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December 2014

# 4N29M, 4N30M, 4N32M, 4N33M, H11B1M, TIL113M 6-Pin DIP General Purpose Photodarlington Optocoupler

## Features

- High Sensitivity to Low Input Drive Current
- Meets or Exceeds All JEDEC Registered Specifications
- 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

## Description

The 4N29M, 4N30M, 4N32M, 4N33M, H11B1M, and TIL113M have a gallium arsenide infrared emitter optically coupled to a silicon planar photodarlington.

## Applications

- Low Power Logic Circuits
- Telecommunications Equipment
- Portable Electronics
- Solid State Relays
- Interfacing Coupling Systems of Different Potentials and Impedances

## Schematic

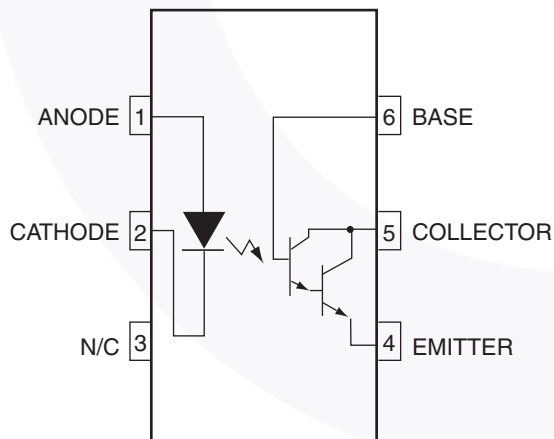


Figure 1. Schematic

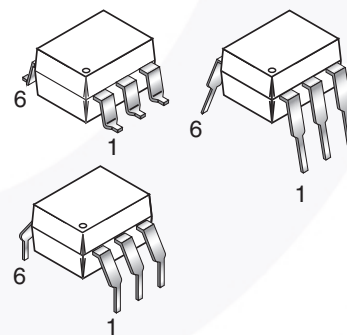


Figure 2. Package Outlines

## 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 @ $T_A = 25^\circ\text{C}$	270	mW
	Derate Above $25^\circ\text{C}$	3.3	mW/°C
<b>EMITTER</b>			
$I_F$	Continuous Forward Current	80	mA
$V_R$	Reverse Voltage	3	V
$I_F(pk)$	Forward Current – Peak (300 $\mu\text{s}$ , 2% Duty Cycle)	3.0	A
$P_D$	LED Power Dissipation @ $T_A = 25^\circ\text{C}$	120	mW
	Derate above $25^\circ\text{C}$	2.0	mW/°C
<b>DETECTOR</b>			
$BV_{CEO}$	Collector-Emitter Breakdown Voltage	30	V
$BV_{CBO}$	Collector-Base Breakdown Voltage	30	V
$BV_{ECO}$	Emitter-Collector Breakdown Voltage	5	V
$P_D$	Detector Power Dissipation @ $T_A = 25^\circ\text{C}$	150	mW
	Derate Above $25^\circ\text{C}$	2.0	mW/°C
$I_C$	Continuous Collector Current	150	mA

## Electrical Characteristics

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

### Individual Component Characteristics

Symbol	Parameter	Test Conditions	Device	Min.	Typ.	Max.	Unit
<b>EMITTER</b>							
$V_F$	Input Forward Voltage <sup>(2)</sup>	$I_F = 10\text{ mA}$	4NXXM		1.2	1.5	V
			H11B1M, TIL113M	0.8	1.2	1.5	V
$I_R$	Reverse Leakage Current <sup>(2)</sup>	$V_R = 3.0\text{ V}$	4NXXM		0.001	100	$\mu\text{A}$
		$V_R = 6.0\text{ V}$	H11B1M, TIL113M		0.001	10	$\mu\text{A}$
C	Capacitance <sup>(2)</sup>	$V_F = 0\text{V}, f = 1.0\text{ MHz}$	All		150		pF
<b>DETECTOR</b>							
$BV_{CEO}$	Collector-Emitter Breakdown Voltage <sup>(2)</sup>	$I_C = 1.0\text{ mA}, I_B = 0$	4NXXM, TIL113M	30	60		V
			H11B1M	25	60		V
$BV_{CBO}$	Collector-Base Breakdown Voltage <sup>(2)</sup>	$I_C = 100\text{ }\mu\text{A}, I_E = 0$	All	30	100		V
$BV_{ECO}$	Emitter-Collector Breakdown Voltage <sup>(2)</sup>	$I_E = 100\text{ }\mu\text{A}, I_B = 0$	4NXXM	5.0	10		V
			H11B1M, TIL113M	7	10		V
$I_{CEO}$	Collector-Emitter Dark Current <sup>(2)</sup>	$V_{CE} = 10\text{ V}, \text{Base Open}$	All		1	100	nA

#### Notes:

2. Indicates JEDEC registered data.

**Electrical Characteristics** (Continued) $T_A = 25^\circ\text{C}$  Unless otherwise specified.**Transfer Characteristics**

Symbol	Parameter	Test Conditions	Device	Min.	Typ.	Max.	Unit
<b>DC CHARACTERISTICS</b>							
$I_{C(CTR)}$	Collector Output Current <sup>(3)(4)(5)</sup>	$I_F = 10\text{ mA}, V_{CE} = 10\text{ V}, I_B = 0$	4N32M, 4N33M	50 (500)			mA (%)
			4N29M, 4N30M	10 (100)			mA (%)
		$I_F = 1\text{ mA}, V_{CE} = 5\text{ V}$	H11B1M	5 (500)			mA (%)
		$I_F = 10\text{ mA}, V_{CE} = 1\text{ V}$	TIL113M	30 (300)			mA (%)
$V_{CE(SAT)}$	Saturation Voltage <sup>(3)(5)</sup>	$I_F = 8\text{ mA}, I_C = 2.0\text{ mA}$	4NXXM			1.0	V
			TIL113M			1.25	V
		$I_F = 1\text{ mA}, I_C = 1\text{ mA}$	H11B1M			1.0	V
<b>AC CHARACTERISTICS</b>							
$t_{on}$	Turn-on Time	$I_F = 200\text{ mA}, I_C = 50\text{ mA}, V_{CC} = 10\text{ V}, R_L = 100\ \Omega$	4NXXM, TIL113M			5.0	$\mu\text{s}$
		$I_F = 10\text{ mA}, V_{CE} = 10\text{ V}, R_L = 100\ \Omega$	H11B1M		25		$\mu\text{s}$
$t_{off}$	Turn-off Time	$I_F = 200\text{ mA}, I_C = 50\text{ mA}, V_{CC} = 10\text{ V}, R_L = 100\ \Omega$	4N32M, 4N33M, TIL113M			100	$\mu\text{s}$
			4N29M, 4N30M			40	$\mu\text{s}$
		$I_F = 10\text{ mA}, V_{CE} = 10\text{ V}, R_L = 100\ \Omega$	H11B1M		18		$\mu\text{s}$
BW	Bandwidth <sup>(6)(7)</sup>				30		kHz

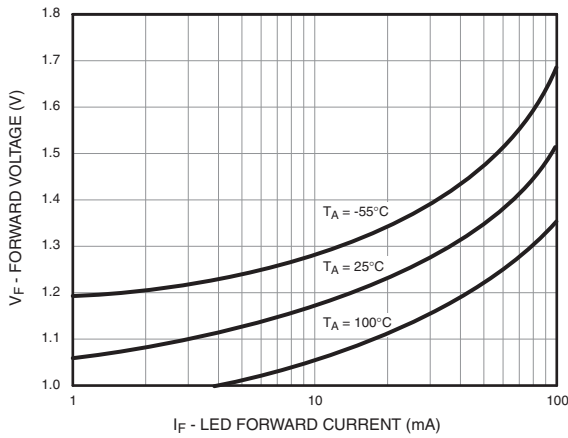
**Notes:**

- Indicates JEDEC registered data.
- The current transfer ratio( $I_C / I_F$ ) is the ratio of the detector collector current to the LED input current.
- Pulse test: pulse width = 300  $\mu\text{s}$ , duty cycle  $\leq 2.0\%$ .
- $I_F$  adjusted to  $I_C = 2.0\text{ mA}$  and  $I_C = 0.7\text{ mA rms}$ .
- The frequency at which  $I_C$  is 3 dB down from the 1 kHz value.

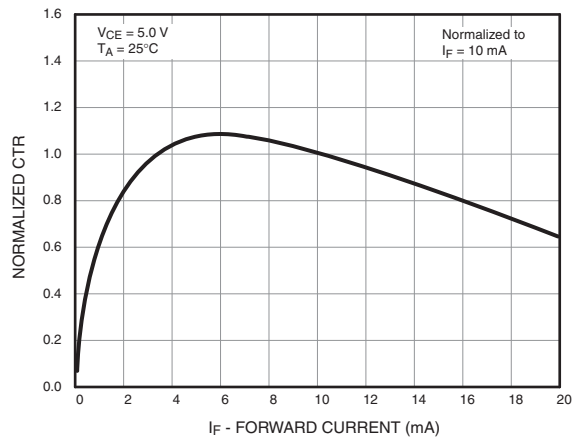
**Isolation Characteristics**

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	$V_{I-O} = 0\text{ V}, f = 1\text{ MHz}$		0.2		pF
$R_{ISO}$	Isolation Resistance	$V_{I-O} = \pm 500\text{ VDC}, T_A = 25^\circ\text{C}$	$10^{11}$			$\Omega$

## Typical Performance Curves



**Figure 3. LED Forward Voltage vs. Forward 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 Curves (Continued)

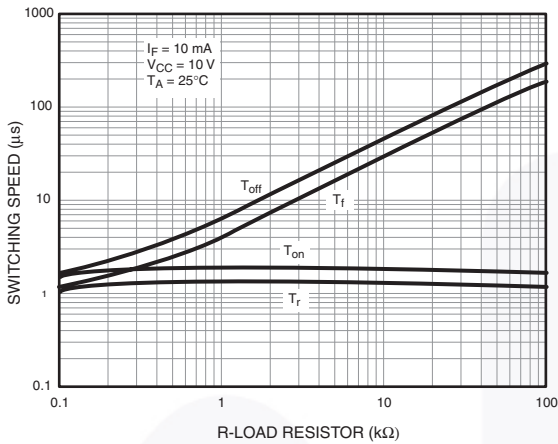


Figure 9. Switching Speed vs. Load Resistor

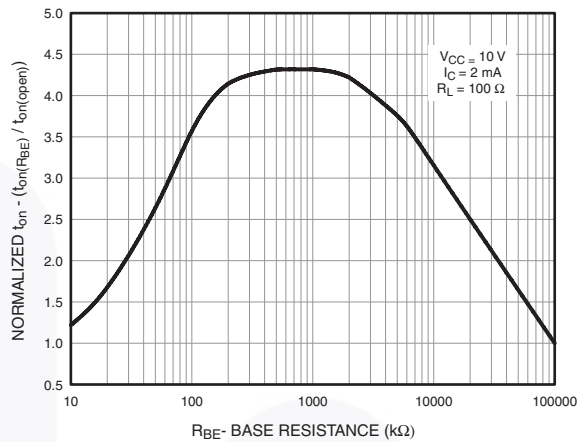


Figure 10. Normalized  $t_{on}$  vs.  $R_{BE}$



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

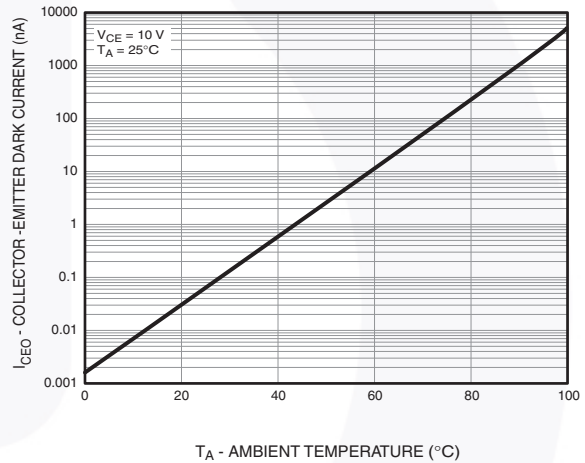


Figure 12. Dark Current vs. Ambient Temperature

### Switching Time Test Circuit and Waveform

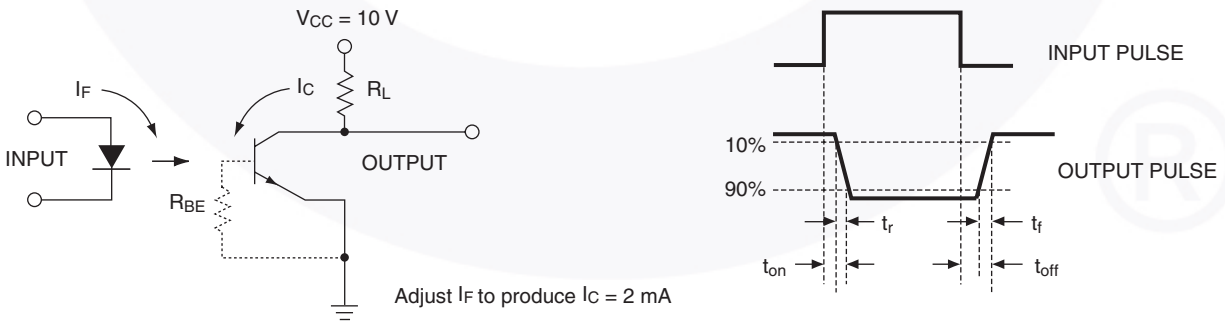


Figure 13. Switching Time Test Circuit and Waveform



### Reflow Profile

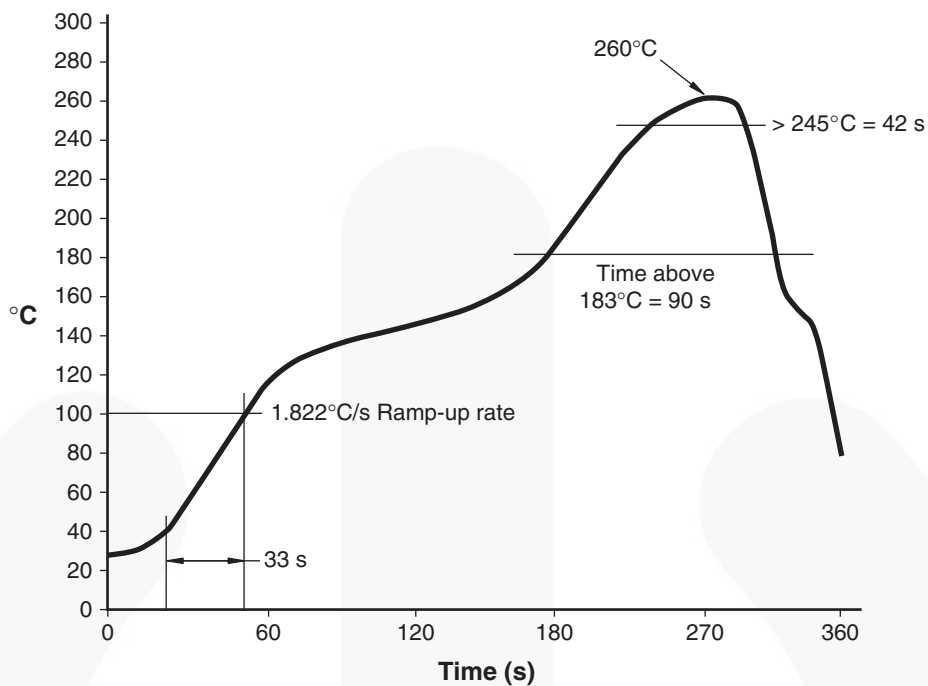


Figure 14. Reflow Profile

## Ordering Information

Part Number	Package	Packing Method
4N29M	DIP 6-Pin	Tube (50 Units)
4N29SM	SMT 6-Pin (Lead Bend)	Tube (50 Units)
4N29SR2M	SMT 6-Pin (Lead Bend)	Tape and Reel (1000 Units)
4N29VM	DIP 6-Pin, DIN EN/IEC60747-5-5 Option	Tube (50 Units)
4N29SVM	SMT 6-Pin (Lead Bend), DIN EN/IEC60747-5-5 Option	Tube (50 Units)
4N29SR2VM	SMT 6-Pin (Lead Bend), DIN EN/IEC60747-5-5 Option	Tape and Reel (1000 Units)
4N29TVM	DIP 6-Pin, 0.4" Lead Spacing, DIN EN/IEC60747-5-5 Option	Tube (50 Units)

**Note:**

8. The product orderable part number system listed in this table also applies to the 4N30M, 4N32M, 4N33M, H11B1M, and TIL113M devices.

## Marking Information

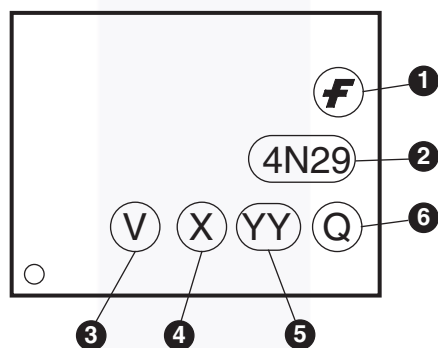
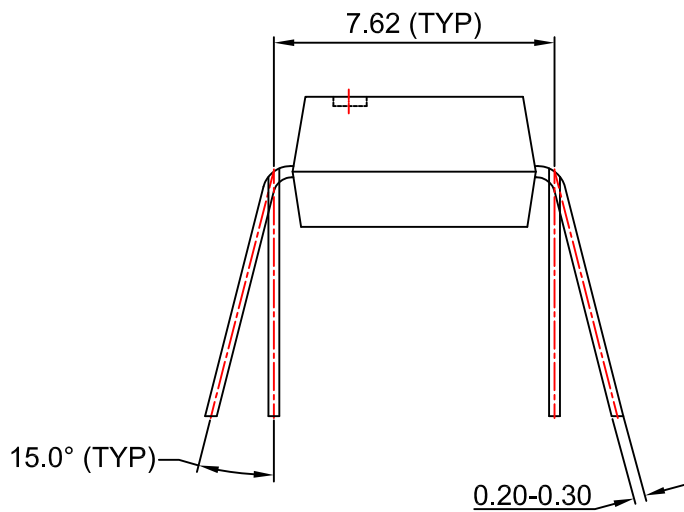


Figure 15. Top Mark

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., "4"
5	Digit Work Week, Ranging from "01" to "53"
6	Assembly Package Code



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