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DETAIL SPECIFICATION

SWITCHES, ANTENNA, RADIO FREQUENCY, 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 solid-state antenna switches for use at radio frequencies (see 6.1).

1.2 Part or Identifying Number (PIN). The PIN is to be as follows:

M83739/	1	-01
Military designator	Specification sheet number	dash number

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3 and 4 of this specification. This section does not include documents cited in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements documents cited in sections 3 and 4 of this specification, whether or not they are listed.

2.2 Government documents.

2.2.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract (see 6.2).

MIL-DTL-3643	-	Connectors, Coaxial, Radio Frequency, Series HN, and Associated Fittings, General Specification For.
MIL-DTL-5541	-	Chemical Conversion Coatings on Aluminum and Aluminum Alloys.
MIL-DTL-14072	-	Finishes for Ground Based Electronic Equipment.
MIL-PRF-19500	-	Semiconductor Devices, General Specification For.
MIL-PRF-31032	-	Printed Circuit Board/Printed Wiring Board, General Specification For.
MIL-PRF-38535	-	Integrated Circuits (Microcircuits) Manufacturing, General Specification For.
MIL-PRF-39012	-	Connectors, Coaxial, Radio Frequency; General Specification For.
MIL-DTL-83723	-	Connector, Electrical (Circular, Environmental Resisting) Receptacles and Plugs, General Specification For.

Comments, suggestions or questions on this document should be addressed to DLA Land and Maritime, ATTN: VAT, Post Office Box 3990, Columbus, OH 43218-3990, or emailed to Tubesamps@dla.mil. Since contact information can change, you may want to verify the currency of this address information using the ASSIST Online database at https://assist.daps.dla.mil.

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DEPARTMENT OF DEFENSE STANDARDS

MIL-STD-202	-	Electronic and Electrical Component Parts.
MIL-STD-461	-	Requirements for the Control of Electromagnetic Interference Characteristics of Subsystems and Equipment.
MIL-STD-889	-	Dissimilar Metals.
MIL-STD-1285	-	Marking of Electrical and Electronic Parts.

(Unless otherwise indicated, copies of the above specifications, standards, and handbooks are available from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094 and are available online at https://assist.daps.dla.mil/.)

2.3 Non-Government publications. The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract (see 6.2).

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)

ISO 10012	-	Measurement Management Systems - Requirements for Measurement Processes and Measuring Equipment.

(Copies are available online at http://iso.org or http://www.iso.org/iso/home.htm or from American National Standards Institute, 13th Floor, 11 West 42nd Street, New York, NY 10036-0350.)

NATIONAL CONFERENCE OF STANDARDS LABORATORIES (NCSL)

NCSL Z540.3	-	Calibration Laboratories and Measuring and Test Equipment.

(Copies of the above document are available at National Conference of Standards Laboratories (NCSL), 2995 Wilderness Place Suite 107, Boulder, CO 80301-5404, United States, or at http://www.ncsli.org.)

2.4 Order of precedence. Unless otherwise noted herein or in the contract, in the event of a conflict between the text of this document and the references cited herein (except for related specification sheets), the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 Specification sheets. The individual item requirements shall be as specified herein and in accordance with the applicable specification sheet (see 6.2).

3.2 First article acceptance. Antenna switches furnished under this specification shall be products which pass first article acceptance testing (see 4.5 and 6.3).

3.3 Reliability. Reliability of switches furnished under this specification shall be established and maintained in accordance with suitable procedures and requirements.

3.4 Materials. The materials shall be as specified herein. However, when materials are other than specified herein, a material shall be used which will enable the switches to meet the requirements of this specification. Acceptance or approval of any constituent material shall not be construed as a guaranty of the acceptance of the finished product (see 4.3).

3.4.1 Finish. If the body of a switch is painted, it shall be painted with a semi-gloss or dull black enamel finish in accordance with type II of MIL-DTL-14072. Unless otherwise specified (see 6.2), all aluminum not intended to make electrical contact shall be treated in accordance with MIL-DTL-5541, class 3.

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3.4.2 Dissimilar metals. Unless suitably protected against electrolytic corrosion, dissimilar metals shall not be used in intimate contact with each other. Dissimilar metals are defined in MIL-STD-889.

3.4.3 Fungus inert. Materials used in the construction of switches shall be fungus inert (see 6.4 and table I).

3.4.4 Pure tin. The use of pure tin, as an underplate or final finish, is prohibited both internally and externally. Tin content of antenna switch components and solder shall not exceed 97 percent by mass. Tin shall be alloyed with a minimum of 3 percent lead, by mass (see 6.6).

3.5 Design and construction.

3.5.1 Dimensions, mounting, and weight. Envelope dimensions, mounting, mounting dimensions, connector arrangement, and weight shall be as specified (see 3.1).

3.5.2 Micro-electronic circuits. Micro-electronic circuits shall be in accordance with MIL-PRF-38535, class B minimum. The design shall incorporate a minimum number of components.

3.5.3 Semiconductors. Semiconductors shall be in accordance with MIL-PRF-19500, TX or TXV level.

3.5.4 Printed circuit boards. Printed circuit boards shall be in accordance with MIL-PRF-31032.

3.5.5 Connectors.

3.5.5.1 Radio frequency (RF) connectors. Connectors for a specific switch shall be as required (see 3.1). Material, design, and construction of the types listed below shall conform to the specifications as follows:

Type of RF connector	Specification
N	MIL-PRF-39012
TNC	MIL-PRF-39012
BNC	MIL-PRF-39012
SMA	MIL-PRF-39012
SMC	MIL-PRF-39012
SC	MIL-PRF-39012
C	MIL-PRF-39012
HN	MIL-DTL-3643

3.5.5.2 Power connectors. Connectors for a specific switch shall be as required (see 3.1). Materials, design, and construction shall conform to MIL-DTL-83723.

3.5.6 Configuration. Switches shall be furnished with the number of positions specified (see 3.1).

3.5.7 Sequence. Unless otherwise specified (see 3.1), switches shall have a break-before-make or make-before-break sequence of operation.

3.5.8 Nominal impedance. Nominal impedance shall be as specified (see 3.1).

3.5.9 Maintainability. Unless otherwise specified (see 3.1), switches furnished under this specification shall be the non-repairable types. Mounting provisions shall insure that a minimal amount of time and effort is required for removal and replacement, using standard tools only.

3.5.10 Housings. Switch housings shall be as identified below and as specified (see 3.1).

a. Enclosed (to exclude humidity): Type E.

b. Hermetically sealed: Type H.

c. Immersion-proof: Type I.

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3.5.11 Frequency range. Switches shall be designed to operate throughout specified frequency range (see 3.1).

3.5.12 Electromagnetic interference. Electromagnetic interference requirements for switches shall be in accordance with MIL-STD-461.

3.6 Performance.

3.6.1 Switching rate. When switches are tested as specified in 4.7.2, the switching rate shall not exceed the value specified (see 3.1).

3.6.2 Primary input power. When switches are tested as specified in 4.7.2, the primary input power shall not exceed the value specified (see 3.1).

3.6.3 Transition (overlap) time. When switches are tested as specified in 4.7.3, the transition time shall not exceed the value specified (see 3.1). The transition time is the period when the outputs are considered in parallel and the isolation is minimum.

3.6.4 Voltage standing wave ratio (VSWR). When switches are tested as specified in 4.7.4, the VSWR shall not exceed the value(s) specified (see 3.1).

3.6.5 Isolation. When switches are tested as specified in 4.7.5, the isolation between outputs shall be not less than the value specified (see 3.1).

3.6.6 Insertion loss. When switches are tested as specified in 4.7.6, the insertion loss shall not exceed the value specified (see 3.1).

3.6.7 RF power handling capability. When switches are tested as specified in 4.7.7, with rated peak power, and rated average power (when specified, see 3.1) passing through the switch, no evidence of breakdown shall be evident. Following each test, the VSWR value (see 3.1) shall be no greater than specified (see 3.1). Unless otherwise specified (see 3.1), switches shall be required to switch under power.

3.6.8 Temperature shock. When switches are tested as specified in 4.7.8, the VSWR, isolation, insertion loss, primary input power, switching rate, and transition time shall be as specified (see 3.1).

3.6.9 Vibration. When switches are tested as specified in 4.7.9, the VSWR, isolation, insertion loss, primary input power, switching rate, and transition time shall be as specified (see 3.1).

3.6.10 Humidity (applicable to type E only). When switches are tested as specified in 4.7.10, the VSWR, isolation, insertion loss, primary input power, switching rate, and transition time shall be as specified (see 3.1).

3.6.11 Hermetic seal (applicable to type H only). When switches are tested as specified in 4.7.11, the leakage rate shall not exceed the applicable value specified below. The volume shall be computed using the external dimensions of the switch housing, disregarding any mounting (screw, stud).

Sealed volume of case	Maximum allowable leakage
Greater than 2 cubic inches	1×10^{-6} atm cc/sec
2 cubic inches or less	1×10^{-8} atm cc/sec

3.6.12 Immersion (applicable to type I only). When switches are tested as specified in 4.7.12, the VSWR, isolation, insertion loss, primary input power, switching rate, and transition time shall be as specified (see 3.1).

3.6.13 Salt Atmosphere . When switches are tested as specified in 4.7.13, the VSWR, isolation, insertion loss, primary input power, switching rate, and transition time shall be as specified (see 3.1).

3.6.14 Shock. When switches are tested as specified in 4.7.14, the VSWR, isolation, insertion loss, primary input power, switching rate, and transition time shall be as specified (see 3.1).

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3.6.15 Temperature-altitude. When switches are tested as specified in 4.7.15, the VSWR, isolation, insertion loss, primary input power, switching rate, and transition time shall be as specified (see 3.1).

3.6.16 Reliability. Unless otherwise specified (see 3.1), switches shall provide a minimum acceptable mean-time-between-failure (MTBF) of 10,000 hours.

3.7 Marking (see 3.1). Switches shall be marked with the manufacturer's code identification and the military PIN (see 3.1 and 6.2). The date of manufacture of the item shall be marked on the part. The date code shall be as specified in MIL-STD-1285.

a. Switches shall be marked with the type of supply, the operating voltage, and the frequency.

b. Input and output connections shall be identified in a logical manner.

The marking shall remain legible after completing all environmental tests.

3.8 Recycled, recovered, or environmentally preferable materials. Recycled, recovered, or environmentally preferable materials should be used to the maximum extent possible, provided that the material meets or exceeds the operational and maintenance requirements, and promotes economically advantageous life cycle costs.

3.9 Workmanship. Switches shall be processed in such a manner as to be uniform in quality and shall be free from corrosion and other defects that will affect life, serviceability, or appearance.

4. VERIFICATION

4.1 Test equipment and inspection facilities. Test and measuring equipment and inspection facilities of sufficient accuracy, quality, and quantity to permit performance of the required inspection shall be established and maintained by the supplier. The establishment and maintenance of a calibration system to control the accuracy of the measuring and test equipment shall be in accordance with NCSL Z540.3 and ISO 10012.

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

a. Materials inspection (see 4.3).

b. First article acceptance inspection (see 4.5).

c. Conformance inspection (see 4.6).

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 switches, are in accordance with the applicable referenced specifications or requirements prior to such fabrication.

TABLE I. Materials inspection.

Material	Requirement paragraph	Applicable documents
Finishes	3.4.1	MIL-DTL-5541, MIL-DTL-14072
Dissimilar metals	3.4.2	MIL-STD-889
Fungus inert	3.4.3	(see 6.4)
Micro-electronic circuits	3.5.2	MIL-PRF-38535
Semiconductors	3.5.3	MIL-PRF-19500
Printed circuit boards	3.5.4	MIL-PRF-31032
Connectors	3.5.5	MIL-PRF-39012, MIL-DTL-3643, MIL-DTL-83723
Pure tin	3.4.4	Prohibited (see 6.6)

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-202.

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4.5 First article acceptance inspection. First article acceptance inspection shall be performed at a laboratory acceptable to the Government (see 3.2 and 6.3) on sample units produced with equipment and procedures normally used in production.

4.5.1 Sample size. Four switches shall be subjected to first article inspection. Each switch with a different basic design shall be first article accepted separately.

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 into two groups of two units each. The sample units shall then be subjected only to the inspections indicated for the particular group.

TABLE II. First article inspection.

Examination or test	Requirement paragraph	Test paragraph
Group I (all samples)		
Visual and mechanical examination	3.4, 3.5.1, and 3.9	4.7.1
Marking	3.7	4.7.1
Switching rate	3.6.1	4.7.2
Primary input power	3.6.2	4.7.2
Transition time	3.6.3	4.7.3
Voltage standing wave ratio	3.6.4	4.7.4
Isolation	3.6.5	4.7.5
Insertion loss	3.6.6	4.7.6
RF power handling capability	3.6.7	4.7.7
Temperature shock	3.6.8	4.7.8
Vibration	3.6.9	4.7.9
Group II (2 samples)		
Salt Atmosphere	3.6.13	4.7.13
Shock	3.6.14	4.7.14
Temperature-altitude	3.6.15	4.7.15
Group III (2 samples)		
Humidity (applicable to type E only)	3.6.10	4.7.10
Hermetic seal (applicable to type H only)	3.6.11	4.7.11
Immersion (applicable to type I only)	3.6.12	4.7.12

4.5.3 Failures. No failures shall be allowed for first article inspection; a failure shall be anything that does not meet the requirements of the specification.

4.5.4 Reliability inspections. Seven switches shall be tested for reliability. Two of the seven switches shall continue through a longevity test. Longevity test shall not be a criteria for first article acceptance of the switch. Acceptance shall be judged by the responsible activity (see 6.3).

4.6 Conformance inspection.

4.6.1 Inspection of product for delivery. Inspection of product for delivery shall consist of group A.

4.6.1.1 Inspection lot. An inspection lot shall consist of all switches of the same PIN, produced under essentially the same conditions, and offered for inspection at one time.

4.6.1.2 Group A inspection. Group A inspection shall consist of the examination and tests specified in table III, in the order shown.

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TABLE III. Group A inspection.

Examination or test	Requirement paragraph	Test paragraph
Subgroup I		
Visual and mechanical examination	3.4, 3.5.1, and 3.9	4.7.1
Marking	3.7	4.7.1
Switching rate	3.6.1	4.7.2
Primary input power	3.6.2	4.7.2
Transition time	3.6.3	4.7.3
Voltage standing wave ratio	3.6.4	4.7.4
Isolation	3.6.5	4.7.5
Insertion loss	3.6.6	4.7.6
Subgroup II		
Acceptance reliability	3.6.16	---

4.6.1.2.1 Group A sampling plan. For subgroup II, the monthly sample size shall be tested. Statistical sampling and inspection shall be performed on an inspection lot basis with a random sample of switches selected in accordance with table IV. Acceptance shall be based upon the zero defect sampling plan. No failures shall be permitted.

TABLE IV. Group A sampling plan.

Lot size	Sample size
1 - 13	100 percent
14 - 150	13
151 - 280	20
281 - 500	29
501 - 1,200	34
1,201 - 3,200	42
3,201 - 10,000	50
10,001 - 35,000	60
35,001 - 150,000	74
150,001 - 500,000	90
500,001 and over	102

4.6.1.3 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. Such lots shall be separated from new lots, and shall be clearly identified as re-inspected lots.

4.6.2 Conformance verification inspection. Conformance verification inspection shall consist of group B. Delivery of products which have passed group A shall not be delayed pending the results of these conformance verification inspections.

4.6.2.1 Group B inspection. Group B inspection shall consist of the tests specified in table V in the order shown. Group B inspection shall be made on sample units which have passed group A inspection.

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TABLE V. Group B inspection.

Test	Requirement paragraph	Test paragraph	Number of sample units to be inspected
RF power handling capability	3.6.7	4.7.7	6
Temperature shock	3.6.8	4.7.8	
Vibration	3.6.9	4.7.9	
Salt Atmosphere	3.6.13	4.7.13	
Shock	3.6.14	4.7.14	
Temperature-altitude	3.6.15	4.7.15	
Humidity (applicable to type E only)	3.6.10	4.7.10	
Hermetic seal (applicable to type H only)	3.6.11	4.7.11	
Immersion (applicable to type I only)	3.6.12	4.7.12	

4.6.2.1.1 Sampling plan. Sample units shall be selected every 6 months. Upon passing this inspection, the supplier may select sample units every 12 months. If the second level of sampling is passed two successive times, the supplier may select sample units every 24 months. In the event of a failure, sampling may revert to the 6-month interval.

4.6.2.1.2 Failures. If failures occur, the sample shall be considered to have failed.

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

4.7 Methods of examination and test.

4.7.1 Visual and mechanical examination (see 3.4, 3.5.1, 3.7, and 3.9). Switches shall be examined to verify that the materials, size, mounting, weight, design, construction, finish, marking, and workmanship are in accordance with the applicable requirements.

4.7.2 Switching rate and primary input power (see 3.6.1 and 3.6.2). The switching rate and primary input power of the switch shall be determined at the center of the specified (see 3.1) RF frequency range and the primary input voltage and frequency (when applicable) at the specified (see 3.1) nominal, lowest, and highest value.

4.7.3 Transition time (see 3.6.3). The transition time shall be measured by determining the length of time that the isolation between outputs is at the lowest value. Test shall be made with the switch energized with nominal input power and an RF signal into one RF output and a pad, detector, and oscilloscope connected to another RF output. The RF signal shall be at the center frequency of the specified frequency range.

4.7.4 Voltage standing wave ratio (VSWR) (see 3.6.4). The VSWR shall be determined for each switch position and when specified (see 3.1), during the period when the outputs are in parallel. Unless otherwise specified (see 3.1), swept frequency technique shall be used to determine the VSWR over the specified (see 3.1) frequency range.

4.7.5 Isolation (see 3.6.5). With the switch energized with nominal input power, the isolation between outputs shall be determined using the swept frequency technique over the specified frequency range.

4.7.6 Insertion loss (see 3.6.6). The insertion loss shall be measured with the switch stopped on each RF output. Swept frequency technique shall be used to determine the insertion loss over the specified frequency range (see 3.1).

4.7.7 RF power handling capability (see 3.6.7). With the switch energized with nominal input power, the switch shall be subjected to the specified (see 3.1) RF power and frequency for the specified period of time. During the test the switch shall be terminated with the specified load. After the test, the VSWR shall be measured as specified in 4.7.4.

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4.7.8 Temperature shock (see 3.6.8). Switches shall be placed within a test chamber wherein the highest specified temperature (see 3.1) is maintained. Unless otherwise specified, switches shall be exposed to this temperature for a period of 4 hours; at the conclusion of this time and within 5 minutes, unless otherwise specified, the switches will be transferred to a chamber having the lowest specified temperature (see 3.1) for a period of 4 hours. This constitutes one cycle of temperature shock. Switches shall be non-operating for the entire exposure. Three complete cycles shall be performed on a continuing basis. However, either the high or the low temperature soak periods can be extended to an overnight period to prevent interruption of the transfer sequence. After the test, the switches shall be subjected to the individual tests of group I in table III.

4.7.9 Vibration (see 3.6.9). Switches shall be tested in accordance with MIL-STD-202, method 204, test condition C. After the test, switching rate, primary input power, transition time, VSWR, isolation, and insertion loss shall be measured as specified in 4.7.2 through 4.7.6, respectively.

4.7.10 Humidity (applicable to type E only) (see 3.6.10). Switches shall be tested in accordance with MIL-STD-202, method 103, test condition A. After the test, switching rate, primary input power, transition time, VSWR, isolation, and insertion loss shall be measured as specified in 4.7.2 through 4.7.6, respectively.

4.7.11 Hermetic seal (applicable to type H only) (see 3.6.11). Hermetically-sealed switches shall be tested in accordance with method 112 of MIL-STD-202. The following details shall apply:

a. Test condition letter: C (protective connector caps shall be used during test).

b. Procedure III.

c. Degree of leakage rate sensitivity: See 3.6.11.

4.7.12 Immersion (applicable to type I only) (see 3.6.12). Immersion-proof switches shall be tested in accordance with method 104 of MIL-STD-202. The following details shall apply:

a. Test condition letter: A (protective connector caps shall be used during test).

b. During test cycle and while submerged, the sample shall be subjected to a low barometric pressure of 3.44 in Hg (50,000 feet altitude).

c. Measurements: No leakage as evidenced by a continuous stream of bubbles. Bubbles which are the result of entrapped air on the exterior surface of the switch shall not be considered as an indication of leakage.

After the test, switching rate, primary input power, transition time, VSWR, isolation, and insertion loss shall be measured as specified in 4.7.2 through 4.7.6, respectively.

4.7.13 Salt Atmosphere (see 3.6.13). Switches shall be tested in accordance with MIL-STD-202, method 101, test condition B. After the test, switching rate, primary input power, transition time, VSWR, isolation, and insertion loss shall be measured as specified in 4.7.2 through 4.7.6, respectively.

4.7.14 Shock (see 3.6.14). Switches shall be tested in accordance with MIL-STD-202, method 213, figure 213-2, time duration 11 ms, 20 g's. After the test, switching rate, primary input power, transition time, VSWR, isolation, and insertion loss shall be measured as specified in 4.7.2 through 4.7.6, respectively.

4.7.15 Temperature-altitude (see 3.6.15). Switches shall be tested individually for environmental effects of altitude and temperature in accordance with (1) MIL-STD-202, method 105, test condition D and (2) MIL-STD-202, method 107, test condition B, with environmental test chamber exposure times of 2 hours for step 1 and of 4 hours for step 3. After each test, switching rate, primary input power, transition time, VSWR, isolation, and insertion loss shall be measured as specified in 4.7.2 through 4.7.6, respectively.

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5. PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). When packaging of materiel is to be performed by DoD or in-house contractor personnel, these personnel need to contact the responsible packaging activity to ascertain packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activities within the Military Service or Defense Agency, or within the military service's system commands. Packaging data retrieval is available from the managing Military Department's or Defense Agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

6. NOTES

(This section contains information of a general or explanatory nature which may be helpful, but is not mandatory.)

6.1 Intended use. Switches covered by this document are designed for use with RF coaxial transmission line systems.

6.2 Acquisition requirements. Acquisition documents must specify the following:

a. Title, number, and date of this specification, the applicable specification sheet, and the complete PIN.

b. Specify when aluminum should not be anodized (see 3.4.1).

c. Packaging requirements (see 5.1).

d. Special marking, if required.

6.3 First article acceptance. Information pertaining to first article inspection and approval of products covered by this specification should be obtained from the acquiring activity.

6.4 Fungus-inert materials (see 3.4.3 and Table I). MIL-HDBK-454, Guideline 4 provides guidance on fungus-inert materials.

6.5 Subject term (key word) listing.

Coaxial transmission line	Finish	Printed circuit boards
Connectors	Housings	Semiconductor devices
Dissimilar metals	Insertion loss	Transition time
Electromagnetic interference	Isolation	VSWR

6.6 Tin whisker growth (see 3.4.4). The use of alloys with tin content greater than 97 percent, by mass, may exhibit tin whisker growth problems after manufacture. Tin whiskers may occur anytime from a day to years after manufacture and can develop under typical operating conditions, on products that use such materials. Conformal coatings applied over top of a whisker-prone surface will not prevent the formation of tin whiskers. Alloys of 3 percent lead, by mass, have shown to inhibit the growth of tin whiskers. For additional information on this matter, refer to ASTM-B545 (Standard Specification for Electrodeposited Coatings of Tin).

6.7 Environmentally preferable material. Environmentally preferable materials should be used to the maximum extent possible to meet the requirements of this specification. As of the dating of this document, the U.S. Environmentally Protection Agency (EPA) is focusing efforts on reducing 31 priority chemicals. The list of chemicals and additional information is available on their website at http://www.epa.gov/osw/hazard/wastemin/priority.htm. Included in the list of 31 priority chemicals are cadmium, lead, and mercury. Use of the materials on the list should be minimized or eliminated unless needed to meet the requirements specified herein (see section 3).

6.8 Changes from previous issue. The margins of this specification are marked with vertical lines to indicate where changes from the previous issue were made. This was done as a convenience only and the Government assumes no liability whatsoever for any inaccuracies in these notations. Bidders and contractors are cautioned to evaluate the requirements of this document based on the entire content irrespective of the marginal notations and relationship to the last previous issue.

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