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July 2016

# MCT9001

## 8-Pin Dual Channel Phototransistor Optocoupler

### Features

- Two Isolated Channels Per Package
- Safety and Regulatory Approvals:
  - UL1577, 4,170 VAC<sub>RMS</sub> for 1 Minute
  - DIN-EN/IEC60747-5-5, 890 V Peak Working Insulation Voltage

### Applications

- AC line/digital logic – isolate high voltage transients
- Digital logic/digital logic – eliminate spurious grounds
- Digital logic/AC triac control – isolate high voltage transients
- Twisted pair line receiver – eliminate ground loop feedthrough
- Telephone/telegraph line receiver – isolate high voltage transients
- High frequency power supply feedback control – maintain floating grounds and transients
- Relay contact monitor – isolate floating grounds and transients
- Power supply monitor – isolate transients

### Description

The general purpose optocoupler, MCT9001, has two isolated channels in a standard plastic 8-pin dual-in-line (DIP) package for density applications. Each channel consists of a gallium arsenide infrared emitting diode driving a NPN silicon planar phototransistor. For four channel applications, two packages fit into a standard 16-pin DIP socket.

### Functional Schematic

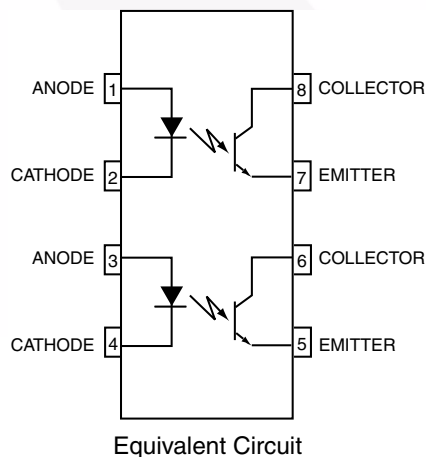


Figure 1. Schematic

### Package Outlines

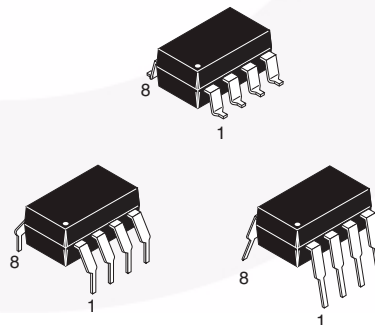


Figure 2. Package Outlines

## 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		55/115/21
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	1424	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	1668	V <sub>peak</sub>
V <sub>IORM</sub>	Maximum Working Insulation Voltage	890	V <sub>peak</sub>
V <sub>IOTM</sub>	Highest Allowable Over-Voltage	8000	V <sub>peak</sub>
	External Creepage	≥ 7	mm
	External Clearance	≥ 7	mm
DTI	Distance Through Insulation (Insulation Thickness)	≥ 0.4	mm
T <sub>S</sub>	Case Temperature <sup>(1)</sup>	175	°C
I <sub>S,INPUT</sub>	Input Current <sup>(1)</sup>	60	mA
P <sub>S,OUTPUT</sub>	Output Power <sup>(1)</sup>	150	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.  $T_A = 25^\circ\text{C}$  unless otherwise specified.

Symbol	Parameter	Value	Unit
$T_{STG}$	Storage Temperature	-55 to +150	$^\circ\text{C}$
$T_{OPR}$	Operating Temperature	-55 to +100	$^\circ\text{C}$
$T_J$	Junction Temperature	-55 to +125	$^\circ\text{C}$
$T_{SOL}$	Lead Solder Temperature	260 for 10 seconds	$^\circ\text{C}$
$P_D$	Total Device Power Dissipation @ $T_A = 25^\circ\text{C}$	400	mW
	Derate Above $25^\circ\text{C}$	4.83	mW/ $^\circ\text{C}$
<b>EMITTER (Each channel)</b>			
$I_F$	DC / Average Forward Input Current	60	mA
$I_F(pk)$	Forward Current - Peak (PW = $1\mu\text{s}$ , 300pps)	3	A
$V_R$	Reverse Input Voltage	5.0	V
$P_{D(EMITTER)}$	Total Power Dissipation @ $T_A = 25^\circ\text{C}$	100	mW
	Derate Above $25^\circ\text{C}$	1.1	mW/ $^\circ\text{C}$
<b>DETECTOR</b>			
$I_C$	Continuous Collector Current	30	mA
$P_{D(DETECTOR)}$	Total Power Dissipation @ $T_A = 25^\circ\text{C}$	150	mW
	Derate Above $25^\circ\text{C}$	1.67	mW/ $^\circ\text{C}$

## 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	$I_F = 10\text{ mA}$		1.0	1.3	V
$I_R$	Reverse Leakage Current	$V_R = 5\text{ V}$			10	$\mu\text{A}$
$C_J$	Junction Capacitance	$V_F = 0\text{ V}, f = 1\text{ MHz}$		50		pF
<b>DETECTOR</b>						
$BV_{CEO}$	Collector-to-Emitter Breakdown Voltage	$I_C = 0.5\text{ mA}, I_F = 0$	55			V
$BV_{ECO}$	Emitter-to-Collector Breakdown Voltage	$I_E = 100\text{ }\mu\text{A}, I_F = 0$	7			V
$I_{CEO}$	Collector-to-Emitter Dark Current	$V_{CE} = 24\text{ V}, I_F = 0$		5	100	nA
		$V_{CE} = 24\text{ V}, T_A = 85^\circ\text{C}$			50	$\mu\text{A}$
$C_{CE}$	Capacitance	$V_{CE} = 0\text{ V}, f = 1\text{ MHz}$		8		pF

### Transfer Characteristics

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
<b>DC CHARACTERISTICS</b>						
CTR	Current Transfer Ratio, Collector-to-Emitter	$I_F = 5\text{ mA}, V_{CE} = 5\text{ V}$	50		600	%
$CTR_{(SAT)}$		$I_F = 8\text{ mA}, V_{CE} = 0.4\text{ V}$	30			%
$V_{CE(SAT)}$	Saturation Voltage, Collector-to-Emitter	$I_F = 8\text{ mA}, I_C = 2.4\text{ mA}$			0.4	V
<b>AC CHARACTERISTICS</b>						
<b>Non-Saturated</b>						
$T_{ON}$	Turn-On Time	$R_L = 100\text{ }\Omega, I_C = 2\text{ mA}, V_{CC} = 10\text{ V}$		3.0		$\mu\text{s}$
$T_{OFF}$	Turn-Off Time			3.0		$\mu\text{s}$
$T_R$	Rise Time			2.4		$\mu\text{s}$
$T_F$	Fall Time			2.4		$\mu\text{s}$
<b>Saturated</b>						
$T_{ON}$	Turn-On Time	$I_F = 16\text{ mA}, R_L = 1.9\text{ k}\Omega, V_{CE} = 5\text{ V}$		2.4		$\mu\text{s}$
$T_{OFF}$	Turn-Off Time			25.0		$\mu\text{s}$

### Isolation Characteristics

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$V_{ISO}$	Input-Output Isolation Voltage	$I_{I-O} \leq 10\text{ }\mu\text{A}, t = 1\text{ Minute}$	5,000			$V_{AC_{RMS}}$
$C_{ISO}$	Isolation Capacitance	$f = 1\text{ MHz}$		0.5		pF
$R_{ISO}$	Isolation Resistance	$V_{I-O} = 500\text{ VDC}$	$10^{11}$			$\Omega$

## Typical Performance Curves

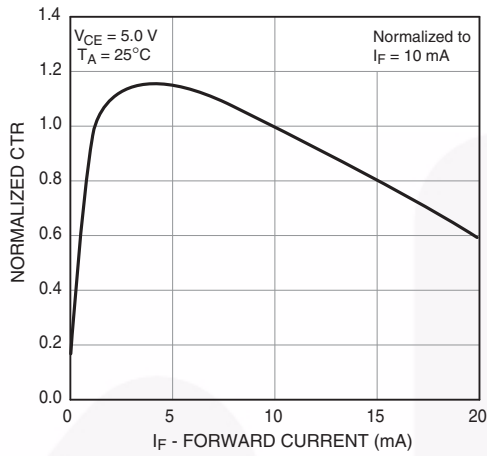


Fig. 3 Normalized CTR vs. Forward Current

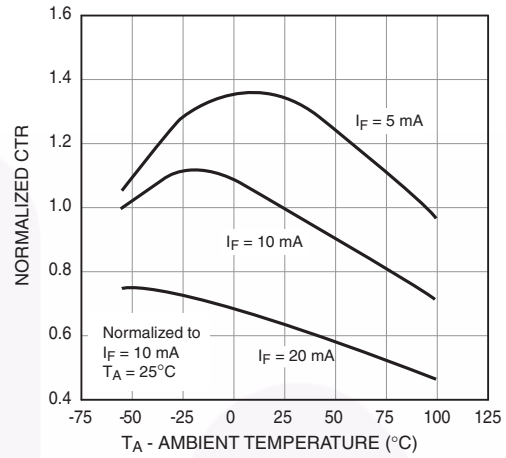


Fig. 4 Normalized CTR vs. Ambient Temperature



Fig. 5 Dark Current vs. Ambient Temperature



Fig. 6 Switching Speed vs. Load Resistor

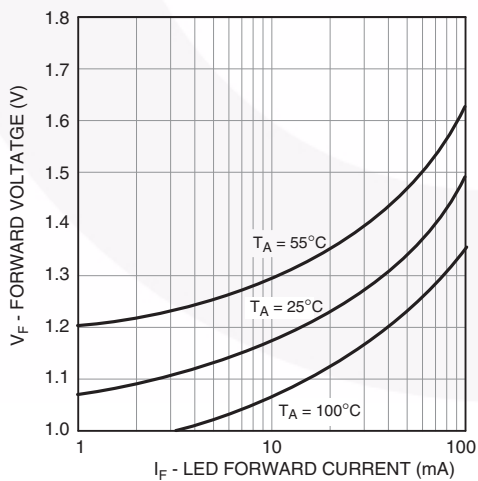


Fig. 7 LED Forward Voltage vs. Forward Current

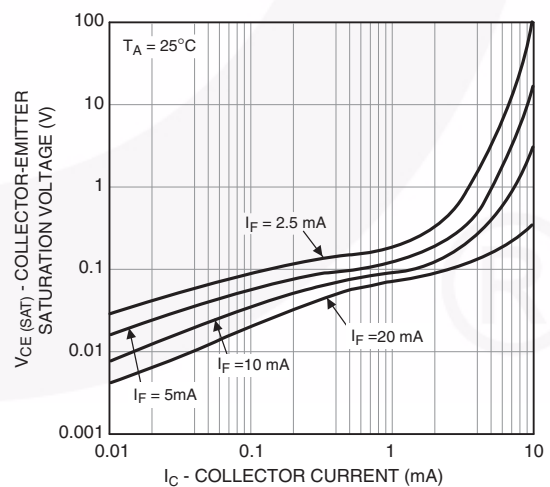


Fig. 8 Collector-Emitter Saturation Voltage vs. Collector Current

## Switching Time Test Circuit and Waveforms

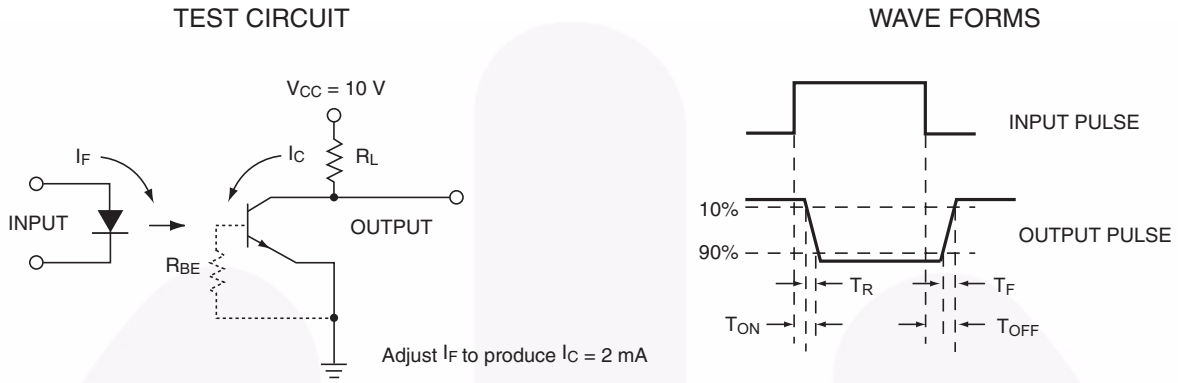


Figure 9. Switching Time Test Circuit and Waveforms

### Reflow Profile



Profile Feature	Pb-Free Assembly Profile
Temperature Min. (T <sub>sm</sub> )	150°C
Temperature Max. (T <sub>sm</sub> )	200°C
Time (t <sub>s</sub> ) from (T <sub>sm</sub> to T <sub>sm</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.



## Ordering Information

Part Number	Package	Packing Method
MCT9001	DIP 8-Pin	Tube (50 units per tube)
MCT9001S	SMT 8-Pin (Lead Bend)	Tube (50 units per tube)
MCT9001SD	SMT 8-Pin	Tape and Reel (1,000 units per reel)
MCT9001300	DIN EN/IEC 60747-5-5 Option	Tube (50 units per tube)
MCT90013S	SMT 8-Pin (Lead Bend); DIN EN/IEC 60747-5-5 Option	Tube (50 units per tube)
MCT90013SD	SMT 8-Pin; DIN EN/IEC 60747-5-5 Option	Tape and Reel (1,000 units per reel)
MCT9001300W	0.4" Lead Spacing; DIN EN/IEC 60747-5-5 Option	Tube (50 units per tube)

## Marking Information

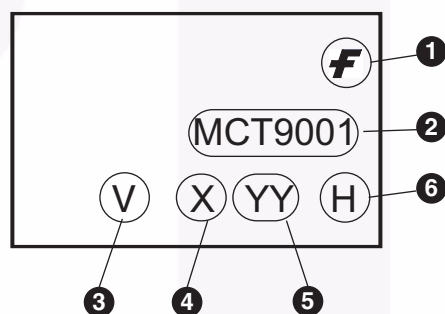


Figure 10. Top Mark

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



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