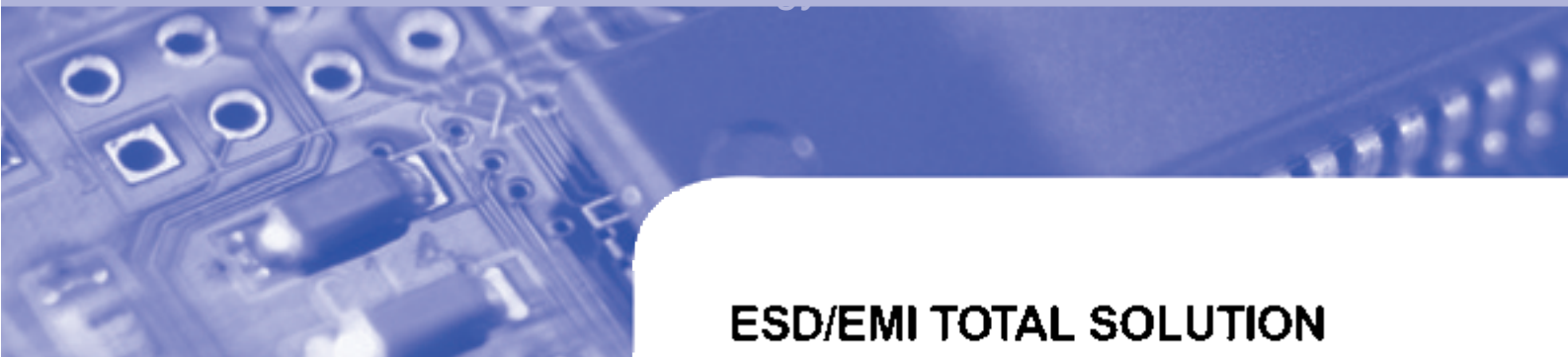




ESD/EMI TOTAL SOLUTION

CHIP VARISTOR



CONTENTS

PRODUCTS OVERVIEW	1
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Transient Voltage Suppressors Applications	16
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
Transients :		
Peak Single Pulse Surge Current 8/20μs Waveform (Imax)	20 to 250	A
Single Pulse Surge Energy, 10/1000μs Waveform (Wmax)	0.05 to 2.5	J
Operating Ambient Temperature	-55 to +125	°C
Storage Temperature Range	-55 to +150	°C
Threshold Voltage Temperature Coefficient	< - 0.05	%/°C
Response Time	< 1	ns
Climatic Category	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

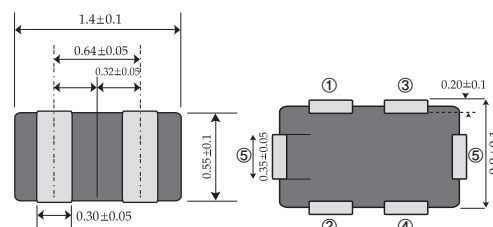
Ordering information

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

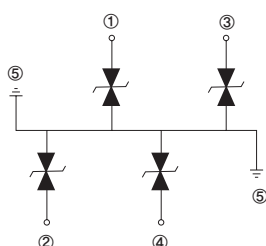
Specifications

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

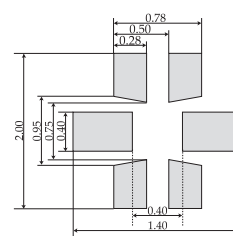
Dimensions (unit : mm)



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

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

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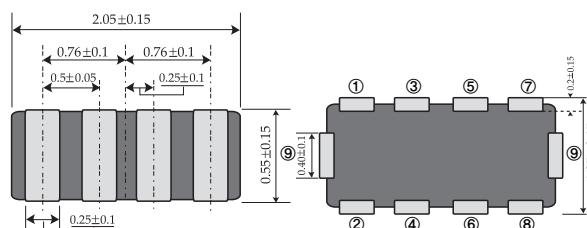
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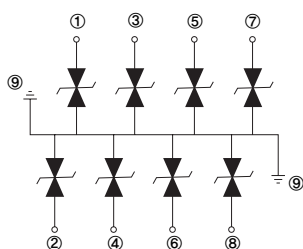
Specifications

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

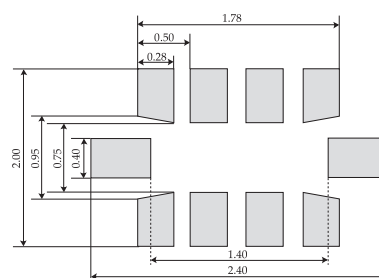
Dimensions (unit : mm)



Equivalent Circuit Diagram



Pad layout



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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

AVNC	18	S	05	D	015
Low Capacitance Varistor array	Maximum Continuous Working Voltage - Vdc	Vn Tolerance : K = $\pm 10\%$, L = $\pm 15\%$, M = $\pm 20\%$, 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.) < 20 μ A	Breakdown Voltage Vn Volts 1mA DC	Clamping Voltage Vc Volts(max.)	Clamping Current Ic Amp 8/20 μ S	Peak Current Imax Amp(max.) 8/20 μ S	Transient Energy Wmax Joules(max.) 10/1000 μ S	Capacitance C pF(Typ.) 0.5Vrms@ 1KHz	Resistance* R Mega Ohms (min.) 3V DC
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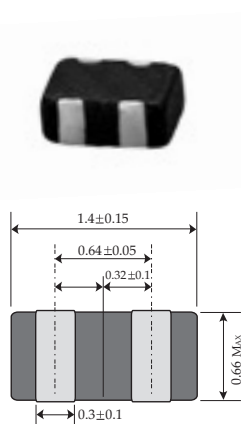
► AVNC Series (0402 Dual Array)

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

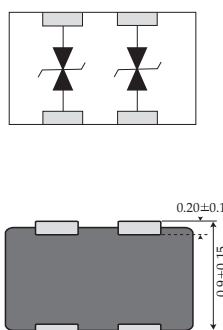
► AVNC Series (0603 Dual Array)

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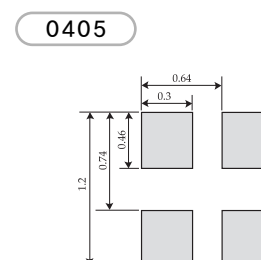
Dimensions (unit : mm)



Equivalent Circuit Diagram



Pad layout



※ Customized properties are available upon request.

*1 Resistance after soldering is 10M Ω min. [Reflow soldering condition] Temperature profile : 230 $^{\circ}$ C 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

AVNC	18	S	05	Q	015
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
---	--	---	--	--	--	--	--	--

► AVNC Series - (0402 Quad Array)

AVNC	5S	05	Q	050	5.5	10-14	25	1.0	10	0.03	50	10
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

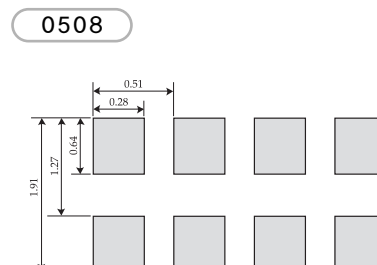
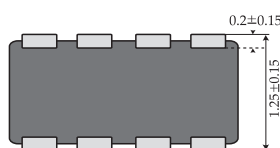
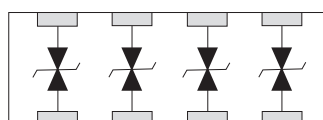
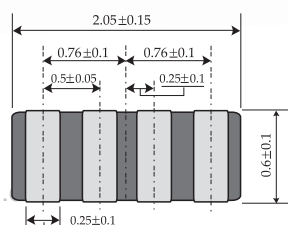
► AVNC Series - (0603 Quad Array)

AVNC	18S	06	Q	120	18	24-32	45	1.0	30	0.05	120	10
AVNC	14S	06	Q	350	14	18-24	35	1.0	30	0.1	350	10

Dimensions (unit : mm)

Equivalent Circuit Diagram

Pad layout



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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

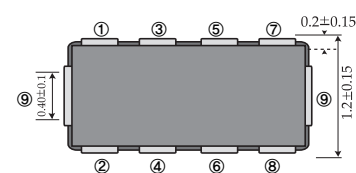
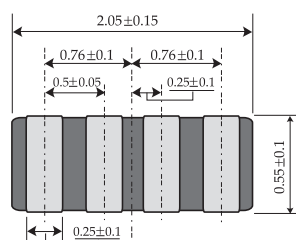
Ordering information

AVRC	5	S	05	Q	050	100R
R-C Type EMI-ESD Filter	Maximum Continuous Working Voltage - Vdc	Vn Tolerance :				Typical Resistance: 100R=100Ω
	K = ±10%, L = ±15%, M = ±20%, S = Special order		Chip Size : 05 = 0508	Configuration : Q = 4 element	Typical Capacitance @ 1MHz : 050= 50pF	

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 max Typ.		Resistance IR Mega Ohms (min.) 3V DC	Resistance R Ohms (Typ) 3V DC
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)



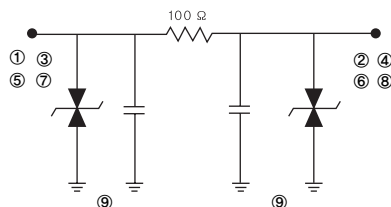
※ Customized properties are available upon request.

*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.

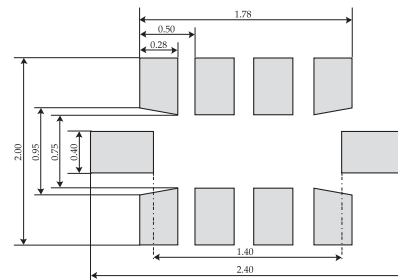
R-C Type EMI-ESD Filter

AVRC Series

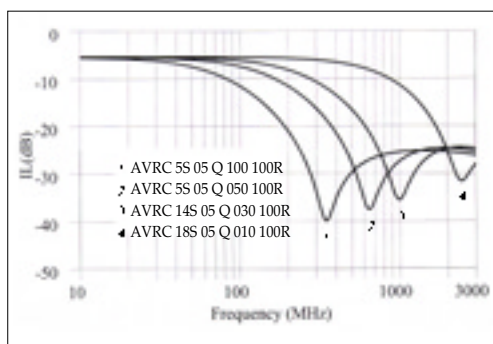
Equivalent Circuit Diagram



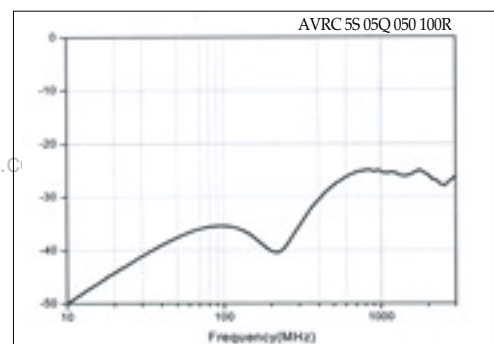
Pad layout



Frequency Characteristics



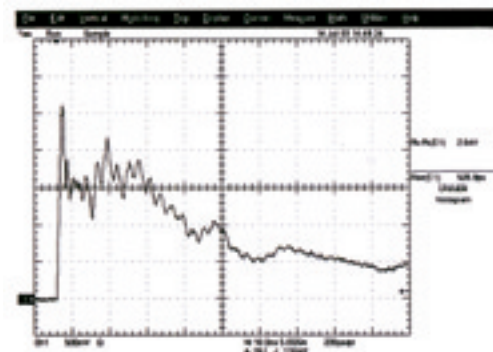
Frequency vs. Insertion Loss Curve



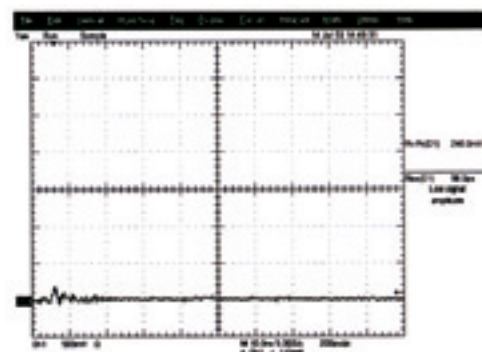
Crosstalk with port1 & port2

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

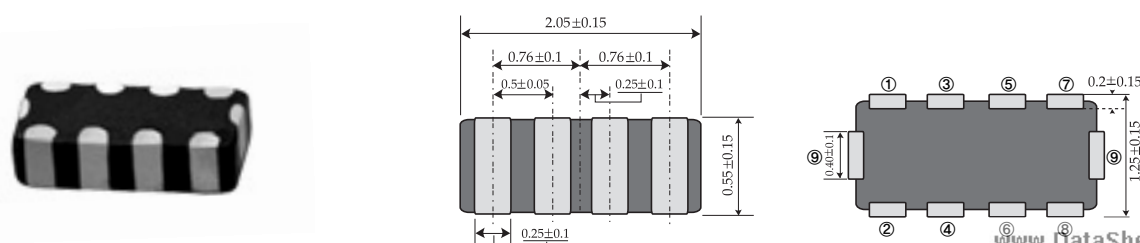
Ordering information

AVFC	5	S	05	Q	050
Feed-thru Type EMI-ESD Filter	Maximum Continuous Working Voltage - Vdc	Vn Tolerance : K = ±10%, L = ±15%, M = ±20%, S = Special order	Chip Size : 05 = 0508	Configuration : Q = 4 element	Typical Capacitance @ 1MHz : 050 = 50pF

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 max Typ.		Resistance R Mega Ohms (min.) 3V DC
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)



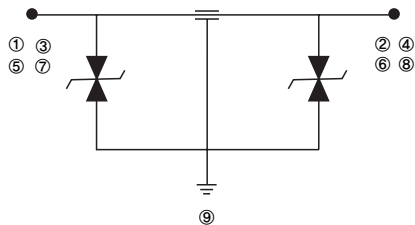
※ Customized properties are available upon request.

*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.

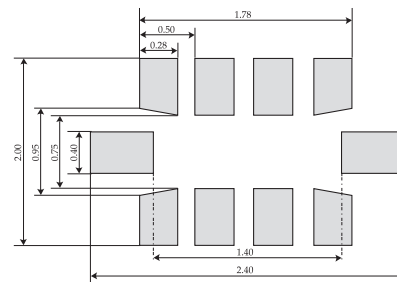
Feed Thru Type EMI-ESD Filter

AVFC Series

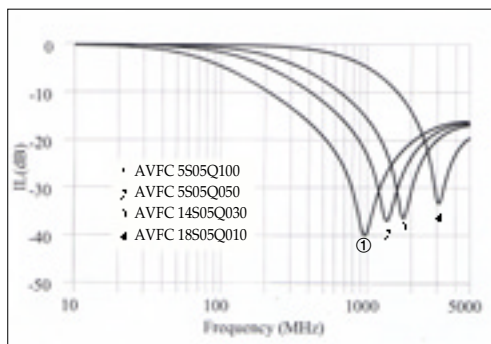
Equivalent Circuit Diagram



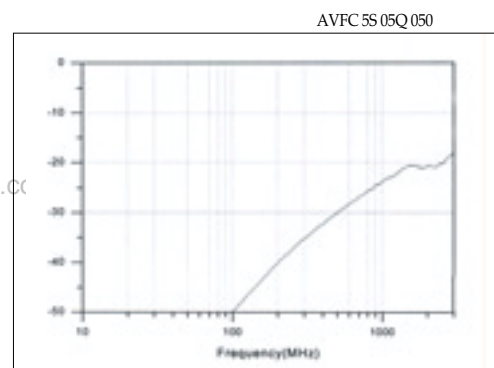
Pad layout



Frequency Characteristics



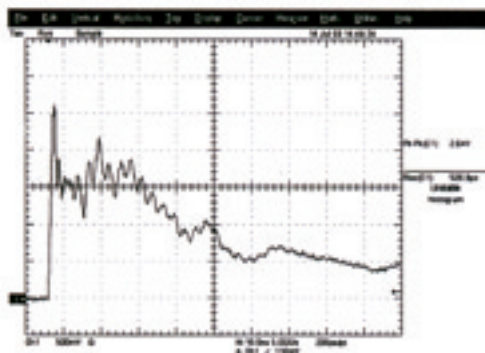
Frequency vs. Insertion Loss Curve



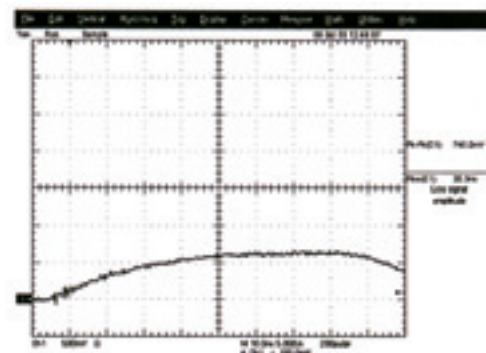
Crosstalk with port1 & port2

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.

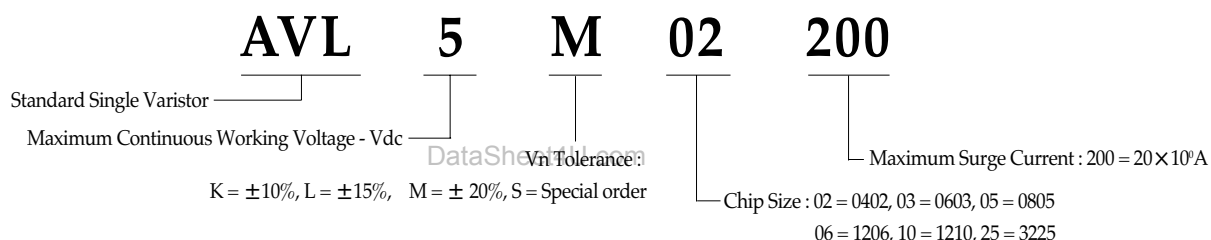
Features

- 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

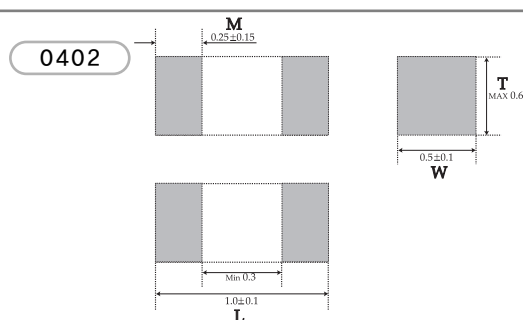
Application

- 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)

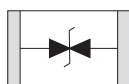
Ordering information



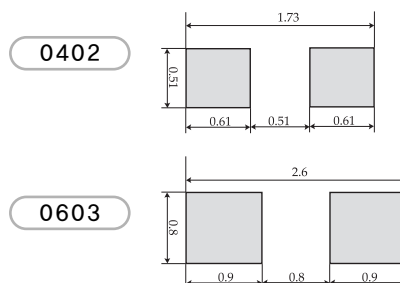
Dimensions



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	Max 1.2

High Power

AVL Series

• 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* ¹ 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

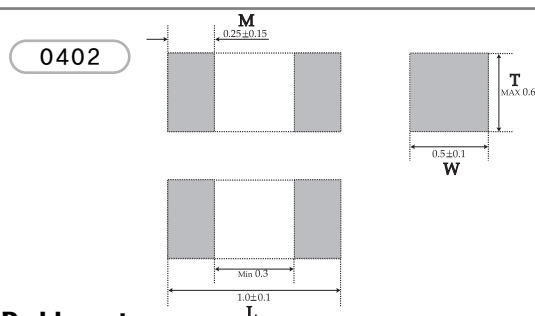
Ordering information

AVLC	5	S	02	050
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				

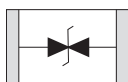
Specifications

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

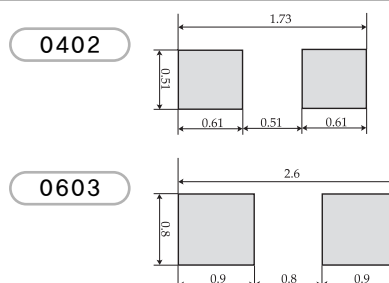
Dimensions



Equivalent Circuit Diagram



Pad layout



Term	Symbol	
Rated AC Voltage	V _{rms}	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 _{dc}	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 _{rms} =1.1 × V
Leakage Current	I _d	The current passing through the varistor at V _{dc} and at 25°C
Varistor voltage	V _n	Voltage across the varistor measured at a given reference current I _n
Reference Current	I _n	Reference current
Clamping Voltage Protection Level	V _c	The peak voltage developed across the varistor under standard atmospheric conditions when passing an 8/20 μs class current pulse
Voltage Clamping Ratio	V _c /V _{app}	A figure of merit measure of the varistor clamping effectiveness as defined by the symbols V _c /V _{app} , where (V _{app} =V _{rms} or V _{dc})
Class Current	I _c	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 _{max}	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 _{max}	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 _n and I ₂ , as described by $I = kV^{\exp(\alpha)}$ where k is a device constant, $I_2 \leq I \leq I_n$, and $\alpha = \log(I_1/I_n) / \log(V_1/V_n) = 1 / \log(V_1/V_n)$, where: I _n - reference current (1mA, or 0.1mA), V _n -varistor voltage, I ₁ =10I _n , V ₁ - the voltage measured at I ₁
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

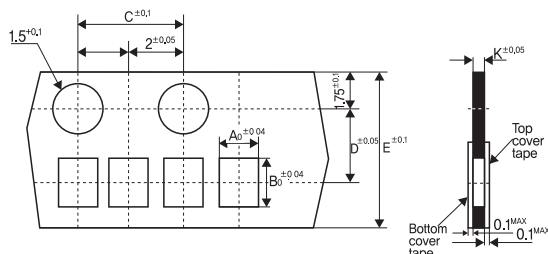
Device Parameter		Circuit Condition
V _{dc} (V)	≥	120% of Normal circuit operating voltage
I _{max} (A)	≥	Expected transient current
V _c (V)	≤	Maximum allowable voltage across the protected component
C	<	Maximum loading capacitance for signal integrity

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

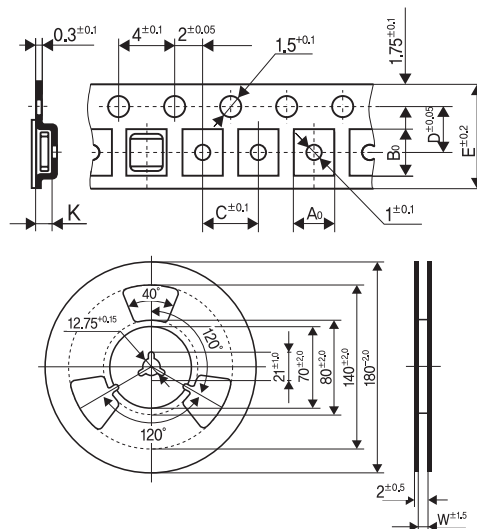
TAPE AND REEL SPECIFICATION & SOLDERING RECOMMENDATION

Conforms to IEC Publication 286 - 3

SIZE 0402

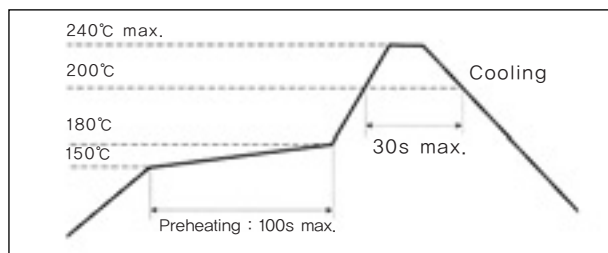


SIZE 0603 ~ 3225

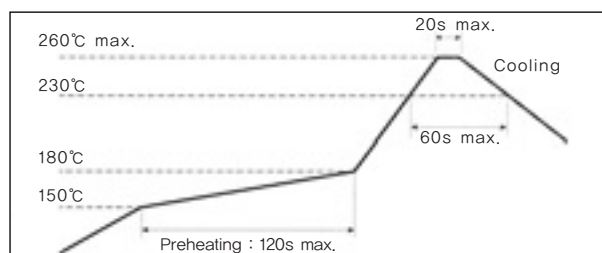


Size	Units	0402	0603	0805	1206	1210	3225
A ^o	(mm)	0.62	1.0	1.7	2.0	3	7
B ^o	(mm)	1.12	1.8	2.5	3.8	3.8	8.7
C	(mm)	4	4	4	4	4	12
D	(mm)	3.5	3.5	3.5	3.5	3.5	7.5
E	(mm)	8	8	8	8	8	16
K	(mm)	0.6	1.2	1.4	2.2	2.2	3.7
W	(mm)		8.4	8.4	8.4	8.4	16.4
Units/Reel	pcs	10,000	4,000	4,000	3,500	3,500	1,500

Sn/Pb Solder paste



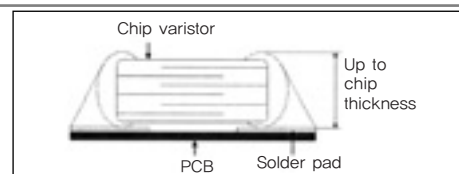
Pb free Solder paste



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(CI 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

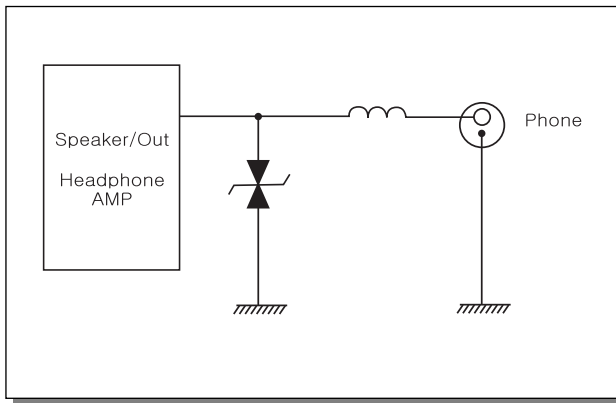
Speaker jack Protection

Required characteristics of ESD Suppressors

Rated DC Volt. : < 18V

Energy rating : < 0.05J

Capacitance : Concern on many designs



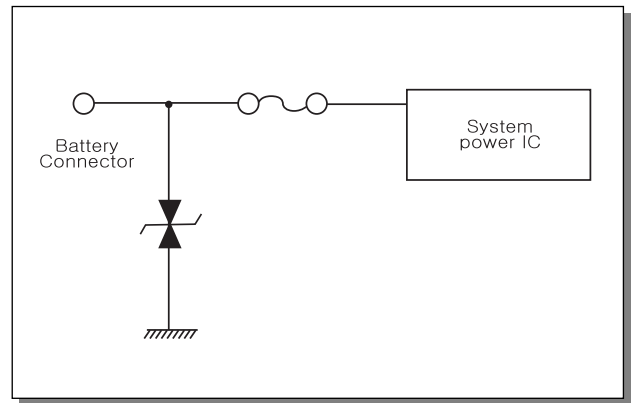
Power Supply Protection

Required characteristics of ESD Suppressors

Rated DC Volt. : < 5V

Energy rating : < 0.05J

Capacitance : No Concern



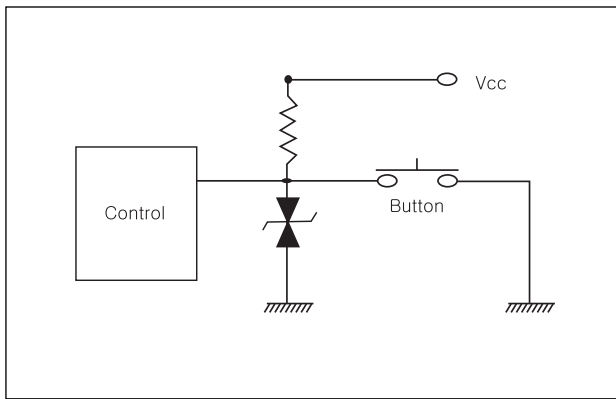
Button Protection

Required characteristics of ESD Suppressors

Rated DC Volt. : < 18V

Energy rating : < 0.05J

Capacitance : Concern on many designs



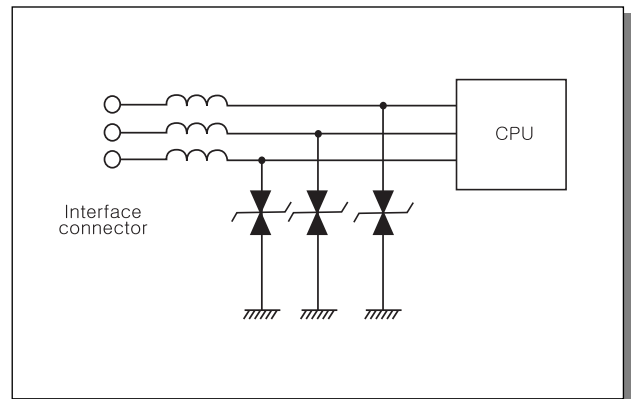
Data interface Protection

Required characteristics of ESD Suppressors

Rated DC Volt. : < 18V

Energy rating : < 0.05J

Capacitance : Should be minimized



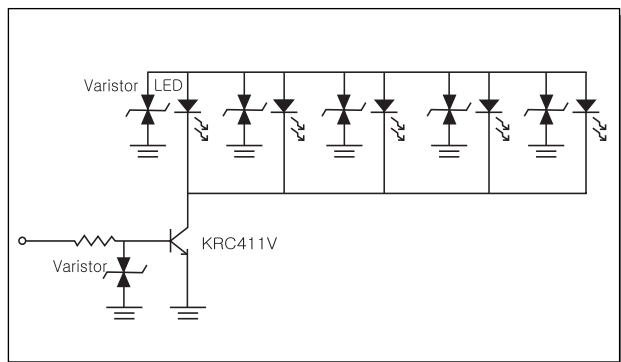
Key Pad LED Protection

Required characteristics of ESD Suppressors

Rated DC Volt. : < 18V

Energy rating : < 0.05J

Capacitance : Concern on many designs



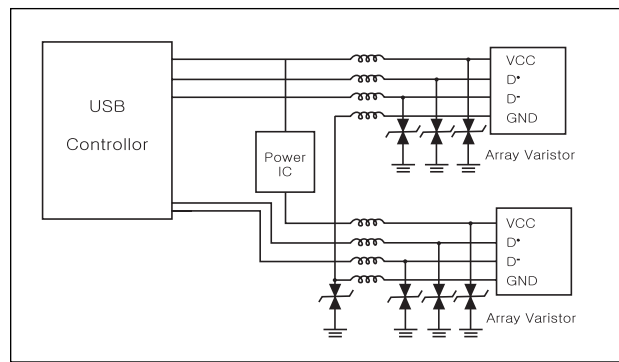
USB Interface Protection

Required characteristics of ESD Suppressors

Rated DC Volt. : < 18V

Energy rating : < 0.05J

Capacitance : Depend on data transmission rate



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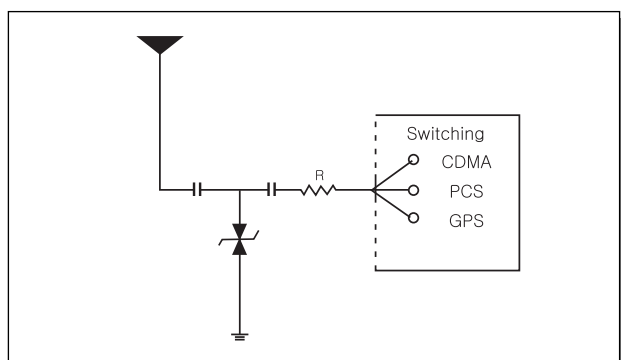
Antenna Switching Module Protection

Required characteristics of ESD Suppressors

Rated DC Volt. : < 18V

Energy rating : < 0.05J

Capacitance : Should be minimized



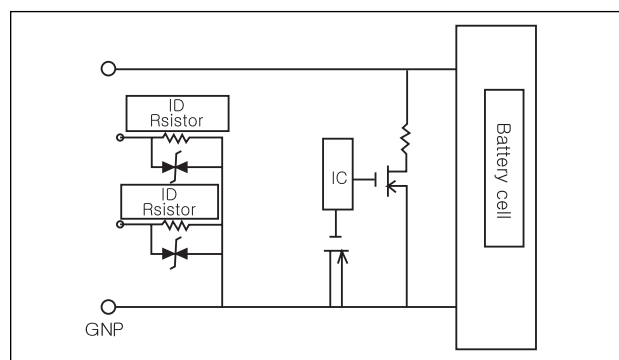
Module Protection

Required characteristics of ESD Suppressors

Rated DC Volt. : < 18V

Energy rating : < 0.1J

Capacitance : No Concern



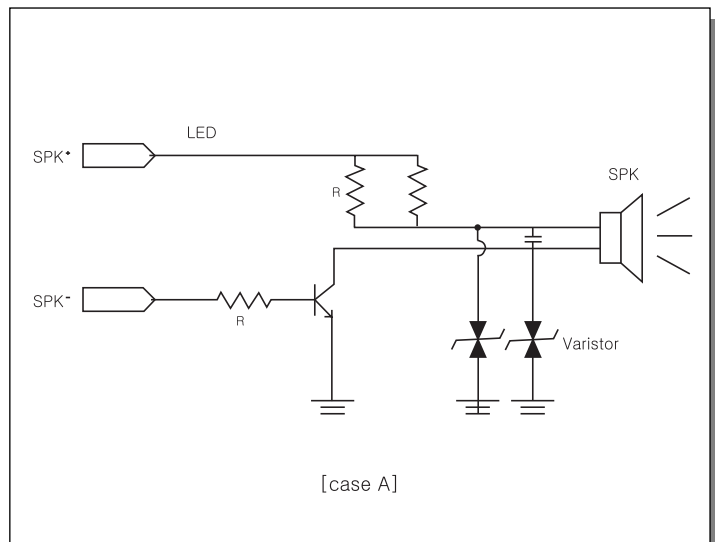
Speaker Protection in LCD Module

Required characteristics of ESD Suppressors

Rated DC Volt. : < 18V

Energy rating : < 0.05J

Capacitance : Concern on many designs



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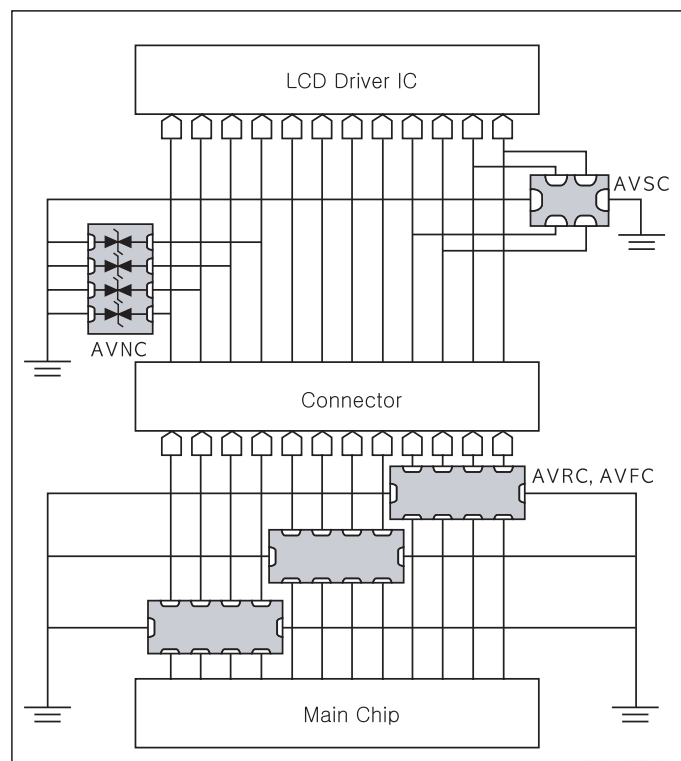
LCD data line & Module Protection

Required characteristics of ESD Suppressors

Rated DC Volt. : < 18V

Energy rating : < 0.05J

Capacitance : Should be minimized



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Notebook & Desktop Computer Protection

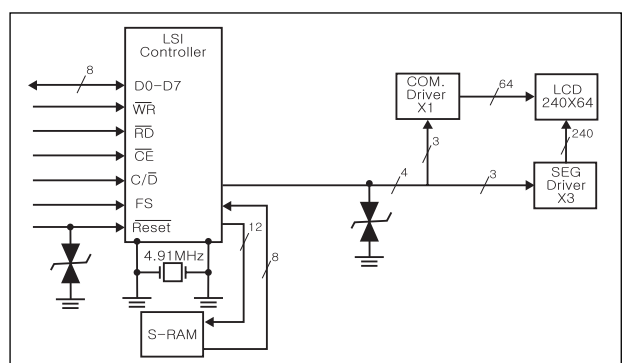
LCD Protection

Required characteristics of Transient Voltage Suppressors

Rated DC Volt. : < 5.6V

Energy rating : < 0.1J

Capacitance : Preferred to be minimum



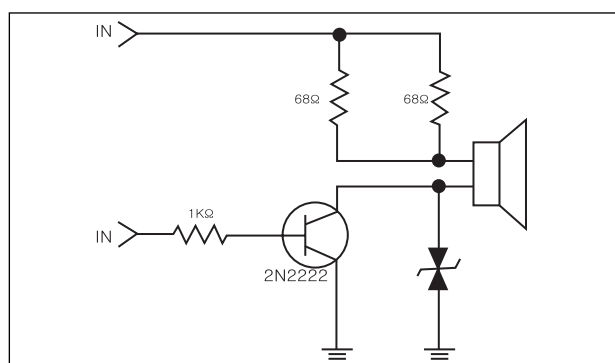
Audio Circuit Protection

Required characteristics of Transient Voltage Suppressors

Rated DC Volt. : 14V - 18V

Energy rating : Typically 0.1J

Capacitance : No concern



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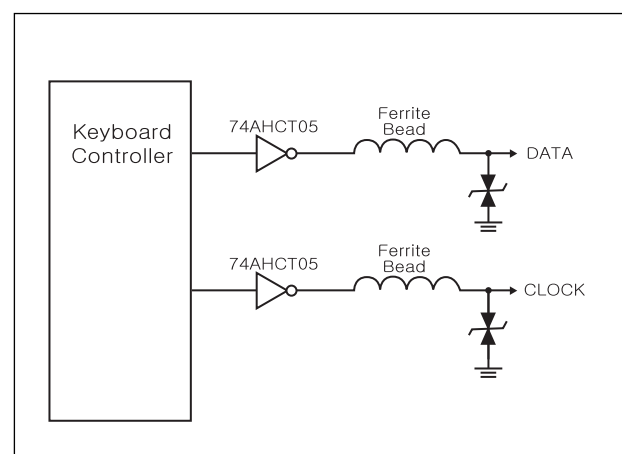
Keyboard Protection

Required characteristics of Transient Voltage Suppressors

Rated DC Volt. : > 5.6V

Energy rating : < 0.4J

Capacitance : Preferred to be minimum



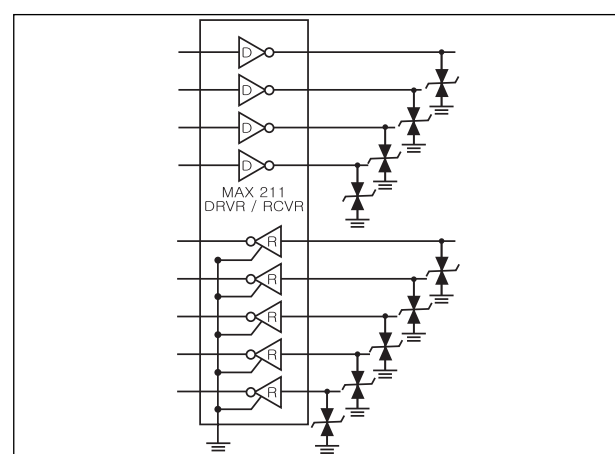
I/O Port Protection

Required characteristics of Transient Voltage Suppressors

Rated DC Volt. : 14V - 18V

Energy rating : Typically 0.05J - 0.1J

Capacitance : Should be minimized

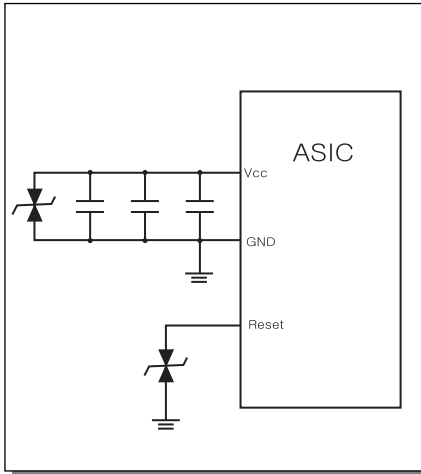


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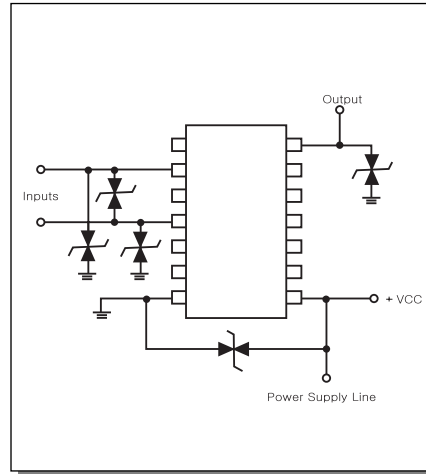
www.DataSheet4U.com

Semiconductor Device Protection

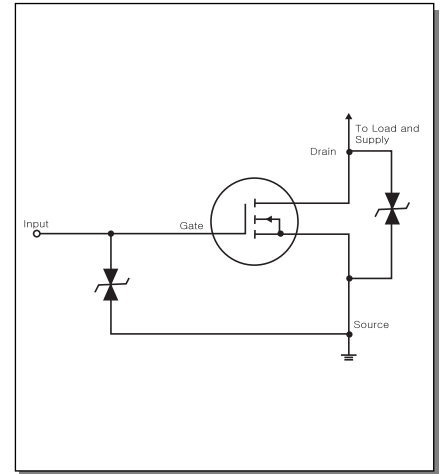
ASIC Protection



IC Protection



MOSFET Protection



Micro Controllers Relays

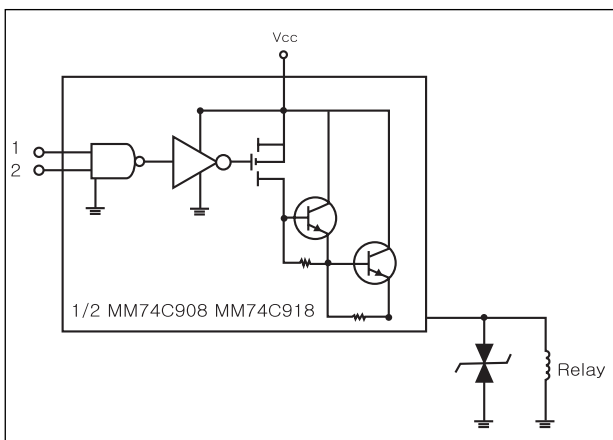
CMOS Relay Drivers

Required characteristics of Transient Voltage Suppressors

Rated DC Volt. : $\geq$ Relay voltage

Energy rating : Typically $> 0.3J$

Capacitance : No concern



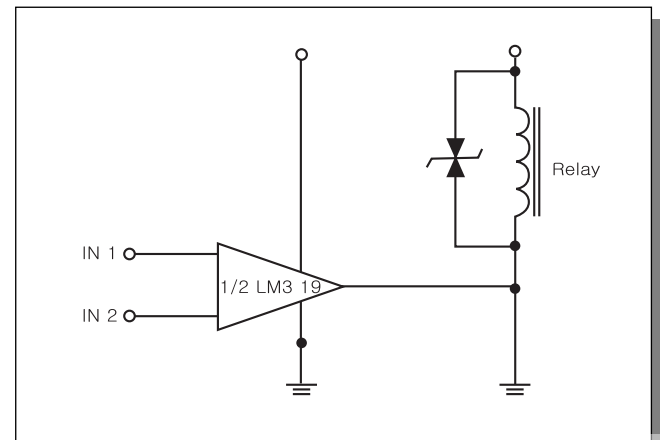
LM319 Relay Driver

Required characteristics of Transient Voltage Suppressors

Rated DC Volt. : $\geq$ Relay voltage

Energy rating : Typically $> 0.3J$

Capacitance : No concern



Sensor Protection

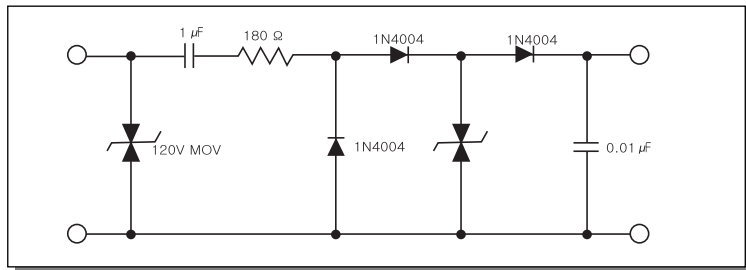
Typical Sensor Protection

Required characteristics of Transient Voltage Suppressors

Rated DC Volt. : Typically > 14V

Energy rating : Typically > 0.4J

Capacitance : No concern



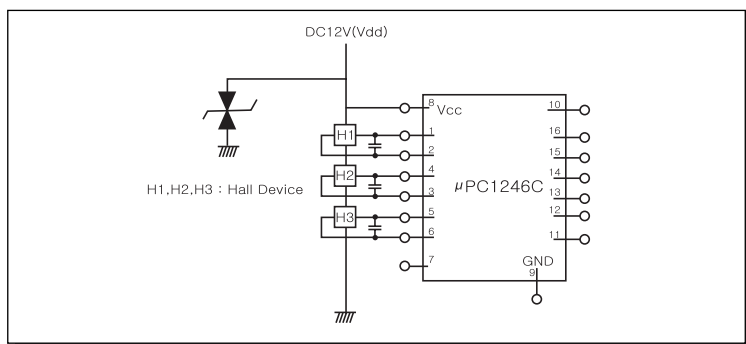
Hall Device Protection

Required characteristics of Transient Voltage Suppressors

Rated DC Volt. : $\geq$ Control voltage

Energy rating : Typically > 0.3J

Capacitance : No concern



Preamplifier/Optics Protection

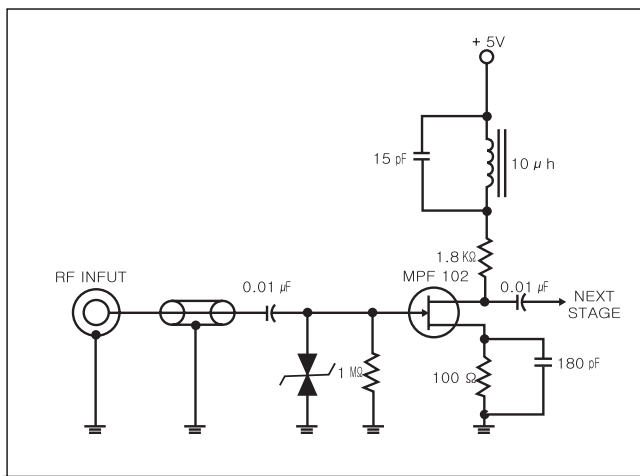
Preamplifier Protection

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

