SOLID STATE OPTRONICS

# M212

1 Form B
400V / 35Ω
MOSFET Output Solid State Relay

## Description

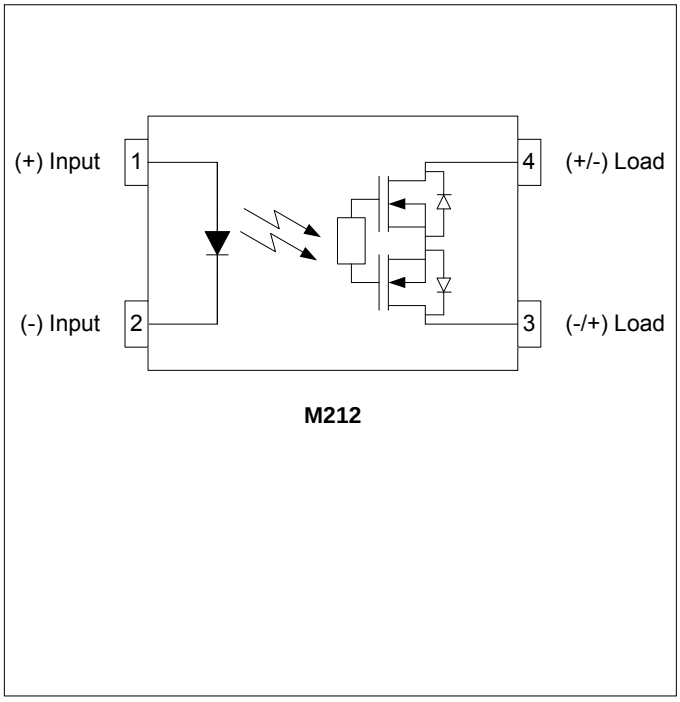
The M212 is a bi-directional, single-pole, single-throw, normally closed multipurpose solid-state relay in a miniature 4-pin small outline package. It is designed to replace electromechanical relays in general purpose switching applications. The relay consists of an integrated circuit that drives two rugged source-to-source depletion type DMOS transistors - optically coupled to a light emitting diode. The output MOS transistors are protected with free-wheeling diodes that can handle up to 1.5A of inrush current, making the relay ideal for switching lamps and highly inductive loads.

The M212 comes standard in a 4 pin SOP package.

## Applications

- Medical Equipment
- Security Systems
- Meter Reading Equipment
- Data Acquisition
- Battery Monitoring
- Multiplexers

## Schematic Diagram




**M212**

## Features

- High Input-to-Output Isolation (1.5kV MIN)
- Low Input Control Current (1.5mA TYP)
- 120mA Maximum Continuous Load Current
- Low On Resistance (35Ω MAX)
- Ultra Miniature 4SOP Package
- Long Life / High Reliability
- RoHS / Pb-Free / REACH Compliant

## Agency Approvals

| | |
|---|---|
| UL/C-UL: | File # E201932 |
| VDE: | File # 40035191 (EN 60747-5-2) |

## Absolute Maximum Ratings

The values indicated are absolute stress ratings. Functional operation of the device is not implied at these or any conditions in excess of those defined in electrical characteristics section of this document. Exposure to absolute Maximum Ratings may cause permanent damage to the device and may adversely affect reliability.

| | |
|---|---|
| Storage Temperature | -55 to +125°C |
| Operating Temperature | -40 to +85°C |
| Continuous Input Current | 50mA |
| Transient Input Current | 500mA |
| Reverse Input Control Voltage | 5V |
| Input Power Dissipation | 40mW |
| Total Power Dissipation | 400mW |
| Solder Temperature – Wave (10sec) | 260°C |
| Solder Temperature – IR Reflow (10sec) | 260°C |

## Ordering Information

| Part Number | Description |
|---|---|
| M212 | 4 pin SOP, (100/Tube) |
| M212-TR | 4 pin SOP, Tape and Reel (2000/Reel) |

**NOTE: Suffixes listed above are not included in marking on device for part number identification**

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M212/TR
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001603

## Electrical Characteristics, $T_A$ = 25°C (unless otherwise specified)

| Parameter | Symbol | Min. | Typ. | Max. | Units | Test Conditions |
|---|---|---|---|---|---|---|
| **Input Specifications** | | | | | | |
| LED Forward Voltage | $V_F$ | - | 1.2 | 1.5 | V | $I_F$ = 10mA |
| LED Reverse Voltage | $BV_R$ | 5 | - | - | V | $I_R$ = 10µA |
| Input Reverse Current | $I_R$ | - | - | 10 | µA | $V_R$ = 5V |
| Turn-On Current | $I_F$ | - | 0.5 | - | mA | $I_O$ = 100mA |
| Turn-Off Current | $I_{F(OFF)}$ | - | 1.5 | 5.0 | mA | $I_O$ = 100mA |
| **Output Specifications** | | | | | | |
| Blocking Voltage | $V_B$ | 400 | - | - | V | $I_O$=1µA |
| Continuous Load Current | $I_O$ | - | - | 120 | mA | $I_F$=0mA |
| On Resistance | $R_{ON}$ | - | 25 | 35 | Ω | $I_F$=0mA, $I_O$=100mA |
| Leakage Current | $I_{Oleak}$ | - | 0.2 | 1 | µA | $I_F$=5mA, $V_O$=400V |
| Output Capacitance | $C_{OUT}$ | - | 25 | - | pF | $V_O$=25V, f=1.0MHz |
| Offset Voltage | $V_{OFFSET}$ | - | - | 0.2 | mV | $I_F$=0mA |
| **Coupled Specifications** | | | | | | |
| Turn-On Time | $T_{ON}$ | - | 0.1 | 0.5 | mS | $I_F$=0mA, $I_O$=100mA |
| Turn-Off Time | $T_{OFF}$ | - | 1.5 | 3 | mS | $I_F$=5mA, $I_O$=100mA |
| Coupled Capacitance | $C_{COUPLED}$ | - | 3 | - | pF | |
| Contact Transient Ratio | - | 2,000 | 7,000 | 0 | V/µS | dV = 50V |
| **Isolation Specifications** | | | | | | |
| Isolation Voltage | $V_{ISO}$ | 1500 | - | - | $V_{RMS}$ | RH ≤ 50%, t=1min |
| Input-Output Resistance | $R_{I-O}$ | - | $10^{12}$ | - | Ω | $V_{I-O}$ = 500$V_{DC}$ |

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## M212 Performance & Characteristics Plots, $T_A$ = 25°C (unless otherwise specified)

**Figure 1:** *Typical Turn-On Time Distribution* (N = 100, $T_a$ = 25ºC)

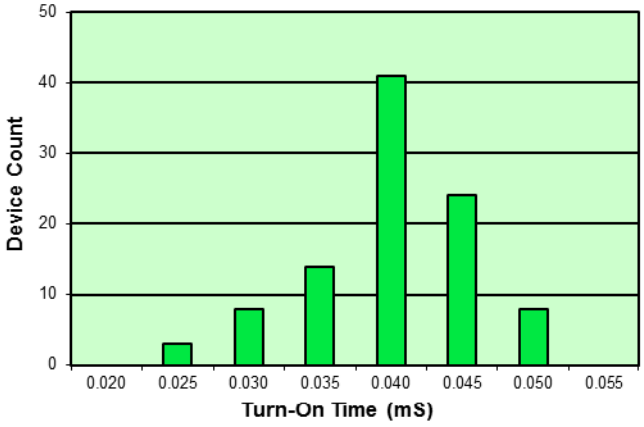



**Figure 2:** *Typical Turn-Off Time Distribution* (N = 100, $T_a$ = 25ºC)

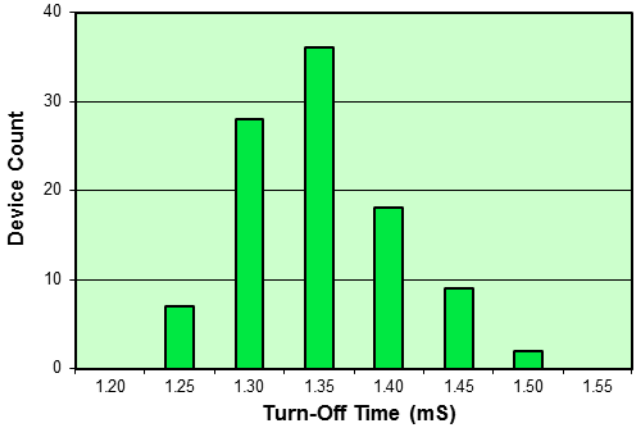



**Figure 3:** *Typical On-Resistance Distribution* (N = 100, $T_a$ = 25ºC)

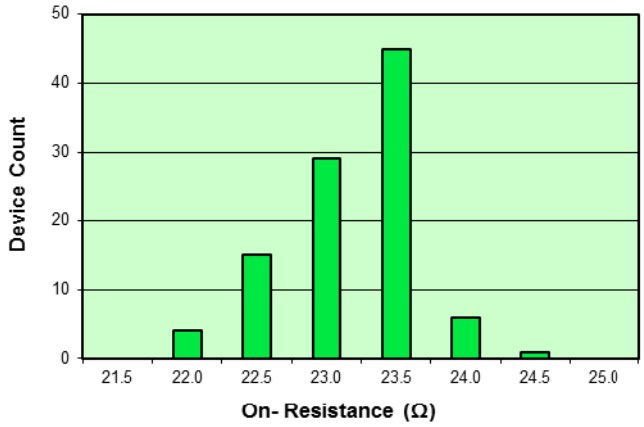



**Figure 4:** *Typical Output Leakage Current Distribution* (N = 100, $T_a$ = 25ºC)

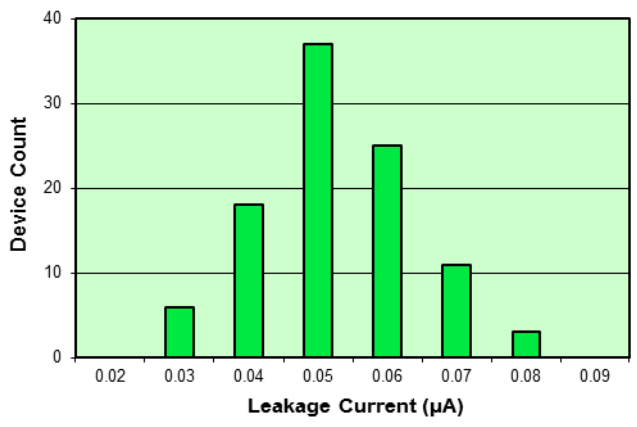



**Figure 5:** *Typical Blocking Voltage Distribution* (N = 100, Ta = 25ºC)

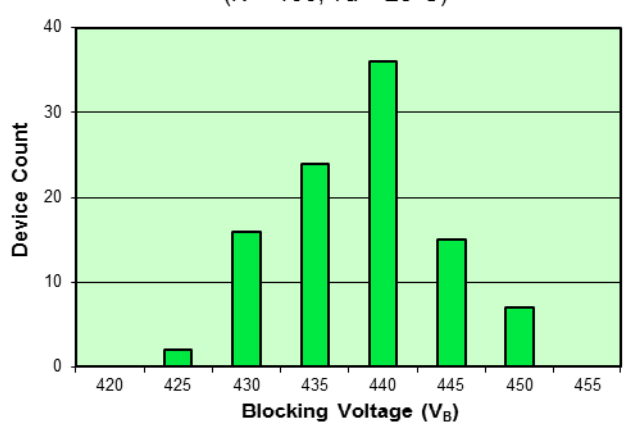
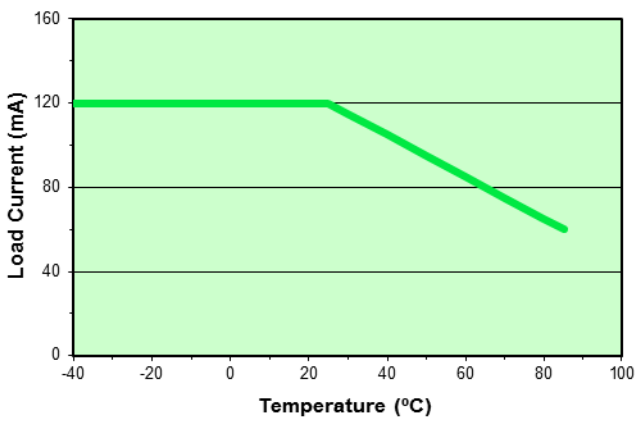



**Figure 6:** *Maximum Load Current vs. Temperature*

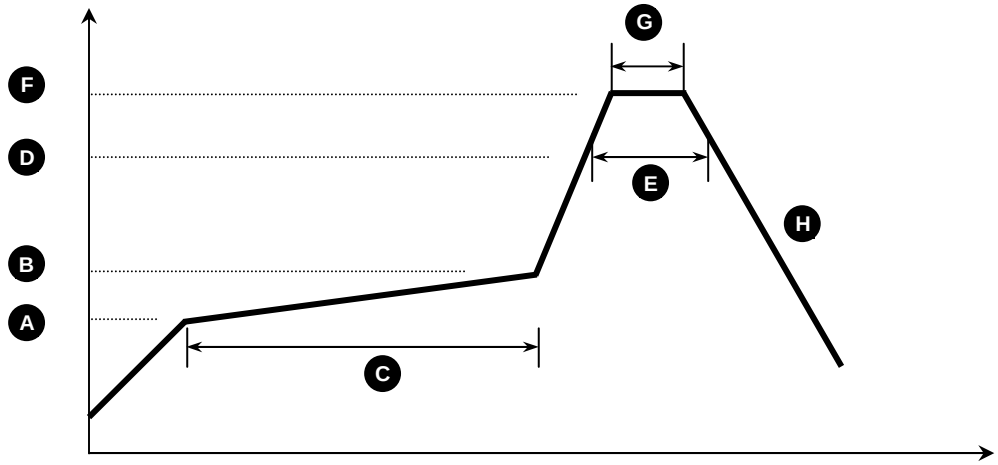



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## M212 Solder Reflow Temperature Profile Recommendations

### (1) *Infrared Reflow*:

Refer to the following figure as an example of an optimal temperature profile for single occurrence infrared reflow. Soldering process should not exceed temperature or time limits expressed herein. Surface temperature of device package should not exceed 250ºC:




| Process Step | Description | Parameter |
|---|---|---|
| A | Preheat Start Temperature (ºC) | 150ºC |
| B | Preheat Finish Temperature (ºC) | 180ºC |
| C | Preheat Time (s) | 90 - 120s |
| D | Melting Temperature (ºC) | 230ºC |
| E | Time above Melting Temperature (s) | 30s |
| F | Peak Temperature, at Terminal (ºC) | 260ºC |
| G | Dwell Time at Peak Temperature (s) | 10s |
| H | Cool-down (ºC/s) | <6ºC/s |

### (2) *Wave Solder*:

| | |
|---|---|
| Maximum Temperature: | 260ºC (at terminal) |
| Maximum Time: | 10s |
| Pre-heating: | 100 - 150ºC (30 - 90s) |
| Single Occurrence | |

### (3) *Hand Solder*:

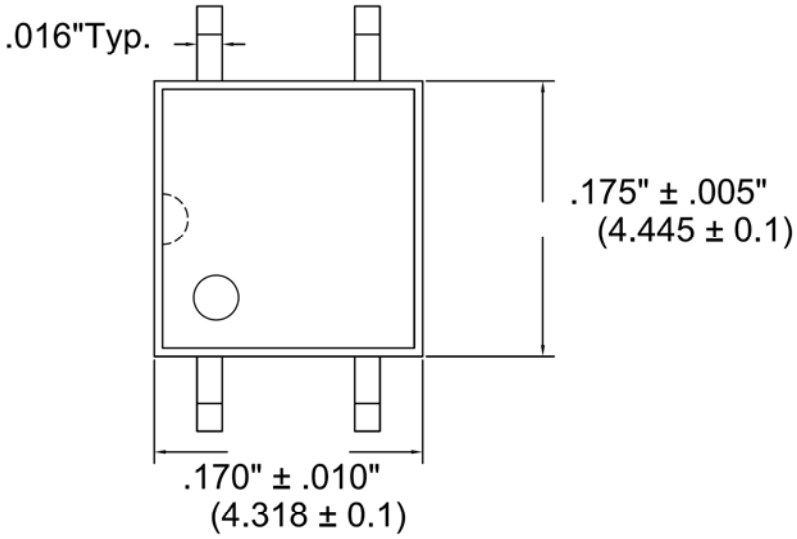
| | |
|---|---|
| Maximum Temperature: | 350ºC (at tip of soldering iron) |
| Maximum Time: | 3s |
| Single Occurrence | |

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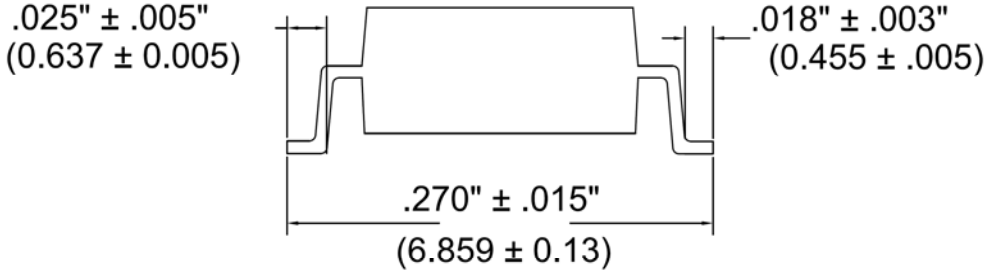
## M212 Package Dimensions

*4 PIN SOP Package*

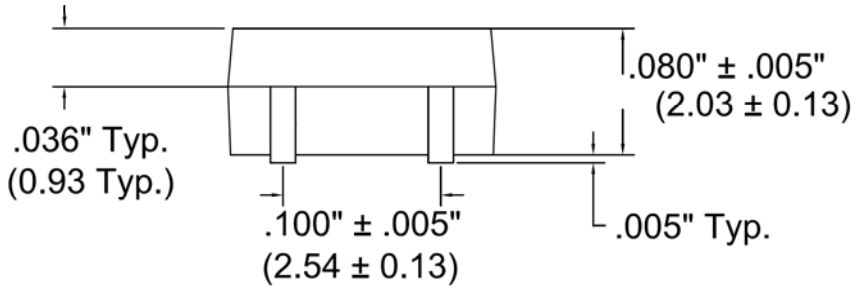
***Note:*** *All dimensions in inches with millimeters [mm] in parenthesis ()*




**TOP VIEW**




**END VIEW**



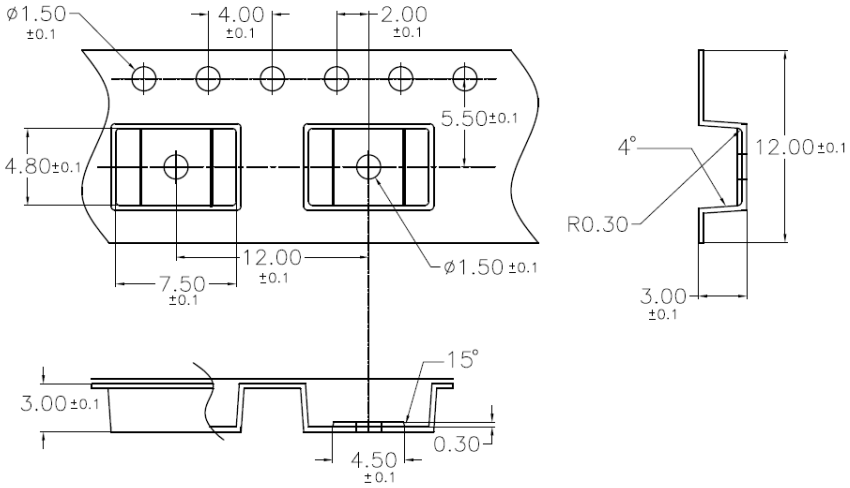

**SIDE VIEW**

### M212 Packaging Specifications

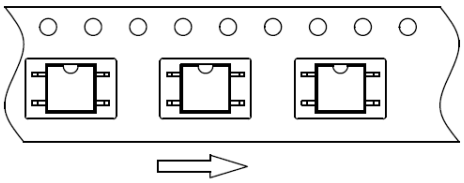
*Tape & Reel Specifications (T&R)*

***Note:*** *All dimensions in millimeters [mm]*

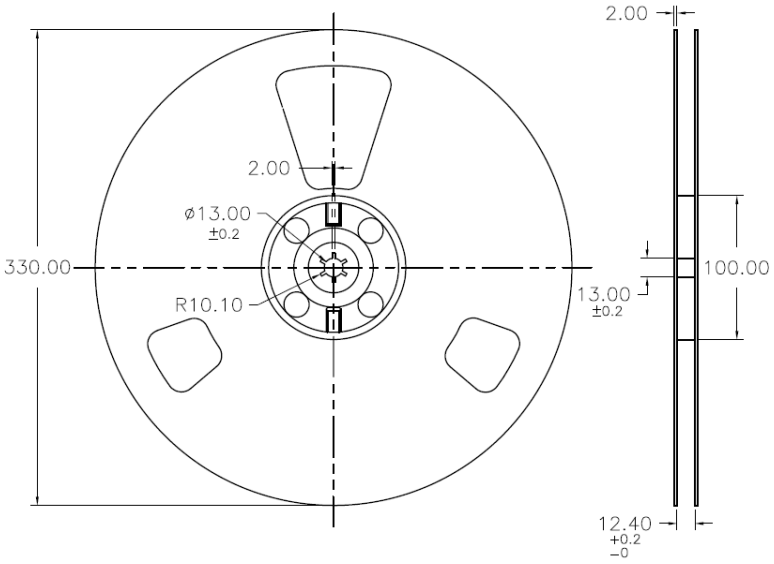
## Outline and Dimension (Tape)




## Parts Orientation and Tape Direction

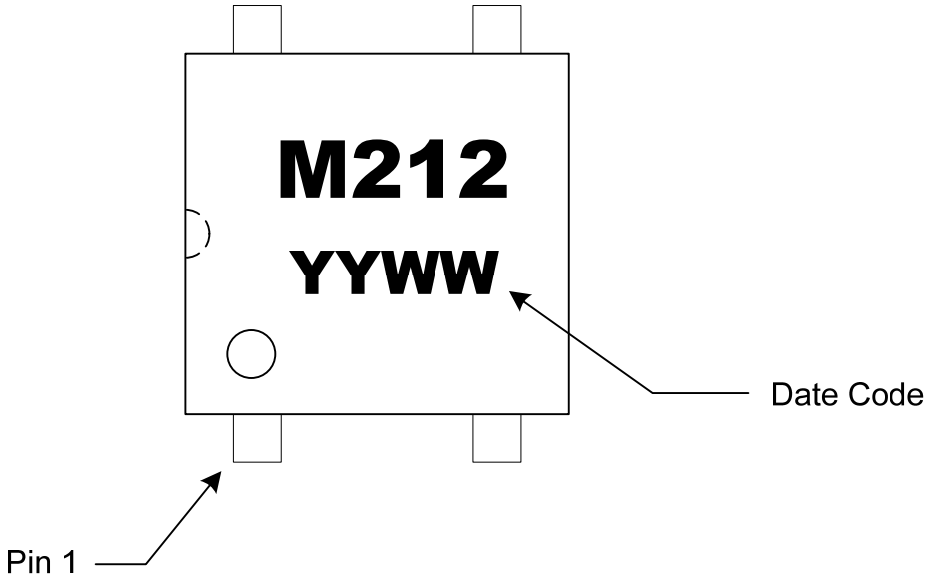


## Outline and Dimensions (Reel)




**Packaging: 2,000 pcs / reel**

**M212 Package Marking**




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