Origination Form

Specifications

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Date:	2025-06-12T20:52:59Z	**Associated Specs:**	635, 682

Summary:

The proposed edits to this section are to: 1. Update content to remove obsolete requirements or technologies and reflect current industry practice for multiple devices within the specification based on TERL product evaluations, past MSP approvals, and other reasons. 2. Update and move material content for embedded junction boxes from 635 to 996.

Justification:

The language needs to be changed to update requirements to meet stakeholder needs and reflect current technologies and practices.

Do the changes affect other types of specifications?

Neither

List Specifications Affected:

Other Affected Documents/Offices	Contacted	Yes/No
Other Standard Plans		No
Florida Design Manual		No
Structures Manual		No
Basis of Estimates Manual		No
Approved Product List		No
Construction Office		No
Maintenance Office		No
Materials Manual		No
Traffic Engineering Manual		No

Are changes in line with promoting and making progress on improving safety, enhancing mobility, inspiring innovation, and fostering talent; explain how?

Yes. Changes reflect stakeholder needs, update and clarify technical requirements, and improve consistency and quality of specification content.

What financial impact does the change have; project costs, pay item structure, or consultant fees?

No expected financial impact.

What impact does the change have on production or construction schedules?

No expected impacts to production or construction schedules.

How does this change improve efficiency or quality?

Changes improve efficiency and quality by updating requirements to address user needs, fostering consistency, and adhering to standardized formatting styles.

Which FDOT offices does the change impact?

Traffic Engineering and Operations Office

What is the impact to districts with this change?

Districts will benefit from updated requirements that better reflect current products and industry practices.

Does the change shift risk and to who?

No expected shift in risk.

Provide summary and resolution of any outstanding comments from the districts or industry.

Comments and Responses are available on the Track the Status of Revisions hyperlink located on the Specifications landing page: https://www.fdot.gov/programmanagement/Specs.shtm

What is the communication plan?

Through the established specification revision process (e.g., Internal and Industry Review)

What is the schedule for implementation?

The Standard Specifications eBook and Workbook are effective July 1st every year.

INTELLIGENT TRANSPORTATION SYSTEM DEVICE AND AUXILIARY COMPONENT MATERIALS
(REV 6-12-25)

SUBARTICLE 996-1.3 is deleted and the following substituted:

996-1.3 Abbreviations: The following abbreviations are used in this Section:

Alternating Current (AC)
Closed Circuit Television (CCTV)
Direct Current (DC)
Hypertext Transfer Protocol (HTTP)
International Electrotechnical Commission (IEC)
Internet Protocol (IP)
International Organization for Standardization (ISO)
Local Area Network (LAN)
Network Time Protocol (NTP)
Pan, Tilt, Zoom (PTZ)
Surge Protective Device (SPD)
Telecommunications Industry Association (TIA)
Uniform Resource Locator (URL)
Ultraviolet (UV)

SUBARTICLE 996-2.2.1 is deleted and the following substituted:

996-2.2.1 Camera: CCTV cameras shall be compliant with the Code of Federal Regulations Section 200.216 Prohibition on certain telecommunications and video surveillance services or equipment https://www.ecfr.gov/current/title-2/subtitle-A/chapter-II/part-200/subpart-C/section-200.216. Cameras shall be compatible with the current version of the Department's SunGuide® software system. Camera types include pan-tilt-zoom (PTZ) and fixed.

Cameras shall be IP cameras that provide the following features and capabilities:

1. Day (color)/night (monochrome) switchover.
2. Manual and automatic focus.
3. Automatic iris.
4. Ability to produce clear, detailed, and usable video images of the areas, objects, and other subjects visible from a roadside field site. Video produced by the camera is true, accurate, distortion free, and free from transfer smear, oversaturation, and any other image defect that negatively impacts image quality under all lighting and weather conditions in both color and monochrome modes.
5. Automatic gain control (AGC).
~~6. A minimum signal-to-noise ratio of 50 dB.~~
~~7~~6. Automatic color balance that references the white areas of the scene through the lens.
~~8~~7. An automatic electronic shutter that is user selectable from 1/60 to 1/10,000 of a second.

~~9~~8. PTZ cameras shall include a minimum 10x digital zoom.

~~10~~9. PTZ cameras shall include programmable azimuth and compass display with the ability to display pan and tilt position with a 1 degree resolution.

Cameras shall provide titling and masking features including, but not limited to, programmable camera title, programmable preset titles for each preset position, and programmable privacy zones. Programmable titles shall allow a minimum of 18 characters per line.

SUBARTICLE 996-2.2.4.2 is deleted and the following substituted:

996-2.2.4.2 Video Encoding: The camera shall utilize the Moving Picture Experts Group's MPEG4 part 10 (H.264) video compression technology in accordance with the ISO and IEC requirements detailed in the ISO/IEC 14496-10:2009 Standard.

Cameras shall establish unicast and multicast sessions using RTSP. ~~The encoded video shall transmit using programmable bit rates and the camera supports, at a minimum, a fixed bit rate mode~~Cameras shall support variable bit rate encoding. Cameras must be able to provide 2 simultaneous multicast streams using different configurations (e.g., multicast address, resolution, frame rate, bitrate, etc.).

The camera's encoded video shall support resolutions that include~~;~~ , but are not limited to, those defined in Table 996-1. The camera shall deliver color and monochrome video at 30 frames per second (fps), regardless of resolution.

Table 996-1
Minimum Resolution Requirements

Format	Vertical Resolutions
H.264	240, 480, 1080
Note: The resolutions attained depend on the data transmission rate.	

SUBARTICLE 996-2.3 is deleted and the following substituted:

996-2.3 Video Display Control System:

996-2.3.1 Display Control System: The video display control system shall allow ~~the operator~~multiple authorized users to control and manage the display of video and computer-generated graphics on the display equipment connected to the system as well as provide selection and switching of multiple sources for display, including video streams available on the Traffic Management Center (TMC) Ethernet network. The display control system shall also allow ~~for operator~~authorized users to control ~~of~~ all displays from the same workstation that is used for the SunGuide® operator interface. ~~The video display control system shall decode and display all video streams produced by encoders listed on the APL.~~

The video display control system shall be able to simultaneously display~~s~~ a minimum of 32 video ~~windows, each containing streaming video at a minimum resolution of 720 pixels by 480 pixels and frame rate of 30 fps~~streams on various display layouts. The system shall allow ~~any display window to be sized from 1/32 of the total display area up to the total display area, and any size in between~~display of multiple video windows containing streaming

video from different sources using various common codecs (e.g., H.264, MPEG-2) at various resolutions and bitrates. Common resolution, frame rate, and bitrate for streaming sources includes 1920x1080, 30FPS, 3Mb/s video streams.

The video display control system hardware shall be designed to be a specialized computing platform for video wall control and management that is rack mounted and secured in an EIA 19 inch equipment rack and operated on an enterprise Ethernet network domain. Any ~~system incorporating~~ Personal Computer (PC) hardware incorporated within the system shall use current microprocessor technology and commercial, off-the-shelf components, including RAM, hard disk drives, ~~and~~ network interface cards, operating system, and applications ~~sufficient to provide the functional requirements of the system~~.

The video display control system shall be expandable and scalable to support any combination of inputs and outputs.

The video display control system shall have a minimum configuration of ~~4 composite video inputs, 4 component (red, green, and blue (RGB) video inputs, and~~ 4 High-Definition Multimedia Interface (HDMI) inputs and 12 HDMI outputs~~as well as network connections, decoders, and associated hardware and software required to display 32 inputs simultaneously at a minimum resolution of 720 pixels by 480 pixels and a frame rate of 30 fps~~.

~~The video display control system shall have a minimum configuration of 4 composite video outputs, 2 component (RGB video outputs), and 4 HDMI outputs.~~

996-2.3.2 Display Control Software: The display control software shall provide centralized system management functions and allow multiple ~~operators~~ authorized users to control all features and functions of the video display control system. These features and functions shall include~~, but are not limited to,~~ creation of display layouts (i.e., customizable window arrangements that include multiple sources displayed at various sizes); selection of video sources for display, including switching layouts; adjusting the size, location, and layout of video and other graphic information the system displays; and system configuration and setup. The control software shall be able to operate ~~a video~~display walls composed of multiple display components as though ~~it were a~~they are single, high-resolution displays.

The system shall provide a user interface that allows users to create, edit, store, and recall content arrangement on multiple displays (i.e., primary and secondary display walls as well as freestanding displays) and allow any display window to be sized from 1/32 of the total display area up to the total display area, and any size in between by dragging, dropping, moving, layering, and resizing content boundaries.

The display control software shall include a ~~non-proprietary Software Development Kit (SDK) including, but not limited to, an~~documented Application Programming Interface (API) that describes interfaces and protocols which can be used to integrate system features and functions with third-party applications. The display control software shall accept external alarm triggers to automatically switch layouts.

996-2.3.3 ~~Controller~~ Inputs and Outputs: The video display control system shall support and display a variety of video and data inputs simultaneously, including ~~composite and component NTSC video,~~ HDMI, ~~Digital Visual Interface (DVI),~~and network computer desktop graphics sources such as Video Graphics Array (VGA), Super Video Graphics Array (SVGA), and Super Extended Graphics Array (SXGA) computer graphics via remote desktop connections. All inputs and outputs shall allow ~~for operator control in order~~authorized users to display any or all ~~of~~ this information on any number of display devices within the system. All inputs ~~and~~, outputs, and display windows shall be able to be sized and resized with and without

constrained proportions across multiple screens and moved at will around any display area and combination of displays.

The video display control system shall be expandable and scalable to support ~~any combination of~~additional inputs and outputs. The video display control system shall be provided with a minimum configuration of ~~4 composite video inputs, 4 component (RGB video inputs), and~~ 4 HDMI inputs and 12 HDMI outputs. All HDMI interfaces must be HDMI 2.0 and capable of 4K resolution at 60 frames per second. The video display control system shall include all~~as well as~~ network connections, decoders, and associated hardware and software required to simultaneously display ~~32 inputs simultaneously at a minimum resolution of 720 pixels by 480 pixels and a frame rate of 30 fps, or as shown in the Plans. Provide the video display control system with a minimum configuration of 4 composite video outputs, 2 component (RGB video outputs), and 4 HDMI outputs. The video display control system can be expanded to accommodate at least 128 discreet inputs and outputs.~~32 video streams from different sources.

~~A single input shall be able to be routed to~~The video display control system must be able to simultaneously display a single input source on multiple displays ~~simultaneously~~ and multiple input~~s~~ sources on ~~can be routed to~~ a single display ~~simultaneously for viewing in separate windows~~. ~~All inputs and outputs shall be synchronized by the video display control system and s~~Switching between inputs or outputs ~~does~~ shall not cause displayed images to unlock, roll, or otherwise exhibit visible distortion.

996-2.3.3.1 ~~Analog Video:~~ ~~The video display control system shall be able to accept S-video, composite, and component video sources, and can digitize these signals for manipulation and display on any display device attached to the system. All analog video inputs shall use BNC connectors.~~**Network Connections:** The video display control system shall use a single 10/100/1000 RJ45 Ethernet port for network connection. If the video display control system requires multiple Ethernet ports to provide required functionality (e.g., additional ports for decoder card connections), the system must be supplied with a managed Ethernet switch that provides ports for additional connections.

Analog video sources shall display within their own windows and can be resized up to or beyond their native resolution to conform to the wall display size.

996-2.3.3.2 Digital Video: The video display control system shall be able to accept digital video sources ~~and can~~as well as manipulate and display these signals on any display attached to the system. All digital video inputs and outputs shall use HDMI connectors unless otherwise ~~directed~~shown in the Plans. All HDMI interfaces shall be HDMI 2.0 and capable of 4K resolution at 60 frames per second.

~~Each MPEG video stream shall display within its own window and be freely movable and sizable up to or beyond its native resolution to conform to the wall display size.~~

~~**996-2.3.3.3 RGB Video:** Include an analog input that enables the TMC operator to project an exact copy of their workstation desktop display on the video wall display. Analog RGB inputs shall allow native images up to 1,280 pixels by 1,024 pixels at 60 Hz to be displayed on the video wall.~~

~~RGB inputs shall be sizable up to or beyond their native resolution to conform to the wall display size.~~ **996-2.3.3.43 Streaming Media:** The video display control system shall be able to display a minimum of 32 compressed video streams simultaneously ~~in MPEG-2 over TCP/UDP/RTP over IP and supports multicasting as defined in~~

~~Version 2 of the IGMP~~. The video display control system ~~can~~ shall display MPEG-~~4~~2 and H.264 streams. ~~The MPEG video input interface is, at minimum, a 10/100 megabit per second network port per every 15 streams.~~ Each video stream shall display within its own window and be freely movable and sizable up to or beyond its native resolution to conform to the wall display size.

996-2.3.3.~~5~~4 ~~Primary~~ Display Output: The ~~V~~video display control system ~~can~~ shall be able to process ~~the~~ various signal input types to be output and viewed on display walls and freestanding display monitors, such as ~~the RGB feeds from monitor outputs and~~ multi-window layouts of streaming video feeds and desktop computer graphics (e.g., applications on network computers via remote desktop display windows). ~~The unit shall provide direct digital streaming video through cable feeds using a digital video decoder. The video display control system shall provide the layout definitions for each signal to be displayed and save the predefined layouts and shall also permit switching of the predefined layouts and accept external alarm triggers to change the layouts.~~

The output capacity shall have sufficient memory and processing speed to provide fast rendering of video and image displays simultaneously on a minimum of 12 HDMI displays unless otherwise shown in the Plans. ~~The output has, at a minimum, a dual HDMI connector that supports 1,280 horizontal pixels by 1,024 vertical pixels or greater resolution. The color depth is a minimum of 24 bits per pixel.~~

996-2.3.4 Electrical Requirements: Provide equipment that operates on 120 V_{AC} at a frequency of 60 Hz. Furnish a transformer or other necessary means of power conversion for any device that requires another voltage or frequency.

SUBARTICLE 996-3.2 is deleted and the following substituted:

996-3.2 Managed Field Ethernet Switch:

996-3.2.1 Description: The Managed Field Ethernet Switch (MFES) shall be compliant with the Code of Federal Regulations Section 200.216 Prohibition on certain telecommunications and video surveillance services or equipment https://www.ecfr.gov/current/title-2/subtitle-A/chapter-II/part-200/subpart-C/section-200.216.

The MFES ~~provides wire-speed fast Ethernet connectivity at transmission rates of 100 megabits per second~~ shall provide Ethernet connectivity at transmission rates of 10/100/1000 megabits per second (Mbit/s).

Each MFES shall be managed individually and as a group for switch configuration, performance monitoring, and troubleshooting. The MFES shall include Layer 2+ capabilities, including, Quality of Service (QoS), IGMP v2, rate limiting, security filtering, and general management.

The MFES shall support half and full duplex Ethernet communications.

The MFES shall provide 99.999% error-free operation. The MFES shall comply with Ethernet data communication requirements using single-mode fiber optic transmission medium and Category 5E copper transmission medium.

The MFES shall have a minimum mean time between failures (MTBF) of 10 years, or 87,600 hours, as calculated using the Bellcore/Telcordia SR-332 standard for reliability prediction.

996-3.2.2 Networking Standards: The MFES shall comply with all applicable IEEE networking standards for Ethernet communications, including but not limited to:

1. IEEE 802.1Q standard for Local and Metropolitan Area Networks - Bridges and Bridged Networks used with port-based Virtual Local Area Networks (VLANs) and Rapid Spanning Tree Protocol (RSTP).

2. IEEE 802.1-p for QoS.

3. IEEE 802.3 standard for LAN and Metropolitan Area Network (MAN) access and physical layer specifications.

4. IEEE 802.3u ~~supplement~~ standard regarding 100BASE-X ~~Base TX/100 Base FX~~.

5. IEEE 802.3x standard regarding flow control with full duplex operation.

6. IEEE 802.3z standard regarding 1000BASE-X.

996-3.2.3 Optical Ports: All fiber optic link ports operate at 1,310 or 1,550 nanometers in single mode. All optical ports are Type ST, SC, LC, or FC only. Mechanical transfer registered jack (MTRJ) type connectors are not allowed.

MFES shall provide a minimum of two optical 1000BASE-X ~~Base FX~~ ports capable of transmitting data at 1000 Mbit/s~~megabits per second~~. MFES shall provide optical ports designed for use with a pair of fibers; one fiber will transmit (TX) data and one fiber will receive (RX) data. The optical ports shall have an optical power budget of at least 15 dB.

996-3.2.4 Copper Ports: MFES shall include a minimum of four copper ports. All copper ports shall be Type RJ-45 and shall auto-negotiate speed (i.e., 10/100/1000 Mbit/s ~~Base~~) and duplex (i.e., full or half). All ~~10/100 Base TX~~ 1000BASE-T ports shall meet the specifications detailed in this section and shall be compliant with the IEEE 802.3 standard pinouts.

Ethernet over very high speed digital subscriber line (EoVDSL) ports shall support standard telephone-grade twisted copper pair and automatically negotiate the fastest data rate possible depending on cable length and quality.

996-3.2.5 Management Capability: The MFES shall support all Layer 2 management features and certain Layer 3 features related to multicast data transmission and routing. These features shall include, but not be limited to:

1. An MFES that is a port-based VLAN and supports VLAN tagging that meets or exceeds specifications as published in the IEEE 802.1Q standard and has a minimum 4-kilobit VLAN address table.

2. 2. A forwarding/filtering rate that is a minimum of 14,880 packets per second for 10 Mbit/s~~megabits per second~~ and 148,800 packets per second for 100 Mbit/s~~megabits per second~~, and 1,488,000 packets per second for 1000 Mbit/s.

3. A minimum 4 kilobit media access control (MAC) address table.

4. Support of, at a minimum, IGMPv2.

5. Support of remote and local setup and management via Secure Shell Version 2 (SSHv2) and secure Web-based graphical user interface (GUI).

6. Support of the Simple Network Management Protocol (SNMP) version ~~1/2/3~~2 and version 3. Verify that the MFES can be accessed using ~~the resident TIA-232 management port or~~ a serial console port and a telecommunication network.

7. Support of Remote Authentication Dial-In User Service (RADIUS) or Terminal Access Controller Access-Control System Plus (TACACS+)

8. Support of remote monitoring (RMON) of the Ethernet agent and the ability to be upgraded to switch monitoring (SMON), if necessary.

9. Support of Secure Copy (SCP) or Secure File Transfer Protocol (SFTP) and either Network Time Protocol (NTP) or the Simple Network Time Protocol (SNTP). Ensure that the MFES supports port mirroring for troubleshooting purposes when combined with a network analyzer.

10. Data security compliant with the National Institute of Standards and Technology (NIST) requirements as defined in the Federal Information Processing Standard (FIPS) Publication (PUB)-197 and support for the Advanced Encryption Standard (e.g., AES-256).

996-3.2.6 Mechanical Requirements: Every conductive contact surface or pin shall be gold-plated or made of a noncorrosive, nonrusting, conductive metal. Do not use self-tapping screws on the exterior of the assembly. All parts shall be made of corrosion-resistant materials, such as plastic, stainless steel, anodized aluminum, brass, or gold-plated metal.

996-3.2.7 Electrical Requirements: The MFES shall operate on a nominal Voltage of 120 V_{AC}. Supply an appropriate voltage converter for devices that require operating voltages of less than 120 V_{AC}. The MFES shall have diagnostic Light Emitting Diodes (LEDs), including link, TX, RX, and power LEDs.

996-3.2.8 Environmental Requirements: MFES shall operate properly during and after being subjected to the environmental testing procedures described in NEMA TS 2, Sections 2.2.7, 2.2.8, and 2.2.9.

SUBARTICLE 996-3.3 is deleted and the following substituted:

996-3.3 Managed Hub Ethernet Switch:

996-3.3.1 Description: The Managed Hub Ethernet Switch (MHES) shall be compliant with the Code of Federal Regulations Section 200.216 Prohibition on certain telecommunications and video surveillance services or equipment https://www.ecfr.gov/current/title-2/subtitle-A/chapter-II/part-200/subpart-C/section-200.216.

The MHES shall provide Ethernet connectivity at transmission rates of 10/100/1000/10000 megabits per second (Mbit/s). The MHES shall support half and full duplex Ethernet communications. The MHES must support 12000 IPv4 routes and 2000 IPv6 routes and all routing protocols shall be in performed hardware to ensure maximum speed.

The MHES shall support management individually and as a group for switch configuration, performance monitoring, and troubleshooting. The MHES shall include Layer 2 capabilities, including, QoS, IGMP v2, rate limiting, security filtering, and general management.

The MHES shall include full Layer 3 capabilities, including Open Shortest Path First (OSPF) routing protocol, Routing Information Protocol (RIP), and Protocol Independent Multicasting (PIM). The MHES includes all license(s) required to utilize all Layer 3 features.

996-3.3.2 Networking Standards: The MHES shall comply with all applicable IEEE networking standards for Ethernet communications, including:

1. IEEE 802.1Q Standard for Local and Metropolitan Area Networks - Bridges and Bridged Networks used with port-based VLANs and RSTP.

2. IEEE 802.-1p for QoS.

3. IEEE 802.3 standard for LAN and MAN access and physical layer specifications.

4. IEEE 802.3u supplement standard regarding 100 BASE-X ~~Base TX/100 Base FX~~.

5. IEEE 802.3x standard regarding flow control with full duplex operation.

6. IEEE 802.3z supplement standard regarding 1000 BASE-X ~~Base X~~.

996-3.3.3 Optical Ports: All fiber optic link ports operate at 1,310 or 1,550 nanometers in single mode. Provide Type LC connectors unless otherwise directed. MTRJ type connectors are not allowed.

MHES shall provide a minimum of 6 optical ports capable of transmitting data at 10/100/1000/10000 ~~megabits per second~~ Mbit/s. MHES shall provide optical ports designed for use with a pair of fibers; one fiber will transmit (TX) data and one fiber will receive (RX) data. The optical ports shall have an optical power budget of at least 15 dB.

996-3.3.4 Copper Ports: MHES shall include a minimum of 12~~10/100/1000 Base TX~~ 1000BASE-T copper ports. All copper ports shall be Type RJ-45 and shall auto-negotiate speed (i.e., 10/100/1000 Mbit/s~~Base~~) and duplex (i.e., full or half). All ~~10/100/1000 Base TX~~1000BASE-T ports shall meet the specifications detailed in this section and shall be compliant with the IEEE 802.3 standard pinouts.

996-3.3.5 Management Capability: MHES shall support all Layer 2 management features and all Layer 3 features as defined by this Section. Layer 2 and Layer 3 features must include:

1. Port-based VLAN and VLAN tagging that meets or exceeds specifications as published in the IEEE 802.1Q standard and has a minimum 4-kilobit VLAN address table.

2. A forwarding/filtering rate that is a minimum of 14,880 packets per second for 10 ~~megabits per second~~Mbit/s, 148,800 packets per second for 100 ~~megabits per second~~Mbit/s, and 1,488,000 packets per second for 1000 ~~megabits per second~~Mbit/s.

3. A minimum 4 kilobit MAC address table.

4. Support of IGMPv2.

5. Support of remote and local setup and management via SSHv2 and secure Web-based GUI.

6. Support of SNMP version 2 and version 3.

7. Support of RADIUS or TACACS+.

8. Support of RMON of the Ethernet agent and the ability to be upgraded to SMON, if necessary.

9. Support of SCP or SFTP and either NTP or SNTP. Ensure that the MHES supports port mirroring for troubleshooting purposes when combined with a network analyzer.

10. Sampled Flow Network Monitoring export protocol capable of being turned on or off on individual Ethernet ports without affecting traffic.

11. OSPF routing protocol. 12000 IPv4 routes and 2000 IPv6 routes.

12. RIP.

13. Virtual Router Redundancy Protocol (VRRP).

14. Data security compliant with NIST FIPS PUB-197 (e.g., AES-256).

996-3.3.6 Mechanical ~~Specifications~~Requirements. Ensure the MHES is no greater than 1 Rack Unit tall.

Every conductive contact surface or pin shall be gold-plated or made of a noncorrosive, nonrusting, conductive metal. Do not use self-tapping screws on the exterior of the

assembly. All parts shall be made of corrosion-resistant materials, such as plastic, stainless steel, anodized aluminum, brass, or gold-plated metal.

996-3.3.7 Electrical ~~Specifications~~Requirements. MHES ~~must~~ shall operate on a nominal voltage of 120 V_{AC}. Supply an appropriate voltage converter for devices that require operating voltages of less than 120 V_{AC}. The MHES shall have diagnostic LEDs, including link, TX, RX, and power LEDs.

996-3.3.8 Environmental ~~Specifications~~Requirements. Ensure that the MHES has an operating temperature range of -34° Celsius to 74° Celsius. Ensure that the MHES can withstand 90 percent non-condensing relative humidity at 40° Celsius.

SUBARTICLE 996-3.4.1 is deleted and the following substituted:

996-3.4.1 Description: The device server allows the connection of serial devices with TIA-232, TIA-422, and TIA-485 connections to an Ethernet network. The device server provides a TCP/IP interface to one or more field devices using TIA-232/422/485 standard connections. The device server supports TCP/IP, UDP/IP, Dynamic Host Configuration Protocol (DHCP), Address Resolution Protocol (ARP), Internet Control Message Protocol (ICMP), SNMP, Hypertext Transfer Protocol (HTTP), and telnet.

The device server shall provide 99.999% error-free operation and TIA-compatible Ethernet data communication by way of a Category 5E copper or fiber optic transmission medium.

The device server is resistant to all electromagnetic interference.

Data security shall comply with SSHv2, or ~~the~~ NIST ~~requirements as defined in the Federal Information Processing Standard (~~FIPS~~) Publication (~~ PUB~~)~~-197 (e.g., AES-256)~~for the Advanced Encryption Standard (AES)~~.

The device server has a minimum mean time between failures (MTBF) of 10 years, or 87,600 hours.

SUBARTICLE 996-4.2 is deleted and the following substituted:

996-4.2 Surge Protective Device:

996-4.2.1 Description: Surge Protective Devices (SPDs) protect electronics from lightning, transient voltage surges, and induced current.

996-4.2.2 SPD for 120 Volt or 120/240 Volt Power: The SPD shall include L-N, L-G, and N-G protection and have a maximum surge current rating of 50 kA per phase or greater. The SPD shall meet the requirements of UL 1449~~, Third Edition~~ and be listed by a NRTL. Voltage Protection Rating (VPR) shall be 700V maximum for 120V protection modes and shall be 1100V maximum for 240V protection modes.

The SPD shall have a visual indication system that monitors the weakest link in each mode and shows normal operation or failure status and also provides one set of normally open (NO)/normally closed (NC) Form C contacts for remote alarm monitoring. SPDs installed outside of a cabinet~~The~~ enclosure ~~for a SPD~~ shall have a NEMA 4 rating.

996-4.2.3 SPD at Point of Use: The SPD shall comply with the minimum functional requirements shown in Table 996-3. The units shall be rated at 15 or 20 amps load and are configured with receptacles.

The units shall have internal fuse protection and provide common mode (L+N-G) protection.

996-4.2.4 SPD for Low-Voltage Power, Control, Data and Signal Systems: The SPD devices shall comply with the minimum functional requirements shown in Table 996-3 for all available modes (i.e., power L-N, N-G; L-G, data and signal center pin-to-shield, L-L, L-G, and shield-G where appropriate).

Table 996-3				
SPD Minimum Requirements				
~~Circuit Description~~Application	~~Clamping~~ Breakdown or Sparkover Voltage	Data Rate	Surge Capacity	Maximum Let-Through Voltage at Surge Capacity
12 V_{DC}	15-20 volts	N/A	5kA per mode (8x20 µs)	<150 Vpk
24 V_{AC}	30-55 volts	N/A	5kA per mode (8x20 µs)	<175 Vpk
48 V_{DC}	60-85 volts	N/A	5kA per mode (8x20 µs)	<200 Vpk
120 V_{AC} at POU	150-200 volts	N/A	20kA per mode (8x20 µs)	<550 Vpk
Coaxial Composite Video	4-8 volts	N/A	10kA per mode (8x20 µs)	<65 Vpk (8x20 µs/1.2x50µs; 6kV, 3kA)
RS422/RS485	8-15 volts	10 Mbps	10kA per mode (8x20 µs)	<30 Vpk
T1	13-30 volts	10 Mbps	10kA per mode (8x20 µs)	<30 Vpk
Ethernet Data	~~7~~5-12 volts	1 Gbps	1kA per mode (8x20~~10x1000~~ µs)	<725 Vpk @ 2kA 8x20 µs L-G <80 Vpk @ 100A 8x20 µs L-L ~~<30 Vpk~~
PoE	90 volts ± 20% ~~60-70 volts~~	1 Gbps	~~5~~1kA per mode (8x20 µs)	<725 Vpk @ 2kA 8x20 µs L-G <80 Vpk @ 100A 8x20 µs L-L ~~<200Vpk~~ ~~(100kHz 0.5µs; 6kV, 500A)~~
PoE+, PoE++	90 volts ± 20% ~~<150~~	1 Gbps	1kA ~~L-G~~per mode (8x20 µs)	<725 Vpk @ 2kA 8x20 µs L-G <80 Vpk @ 100A 8x20 µs L-L ~~<350V~~

SPDs for PoE, PoE+, and PoE++ applications shall meet IEEE ~~8~~802-3.

The SPDs shall meet the requirements of UL 497B or UL 497C, as applicable, and are listed by a NRTL.

996-4.2.5 Mechanical ~~Specifications~~Requirements: All parts shall be made of corrosion-resistant materials, such as plastic, stainless steel, anodized aluminum, brass, or gold-plated metal.

996-4.2.6 Environmental ~~Specifications~~Requirements: The SPDs shall operate properly during and after being subjected to the environmental testing procedures described in NEMA TS 2, Sections 2.2.7, 2.2.8, and 2.2.9.

ARTICLE 996-5 is deleted and the following substituted:

996-5 Pull Boxes, Splice Boxes, Junction Boxes, and Fiber Optic Splice Vaults.

996-5.1 Pull and Splice Boxes: Pull and splice boxes must be listed on the Department's Approved Product List (APL). Manufacturers seeking evaluation of their product shall submit an application in accordance with Section 6.

The box bodies and covers shall be free of flaws such as cracks, sharp, broken, or uneven edges, and voids.

Ensure in-ground boxes have an open bottom design.

996-5.1.1 Marking: The following information shall be permanently cast or engraved into the top surface of all pull and splice box covers. If used, identification plates shall be UV stable, mechanically fastened, bonded with adhesive material suitable for outdoor applications, and capable of installation in the field

1. Mark application as follows:
   FDOT TRAFFIC SIGNAL for signalized intersections
   FDOT FIBER OPTIC CABLE for fiber optic cable
   FDOT ITS for device data/power cables ≤ 48V
   FDOT LIGHTING for highway lighting
   FDOT TRAFFIC MONITORING for traffic monitoring
   FDOT ELECTRICAL for other electrical applications
   TPK ITS FIBER OPTIC for Turnpike ITS fiber optic cable
   TPK ITS ELECTRIC for Turnpike ITS electric power
   TPK ITS LOCATE for Turnpike ITS fiber locate cables
   TPK ITS COMPOSITE for Turnpike ITS electric power (<50 Volts)
   TPK LIGHTING for Turnpike highway lighting
2. Manufacturer's name or logo
3. FDOT APL approval number
4. TIER rating per Section 996-5.1.4

The date of manufacture (month/day/year, or date code) shall be permanently located on the top or bottom of the cover. The interior of the box body shall have a permanent marking that includes the manufacturer part/model number and date of manufacture near the top of box in a location that is visible after installation when the cover is removed.

996-5.1.2 Dimensions:

Table 996-4
Minimum Dimensions for Pull and Splice Boxes

Application:	Type:	Minimum Size(inches):	Notes:

Signalized Intersection and Lighting	Pull Box	13W x 24L x 12D	Provide a minimum area of 240 square inches and no inside dimension less than 12 inches.
Fiber Optic Cable	Pull Box	24W x 36L x 24D	
ITS	Rectangular splice box	30W x 60L x 36D	
	Round splice box	36Dia. x 36D	

996-5.1.3 Fabrication: Box covers shall be constructed of concrete, polymer concrete or other materials meeting the requirements of this Section.

Box covers with lifting slots and a flush-seating lockdown mechanism shall be provided. Penta-head or other non-standard, security type lockdown lag bolts shall be used. Lockdown bolts and lifting slots shall be Type 316, 304, or 302 passivated stainless steel or brass. Lockdown bolt assembly shall be designed to prevent seizing and can be removed without damaging the cover or box body. The lockdown bolt threaded insert/nut assembly shall be field replaceable.

996-5.1.4 Testing Requirements: Pull and splice boxes must have a TIER 15 load capacity per the American National Standards Institute/Society of Cable Telecommunications Engineers (ANSI/SCTE) 77 2017 Specification for Underground Enclosure Integrity. Pull and splice boxes must have a TIER 22 load capacity when used for ITS applications on toll road corridors; this excludes express lane corridors.

Additionally, meet the following additional clarifications and requirements:

1. Apply all environmental tests to the box and its cover.
2. All flexural testing shall be conducted in accordance with an appropriate ASTM standard and clearly stated in the report.
3. Perform repetitions of Cycle 1 in Table X2.1 of ASTM G154 for a minimum duration of 1,000 hours for the simulated sunlight exposure test.
4. Use deflection-measuring devices positioned to measure vertical and lateral deflection (wherever maximum deflection occurs) for the vertical sidewall load test.
5. Conduct the lateral sidewall pressure, vertical sidewall load and cover vertical load tests without any removable or permanent wall to wall supporting beams located in the interior or top of the box opening.

When testing pull and splice boxes of various sizes (width x length x depth), the cover impact test, internal equipment protection test, coefficient of friction test, and all environmental tests, can be completed using a single representative box/cover (instead of samples from all box/cover sizes) as long as the test report indicates the following:

1. Materials of construction, compositions, and manufacturing processes are identical for all box and cover sizes submitted for listing on the APL.
2. Size (width x length x depth) of the representative box/cover.

996-5.2 Fiber Optic Splice Vaults: Construct fiber optic splice vaults in accordance with Standard Plans, Index 635-005.

Manufacturers of fiber optic splice vaults must meet the requirements of Section 105 and be listed on the Department's Production Facility Listing.

Construct the vault top and bottom with concrete in accordance with Section 346, and use steel reinforcement bars in accordance with Section 415.

Construct the concrete apron per the requirements of Section 347.

Use non-shrink grout per the requirements of Sections 400 and 934.

Provide hook racks and mount them to the interior walls of the fiber optic splice vaults per the Standard Plans. Precast steel inserts into the vault's interior walls, and attach the racks using galvanized steel bolts threaded into these inserts.

Provide cable support hooks and mount them to the compatible installed hook racks for supporting the fiber optic cabling and fiber optic splice enclosures. Provide two hooks per rack as shown in the Standard Plans.

Racks, cable support hooks, and inserts must be made of steel material that is galvanized per ASTM A153 or A123.

996-5.3 Toll Site Pull Boxes: In addition to the Pull Box requirements of 996-5.1, use UL listed or other National Recognized Testing Laboratory (NRTL) listed handhole enclosures (pull and splice boxes) from the APL.

Use un-reinforced polymer concrete enclosures for toll site pull box covers. Provide one-piece covers with two hold-down bolts.

996-5.3.1 Toll Site Pull Box Marking: The following information must be permanently cast or engraved into the top surface of all pull and splice box covers. If used, identification plates shall be UV stable, mechanically fastened, bonded with adhesive material suitable for outdoor applications, and capable of installation in the field.

1. Mark application as follows:
   TPK TOLL LOOPS for loops
   TPK GANTRY DATA for gantry data
   TPK GANTRY POWER for gantry power
   TPK ITS INTERFACE for ITS lateral
2. Manufacturer's name or logo
3. FDOT APL approval number
4. TIER rating per 996-5.1.4

The date of manufacture (month/day/year, or date code) must be permanently located on the top or bottom of the cover. The interior of the box body must have a permanent marking that includes the manufacturer part/model number and date of manufacture near the top of box in a location that is visible after installation when the cover is removed.

996-5.3.2 Toll Site Pull Box Dimensions: The dimensions for pull boxes used at toll sites are listed below:

Table 996-5
Minimum Dimensions for Toll Site Pull Boxes

Application:	Type:	Size (inches):
Gantry power	Pull Box	24W x 36L x 24D
Gantry data		
Fiber optic cable		
Leased line communications		
Toll Loop	Pull Box	30W x 48L x 24D
Grounding	Pull Box	12W x 12L x 12D

996-5.4 Junction Boxes: Junction boxes shall provide a weatherproof enclosure for cable routing and cable terminations. The outside surfaces of junction boxes shall have a smooth,

uniform finish. Boxes shall be free of burrs, pits, sharp corners, and dents. All welds shall be neatly formed and free of cracks, blow holes, and other irregularities.

996-5.4.1 Aerial Junction Boxes: Aerial junction boxes shall be galvanized steel, aluminum, or NEMA 4X (non-metallic). Aerial junction boxes shall have minimum inside dimensions of 8 inches wide by 8 inches long and 3 inches deep.

996-5.4.2 Mounted Junction Boxes: Mounted junction boxes shall be fabricated of 5052 sheet aluminum alloy with a minimum thickness of 1/8 inch and have a hinged door and lock. Pole and cabinet mounted junction boxes shall have minimum inside dimensions of 13 inches long by 10 inches wide and 3 inches deep. Base mounted junction boxes shall have minimum inside dimensions of 21 inches long by 10 inches wide and 8 inches deep.

996-5.4.3 Embedded Junction Boxes: Embedded junction boxes shall be NEMA 4X (non-metallic) or galvanized steel. Galvanized steel boxes and covers shall be fabricated from steel meeting the requirements of ASTM A36 or A830 Gr 1010 that is a minimum of 1/8" thick and galvanized in accordance with ASTM A123. Boxes for installation in areas exposed to vehicular impacts shall have galvanized steel covers that are a minimum thickness of 3/8".

SUBARTICLE 996-7.2 is deleted and the following substituted:

996-7.2 Uninterruptible Power Supply (UPS): The UPS shall be either a line interactive or online/double-conversion UPS. UPS assemblies shall be designed for installation in a roadside NEMA 3R enclosure to provide battery backup functionality for traffic control systems, including traffic signal and intelligent transportation system (ITS) devices. UPS assemblies shall include batteries provided by the UPS manufacturer or in accordance with manufacturer's requirements.

Loss of utility power, transfer from utility power to battery power, and transfer back to utility power shall not interfere with normal operation of connected equipment. In the event of UPS failure or battery depletion, connected equipment shall be energized automatically upon restoration of utility power.

The UPS shall operate in hot standby mode with power transfer being accomplished in 40 milliseconds or less.

Removal and replacement of the UPS shall not disrupt the operation of the equipment being protected.

All harnesses necessary to connect and operate the system shall be included. All connectors shall be keyed to prevent improper connection.

996-7.2.1 Configuration and Management: The UPS shall support local and remote configuration and management, including access to all user-programmable features as well as alarm monitoring, event logging, and diagnostic utilities. The UPS shall support SNMP, including configurable alarm and event trap notifications.

Configuration and management functions shall be password protected.

Alarm function monitoring shall include the following: loss of utility power, inverter failure, low battery, voltage, and temperature out of range. The UPS shall include an event log that indicates the date and time of the following events: AC high, AC low, AC frequency error, AC fail/blackout, and over temperature. The UPS event log shall be able to store a minimum of 60 events.

The UPS shall include a front panel display and controls that allows ~~programming of configurable parameters, features, and functions~~password-protected

configuration of network settings and review of operational status without the need for another input device. The UPS shall have visual indications for Power-On, Mode of Operation (utility power or inverter), Battery Status, Alarm Status, Load Levels, and AC Output Voltage.

996-7.2.2 Communication Interfaces: The UPS shall include an Ethernet port (RJ45) for local control using a laptop PC and remote control via a network connection.

996-7.2.3 Batteries: Batteries must be provided by the UPS manufacturer or in accordance with manufacturer's recommendations. Batteries shall be sealed and require no maintenance, cause no corrosion, and be capable of maintaining 80% of original capacity and performance for a minimum of five years.

The UPS shall be supplied with a wiring harness for battery connections. The battery wiring harness shall allow 6 feet of separation between the UPS and its battery bank. Battery terminals shall include a protective covering to prevent accidental spark or shorting.

The UPS shall include battery management functions that includes ~~active or equalized balancing;~~ monitoring of temperature, voltage, and amperage of charge and discharge; and temperature compensated automatic charging to maximize the life of the batteries.

996-7.2.4 Electrical Requirements: ~~UPS assemblies used to provide backup power in an ITS cabinet shall provide a minimum of 350 watts (at 120 V_{AC}) of continuous backup power for a minimum of two hours.~~

~~UPS assemblies used to provide backup power in a traffic signal controller cabinet shall provide a minimum 400 watts (at 120 V_{AC}) of continuous power for a minimum of 6.5 hours.~~

Frequency shall be regulated to 60 Hz, plus or minus 0.5 Hz, while the UPS is supplying power. The UPS shall operate on 85 to 140 V_{AC} without requiring assistance from the batteries.

The UPS shall be listed to the requirements of UL 1778. Upstream back feed voltage from the UPS shall be less than 1 $V_{AC.}$

Double-conversion UPS shall be capable of simultaneously producing fully regenerated and regulated, conditioned, True Sine Wave power and hot standby AC output, and have a minimum operating efficiency of 90%.

996-7.2.4.1 UPS for ITS Cabinet: UPS assemblies used to provide backup power in an ITS cabinet shall provide a minimum of 350 watts (at 120 V_{AC}) of continuous backup power for a minimum of two hours.

996-7.2.4.2 UPS for Traffic Signal Controller Cabinet: UPS assemblies used to provide backup power in a traffic signal controller cabinet shall provide a minimum 400 watts (at 120 V_{AC}) of continuous power for a minimum of 6.5 hours.

996-7.2.5 Traffic Signal UPS Cabinet: Cabinets used to house traffic signal UPS assemblies shall be designed to be mounted to the side of a traffic cabinet or base mounted. Cabinets shall be currently listed on the APL or meet the requirements of Section 676. Cabinets shall ~~meet the requirements of Section 676 and~~ include shelves and rack rails to house all UPS system components including the UPS, batteries, harnesses, switches, surge protective device, power terminal block and a generator hookup with transfer switch. The UPS cabinet shall allow a maintenance technician to safely insert power for traffic signal operation while the UPS or associated equipment is serviced or replaced.

A surge protective device shall be installed where the supply circuit enters the cabinet in accordance with Section 620-2.

The cabinet shall include a 20 A, 120 volt, 60 Hz GFCI receptacle. The receptacle shall be wired to utility power and not regulated by the UPS module. The cabinet shall include a main breaker and a breaker for the technician GFCI outlet.

996-7.2.5.1 Transfer Switch and Generator Access Panel: The cabinet shall include an automatic transfer switch and generator access panel in accordance with Section 676. The generator access door shall not protrude more than 1 inch when closed.

996-7.2.6 Mechanical Requirements: All parts shall be made of corrosion-resistant materials such as plastic, stainless steel, anodized aluminum, brass, or gold-plated metal. All fasteners exposed to the elements shall be Type 304 or 316 passivated stainless steel.

996-7.2.7 Environmental Requirements: UPS assemblies, including batteries, shall provide continuous power with specified wattage and operate properly during and after being subjected to the environmental testing procedures described in NEMA TS 2, Sections 2.2.7, 2.2.8, and 2.2.9.

SUBARTICLE 996-7.3 is deleted and the following substituted:

996-7.3 Remote Power Management Unit (RPMU): The RPMU shall be designed for installation in a roadside Traffic Cabinet to provide remote control of electrical receptacles.

996-7.3.1 Configuration and Management: Provide a RPMU that supports local and remote configuration and management, including access to all user-programmable features as well as alarm monitoring, event logging, and diagnostic utilities.

Configuration and management functions shall be password protected.

The RPMU shall include an event scheduler that can store a minimum of 60 events.

The RPMU shall include LED indicators for relay inputs and outlet status.

Upon loss of communications the RPMU shall maintain each receptacle and relay in its currently stored state of operation.

Upon restoration of electrical power after an outage the RPMU shall automatically restore each receptacle and relay to its previously stored state of operation and all configurable parameters shall be retained.

The unit shall support SNMP ~~v2c~~, including trap notifications of receptacle state changes.

996-7.3.2 Communication Interfaces: The RPMU shall have an Ethernet port (RJ45) for local control using a laptop PC and remote control via a network connection.

996-7.3.3 Electrical Requirements: The RPMU shall have a minimum of 6 NEMA 5-15R receptacles, nominal 120 V_{AC}. The RPMU shall have a minimum current capacity of 12 amperes (amps).

996-7.3.4 Mechanical Requirements: All parts shall be made of corrosion-resistant materials such as plastic, stainless steel, anodized aluminum, brass, or gold-plated metal. All fasteners exposed to the elements shall be Type 304 or 316 passivated stainless steel.

996-7.3.5 Environmental Requirements: The RPMU shall operate properly during and after being subjected to the environmental testing procedures described in NEMA TS 2, Sections 2.2.7, 2.2.8, and 2.2.9.