

MILITARY SPECIFICATION
SWITCH BOX, SA-1997/U

This specification is approved for use by the Naval Electronic Systems Command, Department of the Navy, and is available for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers requirements and tests for the SA-1997/U switch box, hereinafter referred to as the switch box. The switch box is part of the secure voice system of the communications subsystem for use on all naval platforms.

2. APPLICABLE DOCUMENTS

2.1 Government document.

2.1.1 Specifications, standards, and handbooks of the issue listed in the Department of Defense Index of Specifications and Standards (DoDISS) specified in the solicitation form a part of this specification to the extent specified herein.

SPECIFICATIONS

FEDERAL

QQ-N-290

Nickel Plating (Electrodeposited)

MILITARY

MIL-S-901

Shock Tests, H.I. (High-Impact), Shipboard Machinery, Equipment and Systems, Requirements for (Navy)

MIL-C-5015

Connector, Electrical, Circular Threaded, AN Type, General Specification for

MIL-E-16400

Electronic, Interior Communication and Navigation Equipment, Naval Ship and Shore, General Specification For

MIL-E-17555

Electronic and Electrical Equipment, Accessories, and Repair Parts, Packaging and Packing of

MIL-S-19500

Semiconductor Device, General Specification for

MIL-C-45204

Gold Plating, Electrode Deposited

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Naval Electronic Systems Command, Attn: ELEX 81111, Washington, D.C. 20360, by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

STANDARDS

MILITARY

MIL-STD-105	Sampling Procedures and Tables for Inspection by Attributes
MIL-STD-108	Definition of and Basic Requirement for Enclosures for Electric and Electronic Equipment
MIL-STD-109	Quality Assurance Terms and Definitions
MIL-STD-167-1	Mechanical Vibrations of Shipboard Equipment (Type I - Environmental and Type I - Internally Excited)
MIL-STD-242	Electronic Equipment Parts, Selected Standards
MIL-STD-454	Standard General Requirements for Electronic Equipment
MIL-STD-461	Electromagnetic Emission and Susceptibility Requirements for The Control of Electromagnetic Interference
MIL-STD-462	Electromagnetic Interference Characteristics, Measurement of
MIL-STD-965	Parts Control Program
MIL-STD-1310	Shipboard Bonding, Grounding, and Other Techniques for Electromagnetic Compatibility and Safety

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

3. REQUIREMENTS

3.1 General. The switch box shall be capable of providing for the selection and switching of up to 10 specified voice channels to a secure telephone on any service. The switch box will enable any one of 10 secure voice channels (comprised of 10 active wires each) to be routed to a secure telephone interface by means of channel switch box. The switch box shall conform to the requirements of MIL-E-16400, to the extent specified herein. The selector switch may be deck, shelf or overhead mounted by means of four 10-32 tapped holes located in both the top and bottom of the enclosure. Enclosure grounding shall be in accordance with MIL-STD-1310.

3.2 First article. When specified, a sample shall be subjected to first article inspection (see 4.3 and 6.2).

3.3 Characteristics.

3.3.1 Performance characteristics. The switch box shall be capable of switching any one of 10 (10 active wires each) voice channels to one remote voice position. The switch box shall be in accordance with the requirements specified in 3.3.1.1 through 3.3.1.8.

3.3.1.1 Push and pull operation. The switch box shall permit the selection of any switch position. The switch knob, when pushed in, shall effect the contact closure and prevent rotation of the switch. The switch knob, when pulled out, shall effect the contact opening and allow the switch to be rotated to any selected position.

3.3.1.2 Signals. The switch box shall be capable of switching signals on the 10 active wires to the output cable. The switch box shall be capable of performing switching functions for the input signals having the characteristics specified in 3.3.1.2.1 through 3.3.1.2.3.

3.3.1.2.1 Transmit audio pair. The transmit audio signal shall have a level from the telephone of 0 decibels referred to one milliwatt (dBm) nominal, + 14 dBm maximum and a frequency response of 150 hertz (HZ) to 4 kilohertz (KHZ) \pm 3 decibels (dB).

3.3.1.2.2 Receive audio pair. The receive audio signal shall have a level of 0 dBm nominal, + 10 dBm maximum and a frequency response of 150 Hz to 4 kHz \pm 6 dB.

3.3.1.2.3 Switched straight through circuits. The push-to-talk (PTT), signal ground, + 24 volts direct current (VDC), mode indicator, hook switch ground, and mode select line shall also be switched and shall conform to the requirements specified in a through d.

- a. Resistance of closed contact: 0.1 ohms maximum
- b. Resistance of open contact: 100 Kilo (k) ohms minimum
- c. Current: 400 milliamperes (mA), noninductive
- d. Voltage: + 24 VDC

3.3.1.3 Signal isolation. The cross-talk isolation shall be not less than 80dB between the transmit and receive audio pairs of each of the 10 voice channels and between each audio pair of a selected channel, and any other pair connected to the switch box as measured with a selected channel, and any other pair connected to the switch box with a 1000 Hz signal across a 600 ohm impedance.

3.3.1.4 Contact resistance. The switch contacts shall have a through-point contact resistance of not greater than 0.1 ohm.

3.3.1.5 Switching current capacity. The switch contacts shall be capable of switching not less than 0.125 ampere at 120 VDC make or break.

3.3.1.6 Wafer coating. The switch wafer conductors shall be printed wiring on insulated material with a conductor surface coating of gold plating with a minimum thickness of 50 millionths of an inch in accordance with MIL-G-45204, over 0.0002 inch of nickel plating in accordance with QQ-N-290.

3.3.1.7 Rotor contacts. The switch contacts shall be made of phosphor-bronze with a gold plating thickness of not less than 50 millionths of an inch over not less than 50 millionths of an inch of nickel in accordance with MIL-G-45204 and QQ-N-290, respectively.

3.3.1.8 Wiring. The switch box shall be wired so that all lines which comprise a single voice channel shall be switched simultaneously upon selection of a channel.

3.3.2 Physical characteristics. The switch box shall conform to the requirements specified in 3.3.2.1 and 3.3.2.2.

3.3.2.1 Size. The switch box dimensions in the operational configuration, exclusive of associated external cables and switch knob, shall not exceed a through c:

- a. Height: 20.32 centimeters (cm) (8 inches (in))
- b. Width: 17.78 cm (7 in)
- c. Depth: 17.27 cm (6.8 in)

3.3.2.2 Weight. The weight of the switch box, exclusive of associated external cables, shall not exceed 3.18 kilograms (kg) (7 pounds (lbs)).

3.3.3 Reliability. The quantitative reliability requirements expressed in mean-cycle-between-failures (MCBF) shall be no less than 100,000 operations which is specified as a 360-degree sweep of the selector switch knob with a circuit connection made at each of the 10 positions during the 360-degree rotation.

3.3.4 Maintainability requirements. The mean-time-to-repair (MTTR) shall not exceed 0.7 hours. The maximum repair time shall not exceed 1.75 hours.

3.3.5 Environmental service conditions. The switch box shall be utilized in sheltered areas. The switch box shall be capable of continuous reliable operation, within the performance characteristics specified in 3.3.1, under the requirements specified in 3.3.5.1 through 3.3.5.4. The switch box shall operate within tolerances throughout the tests specified herein without alignment or adjustment, other than accessible controls utilized during normal operations.

3.3.5.1 Operating temperature range. The switch box will be utilized in a sheltered area and shall maintain specified performance when exposed to the high and low operating temperature range after being subjected to the non-operating temperatures of Range 4 of MIL-E-16400.

3.3.5.2 Non-operating temperature range. The switch box shall not be damaged nor shall operational performance be degraded when restored to the operating temperature range after being subjected to the non-operating temperatures of Range 4 of MIL-E-16400.

3.3.5.3 Shock. The switch box shall be designed to conform to the shock requirements of MIL-S-901, Grade A.

3.3.5.4 Vibration. The switch box shall withstand an environmental vibration in accordance with MIL-STD-167-1, Type 1.

3.3.6 Electromagnetic susceptibility. The switch box shall conform to the requirements of RS01 and RS03 of MIL-STD-461, except as specified in a and b.

- a. The limits of FIGURE 1 shall be used for RS01.
- b. RS03 shall be performed at 10 volts per meter from 150 kHz to 30 megahertz (MHz), modulated 50 percent at 1000 Hz.

3.4 Parts, materials and processes. Parts, materials and processes shall conform to the requirements specified in 3.4.1. and 3.4.2.

3.4.1 Parts control. The parts to be used in the switch box shall be controlled in accordance with MIL-STD-965, Procedure 1.

3.4.2 Selection of parts. Selection of parts shall conform to MIL-STD-242.

3.5 Maintenance design. Maintenance design shall be as specified in 3.5.1. and 3.5.2.

3.5.1 Accessibility. Switch assemblies shall be arranged so that access to any assembly will not require removing any other assembly or parts except access panels.

3.5.2 Removable wafer feature. The switch box shall employ removable wafer sections, allowing replacement without unsoldering or switch box disassembly.

3.6 Mechanical design and construction. Mechanical design and construction shall be as specified in 3.6.1 through 3.6.5.

3.6.1 Degree of enclosure. Enclosures shall conform to the requirements of MIL-STD-108. The degree of enclosure shall be dripproof (45 degrees) as specified in MIL-STD-108.

3.6.2 Connectors (external). The connectors shall be selected in accordance with Class D of MIL-C-5015. A captive metal cap shall be provided for all connectors.

3.6.3 Front panel. The front panel shall contain the numbers 1 to 10 evenly spaced around the selector knob. The numbers shall be at least 0.476 cm (0.1875 (3/16) in) high.

3.6.4 Designation strip holders. Designation strip holders shall be provided on the front panel for identifying the channel number or circuit name, or both, relationship for the ten channels.

3.6.5 Selector knob. There shall be a selector knob on the front panel. The knob shall be capable of being easily gripped by an operator, readily pulled out, turned, and pushed in. The selector knob shall contain a pointer.

3.7 Workmanship.

3.7.1 General workmanship. Workmanship shall conform to Requirement 9 of MIL-STD-454. Soldering shall conform to Requirement 5 of MIL-STD-454.

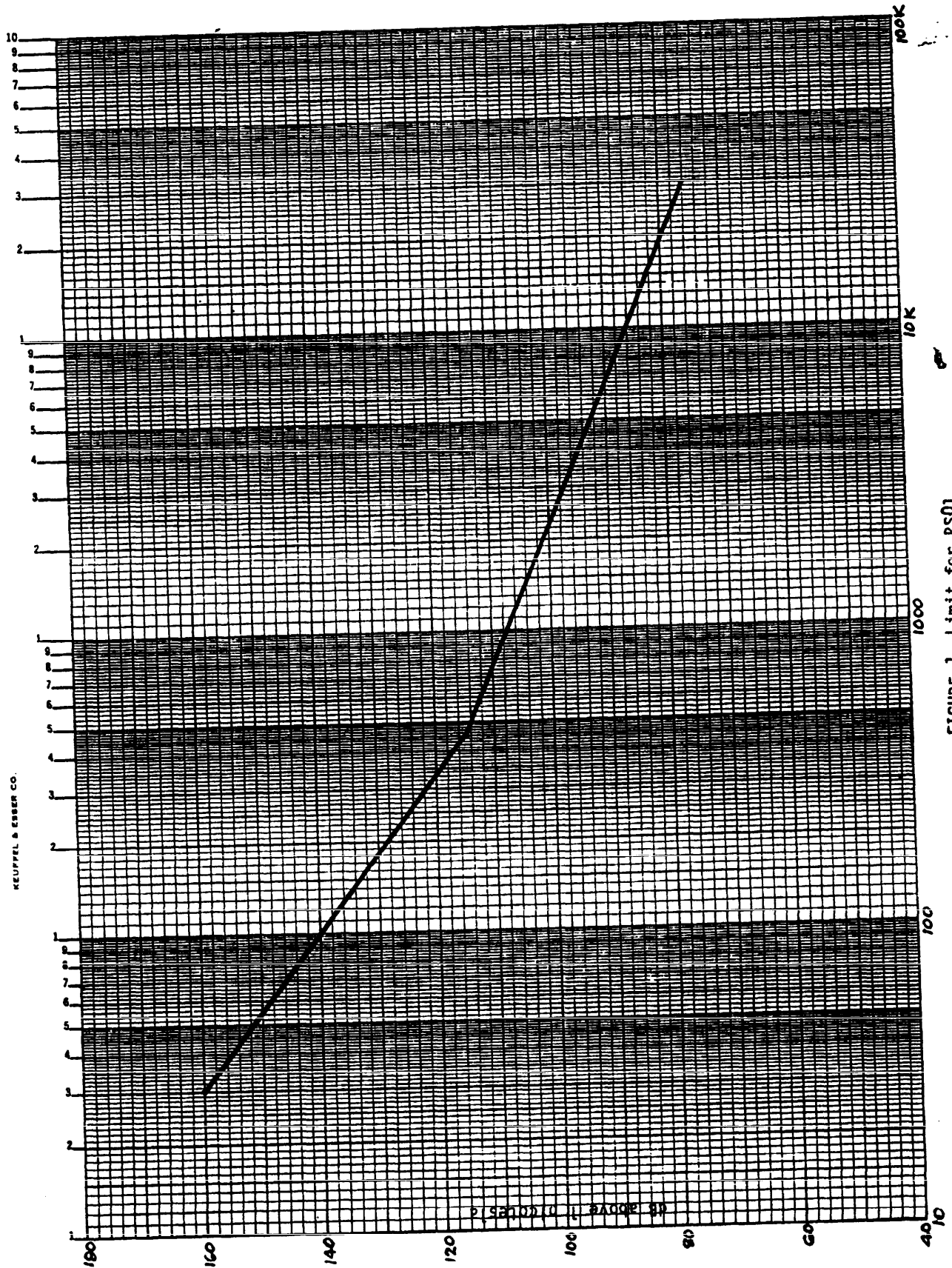


FIGURE 1. Limit for RSDI.

3.7.2 Workmanship screen. The selector switch shall withstand a defect detection vibration screen of random type vibration at $0.04g^2/Hz \pm 3$ dB from 80 Hz to 350 Hz and temperature cycling as specified in 4.4.1.2.1 and 4.4.1.2.2.

3.8 Safety. The switch box shall conform to the requirements of the paragraphs specified in a through d of MIL-STD-454, Requirement 1:

- a. Ground potential
- b. Guards and barriers
- c. Connectors, electrical
- d. Signs

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the contractor is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract or purchase order, the contractor 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 the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

4.1.1 Government verification. All quality assurance operations performed by the contractor will be subject to Government verification at any time. Verification will consist of a) Surveillance of the operations to determine that practices, methods, and procedures of the written quality program are being properly applied, b) Government product inspection to measure quality of the product to be offered for acceptance, c) Government inspection of delivered products to assure compliance with this specification. Failure of the contractor to promptly correct deficiencies discovered by him or of which he is notified shall be cause for suspension of acceptance until corrective action has been taken or until conformance of the product to prescribed criteria has been demonstrated.

4.1.2 Quality assurance terms and definitions. Quality assurance terms used in this specification shall be defined in MIL-STD-109.

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

- a. First article inspection (see 4.3)
- b. Quality conformance inspection (see 4.4)
 - 1. In-process inspection (see 4.4.1)
 - 2. Production inspection (see 4.4.2)
 - 3. Production control inspection (see 4.4.3)
 - 4. Environmental inspection (see 4.4.4)
- c. Reliability testing (see 4.6)
- d. Maintainability demonstration (see 4.7)
- e. Inspection of preparation for delivery (see 4.8)

4.3 First article inspection. Unless otherwise specified (see 6.2), one unit shall be required for first article inspection. First article inspection shall consist of all examination and testing necessary to determine compliance with the requirements of this specification. First article inspection shall include the tests specified in 4.4.2, 4.4.3, 4.4.4 and the additional first article inspections given in TABLE I.

TABLE I. Additional first article inspections.

Inspection or test	Requirement paragraph	Test paragraph
Performance	3.3.1	4.5
Push and Pull operation	3.3.1.1	4.5.7
Signals	3.3.1.2	4.5.2
Switching current capacity	3.3.1.5	4.5.1
Wafer coating	3.3.1.6	4.5.8
Rotor contacts	3.3.1.7	4.5.9
Shock	3.3.5.3	4.5
Vibration	3.3.5.4	4.5
Parts, materials, and processes	3.4	4.5
Accessibility	3.5.1	4.5.10
Removable wafer feature	3.5.2	4.5.11
Connectors	3.6.2	4.5
Reliability	3.3.3	4.6
Selector knob	3.6.5	4.5.13
General workmanship	3.7.1	4.4.1.1

4.4 Quality conformance inspection.

4.4.1 In-process inspections. Each switch box shall be subjected to the inspections of 4.4.1.1 through 4.4.4.3.

4.4.1.1 General workmanship. The switch box, including subassemblies and assemblies, shall be examined for workmanship and soldering during the fabrication and assembly process to ensure conformance to the requirements of 3.7.1.

4.4.1.2 Workmanship screen. Prior to conducting temperature cycling, vibration shall be performed on each switch box. The vibration may be performed at the assembly drawer, or end item level. All the hardware, including cables and connectors, shall be exposed to vibration.

4.4.1.2.1 Random vibration. The vibration shall be random, or subject to procuring activity approval, pseudo-random or complex wave-form vibration, for an accumulated time of 10 minutes in the axis deemed most susceptible to vibration excitation. All items shall be hard-mounted (without shock isolators) and shall be subjected to the vibration conditions of FIGURE 2. The control accelerometer shall be located next to one of the mounting points of the item under vibration. Switch boxes having a bandwidth no greater than 10 Hz for vibration frequencies up to 500 Hz and 100 Hz for vibration frequencies above 500 Hz shall be used for a control and analysis of the acceleration spectral density (ASD). The item shall be energized during vibration and appropriate input signals applied to observe any abnormal conditions of the output functional characteristics. All failures occurring during test shall be corrected and the vibration resumed.

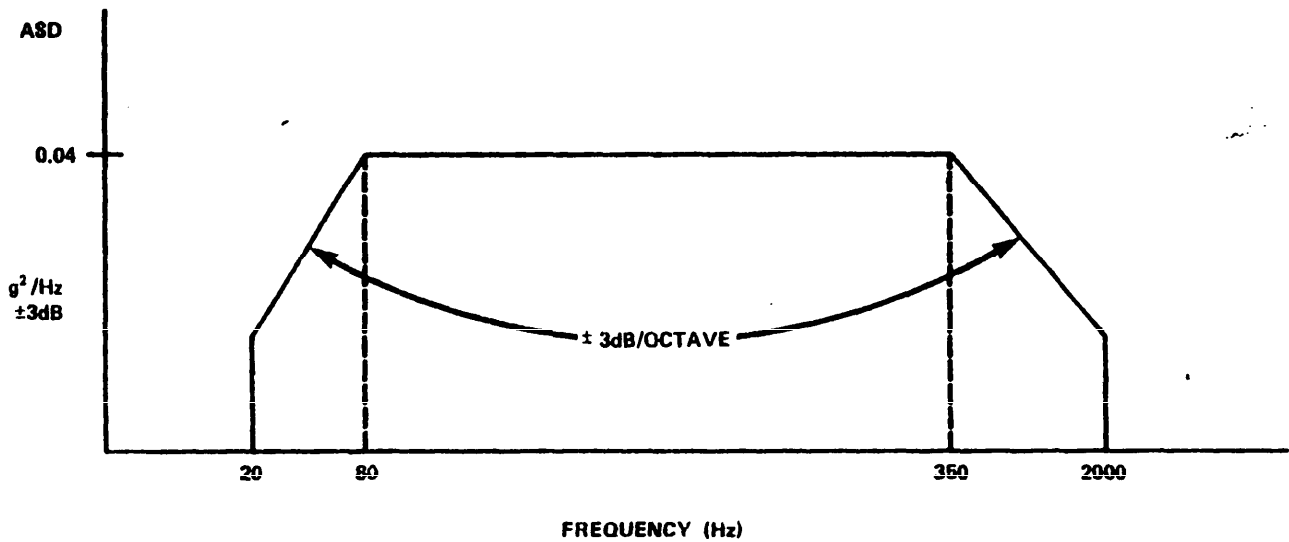


FIGURE 2. Random vibration curve.

4.4.1.2.2 Temperature cycling. Each switch box shall be subjected to 10 cycles of the temperature curve indicated below. The temperature rate of change shall be not less than 5° centigrade (C) per minute. Switch box power shall be turned on and off at the indicated times. The switch box shall be positioned for maximum exposure to the changing temperature. Where performance measurements are called for, a minimal functional operating test shall be performed. The dwell time shall be maintained until the largest electrical or electronic part in the switch box reaches 80 percent of the chamber temperature. When failures occur, the switch box shall be reworked and the cycling continued for a cumulative total of 10 cycles.

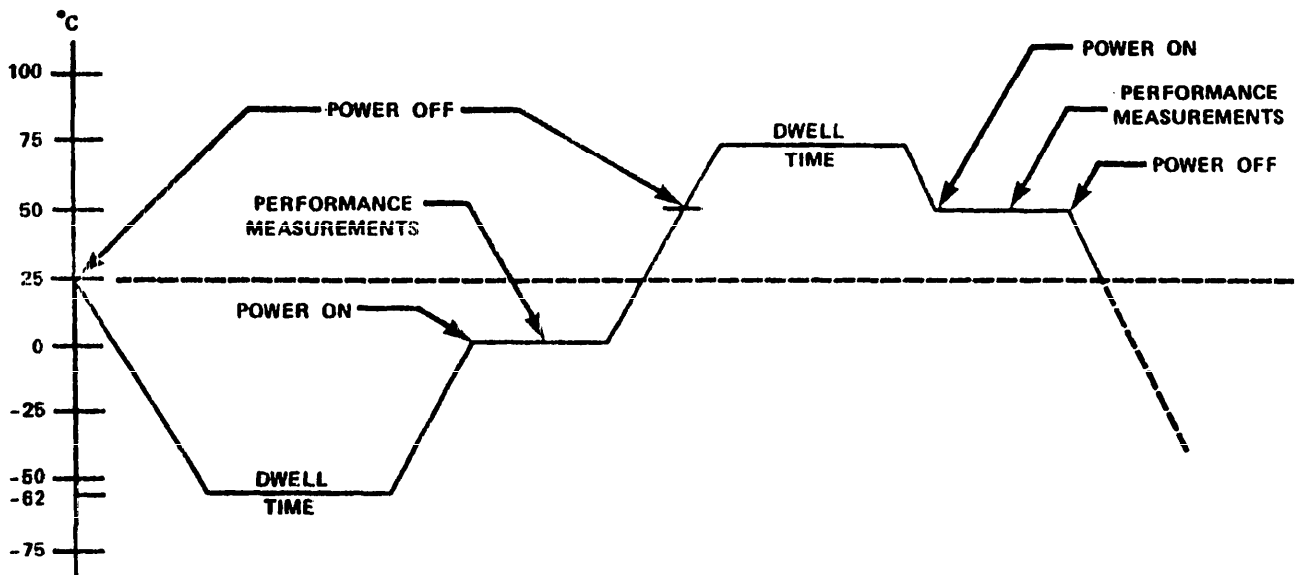


FIGURE 3. Temperature curve (one cycle).

4.4.2 Production inspection. Production inspection shall be made on every switch box offered for delivery. The inspection shall comprise such examination and testing as will prove the workmanship and reveal any omissions and errors of the production process, such as functional and performance tests at a limited number of points, tests which detect deviations from design, tests of adjustment, and tests which detect hidden defects of material. Production inspection shall include the inspections shown in TABLE II.

TABLE II Production inspection.

Inspection or test	Requirement paragraph	Test paragraph
Contact resistance	3.3.1.4	4.5.4
Front panel	3.6.3	4.5.12
Designation strip holders	3.6.4	4.4.1.1
Safety	3.8	4.5.14

4.4.3 Production control inspection. Production control inspection, including sampling, shall conform to TABLE II and to the inspection procedures of MIL-STD-105, using the special inspection levels. The inspection level shall be S-3 for normal, tightened, and reduced inspection. Production control inspection shall be performed on switch boxes that have passed production inspection. The switch box shall satisfactorily conform to the requirements of production control inspection prior to release for shipment.

TABLE II Production control inspection.

Inspection or test	Requirement paragraph	Test paragraph	AQL percent
Signal isolation	3.3.1.3	4.5.5	6.5
Size <u>1</u>	3.3.2.1	4.5	6.5
Weight <u>1</u>	3.3.2.2	4.5.	6.5
<u>1</u> Size and weight need only be performed on the first lot produced.			

4.4.3.1 Rejected lots. If an inspection lot is rejected, the contractor may withdraw the lot from further inspection. The contractor may also rework a rejected lot to correct the defective switch boxes and reinspect the lot, using tightened inspection. Rejected lots shall be kept separate from new lots and shall not lose identity.

4.4.4 Environmental inspection. Environmental inspection shall be as listed in TABLE III and shall be performed on switch boxes which have been subjected to and have passed production inspection. (see 6.4.)

TABLE III. Environmental inspection.

Inspection or test	Requirement paragraph	Test paragraph
Temperature, operating	3.3.5.1	4.5
Temperature, non-operating	3.3.5.2	4.5
Electromagnetic susceptibility	3.3.6	4.5.6
Degree of enclosure	3.6.1	MIL-STD-108

4.4.4.1 Sampling for environmental inspection. One switch box shall be selected from each successive 50 switch boxes, or fraction thereof, produced. The first sample switch box shall be selected from the first month's production.

4.4.4.2 Nonconforming environmental sample switch boxes. If a sample switch box fails the inspection specified in 4.4.4, the contractor shall immediately investigate the cause of failure and shall report to the Quality Assurance Representative the results thereof and details of the corrective action taken to correct switch box of product which were manufactured under the same conditions, with the same materials, processes, and so forth. If the Quality Assurance Representative does not consider that the corrective action will enable the product to conform to the specified requirements, or if the contractor cannot determine the cause of failure, the matter shall be referred to the contracting officer (see 6.4).

4.4.4.3 Reinspection of conforming environmental sample switch boxes. Unless otherwise specified in the contract (see 6.2), sample switch boxes which have been subjected to, and have passed, environmental tests may be accepted on the contract provided they are resubjected to, and pass, production inspection after repair of all damage.

4.5 Test Methods Examinations and tests. Examinations and tests shall be conducted in accordance with the applicable tests methods of MIL-E-16400, except as specified in 4.5.1 through 4.5.14.

4.5.1 Switching current capacity test. A current switching test shall be performed on the completely assembled switch box to demonstrate conformance to the requirements of 3.3.1.5.

4.5.2 Signal handling tests. The switch box shall be tested to determine compliance with all the signal handling characteristics of 3.3.1.2.

4.5.3 Connector examination. Connectors shall be examined to determine conformance to the requirements of 3.6.2.

4.5.4 Contact resistance measurement. Each switch contact shall be measured for contact resistance after assembly of the switch box is completed.

4.5.5 Isolation test. The switch box shall be checked for isolation (see 3.3.1.3) utilizing the standard test tone frequency of 1000 Hz \pm 25 Hz introduced at an input level of + 4dBm.

4.5.6 Electromagnetic susceptibility test. The requirements of 3.3.6 shall be verified by tests performed in accordance with MIL-STD-462.

4.5.7 Push and Pull operation. A test shall be performed which will demonstrate push and pull and make or break operation for each switch on the switch box.

4.5.8 Wafer coating. A sample of the printed wiring switch conductors shall be examined to determine correct thickness and adhesion of coatings.

4.5.9 Rotor Contacts. A sample of the rotor contacts shall be examined to determine correct thickness and adhesion of coatings.

4.5.10 Accessibility. The contractor shall demonstrate access to all modules without the removal of any other module.

4.5.11 Removable wafer feature. The contractor shall demonstrate that wafer sections from any switch shall be easily removable without unsoldering any connections or disassembly of the box.

4.5.12 Front panel. Numbers around the front panel shall be examined for compliance with 3.6.3.

4.5.13 Selector knob. The selector knob shall be examined for compliance with 3.6.5.

4.5.14 Safety. The switch box shall be examined for compliance with the safety requirements identified in 3.8.

4.6 Reliability testing.

4.6.1 Rotary switch life. Each rotary switch shall be subjected to a contact reliability test to demonstrate a minimum life of 25,000 operations before failure.

4.6.2 Test conditions. Testing shall be performed at an ambient temperature of $\pm 50^{\circ}\text{C}$. Input current and voltage levels shall be as specified in 3.3.1.2. The switching rate shall be determined by the contractor but shall not result in excessive internal heating of the device. A switching-sequence shall be established which will approximate actual service usage of the switch when installed in the switch box.

4.6.3 Accept or reject criteria. Accept or reject criteria shall be in accordance with TABLE C-1 of MIL-S-19500 using a lot tolerance percent defective of 20 and an acceptance number (C) not to exceed 2. Each test sample shall be cycled for a minimum of 25,000 operations and shall be considered defective if it experiences a contact failure or exhibits intermittent electrical operation prior to 25,000 operations.

4.6.4 Disposition of test samples. Switches subjected to the life test shall neither be installed in deliverable equipments nor delivered to the Government as part of a contractor quantity of spare parts.

4.7 Maintainability demonstration. The MTTR requirement of 3.3.4 shall be tested by demonstration.

4.8 Inspection of preparation for delivery. Inspections shall be conducted to ensure conformance with the requirements of Section 5.

5. PACKAGING

(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 contractors shall be specified in the individual order.)

5.1 Preservation, packaging, packing, and marking. Unless otherwise specified, preparation for delivery shall be in accordance with the applicable levels of preservation, packaging, packing, and marking specified in MIL-E-17555 (see 6.2).

6. NOTES

6.1 Intended use. The switch boxes covered by this specification are intended for use onboard ships, in shore installations, and in aircraft.

6.2 Ordering data. Procurement documents should specify the following:

- a. Title, number, and date of this specification
- b. Number of first articles if other than specified in 4.3
- c. When conforming environmental sample units may not be accepted on the contract (see 4.4.4.3)
- d. Applicable levels of preservation, packaging, packing, and marking (see 5.1)

6.3 First article. When a first article is required, it shall be tested and approved under the appropriate provisions of 7-104.55 of the Defense Acquisition Regulation (DAR). The first article should be a first production item. The first article should consist of one unit. The contracting officer should include specific instructions in all procurement instruments, regarding arrangements for examinations, tests, and approval of the first article.

6.4 Environmental inspection. Approval to ship may be withheld at the discretion of the Government, pending the decision from the contracting officer on the adequacy of corrective action (see 4.4.4.2).

6.5 Data requirements. When this specification is used in an acquisition which incorporates a DD Form 1423, Contract Data Requirements List (CDRL), the data requirements identified below shall be developed as specified by an approved Data Item Description (DD Form 1664) and delivered in accordance with the approved CDRL incorporated into the contract. When the provisions of DAR 7-104.9 (n) (2) are invoked and the DD Form 1423 is not used, the data specified below shall be delivered by the contractor in accordance with the contract or purchase order requirements. Deliverable data required by this specification is cited in the following paragraphs.

<u>Paragraph No.</u>	<u>Data requirement title</u>	<u>Applicable DID no Option</u>
4.5	Procedures, Test	UDI-T-22710
4.4	Report, Quality Conformance Inspection	UDI-R-22572
3.4	Nonstandard Part Approval/Requests Proposed Additions to an approved PPSL	DI-E-7027
4.3	Report, First Article Inspection	DI-T-4902

(Data item descriptions related to this specification, and identified in section 6 will be approved and listed as such in DOD 5000.19L., Vol. II, AMSDL. Copies of data item descriptions required by the contractors in connection with specific acquisition functions should be obtained from the Naval Publications and Forms Center or as directed by the contracting officer.)

Preparing Activity
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(Project 5805-N306)

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NOTE: This form shall not be used to submit requests for waivers, deviations or clarification of specification requirements on current contracts. Comments submitted on this form do not constitute or imply authorization to waive any portion of the referenced document(s) or to amend contractual requirements.

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MIL-3-28868

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