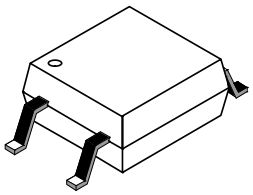
3.3 V/5 V Logic Gate Output Optocoupler with High Noise Immunity

FODM8071



MFP5 4.1 x 4.4, 2.54P
CASE 100AM

Description

The FODM8071 is a 3.3 V / 5 V high−speed logic gate output optocoupler, which supports isolated communications allowing digital signals to communicate between systems without conducting ground loops or hazardous voltages. It utilizes **onsemi**'s patented coplanar packaging technology, OPTOPLANAR®, and optimized IC design to achieve high−immunity, characterized by high common mode rejection specifications.

This high−speed logic gate output optocoupler, housed in a compact 5−pin Mini−Flat package, consists of a highspeed AlGaAs LED at the input coupled to a CMOS detector IC at the output. The detector IC comprises an integrated photodiode, a high−speed transimpedance amplifier and a voltage comparator with an output driver. The CMOS technology coupled with a high−efficiency LED achieves low power consumption as well as very high speed (55 ns propagation delay, 20 ns pulse width distortion).

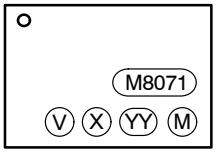
Features

- High−noise Immunity Characterized by Common Mode Rejection
  - 20 kV/μs Minimum Common Mode Rejection
- High Speed
  - 20 Mbit/s Date Rate (NRZ)
  - 55 ns Maximum Propagation Delay
  - 20 ns Maximum Pulse Width Distortion
  - 30 ns Maximum Propagation Delay Skew
- 3.3 V and 5 V CMOS Compatibility
- Specifications Guaranteed Over 3 V to 5.5 V Supply Voltage and −40°C to +110°C Temperature Range
- Safety and Regulatory Approvals:
  - UL1577, 3750 VAC_{RMS} for 1 Minute
  - DIN EN/IEC60747−5−5
- These are Pb−Free Devices

Applications

- Microprocessor System Interface:
  – SPI, I^2C
- Industrial Fieldbus Communications:
  – DeviceNet, CAN, RS485
- Programmable Logic Control
- Isolated Data Acquisition System
- Voltage Level Translator

MARKING DIAGRAM



M8071 = Device Number
V = DIN EN/IEC60747−5−5 Option (Note: Only Appears on Parts Ordered with This Option)
X = One Digit Year Code, e.g., '4'
YY = Two Digit Work Week, Ranging from '01' to '53'
M = Assembly Package Code

PIN CONNECTIONS

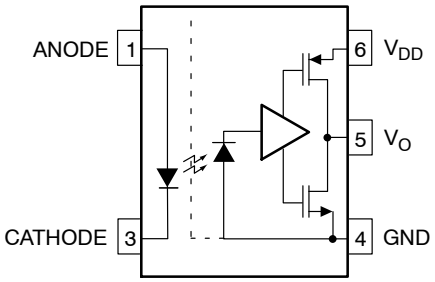


Figure 1. PIN CONNECTION

TRUTH TABLE

LED	Output
Off	High
On	Low

RELATED RESOURCES

FOD8001 Product Folder
FOD0721 Product Folder

ORDERING INFORMATION

See detailed ordering and shipping information on page 9 of this data sheet.

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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_{RMS}	I–IV
	< 300 V_{RMS}	I–III
Climatic Classification		40/110/21
Pollution Degree (DIN VDE 0110/1.89)		2
Comparative Tracking Index		175

Symbol	Parameter	Value	Unit
V_{PR}	Input−to−Output Test Voltage, Method A, V_{IORM} x 1.6 = V_{PR}, Type and Sample Test with t_m = 10 s, Partial Discharge < 5 pC	904	V_{peak}
	Input−to−Output Test Voltage, Method B, V_{IORM} x 1.875 = V_{PR}, 100% Production Test with t_m = 1 s, Partial Discharge < 5 pC	1060	V_{peak}
V_{IORM}	Maximum Working Insulation Voltage	565	V_{peak}
V_{IOTM}	Highest Allowable Over−Voltage	4000	V_{peak}
	External Creepage	≥ 5	mm
	External Clearance	≥ 5	mm
DTI	Distance Through Insulation (Insulation Thickness)	≥ 0.4	mm
T_S	Case Temperature (Note 1)	150	°C
$I_{S,INPUT}$	Input Current (Note 1)	200	mA
$P_{S,OUTPUT}$	Output Power (Note 1)	300	mW
R_{IO}	Insulation Resistance at T_S, V_{IO} = 500 V (Note 1)	> 10^9	Ω

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

PIN DEFINITIONS

Number	Name	Function Description
1	ANODE	Anode
3	CATHODE	Cathode
4	GND	Output Ground
5	V_O	Output Voltage
6	V_{DD}	Output Supply Voltage

ABSOLUTE MAXIMUM RATINGS (T_A = 25°C, unless otherwise noted)

Symbol	Parameter	Value	Unit
T_{STG}	Storage Temperature	−40 to +125	°C
T_{OPR}	Operating Temperature	−40 to +110	°C
T_J	Junction Temperature	−40 to +125	°C
T_{SOL}	Lead Solder Temperature (Refer to Reflow Temperature Profile)	260 for 10 s	°C
IF	Forward Current	20	mA
V_R	Reverse Voltage	5	V
V_{DD}	Supply Voltage	0 to 6.0	V
V_O	Output Voltage	−0.5 to V_{DD} + 0.5	V
I_O	Average Output Current	10	mA
PD_I	Input Power Dissipation (Note 2, 4)	40	mW
PD_O	Output Power Dissipation (Note 3, 4)	70	mW

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.

2. Derate linearly from 95°C at a rate of −1.4 mW/°C.
3. Derate linearly from 100°C at a rate of −3.47 mW/°C.
4. Functional operation under these conditions is not implied. Permanent damage may occur if the device is subjected to conditions outside these ratings.

RECOMMENDED OPERATING CONDITIONS

Symbol	Parameter	Min	Max	Unit
T_A	Ambient Operating Temperature	−40	+110	°C
V_{DD}	Supply Voltages (Note 5)	3.0	5.5	V
V_{FL}	Logic Low Input Voltages	0	0.8	V
I_{FH}	Logic High Input Current	5	16	mA
I_{OL}	Logic Low Output Current	0	7	mA

Functional operation above the stresses listed in the Recommended Operating Ranges is not implied. Extended exposure to stresses beyond the Recommended Operating Ranges limits may affect device reliability.

5. 0.1 μF bypass capacitor must be connected between 4 and 6.

ELECTRICAL CHARACTERISTICS Apply over all recommended conditions (T_A = −40°C to +110°C, 3.0 V ≤ V_{DD} ≤ 5.5 V unless otherwise specified.) All typical values are measured at T_A = 25°C and V_{DD} = 3.3 V.

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
INPUT CHARACTERISTICS						
V_F	Forward Voltage	I_F = 10 mA (Figure 2)	1.05	1.35	1.80	V
BV_R	Input Reverse Breakdown Voltage	I_R = 10 μA	5	15	–	V
I_{FHL}	Threshold Input Current	(Figure 3)	–	2.8	5.0	mA
OUTPUT CHARACTERISTICS						
I_{DDL}	Logic Low Output Supply Current	V_{DD} = 3.3 V, I_F = 10 mA (Figures 4 and 6)	–	3.3	4.8	mA
		V_{DD} = 5.0 V, I_F = 10 mA (Figures 4 and 7)	–	4.0	5.0	mA
I_{DDH}	Logic High Output Supply Current	V_{DD} = 3.3 V, I_F = 0 mA (Figure 5)	–	3.3	4.8	mA
		V_{DD} = 5.0 V, I_F = 0 mA (Figure 5)	–	4.0	5.0	mA
V_{OH}	Logic High Output Voltage	V_{DD} = 3.3 V, I_O = −20 μA, I_F = 0 mA	V_{DD}−0.1 V	3.3	–	V
		V_{DD} = 3.3 V, I_O = −4 mA, I_F = 0 mA	V_{DD}−0.5 V	3.1	–	V
		V_{DD} = 5.0 V, I_O = −20 μA, I_F = 0 mA	V_{DD}−0.1 V	5.0	–	V
		V_{DD} = 5.0 V, I_O = −4 mA, I_F = 0 mA	V_{DD}−0.5 V	4.9	–	V
V_{OL}	Logic Low Output Voltage	I_O = 20 μA, I_F = 10 mA	–	0.0027	0.01	V
		I_O = 4 mA, I_F = 10 mA	–	0.27	0.80	V

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

SWITCHING CHARACTERISTICS Apply over all recommended conditions (T_A = −40°C to +110°C, 3.0 V ≤ V_{DD} ≤ 5.5 V unless otherwise specified.) All typical values are measured at T_A = 25°C and V_{DD} = 3.3 V.

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
Date Rate (Note 6)			–	–	20	Mbps
t_{PW}	Pulse Width		50	–	–	ns
t_{PHL}	Propagation Delay Time to Logic Low Output	C_L = 15 pF (Figure 8, 9 and 13)	–	31	55	ns
t_{PLH}	Propagation Delay Time to Logic High Output	C_L = 15 pF (Figure 8, 9 and 13)	–	25	55	ns
PWD	Pulse Width Distortion, $\lvert t_{PHL} - t_{PLH} \rvert$	C_L = 15 pF (Figure 10 and 11)	–	5.5	20	ns
t_{PSK}	Propagation Delay Skew	C_L = 15 pF (Note 7)	–	–	30	ns
t_R	Output Rise Time (10% to 90%)	(Figure 12 and 13)	–	5.8	–	ns
t_F	Output Fall Time (90% to 10%)	(Figure 12 and 13)	–	5.3	–	ns
$\lvert CM_H \rvert$	Common Mode Transient Immunity at Output High	I_F = 0 mA, V_O > 0.8 V_{DD}, V_{CM} = 1000 V, T_A = 25°C (Figure 14) (Note 8)	20	40	–	kV/μs
$\lvert CM_L \rvert$	Common Mode Transient Immunity at Output Low	I_F = 5 mA, V_O < 0.8 V, V_{CM} = 1000 V, T_A = 25°C (Figure 14) (Note 8)	20	40	–	kV/μs
C_{PDO}	Output Dynamic Power Dissipation Capacitance (Note 9)		–	4	–	pF

6. Data rate is based on 10 MHz, 50% NRZ pattern with a 50 ns minimum bit time.
7. t_{PSK} is equal to the magnitude of the worst case difference in t_{PHL} and/or t_{PLH} that will be seen between any two units from the same manufacturing date code that are operated at same case temperature (±5°C), at the same operating conditions, with equal loads (R_L = 350 Ω and C_L = 15 pF), and with an input rise time less than 5 ns.
8. Common mode transient immunity at output high is the maximum tolerable positive dVcm/dt on the leading edge of the common mode impulse signal, Vcm, to assure that the output will remain high. Common mode transient immunity at output low is the maximum tolerable negative dVcm/dt on the trailing edge of the common pulse signal, Vcm, to assure that the output will remain low.
9. Unloaded dynamic power dissipation is calculated as follows: C_{PD} x V_{DD} x f + I_{DD} + V_{PD} where *f* is switched time in MHz.

ISOLATION CHARACTERISTICS

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V_{ISO}	Input−Output Isolation Voltage	f = 60 Hz, t = 1.0 min., I_{I-O} ≤ 10 μA (Note 10, 11)	3750	–	–	VAC_{RMS}
R_{ISO}	Isolation Resistance	V_{I-O} = 500 V (Note 10)	10^{11}	–	–	Ω
C_{ISO}	Isolation Capacitance	V_{I-O} = 0 V, f = 1.0 Mhz (Note 10)	–	0.2	–	pF

10. Device is considered a two terminal device: pins 1 and 3 are shorted together and pins 4, 5 and 6 are shorted together.
11. 3,750 VAC_{RMS} for 1 minute duration is equivalent to 4,500 VAC_{RMS} for 1 second duration.

TYPICAL PERFORMANCE CURVES

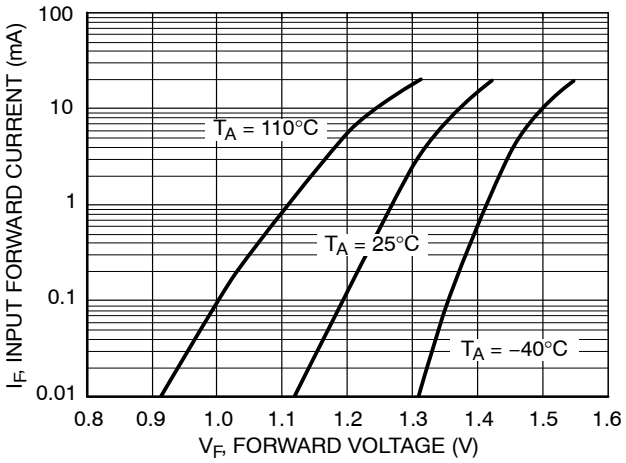

Figure 2. Input Forward Current vs. Forward Voltage

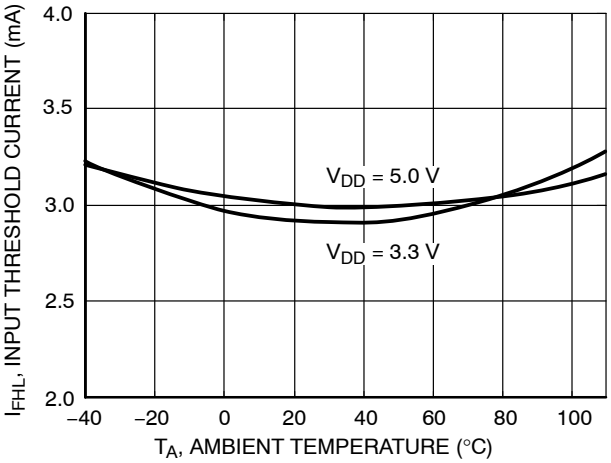

Figure 3. Input Threshold Current vs. Ambient Temperature

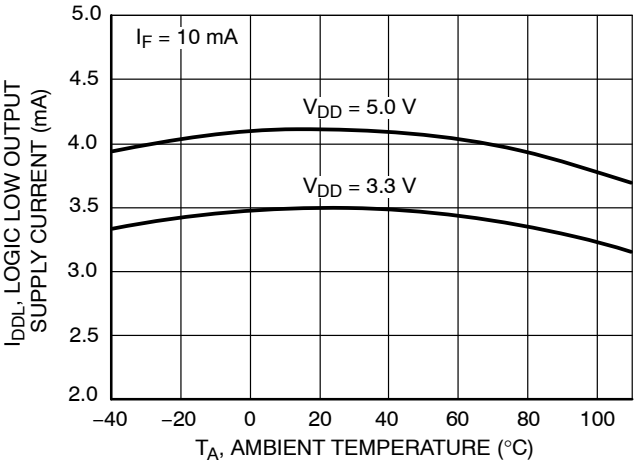

Figure 4. Logic Low Output Supply Current vs. Ambient Temperature

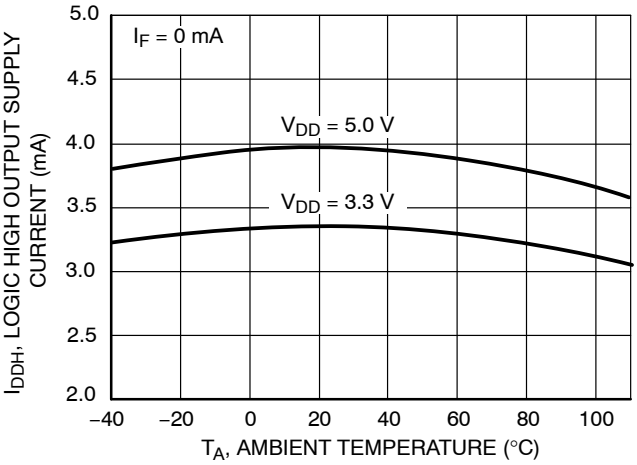

Figure 5. Logic High Output Supply Current vs. Ambient Temperature

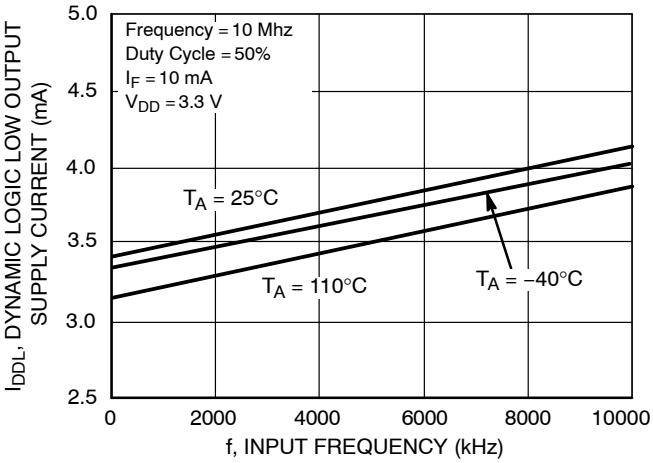

Figure 6. Dynamic Logic Low Output Supply Current vs. Input Frequency (V_{DD} = 3.3 V)

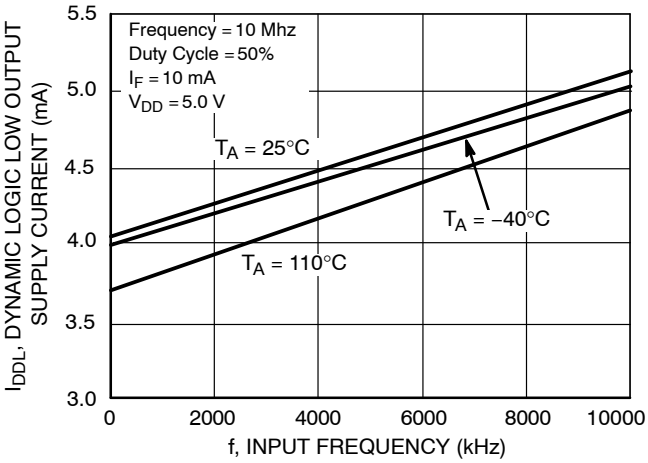

Figure 7. Dynamic Logic Low Output Supply Current vs. Input Frequency (V_{DD} = 5.0 V)

TYPICAL PERFORMANCE CURVES

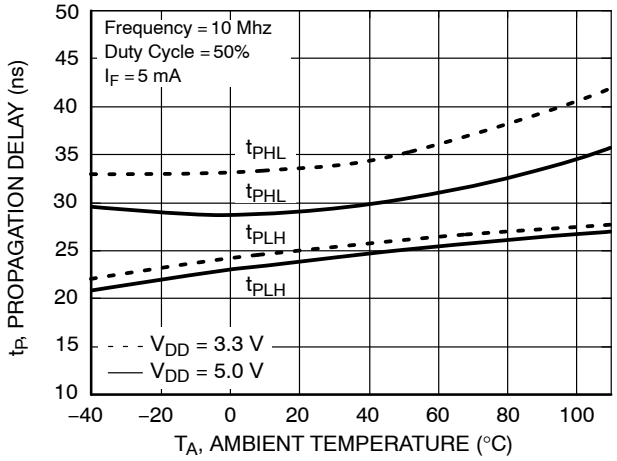

Figure 8. Propagation Delay vs. Ambient Temperature

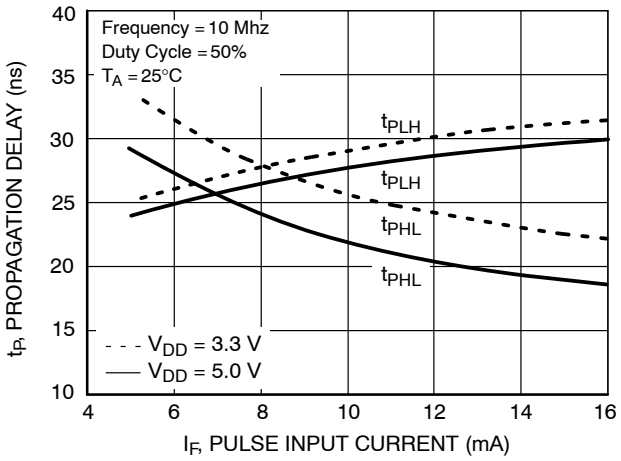

Figure 9. Propagation Delay vs. Pulse Input Current

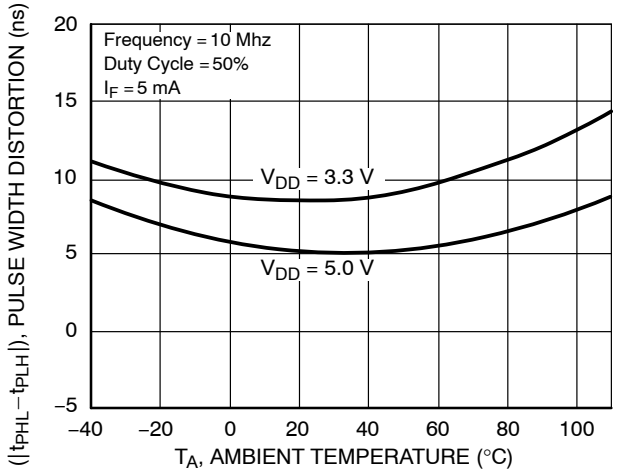

Figure 10. Pulse Width Distortion vs. Ambient Temperature

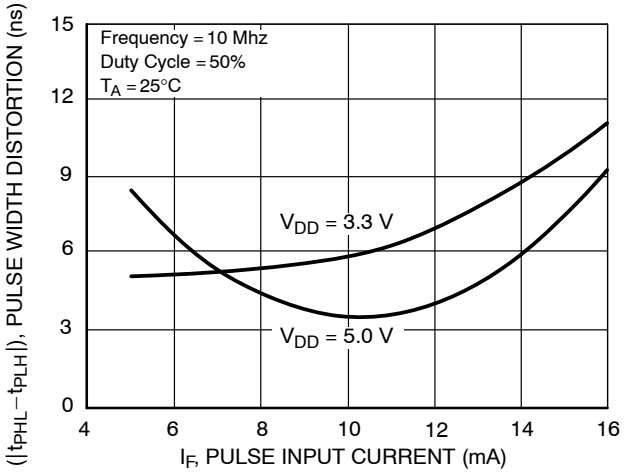

Figure 11. Pulse Width Distortion vs. Pulse Input Current

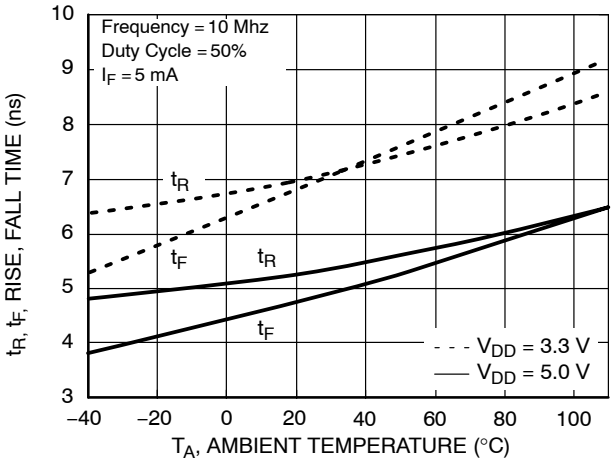

Figure 12. Rise and Fall Time vs. Ambient Temperature

TEST CIRCUITS

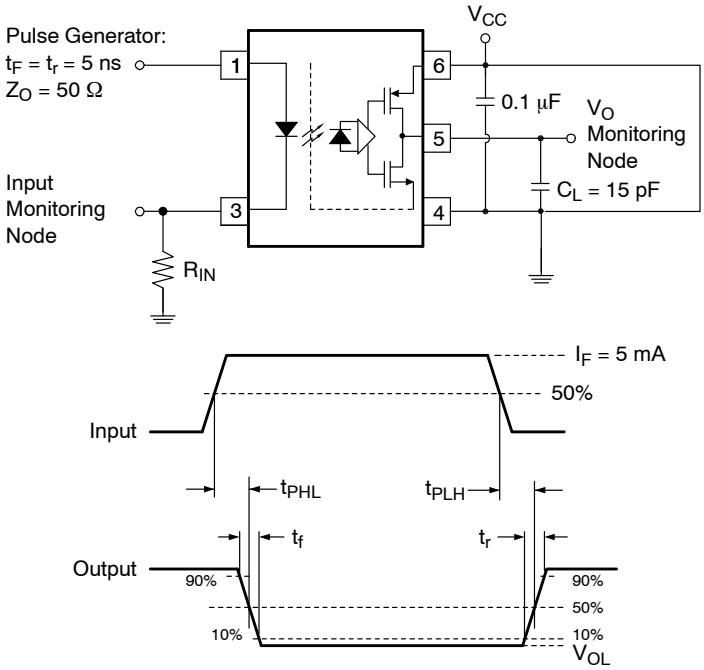

Figure 13. Test Circuit for Propagation Delay, Rise Time, and Fall Time

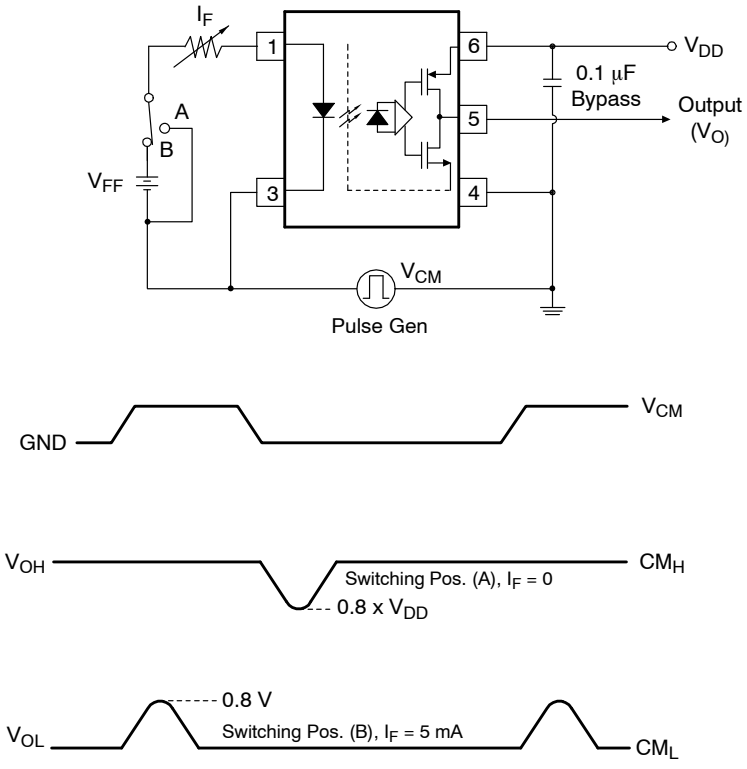

Figure 14. Test Circuit for Instantaneous Common Mode Rejection Voltage

REFLOW PROFILE

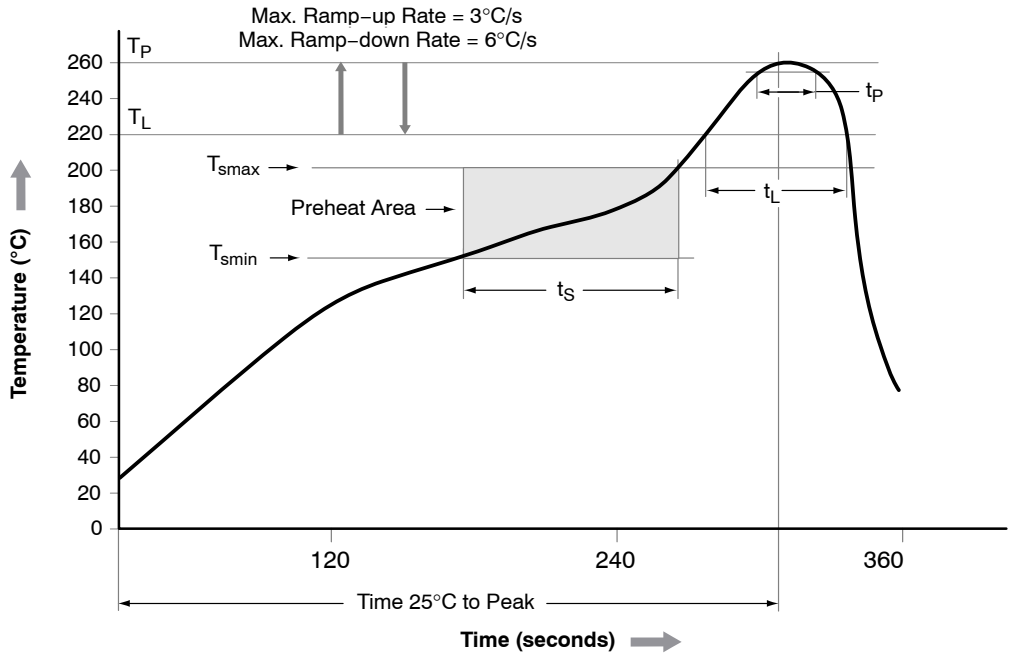

Figure 15. Reflow Profile

Table 1. REFLOW PROFILE

Profile Feature	Pb−Free Assembly Profile
Temperature Minimum (Tsmin)	150°C
Temperature Maximum (Tsmax)	200°C
Time (t_S) from (Tsmin to Tsmax)	60 – 120 seconds
Ramp−up Rate (t_L to t_P)	3°C/second maximum
Liquidous Temperature (T_L)	217°C
Time (t_L) Maintained Above (T_L)	60 – 150 seconds
Peak Body Package Temperature	260°C +0°C / −5°C
Time (t_P) within 5°C of 260°C	30 seconds
Ramp−down Rate (T_P to T_L)	6°C/second maximum
Time 25°C to Peak Temperature	8 minutes maximum

ORDERING INFORMATION

Part Number	Package	Shipping†
FODM8071	Mini−Flat 5−Pin, 4.1 x 4.4, 2.54P	100 Units / Tube
FODM8071R2	Mini−Flat 5−Pin, 4.1 x 4.4, 2.54P	2500 / Tape & Reel

†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.

- All packages are lead free per JEDEC: J−STD−020B standard.

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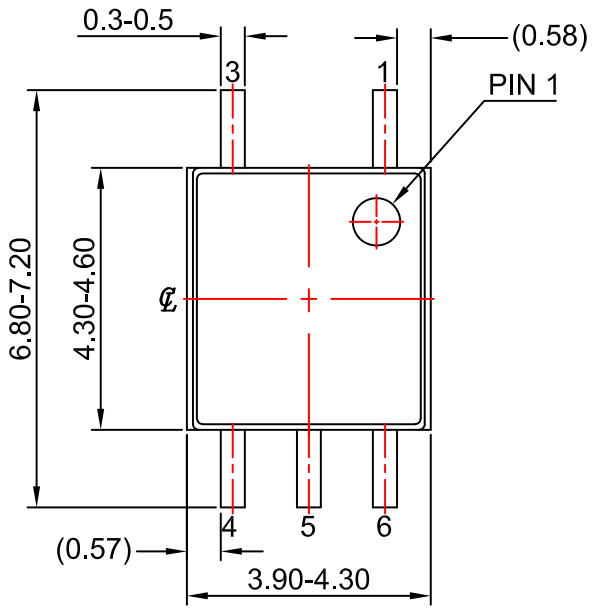
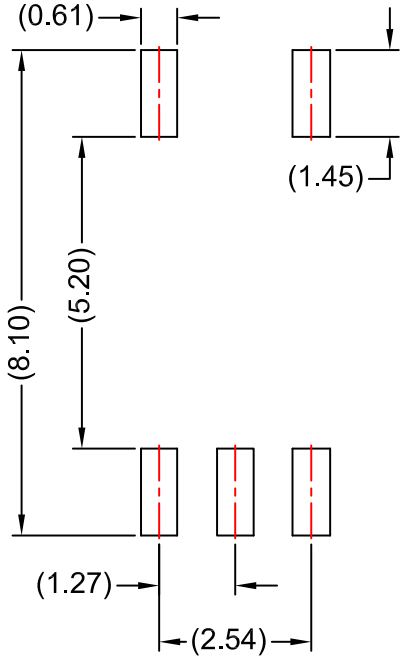
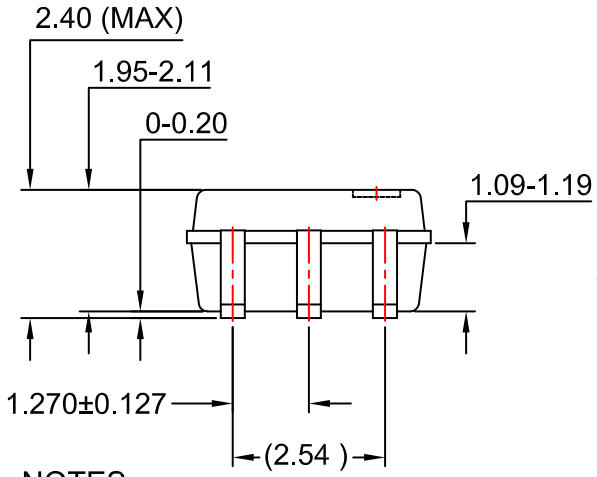
MFP5 4.1X4.4, 2.54P
CASE 100AM
ISSUE O

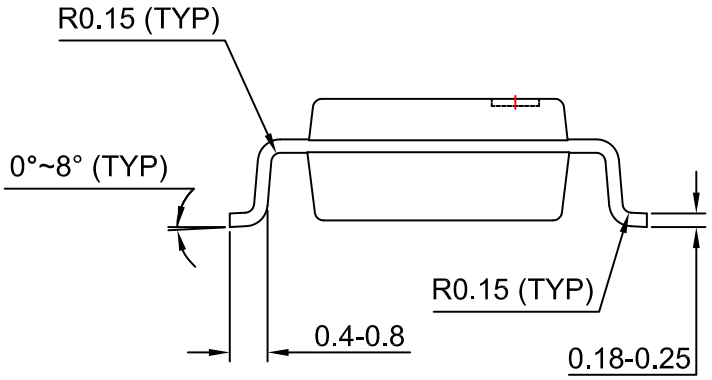
DATE 31 AUG 2016





LAND PATTERN RECOMMENDATION





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