

MN1380 Series

CMOS LSIs for Voltage Detection

■ Overview

The MN1380 series are elements that monitor the power supply voltage supplied to microcomputers and other LSI systems and issue reset signals for initializing the system after the power is first applied or for preventing runaway operation when the supply voltage fluctuates.

There is a choice of three output types: CMOS output, N-channel open drain output, and inverted CMOS output. There are also three package types: M, TO-92, and a mini type for surface mounting.

Choose the ideal element for your application from the series' wide selection of detection ranks (17 ranks between 2.0 and 4.9 volts), output types, and package types.

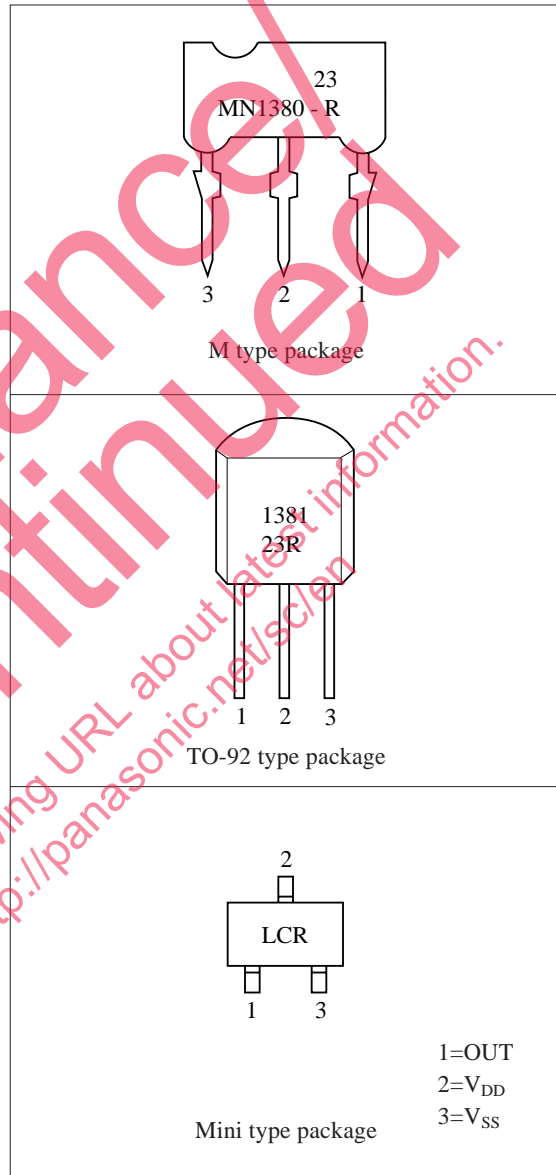
■ Features

- Three-pin element requiring no adjustment
- Wide selection of detection ranks (17 ranks between 2.0 and 4.9 volts)
- Highly precise detection voltage
- Detection voltage with hysteresis characteristic
 $\Delta V_D = 50 \text{ mV}$ for ranks C to K
 $\Delta V_D = 100 \text{ mV}$ for ranks L to U
- Low current consumption: $I_{DD} = 1\mu\text{A}$ (typ.) for $V_{DD} = 5 \text{ V}$
- Low fluctuation in detection voltage with temperature (typ. $1 \text{ mV}/^\circ\text{C}$)
- Wide selection of output types: CMOS output, N-channel open drain output, and inverted CMOS output
- Wide selection of package types: M, TO-92, and a mini type for surface mounting.

■ Applications

- Battery checkers
- Power outage detectors
- Level discriminators
- Memory backup systems
- Microcomputer reset circuits
- Reset circuits for other electronic circuits

■ Pin Assignment



■ MN1380 Series Naming Conventions

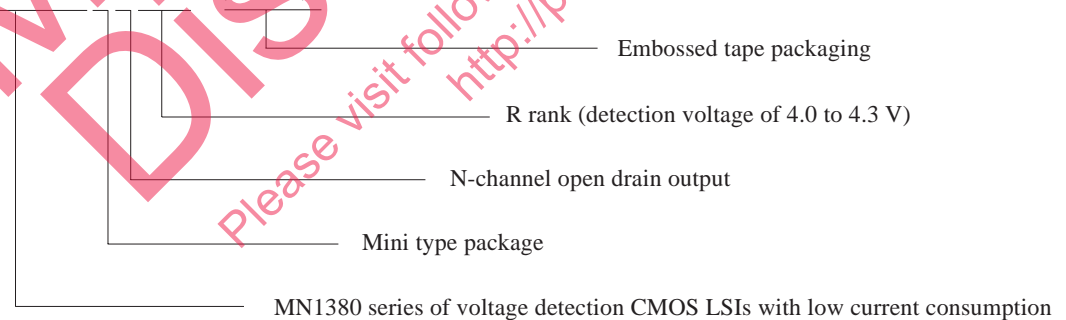
The MN1380 series offers a wide selection of detection ranks, output types, package types, and packaging. All combinations use the following naming conventions. When ordering, be sure to give the correct part number using these naming conventions.

MN13801-R (TA)



(Example)

MN13821-R (TW)



■ Minimum Packaging Unit

- Bulk (M and TO-92 types) 1,000
- Magazine (Mini type) 50
- Taping (Mini and TO-92 types) 3,000

■ Series Lineup

| Output | Package | M type Package | TO-92 type Package | Mini type Package |
|-----------------------------|---------|----------------|--------------------|-------------------|
| CMOS output | | MN1380 | MN1381 | MN1382 |
| N-channel open drain output | | MN13801 | MN13811 | MN13821 |
| Inverted CMOS output | | MN13802 | MN13812 | MN13822 |

■ Detection Ranks (on Voltage)

| Rank | Detection Voltage for Drop in Power Supply Voltage (V_{DL}) | | Unit | Detection Voltage Hysteresis Width (ΔV_D) | | Unit |
|------|---|-----|------|---|-----|------|
| | min | max | | min | max | |
| C | 2.0 | 2.2 | V | 50 | 300 | mV |
| D | 2.1 | 2.3 | | | | |
| E | 2.2 | 2.4 | | | | |
| F | 2.3 | 2.5 | | | | |
| G | 2.4 | 2.6 | | | | |
| H | 2.5 | 2.7 | | | | |
| J | 2.6 | 2.9 | V | 50 | 300 | mV |
| K | 2.8 | 3.1 | | | | |
| L | 3.0 | 3.3 | | | | |
| M | 3.2 | 3.5 | V | 100 | 300 | mV |
| N | 3.4 | 3.7 | | | | |
| P | 3.6 | 3.9 | | | | |
| Q | 3.8 | 4.1 | | | | |
| R | 4.0 | 4.3 | | | | |
| S | 4.2 | 4.5 | | | | |
| T | 4.4 | 4.7 | | | | |
| U | 4.6 | 4.9 | | | | |

Maintenance
 Discontinued

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■ Block Diagram



Note *1: Circuits vary slightly depending on the output type (CMOS output, N-channel open drain output, or inverted CMOS output)

■ Pin Descriptions

| Pin No. | Symbol | Function Description |
|---------|-----------------|-------------------------|
| 1 | OUT | Reset signal output pin |
| 2 | V _{DD} | Power supply pin |
| 3 | V _{SS} | Ground pin |

■ Absolute Maximum Ratings $V_{SS}=0V, T_a=25^{\circ}C$

| Parameter | Symbol | Rating | Unit |
|-------------------------------|-----------|----------------------|-------------|
| Power supply voltage | V_{DD} | 7.0 | V |
| Output voltage | V_O | -0.3 to $V_{DD}+0.3$ | V |
| Operating ambient temperature | T_a | -20 to +70 | $^{\circ}C$ |
| Storage temperature | T_{stg} | -55 to +125 | $^{\circ}C$ |

■ Recommended Operating Conditions $V_{SS}=0V, T_a=25^{\circ}C$

| Parameter | Symbol | Conditions | min | typ | max | Unit |
|----------------------|----------|----------------------|-----|-----|-----|------|
| Power supply voltage | V_{DD} | See Figures 1 and 4. | 1.5 | | 6.0 | V |

■ Electrical Characteristics

 1) DC Characteristics $V_{SS}=0V, T_a=-20^{\circ}C$ to $+70^{\circ}C$

| Parameter | Symbol | Conditions | min | typ | max | Unit |
|---|--------------|---|----------------------------------|-------------|----------|---------|
| Power supply current | I_{DD} | $V_{DD} = 5V$ *1 Load resistance = 10 k Ω | | 1 | 5 | μA |
| Detection voltage for drop in power supply voltage *2 | V_{DL} | $T_a=25^{\circ}C$ See Figures 1 and 4. | *2 | | *2 | V |
| Detection voltage hysteresis width *2 | ΔV_D | See Figures 1 and 4. | *2 | | *2 | mV |
| "H" level output voltage | V_{OH} | CMOS output | $I_{OH}=-40\mu A$ | $0.8V_{DD}$ | V_{DD} | V |
| | | Inverted CMOS output | $V_{DD}=1.8V$ $I_{OH}=-0.5mA$ | 0.8 | V_{DD} | |
| "L" level output voltage | V_{OL} | N-channel open drain output | $V_{DD}=1.8V$ $I_{OL}=0.7mA$ | V_{SS} | 0.4 | V |
| | | Inverted CMOS output | $V_{DD}=6.0V$ $I_{OH}=0.3mA$ | V_{SS} | 0.6 | |

Notes

*1: This includes the output pin's leakage current.

*2: For particulars, see the detection voltage rank table.

■ Electrical Characteristics (continued)

2) AC Characteristics $V_{SS}=0V, T_a=25^{\circ}C$

| Parameter | Symbol | Conditions | Allowable Value (typ) | | | Unit |
|--------------------|----------|----------------------------|----------------------------|-------------------------------|-------------------------------|-------|
| | | | MN1380 MN1381 MN1382 | MN13801 MN13811 MN13821 | MN13802 MN13812 MN13822 | |
| Reset release time | t_{OH} | See Figures 2 and 3. | Rank | | | |
| | | | C | | | |
| | | | D | | | |
| | | | E | 3.0 | 2.5 | 230.0 |
| | | | F | | | |
| | | | G | | | |
| | | | H | | | |
| | | | J | 3.0 | 3.0 | 100.0 |
| | | | K | | | |
| | | | L | | | |
| | | | M | | | |
| | | | N | | | |
| | | | P | | | |
| | | | Q | 2.0 | 4.0 | 30.0 |
| | | | R | | | |
| | | | S | | | |
| T | | | | | | |
| Reset time | t_{OL} | See Figures 2 and 3. | C | | | |
| | | | D | | | |
| | | | E | 250.0 | 160.0 | 3.0 |
| | | | F | | | |
| | | | G | | | |
| | | | H | | | |
| | | | J | 115.0 | 100.0 | 3.0 |
| | | | K | | | |
| | | | L | | | |
| | | | M | | | |
| | | | N | | | |
| | | | P | | | |
| | | | Q | 15.0 | 35.0 | 3.0 |
| | | | R | | | |
| | | | S | | | |
| | | | T | | | |

■ Description of Operation

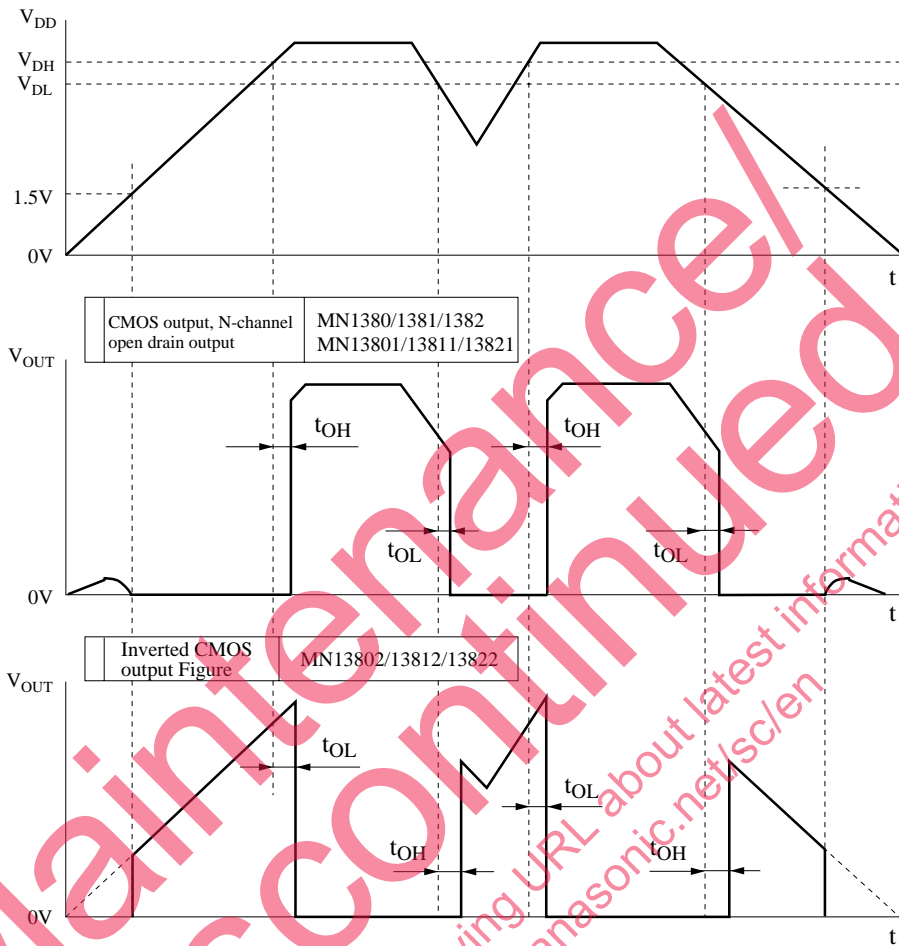


Figure 1. Description of Operation

Notes

- 1: Output cannot be specified for power supply voltages under 1.5 V because operation is not guaranteed for that range.
- 2: V_{DL} : Detection voltage for drop in power supply voltage
 V_{DH} : Detection voltage for rise in power supply voltage
 t_{OL} : Time lag between the time that the power supply voltage reaches the detection voltage (V_{DL} or V_{DH}) and the time that the output pin (OUT) goes to "L" level.
 t_{OH} : Time lag between the time that the power supply voltage reaches the detection voltage (V_{DL} or V_{DH}) and the time that the output pin (OUT) goes to "H" level.
- 3: These characteristics for the N-channel open drain output are when a load resistor is connected between the OUT and V_{DD} pins.

■ Description for Measuring the Output Characteristics



Figure 2. Description chart of Measuring the Output Characteristics



Figure 3. Circuit for Measuring the Output Characteristics

■ Description for Measuring the I/O Characteristics



Figure 4. Description chart for Measuring the I/O Characteristics

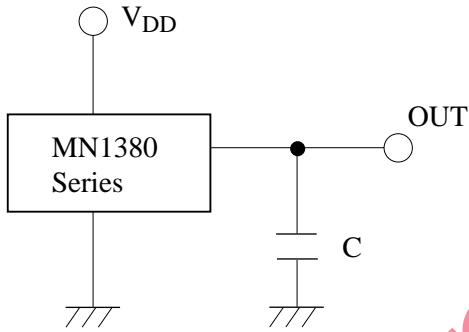
Notes

- 1: Output cannot be specified for power supply voltages under 1.5 V because operation is not guaranteed for that range.
- 2: V_{DL} : Detection voltage for drop in power supply voltage
 V_{DH} : Detection voltage for rise in power supply voltage
- 3: These characteristics for the N-channel open drain output are when a load resistor is connected between the OUT and V_{DD} pins.

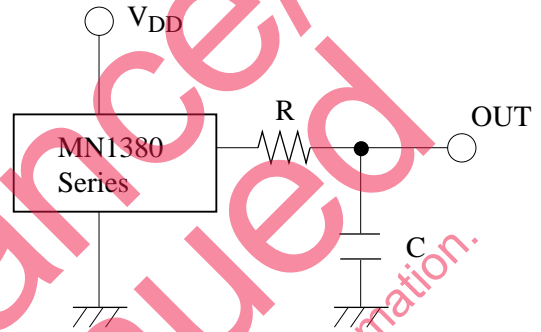
■ Application Circuit Example

Connect resistors, capacitors, and the like only to the output pin on the MN1380 series element. Note that connecting them to the Power source pins changes V_{DH} , V_{DL} , and ΔV_D .

Sample Circuit 1



Sample Circuit 2



Select the values of R and C to match the application.

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■ Package Dimensions (Unit: mm)

M type package



Note) The package will be changed to lead-free type (M3A). See the new package dimensions section later of this datasheet.

■ Package Dimensions (Unit: mm)(continued)

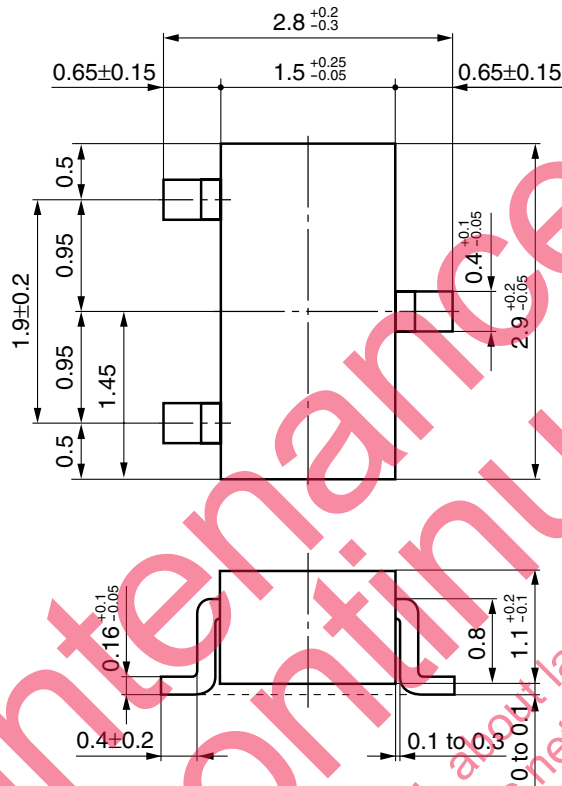
TO-92 type package



Note) The package will be changed to lead-free type (SSIP003-P-0000S). See the new package dimensions section later of this datasheet.

■ Package Dimensions (Unit: mm)(continued)

Mini type package



Note) The package will be changed to lead-free type (MINI-3DC). See the new package dimensions section later of this datasheet.

■ Reference Characteristics

The following characteristics curves represent results from a specific sample therefore they do not guarantee the characteristics for the final product.

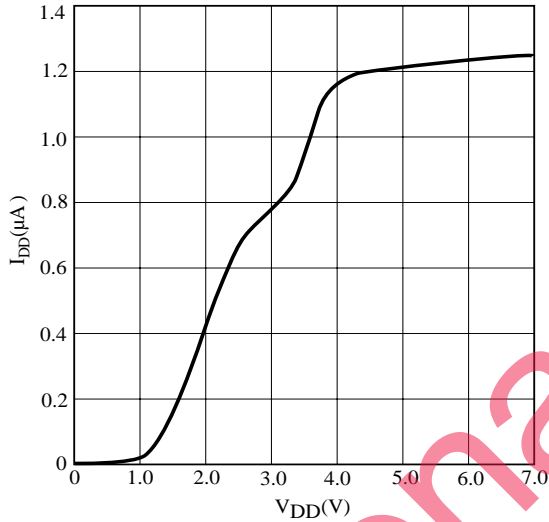


Figure 5.a. I_{DD} vs. V_{DD} Characteristic (Rank Q)



Figure 5.b. Measurement Circuit

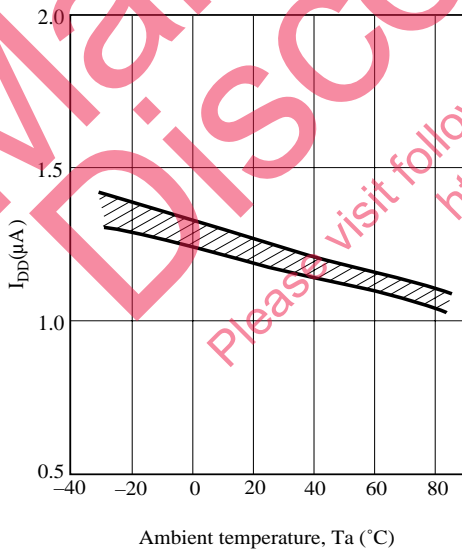


Figure 6.a. I_{DD} Temperature Characteristic (Rank Q)

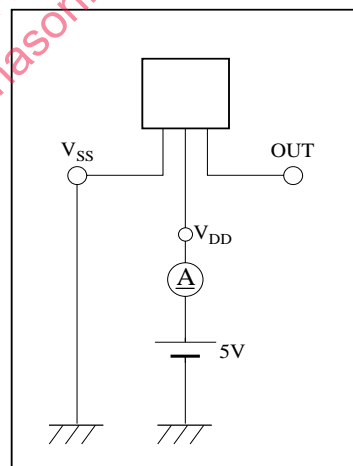


Figure 6.b. Measurement Circuit

■ Reference Characteristics (continued)



Figure 7.a. V_{DL}/V_{DH} Temperature Characteristic (Rank Q)

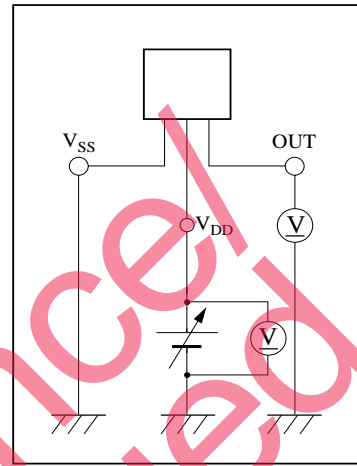


Figure 7.b. Measurement Circuit



Figure 8.a. ΔV_D Temperature Characteristic (Rank Q)

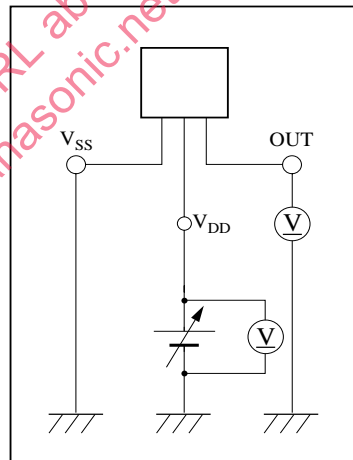


Figure 8.b. Measurement Circuit

■ Reference Characteristics (continued)



Figure 9.a. I_{OL} vs. V_{OL} Characteristic



Figure 9.b. Measurement Circuit



Figure 10.a. I_{OH} vs. V_{OH} Characteristic



Figure 10.b. Measurement Circuit

■ Reference Characteristics (continued)

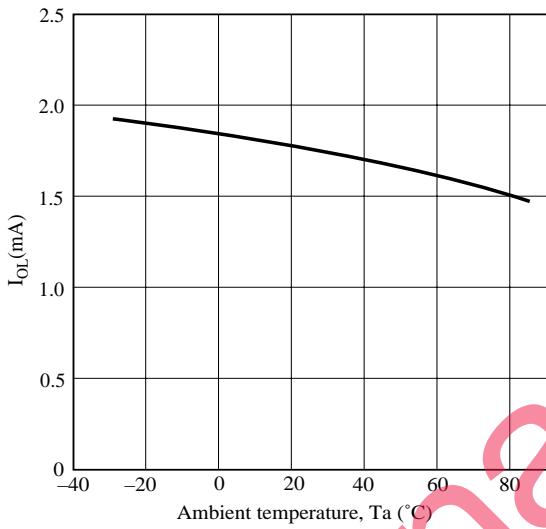


Figure 11.a. I_{OL} vs. Temperature Characteristic

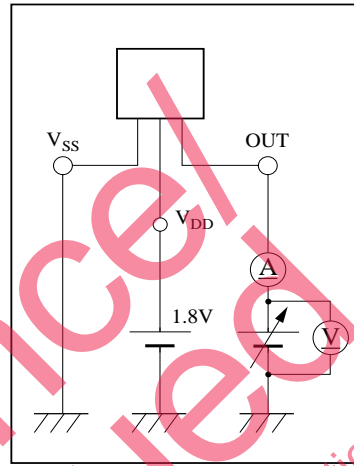


Figure 11.b. Measurement Circuit



Figure 12.a. I_{OH} vs. Temperature Characteristic

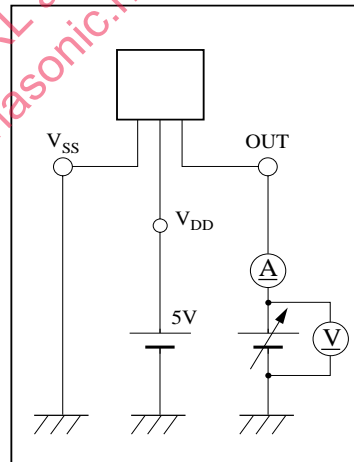


Figure 12.b. Measurement Circuit

■ TO-92 Type Package Taping-Specifications (MN1381/MN13811/MN13812)



Figure 13. TO-92 Type Package Taping-Dimensions (Ammunition pack)

TO-92 Type Package Taping Dimensions (Ammunition pack)

| Name | Symbol | Length (mm) | Name | Symbol | Length (mm) |
|--------------------------|----------|---------------------------------------|-------------------------------|--------|-------------|
| Product height* | A | 5.3 max | Adhesive tape width | W0 | 6.0±0.5 |
| Product width* | A1 | 5.2 max | Feed hole position | W1 | 9.0±0.5 |
| Product thickness* | T | 4.2 max | Adhesive tape position | W2 | 0.5 max |
| Lead width* | d | 0.45 ^{+0.15} _{-0.1} | Distance to top of product | H | 25.0 max |
| Taped lead length | l1 | 2.0 max | Distance to bottom of product | H0 | 19.0±0.5 |
| Product pitch | P | 12.7±1.0 | Lead clinch height | H1 | 16.0±0.5 |
| Feed hole pitch | P0 | 12.7±0.3 | Feed hole diameter | D0 | 4.0±0.2 |
| Feed hole position | P1 | 6.35±0.5 | Tape thickness | t1 | 0.7±0.2 |
| Lead spacing | F1, F2 | 2.5 ^{+0.5} _{-0.2} | Total tape thickness | t2 | 1.5 max |
| Product deflection angle | Δh1, Δh2 | 2.0 max | | | |
| Tape width | W | 18.0 ^{+1.0} _{-0.5} | | | |

Note*1: For further details, see the specifications issued separately.

| W | H | D |
|-----|-----|----|
| 330 | 250 | 41 |

Unit: mm



Figure 14. Box Dimensions for TO-92 Type Packages with Ammunition pack

■ Embossed Taping Specifications for Mini Type Package (MN1382/MN13821/MN13822)

There is a choice of two orientations, TW and TX, for the product relative to the tape.



(Marking surface on top)

Figure 15. TW Orientation



(Marking surface on top)

Figure 16. TX Orientation



Product orientation A is labeled TW; orientation B, TX.

Figure 17. Embossed Taping Dimensions for Mini Type Package



Figure 18. Embossed Taping Reel Dimensions for Mini Type Package

■ Reliability Testing Results for MN1380 Series

(1) M type package (MN1380/MN13801/MN13802) and TO-92 type package (MN1381/MN13811/MN13812)

| Test Subjects | Test Conditions | Results |
|---|--|---------|
| Operating lifetime test | $V_{DD}=5.5V$, $T_a=125^{\circ}C$, $t=1000hrs$ | 0/15 |
| High-temperature storage test | $T_a=150^{\circ}C$, $t=1000hrs$ | 0/15 |
| Low-temperature storage test | $T_a=-65^{\circ}C$, $t=1000hrs$ | 0/15 |
| High-temperature, high-humidity storage test | $T_a=85^{\circ}C$, $RH=85\%$, $t=1000hrs$ | 0/15 |
| High-temperature, high-humidity bias test | $V_{DD}=5.5V$, $T_a=85^{\circ}C$, $RH=85\%$, $t=1000hrs$ | 0/15 |
| Thermal shock test | $T_a=150^{\circ}C$ and $-65^{\circ}C$. Five minutes at each temperature for ten cycles | 0/15 |
| Temperature cycle test | $T_a=150^{\circ}C$ and $-65^{\circ}C$. Thirty minutes at each temperature for ten cycles | 0/15 |
| Pressure cooker test | Two atmospheres for 50 hours at ambient temperature (T_a) of $121^{\circ}C$ | 0/15 |
| Soldering test | Ambient temperature (T_a) of $230^{\circ}C$ for five seconds | 0/15 |
| Solder heat resistance test | Ambient temperature (T_a) of $270^{\circ}C$ for ten seconds | 0/15 |

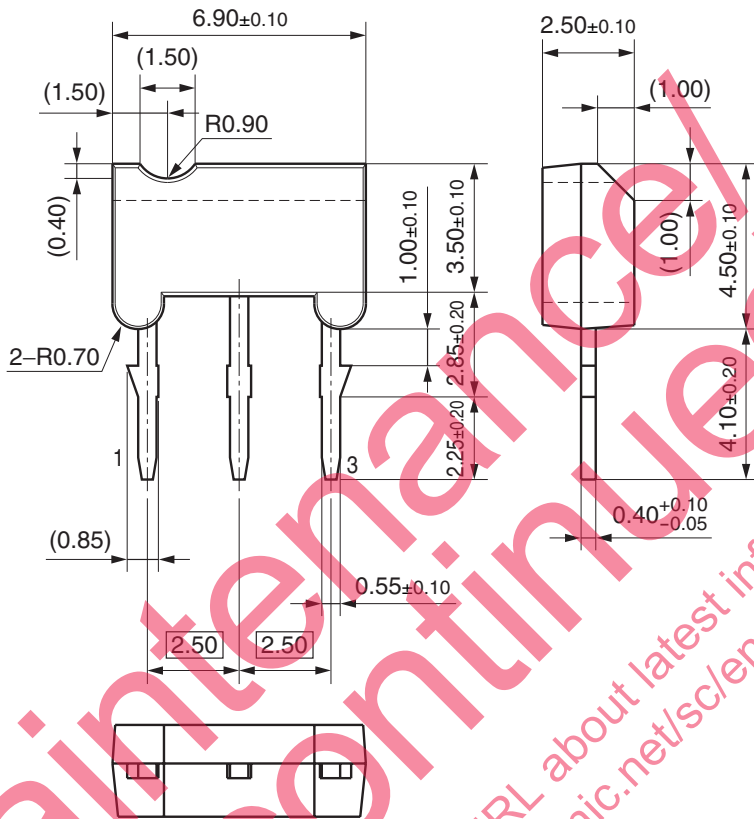
(2) Mini type package (MN1382/MN13821/MN13822)

| Test Subjects | Test Conditions | Results |
|---|--|---------|
| Operating lifetime test | $V_{DD}=5.5V$, $T_a=125^{\circ}C$, $t=1000hrs$ | 0/15 |
| High-temperature storage test | $T_a=150^{\circ}C$, $t=1000hrs$ | 0/15 |
| Low-temperature storage test | $T_a=-65^{\circ}C$, $t=1000hrs$ | 0/15 |
| High-temperature, high-humidity storage test | $T_a=85^{\circ}C$, $RH=85\%$, $t=1000hrs$ | 0/15 |
| High-temperature, high-humidity bias test | $V_{DD}=5.5V$, $T_a=85^{\circ}C$, $RH=85\%$, $t=1000hrs$ | 0/15 |
| Thermal shock test | $T_a=150^{\circ}C$ and $-65^{\circ}C$. Five minutes at each temperature for ten cycles | 0/15 |
| Temperature cycle test | $T_a=150^{\circ}C$ and $-65^{\circ}C$. Thirty minutes at each temperature for ten cycles | 0/15 |
| Pressure cooker test *1 | Two atmospheres for 24 hours at ambient temperature (T_a) of $121^{\circ}C$ | 0/15 |
| Soldering test | Ambient temperature (T_a) of $230^{\circ}C$ for five seconds | 0/15 |
| Solder heat resistance test *1 | Ambient temperature (T_a) of $260^{\circ}C$ for five seconds | 0/15 |

Note*1: Note that the testing conditions for the mini package differ from those for the other two packages.

■ New Package Dimensions (Unit: mm)

- M3A (Lead-free package)

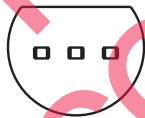
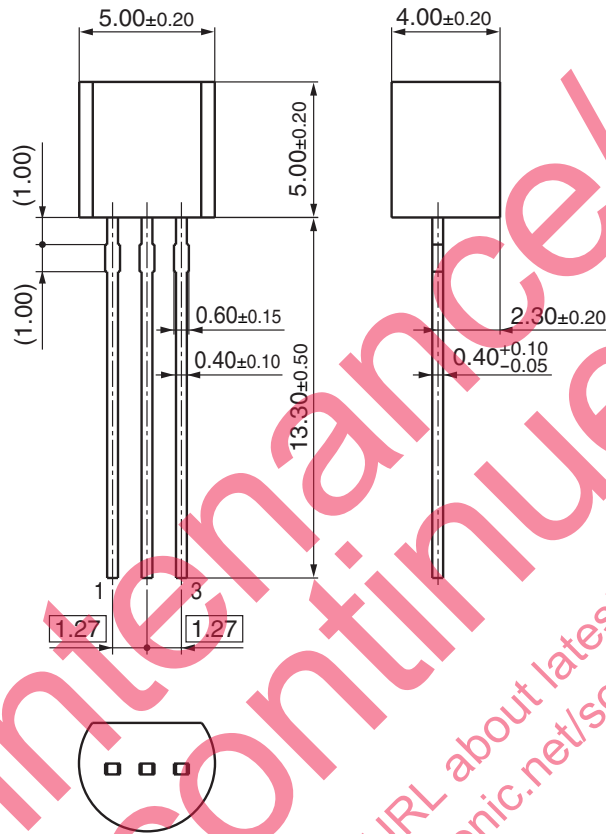


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■ New Package Dimensions (Unit: mm)(continued)

- SSIP003-P-0000S (Lead-free package)



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■ New Package Dimensions (Unit: mm)(continued)

- MINI-3DC (Lead-free package)



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reliability are required, or if the failure or malfunction of the prod-

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bsolute maximum rating and the guaranteed operating conditions
(.). Especially, please be careful not to exceed the range of absolute
er-off and mode-switching. Otherwise, we will not be liable for any

, take into the consideration of incidence of break down and failure
n the systems such as redundant design, arresting the spread of fire
al injury, fire, social damages, for example, by using the products.

own and characteristics change due to external factors (ESD, EOS,
mounting or at customer's process. When using products for which
shelf life and the elapsed time since first opening the packages.

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