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February 2011

FOD3182 3A Output Current, High Speed MOSFET 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
- 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: 10V to 30V
- Use of P-Channel MOSFETs at output stage enables output voltage swing close to the supply rail (rail-to-rail output)
- 5000Vrms, 1 minute isolation
- Under voltage lockout protection (UVLO) with hysteresis – optimized for driving MOSFETs
- Minimum creepage distance of 8.0mm
- Minimum clearance distance of 10mm to 16mm (option TV or TSV)
- Minimum insulation thickness of 0.5mm
- UL and VDE*
- 1,414 peak working insulation voltage (V_{IORM})

*Requires 'V' ordering option

Applications

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

Description

The FOD3182 is a 3A Output Current, High Speed MOSFET Gate Drive Optocoupler. It consists of an 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 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 7.4V | 0V to 7V | Low |
| On | 7.4V to 9V | 7V to 8.5V | Transition |
| On | 9V to 30V | 8.5V 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, $V_{IORM} \times 1.875 = V_{PR}$, 100% Production Test with $t_m = 1$ sec., Partial Discharge < 5pC | 2651 | | | |
| | Input to Output Test Voltage, Method a, $V_{IORM} \times 1.5 = V_{PR}$, 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 | | | 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 (Duty Factor $\leq 2.7\%$) | 250 | | | mW |
| R_{IO} | Insulation Resistance at T_S , $V_{IO} = 500V$ | 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 | Units |
|-------------------|--|-----------------|------------------|
| 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 – Wave solder (Refer to Reflow Temperature Profile, pg. 22) | 260 for 10 sec. | $^\circ\text{C}$ |
| $I_{F(AVG)}$ | 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 ⁽⁴⁾ | 250 | mW |
| P_D | Total Power Dissipation ⁽⁵⁾ | 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 | 10 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 $V_{DD} = 30V$, $V_{SS} = 0V$, $T_A = 25^\circ C$, unless otherwise specified.

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|--------------------|---|--|----------------|------|----------------|-------|
| I_{OH} | High Level Output Current | $V_{OH} = (V_{DD} - V_{SS} - 1V)$ | 0.5 | 0.9 | | 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 ⁽⁵⁾⁽⁶⁾ | $I_O = -100mA$ | $V_{DD} - 0.5$ | | | V |
| V_{OL} | Low Level Output Voltage ⁽⁵⁾⁽⁶⁾ | $I_O = 100mA$ | | | $V_{SS} + 0.5$ | V |
| I_{DDH} | High Level Supply Current | Output Open, $I_F = 10$ to $16mA$ | | 2.6 | 4.0 | mA |
| I_{DDL} | Low Level Supply Current | Output Open, $V_F = -3.0$ to $0.8V$ | | 2.5 | 4.0 | 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 | $V_O > 5V$, $I_F = 10mA$ | 7 | 8.3 | 9 | V |
| V_{UVLO-} | | $V_O < 5V$, $I_F = 10mA$ | 6.5 | 7.7 | 8.5 | V |
| $UVLO_{HYST}$ | UVLO Hysteresis | | | 0.6 | | V |
| BV_R | Input Reverse Breakdown Voltage | $I_R = 10\mu A$ | 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 $V_{DD} = 30V$, $V_{SS} = 0V$, $T_A = 25^\circ C$, unless otherwise specified.

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|-------------------------------------|---|---|------|------|------|-------------|
| t_{PLH} | Propagation Delay Time to High Output Level ⁽⁷⁾ | $I_F = 10mA$, $R_g = 10\Omega$, $f = 250kHz$, Duty Cycle = 50%, $C_g = 10nF$ | 50 | 120 | 210 | ns |
| t_{PHL} | Propagation Delay Time to Low Output Level ⁽⁷⁾ | | 50 | 145 | 210 | ns |
| P_{WD} | Pulse Width Distortion ⁽⁸⁾ | | 35 | 65 | ns | |
| P_{DD} ($t_{PHL} - t_{PLH}$) | Propagation Delay Difference Between Any Two Parts ⁽⁹⁾ | | -90 | 90 | ns | |
| t_r | Rise Time | $C_L = 10nF$, $R_g = 10\Omega$ | | 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 |
| $ CM_H $ | Output High Level Common Mode Transient Immunity ^{(10) (11)} | $T_A = +25^\circ C$, $I_f = 7mA$ to $16mA$, $V_{CM} = 2kV$, $V_{DD} = 30V$ | 35 | 50 | | kV/ μs |
| $ CM_L $ | Output Low Level Common Mode Transient Immunity ^{(10) (12)} | $T_A = +25^\circ C$, $V_f = 0V$, $V_{CM} = 2kV$, $V_{DD} = 30V$ | 35 | 50 | | kV/ μs |

Isolation Characteristics

| Symbol | Parameter | Test Conditions | Min. | Typ.* | Max. | Unit |
|-----------|--|---|------|-----------|------|-----------|
| V_{ISO} | Withstand Isolation Voltage ^{(13) (14)} | $T_A = 25^\circ C$, R.H. < 50%, $t = 1min.$, $I_{I-O} \leq 10\mu A$ | 5000 | | | V_{rms} |
| R_{I-O} | Resistance (input to output) ⁽¹⁴⁾ | $V_{I-O} = 500V$ | | 10^{11} | | Ω |
| C_{I-O} | Capacitance (input to output) | Freq. = 1MHz | | 1 | | pF |

*Typical values at $T_A = 25^\circ C$

Notes:

1. Derate linearly above +79°C free air temperature at a rate of 0.37mA/°C.
2. Maximum pulse width = 10μs, maximum duty cycle = 11%.
3. Derate linearly above +79°C, free air temperature at the rate of 5.73mW/°C.
4. No derating required across operating temperature range.
5. 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.
6. Maximum pulse width = 1ms, maximum duty cycle = 20%.
7. 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.
8. PWD is defined as $|t_{PHL} - t_{PLH}|$ for any given device.
8. The difference between t_{PHL} and t_{PLH} between any two FOD3182 parts under same operating conditions, with equal loads.
10. Pin 1 and 4 need to be connected to LED common.
11. 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. $V_O > 15V$).
12. 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. $V_O < 1.0V$).
13. 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 $I_{L-O} < 10\mu A$).
14. 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

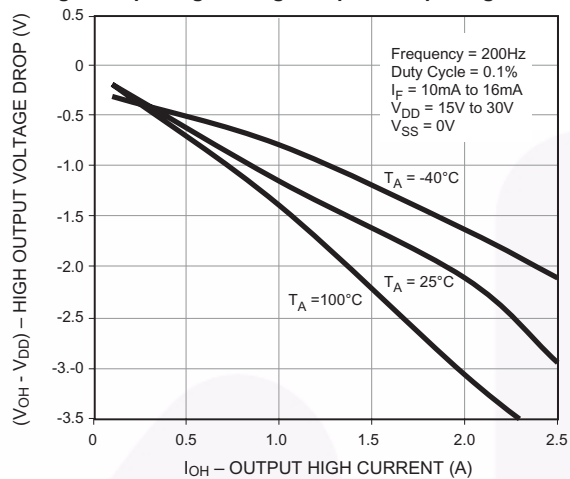


Fig. 2 Output High Voltage Drop vs. Ambient Temperature



Fig. 3 Output High Current vs. Ambient Temperature

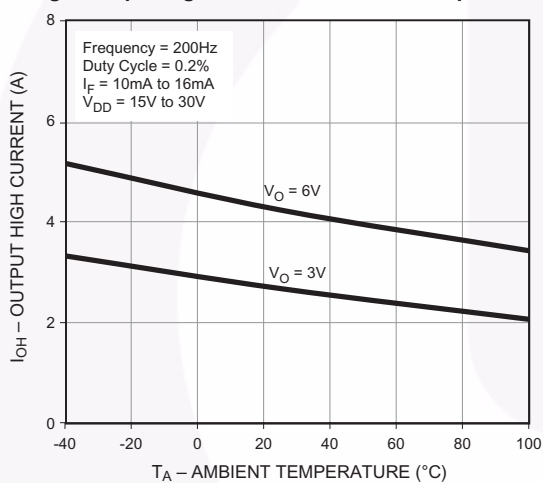


Fig. 4 Output High Current vs. Ambient Temperature



Fig. 5 Output Low Voltage vs. Output Low Current

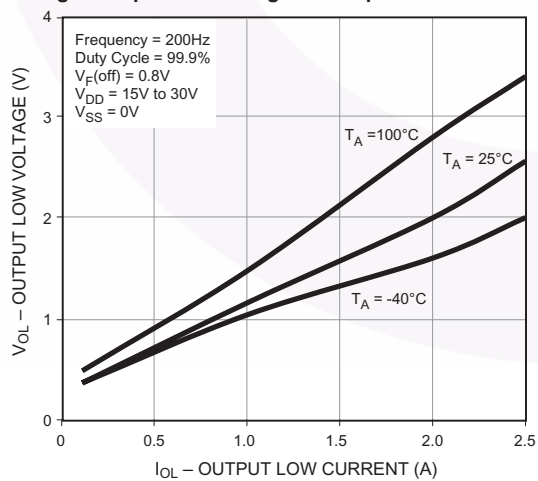


Fig. 6 Output Low Voltage vs. Ambient Temperature



Typical Performance Curves (Continued)

Fig. 7 Output Low Current vs. Ambient Temperature

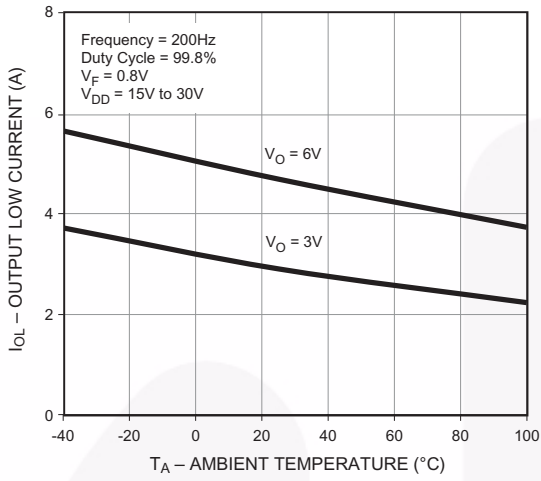


Fig. 8 Output Low Current vs. Ambient Temperature

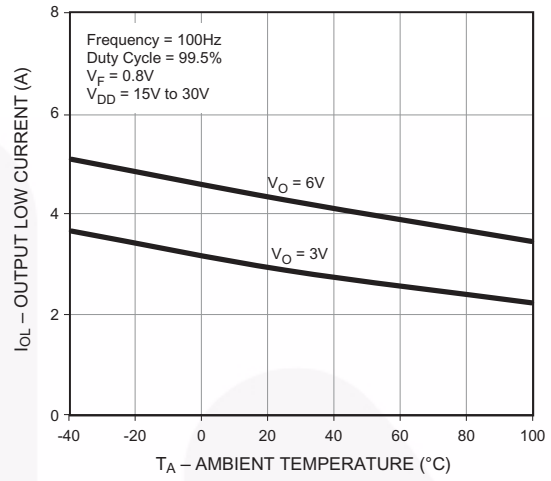


Fig. 9 Supply Current vs. Ambient Temperature



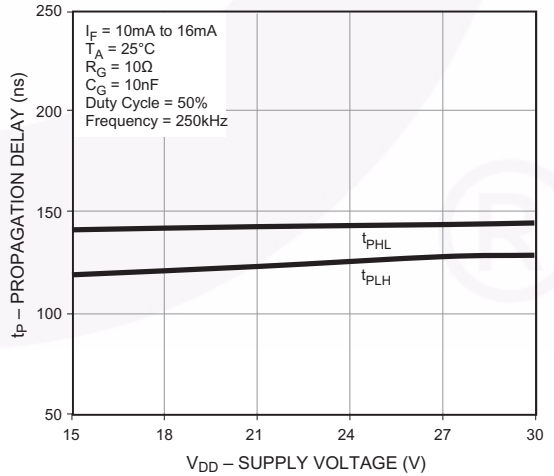
Fig. 10 Supply Current vs. Supply Voltage



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

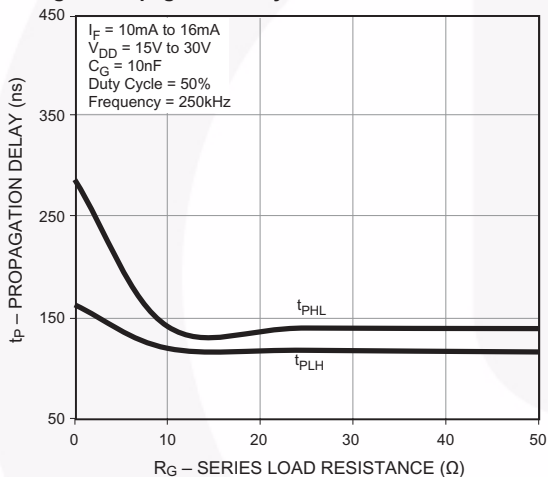


Fig. 16 Propagation Delay vs. Series Load Capacitance



Fig. 17 Transfer Characteristics



Fig. 18 Input Forward Current vs. Forward Voltage



Typical Performance Curves (Continued)



Test Circuit



Figure 20. I_{OL} Test Circuit



Figure 21. I_{OH} Test Circuit

Test Circuit (Continued)



Figure 22. V_{OH} Test Circuit

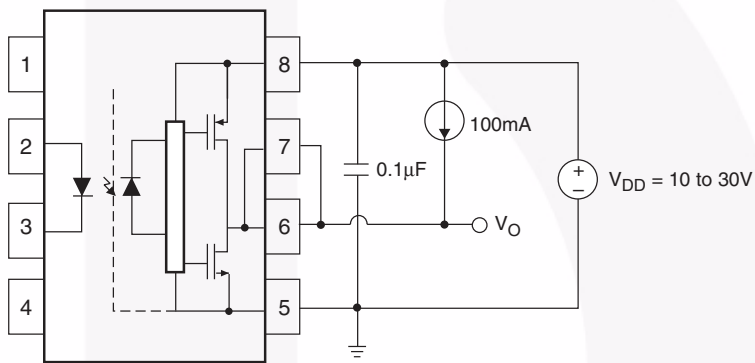


Figure 23. V_{OL} Test Circuit



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

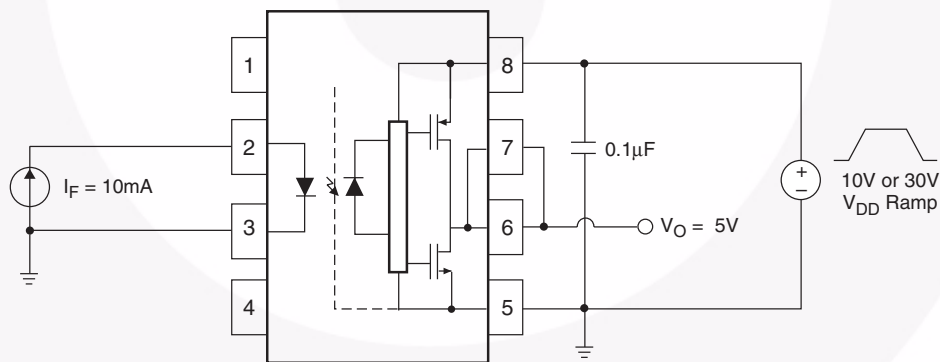


Figure 28. UVLO Test Circuit

Test Circuit (Continued)

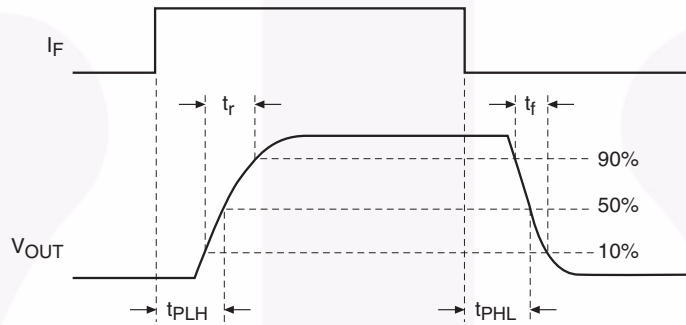


Figure 29. t_{PHL} , t_{PLH} , t_r and t_f Test Circuit and Waveforms

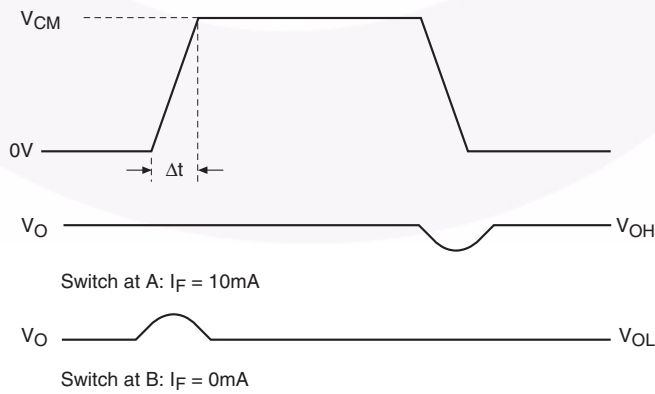
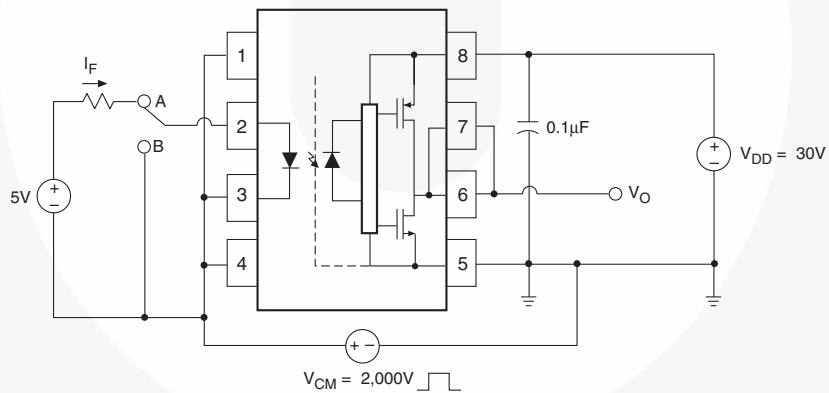


Figure 30. CMR Test Circuit and Waveforms

Ordering Information

| Part Number | Package | Packing Method |
|--------------|---|--------------------------------------|
| FOD3182 | DIP 8-Pin | Tube (50 units per tube) |
| FOD3182S | SMT 8-Pin (Lead Bend) | Tube (50 units per tube) |
| FOD3182SD | SMT 8-Pin (Lead Bend) | Tape and Reel (1,000 units per reel) |
| FOD3182V | DIP 8-Pin, IEC60747-5-2 option | Tube (50 units per tube) |
| FOD3182SV | SMT 8-Pin (Lead Bend), DIN EN/IEC 60747-5-2 option | Tube (50 units per tube) |
| FOD3182SDV | SMT 8-Pin (Lead Bend), DIN EN/IEC 60747-5-2 option | Tape and Reel (1,000 units per reel) |
| FOD3182TV | DIP 8-Pin, 0.4" Lead Spacing, DIN EN/IEC 60747-5-2 option | Tube (50 units per tube) |
| FOD3182TSV | SMT 8-Pin, 0.4" Lead Spacing, DIN EN/IEC 60747-5-2 option | Tube (50 units per tube) |
| FOD3182TSR2 | SMT 8-Pin, 0.4" Lead Spacing | Tape and Reel (700 units per reel) |
| FOD3182TSR2V | SMT 8-Pin, 0.4" Lead Spacing, DIN EN/IEC 60747-5-2 option | Tape and Reel (700 units per reel) |

Marking Information



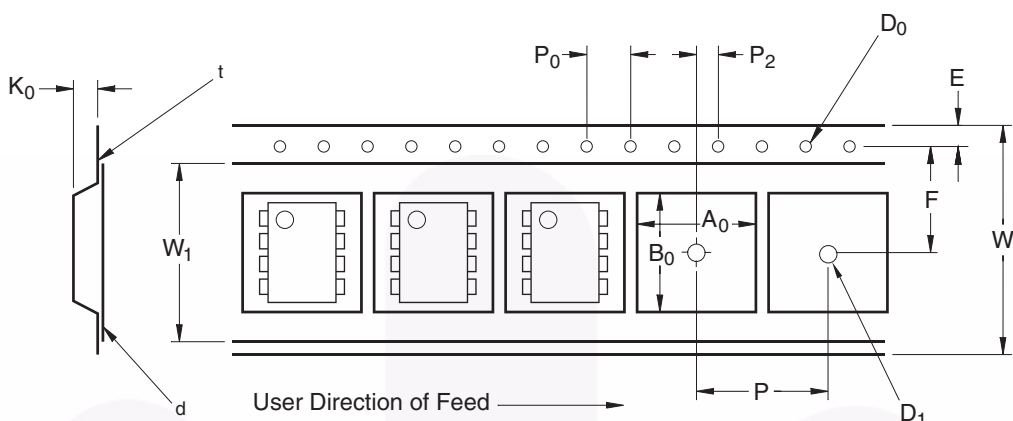
| Definitions | |
|-------------|---|
| 1 | Fairchild logo |
| 2 | Device number |
| 3 | VDE mark (Note: Only appears on parts ordered with DIN EN/IEC 60747-5-2 option – See order entry table) |
| 4 | Two digit year code, e.g., '11' |
| 5 | Two digit work week ranging from '01' to '53' |
| 6 | Assembly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

Carrier Tape Specifications – Option S



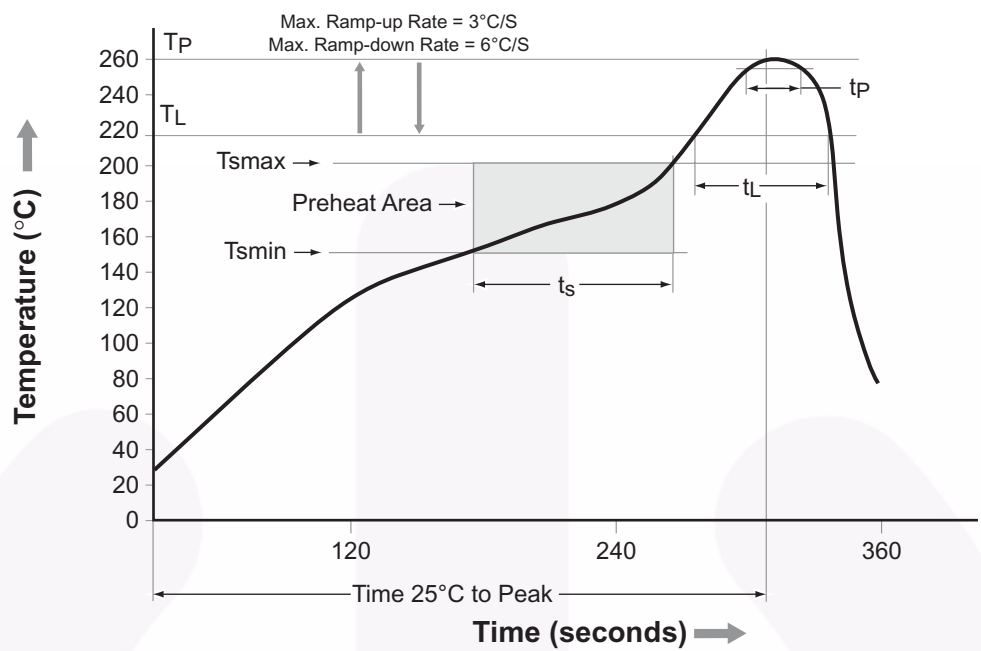
| Symbol | Description | Dimension in mm |
|----------------|---------------------------------|-----------------|
| W | Tape Width | 16.0 ± 0.3 |
| t | Tape Thickness | 0.30 ± 0.05 |
| P ₀ | Sprocket Hole Pitch | 4.0 ± 0.1 |
| D ₀ | Sprocket Hole Diameter | 1.55 ± 0.05 |
| E | Sprocket Hole Location | 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

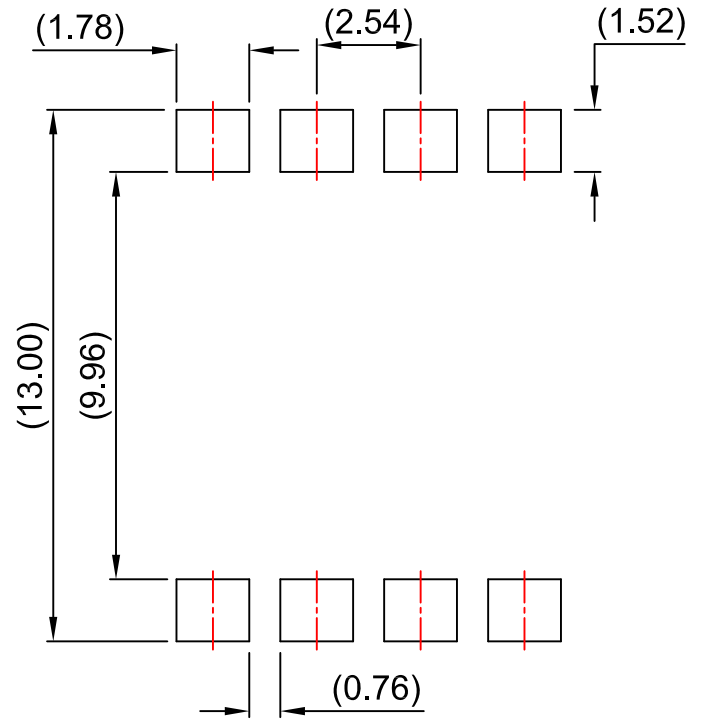


| Symbol | Description | Dimension in mm |
|----------------|---------------------------------|-----------------|
| W | Tape Width | 24.0 ± 0.3 |
| t | Tape Thickness | 0.40 ± 0.1 |
| P ₀ | Sprocket Hole Pitch | 4.0 ± 0.1 |
| D ₀ | Sprocket Hole Diameter | 1.55 ± 0.05 |
| E | Sprocket Hole Location | 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 |

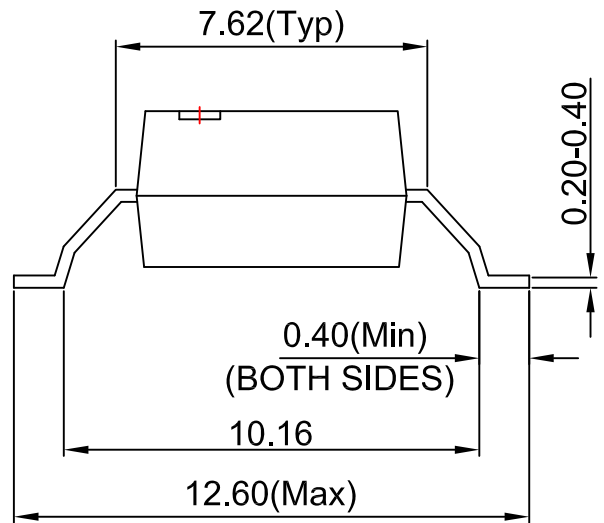
Reflow Profile



| Profile Feature | Pb-Free Assembly Profile |
|---------------------------------|--------------------------|
| Temperature Min. (Tsmín) | 150°C |
| Temperature Max. (Tsmáx) | 200°C |
| Time (ts) from (Tsmín to Tsmáx) | 60–120 seconds |
| Ramp-up Rate (tL to tp) | 3°C/second max. |
| Liquidous Temperature (TL) | 217°C |
| Time (tL) Maintained Above (TL) | 60–150 seconds |
| Peak Body Package Temperature | 260°C +0°C / -5°C |
| Time (tp) within 5°C of 260°C | 30 seconds |
| Ramp-down Rate (TP to TL) | 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.
- C) DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH, AND TIE BAR EXTRUSION
- D) DWG FILENAME AND REVISION: MKT-N08Lrev2.





- NOTES:
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PIN 1

15.0° (MAX)

10.16 (TYP)

0.20-0.40



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