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# FODM452, FODM453

## 5-Pin Mini Flat Package High Speed Transistor Optocoupler

### Features

- Compact 5-pin mini flat package
- High speed-1 MBit/s
- Superior CMR-15kV/μs at  $V_{CM} = 1500V$  (FODM453)
- Performance guaranteed over temperature (0–70°C)
- U.L. recognized (File # E90700)
- VDE0884 recognized (File # 136480)
  - Ordering option V, e.g., FODM452V
- 260°C reflow capability for Pb-free assembly

### Applications

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

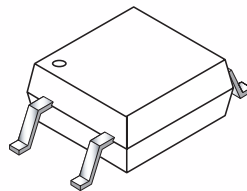
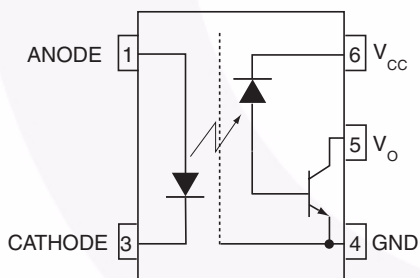
### Description

The FODM452 and FODM453 optocouplers consist of an AlGaAs LED optically coupled to a high speed photo-detector transistor. The devices are housed in a compact 5-pin mini flat package for optimum mounting density. The FODM453 features a high CMR rating for optimum common mode transient immunity.

### Related Resources

- [www.fairchildsemi.com/products/opto/](http://www.fairchildsemi.com/products/opto/)
- [www.fairchildsemi.com/pf/FO/FODM611.html](http://www.fairchildsemi.com/pf/FO/FODM611.html)
- [www.fairchildsemi.com/pf/FO/FODM8061.html](http://www.fairchildsemi.com/pf/FO/FODM8061.html)
- [www.fairchildsemi.com/pf/FO/FODM8071.html](http://www.fairchildsemi.com/pf/FO/FODM8071.html)

### Functional Schematic



### Truth Table

| LED | Output |
|-----|--------|
| Off | High   |
| On  | Low    |

## Pin Definitions

| Number | Name     | Function Description  |
|--------|----------|-----------------------|
| 1      | ANODE    | Anode                 |
| 3      | CATHODE  | Cathode               |
| 4      | GND      | Output Ground         |
| 5      | $V_O$    | Output Voltage        |
| 6      | $V_{CC}$ | Output Supply Voltage |

## Safety and Insulation Ratings for Mini-Flat Package (SO5 Pin)

As per IEC60747-5-2 (Pending Certification). 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 main voltage < 150Vrms                                                                                                             |        | I-IV     |      |            |
|            | For rated main voltage < 300Vrms                                                                                                             |        | I-III    |      |            |
|            | Climatic Classification                                                                                                                      |        | 40/85/21 |      |            |
|            | 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 < 5 pC | 1060   |          |      |            |
| $V_{PR}$   | 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  | 848    |          |      |            |
| $V_{IORM}$ | Max Working Insulation Voltage                                                                                                               | 565    |          |      | $V_{peak}$ |
| $V_{IOTM}$ | Highest Allowable Over Voltage                                                                                                               | 4000   |          |      | $V_{peak}$ |
|            | External Creepage                                                                                                                            | 5.0    |          |      | mm         |
|            | External Clearance                                                                                                                           | 5.0    |          |      | mm         |
|            | Insulation thickness                                                                                                                         | 0.5    |          |      | mm         |
| $T_{Case}$ | Safety Limit Values, Maximum Values allowed in the event of a failure, Case Temperature                                                      | 150    |          |      | °C         |
| $R_{IO}$   | Insulation Resistance at $T_S$ , $V_{IO} = 500V$                                                                                             | $10^9$ |          |      | $\Omega$   |

**Absolute Maximum Ratings** ( $T_A = 25^\circ\text{C}$  unless otherwise noted)

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 +85  | $^\circ\text{C}$ |
| <b>EMITTER</b>  |                                                                                        |             |                  |
| $I_F$ (avg)     | DC/Average Forward Input Current                                                       | 25          | mA               |
| $I_F$ (pk)      | Peak Forward Input Current (50% duty cycle, 1ms P.W.)                                  | 50          | mA               |
| $I_F$ (trans)   | Peak Transient Input Current ( $\leq 1\mu\text{s}$ P.W., 300pps)                       | 1.0         | A                |
| $V_R$           | Reverse Input Voltage                                                                  | 5           | V                |
| $P_D$           | Input Power Dissipation<br>(No derating required over specified operating temp range)  | 45          | mW               |
| <b>DETECTOR</b> |                                                                                        |             |                  |
| $I_O$ (avg)     | Average Output Current                                                                 | 8           | mA               |
| $I_O$ (pk)      | Peak Output Current                                                                    | 16          | mA               |
| $V_{CC}$        | Supply Voltage                                                                         | -0.5 to 30  | V                |
| $V_O$           | Output Voltage                                                                         | -0.5 to 20  | V                |
| $P_D$           | Output Power Dissipation<br>(No derating required over specified operating temp range) | 100         | mW               |

## Electrical Characteristics (T<sub>A</sub> = 0 to 70°C unless otherwise specified)

### Individual Component Characteristics

| Symbol                           | Parameter                                  | Test Conditions                                                                            | Min. | Typ.* | Max. | Unit  |
|----------------------------------|--------------------------------------------|--------------------------------------------------------------------------------------------|------|-------|------|-------|
| <b>EMITTER</b>                   |                                            |                                                                                            |      |       |      |       |
| V <sub>F</sub>                   | Input Forward Voltage                      | I <sub>F</sub> = 16mA, T <sub>A</sub> = 25°C                                               |      | 1.60  | 1.7  | V     |
|                                  |                                            | I <sub>F</sub> = 16mA                                                                      |      |       | 1.8  |       |
| B <sub>VR</sub>                  | Input Reverse Breakdown Voltage            | I <sub>R</sub> = 10μA                                                                      | 5.0  |       |      | V     |
| ΔV <sub>F</sub> /ΔT <sub>A</sub> | Temperature Coefficient of Forward Voltage | I <sub>F</sub> = 16mA                                                                      |      | -1.8  |      | mV/°C |
| <b>DETECTOR</b>                  |                                            |                                                                                            |      |       |      |       |
| I <sub>OH</sub>                  | Logic High Output Current                  | I <sub>F</sub> = 0mA, V <sub>O</sub> = V <sub>CC</sub> = 5.5V, T <sub>A</sub> = 25°C       |      | .001  | 0.5  | μA    |
|                                  |                                            | I <sub>F</sub> = 0 mA, V <sub>O</sub> = V <sub>CC</sub> = 15V, T <sub>A</sub> = 25°C       |      | .001  | 1    |       |
|                                  |                                            | I <sub>F</sub> = 0mA, V <sub>O</sub> = V <sub>CC</sub> = 15V                               |      |       | 50   |       |
| I <sub>CCL</sub>                 | Logic Low Supply Current                   | I <sub>F</sub> = 16mA, V <sub>O</sub> = Open, V <sub>CC</sub> = 15V                        |      | 100   | 200  | μA    |
| I <sub>CCH</sub>                 | Logic high supply current                  | I <sub>F</sub> = 0 mA, V <sub>O</sub> = Open, V <sub>CC</sub> = 15V, T <sub>A</sub> = 25°C |      | 0.05  | 1    | μA    |
|                                  |                                            | I <sub>F</sub> = 0mA, V <sub>O</sub> = Open, V <sub>CC</sub> = 15V                         |      |       | 2    |       |

### Transfer Characteristics

| Symbol          | Parameter                             | Test Conditions                                                                            | Min.                                        | Typ.* | Max | Unit |   |
|-----------------|---------------------------------------|--------------------------------------------------------------------------------------------|---------------------------------------------|-------|-----|------|---|
| <b>COUPLED</b>  |                                       |                                                                                            |                                             |       |     |      |   |
| CTR             | Current Transfer Ratio <sup>(1)</sup> | I <sub>F</sub> = 16mA, V <sub>CC</sub> = 4.5V                                              | T <sub>A</sub> = 25°C V <sub>OL</sub> =0.4V | 20    |     | 50   | % |
|                 |                                       |                                                                                            | V <sub>OL</sub> =0.5V                       | 15    |     |      |   |
| V <sub>OL</sub> | Logic LOW Output Voltage              | I <sub>F</sub> = 16mA, I <sub>O</sub> = 3mA, V <sub>CC</sub> = 4.5V, T <sub>A</sub> = 25°C |                                             |       | 0.4 | V    |   |
|                 |                                       | I <sub>F</sub> = 16mA, I <sub>O</sub> = 2.4mA, V <sub>CC</sub> = 4.5 V                     |                                             |       | 0.5 |      |   |

### Switching Characteristics (V<sub>CC</sub> = 5V)

| Symbol           | Parameter                                    | Test Conditions                                                                                                                        | Device  | Min. | Typ.* | Max. | Unit  |
|------------------|----------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------|---------|------|-------|------|-------|
| T <sub>PHL</sub> | Propagation Delay Time to Logic LOW          | R <sub>L</sub> = 1.9kΩ, I <sub>F</sub> = 16mA, T <sub>A</sub> = 25°C <sup>(2)</sup> (Fig. 9)                                           |         |      | 0.40  | 0.8  | μs    |
|                  |                                              | R <sub>L</sub> = 1.9kΩ, I <sub>F</sub> = 16mA <sup>(2)</sup> (Fig. 9)                                                                  |         |      |       | 1.0  |       |
| T <sub>PLH</sub> | Propagation Delay Time to Logic HIGH         | R <sub>L</sub> = 1.9kΩ, I <sub>F</sub> = 16mA, T <sub>A</sub> = 25°C <sup>(2)</sup> (Fig. 9)                                           |         |      | 0.35  | 0.8  | μs    |
|                  |                                              | R <sub>L</sub> = 1.9kΩ, I <sub>F</sub> = 16mA <sup>(2)</sup> (Fig. 9)                                                                  |         |      |       | 1.0  |       |
| CM <sub>H</sub>  | Common Mode Transient Immunity at Logic HIGH | I <sub>F</sub> = 0mA, V <sub>CM</sub> = 10V <sub>P-P</sub> , R <sub>L</sub> = 1.9kΩ, T <sub>A</sub> = 25°C <sup>(3)</sup> (Fig. 10)    | FODM452 | 5    | 15    |      | KV/μs |
|                  |                                              | I <sub>F</sub> = 0mA, V <sub>CM</sub> = 1500V <sub>P-P</sub> , R <sub>L</sub> = 1.9kΩ, T <sub>A</sub> = 25°C <sup>(3)</sup> (Fig. 10)  | FODM453 | 15   | 40    |      | KV/μs |
| CM <sub>L</sub>  | Common Mode Transient Immunity at Logic LOW  | I <sub>F</sub> = 16mA, V <sub>CM</sub> = 10V <sub>P-P</sub> , R <sub>L</sub> = 1.9kΩ, T <sub>A</sub> = 25°C <sup>(3)</sup> (Fig. 10)   | FODM452 | 5    | 15    |      | KV/μs |
|                  |                                              | I <sub>F</sub> = 16mA, V <sub>CM</sub> = 1500V <sub>P-P</sub> , R <sub>L</sub> = 1.9kΩ, T <sub>A</sub> = 25°C <sup>(3)</sup> (Fig. 10) | FODM453 | 15   | 40    |      | KV/μs |
| BW               | Bandwidth                                    | R <sub>L</sub> = 100Ω                                                                                                                  |         |      | 3     |      | MHz   |

### Isolation Characteristics

| Symbol           | Characteristics                   | Test Conditions                                            | Min. | Typ.* | Max. | Unit             |
|------------------|-----------------------------------|------------------------------------------------------------|------|-------|------|------------------|
| V <sub>ISO</sub> | Withstand Insulation Test Voltage | RH ≤ 50%, T <sub>A</sub> = 25°C, t = 1 min. <sup>(4)</sup> | 3750 |       |      | V <sub>RMS</sub> |
| C <sub>I-O</sub> | Capacitance (Input to Output)     | f = 1MHz <sup>(4)</sup>                                    |      | 0.2   |      | pF               |

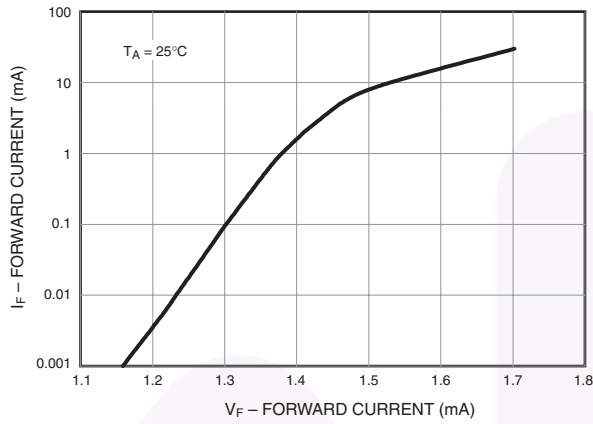
\*All Typicals at T<sub>A</sub> = 25°C

**Notes:**

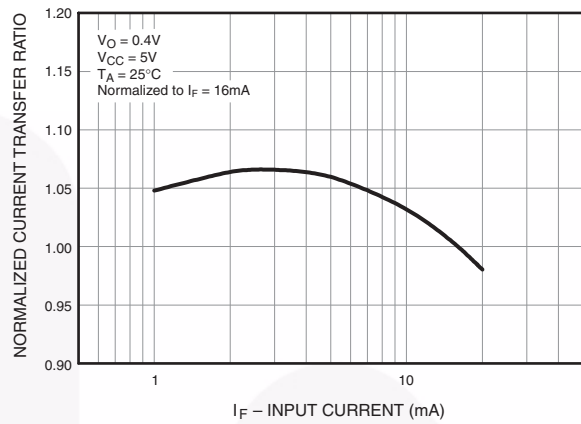
1. Current Transfer Ratio is defined as a ratio of output collector current,  $I_O$ , to the forward LED input current,  $I_F$ , times 100%.
2. The 1.9k $\Omega$  load represents 1 TTL unit load of 1.6mA and 5.6k $\Omega$  pull-up resistor.
3. Common mode transient immunity in logic high level is the maximum tolerable (positive)  $dV_{cm}/dt$  on the leading edge of the common mode pulse signal  $V_{CM}$ , to assure that the output will remain in a logic high state (i.e.,  $V_O > 2.0V$ ). Common mode transient immunity in logic low level is the maximum tolerable (negative)  $dV_{cm}/dt$  on the trailing edge of the common mode pulse signal,  $V_{CM}$ , to assure that the output will remain in a logic low state (i.e.,  $V_O < 0.8V$ ).
4. Device is considered a two terminal device: Pins 1, and 3 are shorted together and Pins 4, 5, and 6 are shorted together.

## Typical Performance Curves

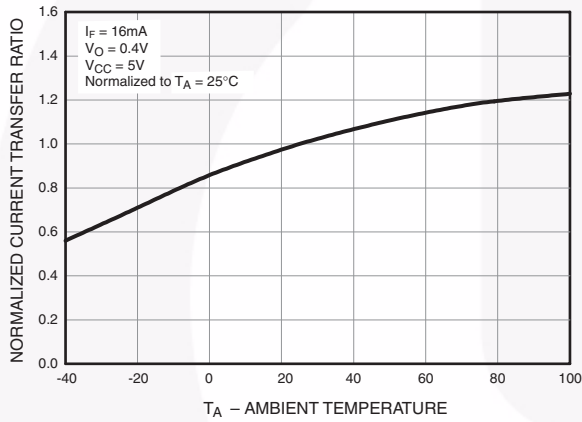
**Fig. 1 Input Forward Current vs Forward Voltage**



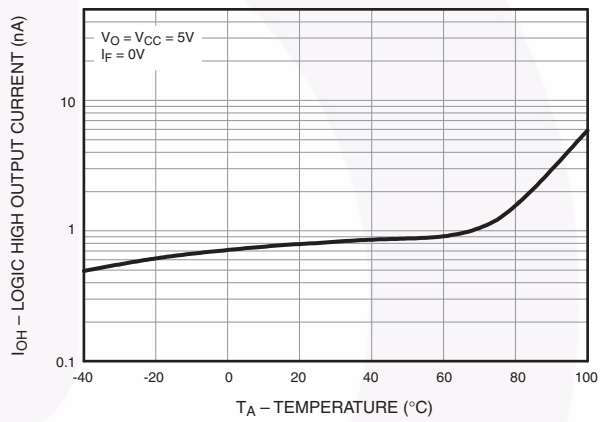
**Fig. 2 Normalized Current Transfer Ratio vs. Input Current**



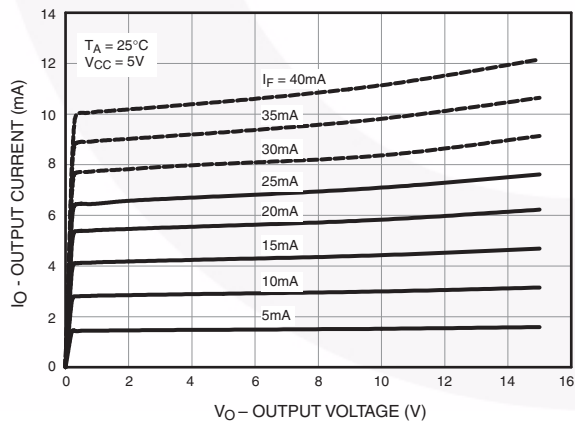
**Fig. 3 Normalized Current Transfer Ratio vs. Ambient Temperature**



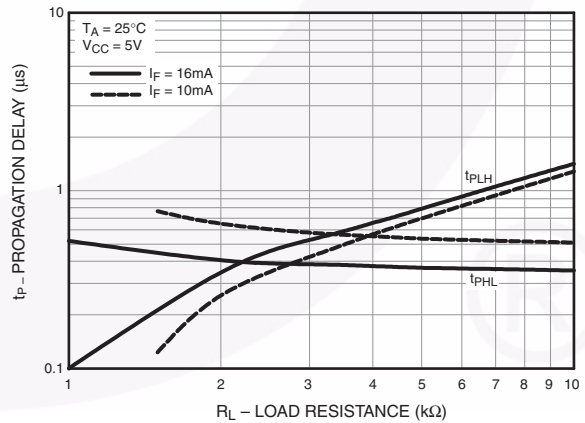
**Fig. 4 Logic High Output Current vs. Ambient Temperature**



**Fig. 5 DC and Pulsed Transfer Characteristics**



**Fig. 6 Propagation Delay vs. Load Resistance**



Typical Performance Curves (Continued)

Fig. 7 Propagation Delay vs. Ambient Temperature

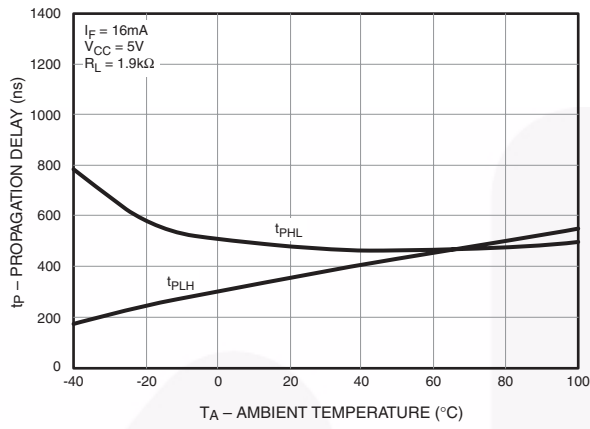
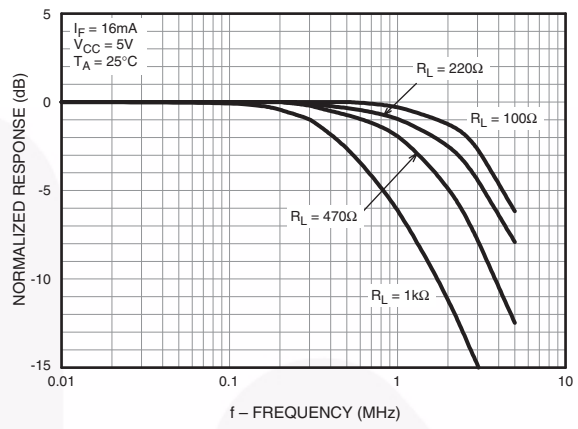
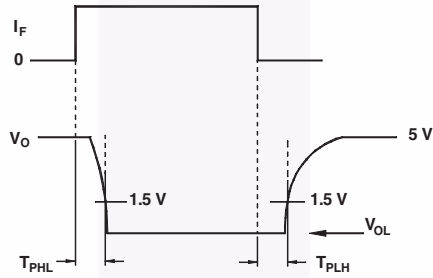
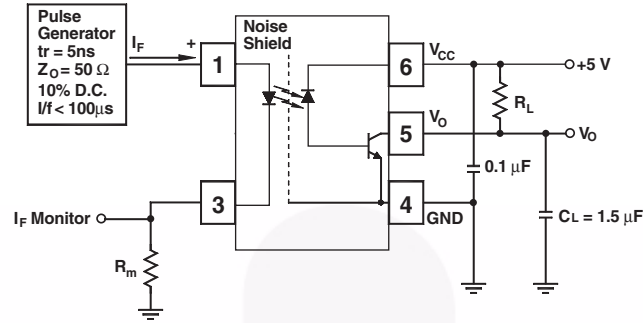
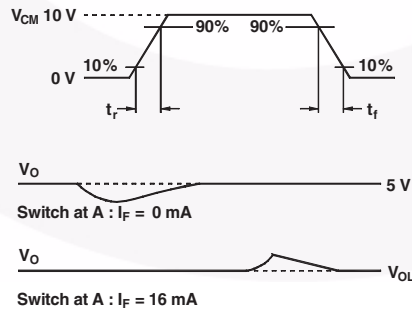
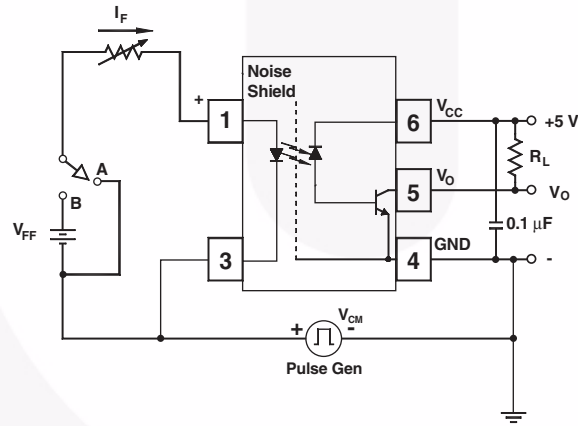


Fig. 8 Frequency Response



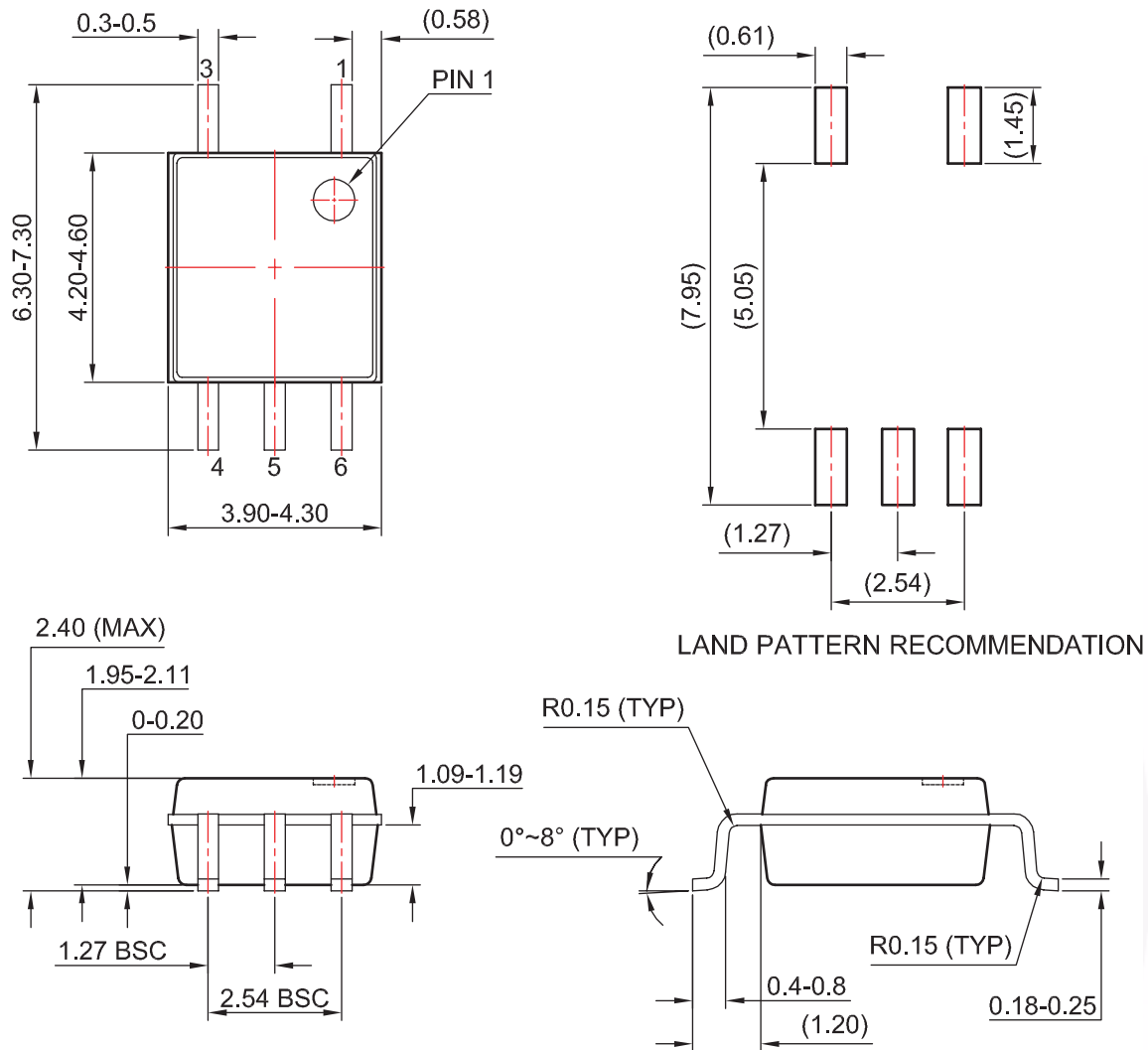


**Fig. 9 Switching Time Test Circuit**



**Fig. 10 Common Mode Immunity Test Circuit**

## Package Dimensions



### Notes:

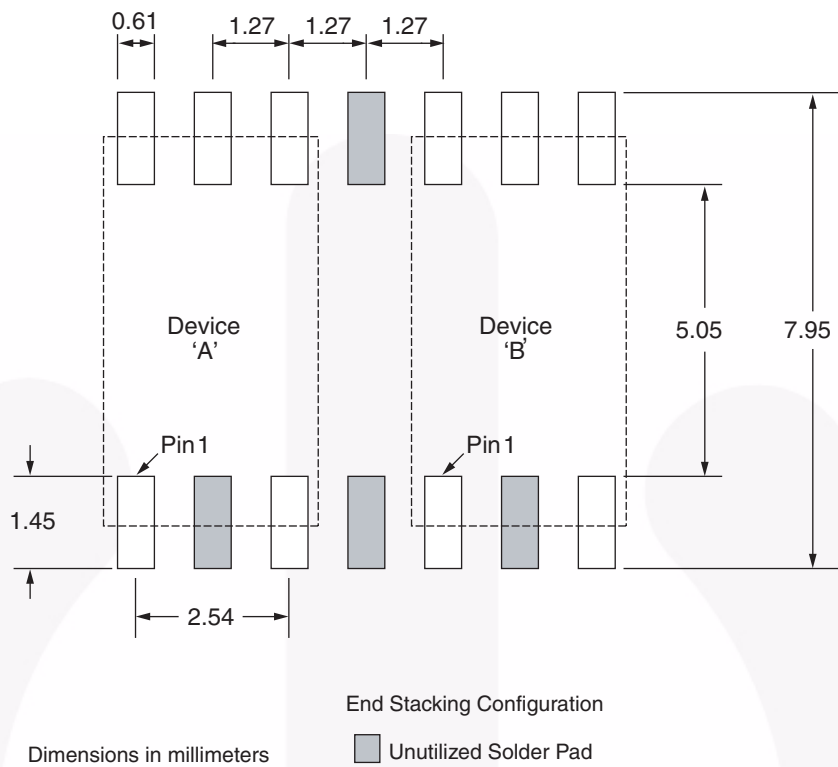
1. No standard applies to this package.
2. All dimensions are in millimeters.
3. Dimensions are exclusive of burrs, mold flash, and tie bar extrusion.
4. Drawings filename and revision: MKT-MFP05A.

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.

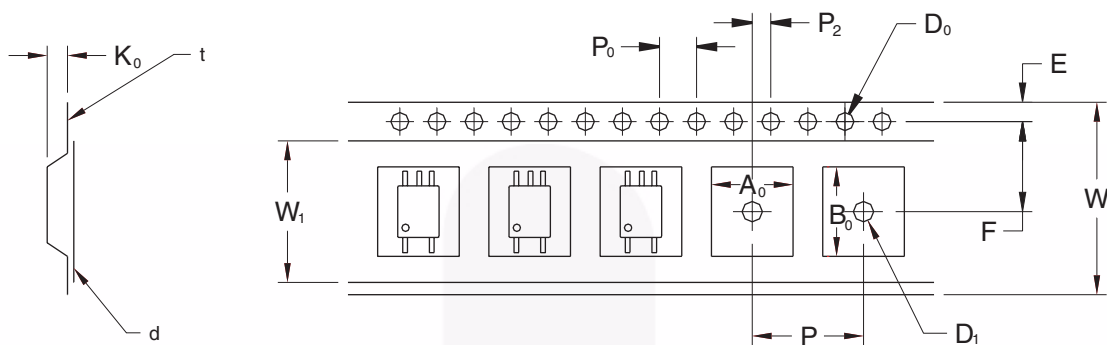
Always visit Fairchild Semiconductor's online packaging area for the most recent package drawings:

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

### Footprint Drawing for PCB Layout



## Tape and Reel Dimensions

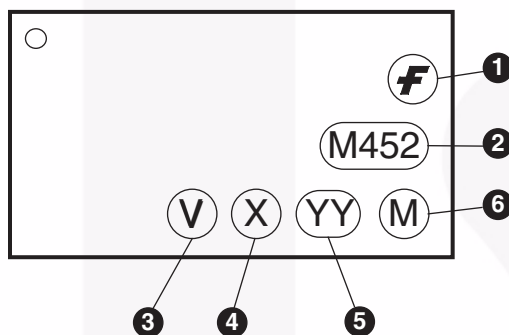


|                                 |                | 2.54 Pitch        |
|---------------------------------|----------------|-------------------|
| Description                     | Symbol         | Dimensions (mm)   |
| Tape Width                      | W              | 12.00 +0.30/-0.10 |
| Tape Thickness                  | t              | 0.30 ±0.05        |
| Sprocket Hole Pitch             | P <sub>0</sub> | 4.00 ±0.10        |
| Sprocket Hole Diameter          | D <sub>0</sub> | 1.50 +0.10/-0.0   |
| Sprocket Hole Location          | E              | 1.75 ±0.10        |
| Pocket Location                 | F              | 5.50 ±0.10        |
|                                 | P <sub>2</sub> | 2.00 ±0.10        |
| Pocket Pitch                    | P              | 8.00 ±0.10        |
| Pocket Dimension                | A <sub>0</sub> | 4.40 ±0.10        |
|                                 | B <sub>0</sub> | 7.30 ±0.10        |
|                                 | K <sub>0</sub> | 2.30 ±0.10        |
| Pocket Hole Diameter            | D <sub>1</sub> | 1.50 Min.         |
| Cover Tape Width                | W <sub>1</sub> | 9.20              |
| Cover Tape Thickness            | d              | 0.065 ±0.010      |
| Max. Component Rotation or Tilt |                | 10° Max.          |
| Devices Per Reel                |                | 2500              |
| Reel Diameter                   |                | 330mm (13")       |

### Ordering Information

| Option | Order Entry Identifier<br>(example) | Description                                 |
|--------|-------------------------------------|---------------------------------------------|
| R2     | FODM452R2                           | Tape and Reel (2500 per reel)               |
| V      | FODM452V                            | IEC60747-5-2                                |
| R2V    | FODM452R2V                          | IEC60747-5-2, Tape and Reel (2500 per reel) |

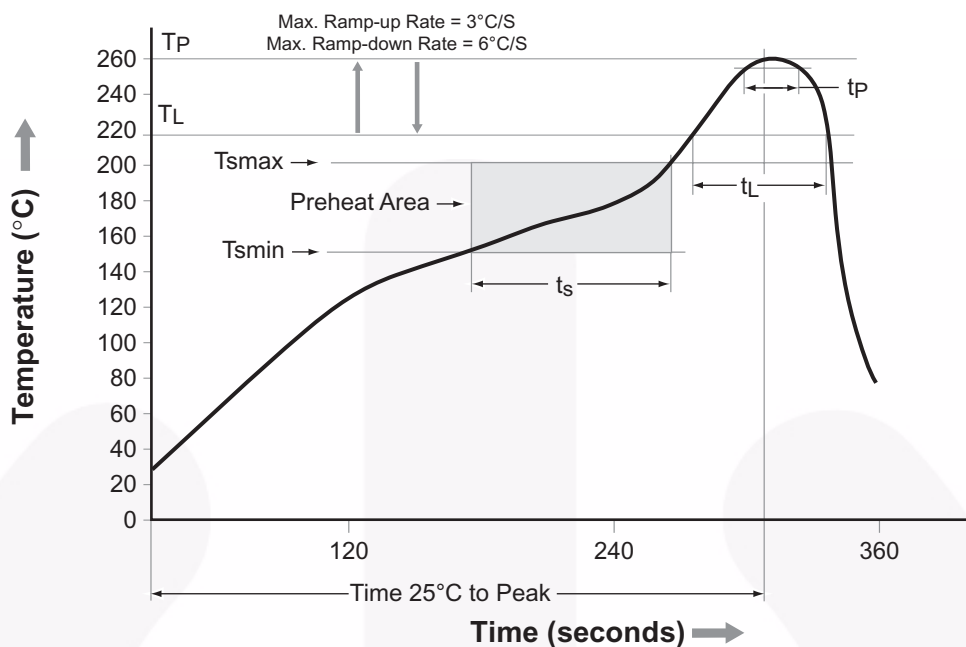
### Marking Information



#### Definitions

|   |                                                                                                 |
|---|-------------------------------------------------------------------------------------------------|
| 1 | Fairchild logo                                                                                  |
| 2 | Device number                                                                                   |
| 3 | IEC60747-5-2 mark (Note: Only appears on parts ordered with VDE option – See order entry table) |
| 4 | One digit year code, e.g., '7'                                                                  |
| 5 | Two digit work week ranging from '01' to '53'                                                   |
| 6 | Assembly package code                                                                           |

## Reflow Profile



| Profile Feature                                  | Pb-Free Assembly Profile |
|--------------------------------------------------|--------------------------|
| Temperature Min. ( $T_{smin}$ )                  | 150°C                    |
| Temperature Max. ( $T_{smax}$ )                  | 200°C                    |
| Time ( $t_s$ ) from ( $T_{smin}$ to $T_{smax}$ ) | 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.           |



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|--------------------------|------------------------------------------------|---------------------------------------|------------------|
| AccuPower™               | F-PFS™                                         | OPTOPLANAR®                           | SYSTEM GENERAL®  |
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| Build it Now™            | Green FPS™ e-Series™                           | QFET®                                 | TINYOPTO™        |
| CorePLUS™                | Gmax™                                          | QS™                                   | TinyPower™       |
| CorePOWER™               | GTO™                                           | Quiet Series™                         | TinyPWM™         |
| CROSSVOL™                | IntelliMAX™                                    | RapidConfigure™                       | TinyWire™        |
| CTL™                     | ISOPLANAR™                                     | Saving our world, 1mW/W/kW at a time™ | TranSiC™         |
| Current Transfer Logic™  | Making Small Speakers Sound Louder and Better™ | SignalWise™                           | TriFault Detect™ |
| DEUXPEED®                | MegaBuck™                                      | SmartMax™                             | TRUECURRENT®*    |
| Dual Cool™               | MICROCOUPLER™                                  | SMART START™                          | μSerDes™         |
| EcoSPARK®                | MicroFET™                                      | Solutions for Your Success™           | UHC®             |
| EfficientMax™            | MicroPak™                                      | SPM®                                  | Ultra FRFET™     |
| ESBC™                    | MicroPak2™                                     | STEALTH™                              | UniFET™          |
| F <sup>®</sup>           | MillerDrive™                                   | SuperFET®                             | VCX™             |
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| FACT Quiet Series™       | MTi®                                           | SuperSOT™-8                           | XST™             |
| FACT®                    | MTx®                                           | SupreMOS®                             | Xsens™           |
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