ITEM 10680.840328 M - FURNISH COAXIAL CABLE TRUNK AMPLIFIER WITH AUTOMATIC LEVEL CONTROL (ALC)

DESCRIPTION:

The Contractor shall furnish and install coaxial cable amplifiers in accordance with the Contract Documents and as ordered by the Engineer.

Functional Requirements:

A coaxial cable amplifier is defined as a two-way repeater amplifier, including power supply, spaced approximately every 1130 m in the primary trunk cables and major distribution coaxial cables of the cable network. The trunk amplifiers shall incorporate a feed-forward amplifier for the inbound amplifier and a conventional push-pull amplifier for the outbound amplifier. Closed loop automatic level control (ALC) shall be used for both the inbound and outbound modules.

MATERIALS:

OPERATIONAL REQUIREMENTS

All parameters shall be measured at the input/output ports of the amplifier housing.

Input and Output Impedance

75 ohm (nominal)

Frequency Bands

Outbound: 5-30 MHz

Inbound: 50-108 MHz

Full Gain

34 dB minimum @ 108 MHz, 18 dB minimum at 30 MHz.
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_____ Rated Output

Rated amplifier output signal level shall be at least 55 dBmV over the full range of the inbound amplifier and 57 dBmV for the outbound amplifier. These levels shall be obtained where cross modulation is -57 dB, or less.

_____ Spacing

Minimum spacing shall be 32 dB at 108 MHz and 18 dB at 30 MHz.

_____ Hum Modulation

The induced hum modulation shall not exceed -70 dB below the average output level (both the inbound and outbound amplifiers).

_____ Manual Gain Adjustment

Manual gain adjustment shall be included at the amplifier interstage level for the inbound amplifier. The adjustment range shall be at least 0 to 8 dB. Manual gain adjustment shall be included at the input to the outbound amplifier. The adjustment range shall be at least 0 to 8 dB.

_____ Response Flatness

The response shall be flat within + 0.25 dB across both the inbound and outbound bands.

_____ Operating Levels

Inbound: (50-108 MHz) -

Input: +15 dBmV, typical, at 108 MHz

Output: +47 dBmV, typical, at 108 MHz
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Outbound: (5-30 MHz) -

   Input: +18 dBmV, typical, at 30 MHz
   Output: +36 dBmV, typical, at 30 MHz

Factory Alignment - Flat Loss

12 dB minimum at 108 MHz
12 dB minimum at 30 MHz

Return Loss - Input and Output

20 dB minimum at 50-108 MHz
16 dB minimum at 5-30 MHz

Distortion Characteristics

(1) Cross Modulation Ratio:

   -85 dB max., (50-108 MHz)

   -80 dB max., (5-30 MHz)

(2) Second Order Harmonic Distortion:

   -90 dB max., (50-108 MHz)

   -70 dB max., (5-30 MHz)

(3) Third Order Harmonic Distortion:

   -95 dB max., (50-108 MHz)

   -85 dB max., (5-30 MHz)
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(4) C. W. Composite Beat:

-90 dB max.

____Maximum Noise Figure (Without Equalizers)

Maximum noise figure shall be measured under factory aligned conditions with the ALC turned back at least 3 dB and gain adjustment set for maximum gain with both amplifiers.

8 dB at 108 MHz

9 dB at 30 MHz

____Automatic Level Control (ALC)

Pilot signals generated at the interconnect extremities shall be used to control the amplifier signal levels in order to compensate for changes in cable attenuation with temperature.

- Typical pilot generator frequencies shall be 30 MHz for the outbound amplifier and 54 MHz and 107.9 MHz for the inbound amplifier.

- The ALC circuit used in the inbound amplifier shall equalize the amplifier's overall gain such that, as the coaxial cable attenuation varies with temperature up to + 3 dB minimum at 107.9 MHz (between trunk amplifiers), the combined amplifier gain minus cable loss will be held at a difference of less than + 0.30 dB.

____Slope Control Range

The slope control range shall be at least 8 dB for the inbound (108 MHz) amplifier and at least 3 dB for the outbound (30 MHz) amplifier. The manual slope control shall be located at the amplifier interstage level for the inbound amplifier.

____ELECTRICAL REQUIREMENTS
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_____ Power

A self-contained power supply that will provide all the voltages required for the operation of the amplifier modules shall be included in the amplifier package. This supply shall operate from an external 120 VAC 60 Hz power source. This source shall be either a cabinet receptacle or a pole-mounted power distribution center as shown on the plans. The power supply shall operate properly when the input voltage is in the range of 95 volts to 135 volts. Filtering and RFI suppression shall be provided on the power line input.

_____ Current Drain (A.C.)

Current drain shall be 0.6 amperes maximum.

_____ Surge Protection

_____ Power Line Surge Protection

A power line surge protector shall be installed in each unit between input power circuit and ground. The surge protector shall have the following characteristics:

(a) **Working Voltage**

The unit shall be rated for operation on AC power lines with a voltage rating of 130 volts RMS and 184 volts peak for nominal 115 VAC.

(b) **Surge Voltage**

The unit shall limit the surge voltage to the equipment to 360 volts while conducting a peak surge current of 6,000 amperes. The surge current shall be an unsymmetrical triangular wave (designated 8 x 20 microseconds) that requires 8 microseconds to reach peak value and at 20 microseconds will have half the peak value.

(c) **Energy Rating**

The unit shall be capable of dissipating 50 joules of surge energy without
damage to itself. The unit shall have a one-watt dissipation rating.

Coaxial Cable Surge Protector

Each coaxial port shall be provided with a gas discharge tube surge protector located between the cable entry and/or exit to the equipment. The surge protector shall have the following characteristics:

(a) **Working Voltage**

The unit shall not introduce a series or shunt impedance to the signal path such that it interferes with the operation of the equipment.

(b) **Surge Voltage**

The unit shall limit the surge voltage to a level that is less than twice the maximum specified operating voltage of the equipment being protected. This surge voltage shall occur while conducting a peak surge current of 5,000 amperes. The surge current shall be a standard (8 x 20 microsecond) triangular wave.

(c) **Energy Rating**

The unit shall be capable of dissipating 50 joules of surge energy without damage to itself.

(d) **Detail Characteristics**

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**MECHANICAL REQUIREMENTS**
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Packaging

The amplifiers shall be packaged in a corrosion proof, 3 mm thick, aluminum or cast aluminum case (or equal as approved by the Engineer) suitable for mounting on a cabinet backpanel or overhead strand messenger as shown on the plans. These enclosures shall be gasketed so that, with all connector ports properly sealed, a weatherproof case will be formed, suitable for an underground operating environment including intermittent salt water immersion.

The case shall provide sufficient heat sinking (especially for the intermediate and output hybrid amplifier modules) to permit compliance with the MTBF requirement listed below.

Dimensions

The outer dimensions of the amplifier shall not exceed the following:

- Length: 610 mm
- Width: 254 mm
- Height: 178 mm

Connectors

The main coaxial input and output connectors shall be located at each end of the enclosure using Type I coaxial cable connector ports.

Secondary Tap

An input tap shall be provided on the side of the enclosure and shall be connected to the input of the inbound (50-108 MHz) module with 20 dB series attenuation F61A type female chassis.

CONSTRUCTION DETAILS:

All incidental parts which are not shown on the plans or specified herein and which are necessary to complete the INFORM installation or required for modifying existing
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systems, shall be furnished and installed as though such parts were shown on the plans or specified herein. All systems shall be complete and in operation to the satisfaction of the Engineer at the time of completion of the work.

Except for gas protectors, amplifier stations shall employ all solid state construction. The latest generation hybrid amplifiers shall be used in both the inbound and outbound amplifier sections, except that discrete transistors and components may be employed for the front end and intermediate amplifier stages.

_____ Electrical

_____ Design Life

All components in their normal circuit applications shall be designed to operate continuously for at least 15 years.

_____ Wire Size

All wiring shall be of such size to satisfy good engineering practices and meet the requirements of the National Electric Code.

_____ Sleeving

All wiring connected to terminal strips shall be identified by the use of insulated pre-printed sleeving slipped over the wire before final attachment, or other suitable identification.
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_____ Wire Dressing

All wires shall be cut to proper length before assembly. No wire shall be doubled back to take up slack. Wires shall be neatly laced into cables with nylon lacing or plastic straps. Cables shall be secured with suitable clamps.

_____ Transient Suppression

All DC relays, solenoids, and holding coils shall have diodes across the coils for transient suppression.

_____ Protection

The equipment shall contain readily accessible, normally resettable or replaceable circuit protection devices (such as circuit breakers or fuses) for equipment and power source protection.

_____ Fail Safe

The equipment shall be designed such that the failure of the equipment shall not cause the failure of any other.

_____ Mechanical

_____ Modular Design

The amplifier shall be modular in design such that major portions may be replaced in the field.

_____ Keying

Modules of unlike function shall be mechanically keyed to prevent insertion into the wrong socket or connector.
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Identification

All modules and assemblies shall be clearly identified with name, model number, serial number, and any other pertinent information required to facilitate equipment maintenance.

Maintenance Provisions

All equipment shall be designed for ease of maintenance. All component parts shall be readily accessible for inspection and maintenance. The only tools and test instruments required for maintenance by Maintenance personnel shall be simple hand held tools and various meters. Equipment shall be designed for field maintenance (isolation of malfunctions to particular modules or assemblies) by non-engineering personnel working under difficult conditions.

All systems shall be complete and in operation to conform with the requirements listed above or as shown by the Contract Documents and as ordered by the Engineer.

Design and Layout Review

The Contractor shall furnish cut sheets, shop drawings, and block and schematic diagrams which show in detail all proposed materials, dimensions, electronic layouts, part numbers, part values, and operation parameters prior to the construction of the coaxial amplifiers for the approval of the Engineer.

Environmental Requirements

The coaxial amplifier shall meet all of its specified requirements or as shown by the Contract Documents and as ordered by the Engineer during and after subjection to any combination of the following requirements.

Ambient Temperature

Range of -34°C to 74°C.
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Temperature Shock

Not to exceed 17°C per hour, during which the relative humidity shall not exceed 95%.

Relative Humidity Range

Not to exceed 95% over the temperature range of 4°C to 44°C.

Moisture Condensation

On all surfaces caused by temperature changes.

Vibration

The field equipment supplied under terms of this specification shall show no degradation of mechanical structure, soldered components, plug in components or satisfactory operation in accordance with the manufacturer's equipment specifications after being subjected to the following vibration test. The device shall be secured to the (shaker) head of a suitable electromechanical shaker in the vertical, lateral and longitudinal planes respectively. The object of the test is to vibrate the device in each of the three mutually perpendicular axes, in accordance with the following levels and/or parameters:

Amplitude - 0.06 "Double Amplitude" (peak to peak).

Linear Acceleration (g's) - 5 maximum.

Linear Velocity - approximately 188.0 mm per second.

Frequency - 40 Hz.

Duration - 5 minute dwell in each axis.
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High-Frequency Interference

The equipment operation shall be unaffected by line voltage spikes of up to ±300 volts amplitude at 2500 watts peak power and 1 microseconds pulse rise time, 10 microsecond pulse rise time and 10 microsecond pulse width at a repetition rate of one pulse every other cycle moving uniformly over the full wave once every 3 seconds for 10 minutes.

Quality Assurance Provisions

The coaxial amplifiers shall satisfy the following quality assurance provisions.

Factory Demonstration Test

The Contractor shall be responsible for the implementation of factory demonstration tests at the manufacturer's facility. The Engineer shall be notified a minimum of ten (10) calendar days before the start of the tests.

Unless otherwise shown by the Contract Documents or as ordered by the Engineer, each equipment accepted shall have passed the following individual tests:

a. Examination of Product
b. Continuity Test
c. Operational Test

Design Approval Test

Unless otherwise shown by the Contract Documents or as ordered by the Engineer, design approval tests shall be conducted by the Contractor on one or more sample equipments of each type to determine if the design of the equipment meets the requirement of the specification. The Engineer shall be notified a minimum of ten (10) calendar days in advance of the time when tests are to be conducted.

In the case of standard product line equipment, the Engineer and INFORM Project Director may waive the design approval tests if the manufacturer's written specifications (functional and environmental) are equal to or better than those in Section 6 of this appendix and he so states in writing or if the Contractor provides
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certification by an independent testing laboratory that these design approval tests have
been previously satisfactorily completed.

Tests

The following design approval tests shall be performed on the equipment. These tests
may be modified as shown by the Contract Documents or as ordered by the Engineer.

a. Temperature and Condensation
b. Power Variation
c. Relative Humidity
d. High Frequency Interference
e. Vibration

Test Procedures

The Contractor shall provide all factory demonstration and design approval test
procedures and data forms for approval to the Engineer. The test procedures shall have
the approval of the Engineer prior to submission of equipment for tests. The
Contractor shall furnish data forms containing all the data taken, as well as quantitative
results for all tests. The data forms shall be signed by an authorized representative of
the equipment manufacturer. At least one (1) copy of the data forms shall be sent to
the Engineer. The test procedures shall include the sequence of conducting the tests.

Equipment Reliability

The MTBF of each amplifier shall be greater than 300,000 hours exclusive of failures
induced by lightning, or other power line faults, whose absorbed energy shall exceed
the protective capabilities of the surge protector.

METHOD OF MEASUREMENT:

The amplifier will be measured as the number of complete units furnished in
accordance with the Contract Documents or as directed by the Engineer.

BASIS OF PAYMENT:
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The unit price bid for each amplifier shall include the cost of furnishing all labor,
materials, tools, and equipment necessary to complete the work in accordance with the
Contract Documents. Payment for all documentation required and the testing
referenced herein shall be included in the bid item. The installation of each amplifier
will be paid for under a separate item.