SECTION 27 41 16

INTEGRATED AUDIO-VIDEO SYSTEMS AND EQUIPMENT

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PART 1 GENERAL

1.1 SECTION INCLUDES

A. Presentation System –
A single unit integrated digital media presentation system. The single central switching and control unit integrates audio-video switching, audio mixing and amplification, and complete system control.

SPECIFIER: Retain the following article if the AV controller specified in this section is controlling:

- *A building lighting system (lighting system may be a stand-alone system connected via network interface).*
- *Lighting equipment connected to other systems (any lighting equipment whose primary controller is not the controller specified in this section but is connected to it via some type of control interface).*
- *Lighting equipment specified in other sections.*
- *Existing Lighting equipment.*

B. Integrated Controller –
Advanced control functions and sequences for integrated lighting [systems] [equipment].

SPECIFIER: Retain the following article if the AV controller specified in this section is connected to or integrated with user interfaces (keypads, touchpanels, Browser GUIs, etc.) specified in other sections.

C. Host Processor –
Host control processor for user control interfaces.

SPECIFIER: Retain the following article if the AV controller specified in this section is connected to or integrated with a system scheduling and management server such as Crestron FUSION, where the controller in this section provides interfacing and control of equipment being scheduled and managed.

D. Device Controller –
Device and equipment controller for scheduling and management servers.

1.2 RELATED REQUIREMENTS

A. Section 25 08 00
Commissioning of Integrated Automation

B. Section 25 10 00
Integrated Automation Network Equipment

C. Section 25 11 13
Integrated Automation Network Servers

D. Section 25 13 13
Integrated Automation Control and Monitoring Network Supervisory Control

E. Section 25 13 16
Integrated Automation Control and Monitoring Network Integration Panels

F. Section 25 13 19
Integrated Automation Control and Monitoring Network Interoperability

G. Section 25 15 16
Integrated Automation Software for Control and Monitoring Networks

H. Section 26 09 43.13
Digital-Network Lighting Controls

I. Section 27 15 00
Communications Horizontal Cabling

J. Section 27 41 00
Audio-Video Systems

1.3 REFERENCES

A. Abbreviations and Acronyms

1. CEC: Consumer Electronics Control
2. EDID: Extended display identification data
3. HDCP: High-bandwidth Digital Content Protection
4. HDMI: High-Definition Multimedia Interface
5. IDF: Intermediate Distribution Frame
6. KSV: Key Selection Vector
7. MDF: Main Distribution Frame
8. NVP: Nominal Velocity of Propagation

B. Definitions

1. Channel: The end-to-end transmission path between two points including all patch or extension cords. The path at which application-specific equipment is connected.
2. Permanent Link: The installed twisted pair cable link excluding test and patch cords.
3. Permalink: see Permanent Link.

4. Nominal Velocity of Propagation: (NVP) expresses the speed of the electrical signals along the cabling link in relation to the speed of light in vacuum (3x108 m/second). Insulation characteristics and twist rate of the wire pair influence NVP in minor ways.

C. Reference Standards

1. ANSI/TIA-568-C "Requirements for Field Test Instruments and Measurements for Balanced Twisted-Pair Cabling"
2. ANSI/TIA-568-C.2 "Commercial Balanced Twisted-Pair Telecommunications Cabling and Components Standard".
3. ANSI/TIA-1152 "Generic Telecommunications Cabling for Customer Premises"

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Manufacturer:
Subject to compliance with requirements, provide products of Crestron Electronics, Inc., Rockleigh, NJ 07647, Phone 800-237-2041, Fax: 201-767-1903, www.crestron.com [or comparable products from a single manufacturer approved by A/E prior to bidding], with the following components and characteristics.

2.2 DIGITAL MEDIA PRESENTATION SYSTEM

A. Basis of Design Product:

1. **Crestron, DMPS-[100/200/300]-C** Digital Media Presentation System.

B. System Architecture

1. The Digital Media Presentation system shall be a single central switching and control unit integrating the following functions:
    a. Audio matrix switching.
    b. Microphone pre-amplification.
    c. Microphone and program audio mixing.
    d. Audio amplification.
    e. Digital multi-channel audio router.
    f. Analog to digital video transcoding.
    g. Video matrix switching.
    h. Single Cable Signal Transmission.
    i. System control processing.
2. External Single Cable Signal Transmission transmitter and receiver units.
3. System user interfaces.
4. AV source devices.
5. HDMI Video display devices.
6. System devices under control.

C. Front Panel Control Interface

1. The front panel user interface shall control the following system functions:
    a. Volume control.
    b. Program audio mute.
    c. Source routing.

2.3 AUDIO MATRIX SWITCHER

A. Switcher Signal Routing

1. Any stereo input signal shall be routable to:
    a. Any single stereo output.
    b. Multiple stereo outputs.
    c. Power amplifier input.
    d. HDMI output.
    e. Single Cable Signal Transmission transmitter output.
2. The internal stereo switcher shall have multiple stereo inputs.
3. Each internal stereo switcher input shall be internally connected to one of three external input connection types.
    a. Type 1 – Two mutually exclusive input connections switched into one switcher input.
        1) Detachable terminal block - Balanced or unbalanced stereo line level analog audio.
        2) 19-pin Type A HDMI female connector with stereo audio.
    b. Type 2 – Three mutually exclusive input connections switched into one switcher input.
        1) Detachable terminal block - Balanced or unbalanced stereo line level analog audio.
        2) 19-pin Type A HDMI female connector: stereo audio.
        3) RCA female S/PDIF coaxial digital audio input: 2ch PCM
    c. Type 3 – One 8-pin RJ-45 shielded female Single Cable Signal Transmission compliant connector with stereo audio.

2.4 MICROPHONE PREAMPLIFIER

A. Microphone Inputs
1. Each internal microphone preamplifier input shall be connected to two mutually exclusive input connections.
    a. Detachable terminal block - Balanced microphone level analog audio with switchable 48 volt DC phantom power.
    b. Detachable terminal block - Balanced or unbalanced line level analog audio.

2.5 MICROPHONE AND PROGRAM AUDIO MIXER

A. Independent Mixes
1. All stereo audio outputs shall be capable of outputting independent microphone and program audio mixes.
    a. All stereo sources and microphone sources shall be available simultaneously.
    b. All stereo sources and microphone sources shall have controllable levels in mixed output signal.

2.6 AUDIO AMPLIFIER

A. Integrated Audio Power Amplification

1. Three mutually exclusive amplifier modes.

a. 4 ohm, 8 ohm mode: Stereo, 20 Watts RMS per channel at 4 ohms or 8 ohms.

b. 70V mode: mono, 40 Watts RMS per channel.

c. 100V mode: mono, 40 Watts RMS per channel.

2.7 VIDEO MATRIX SWITCHER

A. Switcher Signal Routing

1. Any video input signal shall be routable to:

a. Any single video output.

b. Multiple video outputs.

2. The internal video switcher shall have multiple inputs.

3. Each internal switcher input shall be internally connected to one of four external input connection types.

a. Type 1 – Two mutually exclusive input connections switched into one switcher input.

1) DB15HD female connector.

2) 19-pin Type A HDMI female connector.

b. Type 2 – Three mutually exclusive input connections switched into one switcher input.

1) DB15HD female connector.

2) 19-pin Type A HDMI female connector.

3) Three BNC female connectors.

c. Type 3 – One 19-pin Type A HDMI female connector.

d. Type 4 – One 8-pin RJ-45 shielded female Single Cable Signal Transmission compliant connector.

4. Video matrix switching shall be executed in the digital domain.

2.8 ANALOG TO DIGITAL VIDEO TRANSCODER

A. Resolution

1. Convert all analog video to digital video at source resolution.

2.9 SINGLE CABLE SIGNAL TRANSMISSION

A. Transmitter and Receiver

1. Integrated transmitter and receiver connections for single cable signal transmission.

B. Supported signal and data types:

1. Uncompressed video and audio.
2. HDMI with HDCP.
3. 100Mbps Ethernet.
4. USB HID.
5. Bidirectional device control signals.

C. Cable and Connectors

1. Cat5e or Cat6 LAN cable.
2. RJ-45 modular connectors.

D. Maximum Cable Lengths

1. 330 feet (100 meters).

E. Devise Power

1. The single cable signal transmission technology shall be capable of providing power for compatible remote transmitter and receiver devices.

2.10 SYSTEM CONTROL PROCESSOR

A. Control Processor

1. The Central Switching And Control Unit shall include an integrated microprocessor based control processor.

B. Minimum Characteristics:

1. Utilize a real time, event driven, multi-tasking, multi-threaded operating system. Processor shall communicate directly with Ethernet, control ports and proprietary control network utilizing high-speed, parallel bus infrastructure.
2. Control processor shall utilize a FAT32 file structure. Support internal communications speed via two, independent communications busses.
3. First control bus speed shall be at least 40 mb/s,
4. Second control bus speed shall be at least 300 mb/s.
5. Control system shall be capable of firing all IR ports simultaneously.
6. Control System shall support 10/100 BaseT Ethernet Modules, via a direct processor 300 mb/s communications bus that supports all of the following features:
    a. TCP/IP Communications
    b. DHCP and DNS Support
    c. Native Email Client
    d. Remote Diagnostics
    e. Remote Program Loading and Administration
    f. SNMP Support

g. Built-In Web Server

h. SSL security plug in

i. Support user assigned or dynamic IP address.

C. External Ports

The control system shall be equipped with the following external connection ports:

1. Infrared Output

   a. Four 2-pin 3.5mm detachable terminal blocks, IR/Serial output ports;

      1) IR output up to 1.2 MHz; One-way serial TTL/RS-232 (0-5 Volts) 2 up to 9600 baud .

2. Infrared Input

   a. One 3-pin 3.5 mm detachable terminal block.

      1) Supports RC-5 IR commands via external IR transmitters.

3. Digital Input

   a. One 5-pin 3.5mm detachable terminal block.

      1) Comprised of 4 digital/contact closure inputs.

      2) Rated for 0-24 Volts DC, referenced to GND.

      3) Input Impedance: 2.2k ohms pulled up to 5 Volts DC.

      4) Logic Threshold: 2.5 Volts DC nominal with 1 Volt hysteresis band.

4. Relay

   a. One 8-pin 3.5mm detachable terminal block.

      1) Comprised of 4 normally open, isolated relays.

      2) Rated 1 Amp, 30 Volts AC/DC.

      3) MOV arc suppression across contacts.

5. Serial Communication Port

   a. Two DB9 male, bidirectional RS-232 ports.

   b. Up to 115.2k baud, hardware and software handshaking support for communication with serial devices.

6. Ethernet

   a. One 8-wire RJ45 with 2 LED indicators.

      1) 10/100/1000BaseT Ethernet port.

      2) Green LED indicates link status.

      3) Amber LED indicates Ethernet activity.

7. Communication Network

   a. Four 4-pin 3.5mm detachable terminal blocks.

      1) Master net communications ports.

      2) Ports are paralleled.

2.11 SYSTEM FUNCTIONS AND SEQUENCES

A. Audio-Video Control Functions

Specifier:
Retain the following article if Division 26 Lighting System integration is required in the project.

All Room/area sensor feedback (occupancy, daylight, etc.) provided by the lighting system control processors via the Crestron Remote System Definition (.rsd) file.

1. Room occupancy status shall be based on sensor data provided by Lighting system as specified in Section 26 09 43.13

Specifier: AV control system programming functionality is project specific, add required functionality here.

2. Room modes: TBD
3. System control functions: TBD

B. Lighting and Shade Control Functions

Specifier:
Retain the following articles if Division 26 Lighting System integration is required in the project.

All lighting and shade systems are to be controlled by the lighting system(s) specified in Section 26 09 43.13. This system (AV Control system) will have complete control of the lighting and shades system via the Remote System Definition (.rsd) file provided by the lighting system contractor/installer. Coordination with lighting system contractor is required in order to integrate required functionality into the .rsd inter-system communication file.

1. Access to full control capability of integrated lighting and shade systems shall be provided by: Custom Software Control Interface as specified in Section 26 09 43.13.
2. Basic System Control Functions - Lighting system functions as defined by Section 26 09 43.13 shall be accessible by the AV Automation Control Processor. All stored information shall be maintained by the lighting system control processors and only accessed and edited by the AV Automation Control Processors.
3. Advanced System Control Functions – Lighting system functions as defined by Section 26 09 43.13 shall be accessible by the AV Automation Control Processor. All stored information shall be maintained by the lighting system control processors and only accessed and edited by the AV Automation Control Processors.

2.12 USER INTERFACE CONTROL FUNCTIONS

A. As Specified in Division 25.

2.13 USER INTERFACE CONTROLLERS

A. As Specified in Division 25.

PART 3 EXECUTION

3.1 INSTALLERS / TECHNICIANS / ENGINEERS

A. Digital Media System Contractors/Sub Contractors

1. Trained technicians who have successfully attended an appropriate training program and have obtained a certificate as proof thereof shall execute the tests specified in this section.

SPECIFIER: Insert additional certifications/credentials as required based on project needs.

2. Training Certifications:

SPECIFIER: Crestron offers three DigitalMedia training courses/certificaitons.

DigitalMedia Certified Designer (DMC-D) - A DM Certified Designer understands the fundamental differences between analog and digital systems and the unique design considerations needed to ensure reliable operation.

DIgitalMedia Certified Technician (DMC-T) - A DM Certified Technician can perform all of the copper and fiber termination options available for DM systems, perform cable plant certification and install and test the performance capabilities of a Crestron DigitalMedia system.

DigitalMedia Certified Engineer (DMC-E) – The DMC-E Certified Engineer program includes the DMC-D certification and DMC-T Certification. A DM Certified Engineer can perform DMC-D and DMC-T roles as well as commissioning, system setup, diagnostics, testing and reporting. Only a DMC-E is equipped to fully execute and support a DM project.

a. Technicians performing Cable Installation and termination shall hold a Crestron DigitalMedia Certified Technician (DMC-T) certification.

b. Engineers Commissioning the digital media system shall hold a Crestron DigitalMedia Certified Engineer (DMC-E) certification.

3.2 QUALITY CONTROL - CAT5E/CAT6 CABLE CERTIFICATION

SPECIFIER: The following section includes test requirements for Crestron DM-CBL-8G and 3rd party CAT5E or CAT6 cable. The requirements are written for Permanent Link certification but may be applied to Channel as well.

Crestron suggests using the Fluke DTX-1800 Certification Tester.

A. General Field Test Requirements

1. All CAT5E/CAT6 cabling links in the DigitalMedia installation shall be tested for the following, in accordance with the field test specifications defined in ANSI/TIA-568-C.2 "Commercial Balanced Twisted-Pair Telecommunications Cabling and Components Standard". This document will be referred to as the "Category 5e Standard":

a. Wire Map

b. Length

c. Insertion Loss

d. NEXT Loss

e. PS NEXT Loss

f. ACR-F Loss

g. PS ACR-F Loss

h. Return Loss

i. Propagation Delay

j. Delay Skew

2. The installed twisted-pair horizontal links shall be tested from terminated end point to terminated end point for compliance with the "*Permanent Link*" performance specification as defined in the Category 5e Standard.

3. One hundred percent of the installed cabling links must pass the requirements of the Category 5e Standard mentioned in [A.1] above and as further detailed in Section [B]. Any failing link must be diagnosed and corrected. The corrective action shall be followed with a new test to prove that the corrected link meets the performance requirements. The final and passing result of the tests for all links shall be provided in the test results documentation in accordance with [Section C] below.

4. The test equipment (tester) shall comply with the accuracy requirements for level IIe field testers as defined in ANSI/TIA-1152. The tester including the appropriate interface adapter must meet the specified accuracy requirements. The accuracy requirements for the permanent link test configuration (baseline accuracy *plus* adapter contribution) are specified in Table 2 of ANSI/TIA-1152 (Table 2 in this TIA document also specifies the accuracy requirements for the Channel configuration).

5. The RJ45 test plug shall fall within the values specified in ANSI/TIA-568-C Annex C for NEXT, FEXT and Return Loss.

6. The tester shall be within the calibration period recommended by the vendor in order to achieve the vendor-specified measurement accuracy.

7. The tester interface adapters must be of high quality and the cable shall not show any twisting or kinking resulting from coiling and storing of the tester interface adapters. In order to deliver optimum accuracy, preference is given to a permanent link interface adapter for the tester that can be calibrated to extend the reference plane of the Return Loss measurement to the permanent link interface. To ensure that normal handling on the job does not cause measurable Return Loss change, the adapter cord cable shall not be of twisted-pair construction.

8. The Pass or Fail condition for the link-under-test is determined by the results of the required individual tests (detailed in Section 4.2.2 of ANSI/TIA-1152). Any Fail result yields a Fail for the link-under-test. In order to achieve an overall Pass condition, the results for each individual test parameter must Pass.

9. A Pass or Fail result for each parameter is determined by comparing the measured values with the specified test limits for that parameter.

SPECIFIER: Optional Requirements, include as needed:

10. A representative of the end-user shall be invited to witness field testing. The representative shall be notified of the start date of the testing phase five business days before testing commences.

11. A representative of the end-user will select a random sample of 5% of the installed links. The representative (or his authorized delegate) shall test these randomly selected links and the results are to be stored. The results obtained shall be compared to the data provided by the installation contractor. If more than 2% of the sample results differ in terms of the pass/fail determination, the installation contractor under supervision of the end-user representative shall repeat 100% testing and the cost shall be borne by the installation contractor.

B. Performance Test Parameters

The test parameters are defined in the Category 5e Standard. The test of each link shall contain all of the following parameters as detailed below. In order to pass the test, all measurements (at each frequency in the range from 1 MHz through 100 MHz) must meet or exceed the limit value determined in the above-mentioned standard.

1. Wire Map - Shall report Pass if the wiring of each wire-pair from end to end is determined to be correct.

2. Length - The field tester shall be capable of measuring length of all pairs of a basic link or channel based on the propagation delay measurement and the average value for NVP. The physical length of the link shall be calculated using the pair with the shortest electrical delay. This length figure shall be reported and shall be used for making the Pass/Fail decision. The Pass/Fail criteria are based on the maximum length allowed for the Permanent Link configuration (90 meters – 295 feet) plus 10% to allow for the variation and uncertainty of NVP.

3. Insertion Loss (Attenuation) - Insertion Loss is a measure of signal loss in the permanent link or channel. The term "Attenuation" has been used to designate "Insertion Loss." Insertion Loss shall be tested from 1 MHz through 100 MHz in maximum step size of 1 MHz. It is preferred to measure insertion loss at the same frequency intervals as NEXT Loss in order to provide a more accurate calculation of the Attenuation-to-Crosstalk ratio (ACR) parameter. Minimum test results documentation (summary results): Identify the worst wire pair (1 of 4 possible). The test results for the worst wire pair must show the highest attenuation value measured (worst case), the frequency at which this worst case value occurs, and the test limit value at this frequency.

4. NEXT Loss - Pair-to-pair near-end crosstalk loss (abbreviated as NEXT Loss) shall be tested for each wire pair combination from each end of the link (a total of 12 pair combinations). This parameter is to be measured from 1 through 100 MHz. NEXT Loss measures the crosstalk disturbance on a wire pair at the end from which the disturbance signal is transmitted (near-end) on the disturbing pair. The maximum step size for NEXT Loss measurements shall not exceed the maximum step size defined in the Category 5e Standard as shown in Table 1. Minimum test results documentation (summary results): Identify the wire pair combination that exhibits the worst case NEXT margin and the wire pair combination that exhibits the worst value of NEXT (worst case). NEXT is to be measured from each end of the link-under-test. These wire pair combinations must be identified for the tests performed from each end. Each reported case should include the frequency at which it occurs as well as the test limit value at this frequency.

Table 1 - Maximum frequency step size as defined in ANSI/TIA-1152

Frequency Range (MHz)	Maximum Step size (MHz)
1 – 31.25	0.15
31.26 – 100	0.25

5. PS NEXT Loss - Power Sum NEXT Loss shall be evaluated and reported for each wire pair from both ends of the link under-test (a total of eight results). PS NEXT Loss captures the combined near-end crosstalk effect (statistical) on a wire pair when all other pairs actively transmit signals. Like NEXT this test parameter must be evaluated from 1 through 100 MHz and the step size may not exceed the maximum step size defined in the Category 5e Standard as shown in Table 1. Minimum test results documentation (summary results): Identify the wire pair that exhibits the worst-case margin and the wire pair that exhibits the worst value for PS NEXT. These wire pairs must be identified for the tests performed from each end. Each reported case should include the frequency at which it occurs as well as the test limit value at this frequency.

6. ACR-F Loss, pair-to-pair - Attenuation Crosstalk Ratio Far-end is calculated from the pair-to-pair FEXT Loss. It shall be measured for each wire-pair combination from both ends of the link under-test. FEXT Loss measures the crosstalk disturbance on a wire pair at the opposite end (far-end) from which the transmitter emits the disturbing signal on the disturbing pair. FEXT is measured to compute ACR-F Loss that must be evaluated and reported in the test results. ACR-F measures the relative strength of the far-end crosstalk disturbance relative to the attenuated signal that arrives at the end of the link. This test yields 24 wire pair combinations. ACR-F is to be measured from 1 through 100 MHz and the maximum step size for FEXT Loss measurements shall not exceed the maximum step size defined in the standard as in Table 1. Minimum test results documentation (summary results): Identify the wire pair combination that exhibits the worst-case margin and the wire pair combination that exhibits the worst value for ACR-F. These wire pairs must be identified for the tests performed from each end. Each reported case should include the frequency at which it occurs as well as the test limit value at this frequency.

7. PS ACR-F Loss - Power Sum Attenuation Crosstalk Ratio Far-end is a calculated parameter that combines the effect of the FEXT disturbance from three wire pairs on the fourth one. This test yields eight wire-pair combinations. Each wire-pair is evaluated from 1 through 100 MHz in frequency increments that do not exceed the maximum step size defined in the standard as shown in Table 1. Minimum test results documentation (summary results): Identify the wire pair that exhibits the worst pair combinations must be identified for the tests performed from each end. Each reported case should include the frequency at which it occurs as well as the test limit value at this frequency.

8. Return Loss - Return Loss (RL) measures the total energy reflected on each wire pair. Return Loss is to be measured from both ends of the link-under-test for each wire pair. This parameter is also to be measured form 1 through 100 MHz in frequency increments that do not exceed the maximum step size defined in the

Category 5e Standard as shown in Table 1. Minimum test results documentation (summary results): Identify the wire pair that exhibits the worst-case margin and the wire pair that exhibits the worst value for Return Loss. These wire pairs must be identified for the tests performed from each end. Each reported case should include the frequency at which it occurs as well as the test limit value at this frequency.

9. Propagation Delay - Propagation delay is the time required for the signal to travel from one of the link to the other. This measurement is to be performed for each of the four wire pairs. Minimum test results documentation (summary results): Identify the wire pair with the worst-case propagation delay. The report shall include the propagation delay value measured as well as the test limit value.

10. Delay Skew - [as defined in the Category 5e Standard; Section 6.2.19] This parameter shows the difference in propagation delay between the four wire pairs. The pair with the shortest propagation delay is the reference pair with a delay skew value of zero. Minimum test results documentation (summary results): Identify the wire pair with the worst-case propagation delay (the longest propagation delay). The report shall include the delay skew value measured as well as the test limit value.

C. Test Result Documentation

1. The test results/measurements shall be transferred into a Windows based database utility that allows for the maintenance, inspection and archiving of these test records. A guarantee must be made that the measurement results are transferred to the PC unaltered, i.e., "as saved in the tester" at the end of each test and that these results cannot be modified at a later time.

2. The database for the completed job shall be stored and delivered on CD-ROM or DVD including the software tools required to view, inspect, and print any selection of test reports.

3. A paper copy of the test results shall be provided that lists all the links that have been tested with the following summary information

   a. The identification of the link in accordance with the naming convention defined in the overall system documentation

   b. The overall Pass/Fail evaluation of the link-under-test including the NEXT Headroom (overall worst case) number

   c. The date and time the test results were saved in the memory of the tester.

4. General Information to be provided in the electronic data base with the test results information for each link:

   a. The identification of the customer site as specified by the end-user

   b. The identification of the link in accordance with the naming convention defined in the overall system documentation

   c. The overall Pass/Fail evaluation of the link-under-test

   d. The name of the test limit selected to execute the stored test results

   e. The cable type and the value of NVP used for length calculations

   f. The date and time the test results were saved in the memory of the tester

g. The brand name, model and serial number of the tester

h. The identification of the tester interface

i. The revision of the tester software and the revision of the test limits database in the tester

j. The test results information must contain information on each of the required test parameters that are listed in Section B and as further detailed below under paragraph C5.

5. The detailed test results data to be provided in the electronic database must contain the following information:

6. For each of the frequency-dependent test parameters, the value measured at every frequency during the test is stored. The PC-resident database program must be able to process the stored results to display and print a color graph of the measured parameters. The PC-resident software must also provide a summary numeric format in which some critical information is provided numerically as defined by the summary results (minimum numeric test results documentation) as outlined above for each of the test parameters.

a. Length: Identify the wire-pair with the shortest electrical length, the value of the length rounded to the nearest 0.1 m330 and the test limit value

b. Propagation delay: Identify the pair with the shortest propagation delay, the value measured in nanoseconds (ns) and the test limit value

c. Delay Skew: Identify the pair with the largest value for delay skew, the value calculated in nanoseconds (ns) and the test limit value

d. Insertion Loss (Attenuation): Minimum test results documentation as explained in Section B for the worst pair

e. Return Loss: Minimum test results documentation as explained in Section B for the worst pair as measured from each end of the link

f. NEXT, ACR-F: Minimum test results documentation as explained in Section B for the worst pair combination as measured from each end of the link

g. PS NEXT and PS ACR-F: Minimum test results documentation as explained in Section B for the worst pair as measured from each end of the link

3.3 SYSTEM TESTING AND COMMISSIONING

A. Testing

1. A DigitalMedia Certified Engineer (DMC-E) shall perform the contractor verification tests.

2. Contractor shall verify that all components of the system are installed according to manufacturers specifications and are compliant with Division 27 specifications.

B. Commissioning

1. A DigitalMedia Certified Engineer (DMC-E) shall perform acceptance testing and commissioning.

SPECIFIER: Retain the following for DigitalMedia modular i/o matrix switchers.

2. The contractor shall provide a copy of the system commissioning Test Report in electronic format.
    a. All reported information shall be generated by the digital media matrix unit and the configuration software.
3. Commissioning engineer shall run all available tests and include all installed system components.
4. Commissioning Test Report shall include the following:
    a. Tests Failures and Notices
        1) Sink Device EDID Test – Open items or failures shall not be accepted.
        2) Cable Length Test - Open items or failures shall not be accepted.
        3) HDCP KSV Limitations – Limitations shall not be accepted.
        4) Cable Limitations – Limitations shall not be accepted.
        5) EDID Limitations – Limitations shall not be accepted.
        6) Cable Length Limits exceeded – Failing cables shall not be accepted.
    b. Device Model Number, Serial Number, and Firmware Version for main chassis and each input and output card.
    c. Device Model Number, Serial Number, and Firmware Version for connected transmitter and receiver devices.
    d. EDID – Input Resolution and 3D support status for each input.
    e. EDID – Supported Output Resolution and 3D support status for devices connected to each output.
    f. EDID – Supported Audio formats for each input.
    g. EDID – Supported Audio formats for devices connected to each output.

END OF SECTION 27 41 16