

# FOD0708 Single Channel CMOS Optocoupler, FOD0738 Dual Channel CMOS Optocoupler

## Features

- +5V CMOS compatibility
- 15ns typical pulse width distortion
- 30ns max. pulse width distortion
- 40ns max. propagation delay skew
- High speed: 15 MBd
- 60ns max. propagation delay
- 10kV/μs minimum common mode rejection
- -40°C to 100°C temperature range
- UL approved (file #E90700)

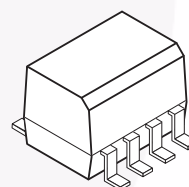
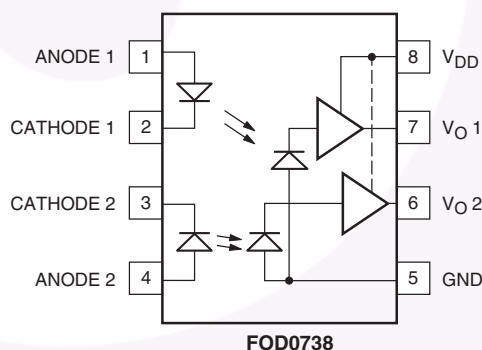
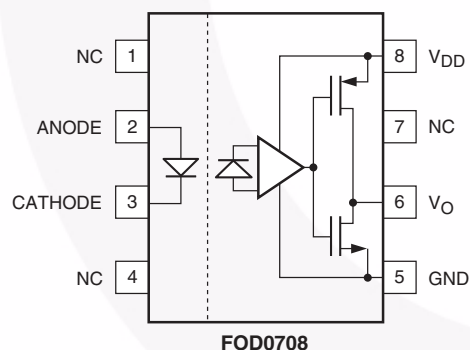
## Applications

- Line receivers
- Pulse transformer replacement
- Output interface to CMOS-LSTTL-TTL
- Wide bandwidth analog coupling

## General Description

The FOD0708 and FOD0738 optocouplers consist of an AlGaAs LED optically coupled to a high speed trans-impedance amplifier and voltage comparator. These optocouplers utilize the latest CMOS IC technology to achieve outstanding performance with very low power consumption. The devices are housed in a compact 8-pin SOIC package for optimum mounting density.

## Schematics



### TRUTH TABLE

| LED | V <sub>O</sub> OUTPUT |
|-----|-----------------------|
| OFF | H                     |
| ON  | L                     |

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

**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                                                    | Min.                                                                                                                                                 | Max.           | Units            |
|----------|--------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|------------------|
| $T_S$    | Storage Temperature                                          | -40                                                                                                                                                  | +125           | $^\circ\text{C}$ |
| $T_A$    | Ambient Operating Temperature                                | -40                                                                                                                                                  | +100           | $^\circ\text{C}$ |
| $V_{DD}$ | Supply Voltages                                              | 0                                                                                                                                                    | 6              | Volts            |
| $V_O$    | Output Voltage                                               | -0.5                                                                                                                                                 | $V_{DD} + 0.5$ | Volts            |
| $I_O$    | Average Output Current                                       |                                                                                                                                                      | 2              | mA               |
| $I_F$    | Average Forward Input Current                                |                                                                                                                                                      | 20             | mA               |
|          | Lead Solder Temperature                                      | 260 $^\circ\text{C}$ for 10 sec., 1.6 mm below seating plane                                                                                         |                |                  |
|          | Solder Reflow Temperature Profile                            | See Solder Reflow Temperature Profile Section                                                                                                        |                |                  |
|          | LED Power Dissipation<br>Single Channel<br>Dual Channel      | 40mW (derate above 95 $^\circ\text{C}$ , 1.4mW/ $^\circ\text{C}$ )<br>40mW per channel (derate above 90 $^\circ\text{C}$ , 1.2mW/ $^\circ\text{C}$ ) |                |                  |
|          | Detector Power Dissipation<br>Single Channel<br>Dual Channel | 85mW (derate above 75 $^\circ\text{C}$ , 1.8mW/ $^\circ\text{C}$ )<br>65mW per channel (derate above 90 $^\circ\text{C}$ , 2.0mW/ $^\circ\text{C}$ ) |                |                  |

**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. | Units            |
|----------|-------------------------------|------|------|------------------|
| $T_A$    | Ambient Operating Temperature | -40  | +100 | $^\circ\text{C}$ |
| $V_{DD}$ | Supply Voltages               | 4.5  | 5.5  | Volts            |
| $I_F$    | Input Current (ON)            | 10   | 16   | mA               |

**Electrical Characteristics** ( $T_A = -40^\circ\text{C}$  to  $+100^\circ\text{C}$ ) and  $4.5\text{ V} \leq V_{DD} \leq 5.5\text{ V}$ 

| Symbol    | Parameter                                               | Test Conditions                          | Min. | Typ.*      | Max.         | Units | Fig. |
|-----------|---------------------------------------------------------|------------------------------------------|------|------------|--------------|-------|------|
| $V_F$     | Input Forward Voltage                                   | $I_F = 12\text{mA}$                      | 1.3  | 1.45       | 1.8          | V     | 9    |
| $BV_R$    | Input Reverse Breakdown Voltage                         | $I_R = 10\mu\text{A}$                    | 5    |            |              | V     |      |
| $V_{OH}$  | Logic High Output Voltage                               | $I_F = 0, I_O = -20\mu\text{A}$          | 4.0  | 5.0        |              | V     |      |
| $V_{OL}$  | Logic Low Output Voltage                                | $I_F = 12\text{mA}, I_O = 20\mu\text{A}$ |      | 0.01       | 0.1          | V     |      |
| $I_{TH}$  | Input Threshold Current (FOD0708)<br>(FOD0738)          | $I_{OL} = 20\mu\text{A}$                 |      | 4.0<br>4.4 | 8.2<br>8.2   | mA    | 1,5  |
| $I_{DDL}$ | Logic Low Output Supply Current (FOD0708)<br>(FOD0738)  | $I_F = 12\text{mA}$                      |      | 3.4<br>6.9 | 14.0<br>18.0 | mA    | 3,7  |
| $I_{DDH}$ | Logic High Output Supply Current (FOD0708)<br>(FOD0738) | $I_F = 0$                                |      | 3.7<br>7.5 | 11.0<br>15.0 | mA    | 4,8  |

\*All typicals at  $T_A = 25^\circ\text{C}$  and  $V_{DD} = 5\text{V}$  unless otherwise noted.

**Switching Characteristics** Over recommended temperature ( $T_A = -40^\circ\text{C}$  to  $+100^\circ\text{C}$ ) and  $4.5\text{ V} \leq V_{DD} \leq 5.5\text{ V}$ . All typical specifications are at  $T_A = 25^\circ\text{C}$ ,  $V_{DD} = +5\text{ V}$ .

| Symbol    | Parameter                                           | Test Conditions                                                                                  | Min.          | Typ.* | Max. | Units             |
|-----------|-----------------------------------------------------|--------------------------------------------------------------------------------------------------|---------------|-------|------|-------------------|
| $t_{PHL}$ | Propagation Delay Time to Logic Low Output          | $I_F = 12\text{mA}$ , $C_L = 15\text{pF}$<br>CMOS Signal Levels (Note 1) (Fig. 10)               | 20            |       | 60   | ns                |
| $t_{PLH}$ | Propagation Delay Time to Logic High Output         | $I_F = 12\text{mA}$ , $C_L = 15\text{pF}$<br>CMOS Signal Levels,<br>(Note 1) (Fig. 10)           | FOD0708<br>13 |       | 60   | ns                |
|           |                                                     |                                                                                                  | FOD0738<br>11 |       | 60   |                   |
| PW        | Pulse Width                                         |                                                                                                  | 100           |       |      | ns                |
| PWD       | Pulse Width Distortion                              | $I_F = 12\text{mA}$ , $C_L = 15\text{pF}$ ,<br>CMOS Signal Levels (Note 2)                       | 0             |       | 30   | ns                |
| $t_{PSK}$ | Propagation Delay Skew                              | $I_F = 12\text{mA}$ , $C_L = 15\text{pF}$ ,<br>CMOS Signal Levels (Note 3)                       |               |       | 40   | ns                |
| $t_R$     | Output Rise Time (10%–90%)                          | $I_F = 12\text{mA}$ , $C_L = 15\text{pF}$ ,<br>CMOS Signal Levels                                |               | 12    |      | ns                |
| $t_F$     | Output Fall Time (90%–10%)                          | $I_F = 12\text{mA}$ , $C_L = 15\text{pF}$ ,<br>CMOS Signal Levels                                |               | 8     |      | ns                |
| $CM_H$    | Common Mode Transient Immunity at Logic High Output | $V_{CM} = 1000\text{V}$ , $T_A = 25^\circ\text{C}$ , $I_F = 0\text{mA}$ ,<br>(Note 4) (Fig. 11)  | 25            | 50    |      | kV/ $\mu\text{s}$ |
| $CM_L$    | Common Mode Transient Immunity at Logic Low Output  | $V_{CM} = 1000\text{V}$ , $T_A = 25^\circ\text{C}$ , $I_F = 12\text{mA}$ ,<br>(Note 5) (Fig. 11) | 25            | 50    |      | kV/ $\mu\text{s}$ |

\*All typicals at  $T_A = 25^\circ\text{C}$  and  $V_{DD} = 5\text{V}$  unless otherwise noted.

**Isolation Characteristics** ( $T_A = -40^\circ\text{C}$  to  $+100^\circ\text{C}$  Unless otherwise specified.)

| Characteristics                         | Test Conditions                                                                                                  | Symbol    | Min  | Typ.*     | Max | Unit          |
|-----------------------------------------|------------------------------------------------------------------------------------------------------------------|-----------|------|-----------|-----|---------------|
| Input-Output Insulation Leakage Current | Relative humidity = 45%,<br>$T_A = 25^\circ\text{C}$ , $t = 5\text{s}$ ,<br>$V_{I-O} = 3000\text{ VDC}$ (Note 6) | $I_{I-O}$ |      |           | 1.0 | $\mu\text{A}$ |
| Withstand Insulation Test Voltage       | $I_{I-O} \leq 10\mu\text{A}$ , $R_H < 50\%$ ,<br>$T_A = 25^\circ\text{C}$ , $t = 1\text{ min.}$ (Note 6)         | $V_{ISO}$ | 2500 |           |     | $V_{RMS}$     |
| Resistance (Input to Output)            | $V_{I-O} = 500\text{V}$ (Note 6)                                                                                 | $R_{I-O}$ |      | $10^{12}$ |     | $\Omega$      |
| Capacitance (Input to Output)           | $f = 1\text{MHz}$ (Note 6)                                                                                       | $C_{I-O}$ |      | 0.6       |     | pF            |

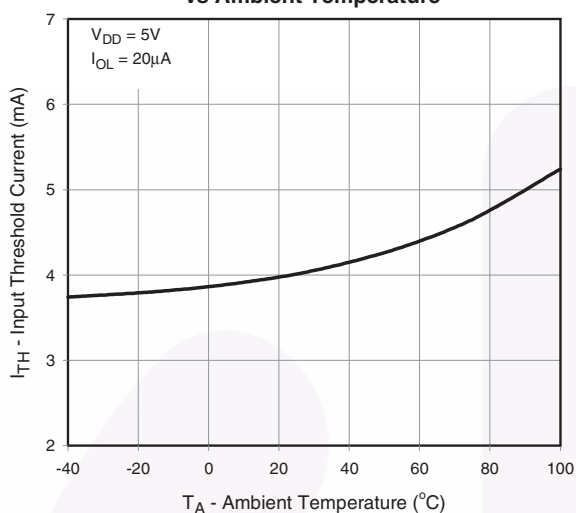
\*All typical values are at  $V_{CC} = 5\text{ V}$ ,  $T_A = 25^\circ\text{C}$

**Notes:**

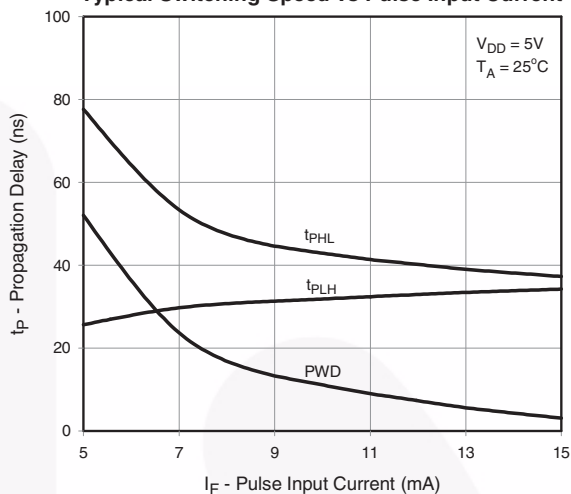
1. Propagation delay time, high to low ( $t_{PHL}$ ), is measured from the 50% level on the rising edge of the input pulse to the 2.5V level of the falling edge of the output voltage signal. Propagation delay time, low to high ( $t_{PLH}$ ), is measured from the 50% level on the falling edge of the input pulse to the 2.5V level of the rising edge of the output voltage signal.
2. Pulse width distortion is defined as the absolute difference between the high to low and low to high propagation delay times,  $|t_{PHL} - t_{PLH}|$ .
3. Propagation delay skew,  $t_{PSK}$ , is defined as the worst case difference in  $t_{PHL}$  or  $t_{PLH}$  between units within the recommended operating range of the device.
4.  $CM_H$  – The maximum tolerated rate of rise of the common mode voltage to ensure the output will remain in the high state, (i.e.,  $V_{OUT} > 2.0\text{V}$ ) Measured in kilovolts per microsecond (kV/ $\mu\text{s}$ ).
5.  $CM_L$  – The maximum tolerated rate of fall of the common mode voltage to ensure the output will remain in the low state, (i.e.,  $V_{OUT} < 0.8\text{V}$ ). Measured in kilovolts per microsecond (kV/ $\mu\text{s}$ ).
6. Isolation voltage,  $V_{ISO}$ , is an internal device dielectric breakdown rating. For this test, pins 1,2,3,4 are common, and pins 5,6,7,8 are common.

## Typical Performance Curves

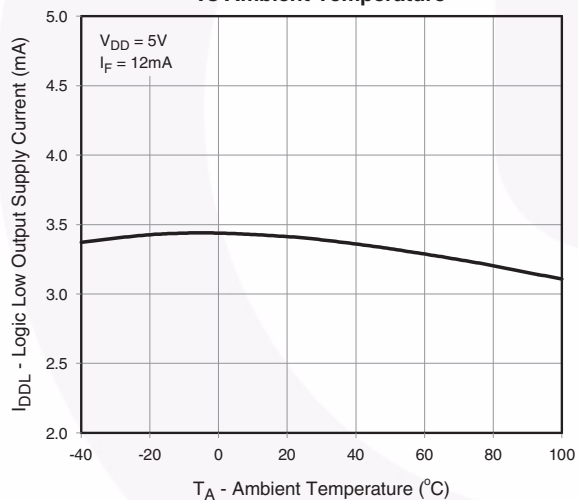
**Figure 1. FOD0708**  
Typical Input Threshold Current  
vs Ambient Temperature



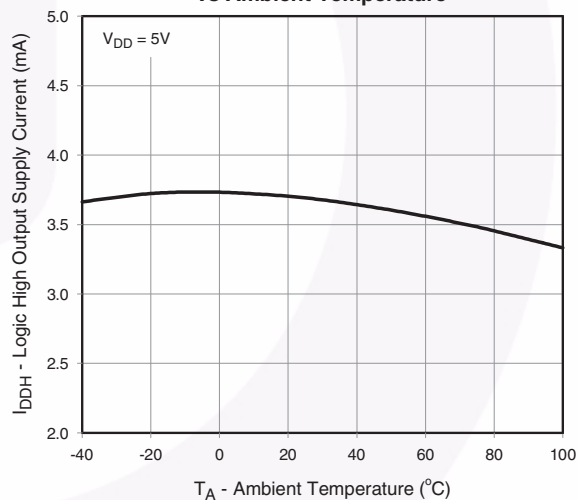
**Figure 2. FOD0708**  
Typical Switching Speed vs Pulse Input Current



**Figure 3. FOD0708**  
Typical Logic Low Output Supply Current  
vs Ambient Temperature

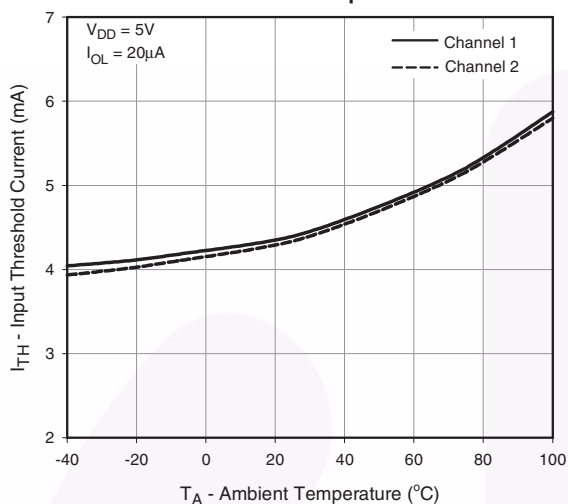


**Figure 4. FOD0708**  
Typical Logic High Output Supply Current  
vs Ambient Temperature

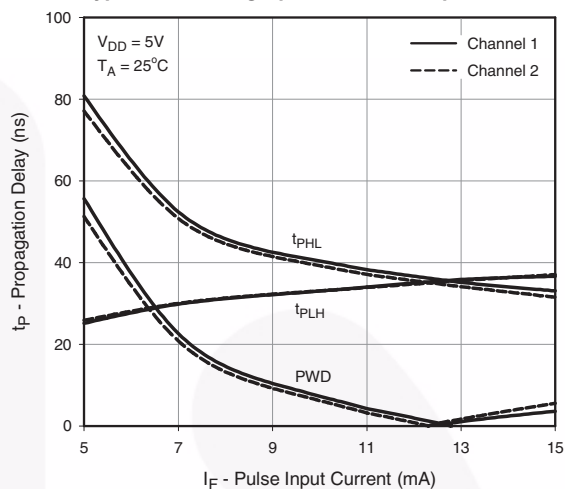


## Typical Performance Curves (Continued)

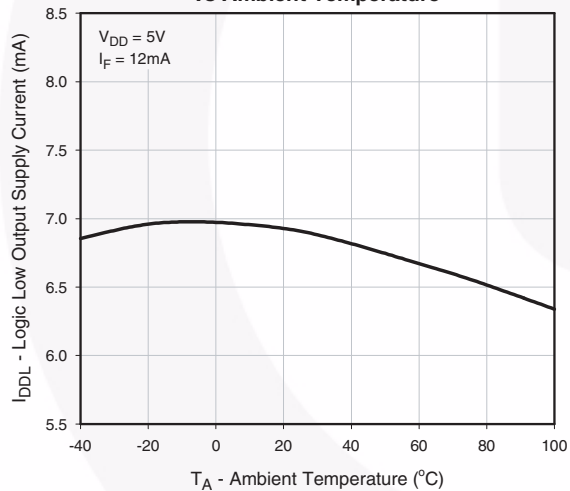
**Figure 5. FOD0738**  
Typical Input Threshold Current  
vs Ambient Temperature



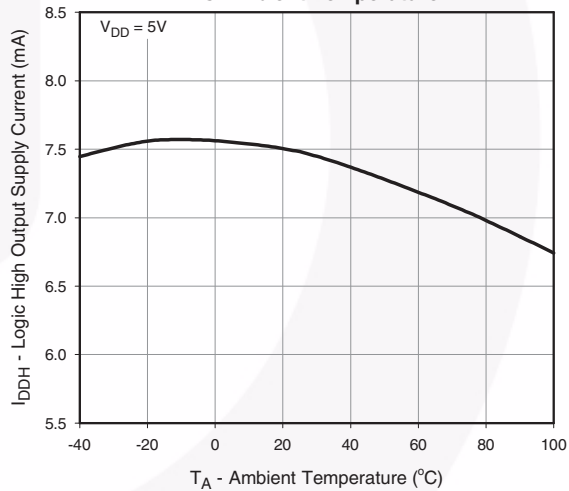
**Figure 6. FOD0738**  
Typical Switching Speed vs Pulse Input Current

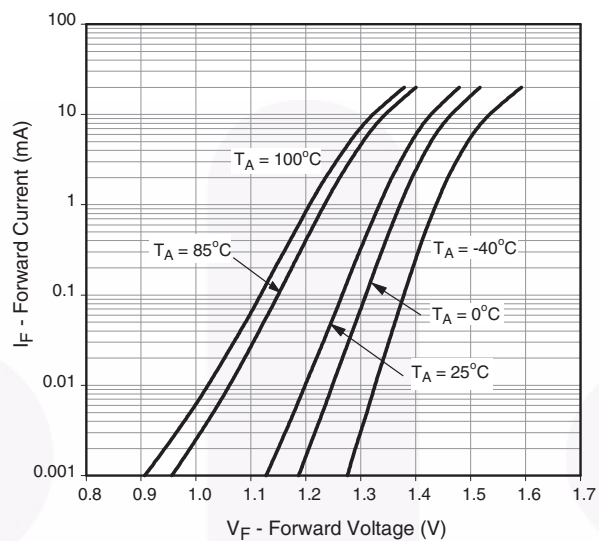


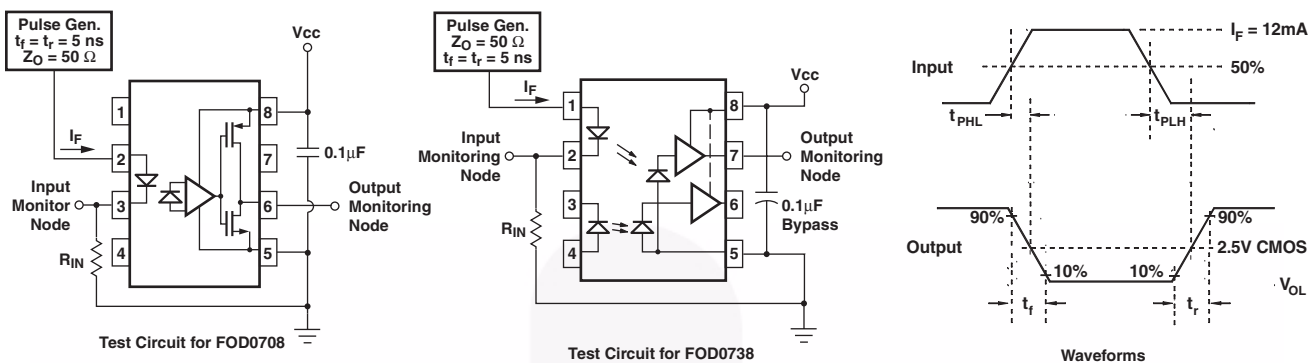
**Figure 7. FOD0738**  
Typical Logic Low Output Supply Current  
vs Ambient Temperature



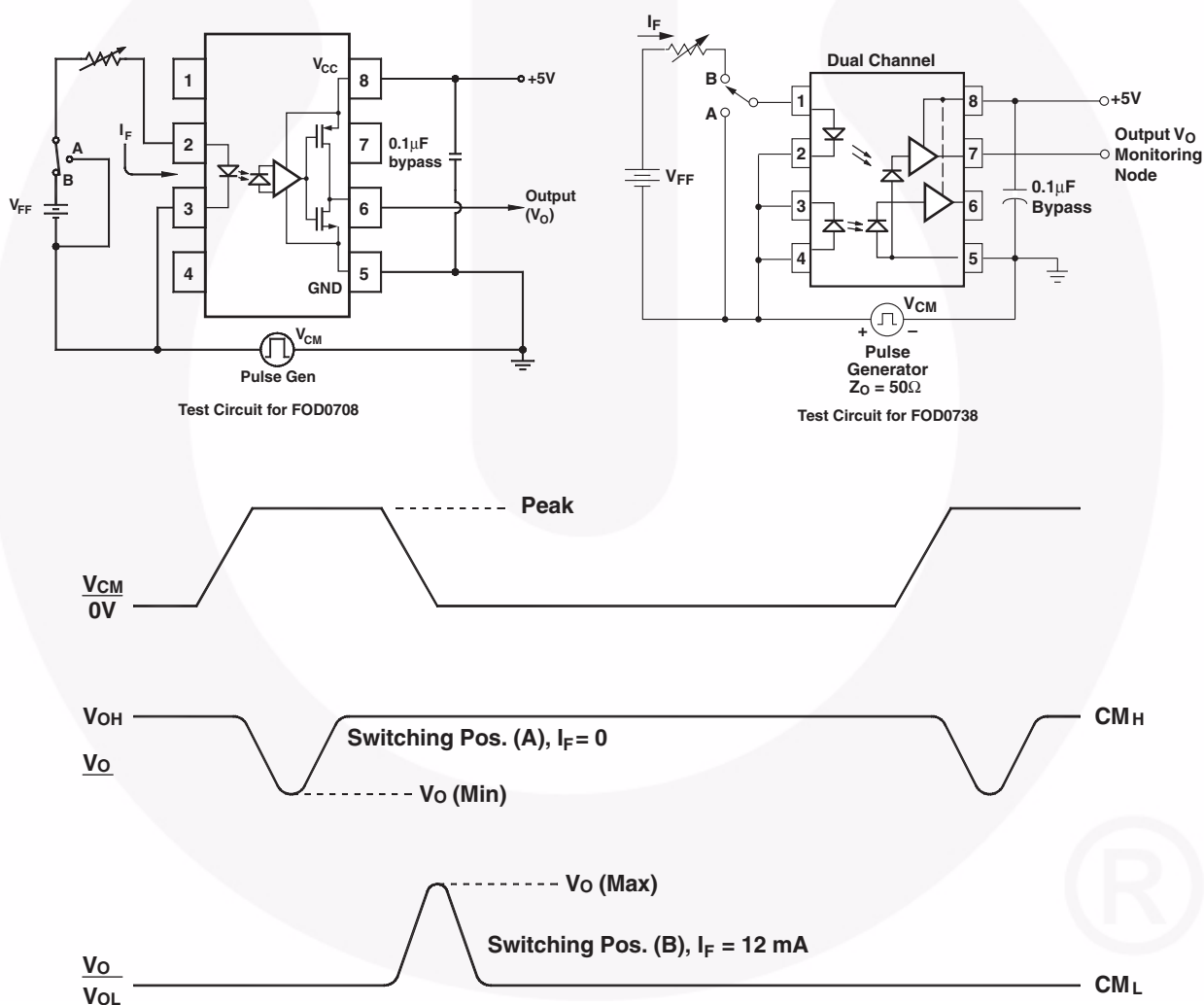
**Figure 8. FOD0738**  
Typical Logic High Output Supply Current  
vs Ambient Temperature



**Typical Performance Curves** (Continued)**Figure 9. Input Forward Current vs. Forward Voltage**



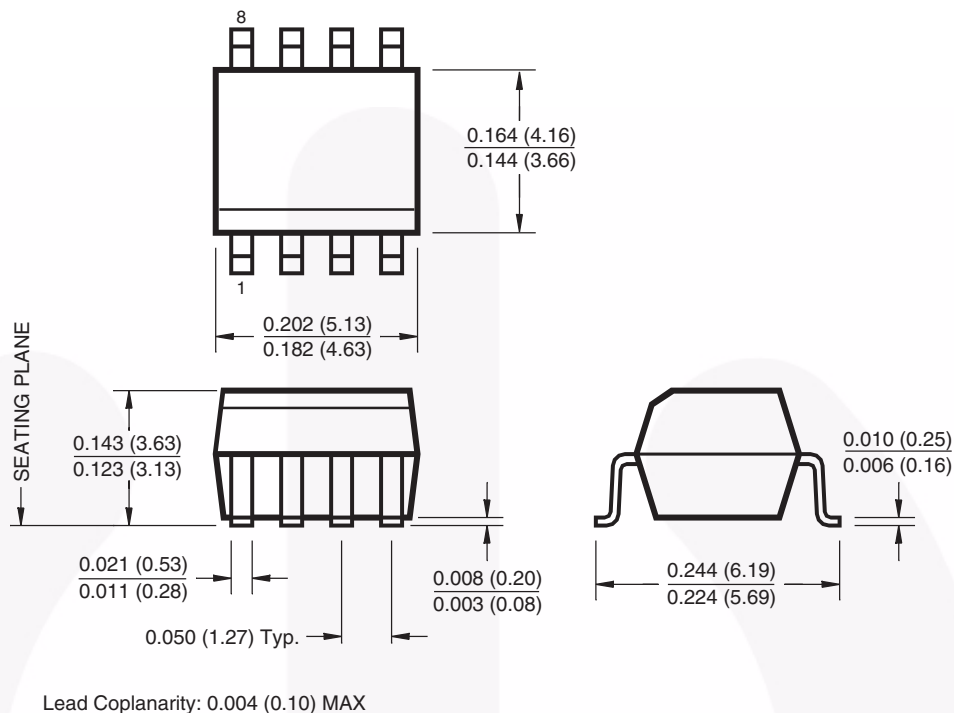
**Fig. 10 Test Circuit and Waveforms for  $t_{PLH}$ ,  $t_{PHL}$ ,  $t_r$  and  $t_f$ .**



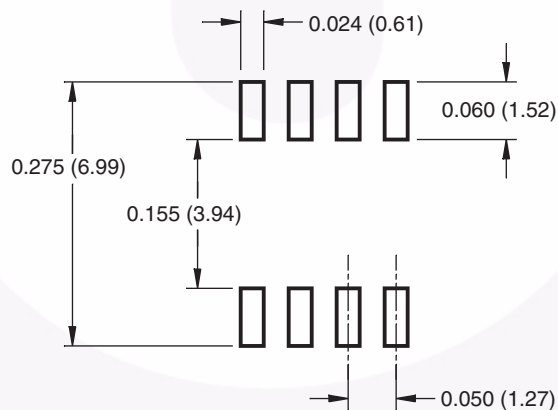
**Fig. 11 Test Circuit Common Mode Transient Immunity (FOD0708 and FOD0738)**

## Package Dimensions

### 8-pin SOIC Surface Mount



### Recommended Pad Layout



Dimensions in inches (mm).

Package drawings are provided as a service to customers considering Fairchild components. Drawings may change in any manner without notice. Please note the revision and/or date on the drawing and contact a Fairchild Semiconductor representative to verify or obtain the most recent revision. Package specifications do not expand the terms of Fairchild's worldwide terms and conditions, specifically the warranty therein, which covers Fairchild products.

Always visit Fairchild Semiconductor's online packaging area for the most recent package drawings:

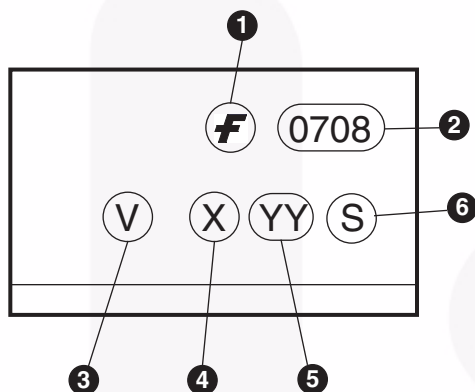
<http://www.fairchildsemi.com/packaging/>



## Ordering Information

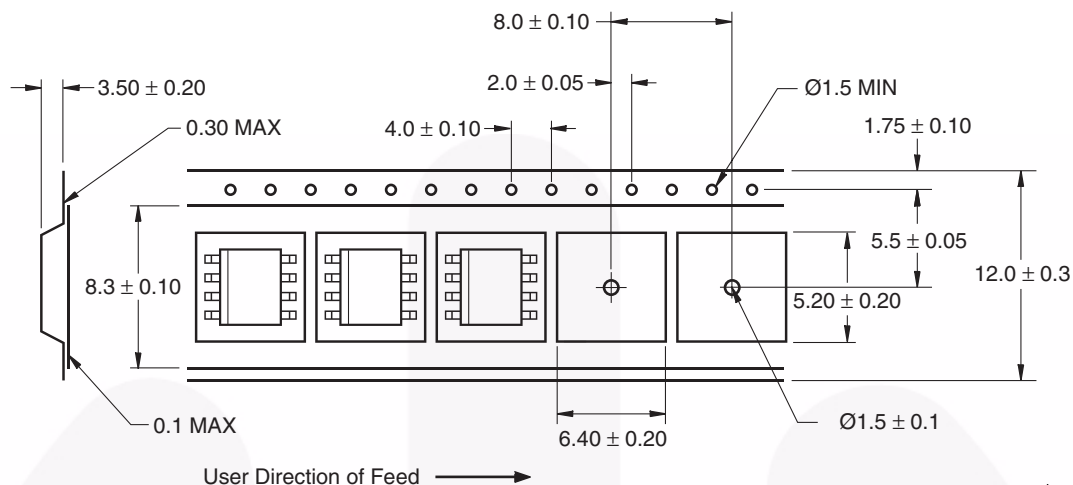
| Option    | Order Entry Identifier | Description                          |
|-----------|------------------------|--------------------------------------|
| No Suffix | FOD0708                | Shipped in tubes (50 units per tube) |
| R2        | FOD0708R2              | Tape and Reel (2500 units per reel)  |

## Marking Information

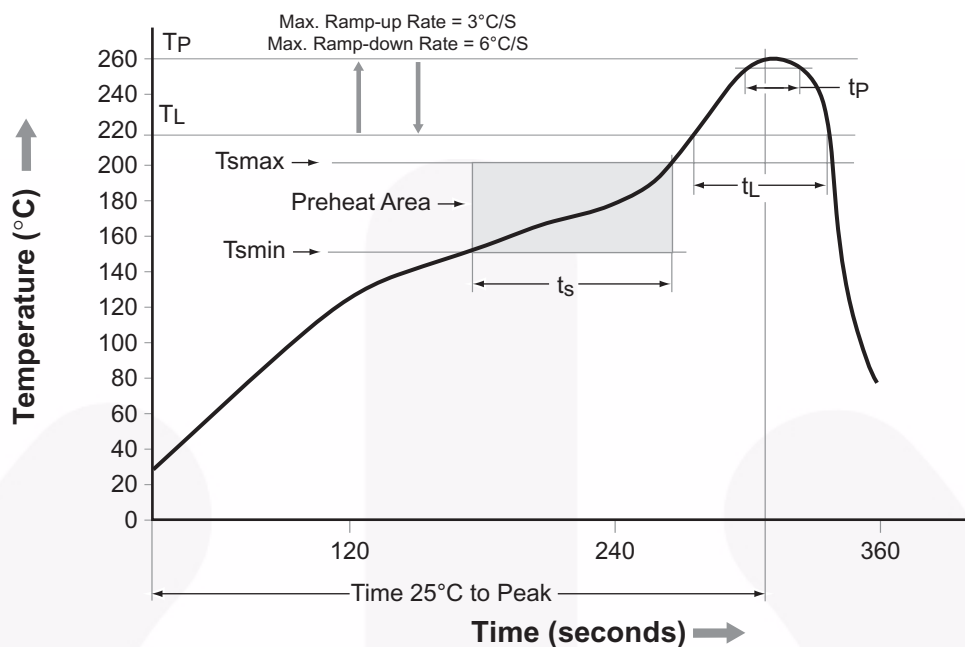


| Definitions |                                                                                        |
|-------------|----------------------------------------------------------------------------------------|
| 1           | Fairchild logo                                                            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

## Carrier Tape Specification



## Reflow Profile



| Profile Feature                                                       | Pb-Free Assembly Profile |
|-----------------------------------------------------------------------|--------------------------|
| Temperature Min. (T <sub>smin</sub> )                                 | 150°C                    |
| Temperature Max. (T <sub>smax</sub> )                                 | 200°C                    |
| Time (t <sub>s</sub> ) from (T <sub>smin</sub> to T <sub>smax</sub> ) | 60–120 seconds           |
| Ramp-up Rate (t <sub>L</sub> to t <sub>p</sub> )                      | 3°C/second max.          |
| Liquidous Temperature (T <sub>L</sub> )                               | 217°C                    |
| Time (t <sub>L</sub> ) Maintained Above (T <sub>L</sub> )             | 60–150 seconds           |
| Peak Body Package Temperature                                         | 260°C +0°C / -5°C        |
| Time (t <sub>p</sub> ) within 5°C of 260°C                            | 30 seconds               |
| Ramp-down Rate (T <sub>p</sub> to T <sub>L</sub> )                    | 6°C/second max.          |
| Time 25°C to Peak Temperature                                         | 8 minutes max.           |



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|                                                                                      |                                                                                            |                                                                                                    |                                                                                             |
|--------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------|
| Auto-SPM™                                                                            | F-PFS™                                                                                     | PowerTrench®                                                                                       | The Power Franchise®                                                                        |
| Build it Now™                                                                        | FRFET®                                                                                     | PowerXS™                                                                                           | the power franchise                                                                         |
| CorePLUS™                                                                            | Global Power Resource™                                                                     | Programmable Active Droop™                                                                         | TinyBoost™                                                                                  |
| CorePOWER™                                                                           | Green FPS™                                                                                 | QFET®                                                                                              | TinyBuck™                                                                                   |
| CROSSVOLT™                                                                           | Green FPS™ e-Series™                                                                       | QS™                                                                                                | TinyLogic®                                                                                  |
| CTL™                                                                                 | Gmax™                                                                                      | Quiet Series™                                                                                      | TINYOPTO™                                                                                   |
| Current Transfer Logic™                                                              | GTO™                                                                                       | RapidConfigure™                                                                                    | TinyPower™                                                                                  |
| EcoSPARK®                                                                            | IntelliMAX™                                                                                |  TM               | TinyPWM™                                                                                    |
| EfficientMax™                                                                        | ISOPLANAR™                                                                                 | Saving our world, 1mW/W/kW at a time™                                                              | TinyWire™                                                                                   |
| EZSWITCH™*                                                                           | MegaBuck™                                                                                  | SmartMax™                                                                                          | TriFault Detect™                                                                            |
|  ™* | MICROCOUPLER™                                                                              | SMART START™                                                                                       | TRUECURRENT™*                                                                               |
|  ®  | MicroFET™                                                                                  | SPM®                                                                                               | µSerDes™                                                                                    |
| Fairchild®                                                                           | MicroPak™                                                                                  | STEALTH™                                                                                           |  SerDes® |
| Fairchild Semiconductor®                                                             | MillerDrive™                                                                               | SuperFET™                                                                                          | UHC®                                                                                        |
| FACT Quiet Series™                                                                   | MotionMax™                                                                                 | SuperSOT™-3                                                                                        | Ultra FRFET™                                                                                |
| FACT®                                                                                | Motion-SPM™                                                                                | SuperSOT™-6                                                                                        | UniFET™                                                                                     |
| FAST®                                                                                | OPTOLOGIC®                                                                                 | SuperSOT™-8                                                                                        | VCX™                                                                                        |
| FAST®                                                                                | OPTOPLANAR®                                                                                | SupreMOS™                                                                                          | VisualMax™                                                                                  |
| FastvCore™                                                                           |  PDP SPM™ | SyncFET™                                                                                           | XS™                                                                                         |
| FETBench™                                                                            | Power-SPM™                                                                                 | Sync-Lock™                                                                                         |                                                                                             |
| FlashWriter®*                                                                        |                                                                                            |  SYSTEM GENERAL®* |                                                                                             |
| FPS™                                                                                 |                                                                                            |                                                                                                    |                                                                                             |

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## PRODUCT STATUS DEFINITIONS

### Definition of Terms

| Datasheet Identification | Product Status        | Definition                                                                                                                                                                                          |
|--------------------------|-----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Advance Information      | Formative / In Design | Datasheet contains the design specifications for product development. Specifications may change in any manner without notice.                                                                       |
| Preliminary              | First Production      | Datasheet contains preliminary data; supplementary data will be published at a later date. Fairchild Semiconductor reserves the right to make changes at any time without notice to improve design. |
| No Identification Needed | Full Production       | Datasheet contains final specifications. Fairchild Semiconductor reserves the right to make changes at any time without notice to improve the design.                                               |
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