

MICHIGAN  
DEPARTMENT OF TRANSPORTATION  
  
SPECIAL PROVISION  
FOR  
**VIDEO TRAFFIC DETECTION SYSTEM**

SIG:EMS

1 of 8

APPR:HLO:NJB:05-05-20  
FHWA:APPR:05-06-20

**a. Description.** This work consists of furnishing and installing a video traffic detection system including up to eight cameras mounted on span wire, mast arm, truss arm, or other structure as approved by the Engineer at an intersection as indicated on the plans.

**b. Material.** Provide video traffic detection system and camera(s) in accordance with this special provision. Provide hardware wiring and other appurtenant materials in accordance with sections 918 and 921 of the Standard Specifications of Construction and this special provision.

1. System Requirements.

A. System Hardware. The video traffic detection system hardware consists of a video detection processor (VDP), a video monitor or associated equipment required to setup the VDP, an extension module (EM), a surge suppressor for each video input, all mounted in a standard detector rack; a pointing device; and one up to eight video cameras. Ensure installed video traffic detection system and camera(s) is compatible with existing solid state pretimed or actuated traffic signal control equipment and cabinet environments. Ensure both the VDP and the camera are from the same supplier to ensure compatibility.

B. System Software. Ensure the system software is capable of detecting vehicles in multiple lanes using only the video image. Ensure software is capable of allowing the operator to program up to 24 detection zones per camera by placing zones on a video image using only a video menu and a pointing device connected to the VDP. Programming camera detection zones must not require the use of a separate computer; however, the software must provide the option of programming with a separate computer via a Recommended Standard (RS)-232 port.

2. System Functional Capabilities.

A. Ensure the VDP provides all of the following functional capabilities:

(1) Process video signal from one to two video camera, digital video disc (DVD) or video tape player sources, depending upon the VDP module used.

(2) Accept video signal input in *National Transmission Standards Committee (NTSC)* or Programmable Array Logic (PAL) composite video format, and digitize and analyze the signal in real time.

(3) Process images from all video inputs simultaneously when dual VDP's are provided.

(4) Detect the presence of vehicles in up to 24 detection zones per camera with each detection zone approximately the width and length of one car.

(5) Store up to three different detector zone patterns and switch to any of the three different detector patterns within 1 second of user request via menu selection with the pointing device.

(6) Detect vehicles in real time as they travel across each detector zone.

(7) Accept new detector patterns from an external computer through the RS-232 port when that computer uses the correct communication protocol for downloading detector patterns.

(8) Prevent memory loss during power outages.

(9) Continue to operate using the existing zone configurations when the operator is defining or modifying a zone pattern and not allow the new zone configuration to go into effect until the configuration is saved by the operator.

(10) Be programmable by the user to switch automatically to any one of the stored configurations, based on the time of day.

(11) Provide dynamic zone reconfiguration (DZR) to enable normal detector operation of existing zones (except the one being added or modified) during the setup process.

(12) Process the video input from each camera at 30 frames per second.

(13) Output a constant call on any detection channel corresponding to the zone being modified, for each enabled detector output channel if a loss of video signal occurs, and during the background learning period.

B. Ensure the extension module provides all of the following functional capabilities:

(1) Enable the user to plug an extension module into the appropriate slot in the detector rack without the need to rewire the detector rack.

(2) Can detect vehicles and bicycles in real time as they travel across each detection zone.

(3) Can support bicycle type zones where the zone can differentiate between motorized vehicles and bicycles, producing a call for one but not the other.

C. Ensure the detection zones configuration provides all of the following functional capabilities:

(1) Can support up to 24 detection zones, per camera, and each detection zone can be sized to suit the site and desired vehicle detection region.

(2) Indicates vehicle presence in multiple detection zones on a single detector output channel by linking channels using "AND" or "OR" commands.

(3) Allows detection zone outputs to be configurable to select presence, pulse, extend, and delay outputs. Ensure timing parameters of pulse extend, and delay outputs are user definable between 0.1 to 25.0 seconds.

(4) Activates a detection zone on the video overlay display to confirm vehicle detection when a vehicle is detected crossing a detection zone.

(5) Ensure not less than 98 percent detection accuracy in good weather conditions, and not less than 96 percent accuracy under weather conditions (i.e., rain, snow, or fog), which reduce visibility. Detection accuracy is dependent upon camera placement, camera quality, and detection zone location. These accuracy levels do not include allowances for occlusion or poor video due to camera location or quality.

(6) Features directional detection zones to reduce false detections from objects traveling in other directions.

(7) Allows detection zone setup without site-specific information such as latitude and longitude or temporal information such as date and time.

(8) Can detect vehicles and bicycles in real time as they travel across each detection zone.

(9) Provides six additional count zones for bicycles, separate from the 6 data collection zones for vehicles, to accumulate bicycle counts at user specified intervals.

(10) Has the ability to have extensions assigned to individual bicycle zones for applications where the traffic controller does not have bicycle specific detection inputs.

### 3. System Operational Capabilities.

A. Ensure the VDP provides all of the following operational capabilities:

(1) Designed to mount in a standard *NEMA TS 1, TS 2, 2070* Advance Transportation Controller (ATC), 170 type detector rack using the edge connector to obtain power and provide contact closure outputs.

(2) Provides only two camera processors for standard and wide angle cameras. Provides one camera processors for span wire cameras.

(3) Operates satisfactorily in a temperature range from -30 degrees Fahrenheit (F) to 165 degrees F (-35 degrees Celsius (C) to 74 degrees C) and a relative humidity range from 0 percent to 95 percent, non-condensing as set forth in *NEMA* specifications.

(4) Powered by 12 or 24 volts direct current (VDC) and automatically compensates for the different input voltages.

(5) Power consumption less than or equal to 300 milliamps at 24 VDC.

(6) Include an RS-232 port for serial communications with a remote computer.

Ensure the VDP RS-232 port is multi drop compatible with a 9 pin "D" subminiature connector on the front panel of the VDP.

(7) Use flash memory technology to enable loading modified or enhanced software through the RS-232 port without modifying the VDP hardware.

(8) Display detector outputs for each channel of detection, in real time when the system is operational, with visual cues such as light emitting diodes (LEDs) on the front panel.

(9) Include on the front panel of the single and dual VDPs, one or two Baynet Neill Concelman (BNC) video input connectors suitable for RS-170 video inputs as required. Ensure the video input includes a switch-selectable 75 ohm or high impedance termination to allow camera video to be routed to other devices, as well as input to the VDP for vehicle detection.

(10) Include on the front panel, one BNC video output providing real time video output that can be routed to other devices.

(11) Include, on the front panel, a detector test switch to allow the user to place either a constant call or a momentary call, depending on the position of the switch, on each channel.

(12) Provide transient voltage suppression and isolation for the video inputs.

(13) Ensure the one volt peak to peak video signal integrity is maintained via amplification despite video cabling losses and externally induced transients. Ensure the amplifier has a minimum common mode rejection at 60 hertz (Hz) of 90 decibel (dB).

(14) Bond and ground all equipment per the *NEC*.

(15) The ability to assign a separate output channel for bicycle zones to allow traffic controllers to implement special bicycle timing for applications where the traffic controller has separate bicycle detection inputs.

(16) Employ dynamic zone stabilization (DZS) to provide motion tracking and compensation for swaying camera sensors mounted on dual span wires.

(17) Compensate for swaying motions by tracking the position of the stop bar (or limit line) for the approaching vehicle or bicycle movement. Compensate for low frequency (cable sag) motion due to temperature changes during the day. Compensate for moderate frequency motion induced by winds. Compensate for up to  $\pm 5$  degrees of tilt from vertical without any adverse detection false calls or dropped calls.

B. Ensure the EM provides all of the following operational capabilities:

(1) Power consumption less than or equal to 120 milliamps at 24 DC.

(2) Designed to mount in a standard *NEMA TS 1*, *TS 2*, 2070 ATC, 170 type

detector rack using the edge connector to obtain power and provide contact closure outputs.

(3) Mounts in a standard detector rack without the need for adapters or for rewiring the detector rack.

(4) Includes, on the front panel, a detector test switch to allow the user to place either a constant call or a momentary call, depending on the position of the switch, on each channel.

(5) Includes detector output pin out that is compatible with industry standard detector racks.

C. Ensure the camera(s) provides all of the following operational capabilities:

(1) Ability to transmit the composite video signal, with minimal signal degradation, up to 1,000 feet under ideal conditions.

(2) Produces a video image allowing detection of vehicles under a minimum range of scene luminance of 0.1 lux to 10,000 lux or the minimum range from night time to day time, whichever is greater.

(3) Is digital signal processor (DSP) based and uses a charge coupled device (CCD) sensing element and outputs color video with resolution of not less than 550 Television lines. Ensure the color CCD imager has a minimum pixel count of 380K (NTSC)/440K (PAL).

(4) Includes an electronic shutter control based upon average scene luminance and is equipped with an auto-iris lens that operates in tandem with the electronic shutter.

(5) Uses automatic white balance.

(6) Has horizontal field of view adjustable from 4.6 degrees to 53.6 degrees. If plans call for a "wide angle lens" provide a minimum 60 degrees horizontal field of view. If the plans call for "span wire mounting" provide a camera with a junction box and span wire mount kit for either top span mount or tethered span mount.

(7) Includes a 12x zoom lens with a variable focal length of 3.7 mm to 44.4 mm and an auto focus feature with manual override; ensure lens is adjustable to suit the site geometry without opening up the camera housing.

(8) Includes automatic gain control (AGC) to produce a satisfactory image at night.

(9) Ensure the camera imager employs wide dynamic range (WDR) technology to compensate for wide dynamic outdoor lighting conditions. Ensure the dynamic range is greater than 100db.

(10) Allows presetting zoom and focus positioning information and recall of the previously stored preset upon restarting after a loss of power.

(11) Is powered by 120 volt alternating current (VAC) 60Hz. Ensure power consumption is less than 10 watts under all conditions.

(12) Is housed in a weather tight sealed enclosure fabricated from 6061-T6 anodized aluminum *ASTM B209*, or approved equal. Field rotatable to allow proper alignment between the camera and the traveled road surface. Equipped with a sun shield designed to prevent water from flowing in the camera's field of view. Includes a proportionally controlled heater to ensure proper operation of the lens iris at low temperatures and prevent moisture condensation on the glass face of the enclosure. Includes a glass face on the front of the enclosure that is treated with an anti-reflective coating and a special coating to minimize the buildup of environmental debris such as dirt and water spots. Equipped with separate, weather tight connections for power and video cables at the rear of the enclosure to allow diagnostic testing and viewing of video at the camera while the camera is installed on a mast arm or pole. Ensures that the camera operates satisfactorily in a temperature range from -29 degrees F to 140 degrees F (-34 degrees C to 60 degrees C) and a relative humidity range from 0 percent to 100 percent. Ensures that the video signal is fully isolated from the camera enclosure and power cabling.

#### 4. Cabling.

A. Ensure the coaxial cable between the camera and cabinet is a 75 ohm, precision video cable with 20 gauge solid bare copper conductor (9.9 ohms/meter), solid polyethylene insulating dielectric, 98 percent (minimum) tinned copper double-braided shield and black polyethylene outer covering. Signal attenuation must not exceed 0.78dB per 100 feet at 10 megahertz (MHz). Nominal outside diameter must be 0.304 inches. Ensure the cable is suitable for installation in conduit or overhead with appropriate span wire. Use 75 ohm BNC plug connectors at both the camera and the cabinet ends. Ensure the video detection system supplier approve the coaxial cable, BNC connector, and crimping tool. Follow manufacturer's instructions to ensure proper connection.

B. Ensure the power cabling is 16 American Wire Gauge three conductor cable with a minimum outside diameter of 0.325 inches and a maximum diameter of 0.490 inches. Ensure the cabling complies with the NEC, as well as local electrical codes.

5. Bus Interface Unit (BIU). Provide a BUI that meets the requirements of *Section 8 of the NEMA TS2-Specification*. Provide one 6 foot Port 1 communications cable to connect from the detector rack BIU to the controller unit.

6. Warranty. Provide materials with a 3 year manufacturer's warranty, transferable to the MDOT, that the supplied materials are free from all defects in materials and workmanship. Furnish the warranty and other applicable documents from the manufacturer, and a copy of the invoice showing the date of shipment, to the Engineer prior to acceptance. During the warranty period, the manufacturer must provide the following services at the manufacturer's pricing and terms of sale current at the time of the order:

A. Repair with new or refurbished materials, or replace at no charge, any product containing a warranty defect, provided the product is returned to the manufacturer's factory or authorized repair site.

B. Be responsible for all costs associated with shipping products repaired or replaced

under warranty.

C. Maintain an adequate inventory of parts to support maintenance and repair of the video detection system during the warranty period.

D. Parts to be delivered within 30 days of placement of order.

E. Provide technical support for the video detection system by factory certified personnel. Ensure telephone technical support is provided within 4 hours of the time a call is made by a user. Ensure on-site technical support is also provided as required for installation of repaired or replaced equipment.

F. Provide VDP software updates to the Department or the Local Agency responsible for the project at no additional cost.

**c. Construction.** Furnish and install the video traffic detection system as shown on the plans or as directed by the Engineer. Ensure that the video detection system is installed as documented by installation materials provided by the manufacturer. Complete this work in accordance with sections 819 and 820 of the Standard Specifications for Construction, the applicable typical signal construction detail, and this special provision.

When Video Traffic Detection System is called for, deliver all equipment internal to the controller cabinet to the MDOT Statewide Signal shop or to the inspecting agency for setup and installation in the controller cabinet.

Install non-span wire camera(s) with the bottom of the camera housing not less than 30 feet above the roadway, or as shown on the plans, and install each camera over the traveled way on which it will detect vehicles. Ensure each camera views approaching vehicles at a distance not greater than 350 feet.

Install span wire camera(s) with the bottom of the camera housing not less than 23 feet above roadway with a higher mounting height preferred, or as shown on the plans, and install each camera over the traveled way on which it will detect vehicles. Ensure each camera views approaching vehicles at a distance not greater than 200 feet.

Install the camera equipment only after all other signal equipment has been installed and inspected. Obtain the Engineer's approval prior to beginning camera installation. Correct camera installation that was completed prior to the approval of the Engineer, and which is found to be non-optimal placement of the cameras at no additional cost to the contract. The Engineer will not authorize extra payment or time extensions for work required to reorient or move the camera(s).

**d. Measurement and Payment.** The completed work, as described, will be measured and paid for at the contract unit price using the following pay item:

Pay Item	Pay Unit
Video Traf Detection Camera, Span Wire Mtd .....	Each
Video Traf Detection Camera .....	Each
Video Traf Detection System .....	Each
Video Traf Detection Camera, Span Wire Mtd, Rem.....	Each
Video Traf Detection Camera, Rem.....	Each

Video Traf Detection System, Rem.....	Each
Video Traf Detection Camera, Span Wire Mtd, Salv .....	Each
Video Traf Detection Camera, Salv .....	Each
Video Traf Detection System, Salv .....	Each

1. **Video Traf Detection Camera, Span Wire Mtd** includes a complete and operating video traffic detection camera, which is span wire mounted and detects vehicles on one roadway approach at an intersection, as shown on the plans or as directed by the Engineer.

2. **Video Traf Detection Camera** includes a complete and operating video traffic detection camera, which detects vehicles on one roadway approach at an intersection, as shown on the plans or as directed by the Engineer.

3. **Video Traf Detection System** includes a complete and operating video traffic detection system, as shown on the plans or as directed by the Engineer.

4. **Video Traf Detection Camera, Span Wire Mtd, Rem** includes removing, storing and disposing of removed material for a span wire mounted video traffic detection camera.

5. **Video Traf Detection Camera, Rem** includes removing, storing and disposing of removed material for a video traffic detection camera

6. **Video Traf Detection System, Rem** includes removing, storing and disposing of removed material for a video traffic detection system.

7. **Video Traf Detection Camera, Span Wire Mtd, Salv** includes removing an existing span wire mounted video traffic detection camera, storing the removed materials on site, and reinstalling materials at a location shown on the plans or as directed by the Engineer.

8. **Video Traf Detection Camera, Salv** includes removing an existing video traffic detection camera, storing the removed materials on site, and reinstalling materials at a location shown on the plans or as directed by the Engineer.

9. **Video Traf Detection System, Salv** includes removing an existing video traffic detection system, storing the removed materials on site, and reinstalling materials at a location shown on the plans or as directed by the Engineer.