Chip Varistors
Countermeasure for surge voltage and static electricity

AVR series

AVRM0402/AVRL0402 0402 [01005 inch]*
AVRM0603/AVRL0603 0603 [0201 inch]
AVRM1005/AVRL1005 1005 [0402 inch]
AVRM1608/AVRL1608 1608 [0603 inch]
AVRM2012 2012 [0805 inch]

* Dimensions Code JIS[EIA]
REMINDERS FOR USING THESE PRODUCTS

Before using these products, be sure to request the delivery specifications.

SAFETY REMINDERS

Please pay sufficient attention to the warnings for safe designing when using these products.

⚠️ REMINDERS

○ Please observe the following precautions in order to avoid problems with chip varistors such as characteristic degradation and element destruction.

  Please store these products in an environment with a temperature of 5 to 40°C and humidity level of 20 to 70%RH, and use them within six months.

  Poor storage conditions may lead to the deterioration of the solderability of the edge electrodes, so please be careful to avoid contact with humidity, dew condensation, dust, toxic gas (hydrogen, hydrogen sulfide, sulfurous acid, chlorine, ammonia, etc.), direct sunlight, and so on.

  Please do not use products that have been dropped or detached when mounting.

  Please solder with the reflow soldering method, and not the flow (dip) soldering method.

○ Please observe the following precautions to avoid problems with varistors such as characteristic degradation and element destruction, which ultimately lead to the generation of heat and smoke with the elements.

  Do not use in locations where the temperatures exceed the operating temperature range such as under direct sunlight or near sources of heat.

  Do not use in locations where there are high levels of humidity such as under direct exposure to weather and areas where steam is released.

  Do not use in locations such as dusty areas, high-saline environments, places where the atmosphere is contaminated with corrosive gas, etc.

  Avoid powerful vibrations, impact (such as by dropping), pressure, etc. that may lead to splitting in the products.

  **Do not use with a voltage that exceeds the maximum allowable circuit voltage.**

  When resin coating (including modular) a varistor, do not use a resin that will cause deterioration of the varistor. Be sure never to use resin that generates hydrogen as palladium is used for the inner electrode.

  Avoid attachment near combustible materials.

○ Please contact our sales offices when considering the use of the products listed on this catalog for applications, whose performance and/or quality require a more stringent level of safety or reliability, or whose failure, malfunction or trouble could cause serious damage to society, person or property (‘specific uses’ such as automobiles, airplanes, medical instruments, nuclear devices, etc.) as well as when considering the use for applications that exceed the range and conditions of this catalog.

  Please also contact us when using these products for automotive applications.

○ Please note that we are not responsible for any damages or losses incurred resulting from the use of these products that exceeds the range and conditions of this catalog or specific uses.

○ Please take appropriate measures such as acquiring protective circuits and devices that meet the uses, applications, and conditions of the instruments and keeping backup circuits.
Chip Varistors
Countermeasure for surge voltage and static electricity

Overview of the AVR Series

**CHARACTERISTICS OF CHIP VARISTOR**

Varistors are voltage dependent nonlinear resistive elements with a resistance that decreases rapidly when the voltage is over the constant value. Varistor is equivalent with Zener diode of two series connection. Therefore, do not have polarity.

**CURRENT vs. VOLTAGE CHARACTERISTICS**

- **Without Varistor**
  A malfunction and failure of electronic equipment

- **With Varistor**
  Suppress abnormal voltage by inserting varistor in a circuit

---


• All specifications are subject to change without notice.
Overview of the AVR Series

■ MEASURING CIRCUIT

![Diagram of measuring circuit with varistors and without varistors]

Without Varistor

With Varistor

AVRL101A3R3FTA (3.3pF)

AVRL101A6R8GTA (6.8pF)

■ MERITS OF REPLACEMENT FROM ZENER DIODE

(1) Reduction in the Number of Parts

Production examples

Zener diode + capacitor → Chip varistor

Example of replacement at audio terminal

(2) Improved Electrostatic Absorption Capability

Compare data of chip varistor and zener diode about IC protection

ESD measurements of CMOS-ICs with AVR-type varistors and zener diodes

![Graph showing insulation resistance vs. ESD voltage]

CMOS: D74HC04C
ESD generator: Noise Laboratory Co., Ltd., ESS-630A
200pF-0Ω method model equipment
Contact type discharge
ESD applied point: Vcc-ground

* All specifications are subject to change without notice.
Overview of the AVR Series

FEATURES

- No polarity, due to symmetrical current-voltage characteristics. Equivalent to anode common type Zener diode.
- Excellent electrostatic absorption capability. Response is as good or better than Zener diode. Keeps symmetrical current-voltage characteristics even after electrostatic absorption.
- Adopted the inner electrodes lamination structure.
  - Wide range of varistor voltages are available in series (6.8 to 90V).
  - Low capacitance items are available in series (from 1.1pF).
  - World’s smallest 0402-, 0603-, 1005-, 1608-, 2012-chip size are available in series.
- Excellent mount reliability. Good for Pb-free soldering. Adopted (Ni/Sn) electroplating. Achieved good solderability and solder heat resistance.
- Can replace a Zener diode + capacitor combination. Reduced footprint and total mounting cost.

APPLICATION

- Electrostatic absorption
- Pulse noise absorption

APPLICATION EXAMPLES

<table>
<thead>
<tr>
<th>Consumer product</th>
<th>Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mobile phone</td>
<td>Data terminal</td>
</tr>
<tr>
<td>Digital video camera</td>
<td>LCD panel</td>
</tr>
<tr>
<td>Digital camera</td>
<td>Touch panel</td>
</tr>
<tr>
<td>PDA</td>
<td>Button and switch unit</td>
</tr>
<tr>
<td>Note PC</td>
<td>Battery terminal</td>
</tr>
<tr>
<td>DVD-ROM, CD-ROM</td>
<td>Audio-Video input-output terminal</td>
</tr>
<tr>
<td>CD/MD/MP3 player</td>
<td>Microphone/receiver unit</td>
</tr>
<tr>
<td>Game machine</td>
<td>Controller unit</td>
</tr>
<tr>
<td>In-car equipment</td>
<td>CAN-BUS</td>
</tr>
<tr>
<td></td>
<td>ECU</td>
</tr>
<tr>
<td></td>
<td>Connector</td>
</tr>
<tr>
<td></td>
<td>Air conditioner panel</td>
</tr>
<tr>
<td></td>
<td>Car audio</td>
</tr>
<tr>
<td></td>
<td>Car navigation</td>
</tr>
</tbody>
</table>

SMART PHONE

- Microphone/Receiver
- Button
- To LCD driver
- LCD panel
- Data terminal
- : Chip varistor

USB2.0

- USB IC
- VDD
- USB cable
- USB connector
- : Chip varistor

AUDIO, VIDEO

- Microphone
- Video1
- Video2
- Video3
- Video5
- Audio L/MONO
- Audio L
- Audio R
- : Chip varistor

* All specifications are subject to change without notice.
## Overview of the AVR Series

### PART NUMBER CONSTRUCTION

<table>
<thead>
<tr>
<th>Series name</th>
<th>LxW Dimensions (mm)</th>
<th>Structure code</th>
<th>Operating voltage (V)</th>
<th>Varistor voltage tolerance (%)</th>
<th>Packaging style</th>
<th>Capacitance or TDK internal code</th>
<th>Capacitance tolerance (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>AVRM 1005</td>
<td>G13/G3</td>
<td>6R8</td>
<td>N</td>
<td>T</td>
<td>101</td>
<td>N</td>
<td>±30</td>
</tr>
<tr>
<td>0402</td>
<td>0.4×0.2</td>
<td></td>
<td>6R8</td>
<td>M</td>
<td>±20</td>
<td>M</td>
<td>±30</td>
</tr>
<tr>
<td>0603</td>
<td>0.6×0.3</td>
<td></td>
<td>270</td>
<td>M</td>
<td>±20</td>
<td>N</td>
<td>±30</td>
</tr>
<tr>
<td>1005</td>
<td>1.0×0.5</td>
<td></td>
<td>270</td>
<td>N</td>
<td>±30</td>
<td>N</td>
<td>±30</td>
</tr>
<tr>
<td>1608</td>
<td>1.6×0.8</td>
<td></td>
<td>270</td>
<td>N</td>
<td>±30</td>
<td>N</td>
<td>±30</td>
</tr>
</tbody>
</table>

* When the capacitance is not included in the part number, the capacitance tolerance is also not described.

### OPERATING TEMPERATURE RANGE, PACKAGE QUANTITY, PRODUCT WEIGHT

<table>
<thead>
<tr>
<th>Type</th>
<th>Operating temperature* (°C)</th>
<th>Storage temperature** (°C)</th>
<th>Package quantity (pieces/reel)</th>
<th>Individual weight (mg) typ.</th>
</tr>
</thead>
<tbody>
<tr>
<td>AVRM0402</td>
<td>–40 to +85</td>
<td>–40 to +85</td>
<td>20,000</td>
<td>0.1</td>
</tr>
<tr>
<td>AVRL0402</td>
<td>–40 to +85</td>
<td>–40 to +85</td>
<td>20,000</td>
<td>0.1</td>
</tr>
<tr>
<td>AVRM0603</td>
<td>–40 to +85</td>
<td>–40 to +85</td>
<td>15,000</td>
<td>0.2</td>
</tr>
<tr>
<td>AVRL0603</td>
<td>–40 to +85</td>
<td>–40 to +85</td>
<td>15,000</td>
<td>0.2</td>
</tr>
<tr>
<td>AVRM1005</td>
<td>–40 to +125</td>
<td>–40 to +125</td>
<td>10,000</td>
<td>1.2</td>
</tr>
<tr>
<td>AVRL1005</td>
<td>–40 to +125</td>
<td>–40 to +125</td>
<td>10,000</td>
<td>1.2</td>
</tr>
<tr>
<td>AVRM1608</td>
<td>–40 to +125</td>
<td>–40 to +125</td>
<td>4,000</td>
<td>5</td>
</tr>
<tr>
<td>AVRL1608</td>
<td>–40 to +125</td>
<td>–40 to +125</td>
<td>4,000</td>
<td>5</td>
</tr>
<tr>
<td>AVRM2012</td>
<td>–40 to +125</td>
<td>–40 to +125</td>
<td>2,000</td>
<td>12</td>
</tr>
</tbody>
</table>

* Operating temperature range includes self-temperature rise.
** The Storage temperature range is for after the circuit board is mounted.

### OPERATIONAL VOLTAGE RANGES

- AVRM0402/AVRL0402 types: 25
- AVRM0603/AVRL0603 types: 25
- AVRM1005/AVRL1005 types: 19
- AVRM1608/AVRL1608 types: 28
- AVRM2012 type: 28

• All specifications are subject to change without notice.
Overview of the AVR Series

**TERMINOLOGY**

<table>
<thead>
<tr>
<th>Item</th>
<th>Unit</th>
<th>Terminology</th>
</tr>
</thead>
<tbody>
<tr>
<td>Varistor voltage (Breakdown voltage)</td>
<td>V1mA (V)</td>
<td>Voltage measured across the varistor when DC1mA is applied.</td>
</tr>
<tr>
<td>Maximum continuous voltage (Rated voltage)</td>
<td>Vdc (V)</td>
<td>Maximum DC voltage that can be applied continuously. Varistor leakage current: 50μA max. (Within the range of maximum allowable circuit voltage)</td>
</tr>
<tr>
<td>Clamping voltage</td>
<td>Vcl (V)</td>
<td>Voltage appearing across the varistor when a pulse current (8/20μs(^1)) of specified peak value is applied.</td>
</tr>
<tr>
<td>Maximum energy</td>
<td>E (Joule)</td>
<td>Maximum energy that can be absorbed without deteriorating varistor characteristics when an impulse current (10/1000μs(^2)) is applied once.</td>
</tr>
<tr>
<td>Maximum peak current</td>
<td>Ip (A)</td>
<td>Maximum current that can be withstood without deteriorating varistor characteristics when an impulse current (8/20μs(^1)) is applied once.</td>
</tr>
<tr>
<td>Capacitance</td>
<td>C (pF)</td>
<td>Capacitance measured at 1kHz (or 1MHz) of oscillator frequency and 1Vrms of oscillator voltage.</td>
</tr>
<tr>
<td>Insulation resistance</td>
<td>RdC (MΩ)</td>
<td>Insulation resistance appearing across the varistor when specified voltage is applied.</td>
</tr>
</tbody>
</table>

*\(^1\) 8/20μs test waveform

\[\text{Time} \quad 8\mu s \quad 20\mu s\]

\[\text{Current} \quad 100\% \quad 90\% \quad 50\%\]

*\(^2\) 10/1000μs test waveform

\[\text{Time} \quad 10\mu s \quad 1000\mu s\]

\[\text{Energy} \quad 100\% \quad 90\% \quad 50\%\]

• All specifications are subject to change without notice.
Overview of the AVR Series

RECOMMENDED REFLOW PROFILE

<table>
<thead>
<tr>
<th>Preheating</th>
<th>Soldering</th>
<th>Peak</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temp.</td>
<td>Time</td>
<td>Temp.</td>
</tr>
<tr>
<td>T1 150°C</td>
<td>T2 180°C</td>
<td>T3 230°C</td>
</tr>
</tbody>
</table>

• All specifications are subject to change without notice.
AVR series

AVRM0402/AVRL0402 Types

**SHAPE & DIMENSIONS**

![Diagram showing dimensions in mm]

**INTERNAL STRUCTURE**

- Inner electrode (Palladium)
- Varistor body (Zinc Oxide: ZnO semiconductor ceramics)
- Sn plating
- Ag termination underlayer
- Ni plating

**RECOMMENDED LAND PATTERN**

![Diagram showing recommended land pattern]

**CIRCUITS DIAGRAM**

![Circuit diagram]

- All specifications are subject to change without notice.
### ELECTRICAL CHARACTERISTICS

#### AVR series  **AVRM0402/AVRL0402 Types**

#### CHARACTERISTICS SPECIFICATION TABLE

##### AVR0402

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Varistor voltage (Breakdown voltage) $V_{1mA}(V)$ [DC1mA] typ.</th>
<th>Maximum continuous voltage (Rated voltage) $V_{dc}(V)$ max.</th>
<th>Clamping voltage $V_{cl}(V)$ [8/20μs] max.</th>
<th>Maximum energy $E$(Joule) [10/1000μs] max.</th>
<th>Maximum peak current $I_{p}(A)$ [8/20μs] max.</th>
<th>Capacitance $C$(pF) [1kHz, 1Vrms] typ.</th>
<th>Insulation resistance $R_{dc}$(MΩ) [3Vrms] min.</th>
</tr>
</thead>
<tbody>
<tr>
<td>AVRM0402C6R8NT101N</td>
<td>6.8 (4.76 to 8.84)</td>
<td>3.5</td>
<td>15[1A]</td>
<td>0.01</td>
<td>4</td>
<td>100 (70 to 130)</td>
<td></td>
</tr>
<tr>
<td>AVRM0402C120MT330N</td>
<td>12 (9.8 to 14.4)</td>
<td>5.5</td>
<td>20[1A]</td>
<td>0.005</td>
<td>1</td>
<td>33 (23.1 to 43.9)</td>
<td></td>
</tr>
</tbody>
</table>

##### AVRL0402

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Varistor voltage $V_{1mA}(V)$ [DC1mA]</th>
<th>Maximum continuous voltage (Rated voltage) $V_{dc}(V)$ max.</th>
<th>Capacitance $C$(pF) [1MHz, 1Vrms]</th>
<th>Insulation resistance $R_{dc}$(MΩ) [3Vrms]</th>
</tr>
</thead>
<tbody>
<tr>
<td>AVRL041E1R1NTA</td>
<td>39</td>
<td>25</td>
<td>1.1[0.8 to 1.4]</td>
<td>10</td>
</tr>
</tbody>
</table>

*All specifications are subject to change without notice.*
AVR series  
AVRM0402/AVRL0402 Types

**ELECTRICAL CHARACTERISTICS**

- **CURRENT vs. VOLTAGE CHARACTERISTICS**

![Current vs. Voltage Characteristics](image1)

- **IMPEDANCE vs. FREQUENCY CHARACTERISTICS**

![Impedance vs. Frequency Characteristics](image2)

- **TRANSMISSION CHARACTERISTICS**

![Transmission Characteristics](image3)

- **CAPACITANCE vs. FREQUENCY CHARACTERISTICS**

![Capacitance vs. Frequency Characteristics](image4)

• All specifications are subject to change without notice.
AVR series

AVRM0603/AVRL0603 Types

**SHAPE & DIMENSIONS**

- 0.6±0.03
- 0.3±0.03
- 0.3±0.03
- 0.1 min.

**INTERNAL STRUCTURE**

- Inner electrode (Palladium)
- Varistor body (Zinc Oxide: ZnO semiconductor ceramics)
- Sn plating
- Ag termination underlayer
- Ni plating

**RECOMMENDED LAND PATTERN**

- 0.2 to 0.3
- 0.25 to 0.35
- 0.2 to 0.3

**CIRCUITS DIAGRAM**

• All specifications are subject to change without notice.
## AVR series AVRM0603/AVRL0603 Types

### ELECTRICAL CHARACTERISTICS

### CHARACTERISTICS SPECIFICATION TABLE

#### AVRM0603

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Varistor voltage (Breakdown voltage)</th>
<th>Maximum continuous voltage (Rated voltage)</th>
<th>Clamping voltage</th>
<th>Maximum energy</th>
<th>Maximum peak current</th>
<th>Capacitance [1kHz, 1Vrms]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>V1mA(V) [DC1mA]</td>
<td>Vdc(V) max.</td>
<td>Vcl(V) [8/20μs]</td>
<td>E(Joule) [10/1000μs] max.</td>
<td>Ip(A) [8/20μs] max.</td>
<td>C(pF) typ.</td>
</tr>
<tr>
<td>AVRM0603C6R8NT331N</td>
<td>6.8 (4.76 to 8.84)</td>
<td>3.5</td>
<td>14[1A]</td>
<td>0.02</td>
<td>16</td>
<td>330 (231 to 429)</td>
</tr>
<tr>
<td>AVRM0603C6R8NT101N</td>
<td>6.8 (4.76 to 8.84)</td>
<td>3.5</td>
<td>14[1A]</td>
<td>0.01</td>
<td>10</td>
<td>100 (70 to 130)</td>
</tr>
<tr>
<td>AVRM0603C080MT101N</td>
<td>8 (6.4 to 9.6)</td>
<td>5.5</td>
<td>17[1A]</td>
<td>0.01</td>
<td>4</td>
<td>100 (70 to 130)</td>
</tr>
<tr>
<td>AVRM0603C120MT101N</td>
<td>12.8 (10 to 15.6)</td>
<td>5.5</td>
<td>20[1A]</td>
<td>0.01</td>
<td>5</td>
<td>100 (70 to 130)</td>
</tr>
<tr>
<td>AVR-M0603C120MTAAB</td>
<td>12 (9.6 to 14.4)</td>
<td>7.5</td>
<td>23[1A]</td>
<td>0.01</td>
<td>1</td>
<td>33</td>
</tr>
<tr>
<td>AVRM0603C120MT150N</td>
<td>12.8 (10 to 15.6)</td>
<td>5.5</td>
<td>35[1A]</td>
<td>0.003</td>
<td>1</td>
<td>15 (10.5 to 19.5) [1MHz]</td>
</tr>
<tr>
<td>AVRM0603C200MT150N</td>
<td>20 (16.0 to 24.0)</td>
<td>12</td>
<td>40[1A]</td>
<td>0.01</td>
<td>1</td>
<td>15 (10.5 to 19.5) [1MHz]</td>
</tr>
</tbody>
</table>

#### AVRL0603

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>V1mA(V)</td>
<td>Vdc(V) max.</td>
<td>C(pF) [1MHz, 1Vrms]</td>
<td>Rdc(MΩ)</td>
</tr>
<tr>
<td>AVRL061E1R1NTA</td>
<td>39</td>
<td>25</td>
<td>1.1[0.8 to 1.4]</td>
<td>10</td>
</tr>
</tbody>
</table>

*All specifications are subject to change without notice.*
**AVR series AVR M0603/AVRL0603 Types**

### ELECTRICAL CHARACTERISTICS

#### CURRENT vs. VOLTAGE CHARACTERISTICS

![Current vs. Voltage Graph]

- Graph showing the current (A) vs. voltage (V) characteristics.

- Key points:
  - $V_{1mA}=6.8V$
  - $V_{1mA}=12V$
  - $V_{1mA}=39V$

#### IMPEDANCE vs. FREQUENCY CHARACTERISTICS

![Impedance vs. Frequency Graph]

- Graph showing the impedance (Ω) vs. frequency (MHz).

- Key points:
  - 1.1pF
  - 100pF
  - 33pF
  - 15pF

#### TRANSMISSION CHARACTERISTICS

![Transmission Graph]

- Graph showing the insertion loss (dB) vs. frequency (MHz).

- Key points:
  - 1.1pF
  - 100pF
  - 33pF
  - 15pF

#### CAPACITANCE vs. FREQUENCY CHARACTERISTICS

![Capacitance vs. Frequency Graph]

- Graph showing the capacitance (pF) vs. frequency (MHz).

- Key points:
  - 1.1pF
  - 100pF
  - 33pF
  - 15pF

*All specifications are subject to change without notice.*
AVR series

AVRM1005/AVRL1005 Types

**SHAPE & DIMENSIONS**

Dimensions in mm

**INTERNAL STRUCTURE**

- Inner electrode (Palladium)
- Zinc Oxide: ZnO semiconductor ceramics
- Varistor body
- Sn plating
- Ag termination underlayer
- Ni plating

**RECOMMENDED LAND PATTERN**

- Dimensions: 0.35 to 0.45, 0.3 to 0.5, 0.35 to 0.45

**CIRCUITS DIAGRAM**

*All specifications are subject to change without notice.*
## ELECTRICAL CHARACTERISTICS

### CHARACTERISTICS SPECIFICATION TABLE

#### AVR1005

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Varistor voltage (Breakdown voltage)</th>
<th>Maximum continuous voltage (Rated voltage)</th>
<th>Clamping voltage</th>
<th>Maximum energy</th>
<th>Maximum peak current</th>
<th>Capacitance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>V_{1mA}(V)</td>
<td>V_{dc}(V)</td>
<td>V_{cl}(V)</td>
<td>E(Joule) [10/1000μs] max.</td>
<td>I_{p}(A) [8/20μs] max.</td>
<td>C(pF) [10kHz, 1Vrms] typ.</td>
</tr>
<tr>
<td>AVRM1005C6R8NT331N</td>
<td>6.8 (4.76 to 8.84)</td>
<td>3.5</td>
<td>15[1A]</td>
<td>0.008</td>
<td>24</td>
<td>330 [231 to 429]</td>
</tr>
<tr>
<td>AVRM1005C6R8NT101N</td>
<td>6.8 (4.76 to 8.84)</td>
<td>3.5</td>
<td>14[1A]</td>
<td>0.02</td>
<td>10</td>
<td>100 (70 to 130)</td>
</tr>
<tr>
<td>AVR-M1005C080MTAAB</td>
<td>8 (6.4 to 9.6)</td>
<td>5.5</td>
<td>14[1A]</td>
<td>0.04</td>
<td>25</td>
<td>650</td>
</tr>
<tr>
<td>AVR-M1005C080MTADB</td>
<td>8 (6.4 to 9.6)</td>
<td>5.5</td>
<td>14[1A]</td>
<td>0.04</td>
<td>25</td>
<td>480</td>
</tr>
<tr>
<td>AVR-M1005C080MTBBB</td>
<td>8 (6.4 to 9.6)</td>
<td>5.5</td>
<td>15[1A]</td>
<td>0.02</td>
<td>3</td>
<td>100</td>
</tr>
<tr>
<td>AVR-M1005C080MTACB</td>
<td>8 (6.4 to 9.6)</td>
<td>5.5</td>
<td>19[1A]</td>
<td>0.01</td>
<td>1</td>
<td>33</td>
</tr>
<tr>
<td>AVR-M1005C120MTACC</td>
<td>12 (9.6 to 14.4)</td>
<td>7.5</td>
<td>21[1A]</td>
<td>0.01</td>
<td>24</td>
<td>460 [1MHz]</td>
</tr>
<tr>
<td>AVR-M1005C120MTAAB</td>
<td>12 (9.6 to 14.4)</td>
<td>7.5</td>
<td>20[1A]</td>
<td>0.05</td>
<td>10</td>
<td>130</td>
</tr>
<tr>
<td>AVR-M1005C180MTAAB</td>
<td>18 (14.4 to 21.6)</td>
<td>11</td>
<td>33[1A]</td>
<td>0.06</td>
<td>16</td>
<td>120 [1MHz]</td>
</tr>
<tr>
<td>AVRM1005C270K101N</td>
<td>27 (24 to 30)</td>
<td>19</td>
<td>44[1A]</td>
<td>0.06</td>
<td>4</td>
<td>100 (70 to 130)</td>
</tr>
<tr>
<td>AVR-M1005C270MTAAB</td>
<td>27 (21.6 to 32.4)</td>
<td>15</td>
<td>47[1A]</td>
<td>0.06</td>
<td>4</td>
<td>40</td>
</tr>
<tr>
<td>AVR-M1005C270MTABB</td>
<td>27 (21.6 to 32.4)</td>
<td>15</td>
<td>49[1A]</td>
<td>0.05</td>
<td>1</td>
<td>15</td>
</tr>
</tbody>
</table>

#### AVR1005

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Varistor voltage [DC1mA typ.]</th>
<th>Maximum continuous voltage (Rated voltage) V_{dc}(V) max.</th>
<th>Capacitance C(pF) [1MHz, 1Vrms]</th>
<th>Insulation resistance R_{dc}(MΩ) [3Vrms] min.</th>
</tr>
</thead>
<tbody>
<tr>
<td>AVRL101A1R1NTA</td>
<td>90</td>
<td>10</td>
<td>1.1 [0.8 to 1.4]</td>
<td>10</td>
</tr>
<tr>
<td>AVRL101A1R1NTB</td>
<td>39</td>
<td>10</td>
<td>1.1 [0.8 to 1.4]</td>
<td>10</td>
</tr>
<tr>
<td>AVRL101C2R2DTA</td>
<td>90</td>
<td>16</td>
<td>2.2 [1.7 to 2.7]</td>
<td>10</td>
</tr>
<tr>
<td>AVRL101A3R3FTA</td>
<td>27</td>
<td>10</td>
<td>3.3 [2.3 to 4.3]</td>
<td>10</td>
</tr>
<tr>
<td>AVRL101A6R8GTA</td>
<td>27</td>
<td>10</td>
<td>6.8 [4.8 to 8.8]</td>
<td>10</td>
</tr>
</tbody>
</table>

• All specifications are subject to change without notice.
ELECTRICAL CHARACTERISTICS

CURRENT vs. VOLTAGE CHARACTERISTICS

IMPEDANCE vs. FREQUENCY CHARACTERISTICS

TRANSMISSION CHARACTERISTICS

CAPACITANCE vs. FREQUENCY CHARACTERISTICS

• All specifications are subject to change without notice.
AVR series

AVRM1608/AVRL1608 Types

SHAPE & DIMENSIONS

[Dimensions diagram showing 1.6x0.1, 0.8x0.1, 0.2 min.]

INTERNAL STRUCTURE

[Diagram showing internal components: Inner electrode (Palladium), Varistor body (Zinc Oxide: ZnO semiconductor ceramics), Sn plating, Ag termination, Ni plating, underlayer.]

RECOMMENDED LAND PATTERN

[Recommended land pattern diagram with dimensions 0.6 to 0.8 for each aspect.]

CIRCUITS DIAGRAM

[Diagram showing circuit connections with labels.]

• All specifications are subject to change without notice.
## ELECTRICAL CHARACTERISTICS

### CHARACTERISTICS SPECIFICATION TABLE

#### AVR1608

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Varistor voltage (Breakdown voltage)</th>
<th>Maximum continuous voltage (Rated voltage)</th>
<th>Clamping voltage</th>
<th>Maximum energy</th>
<th>Maximum peak current</th>
<th>Capacitance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>V₁mA (V) [DC1mA]</td>
<td>Vdc (V) max.</td>
<td>Vcl (V) [8/20μs] max.</td>
<td>E (Joule) [10/1000μs] max.</td>
<td>Ip (A) [8/20μs] max.</td>
<td>C (pF) [1kHz, 1Vrms] typ.</td>
</tr>
<tr>
<td>AVR-M1608C080MTAAB</td>
<td>8 (6.4 to 9.6)</td>
<td>5.5</td>
<td>15 [2A]</td>
<td>0.09</td>
<td>30</td>
<td>650</td>
</tr>
<tr>
<td>AVR-M1608C120MT6AB</td>
<td>12 (9.6 to 14.4)</td>
<td>7.5</td>
<td>20 [2A]</td>
<td>0.09</td>
<td>50</td>
<td>1050</td>
</tr>
<tr>
<td>AVR-M1608C120MT2AB</td>
<td>12 (9.6 to 14.4)</td>
<td>7.5</td>
<td>20 [2A]</td>
<td>0.06</td>
<td>15</td>
<td>400</td>
</tr>
<tr>
<td>AVR-M1608C180MT6AB</td>
<td>18 (14.4 to 21.6)</td>
<td>11</td>
<td>30 [2A]</td>
<td>0.1</td>
<td>30</td>
<td>600</td>
</tr>
<tr>
<td>AVR-M1608C220MT6AB</td>
<td>22 (19.8 to 24.2)</td>
<td>16</td>
<td>34 [2A]</td>
<td>0.1</td>
<td>30</td>
<td>560</td>
</tr>
<tr>
<td>AVR-M1608C220MT2AB</td>
<td>22 (19.8 to 24.2)</td>
<td>16</td>
<td>37 [2A]</td>
<td>0.03</td>
<td>10</td>
<td>210</td>
</tr>
<tr>
<td>AVR-M1608C270KT6AB</td>
<td>27 (24 to 30)</td>
<td>19</td>
<td>42 [2A]</td>
<td>0.1</td>
<td>48</td>
<td>430</td>
</tr>
<tr>
<td>AVR-M1608C270KT2AB</td>
<td>27 (24 to 30)</td>
<td>19</td>
<td>42 [2A]</td>
<td>0.1</td>
<td>20</td>
<td>160</td>
</tr>
<tr>
<td>AVR-M1608C270KT4CB</td>
<td>27 (24 to 30)</td>
<td>19</td>
<td>54 [2A]</td>
<td>0.05</td>
<td>10</td>
<td>60</td>
</tr>
<tr>
<td>AVR-M1608C270KT600M</td>
<td>27 (24 to 30)</td>
<td>19</td>
<td>53 [2A]</td>
<td>0.02</td>
<td>28</td>
<td>80 (64 to 96)</td>
</tr>
<tr>
<td>AVR-M1608C270MTAAB</td>
<td>27 (21.6 to 32.4)</td>
<td>17</td>
<td>52 [2A]</td>
<td>0.05</td>
<td>2</td>
<td>30</td>
</tr>
<tr>
<td>AVR-M1608C270MTABB</td>
<td>27 (21.6 to 32.4)</td>
<td>17</td>
<td>52 [2A]</td>
<td>0.05</td>
<td>2</td>
<td>15</td>
</tr>
<tr>
<td>AVR-M1608C270MTACB</td>
<td>27 (21.6 to 32.4)</td>
<td>17</td>
<td>52 [2A]</td>
<td>0.05</td>
<td>2</td>
<td>15</td>
</tr>
<tr>
<td>AVR-M1608C270MTACB</td>
<td>27 (21.6 to 32.4)</td>
<td>17</td>
<td>52 [2A]</td>
<td>0.05</td>
<td>2</td>
<td>15</td>
</tr>
</tbody>
</table>

#### AVR1608

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Varistor voltage (Breakdown voltage)</th>
<th>Maximum continuous voltage (Rated voltage)</th>
<th>Capacitance</th>
<th>Insulation resistance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>V₁mA (V) [DC1mA]</td>
<td>Vdc (V) max.</td>
<td>C (pF) [1MHz, 1Vrms]</td>
<td>Rdc (MΩ) [3Vrms] min.</td>
</tr>
<tr>
<td>AVR161A1R1NTA</td>
<td>90</td>
<td>10</td>
<td>1.1 [0.8 to 1.4]</td>
<td>10</td>
</tr>
<tr>
<td>AVR161A1R1NTB</td>
<td>39</td>
<td>10</td>
<td>1.1 [0.8 to 1.4]</td>
<td>10</td>
</tr>
<tr>
<td>AVR161A3R3FTA</td>
<td>27</td>
<td>10</td>
<td>3.3 [2.3 to 4.3]</td>
<td>10</td>
</tr>
<tr>
<td>AVR161A3R3FTA</td>
<td>27</td>
<td>10</td>
<td>3.3 [2.3 to 4.3]</td>
<td>10</td>
</tr>
</tbody>
</table>

* All specifications are subject to change without notice.
AVR series  AVR M1608/AVRL1608 Types

**ELECTRICAL CHARACTERISTICS**

- **CURRENT vs. VOLTAGE CHARACTERISTICS**
  - Voltage (V) vs. Current (A)
  - Different curves for V1mA = 8V, 12V, 18V, 22V, 27V, 39V

- **IMPEDANCE vs. FREQUENCY CHARACTERISTICS**
  - Impedance (Ω) vs. Frequency (MHz)
  - Curves for various capacitance values (1.1pF, 3.3pF, 6.8pF, 15pF, 30pF, 1050pF)

- **TRANSISSION CHARACTERISTICS**
  - Insertion loss (dB) vs. Frequency (MHz)
  - Curves for different capacitance values (1050pF, 600pF, 400pF, 160pF, 15pF, 30pF, 1.1pF)

- **CAPACITANCE vs. FREQUENCY CHARACTERISTICS**
  - Capacitance (pF) vs. Frequency (MHz)
  - Curves for various values (1.1pF, 3.3pF, 6.8pF, 600pF, 400pF, 160pF, 1050pF)

• All specifications are subject to change without notice.
AVR series
AVRM2012 Type

**SHAPE & DIMENSIONS**

- 2.0 x 0.2 mm
- 1.25 x 0.2 mm
- 1.0 x 0.2 mm
- 0.2 mm minimum

Dimensions in mm

**INTERNAL STRUCTURE**

- Varistor body (Zinc Oxide: ZnO semiconductor ceramics)
- Inner electrode (Palladium)
- Sn plating
- Ag termination
- Ni plating
- Underlayer

**RECOMMENDED LAND PATTERN**

- 0.7 to 0.9 mm
- 0.9 to 1.2 mm
- 0.7 to 0.9 mm

**CIRCUITS DIAGRAM**

- Diagram showing connections

*All specifications are subject to change without notice.*
AVR series  **AVRM2012 Type**

### ELECTRICAL CHARACTERISTICS

<table>
<thead>
<tr>
<th>CHARACTERISTICS SPECIFICATION TABLE</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Varistor voltage (Breakdown voltage)</th>
<th>Maximum continuous voltage (Rated voltage)</th>
<th>Clamping voltage</th>
<th>Maximum energy</th>
<th>Maximum peak current</th>
<th>Capacitance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$V_{1mA}$ (V) [DC1mA]</td>
<td>$V_{dc}$ (V) max.</td>
<td>$V_{cl}$ (V) [8/20μs] max.</td>
<td>$E$ (Joule) [10/1000μs] max.</td>
<td>$I_p$ (A) [8/20μs] max.</td>
<td>$C$ (pF) [1kHz, 1Vrms] typ.</td>
</tr>
<tr>
<td>AVR-M2012C120MT6AB</td>
<td>12 (9.6 to 14.4)</td>
<td>7.5</td>
<td>20 [5A]</td>
<td>0.2</td>
<td>60</td>
<td>1000</td>
</tr>
<tr>
<td>AVR-M2012C220KT6AB</td>
<td>22 (19.8 to 24.2)</td>
<td>16</td>
<td>38 [5A]</td>
<td>0.3</td>
<td>100</td>
<td>800</td>
</tr>
<tr>
<td>AVR-M2012C390KT6AB</td>
<td>39 (35 to 43)</td>
<td>28</td>
<td>62 [5A]</td>
<td>0.3</td>
<td>100</td>
<td>430</td>
</tr>
</tbody>
</table>

• All specifications are subject to change without notice.
AVR series  AVRM2012 Type

**ELECTRICAL CHARACTERISTICS**

- **CURRENT vs. VOLTAGE CHARACTERISTICS**
- **IMPEDANCE vs. FREQUENCY CHARACTERISTICS**
- **TRANSMISSION CHARACTERISTICS**
- **CAPACITANCE vs. FREQUENCY CHARACTERISTICS**

*All specifications are subject to change without notice.*
AVR series

Electrostatic discharge tests

ELECTROSTATIC DISCHARGE TESTS (EXAMPLE)

- **AVR-M1005C080MTAAB**

- **AVR-M1608C080MTAAB**

- **AVR101A3R3FTA**

- **AVR161A3R3FTA**

○ Test conditions
150pF, 330Ω contact discharge
Charged voltage /8kV, 0.1s interval

○ Measurement equipment

- All specifications are subject to change without notice.
AVR series

Electrostatic absorption characteristics

**DISCHARGE CURRENT WAVEFORM**

![Discharge current waveform graph](image)

**DISCHARGE VOLTAGE WAVEFORM (EXAMPLE)**

![Discharge voltage waveform graph](image)

**ESD ABSORPTION CHARACTERISTICS**

**COMPARISON OF VARIOUS ELEMENTS**

(EXAMPLE)

<table>
<thead>
<tr>
<th>Component</th>
<th>Clamping Voltage (V)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Open waveform</td>
<td>271</td>
</tr>
<tr>
<td>AVR-M1005C120MTAAB</td>
<td>258</td>
</tr>
<tr>
<td>AVR-M1005C080MTAAB</td>
<td>269</td>
</tr>
<tr>
<td>Zener diode / Vz: 6.2V</td>
<td>93</td>
</tr>
</tbody>
</table>

**WAVEFORM PARAMETERS [IEC61000-4-2]**

<table>
<thead>
<tr>
<th>Test level</th>
<th>ESD Charge voltage (kV)</th>
<th>First peak current of discharge (A)</th>
<th>Rise time (ns)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>7.5</td>
<td>0.7 to 1.0</td>
</tr>
<tr>
<td>2</td>
<td>4</td>
<td>15</td>
<td>0.7 to 1.0</td>
</tr>
<tr>
<td>3</td>
<td>6</td>
<td>22.5</td>
<td>0.7 to 1.0</td>
</tr>
<tr>
<td>4</td>
<td>8</td>
<td>30</td>
<td>0.7 to 1.0</td>
</tr>
</tbody>
</table>

**MEASUREMENT EQUIPMENT**

![Measurement equipment diagram](image)

• All specifications are subject to change without notice.
Voltage Protection Devices

AVR series

Packaging Style

**REEL DIMENSIONS**

![Reel Dimensions Diagram]

**TAPE DIMENSIONS**

![Tape Dimensions Diagram]

<table>
<thead>
<tr>
<th>Type</th>
<th>A</th>
<th>B</th>
<th>P1</th>
<th>K</th>
</tr>
</thead>
<tbody>
<tr>
<td>AVRM0402/AVRL0402</td>
<td>0.26±0.04</td>
<td>0.46±0.04</td>
<td>2.0±0.05</td>
<td>0.4max.</td>
</tr>
<tr>
<td>AVRM0603/AVRL0603</td>
<td>0.38±0.05</td>
<td>0.68±0.05</td>
<td>2.0±0.05</td>
<td>0.45max.</td>
</tr>
<tr>
<td>AVRM1005/AVRL1005</td>
<td>0.65±0.1</td>
<td>1.15±0.1</td>
<td>2.0±0.05</td>
<td>0.65max.</td>
</tr>
<tr>
<td>AVRM1608/AVRL1608</td>
<td>1.1±0.2</td>
<td>1.9±0.2</td>
<td>4.0±0.1</td>
<td>1.1max.</td>
</tr>
<tr>
<td>AVRm2012</td>
<td>1.6±0.2</td>
<td>2.3±0.2</td>
<td>4.0±0.1</td>
<td>1.7max.</td>
</tr>
</tbody>
</table>

Dimensions in mm

**All specifications are subject to change without notice.**