



## 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

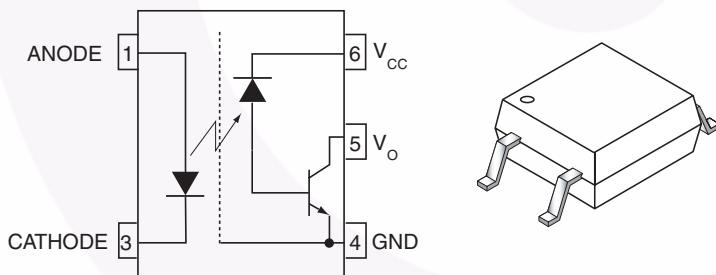
#### Description

The FODM452 and FODM453 optocouplers consist of an AlGaAs LED optically coupled to a high speed photodetector 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/pto/](http://www.fairchildsemi.com/products/pto/)
- [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, $VIORM \times 1.875 = V_{PR}$ , 100% Production Test with $t_m = 1$ sec, Partial Discharge < 5 pC	1060			
$V_{PR}$	Input to Output Test Voltage, Method a, $VIORM \times 1.5 = V_{PR}$ , 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 $T_S$ , $V_{IO} = 500V$	$10^9$			Ω

**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	°C
$T_{OPR}$	Operating Temperature	-40 to +85	°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 (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 (No derating required over specified operating temp range)	100	mW

## Electrical Characteristics ( $T_A = 0$ to $70^\circ\text{C}$ unless otherwise specified)

### Individual Component Characteristics

Symbol	Parameter	Test Conditions	Min.	Typ.*	Max.	Unit
<b>EMITTER</b>						
$V_F$	Input Forward Voltage	$I_F = 16\text{mA}, T_A = 25^\circ\text{C}$		1.60	1.7	V
		$I_F = 16\text{mA}$			1.8	
$B_{VR}$	Input Reverse Breakdown Voltage	$I_R = 10\mu\text{A}$	5.0			V
$\Delta V_F/\Delta T_A$	Temperature Coefficient of Forward Voltage	$I_F = 16\text{mA}$		-1.8		$\text{mV}/^\circ\text{C}$
<b>DETECTOR</b>						
$I_{OH}$	Logic High Output Current	$I_F = 0\text{mA}, V_O = V_{CC} = 5.5\text{V}, T_A = 25^\circ\text{C}$		.001	0.5	$\mu\text{A}$
		$I_F = 0\text{mA}, V_O = V_{CC} = 15\text{V}, T_A = 25^\circ\text{C}$		.001	1	
		$I_F = 0\text{mA}, V_O = 15\text{V}$			50	
$I_{CL}$	Logic Low Supply Current	$I_F = 16\text{mA}, V_O = \text{Open}, V_{CC} = 15\text{V}$		100	200	$\mu\text{A}$
$I_{CH}$	Logic high supply current	$I_F = 0\text{mA}, V_O = \text{Open}, V_{CC} = 15\text{V}, T_A = 25^\circ\text{C}$		0.05	1	$\mu\text{A}$
		$I_F = 0\text{mA}, V_O = \text{Open}, V_{CC} = 15\text{V}$			2	

### Transfer Characteristics

Symbol	Parameter	Test Conditions	Min.	Typ.*	Max	Unit
<b>COUPLED</b>						
$CTR$	Current Transfer Ratio <sup>(1)</sup>	$I_F = 16\text{mA}, V_{CC} = 4.5\text{V}$	$T_A = 25^\circ\text{C}$	20		50
		$V_{OL} = 0.4\text{V}$	$V_{OL} = 0.5\text{V}$	15		%
$V_{OL}$	Logic LOW Output Voltage	$I_F = 16\text{mA}, I_O = 3\text{mA}, V_{CC} = 4.5\text{V}, T_A = 25^\circ\text{C}$			0.4	V
		$I_F = 16\text{mA}, I_O = 2.4\text{mA}, V_{CC} = 4.5\text{V}$			0.5	

### Switching Characteristics ( $V_{CC} = 5\text{V}$ )

Symbol	Parameter	Test Conditions	Device	Min.	Typ.*	Max.	Unit
$T_{PHL}$	Propagation Delay Time to Logic LOW	$R_L = 1.9\text{k}\Omega, I_F = 16\text{mA}, T_A = 25^\circ\text{C}$ <sup>(2)</sup> (Fig. 9)			0.40	0.8	$\mu\text{s}$
		$R_L = 1.9\text{k}\Omega, I_F = 16\text{mA}$ <sup>(2)</sup> (Fig. 9)				1.0	$\mu\text{s}$
$T_{PLH}$	Propagation Delay Time to Logic HIGH	$R_L = 1.9\text{k}\Omega, I_F = 16\text{mA}, T_A = 25^\circ\text{C}$ <sup>(2)</sup> (Fig. 9)			0.35	0.8	$\mu\text{s}$
		$R_L = 1.9\text{k}\Omega, I_F = 16\text{mA}$ <sup>(2)</sup> (Fig. 9)				1.0	$\mu\text{s}$
$ CM_H $	Common Mode Transient Immunity at Logic HIGH	$I_F = 0\text{mA}, V_{CM} = 10\text{V}_{P-P}, R_L = 1.9\text{k}\Omega, T_A = 25^\circ\text{C}$ <sup>(3)</sup> (Fig. 10)	FODM452	5	15		$\text{KV}/\mu\text{s}$
		$I_F = 0\text{mA}, V_{CM} = 1500\text{V}_{P-P}, R_L = 1.9\text{k}\Omega, T_A = 25^\circ\text{C}$ <sup>(3)</sup> (Fig. 10)	FODM453	15	40		$\text{KV}/\mu\text{s}$
$ CM_L $	Common Mode Transient Immunity at Logic LOW	$I_F = 16\text{mA}, V_{CM} = 10\text{V}_{P-P}, R_L = 1.9\text{k}\Omega, T_A = 25^\circ\text{C}$ <sup>(3)</sup> (Fig. 10)	FODM452	5	15		$\text{KV}/\mu\text{s}$
		$I_F = 16\text{mA}, V_{CM} = 1500\text{V}_{P-P}, R_L = 1.9\text{k}\Omega, T_A = 25^\circ\text{C}$ <sup>(3)</sup> (Fig. 10)	FODM453	15	40		$\text{KV}/\mu\text{s}$
BW	Bandwidth	$R_L = 100\Omega$			3		MHz

### Isolation Characteristics

Symbol	Characteristics	Test Conditions	Min.	Typ.*	Max.	Unit
$V_{ISO}$	Withstand Insulation Test Voltage	$RH \leq 50\%, T_A = 25^\circ\text{C}, t = 1\text{ min.}$ <sup>(4)</sup>	3750			$\text{V}_{\text{RMS}}$
$C_{I-O}$	Capacitance (Input to Output)	$f = 1\text{MHz}$ <sup>(4)</sup>		0.2		pF

\*All Typicals at  $T_A = 25^\circ\text{C}$

**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  $1.9\text{k}\Omega$  load represents 1 TTL unit load of  $1.6\text{mA}$  and  $5.6\text{k}\Omega$  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.,  $V_O > 2.0\text{V}$ ). 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.,  $V_O < 0.8\text{V}$ ).
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

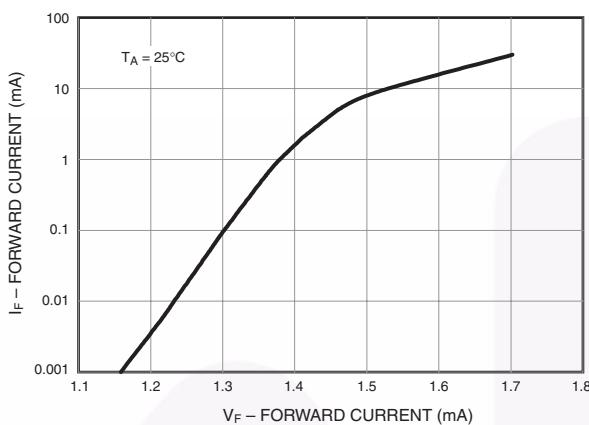


Fig. 2 Normalized Current Transfer Ratio vs. Input Current

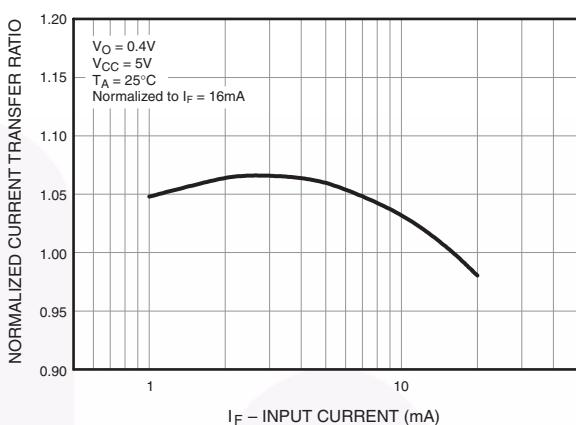


Fig. 3 Normalized Current Transfer Ratio vs. Ambient Temperature

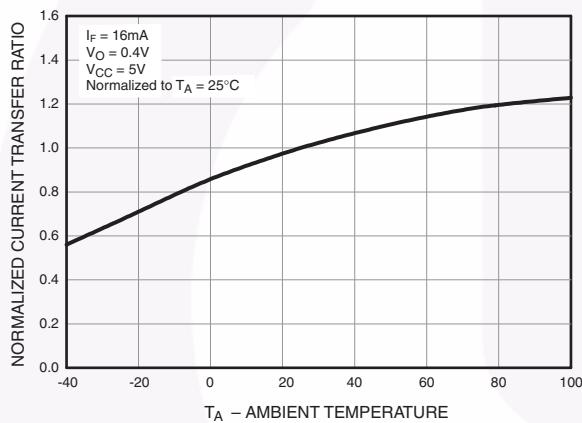


Fig. 4 Logic High Output Current vs. Ambient Temperature

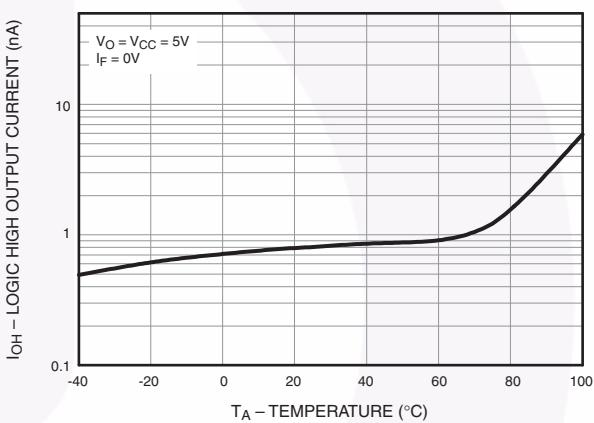


Fig. 5 DC and Pulsed Transfer Characteristics

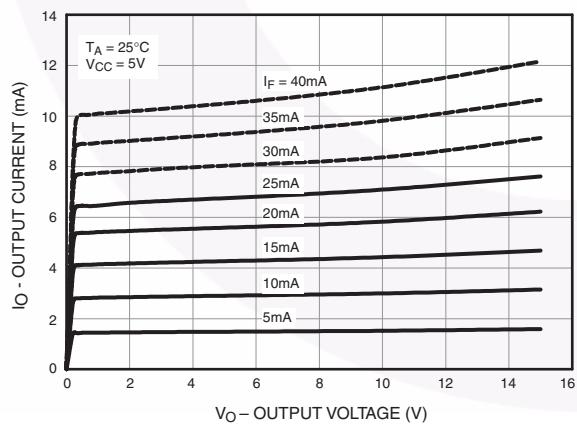
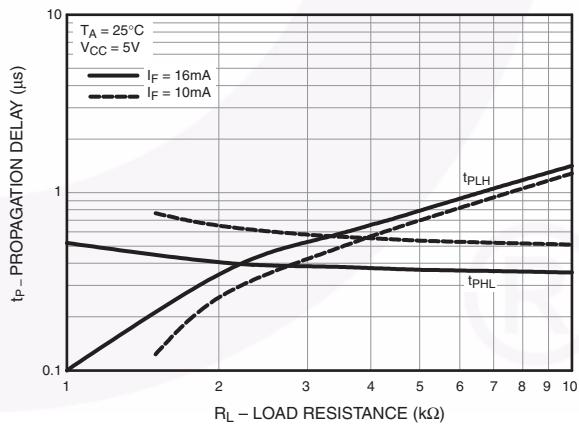


Fig. 6 Propagation Delay vs. Load Resistance



## Typical Performance Curves (Continued)

Fig. 7 Propagation Delay vs. Ambient Temperature

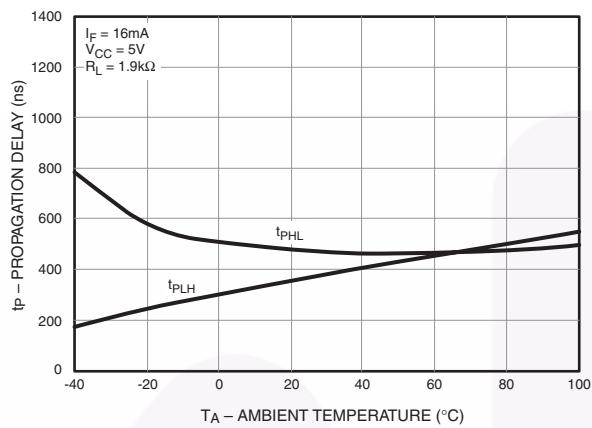
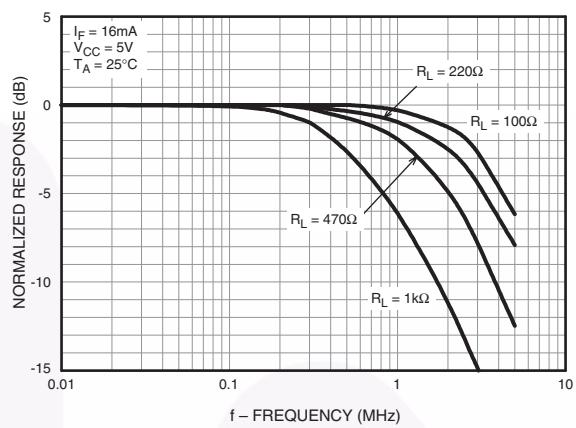


Fig. 8 Frequency Response



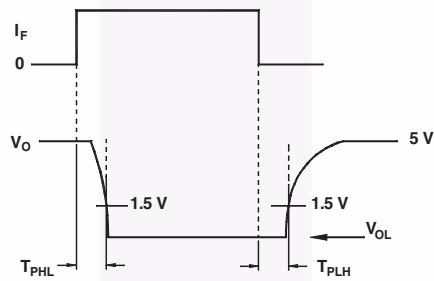
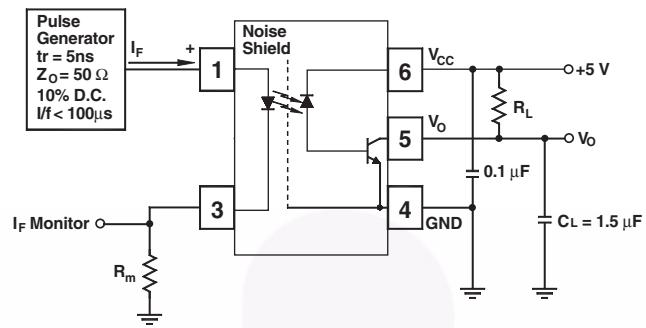


Fig. 9 Switching Time Test Circuit

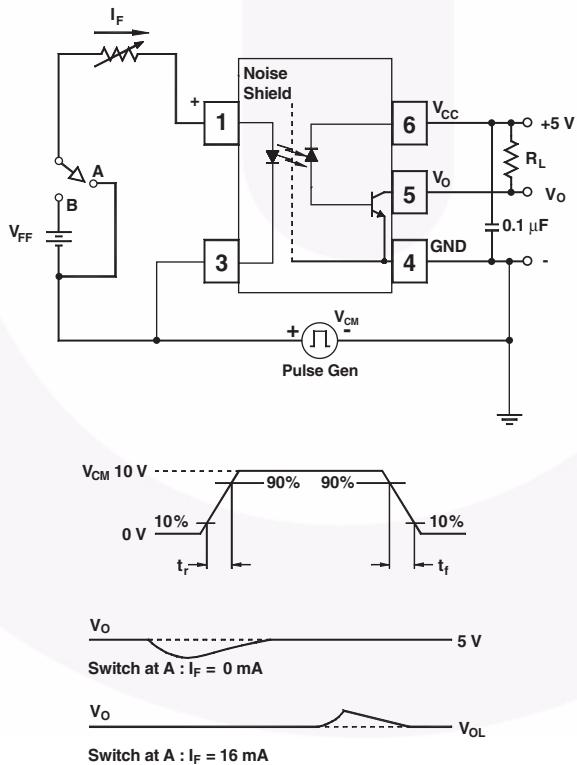
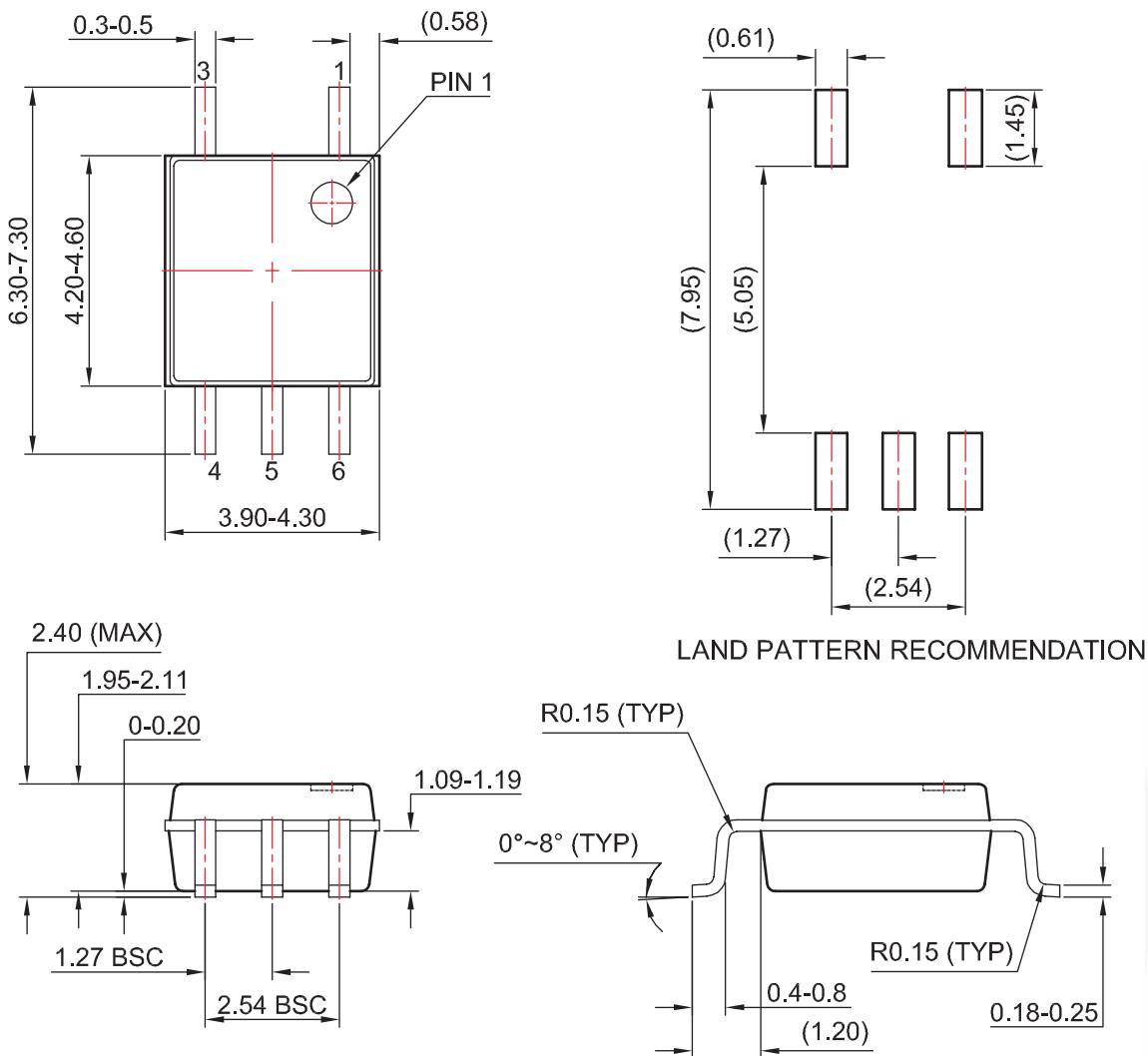


Fig. 10 Common Mode Immunity Test Circuit

## Package Dimensions



### Notes:

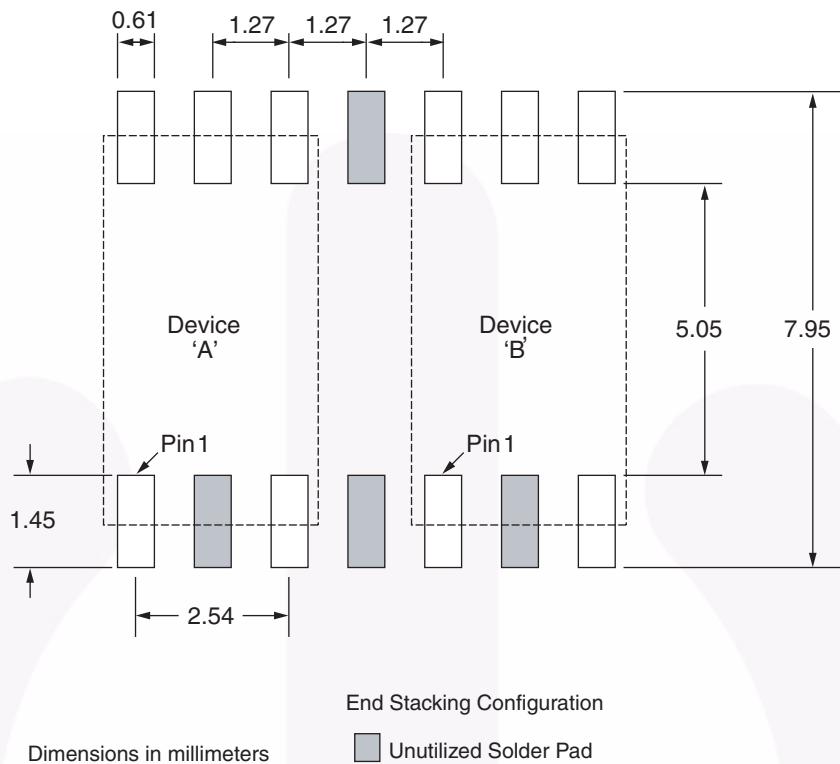
1. No standard applies to this package.
2. All dimensions are in millimeters.
3. Dimensions are exclusive of burrs, mold flash, and tie bar extrusion.
4. Drawings filename and revision: MKT-MFP05A.

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.

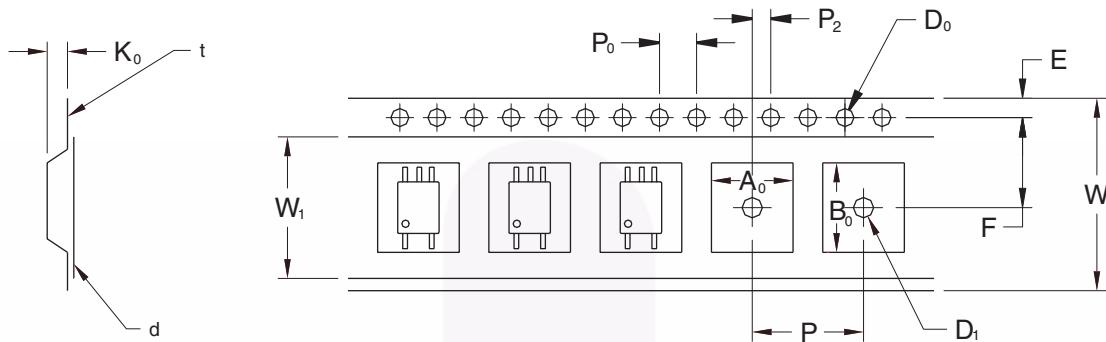
Always visit Fairchild Semiconductor's online packaging area for the most recent package drawings:

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## Footprint Drawing for PCB Layout



## Tape and Reel Dimensions



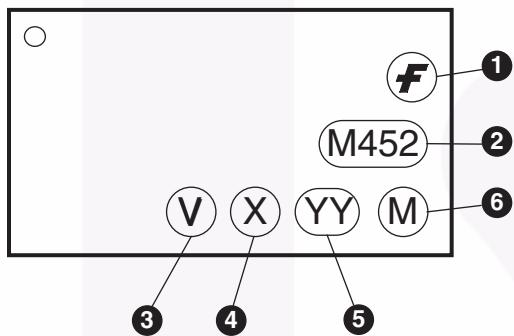
### 2.54 Pitch

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 (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)

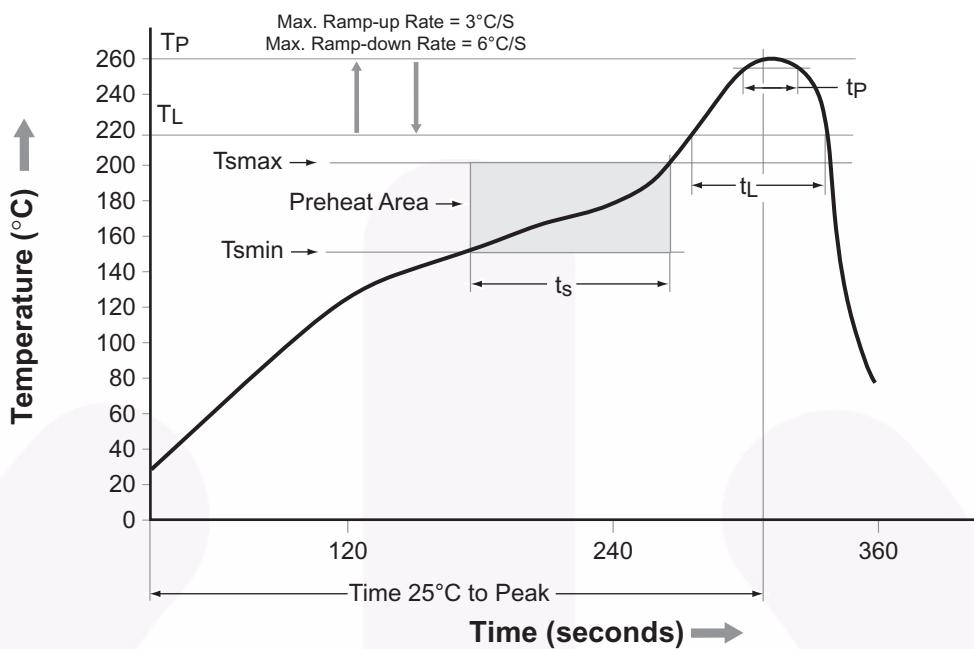
## Marking Information



### 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. (Tsmin)	150°C
Temperature Max. (Tsmax)	200°C
Time (t <sub>S</sub> ) from (Tsmin to Tsmax)	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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#### 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.
Obsolete	Not In Production	Datasheet contains specifications on a product that is discontinued by Fairchild Semiconductor. The datasheet is for reference information only.

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