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March 2016

FOD8314, FOD8314T

1.0 A Output Current, Gate Drive Optocoupler in Stretched Body SOP 6-Pin

Features

- FOD8314T - 8 mm Creepage and Clearance Distance, and 0.4 mm Insulation Distance to Achieve Reliable and High-Voltage Insulation
- 1.0 A Output Current Driving Capability for Medium-Power IGBT/MOSFET
 - Use of P-Channel MOSFETs at Output Stage Enables Output Voltage Swing Close to Supply Rail
- 20 kV/ μ s Minimum Common Mode Rejection
- Wide Supply Voltage Range: 15 V to 30 V
- Fast Switching Speed Over Full Operating Temperature Range
 - 500 ns Maximum Propagation Delay
 - 300 ns Maximum Pulse Width Distortion
- Under-Voltage Lockout (UVLO) with Hysteresis
- Extended Industrial Temperature Range: -40°C to 100°C
- Safety and Regulatory Approvals:
 - UL1577, 5,000 V_{RMS} for 1 Minute
 - DIN EN/IEC60747-5-5, 1,140 V 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

- [FOD3150, High Noise Immunity, 1.0 A Output Current, Gate Drive Optocoupler Datasheet](#)
- www.fairchildsemi.com/products/optoelectronics/

Description

The FOD8314 series is a 1.0 A output current gate drive optocoupler, capable of driving medium-power IGBT/MOSFETs. It is ideally suited for fast-switching driving of power IGBT and MOSFET used in motor-control inverter applications, and high-performance power systems.

The FOD8314 series utilizes stretched body package to achieve 8 mm creepage and clearance distances (FOD8314T), and optimized IC design to achieve reliably high-insulation voltage and high-noise immunity.

The FOD8314 series consists of an Aluminum Gallium Arsenide (AlGaAs) Light-Emitting Diode (LED) optically coupled to an integrated circuit with a high-speed driver for push-pull MOSFET output stage. The device is housed in a stretched body, 6-pin, small outline, plastic package.

Functional Schematic

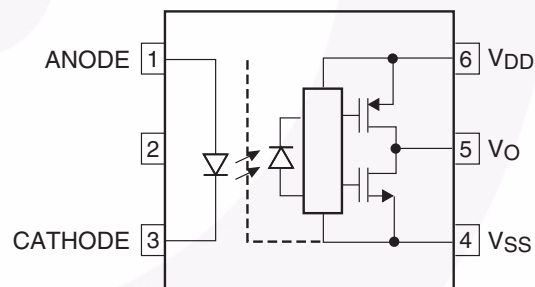


Figure 1. Schematic

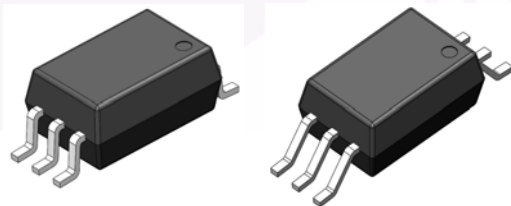


Figure 2. Package Outline

FOD8314, FOD8314T — 1.0 A Output Current, Gate Drive Optocoupler in Stretched Body SOP 6-Pin

Truth Table

| LED | $V_{DD} - V_{SS}$ "Positive Going" (Turn-on) | $V_{DD} - V_{SS}$ "Negative Going" (Turn-off) | V_O |
|-----|---|--|------------|
| Off | 0 V to 30 V | 0 V to 30 V | LOW |
| On | 0 V to 11.5 V | 0 V to 10 V | LOW |
| On | 11.5 V to 14.5 V | 10 V to 13 V | Transition |
| On | 14.5 V to 30 V | 13 V to 30 V | HIGH |

Pin Definitions

| Pin # | Name | Description |
|-------|----------|-------------------------|
| 1 | ANODE | LED Anode |
| 2 | N.C | Not Connection |
| 3 | CATHODE | LED Cathode |
| 4 | V_{SS} | Negative Supply Voltage |
| 5 | V_O | Output Voltage |
| 6 | V_{DD} | Positive Supply Voltage |

Pin Configuration



Figure 3. 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.

| Parameter | | Characteristics | |
|---|------------------------|-----------------|-----------|
| | | FOD8314 | FOD8314T |
| Installation Classifications per DIN VDE 0110/1.89 Table 1, For Rated Mains Voltage | < 150 V _{RMS} | I-IV | I-IV |
| | < 300 V _{RMS} | I-IV | I-IV |
| | < 450 V _{RMS} | I-III | I-IV |
| | < 600 V _{RMS} | I-III | I-III |
| Climatic Classification | | 40/100/21 | 40/100/21 |
| Pollution Degree (DIN VDE 0110/1.89) | | 2 | 2 |
| Comparative Tracking Index | | 175 | 175 |

| Symbol | Parameter | Value | | Unit |
|-----------------------|--|-----------------|-----------------|-------------------|
| | | FOD8314 | FOD8314T | |
| V _{PR} | Input-to-Output Test Voltage, Method B, V _{IORM} × 1.875 = V _{PR} , 100% Production Test with t _m = 1 s, Partial Discharge < 5 pC | 1,671 | 2,137 | V _{peak} |
| | Input-to-Output Test Voltage, Method A, V _{IORM} × 1.6 = V _{PR} , Type and Sample Test with t _m = 10 s, Partial Discharge < 5 pC | 1,426 | 1,824 | V _{peak} |
| V _{IORM} | Maximum Working Insulation Voltage | 891 | 1,140 | V _{peak} |
| V _{IOTM} | Highest Allowable Over-Voltage | 6,000 | 8,000 | V _{peak} |
| | External Creepage | ≥ 8.0 | ≥ 8.0 | mm |
| | External Clearance | ≥ 7.0 | ≥ 8.0 | mm |
| DTI | Distance Through Insulation (Insulation Thickness) | ≥ 0.4 | ≥ 0.4 | mm |
| | Safety Limit Values – Maximum Values Allowed in the Event of a Failure, | | | |
| T _S | Case Temperature | 150 | 150 | °C |
| I _{S,INPUT} | Input Current | 200 | 200 | mA |
| P _{S,OUTPUT} | Output Power | 600 | 600 | mW |
| R _{IO} | Insulation Resistance at T _S , V _{IO} = 500 V | 10 ⁹ | 10 ⁹ | Ω |

Absolute Maximum Ratings ($T_A = 25^\circ\text{C}$ 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 | Unit |
|--------------------------------------|--|----------------------|------------------|
| T_{STG} | Storage Temperature | -40 to +125 | $^\circ\text{C}$ |
| T_{OPR} | Operating Temperature | -40 to +100 | $^\circ\text{C}$ |
| T_{J} | Junction Temperature | -40 to +125 | $^\circ\text{C}$ |
| T_{SOL} | Lead Solder Temperature (Refer to Reflow Temperature Profile) | 260 for 10 sec | $^\circ\text{C}$ |
| $I_{\text{F(AVG)}}$ | Average Input Current | 25 | mA |
| V_{R} | Reverse Input Voltage | 5.0 | V |
| $I_{\text{O(PEAK)}}$ | Peak Output Current ⁽¹⁾ | 1.5 | A |
| V_{DD} | Supply Voltage | 0 to 35 | V |
| $V_{\text{O(PEAK)}}$ | Peak Output Voltage | 0 to V_{DD} | V |
| $t_{\text{R(IN)}}, t_{\text{F(IN)}}$ | 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 = 10 μs , maximum duty cycle = 0.2%.
2. No derating required across operating temperature range.
3. Derate linearly from 25 $^\circ\text{C}$ at a rate of 5.2 mW/ $^\circ\text{C}$.
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 | $^\circ\text{C}$ |
| $V_{\text{DD}} - V_{\text{SS}}$ | Supply Voltage | 16 | 30 | V |
| $I_{\text{F(ON)}}$ | Input Current (ON) | 10 | 16 | mA |
| $V_{\text{F(OFF)}}$ | Input Voltage (OFF) | 0 | 0.8 | V |

Isolation Characteristics

Apply over all recommended conditions, typical value is measured at $T_A = 25^\circ\text{C}$.

| Symbol | Parameter | Conditions | Min. | Typ. | Max. | Unit |
|-----------|--------------------------------|--|------|-----------|------|----------------|
| V_{ISO} | Input-Output Isolation Voltage | $T_A = 25^\circ\text{C}$, R.H. < 50%, $t = 1.0$ minute, $I_{I-O} \leq 20 \mu\text{A}^{(5)(6)}$ | 5000 | | | $V_{AC_{RMS}}$ |
| R_{ISO} | Isolation Resistance | $V_{I-O} = 500 \text{ V}^{(5)}$ | | 10^{11} | | Ω |
| C_{ISO} | Isolation Capacitance | $V_{I-O} = 0 \text{ V}$, Frequency = 1.0 MHz ⁽⁵⁾ | | 1 | | pF |

Notes:

- Device is considered a two terminal device: pins 1, 2 and 3 are shorted together and pins 4, 5 and 6 are shorted together.
- 5,000 $V_{AC_{RMS}}$ for 1 minute duration is equivalent to 6,000 $V_{AC_{RMS}}$ for 1 second duration.

Electrical Characteristics

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

| Symbol | Parameter | Conditions | Min. | Typ. | Max. | Unit |
|-------------------|---|---|----------------------------------|----------------------------------|----------------------------------|--------|
| V_F | Input Forward Voltage | | 1.1 | 1.5 | 1.8 | V |
| $\Delta(V_F/T_A)$ | Temperature Coefficient of Forward Voltage | $I_F = 10 \text{ mA}$ | | -1.8 | | mV/°C |
| BV_R | Input Reverse Breakdown Voltage | $I_R = 10 \mu\text{A}$ | 5 | | | V |
| C_{IN} | Input Capacitance | $f = 1 \text{ MHz}$, $V_F = 0 \text{ V}$ | | 20 | | pF |
| I_{OH} | High Level Output Current ⁽¹⁾ | $V_{OH} = V_{DD} - 0.75 \text{ V}$ $V_{OH} = V_{DD} - 4 \text{ V}$ | 0.2 1.0 | | | A A |
| I_{OL} | Low Level Output Current ⁽¹⁾ | $V_{OL} = V_{SS} + 0.75 \text{ V}$ $V_{OL} = V_{SS} + 4 \text{ V}$ | 0.2 1.0 | | | A A |
| V_{OH} | High Level Output Voltage ⁽⁷⁾⁽⁸⁾ | $I_F = 10 \text{ mA}$, $I_O = -1.0 \text{ A}$ $I_F = 10 \text{ mA}$, $I_O = -100 \text{ mA}$ | $V_{DD} - 6.0$ $V_{DD} - 0.5$ | $V_{DD} - 1.5$ $V_{DD} - 0.1$ | | V V |
| V_{OL} | Low Level Output Voltage ⁽⁷⁾⁽⁸⁾ | $I_F = 10 \text{ mA}$, $I_O = 1.0 \text{ A}$ $I_F = 0 \text{ mA}$, $I_O = 100 \text{ mA}$ | | $V_{SS} + 1.5$ $V_{SS} + 0.1$ | $V_{SS} + 6.0$ $V_{SS} + 0.5$ | V V |
| I_{DDH} | High Level Supply Current | $V_O = \text{Open}$, $I_F = 7$ to 16 mA | | 2.9 | 5.0 | mA |
| I_{DDL} | Low Level Supply Current | $V_O = \text{Open}$, $V_F = 0$ to 0.8 V | | 2.8 | 5.0 | mA |
| I_{FLH} | Threshold Input Current Low to High | $I_O = 0 \text{ mA}$, $V_O > 5 \text{ V}$ | | 1.5 | 7.5 | mA |
| V_{FHL} | Threshold Input Voltage High to Low | $I_O = 0 \text{ mA}$, $V_O < 5 \text{ V}$ | 0.8 | | | V |
| V_{UVLO+} | UnderVoltage Lockout Threshold | $I_F = 10 \text{ mA}$, $V_O > 5 \text{ V}$ | 11.5 | 12.7 | 14.5 | V |
| V_{UVLO-} | Threshold | $I_F = 10 \text{ mA}$, $V_O < 5 \text{ V}$ | 10.0 | 11.2 | 13.0 | V |
| $UVLO_{HYS}$ | UnderVoltage Lockout Threshold Hysteresis | | | 1.5 | | V |

Notes:

- In this test, V_{OH} is measured with a dc load current of 100 mA. When driving capacitive load V_{OH} will approach V_{DD} as I_{OH} approaches 0 A.
- Maximum pulse width = 1 ms, maximum duty cycle = 20%.

Switching Characteristics

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

| Symbol | Parameter | Conditions | Min. | Typ. | Max. | Unit |
|------------------------|--|---|---|------|------|-------------------------|
| t_{PHL} | Propagation Delay Time to Logic Low Output ⁽⁹⁾ | $I_F = 7 \text{ mA to } 16 \text{ mA}$, $R_g = 10 \Omega$, $C_g = 10 \text{ nF}$, $f = 10 \text{ kHz}$, Duty Cycle = 50% | 100 | 270 | 500 | ns |
| t_{PLH} | Propagation Delay Time to Logic High Output ⁽¹⁰⁾ | | 100 | 260 | 500 | ns |
| 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 | |
| t_F | Output Fall Time (90% to 10%) | | 40 | | ns | |
| $t_{ULVO \text{ ON}}$ | ULVO Turn On Delay | | $I_F = 10 \text{ mA}$, $V_O > 5 \text{ V}$ | | 0.8 | |
| $t_{ULVO \text{ OFF}}$ | ULVO Turn Off Delay | $I_F = 10 \text{ mA}$, $V_O < 5 \text{ V}$ | | 0.2 | | μs |
| $ CM_H $ | Common Mode Transient Immunity at Output High | $V_{DD} = 30 \text{ V}$, $I_F = 10 \text{ mA to } 16 \text{ mA}$, $V_{CM} = 2000 \text{ V}$, $T_A = 25^\circ\text{C}$ ⁽¹³⁾ | 20 | 50 | | $\text{kV}/\mu\text{s}$ |
| $ CM_L $ | Common Mode Transient Immunity at Output Low | $V_{DD} = 30 \text{ V}$, $V_F = 0 \text{ V}$, $V_{CM} = 2000 \text{ V}$, $T_A = 25^\circ\text{C}$ ⁽¹⁴⁾ | 20 | 50 | | $\text{kV}/\mu\text{s}$ |

Notes:

- Propagation delay t_{PHL} 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.
- Propagation delay t_{PLH} 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.
- PWD is defined as $|t_{PHL} - t_{PLH}|$ for any given device.
- The difference between t_{PHL} and t_{PLH} between any two FOD8314 parts under the same operating conditions, with equal loads.
- Common mode transient immunity at output high is the maximum tolerable negative dV_{cm}/dt on the trailing edge of the common mode impulse signal, V_{CM} , to ensure that the output remains high (i.e., $V_O > 15.0 \text{ V}$).
- Common mode transient immunity at output low is the maximum tolerable positive dV_{cm}/dt on the leading edge of the common pulse signal, V_{CM} , to ensure that the output remains low (i.e., $V_O < 1.0 \text{ V}$).

Typical Performance Characteristics

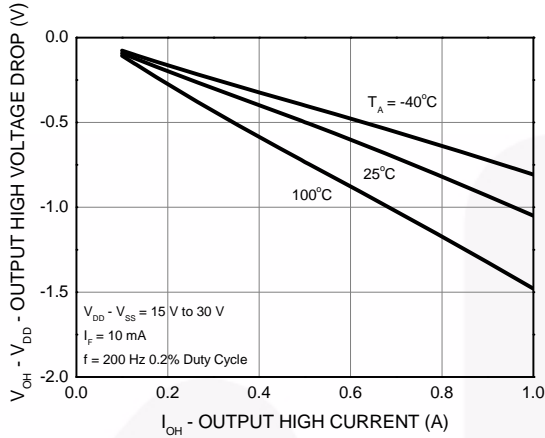


Figure 4. Output High Voltage Drop vs. Output High Current



Figure 5. Output High Voltage Drop vs. Ambient Temperature

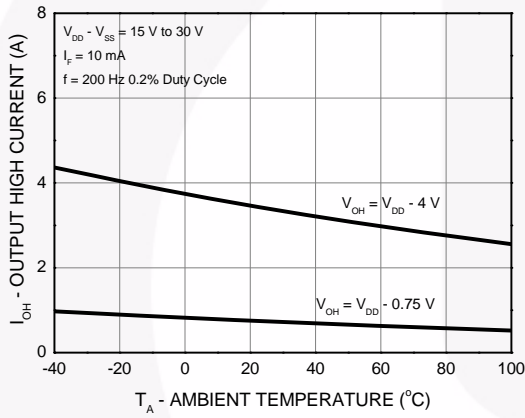


Figure 6. Output High Current vs. Ambient Temperature

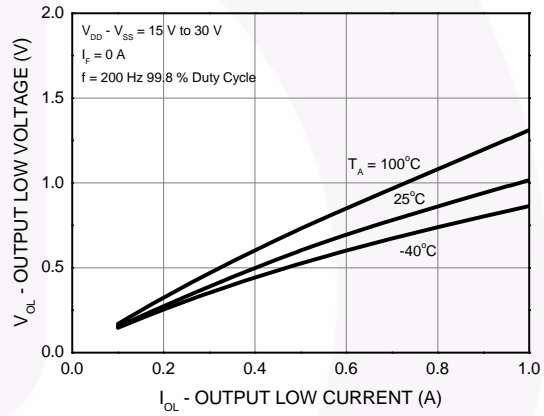


Figure 7. Output Low Voltage vs. Output Low Current

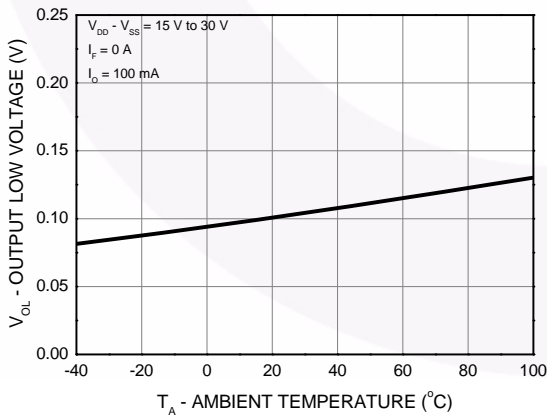


Figure 8. Output Low Voltage vs. Ambient Temperature

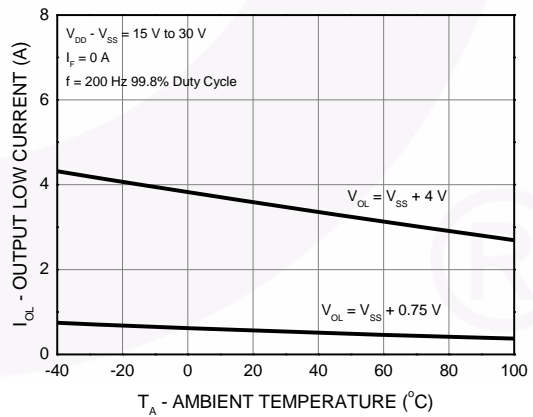


Figure 9. Output Low Current vs. Ambient Temperature

Typical Performance Characteristics (Continued)



Figure 10. Supply Current vs. Ambient Temperature

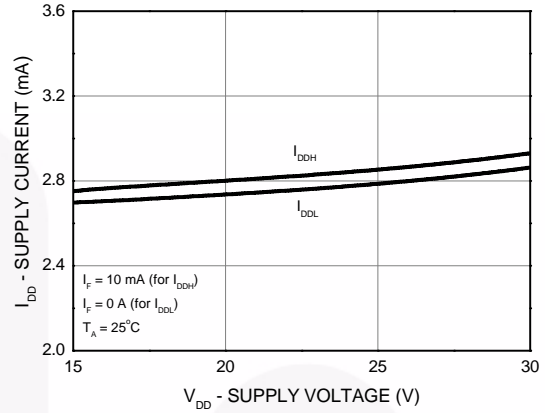


Figure 11. Supply Current vs. Supply Voltage

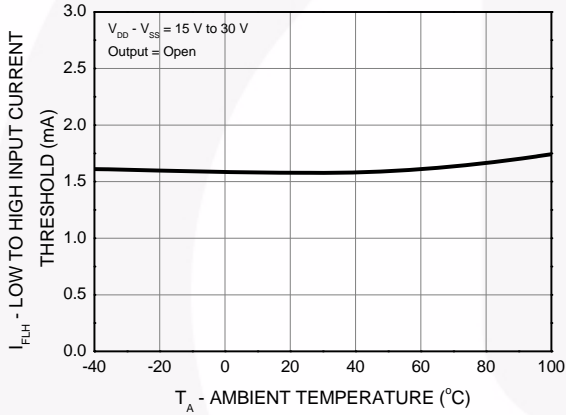


Figure 12. Low to High Input Current Threshold vs. Ambient Temperature

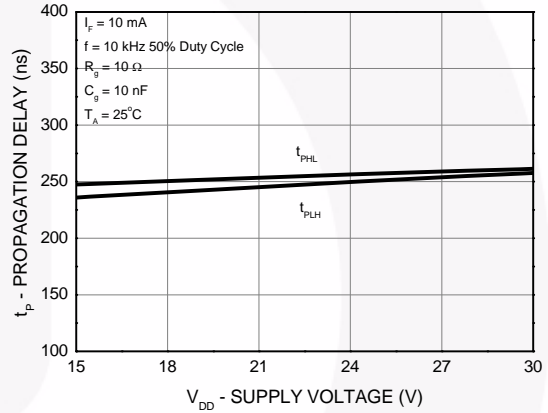


Figure 13. Propagation Delay vs. Supply Voltage

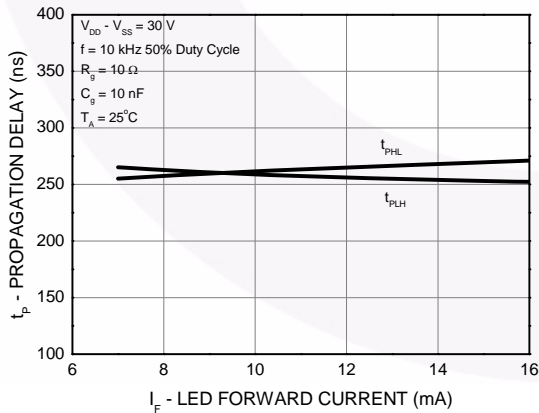


Figure 14. Propagation Delay vs. LED Forward Current

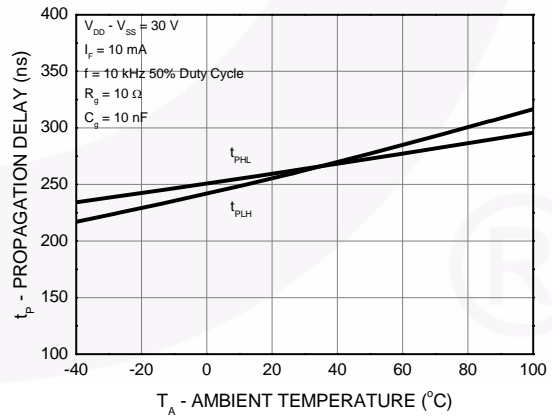


Figure 15. Propagation Delay vs. Ambient Temperature

Typical Performance Characteristics (Continued)



Figure 16. Propagation Delay vs. Load Resistance

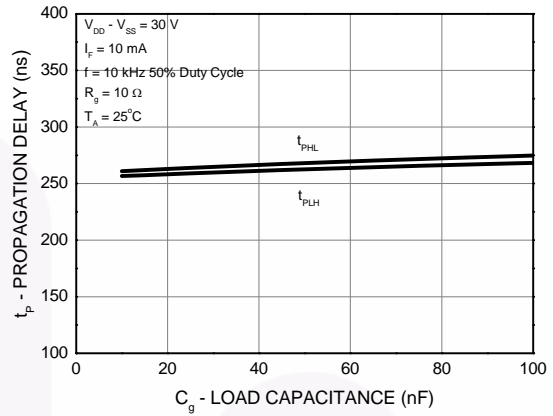


Figure 15. Propagation Delay vs. Load Capacitance



Figure 18. Transfer Characteristics

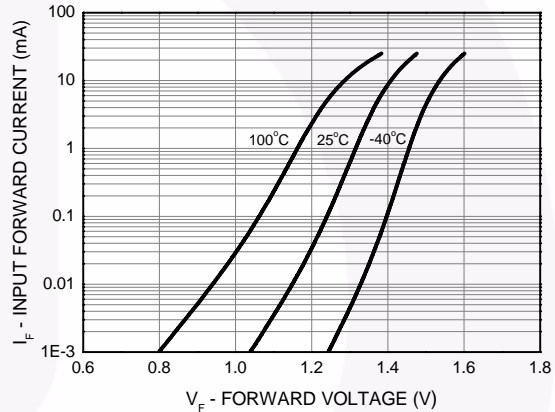


Figure 19. Input Forward Current vs. Forward Voltage



Figure 20. Under Voltage Lockout

Test Circuit

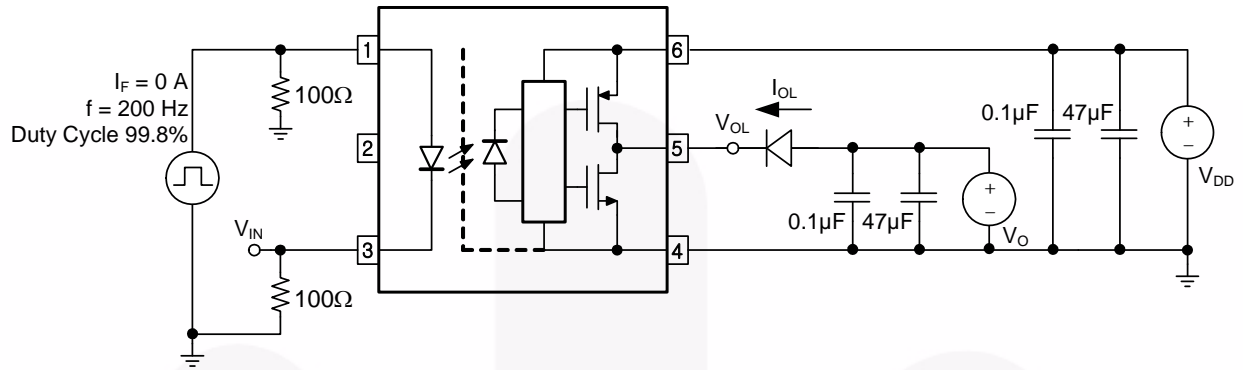


Figure 21. I_{OL} Test Circuit



Figure 22. I_{OH} Test Circuit

Test Circuit (Continued)

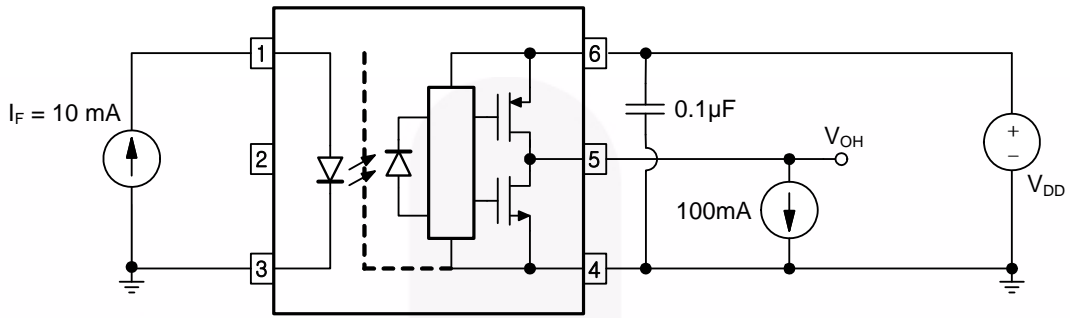


Figure 23. V_{OH} Test Circuit

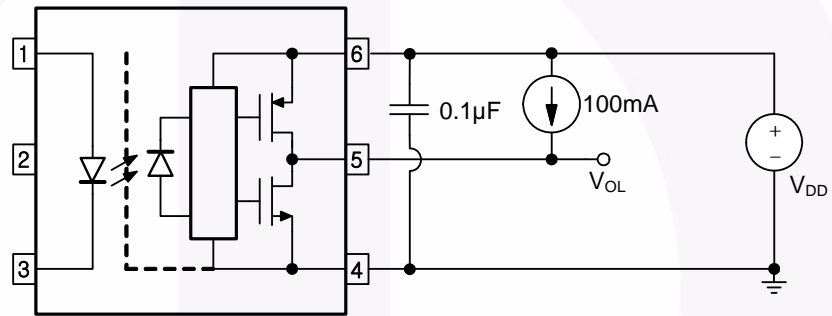


Figure 24. V_{OL} Test Circuit

Test Circuit (Continued)

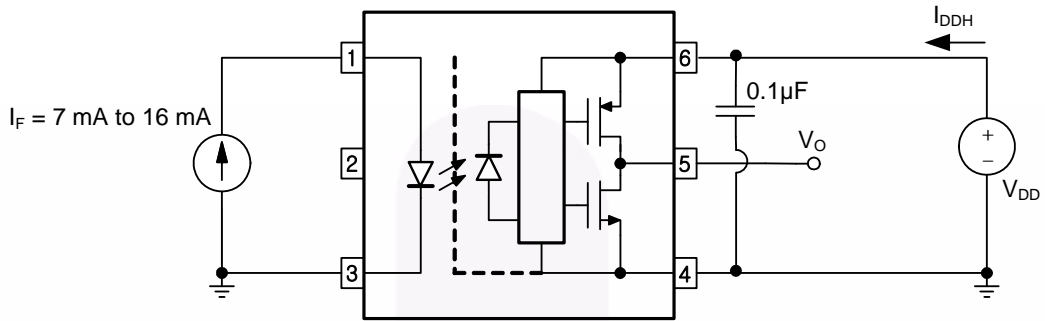


Figure 25. I_{DDH} Test Circuit

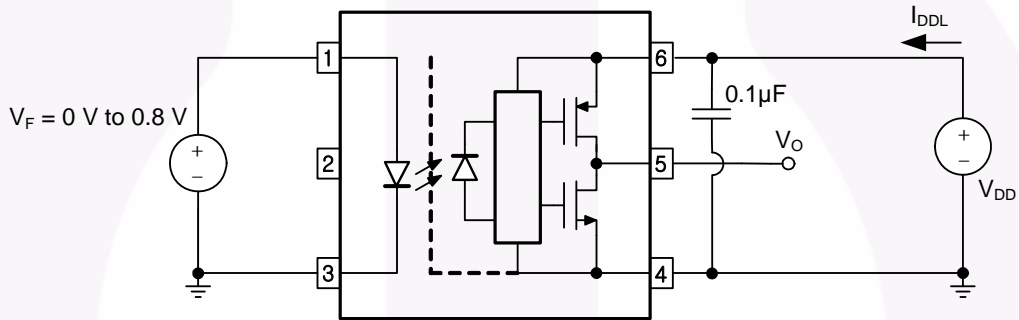


Figure 26. I_{DDL} Test Circuit

Test Circuit (Continued)

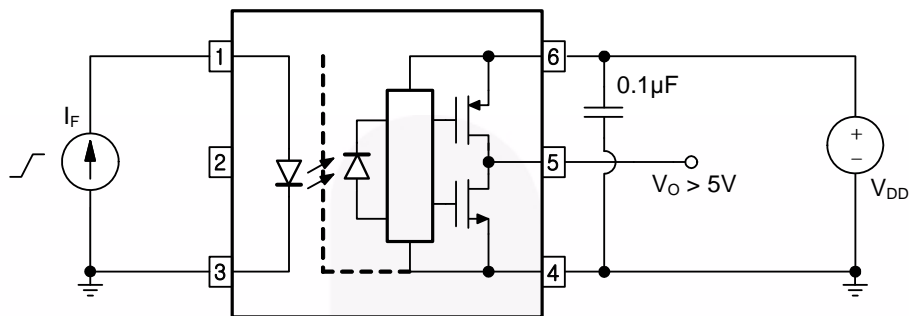


Figure 27. I_{FLH} Test Circuit

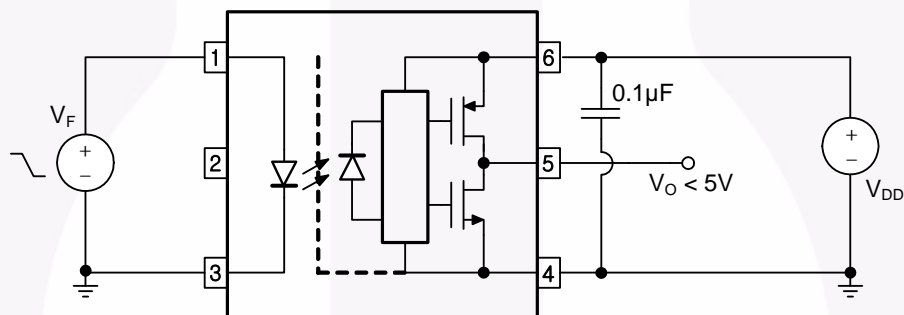


Figure 28. V_{FHL} Test Circuit

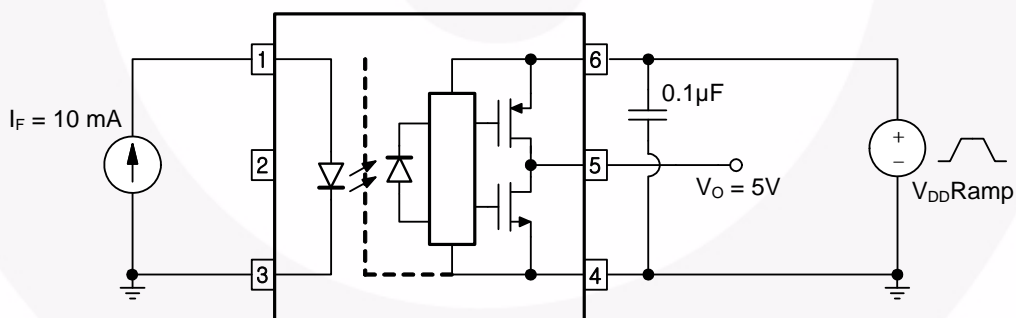


Figure 29. UVLO Test Circuit

Test Circuit (Continued)

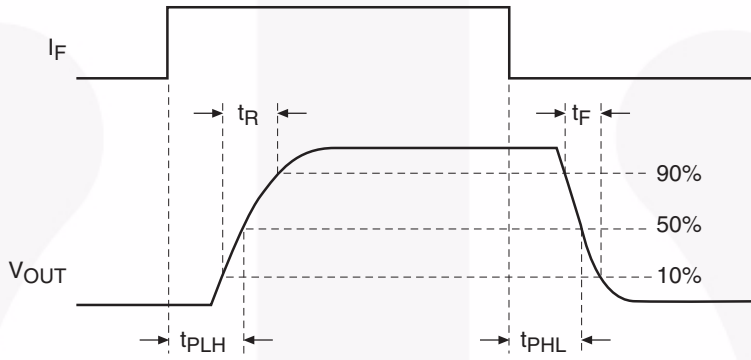
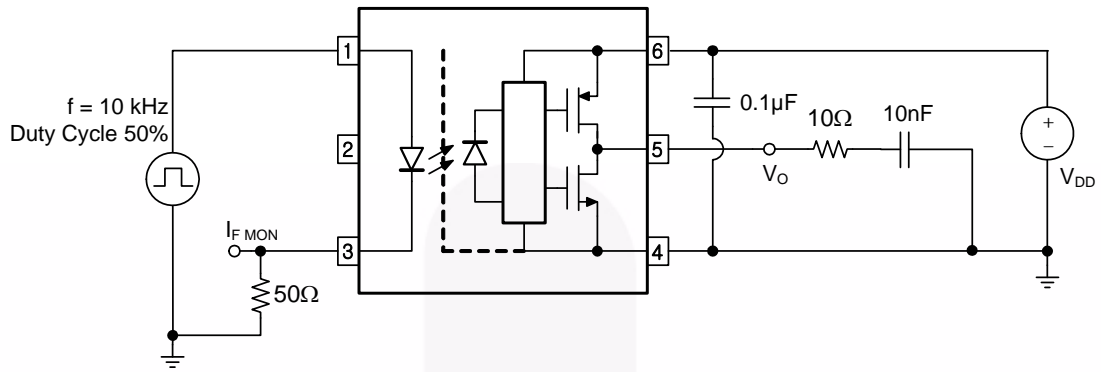


Figure 30. t_{PHL} , t_{PLH} , t_R and t_F Test Circuit and Waveforms

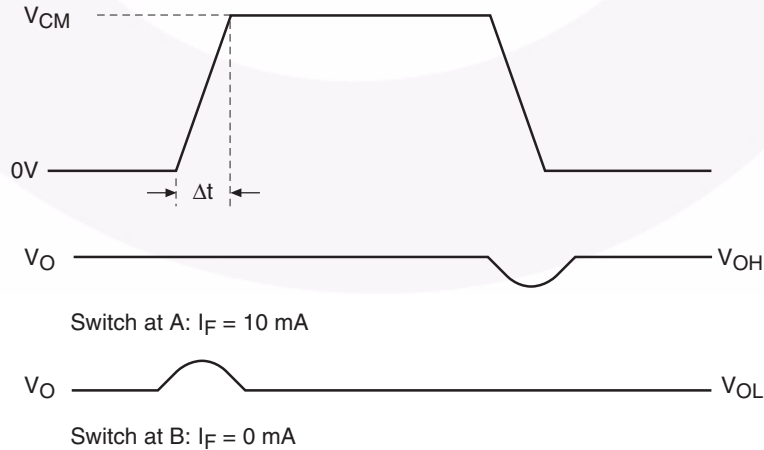
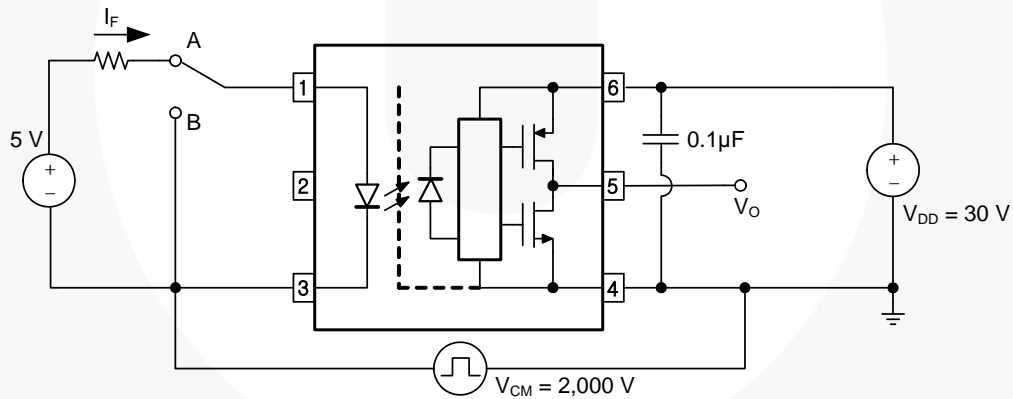
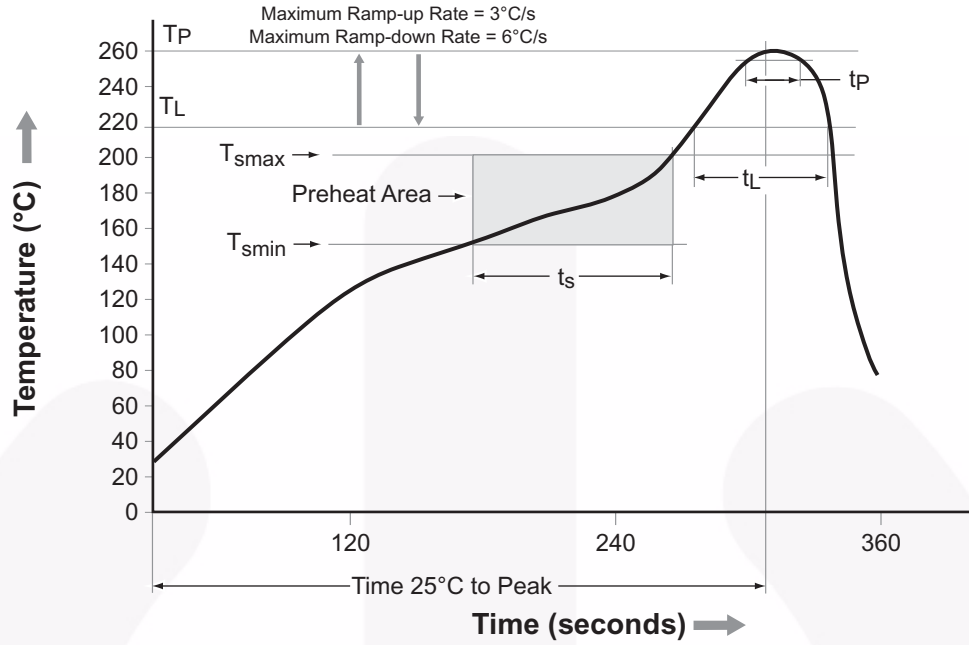


Figure 31. CMR Test Circuit and Waveforms

Reflow Profile



| Profile Feature | Pb-Free Assembly Profile |
|--|--------------------------|
| Temperature Minimum (T_{smin}) | 150°C |
| Temperature Maximum (T_{smax}) | 200°C |
| Time (t_s) from (T_{smin} to T_{smax}) | 60 s to 120 s |
| 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 s to 150 s |
| Peak Body Package Temperature | 260°C +0°C / -5°C |
| Time (t_p) within 5°C of 260°C | 30 s |
| Ramp-Down Rate (T_P to T_L) | 6°C/s maximum |
| Time 25°C to Peak Temperature | 8 minutes maximum |

Figure 32. Reflow Profile

Ordering Information

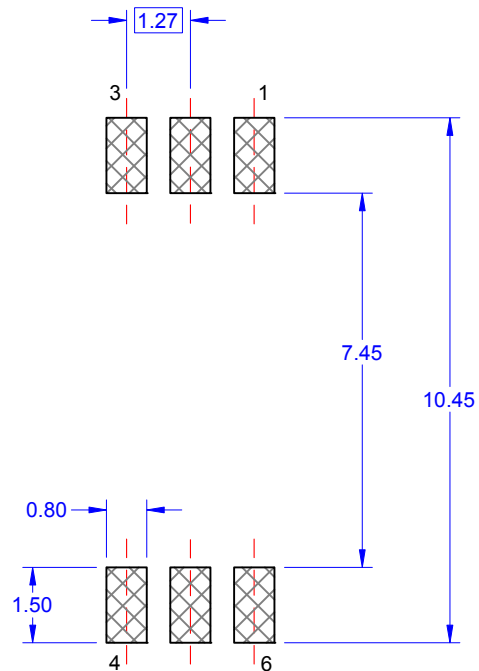
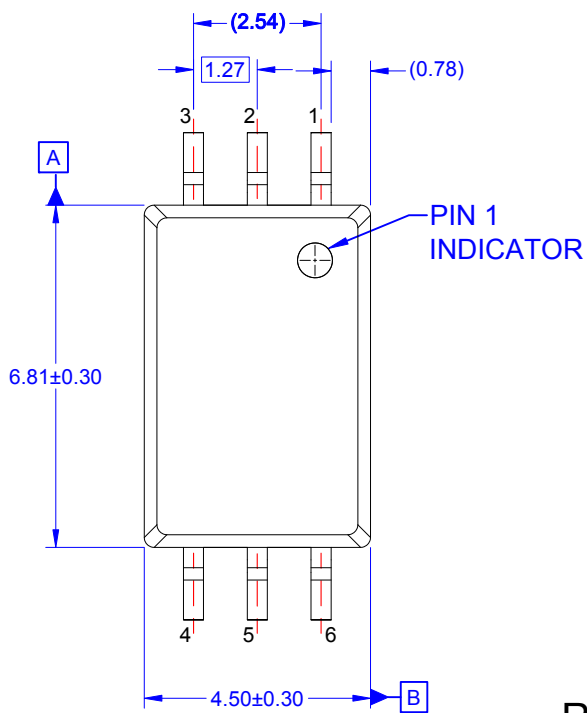
| Part Number | Package | Packing Method |
|-------------|--|--------------------------------------|
| FOD8314 | Stretched Body SOP 6-Pin | Tube (100 units per tube) |
| FOD8314R2 | Stretched Body SOP 6-Pin | Tape and Reel (1,000 units per reel) |
| FOD8314V | Stretched Body SOP 6-Pin, DIN EN/IEC60747-5-5 Option | Tube (100 units per tube) |
| FOD8314R2V | Stretched Body SOP 6-Pin, DIN EN/IEC60747-5-5 Option | Tape and Reel (1,000 units per reel) |
| FOD8314T | Stretched Body SOP 6-Pin, Wide Lead | Tube (100 units per tube) |
| FOD8314TR2 | Stretched Body SOP 6-Pin, Wide Lead | Tape and Reel (1,000 units per reel) |
| FOD8314TV | Stretched Body SOP 6-Pin, Wide Lead, DIN EN/IEC60747-5-5 Option | Tube (100 units per tube) |
| FOD8314TR2V | Stretched Body SOP 6-Pin, Wide Lead, 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.

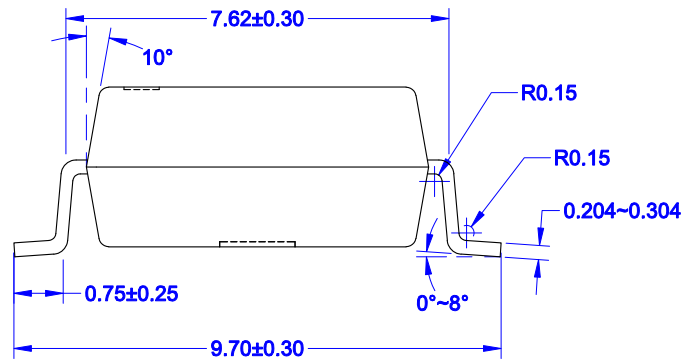
Marking Information



| Definitions | |
|-------------|---|
| 1 | Fairchild Logo |
| 2 | Device Number, e.g. 8314 |
| 3 | DIN EN/IEC60747-5-5 Option (only appears on component ordered with this option) |
| 4 | Last Digit Year Code, e.g. '5' |
| 5 | Two Digit Work Week Ranging from '01' to '53' |
| 6 | Assembly Package Code |



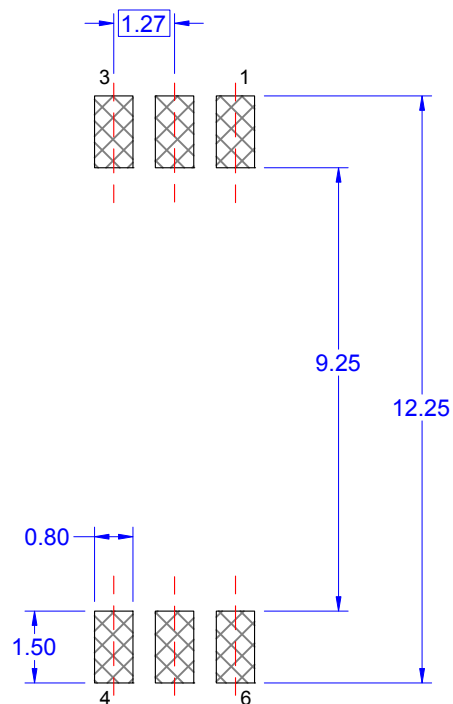
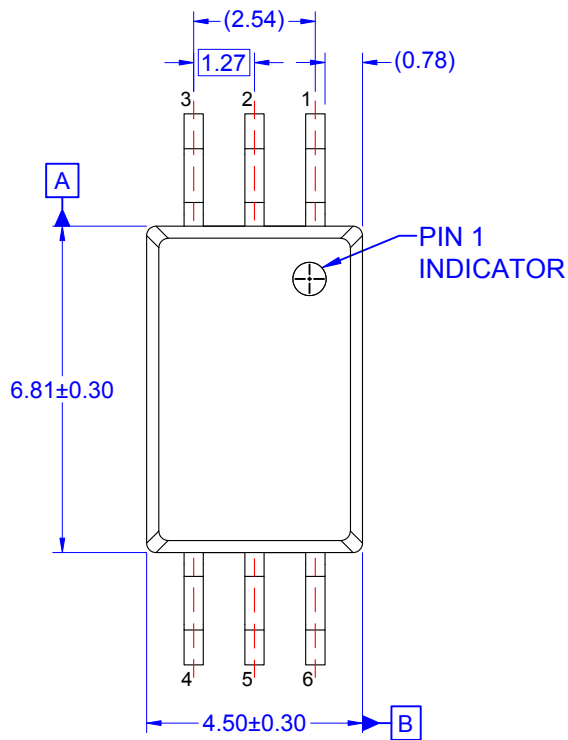
RECOMMENDED LAND PATTERN



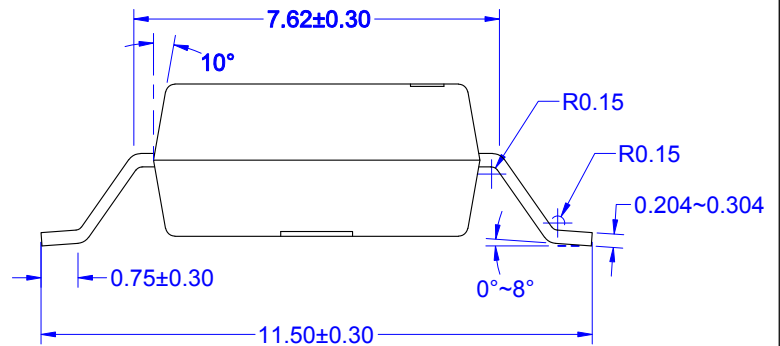
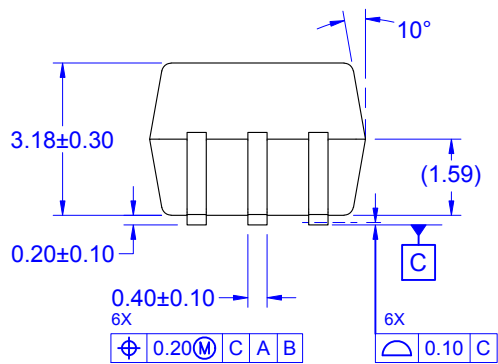
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- B) ALL DIMENSIONS ARE IN MILLIMETERS.
- C) DIMENSIONS DO NOT INCLUDE BURRS OR MOLD FLASH, AND TIE BAR EXTRUSION.
- D) DIMENSIONING AND TOLERANCING PER ASME Y14.5M-2009.
- E) DRAWING FILE NAME: MKT-M06BREV1





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