

HIGH POWER RADIO FREQUENCY (RF) SWITCHES WITH INTEGRATED DRIVERS

1.0 Scope

The Naval Research Laboratory (NRL) has a requirement for a set of 24 solid state, high power Single Pole Double Throw (SPDT) switches with integrated drivers, (hereinafter referred to as "devices") for use in an indoor laboratory environment (see Specification 3.4). The devices shall be matched to each other in phase and attenuation in accordance with the provisions described herein. The devices are to replace existing devices in a currently operational system, which imposes strict limitations on the size and performance of each device. Along with the hardware, the manufacturer shall also deliver outline drawings, test procedures, test data and a certificate of compliance as required by Specification 7.0. The devices shall meet or exceed the following minimum specifications:

2.0 Applicable Documents

The following documents of the issue in effect on the date of invitation for bids or requests for proposals (except where specific revisions are referred to herein) form a part of this specification to the extent specified herein.

2.1 Government Documents

2.1.1 Government Specifications

MIL-C-39012 - Connector, Coaxial, Radio Frequency; General Specification for

FED-STD-595 - Paint, Specification

3.0 REQUIREMENTS

3.1 Electrical and Mechanical Requirements

3.2.1 Electrical Requirements

The D.C. power to the devices shall be supplied by solder terminals as shown in Figure 1.

3.2.2 Mechanical Requirements

The devices shall be mounted on a flat surface. Thru-holes in the housing shall be provided for this purpose (see Figure 1). The device shall meet all performance requirements of this specification under the ambient operating conditions specified in Specification 3.4.

3.2.3 Connectors

All connectors shall be female type SMA coaxial RF connectors. Housings shall be of unplated stainless steel, center contacts shall be of gold plated copper.

3.3 Design and Construction

Design and construction shall be in accordance with current industry standards. Upon request of the NRL, the contractor shall submit a description of the manufacturing process, including methods and techniques used.

3.3.1 Finish

The exterior surfaces of all units, except for connectors and surfaces designated for mounting, shall have a protective paint coating appropriate for the environmental conditions of Specification 3.4.

3.4 Ambient Operating Conditions

The ambient operating conditions are as defined below:

Temperature: $70^{\circ}\text{F} \pm 15^{\circ}\text{F}$

Humidity: less than or equal to 90%

3.5 Performance Characteristics

The performance characteristics specified below shall apply for all ambient operating conditions defined above. The minimum performance characteristics are as follows:

3.5.1 Operating Frequency Range

The operating frequency range of the device shall be from 8.0 to 18.0 GHz.

3.5.2 Impedance

The nominal RF impedance at all ports shall be 50 ohms.

3.5.3 Return Loss

The return loss at any RF port shall be less than or equal to -10.0 dB for any frequency in the operating band.

3.5.4 Insertion Loss

For any RF path biased to its low-loss state, the insertion loss shall be less than or equal to 2.0 dB over the operating frequency range.

3.5.5 Insertion Loss Matching

For any RF path biased to its low-loss state, the insertion loss of the path shall not differ from that of any other such path by more than ± 0.3 dB, for any given frequency point in the operating band.

3.5.6 Insertion Loss Power Sensitivity

For any RF path biased to its low-loss state, the insertion loss of the path shall not vary by more than 0.2 dB for any differential in applied RF power, consistent with Specification 3.5.9 below.

3.5.7 Insertion Phase Matching

For any RF path biased to its low-loss state, the insertion phase of the path shall not differ from that of any other such path by more than $\pm 15^\circ$, for any given frequency point in the operating band.

3.5.8 Isolation

For all frequencies over the operating range, the isolation between the common port and either selectable port, biased to its high-loss state, shall be a minimum of 60 dB. The isolation between the 2 selectable ports, when either is biased to its high-loss state, shall also be a minimum of 60 dB.

3.5.9 Power Handling

The unit shall be capable of processing minimum RF power levels of 50 W CW, including during transitions between switch states (“hot switching”), without sustaining damage or degradation of performance. This requirement shall apply for all frequencies in the operating band.

3.5.10 EMI Suppression

The solder terminals for logic control and DC supply shall be provided with electromagnetic interference (EMI) filters. These shall suppress all EMI signals by a minimum of 100 dB.

3.5.11 Switching Characteristics

Switching speeds shall be as shown in the table below, in accordance with the conventional definitions of these terms:

Rise Time	15 ns, maximum
Fall Time	15 ns, maximum
ON Time	35 ns, maximum

OFF Time 35 ns, maximum

3.5.12 Control Logic

The device shall be TTL compatible. Logic "0" (-0.3 to +0.8V) shall command the port to the low-loss state. Logic "1" (2.0 to +5.0V) shall command the port to the high-loss state.

3.5.13 DC Operating Power

Each device shall meet all performance requirements of this specification when supplied with the following operating voltages:

+5V±5%

-36V±10%

For each voltage, the current consumption shall not exceed 150 milliamperes.

3.6 Marking

All units shall be marked with a part number unique to this specification, serial number, and the manufacturers' identification. All RF ports, operating voltage and control logic terminals shall be appropriately identified.

3.7 Interchangeability

All units supplied in conformance with this specification and assigned a specific part number shall be electrically and mechanically interchangeable. Any change in design, materials, or processes for any device which is determined by the Naval Research Laboratory to affect interchangeability will require assignment of a new part number and preparation of a new or revised detailed specification documenting the change.

4.0 QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for Inspection

Unless otherwise specified in the contract, the manufacturer is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract, the manufacturer may use his own or any other facilities suitable for the performance of the inspection requirements specified herein. After delivery of all items, NRL reserves the right to withhold final acceptance for a period of 30 days, so that NRL may perform any testing needed to assure that the delivered items are in compliance with this specification. During this period, any items found not to be in compliance with this specification will be returned to the contractor, at the contractor's expense, for rework. The terms of the contract will be deemed as having been met

when the entire lot of the items ordered and the factory test data have been accepted by NRL.

4.2 Quality Conformance Inspection

4.2.1 Inspection of Product for Delivery

Inspection shall consist of the examinations and tests specified in paragraph 4.3.2 and shall be performed on all of the units produced.

4.3 Methods of Examination or Test

4.3.1 Visual and Mechanical Examination

The units shall be examined to verify that the design, construction, physical dimensions, finish, marking and workmanship are in accordance with this specification.

4.3.2 Electrical and Mechanical Tests

The contractor shall perform all tests required by the performance test plan on all articles delivered. All electrical test methods shall be described in adequate detail to be understood and performed by independent testing. All test results shall be provided to NRL for review prior to shipment of the first article. Delivery shall commence only after NRL has determined from the data supplied that all items are in compliance with this specification.

4.4 Test Conditions and Equipment

4.4.1 Conditions

Unless otherwise specified herein, all inspections shall be made under the operating conditions specified in Specification 3.4.

4.4.2 Test Facilities and Equipment

All measuring instruments, either at the manufacturer's facilities or at an outside testing facility selected by the manufacturer for this purpose, shall be calibrated against company standards at scheduled intervals acceptable to NRL. The company standards shall be traceable to the National Bureau of Standards. The contractor has the responsibility for ensuring the validity of all calibrations.

4.5 Quality Confirmation

4.5.1 Certificate of Compliance

A Certificate of Compliance shall be supplied with this material, guaranteeing that all requirements of the specification have been met.

4.5.2 Warranty

The contractor shall offer the Government at least the same warranty terms, including offers of extended warranties, offered to the general public in customary commercial practice. These warranty terms must be included in the price of the devices. The period of the warranty shall begin upon acceptance.

5.0 Preparation for Delivery

5.1 Preservation and Packaging

Units shall be preserved and packaged in a manner that will afford adequate protection against corrosion, deterioration, and physical damage during shipment from the supply source to NRL. Packaging shall conform to the supplier's standard commercial practice.

6.0 Contractor Visitation

6.1 Monitoring

NRL retains the right to visit the manufacturer's facility (ies) to perform monitoring functions at such times as is deemed necessary to insure proper performance of the devices furnished in accordance with this specification. This will include witnessing the performance of any of the referenced examinations or tests. Upon request, the manufacturer shall provide complete non-proprietary information concerning reliability, test methods, test equipment, and quality control procedures, processes, documentation, and implementation.

7.0 Documentation

All documentation shall be supplied on a CD-ROM or DVD-ROM computer disk and shall consist of one or more Adobe[®] Acrobat[®] (*.pdf) files (version 5.0 or greater). The following data shall be supplied as stated in the Contract Data Requirements List (CDRL), DD Form 1423:

7.1 Outline Drawing

The contractor shall supply an outline drawing which shall define the physical features of the devices, in accordance with the guidelines of Figure 1. The drawing shall show all external dimensions and their tolerances, the location and size of marking, mounting holes, external connections and connector types.

7.2 Performance Test Plan

The Performance Test Plan (PTP) shall detail the procedure used for performance testing, including methods used for ensuring phase and attenuation tracking between units, special test circuits, equipment and quantity required, equipment accuracy, and certificate period. Approval by the NRL of the performance test plan is required prior to first article acceptance.

7.3 Acceptance Test Data

Acceptance Test Data shall include the results of testing to insure that all of the electrical parameters of Specification 3.5 are met. This test data includes plots, print-outs, and other pertinent information required for performance verification.

