

MILITARY SPECIFICATION  
SWITCHES, COAXIAL, RADIO FREQUENCY TRANSMISSION  
LINE (FOR USE WITH ELECTRONIC COUNTERMEASURES EQUIPMENT),  
GENERAL SPECIFICATION

1. SCOPE

1.1 Scope. - This specification covers the detail requirements and test procedures for 50-ohm, radio frequency (r. f.) coaxial switches for use in Navy electronic countermeasures equipment.

1.2 Classification. - Coaxial switches shall be of the following types as specified in the specification sheet.

- Type I - Single pole, double throw (SPDT).
- Type II - Double pole, double throw (DPDT).

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

MILITARY

- MIL-S-3928 - Switches, Coaxial, Radio Frequency Transmission Line, General Specification.
- MIL-C-5015 - Connectors, Electrical, AN Type.
- MIL-C-23329 - Connectors, Coaxial, R. F., Series BNC, TNC, N, and C.
- MIL-S-24067/1 - Switches, Coaxial, Radio Frequency Transmission Line (For Use With Electronic Countermeasures Equipment) Single Pole, Double Throw, Type I.
- MIL-S-24067/2 - Switches, Coaxial, Radio Frequency Transmission Line (For Use With Electronic Countermeasures Equipment, Double Pole, Double Throw, Type II.
- MIL-G-45204 - Gold Plating, Electrodeposited.
- MIL-C-45662 - Calibration System Requirements.

STANDARDS

MILITARY

- MIL-STD-105 - Sampling Procedures and Tables for Inspection by Attributes.
- MIL-STD-130 - Identification Marking of U. S. Military Property.
- MIL-STD-202 - Test Methods for Electronic and Electrical Component Parts.
- MS3102 - Connector, Receptacle, Electrical, Box Mounting.

(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.

OFFICIAL CLASSIFICATION COMMITTEE  
Uniform Freight Classification Rules

(Application for copies should be addressed to the Official Classification Committee, 1 Park Avenue, at 33rd Street, New York 16, N. Y.)

3. REQUIREMENTS

3.1 Specification sheets. - Individual switches shall be as specified herein and in accordance with the applicable specification sheets listed in section 2.

3.2 Preproduction. - A preproduction sample shall be tested as specified in 4.4. The sample shall be representative of the manufacturer's normal production, and shall, insofar as practical, have been made on tools and with the quality control that would be used on the production run.

3.3 Material. - The materials employed in the fabrication of the switches shall be as specified herein. When no specific material is specified, a suitable material shall be employed.

3.4 Design and construction. - Coaxial switches shall be of the design, construction, and physical dimensions specified on the specification sheet. Each switch shall be of the nonlatching type with suitable position indications.

3.5 Position indication. - Each switch shall be provided with position indicators which shall operate only after insurance of satisfactory r. f. switching performance. The position indicating circuitry shall be designed to handle 2 amperes, noninductive, at 28 volts direct current (d. c. ).

3.6 Connectors. - The input and output r. f. connectors of each switch shall be series "N", meeting the mating end dimensional requirements of MIL-C-23329. The center contacts of the r. f. connectors shall be gold plated in accordance with type II, class 2, of MIL-G-45204, and shall be captive within the connector shell to prevent any axial movement upon application of a 5-pound force. The power connector shall be MS3102R-14S-6P in accordance with MS3102 (MIL-C-5015).

3.7 Electrical requirements. -

3.7.1 R. f. performance characteristics. - When tested in a 50-ohm system as specified in the applicable test paragraph, the r. f. performance shall be as shown in table I.

Table I - R. f. performance characteristics.

Frequency range (gigacycles)	Maximum VSWR	Maximum insertion loss (db)	Minimum isolation (db)
1 to 2.5	1.20	0.1	60
2.5 to 4.5	1.25	0.2	60
4.5 to 7.0	1.30	0.3	55
7.0 to 10.75	1.35	0.35	50

3.7.2 R. f. power. - The switch shall handle, with no evidence of breakdown, 1000 watts peak r. f. power, 10 watts average in either mode of operation, and during switching.

3.7.3 Switching time. - The switching time between positions shall be less than 40 milliseconds.

3.7.4 Pick-up voltage. - At any point within the specified operating temperature range, the solenoid shall be actuated upon application of 20 volts, d. c. , maximum.

3.7.5 Drop-out voltage. - At any point in the specified operating temperature range, the switch shall return to its deenergized position when the applied voltage drops to 2 volts d. c. minimum.

3.7.6 Holding current. - The maximum holding current at 30 volts d. c. shall be 0.7 ampere at 20°C. The maximum surge current at 30 volts d. c. shall be 1.5 amps at 20°C.

3.8 Environmental requirements. - The switch shall be capable of operating under each and all of the environmental conditions specified hereinafter.

- 3.8.1 Operating life. - Each switch shall have a minimum operating life of 200,000 cycles under the environmental conditions specified herein.
- 3.8.2 Temperature cycling. - The switch shall meet the requirements of 3.7.1 when subjected to the temperature cycling test specified in 4.6.7.
- 3.8.3 Humidity cycling. - The switches shall show no evidence of corrosion or physical degradation, and shall meet the requirements of 3.7.1 after being subjected to the humidity cycling test specified in 4.6.8.
- 3.8.4 Shock. - The switch shall show no signs of damage, and shall not exhibit any intermittent contact when subjected to the shock test specified in 4.6.9.
- 3.8.5 Vibration. - The switch shall show no signs of damage, and shall exhibit no intermittent contact when subjected to the vibration test specified in 4.6.10.
- 3.8.6 Corrosion resistance. - There shall be no evidence of corrosion, and the switch shall meet the requirements of 3.7.3, when subjected to the salt spray test specified in 4.6.11.
- 3.9 Marking. - In addition to each of the positions indicated, the switches shall be marked with the type and manufacturer's code letters in accordance with MIL-STD-130.
- 3.10 Finish. - Unless otherwise specified herein, switches shall be suitably finished to meet the environmental requirements specified herein (see 3.8).
- 3.11 Workmanship. - Switches shall be processed in such a manner as to be uniform in quality, and shall be free from defects that will affect life, serviceability, or appearance.

#### 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, the supplier may utilize his own facilities or any commercial laboratory acceptable to 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 Test equipment and inspection facilities. - Test equipment and inspection facilities shall be of sufficient accuracy, quality, and quantity to permit performance of the required inspection. The supplier shall establish calibration of inspection equipment to the satisfaction of the Government, in accordance with MIL-C-45662.

4.2 Classification of inspection. - The examination and testing of switches shall be classified as follows:

- (a) Preproduction inspection (see 4.4).
- (b) Quality conformance inspection (see 4.5).

4.3 Inspection conditions. - Unless otherwise specified herein, inspection conditions shall be in accordance with MIL-STD-202.

4.4 Preproduction inspection. - Preproduction inspection shall be conducted by the supplier after award of the contract and prior to production. Preproduction inspection shall consist of the examination and tests listed in table II in the order shown. No failure is permitted.

4.5 Quality conformance inspection. - Quality conformance inspection shall consist of groups A and C inspection. Examination and tests shall consist of those listed in applicable tables, and shall be conducted in the sequence shown.

Table II - Preproduction inspection.

Test	Requirement paragraph	Method paragraph
Visual and dimensional examination		4. 6. 1
Design and construction dimensions, orings, switching sequence	3. 4	
Connectors	3. 6	
Materials	3. 3	
Finishes	3. 10	
Marking	3. 9	
Workmanship	3. 11	
Position indicators	3. 5	
Switching time	3. 7. 3	4. 6. 6
Pickup voltage	3. 7. 4	4. 6. 5
Drop out voltage	3. 7. 5	4. 6. 5
Holding current	3. 7. 6	4. 6. 5
VSWR (swept frequency)	3. 7. 1	4. 6. 2
Insertion loss	3. 7. 1	4. 6. 4
Isolation	3. 7. 1	4. 6. 3
RF power	3. 7. 2	4. 6. 12
Temperature cycling	3. 8. 2	4. 6. 7
Humidity cycling	3. 8. 3	4. 6. 8
Shock	3. 8. 4	4. 6. 9
Vibration	3. 8. 5	4. 6. 10
Salt spray	3. 8. 6	4. 6. 11
Operating life	3. 8. 1	4. 6. 13

4. 5. 1 Group A inspection. - Group A inspection shall consist of examination and tests listed in table III.

Table III - Group A inspection.

Test	Requirement paragraph	Method paragraph
VSWR	3. 7. 1	4. 6. 2
Isolation	3. 7. 1	4. 6. 4
Insertion loss	3. 7. 1	4. 6. 3
Dimensional examination	3. 2	4. 6. 1

4. 5. 1. 1 Sampling Plan for group A Inspection. - Group A inspection shall be conducted on every unit offered for delivery.

4. 5. 1. 2 Preconditioning for group A inspection. - Each switch shall be subjected to 10, 000 actuations prior to conducting the group A tests.

4. 5. 2 Group C inspection. - Group C inspection shall consist of the tests listed in table IV.

4. 5. 2. 1 Sampling for group C inspection. - Statistical sampling shall be in accordance with MIL-STD-105 for special inspection. The inspection level shall be level S-3 and the acceptable quality levels (AQL) shall be as specified in table IV. No group C inspection is required for quantities under 50 units.

Table IV - Group C inspection.

Test	Requirement paragraph	Method paragraph	AQL (percent)
Operating life <sup>1/</sup>	3.8.1	4.6.13	10
Temperature cycling <sup>2/</sup>	3.8.2	4.6.7	10

<sup>1/</sup>Limited to 40,000 cycles after which VSWR, isolation and insertion loss shall be determined.

<sup>2/</sup>The pickup and drop out voltage and holding current shall be determined at the temperature extremes.

#### 4.6 Methods of examination and tests. -

4.6.1 Visual, mechanical, and dimensional examination. - Switches shall be examined to verify that the materials, dimensions, design, finishes, connectors, position indicators, marking, and workmanship are in accordance with the applicable requirements (see 3.2, 3.4, 3.5, 3.6, 3.9, and 3.10).

4.6.2 Swept Frequency VSWR. - The switch shall be tested in each position as shown in figure 1. In this test a slowly swept audio-modulated r. f. signal is fed to the directional coupler and the switch under test. The directional coupler provides two output signals, one proportional to the reflected power and the other proportional to the incident power. These signals are fed to a ratiometer which in turn supplies a voltage proportional to the reflection coefficient. This signal is applied to the vertical plates of the scope which is swept by the same sweep as the oscillator. The presentation is a continuous display of reflection coefficient versus frequency. Test shall be conducted in every position.

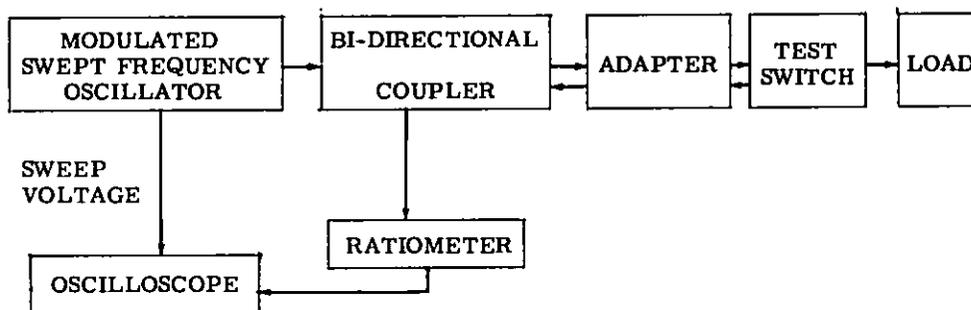


Figure 1 - Swept frequency VSWR

The directional couplers employed in this test set-up should have a minimum directivity of 30 db across the band. The load should have a VSWR of 1.04 maximum. The highest VSWR peak in each frequency band shall be examined by a suitable slotted line technique.

4.6.3 Isolation. - The isolation shall be measured over the frequency range specified employing a suitable measuring technique. In the event of disagreement regarding results, the technique shown in figure 2 shall be employed.

4.6.4 Insertion loss. - The insertion loss shall be measured over the frequency range specified by a technique acceptable to the procuring activity. In the event there is a disagreement regarding the results, the technique shown in figure 3 shall be employed.

4.6.5 Pick-up and dropout voltage. - A gradually increasing voltage shall be applied to the terminals of the actuating circuit. The value of the voltage at which the switch contacts assume the energized

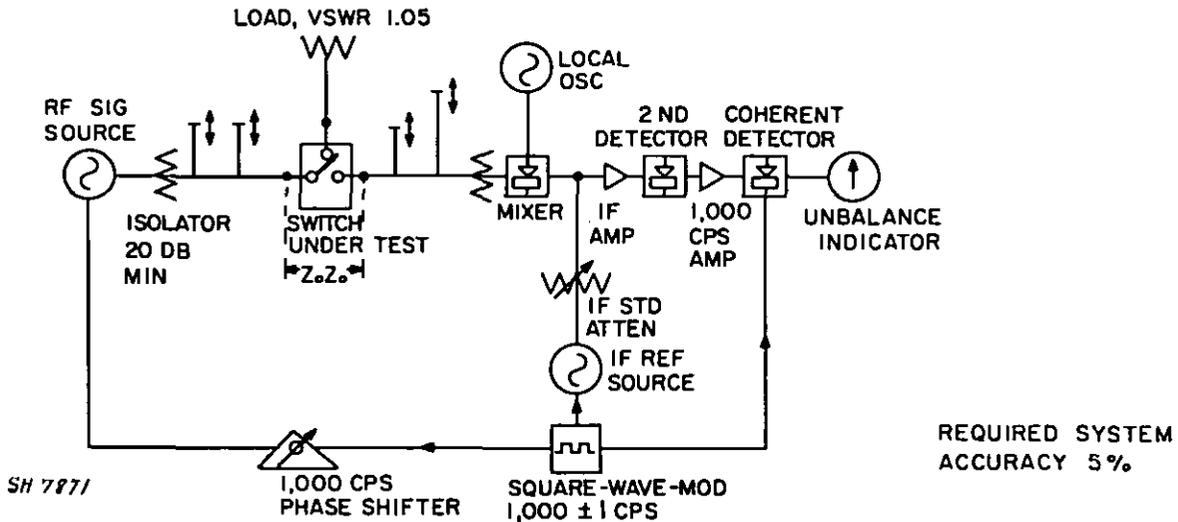


Figure 2 - Test set up for isolation measurements for switch by parallel intermediate frequency substitution method

position shall be measured. With 30 volts applied to the terminals, the operating current shall be measured. The voltage shall then be reduced gradually. A suitable indicating device shall be used to determine the voltage at which the switch moves into the deenergized position.

4.6.6 Switching time. - The switching time shall be measured using an electronic time interval recorder having two connections, one for start and one for stop. The start input connection of the recorder shall be connected to the actuating circuit of the switch so that energizing the actuator circuit starts the recorder. The stop input connection of the recorder shall be connected in series with a low voltage d. c. supply across the switch r. f. input and the r. f. output position adjacent to the one in which the switch is initially oriented. When the actuator circuit is energized, the time interval recorder measures the switching time between adjacent switch positions in direction of switching.

4.6.7 Temperature cycling. - Switches shall be tested in accordance with method 102 of MIL-STD-202. The following details shall apply:

- (a) Mounting - No special mounting required.
- (b) Test condition - Condition D.
- (c) The pickup and drop voltage shall be determined at extreme temperature.
- (d) Measurements - After completion of the final cycle, the insertion loss, VSWR, and isolation shall be measured as specified in 4.6.4, 4.6.2 and 4.6.3, respectively.

4.6.8 Moisture resistance. - Switches shall be tested in accordance with method 106 of MIL-STD-202. The following details shall apply:

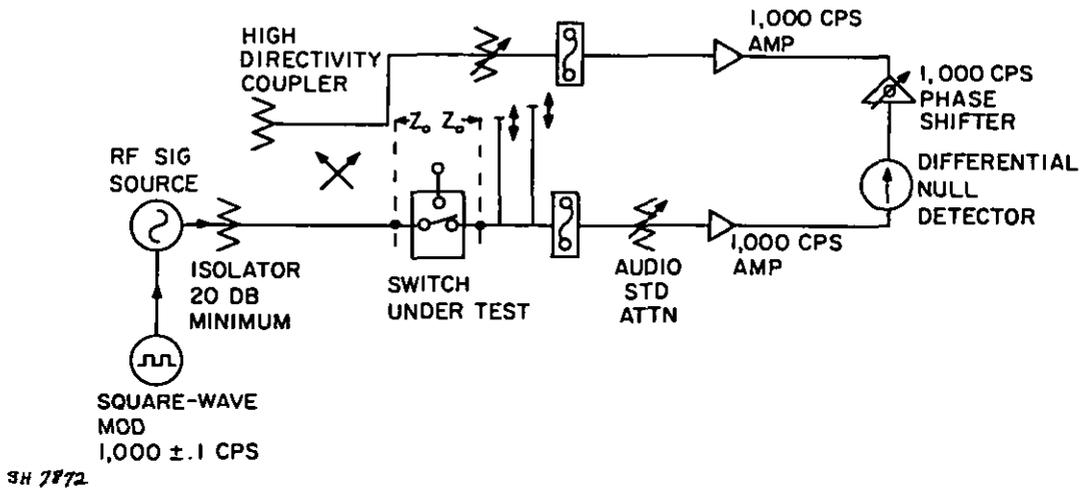


Figure 3 - Test set-up for insertion loss measurements for switch by dual channel audio-substitution method

- (a) Initial measurements - Not applicable.
- (b) Polarization voltage - Not applicable.
- (c) Loading voltage - Not applicable.
- (d) Steps 7a & 7b shall be omitted from the test.
- (e) Final measurements - After the 24-hour drying period, the insertion loss, VSWR, and isolation shall be measured as specified in 4.6.4, 4.6.2, and 4.6.3 respectively.

4.6.9 Shock. - Switches shall be tested in accordance with method 205 of MIL-STD-202, as applicable. The following details shall apply:

- (a) Mounting fixtures - Rigidly mounted.
- (b) Electrical load - None.
- (c) Test Condition - C.
- (d) Tests and measurements during and after shock. - During the test a suitable indicating device shall be connected across the closed contacts to determine if contacts remain continuously in the proper position (10 microseconds of chatter allowed for response time of chatter monitoring equipment).

4.6.10 Vibration. - Switches shall be tested in accordance with method 201 of MIL-STD-202. The following details shall apply:

- (a) Mounting - Rigidly mounted.
- (b) Electrical load - None.
- (c) Measurements - During the test a suitable indicating device shall be connected across the closed contacts to determine whether contacts remain continuously in the proper position (10 microseconds of chatter allowed for response time of chatter monitoring equipment).

4.6.11 Salt spray. - Switches shall be tested in accordance with method 101 of MIL-STD-202. The following details shall apply:

- (a) 20 percent solution.
- (b) Special mounting - Not applicable.
- (c) Test condition A
- (d) Following this test, visual examination shall be made, and the switching time shall be measured as specified in 4.6.6. During the test, the r.f. connectors should be protected by suitable caps.

4.6.12 Power handling capability. - Power handling capability shall be determined by connecting the switch to a source of r.f. power adjusted to the maximum frequency for which the switch is rated. The switch shall be terminated in a 50-ohm resistive load capable of absorbing the power supplied. The average power for which the switch is rated shall be applied continuously for 1 hour.

4.6.13 Operating life. - Switches shall be operated through the available circuit selections for the rated life of the switch and, for continuous duty switches, at the specified operating rate. During the test, no r.f. voltage shall be applied. After this test, the VSWR, insertion loss, and isolation shall be measured as specified in 4.6.2, 4.6.4, and 4.6.3.

## 5. PREPARATION FOR DELIVERY

### 5.1 Domestic shipment and early use of switches, coaxial. -

5.1.1 Preservation and packaging. - Preservation and packaging shall be sufficient to afford adequate protection against corrosion, deterioration and physical damage during shipment from the supply source to the using activity and until early installation and may conform to the supplier's commercial practice when such meets these requirements.

5.1.2 Packing. - Packing shall be accomplished in a manner which will insure acceptance by common carrier at the lowest rate and will afford protection against physical or mechanical damage during direct shipment from the supply source to the using activity for early installation. The shipping containers or method of packing shall conform to the Uniform Freight Classification Rules and Regulations or other carrier regulations as applicable to the mode of transportation and may conform to the supplier's commercial practice when such meets these requirements.

5.1.3 Marking. - Shipment marking information shall be provided on interior packages and exterior shipping containers in accordance with the contractor's commercial practice. The information shall include nomenclature, Federal stock number or manufacturer's part number, contract or order number, contractor's name and destination.

5.2 Domestic shipment and storage or overseas shipment of switches, coaxial. - The following provides various levels of protection during domestic shipment and storage or overseas shipment which may be required when procurement is made (see 6.2).

(5.2.1 Preservation and packaging, packing, and marking. - Switches shall be preserved and packaged level A or C and packaged levels A, B, or C in accordance with MIL-S-3928.)

## 6. NOTES

6.1 Intended use. - The switches covered under this specification are intended for use in very broad-band circuits requiring a high degree of reliability under the adverse conditions encountered in Naval service.

6.2 Ordering data. - Procurement documents should specify the following:

- (a) Title, number, and date of this specification.
- (b) Title, number, and date of applicable specification sheet and part number.
- (c) Preservation and packaging, packing, and marking instructions if other than specified in 5.1 (see 5.2).

Preparing activity:  
Navy - SH  
(Project 5985-N171Sh)

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# SPECIFICATION ANALYSIS SHEET

Form Approved Budget Bureau No. 119-R004

### INSTRUCTIONS

This sheet is to be filled out by personnel either Government or contractor, involved in the use of the specification in procurement of products for ultimate use by the Department of Defense. This sheet is provided for obtaining information on the use of this specification which will insure that suitable products can be procured with a minimum amount of delay and at the least cost. Comments and the return of this form will be appreciated. Fold on lines on reverse side, staple in corner, and send to preparing activity.

SPECIFICATION

ORGANIZATION

CITY AND STATE

CONTRACT NO.

QUANTITY OF ITEMS PROCURED

DOLLAR AMOUNT

\$

MATERIAL PROCURED UNDER A

DIRECT GOVERNMENT CONTRACT

SUBCONTRACT

1. HAS ANY PART OF THE SPECIFICATION CREATED PROBLEMS OR REQUIRED INTERPRETATION IN PROCUREMENT USE?  
A. GIVE PARAGRAPH NUMBER AND WORDING.

B. RECOMMENDATIONS FOR CORRECTING THE DEFICIENCIES

2. COMMENTS ON ANY SPECIFICATION REQUIREMENT CONSIDERED TOO RIGID

3. IS THE SPECIFICATION RESTRICTIVE?

YES     NO    IF "YES", IN WHAT WAY?

4. REMARKS (Attach any pertinent data which may be of use in improving this specification. If there are additional papers, attach to form and place both in an envelope addressed to preparing activity)

SUBMITTED BY (Printed or typed name and activity)

DATE