C}$	$10^{11}$			$\Omega$

### Typical Performance Characteristics

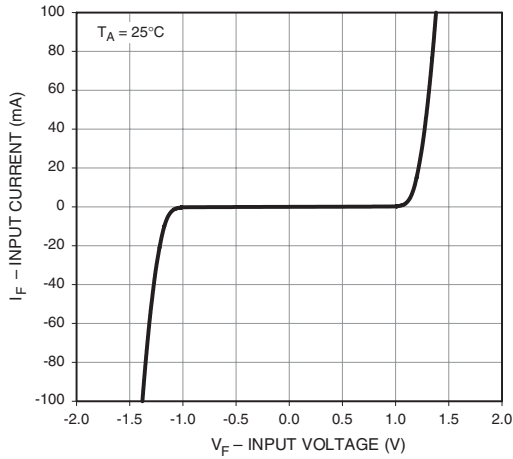


Figure 3. Input Voltage vs. Input Current

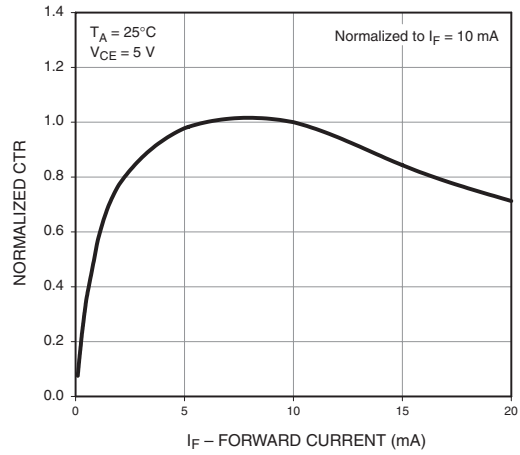


Figure 4. Normalized CTR vs. Forward Current

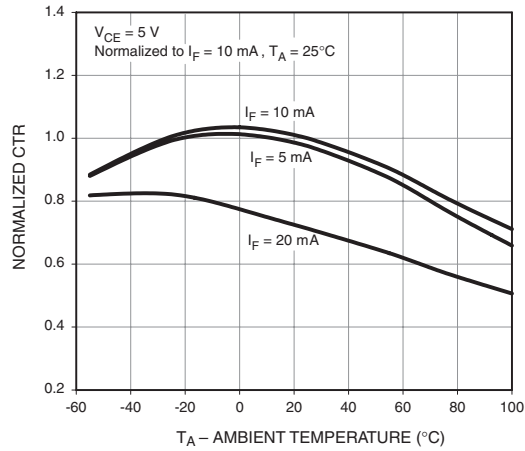


Figure 5. Normalized CTR vs. Ambient Temperature

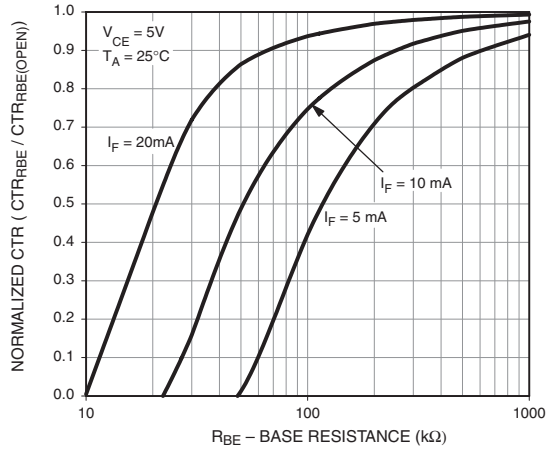


Figure 6. CTR vs. RBE (Unsaturated)

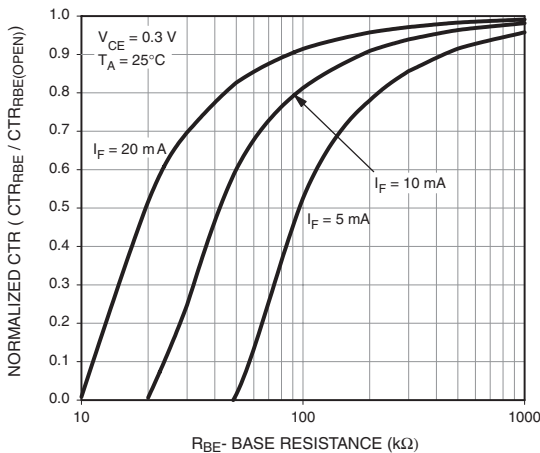


Figure 7. CTR vs. RBE (Saturated)

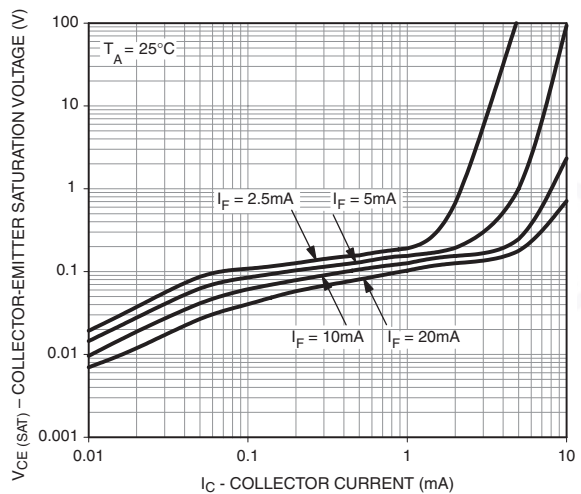


Figure 8. Collector-Emitter Saturation Voltage vs. Collector Current

Typical Performance Characteristics (Continued)

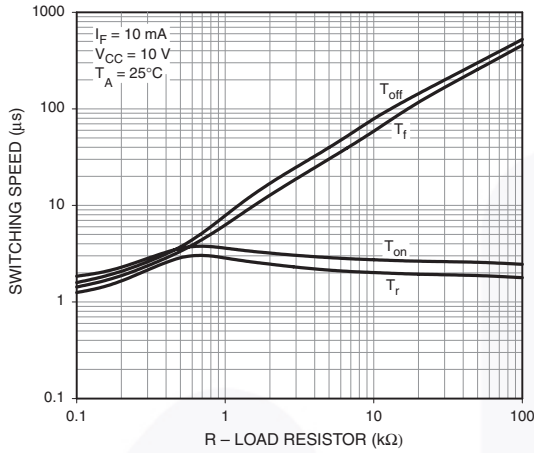


Figure 9. Switching Speed vs. Load Resistor

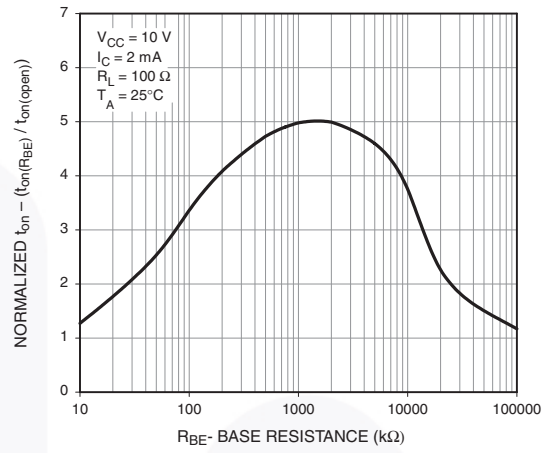


Figure 10. Normalized  $t_{on}$  vs.  $R_{BE}$

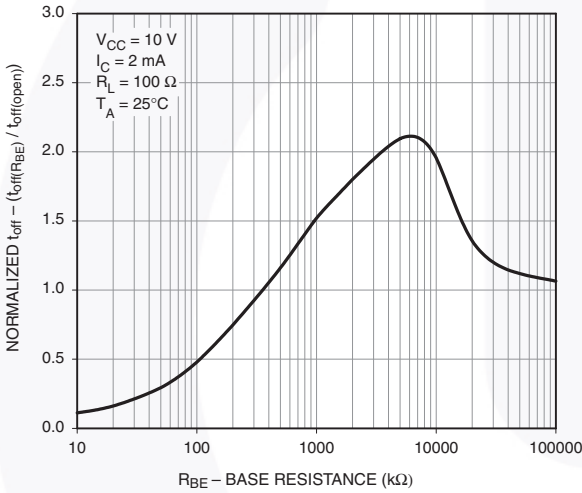


Figure 11. Normalized  $t_{off}$  vs.  $R_{BE}$

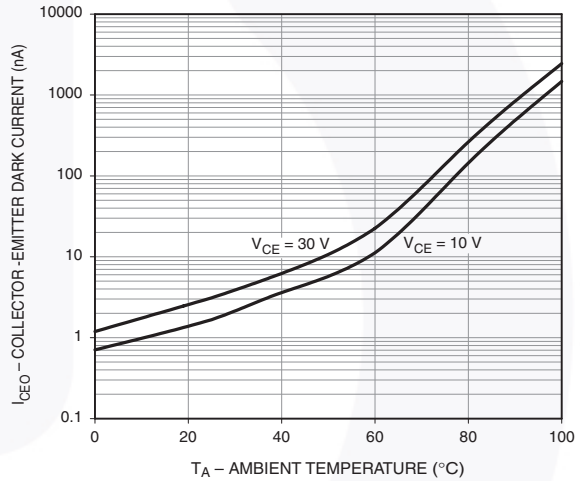


Figure 12. Dark Current vs. Ambient Temperature

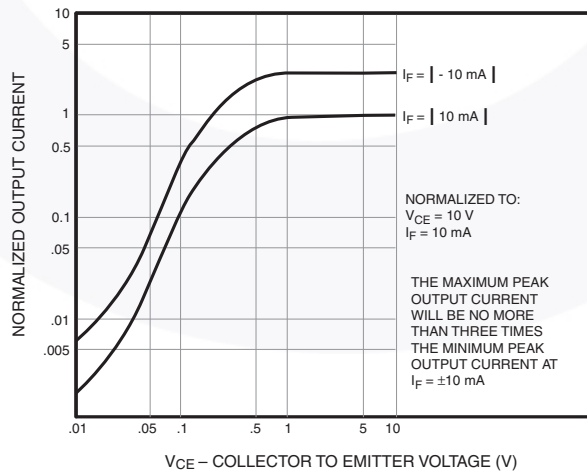


Figure 13. Output Symmetry Characteristics

### Reflow Profile

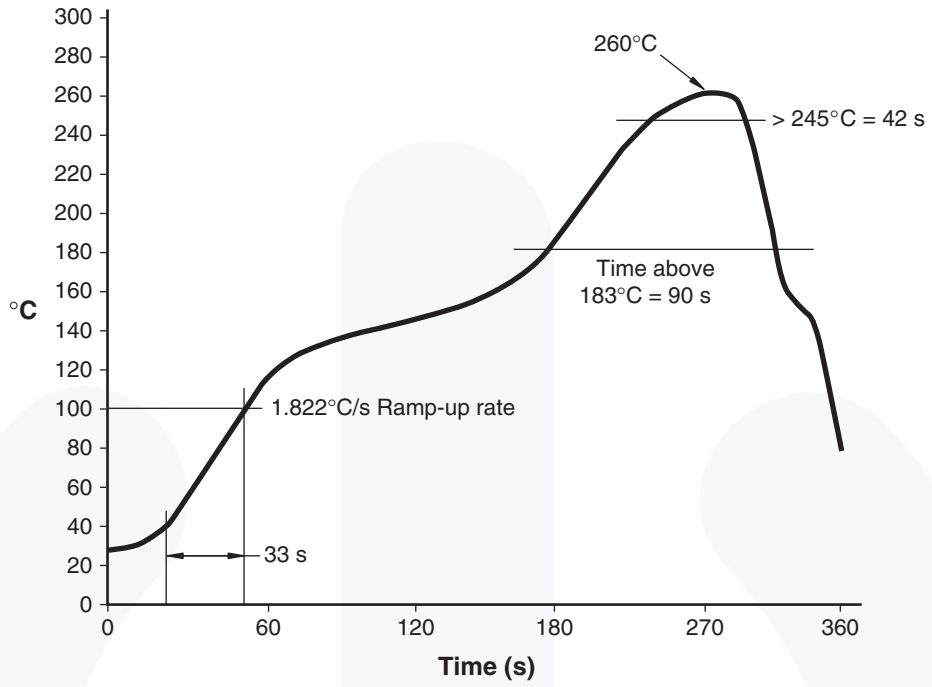


Figure 14. Reflow Profile



## Ordering Information

Part Number	Package	Packing Method
H11AA1M	DIP 6-Pin	Tube (50 Units)
H11AA1SM	SMT 6-Pin (Lead Bend)	Tube (50 Units)
H11AA1SR2M	SMT 6-Pin (Lead Bend)	Tape and Reel (1000 Units)
H11AA1VM	DIP 6-Pin, DIN EN/IEC60747-5-5 Option	Tube (50 Units)
H11AA1SVM	SMT 6-Pin (Lead Bend), DIN EN/IEC60747-5-5 Option	Tube (50 Units)
H11AA1SR2VM	SMT 6-Pin (Lead Bend), DIN EN/IEC60747-5-5 Option	Tape and Reel (1000 Units)
H11AA1TVM	DIP 6-Pin, 0.4" Lead Spacing, DIN EN/IEC60747-5-5 Option	Tube (50 Units)

**Note:**

2. The product orderable part number system listed in this table also applies to the H11AA4M device.

## Marking Information

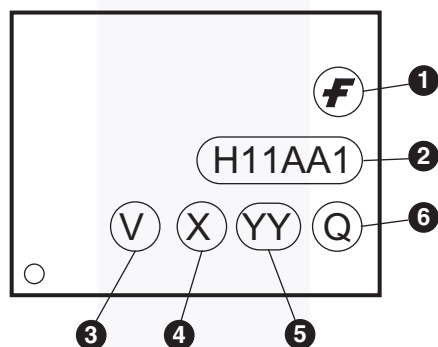


Figure 15. Top Mark

Table 1. Top Mark Definitions

1	Fairchild Logo
2	Device Number
3	DIN EN/IEC60747-5-5 Option (only appears on component ordered with this option)
4	One-Digit Year Code, e.g., "5"
5	Digit Work Week, Ranging from "01" to "53"
6	Assembly Package Code





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