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# CNY171M, CNY172M, CNY173M, CNY174M, CNY17F1M, CNY17F2M, CNY17F3M, CNY17F4M, MOC8106M 6-Pin DIP High $BV_{CEO}$ Phototransistor Optocouplers

## Features

- High  $BV_{CEO}$ : 70 V Minimum (CNY17XM, CNY17FXM, MOC8106M)
- Closely Matched Current Transfer Ratio (CTR) Minimizes Unit-to-Unit Variation
- Current Transfer Ratio In Select Groups
- Very Low Coupled Capacitance Along With No Chip-to-Pin 6 Base Connection for Minimum Noise Susceptability (CNY17FXM, MOC8106M)
- Safety and Regulatory Approvals:
  - UL1577, 4,170  $VAC_{RMS}$  for 1 Minute
  - DIN-EN/IEC60747-5-5, 850 V Peak Working Insulation Voltage

## Applications

- Power Supply Regulators
- Digital Logic Inputs
- Microprocessor Inputs
- Appliance Sensor Systems
- Industrial Controls

## Description

The CNY17XM, CNY17FXM, and MOC8106M devices consist of a gallium arsenide infrared emitting diode coupled with an NPN phototransistor in a dual in-line package.

## Package Outlines



Figure 1. Package Outlines

## Schematics



Figure 2. Schematics

## 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–IV            |
| Climatic Classification   |                        | 55/100/21       |
| 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  | 1360              | 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 | 1594              | V <sub>peak</sub> |
| V <sub>IORM</sub>     | Maximum Working Insulation Voltage   | 850               | V <sub>peak</sub> |
| V <sub>IOTM</sub>     | Highest Allowable Over-Voltage   | 6000              | V <sub>peak</sub> |
|                       | External Creepage  | ≥ 7               | mm                |
|                       | External Clearance   | ≥ 7               | mm                |
|                       | External Clearance (for Option TV, 0.4" Lead Spacing)  | ≥ 10              | mm                |
| DTI                   | Distance Through Insulation (Insulation Thickness)   | ≥ 0.5             | mm                |
| T <sub>S</sub>        | Case Temperature <sup>(1)</sup>  | 175               | °C                |
| I <sub>S,INPUT</sub>  | Input Current <sup>(1)</sup>   | 350               | mA                |
| P <sub>S,OUTPUT</sub> | Output Power <sup>(1)</sup>  | 800               | 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.

| Symbol              | Parameters   | Value              | Units |
|---------------------|--|--------------------|-------|
| <b>TOTAL DEVICE</b> |  |                    |       |
| T <sub>STG</sub>    | Storage Temperature  | -40 to +125        | °C    |
| T <sub>A</sub>      | Ambient Operating Temperature  | -40 to +100        | °C    |
| T <sub>J</sub>      | Junction Temperature   | -40 to +125        | °C    |
| T <sub>SOL</sub>    | Lead Solder Temperature  | 260 for 10 seconds | °C    |
| P <sub>D</sub>      | Total Device Power Dissipation @ 25°C (LED plus detector)<br>Derate Linearly From 25°C | 270                | mW    |
|                     |  | 2.94               | mW/°C |
| <b>EMITTER</b>      |  |                    |       |
| I <sub>F</sub>      | Continuous Forward Current   | 60                 | mA    |
| V <sub>R</sub>      | Reverse Voltage  | 6                  | V     |
| I <sub>F</sub> (pk) | Forward Current – Peak (1 μs pulse, 300 pps)   | 1.5                | A     |
| P <sub>D</sub>      | LED Power Dissipation 25°C Ambient<br>Derate Linearly From 25°C                        | 120                | mW    |
|                     |  | 1.41               | mW/°C |
| <b>DETECTOR</b>     |  |                    |       |
| I <sub>C</sub>      | Continuous Collector Current   | 50                 | mA    |
| V <sub>CEO</sub>    | Collector-Emitter Voltage  | 70                 | V     |
| V <sub>ECO</sub>    | Emitter Collector Voltage  | 7                  | V     |
| P <sub>D</sub>      | Detector Power Dissipation @ 25°C<br>Derate Linearly from 25°C                         | 150                | mW    |
|                     |  | 1.76               | mW/°C |

## Electrical Characteristics

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

### Individual Component Characteristics

| Symbol          | Parameters                                | Test Conditions                         | Device            | Min. | Typ.  | Max. | Units         |
|-----------------|---|---|-------------------|------|-------|------|---------------|
| <b>EMITTER</b>  |   |   |                   |      |       |      |               |
| $V_F$           | Input Forward Voltage                     | $I_F = 10\text{ mA}$                    | All Devices       | 1.0  | 1.15  | 1.50 | V             |
|                 |   | $I_F = 60\text{ mA}$                    | CNY17XM, CNY17FXM | 1.0  | 1.35  | 1.65 | v             |
| $C_J$           | Capacitance                               | $V_F = 0\text{ V}, f = 1.0\text{ MHz}$  | All Devices       |      | 18    |      | pF            |
| $I_R$           | Reverse Leakage Current                   | $V_R = 6\text{ V}$                      | All Devices       |      | 0.001 | 10   | $\mu\text{A}$ |
| <b>DETECTOR</b> |   |   |                   |      |       |      |               |
| $BV_{CEO}$      | Breakdown Voltage<br>Collector-to-Emitter | $I_C = 1\text{ mA}, I_F = 0$            | All Devices       | 70   | 100   |      | V             |
|                 |   |   | CNY17XM           | 70   | 120   |      | V             |
| $BV_{CBO}$      | Collector-to-Base                         | $I_C = 10\text{ }\mu\text{A}, I_F = 0$  | CNY17XM           | 70   | 120   |      | V             |
| $BV_{ECO}$      | Emitter-to-Collector                      | $I_E = 100\text{ }\mu\text{A}, I_F = 0$ | All Devices       | 7    | 10    |      | V             |
| $I_{CEO}$       | Leakage Current<br>Collector-to-Emitter   | $V_{CE} = 10\text{ V}, I_F = 0$         | All Devices       |      | 1     | 50   | nA            |
|                 |   |   | CNY17XM           |      |       | 20   | nA            |
| $I_{CBO}$       | Collector-to-Base                         | $V_{CB} = 10\text{ V}, I_F = 0$         | CNY17XM           |      |       | 20   | nA            |
| $C_{CE}$        | Capacitance<br>Collector-to-Emitter       | $V_{CE} = 0, f = 1\text{ MHz}$          | All Devices       |      | 8     |      | pF            |
|                 |   |   | CNY17XM           |      | 20    |      | pF            |
|                 |   |   | CNY17XM           |      | 10    |      | pF            |
| $C_{CB}$        | Collector-to-Base                         | $V_{CB} = 0, f = 1\text{ MHz}$          | CNY17XM           |      | 20    |      | pF            |
| $C_{EB}$        | Emitter-to-Base                           | $V_{EB} = 0, f = 1\text{ MHz}$          | CNY17XM           |      | 10    |      | pF            |

### Transfer Characteristics

| Symbol         | Parameters                           | Test Conditions                            | Device            | Min. | Typ. | Max. | Units |
|----------------|--------------------------------------|--|-------------------|------|------|------|-------|
| <b>COUPLED</b> |                                      |  |                   |      |      |      |       |
| CTR            | Current Transfer Ratio               | $I_F = 10\text{ mA}, V_{CE} = 10\text{ V}$ | MOC8106M          | 50   |      | 150  | %     |
|                |                                      | $I_F = 10\text{ mA}, V_{CE} = 5\text{ V}$  | CNY171M, CNY17F1M | 40   |      | 80   | %     |
|                |                                      | $I_F = 10\text{ mA}, V_{CE} = 5\text{ V}$  | CNY172M, CNY17F2M | 63   |      | 125  | %     |
|                |                                      | $I_F = 10\text{ mA}, V_{CE} = 5\text{ V}$  | CNY173M, CNY17F3M | 100  |      | 200  | %     |
|                |                                      | $I_F = 10\text{ mA}, V_{CE} = 5\text{ V}$  | CNY174M, CNY17F4M | 160  |      | 320  | %     |
| $V_{CE(SAT)}$  | Collector-Emitter Saturation Voltage | $I_C = 0.5\text{ mA}, I_F = 5\text{ mA}$   | MOC8106M          |      |      | 0.4  | V     |
|                |                                      | $I_C = 2.5\text{ mA}, I_F = 10\text{ mA}$  | CNY17XM/CNY17FXM  |      |      | 0.4  | V     |

## Electrical Characteristics (Continued)

T<sub>A</sub> = 25°C unless otherwise specified.

### AC Characteristics

| Symbol                              | Parameters    | Test Conditions   | Device                            | Min. | Typ. | Max. | Units |
|-------------------------------------|---------------|---|-----------------------------------|------|------|------|-------|
| <b>NON-SATURATED SWITCHING TIME</b> |               |   |                                   |      |      |      |       |
| t <sub>on</sub>                     | Turn-On Time  | I <sub>C</sub> = 2.0 mA, V <sub>CC</sub> = 10 V, R <sub>L</sub> = 100 Ω | All Devices                       |      | 2.0  | 10.0 | μs    |
| t <sub>off</sub>                    | Turn-Off Time | I <sub>C</sub> = 2.0 mA, V <sub>CC</sub> = 10 V, R <sub>L</sub> = 100 Ω | All Devices                       |      | 3.0  | 10.0 | μs    |
| t <sub>d</sub>                      | Delay Time    | I <sub>F</sub> = 10 mA, V <sub>CC</sub> = 5 V, R <sub>L</sub> = 75 Ω    | CNY17XM/CNY17FXM                  |      |      | 5.6  | μs    |
| t <sub>r</sub>                      | Rise Time     | I <sub>F</sub> = 10 mA, V <sub>CC</sub> = 5 V, R <sub>L</sub> = 75 Ω    | CNY17XM/CNY17FXM                  |      |      | 4.0  | μs    |
| t <sub>s</sub>                      | Storage Time  | I <sub>F</sub> = 10 mA, V <sub>CC</sub> = 5 V, R <sub>L</sub> = 75 Ω    | CNY17XM/CNY17FXM                  |      |      | 4.1  | μs    |
| t <sub>f</sub>                      | Fall Time     | I <sub>F</sub> = 10 mA, V <sub>CC</sub> = 5 V, R <sub>L</sub> = 75 Ω    | CNY17XM/CNY17FXM                  |      |      | 3.5  | μs    |
| <b>SATURATED SWITCHING TIMES</b>    |               |   |                                   |      |      |      |       |
| t <sub>d</sub>                      | Delay Time    | I <sub>F</sub> = 20 mA, V <sub>CC</sub> = 5 V, R <sub>L</sub> = 1 kΩ    | CNY171M/F1M                       |      |      | 5.5  | μs    |
|                                     |               | I <sub>F</sub> = 10 mA, V <sub>CC</sub> = 5 V, R <sub>L</sub> = 1 kΩ    | CNY172M/3M/4M<br>CNY17F2M/F3M/F4M |      |      | 8.0  | μs    |
| t <sub>r</sub>                      | Rise Time     | I <sub>F</sub> = 20 mA, V <sub>CC</sub> = 5 V, R <sub>L</sub> = 1 kΩ    | CNY171M/F1M                       |      |      | 4.0  | μs    |
|                                     |               | I <sub>F</sub> = 10 mA, V <sub>CC</sub> = 5 V, R <sub>L</sub> = 1 kΩ    | CNY172M/3M/4M<br>CNY17F2M/F3M/F4M |      |      | 6.0  | μs    |
| t <sub>s</sub>                      | Storage Time  | I <sub>F</sub> = 20 mA, V <sub>CC</sub> = 5 V, R <sub>L</sub> = 1 kΩ    | CNY171M/F1M                       |      |      | 34.0 | μs    |
|                                     |               | I <sub>F</sub> = 10 mA, V <sub>CC</sub> = 5 V, R <sub>L</sub> = 1 kΩ    | CNY172M/3M/4M<br>CNY17F2M/F3M/F4M |      |      | 39.0 | μs    |
| t <sub>f</sub>                      | Fall Time     | I <sub>F</sub> = 20 mA, V <sub>CC</sub> = 5 V, R <sub>L</sub> = 1 kΩ    | CNY171M/F1M                       |      |      | 20.0 | μs    |
|                                     |               | I <sub>F</sub> = 10 mA, V <sub>CC</sub> = 5 V, R <sub>L</sub> = 1 kΩ    | CNY172M/3M/4M<br>CNY17F2M/F3M/F4M |      |      | 24.0 | μs    |

### Isolation Characteristics

| Symbol           | Characteristic                 | Test Conditions                                    | Min.             | Typ. | Max. | Units                          |
|------------------|--------------------------------|--|------------------|------|------|--------------------------------|
| V <sub>ISO</sub> | Input-Output Isolation Voltage | t = 1 Minute                                       | 4170             |      |      | V <sub>AC</sub> <sub>RMS</sub> |
| C <sub>ISO</sub> | Isolation Capacitance          | V <sub>I-O</sub> = 0 V, f = 1 MHz                  |                  | 0.2  |      | pF                             |
| R <sub>ISO</sub> | Isolation Resistance           | V <sub>I-O</sub> = ±500 VDC, T <sub>A</sub> = 25°C | 10 <sup>11</sup> |      |      | Ω                              |

### Typical Performance Characteristics



Figure 3. Normalized CTR vs. Forward Current



Figure 4. Normalized CTR vs. Ambient Temperature



Figure 5. CTR vs. R<sub>BE</sub> (Unsaturated)



Figure 6. CTR vs. R<sub>BE</sub> (Saturated)



Figure 7. Switching Speed vs. Load Resistor



Figure 8. Normalized  $t_{on}$  vs. R<sub>BE</sub>

Typical Performance Characteristics (Continued)



Figure 9. Normalized  $t_{off}$  vs.  $R_{BE}$



Figure 10. LED Forward Voltage vs. Forward Current



Figure 11. Collector-Emitter Saturation Voltage vs. Collector Current



### Switching Test Circuit and Waveforms



Figure 12. Switching Test Circuit and Waveforms

### Reflow Profile



Figure 13. Reflow Profile

## Ordering Information

| Part Number | Package  | Packing Method             |
|-------------|--|----------------------------|
| CNY171M     | DIP 6-Pin  | Tube (50 Units)            |
| CNY171SM    | SMT 6-Pin (Lead Bend)                                    | Tube (50 Units)            |
| CNY171SR2M  | SMT 6-Pin (Lead Bend)                                    | Tape and Reel (1000 Units) |
| CNY171TM    | DIP 6-Pin, 0.4" Lead Spacing                             | Tube (50 Units)            |
| CNY171VM    | DIP 6-Pin, DIN EN/IEC60747-5-5 Option                    | Tube (50 Units)            |
| CNY171SVM   | SMT 6-Pin (Lead Bend), DIN EN/IEC60747-5-5 Option        | Tube (50 Units)            |
| CNY171SR2VM | SMT 6-Pin (Lead Bend), DIN EN/IEC60747-5-5 Option        | Tape and Reel (1000 Units) |
| CNY171TVM   | DIP 6-Pin, 0.4" Lead Spacing, DIN EN/IEC60747-5-5 Option | Tube (50 Units)            |

**Note:**

2. The product orderable part number system listed in this table also applies to the CNY17FXM product family and the MOC8106M device.

## Marking Information



Figure 14. 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., "4"  |
| 5 | Digit Work Week, Ranging from "01" to "53"                                      |
| 6 | Assembly Package Code   |



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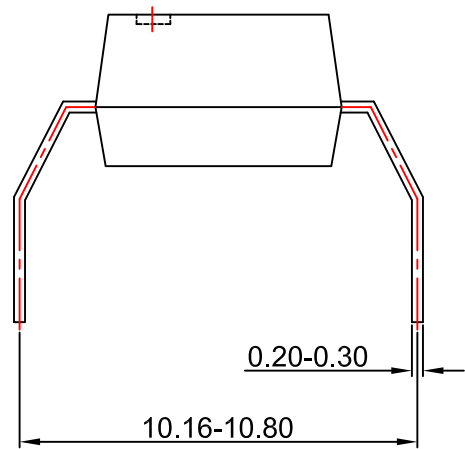
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Тел: +7 (812) 336 43 04 (многоканальный)

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