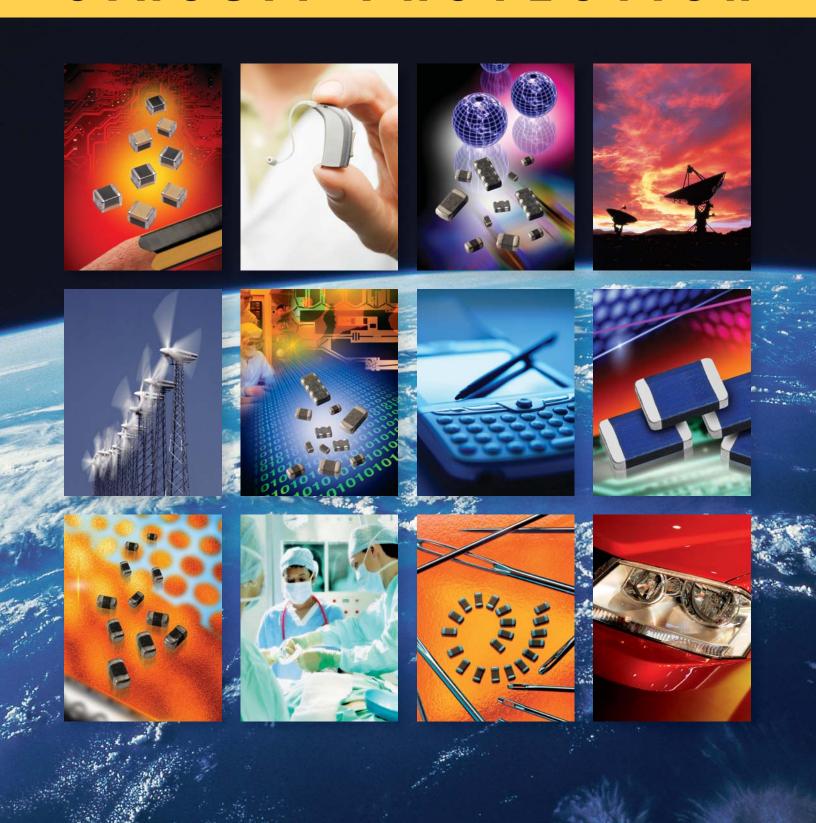


AVX Multilayer Varistors and NTC Thermistors

CIRCUIT PROTECTION





AVX Multilayer Ceramic Transient Voltage Suppressors











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:

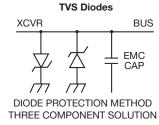
- Automotive
- Consumer
- Home appliances
- Automation
- Lighting

- Industrial/Professional
- Medical
- Renewable/Smart Energy
- Military





TVS & EMI



TVS + EMI





AVX Professional, Industrial & Commercial Grade Series (non-Auto grade)

TVS + EMI FILTERING

Series	PN Code	Fig.	Technic	al Data	Features	Applications Examples	
TransGuard®	VC VG	***	Case size: Working Voltage: Energy: Peak Current:	0402 - 3220 3.3 - 85Vdc 0.05J - 12J 20A - 2000A	Wide range of multilayer varistors for bi-directional overvoltage protection as well as EMI/RFI attenuation.	IC ProtectionDC MotorsAutomationLEDAlarms	Inductive switching Bluetooth I/O Lines Portable devices
Miniature 0201 MLV	VC0201	**	Case size: Working Voltage: Energy: Peak Current:	0201 3.5 - 16Vdc 0.01, 0.02J 1 - 10A	Miniature 0201 varistor for any circuits with space constraints or for embedded applications.	Hearing AidPortable devicesEmbedded designs	Smart cards Electronic tags
StaticGuard	VC**LC	Les	Case size: Working Voltage: Energy: Capacitance:	0402 - 1206 18Vdc 0.02J - 0.1J 40 - 200pF	Lower capacitance version of TransGuard® for bi-directional ESD protection as well as EMI/RFI attenuation.	SensorsCMOSSwitches	Data lines Bipolar and SiGe based systems
MultiGuard Array	MG	"E W	Case size: Working Voltage: Energy: Peak Current:	0405 - 0612 5.6 - 18Vdc 0.02 - 0.1J 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.	I/O LinesPortable equipmentRadios	Programming ports Differential data lines ASIC
Controlled Capacitance	VCAC	4)	Case size: Working Voltage: Peak Current: Capacitance:	0402, 0603 9 - 30Vdc 2 - 120A 33 - 1000pF	Varistors developed for use in mixed signal environment for targeted EMI/RFI filtering and transient suppression.	EMI TVS Module Control High Speed ASICs	• Sensors • IC
Radial CapGuard™	CG	7	Case size: Working Voltage: Peak Current: Capacitance:	Radial 26, 45Vdc 200A 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.	Inductive loads DC Motors Relays	TVS and radiated and conducted noise filtering
TransFeed	V*F	A B B	Case size: Working Voltage: Energy: Peak Current:	0805 5.6 - 26Vdc 0.1 - 0.3J 20 - 120A	Varistor with FeedThru filter construction offers transient protection with enhanced noise reduction and low parallel inductance.	Imaging GPS Bar code scanners Instrumentation	I/O Lines Power line conditioning

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

Series	PN Code	Fig.	Technic	cal Data	Features	Applications	s Examples
USB Series	USB	- H	Case size: Working Voltage: Peak Current: Capacitance:	0402 - 0612 18Vdc 4A 3 -10pF	Low capacitance varistors designed for use in high-speed data lines and other capacitance sensitive applications.	SensorsData linesUSB/FirewireEthernet	• Computers • LCD
Communication Bus Varistors	CAN FLX	ES TO	Case size: Working Voltage: Peak Current: Capacitance:	0402 - 0612 18, 32Vdc 4 - 10A 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.	Data lines General I/O protocols CMOS	 Module interfaces Switches Sensors
AntennaGuard	VC**AG	100	Case size:	0402 - 0603	Low capacitance varistors with low leakage and low loss designed for protection in	RF Circuits Antennas	Sensors Data lines
Antenna PowerGuard	VCAS**AP		Working Voltage: Capacitance:	18 - 30Vdc 1.5 - 12pF	RF circuits, antennas, high-speed data lines, optic circuits and capacitance sensitive applications.	WLAN Ethernet	• USB
Sub pF AG Series	VCH4**AG		Case size: Working Voltage: Capacitance:	0402 10 - 15Vdc 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.	RF CircuitsAntennasWLANSensorsData lines	HDMI USB 2.0 Touch controls Touch screens

TVS + LOW POWER AC/LOW SIGNAL DISTORTION

Series	PN Code	Fig.	Technic	al Data	Features	Applications	Examples
Miniature MAV Series	MAV		Case size: Working Voltage: Peak Current: Capacitance:	0402 - 0603 70Vdc/52Vac 1 - 3A 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.	LC resonant circuits Keyless entry Data lines Multiplex BUS Systems	• AC Sampling Circuitry • Transformer Secondaries





AVX Professional, Industrial & Commercial Grade Series (non-Auto grade)

TVS + VERY LOW LEAKAGE

Series	PN Code	Fig.	Technical Data	Features	Applications Examples
UltraGuard	VCUG MGUG	THE PARTY OF	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.	Portable equipment

TVS + HARSH ENVIRONMENT

Series	PN Code	Fig.	Technic	al Data	Features	Applications Examples	
Glass Encapsulated TransGuard®	VG	4	Case size: Working Voltage: Energy: Peak Current:	1206 - 3220 16 - 100Vdc 0.7 - 12J 200 - 2000A	High energy range extension of TransGuard varistors. In addition the glass encapsulation provides enhanced resistance against harsh environment.	Harsh Environment High Energy Applications	DC motors Inductive Loads
Glass Encapsulated Varistors	VJ	T	Case size: Working Voltage: Energy: Peak Current:	1206 - 3220 16 - 385Vdc 0.3 - 15J 120 - 3000A	Glass encapsulated high energy, large case size varistors. The glass encapsulation provides enhanced resistance against harsh environment.	Harsh Environment High Energy Applications	DC motors Inductive Loads
Radial and Axial Varistors	VR**AS VR**AT VA		Case size: Working Voltage: Energy: Peak Current:	Radial, Axial 3.3 - 60Vdc 0.1 - 2.0J 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.	DC Motors Inductive loads Down hole drilling Relays	White goods Industrial equipment Sensors
High Temp Automotive	CANAT VCAT CANATL	田	Case size: Working Voltage: Peak Current: Capacitance:	0603 - 0612 18 - 32Vdc 4 - 5A 10 - 22pF	High temperature, low capacitance varistors with low leakage and low loss, specified to +150°C.	High Temperature applications Data lines	RF Circuits Sensors

GENERAL APPLICATIONS EXAMPLES



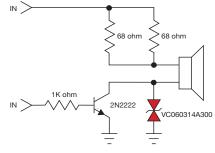




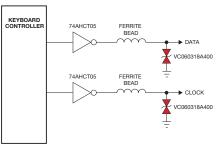


- Industrial Applications
- Communication
- Household Appliances
- Automation
- Safety and Security
- **Energy and Smart Grid**
- LED Lighting Commercial
- Healthcare
- Hobby
- Transportation
- and more

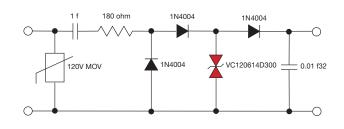
AUDIO PROTECTION



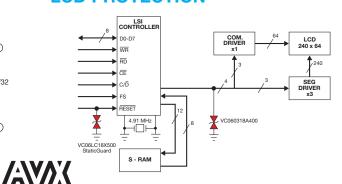
KEYBOARD PROTECTION



SENSOR PROTECTION



LCD PROTECTION





AVX Automotive Grade TransGuard Series (AEC-Q200 Qualified)

TVS / LOAD DUMP (TRANSGUARD®) + EMI FILTERING

Series	PN Code	Fig.	Technic	al Data	Features	Application	s Examples
TransGuard® Automotive	VCAS VGAS	***	Case size: Working Voltage: Energy: Peak Current:	0402 - 3220 3.3 - 85Vdc 0.05J - 13J 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.	All automotive applicationsSafetyBody electronicsDrive train	Comfort & convenience Load dump protection
StaticGuard Automotive Series	VCAS**LC	FEE	Case size: Working Voltage: Energy: Capacitance:	0402 - 0805 18Vdc 0.02 - 0.1J 40 - 80pF	Lower capacitance version of TransGuard® for bi-directional ESD protection as well as EMI/RFI attenuation.	CMOS Module Interfaces Sensors Data lines	Transceiver chips General purpose logic
Controlled Capacitance	VCAC	Peak Current: 2 - 120A		9 - 30Vdc	Varistors developed for use in mixed signal environment for targeted EMI/RFI filtering and transient suppression.	EMI TVS Module Control High Speed	• ASICs • Sensors • IC
Radial CapGuard™	CG	7	Case size: Working Voltage: Peak Current: Capacitance:	Radial 26, 45Vdc 200A 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.	Inductive loads DC Motors (e.g. window lifters, central lock)	TVS and radiated and conducted noise filtering
TransFeed Automotive	V*AF		Case size: Working Voltage: Energy: Peak Current:	0805 5.6 - 26Vdc 0.1 - 0.3J 20 - 120A	Varistors with FeedThru filter construction for transient voltage protection with enhanced noise reduction and low parallel inductance.	Drive by Wire Electric Mirror LCD Dashboard Driver	I/O ports Power line conditioning

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

Series	PN Code	Fig.	Technic	al Data	Features	Applications Examples	
Communication Bus Varistors	3 3 3 3 3 4 7		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.	CAN Bus FlexRay Data lines	Body control modules General I/O protocols		
AntennaGuard	VCAS**AG	-	Case size: 0402 - 0		Low capacitance varistors with low leakage and low loss designed for protection in RF	RF Circuits Sensors	BluetoothCameras
Antenna PowerGuard	VCAS**AP	2	Working Voltage: 18 - 30Vdc Capacitance: 1.5 - 12pF		circuits, antennas, high-speed data lines, optic circuits and capacitance sensitive applications.	AntennasData linesCrash avoidance	
Sub pF AG Automotive	Sub pF AG Automotive 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.	RF CircuitsSensorsAntennasData linesBluetoothUSB 2.0	HDMI Cameras Crash avoidance Touch controls Touch screens		

TVS + HARSH ENVIRONMENT/HIGH TEMPERATURE

Series	PN Code	Fig.	Technic	al Data	Features	Applications	Examples
Glass Encapsulated Automotive TransGuard®	VGAS	4	Case size: Working Voltage: Energy: Peak Current:	1206 - 3220 16 - 85Vdc 0.7 - 13J 200 - 2000A	Glass encapsulated high energy, large case size automotive series varistors. The glass encapsulation provides enhanced resistance against harsh environment.		Power SteeringLoad Dump Protection
Glass Encapsulated Automotive Varistors	VJ**MA VJ**PA		Case size: Working Voltage: Energy: Peak Current:	1206 - 3220 16 - 34Vdc 0.3 - 13.8J 120 - 3000A	Glass encapsulated high energy, large case size automotive series varistors. The glass encapsulation provides enhanced resistance against harsh environment.		Power SteeringLoad Dump Protection
High Temperature Automotive	CANAT VCAT	田園	Case size: Working Voltage: Peak Current: Capacitance:	0603 - 0612 18Vdc 4A. 12, 22pF	High temperature low capacitance varistors with low loss, specified to +150°C.	Under hood/ High Temp Communication Bus RF Circuits Sensors	 Body control module Transmission control unit
High Temperature Low Leakage Automotive	CANATL	THE STATE OF	Case size: Working Voltage: Peak Current: Capacitance:	0603 32Vdc 5A 10pF	High temperature low capacitance varistors with low leakage and low loss, specified to +150°C.	Under hood/ High TempCommunication BusRF CircuitsSensors	 Body control module Transmission control unit
Radial Leaded Automotive TransGuard®	VR**AS VR**AT		Case size: Working Voltage: Energy: Peak Current:	Radial 14 - 48Vdc 0.1 - 2.0J 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.	DC Motors	Under hood/ High TempTurbocharger





AVX Automotive Grade TransGuard Series (AEC-Q200 Qualified)

TVS + LOW POWER AC/LOW SIGNAL DISTORTION

Series	PN Code	Fig.	Technical Data		Features	Applications	Examples
Miniature MAV Series	MAV		Case size: Working Voltage: Peak Current: Capacitance:	70Vdc/52Vac 1 - 3A	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.	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 bidirectional.

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)
- AEC-Q200-002
- ISO 10605
 - CI-260

CI-220

- Jump Start
- ISO 16750-2
- ISO 7637 Pulse 1-3
- IEC 61000-4-2, etc.

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)

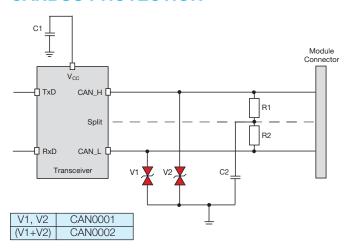
When used in communication bus designs, MLVs can save approximately 90% of the board area involved with diode/EMC cap solutions. In addition, MLVs offer a FIT rate <0.1, an ability to be used at temperatures up to 150° C and a fast turn on time.

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.

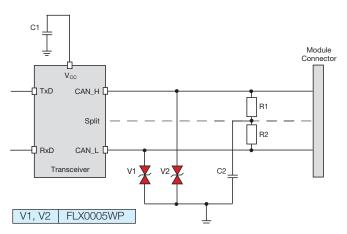
Example of suitable AVX series based on data speed and line type is shown below:

SERIES	BUS		DATA SPEED	
Sub pF AntennaGuard Automotive Serie	es HDMI		3.2 Gbps	High Speed
	1394a		400 Mbps	
AG/Sub pF AG Automotive Series,	MOST		45 Mbps	
Miniature AC	TTP		25 Mbps	
FlexRay	FlexRay		10 Mbps	Data
CAN, FlexRay, AG Series	TTCAN		1 Mbps	Data
Only, Floxitay, Act ochos	CAN		1 Mbps - 50 Kbps	
TransGuard® Automotive Series,	Safe-by-Wire		150 Kbps	
StaticGuard Automotive Series,				
Radial Varistor	LIN		<20 Kbps	Low Speed
TransGuard® Automotive Series,				
StaticGuard Automotive Series,	ALL			Power Line
Radial Varistor, Miniature MAV,	ALL			I OWEI LINE
TransFeed Automotive Series				
TransFeed Automotive Series,	10-100 Mbps			Cutoff Frequency
Controlled Capacitance				outon riequency

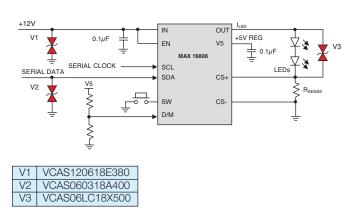
CANBUS PROTECTION



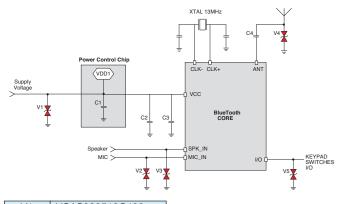
FLEXRAY PROTECTION



LED DRIVER PROTECTION



BLUETOOTH



V1	VCAS080518C400
V2, V3	VCAS060314A300
V4	VCAS06AG183R0YAT
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 - 1ΜΩ	±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	2.4 - 3.0mm	2k0 - 100k0	±1%, ±2%, ±3%	-55 to +150°C
NP / NK	2.1 0.011111	21/32 1001/32	1 70, 12 70, 10 70	00 10 1 100 0



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

PN	Size	Resistance	Tolerance	Temp
ND / NE	3 - 9mm	680 - 1M0	±5% ±10% ±20%	-55 to +150°C
NV / NR	0 0111111	0012 110112	10/0 110/0 120/0	00 10 1 100 0

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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