A KYOCERA GROUP COMPANY

# AVX Multilayer Varistors and NTC Thermistors

## CIRCUIT PROTECTION





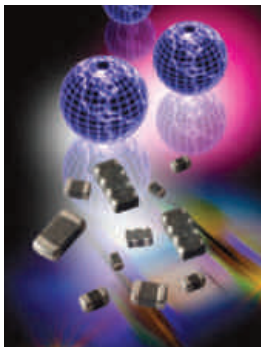


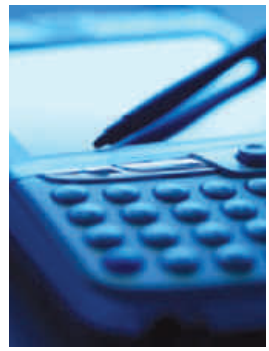


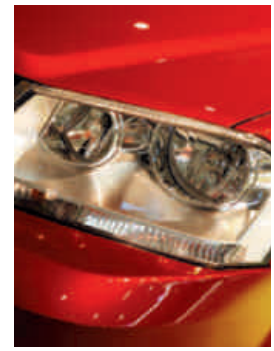



# TransGuard®

## 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

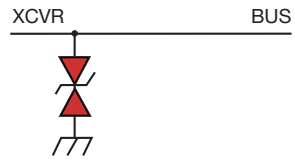
- SMT 0201 - 3220, Axial and Radial configuration
- Bi Directional transient voltage protection
- EMI Filtering in the off-state
- Very fast response (< 1ns)
- Multiple strikes capability
- High reliability
- No derating over operating temperature range -55°C to +125°C (+150°C components available)
- 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

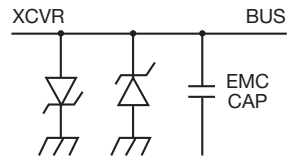
**MultiLayer Varistors (MLVs)**




MLV PROTECTION METHOD
SINGLE COMPONENT SOLUTION

**TVS & EMI**

**TVS Diodes**




DIODE PROTECTION METHOD
THREE COMPONENT SOLUTION

**TVS + EMI**

# TransGuard®

## AVX Multilayer Ceramic Transient Voltage Suppressors

## AVX VARISTORS – PRODUCT SELECTION GUIDE

| Series | PN Code | Fig. | Technical Data | | Features / Applications |
|---|---|---|---|---|---|
| TransGuard® | VC<br>VG |  | Case size:<br>Working Voltage:<br>Energy:<br>Peak Current: | 0402 - 2220<br>3.3 - 85Vdc<br>0.05J - 12J<br>20A - 2000A | Wide range of multilayer varistors for bi-directional overvoltage protection as well as EMI/RFI attenuation. |
| TransGuard®<br>Automotive Series | VCAS<br>VGAS |  | Case size:<br>Working Voltage:<br>Energy:<br>Peak Current: | 0402 - 2220<br>5.6 - 85Vdc<br>0.05J - 12J<br>20A - 2000A | Wide range multilayer varistors for bi-directional overvoltage protection as well as EMI/RFI attenuation in automotive applications (AEC-Q200). |
| StaticGuard | VC**LC |  | Case size:<br>Working Voltage:<br>Energy:<br>Capacitance: | 0402 - 1206<br>18Vdc<br>0.02J - 0.1J<br>40 - 200pF | Lower capacitance version of TransGuard® for bi-directional ESD protection as well as EMI/RFI attenuation. |
| StaticGuard<br>Automotive Series | VCAS**LC |  | Case size:<br>Working Voltage:<br>Energy:<br>Capacitance: | 0402 - 0805<br>18Vdc<br>0.02 - 0.1J<br>40 - 80pF | Lower capacitance version of TransGuard® for bi-directional ESD protection as well as EMI/RFI attenuation in automotive applications (AEC-Q200). |
| Miniature 0201 MLV | VC0201 |  | Case size:<br>Working Voltage:<br>Energy:<br>Peak Current: | 0201<br>3.5 - 16Vdc<br>0.01, 0.02J<br>1 - 10A | Miniature 0201 varistor for any circuits with space constraints or for embedded applications. |
| MultiGuard Array | MG |  | Case size:<br>Working Voltage:<br>Energy:<br>Peak Current: | 0405 - 0612<br>5.6 - 18Vdc<br>0.02 - 0.1J<br>15 - 30A | 2 and 4-element MLV arrays to protect multiple lines against ESD while saving board space and pick and place costs. |
| UltraGuard<br>Low Leakage Varistors | VCUG<br>MGUG |  | Case size:<br>Working Voltage:<br>Energy:<br>Peak Current: | 0402 - 0612<br>3.0 - 32Vdc<br>0.02 - 0.4J<br>10 - 150A | Low leakage (<1µA) varistors for battery operated devices, high clock speed IC, low voltage power conversion circuits and low leakage requirements. |
| Communication<br>Bus Varistors | CAN<br>FLX |  | Case size:<br>Working Voltage:<br>Peak Current:<br>Capacitance: | 0402 - 0612<br>18, 32Vdc<br>4 - 10A<br>15 - 37pF | Low capacitance varistors designed for protection of communication bus, data lines and other capacitance sensitive automotive (AEC-Q200) as well as general applications. |
| Low Capacitance<br>USB Series | USB |  | Case size:<br>Working Voltage:<br>Peak Current:<br>Capacitance: | 0402 - 0612<br>18Vdc<br>4A<br>3 - 10pF | Low capacitance varistors designed for use in high-speed data lines and other capacitance sensitive applications. |
| AntennaGuard<br>Low Capacitance<br>Varistors | VC**AG |  | Case size:<br>Working Voltage:<br>Capacitance: | 0402 - 0603<br>18Vdc<br>3, 12pF | Low capacitance varistors designed for protection in RF circuits, antennas, sensors, high-speed data lines, optic circuits and other capacitance sensitive applications etc. |
| AntennaGuard<br>Low Capacitance<br>Automotive Series | VCAS**AG | | Case size:<br>Working Voltage:<br>Capacitance: | 0402 - 0603<br>18Vdc<br>3, 12pF | Low capacitance varistors designed for protection in RF circuits, antennas, sensors, high-speed data lines, optic circuits and capacitance sensitive applications in automotive applications (AEC-Q200). |
| Sub pF AG Series<br>Ultra-Low Capacitance | VCH4**AG |  | Case size:<br>Working Voltage:<br>Capacitance: | 0402<br>10-15Vdc<br>0.47, 0.8pF | Ultra-low capacitance (<1pF) varistors designed for protection in RF circuits, antennas, sensors, high-speed data lines, optic circuits and capacitance sensitive applications. |
| Sub pF AG<br>Automotive Series<br>Ultra-Low Capacitance | VCH4**AG | | Case size:<br>Working Voltage:<br>Capacitance: | 0402<br>16Vdc<br>0.8pF | Ultra-low capacitance (<1pF) varistor designed for protection in RF circuits, sensors, high-speed data lines, optic circuits and capacitance sensitive automotive (AEC-Q200) applications. |
| Controlled<br>Capacitance | VCAC | | Case size:<br>Working Voltage:<br>Peak Current:<br>Capacitance: | 0603<br>22, 26Vdc<br>30A<br>47, 82pF | Varistors developed for use in mixed signal environment for targeted EMI/RFI filtering and transient suppression in automotive (AEC-Q200) and general applications. |
| Miniature MAV Series | MAV |  | Case size:<br>Working Voltage:<br>Peak Current:<br>Capacitance: | 0402 - 0603<br>70Vdc<br>1 - 3A<br>6 - 22pF | Varistors designed for low power AC circuit protection, transient suppression in LC resonant circuits and higher DC voltage data lines protection in automotive (AEC-Q200) and general applications. |

# TransGuard®

## AVX Multilayer Ceramic Transient Voltage Suppressors

| Series | PN Code | Fig. | Technical Data | Features / Applications |
|---|---|---|---|---|
| Glass Encapsulated TransGuard® | VG |  | Case size: 1206 - 2220<br>Working Voltage: 16 - 85Vdc<br>Energy: 0.7 - 12J<br>Peak Current: 200 - 2000A | High energy range extension of TransGuard varistors. In addition the glass encapsulation provides enhanced resistance against harsh environment. |
| Glass Encapsulated TransGuard® Automotive Series | VGAS | | Case size: 1206 - 2220<br>Working Voltage: 16 - 65Vdc<br>Energy: 0.7 - 12J<br>Peak Current: 200 - 2000A | High energy range extension of TransGuard automotive series varistors for automotive (AEC-Q200) applications. In addition the glass encapsulation provides enhanced resistance against harsh environment. |
| High Temperature Automotive Series | CANAT VCAT |  | Case size: 0603 - 0612<br>Working Voltage: 18Vdc<br>Peak Current: 4A<br>Capacitance: 12, 22pF | High temperature varistors specified to +150ºC for automotive (AEC-Q200) and general applications. |
| High Temperature Low Leakage Automotive Series | CANATL | | Case size: 0603<br>Working Voltage: 32Vdc<br>Peak Current: 5A<br>Capacitance: 10pF | High temperature varistors with low leakage, specified to +150ºC for high temperature automotive (AEC-Q200) and general applications. |
| Radial Leaded Automotive TransGuard® | VR**AS |  | Case size: Radial<br>Working Voltage: 18 - 48Vdc<br>Energy: 0.7 - 1.6J<br>Peak Current: 200 - 500A | Radial leaded epoxy coated varistors, designed for durability in harsh environments for automotive (AEC-Q200) and general applications. |
| Radial Leaded High Temperature Automotive TransGuard® | VR**AT | | Case size: Radial<br>Working Voltage: 14 - 48Vdc<br>Energy: 0.1 - 2.0J<br>Peak Current: 30 - 250A | High temperature, radial leaded epoxy coated varistors, specified to +150ºC. Designed for durability in harsh environments and for high temperature automotive (AEC-Q200) and general applications. |
| Radial CapGuard | CG |  | Case size: Radial<br>Working Voltage: 26, 45Vdc<br>Peak Current: 200A<br>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 in automotive (AEC-Q200) and general applications. |
| Axial TransGuard and StaticGuard | VA |  | Case size: Axial<br>Working Voltage: 3.3 - 60Vdc<br>Energy: 0.1 – 2.0J<br>Peak Current: 30 - 300A | Axial Version of TransGuard® and StaticGuard varistors for bi-directional overvoltage protection as well as EMI/RFI attenuation in the off-state. |
| TransFeed | V*F |  | Case size: 0805, 0612<br>Working Voltage: 5.6 - 26Vdc<br>Energy: 0.05 - 0.3J<br>Peak Current: 15 - 120A | Varistor with FeedThru filter construction for transient protection with enhanced attenuation characteristics for EMI reduction. |
| TransFeed Automotive Series | V*AF |  | Case size: 0805, 0612<br>Working Voltage: 5.6 - 26Vdc<br>Energy: 0.05 - 0.3J<br>Peak Current: 15 - 120A | Varistor with FeedThru filter construction for transient protection with enhanced attenuation characteristics for EMI reduction for automotive (AEC-Q200) applications. |
| SnPb Multilayer Varistors | VCLD |  | Case size: 0603 - 1210<br>Working Voltage: 5.6 - 85Vdc<br>Energy: 0.1 – 2.0J<br>Peak Current: 30 - 500A | Varistors with SnPb termination for bi-directional overvoltage protection as well as EMI/RFI attenuation in the off-state. |
| Glass Encapsulated MLV | VJ |  | Case size: 1206 - 3220<br>Working Voltage: 16 - 385Vdc<br>Energy: 0.3 - 15J<br>Peak Current: 120 - 2000A | Special series of high energy, large case size varistors for automotive, industrial/commercial and telecom applications. |

## AVX VARISTORS – AUTOMOTIVE APPLICATIONS EXAMPLES

### 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

- TPMS, TPS
- Airbag
- Traction Control
- Immobilizer
- Central locking system
- ABS
- Bus Interface
- Sensors
- Camera
- Crash Avoidance
- Satelitte links and more

### VEHICLE TYPES

- Passenger Cars
- Hybrid/Electrical Cars
- Commercial/Utility Vehicles
- Agricultural Vehicles
- Construction Vehicles
- Motorcycles
- Marine

### AFTERMARKET

Critical add-ons where AEC-Q200 components are required such as:

- LED light modules
- Obstacle detection sensors
- and more

### BODY ELECTRONICS

- Electronic control unit
- HID and LED lighting
- Windshield wipers
- Communication Bus / Data lines
- Transponders
- Electronic stability control
- Lamp/LED driver
- Underhood modules
- Rain sensor
- Light sensor
- LCD dashboard driver and more

### DRIVE TRAIN

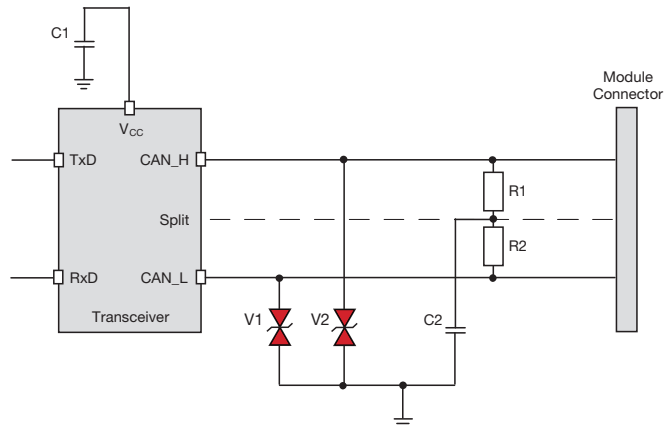
- HEV Modules / Monitors
- GFI
- HEV Relays and disconnects
- Sensors, RF links
- Power conversion interfaces
- Regenerative braking
- Electric drive
- Engine Start/Stop
- TVS&EMI Filtering on high power drain circuits
- and more

## AVX VARISTORS – AUTOMOTIVE APPLICATIONS EXAMPLES

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

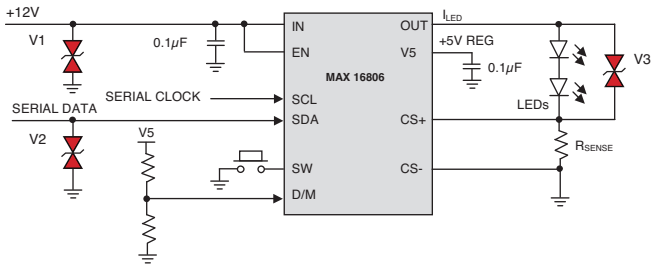
| SERIES | BUS | DATA SPEED | |
|---|---|---|---|
| Sub pF AntennaGuard Automotive Series | HDMI | 3.2 Gbps | High Speed |
| | 1394a | 400 Mbps | |
| AG/Sub pF AG Automotive Series, | MOST | 45 Mbps | |
| Miniature AC | TTP | 25 Mbps | |
| FlexRay | FlexRay | 10 Mbps | Data |
| CAN, FlexRay, AG Series | TTCAN | 1 Mbps | |
| | 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, Radial Varistor, Miniature MAV, TransFeed Automotive Series | ALL | | Power Line |
| TransFeed Automotive Series, Controlled Capacitance | 10-100 Mbps | | Cutoff Frequency |

## CAN BUS



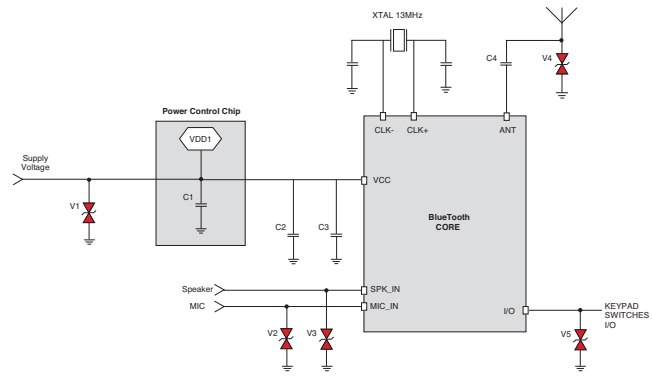

| Component | AVX Part Number | Specification |
|---|---|---|
| V1, V2 | CAN0001RP | 0603, 18Vdc, 0.015J, 4A, 22pF max |
| (V1+V2) | CAN0002RP | 0405 Dual Array, 0.015J, 4A, 22pF max |

## LED DRIVER




| Component | AVX Part Number | Specification |
|---|---|---|
| V1 | VCAS120618E380 | 1206, 18Vdc, 0.5J, 200A, 930pF |
| V2 | VCAS060318A400 | 0603, 18Vdc, 0.1J, 30A, 150pF |
| V3 | VCAS06LC18X500 | 0603, 18Vdc, 0.05J, 30A, 50pF |

## BLUETOOTH



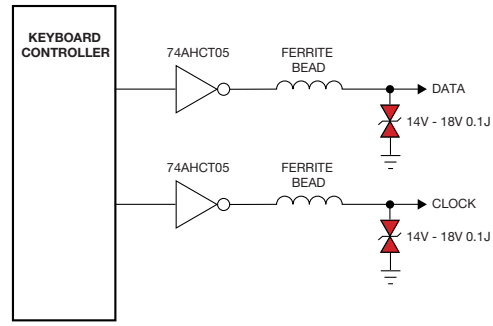

| Component | AVX Part Number | Specification |
|---|---|---|
| V1 | VCAS080518C400 | 0805, 18Vdc, 0.3J, 120A, 550pF typ |
| V2, V3 | VCAS060314A300 | 0603, 14Vdc, 0.1J, 30A, 350pF typ |
| V4 | VCAS06AG183R0YAT | 0603, 18Vdc, 3pF max |
| V5 | VCAS040218X400 | 0402, 18Vdc, 0.05J, 20A, 65pF typ |

## AVX VARISTORS – GENERAL APPLICATIONS EXAMPLES

### APPLICATIONS

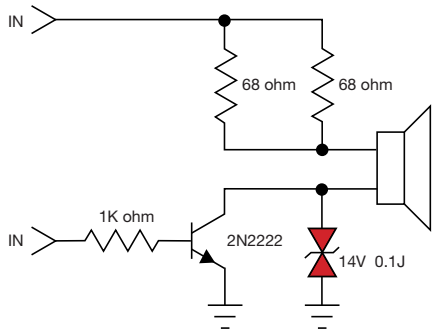
- Industrial Applications
- Communication
- Household Appliances
- Automation
- Safety and Security
- Energy and Smart Grid
- LED Lighting
- Computers
- Commercial
- Consumer
- Healthcare
- Hobby
- Transportation
- Military
- and more

### KEYBOARD PROTECTION



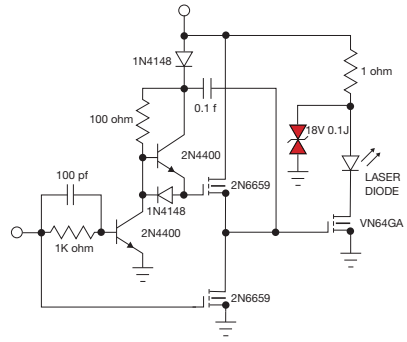

| Component | AVX Part Number | Specification |
|---|---|---|
| V1, V2 | VC060318A400 | 0603, 18Vdc, 0.1J, 30A,150pF max |

### AUDIO PROTECTION



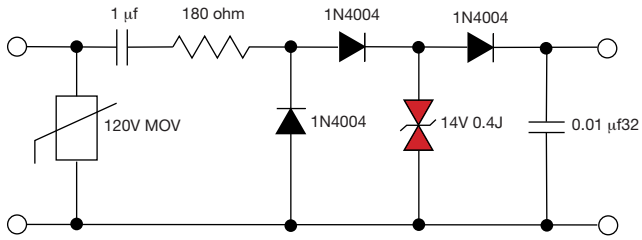

| Component | AVX Part Number | Specification |
|---|---|---|
| V1 | VC060314A300 | 0603, 14Vdc, 0.1J, 30A,350pF |

### LASER DIODE PROTECTION



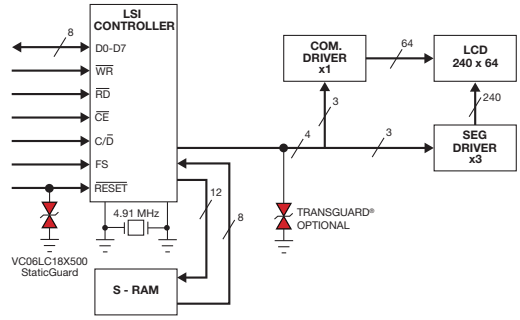

| Component | AVX Part Number | Specification |
|---|---|---|
| V1 | VC060318A400 | 0603, 18Vdc, 0.1J, 30A,150pF |

### SENSOR PROTECTION




| Component | AVX Part Number | Specification |
|---|---|---|
| V1 | VC120614D300 | 1206, 14Vdc, 0.4J, 150A,1050pF |

### LCD PROTECTION




| Component | AVX Part Number | Specification |
|---|---|---|
| V1 | VC06LC18X500 | 0603, 18Vdc, 0.05J, 30A, 50pF |
| V2 | VC060318A400 | 0603, 18Vdc, 0.1J, 30A, 150pF |

# 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.

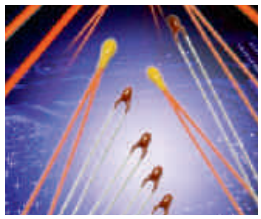
## AVX NTC THERMISTORS SERIES OVERVIEW

### 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<br>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<br>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



For more information, please visit
http://www.avx.com



Product Catalog
**Varistors**
Scan Code for Catalog

Product Catalog
**NTC Thermistors**
Scan Code for Catalog

**AVX Corporation**
1 AVX Blvd.
Fountain Inn, SC 29644, USA