

**ESD/EMI TOTAL SOLUTION**

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# **CHIP VARISTOR**

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Typical Circuits Requiring Protection	

AMECS Transient Voltage Suppressors are ZnO based devices designed for protection of low and medium voltage electronic circuits against electrostatic discharge and voltage or current transient surges. They have nonlinear voltage-current characteristics similar to back-to-back zener diodes and their multilayer structure provide many advantages comparing with zener diodes. Their breakdown voltage can range from 4V to 470V, surge current from 30A to 400A, capacitance value from 0.8 pF to 7.5 nF and their size from 0402 to 3225.

AMECS Transient Voltage Suppressors cover different application fields, such as :

1. ICs and low voltage electronic circuits protection
2. Automotive electronics protection
3. Telecommunication

Protective device that has been used for protection of ICs and low voltage electronic circuits for years is Zener diode. AMECS Transient Voltage Suppressors are a new SMD protective device, which present real and serious competition to Zener diode in numerous aspects:

- Symmetrical I-V characteristics
- Fastest response time (< 1ns)
- Variable capacitance values
- Low leakage current
- High surge current capability
- EMI / RFI attenuation characteristics
- High surge energy capability
- Good energy dissipation capability
- High reliability
- Good temperature stability
- Small size
- SMD compatibility

In the field of automotive electronics and telecommunications AMECS Transient Voltage Suppressors compete with standard disc varistors. Their advantages are :

- Low clamping voltage
- Fast response time shorter than 5ns
- Variable capacitance values
- Low leakage current
- High current capability of the unit volume
- High energy capability of the unit volume
- Good energy dissipation capability
- Maximum operating Temp. up to +125°C
- Good temperature stability
- High reliability
- Small size
- SMD compatibility

## Absolute Maximum Ratings

	Value	Units
<b>Transients :</b>		
Peak Single Pulse Surge Current 8/20 $\mu$ s Waveform (Imax)	20 to 250	A
Single Pulse Surge Energy, 10/1000 $\mu$ s Waveform (Wmax)	0.05 to 2.5	J
<b>Operating Ambient Temperature</b>	-55 to +125	°C
<b>Storage Temperature Range</b>	-55 to +150	°C
<b>Threshold Voltage Temperature Coefficient</b>	< - 0.05	%/°C
<b>Response Time</b>	< 1	ns
<b>Climatic Category</b>	55/125/56	

# Compact Array (Space Saved)

## AVSC -F Series (4\_element)

### Features

- Four elements in one chip
- 0405 sizes
- World smallest size
- Meets IEC 61000-4-2 (ESD), Level 4 & IEC 61000-4-4 (EFT), Level 4 requirements
- ESD Protection > 30KV
- Low capacitance for high frequency data line protection
- Fast response time < 1ns

### Application

- LCD Module
- Mobile Phone/PDAs
- MP3 Player
- Digital Camera
- ESD Protection for sensitive IC
- I/O Port, Keypad for portable devices
- Wireless Handsets
- Lap top computer
- Desk top computer

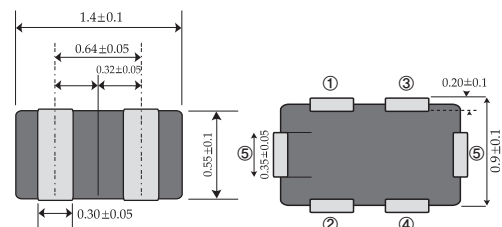
### Ordering information

<b>AVSC</b>	<b>5</b>	<b>S</b>	<b>04</b>	<b>F</b>	<b>025</b>
Compact Array Varistor	Maximum Continuous Working Voltage - Vdc	Vn Tolerance :	Chip Size : 04 = 0405	Configuration : F = 4 element	Typical Capacitance @ 1MHz : 025 = 25pF
K = ±10%, L = ±15%, M = ±20%, S = Special order					

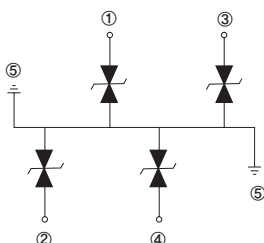
### Specifications

Type	Symbol	Units	Test Condition	Working Voltage Vdc Volts(max.) < 20μA	Breakdown Voltage Vn Volts 1mA DC	Clamping Voltage Vc Volts(max.)	Clamping Current Ic Amp 8/20μS	Peak Current Imax Amp(max.) 8/20μS	Transient Energy Wmax Joules(max.) 10/1000μS	Capacitance C pF(Typ.) 0.5Vrms @ 1MHz		Resistance* R Mega Ohms (min.) 3V DC	
										max	Typ.		
AVSC	18S	04	F	010	18	24-32	45	1.0	5	0.005	10	8	10
AVSC	5S	04	F	025	5.5	10-14	25	1.0	5	0.03		25	10
AVSC	5S	04	F	050	5.5	10-14	25	1.0	10	0.03		50	10

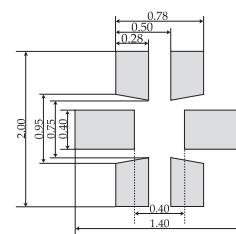
### Dimensions (unit : mm)



### Equivalent Circuit Diagram



### Pad layout



※ Customized properties are available upon request.

\*1 Resistance after soldering is 10MΩ min. [Reflow soldering condition] Temperature profile : 230℃ max., 5sec Solder paste : Tamura (Japan) RMA 20-21 L, Measurement shall be made 1 hour after soldering.

# Compact Array (Space Saved)

## AVSC -E Series (8\_element)

### Features

- Eight elements in one chip
- 0508 sizes
- World smallest size
- Meets IEC 61000-4-2 (ESD), Level 4 & IEC 61000-4-4 (EFT), Level 4 requirements
- ESD Protection > 30KV
- Low capacitance for high frequency data line protection
- Fast response time < 1ns

### Application

- LCD Module
- Mobile Phone/PDAs
- MP3 Player
- Digital Camera
- ESD Protection for sensitive IC
- I/O Port, Keypad for portable devices
- Wireless Handsets
- Lap top computer
- Desk top computer

### Ordering information

<b>AVSC</b>	<b>5</b>	<b>S</b>	<b>05</b>	<b>E</b>	<b>025</b>
Compact Array Varistor	Maximum Continuous Working Voltage - Vdc	Vn Tolerance :	Chip Size : 05 = 0508	Configuration : E= 8 element	Typical Capacitance @ 1MHz : 025 = 25pF
K = ±10%, L = ±15%, M = ± 20%, S = Special order					

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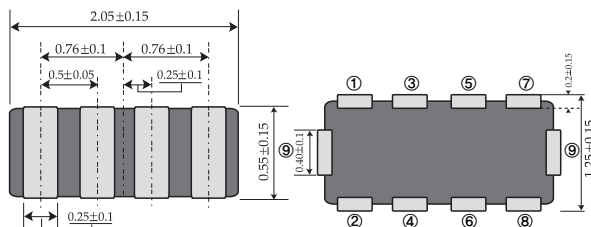
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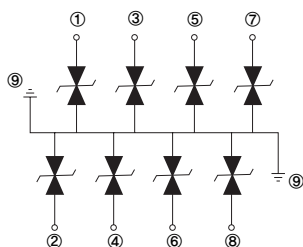
### • Specifications

Type	Symbol	Units	Test Condition	Working Voltage Vdc Volts(max.) < 20µA	Breakdown Voltage Vn Volts 1mA DC	Clamping Voltage Vc Volts(max.)	Clamping Current Ic Amp 8/20µS	Peak Current Imax Amp(max.) 8/20µS	Transient Energy Wmax Joules(max.) 10/1000µS	Capacitance C pF(Typ.) 0.5Vrms@ 1MHz		Resistance* R Mega Ohms (min.) 3V DC	
										max	Typ.		
AVSC	18S	05	E	010	18	24-32	45	1.0	5	0.005	10	8	10
AVSC	5S	05	E	025	5.5	10-14	25	1.0	5	0.03		25	10
AVSC	5S	05	E	050	5.5	10-14	25	1.0	10	0.03		50	10

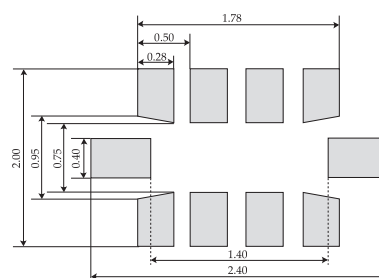
### Dimensions (unit : mm)



### Equivalent Circuit Diagram



### Pad layout



3

\* Customized properties are available upon request.

\*1 Resistance after soldering is 10MΩ min. [Reflow soldering condition] Temperature profile : 230°C max. , 5sec Solder paste : Tamura (Japan) RMA 20-21 L, Measurement shall be made 1 hour after soldering.

# General Array

## AVNC Series (2\_element)

### Features

- Two elements in one chip
- 0405, 0508 Sizes
- Meets IEC 61000-4-2 (ESD), Level 4 & IEC 61000-4-4 (EFT), Level 4 requirements
- ESD Protection > 30KV
- Low capacitance for high frequency data line protection
- Fast response time < 1ns

### Application

- LCD Module
- I/O Port Application
- Cellular Phone
- PCMCIA / Compact Flash Card
- RS-232 & RS-423 Data Lines
- DSP Products

### Ordering information

<b>AVNC</b>	<b>18</b>	<b>S</b>	<b>05</b>	<b>D</b>	<b>015</b>
Low Capacitance Varistor array	Maximum Continuous Working Voltage - Vdc	Vn Tolerance : K = ±10%, L = ±15%, M = ± 20%, S = Special order	Chip Size : 04 = 0405, 05 = 0508	Configuration : D = 2 element	Typical Capacitance @ 1KHz : 015 = 15pF

### • Specifications

Type Symbol Units Test Condition	Working Voltage Vdc Volts(max.) < 20µA	Breakdown Voltage Vn Volts 1mA DC	Clamping Voltage Vc Volts(max.)	Clamping Current Ic Amp 8/20µS	Peak Current Imax Amp(max.) 8/20µS	Transient Energy Wmax Joules(max.) 10/1000µS	Capacitance C pF(Typ.) 0.5Vrms@ 1KHz	Resistance* R Mega Ohms (min.) 3V DC
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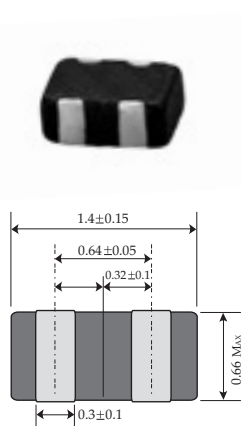
#### ▶ AVNC Series (0402 Dual Array)

AVNC	5S	04	D	050	5.5	10-14	25	1.0	10	0.03	50	10
AVNC	14S	04	D	050	14	18-24	40	1.0	10	0.03	50	10
AVNC	18S	04	D	015	18	24-32	45	1.0	5	0.005	15	10

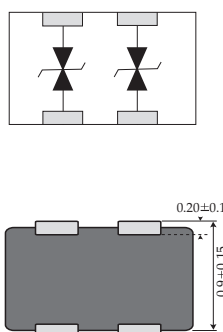
#### ▶ AVNC Series (0603 Dual Array)

AVNC	18S	05	D	120	18	24-32	45	1.0	30	0.05	120	10
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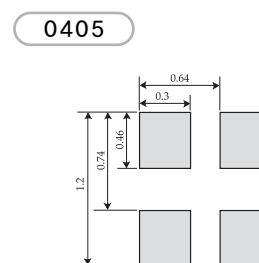
### Dimensions (unit : mm)



### Equivalent Circuit Diagram



### Pad layout



※ Customized properties are available upon request.

\*1 Resistance after soldering is 10MΩ min. [Reflow soldering condition] Temperature profile : 230℃ max., 5sec Solder paste : Tamura (Japan) RMA 20-21 L, Measurement shall be made 1 hour after soldering.

# General Array

## AVNC Series (4\_element)

### Features

- Four elements in one chip
- 0508, 0612 Sizes
- Meets IEC 61000-4-2 (ESD), Level 4 & IEC 61000-4-4 (EFT), Level 4 requirements
- ESD Protection > 30KV
- Low capacitance for high frequency data line protection
- Fast response time < 1ns

### Application

- LCD Module
- I/O Port Application
- Cellular Phone
- PCMCIA / Compact Flash Card
- RS-232 & RS-423 Data Lines
- DSP Products

### Ordering information

<b>AVNC</b>	<b>18</b>	<b>S</b>	<b>05</b>	<b>Q</b>	<b>015</b>
Low Capacitance Varistor array	Maximum Continuous Working Voltage - Vdc	Vn Tolerance: K = ±10%, L = ±15%, M = ± 20%, S = Special order	Chip Size : 05 = 0508, 06 = 0612	Configuration : Q= 4 element	Typical Capacitance @ 1KHz : 015 = 15pF

### Specifications

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Type Symbol Units Test Condition	Working Voltage Vdc Volts(max.) < 20μA	Breakdown Voltage Vn Volts 1mA DC	Clamping Voltage Vc Volts(max.)	Clamping Current Ic Amp 8/20μS	Peak Current Imax Amp(max.) 8/20μS	Transient Energy Wmax Joules(max.) 10/1000μS	Capacitance C pF(Typ.) 0.5Vrms@ 1KHz	Resistance* R Mega Ohms (min.) 3V DC
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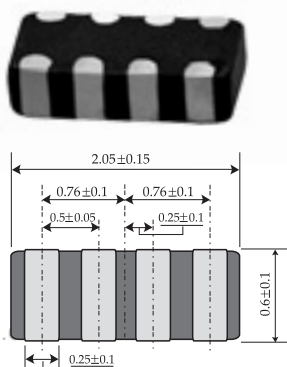
#### ▶ AVNC Series - (0402 Quad Array)

AVNC	5S	05	Q	050	Working Voltage Vdc	Breakdown Voltage Vn	Clamping Voltage Vc	Clamping Current Ic	Peak Current Imax	Transient Energy Wmax	Capacitance C	Resistance* R
AVNC	14S	05	Q	050	14	18-24	40	1.0	10	0.03	50	10
AVNC	18S	05	Q	050	18	24-32	45	1.0	5	0.03	50	10
AVNC	18S	05	Q	015	18	24-32	45	1.0	5	0.005	15	10

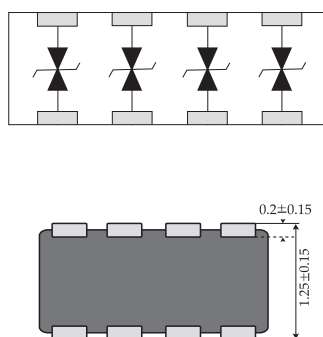
#### ▶ AVNC Series - (0603 Quad Array)

AVNC	18S	06	Q	120	Working Voltage Vdc	Breakdown Voltage Vn	Clamping Voltage Vc	Clamping Current Ic	Peak Current Imax	Transient Energy Wmax	Capacitance C	Resistance* R
AVNC	14S	06 <td>Q</td> <td>350</td> <td>14</td> <td>18-24</td> <td>35</td> <td>1.0</td> <td>30</td> <td>0.1</td> <td>350</td> <td>10</td>	Q	350	14	18-24	35	1.0	30	0.1	350	10

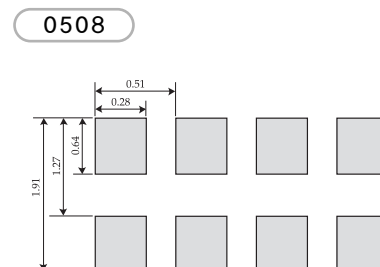
### Dimensions (unit : mm)



### Equivalent Circuit Diagram



### Pad layout



# R-C Type EMI-ESD Filter

## AVRC Series

### Features

- Four elements in one chip
- 0508 sizes
- Meets IEC 61000-4-2 (ESD), Level 4 & IEC 61000-4-4 (EFT), Level 4 requirements
- ESD Protection > 30KV
- Low capacitance for high frequency data line protection
- Fast response time < 1ns

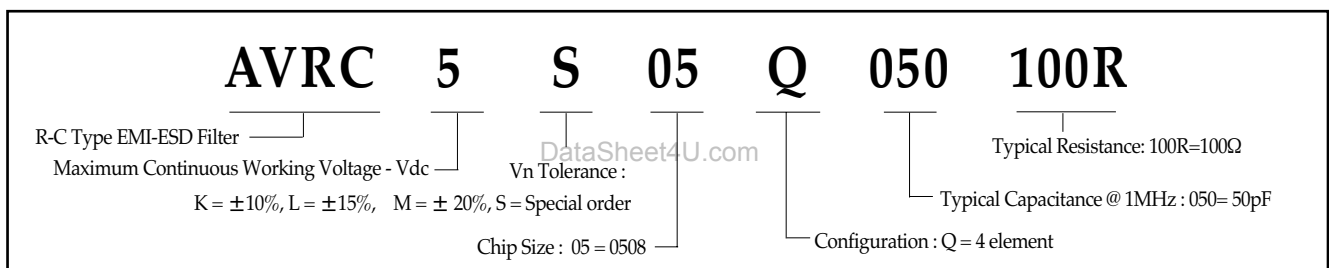
### Application

- LCD Module
- Mobile Phone/PDAs
- MP3 Player
- Digital Camera
- ESD Protection for sensitive IC
- I/O Port, Keypad for portable devices
- Wireless Handsets
- Lap top computer
- Desk top computer

### Special Features

- EMI Filtering with ESD protection

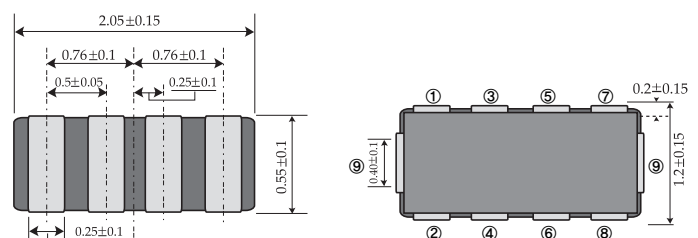
### Ordering information



### Specifications

Type Symbol Units Test Condition	Working Voltage Vdc Volts(max.) < 20μA	Breakdown Voltage Vn Volts 1mA DC	Clamping Voltage Vc Volts(max.)	Clamping Current Ic Amp 8/20μS	Peak Current Imax Amp(max.) 8/20μS	Transient Energy Wmax Joules(max.) 10/1000μS	Capacitance C pF(Typ.) 0.5Vrms@ 1MHz		Resistance IR Mega Ohms (min.) 3V DC	Resistance R Ohms (Typ) 3V DC
							max	Typ.		
AVRC 18S 05 Q 010 100R	18	24-32	45	1.0	5	0.005	5	4	10	100
AVRC 14S 05 Q 030 100R	14	18-24	45	1.0	5	0.005		15	10	100
AVRC 5S 05 Q 050 100R	5.5	10-14	25	1.0	10	0.03		25	10	100
AVRC 5S 05 Q 100 100R	5.5	10-14	25	1.0	10	0.03		50	10	100

### Dimensions (unit : mm)



※ Customized properties are available upon request.

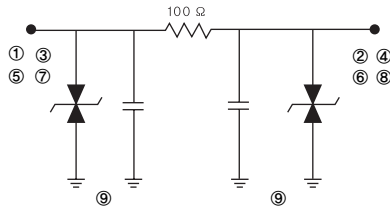
\*1 Resistance after soldering is 10MΩ min. [Reflow soldering condition] Temperature profile : 230℃ max., 5sec Solder paste : Tamura (Japan) RMA 20-21 L. Measurement shall be made 1 hour after soldering.



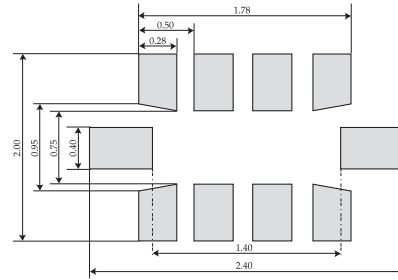
# R-C Type EMI-ESD Filter

## AVRC Series

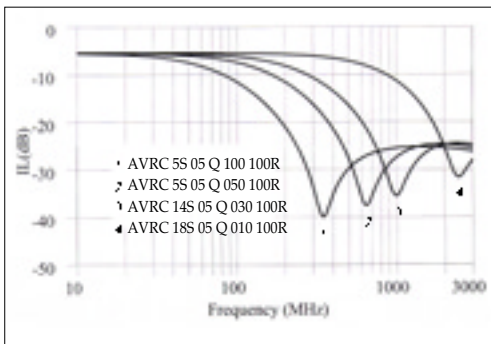
### Equivalent Circuit Diagram



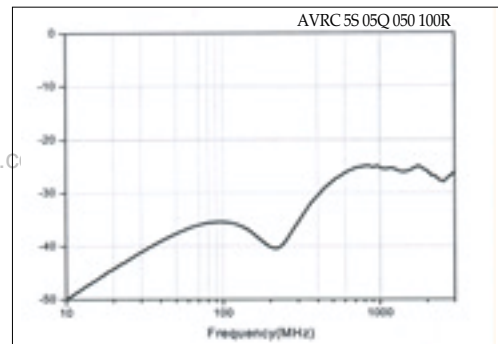
### Pad layout



### Frequency Characteristics



Frequency vs. Insertion Loss Curve

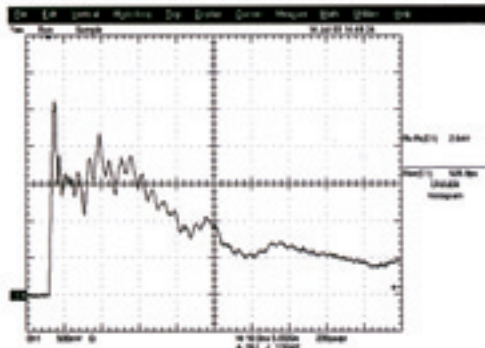


Crosstalk with port1 & port2

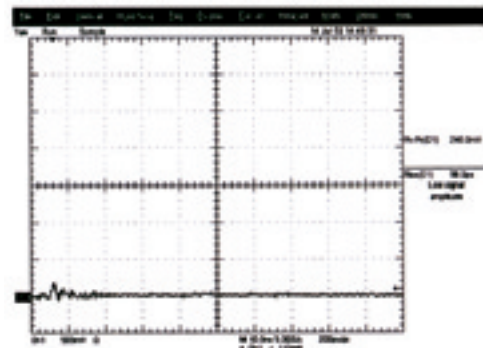
AVRC SERIES

### ESD Protection Efficiency (Contact 8KV ESD Strike)

ESD Curve Input (IEC61000-4-2 Standard Waveform)



ESD Curve Output



# Feed Thru Type EMI-ESD Filter

## AVFC Series

### Features

- Four elements in one chip
- 0508 sizes
- Meets IEC 61000-4-2 (ESD), Level 4 & IEC 61000-4-4 (EFT), Level 4 requirements
- ESD Protection > 30KV
- Low capacitance for high frequency data line protection
- Fast response time < 1ns

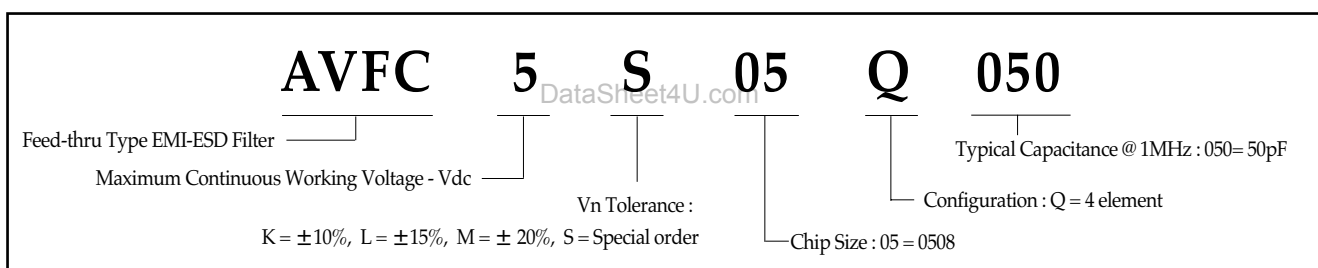
### Application

- LCD Module
- Mobile Phone/PDAs
- MP3 Player
- Digital Camera
- ESD Protection for sensitive IC
- I/O Port, Keypad for portable devices
- Wireless Handsets
- Lap top computer
- Desk top computer
- Acoustic Part

### Special Features

- EMI Filtering with ESD protection

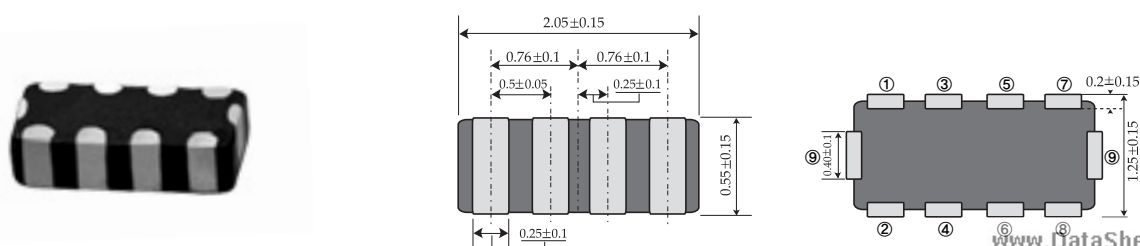
### Ordering information



### Specifications

Type Symbol Units Test Condition	Working Voltage Vdc Volts(max.) < 20μA	Breakdown Voltage Vn Volts 1mA DC	Clamping Voltage Vc Volts(max.)	Clamping Current Ic Amp 8/20μS	Peak Current Imax Amp(max.) 8/20μS	Transient Energy Wmax Joules(max.) 10/1000μS	Capacitance C pF(Typ.) 0.5Vrms@ 1MHz		Resistance*1 R Mega Ohms (min.) 3V DC
							max	Typ.	
AVFC 18S 05 Q 010	18	24-32	45	1.0	5	0.005	10	8	10
AVFC 14S 05 Q 030	14	18-24	40	1.0	5	0.005		30	10
AVFC 5S 05 Q 050	5.5	10-14	25	1.0	10	0.03		50	10
AVFC 5S 05 Q 100	5.5	10-14	25	1.0	10	0.03		100	10

### Dimensions (unit : mm)



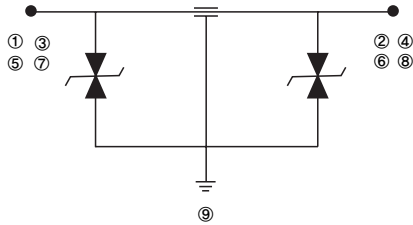
※ Customized properties are available upon request.

\*1 Resistance after soldering is 10MΩ min. [Reflow soldering condition] Temperature profile : 230℃ max., 5sec Solder paste : Tamura (Japan) RMA 20-21 L. Measurement shall be made 1 hour after soldering.

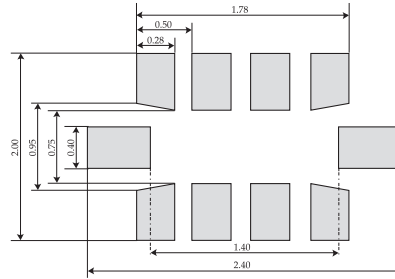
# Feed Thru Type EMI-ESD Filter

## AVFC Series

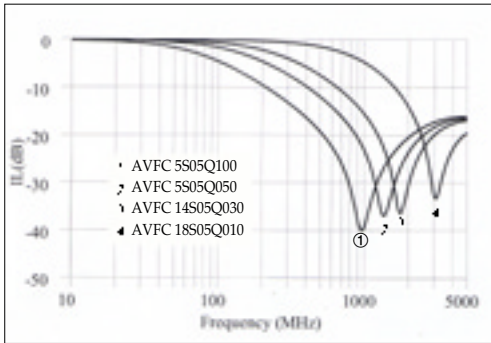
### Equivalent Circuit Diagram



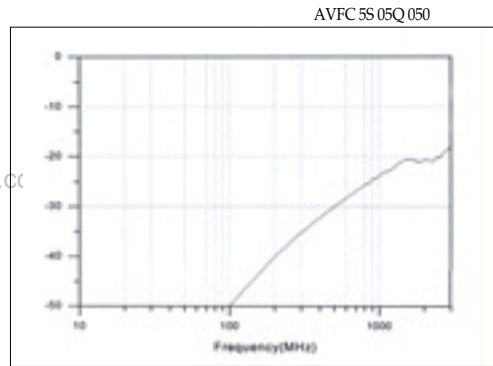
### Pad layout



### Frequency Characteristics



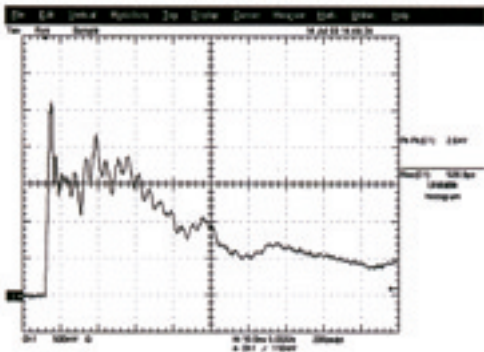
Frequency vs. Insertion Loss Curve



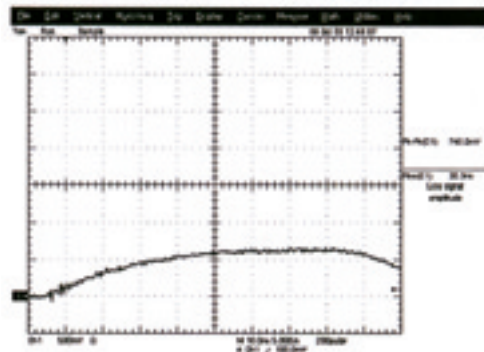
Crosstalk with port1 & port2

### ESD Protection Efficiency (Contact 8KV ESD Strike)

ESD Curve Input (IEC61000-4-2 Standard Waveform)



ESD Curve Output



# High Power

## AVL Series

### Description

AVL Series are designed to protect sensitive electronics devices against high voltage transient surges in the low voltage region. They offer excellent transient energy absorption due to improved energy volume distribution and power dissipation. AVL series cover wide DC operating voltage range from 5V to 56V.

### Features

- Multilayer construction technology
- Wide operating voltage range Vdc : 3V to 56V
- 5 Model sizes available : 0402, 0603, 1206 and 1210
- ESD protection > 30KV
- Short response time < 1ns
- Bidirectional clamping and low clamping voltage
- - 55°C to + 125°C operating temperature range
- No plastic coating guarantees better flammability rating
- Low Leakage current after soldering max. 20µA at Vdc

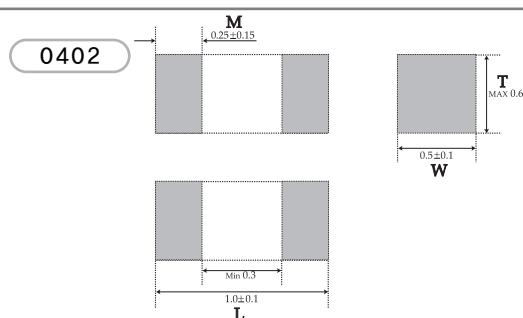
### Application

- Mobile Phone/PDAs
- MP3 Player
- Digital Camera
- ESD Protection for sensitive IC
- I/O Port, Keypad for portable devices
- Wireless Handsets
- Lap top computer
- Desk top computer
- HDD • DVD
- Digital TV (PDP TV, LCD TV)

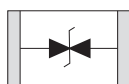
### Ordering information

<b>AVL</b>	<b>5</b>	<b>M</b>	<b>02</b>	<b>200</b>
Standard Single Varistor	Maximum Continuous Working Voltage - Vdc	Vn Tolerance:	Chip Size : 02 = 0402, 03 = 0603, 05 = 0805 06 = 1206, 10 = 1210, 25 = 3225	Maximum Surge Current : 200 = 20 × 10 <sup>3</sup> A
K = ±10%, L = ±15%, M = ± 20%, S = Special order				

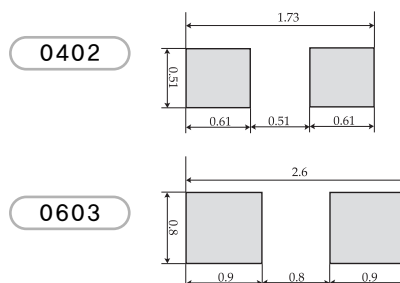
### Dimensions



### Equivalent Circuit Diagram



### Pad layout



Size	0402	0603	0805	1206	1210
L(mm)	1.0 ± 0.10	1.6 ± 0.15	2.0 ± 0.2	3.2 ± 0.3	3.2 ± 0.3
W(mm)	0.5 ± 0.10	0.8 ± 0.15	1.25 ± 0.2	1.6 ± 0.3	2.5 ± 0.3
M(mm)	0.25 ± 0.15	0.35 ± 0.15	0.4 ± 0.2	0.5 ± 0.25	0.5 ± 0.25
T(mm)	Max 0.6	Max 0.9	Max 1.1	Max 1.2	

# High Power

## AVL Series

### • Specifications

Type Symbol Units Test Condition	Working Voltage Vdc Volts(max.) < 20 $\mu$ A	Breakdown Voltage Vn Volts 1mA DC	Clamping Voltage Vc Volts(max.)	Clamping Current Ic Amp 8/20 $\mu$ S	Peak Current Imax Amp(max.) 8/20 $\mu$ S	Transient Energy Wmax Joules(max.) 10/1000 $\mu$ S	Capacitance C pF(Typ.) 0.5Vrms @ 1KHz @ 1MHz ■	Resistance* R Mega Ohms (min.) 3V DC
---	--	---	--	--	--	--	---	--

#### ► Size 0402

AVL 5M 02 200	5.5	8	15.5	1.0	20	0.05	480	10
AVL 8M 02 200	8	11	20	1.0	20	0.05	230	10
AVL 11L 02 200	11	15	30	1.0	20	0.05	180	10
AVL 14K 02 200	14	18	35	1.0	20	0.05	160	10
AVL 18K 02 200	18	22	40	1.0	20	0.05	90	10

#### ► Size 0603

AVL 5M 03 300	5.5	8	15	1.0	30	0.1	800	10
AVL 8M 03 300	8	11	25	1.0	30	0.1	500	10
AVL 14K 03 300	14	18	35	1.0	30	0.1	350	10
AVL 18S 03 LC120	18	24-32	45	1.0	30	0.05	120	10
AV 18S 03 LC30 ■	18	24-32	45	1.0	2	0.05	30	10
AVL 18S 03 LC15 ■	18	24-32	45	1.0	2	0.05	15	10
AVL 18S 03 LC03 ■	18	24-32	45	1.0	2	0.05	3	10

#### ► Size 0805

AVL 8M 05 400	8	11	21	1.0	40	0.1	800	10
AVL 8M 05 121	8	11	21	1.0	120	0.3	1000	10
AVL 11L 05 400	11	15	25	1.0	40	0.1	600	10
AVL 11L 05 121	11	15	25	1.0	120	0.3	800	10
AVL 14K 05 400	14	18	35	1.0	40	0.1	400	10
AVL 14K 05 121	14	18	35	1.0	120	0.3	750	10
AVL 18K 05 400	18	22	38	1.0	40	0.1	400	10
AVL 18K 05 121	18	22	38	1.0	120	0.3	600	10
AVL 22K 05 400	22	27	49	1.0	40	0.1	350	10
AVL 22K 05 121	22	27	49	1.0	120	0.3	500	10
AVL 26K 05 400	26	33	54	1.0	40	0.1	300	10
AVL 26K 05 121	26	33	54	1.0	120	0.3	400	10

#### ► Size 1206

AVL 14K 06 151	14	18	33	2.0	150	0.4	2000	10
AVL 18K 06 151	18	22	38	2.0	150	0.4	1500	10
AVL 22K 06 151	22	27	44	2.0	150	0.4	1400	10
AVL 26K 06 151	26	33	54	2.0	150	0.4	1300	10
AVL 31K 06 151	31	39	65	2.0	150	0.4	1150	10
AVL 38K 06 151	38	47	77	2.0	150	0.4	1000	10
AVL 45K 06 151	45	56	90	2.0	150	0.4	700	10
AVL 56K 06 151	56	68	110	2.0	150	0.4	550	10

# Low Capacitance

## AVLC Series

### Features

- Meets IEC 61000-4-2 (ESD), Level 4 & IEC 61000-4-4 (EFT), Level 4 requirements
- ESD Protection > 30 KV
- Low capacitance for high frequency data line protection
- Small size {0402 (1.0×0.5mm), 0603 (1.6×0.8mm) }
- Fast response time < 1ns
- Available in tape and reel for automatic pick and place

### Application

- Mobile Phone & PDA
- Cellular Phone
- PCMCIA / Compact Flash Card
- RS-232 & RS-423 Data Lines
- USB Data Lines
- MCM Boards
- LCD Module

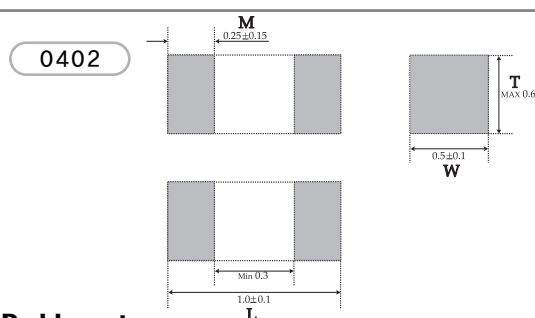
### Ordering information

<b>AVLC</b>	<b>5</b>	<b>S</b>	<b>02</b>	<b>050</b>
Low Capacitance Single Varistor	Maximum Continuous Working Voltage - Vdc	Vn Tolerance :	Chip Size : 02 = 0402, 03 = 0603	Typical Capacitance @ 1KHz : 050 = 50pF
K = ±10%, L = ±15%, M = ±20%, S = Special order				

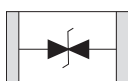
### Specifications

Type	Symbol	Units	Test Condition	Working Voltage Vdc Volts(max.) < 20μA	Breakdown Voltage Vn Volts 1mA DC	Clamping Voltage Vc Volts(max.)	Clamping Current Ic Amp 8/20μS	Peak Current Imax Amp(max.) 8/20μS	Transient Energy Wmax Joules(max.) 10/1000μS	Capacitance C pF(Typ.) 0.5Vrms @ 1KHz @ 1MHz ■	Resistance* R Mega Ohms (min.) 3V DC
AVLC	5S	02	100	5.5	10-14	25	1.0	20	0.05	100	10
AVLC	5S	02	050	5.5	10-14	25	1.0	10	0.03	50	10
AVLC	14S	02	100	14	18-24	40	1.0	20	0.05	100	10
AVLC	14S	02	050	14	18-24	40	1.0	10	0.03	50	10
AVLC	18S	02	015	18	24-32	45	1.0	5	0.005	15	10
AVLC	18S	02	003 ■	18	90-160	300	1.0	1	0.005	3	10
AVLC	18S	02	001 ■	18	60-80	200	1.0	0.8	0.005	0.8	10

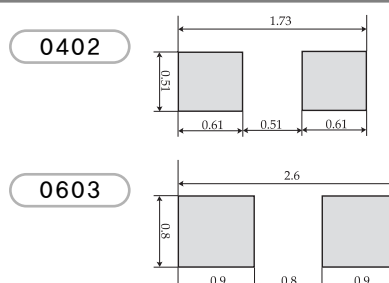
### Dimensions



### Equivalent Circuit Diagram



### Pad layout



Term	Symbol	
Rated AC Voltage	V <sub>rms</sub>	Maximum continuous sinusoidal RMS voltage (<5% total harmonic distortion) which may be applied to the component under continuous operating conditions at 25°C
Rated DC Voltage	V <sub>dc</sub>	Maximum continuous DC voltage (<5% ripple) which may be applied to the component under continuous operating conditions at 25°C
Supply Voltage	V	The voltage by which the system is designated and to which certain operating characteristics of the system are referred; normally V <sub>rms</sub> =1.1 × V
Leakage Current	I <sub>d</sub>	The current passing through the varistor at V <sub>dc</sub> and at 25°C
Varistor voltage	V <sub>n</sub>	Voltage across the varistor measured at a given reference current I <sub>n</sub>
Reference Current	I <sub>n</sub>	Reference current
Clamping Voltage Protection Level	V <sub>c</sub>	The peak voltage developed across the varistor under standard atmospheric conditions when passing an 8/20 μs class current pulse
Voltage Clamping Ratio	V <sub>c</sub> /V <sub>app</sub>	A figure of merit measure of the varistor clamping effectiveness as defined by the symbols V <sub>c</sub> /V <sub>app</sub> , where (V <sub>app</sub> =V <sub>rms</sub> or V <sub>dc</sub> )
Class Current	I <sub>c</sub>	A peak value of current which is 1/10 of the maximum peak current for 100 pulses at two per minute for the 8/20 μs pulse
Rated Single Pulse Transient Energy	W <sub>max</sub>	Energy which may be dissipated for a single 10/1000 μs impulse of a maximum rated current, with rated RMS voltage or rated DC voltage also applied without causing device failure
Rated Peak Single Pulse Transient Current	I <sub>max</sub>	Maximum peak current which may be applied for a single 8/20 μs impulse, with rated line voltage also applied, without causing device failure
Rated Transient Average Power Dissipation	P	Maximum average which may be dissipated due to a group of pulses occurring within a specified isolated time period, without causing device failure at 25°C
Capacitance	C	Capacitance between two terminals of the varistor measured at 1 kHz
Nonlinear Exponent	α	A measure of varistor nonlinearity between two given operating currents, I <sub>1</sub> and I <sub>2</sub> , as described by $I = kV^{\alpha}$ where k is a device constant, $I_2 \leq I_1 \leq I_n$ , and $\alpha = \frac{\log(I_1/I_2)}{\log(V_1/V_2)}$ , where: I <sub>n</sub> -reference current (1mA, or 0.1mA), V <sub>n</sub> -varistor voltage, I <sub>1</sub> =10I <sub>n</sub> , V <sub>1</sub> -the voltage measured at I <sub>1</sub>
Response Time		The time lag between application of a surge and varistor's 'turn-on' conduction action
Varistor voltage Temperature Coefficient		$(V_n \text{ at } 85^{\circ}\text{C} - V_n \text{ at } 25^{\circ}\text{C}) / ((V_n \text{ at } 25^{\circ}\text{C}) \times 60^{\circ}\text{C}) \times 100$
Insulation Resistance		Minimum resistance between shorted terminals and varistor surface
Isolation Voltage		Minimum voltage applied for one minute between shorted terminals and varistor surface
Operating Temperature		The range of ambient temperature for which the varistor is designed to operate continuously, as defined by the temperature limits of its climatic category
Climatic Category	LCT/UCT/DHD	UCT=Upper Category Temperature, LCT=Lower Category Temperature, DHD=Dump Heat Test Duration
Storage Temperature		Storage temperature range without voltage applied
Current Energy Derating		Derating of maximum values when operated above 85°C

## SELECTION GUIDELINES & APPLICATION FIELDS

The selection of Transient Voltage Suppressors involves comparison of device parameter with circuit conditions. The following selection guidelines are recommended:

1. Select Transient Voltage Suppressors with a rated voltage greater than or equal to the normal operating voltage of the circuit.
2. Select Transient Voltage Suppressors which is capable of dissipating the expected transient peak pulse current.
3. The Transient Voltage Suppressors clamping voltage should be less than the maximum voltage handling capability of the protected circuit for the same pulse waveform.
4. For systems using high speed data rates, Transient Voltage Suppressors capacitance will have to be considered.

There may be applications where the actual transient current cannot be defined. Often, the designer will have to meet the requirements of certain transient immunity specification. As the very least, identification of the source of the threat is necessary; lightning, inductive switching, ESD, etc.

### Summary of Selection

Device Parameter		Circuit Condition
Vdc (V)	≥	120% of Normal circuit operating voltage
Imax (A)	≥	Expected transient current
Vc (V)	≤	Maximum allowable voltage across the protected component
C	<	Maximum loading capacitance for signal integrity

Market	Communication	Computer & Peripheral	Consumer Product	Car Electronics
<b>Application</b>	<b>Cellular/ cordless phone</b> LCD display Programming port Charger Key pads Speaker & Microphone ASIC protection Laser diode protection FETs protection	<b>Personal computer</b> Audio card Keyboards I/O ports RS232/RS422/IEEE 488 Interface card	<b>Security system</b> Sensor protection Key pads Microprocessor reset & I/O protection LCD display  <b>CATV</b> LNA FETs protection Logic box protection	<b>ECU protection</b>  <b>Multiplex I/O line</b>  <b>ABS system</b>
	<b>Secondary phone line</b>	<b>Printer &amp; Scanner</b> Paper feeders Key pads Opto sensors	<b>Portable equipment</b> Camcorder Cassette player CD player MD player Digital camera PDAs	<b>Airbag system</b>  <b>Audio system</b>
	<b>Data line connection</b>	<b>Hard disc drive</b> Vcc protection		<b>Navigation system</b>
	<b>Line card</b>	<b>FAX / MODEM</b>		<b>Smart sensor &amp; actuator</b>
	<b>Fax machine</b>	<b>Note book computer</b> LCD display Audio card Keyboard I/O ports Charger PCMCIA cards		<b>Ignition circuit</b>  <b>Motor control boards</b>

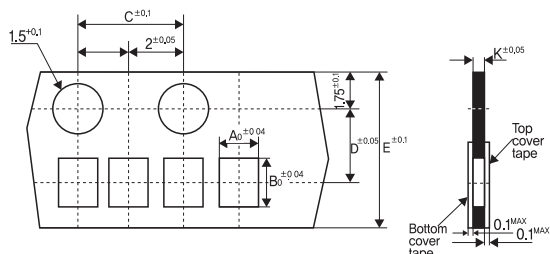




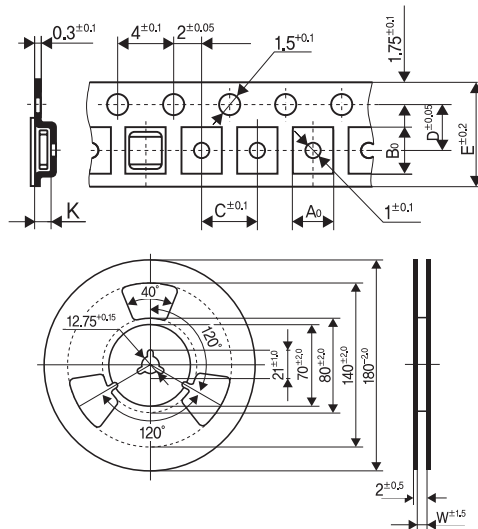
# TAPE AND REEL SPECIFICATION & SOLDERING RECOMMENDATION

Conforms to IEC Publication 286 - 3

## SIZE 0402

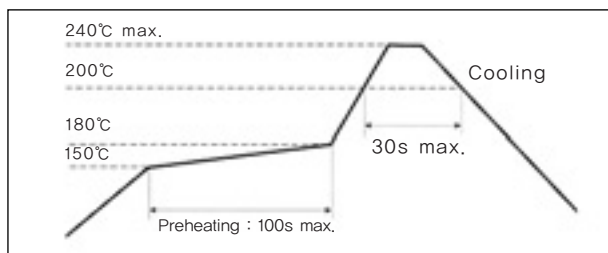


## SIZE 0603 ~ 3225

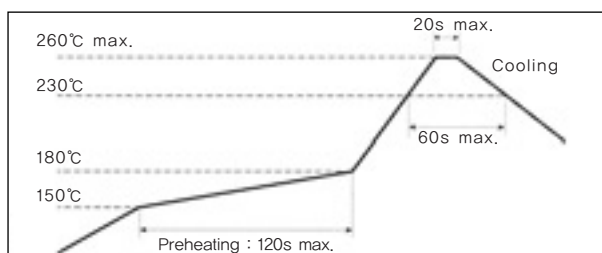


Size	Units	0402	0603	0805	1206	1210	3225
A <sub>0</sub>	(mm)	0.62	1.0	1.7	2.0	3	7
B <sub>0</sub>	(mm)	1.12	1.8	2.5	3.8	3.8	8.7
C	(mm)	4	4	4	4	4	12
D	(mm)	3.5	3.5	3.5	3.5	3.5	7.5
E	(mm)	8	8	8	8	8	16
K	(mm)	0.6	1.2	1.4	2.2	2.2	3.7
W	(mm)		8.4	8.4	8.4	8.4	16.4
Units/Reel	pcs	10,000	4,000	4,000	3,500	3,500	1,500

### Sn/Pb Solder paste

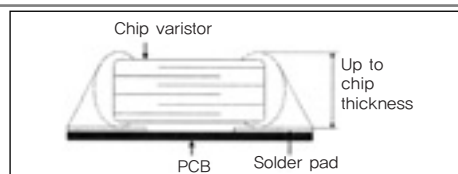


### Pb free Solder paste



### Repair soldering

Allowable time and temperature for making correction with a soldering iron : $350 \pm 10^{\circ}\text{C}$ , 3 sec.  
Optimum solder amount when corrections are made using a soldering iron



### Soldering Guidelines

- Our chip varistors are designed for reflow soldering only. Do not use flow soldering
- Use Sn/Pb/Ag(62/36/2) or equivalent solder.
- Use non-activated flux(Cl content 0.2% max.)
- Follow the recommended soldering conditions to avoid varistor damage

### Storage Recommendation

The components should be used within 6 months. They are to be left in the original package in order to avoid soldering problems caused by oxidized terminals. Air humidity should be less than 40%.

# Transient Voltage Suppressors Applications

## TYPICAL CIRCUITS REQUIRING PROTECTION

### Mobile Phone Protection

Speaker Jack protection  
Power Supply protection  
Button protection  
Data Interface protection  
Key Pad LED protection  
USB Interface protection  
Antenna Switching Module protection  
Battery Protected Circuit Module protection  
Speaker Jack Protection in LCD Module  
LCD Data Line & Module protection

### Notebook & Desktop Computer Protection

LCD protection  
Audio circuit protection  
Keyboard protection  
I/O port protection

### Semiconductor Device Protection

ASIC protection  
IC protection  
MOSFET protection

### Micro Controllers Relays, DC motors Protection

CMOS relay driver  
LM319 relay driver

### Sensor Protection

Typical sensor protection  
Hall device protection

### Preamplifier Protection

### Optic Protection

# Mobile Phone Protection

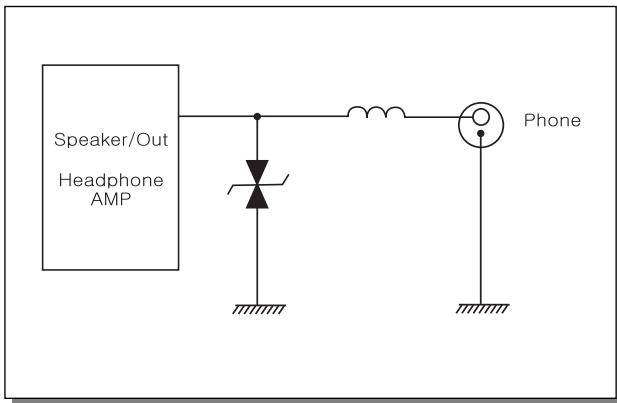
## Speaker jack Protection

### Required characteristics of ESD Suppressors

Rated DC Volt. : < 18V

Energy rating : < 0.05J

Capacitance : Concern on many designs



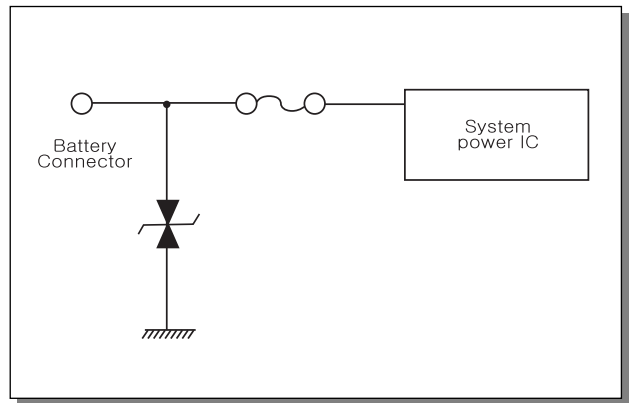
## Power Supply Protection

### Required characteristics of ESD Suppressors

Rated DC Volt. : < 5V

Energy rating : < 0.05J

Capacitance : No Concern



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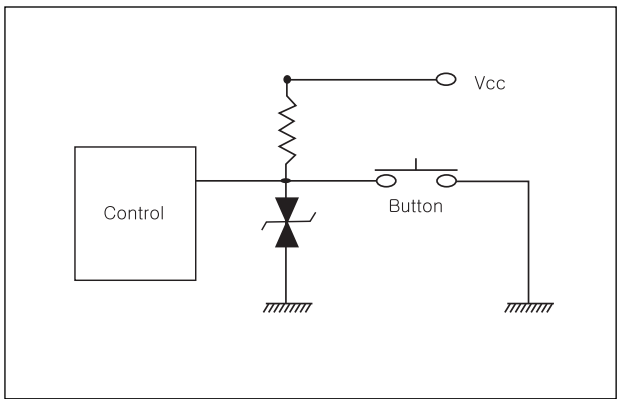
## Button Protection

### Required characteristics of ESD Suppressors

Rated DC Volt. : < 18V

Energy rating : < 0.05J

Capacitance : Concern on many designs



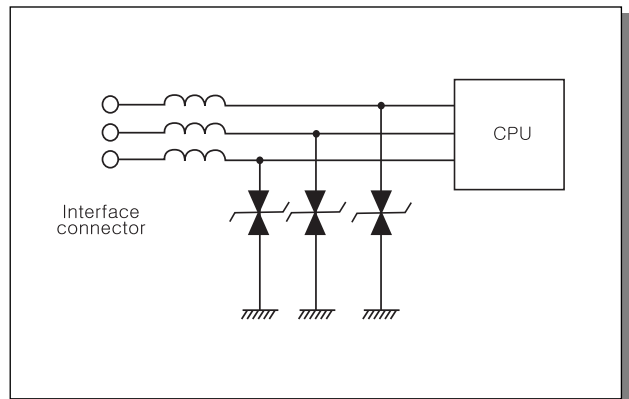
## Data interface Protection

### Required characteristics of ESD Suppressors

Rated DC Volt. : < 18V

Energy rating : < 0.05J

Capacitance : Should be minimized



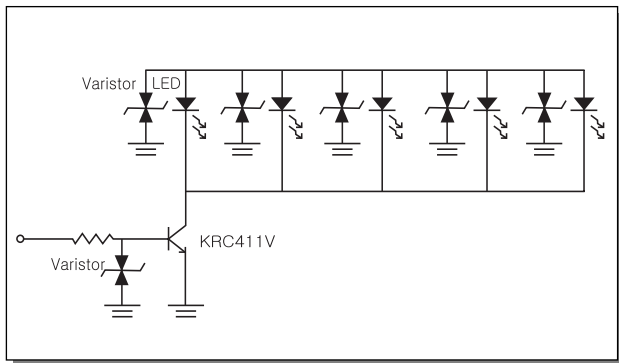
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## Key Pad LED Protection

### Required characteristics of ESD Suppressors

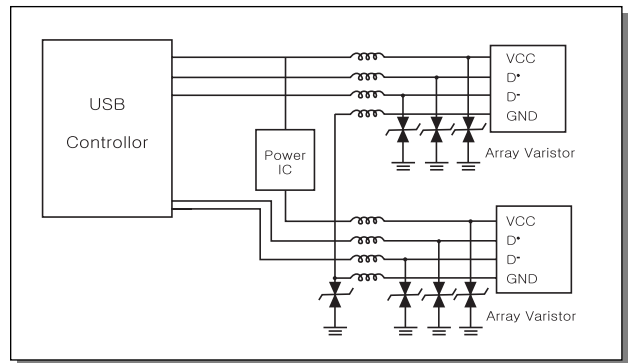
Rated DC Volt. : < 18V  
 Energy rating : < 0.05J  
 Capacitance : Concern on many designs



## USB Interface Protection

### Required characteristics of ESD Suppressors

Rated DC Volt. : < 18V  
 Energy rating : < 0.05J  
 Capacitance : Depend on data transmission rate



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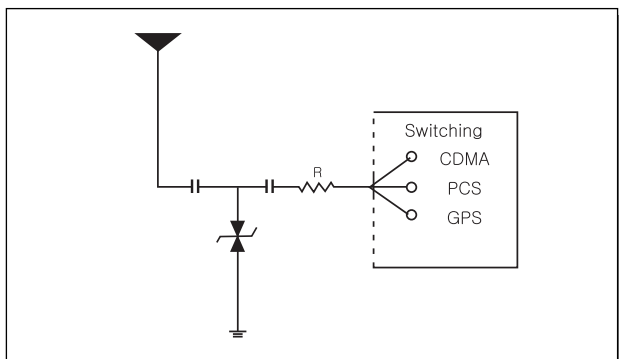
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## Antenna Switching Module Protection

### Required characteristics of ESD Suppressors

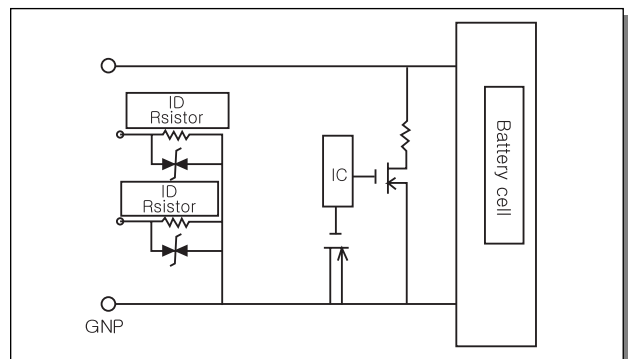
Rated DC Volt. : < 18V  
 Energy rating : < 0.05J  
 Capacitance : Should be minimized



## Module Protection

### Required characteristics of ESD Suppressors

Rated DC Volt. : < 18V  
 Energy rating : < 0.1J  
 Capacitance : No Concern



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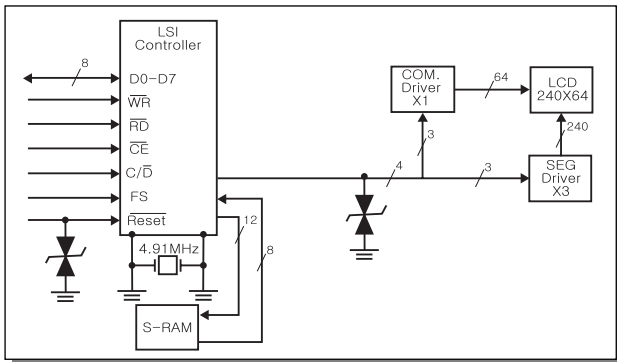


# Notebook & Desktop Computer Protection

## LCD Protection

### Required characteristics of Transient Voltage Suppressors

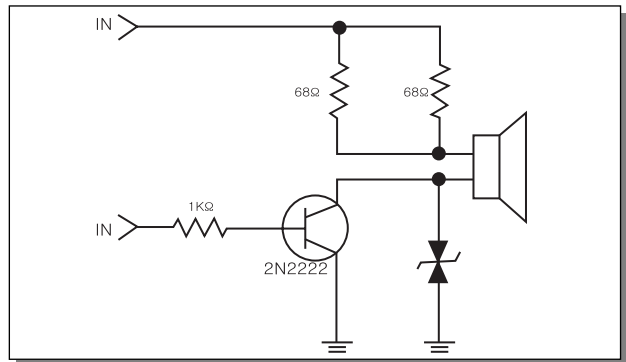
Rated DC Volt. : < 5.6V  
 Energy rating : < 0.1J  
 Capacitance : Preferred to be minimum



## Audio Circuit Protection

### Required characteristics of Transient Voltage Suppressors

Rated DC Volt. : 14V - 18V  
 Energy rating : Typically 0.1J  
 Capacitance : No concern



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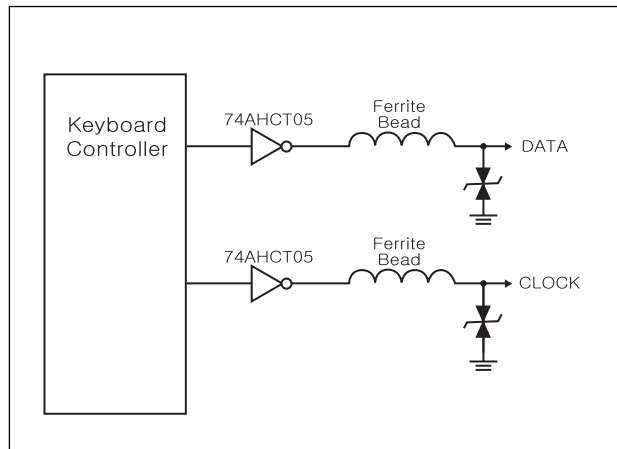
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## Keyboard Protection

### Required characteristics of Transient Voltage Suppressors

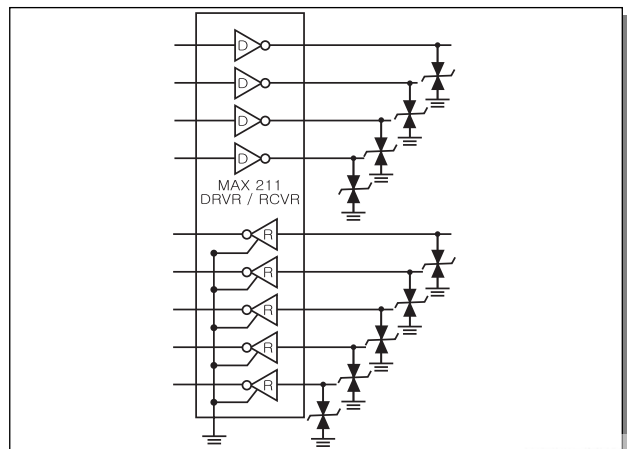
Rated DC Volt. : > 5.6V  
 Energy rating : < 0.4J  
 Capacitance : Preferred to be minimum



## I/O Port Protection

### Required characteristics of Transient Voltage Suppressors

Rated DC Volt. : 14V - 18V  
 Energy rating : Typically 0.05J - 0.1J  
 Capacitance : Should be minimized

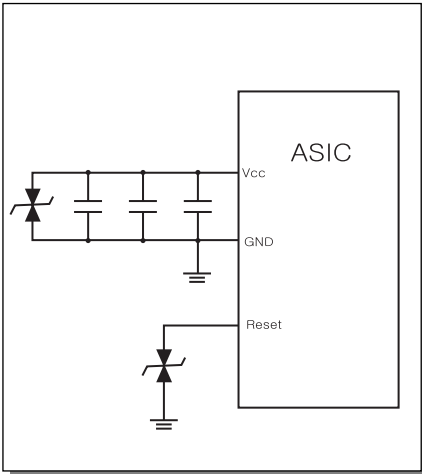


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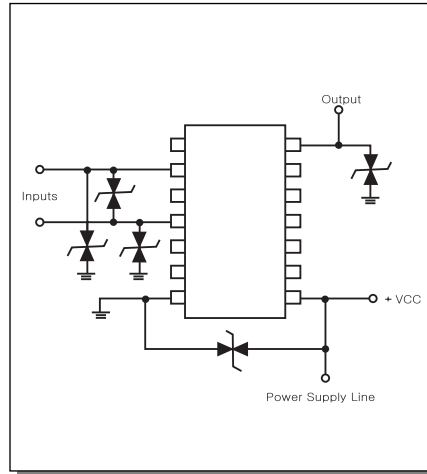
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# Semiconductor Device Protection

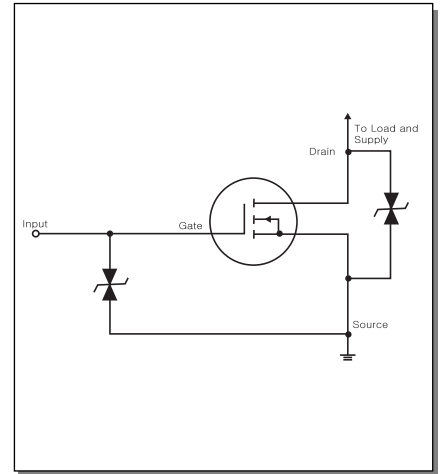
## ASIC Protection



## IC Protection



## MOSFET Protection

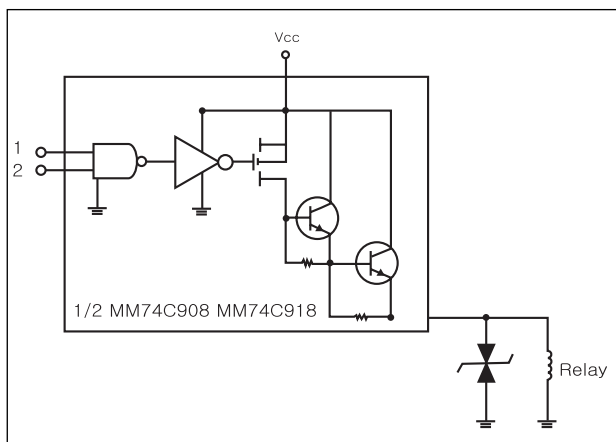


# Micro Controllers Relays

## CMOS Relay Drivers

### Required characteristics of Transient Voltage Suppressors

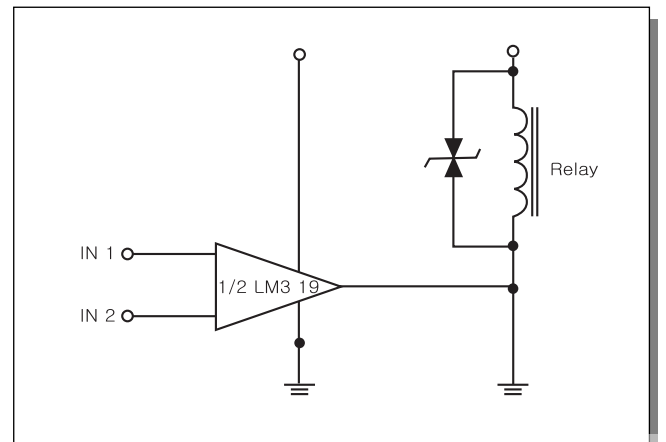
Rated DC Volt. :  $\geq$  Relay voltage  
 Energy rating : Typically  $> 0.3J$   
 Capacitance : No concern



## LM319 Relay Driver

### Required characteristics of Transient Voltage Suppressors

Rated DC Volt. :  $\geq$  Relay voltage  
 Energy rating : Typically  $> 0.3J$   
 Capacitance : No concern

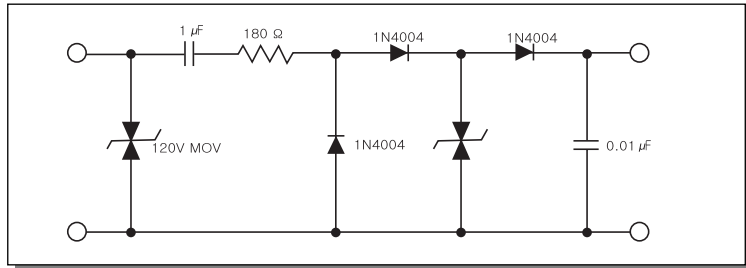


# Sensor Protection

## Typical Sensor Protection

### Required characteristics of Transient Voltage Suppressors

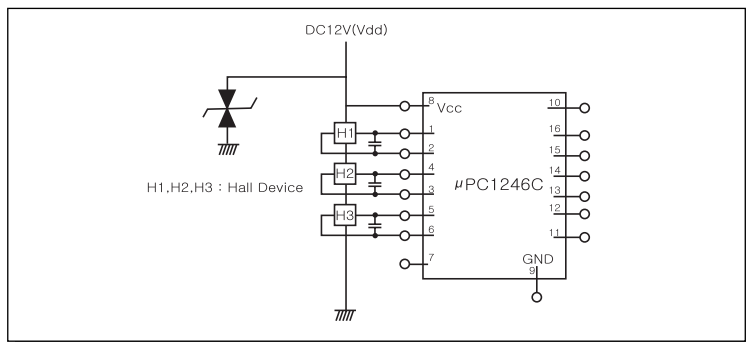
Rated DC Volt. : Typically > 14V  
 Energy rating : Typically > 0.4J  
 Capacitance : No concern



## Hall Device Protection

### Required characteristics of Transient Voltage Suppressors

Rated DC Volt. :  $\geq$  Control voltage  
 Energy rating : Typically > 0.3J  
 Capacitance : No concern

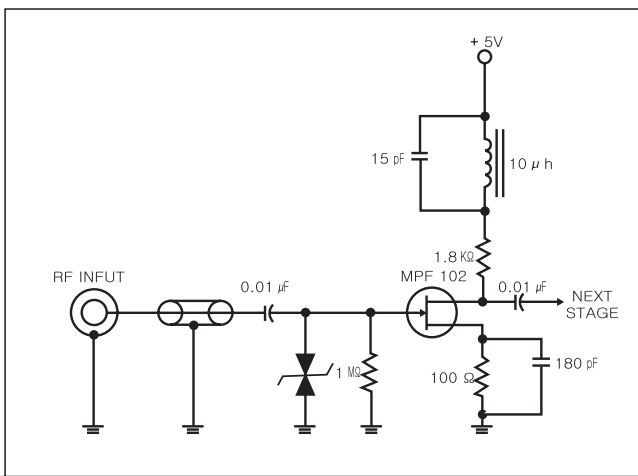


# Preamplifier/Optics Protection

## Preamplifier Protection

### Required characteristics of Transient Voltage Suppressors

Rated DC Volt. : Typically 18V - 26V  
 Energy rating : 0.05J - 0.9J  
 Capacitance : Concern on many designs



## Laser Diode Protection

### Required characteristics of Transient Voltage Suppressors

Rated DC Volt. :  $\geq$  18V  
 Energy rating : 0.1J  
 Capacitance : Should be minimized

