会TDK

Varistors(SMD)

Conformity to RoHS Directive

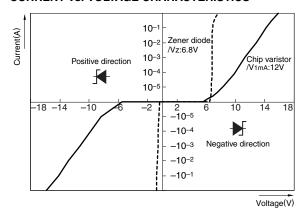
Countermeasure for Surge Voltage and Static Electricity

AVR Series AVR-M, AVRL Types

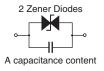
Varistors are voltage dependent nonlinear resistive elements with a resistance that decreases rapidly when the voltage is over the constant value.

Varistor is equivalent with Zener diode of two series connection. Therefore, do not have polarity.

CURRENT vs. VOLTAGE CHARACTERISTICS

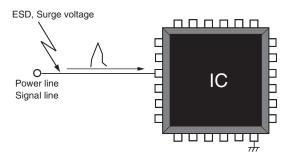


EQUIVALENT CIRCUIT



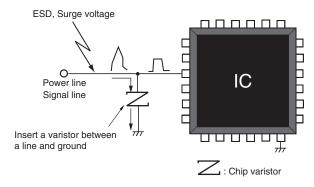
THE EFFECT OF THE VARISTOR WITHOUT VARISTOR

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.

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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 39V).

Low capacitance items are available in series (1.1pF to). World's smallest 0402-, 0603-, 1005-, 1608-, 2012-chip types 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.

APPLICATIONS

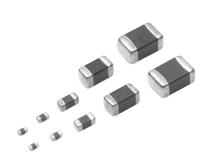
- · Electrostatic absorption
- Pulse noise absorption

TEMPERATURE RANGES

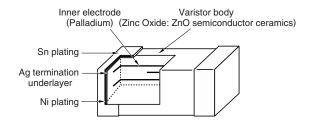
Туре	AVR-M1005/1608/2012	AVR-M0402/0603/AVRL
Operating	–40 to +125°C	-40 to +85°C
Storage	-40 to +125°C	-40 to +85°C

APPLICATION EXAMPLES

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



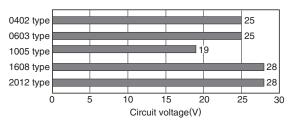
INTERNAL STRUCTURE



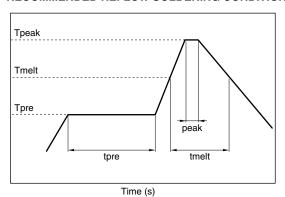
CIRCUITS SYMBOL



OPERATIONAL VOLTAGE RANGES



RECOMMENDED REFLOW SOLDERING CONDITIONS



		Specification	
Item		For eutectic	For lead-free
		solder	solder
Tpre	Preheating temperature	160 to 180°C	150 to 180°C
Tmelt	Solder melting temperature	200°C	230°C
Tpeak	Peak temperature	240°C max.	260°C max.
tpre	Preheating time	100s max.	120s max.
tmelt	Time to reach higher than the solder melting temperature	30s max.	40s max.
	Number of possible reflow cycles	2 max.	2 max.

[•] All specifications are subject to change without notice.

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AVR-M TYPE PRODUCT IDENTIFICATION

AVR-M	1005	С	270	M	Т	AAB
(1)	(2)	(3)	(4)	(5)	(6)	(7)

AVRM	1005	С	6R8	Ν	Т	101	Ν
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)

(1) Series name

(2) Dimensions L×W

0402	0.4×0.2mm	
0603	0.6×0.3mm	
1005	1.0×0.5mm	
1608	1.6×0.8mm	
2012	2.0×1.2mm	

(3) Structure code

(4) Varistor voltage

270	27×10 ⁰ V	

(5) Varistor voltage tolerance

K	±10%	
M	±20%	
N	±30%	

(6) Packaging style

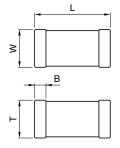
Т	Taping	
•	iaping	

(7) Capacitance and TDK internal code

(5) Capacitance tolerance

N ±30%	N ±30%
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SHAPES AND DIMENSIONS 0402/0603/1005/1608/2012 TYPES

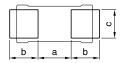




Dimensions in mm

Туре	L	W	Т	B min.	Weight (mg)typ.
0402	0.4±0.02	0.2±0.02	0.2±0.02	0.07	0.1
0603	0.6±0.03	0.3±0.03	0.3±0.03	0.1	0.2
1005	1.0±0.05	0.5±0.05	0.5±0.05	0.1	1.2
1608	1.6±0.1	0.8±0.1	0.8±0.1	0.2	5
2012	2.0±0.2	1.25±0.2	1.0±0.2	0.2	15

RECOMMENDED PC BOARD PATTERN



Dimensions in mm

Туре	а	b	С
0402	0.2	0.15 to 0.2	0.18 to 0.2
0603	0.25 to 0.35	0.2 to 0.3	0.25 to 0.35
1005	0.3 to 0.5	0.35 to 0.45	0.4 to 0.6
1608	0.6 to 0.8	0.6 to 0.8	0.6 to 0.8
2012	0.9 to 1.2	0.7 to 0.9	0.9 to 1.2



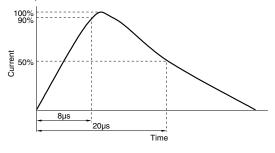
ELECTRICAL CHARACTERISTICS

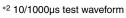
Part No.	(Break	or voltage down voltage) V)[DC1mA]	Maximum continuous voltage (Rated voltage) Vdc(V) max.	Clamping voltage Vcl(V) [8/20µs]	Maximum energy E(Joule) [10/1000µs] max.	Maximum peak current lp(A) [8/20µs] max.	Capacitance C(pF) [1kHz, 1Vrms] typ.	Packaging quantities (Taping) (pieces/reel)
0402 type								
AVRM0402C6R8NT101N	6.8	(4.76 to 8.84)	3.5	15[1A]	0.01	4	100 (70 to 130)	- 20,000
AVRM0402C120MT330N	12	(9.6 to 14.4)	5.5	20[1A]	0.005	1	33 (23.1 to 43.9)	- 20,000
0603 type								_
AVRM0603C6R8NT331N	6.8	(4.76 to 8.84)	3.5	14[1A]	0.02	16	330 (231 to 429)	
AVRM0603C6R8NT101N	6.8	(4.76 to 8.84)	3.5	14[1A]	0.01	10	100 (70 to 130)	_
AVRM0603C080MT101N	8	(6.4 to 9.6)	5.5	17[1A]	0.01	4	100 (70 to 130)	_
AVRM0603C120MT101N	12.8	(10 to 15.6)	5.5	20[1A]	0.01	5	100 (70 to 130)	15,000
AVR-M0603C120MTAAB	12	(9.6 to 14.4)	7.5	23[1A]	0.01	1	33	_
AVRM0603C120MT150N	12.8	(10 to 15.6)	5.5	35[1A]	0.003	1	15 (10.5 to 19.5)	_
AVRM0603C200MT150N	20	(16.0 to 24.0)	12	40[1A]	0.01	1	15 (10.5 to 19.5) [1MHz]	=
1005 type								
AVRM1005C6R8NT331N	6.8	(4.76 to 8.84)	3.5	15[1A]	0.008	24	330 (231 to 429)	
AVRM1005C6R8NT101N	6.8	(4.76 to 8.84)	3.5	14[1A]	0.02	10	100 (70 to 130)	=
AVR-M1005C080MTAAB	8	(6.4 to 9.6)	5.5	14[1A]	0.04	25	650	=
AVR-M1005C080MTADB	8	(6.4 to 9.6)	5.5	14[1A]	0.04	25	480	-
AVR-M1005C080MTABB	8	(6.4 to 9.6)	5.5	15[1A]	0.02	3	100	=
AVR-M1005C080MTACB	8	(6.4 to 9.6)	5.5	19[1A]	0.01	1	33	40.000
AVR-M1005C120MTACC	12	(9.6 to 14.4)	7.5	21[1A]	0.01	24	460 [1MHz]	- 10,000
AVR-M1005C120MTAAB	12	(9.6 to 14.4)	7.5	20[1A]	0.05	10	130	-
AVR-M1005C180MTAAB	18	(14.4 to 21.6)	11	30[1A]	0.06	16	120 [1MHz]	_
AVRM1005C270KT101N	27	(24 to 30)	19	44[1A]	0.06	4	100 (70 to 130)	=
AVR-M1005C270MTAAB	27	(21.6 to 32.4)	15	47[1A]	0.06	4	40	-
AVR-M1005C270MTABB	27	(21.6 to 32.4)	15	49[1A]	0.05	1	15	_
1608 type								
AVR-M1608C080MTAAB	8	(6.4 to 9.6)	5.5	15[2A]	0.09	30	650	
AVR-M1608C120MT6AB	12	(9.6 to 14.4)	7.5	20[2A]	0.09	50	1050	-
AVR-M1608C120MT2AB	12	(9.6 to 14.4)	7.5	20[2A]	0.06	15	400	_
AVR-M1608C180MT6AB	18	(14.4 to 21.6)	11	30[2A]	0.1	30	600	-
AVR-M1608C220KT6AB	22	(19.8 to 24.2)	16	34[2A]	0.1	30	560	_
AVR-M1608C220KT2AB	22	(19.8 to 24.2)	16	37[2A]	0.03	10	210	_
AVR-M1608C270KT6AB	27	(24 to 30)	19	42[2A]	0.1	48	430	4,000
AVR-M1608C270KT2AB	27	(24 to 30)	19	42[2A]	0.1	20	160	- '
AVR-M1608C270KTACB	27	(24 to 30)	19	54[2A]	0.05	10	60	-
AVRM1608C270KT800M	27	(24 to 30)	19	53[2A]	0.02	28	80 (64 to 96)	_
AVR-M1608C270MTAAB	27	(21.6 to 32.4)	17	52[2A]	0.05	2	30	-
AVR-M1608C270MTABB	27	(21.6 to 32.4)	17	52[2A]	0.05	2	15	-
AVRM1608C390KT271N	39	(35 to 43)	28	69[2A]	0.1	78	270 (189 to 351)	=
2012 type		· , , , , , , , , , , , , , , , , , , ,					· ,	
AVR-M2012C120MT6AB	12	(9.6 to 14.4)	7.5	20[5A]	0.2	60	1000	
AVR-M2012C220KT6AB	22	(19.8 to 24.2)	16	38[5A]	0.3	100	800	2,000
AVR-M2012C390KT6AB	39	(35 to 43)	28	62[5A]	0.3	100	430	= *
		` '						

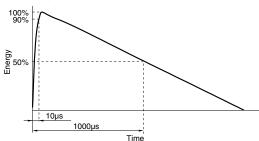
TERMINOLOGY

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









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AVRL TYPE PRODUCT IDENTIFICATION

 $\frac{\text{AVRL}}{(1)} \ \frac{10}{(2)} \ \frac{1A}{(3)} \ \frac{3\text{R3}}{(4)} \ \frac{\text{F}}{(5)} \ \frac{\text{T}}{(6)} \ \frac{\text{A}}{(7)}$

(1) Series name

(2) Dimensions L×W

04	0.4×0.2mm	
06	0.6×0.3mm	
10	1.0×0.5mm	
16	1.6×0.8mm	

(3) Maximum continuous voltage

0	
10Vdc	
16Vdc	
25Vdc	
	10Vdc 16Vdc

(4) Capacitance

1R1	1.1pF
2R2	2.2pF
3R3	3.3pF
6R8	6.8pF

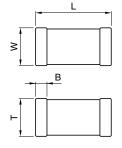
(5) Capacitance tolerance

N	±0.3pF	
D	±0.5pF	
F	±1pF	
G	±2pF	

(6) Packaging style

|--|

SHAPES AND DIMENSIONS

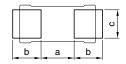




Dimensions in mm

Туре	L	W	Т	B min.	Weight (mg)typ.
0402	0.4±0.02	0.2±0.02	0.2±0.02	0.07	0.1
0603	0.6±0.03	0.3±0.03	0.3±0.03	0.1	0.2
1005	1.0±0.05	0.5±0.05	0.5±0.05	0.1	1.2
1608	1.6±0.1	0.8±0.1	0.8±0.1	0.2	5

RECOMMENDED PC BOARD PATTERN



Dimensions in mm

Type	а	b	С
0402	0.2	0.15 to 0.2	0.18 to 0.2
0603	0.25 to 0.35	0.2 to 0.3	0.25 to 0.35
1005	0.3 to 0.5	0.35 to 0.45	0.4 to 0.6
1608	0.6 to 0.8	0.6 to 0.8	0.6 to 0.8

(7) Varistor voltage and TDK internal code

ELECTRICAL CHARACTERISTICS

Part No.	Capacitance C(pF) [1MHz, 1Vrms]	Maximum continuous voltage (Rated voltage) Vdc(V) max.	Insulation resistance Rdc($M\Omega$) [3Vrms] min.	Varistor voltage V _{1m} A(V)[DC1mA] typ.	Packaging quantities (Taping) (pieces/reel)
0402 type					
AVRL041E1R1NTA	1.1[0.8 to 1.4]	25	10	39	20,000
0603 type					
AVRL061E1R1NTA	1.1[0.8 to 1.4]	25	10	39	15,000
1005 type					
AVRL101A1R1NTA	1.1[0.8 to 1.4]	10	10	90	
AVRL101A1R1NTB	1.1[0.8 to 1.4]	10	10	39	_
AVRL101C2R2DTA	2.2[1.7 to 2.7]	16	10	90	10,000
AVRL101A3R3FTA	3.3[2.3 to 4.3]	10	10	27	=
AVRL101A6R8GTA	6.8[4.8 to 8.8]	10	10	27	_
1608 type					
AVRL161A1R1NTA	1.1[0.8 to 1.4]	10	10	90	
AVRL161A1R1NTB	1.1[0.8 to 1.4]	10	10	39	4.000
AVRL161A3R3FTA	3.3[2.3 to 4.3]	10	10	27	- 4,000
AVRL161A6R8GTA	6.8[4.8 to 8.8]	10	10	27	-

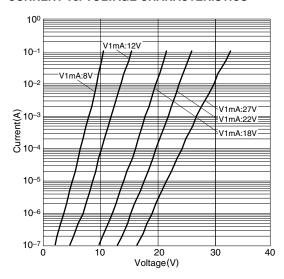
TERMINOLOGY

Item	Unit	Terminology
Capacitance	С	Capacitance measured at 1MHz of oscillator frequency and 1Vrms
Capacitance	(pF)	of oscillator voltage.
Maximum continuous	Vdc	Maximum DC voltage that can be applied continuously.
voltage (Rated voltage)		Varistor leakage current: 50µA max.
vollage (haleu vollage)	(V)	(Within the range of maximum allowable circuit voltage)
Insulation resistance	Rdc	Insulation resistance appearing across the varistor when specified
insulation resistance	$(M\Omega)$	voltage is applied.
Varistor voltage V1mA		Voltage measured across the varistor when DC1mA is applied.
(Breakdown voltage)	(V)	voltage measured across the varistor when DC IIIA is applied.

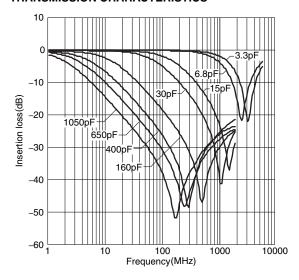
[•] All specifications are subject to change without notice.

ATDK

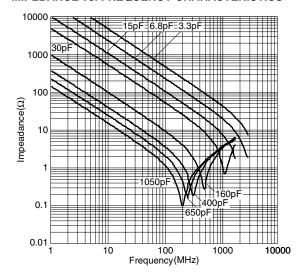
TYPICAL ELECTRICAL CHARACTERISTICS CURRENT vs. VOLTAGE CHARACTERISTICS



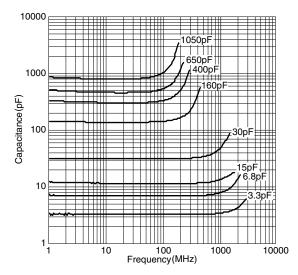
TRANSMISSION CHARACTERISTICS



IMPEDANCE vs. FREQUENCY CHARACTERISTICS



CAPACITANCE vs. FREQUENCY CHARACTERISTICS



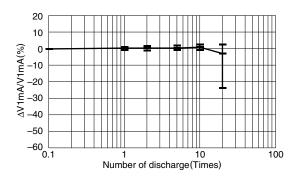
[•] All specifications are subject to change without notice.

ATDK

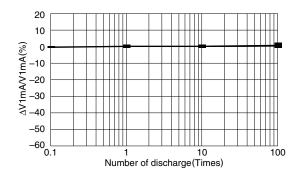
ELECTROSTATIC DISCHARGE TESTS TEST CONDITIONS

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

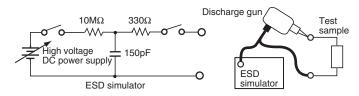
AVR-M0603 TYPE



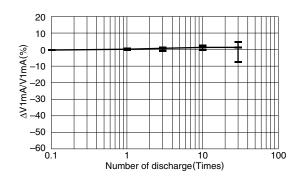
AVR-M1608 TYPE



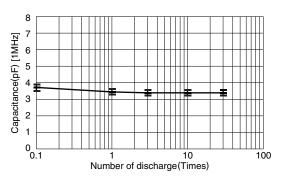
MEASURING CIRCUIT



AVR-M1005 TYPE



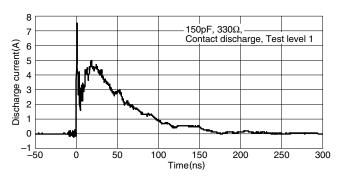
AVRL101A3R3F



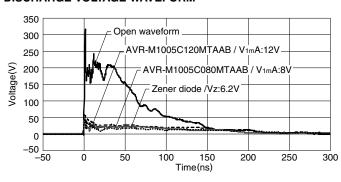
[•] All specifications are subject to change without notice.

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ELECTROSTATIC ABSORPTION CHARACTERISTICS DISCHARGE CURRENT WAVEFORM



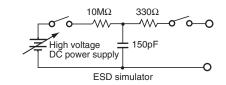
DISCHARGE VOLTAGE WAVEFORM

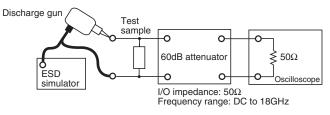


WAVEFORM PARAMETERS [IEC61000-4-2]

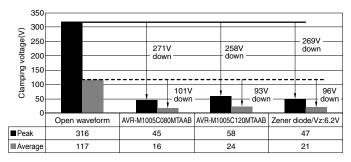
Test level	ESD Charge voltage (kV)	First peak current of discharge (A)	Rise time (ns)
1	2	7.5	0.7 to 1.0
2	4	15	0.7 to 1.0
3	6	22.5	0.7 to 1.0
4	8	30	0.7 to 1.0

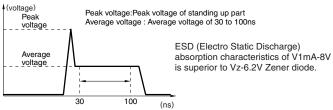
MEASURING CIRCUIT





ESD ABSORPTION CHARACTERISTICS COMPARISON OF VARIOUS ELEMENTS





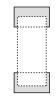
[•] All specifications are subject to change without notice.

MERITS OF REPLACEMENT FROM ZENER DIODE

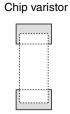
(1) Reduction in the number of parts **REDUCTION EXAMPLES**

Zener diode+capacitor

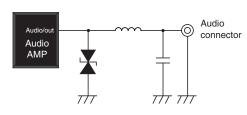
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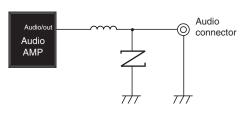






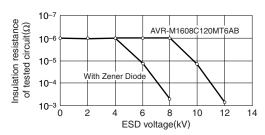
EXAMPLE OF REPLACEMENT AT AUDIO TERMINAL





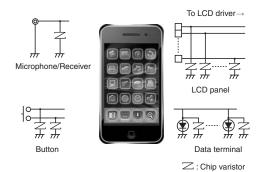
: Chip varistor

(2) Improved electrostatic absorption capability COMPARE DATA OF CHIP VARISTOR AND ZENER DIODE ABOUT IC PROTECTION

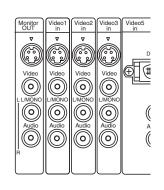


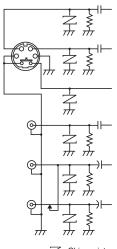
CMOS: D74HC04C ESD generator : Noise Laboratory Co.,Ltd., ESS -630A 200pF-0 Ω method model equipment Contact type discharge ESD applied point: Vcc-ground

APPLICATION EXAMPLES SMART PHONE



AUDIO/VIDEO



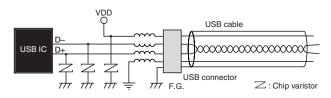


∠: Chip varistor

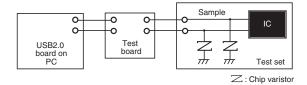
[•] All specifications are subject to change without notice.

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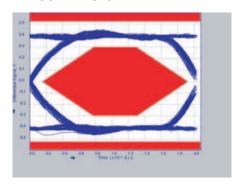
APPLICATION EXAMPLES USB 2.0



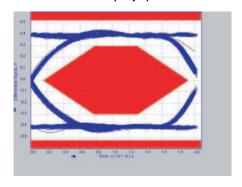
MEASURING CIRCUIT



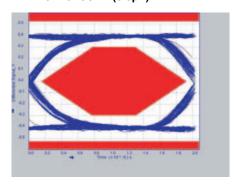
WITHOUT VARISTOR



WITH VARISTOR AVRL101A3R3FTA (3.3pF)



AVRL101A6R8GTA (6.8pF)



[•] All specifications are subject to change without notice.