

NORTH ORANGE COUNTY COMMUNITY COLLEGE DISTRICT
SECTION 27 12 00 – COMMUNICATIONS BUILDING (RF) SYSTEM
SAMPLE SPECIFICATION

RELATED SECTIONS:

Section 27 00 00 General Requirements
Section 27 02 00 General Communication Requirements
Section 27 05 26 Grounding and Bonding for Communications
Section 27 05 28 Pathways for Communications Systems
Section 27 05 37 Fire-Stopping for Communication Systems
Section 27 10 00 Structured Cabling Testing
Section 27 11 00 Communication Equipment Room Fittings
Section 27 13 00 Communications Backbone Cabling
Section 27 13 23 ABF Fiber Optic Cabling
Section 27 15 00 Communications Horizontal Cabling
Section 27 16 00 Communications Connection Cords

PART 1 – GENERAL

1.1 SCOPE

- A. The Contractor shall construct a Bi-directional (RF) MATV System capable of two way transmission of audio, and video utilize frequencies between 5 and 50 MHZ. The forward transmission component of the system shall utilize frequencies between 54 and 1000 MHZ.
- B. The Contractor shall provide, install, place into operation, adjust, test, debug, document, warrant and provide operational instructions as described, hereinafter “provide” coaxial cables, active and passive equipment as specified herein and indicated on the Drawings for the Bi-directional (RF) MATV System.
- C. The Contractor shall provide and install one (1) optical transmitter, in the MATV System head-end. This optical transmitter will be the source of the programming, for the Bi- directional (RF) MATV System.
- D. The Contractor shall, in order to provide a complete working system, provide and install two (2) yellow single-mode fiber optic jumper cables. One is these jumpers is to be placed from the Contractor provided optical transmitter in the MATV System head-end to the backbone. Its configuration is FC/APC <> LC. The second jumper connects the Contractor provided optical receiver, located in the Building Distribution Frame (BDF) of the building to the backbone. Its configuration is FC <> LC. Each cable shall be sufficiently long enough (including slack) to connect either the receiver or transmitter to the “adjacent” fiber patch panel. The inter-building pathway (backbone) will be identified by the Campus Representative.
- E. Prior to installation of any equipment, the Contractor’s Broadband Communications Engineer shall review the proposed Bi-directional (RF) MATV System schematic and shall submit to the Engineer a red lined copy reflecting any changes based upon client requests, Contractor observations, field conditions, and/or product related issues

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- F. The Contractor shall install the coaxial backbone cables on the outboard side of the distribution pathways (cable trays) in the ground support clamp specified.
- G. After placement and measurement of the coaxial cables, the Contractor shall submit a schematic reflecting actual cable lengths, projected gain, projected loss, attenuator values, equalizer values, directional coupler values, eight port tap values, and any other pertinent Bi-directional (RF) MATV System design information.
- H. The Contractor shall provide and install one (1) Building Information Channel modulator in the Building Distribution Frame (BDF) of the building. The frequency used by this modulator will be determined by the District.

1.2 APPLICABLE PUBLICATIONS

- A. As defined in Section 27 00 00 and 27 05 00 Telecommunications General Requirements
- B. North Orange County Community College District Telecommunications Standards dated 2015.
- C. Federal Communications Commission (FCC) Part 15 and Part 76
- D. National Electrical Code (NEC) Article 820
- E. National Cable Television Association (N.C.T.A.)
(1) Recommended Practices for Measurements on Cable Television Systems

1.3 COMPLIANCE, TESTS AND INSPECTIONS

- A. The Contractor shall perform the work in conformance with professional standards and the requirements of authorities having jurisdiction.
- B. The Contractor shall conduct proof of performance testing and arrange inspections to demonstrate conformance with the requirements of authorities having jurisdiction.

1.4 DELIVERY AND STORAGE OF MATERIALS

- A. The Contractor shall store materials, delivered to the site, only in designated areas.
- B. The Contractor shall store materials at the site in containers clearly marked with the quantity, manufacturer, model number and description of the enclosed materials.
- C. Coaxial cable reels shall be stored in a designated area, either indoors or outdoors.
- D. The coaxial cable reels shall be stored upright, on the rolling edge.
- E. If the coaxial cable reels are stored outside, the ground shall be somewhat level and have good drainage. This will reduce the possibility of deterioration of the reel flanges.

1.5 COORDINATION OF THE WORK

- A. The Contractor shall maintain a competent supervisor and supporting technical personnel, acceptable to the District's representative, until final Acceptance of the Bi- directional (RF) MATV System.

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- B. System work with related trades. In the event of a conflict, delayed or improper preparatory work by others, notify the District's representative immediately; the District's representative's decision shall be binding. The Contractor shall coordinate the Bi-directional (RF) MATV
- C. The Contractor shall verify all dimensions, sizes, cables, devices, and equipment described herein and as indicated on the Drawings, before proceeding with the work.
- D. The Contractor shall regularly examine conditions at the site which may affect the work. Ensure proper conditions for the work before procurement of materials or their scheduled installation. Assume the costs for replacement or modification of materials as required for their proper integration into the work.
- E. The Contractor shall provide and install all support or positioning members required for the work. Submit drawings to the Architect for written acceptance, prior to installation.

1.6 ACCEPTANCE OF THE WORK

- A. The Contractor shall install temporary provisions satisfactory to District and at no cost in the event that material, device, equipment, system, or workmanship is found unacceptable ten (10) days prior to the completion date, until final Acceptance of the work.

1.7 WARRANTY

- A. The Contractor shall warrant the work to be free from defects in materials and workmanship for twelve (12) months from final Acceptance. Provide all necessary materials and services for repair or temporary installation pending repair without cost.
- B. The Contractor shall maintain regular service facilities and provide a qualified broadband communications technician familiar with this work at the site within twenty four (24) hour notice of a malfunction, including weekends and holidays.
- C. The Contractor shall conduct warranty repairs and service at the job site unless in violation of manufacturer's warranty; in the latter event, provide substitute equipment and devices, acceptable to the District for the duration of offsite repairs.
- D. The Contractor shall transport warranty, substitute and/or test systems, equipment, devices, materials, parts, and personnel to and from the job site at no additional cost.

1.8 SUBMITTALS

- A. Submit under provisions of Sections
- B. Qualifications
 - (1) Provide evidence that the qualified contractor is and has been licensed and engaged in the business of designing, installing, and servicing Bi-directional (RF) MATV Systems for at least the past eight (8) consecutive years.

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- (2) Include a description of the bidding contractor's parts storage, engineering, fabrication, assembly, testing, and service facilities within sixty (60) miles of the site.
- (3) Provide documented proof that all work undertaken on the Bi-directional (RF) MATV system will be under the direct supervision of a qualified Broadband Communications Engineer.

A qualified "Broadband Communications Engineer" is defined as someone that can demonstrate successfully completing the design and installation of multi-channel radio frequency and fiber optic cable television systems for a period of at least five years, or can demonstrate the completion of a manufacturer's certified training course in system design and a minimum of two years of experience.

- a. Experience must include system design, installation, activation, balancing, acceptance testing, and documentation.
- (4) Provide documented proof that all work undertaken on the Bi-directional (RF) MATV system is conducted by qualified Broadband Communications Technicians.

A qualified "Broadband Communications Technician" is defined as someone that has installed and serviced multi-channel radio frequency and fiber optic cable television systems for a period of at least four years, or can demonstrate the completion of a certified training course in broadband communications system installation, service, and a minimum of two years of experience.

- a. Experience must include system installation, inspection, activation, balancing, acceptance testing, and service.
- (5) Include a statement confirming that the Bi-directional (RF) MATV System is fully in conformance with the Specifications and Drawings.

C. Post Award Submittals

- (1) The Contractor shall prepare and submit one (1) paper reproducible of each drawing and three (3) signed copies of each text item within thirty (30) days of Award.
- (2) The Contractor shall prepare and submit a Bill of Materials, itemizing the materials, devices, and equipment required for the work, including the following information for each item listed:
 - a. Quantity
 - b. Generic name or description
 - c. Corresponding Specifications item or Drawing detail
 - d. Manufacturer's name and model number
 - e. Manufacturer's specification sheet annotated to distinguish the specific model
- (3) Prior to the installation of the Bi-directional (RF) MATV system, the Contractor shall obtain and review the suggested system design schematic, provided in the contract documents, and reflect any changes based on:
 - a. Contractor's observation

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- b. Current product conditions
 - c. Requests from the NOCCCD
 - (4) The Contractor shall prepare and submit a Drawing List including the unique number and title of each drawing to be submitted; each the same size as the Contract Documents. The List may be revised, as necessary.
 - (5) The Contractor shall prepare and submit a Work Schedule identifying principal tasks of this work and the projected completion dates, precedent tasks of others and their must complete dates. Include submittals, submittal review, resubmittal, submittal final review, District orientation, cable installation, equipment installation, cable termination, system activation, preliminary testing and adjustment, proof of performance testing and adjustment, record document review, District training, and final Acceptance.
 - (6) The Contractor shall prepare and submit a Proof of Performance Test Form describing each procedure and the test equipment used to verify that the work is in conformance with the National Cable Television Association Recommended Practices for Measurements on Cable Television Systems.
 - (7) The Contractor shall prepare and submit the test equipment calibration record and certification, prior to beginning the Proof of Performance testing procedures.
- D. Floor Plan and Schematic Drawing Submittal
- (1) The Contractor shall prepare and submit one (1) print and one (1) paper reproducible of each drawing, within sixty (60) days of Award.
 - (2) The Contractor shall prepare and submit scaled floor plans utilizing AutoCAD, revision 14 or better, plots, obtained from the District's representative, that include:
 - a. Coaxial cables
 - b. Cable tray, conduit, and sleeves
 - c. Junction and pull boxes
 - d. Active and passive system components
 - e. Room names and numbers
 - (3) The Contractor shall prepare and submit a schematic diagram that indicates:
 - a. Generic names and/or descriptions of all system components
 - b. Manufacturer's names and model numbers
 - c. Exact locations of all system components
 - d. Room names and numbers
- E. Preliminary Record Documents
- (1) The Contractor shall prepare and submit one (1) print and one (1) paper reproducible Bi-directional (RF) MATV System schematic diagram that includes:
 - a. Generic names and/or descriptions of all system components
 - b. Manufacturer's names and model numbers
 - c. Exact locations of all system components
 - d. Room names and numbers
 - (2) The Contractor shall prepare and submit one (1) print and one (1) paper reproducible as built drawing of the Bi-directional (RF) MATV System that

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includes:

- a. Actual routing and lengths of the coaxial cables
 - b. Cable tray, conduit, and sleeves
 - c. Junction and pull boxes
 - d. Room names and numbers.
 - e. Measured signal levels, at the input and output of all system components
 - f. Exact location of the signal processor, television modulator, character generator, optical transmitter, optical receiver, system amplifiers, line splitters, and line terminators.
 - g. Exact location and associated values of the attenuators
- (3) The Contractor shall prepare and submit three (3) signed copies of a bound manual, with labeled dividers, that includes:
- a. Instructions, brochures, manuals, and other product specific information published by the manufacturers of the Bi-directional (RF) MATV System components, devices, and equipment.
- (4) The Contractor shall prepare and submit three (3) signed copies of a bound manual, with labeled dividers, that includes:
- a. Methods, results, and records of the proof of performance testing procedures
 - b. Test equipment calibration record and certification
 - c. Representations of the proof of performance test results, including signal levels, at the input of the optical transmitter
 - d. Representations of the proof of performance test results, including signal levels, at the output of the optical receiver
 - e. Representations of the proof of performance test results, including signal levels, for the input to the system amplifiers
 - f. Representations of the proof of performance test results, including signal levels, at the output of the system amplifiers
 - g. Representations of the proof of performance test results, including signal levels, for each of the system “end of lines”
 - h. Signal leakage measurement test results, and records for each floor of the building

PART 2 – PRODUCTS

2.1 SECTION INCLUDES

- A. Signal Processor
- B. Television Modulator
- C. Character Generator
- D. Optical Transmitter
- E. Optical Receiver
- F. System Amplifiers
- G. Directional Couplers
- H. Line Splitters
- I. Eight Port Taps
- J. Connectors

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- K. Line Terminators
- L. TV/Monitor Bracket and Mounting Hardware

2.2 SIGNAL PROCESSOR

A. Materials

(1) The signal processor must provide the following minimum performance characteristics:

- a. Frequency range 7 to 1000 MHZ.
- b. Input channel T-7
- c. Output channel Agile
- d. Output level 60 dBmV
- e. Aural/Visual carrier ratio (dB) -10 to -17
- f. Spurious outputs (dBc) -60
- g. Broadband noise (dBc) -76

- B. Manufacturer: Blonder Tongue Laboratories, Inc. or authorized equivalent
- C. Model: AP60 - 450 with Option 17, Sub band input
- D. This model is the campus standard.

2.3 TELEVISION MODULATOR - RETURN FEED

A. Materials

(1) The television modulator must provide the following minimum performance characteristics:

- a. Frequency range 7 to 1000 MHz.
- b. Signal inputs baseband audio and video
- c. Output channel Agile
- d. Output level 60 dBmV.
- e. Aural/Visual carrier ratio (dB) -10 to -17
- f. Spurious outputs (dBc) -60
- g. C/N ratio in channel (dB) 68
- h. Broadband noise (dBc) -76
- i. Output impedance 75 Ohms

- B. Manufacturer: Blonder Tongue Laboratories, Inc. or authorized equivalent
- C. Model: AM - 60 - 450, with option 04, Sub-band output
- D. This model is the campus standard.

2.4 TELEVISION MODULATOR - BUILDING INFORMATION CHANNEL

A. Materials

(1) The television modulator must provide the following minimum performance characteristics:

- a. Frequency range 50 to 1000 MHz
- b. Signal inputs baseband audio and video
- c. Output channel Agile
- d. Output level 60 dBmV
- e. Aural/Visual carrier ratio (dB) -10 to -17
- f. Spurious outputs (dBc) -60
- g. C/N ratio in channel (dB) 68

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- h. Broadband noise (dBc) -76
- i. Output impedance 75 Ohms
- B. Manufacturer: Blonder Tongue Laboratories, Inc. or authorized equivalent
- C. Model: AM - 60 - 450, with option 04, Sub-band output
- D. This model is the campus standard.

2.5 CHARACTER GENERATOR

A. Materials

- (1) The character generator must provide the following minimum performance characteristics:
 - a. Format NTSC (1.0VPP into 75 Ohms)
 - b. Text Colors Sixteen (16)
 - c. Background colors Six (6)
 - d. Messages Ninety (90)
 - e. Outputs Six (6) BNC type
- (2) Manufacturer: D. Co Specialty Video Products or authorized equivalent
- (3) Model: The Kid C/G or equivalent

2.6 OPTICAL TRANSMITTER

A. Materials

- (1) The optical transmitter must convert radio frequency signals to light energy.
- B. Manufacturer: Harmonics, Inc. or authorized equivalent
- C. Model: POWERLINK II;6 DB;1GHZ;AS (PWL4106S-AS)
- D. This model is the campus standard.

2.7 OPTICAL RECEIVER

A. Materials

- (1) The optical receiver must convert light energy to radio frequency signals.
- B. Manufacturer: Harmonics, Inc. or authorized equivalent
 - (1) Model: RETURN PATH RECEIVER;SC/APC (HRR4104-AS)
- C. This model is the campus standard.

2.8 SYSTEM AMPLIFIERS

A. Materials

- (1) Amplifiers must meet or exceed the following specifications:
 - a. Frequency range: 5 to 1000 MHz.
 - b. Channel loading: 137 channels
 - c. Output level: 50dBmV at 861 MHz.
- (2) Amplifiers must be equipped with reverse amplifier as specified in the SA-II matrix number.
- (3) Amplifiers must be locally powered via a power insertion device: Lectro PCS- MXP-114L Mini-max
- B. Manufacturer: Scientific Atlanta. or authorized equivalent

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- C. This model is the campus standard.

2.9 DIRECTIONAL COUPLERS

- A. Materials
 - (1) Directional couplers must meet or exceed the following specifications:
 - a. Frequency range: 5 to 1000 MHz.
 - b. Housing and faceplate to be constructed of die cast aluminum
 - c. Minimum isolation: 18 dB
 - d. Capable of bi-directional operation
- B. Manufacturer: Scientific Atlanta. or authorized equivalent
- C. Model SADC Series
- D. This model is the campus standard.

2.10 LINE SPLITTERS

- A. Materials
 - (1) The line splitters must meet or exceed the following specifications:
 - a. Frequency range: 5 to 1000 MHz.
 - b. Housing and faceplate to be constructed of die cast aluminum
- B. Manufacturer: Scientific Atlanta. or authorized equivalent
- C. Model SAS Series
- D. This model is the campus standard.

2.11 EIGHT PORT TAPS

- A. Materials
 - (1) The Eight Port Taps must meet or exceed the following specifications:
 - a. Frequency range: 5 to 1000 MHz.
 - b. Housing and faceplate to be constructed of die cast aluminum
 - c. Each tap labeled with the tap value
 - d. Capable of bi-directional operation
- B. Manufacturer: Scientific Atlanta. or authorized equivalent
- C. Model SAT Series
- D. This model is the campus standard.

2.12 CONNECTORS

- A. Male Connectors
 - (1) The "F" style connectors for the plenum rated RG-6 quad shield drop cable shall be equipped with an integral ribbed crimp ring.
 - (2) Only a connector recommended by the cable manufacturer shall be installed.
- B. Female to female connectors
 - (1) The F-81 connectors shall be installed with wall plates at all drop locations.
 - (2) The bend radius of any cable installed must not exceed the manufactures specifications. In those cases, such as in wire mold, where the minimum radius cannot be maintained, a 90 degree fitting is to be used provided the performance criteria is not jeopardized.

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- (3) The faceplate used at the TV/monitor locations (primary and secondary, +84" and +42") will be a (Provide Part Number Here) 106313646. This faceplate is to be installed on a single gang mud ring. The F-81 connectors shall be placed in the upper left location. The three (3) other openings will be equipped with (Provide Part Number Here) dust covers.
- C. .500 Connectors
- (1) The pin type connectors for the riser and/or plenum rated 500 coaxial cable shall be designed to mate with the various active and passive components on the riser and plenum portion of the distribution system.
- (2) Only a connector recommended by the cable manufacturer shall be installed.
- D. Manufacturers: Gilbert Engineering Company, Inc., and Augat LRC.

2.13 LINE TERMINATORS

- A. Materials
- (1) The line terminators must meet or exceed the following specifications:
- Characteristic impedance = 75 Ohms
 - Designed to be installed in an eight port tap housing.
- B. Manufacturer: Gilbert Engineering Company, Inc.
- C. Model: 'KS' Terminator

2.14 TV/MONITOR BRACKET AND MOUNTING HARDWARE

- A. Materials
- The TV/monitor bracket and mounting hardware consists of the wall bracket, support arm, TV/monitor cradle, safety straps, etc.*
- B. Manufacturer: Lucasey Manufacturing Corp.
- C. Model DSCM 2030.
- D. This model is the campus standard. No exceptions allowed.

2.15 MISCELLANEOUS HARDWARE

- A. The Contractor shall provide and install all hardware necessary to provide a fully operational Bi-directional (RF) MATV system. Miscellaneous hardware shall include but is not limited to: diplex filters, identification labels, power supplies, interface kits, fiber optic jumper cables, coaxial jumper cables, connectors, attenuators, equalizers, terminators, interstage trim networks, nuts, bolts, washers, screws, cable ties, straps, spacers, hooks, sleeves, strain reliefs, clamps, arms, braces, and brackets.

PART 3 – EXECUTION

3.1 SECTION INCLUDES

- A. General Installation
- B. Signal Processor
- C. Television Modulator
- D. Character Generator
- E. Optical Transmitter

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- F. Optical Receiver
- G. System Amplifiers
- H. Directional Couplers
- I. Line Splitters
- J. Eight Port Taps
- K. Connectors
- L. Line Terminators
- M. TV/monitor Bracket and Mounting Hardware
- N. Activation and Balancing
- O. Proof of Performance Testing Procedures
- P. Proof of Performance Testing Documentation
- Q. As-Built Drawing
- R. Broadband Communications Engineer
- S. Broadband Communications Technician
- T. Complete Bi-directional (RF) MATV System

3.2 GENERAL INSTALLATION

- A. All Bi-directional (RF) MATV System installation work must be performed according to published industry guidelines, rules, and regulations. If disputes occur, local, state, and national codes have precedence; then North Orange County District Community College District policies and procedures; then standards such as the National Cable Television Association (NCTA); then guidelines from firms such as Building Industry Consulting Services International (BICSI), then finally, manufacturer recommendations.
- B. The Contractor shall provide sufficient trained staff to monitor all work undertaken and to ensure the terms of the contract documents are met throughout the installation process. Work completed which is not in compliance with the contract documents will not be excused simply because installation staff were not aware of the specific requirements. Additional Contractor costs and delays could develop if equipment must be removed to conduct inspections or correct deficiencies so it is important the on-site staff are familiar with this document.
- C. The Contractor shall, at all times, make every effort to conduct all Bi-directional (RF) MATV System installation work in a manner so as to minimize the impact on the students, staff, and facilities of NOCCCD. Whenever possible, all work will be hidden behind finished materials.
- D. The Contractor is required to provide and install all pathway and cable support hardware necessary to successfully complete the installation of the Bi-directional (RF) MATV System. This includes, but is not limited to, hangers, ladder racks, support brackets, conduit and sleeves and tie-wraps.
- E. The Contractor shall ensure that only staff fully qualified to work on specific types of materials are allowed to undertake the required installation. Particularly, coaxial and fiber optic cable placement, termination, splicing, and testing shall only be undertaken by staff who can show completion of manufacturer-approved training class in each of the identified areas.

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- F. The Contractor shall provide all hardware, and miscellaneous components necessary to provide a complete Bi-directional (RF) MATV System.
- G. The Contractor and District's representative shall jointly coordinate the implementation of the project. To that end a pre-installation meeting(s) will occur between the various trade representatives and the District representatives (ITR) prior to the installation of any facilities (equipment, copper cable termination blocks, voice/data/video systems, electrical service, HVAC ducts/units, etc.) in communication rooms or in building spaces.

3.4 TELEVISION MODULATORS

- A. The Contractor shall provide and install one (1) television modulator (Building Information Channel) as specified and as recommended by the manufacturer.
- B. The Contractor shall provide and deliver one (1) channel T-7 television modulator (Return Feed) to process the return feed from the building to the District's representative.
- C. The installation of the television modulator shall be accomplished using tools and support hardware designed for the television modulator, and following procedures identified by the manufacturer.
- D. The Contractor shall provide and install all components required for the satisfactory operation of the television modulators.

3.5 CHARACTER GENERATOR

- A. The Contractor shall provide and install character generator if specified in the project plans, and as recommended by the manufacturer.
- B. The installation of the character generator shall be accomplished using tools and support hardware designed for the character generator, and following procedures identified by the manufacturer.
- C. The Contractor shall provide and install all components required for the satisfactory operation of the character generator.

3.6 OPTICAL TRANSMITTER

- A. The Contractor shall provide and install in the campus head-end an optical transmitter as specified and as recommended by the manufacturer.
- B. The installation of the optical transmitter shall be accomplished using tools and support hardware designed for the optical transmitter, and following procedures identified by the manufacturer.
- C. The Contractor shall provide and install

3.7 OPTICAL RECEIVER

- A. The Contractor shall provide and install optical receiver as specified and as recommended by the manufacturer.
- B. The installation of the optical receiver shall be accomplished using tools and support hardware designed for the optical receiver, and following procedures identified by the manufacturer.

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- C. The Contractor shall provide and install all components required for the satisfactory operation of the optical receiver.

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- A. The Contractor shall provide and install system amplifiers as specified in the project plans, and as recommended by the manufacturer.
- B. The installation of the system amplifiers shall be accomplished using tools and support hardware designed for the system amplifiers, and following procedures identified by the manufacturer.
- C. The Contractor shall provide and install all components required for the satisfactory operation of the system amplifiers.

3.9 DIRECTIONAL COUPLERS

- A. The Contractor shall provide and install directional coupler as specified in project plans, and as recommended by the manufacturer.
- B. The installation of the directional couplers shall be accomplished using tools and support hardware designed for the directional couplers, and following procedures identified by the manufacturer.
- C. The Contractor shall provide and install all components required for the satisfactory operation of the directional couplers.

3.10 LINE SPLITTERS

- A. The Contractor shall provide and install two way line splitters as specified in project plans, and as recommended by the manufacturer.
- B. The Contractor shall provide and install A three way line splitter as specified in project plans, and as recommended by the manufacturer.
- C. The installation of the line splitters shall be accomplished using tools and support hardware designed for the line splitters, and following procedures identified by the manufacturer.
- D. The Contractor shall provide and install all components required for the satisfactory operation of the line splitters.

3.11 EIGHT PORT TAPS

- A. The Contractor shall provide and install eight port taps as specified in project plans, and as recommended by the manufacturer.
- B. The installation of the eight port taps shall be accomplished using tools and support hardware designed for the eight port taps, and following procedures identified by the manufacturer.
- C. The Contractor shall provide and install all components required for the satisfactory operation of the eight port taps.
- D. The Contractor shall provide and install a 75 Ohm port terminator on all unused ports of the eight port taps.

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- A. The Contractor shall provide and install all connectors as required in the project plans, and as recommended by the manufacturer.
- B. The installation of all connectors shall be accomplished using tools designed for the connectors, and following procedures identified by the manufacturer.
- C. The installation of all connectors must be undertaken in such a manner as to prevent the disruption of working communications services to other departments.
- D. The Contractor shall provide and install all components required for the satisfactory operation of the connectors.

3.13 LINE TERMINATORS

- A. The Contractor shall provide and install line terminators as required in the project plans, and as recommended by the manufacturer.
- B. The installation of all line terminators shall be accomplished using tools designed for the line terminators, and following procedures identified by the manufacturer.
- C. The installation of all line terminators must be undertaken in such a manner as to prevent the disruption of working communications services of other departments.
- D. The Contractor shall provide and install all components required for the satisfactory operation of the line terminators.

3.14 TV/MONITOR WALL BRACKET AND MOUNTING HARDWARE

- A. The Contractor shall install at each location specified in the contract documents one each Lucasey wall bracket as detailed.
- B. The Contract shall deliver to the District's representative the Lucasey support arm and enclosure to be installed by others.

3.15 ACTIVATION AND BALANCING

- A. The Contractor shall activate and balance both the forward and reverse components of the Bi-directional (RF) MATV System.
- B. The Bi-directional (RF) MATV System "end of line" is defined as an MATV outlet fed from the last eight port tap on each terminated coaxial cable leg.
- C. The activation and balancing process shall achieve the following forward performance parameters for each Bi-directional (RF) MATV System "end of line":
 - Minimum video signal level:* 3 dBmV
 - Maximum Video signal level:* 10 dBmV
 - Maximum difference between adjacent video carriers:* 3 dBmV
 - Maximum difference between any video carriers:* 8 dBmV
 - Minimum A/V carrier Ratio:* 10 dB
 - Miaximum A/V carrier Ratio:* 17 dB
 - Carrier to nosie ratio:* -46 dBc mimimum
 - Hum:* 3& maximum
- D. The forward and reverse activation and balancing procedures shall be conducted in order to provide a fully operational Bi-directional (RF) MATV System that is capable of achieving satisfactory proof of performance testing results.

3.16 PROOF OF PERFORMANCE TESTING PROCEDURES

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- A. The Contractor shall conduct witnessed proof of performance testing procedures on the Bi-directional (RF) MATV System including all cables, passive and active devices. Details of the methods that must be followed for conducting the proof of performance testing will be found in the current edition of the NCTA (National Cable Television Association) Recommended Practices for Measurements on Cable Television Systems.
- B. The Contractor shall provide modern, and fully operational broadband communications systems test equipment capable of providing complete, clear and legible representations of the proof of performance test results.
- C. All Bi-directional (RF) MATV System proof of performance testing shall be conducted using broadband communications system test equipment that has been calibrated within six months of the required proof of performance tests.
- D. The Contractor shall prepare and submit three signed copies of the broadband communications system test equipment calibration record and certification, prior to beginning the proof of performance testing procedures.
- E. The broadband communications systems test equipment shall include, but is not limited to:
- Television Modulator Television Demodulator Cable TV System Analyzer Spectrum Analyzer*
 - Signal Level Meter*
 - Leakage Detection and Monitoring Devices Time Domain Reflectometer*
 - Signal Generator Vectorscope*
 - Video Waveform Monitor Multimeter*
 - Sweep System*
 - Television Monitor Receiver*
- F. The Contractor shall provide and combine a 750 MHz. carrier with television signals from LOCAL SERVICE PROVIDER and NOCCCD. These combined television signals shall be supplied to the input of the optical transmitter, for testing the forward components of the Bi-directional (RF) MATV System.
- G. If the signals mentioned above are not available, the Contractor shall provide multiple radio frequency signals from a matrix type signal generator. These generated signals shall be supplied to the input of the optical transmitter, for testing the forward component of the Bi-directional (RF) MATV System.
- H. The Contractor shall provide baseband video and audio signals, for input to the Contractor provided channel T-7 television modulator. The channel T-7 television modulator shall be the signal source for the proof of performance testing procedures, for testing the reverse component of the Bi-directional (RF) MATV System.
- I. The signals at the Bi-directional (RF) MATV System “end of lines” shall be free of additional noise and distortion, as judged by the Inspector. The Contractor will demonstrate that the signals at the Bi-directional (RF) MATV System “end of lines” conforms to the quality standard established by the NOCCCD. If excessive noise or any other picture impairments are present, the Contractor will be required to either resolve the problem or demonstrate the problem is not a result of work

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undertaken as part of this contract. At a minimum, the following tests may be required to demonstrate the origin of the problem:

- J. The Contractor shall conduct witnessed signal leakage testing measurements in the following manner:
 - (1) The Contractor shall use the appropriate radio frequency signal leakage detection and monitoring devices to obtain readings on each floor of the building.
 - (2) The Contractor shall identify and correct any signal leakage in excess of that allowed by FCC and NCTA guidelines.
 - (3) The Contractor shall prepare and submit three signed copies of the signal leakage measurement test results and records for each floor of the building.
- K. All proof of performance testing shall be conducted following NCTA published guidelines and all final measurements shall fall within NCTA standards. The Bi-directional (RF)
- L. MATV System shall be inspected, diagnosed, analyzed, repaired, adjusted, balanced, and/or reconfigured until the system meets or exceeds the NCTA standards.
- M. The proof of performance testing procedures are to ensure that the Bi-directional (RF) MATV System is complete and fully operational when turned over to NOCCCD, for use.

3.17 PROOF OF PERFORMANCE TESTING DOCUMENTATION

- A. The Contractor shall prepare and submit three (3) signed copies of a bound manual, with labeled dividers that includes:
 - (1) Methods, results, and records of the proof of performance testing procedures
 - (2) Test equipment calibration record and certification
 - (3) Representations of the proof of performance test results, including signal levels, at the input of the optical transmitter
 - (4) Representations of the proof of performance test results, including signal levels, at the output of the optical receiver
 - (5) Representations of the proof of performance test results, including signal levels, for the input to the system amplifiers
 - (6) Representations of the proof of performance test results, including signal levels, at the output of the system amplifiers
 - (7) Representations of the proof of performance test results, including signal levels, for each of the system “end of lines”
 - (8) Signal leakage measurement test results, and records for each floor of the building

3.18 BIDIRECTIONAL (RF) MATV SYSTEM AS BUILT DRAWING

- A. The Contractor shall provide a Bi-directional (RF) MATV System as built drawing.
 - (1) The Contractor shall prepare and submit three signed copies of the Bi-directional (RF) MATV System as built drawing.
 - (2) The Bi-directional (RF) MATV System as built drawing shall depict the

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actual routing and lengths of the coaxial cables.

- (3) The Bi-directional (RF) MATV System as built drawing shall record the measured signal levels, at 6 MHz., 54 MHz., 550 MHz. and 861 Mhz MHz., at the input and output of all Bi-directional (RF) MATV System components.
 - (4) The Bi-directional (RF) MATV System as built drawing shall also include the exact location of the signal processor, television modulator, character generator, amplifiers, line splitters, and line terminators.
 - (5) The Bi-directional (RF) MATV System as built drawing shall also indicate the exact location and associated values of the attenuators, equalizers, directional couplers, and eight port taps.
- B. The Contractor's shall provide electronic cable records of all video system components and cabling installed. These records include but are not limited to cable lengths, tap values, cable ID, etc. The records shall be provide in an electronic file (Excel) approved by the District.

3.19 BROADBAND COMMUNICATIONS ENGINEER

- A. The Contractor shall provide or subcontract with a qualified Broadband Communications Engineer to provide supervision of the installation, activation, balancing, and proof of performance testing of the Bi-directional (RF) MATV System.
- B. The Contractor's Broadband Communications Engineer shall be on-site for progress meetings, as scheduled by the NOCCCD, Construction Coordinator.
- C. The Contractor's Broadband Communications Engineer shall provide, full time, on site supervision of all installation, activation, balancing, and proof of performance testing associated with the Bi-directional (RF) MATV System.
- D. The Contractor's Broadband Communications Engineer shall provide direction in the final selection of all Bi-directional (RF) MATV System components and their final placement.

3.20 BROADBAND COMMUNICATIONS TECHNICIAN

- A. The Contractor shall provide or subcontract with a qualified Broadband Communications Technician for the installation, activation, balancing, and proof of performance testing of the Bi-directional (RF) MATV System.

3.21 COMPLETE BIDIRECTIONAL (RF) MATV SYSTEM

- A. The Contractor is responsible for the installation, activation, balancing, and proof of performance testing of the Bi-directional (RF) MATV System to ensure the completed system function as outlined in the contract documents, as specified by the District and as recommended by the NCTA.

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