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December 2014

# 4N38M, H11D1M, H11D3M, MOC8204M 6-Pin DIP High Voltage Phototransistor Optocouplers

## Features

- High Voltage:
  - MOC8204M,  $BV_{CEO} = 400\text{ V}$
  - H11D1M,  $BV_{CEO} = 300\text{ V}$
  - H11D3M,  $BV_{CEO} = 200\text{ V}$
- Safety and Regulatory Approvals:
  - UL1577, 4,170  $VAC_{RMS}$  for 1 Minute
- DIN-EN/IEC60747-5-5, 850 V Peak Working Insulation Voltage

## Applications

- Power Supply Regulators
- Digital Logic Inputs
- Microprocessor Inputs
- Appliance Sensor Systems
- Industrial Controls

## Description

The 4N38M, H11D1M, H11D3M, and MOC8204M are phototransistor-type optically coupled optoisolators. A gallium arsenide infrared emitting diode is coupled with a high voltage NPN silicon phototransistor. The device is supplied in a standard plastic six-pin dual-in-line package.

## Schematic

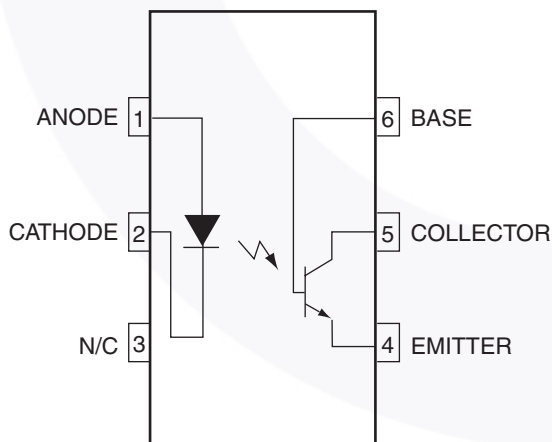


Figure 1. Schematic

## Package Outlines

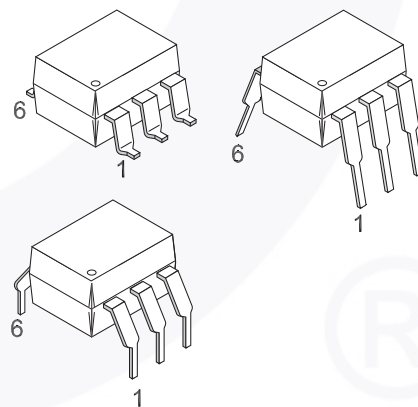


Figure 2. Package Outlines

4N38M, H11D1M, H11D3M, MOC8204M — 6-Pin DIP High Voltage 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	Device	Value	Unit
<b>TOTAL DEVICE</b>				
T <sub>STG</sub>	Storage Temperature	All	-40 to +125	°C
T <sub>OPR</sub>	Operating Temperature	All	-40 to +100	°C
T <sub>J</sub>	Junction Temperature	All	-40 to +125	°C
T <sub>SOL</sub>	Lead Solder Temperature	All	260 for 10 seconds	°C
P <sub>D</sub>	Total Device Power Dissipation @ T <sub>A</sub> = 25°C	All	420	mW
	Derate Above 25°C		3.5	mW/°C
<b>EMITTER</b>				
I <sub>F</sub>	Forward DC Current <sup>(2)</sup>	All	80	mA
V <sub>R</sub>	Reverse Input Voltage <sup>(2)</sup>	All	6.0	V
I <sub>F(pk)</sub>	Forward Current – Peak (1 μs pulse, 300pps) <sup>(2)</sup>	All	3.0	A
P <sub>D</sub>	LED Power Dissipation @ T <sub>A</sub> = 25°C <sup>(2)</sup>	All	120	mW
	Derate Above 25°C		1.41	mW/°C
<b>DETECTOR</b>				
P <sub>D</sub>	Power Dissipation @ T <sub>A</sub> = 25°C	All	300	mW
	Derate linearly above 25°C		4.0	mW/°C
V <sub>CEO</sub>	Collector to Emitter Voltage <sup>(2)</sup>	MOC8204M	400	V
		H11D1M	300	V
		H11D3M	200	V
		4N38M	80	V
V <sub>CBO</sub>	Collector Base Voltage <sup>(2)</sup>	MOC8204M	400	V
		H11D1M	300	V
		H11D3M	200	V
		4N38M	80	V
V <sub>ECO</sub>	Emitter to Collector Voltage <sup>(2)</sup>	H11D1M, H11D3M, MOC8204M	7	V
I <sub>C</sub>	Collector Current (Continuous)	All	100	mA

### Note:

2. Parameters meet or exceed JEDEC registered data (for 4N38M only).

## Electrical Characteristics

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

### Individual Component Characteristics

Symbol	Characteristic	Test Conditions	Device	Min.	Typ.	Max.	Unit
<b>EMITTER</b>							
$V_F$	Forward Voltage <sup>(3)</sup>	$I_F = 10\text{ mA}$	All		1.15	1.50	V
$\frac{\Delta V_F}{\Delta T_A}$	Forward Voltage Temperature Coefficient		All		-1.8		mV/°C
$BV_R$	Reverse Breakdown Voltage	$I_R = 10\text{ }\mu\text{A}$	All	6	25		V
$C_J$	Junction Capacitance	$V_F = 0\text{ V}, f = 1\text{ MHz}$	All		50		pF
		$V_F = 1\text{ V}, f = 1\text{ MHz}$			65		pF
$I_R$	Reverse Leakage Current <sup>(3)</sup>	$V_R = 6\text{ V}$	All		0.05	10	$\mu\text{A}$
<b>DETECTOR</b>							
$BV_{CEO}$	Breakdown Voltage Collector-to-Emitter <sup>(3)</sup>	$R_{BE} = 1\text{ M}\Omega,$ $I_C = 1.0\text{ mA}, I_F = 0$	MOC8204M	400			V
			H11D1M	300			V
			H11D3M	200			V
			No RBE, $I_C = 1.0\text{ mA}$	4N38M	80		
$BV_{CBO}$	Collector to Base <sup>(3)</sup>	$I_C = 100\text{ }\mu\text{A}, I_F = 0$	MOC8204M	400			V
			H11D1M	300			V
			H11D3M	200			V
			4N38M	80			V
$BV_{EBO}$	Emitter to Base	$I_E = 100\text{ }\mu\text{A}, I_F = 0$	4N38M	7			V
$BV_{ECO}$	Emitter to Collector	$I_E = 100\text{ }\mu\text{A}, I_F = 0$	All	7	10		V
$I_{CEO}$	Leakage Current Collector to Emitter <sup>(3)</sup> ( $R_{BE} = 1\text{ M}\Omega$ )	$V_{CE} = 300\text{ V}, I_F = 0,$ $T_A = 25^\circ\text{C}$	MOC8204M			100	nA
		$V_{CE} = 300\text{ V}, I_F = 0,$ $T_A = 100^\circ\text{C}$				250	$\mu\text{A}$
		$V_{CE} = 200\text{ V}, I_F = 0,$ $T_A = 25^\circ\text{C}$	H11D1M			100	nA
		$V_{CE} = 200\text{ V}, I_F = 0,$ $T_A = 100^\circ\text{C}$				250	$\mu\text{A}$
		$V_{CE} = 100\text{ V}, I_F = 0,$ $T_A = 25^\circ\text{C}$	H11D3M			100	nA
		$V_{CE} = 100\text{ V}, I_F = 0,$ $T_A = 100^\circ\text{C}$				250	$\mu\text{A}$
			No $R_{BE}, V_{CE} = 60\text{ V},$ $I_F = 0, T_A = 25^\circ\text{C}$	4N38M			50

**Note:**

3. Parameters meet or exceed JEDEC registered data (for 4N38M only).

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

Symbol	Characteristics	Test Conditions	Device	Min.	Typ.	Max.	Unit
<b>EMITTER</b>							
CTR	Current Transfer Ratio, Collector-to-Emitter	$I_F = 10\text{ mA}, V_{CE} = 10\text{ V}, R_{BE} = 1\text{ M}\Omega$	H11D1M, H11D3M, MOC8204M	2 (20)			mA (%)
		$I_F = 10\text{ mA}, V_{CE} = 10\text{ V}$	4N38M	2 (20)			mA (%)
$V_{CE(SAT)}$	Saturation Voltage <sup>(4)</sup>	$I_F = 10\text{ mA}, I_C = 0.5\text{ mA}, R_{BE} = 1\text{ M}\Omega$	H11D1M, H11D3M, MOC8204M		0.1	0.4	V
		$I_F = 20\text{ mA}, I_C = 4\text{ mA}$	4N38M			1.0	V
<b>SWITCHING TIMES</b>							
$t_{ON}$	Non-Saturated Turn-on Time	$V_{CE} = 10\text{ V}, I_C = 2\text{ mA}, R_L = 100\ \Omega$	All		5		$\mu\text{s}$
$t_{OFF}$	Turn-off Time		All		5		$\mu\text{s}$

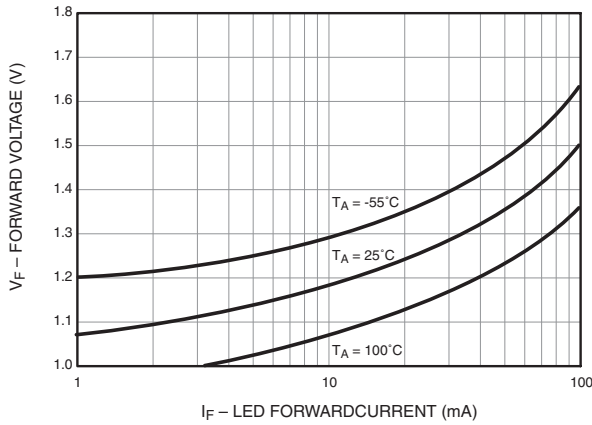
**Note:**

4. Parameters meet or exceed JEDEC registered data (for 4N38M only).

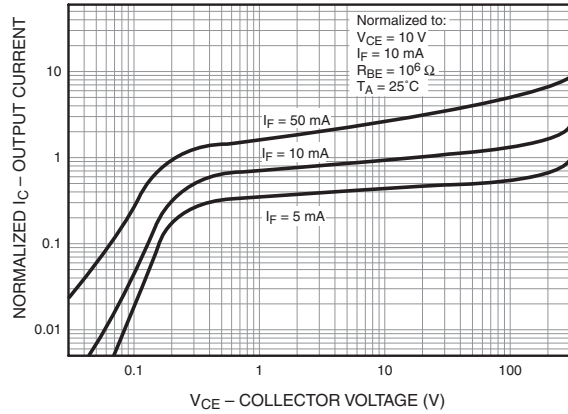
**Isolation Characteristics**

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

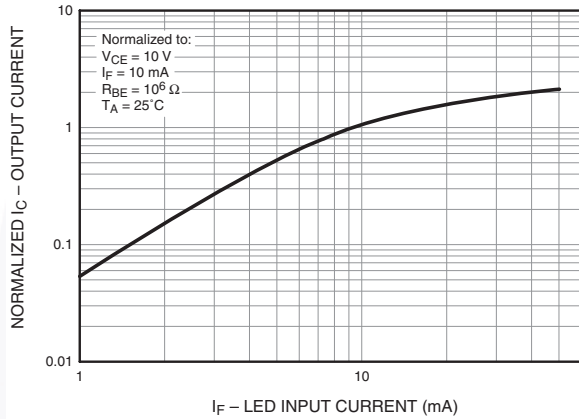
### Typical Performance Curves



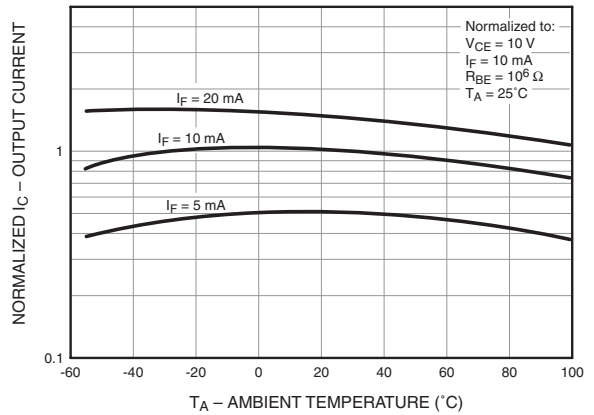
**Figure 3. LED Forward Voltage vs. Forward Current**



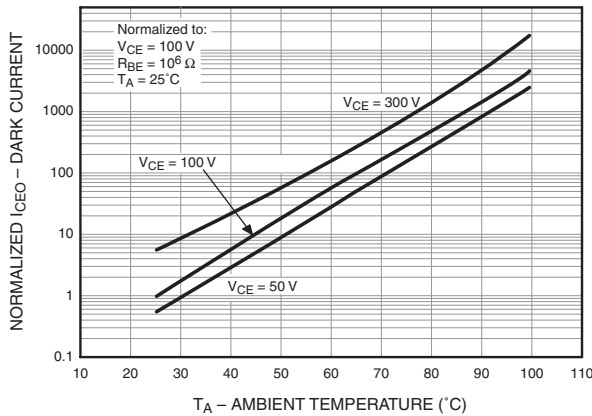
**Figure 4. Normalized Output Characteristics**



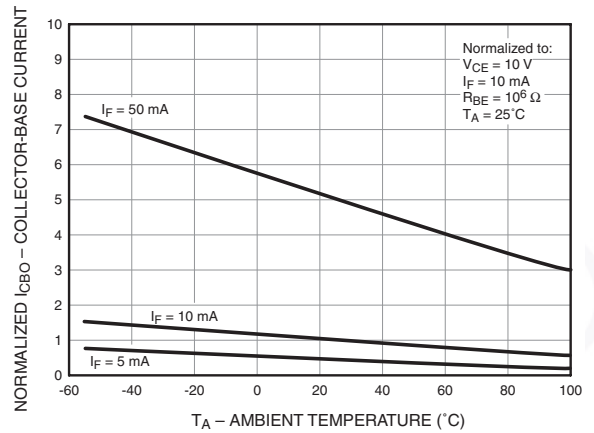
**Figure 5. Normalized Output Current vs. LED Input Current**



**Figure 6. Normalized Output Current vs. Temperature**



**Figure 7. Normalized Dark Current vs. Ambient Temperature**



**Figure 8. Normalized Collector-Base Current vs. Temperature**

### Reflow Profile



Figure 9. Reflow Profile

## Ordering Information

Part Number	Package	Packing Method
H11D1M	DIP 6-Pin	Tube (50 Units)
H11D1SM	SMT 6-Pin (Lead Bend)	Tube (50 Units)
H11D1SR2M	SMT 6-Pin (Lead Bend)	Tape and Reel (1000 Units)
H11D1VM	DIP 6-Pin, DIN EN/IEC60747-5-5 Option	Tube (50 Units)
H11D1SVM	SMT 6-Pin (Lead Bend), DIN EN/IEC60747-5-5 Option	Tube (50 Units)
H11D1SR2VM	SMT 6-Pin (Lead Bend), DIN EN/IEC60747-5-5 Option	Tape and Reel (1000 Units)
H11D1TVM	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 4N38M, H11D3M, and MOC8204M devices.

## Marking Information

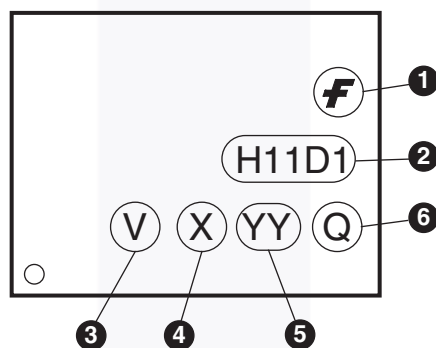


Figure 10. 12. Top Mark

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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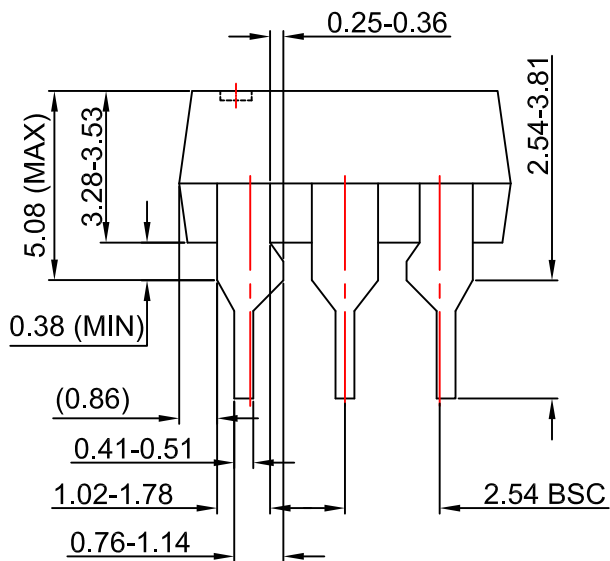
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