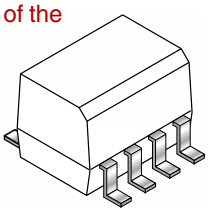
# OPTICALLY ISOLATED ERROR AMPLIFIER

# FOD2712

## DESCRIPTION



The FOD2712 Optically Isolated Amplifier consists of the popular RC431A precision programmable shunt reference and an optocoupler. The optocoupler is a gallium arsenide (GaAs) light emitting diode optically coupled to a silicon phototransistor. The reference voltage tolerance is 1%. The current transfer ratio (CTR) ranges from 100% to 200%.

It is primarily intended for use as the error amplifier/reference voltage/optocoupler function in isolated ac to dc power supplies and dc/dc converters.

When using the FOD2712, power supply designers can reduce the component count and save space in tightly packaged designs. The tight tolerance reference eliminates the need for adjustments in many applications.

The device comes in a compact 8-pin small outline package.

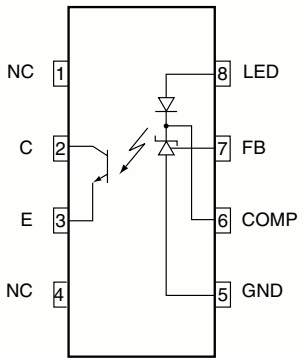
## FEATURES

- Optocoupler, precision reference and error amplifier in single package
- 1.240V ± 1% reference
- CTR 100% to 200%
- 2,500V RMS isolation
- VDE approval 136616
- BSI approval 8661 and 8662
- UL approval E90700
- CSA approval 1113643

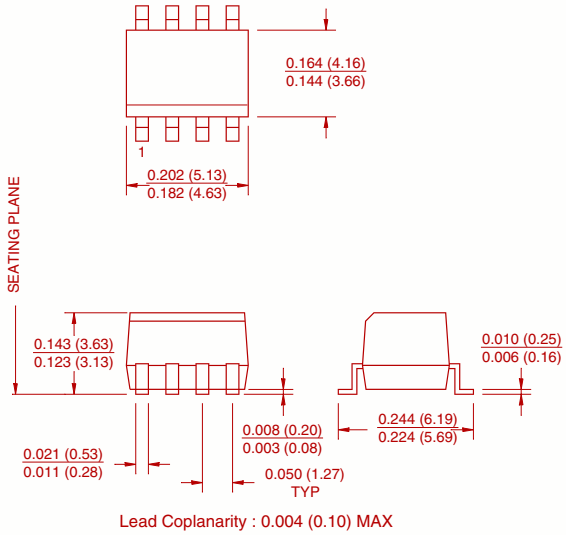
## APPLICATIONS

- Power system for workstations
- Telecom central office supply
- Telecom bricks

**FUNCTIONAL BLOCK DIAGRAM**




## PACKAGE DIMENSIONS



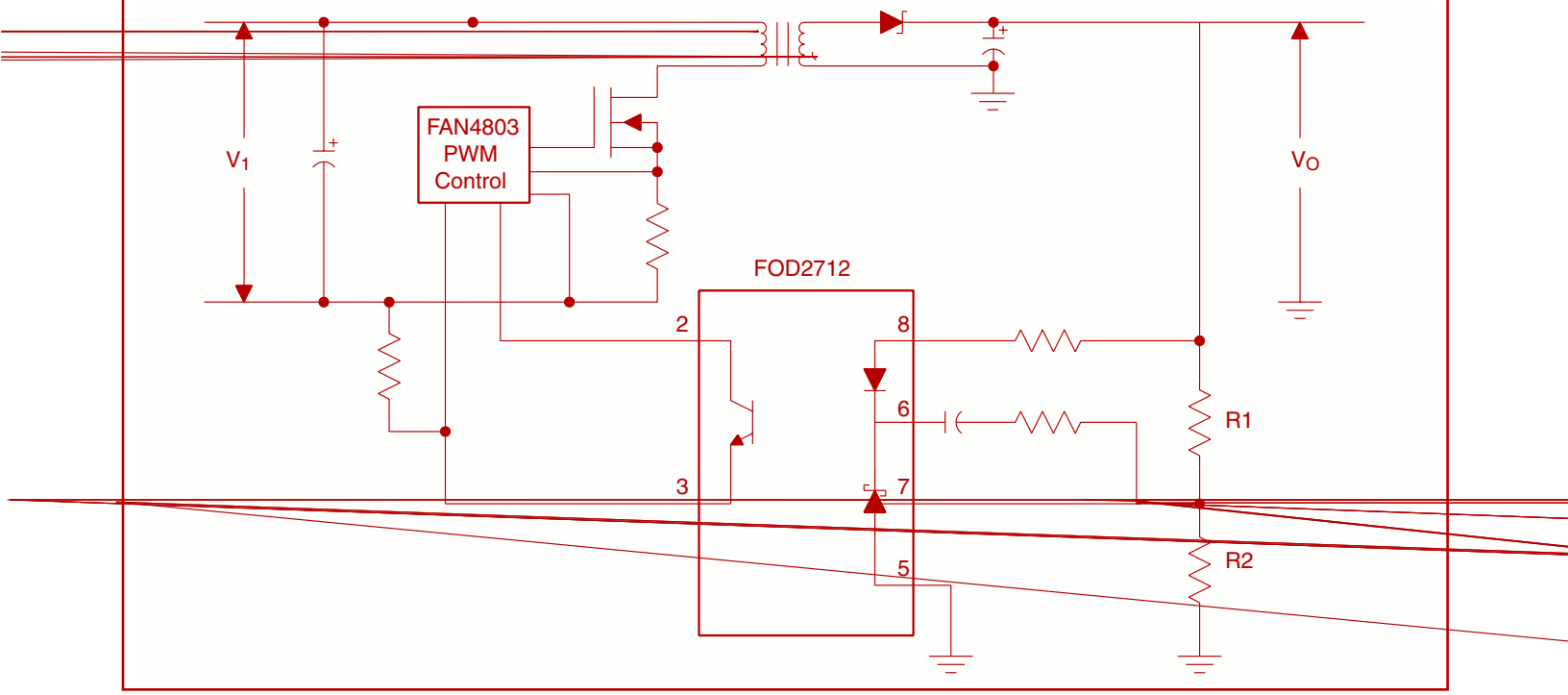

**NOTE**
All dimensions are in inches (millimeters)

## PIN DEFINITIONS

| Pin Number | Pin Name | Pin function description |
|---|---|---|
| 1 | NC | Not connected |
| 2 | C | Phototransistor Collector |
| 3 | E | Phototransistor Emitter |
| 4 | NC | Not connected |
| 5 | GND | Ground |
| 6 | COMP | Error Amplifier Compensation. This pin is the output of the error amplifier. * |
| 7 | FB | Voltage Feedback. This pin is the inverting input to the error amplifier |
| 8 | LED | Anode LED. This pin is the input to the light emitting diode. |

* The compensation network must be attached between pins 6 and 7.

## TYPICAL APPLICATION




## ABSOLUTE MAXIMUM RATINGS ($T_A$ = 25°C Unless otherwise specified.)

| Parameter | Symbol | Value | Units |
|---|---|---|---|
| Storage Temperature | $T_{STG}$ | -55 to +125 | °C |
| Operating Temperature | $T_{OPR}$ | -40 to +85 | °C |
| Reflow Temperature Profile (refer to fig. 21) | | | |
| Input Voltage | $V_{LED}$ | 13.2 | V |
| Input DC Current | $I_{LED}$ | 20 | mA |
| Collector-Emitter Voltage | $V_{CEO}$ | 30 | V |
| Emitter-Collector Voltage | $V_{ECO}$ | 7 | V |
| Collector Current | $I_C$ | 50 | mA |
| Input Power Dissipation (note 1) | PD1 | 145 | mW |
| Transistor Power Dissipation (note 2) | PD2 | 85 | mW |
| Total Power Dissipation (note 3) | PD3 | 145 | mW |

Notes
1. Derate linearly from 25°C at a rate of 2.42 mW/ °C
2. Derate linearly from 25°C at a rate of 1.42 mW/ °C.
3. Derate linearly from 25°C at a rate of 2.42 mW/ °C.
4. Functional operation under these conditions is not implied. Permanent damage may occur if the device is subjected to conditions outside these ratings.

## ELECTRICAL CHARACTERISTICS ($V_{CC}$ = 12V, $T_A$ = 25°C Unless otherwise specified.)

### INPUT CHARACTERISTICS

| Parameter | Test Conditions | Symbol | Min | Typ** | Max | Unit |
|---|---|---|---|---|---|---|
| LED forward voltage | ($I_{LED}$ = 10 mA, $V_{COMP}$ = $V_{FB}$)(Fig.1) | $V_F$ | | | 1.5 | V |
| Reference voltage (-40 to +85°C) | ($V_{COMP}$ = $V_{FB}$, $I_{LED}$ = 10 mA (Fig.1) | $V_{REF}$ | 1.221 | | 1.259 | V |
| (25°C) | | | 1.228 | 1.240 | 1.252 | |
| Deviation of $V_{REF}$ over temperature - See Note 1 | ($T_A$ = -40 to +85°C) | $V_{REF\ (DEV)}$ | | 4 | 12 | mV |
| Ratio of Vref variation to the output of the error amplifier | ($I_{LED}$ = 10 mA, $V_{COMP}$ = $V_{REF}$ to 12 V) (Fig.2) | $\Delta V_{REF}/\Delta V_{COMP}$ | | -1.5 | -2.7 | mV/V |
| Feedback input current | ($I_{LED}$ = 10 mA, R1 = 10 kΩ) (Fig.3) | $I_{REF}$ | | 0.15 | 0.5 | µA |
| Deviation of $I_{REF}$ over temperature - See Note 1 | ($T_A$ = -40 to +85°C) | $I_{REF\ (DEV)}$ | | 0.15 | 0.3 | µA |
| Minimum drive current | ($V_{COMP}$ = $V_{FB}$) (Fig.1) | $I_{LED\ (MIN)}$ | | 55 | 80 | µA |
| Off-state error amplifier current | ($V_{LED}$ = 6 V, $V_{FB}$ = 0) (Fig.4) | $I_{(OFF)}$ | | 0.001 | 0.1 | µA |
| Error amplifier output impedance - See Note 2 | ($V_{COMP}$ = $V_{FB}$, $I_{LED}$ = 0.1 mA to 15 mA, f<1 kHZ) | $\lvert Z_{OUT}\rvert$ | | 0.25 | | Ohm |

1. The deviation parameters $V_{REF(DEV)}$ and $I_{REF(DEV)}$ are defined as the differences between the maximum and minimum values obtained over the rated temperature range. The average full-range temperature coefficient of the reference input voltage, $\Delta V_{REF}$, is defined as:

$$\lvert\Delta V_{REF}\rvert(\text{ppm/°C}) = \frac{\{V_{REF(DEV)}/V_{REF}(T_A = 25°C)\} \times 10^6}{\Delta T_A}$$

where $\Delta T_A$ is the rated operating free-air temperature range of the device.

2. The dynamic impedance is defined as $\lvert Z_{OUT}\rvert = \Delta V_{COMP}/\Delta I_{LED}$. When the device is operating with two external resistors (see Figure 2), the total dynamic impedance of the circuit is given by:

$$\lvert Z_{OUT,\,TOT}\rvert = \frac{\Delta V}{\Delta I} \approx \lvert Z_{OUT}\rvert \times \left[1 + \frac{R1}{R2}\right]$$

## OUTPUT CHARACTERISTICS ($T_A$ = 25°C Unless otherwise specified.)

| Parameter | Test Conditions | Symbol | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| Collector dark current | ($V_{CE}$ = 10 V) (Fig. 5) | $I_{CEO}$ | | | 50 | nA |
| Collector-emitter voltage breakdown | ($I_C$ = 1.0mA) | $BV_{CEO}$ | 70 | | | V |
| Emitter-collector voltage breakdown | ($I_E$ = 100 µA) | $BV_{ECO}$ | 7 | | | V |

## TRANSFER CHARACTERISTICS ($T_A$ = 25°C Unless otherwise specified.)

| Parameter | Test Conditions | Symbol | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| Current transfer ratio | ($I_{LED}$ = 10 mA, $V_{COMP}$ = $V_{FB}$, $V_{CE}$ = 5 V) (Fig. 6) | CTR | 100 | | 200 | % |
| Collector-emitter saturation voltage | ($I_{LED}$ = 10 mA, $V_{COMP}$ = $V_{FB}$, $I_C$ = 2.5 mA) (Fig. 6) | $V_{CE\ (SAT)}$ | | | 0.4 | V |

## ISOLATION CHARACTERISTICS ($T_A$ = 25°C Unless otherwise specified.)

| Parameter | Test Conditions | Symbol | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| Input-output insulation leakage current | (RH = 45%, $T_A$ = 25°C, t = 5s, $V_{I-O}$ = 3000 VDC) (note. 1) | $I_{I-O}$ | | | 1.0 | µA |
| Withstand insulation voltage | (RH <= 50%, $T_A$ = 25°C, t = 1 min) (notes. 1) | $V_{ISO}$ | 2500 | | | Vrms |
| Resistance (input to output) | $V_{I-O}$ = 500 VDC (note. 1) | $R_{I-O}$ | | $10^{12}$ | | Ohm |

## SWITCHING CHARACTERISTICS ($T_A$ = 25°C Unless otherwise specified.)

| Parameter | Test Conditions | Symbol | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| Bandwidth | (Fig. 7) | $B_W$ | | 10 | | kHZ |
| Common mode transient immunity at output high | ($I_{LED}$ = 0 mA, $\|V_{cm}\|$ = 10 $V_{PP}$ RL = 2.2 kΩ (Fig. 8) (note. 2) | $\|CMH\|$ | | 1.0 | | kV/µs |
| Common mode transient immunity at output low | ($I_{LED}$ = 10 mA, $\|V_{cm}\|$ = 10 $V_{PP}$ RL = 2.2 kΩ (Fig. 8) (note. 2) | $\|CML\|$ | | 1.0 | | kV/µs |

Notes

1. Device is considered as a two terminal device: Pins 1, 2, 3 and 4 are shorted together and Pins 5, 6, 7 and 8 are shorted together.
2. Common mode transient immunity at output high is the maximum tolerable (positive) dVcm/dt on the leading edge of the common mode impulse signal, Vcm, to assure that the output will remain high. Common mode transient immunity at output low is the maximum tolerable (negative) dVcm/dt on the trailing edge of the common pulse signal,Vcm, to assure that the output will remain low.

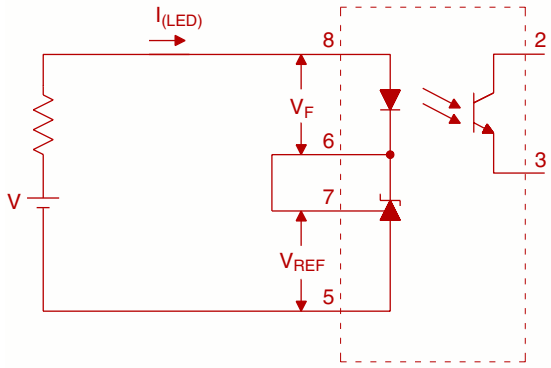



FIG. 1. $V_{REF}$, $V_F$, $I_{LED}$ (min) TEST CIRCUIT

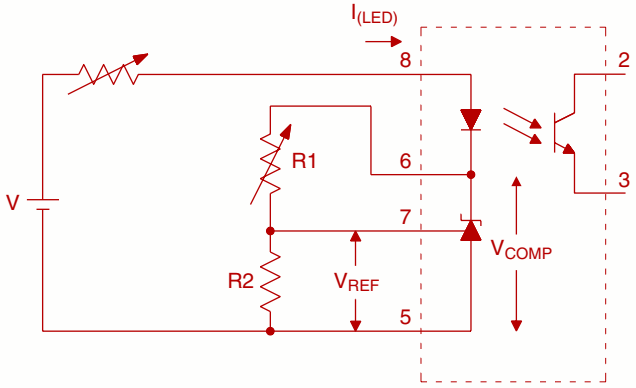



FIG. 2. $\Delta V_{REF}/\Delta V_{COMP}$ TEST CIRCUIT

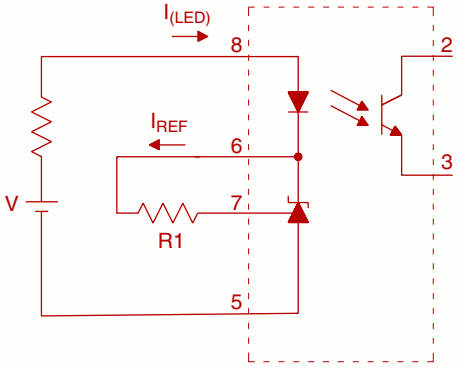



FIG. 3. $I_{REF}$ TEST CIRCUIT

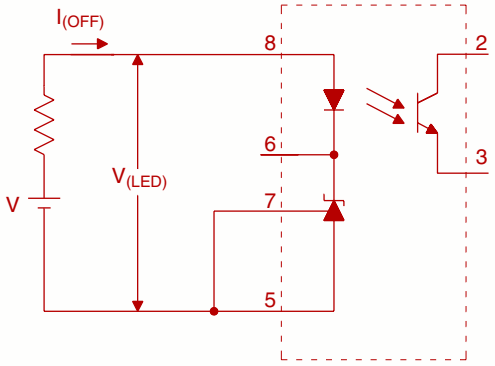



FIG. 4. $I_{(OFF)}$ TEST CIRCUIT

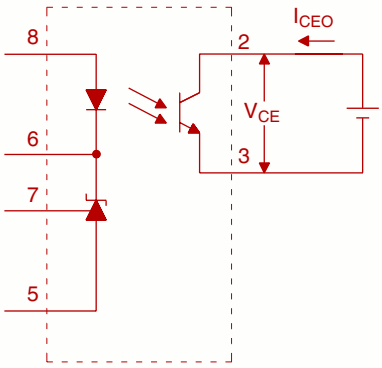



FIG. 5. $I_{CEO}$ TEST CIRCUIT

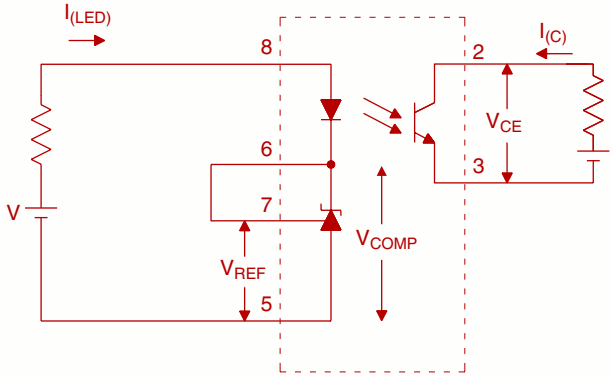



FIG. 6. CTR, $V_{CE(sat)}$ TEST CIRCUIT

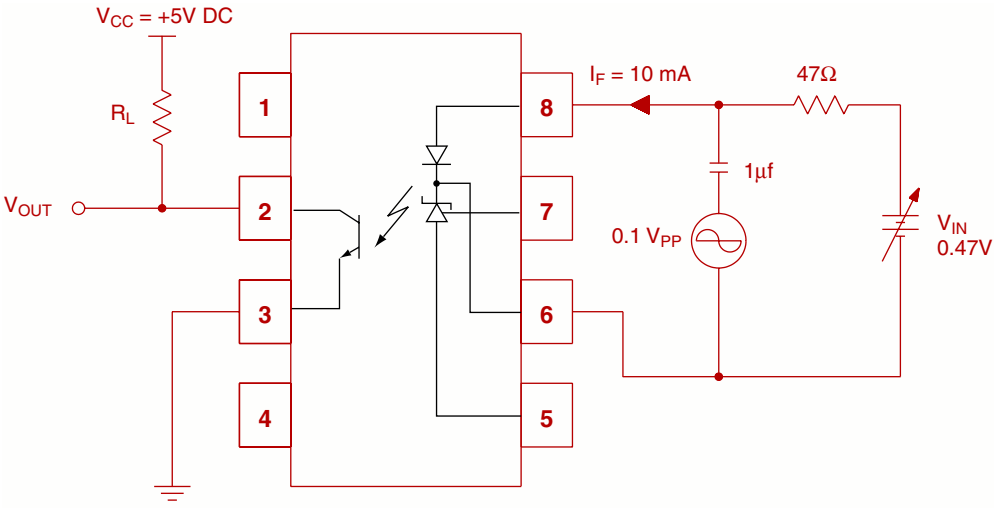



**Fig. 7 Frequency Response Test Circuit**

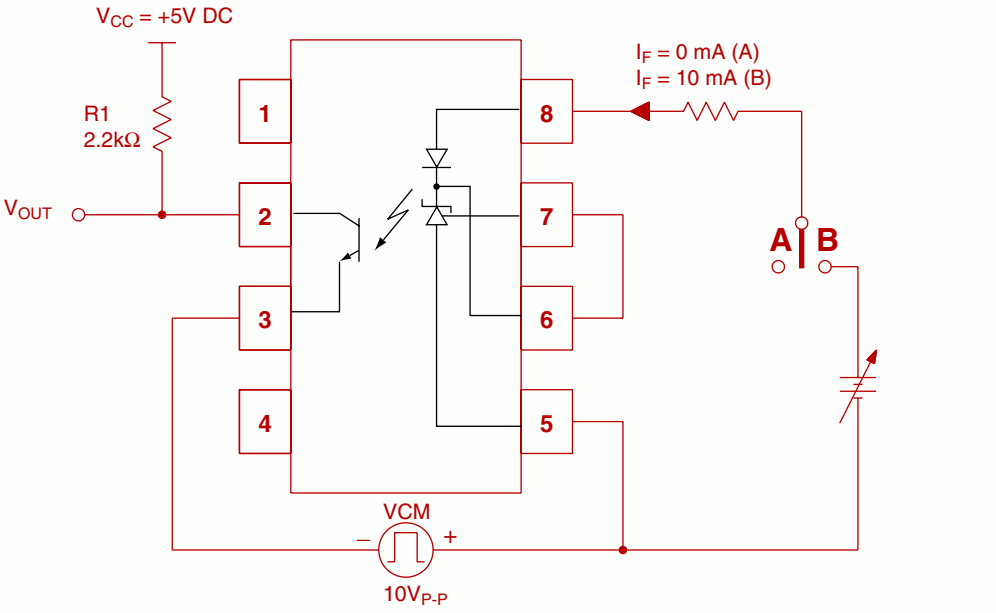


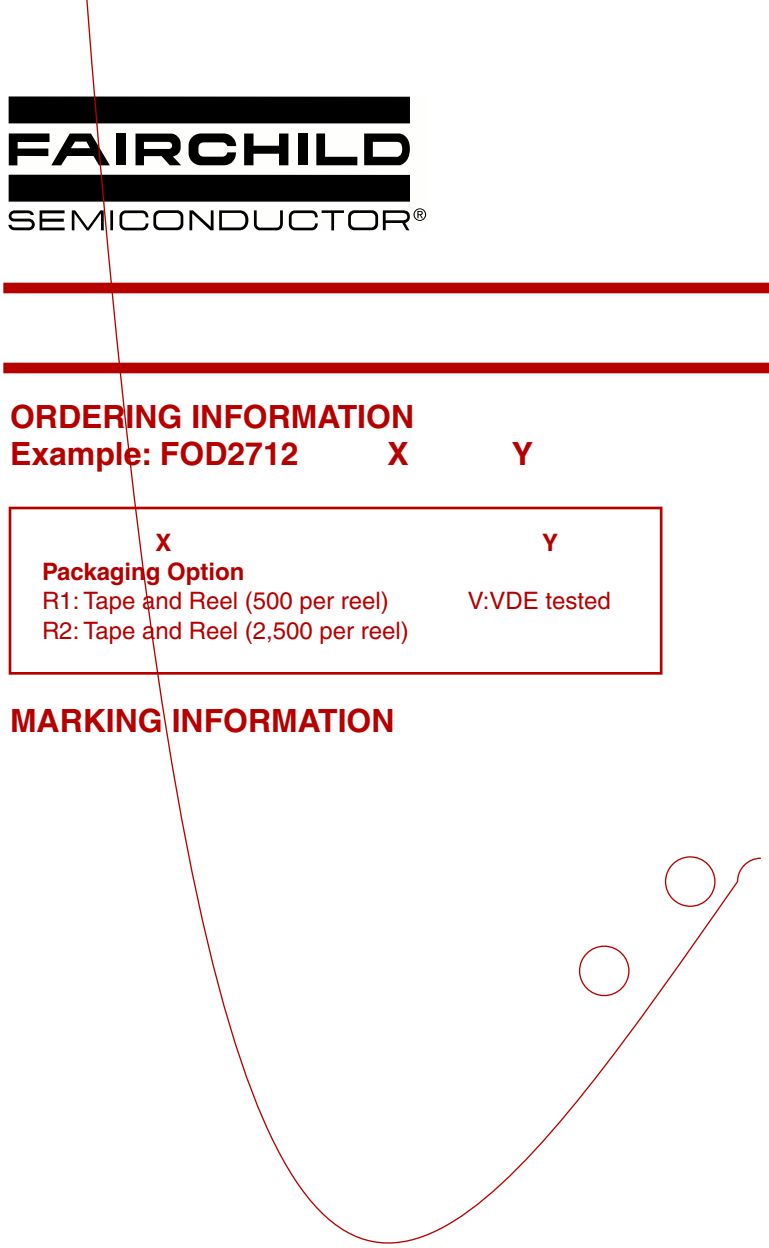

**Fig. 8 CMH and CML Test Circuit**

## ORDERING INFORMATION

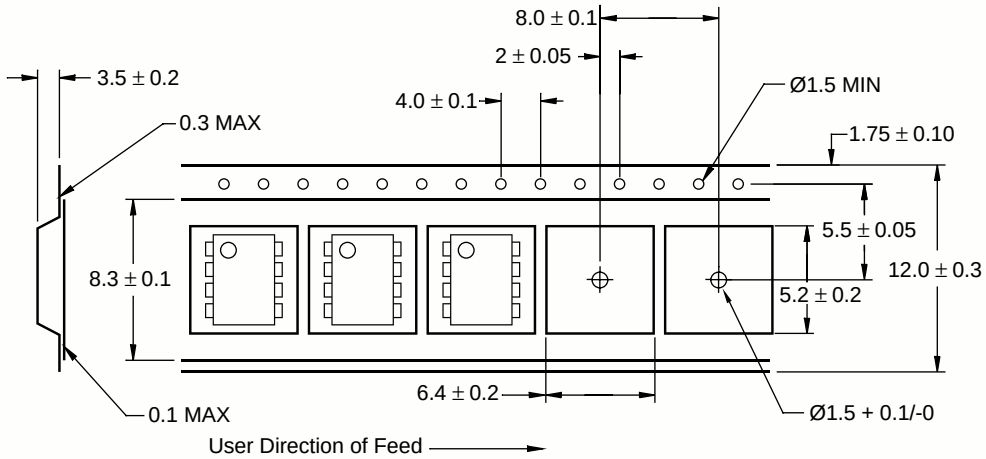
**Example: FOD2712 X Y**

| X | Y |
|---|---|
| **Packaging Option** | |
| R1: Tape and Reel (500 per reel) | V:VDE tested |
| R2: Tape and Reel (2,500 per reel) | |

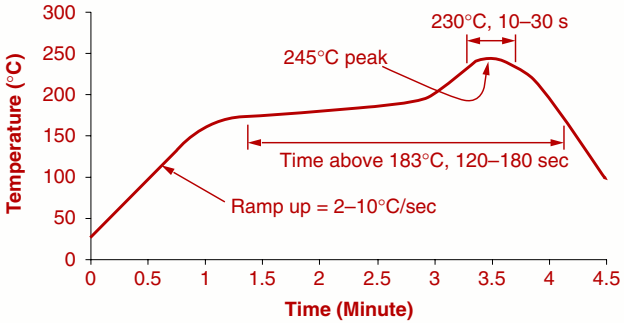
## MARKING INFORMATION



## Carrier Tape Specifications




## Reflow Profile




- Peak reflow temperature: 245°C (package surface temperature)
- Time of temperature higher than 183°C for 120–180 seconds
- One time soldering reflow is recommended

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