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FOD3184
3A Output Current, High Speed MOSFET/IGBT Gate Driver Optocoupler

Features

- High noise immunity characterized by 50kV/µs (Typ.) common mode rejection @ V_{CM} = 2,000V
- Guaranteed operating temperature range of -40°C to +100°C
- 3A peak output current for medium power MOSFET/IGBT
- Fast switching speed
  – 210ns max. propagation delay
  – 65ns max pulse width distortion
- Fast output rise/fall time
  – Offers lower dynamic power dissipation
- 250kHz maximum switching speed
- Wide V_{DD} operating range from 15V to 30V
- Use of P-Channel MOSFETs at output stage enables output voltage swing close to the supply rail (rail-to-rail output)
- Under voltage lockout protection (UVLO) with hysteresis – optimized for driving IGBTs
- Safety and regulatory approvals
  – UL1577, 5,000 VAC_{RMS} for 1 min.
  – DIN EN/IEC 60747-5-2, 1,414 peak working insulation voltage
    • Minimum creepage distance of 8.0mm
    • Minimum clearance distance of 8mm to 16mm (option TV or TSV)
    • Minimum insulation thickness of 0.5mm

Applications

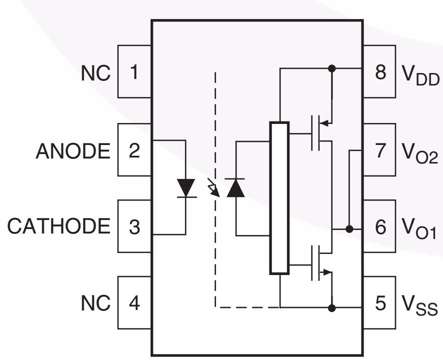
- Plasma Display Panel
- High performance DC/DC convertor
- High performance switch mode power supply
- High performance uninterruptible power supply
- Isolated Power MOSFET/IGBT gate drive

Description

The FOD3184 is a 3A Output Current, High Speed MOSFET/IGBT Gate Drive Optocoupler. It consists of a aluminium gallium arsenide (AlGaAs) light emitting diode optically coupled to a CMOS detector with PMOS and NMOS output power transistors integrated circuit power stage. It is ideally suited for high frequency driving of power MOSFETS/IGBT used in Plasma Display Panels (PDPs), motor control inverter applications and high performance DC/DC converters.

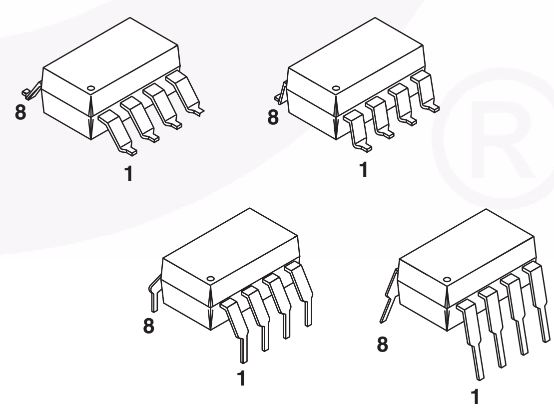
The device is packaged in an 8-pin dual in-line housing compatible with 260°C reflow processes for lead free solder compliance.

Functional Block Diagram



Note:
A 0.1µF bypass capacitor must be connected between pins 5 and 8.

Package Outlines



Truth Table

LED	$V_{DD}-V_{SS}$ "Positive Going" (Turn-on)	$V_{DD}-V_{SS}$ "Negative Going" (Turn-off)	V_O
Off	0V to 30V	0V to 30V	Low
On	0V to 11.5V	0V to 10V	Low
On	11.5V to 13.5V	10V to 12V	Transition
On	13.5V to 30V	12V to 30V	High

Pin Definitions

Pin #	Name	Description
1	NC	Not Connected
2	Anode	LED Anode
3	Cathode	LED Cathode
4	NC	Not Connected
5	V_{SS}	Negative Supply Voltage
6	V_{O2}	Output Voltage 2 (internally connected to V_{O1})
7	V_{O1}	Output Voltage 1
8	V_{DD}	Positive Supply Voltage

Safety and Insulation Ratings

As per DIN EN/IEC 60747-5-2. 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.

Symbol	Parameter	Min.	Typ.	Max.	Unit
	Installation Classifications per DIN VDE 0110/1.89 Table 1				
	For Rated Mains Voltage < 150Vrms		I–IV		
	For Rated Mains Voltage < 300Vrms		I–IV		
	For Rated Mains Voltage < 450Vrms		I–III		
	For Rated Mains Voltage < 600Vrms		I–III		
	For Rated Mains Voltage < 1000Vrms (Option T, TS)		I–III		
	Climatic Classification		40/100/21		
	Pollution Degree (DIN VDE 0110/1.89)		2		
CTI	Comparative Tracking Index	175			
V_{PR}	Input to Output Test Voltage, Method b, V_{IORM} x 1.875 = V_{PR}, 100% Production Test with tm = 1 sec., Partial Discharge < 5pC	2651			
	Input to Output Test Voltage, Method a, V_{IORM} x 1.5 = V_{PR}, Type and Sample Test with tm = 60 sec.,Partial Discharge < 5 pC	2121			
V_{IORM}	Max Working Insulation Voltage	1,414			V_{peak}
V_{IOTM}	Highest Allowable Over Voltage	6000			V_{peak}
	External Creepage	8			mm
	External Clearance	7.4			mm
	External Clearance (for Option T or TS - 0.4" Lead Spacing)	10.16			mm
	Insulation Thickness	0.5			mm
	Safety Limit Values – Maximum Values Allowed in the Event of a Failure				
T_{Case}	Case Temperature	150			°C
$I_{S,INPUT}$	Input Current	25			mA
$P_{S,OUTPUT}$	Output Power	250			mW
R_{IO}	Insulation Resistance at T_S, V_{IO} = 500V	10^9			Ω

Absolute Maximum Ratings (T_A = 25°C unless otherwise specified)

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	Units
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 – Wave solder (Refer to Reflow Temperature Profile, pg. 22)	260 for 10 sec.	°C
$I_{F(AVG)}$	Average Input Current(1)	25	mA
$I_{F(tr, tf)}$	LED Current Minimum Rate of Rise/Fall	250	ns
V_R	Reverse Input Voltage	5	V
$I_{OH(PEAK)}$	"High" Peak Output Current(2)	3	A
$I_{OL(PEAK)}$	"Low" Peak Output Current(2)	3	A
$V_{DD} – V_{SS}$	Supply Voltage	-0.5 to 35	V
$V_{O(PEAK)}$	Output Voltage	0 to V_{DD}	V
P_O	Output Power Dissipation(3)	250	mW
P_D	Total Power Dissipation(3)	295	mW

Recommended Operating Conditions

The Recommended Operating Conditions table defines the conditions for actual device operation. Recommended operating conditions are specified to ensure optimal performance to the datasheet specifications. Fairchild does not recommend exceeding them or designing to absolute maximum ratings.

Symbol	Parameter	Value	Units
$V_{DD} – V_{SS}$	Power Supply	15 to 30	V
$I_{F(ON)}$	Input Current (ON)	10 to 16	mA
$V_{F(OFF)}$	Input Voltage (OFF)	-3.0 to 0.8	V

Electrical-Optical Characteristics (DC)

Apply over all recommended conditions, typical value is measured at V_{DD} = 30V, V_{SS} = 0V, T_A = 25°C, unless otherwise specified.

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{OH}	High Level Output Current	$V_{OH} = (V_{DD} – V_{SS} – 1V)$		-0.9	-0.5	A
		$V_{OH} = (V_{DD} – V_{SS} – 6V)$			-2.5	
I_{OL}	Low Level Output Current	$V_{OL} = (V_{DD} – V_{SS} + 1V)$	0.5	1		A
		$V_{OL} = (V_{DD} – V_{SS} + 6V)$	2.5			
V_{OH}	High Level Output Voltage(4)(5)	I_O = -100mA, I_F = 10mA	V_{DD} – 0.5			V
		I_O = -2.5A, I_F = 10mA	V_{DD} – 7			
V_{OL}	Low Level Output Voltage(4)(5)	I_O = 100mA , I_F = 0mA			V_{SS} + 0.5	V
		I_O = 2.5A, I_F = 0mA			V_{SS} + 7	
I_{DDH}	High Level Supply Current	Output Open, I_F = 10 to 16mA		2.6	3.5	mA
I_{DDL}	Low Level Supply Current	Output Open, V_F = -3.0 to 0.8V		2.5	3.5	mA
I_{FLH}	Threshold Input Current Low to High	I_O = 0mA, V_O > 5V		3.0	7.5	mA
V_{FHL}	Threshold Input Voltage High to Low	I_O = 0mA, V_O < 5V	0.8			V
V_F	Input Forward Voltage	I_F = 10mA	1.1	1.43	1.8	V
$\Delta V_F / T_A$	Temperature Coefficient of Forward Voltage	I_F = 10mA		-1.5		mV/°C
V_{UVLO+}	UVLO Threshold	V_O > 5V, I_F = 10mA	11.5	13.0	13.5	V
$V_{UVLO–}$		V_O < 5V, I_F = 10mA	10.0	11.5	12.0	V
$UVLO_{HYST}$	UVLO Hysteresis			1.5		V
BV_R	Input Reverse Breakdown Voltage	I_R = 10µA	5			V
C_{IN}	Input Capacitance	f = 1MHz, V_F = 0V		25		pF

Switching Characteristics

Apply over all recommended conditions, typical value is measured at V_{DD} = 30V, V_{SS} = 0V, T_A = 25°C, unless otherwise specified.

Symbol	Parameter	Test Conditions	Min.	Typ.*	Max.	Unit
t_{PLH}	Propagation Delay Time to High Output Level(6)	I_F = 10mA, R_g = 10Ω, f = 250kHz, Duty Cycle = 50%, C_g = 10nF	50	120	210	ns
t_{PHL}	Propagation Delay Time to Low Output Level(6)		50	145	210	ns
P_{WD}	Pulse Width Distortion(7)			35	65	ns
P_{DD} ($t_{PHL} - t_{PLH}$)	Propagation Delay Difference Between Any Two Parts(8)		-90		90	ns
t_r	Rise Time	C_L = 10nF, R_g = 10Ω		38		ns
t_f	Fall Time			24		ns
$t_{UVLO\ ON}$	UVLO Turn On Delay			2.0		µs
$t_{UVLO\ OFF}$	UVLO Turn Off Delay			0.3		µs
$\mid CM_H \mid$	Output High Level Common Mode Transient Immunity(9) (10)	T_A = +25°C, I_f = 10mA to 16mA, V_{CM} = 2kV, V_{DD} = 30V	35	50		kV/µs
$\mid CM_L \mid$	Output Low Level Common Mode Transient Immunity(9) (11)	T_A = +25°C, V_f = 0V, V_{CM} = 2kV, V_{DD} = 30V	35	50		kV/µs

*Typical values at T_A = 25°C

Isolation Characteristics

Symbol	Parameter	Test Conditions	Min.	Typ.*	Max.	Unit
V_{ISO}	Withstand Isolation Voltage(12) (13)	T_A = 25°C, R.H. < 50%, t = 1min., I_{I-O} ≤ 10µA	5000			V_{rms}
R_{I-O}	Resistance (input to output)(13)	V_{I-O} = 500V		10^{11}		Ω
C_{I-O}	Capacitance (input to output)	Freq. = 1MHz		1		pF

*Typical values at T_A = 25°C

Notes:

1. Derate linearly above +79°C free air temperature at a rate of 0.37mA/°C.
2. Maximum pulse width = 10µs.
3. Derate linearly above +79°C, free air temperature at the rate of 5.73mW/°C.
4. In this test, V_{OH} is measured with a dc load current of 100mA. When driving capacitive load V_{OH} will approach V_{DD} as I_{OH} approaches zero amps.
5. Maximum pulse width = 1ms, maximum duty cycle = 20%.
6. t_{PHL} propagation delay is measured from the 50% level on the falling edge of the input pulse to the 50% level of the falling edge of the V_O signal. t_{PLH} propagation delay is measured from the 50% level on the rising edge of the input pulse to the 50% level of the rising edge of the V_O signal.
7. PWD is defined as $| t_{PHL} – t_{PLH} |$ for any given device.
8. The difference between t_{PHL} and t_{PLH} between any two FOD3184 parts under same operating conditions, with equal loads.
9. Pin 1 and 4 need to be connected to LED common.
10. Common mode transient immunity in the high state is the maximum tolerable dV_{CM}/dt of the common mode pulse V_{CM} to assure that the output will remain in the high state (i.e. V_O > 15V).
11. Common mode transient immunity in a low state is the maximum tolerable dV_{CM}/dt of the common mode pulse, V_{CM}, to assure that the output will remain in a low state (i.e. V_O < 1.0V).
12. In accordance with UL 1577, each optocoupler is proof tested by applying an insulation test voltage > 6000Vrms, 60Hz for 1 second (leakage detection current limit I_{I-O} < 10µA).
13. Device considered a two-terminal device: pins on input side shorted together and pins on output side shorted together.

Typical Performance Curves

Fig. 1 Output High Voltage Drop vs. Output High Current

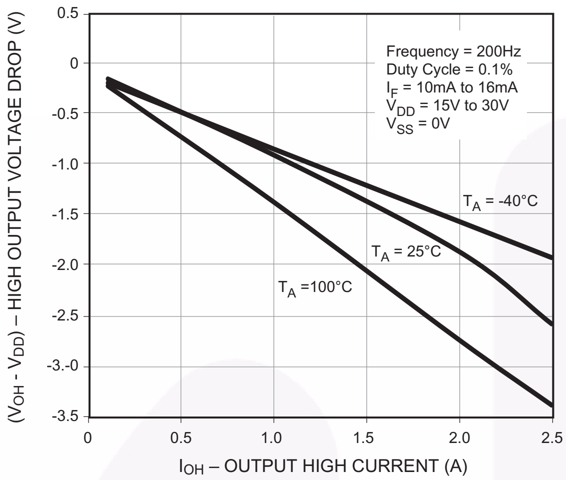


Fig. 2 Output High Voltage Drop vs. Ambient Temperature

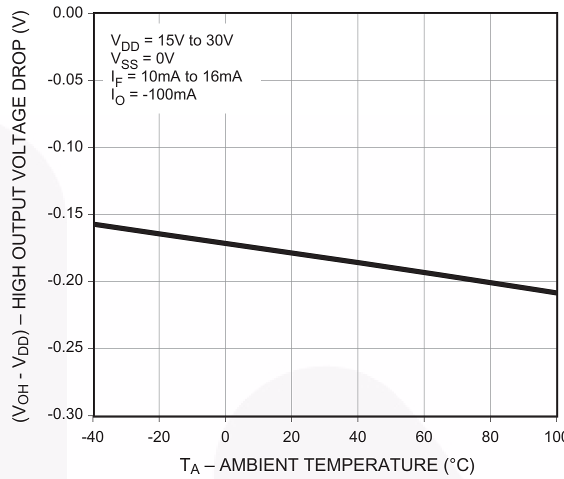


Fig. 3 Output High Current vs. Ambient Temperature

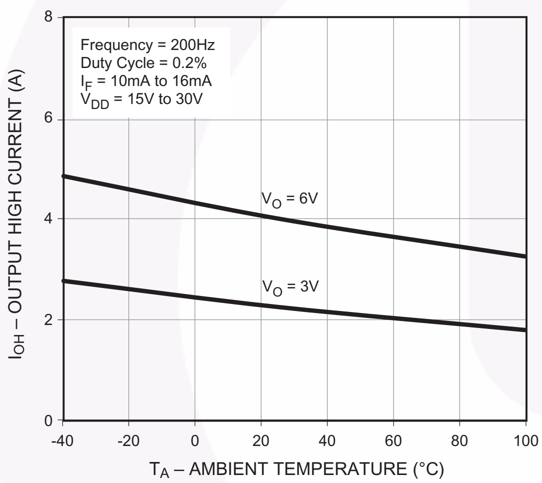


Fig. 4 Output High Current vs. Ambient Temperature

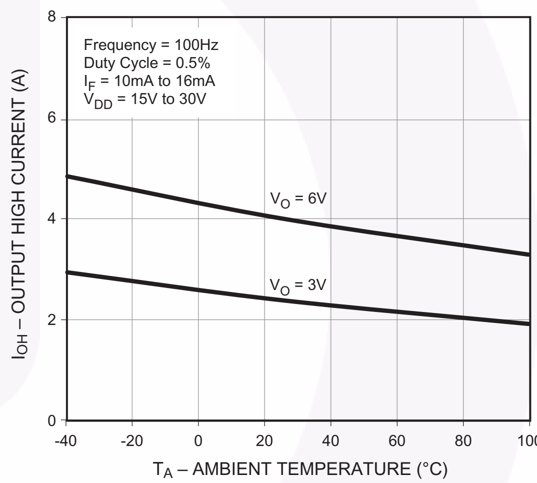


Fig. 5 Output Low Voltage vs. Output High Current

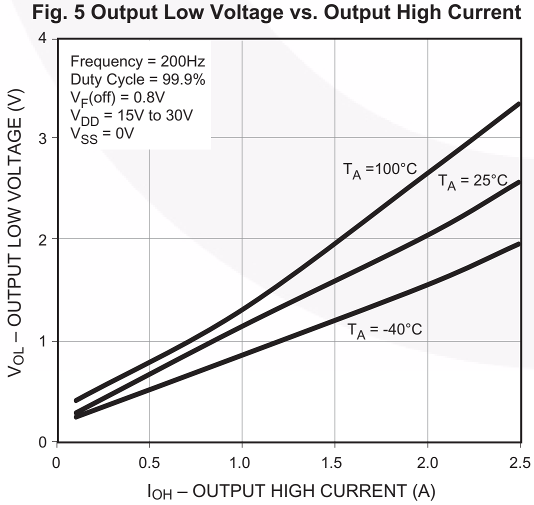
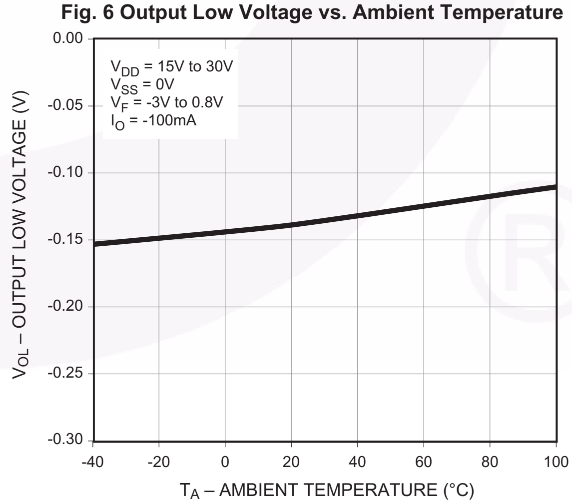


Fig. 6 Output Low Voltage vs. Ambient Temperature



Typical Performance Curves (Continued)

Fig. 7 Output Low Current vs. Ambient Temperature

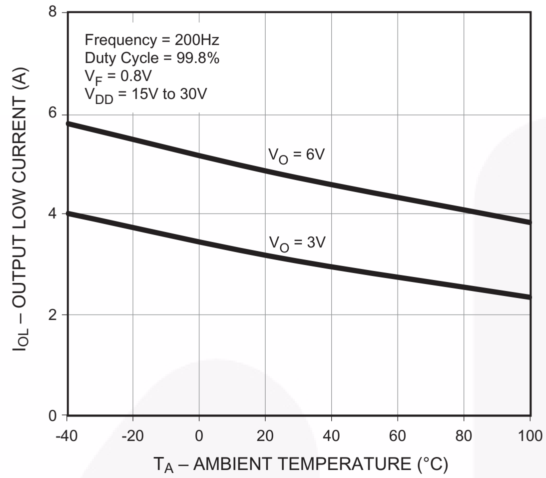


Fig. 8 Output Low Current vs. Ambient Temperature

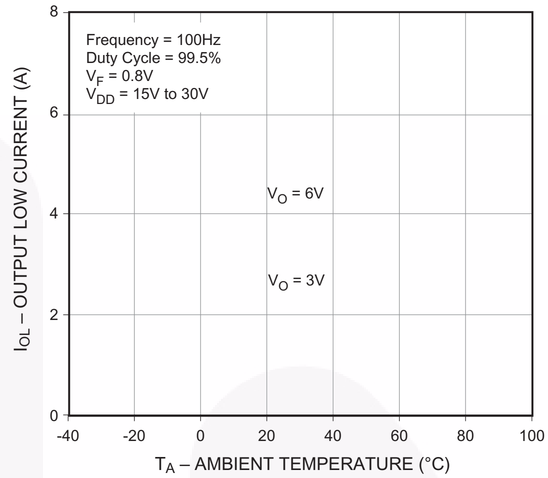


Fig. 9 Supply Current vs. Ambient Temperature

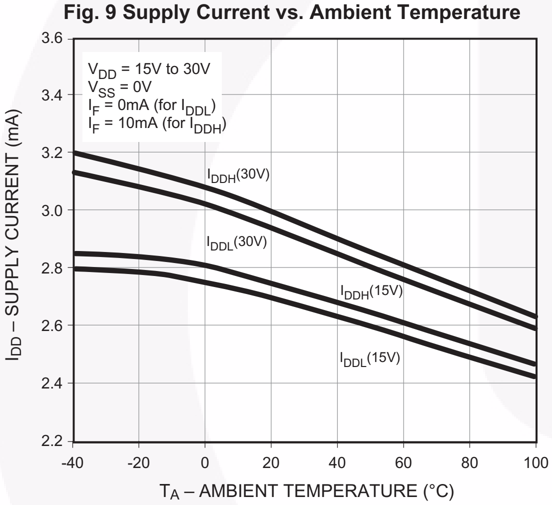


Fig. 10 Supply Current vs. Supply Voltage

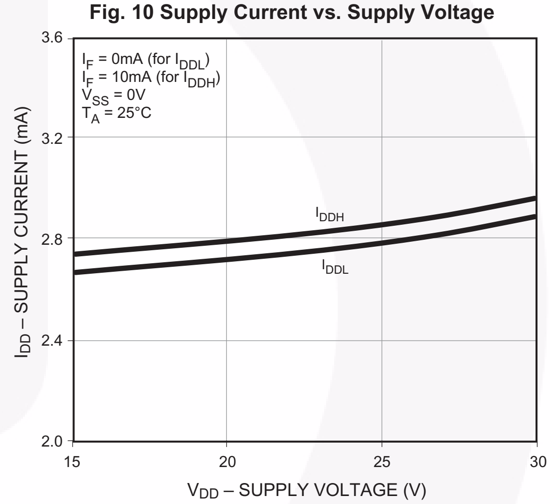


Fig. 11 Low-to-High Input Current Threshold vs. Ambient Temperature

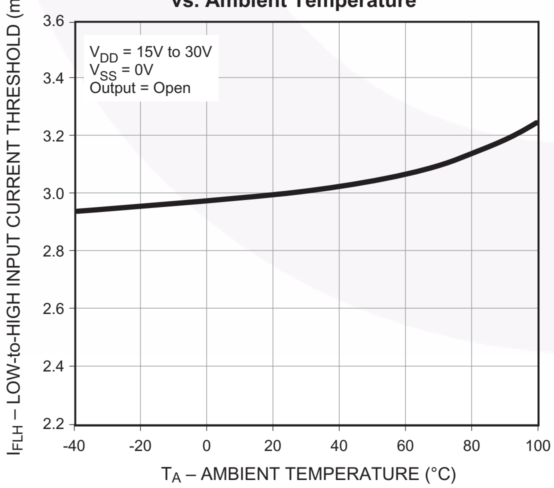
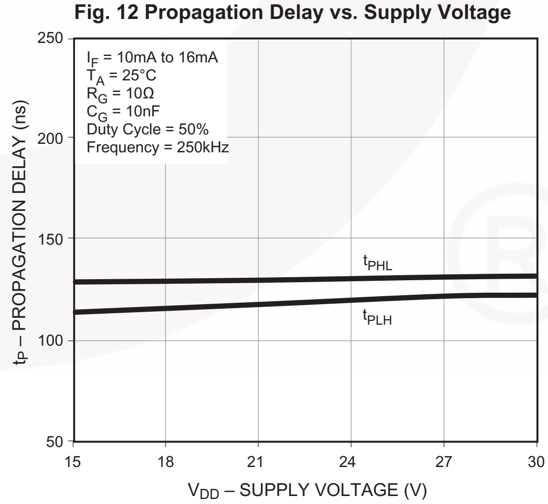


Fig. 12 Propagation Delay vs. Supply Voltage



Typical Performance Curves (Continued)

Fig. 13 Propagation Delay vs. LED Forward Current

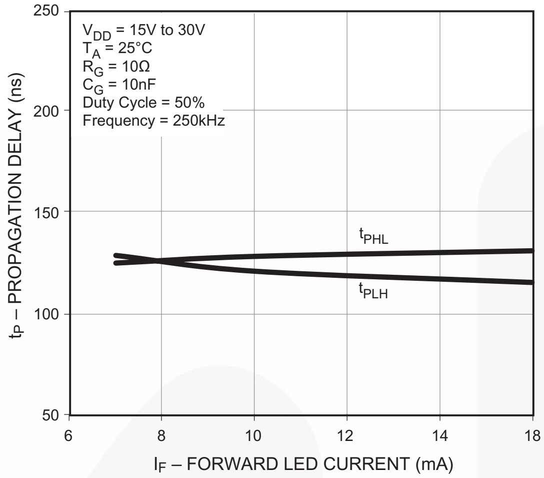


Fig. 14 Propagation Delay vs. Ambient Temperature

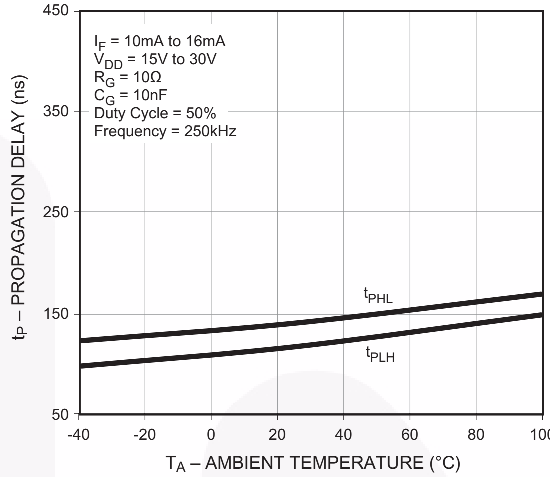


Fig. 15 Propagation Delay vs. Series Load Resistance

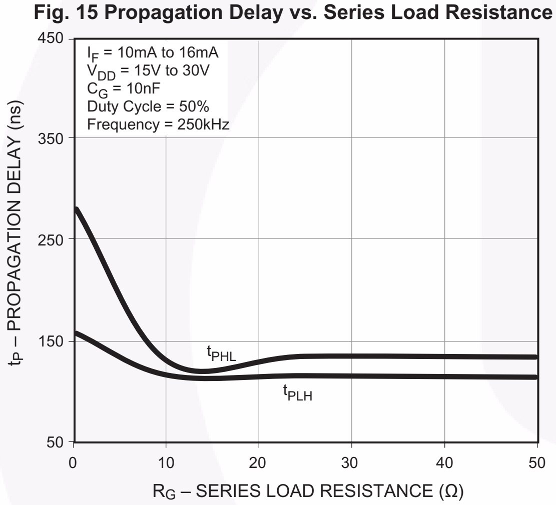


Fig. 16 Propagation Delay vs. Series Load Capacitance

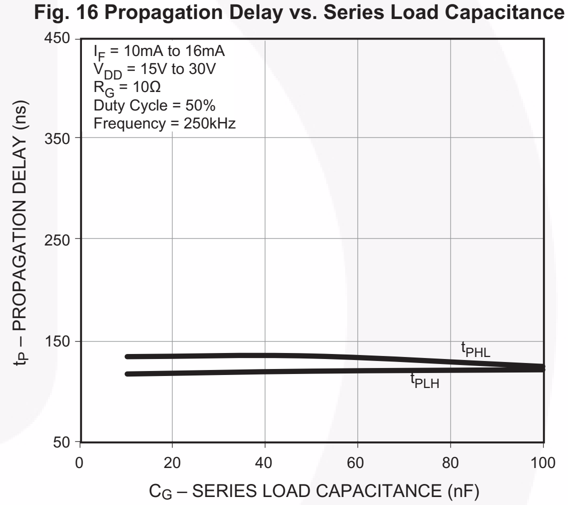


Fig. 17 Transfer Characteristics

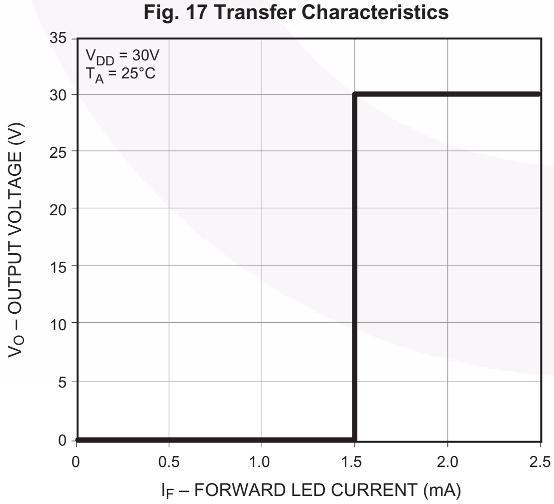
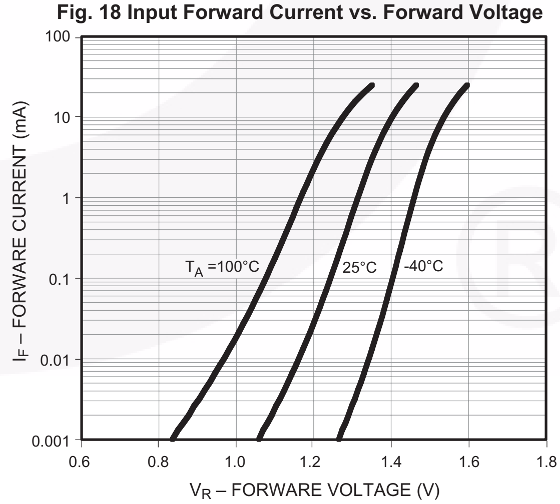
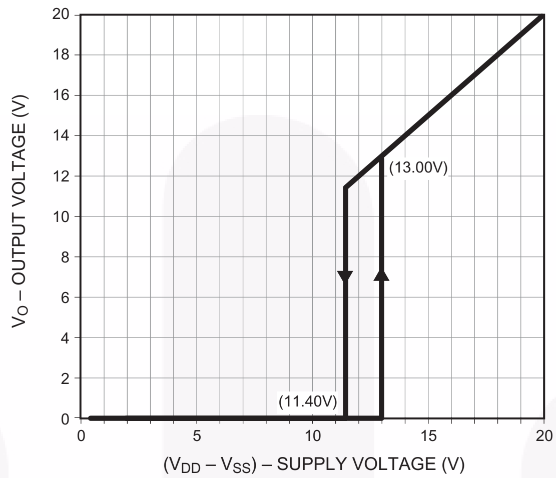


Fig. 18 Input Forward Current vs. Forward Voltage

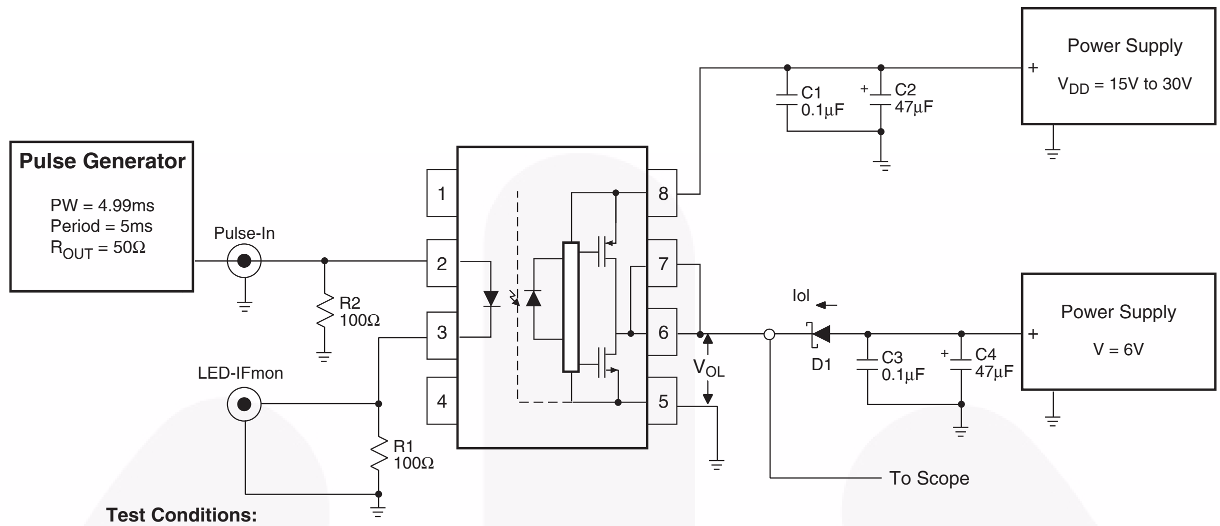


Typical Performance Curves (Continued)

Fig. 19 Under Voltage Lockout

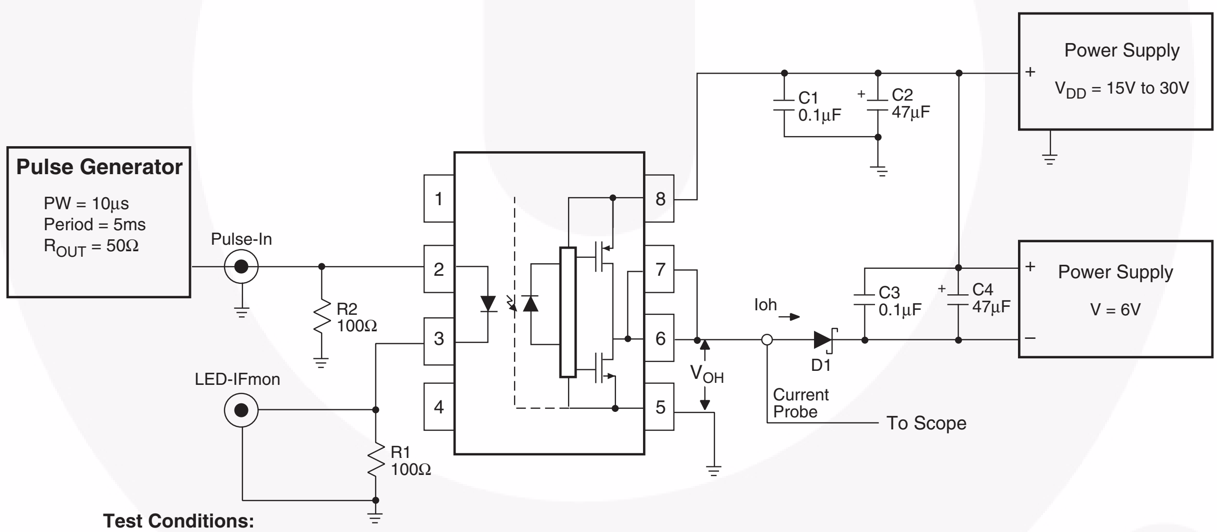


Test Circuit



Test Conditions:
Frequency = 200Hz
Duty Cycle = 99.8%
V_{DD} = 15V to 30V
V_{SS} = 0V
$V_{F(OFF)}$ = -3.0V to 0.8V

Figure 20. I_{OL} Test Circuit



Test Conditions:
Frequency = 200Hz
Duty Cycle = 0.2%
V_{DD} = 15V to 30V
V_{SS} = 0V
I_F = 10mA to 16mA

Figure 21. I_{OH} Test Circuit

Test Circuit (Continued)

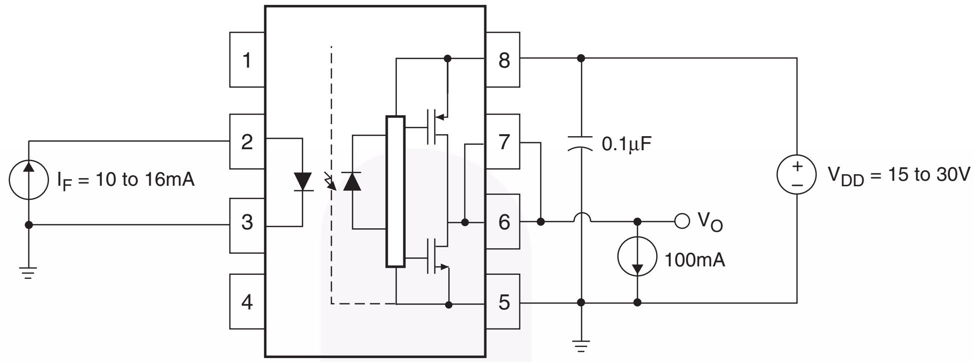


Figure 22. V_{OH} Test Circuit

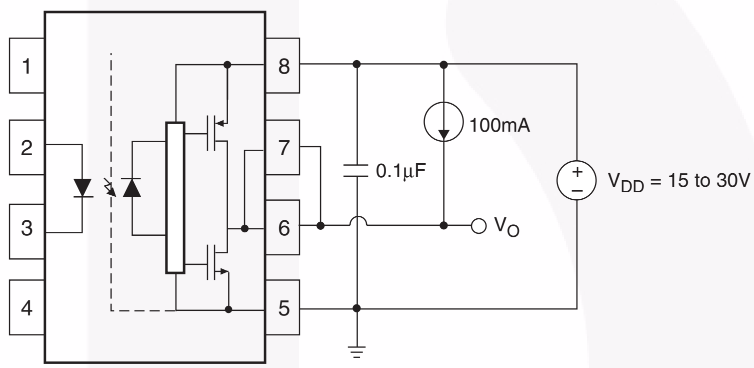


Figure 23. V_{OL} Test Circuit

Test Circuit (Continued)

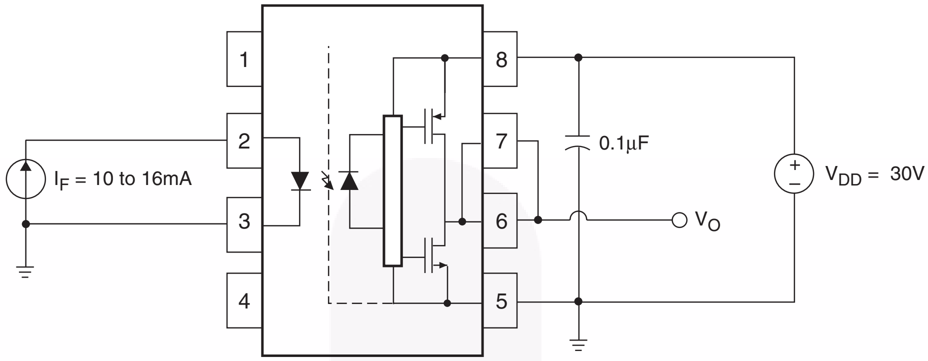


Figure 24. I_{DDH} Test Circuit

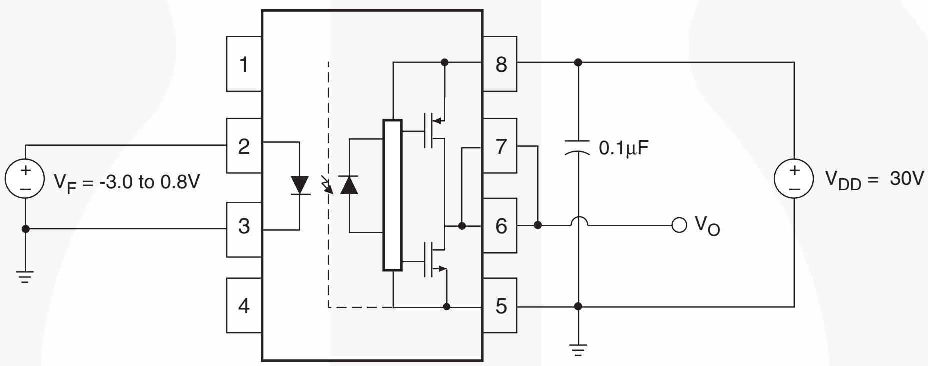


Figure 25. I_{DDL} Test Circuit

Test Circuit (Continued)

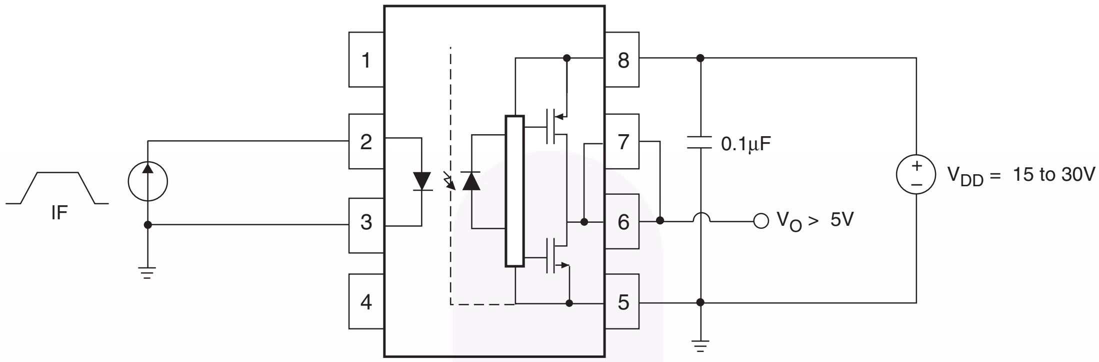


Figure 26. I_{FLH} Test Circuit

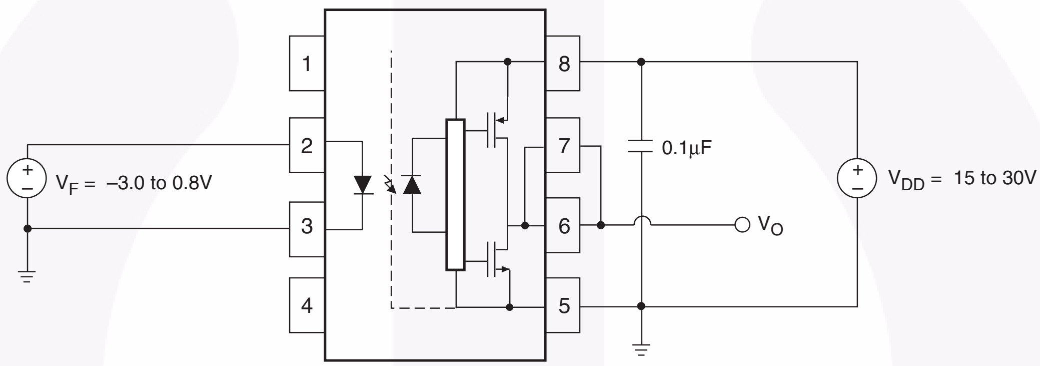


Figure 27. V_{FHL} Test Circuit

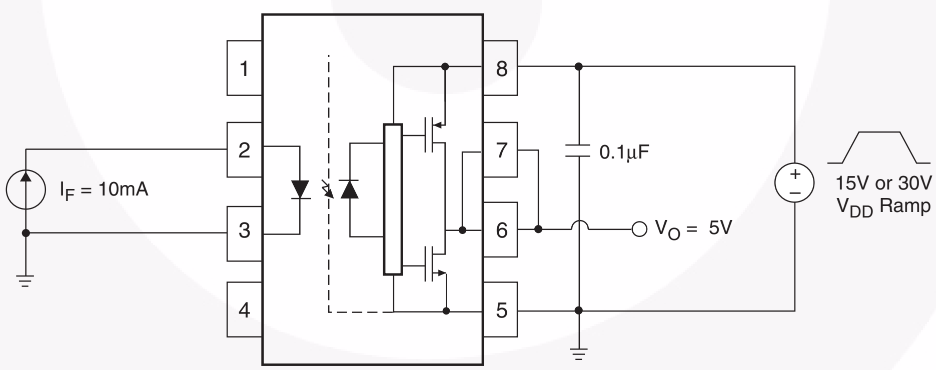


Figure 28. UVLO Test Circuit

Test Circuit (Continued)

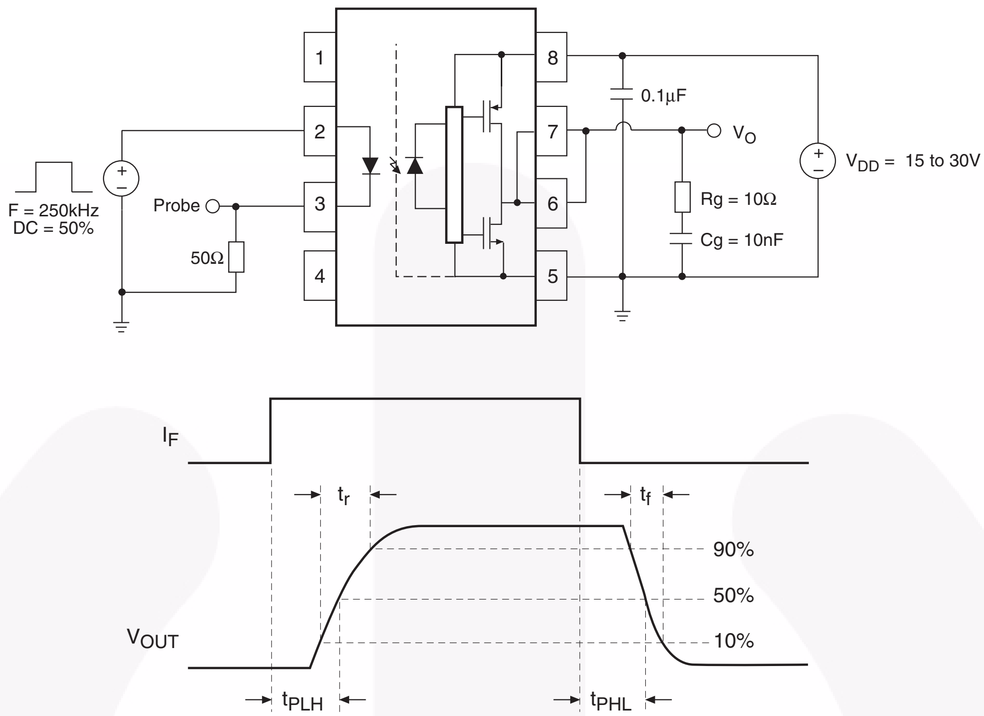


Figure 29. t_{PHL}, t_{PLH}, t_r and t_f Test Circuit and Waveforms

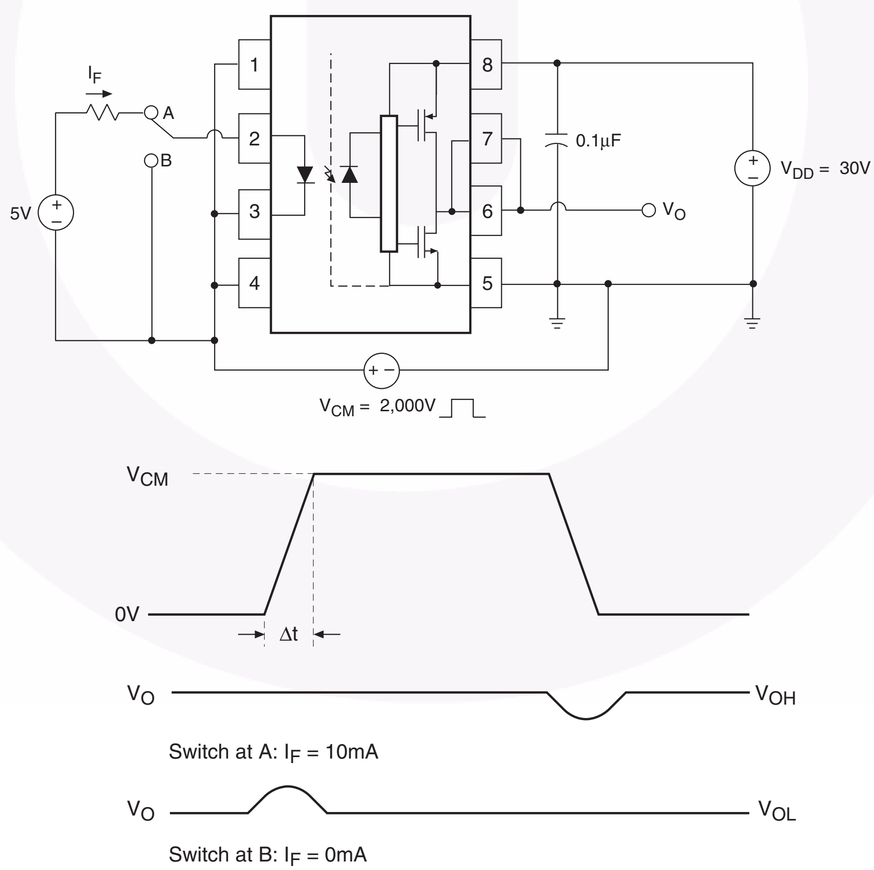
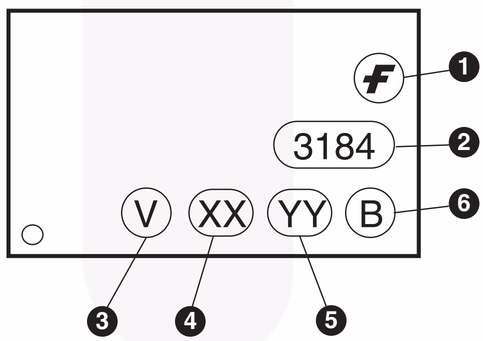


Figure 30. CMR Test Circuit and Waveforms

Ordering Information

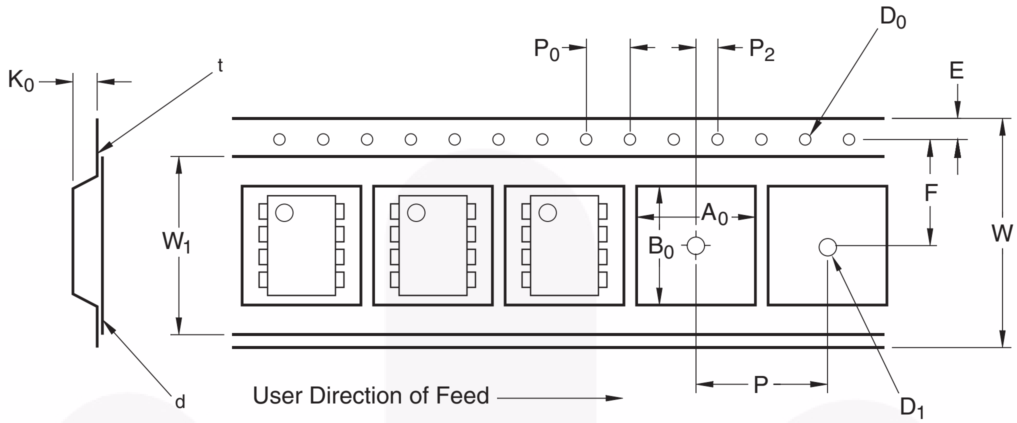
Part Number	Package	Packing Method
FOD3184	DIP 8-Pin	Tube (50 units per tube)
FOD3184S	SMT 8-Pin (Lead Bend)	Tube (50 units per tube)
FOD3184SD	SMT 8-Pin (Lead Bend)	Tape and Reel (1,000 units per reel)
FOD3184V	DIP 8-Pin, DIN EN/IEC 60747-5-2 option	Tube (50 units per tube)
FOD3184SV	SMT 8-Pin (Lead Bend), DIN EN/IEC 60747-5-2 option	Tube (50 units per tube)
FOD3184SDV	SMT 8-Pin (Lead Bend), DIN EN/IEC 60747-5-2 option	Tape and Reel (1,000 units per reel)
FOD3184TV	DIP 8-Pin, 0.4" Lead Spacing, DIN EN/IEC 60747-5-2 option	Tube (50 units per tube)
FOD3184TSV	SMT 8-Pin, 0.4" Lead Spacing, DIN EN/IEC 60747-5-2 option	Tube (50 units per tube)
FOD3184TSR2V	SMT 8-Pin, 0.4" Lead Spacing, DIN EN/IEC 60747-5-2 option	Tape and Reel (700 units per reel)

Marking Information



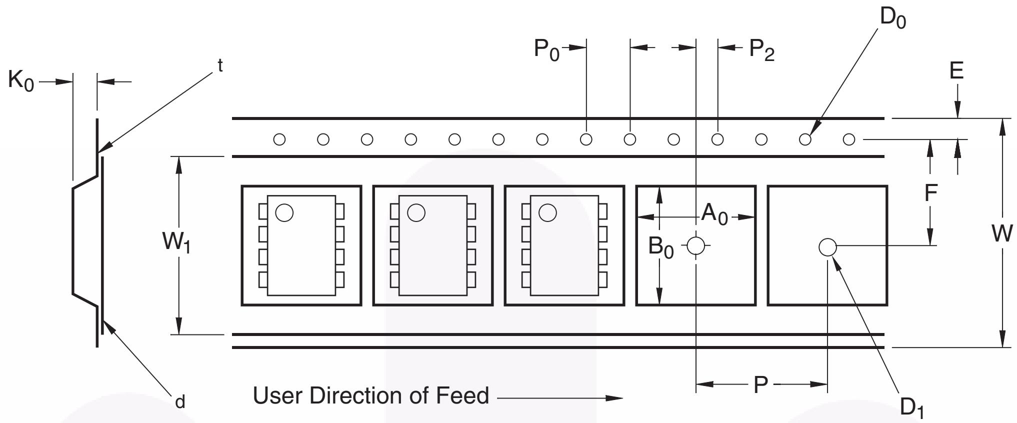
Definitions	
1	Fairchild logo
2	Device number
3	VDE mark (Note: Only appears on parts ordered with DIN EN/IEC 60747-5-2 option – See order entry table)
4	Two digit year code, e.g., '11'
5	Two digit work week ranging from '01' to '53'
6	Assembly package code

Carrier Tape Specifications – Option S



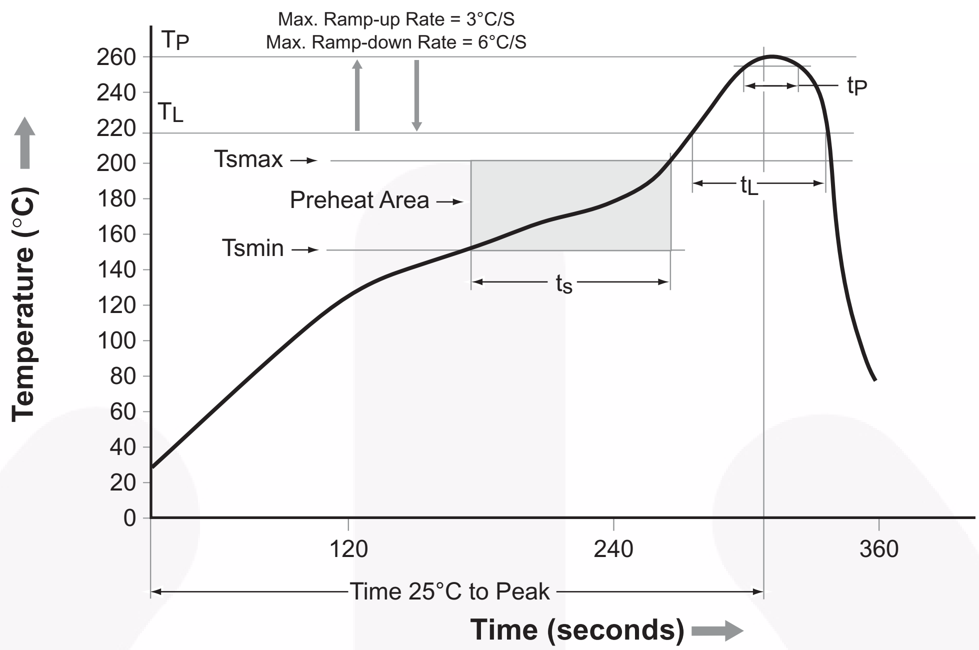
Symbol	Description	Dimension in mm
W	Tape Width	16.0 ± 0.3
t	Tape Thickness	0.30 ± 0.05
P_0	Sprocket Hole Pitch	4.0 ± 0.1
D_0	Sprocket Hole Diameter	1.55 ± 0.05
E	Sprocket Hole Location	1.75 ± 0.10
F	Pocket Location	7.5 ± 0.1
P_2		2.0 ± 0.1
P	Pocket Pitch	12.0 ± 0.1
A_0	Pocket Dimensions	10.30 ±0.20
B_0		10.30 ±0.20
K_0		4.90 ±0.20
W_1	Cover Tape Width	13.2 ± 0.2
d	Cover Tape Thickness	0.1 max
	Max. Component Rotation or Tilt	10°
R	Min. Bending Radius	30

Carrier Tape Specifications – Option TS

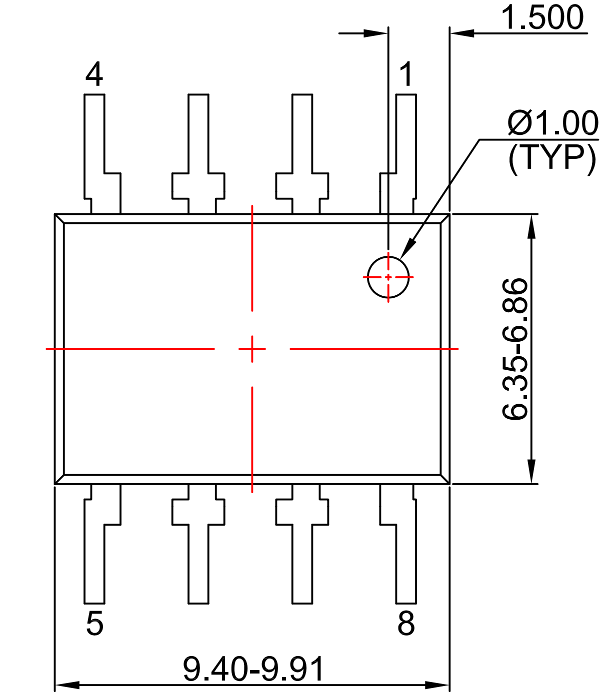


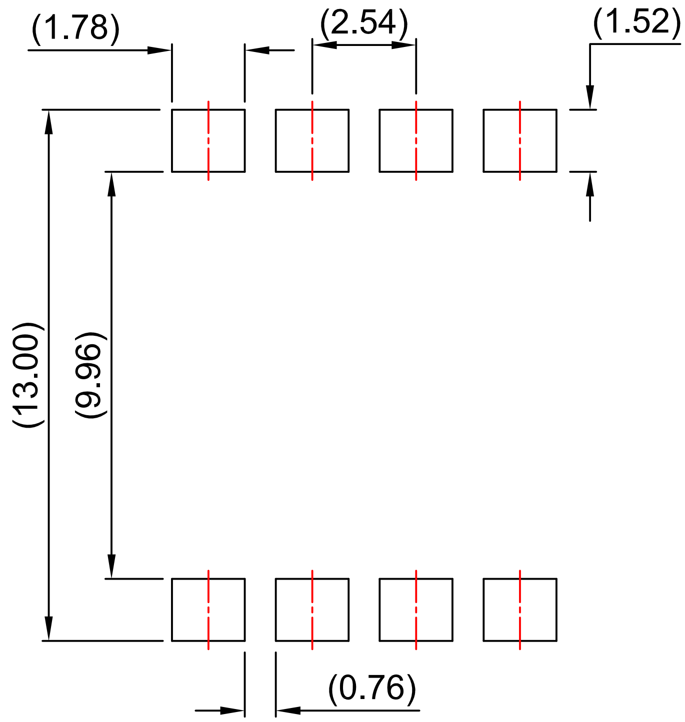
Symbol	Description	Dimension in mm
W	Tape Width	24.0 ± 0.3
t	Tape Thickness	0.40 ± 0.1
P_0	Sprocket Hole Pitch	4.0 ± 0.1
D_0	Sprocket Hole Diameter	1.55 ± 0.05
E	Sprocket Hole Location	1.75 ± 0.10
F	Pocket Location	11.5 ± 0.1
P_2		2.0 ± 0.1
P	Pocket Pitch	16.0 ± 0.1
A_0	Pocket Dimensions	12.80 ± 0.1
B_0		10.35 ± 0.1
K_0		5.7 ±0.1
W_1	Cover Tape Width	21.0 ± 0.1
d	Cover Tape Thickness	0.1 max
	Max. Component Rotation or Tilt	10°
R	Min. Bending Radius	30

Reflow Profile

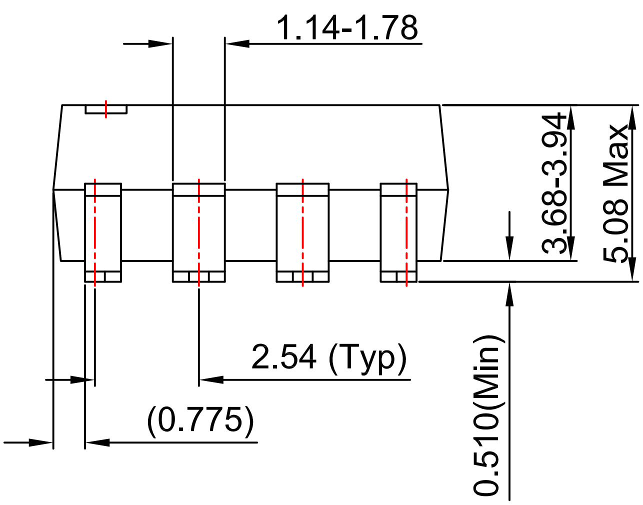


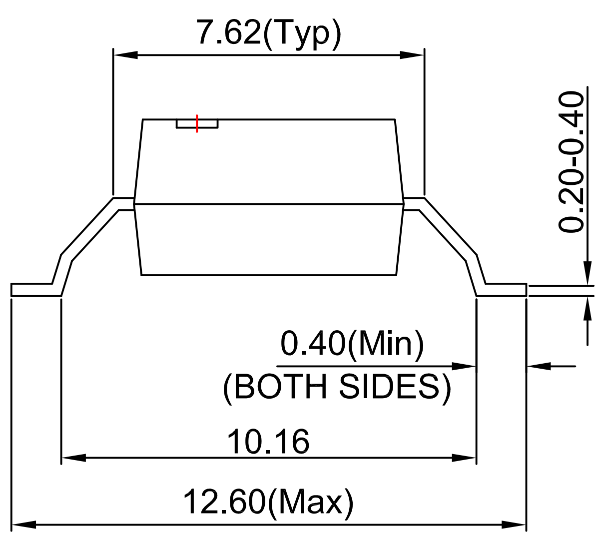
Profile Freature	Pb-Free Assembly Profile
Temperature Min. (Tsmin)	150°C
Temperature Max. (Tsmax)	200°C
Time (t_S) from (Tsmin to Tsmax)	60–120 seconds
Ramp-up Rate (t_L to t_P)	3°C/second max.
Liquidous Temperature (T_L)	217°C
Time (t_L) Maintained Above (T_L)	60–150 seconds
Peak Body Package Temperature	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 max.
Time 25°C to Peak Temperature	8 minutes max.





LAND PATTERN RECOMMENDATION





NOTES:

A) NO STANDARD APPLIES TO THIS PACKAGE

B) ALL DIMENSIONS ARE IN MILLIMETERS.

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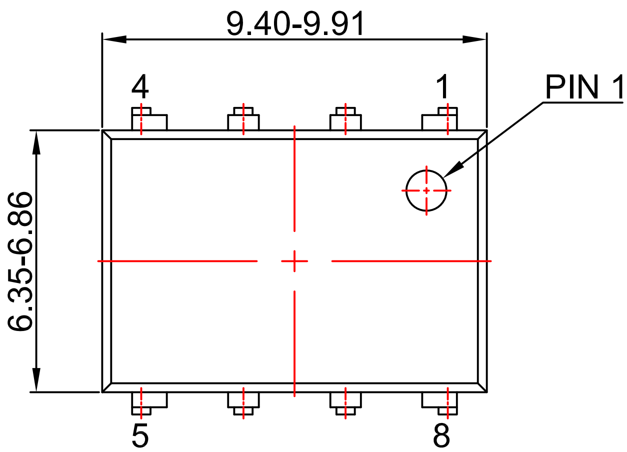
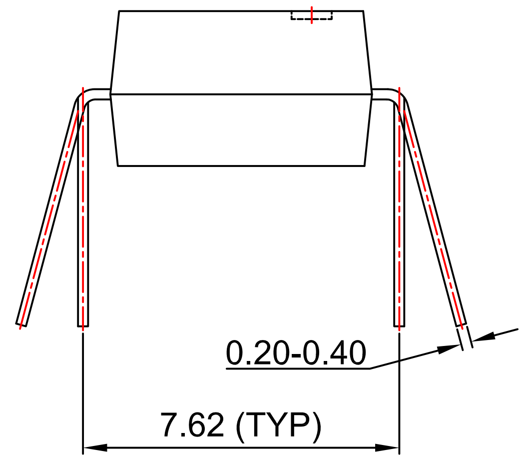
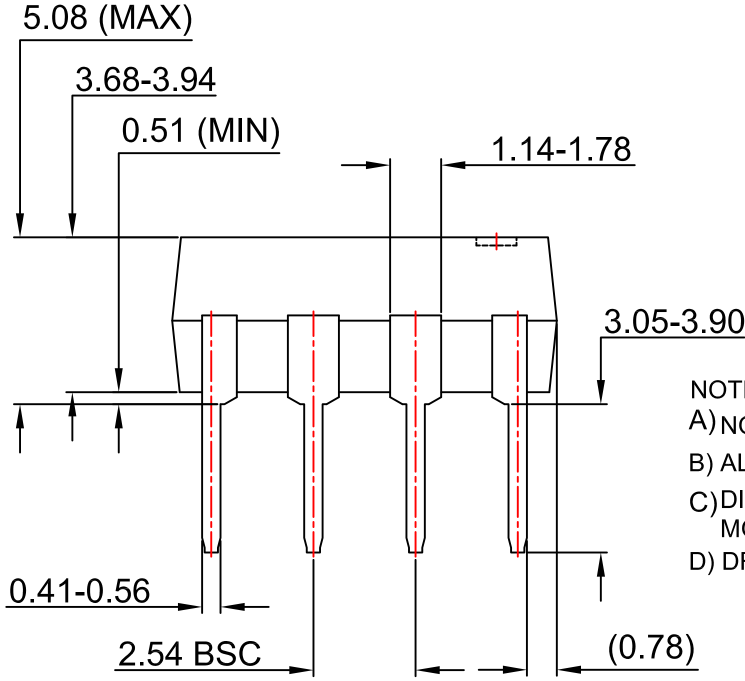
D) DWG FILENAME AND REVISION: MKT-N08Lrev2.

FAIRCHILD™







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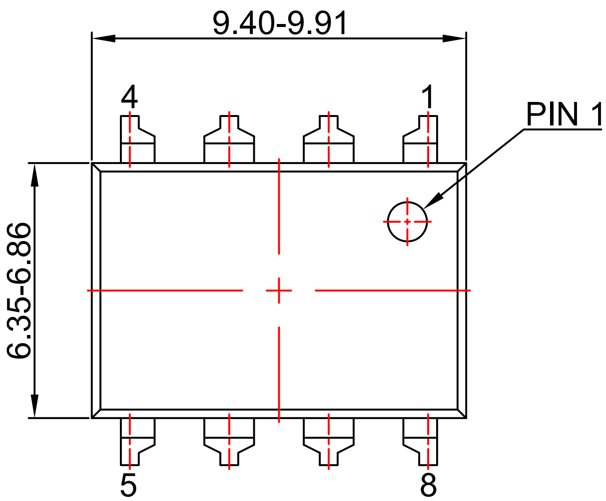
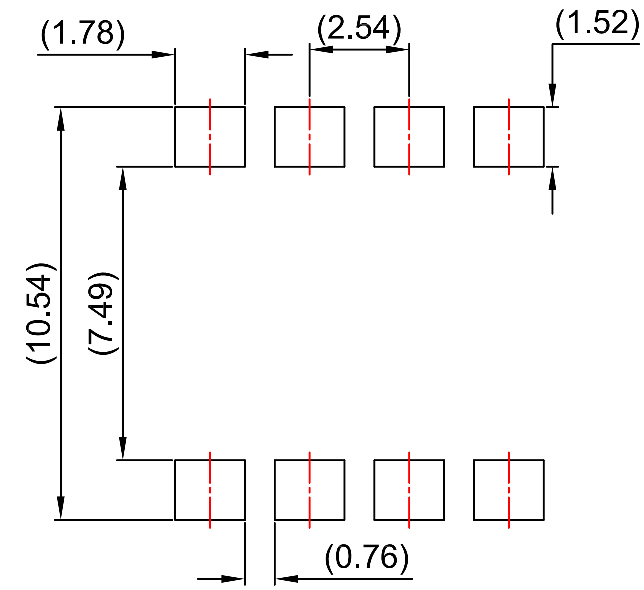
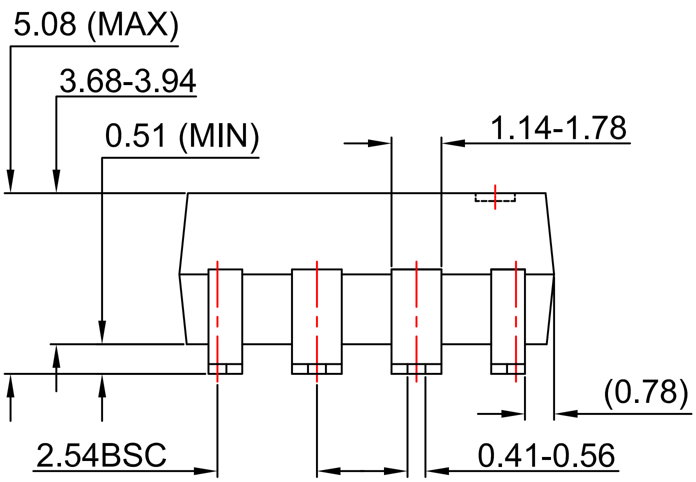
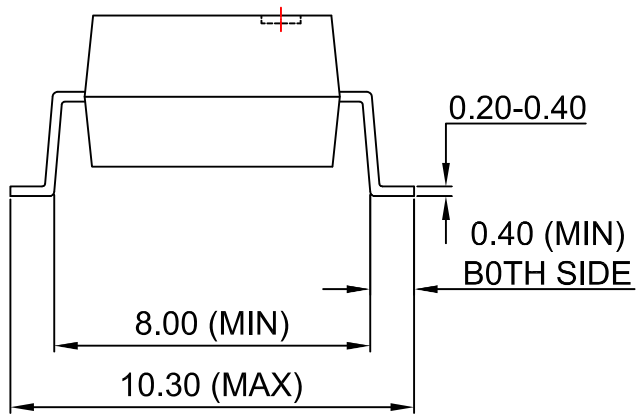




LAND PATTERN RECOMMENDATION





NOTES:

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C) DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH, AND TIE BAR EXTRUSION

D) DRAWING FILENAME AND REVSION: MKT-N08Hrev7.

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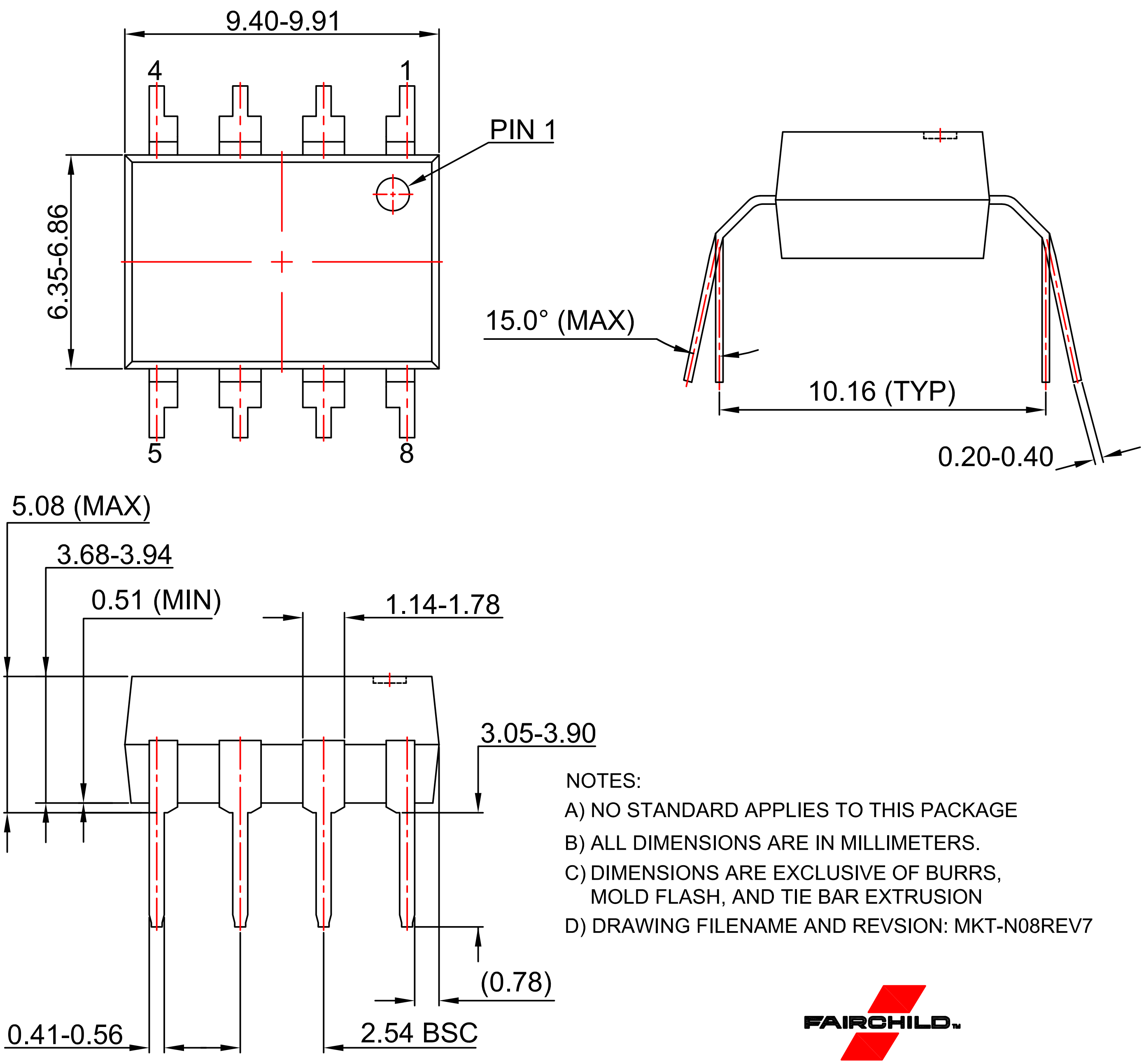

NOTES:

A) NO STANDARD APPLIES TO THIS PACKAGE

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C) DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH, AND TIE BAR EXTRUSION

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