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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<sub>RMS</sub> 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

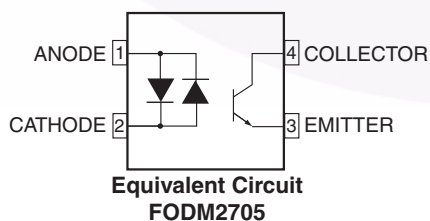
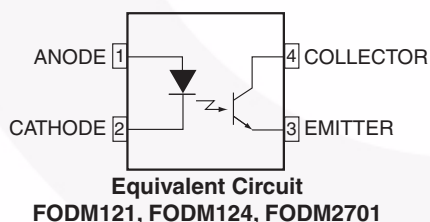


Figure 1. Schematic

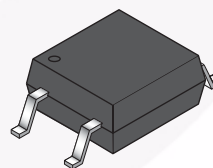


Figure 2. Package Outlines

## 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 <sub>RMS</sub> | I–IV            |
|                                                                                     | < 300 V <sub>RMS</sub> | I–III           |
| Climatic Classification                                                             |                        | 40/110/21       |
| Pollution Degree (DIN VDE 0110/1.89)                                                |                        | 2               |
| Comparative Tracking Index                                                          |                        | 175             |

| Symbol                | Parameter                                                                                                                                                      | Value             | Unit              |
|-----------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|-------------------|
| V <sub>PR</sub>       | Input-to-Output Test Voltage, Method A, V <sub>IORM</sub> × 1.6 = V <sub>PR</sub> , Type and Sample Test with t <sub>m</sub> = 10 s, Partial Discharge < 5 pC  | 904               | V <sub>peak</sub> |
|                       | Input-to-Output Test Voltage, Method B, V <sub>IORM</sub> × 1.875 = V <sub>PR</sub> , 100% Production Test with t <sub>m</sub> = 1 s, Partial Discharge < 5 pC | 1060              | V <sub>peak</sub> |
| V <sub>IORM</sub>     | Maximum Working Insulation Voltage                                                                                                                             | 565               | V <sub>peak</sub> |
| V <sub>IOTM</sub>     | Highest Allowable Over-Voltage                                                                                                                                 | 6000              | V <sub>peak</sub> |
|                       | External Creepage                                                                                                                                              | ≥ 5               | mm                |
|                       | External Clearance                                                                                                                                             | ≥ 5               | mm                |
| DTI                   | Distance Through Insulation (Insulation Thickness)                                                                                                             | ≥ 0.4             | mm                |
| T <sub>S</sub>        | Case Temperature <sup>(1)</sup>                                                                                                                                | 150               | °C                |
| I <sub>S,INPUT</sub>  | Input Current <sup>(1)</sup>                                                                                                                                   | 200               | mA                |
| P <sub>S,OUTPUT</sub> | Output Power <sup>(1)</sup>                                                                                                                                    | 300               | mW                |
| R <sub>IO</sub>       | Insulation Resistance at T <sub>S</sub> , V <sub>IO</sub> = 500 V <sup>(1)</sup>                                                                               | > 10 <sup>9</sup> | 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.  $T_A = 25^\circ\text{C}$  Unless otherwise specified.

| Symbol               | Parameter                                   |                         | Value          | Unit  |
|----------------------|---------------------------------------------|-------------------------|----------------|-------|
| TOTAL PACKAGE        |                                             |                         |                |       |
| T <sub>STG</sub>     | Storage Temperature                         |                         | -40 to +125    | °C    |
| T <sub>OPR</sub>     | Operating Temperature                       |                         | -40 to +110    | °C    |
| T <sub>J</sub>       | Junction Temperature                        |                         | -40 to +125    | °C    |
| T <sub>SOL</sub>     | Lead Solder Temperature                     |                         | 260 for 10 sec | °C    |
| EMITTER              |                                             |                         |                |       |
| I <sub>F (avg)</sub> | Continuous Forward Current                  |                         | 50             | mA    |
| I <sub>F (pk)</sub>  | Peak Forward Current (1 μs pulse, 300 pps.) |                         | 1              | A     |
| V <sub>R</sub>       | Reverse Voltage                             |                         | 6              | V     |
| P <sub>D</sub>       | Power Dissipation                           |                         | 70             | mW    |
|                      | Derate linearly (Above 75°C)                |                         | 1.41           | mW/°C |
| DETECTOR             |                                             |                         |                |       |
| I <sub>C</sub>       | Continuous Collector Current                |                         | 80             | mA    |
| V <sub>CEO</sub>     | Collector-Emitter Voltage                   | FODM121 Series, FODM124 | 80             | V     |
|                      |                                             | FODM2701, FODM2705      | 40             |       |
| V <sub>ECO</sub>     | Emitter-Collector Voltage                   |                         | 6              | V     |
| P <sub>D</sub>       | Power Dissipation                           |                         | 150            | mW    |
|                      | Derate linearly (Above 80°C)                |                         | 3.27           | mW/°C |

## Electrical Characteristics

$T_A = 25^\circ\text{C}$  unless otherwise specified.

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

### 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.

## Typical Performance Curves

$T_A = 25^\circ\text{C}$  unless otherwise specified.

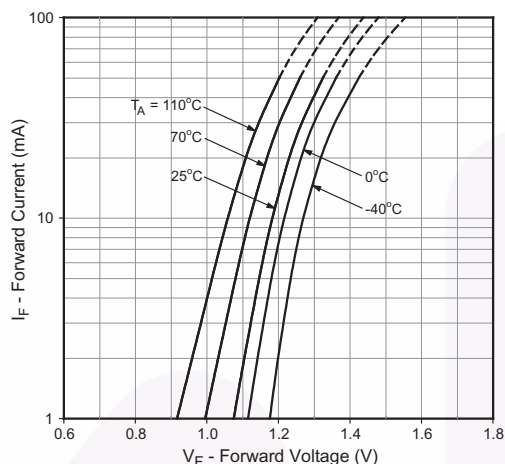


Fig. 3 Forward Current vs. Forward Voltage

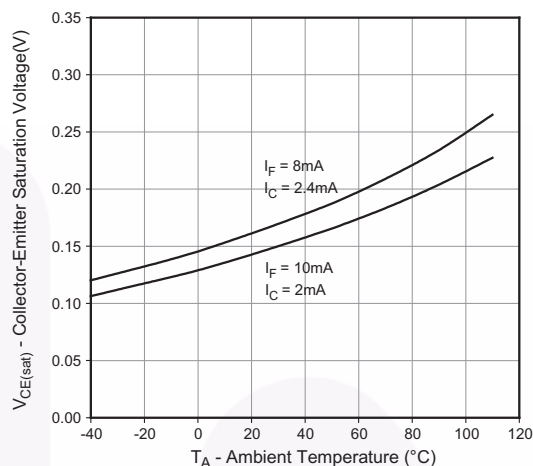


Fig. 4 Collector-Emitter Saturation Voltage vs. Ambient Temperature (FODM121/2701/2705)

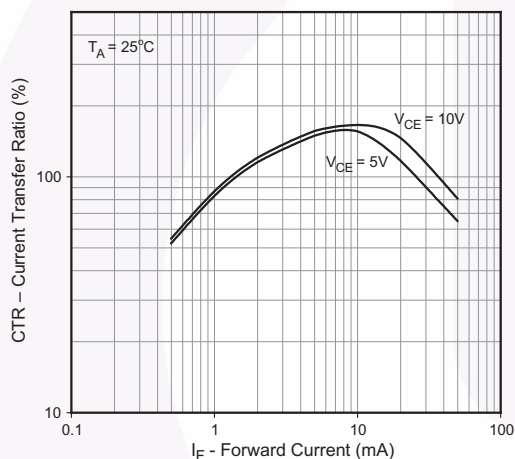


Fig. 5 Current Transfer Ratio vs. Forward Current (FODM121/2701/2705)

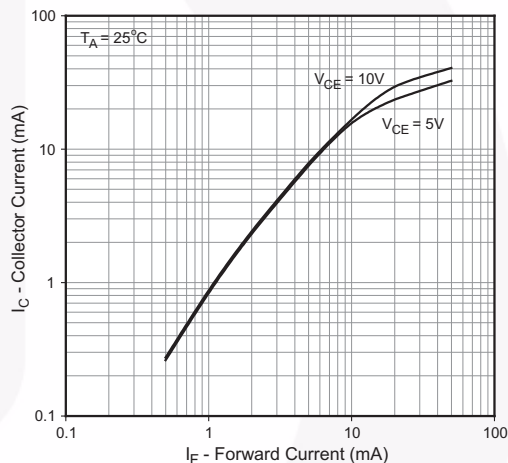


Fig. 6 Collector Current vs. Forward Current (FODM121/2701/2705)

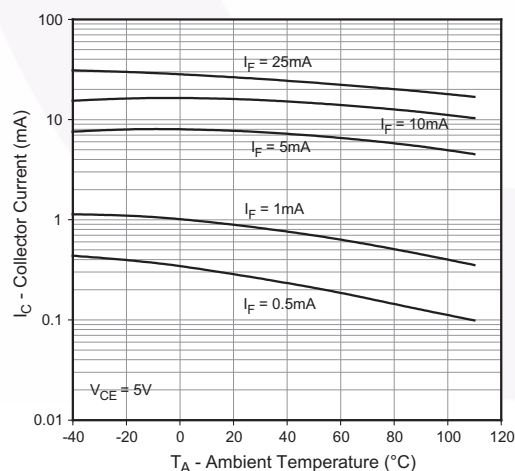


Fig. 7 Collector Current vs. Ambient Temperature (FODM121/2701/2705)

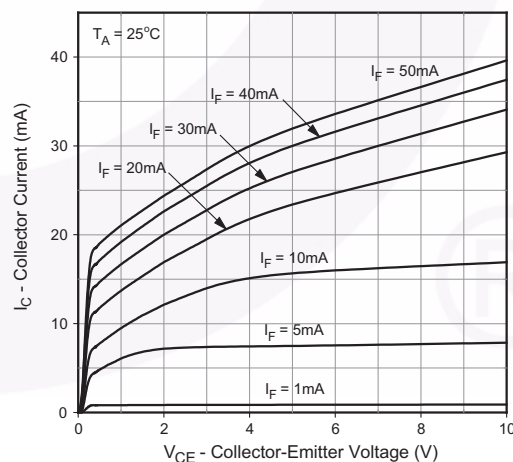
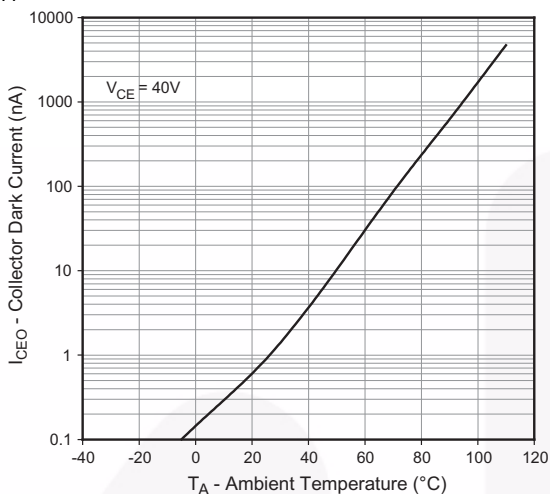


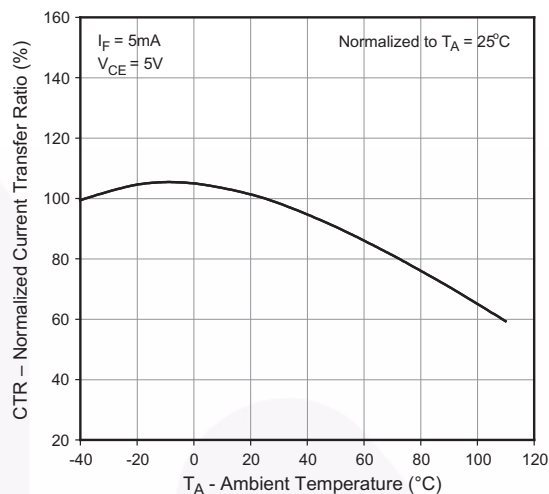
Fig. 8 Collector Current vs. Collector-Emitter Voltage (FODM121/2701/2705)

# Typical Performance Curves (Continued)

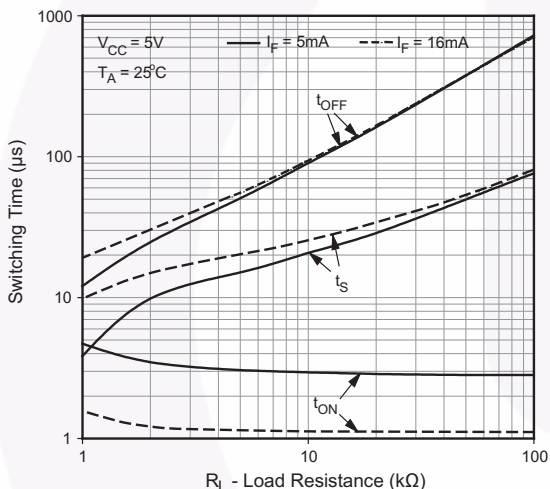
$T_A = 25^\circ\text{C}$  unless otherwise specified.



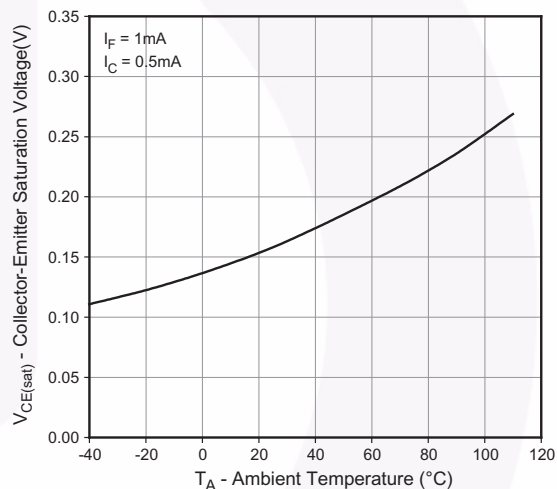
**Fig 9. Collector Dark Current vs. Ambient Temperature (FODM121/2701/2705)**



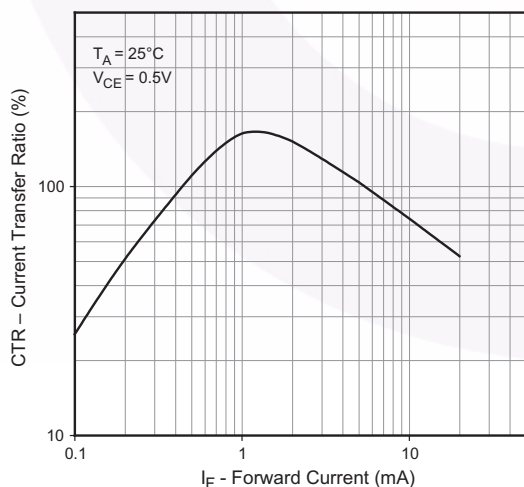
**Fig 10. Normalized Current Transfer Ratio vs. Ambient Temperature (FODM121/2701/2705)**



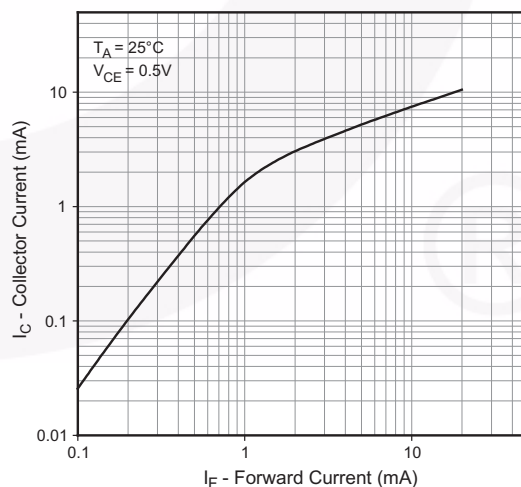
**Fig 11. Switching Time vs. Load Resistance (FODM121/2701/2705)**



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



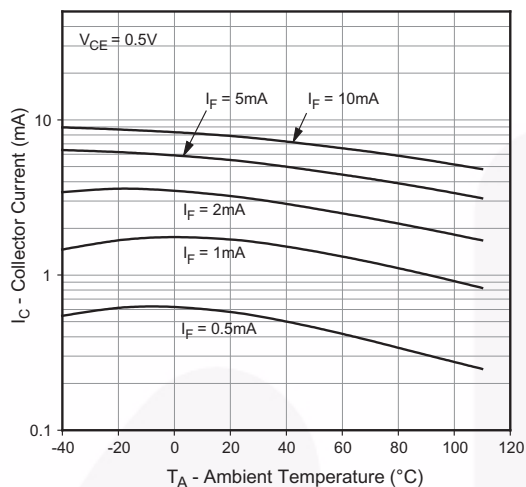
**Fig 13. Current Transfer Ratio vs. Forward Current (FODM124)**



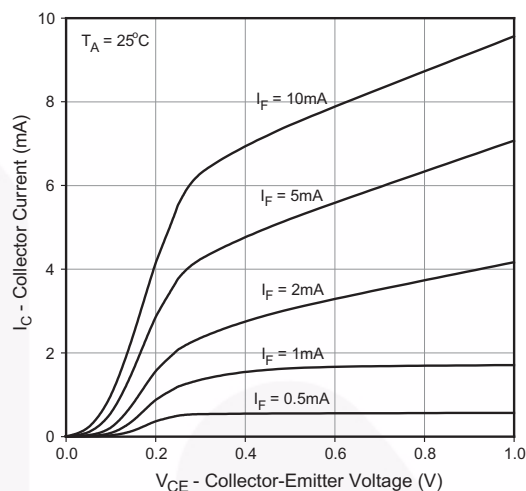
**Fig 14. Collector Current vs. Forward Current (FODM124)**

## Typical Performance Curves (Continued)

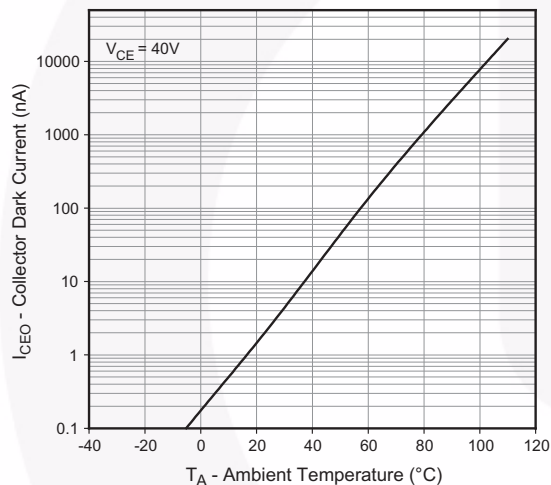
$T_A = 25^\circ\text{C}$  unless otherwise specified.



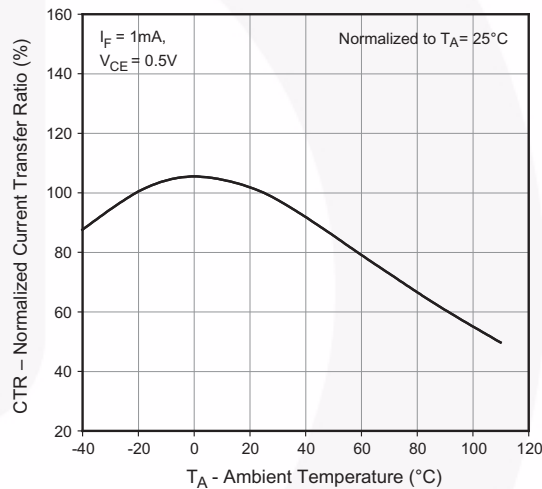
**Fig. 15. Collector Current vs. Ambient Temperature (FODM124)**



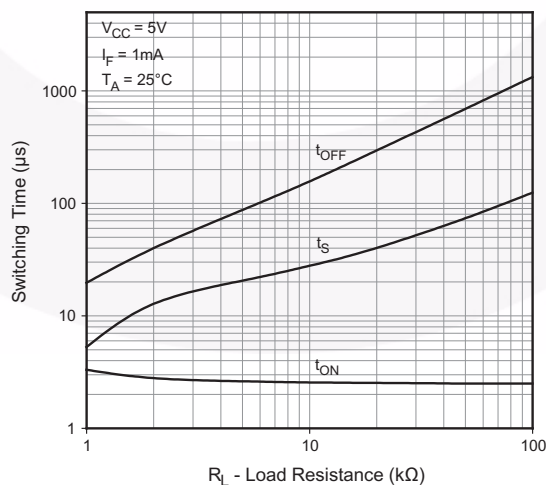
**Fig. 16 Collector Current vs. Collector-Emitter Voltage (FODM124)**



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

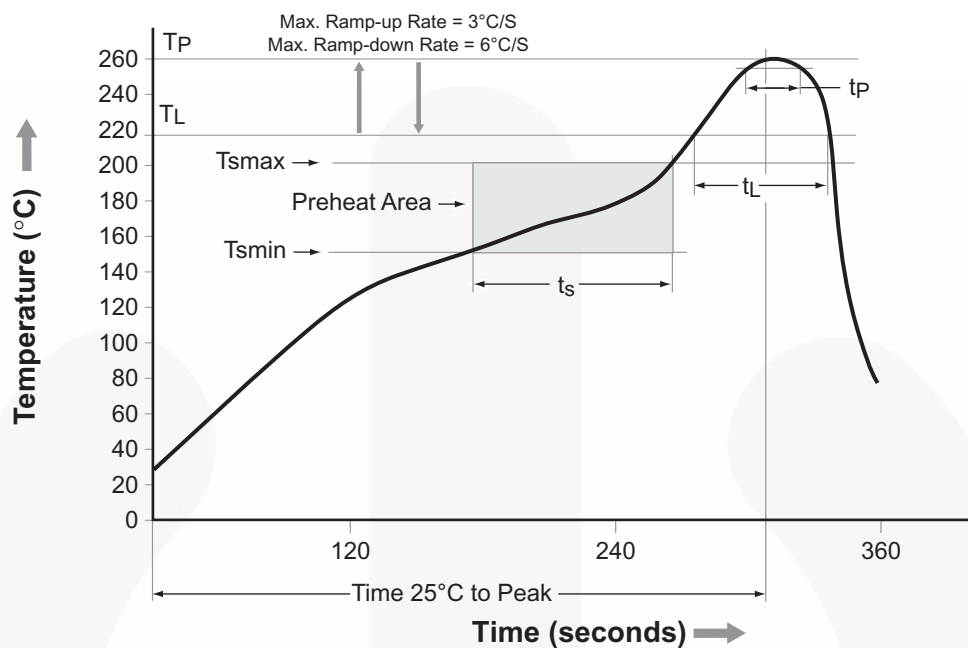


**Fig. 18 Normalized Current Transfer Ratio vs. Ambient Temperature (FODM124)**



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

## Reflow Profile



| Profile Feature                                                     | Pb-Free Assembly Profile |
|---------------------------------------------------------------------|--------------------------|
| Temperature Min. (T <sub>sm</sub> )                                 | 150°C                    |
| Temperature Max. (T <sub>smax</sub> )                               | 200°C                    |
| Time (t <sub>s</sub> ) from (T <sub>sm</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.           |

## 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

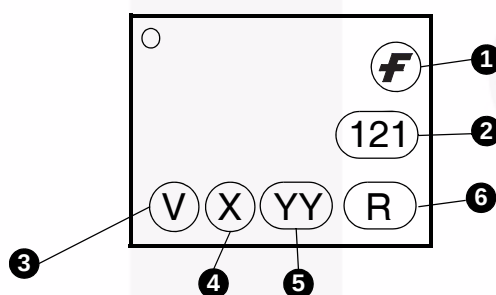
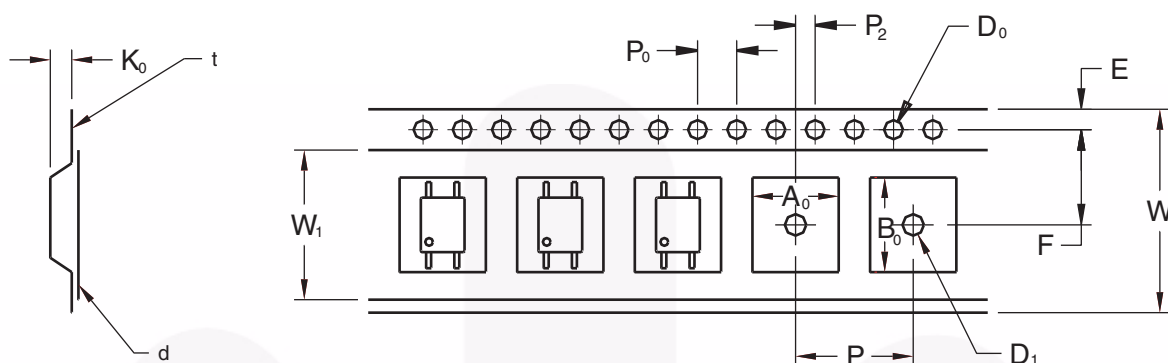


Figure 20. Top Mark

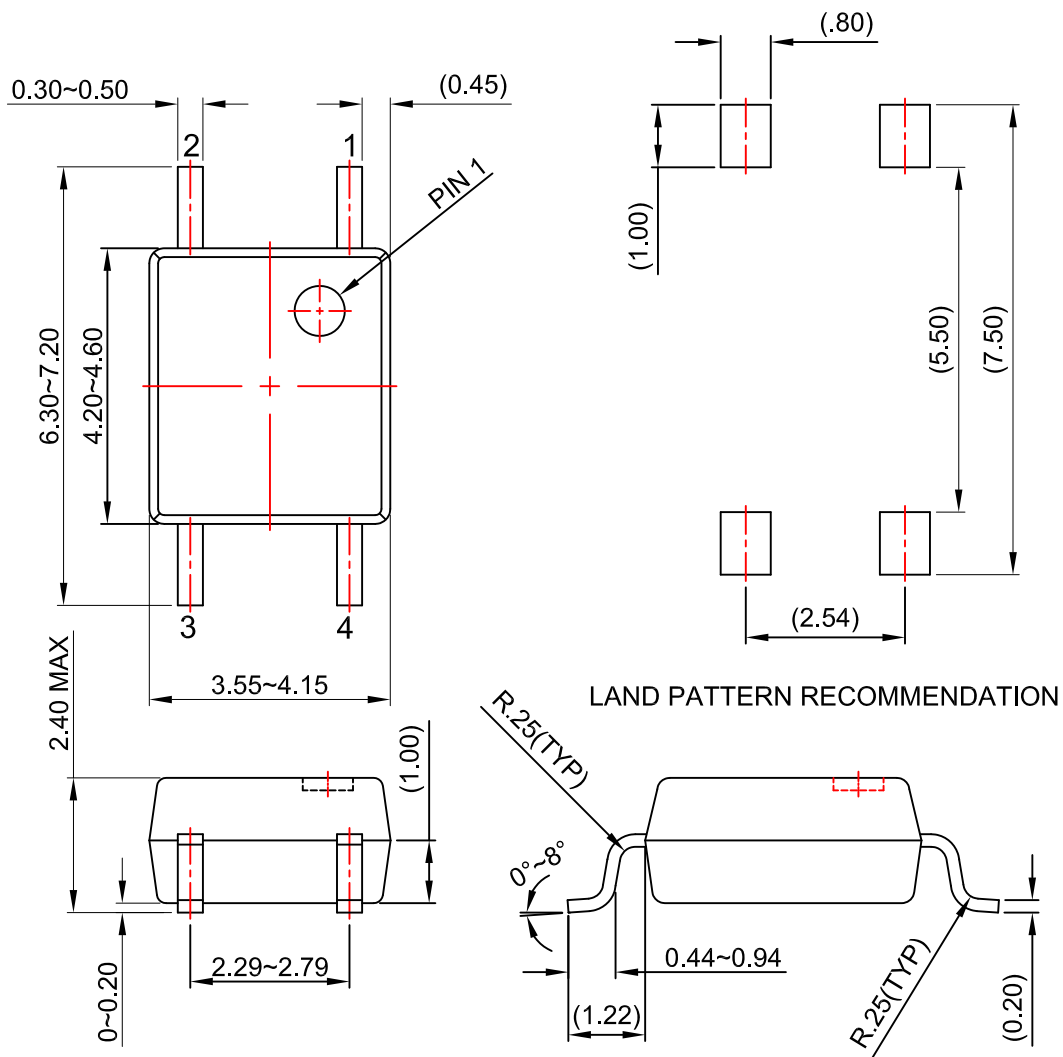
Table 1. Top Mark Definitions

|   |                                                                                 |
|---|---------------------------------------------------------------------------------|
| 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



|                                 |                | 2.54 Pitch   |
|---------------------------------|----------------|--------------|
| Description                     | Symbol         | Dimensions   |
| Tape Width                      | W              | 12.00±0.4    |
| Tape Thickness                  | t              | 0.35±0.02    |
| Sprocket Hole Pitch             | P <sub>0</sub> | 4.00±0.20    |
| Sprocket Hole Dia.              | D <sub>0</sub> | 1.55±0.20    |
| Sprocket Hole Location          | E              | 1.75±0.20    |
| Pocket Location                 | F              | 5.50±0.20    |
|                                 | P <sub>2</sub> | 2.00±0.20    |
| Pocket Pitch                    | P              | 8.00±0.20    |
| Pocket Dimension                | A <sub>0</sub> | 4.75±0.20    |
|                                 | B <sub>0</sub> | 7.30±0.20    |
|                                 | K <sub>0</sub> | 2.30±0.20    |
| Pocket Hole Dia.                | D <sub>1</sub> | 1.55±0.20    |
| Cover Tape Width                | W <sub>1</sub> | 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.



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