FAIRCHILD SEMICONDUCTOR®

May 2012

FOD8321
2.5A Output Current, Gate Drive Optocoupler in Optoplanar® Wide Body SOP 5-Pin

Features

- Fairchild's Optoplanar® packaging technology provides reliable and high voltage insulation with greater than 8mm creepage and clearance distance, and 0.5mm internal insulation distance while still offering a compact footprint
- 2.5A output current driving capability for medium power IGBT/MOSFET
  - Use of P-Channel MOSFETs at output stage enables output voltage swing close to the supply rail
- 20kV/µs Minimum Common Mode Rejection
- Wide Supply Voltage range from 15V to 30V
- Fast Switching Speed over full operating temperature range
  - 500ns max. propagation delay
  - 300ns max. pulse width distortion
- UnderVoltage LockOut (UVLO) with hysteresis
- Extended industrial temperate range, -40 to 100°C temperature range
- Safety and regulatory approvals
  - UL1577, 5,000V_{RMS} for 1 min.
  - DIN EN/IEC60747-5-5, 1,414V peak working insulation voltage

Applications

- AC and brushless DC motor drives
- Industrial inverter
- Uninterruptible power supply
- Induction heating
- Isolated IGBT/Power MOSFET gate drive

Related Resources

- FOD3120, High Noise Immunity, 2.5A Output Current, Gate Drive Optocoupler Datasheet

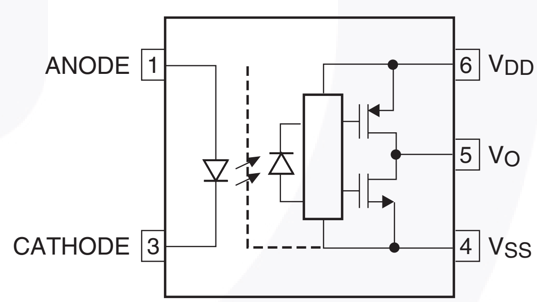
Description

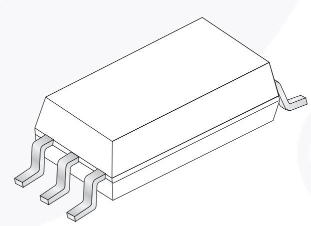
The FOD8321 is a 2.5A Output Current Gate Drive Optocoupler, capable of driving medium power IGBT/MOSFETs. It is ideally suited for fast switching driving of power IGBT and MOSFETs used in motor control inverter applications, and high performance power systems.

It utilizes Fairchild's coplanar packaging technology, Optoplanar®, and optimized IC design to achieve reliably high insulation voltage and high noise immunity.

It consists of a aluminum gallium arsenide (AlGaAs) light emitting diode optically coupled to an integrated circuit with a high-speed driver for push-pull MOSFET output stage. The device is housed in a wide body 5-pin small outline plastic package.

Functional Schematic





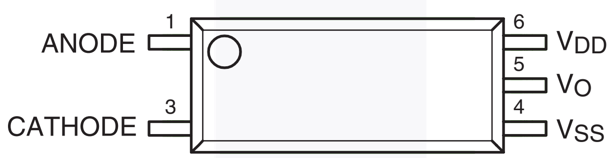
Truth Table

LED	V_{DD}–V_{SS} "Positive Going" (Turn-on)	V_{DD}–V_{SS} "Positive 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 14.5V	10V to 13V	Transition
On	14.5V to 30V	13V to 30V	High

Pin Definitions

Pin #	Name	Description
1	Anode	LED Anode
3	Cathode	LED Cathode
4	V_{SS}	Negative Supply Voltage
5	V_O	Output Voltage
6	V_{DD}	Positive Supply voltage

Pin Configuration



Safety and Insulation Ratings

As per DIN EN/IEC60747-5-5. 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.

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–IIII		
	For Rated Mains Voltage < 600Vrms		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 t_m = 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 t_m = 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	8.0			mm
	External Clearance	8.0			mm
	Insulation Thickness	0.5			mm
	Safety Limit Values – Maximum Values Allowed in the Event of a Failure				
T_S	Case Temperature	150			°C
$I_{S,INPUT}$	Input Current	200			mA
$P_{S,OUTPUT}$	Output Power	600			mW
R_{IO}	Insulation Resistance at T_S, V_{IO} = 500V	10^9			Ω

Absolute Maximum Ratings (T_A = 25ºC 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 (Refer to Reflow Temperature Profile)	260 for 10 sec	°C
$I_{F(AVG)}$	Average Input Current	25	mA
F	Operating Frequency	50	kHz
V_R	Reverse Input Voltage	5.0	V
$I_{O(PEAK)}$	Peak Output Current(1)	3.0	A
V_{DD}	Supply Voltage	0 to 35	V
$V_{O(PEAK)}$	Peak Output Voltage	0 to V_{DD}	V
$t_{R(IN)}$, $t_{F(IN)}$	Input Signal Rise and Fall Time	500	ns
PD_I	Input Power Dissipation(2)(4)	45	mW
PD_O	Output Power Dissipation(3)(4)	500	mW

Notes:
1. Maximum pulse width = 10µs, maximum duty cycle = 0.2%.
2. No derating required across operating temperature range.
3. Derate linearly from 25°C at a rate of 5.2mW/°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

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	Min.	Max.	Unit
T_A	Ambient Operating Temperature	-40	100	°C
$V_{DD} - V_{SS}$	Supply Voltage	16	30	V
$I_{F(ON)}$	Input Current (ON)	10	16	mA
$V_{F(OFF)}$	Input Voltage (OFF)	0	0.8	V

Isolation Characteristics

Apply over all recommended conditions, typical value is measured at T_A = 25ºC

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Units
V_{ISO}	Input-Output Isolation Voltage	T_A = 25ºC, R.H. < 50%, t = 1.0min, $I_{I-O} \leq 20\mu A$, 50Hz(5)(6)	5,000			V_{RMS}
R_{ISO}	Isolation Resistance	V_{I-O} = 500V(5)		10^{11}		Ω
C_{ISO}	Isolation Capacitance	V_{I-O} = 0V, Freq = 1.0MHz(6)		1		pF

Notes:

5. Device is considered a two terminal device: Pins 1 and 3 are shorted together and Pins 4, 5 and 6 are shorted together.
6. 5,000 VAC_{RMS} for 1 minute duration is equivalent to 6,000 VAC_{RMS} for 1 second duration.

Electrical Characteristics

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

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Units	Figure
V_F	Input Forward Voltage	I_F = 10mA	1.1	1.5	1.8	V	16
$\Delta(V_F / T_A)$	Temperature Coefficient of Forward Voltage			-1.8		mV/°C	
BV_R	Input Reverse Breakdown Voltage	$I_R = 10\mu A$	5			V	
C_{IN}	Input Capacitance	f = 1MHz, V_F = 0V		60		pF	
I_{OH}	High Level Output Current(1)	$V_{OH} = V_{DD} – 3V$	1.0	2.0	2.5	A	1, 3
		$V_{OH} = V_{DD} – 6V$	2.0		2.5	A	1, 3, 19
I_{OL}	Low Level Output Current(1)	$V_{OL} = V_{SS} + 3V$	1.0	2.0	2.5	A	4, 6
		$V_{OL} = V_{SS} + 6V$	2.0		2.5	A	4, 6, 18
V_{OH}	High Level Output Voltage(7)(8)	I_F = 10mA, I_O = -2.5A	V_{DD} – 6.25	V_{DD} – 2.5		V	1
		I_F = 10mA, I_O = -100mA	V_{DD} – 0.5	V_{DD} – 0.1		V	1, 2, 20
V_{OL}	Low Level Output Voltage(7)(8)	I_F = 10mA, I_O = 2.5A		V_{SS} + 2.5	V_{SS} + 6.25	V	4
		I_F = 0mA, I_O = 100mA		V_{SS} + 0.1	V_{SS} + 0.5	V	5, 21
I_{DDH}	High Level Supply Current	V_O Open, I_F = 10 to 16mA		2.9	5	mA	7, 8, 22
I_{DDL}	Low Level Supply Current	V_O Open, V_F = 0 to 0.8V		2.8	5	mA	7, 8, 23
I_{FLH}	Threshold Input Current Low to High	I_O = 0mA, V_O > 5V		2.4	7.5	mA	9, 15, 24
V_{FHL}	Threshold Input Voltage High to Low	I_O = 0mA, V_O < 5V	0.8			V	25
V_{UVLO+}	UnderVoltage Lockout Threshold	I_F = 10mA, V_O > 5V	11.5	12.7	14.5	V	17, 26
V_{UVLO-}		I_F = 10mA, V_O < 5V	10.0	11.2	13.0	V	17, 26
$UVLO_{HYS}$	UnderVoltage Lockout Threshold Hysteresis			1.5		V	

Notes:

7. 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.
8. Maximum pulse width = 1ms, maximum duty cycle = 20%.

Switching Characteristics

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

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Units	Figure
t_{PHL}	Propagation Delay Time to Logic Low Output(9)	I_F = 10mA to 16mA, Rg = 10Ω, Cg =10nF, f = 10kHz, Duty Cycle = 50%	100	285	500	ns	10, 11, 12, 13, 14, 27
t_{PLH}	Propagation Delay Time to Logic High Output(10)		100	260	500	ns	10, 11, 12, 13, 14, 27
PWD	Pulse Width Distortion(11) $\|t_{PHL} – t_{PLH}\|$			25	300	ns	
PDD (Skew)	Propagation Delay Difference Between Any Two Parts(12)		-350		350		
t_R	Output Rise Time (10% to 90%)			60		ns	27
t_F	Output Fall Time (90% to 10%)			60		ns	27
$t_{ULVO\ ON}$	ULVO Turn On Delay	I_F = 10mA, V_O > 5V		0.8		µs	
$t_{ULVO\ OFF}$	ULVO Turn Off Delay	I_F = 10mA, V_O < 5V		0.4		µs	
$\|CM_H\|$	Common Mode Transient Immunity at Output High	T_A = 25°C, V_{DD} = 30V, I_F = 10 to 16mA, V_{CM} = 2000V(13)	20	50		kV/µs	28
$\|CM_L\|$	Common Mode Transient Immunity at Output Low	T_A = 25°C, V_{DD} = 30V, V_F = 0V, V_{CM} = 2000V(14)	20	50		kV/µs	28

Notes:

9. 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.
10. 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.
11. PWD is defined as | $t_{PHL} – t_{PLH}$ | for any given device.
12. The difference between t_{PHL} and t_{PLH} between any two FOD8321 parts under same operating conditions, with equal loads.
13. Common mode transient immunity at output high is the maximum tolerable negative dVcm/dt on the trailing edge of the common mode impulse signal, Vcm, to assure that the output will remain high (i.e. V_O > 15.0V).
14. Common mode transient immunity at output low is the maximum tolerable positive dVcm/dt on the leading edge of the common pulse signal, Vcm, to assure that the output will remain low (i.e. V_O < 1.0V).

Typical Performance Characteristics

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

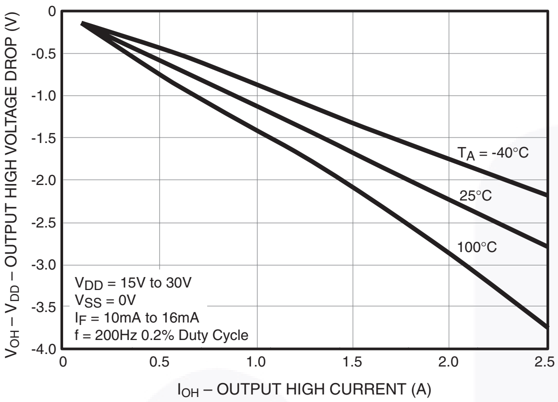


Figure 2. Output High Voltage Drop vs. Ambient Temperature

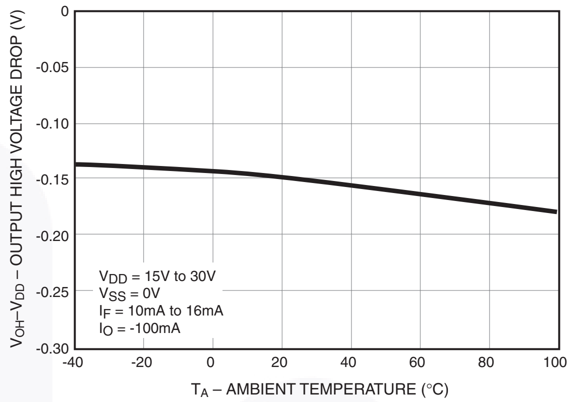


Figure 3. Output High Current vs. Ambient Temperature

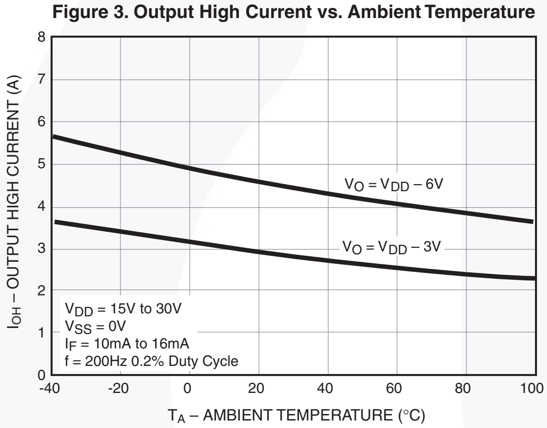


Figure 4. Output Low Voltage vs. Output Low Current

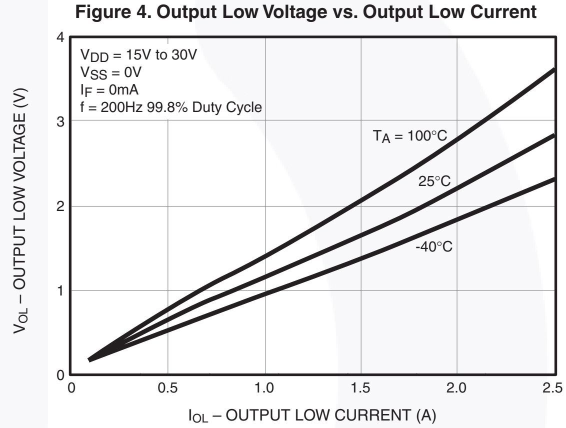


Figure 5. Output Low Voltage vs. Ambient Temperature

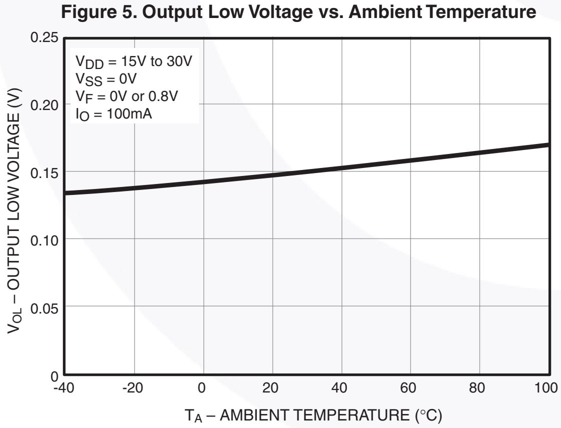
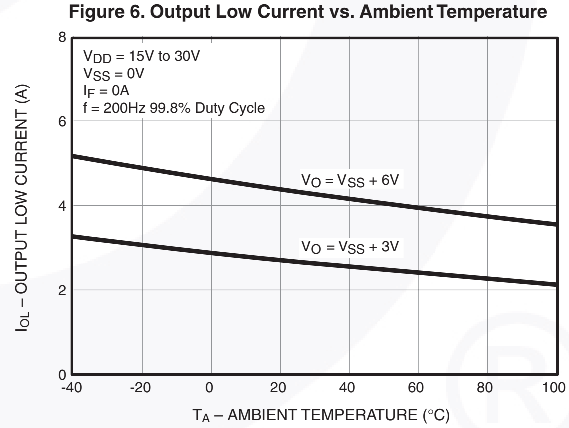


Figure 6. Output Low Current vs. Ambient Temperature



Typical Performance Characteristics (Continued)

Figure 7. Supply Current vs. Ambient Temperature

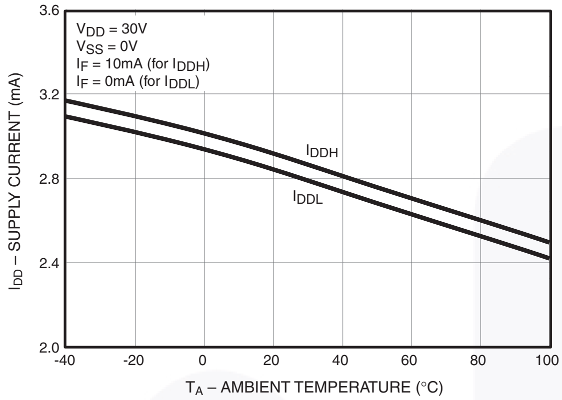


Figure 8. Supply Current vs. Supply Voltage

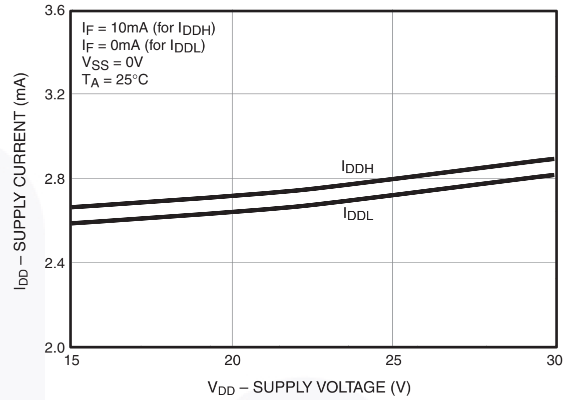


Figure 9. Low to High Input Current Threshold vs. Ambient Temperature

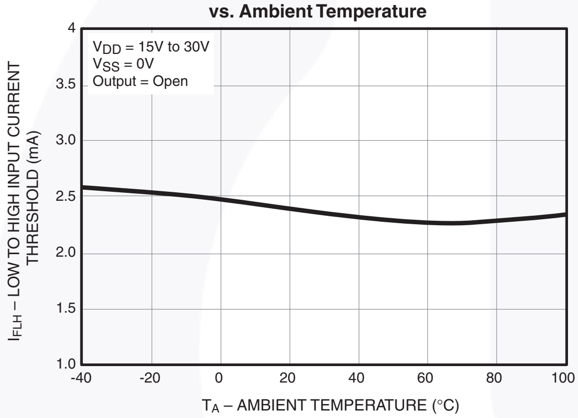


Figure 10. Propagation Delay vs. Supply Voltage

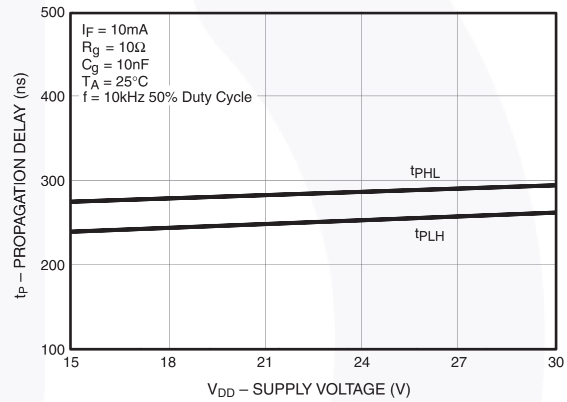


Figure 11. Propagation Delay vs. LED Forward Current

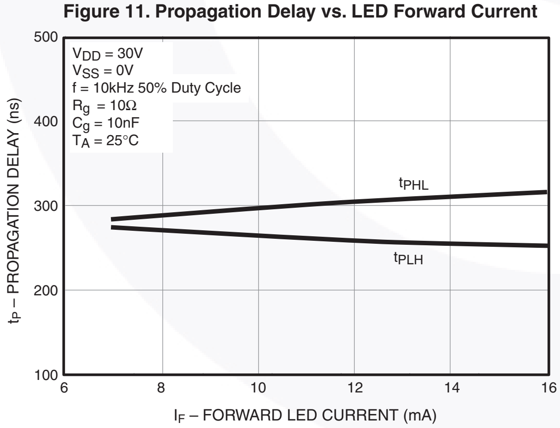
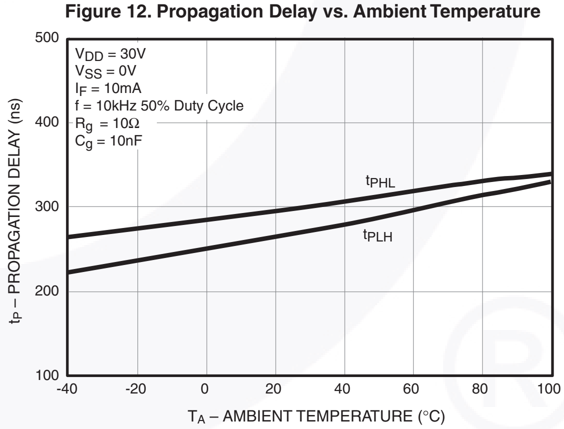


Figure 12. Propagation Delay vs. Ambient Temperature



Typical Performance Characteristics (Continued)

Figure 13. Propagation Delay vs. Series Load Resistance

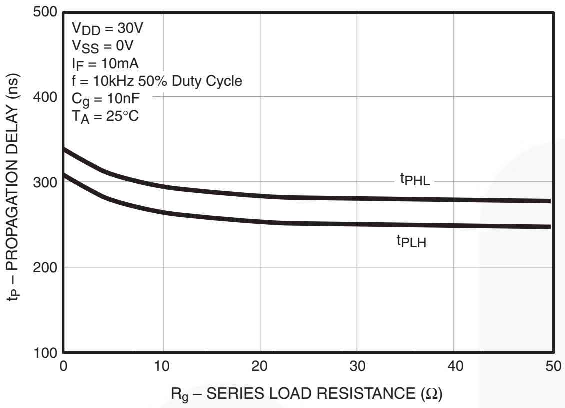


Figure 14. Propagation Delay vs. Load Capacitance

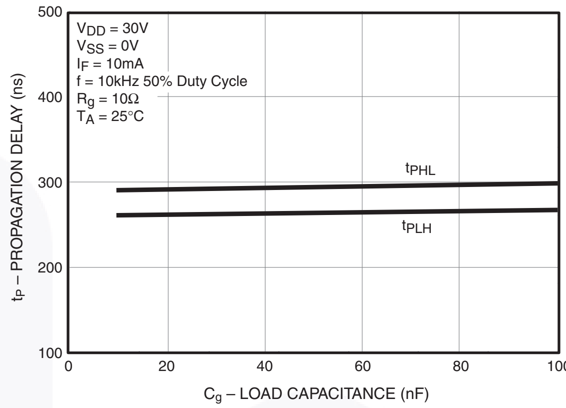


Figure 15. Transfer Characteristics

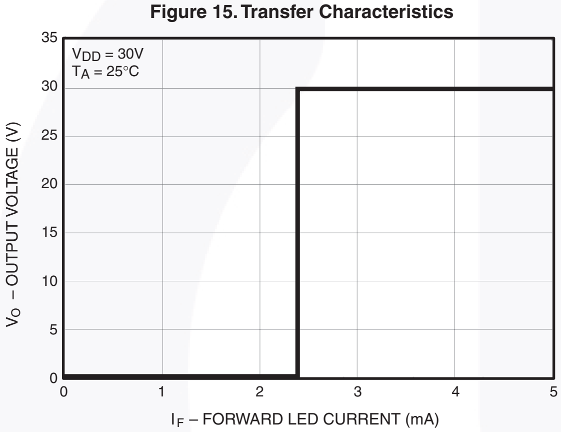


Figure 16. Input Forward Current vs. Forward Voltage

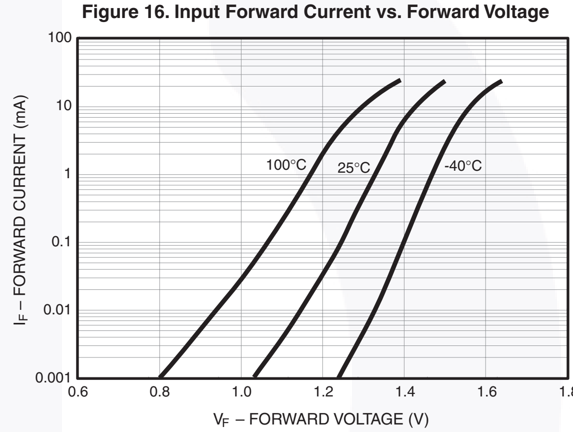
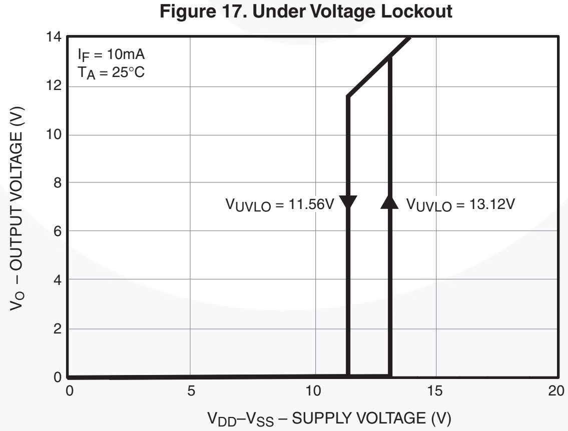
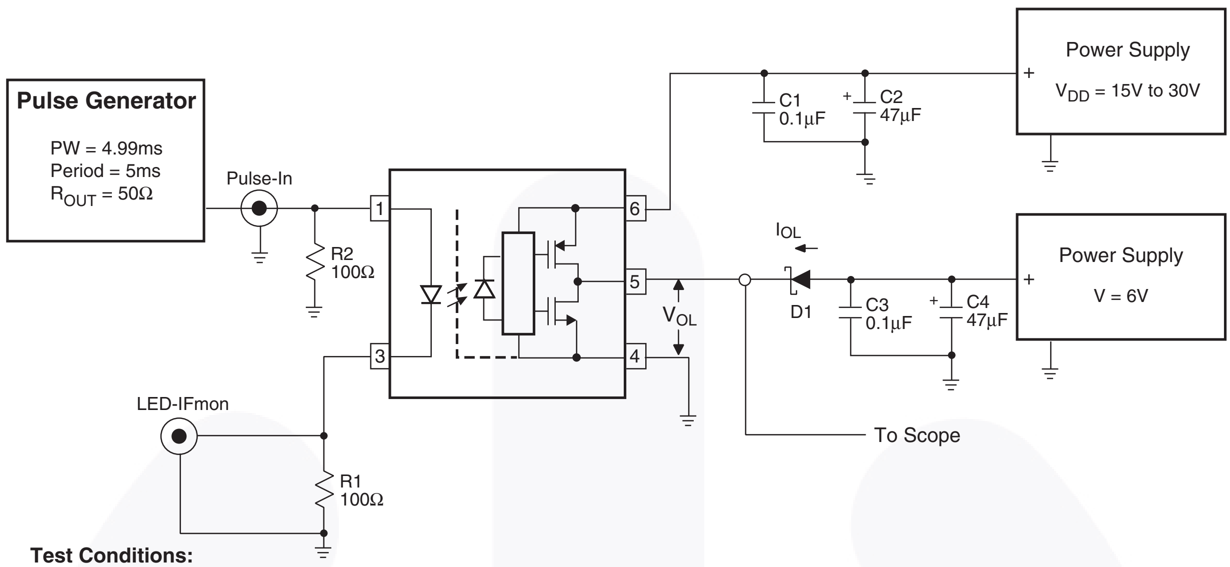


Figure 17. Under Voltage Lockout

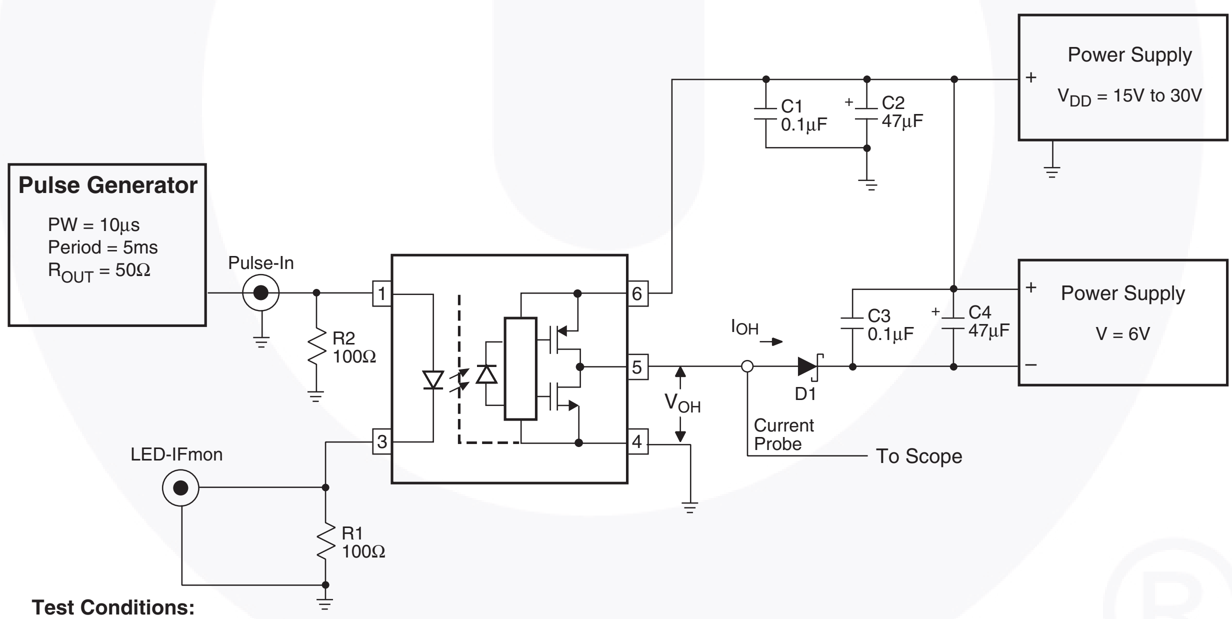


Test Circuit



Test Conditions:
Frequency = 200Hz
Duty Cycle = 99.8%
V_{DD} = 15V to 30V
V_{SS} = 0V
I_F = 0mA

Figure 18. 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 19. I_{OH} Test Circuit

Test Circuit (Continued)

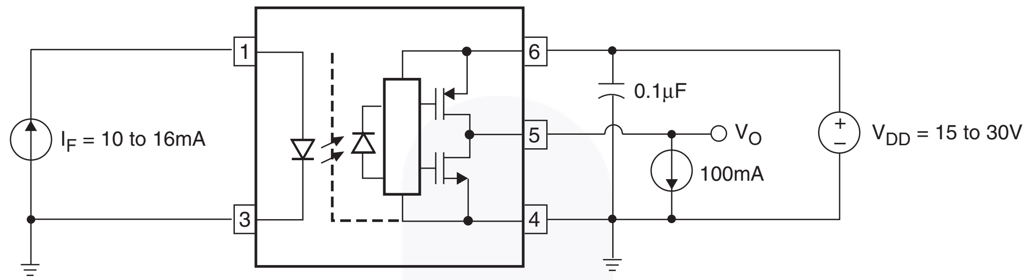


Figure 20. V_{OH} Test Circuit

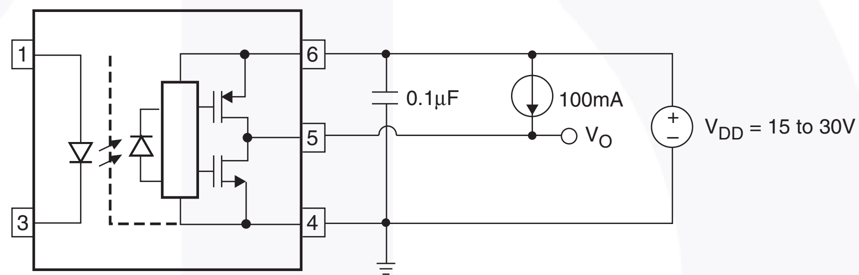


Figure 21. V_{OL} Test Circuit

Test Circuit (Continued)

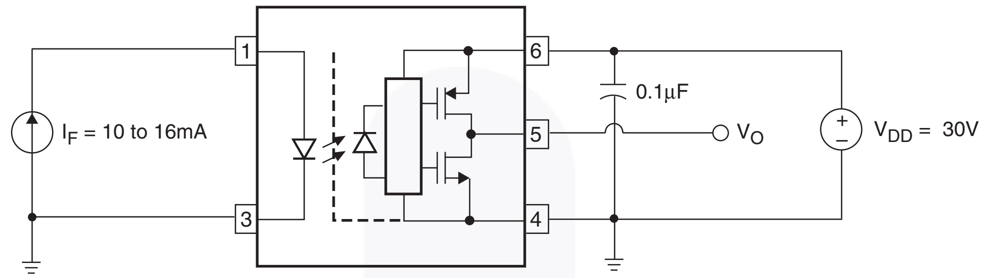


Figure 22. I_{DDH} Test Circuit

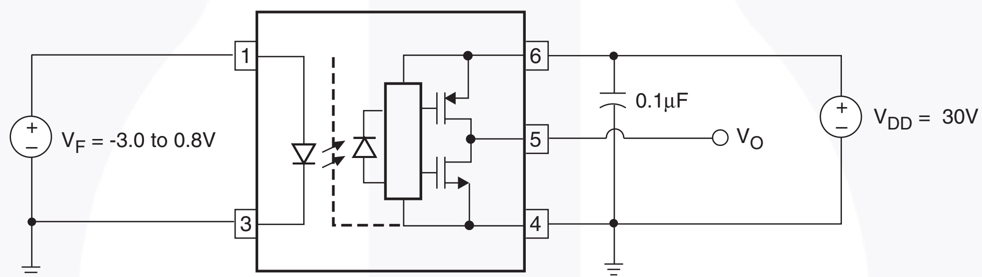


Figure 23. I_{DDL} Test Circuit

Test Circuit (Continued)

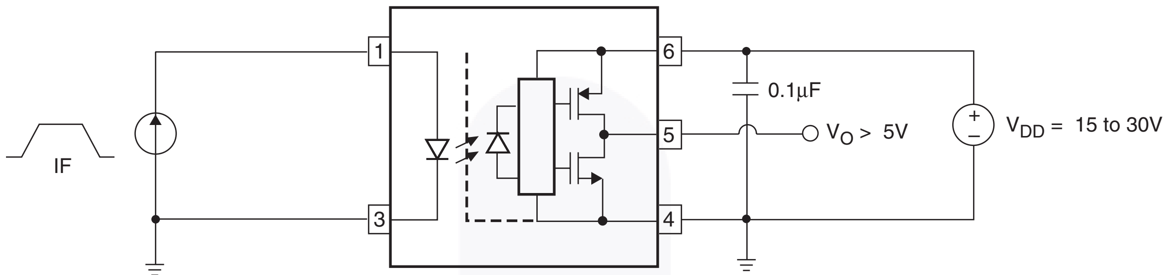


Figure 24. I_{FLH} Test Circuit

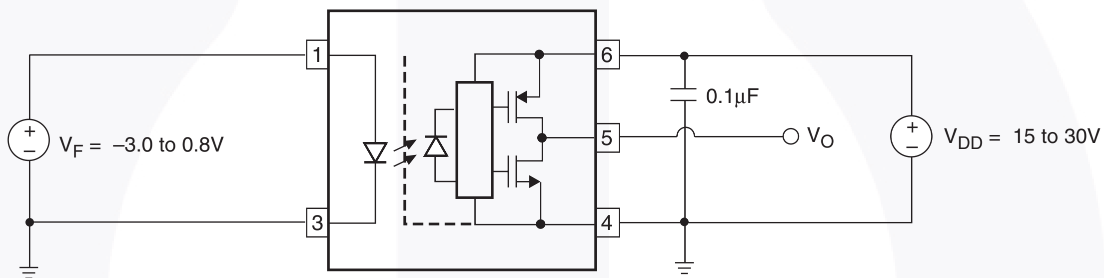


Figure 25. V_{FHL} Test Circuit

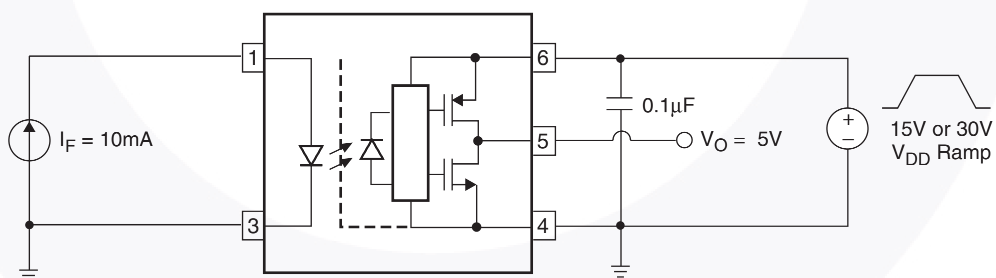


Figure 26. UVLO Test Circuit

Test Circuit (Continued)

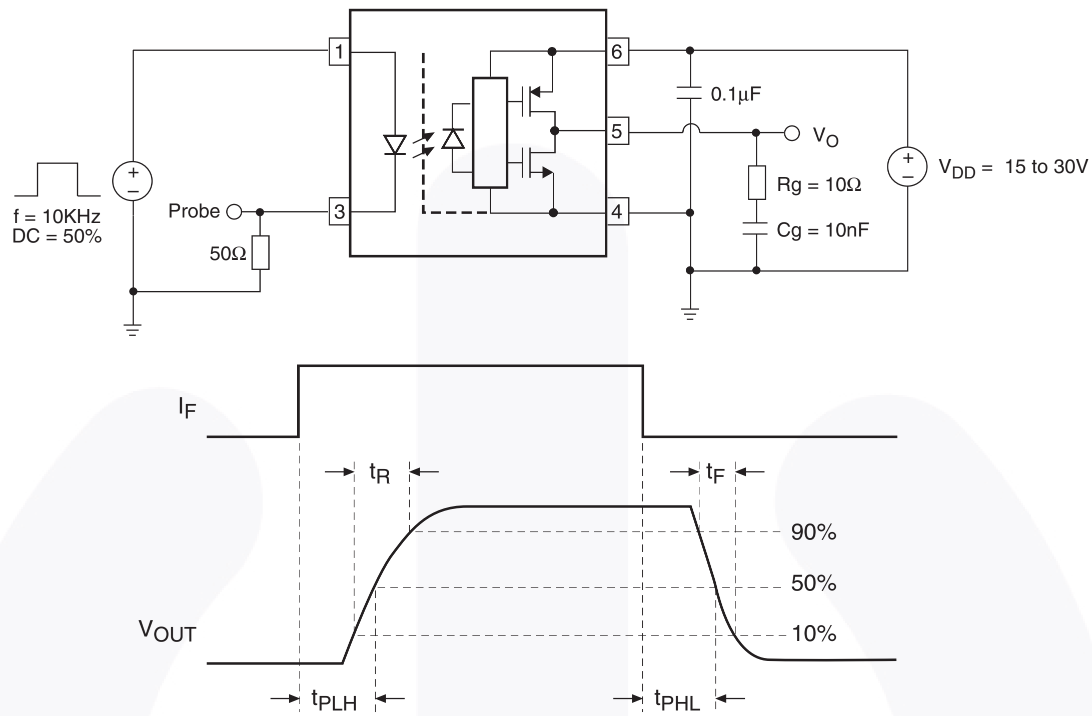


Figure 27. t_{PHL}, t_{PLH}, t_R and t_F Test Circuit and Waveforms

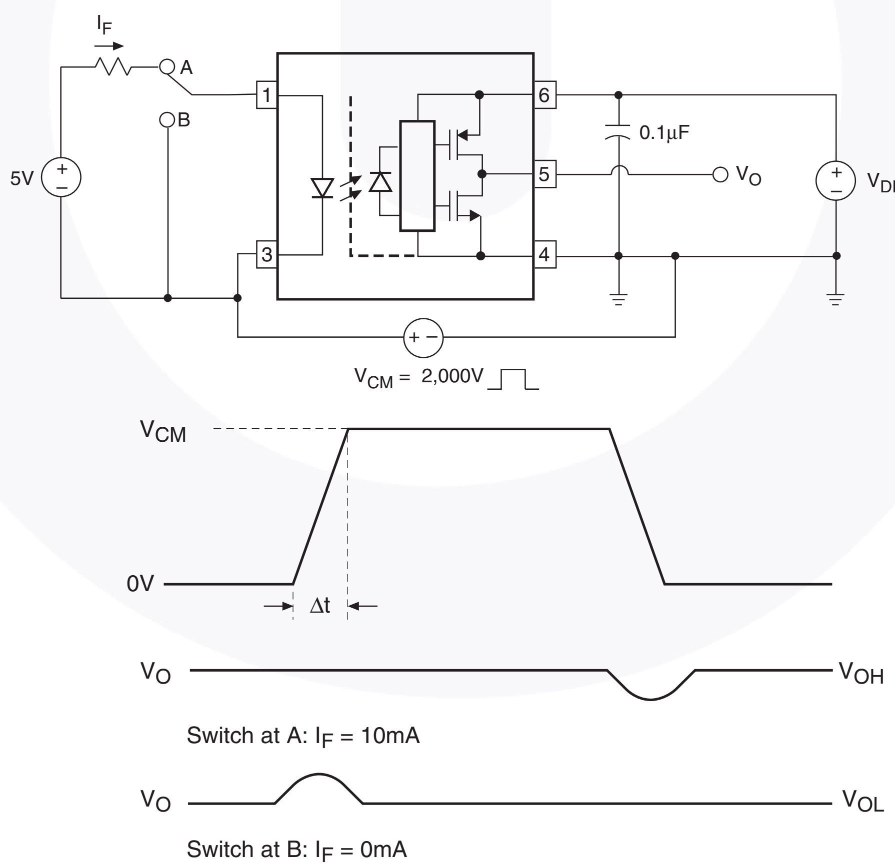


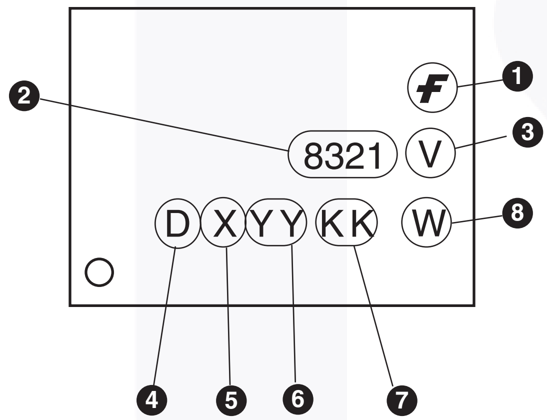
Figure 28. CMR Test Circuit and Waveforms

Ordering Information

Part Number	Package	Packing Method
FOD8321	Wide Body SOP 5-Pin	Tube (100 units per tube)
FOD8321R2	Wide Body SOP 5-Pin	Tape and Reel (1,000 units per reel)
FOD8321V	Wide Body SOP 5-Pin, DIN EN/IEC60747-5-5 Option	Tube (100 units per tube)
FOD8321R2V	Wide Body SOP 5-Pin, DIN EN/ IEC60747-5-5 Option	Tape and Reel (1,000 units per reel)

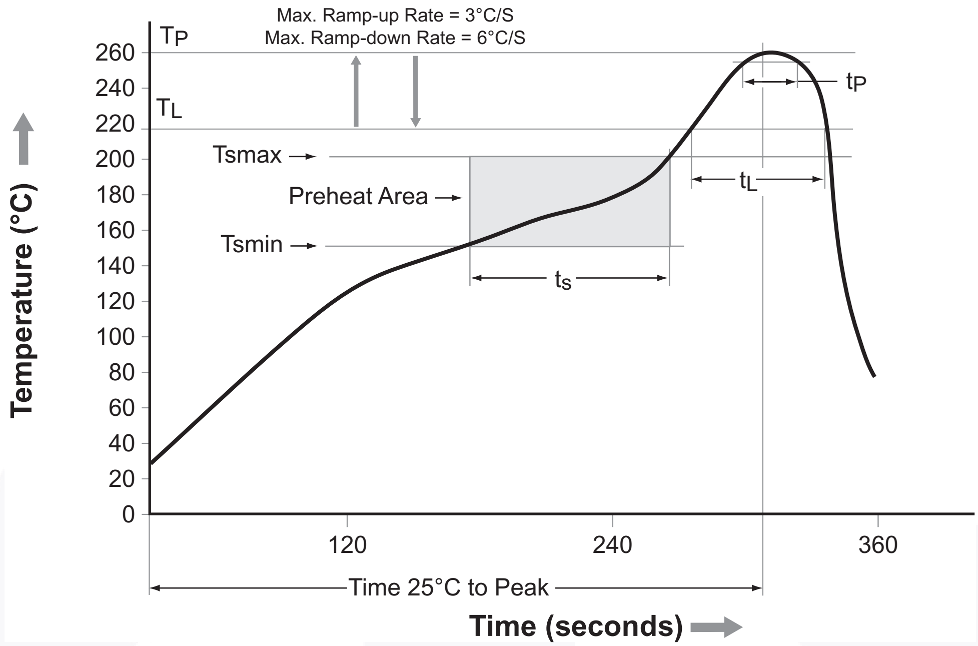
All packages are lead free per JEDEC: J-STD-020B standard.

Marking Information



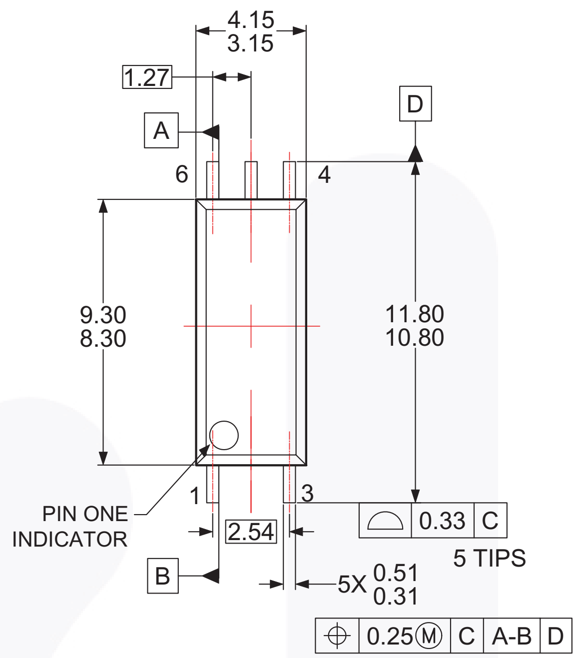
Definitions	
1	Fairchild logo
2	Device number, e.g., ‘8321’ for FOD8321
3	DIN EN/IEC60747-5-5 Option (only appears on component ordered with this option)
4	Plant code, e.g., ‘D’
5	Last digit year code, e.g., ‘C’ for 2012
6	Two digit work week ranging from ‘01’ to ‘53’
7	Lot traceability code
8	Package assembly code, W

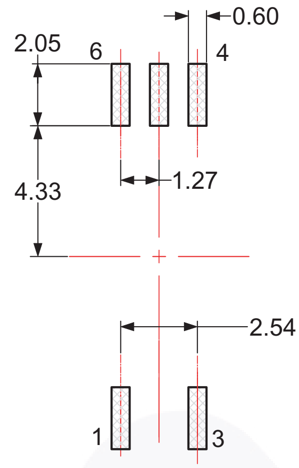
Reflow Profile



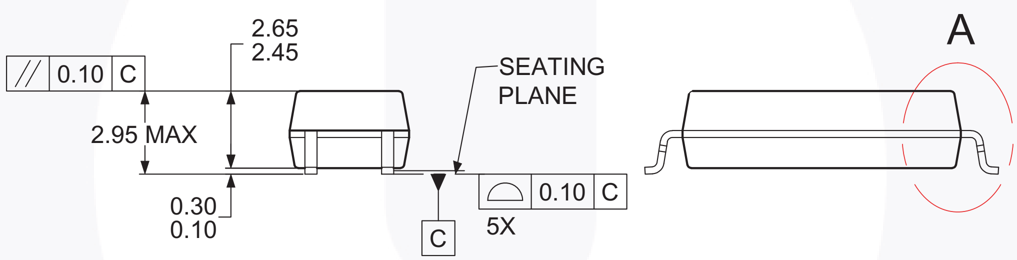
Profile Freature	Pb-Free Assembly Profile
Temperature Min. (Tsmin)	150°C
Temperature Max. (Tsmax)	200°C
Time (t_S) from (Tsmin to Tsmax)	60–120 seconds
Ramp-up Rate (t_L to t_P)	3°C/second max.
Liquidous Temperature (T_L)	217°C
Time (t_L) Maintained Above (T_L)	60–150 seconds
Peak Body Package Temperature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

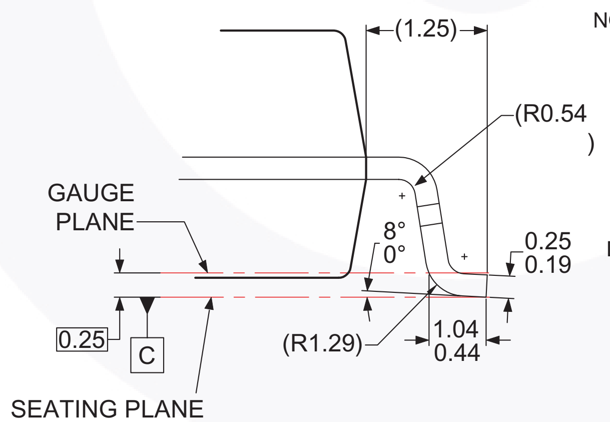
Package Dimensions





LAND PATTERN RECOMMENDATION





DETAIL A
SCALE: 3.2:1

NOTES: UNLESS OTHERWISE SPECIFIED

A) THIS PACKAGE DOES NOT CONFORM TO ANY STANDARD.
B) ALL DIMENSIONS ARE IN MILLIMETERS.
C) DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH AND TIE BAR PROTRUSIONS
D) DRAWING CONFORMS TO ASME Y14.5M-1994
E) DRAWING FILE NAME: MKT-M05BREV1

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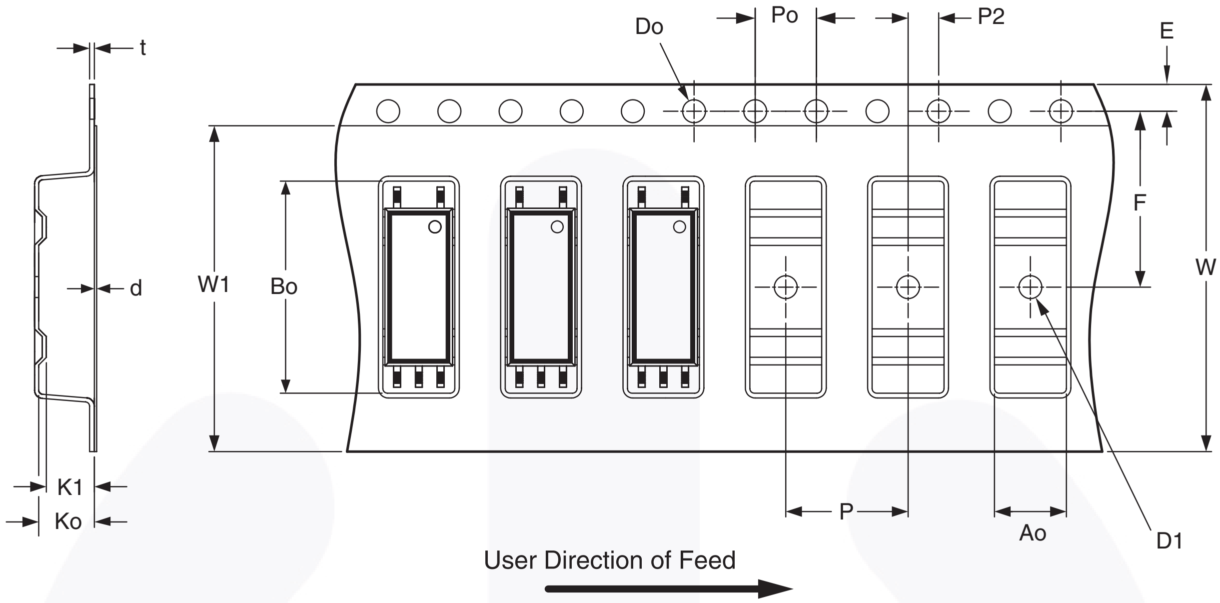
Carrier Tape Specification (SOIC-5L OPTO R2 & R2V Option)



Symbol	Description	Dimmension in mm
W	Tape Width	24.00 + 0.20 / -0.10
t	Tape Thickness	0.30 ± 0.05
Po	Sprocket Hole Pitch	4.00 ± 0.20
Do	Sprocket Hole Diameter	1.50 + 0.10 / -0.00
D1	Pocket Hole Diameter	1.50 + 0.25 / -0.00
E	Sprocket Hole Location	1.75 ± 0.10
F	Pocket Location	11.50 ± 0.10
P2		2.00 ± 0.10
P	Pocket Pitch	8.00 ± 0.10
Ao	Pocket Dimension	4.50 ± 0.10
Bo		12.00 ± 0.10
Ko		3.35 ± 0.10
K1		2.85 ± 0.10
W1	Cover Tape Width	21.30 ± 0.10
d	Cover Tape Thickness	0.05 ± 0.01
	Max Component Rotation or Tilt	10°

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Definition of Terms

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