

## **Section 16000**

### **Transient Voltage Surge Suppressor (TVSS)**

also termed **Surge Protective Device (SPD)**

**SCOPE:** The work under this section shall include all materials, labor and auxiliaries required to install complete surge suppression for the protection of building electrical and electronic systems from the effects of transient voltages at Main AC and Branch AC locations. It includes the definition and specifications for protection of microprocessor based (Critical) and electro-mechanical based (Non-Critical) loads.

#### **1.0 GENERAL**

**1.1. Description:** This document defines minimum TVSS performance requirements to protect critical electronic equipment. It further details TVSS electrical, environmental, mechanical, and installation parameters pertinent to utilizing TVSS at Main and Branch distribution panels applications.

**1.2. Definitions:** The following selected terms are used in this specification.

**Arrester:** A lightning arrester's primary function is for use in outdoor applications to protect transformers, wiring conductors and other distribution equipment from insulation breakdown. It limits transient voltages and diverts surge currents.

**Back-up:** The suppression stage(s) that are intended to assume suppression responsibilities in the event of a primary suppression stage failure.

**Common Mode:** Suppression activities accomplished between the Phase and Ground conductors and between the Neutral and Ground conductors of an AC power circuit.

**Critical Load (CL):** Any main or branch panel location which provides power to a microprocessor based system, computerized load or sensitive circuitry.

**Electro-mechanical based load:** Any AC or DC powered load that is not computerized and does not incorporate micro-processors or sensitive circuitry.

**Hybrid Suppressor:** Surge suppressors utilizing multiple and different suppression technologies in their design parameters which are intended to operate as a single coordinated system.

**Maximum allowable Continuous Operating Voltage (MCOV):** The maximum continuous operating voltage (MCOV) that a TVSS can withstand without failure. (ref. IEC 61643-1)

## Section 16000, Transient Voltage Surge Suppressor

**Metal Oxide Varistor (MOV):** The variable resistor component utilized for surge suppression. This variable resistor is constructed of sintered metal oxides, primarily zinc oxide. They are voltage dependant non-linear devices used to limit surge voltages and divert surge currents.

**Microprocessor based load:** Any AC or DC powered load that is computerized, incorporates micro-processors or sensitive circuitry.

**Non-Critical Load (NCL):** Any main or branch panel location which provides power to electro-mechanical loads and/or all electrical loads not covered in the definition of critical loads. (i.e. loads that only require insulation breakdown protection)

**Normal Mode:** Suppression accomplished between the Phase conductors and between the Phase and Neutral conductors of an AC power circuit.

**Primary Suppression:** Suppression stage that is intended to provide voltage limiting and to dissipate the majority of the transient energy.

**Silicon Avalanche Suppressor Diode (SASD):** The individual solid-state suppression component utilized by TVSS manufacturers to prevent permanent damage to sensitive electronic components. During non-surge conditions they exhibit high impedance such that normal operation of equipment is unaffected. When a surge condition occurs, they avalanche and divert/shunt the damaging transient energy (current and voltage) away from the load.

**Surge Voltage Rating (SVR):** (UL 1449, 2<sup>nd</sup> Edition) Similar to the VPL, but performed at a specific voltage, current, and waveform (i.e. 6Kv, 1.2/50 $\mu$ S; 500A 8/20 $\mu$ S waveforms)

**Transient Voltage Surge Suppressor (TVSS), also termed Surge Protective Device (SPD):** Describes the equipment necessary to protect electronic devices at AC distribution panels from the affects of induced lightning, external switching transients, and internally generated switching transients generated by inductive and/or capacitive load switching. It limits transient voltages and diverts surge currents.

**Voltage Protection Level (VPL):** The maximum peak voltage of the surge suppressor allows to pass along to equipment or loads after the application of a test wave of a specific voltage, current and duration. The test waveform is defined by IEEE C62.41. The test parameters are set forth in IEEE C62.45. This term is used to indicate the highest level of peak voltage to which the protected equipment will be exposed.

Section 16000, Transient Voltage Surge Suppressor

**1.3. Industry Reference Standards:** The following specifications and standards are incorporated into and become a part of this specification by reference:

- a) National Fire Protection Association (NFPA) No. 70
- b) National Electric Code (NEC). (as applicable)
- c) Underwriters Laboratories, Inc. (UL) No. 1449 Standard for Fire and Safety-TVSS
- d) ANSI/IEEE C62.41-1991 Edition, Recommended Practice on Surge Voltages in Low Voltage AC Power Circuits.
- e) Underwriters Laboratories, Inc. No. 1950 Standard for Information Technology Equipment.
- f) IEEE/ANSI C62.45-1992, IEEE Guide on Surge Testing for Equipment Connected to Low-Voltage AC Power Circuits
- G) IEC 61643 International Standard Surge Protective Devices connected to low voltage power distribution Systems.

**2.0 PRODUCTS**

**2.1 Acceptable Manufacturers: Products available from the following manufacturers comply with these specifications and are acceptable:**

**a) Critical Load Applications (CL), (microprocessor based):**

Transtector Systems, Inc.  
10701 Airport Drive  
Hayden Lake, ID 83835  
Tel: 1-800-882-9110 or 208-772-8515  
FAX: 208-762-6133

**b) Non-Critical Load Applications (NCL), (electro-mechanical based):**

Specified Power Device  
P.O. Box 1628  
Hayden Lake, ID 83835  
Tel: 1-800-882-9110 or 208-772-8515  
Fax 208-762-6133

**C) Other engineering approved equal products:** Approval shall be in writing and shall be authorized 10 days prior to bid date. Products shall meet all performance criteria set forth in this specification.

**2.2. Mechanical Coordination:** Coordinate TVSS installation with distribution panel architectural and structural features, with equipment installed under other sections of the specifications, and with other electrical devices to insure equipment access and that clearance minimums are provided.

Section 16000, Transient Voltage Surge Suppressor

**2.3. Warranty:** The equipment shall be warranted against defects in material and/or workmanship for a minimum of five years.**Submittals:** Refer to the specifications within this document for detail on minimum requirements. All "as equals" shall be pre-approved 10 days prior to bid date.

**2.4. Manufacturer's Product Data:** Submit material specifications, installation diagrams and performance data. Specifications shall also detail the minimum information as listed below:

- a) Electrical characteristics and ratings for each specific TVSS. (CL and NCL applications)
- b) Dimensions, weights, mounting provisions, and connection details to the power system.
- c) Provide documentation of listing/recognition to the latest revision of UL 1449 (2<sup>nd</sup> addition). Submittals without this documentation will be rejected.
- d) Overcurrent protection requirements (fuse or circuit breaker) shall be defined and located external to the TVSS device.
- e) Manufacturer shall be able to provide documentation verifying that the TVSS is a standard product design.

**3.0. PRODUCT PERFORMANCE SPECIFICATIONS**

**3.1. General Requirements:** AC power circuits should be protected by a suppressor attached in parallel with the line and/or line/neutral conductors at the pertinent distribution panel.

**3.2 Electrical Operating Environment:** The TVSS System, as required, shall be available in models to protect the following individual distribution panel configurations:

Voltage System Configuration VRMS	Number of Phases	Number of Conductors
100 - 127	1	2
220-240	1	2
240/120	1	3
208/120	3	4
380/220	3	4
415/240	3	4
240	3	3
480/277	3	4
480	3	3

**Table 1: Electrical Operating Environment**

All TVSS devices shall operate as a total coordinated and engineered

Section 16000, Transient Voltage Surge Suppressor

system, as well as be engineered as a system by the manufacturer.

**3.3. Maximum Continuous Operating Voltages (MCOV):** MCOV of TVSS shall not be less than 115% of the nominal system operating voltage.

- a) **Temperature and Relative Humidity:** All TVSS components shall be rated with an operating temperature range of -40° to +120° F, (-30° to +65° C and from 0 to 85% Relative humidity, non-condensing.
- b) **Altitude:** TVSS components shall operate in altitudes up to 20,000 feet (6100 meters) above sea level.
- c) **EMI/RFI:** No TVSS or component shall generate appreciable magnetic fields at levels sufficient to damage stored magnetic data.
- d) **Power Consumption and Harmonic Distortion:** Average power consumption of any single system shall be less than 10 watts per phase. System shall not contribute to, or create any harmonic distortion.
- e) **Operating Frequency:** The operating frequency range shall be 50/60 Hz.
- f) **System Wiring:** All TVSS shall be connected in parallel with the power system they are protecting. Series connected components **shall not** be utilized.

**3.4. Operation:** Operational characteristics of the TVSS system:

- a) During normal suppression operation, the TVSS shall not short-circuit or "crowbar" the power circuit resulting with AC power disruptions to protected equipment loads.
- b) The TVSS shall incorporate individual suppression modules to suppress transient activity on each AC power phase.
- c) Suppression modules shall be field replaceable.
- d) TVSS performance parameters shall not degrade from published specifications as long as system performance parameters are not exceeded.
- e) Suppression paths shall not be to ground circuits. Common Mode - Line (Phase) to Ground (L-G) or Neutral to Ground (N-G) suppression paths are unacceptable. Only Normal Mode - Line (Phase) to Neutral (L-N) for Wye and single phase systems or Line (Phase) to Line (Phase) (L-L) for Delta configured TVSS systems shall be acceptable.
- f) Each suppression module, "Primary" or "Back-Up" shall be capable of full power dissipation offering protection on a per phase and per polarity basis.
- g) The TVSS shall accomplish Bi-polar and Bi-directional transient suppression for each AC power phase.
- h) The TVSS response time shall be 5 nanoseconds or less.

## Section 16000, Transient Voltage Surge Suppressor

**3.5. Mechanical:** The TVSS enclosure or other components if fabricated from a non-metallic material shall have a minimum UL fire rating of UL 94-5V. The enclosure shall be a minimum of NEMA type 4 or 4X, CSA type 4, and/or IEC, IP66.

**3.6. Status Indication:** Suppressor modules shall incorporate the following operational and status indicators:

- a) A visual indicator that illuminates as AC power is applied to the TVSS.
- b) A visual indicator that illuminates to indicate normal suppressor operation.

**3.6.1. Remote Status Indicators shall be optional:**

- a) Remote Status Indicators shall consist of "dry" isolated relay contacts that will change states with loss of suppressor function or with loss of applied electrical power. Relays shall provide contacts labeled C (common), NC (normally closed), and NO (normally open) with respect to the power off initial condition.
- b) Relay shall comply to UL 1950 Voltage Isolation requirements.

**3.7. SUPPRESSION COMPONENTS:**

**3.7.1. Critical Load (CL) applications.** Only Silicon Avalanche Suppressor Diodes (SASDs) shall be used as the sole "Primary" suppression component.

- a) **Silicon Avalanche Suppression Diodes (SASDs) shall be used as the sole "Primary" suppression component** whether used as an independent suppression module or utilized with a "Back-Up" module.
- b) Metal Oxide Varistors (MOVs) **shall not** be used as primary suppression component. Metal Oxide Varistors (MOVs) may be used only as independent "Back-Up" suppression modules when used in conjunction with independent "Primary" SASD modules.
- c) Hybrid designs incorporating multiple or different suppression technologies are not allowed.
- d) Suppression systems shall not employ any other technologies such as gas tubes, spark gap devices, selenium or filters.
- e) Normal Mode Protection only. Common Mode NOT acceptable except at the main service panel or panels. These are defined as panels where there is a neutral to ground bond. NOTE: Common Mode Protection is not required at these Locations.

Section 16000, Transient Voltage Surge Suppressor

**Non-Critical Load (NCL) applications.** Only Silicon Avalanche Suppressor Diodes (SASDs) or Metal Oxide Varistors (MOVs) shall be utilized.

- a) Only Silicon Avalanche Suppression Diodes (SASDs) or Metal Oxide Varistors (MOVs) shall be used in all suppression stages.
- b) Hybrid designs incorporating multiple or different suppression technologies are not allowed.
- c) TVSS suppression system shall not employ any other technologies such as Gas tubes, Spark Gap devices, selenium or filters.

**3.8. TRANSIENT VOLTAGE SURGE SUPPRESSOR (TVSS):** The TVSS shall be UL 1449 2<sup>nd</sup> Addition listed for Permanently Connected Products. The maximum Surge Voltage Rating (SVR) per table 60.1 of UL 1449 shall be as follows for each AC voltage configuration:

Voltage System Configuration VRMS	Critical Load (CL) (SVR) Vpk	Non-Critical Load (NCL) (SVR) Vpk
120 VRMS, Single Phase	330 (L-N)	500 (L-N)
240/120 VRMS, Single Phase	330 (L-N)	500 (L-N)
208/120 VRMS, Poly-Phase	330 (L-N)	500 (L-N)
240 VRMS, Single Phase	400 (L-N)	800 (L-N)
240 VRMS, Poly-Phase	400 (L-L)	800 (L-L)
380/220 VRMS, Poly-Phase	400 (L-N)	800 (L-N)
415/240 VRMS, Poly-Phase	600 (L-N)	800 (L-N)
480/277 VRMS, Poly-Phase	600 (L-N)	1200 (L-N)
480 VRMS, Poly-Phase	900 (L-L)	1200 (L-L)

**Table 2: Surge Voltage Rating (SVR) per table 60.1 of UL 1449**

**3.9. Additional Surge Voltage Ratings:** In addition to the UL 1449 Surge Voltage Ratings (SVR), additional ratings shall be supplied for Main Distribution Panel for Critical Load (CL) installations. This performance rating shall use the high stress 10X1000 microsecond ( $\mu$ S) waveform found in table 8 of the IEEE C62.41-1991. The Surge Voltage Rating (SVR) shall not exceed the SVR rating provided in Table 1.0.

**3.10. Main AC Panel Applications:** At Main AC Distribution panels for Critical Load (CL) and Non-Critical Load (NCL) applications, the following Transtector Systems or Specified Power Devices are acceptable:

Section 16000, Transient Voltage Surge Suppressor

**Critical Load (CL) Applications:**

**Transtector Systems - APEX III, APEX IV SERIES SDA Series**

**Non-Critical Load (NCL) Applications**

**Transtector Systems - SPD Series and Aegis Series**

**3.11 Branch AC Panel Applications:** At Branch AC Distribution panels for Critical Load (CL) and Non-Critical Load (NCL) applications, the following Transtector Systems or Specified Power Devices are acceptable:

**Critical Load (CL) Applications:**

**Transtector Systems: APEX II SERIES, APEX III SERIES, APEX IV SERIES and SDA series 5ka & 10ka**

**Non-Critical Load (NCL) Applications:**

**Transtector Systems: Aegis for Main service panels and SPD Series for NCL secondary panels**

**4.0 INSTALLATION**

**4.1. Service Panel Protection:** The installation shall comply with the manufacturers' printed instructions, and any national and local wiring codes.

**4.2. Field Quality Control:** Upon completion of installation, the TVSS shall not require testing of any kind.