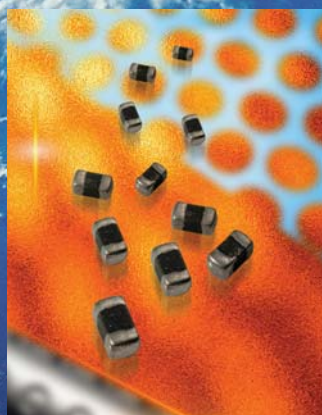
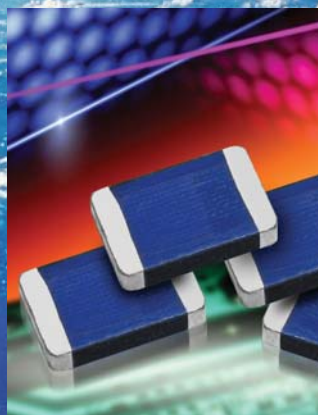
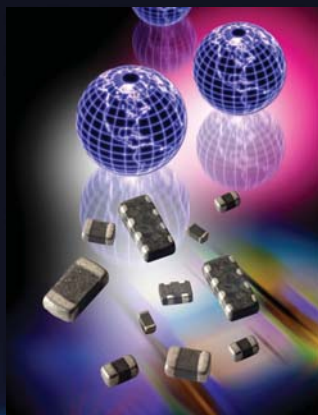
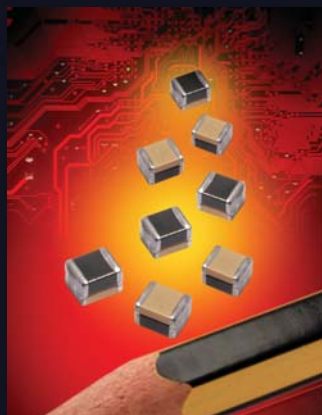


C I R C U I T P R O T E C T I O N





AVX TRANSGUARD® - MULTILAYER VARISTORS

The AVX TransGuard® Varistors - Transient Voltage Suppressors (TVS) with unique high-energy multilayer construction represent state-of-the-art overvoltage circuit protection. Monolithic multilayer construction provides protection from voltage transients caused by ESD (e.g. IEC 61000-4-2), lightning, inductive switching, automotive related transients such as load dump (ISO 7637-2-5), jump start with and other automotive transients (e.g. ISO 7637 Pulse 1-3, AEC-Q200-002, ISO 10605, ISO 16750-2, CI-220, CI-260) and more.

AVX Varistors provide bi-directional transient voltage protection in the on-state and EMI/RFI attenuation in the off-state which allows designers to combine the circuit protection and EMI/RFI attenuation function into a single highly reliable device. Parts are designed for use in temperatures from -55°C to +125°C (+150°C components available) with no derating, exhibit very fast response, multiple strikes capability and high reliability. In addition, AVX automotive series varistors are AEC-Q200 qualified.

AVX Varistors are provided in different mounting options, covering wide range of applications requirements. Surface mount varistors are available in single element or multiple element (array) EIA industry standard packages. The parts are RoHS compliant and offer excellent solderability thanks to Ni Barrier/100% Sn termination; Pd/Ag parts for hybrid assembly are also available as option upon request. AVX also offers SnPb termination as a special option. Thru-hole components are supplied as conformally epoxy coated axial and radial devices and are RoHS compliant.

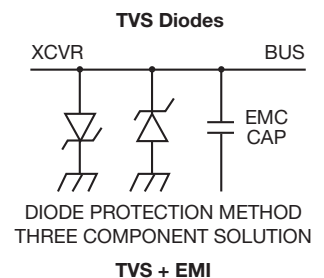
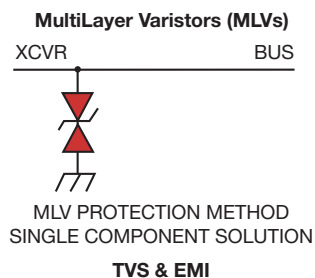
BENEFITS AND FEATURES

- SMT 0201 - 3220, Axial and Radial configuration
- Bi Directional transient voltage protection
- EMI Filtering in the off-state
- Very fast response (< 1ns)
- Multiple strikes capability
- High reliability
- No derating over operating temperature range -55°C to +125°C (+150°C components available)
- High peak current and high energy options
- Low capacitance parts for RF, high speed data lines and capacitance sensitive applications
- AEC-Q200 qualified automotive series
- RoHS Compliant

APPLICATIONS

AVX Varistors are used in wide range of application sectors such as:

- Automotive
- Consumer
- Home appliances
- Automation
- Lighting
- Industrial/Professional
- Medical
- Renewable/Smart Energy
- Military



TVS + EMI FILTERING

Series	PN Code	Fig.	Technical Data	Features	Applications Examples
TransGuard®	VC VG		Case size: 0402 - 3220 Working Voltage: 3.3 - 85Vdc Energy: 0.05J - 12J Peak Current: 20A - 2000A	Wide range of multilayer varistors for bi-directional overvoltage protection as well as EMI/RFI attenuation.	<ul style="list-style-type: none"> • IC Protection • DC Motors • Automation • LED • Alarms <ul style="list-style-type: none"> • Inductive switching • Bluetooth • I/O Lines • Portable devices
Miniature 0201 MLV	VC0201		Case size: 0201 Working Voltage: 3.5 - 16Vdc Energy: 0.01, 0.02J Peak Current: 1 - 10A	Miniature 0201 varistor for any circuits with space constraints or for embedded applications.	<ul style="list-style-type: none"> • Hearing Aid • Portable devices • Embedded designs <ul style="list-style-type: none"> • Smart cards • Electronic tags
StaticGuard	VC**LC		Case size: 0402 - 1206 Working Voltage: 18Vdc Energy: 0.02J - 0.1J Capacitance: 40 - 200pF	Lower capacitance version of TransGuard® for bi-directional ESD protection as well as EMI/RFI attenuation.	<ul style="list-style-type: none"> • Sensors • CMOS • Switches <ul style="list-style-type: none"> • Data lines • Bipolar and SiGe based systems
MultiGuard Array	MG		Case size: 0405 - 0612 Working Voltage: 5.6 - 18Vdc Energy: 0.02 - 0.1J Peak Current: 15 - 30A	MultiGuards are 2 and 4-element MLV arrays to protect multiple lines against ESD while saving board space and pick and place costs.	<ul style="list-style-type: none"> • I/O Lines • Portable equipment • Radios <ul style="list-style-type: none"> • Programming ports • Differential data lines • ASIC
Controlled Capacitance	VCAC		Case size: 0402, 0603 Working Voltage: 9 - 30Vdc Peak Current: 2 - 120A Capacitance: 33 - 1000pF	Varistors developed for use in mixed signal environment for targeted EMI/RFI filtering and transient suppression.	<ul style="list-style-type: none"> • EMI TVS Module Control • High Speed ASICs <ul style="list-style-type: none"> • Sensors • IC
Radial CapGuard™	CG		Case size: Radial Working Voltage: 26, 45Vdc Peak Current: 200A Capacitance: 0.47, 1µF	TransGuard® varistor and RF filtering high capacitance ceramic capacitor integrated into single radial leaded component for bi-directional overvoltage protection and RFI noise suppression.	<ul style="list-style-type: none"> • Inductive loads • DC Motors • Relays <ul style="list-style-type: none"> • TVS and radiated and conducted noise filtering
TransFeed	V*F		Case size: 0805 Working Voltage: 5.6 - 26Vdc Energy: 0.1 - 0.3J Peak Current: 20 - 120A	Varistor with FeedThru filter construction offers transient protection with enhanced noise reduction and low parallel inductance.	<ul style="list-style-type: none"> • Imaging • GPS • Bar code scanners • Instrumentation <ul style="list-style-type: none"> • I/O Lines • Power line conditioning

TVS + LOW SIGNAL DISTORTION/LOW LOSS (LOW CAPACITANCE)

Series	PN Code	Fig.	Technical Data	Features	Applications Examples
USB Series	USB		Case size: 0402 - 0612 Working Voltage: 18Vdc Peak Current: 4A Capacitance: 3 - 10pF	Low capacitance varistors designed for use in high-speed data lines and other capacitance sensitive applications.	<ul style="list-style-type: none"> • Sensors • Data lines • USB/Firewire • Ethernet <ul style="list-style-type: none"> • Computers • LCD
Communication Bus Varistors	CAN FLX		Case size: 0402 - 0612 Working Voltage: 18, 32Vdc Peak Current: 4 - 10A Capacitance: 15 - 37pF	Low capacitance varistors designed for protection of communication bus, data lines and other capacitance sensitive applications with high reliability and high inrush current capability compared to diodes.	<ul style="list-style-type: none"> • Data lines • General I/O protocols • CMOS <ul style="list-style-type: none"> • Module interfaces • Switches • Sensors
AntennaGuard	VC**AG		Case size: 0402 - 0603 Working Voltage: 18 - 30Vdc Capacitance: 1.5 - 12pF	Low capacitance varistors with low leakage and low loss designed for protection in RF circuits, antennas, high-speed data lines, optic circuits and capacitance sensitive applications.	<ul style="list-style-type: none"> • RF Circuits • Antennas • WLAN • Ethernet <ul style="list-style-type: none"> • Sensors • Data lines • USB
Antenna PowerGuard	VCAS**AP				
Sub pF AG Series	VCH4**AG		Case size: 0402 Working Voltage: 10 - 15Vdc Capacitance: 0.47, 0.8pF	Ultra-low capacitance (<1pF) varistors with low leakage and low loss designed for protection in RF circuits, antennas, sensors, high-speed data lines, optic circuits and capacitance sensitive applications.	<ul style="list-style-type: none"> • RF Circuits • Antennas • WLAN • Sensors • Data lines <ul style="list-style-type: none"> • HDMI • USB 2.0 • Touch controls • Touch screens

TVS + LOW POWER AC/LOW SIGNAL DISTORTION

Series	PN Code	Fig.	Technical Data	Features	Applications Examples
Miniature MAV Series	MAV		Case size: 0402 - 0603 Working Voltage: 70Vdc/52Vac Peak Current: 1 - 3A Capacitance: 6 - 22pF	Varistors designed for low power AC circuit protection, transient suppression in LC resonant circuits and higher DC voltage data lines protection. 110V p-to-p capability at 125kHz.	<ul style="list-style-type: none"> • LC resonant circuits • Keyless entry • Data lines • Multiplex BUS Systems <ul style="list-style-type: none"> • AC Sampling Circuitry • Transformer Secondaries

TVS + VERY LOW LEAKAGE

Series	PN Code	Fig.	Technical Data	Features	Applications Examples
UltraGuard	VcUG MGUG		Case size: 0402 - 0612 Working Voltage: 3.0 - 32Vdc Energy: 0.02 - 0.4J Peak Current: 10 - 150A	Low leakage (<1µA) varistors for battery operated devices, high clock speed IC, low voltage power conversion circuits and low leakage requirements.	<ul style="list-style-type: none"> Portable equipment High clock speed IC Battery-operated device Fingerprint ID Sensors Optics circuits

TVS + HARSH ENVIRONMENT

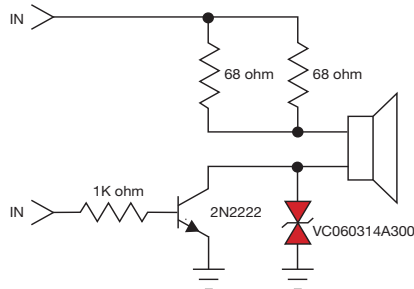
Series	PN Code	Fig.	Technical Data	Features	Applications Examples
Glass Encapsulated TransGuard®	VG		Case size: 1206 - 3220 Working Voltage: 16 - 100Vdc Energy: 0.7 - 12J Peak Current: 200 - 2000A	High energy range extension of TransGuard varistors. In addition the glass encapsulation provides enhanced resistance against harsh environment.	<ul style="list-style-type: none"> Harsh Environment Applications DC motors Inductive Loads
Glass Encapsulated Varistors	VJ		Case size: 1206 - 3220 Working Voltage: 16 - 385Vdc Energy: 0.3 - 15J Peak Current: 120 - 3000A	Glass encapsulated high energy, large case size varistors. The glass encapsulation provides enhanced resistance against harsh environment.	<ul style="list-style-type: none"> Harsh Environment Applications DC motors Inductive Loads
Radial and Axial Varistors	VR**AS VR**AT VA		Case size: Radial, Axial Working Voltage: 3.3 - 60Vdc Energy: 0.1 - 2.0J Peak Current: 30 - 500A	Radial and axial leaded epoxy coated varistors, designed for durability in harsh environments and applications where leaded component is preferred. VRAT series are specified up to +150°C.	<ul style="list-style-type: none"> DC Motors Inductive loads Down hole drilling Relays White goods Industrial equipment Sensors
High Temp Automotive	CANAT VCAT CANATL		Case size: 0603 - 0612 Working Voltage: 18 - 32Vdc Peak Current: 4 - 5A Capacitance: 10 - 22pF	High temperature, low capacitance varistors with low leakage and low loss, specified to +150°C.	<ul style="list-style-type: none"> High Temperature applications Data lines RF Circuits Sensors

GENERAL APPLICATIONS EXAMPLES

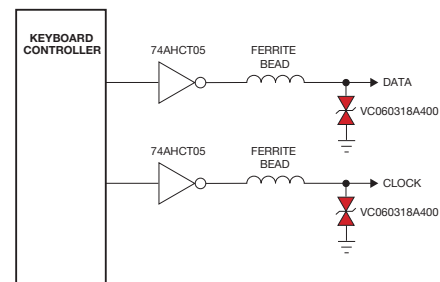


- Industrial Applications
- Communication
- Household Appliances
- Automation
- Safety and Security
- Energy and Smart Grid
- LED Lighting
- Commercial
- Healthcare
- Hobby
- Transportation
- and more

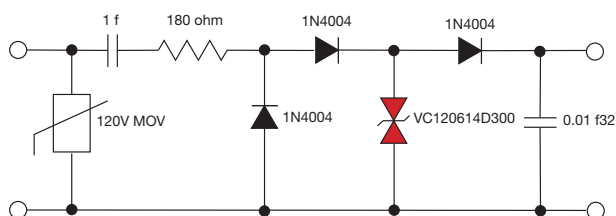
AUDIO PROTECTION



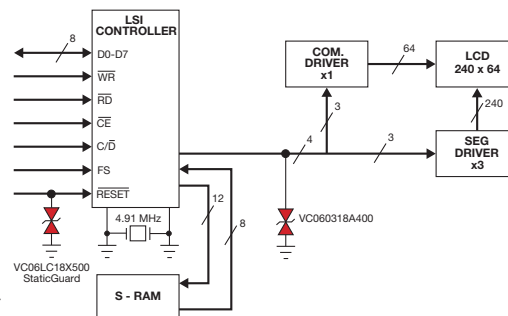
KEYBOARD PROTECTION



SENSOR PROTECTION



LCD PROTECTION



AVX Automotive Grade TransGuard Series (AEC-Q200 Qualified)

TVS / LOAD DUMP (TRANSGUARD®) + EMI FILTERING

Series	PN Code	Fig.	Technical Data	Features	Applications Examples
TransGuard® Automotive	VCAS VGAS		Case size: 0402 - 3220 Working Voltage: 3.3 - 85Vdc Energy: 0.05J - 13J Peak Current: 20A - 2000A	Wide range multilayer varistors for bi-directional overvoltage protection as well as EMI/RFI attenuation. Specified with load dump and jump start rating where applicable.	<ul style="list-style-type: none"> All automotive applications Safety Body electronics Drive train <ul style="list-style-type: none"> Comfort & convenience Load dump protection
StaticGuard Automotive Series	VCAS**LC		Case size: 0402 - 0805 Working Voltage: 18Vdc Energy: 0.02 - 0.1J Capacitance: 40 - 80pF	Lower capacitance version of TransGuard® for bi-directional ESD protection as well as EMI/RFI attenuation.	<ul style="list-style-type: none"> CMOS Module Interfaces Sensors Data lines <ul style="list-style-type: none"> Transceiver chips General purpose logic
Controlled Capacitance	VCAC		Case size: 0402, 0603 Working Voltage: 9 - 30Vdc Peak Current: 2 - 120A Capacitance: 33 - 1000pF	Varistors developed for use in mixed signal environment for targeted EMI/RFI filtering and transient suppression.	<ul style="list-style-type: none"> EMI TVS Module Control High Speed <ul style="list-style-type: none"> ASICs Sensors IC
Radial CapGuard™	CG		Case size: Radial Working Voltage: 26, 45Vdc Peak Current: 200A Capacitance: 0.47, 1µF	TransGuard® varistor and RF filtering high capacitance ceramic capacitor integrated into single radial leaded component for bi-directional overvoltage protection and RFI noise suppression.	<ul style="list-style-type: none"> Inductive loads DC Motors (e.g. window lifters, central lock) <ul style="list-style-type: none"> TVS and radiated and conducted noise filtering
TransFeed Automotive	V*AF		Case size: 0805 Working Voltage: 5.6 - 26Vdc Energy: 0.1 - 0.3J Peak Current: 20 - 120A	Varistors with FeedThru filter construction for transient voltage protection with enhanced noise reduction and low parallel inductance.	<ul style="list-style-type: none"> Drive by Wire Electric Mirror LCD Dashboard Driver <ul style="list-style-type: none"> I/O ports Power line conditioning

TVS + LOW SIGNAL DISTORTION/LOW LOSS (LOW CAPACITANCE)

Series	PN Code	Fig.	Technical Data	Features	Applications Examples
Communication Bus Varistors	CAN FLX		Case size: 0402 - 0612 Working Voltage: 18, 32Vdc Peak Current: 4 - 10A Capacitance: 15 - 37pF	Low capacitance varistors designed for protection of communication bus, data lines and other capacitance sensitive applications with high reliability and high inrush current capability compared to diodes.	<ul style="list-style-type: none"> CAN Bus FlexRay Data lines <ul style="list-style-type: none"> Body control modules General I/O protocols
AntennaGuard	VCAS**AG		Case size: 0402 - 0603 Working Voltage: 18 - 30Vdc Capacitance: 1.5 - 12pF	Low capacitance varistors with low leakage and low loss designed for protection in RF circuits, antennas, high-speed data lines, optic circuits and capacitance sensitive applications.	<ul style="list-style-type: none"> RF Circuits Sensors Antennas Data lines <ul style="list-style-type: none"> Bluetooth Cameras Crash avoidance
Sub pF AG Automotive	VCASH4		Case size: 0402 Working Voltage: 16Vdc Capacitance: 0.8pF	Ultra-low capacitance (<1pF) varistors with low leakage and low loss designed for protection in RF circuits, antennas, sensors, high-speed data lines, optic circuits and capacitance sensitive applications.	<ul style="list-style-type: none"> RF Circuits Sensors Antennas Data lines Bluetooth USB 2.0 <ul style="list-style-type: none"> HDMI Cameras Crash avoidance Touch controls Touch screens

TVS + HARSH ENVIRONMENT/HIGH TEMPERATURE

Series	PN Code	Fig.	Technical Data	Features	Applications Examples
Glass Encapsulated Automotive TransGuard®	VGAS		Case size: 1206 - 3220 Working Voltage: 16 - 85Vdc Energy: 0.7 - 13J Peak Current: 200 - 2000A	Glass encapsulated high energy, large case size automotive series varistors. The glass encapsulation provides enhanced resistance against harsh environment.	<ul style="list-style-type: none"> Harsh Environment Applications <ul style="list-style-type: none"> Power Steering Load Dump Protection
Glass Encapsulated Automotive Varistors	VJ**MA VJ**PA		Case size: 1206 - 3220 Working Voltage: 16 - 34Vdc Energy: 0.3 - 13.8J Peak Current: 120 - 3000A	Glass encapsulated high energy, large case size automotive series varistors. The glass encapsulation provides enhanced resistance against harsh environment.	<ul style="list-style-type: none"> Harsh Environment Applications <ul style="list-style-type: none"> Power Steering Load Dump Protection
High Temperature Automotive	CANAT VCAT		Case size: 0603 - 0612 Working Voltage: 18Vdc Peak Current: 4A Capacitance: 12, 22pF	High temperature low capacitance varistors with low loss, specified to +150°C.	<ul style="list-style-type: none"> Under hood/ High Temp Communication Bus RF Circuits Sensors <ul style="list-style-type: none"> Body control module Transmission control unit
High Temperature Low Leakage Automotive	CANATL		Case size: 0603 Working Voltage: 32Vdc Peak Current: 5A Capacitance: 10pF	High temperature low capacitance varistors with low leakage and low loss, specified to +150°C.	<ul style="list-style-type: none"> Under hood/ High Temp Communication Bus RF Circuits Sensors <ul style="list-style-type: none"> Body control module Transmission control unit
Radial Leaded Automotive TransGuard®	VR**AS VR**AT		Case size: Radial Working Voltage: 14 - 48Vdc Energy: 0.1 - 2.0J Peak Current: 30 - 500A	Radial and axial leaded epoxy coated varistors, designed for durability in harsh environments and applications where leaded component is preferred. VRAT series are specified up to +150°C.	<ul style="list-style-type: none"> Inductive switching DC Motors Relays <ul style="list-style-type: none"> Under hood/ High Temp Turbocharger

TVS + LOW POWER AC/LOW SIGNAL DISTORTION

Series	PN Code	Fig.	Technical Data	Features	Applications Examples
Miniature MAV Series	MAV		Case size: 0402 - 0603 Working Voltage: 70Vdc/52Vac Peak Current: 1 - 3A Capacitance: 6 - 22pF	Varistors designed for low power AC circuit protection, transient suppression in LC resonant circuits and higher DC voltage data lines protection. 110V peak to peak capability at 125kHz.	<ul style="list-style-type: none"> • LC resonant circuits • Keyless entry • Immobilizers • Data lines

AUTOMOTIVE APPLICATIONS



Comfort and Convenience

- Electric Mirror
- GPS Location System
- Electric Controls
- Communication Bus
- Data lines
- Keyless Entry
- RF Circuits
- LED Lamp
- Audio Entertainment
- HDMI Interface
- Sensors and more

Safety

- Passenger Cars
- Hybrid And Electric Cars
- Commercial/Utility Vehicles
- Construction Vehicles
- Agricultural Vehicles
- Motorcycles

AUTOMOTIVE TRANSIENTS

Today's automobiles are using new technologies based on electronics systems connected by wide variety of network to provide increased safety, convenience and comfort, to reduce emissions, increase fuel efficiency and more. During the lifetime these systems are subjected to many overvoltage transient surges. To ensure safe and reliable function it is necessary to protect these sensitive systems against overvoltage surges.

AUTOMOTIVE POWER RAIL TRANSIENTS

The transients on automotive power rails are usually medium to high energy transients and are caused by engine start such as Jump start (connecting other cars battery to jump start the engine), Load Dump (sudden load disconnect from alternator) or inductive switching (caused by DC motors on/off switching - e.g. window lifter, wipers, adaptive headlights). These transients are typically bi-directional.

AUTOMOTIVE DATA LINE TRANSIENTS

Data lines connecting the automotive systems need to be protected against various ESD pulses to ensure sensitive electronics protection. These transients are mainly caused by human interaction with the electronics systems (controls, buttons and ports) or by interaction between systems due to different charge build up. These transients are typically bidirectional and very fast.

AVX MULTILAYER VARISTORS IN AUTOMOTIVE APPLICATIONS

The EMC requirements of today's automotive electronics are a natural fit for the use of AVX Multilayer Varistors (MLVs).

AVX Automotive Series Varistors provide reliable protection against automotive related transients - such as Load Dump, Jump Start and ESD to protect the growing number of electronics systems used in automotive applications.

TRANSIENT EXAMPLES:

- Load dump (ISO 7637-2-5)
- Jump Start
- ISO 7637 Pulse 1-3
- IEC 61000-4-2, etc.
- AEC-Q200-002
- ISO 10605
- ISO 16750-2
- CI-220
- CI-260

The parts offer fast turn on time, bi-directional protection, excellent multiple strikes capability and in addition also EMI/RFI filtering in the off-state that can improve overall system EMC performance.

High power MLV designs have been revised and miniaturized to allow efficient protection of today's most widely used communication bus designs.

AVX Automotive Grade TransGuard Series (AEC-Q200 Qualified)

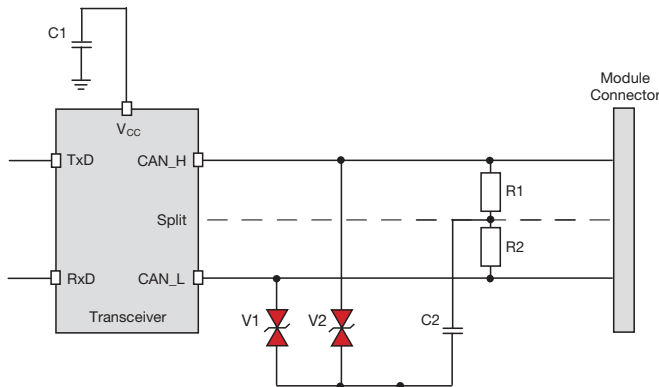
When used in communication bus designs, MLVs can save approximately 90% of the board area involved with diode/EMC cap solutions. In addition, MLVs offer a FIT rate <0.1, an ability to be used at temperatures up to 150°C and a fast turn on time.

MLVs have traditionally been used in inductively generated automotive transient suppression applications such as motors, relays and latches. MLVs offer a large inrush current capability in a small package, high-energy transient suppression and a broad and definable off state bulk EMC capacitance. These, coupled with an extremely low FIT rate and excellent process capability makes MLVs a common device in today's intermediate to high power automotive circuit protection.

Example of suitable AVX series based on data speed and line type is shown below:

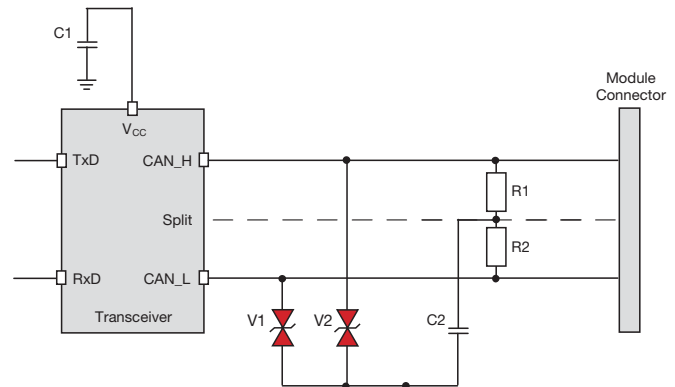
SERIES	BUS	DATA SPEED	
Sub pF AntennaGuard Automotive Series	HDMI 1394a	3.2 Gbps	High Speed
		400 Mbps	
AG/Sub pF AG Automotive Series, Miniature AC	MOST	45 Mbps	Data
		25 Mbps	
		10 Mbps	
FlexRay	FlexRay	1 Mbps	Data
CAN, FlexRay, AG Series	TTCAN	1 Mbps - 50 Kbps	
TransGuard® Automotive Series, StaticGuard Automotive Series, Radial Varistor	Safe-by-Wire	150 Kbps	Low Speed
		LIN	
TransGuard® Automotive Series, StaticGuard Automotive Series, Radial Varistor, Miniature MAV, TransFeed Automotive Series	ALL		Power Line
		TransFeed Automotive Series, Controlled Capacitance	10-100 Mbps

CANBUS PROTECTION



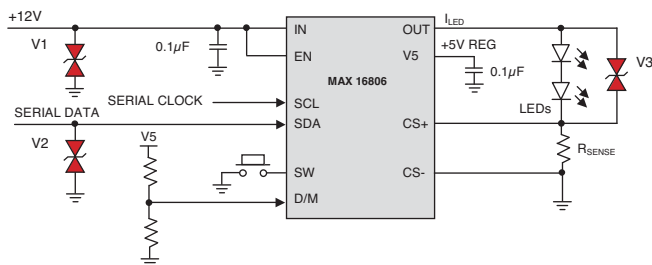
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(V1+V2)	CAN0002

FLEXRAY PROTECTION



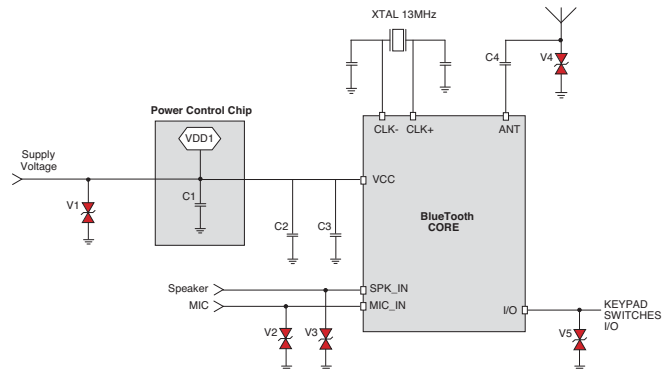
V1, V2	FLX0005WP
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LED DRIVER PROTECTION



V1	VCAS120618E380
V2	VCAS060318A400
V3	VCAS06LC18X500

BLUETOOTH



V1	VCAS080518C400
V2, V3	VCAS060314A300
V4	VCAS06AG183ROYAT
V5	VCAS040218X400

NTC Thermistors



For Automotive, Industrial and Commercial Applications

AVX offers reliable NTC thermistor solutions for a wide range of automotive, professional, industrial and commercial applications. Available in SMT, leaded, or leadless form, they provide multiple stability options and a wide resistance range with the option to offer customized solutions. Thermistors are widely used in temperature sensing or temperature compensation applications.

AVX NTC THERMISTORS SERIES OVERVIEW

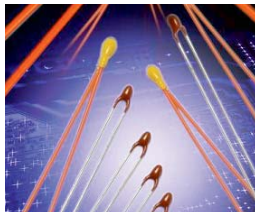


SMT Thermistors

0603 to 1206 case size Thermistors are widely used for temperature compensation as well as for temperature control of printed circuits in wide range of applications. Available with Ni barrier/100% Sn termination for lead free soldering or with PdAg termination for hybrid assembly.

AEC
Q200

PN	Case Size	Resistance	Tolerance	Temp
NB / NC	0603 - 1206	10Ω - 1MΩ	±5%, ±10%, ±20%	-55 to +150°C



High Accuracy Thermistors

High precision resistance and ability to reproduce the sensibility index B makes these parts ideal for temperature measurement. These small head size thermistors with rapid response times are able to meet the most accurate requirements.

AEC
Q200

PN	Size	Resistance	Tolerance	Temp
NI / NJ NP / NK	2.4 - 3.0mm	2kΩ - 100kΩ	±1%, ±2%, ±3%	-55 to +150°C



Disc Thermistors

AVX disc thermistors with excellent thermal and electrical stability, resistance to mechanical and thermal shock with a wide range of resistance values for applications such as temperature measurement or thermal compensation.

AEC
Q200

PN	Size	Resistance	Tolerance	Temp
ND / NE NV / NR	3 - 9mm	68Ω - 1MΩ	±5% ±10% ±20%	-55 to +150°C

APPLICATION EXAMPLES

AUTOMOTIVE

- Outside Temperature
- Navigation System
- Air Conditioning
- Radio
- Auxiliary Heating System for Diesel
- Oil Temperature
- Evaporator Probe
- Water Temperature
- Electric Pump Module
- Air Intake Temperature
- Alarm
- Seats Heating
- and more

CONSUMER/INDUSTRIAL

- Mobile Phones
- Battery Packs
- Battery Chargers
- LCD Compensation
- Base Stations
- Home Appliances
- HVAC Systems
- Industrial Equipment
- Fans
- Fire detectors
- and more

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