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SUPERSEDING
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MILITARY SPECIFICATION

POWER CONTROLLER, SOLID STATE, GENERAL SPECIFICATION FOR

This specification is approved for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers the general requirements for the design, manufacture, and test of solid state power controllers (6.1) of both DC and AC ratings for use in aircraft electric power systems.

1.2 Classification. Power controllers shall be classified as specified herein:

1.2.1 Enclosure design. The enclosure design is identified by a single digit as follows:

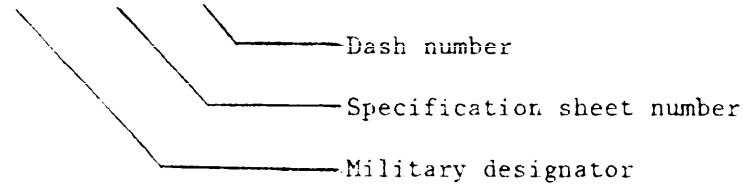
Type	Enclosure
1	Open
2	Enclosed
3	Sealed (other than hermetically)
4	Hermetically sealed

1.2.2 Military part number. The military part number shall consist of the letter "M", the basic number of the specification sheet, and an assigned dash number (3.1) as shown in the following:

Beneficial comments (additions, deletions, recommendations) and any pertinent data which may be of use in improving this document should be addressed to: Engineering Specifications and Standards Department, (Code 9313), Naval Air Engineering Center, Lakehurst, NJ 08733, by using the self-addressed Standardization Document Improvement Proposal, or by letter.

FSC 6110

Example: M00000 / 00 - 000



2. APPLICABLE DOCUMENTS

2.1 The following documents of the issue in effect on date of invitation for bids or request for proposal form a part of this specification to the extent specified herein.

SPECIFICATIONS

Federal

PPP-T-60	Tape, Pressure Sensitive, Adhesive, Waterproof for Packaging
PPP-T-76	Tape, Pressure, Sensitive, Adhesive, Paper, Water Resistant (for Carton Sealing)
PPP-F-320	Fiberboard, Corrugated and Solid Sheet Stock (Container Grade) and Cut Shapes
PPP-B-566	Box, Folding, Paperboard
PPP-B-636	Box, Fiberboard
PPP-B-676	Box Setup
ZZ-R-765	Rubber, Silicone; Low and High Temperature and Tear Resistant

Military

MIL-I-10	Insulating Materials, Electrical, Ceramic, Class L

SPECIFICATIONS (Continued)

Military (Cont'd)

MIL-M-14	Molding Plastics and Molded Plastic Parts, Thermosetting
MIL-P-116	Preservation, Methods of
MIL-P-997	Plastic Material, Laminated, Thermosetting, Electrical Insulation: Sheets, Glass Cloth, Silicone Resin
MIL-C-5015	Connectors, Electric, "AN" Type
MIL-E-5556	Enamel, Camouflage, Quick Drying
MIL-C-8384	Connectors, Plug and Receptacle, Electrical (Molded Body); and Accessories, General Specification for
MIL-S-12883	Sockets and Accessories, for Plug-In Electric Components, General Specification for
MIL-P-15037	Plastic Sheet, Laminated, Thermosetting, Glass-Cloth, Melamine-Resin
MIL-P-15047	Plastic Material, Laminated Thermosetting, Sheets, Nylon Fabric Base, Phenolic-Resin
MIL-N-18307	Nomenclature and Identification for Electronic Aeronautical, and Aeronautical Support Equipment Including Ground Support Equipment
MIL-G-45204	Gold Plating, Electrodeposited
MIL-C-45662	Calibration System Requirements

STANDARDS

Federal

Fed-STD-595	Color Requirements for Individual Color Chips (3 x 5 Supplements)

STANDARDS

Military

MIL-STD-105	Sampling Procedures and Tables for Inspection by Attributes
MIL-STD-129	Marking for Shipment and Storage
MIL-STD-147	Palletized and Containerized Unit Loads 40 Inch X 48 Inch Pallets, Skids, Runners, or Pallet Type Base
MIL-STD-202	Test Methods for Electronic and Electrical Component Parts
MIL-STD-454	Standard General Requirements for Electronic Equipment
MIL-STD-456	Electronic Parts, Data and Source Coding for
MIL-STD-461	Electromagnetic Interference Characteristics Requirements for Equipment
MIL-STD-704	Electric Power, Aircraft, Characteristics and Utilization of
MIL-STD-749	Preparation and Submission of Data for Approval of Nonstandard Electronic Parts
MIL-STD-810	Environmental Test Methods
MS27726	Integrated Wire Termination System for Use on Electrical Components
MIL-HDBK-217	Reliability Prediction of Electromagnetic Equipment

(Copies of specifications, standards, drawings, and publications required by suppliers in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer).

2.2 Other publications. The following documents form a part of this specification to the extent specified herein. Unless otherwise indicated, the issue in effect on date of invitation for bids or request for proposal shall apply.

shall be printed using the screens, line and area patterns

NATIONAL BUREAU OF STANDARDS

Handbook H28 — Screw-Thread Standards for Federal Service

(Application for copies should be addressed to the Superintendent of Documents, Government Printing Office, Washington, DC 20402.)

3. REQUIREMENTS

3.1 Specification sheets. The individual controller requirements shall be as specified herein and in accordance with the applicable specification sheet. In the event of conflict between requirements of this specification and the specification sheet, the latter shall govern, (6.2.1).

3.2 Power controller categories. Power controllers furnished under this specification shall be Category I or II as defined herein.

3.2.1 Category I Power controllers completely defined by a military specification sheet (3.1, 4.5, and 6.2.1).

3.2.2 Category II. Power controllers the same as category I, except for minor differences such as terminations and mounting means, which do not change the basic design or construction of the qualified controller. Category II controllers shall be procured from a source listed on the applicable qualified products list for the particular similar product in category I. Category II power controllers are non-standard 1/ (4.6 and 6.2.2) and shall not be maintained in Government inventory. Category II controllers shall be directly replaceable by Category I controllers.

3.3 Qualification. Category I controllers furnished under this specification shall be products which are qualified for listing on the applicable qualified products list at the time set for opening of bids (4.5 and 6.4).

3.4 Materials. Materials shall be as specified herein. However, when a definite material is not specified, a material shall be used which will enable the controllers to meet the performance requirements of this specification. Materials used shall be self-extinguishing; and shall not support combustion, give off noxious gases in harmful quantities, give off gases in quantities sufficient to cause explosion of sealed enclosures, cause contamination to any part of the controller, or form current-carrying tracks when subjected to any of the tests specified herein. Unless otherwise specified (3.1), the selection of material shall be such as to provide a shelf-life of at least ten years without affecting the operation of the controller. Acceptance or approval of any constituent material shall not be construed as a guarantee of the acceptance of the finished product.

1/ Test reports shall be prepared in accordance with MIL-STD-749

whether the quick release fitting is locked or released.

3.4.1 Plastic. Laminated plastic material shall conform to MIL-P-997, MIL-P-15037 and MIL-P-15047. Molded plastic material shall conform to MIL-M-14. Cotton-filled or wood-flour-filled materials shall not be used.

3.4.2 INTENTIONALLY BLANK

3.4.3 Fungus-resistant (not applicable to interior of Type 4 controllers). Materials used in the construction of power controllers shall be fungus inert (Requirement 4 of MIL-STD-454).

3.4.4 Metals. Metals shall be of a corrosion-resistant type or shall be plated or treated to resist corrosion.

3.4.5 Rubber. Rubber shall conform to ZZ-R-765.

3.4.6 Potting compounds. The selection and use of encapsulating materials (potting compounds) shall be in accordance with MIL-STD-454, Requirement 47.

3.5 Design and construction. Power controllers shall be of the design, construction, weight, and physical dimensions specified (3.1). Controllers shall be so designated to insure power operation in any attitude when mounted to a suitable heat sink. The construction of the controllers shall preclude mechanical damage, flaking of the finish, loosening of the terminals, or deterioration of marking when subjected to the test methods in Section 4 of this specification.

3.5.1 Threaded parts. All threaded parts shall be in accordance with Handbook H28. 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, which is used in the fine-thread series. Terminal threads shall be class 2A and 2B for external and internal threads, respectively.

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

3.5.2 Enclosure. The enclosure shall be electrically isolated and shall provide means for grounding. All exterior surfaces of the enclosure, excluding the mounting surface, shall be finished with lusterless black paint (color 37038) per FED-STD-595 and MIL-E-5556.

3.5.3 Hardware. Specified hardware (3.1) shall be supplied.

3.5.4 Mounting means. As specified (3.1.)

3.5.4.1 Bracket. Mounting brackets shall be an integral part of the controller enclosure.

3.5.5 External terminations. As specified (3.1).

3.5.5.1 Solder. Terminals shall be capable of being readily soldered. Unless otherwise specified (3.1), solder terminals shall not be gold plated.

3.5.5.1.1 Solder Lug. Terminals may be of any shape and shall be designed to accommodate two conductors.

3.5.5.1.2 Print-circuit. Terminals shall be placed for compatibility with printed-circuit spacing as specified (3.1).

3.5.5.1.3 Solderability. For qualification inspection, controllers shall be tested as specified in 4.8.3 and shall meet the applicable requirements of Method 208 of MIL-STD-202.

3.5.5.1.4 Resistance to soldering heat. For qualification inspection, controllers shall be tested as specified in 4.8.17, in accordance with Method 210 of MIL-STD-202, and shall subsequently meet the requirements of paragraph 3.13.1.

3.5.5.2 Plug-in (connector). Terminals for plug-in headers shall conform to the dimensions and contact arrangements necessary for proper mating with the applicable terminations conforming to MIL-C-5015, MIL-C-8384, or MIL-S-12883. Pin contacts only shall be used. Unless otherwise specified (3.1), terminals shall be gold plated in accordance with MIL-G-45204, Type II, Class 1 over nickel plate 0.0001 to 0.0003 inch thick.

3.5.5.3 Integrated. Controllers designed for removable and insertable terminations shall be in accordance with MS27726.

3.6 Conditioning (run-in). When tested as specified in 4.8.2, the controller shall perform satisfactorily during each operation (3.1).

3.7 INTENTIONALLY BLANK

3.8 Seal. When tested as specified in 4.8.4, the leakage rate shall not exceed 10-6 atm cc/sec. for type 4 controllers.

3.9 Dielectric withstanding voltage. When tested as specified in 4.8.5, there shall be no leakage current in excess of 1.0 milliampere (ma) nor evidence of damage due to arcing (air discharge), flashover (surface discharge), or insulation breakdown (puncture discharge).

3.10 Insulation resistance. When tested as specified in 4.8.6, the insulation resistance shall be greater than 100 megohms.

3.11 Electrical characteristics. Controllers shall not be damaged when exposed to supply voltage variations as defined in MIL-STD-704 and shall be capable of controlling power to reactive and resistive loads.

3.11.1 Turn-on and turn-off voltage. When tested as specified in 4.8.7.1, the turn-on and turn-off voltage shall be as specified (3.1).

3.11.2 Turn-on and turn-off time. When tested as specified in 4.8.7.2, the turn-on and turn-off time shall be as specified (3.1).

3.11.3 Load voltage rise and fall time. When tested as specified in 4.8.7.3, the rise and fall time shall be as specified (3.1).

3.11.4 Isolation. The isolation test voltage shall be as specified (3.1). When tested as specified in 4.8.7.4, the controller shall have a minimum isolation resistance of 100 megohms.

3.11.5 Control signal. When tested as specified in 4.8.7.5, the control signal shall be as specified (3.1).

3.11.6 Voltage drop. When tested as specified in 4.8.7.6, the voltage drop shall not exceed the value specified (3.1) for load current values from no load to 100% rated.

3.11.7 Leakage current. When tested as specified in 4.8.7.7, the leakage current shall not exceed the values specified (3.1).

3.11.8 Power dissipation. When tested as specified in 4.8.7.8, the power dissipation shall not exceed the values specified (3.1).

3.11.9 Overload characteristics

3.11.9.1 Current limiting. When specified (3.1) and tested as specified in 4.8.7.9.1, the output current shall be within the limits specified (3.1). At the initiation of the overload condition, the peak let through current (6.5.4.1) shall not exceed the value specified (3.1).

3.11.9.2 Trip time

3.11.9.2.1 Nonrepetitive reset. When tested as specified in 4.8.7.9.2 (a), the trip time shall be within the limits specified (3.1).

3.11.9.2.2 Repetitive reset When tested as specified in 4.8.7.9.2 (b), the controller shall reset; however, the trip time shall be less than the time specified (3.1). The controller shall not be damaged.

3.11.10 Coordination. When tested as specified in 4.8.7.10, only the lower rated power controllers shall trip, in the series connected pair of power controllers of rating ratios as specified (3.1).

3.11.11 Rupture capacity. When tested as specified in 4.8.7.11, the controller shall trip and there shall be no damage to the controller. The controller shall be resettable within 10 minutes after each test.

3.11.12 Reset voltage. When tested as specified in 4.8.7.12, the controller shall reset.

3.11.13 Reset time

3.11.13.1 Application time to reset. When tested as specified in 4.8.7.13, the power controller shall not reset when a reset signal is applied for a time duration less than the minimum specified (3.1). The controller shall reset when a reset signal is applied for the maximum time specified (3.1) or longer.

3.11.13.2 Removal time to reset. When tested as specified in 4.8.7.13, the controller shall not reset when the control signal is removed for a time duration less than the minimum time specified and reapplied (3.1). The controller shall reset when the control signal is removed for the maximum time specified (3.1) or longer and reapplied.

3.11.14 State indication. When controllers are tested as specified in 4.8.7.14, the state indication (6.5.19, 6.5.20) shall be as specified (3.1).

3.11.15 Reset immunity. When tested as specified in 4.8.7.15, there shall be no power interruption, voltage spikes or oscillations on the power output circuit.

3.11.16 Ripple current (dc controller). When tested as specified in 4.8.7.16, the ripple current (6.5.27) generated by the dc controller shall not exceed the value specified (3.1).

3.11.17 Trip-free characteristics. When tested as specified in 4.8.7.17, the controller shall reset, trip-out and stay tripped out for the duration of the test.

3.11.18 INTENTIONALLY BLANK

3.11.19 Operating voltage transients. When tested as specified in 4.8.7.19, with the control signal OFF, the controller shall not be damaged, be tripped or deviate from the OFF state. With the control signal ON, the controller shall not be damaged or tripped, but may go to the OFF state as specified (3.1).

3.11.20 Transient spike overvoltage (DC controllers). When tested as specified in 4.8.7.20, the controller shall not be damaged, shall stay ON when controlled ON and shall stay OFF when controlled OFF.

3.11.21 INTENTIONALLY BLANK

3.11.22 Control input transients. When tested as specified in 4.8.7.22, the controller shall not be damaged.

3.11.23 Zero voltage Turn-On and Zero current turn-off. When tested as specified in 4.8.7.23, controller turn-on shall occur at zero voltage cross-over within the voltage or time specified (3.1), and the controller turn-off shall occur at zero current crossover within the current or time specified (3.1). The controller shall turn-on and turn-off at the same voltage slope (turn-off at the opposite half-cycle from turn-on), when specified (3.1).

3.11.24 INTENTIONALLY BLANK

3.11.25 Common mode rejection. When tested as specified in paragraph 4.8.7.25, the controller shall remain in the turned ON or turned OFF state as commanded.

3.11.26 DC offset voltage (AC controllers). When tested as specified in 4.8.7.26, the dc offset voltage shall not exceed the value specified (3.1) for the load current values specified (3.1).

3.11.27 Stabilization time. Controllers shall not pass power to the output during the stabilization time unless commanded to do so.

3.12 Fail-safe. The controllers shall 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 4.8.8, the fail-safe element (fuse) shall open the circuit at currents and time specified (3.1).

3.13 Environmental characteristics. Unless otherwise specified, the controller shall meet the requirements of paragraph 3.13.1 when subjected to the following tests:

Temperature shock	4.8.9
Vibration	4.8.11

Acceleration	4.8.12
Salt fog	4.8.13
Temperature altitutde	4.8.14
Humidity	4.8.16
Resistance to soldering heat	4.8.17
Shock	4.8.19
Life	4.8.20
Explosive atmosphere	4.8.8
Explosive decompression	4.8.21

3.13.1 Performance criteria. Unless otherwise specified, the controller shall meet the following criteria when subjected to the tests given in paragraph 3.13.

Design and construction	3.5
Dielectric withstanding	3.9
Insulation resistance	3.10
Electrical characteristics	3.11

3.14 Terminal strength. When controllers are tested as specified in 4.8.15, there shall be no loosening or breaking of the terminals, and there shall be no deformation to the threads of screw terminals, no bending (see NOTE) of a pin or damage to the insulating base of plug-in controllers, nor shall there be any other damage which would adversely affect the normal operation of the controller.

NOTE

Bending of solder terminals shall not be construed as damage; bending of plug-in terminals shall not be construed as damage, provided they can be reformed in a manner to permit proper mating with the applicable socket.

3.15 Electromagnetic compatibility. When tested as specified in 4.8.18, controllers shall meet the requirements of MIL-STD-461, Class IC.

3.16 Case-to-sink thermal resistance. The thermal resistance shall be as specified in (3.1) when mounted dry to a flat metal plate (0.001 inch per inch) with a surface finish of 63 micro-inches or less and a mounting torque as specified (3.1).

3.17 Marking. Controllers shall be marked in accordance with the requirements of MIL-N-18307. In addition, the following information shall be included:

(a) Rated control voltages (3.1)

(b) Rated output voltage and current (3.1)

(c) Terminal nomenclature (3.1)

(d) Terminals (3.1)

(e) Manufacture date code in accordance with MIL-STD-456

3.18 Workmanship. Workmanship shall be in accordance with MIL-STD-454, Requirement 9

3.19 Operation at temperature extremes. The controller shall meet the electrical characteristics of 3.11 when tested in accordance with paragraphs 4.8.10.

3.20 Life. When power controllers are tested in accordance with paragraph 4.8.20, there shall be no evidence of performance degradation.

3.21 Explosive decompression. The controllers shall not be damaged when tested as specified in 4.8.21.

3.22 Reliability. When operated within the environmental and operational limits specified herein, the controllers shall achieve a reliability, expressed in a mean time between failures (MTBF), as specified (3.1). Failure is defined as the inability to provide all the performance characteristics specified herein. Reliability requirements will be verified by analysis per MIL-HDBK-217.

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, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in this specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

4.1.1 Test equipment and inspection facilities. The supplier shall establish and maintain a calibration system in accordance with MIL-C-45662.

4.2 Classification of inspections. The inspections specified herein are classified as follows:

(a) Materials inspection (see 4.3)

(b) Qualification inspections (see 4.5)

(c) Inspection of Category II power controllers (see 4.6)

(d) Quality conformance inspection (see 4.7)

4.3 Materials inspection. Materials inspection shall consist of certification supported by verifying data that the materials listed in Table I used in fabricating the power controllers are in accordance with the applicable referenced specifications prior to such fabrication.

4.4 Inspection conditions. Unless otherwise specified herein, all inspections shall be performed in accordance with the test conditions specified in the "GENERAL REQUIREMENTS" of MIL-STD-810.

4.4.1 Power supply. The power supply shall have no more than 10 percent regulation at twice the specified load current. A dc power supply shall have no more than 5 percent voltage ripple. An ac power supply shall be within 1 percent of the specified frequency and shall be sinusoidal with a form factor between 0.95 and 1.25.

4.4.1.1 Grounding. The negative side of the dc power supply shall be grounded; one side of the single phase ac power supply shall be grounded, or the neutral of the three-phase ac power supply shall be grounded, as applicable. The grounds of the control circuits in the controller being tested shall be connected to the grounded side of their power supply. The load of the controller shall be connected to the grounded side of the output power supply.

4.4.2 Load conditions during test. Full load shall imply operation by the specified (3.1) control parameters with the maxium rated voltage and load current applied to the output circuit. Under these conditions a suitable heat removal apparatus (4.4.3) shall be used. No load shall imply operation by the specified (3.1) control parameters with the maximum rated voltage and the minimum load current required to determine the circuit state. Under these conditions heat removal apparatus may not be required.

4.4.3 Heat removal. Heat removal apparatus shall consist of a heat sink of known characteristics (3.16) which can be adjusted and monitored to provide the cooling necessary to prevent the heat sink temperature from exceeding the specified maximum (3.1).

4.4.4 Temperature stabilization of test items.

4.4.4.1 Nonoperating. Temperature stabilization shall occur when the case temperature does not differ more than 2.0°C from the ambient temperature.

4.4.4.2 Operating. Temperature stabilization shall occur when the case temperature does not change more than 2.0°C (3.6°F) per hour.

4.5 Qualification inspection (Category I power controllers Only (see 3.2.1). Qualification inspection shall be performed at a laboratory acceptable to the Government (6.4) on sample units selected from a production lot.

4.5.1 Sample size. The number of power controllers to be subjected to qualification inspection shall be as specified in Table II.

4.5.2 Inspection routine. The sample shall be subjected to the inspections specified in Table II, 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 II, for Groups II and III (as applicable) and subjected to the inspections for their particular group.

4.5.3 Failures. Failures in excess of those allowed in Table II shall be cause for refusal to grant qualification approval.

4.5.4 Retention of qualification. To retain qualification, the supplier shall forward, at 24-month intervals, to the qualifying activity, a summary of Group A tests, indicating as a minimum the number of lots which passed and the number which failed, and the complete results of Group B and C tests, including the number and type of any part failure. The summary shall include those tests performed during that 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.

4.6 Inspection of Category II power controllers. Tests to verify suitability of the variations from Category I controllers shall be as specified and shall be performed by the supplier, after award of contract, and prior to production.

4.7 Quality conformance inspection

4.7.1 Inspection of product for delivery. Inspection of product for delivery shall consist of Group A inspection. Except as specified in 4.7.2.2.3, delivery of products which have passed Group A inspection shall not be delayed pending the results of the Group B and C inspections.

4.7.1.1 Inspection lot. An inspection lot, as far as practicable, shall consist of all power controllers of the same enclosure, configuration, vibration characteristic, temperature class, shock type, produced under essentially the same conditions within a period not to exceed four weeks, and offered for inspection at one time.

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

4.7.1.2.1 Sampling plan. Sampling plan shall be as specified in Table III. Statistical sampling and inspection for Group A-II shall be in accordance with MIL-STD-105 for general inspection level II. Acceptable Quality Level (AQL) shall be as specified in Group-A-II Table III. Samples which fail Group A-II may be reworked and resubmitted using the tightening inspection in accordance with MIL-STD-105. Major and minor defects shall be as defined in MIL-STD-105.

4.7.1.2.2 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.

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

4.7.2 Periodic inspection. Periodic inspections shall consist of Groups B and C inspections.

4.7.2.1 Group B inspections. Group B inspection shall consist of the test(s) specified in Table IV, and shall be performed in the order shown.

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

4.7.2.1.2 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. Resubmitted 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.

4.7.2.1.3 Disposition of sample units. Sample units which have been subjected to a Group B inspection shall not be delivered on the contract or purchase order.

4.7.2.2 Group C inspection.

4.7.2.2.1 Sampling plan. Every 24 months, controllers shall be subjected to the inspections of Table II, performed in the order shown. The number of failures allowed shall be as specified in Table II.

4.7.2.2.2 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.

4.7.2.2.3 Noncompliance. If a sample fails to pass Group C inspection, the supplier shall take corrective action on the materials or processes, or both, as warranted, and 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 Government, 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 reinstituted; however, final acceptance shall be withheld until Group C reinspection has shown that the corrective action was successful.

4.7.3 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.

4.8 Methods of examination and tests. When applicable, testing of power controllers with plug-in terminations shall be performed with the appropriate or specified socket or connector mated to the controller.

4.8.1 Visual and mechanical examination. Power controllers shall be examined to verify that the materials, external design and construction, physical dimensions, marking and workmanship are in accordance with the applicable requirements (3.1, 3.4, 3.5, 3.17, and 3.18).

4.8.2 Conditioning (run-in)(3.6). Power controllers shall be subjected to 5,000 operations at a rate of 1 to 60 operations per second under the following conditions:

(a) The control input shall be energized at the rated turn-on signal (3.1).

(b) Unless otherwise specified, the load shall be rated resistive load.

(c) The unit shall be cycled at 50±5 percent duty cycle.

4.8.3 Solderability (3.5.5.1.3). Controllers shall be tested in accordance with Method 208 of MIL-STD-202. The following details shall apply:

(a) Number of terminations of each part to be tested - All.

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

4.8.4 Seal (3.8)

4.8.4.1 Type 3 controllers. Controllers shall be tested in accordance with Method 112 of MIL-STD-202. The following details shall apply:

(a) Test Condition - B

(b) Measurements after test - Not applicable.

4.8.4.2 Type 4 controllers. Controllers shall be tested in accordance with Method 112 of MIL-STD-202. The following details shall apply:

(a) Test Condition - C (Procedure III or IV, at the option of the Manufacturer). Test Condition - B shall be used to test for gross leaks.

(b) Leakage rate -10^{-6} atm cc/sec.

(c) Reduced pressure of chamber and duration of pressurization (Procedure IV)-Below 5 mm of mercury for 6 hours.

(d) Measurements after test - Not applicable.

4.8.5 Dielectric withstanding voltage (3.9). Controllers 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 (3.1)

(c) Nature of potential - AC.

(d) Duration - 60 seconds

(e) Points of application - All terminals shall be shorted together and the test voltage applied from terminals to case.

(f) Leakage current - 1.0 ma maximum

(g) Following these tests, controllers shall be examined for evidence of arcing, flashover, insulation breakdown and damage.

(h) Measurements after test - Insulation resistance.

4.8.5.2 At reduced barometric pressure. Controllers specified for operation above 10,000 feet 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

(c) Test requirements at reduced pressure - As specified in 4.8.5.1 except test voltage shall be as specified (3.1).

4.8.6 Insulation resistance (3.10). Controllers shall be tested in accordance with Method 302 of MIL-STD-202. The following details shall apply:

(a) Test condition - A

(b) Preparations - None

(c) Points of measurements - The terminals shall be shorted together and measurements taken between enclosure and terminals.

(d) Electrification time - 2 minutes.

(e) Measurement error - As specified in MIL-STD-202.

4.8.7 Electrical characteristics. When performing electrical tests, the controllers shall be mounted on a suitable heat sink (4.4.3).

4.8.7.1 Turn on and turn off voltage (3.11.1 and 6.5). The turn on and turn off shall be verified as specified in 4.8.7.1.1 and 4.8.7.1.2.

4.8.7.1.1. Turn on voltage. With the controller connected as shown in Figure 1, apply rated load voltage and adjust the load resistance for rated load ±10 percent (6.5). Apply the minimum turn on signal with the control function generator and note that the controller turns ON.

4.8.7.1.2 Turn off voltage. With the controller ON at rated control signal, apply the maximum turn off signal with the function generator and note that the controller turns OFF.

4.8.7.2 Turn on and turn off time (3.11.2 and 6.5). Measure turn on and turn off times with the controller operated as in 4.8.7.1.

4.8.7.3 Load voltage rise and fall time (3.11.3 and 6.5). Measure the rise and fall times with the controller operated as in 4.8.7.1.

4.8.7.4 Isolation (3.11.4). The power-in terminal, power-out terminal and power-ground terminal shall be shorted together. Where applicable, the control terminal, reset terminal, state indication terminal, and signal ground terminal shall be shorted together. The points of application shall be the signal ground and power ground terminals and electrification time shall be two minutes.

4.8.7.5 Control signal (3.11.5). With rated load voltage applied, apply control signal level as specified (3.1) and measure control current or voltage. Repeat test for each control signal level specified (3.1).

4.8.7.6 Voltage drop (3.11.6). With the controller 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 percent rated load. For AC controllers, a True RMS voltmeter shall be used.

4.8.7.7 Leakage current (3.11.7). Connect the controller as shown in Figure 1 with the load resistance adjusted for a maximum of 10 ohms, rated load voltage applied with the control circuit open, read the leakage current. Repeat the test with the controller command OFF.

4.8.7.8 Power dissipation (3.11.8). Connect the controller as shown in Figure 1 with the load resistance adjusted for short circuit (6.5), rated load voltage applied, and the controller command OFF, measure the power dissipation for the OFF state. With the control command ON, measure the power dissipation for the ON state for loads of 10, 50 and 100 percent rated load, unless otherwise specified (3.1).

4.8.7.9 Overload characteristics tests

4.8.7.9.1 Current limiting (3.11.9.1). Connect the controller as shown in Figure 1.

(a) Adjust the load resistor for short circuit (6.5) and apply rated load voltage. Apply rated control signal and verify that the output current remains within the limits specified (3.1).

(b) With the load resistor adjusted for rated load, apply rated load voltage and control signal. While monitoring the current out of the controller apply a short circuit (6.5) across the load and measure the let thru current and response time.

4.8.7.9.2 Trip time (3.11.9.2). Connect the power controller as shown in Figure 1.

(a) Non-repetitive reset (6.5) - With rated load voltage, verify that the controller meets the specified trip characteristics (3.1) at various current levels.

(b) Repetitive Reset - With rated load voltage and load resistor adjusted for short circuit, verify that the controller meets the specified repetitive reset requirements (3.1). Reapply control signal the specified number of times (3.1) at the intervals specified (3.1).

4.8.7.10 Coordination. Connect (with conductors of negligible impedence) the specified (3.1) pair of power controllers in series, as shown in Figure 1A. Follow the test procedure of 4.8.7.9.2(a) except that the control signal of the higher rated device shall be applied before the lower rated, and the trip time need not be monitored.

4.8.7.11 Rupture capacity (3.11.11). The controller shall be connected per Figure 1, except that the power source shall be calibrated for the specified rupture current (3.1) with the power terminals of the controller shorted. The open circuit voltage before application of the rupture current shall be rated voltage (3.1). Records of voltage, current and time shall be obtained. The controller shall be subjected to the following test sequence.

(a) 4 tests with the controller ON carrying no load current, before application of the rupture current.

(b) 4 tests with the controller OFF rupture circuit completed, and rupture current indicated by the controller being turned on.

(c) After preceding tests, test dielectric withstanding voltage (4.8.5.1) and trip time (4.8.7.9.2 (a)).

The controller shall be reset within 10 minutes after each rupture test. There shall be sufficient time between rupture tests to allow temperature stabilization.

4.8.7.12 Reset voltage (3.11.12). Connect the controller as shown in figure 1. Apply rated load voltage and adjust the load resistance for 200±10 percent rated load. Adjust control function generator for rated control signal and reset generator for minimum reset

signal. Apply control signal and observe that the controllers turns ON and trips out. Apply reset signal, and observe that the controller resets.

4.8.7.13 Time to reset (3.11.13). Follow the same procedure as 4.7.8.12, except the reset signal shall be applied for a time duration of 0.5 milliseconds less than the minimum specified time (3.1). Observe that the controller does not reset. Apply a reset signal for 0.5 milliseconds longer than the maximum time specified (3.1). Observe that the controller does reset. Repeat test, using the control signal as a means for reset.

4.8.7.14 State indication signal (3.11.14). Follow the same procedure as 4.8.7.12, except that, after the controller trips out, the state indication signal shall be monitored.

4.8.7.15 Reset immunity (3.11.15). Connect the controller as shown in Figure 1. With the load voltage and the load adjusted for rated values, apply the minimum control signal specified (3.1) to operate the controller to the ON state. Apply the rated reset signal 10 times and simultaneously monitor the power out circuit to verify no change in the output state. Repeat test with control signal adjusted to the maximum turn off voltage specified (3.1).

4.8.7.16 Ripple current (3.11.16). With the dc controller connected as shown in Figure 1, monitor the output load current and measure the peak-to-peak value of ripple current generated by the controller under each of the following load conditions: 10% rating, 100% rating, and short circuit.

4.8.7.17 Trip-free characteristic (3.11.17). With the controller connected as shown in Figure 1, apply rated voltage, adjust load resistor for short circuit, and command controller ON. Observe the controller trips out. Reset the controller and command controller ON. Maintain the ON command for one minute minimum and verify that the controller resets and trips only once.

4.8.7.18 INTENTIONALLY BLANK

4.8.7.19 Operating voltage transients (3.11.19). Connect the controller as shown in Figure 1. Adjust load resistor for rated load.

(a) OFF state. Adjust control function generator for specified (3.1) maximum turn-off signal. Apply rated load voltage for at least 5 seconds and then apply a voltage transient specified (3.1). Repeat test for each voltage transient specified (3.1).

(b) ON state. Adjust control function generator for specified (3.1) minimum turn-on signal. Apply rated supply voltage for

at least 5 seconds and then apply a voltage transient specified (3.1). Repeat test for each voltage transient specified (3.1).

4.8.7.20 Transient Spike overvoltage (DC controllers) (3.11.20). Connect controllers as shown in Figure 1. Adjust load control resistor for rated load and control signal for specified (3.1) turn-off signal. Apply spike waveform, as specified below, to the power input terminal of the power controller. The above transient shall then be applied to the power output terminal of the controller. The 600 volt dc source shall have 50±10 percent ohm impedance and shall satisfy the following requirements:

Open-circuit voltage:	±600 volts peak
Risetime:	0.9±0.2 microseconds
Falltime:	10.0±1.0 microseconds
Pulsewidth (50% amplitude points):	5.0±0.1 microseconds
Repetition rate (aperiodic):	Not greater than 50 Hz
Source energy capability:	Not less than 0.01 joule

4.8.7.21 INTENTIONALLY BLANK

4.8.7.22 Control input transients (3.11.22). The following transients shall be applied between the signal ground terminal and the control terminal (source impedance is 250 ohms):

(a) A train of ten pulses of plus and minus 100 volts peak amplitude and 100 microsecond duration each, repeated 10 times at 3 second intervals.

(b) Repeat test (a) between terminals, reset and ground, trip indication and ground control and ground.

4.8.7.23 Zero voltage turn-on and zero current turn-off (3.11.23 and 6.5). Connect the controller as shown in Figure 1. Apply rated load voltage and adjust load resistor for rated load. With the control function generator adjusted for rated turn on signal, apply and remove the control signal and monitor the load voltage and current. Repeat test 10 times.

4.8.7.24 INTENTIONALLY BLANK

4.8.7.25 Common mode rejection (3.11.25). With a common mode signal of ±10 volts peak swept from 1.0 Hz to 100 KHz applied between the signal ground and power ground (Figure 1) and with an ON command, verify that the power controller does not turn OFF or does not intermittently operate between ON and OFF. Repeat the test except with an OFF command.

4.8.7.26 DC offset voltage (AC controllers)(3.11.26). With the controller connected as shown in Figure 1, apply rated load voltage and adjust the load impedance to values between zero and 100% (10% P.F. lagging to 10% leading). The dc voltage as measured between the power input and power output terminal of the controller shall not exceed the value specified (3.1).

4.8.7.27 Stabilization time (3.11.27). With the controller connected as shown in Figure 1, command controller OFF with load resistor set for rated load. Apply rated supply voltage and observe transient output voltage. After 500 milliseconds, command controller ON and observe output voltage.

4.8.8 Fail-Safe (3.12). Specified (3.1) number of power controllers must be constructed with their "pass sections" intentionally shorted with no more than 0.05 ohms across any solid state device. Connect one of these shorted power controllers as shown in Figure 1. Adjust load resistors for values of current as specified (3.1). Apply rated load voltage and record time fail-safe element takes to clear. Repeat for each value specified (3.1). All fail-safe tests shall be conducted with the power controller in an explosive atmosphere as specified in procedure I, method 511 of MIL-STD-810, if explosive atmosphere is specified (3.1).

4.8.9 Temperature shock (3.13). Controllers shall be tested in accordance with Method 503 of MIL-STD-810. The following details and exception shall apply:

(a) Special mounting - Controllers, without heat sink, shall be suspended in the test chamber by twine or other non-heat-conducting material in a plane parallel to the normal air flow.

(b) Temperature levels - As specified (3.1).

(c) Loading conditions - No load (4.4.2)

(d) Inspections during test - At each temperature extreme during step 7, the tests given in 3.13.1 shall be performed.

(e) Inspections after test - As specified in 3.13.1.

4.8.10 Operation at temperature extremes (3.19). The controller shall be tested for operation at temperature extremes in accordance with the following:

(a) Minimum Temperature - While de-energized, the power controller shall be soaked for 2 hours minimum while mounted on the appropriate heat sink in minimum ambient temperatures specified (3.1). At the end of the soak period, the controller

shall meet the electrical characteristics requirements of paragraph 3.11.

(b) Temperature Range - With applied rated load voltage, load adjusted to the specified value (3.1) and the control voltage set to the minimum turn ON value (3.1), the output voltage wave form shall be monitored and voltage drop measured when the power controller temperature is varied from the minimum stabilized temperature to the maximum specified stabilized temperature (3.1).

(c) Maximum Temperature- While de-energized, the power controller shall be soaked for 2 hours minimum while mounted on the appropriate heat sink at the maximum heat sink temperature specified (3.1). At the end of the soak period, while maintaining the specified heat sink temperature, the controller shall meet the electrical characteristics requirements of paragraph 3.11.

4.8.11 Vibration (3.13). Controllers shall be tested in accordance with Procedure II, Method 514 of MIL-STD-810. The following details and exceptions shall apply:

(a) In Part I the sinusoidal vibration test curve shown in Figure 2 of this specification shall be used.

(b) Delete Part II.

(c) In Part III curve AH shall be used.

(d) The time schedule of Table 512-IV shall be used.

(e) Inspections during test - During the entire vibration schedule the controller shall be cycled 15 minutes OFF and 15 minutes ON full load (4.4.2). All parameters shall be monitored continuously.

(f) Inspections after tests - As specified in 3.13.1.

4.8.12 Acceleration (3.13). Controllers shall be tested in accordance with Procedure II, Method 513 of MIL-STD-810. The following details and exceptions shall apply:

(a) Acceleration level - As specified (3.1).

(b) Test conditions - In each of six directions the controller shall be de-energized for one minute with rated load voltage applied. The controller shall not pass power to the output. In each of six directions, the controller shall be energized for one minute with rated load. The controller shall not show any interruption of output power.

(c) Inspections after test - As specified in 3.13.1.

4.8.13 Salt fog (3.13). Controllers shall be tested in accordance with Procedure I, Method 509 of MIL-STD-810. The following details shall apply:

(a) Inspections after exposure - Controllers shall be examined for evidence of corrosion, peeling, blistering of the finish, and exposure of base metal.

(b) Inspections after test - After the drying period, the controllers shall be examined as specified in 3.13.1.

4.8.14 Temperature-altitude (3.13). Controllers shall be tested in accordance with Procedure I, Method 504, of MIL-STD-810. The following details and exceptions shall apply:

(a) Equipment category - 3

(b) Test item operation - Full load (4.4.2)

(c) Heat removal - During controller operation the heat removal apparatus (4.4.3) shall be adjusted to allow the case temperature to rise to its highest value but not to exceed the maximum specified (3.1). Heat removal parameters shall be monitored to permit the determination of cooling requirements.

(d) Inspection after tests - As specified in 3.13.1.

4.8.15 Terminal strength (3.14). Power controllers shall be tested in accordance with Method 211 of MIL-STD-202 in accordance with the following, as applicable. Unless otherwise specified herein, two terminals of each discrete design, size, and configuration shall be tested; however, if there is only one of such design, size and configuration, it shall be tested.

4.8.15.1 Pull test (all terminal types). Terminals shall be tested as specified in test Condition A. The force shall be as specified (3.1).

4.8.15.2 Bend test (not applicable to plug-in terminals). Terminals shall be tested as specified in test Condition B (two bends) or C, as applicable. Loads for test Condition C shall be as specified (3.1).

4.8.15.3 Bend test (plug-in terminals of a standard octal base). The lesser of five or all terminals shall be tested in applying a force of five pounds normal to the axis of the pin within 0.125 inch of the tip of the pin.

4.8.15.4 Torque test (screw terminals). All terminals shall be tested as specified in test Condition E as follows:

Screw Size	Torque (Lb-In)
4-40	4.4
6-32	10.0
8-32	20.0
10-32	32.0
10-24	35.0

Following these tests, power controllers shall be examined for evidence of loosening or breaking of the terminals and other damage that could adversely affect the normal operation of the power controller.

4.8.16 Humidity (3.13). Controllers shall be tested in accordance with Procedure I, Method 507 of MIL-STD-810. The following details and exceptions shall apply:

(a) Mounting - On a corrosion-resistant panel by normal mounting means.

(b) Inspections during test - During Step 7, the controller shall be subjected to the tests specified in 3.13.1.

NOTE

The dielectric withstanding voltage shall be measured with a test voltage of 90 percent of the initial test potential.

4.8.17 Resistance to soldering heat (3.13). Power controllers shall be tested in accordance with Method 210 of MIL-STD-202. The following details and exception shall apply:

(a) Depth of immersion in molten solder - Within 0.060±0.020 inch of the controller base.

(b) Test conditions - At 232°±3°C for 60±5 seconds.

(c) Inspection after test - As specified in 3.13.1.

4.8.18 Electromagnetic compatibility (3.15). Controllers shall be tested as specified in MIL-STD-461.

4.8.19 Shock (3.13). Controllers shall be tested in accordance with Procedure IV, Method 516 of MIL-STD-810. The following details and exceptions shall apply:

(a) Pulse configuration - Half sine wave with level and duration as specified (3.1).

(b) Electrical load conditions - In each of the six directions the controller shall be ON full load (4.4.2) for the first shock pulse and OFF for the second.

(c) Inspections after test - As specified in 3.13.1.

4.8.20 Life (3.13). Power controllers shall be mounted by their normal mounting means and connected to control maximum rated load at maximum rated output voltage. Controllers shall be continuously cycled ON-OFF at 50% duty cycle at 30 cycles per second at maximum rated case temperature for 500 hours, and minimum rated case temperature for 500 hours. Minimum turn-on voltage shall be applied to the control input for each ON period and maximum turn-off voltage for each OFF period. Once every 24 hours (with a minimum of 12 hours between monitor times), the controller shall be monitored for proper operation for at least 5 minutes. At the end of each temperature period, and with the controller still in the applicable environment, the controller shall meet the requirements of paragraph 3.13.1.

4.8.21 Explosive decompression (3.21). Subject the controller to an explosive decompression of the surrounding air by changing air pressure from 11.1 psia to 0.65 psia in a time less than 0.02 seconds.

5. PREPARATION FOR DELIVERY

(The preparation for delivery requirements specified herein apply only for direct Government procurements. Preparation for delivery requirements of referenced documents listed in Section 2 do not apply unless specifically stated in the contract or order. Preparation for delivery requirements for products procured by contracts shall be as specified in the individual order.)

5.1 Preservation and packaging. Preservation and packaging shall be Level A or C, as specified (6.2).

5.1.1 Level A

5.1.1.1 Cleaning. Power controllers shall be cleaned in accordance with MIL-P-116, process C-1.

5.1.1.2 Drying. Power controllers shall be dried in accordance with MIL-P-116.

5.1.1.3 Preservation application. None required.

5.1.1.4 Unit packaging. Unless otherwise specified (6.2), power controllers shall be individually packaged in accordance with the methods of MIL-P-116 designated herein insuring compliance with the general requirements paragraph under methods of preservation (unit protection) and the physical protection requirements paragraph therein. Terminals and mounting studs shall be blocked or cushioned to prevent bending or fracture.

5.1.1.4.1 Hermetically-sealed power controllers. Hermetically-sealed controllers shall be individually packaged in accordance with MIL-P-116, Method III.

5.1.1.4.2 Non-hermetically-sealed power controllers. Non-hermetically-sealed controllers shall be individually packaged in accordance with MIL-P-116, IA-8.

5.1.1.5 Intermediate packaging. Power controllers, packaged as described in 5.1.1.4, shall be placed in intermediate containers conforming to PPP-B-566 or PPP-B-676. Intermediate containers shall be uniform in size, shape, and quantities, shall be of minimum tare and cube, and shall contain multiples of 5 unit packages, not to exceed 100 packages or 10 pounds. No intermediate packaging is required when the total quantity is shipped to a single destination is less than 50 units.

5.1.2 Level C. Each cleaned and dried power controller shall be individually packaged in a manner that will afford adequate protection against corrosion, deterioration, and physical damage during shipment from supply source to the first receiving activity.

5.2 Packing. Packing shall be Level A, B or C, as specified (6.2).

5.2.1 Level A. The packaged power controllers shall be packed in fiberboard containers conforming to PPP-B-636, class weather resistant, style optional, special requirement. In lieu of the closure and waterproofing requirements in the appendix of PPP-B-636, closure and waterproofing shall be accomplished by sealing all seams, corners, and manufacturer's joints with tape, 2 inches minimum width conforming to PPP-T-60, Class 1, or PPP-T-76. Banding (reinforcement requirements) shall be applied in accordance with the appendix to PPP-B-636, using nonmetallic or tape bending only.

5.2.2 Level B. The packaged power controllers shall be packed in fiberboard containers conforming to PPP-B-636, class domestic, style optional, special requirement. Closures shall be in accordance with the appendix thereto. For Army procurement, fiberboard containers shall be class weather-resistant as specified in Level A.

5.2.3 Level C. The packaged power controllers shall be packed in shipping containers in a manner that will afford adequate protection against damage during shipment from the supply source to the first receiving activity. This pack shall conform to the applicable carrier rules and regulations.

5.2.4 Unitized loads. Unitized loads, commensurate with the level of packaging specified in the contract or order, shall be used whenever quantities for shipment to one destination equal 50 cubic feet or more.

5.2.4.1 Level A. Power controllers, packed as specified in 5.2.1, shall be placed on a pallet, load type 1, conforming to MIL-STD-147. A fiberboard cap, having two sides extending down the stacked load at least 12 inches, shall be positioned over the load to accommodate marking requirements. The cap shall be in accordance with PPP-F-320, class weather resistant. The load shall be strapped to the pallet.

5.2.4.2 Level B. Power controllers, packed as specified in 5.2.2, shall be unitized as specified in 5.4.2.1, except that fiberboard cap shall be class domestic. For Army use only, caps shall be weather resistant as specified in Level A.

5.2.4.3 Level C. Power controllers, packed as specified in 5.2.3, shall be unitized as specified in 5.2.4.1, except that pallet and cap shall be of the type, size, and kind commonly used for the purpose and shall conform to the applicable carrier rules and regulations.

5.3 Marking. In addition to any special marking required by the contract or order, each unit package, intermediate, and exterior container shall be marked in accordance with MIL-STD-129.

5.4 General. Exterior containers shall be of minimum tare and cube consistent with the protection required and shall contain equal quantities of identical stock numbered items to the greatest extent possible.

5.5 Inspection. Inspection of military packaging shall be in accordance with 4.7.3.

6. NOTES

6.1 Intended use. Power controllers conforming to this specification 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 in direct and alternating current (single or multiphase) electrical systems. Their principal areas of application are for aircraft, missiles, spacecraft, and ground

support equipment.This does not preclude the use of power controllers in other military applications.

6.2 Ordering data. Procurement documents should specify the following:

6.2.1 Category I (power controllers covered by specification sheets) (3.2.1).

(a) Title, number and date of this specification.

(b) Title, number and date of the applicable specification sheet, and the military part number.

(c) The packaging and packing level required (Section 5).

6.2.2 Category II (qualified controllers with modification) (3.2.2).

(a) Title, number, and date of this specification.

(b) Title, number, and date of applicable specification sheet for similar power controller.

(c) Military part number of similar qualified power controller.

(d) Manufacturer's part number of modified power controller.

(e) Details of the variations from the specification sheet.

(f) Inspection requirements (to verify variations from Category I power controllers)(4.6).

(1) Tests to be performed (if any)

(2) The laboratory at which inspection is to be performed.

(3) Samples and submission data, if other than that specified.

(g) The packaging and packing level specified (see Section 5).

6.3 Indirect shipments. The preservation and packaging, packing and marking specified in Section 5 apply only to direct purchases by or direct shipments to the Government and are not intended to apply to contracts or orders between the supplier and prime contractor.

6.4 Qualification. With respect to products requiring qualification, awards will be made only for such products as have, prior to the time set for opening bids, been tested and approved for inclusion in the applicable Qualified Products Lists whether or not such products have actually been so listed by this date. The attention of the suppliers is called to this requirement and manufacturers are urged to arrange to have the products they propose to offer to the Federal Government tested for qualification in order that they may be eligible to be awarded contracts or orders for the products covered by this specification. The activity responsible for the Qualified Products List is the NAVAIRSYSCOMHQ (Naval Air Systems Command), Washington, DC 20361, and information pertaining to qualification of products may be obtained from that activity.

6.4.1 Copies of "Provisions Governing Qualification SD-6" may be obtained upon application to the Commanding Officer, Naval Publications and Forms Center, 5801 Tabor Avenue, Philadelphia, PA 19120.

6.5 Definitions. The definitions listed below are not a complete glossary of solid state power controller terminology, but rather are intended as definitions of the technical terms as applied within this specification.

6.5.1 Power controller. A power controller is a 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 command 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 limits the current to a specified value.

6.5.2 INTENTIONALLY BLANK

6.5.3 INTENTIONALLY BLANK

6.5.4 Current limiting. A protective characteristic of a controller which limits the output current to a specified value. This limit thus defines the maximum value of overload current prior to tripping.

6.5.5 Trip. The automatic interruption of current which results from electrical overloads.

6.5.6 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.

6.5.7 Zero voltage turn on and zero current turn off. A characteristic that requires the power controller to turn ON and turn OFF only at the half-cycle zero crossing point when connected to a resistive load, regardless of when the control signal is applied or removed.

6.5.8 Trip time. The time lapse between the application of an overload or fault and the 10 percent value of rated output current.

6.5.9 Reset. The restoration of the tripped power controller to a state from which it can be turned ON.

6.5.10 Turn-on signal. The control signal level at which the power controller is turned ON.

6.5.11 Turn-off signal. The control signal level at which the power controller is turned OFF.

6.5.12 Supply voltage. The voltage applied between the power input terminal of the controller and the power ground.

6.5.13 Load voltage. The voltage between the power output terminal of the controller and the power ground.

6.5.14 Turn on time. See figure 3.

6.5.15 Turn off time. See figure 3.

6.5.16 Rise time. See (a) of figure 3.

6.5.17 Fall time. See (a) of figure 3.

6.5.18 INTENTIONALLY BLANK

6.5.19 ON state. That condition which, with the turn on signal applied, the device allows power to be passed to the load.

6.5.20 OFF state. That condition when the device prevents power from being passed to the load.

6.5.21 Short circuit. A short circuit is defined as a very low impedance applied between the output terminal and ground.

6.5.22 Application time to reset. The time interval the reset signal must be applied to cause reset (3.1).

6.5.23 Removal time to reset. The time interval the control signal must be removed before re-application to cause reset (3.1).

6.5.24 Nonrepetitive reset. The minimum specified (3.1) time interval between tripout and reset for which the trip charcteristics are valid.

6.5.25 Rupture current. The value of current in a circuit which reflects the capabilities of the power source without the effects of the controller.

6.5.26 Power dissipation. When the power controller is ON, the power dissipation shall include all power dissipated in the power switching circuit, power losses due to internal leakage currents, and power supplies. Control input and reset signals shall be excluded. When power controller is OFF, the power dissipation shall include only dissipation due to leakage currents and internal power supplies.

6.5.27 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)

Custodians:
Navy - AS
Air Force - 11
Army - ME

Review activity:
Air Force - 99

Preparing activity:
Navy - AS
(Project No. 6110-0028)

Table I (4.3)
MATERIALS INSPECTION

Material	Requirement Paragraph	Applicable Specification
Plastic	3.4.1	MIL-P-997, MIL-P-15037, MIL-P-15047, MIL-M-14
Ceramic	3.4.2	MIL-I-10
Rubber	3.4.5	ZZ-R-765

Table II (4.5.2)
QUALIFICATION INSPECTION

Examination or Test	Requirement Paragraph	Method Paragraph	No. of Sample Units To be Tested	No. of Failures Allowed
Group I				
Conditioning (run in)	[illegible]	[illegible]	[illegible]	[illegible]
Visual and mechanical examination: External	3.1, 3.4, 3.5, 3.17, 3.18	4.8.[illegible]		
Seal	3.8	[illegible]		
Dielectric withstanding voltage	[illegible]	[illegible]		
Insulation resistance	[illegible]	[illegible]		
Electrical characteristics:	3.11	[illegible]		
Turn off voltage	3.11.1	[illegible]		
Turn on voltage	3.11.1	[illegible]		
Turn off time	3.11.2	[illegible]		
Turn on time	3.11.2	[illegible]		
Load voltage rise and fall time	3.11.3	[illegible]		
Isolation	3.11.4	[illegible]		
Control input	3.11.5	[illegible]		
Voltage drop	3.11.6	[illegible]		
Leakage current	3.11.7	[illegible]		
Power dissipation	3.11.8	[illegible]		
Overload characteristics	3.11.9	4.8.7.9		
Coordination	3.11.10	4.8.7.10		
Rupture capacity	3.11.11	[illegible]		
Reset voltage	3.11.12	[illegible]		
Reset time	3.11.13	[illegible]		
State indication	3.11.14	[illegible]		
Reset immunity	3.11.15	[illegible]		
Ripple current	3.11.16	[illegible]		
Trip free characteristics	3.11.17	[illegible]		
Operating voltage transients	3.11.19	[illegible]		
Transient spike overvoltage	3.11.20	[illegible]		
Control input transients	3.11.22	[illegible]		
Zero voltage turn on and and zero current turn off	3.11.23	[illegible]		
Common mode rejection	[illegible]	[illegible]		
DC offset voltage	[illegible]	[illegible]		
Stabilization time	[illegible]			
Fail safe	[illegible]	[illegible]		
Group II				
Temperature shock	[illegible]	[illegible]	[illegible]	[illegible]
Vibration	[illegible]	[illegible]		
Acceleration	[illegible]	[illegible]		
Salt fog	[illegible]	[illegible]		
Temperature altitude	[illegible]	[illegible]		
Terminal strength	[illegible]	[illegible]		
Humidity	[illegible]	[illegible]		
Seal	[illegible]	[illegible]		
Operational temperature extremes	[illegible]	[illegible]		
Visual and mechanical examination	3.1, 3.4, 3.5, 3.17, 3.18	4.8.[illegible]		
Group III				
Electromagnetic compatibility	[illegible]	[illegible]	[illegible]	[illegible]
Terminal strength	[illegible]	[illegible]		
Shock	[illegible]	[illegible]		
Life (1)	[illegible]	[illegible]		
Seal	[illegible]	[illegible]		
Electrical characteristics	[illegible]	[illegible]		
Turn off voltage	[illegible]	[illegible]		
Turn on voltage	[illegible]	[illegible]		
Turn off time	[illegible]	[illegible]		
Turn on time	3.11.2	[illegible]		
Control input	[illegible]	[illegible]		
Output voltage drop	[illegible]	4.8.7.6		
Power dissipation	3.11.8	4.8.7.8		
Visual and mechanical examination	3.1, 3.4, 3.5, 3.17, 3.18	4.8.1		

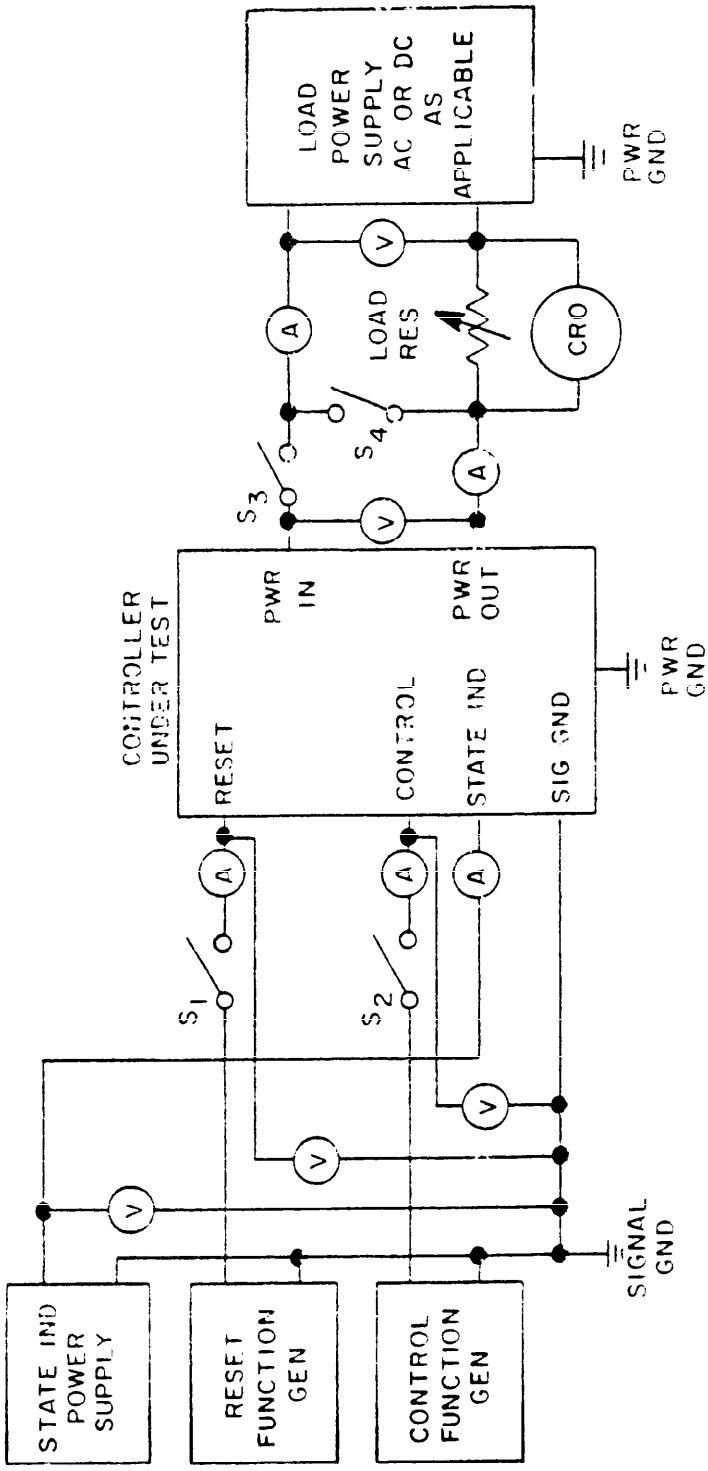
(1) Four extra samples (4 total of 8) shall be subjected to life test.

Table III (4.7.1.2)
GROUP A INSPECTION

Examination or Test	Requirement Paragraph	Method Paragraph	No. of Sample Units to be Inspected
I			
Conditioning (run-in)	3.6	4.8.2	
Dielectric withstanding voltage	3.9	4.8.5	100%
Insulation resistance	3.10	4.8.6	Inspection
Electrical characteristics:	3.11	4.8.7	
Turn off voltage	3.11.1	4.8.7.1	AQL Not
Turn on voltage	3.11.1	4.8.7.1	Applicable
Turn off time	3.11.2	4.8.7.2	
Turn on time	3.11.2	4.8.7.2	
Control input	3.11.5	4.8.7.5	
Voltage drop	3.11.6	4.8.7.6	
Leakage current	3.11.7	4.8.7.7	
Overload characteristics	3.11.9	4.8.7.9	
Coordination	3.11.10	4.8.7.10	
Reset voltage	3.11.12	4.8.7.12	
Reset time	3.11.13	4.8.7.13	
State indication	3.11.14	4.8.7.14	
Zero voltage crossover turn on and zero current cross-over turn off	3.11.23	4.8.7.23	
Common mode rejection	3.11.25	4.8.7.25	
DC offset voltage	3.11.26	4.8.7.26	
II			
Visual and mechanical examination (external)	3.1, 3.4, 3.5, 3.17, 3.18	4.8.1	100% Inspection AQL Percent Defective Major 1.0% Minor 4.0%

Table IV
GROUP B INSPECTION

Examination or Test	Requirement Paragraph	Method Paragraph	No. of Sample Units To be Tested	No. of Failures Allowed
Dielectric withstanding voltage	3.9	4.8.5	4	0
Insulation resistance	3.10	4.8.6		
Turn off voltage	3.11.1	4.8.7.1		
Turn on voltage	3.11.1	4.8.7.1		
Power Dissipation	3.11.8	4.8.7.8		
Operation voltage transient	3.11.19	4.8.7.19		
Temperature shock	3.13	4.8.9		
Seal	3.8	4.8.4		



NOTE: S_1 AND S_2 ARE BOUNCELESS SWITCHES.

FIGURE 1. TEST CIRCUIT (4.8.7, 4.8.8)

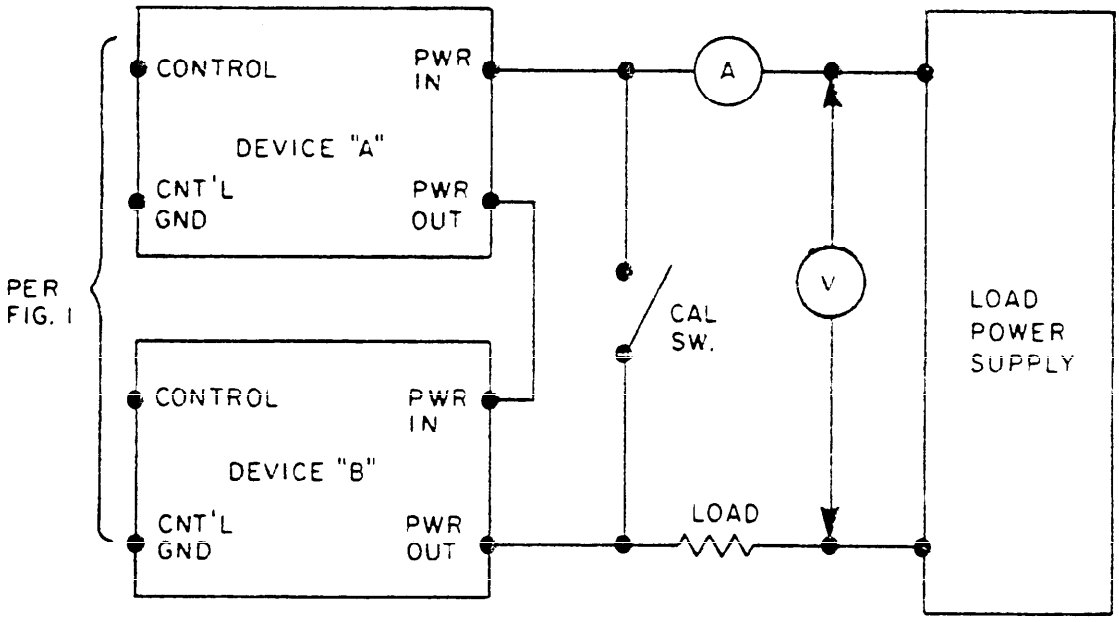


FIGURE 1A. TEST CIRCUIT (4.8.7.10)

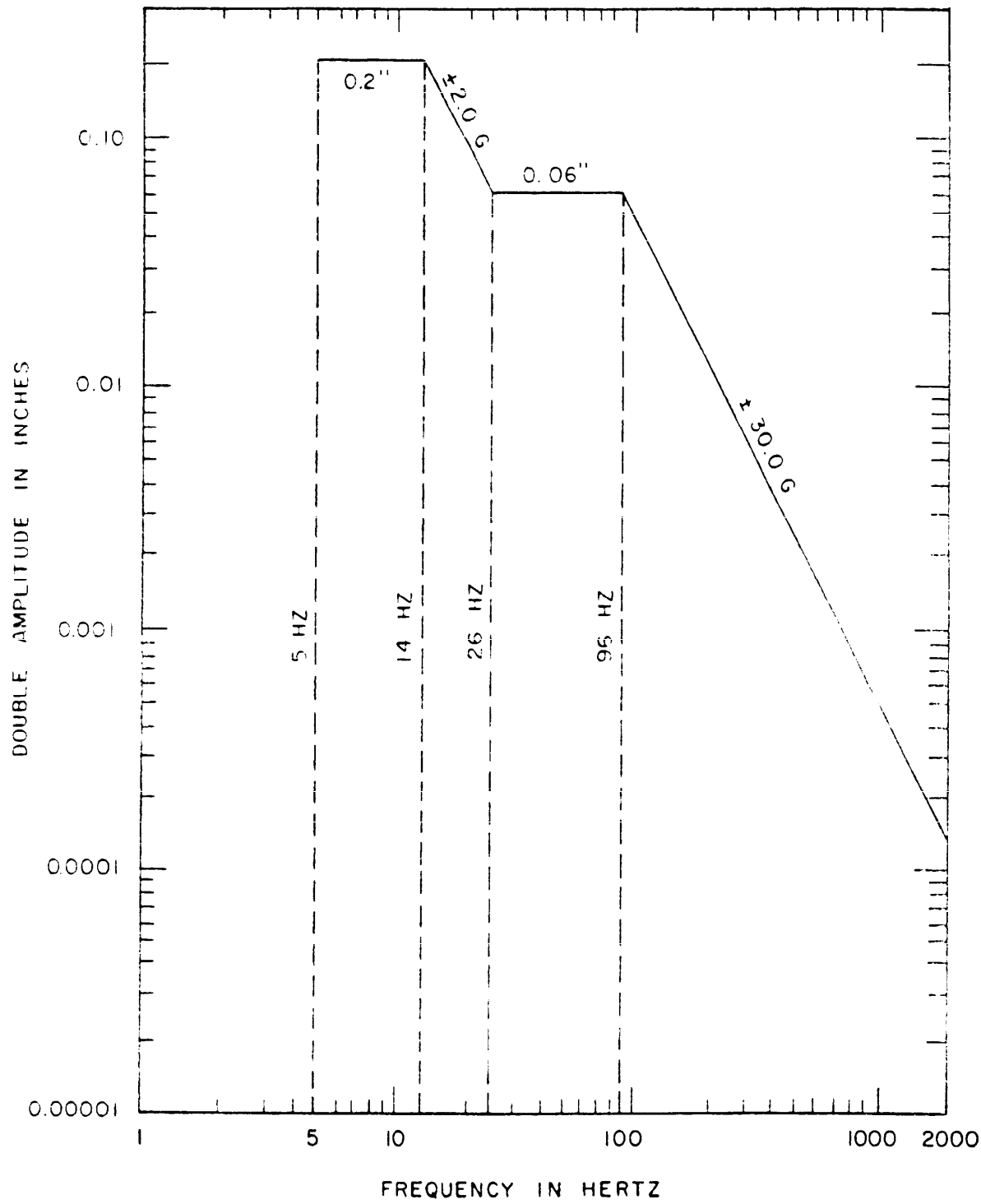


FIGURE 2. VIBRATION LEVEL CURVE (4.8.11)

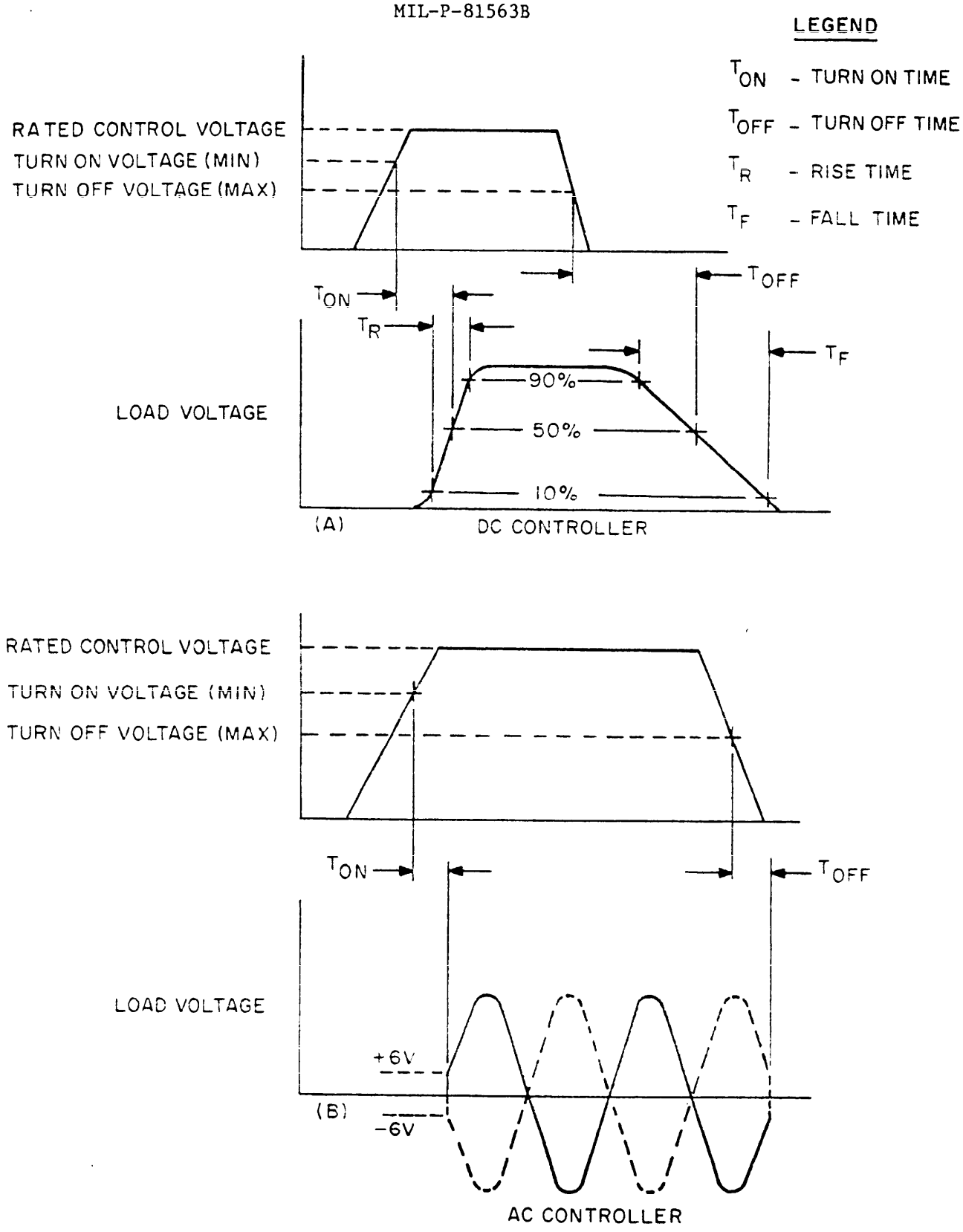


FIGURE 3. ILLUSTRATION OF TIMING CHARACTERISTICS
(6.5.14, 6.5.15, 6.5.16, 6.5.17)

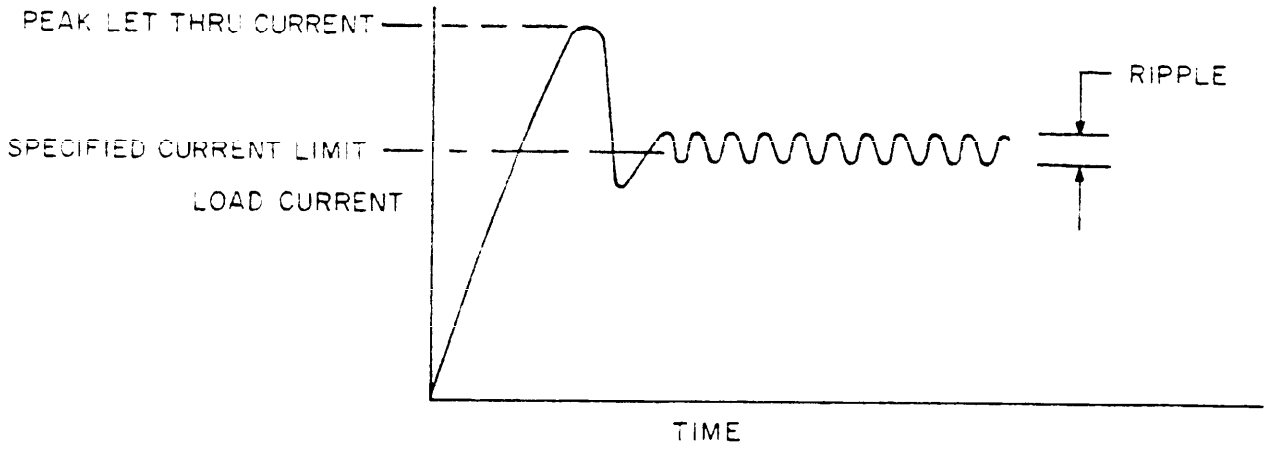


FIGURE 4. (6.5.27)

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