SAE Aerospace
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AEROSPACE STANDARD

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Solid State Power Controller, General Standard For

RATIONALE

This document was created to fill the need for a solid state power controller (SSPC) standard in the aerospace industry. SSPC use has become common practice within the industry. Presently there are no known guiding documents addressing these requirements. The document will define the minimum electrical, environmental, and reliability requirements for these devices in aerospace applications.

1. SCOPE

1.1 Scope

This SAE Aerospace Standard (AS) covers the general requirements for the design, manufacture, and test of Solid State Power Controllers (SSPCs) of both dc and ac ratings for use in electrical power systems. SSPCs conforming to this standard are intended for use in controlling the making and breaking of power circuits for electrically operated equipment and devices, and for providing overload and short-circuit protection.

1.2 Field of Application

The principal areas of application of SSPCs are in electrical power distribution systems of aircraft, missiles, ground vehicles, spacecraft, and ground support equipment. This does not preclude the use of SSPCs in other applications.

2. REFERENCES

2.1 Applicable Documents

The following publications form a part of this document to the extent specified herein. The latest issue of SAE publications shall apply. The applicable isue of other publications shall be the issue in effect on the date of the purchase order. In the event of conflict between the text of this document and references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

2.1.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or 724-776-4970 (outside USA), www.sae.org.

AS1212	Electric Power, Aircraft, Characteristics and Utilization of
AS1831	Electrical Power, 270 V DC, Aircraft, Characteristics and Utilization of
AS9000	Aerospace Basic Quality System Standard
AMS 2422	Plating, Gold

2.1.2 ANSI Publications

Available from American National Standards Institute, 25 West 43rd Street, New York, NY 10036-8002, Tel: 212-642-4900, www.ansi.org.

ANSI Z540-1 General Requirements for Calibration Laboratories and Measuring and Test Equipment

2.1.3 ASME Publications

Available from American Society of Mechanical Engineers, 22 Law Drive, P.O. Box 2900, Fairfield, NJ 07007-2900, Tel: 973-882-1170, www.asme.org.

ASME B1.13M-2001 Metric Screw Threads - M Profile

2.1.4 ISO Publications

Available from American National Standards Institute, 25 West 43rd Street, New York, NY 10036-8002, Tel: 212-642-4900, www.ansi.org.

ISO-9000 Quality Management Systems - Fundamentals and Vocabulary

ISO-10012-1 Quality Assurance Requirements for Measuring Equipment; Part 1: Meteorological Confirmation System for Measuring Equipment

ISO-68-1:1998 ISO General Purpose Screw Threads - Basic Profile - Part 1: Metric Screw Threads

2.1.5 RTCA Publications

Available from Radio Technical Commission for Aeronautics Inc., 1828 L Street, NW, Suite 805, Washington, DC 20036, Tel: 202-833-9339, www.rtca.org.

RTCA/DO-160 Environmental Conditions and Test Procedures for Airborne Equipment

2.1.6 U.S. Government Publications

Available from the Document Automation and Production Service (DAPS), Building 4/D, 700 Robbins Avenue, Philadelphia, PA 19111-5094, Tel: 215-697-6257, http://assist.daps.dla.mil/quicksearch/.

MIL-STD-129 Standard Practice for Military Marking

MIL-STD-130 Identification Marking of U.S. Military Property

MIL-STD-202 Test Method Standard for Electronic and Electrical Component Parts

MIL-HDBK-217 Reliability Prediction of Electronic Equipment

MIL-HDBK-454 General Guidelines for Electronic Equipment

MIL-STD-461 Requirements for Control of Electromagnetic Interference Characteristics of Subsystems and Equipment

MIL-STD-704 Aircraft Electric Power Characteristics

MIL-STD-810 Environmental Engineering Considerations and Laboratory Tests

MIL-STD-883 Test Method Standard Microcircuits

MIL-HDBK-965 Acquisition Practices for Parts Management

MIL-STD-1686 Electrostatic Discharge Control Program for Protection of Electrical and Electronic Parts, Assemblies and Equipment (Excluding Electrically Initiated Explosive Devices) (Metric)

MIL-STD-1916 DoD Preferred Methods for Acceptance of Product

MIL-PRF-19500 Semiconductor Devices, General Specification for

MIL-PRF-38534 Hybrid Microcircuits, General Specification for

MIL-T-81714 Terminal Junction System (TJS), Environment Resistant, General Specification For

FED-STD-H28 Screw Thread Standards for Federal Services

2.2 Definitions and Terminology

The definitions listed below are not a complete glossary of SSPC terminology, but rather are intended as definitions of the technical terms as applied within this document.

APPLICATION TIME TO RESET: The time interval the reset signal must be applied to cause reset.

COORDINATION: Refers to the instance where a given overload must trip the lowest rated SSPC in a cascaded system to prevent turn off of other loads that are not involved or affected by the fault.

CURRENT LIMITING: A protective characteristic of an SSPC which limits the output current to a specified value. This limit thus defines the maximum value of overload current prior to tripping.

FAIL SAFE (DUAL SAFETY): A second element used to interrupt an overload current in the event of a failure in the SSPC's primary switch.

FALL TIME: See Figure 3(A).

LOAD VOLTAGE: The voltage between the power output terminal of the SSPC and the power ground.

INSTANTANEOUS TRIP: An immediate trip function that protects the solid state switch from turning on into a short circuit (>1000% rated load).

NON-REPETITIVE RESET: The minimum specified time interval between tripout and reset for which the trip characteristics are valid.

OFF STATE: That condition under which the device prevents power from being passed to the load.

ON STATE: That condition under which, with the turn-on signal applied, the device allows power to be passed to the load.

PEAK LET THROUGH CURRENT: The maximum value of current available to the load through the device during the first 100 microseconds after application of the overload or fault condition (see Figure 4).

POWER CONTROLLER: A switching and protection device providing an output power switch which presents a low impedance between its supply and load terminals when in the ON state and a high impedance in the OFF state. The state of the power switch normally conforms to that represented by a signal externally applied to the controller. The state of the power switch is represented by an indication signal. The controller trips to isolate the load circuit from the supply on detection of an electrical overload or momentarily limits the current to a specified value.

POWER DISSIPATION: All power dissipated in the power switching circuit and power losses due to internal leakage currents, power supplies, control input, status, and reset signals.

RATED CURRENT: The intended maximum current an SSPC is capable of carrying for an indefinite amount of time without tripping.

REPETITIVE RESET: The time period after a trip condition and subsequent overload in which the SSPC reduces the trip time relationship based on thermal memory.

RESET: The restoration of the tripped SSPC to a state from which it can be turned ON.

RISE TIME: See Figure 3(A).

SHORT CIRCUIT: A short circuit is defined as an impedance of less than 1 mΩ applied between the output terminal and ground.

SUPPLY VOLTAGE: The voltage applied between the power input terminal of the SSPC and the power ground.

THERMAL MEMORY: The ability of an SSPC to take into account the thermal energy retained in a wire or device.

TRIP: The automatic interruption of current that results from electrical overloads.

TRIP CURVE CHARACTERISTICS: The trip curve sets the minimum and maximum trip points of the SSPC and is plotted as current verses time, typically an inverse I^2t relationship.

TRIP FREE: A characteristic which will not allow a device to be maintained ON with a continued application of an input signal when carrying an overload current that would normally cause the device to trip.

TRIP TIME: The time lapse between the application of an overload or fault and the 10% value of rated output current.

TURN-OFF SIGNAL: The control signal level at which the SSPC is turned OFF.

TURN-OFF TIME: See Figure 3.

TURN-ON SIGNAL: The control signal level at which the SSPC is turned ON.

TURN-ON TIME: See Figure 3.

ZERO VOLTAGE TURN-ON (ZVTO) AND ZERO CURRENT TURN-OFF (ZCTO): A characteristic that requires the SSPC to turn ON and turn OFF only at the half-cycle crossing point when connected to a resistive load, regardless of when the control signal is applied or removed (ac SSPCs only).

2.3 SSPC Interface List and Definitions

The following provides a listing, along withdefinitions, of the primary and secondary interfaces for the device. The primary interfaces are the minimum required for all devices procured under this specification. The secondary interfaces are the optional inputs and outputs available to the user. The secondary interfaces required must be specified in the detail specification sheets. The associated interface definitions are provided to minimize any misunderstanding that might occur between the user and supplier as to the function of the interface specified.

a. PRIMARY INPUTS: The primary inputs are the minimum required for device procurement under this specification.

1. ON/OFF CONTROL: A discrete two-level signal that commands the device output ON or OFF. Application of the ON command will cause the device output to close, allowing power to flow from the source to the load. Application of the OFF command will cause the device output to open removing power from the load.

2. POWER INPUT: The power received from the source, to be controlled by the device for connection to the utilization equipment.

b. SECONDARY INPUTS: The secondary inputs are additional capabilities available to the user, the characteristics of which must be defined in the detail specification sheet.

1. ADDRESS: A digital signal that provides a logical or physical address to the device for incorporation in the device memory.

2. BIT INITIATE: A signal which commands a 'self test' of the device as defined in the detail specification sheet. This test must not affect the device output switch condition.

3. CONFIGURABILITY: The ability to physically set the device characteristics by use of an external resistor, jumper leads, or other external fixed connections.

4. CONFIGURATION DATA: An analog or digital signal requesting a reading of device parameters such as rating, part number, modification status, address/installation position, trip level/time setting, and limit level/time as defined in the detail specification sheet. For devices with programmable characteristics.

5. ENABLE BIAS: A discrete two-level voltage signal that when true, allows the device to change state based on the ON/OFF control signal.

6. PROGRAMMABLE CHARACTERISTICS: Inputs that allow changes in the device's default settings, as defined in the detail specification sheet. These inputs can revise the device's operating characteristics such as the time-current trip relationship and steady-state current rating.

7. RESET: An 'edge sensitive' signal that, when applied, closes the device output reconnecting power to the load and restoring the device to its original, no-fault condition. (The ON/OFF control signal can also be used for reset purposes in conjunction with or in lieu of the RESET signal.)

8. SERIAL ENABLE: A signal that enables serial output information, as defined in the detail specification sheet, to be sent.

9. TRIP INHIBIT: A discrete two-level signal that inhibits the normal device trip characteristics. When applied in a true (high) state, it overrides some or all of the device's internal preprogrammed trip characteristics as defined in the detail specification sheet.

c. PRIMARY OUTPUTS: The primary outputs are the minimum required for device procurement under this specification.

1. POWER OUTPUT: The power received from the source and provided by the device to the utilization equipment when all specified control and protection parameters have been satisfied.

2. STATUS OUTPUT: A discrete signal that provides state indication (on/off) of the output power switch of the device.

d. SECONDARY OUTPUTS: The secondary outputs are additional capabilities available to the user, the characteristics of which must be defined in the detail specification sheet.

1. BUILT-IN TEST (BIT): An analog or digital signal that indicates an internal device fault has occurred. This signal should be provided either in response to a BIT initiate request or upon a known failure occurrence during normal operation without benefit of a BIT initiate request as defined in the detail specification sheet.

2. CONFIGURATION DATA: A digital signal in response to a configuration data request that provides a reading of device parameters such as rating, part number, modification status, address/installation position, trip level/time setting, and limit level/time as defined in the detail specification sheet. (For devices with programmable characteristics.)

3. CURRENT LEVEL: An analog or digital signal indicating either that the current has exceeded a predefined level or a discrete range of current levels as defined in the detail specification sheet.

4. INTEND TO TRIP: An analog or digital signal indicating either that the device intends to trip allowing the system or user to take corrective action prior to power being disconnected from the load or that the device would trip but has been inhibited. With a digital device, the type of intended trip could also be provided.

5. OVERCURRENT TRIP INDICATION: A discrete signal that indicates that the device has tripped due to an overcurrent condition. [This may be achieved by use of the STATUS output.]

6. OVERTEMPERATURE TRIP: A discrete signal that indicates that the device has experienced a protective trip due to the internal temperature exceeding a predefined temperature.

3. REQUIREMENTS

3.1 Specification Sheets

The individual item requirements shall be as specified herein and in accordance with the applicable specification sheet. In the event of any conflict between the requirements of this standard and the specification sheet, the latter shall govern. If a specific requirement specified herein is not required for an item, it shall be so indicated on the specification sheet, e.g., Shock - N/A.

3.2 Qualification

SSPCs furnished under this standard shall be products that have been verified to have met the qualification requirements specified herein and applicable specification sheet.

3.3 Materials

Materials shall be used which will enable the SSPC to meet the performance requirements of this standard. Materials used shall be self-extinguishing, and shall not support combustion, give off noxious gases in harmful quantities, give off gases in quantities or rates sufficient to cause explosion of sealed enclosures, cause contamination to any part of the SSPC, or form current-carrying tracks when subjected to any of the tests specified herein. The selection of materials shall be such as to provide a shelf-life of at least ten years without affecting the operation of the SSPC.

3.3.1 Fungus-resistant

Materials used in the construction of SSPCs shall be fungus inert. Use Guideline 4 of MIL-HDBK-454.

3.3.2 Metals

Metals shall be of a corrosion-resistant type or shall be plated or treated to resist corrosion. Use Guideline 15 of MIL-HDBK-454.

3.3.2.1 Plated Finishes

a. Use of tin plating is prohibited internally and externally. Use of tin-lead finishes or other tin-alloy finishes are acceptable provided the minimum lead content is 3%.

b. Use of zinc plating is prohibited internally and externally.

c. Use of cadmium plating is prohibited internally and externally.

3.3.2.2 Dissimilar Metals

Use Guideline 16 of MIL-HDBK-454 for the selection of metals in contact with each other. When dissimilar metals are used in contact with each other, protection against electrolysis shall be provided.

3.4 Design and Construction

SSPCs shall be of the design, construction, weight, and physical dimensions specified in the specification sheet. SSPCs shall be designed to insure proper operation in any attitude when mounted to a suitable heat sink if required. The construction of SSPCs shall preclude mechanical or electrical damage, flaking of the finish, loosening of the terminals, or deterioration of marking when subjected to the test methods of this standard.

3.4.1 Threaded Parts

All threaded parts shall be in accordance with FED-STD-H28 and ISO-9000. Metric threads shall be in accordance with ASME B1.13M-2001 and ISO-68-1:1998. Where practical, all threads shall be in conformity with the coarse-thread series. The fine-thread series may be used only for applications that show a definite advantage through their use. Where a special diameter-pitch combination is required, the thread shall be of American National Form and of any pitch between 16 and 36 that is used in the fine-thread series. Metric threads shall be of the M profile and of any pitch between 0.7 and 1.5. Terminal threads shall be class 2A and 2B for external and internal threads, respectively, or for metric threads, shall be Class 6G and 6H for external and internal threads, respectively.

3.4.1.1 Engagement of Threaded Parts

All threaded external parts shall engage by at least three full threads with all required hardware assembled.

3.4.2 Enclosure

The enclosure shall be electrically isolated from the circuit and shall provide means for grounding. Printed circuit board mounted SSPCs shall provide an electrically isolated heat sink contact area when specified. Mounting brackets, if used, shall be an integral part of the enclosure.

3.4.2.1 Seal

For hermetically-sealed SSPCs the maximum leak rate shall be as specified in Method 1014, Condition A, of MIL-STD-883 when tested as specified in 4.7.3.

3.4.2.2 Junction-to-Case Thermal Resistance

The thermal resistance shall be as specified at standard atmosphere and pressure.

3.4.3 External Terminations

3.4.3.1 Solder

Solder-lug terminals shall be designed to accommodate two conductors. Unless otherwise specified, solder terminals shall not be gold plated.

3.4.3.1.1 Printed Circuits

Terminals shall be placed for compatibility with printed circuit spacing as specified in the specification sheet.

3.4.3.1.2 Solderability

Where specified for qualification inspection, SSPCs shall be tested as specified in 4.7.2 and shall meet the applicable requirements of Method 208 of MIL-STD-202 or Method 2003 of MIL-STD-883.

3.4.3.1.3 Resistance to Soldering Heat

Where specified for qualification inspection, SSPCs shall be tested as specified in 4.7.16, and shall subsequently meet the requirements of 3.7.2.

3.4.3.2 Plug-in (Connector)

Unless otherwise specified in the specification sheet, plug-in terminals shall be gold plated in accordance with AMS 2422D over nickel plate 0.0001 to 0.0003 in thick.

3.4.3.3 Integrated

SSPCs designed with removable and insertable termination shall be in accordance with MIL-T-81714.

3.4.3.4 Hybrid

For hybrid microcircuits, lead or terminal material and finish shall be in accordance with MIL-PRF-38534 or as specified in the specification sheet.

3.4.3.5 Threaded Terminations

Terminations shall be in accordance with MIL-HDBK-454, Guideline 19.

3.5 Electrical Characteristics

When tested as specified in 4.7.6, SSPCs shall operate with supply voltage variations in accordance with the applicable specification (AS1212, AS1831, MIL-STD-704, RTCA/DO-160). SSPCs shall be capable of controlling reactive and resistive loads as required by the applicable specification sheet.

3.5.1 Dielectric Withstanding Voltage

When tested as specified in 4.7.4, there shall be no leakage current in excess of 1.0 mA nor evidence of damage due to arcing (air discharge), flashover (surface discharge), or insulation breakdown (puncture discharge). The dielectric withstanding test shall be followed by the insulation resistance test paragraph of 4.7.5.

3.5.2 Insulation Resistance

When tested as specified in 4.7.5, the insulation resistance shall be greater than 100 mΩ.

3.6 Functional and Electrical Performance

The SSPC shall meet the performance as specified in the detail specification sheet for the following electrical characteristics as applicable.

3.6.1 Control Signal

When tested as specified in 4.7.6.1, the control signal shall perform as specified.

3.6.2 Turn-on and Turn-off Time

When tested as specified in 4.7.6.2, the turn-on and turn-off time shall be as specified.

3.6.3 Load Voltage Rise and Fall Time

When tested as specified in 4.7.6.3, the rise and fall time shall be as specified.

3.6.4 Isolation

The control/power isolation test voltage shall be as specified in the specification sheet, when tested as specified in 4.7.6.4.

3.6.5 Control and Built-in Test (BIT) Signal Levels

3.6.5.1 Control Signal Levels

When tested as specified in 4.7.6.5, the control signal levels shall perform as specified.

3.6.5.2 BIT Signal Levels

When BIT is specified, the signal levels shall be developed and tested as specified in 4.7.6.5.

3.6.6 Voltage Drop

When tested as specified in 4.7.6.6, the voltage drop shall not exceed the specified value for load current values from no load to 100% rated.

3.6.7 Off State Leakage Current

When tested as specified in 4.7.6.7, the leakage current limit shall not be exceeded.

3.6.8 Power Dissipation

When tested as specified in 4.7.6.8, the power dissipation shall not be exceeded.

3.6.9 Fault Detection and Response

The primary protective function of an SSPC is protecting interconnect wiring between the power bus and the using equipment. The thermal inverse I^2t trip characteristic of some circuit breakers can be electronically simulated in the control circuit of an SSPC. Thermal memory of repeated high current load faults is also a characteristic of some SSPCs. Alternately, SSPCs can have much shorter times to trip than thermal breakers. SSPCs can also afford protection for the load equipment and with their ability to detect very fast rising current.

3.6.9.1 Current Limiting

When specified in the specification sheet and tested as specified in 4.7.6.9.1, the output current shall be within the limits specified. At the initiation of the overload condition, the peak let through current shall not exceed the value specified.

3.6.9.1.1 Non-repetitive Trip

When tested as specified in 4.7.6.9.2(a), the SSPC shall not reset until commanded and the trip time shall be within the limits specified. The SSPC shall not be damaged.

3.6.9.1.2 Repetitive Trip

When tested as specified in 4.7.6.9.2(b), the SSPC shall not reset until commanded and the trip time shall meet the time specified. The SSPC shall not be damaged.

3.6.9.2 Trip-free Characteristics

When tested as specified in 4.7.6.9.3 the SSPC shall reset, trip-out and stay tripped out for the duration of the test.

3.6.9.3 Ground Fault

When tested as specified in 4.7.6.9.4 the SSPC shall trip-out and stay tripped out for the duration of the test. The SSPC shall not be damaged.

3.6.9.4 Arc Fault

When tested as specified in 4.7.6.9.5 the SSPC shall trip-out and stay tripped out for the duration of the test. The SSPC shall not be damaged.

3.6.10 Reset Function

When tested as specified in 4.7.6.10, the SSPC shall only reset when commanded as specified. The SSPC shall not reset without an external command.

3.6.11 State Indication

State indication shall include the detection of load current above or below a minimum current threshold (current status) and/or the presence or absence of output power (voltage status) as specified. These state indication signals, in conjunction with the control signal, shall be capable of providing feedback on normal SSPC operation or SSPC faults as specified. The SSPC shall provide the specified state indication when tested as specified in 4.7.6.11.

3.6.11.1 State Indication Delay

The response time to a change of state shall not exceed the time specified.

3.6.12 Operating Voltage Transients

When tested as specified in 4.7.6.12(a), the SSPC shall not be damaged or deviate from the OFF state. When tested as specified in 4.7.6.12(b), the SSPC shall not be damaged or tripped, but may go to the OFF state for the time specified.

3.6.13 Transient Spike Overvoltage

When tested as specified in 4.7.6.13, the SSPC shall not be damaged, shall stay ON when commanded ON and shall stay OFF when commanded OFF.

3.6.14 Control/Status Transients

When tested as specified in 4.7.6.14, the SSPC shall not be damaged. When the control circuit is tested, the SSPC may momentarily change state but shall recover to the pre-transient state.

3.6.15 Zero Voltage Turn-on Zero Current Turn-off (ac SSPCs)

When tested as specified in 4.7.6.15, SSPC turn-on shall occur at zero voltage crossover within the voltage or time specified, and the SSPC turn-off shall occur at zero current crossover within the current or time specified. The SSPC shall turn-on and turn-off at the same voltage slope when specified.

3.6.16 Common Mode Rejection

When tested as specified in 4.7.6.16, the SSPC shall remain in the turned ON or turned OFF state as commanded.

3.6.17 DC Offset Voltage (ac SSPCs)

When tested as specified in 4.7.6.17, the dc offset voltage shall not exceed the value specified for the load current values specified.

3.6.18 Stabilization Time

When tested in accordance with 4.7.6.18, SSPCs shall not pass power to the output during the stabilization time unless commanded to do so.

3.6.19 Fail-safe

SSPCs may incorporate a "fail-safe" feature in the event the "trip-circuit" fails to perform its function during an overload condition. When tested as specified in 4.7.7, the fail-safe element shall open the circuit at the currents and times specified. When a “fail-safe” feature is not incorporated, the SSPC shall perform during overload conditions when tested as specified in 4.7.21.

3.7 Performance Characteristics

Unless otherwise specified, the SSPC shall meet the requirements of 3.7.1 when subjected to the following tests:

a. Terminal Strength: 4.7.14

b. Thermal shock: 4.7.8

c. Operational temperature extremes: 4.7.9

d. Vibration: 4.7.10

e. Acceleration: 4.7.11

f. Salt fog: 4.7.12

g. Temperature altitude: 4.7.13

h. Humidity: 4.7.15

i. Resistance to soldering heat: 4.7.16

j. Shock: 4.7.18

k. Life: 4.7.19

l. Explosive atmosphere: 4.7.7 or 4.7.21

m. Explosive decompression: 4.7.20

3.7.1 Performance Criteria

Unless otherwise specified, the SSPC shall meet the following criteria when subjected to the tests specified in 3.7.

a. Design and construction: 3.4

b. Dielectric withstanding: 3.5.1

c. Insulation resistance: 3.5.2

d. Electrical characteristics: 3.5

e. Seal: 3.4.2.1

3.7.2 Terminal Strength

When SSPCs are tested as specified in 4.7.14, there shall be no loosening or breaking of the terminals and there shall be no deformation to the threads of screw terminals, no bending[1] of a pin or damage to the insulating base of plug-in SSPCs, nor shall there be any other damage which would adversely affect the normal operation of the SSPC. For hermetically sealed SSPCs, hermetic seal integrity shall be checked.

3.7.3 Lightning, Electrostatic Discharge, and Electromagnetic Compatibility

When tested as specified in 4.7.17, SSPCs shall meet the requirements of MIL-STD-461, and/or RTCA/DO-160 as specified in the detail specification sheet.

3.8 Marking

SSPCs shall be marked in accordance with the requirements of MIL-STD-130. Hybrid microcircuits shall be marked in accordance with MIL-PRF-38534. As a minimum, the following shall be included:

a. Part number

b. Rated output voltage and current

c. Terminal designation

d. Manufacturing date code and CAGE code in accordance with MIL-PRF-38534.

e. Electrostatic discharge (ESD) identifier per MIL-STD-1686, as applicable.

As space permits, additional optional markings may be provided as specified.

[1] Bending of solder and plug-in terminals shall not be necessarily construed as damaged provided that they can be reformed in a manner to permit proper mating with the applicable socket.

3.9 Workmanship

Workmanship shall be in accordance with MIL-HDBK-454, Guideline 9. For hybrid microcircuits, workmanship criteria shall be in accordance with MIL-PRF-38534. All procedures and processing shall be documented and controlled by appropriate specifications, i.e., ISO-9000, etc.

3.10 Reliability

When operated within the environmental and operational limits specified herein, the SSPCs shall achieve a reliability rate expressed in a mean time between failures (MTBF), as specified in the specification sheet. Failure is defined as the inability to provide all the performance characteristics specified herein. Reliability requirements may be verified by analysis per MIL-HDBK-217 or equivalent.

3.11 Maintainability

The SSPC and its components shall meet the requirements of this specification without the need for any routine servicing or maintenance actions.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for Inspection

Unless otherwise specified in the contract or purchase order, the supplier is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract or order, the supplier may use his own or any other facilities suitable for the performance of the inspection requirements specified herein.

4.2 Responsibility for Compliance

All items must meet all requirements of Sections 3 and 4. The inspection set forth in this standard shall become a part of the supplier's overall inspection system or quality program. The absence of any inspection requirements in the standard shall not relieve the supplier of the responsibility of assuring that all products or supplies comply with all requirements of the contract.

4.3 Inspection Conditions

Unless otherwise specified herein, all inspections shall be performed in accordance with test conditions specified in the "General Requirements" of MIL-STD-810, or for hybrid microcircuits, the test conditions specified in the "General Requirements" of MIL-STD-883.

4.3.1 Load Conditions During Test

Full load shall imply operation by the specified control parameters with the maximum rated voltage.

4.3.2 Connections

When applicable, testing of SSPCs with plug-in terminations shall be performed with the appropriate or specified socket or connector mated to the SSPC.

4.3.3 Heat Removal

Heat removal apparatus shall consist of a heat sink of known characteristics (see 3.4.2.2) that can be adjusted and monitored to provide the cooling necessary to prevent the heat sink temperature from exceeding the specified maximum.

4.3.4 Temperature Stabilization of Test Items

4.3.4.1 Non-operating

Temperature stabilization shall occur when the case temperature does not differ more than 2 °C from the ambient temperature.

4.3.4.2 Operating

Temperature stabilization shall occur when the case temperature does not change more than 2 °C per hour.

4.3.5 Test Equipment and Inspection Facilities

The supplier shall establish and maintain a calibration system in accordance with ISO-10012-1 or ANSI Z540-1.

4.4 Materials Inspection

Materials inspection shall consist of certification supported by verifying data that the materials used in fabricating the SSPCs are in accordance with the applicable referenced specifications prior to such fabrication.

4.4.1 Hybrid Microcircuits

Hybrid microcircuits shall meet the inspection requirements, including element evaluation, process controls, and device screening, satisfied by successful completion of the Quality Conformance Inspection testing for Groups A, B, C, and D as specified in MIL-PRF-38534.

4.4.1.1 Sample sizes, testing frequency, and data reporting shall be as specified in MIL-PRF-38534.

4.4.1.2 End point electrical testing parameters for Groups A and C testing shall be as specified in the applicable specification sheet.

4.5 Qualification Test and Inspection

Qualification inspection shall be performed at a laboratory acceptable to the qualifying activity on sample units selected from a production lot.

4.5.1 Sample Size

The number of SSPCs to be subjected to qualification inspection shall be as specified in Table 1.

4.5.2 Inspection Routine

The sample shall be subjected to the inspections specified in Table 1, in the order shown. All sample units shall be subjected to the inspections of Group I. The sample shall then be divided as specified in Table 1, for Groups II and III (as applicable) and subjected to the inspections for their particular group.

4.5.2.1 Optionally for hybrid microcircuits, Groups II and III of Table 1 may be satisfied by successful completion of Groups B, C, and D in accordance with MIL-PRF-38534.

TABLE 1 - QUALIFICATION/GROUP C INSPECTION

Examination for Test	Requirement Paragraph	Method Paragraph	No. of Sample Units to be Tested	No. of Failures Allowed
Group I				
Visual & mechanical examination: External	3.3, 3.4, 3.8, 3.9	4.7.1		
Solderability	3.4.3.1.2	4.7.2		
Seal	3.4.2.	4.7.3		
Dielectric withstanding voltage	3.5.1	4.7.4		
Insulation Resistance	3.5.2	4.7.5		
Electrical Characteristics:				
Control signal	3.6.1	4.7.6.1		
Turn-off time and turn-on time	3.6.2	4.7.6.2		
Load voltage rise and fall time	3.6.3	4.7.6.3		
Isolation	3.6.4	4.7.6.4		
Control and BIT signals	3.6.5	4.7.6.5		
Voltage drop	3.6.6	4.7.6.6		
Off state leakage current	3.6.7	4.7.6.7		
Power dissipation	3.6.8	4.7.6.8		
Overload characteristics				
Current limiting	3.6.9.1	4.7.6.9.1		
Non-repetitive trip	3.6.9.1.1	4.7.6.9.2(a)		
Repetitive trip	3.6.9.1.2	4.7.6.9.2(b)	8	0
Trip free characteristics	3.6.9.2	4.7.6.9.3		
Ground Fault	3.6.9.3	4.7.6.9.4		
Arc Fault	3.6.9.4	4.7.6.9.5		
Reset Signal	3.6.10	4.7.6.10		
State indication and delay	3.6.11, 3.6.11.1	4.7.6.11		
Operating voltage transients	3.6.12	4.7.6.12		
Transient spike overvoltage	3.6.13	4.7.6.13		
Control/status transients	3.6.14	4.7.6.14		
Zero voltage turn-on and zero current turn-off	3.6.15	4.7.6.15		
Common mode rejection	3.6.16	4.7.6.16		
DC offset voltage	3.6.17	4.7.6.17		
Stabilization time	3.6.18	4.7.6.18		
Fail-safe	3.6.19	4.7.7 or 4.7.21		

TABLE 1 - QUALIFICATION/GROUP C INSPECTION (CONTINUED)

Examination for Test	Requirement Paragraph	Method Paragraph	No. of Sample Units to be Tested	No. of Failures Allowed
Group II				
Thermal shock	3.7	4.7.8		
Vibration	3.7	4.7.10		
Acceleration	3.7	4.7.11		
Salt fog	3.7	4.7.12	4	0
Temperature altitude	3.7	4.7.13		
Terminal strength	3.7.2	4.7.14		
Humidity	3.7	4.7.15		
Operational temperature extremes	3.7	4.7.9		
Visual and mechanical examination	3.3, 3.4, 3.8, 3.9	4.7.1		
Group III				
Electromagnetic compatibility	3.7.3	4.7.17		
Terminal strength	3.7.2	4.7.14		
Shock	3.7	4.7.18		
Life 1/	3.7	4.7.19		
Seal	3.4.2.1	4.7.3		
Electrical characteristics:			4	0
Control signal	3.6.1	4.7.6.1		
Turn-on time and turn-off time	3.6.2	4.7.6.2		
Control and BIT signals	3.6.5	4.7.6.5		
Output voltage drop	3.6.6	4.7.6.6		
Power dissipation	3.6.8	4.7.6.8		
Visual & mechanical examination	3.3, 3.4, 3.8, 3.9	4.7.1		

1/ Four extra samples (a total of 8) shall be subjected to life test.

4.5.3 Retention of Qualification

To retain qualification, the supplier shall forward, at 24-month intervals, to the qualifying activity, a summary of Group A tests (Table 2), indicating as a minimum the number of lots which passed and the number which failed, and the complete results of Group B tests (Table 3), including the number and type of any part failure. The summary shall include those tests performed during the 24-month period. If the summary of the test results indicates nonconformance with specification requirements, action shall be taken to remove the failing product from the qualified products list. Failure to submit the summary shall result in loss of qualification for that product. In addition to the periodic submission of inspection data, the supplier shall immediately notify the qualifying activity at any time during the 24-month period that the inspection data indicates failure of the qualified product to meet the requirements of the specification. In the event that no production occurred during the reporting period, a report to that effect shall be submitted.

TABLE 2 - GROUP A INSPECTION

Examination or Test	Requirement Paragraph	Method Paragraph	No. of Sample Units to be Inspected
Group I			
Dielectric withstanding voltage	3.5.1	4.7.4.1	100%
Insulation resistance	3.5.2	4.7.5	Inspection
Electrical characteristics:			
Control signal	3.6.1	4.7.6.1	AQL Not Applicable
Turn-on and turn-off time	3.6.2	4.7.6.2	
Load voltage rise and fall time	3.6.3	4.7.6.3	
Control and BIT signals	3.6.5	4.7.6.5	
Voltage drop	3.6.6	4.7.6.6	
Off state leakage current	3.6.7	4.7.6.7	
Overload characteristics	3.6.9	4.7.6.9	
Reset signal	3.6.10	4.7.6.10	
State indication and delay	3.6.11, 3.6.11.1	4.7.6.11	
Zero voltage crossover turn-on and zero current crossover turn-off	3.6.15	4.7.6.15	
DC offset voltage	3.6.17	4.7.6.17	
Group II			100% Inspection
Visual & Mechanical Examination (external)	3.3, 3.4, 3.8, 3.9	4.7.1	AQL % Defective Major 1.0% Minor 4.0%

TABLE 3 - GROUP B INSPECTION

Examination or Test	Requirement Paragraph	Method Paragraph	No. of Sample Units to be Tested	No. of Failures Allowed
Dielectric withstanding voltage	3.5.1	4.7.4.1		
Insulation resistance	3.5.2	4.7.5		
Turn-on and turn-off time	3.6.2	4.7.6.2	2	0
Control and BIT signals	3.6.3	4.7.6.5		
Power dissipation	3.6.8	4.7.6.8		
Operating voltage transient	3.6.12	4.7.6.12		
Thermal shock	3.7	4.7.8		
Seal	3.4.2.1	4.7.3		

4.6 Quality Conformance Inspection

4.6.1 Inspection of Product for Delivery

Inspection of product for delivery shall consist of Group A inspection. Except as specified in 4.6.3.2, delivery of products which have passed Group A inspection shall not be delayed pending the results of the Group B and C inspections.

4.6.1.1 Inspection Lot

An inspection lot, as far as practicable, shall consist of all SSPCs of the same enclosure, and configuration, produced under essentially the same conditions within a period not to exceed four weeks, and offered for inspection at one time.

4.6.1.2 Group A Inspection

Group A inspection shall consist of the examinations and tests specified in Table 2, in the order shown.

4.6.1.2.1 Sampling Plan

Sampling plan shall be as specified in Table 2. Statistical sampling and inspection for Group A-II shall be in accordance with MIL-STD-1916 for general inspection level II. Acceptable Quality Level (AQL) shall be as specified in Group A-II Table 2. Samples which fail Group A-II may be reworked and resubmitted using the tightening inspection in accordance with MIL-STD-1916.

4.6.1.2.2 Disposition of Sample Units

Sample units which have been subjected to and have passed Group A inspection shall be delivered on the contract or purchase order.

4.6.1.2.3 Rejection Samples

Rejection samples for Group A-I may be reworked once and resubmitted for inspection.

4.6.2 Periodic Inspection

Periodic inspection shall consist of Groups B and C inspections.

4.6.2.1 Group B Inspection

Group B inspection shall consist of the tests(s) specified in Table 3 and shall be performed in the order shown. Optionally for hybrid microcircuits, Group B specified in Table 3 may be satisfied by successful completion of Group B in accordance with MIL-PRF-38534.

4.6.2.1.1 Sampling Plan

The number of sample units specified in Table 3 shall be selected every six months from inspection lots which have passed Group A inspection.

4.6.2.1.2 Rejected Lots

If an inspection lot is rejected, the supplier may rework it to correct the defects, or screen out the defective units, and resubmit for inspection. Re-submittal lots shall be subjected to Groups A and B inspection. Such lots shall be separated from new lots, and shall be clearly identified as reworked lots.

4.6.2.1.3 Disposition of Sample Units

Sample units that have been subjected to a Group B inspection shall not be delivered on the contract or purchase order unless otherwise specified.

4.6.3 Group C Inspection

Optionally for hybrid microcircuits, Group C test requirements specified in Table 1 shall be satisfied by successful completion of Group C in accordance with MIL-PRF-38534.

4.6.3.1 Sampling Plan

Every 24 months, sample units from inspection lots that have passed Group B inspection shall be subjected to the inspections of Table 1, performed in the order shown.

4.6.3.2 Disposition of Sample Units

Unless otherwise specified, sample units which have been subjected to Group C inspection shall not be delivered on the contract or purchase order.

4.6.3.3 Noncompliance

If a sample fails to pass Group C inspection, specified in Table 1, the supplier shall take corrective action on the materials or processes, or both, as warranted, on all units of product which were manufactured under essentially the same conditions, with essentially the same materials, processes, etc., and which are considered subject to the same failure. Acceptance of the product shall be discontinued until corrective action, acceptable to the procuring authority, has been taken. After the corrective action has been taken, Group C inspection shall be repeated on additional sample units. Groups A and B inspections may be re-instituted; however, final acceptance shall be withheld until Group C re-inspection has shown that the corrective action was successful.

4.6.4 Inspection of Preparation for Delivery

Sample packages or packs and the inspection of the preservation, packaging, packing, and marking for shipment and storage shall be in accordance with the requirements of Section 5.

4.7 Methods of Examination and Tests

NOTE: For verification and testing, MIL-STD-883, MIL-STD-202, MIL-STD-810, or RTCA DO-160 may be used, based on manufacturing technology and application.

4.7.1 Visual and Mechanical Examination

SSPCs shall be examined to verify that the materials, external design and construction, physical dimensions, marking and workmanship are in accordance with the applicable requirements.

4.7.2 Solderability

When applicable, SSPCs shall be tested in accordance with Method 208 of MIL-STD-202 or Method 2003 of MIL-STD-883. The following shall apply:

a. All terminations of each part shall be tested.

b. Depth of immersion in flux and solder - Leads shall be immersed to within 1/16 in of the seal or case.

4.7.3 Seal

Hermetically sealed SSPCs shall be tested in accordance with Method 1014 of MIL-STD-883. The following shall apply: (subject to determination by Farshid)

a. Test Condition - Gross leak and fine leak.

b. Measurements after test - Not applicable.

4.7.4 Dielectric Withstanding Voltage

SSPCs shall be tested as specified in 4.7.4.1 and 4.7.4.2.

4.7.4.1 At Atmospheric Pressure

SSPCs shall be tested in accordance with Method 301 of MIL-STD-202. The following details shall apply:

a. Preparation - Not applicable.

b. Test voltage - As specified in the specification sheet.

c. Nature of potential - ac.

d. Points of application - All terminals shall be shorted together and the test voltage applied from terminals to case and mutually isolated sections of the device.

e. Leakage current - 1ma maximum.

f. Following these tests, SSPCs shall be examined for evidence of arcing, flashover, insulation breakdown, and damage.

g. Measurements after test - Insulation resistance as specified in 4.7.5.

4.7.4.2 At Reduced Barometric Pressure

SSPCs specified for operation above 10,000 ft shall be tested in accordance with Method 105 of MIL-STD-202. The following details shall apply:

a. Method of mounting - Normal mounting means.

b. Test condition - D or as specified in the individual specification.

c. Test requirements at reduced pressure - As specified in 4.7.4.1 except test voltage shall be as specified in the specification sheet.

4.7.5 Insulation Resistance

SSPCs shall be tested in accordance with Method 302 of MIL-STD-202 or Method 1003 of MIL-STD-883, as applicable.

4.7.6 Electrical Characteristics

When performing electrical tests, the SSPCs shall be mounted on a suitable heat sink (see 4.3.3).

4.7.6.1 Control Signal

The control signal shall be verified as specified in 4.7.6.1.1 and 4.7.6.1.2. If an enable/bias signal is used, testing in both the ON and OFF state of this signal shall be performed.

4.7.6.1.1 Turn-on Signal

With the SSPC connected as shown in Figure 1, apply rated supply voltage and adjust the load resistance for rated load +5/-0%. Apply the minimum turn-on signal with the control function generator and note that the SSPC turns ON.

4.7.6.1.2 Turn-off signal

With the SSPC ON at rated control signal, apply the maximum turn-off signal with the function generator and note that the SSPC turns OFF.

4.7.6.2 Turn-on and Turn-off Time

Measure turn-on and turn-off times with the SSPC operated as in 4.7.6.1.1 and 4.7.6.1.2.

4.7.6.3 Load Voltage Rise and Fall Time

Measure the rise and fall times with the SSPC operated as in 4.7.6.1.1 and 4.7.6.1.2.

4.7.6.4 Isolation

The power-in terminal, power-out terminal, and power-ground terminal shall be shorted together. All remaining terminals shall be shorted together. The points of voltage application as specified in the specification sheet shall be the signal ground and power ground terminals. Electrification time shall be two minutes maximum.

4.7.6.5 Control and BIT Signal Levels

With rated supply voltage applied, apply control signal level, and BIT signal level as specified and measure control current or voltage. Repeat test for each control and BIT signal level specified. Where maximum control signal levels are specified, the signal shall be applied for 10 min without damage to the SSPC.

4.7.6.6 Voltage Drop

With the SSPC connected as shown in Figure 1, measure the voltage between the power-in and the power-out terminals while operating at 10, 50, and 100% rated load. For ac SSPCs, a true RMS voltmeter shall be used.

4.7.6.7 Leakage Current

Connect the SSPC as shown in Figure 1 with the load resistance adjusted for maximum of 10 Ω and rated supply voltage applied to the power in terminal with the control circuit commanded OFF. Read the leakage current.

4.7.6.8 Power Dissipation

Connect the SSPC as shown in Figure 1 with the load resistance adjusted for short circuit, rated supply voltage applied to the power in terminal, and the SSPC commanded OFF. Calculate the power dissipation for the OFF state, including bias and control. With the SSPC commanded ON, calculate the power dissipation for the ON state for loads of 10, 50, and 100% rated load, unless otherwise specified in the specification sheet, including bias and control power.

4.7.6.9 Fault Detection and Response Characteristics Tests

4.7.6.9.1 Current Limiting

Connect the SSPC as shown in Figure 1. With the SSPC OFF, adjust the load resistor for short circuit and apply rated supply voltage. While monitoring the SSPC output current, enable the SSPC and measure the let through current level and the current limit level.

4.7.6.9.2 Trip Time

Connect the SSPC as shown in Figure 1.

a. Non-repetitive trip: With rated supply voltage, verify that the SSPC meets the trip characteristics at various current levels as specified in the specification sheet.

b. Repetitive trip: With rated supply voltage and load resistor adjusted for the specified fault currents, verify that the SSPC meets the repetitive reset requirements as specified in the specification sheet. Reapply control signal the number of times at the intervals as specified in the specification sheet.

c. Instantaneous Trip: With rated supply voltage and load resistor adjusted to less than 1 milliohm, verify that the SSPC meets the instantaneous trip characteristics.

4.7.6.9.3 Trip-free Characteristics

Connect the SSPC as shown in Figure 1. Apply rated voltage, adjust load resistor for short circuit, and command the SSPC ON. Observe the SSPC trips out. Reset the SSPC and command SSPC ON. Maintain the ON command for one minute minimum and verify that the SSPC resets and trips only once.

4.7.6.9.4 Ground Fault

When ground fault protection is specified, testing will be as required by the detail specification.

4.7.6.9.5 Arc Fault

When arc fault protection is specified, testing will be as required by the detail specification.

4.7.6.10 Reset Function

Connect the SSPC as shown in Figure 1. Apply rated supply voltage and adjust the load resistance for 200 +0/-10% rated load. Adjust control function generator for nominal control signal. Apply the turn-on signal and observe that the SSPC turns on. Observe that the SSPC does not reset. Apply the turn-off signal and reapply the turn-on signal after the maximum application time to reset specified in the specification sheet. Observe that the SSPC does reset.

4.7.6.11 State Indication Signal(s)

Connect the SSPC as shown in Figure 1. Apply rated voltage and adjust the load resistance for 100% rated load. Apply an OFF command to the control input. Monitor the specified state indication feedback to verify normal OFF operation and delay times. Apply an ON command to the control input and verify normal ON operation and delay times. Reduce the load current below the indication threshold. Increase the load current above the trip threshold and observe that the SSPC trips and verify specified trip indication and delay times.

4.7.6.12 Operating Voltage Transients

Connect the SSPC as shown in Figure 1. Adjust load resistor for rated load. Transients shall be as specified by MIL-STD-704 or RTCA/DO-160.

a. OFF state. Adjust control function generator for specified maximum turn-off signal. Apply rated supply voltage for at least 5 s and then apply a voltage transient specified. Repeat test for each voltage transient specified. The SSPC shall not be damaged or turn on as a result of transients.

b. ON state. For normally OFF SSPCs. Adjust control function generator for specified minimum turn-on signal. Apply rated supply voltage for at least 5 s and then apply a voltage transient specified. Repeat test for each voltage transient specified.

4.7.6.13 Transient Spike Overvoltage

Connect the SSPC as shown in Figure 1. Adjust load resistor for rated load and control signal for the turn-off signal specified in the specification sheet. Apply spike waveform, as specified below, to the power input terminal of the SSPC. The transient shall then be applied to the power output terminal of the SSPC. The 600 V DC source shall have 50 (±10%) ohm impedance and shall satisfy the following requirements:

a. Open-circuit voltage: ±600 V peak

b. Rise time: 0.9 µs ± 0.2 µs

c. Fall time: 10.0 µs ± 1.0 µs

d. Pulsewidth (50% amplitude points): 5.0 µs ± 0.1 µs

e. Repetition rate (aperiodic): Not greater than 50 Hz

f. Source energy capability: Not less than 0.01 joule

4.7.6.14 Control Input/Status Signal Transients

The following transients shall be applied between the signal ground terminal and the control terminal (source impedance is 250 Ω).

a. A train of ten pulses of ±100 V peak amplitude and 100 µs duration each, repeated 10 times at 3-s intervals.

b. Repeat test (a) between all pairs of active terminals on the SSPC.

4.7.6.15 Zero Voltage Turn-On (ZVTO) and Zero Current Turn-Off (ZCTO)

Connect the SSPC as shown in Figure 1. Apply rated supply voltage and adjust load impedance for rated load with a 45% lagging power factor. Apply the nominal turn-on signal and subsequently apply the nominal turn-off signal. Monitor the load voltage and current. Repeat test 10 times. Adjust the load impedance to reduce the load current below the specified minimum and repeat.

4.7.6.16 Common Mode Rejection

With a common mode signal of ±10 V peak swept from 1.0 to 100 Hz applied between the signal ground and power ground (Figure 1) and with an ON command, verify that the SSPC does not turn OFF or does not intermittently operate between ON and OFF. Repeat the test except with an OFF command and verify that the SSPC does not turn ON.

4.7.6.17 DC Offset Voltage (ac SSPCs)

Connect the SSPC connected as shown in Figure 1. Apply rated line voltage and adjust the load impedance to provide current values between 10 and 100% of rating (10% P.F. > lagging to 10% leading). With a short circuit applied to the SSPC from line terminal to load terminal, measure the dc content of the ac supply. Remove the short circuit and measure the dc content at the load terminal. The difference in the two measurements is the dc offset introduced by the SSPC and shall not exceed the value specified in the specification sheet.

4.7.6.18 Stabilization Time

Connect the SSPC connected as shown in Figure 1. With the control input set to its logic off state, the load adjusted for rated current, and supply voltage off, turn-on supply voltage and monitor load current. Verify no transient current flow through the load greater than specified in the specification sheet. Remove the supply voltage for sufficient time to stabilize the SSPC voltages at zero and apply an ON command to the SSPC. Switch supply voltage to rated voltage and monitor only when the SSPC voltage reaches the necessary level within the time interval as specified in the specification sheet and that the current exhibits no switching transients. Interrupt the supply voltage to provide the power outage duration as specified in the specification sheet with the SSPC still commanded ON. Verify that load current is re-established following the power outages within the time interval specified in the specification sheet.

4.7.7 Fail-safe

The specified number of SSPCs must be constructed with their "pass sections" intentionally shorted with resistance as specified in the specification sheet across any solid state device. Connect one of these shorted SSPCs as shown in Figure 1. Adjust load resistors for values of current as specified in the specification sheet. Apply rated load voltage and record time fail-safe element takes to clear. Repeat for each value specified in the specification sheet. If specified, all fail-safe tests shall be conducted with the SSPC in an explosive atmosphere as specified in Method 109 of MIL-STD-202.

4.7.8 Thermal Shock

SSPCs shall be tested in accordance with Method 1011 of MIL-STD-883, or applicable test method of RTCA DO-160, or as specified.

4.7.9 Operation at Temperature Extremes

The SSPC shall be tested for operation at temperature extremes in accordance with the following:

a. Minimum Temperature - While de-energized, the SSPC shall be soaked for 2 h minimum while mounted on the appropriate heat sink in minimum ambient temperatures specified. At the end of the soak period while maintaining the specified heat sink temperature, the SSPC shall meet the requirements of Table 4.

b. Temperature Range - Apply the rated supply voltage, adjust load to the specific value and set the control signal to the minimum turn ON value for normally OFF and then for maximum ON value for normally ON. Monitor the output voltage wave form and measure the voltage drop between the power-in and power-out terminals when the SSPC's temperature is at the maximum specified stabilized temperature.

c. Maximum Temperature - While de-energized, the SSPC shall be soaked for 2 h minimum while mounted on the appropriate heat sink at the maximum heat sink temperature specified. At the end of the soak period, while maintaining the specified heat sink temperature, the SSPC shall meet the requirements of Table 4.

4.7.10 Vibration

SSPCs shall be tested in accordance with Method 2005 of MIL-STD-883 or Procedure I, Method 514 of MIL-STD-810 or applicable test method of RTCA DO-160 as appropriate for the application. Figure 2 is an example of a vibration level curve.

TABLE 4 - PERFORMANCE UNDER ENVIRONMENTAL CONDITIONS

Test Paragraph	Requirement Paragraph									
	3.6.*									
* =	1	2	3	4	5	6	7	8	9	10
4.7.8	X	X	X	X	X	X	X	X	X	X
4.7.9	#	#	#	#	#	#	#	#	#	#
4.7.10	X	X	X	X	X	X	X	X	X	X
4.7.11	X	X	X	X	X	X	X	X	X	X
4.7.12	X	X	X	X	X	X	X	X	X	X
4.7.13	#	#	#	#	#	#	#	#	#	#
4.7.15	#	#	#	#	#	#	#	#	#	#
4.7.16	X	X	X	X	X	X	X	X	X	X
4.7.18	X	X	X	X	X	X	X	X	X	X
4.7.19	#	#	#	#	#	#	#	#	#	#
4.7.20	X	X	X	X	X	X	X	X	X	X
	3.6.*									
* =	11	12	13	14	15	16	17	18		4.7.1
4.7.8	X	X	X	X	X	X	X	X		X
4.7.9	#	#	#	#	#	#	#	#		X
4.7.10	X	X	X	X	X	X	X	X		X
4.7.11	X	X	X	X	X	X	X	X		X
4.7.12	X	X	X	X	X	X	X	X		X
4.7.13	#	#	#	#	#	#	#	#		X
4.7.15	#	#	#	#	#	#	#	#		X
4.7.16	X	X	X	X	X	X	X	X		X
4.7.18	X	X	X	X	X	X	X	X		X
4.7.19	#	#	#	#	#	#	#	#		X
4.7.20	X	X	X	X	X	X	X	X		X

- Measurement performed during test.
X - Measurement performed after test.

4.7.11 Acceleration

SSPCs shall be tested in accordance with Method 2001 of MIL-STD-883 or Procedure II, Method 513 of MIL-STD-810 or applicable test method of RTCA DO-160 as appropriate for the application.

4.7.12 Salt Fog

SSPCs shall be tested in accordance with Method 1009 of MIL-STD-883 or Method 509 of MIL-STD-810 or applicable test method of RTCA DO-160 as appropriate for the application.

4.7.13 Temperature-altitude

SSPCs shall be tested in accordance with Procedure III, Method 520.2 of MIL-STD-810 or applicable test method of RTCA DO-160. The following details and exceptions shall apply:

a. The maximum and minimum temperatures and the maximum altitude shall be as specified in the specification sheet. Vibration and humidity stresses are not required.

b. Test item operation - Full load.