November 2015

# FODM121 Series, FODM124, FODM2701, FODM2705
# 4-Pin Full Pitch Mini-Flat Package Phototransistor Optocouplers

## Features

- More than 5 mm Creepage/Clearance
- Compact 4-Pin Surface Mount Package (2.4 mm Maximum Standoff Height)
- Current Transfer Ratio in Selected Groups:

  DC Input:

  FODM121: 50–600%

  FODM121A: 100–300%

  FODM121B: 50–150%

  FODM121C: 100–200%

  FODM124: 100% MIN

  FODM2701: 50–300%

  AC Input:

  FODM2705: 50–300%
- Safety and Regulatory Approvals:
  - UL1577, 3,750 $VAC_{RMS}$ for 1 Minute
  - DIN-EN/IEC60747-5-5, 565 V Peak Working Insulation Voltage

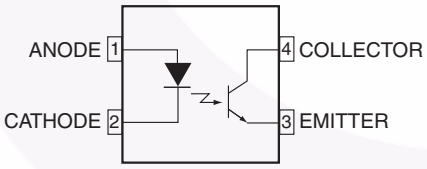
## Applications

- Digital Logic Inputs
- Microprocessor Inputs
- Power Supply Monitor
- Twisted Pair Line Receiver
- Telephone Line Receiver

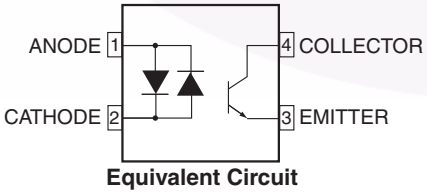
## Description

The FODM121 series, FODM124, and FODM2701 consists of a gallium arsenide infrared emitting diode driving a phototransistor in a compact 4-pin mini-flat package. The lead pitch is 2.54 mm. The FODM2705 consists of two gallium arsenide infrared emitting diodes connected in inverse parallel for AC operation.

## Functional Block Diagram




**Equivalent Circuit**
**FODM121, FODM124, FODM2701**




**Equivalent Circuit**
**FODM2705**

**Figure 1. Schematic**

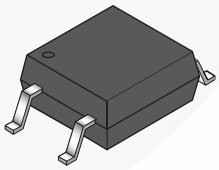


**Figure 2. Package Outlines**



©2006 Fairchild Semiconductor Corporation

## Safety and Insulation Ratings

As per DIN EN/IEC 60747-5-5, this optocoupler is suitable for “safe electrical insulation” only within the safety limit data. Compliance with the safety ratings shall be ensured by means of protective circuits.

| Parameter | | Characteristics |
|---|---|---|
| Installation Classifications per DIN VDE 0110/1.89 Table 1, For Rated Mains Voltage | < 150 $V_{RMS}$ | I–IV |
| | < 300 $V_{RMS}$ | I–III |
| Climatic Classification | | 40/110/21 |
| Pollution Degree (DIN VDE 0110/1.89) | | 2 |
| Comparative Tracking Index | | 175 |

| Symbol | Parameter | Value | Unit |
|---|---|---|---|
| $V_{PR}$ | Input-to-Output Test Voltage, Method A, $V_{IORM}$ x 1.6 = $V_{PR}$, Type and Sample Test with $t_m$ = 10 s, Partial Discharge < 5 pC | 904 | $V_{peak}$ |
| | Input-to-Output Test Voltage, Method B, $V_{IORM}$ x 1.875 = $V_{PR}$, 100% Production Test with $t_m$ = 1 s, Partial Discharge < 5 pC | 1060 | $V_{peak}$ |
| $V_{IORM}$ | Maximum Working Insulation Voltage | 565 | $V_{peak}$ |
| $V_{IOTM}$ | Highest Allowable Over-Voltage | 6000 | $V_{peak}$ |
| | External Creepage | ≥ 5 | mm |
| | External Clearance | ≥ 5 | mm |
| DTI | Distance Through Insulation (Insulation Thickness) | ≥ 0.4 | mm |
| $T_S$ | Case Temperature[1] | 150 | °C |
| $I_{S,INPUT}$ | Input Current[1] | 200 | mA |
| $P_{S,OUTPUT}$ | Output Power[1] | 300 | mW |
| $R_{IO}$ | Insulation Resistance at $T_S$, $V_{IO}$ = 500 V[1] | > $10^9$ | Ω |

**Note:**

1. Safety limit values – maximum values allowed in the event of a failure.

## Absolute Maximum Ratings

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. $T_A$ = 25°C Unless otherwise specified.

| Symbol | Parameter | | Value | Unit |
|---|---|---|---|---|
| **TOTAL PACKAGE** | | | | |
| $T_{STG}$ | Storage Temperature | | -40 to +125 | °C |
| $T_{OPR}$ | Operating Temperature | | -40 to +110 | °C |
| $T_J$ | Junction Temperature | | -40 to +125 | °C |
| $T_{SOL}$ | Lead Solder Temperature | | 260 for 10 sec | °C |
| **EMITTER** | | | | |
| $I_{F\ (avg)}$ | Continuous Forward Current | | 50 | mA |
| $I_{F\ (pk)}$ | Peak Forward Current (1 µs pulse, 300 pps.) | | 1 | A |
| $V_R$ | Reverse Voltage | | 6 | V |
| $P_D$ | Power Dissipation | | 70 | mW |
| | Derate linearly (Above 75°C) | | 1.41 | mW/°C |
| **DETECTOR** | | | | |
| $I_C$ | Continuous Collector Current | | 80 | mA |
| $V_{CEO}$ | Collector-Emitter Voltage | FODM121 Series, FODM124 | 80 | V |
| | | FODM2701, FODM2705 | 40 | |
| $V_{ECO}$ | Emitter-Collector Voltage | | 6 | V |
| $P_D$ | Power Dissipation | | 150 | mW |
| | Derate linearly (Above 80°C) | | 3.27 | mW/°C |

©2006 Fairchild Semiconductor Corporation

## Electrical Characteristics

$T_A$ = 25°C unless otherwise specified.

| Symbol | Parameter | Device | Test Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|---|
| **INDIVIDUAL COMPONENT CHARACTERISTICS** | | | | | | | |
| **Emitter** | | | | | | | |
| $V_F$ | Forward Voltage | FODM121 Series, FODM124 | $I_F$ = 10 mA | 1.0 | | 1.3 | V |
| | | FODM2701 | $I_F$ = 5 mA | | | 1.4 | |
| | | FODM2705 | $I_F$ = ±5 mA | | | | |
| $I_R$ | Reverse Current | FODM121 Series, FODM124, FODM2701 | $V_R$ = 5 V | | | 5 | µA |
| **Detector** | | | | | | | |
| $BV_{CEO}$ | Collector-Emitter Breakdown Voltage | FODM121 Series, FODM124 | $I_C$ = 1 mA, $I_F$ = 0 | 80 | | | V |
| | | FODM2701, FODM2705 | | 40 | | | |
| $BV_{ECO}$ | Emitter-Collector Breakdown Voltage | All | $I_E$ = 100 µA, $I_F$ = 0 | 7 | | | V |
| $I_{CEO}$ | Collector Dark Current | All | $V_{CE}$ = 40 V, $I_F$ = 0 | | | 100 | nA |
| $C_{CE}$ | Capacitance | All | $V_{CE}$ = 0 V, f = 1 MHz | | 10 | | pF |
| **TRANSFER CHARACTERISTICS** | | | | | | | |
| CTR | DC Current Transfer Ratio | FODM2701 | $I_F$ = 5 mA, $V_{CE}$ = 5 V | 50 | | 300 | % |
| | | FODM2705 | $I_F$ = ±5 mA, $V_{CE}$ = 5 V | 50 | | 300 | |
| | | FODM121 | $I_F$ = 5 mA, $V_{CE}$ = 5 V | 50 | | 600 | |
| | | FODM121A | | 100 | | 300 | |
| | | FODM121B | | 50 | | 150 | |
| | | FODM121C | | 100 | | 200 | |
| | | FODM124 | $I_F$ = 1 mA, $V_{CE}$ = 0.5 V | 100 | | 1200 | |
| | | | $I_F$ = 0.5 mA, $V_{CE}$ = 1.5 V | 50 | | | |
| | CTR Symmetry | FODM2705 | $I_F$ = ±5 mA, $V_{CE}$ = 5 V | 0.3 | | 3.0 | |
| $V_{CE(SAT)}$ | Saturation Voltage | FODM121 Series | $I_F$ = 8 mA, $I_C$ = 2.4 mA | | | 0.4 | V |
| | | FODM124 | $I_F$ = 1 mA, $I_C$ = 0.5 mA | | | 0.4 | |
| | | FODM2701 | $I_F$ = 10 mA, $I_C$ = 2 mA | | | 0.3 | |
| | | FODM2705 | $I_F$ = ±10 mA, $I_C$ = 2 mA | | | 0.3 | |
| $t_r$ | Rise Time (Non-Saturated) | All | $I_C$ = 2 mA, $V_{CE}$ = 5 V, $R_L$ = 100 Ω | | 3 | | µs |
| $t_f$ | Fall Time (Non-Saturated) | All | $I_C$ = 2 mA, $V_{CE}$ = 5 V, $R_L$ = 100 Ω | | 3 | | µs |
| **ISOLATION CHARACTERISTICS** | | | | | | | |
| $V_{ISO}$ | Steady State Isolation Voltage(2) | All | 1 minute | 3750 | | | $VAC_{RMS}$ |

**Note:**

2. Steady state isolation voltage, $V_{ISO}$, is an internal device dielectric breakdown rating. For this test, pins 1 and 2 are common, and pins 3 and 4 are common.

©2006 Fairchild Semiconductor Corporation

## Typical Performance Curves

$T_A$ = 25°C unless otherwise specified.

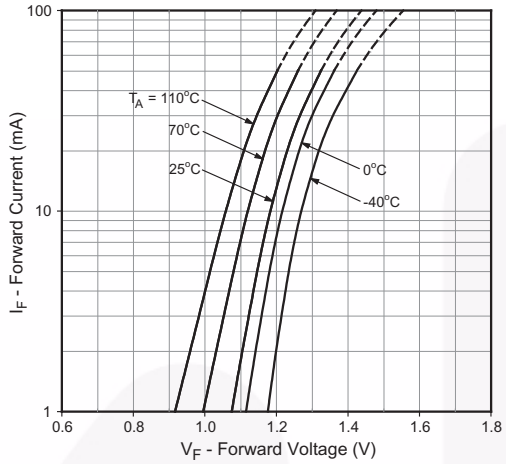



**Fig. 3 Forward Current vs. Forward Voltage**

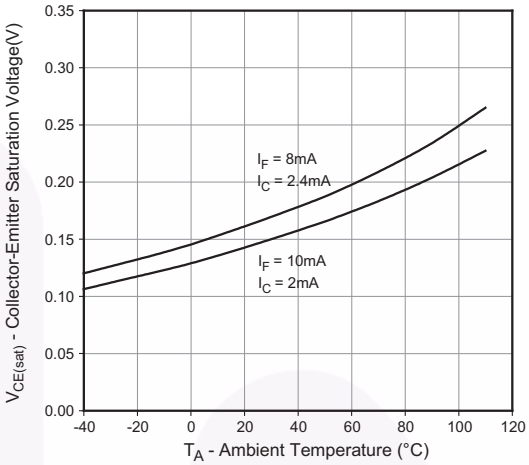



**Fig. 4 Collector-Emitter Saturation Voltage vs. Ambient Temperature (FODM121/2701/2705)**

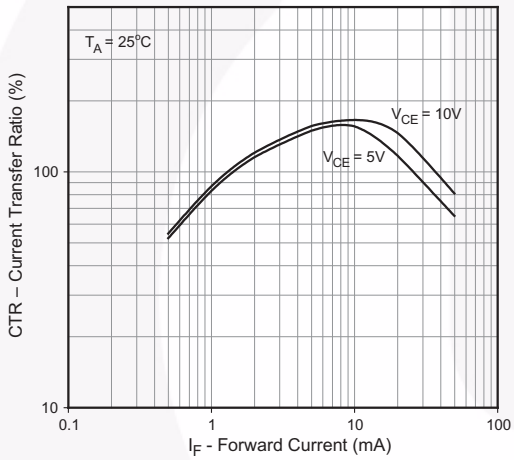



**Fig. 5 Current Transfer Ratio vs. Forward Current (FODM121/2701/2705)**

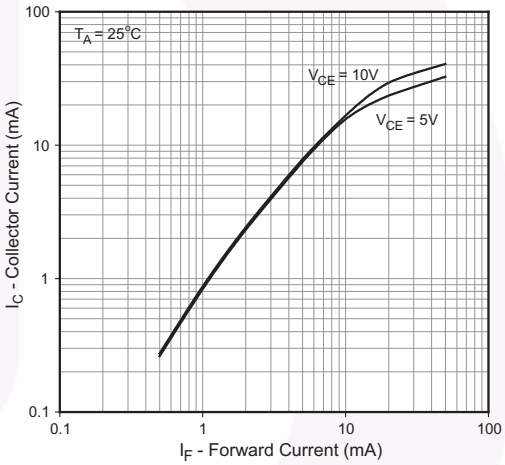



**Fig. 6 Collector Current vs. Forward Current (FODM121/2701/2705)**

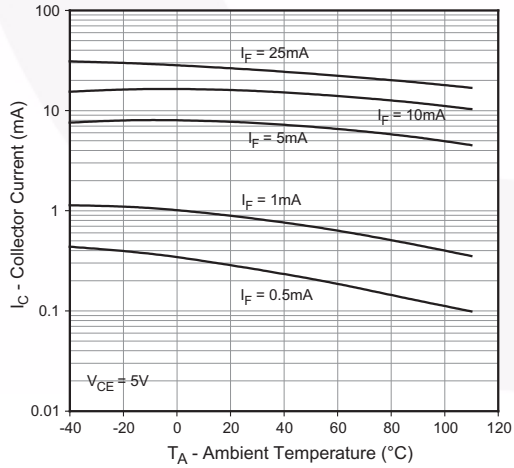



**Fig. 7 Collector Current vs. Ambient Temperature (FODM121/2701/2705)**

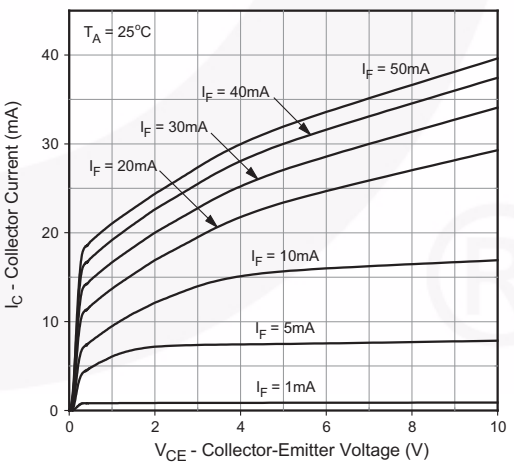



**Fig. 8 Collector Current vs. Collector-Emitter Voltage (FODM121/2701/2705)**

## Typical Performance Curves (Continued)

$T_A$ = 25°C unless otherwise specified.

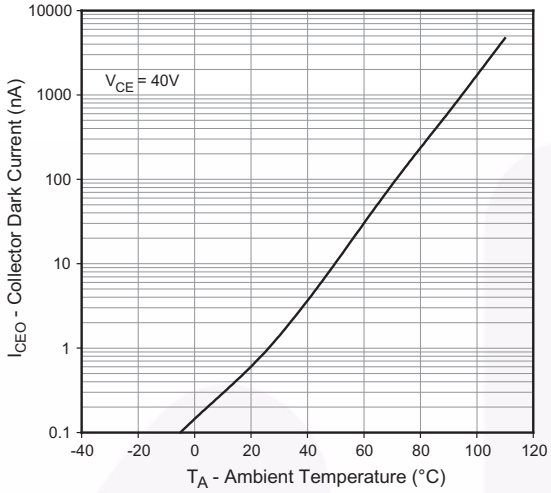



**Fig 9. Collector Dark Current vs. Ambient Temperature (FODM121/2701/2705)**

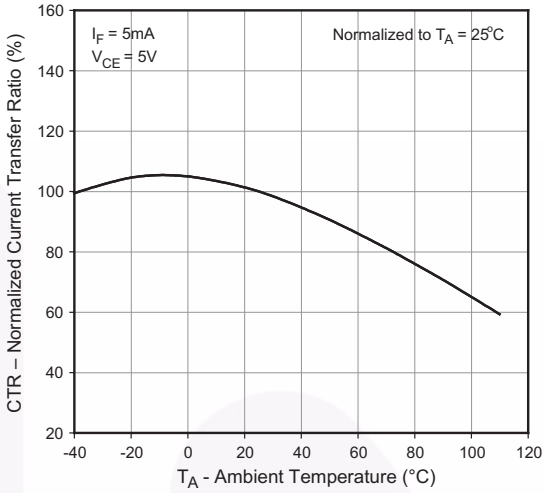



**Fig. 10 Normalized Current Transfer Ratio vs. Ambient Temperature (FODM121/2701/2705)**

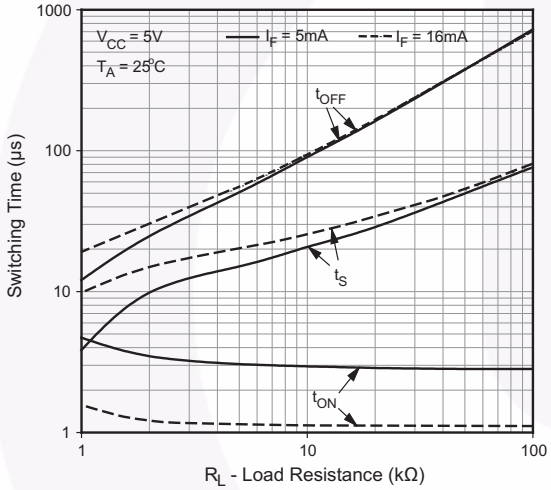



**Fig. 11 Switching Time vs. Load Resistance (FODM121/2701/2705)**

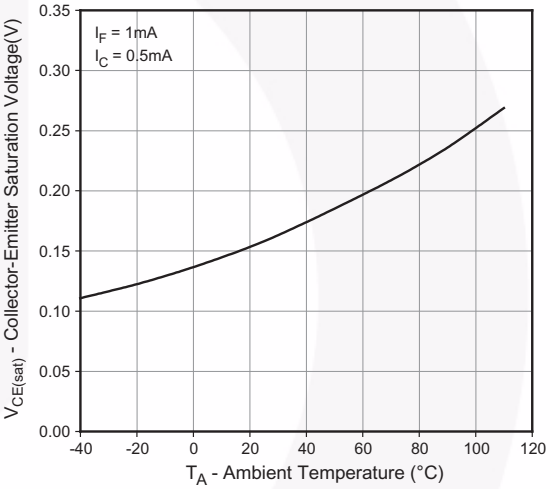



**Fig. 12 Collector-Emitter Saturation Voltage vs. Ambient Temperature (FODM124)**

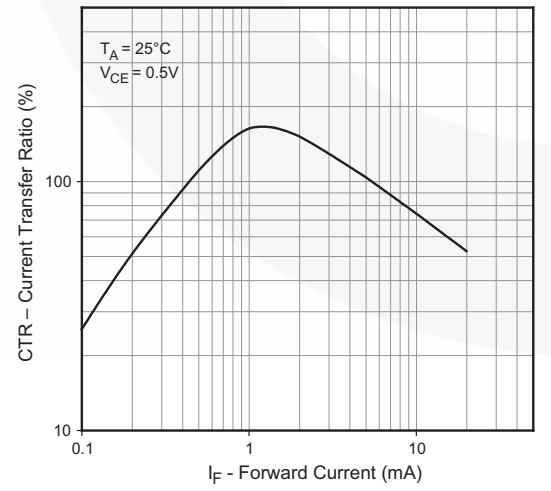



**Fig. 13 Current Transfer Ratio vs. Forward Current (FODM124)**

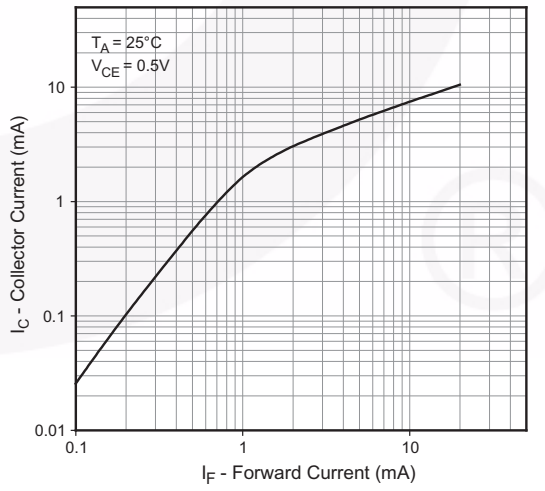



**Fig 14. Collector Current vs. Forward Current (FODM124)**

## Typical Performance Curves (Continued)

$T_A$ = 25°C unless otherwise specified.

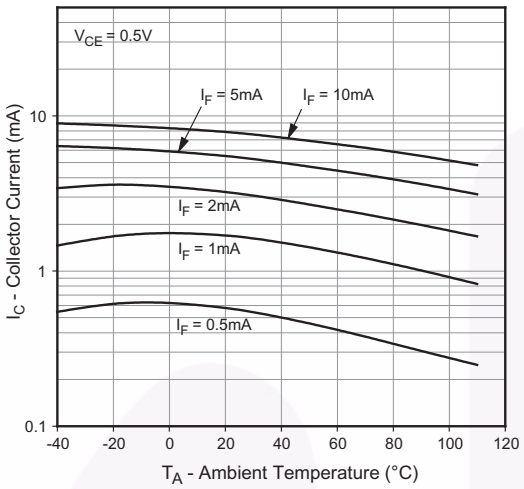



**Fig 15. Collector Current vs. Ambient Temperature (FODM124)**

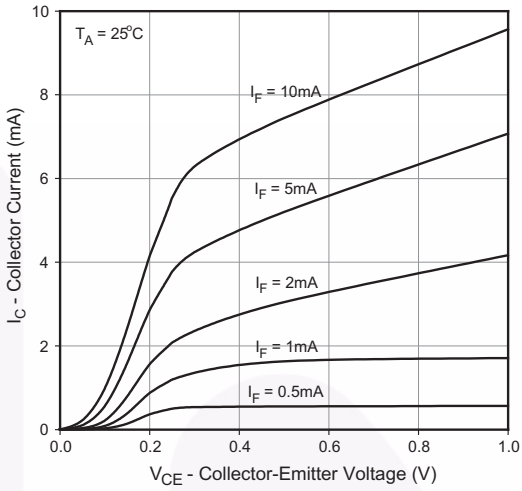



**Fig. 16 Collector Current vs. Collector-Emitter Voltage (FODM124)**

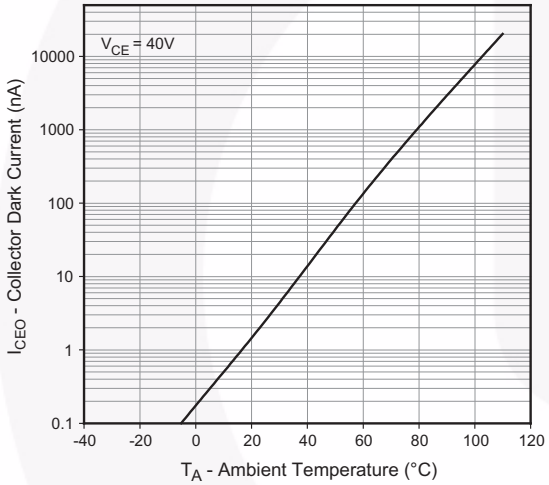



**Fig. 17 Collector Dark Current vs. Ambient Temperature (FODM124)**

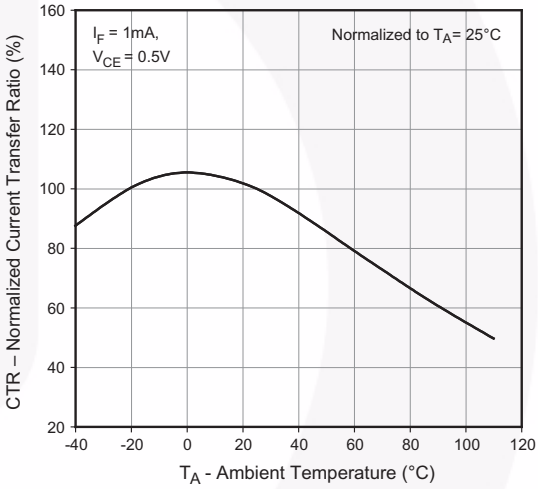



**Fig. 18 Normalized Current Transfer Ratio vs. Ambient Temperature (FODM124)**

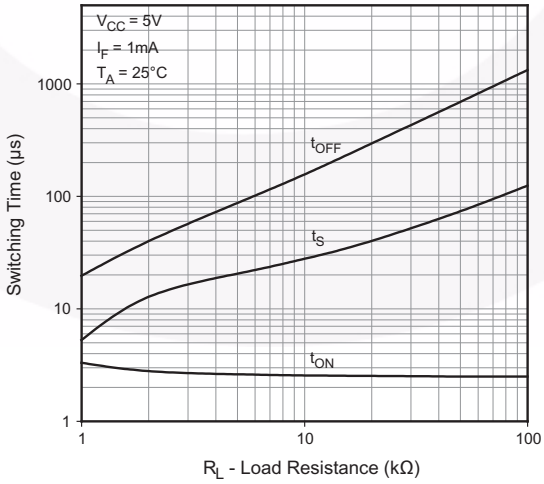
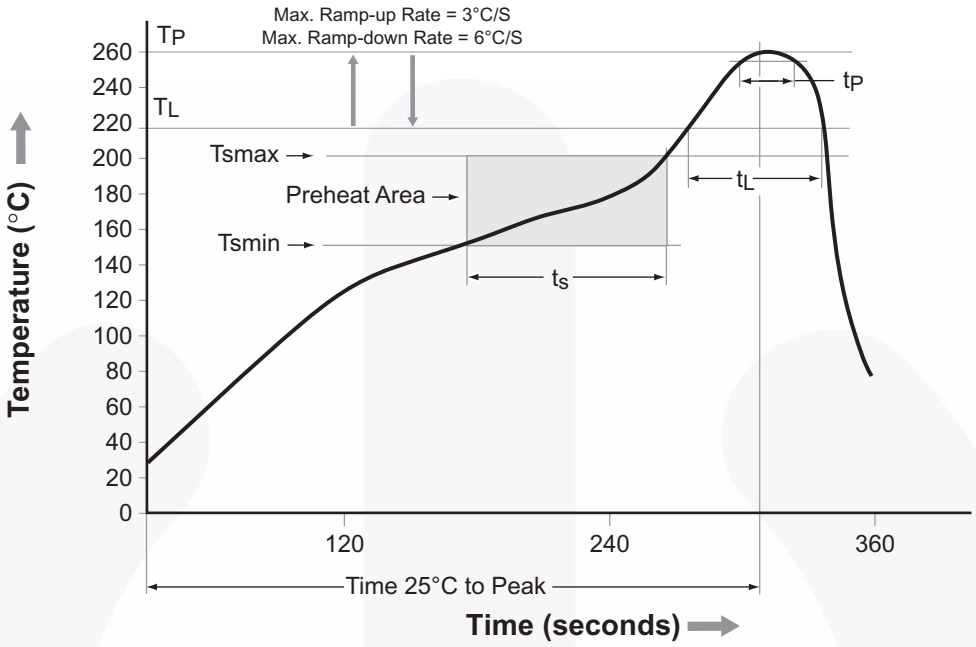



**Fig. 19 Switching Time vs. Load Resistance (FODM124)**

## Reflow Profile




| Profile Freature | Pb-Free Assembly Profile |
|---|---|
| Temperature Min. (Tsmin) | 150°C |
| Temperature Max. (Tsmax) | 200°C |
| Time ($t_S$) from (Tsmin to Tsmax) | 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. |

## Ordering Information

| Part Number | Package | Packing Method |
|---|---|---|
| FODM121 | Full Pitch Mini-Flat 4-Pin | Tube (100 units) |
| FODM121R2 | Full Pitch Mini-Flat 4-Pin | Tape and Reel (2500 Units) |
| FODM121V | Full Pitch Mini-Flat 4-Pin, DIN EN/IEC60747-5-5 Option | Tube (100 Units) |
| FODM121R2V | Full Pitch Mini-Flat 4-Pin, DIN EN/IEC60747-5-5 Option | Tape and Reel (2500 Units) |

**Note:**

The product orderable part number system listed in this table also applies to the FODM121A, FODM121B, FODM121C, FODM124, FODM2701, and FODM2705 products.

## Marking Information

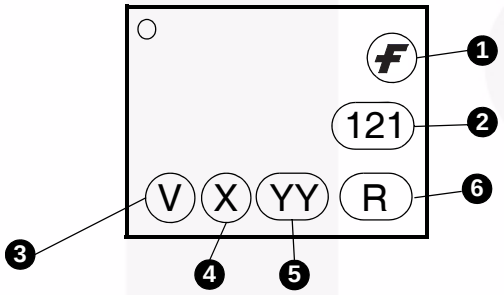
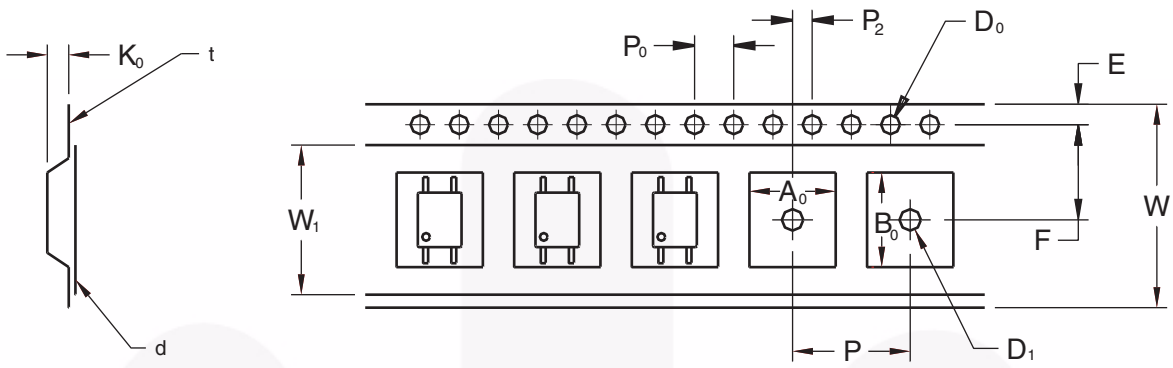



**Figure 20. Top Mark**

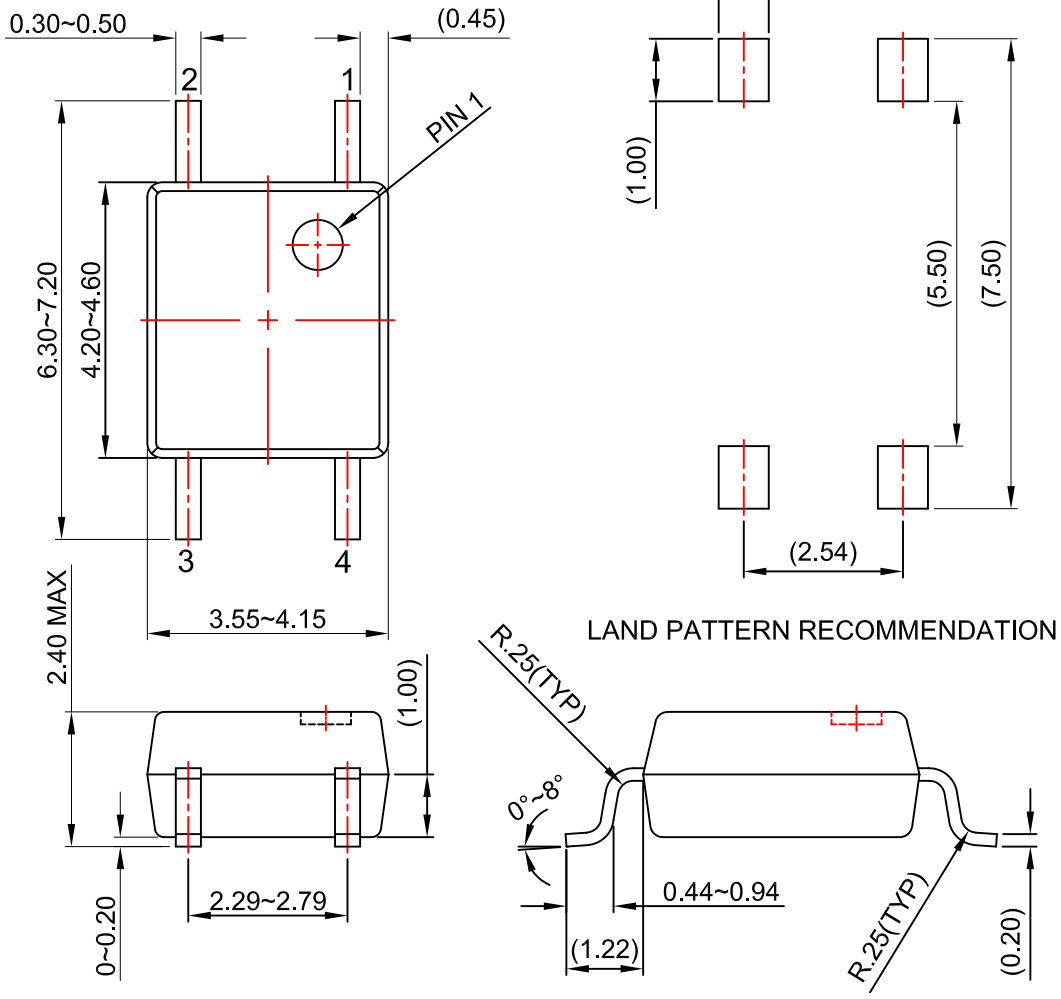
**Table 1. Top Mark Definitions**

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

## Carrier Tape Specifications




| Description | Symbol | 2.54 Pitch Dimensions |
|---|---|---|
| Tape Width | W | 12.00±0.4 |
| Tape Thickness | t | 0.35±0.02 |
| Sprocket Hole Pitch | $P_0$ | 4.00±0.20 |
| Sprocket Hole Dia. | $D_0$ | 1.55±0.20 |
| Sprocket Hole Location | E | 1.75±0.20 |
| Pocket Location | F | 5.50±0.20 |
| | $P_2$ | 2.00±0.20 |
| Pocket Pitch | P | 8.00±0.20 |
| Pocket Dimension | $A_0$ | 4.75±0.20 |
| | $B_0$ | 7.30±0.20 |
| | $K_0$ | 2.30±0.20 |
| Pocket Hole Dia. | $D_1$ | 1.55±0.20 |
| Cover Tape Width | $W_1$ | 9.20 |
| Cover Tape Thickness | d | 0.065±0.02 |
| Max. Component Rotation or Tilt | | 20° max |
| Devices Per Reel | | 2500 |
| Reel Diameter | | 330 mm (13") |




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) DRAWING FILENAME AND REVISION: MKT-MFP04Crev3.

FAIRCHILD

## TRADEMARKS

The following includes registered and unregistered trademarks and service marks, owned by Fairchild Semiconductor and/or its global subsidiaries, and is not intended to be an exhaustive list of all such trademarks.

AccuPower™
AttitudeEngine™
Awinda®
AX-CAP®*
BitSiC™
Build it Now™
CorePLUS™
CorePOWER™
*CROSSVOLT*™
CTL™
Current Transfer Logic™
DEUXPEED®
Dual Cool™
EcoSPARK®
EfficientMax™
ESBC™
Fairchild®
Fairchild Semiconductor®
FACT Quiet Series™
FACT®
FastvCore™
FETBench™
FPS™
F-PFS™
FRFET®
Global Power Resource SM
GreenBridge™
Green FPS™
Green FPS™ e-Series™
G*max*™
GTO™
IntelliMAX™
ISOPLANAR™
Making Small Speakers Sound Louder and Better™
MegaBuck™
MICROCOUPLER™
MicroFET™
MicroPak™
MicroPak2™
MillerDrive™
MotionMax™
MotionGrid®
MTi®
MTx®
MVN®
mWSaver®
OptoHiT™
OPTOLOGIC®
OPTOPLANAR®
®
Power Supply WebDesigner™
PowerTrench®
PowerXS™
Programmable Active Droop™
QFET®
QS™
Quiet Series™
RapidConfigure™
™
Saving our world, 1mW/W/kW at a time™
SignalWise™
SmartMax™
SMART START™
Solutions for Your Success™
SPM®
STEALTH™
SuperFET®
SuperSOT™-3
SuperSOT™-6
SuperSOT™-8
SupreMOS®
SyncFET™
Sync-Lock™
SYSTEM GENERAL®*
TinyBoost®
TinyBuck®
TinyCalc™
TinyLogic®
TINYOPTO™
TinyPower™
TinyPWM™
TinyWire™
TranSiC™
TriFault Detect™
TRUECURRENT®*
µSerDes™
SerDes™
UHC®
Ultra FRFET™
UniFET™
VCX™
VisualMax™
VoltagePlus™
XS™
Xsens™
仙童®

* Trademarks of System General Corporation, used under license by Fairchild Semiconductor.

## DISCLAIMER

FAIRCHILD SEMICONDUCTOR RESERVES THE RIGHT TO MAKE CHANGES WITHOUT FURTHER NOTICE TO ANY PRODUCTS HEREIN TO IMPROVE RELIABILITY, FUNCTION, OR DESIGN. TO OBTAIN THE LATEST, MOST UP-TO-DATE DATASHEET AND PRODUCT INFORMATION, VISIT OUR WEBSITE AT HTTP://WWW.FAIRCHILDSEMI.COM. FAIRCHILD DOES NOT ASSUME ANY LIABILITY ARISING OUT OF THE APPLICATION OR USE OF ANY PRODUCT OR CIRCUIT DESCRIBED HEREIN; NEITHER DOES IT CONVEY ANY LICENSE UNDER ITS PATENT RIGHTS, NOR THE RIGHTS OF OTHERS. THESE SPECIFICATIONS DO NOT EXPAND THE TERMS OF FAIRCHILD'S WORLDWIDE TERMS AND CONDITIONS, SPECIFICALLY THE WARRANTY THEREIN, WHICH COVERS THESE PRODUCTS.

## AUTHORIZED USE

Unless otherwise specified in this data sheet, this product is a standard commercial product and is not intended for use in applications that require extraordinary levels of quality and reliability. This product may not be used in the following applications, unless specifically approved in writing by a Fairchild officer: (1) automotive or other transportation, (2) military/aerospace, (3) any safety critical application – including life critical medical equipment – where the failure of the Fairchild product reasonably would be expected to result in personal injury, death or property damage. Customer's use of this product is subject to agreement of this Authorized Use policy. In the event of an unauthorized use of Fairchild's product, Fairchild accepts no liability in the event of product failure. In other respects, this product shall be subject to Fairchild's Worldwide Terms and Conditions of Sale, unless a separate agreement has been signed by both Parties.

## ANTI-COUNTERFEITING POLICY

Fairchild Semiconductor Corporation's Anti-Counterfeiting Policy. Fairchild's Anti-Counterfeiting Policy is also stated on our external website, www.fairchildsemi.com, under Terms of Use

Counterfeiting of semiconductor parts is a growing problem in the industry. All manufacturers of semiconductor products are experiencing counterfeiting of their parts. Customers who inadvertently purchase counterfeit parts experience many problems such as loss of brand reputation, substandard performance, failed applications, and increased cost of production and manufacturing delays. Fairchild is taking strong measures to protect ourselves and our customers from the proliferation of counterfeit parts. Fairchild strongly encourages customers to purchase Fairchild parts either directly from Fairchild or from Authorized Fairchild Distributors who are listed by country on our web page cited above. Products customers buy either from Fairchild directly or from Authorized Fairchild Distributors are genuine parts, have full traceability, meet Fairchild's quality standards for handling and storage and provide access to Fairchild's full range of up-to-date technical and product information. Fairchild and our Authorized Distributors will stand behind all warranties and will appropriately address any warranty issues that may arise. Fairchild will not provide any warranty coverage or other assistance for parts bought from Unauthorized Sources. Fairchild is committed to combat this global problem and encourage our customers to do their part in stopping this practice by buying direct or from authorized distributors.

## 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. |

Rev. I77