

FDOT Pay Item # 660-4-11 & 660-4-12: Vehicle Detector System - Video, F&I, Cabinet and Above Ground Equipment Broward County Pay Item Notes; Effective Date: 04-08-2020

The following pay item notes are for Video Detection hardware and components. The type of camera will be specified in the plans or at the time of the shop drawing approval. The Contractor shall make all video detectors installed as part of the project fully operational in accordance with their associated isolated intersection signal timing chart within 24 hours of their installation. The video detection system shall be on the Florida Department of Transportation (FDOT) Approved Products List and meet all qualifying specifications identified herein or as described in FDOT Section 660-3 "Installation Requirements" and Section 660-4 "Acceptance Testing" as it applies to Video Vehicle Detection Systems. Deviations from the FDOT Section 660 specifications shall be approved in writing by the Engineer of Record prior to installation. No exceptions will be made for variations from the FDOT specification and/or the plan sets performed by the Contractor. Errors because of variations shall be fixed at the Contractor's expense, no additional compensation will be provided.

To verify conformance with the accuracy requirements in this section, the Contractor shall develop and submit a test plan to the Design Criteria Professional for approval. The test plan shall perform evaluations by comparing sample data collected from the vehicle detection system with ground truth data collected during the same time by human observation or by another method approved by the Design Criteria Professional. Base the vehicle detection system's performance evaluation on sample data taken over a minimum of three time periods (daytime from 6 a.m. to 10 a.m., evening from 4:00 p.m. to 8:00 p.m. and nighttime from 10 p.m. to 2 a.m.), under a variety of traffic conditions (peak and off-peak). Sample data sets collected shall consist of a minimum of 15-minute periods per approach. The test plan shall describe the data collection process in detail. The test plan shall include the following:

- a. A description of the test conditions during the data collection process (i.e. light intensity, ambient temperature [high & low temperature for the day], wind intensity, recording time and duration, environmental conditions such as rain, fog and any other relevant information requested by the Design Criteria Professional.)
- b. Roadway geometric conditions (i.e. number and direction of approaches; number of lanes per approach and lane type; and camera placement and viewing details.)
- c. Percentage of accurate detection (minimum allowable correct detection is 98% under normal day and night conditions and 96% under adverse conditions, fog and rain, etc.).
- d. Percentage of discrepant calls (maximum percentage of discrepant calls is 2% under normal conditions and 4% under adverse conditions). Discrepant calls are either false or missed calls.
 - i. False call: Detector detects a vehicle when none is present. Examples of false calls are:
 1. Shadows of cars activating the detectors in the adjacent lanes
 2. Headlights of vehicles activating the detectors
 3. Vehicles activating detectors in the adjacent lanes
 4. Vehicles activating detectors in opposing lanes
 5. Extended detection even after the vehicles have moved out of the detection zone
 6. Additional detections due to movement or vibration of camera
 7. Vehicles being detected more than once

- ii. Missed call: Detector does not recognize the presence of a vehicle when vehicle is present or is passing through detection zone. Examples of missed calls are:
1. Vehicles blending in with the background and not detected
 2. Vehicle initially detected but dropped in the detection zone
 3. Vehicles not detected due to occlusion
 4. Vehicles not detected due to processor's inability to discern movement within detection zone due to environmental or optical conditions

The Contractor shall be responsible for recording the test periods per approach with the video images displaying the correct date and timestamp. The Contractor will deliver the recording in DVD format to the County and then review the recordings with County staff during the accuracy testing period for approval. The Contractor shall be compensated for all labor (work hours) and equipment necessary to complete a successful Video Detection accuracy test and/or Field Acceptance Test under FDOT Pay Item #660-4-XX Series - Video Detection System. It is the Contractor's responsibility to review the placement of the Video Image Detection Devices and coordinate with the Engineer of Record to determine the most optimal location for the Video Image Detection Devices to be installed at, in order to meet the performance requirements of these technical specifications.

In addition to the FDOT Section 660 Specifications, the Contractor shall provide a system that meets the following minimum physical and functional requirements of a video detection system. The system shall be capable of monitoring all vehicles on a roadway, providing video-based vehicle detection and have the capability of being programmed via a PC, CRT display, and a mouse or keypad. As a minimum, the video detection system shall consist of the following:

Equipment considered included in FDOT Pay Item 660-4-11 Cabinet Equipment

- Machine Vision Processor or Video Image Processor unit
- SDLC interface board (not standard BIU)
- Ethernet connectivity (band width scalable) card / device for streaming video
- Camera focusing devices
- Surge suppressors

Equipment considered included in FDOT Pay Item 660-4-12 Above Ground Equipment

- Color video cameras with IR filter, enclosure, and sunshields
- Thermal video cameras with IR filter, enclosure, and sunshields
- Camera focusing devices
- Mounting bracket and arms
- Coaxial/power cable; broadband over power line (BPL); category 6 ethernet cable (CAT6E)
- Point discharge dissipation terminal

Incidentals to the above-mentioned pay items

- Supplemental interface hardware, cabling, and other system components are considered incidental to video processors
- Video Detection Management Software
- Training for installation, operation, and maintenance
- All other necessary equipment to make this a complete and operational system

The cost of the video detection system shall include necessary hardware, software, and firmware, as an assembly, in order to remotely access/setup the configuration settings and be able to provide video streaming to the end user from remote location with the proper

permissions. The cost of the video detection system shall include necessary hardware, software and firmware that discriminately detects the presence of individual vehicles and bicycles in a single or multiple lane using only the video image.

The system shall provide a detection/tracking mechanism that detects/counts pedestrian volume moving within the crossing area, and determine the average, maximum, and minimum speed of pedestrians moving within the crossing zone. The system shall also provide discrete outputs when pedestrians are in the crosswalk during normal crossing phases and when a red phase input has been detected.

1. **Machine Vision Processor Minimum Specifications**

The system will have a Machine Vision Processor (MVP) located inside the cabinet and will be modular by design to fit directly into the Detector Racks of NEMA TS1 and TS2, 170, 332, 333 or 336 Traffic Control Cabinets. 2070 Traffic Controllers can also be installed in the NEMA 332, 333 or 336 cabinets. The MVPs shall be interchangeable between rack mount installations without replacing or modifying the existing MVP units. The MVP module shall be able to connect to a camera. The system will have a rack mount power supply that is self-contained and have a standalone configuration. At a minimum, an eight-channel detector rack shall be included in each assembly. The video image processor shall have the capability to relearn the roadway image in less than six minutes after start up. It shall have the ability to provide information on the status of power, system communications, input video status and output detection status. The MVP in a TS2 type 1 or a hybrid TS1 using SDLC for detection shall be able to display on its monitor screen in addition to the detection zones, a signal face showing the active signal phase indication that is currently on with the associated detection zones.

The system shall be designed to operate reliably in the adverse environment of roadside cabinets and shall meet or exceed all NEMA TS1 and TS2, as well as ATC environmental specifications. The MVP Video inputs shall be 75 ohms impedance. Ambient operating temperature shall be from -34 to +74 degrees Centigrade at 0 to 95% relative humidity non-condensing.

Rack mount installations shall be powered by the detector rack power supply and the power consumption in this configuration shall not exceed the ratings of the power supply. Surge ratings shall be set forth in the NEMA TS1 and TS2 specifications. Serial communications shall be via an RS232 serial port or Ethernet communication port (RJ-45 connection). The Ethernet communications port shall meet the latest applicable IEEE Ethernet Protocol standards and shall be capable of communicating at a minimum of 10 mbps. These ports can be used for communications to a laptop, a hardened Ethernet switch or fiber modem for upload/download detector configurations, count, turning movement, queue length data, technical events, send firmware upgrades and carryout remote setup of detectors.

A standard internet browser shall connect to Ethernet IP addressable port (RJ-45 connection) to monitor and set-up the MVP boards. Each MVP board shall have 4 opto-isolated open collector outputs. A minimum of twenty (20) additional outputs shall be available (e.g. via an expansion port). The outputs shall be programmed for signaling the presence, the arrival or the departure of vehicles in a minimum of 24 detection zones per video image. Each MVP board shall have error detection. An output contact will provide a constant call if the video signal is bad or the MVP board is not functioning properly. The MVP and camera shall be able to detect vehicles under an overpass location. The MVP board shall go into a recall state in cases of severe degraded visibility (i.e., fog, blizzard,

etc.). Under adverse field-of-vision conditions, the system will default to invoke a maximum recall when failure-to-detect conditions are experienced. Adverse visibility conditions may include shadows, heavy rain, fog, sunburst phenomenon and direct and in-direct glare. Normal detection resumes when visibility improves above the user defined quality level. Operator selectable recall shall be available. The operator shall have the ability to assign selectable outputs for recall.

TS2 cabinets shall have all detection connected via SDLC. The MVP in the TS2 environment shall:

1. Communicate with controller detection calls.
2. Controller communicates with MVP active phases.
3. Send alarm status to controller.

Selecting a video image for display on a monitor should be a user-friendly procedure and be accomplished within 10 seconds. The MVP board shall have the capability to reset video detectors to “relearn” the roadway image. During “relearn”, selectable recall can be enabled or disabled for immediate operation. External surge suppression, independent of the MVP board, shall separate the MVP from the image sensor. The MVP board shall have the ability to provide information on the status of input power, system communications, input video status and output detection status. The MVP expansion board, if used, shall have the ability to provide information on the status of input power, system communications and output detection status. The functional capabilities of the MVP shall also include Real Time Detection. Each MVP board shall be capable of processing the video signal. The video signal shall be analyzed in real time.

The System shall provide software MPEG- 4 video compression at 30 frames per second and must be compatible with the Broward County Barco brand video wall. The system shall be expandable up to 8 cameras that may be connected to different MVP units and programmed independently. The system shall be capable of displaying detectors on the video image with associated outputs. Outputs/Inputs status will be indicated on the screen. Selectable text overlay will also include the ability to view raw video without any verbiage and/or detectors for monitoring purposes.

Each MVP board will detect within the view of the connected camera the presence of vehicles in user-defined zones. Detectors available shall be presence, count, queue length, turning movement, delay, extension, or pulse mode of either arrival or departure of vehicles. Delay and extension shall be defined between 0.1-25 seconds in increments of 0.1 seconds. Pulse mode shall be 125ms +/- 25ms. Queue length detector thresholds can be programmed to generate an output when the threshold is exceeded. The MVP board shall be programmed with a standard CCTV monitor, laptop or keypad, and/or mouse plugged into the MVP serial port, USB or Ethernet port to facilitate detector programming. Via the serial/Ethernet port, detector configurations can be uploaded to a computer and stored on disk. The MVP board shall have the ability to be remotely accessed on a network environment and will be able to display phase feedback from the controller. The MVP board shall have firmware upgrade capability both locally and remotely.

Each MVP board shall have the ability to define directional detectors capable of only detecting vehicles traveling in a desired direction within a desired detection zone. The detector zones shall also have the capability of being linked through the use of Boolean functions (i.e. AND, OR) to improve detection sensitivity. To facilitate “fine tuning” of detection zones, provisions shall be made to change the sensitivity of each detection zone

independently and adjust sensitivity of detector by adding or removing additional detection zones within a detection area. All detectors and parameters can be changed without interrupting detection. For example: when one detector is modified, all existing detectors continue to operate, including the one that is being modified. When the new position is confirmed, the new detector file will enter a learning phase. Once the new detector is fully functional, it will take over the job of the old one. In this way, the detector is always fully operational with no interruption on any detector, even during modification. Learning phases for new detectors shall in general, not exceed 6 minutes. Eight detector zones per MVP Board input may be used as count, turning movement and queue length detectors. These detectors will be in addition to the 24 zones for presence and will detect and store data at user-defined intervals of at least 5, 15, 30 and 60 minutes. It shall be possible for each MVP board to store approximately one month of eight data zones with three vehicle classifications in non-volatile memory. Additional archive data will be stored on the Traffic Management System Server. Associated software may be used with a PC to download data and export to a spreadsheet. Software will also be used to upload/download detector configurations, count, turning movement, queue length and other traffic data, technical events, send software versions upgrades and do remote setup of detectors. The MVP board shall have an internal clock with daylight savings time system, which can be enabled or disabled. The MVP board shall monitor the DC green outputs of each movement and provide Delay Detection and Stretch Detection Program capability with Green Overrides programmable for each detection zone. Intervals shall be programmed in whole second increments from 0" to 60".

2. Image Sensor Camera Minimum Specifications

The image sensor camera shall be non-proprietary, commercially available, off the shelf (COTS) Industrial Block Type integrated camera/lens single piece camera model. A two-piece camera and lens combination shall not be acceptable. The camera shall be repairable and replaceable.

The unit shall be a high-resolution color charge-coupled device (CCD) or thermal camera, designed for professional video detection systems to capture images of vehicles under all weather and lighting conditions including approaches under overpasses. Incorporating the latest in color CCD technology, the video camera shall provide detailed video without lag, image retention, or geometric distortion.

The Image Sensor Camera System must be enclosed in a sealed assembly with the following minimum specifications:

Description	Minimum Specification
Temperature range	-34 to + 74 degrees Celsius
Humidity	0% to 100% relative, non-condensing
Vibration	0.5G, 5-30 Hz
Shock	10G in all 3 axes
Connectors	BNC for video out or terminal block type quick connectors, both types configured 90 degrees down to relieve stress at the connector or military MS 14-18.
Finish	Off-white, semi-gloss polyurethane
Construction	A non-corrosive aluminum housing

Heater	Integral glass window heater only. A proportionally controlled closed loop window heater drive circuit with outside temperature sensor unit to provide fog-free window operation under all environmental conditions. The transference of heat to the window from the sled is not an acceptable method.
Rated input voltage	12VDC or 24VAC +/-10% @60Hz or 110 Volt AC nominal
Imager	Color with automatic white balance
Signal to noise ratio	50 dB minimum AGC30 dB
Light range	.003 lux capable auto-iris lens
Focal Length	3° minimum zoom to 55° wide angle with a minimum 25x zoom
Focus	Automatic/adjustable
Video out	NTSC 1.0 volts peak-to-peak +/- 0.1 volt @ 75 Ohms

Camera Assemblies

The camera assembly shall include a weatherproof sealed housing and an integral sunshield for outdoor installation. The housing shall be sealed to prevent moisture entry from both temperature variations and wind driven rain.

The weatherproof housing shall incorporate a mounting bracket to allow proper positioning of the camera. The mounting bracket shall be pre-drilled to allow attachment to standard brackets for mounting on mast arms or on luminaire arms. A single military style connector at the back of the housing for both video and power cables shall be provided to make the camera assembly field replaceable if service is required. Video and power cables will be specially constructed for proper fit connectors, all wire connections to be soldered and not crimped. The connector shall be weatherproof and corrosion resistant. A low maintenance, hydrophilic coated, energy saving, non-fogging camera faceplate with a thermostatically controlled integral window heater shall be located in the housing to minimize condensation. The window heater will have a proportionally controlled closed loop window heater drive circuit with outside temperature sensor unit to provide fog-free window operation under all environmental conditions.

The sunshield shall minimize the heating of the housing during hot weather. The sunshield shall extend beyond the ends of the weatherproof housing to minimize rain on the faceplate or body of the housing to eliminate dripping water in the line of sight of the camera.

The weatherproof housing shall be constructed of rugged, corrosion-resistant materials such as aluminum, powder-coated aluminum and/or stainless steel, suitable for outdoor use. It shall include a rubber boot to enclose the back of the camera and its wiring connections. As a minimum, the weatherproof housing shall meet the following specifications:

Description	Minimum Specification
Temperature range	-34 to + 74 degrees Celsius
Cable Entry	Special fit weather tight and corrosion resistant connections. All wire connections to be soldered and not crimped.
Finish	Off-white semi-gloss polyurethane

Construction	Extruded housing, with rear end cap, front cap with glass faceplate, and cradle and sunshield constructed of corrosion-resistant materials such as aluminum, powder-coated aluminum and/or stainless steel.
Window	3 mm (min) thick glass that includes a thermostatically controlled window Heater/defogger
Rated input voltage	115 VAC 60 hertz
Voltage range	108 VAC to 132 VAC
Output Voltage	24 VAC 60 Hertz
Nominal Power	30 Watts (Includes 20 Watts max for Heater)
Enclosure protection	Waterproof and dust-tight in a NEMA-4 IP65, enclosure Type 3

3. **Camera Focusing Device**

This device shall allow the using agency to focus and zoom the camera lens from the Traffic Control Cabinet or Camera and Transportation Management Center (if communication infrastructure is available) to obtain a clear picture for setting up detection zones.

4. **Lightning and Surge Protection**

The video surge suppressor shall provide coaxial cable connection points to an EDCO CX06-M transient suppressor for each image sensor and as a minimum shall include the following:

Description	Minimum Specification
Peak Surge Current (8x20us)	5KA
Technology	Hybrid, Solid State
Attenuation	0.1db @ 10Mhz
Response Time	<1 nanosecond
Protection	Line to ground
Shield to Ground	(isolated shield modules)
Clamp Voltage	6 volts
Connectors	BNC
Impedance	75 Ohms
Temperature	-34 to +74 degrees C
Humidity	0%-95% relative, non-condensing
UL listed	UL 497B

5. **Point Dissipation Terminals**

Point Discharge Dissipation Terminals shall be provided for each camera and as a minimum shall include the following:

- One 4.5-inch Spiral wound dissipation brush with 0.010-inch diameter x 3.75-inch dissipation wire (dissipation assembly shall be constructed from High Grade 316 Stainless Steel). Diameter of each dissipater unit shall be 5/8 inch with a minimum length of 24 inches.
- The dissipation bracket and camera shall have a continuous bond for grounding

to form an array per manufacturers' recommendations.

Install a circuit protection (circuit breaker) for each camera feed inside the cabinet to each camera.

Ground

A #10-gauge green ground wire to be connected from the provided ground lug on the camera bracket to the nearest appropriate ground point. On mast arm locations, that ground point may be on an unpainted area of the mast or at the ground rod at the pole base. On span wire installations, the ground point would be on the nearest grounded span wire. There is usually a pigtail coming out from the concrete pole that is tied to a ground rod at the pole base. This would be an appropriate point of contact. The ground will not be tied back to the controller cabinet.

6. Mounting Arm Brackets

Camera bracket assemblies shall all provide for adjustments for both the vertical and horizontal orientation of the camera. Camera attachments shall be designed to securely fasten the camera to prevent the camera assembly from oscillation, vibration, falling into the path of vehicles or becoming loose. Miscellaneous hardware shall be stainless steel or galvanized steel. In addition, the following items will be required, depending on the type of traffic signal support structure:

- An Astro Bracket with a six-foot gusset shall be provided for traffic signal mast arm installations.
- A complete unit for Concrete Strain Poles shall include an extended tilt & pan, vertical mount, 2-piece camera bracket, with a 12 in. nipple length. The complete unit for Concrete Strain Pole shall be in Aluminum. When called for on plans to improve camera placement, a clamp-on cantilever arm at least 12 ft. in length may also be required.

7. Use of Additional Cameras to Ensure Detection Accuracy

The Contractor shall be responsible for determining the need for additional camera assemblies and/or alternate configurations to ensure required accuracy of vehicle detection in all required travel lanes. This is particularly critical for large span-wire intersections for which corner-firing from the strain poles is the only available option, and resulting oblique angles are conducive for occlusions due to high-profile vehicles. The Contractor may use up to eight (8) cameras per intersection under such conditions. Alternative mounting structures (supplemental poles, etc.) may also be considered if approved in advance by the Design Criteria Professional

8. Image sensor or Video-Cable (Coaxial and Power)

Coaxial & Power cable shall be suitable for exterior use and in direct sunlight. Power cable shall have enough conductors to power the camera assembly as well as provide zoom and focus control. The cable will be used for zooming and focusing of the image sensor from the controller cabinet.

9. Locate Wire and Locate Wire Grounding Unit

A locate wire shall be installed and shall be single copper conductor with a minimum gauge of No. 12 AWG. The locate wire shall be insulated using a 45 mm minimum thickness orange polyethylene sheath and marked to identify the manufacturer and conductor size. All

locate wires shall be attached to a wire grounding unit (WGU) dedicated to safely dissipate high transient voltages or other foreign electrical surges into the designated vehicle detection system. A locate wire continuity test report per FDOT Section 630 shall be provided. The WGU shall conform to the following:

- Allows signals generated by locate systems transmitters to pass through the protection system without going to ground.
- The protection system automatically resets and passes locate system transmitter signals after the unit has been grounded to dissipate over-voltages.
- Is intended for below or above grade applications. Ground the WGU to a driven rod within 10 feet of the system using a No. 6 AWG single conductor wire with green insulation. The WGU shall be enclosed for protection from environmental hazards and is accessible for the connection of portable locate system transmitters.
- The WGU shall meet the following minimum specifications for surge protection:

Description	Minimum Specification
Surge Element	3-element maximum duty fail safe gas tube
Rating	40,000 A surge capacity (single-cycle, 8 by 30 microsecond waveform)
Life	Minimum 1000 surges (1000 A to ground)
Fail-Safe	Integral fail-shortened device
Insulation Resistance	1000 megohm minimum at 100 volts of direct current (VDC)
Clamp Voltages	a. Impulse at 100 volts per microsecond: Typically, 500 volts b. Direct Current: 300 to 500 volts.

10. Video Detection Management System (VDMS)

The VDMS application software shall be a client-server PCP/IP based system. It shall be compatible to be installed on the latest version of the Windows operating system server and several clients on a network of multiple desktops and laptops. The County shall be provided a site license for the client-server software. Any software upgrades and updates shall be provided to the County at no additional cost during the warranty period.

The VDMS shall collect real time traffic data from Video Image Processing modules and monitor an entire video detection system or network of video detection systems over an Ethernet (TCP/IP) based communication system if available at the Video Detection Site location. The System software will be installed and integrated by the Contractor staff.

Traffic data from the detector units shall be transmitted at user-defined integration intervals of 5, 15, 30 and 60 minutes to the server. 100GB of storage will hold one year's worth of traffic data for 350 four camera intersections with 16 count zones each in 15-minute storage bins. The VDMS shall run and store traffic data and events on County approved server database.

11. **Warranty and Support**

The manufacturer/supplier shall provide a minimum limited **four-year** standard warranty on parts and labor on the following video detection system components:

- a. Imager sensor camera
- b. Machine Vision processor
- c. SDLC communication board
- d. Network module
- e. I/O module
- f. Video encoder

During the warranty period, technical support shall be available from the manufacturer via telephone within 4 hours of the time a call is made by a user, and this support shall be available from factory-certified personnel. If an issue cannot be resolved by telephone, factory-certified personnel shall be available at the equipment installation location within 7 calendar days for technical support to resolve the issue.

The manufacturer/supplier shall maintain an adequate inventory of parts to support maintenance and repair of the video detection system. These parts shall be available for delivery within 10 calendar days of placement of an acceptable order.

The manufacturer shall maintain an ongoing program of technical support for the video detection system during the warranty period. This technical support shall be available via telephone or personnel sent to the installation site. Installation and/or training support shall be provided by factory-authorized representative and shall be a minimum, IMSA-Level II Traffic Signal Technician certified.

Any software upgrades and updates during the 4-year warranty period shall be provided to the County at no additional cost. Complete product documentation shall be supplied with all equipment.