

**Construction Specification for
Overhead Radar Detection**

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TTS 810.300.01 SCOPE

This specification covers requirements for the supply, installation, configuration, integration, and testing of non-intrusive traffic sensor (NITS) units and the auxiliary equipment required to provide traffic signal actuation and vehicle detection at signalized intersections. For the installations where temporary detection is required during construction, the same NITS units shall be installed to provide temporary detection and relocated to their permanent placement following completion of construction.

TTS 810.300.02 REFERENCES

This specification refers to the following standards, specifications, or publications:

City of Toronto Standard Specifications

TS 803	Ducts
TS 804	Cables
TTS 813.100	Construction Specification for Grounding and Bonding

Canadian Standards Association

C22.2 No. 65	Wire Connectors
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Electronic Industries Alliance/Telecommunication Industry Association

TIA/EIA-195C	Electrical and Mechanical Characteristics for Terrestrial Microwave Relay System Antennae and Passive Reflector
EIA/TIA-232-E	Interface between Data Terminal Equipment and Data Circuit Terminating Equipment Employing Serial Binary Data Interchange
EIA/TIA-485-A1	A standard defining the electrical characteristics of drivers and receivers for use in serial communications system

Innovation, Science and Economic Development Canada

RSS-210	Licence Exempt Radio Apparatus: Category I Equipment, Issue 10, December 2019
ICES-003	Interference-Causing Equipment Standard Information Technology Equipment, Issue 6

Institute of Electrical and Electronics Engineers

IEEE 802.3	Ethernet Networks Standards
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National Electrical Manufacturers Association (NEMA)

NEMA 250	Enclosures for Electrical Equipment (1000 Volts Maximum)
NEMA TS2	Traffic Controller Assemblies with NTCIP Requirements

Other

Ontario Electrical Safety Code

TTS 810.300.03 DEFINITIONS

For the purpose of this specification, the following definitions apply:

Controller Interface Device (CID) means the device that serves as an intermediate between the Controller in the field cabinet and the NITS unit to manage the flow of data and power and all associated wiring and connectors required to complete the connection.

NEMA standards means 'NEMA TS2' and all revisions.

NITS means NITS unit, mounting bracket, conduit and wiring system, and data repeaters.

Pre-installation Testing (PIT) means all testing of hardware undertaken prior to installation of equipment.

Proof of Performance Testing (POP) means all testing undertaken following the installation of equipment to verify the physical and operational features of each item of equipment.

SDLC means Synchronous Data Link Control which is a communications protocol used in traffic control cabinets for two-way simultaneous communication link between components. The link may have a point-to-point, multipoint or loop configuration.

SDLC Cable means the cable used to add traffic devices to an SDLC bus in a NEMA TS-2 traffic cabinet.

Serial Communication means the process of sending data one bit at a time, sequentially, over a communication channel or computer bus.

System Integration Testing (SIT) means all testing required to verify the operation of all NITS units with the traffic Controller, modems and head-end equipment.

TTS 810.300.04 DESIGN AND SUBMISSION REQUIREMENTS

TTS 810.300.04.01 Submission Requirements

The following documentation shall be submitted to the Contract Administrator for each intersection:

NITS units and CID supplied for each intersection shall be of the same brand for all actuation requirements.

The placement of the NITS units within each intersection indicating how the actuation and traffic detection requirements of each specific intersection are met. The submission shall contain layout design and installation drawings, indicating the following.

- NITS unit placement on the poles
- NITS unit mounting height on poles
- NITS unit mounting method
- NITS unit detection zone, reflecting intersection actuation requirements
- NITS unit cable routing to the traffic controller cabinet
- NITS unit grounding methods and components
- Placement of any other hardware required to complete the installation

The proposed equipment configuration for each intersection. The submission shall contain a block diagram showing end to end communications between the NITS units and the Controller indicating the following:

- in cabinet hardware components
- auxiliary hardware components such as protocol converters, signal repeater, and extenders surge suppressors
- communication protocols
- wiring type
- connectors and terminals
- supply voltage to NITS unit and other hardware components
- details of environmental housing for components

The submission shall also, include specification sheets for the NITS units and all auxiliary hardware, cables and connectors.

A notification of completion of site installation for NITS units and associated hardware.

For information, the City currently approves and utilizes Wavetronix Matrix units for intersection detection.

TTS 810.300.05 MATERIALS

The materials shall include all components and wiring required to achieve data communication between the NITS units and the Controller in the traffic controller cabinet.

TTS 810.300.05.01 Functional

The NITS unit shall be capable of continuously detecting vehicles, motorcycles, bicycles and other motor vehicles at stop bar or setback distance from the stop bar, wherein the call in the detection area is held for as long as the vehicle remains in the area of detection.

The NITS unit shall be able to simultaneously detect all required traffic, with no need for switching between operational modes, re-configuration, or relocation of the unit.

The NITS unit shall provide presence data accuracy greater than 97%.

The NITS unit shall be capable of detection within a full range of distances present at intersections within the City's jurisdiction, with detection range of at least 3 m to 40 m and a horizontal field of view (FOV) greater than 40°.

The NITS unit shall be capable of detecting a vehicle within one second of entering a detection zone.

The NITS unit shall be configurable for up to 16 detection zones. The detection zones shall be configurable by direction of traffic such that traffic travelling in other directions does not trigger a false positive. The detection zones shall be configurable to shapes and sizes that fit the traffic lane configuration at intersection.

The NITS unit shall be capable of detecting up to six lanes of traffic.

The NITS units shall be approved for licence free operation in Canada. The NITS units shall not cause interference or be susceptible to interference from any system emitting radio waves. The NITS units shall meet Industry Canada ICES-003 (Issue 6) Interference-Causing Equipment Standard for Digital Apparatus rule for Electromagnetic Interference.

The NITS unit shall operate at a frequency of 24-24.25GHz (K-band).

The NITS unit shall be able to collect and store volume counts for detection zones required for intersection actuation as well as for the detection zones that are not used for intersection actuations.

TTS 810.300.05.02 Physical

The units shall be supplied with an adjustable mounting mechanism consisting of a plated steel universal ball joint secured to a bracket intended for banding to a steel, concrete, or wooden pole.

The materials used for construction of the mounting bracket shall be weather-resistant and capable of supporting a 10 kg load.

The mounting bracket shall allow for the necessary degrees of rotation as required by the manufacturer to allow for installation and aiming of the NITS unit.

The weight of NITS units shall not exceed 2 kg.

TTS 810.300.05.03 Electrical

The NITS enclosure shall include a water tight connector suitable for Toronto's environment.

The materials shall include power supply units to convert the 120 VAC 60 Hz supply in the controller cabinet to the operating voltage required to power the NITS units and other components required for operation.

The NITS unit shall include on board transient surge suppressor.

Communication Protocol

The NITS unit shall be compatible with Controllers currently utilized by the City, such as Peek 1000 and Econolite Cobalt.

All hardware and software required for configuration, calibration, and testing of the NITS units locally and remotely shall be supplied.

The item shall include any required additional hardware such as signal repeaters and PoE extenders to achieve the NITS units communication with the equipment in the controller cabinet, as dictated by intersection geometry and communication protocol being used.

The additional hardware shall be housed in the environmental enclosure and include secure closing mechanism to prevent unauthorized access. The environmental enclosure shall be appropriately sized, and include electrical and environmental design to meet the equipment needs at each site.

TTS 810.300.05.04 Environmental

The NITS unit shall not be affected by environmental conditions such as rain, wind, snowfall and dust.

The NITS units shall be housed in a NEMA-4X enclosure that is able to withstand outdoor, year-round installation and operation in the Toronto climate. The operating temperature shall be in the range of -30°C to +74°C and up to 95% relative humidity.

TTS 810.300.05.05 Cables and Connectors

All interface cables and connectors required to complete connections between the NITS units and the Controller (assume 50 m) in the traffic controller cabinet shall be supplied as part of this tender item.

The cables shall meet the industry standards for the protocol used and shall be designed for installation in the outdoor environment, underground ducts, and UV rated for aerial application as required by the installation. All conductors shall be colour coded.

The metallic conductors shall be stranded copper, sized according to the load and distance at each NITS unit location.

The cable between the environmental enclosure on the NITS pole and the equipment in the controller cabinet shall be continuous. No intermediate splices shall be allowed.

The connectors for current-carrying cables shall meet the requirements of CSA C22.2 No. 65. Interface cables and connector pin-outs shall support data and power connections according to the manufacturer's recommendations and equipment interface requirements. All connectors shall have a metallic shield and shall be capable of fastening to the mating device such that pulling on the cable or connector does not result in a loss of connection. The connector shall be male or female, as required by the mating device and shall be supplied with solder-less, gold-plated pins or receptacles which shall be capable of being relocated within the connector housing.

Signal repeaters shall be installed when the total cable length from controller cabinet to the NITS unit exceeds the maximum length as dictated by the protocol being used. The signal repeaters shall be supplied and installed as per manufacturer recommendations.

TTS 810.300.05.06 Conduits

The conduits shall be 50 mm rigid polyvinyl chloride (PVC). Installation of the conduits shall be according to TS 803.

TTS 810.300.05.07 Controller Interface

Controller Interface Device (CID)

The CID shall be supplied as a part of the NITS unit tender item and compliant with the following specifications:

- The CID shall be compatible with NEMA TS2 standards.
- The CID shall be capable of interfacing with at least 4 field detectors

- The CID shall be equipped with an SDLC port, compliant with NEMA specifications, to interface with the traffic controller.
- An Ethernet communication port shall be supported by the CID. The Ethernet port shall be compliant with IEEE 802.3 and shall be an RJ-45 type connector. The connection of the CID to the City's network shall allow for remote configuration and remote access to live-data from the NITS units.
- The CID shall be capable of operating in a temperature range from -34°C to +74°C and a humidity range from 0% to 95%, as per NEMA specifications.
- The system shall provide a fail-safe operation such that, should any system component (software or hardware) fail, a positive detection will be provided to the Controller emulating a loop detector "stuck on". This failure status should be indicated on the status indicator.
- CID shall be supplied with all components required to operate on 120V power source available in the traffic signal cabinet.
- CID shall include either external or on-board transient surge protection.
- The CID shall support local and remote communication with a computer for configuration purposes.
- CID shall have a Windows based interface for device configuration.

SDLC Y Cable

For intersections where detection combines inductive loops and NITS, SDLC Y cable shall be supplied as part of NITS tender item to enable both detection technologies to interconnect to the traffic signal Controller.

- SDLC Y cable shall be comprised of 4 pair 22 AWG stranded tinned copper conductors, foil shielded with drain and include PVC jacket and insulation.
- SDLC Y cable shall be NEMA compliant, rated to 300V RMS.
- Operating temperature shall be -30°C to +105°C.
- SDLC Y cable shall be at least 1.2 m in length and accommodate equipment placement in the cabinet.
- SDLC Y cable shall include two male and one female connectors featuring latching blocks and gold-plated contacts.

TTS 810.300.05.08 Ground Materials

- Grounding shall be according to TTS 813.100.

TTS 810.300.06 EQUIPMENT – Not Used

TTS 810.300.07 CONSTRUCTION

TTS 810.300.07.01 Non-intrusive Traffic Sensor Units

The NITS units shall be securely mounted according to the manufacturer's installation guidelines and positioned to achieve the detection and actuation functions required at the intersection where they are installed.

The NITS units shall be mounted so as not to interfere with operation and maintenance of other equipment on the poles.

The NITS units shall be mounted at a height as recommended by the manufacturer guidelines based on the pole position and intersection detection zones requirements.

The NITS units and other equipment shall be bonded to the intersection and traffic signal controller cabinet ground system and according to manufacturer's installation guidelines.

The installation of NITS units shall include calibration and configuration of the units to ensure their operation is in accordance with the detection requirements defined for the intersection.

TTS 810.300.07.02 Cables and Conduits

The cables shall be installed between the NITS unit and the traffic controller cabinet through the traffic signal pole and utilizing existing underground duct system containing other cables required to operate the signalized intersection. The cable length shall include only enough slack to allow for no tension installation. No excess coils of cable shall be left in underground handholes or cabinet. All cable installations shall be according to TS 804.

The cables and connectors shall not be stressed during or after the installation. All cables shall be installed neatly and shall be secured to rigid structures using industry standard fastening devices. Care shall be exercised during the cable installation process so as not cause any damage to existing cables and connections.

When the site conditions require NITS installation of NITS cable external to the pole, the installation shall include external PVC duct terminated with a weather head and connected to the underground handhole. The duct shall be attached to the pole by means of metal bands and buried underground according to TS 803.

The new cables and connectors shall be tested for continuity to verify their operational status prior to connecting the equipment and power supply components.

All NITS cables shall be labelled with a printed vinyl label, in the traffic signal controller cabinet for ease of identification. The cables shall be labelled according to the direction of traffic and the detection zones that the NITS unit is detecting; examples EB-LT, SB – Thru and RT.

All cables inside the traffic signal controller cabinet shall be installed neatly ensuring that there are no loose cables. Any incoming cables shall be neatly bundled and held in place with nylon cable ties.

TTS 810.300.07.03 Controller Interface

The CID shall be installed in the traffic controller cabinet, as dictated by the product requirements.

The CID power cable shall be connected to the power receptacle in the cabinet.

SDLC Y cable shall be installed if required, to enable interface between the CID and the traffic Controller.

TTS 810.300.07.04 Surge Suppression and Auxiliary Equipment

Transient voltage surge suppressors shall be installed, as dictated by product requirements.

The surge suppression hardware shall be connected to ground according to TS 813. The ground wire shall be bonded to the existing grounding terminal present at the pole and the cabinet.

Other auxiliary equipment such as signal repeaters or PoE extenders or both and other components required to complete installation shall be contained within the NITS unit or in the external environmental enclosure.

TTS 810.300.07.05 Configuration, Testing and Integration of NITS

The NITS units detection at each intersection shall be configured and tested as per product manufacturer installation manual and as dictated by the intersection operations requirements.

The NITS units detection shall be configured and tested with the assistance of the NITS units manufacturer representative on site.

The configuration, integration and verification of the NITS units shall be carried out as follows:

- The NITS unit shall be calibrated and verified using the manufacturer supplied software.
- The NITS units shall be configured as per approved product design documentation for each intersection.
- NITS units detection shall be validated by simulating calls and the associated phases time out.
- The validation of NITS units shall be performed in the presence of the City representative. The results shall be within the allowed accuracy as stated elsewhere in this Specification.
- The Contractor shall verify by calling the Communication System Officer (CSO) that NITS units are functional at the head-end system based on the detector logs.

TTS 810.300.07.06 Non-intrusive Traffic Sensors – Temporary

Where NITS units are installed to provide traffic signal actuation during construction, the NITS, temporary cables and all auxiliary components shall be installed on poles and overhead span wires, or a combination of the temporary and permanent infrastructure that is installed to operate the signalized intersection.

The placement of the NITS shall meet the intersection actuation requirements designed for the temporary operation. The Contractor shall complete the initial installation, calibration and testing in accordance with the requirements in this specification.

The Contractor shall be responsible for adjustment of the detection zones and recalibration of the NITS units to ensure the continuous detection functions throughout the construction staging. The Contractor shall be required to address any problems with malfunctioning units within 24 hours or 48 hours on weekends and holidays.

The NITS units, mounting hardware, Controller Interface and auxiliary equipment shall be relocated to their permanent position at the completion of temporary operation.

All temporary NITS cables, and components not required for the permanent installation are to be removed from the site upon the completion of the temporary stage.

TTS 810.300.07.07 Training

On request of the City, training on how to configure, install and maintain and troubleshoot the system shall be provided to City staff and applicable designates such as City Electrical Maintenance Contractor at no extra cost to the City.

Training material shall be provided to the City for review two (2) weeks prior to commencement of the training session.

TTS 810.300.07.08 Maintenance Period

Contractor to provide 1-year of support services after date of installation in case of failed or inconsistent operations or detection or both observed by the City. This includes reconfiguration, testing and recalibration.

TTS 810.300.08 QUALITY ASSURANCE – Not Used

TTS 810.300.09 MEASUREMENT FOR PAYMENT

**TTS 810.300.09.01 Overhead Radar Detection System (1 Approach)
Overhead Radar Detection System (2 Approaches)**

For measurement purposes, a count shall be made of number of overhead radar detection systems installed.

TTS 810.300.10 BASIS OF PAYMENT

**TTS 810.300.10.01 Overhead Radar Detection System (1 Approach) – Item
Overhead Radar Detection System (2 Approaches) – Item**

Payment at the Contract Price for the above tender items shall be full compensation for all labour, Equipment and Material to do the Work.