

# 4-Pin Full Pitch Mini-Flat Package Phototransistor Optocouplers

## FODM121 Series, FODM124, FODM2701, FODM2705

### Description

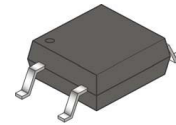
The FODM121 series, FODM124, and FODM2701 consists of a gallium arsenide infrared emitting diode driving a phototransistor in a compact 4-pin mini-flat package. The lead pitch is 2.54 mm. The FODM2705 consists of two gallium arsenide infrared emitting diodes connected in inverse parallel for AC operation.

### 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
- This Device is Pb-Free and is RoHS Compliant

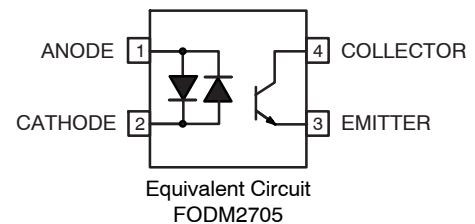
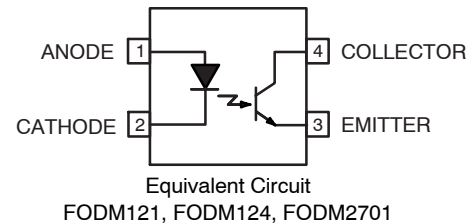
### Applications

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



MFP4 3.85X4.4, 2.54P  
CASE 100AP

### PIN CONNECTIONS



### MARKING DIAGRAM



|      |                              |
|------|------------------------------|
| ON   | = onsemi Logo                |
| 121x | = Device Number              |
| V    | = DIN EN/IEC60747-5-5 Option |
| X    | = One-Digit Year Code        |
| YY   | = Digit Work Week            |
| R    | = Assembly Package Code      |

### ORDERING INFORMATION

See detailed ordering and shipping information on page 7 of this data sheet.

# FODM121 Series, FODM124, FODM2701, FODM2705

## 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.<br>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 (Note 1)                                                                                                                                      | 150               | °C                |
| I <sub>S,INPUT</sub>  | Input Current (Note 1)                                                                                                                                         | 200               | mA                |
| P <sub>S,OUTPUT</sub> | Output Power (Note 1)                                                                                                                                          | 300               | mW                |
| R <sub>IO</sub>       | Insulation Resistance at T <sub>S</sub> , V <sub>IO</sub> = 500 V (Note 1)                                                                                     | > 10 <sup>9</sup> | Ω                 |

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

## ABSOLUTE MAXIMUM RATINGS T<sub>A</sub> = 25°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 s | °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    |                         | 7    | V     |
| P <sub>D</sub>   | Power Dissipation            |                         | 150  | mW    |
|                  | Derate linearly (Above 80°C) |                         | 3.27 | mW/°C |

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

# FODM121 Series, FODM124, FODM2701, FODM2705

**ELECTRICAL CHARACTERISTICS**  $T_A = 25^\circ\text{C}$  Unless otherwise specified.

| Symbol | Parameter | Device | Test Conditions | Min | Typ | Max | Unit |
|--------|-----------|--------|-----------------|-----|-----|-----|------|
|--------|-----------|--------|-----------------|-----|-----|-----|------|

## INDIVIDUAL COMPONENT CHARACTERISTICS

|                 |                                     |                                   |                                         |     |    |     |               |
|-----------------|-------------------------------------|-----------------------------------|-----------------------------------------|-----|----|-----|---------------|
| <b>Emitter</b>  |                                     |                                   |                                         |     |    |     |               |
| $V_F$           | Forward Voltage                     | FODM121 Series, 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, FODM124, FODM2701 | $V_R = 5\text{ V}$                      | –   | –  | 5   | $\mu\text{A}$ |
| <b>Detector</b> |                                     |                                   |                                         |     |    |     |               |
| $BV_{CEO}$      | Collector–Emitter Breakdown Voltage | FODM121 Series, FODM124           | $I_C = 1\text{ mA}, I_F = 0$            | 80  | –  | –   | V             |
|                 |                                     | FODM2701, FODM2705                |                                         | 40  | –  | –   |               |
| $BV_{ECO}$      | Emitter–Collector 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            |

## TRANSFER CHARACTERISTICS

|               |                           |                |                                                                   |     |   |      |               |
|---------------|---------------------------|----------------|-------------------------------------------------------------------|-----|---|------|---------------|
| CTR           | DC Current Transfer 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 (Non–Saturated) | All            | $I_C = 2\text{ mA}, V_{CE} = 5\text{ V}, R_L = 100\text{ }\Omega$ | –   | 3 | –    | $\mu\text{s}$ |
| $t_f$         | Fall Time (Non–Saturated) | All            | $I_C = 2\text{ mA}, V_{CE} = 5\text{ V}, R_L = 100\text{ }\Omega$ | –   | 3 | –    | $\mu\text{s}$ |

## ISOLATION CHARACTERISTICS

|           |                                         |     |          |      |   |   |               |
|-----------|-----------------------------------------|-----|----------|------|---|---|---------------|
| $V_{ISO}$ | Steady State Isolation Voltage (Note 2) | All | 1 minute | 3750 | – | – | $V_{AC(RMS)}$ |
|-----------|-----------------------------------------|-----|----------|------|---|---|---------------|

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

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)

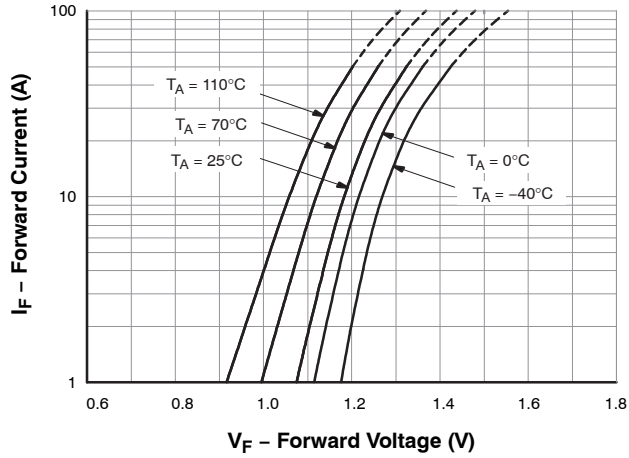


Figure 1. Forward Current vs. Forward Voltage

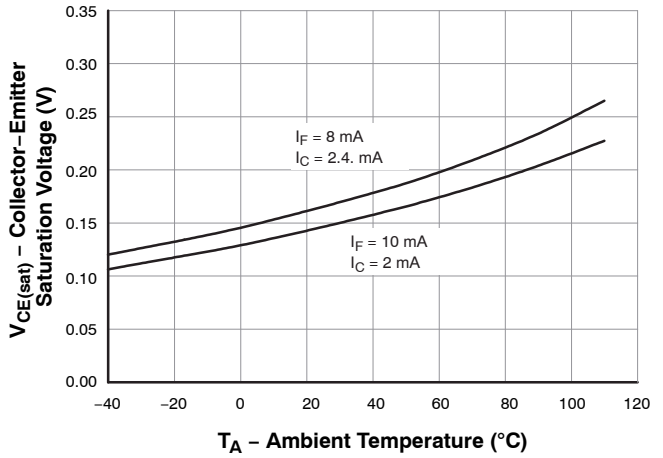


Figure 2. Collector-Emitter Saturation Voltage vs. Ambient Temperature (FODM121/2701/2705)

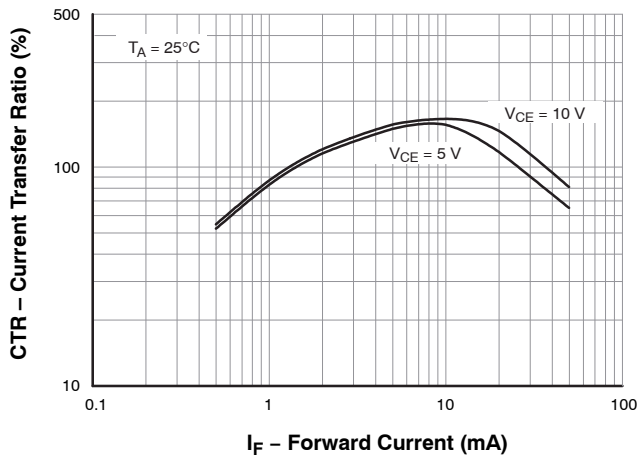


Figure 3. Current Transfer Ratio vs. Forward Current (FODM121/2701/2705)

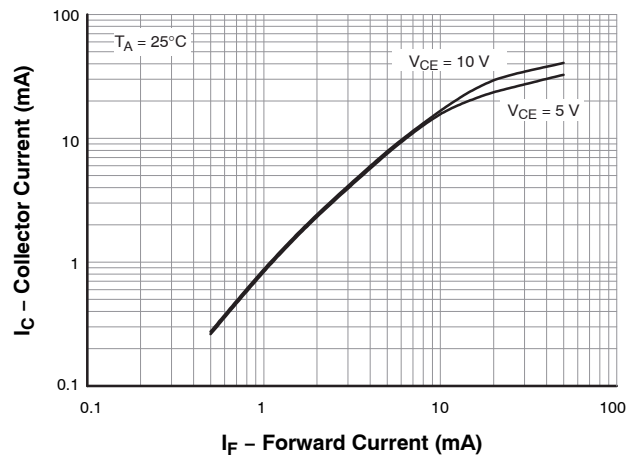


Figure 4. Collector Current vs. Forward Current (FODM121/2701/2705)

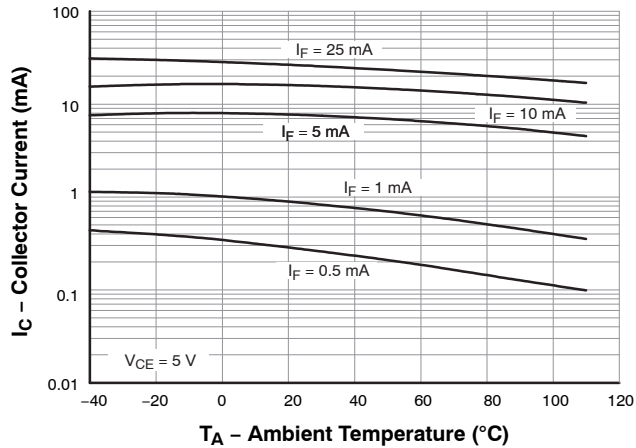


Figure 5. Collector Current vs. Ambient Temperature (FODM121/2701/2705)

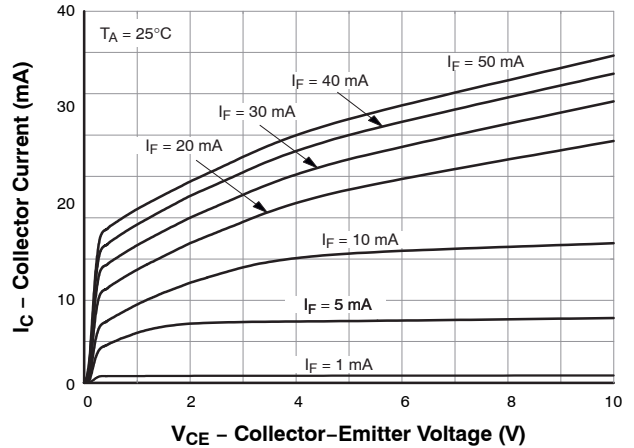


Figure 6. Collector Current vs. Ambient Temperature (FODM121/2701/2705)

TYPICAL PERFORMANCE CURVES (CONTINUED)

( $T_A = 25^\circ\text{C}$  UNLESS OTHERWISE SPECIFIED)

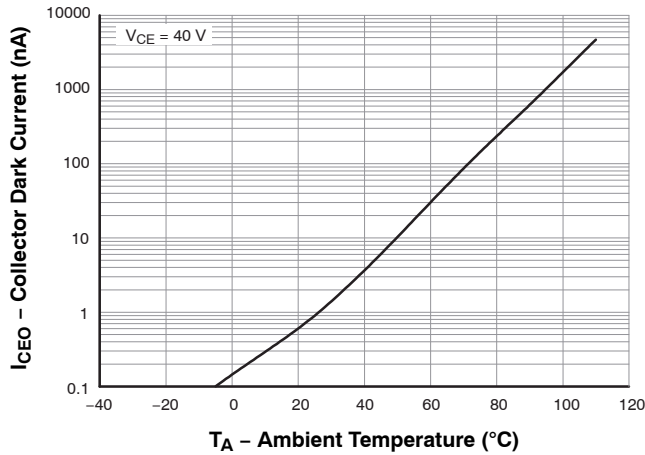


Figure 7. Collector Dark Current vs. Ambient Temperature (FODM121/2701/2705)

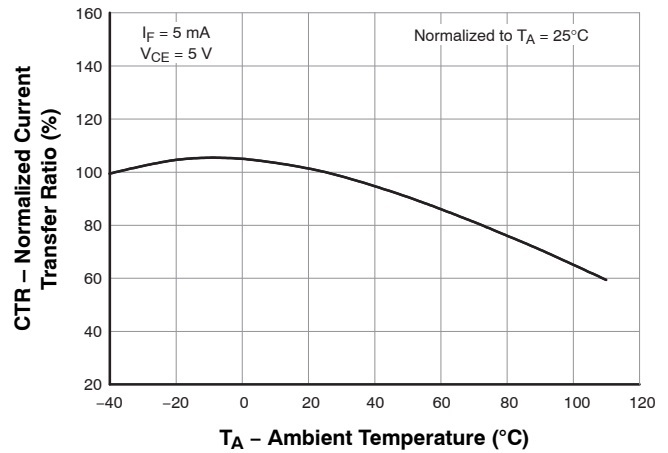


Figure 8. Normalized Current Transfer Ratio vs. Ambient Temperature (FODM121/2701/2705)

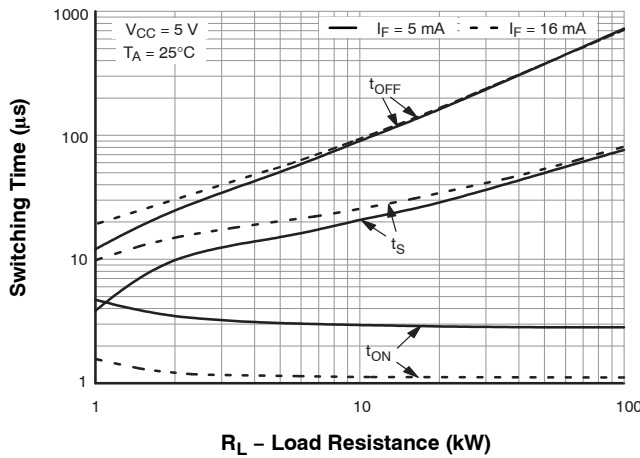


Figure 9. Switching Time vs. Load Resistance (FODM121/2701/2705)

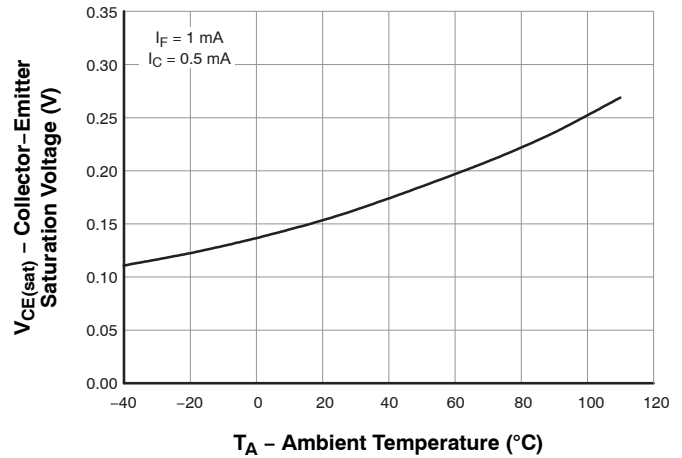


Figure 10. Collector-Emitter Saturation Voltage vs. Ambient Temperature (FODM124)

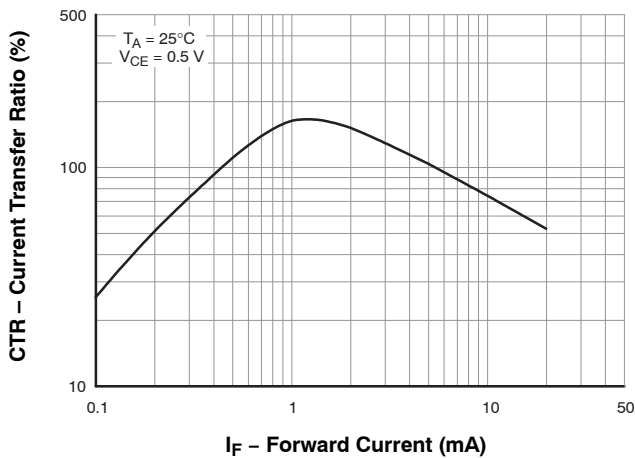


Figure 11. Current Transfer Ratio vs. Forward Current (FODM124)

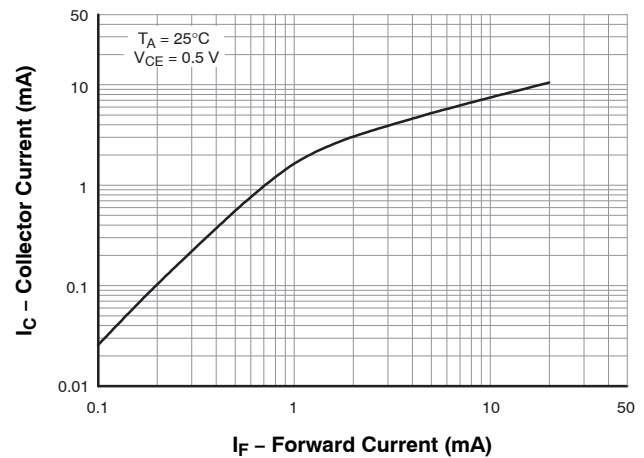


Figure 12. Collector Current vs. Forward Current (FODM124)

TYPICAL PERFORMANCE CURVES (CONTINUED)

( $T_A = 25^\circ\text{C}$  UNLESS OTHERWISE SPECIFIED)

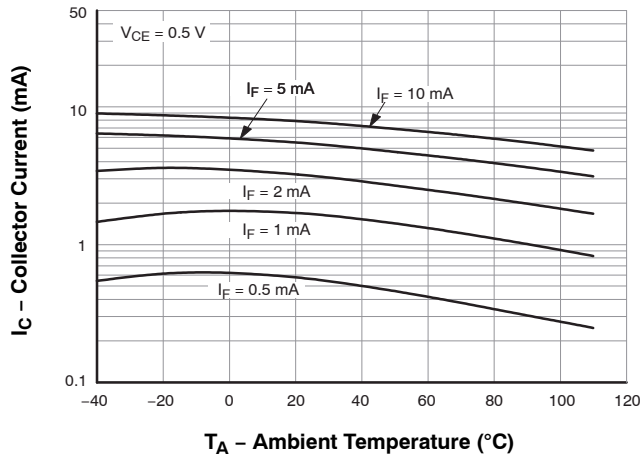


Figure 13. Collector Current vs. Ambient Temperature (FODM124)

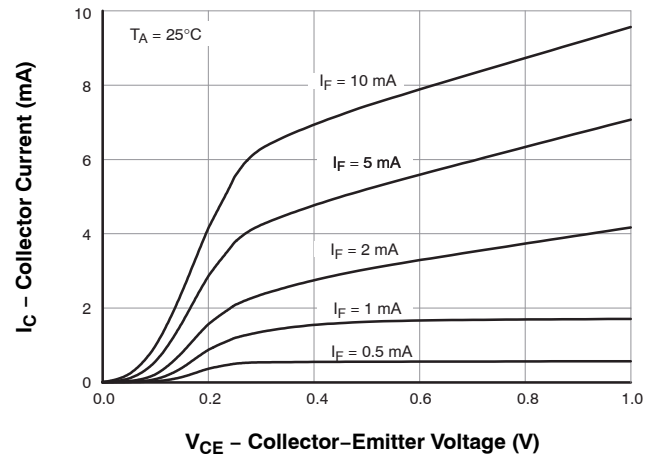


Figure 14. Collector Current vs. Collector-Emitter Voltage (FODM124)

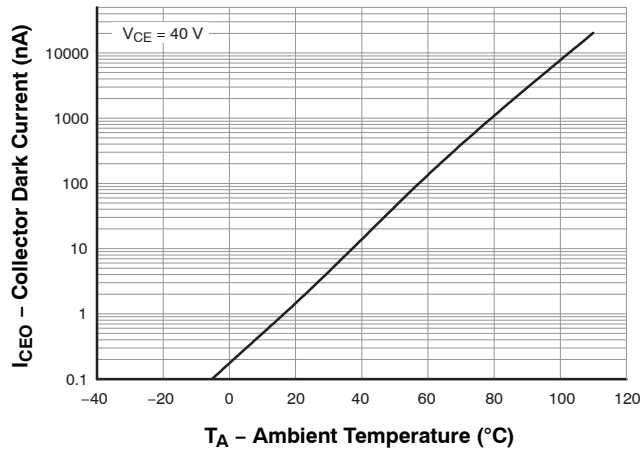


Figure 15. Collector Dark Current vs. Ambient Temperature (FODM124)

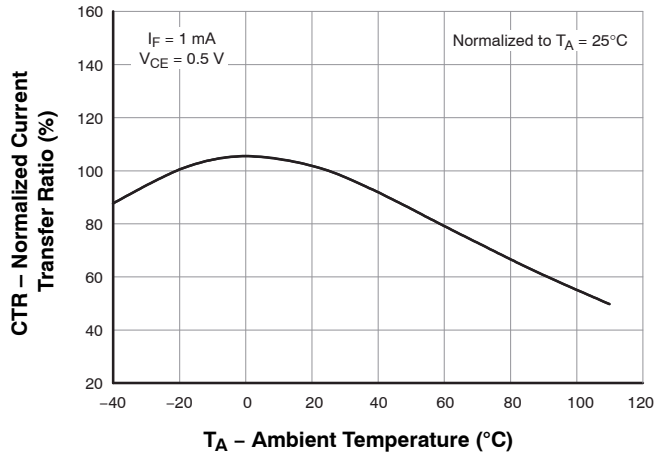


Figure 16. Normalized Current Transfer Ratio vs. Ambient Temperature (FODM124)

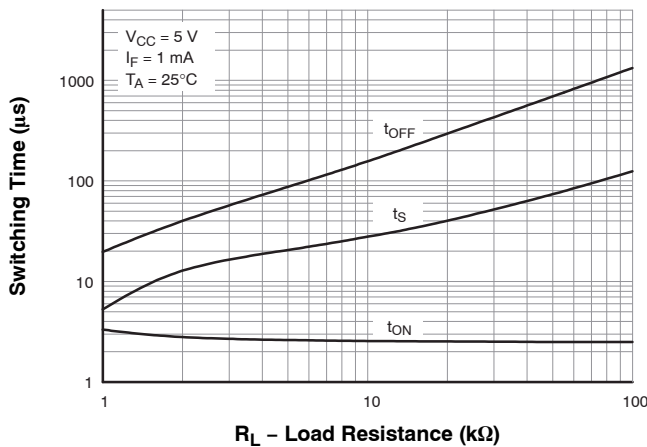
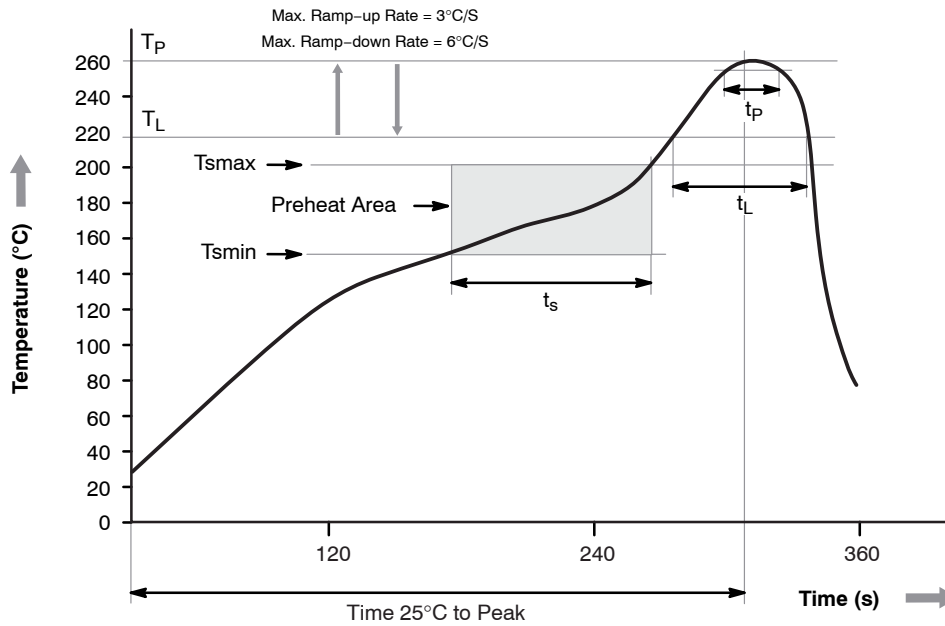


Figure 17. Switching Time vs. Load Resistance (FODM124)

## REFLOW PROFILE



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

## ORDERING INFORMATION

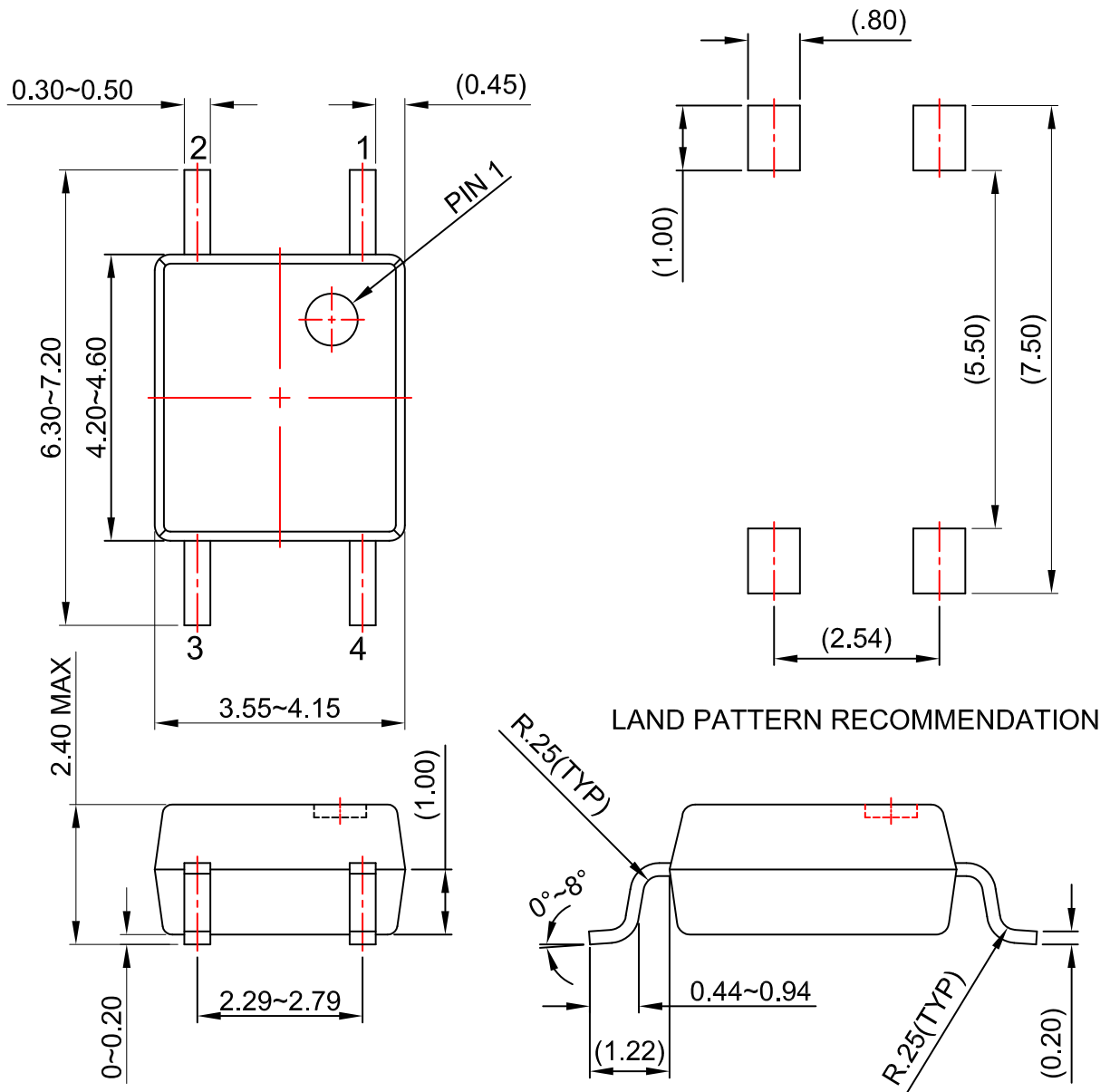
| Part Number (Note 3) | Package                                                | Shipping <sup>†</sup> |
|----------------------|--------------------------------------------------------|-----------------------|
| FODM121              | Full Pitch Mini-Flat 4-Pin                             | 100 / Tube            |
| FODM121R2            | Full Pitch Mini-Flat 4-Pin                             | 2,500 / Tape and Reel |
| FODM121V             | Full Pitch Mini-Flat 4-Pin, DIN EN/IEC60747–5–5 Option | 100 / Tube            |
| FODM121R2V           | Full Pitch Mini-Flat 4-Pin, DIN EN/IEC60747–5–5 Option | 2,500 / Tape and Reel |

<sup>†</sup>For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

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

**MFP4 3.85X4.4, 2.54P**  
CASE 100AP  
ISSUE O

DATE 31 AUG 2016



**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

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