ADVANCED SOLID-STATE TRAFFIC CONTROLLER
ASTC

PROCUREMENT SPECIFICATION

Version 4.2.1

June 2013

Prepared for

NEW YORK CITY DEPARTMENT OF TRANSPORTATION

Prepared by

JHK Engineering, PC

253 W 35 St. 3rd Floor
New York, NY 10001

REVISION CONTROL

Revision No.	Date	Description of Changes	Author	Checked
4.0	5/8/2013	Updated to reflect as-built for Version 3	Rausch	
4.1	5/15/2013	Minor changes during edit	Rausch	
4.2	6/10/2013	Updates from NYCDOT	Rausch	

ASTC Sample Bid Tabulation Items

The following table indicates the equipment model numbers that will be referenced for procurement using this specification. The specific quantity/versions of the ASTC will be identified in the RFQ or RFP documents. For the detailed description of the specific items to be supplied for each model number, refer to Section 16.

ITEM Number	Cfg Table 26	Basis	QTY	Description	Unit Price	Total Price
ASTC-6-5	6-5	EA		NTCIP with Ethernet & NYCWiN – 6 L/S		
ASTC-8-5	8-5	EA		NTCIP with Ethernet & NYCWiN – 8 L/S		
ASTC-12-5	12-5	EA		NTCIP with Ethernet & NYCWiN – 12 L/S		
System Support Equipment						
BIU Model S		EA		Model BIU-S as described herein		
ASTC-CU		EA		Controller unit only (without cabinet)		
AUX		EA		Auxiliary Controller cabinets complete		
Laptop		EA		Laptop computers & ASTC support software		
PDA		EA		Universal Power Distribution Assy.		
BIU		EA		Standard BIU		
Address Card		EA		Cabinet address card with all diodes		
CMU		EA		CMU with diode board		
CMU Diode		EA		Diode Board for CMU with all diodes		
Inventory System		L/S		Inventory Management System		
Development Station		L/S		Software Development Station		
Load Switches		EA		3 circuit plug-in load switches		
Flasher		EA		2 circuit plug-in flasher		
Flash Transfer		EA		Flash Transfer Relay		
Antenna		EA		NYCWiN antenna assembly		
NYCWiN PS		EA		Power supply for NYCWiN router		
Cable set		EA		1 complete cable set for all cables in ASTC - 8 cabinet		
Termination		EA		Termination cards for 485 bus		
Red-jump		EA		Red flash programming jumper		
Yel-jump		EA		Yellow flash programming jumper		
USB		EA		USB memory Device		
Inspection		L/S		Inspection | This will be provided by NYCDOT		

TABLE OF CONTENTS

List of Tables

1 Introduction

1) This **A**dvanced **S**olid-State **T**raffic **C**ontroller (ASTC) specification will be used to purchase electronic traffic controllers to replace New York City's existing electromechanical controllers.

2) This ASTC specification is intended to procure a reliable traffic controller to meet the specialized needs of New York City. The ASTC specification presented in the following sections, employs accepted standards where possible (e.g., New York State, NEMA, NTCIP, CALTRANS), uses new standards where cost effective and stable (e.g. ATC), and assumes that the *Controller Unit* and *Cabinet* may need to be custom *packaged* to meet NYC size and functional requirements.

3) The ASTC specification has been designed to use industry standard, replaceable modules and subassemblies in a *custom constructed cabinet* which uses many of the features of a New York State standard 179 controller and 330 cabinet. This approach allows a compact size, expandable configuration, and simplified cabinet wiring. The major change is the use of the NEMA Bus Interface Unit (BIU) and the EIA/TIA-485 serial interface to the cabinet devices (TS2-Type 1) instead of the traditional 170/179 C1 connector or the NEMA A, B, C, & D harnesses. This has the advantage of simplifying the cabinet wiring while still allowing expansion and flexibility for the future. To meet this approach, the input/output (I/O) functions of the serial protocol must be custom mapped (configured) allowing different I/O configurations from those shown in the NEMA standard. However, the assignment of I/O functions to the BIU has been done in a manner which is consistent with the electronic interface of the NEMA BIU which *should* eliminate the need for changes to the BIU hardware and software depending on the CONTRACTOR's design.

4) This ASTC specification *does not allow* the use of the ITS cabinet Serial Interface Unit (SIU), ITS Cabinet Controller Monitor Unit, and the Auxiliary Monitor Unit (AMU) as an equal for the BIU based cabinet presented herein. This was done to simplify the supply of spare parts and to stay with the proven NEMA/NYSDOT/TEES cabinet devices that have been widely deployed.

5) For the controller unit, CONTRACTORS are required to use the *Engine Board* as described in the ATC specification (5.2b) adopted as a joint ITE, NEMA, AASHTO standard. Use of the ITS cabinet Power Supplies and other assemblies such as the input files and output files is not required. Note that due to some ambiguities in the 5.2b standards and the need for indicators for the system Ethernet port, the current vendor assigned some of the unused pins for specific functions. These same assignments are required under this new contract such that the engine board is an interchangeable device between suppliers of the controller unit.

6) The functionality and wiring within the controller cabinet have also been specified so that the controller units and all plug-ins (e.g. Load Switches, Detector modules, Flasher) will be interchangeable from multiple vendors. This approach minimizes the risks and costs associated with new technology by allowing vendors to leverage existing, proven designs.

7) Size and cost were major considerations for the approach in this specification. The cabinet must be smaller than existing standard type 170/3xx and NEMA cabinets due to the very limited sidewalk space in the New York City environment. At the same time, the specification seeks to avoid the use of proprietary modules and subassemblies within the cabinet except as specified herein.

8) An analysis of New York City's more than 12,000 existing traffic controllers indicates that over 90% of the signalized intersections are two-phase intersections, and another 5% are three-phase intersections. This ASTC specification has been developed to focus on this 95% of the signalized intersections with a cost effective, yet expandable solution with 6 load switches and 4 input file slots. For the balance of the intersections, two additional, larger signal controller cabinets and an auxiliary cabinet (with additional load switch bays and/or input files) will be used. For most of the larger installations, an ASTC-12 cabinet assembly has been defined herein which provides 12 load switches and 10 input file slots. Additional expansion can be provided through the use of additional cabinets or use of conventional NEMA TS2 Type 1 serial cabinets. The ASTC-12 is further described in Section 5. Further, an 8 load switch version has also been added to accommodate those 2 phase intersections which need only a few additional signals for such features as bicycle lanes and transit signal queue jump indications.

9) A conceptual block diagram of the basic ASTC[1] is shown in Figure 1. The basic ASTC consists of the following elements:

- Cabinet with terminal facilities (field terminal blocks)
- Output Assembly with 6 load switches (LS), 2 flash transfer relays (FTR), 4 flash programming jumpers
- Input Assembly, with 4 input slots including provision for both dual channel and quad channel detectors
- Signal Conflict Monitor Unit (CMU) – Model 2010
- Cabinet Power Distribution Assembly (PDA)
- Controller Unit (CU) - the main traffic control processor
- Flasher
- NEMA Bus Interface Unit (BIU)

10) This specification is intended to be functional in nature allowing bidders the flexibility of repackaging existing products. Bidders are encouraged to propose alternate designs that meet or exceed the requirements stated herein. However, such alternates must be fully compliant with the requirements and goals as stated herein. It is essential that the cabinet be independent of the controller unit assembly such that different manufacturers' controller units can be used in the cabinets with compatible EIA/TIA 485 communications protocols to the cabinet input/output assemblies. Further, subassemblies such as the conflict monitor must use industry accepted and documented standards for form, fit, and function. Integrated designs, which incorporate non-standard electronic subassemblies as integral to the cabinet, will not be accepted. The acceptability of alternate designs shall be at the sole judgment of the CITY.

1.1 Summary of Differences from NEMA and NYS 179/330 Standards

1) The following is a summary of the differences between the standard NEMA, the New York State 179 controller and 330 cabinet, and the requirements for the New York City ASTC

[1] Note that an ASTC-6 is a 6 load switch controller and the ASTC-12 is a 12 load switch controller and an ASTC-8 is an 8 load switch controller. In general, the term ASTC refers to generic requirements or those for the ASTC-6 even if not specifically identified.

controller and cabinet. This list is not guaranteed to be complete; the details that follow in this specification shall govern. This list is being provided to assist potential bidders in understanding the differences as they read these specifications.

a) The size has been reduced to fit the urban space limitations

b) The BIU input/output assignments have been changed; a single BIU is intended to support detector inputs, load switch outputs, a watchdog, a cabinet address, etc. for the ASTC-6 cabinet. However, the electrical characteristics of the NEMA BIU specification have not been changed.

c) BIU functionality, although consistent with electrical characteristics of the NEMA TS2 standard, requires support for dynamic assignment of input and output functions for the ASTC-6 & ASTC-12 using the TF#3 and TF#4 (ASTC-12). Detector processing (for those detectors connected to these two BIUs) is performed by the Controller using a 60 Hz scan rate and not in the BIU for these two modes (TF#3 and TF#4). This approach was used because the BIU does not allow the different types of input functions (e.g. system detectors and control lines) to be assigned within the same BIU.

d) The controller must interrogate the BIUs more frequently (60 Hz) than required by the NEMA standard (~10 Hz); this is necessary to support the detector input processing accuracy.

e) The cabinet does not include current monitoring for the traffic signal loads

f) The cabinet does not support dimming of the load switches (using phase omission AC switching techniques). Dimming shall not be supported.

g) There is no cabinet line frequency clock (however, the controller must maintain internal clock accuracy based upon the AC power line when AC power is present.)

h) The cabinet uses a modified NYSDOT type PDA, but adopts the evolving ATC standard for flash transfer and signal power contactor operation (e.g. normally energized relays)

i) Only a limited number of inputs and outputs are supported in the basic cabinet, however, it is required that these inputs and outputs be configurable and that additional BIUs can be added to extend the number of detectors and functions supported. Under such circumstances, the controller shall be able to handle standard detector inputs from these additional BIUs or additional cabinet functions.

j) Many of the standard NEMA functions [e.g. Hold, Yield, Force-off, etc.] are not wired or available in the basic cabinet. However, they must be configurable such that they can be assigned to control points within the input file or to additional BIUs to support the attachment of external control devices.

k) A 12 VAC power supply meeting NEMA requirements has been added to the PDA to support the opto-isolated inputs for the BIU for such functions as pedestrian push buttons and preemption.

l) A hard coded cabinet address (using diodes) mounted on an address card plugged into a special slot adjacent to the input card file is used to determine the ID of the cabinet database and cabinet IP address. This is to eliminate the need for any technician input when exchanging a controller when system communications are available and to reduce the possibility of a technician loading the wrong database from a local laptop computer or USB memory device.

m) The display and control panel on the controller is ‘diagnostic’ in nature and does not support operator changes to operating and timing parameters (except the internal

clock). Such parameters can only be accessed through the laptop interface or the system port. Only 4 keys are required for navigation to view all parameters and status information. The displays have been simplified to show the technician all of the relevant operating information necessary for most maintenance operations.

n) The cabinet must support a variety of communications media and schemas including Ethernet and EIA/TIA-232. Port functions must be assignable via the loaded database (laptop or USB memory device) or the central system depending on the nature of the assignment. The ASTC shall include default (factory) assignments to be approved by the CITY.

o) The conflict monitor (CMU) uses a modified Model 210 (a.k.a. Model 2010) due to the nature of the NEMA type startup and flash requirements. The threshold voltages for the 2010 have also been modified and the conflict flash wiring has been changed to match the NEMA type fail-safe operation.

p) Support for a USB type memory device has been added to the controller. The intended uses of this memory device are to support loading controller configuration and timing data as well as controller firmware and the operating system. Use of the USB device is intended to eliminate the need for a laptop computer when replacing a controller and should greatly simplify and speed up the process of updating the firmware and database when necessary.

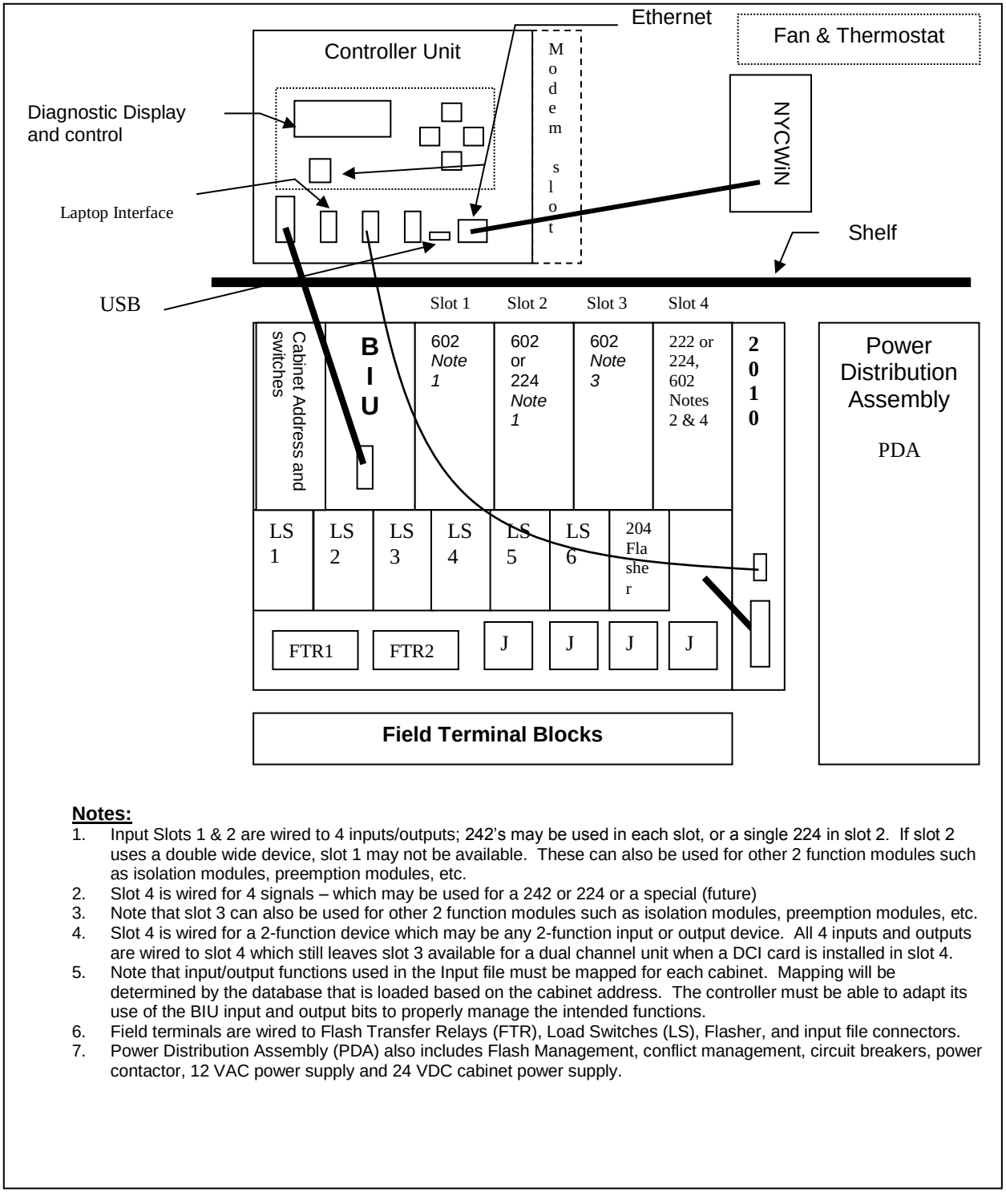
q) The Cabinet includes a MIMO (multiple-input and multiple-output) antenna and separate 24 VDC power supply for a wireless router to be used on the City's wireless network (NYCWiN).

2) Figure 1 provides a conceptual block diagram for the ASTC to assist the bidder in understanding the context for each of the cabinet subassemblies. However, this is intended to be conceptual in nature and is not intended to suggest any specific design or required layout.

3) Note: the terms ASTC, ASTC-6, ASTC-8, and ASTC-12 are used throughout this document. In general, the term ASTC shall apply to basic functionality and all of the base requirements for the ASTC-6, the ASTC-8, and ASTC-12 versions of the controller. The ASTC-6 supports 6 load switches and includes provision for up to 4 general purpose input cards while the ASTC-12 includes provisions for 12 load switches and 10 general purpose input cards. The ASTC-12 also includes an expansion connector such that the number of load switches can be expanded to 16 with additional input cards as well. The ASTC-8 is a reduced ASTC-12 – refer to Section 6.

Figure 1 - ASTC *Conceptual* Block Diagram

Note: This block diagram is notional and is not intended to imply any particular design or layout for the cabinet and subassemblies. The CONTRACTOR shall develop a physical, mechanical, and electrical layout that meets the requirements of this specification. Note that not all features and functions required are shown.



Notes:

1. Input Slots 1 & 2 are wired to 4 inputs/outputs; 242's may be used in each slot, or a single 224 in slot 2. If slot 2 uses a double wide device, slot 1 may not be available. These can also be used for other 2 function modules such as isolation modules, preemption modules, etc.
2. Slot 4 is wired for 4 signals – which may be used for a 242 or 224 or a special (future)
3. Note that slot 3 can also be used for other 2 function modules such as isolation modules, preemption modules, etc.
4. Slot 4 is wired for a 2-function device which may be any 2-function input or output device. All 4 inputs and outputs are wired to slot 4 which still leaves slot 3 available for a dual channel unit when a DCI card is installed in slot 4.
5. Note that input/output functions used in the Input file must be mapped for each cabinet. Mapping will be determined by the database that is loaded based on the cabinet address. The controller must be able to adapt its use of the BIU input and output bits to properly manage the intended functions.
6. Field terminals are wired to Flash Transfer Relays (FTR), Load Switches (LS), Flasher, and input file connectors.
7. Power Distribution Assembly (PDA) also includes Flash Management, conflict management, circuit breakers, power contactor, 12 VAC power supply and 24 VDC cabinet power supply.

1.2 General Contract Requirements

1) It is the intent of this contract to procure advanced solid-state traffic controllers which are compatible with the existing ASTC operation, the existing ASTC equipment provided by US Traffic Corporation[2] on previous procurement contracts (which used Version 1.6, Version 2.6, and Version 3.13.3 of this specification), and the National Transportation Communications for ITS Protocol (NTCIP). Subsequent sections will refine these compatibility requirements.
2) The following general requirements shall apply to this contract.

1.2.1 Pre-bid conference

1) A pre-bid conference will be held at the CITY offices at 34-02 Queens Blvd in Queens or at another location specified by the CITY.
2) When possible, questions submitted at least 5 business days prior to the pre-bid conference will be addressed anonymously at the session.
3) All questions submitted shall identify the specific section(s) of the specifications which are in doubt or for which clarification/change is requested. Attendees to the pre-bid meeting will be asked to document their specific questions or requests for clarification.
4) **Questions that may result in a change to the specification will** only be accepted during the pre-bid meeting if submitted in written form on sheets provided.

1.2.2 Requests for clarifications

1) Requests for clarifications and questions regarding the bid documents shall be submitted in writing to to **Mr. Clifton Haynes** and a copy must be sent to **Mr. Mohamad Talas**[3]:

Address:	Telephone/Fax
Ian Yap New York City Department of Citywide Administrative Services Municipal Building (18th Floor) 1 Center Street New York, NY 10007 Email: iyap@dcas.nyc.gov	Tel: (+1) 212-669-8510 Fax: (+1) 212-669-4867

Address:	Telephone/Fax
Mohamad Talas New York City DOT 34-02 Queens Blvd. Long Island City, NY 11101 Email: MTALAS@DOT.NYC.GOV	Tel: (+1) 718-786-2008 Fax: (+1) 718-786-5482

2) All requests shall identify the specific section(s) of the specifications which are in doubt or for which clarification/change is requested.
3) Answers to questions will be transmitted to all bidders via first class mail, fax, and email.

[2] US Traffic Corporation; contact through Peek www.peek-traffic.com
[3] Note that Mohamad Talas is listed at the principal contact for the NYCDOT for any procurement or contract which uses this specification. This is subject to change; the DOT contact person will be noted in the advertisement for the procurement and at the time of contract award.

4) All perspective bidders shall provide a valid email address. Email addresses provided shall be capable of accepting attachments at least 5 MB in size in PDF format[4]. Email may be used by the CITY to transmit information to perspective bidders throughout the bidding process. The CITY shall not be responsible for the reliability of email as a form of distribution and communications. All email must also be transmitted in written form and received by NYCDOT at least 10 business days prior to the bid opening.

5) All perspective bidders shall provide a valid Fax number. The CITY will use this to transmit notices of addendum or changes to the specifications but will not use this to transmit large documents which might include changes to the specifications. The Fax is intended to notify the bidder that information has been transmitted via email such that the bidder is aware of email that should have been received. However, similar to email, transmission of a fax is no assurance of receipt. The CITY shall have no liability for the reliability or receipt of faxes transmitted to the bidders' identified fax number; acknowledgement of receipt by the CITY's fax equipment shall be sufficient proof that the fax was delivered.

6) The bidder is required to provide acknowledgement of receipt of all updates and addendum transmitted by NYCDOT for this bid. Such acknowledgement shall include the cover page of the addendum transmitted by NYCDOT.

1.2.3 Prototype Development and Approval

1) As part of this project, a prototype cabinet (for each type) and controller must be developed as per this procurement specification. The bidder shall be prepared to make 'minor modifications' to the design of the cabinet (with no change in cost) based upon CITY review. The CONTRACTOR is encouraged to work closely with the CITY to avoid unnecessary re-work and un-reimbursed costs due to interpretation of the specifications.

2) If the manufacturer has previously submitted a complete controller and cabinet and proven that it complies with the requirements of these specifications, the requirement for a prototype development may be waived by the CITY if requested by the CONTRACTOR. However, substantive changes, as determined by the CITY, will necessitate the full development and testing of a prototype – and the full repeat of the Design Approval Testing referenced in Section 9. If the perspective bidder is in doubt, then they must provide all relevant information and seek approval of the CITY at least 10 days prior to the bid date.

1.2.4 Availability of Existing System and Documentation

1) The as-built documentation, sample units and manuals provided for the traffic control system and all communications devices are available for inspection and review at the Traffic Management Center (TMC). Bidders wishing to view this material and/or equipment shall contact *Mr. Mohamad Talas* of NYC at (718) 786-2008 to arrange a time when the documents can be reviewed.

2) The existing ASTC units provided by US Traffic Corporation (hereinafter referred to as USTC) are available for inspection at the TMC. However, detailed design information for the existing units will only be provided to the **successful bidder** after the execution of a non disclosure agreement (NDA) [see Section 17 of this specification for a sample NDA] protecting the ownership of the design. Such information is divided into 2 parts, proprietary and non-proprietary. Non-proprietary information is freely available to qualified bidders upon request. This includes the MIB for the ASTC. Proprietary information including the source code for the existing controller is available in printed form for inspection prior to the bid upon

[4] Note that perspective bidders need to ensure that email coming from NYCDOT is "white listed" and that attached adobe format documents are accepted and delivered.

execution of an NDA as shown in Section 17 but will only be made available electronically to the successful bidder after execution of the NDA.

3) Documentation (including source code) at the TMC shall not be removed or copied.

4) Equipment may not be removed from the premises.

5) The CITY will arrange for access to the existing systems to assist potential bidders in evaluating their proposed designs and to clarify any questions. The CITY will also make space available for CONTRACTOR inspection when possible and only by coordination with Mr. Mohamad Talas as noted above.

6) The CITY does not warrant or guarantee the accuracy or completeness of any documentation available for the Traffic Control System or the existing ASTC controllers. All documentation is made available for inspection on an AS-IS basis. It is up to the bidder to review the equipment, system operation, and documentation and to design and construct equipment to meet these specifications.

1.3 Manufacture's Qualifications

1) The manufacturer must have manufactured a minimum of 300 solid state traffic signal controllers for the US domestic market during the last 3 years and at least 100 controllers shall have been in operation on the street (within the US) for a minimum of 24 months. Traffic controllers, for this qualification requirement, shall be interpreted to mean intersection control with at least 2 phase vehicle control driving signal heads and supporting NTCIP communications.

2) The ASTC consists of four major 'assemblies': 1) the **controller**, 2) the controller **software** (firmware), 3) the **cabinet** (including the PDA, and load switches), and 4) the complex **electronic plug-in assemblies** (including 2010 conflict monitor, BIU, and detector modules) It is the intent of this requirement that the bidder be able to demonstrate that they can meet this qualification for each (and all) of these categories by at least one member of their team and that the named member/supplier will be providing these specific assemblies. If a supplier is used for major plug-in assemblies (e.g. BIU, 2010), then the named supplier must also meet this qualification requirement. NYCDOT has included this general qualification to ensure that the bidders have the actual experience of providing these types of assemblies for traffic control installations in the US.

3) If the bidder proposes a team to meet these qualification requirements, then the CONTRACTOR shall not change team composition without written approval from the CITY. Further, if the bidder submits multiple team members to meet specific requirements, each submitted team member must meet these qualification requirements for the proposed items. The bidder must name which items will be supplied by which team member. Failure of a team member to meet these qualifications shall cause the team to be considered non-qualified.

4) Failure to comply with all of these requirements (above) shall constitute grounds for disqualification.

5) The prospective bidder shall provide the names, dates, contract numbers, and contact information to substantiate their qualification. This documentation shall be provided **with their bid proposal**. The CITY shall review this qualification information and shall determine the acceptability of the response prior to the award of the contract.

6) The bidder shall submit information for **all** public agencies to which the CONTRACTOR has provided traffic controllers during the past three years. Note that this shall include all public agencies currently using the CONTRACTOR'S products supplied within the past three years within the United States. The following information shall be provided:

   - Prime contractor (if other than the bidder)
   - Name and address of the agency
   - Total number of controllers provided to the agency
   - Date(s) of installation (if a supply and install contract)
   - Date(s) of delivery (if a supply contract)
   - Name of a contact (person) within the agency including telephone numbers for voice and fax. Include e-mail address if known.
   - For each contract, the following questions must be addressed:
     - Type of controllers supplied
     - Was the order delivered on time? If not, what delays were encountered and what were the reasons for the delays.
     - During the first 12 months of operation, what percentage and number of the controllers required repair for all causes? Classify the failures as follows:
       a) Knock-down or abuse
       b) Electronic/mechanical failures
       c) Environmental failures (e.g. lightning)
       d) Unknown

1.4 Correspondence and Contract Documents

1) All requests from the CONTRACTOR shall be submitted to the CITY in written (hard copy) form. This shall include but not be limited to requests for changes, time extensions, project submittals, drawings, requests for clarifications, schedules, etc. The number of copies is listed elsewhere herein.

2) Verbal discussions, telephone calls, etc. shall be committed to a written document if there are any issues regarding any technical aspects of the project, schedules, deliverables, performance, or costs. The written document shall be transmitted (electronically and in hard copy) to the CITY by the CONTRACTOR **within 5 business days of the verbal discussion**. The document shall clearly and concisely state what was discussed and shall clearly and concisely indicate any conclusions and all decisions made. The CITY shall review this document for accuracy. The CITY shall have the right to make corrections to this document. Only the final CITY approved document shall be used for later reference. If the CITY has not commented on or revised the document within 20 business days after receipt, it shall be assumed to be an accurate representation of the discussions as transmitted.

3) Following all meetings and teleconferences, the CONTRACTOR shall prepare detailed minutes of the meeting/teleconference including any decisions, clarifications, changes and action items. All action items shall clearly indicate the action, person responsible for the action, and the date the action is to be completed. The minutes shall be submitted to the CITY for review. The CITY may make changes and adjustments to the meeting minutes and shall distribute the revised report to all parties. Only the final meeting minutes reviewed and approved by the CITY shall be used for later reference. Meeting minutes shall be transmitted to the CITY within 5 business days of the meeting. If the CITY has not commented on or revised the meeting minutes within 20 business days after receipt, they shall be assumed to be an accurate representation of the meeting as transmitted.

4) All fax transmittals shall be followed up with a [mailed] hard copy of the same document that must be received by the CITY within 5 business days. Note that the CONTRACTOR shall not assume that faxed documents have been received intact; thus, a confirmation that a fax has been transmitted does not constitute proof that the intended party received the fax. The date stamped on the received hard copy document shall be used for measuring all contract schedules and milestones.

5) All documents received by the CITY shall be date stamped upon receipt. The date the document is received and stamped by the CITY (and not the date sent by the CONTRACTOR) shall be used for measuring all contract schedules and milestones.

6) All documents transmitted by the CONTRACTOR shall be dated, numbered, and identified by the CONTRACTOR. Numbers shall be sequential from the start of the project. No numbers shall be skipped. The CONTRACTOR shall maintain on ongoing list of all documents transmitted; the list shall include the topic of the document, date of transmission, and person(s) to whom the document was sent. This list shall be maintained on a secure web site maintained by the CONTRACTOR.

7) The CONTRACTOR shall maintain a secure web site which shall contain electronic copies of all documents transmitted to the CITY. The web site shall only be accessible by personnel authorized by NYCDOT. The secure web site shall maintain a log of all persons accessing the web site; this log shall note the date, time, IP Address, and person logging in and shall be accessible to the CITY.

8) Documents may be transmitted to the CITY via email to expedite delivery. However, all email transmittals shall be followed up with a hard copy of the same document that must be received by the CITY within 5 business days. Note that the CONTRACTOR shall not assume that emailed documents have been received intact; thus, a confirmation that an email has been received does not constitute proof that the intended party received the email. The date stamped on the received hard copy document shall be used for measuring all contract schedules and milestones.

9) The delivery of all items to the CITY including but not limited to submittals, documentation, software, subassemblies, training, test equipment, controllers, etc. shall include a memorandum of transmittal to *Mr. Mohamad Talas* identifying the specific deliverable enclosed and identifying what contract requirement is being addressed. Deliveries without such a memorandum of transmittal shall be considered informal in nature and shall not constitute completion with regard to project schedules [e.g. milestones], payments, or work items.

10) All multi-page documents transmitted to the CITY shall include page numbers indicating the total number of pages as well as the current page; page numbers shall not be skipped. Each page shall also indicate the document number.

11) At the request of the City, the CONTRACTOR may be required to conduct periodic teleconferences and/or web conferences to review the status of design, construction, deliveries, testing, documentation, etc. if the City believes such periodic discussions are necessary. The CONTRACTOR shall be responsible for providing a teleconferencing number and web conference support at no additional cost to the City.

1.5 Supplemental Information Required with the Bid

1) As noted herein, the bidder is required to provide certain supplemental information with his/her bid. **This information shall be included as an attachment to the bid book**. The

following checklist is provided to assist the bidder in ensuring that the necessary supplemental information has been included. Failure of the bidder to include this information may be grounds to reject the bid. All pages shall be numbered continuously showing the total number of pages attached (page X of Y) and shall contain the bidders name, the bid number and the date of the bid opening. All information provided shall clearly indicate the section of the specifications addressed and information being provided.

2) The bidder shall copy this check list (page) and include it with the bid documents.

SUPPLEMENTAL INFORMATION CHECKLIST			
✔		**Required information**	**Specification Reference**
	1	Project Schedule	Section 15 Paragraph (2)
	2	Qualifications	Section 1.3 paragraph (4)
	3	Three Year supply history	Section 1.3 paragraph (6)
	4	Warranty Disclosure	Section 2.12.2
	5	Annual Cost to extend software warrantee	Section 13.1
	6	Source code license requirements	Section 4.3.2 paragraph (9)
	7	Details for any third party software	Section 4.3.2
	8	Listing of all custom electronic components and a price for the supply of such over the 15 year life after the expiration of the warranty.	Section 2.10.2
	9	Acknowledgement of receipt of all addendum and notices transmitted by NYCDOT	Section 1.2.2
	10	Degree of backward compatibility supported	Section 1.6.3

Bidders name: _____

Contact Person: _____

Bidders Address: _____

_____

Telephone Number: _____

Fax Number: _____

Email Address: _____

1.6 Interchangeability and Compatibility with Existing Units

1) This specification describes the requirements for the ASTC-6, ASTC-8, and ASTC-12 for New York City. The CITY has already purchased over 10,000 of these controllers through previous contracts and requires that all new controllers provided under these specifications be compatible with and interchangeable with the existing units as described herein. The existing units are available for inspection and testing at the Traffic Management Center (TMC) at 28-11 Queens Plaza North or the CITY maintenance shop. Perspective bidders shall make arrangements with the CITY as described herein for any inspections of the units and their documentation.

2) New York City DOT has received shop drawings, maintenance manuals, protocol documentation, and user documentation for the existing units. The existing vendor has also provided the source code for the controller software and established a development environment for further use by the CITY. This information is available for inspection by perspective bidders prior to the bid subject to the execution of the non-disclosure agreement (NDA) included herein (Section 17). All such information including the MIB for the NTCIP database, the controller firmware, and project documentation will be available in electronic form to the successful bidder subject to the NDA. The CITY does not guarantee the accuracy of this information. It is the responsibility of the bidder to make all necessary field observations, measurements, documentation reviews, etc. to develop a compatible and interchangeable product.

3) Note that use of such information, which may be the intellectual property of the previous supplier, is restricted to equipment and services provided **exclusively to NYCDOT** for this material procurement. Any other use of this material including but not limited to other projects or other locations is prohibited unless specifically authorized in writing by NYCDOT and approved by the original supplier. Bidders are alerted that the current owner of the software may have legal recourse if the technical information is used for any purpose not specifically authorized herein or authorized in writing by the owner of this intellectual property.

4) To assist the CONTRACTOR in developing their bid for this project, the bidder may review all of the as-built information including user and maintenance documentation provided by the previous vendor. The CITY does not guarantee the accuracy of the information provided. It is the responsibility of the Bidder to make all necessary field observations, measurements, documentation reviews, etc. to develop a compatible and interchangeable design. The CITY shall have no liability for existing software and engineering information provided.

5) NYCDOT has received copies of the previous vendor's software source code that may be used by the CONTRACTOR for implementation under this contract. However, the CITY makes no guarantees as to the usability, completeness, or accuracy of any of this information. It is the responsibility of the CONTRACTOR to determine usability of the software and to make any necessary changes and additions to meet the requirements stated herein or use their own software. Note that the existing software may include 'bugs' which have not been discovered or which are known but have not been corrected at the time of this bid. It shall be the responsibility of the CONTRACTOR to correct any such defects found during the testing and warrantee for the controllers provided under this procurement at no cost to the CITY.

6) Prototype testing and design approval testing (reference Section 9) shall include tests to verify the interchangeability required herein.

1.6.1 Definition of interchangeability

1) All versions of the ASTC-6, ASTC-8, and ASTC-12 produced by different manufacturers shall be interchangeable as described below. Interchangeable is defined as meeting the

same form factor, fit, and function such that the assembly or subassemblies identified in Section 1.6.2 below, shall be interchangeable with the units currently being deployed from the previous contracts. All plug-in units shall perform identically. Plug-in assemblies shall be such that they can be freely interchanged between new controllers and older controllers without modification or changes to the controller settings, software, or database. Plug-ins from the new cabinets must work in the older controller cabinets and plug-ins from the old controller cabinets must work in the new controller cabinets. Note that there are certain exceptions to these interchangeability requirements and they are specifically noted below – no other deviations shall be accepted. The required interchangeability shall apply for the specific subassemblies listed in Section 1.6.2 below.

2) It is not intended that the CONTRACTOR copy the existing unit, only that the assemblies and subassemblies be **individually** interchangeable as described in Section 1.6.2 below. To clarify, individually shall mean each assembly or subassembly without the need to replace other assemblies or subassemblies.

3) Note that it is not required that the internal circuit cards within the controller unit be interchangeable. The controller unit is considered a single interchangeable assembly.

1.6.2 Interchangeable assemblies and subassemblies

1) Any combination of the following assemblies, plug-ins, and subassemblies shall be interchangeable (reference section 1.6.1):

   (a) The cabinet address card shall be interchangeable and the layout of the circuit board shall be similar in nature so as to minimize confusion when reading the address or cutting the diodes to form the cabinet address. This shall include the same switches and labels.

   (b) The PDA assembly shall be interchangeable with the existing unit. The front panel layout shall be similar and the location of the connectors shall be such that all cables can be easily installed with sufficient slack for a safe connection.

   (c) The BIU shall be fully interchangeable.

   (d) The 2010 Conflict monitor (CMU) shall be fully interchangeable. Note that several changes were made to the standard 2010 including the use of an unused pin for the flash relay and altered voltage thresholds. In addition, the ASTC software supports a serial connection to the 2010 from a serial port on the controller unit. The protocol for this connection has been provided and at a minimum, the 2010 provided by the CONTRACTOR shall support the protocol to ensure interchangeable operation.

   (e) All load switches shall be interchangeable.

   (f) All input file modules shall be interchangeable; this shall include but not be limited to detector cards, and isolation modules.

   (g) Controller Unit (as a total unit) shall be interchangeable – it is important that the location and type of connectors used for the serial ports and Ethernet port be located in roughly the same location with the same labeling so that cabling is interchangeable

   (h) The location of the power outlet at the top of the cabinet shall be such that the shelf mounted assemblies can continue to reach the power source.

   (i) The labeling of the terminal blocks shall be identical and the location shall be roughly the same such that the field wiring can be easily installed in either version of the cabinet.

   (j) The cabinet as a whole shall be interchangeable; this requires that the location of the conduit entry and cabinet mounting hardware be compatible with the existing design.

The CONTRACTOR shall work with the CITY to determine the exact requirements and tolerances for this mounting arrangement.

(k) It is desired, but not required that the card racks and PDA assembly combination be interchangeable between vendors so that total cabinet replacement is not required in the event of damage to the backplane.

1.6.3 Controller Functionality Compatibility

1) The controller firmware source code is available for inspection and use for this project by the successful bidder after execution of a non-disclosure agreement to protect the rights of the previous vendor. A sample *Non Disclosure Agreement* is included in Section 17. As noted in this procurement, the CITY does not own this software; it is owned by the previous vendor, US Traffic Corporation. The CITY has the right to use and modify this software (and to hire others to modify the software) for traffic controllers located within the boundaries of NYC traffic control responsibility. The provisions of its acquisition are outlined in Section 4.3 herein.

2) The controller unit provided under this specification shall be interchangeable with the existing unit and shall implement the NEMA conformance groups and NTCIP data elements as included herein. The MIB for the existing traffic controller shall work interchangeably with the new traffic controller when connected to the central system. While additional functions may be available, the full and complete support for the existing ASTC shall be supported by the same objects and value ranges as a minimum.

3) The controller shall fully support the following communications protocols as described herein:

    i. NTCIP via the Local Serial port (serial communications)

    ii. NTCIP using the System Ethernet port (which will be connected to a wireless or wired Ethernet media).

    iii. NTCIP via an all Ethernet ports located on the front of the unit.

4) The previous contractor provided laptop software as outlined herein to manage the database of the ASTC including firmware loading, real time monitoring, database viewing, and USB memory device configuration and loading. Note that this laptop software is available in executable form and can be installed on most XP laptops. If the CONTRACTOR provides different laptop software than the existing system, then the following requirements shall apply:

    i. The new laptop software shall fully support both the existing ASTC's and the new controllers.

    ii. Translation software shall be provided which converts from the existing file and database structure to the new file formats and structure.

    iii. The new laptop software must be able to create USB files which are backward compatible with the existing ASTC's.

5) It is required that the new controller function properly in the existing cabinets, including form, fit, and function. It is also required that the existing ASTC phase 2 & 3 controller units function interchangeably in the new cabinets.

6) USB Memory device compatibility

    i. The USB memory device currently supported by the existing controllers must also be supported by the new controllers.

ii. The file formats, compression, and naming conventions between the new and the existing ASTC's on the USB memory device must be compatible.

iii. It must be possible to keep the firmware, database, and operating system for the existing ASTC on the same memory device as the new controllers without interference. While the new controllers may require a different firmware and operating system file format, the new format must not confuse the existing ASTC and the older files must not confuse the new ASTC's.

iv. If the individual configuration and timing information (database) is different between the new and the existing ASTC's, then it shall be possible to store both on the memory device and the controller shall automatically determine which one is appropriate.

v. The new laptop software shall be able to create USB database files that are compatible with the existing ASTC's.

vi. The file **format** for the new ASTC database must be the same as the existing ASTC although there may be a different compliment of objects supported due to changes in the functionality and hence the NTCIP objects supported by the controllers.

vii. The CONTRACTOR is required to provide conversion software, if necessary, to convert the database from any o f the existing ASTCs to the new ASTC and the reverse. Such translation shall be automatic upon creation of the USB database. The intended operation is such that the USB memory device created on the new laptop software shall be fully backward compatible with the all existing versions of the ASTC. Further, the new laptop software can read the contents of the USB memory device from the existing versions of the ASTC and convert the database to the new format.

7) The bidder's implementation shall use the Linux operating system for the ASTC controller unit and the board support package (BSP) as noted in ATC standard. These standards are available on the ITE web site at www.ite.org [http://www.ite.org/standards/atc/]. The most recent version of the standard (5.2b) includes Annex A which identifies the minimum Linux Kernel Configuration. All features and functions required by the ASTC shall be included in the drivers developed and delivered as part of this contract. It is recognized that there may be differences since the ASTC allows more flexibility to the CONTRACTOR in terms of construction and interfaces. The goal is to simplify software portability. The CONTRACTOR shall be required to submit their proposed modifications to the Board Support Package (BSP) of the ATC standard; the CITY shall review the proposed design and may require modifications to support the goal of software portability.

8) During the contract negotiation process, the CITY worked with the previous supplier to expand the capabilities beyond the basic requirements of the ATC 5.2b standard. These extensions must be included in the ASTC's supplied under this and future procurements. These upgrades included the following:

i. Three (3) Ethernet connections through an Ethernet switch to the two Ethernet ports located on the ASTC engine board are required. One is connected to the system communications port, while the other two are available for additional applications including connection to a laptop computer, connection to Connected Vehicle Road Side Equipment (RSE) Dedicated Short Range Communications (DSRC) to support the Signal Phase and Timing, MAP, along with priority and preemption messages associated with the SAE J2735 standard. The IP address of each port (2 on the engine board) shall be configurable.

ii. The flash memory for the controller was increased from 8 MB to 16 MB as a minimum; this was added to provide additional memory space to support additional applications in the future; the connected vehicle RSE is an example of such an application.

iii. Hardware encryption was added to the microprocessor supplied; this was added to support additional security measures if required in the future.

9) The current units also provide considerably more processing power than the minimum required by the ATC 5.2b standard; the processing power of the units provided under this contract and future procurements shall be not less than that of the existing units.

1.6.4 Limitations of interchangeability

1) It is not required that the existing ASTC controller units (i.e. those provided by USTC during the initial procurement of 1000 pieces) be interchangeable with the new controllers. The CITY recognizes that the existing controller units may not be fully compatible with the new cabinets provided under this contract due to changes in the cabinet.

2) Where the same plug-in type subassemblies are used (e.g. BIU) then they must be interchangeable.

3) The new controllers must be interchangeable in the existing cabinets from all previous procurements. It must be possible to install a new controller unit into the existing cabinet and have it automatically detect this condition and adjust its operation to work properly in the existing cabinet. This includes support for all cabinet Input/output (P1 port) and an optional UPS. The CONTRACTOR is also cautioned that since the inputs and outputs may be dynamically configured, the new controller must fully support the operation configured for the specific cabinet it "finds itself" located within. Operator interaction with the controller shall not be required when the new controller is installed in the old cabinet.

1.6.5 Interchangeability Verification

1) The CONTRACTOR shall be required to demonstrate the interchangeability as required above during the Prototype and Design Approval Testing for the new version of the controller. This interchangeability shall be demonstrated at all operating temperatures, voltages, transients, and power interruptions. The CITY will determine which modules are to be interchanged from a collection of production subassemblies during the testing.

2) The CONTRACTOR shall provide a complete submission detailing how compatibility and interchangeability are supported between the new and the old controller and cabinet.

1.7 Testing and Product Qualification

1) This specification includes extensive requirements for design submittals, prototypes, prototype testing, design reviews, design approval testing, and evaluations. Some of the testing requirements may be waived at the discretion of the CITY, if the CONTRACTOR can show that the product(s) that are proposed have already passed an equivalent series of acceptance tests as described herein (Section 9). This includes Design Approval Testing (DAT) as described in Section 9.4. In order to be waived, the CONTRACTOR must show all of the following:

   a. That the design proposed is identical to the unit previously tested

   b. That the construction proposed is identical to the unit previously tested

   c. That the testing was successfully completed to the satisfaction of NYCDOT; this means that the testing was thorough and verified compliance to all of the requirements of these specifications and related standards. (Note that NYCDOT

will not accept test results which were not witnessed by NYCDOT or its representatives.)

d. That the units are currently in operation within NYCDOT, operating on-line with the CITY's Traffic Control System

e. That the new units and all plug-in assemblies are interchangeable with the existing ASTC as required herein

2) Even if the Prototype Testing and Design Approval Testing requirements are waived, all other testing will continue to be required. This includes Factory Acceptance Testing, Site Acceptance Testing, and 60 day site burn-in.

3) Even if the CITY waives the Design Approval Testing requirement as outlined above, the requirements for product submittals are not waived; the CONTRACTOR shall be required to supply all product submittals as described herein.

4) No separate payment will be made for any submittals or testing as required herein. All costs associated with the design, submittals, and testing including but not limited to Prototype Testing, Design Approval Testing, Factory Acceptance Testing, site acceptance testing, and 60 day burn-in testing shall be included in the cost of the items supplied under this contract.

1.8 Other Compatibility Requirements

1) If the CONTRACTOR elects to provide software which is built using the CITY's existing development environment or a development environment compatible with the one provided by the previous contractor, then the CONTRACTOR shall use the existing code management system and shall be responsible for updating all source code on the CITY's development environment using that code management system.

2) If the CONTRACTOR upgrades or otherwise modifies the development system for the work on this contract, than such upgrades shall become the property of the CITY upon project completion. The CONTRACTOR shall provide properly licensed copies of all software, libraries, etc. used for the development system.

3) The existing development system will be available for inspection. However, the source code will only be made available to the successful bidder in electronic form after award of the contract and the execution of the appropriate NDA. The source code is available for inspection prior to the bid at the CITY's facilities only.

4) The previous supplier, U.S. Traffic Corporation, owns the copyright for all of the software developed for the existing ASTC. The copyright laws of the United States will govern all changes and additions to the existing software. The CITY shall have the perpetual right to use any additions, corrections, and changes made to the existing software for use as identified in Section 4.3 of the Specifications. Further, the CONTRACTOR shall hold the CITY harmless in any lawsuits that may arise from the CONTRACTOR'S use of the existing source code.

5) The United States Copyright laws shall determine the ownership of all changes and additions to the existing software. The CONTRACTOR shall not have any rights to use the original software or any changes thereto for any other use except for products provided exclusively for use by NYCDOT.

6) All source code modified for and developed for use with the ASTC as supplied to NYCDOT shall be provided to the CITY electronically upon acceptance of the software. Further, should subsequent use discover "bugs" or require additional features and functions, the ASTC source code shall be updated by the CONTRACTOR to reflect the as-built versions once all changes have been completed and verified.

7) The previous contractor provided an inventory management system for tracking the ASTC and all of its subassemblies. The CONTRACTOR shall use this system and shall update the database as units are sent to the CITY and units are cycled for repair as described herein. It the CONTRACTOR elects to provide an alternate inventory tracking system, and then the CONTRACTOR shall be responsible for providing translation software to convert all records on the existing system to the new system and shall provide all reports currently supported by the existing system. Further, if the new system requires additional hardware or software, the CONTRACTOR shall provide this software and hardware to the CITY at no additional cost. The Inventory tracking system shall be on-line and in full operation at NYCDOT prior to the initial delivery of any ASTC-6/ASTC-8/ASTC-12 equipment purchased under this contract.
8) The CONTRACTOR shall follow the CITY's operating procedures regarding use of this inventory system.
9) This specification has been updated to reflect the changes introduced by the vendor during the first and second procurements. However, it is possible that some of these changes may have been missed or improperly stated; any deviations from the existing construction must be brought to the attention of the CITY for resolution before implementation. The CITY shall determine the best resolution and the CONTRACTOR shall adjust his design accordingly without further compensation. The bidder is directed to carefully inspect the existing product when preparing their bid and bring such issues to the attention of the CITY for clarification at least 10 business days prior to the bid opening date.
10) Existing product and system inspection must take place on the CITY property. The equipment, documentation, and assemblies may not be removed from the CITY's premises. The bidder is free to conduct any tests or inspections deemed necessary including but not limited to visual inspection of the source code, the inventory management system, the laptop software (for both the ASTC and the 2010 conflict monitor), assembly and disassembly of any unit or subassembly, inspection of all hardware components and subassemblies, and by direct measurement of any data exchanges between and among the equipment, subassemblies, and the VTCS. Such inspections must be coordinated with NYCDOT as directed herein.
11) The City will arrange for the contractor to connect to the system using the wireless units at a location under the City's control if requested in writing by the bidder. The bidder will be allowed to connect his own equipment to the system through the wireless network if reviewed and approved by the City and if the trials are in conformance to the City's security requirements.

2 General Technical Requirements

1) This specification defines the minimum general technical requirements applicable to discrete electronic components, and the mechanical, electrical design, and construction of all assemblies and subassemblies

2) These requirements also describe the means and testing profiles by which the equipment as a whole and in parts shall be tested to determine compliance with these specifications.

3) This specification identifies the ambient conditions within which the equipment must operate satisfactorily and reliably.

4) Other standards invoked. Unless noted otherwise, the ASTC shall meet the requirements set forth in the following standards:

- NEMA Standard Publication: NEMA TS 2-2003 for Traffic Controller Assemblies (Note this has now been modified to ban the use of Mercury.)
- New York State Transportation Management Equipment Specifications, March 2010. (Available from the NYSDOT web site).
- Where specifically noted, the ASTC controller unit shall comply with the specific provisions of the Joint AASHTO/ITE/NEMA standard for the Advanced Transportation Controller (ATC) – and the CALTRANS TEES for the 2070 as of the time of the bid.
- The National Transportation Communications for ITS Protocols (NTCIP) standards as noted herein.

5) The equipment, materials, and installation shall conform to the applicable requirements of the Underwriters Laboratories Incorporated (UL), the Electronic Industries Association (EIA), the National Electrical Code (NEC), National Electrical Safety Council (NESC), the American Society of Testing and Materials (ASTM), the Insulated Power Cable Engineers Associates (IPCEA), Illumination Engineers Society (IES), the Institute of Transportation Engineers (ITE), the American National Standards Institute (ANSI), the Rural Electrification Administration (REA), and the National Electronic Manufacturers Association (NEMA). [Note that UL listing/certification of the complete ASTC cabinet is not a requirement.]

2.1 Clarifications and precedence

1) Where there are conflicts between this specification and any other documents or standards listed above, the bidder shall bring such conflicts to the attention of the CITY for resolution at least 10 business days prior to the bid opening. After award of the contract, the judgment of the CITY shall considered final in all cases without further compensation to the CONTRACTOR.

2) The specific requirements of this specification shall take precedence over existing federal, state, and local standards or specifications unless otherwise noted.

3) Any conflicts within this specification must be brought to the attention of the CITY for resolution prior to construction.

2.2 Definitions

1) Wherever used in these specifications the following interpretation shall apply:

   - State - State of New York Department of Transportation (also NYS and NYSDOT)
   - CITY – New York City DOT (also NYC and NYCDOT)/New York City Department of Citywide Administrative Services. (also NYC and NYCDCAS).
   - ENGINEER – The CITY'S representative who shall be responsible for reviewing all documents; the ENGINEER shall be responsible for interpreting this specification. The CITY may hire a consultant to act as the ENGINEER for this project.
   - CONTRACTOR – the CONTRACTOR is used interchangeably in this document to refer to the single business entity that executes a contract with the CITY for the supply of the equipment and services described in this document.

2.3 Glossary

1) Wherever in these specifications the following terms or abbreviations are used, the intent and meaning shall be interpreted as follows:

TERM	**DESCRIPTION OR DEFINITION**
AC	Alternating Current
AC+	120 VAC, 60 hertz Ungrounded Power Source
AC-	120 VAC, 60 hertz Grounded Return to the Power Source
AMU	Auxiliary Monitoring Unit – this is part of the cabinet monitoring system for the ITS cabinet standards development effort; it monitors voltage and current for the load switches.
ASTC	Advanced Solid State Traffic Controller: the name given to the controller being specified for NYCDOT. This has been chosen to distinguish it from the ATC standards development program. ASTC-8 is an 8 load switch version, ASTC-12 is the larger 12 load switch version.
ATC	Advanced Transportation Controller – refers to the national standards development of a 170 replacement and a successor to the 2070.
AWG	American Wire Gauge – used to identify wire thickness
bps	Bits Per Second; A measure of data transmission speed
Buffer	A temporary storage location for data. The buffer accumulates backed-up information for later release.
Bus	A common channel between internal hardware devices, such as between CPU and disk controller.
BIU	Bus Interface Unit – Converts NEMA TS2-Type 1 EIA/TIA-485 Serial Data to cabinet discrete inputs and outputs.
Cabinet	An outdoor enclosure for housing the microprocessor or controller unit and associated equipment.
CPU	Central Processing Unit - The chip that controls all computer operations and performs computations. Also may refer to the entire physical unit housing the chip.
CFM	Conflict Monitor Unit – a device which monitors the Green, Yellow and red AC load switch outputs and monitors the CPU watchdog; conflicts detected or the absence of a proper red signal or watchdog signal cause the unit to force the signal displays to the flashing state.
Channel	An information path from a discrete input to a discrete output.
CMOS	Complementary Metal Oxide Semiconductor
CMU	Cabinet Monitoring Unit - this term is used throughout this document to identify the cabinet monitoring system – also referred to as the 2010 and CFM.
COTS	Commercial of the Shelf Software – implies that this is a standard product offering available for purchase from commercial software vendors.
CSV	Comma Separated Values, sometimes also called Comma Delimited.
CU	Controller Unit
DAT	Design Approval Test – performed to verify that the production unit design fully complies with the requirements of the specifications.
DC	Direct Current
DCI	DC Communications Interface Card – used for the 100 VDC existing communications system. This is no longer being supported and not required.
CSU/DSU	Channel Service Unit/Data Service Unit
EBR	Exception Based Reporting
EPROM	Erasable Programmable Read – Only Memory (typically Ultra Violet light to erase)

TERM	DESCRIPTION OR DEFINITION
EEPROM	Electrically Erasable Programmable Read – Only Memory.
Equal	Connectors: complying with the physical dimensions, contact/pin material, plating and method of connection. To be considered Equal, the connector must properly intermate with the specified device. Devices: conforming to form factor, function, pin out, electrical and operating parameter requirements, access times and interface parameters of the specified device. Interpretation shall be in the judgment of the ENGINEER.
FAT	Factory Acceptance Test – the testing process executed on all production units at the factory prior to shipment to NYCDOT.
FLASH MEMORY	Flash memory (sometimes called "flash RAM") is a type of nonvolatile memory that can be electrically erased and reprogrammed in units of memory called blocks. It is a variation of electrically erasable programmable read-only memory (EEPROM).
Hz	Hertz (frequency)
ITS	Intelligent Transportation System
Jumper	A means of connecting/disconnecting two or more conductive points by soldering/de-soldering a conductive wire.
K	(KB) or kilobytes; 1 thousand bytes (actually 2^{10} or 1,024 bytes). Computer RAM memories are usually defined in terms of kilobytes. Thus when a computer has 128K of memory, it has 131,072 bytes of memory.
LCD	Liquid Crystal Display – used for alphanumeric displays; very low power consumption which operates using reflective or transmission properties of display material.
LED	Light Emitting Diode; lights usually produce a red glow. May also be amber and green.
LFC	Line Frequency Clock – a clock signal at 60 Hz referenced to the AC power line
MA or ma	Milliamp
Megabyte	(M,MB); one million bytes (actually 2^{20} or 1,048,576 bytes). Used to define a large volume of data. Hard disk storage capacity is measured in megabytes.
MIB	Management Information Base (Reference the NTCIP Guide)
Modem	Modulator/Demodulator. A device which takes a computer's digital impulse and converts it into a signal to be sent over transmission lines (usually telephone lines). It also decodes the signal back to a digital impulse for acceptance in the computer.
Module	A functional unit that plugs into an assembly.
Motherboard	A printed circuit connector interface board, typically with no active or passive components. However, the use of passive components is accepted for most applications.
Ms	Milliseconds (also ms)
MTBF	Mean time between failures
MTTR	Mean time to repair
NA	Not Assigned, cannot be used; (also N/A)
NC	Not connected; (also N/C)
NEMA	National Electrical Manufacturer's Association (Sponsor /developer of the traffic controller equipment standards)
Ns	Nanoseconds (also ns)
NTCIP	National Transportation Communications for ITS Protocol – the US standards for center to roadside communications for such devices as traffic controllers
NYC	Also NYCDOT: New York City Department of Transportation
NYS	Also NYSDOT: New York State Department of Transportation

TERM	DESCRIPTION OR DEFINITION
pdf	Portable Document Format – refers to a specific file format for printed documents developed by adobe
Port	A channel (outlet) that connects the controller to external devices. May be parallel or serial.
Power Failure	Incoming Line Voltage falls below 93 (91 +/- 2) VAC for 500 milliseconds or more.
Power Restoration	Incoming Line Voltage rises to 95 (+0/- 2) VAC for 500 milliseconds or more.
PPM	Parts per million
PROM	Programmable Read Only Memory
RAM	(Random Access Memory) is the memory which is accessible by the CPU. The CPU has the ability to change or customize the information stored in the RAM.
RCU	Remote Communications Unit – Used in Manhattan to interface the controller to the coaxial cable communications facility.
SDLC	Synchronous Data Link Control
Serial Interface	A device which processes information one (1) bit at a time from the computer to a printer or other peripheral units.
SIU	Serial Interface Unit – refers to a subassembly in the new ITS cabinet standard – reference the CALRTANS TEES 2002.
SNMP	Simple Network Management Protocol
State	State of New York
TBC	Time Based Coordination – indicates that coordination or plan selection is based upon the time of day using an internal clock.
TEES	CALTRANS Transportation Electrical Equipment Specifications – references in this specification refer to version 2002 with addendum and errata.
TMC	Traffic Management Center; The NYC Signal System TMC is located at 28-11 Queens Plaza North, Long Island City.
UPS	Uninterruptible power supply – meaning a battery or generator will be provided to supply power when power is not available from the normal power service (ConEd)
UTDF	Universal Traffic Data Format
UV	Ultraviolet
VAC	Voltage Alternating Current
VDC	Voltage Direct Current
VIDT	Voice Insertion Directional Tap – used in Manhattan to separate the high and low frequency signals, provide a directional tap for voice insertion, and switchable attenuation.
VTCS	Vehicular Transportation Control System – NY City's centralized traffic control system.
Watchdog Timer	Monitoring circuit external to the Controller Unit (CU) which senses a CU output function (via the BIU). No change in state of the line for one (1) second denotes a microprocessor unit error and a watchdog action [by the CMU] is required as described in these specifications.

2.4 General Requirements

1) All materials furnished or assembled shall be corrosion resistant and in accordance with *New York State Transportation Management Equipment Specifications* dated March 2010 and general Industry Standards. Note that corrosion resistant shall mean that the material shall not degrade (e.g. rust, powder) when subjected to moisture under any circumstances. **Plated hardware is not acceptable**.

2) All equipment furnished under these specifications shall be of solid-state design. The use of vacuum or gaseous tubes or electromechanical devices within the equipment will not be acceptable unless otherwise indicated.

3) General requirements outlined in PART I, Chapter 1 of the *New York State Transportation Management Equipment Specifications dated March 2010* are applicable to all solid-state electronic field apparatus whether or not set forth in this specification.

4) The CONTRACTOR shall be responsible for all incidental accessories necessary to make the ASTC and all of its elements complete and ready for operation, even if not particularly specified. Such incidentals shall be furnished, delivered, and installed by the CONTRACTOR without additional compensation or expense to the CITY. Minor details not usually shown or specified, but necessary for the proper installation and operation of the ASTC shall be included in the work in the CONTRACTOR's bid price, the same as if herein specified. By the submittal of a bid, it is understood and agreed by the CONTRACTOR that the system description provided herein is complete and includes all equipment necessary for the proper functioning of the ASTC and all equipment, even though every item may not be specifically mentioned.

5) All equipment and component parts furnished shall be new, be of the latest design and manufacture, and be in an operable condition at the time of delivery. All parts shall be of high quality workmanship, and no part or attachment shall be substituted or applied contrary to the manufacturer's recommendations and standard practices.

6) Obsolete components, components no longer supported by the manufacturer, components not recommended for new designs, components which have been discontinued or which the CONTRACTOR should have reasonably been expected to know were discontinued, or components which the vendor has announced plans to discontinue at the time of the bid shall not be used in the design of any assembly/subassemblies provided under this contract.

7) The apparent silence of the specifications as to any detail, or the apparent omission from them of a detailed description concerning any work to be done and materials to be furnished shall be regarded as meaning that only the best general practice is to prevail and that only the best material and workmanship is to be used. Interpretation of these Specifications shall be made upon that basis.

8) The use of Nylon material shall be avoided in the cabinet construction wherever possible unless specifically noted otherwise in these specifications. Nylon will be acceptable for the Molex connectors for the PDA. Approval of the ENGINEER is required for all other usage of nylon components.

9) All adhesives used shall have a minimum of 20 years of expected life under adverse field conditions. The CONTRACTOR shall not use 'stick-on' retention devices for any purpose unless specifically authorized by the CITY. The CONTRACTOR shall be required to show

proof of the life expectancy of the adhesives proposed backed by the manufacturer of the material.

10) Where the cabinet includes panels which must 'open', 'drop-down' or otherwise be moved to provide access to connectors, devices, option jumpers, etc., these panels shall use ¼ turn winged metal fasteners or similar simple but reliable latching mechanisms and not screw-in nuts or 'PEM studs'. Access to the 'concealed' area shall not require any tools even under adverse and aged conditions.

11) All assemblies and subassemblies shall have a unique serial number, which is permanently affixed to the unit. The previous contractor provided an inventory management system and database used to track the maintenance history of each unit. It shall be the responsibility of the CONTRACTOR to utilize this database for the new ASTC-6, ASTC-8, & ASTC-12 controllers from the time of module delivery through the completion of the warranty. The data entered shall include serial numbers and maintenance history for each subassembly, circuit card, or device [e.g. load switch]. The CONTRACTOR shall update the CITY'S database on a monthly basis throughout the contract. The CONTRACTOR shall ensure that the serial number records are accurate at the time of delivery and the CITY will maintain the accuracy of the database (on the CITY'S PC) if CITY personnel make changes in the field. The maintenance history shall track all modifications, changes, and failures on each subassembly from the time of assembly forward.

12) The assembly and sub assembly serial numbers shall include an obviously readable date of manufacture, the vendor's ID, and the subassembly or assembly ID. It shall be possible from viewing the serial number to determine the module (PDA, BIU, ADD, etc.), the date of manufacture (0104 – January 2004 or some other obvious encoding of the date – e.g. week-year, day-year), and the manufacturer (Alpha character determined in cooperation with the CITY), and the serial number for this specific unit. Serial numbers (for specific units) shall not overlap between procurement contracts. The CONTRACTOR shall work with the CITY to determine an acceptable numbering scheme and starting numbers for serial numbers. Note that the CITY tracks the serial numbers by procurement contract; hence, the scheme used for serial numbers needs to identify the specific contract as well as the unique unit.

13) *Windows (and windows XP or NT)* software is used as a *placeholder* throughout this document to describe the current, most stable version of the Microsoft Operating system software for use in a commercial environment – with the available service packs. As a result of the rapidly changing software industry, newer versions of this operating environment may be the established 'standard' at the time of delivery. It is the intent of this specification that desktop PC software (and laptop software) be provided for the generally accepted operating system at the time of delivery. As of 2013, Windows 7 professional would be considered the required deployment platform. The CONTRACTOR shall ensure that the software provided under this contract (e.g. development environment, laptop software, inventory software, testing software) operates properly under the most current operating system. It is also recognized that configuration management is an important issue and that porting software to the "latest" version of the operating platforms brings some risk to a deployment. The CONTRACTOR shall work closely with the CITY to determine the appropriate operating system for all software delivered under this contract.

14) All windows based computers provided under this contract including but not limited to laptop computers, desk-top computers, development equipment, and inventory equipment shall be supplied complete with the following software licensed for use by the CITY. Licenses shall be for the full and complete software package and not "demonstration" or limited functionality versions. This list shall include *Microsoft Office* including Power Point, Word,

Excel, WinZip, Access, Front Page, Backup (Norton Ghost or equivalent), Outlook, Visio, Internet Explorer, Microsoft Project, WireShark, and other utilities generally provided with Microsoft office. The CONTRACTOR shall also provide a license and upgrades for one year following acceptance of the last unit for *Norton* Antivirus or approved equal. All software including operating system, applications, and antivirus shall be fully loaded on the computer at the time of delivery. All software shall be provided on CD or DVD which is readable on the machine provided. User documentation shall be provided in hard copy where available. (Note: where the computer vendor often provides the system complete with all software pre-loaded, and requires the owner to make the appropriate CD/DVD backups, it shall be the responsibility of the CONTRACTOR to make such backups/installation CD/DVD(s) for each machine delivered.)

2.5 General Operational Requirements

2.5.1 Indicator Lights and Character Displays

1) Reference New York State Transportation Management Equipment Specifications, *March 2010*, Part I – Chapter I: Section IV, Paragraph 1 in addition to those requirements set forth herein.

2) Indicators may use LCD technology; if LCD's are used they shall be clearly visible both during the daylight and nighttime. LCD's must also include any necessary heaters to ensure sub-second responsive operation over the full environmental range. LCD's shall include contrast/viewing angle adjustments if necessary for proper viewing by maintenance personnel. If a heater is used, it shall be activated when the operator presses any key and whenever the cabinet door is open and shall go off after a period of 15 minutes of non-use with the door closed and shall reactivate upon further operator interaction (or remain on while the door is open). The controller shall include circuitry that only activates the heater as necessary only at low temperatures, and then in proportion to the amount of energy required to operate properly. The heater shall become active when the cabinet door is opened and shall be turned off 15 minutes after the door is closed. Alternatively, the CONTRACTOR may employ a LCD technology that provides sub-second response over the temperature range without a heater. The LCD shall be backlit for night-time visibility. The back-light shall be active when any key is pressed and shall be extinguished 10 minutes after the last key-pad activation. The heating element shall be of such design that the LCD shall be fully operational and meet the operational requirements stated above within 2 minutes of activation.

3) Incandescent indicators shall not be used for any element of the ASTC controller or cabinet.

2.5.2 Contact Material

1) Reference New York State Transportation Management Equipment Specifications, *March 2010*, Part I – Chapter I: Section IV, Paragraph 2.

2.6 Electrical Requirements

2.6.1 Constancy of Intervals

1) Reference New York State Transportation Management Equipment Specifications, *March 2010*, Part I – Chapter I: Section V, Paragraph 1.

2) The electronic subassemblies which are mounted within the cabinet shall not use any fans or similar active mechanical devices to manage the airflow. Only the cabinet itself shall include a fan assembly as described herein.

2.6.2 Humidity

1) Reference New York State Transportation Management Equipment Specifications, *March 2010*, Part I – Chapter I: Section V, Paragraph 1.1.1

2.6.3 Applied Power

1) Reference New York State Transportation Management Equipment Specifications, August, 1998, Part I – Chapter 1: Section V, Paragraph 2, except as noted below. All requirements noted below shall apply for all temperatures specified for equipment operation; units shall be tested to verify that the equipment meets all of these requirements.

2) All circuits shall commence operation on or before 95 volts as the applied voltage is brought from 0 to 95 volts at a rate of 1 (+/- 0.5) volts per second.

3) All circuits shall suspend operation on or below 95 volts as the applied voltage is brought from 120 to 0 volts at rate of 1 (+/- 0.5) volts per second.

4) All circuits, memory, clocks, and functions of the controller shall not be corrupted by slowly varying input voltages, transients, and power outages as specified herein. The controller unit and all other devices located within the controller cabinet (e.g. CMU, BIU, detectors) shall include properly designed reset circuits that shall ensure that the device starts correctly and shuts down correctly without operator intervention regardless of the fluctuations on the AC power line.

5) The controller, cabinet and all equipment shall function properly during and after power interruptions (from an electromechanical contact) which cycle the power on for ~560 milliseconds and off for ~375 milliseconds for a period of 2 minutes. Prior to this test, the controller shall have completed its initialization and shall be communicating with the central computer. While the signal heads will appear to flash at this rate, the controller, monitor, modems and other devices (except relays) shall continue to be unaffected by this interruption of power. Note that functioning properly is defined as continuing to run normal green-yellow-red traffic control without interruption or anomalies of any kind including but not limited to reverting to cabinet flash, corruption of memory, loss of communications, time-of-day and clock corruption, excessive drift to the time-of-day clock as described in Section 4.1 of the Specifications, conflict detection, and loss of detector inputs.

6) All equipment, when housed within the specified cabinet shall be unaffected by transient voltages normally experienced on commercial power lines. Equipment, both normally supplied with the cabinet and purchased separately from it, must be tested for compliance as specified in paragraphs 7) and 8) below.

7) With the equipment under test housed in the ASTC cabinet with surge protection specified herein, a 25 microfarad capacitor charged to +\- 2000 volts shall be discharged onto the AC line of the cabinet at its Main breaker. The capacitor shall be discharged at the specified voltage, a total of 50 times, at a rate of once every 10 seconds. [Note that tests shall be performed with both +2000 and –2000 volts.] The equipment under test, to be in compliance, will function normally during and after the test. Applied line voltage for this test shall be 120 +\- 12 VAC. [Note: during all testing, the ENGINEER shall determine the

voltages under which this test is performed.] Note that the wiring for this test shall be such that the 2000 volt spike is discharged within 10 feet of the cabinet connected using #12 AWG wire to the unit under test and that the power line feed and other loads are isolated in a manner which forces the impulse to be managed within the traffic control cabinet and not in other circuits and the branch feed.

8) With the equipment under test housed in the ASTC cabinet with its (the cabinet's) surge protectors removed, a transient voltage of +\- 300 volts shall be synchronously applied to the AC line of the cabinet at its Main breaker. The transient voltage shall be moved uniformly over the full AC waveform once every second. The transient voltage may also be applied constantly at any point on the AC waveform. The transient voltage shall have a peak noise power of 5 kilowatts with a pulse rise time of 500 ns. The applied line voltage for this test shall be 120 +\- 12 VAC. The equipment that is being tested to be in compliance will function normally during and after the test. [Note: during acceptance and design approval testing, the ENGINEER shall determine the voltages under which this test is performed.]

9) Equipment generally housed in the cabinet such as the detector input units, CMU, and BIU, will be operated, when tested, in the equipment that they are designed to operate in.

10) All equipment shall operate as specified for power interruptions varying from 10 ms to 10 minutes or longer; the testing shall verify that power interruptions of varying duration from 450 ms to 2 seconds in 100 ms increments do not adversely affect normal operation. During such testing, the ENGINEER shall specify the various test times.

11) All equipment shall be capable of normal operation after having been in a dry, cold state when a minimum of 95 volts is applied. A dry cold state is defined as having been placed in a state of -37°C and less than 10% humidity for a period of at least five (5) hours without applied power.

12) The ASTC shall provide electrostatic discharge (ESD) protection to IEC 61000-4-2 (ESD) at ±15kV (air) and at ±8kV (contact) for the front mounted serial interface ports, the Ethernet port, and the USB ports. In addition, this test shall be performed discharging at various locations throughout the cabinet to the cabinet frame or other chassis.

13) Summary: the ASTC (controller unit in a cabinet with all peripherals and plug-ins) shall function either continuously without interruption or shall always restart properly in the presence of various transients on the power line as noted above and in the NEMA TS2-2003 standard. It is not acceptable for the traffic controller (including CMU) to require a reset or other operator intervention (e.g. cycle power again) to restore normal operation after transients and interruptions on the power line (or ESD) of any type. The CONTRACTOR shall demonstrate both through testing and through inspection of their design that all reset circuits and startup software and the environment within the cabinet have been designed to meet this requirement.

14) The ASTC shall include appropriate hardware and software fault recovery provisions for all communications "channels" such that any disconnection/reconnection or character stream or improper data and/or voltages present on the communications interfaces will not prevent the ASTC from recovering within 1 minute without operator intervention or power cycling of the unit.

2.6.4 Electrical Connections

2) Reference New York State Transportation Management Equipment Specifications, *March 2010*, Part I – Chapter I: Section V, Paragraph 3.

2.6.5 Power Supply

1) The PDA shall meet the requirements set forth in the New York State Transportation Management Equipment Specifications, *March 2010*, Part I – Chapter I: Section V, Paragraph 4 in addition to those requirements set forth herein.

2) An integral cabinet mounted regulated power supply shall be designed to generate all DC and AC voltages required for operation of all equipment except as noted below and Section 3.9.11. The cabinet power supply shall Reference New York State Transportation Management Equipment Specifications, *March 2010*, Part I – Part V.

3) Cabinet transient and RFI protection: The cabinet transient and RFI protection shall conform to the requirements set forth in the New York State Transportation Management Equipment Specifications, *March 2010*, Part I – Part V.

2.6.6 Cabinet Wiring

1) Reference New York State Transportation Management Equipment Specifications, *March 2010*, Part I – Chapter I: Section V, Paragraph 5.

2) The CONTRACTOR may use printed circuit wiring for any or all cabinet wiring, however, all printed circuit wiring shall be protected from damage which might be caused by short circuits in the field wiring, overloads, insertion and removal of assemblies and subassemblies, water entry to the cabinet, moisture, and defective components. **Under no circumstances shall any field wiring error or short circuit, equipment failure or other circuit failure cause damage to the traces or connections on any mother board or printed circuit board backplane. Special attention must be paid to all connectors and traces used for low current monitoring to ensure that printed circuit wiring cannot be damaged. If printed circuit boards are used for the cabinet wiring, the CONTRACTOR shall ensure that the conformal coating and masking are such that moisture cannot induce false signals to the CMU.**

3) The load switches, flasher, input cards, address card, BIU, CMU, and the controller unit shall be hot swappable – meaning that the cabinet power need not be turned off to replace any of these devices. The design of the mechanical and electrical characteristics of these devices and their respective mounting sockets, slots, and connectors shall be such that insertion and removal cannot damage the device, the cabinet wiring, any other device installed or connected to the cabinet, or cause harm or injury to the maintenance technician.

4) All cables used within the cabinet that are used to connect the various subassemblies shall be stranded and shall remain “very flexible” at temperatures down to –20F. This shall apply to all power cables, and serial connect cables. This shall apply to any cable that must be moved or disconnected and re-connected for the purpose of removing and replacing any of the field replaceable subassemblies or units.

5) All wiring in the cabinet shall be installed such that it cannot come into contact with sharp edges or other sharp hardware that might damage the cable, insulation, or cause short circuits over the life of the unit. Wires and cabling shall be secured in a manner that does not degrade the insulation over time to shorten the life of the wiring or connectors.

6) All cables installed within the cabinet, including but not limited to the UPS to ASTC, ASTC to CMU, ASTC P1 cable, Red Monitor Cable, ASTC to NYCWiN router, and power cables as necessary shall be routed and affixed in a manner which prevents them from becoming

entangled in the door mechanisms and from being damaged or altering the operation of any device during maintenance activities.

2.7 Components

2.7.1 General

1) Reference New York State Transportation Management Equipment Specifications, *March 2010*, Part I – Chapter I: Section VI, Paragraph 1, except as noted below.

2) No component shall be applied or used contrary to the manufacturer's ratings and published data sheets without written confirmation from the component manufacturer stating that the ASTC usage will not shorten the design life or compromise the operational integrity of the unit..

3) The CONTRACTOR shall ensure that all electrical and electronic components used for the construction of the ASTC are acquired through manufacturer authorized distribution channels for the specific component. The CONTRACTOR shall maintain records that can trace the origin of all electrical and electronic components to the original component manufacturer. All electronic and electrical components used for the construction of the ASTC shall be warranted by the original manufacturer against defects. If requested by the CITY, the CONTRACTOR shall provide certification of authenticity for any and all electrical and electronic components. Any deviation from this requirement must be requested in advance and in writing for each component in question and must show justification for using an alternate source of supply. The CONTRACTOR shall be liable for all costs incurred by all parties to locate and replace counterfeit parts in all ASTCs whether installed or in inventory if the operating integrity or long term reliability of the ASTC may be affected. The equipment warranty shall be restarted after the replacement of suspect or compromised components. Further, in the event of an apparent "bad batch" of electrical or electronic components which cause failure or unreliable operation of the ASTC, the CITY may require that the CONTRACTOR perform an analysis, at the CONTRACTOR 's expense, to determine the exact cause of the failure and replace the suspect component in all installed and any inventory of ASTC's at the CONTRACTOR 's expense. The warranty of the equipment shall be restarted once the suspect component has been replaced.

4) The CONTRACTOR is required to develop and maintain a quality assurance (QA) program for all purchased components. The QA procedures must show how vendors are qualified and how the components are inspected and tested prior to use in the ASTC. The QA procedure must describe how the vendors' performance is tracked and how the approved vendor lists are updated.

5) When integrated circuits are provided which are of such special design or programming that they **preclude** the *off-the-shelf* purchase of identical components from any licensed wholesale electronics distributor or component manufacturer, one (1) exact duplicate integrated circuit shall be furnished with every ten (10) integrated circuits provided.

6) When any programmable unit is supplied as part of the CONTRACTOR'S equipment (e.g. controller unit, BIU, Conflict monitor), the CONTRACTOR shall include diagnostic firmware. This diagnostic firmware shall run continuously **during normal operation** to determine if the device is (continues) functioning properly. If the diagnostic software determines that the device is no longer operating properly, it shall terminate operation in a manner that causes the cabinet to the flashing condition and it shall indicate that such a failure has occurred and provide information as to the nature of the failure so that the defective module can be clearly identified.

7) Whenever any field or factory programmable device is used in the ASTC, including but not limited to logic arrays, EPROM's, etc., the CONTRACTOR shall provide detailed programming information and configuration in electronic form to allow the CITY to purchase replacement components suitably programmed directly from the manufacturer or through common electronic distribution channels.

2.7.2 Socket Requirements

1) Reference New York State Transportation Management Equipment Specifications, March 2010, Part I – Chapter I: Section VI, Paragraph 2. Paragraph 2.2 shall not be a requirement.

2) Note that all EPROM, EEPROM, and ROM memory chips shall be socket mounted unless the device can be re-programmed in circuit without removal. If the device can be re-programmed in circuit, then the CONTRACTOR shall provide 5 sets of all necessary cables, fixtures, software and programming devices to allow the CITY to re-program the device for future alterations to the hardware or for component replacement.

2.7.3 Component Design Life

1) Reference New York State Transportation Management Equipment Specifications, March 2010, Part I – Chapter I: Section VI, Paragraph 6. The ASTC shall have a minimum design life of **15 years** under normal field operating conditions.

2.7.4 Labeling of Components

1) The circuit reference symbol for each component part shall be clearly marked on the circuit card or mounting surface. The markings shall be clearly visible with all components installed.

2.7.5 High quality electronic components shall be used

1) Reference New York State Transportation Management Equipment Specifications, March 2010, Part I – Chapter I: Section VI, Paragraph 8, except replace the words "The State" with "The CITY".

2.7.6 Capacitors

1) Reference New York State Transportation Management Equipment Specifications, March 2010, Part I – Chapter I: Section VI, Paragraph 9.

2.7.7 Potentiometers

1) Reference New York State Transportation Management Equipment Specifications, March 2010, Part I – Chapter I: Section VI, Paragraph 10.

2.7.8 Resistors

1) Reference New York State Transportation Management Equipment Specifications, March 2010, Part I – Chapter I: Section VI, Paragraph 11.

2.7.9 Semiconductor Devices

1) Reference New York State Transportation Management Equipment Specifications, March 2010, Part I – Chapter I: Section VI, Paragraph 12.

2.7.10 Transformers and Inductors

1) Reference New York State Transportation Management Equipment Specifications, March 2010, Part I – Chapter I: Section VI, Paragraph 13.

2.7.11 Circuit Breakers

1) Reference New York State Transportation Management Equipment Specifications, March 2010, Part I – Chapter I: Section VI, Paragraph 14.

2.7.12 Component Grade

1) Reference New York State Transportation Management Equipment Specifications, March 2010, Part I – Chapter I: Section VI, Paragraph 15.

2.7.13 Batteries

1) Reference New York State Transportation Management Equipment Specifications, March 2010, Part I – Chapter I: Section VI, Paragraph 16. Note that batteries are not allowed in any ASTC subassembly or for any timing devices even though allowed by the NYS Specification.

2.7.14 Make-and-Break Device

1) Reference New York State Transportation Management Equipment Specifications, March 2010, Part I – Chapter I: Section VI, Paragraph 17. Note that it shall be the responsibility of the CONTRACTOR to ensure the proper use of snubber and contact protection circuits to minimize generated electrical noise which might cause operational problems for equipment placed within the cabinet.

2.7.15 Front Panel Mounted Fuses

1) Reference New York State Transportation Management Equipment Specifications, March 2010, Part I – Chapter I: Section VI, Paragraph 18 except as set forth herein.

2) All fuses shall be accessible without the removal or disassembly of any equipment within the cabinet installation.

3) Fuses shall not disengage or be damaged by normal maintenance procedures or inadvertent ‘bumping’ of the fuse holder. Fuses shall be installed such that there is no danger to service personnel during replacement or inspection.

2.7.16 Ribbon Cables

1) Reference New York State Transportation Management Equipment Specifications, March 2010, Part I – Chapter I: Section VI, Paragraph 19, except replace the words "179 controller" with "controller unit".

2.7.17 Jumpers

1) Where option jumpers are used, two (2) pin jumpers are required. A slide-on jumper between two adjacent pins shall complete or bypass the circuit. Pins shall also be required for each jumper that may need storage during its useful field life. All such jumpers shall use gold plated pins and gold plated contacts.

2.8 Mechanical Requirements

2.8.1 Metal Cases

1) Reference New York State Transportation Management Equipment Specifications , March 2010, Part I – Chapter I: Section VII, Paragraph 1 except as set forth herein.

2) All case materials used shall be non-corrosive (e.g. aluminum, stainless steel).

3) All hardware as a minimum shall be 18-8 stainless steel.

4) Self-tapping sheet metal screws shall not be used.

5) Only threaded inserts, quarter-turn fasteners or captive nuts with lock washers shall be used for all hardware. Where captive nuts are used, they shall be installed in such a manner as to eliminate the possibility of damage during installation or removal.

6) Where threaded inserts may be used, the CONTRACTOR shall indicate the method used to ensure the integrity of the installation process. Threaded inserts shall not be used where they might be damaged in shipping or handling.

7) Rivets of any kind shall not be used except as specified herein.

8) All corners and edges shall be de-burred and rounded to avoid personal injury.

2.8.2 Modular or Printed Circuit Design

1) Reference New York State Transportation Management Equipment Specifications, March 2010, Part I – Chapter I: Section VII, Paragraph 2.

2.8.3 Inspection

1) Reference New York State Transportation Management Equipment Specifications, March 2010, Part I – Chapter I: Section VII, Paragraph 3.

2.8.4 Model Numbers

1) Reference New York State Transportation Management Equipment Specifications, March 2010, Part I – Chapter I: Section VII, Paragraph 4, except as noted below.

2) Except for the ASTC cabinet, in addition to any assignment of model numbers by the manufacturer, four (4) digits shall be displayed on the front panel in bold type, at least 0**.**375 inches high. The first three (3) of these digits are supplied in the model number assignment Table below (ref 2.8.7). A fourth digit shall be assigned by the CITY at such time as a particular sample is qualified as acceptable. The label shall be subject to approval by the CITY. The CONTRACTOR shall work with the CITY to identify a material and mounting method that is acceptable to the CITY. The numbers shall be clearly readable at a distance of 3 feet by a person with normal 20-20 vision.

3) For the ASTC cabinet, seven (7) digits shall be displayed on the inside of the front door, at least 0**.**375 inches high. The first three (3) digits are "NYC". Four (4) additional digits shall be assigned by the CITY at such time as a particular sample is qualified as acceptable.

2.8.5 Tolerances

1) Reference New York State Transportation Management Equipment Specifications, March 2010, Part I – Chapter I: Section VII, Paragraph 5.

2.8.6 Input Cards

1) Reference New York State Transportation Management Equipment Specifications, March 2010, Part I – Chapter I: Section VII, Paragraph 6, except replace the words "Model 330" with "ASTC" as noted below.

2) All input cards designed to be used in the ASTC detector rack (input file) shall be mounted on an edge-connected, printed circuit board of the following dimensions (reference Figure 2)

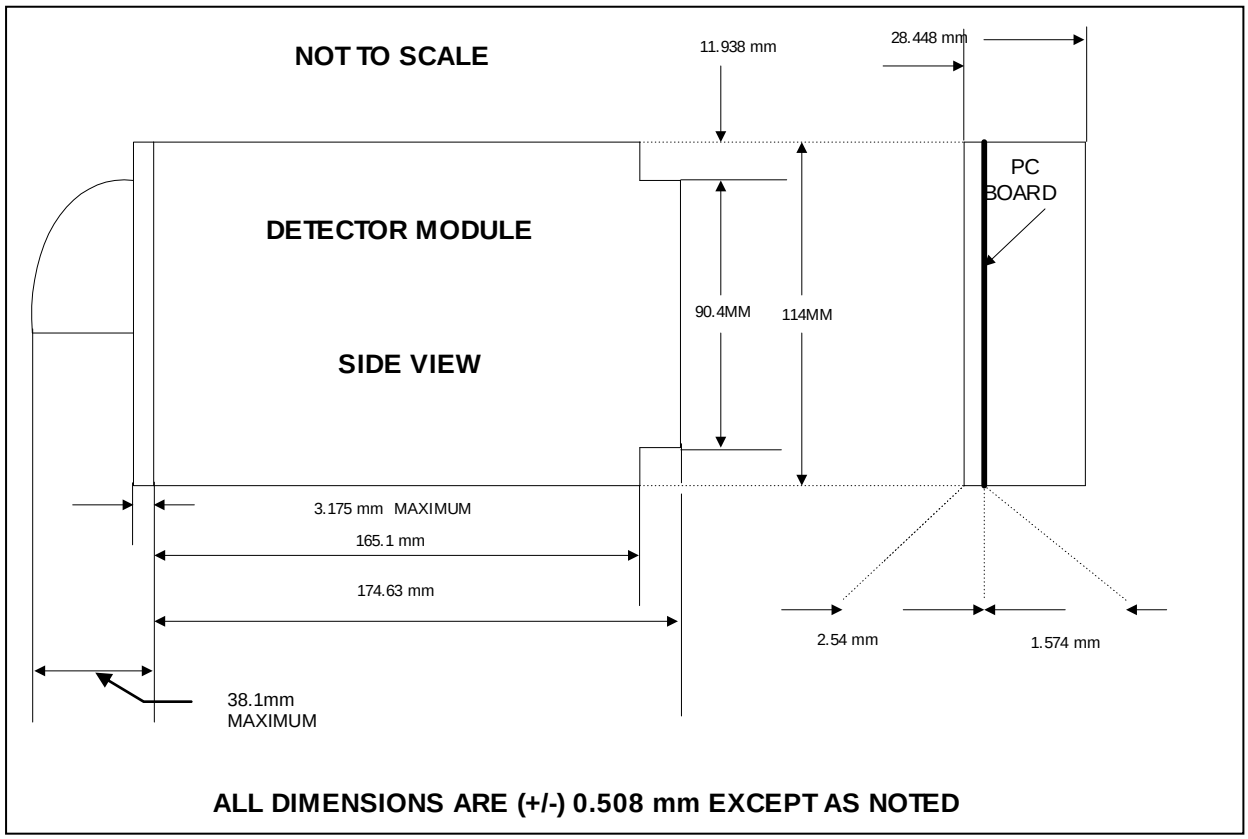


Figure 2 - Dimension for Detector Input Card (2 channel)

2.8.7 Model Number Assignment Table

1) The ASTC specification is based upon a combination of NEMA TS2-1 2003 and the NYS Transportation Management Specification for the 179 controller and 330 cabinet. The ASTC cabinet is intended to utilize as many standard plug-in assemblies as possible. The following chart lists the plug-ins to be used. (Note that several of these also include some minor modifications which clarify some commonly accepted operating parameters).

DESCRIPTION	MODEL NO.
solid-state load switch	200*
solid-state Flasher	204*
solid-state Monitor	2010
Quad Loop Vehicle Detector Module	224
Dual Isolation Module (DC)	242
Quad Isolation Module (DC)	244
Dual Isolation Module (AC)	252

***Note**: the solid state load switches and flasher shall be compatible with the use of LED signal heads such that the signal heads operate properly and without degradation whether only LED signals are used or a mixture of LED and incandescent signals are used. Further, the load switches shall be of such design that the signal monitoring circuits of the CMU unit properly detect failures and are not affected by normal operation. These (and all requirements) shall apply for all temperatures, line voltages, power surges, transients, and power interruptions as required in these specifications.

2.9 Maintenance

1) Reference New York State Transportation Management Equipment Specifications, March 2010, Part I – Chapter I: Section VIII.

2.10 Engineering

2.10.1 Human Engineering

1) Reference New York State Transportation Management Equipment Specifications, March 2010, Part I – Chapter I: Section IX, Paragraph 1.

2.10.2 Design Engineering

1) Reference New York State Transportation Management Equipment Specifications , March 2010, Part I – Chapter I: Section IX, Paragraph 2, except for subparagraph 2.9.2.2 replace the words "(see Section IV Electrical Requirements)" with the words "(see Section 2.6 Electrical Requirements of this ASTC Procurement Specification)" and as noted below.

2) Any component required in the circuit design which has special or unique characteristic(s), which would limit that component to certain manufacturers or suppliers shall be made available by the CONTRACTOR over the 15 year life of the unit, so as to facilitate rapid field repair of a unit. Further, the CONTRACTOR shall seek approval from the CITY and justify such vendor specific restrictions prior to approval of the design. The CONTRACTOR shall provide a detailed listing of all components that fall into this category and shall provide a price for the supply of replacement parts for the life of the unit after the expiration of the warranty.

2.10.3 Generated Noise

1) No item or subassembly supplied on these specifications shall emit audible noise greater than 40 db (A) at 1 foot from the unit.

2.11 Construction of Printed Circuit Boards

2.11.1 Design, Fabrication and Mounting

1) Reference New York State Transportation Management Equipment Specifications, March 2010, Part I – Chapter I: Section X, Paragraph 1.

2.11.2 Soldering

1) Reference New York State Transportation Management Equipment Specifications, March 2010, Part I – Chapter I: Section X, Paragraph 2.

2.11.3 Definitions

1) Reference New York State Transportation Management Equipment Specifications, March 2010, Part I – Chapter I: Section X, Paragraph 3.

2.11.4 Board Tolerance

1) Reference New York State Transportation Management Equipment Specifications, March 2010, Part I – Chapter I: Section X, Paragraph 4.

2.11.5 Quality Control

1) Reference New York State Transportation Management Equipment Specifications, March 2010, Part I – Chapter I: Section 1, Paragraph 2, except replace the words "New York State" with "New York City".

2.11.6 Units

1) Every completely assembled unit shall be submitted to a full cycling (including temperature, humidity, and line voltage variations) and timing test. This is discussed in the burn-in requirements in Section 9.5.

2) The unit shall be visually inspected to assure proper placement, mounting, and compatibility of sub-assemblies.

2.12 New York City Year 2000 Warranty Standard

Note that the City of New York requires that all products adhere to the terms of this warrantee as a minimum.

2.12.1 Definitions

1) For purposes of this warranty, the following definitions shall apply:

   a) “Product” shall include, without limitation: any piece or component of equipment, hardware, firmware, middleware, custom or commercial software, or internal components or subroutines therein which perform any date/time data recognition function, calculation, comparing or sequencing. Where such services are being furnished, e.g. consulting, systems integration, code or data conversion or data entry, the term “Product” shall include resulting deliverables.

   b) “Vendor’s Product” shall include all Product delivered under this Agreement.

2.12.2 Warranty Disclosure

1) At the time of bid or Product quote, the CONTRACTOR is required to disclose the following information in writing to the CITY:
   a) ***For Vendor Product and for Products (including, but not limited to, Vendor and/or Third Party Products and/or Authorized User's Installed Product) which have been specified to perform as a system:*** Compliance or non-compliance of the Products individually or as a system with the Warranty Statement set forth below;

2.12.3 Warranty Statement

1) Year 2000 warranty 'compliance' shall be defined in accordance with the following warranty statement:

   "Vendor warrants that Product(s) furnished pursuant to this agreement shall, when used in accordance with the Product documentation, be able to accurately process date/time data (including, but not limited to, calculating, comparing, and sequencing) from, into, in, and between the twentieth and twenty-first centuries, and the years 1999 and 2000, including leap year calculations. This shall include all date transitions during (e.g. leap year and daylight savings time) the twenty-first century. Where a purchase requires that specific Products must perform as a package or system, this warranty shall apply to the products as a system.

2) In the event of any breach of this warranty, Vendor shall restore the Product to the same level of performance as warranted herein, or repair or replace the Product with conforming Product so as to minimize interruption to ongoing operations, time being of the essence, at CONTRACTOR's sole cost and expense. This warranty does not extend to user's errors in data entry or data conversion.

3) *This warranty shall survive beyond termination or expiration of the agreement. Nothing in this warranty shall be construed to limit any rights or remedies otherwise available under this agreement."*

3 Cabinet Housing

3.1 Cabinet Construction

3.1.1 Housing

1) The cabinet housing shall be weatherproof, rainproof, with the top of the enclosure either crowned or sloped to prevent standing water. The cabinet shall be constructed to shield the top of the cabinet door to prevent water from entering between the top door gasket and the cabinet.

2) The cabinet housing shall have a single front door, equipped with a three-point latch and lock. The cabinet shall be fabricated for side of pole mounting and shall be suitably re-enforced for both pole mounting and base mounting. Under certain circumstances, the cabinet may be mounted on its bottom to a pedestal flange or concrete base.

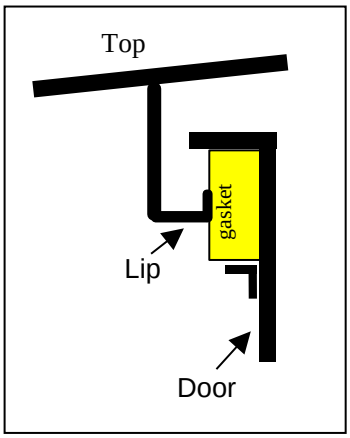
3) All exterior seams and the cabinet as a whole shall meet the requirements for Type 3R enclosures according to NEMA Standards Publication 250-1991.

4) The ASTC-6 cabinet shall be clean-cut in design and appearance. The maximum exterior dimensions, including the cabinet door (but not including the removable handle) shall be as follows:

35 inches High by 20 inches Wide by 15 inches Deep

5) No part of the cabinet shell assembly including any protrusions from the power supply and power distribution assembly shall extend further than 7/8-inches in front of the plane formed by the front of the cabinet shell. No part of the cabinet door or any attachment to it shall extend further than 1-inch from the door into the areas of the controller, detector rack, power supply or power distribution areas, when the door is closed. No part of the cabinet door or any attachment to it shall extend further than 2.25 inches in any area when the door is closed. Tolerance for all of the dimensions is ± 0**.**175 inches. All equipment shall be arranged inside the cabinet such that door hardware shall never cause damage to any internal device or subassembly. All cables shall be arranged in a manner such that they are not damaged or stressed when the door is closed.

3.1.2 Material



1) The cabinet housing, doors, and gasket channels shall be fabricated of 0.1875-inch minimum thickness aluminum sheet, using Grade 5052-H32 aluminum alloy. The sheet aluminum shall be adequately reinforced as necessary. If necessary, reinforcing supports shall be welded to the inside of the door to prevent the warping or twisting of the door. (Note that a minor deviation was allowed for the current cabinet in the form of a lip using 0**.**125 inch material at the top of the door to improve water management over the door opening – see figure at the right. This deviation to the 0**.**1875 inch thickness requirement will be allowed providing all seams for this lip are continuously welded and only the top lip of the door opening is so modified. Such a deviation must be submitted for approval by the ENGINEER.)

2) A certificate of compliance from the manufacturer (signed by a responsible officer of the company with direct knowledge of the materials and construction for the ASTC) shall be

furnished certifying that the material used in the construction of the cabinet housing complies with the requirements of *paragraph 1) above.*

3.1.3 Construction

1) All construction shall be free of dents, scratches, weld burn through and abrasions harmful to the strength and general appearance. All exterior seams for the cabinet housing and door shall be continuously welded and shall be smooth and free of impurities. All exterior corners shall be rounded.

2) An area shall be provided within the lower center portion of the rear cabinet wall for wire and cable entrances. This area shall not be less than 6 inches by 4½ inches on the centerline of the width of the cabinet. Two holes for 1½ inch diameter conduit entry shall be located in this area. The conduit entry holes shall be located by the CITY and pre-punched by the CONTRACTOR prior to the delivery of the cabinet.

4) There shall be no sharp edges or protrusions on the cabinet whether open or closed which might pose a risk of personnel cuts or injury. All sharp edges shall be sanded and deburred before painting.

3.1.4 Exterior Surfaces

1) The exterior surface of the controller cabinet shall be powder coated, using medium green to match Federal Specification 595B Color 14062.

3.1.5 Gasketing

1) The housing shall have a door, securely gasketed, which shall include substantially the full area of the front of the cabinet. Gasketing shall be provided on all door openings and shall be of dust-tight permanent type that will not peel off or deteriorate. Gaskets shall be 0.25-inch minimum thickness closed cell neoprene and shall be installed with contact cement for a permanent bond. The mating surface shall be sprayed or otherwise coated with a silicon lubricant to prevent sticking to the mating metal surface.

2) The gasket material shall not be damaged by normal cabinet cleaning agents and solvents normally used to remove graffiti from the exterior of the cabinet.

3) Gasket material shall be UV resistant.

4) The design of the door and gasket shall be such that the integrity of the gasket material shall not be required to ensure that the internal cabinet assemblies are protected from water damage under adverse environmental conditions. Cabinet door assemblies shall be designed in such a way that damaged gaskets do not allow water to enter the cabinet.

5) Gasket material shall be continuous along the entire top of the cabinet door with no seams or joints in this section.

3.1.6 Cabinet Door

1) The cabinet door shall be hinged on the right side when facing the cabinet. The door hinge shall be continuous and bolted (piano) to the cabinet and door utilizing ¼ - 20 stainless steel carriage bolts and nylock nuts. The hinge shall be made of 0**.**075 inch stainless steel and shall have a 3 inch open width with a 0.250 inch diameter stainless steel carriage hinge pin. The hinge pin shall be capped top and bottom by weld to render it tamper proof. The hinge leafs shall not be surface mounted on the outside of the cabinet. They shall be mounted between the door and the cabinet. The cabinet door hinges shall be bolted to the cabinet

housing in a manner that prevents unauthorized personnel from removing the door with commonly available tools.

2) The cabinet shall be equipped with an automatic, self-engaging catch to hold the door open at 135 degrees ± 25 degrees. The catch shall be capable of holding the door open in a 140 Mile Per Hour wind coming at an incidence angle of 90 degrees referenced to the plane of the door. A means shall be provided to minimize the accidental release of the doorstop. The catch shall also be easily and reliably disengaged when closing the door so that the door and catch are not damaged.

3) The door shall be furnished with a three-point latching mechanism. The latching mechanism shall be a three-point draw roller type. Push rods shall be turned edgewise at the outward supports and shall be 0**.**250 inch by 0**.**750 inch stainless steel, minimum. Rollers shall have a minimum diameter of .875 inch and shall be made of *nylon*. The center catch shall be fabricated from 0**.**134 inch stainless steel minimum. Stainless steel compensating wear guards shall be used at contact point for the three point latching; these shall be pop or blind riveted to the cabinet.

4) The three-point locking mechanism shall be fabricated so that it may be actuated by rotating a removable 5/8-inch hex key door handle. The hex socket and locking cam shall rotate on a 0.5-inch minimum diameter shaft. The socket, shaft and hex key shall be fabricated from stainless steel, grade 2011P3 aluminum, or other material plated to prevent corrosion. The socket and shaft shall be field-replaceable with common tools. The socket head shall be protected from being rotated with a pipe wrench or similar tool. Designs shall be subject to approval by NYC DOT prior to fabrication. Note that the removable hex handle should not be provided; the CITY has sufficient handles for its maintenance needs.

5) The locking mechanism shall be designed such that tie BIU cable cannot be damaged or pinched when opening or closing the door under all environmental conditions.

3.1.7 Water Management

1) The cabinet shall be constructed such that defective, aged, and damaged gasket material shall not allow water to enter the cabinet in any areas that might cause damage to the equipment or wiring mounted inside or the operation of the signals.

2) The cabinet shall properly manage any condensation which may occur internally such that moisture cannot damage any of the internal cabinet assemblies, subassemblies, wiring or devices.

3) There shall be no holes, seams, or attachments to the top of the cabinet that might cause water to leak for any reason.

4) The CONTRACTOR shall recognize that mounting holes will be field drilled by an *installation* contractor in the re-enforced mounting areas on the back of the cabinet along the top and bottom edges. These mounting areas must be smooth surfaces to allow the installation contractor to waterproof the mounting.

5) Weep holes approximately 3/16 inch in diameter shall be drilled in the bottom floor of the cabinet such that water does not accumulate in the cabinet. Weep holes shall be located so as to prevent damage to internal assemblies and wiring in the event of vandals.

3.1.8 Door Lock

1) The lock for the cabinet door shall be of the self-locking, heavy duty, pin tumbler, cylinder rim type. It shall be the Key and Lock currently used by NYCDOT and the lock shall include a dust cover. Two keys, constructed of brass or stainless steel are to be furnished with each cabinet. When the door is closed and latched, with the key removed, the door shall lock. The successful bidder shall contact NYCDOT for details of the key and lock after award.

2) During the installation of the lock, good grade of commercial silicone will be put around the cylinder to form a weather barrier between the front of the lock and the inside of the cabinet door. A stainless steel lock protector plate shall be installed over the rear of the lock to prevent the rear of the lock from being punched out from the front of the cabinet.

3.1.9 Cabinet Ventilation

1) Each cabinet shall be provided with louvered vents in the cabinet door for fresh air. The vents shall be screened against the entrance to remove dust and foreign matter, with a removable and replaceable air filter *16 inch x 6 inch x 1 inch* deep to filter incoming air. The filter shall be *Eco Air* type disposable filter or equivalent [reference: Eco-Air Products, Inc., San Diego, CA 92126, 619-271-8111] which is currently used and stocked by the CITY. The filter shall be a UL classified air filter-Class 2 644N.

2) The filter shall overlap the vents by at least 1 inch and shall be held firmly in place with bottom and side brackets and a spring-loaded upper clamp. Provisions shall be made in the design of the vents to prevent snow and rain from being blown through the vents into the cabinet.

3) The bottom filter bracket shall be formed into a waterproof sump with drain holes to the outside. The louvered vents shall be designed and constructed so that a stream of water from a pressure head, such as a *Rainbird* sprinkler or other type of water spray test, will not enter the cabinet. The louvered area shall be less than the filtered area.

3.1.10 Cabinet Exhaust Fan

1) Each cabinet shall be equipped with an electric exhaust fan, Comair Rotron No. MU2B1 or equal, with ball bearings and a capacity not less than 100 cubic feet per minute. The cabinet shall be provided with a 30 square inches minimum screened exhaust vent. The exhaust fan and exhaust vent shall be located in the underside of the top of the cabinet and completely wired and interconnected.

2) The area of the exhaust vent and the exhaust fan shall be designed to prevent snow or rain from reaching the fan area and from entering the cabinet's main area regardless of whether the fan is operating. Design of this area shall include baffling to block the entrance of moisture yet provide adequate ventilation. This area shall also be sloped to drain any moisture that may get into this area to the outside of the cabinet.

3) The fan shall be capable of operating continuously for a **minimum** of 20,000 hours in a +50 °C (+122 °F) environment without the need for after-installation maintenance, excluding filter replacement. The cabinet fan circuit shall be fused using a ¼ amp time-delay fuse and be labeled as such. The fan terminals shall be insulated or covered so that no parts having line voltage are exposed. The fan fuse shall be located in the vicinity of the fan, and shall be attached to the cabinet housing.

4) The fan shall be screened or otherwise protected to prevent personal injury or the inadvertent encroachment of wires or other internal elements which might be damaged or interfere with the operation of the fan.

5) Each cabinet shall be provided with a thermostat to control the operation of the fan or cooling system. The thermostat turn-on point shall be fixed at 85°F with a differential of not more than +9 °F between automatic turn-on and turn-off. The thermostat shall be located on the inside top portion of the cabinet not lower than 6 inches from the top of the cabinet and mounted so that the air temperature within the cabinet is accurately monitored (+/- 5°F) . All fan control contacts shall be protected by RFI suppression devices to eliminate the introduction of EMI noise into the cabinet power supply system.

6) The fan construction and fusing shall be designed such that blockage of the exhaust vents shall not cause the fuse to blow or the fan to be damaged or the ingress of water or foreign matter to the cabinet.

3.1.11 Thermal Alarm

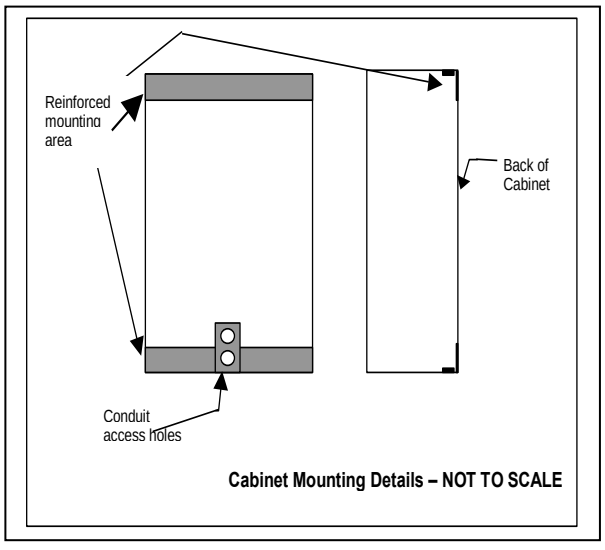
1) The cabinet shall include an internal over-temperature sensor which shall be set for 150 F (+/- 7 F) which shall be mounted near the top of the cabinet, but shall not be in contact with the external surface of the cabinet. The thermal sensor shall provide a contact closure that is wired to the door open/cabinet alarm function such that an alarm indication is presented to the BIU whenever the temperature sensor is above the 150 degree set-point. This set-point shall not be field adjustable. The sensor shall be mounted such that it accurately measures the temperature of the air near the top of the cabinet and in the area of the controller unit. The sensor unit shall be field replaceable. The sensor unit shall be sealed such that it is not adversely affected by moisture, dirt, or mechanical stress.

2) The cabinet shall include an indicator or other suitable display which shall illuminate whenever there is a thermal alarm present.

3) The BIU shall be able to detect an alarm whenever the door is open or the over-temperature sensor is above the threshold.

3.1.12 Cabinet Mounting

1) The cabinet shall be mounted on the side of a pole. The cabinet shall be furnished with reinforced mounting areas along the top and bottom 3 inches of the back of the cabinet as shown to the right. Mounting holes will be field drilled by the installation contractor in this area. The reinforced mounting areas shall be a minimum of 0.375 inches thick.



Cabinet Mounting Details – NOT TO SCALE

2) The mounting area shall include reinforcement angle or other stiffening techniques to prevent the back of the cabinet from deforming when attached to the pole.

3) The 3 inch mounting area at the top shall be accessible with the equipment removed from the shelf;

4) Equipment located in the lower section of the cabinet shall not need to be removed to gain access to the mounting bolts along the bottom rear of the cabinet.

5) The design of the cabinet mounting shall take into account the interaction of dissimilar metals between mounting hardware, brackets and the cabinet constructs.

6) The CONTRACTOR shall work with the CITY to develop a design for the cabinet mounting which is readily accessible for installation and removal without risk of damage to the internal assemblies. Further, it is necessary to tighten the mounting hardware without removing the cabinet assemblies.

7) The CONTRACTOR is not responsible for the actual pole mounting hardware except as specified herein (reference Section 3.1.17).

3.1.13 Labeling

1) The cabinet shall be furnished with a metal plate embossed with the following two (2) lines of text:

   TRAFFIC CONTROL
   NEW YORK CITY

2) Alternatively, the information noted above may be permanently etched or embossed into the cabinet door in such a manner as to be clearly visible on the exterior of the cabinet.

3) If a plate is used, it shall be 11 inch in length and 5 inch tall and welded the outside of the front door with the center of the plate located at the vertical centerline and midway between the top and the middle of the door. This plate shall be painted with the same green paint as the exterior of the cabinet. The text shall have letters that are 0.875 inch in height; the information noted above shall be embossed in a manner which allows this information to be read even after several coats of paint have been added to the cabinet. The welding for this plate shall be neat in appearance.

4) The controller cabinet shall also be identified by model number, a serial number, and NYC DOT on a metal plate visible on the inside of the cabinet. Consecutive serial numbers shall also be stamped on the metal name identification plate and fastened to the inside of the cabinet by rivets which shall not protrude or otherwise be visible on the exterior of the cabinet.

5) All equipment furnished in the cabinet shall be clearly and permanently labeled. Marker strips on the vehicle detector racks and the load switch racks shall be part of and be located immediately below the subject module. The strips shall be made of material that can be legibly written on with pencil or ballpoint pen.

6) NYCDOT requires that each separate procurement contract or construction contract have serial numbers which are unique and identifiable. The CONTRACTOR shall work with the CITY to establish a numbering scheme that allows the CITY and its maintenance contractors to quickly identify the specific contract which provided the controllers. This requirement shall be true for all subassemblies as well so that the CITY can identify the origin of the part and determine which contractor is responsible for its maintenance.

3.1.14 Cabinet Shelf

1) A metal shelf shall be provided for a shelf mounted controller unit and communications devices.

2) The equipment and shelf shall be arranged so that it is possible to remove any piece of equipment from the cabinet without removing any other piece of equipment. The shelf shall be located at the top part of the cabinet and shall have sufficient space to place or remove a piece of equipment of *8 inch H by 10 inch W by 13 inch D.* All shelf-mounted equipment shall be arranged to allow removal and replacement without the removal of adjacent equipment.

3) The cabinet shelf shall cover the full horizontal dimension (except for a gap for air flow at the sides) of the cabinet with a minimum of a ¾ inch gap between the shelf and the back of the cabinet. The shelf shall be constructed in a manner which will support a controller (not to exceed 20 pounds) and communications adapter (not to exceed 10 pounds) with cables, without deformation. Cables shall extend from the back of the cabinet to the front such that all connections are made to the front of the devices. The shelf shall include a lip at the back of the shelf to prevent objects from falling down behind backplane.

3.1.15 Power to the Shelf Mounted Devices

1) Power (AC line) to all shelf mounted devices shall be provided via separate power cords which are permanently attached (wired into) to the device and plugged into outlets in the controller cabinet. The power outlet shall be accessible such that the device can be easily removed from the cabinet without the need for disassembly.

2) Where the device is powered from a low voltage DC supply, the power may be included in the control harness for the device.

3) All shelf-mounted devices must include a front panel mounted power-on switch with replaceable fuse or circuit breaker. All devices shall include an indicator that indicates that it is currently powered.

4) Power for the shelf mounted devices (minimum of 2 duplex outlets [4 sockets]: communications device, controller unit, additional control equipment); shall be filtered and protected from surges. These outlets shall not be GFI protected.

3.1.16 Cables

1) All cables used in the cabinet shall be of sufficient length such that the cable and connector are not strained during normal operation. Cables shall be covered with an outer jacket and shall remain flexible at all ambient temperatures.

2) All cables shall include sufficient slack to allow easy insertion and removal under adverse conditions without the need to remove other equipment to gain access to the cable.

3) All cables shall be clearly labeled at the termination connector so as to clearly indicate the insertion orientation and intended socket/plug or device. Labels shall match the wiring diagrams.

4) All cables shall be installed such that they do not present a danger of shorting other equipment in the cabinet when left to ‘dangle’.

5) All cables shall not have too much slack such that they are easily damaged when the maintenance or engineering staff closes the cabinet door.

6) Cables shall be protected from damage caused by contact with sharp edges during shipping, servicing, and normal use.

7) Cables shall not become 'stiff' and difficult to manipulate at ambient temperatures normally experienced in New York City.

8) Cables shall be routed and affixed in a manner which prevents damage by the door mechanism as noted above.

3.1.17 Cabinet Installation Kit

1) Each cabinet shall be supplied with a cabinet installation kit. **All mounting hardware shall be stainless steel** unless otherwise noted. Each kit shall consist of the following:

    a. Five carriage bolts 1-3/4" long 3/8" diameter; carriage bolts shall have 16 threads per inch and be supplied with hex nuts, flat washers and lock washers for each bolt. One neoprene sealing washer with a 0**.**364" ID, a 1½" OD & 0**.**125" thick shall be supplied for each bolt.

    b. Two 3/8-16 Acorn nuts shall be supplied with each cabinet.

    c. One lock nut of cast aluminum material for pipe size 1½" national pipe straight (NPS) cut tread; taper cut treads are not acceptable. Lock nuts shall be Marbelite Co. # TA 2178 or GTE #HN-150 or approved equal. One schedule 80 1½ inch nipple x 1½ inch long with a NPS cut tread. The locknut shall be free turning by hand only for the length of the nipple with no binding or rough spots. The nipple must also tread into a field taped 1½ inch NPS hole freely using hand pressure with no tools. This nipple shall have a chamfered outside edge and a round inside edge on both ends. One cast aluminum chase nipple 1 3/8 inch (1.375) long see NYC /Traffic detail drawing # LG_167-S. Both nipples shall have a neoprene gasket with a 2 ½" OD -1 7/8" ID & 0**.**125 thick supplied.

    d. A tube of paintable clear silicone sealer (APX 2.5 Ounce squeeze tube) shall be supplied for each controller; these tubes shall be shipped separately from the controller. Boxes of the silicone sealer shall be clearly labeled as to date of manufacture and usable life.

3.2 Cabinet Interface

1) The cabinet shall use a NEMA type serial interface bus conforming to NEMA Standards Publication TS 2-2003, *Traffic Controller Assemblies with NTCIP Requirements*, and as modified herein. The Port 1 serial connection shall originate on Port 1 on the controller unit and attach to the input file where it shall connect to the BIU and an auxiliary connector for future expansion to an auxiliary cabinet or second BIU. The expansion connector shall be easily accessible for future expansion and shall be protected from contaminants such that it will be undamaged and reliable when the expansion takes place. The expansion connector assembly shall include transient protection devices such that cables extending to exterior cabinets are not damaged by static discharges. The location and connectors shall match the existing cabinet construction.

2) The Port 1 interface shall conform to Section 3.3 of the NEMA specification except as noted herein.

3) A single BIU will be used to provide all ASTC-6 cabinet functions and two (2) will be used for the ASTC-8 and ASTC-12.

4) The single BIU shall be identified as a TF BIU #3 and all cabinets shall include this BIU when used in NYC. Upon power up, the controller unit must read the 16 bit cabinet address to determine the appropriate database which will specify the Input/output mapping for this cabinet. Since the input file and output load switches can be assigned to a wide variety of functions, it is necessary for the controller unit to read the cabinet address in order to establish the communications address and schema, input file assignments, and load switch (output) assignments. Further, the cabinet address will identify the unique database and timing parameters for the controller operation.

5) The Cabinet includes a watchdog signal (assigned to a BIU output) to the conflict monitor that is driven by the BIU. The absence of this signal shall cause the cabinet to go to cabinet flash. The watchdog operation shall match that of the standard New York State cabinet.

6) A Conflict Monitor Unit (CMU) is included to track the operations, including, red monitoring, conflict monitoring, and watchdog monitoring and to support the initialization procedures.

7) Note that NYS standard current monitoring of signal loads is <u>not</u> included in this specification. It is not required that the load switches and/or PDA include the ability to monitor the signal loads to report outages.

8) For the larger cabinet, ASTC-12 an additional BIU will be used. Where additional detectors and load switches may be necessary, an auxiliary cabinet will be used and it shall support additional BIUs for the detectors and/or load switches using custom assignments for those functions.

9) The CONTRACTOR shall be required to demonstrate that the ASTC controller unit can fully support the TF3 and TF4 and allow the connection of additional DET BIUs and expansion TF BIUs where additional load switches or additional inputs are required. The CONTRACTOR shall be required to demonstrate the support for an additional expansion cabinet with at least one DET BIU and one TF2 BIU.

10) The ASTC shall fully support the concept of expanding the input file capabilities with the addition of more sophisticated detectors such as the RTMS[5] device communicating with the controller by simulating a DET BIU through the 485 bus. The ASTC shall support up to 4 DET BIUs for certain monitoring stations.

11) It shall not be necessary for the ASTC to control traffic signals to be used for detector monitoring. The ASTC may be configured in a special cabinet (including an address card) and support only data collection from either input devices (e.g. 242, 224) or DET BIU devices.

12) Note that NYCDOT also specifies a special BIU which acts as both a TF3 BIU in either an ASTC-6 or ASTC-12 cabinet with a serial interface to connect to and EIS Model G4 Spider

[5] A microwave detector assembly provided by EIS Electronic Integrated Systems Inc., 150 Bridgeland Ave.,Toronto, ON (Canada) that can support multiple lanes from a single sensor.

network device and emulate both a Detector BIU 3 and 4. The specifications for this device are shown in Section 3.9.20.

13) Where additional detector BIUs are included in the implementation, the failure of the BIU shall not cause the cabinet to go to flash; sensors assigned to the failed Detector BIU shall be considered continuously activated (continuous call) such that detectors used for actuation shall cause the apparent detection of a continuous vehicle, and occupancy shall be 100%; and this will trip error indications.

14) The P1 cable termination and connectors for the BIU, the termination card, and the Controller Unit shall be designed to accept the screw-type connector retention. The cables shall include molded retention screws which shall be knurled so that they can be screwed in/out without the use of any tools, and shall include a slotted head. These shall be retained in the connector body and shall screw into appropriate retention blocks on the chassis in a manner that prevents the threaded insert from turning.

15) The CONTRACTOR shall ensure that the mounting of the retention blocks in the ASTC-CU are installed such that they cannot turn or become loose during removal/installation of the mating connector.

3.3 Cabinet Subassemblies

1) The controller cabinet shall include one or more internal assemblies to house the input cards, load switches, conflict monitor, field terminals, flash transfer relays, etc. While this specification describes each as a unique subassembly, the CONTRACTOR is encouraged to consolidate these functions where necessary to simplify the mechanical and/or electrical details of the cabinet. However, all plug-in devices (including flash programming jumpers, flash transfer relays, load switches, flashers, conflict monitor, input file cards, and BIUs) shall be visible, removable, and replaceable without disassembling any other portion of the unit. This may be accomplished by hinged assemblies, but no tools shall be required and access to the devices shall not expose the service personnel to hazardous voltages. Further, the cabinet design must retain the modularity of the individual plug-in devices; the CONTRACTOR may not integrate these electronic devices into the electrical/electronic design of the cabinet.

2) The design of the cabinet components and subassemblies shall be such that a single electrician can easily remove and replace any field serviceable component in less than 15 minutes under adverse field conditions using only common hand tools. Assemblies and subassemblies that mount into the cabinet shall be self-fixturing and include mounting studs or similar techniques to allow the equipment to be easily installed. It is preferable, but not required, that a single frame be used to mount all components and that this frame install into the cabinet as a single assembly. It should be noted that ease of installation and removal is essential to allow the field technicians to quickly replace the ‘guts’ of the cabinet without damage to any component or subassembly. The design of the mounting and choice of hardware shall eliminate the possibility of damage to the cabinet or assemblies caused by cross-threaded nut/bolt installation. If installation/removal requires the use of tools, the procedure shall be simple and obvious to an untrained technician; tool access shall not subject the technician to likely injury caused by sharp edges, etc. Note that removal and replacement of the entire backplane – i.e. removal of most of the “guts” of the controller, is included in the 15 minute requirement.

3) Each assembly and subassembly shall be clearly and permanently labeled as the **Property of NEW YORK CITY** with a unique serial number and make and model number and manufacturer's name. These shall be visible with the front cabinet door open and without disassembly of the unit.

4) Where assemblies include connectors for additional modules or future expansion, such connectors shall be protected from damage and dirt by protective covers or dummy connectors. It may be many years before additional input cards or output functions are used; the CONTRACTOR shall ensure that these option jumpers and expansion connectors are properly protected for future use.

5) All load switches, relays, flasher(s), circuit breakers, fuses, and switches within the facilities shall be uniquely identified, and shall be referenced on the cabinet diagram. Component nomenclature on non plug-in devices shall be on or adjacent to the component. Component nomenclature for plug-in devices shall be adjacent to the receptacle for the device. Nomenclature shall be permanent and legible at a distance of 2 feet by a person of 20-20 sight.

3.3.1 Input File Rack

1) A cabinet input file shall be provided. The input file rack shall be capable of housing four (4) standard input cards (Reference New York State Transportation Management Equipment Specifications, March 2010) as follows:

   - Slot 1 – Can house a detector module (or other standard dual modules such as isolation modules)
   - Slot 2 – Can house a dual or a quad detector or other dual or quad modules such as isolation modules providing slot one is unused.
   - Slot 3 may be used for a quad/dual detector module or dual/quad isolation modules. If a quad module is used, slot 2 must be unused.
   - Slot 4 may be used for a dual/quad detector or isolation module providing the module in slot 3 does not interfere with the mechanical space of the fourth slot.

2) In addition, any of the slots could be used for preemption modules, isolation modules, or other intersection control devices.

3) The input file rack shall provide card guides (top and bottom) and a 22-pin edge-connector on **.**156 inch centers, mounted vertically for each slot. The edge connectors shall be double sided connectors with the numbered side of each pin shorted to its respective lettered side internally. Connector center to center spacing shall be 1.20 inches. The input file shall allow air circulation through the top, bottom, and rear of the input file. There shall be no obstruction within 1.0 inches above and below the input file within the open area. This is to ensure adequate air flow in the area of the input cards. The CONTRACTOR may present an alternate design which meets the intent of this requirement.

4) Typically, the eight (8) pins (D, E, J, K, P, R, U, V) on each input module edge connector shall be wired to field terminals to provide for four (4) loop detector channels as shown below. This information is clarified for the 4 slot input files in Table 1 and Table 2.

   Pin D – Loop 1 terminal A (e.g. CH1)
   Pin E – Loop 1 terminal B (e.g. CH1)

Pin J – Loop 2 terminal A (e.g. CH2)
Pin K – Loop 2 terminal B (e.g. CH2)
Pin P – Loop 3 terminal A (e.g. CH3) Note 1
Pin R – Loop 3 terminal B (e.g. CH3) Note 1
Pin U – Loop 4 terminal A (e.g. CH4) Note 1
Pin V – Loop 4 terminal B (e.g. CH4) Note 1
Note 1: P,R,U,V are not wired for all slots – see the detailed input file wiring on Diagram 1.

5) The collector outputs of each channel (F, W, S, Y) shall be connected to the BIU input terminals as shown. All emitters shall be connected to logic ground (H, X, T, Z). Note that S and Y are not wired for all slots – see Diagram 1.

6) Two detector resets are to be wired in the cabinet. Detector resets are combined for slots 1 and 2 and they are also combined for slots 3 and 4. Detector reset (C) for slots 1 and 2 are wired to BIU input/output 7 and detector reset (C) for slots 3 and 4 are wired to BIU input/output 8.

7) The input file rack shall be constructed in a modular manner and shall be removable from the cabinet shell without the use of special tools. The harness running from the input file to the field terminal blocks shall be connectorized at the rear of the input file. All plug connectors shall be identified in an appropriate manner for mating purposes. Wiring between the input file rack and field terminals shall be shielded or twisted pair. Wiring to other cabinet assemblies (e.g. Output file) shall also be connectorized. There is no requirement that the input files and output files or their inter-unit cable assemblies be compatible with the existing version of the ASTC.

8) Note that pin 'L' is used for a chassis ground to all input file card slots. This connection shall be sized such that the input file cards can use this connection for lightning and surge protection for the input circuits such as the telephone lines and loop detection lines.

9) Note that the CONTRACTOR shall have the option of integrating the Input file, the output file, and the field terminal blocks into a single unit. The wiring between these units may be printed circuit or individual wires or a combination of both (i.e. the connections between the field terminal blocks and the input file need not be connectorized as noted in paragraph 7) above. If this approach is used, the entire assembly must be removable without the use of special tools or the disassembly of the cabinet.

10) Note that the input file input and output assignments shall be dynamically configurable such that they can be used for any of the NEMA functions including but not limited to Pre-emption inputs, Pedestrian inputs, NEMA functions (Force off, Hold, status, Omit, etc.), and output functions.

11) Note that the input file is to be wired in a manner consistent with the existing input files. The CONTRACTOR shall verify the wiring of the existing input files before designing a compatible input file to ensure compatibility with the existing files. If there are differences, then the CONTRACTOR shall bring them to the attention of the CITY for resolution prior to completing the design and construction of any units. The CONTRACTOR shall not be reimbursed for any costs due to discrepancies between the existing input file wiring and the above.

3.3.2 Switches

1) The input file (or other cabinet location) shall include switches for the following functions. These switches shall be mounted on the cabinet address card:

   - Stop-timing: (CMU-BB) This switch shall be parallel wired with an output from the signal conflict monitor and shall be wired to the BIU Input #2. The controller shall recognize this function and react as noted in the NEMA TS2 specification.

   - External Min Recall: This switch shall be wired to BIU input #6. The controller shall react in accordance with the NEMA TS2 specification. Note that this switch shall cause the controller to cycle all phases including both vehicle and pedestrian displays.

3.3.3 Police Jack/Cable

1) The input file (or other cabinet location) shall include an input jack for the connection of a control cable to allow a local operator to manually advance the controller. The jack shall accept a ¼ inch 3-conductor Phono plug; contact areas shall be gold plated. Upon insertion of the plug, the manual control function shall be enabled and the switch shall provide an interval advance as the push button is pressed to manually advance the controller. The following electrical connections shall be supported by the push button cable and jack:

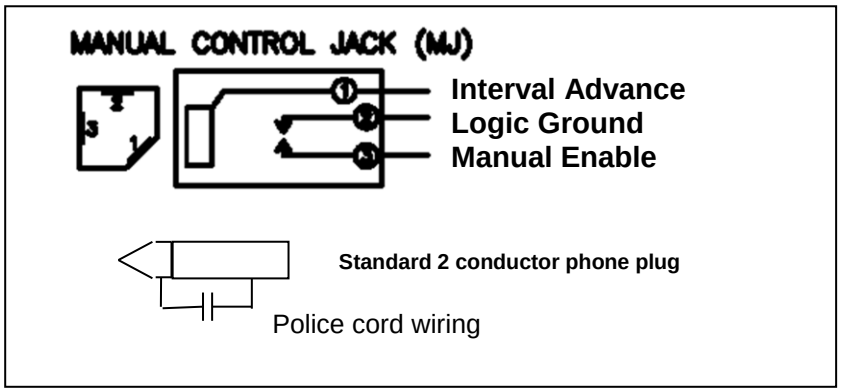
   - Logic ground: this shall be connected to the ground side of the cabinet 24 VDC logic supply.

   - Manual Control Enable: this shall be connected to BIU input #4 and shall be grounded when the plug is inserted.

   - Interval Advance: this shall be connected to BIU input #5 and shall connect to logic ground when the police button is pressed.

   - Chassis ground shall be used to protect the metallic button assembly.

2) The CONTRACTOR shall supply manual control cables as noted in the bid documents. The manual control cable shall include an environmentally protected push button for the *interval advance* function. The manual control cable shall be an environmentally protected cable that is not damaged or otherwise affected due to moisture. The conductors shall be stranded and very flexible at temperatures down to –20F. The cable shall be a minimum of 10 feet and shall be supplied with a 3-conductor Phono plug to mate with the police jack listed above. Cable shall be the 'coiled cord' type that extends to the 10 foot dimension.

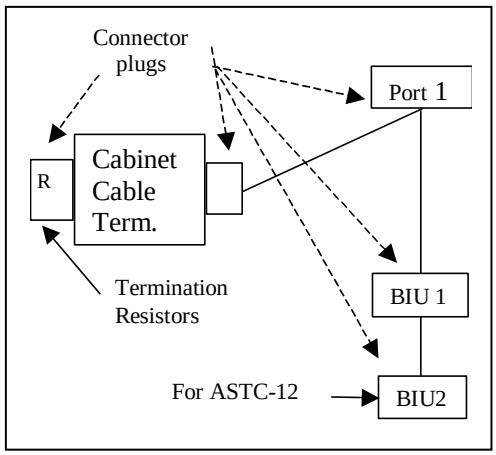


3) The jack/plug arrangement and switching shall be such that insertion/removal of the plug does not cause the controller to advance; the controller shall advance only when the push button is pressed. The wiring shown shall be used for the Phono plug. *Note that this is a special order jack.*

4) The phone jack wiring and functionality shall be interchangeable with the existing ASTC cabinets. The existing phone plugs shall be usable in the new cabinets, and the new cables shall function properly in the old ASTC cabinets.

3.3.4 NEMA Port wiring

1) The BIU data cable shall terminate on the controller unit and the BIU with provisions for extension of this bus with an additional connector mounted in the cabinet as shown.



2) The cabinet shall include a connector that shall conform to NEMA TS2 Port 1 physical and electrical specifications. This connector shall allow the Port 1 serial bus to be expanded to an auxiliary cabinet to support additional input files and output devices should additional detectors and signal heads be required.

3) The serial bus must be properly terminated and protected such that it can be extended to an auxiliary cabinet for future expansion. The termination is contained in the dummy plug which is attached to the cabinet termination card. The CONTRACTOR's approach must be consistent with the current design for cabinet expansion and serial bus termination and protection.

4) A BIU slot shall be provided within the input file to accommodate a BIU as described in Section 3.9.5. A dual row 64 pin female DIN 41612 Type B connector shall be provided for the BIU unit. Card guides shall be provided for both edges of the BIU. The BIU address pins for the BIU rack position connector shall be connected to correspond to the BIU address 2. (Note that the controller must read this BIU to determine its cabinet address which is used to determine the proper database and communications; these specifics are described later.)

5) At least 30% of the area above and beneath each BIU shall be open to allow for the free flow of air through the BIU rack. There shall be no obstruction within 1.0 inch above and below the BIU rack within the open area.

6) The BIU input slot connector shall be a male 64 pin DIN 41612 Type B series. The connector shall be centered at the edge of the circuit board and oriented with pin 1 located at the top of the unit. The circuit board edge shall align with the connector per DIN 41612. The connector pin assignments shall be as defined in Section 8.8.3.1 in NEMA TS2-2003.

7) Wiring Diagram 1 shows the required input file wiring for the input cards.

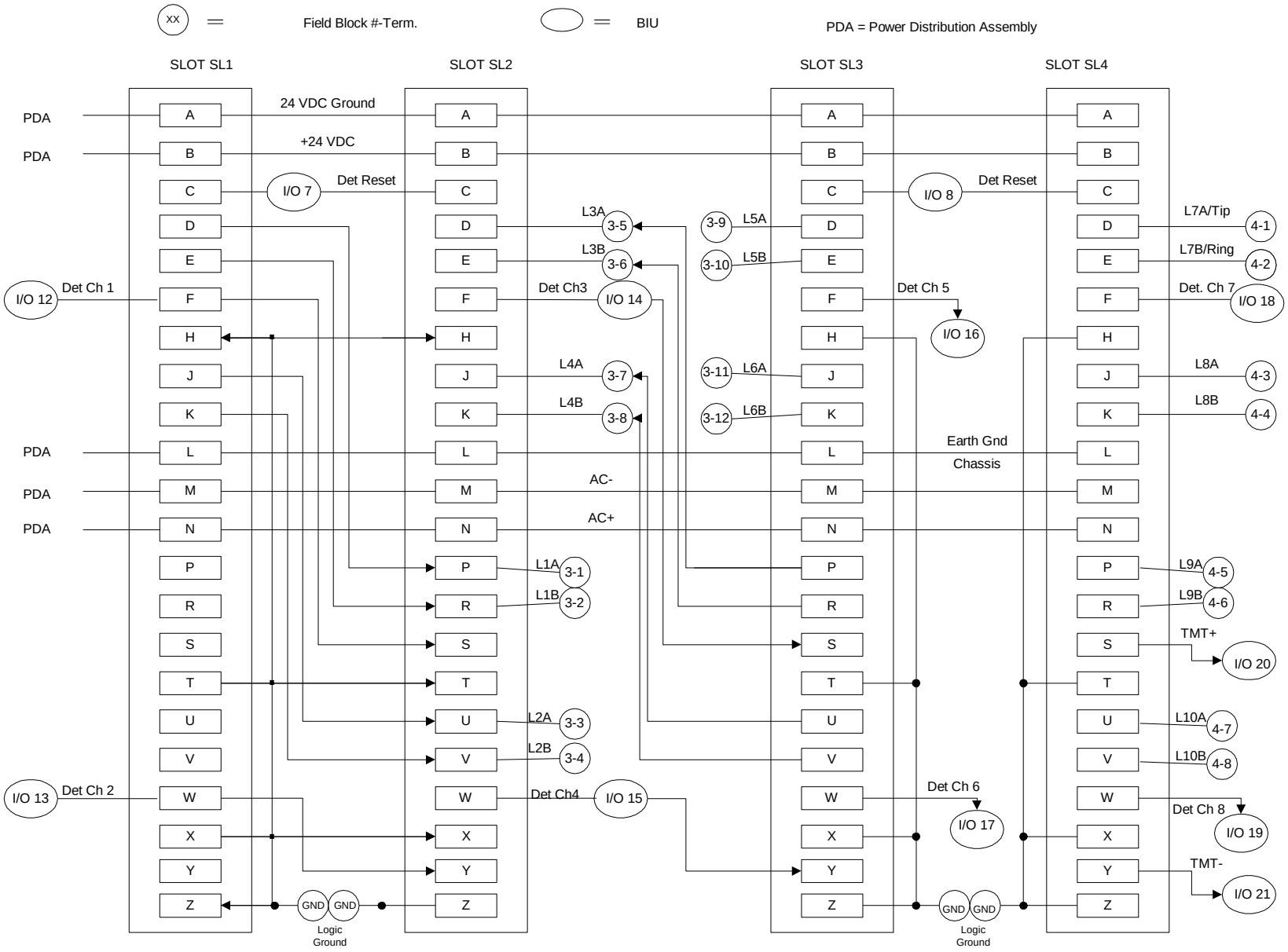


Diagram 1 Input Rack Wiring - See Section 3.3.4

3.3.5 Conflict Monitor Rack

1) The conflict monitor (CMU) module, described elsewhere in this specification shall be mounted in the output file and be readily serviceable without special tools. The mounting arrangement shall contain sufficient vent holes to provide for air circulation around the monitor module.

2) The CMU shall support hot insertion and removal without damage to the unit. Alignment and dimensions of the CMU mounting assembly shall be such that the card shall fully seat into the connector and remain firmly in place during operation.

3) Card guides shall be provided to guide and support the printed circuit board of the monitor module. A rigidly supported printed circuit board edge connector, having two rows of 28/56 interdependent bifurcated contacts on 3.9624 mm centers, shall be provided. The connector shall mate with the monitor unit described elsewhere in these specifications. This connector shall not be supplied with a key.

3) The connector shall meet or exceed the following requirements:

Operating Voltage:	600 volts AC (RMS)
Current Rating:	5 amperes
Insulation Resistance:	500 meg-ohms
Contact Material:	Copper alloy plated with 0.00127 mm of nickel and 0.000381 mm or greater of gold on top of nickel
Board thickness:	1.499 mm to 1.676 mm
Contact Resistance:	0.006 ohms

3.3.6 Load Rack

1) The load rack shall mate with the solid-state switch pack and flasher described elsewhere. It shall be capable of containing 6 switch packs, 1 flasher, 2 flash transfer relays, and 4 programming plugs to select emergency flashing output on 4 of the switch packs. A shelf/bracket shall be provided in the rack to support the installed switch packs and flasher unit. Dimensional spacing between the switch packs and switch pack/flasher shall conform to the New York State Transportation Management Equipment Specifications , March 2010. Note that the switch packs and flasher must properly handle LED signal loads and mixtures of LED and non-LED signal loads (e.g. Incandescent, neon, fluorescent) without any degradation or improper operation (false tripping or failure to recognize) of the conflict monitor.

2) On the primary side of the flasher there shall be a 15-ampere MDL type time delay fuse. Fuses shall be readily serviceable without special tools and live parts shall be covered. Fuses shall be located on the power distribution assembly. Additional flashers will require additional fusing.

3) The required number of solid-state switch packs and the flasher shall be housed within a rack. A means to support and retain the switch packs and flasher shall be provided. Each rack shall be equipped and wired for the required complement of solid-state switch packs and a flasher, so that no additional hardware or wiring to the rack is required.

4) Upon insertion of the load switch pack, at least 50% of the area above and beneath the load switch or flasher (between 0.5 and 1.5 inches) on either side of the centerline of the device, shall be open to allow for the free flow of air across the load switches or flashers. There shall be no obstruction within 1.0 inch above and below the units within the open area.

5) It shall be possible to flash either the Yellow or Red indication on any load switch output assigned to a vehicle movement and to change from one color indication to the other by use of simple tools without the need to unsolder or re-solder connections.

6) Flash configuration jumper plugs and jumpers shall be provided for load switches 1-4 only. The flash configuration jacks may be mounted in a manner which requires that other assemblies be 'moved' using hinged doors or drop-down techniques; however, the method to gain access shall not require the use of any tools, and shall not expose the technician to dangerous voltages, further, it shall be possible to open the cabinet and view the jumpers while the cabinet is fully operational and without affecting the operation of the cabinet.

3.3.7 Door Switches

1) The cabinet shall include 2 door switches as specified herein. One of the switches provides the flash/conflict monitor interlock function and the other switch is used as an input (through the BIU) to the controller to monitor the cabinet door position. This BIU monitored door switch shall be closed whenever the door is open and open whenever the door is closed. This switch shall be wired to BIU input #8. Note that this input to the BIU is also used for a cabinet alarm to indicate an over-temperature situation described elsewhere herein.

2) Door switches shall be mounted such that they are not subject to water damage.

3) Door switches shall be mounted and wired such that they cannot be easily accessed or defeated by maintenance personnel.

4) Switch wiring shall not subject maintenance personnel to any hazardous voltages due to inadvertent contact, moisture, or switch defects.

5) The door switch functions may be accomplished with a 12 VAC relay (using the 12 VAC isolated supply) in the PDA driven by a single pole switch in the door. If this option is selected, the relay shall be energized when the door is open and de-energized when the door is closed. Removal of the relay shall cause the cabinet to flash.

3.3.8 Rear Panel (Terminal & Facilities)

1) Each electrical terminal shall be uniquely identified and shall be referenced by the cabinet wiring diagram. Terminal(s) nomenclature shall be adjacent to (or on top of) the terminal(s). The nomenclature for terminals accessible from the front of a panel shall be visible from the front of the panel. Nomenclature shall be permanent and legible.

2) The terminals shall be easy to access with the front cabinet door open. Terminals shall be located at the lower rear of the controller back panel. However, terminals shall not interfere with the conduit entry area or the lower mounting area. Further, the terminal blocks shall be mounted such that there is sufficient room for the cables to be 'stored' or looped at the bottom of the cabinet while still providing access to the terminal blocks.

3) Two different types of terminal blocks shall be used for the field terminals. Signal wires from the load switches shall be Marathon type tubular compression blocks. These blocks shall include marker strips which are labeled in accordance with directions from the CITY. This type of terminal block shall also be used for the incoming power connection to the cabinet which shall terminate first on the terminal facility back panel then connect to the PDA using

a fully insulated slip-on connector[6]. [Reference: Marathon Terminal Block part number (or equal): 1112S for the signal circuits and 1102S for the power termination].

3.4 Wiring

1) All cabinet wiring harnesses shall be neat, firm and routed to minimize cross-talk and electrical interference. All wires in a harness shall be laced or bound together, arranged and made secure by the use of wiring harnesses, cable sheaths, cable wraps, or raceways. Cabling shall be arranged so that any removable assembly may be removed without disturbing conductors not associated with that assembly.

2) Wiring within the cabinet shall conform to National Electric Code practices and UL requirements with respect to fusing currents and insulation.

3) Printed circuit motherboards may be used to eliminate or reduce cabinet wiring; reference paragraph 7) below. Where such printed circuit motherboards are used for cabinet wiring, they shall be conformal coated in such a manner that eliminates the possibility of water damage to the circuits, traces, or operation of the controller caused by condensation or incidental water on the equipment shelf.

4) Cabling shall be routed to prevent conductors from being in contact with metal edges. Power wiring (120 VAC) shall be bundled separately by function, or shielded separately by function from all low voltage control circuits. All electrical connections on the back of the cabinet rack shall be soldered or made with locking type connectors.

5) All conductors and live terminals or parts, which could be hazardous to maintenance personnel, shall be covered with suitable insulating material. Within the cabinet wiring, the DC ground and earth ground shall be electrically isolated from the AC neutral by 500 meg-ohms.

6) Conductors within the cabinet between the AC service terminals and the switch pack circuit breakers, including the switch pack breakers and signal light neutral, shall be rated so as to withstand short circuits on any field output line without deterioration. All AC switch pack wiring shall be capable of surviving a short circuit (which trips the breaker or fuse) on any circuit without damage.

7) All wiring used within the controller cabinet (including printed circuit wiring) shall be sized and protected such that short circuits on any field circuit(s) (including but not limited to detectors, signal heads, red monitoring, pedestrian signals, etc.) or the failure of any cabinet device or component shall not cause damage to the circuit traces or cabinet wiring. Insertion and removal of any card or component shall not cause damage to the connectors or wiring within the cabinet.

8) All wiring used within the controller cabinet (including printed circuit wiring) shall be sized and protected such that inadvertent connection to live voltages on any field circuit(s) (including but not limited to detectors, signal heads, pedestrian signals, etc.) shall not cause damage to the circuit traces or cabinet wiring. Under no circumstances shall short circuits or failure of a device cause damage to circuit traces or cabinet wiring.

[6] The slip-on connector for the new versions of the ASTC shall fully mate with the slip-on connector used for the previous versions of the ASTC.

3.5 Ground Bars

1) Two (2) solid copper or brass bus bars with through pressure (screw) connectors shall be provided on the floor of the cabinet housing. These bus bars shall be capable of accepting wire sizes in the range of AWG #6 to AWG #16 gauge. Each bus bar shall be supplied with a plated copper or brass lug capable of accepting a AWG #4 to AWG #14 gauge wire. The lug shall be connected to one pole of each bus bar and be UL approved for connection to either copper or aluminum wire and marked for ground bonding.

2) One (1) bus bar shall function as an AC minus (common) bus bar. This bus bar shall be located on the front side of the (closest to the cabinet door) cabinet floor and positioned parallel to the cabinet door, with a minimum of 12 terminal connecting points. The bus bar shall be securely mounted to and electrically isolated from the floor of the cabinet. The bar shall be connected to the chassis ground bus bar by a single AWG #6 wire.

3) One (1) bus bar shall function as a chassis (earth ground) bus bar. It shall be identical to the AC- bus bar except that this bus bar shall be securely fastened approximately 3/8 inch off the floor of the cabinet using stainless steel spacers so that the bus bar does not sit in moisture which accumulates in the bottom of the cabinet. It shall be electrically bonded to the cabinet and located on the right side of the cabinet floor, adjacent and parallel to the *PDA assembly*.

4) The AC-, chassis and logic ground shall be isolated from each other throughout the assembly, including any auxiliary sub-panels. Spacing between ground bars shall not be less than 1-1/2 inch apart. The only connection between AC- and chassis is called out in paragraph 2) above.

5) The unit shall be equipped with two power line surge protectors between both line conductors (AC+ and AC-) and equipment ground. The protectors shall be installed in the PDA.

3.6 Relay Transient Protection

1) All AC relays used in the cabinet shall have a resistor-capacitor snubber network placed across their coils. This network shall be designed to suppress the high voltage transients generated by the relay coils. The parallel combination of the two flash transfer relays shall have only one of these networks. All DC relays shall have diodes placed across their coils to suppress switching transients.

3.7 Terminal Blocks

1) All terminal blocks shall be of the high-density tubular compression types, with rotation resistant square type terminals to prevent the terminals from loosening if excess torque is applied to the terminals. Terminal blocks located within the cabinet shall be accessible to the extent that it shall not be necessary to remove the controller unit or any other modules from the cabinet. Terminals shall conform to NEMA TS2-2003 Section 5.3.6.1 where applicable.

2) The terminals and facilities layout shall be arranged in a manner that allows all equipment to be readily accessible. All terminals carrying 120 VAC in normal operation shall be covered unless otherwise protected by recessing or by terminal strip barriers. This includes all terminals exposed when the front door of the cabinet is open and all panels and covers are in their normal operating position.

3) All terminal blocks shall be mounted at the lower rear of the cabinet and shall be accessible with the cabinet door open.

4) Power distribution components as required shall be located in the lower section of the cabinet and the incoming AC power line shall wire directly to the PDA and the bus bars at the bottom of the cabinet.

5) Field terminals shall be numbered as shown in Table 1 and Table 2 below:

Table 1 Field Terminals – Signal Heads

#	Label	Function	Signal	Connection
Terminal Block 1				
1	R1	1R	Load Switch 1 Red	FSH*/LS1
2	A1	1Y	Load Switch 1 Yellow	FSH/LS1
3	G1	1G	Load Switch 1 Green	LS1
4	R2	2R	Load Switch 2 Red	FSH/LS2
5	A2	2Y	Load Switch 2 Yellow	FSH/LS2
6	G2	2G	Load Switch 2 Green	LS2
7	R3	3R	Load Switch 3 Red	FSH/LS3
8	A3	3Y	Load Switch 3 Yellow	FSH/LS3
9	G3	3G	Load Switch 3 Green	LS3
10	R4	4R	Load Switch 4 Red	FSH/LS4
11	A4	4Y	Load Switch 4 Yellow	FSH/LS4
12	G4	4G	Load Switch 4 Green	LS4
Terminal Block 2				
1	DW1	5R	Load Switch 5 Red	LS5
2	SP1	5Y	Load Switch 5 Yellow	LS5
3	W1	5G	Load Switch 5 Green	LS5
4	DW2	6R	Load Switch 6 Red	LS6
5	SP2	6Y	Load Switch 6 Yellow	LS6
6	W2	6G	Load Switch 6 Green	LS6
7	PC COM		Ped Common (common side of 12VAC)[7]	PDA
8	PE COM		Preempt Common (common side of 12VAC)	PDA
9	Logic Gnd		Logic Ground	PDA
10	+24VDC		Cabinet DC Power	PDA
11	AC+		Cabinet AC+ unfiltered	PDA
12	L1		Incoming AC power line	Fully Insulated slip-on to PDA
*Note that FSH indicates that it is routed through a flash configuration jumper and flash transfer relay				

[7] Note that 12VAC is used to drive the Pre-empt input common side of the BIU inputs and the contacts are then switched to ground (PE COMM, PC COMM) by the push-button or control relay.

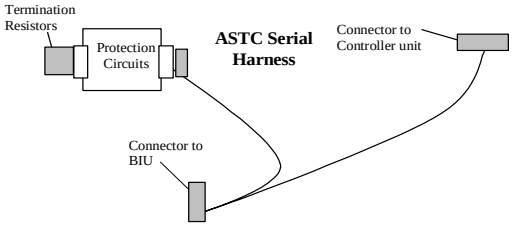
Table 2 Field Terminal Blocks - Other Circuits

#	Function/Label	Signal	Connection
Terminal Block 1			
1	L1A	Detector Channel 1 Loop	SL1-D & SL2-P
2	L1B	Detector Channel 1 Loop	SL1-E & SL2-R
3	L2A	Detector Channel 2 Loop	SL1-J & SL2-U
4	L2B	Detector Channel 2 Loop	SL1-K & SL2-V
5	L3A	Detector Channel 3 Loop	SL3-P & SL2-D
6	L3B	Detector Channel 3 Loop	SL3-R & SL2-E
7	L4A	Detector Channel 4 Loop	SL3-U & SL2-J
8	L4B	Detector Channel 4 Loop	SL3-V & SL2-K
9	L5A	Detector Channel 5 Loop	SL3-D
10	L5B	Detector Channel 5 Loop	SL3-E
11	L6A	Detector Channel 6 Loop	SL3-J
12	L6B	Detector Channel 6 Loop	SL3-K
Terminal Block 2			
1	L7A	Detector Channel 7 Loop	SL4-D
2	L7B	Detector Channel 7 Loop	SL4-E
3	L8A	Detector Channel 8 Loop	SL4-J
4	L8B	Detector Channel 8 Loop	SL4-K
5	L9A	Detector Channel 9 Loop	SL4-P
6	L9B	Detector Channel 9 Loop	SL3-R
7	L10A	Detector Channel 10 Loop	SL3-U
8	L10B	Detector Channel 10 Loop	SL3-V
9	PC1	Pedestrian 1 Detector	BIU Opto in 1
10	PC2	Pedestrian 2 Detector	BIU Opto in 2
11	PE1	Preempt 1 Detector	BIU Opto in 3
12	PE2	Preempt 2 Detector	BIU Opto in 4

3.8 Port 1 Connectors (Cabinet serial bus)

1) One (1) Port 1 communications Port shall be provided on the front of the controller unit as specified herein. The Port 1 Connector will support the high-speed serial data protocols to connect to the BIU(s). This bus will be used for future cabinet expansion.

2) The input file (or cabinet) shall include a single 'pig-tail' harness. One end shall attach directly to the Port 1 connector on the front of the shelf mounted controller unit; one end shall attach directly to the front of the BIU located in the input file; the third connector shall attach to a termination/expansion block mounted in the controller cabinet. The termination/expansion block shall include surge protection and provisions for a termination or expansion connector.



3) Each communications cable shall provide twisted pairs for the Tx Data, Tx Clock, Rx Data, Rx Clock signals. The twisted pair shall use at a minimum 24 AWG stranded wire and have a characteristic impedance of 120 ohms nominal. Overall cable length shall not exceed 15 feet. The communication cable shall include an overall shield or alternately each twisted

pair within the cable shall be shielded. A shield shall be connected to Earth Ground only at the Port 1 connector (pin 12). The other end of the shield shall be left floating.

4) A separate connector with termination resistors shall attach to the expansion connector as shown when no MMU or other expansion cabinet is used. For the ASTC-12 cabinet, the harness shall include a connector for the second BIU.

5) All cable harness connectors shall be male and all cabinet mounted connectors shall be female.

6) Due to of the transmission line characteristics required, the communications cable used shall be recommended by the ASTC manufacturer. Each communication cable connector shall be a 15 pin metal shell "D"' subminiature type. The connector shall utilize male contacts with 15 millionths of an inch gold plating in the contact area. The connector shall intermate with an Amp Incorporated part number 205206-1 or equivalent and be equipped with spring latches.

3.8.1 Conflict, Flash, and Startup Functions

1) In addition to the standard specifications for the Model 2010 conflict monitor (CMU) and the cabinet invoked through the NEMA TS2-2003 and the NYS 170 specifications, the additional functional requirements listed below shall also apply to the ASTC cabinet operation and components.

2) The signal loads (load switches 1-6) shall be wired to a single circuit breaker. The circuit breaker shall include an auxiliary contact that opens when the breaker is tripped or switched to the *off* position. This auxiliary contact shall be used to ensure that if the breaker trips *off* or is switched *off*, the signals shall be set to flashing operation. This shall be immediate and automatic and shall not trip the CMU to the conflict condition.

3) The cabinet shall include two switches; one shall be labeled "**SIGNALS ON/OFF**" and the other shall be labeled "**FLASH ON/OFF**". These switches shall be accessible at the front of the cabinet without the need to move or remove any other equipment. They shall be protected from inadvertent activation. They shall be clearly labeled as to function and operation. Switch operation shall be as shown in Table 3.

Table 3 Cabinet Switch Functions

Switch	On position	Off position
SIGNALS ON/OFF ***SW1***	Signal Displays shall be enabled and shall run normal three-color operation unless SW2 is on or the cabinet is in conflict.	Signals shall be dark regardless of the condition of the flash switch or the conflict condition. Turning the signals off shall not result in a conflict condition and restoring signal power shall restore normal operation.
FLASH ON/OFF ***SW2***	Signals shall enter the flashing mode immediately. The signal heads to be flashed shall be determined by the flash programming jumper plugs. This condition shall not cause the conflict monitor to detect a conflict condition or fail condition.	The cabinet shall operate in normal three-color display mode unless there is a conflict or SW1 is in the off position.
Additional Switch Requirements: ▪ Changing SW1 from the **off** to the **on** position shall immediately restore three color operation without regard to the controller commanded signal display. Neither SW1 nor SW2 shall activate the stop timing function of the controller. ▪ Red monitoring shall be disabled during flashing operation such that the conflict monitor does not detect a failed condition as being caused by the flashing operation. ▪ Use of the switches shall not cause the conflict monitor to trip to the latched failed condition.		

4) Detection of a signal conflict shall cause the conflict monitor to activate **STOP TIMING** input function to the controller and shall cause the cabinet to enter the flashing condition until reset by a field technician. The detection of a signal conflict shall be 'remembered' even through power failures such that the signals shall continue flashing operation after the restoration of power.

5) Flash transfer relays (FTR) shall operate in the normally energized condition during three-color operation. FTRs shall de-energize to cause flashing operation.

6) The signal master contactor (MC) shall operate in the normally energized condition to provide power to the load switches for normal three-color operation.

7) It shall not be possible to operate the controller in three-color operation with the conflict monitor removed when the door is closed. With the door open, it shall be possible to run normal three-color operation with the conflict monitor removed.

8) The Model 2010 signal conflict monitor shall monitor the cabinet 24 VDC power supply, line voltage and watchdog timer provided by the BIU. Failure of any of these signals/voltages shall cause the cabinet to flash.

9) The cabinet shall be wired, and the controller input/output and functions shall support orderly transition into and out of cabinet flash, power transitions, and startup.

10) On power turn-on the CMU shall apply the stop timing signal, deactivate the flash transfer relays and deactivate the power to the contactor. The controller shall recognize the presence of the stop time input and shall hold the controller. Upon release of the stop timing input to the BIU, the controller shall set the BIU outputs for the startup condition as noted in Section 3.5.5.1 of the NEMA specifications. 250 milliseconds later the CMU will activate the FTRs and the main power contactor. The Controller Unit (CU) shall continue with the startup state as programmed in the configuration database. Note that if the database does not match the cabinet address or is otherwise corrupted, the controller shall inhibit the output of all load switches, suppress the watchdog timer output and provide an indication in the diagnostic display indicating the cause of the failure.

3.8.2 Additional Notes for Wiring the Model 2010 Signal Monitor

1) The Model 2010 conflict monitor includes capabilities required by the standard but not used within this cabinet. While the Model 2010 must fully comply with the requirements of the device specification, the following additional requirements shall apply to the signal monitor wiring for the ASTC cabinet.

2) Since only six load switches are supported by the cabinet, the load switches shall be pre-wired to the conflict monitor channels as outlined in Table 4.

Table 4 Load Switch/Channel Assignments

Signal	Channel	Signal	Channel
LS1	Channel 1	LS2	Channel 2
LS3	Channel 3	LS4	Channel 4
W1 LS5	Channel 13 (grn)	W2 LS6	Channel 14 (grn)
DW1 LS5	Channel 13 (red)	DW2 LS6	Channel 14 (red)
LS5 yellow	Channel 15 (grn)	LS6 Yellow	Channel 15 (red)

3) Red channels 1 thru 4 shall be wired to the red load switch circuits for load switches 1 thru 4 respectively. The Red for Channels 13, 14, and 15 shall be wired as shown. The CONTRACTOR shall provide red option jumpers in the form of insulated plug jumpers at the load-switch connectors for use when a load switch is not installed. The handles shall be insulated and marked with red. Material shall be non-corrosive and maintain good electrical contact between the 120 VAC in the load switch socket and the red circuit of the load switch. Jumpers must be removed to install a load switch. *[Special note: Version 2 of this specification required that there be a jumper for some of this wiring. The CITY has decided to only use PED's for load switches 5 and 6 and hence the jumper is not necessary and shall not be provided.]*

4) Any control relays necessary to manage the cabinet flash, conflict monitor interlocks, etc. shall be mounted inside the PDA.

3.8.3 Additional Requirements for the Controller Functionality

1) The controller shall continuously monitor the STOP TIMING function and shall use the transition from true to false as the indication to initiate three color operation. The controller shall start its initialization sequence as programmed in its configuration database. (Reference NEMA TS2-2003 Section 3.5.5.1).

2) The controller shall support 'soft flash' by allowing the controller to flash the appropriate signals using the load switches. To ensure that the soft flash does not trip the CMU, the BIU shall output a 'disable red monitoring' function which shall inhibit the monitoring for the

controller. Further, the flashing amber indications on the signal heads shall not trip the failure detection logic within the CMU under these conditions.

3) All controller timing functions and its time keeping functions shall use the AC power line as a reference when AC power is available. All internal clocks used for coordination shall be referenced to the AC power line and shall drift with the AC power line and shall not attempt to track to a crystal or WWV reference (depending on the setting of the clock reference function). Clocks will be downloaded from either the laptop interface or via the system communications port where possible after which they shall track the power line. When required, the controller shall track the AC power line for its clock and shall not be adversely affected by transients, brown-out conditions, dropouts, and noise on the AC line.

4) During power interruptions and transients, the controller shall include internal clock management circuitry such that short transients (< 2.7 minutes) do not introduce **any** errors or drift into the controller's clocks. Outages longer than 2.7 minutes shall not cause the clock to drift by more than +/-.005%.

5) It shall be possible to view and set the controller time clock to within +/- one second from the limited function front panel pushbuttons and readout (described in Section 7.2) without the use of a laptop computer. It shall also be possible for the field technician to request an immediate update of the controller clock from the central system where the communications channel is available.

6) It shall be possible to connect the laptop to any controller and synchronize the laptop clock from the controller. Thus, a technician can go to any working controller with central communications, cause the controller clock to be updated via the front panel, then synchronize the laptop from the controller.

7) It shall be possible for the field technician to request an immediate download of the controller database from the central computer using the limited function front panel pushbuttons and readout (described in Section 7.2) without the use of a laptop computer.

8) This specification and the NEMA standards require many interactions between a laptop computer and the controller unit using a designated port on the front of the controller. All access to the controller database and other parameters which may affect its operation shall be password protected by the controller such that the operator must log into the controller at the start of each session; further, the session shall terminate by either a logout or a time-out for a configurable length of time. The controller shall keep track of the operator ID whenever changes to the database are made logging the date/time and operator ID whenever changes are made via the laptop interface. This data shall be up-loadable by both the laptop and the central computer using a logical block specified by the CONTRACTOR.

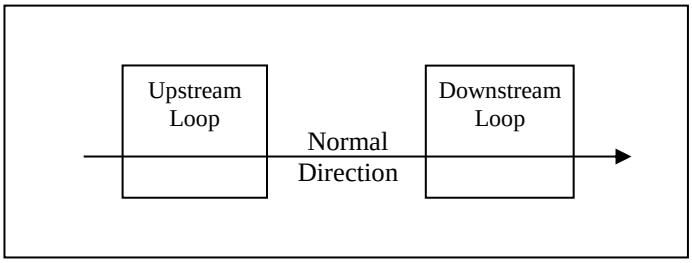
9) Because the controller includes the capability of dynamically re-configuring the outputs and inputs to match the needs of a specific intersection, there is no "default" operation possible in the event that the controller's database does not match the cabinet address. Upon power up, the controller shall read the cabinet address and determine if the database matches the cabinet address and is valid. If it is valid, then it will commence three color operation as described herein. However, if the database does not match, then the controller shall suppress the watchdog output, and automatically "search" for a source for its database. This source may be a USB memory device, the laptop computer, or the central system. The controller shall raise its "download request" flag and await the download operation. If a laptop computer is connected, it shall automatically interrogate the controller for this flag, determine the controller cabinet address, and download the database (including

configuration information and timing plans) for the specific cabinet (all without operator intervention on the laptop or the controller). Once this data is received, the controller shall automatically start issuing watchdog signals and commence three-color operation unless prevented by the conflict monitor. If there is a remote data link to the central computer, the remote computer shall be able to perform the same operation as the laptop computer. When multiple input devices are available to download the controller database, the priority shall be: 1) highest – USB; 2) Ethernet; 3) lowest –serial port.

10) It is important that the ASTC support as much automation as possible in a safe manner. If the ASTC contains the proper firmware and operating system, the technician should be able to simply install the new controller unit and the remainder of the operations are automatic. To load new operating system or firmware, a special power-up sequence will allow the operator to control these activities with either the laptop or the USB memory device.

3.8.4 Support for Screen-line Detectors

1) At selected locations throughout the CITY, *screen line* detectors will be used to measure individual vehicles for reports and planning purposes. The information to be captured includes the vehicle length and speed. The following model is for traditional road loops but can be provided by microwave and video detection systems as well.



2) Loops shall be individually configurable to form trap pairs. The trap pairs will be used to compute travel time and occupancy which will then be used to determine the vehicle length and speed. SNMP managed parameters shall be used to identify which detector input (from either a wired input in the cabinet or an auxiliary DET BIU connected to the serial bus) is the upstream and which is the downstream detector.

3) The trap pair shall also include a parameter that shall indicate “normal” direction of travel (from upstream to downstream) or the “reverse” direction. It shall be possible to change the direction of the trap without causing latch-up or other data collection errors. All data in the vehicle profile buffers shall be purged at the time of the reversal.

4) Travel times and occupancy times shall be reported in increments of $1/60^{th}$ of a second. The *vehicle profile* shall use 16 bit integers to store the travel time and occupancy times. These timers shall stop at ‘FFFF’ in the event of overflow.

5) The traps shall automatically clear themselves of “stored” vehicles and auto synchronize to accept new vehicles even under heavy traffic conditions.

6) As a vehicle enters the upstream loop, its occupancy will be captured. The vehicle entry to the upstream loop marks time T1; when the vehicle enters the downstream, loop, this marks time T2. When the vehicle exits the upstream loop this marks T3; when the vehicle exits the downstream this marks T4. Note that T3 may occur before T2 and another vehicle may actually enter the upstream loop before the first vehicle exits the downstream loop. The trap monitoring application shall take this into account and shall track individual vehicles through the trap and compute the values for each vehicle.

7) To compute the travel time, the 2 measured travel times, T2-T1 and T4-T3, shall be compared; if the difference is less than *entryExitThreshold* (a configurable parameter in percent of the reading) then the average of the two values will be used. If the difference is greater that *entryExitThreshold,* then the shorter of the 2 times will be used; if the T2-T1 is

used, then the T3-T1 occupancy time will be used; if the T4-T3 time is used, then the T4-T2 occupancy time will be used. If the average travel time is used, then the occupancy time for the downstream loop (T4-T3) will be used.

8) At the time the vehicle exits the downstream loop, a *vehicle profile* shall be created to represent the occupancy time and the travel time. This profile shall be added to a buffer in the ASTC which shall hold all vehicle profiles until polled or scheduled for exception based reporting. The vehicle profile buffer shall be variable length with provision for storing at least 50 profiles. A separate buffer shall be established for each trap pair and the controller shall be able to support a minimum of 16 traps (32 detectors) using auxiliary DET BIU's. [NTCIP objects shall be established to indicate the number of traps supported, the number of profiles supported, input to trap assignments, thresholds, etc.]

9) Each trap buffer shall be held in a variable length block object which shall also include a status byte indicating whether there have been any counter overflows or errors encountered as vehicle profiles have been entered into the buffer. Each buffer shall include an index counter which shall increment when the buffer is transmitted to the central computer. The block shall also indicate the number of vehicle profiles contained in the block and the number of vehicles that entered the upstream loop and the number of vehicles that exited the downstream loop (it is recognized that these may be different from the actual number of profiles due to lane changing and detection errors). Each "GET" request for the buffer contents will specify the index counter; if the counter is for the previous buffer, it indicates that there was an error in the previous transmission and the older buffer contents shall be re-transmitted. If the requested index is for the next index, then the older buffer shall be purged and made ready for the next collection interval and the requested block shall be transmitted. It is expected that these buffers will be collected on the order of once per minute. If the current buffer becomes full, then further data shall be lost and the buffer overflow status flag shall be set.

10) The detector monitoring application shall include a object that indicates the number of vehicles stored in the active (accumulating) buffer for each trap pair. This object shall be visible (read only) to the central system and may be included in the exception based reporting scheme such that the NTCIP Exception reporting mechanism can be used to transmit the buffer when the number of vehicle profiles reaches a certain number. In this case, the index counter shall be incremented and a new buffer shall be started when the trigger has been detected.

11) The ASTC shall also support the assignment of any detector input (both wired and auxiliary) to multiple functions including but not limited to actuation detectors, system detectors, and queue detectors. Such assignments may be concurrent in which case, all calculations shall be performed on the sensor inputs and the data shall be provided to the appropriate applications.

12) The trap detector logic shall be able to manage situations where more than one vehicle is in the trap pair due to slow moving traffic and it shall include failure detection logic to automatically clear itself from any lost vehicles or lane changes during the detection process.

13) The objects to configure and upload the trap pairs is shown in the MIB for the ASTC.

3.9 Cabinet Peripherals

1) The design of the following assemblies/subassemblies: load switches, detector modules, BIU, isolation modules, flashers, and all communication adapters (plug-in modems, external modems), shall be such that they can be inserted and removed live (with power present on any or all pins) without the risk of personal injury to the operator/technician, damage to the assembly/subassembly, damage to the controller or any other device, and the device shall

always start properly. The insertion/removal of the communication device(s) shall not disrupt normal traffic control operation and the controller unit shall automatically recover and commence proper communications upon the installation of, or restoration of power to, the communications adapter without operator intervention.

3.9.1 Load Switches

1) The solid-state switch and switch packs shall conform to the New York State Transportation Management Equipment Specifications Detailed Specification on Solid State Switch and Switch Pack Modules, in Part III, Chapter 9, dated March 2010.

2) Load switches shall be compatible with LED signal heads.

3) Load switches shall meet the NEMA TS2 2003

4) The cabinet shall be wired for 6 solid state load switches. Cabinets shall be supplied with the number of load switches as indicated by the model number charts in Section 16. All load switches shall be the three-circuit type, with three input indicator lights, and shall be compatible with the NYS Model 200 switch pack.

3.9.2 Conflict Monitor Module

1) The conflict monitor unit (CMU) shall be the Model 2010 ECL conflict monitor or equivalent. It shall conform to the Event Logging Signal Monitor Procurement Specifications attached as Section 18.

2) The Conflict Monitor shall be supplied complete with a Program Card and a Red Interface Connector and cable to the backplane. Note that the 120 VAC signals connected to the red monitor cable shall be protected such that short circuits in the cable do not damage the cable, the connectors, or the backplane wiring of the controller cabinet.

3) The Conflict Monitor shall plug into the input/output File Rack through a printed circuit dual row 56 contact connector. The contact assignments shall be as shown on Table 5.

Table 5 Conflict Monitor Unit Connector (P3)

PIN	FUNCTION	Cab Conn.		PIN	FUNCTION	Cab Conn.
1	CHANNEL 2 GREEN	LS2G		A	CHANNEL 2 YELLOW	LS2Y
2	CHANNEL 13 GREEN	LS5G		B	CHANNEL 6 GREEN	N/C
3	CHANNEL 6 YELLOW	N/C		C	CHANNEL 15 GREEN	LS5Y
4	CHANNEL 4 GREEN	LS4G		D	CHANNEL 4 YELLOW	LS4Y
5	CHANNEL 14 GREEN	LS6G		E	CHANNEL 8 GREEN	N/C
6	CHANNEL 8 YELLOW	N/C		F	CHANNEL 16 GREEN	N/C
7	CHANNEL 5 GREEN	N/C		H	CHANNEL 5 YELLOW	N/C
8	CHANNEL 13 YELLOW	N/C		J	CHANNEL 1 GREEN	LS1G
9	CHANNEL 1 YELLOW	LS1Y		K	CHANNEL 15 YELLOW	N/C
10	CHANNEL 7 GREEN	N/C		L	CHANNEL 7 YELLOW	N/C
11	CHANNEL 14 YELLOW	N/C		M	CHANNEL 3 GREEN	LS3G
12	CHANNEL 3 YELLOW	LS3Y		N	CHANNEL 16 YELLOW	N/C
13	CHANNEL 9 GREEN	N/C		P	NOT ASSIGNED	N/C
14	NOT ASSIGNED	N/C		R	CHANNEL 10 GREEN	N/C
15	CHANNEL 11 YELLOW	N/C		S	CHANNEL 11 GREEN	N/C
16	CHANNEL 9 YELLOW	N/C		T	NOT ASSIGNED	N/C
17	NOT ASSIGNED	N/C		U	CHANNEL 10 YELLOW	N/C
===				===		
18	CHANNEL 12 YELLOW	N/C		V	CHANNEL 12 GREEN	N/C
19	NOT ASSIGNED	N/C		W	NOT ASSIGNED	N/C
20	CHASSIS GROUND	Chassis		X	NOT ASSIGNED	N/C
21	AC-	LS Bay		Y	DC GROUND	TB
22	WATCHDOG TIMER	BIU		Z	EXTERNAL RESET	N/C
23	+24VDC	PDA		AA	+24VDC	PDA
24	[PINS 24 AND 25]			BB	STOP TIME	BIU
25	[ARE TIED TOGETHER]			CC	NOT ASSIGNED	
26	NOT ASSIGNED	N/C		DD	NOT ASSIGNED	
27	OUTPUT SW, NC	PDA		EE	OUTPUT SW, SIDE #2 (MC Coil)	PDA
28	OUTPUT SW, NO			FF	AC Line	PDA

NOTE: Pins 23 and AA are shorted together. Maximum current rating is 500 milliamps. Pins 24 and 25 are shorted together. The Monitor circuit and the Program Card mate with a 28/56 pin double sided edge-card connector having .156 inch centers. Pin EE is the common side of the output switch with pin 27 providing a NC contact (opens to flash) and 28 providing a NO contact (closes to flash); This allows the 2010 to be used in either a 170 type or an ASTC type cabinet supporting both NEMA and 170 type flash wiring.
N/C = No connection
(=== Position for key slot)

4) The Program Card shall be used to assign conflicting channels. It shall plug into the Model 2010ECL or equal through a printed circuit dual row 56 contact connector. The contact assignments shall be as shown on Table 6.

5) With the ASTC-6 wiring as shown, load switches 5 and 6 are wired for 3 pedestrian signal heads and are subsequently wired to the Green circuits for CMU channels 13, 14, 15. The CONTRACTOR is to provide jumpers or install biasing resistors that will ensure that the red signal is detected in the absence of a load switch and/or absence of use for the specific circuit. Thus, while the red jumpers can be installed in the load switch socket for either or both the channel 13 and 14 red monitoring, the channel 15 red may not be used and hence some form of biasing resistor is required to ensure that the red monitor “sees” a sufficient signal (>70 VRMS). The CONTRACTOR shall develop a biasing and/or jumper arrangement for approval by the CITY. The CONTRACTOR shall ensure that the biasing resistors or jumpers do not interfere with the normal operation of the conflict monitor when load switches 5 and 6 are installed.

Table 6 Programming Card Connector Assignments

PIN	FUNCTION (COMPONENT SIDE)		PIN	FUNCTION (CIRCUIT SIDE)
1	CHANNEL 2 GREEN		A	CHANNEL 1 GREEN
2	CHANNEL 3 GREEN		B	CHANNEL 2 GREEN
3	CHANNEL 4 GREEN		C	CHANNEL 3 GREEN
4	CHANNEL 5 GREEN		D	CHANNEL 4 GREEN
5	CHANNEL 6 GREEN		E	CHANNEL 5 GREEN
6	CHANNEL 7 GREEN		F	CHANNEL 6 GREEN
7	CHANNEL 8 GREEN		H	CHANNEL 7 GREEN
8	CHANNEL 9 GREEN		J	CHANNEL 8 GREEN
9	CHANNEL 10 GREEN		K	CHANNEL 9 GREEN
10	CHANNEL 11 GREEN		L	CHANNEL 10 GREEN
11	CHANNEL 12 GREEN		M	CHANNEL 11 GREEN
12	CHANNEL 13 GREEN		N	CHANNEL 12 GREEN
13	CHANNEL 14 GREEN		P	CHANNEL 13 GREEN
14	CHANNEL 15 GREEN		R	CHANNEL 14 GREEN
15	CHANNEL 16 GREEN		S	CHANNEL 15 GREEN
16	DC GROUND		T	CONFLICT
17	CHANNEL 1 YELLOW		U	CHANNEL 9 YELLOW
18	CHANNEL 2 YELLOW		V	CHANNEL 10 YELLOW
19	CHANNEL 3 YELLOW		W	CHANNEL 11 YELLOW
20	CHANNEL 4 YELLOW		X	CHANNEL 12 YELLOW
21	CHANNEL 5 YELLOW		Y	CHANNEL 13 YELLOW
22	CHANNEL 6 YELLOW		Z	CHANNEL 14 YELLOW
23	CHANNEL 7 YELLOW		AA	CHANNEL 15 YELLOW
24	CHANNEL 8 YELLOW		BB	CHANNEL 16 YELLOW
===			===	
25	N.C.		CC	N.C.
26	N.C.		DD	N.C.
27	N.C.		EE	N.C.
28	YELLOW INHIBIT COMMON		FF	N.C.

=== Mating connector shall be keyed between pins 24 and 25 and also BB and CC.

The Monitor circuit and the Program Card mate with a 28/56 pin double sided edge-card connector having 0.156 inch centers.

6) A red interface connector shall be supplied and wired to the red outputs for load switches 1 through 6 as shown. The cabinet shall be equipped with red programming connector as shown in Table 7 that can be assigned to a fixed 120 VAC source or the output of the respective load switch. The Red Interface Connector's pin assignments shall be as shown on Table 7. The red jumpers shall be constructed of non-corrosive, electrical conducting material with an insulated handle and shall be red. The jumpers shall be inserted into the empty load-switch slots to short the AC to the red signal connection when there is no signal head installed. Jumpers shall be removable with the power present without risk of operator injury. Jumpers shall be clearly visible and durable and subject to approval by the CITY.
7) The ASTC Cabinets shall include provisions for detecting the removal of the CMU such that the central system can be alerted. The CONTRACTOR shall match the existing wiring that provides this capability.

Table 7 Red Interface Connector (P1)

PIN	FUNCTION	Typical Conn.
1	CHANNEL 15 RED	LS 6 Y
2	CHANNEL 16 RED	AC
3	CHANNEL 14 RED	LS 6 R
4	CHASSIS GROUND (see note)	
5	CHANNEL 13 RED	LS 5 R
6	SPECIAL FUNCTION #2	N/C
7	CHANNEL 12 RED	AC
8	SPECIAL FUNCTION #1	N/C
9	CHANNEL 10 RED	AC
10	CHANNEL 11 RED	AC
11	CHANNEL 9 RED	AC
12	CHANNEL 8 RED	AC
13	CHANNEL 7 RED	AC
14	CHANNEL 6 RED	AC
15	CHANNEL 5 RED	AC
16	CHANNEL 4 RED	Ls 4
17	CHANNEL 3 RED	LS 3
18	CHANNEL 2 RED	LS 2
19	CHANNEL 1 RED	LS 1
20	RED ENABLE	BIU
Pin 4 is not used in the cabinet. N/C Chassis ground is available through the edge connector at the rear of the card cage.		

8) The Conflict Monitor shall have an EIA/TIA-232 9-pin connector configured as shown on Table 8.

Table 8 J1 Connector Wiring

PIN	FUNCTION	I/O
1	DCD	O
2	TX DATA	O
3	RX DATA	I
4	DTR	I
5	SIGNAL GND	
6	DSR	O
7	CTS	I
8	RTS	O
9	NC	
Note: This connector is not connected to the rest of the ASTC. It is to be covered and protected.		

3.9.3 Detector Modules

1) The quad (224) vehicle detector modules shall conform to the New York State Transportation Management Equipment Specifications Detailed Specification on Dual and Quad Loop Vehicle Detector Modules, in Part III, Chapter 3, dated March 2010.

2) In addition, the detector modules shall conform to the following requirements:

   - Detector modules shall not require more than 50 ma of current from the 24 VDC cabinet power supply for each channel.
   - Detector modules shall include a test switch accessible from the front of the unit which shall allow a technician to place a call for each detector for test and maintenance purposes.

3) Detector modules shall be provided as shown in the bid tabulation. Connectors for unused detector slots shall be protected from physical and environmental damage.

4) The input circuits on the detector modules shall include surge protection to prevent surges occurring on the loop inputs from damaging the detector modules or causing damage to any other internal cabinet systems. The input file ground bus shall be sized sufficiently to provide the proper ground path to meet this requirement.

3.9.4 Isolation Modules

1) The dual AC isolation module (252) shall conform to the New York State Transportation Management Equipment Specifications Detailed Specification on Dual AC Isolation Modules, in Part III, Chapter 7, dated March 2010.

3) The dual DC isolation module (242) and Quad Isolation module (244) shall conform to the New York State Transportation Management Equipment Specifications Detailed Specification on Dual and Quad Isolation Modules, in Part III, Chapter 6, dated March 2010.

3.9.5 Bus Interface Unit (BIU)

1) The cabinet shall contain one Bus Interface Unit, with address 2 (TF BIU #3 listed in the NEMA TS2 specifications) mounted into the input file. (Note: all cabinets shall be supplied with a new BIU regardless of other equipment included in the installation.)

2) The BIU shall meet all requirements in NEMA TS2-2003 with the additional functions noted below. It is a requirement of this specification that a single BIU be used to handle all of the functions for the ASTC cabinet. Table 9 lists the assignments for this BIU. (Note that an additional BIU is used for the ASTC-12).

3) The BIU shall fully support the input and output functions listed in Table 9. In order to ensure the accuracy of the detector data processing, as well as the accuracy of processing, deciphering, and transmitting the 100 VDC communications pulses currently used for the outer boroughs, it will be necessary to scan the inputs to the BIU and to drive the outputs of the BIU at a minimum of 60 Hz. The Controller unit shall transmit Type 12 command frames to the TF BIU #3 and read Type 140 input frames 60 times per second – while still retaining capacity for additional BIUs for expanding the number of inputs (input files) and outputs (output files) including more system detectors or an auxiliary video detection device which ‘looks like’ a detector BIU.

4) For all BIU inputs, the BIU shall ensure that input signals are not 'lost' due to the 'granularity' of the scanning operation. Any input which is true (as per NEMA signal timing and voltage requirements) during the 1/60th of a second preceding the read shall be reported as true. If the input was false during the entire interval, the input shall be reported as false. The BIU inputs shall be filtered to eliminate transitions as defined for inputs by the NEMA specification.

5) The Controller Unit (CU) shall also send Type 9 messages to ensure synchronization of time within the BIU.

6) For the 6 load switch outputs, two bits are assigned according to NEMA TS 2-1998 Section 3.3.1.4.1.1 however, dimming is not supported in this cabinet.

7) Note that this ASTC specification requires that BIU inputs and outputs be configured dynamically (at initialization) based upon the database for the controller which is based on the cabinet address. The Controller unit shall set unused outputs to the false condition so that the input data can be determined by the current status of the input signal on the circuit. There shall be no restrictions on the use of *input/output* signals (as designated by the NEMA specification) to be used as either inputs or outputs. Note that for some Input card file slots, 4 wires shall be connected to BIU input/output pins. Thus, with software configuration changes, the functions could be either inputs or outputs. As an example, Slot 4 could be used for 4 inputs with a quad detector or 2 inputs and 2 outputs for the outer borough communications module. Similarly, preemption devices and/or isolators may be used in any slot. The cabinet wiring remains the same for both instances; only configuration information shall be necessary to determine the functions. As a further example, an auxiliary cabinet could be used with a BIU that would house a transit signal priority device that would use the NEMA status and control signals to control the actions of the traffic controller.

8) The BIU shall automatically set all outputs to the false (off) condition if the BIU does not receive any command frames addressed to the specific BIU within a time-out period. This time-out period shall be 3 seconds. Note that the BIU must never become 'hung up' and must always restore proper operation when the connection is restored.

9) The Terminal and Facilities BIU address inputs shall control the assignment of input/output functions for BIU Address 2 (TF #3) for the ASTC-6 cabinet are shown in Table 9.

Table 9 BIU Function Assignments

	ASTC Basic		
Signal	**Function**	**Cabinet Location**	**Description Of Function**
Output 1	Address Select 1 (O)	Diodes	Cabinet address selection output
Output 2	Address Select 2 (O)	Diodes	Cabinet address selection output
Output 3	Address Select 3 (O)	Diodes	Cabinet address selection output
Output 4	Address Select 4 (O)	Diodes	Cabinet address selection output
Output 5	Watchdog	CMU-22	Drives the Model 2010 watchdog circuit
Output 6	Disable Red Monitor	CMU (P1-20)	Disables red monitoring during preemption or flash
Output 7	Detector Reset Slot 1 & 2 (O)	Input File Slot 1 C Slot 2 C	Issues a detector reset to slots 1 & 2
Output 8	Detector Reset Slot 3 & 4 (O)	Input File Slot 3 C Slot 4 C	Issues a detector reset to slots 3 & 4
Output 9	Load Switch 1 Red Driver	Output File L/S 1 pin 6	Activate load switch circuit
Output 10	Load Switch 1 Yellow Driver	Output File L/S 1 pin 8	Activate load switch circuit
Output 11	Load Switch 1 Green Driver	Output File L/S 1 pin 10	Activate load switch circuit
Output 12	Load Switch 2 Red Driver	Output File L/S 2 pin 6	Activate load switch circuit
Output 13	Load Switch 2 Yellow Driver	Output File L/S 2 pin 8	Activate load switch circuit
Output 14	Load Switch 2 Green Driver	Output File L/S 2 pin 10	Activate load switch circuit
Output 15	Load Switch 3 Red Driver	Output File L/S 3 pin 6	Activate load switch circuit
Input/Output 1	Load Switch 3 Yellow Driver	Output File L/S 3 pin 8	Activate load switch circuit
Input/Output 2	Load Switch 3 Green Driver	Output File L/S 3 pin 10	Activate load switch circuit
Input/Output 3	Load Switch 4 Red Driver	Output File L/S 4 pin 6	Activate load switch circuit
Input/Output 4	Load Switch 4 Yellow Driver	Output File L/S 4 pin 8	Activate load switch circuit
Input/Output 5	Load Switch 4 Green Driver	Output File L/S 4 pin 10	Activate load switch circuit
Input/Output 6	Load Switch 5 Red Driver	Output File L/S 5 pin 6	Activate load switch circuit
Input/Output 7	Load Switch 5 Yellow Driver	Output File L/S 5 pin 8	Activate load switch circuit
Input/Output 8	Load Switch 5 Green Driver	Output File L/S 5 pin 10	Activate load switch circuit
Input/Output 9	Load Switch 6 Red Driver	Output File L/S 6 pin 6	Activate load switch circuit
Input/Output 10	Load Switch 6 Yellow Driver	Output File L/S 6 pin 8	Activate load switch circuit
Input/Output 11	Load Switch 6 Green Driver	Output File L/S 6 pin 10	Activate load switch circuit
Input/Output 12	Detector Channel 1 Call (I)	Input File Slot 1 F	Calling or system detector (V, O)

	ASTC Basic		
Signal	**Function**	**Cabinet Location**	**Description Of Function**
Input/Output 13	Detector Channel 2 Call (I)	Input File Slot 1 W	Calling or system detector (V, O)
Input/Output 14	Detector Channel 3 Call (I)	Input File Slot 2 F	Calling or system detector (V, O)
Input/Output 15	Detector Channel 4 Call (I)	Input File Slot 2 W	Calling or system detector (V, O)
Input/Output 16	Detector Channel 5 Call (I)	Input File Slot 3 F	Calling or system detector (V, O)
Input/Output 17	Detector Channel 6 Call (I)	Input File Slot 3 W	Calling or system detector (V, O)
Input/Output 18	Detector Channel 7 Call (I)	Input File Slot 4 F	Calling or system detector (V, O)
Input/Output 19	Detector Channel 8 Call (I)	Input File Slot 4 W	Calling or system detector (V, O)
Input/Output 20	Detector Channel 9 Call (I)	Input File Slot 4 S	Calling or system detector (V, O)
Input/Output 21	Detector Channel 10 Call (I)	Input File Slot 4 Y	Calling or system detector (V, O)
Input/Output 22	Address Bit 1 (I)	Diodes	Cabinet address input
Input/Output 23	Address Bit 2 (I)	Diodes	Cabinet address input
Input/Output 24	Address Bit 3 (I)	Diodes	Cabinet address input
Input 1	Address Bit 4 (I)	Diodes	Cabinet address input
Input 2	Stop Timing (I)	CMU-BB	Stops signal timing (conflict) and signals initialization
Input 3	Address Bit Parity (I)	Diodes	Cabinet address input
Input 4	Manual Control Enable (I)	Switch – police plug	Executes NEMA manual control enable function
Input 5	Interval Advance (I)	Switch – police plug	Executes NEMA advance function
Input 6	External Minimum Recall (I)	Toggle Switch	For use when detectors are faulty
Input 7	Cabinet Flash Monitor (I)	TBD	Indicates that the cabinet is in flash
Input 8	Cabinet Alarm (I)	Door switch and alarm circuit	door status and other cabinet alarms
Opto Input 1	Pedestrian Detector 1 (I)	Terminal	PED button
Opto Input 2	Pedestrian Detector 2 (I)	Terminal	PED button
Opto Input 3	Preemption 1 (I)	Terminal	Preemption
Opto Input 4	Preemption 2 (I)	Terminal	Preemption
Opto Common	12 VAC	PDA	
Address Bit 0	OFF - BIU Address Assignment	Handled on the input file	BIU Address – TF#3
Address Bit 1	ON - BIU Address Assignment	Handled on the input file	BIU Address – TF#3
Address Bit 2	OFF - BIU Address Assignment	Handled on the input file	BIU Address – TF#3
Address Bit 3	OFF - BIU Address Assignment	Handled on the input file	BIU Address – TF#3
Data Transmit	Reserved	Nc	

	ASTC Basic		
Signal	**Function**	**Cabinet Location**	**Description Of Function**
Data Receive	Reserved	Nc	
+24 VDC	Power Supply Interface	PDA	24 VDC to BIU
Logic Ground		PDA	Power/logic ground to BIU
Earth Ground		PDA	Chassis ground for BIU
Line Freq. Ref.	Line Frequency Reference	PDA	Not used (grounded in the edge connector)

Notes for Table 9:

1. The input file is configurable. Where the Table has noted “Calling or system detector (V, O)” this may be any type of input card or circuit including isolators, preemption inputs etc. The concept is to allow the input slots to be used as needed at the intersection using dynamic configuration capabilities of the controller.
2. The use of the output circuits is also configurable such that any load switch can be used for any function. The only limitation is the flash transfer relays.
3. The opto-isolator inputs have been arbitrarily assigned to PED and Preemption, however, these shall be configurable for any needed cabinet function.

3.9.6 Cabinet Addressing

1) Each cabinet shall be assigned a unique 16 bit address which shall be programmed into the input file using an array of diodes.

2) The address shall be read by the Controller unit by activating one of the BIU outputs and reading the ½ byte input. Each ½ byte shall include an odd parity bit to validate the integrity of the data. The controller shall use this cabinet address to develop its communications address and identify the database for the controller parameters. The addressing schema will be provided by the CITY.

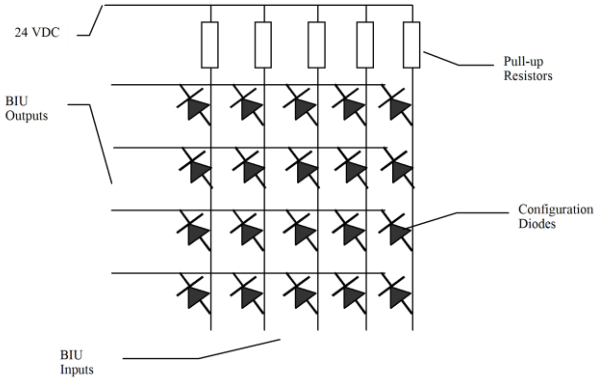


Figure 2 Cabinet Addressing

3) A total of four ½ bytes shall be read to create a 16 bit address.

4) The cabinet address shall be contained on a plug-in card mounted in the input file which also contains the **Min Recall** and **Stop Timing** switches (reference Section 3.3.2); these switches shall be mounted on the front face plate of the card. Cabinet addressing shall not use any form of switching device such as pin jumpers, DIP switches, etc. The plug-in card shall be provided with a full complement of 20 diodes mounted onto the circuit card; the installation contractor shall remove the necessary diodes to create a unique address for the cabinet. The controller unit display shall allow the operator to quickly verify the cabinet address. The layout and location of the labels for the address card shall match the existing address card as much as possible to avoid possible confusion by field personnel.

5) The address board shall include a location to clearly identify the cabinet address. The diodes shall be protected from damage during any handling and field insertion/removal. The connector arrangement shall be protected from dirt and moisture such that its operation is reliable for a minimum of 20 years under normal field operating conditions. It shall be possible to easily re-solder or replace the diodes to change the address.

6) At power turn-on or controller initialization, the Controller Unit (CU) shall read the cabinet address. If a parity error is detected, then the controller shall indicate this error on the front panel of the unit and **shall not attempt to communicate** with the central computer. The cabinet shall remain in the flashing state until the error is corrected. After the initial power turn-on, the controller unit shall continue to monitor the cabinet address at least once per minute. If an error is detected (or its removal is detected), it shall report the error to the central computer and shall continue to use its old address until reset (or power is turned off). The address reading operation shall be structured such that transients, startup, or other cabinet transient anomalies do not allow the use of a false address.

7) The cabinet address is used to request a download of the controller database which is necessary to configure the controller's inputs, outputs, and operation (e.g. actuated [NEMA dual ring] operation, pre-timed operation), and the type of communications protocol which will be supported (e.g. NTCIP); note that the controller reverts to NTCIP (and USB) download over the Ethernet port and the serial port .

8) The cabinet address is unique and must be used by the CU to verify that the local database is proper for the intersection location. (The controller unit must note the cabinet address when its database is loaded, and shall not attempt to operate using a database that was not loaded when the controller had this address.)

9) In the event that the controller is accessed via a laptop computer using the local interface port, the controller shall use this unique cabinet address to automatically access the correct database from the laptop computer. Thus a copy of all cabinet/controller databases must be held on the laptop computer and only the one identified by the cabinet address shall be used.

10) An NTCIP object has been assigned for the 16 bit cabinet address identified above. This object shall also be used for the laptop communications to identify the specific cabinet type and location to ensure compatibility with the database of the controller. The controller database shall be identified by a 16 bit address which shall be used to ensure that the database of the controller matches the specific cabinet. This database shall include all necessary cabinet configuration parameters related to the assignment of input and output functions to the BIU(s) as well as all timing plans and other configuration parameters. Upon power-up or initialization, the controller shall not commence normal three color operation unless the identifier of the configuration and timing database matches the cabinet ID.

3.9.7 Assignment of cabinet addresses

The cabinet address has the following form for specific address assignments:

3.9.7.1 IP Address:

AAAAAAAA.BBBBBBBB

The 16 bit cabinet address is used to form the low order bytes of the IP address of the cabinet. This will be used for NTCIP and other forms of communications. The NTCIP protocol shall conform to NEMA TS2-2003, Section 3.3.6 for Actuated Type 1 (A1N Level 2) and Pretimed Type 1 (P1N Level 2) controllers.

The high order two bytes of the IP address are specified in an NTCIP object established for this purpose and will default to the identified values. Hence, the full cabinet IP address is of the form: DEFAULT.DEFAULT.AAAAAAAA.BBBBBBBB.

The default high order 2 bytes of the IP address will be identified prior to the delivery of the controllers; the vendor shall then implement these as the default parameters such that whenever the controller is replaced or the firmware is replaced, it shall revert to the Default IP address for the high order 2 bytes.

Note that the CITY will also specify the IP address for the Central Computer system such that a trap can be pre-configured (default) within the ASTC to notify the central computer whenever it is restored from a power failure condition.

3.9.7.2 NTCIP (other)

AAAAAAAAAA.NNNNNN

For slow speed Point to Multi-Point (PMP) communications the N..N bits shall be used to form a unique cabinet identifier. N…N bits shall be used for the NTCIP 6 bit (short) address as called out in NEMA TS3.3-1996 Section 3.3.3.1 Figure 3-3.

A..A is concatenated with the NTCIP address to form a unique cabinet address for this communications configuration.

3.9.8 Protocol assignment

1) Since the controller must support a range of different types of protocols, an NTCIP private object, `astcProtocol`, has been added to the controller to identify the protocol to be used.

2) The ASTC software shall use the object `astcProtocol` to identify the type of control protocol to be supported. Refer to the MIB details for this object. Note that this object should be set to a '0' (Zero) which is the default for NTCIP using IP addressing.

3.9.8.1 Default IP address parameters

1) The CITY will provide the CONTRACTOR with the default IP address high order byte settings prior to delivery; this will also include the subnet mask and gateway address which are to be pre-programmed as the default settings in the read/write configuration objects. The CONTRACTOR shall plan for this and shall receive no additional compensation to pre-program these default settings into all ASTC units shipped to the CITY.

2) In addition, these values shall be read/write such that the CITY can re-program them as necessary for use on other communications media and systems.

3.9.9 Ethernet communications

1) NYCDOT is currently using a variety of communications media for wireless and wired communications to its traffic controllers. These include EvDO from Sprint and NYCWiN which is part of an overall NYC metropolitan wireless network for government services. The controller unit includes provisions for both Ethernet and serial communications. The controller cabinet shall include shelf space for the mounting of a modem where necessary. Samples of the modems currently being used are available for inspection.

2) Future procurement specifications shall determine the specific modem to be provided.

3) Any of the serial ports available at the front panel of the controller unit shall be available for use in connecting to the system communications.

4) In addition to the communications interfaces described for NTCIP, the controller shall include a 10/100BaseT Ethernet adapter with front mounted RJ45 jack that can be used to attach to an Ethernet interface device such as cable modems, Ethernet switches, media converters, DSL, WiFi devices and other wireless interfaces. The Ethernet interface shall conform to IEEE 802.3 standards for 10BaseT and 100BaseT operation. The controller shall automatically detect the data rate interface available from the external device and adjust its operation to match the highest rate available. This port shall support TCP/IP and UDP/IP using the IP address assigned with the NTCIP parameters and the cabinet address card.

5) The ASTC shall fully support NTCIP communications via the Ethernet port and the 9-pin serial port. It shall fully support both PPP and PMPP protocols through the serial port. It shall also support the full contention based field reporting and upload/download functionality described herein.

6) It is required that the ASTC support the exception based reporting and wireless communications design described in the existing ASTC documentation - which is available for review. This documentation describes the use of SNMP TRAPS (based on NTCIP 1103), and database management. Note that the ASTC was purchased before the finalization and publication of NTCIP 1103 Version 3 which identified the use of exception based reporting. As a result, there are differences between the objects and operation identified in the NTCIP 1103 and the ASTC. Suppliers are to match the operation of the existing ASTC with respect to Exception Based Reporting; the MIB is enclosed.

7) Note that data encryption and authentication are handled external to the traffic controller by the wireless IP router installed as part of the NYCWiN system in the cabinet and provides a VPN tunnel to the TMC.

8) The CITY may utilize EVDO, 3G, 4G, LTE and similar wireless service from local wireless carriers to provide connectivity to certain locations. The CONTRACTOR is required to ensure that the ASTC will also support connection to this network; thus the operating system shall support the use of a gateway for the communications to the central system using the Ethernet port.

9) Based on the specific media and service, the network parameters including the gateway address, subnet mask, and high order 2 bytes of the IP address will be identified prior to shipment and shall then be programmed into the unit as the default parameters. These parameters shall be read/write and may be updated using the Ethernet, USB, and serial ports using the laptop software provided or the central system.

3.9.10 Cabinet communications support

1) For the external modem, the cabinet shall include an accessible outlet (non GFI protected) for the attachment of the modem power supply. This outlet shall be mounted at the top of the cabinet along with the controller power outlet.

3.9.11 Power Distribution Assembly (PDA)

1) The ASTC cabinet shall include a removable power supply and power distribution assembly (PDA). The requirements stated below are based on the existing NYS 330 cabinet specification which has been augmented to include a 12 VAC power source for the pedestrian inputs and modified to conform to the NEMA contactor and flash transfer relay operation (which is consistent with the new ITS cabinet standard being jointly developed by NEMA, ITE, AASHTO and CALTRANS).

2) All wiring within the PDA shall conform to UL 1449 and National Electrical Code standards for wire gage and insulation.

3) Note that Version 3 and 4 of this specification revised the 120 VAC current requirements for the signal loads of the Power Distribution Subsystem; the PDA shall be constructed in a manner which is interchangeable with the existing Version 3 PDA assuming that the actual signal loads are also reduced.

4) A universal PDA was developed for all three cabinet types (ASTC-6, ASTC-8, and ASTC-12) such that the single PDA is interchangeable in all cabinets. The CONTRACTOR shall ensure compatibility with the existing PDA (version 3).

5) All equipment located in the cabinet (e.g. BIU, Load Switches, Loop Detectors, Isolation Modules, Conflict Monitors) shall be designed to operate properly with the ASTC cabinet power supply as specified herein.

6) The Power Distribution Assembly (PDA) shall be constructed in a completely modular manner. The PDA shall be mounted to the cabinet shell using ¼ turn aircraft type fasteners; threaded inserts shall not be used. Two (2) non threaded mounting studs, protruding from the PDA shell shall be provided for alignment and mounting purposes. It shall be possible for a trained electrician to remove and replace the PDA in a field cabinet in less than 5 minutes under adverse conditions (including night time maintenance) without damage to the unit, the cabinet, or any other subassembly or equipment in the cabinet.

7) Connections between the PDA and the Cabinet or Cabinet shell, except for Main AC +, Surge Protector AC- and Surge Protector Earth Ground shall be made via three (3) connectors identified and labeled as PDA1, PDA2 and PDA3. The wire harnesses for the PDA connections shall be such that improper installation is impossible under normal circumstances. The Gender of PDA1 and PDA2 have been made different to preclude the improper installation. Wire harnesses extending 25.4 mm to 76.2 mm beyond the rear of the PDA unit and terminating into connectors PDA1 (Molex #03-06-2151 or equal) and PDA2 (Molex #03-06-1151 or equal) shall mate with cabinet shell connectors PDA1 (Molex #03-06-1151 or equal) and PDA2 (Molex #03-06-2151 or equal). The cabinet shell connectors shall be rigidly mounted to the shell directly behind the PDA. The distance of the cabinet shell PDA1 from the bottom of the shell shall be approximately 215.9 mm; for PDA2 approximately 114.3 mm. Connector PDA3 (Molex #03-06-1151 or equal) shall be rigidly mounted to the lower side of the PDA facing the ground busses, approximately 139.7 mm from the front of the unit.

8) A wire harness terminating into Cabinet PDA3 shall mate with PDA connector PDA3. The wire harness shall have sufficient slack to provide adequate strain relief when the connectors are mated. In addition, wires in this harness from the door switch, and controller shall be routed behind the cabinet shell. Pin functions for PDA1, PDA2 and PDA3 are shown in Table 10, Table 11 and Table 12.

9) Note that the Molex connectors as specified use nylon material which is an exception to the specifications which otherwise prohibit the use of this material. The PDA is permitted to use nylon connectors as provided in the phase 3 units.

Table 10 PDA1 (P) Connector Assignments[8]

PIN		Cabinet
1	Breaker 1	Switch Pack 1**
2		
3		
4		
5	Breaker 2	Switch Pack 4** & 6**
6		
7		
8		
9	Flasher AC+	Flasher Power
10		
11	Breaker 1	Switch pack 2** & 5**
12		
13		
14		
15	Breaker 2	Switch Pack 3**

Table 11 PDA2 (S) Connector Assignments

PIN		Cabinet
1	CM Fail (PDA DS)	CMU circuit
2	CM Fail (From PDA)	CMU Circuit
3	CMU fail (To PDA)	CMU Circuit
4	CMU Interlock (AC)	CMU Flash Circuits
5	CAB Alarm	BIU
6	12 VAC	Field TB
7	Chassis GND	
8	AC-	AC-
9	AC+	AC+
10		
11	MC Coil	Door switches and CMU
12	Logic Gnd	
13	+24 VDC	
14		
15	CMU switch Interlock	Note this is reserved for an additional CMU interlock within the cabinet that shall be present and reserved for future use.
DS = Door Switch		

[8] The CONTRACTOR is responsible for ensuring that the cabinet wiring and the PDA wiring provide the functionality described herein and intermate and are interchangeable with the existing version 3 PDA assembly.

Table 12 PDA3 (S) Connector Assignments

PIN		Cabinet
1	AC+ out from Series portion of Surge Protector	Controller Receptacle AC+
2	AC- out from Series portion of Surge Protector	Controller Receptacle AC-
3	Earth Gnd	Earth Gnd Bus Bar
4	Equip CB	Fan Fuse
5		
6		
7		
8	AC-	AC- Bus Bar
9		
10		
11	To DS (Interlock)	Door Switch
12	To DS (Interlock)	Door Switch
13	Cab Alarm	Door and thermal alarm
14	Logic Gnd	Door and thermal alarm
15	+24 VDC	Door alarm indicator

7) The main 24 VDC power supply shall conform to the New York State Transportation Management Equipment Specifications, March 2010, Part IV – Section II, Paragraphs, 2 and 4, except that it shall be augmented by 12 VAC supply for use in Pedestrian isolation circuits. The 24 VDC supply shall have 50% additional capacity for additional cabinet peripherals.

8) The following equipment shall be installed in the Power distribution assembly and be readily accessible for replacement:

   - Signal contactor (energized for three color operation, de-energized for flash or no signal display operation)

   - Two (2) 10 amp switch pack circuit breakers with an auxiliary switch feature (to note when the breaker has been tripped); this switch shall be used to ensure that if the load breaker is tripped, the cabinet goes into flash.

   - 15 amp MDA time delay fuse for the Model 204 flasher

   - 10 amp MDA time delay fuse for the processor power cord and the modem outlet receptacle mounted and labeled “CNTRLR PWR”

   - Miscellaneous cabinet control relays including the flasher relay and the conflict monitor door switch relay.

   - A single 20 amp main breaker.

9) The PDA shall not include a flash switch. Flash operation is driven by the flash switch described in section 3.8.1 that shall always be active, regardless of the state of the controller unit. (i.e. the switch shall perform the desired function)

3.9.12 Unregulated 12 volts AC

1) The unregulated voltage shall nominally measure 12 volts with an **AC Line** voltage of 120 volts and shall be no less than 7.5 volts with an **AC Line** voltage of 89 volts.
2)
2) The 12 VAC output shall be rated for a minimum of 0**.**250 Amps. The 12 VAC will be used for sensing pedestrian push buttons and remote devices (e.g. Preemption) via the opto isolated inputs to the BIU.

3) The 12 VAC output shall be protected such that the supply is not damaged if the output voltages are shorted to the return side. The 12 VAC supply shall automatically revert to normal operation when the short circuit is removed.

4) Reference NEMA TS 2-2003 Section 5.3.5.3.

3.9.13 Circuit Breaker

1) All circuit breakers used in the cabinet shall be approved and listed by UL. The trip and frame size shall be plainly and permanently marked. They shall be magnetic type breakers with their overload trip points unaffected by temperature. Contacts shall be silver alloy enclosed in an arc-suppressing chamber. Minimum interrupting capacity shall be 5000 amperes, RMS.

2) The main circuit breaker, labeled “Main CB” shall be a single pole automatic trip, short delay and trip indicating type, rated for 20 amperes. The cabinet wiring shall be rated for 20 amperes. The electrical service shall be connected to the main breaker using a secured push-on pin and a totally enclosed connector on the feed wire. The protected connector shall be capable of accepting wire sizes in the range of AWG #6 to AWG #14. The push-on connector shall be mounted to the PDA and wired to the main breaker such that no electrical contacts or connections are stressed when the connection is made to the PDA. The push-on PDA mounted pin shall be positioned so that its opening faces the bottom of the cabinet. The bottom of the PDA unit shall be open directly below the lug to facilitate the insertion/removal of the service feed. The push-on connector shall be protected such that it cannot short to the cabinet or other metal parts. The CONTRACTOR may alter the connector orientation with the approval of the CITY.

3) The equipment circuit breaker, labeled “GFI/AUX C.B.”, shall be a single pole automatic trip, short delay and trip indicating type, rated at 15 amperes at 125 VAC.

4) The switch pack breakers shall consist of two single pole 10 ampere circuit breakers with an auxiliary switch feature and medium trip delay characteristic (Carlingswitch A Series or equal). The auxiliary circuit shall be wired in series so that if the breaker is tripped it shall cause the signal contactor to be de-energized. The breaker’s auxiliary contacts shall be rated at 5 amperes (minimum) at 120 VAC (min). This breaker shall be labeled “Signals”.

3.9.14 Receptacles

1) The cabinet shall include a service duplex outlet on the front of the PDA (accessible from the front of the cabinet). The receptacle shall be a duplex type, rated for 15 amps, and have a ground fault circuit interruption as defined in the National Electrical Code. This duplex outlet shall be a heavy duty industrial type with screw-terminals for all connections.

2) The controller unit power cord shall connect to a separate receptacle fed from a connector on the PDA. There shall be 2 duplex outlets (total of 4 available sockets) available at the top of the cabinet to supply power to the wireless router, the controller unit, and other auxiliary equipment.

3) The controller power AC+ and AC- shall be tied to the series portion of the power line surge protector through the PDA via a shielded cable, Belden No. 83336 or equal. The earth ground (green) wire and shield leader of the cable shall be directly connected to the cabinet earth ground bus bar.

4) The signal contactor shall be a 'normally open' contact configuration and capable of switching 20 amperes at 120 volts AC (including a tungsten lamp load). It shall be rated for continuous operation with a minimum of a 20-year energized, full load life. Under normal 3-color operation, the contactor shall be energized and the contactor shall be de-energized for flashing operation.

5) Note that mercury shall not be used in the contactor.

3.9.15 Protectors

1) An integrated series and parallel hybrid power line surge protector (EDCO No. SHA ACP-340 or equal) shall be installed on the incoming power line. The surge protector shall be capable of reducing the effect of transient voltages applied to the AC line. Gas-discharge devices shall not be used in the protector.

2) The protector shall meet or exceed the following specifications.

Normal Mode Surge Protection (Line to Neutral)

Peak Current	20 Kamps (8x20 microsecond wave shape)
Life Test	5x maximum voltage clamp change before and after 25 20 Kamp surges (8x20 microsecond wave shape)
Clamp Voltage	300 Volts Max at 20 Kamp surge
Response Time	Voltage across device never exceeds 300V during surge

Common Mode Surge Protection Neutral to Earth Ground

Clamp Voltage	700 Volts max at 20 Kamp maximum (8x20 microsecond wave shape)

Operating Characteristics

Temperature Range	-40 to +85 Celsius
Continuous Service Current	10 Amps maximum at 120 VAC 60 Hz through series filter

MIL-STD 220 Insertion Loss Specification for Series Filter

Frequency of Applied Signal	Insertion Loss (db)
60 Hz	0
10KHz	34
50KHz	55
100KHz	76
500KHz	76
2MHz	68
5MHz	58
10MHz	58
20MHz	63

3) The protector shall be epoxy-encapsulated in a flame-retardant material and enclosed in a metal housing.

4) The line surge protector shall be wired to the load side of the main circuit breaker. Wiring to and from the surge protector shall be kept as short as possible and shall be routed separate from all other PDA wiring.

3.9.16 Flasher

1) The ASTC Cabinet shall be supplied with a solid state flasher in accordance with New York State Transportation Management Equipment Specifications, March 2010, Part III – Chapter 8 for a Model #204 flasher relay.

3.9.17 Flash Transfer Relays

1) Two Flash transfer relays shall be provided and wired in the cabinet. Flash transfer relays and sockets shall adhere to New York State Transportation Management Equipment Specifications, March 2010, Part IV – Chapter I: Section II, Paragraph 6.5.

3.9.18 Flash Programming

1) Flash programming jumpers, wiring and materials shall conform to the New York State Transportation Management Equipment Specifications, March 2010, Part IV – Chapter I: Section II, Paragraph 6.6 except as follows: Two (2) Red, two (2) Yellow, and two (2) white programming plugs shall be provided.

3.9.19 Flasher Circuit Assignment

1) The following Table shall determine the interconnection between the solid-state flasher and the switch packs. Each switch pack shall be assigned to one of the two solid-state flasher load circuits as follows:

Load Circuit #1	Load Circuit #2
S.P. 1	S.P. 3
S.P. 2	S.P. 4

2) Note that although the cabinet is wired with 6 Load Switches, only 4 load switches (1, 2, 3, and 4) are wired to flash transfer relays. Load Switches 5 and 6 are reserved for PED or other auxiliary functions and shall remain dark (no output) when the power contactor is de-energized (i.e. in the cabinet flashing condition).

3) For full three phase operation, load switches 1, 2, and 3 would be wired to the vehicle displays, and circuits 4, 5, and 6 would be wired to the PED displays and the flash jumpers for circuit 4 would cause the display to be dark during the cabinet flashing condition.

3.9.20 BIU Model S

1) When shown in the bid documents, the CONTRACTOR shall provide special BIUs which shall support both the normal TF3 functionality as required for an ASTC-6, ASTC-8, and ASTC-12 cabinet, but shall also emulates both a Detector BIU 3 and Detector BIU 4 when connected to an EIS model G4 Spider network controller or equal. The purpose of this connection is to use the input file space to provide for the power to the Spider wireless network card, while using the serial interface to the Spider network card to retrieve the real-time detector actuation data. The BIU would then convert the data received from the EIS network to actuations into NEMA standard message contents for Frames 150, 151, 154, and 155 to support up to 32 detectors using conventional virtual loops or detection zones.

2) Indicators on the front of the BIU shall display the communications status to the Spider network as well as the normal communications status for the 485 channel.

3) The CITY has acquired several samples of this type of BIU which are currently being used to collect system sensor data for adaptive control arteries. The CONTRACTOR shall ensure compatible and interchangeable operation for the devices provided under this contract.

3.9.21 NYCWiN Antenna – installed

1) All NTCIP controller cabinets shall be equipped with a custom 2.6 GHz band antenna which is to include lead-in cable and termination to connect to the NYCWiN modem which will be supplied by others. The Custom Antenna shall meet the following specifications:

Type	Dual MIMO
Center frequency	2600 MHz
Bandwidth	200 MHz
Gain	3 dBi minimum over bandwidth (omni)
Maximum power	2 Watts
VSWR	2:1 maximum over bandwidth
Polarization	Vertical & Horizontal
Nominal impedance	50 Ohms
Ground Plane	21”x15” minimum
Mount	Male stud N-Type, lock washer plus double nut, vandal proof, 5/8” hole, rubber O-ring gasket
Cable	Dual 36” LMR-240-DB pigtails
Connectors	TNC male right angle
Dimensions	1.8” H x 4.5” OD at the base (maximum)
Operating temperature	-20 ^{o} C to +60^{o} C
Shape	Hemisphere
Case material	UV resistant, ruggedized plastic
Color	Match the color of the cabinet

2) The antenna shall be mounted to the top of the cabinet as directed by the CITY and shall be mounted with sealant and hardware that cannot loosen under vibration and shall not leak with age.

3) The antenna installation shall be complete with all hardware, sealant, cable, and termination of the length approved by The CITY.

3.9.22 Power supply for NYCWiN wireless router

1) The ASTC cabinets will be equipped with wireless routers to provide universal connectivity between the intersections and the Traffic Management Center (TMC). The router will be shelf mounted but it requires a 24 VDC power supply for its operation. Since all of the ASTC intersections will use NYCWiN for the communications media, the CONTRACTOR is

required to supply and install the 24 VDC supply to support the NYCWiN router in accordance with the following specification.

2) Each ASTC cabinet shall be equipped with a separate 24 VDC power supply with cable and connector to terminate on, and provide power to the Class 4B wireless router being provided under another contract. The minimum power supply specifications are shown in the table below:

Item	Power Supply Specification
Output	
▪ DC Voltage	24V
▪ Rated Current	1A
▪ Current Range	0~1A
▪ Rated Power	24W
▪ Ripple & Noise (Max, note 2)	150mVp-p
▪ Voltage Adj Range	21.6~26.4V
▪ Voltage Tolerance (note 3)	+/-1.0%
▪ Line Regulation	+/-1.0%
▪ Load Regulation	+/-1.0%
▪ Setup, rise, hold time	1000ms, 30ms, 20ms /115 VAC at full load
Input	
▪ Voltage Range	85~264VAC
▪ Frequency Range	47~63Hz
▪ Efficiency (Typ.)	84%
▪ AC Current	0.55A/115VAC 0.35A/230VAC
▪ Inrush Current (max)	Cold Start 20A/115VAC 40A/230VAC
▪ Leakage Current	<1mA/240VAC
Protection	
▪ Over Load	105~160% rated output power
▪ Over Voltage	27.6~32.4V
Environment	
▪ Working Temp.	-20~+70degC (refer to output load derating curve) 50%@70C
▪ Working Humidity	20~90% RH non-condensing
▪ Storage Temp., Humidity	-40~+85degC, 10~95% RH
▪ Temp. Coefficient	+/-0.03%/degC (0~50degC)
Vibration	10~500Hz, 2G 10min/cycle, period for 60min each along x,y,z axes
Notes	
1. All parameters NOT specifically noted are measured at 230VAC input, rated load and 25degC of ambient temp.	
2. Ripple & noise are measured at 20MHz of bandwidth by using 12" twisted pair wire terminated with a 0.1uf & 47uf parallel capacitor	
3. Tolerance: includes set up tolerance, line regulation and load regulation.	

3) The manufacturer of the wireless router has verified that the model MDR-20-24 power supply manufactured by MeanWell (www.meanwell.com) meets these requirements. Acceptance testing of the Wireless Router was performed with this device. The CONTRACTOR shall provide this supply or an approved equal for the ASTC and it shall plug into an outlet at the top of the cabinet. This power supply shall be securely mounted to the shelf in a manner that shall not degrade its performance and the cables to the power outlet and wireless router shall not interfere with:

a.) The visibility of the wireless router's indicators,
b.) The indicators on the power supply,
c.) Access to the ASTC controller unit,
d.) Visibility of the ASTC front panel and indicators,
e.) The door mechanisms.

4) Cable lengths shall be kept to a minimum to eliminate the need to restrain them in the cabinet.

5) The mounting shall be similar to the current mounting system; the CONTRACTOR shall work with the City to develop a suitable mounting system at no additional cost to the City.

6) Power supplies purchased under previous contracts shall mount into the new cabinets and power supplies provided with the new cabinets shall mount into the old cabinets without modification to either the supply or the cabinet.

4 Controller Unit

1) The controller unit for the ASTC-12, ASTC-8, and ASTC-6 shall be identical. Identical shall mean functionally, electrically, and mechanically. All controllers shall function properly in any cabinet and cabinet type designed to meet these specifications. All controller units shall fully support flexible functionality using the serial interface such that larger cabinet configurations including additional load switches and more inputs can be supported without changes to the controller unit up to the fully configured NEMA cabinet and NEMA functions described in TS2-2003. The controller shall automatically determine the cabinet address upon startup and use the database for that location; that database shall identify the type of cabinet (ASTC-6, ASTC-8, or ASTC-12) and the number and type of BIU's attached and the I/O mapping for all BIU input and output functions. This database shall also identify if additional TF BIUs (#1, 2) are being used for other NEMA functions.

2) The default mapping of the input/output functions for the BIU's for the ASTC-6, ASTC-8, and ASTC-12 cabinets are shown herein and shall be used when there is no identified custom I/O mapping. The custom I/O mapping shall overlay the default settings such that only the exceptions are necessary in the NTCIP compatible data exchanges. More details on the I/O mapping are explained in the MIB.

4.1 General

1) The controller unit shall be of modular design. Circuit boards shall be readily accessible for maintenance. It shall be permissible to accomplish this by use of extender boards and cables. All fuses, connectors, and controls shall be accessible from the front of the controller unit.

2) This specification establishes the requirements for the controller unit without defining the internal construction (e.g. circuit cards). The controller must meet the form, fit, and functional requirements (in addition to all noted environmental requirements) as stated herein. The interfaces are defined so that controller units from different manufacturers will be interchangeable in the controller cabinet specified. Modems from different manufacturers shall be interchangeable in the modem slot if provided.

3) Optional: The controller unit may include provisions for a plug-in modem or a level conversion assembly with two serial ports accessible to this card. The serial ports shall be configurable to support commonly available serial communications bit rates from 1200 bps to 115 Kbps. The ASTC shall default to communications with an external device or system via the serial port and the Ethernet adapter which shall then configure the type of communications to be supported. Both automatic remote and local database loading must be supported.

4) This design requires that the controller unit provide 4 serial ports, three Ethernet ports, and one USB port. The Ethernet ports, USB port, and all four of the serial ports shall be accessible from the front of the controller without a modem board installed. Two additional serial ports shall be accessible to the optional modem card at the backplane of the controller unit if provided.

5) The top of the controller unit housing shall be closed and free of any vent or other openings such that dirt, dust, water and other debris cannot enter the unit from the top. While it is recognized that ventilation may be necessary to meet the environmental requirements

stated herein, ventilation shall be designed such that foreign debris and water cannot easily enter the case under normal operation and handling and that the possibility of damage during handling, storage and shipping is minimized.

6) The controller shall be constructed such that it can be shipped individually via common carrier (e.g. USPS, UPS, Fed-Ex) without damage and without disassembly or removal of internal components or subassemblies. The CONTRACTOR shall be required to provide reusable shipping cartons for the controller and all cabinet subassemblies for use by the CITY and other maintenance contractors in shipping the units to the factory for repair or replacement as directed by the CITY. All spares (including subassemblies) shall be supplied in reusable shipping containers.

7) The basic functions of the controller are intended to be contained on the internal program memory and all parameters for operation shall be downloadable via a laptop interface connector, all Ethernet ports, USB port using a USB memory device, and the system Port depending upon the communications media available. When the communications media can transmit and receive data, it shall be possible to download all operational parameters via the system communications port.

8) The controller 'firmware' (i.e. basic functionality) shall be contained in FLASH-RAM such that it can be loaded via the laptop interface or USB memory device at the front of the unit with an operator present. During the FLASH-RAM update, the controller shall be in the flash condition (watchdog trip) or the signals shall be off. It shall not be necessary to open or otherwise disassemble the unit, replace any device, or set any switch to complete the program update. The controller shall note the date and time that the firmware is loaded and it shall also note the version number of the firmware which shall be visible on the front panel display. This information shall be available for retrieval as NTCIP compatible objects.

9) It shall be possible to power-up the controller on the bench without a cabinet attached such that a database can be loaded, the operating system can be loaded, and the application firmware can be loaded, and so that the event log can be retrieved. The mechanism for allowing this is left to the CONTRACTOR.

10) The controller firmware shall continuously check the integrity of its internal memory (program code) and the local database. If the controller detects a fault, it shall immediately terminate its watchdog output (in the false condition), turn off all displays and the cabinet shall enter the flashing state. If this occurs, the controller shall place an indication in the front panel display that shall indicate the detected cause of the failure. This status shall be indicated to the central system. However, three color operation can only be re-established with a service technician present.

11) The ASTC controller shall include internal holdup for all clock and configuration parameters including timing plans and error logs, for a minimum of 7 days under all environmental conditions. The means to maintain the memory and clock shall not include batteries, but shall rely on 'super capacitor' or equivalent technology. Clock accuracy when on battery shall be ±.005% at 25C no worse than ± .02% over the full temperature range.

12) The ASTC controller shall include internal clock management hardware, software or a combination of both such that power line disruptions including but not limited to brief interruptions (<10 seconds), transients, noise, brown-out transients (single or multiple pulse drop out), droop, notches, and ringing do not cause the controller to lose or gain time with

respect to the power grid. For the purposes of measuring the controller response to such disruptions, the CONTRACTOR shall assume that the power grid is running at 60.0 Hz. The CONTRACTOR shall document the algorithm and electronics used to manage this accuracy for both real-time and time of day clock functions. This capability shall be demonstrated during the Design Approval Testing described herein.

13) The hardware and/or software shall include filters that ensure that power interruptions >10 seconds do not cause the loss or gain of more than a single 60.0 Hz clock pulse, plus the additional gain or loss attributable to the crystal clock accuracy. The CONTRACTOR shall document the algorithm and electronics used to manage this accuracy for time of day clock functions

14) The Controller shall include firmware/software which continuously monitors the active processes for proper operation. If a process failure is detected, the controller shall attempt to restart the process as long as such a restart cannot adversely affect the normal three-color operation. This feature is intended to restart or restore communications to the CMU, UPS, or central system should any of these connections become corrupted. Restarting the process to restore normal operation is preferred over the simple shutdown noted in Paragraph (#10) above. However, this requirement is not intended to allow the controller to restart any operation/process which might compromise normal three-color operation including sequence of displays or minimum duration of any display.

4.2 Dimensions

1) The controller unit shall be shelf mounted. The height of the controller unit shall not exceed 8 inches. The depth of the controller unit, including connectors, harnesses, and protrusions, shall not exceed 11.5 inches. The width of the controller unit shall not exceed 10 inches. All connections except the power cord shall be made on the front of the unit. The power cord may be attached to the back of the unit.

4.3 Software/Firmware

(Note that this section applies to all software including firmware as described herein and not just the controller unit software/firmware)

1) For the following section, the term SOFTWARE shall include all program code whether it is firmware, embedded software, down-loadable software, laptop software, diagnostic software, Controller Unit software, etc. Program instructions in any form which are necessary for the operation and support of the controllers and all modules except as noted below shall constitute the SOFTWARE referenced below.

2) The lap-top software for managing the ASTC database and all exchanges with the ASTC is included in the term SOFTWARE and shall be governed by the provisions of this section of the specifications.

3) The firmware embedded in the BIU and in the CMU is <u>not</u> included in the software listed below. However, the vendor shall provide source code listings for the BIU and the 2010 firmware. The vendor is not required to provide a complete development environment for BIU and CMU specific source code. The source BIU and CMU code shall be provided in electronic and hard copy form (2 copies). Any display programs necessary to view and print the source code in an easily readable manner shall be included..

4.3.1 Source Code

1) The SOFTWARE source code shall be provided to the CITY prior to acceptance of the equipment. Acceptance is defined in Section 9.9. **Acceptance of the equipment cannot occur if the SOFTWARE source code and all required documentation has not been provided and accepted by the CITY. Acceptance of the equipment and the start of any warranty shall be delayed until the source code and documentation has been reviewed, approved, and accepted by the CITY.**

2) The provisions of this section shall apply to both the existing SOFTWARE if modified by the CONTRACTOR and to any new SOFTWARE developed or provided for this contract.

3) The CITY shall have the unrestricted and perpetual right to use and modify all SOFTWARE including embedded firmware for use within the jurisdictional boundaries of NY CITY. The perpetual right to use and modify this SOFTWARE shall not depend upon the execution of any maintenance and/or support contracts with the CONTRACTOR or other product vendors.

4) Further, if there are additional traffic signals which abut the CITY and are connected directly to the central system (by wired or wireless media) operated by NYCDOT, the CITY shall have the right to deploy the SOFTWARE at these intersections without any additional cost as well.

5) The CONTRACTOR shall provide NYCDOT with properly licensed copies of all SOFTWARE necessary for the laptop support including upload/download, diagnostics, and firmware updates.

6) It is understood that the SOFTWARE represents the intellectual property of the CONTRACTOR and the CITY shall maintain its confidentiality. However, the CITY shall have the right to hire independent contractors, other companies, or staff to develop and complete modifications to the SOFTWARE; such contractors and staff shall execute non-disclosure agreements with the CITY such that the SOFTWARE is used exclusively for the CITY of New York and is not provided to others in any form and is only available within the entity on a need to know basis. A copy of the Non Disclosure agreement is contained in Appendix 17.

7) The CITY shall have the unrestricted right to provide the CONTRACTOR's SOFTWARE to any additional suppliers for modification and/or use within the jurisdictional boundaries of NY CITY and for traffic signals which abut the CITY and are connected (wired or wireless) to the central system operated by NYCDOT. Such users of the SOFTWARE shall execute the Non Disclosure Agreement contained in Appendix 17.

8) If the CITY modifies or causes modifications to the controller unit software (i.e. the unit that executes the intersection control) by parties other than the original vendor, or if the CITY uses the controller unit software in a traffic controller unit which is not from the original equipment supplier, the CITY will indemnify the original vendor from all claims arising from the operation of the traffic controllers so modified (i.e. running the modified software). The CITY shall maintain accurate records of all such modifications.

9) However, the CONTRACTOR who supplies the controller unit under this contract shall be responsible for the operation of the ASTC software they provide in all controllers supplied

under this contract. To clarify, if the CONTRACTOR elects to use ASTC software provided by others, or elects to modify the software provided by others, then the CONTRACTOR shall become responsible for all aspects of the software so provided. The CONTRACTOR shall assume responsibility for the correction of any and all software bugs that might exist in the software provided by the CITY that is or was used in the previous vendors' units.

4.3.2 Development and support environment

1) In order for the CITY to modify the SOFTWARE, the CONTRACTOR shall provide and set up a complete SOFTWARE development environment including computer, printer, and all necessary software to allow the CITY or its consultants to modify and deploy the software as described in Section 4.3. The computer shall include a LAN connection (10/100BaseT Ethernet), EPROM Programmer for any EPROMS used in any of the ASTC devices, a CD/DVD reader/writer. The development facility shall include all necessary media to allow the environment to be constructed (installed) on a virgin machine including operating system, network interfaces, drivers, and all SOFTWARE. Installation of the development system support software requires that the software installation CD's be provided; the use of a simple backup-restore utility is not acceptable. Utilities shall be provided to allow the full use of all peripherals installed in or attached to the development system.

2) The development environment shall include, but not be limited to, text editors, compilers, language pre-processors, libraries, source code, code management utilities, tool kits, operating systems, backup and restore utilities, partition utilities, anti-virus utilities, firewalls, network utilities, database software, and report generators necessary to support modifications to and deployment of the SOFTWARE. All software shall be fully licensed for use by New York City on the development environment or subsequent replacement machines. Acceptance of the development station will require that the CONTRACTOR demonstrate that all installation CD's and vendor documentation has been provided, and that the source code for all SOFTWARE as required herein is delivered.

3) For the lap-top SOFTWARE, the CONTRACTOR shall provide all software necessary to construct "installation CD's" that will automatically install the SOFTWARE and all icons and library software necessary to fully support the installation on a virgin laptop computer. This shall include any database or other utility software not normally provided with the basic software installation (e.g. Windows XP home addition).

4) All SOFTWARE shall be written in high level languages such as Java, C, C++ or another language approved by the ENGINEER. The SOFTWARE shall be compiled with current versions of the appropriate compilers and the compilers and development utilities shall be current at the time of delivery. Current shall mean that the product is actively used by the computer industry for new developments, and that the product is currently supported by the software developer, and that all the most recent updates and revisions have been made to the compilers and other development utilities.

5) The CONTRACTOR shall also provide a software development and configuration management software suite which shall be used to manage and track all of the source code and documentation (hardware and software).

6) All SOFTWARE source code shall be provided in electronic form suitable for use with the development environment provided by the CONTRACTOR.

7) The development environment shall fully support the ability to modify and deploy the SOFTWARE, load the new SOFTWARE onto the laptop computer and download the new SOFTWARE to the controller in the field from the 10/100BaseT connector, the serial interface, and the USB memory device. It shall also support the loading of the SOFTWARE onto a USB memory device in a format which can be read by the ASTC to load the operational SOFTWARE.

8) The CONTRACTOR shall demonstrate that the source code is complete and accurate by building the complete SOFTWARE from the source code and development environment provided; the production version generated by this process shall be the only SOFTWARE used for all acceptance testing.

9) If the CONTRACTOR has included third party products as part of the SOFTWARE, then such products shall be included in the source provided; the CITY will execute an appropriate software license with the third party that shall be paid for by the CONTRACTOR. If the source code for such third party software is not generally available, then only the object code for this software must be provided. All such instances shall be brought to the attention of the ENGINEER prior to use for approval and **shall be noted in the bid documents.**

10) It is the intent of these special provisions that the CITY shall be able to modify the controller functionality as necessary to support additional control functions, communications schemas, and computer platforms. Further, the CITY shall be able to contract with third parties to port this SOFTWARE to future platforms or may make the SOFTWARE available to other parties for the supply of compatible controllers exclusively for New York City DOT.

11) The cost for the development environment shall be included in the cost of the identified bid item. The development equipment shall be provided prior to site testing of the controllers.

12) If there is no bid quantity for the software development bid item, then the source code shall be provided for the existing software development station and the cost thereof shall be included in the cost of the items bid.

13) Note that even if the software provided is identical to that previously provided under another contract, the CONTRACTOR is required to provide a new software development station as described herein if so identified in the bid tabulation. .

4.3.3 Software documentation

1) The CONTRACTOR shall provide SOFTWARE documentation to the CITY sufficient to enable an experienced programmer to modify the SOFTWARE. This shall include configuration information, *make* file description, code management documentation, and instructions in how to setup and install all software on a machine with an empty, formatted hard drive. Documentation shall also identify the procedures for loading all SOFTWARE including but not limited to EPROM preparation using the EPROM burner provided if required. (Note: the term EPROM is used here to describe any special chip which must be “burned” and installed in any ASTC cabinet device or the controller; if the CONTRACTOR uses EEPROM or similar devices that can be programmed without the replacement of the chips, then the CONTRACTOR shall provide any and all devices and cables necessary to allow the programming to take place “in the unit”.)

2) The CONTRACTOR shall include detailed database documentation for the source code used by the ASTC controller. The CITY shall have the unrestricted right to use this documentation for its system development and for sharing with other contractors for the purpose of modifying or supplying controllers to the CITY (subject to the execution of a Non Disclosure Agreement).

3) The SOFTWARE documentation shall also include description of all function calls, classes, subclasses, database schema, application of COTS software, and object models.

4) All source code shall include in-line comments and documentation in the header files to identify the function being performed, variables, and algorithms, control strategies, errors, etc.

5) All error codes shall be clearly documented in a single manual for easy reference.

6) The CONTRACTOR shall provide detailed documentation regarding the SOFTWARE structure including object models, timing dependencies, linkages, and relationships between functions and procedures.

7) The SOFTWARE documentation shall be submitted to the CITY for review and approval for acceptable level of detail and thoroughness. The SOFTWARE documentation must be provided prior to acceptance and payment for the equipment. The acceptance of the controllers shall not occur until the SOFTWARE documentation has been reviewed, approved, and accepted by the CITY. If subsequent changes are required due to SOFTWARE defects or contracted changes, the provided documentation must be updated within 60 days of the SOFTWARE correction.

4.4 Test Scripts

1) The CONTRACTOR is required to develop test plans as described in the testing program to verify that the controller supports all of the features and functions identified herein and by referenced documents. It is anticipated that the CONTRACTOR will utilize or develop test software that can be used to run test scripts to verify the operation of the ASTC based on communications exchanges over the Ethernet port and the configuration of the ASTC database. The CONTRACTOR shall provide a licensed copy of this test software such that the City can perform additional verification testing or regression testing when software changes are made. This test software shall run on the laptop computers specified herein.
2) The CONTRACTOR shall also provide the electronic copy of all scripts and test procedures used to verify the functionality of the ASTC. The scripts shall be compatible with the test software,
3) The CITY shall the right to use this test software and test scripts and procedures for future testing of the ASTC.

4.5 Interfaces

1) The following sections describe 5 serial interfaces to be provided by the controller unit. All five are to be available as connectors on the front of the controller unit.

2) All of the data rates for all ports shall be configurable by software means such that the cabinet database can be used to identify the specific protocols, data rates, etc.

4.5.1 Port 1 Connector

1) The Port 1 connector shall be located on the front of the controller unit. Port 1 shall be a high-speed full duplex data channel to facilitate communications between the controller unit, the BIU(s), and future expansion to additional BIUs or similar devices.

2) The Controller Unit and the BIU(s) exchange information on a regular basis. Port 1 shall use EIA-485 serial communications interface with noise immunity characteristics. SDLC (synchronous data link) communication protocol with a bit rate of 153,600 bits-per-second, utilizing sophisticated error checking shall be used on Port 1. Error checking shall be in conformance to NEMA TS2-2003 requirements. Port 1 shall also be able to support (via software setup) the high speed ITS Cabinet serial interface bus.

3) The Port 1 connector shall be a 15 pin metal shell D sub-miniature type connector. The connector shall utilize female contacts with 15 millionths of an inch minimum gold plating in the mating area. The connector shall be equipped with latching blocks. The connector shall intermate with a 15 pin D type connector which is equipped with retention screws. Pin connections are as indicated in NEMA TS-2 specifications. (Note: all of the serial port connectors on the front of the ASTC shall use screw retention mounting; the threaded inserts on the connectors shall be installed such that they will not “turn in place” or allow the mounting hardware to become loose behind the panel.)

4) The serial port shall comply with all NEMA TS2 requirements for data exchanges. While this specification presents a design using a single BIU (for the ASTC-6), larger cabinets (ASTC-8, ASTC-12) will include additional BIUs to provide for an increased number of load switches and input cards.

5) The CONTRACTOR shall indicate how this expansion will take place such that the controller cabinet can be fully configured to support 24 load switches and 64 detector inputs using additional BIUs for detectors, and load switches.

4.5.2 Serial Interface Ports

1) The controller unit shall have four (4) EIA/TIA-232 asynchronous serial interface ports, as outlined below, which shall be mounted on the front of the controller and shall be metal shell “D” subminiature type connector. The connector shall utilize female contacts with 15 millionths of an inch minimum gold plating in the mating areas. The connectors shall be equipped with screw sockets to accept commonly used screw down retention hardware. The connector shall mate with a 9-pin “D” type connector that is equipped with holding screws. Note that the construction shall be such that the retention nuts which are affixed to the connectors **shall not come loose or unscrew**.

2) The data rate for each Port shall be selectable via software internal to the controller unit and shall support data rates from 1200 bits-per-second to a minimum of 115.2 Kbps. Pin connections shall be according with the charts shown herein. (The following data rates must be supported: 1200, 2400, 4800, 9600, 19.2k, 38.4k, and 115.2k).

3) The ports shall be used for communications to a central system, laptop PC access, and future expansion, such as detector devices. The four ports shall be labeled as PC, UPS, CMU, and RS232.

4) All interface ports (including Ethernet ports) shall include indicators for transmit and receive operation. The indicators shall show activity on the ports. For the Ethernet ports, the indicators shall show the presence of a valid connection and transmission activity.

4.5.3 PC Port (9 pin)

1) The PC Port shall be used to connect to the system (for serial communications) or a laptop PC. An interface and connector shall be provided for interconnecting the controller unit to the system interconnect lines if so designated in the Bid Table.

2) The PC Port shall be configurable for data rates from 1200 bits-per-second to 115.2 Kbps with an EIA/TIA-232 interface to support connection to a local modem.

3) This Port shall be able to support NTCIP.

4) Note that it shall be possible to assign the PC port to be used for communications to the central system. The database shall identify the port to be used.

5) The PC Port shall be used to perform data transfers between an external laptop computer and the controller unit to execute any data transfer normally allowed by the communications channel (Ethernet) to central. The CONTRACTOR shall demonstrate this capability with software and the laptop computer provided by the CONTRACTOR. If communications is being carried out on the System Ethernet port, this PC Port shall allow the external laptop to perform all other functions of reading/writing the database unless the central computer is attempting a download. If both the PC Port and Central Ethernet Port are requesting a simultaneous download, the controller unit shall ignore the Central request and indicate this condition in the feedback data to the Central system.

4.5.4 CMU Port (9 Pin)

1) The CMU Port shall be used to for data exchanges between the controller unit and the 2010 conflict monitor unit.

2) The exchanges with the CMU shall ensure that the clock of the CMU remains synced to within 1 second of the controller's clock, and shall be used to upload the logs and CMU status upon request from the central system.

3) The CMU port shall be an EIA/TIA-232-E Data Terminal Equipment interface. The CONTRACTOR shall provide the cable necessary to connect the CMU to the controller unit.

4) The ASTC shall include software that supports the uploading of the CMU status and logs using NTCIP objects as established in the existing MIB.

4.5.5 UPS Port (9-pin)

1) This Port shall be available for connection directly to a UPS when present. The interface levels shall be compatible with the corresponding Type 2070 port as defined by the Type 2070 specification.

2) The data rates for this port shall be selectable from 300 bits-per-second to 153.6 Kbps via software means and shall include 57.6 Kbps as an available rate.

3) This port shall be internally configurable (jumpers) to be either EIA/TIA-232E or EIA/TIA-485.

4) When not used for a UPS, this port may be assigned to act as an additional PC port capable of accepting NTCIP exchanges.

4.5.6 Port assignments and Pin assignments

1) The serial ports will normally be assigned as follows:

- **Port 1**: DB15S

Pin Number	Function
1	TX Data +
2	ISO_GND
3	TX Clock +
4	ISO_GND
5	RX Data +
6	ISO_GND
7	RX Clock +
8	ISO_GND
9	TX Data -
10	PORT 1 Disable
11	TX Clock -
12	EQ GND
13	RX Data -
14	Not connected
15	RX Clock -

- **PC (2):** DE9P

Pin Number	Function
1	DCD
2	RXD
3	TXD
4	DTR (optional)
5	Logic GND
6	DSR (optional)
7	RTS
8	CTS
9	RI (optional)

- **CMU & RS232 Ports (3 & 5)**: DE9P

Pin Number	Function
1	DCD
2	RXD
3	TXD
4	DTR (optional)
5	Logic GND
6	DSR (optional)
7	RTS
8	CTS
9	RI (optional)

- **UPS (4):** DE9P

Pin Number	EIA-232 Function	EIA-485 Function
1	DCD (optional)	RX Data +
2	RXD	Not Connected
3	TXD	ISO_GND2
4	DTR (optional)	Not Connected
5	Logic GND	TX Data +
6	DSR (optional)	RX Data –
7	RTS (optional)	Not Connected
8	CTS (optional)	Not Connected
9	RI (optional)	TX Data -

2) All 5 serial ports on the front of the ASTC shall be electrically isolated from each other and from the internal power supplies of the controller. The serial ports will be connected nominally as:

   Port 1 – Cabinet TS2 serial bus

   Port 2 – PC Port to a laptop using a serial interface)

   Port 3 – Conflict monitor connection

   Port 4 – Connection to the UPS when present

   Port 5 – Spare for future use

3) The connector assignments labeled as optional need not be present, but if they are present, they shall have the designated function. Optional signals not provided shall be no connection at the connector.

4.5.7 Ethernet Interfaces

1) The controller shall be equipped with three 10/100BaseT network interfaces conforming to IEEE 802.3 for twisted pair. The network interfaces shall support transmission at both 100 Mb and 10Mb rate. The CONTRACTOR shall be responsible for obtaining the MAC address for the Ethernet adapters. The inventory system database updates shall include the listing of the unique MAC addresses.

2) The MAC addresses of the Ethernet adapters shall be available through the ASTC controller front panel display and through the laptop interface. Through a simple set of commands on the front panel buttons and the laptop interface, a field technician shall be able to determine the MAC address of the Ethernet adapter. All MAC addresses shall be available to the central system through SNMP objects.

3) The Ethernet ports shall support TCP/IP & UDP/IP, SNMP, and NTCIP (including SNMP, STMP). The CONTRACTOR shall work with the CITY to select the appropriate options as listed in NTCIP 2202 - -Internet (TCP/IP and UDP/IP) transport profile and NTCIP 2104 subnet profile for Ethernet.

4) It is required that the Ethernet ports be usable for firmware loading (both operating system and application software) and major database loading for the controller.

5) The system Ethernet port shall support (as an option) DHCP (Dynamic Host Configuration Protocol - Request for Comments: 2131 March 1997) for the assignment of an IP address. The ASTC must provide a DHCP client, and the laptop or other system connection must provide a DHCP server. To ensure a unique device name, the 16 bit cabinet address shall be used to form a unique name of the form: **NYCASTCaaaa** where **aaaa** is the hex (0-F) equivalent of the 16 bit cabinet address. This provides the capability of assigning a unique IP address based upon the location. The Text parameters (NYCASTC) shall be configurable and shall default to the value shown. An NTCIP Read-write object shall be established to manage this parameter.

6) Nominally, the IP address for the system Ethernet port shall be developed from default parameters for the high order 2 bytes and the 16 bit cabinet address for the low order 2 bytes. The upper portions of the Ethernet address along with the necessary network parameters will be provided by the CITY prior to delivery.

7) The second and third Ethernet ports are reserved for connection to a laptop or other cabinet or external device. The network parameters for the second Ethernet port shall match the existing units to ensure compatibility with all existing test equipment and installations.

4.5.8 Protocols to be supported

1) The controller shall support the following serial protocols: the NTCIP protocol for actuated control, an NTCIP compatible protocol for pre-timed operation. Note that the controller units shall match the existing operation such that the new controllers are interchangeable with the existing controller units from both of the previous supply contracts as noted in Section 1.6.

4.6 NTCIP Requirements

1) The ASTC actuated version shall conform to group A1N Level 2 of NEMA TS2.

2) The ASTC pre-timed version shall conform to group P1N Level 2 of NEMA TS2. The object set for pre-timed operation shall be as specified in the existing MIB. Note that the first vendor (US Traffic) has provided a complete MIB for the current version of the ASTC. The

new CONTRACTOR shall support the same MIB and custom objects as specified therein. Additional custom objects will be permitted but will not be supported by the system. All required functionality to match the existing operation must be supported through the existing MIB.

3) The NTCIP communications support shall adhere to the following timing constraints: whenever a message is received by the controller which requires the controller to respond, (e.g. all messages except a broadcast message) the controller shall initiate its response within 40 milliseconds (i.e. start the transmission of data). Further, the data shall be transmitted continuously (i.e. no gaps between characters) until the transmission is complete.

4) The ASTC shall fully support all features listed in NTCIP 1103 – the latest approved version at the time of the bid letting including Simple Network Management Protocol (SNMP), Simple Transportation Management Protocol (STMP), and trap management objects in Section 6. However, the current implementation of the NTCIP traps deviates from the 1103 V3 standard due to the delayed development and approval of the NTCIP 1103 standard. In fact, as of the date of this letting, Version 3 of the NTCIP 1103 had not been published and therefore draft versions must be used The new ASTC shall match the operation and MIB contents of the existing units to ensure compatibility with the existing system and test equipment. It is the responsibility of the CONTRACTOR to review the existing implementation and ensure interchangeable operation.

5) Once-per second communications will be critical to the central management of the controllers. NTCIP relies on “dynamic object” (STMP) capability to allow the central computer to program a list of data items to be returned in response to a “short-hand” request. The controller must support all 13 dynamic objects.

6) In order to support the uploading and downloading of the controller database over relatively slow channels, it is essential that the Controller support the “logical blocks” as defined in the latest version of the NTCIP 1202 standard. The CONTRACTOR must support the existing block objects developed for the existing ASTC. Upon receipt of a database download block, the controller must respond within the timing envelope described. In addition, the receipt of multiple database download blocks in rapid succession must not result in any communications errors, NTCIP (SNMP) error codes, or communications turn-around delays. The downloading of data must not interfere with the normal trap or event driven reporting operations. They shall occur concurrently with the block transfers.

7) The ASTC shall implement *optional objects* as defined in NEMA TS 3.5 Actuated Signal Controller Object Definitions (Ref. TS2-2003 V2.06 Section 3.3.6) in accordance with the following:

FEATURE	**NEMA NTCIP 1202 Version 2 Clause**
phaseRedRevert	2.2.2.10
phaseCarsBeforeReduction	2.2.2.14
phaseReduceBy	2.2.2.16
phaseDynamicMaxLimit	2.2.2.18
phaseDynamicMaxStep	2.2.2.19
phaseControlGroupForceOff	2.2.5.5
maxAlarmGroups	2.4.11
preemptDwellPed	2.7.2.14
ringControlGroupRedRest	2.8.5.7

ringControlGroupOmitRedClear	2.8.5.8

8) The MIB contains a number of objects which were added to the standard 1202 NTCIP standard to support required feedback or extended operation. These are listed in the MIB for the ASTC and include but are not limited to the following:

   a) `crdTransitionStatus`

   b) `unDownloadRequest`

   c) Critical Intersection Control object set

9) In addition to the objects shown above, the current ASTC supports a number of special objects which provide information specific to the NY City implementation including but not limited to cabinet address, and cabinet configuration information. NYCDOT will provide the MIB which is to be used by the CONTRACTOR for their implementation of the ASTC. The CONTRACTOR may provide additional functionality not included in the current MIB, but the new controllers shall be fully compatible (interchangeable) with the existing units for NEMA NTCIP compliance. The MIB used for the existing ASTC is available for inspection and will be provided electronically to the CONTRACTOR after contract award.

10) Note that the current MIB includes data objects for functionality that is no longer supported by the ASTC; this is legacy functionality and includes the DC Interconnect capabilities and the Manhattan coaxial cable communications support. This functionality may also exist within the source code for the ASTC as delivered for Phase 3. In order to maintain compatibility with the USB database loading and other objects, these data objects may continue to be required although their values are ignored.

11) The CONTRACTOR must support the standard NTCIP objects for all functionality listed within the TS2 standard and the NTCIP 1202 V2 standard. Under no circumstances shall the CONTRACTOR use proprietary objects in lieu of standard objects for the specified functionality. Further, all NEMA TS2 functionality shall be managed through the standard NTCIP 1201 and 1202 objects including but not limited to the scheduler and event logging constructs. If the CONTRACTOR chooses to provide extended capability, such extensions must not interfere or interact with any of the standard objects; further, if employed, it shall not be necessary to configure any such proprietary extensions for the traffic controller to perform all of the NEMA functions and custom NYCDOT functions described herein.

12) The ASTC shall support a minimum of 8 digital inputs and 8 digital outputs under the ***Auxiliary I/O Objects*** from NTCIP 1201. These inputs shall be mappable using the general purpose I/O mapping capability of the ASTC. Note that timing plans may also access these special functions (1-8) for output activation. These shall correspond to special functions 1-8 in the I/O mapping matrix. In addition, it shall be possible to identify the output as a flashing output or steady state output. If it is a flashing output, the flash rate shall be programmable to be 30, 60, 120 Flashes per minute. The CONTRACTOR is required to extend the MIB to support this functionality.

13) Finally, if the CONTRACTOR chooses to provide custom extensions, such extensions shall be fully documented and included in the MIB for the controller. The CITY shall have the unrestricted right to publish the MIB and descriptions of all such extended functionality for future procurements and the CONTRACTOR shall not have any cause for legal action against the CITY if these extended features are provided by other vendors.

14) Note: the CONTRACTOR shall refer to the MIB and existing operation to ensure an interchangeable unit. While the CITY has required conformance to the standards, there

have been many situations where the NTCIP standards were incomplete, undergoing change, or required extensions to meet the operational requirements of NYCDOT. What is required is interchangeable operation – and hence, decisions which were made in earlier versions will affect the new procurement in ways that may not conform to the final standard or revised standards. The CONTRACTOR shall work with the CITY to resolve these issues in a manner acceptable to the CITY without additional cost.

4.6.1 Time Management

1) Time Synchronization Objects: The New York City, NTCIP Traffic Management System actuated signal controllers supports non-standard, NTCIP objects used for time synchronization, *timeSource* and *timeSourceCommunicationStatus*. Note that the NTCIP *1201::globalTime* is still available and may be set where the communications delays are deterministic in nature. Refer to the MIB for a discussion of their operation. The timeSource object shall default to use of the 60 Hz power line.

2) The central computer will identify the source to be used (line frequency or absolute). If the time reference is the local LFC (Line Frequency Clock), then the central system may elect to set the controller's internal clock relative to a local absolute reference.

3) It is assumed that the controllers may be equipped with a local absolute time receiver (e.g. WWV, GPS) to perform this function (Note that this is optional and not currently included in this procurement specification, however, the controller shall be prepared to accept these objects). The ASTC will be expected to communicate directly with this device to receive accurate time information which will be used when setting the clock (*1201::globalTime*). When the controller is set to use a GPS input, it adjusts its local *1201::globalTime* track this absolute reference.

4.6.2 Database requirements

1) It is required that the ASTC be able to support downloading the entire database as a single database transaction (Ref. NTCIP 1201). The central system may download and verify selected blocks or the entire controller database including all configuration parameters.
2) The Database verify objects shall conform to Version 2 of the NTCIP 1201 Standard.

4.6.3 Daylight Savings Time (DST)

1) The parameters for the management of DST shall be configurable and if the NTCIP working group has established such parameters at the time of deployment, they shall be used.
2) As a minimum, the parameters shall allow the specification of the month, week of month (first, second, third, fourth, last), day of week for the changes to occur assuming that the change occurs at 2:00 AM on the selected day. Both the jump forward and the fall back shall be individually configurable.
3) As a minimum, the controller shall allow at least 8 entries in the DST table identified in the revised NTCIP 1201.

4.6.4 Pre-configured power-up trap

1) The CONTRACTOR shall work with the CITY and its consultant to develop a default power-up trap message and a default trap channel using the NTCIP 1103 standard to initiate the transmission of a message to the TMC upon the restoration of power to the unit. The content of the trap message shall be configurable and the trap channel parameters shall be configurable.

2) The power-up trap shall be active even if the database for the controller does not match the existing cabinet address. This trap shall be used to announce the presence of the controller and to request a database download whenever the database does not match the cabinet address.

4.6.5 Exception based reporting (EBR) requirements

1) The ASTC shall support the NTCIP over a wireless or similar Ethernet based communications media. This includes both polled and exception based reporting. The following sections identify the requirements for this communications. The requirements follow very closely the NTCIP standards, but deviate slightly in an effort to improve the efficiency and flexibility of the communications.

2) The ASTC shall support the system communications through either a serial port or the Ethernet port. Both ports shall fully support the system communications, and at startup the ASTC shall use the protocol object to determine which port to use for system communications. The default setting for the communications protocol object shall be the Ethernet port for system communications.

3) The ASTC shall support exception based reporting such that it is not necessary to poll the controller in order to determine its status. Rather, the controller shall be programmable to report configurable changes of status on a macroscopic and microscopic level as well as periodic basis. In general, the ASTC must support the concept of configured reporting of changes of state (e.g. G→Y, Y→R, R→G, for each phase including Ped movements), changes of phase, detector actuations, failures, plan changes, and periodic detector data. The new traffic controllers shall match the existing functionality including MIB data elements, error management, timing, and operation.

4) The ASTC must fully support the *traps* and *trap* objects as previously implemented; these deviate in some respects from NTCIP 1103. The event table will be extended to support dynamic objects (report blocks and watch blocks) and multiple trap channels with varying retry requirements.

4.6.6 Applicable NTCIP Standards

1) The following table lists the applicable NTCIP standards. For this procurement, the latest version at the time of the award shall govern. It is understood that many of these standards are undergoing changes. The CONTRACTOR shall be expected to adjust their implementation to accommodate such changes.

2) Where the current ASTC implementation deviates from the standards, this was due to the fact that the NTCIP standards development/modifications lagged the software development and hence there are some differences. The new ASTC shall be backward compatible with the existing system without changes. It shall be the responsibility of the CONTRACTOR to ensure this backward compatibility through field observations and measurements. Testing shall be performed to verify this full backward compatibility.

Standard Number	Title	Status & Date
4.6.6.1 Primary Standard(s)		
NTCIP 1202	Object Definitions for Actuated Signal Controllers	Version 2
4.6.6.2 Secondary/Supporting Standard(s)		
NTCIP 1201	Global Object Definitions	v02.16 User Comment Draft February 2002
4.6.6.3 Base Standards and Protocols		
NTCIP 1101 Amendment 1	Simple Transportation Management Framework (STMF)	Jointly Approved: January 2001
NTCIP 1102	Octet Encoding Rules	Recommended: September 2000
NTCIP 1103 V2	Transportation Management Protocol	Recommended Note also that there is a version 3 pending final editing which should be used.
NTCIP 1209	Transportation Sensor Systems	User Comment Draft: July 1999
NTCIP 2101:2001	Subnet Profile - Point to Multi Point Protocol/RS232	Published: November 2001
NTCIP 2102	Subnet Protocol - Point to Multi Point Protocol /FSK	Recommended: June 2001
NTCIP 2103	Subnet Protocol -Point to Point Protocol/RS232	Recommended: September 2001
NTCIP 2104	Subnet Protocol - Ethernet	Recommended: June 2001
NTCIP 2201	Transport Protocol - Transportation	Recommended: September 2001
NTCIP 2202:2001	Transport Protocol - Internet (TCP/IP and UDP/IP)	Published: December 2001
NTCIP 2301:2001	Application Protocol - Simple Transportation Management Framework	Published: December 2001

4.6.7 Support for NTCIP 1103

1) A minimum of 13 Dynamic objects, watch blocks, and report blocks shall be provided. The minimum of 32 event classes shall be supported. A minimum of 16 Trap Channels shall be supported. The minimum queue depth for each channel shall be 16 events.

2) Where there is a conflict between the NTCIP 1103 standard and the current ASTC operation, the CONTRACTOR shall be responsible for ensuring that the ASTC operation is compatible with the central system.

3) Note that Version 3 of 1103 includes the support for NTCIP traps and has not been published. The ASTC implemented an earlier version of 1103V3 prior to final acceptance by the NTCIP joint committee. Further, the ASTC MIB has some differences from 1103V3. The CONTRACTOR shall use the ASTC MIB items and duplicate the existing operation. Note further that the “trains” and “Chains” feature included in NTCIP 1103V3 are not employed for the ASTC.

4.6.8 Protection for critical data

1) The current ASTC allows the central system to download all configuration data including but not limited to I/O mapping. Certain restrictions have been placed on controller operational conditions to allow the remote downloading of the data. All such restrictions shall conform to the existing operation. For example, the current ASTC requires that the cabinet door be open and that the cabinet be in a flashing condition to download and implement a new I/O circuit map (unless the map is identical to the existing map in which case the download request is acknowledged but ignored).
2) The following data shall be restricted and only downloadable from the central system when the cabinet door is open and the cabinet is in the flashing condition: I/O mapping, deletion/addition of phases, activate/deactivate load switch channels, change of phase/ring structure, (for example, move a phase across the ring barrier or add a phase to a new ring). Sequence data shall be downloadable without such restrictions as long as no phase is moved to the other side of the ring barrier
3) To avoid the appearance of errors when a full controller download is commanded by the operator, whenever the full download of the restricted data is attempted, if the data is identical to the data already stored in the controller, the controller shall acknowledge and accept the data without errors, but shall not disturb the operation of the controller. Only if the data is different from that stored, will the controller issue an error response.

4.6.9 Block Object Support

1) All parameters resident in the controller unit shall be user modifiable and verifiable through block data (block objects) for upload and download transfers between the controller unit and Central (note that there may be some limitations due to unsafe operation – however, even these parameters shall be accessible for central download when a technician is present in the field, and the controller is in flash to facilitate central maintenance support). Where the NTCIP standards include such block objects, they shall be used. Where NTCIP does not include such objects (E.G. NTCIP 1103), the CONTRACTOR shall develop such block objects to streamline the upload and download process.

4.7 Electrical Interfaces

1) The electrical interfaces within the controller unit shall comply with the specifications detailed in Section 3.3.1.2, of NEMA TS-2 Standard electrical interface.

2) All parameters resident in the controller unit shall be user modifiable and verifiable through block data upload and download through the EIA/TIA-232 Port for PC access and the Ethernet port.

3) A total of 10 sets of cables shall be provided for connecting the laptop computer directly to the controller unit. Each cable shall be 12-ft. long. Cables shall be common data cables and common 100BaseT cables and shall not use custom connectors or custom wiring configurations. It shall be possible to purchase additional cables from most common computer outlets (e.g. cross-over cables). Since these connections will be directly to the laptop computer, the cables shall be cross-over cables that allow this direct connection.

4) All interface cables shall be “extra flexible” such that they are flexible at all outdoor ambient temperatures normally experienced in New York City.

4.8 Data and Clock Communications Protocol

1) The ASTC cabinet and controller unit shall fully support the NEMA TS2 Type 1 serial cabinet interface with the changes noted below. The intent of this specification is to develop a compact controller with a single BIU for all basic cabinet functions: 4 input file slots, 6 load switches, and some auxiliary cabinet functions. These functions are shown in section 3.9.5.

2) The Controller unit shall be the master and shall transmit and receive frames to and from the BIU as noted in the NEMA TS2-2003 specification. Because of the specific assignments for the BIU I/O pins and functions, frame types 12 and 140 have special meaning for the ASTC. Those changes are noted below.

3) In order to expand the cabinet with additional signals and detector inputs, the controller shall also support the expanded NEMA TS2-2003 BIU functions and message sets. For larger cabinets, normal (NEMA) BIU functions shall apply. The larger cabinet is not specified herein. Upon startup, the CU shall interrogate the BIU TF#3 for the cabinet Address code, then, using that data, it shall configure its inputs and outputs according to the unique requirements of the cabinet (based on the database loaded). Thus, for an ASTC-12 cabinet, BIU TF#3 shall only be used for the basic functions; expanded inputs and outputs shall be handled by BIU TF#4 and above. For additional cabinets, BIU TF1 and TF2 may be used, but their functions shall be configurable for an expanded number of load switches, inputs, outputs, and NEMA control and monitor functions (reference NEMA TS2-2003 functions listed for TF1, TF2, TF3, and TF4 BIU's).

4) In addition, it shall be possible to add Detector BIU's to the cabinet in the form of additional input files and/or special detector processing subassemblies that simulate a DET BIU to handle multiple lanes of more complex vehicle detection technologies. In this case, the ASTC shall provide full access to these additional detectors for any detector function within the cabinet. However, where a detector BIU is used for system sensors or actuation detectors, if the BIU fails to respond, the controller shall interpret actuation detection as being constantly present, and system sensors as providing zero counts and zero occupancy. The controller and cabinet shall not revert to flashing operation in the event of the failure of one or more detector BIUs.

5) In addition, it shall be possible to add additional output files to support additional load switches for larger complex intersections that cannot be managed with the ASTC-12 configuration. The ASTC database shall allow such extensions to be added without additional software.

4.8.1 Type 12 Frame

1) The destination of these frames is the TF BIU #3. This command frame provides for driving all of the output signals in the basic cabinet. Input/output pins that are designated as Inputs or Reserved must be driven to the logic false state at all times in this Type 12 frame.

2) Table 13 shows the Type 12 frame bit assignments.

Table 13 Type 12 Command Frame

Bit	Function	Function
1	0	Type 12 Command Frame
2	0	Type 12 Command Frame
3	1	Type 12 Command Frame

Bit	Function	Function
4	1	Type 12 Command Frame
5	0	Type 12 Command Frame
6	0	Type 12 Command Frame
7	0	Type 12 Command Frame
8	0	Type 12 Command Frame
9	Output 1	Select address nibble 1[3]
10	Output 2	Select address nibble 2[3]
11	Output 3	Select address nibble 3[3]
12	Output 4	Select address nibble 4[3]
13	Output 5	Watchdog[1]
14	Output 6	Disable red monitoring
15	Output 7	Detector Reset Slot 1 & 2[∞]
16	Output 8	Detector Reset Slot 3 & 4[∞]
17	Output 9	Load Switch 1 Red Driver
18	Output 10	Load Switch 1 Yellow Driver
19	Output 11	Load Switch 1 Green Driver
20	Output 12	Load Switch 2 Red Driver
21	Output 13	Load Switch 2 Yellow Driver
22	Output 14	Load Switch 2 Green Driver
23	Output 15	Load Switch 3 Red Driver
24	Reserved	
25	Input/Output 1	Load Switch 3 Yellow Driver
26	Input/Output 2	Load Switch 3 Green Driver
27	Input/Output 3	Load Switch 4 Red Driver
28	Input/Output 4	Load Switch 4 Yellow Driver
29	Input/Output 5	Load Switch 4 Green Driver
30	Input/Output 6	Load Switch 5 Red Driver
31	Input/Output 7	Load Switch 5 Yellow Driver
32	Input/Output 8	Load Switch 5 Green Driver
33	Input/Output 9	Load Switch 6 Red Driver
34	Input/Output 10	Load Switch 6 Yellow Driver
35	Input/Output 11	Load Switch 6 Green Driver
36	Input/Output 12	-off-[2∞]
37	Input/Output 13	-off-[2∞]
38	Input/Output 14	-off-[2∞]
39	Input/Output 15	-off-[2∞]
40	Input/Output 16	-off-[2∞]
41	Input/Output 17	-off-[2]
42	Input/Output 18	-off-[2]
43	Input/Output 19	-off-[2]
44	Input/Output 20	-off-[2]
45	Input/Output 21	-off-[2]
46	Input/Output 22	-off-[2∞]
47	Input/Output 23	-off-[2∞]
48	Input/Output 24	-off-[2∞]

Bit	Function	Function
[∞] Indicates that this is a configurable function determined by the cabinet configuration. -off- indicates that this output must be set to the false (off conditions) to allow the BIU contact to be used as an input, however, this is also configurable as the input slots may be used for inputs or outputs as necessary for such functions as NEMA control functions, DC communications drivers or receivers, special functions, and preemption. [1] This output must be toggled as described for a standard 170/179 watchdog signal and as necessary to support the Model 2010 Conflict Monitor [2] These outputs must be set to the off (false) condition so that the BIU inputs can be used. These functions are not configurable by cabinet. [3] Only one nibble can be selected at a time.		

3) Outputs shall change state immediately upon the receipt of a Type 18 frame as noted in the NEMA specification. To clarify, although an output may be designated as a load switch by the NEMA BIU output chart, many of the outputs have been re-assigned to other functions for the ASTC. The BIU shall immediately change output state (within 20 ms) as noted in NEMA TS2-2003 Section 3.3.1.4.1.9 & Section 8.8.4. Outputs shall change state regardless of the state of the Line Frequency Clock (LFC) input signal; the ASTC does not include a LFC signal. Note that the LFC input (pin 31 B) is not connected.

4.8.2 Type 140

1) The source of these frames is the TF BIU #3. This frame type shall be transmitted only if a Type 12 Frame has been correctly received from the primary station. If a Type 12 Frame is received from the primary station with a CRC error, then this frame type shall not be issued. Input/Output pins that are designated as Outputs for the BIU for this cabinet shall be ignored in this frame.

2) Table 14 shows the Type 140 response frame bit assignments.

Table 14 Type 140 Response Frame Bit Assignments

Bit	Function	Function
1	0	Type 140 Response Frame
2	0	Type 140 Response Frame
3	1	Type 140 Response Frame
4	1	Type 140 Response Frame
5	0	Type 140 Response Frame
6	0	Type 140 Response Frame
7	0	Type 140 Response Frame
8	1	Type 140 Response Frame
9	Input/Output 1	Output – not used[1]
10	Input/Output 2	Output – not used[1]
11	Input/Output 3	Output – not used[1]
12	Input/Output 4	Output – not used[1]
13	Input/Output 5	Output – not used[1]
14	Input/Output 6	Output – not used[1]
15	Input/Output 7	Output – not used[1]
16	Input/Output 8	Output – not used[1]
17	Input/Output 9	Output – not used[1]
18	Input/Output 10	Output – not used[1]
19	Input/Output 11	Output – not used[1]

Bit	Function	Function
20	Input/Output 12	Calling or System Detector – 1[2]
21	Input/Output 13	Calling or System Detector – 2[2]
22	Input/Output 14	Calling or System Detector – 3[2]
23	Input/Output 15	Calling or System Detector – 4[2]
24	Input/Output 16	Calling or System Detector – 5[2]
25	Input/Output 17	Calling or System Detector – 6[2]
26	Input/Output 18	Calling/System detector – 7[2]
27	Input/Output 19	Calling/System detector – 8[2]
28	Input/Output 20	Calling/System detector – 9[2]
29	Input/Output 21	Calling/System detector – 10[2]
30	Input/Output 22	Cabinet address 1 (LSB)
31	Input/Output 23	Cabinet address 2
32	Input/Output 24	Cabinet address 4
33	Input 1	Cabinet address 8 (MSB)
34	Input 2	Stop timing
35	Input 3	Address Parity bit (for each nibble)
36	Input 4	Manual control enable
37	Input 5	Interval advance
38	Input 6	External Min. Recall
39	Input 7	Cabinet Flash
40	Input 8	Door open/alarm
41	Opto-Input 1	Pedestrian Detector 1[3]
42	Opto-Input 2	Pedestrian Detector 2[3]
43	Opto-Input 3	Preemption 1[3]
44	Opto-Input 4	Preemption 2[3]
45	Reserved	
46	Reserved	
47	Reserved	
48	Reserved	

[1] These inputs are not used because the BIU outputs are used for dedicated functions.
[2] These functions are configurable by cabinet depending upon the wiring and cards in the input file slots. The function shown is the nominal function.
[3] These functions are configurable by cabinet.

4.8.3 Frame Timing

1) Frame timing shall meet NEMA TS2-2003 specifications Section 3.3.1.5 except as noted below:

2) The Type 12 frame shall be transmitted at a rate of 60 times per second.

3) The Type 18 frame must be sent whenever any of the output settings for the Type 12 frame change. (Note that for the ASTC-12 cabinet, see Section 5, the transmission of the Type 12 and 13 frames should be coordinated so that the Type 18 frame does not incorrectly change the output states.)

4) The BIU shall respond to the CU with Type 140 Frames in response to each Type 12 frame which shall accurately reflect the condition of all input signals at the BIU.

5) Command Frame Scheduling for the basic ASTC configuration shall only include the Type 12, Type 18, and the Type 9 frames. Additional frames will only be required for larger cabinet configurations and auxiliary cabinets.

6) Note that the high speed scanning for input frame Type 140 is necessary to support the detector pulse width accurately. Note that the BIU types used do not support detector preprocessing, hence the CU must read the inputs more rapidly so that volume and occupancy can be computed by the CU.

5 Expanded Cabinet Type [ASTC-12]

1) A small percentage of the intersections within the CITY cannot be supported with the basic 6 load switch ASTC because of the limited number of load switches (signal circuits) and/or limitations on the number of inputs. For those circumstances, a larger version of the ASTC cabinet must be used.

2) The larger version is designated as the ASTC-12 and is based upon the standard NYS 330 cabinet configuration with changes as noted herein. A summary of the major elements of the Larger cabinet is listed below:
    - A larger version of the input file is used with 10 Slots for cards and slots for 2 BIU's.
    - Two BIU's are required: both will be mounted in the input file with a cross connect between the input file and the output file.
    - The number of load switches has been expanded from 6 to 12.
    - The number of flash transfer relays has been expanded from 2 to 6.
    - The field terminal blocks have been increased to handle the added input circuits and load switches.
    - The cabinet is larger and more closely resembles the 330 cabinet.
    - A configuration connector has been added so that Load Switches 9-12 can support any combination of circuits from 6 PED circuits to 4 three circuit signal heads.
    - An auxiliary cabinet support connector has been added so that 4 more load switches can be added to the intersection and properly wired to the Conflict Monitor.

3) The ASTC-12 shall meet all requirements for the basic ASTC-6 except as noted below. The following sections detail the changes required for the ASTC-12. Where a conflict exists between the requirements stated in this section, 5, and the balance of the document, the provisions of this section shall take precedence. If the bidder determines that there is a conflict between the basic requirements of the ASTC and the specific modifications for the ASTC-12, these must be brought to the attention of the CITY in writing (reference Sections 1.2 and 2.1).

4) It is a requirement of these specifications that the ASTC-12 fully support the variety of communications schemas as listed for the ASTC-6 and that the controller unit itself and all functionality be identical. As with the ASTC-6, the ASTC-12 shall be fully configurable as to the assignment of input and output functions for the input slots and load switches.

5) The ASTC-12 must also retain the cabinet addressing scheme for the first BIU (TF #3) such that the controller can always read the cabinet address and determine the configuration and number of BIUs, load switches, etc. Note that Table 15 and Table 16 list the pin/function assignments for both BIU's. The functions shown match the capabilities of the BIU.

6) The bit assignments for the Type 12 Frame (reference NEMA TS2-2003 Section 3.3.1.4.1.7) for the ASTC-12 are shown in Table 17.

7) The bit assignments for the Type 140 Frame (reference NEMA TS2-2003 Section 3.3.1.4.2.5) for the ASTC-12 are shown in Table 18.

8) The bit assignments for the Type 13 frame (reference NEMA TS2-1998, Section 3.3.1.4.1.8) for the ASTC 12 are shown in Table 19.

9) The bit assignments for the Type 141 frame (reference NEMA TS2-1998, Section 3.3.1.4.1.7) for the ASTC 12 are shown in Table 20.

10) The ASTC-12 uses two BIU's; the first one will be addressed as BIU TF #3 (as prescribed in the NEMA specification) and will use the I/O assignments shown in Table 15. The second BIU will be assigned address BIU TF #4 with the I/O assignments as shown in Table 16.

11) For the ASTC-12, Type 12 frames will be sent to the TF-#3 with Type 140 response frames (reference Table 17 and Table 18). The second BIU will be assigned address TF-#4 and will be sent Type 13 frames with a response of Type 141 frames (Reference NEMA TS2 1998 3.3.1.4). Both BIU's will respond to Type 9 and Type 18 frames as prescribed in the NEMA specification.

12) The input file wiring for the ATSC-12 shall be similar to the ASTC except that there is no special wiring for the last slot (#10). Slot 1 and 2 are wire the same as shown for the ASTC, and the wiring continues to cascade such that loops 1,2, are input from slot one, 3 and 4 for slot 2, 5 and 6 for slot three etc. and either a dual or a quad can be plugged into any slot except slot 1. However, each detector slot has a separate reset function connected to the BIU output as shown in Table 15.

13) The ASTC-12 cabinet shall be wired to support <u>both</u> an expansion cabinet and configurable monitor wiring for load switches 9-12.

5.1 BIU input and output assignment Tables

Table 15 BIU Input Function Assignments for ASTC-12

	ASTC-12 Input		
Signal	**Function**	**Cabinet Location**	**Description Of Function**
Output 1	Address Select 1 (O)	Diodes	Cabinet address selection output
Output 2	Address Select 2 (O)	Diodes	Cabinet address selection output
Output 3	Address Select 3 (O)	Diodes	Cabinet address selection output
Output 4	Address Select 4 (O)	Diodes	Cabinet address selection output
Output 5	Watchdog	CMU-22	Drives the Model 2010 watchdog circuit
Output 6	Disable Red Monitor	CMU (P1-20)	Disables red monitoring during preemption or flash
Output 7	Detector Reset Slot 1 (O)	Input File Slot 1 C	Issues a detector reset to slot 1
Output 8	Detector Reset Slot 2 (O)	Input File Slot 2 C	Issues a detector reset to slot 2
Output 9	Detector Reset Slot 3 (O)	Input File Slot 3 C	Issues a detector reset to slot 3
Output 10	Detector Reset Slot 4 (O)	Input File Slot 4 C	Issues a detector reset to slot 4
Output 11	Detector Reset Slot 5 (O)	Input File Slot 5 C	Issues a detector reset to slot 5
Output 12	Detector Reset Slot 6 (O)	Input File Slot 6 C	Issues a detector reset to slot 6
Output 13	Detector Reset Slot 7 (O)	Input File Slot 7 C	Issues a detector reset to slot 7
Output 14	Detector Reset Slot 8 (O)	Input File Slot 8 C	Issues a detector reset to slot 8
Output 15	Detector Reset Slot 9 (O)	Input File Slot 9 C	Issues a detector reset to slot 9
Input/Output 1	Detector Reset Slot 10 (O)	Input File Slot 10 C	Issues a detector reset to slot 10
Input/Output 2	Detector Channel 1 Call (I)	Input File Slot 1 F	Calling or system detector (V, O)*
Input/Output 3	Detector Channel 2 Call (I)	Input File Slot 1 W	Calling or system detector (V, O)
Input/Output 4	Detector Channel 3 Call (I)	Input File Slot 2 F	Calling or system detector (V, O)
Input/Output 5	Detector Channel 4 Call (I)	Input File Slot 2 W	Calling or system detector (V, O)
Input/Output 6	Detector Channel 5 Call (I)	Input File Slot 3 F	Calling or system detector (V, O)
Input/Output 7	Detector Channel 6 Call (I)	Input File Slot 3 W	Calling or system detector (V, O)
Input/Output 8	Detector Channel 7 Call (I)	Input File Slot 4 F	Calling or system detector (V, O)
Input/Output 9	Detector Channel 8 Call (I)	Input File Slot 4 W	Calling or system detector (V, O)
Input/Output 10	Detector Channel 9 Call (I)	Input File Slot 5 F	Calling or system detector (V, O)
Input/Output 11	Detector Channel 10 Call (I)	Input File Slot 5 W	Calling or system detector (V, O)
Input/Output 12	Detector Channel 11 Call (I)	Input File Slot 6 F	Calling or system detector (V, O)
Input/Output 13	Detector Channel 12 Call (I)	Input File Slot 6 W	Calling or system detector (V, O)
Input/Output 14	Detector Channel 13 Call (I)	Input File Slot 7 F	Calling or system detector (V, O)

	ASTC-12 Input		
Signal	**Function**	**Cabinet Location**	**Description Of Function**
Input/Output 15	Detector Channel 14 Call (I)	Input File Slot 7 W	Calling or system detector (V, O)
Input/Output 16	Detector Channel 15 Call (I)	Input File Slot 8 F	Calling or system detector (V, O)
Input/Output 17	Detector Channel 16 Call (I)	Input File Slot 8 W	Calling or system detector (V, O)
Input/Output 18	Detector Channel 17 Call (I)	Input File Slot 9 F	Calling or system detector (V, O)
Input/Output 19	Detector Channel 18 Call (I)	Input File Slot 9 W	Calling or system detector (V, O)
Input/Output 20	Detector Channel 19 Call (I)	Input File Slot 10 F	Calling or system detector (V, O)
Input/Output 21	Detector Channel 20 Call (I)	Input File Slot 10 W	Calling or system detector (V, O)
Input/Output 22	Address Bit 1 (I)	Diodes	Cabinet address input
Input/Output 23	Address Bit 2 (I)	Diodes	Cabinet address input
Input/Output 24	Address Bit 3 (I)	Diodes	Cabinet address input
Input 1	Address Bit 4 (I)	Diodes	Cabinet address input
Input 2	Stop Timing	CMU-BB	Stops signal timing (conflict) and signals initialization
Input 3	Address Bit Parity (I)	Diodes	Cabinet address input
Input 4	Manual Control Enable (I)	Switch – police plug	Executes NEMA manual control enable function
Input 5	Interval Advance (I)	Switch – police plug	Executes NEMA advance function
Input 6	External Minimum Recall (I)	Toggle Switch	For use when detectors are faulty
Input 7	Cabinet Flash	TBD	Indicates the cabinet is in flash
Input 8	Cabinet Alarm	Door switch and alarm circuit	Door status and other cabinet alarms
Opto Input 1	Pedestrian Detector 1	Terminal	Ped button
Opto Input 2	Pedestrian Detector 2	Terminal	Ped button
Opto Input 3	Preemption 1	Terminal	Preemption
Opto Input 4	Preemption 2	Terminal	Preemption
Opto Common	12 VAC	PDA	
Data Transmit	Reserved	Nc	
Data Receive	Reserved	Nc	
Address Bit 0	OFF - BIU Address Assignment	Handled on the input file	BIU Address – TF#3
Address Bit 1	ON - BIU Address Assignment	Handled on the input file	BIU Address – TF#3
Address Bit 2	OFF - BIU Address Assignment	Handled on the input file	BIU Address – TF#3
Address Bit 3	OFF - BIU Address Assignment	Handled on the input file	BIU Address – TF#3
+24 VDC	Power Supply Interface	PDA	24 VDC to BIU
Logic Ground		PDA	Power/logic ground to BIU
Earth Ground		PDA	Chassis ground for BIU
Line Freq. Ref.	Line Frequency Reference		Not used

	ASTC-12 Input		
Signal	**Function**	**Cabinet Location**	**Description Of Function**
[1] For the DC Interconnect these functions are used; note that slot 9 must be empty if DCI is used for the DC interconnect.			

Table 16 BIU Output Function Assignments for ASTC-12

	ASTC-12 Output		
Signal	**Function**	**Cabinet Location**	**Description Of Function**
Output 1	Load Switch 1 Red Driver	Output File L/S 1 pin 6	Activate load switch circuit
Output 2	Load Switch 1 Yellow Driver	Output File L/S 1 pin 8	Activate load switch circuit
Output 3	Load Switch 1 Green Driver	Output File L/S 1 pin 10	Activate load switch circuit
Output 4	Load Switch 2 Red Driver	Output File L/S 2 pin 6	Activate load switch circuit
Output 5	Load Switch 2 Yellow Driver	Output File L/S 2 pin 8	Activate load switch circuit
Output 6	Load Switch 2 Green Driver	Output File L/S 2 pin 10	Activate load switch circuit
Output 7	Load Switch 3 Red Driver	Output File L/S 3 pin 6	Activate load switch circuit
Output 8	Load Switch 3 Yellow Driver	Output File L/S 3 pin 8	Activate load switch circuit
Output 9	Load Switch 3 Green Driver	Output File L/S 3 pin 10	Activate load switch circuit
Output 10	Load Switch 4 Red Driver	Output File L/S 4 pin 6	Activate load switch circuit
Output 11	Load Switch 4 Yellow Driver	Output File L/S 4 pin 8	Activate load switch circuit
Output 12	Load Switch 4 Green Driver	Output File L/S 4 pin 10	Activate load switch circuit
Output 13	Load Switch 5 Red Driver	Output File L/S 5 pin 6	Activate load switch circuit
Output 14	Load Switch 5 Yellow Driver	Output File L/S 5 pin 8	Activate load switch circuit
Output 15	Load Switch 5 Green Driver	Output File L/S 5 pin 10	Activate load switch circuit
Input/Output 1	Load Switch 6 Red Driver	Output File L/S 6 pin 6	Activate load switch circuit
Input/Output 2	Load Switch 6 Yellow Driver	Output File L/S 6 pin 8	Activate load switch circuit
Input/Output 3	Load Switch 6 Green Driver	Output File L/S 6 pin 10	Activate load switch circuit
Input/Output 4	Load Switch 7 Red Driver	Output File L/S 7 pin 6	Activate load switch circuit
Input/Output 5	Load Switch 7 Yellow Driver	Output File L/S 7 pin 8	Activate load switch circuit
Input/Output 6	Load Switch 7 Green Driver	Output File L/S 7 pin 10	Activate load switch circuit
Input/Output 7	Load Switch 8 Red Driver	Output File L/S 8 pin 6	Activate load switch circuit
Input/Output 8	Load Switch 8 Yellow Driver	Output File L/S 8 pin 8	Activate load switch circuit
Input/Output 9	Load Switch 8 Green Driver	Output File L/S 8 pin 10	Activate load switch circuit
Input/Output 10	Load Switch 9 Red Driver	Output File L/S 9 pin 6	Activate load switch circuit
Input/Output 11	Load Switch 9 Yellow Driver	Output File L/S 9 pin 8	Activate load switch circuit
Input/Output 12	Load Switch 9 Green Driver	Output File L/S 9 pin 10	Activate load switch circuit

	ASTC-12 Output		
Signal	**Function**	**Cabinet Location**	**Description Of Function**
Input/Output 13	Load Switch 10 Red Driver	Output File L/S 10 pin 6	Activate load switch circuit
Input/Output 14	Load Switch 10 Yellow Driver	Output File L/S 10 pin 8	Activate load switch circuit
Input/Output 15	Load Switch 10 Green Driver	Output File L/S 10 pin 10	Activate load switch circuit
Input/Output 16	Load Switch 11 Red Driver	Output File L/S 11 pin 6	Activate load switch circuit
Input/Output 17	Load Switch 11 Yellow Driver	Output File L/S 11 pin 8	Activate load switch circuit
Input/Output 18	Load Switch 11 Green Driver	Output File L/S 11 pin 10	Activate load switch circuit
Input/Output 19	Load Switch 12 Red Driver (I)	Output File L/S 12 pin 6	Activate load switch circuit
Input/Output 20	Load Switch 12 Yellow Driver (I)	Output File L/S 12 pin 8	Activate load switch circuit
Input/Output 21	Load Switch 12 Green Driver(I)	Output File L/S 12 pin 10	Activate load switch circuit
Input/Output 22	not used		
Input/Output 23	not used		
Input/Output 24	not used		
Input 1	not used		
Input 2	not used		
Input 3	not used		
Input 4	not used		
Input 5	not used		
Input 6	not used		
Input 7	not used		
Input 8	not used		
Opto Input 1	Pedestrian Detector 3	Terminal	Ped button
Opto Input 2	Pedestrian Detector 4	Terminal	Ped button
Opto Input 3	Preemption 3	Terminal	Preemption
Opto Input 4	Preemption 4	Terminal	Preemption
Opto Common	12 VAC	PDA	
Data Transmit	Reserved	Nc	
Data Receive	Reserved	Nc	
Address Bit 0	ON - BIU Address Assignment	Handled on the input file	BIU Address – TF#4
Address Bit 1	ON - BIU Address Assignment	Handled on the input file	BIU Address – TF#4
Address Bit 2	OFF - BIU Address Assignment	Handled on the input file	BIU Address – TF#4
Address Bit 3	OFF - BIU Address Assignment	Handled on the input file	BIU Address – TF#4
+24 VDC	Power Supply Interface	PDA	24 VDC to BIU
Logic Ground		PDA	Power/logic ground to BIU

	ASTC-12 Output		
Signal	**Function**	**Cabinet Location**	**Description Of Function**
Earth Ground		PDA	Chassis ground for BIU
Line Freq. Ref.	Line Frequency Reference		Not used

5.2 Notes for Table 15 and Table 16

1. The input file is configurable. Where the Table has noted “Calling or system detector (V, O)” this may be any type of input card or circuit including isolators, preemption inputs etc. The concept is to allow the input slots to be used as needed at the intersection using dynamic configuration capabilities of the controller.
2. The use of the output circuits is also configurable such that any load switch can be used for any function. The only limitation is the flash transfer relays.
3. The outputs are also to be configurable such that unused circuits (i.e. PED amber) can be used for such things as additional PED’s, special functions, and preempt outputs, etc.
4. The opto-isolator inputs have been assigned to PED and Preemption, however, these can be configured for any needed cabinet function. Note that the PED and Preemption inputs from both BIU’s are available for use.
5. Dimming is not used.

5.3 BIU Serial Bus Protocol Assignments

Table 17 Type 12 Command Frame for ASTC-12

Bit	Function	Function
1	0	Type 12 Command Frame
2	0	Type 12 Command Frame
3	1	Type 12 Command Frame
4	1	Type 12 Command Frame
5	0	Type 12 Command Frame
6	0	Type 12 Command Frame
7	0	Type 12 Command Frame
8	0	Type 12 Command Frame
9	Output 1	Select address nibble 1[3]
10	Output 2	Select address nibble 2[3]
11	Output 3	Select address nibble 3[3]
12	Output 4	Select address nibble 4[3]
13	Output 5	Watch dog[1]
14	Output 6	Disable red monitoring
15	Output 7	Detector Reset Slot 1 [∞]
16	Output 8	Detector Reset Slot 2[∞]
17	Output 9	Detector Reset Slot 3[∞]
18	Output 10	Detector Reset Slot 4[∞]
19	Output 11	Detector Reset Slot 5[∞]
20	Output 12	Detector Reset Slot 6[∞]
21	Output 13	Detector Reset Slot 7[∞]
22	Output 14	Detector Reset Slot 8[∞]
23	Output 15	Detector Reset Slot 9[∞]
24	Reserved	
25	Input/Output 1	Detector Reset Slot 10[∞]
26	Input/Output 2	-off-[2∞]
27	Input/Output 3	-off-[2∞]
28	Input/Output 4	-off-[2∞]
29	Input/Output 5	-off-[2∞]
30	Input/Output 6	-off-[2∞]
31	Input/Output 7	-off-[2∞]
32	Input/Output 8	-off-[2∞]
33	Input/Output 9	-off-[2∞]
34	Input/Output 10	-off-[2∞]
35	Input/Output 11	-off-[2∞]
36	Input/Output 12	-off-[2∞]
37	Input/Output 13	-off-[2∞]
38	Input/Output 14	-off-[2∞]
39	Input/Output 15	-off-[2∞]
40	Input/Output 16	-off-[2∞]
41	Input/Output 17	-off-[2∞]
42	Input/Output 18	-off-[2∞]
43	Input/Output 19	-off-[2∞]
44	Input/Output 20	-off-[2∞]
45	Input/Output 21	-off-[2∞]
46	Input/Output 22	-off-[2∞]
47	Input/Output 23	-off-[2∞]

Bit	Function	Function
48	Input/Output 24	-off-[2∞]

[∞] Indicates that this is a configurable function determined by the cabinet configuration. -off- indicates that this output must be set to the false (off conditions) to allow the BIU contact to be used as an input, however, this is also configurable as the input slots may be used for inputs or outputs as necessary for such functions as DC communications drivers or receivers, special functions, and preemption.

[1] This output must be toggled as described for a standard 170/179 watchdog signal and as necessary to support the Model 2010 Conflict Monitor

[2] These outputs must be set to the off (false) condition so that the BIU inputs can be used. These functions are not configurable by cabinet.

[3] Only one nibble (4 bits) can be selected at a time.

Table 18 Type 140 Response Frame Bit Assignments For The ASTC-12

Bit	Function	Function
1	0	Type 140 Response Frame
2	0	Type 140 Response Frame
3	1	Type 140 Response Frame
4	1	Type 140 Response Frame
5	0	Type 140 Response Frame
6	0	Type 140 Response Frame
7	0	Type 140 Response Frame
8	1	Type 140 Response Frame
9	Input/Output 1	Output – not used[1] (Detector reset)
10	Input/Output 2	Calling or System Detector – SL1/1[2]
11	Input/Output 3	Calling or System Detector – SL1/2[2]
12	Input/Output 4	Calling or System Detector – SL2/1[2]
13	Input/Output 5	Calling or System Detector – SL2/2[2]
14	Input/Output 6	Calling or System Detector – SL3/1[2]
15	Input/Output 7	Calling or System Detector – SL3/2[2]
16	Input/Output 8	Calling or System Detector – SL4/1[2]
17	Input/Output 9	Calling or System Detector – SL4/2[2]
18	Input/Output 10	Calling or System Detector – SL5/1[2]
19	Input/Output 11	Calling or System Detector – SL5/2[2]
20	Input/Output 12	Calling or System Detector – SL6/1[2]
21	Input/Output 13	Calling or System Detector – SL6/2[2]
22	Input/Output 14	Calling or System Detector – SL7/1[2]
23	Input/Output 15	Calling or System Detector – SL7/2[2]
24	Input/Output 16	Calling or System Detector – SL8/1[2]
25	Input/Output 17	Calling or System Detector – SL8/2[2]
26	Input/Output 18	Calling or System Detector – SL9/1[2]
27	Input/Output 19	Calling or System Detector – SL9/2[2]
28	Input/Output 20	Calling or System Detector – SL10/1[2]
29	Input/Output 21	Calling or System Detector – SL10/2[2]
30	Input/Output 22	Cabinet address 1 (LSB)
31	Input/Output 23	Cabinet address 2
32	Input/Output 24	Cabinet address 4
33	Input 1	Cabinet address 8 (MSB)
34	Input 2	Stop timing
35	Input 3	Address Parity bit (for each nibble)
36	Input 4	Manual control enable
37	Input 5	Interval advance
38	Input 6	External Min. Recall
39	Input 7	Cabinet Flash
40	Input 8	Door open/cabinet alarm
41	Opto-Input 1	Pedestrian Detector 1[3]
42	Opto-Input 2	Pedestrian Detector 2[3]
43	Opto-Input 3	Preemption 1[3]
44	Opto-Input 4	Preemption 2[3]
45	Reserved	
46	Reserved	
47	Reserved	
48	Reserved	

Bit	Function	Function
[1] These inputs are not used because the BIU outputs are used for dedicated functions. [2] These functions are configurable by cabinet depending upon the wiring and cards in the input file slots. The function shown is the nominal function. [3] These functions are configurable by cabinet.		

Table 19 Type 13 Command Frame for ASTC-12

Bit	Function	Function
1	1	Type 13 Command Frame
2	0	Type 13 Command Frame
3	1	Type 13 Command Frame
4	1	Type 13 Command Frame
5	0	Type 13 Command Frame
6	0	Type 13 Command Frame
7	0	Type 13 Command Frame
8	0	Type 13 Command Frame
9	Output 1	Load Switch 1 Red Driver
10	Output 2	Load Switch 1 Yellow Driver
11	Output 3	Load Switch 1 Green Driver
12	Output 4	Load Switch 2 Red Driver
13	Output 5	Load Switch 2 Yellow Driver
14	Output 6	Load Switch 2 Green Driver
15	Output 7	Load Switch 3 Red Driver
16	Output 8	Load Switch 3 Yellow Driver
17	Output 9	Load Switch 3 Green Driver
18	Output 10	Load Switch 4 Red Driver
19	Output 11	Load Switch 4 Yellow Driver
20	Output 12	Load Switch 4 Green Driver
21	Output 13	Load Switch 5 Red Driver
22	Output 14	Load Switch 5 Yellow Driver
23	Output 15	Load Switch 5 Green Driver
24	Reserved	
25	Input/Output 1	Load Switch 6 Red Driver
26	Input/Output 2	Load Switch 6 Yellow Driver
27	Input/Output 3	Load Switch 6 Green Driver
28	Input/Output 4	Load Switch 7 Red Driver
29	Input/Output 5	Load Switch 7 Yellow Driver
30	Input/Output 6	Load Switch 7 Green Driver
31	Input/Output 7	Load Switch 8 Red Driver
32	Input/Output 8	Load Switch 8 Yellow Driver
33	Input/Output 9	Load Switch 8 Green Driver
34	Input/Output 10	Load Switch 9 Red Driver
35	Input/Output 11	Load Switch 9 Yellow Driver
36	Input/Output 12	Load Switch 9 Green Driver
37	Input/Output 13	Load Switch 10- Red Driver
38	Input/Output 14	Load Switch 10 Yellow Driver
39	Input/Output 15	Load Switch 10 Green Driver
40	Input/Output 16	Load Switch 11 Red Driver
41	Input/Output 17	Load Switch 11 Yellow Driver
42	Input/Output 18	Load Switch 11 Green Driver
43	Input/Output 19	Load Switch 12 Red Driver
44	Input/Output 20	Load Switch 12 Yellow Driver
45	Input/Output 21	Load Switch 12 Green Driver
46	Input/Output 22	-off-[1∞]
47	Input/Output 23	-off-[1∞]
48	Input/Output 24	-off-[1∞]

Bit	Function	Function
[∞] Indicates that this is a configurable function determined by the cabinet configuration. -off- indicates that this output must be set to the false (off conditions) to allow the BIU contact to be used as an input. [1] These outputs must be set to the off (false) condition so that the BIU inputs can be used. These functions are not configurable by cabinet.		

Table 20 Type 141 Response Frame Bit Assignments for the ASTC-12

Bit	Function	Function
1	1	Type 141 Response Frame
2	0	Type 141 Response Frame
3	1	Type 141 Response Frame
4	1	Type 141 Response Frame
5	0	Type 141 Response Frame
6	0	Type 141 Response Frame
7	0	Type 141 Response Frame
8	1	Type 141 Response Frame
9	Input/Output 1	Output – not used[1]
10	Input/Output 2	Output – not used[1]
11	Input/Output 3	Output – not used[1]
12	Input/Output 4	Output – not used[1]
13	Input/Output 5	Output – not used[1]
14	Input/Output 6	Output – not used[1]
15	Input/Output 7	Output – not used[1]
16	Input/Output 8	Output – not used[1]
17	Input/Output 9	Output – not used[1]
18	Input/Output 10	Output – not used[1]
19	Input/Output 11	Output – not used[1]
20	Input/Output 12	Output – not used[1]
21	Input/Output 13	Output – not used[1]
22	Input/Output 14	Output – not used[1]
23	Input/Output 15	Output – not used[1]
24	Input/Output 16	Output – not used[1]
25	Input/Output 17	Output – not used[1]
26	Input/Output 18	Output – not used[1]
27	Input/Output 19	Output – not used[1]
28	Input/Output 20	Output – not used[1]
29	Input/Output 21	Output – not used[1]
30	Input/Output 22	Output – not used[1]
31	Input/Output 23	Output – not used[1]
32	Input/Output 24	Output – not used[1]
33	Input 1	Input – not used[1]
34	Input 2	Input – not used[1]
35	Input 3	Input – not used[1]
36	Input 4	Input – not used[1]
37	Input 5	Input – not used[1]
38	Input 6	Input – not used[1]
39	Input 7	Input – not used[1]
40	Input 8	Input – not used[1]
41	Opto-Input 1	Pedestrian Detector 3[2]
42	Opto-Input 2	Pedestrian Detector 4[2]
43	Opto-Input 3	Preemption 3[2]
44	Opto-Input 4	Preemption 4[2]
45	Reserved	
46	Reserved	
47	Reserved	
48	Reserved	

Bit	Function	Function
[1] These inputs are not used because the BIU outputs are used for dedicated functions or are not used for this BIU.. [2] These functions are configurable by cabinet.		

5.4 Frame Timing

1) Frame timing shall meet NEMA TS2-2003 specifications Section 3.3.1.5 except as noted below:

2) The Types 12 & 13 frame shall be transmitted at a rate of 60 times per second.

3) The Type 18 frame must be sent whenever any of the output settings for the Type 12 frame change. For the ASTC-12 cabinet, the transmission of the Type 12 and 13 frames must be coordinated so that the Type 18 frame does not incorrectly change the output states.

4) The BIU TF-#3 shall respond to the CU with Type 140 Frames in response to each Type 12 frame that shall accurately reflect the condition of all input signals at the BIU. The BIU TF-#4 shall respond to the CU with Type 141 Frames in response to each Type 13 frame that shall accurately reflect the condition of all input signals at the BIU.

5) Command Frame Scheduling for the basic ASTC configuration shall include the Type 12, Type 13, Type 18, and the Type 9 frames. Additional frames will only be required for larger cabinet configurations and auxiliary cabinets.

6) Note that the high speed scanning for input frame Types 140 and 141 are necessary to support both the 100 VDC interconnect (now discontinued) signal timing and the detector/Ped processing using the BIU inputs for system sensors without allowing the BIU to do the necessary processing of the detector data.

5.5 PDA Modifications

1) A single universal PDA has been specified for the ASTC-6, -8, and -12. The circuit breakers shall be assigned to the load switches as follows:

Breaker	Switch Pack
CB1	1,2,3,7,8,9
CB2	4,5,6,10,11,12

5.6 Cabinet Size Modifications

1) The ASTC-12 shall not exceed the following dimensions:
   - 22 inches wide
   - 15 inches deep
   - 51 inches tall

2) The air filter shall be identical to the basic ASTC.

3) Conduit entry and mounting shall be similar to the basic ASTC. Conduit entry may be larger as determined by the CITY. The conduit access area and clear areas shall be the same as for the basic ASTC.

5.7 Flexible Support for load switches 9-12

1) In addition to provisions for an auxiliary cabinet, the ASTC-12 cabinet shall be wired with a header to allow load switches 9-12 to be configured as 4 vehicle movements (R, Y, G) or 6 pedestrian movements (W, DF), or combinations in between.

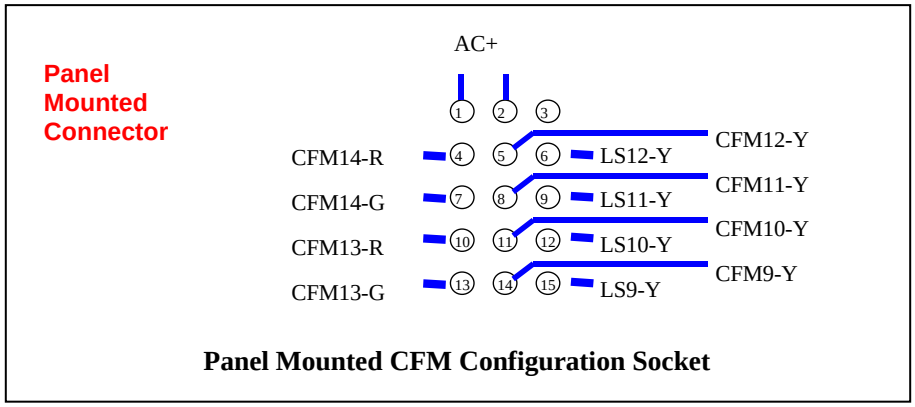
2) Each cabinet shall include a 15-pin Molex header to support general purpose cross wiring for the last 4 load switches and CMU channels 13, 14. The wiring shown below is representative of the concept. The CONTRACTOR is free to propose alternatives that meet the intended functionality. Every cabinet may require the installation of a jumper plug that would nominally connect the yellow signals to the CMU yellow inputs for channels 9-12 and AC+ to the red monitoring for channels 13 and 14:

CMU Channel Wiring	**Cabinet Wiring**	**Jumper Wiring**	**Normal 12-circuit Cabinet Wiring**	**Notes**
CH9-R	LS9-R			
CH9-Y	Conn-14	Conn-15	LS9-Y	For Veh Yel
CH9-G	LS9-G			
CH10-R	LS10-R			
CH10-Y	Conn-11	Conn-12	LS10-Y	For Veh Yel
CH10-G	LS10-G			
CH11-R	LS11-R			
CH11-Y	Conn-8	Conn-9	LS11-Y	For Veh Yel
CH11-G	LS11-G			
CH12-R	LS12-R			Veh R or Ped DW
CH12-Y	Conn-5	Conn-6	LS12-Y	For Veh Yel
CH12-G	LS12-G			
CH13-R	Conn-10	Conn-1	AC+	Ped 13 DW
CH13-Y	N/C			
CH13-G	Conn-13			Ped 13 W
CH14-R	Conn-4	Conn-2	AC+	Ped 14 DW
CH14-Y	N/C			
CH14-G	Conn-7			Ped 14 W
Conn – refers to the flexible programming jumper for load switches 9-12 and CMU circuits 9-14.				

3) Using this configuration, a jumper plug could be configured such that the cabinet can support the following:

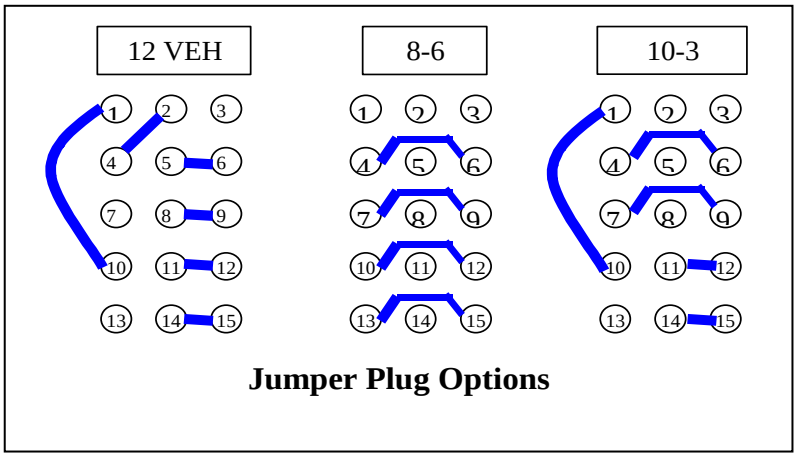
Vehicle Movements	**Ped Movements**	**Jumpers**	**# Circuits**
8	6	6-4, 9-7, 12-10, 13-15	14
9	4	6-4, 9-7, 11-12, 14-15, 10-1	13
10	3	Same as 9 and 4	13
11	1	5-6, 8-9, 11-12, 14-15, 10-1, 4-2	12
12	n/a	Same as 11 and 1	12

4) The ASTC-12 cabinet shall be provided with an auxiliary jumper for nominal 12 vehicle movements with the jumpers 5-6, 8-9, 11-12, 14-15, 10-1, 4-2 installed. When the auxiliary cabinet is included, the jumpers 4-2 and 10-1 shall be removed to allow all three circuits to be fully wired in the auxiliary cabinet.



Panel Mounted CFM Configuration Socket

5) The plug in jumper connector shall be wired as shown for the various configurations of vehicle and pedestrian movements within the ASTC-12 cabinet.



Jumper Plug Options

6) Note that to use any available yellow circuit for a Special Function will require that the CMU be configured to support that feature without causing a conflict or forcing a red failure.

5.8 Conflict monitoring wiring modifications

1) The conflict monitor wiring shall be wired in accordance with Table 21.

Table 21 Monitor Unit Connector (P3) for ASTC-12

PIN	FUNCTION	Cab Conn.		PIN	FUNCTION	Cab Conn.
1	CHANNEL 2 GREEN	LS2G		A	CHANNEL 2 YELLOW	LS2Y
2	CHANNEL 13 GREEN	**		B	CHANNEL 6 GREEN	LS6G
3	CHANNEL 6 YELLOW	LS6Y		C	CHANNEL 15 GREEN	AUX
4	CHANNEL 4 GREEN	LS4G		D	CHANNEL 4 YELLOW	LS4Y
5	CHANNEL 14 GREEN	**		E	CHANNEL 8 GREEN	LS8G
6	CHANNEL 8 YELLOW	LS8Y		F	CHANNEL 16 GREEN	AUX
7	CHANNEL 5 GREEN	LS5G		H	CHANNEL 5 YELLOW	LS5Y
8	CHANNEL 13 YELLOW	**		J	CHANNEL 1 GREEN	LS1G
9	CHANNEL 1 YELLOW	LS1Y		K	CHANNEL 15 YELLOW	AUX
10	CHANNEL 7 GREEN	LS7G		L	CHANNEL 7 YELLOW	LS7Y
11	CHANNEL 14 YELLOW	**		M	CHANNEL 3 GREEN	LS3G
12	CHANNEL 3 YELLOW	LS3Y		N	CHANNEL 16 YELLOW	AUX
13	CHANNEL 9 GREEN	**		P	NOT ASSIGNED	N/C
14	NOT ASSIGNED	N/C		R	CHANNEL 10 GREEN	**
15	CHANNEL 11 YELLOW	**		S	CHANNEL 11 GREEN	**
16	CHANNEL 9 YELLOW	**		T	NOT ASSIGNED	N/C

PIN	FUNCTION	Cab Conn.		PIN	FUNCTION	Cab Conn.
17	NOT ASSIGNED	N/C		U	CHANNEL 10 YELLOW	**
===				===		
18	CHANNEL 12 YELLOW	**		V	CHANNEL 12 GREEN	**
19	NOT ASSIGNED	N/C		W	NOT ASSIGNED	N/C
20	CHASSIS GROUND	Chassis		X	NOT ASSIGNED	N/C
21	AC-	LS Bay		Y	DC GROUND	TB
22	WATCHDOG TIMER	BIU		Z	EXTERNAL RESET	N/C
23	+24VDC	PDA		AA	+24VDC	PDA
24	[PINS 24 AND 25]			BB	STOP TIME	BIU
25	[ARE TIED TOGETHER]			CC	NOT ASSIGNED	
26	NOT ASSIGNED	N/C		DD	NOT ASSIGNED	
27	OUTPUT SW – NC Contact	PDA		EE	OUTPUT SW, SIDE #2 (MC Coil)	PDA
28	OUTPUT SW, NO Contact	N/C		FF	AC Line	PDA

NOTE: Pins 23 and AA are shorted together. Maximum current rating is 500 milliamps. Pins 24 and 25 are shorted together. The Monitor circuit and the Program Card mate with a 28/56 pin double sided edge-card connector having .156 inch centers. Note that the cabinet uses NEMA flash control wiring, hence the NC contact is needed for the 2010 CMU.
N/C = No connection
(=== Position for key slot)
** denotes connection as shown in Section 5.7.
AUX denotes connection per the auxiliary connector shown in Section 5.12

2) Note that this wiring assigns Channels 1-8 to load switches 1-8. It then assigns Channels 9-14 to support PED or Vehicle functions – using 2 circuits or 3 circuits per load switch.

3) A red interface connector shall be supplied and wired to the red outputs for load switches as shown. The cabinet shall be equipped with red programming jumpers as shown in Table 22 that can be assigned to a fixed 120 VAC source or the output of the respective load switch. Jumper wiring shall be done such that improper operation cannot occur and that no damage can result to the circuit board and jumpers if a load switch is inadvertently inserted or removed. The red jumpers shall be constructed of non-corrosive, electrical conducting material with an insulated handle and shall be red. The jumpers shall be inserted into the empty load-switch slots to short the AC to the red signal connection when there is no signal head installed. Jumpers shall be removable with the power present without risk of operator injury. Jumpers shall be clearly visible and durable and subject to approval by the CITY.

4) The balance of the red inputs shall be wired to a fixed source of 120 VAC. The Red Interface Connector's pin assignments shall be as shown on Table 22.

5) The red interface cable and circuits shall be protected such that short circuits cannot damage the red interface cable, the connectors, or the backplane wiring (or circuit traces).

6) Note that it is required that the new cabinets be fully compatible with the existing phase 2 cabinets and they shall be tested for this conformance. Where there are specific requirements within this specification which are in conflict with the existing implementation, the CONTRACTOR shall bring such information to the CITY's attention for resolution. Changes required between this specification and ensuring interoperability shall be made at no expense to the CITY and no adjustment to the unit price for any item in the bid documents.

Table 22 Red Interface Connector (P1) for ASTC-12

PIN	FUNCTION	Cab Conn.
1	CHANNEL 15 RED	AUX
2	CHANNEL 16 RED	AUX
3	CHANNEL 14 RED	**
4	CHASSIS GROUND (see note)	
5	CHANNEL 13 RED	**
6	SPECIAL FUNCTION #2	N/C
7	CHANNEL 12 RED	**
8	SPECIAL FUNCTION #1	N/C
9	CHANNEL 10 RED	**
10	CHANNEL 11 RED	**
11	CHANNEL 9 RED	**
12	CHANNEL 8 RED	LS 8
13	CHANNEL 7 RED	LS 7
14	CHANNEL 6 RED	LS 6
15	CHANNEL 5 RED	LS 5
16	CHANNEL 4 RED	LS 4
17	CHANNEL 3 RED	LS 3
18	CHANNEL 2 RED	LS 2
19	CHANNEL 1 RED	LS 1
20	RED ENABLE	BIU
Pin 4 is not used in the cabinet. N/C Chassis ground is available through the edge connector at the rear of the card cage. ** denotes wiring according to Section 5.7 AUX – denotes wiring per Section 5.12		

5.9 Field terminal modifications

1) The field terminals shall be modified as shown in Table 23 and Table 24.

Table 23 Field terminals – Signal Heads for ASTC-12

#	Label	Function	Signal	Connection
TERMINAL Block FT1				
1	1R	1R	Load Switch 1 Red	FSH*/LS1
2	1Y	1Y	Load Switch 1 Yellow	FSH/LS1
3	1G	1G	Load Switch 1 Green	LS1
4	2R	2R	Load Switch 2 Red	FSH/LS2
5	2Y	2Y	Load Switch 2 Yellow	FSH/LS2
6	2G	2G	Load Switch 2 Green	LS2
7	3R	3R	Load Switch 3 Red	FSH/LS3
8	3Y	3Y	Load Switch 3 Yellow	FSH/LS3
9	3G	3G	Load Switch 3 Green	LS3
10	4R	4R	Load Switch 4 Red	FSH/LS4
11	4Y	4Y	Load Switch 4 Yellow	FSH/LS4
12	4G	4G	Load Switch 4 Green	LS4
TERMINAL Block FT2				
1	5R	5R	Load Switch 5 Red	FSH*/LS5
2	5Y	5Y	Load Switch 5 Yellow	FSH/LS5
3	5G	5G	Load Switch 5 Green	LS5
4	6R	6R	Load Switch 6 Red	FSH*/LS6
5	6Y	6Y	Load Switch 6 Yellow	FSH/LS6

#	Label	Function	Signal	Connection
6	6G	6G	Load Switch 6 Green	LS6
7	7R	7R	Load Switch 7 Red	FSH*/LS7
8	7Y	7Y	Load Switch 7 Yellow	FSH/LS7
9	7G	7G	Load Switch 7 Green	LS7
10	8R	8R	Load Switch 8 Red	FSH*/LS8
11	8Y	8Y	Load Switch 8 Yellow	FSH/LS8
12	8G	8R	Load Switch 8 Green	LS8
TERMINAL Block FT3				
1	9R	9G	Load Switch 9 Red	FSH*/LS9
2	9Y	9Y	Load Switch 9 Yellow	FSH/LS9
3	9G	9R	Load Switch 9 Green	LS9
4	10R	10G	Load Switch 10 Red	FSH*/LS10
5	10Y	10Y	Load Switch 10 Yellow	FSH/LS10
6	10G	10R	Load Switch 10 Green	LS10
7	11R	11G	Load Switch 11 Red	FSH*/LS11
8	11Y	11Y	Load Switch 11 Yellow	FSH/LS11
9	11G	11R	Load Switch 11 Green	LS11
10	12R	12G	Load Switch 12 Red	FSH*/LS12
11	12Y	12Y	Load Switch 12 Yellow	FSH/LS12
12	12G	12R	Load Switch 12 Green	LS12
*Note: FSH indicates that the field terminal is wired to the flash transfer relays and flash configuration jumpers connected to the listed load switch.				

Table 24 Field Terminal Blocks - Other Circuits for ASTC-12

#	Function	Signal	Connection
Field Terminal Block FT4			
1	L1A	Detector Channel 1 Loop[9]	SL1-D
2	L1B	Detector Channel 1 Loop	SL1-E
3	L2A	Detector Channel 2 Loop	SL1-J
4	L2B	Detector Channel 2 Loop	SL1-K
5	L3A	Detector Channel 3 Loop	SL2-D
6	L3B	Detector Channel 3 Loop	SL2-E
7	L4A	Detector Channel 4 Loop	SL2-J
8	L4B	Detector Channel 4 Loop	SL2-K
9	L5A	Detector Channel 5 Loop	SL3-D
10	L5B	Detector Channel 5 Loop	SL3-E
11	L6A	Detector Channel 6 Loop	SL3-J
12	L6B	Detector Channel 6 Loop	SL3-K
Field Terminal Block FT5			
1	L7A	Detector Channel 7 Loop	SL4-D
2	L7B	Detector Channel 7 Loop	SL4-E
3	L8A	Detector Channel 8 Loop	SL4-J
4	L8B	Detector Channel 8 Loop	SL4-K
5	L9A	Detector Channel 9 Loop	SL5-D
6	L9B	Detector Channel 9 Loop	SL5-E
7	L10A	Detector Channel 10 Loop	SL5-J
8	L10B	Detector Channel 10 Loop	SL5-K
9	L11A	Detector Channel 11 Loop	SL6-D
10	L11B	Detector Channel 11 Loop	SL6-E
11	L12A	Detector Channel 12 Loop	SL6-J
12	L12B	Detector Channel 12 Loop	SL6-K
Field Terminal Block FT6			
1	L13A	Detector Channel 13 Loop	SL7-D
2	L13B	Detector Channel 13 Loop	SL7-E
3	L14A	Detector Channel 14 Loop	SL7-J
4	L14B	Detector Channel 14 Loop	SL7-K
5	L15A	Detector Channel 15 Loop	SL8-D
6	L15B	Detector Channel 15 Loop	SL8-E
7	L16A	Detector Channel 16 Loop	SL8-J
8	L16B	Detector Channel 16 Loop	SL8-K
9	L17A	Detector Channel 17 Loop	SL9-D
10	L17B	Detector Channel 17 Loop	SL9-E
11	L18A	Detector Channel 18 Loop	SL9-J
12	L18B	Detector Channel 18 Loop	SL9-K
Field Terminal Block FT6			
1	L19A	Detector Channel 19 Loop	SL10-D
2	L19B	Detector Channel 19 Loop	SL10-E
3	L20A	Detector Channel 20 Loop	SL10-J
4	L20B	Detector Channel 20 Loop	SL10-K

[9] Table 24 shows wiring for 2 detectors for each slot. Note that Detectors 1 and 2 in the left slot wire to detectors 3 and 4 in the right slot thus allowing a 4-channel unit to be used in any slot except slot #1. The wiring for the DC interconnect (Tip and ring) are wired to D and E of the respective slot used. Typically, this should be Detector Channel 19.

#	Function	Signal	Connection
5	PC1	Pedestrian 1 Detector	BIU #3 Opto in 1
6	PC2	Pedestrian 2 Detector	BIU #3 Opto in 2
7	PC3	Pedestrian 1 Detector	BIU #4 Opto in 1
8	PC4	Pedestrian 2 Detector	BIU #4 Opto in 2
9	PE1	Preempt 1 Detector	BIU #3 Opto in 3
10	PE2	Preempt 2 Detector	BIU #3 Opto in 4
11	PE3	Preempt 1 Detector	BIU #4 Opto in 3
12	PE4	Preempt 2 Detector	BIU #4 Opto in 4

5.10 Output file modifications

1) The output shall contain 12 three-circuit load switches. All 12 load switches shall be wired to flash programming jumpers.

2) Flash circuits shall be assigned as follows:

Load Circuit #1	**Load Circuit #2**
S.P. 1	S.P. 4
S.P. 2	S.P. 5
S.P. 3	S.P. 6
S.P. 8	S.P. 7
S.P. 9	S.P. 11
S.P. 10	S.P. 12

3) Flash transfer relays and flash configuration jumpers shall be provided for all load switches.

4) Drive circuits shall be wired to the BIU TF-#4 for control.

5) The CMU shall be pre-wired to the 12 load switches with red configuration jumpers for those inputs without red signals.

5.11 Input file modifications

1) The input file shall house two (2) BIU's and include provisions for 10 additional slots to accept standard detector, isolator, or other input or output cards. The individual functions assigned to the rack shall be configurable.
2) The BIU's shall be wired to the functions shown in Section 1.1. If the Input file and the output file are separate subassemblies, then a cable with appropriate connectors shall be used for all wiring between these two assemblies.
3) The input slots shall be cross wired in pairs such that a 4-channel device mounted in one slot will use two channels from one slot and 2 channels from the slot adjacent to it on the right.

5.12 Support for an Expansion Cabinet

1) The ASTC-12 cabinet shall be wired to support an auxiliary cabinet that provides the necessary connections to the conflict monitor to ensure safe operation. In essence, the auxiliary cabinet is to be used to extend the number of circuits required to a maximum of 16.
2) The ASTC-12 cabinet shall be provided and wired as described below. The CONTRACTOR shall develop appropriate component locations and access to the components; the design shall be submitted to the CITY for approval. All connectors and terminal points shall be readily accessible for maintenance purposes without the removal of any other components.
3) Load switches 1-12 shall be wired to CMU channels 1-12 with flash transfer wiring as shown herein.
4) CMU signals 13 through 16 shall be wired to a 15-pin Molex header (with the male pins) as follows[10]:

   Pins 1,2,3 – Channels 13 Green, Yellow, Red
   Pins 4,5,6 – Channels 14 Green, Yellow, Red

[10] Note that the CONTRACTOR is free to propose alternate wiring and connectors that meet the general requirements listed herein and are in keeping with the electrical and mounting provisions of the ASTC-12 cabinet.

Pins 7,8,9 – Channels 15 Green, Yellow, Red
Pins 10, 11, 12 – Channels 16 Green, Yellow, Red
Pin 13 – AC+ (wired to AC signal Bus – Circuit breaker 1) for load switches 13, 14
Pin 14 – AC + (wired to AC signal Bus – Circuit breaker 2) for load switches 15, 16

5) Note that the Red inputs for each of these channels shall be biased to 120 VAC source as follows: channels 13, and 14 to circuit breaker 1 and channels 15 and 16 to circuit breaker 2. The bias resistors shall be visible from the front of the controller assembly such that they can be easily cut out in the event that the external cabinet is used. Replacement of the resistors shall also be possible without removing the backplane from the cabinet.

6) The 15-pin Molex header shall be mounted into all ASTC-12 cabinets. The bias resistor shall be such that in the event the resistor is not removed, the circuit shall perform properly with a typical single LED signal head.

7) The ASTC-12 cabinet shall include terminal connection points for the AC+ from Circuit Breakers 1 and 2, the 24 VDC supply, and Logic Ground, which shall be used for terminating the cables which connect to the auxiliary cabinet. These are used to provide power for the BIU and the load switches in the auxiliary cabinet.

5.13 Auxiliary Cabinet Specification

1) As part of the system support equipment, the CONTRACTOR shall provide auxiliary load switch cabinets as called out in the bid documents; each cabinet shall meet the same requirements as the ASTC-6 cabinet for materials and mechanical construction except as noted below.

2) Each cabinet shall be supplied with a single BIU, 4 load switches, and all connecting harnesses and connectors to mate with the ASTC-12 cabinet CMU/2010 wiring for channels 13 through 16. Cables and connectors shall include extension of the TS2 serial bus, power wiring for the 24 VDC (for the BIU and load switches) and CMU/2010 harness and load switch power wiring.

3) Each cabinet shall be fully wired to support the functionality described herein.

4) Each cabinet shall include a rack assembly with a BIU to drive all three circuits for 4 Load Switches. The BIU shall be configurable to allow any output circuit to become any of the controller functions including but not limited to auxiliary I/O, vehicle displays, pedestrian displays, priority indications, and special functions.

5) The cabinet shall include a field wiring terminal block and 2 bus bars. The bus bars shall be for AC neutral and chassis ground with at least 8 circuits each. They shall be isolated from each other within the auxiliary cabinet. The chassis ground shall be bonded to the cabinet. Each load switch output shall be connected to a field terminal block. The terminals shall be labeled: 13G, 13Y, 13R, etc. through 16R. Terminal blocks shall meet the same requirements as the ASTC-6 cabinet for signal head wiring.

6) The auxiliary cabinet shall not include flash transfer relays, hence, any circuit connected to the auxiliary cabinet shall become dark (out) during conflict or hardware induced cabinet flashing operation.

7) Each cabinet shall be provided with a serial extension cable that shall connect to the serial port cable in the main cabinet either at the surge protection card or the existing cable and the cable shall plug to the BIU and then to a terminator through a gender mender.

8) The cabinet shall be the same depth and width as the ASTC-6 cabinet, but shall not exceed 18 inches in height. The cabinet shall include a door, latch, key, vent and filter which shall match the existing cabinet. The physical characteristics shall be the same as the existing cabinet for construction (including door mechanisms), and color. The cabinet shall not

include any shelf, drawing holder; the cabinet shall include the fan and outlet assembly identical to that of the ASTC-6 cabinet.

9) The auxiliary cabinets shall be provided as a line item on the bid. The CITY shall have the right to purchase additional cabinets in lots of 10 pieces at this same price, adjusted for the consumer price index for New York City.

10) The power wiring (CMU/2010 monitoring circuits) and the Circuit breaker power wiring shall terminate on a connector header of the same type and pin-out to match the expansion cabinet wiring plug described herein.

11) The low voltage wiring for the 24 VDC shall terminate on barrier type terminal blocks.

12) The load switches, BIU, terminal blocks, bus bars, and connectors shall be mounted to a 0.125 inch aluminum mounting plate with mounting holes to match threaded studs which shall be mounted into the auxiliary cabinet. It shall be possible to remove this plate without disassembling any other aspect of the cabinet.

13) Each cabinet shall also include provisions for 4 input cards wired identically to the ASTC-6 input file wiring. The field terminal blocks shall be labeled in a manner similar to the ASTC-6 controller. The inputs shall be wired to the BIU input/output circuits such that any of the control signals can be wired to support either an input or an output function.

14) All of the inputs and outputs within the auxiliary cabinet shall be fully configurable such that they may be assigned to any NEMA function including but not limited to phase hold, force-off, phase omit, vehicle signal head load switch drive, special functions, pedestrian inputs, and actuation detectors, etc.

15) The 4 photo isolated inputs shall be wired to the field terminal block similar to the ASTC-6 and may be assigned to any input function.

16) The CONTRACTOR shall work with the CITY to develop a cabinet layout and mounting system.

17) The full functionality of the Auxiliary cabinet shall be demonstrated as part of the Design Approval Testing; the DAT shall include tests for all versions of the conflict monitor and load switch wiring for the ASTC-12 cabinet the auxiliary cabinet.

6 ASTC-8 Cabinet

1) The CONTRACTOR shall supply a special 8 load switch version of the ASTC cabinet, ASTC-8, which shall support eight (8) 3-circuit load switches as described herein. Unless otherwise noted in this section, the ASTC-8 shall be identical to the ASTC-12.

2) The first 6 load switches shall include flash transfer relays and flash jumpers (3) identical to the ASTC-12.

3) The two (2) additional load switches shall be wired to provide 3 pedestrian circuits in a manner similar to the load switches 9 and 10 in the ASTC-12 cabinet.

4) The ASTC-8 cabinet shall use the ASTC-12 PDA and all plug-in assemblies in an identical manner to the ASTC-12.

5) The BIU assignments for the load switches shall be identical to the assignment of Load Switches 1-8 of an ASTC-12 cabinet.

6) The cabinet shall include provisions (connectors, input chassis wiring, connection to terminal blocks on the back panel) for 6 input cards and the 6^{th} input slot shall be identical to the 10^{th} input slot in the existing ASTC-12.

7) The BIU assignments for the input file shall be identical to the assignment of the last 6 input cards of the ASTC-12 cabinet.

8) The CMU wiring shall be identical to the ASTC-12 wiring for load switches 1-6; the CMU wiring for load switches 7 and 8 shall be such that with the jumpers (similar to the ASTC-12 cabinet) the load switches can support either 2 three-circuit operation or 3 PED signals.

9) The Cabinet mechanical dimensions shall not be greater than:

    a. 22 inches wide (identical to the ASTC-12)

    b. 15 inches deep (Identical to the ASTC-12)

    c. 45 inches tall (6 inches shorter than the ASTC-12)

10) The cabinet shall be wired in such a manner that the ASTC controller unit “thinks” it is mounted in an ASTC-12 cabinet, with a limited number of inputs and outputs; thus all wiring shall use identical Input/output assignments.

7 Controller Functionality

1) The CONTRACTOR shall provide software for the ASTC that meets both the NEMA TS2-2003 pre-timed (PT) (section 3.4) and actuated (ACT) (section 3.5 and 3.6) functional requirements. Upon power up, the controller display shall indicate the type of operation in effect. Plans may be either pre-timed or actuated and the controller shall support both and transition between these two types of operation.

2) A single software package shall be loaded in the ASTC and the database loaded shall determine the type of operation to be supported (e.g. Manhattan, NTCIP).

3) The cabinet address shall be used by the controller to determine whether the database is proper and the database shall specify which operation (actuated or pre-timed) is being used for the current plan.

4) All controllers regardless of whether they support pre-timed or actuated operation shall support the functionality specified in Sections 3.7, 3.8, 3.9, 3.10, 3.11 and 3.12 of the NEMA TS2-2003 specifications.

5) The ASTC basic cabinet has a limited number of inputs, although the NEMA functionality supports many more functions via standard BIU configurations. For the basic operation (both pretimed and actuated), the software shall be automatically configured to function properly without these inputs. However, it shall be possible to re-configure the inputs and outputs to provide selected NEMA functions if desired.

6) Upon the restoration of power, the controller shall begin 3-color operation including setting the watchdog timer in less than 10 seconds under all conditions. The startup and shutdown as well as the intermediate interaction in the event that the power “glitches” as it is going down or being restored shall be designed such that the cabinet does not go to the latched flashing state regardless of the nature of the power disruptions. This requires close coordination between the CMU/2010 design and the controller unit design as well as the design of the BIU drivers to ensure proper watch-dog interaction

7) The conflict monitor and controller design shall be such that power interruptions that occur as the controller is “starting up” shall not cause a latched flashing condition (fail). Cabinet power interruptions as described in the specifications shall not cause a latched flashing condition. This shall include but not be limited to droop, rapid interruptions, slow power loss or recovery, dropped pulses, and frequency deviations within the range of 57-63 Hz. Under no circumstances shall power interruptions of any sort cause the latched flashing condition

of the conflict monitor; the conflict monitor shall automatically recover and allow normal three color operation once power has been stable at (or above) 95 VAC.

7.1 The NEMA specifications are modified or clarified as below

7.1.1 Input/output assignments

1) The ASTC is based upon the concept of a configurable input file and assignable load switches. Because of the limited number of inputs and outputs available with only a single BIU, the controller shall allow identified NEMA functions – including but not limited to auxiliary functions, special functions, preemption, coordination signals, Force-off, Holds, etc. to be assigned based upon specific cabinet configurations. These assignments shall be in the controller configuration database that shall be downloaded upon startup. Any load switch shall be usable for any function, and it shall be possible to assign unused load switch circuits to special functions such as overlaps and auxiliary signs or additional PED circuits as long as the total current for the load switch is not exceeded.

2) The configuration database can be downloaded when the controller unit is powered-up with two buttons (ESC and PGDN – reference Section 7.2) held down during the power up process. When detected, the controller shall further request the operator to confirm the database initialization request by pressing the ENTER button when requested.

3) The controller shall automatically request a database download request if it powers up and the controller database ID does not match the cabinet address. In addition, the controller shall request a database load if the internal database has been corrupted or is invalid.

4) The controller shall continuously monitor the integrity of the database and its application and operating system memory for indications of corruption that might compromise its operation. If such corruption is found, it shall stop the watchdog output and request a download and indicate the error on the front panel.

7.1.2 Initialization

1) Initialization shall occur under any of the following conditions:

   - Restoration of power after a defined power interruption
   - Activation of External Start input (this is currently not wired in the ASTC-6 and ASTC-12 cabinets)
   - A program entry for initialization shall be provided to cause the controller unit to start at the beginning of the defined signal plan interval. As part of the initialization routine, calls shall be placed on all actuated movements and retained until serviced.

7.1.3 Features

1) The controller unit shall be capable of providing the following features:

   - Control for at least 30 timing plans.
   - A minimum of one set of splits for each timing plan. Each split shall provide an adjustable time over a range of 0-255 seconds in 1 second increments for each interval in the sequence
   - At least 16 exception days
   - At least 8 day plans

2) Means shall be provided, for user definition, to adjust the controller clock for daylight savings time (DST). At the proper day and hour specified, the controller shall advance or set back its internal clock one hour and adjust the DST flag in its on-line clock. The controller shall

maintain the proper DST flag after any power outage. If the power outage extends through the transition to/from DST, the controller shall automatically adjust once power is restored.

3) The selection of the day and time for both the advance into DST and out of DST shall be configurable over the communications channels. It shall default to the current settings for New York City.

7.1.4 Modes of Operation

1) Signal plans shall be capable of being selected based on Program Entry (Laptop port), Time Base Control Events and a System Interface. The pattern and signal plan select priority shall be as follows:

   - Program Entry
   - System Interface
   - Time Base Control Event

2) The controller unit shall be capable of being set to manually operate in any pattern and signal plan via Program Entry via the laptop interface. A manual selection of pattern and signal plan shall override all other pattern interface commands. The operator shall be required to specify the duration or end time for the selected plan after which it shall revert to the correct time-of-day (TOD) plan based on the internal scheduler, or a central commanded plan.

3) The controller unit shall be capable of Free mode of operation. During this mode all pattern inputs (timing plan and offset) shall be ignored and offset correction shall not occur. The coordinator shall recognize input requests that conflict with coordinated operation and automatically revert to Free mode while the inputs are active. The inputs that conflict with internal coordination are:

   - Manual Control Enable
   - Stop Time
   - Automatic Flash
   - Any Preemption

4) The controller shall accept requests to change the interval sequence based upon central control inputs and TBC. This shall include varying number of intervals (phase omit) and features such as lead and lag.

7.1.5 Time-Base Control

1) The controller unit shall include provisions for internal Time Base Control. The internal Time Base Control shall be a special program operating within the controller unit. A minimum of 30 different Time Base Control events shall be capable of being programmed over a one year time frame. The Time Base calendar shall provide automatic compensation for leap years. The Time Base Control shall provide for Daylight Savings Time to be programmed to occur automatically as defined by law in most states or not to occur.

2) The Time Base Control program shall output Timing Plan plus Offset commands to the coordination program. It shall be possible to perform functions not necessarily traffic related within the Time Base Control program by programming and use of a minimum of two auxiliary outputs. The Time Base coordination pattern sync (Cycle Zero) shall be user programmable to be referenced to any hour/minute or the event time. Cycle zero reference is the start of Main street green.

3) The Time Base Control external interface shall be via Port 1 (See 3.3.1). The Time Base Control shall operate with an external interface as follows:

   - Time Base Inputs: One input for Time Base control may be assigned. The Time Base On Line input, when active, shall disable the Time Base pattern outputs to the internal coordination program.
   - Time Base Outputs: Two outputs for Time Base Auxiliary may be assigned. The outputs shall be On when their respective auxiliary is part of the current time base event.
   - Output Levels: All logic signals shall be Low state (nominal 0 volts DC) for the operate condition.

7.1.6 Event logging

1) The controller shall support NTCIP event logging and trap functions as identified in the exception design companion document and as defined in NTCIP 1103 including traps.

2) The controller shall also include an internal event log unrelated to the NTCIP 1103/1201 event tables. This log shall match the existing units and it shall be possible to upload this log to the USB memory stick or the laptop software. The laptop software shall include a mechanism to allow easy viewing of the log entries which shall be decoded to show the type of event, date and time of the event and parameters appropriate for the event.

7.1.7 Inputs

NEMA control inputs may be assigned to BIU inputs as shown below:

1) Vehicle Detector – Provision to enter a vehicle call into the controller unit. As a minimum, each vehicle detector input shall be enabled by assignment to any one movement via program entry.

2) Pedestrian Detector – Provision to enter a pedestrian call into the controller unit. As a minimum, each pedestrian detector input shall be enabled by assignment to any one movement, via program entry.

3) System sensor inputs shall also be supported and shall compute volume and occupancy during each reporting interval. Upon request from the central system, the volume and occupancy data from the system sensors shall be reported to the central system. This data may also be assigned to a log and traps that cause the data to be transmitted to the central system based on “triggers”.

4) Trap detectors for computing vehicle travel time and occupancy time for each vehicle through the loop pair.

5) NEMA inputs such as Preempt inputs, force-offs, holds, omits, etc.

6) The CONTRACTOR shall work with the CITY to develop the detector reporting schema which is compliant with the NTCIP data collection protocols. In addition, for Manhattan, the system collects vehicle occupancy and travel time between trap pairs (in 1/60ths of a second). This functionality shall also be supported by the controller unit. Refer to the Manhattan RCU documentation for a more detailed description of this function.

7) It shall be possible to assign detector inputs to multiple functions; it shall be possible for each detector to be assigned as an actuation detector and a system sensor and part of a trap detector pair.

7.1.8 Programming

1) The controller unit shall maintain user programmable variables in non-volatile memory to assure continued proper controller operation with the return of power after power loss.

7.1.9 Plan loading and execution

1) The central system supports a modified version of the UTCS[11] critical intersection control (CIC) that dynamically adjusts the split based on traffic demand. Because of the limited detection used throughout the CITY, a few critical detectors are often used to adjust the split for a large number of intersections. To support this capability, the controller must accept new plan data (splits) while in normal operation for the plan it is currently running.

2) To ensure consistency between vendors, it is required that the controller be able to accept this new plan data for the current plan at any time during the current cycle including during the 2 second all red preceding the start of MSG. Since there will be no change in the offset or cycle length, the controller shall immediately begin using the new split pattern for the execution of the next cycle. The controller must accept the new split information (note that the configuration information will not change) and use it for the new cycle as long as it is received and is valid before the end of the initial portion of the MSG phase. It shall automatically adjust for any time already spent during the initial MSG condition. This new plan data shall not cause the controller to start a transition.

3) The Plan loading and execution shall allow the new plan to change the cycle length and offset; if either parameter changes, the controller shall adopt the new plan at the next top of cycle and shall immediately begin transition to the new plan using the transition parameters described herein. This capability is used to allow the central system to support a limited adaptive control algorithm that analyzes the traffic conditions and modifies the cycle, split, and offset parameters on a cycle by cycle basis to achieve optimum network efficiency.

4) Note that the operation of this central driven adaptive control scheme shall match the existing operation. This requires that there be a “active pattern” (Cycle, Offset, Split) that the controller is running and that the central system is allowed to modify this on a cycle-by-cycle basis causing transition only if there is a change to the cycle length and/or the offset. Because this is dynamic, a separate set of “running pattern” must be used by the controller which does not write these changes to the flash memory – but rather, simply overlays the current plan parameters for the next cycle. Note that a dynamic data collection cycle was also introduced which allows the data collection interval to be changed on a cycle-by-cycle basis for truly cycle-by-cycle adaptive operation. This information is contained in the MIB.

7.1.10 Transition

1) The ASTC supports both pre-timed and actuated operation depending on the data elements. This section describes the required transition mechanism between pre-timed and actuated operation and the reverse.

[11] This stands for Urban Traffic Control System and is a software package developed by the FHWA to manage traffic control in the urban environment; it was developed in the 1970’s and was deployed in many systems during the 1980’s.

2) The TS 2 defines data and operations for the controller to enter into and exit from *flashing* operation when commanded. For pretimed units, it defines the **flash entry interva**l after which the flash operation will commence and the **flash exit interval** that commences steady (stop-and-go) operation at the completion of the flash operation. Likewise it defines **flash entry phases** and **flash exit phases** for actuated operation.

3) The ASTC shall use the same entering and exiting flash operation values to transition between pretimed and actuated operation as shown in the table below.

TS 2 Automatic Flash Parameters			**Flash Operation Transition**	**Required Pretimed-Actuated Operation Transition**
CU	**Parameter**	**Example**	**Description**	**Description**
Pretimed	Flash Entry *Interval*	12	Steady to Flash	Pretimed to Actuated
	Flash Exit Interval	1	Flash to Steady	Pretimed
Actuated	Flash Entry *Phases*	4, 8	Steady to Flash	Actuated to Pretimed
	Flash Exit Phases	2, 6	Flash to Steady	Actuated

4) Note that *flashing* operation is not implied for the transition; this simply uses the *flash entry* parameters to define the transition points.

5) Note that when the ASTC is changing offset (due to a new CIC plan, change of plan, or change in the time of day, the coordinator shall establish a new offset by dwelling in the coord phase(s) until the desired offset is reached.

7.1.11 Special Functionality

1) The following additional capabilities shall be added to the ASTC and appropriate NTCIP objects shall be developed by the CONTRACTOR to support these capabilities. If the NTCIP working groups have established standard objects to manage these functions by the time the controller is ready for prototype testing, then the new standard objects shall be used.

2) **Pedestrian Overlaps:** The controller shall support a minimum of 4 pedestrian overlaps. It shall be possible to assign the pedestrian outputs to any available load switch circuit.

3) **Flashing channel during phase display for actuated operation:** It shall be possible to configure the controller to flash the green/walk indication on any specific phase display channel including overlaps. This shall be configurable for each phase. All other vehicle and pedestrian circuits (red, amber, pedestrian clearance, don't walk) shall remain in normal operations and shall not be affected. The flashing operation shall be at nominal 60 Flashes per minute.

4) **Added (phase 4) flashing capability:** It shall be possible to configure the controller to flash the red and/or yellow indication on any specific phase display channel including overlaps. This shall be configurable for each phase. This shall allow the controller to support the MUTCD specified Flashing Yellow Arrow. Note that flashing yellow arrow is only supported for the ASTC-8 and ASTC-12 cabinets.

5) The controller shall support a minimum of 16 phases and 4 rings per NEMA TS2-2003.

6) The controller shall support all values in the ***phaseOptions*** object from NTCIP 1202. All values selected in this object, if applicable, shall apply on both coordinated and free operations unless otherwise noted. The vehicle and pedestrian recall setting in the *phaseOptions* object, if selected, shall take effect when the controller operates in a free mode. If both the maximum vehicle recall and pedestrian recall are selected, the pedestrian clearance shall be terminated at the same time as the associated vehicle green indication

such that the controller shall time the phase walk duration concurrently with the associated vehicle green indication and rest in walk until the pedestrian clearance is timed. Under no circumstances shall the pedestrian clearance be extended or overlapped with the yellow indication.

7) The controller shall support values 2 thru 4 (i.e., maximum1, maximum2 and *maxInhibit*) in the *coordMaximumMode* object from NTCIP1202. Note that the existing ASTC firmware only supports the value of 4 (*maxInhibit*).

8) The controller shall support values 2 thru 7 in the *splitMode* object from NTCIP 1202 in the coordinated operation. Any value between 2 and 7 in the *splitMode* object, if selected, shall take effect only if the associated phase is enabled in the *phaseOptions* object, and a phase shall not be enabled by setting the phase split mode in the *splitMode* object. Any value between 3 and 6 in the *splitMode* object shall override all recall settings in the *phaseOptions* object in the coordinated operation. If value 2 is selected in the *splitMode* object, the recall setting in the *phaseOptions* object shall take effect in the coordinated operation. If value 6 (*maximumVehicleAndPedestrianRecall*) is selected for a phase in the *splitMode* object, the pedestrian clearance shall be terminated at the same time as the associated vehicle green indication such that the controller shall time the phase walk duration concurrently with the associated vehicle green indication and rest in walk until the pedestrian clearance is timed. Under no circumstances, shall the pedestrian clearance be extended or overlapped with the yellow indication.

9) The controller shall provide the following features for conditional re-service in addition to the requirements in TS2-2003 and NTCIP 1202:

    i) The conditional serviced phase shall be enabled for conditional service via program entry. Note that it is different from TS2-2003 and NTCIP 1202 that require the gapped/maxed phase be enabled for the conditional service.

    ii) The phase selection shall be made in a manner that when the phase gaps out (not yet to start timing the yellow clearance), the time remaining in the other phase's maximum green time shall be greater than or equal to the sum of the vehicle clearance time of the gapped phase and the minimum green time of the conditional serviced phase. Should the other phase gap out during the vehicle clearance interval of the gapped phase, the conditional serviced phase shall NOT be serviced. Instead, both phases shall terminate together and cross the barrier at the same time.

    iii) The conditional serviced phase shall rest in green after the minimum green time is serviced while the other phase has yet gapped or maxed out. Both phases shall terminate the green indications and cross the barrier at the same time.

    iv) Simultaneous gap-out if enabled on the cross-barrier phases shall prevent the preceding phase from being conditionally serviced.

    v) The controller shall also allow a preceding phase to be reserviced if a conflicting phase gaps out during coordination and there is enough time to reservice the phase before the barrier is crossed. Phase reservice shall be capable of being enabled or disabled in each coordination pattern.

10) The controller shall support the volume-density operation based on the setting of volume-density parameters in the phase table per NEMA TS2-2003 and NTCIP 1202. The volume-density operation shall include either variable initial or gap reduction, or both. The variable initial operation shall be initiated by *phaseAddedInitial* and *phaseMaximumInitial*. The gap reduction shall be initiated by *phaseTimeBeforeReduction* and *phaseTimeToReduce*. The controller shall also support *phaseCarsBeforeReduction* and *phaseReduceBy* for an alternate method for gap reduction operation. If any of these

parameters is set to zero, the controller shall disable a portion or the entirety of the volume-density operation. Note that the volume-density operation shall be able to operate in the coordinated mode. The following actuated operations shall be supported:

i) Actuated operation without volume-density

ii) Actuated operation with variable initial only

iii) Actuated operation with gap reduction only

iv) Actuated operation with both variable initial and gap reduction

11) The controller database shall be downloadable to the controller in its entirety using the NTCIP blocks in a simple manner by using the laptop software. The controller shall operate properly as programmed in the database. No individual object download shall be required. The CONTRACTOR shall construct customized NTCIP blocks, if necessary, to ensure a complete database download. Where standard NTCIP blocks have been defined, they shall be used.

12) The controller shall support a minimum of four (4) exclusive pedestrian phases per NEMA TS2-2003. The exclusive pedestrian phase shall include three time settings – walk (0-255 seconds), pedestrian clearance (0-255 seconds) and steady don't walk (0-25.5 seconds). NTCIP currently doesn't define the object for the exclusive pedestrian phase. The CONTRACTOR shall provide customized objects, if necessary, to ensure the proper operation. The pedestrian omit command shall take the same effect as the phase omit command on the exclusive pedestrian phase. The controller shall support Call to Non-actuated (CNA) on the exclusive pedestrian phase.

13) In the coordinated operation, the controller shall internally apply the hold command on the phases with Call to Non-actuated (CNA) enabled such that the phase can rest in walk until the force-off point occurs.

14) The controller shall support Walk Rest Modifier, Actuated Rest in Walk and Pedestrian Recycle in both coordinated and free operations.

15) The controller shall support Flashing Yellow Arrow which shall be configurable as per the existing controller.

16) The controller shall support all of the functionalities provided in the existing ASTC firmware unless otherwise noted.

7.1.12 Other

1) The laptop support software shall be provided on CD-ROM or other form for installation by the CITY following well-documented directions. The software shall be provided using "InstallShield[12]" or equivalent that shall automatically configure the laptop and install the software on the Windows environment. The Laptop software shall operate under a Windows XP operating system – the latest available at the time of delivery unless otherwise approved by the CITY.

2) The laptop software shall communicate with the controller unit using a standard 'COMM' port on the laptop and the Ethernet port; the port to be used will be determined by the field conditions..

3) Additionally, the laptop shall be able to communicate with the controller using one of the Ethernet interfaces.

[12] www.installshield.com

4) It shall be possible to download the firmware or operational software to the controller through the Ethernet port and the serial port. If the serial port is used, the controller shall be able to adapt to the highest data rate available for the port to speed up the programming time.

5) It shall be possible to download the operating system and drivers to the controller through the Ethernet port and the serial port. If the serial port is used, the controller shall be able to adapt to the highest data rate available for the port to speed up the programming time.

6) The CONTRACTOR is required to develop software that manages the various configuration databases on the laptop computer for downloading to the controller unit. The software shall support two levels of authority – one to modify the parameters and timing plans, and one to access the upload/download and control functions. The structure of the laptop software shall be such that a unique database file is stored for each controller with the file identification of cabinet#.xxx where the xxx is an extension of the CONTRACTOR'S choosing. Whenever the controller requests that its database be reloaded, the laptop shall use the file with the cabinet ID to download the parameters.

7) The laptop GUI shall support a 'save as' function to allow one controller database to be easily used for other controller databases. However, the system shall only allow the loading of the database that affects the controller configuration if the cabinet door is open and a technician is present (cabinet in flash). See other restrictions on database loading located elsewhere herein. When loading a database that does not affect the configuration, the laptop must first verify that the database is consistent with the configuration of the intersection. If the database is not consistent with the intersection configuration, it shall not be loaded and shall prompt the operator with an error message indicating the inconsistency.

8) Note that the file creation for controller database files shall be a restricted operation. Only certain operators shall be able to perform this function. For all other operators, the ability to create and edit the controller database files shall be prohibited.

9) It is required that the CONTRACTOR provide 2 distinct versions of the laptop support software: one that has full read/write and database creation capability along with full upload and download functions, viewing functions, etc., and one that will not support any modifications to the database. Each version of the software shall be provided on a separate CD ROM that auto installs. There shall be no simple way to convert the read only version to be able to edit and modify the database. Both versions shall be identical except for this limitation on the ability to modify files.

10) The laptop software shall provide full and complete access to the operational parameters of the controller and all active status and NTCIP data elements. It shall support the block uploading and downloading of the complete controller database as well as partial storage and reading of selected data elements and blocks.

11) The time necessary to fully download or upload the complete controller database shall not exceed 35 seconds when connected to the Ethernet port or the laptop serial port on the front of the unit.

12) In addition, the CONTRACTOR shall provide utilities for printing the database from the laptop and for exporting the data fields in a convenient manner. Further, the database shall be well documented such that the files can be imported to the laptop via a LAN connection when at the control center to ensure coordination between the central database and the laptop database.

13) The CONTRACTOR shall work with the CITY to adjust the format of the reports to show the settings and parameters in a compact and coherent manner.

14) The CONTRACTOR shall provide simple utilities that can be used to synchronize the database between a central computer and the laptop.

15) The database shall also include attributes that identify the last change date, version number, and the person making the change.

16) The laptop software shall allow an operator to place permanent calls on any detector or pedestrian input. This action shall log the date, time and operator making the change. The central computer shall be able to determine that this has been done and shall be able to over-write these actions remotely (i.e. revert to normal operation). The central computer shall also be able to place calls on any phase remotely – both for testing purposes for a single cycle (i.e. until serviced) or permanently to compensate for defective field equipment.

17) The laptop software shall allow for the creation of files for storage on the USB memory device including but not limited to the application firmware, the controller database, and the operating system. The laptop software shall also include utilities to translate the format from the USB memory device to the database format used by the laptop software.

18) When the laptop is connected to the controller unit, and the laptop is running the application software, it shall automatically recognize the download request from the controller and shall automatically select the database for that controller without further operator intervention. It shall automatically download the database to the controller and commence 3 color normal operation.

19) If both the laptop port and the system communications ports are active, then the ASTC shall include this status in the *unitAlarmStatus2* bit 6 – which shall mean local laptop or PDA port active. If the USB memory devices is connected to the ASTC controller unit, then this shall be reported in *unitAlarmStatus2* bit 7.

20) The laptop software shall include a user friendly dynamic display that shall provide a real-time color graphic representation of the intersection and overlay the current signal head conditions and detector actuations on the display. The CONTRACTOR shall supply templates for all intersection types used in NYC and shall allow the database to be configured to select and remember the layout drawing. The laptop software shall provide a simple method of assigning keys or allowing a mouse “click” to create detector actuations. The assignment of signal heads to the intersection display shall be configurable.

21) The laptop shall include a real time dynamic display that mimics the ASTC LCD display screen including date, time, cycle length, offset, time in cycle counter, plan number, intersection name, vehicle actuation, preemption, detector actuation, gap-out, and green extension and max-out and TSP status and timing in effect.

22) The laptop software shall include a conversion utility that shall accept a CSV file (Comma delimited) containing timing plans in UTDF (Universal Traffic Data Format) and converts them to the appropriate NTCIP objects for downloading to the ASTC either through the USB or a direct connection to the ASTC. This utility must be interactive with the user to select the pattern number, but must then automatically configure the database with the new plan information. The CONTRACTOR shall work with the CITY to determine the best approach to providing this service.

23) The laptop software shall include utilities to allow for database conversion from the final database used for the Phase 3 controller to any and all database versions for the Phase 4 procurement program. Such conversion shall support both upgrade to the current version and downgrade to the latest Phase 3 version.

7.2 Front Panel Layout

1) The controller unit shall have a front panel with a *minimum* of 40 characters x 4 lines for providing status and diagnostic information. The front panel shall be liquid crystal or LED display, environmentally hardened, and back-lit for viewing at night. Incandescent indicator lights are not acceptable. The contrast/angle of view for the display shall be controlled on the front panel. Character height shall be such that the letters are clearly readable at a distance of 36 inches from the face by a person with normal 20-20 eyesight.

2) The LCD display shall be fully operable over the temperature range of –34 °C to +70 °C. Fully operable shall be defined to mean that the display shall respond fast enough to allow navigation and accurately view data changing at a rate of once per second.

3) The front panel shall include a *minimum* 4-button keypad for controlling the contents of the display. The keys shall be PgUp, PgDn, Esc, and Enter. The 4 buttons shall allow a maintenance technician to quickly scan through the real-time functions, all inputs, outputs, and all database values. It shall be able to display split times including real-time split information, computed detector values, and all timing parameters. The Enter button shall be used to request operator confirmation for such functions as database reload and clearing the failure log. It is not intended that the front panel provide a means for operators to enter database or timing parameters.

4) Whenever the controller detects a failure, the cause of the failure shall be displayed on the LCD. The faults shall be held in a failure log internal to the controller. Activation of the failure logging function and selection of the failures to be logged shall only be possible from the system port and the laptop interface. The laptop software shall include a provision to upload the fault log and print the information in a well formatted fashion. It shall also be possible to sort the view of the fault log by date/time and by type of fault. The communications protocol through the system port shall also include provisions to upload the fault log to the central computer.

5) The controller shall maintain communications statistics that include the number of data packets received by the controller unit. Other statistics/events to be maintained include the time of the last plan change, the time of the last download, the time and nature of the last failure event.

6) The LCD display and back-light shall automatically blank out after 10 minutes without any key on the keypad being pressed. The LCD display shall show status and diagnostic information continuously. Depressing the Esc key will activate the LCD display’s back-light.

7) The front panel shall also include an LED display which shall ‘flash’ at one second intervals as long as the watchdog signal is being output and all internal power supplies are active.

8) Text and characters shall be provided on the display and appropriately identified to facilitate the determination of the operation of the controller unit. Display screens shall provide for the simultaneous (i.e., concurrent) presentation, where concurrent states exists, of the following states/functions:

- Current Software version
- Date: mm-dd-yy; Time hh:mm:ss
- Current Pattern (Timing Plan #, cycle, offset, split), Current Mode (Manual, System Interface, Time-Base)
- Correction in progress
- Cycle Counter
- Interval in Service; Interval Counter; Vehicle/ped movement active; Presence of vehicle call; Presence of pedestrian call
- Schedule number
- Current Status (on-line, Offline)
- Current Event Auxiliary Functions
- RF level for Manhattan
- Cabinet address
- Throughput calculation for the last 5 minutes in % and number of attempts to transmit packets and the number of packets successfully received.

9) The CONTRACTOR shall work with the CITY to develop screens that are acceptable to the CITY. The current unit displays a series of 5 screens which display all of the input and output status in addition to all of the above. It also provides a means of accessing all of the operational parameters of the unit. It is the intent of this requirement to provide an easy to use, maintenance oriented interface for the field technician.

10) Note that the displays and operation of the front keypad shall be similar or identical to the existing operation in order to avoid confusion for the maintenance personnel. Changes to the current displays and functionality requires the approval of the CITY.

11) If the CONTRACTOR elects to provide a larger display, the display shall be configured such that the same information is spread over the entire display to improve the legibility. Be notified that the display provided for the phase 2 units is considered too small and is not acceptable for future contracts. The current display (Phase 3 units) is approximately 5.75 inches by 1.125 inches and structured 4x40 characters and is acceptable. The CONTRACTOR shall work with the CITY on any changes to the current layout and distribution of characters over the display.

12) The front panel display shall include (as part of the default screen) a communications status indication that shall confirm that the controller is communicating with the TMC via the system Ethernet port; this shall mean that EBR messages are being acknowledged or that the system is polling this device at regular (configurable) intervals. There shall also be in indication that the current control of the plan (i.e. the plan being run) was commanded by the TMC; this shall be tied to the *unitBackupTime* and the current plan.

7.2.1 PC Port

1) The extended capabilities of the display system shall be available through the PC Port EIA/TIA-232 port and the Ethernet port, using a personal computer or laptop.

2) To ensure future compatibility with other vendors, the laptop or PC interface must support the full NTCIP object set. Software shall be provided by the CONTRACTOR to display and access all internal variables only using the NTCIP objects or MIBS constructed for the purpose.

3) The existing laptop software is available for review and use for future implementations of the ASTC. It is important that the new laptop software operate in a manner consistent with the current operation. However, the CITY will consider alternate operation of the laptop

providing the laptop is backward compatible with the existing controller. Backward compatibility shall require that the new software automatically identify the type of ASTC to which it is connected and automatically adapt to support the older database. This shall occur without operator intervention.

4) Where real-time status is displayed, the laptop shall interrogate the ASTC at least once per second and display the status parameters, timers, and variables as they are updated.

7.3 Flash Ram

1) The method of downloading is intended to support the normal EEPROM delays associated with writing to this type of memory. The “burn” process is intended to block further memory upload/download operations until this operation is complete.

2) During its normal operation, the controller shall verify the contents of its RAM and “firmware” with the use of checksums. Whenever a “firmware” failure is detected, the controller shall terminate all three color operations and drive the display to cabinet flash.

3) If the controller detects a check-sum error in its nonvolatile database, it shall report this condition to central and shall not operate until the problem is corrected (i.e. go to cabinet flash). This flag shall be cleared when a successful “burn” operation has been performed.

4) Updating operational parameters shall not interrupt the on-line operation of the unit; the unit shall continue to use its “ram copy” of the database and time all intervals correctly until the next top of cycle at which time the new data shall take effect.

5) Flash RAM shall contain a minimum of 16 MB.

7.4 Time/Event Reconciliation

1) Since the ASTC includes an internal scheduler, it is important that whenever local time-of-day operation is in effect, the plan selected is the proper plan for the current time. When the intersection transitions from on-line operation to off-line operation, the ASTC shall immediately verify (reconcile from midnight) and ensure that the plan in operation is the correct plan for the current time of day based on the database at the time of the transition.

2) Whenever the controller database is updated or its clock is set, it shall immediately determine if the changes should have affected its current operation and shall begin a transition at the next top of cycle if a plan change is necessary, or if there are changes to the current plan (offset, cycle length, split, special functions).

3) In summary, whenever a change is made to the internal schedule (day plan), timing plans, or clock, the controller shall immediately determine if the change would have affected its current operation had it occurred according to new schedule and database, and shall begin a transition at the next top of cycle. Such reconciliation should only look back to the last midnight transition and march forward from then to the current time of day. After the completion of any required transition, the controller shall be operating as though the database update had been completed on the previous day. The controller shall not “wait” until the next “event” to adopt the new parameters/database.

7.5 Support for USB port

1) The controller shall include a USB port on the front of the Unit. The USB port shall conform as a minimum to the USB v2.0 specification for both hardware and software operation in order to support the required transfer operations. The ASTC shall allow the connection of

both USB 1.1 and USB 2.0 compatible memory devices. The hardware shall support ½ Amp of current to the external device.

2) To facilitate the transfer of files between dissimilar equipment, all USB memory devices shall be capable of being formatted using the FAT16 file system. This provides for a maximum per-device storage capacity of 2GB.

3) The software shall support commonly available USB memory devices; it shall not be necessary to purchase a specific manufacturer's device to support the described functionality.

4) Except as noted below, the normal operation of the controller (e.g. green-yellow-red) shall not be affected by the insertion or removal of the USB device. Further, any improper insertion and removal (i.e. during a download or upload) shall not corrupt the ASTC operation or the contents of the USB memory device.

5) The controller shall support the following USB functionality:

    a. The controller shall recognize the insertion of the USB memory device and shall then initiate an operator dialogue to determine the desired operation.

    b. The controller shall support the loading of the controller firmware from the USB memory device. The controller firmware shall have a specific file name such that the controller 'knows' what file to load the new firmware without requesting further information from the operator. If the controller supports multiple versions of the firmware, then the user interface shall assist the operator in selecting the proper version from the memory device. In order to load new firmware into the controller, it shall follow the sequence outlined below:

        i. Transition to cabinet flashing operation. Cycle to the start of Main Street Green and then force the cabinet into flash by stopping the watchdog timer.

        ii. It can then initiate the firmware update.

        iii. At the conclusion of the firmware update, it will reset and start operation. The operator must then reset the conflict monitor and allow the cabinet begin its initialization sequence.

        iv. Interruption of the update process (e.g. removal of the memory device) shall not corrupt the contents of the memory device or the controller such that it cannot recover to initiate another application download from a valid source.

    c. The controller shall support the loading of the operating system and drivers using the USB memory device. This operation shall be identical to the operation for loading the application firmware noted above. If both the operating system (with drivers) and the application must be loaded together, then this shall be forced to occur by the ASTC and operate as noted for loading the application firmware.

    d. The controller shall support the loading of the operational configuration information and timing plans from the USB memory device. Such plan loading and/or configuration loading shall be coordinated with the street operation as follows:

i. If the controller is in flash (startup or conflict flash), then the configuration and timing information shall be loaded after which the controller shall commence green-yellow-red operation in accordance with the initialization plan and the configuration and timing plan information loaded. Note that it may be necessary to reset the conflict monitor based on the operational history of the controller.

ii. If the controller is already controlling the signals (i.e. green-yellow-red) and has a valid database, it shall copy the contents of the USB memory device into a memory buffer and wait for the all red interval preceding start of main-street-green (MSG). The controller shall then time a 2 second all-red condition while it loads the new data into its active database and start normal operation using the new plan information at the conclusion of the all-red time interval. The controller must not further delay the start of MSG.

iii. There shall be minimal disruption to normal operation when transitioning to the new timing and configuration information. The controller shall transition to the new plan based on the transition parameters of the new database.

iv. Interruption of the database loading process (e.g. removal of the memory device) shall not corrupt the contents of the memory device or the controller. Since the entire database must be buffered, a corrupted transfer shall be ignored with an error indication on the front panel of the unit.

v. The loading of the database shall cause an event to be logged in the event table to record the data and time of the update.

6) Timing plans and configuration information shall have a unique file name that shall include the intersection cabinet ID such that the controller will always load the configuration and timing information from the correct file name without operator interaction. If the proper file does not exist on the memory device, the controller will not load the database or corrupt the existing database. If an attempt is made to replace a valid database and there is no valid database for the intersection on the memory device, the request shall be ignored and normal operation shall continue.

7) It shall be possible to store all of the timing and configuration information along with the controller firmware and operating system (and drivers) for all locations on a single memory device. The controller shall select the proper file from the contents of the memory device.

8) The ASTC shall not require that the memory device be permanently attached to the controller. The controller shall not need the memory device to be present once the transfer operation is complete.

9) It shall be possible to dump the controller database and event logs to the memory device through the USB port. The controller shall write a file to the memory device that contains all of the current database and logs. Interruption of the writing process (e.g. removal of the memory device) shall not corrupt the contents of the memory device or the controller.

10) The CONTRACTOR shall provide software for the laptop computer to convert the controller database to files for storage on the USB memory device. The laptop computer shall support the USB memory device and shall include utilities to synchronize the contents of the USB memory device with the database stored on the laptop computer. Such synchronization must be supported to update either the USB device or the laptop database; the operator shall be consulted to determine which type of update is required.

11) The CONTRACTOR shall provide software for the laptop computer that shall be able to read the database and log files created by the traffic controller and convert them into database and configuration files that can be displayed through the normal laptop user interface.

12) It shall be possible to display the log files and print the log files in a "user friendly[13]" formatted manner. The format shall be submitted to the CITY for approval.

13) The USB memory files for the controller database shall be compatible between versions of the software. It shall not be necessary to keep or manage different types of database files for different versions of the software. The existing USB memory configuration and file structure as well as database format shall be used for new controllers. Where additional NTCIP objects may be required, they shall be added to the memory device in such a manner that is backward compatible.

14) A single USB memory device shall have sufficient space to store all of the databases and configuration information for a minimum of 16,000 intersections along with the operating system and firmware such that a single memory device can be used for all actions. This device shall have sufficient spare capacity to allow the uploading of the logs to the memory device for a minimum of 1000 controllers before these files must be purged.

7.6 Serial Interface to the 2010 CMU

1) The Conflict Monitor (see Section 18) includes a serial port on the front of the unit. The CONTRACTOR is to provide a cable that connects the CMU serial port to a spare port on the front of the controller.

2) The CONTRACTOR shall include software within the controller to allow the central computer to transmit messages *through* the controller to the conflict monitor and to receive messages (responses) from the conflict monitor back to the central computer system.

3) It shall not be possible to reset or disable the conflict monitor remotely through this port.

4) The CONTRACTOR shall develop drivers and NTCIP data elements to support the management of this serial communications; where possible this technique shall conform to development efforts of the NTCIP standards working groups.

5) It is anticipated that the central software will be expanded to allow the direct interrogation of the CMU from the remote computer to monitor the logs and controller operation.

6) The controller firmware shall also include a mechanism to automatically update the clock in the CMU from the controller clock such that the CMU clock and the controller clock are within 1 second of each other on a continuous basis. Whenever the controller clock is updated, it shall cause the CMU clock to also be updated according to the 1 second difference criteria. This clock interaction shall include compensation for day light savings time when so triggered by the NTCIP data elements.

[13] It is recognized that this is subjective in nature; the CONTRACTOR shall work closely with the CITY to develop the format for all printed reports so that they are easy to read and concise in their presentation. Reports that simply dump the NTCIP objects in a format of one line per object or use binary encoded presentation will not be acceptable.

7) Conflict monitors provided under this contract shall be backward compatible with the conflict monitors used on the existing contract such that they can be interchanged between old and new cabinets without changes to the controller or the conflict monitor.

7.7 Serial Interface to the UPS

1) The controller shall include support for a serial interface to a UPS when installed. The port assigned to this application shall be configurable.
2) The CITY has purchased some of the UPS devices and the protocol for the device listed in the specifications may not accurately reflect the as-built protocol for the installed units. The bidder is required to research the protocol for the existing unit and to ensure that the ASTC is compatible with the units currently in operation within the CITY.
3) The CONTRACTOR shall include application software in the ASTC that shall interrogate the UPS at least once per minute and shall retrieve the UPS status data for transmission to the central system when requested.
4) The ASTC shall also manage command interaction with the UPS including any necessary password interaction so that the central system can send all available commands to the UPS.
5) As of the development of this specification, the CITY has purchased units from Alpha Technologies (http://www.alpha.com). Since the initial purchase of the alpha UPS units, NYCDOT has purchased additional UPS from other vendors. The existing traffic controller software works with both types of UPS devices. It is required that ASTCs supplied under this contract shall work with all of the UPS units currently installed in the CITY. The supplier shall match the current operation.
6) It is required that the ASTC fully support all status monitoring and commands through the controller unit using custom (non proprietary) NTCIP data elements. The ASTC CONTRACTOR shall use the existing MIB objects.
7) It is intended that these objects will be polled as well as included in the exception based reporting scheme. They will also be included in dynamic objects (STMP) for use in the exception based reporting. The CONTRACTOR may place all of the status information into a single block object, but an individual object shall also be included for the status object that includes the loss of power and other alarms. It is the intent to use this object as the “watch object” in the event log mechanism and then transmit a block object which contains all of the UPS status information.
8) Note that an NTCIP object(s) shall be included in the ASTC communications protocol to the central computer to identify the current state (operating mode) of the UPS and operational characteristics (status) of the UPS. It shall be possible to use this variable (object) to trigger an event to report/log the change of state for the UPS.
9) The commands shall be placed into a single command object and it shall be up to the ASTC to handle the dialog between the UPS and the ASTC to complete the transactions.
10) The interface software shall be such that it will automatically recover without operator intervention in the event of bad commands, errors in the exchange, startup, cable interruptions, sequencing errors, and shut-down. Such recovery shall not take more than 2 minutes to complete under all circumstances.
11) Certain traffic controllers will be equipped with a UPS power source [also referred to as a BBS – battery backup system] that shall continue to power the intersection when the Con Edison power service is not present. The controller shall monitor an input from the UPS

(using the serial port or other means) and shall determine whether the controller is running from a UPS power source or Con Edison power service. When running on UPS power, the controller shall not track the power line for its time keeping functions including but not limited to signal timing, scheduler, and clock management (day, date, time). When running on UPS, the controller shall rely on its internal crystal based oscillator. The transition to and from UPS power shall be performed without the introduction of any disruption to the clock. Such transitions shall not cause the clock to gain or lose more than 0**.**1 (1/10th) seconds with each transition to/from UPS power. This clock drift allowance shall not supersede the clock and time keeping requirements contained elsewhere within this document except when there is a power outage which exceeds ½ second and the UPS is present.

12) The exact format and protocol for the data exchanges between the UPS and the ASTC is available for inspection; it shall be the responsibility of the CONTRACTOR to match the existing ASTC operation and to interface with all UPS devices currently installed in the City. The CONTRACTOR may inspect and reverse engineer such interfaces as necessary; however, interchangeable operation is required.

7.8 Serial Port Assignments

1) The normal serial port assignments are shown below:

    a. Port1 – 485 serial to cabinet BIU's

    b. Port2 – Connected to the laptop or a central system using serial.

    c. Port3 – Connected to the 2010 conflict monitor

    d. Port4 – Where a UPS is present, this is connected to the UPS; otherwise, it may be connected to a laptop computer or a central system using serial communications.

    e. Port 5 – Spare; this may be connected to a laptop computer, central system, or some future cabinet device using serial communications.

    f.

2) These are the nominal port assignments and shall be fully configurable through NTCIP objects. The assignment of ports to applications shall be configurable. Each port shall auto configure based on the database loaded. The default (no database loaded) shall allow the connection of the laptop to Port4. In addition to the above, there is a USB port and an Ethernet port on the front of the unit. The Ethernet port shall default to the system port and the USB functionality shall be as described herein.

3) The use of the serial ports shall be fully configurable and assignable to the applications identified herein.

7.9 Signal Control Priority (TSP)

1) The ASTC shall include software to support Transit Signal Priority (TSP) capability as specified below. The purpose of the proposed TSP algorithms is to maximize the opportunity for transit[14] vehicles to pass through an intersection with fewer stops and delays.

7.9.1 General Requirements:

1) TSP shall support the following modes of operation of the CITY's ASTC:

[14] This description targets transit vehicles. External system components shall identify specific vehicles, which will be identified to the controller as requiring TSP service. The technology used to identify the vehicles to receive TSP preferential treatment has not been identified. The ASTC is intended to respond to a "TSP Vehicle Present" input.

- Actuated (NTCIP/NYCWiN)
- Interval Based Operation (NTCIP/NYCWiN)

2) TSP shall be supported on all phases/intervals.
3) When an identified vehicle enters the Priority Operating Zone (POZ), a TSP request shall be generated and provided to the controller.
4) One or two physical inputs (discrete NEMA signals) shall be used for each TSP approach and collectively shall be called a “TSP Input”. The physical inputs shall be assignable within the input file, an auxiliary cabinet, and to use the isolated inputs wired to the backplane terminal blocks.
5) TSP shall support a minimum of six approaches per intersection. Note that approaches shall be assignable and not dedicated to any specific inputs. Thus, if only 1 or 2 approaches are used, then only 2 TSP inputs need to be assigned.
6) TSP shall not override an active preemption input. Preemption inputs shall be separate from the TSP inputs.
7) Normal TSP operation shall not cause an intersection to be failed “off-line” by the VTCS system. (Note: Recovery from an off-line condition takes approximately 10-15 minutes). For Manhattan, the controller shall respond with a preemption status and return to TBC operation or on-line operation upon completion of the TSP input.
8) All parameters shall be User configurable and certain ones shall be selectable based on the current time-of-day (TOD)/day-of-week (DOW) scheduler.
9) The controller shall include a read/write object to enable/disable TSP operation.
10) The controller shall include an object to indicate when the controller is attempting to perform a TSP operation and the nature of the operation being attempted. It shall be possible to monitor this status through the NTCIP trap mechanism.
11) Dynamic BIU I/O Mapping shall be extended to support mapping of inputs to TSP check-in and check-out inputs.
12) The Laptop software shall be enhanced to support the new TSP data elements and status.
13) . The current MIB for the ASTC includes the objects that support TSP operation and the remote TSP activation message.

7.9.2 Features that shall be included in the TSP implementation

1) Support for both Interval-based and Phase-based operation
2) Only extendable and reducible intervals/phases can be adjusted (i.e. vehicle yellow clearance / pedestrian clearance / red intervals shall not be affected). Minimums shall not be violated
3) Support for both Extension of Green and Early Return to Green
4) TSP parameters configured by TOD (i.e. scheduled). Each phase/interval shall have an extension value and a reduction value. The sum of extensions must be less than or equal to the sum of reductions.
5) Each TSP input shall be assignable to 2 intervals maximum
6) TSP shall support parallel movement bus calls (each direction on a street shall have separate extension/reduction times).

7) TSP shall support phase on demand operation that allows the TSP to request that a specific phase be included in the cycle. As an example, this capability could be used to support a leading left turn to permit the transit vehicle to make a permissive left when present.

8) TSP shall support Queue jumping by allowing the transit vehicle to get an early start through the intersection.

9) The TSP algorithm shall support Split Balancing such that the time "stolen" can be given back during the next cycle.

10) The TSP actions shall be logged internal to the ASTC and the CONTRACTOR shall provide a mechanism to support the uploading of this log information via NTCIP custom objects and this log shall be uploaded to the USB memory device; the laptop software shall be enhanced to allow these logs to viewed in a manner which clearly displays the nature of the event and does not require the decoding of the time or event information.

7.9.3 Algorithm Parameters:

1) The following parameters shall be available on a per Interval/Phase basis and shall be supported by the scheduler based on TOD and DOW:

   a.) Green Extension Time

      (i) The Green Extension Time (GET) is the maximum number of seconds that the transit priority is allowed to extend that green interval by. The User can specify the GET for each TSP phase/interval. The extension is granted on a second-by-second basis up to the maximum GET currently in effect for that phase/interval. The GET is specified in seconds within the range 0..255.

   b.) Green Reduction Time

      (ii) The Green Reduction Time (GRT) is the maximum number of seconds that the transit priority is allowed to reduce that green interval by and hence truncate the red signal presented to the transit vehicle). The User can specify the GRT for each TSP phase/interval. The reduction is granted on a second-by-second basis up to the maximum GRT currently in effect for that phase/interval. The GRT is specified in seconds within the range 0..255.

   c.) Vehicle Travel Time

      (iii) The Vehicle Travel Time (VTT) is a User entered parameter that represents the typical time it takes a transit vehicle to travel from the detection point to either through the intersection (Bus Stop Time = 0) or to the Bus Stop.

      (iv) The VTT is specified by the User for each approach (TSP Request input).

      (v) The VTT is specified in seconds over the range 0..255 where 0 means to use either the Check-out detector or removal of the Constant Call to terminate the TSP request

   d.) Bus Stop Time

      (vi) The Bus Stop Time (BST) is a User entered parameter that represents the typical time a transit vehicle is stopped (near side) to pick up passengers and includes the necessary delay to enter the intersection.

      (vii) The BST is specified by the User for each approach (TSP Request input).

      (viii) The BST is specified in seconds over the range 0..255 where 0 is typically used to indicate that either there is no near-side stop or that the BST is included in the VTT already.

7.9.4 TSP Strategies

1) The TSP shall support the following strategies:

a.) Green Extension Strategy:

* The Green Extension Strategy allows the extension of the current Green interval by as much as GET seconds
* The Green Extension Strategy shall not be used if the transit vehicle can make it through the intersection without extending the green interval.
* The Green Extension Strategy shall only be used if the transit vehicle can benefit from the current green interval being extended.
* The green interval shall only be extended one second at a time up to a maximum GET seconds starting from the normal termination point of the green interval. The Green Extension Strategy shall be terminated when either the transit vehicle clears the intersection, the TSP request input fails, or the maximum GET is reached.
* If the green interval is being extended due to a TSP request, then the green interval shall be terminated immediately upon termination of the Green Extension Strategy termination.
* Upon termination of the Green Extension Strategy, splits for the following phases/intervals of coordinated intersections shall be reduced so that the offset point is not moved or moved only minimally.
* A solid “Don’t Walk” sign shall be displayed during the Green Extension interval for any interval/phase that controls pedestrian signals.
* The Max Split time, if specified, shall be ignored when the Green Extension Strategy is in operation.
* Green extensions shall only occur in the “variable” intervals, and all minimum timings for all affected phases/intervals shall be unaffected both prior to and after the Green extension interval.

b.) Green Reduction Strategy:

The Green Reduction Strategy allows the shortening of the current Green interval by as much as GRT seconds

* The green interval shall not be reduced below its minimum time (i.e. If Phase/Interval Green Time-GRT < Phase/Interval Minimum Green time, then green will be displayed for Phase/Interval Minimum Green Time).
* The Green Reduction Strategy shall only be used if it is necessary to shorten the current Green display to advance to the phase/interval with the TSP request in order to serve it faster.
* The Green Reduction Strategy shall only be used if the transit vehicle can benefit from the current green interval being shortened.
* The green interval shall be reduced by GRT seconds subject to the condition that the minimum timing shall not be violated. The Green Reduction strategy shall be terminated if either the transit vehicle clears the intersection or the TSP request input fails, and under such termination, the current green interval shall resume timing its normal period.

* If the green interval is being shortened due to a TSP request, then the resumption of the normal green interval shall begin immediately upon termination of the Green Reduction Strategy termination.
* Upon termination of the Green Reduction Strategy, splits for the following phases/intervals of coordinated intersections shall be extended so that the offset point is not moved or moved only minimally.
* Green reductions shall only occur in the “variable” intervals, and all minimum timings and vehicle/pedestrian clearance intervals for all affected phases/intervals shall be unaffected both prior to and after the Green reduction interval.
* Once the TSP requested phase/interval is reached, the Green Extension Strategy can be used as required to facilitate the transit vehicle in clearing the intersection.

c.) TSP Priority

* TSP Priority shall be based exclusively on the “First Sequenced, First Served” (FSFS) strategy.
* Under the FSFS Strategy, if a new TSP request is received for a phase/interval that occurs earlier in the sequence than the prior TSP request currently being served, then this new TSP request shall be served first (thereby delaying the original TSP request).
* While performing the Green Extension Strategy on any phase/interval, all other TSP requests shall be ignored (delayed) until the current transit vehicle clears the intersection or the Green Extension Strategy is terminated.

7.9.5 Algorithm Progress Status Capabilities:

1) The real-time state of the current phase/interval shall be enhanced to include the following:
    - Identification of TSP inputs,
    - Whether it is currently being extended or truncated
2) The front panel of the controller shall have a TSP status screen added; this shall indicate the current operation and timing for support of SCP.
3) The front panel of the controller shall have appropriate status screens enhanced to support SCP

7.9.6 Transitioning:

1) To facilitate the ability to regain coordination as quickly and efficiently as possible, the values of GRT and GET must be selected such that the sum of GRT is greater than or equal to the sum of GET in any given cycle. This rule enables the controller to maintain the cycle length while serving the TSP request and therefore the intersection will not lose coordination.
2) Transitioning shall only be performed if the controller is running in coordinated mode and it loses coordination with the adjacent intersections. Due to the restrictions placed on GRT and GET, this is most likely to occur if a plan change is requested while servicing a TSP request.
3) Transitioning shall utilize the algorithm currently in effect within the controller.
4) Transitioning shall not be performed if an uncoordinated controller loses synchronization with respect to its global cycle timer.

7.9.7 Detection Capabilities:

1) The ASTC shall support six (6) “constant call” TSP request inputs; TSP shall be requested and operate only while a call is present; normal operation shall resume once the request is removed (includes transitioning as needed)
2) The ASTC shall also support the use of separate check-in and check-out inputs for each of six (6) approaches. (Note this is twelve (12) physical inputs and six sets of parameters.)
3) The ASTC shall support “check-in/out” and travel time & bus stop time TSP [six (6) physical inputs and sets of parameters].
4) The ASTC shall support TSP detector fail on – Fail TSP input if the “call” requested is greater than a User specified setting in range 0-255 seconds. (0 means never fail). The TSP input must go off too automatically reset the input from the failure mode.
5) Support for TSP detector delay – delay effects of TSP input request by 0..255 seconds (0 = no delay) provided the TSP request input remains active. This delay is also included in the TSP detector fail time (i.e. detector fail time is measured based on the physical signal being input to the controller). Only the Check-in inputs can be delayed.
6) A TSP request must be removed before a new TSP request shall be recognized on that input.
7) Re-service of a TSP Input can be inhibited for a set period of time to help maintain transit vehicle headway. Additionally, a master Re-Service parameter shall be provided for the intersection to control the frequency of application of SCP.
8) Summary; from an implementation point of view:
    * Each TSP Input [one per approach for 6 approaches] will be configured based on the following parameters:
        - TSP Input Valid … 1 = Yes, 2 = No. This parameter indicates whether or not the TSP Input request row in is valid or not. (This parameter is redundant since if the row is not defined, then the TSP input is invalid).
        - “Check In” TSP request detector input (TCIx)… range of ‘x’ is 1-6. Note: Use dynamic BIU I/O mapping to assign a physical input to TCIx.
        - “Check Out” TSP request detector input (TCOx) … range of ‘x’ is 0-6 where 0 means “latching” (i.e. constant call or entry detection only). Note: Use dynamic BIU I/O mapping to assign a physical input to TCOx.
        - “TSP Detect Fail Time” … range is 0..255 (seconds), 0 = never fail.
        - Phases/Intervals called … octet string[6] where each octet is the phase/interval that the TSP input places a request on. There can be from 0-6 octets in the string.
        - TSP Input Re-Service Time (TRT) … 0..65535 (seconds), 0 = no re-service restrictions. Non-zero means that no new TSP request shall be recognized on the TSP input for TRT seconds after the removal of the previous TSP request on that TSP input.
        - Vehicle Travel Time (VTT) as defined elsewhere.
        - Bus Stop Time (BST) as defined elsewhere.

7.9.8 Events Logged

1) All TSP related information, including detection related logs, shall be able to generate events and be logged. The logged information shall contain the time, TSP input number, and event.
2) TSP Requested: Logged on every new receipt of a TSP Request. Request may either be acted upon or ignored as appropriate
3) TSP Ignored (Re-service): TSP service was requested and then removed/failed while either the individual TSP input or intersection as a whole was under re-service restriction.
4) TSP Success: TSP Algorithm successfully helped transit vehicle through the intersection
5) TSP Request Removed: Transit vehicle cleared the intersection without assistance from the TSP algorithm. For example, TSP request appeared during the current green phase/interval and the transit vehicle cleared the intersection prior to any green extension being required.
6) TSP Clear Failure: Transit vehicle failed to clear the intersection prior the algorithm completing (e.g. maximum extension timing out, regardless of whether truncation occurred).
7) TSP Detect Failure: Identified TSP detector has failed on (i.e. max detect timer timed out).
8) TSP Detect Clear: Previously failed TSP detector fault has cleared (i.e. input request has been removed).
9) TSP Aborted: TSP Algorithm needed to abort to maintain the intersection on-line.
10) The controller shall keep a running average of the check-in, check-out for each approach; this shall be a read-write variable and include a counter for the number of vehicles in the calculation. The unit of measure shall be seconds. The counter shall be a single byte counter and once the number of vehicles counted reaches 255, the averaging calculation shall stop. Whenever the central computer resets the vehicle counter, a new accumulation period shall begin.

7.9.9 Reports Generated

1) Key reports shall be generated within the controller as follows. These reports shall follow a configuration similar to the NTCIP volume/occupancy within NTCIP 1202. In particular, a sample period in hours shall be set (range 0..24, 0 = disable reports). An alarm shall be configurable to occur if the percentage of failures exceeds a User configured threshold at the end of the sample period.
    - # TSP Requested during period (per input)
    - # TSP Failures during period (per input)

7.9.10 Estimated Arrival Time functionality

1) The ASTC shall support the estimated travel time functionality of the existing unit. This functionality is described below, however, it is likely that there have been some changes to how this feature functions, and it is the responsibility of the CONTRACTOR to ensure compatible operation as well as re-use of the same objects and block objects of the existing deployment. The intent is to use transit vehicle speed, travel time, queue clearance time, and historical values when determining the *Estimated Arrival Time* of a transit vehicle.

7.9.10.1 General Requirements:

1) The ASTC shall support a Transit Signal Priority (TSP) strategy called “Estimated Arrival Time”, that is based on the preceding sections which describe the requirements for the

"Normal Green Reduction and Green Extension" strategy but with the following additional/changes:

a. Starting upon receipt of a valid TSP Input request, the ASTC shall use the scheduled Vehicle Travel Time (VTT) to calculate an Estimated Arrival Time (EAT) for the transit vehicle to enter the intersection assuming it does not stop at the stop bar and/or near-side bus stop.

b. If the intersection is currently in the requested TSP movement then provide a Green Extension as necessary provided it is expected to benefit the transit vehicle.

c. If the intersection is not in the TSP movement then as necessary use non-TSP Green Reductions to transition the controller such that the intersection is approximately TSP Percent Utilized (TPU) into the first TSP movement at the expiration of the EAT period and then use Green Extension as necessary to assist the transit vehicle.

2) The ASTC shall include a TSP Strategy, "Estimated Departure Time", that is based on the existing "Normal Green Reduction and Green Extension" strategy described above, but with the following changes:

d. Starting upon receipt of a valid TSP Input request, use the scheduled Vehicle Travel Time (VTT) and Bus Stop Time (BST) to calculate an Estimated Departure Time (EDT) for the transit vehicle to enter the intersection after passing the stop bar.

e. If the intersection is currently in the requested TSP movement then provide a Green Extension as necessary provided it is expected to benefit the transit vehicle.

f. If the intersection is not in the TSP movement then, as necessary, use non-TSP Green Reductions to transition the controller such that the intersection is approximately TSP Percent Utilized (TPU) into the first TSP movement at the expiration of the EDT period and then use Green Extension as necessary to assist the transit vehicle.

3) The ASTC shall include a TSP Strategy, "Estimated Travel Window", that is based on the existing "Normal Green Reduction and Green Extension" strategy described above, but with the following changes:

g. Starting upon receipt of a valid TSP Input request, use the scheduled Vehicle Travel Time (VTT) and Bus Stop Time (BST) to calculate an Estimated Travel Window (ETW) based on both an Estimated Arrival Time (EAT) for the transit vehicle to enter the intersection assuming it does not stop at the stop bar and/or near-side bus stop and an Estimated Departure Time (EDT) for the transit vehicle to enter the intersection after passing the stop bar assuming it did stop at the bus stop.

h. The goal of this algorithm is position the ETW within the TSP movement green period using non-TSP Green Reductions and a TSP Green Extension as needed.

i. If the intersection is currently in the requested TSP movement then provide a Green Extension as necessary only if it is expected to benefit the transit vehicle based on a Minimum Window Percentage (MWP) parameter. That is, provide an extension only if at least MWP % of the ETW can be provided if the Green Extension period is fully used.

j. If the intersection is not in the TSP movement then as necessary use non-TSP Green Reductions to transition the controller so that the intersection is normally approximately TSP Percent Utilized (TPU) into the first TSP movement at the start of the ETW.

7.9.10.2 Features that shall be included in the EAT TSP implementation

1) Add a method of estimating the Vehicle Travel Time (VTT) based on the previous check-in/check-out duration.
2) Add a method of estimating the Vehicle Travel Time (VTT) based on a check-in signal and historical speeds over a User specified distance, Vehicle Travel Distance (VTD). Note that the VTD is a fixed value per Phase/Interval since it depends on the detection geometry (i.e. distance from detection point to stop bar).
3) Add a method of estimating the Vehicle Travel Time (VTT) based on a check-in signal and current vehicle speed over a User specified distance, Vehicle Travel Distance (VTD). Note that the VTD is a fixed value per Phase/Interval since it depends on the detection geometry (i.e. distance from detection point to stop bar).

7.9.10.3 Algorithm Parameters:

1) The following parameters shall be available on a per Interval/Phase basis and shall be supported by the scheduler based on TOD and DOW:
   a.) Vehicle Travel Time
      (i) The Vehicle Travel Time (VTT) is a User entered parameter that represents the typical time it takes a transit vehicle to travel from the detection point to either through the intersection (Bus Stop Time = 0) or to the Bus Stop.
      (ii) The VTT is specified by the User for each approach (TSP Request input).
      (iii) The VTT is specified in seconds over the range 0..255 where 0 means to use either the Check-out detector or removal of the Constant Call to terminate the TSP request
   b.) Bus Stop Time
      (i) The Bus Stop Time (BST) is a User entered parameter that represents the typical time a transit vehicle is stopped (near side) to pick up passengers and includes the necessary delay to enter the intersection.
      (ii) The BST is specified by the User for each approach (TSP Request input).
      (iii) The BST is specified in seconds over the range 0..255 where 0 is typically used to indicate that either there is no near-side stop or that the BST is included in the VTT already.
   c.) TSP Percent Utilized
      (i) The TSP Percent Utilized (TPU) represents the targeted vehicle arrival point at the expiration of the EAT period as the percentage into the first TSP movement.
      (ii) The TPU is specified by the User for each approach (TSP Request input).
      (iii) The TPU is specified in percentage over the range 0..100 where 0 represents the beginning of the TSP movement and 100 indicates the end of the TSP movement.
   d.) Minimum Window Percentage

(i) The Minimum Window Percentage (MWP) represents the minimum amount of window that must be included within the TSP movement assuming that the full Green Extension is used in order to authorize the timing plan changes needed to facilitate the TSP request.

(ii) The MWP is specified by the User for each approach (TSP Request input).

(iii) The MWP is specified in percentage over the range 0..100 where 0 represents that no part of the Window is guaranteed to occur during the TSP movement and 100 means that the "full" Window shall occur during the TSP movement up to the maximum TSP movement duration with any remaining Window time occurring at either the beginning or the end as determined by the ASTC.

7.9.11 External inputs and monitoring

1) The ASTC shall include status objects which shall be selectable as EBR watch and report objects to report the current condition of the transit signal priority (TSP) mechanism. If such objects do not currently exist, then the CONTRACTOR shall propose specific objects and provide such information to the NTCIP Actuated Signal Control and Signal Control Priority working groups for consideration.

2) It is required that the TMC be able to remotely command the ASTC to activate the Transit Signal Priority (TSP[15]) operation. While the MIB provides all of the data elements to manage the TSP operation, NYCDOT is planning to use a centrally directed TSP capability for both TSP and emergency vehicle preemption.

3) Refer to the MIB for the operation of the ***tspRemoteCallActivationBlock*** and the ***preemptRemoteCallActivationBlock.***

7.9.11.1 Application notes (refer to the MIB):

1) Each block can be used to set or reset only a single input.

2) It is the responsibility of the controller to arbitrate the priority of the inputs and other actions such as emergency vehicle preempt.

3) All of the rules regarding TSP operation are enforced by the traffic controller.

4) Transmission of a ***tspRemoteCallACtivationBlock*** with a call (1) for an input which is already active has the effect of re-initializing the ***MaxActiveTimer*** without resetting the input.

5) The ***RemoteRequestTimeToActivate*** is intended to account for variable latency of communications, and/or to support the use of an Estimated Time of Arrival (ETA) operation. It is used to delay the action until the future time specified. For communications latency, it is estimated that this may be set to 2 seconds ahead to make provisions for one or 2 retries. However, if the time the command is received has already passed, then the action is taken immediately (set or clear). By allowing this command to support both a time to set and a time to clear, the TSP central system can use this to compensate for delays for either action.

6) This also supports queue jump since that function is assigned to a TSP input and this command (message) can be sent to affect any TSP input. Thus, this command (message) can fully exercise the TSP system at the ASTC.

[15] Note that Signal Control Priority (SCP) and Transit Signal Priority (TSP) are used interchangeably in this specification and both refer to the same function of providing priority service to specific vehicles approaching the intersection or at the intersection based on an input (wired or communications command).

7) The variable ***RemoteRequestMaxActiveTime*** is intended to provide a mechanism for some error handling at the approach level since these remote commands bypass the hardware input error checking of the ASTC.

8) Only one command can be active at a time; it is not allowed to have a pending call (1) and a pending clear (0) timing at the same time. A clear (0) terminates any call (1) activity which may be pending and has not yet occurred;

7.9.11.2 Summary

1) The preceding discussion is to clarify the use of the remote management of the TSP operations. The existing units were modified to support this feature and the new units provided under this contract shall be compatible with the current operation.

2) The MIB and ASTC source code will be provided to bidders for an understanding of how this unit is intended to operate; the source code will be available to the successful bidder at the time of award, subject to the execution of a Non Disclosure agreement for the ASTC source code.

3) The MIB is not considered proprietary by the vendor; however, it is not public for security purposes. It will be made available in electronic form to the lower bidder at the time of contract award.

4) Note that the MIB is subject to change; it is the responsibility of the CONTRACTOR to ensure compatible operation.

7.9.12 External outputs

1) It shall be possible to assign any output circuit to indicate that the transit signal priority request is being granted such that an approaching vehicle can determine that the intersection is attempting to provide transit priority. Outputs may also be assigned to preemption actions such that the controller can activate a separate (configurable) output to indicate that a preemption request is in process. Note that for preemption and transit priority, multiple requests may use the same display indicator.

7.9.13 TSP features which are not supported with the ASTC

1) The following features or functions need not be supported by the SCP:

   a.) There shall be no support for varying priority of TSP inputs. As indicated above, all TSP inputs are first sequenced, first served.

   b.) The TSP algorithms shall not provide for Ped Omits and/or Phase/Interval Omits.

   c.) There is no requirement to support a second attempt at the TSP algorithms even if the **TSP Input** remains active after the first attempt. For example, if, after a GRT strategy followed by a GET strategy at the TSP phase/interval, the transit vehicle still fails to get through the intersection, then do not retry to help it by starting a new GRT strategy.

   d.) If TSP can be disabled during offset seeking, this shall be a configurable option

7.10 Preemption (EVP) via remote command

1) The ASTC shall support the remote activation of preemption plans in the same manner as described above for TSP operation; it shall be possible to activate a preemption plan, terminate a preemption plan, and set the time at which the action (set or terminate) will take place.

2) The objects to manage this capability are identified in the MIB for the ASTC; the CONTRACTOR shall use the MIB objects and match the existing operation.

3) The operation of the remote EVP operation shall be identical to the TSP operation except that the input number refers to a preemption plan or approach instead of a TSP input number.

7.11 Temperature Monitor

1) The ASTC controller shall include an internal temperature monitoring device which shall measure the temperature within the controller unit in the area of the circuit card; the probe shall be placed in a location which is not adjacent to a significant heat generator.

2) The temperature probe shall be reported using the following object: ***controllerTemperature.*** Refer to the MIB to determine how this object may be used.

3) The accuracy of the reading shall be +/- 3 degrees C over the temperature range -30C to +70C without recalibration for the life of the ASTC. The vendor shall provide a chart of the temperature differential between the measured temperature at the board and the ambient temperature around the ASTC unit in when mounted into a typical ASTC-6 cabinet.

7.12 Additional Features which must be supported and not identified elsewhere

1) The ASTC shall support “broadcast Ping” which is used by the wireless network to configure the wireless routers. The CONTRACTOR shall work with the CITY and the NYCWiN contractor to ensure compatible operation in support of the automatic configuration software used by NYCWiN.

2) The system Ethernet port shall be factory configured to be Y.Y.**a.a** – (where Y.Y will be specified by NYCDOT upon award of contract) where ***a.a*** is the 16 bit cabinet address expressed as 2 bytes of the IP address.

3) The gateway IP address for the system port shall be Identified by NYCDOT upon award of contract and the subnet mask for the system port shall be 255.255.0.0.

4) The IP address, gateway, and subnet mask for the second port shall be identified at the time of delivery and shall also be pre-coded in the factory delivered units. (Note that they shall also be available as NTCIP objects that can be modified by SET commands from the central system, laptop, or USB memory load. Such variables shall be read-write and preserved during loss of power.)

5) All of the network interface port characteristics listed in this section shall be subject to change prior to delivery to the CITY. The CONTRACTOR shall request clarification prior to shipment and the CITY shall provide the exact pre-configured information at that time.

6) All of these parameters shall also be accessible as NTCIP objects such that they can be changed by loading them from the laptop, the USB memory device, or via the remote central system.

7) The processor used in the ASTC controller unit shall include hardware encryption such that future software modifications for data security may be implemented. This might include internal VPN support for the traffic controller such that the VPN tunnels currently used are no longer required.

8) The processor bus speeds, machine cycles, and overall processing capability shall be equivalent to or superior to that in the existing Phase 3 units. This shall be demonstrated at the time of the initial submittals.

9) Due to deficiencies in the ATC 5.2b standard, some modifications had to be made to ensure that all of the features required could be supported. The next vendor shall review

such changes and shall discuss with the CITY how they plan to achieve equivalent operation while maintaining backward compatibility. It is required that the engine board be backward compatible with the existing Phase 2 and phase 3 units.

10) For pretimed operation, as well as actuated operation (including interval based control), when cycle time passes through zero, the controller to turn on the “local cycle zero” bit so that the central system can monitor the pretimed interval based operation. This is Bit 2 of the *shortAlarmStatus* object. Note further that this bit shall be a trappable event and shall be reset once the trap is queued for transmission.

11) The ASTC shall provide a single SET command which shall clear all of the trap system parameters. This shall clear the trap management table, the trap table, all watch blocks, and all report blocks. This shall also clear all queues. This command will restore the trap mechanism to a condition that allows an all new configuration to be loaded without the risk of lingering entries that could affect the operation.

7.13 Other Deliverables

7.13.1 Laptop computers

1) The CONTRACTOR shall provide laptop computers with all necessary cables and accessories to support the field database management and programming the controller firmware.

2) The laptop computers shall include a power supply, battery, a charger, and spare battery. The charger and AC power supply shall operate from 100 to 240 VAC 50/60 Hz.

3) The unit shall include a combo CD/RW, DVD+/-R/RW drive, Ethernet adapter, serial port, a minimum of 2 USB ports (USB2.0 with backward compatible support for USB 1.1 devices), and color display (minimum 1280x768 native resolution) clearly visible and readable in bright sunlight. All of these peripherals shall be integral to the unit such that no external devices (or PCMCIA cards) are required.

4) The laptop computers shall include internal WiFi support for at least 802.11b/g operation and all necessary network drivers.

5) The laptop shall include internal Bluetooth support with drivers for such devices as pointing devices, audio input-output, and keyboards.

6) The laptop shall include provisions for an internal 3G modem and SIM card to allow the laptop to be connected to a 3G service if activated by NYCDOT. The CITY will notify the CONTRACTOR of the specific service that is to be used, and the CONTRACTOR shall supply the appropriate internal modem. As a minimum, it shall be able to support Verizon, Sprint, and AT&T equivalent 3G service.

7) The laptop shall include provisions for a spare PCMCIA card which can be used on the NYCWiN network. Note, the WiFi support (see above) must be internal and not require a PCMCIA card.

8) The laptop computers supplied shall be classified as “rugged” and suitable for field use under adverse conditions. The laptop computers, as a minimum, shall meet the following MIL-STD-810E requirements: MIL-STD-810E 514.41.8, MIL-STD 810E 516.4 IV, MIL-STD 810E 501.3 II, MIL-STD 810E 503.3, and MIL-STD 810E 512.3I.

9) The laptop computers shall be considered 'current models' at the time they are supplied and shall be guaranteed for a minimum of 3 years (parts and labor) for commercial use. Laptops shall not be supplied prior to the successful completion of the design approval test and the first delivery of the final ASTC.

10) The laptop computers shall be supplied with rugged carrying cases that shall cushion the computer and allow the operation of the computer without removal from the case. Carrying cases shall be suitable for shipping the computers via air freight, USPS and checked baggage.

11) The battery shall support normal operation for at least 5 hours. Two batteries shall be supplied with each laptop. Batteries shall use Lithium-Ion technology or better.

12) The laptop shall be supplied with a mobile power supply for operation in the automotive environment in addition to nominal 100-240 VAC 50-60 Hz power line.

13) The laptop shall be supplied with a Windows operating system and all necessary utilities for LAN operation which is compatible with the software provided under this contract. Note that if these operating systems have been superseded by newer versions at the time of shipment, the CONTRACTOR may be required, at the discretion of the ENGINEER, to supply the latest version of the equivalent operating system including all utilities and support software.

14) The laptop computer is intended to be used for portable operation where network and internet connectivity may not be available. Hence, the requirement for an internet connection for license management, software installation, or the use of any of the traffic application software and utilities is not allowed.

15) The disk drive shall be at least adequate for the operating system, 16,000 controller databases, application software, utilities etc. with 500% spare disk space (not including swap space). The minimum hard drive capacity shall be 350 GB; the minimum RAM size shall be at least 4 times the manufacturer's recommendation for the applications listed herein but in no case shall it be less than 8GB.

16) Laptop computers shall be supplied with a heavy duty port replicator/docking station for desktop and automotive use.

17) The use of custom 'pig-tail' adapter cables for Ethernet connections, serial connections, and USB connections is not allowed. All interface connections shall be standard DB9 for serial ports, and standard RJ45 for the Ethernet ports respectively. The USB port shall include at least 2 standard USB connection ports. Five (5) spare Ethernet cross-over cables, five (5) spare standard Ethernet cables, and five (5) spare serial cable to connect to the ASTC shall be provided with each laptop computer.

18) The laptop computer shall be a standard offering from an approved computer manufacturer such as Panasonic, Sony, IBM, Dell, or other name-brand manufacturer. The manufacturer shall be subject to approval by the ENGINEER.

19) Software shall be provided for the laptop for support of the ASTC interaction through both the serial ports and the Ethernet ports.

20) Software shall be provided for the laptop to connect to the CMU serial port and display and manage the status of the CMU.

21) All software shall be provided on self installing CD ROMS (or DVD) and complete installation directions shall be provided.

22) Laptops shall be provided with the full Microsoft office suite of software including word processing, spread sheets, email (outlook), power point, database (Access), web browser, Microsoft Project, Visio, Wireshark, remote access (Telnet, secure telnet, etc.), and ftp utility software.

23) The laptop software shall support the creation of the USB databases and the translation between the USB format and the laptop database format. To clarify, it shall be possible to load the USB device with the controller database in the proper format from the laptop database and it shall be possible to copy the controller databases to the USB memory device and have the laptop translate the USB database to its internal database.

7.14 General software performance notes

1) The time required to display the full complement of data shall not require more than one second from the completed request once the applications are running. This shall include the laptop computer graphical user interface and all display screens on the front panel display of the Controller unit.

2) It shall not require more than 35 seconds to complete the loading of the controller database when connected to the laptop computer via a 10BaseT Ethernet port.

3) It shall not require more than 35 seconds to complete the loading of the controller database from the USB memory device.

4) The operational software (traffic control) shall not be affected by any loading on the Ethernet ports and serial ports; all serial and Ethernet ports shall be able to simultaneously accept a continuous stream of information at the highest bit rate allowed.

8 Design Requirements and Review Process

1) These Specifications present an architecture, functional requirements, and conceptual design for the ASTC. The CONTRACTOR shall be responsible for the final design and equipment layout to meet the mechanical and functional requirements of these ASTC specifications. (Note that ASTC includes both the basic ASTC-6, ASTC-8, ASTC-12, and the Auxiliary cabinet).

2) All documents, including submittals, shall be provided on standard letter sized paper and in electronic form using MS Word as specified by the ENGINEER. Drawings shall also be submitted in electronic form in both Visio and AutoCAD compatible format.

3) The CITY will conduct a ‘kick-off’ meeting immediately after the *Notice to Proceed*. This meeting will include a detailed walk-through of the specifications and will provide the CONTRACTOR with the opportunity to present alternative approaches or request clarification as to any aspect of the requirements. This is intended to be an interactive session and the CONTRACTOR shall be prepared to resolve all design and deployment issues as well as project scheduling issues at that meeting.

4) The CONTRACTOR shall conduct a detailed design review (walk-through) of the complete ASTC cabinet and electrical/electronic design with the ENGINEER prior to fabrication. This design review shall cover all equipment, assemblies, and subassemblies proposed by the CONTRACTOR. This design review shall be held at the CITY offices at 34-02 Queens Blvd., in NYC.

5) The CONTRACTOR shall work closely with the CITY's consultants (developers of the central system) to ensure compatibility between the ASTC and the central system and the communications media and schemas. It is required that the ASTC provide reliable, compatible operation with the existing system where the communications media and techniques are the same. It is likely that some iteration of the design process will be required to validate this operation. The CITY will make communications facilities available at the TMC for the CONTRACTOR to test and validate the design and operation of the controller. The consultant will be available to assist the CONTRACTOR by answering questions and establishing test controllers within the traffic control system database for such testing. However, the CONTRACTOR is solely responsible for developing a compatible design and any reverse engineering necessary to ensure compatible operation. The CONTRACTOR is cautioned that the existing documentation may be incomplete and that detailed engineering analysis and reverse engineering may be required to ensure compatible operation. The CITY's consultant will make an effort to assist by providing information where possible.

6) The CONTRACTOR shall fully document all protocols and signals levels (including timing) used between and among the various elements of the ASTC. This shall include but not be limited to all protocols on the EIA/TIA-485 bus, the laptop to controller interface, all conflict monitor interfaces, BIU interfaces, and the system communications interface and UPS. All protocols including but not limited to laptop protocols, cabinet protocols (485 bus), and system communications protocols shall not be proprietary. There shall be no restrictions on the CITY's use of these protocols or their distribution; Non Disclosure agreements shall not be necessary for the distribution of any protocol and performance information. Note that even though these protocols may be specified in other documentation (e.g. NEMA TS2-2003), it is the CONTRACTOR's responsibility to collect this information into a single document and to provide a concise listing of all protocols including sequences (dialogues) and timing. Simply stating that "these are shown in another document" is not acceptable.

7) For the front panel user interface, the CONTRACTOR shall prepare prototype screens for all interactions with the unit, which will be evaluated by the CITY. The user interface shall be efficient and allow the operator to quickly access most operating parameters and device status. The user interface shall be intuitive (for experienced traffic technicians) such that minimal training is required. The CONTRACTOR shall expect minor revisions to the layout and interaction with the screens to suit the needs of the field maintenance personnel at no additional cost. Note that redesign is not anticipated or desired; the CITY would prefer a display and interaction which closely matches the existing units.

8) For the laptop user interface (GUI) for the ASTC controller, the GUI shall include a context sensitive help facility, which will quickly allow an operator to identify how to perform all actions. All GUI screens shall conform to Windows standards and conventions. 'Fly-over' help or 'tool tips' shall be used where possible.

9) The laptop GUI shall be an efficient interface for both the controller operations and parameter/device management. Techniques that continually require pull-down menus and screens that beget more screens to many levels, are not acceptable approaches to the ASTC GUI. The CONTRACTOR shall include context sensitive menus activated with the

right mouse button to facilitate rapid actions. In general, a “double click” on the parameter or device icon should take the user directly to the screen that is likely to be used 80% of the time (the 80/20 rule). The CONTRACTOR shall work with the CITY very early in the project to develop an efficient user interface at no additional cost. Wherever possible, the CONTRACTOR is encouraged to submit this type of information with the bid documents to assist the CITY in understanding the CONTRACTOR’S approach to the system.

10) It is important that the performance of any prototypes or demonstrations of the design match the expected performance of the final product as closely as possible. Experience has shown that demonstrations can appear very fast and easy to use, but the final product may be much slower in performance thus rendering it unacceptable – even though the initial concepts were approved. The performance of the final product shall be equal to or faster than any prototype or demonstration submitted.

11) For all reports (printed from the laptop interface), the CONTRACTOR shall submit sample report formats to the ENGINEER for approval. It is expected that the report generator shall allow easy modifications to the format and elements included in the report. The CONTRACTOR shall plan for such minor modifications to the reports and shall adjust them to meet the specific requirements of the CITY at no additional cost.

12) The work described above is incidental and no separate payment will be made; these costs shall be included in the CONTRACTOR'S price for the various bid items.

9 Acceptance Testing Program

9.1 Waiver of required testing

1) This section sets forth the requirements for a rigorous testing program to verify that the design meets the requirements identified herein for NYCDOT. If the CONTRACTOR has previously completed the Design Approval Test for the equipment they propose to supply, then only the factory acceptance testing (FAT) and 60 day site acceptance test may be required and the prototype and design approval tests may be waived.
2) To meet this requirement, the units tested must be electrically identical and mechanically similar enough such that the results of the previous vibration and shock testing would not be compromised by the changes. However, any significant electrical/electronic design changes will necessitate the completion of the testing program outlined herein.
3) The previous testing must have been equivalent to that outlined herein and the CONTRACTOR must provide written test records showing the successful results on a minimum of 5 simultaneously tested units and that the results were reviewed and witnessed by a representative of NYCDOT.
4) The judgment of the ENGINEER shall be final in all cases; if the CONTRACTOR wishes to determine whether their design meets the criteria noted above, they must submit their request in writing at least 20 business days prior to the bid letting along with all records of the previous testing and their proposed changes.
5) In all cases, unless the software has been previously tested and certified operational by NYCDOT, it shall be the responsibility of the CONTRACTOR to conduct detailed

functional testing of the equipment to demonstrate that it is both interchangeable with the existing units, and that all functionality has been provided and functions correctly.

6) The CONTRACTOR shall have the flexibility to combine the prototype testing and the Design Approval Testing into a single test. Under such circumstances, the DAT provisions shall be followed. This allows the CONTRACTOR to shorten the testing program where their design is equivalent to previous designs or where the CONTRACTOR has the confidence to proceed with the DAT without the benefit of prototype testing.

7) It is important to note, that previous versions of the ASTC were required to support the "vintage" VTCS DC interconnect operation and the Manhattan Coaxial cable interconnect system; those systems have been decommissioned and the ASTC does not need to support those capabilities and will not be tested for those features. The current system is being deployed on an IP network using fiber, 4G/LTE modems, and/or the City's wireless network (NYCWiN). Exception based reporting (EBR) is critical to the operation of the system, although the central system also supports polling the ASTC. The CONTRACTOR is alerted that supporting the EBR paradigm is complex and can be difficult to test. NYCDOT will configure test controllers and make available wireless routers (NYCWiN) for connection and testing on the system if requested by the CONTRACTOR. Such testing must take place in NYC unless the CONTRACTOR can provide a secure IP connection to their facility in which case the CITY may be able to setup and configure remote support for a limited number of controllers. However, this is not guaranteed and may not be representative of the expected system operation.

9.2 General

8) The acceptance-testing program will be thorough and rigorous for this project. The prototype and design approval tests developed by the CONTRACTOR must:

   "Demonstrate that the ASTC and all components supplied under this contract, fully comply with <u>all</u> of the requirements set forth herein including the requirements of the other referenced specifications and standards (e.g. NEMA, NYSDOT, NTCIP)."

9) For all acceptance testing, the term ASTC shall also apply to the ASTC-6, ASTC-8, and ASTC-12. If the procurement under this contract includes multiple types (6, 8, 12), then a mixture of each shall be subjected to the prototype and design approval testing (DAT). Note that it is not the intent of this requirement that acceptance testing be conducted separately for each type, rather that all types are included in the testing. All types shall be fully inspected for conformance to all mechanical, electrical and design requirements.

10) All testing (except *Site Acceptance Test*) shall be performed on/in cabinets which are fully loaded and configured with a full complement of load switches, flash transfer relays, BIU(s), conflict monitor, and communications modules. Input slots shall be fully configured with detector input cards and the test configuration shall include test inputs for both 4 channel and two channel detectors to the maximum number supported. The signal head loads shall duplicate the worst case signal configuration expected for a NYC installation. The signal loads shall include a mixture of LED and incandescent signal loads including mixed loads and loads of each type (e.g. some with LED only – minimum number of heads, and some

with incandescent only and some with both). All outputs shall be continuously monitored for incorrect *behavior*. The test configurations shall be subject to approval by the CITY.

11) The ASTC and cabinet shall be subjected to rigorous testing in three phases: 1) prototype phase; 2) design approval phase; 3) production phase. These tests are identified as the *Prototype Tests,* the *Design Approval Test,* and the *Factory Acceptance Test*. Upon installation, the controller shall be subjected to a *Site Acceptance Test* and 60-day burn-in before acceptance of the unit. This section describes the minimum requirements for these tests.

12) The test procedures shall be structured such that each of the prototype tests, design approval tests, and factory acceptance tests (for a specific lot) can be completed within 4 consecutive 24-hour periods, in a continuous fashion, between Monday 8:00 AM and Friday 4:00 PM of the same week. The CITY shall observe the tests between 8 AM and 6 PM on each day. Any test that is interrupted due to equipment failure, which necessitates any redesign or replacement of components, shall be restarted at a point chosen by the CITY. The CITY's sole judgment shall determine whether the testing is restarted from the beginning or another point in the test procedure.

13) The CITY requires that testing be scheduled such that all parties can return to New York City before midnight on Friday of any week during which testing is performed. Testing may start as early as 8 AM on Monday morning of the week that testing is to be performed. Note that certain tests (e.g. battery clock accuracy) may require longer periods; such tests shall be started upon completion of the Prototype/Design testing described herein and the results shall be recorded and may be inspected by a representative of the CITY.

6) During all phases of the testing, the equipment and test environment shall be continuously monitored by non-volatile means to verify continued proper operation of the system(s) under test and the operation of the test equipment (e.g. temperature chambers). Periodic printouts, paper recording graphs, etc. shall be used to demonstrate the continued operation of the system.

7) The CONTRACTOR shall be responsible for developing the detailed test procedures, all data takes, and the preparation of a test report after each test. All test procedures shall be submitted to the CITY for approval. Note that test procedures shall be step-by-step and shall be thorough including all necessary inspections and design verifications, as well as operational verification. The test procedure shall show the specific section of the specifications being verified by each test.

8) All test procedures shall be delivered to the CITY at least 60 days prior to the scheduled test. The CITY shall conduct a review and respond to the proposed test program within 30 days. If the proposed procedure is *rejected*, the CONTRACTOR shall make the necessary additions and corrections and re-submit allowing a full 30 days for review and approval. If the submittal is returned *'approved with changes'*, the CONTRACTOR shall incorporate the changes *exactly as noted* and may proceed to schedule the test. If the CONTRACTOR disagrees with the noted changes or requests further changes, a review meeting shall be scheduled with the CITY (to be conducted at the CITY offices). At the conclusion of the meeting, the CITY will issue a final ruling. If the submittal is approved, the CONTRACTOR may proceed to schedule the test.

9) The CONTRACTOR shall not schedule any tests (i.e. set or request test dates) until the CITY has approved the test procedures.

10) The ENGINEER shall be notified a minimum of fifteen (15) calendar days in advance of the time a complete test program is to be conducted. The CITY may request that the test date be delayed by up to 14 calendar days due to personnel availability, holidays, etc. Delays up to 14 days shall not be cause for any project delays or claims against the CITY or its agents

for any costs incurred as the result of such delays. Testing shall not be scheduled during weekends or government (NYC) holidays.

11) Only calibrated instrumentation shall be used for all measurements to verify conformance to these specifications. Prior to the start of any testing, the CONTRACTOR shall produce certificates to confirm proper calibration for all instruments. Calibration certificates shall not be more than 12 months old.

12) All test procedures shall be submitted in electronic form for review. The CONTRACTOR shall incorporate changes into the document using the 'change tracking feature' in Microsoft Word. All documents submitted in electronic form shall be in Microsoft WORD format unless the CITY approves a different format.

13) The test procedure submittal shall include detailed wiring diagrams and configuration diagrams for the test environment clearly indicating how the test will be performed and how the equipment under test will be connected.

14) The CONTRACTOR is responsible for all costs associated with the testing (and any re-testing) described herein including but not limited to test and measurement equipment, simulation environments, temperature chambers, recording devices, shipping costs, equipment rentals, consumable supplies, test facilities, communications links, documentation, report generation, and the conduct of the tests. The CONTRACTOR may arrange for the testing to take place at a CONTRACTOR owned facility or independent laboratory, however, in all cases, the CONTRACTOR's engineer shall be present during all testing.

15) Failure of any test due to component failure or design defects shall not be cause for any project delays or claims against the CITY or its agents for any costs incurred as the result of such delays.

16) Time keeping is an important aspect of the ASTC controller unit design. The CONTRACTOR shall demonstrate during the testing that the clock accuracy is maintained during powered operation in the presence of power interruptions and transients. (note that non-powered accuracy shall be +-.005% @ 20°C and as required herein at other temperatures).

17) Prior to the start of any test, the CONTRACTOR shall demonstrate the test environment and demonstrate the ability to detect and log failures. This shall be accomplished by forcing failures and anomalies and showing that the instrumentation detects the problem and records the error/failure.

18) The tests performed shall include verification of the interchangeability with the existing equipment as specified herein. The CITY will provide sample units to the CONTRACTOR to be included in the testing for both prototype and design approval testing.

19) The test environment shall be robust and shall include fully loaded communications with a simulated or actual central system to show that the ASTC can handle the worst case communications loading and throughput. This shall include simultaneous communications on all serial ports and the Ethernet ports and support for an auxiliary cabinet with additional BIU's for detectors and the NEMA control signals.

20) The controller test procedures shall include stress testing on the Ethernet port with maximum throughput (to the limit of the port speeds) simultaneously on all serial ports. During such tests, the controller operation shall be monitored to ensure that the clock keeps proper time (tracks the power line) and that all intervals are properly timed. The controller test procedures shall include accurate clock tracking during both stress testing (above) and power transients and power interruption testing. This testing shall verify that the accuracy of the controller clock requirements is met during all such anomalies.

21) The CONTRACTOR is cautioned that the test procedure must be thorough and include a test case or step to inspect or verify all of the requirements and operation as specified herein and in the referenced specifications and standards. All controllers shall undergo the testing simultaneously and shall be subjected to the same conditions. Simulators shall be provided to accurately simulate the detector inputs for the purpose of verifying all detector measurements including but not limited to traps formed by loop pairs and system sensors. The means of recording the ASTC operation shall be such that no error goes undetected during the full test period.

9.3 Prototype Tests

1) Testing shall be successfully performed on a prototype unit at least sixty (60) days prior to the Design Approval Tests. A prototype unit shall be constructed prior to the fabrication of the production units and shall use similar construction practices and the same components as will be used in the production unit. The prototype test is intended to demonstrate that the proposed design fully complies with the requirements of these specifications and all other specifications and standards invoked (e.g. NEMA TS2-2003).

2) A minimum of one ASTC-6, one ASTC-8, and one ASTC-12 shall be subjected to the prototype testing.

3) The CONTRACTOR shall develop a detailed test procedure with data recording sheets to demonstrate and verify that the ASTC meets **all** of the requirements of this specification – including all referenced documents (e.g. NEMA and NYS 179/330 specification). The test procedure shall follow the NEMA TS2-2003 testing profile as augmented below.

4) All tests shall be conducted in accordance with a test procedure that has been submitted to and approved by the CITY.

5) The test procedure shall include an inspection and design review, which shall verify that, the design, materials, and construction practices conform to the specific requirements of the specifications. This inspection and design review shall include but not be limited to validation of device voltages, resistor ratings, device tolerances, thermal characteristics, mounting techniques and hardware, custom or special devices, serviceability, availability, etc.

6) At the CONTRACTOR'S option, the prototype unit need not be subjected to the vibration and shock tests. However, for the *Design Approval Test,* the units under test shall all be subjected to the shock and vibration testing before functional and environmental testing begins.

7) During all testing, from the start to the completion, the unit(s) under test shall be in continuous operation and shall be continuously monitored for proper operation. The only exception to this requirement is the 'cold soak' period. Temperature and humidity recording devices shall be used to track all environmental conditions. A printer (or other approved mechanism) shall be used to continuously log the status of the equipment and note any failures. During the testing, the simulators and test environment shall interrogate the controller unit at a minimum of once per second. Statistics shall be logged every 15 minutes, and all errors shall be immediately printed. Temperature sensors shall be mounted throughout the controller including the PDA, the controller (internal), and the cabinet to measure temperature rise.

8) Preceding all tests, the CONTRACTOR shall demonstrate that the test environment and monitoring equipment properly detect all anomalies and failures by simulating failures and noting the results.

9) During the testing, the CONTRACTOR shall demonstrate that the ASTC properly performs all of its functions.

10) All costs incurred for the prototype testing shall be included in the various items bid. There will be no separate payment for the prototype testing.

11) As part of the test procedure, the CONTRACTOR shall develop an 'OPERATIONAL TEST' procedure that is a sequence of operations, operator commands, laptop actions, etc. that demonstrate and verify the ASTC functional operation including communications responses, failure management is in accordance with these specifications.

9.3.1 Environmental Conditions

1) The OPERATIONAL TEST shall be successfully performed for the field ASTC under the conditions noted in the NEMA TS2-2003 as modified and augmented below:

2) The ASTC shall be tested for conformance with the requirements of Section 2.6 of this specification at room temperature, the high temperature specified and the low temperature specified.

3) Moisture shall be caused to condense on the EQUIPMENT by allowing it to warm up to room temperature in an atmosphere having relative humidity of at least 40%. The EQUIPMENT shall be satisfactorily operated for two hours under this condition. Operation shall be successfully demonstrated at the nominal voltage of 115 volts and at the voltage extremes noted in Section 2.6

4) All testing shall be performed on the complete ASTC assembly including cabinet, and all plug-ins. The CONTRACTOR shall develop monitored dummy loads to simulate all signal heads and shall develop simulation tests for all controller inputs. System inputs (Ethernet) shall be via a directly connected Ethernet switch and will not include the NYCWiN Class 4 router.

5) The CONTRACTOR shall verify that the ASTC, as a complete unit (cabinet and plug-ins), meets all of the requirements stated herein under all environmental conditions (including temperature, humidity, line voltages, power interruptions, transients, etc.).

6) The CONTRACTOR shall demonstrate that the plug-in components including but not limited to BIU(s), PDA, Detector modules, Load switches, Flash transfer relays, Flasher, 2010 Model CMU, and the controller unit meet the requirements stated herein under all environmental conditions (including temperature, humidity, line voltages, power interruptions, transients, etc.).

7) At the conclusion of the testing, the CONTRACTOR shall furnish data forms containing all of the data taken as well as quantitative results for all tests. Only originals of the printouts, charts and graphs and data recording forms shall be provided. The forms shall be signed by an authorized representative of the testing organization as well as an officer for the CONTRACTOR, certifying that the tests were performed in accordance with the approved procedure and the results were as described on the form. The CONTRACTOR shall submit three copies of the completed test results to the CITY for each test conducted.

8) A test of the standby clock accuracy and the 7 day backup of memory shall be included in the testing. The CONTRACTOR shall start this testing during the final day of testing and shall provide the test results to the CITY upon completion 7 days later. This test shall be performed for all types (ASTC-6, ASTC-8, and the ASTC-12). Upon power up, the time displayed in the default screen shall be compared with a WWV clock used prior to the start of the test and the difference in time shall be noted. Further, the memory of the controller shall be verified to ensure no loss of parameters or timing information or event logs.

9) At the discretion of the CITY, the CITY and/or additional support personnel and consultants shall be present for all testing.

10) CONTRACTOR personnel shall be present during all testing.

11) The testing shall include a mechanism to show that the controller clock and timing of intervals do not shift or drift during the power transients and power interruptions. Measurement of the timing accuracy for the clock drift shall be to 1/60th of a second. A certified line frequency reference shall be used for these measurements.

9.3.2 System Integration Testing

1) At the conclusion of the prototype testing, the CONTRACTOR shall deliver and install the prototype ASTC to the TMC at 28-11 Queens Plaza north for integrated system testing using VTCS and other central hardware provided by the CITY.

2) The CITY shall integrate the controller into the traffic control system for testing.

3) The CONTRACTOR shall allow 45 days for integrated system testing. During that time, the CONTRACTOR shall provide the services of a qualified engineer for up to 80 hours in two trips, to assist the CITY in integrating the ASTC into the on-line system. The CONTRACTOR shall be responsible for all costs associated with this assistance. These costs shall be included in the reference items bid as no separate payment will be made for these services. Should the time required to complete the integrated testing extend beyond the 60 days and this extension is in any way related to design (including software) or component problems with the ASTC, the CONTRACTOR shall provide the full-time on-site assistance of a qualified engineer at the direction of the CITY until the completion of the integration testing. Such extended presence shall be at the sole expense of the CONTRACTOR.

4) The CONTRACTOR shall be responsible for ensuring that the prototype controller remains in proper working order during the integration testing. Should the ASTC experience a hardware or software failure, the CONTRACTOR shall correct the problem within 24 hours or the testing time will be extended without any allowance for contract extensions.

5) During the integration testing, the CONTRACTOR shall expect that minor changes might be required to the ASTC firmware or communications support to accommodate integration with the VTCS system. Such changes will be considered incidental and included in the price bid for the controllers. All such changes shall be managed and logged in the configuration management system.

9.4 Design Approval Test

1) Design approval tests shall be conducted by the CONTRACTOR on samples of the first production units to determine if the design and operation of the ASTC meets all of the requirements of the specifications.

2) The ASTC shall be complete with all necessary software when the Design Approval Testing (DAT) is conducted. Software that is incomplete or lacking functional capabilities required in the contract specifications may cause the DAT to fail at the discretion of the CITY. Where certain functionality cannot be demonstrated unless the ASTC is connected to the system, the full functional testing may be delayed until integration with the central traffic control system. However, simulators must be used to stress test the ASTC during all DAT testing to verify proper operation under a combination of environmental conditions (including power line transients, etc.).

3) In addition, if there are reliability problems with the ASTC during the installation and warranty period, the CITY shall have the right to direct the CONTRACTOR to perform a repeat of the Design Approval Test on units randomly selected by the CITY. For the purpose of defining "reliability problems" it shall mean a failure rate in excess of 5% of the units installed during any 60 day period. The term "failure" shall include but not be limited to the inability of the controller to maintain continuous operation under VTCS control, inability to run normal coordinated and pre-timed three-color operation (as defined by NEMA TS2-2003), the inability to properly execute the local time of day schedule, NTCIP communications failure during which the controller fails to respond or accept properly formatted data, and the inability to properly keep time as specified herein.

4) A minimum of 5 units shall be included in the Design Approval Testing. If the procurement is for a mixture of ASTC-6, ASTC-8, and ASTC-12 units, then a minimum of two (2) ASTC-6 and one (1) ASTC-8, and three (2) ASTC-12 units shall be tested; in addition, an auxiliary cabinet shall be included and connected to one of the ASTC-12 units.

5) The test environment shall be sufficient to allow **all 5 units to be tested simultaneously**. The test environment shall adequately represent the expected street environment including signal loading, detector inputs, communications, and cabinet wiring.

6) The DAT procedure shall include full testing for the flash programming jumpers, the flash and CMU configuration jumpers, and the auxiliary cabinet support as described for the ASTC.

7) The test procedures shall be developed by the CONTRACTOR and shall be submitted to the ENGINEER for approval at least 60 days prior to the start of testing and shall have the approval of the ENGINEER prior to the start of the tests. Procedures shall include copies of all data recording forms. The CONTRACTOR shall furnish data forms containing all of the data taken as well as quantitative results for all tests. The test procedure shall be thorough and shall include tests and/or inspections for all requirements set forth herein or in the standards invoked.

8) The tests shall be conducted in accordance with the approved procedure.

9) Prior to the start of the DAT on 5 controllers; the complete controller, cabinet and peripherals shall be connected to switched source of AC power to perform an extended power failure and recovery test. For this test, the controllers (minimum of 5) shall be connected to a power source through an electromechanical relay. The relay shall be connected to a timer circuit that shall apply power (nominally 110 VAC) for 120 seconds, and then remove power for 2 minutes. This shall cycle continuously for not less than 8 hours; if at any time during this test, any cabinet does not start normal 3-color operation, the test shall be determined to have failed. The CONTRACTOR shall construct monitoring

circuits that shall verify that the controller started normal 3-color operation and that the controller did not enter the flash condition for each transition.

10) The CONTRACTOR is required to develop test procedures that verify that the controller meets the requirements of Section 4.1 paragraphs (11) and (12) and as described for timing accuracy herein.

11) The design approval tests shall consist of all of the tests previously specified in the *prototype test*, as well as shock and vibration test. Testing procedures shall follow the NEMA TS2-2003 testing procedure for vibration and shock. The complete cabinet assembly with all plug-ins shall be subjected to the testing. Shock and vibration testing shall take place before operational and environmental testing. Shelf mounted components shall be subjected to the shock and vibration testing separately prior to the balance of the testing.

12) The ASTC supplied under the terms of this specification shall show no degradation of mechanical structure, soldered components, and plug in components. Further, the unit shall perform all functions without failure after being subjected to the shock and vibration tests.

13) After the completion of these tests the ASTC shall be examined carefully to verify that the ASTC functions properly, that components have not weakened or become loose, nor has any structure warped, bent, or deformed to the degree that the test unit operates improperly, the unit's life has been affected, serviceability/interchangeability has been impacted, or maintenance is required. Any resulting changes in equipment will be scrutinized as far as long term performance may be affected.

14) The wiring shall be checked to determine if continuity is maintained from the terminating end of the harnesses associated with the ASTC under test. The connectors and wiring harnesses that are external to the ASTC under test may be vibration tested separately but must be tested as a unit during the operational and continuity tests. All data and test results shall be recorded on the approved form, for each of the units under test.

15) After the completion of the shock and vibration tests, the ASTC shall be subjected to the full prototype test as described in Section 9.3 above. All of the provisions of Section 2.6 in this document shall also apply to the *Design Approval Test*.

16) All other requirements, which are specified for the prototype tests, shall also apply to the *Design Approval Test*.

9.5 Factory Acceptance Tests

1) The CONTRACTOR shall be responsible for the implementation of factory acceptance tests at the manufacturer's facility. The CITY shall be notified a minimum of fifteen (15) calendar days before the start of any tests.

2) All tests shall be conducted by the CONTRACTOR in accordance with the approved test procedure submitted by the CONTRACTOR for review and approval by the ENGINEER.

3) The purpose of these tests is to ensure that the EQUIPMENT that will be installed has passed all of the other non field related tests and that modifications, additions, and enhancements to the EQUIPMENT have been made that were identified in the previous tests and that the EQUIPMENT performs to specifications.

4) All controllers, assemblies and subassemblies shall undergo a factory acceptance test prior to shipment to NYC.

5) Factory acceptance tests shall consist of a series of individual tests. These individual tests shall consist of:

   - Examination of Product
   - Continuity Test
   - Monitored Burn-in
   - Operational Test

6) Factory demonstration tests are intended to ensure consistent production with regard to the standard established by the Design Approval Test.

9.5.1 Examination of Product

1) The examination of product consists of the careful viewing of the EQUIPMENT on an individual basis to verify that the materials, design, construction, markings, dimensions, tolerances, conformal coating, and workmanship conform to the requirements of these specifications. All units must be examined at the factory.

9.5.2 Continuity Test

1) The continuity test consists of a check of the wiring and harnesses for electrical continuity to verify that the proper connections have been made and that all circuits are fully operational. All units must be continuity tested at the factory.

9.5.3 Monitored Burn-in Test

1) The controller unit and all plug in devices shall be subjected to a monitored burn-in test during which the units shall operate continuously for 48 hours while being temperature cycled from room temperature to 0F then to 145F then to room temperature at a rate not greater than 10F per hour. During this temperature cycle, the ASTC shall be continuously monitored for proper operation. The time spent at each temperature extreme shall be at least 8 hours. During this operation, the line voltage shall be operated at 95 VAC at all temperature extremes for at least 4 hours and at 130 VAC.

2) The communications configuration for the monitored test shall be as specified for the controller type being purchased.

3) The monitored burn-in testing does not require that the cabinet be connected to dummy loads, only that the loads are sufficient for proper operation of the load switches and conflict monitors. This testing may be performed at the subassembly level with the approval of the CITY. However, at least 24 hours shall be spent in the final cabinet assembly with the cabinet door closed prior to shipment.

4) All Ethernet ports shall be connected to an Ethernet communications device during the monitored burn-in. The monitoring systems shall note the time the controller begins communicating and shall maintain communications statistics for the communications with the controller. It shall continuously poll the controller at a rate of not less than once per second for its status and shall record the number of successful polls and any anomalies. A print-out of the log for each controller shall be provided with the shipping and QC documentation with the device. All three Ethernet connections shall be monitored for proper operation during all factory testing.

5) The failure of the device to provide continuous three-color operation (e.g. the cabinet goes to flash), the failure to properly keep time, or the failure to communicate shall constitute a

failure of the device and it shall be repaired and it shall restart the burn-in from the beginning.

6) Note that the record of all failures and testing shall be kept with each device from its initial testing through final shipment. Thus, it shall be possible to review the testing log provided with each subassembly and determine its complete testing and repair history since its initial turn-on and testing.

7) Each cabinet shall be inspected prior to final shipment and the serial numbers of the equipment and burn-in and test records shall be inspected. A single person (for each shift) shall be responsible for the final QA inspection and his/her name shall be included in the packet of information transmitted with the controller cabinet.

8) There shall be a complete final inspection and testing sheet for each completed cabinet that shall note the individual tests and inspections that have been performed including but not limited to mechanical fit, door switches, vent fan and thermostats, filter, door latch and lock assembly, labels, cables, hardware, fit for all devices, serial numbers, etc.

9.5.4 Operational Test

1) The operational test consists of the operation of the ASTC (or subassembly if they are tested separately) for a long enough period to permit EQUIPMENT temperature stabilization, and to check and record all performance characteristics to assure compliance with the requirements of this specification. All units must be tested at the factory.

2) The Operational test may be a subset of the OPERATIONAL TEST procedure used for the Prototype and Design Approval tests with the mutual concurrence of the CONTRACTOR and the CITY.

3) Operational testing shall be performed under full loading conditions including signal loads, input file cards, and signal switching to exercise all functions. This shall include verification of all conflict monitor wiring and all cabinet input/output wiring.

4) Operational testing shall include driving all communications ports including serial ports on the controller and Ethernet ports at their maximum configurable speed in a fully loaded and continuous manner. Data shall be streamed and monitored on all serial ports, and the Ethernet ports shall be flooded to ensure that they experience maximum loading at all times.

9.5.5 Records

1) The results of these four tests are to be recorded on forms prepared by the CONTRACTOR and approved by the CITY for this purpose.

2) A separate form shall be completed for each unit tested recording the make, model number, and serial number for the unit and all internal assemblies as well as the pass-fail status and comments for each test. The completed form shall be signed by an authorized representative of the CONTRACTOR and the manufacturer certifying the conduct of the tests and the results. At least one copy of each completed form shall be provided to the CITY by the CONTRACTOR with each piece of equipment delivered.

3) All units and subassemblies shall be “tracked” following initial construction such that the history of testing, operation, and repair can be inspected. All defects found during the manufacturing process shall be noted in the log for each serial numbered unit. These records shall be included in the maintenance database described elsewhere in this specification.

9.6 Consequences of Test Failure

1) Whenever any of the tests fail, the CONTRACTOR shall determine the cause of the failure and shall make a complete report to the CITY indicating the cause of the failure as well as any design, manufacturing, and corrective changes (if any) instituted to rectify the problem.

2) If, after three attempts, the CONTRACTOR has not successfully completed the prototype test for any of the cabinet types, the CONTRACTOR shall be considered in default and the CITY shall have the right to cancel the contract with no payments to the CONTRACTOR. The CITY shall have the right to award the contract to another bidder in accordance with the CITY procurement regulations and the terms and conditions of this bid. By submitting a bid for this project, the CONTRACTOR agrees to and understands this provision.

3) If, after three attempts, the CONTRACTOR has not successfully completed the Design Approval Test for any of the cabinet types, the CONTRACTOR shall be considered in default and the CITY shall have the right to cancel the contract with no further payment to the CONTRACTOR. Any payments to the CONTRACTOR shall be returned to the CITY and the CONTRACTOR shall remove all equipment from the CITY at the CONTRACTOR's expense. The CITY shall have the right to award the contract to another bidder in accordance with the CITY procurement regulations and the terms and conditions of this bid. By submitting a bid for this project, the CONTRACTOR agrees to and understands this provision.

4) The CITY's failure to enforce paragraphs 2) above and 3) above at the time of the test failure shall not reduce the CITY's right to enforce these provisions at any time after the failure.

5) The sections below list the steps to be taken in the event of a failure for each phase of the testing program.

9.6.1 Prototype test

1) If the unit under test fails the prototype test, the fault shall be corrected and the entire prototype test shall be repeated. If the test cannot be completed within the 4 days originally allocated for testing, the testing shall be terminated and a new test date shall be scheduled with the CITY.

2) As noted above, the CITY may request that the new test date be delayed due to personnel availability, holidays, etc. Delays up to 14 days shall not be considered a cause for any project delays or claims against the CITY or its agents for any costs incurred as the result of such delays.

9.6.2 Design Approval Test

1) Design approval tests shall be performed on randomly select units from an initial (pilot) manufacturing run. If the unit fails the design approval test, the design fault shall be corrected and the entire design approval test shall be repeated. All delivered or installed units shall have the corrections incorporated into them without additional cost to the CITY. If the test cannot be completed within the 4 days originally allocated for testing, the testing shall be terminated and a new test date shall be scheduled with the CITY.

2) As noted above, the CITY may request that the new test date be delayed due to personnel availability, holidays, etc. Delays up to 14 days shall not be considered a cause for any

project delays or claims against the CITY or its agents for any costs incurred as the result of such delays.

9.6.3 Factory Demonstration Test

1) If EQUIPMENT fails the factory demonstration test, the unit shall be corrected or another unit substituted in its place and the test repeated in its entirety.

2) If a unit has been modified or repaired more than twice the unit shall not be accepted without the submission of a report detailing the failure and repair of the unit to the CITY. If in the opinion of the CITY the unit is not suitable, it shall be replaced by a unit free of repair and that has successfully passed the factory demonstration test.

9.7 Delivery

1) The CONTRACTOR is required to notify the CITY when they intend to ship any goods to the CITY facilities (or a designated maintenance or installation contractor) and request permission to ship along with a specific shipping address. The CITY will respond with authorization to ship and a specific address for each shipment. The authorization to ship must accompany each invoice.

2) Each basic ASTC-6 delivered to NYC DOT shall be furnished complete with 1 controller cabinet housing and associated output assembly and input assembly (complete with all jumpers, filters, 1 CMU serial cable, 1 UPS serial cable, 1 cable assembly for the TS2 485 bus, flash programming connectors, terminal blocks, and cables etc.), 1 cabinet address card, 485 termination card and resistors, conflict monitor module (with programming card), 1 power supply (PDA), 1 controller unit, 1 flasher module, 2 flash transfer relays, 6 load switches, 1 BIU, 1 cabinet key, and 1 set of cabinet drawings,. The input devices and communications adapters shall be supplied as listed in Table 26 for each model in Section 16.

3) Each ASTC-8 delivered to NYC DOT shall be furnished complete with 1 controller cabinet housing and associated output assembly and input assembly (complete with all jumpers, filters, , 1 CMU serial cable, 1 UPS serial cable, 1 cable assembly for the TS2 485 bus, flash programming connectors, terminal blocks, and cables etc.), 1 conflict monitor module (with programming card), 1 address card, 1 controller unit, 485 termination card and resistors, 1 power supply (PDA), 1 flasher module, 3 flash transfer relays, 8 load switches, 2 BIUs, 1 cabinet key, and 1 set of cabinet drawings. The input devices and communications adapters shall be supplied as listed Table 26 for each model in Section 16

4) Each ASTC-12 delivered to NYC DOT shall be furnished complete with 1 controller cabinet housing and associated output assembly and input assembly (complete with all jumpers, filters, 1 CMU serial cable, 1 UPS serial cable, 1 cable assembly for the TS2 485 bus, flash programming connectors, CMU configuration jumpers, terminal blocks, and cables etc.), 1 conflict monitor module (with programming card), 1 address card, 1 controller unit, 485 termination card and resistors, 1 power supply (PDA), 1 flasher module, 6 flash transfer relays, 12 load switches, 2 BIUs, 1 cabinet key, and 1 set of cabinet drawings. The input devices and communications adapters shall be supplied as listed Table 26 for each model in Section 16

5) The complete ASTC cabinet (per above) shall be delivered mounted on a compact shipping pallet that will allow it to be easily moved with a conventional pallet-jack. The pallet shall be banded to the cabinet base in a manner that does not deform or damage the paint or

surfaces of the cabinet. The cabinet shall be enclosed in a protective slipcover (cardboard packing) shell.

6) All plug-in assemblies shall be properly packaged or separately packed to ensure no damage from shipping. If the internal assemblies are separately packed, all assemblies for a given cabinet type shall be packed in a single shipping carton.

7) Products furnished to these specifications shall be the same as and equal to the samples tested and shall be exact duplicates of the particular samples accepted by NYC DOT during the Design Approval Tests. This shall not exclude the use of equivalent discrete components. However, if there are any changes to the design of the unit, such changes shall be brought to the attention of the CITY. The CITY may request a repeat of the DAT if the CITY determines that such changes compromise the validity of the previous testing. The judgment of the CITY shall be final in all cases.

8) The CITY may, at its option, open and inspect a sample from each lot delivered. If more than three controllers randomly selected exhibit a quality control problem including but not limited to improper packing, failure to mechanically secure components, improper records, operational failure, defective assemblies, and missing components, the CITY shall have the right to refuse to accept the equipment and direct the contractor to perform a 100% inspection of all of the equipment before it will be considered received.

9.8 Shipping addresses

1) Equipment is to be shipped only to the following addresses unless otherwise directed in writing by NYCDOT. Any equipment which is incorrectly shipped to other addresses (e.g. equipment or repaired items that are shipped to the invoicing address) shall be considered **lost** and shall be replaced by the CONTRACTOR at the CONTRACTOR's expense regardless of who signs for the receipt of such goods. If repaired items are incorrectly shipped to the invoicing address, they shall be replaced by new items of the same type.

2) **All spare parts and system support equipment** shall be shipped to the CITY's maintenance shop at:
   DOT/Signal Shop, 1st Floor, 58-50 57 Rd, Maspeth, NY 11378
   Attention: Dennis Ferrara – 718-894-5291 (hours 7:30 AM -3:00 PM)

3) **Sample (prototype) controllers** shall be shipped to the CITY's maintenance shop at:
   DOT/Signal Lab Room 122 , 34-02 Queens Blvd, Long Island City, NY 11101
   Attention: John Ornas – 718-786-3223 (hours 6:30 AM -3:00 PM)

4) **Production controllers** shall be shipped as directed by the CITY prior to scheduled delivery. Prior to each scheduled shipment, the CONTRACTOR shall first request permission to ship the controllers, and shall then receive written confirmation from the CITY with a specific delivery address. Note that multiple locations may be specified for the delivery of the production equipment based on the installation and maintenance contracts executed by the CITY.

5) Shipping errors are the responsibility of the CONTRACTOR and it shall be the CONTRACTOR's responsibility to retrieve the equipment and transport it to the proper address. Invoices sent for equipment that is not delivered to the proper address will be

returned to the CONTRACTOR and will not be processed for payment until such time as the equipment is delivered to the proper address, inspected, and the invoice is re-issued.

6) Copies of all invoices shall be sent to Mr. Mohamad Talas at the address listed in Section 1.2.2. Copies of all invoices shall also be sent to Mr. John Ornas at the address shown in paragraph (2) above. Copies of all invoices shall include a copy of the authorization to ship with the noted shipping address.

7) Original invoices shall be sent as directed the executed purchase order or contract.

8) EQUIPMENT that arrives in damaged shipping containers or for which there is obvious damage caused by improper packing will be refused at the receiving dock and it shall be the responsibility of the CONTRACTOR to retrieve this equipment, to inspect the equipment for proper operation and to re-ship the equipment to the CITY. Under these circumstances, the CONTRACTOR shall not invoice the CITY until such time as the equipment is delivered in good working order.

9) Note that controllers must not be stacked in the shipping conveyance. They will be removed by the City or its agents using the pallet jacks; shipments which arrive stacked will be refused at the loading dock until they are properly loaded.

9.9 Site Acceptance Test

1) Note: it is likely that the installation contractor will be different from the CONTRACTOR selected by this bid. This section describes the process that will be used to install a new field controller. Regardless of the forces used to complete the installation, payment for the controllers depends upon the successful completion of the 60-day site acceptance test.

2) Each controller will be installed by an *installation contractor* or the CITY at a designated field location. At the time of installation, the *installation contractor* shall load the controller database, configure the cabinet address, and verify all load wiring, input devices, communications connections, and output devices.

3) The controller shall then be tested for proper operation using a test procedure developed by the CITY.

4) At the conclusion of the operational test, the controller shall be placed “on-line” with the central computer system and monitored for 60 days.

5) At the end of 60 consecutive days of failure free operation, the controller will be accepted

6) The CONTRACTOR, under this supply contract, shall be responsible for establishing a sufficient quantity of spare parts and a repair depot within the CITY where defective (or suspect) controllers, subassemblies, and plug-ins can be delivered for repair. New or repaired controllers, subassemblies, and plug-ins shall be available within 24 hours after receipt at the repair depot. The repair depot shall be available to accept units and provide units between the hours of 8:00 AM and 5:00 PM on business days.

7) The controller must operate for 60 consecutive days without a fault to complete the *Site Acceptance Test*. The warranty for the controller shall start after the completion of the *Site Acceptance Test* **providing all other provisions contained in these specifications have been completed**. For the purposes of this testing period, a fault is defined as any functional, software, or hardware failure which occurs under the conditions noted in these

specifications. Failure of the communications media are not included – unless they cause the controller to function improperly (i.e. the controller does not function properly during the outage and after the media problem is corrected – without operator intervention).

8) However, if there is evidence of a hardware defect, a software defect, or a bad batch of components, the time of the warranty shall be suspended, until the problem has been corrected and the controller successfully repeats the 60 day site test as described herein. Once the device has completed the post correction site test, the warrantee shall continue from the point the warrantee was stopped, however, the remaining warrantee shall not be less than 180 days or the remainder of the warranty, whichever is greater.

10 Documentation and Submittal Requirements

10.1 Submittals

1) The CONTRACTOR shall note that approval by the CITY is required for all aspects of the ASTC design. All provisions stated herein shall apply to the ASTC-6, ASTC-8, and ASTC-12 and the auxiliary cabinet.

2) The CONTRACTOR shall submit five printed copies of a complete ASTC design. The submittal shall show all relevant information regarding construction, materials, and equipment to enable the CITY to be able to procure exact replacements of any or all items on the project. To be acceptable, the submittal documents shall be complete and contain all items supplied on the project by the CONTRACTOR. The CITY reserves the right to reject an incomplete submittal without comment.

3) The submittals shall include a logical wiring diagram for the controller cabinet showing all of the signals from each of the following devices to their all of their usage points in the cabinet: BIU, CMU, PDA, Controller, detector modules. This shall be an easy to follow wiring diagram that allows the reviewer to trace the signal origin (e.g. BIU output) through to its usage point (e.g. Load switch); all intermediate cables and connections shall be clearly shown. Note that tables of connections are not considered acceptable as the only form of wiring diagram; the tables must be accompanied by representative wiring diagrams that show the interconnection of the devices in a logical manner.

4) Submittals shall be provided in hard copy and electronic form in Microsoft Word or Acrobat formats on CD-ROM or other suitable media. Documents and submittals may be delivered electronically to expedite the schedule on the project. However, the CONTRACTOR is notified that e-mail should be considered unreliable and that the actual delivery date of the hard copy shall be used to evaluate adherence to the project schedule. If Adobe Acrobat format is used, the text shall be searchable and not a scanned image of a document.

5) The submittals shall be identified by the Contract showing project number, bid item numbers, catalogue part numbers, catalogue cuts, shop drawings, trade names, and schedules or other pertinent information. The materials from any catalogue cuts shall be clearly identified by the CONTRACTOR. The CONTRACTOR shall submit manufacturer's shop drawings, including complete interconnection schematics, and parts lists for review and approval.

6) The CONTRACTOR shall clearly indicate all options and features to be provided on the equipment. Any feature or option that is not specifically noted as "Not supplied" (or crossed out by the CONTRACTOR) shall be assumed to be included in the final product and included in the testing program.

7) There shall be no substitutions for any of the materials on the list submitted without prior written approval by the CITY. Changes to approved materials list shall be submitted in writing to the CITY. If requested by the CITY, the CONTRACTOR shall submit samples of the proposed material for inspection and/or testing.

8) **Where the CONTRACTOR's submittal includes a deviation from the Specifications, such deviation(s) shall be clearly identified as exception(s) and the CONTRACTOR shall specifically request approval of each exception. The CONTRACTOR shall include a complete description of the deviation and the reason for the requested change and identify any secondary effects of the change. Approval of any submittal by the ENGINEER does not constitute approval of any exception(s) or deviation(s) to the Specifications unless specifically noted as described above. Failure on the part of the ENGINEER to discover areas of non-compliant construction, materials, or operation does not constitute approval of such non-compliance.**

9) The work described above is incidental and no separate payment will be made as the cost of same is to be included in the CONTRACTOR's price for the various bid items.

10) The CITY shall be allowed 30 days to conduct a review of any submittal. Partial submittals may be returned with informal comments; however, the CITY shall formally review only **complete** submittals. This is intended to provide the CITY with the complete 'picture' and thus avoid confusion over the implications of design choices, deviations, etc.

11) Timely completion of this project is important to the future of traffic management for New York City. It is assumed that the CONTRACTOR employs and has applied competent engineering staff to the completion of this project. It is further assumed that the CONTRACTOR has several years' experience in the development and production of traffic controllers. Delayed or rejected submittals shall not be a cause for project delays. Note that project submittals are a milestone on this project. Failure to complete the milestones within the time allotted may result in **default** and **contract termination** with monetary consequences to the CONTRACTOR as noted herein.

12) All submittals shall be logically complete. Incomplete and partial submittals may be returned to the CONTRACTOR without comment and review. All material necessary for a submittal review must be included in the submittal and each submittal must not assume any information not contained therein. Submittals shall explain and detail **HOW** the CONTRACTOR intends to satisfy the requirements of the specifications.

10.2 FTP Site

1) The CONTRACTOR shall establish and maintain an FTP site for the posting of all submittals and other project documents. The ftp site shall be password protected and each user shall have a separate login and password protection. Only the CITY shall have delete privileges. All persons may read or add directories or documents to the ftp site. The CONTRACTOR shall use this ftp site to post all submittals simultaneously with their distribution.

2) The ftp site is a convenience for the exchange of large documents and is not a substitute for the CONTRACTOR's responsibility for the delivery of electronic copies of documents.

10.3 Operations and Maintenance Manuals

1) Documentation sets as described herein shall be provided in the quantity identified in the bid documents. Each documentation set shall include schematics and maintenance manuals for the controller unit, conflict monitor, cabinet wiring, and auxiliary equipment (e.g. BIU, cards used in the input file).

2) Operation and maintenance manuals shall be supplied for all items required under this contract. Operation and maintenance manuals shall include the following as a minimum:

1	Table of Contents
2	Glossary
3	General Description
4	General Characteristics
5	Installation instructions
5.1	Description of all database parameters
5.2	Instructions for controller setup and programming
5.3	Instructions for use of the laptop interface
5.4	Instructions for use of the diagnostic display and controls
5.5	Instructions for database and program loading
6	Adjustments
7	Theory of Operation
7.1	Systems description
7.2	Detailed Circuit Description
8	Maintenance
8.1	Preventive Maintenance
8.2	Field Trouble Analysis
8.3	Bench Trouble Analysis
8.4	Trouble shooting Analysis Charts
8.5	Wave Forms where appropriate
8.6	Voltage Measurements
8.7	Voltage Measurement Chart
8.8	Calibration and alignment procedures
9	Parts List
10	Electrical Interconnection Drawing
11	Schematic and logic diagram
12	Assembly drawings and a pictorial diagram showing physical locations and identification of each component
13	Simplified cabinet wiring diagram showing all signals and all intermediate connections.
14	A cabinet configuration management drawing that can be used by the CITY to identify how each cabinet has been configured for each intersection.

3) The CONTRACTOR shall fully document all protocols and interface signals used between and among the various elements of the ASTC. Reference to other documents is not acceptable; the protocol information must be included in the documents provided above.

4) The documentation for the Controller shall include a complete explanation of all parameters, their effect, suggested uses, and a full explanation of the operation which can be expected. This manual shall be instructive in nature and explain how to use the all of the features of the traffic controller from a traffic engineering perspective as to how it will affect intersection operation.

5) Parts listings shall include the component manufacturer's part numbers and procurement instructions.

6) Where a custom part or component (electrical or mechanical) is included in the design, the CONTRACTOR shall provide complete fabrication details to allow the component to be constructed by other third parties. However, the CONTRACTOR does not need to supply printed circuit artwork for printed circuit cards contained within the devices.

7) The CONTRACTOR shall also provide a compilation of manufacturers data sheets for all components used within the complete ASTC cabinet, including but not limited to all plug-ins, load switches, detector modules, controller unit, BIU, CMU, PDA, etc. These data sheets shall be assembled into a single three ring binder. These shall also be converted to PDF format and made available electronically. Scanned copies shall be clearly legible and aligned properly. The data sheets shall include a table of contents and if provided in PDF format, the table of contents shall link to the appropriate data sheet.

8) All documentation shall be provided in both electronic and printed form. The electronic form shall be either Word format or PDF files on CD ROM. If supplied in PDF format, the text and figures shall be suitably indexed and electronically searchable. If manufacturer's datasheets are scanned to create PDF copies, such copies need not be electronically searchable.

9) All documentation shall be submitted to the ENGINEER for review and approval prior to final publication.

10) Documentation shall be provided in bound manuals which are 8.5x11 inches on standard 24 pound paper. All documents shall be legible and neat in appearance. Fonts less than 10 points shall not be used.

11) Drawings may be foldout, and shall be included in the bound manuals. Drawings shall be legible. Fold-out drawings shall not be larger than 11 inch by 17 inch.

12) Drawings shall be logically partitioned where necessary such that complete sections of the design are included on the same drawing.

13) The CITY shall have the right to make additional copies of the documentation for use by employees of the CITY.

14) A minimum of twenty-five (25) documentation sets shall be provided under this contract. At least 5 documentation sets shall be provided with the initial delivery of the prototype for system integration and testing. The balance of the documentation sets shall be delivered with the first delivery of the production controllers. Payment for controllers shall be contingent upon delivery of the documentation. Each documentation set shall be individually packaged.

10.4 Cabinet Wiring Diagrams

1) One (1) set of cabinet wiring diagrams and equipment layout shall be supplied with each cabinet at the time of cabinet delivery. The diagrams shall be non-proprietary and shall identify all circuits in such a manner as to be readily interpreted. These diagrams shall be placed within a plastic holder on the shelf or behind the door in the controller cabinet.

2) One reproducible black-line mylar (4 mil thick) 24 inch by 36 inch shall be provided to the CITY for each cabinet furnished for customization by the installation contractor. The cabinet

wiring diagram shall be provided in electronic form suitable for annotation by the CITY. The electronic form shall be approved by the CITY.

11 Training

1) Prior to the site acceptance of the first unit of each type (after the factory acceptance test), training shall be provided for NYC DOT's engineering, maintenance and operations staff, at a facility provided by NYC DOT. At the time of the training, the CONTRACTOR shall provide 30 copies of all training materials including any referenced maintenance manuals and drawings. The training shall be as described in the following sections.
2) The CONTRACTOR shall submit a training syllabus and samples of the training materials to the CITY for approval**.**
3) **The CONTRACTOR shall not schedule the training session(s) to occur until the CITY has approved the training materials.**
4) All documentation referred to during the training shall be included in the materials provided to each attendee. At the conclusion of the training program, each attendee shall have a complete set of controller and system documentation.
5) The CITY shall have the right to make a video tape of the training sessions for later use.
6) The CONTRACTOR shall plan to conduct each of the training sessions listed below on two separate occasions as directed by the CITY. This provides the opportunity for the CITY to stagger its personnel schedules and repeat the training for multiple crews. Training may be conducted 'after hours' as directed by the ENGINEER without additional compensation. Training sessions shall not exceed 8 hours on any given day.
7) Training must be conducted within 60 days of the delivery of production ASTC units or the CITY may withhold further payment until training has been completed.
8) If for some reason the CONTRACTOR elects to stagger the delivery of each type of traffic controller, the CITY may require that the CONTRACTOR repeat the dual training sessions for each cabinet type as they are made available to the CITY. Under these circumstances, there shall be no additional payment to the CONTRACTOR; this shall be a consequence of the staggered delivery if the schedule cannot be maintained.

11.1 Maintenance Training

1) Training shall be provided for a minimum of 40 hours for at least twenty (20) personnel with an electronics background. The training shall include operation instructions, theory of operation, circuit description, field adjustments, assembly and disassembly procedures, database loading and laptop usage, preventive maintenance procedures, troubleshooting, operation of diagnostic software, operation of the controller and cabinet test sets, bench testers, and repair/replacement of all components.
2) This training is intended to provide CITY personnel and maintenance contractor personnel adequate training for board level diagnostics and board replacement. When completed, the personnel shall know how to troubleshoot to the circuit board level, replace subassemblies, and restore proper operation from a collection of working boards. Component replacement at the board level is not a requirement for this training session. However, backplane repair shall be considered part of the training as there are no active components on the controller backplane.

11.2 Engineering Training

1) Training shall be provided for a minimum of 40 hours for at least ten (10) Engineering and operations personnel. The training shall include a complete demonstration of the operation and capabilities of the equipment. This session must include a complete review of the programming of the conflict monitor, controller operation, cabinet wiring, diagnostic software, and any field adjustments or calibration of the equipment which may be necessary for optimum performance and should stress day-to-day operation and isolation of problems down to the unit level. For example, procedures should be discussed for identifying a faulty module in the field, as opposed to board level repairs. Particular attention shall be given to the operation of the PC based diagnostic program.
2) Training shall be provided in the use of the laptop computer for the loading of firmware and database parameters.
3) Training shall be provided for the configuration and functions of all controller capabilities including communications, coordination, TBC operation, plan parameters, and special features.
4) Training shall include instruction in the use of the database for import and export from a PC based database system.
5) Training shall include use of the software development facility from editing the source code through the entire process of creating a new firmware image and downloading the new functionality (firmware) to the controller.
6) Training shall include the software to support the CMU serial interface.
7) Training shall a complete discussion of the various interactions implied by the MIB for the device such that the trainees fully understand the operation of the loop traps, the trap mechanism, the configuration of the Daylight Savings Time, limitations for the downloading of parameters, interaction of any parameters, and any critical dialogs for the communications exchanges with the central system.
8) Training shall include a complete review and discussion of the Transit Signal Priority including the use of all parameters and interactions with the remote activation for both TSP and EVP.

12 Maintenance and Support

1) The ASTC is a complex device and defects may not be immediately apparent until a significant number of field devices are deployed. If, during the initial 12 months of operation the CITY has reason to suspect a design flaw or poor quality workmanship, the CITY may require that the CONTRACTOR to repeat the *Design Approval Test* on any 5 units designated by the CITY. If a design defect or quality defect is found in the controller [or any of the cabinet subassemblies], the CONTRACTOR shall be required to develop a correction for approval by the CITY. The CITY shall determine whether the ‘repair’ or correction is acceptable.

2) Once the method for correction has been established, the CONTRACTOR shall be responsible for propagating the repair and all costs related to the propagation of the repair to all installed, delivered, and production units at no cost to the CITY. The CONTRACTOR shall also be responsible for all shipping charges and all field installation charges (including safety management of the intersection during the changes if the field operation is affected).

3) During the maintenance and support period, the CONTRACTOR shall establish a depot repair facility within the jurisdictional boundaries of NYC. The CITY or the maintenance

contractor shall deliver any defective or suspect equipment to this maintenance depot. The CONTRACTOR shall then be responsible for determining the cause of the failure and correcting the defect and restoring the device to like new condition. The maintenance depot shall be accessible and available for pickup and drop off of controllers and/or components between the hours of 8:00 AM and 5:00 PM during normal CITY work days. Devices delivered to the maintenance depot shall be repaired and returned to the CITY or maintenance contractor within 10 business days. Sufficient spares are to be maintained by the CONTRACTOR to guarantee this turn-around.

4) As an alternative to the use of a repair depot within the CITY, the CONTRACTOR may provide the CITY with an exchange program whereby the CONTRACTOR provides proper shipping containers and materials to the CITY and a pre-paid freight service will be notified to pickup the defective equipment for return to the CONTRACTOR. The CONTRACTOR shall be responsible for all costs associated with the return including but not limited to packing materials, pickup, shipping costs, insurance, and all materials and labor for the repair. The CITY shall be provided with an internet site or 8xx number to contact for pickup and any return materials authorization necessary. Devices delivered to the shipper shall be returned or replaced within 10 business days.

5) During the production, delivery and warrantee period, the CONTRACTOR shall maintain an accurate inventory control system database for the ASTC and all subassemblies – including but not limited to controller circuit cards, load switches, conflict monitor, flashers, power distribution assembly (PDA), input modules of any kind, modems and communications adapters, MAC Addresses, etc.

6) On a monthly basis, the CONTRACTOR shall provide printed reports to the CITY indicating the number of units delivered, repaired, failed, awaiting repair, and in transit. Those repaired shall include a report of the problem found and repairs made in a detailed manner to permit an engineer to review and understand the symptom, cause, and cure/correction for each repair.

13 Guarantee Period

1) A minimum guarantee of eighteen (18) months for the individual controllers shall start from the completion of the 60-day Site Acceptance test described in Section 9.9.
2) However, if there is evidence of a hardware defect, a software defect, or a bad batch of components, the time of the warranty shall be suspended, until the problem has been corrected and the controller successfully repeats the 60 day site test as described herein. Once the device has completed the post correction site test, the warrantee shall continue from the point the warrantee was stopped, however, the remaining warrantee shall not be less than 180 days or the remainder of the warranty, whichever is greater.
3) If the units are not installed within 120 days of receipt by the CITY, then the warrantee shall start 120 days after receipt by the CITY.
4) **However, the guarantee shall not start until the CONTRACTOR has delivered the final, approved documentation as described in Section 10.3.**
5) **Further, the warrantee shall not start until the full and complete functionality of the ASTC Firmware has been delivered, installed, tested, and functions correctly** in accordance with these specifications and other standards such as the NEMA TS2-2003 and NTCIP standards..

13.1 Extended software warranty

1) The bidder shall include a proposal to extend the software/firmware warrantee for the ASTC in increments of 12 months after the existing warrantee expires. This proposal must be included with the bid documents and shall state the price to extend the software warrantee for each year up to 5 additional years.

2) The CITY shall have the option to purchase the extended warrantee on a year-to-year basis at any time prior to final acceptance of the controllers.

13.2 Repair under Guarantee

1) Any specific printed circuit board may be factory repaired not more than two (2) times during the guarantee period. A third failure shall result in replacement of the printed circuit board with a new one whose guarantee period shall be a minimum of 12 months or the balance of the original warranty (whichever is greater) after a repeat of a 60-day site acceptance test at the same intersection from which it was removed. The old circuit board shall be permanently marked by NYCDOT to ensure that it is never returned to New York City for installation.

2) Any printed circuit board whose components or printed conductor becomes damaged during factory repair shall be replaced with a new board. The guarantee period on the new board shall be equivalent to the remainder of the guarantee of the original board or 12 months whichever is greater.

3) Factory repairs shall be described and reported in detail on a form to be filed with the CITY on a monthly basis within 10 days of the end of each month. The format of the form shall be approved by the CITY.

4) The CONTRACTOR shall be responsible for shipping costs both to and from the factory for equipment repairs that are necessary from the time of initial delivery until the end of the warrantee period.

14 Measure of Payment

14.1 ASTC-6, ASTC-8, and ASTC-12

1) Each ASTC will be measured as the number of complete units furnished in accordance with the contract documents or as directed by the CITY. The prototype units shall be considered for payment at the same price as the production units. A maximum of 5 prototypes of each cabinet type shall be provided under this contract unless otherwise directed by the CITY.

2) Payment for the ASTC-6 [and ASTC-8 and ASTC-12] will be made for the measured quantity at the contract price per each; which price shall be full compensation for design, testing, furnishing, transporting, installing, adjusting, and furnishing all materials, labor, tools, equipment, documentation, warrantee, installation kits, and incidentals necessary to complete the work in accordance with the plans and specifications. (Note that field installation is not a requirement of this contract; this contract is for the supply of the ASTC-6, ASTC-8, and ASTC-12 controllers complete with cabinet and all accessories to a location(s) as specified by NYCDOT.)

3) Note that the line items for payment of the ASTC-6, ASTC-8, and ASTC-12 shall include the complete cabinet with all racks, chassis, and mounting hardware, and all internal subassemblies which shall include the CMU, address card, CMU diode card (fully populated

with all diodes), termination card, PDA, NYCWiN antenna and cables, NYCWiN power supply, input cards as specified, a full complement of load switches (6, 8, or 12), a controller unit, cables for connection to the CMU and UPS and NYCWiN router, cables for connection to the BIU(s) and termination card to support the TS2 serial interface, fan, filter, BIU(s), etc. such that the ASTC is ready for installation and operation. The software provided shall be the latest accepted by the City.

4) Progress payment for the ASTC production units (including auxiliary cabinets) will be made as follows:

   - 80 percent of the contract bid price shall be paid upon the satisfactory completion of the factory acceptance test required for each unit and delivery to the NYCDOT designated warehouse in New York City and successful off-loading of same.

   - 15 percent of the contract bid price shall be paid upon the satisfactory completion of the site acceptance test (reference Section 9.9) for each unit installed. Note, if the delay between the delivery to the CITY and the initial installation by the installation contractor (or the CITY) exceeds 60 days, and the CONTRACTOR has no responsibility for the delay, then the 15% will be paid 120 days after delivery. However, the CONTRACTOR shall not deliver the controllers at a rate faster than 200 per month unless authorized in writing by the CITY. Further, if the reliability of the CONTRACTOR supplied equipment causes the installation to 'lag', the CITY may suspend further deliveries by the CONTRACTOR until the problem is corrected to the satisfaction of the CITY. In addition, if the CITY suspends further installation because of apparent reliability with the CONTRACTOR supplied equipment, then the 120 day payment period shall not start for units delivered but not installed until those units in inventory are installed in the field.

   - The remaining 5 percent shall be paid upon final system acceptance.

5) The CITY shall have the right to increase the number of controller units purchased under this contract at the same contract price adjusted for the consumer price index for the NY City area. Such increases shall be in minimum lots of 100. The base for the consumer price index for all components shall be set at the index in effect 12 months after the notice to proceed or upon the first production delivery of controllers (excludes prototype and Design Approval Testing units) whichever is later.

6) Payment for ASTC Controller Unit Only, shall be full compensation for the Controller Unit and shall include all software, testing, and warranty. This unit shall be supplied without cables except for the power cord and shall be identical to the balance of the Controller Units which are delivered with the complete cabinets. This line item may be used by the City to acquire additional controller units to support additional features at pre-existing ASTC locations with older versions of the unit. As noted herein, the ASTC controller unit must be backward compatible in previous versions of the ATSC cabinet without operator intervention.

14.2 Rate of Delivery

1) The specifications require that the CONTRACTOR deliver 200 controllers per month to the CITY for installation. It is the responsibility of the CITY to ensure timely installation of the controllers. However, if the reliability of the controllers becomes suspect (reference Section 9.4 paragraph 3), then the CITY may, it its option, direct the CONTRACTOR to suspend further deliveries until the problem has been rectified and the CITY issues a written notice to resume delivery. Further, if the reliability of the controllers prevents or slows the CITY's ability to install the new controllers in the street, then the 60 day installation requirement

(reference Section 14.1) may be extended, at the option of the CITY, until such time as the problem has been corrected; under these circumstances the 120 day limitation (Section 14.1) is suspended until the problem has been corrected to the satisfaction of the CITY.

14.3 Supplemental Items

1) The following supplemental items shall be provided according to the bid sheets. Each item specified shall be individually packaged in a reusable shipping container clearly labeled on two sides as to the make, model, serial number, and date of manufacture. All supplemental items shall fully conform to all of the requirements of the ASTC procurement specification. Payment shall be made at the same schedule as the ASTC cabinets.

14.3.1 Auxiliary Cabinets:

1) The auxiliary cabinet when required shall be provided complete with mounting hardware and all cables to connect to the ASTC-12 cabinet.
2) Each cabinet shall include a single BIU, and 4 load switches.

14.4 Other items

1) Payment for all items unless otherwise noted will be made on the basis of 95% at the time of delivery and demonstration of the required functionality, and the remaining 5% at the final acceptance of the project.

14.4.1 System support equipment

The following system support equipment shall be provided under this contract. The City shall have the right to modify the quantity of any item on the system support equipment with appropriate increases and reductions in the contract amount. The CONTRACTOR shall note that the CITY reserves the right to modify the items and allocations within the system support equipment line items based on maintenance requirements.

1) Laptop computers: The number of laptop computers shown in the bid tabulation for the system support equipment shall be provided as described in Section 7.13.1. Each laptop computer shall be provided complete with all necessary cables, batteries, chargers, application software, operating system software and all other utilities and software necessary to support the required functionality. In addition, each laptop shall include current versions of Microsoft Office, network software to support Microsoft networking in a Windows domain, email utilities (Outlook), and network cables. Utilities shall include fax software to allow a fax transmission to a fax service to be used as a printer.

2) Police Cords: Shall only be provided when called out in the bid documents.

3) Spare Parts: Spare parts shall be provided as shown below. The number of each individual element shall be as shown in the bid tabulation. Each subassembly or device shall be individually packaged in a reusable shipping container clearly labeled on two sides as to the make, model, serial number, and date of manufacture. Where alternative designs are accepted, the CONTRACTOR must provide the equivalent number of spare parts and subassemblies for approval by the CITY.

    1. Wireless antennas complete with mounting hardware and cables ready for installation (Section 3.9.21).
    2. Model 2010 ECL conflict monitors (Section 3.9.2) complete with Programming Card
    3. Spare CMU programming cards (Section 3.9.2)
    4. Controller Units complete less modem (Section 4)

5. Spare flash programming jumpers configured for red (Section 3.9.18)
6. Spare flash programming jumpers configured for yellow (Section 3.9.18)
7. Spare universal PDA assemblies (Section 3.9.11)
8. Flash Transfer Relays (Section 3.9.17)
9. NYS model 204 Flashers (Section 3.9.16)
10. Bus interface units (Section 3.9.5)
11. Cabinet Address Cards complete with all diodes installed
12. NYCWiN modem 24 VDC power supply (Section 3.9.22)
13. Spares for each cable assembly internal to the cabinet – this shall include as a minimum the Red monitor cable, 485 serial cables, CMU serial cable, system Ethernet cable, and UPS serial cable, card file interconnect cables. Note that the cable-set shall provide all cables needed for all types of cabinets.
14. Spare termination cards for the 485 bus – including termination connectors.

4) USB memory devices: The CONTRACTOR shall provide USB memory devices as shown in the bid tabulation; these memory devices shall include sufficient storage capacity to hold the controller configuration database and timing information for 12,000 controllers along with the application software for at least 4 versions of the software and 2 versions of the operating system and 50% additional capacity.

5) Software Development Station: The CONTRACTOR shall deliver the complete software development system as described in Section 4.3 including source code and software documentation. The CONTRACTOR shall be responsible for insuring that there is a CITY owned software development platform is suitable for further development of the ASTC software.

6) Inventory Tracking System: The CONTRACTOR shall update the inventory database on a monthly basis as described herein. No software or additional hardware for the inventory tracking system is to be provided under this contract unless the CONTRACTOR elects to use a different system than the one the CITY is now using. In that circumstance, the CONTRACTOR shall provide all necessary hardware and software to the CITY for the continued use of the Inventory tracking function.

14.4.2 Delivery of System Support Equipment

1) The system support equipment shall be supplied prior to or concurrent with the delivery of the first production units. This is essential to ensure a supply of spare parts for emergency maintenance. Failure to deliver the system support equipment within 30 days of the delivery of the production controllers shall cause payment and all warranty time for the production units to be suspended until such time as the delivery of the System Support equipment is completed and accepted by the CITY.

2) The CONTRACTOR shall update the system support equipment including all software and hardware as necessary to ensure compatibility with the field equipment. Further, if there are any changes to the firmware/software of any of the field devices throughout the life of this contract (including warrantee period), the CONTRACTOR shall update the development equipment to the same level.

14.5 Inspection

1) The bid tabulation includes a line item labeled ‘INSPECTION COSTS’. The CITY has established an amount which will be used to cover the CITY’s expenses for travel to attend

the various prototype, design approval, and factory acceptance testing. This reference Item shall be managed as per standard DCAS procedures.

15 Project Schedule

1) The ASTC program will proceed in phases as shown Table 25.
2) The bidder shall develop and submit **with their bid** a detailed schedule showing all milestones, and intermediate submittals as specified in Section 14 of the specification.
3) The schedule shall adhere to the major milestone schedule presented below.
4) The schedule shall clearly indicate the plan for CITY reviews, testing, and delivery.
5) The CONTRACTOR shall keep the CITY appraised of project progress by monthly meetings held at the CITY offices (determined by the CITY) and reports.
6) If, at any time during the project, the CONTRACTOR experiences a delay which he/she reasonably believes is beyond his/her control, he/she shall immediately notify the CITY of the delay, the reason for the delay, and the recovery plan to restore the original project schedule. The CITY **MUST BE NOTIFIED AT THE TIME OF THE DELAY** along with all circumstances of the delay. The CONTRACTOR's failure to notify the CITY within 5 business days of the actual delay and the detailed reason for the delay shall cause the CONTRACTOR to forfeit all rights to any possible contract extension because of the delay. Delays must be specific and may not be general in nature. Delays shall only be allowed as prescribed in the standard conditions of contracting for NYCDOT.
7) If at any time, the CONTRACTOR shall be more than 120 days late in the completion of any Milestone, the CONTRACTOR shall be considered in default and the CITY shall have the right to terminate the contract without further compensation to the CONTRACTOR. The CITY's failure to terminate the contract at the time of default shall not diminish the CITY's right to terminate the contract at any time after the default condition. The CITY shall have the right to award the contract to another bidder in accordance with the CITY procurement regulations and the terms and conditions of this bid. Any money which is due (e.g. unpaid invoices, hold back for 60 day site acceptance test, final acceptance test) the CONTRACTOR at the time of termination shall be forfeit. By submitting a bid for this project, the CONTRACTOR agrees to and understands this provision.

15.1 Phase 1 – Design

1) The CITY will conduct a kick-off meeting concurrent with the issuance of the contract. This meeting will be held at the CITY offices at 34-02 Queens Blvd. and is the CONTRACTOR'S opportunity to present the intended approach and seek clarifications to any issues that may remain unclear.

2) During phase one, the CONTRACTOR shall develop the detailed design, mockups, schematics, material lists, and shop drawings for the controller. The CONTRACTOR shall also develop the detailed plan for supporting the NTCIP objects, and the Pre-timed objects incorporated in the current MIB.

3) The CONTRACTOR shall provide a design briefing to the CITY including preliminary layout drawings within 30 days from the perforation date of the contract (hereinafter referred to as the NTP). The CONTRACTOR shall include handouts and a preliminary design document describing the approach to the ASTC. The briefing shall be held at the CITY offices at 34-02 Queens Blvd.

4) At the design briefing, the CITY will review the CONTRACTOR'S presentation and draft design submittals and make recommendations or provide clarifications for the design. The review of the draft submittals and preliminary designs is intended to aid the CONTRACTOR in the development process and should not be construed to imply approval of the complete design.

5) The CONTRACTOR shall initially construct a complete mechanical prototype including the complete cabinet, all internal assemblies/subassemblies and cable harnesses. This shall include the PDA. The sample or mockup of the controller unit and modem shall be included in the mechanical prototype. It is required that the mockup be included in the 60 day preliminary design walk-through. The CITY will evaluate the proposed design for ease of operation, integrity, ease of maintenance, and materials.

6) The CONTRACTOR shall work closely with the CITY during this phase of the project to effect minor changes and refinements deemed reasonable by the CITY. The CONTRACTOR shall anticipate this type of interaction and shall not expect additional compensation or cost adjustments unless determined by the CITY.

7) Within 60 Days after the NTP, the CONTRACTOR shall complete the detailed design of the ASTC and make formal, detailed submittals of all aspects of the design for CITY review.

8) Phase 1 shall be completed within 90 days from the notice to proceed. Approval by the CITY marks the completion of Milestone #1. Note that to be complete, the detailed design must include all NTCIP documentation.

15.2 Phase 2 – Completion of the prototype(s)

1) Based upon the approved design, the CONTRACTOR shall proceed with the development of one or more prototypes of the complete ASTC.
2) Successful completion of the prototype test for each type of controller shall mark the completion of these milestones. Payment will be made at the unit price when the prototypes are delivered to the CITY in operating condition.
3) Note that for the NTCIP prototype testing, an Ethernet connection will be used with a central system simulator to be provided by the CONTRACTOR. The NTCIP tests shall demonstrate full support for dynamic objects, pre-timed, and actuated support, Exception based reporting, TSP operation and remote TSP activation as well as remote preempt activation, and communications timing. It shall demonstrate full conformance to all of the requirements set forth herein and the NEMA TS2-2003 standards.

15.3 Phase 3 – Design Approval Test Complete

1) After successful completion of the prototype test, the CONTRACTOR may proceed to complete the design approval test.
2) Successful completion of the design approval test for each type of controller shall mark the completion of these milestones. The contract bid price for each controller will be paid upon delivery of the working pre-production model to the CITY for integration and testing.
4) Note that for the NTCIP Design approval testing, an Ethernet connection will be used with a central system simulator to be provided by the CONTRACTOR. The NTCIP tests shall demonstrate full support for dynamic objects, pre-timed, and actuated operation, exception based reporting, Transit Signal Priority, preemption, remote activation of both EVP and TSP, and communications timing.

3) Note that all 5 design approval units shall be delivered to the CITY and paid at the unit price bid. The CITY may authorize additional units to be delivered from the initial production.

15.4 Delivery of Batch 1

1) It is the intent of the CITY to receive an initial order of controllers that will be installed in the CITY and will be monitored for proper operation, reliability, and repairability.

2) The CITY will evaluate their operation for 45 days.

3) At the conclusion of the 45-day observation period, the CITY will evaluate the reliability and operation of the sample units, and notify the CONTRACTOR to proceed with the production quantity if the operation is deemed acceptable.

4) However, if design defects or reliability problems are discovered, the CONTRACTOR shall be required to correct all units and the CITY will restart the 45-day observation period.

15.5 Production

1) After a notice to deliver the balance of the controllers, the CONTRACTOR shall deliver a minimum of 25 controllers per week[16] to the CITY depot or alternate address within the CITY of New York as directed by the ENGINEER.

2) Controllers shall be delivered on a weekly basis. The CONTRACTOR shall ensure that a minimum of 25 controllers is available at the designated facility at the start of each week.

3) Each controller delivered shall be complete with all plug-ins and cables as specified.

4) The CITY shall supervise the installation of the controllers and shall notify the CONTRACTOR of any problems encountered for correction.

5) Accelerated delivery of the controllers shall not be allowed unless the CITY authorizes such accelerated delivery in writing.

6) All production units shall undergo a 60 day site acceptance test as noted in Section 9.9.

7) The order in which the controllers are delivered (ASTC-6, 8, 12) will depend on other contracts. The CITY reserves the right to change the order of priority for these types by notifying the CONTRACTOR in writing after the award of the contract. The CONTRACTOR shall then have 60 days to comply with the altered priority.

15.6 Final acceptance

1) Final acceptance of the controllers shall occur at the end of the warrantee for the last unit delivered.

2) If, during the deployment of the controllers and prior to final acceptance, a design or quality defect is discovered (hardware or software), the CONTRACTOR may be required (at the option of the CITY) to repeat the Design Approval Test on units randomly selected by the CITY. Any design changes necessitated by the design review and re-test shall be corrected by the CONTRACTOR for all equipment supplied under this contract at no cost to the CITY.

[16] While this number has been established, the CITY may wish to accelerate the delivery of these controllers to complete the changeover as quickly as the wireless infrastructure becomes available. This figure may be doubled to 50 per week upon 60 day notice from the CITY.

3) The presence of such design defects, either hardware or software, shall suspend the warranty timer until such time as the problem is corrected in which case the clock shall continue but the remaining warrantee shall be not less than 180 days.

15.7 Milestones

1) The following Table lists the milestones related to this project.

Table 25 Major Project Milestones and Events

Milestone	Description	Calendar Days from NTP
	Kickoff Meeting	0
	Preliminary design review. Design walk through conducted by CONTRACTOR at City offices.	30
	Initial submission of detailed complete design	60
M1	Approved design End of Phase 1	90
M2	Prototype testing of NTCIP ASTC successfully completed	120
	City completes 45 day integration testing of NTCIP interconnect version of the ASTC	165
M3	Design Approval testing of NTCIP versions ASTC successfully completed	150
	Start production delivery	180
M7	Last unit delivered and accepted	TBD
M8	Final acceptance	TBD+18 mos

16 Controller Configurations

1) All ASTC-6 controller configurations supplied shall include 1 CMU (2010), 2 Flash Transfer Relays, a full set of flash programming jumpers, 1 CMU (2010) conflict programming card, 1 Flasher, 1 BIU, 6 loadswitches, PDA, Cabinet address card, and 1 Controller Unit. The input card file equipment shall be provided per the listing in Table 26.

2) All ASTC-8 controller configurations supplied shall include 1 CMU (2010), 3 Flash Transfer Relays, a full set of flash programming jumpers, 1 CMU (2010) conflict programming card, 1 Flasher, 2 BIUs, 8 loadswitches, cabinet address card, PDA, and 1 Controller Unit. The input card file equipment shall be provided per the listing in Table 26.

3) All ASTC-12 controller configurations supplied shall include 1 CMU (2010), 6 Flash Transfer Relays, a full set of flash programming jumpers, 1 CMU (2010) conflict programming card, 1 Flasher, 2 BIUs, 12 loadswitches, cabinet address card, PDA, and 1 Controller Unit. The input card file equipment shall be provided per the listing in Table 26.

4) All ASTC controller cabinets [ASTC-6, ASTC-8, and ASTC-12] shall be supplied with a short RJ45 terminated CAT5E cable (~24 inches long) to connect the ethernet port on the controller with the wireless modem/router to be provided by others. Cable shall use gold

plated RJ45 connectors which include a booted snag less design. Cable shall remain “very” flexible down to 0ºF.

5) All ASTC controller cabinets [ASTC-6, ASTC-8, and ASTC-12] shall be supplied with cables to connect the controller unit to the 2010 CMU.

6) The controller address card shall be fully populated with all diodes.

7) For all NTCIP cabinets, the CONTRACTOR shall supply and install a NYCWiN antenna and lead-in cable which shall be terminated with the appropriate connector at the antenna jack for the NYCWiN modem. This antenna shall be included in the cost of the cabinet and no separate payment will be made for said antenna, cables, and power supply for all new ASTC cabinets.

8) All controllers shall be able to support all types of communications listed in these specifications. The cabinet address and plug-in devices shall determine which communications technique is supported.

9) All cabinets shall include all necessary internal cable assemblies, termination board and termination resistors, and mounting hardware.

10) All cabinets shall include a print pouch and cabinet drawings.

11) Each cabinet shall be provided with 2 keys.

12) Cabinets shall be provided with the air filter installed.

13) For each ASTC-6, the cabinet shall include 4 red programming jumpers; for each ASTC-8, the cabinet shall include 4 red programming jumpers; for each ASTC-12, the cabinet shall include 6 red programming jumpers.

14) Table 26 indicates the number of load switches and input modules to be provided with each delivered ASTC-6, ASTC-8, or ASTC-12.

15) Designation:
252 – NY State Model 252 Dual AC Isolation Module Section 3.9.4
242 – Dual DC Isolation Module Section 3.9.4
244 – Quad DC Isolation Module Section 3.9.4
224 – Quat Detector module Section 3.9.3

Table 26 ASTC Configurations

			Input File - Cards to be mounted in each slots										
Cfg	**Description**	**#LS**	**SL 1**	**SL 2**	**SL 3**	**SL 4**	**SL 5**	**SL 6**	**SL 7**	**SL 8**	**SL 9**	**SL 10**	**Other**
BASIC ASTC-6 Configurations													
6-5	NTCIP Ethernet	6			2 4 2								NYCWiN Antenna & power supply
ASTC-12 Configurations													
12-5	NTCIP Ethernet	12								2 4 2			NYCWiN Antenna & power supply
ASTC-8 Configurations													
8-5	NTCIP Ethernet	8					2 4 2						NYCWiN Antenna & power supply
LS= Load Swtiches, SL indicates the card to be mounted in the input file slot													

17 Non Disclosure Agreement

1) Use of the existing design documentation and software source code is subject to the CONTRACTOR's execution of the non-disclosure agreement presented below. The documentation and source code will only be made after award of contract.

2) Any changes made to the source code remain the property of the OWNER as outlined below with ongoing rights to their use within the New York Signal System as outlined in Section 4.3.

NYCDOT Standard Non-Disclosure (Confidentiality) Agreement

NON-DISCLOSURE AGREEMENT
Propriety Information

This is an Agreement, effective _____, between New York City Department of Transportation (hereinafter referred to as "NYCDOT") and _____(hereinafter referred to as "VENDOR"). It is recognized that it may be necessary to provide certain information to VENDOR for the purpose of developing an equivalent ASTC assembly for use in New York City by NYCDOT. This information is considered proprietary but the original supplier, US Traffic Corporation and or Peek Traffic (hereinafter referred to as "OWNER") and they retain ownership rights to this material. The information provided is for the exclusive purpose of providing a compatible product to NYCDOT and may not be used for any other purpose whatsoever including but not limited to incorporation into a product(s) designed for other applications, product(s) to be supplied to other public agencies either directly or indirectly, or for use in any other locations. Further, VENDOR shall not make known any information regarding the techniques used or the quality of the information provided to any other party except NYCDOT. Note that ASTC refers to all versions of the controller and cabinet developed and produced for NYCDOT. With respect to the information being provided by NYCDOT for the existing ASTC design, the VENDOR agrees as follows:

(1) "Proprietary Information" shall include, but not be limited to, performance data, technical data, documentation, board layouts, software source code, and concepts provided by NYCDOT, not previously published or otherwise disclosed to the general public, not previously available without restriction to the VENDOR or others, nor normally furnished to others without compensation, and which the original OWNER desires to protect against unrestricted disclosure or competitive use, and which is furnished pursuant to this Agreement and appropriately identified as being proprietary when furnished.

(2) In order for Proprietary Information disclosed by NYCDOT to VENDOR to be protected in accordance with this Non- Disclosure Agreement, it must be: (a) in writing; (b) clearly identified as Proprietary Information at the time of its disclosure by each page thereof being marked with an appropriate legend indicating that the information is deemed proprietary by the OWNER of the information; and (c) delivered by letter of transmittal to the individual designated in Paragraph 3 below, or his designee. Where the Proprietary Information is provided in electronic form, this information shall be protected by this agreement even if the information is not provided in hard copy form. Such electronic information shall be considered Proprietary Information if the header or cover page of the electronic document includes notification that the information is proprietary and property of the OWNER.

(3) In order for the Proprietary Information to be protected as described herein, it must be submitted in written or electronic form as discussed in Paragraph 2 above to:

_____

Name:_____

Title:_____

Address:

Telephone No:
Fax No.
Email address:

(4) VENDOR covenants and agrees that it will keep in confidence, and prevent the disclosure to any person or persons outside its organization or to any unauthorized person or persons, any and all Proprietary Information which is received from NYCDOT under this Agreement and has been protected in accordance with paragraphs 2 and 3 hereof; provided however, that VENDOR shall not be liable for disclosure of any such Proprietary Information if the same:

A. Was in the public domain at the time it was disclosed, or
B. Becomes part of the public domain without breach of this Agreement, or
C. Is disclosed with the written approval of the OWNER, or
D. Is disclosed after five (5) years from receipt, or
E. Was independently developed by the VENDOR, or
F. Is or was disclosed by the OWNER to a third party without restriction, or

G. Was known to the VENDOR at the time of disclosure or thereafter becomes known, provided such knowledge was or is lawfully obtained from a source other than the currently disclosing party and without notice at the time such knowledge was obtained of the currently disclosing party's proprietary claims; or

H. Is disclosed pursuant to the provisions of a court order.

The provisions of this Paragraph 4 shall supersede the provisions of any inconsistent legend that may be affixed to said data, and the inconsistent provisions of any such legend shall be without any force or effect.

Any Proprietary Information provided by NYCDOT to the VENDOR shall be used only in furtherance of the purposes described in this Agreement, and shall be, upon request at any time, returned to NYCDOT. If VENDOR loses or makes unauthorized disclosure of the Proprietary Information, it shall notify NYCDOT and the OWNER immediately and take all steps reasonable and necessary to retrieve the lost or improperly disclosed Proprietary Information.

(5) The standard of care for protecting Proprietary Information imposed on the VENDOR will be that degree of care the VENDOR uses to prevent disclosure, publication or dissemination of its own Proprietary Information.

(6) VENDOR shall not be liable for the inadvertent or accidental disclosure of Proprietary Information if such disclosure occurs despite the exercise of the same degree of care as VENDOR normally takes to preserve its own such data or Proprietary Information.

(7) In providing any Proprietary Information hereunder, NYCDOT makes no representations, either express or implied, as to the Proprietary Information's adequacy, sufficiency, or freedom from defect of any kind, including freedom from any patent infringement that may result from the use of such Proprietary Information, nor shall NYCDOT incur any liability or obligation whatsoever by reason of such Proprietary Information, except as provided under Paragraph 4, hereof.

(8) This Agreement contains the entire agreement relative to the protection of Proprietary Information to be exchanged hereunder, and supersedes all prior or contemporaneous oral or written understandings or agreements regarding this issue. This Agreement shall not be modified or amended, except in a written instrument executed by the parties.

(9) Nothing contained in this Agreement shall, by express grant, implication, estoppel or otherwise, create any right, title, interest, or license in or to the inventions, patents, technical data, computer software, or software documentation of the OWNER.

(10) This Agreement will be interpreted and construed in accordance with the laws of the State of New York, without regard to its conflicts of law principles.

(11) This Agreement may not be assigned or otherwise transferred in whole or in part without the express prior written consent of NYCDOT, which consent shall not unreasonably be withheld. This consent requirement shall not apply in the event VENDOR shall change its corporate name or merge with another corporation. This Agreement shall benefit and be binding upon the successors and assigns of the parties hereto.

Signed,

NYCDOT . _____

By:_____ By:_____

Name:_____ Name:_____

Title:_____ Title:_____

Date: _____ Date: _____

18 TYPE 2010 Conflict Monitor SPECIFICATIONS

1) This specification sets forth the minimum requirements for a rack-mountable, sixteen channel, solid-state Model 2010 Signal Monitor for a Type 170 / 179 / 2070 Traffic Cabinet Assembly. At a minimum, the Signal Monitor shall comply with all specifications outlined in Chapter 4 of the California Traffic Signal Control Equipment Specifications, January 1989. Where differences occur, this specification shall govern. The manufacturer of the unit shall be listed on the current California Department of Transportation (CALTRANS) Qualified Products List (QPL) for signal monitors.

2) The Signal Monitor shall be capable of monitoring sixteen channels consisting of a Green input, a Yellow input, and a Red input for each channel. The unit shall also include the enhanced monitoring functions described in Section 18.1, diagnostic display functions described in Section 18.2, event logging functions described in Section 18.3, communications functions described in Section 18.4, and hardware functions described in Section 18.5.

18.1 MONITOR FUNCTIONS

All fault timing shall be computed for each channel individually except for Conflict faults.

18.1.1 Conflict Monitoring

The Signal Monitor shall be able to detect the presence of conflicting green or yellow signal voltages on the AC field terminals between two or more non-compatible channels. A Conflict fault (CONFLICT) shall be a latching fault.

18.1.1.1 Conflict Recognition Time

The Signal Monitor shall trigger when voltages on any conflicting channels are present for more than 500 ms. The Signal Monitor shall not trigger when voltages on any conflicting channels are present for less than 200 ms. Conflicting signals sensed for more than 200 ms and less than 500 ms may or may not trigger the unit.

18.1.2 24VDC Monitoring

The Signal Monitor shall be able to detect that the cabinet +24 VDC supply has fallen below 18 VDC. A 24VDC failure (VDC FAIL) shall be a latching fault.

18.1.2.1 24VDC Recognition Time

The Signal Monitor shall trigger when the voltage on the +24V input is below 18 VDC for more than 500 ms. The Signal Monitor shall not trigger when the voltage on the +24V input is below 18 VDC for less than 200 ms. A voltage level of +22 VDC shall be required to prevent the unit from triggering.

18.1.3 Controller Watchdog Monitoring

The Signal Monitor shall trigger when the Watchdog input does not toggle within the programmed time period (WDT ERROR). The unit shall remain latched in the fault state until reset by the Reset button, an External Reset input command, or AC Line voltage restoring from a AC Line Brownout event (see 18.1.4). A reset resulting from an AC Line Brownout event shall not clear the WDT ERROR LED.

18.1.3.1 Controller Watchdog Latch Option

A programming option shall set the Watchdog monitoring function to a latching mode. Only a reset from the Reset button or External Reset input shall clear a Watchdog fault. An AC Line brownout condition will not reset the fault.

18.1.3.2 Controller Watchdog Recognition Time

A programming option shall set the maximum Watchdog recognition time to 1000 ±100 ms or 1500 ±100 ms.

18.1.3.3 Controller Watchdog Enable Switch

An internal switch shall be provided to disable the Watchdog monitoring function. The switch shall be mounted on the PCB and be clearly labeled "WD ENABLE - ON...OFF". Placement of the switch in the OFF position shall cause monitoring of the Watchdog to be inhibited.

18.1.3.4 WDT ERROR LED Control

The WDT ERROR LED shall illuminate when the unit has been triggered by a Watchdog fault. It shall only be cleared by a reset command from the front panel Reset switch or External Reset input. If the Watchdog monitoring function is inhibited due to the Watchdog Enable switch, the WDT ERROR LED shall flash at a 0.5 Hz rate.

18.1.4 AC Line Monitoring

18.1.4.1 AC Line Brownout Recognition

The Signal Monitor shall be able to detect that the AC Line has fallen below 91 (±2) VAC for greater than 400 ±50 ms. This shall force the output Relay to the de-energized "fault" state, enable the Stop-Time output, and cause the AC POWER LED to flash at a 2 Hz rate. The unit shall maintain this state until the AC Line voltage rises above 94 (±1) VAC for greater than 400 ±50 ms. Note that the 2010 CMU must allow full controller operation at 95 VAC or below when power is restored.

18.1.4.2 AC Line Power-up and Brownout Delay Time

When the AC Line is greater than 95 volts after power-up or Brownout restore, the Signal Monitor shall hold the Output Relay in the de-energized "fault" state and enable the Stop-Time output, for a period of not less than 6.0 ±0.5 seconds and not greater than 10.0 ±0.5 seconds. This flash interval shall be terminated after at least 6.0 ±0.5 seconds if the Signal Monitor has detected at least five transitions of the Watchdog input. If the Signal Monitor does not detect five transitions of the Watchdog input before 10.0 ±0.5 seconds the Signal Monitor shall go to the fault state. During this interval the AC POWER LED shall flash at a 4 Hz rate.

18.1.5 Red Fail Monitoring

The Signal Monitor shall be able to detect the absence of an active voltage on the green and yellow and red field signal inputs of a channel. Red Fail fault (RED FAIL) shall be a latching fault. The Red Fail monitoring function shall be enabled for all channels except when the Red Enable input is not active, or pin #EE is active, or Special Function #1 input is active, or Special Function #2 input is active.

18.1.5.1 Red Fail Recognition Time

The Signal Monitor shall trigger when an active voltage on one of the three inputs of a channel are absent for more than 1500 ms. The Signal Monitor shall not trigger when an

active voltage on one of the three inputs of a channel are absent for less than 1200 ms. Channels without proper voltages sensed for more than 1200 ms and less than 1500 ms may or may not trigger the unit.

18.1.5.2 Red Interface Cable Fault

1) A programming option shall be provided such that operating without the Red Interface cable installed will cause the Signal Monitor to enter the fault mode causing the Output relay contacts to close and enabling the Stop-Time output to the controller. To indicate this fault mode the Red Fail indicator shall be illuminated with all channel indicators Off.

2) To utilize this option, the cabinet shall be wired such that the Red Enable input is only interrupted by the Load Switch bus being de-energized. Any Red Fail preemption control to the monitor shall use the Special Function inputs #1 or #2.

18.1.6 Dual Indication Monitoring

The Signal Monitor shall be able to detect the presence of active voltage on the green and yellow, green and red, or yellow and red field signal inputs of a channel. GYR Dual Indication fault (DUAL IND) shall be a latching fault. This function shall be enabled on a per channel basis using dip switches mounted on the PCB labeled "CH1" through "CH16". The GYR Dual Indication monitoring function shall be enabled for all selected channels except when the Red Enable input is not active or pin #EE is active.

18.1.6.1 GY Dual Indication Monitoring

The Signal Monitor shall be able to detect the presence of active voltage on the green and yellow field signal inputs of a channel. GY Dual Indication fault (DUAL IND) shall be a latching fault. This function shall be enabled with a dip switch on the PCB labeled "GY ENABLE". When the switch is in the ON position, all channels shall be monitored for simultaneous active green and yellow inputs on a channel. When selected by the GY ENABLE switch, the GY Dual Indication monitoring function shall be disabled when pin #EE is active.

18.1.6.2 Dual Indication Recognition Time

The Signal Monitor shall trigger when multiple inputs are active on a channel for more than 500 ms. The Signal Monitor shall not trigger when multiple inputs are active on a channel for less than 250 ms. Channels with multiple voltages active for more than 250 ms and less than 500 ms may or may not trigger the unit.

18.1.7 Sequence (Short or Absent Yellow) Monitoring

The Signal Monitor shall be able to detect that a channel has not provided an adequate Yellow Clearance interval during a green to yellow to red sequence. A Sequence failure (SEQUENCE) shall be a latching fault. This function shall be enabled on a per channel basis using dip switches mounted on the PCB labeled "CH1" through "CH16". The Sequence monitoring function shall be enabled for all selected channels except when the Red Enable input is not active or pin #EE is active.

18.1.7.1 Sequence Recognition Time

The minimum Yellow Clearance interval may be modified by switches mounted on the PCB labeled "YEL TIME 1", "YEL TIME 2", and "YEL TIME 3". The Yellow Clearance interval shall be 2.7 seconds plus 0.2 seconds times the binary sum of the three

switches. The minimum Yellow Clearance interval shall therefore have a range of 2.7 seconds to 4.1 seconds, ± 0.1 seconds.

18.1.8 Configuration Change Monitoring

1) On power-up, reset, and periodically during operation, the Signal Monitor shall compare the current configuration settings with the previously stored value. If the settings have changed, the Signal Monitor shall automatically log the new setting. These settings shall include the permissive diode matrix, all switches, all jumpers, and the Watchdog Enable switch.
2) A programming option shall be provided such that any change in the configuration parameters shall cause the Signal Monitor to enter the fault mode causing the Output relay contacts to close and enabling the Stop-Time output to the controller. To indicate this fault mode the PCA indicator shall flash at a 4 Hz rate. Depressing the Reset button for 5 full seconds shall be required to clear this fault and log the new configuration parameters.
3) If the programming option is not selected, the unit shall not set the fault mode but will still log the configuration change.

18.1.9 Program Card Ajar

When the Programming Card is removed or not seated properly, the Signal Monitor shall force the Output Relay to the de-energized "fault" state, enable the Stop-Time output, and illuminate the PCA LED. A reset command from the front panel Reset switch or External Reset input shall be required once the Program Card is in place.

18.1.10 Exit Flash

When the Signal Monitor exits the flash state (Output relay de-energized) as a result of a Reset command or AC Line brownout restore, the Stop Time output shall go to the inactive state 250 ± 50 ms before the Output relay transfers to the energized state. This transition will provide an early indication to the Controller Unit that the cabinet will transfer from flash to signal operation.

18.2 DISPLAY FUNCTION

It shall be possible to view the active channels for each individual color (GYR) during operation and when latched in a fault state. When the Signal Monitor is latched in a fault state it shall also be possible to view the active channels for each individual color and fault status for each channel for the current fault and the two previous faults.

18.2.1 Previous Fault GYR Display

1) When the Signal Monitor has been triggered by a fault the channel status display will alternate between the channels which were involved in the fault (fault status) for 2 seconds, and the field signals active at the time of the fault for 6 seconds. The channels involved in the fault will flash their respective Green, Yellow, and Red indicators simultaneously at a 4 Hz rate for the 2 second interval.
2) The two previous faults may also be displayed individually. This status is not reset by an AC Line power interruption. To enter this display mode remove the Program Card. The sequence is as follows:

Reset	Event	PCA LED	Fault Status LEDs	Channel Status LEDs
---	#1	Single flash	Current Fault Status (newest)	Current Field status
#1	#2	Double flash	Event #2 Fault Status	Event #2 Field status
#2	#3	Triple flash	Event #3 Fault Status (oldest)	Event #3 Field status
...			(repeats back to top)	

18.3 EVENT LOGGING FUNCTIONS

The Signal Monitor shall be capable of storing in non-volatile memory a minimum of 100 events. Each event shall be marked with the time and date of the event. These events shall consist of fault events, AC Line events, reset events, and configuration change events. The capability to assign a four digit identification number to the unit shall be provided. The event logs shall be uploaded to a PC using the serial port of the Signal Monitor and software provided by the manufacturer.

Each event log report shall contain the following information:

a) Monitor ID#: a four digit (0000-9999) ID number assigned to the monitor.
b) Time and Date: time and date of occurrence.
c) Event Number: identifies the record number in the log. Event #1 is the most recent event.

18.3.1 Monitor Status Report (CS)

The Current Status report shall contain the following information:

a) Fault Type: the fault type description.
b) Field Status: the current GYR field status and field RMS voltages if the monitor is not in the fault state, or the latched field status and field RMS voltages and fault channel status at the time of the fault.
c) Cabinet Temperature: the current temperature if the monitor is not in the fault state, or the latched temperature at the time of the fault.
d) AC Line Voltage: the current AC Line voltage if the monitor is not in the fault state, or the AC Line voltage at the time of the fault.
e) Control Input Status: the current state and RMS voltages of the Red Enable input, EE input, and Special Function #1 and #2 inputs if the monitor is not in the fault state, or the status latched at the time of the fault.

18.3.2 Previous Fault Log (PF)

The Previous Fault log shall contain the following information:

a) Fault Type: the fault type description.
b) Field Status: the latched field status with RMS voltages, and fault channel status at the time of the fault.
c) Cabinet Temperature: the latched temperature at the time of the fault.
d) AC Line Voltage: the AC Line voltage at the time of the fault.
e) Control Input Status: the latched state of the Red Enable input, EE input, and Special Function #1 and #2 inputs at the time of the fault.

18.3.3 AC Line Event Log (AC)

The AC Line log shall contain the following information:

a) Event Type: describes the type of AC Line event that occurred.
   Power-up - AC on, monitor performed a cold start
   Interrupt - AC Line < Brownout level
   Restore - AC restored from AC brown-out or AC interruption (AC Off), no cold start
b) AC Line Voltage: the AC Line voltage at the time of the event.

18.3.4 Monitor Reset Log (MR)

The Monitor Reset log shall contain the following information:

a) The monitor was reset from a fault by the front panel Reset button or External Reset input.

18.3.5 Configuration Change Log (CF)

The Configuration Change log shall contain the following information:

a) Program Card Matrix: the permissive programming for each channel.
b) Yellow Disable Jumpers: the Yellow Disable programming for each channel.
c) Dual/Sequence Switches: the switch programming for each channel.
d) Option Switches: GY Enable, SF1 Polarity, Sequence Timing, Minimum Flash Enable, Configuration Fault Enable, Red Cable Fault enable.
e) Watchdog Programming: Watchdog Enable, Watchdog Latch, and Watchdog timing.
f) Configuration CRC: A unique CRC value which is based on the configuration of items #a though #e above.

The log shall also indicate which items have been changed since the last log entry.

18.4 COMMUNICATIONS FUNCTIONS

18.4.1 Personal Computer Communications

1) The CONTRACTOR shall provide software to access the Signal Monitor status and event logs described in Section 18.3. This software shall operate with Microsoft Windows (2000, XP etc.) installed on a laptop or desk-top computer using one of the internal COMM ports.

2) The CONTRACTOR shall provide software which provides a minimum of the following capabilities:

i) Read all of the diode board settings and to display those in an easy to understand manner
ii) Read and display all of the logs
iii) Read and display all of the operating voltages
iv) Read and display all of the input signals present
v) Ability to reset the logs
vi) Ability to set and view the internal clock

3) The CONTRACTOR shall publish complete details regarding the communications protocol including but not limited to data formats, timing constraints, error handling, etc.

4) All software shall be provided on CD ROM and shall self install. It shall be possible to easily remove the software with a simple uninstall action.

18.4.2 Communications connection to traffic controller

1) The 2010 CMU shall match the communications protocol for the existing unit such that it is interchangeable with the existing 2010's and can fully communicate and support the monitoring of status and clock setting and uploading the log to the traffic controller.

2) The existing protocol is available for examination; the 2010 CMUs provided under this contract shall be interchangeable with the existing units such that all existing functionality including the data exchanges between the CMU and the controller unit are identical.

18.5 HARDWARE

18.5.1 Red Monitoring

18.5.1.1 Red Field Inputs

1) The Signal Monitor shall be capable of monitoring sixteen Red field signals. A Red input shall be sensed active when the input voltage exceeds 70 Vrms. A Red input shall be sensed not active when the input voltage is less than 50 Vrms. A Red input may or may not be sensed active when the input voltage is between 50 Vrms and 70 Vrms.

18.5.1.2 Red Enable Input

1) The Red Enable input shall provide an AC input to the unit which shall enable Red Monitoring, Dual Indication Monitoring, and Sequence monitoring when the input is sensed active.

2) The Red Enable input shall be sensed active when the input voltage exceeds 70 Vrms. The Red Enable input shall be sensed not active when the input voltage is less than 50 Vrms. The Red Enable input may or may not be sensed active when the input voltage is between 50 Vrms and 70 Vrms.

18.5.1.3 Special Function Preemption Inputs

1) The Special Function Preemption inputs #1 and #2 shall provide an AC input to the unit which shall disable Red Fail Monitoring (Lack of Output) only when either input is sensed active.

2) A Special Function input shall be sensed active when the input voltage exceeds 70 Vrms. A Special Function input shall be sensed not active when the input voltage is less than 50 Vrms. A Special Function input may or may not be sensed active when the input voltage is between 50 Vrms and 70 Vrms.

3) A PCB mounted switch shall provide the option to invert the active status of the Special Function #1 input. When the switch is in the ON position, the Special Function #1 input shall be sensed not active when the input voltage exceeds 70 Vrms. The Special Function #1 input shall be sensed active when the input voltage is less than 50 Vrms. The Special Function #1 input may or may not be sensed active when the input voltage is between 50 Vrms and 70 Vrms.

18.5.1.4 Red Interface Connector

1) This connector provides the required inputs for the unit to monitor the Red field signal outputs. It shall be a 3M #3428-5302 type or equivalent and be polarized to insure proper mating with the cable. Ejector latches shall be included to facilitate removal and prevent the cable from inadvertently disconnecting. The unit shall function as a standard 210 Signal Monitor when the cable is disconnected. The pin assignments shall be as shown in the table below.

PIN	FUNCTION	PIN	FUNCTION
1	CHANNEL 15 RED	11	CHANNEL 9 RED
2	CHANNEL 16 RED	12	CHANNEL 8 RED
3	CHANNEL 14 RED	13	CHANNEL 7 RED
4	CHASSIS GROUND*	14	CHANNEL 6 RED
5	CHANNEL 13 RED	15	CHANNEL 5 RED
6	SPECIAL FUNCTION #2	16	CHANNEL 4 RED
7	CHANNEL 12 RED	17	CHANNEL 3 RED
8	SPECIAL FUNCTION #1	18	CHANNEL 2 RED
9	CHANNEL 10 RED	19	CHANNEL 1 RED
10	CHANNEL 11 RED	20	RED ENABLE

*A jumper option shall be provided to allow the connection of Pin #4 to be made with Chassis Ground.

18.5.2 Front Panel

The front panel shall be constructed of sheet aluminum with a minimum thickness of 0.090", and shall be finished with an anodized coating. The model information shall be permanently displayed on the front surface.

18.5.2.1 Indicators

All display indicators shall be mounted on the front panel of the Signal Monitor and shall be water clear, T-1 package, Super Bright type LEDs. All fault LEDs shall be red except the AC POWER indicator which shall be green. A separate Red, Yellow, and Green indicator shall be provided for each channel. The indicators shall be labeled and provide the information as follows:

1) AC POWER: The AC POWER indicator shall flash at a rate of 2 Hz when the unit has detected a low voltage condition as described in Section 2.4. The AC POWER indicator shall flash at a rate of 4 Hz during the minimum flash interval as described in Section 2.4.2. It shall illuminate when the AC Line voltage level is restored above the brownout level. The indicator shall extinguish when the AC Line voltage is less than 80 VAC.

2) VDC FAILED: The VDC FAILED indicator shall illuminate when a 24VDC fault condition is detected. This indicator remains extinguished if the monitor has not been triggered by a 24VDC fault.

3) WDT ERROR: The WDT ERROR indicator shall illuminate when a controller Watchdog fault is detected. If the WD ENABLE switch on the monitor is placed in the OFF position to disable Watchdog monitoring, or the AC Line voltage is below the Watchdog disable level, the WDT ERROR indicator shall flash ON once every 2 seconds.

4) CONFLICT: The CONFLICT indicator shall illuminate when a conflicting proceed signal fault is detected.

5) DIAGNOSTIC: The DIAGNOSTIC indicator shall illuminate when one of the following faults are detected: Internal Watchdog fault, Memory Test fault, or Internal power supply fault. This indicator is intended to inform the service technician of a monitor hardware or firmware failure.

6) RED FAIL: The RED FAIL indicator shall illuminate when an absence of signal is detected on a channel(s). If the Red Enable input is not active, or a Special

Function input is active, or the EE input is active the RED FAIL indicator shall flash ON once every two seconds.

7) DUAL IND: The DUAL IND indicator shall illuminate when a GY-Dual or GYR-Dual Indication fault is detected on a channel(s).

8) SEQUENCE: The SEQUENCE indicator shall illuminate when the minimum Yellow Clearance time has not been met on a channel(s).

9) PCA: The PCA indicator shall illuminate if the Program Card is absent or not properly seated.

   If the unit is in the Diagnostic Display mode, the PCA indicator shall flash ON (once, twice, or three times) to indicate the fault event number being displayed. See Section 18.2.

10) CHANNEL STATUS: During normal operation the 48 Channel Status indicators shall display all active signals (Red, Green, and Yellow).

    In the fault mode the Channel Status indicators shall display all signals active at the time of the fault for six seconds and then indicate the channels involved in the fault for 2 seconds.

18.5.2.2 Front Panel Control

1) RESET Button: A momentary SPST Control switch labeled RESET shall be provided on the unit front panel to reset the monitor circuitry to a non-failed state. The switch shall be positioned on the front panel such that the switch can be operated while gripping the front panel handle. A reset command issued from either the front panel button or External Reset input shall be a one-time reset input to prevent the unit from constant reset due to a switch failure or constant external input, and shall cause all LED indicators to illuminate for 300 ms.

2) The Reset button also provides control of the Diagnostic Display mode. For a complete description of Diagnostic Display operation see Section 18.2.

18.5.2.3 Serial Communications Connector

1) This connector shall be used to provide EIA/TIA-232 serial communications. It shall be an AMP 9721A or equivalent 9 pin metal shell D subminiature type with female contacts. Pin assignments shall be as shown in the Table below.

PIN	FUNCTION
1	DCD*
2	TX DATA
3	RX DATA
4	DTR (Data Terminal Ready)
5	SIGNAL GROUND
6	DSR
7	DSR*
8	CTS*
9	NC

*Jumper options shall be provided to allow the connection of Pin #4 to be made with Pin #7, and the connection of Pin #8 to be made with Pin #1.

18.5.3 Electronics

18.5.3.1 RMS Voltage Sampling

1) High speed sampling techniques shall be used to determine the true RMS value of the AC field inputs. Each AC input shall be sampled at least 32 times per cycle. The RMS voltage measurement shall be insensitive to phase, frequency, and waveform distortion.

18.5.3.2 Internal MPU Watchdog

1) A microprocessor shall be used for all timing and control functions. Continuing operation of the microprocessor shall be verified by an independent monitor circuit, which shall force the Output Relay to the de-energized "fault" state, enable the Stop-Time output, and illuminate the DIAGNOSTIC indicator if a pulse is not received from the microprocessor within 300 ms.

2) If the microprocessor should resume operation, the Signal Monitor shall continue to operate. This monitoring circuit shall also be configurable to latch in the fault state. Once triggered, the unit shall require a power-up cycle to reset the circuit.

18.5.3.3 Sockets

1) In the interest of reliability, only the PROM memory device for the microprocessor firmware shall be socket mounted. The PROM memory socket shall be a precision screw machine type socket with a gold contact finish providing a reliable gas tight seal. Low insertion force sockets or sockets with "wiper" type contacts shall not be acceptable.

2) If the CMU uses a FLASH memory device that can be programmed without removal from the circuit, it does not need to be mounted in a socket. However, the mechanism for programming the FLASH memory shall be such that it can be performed in the field under adverse conditions in less than 5 minutes.

18.5.3.4 Internal Power Supply

1) A built-in, high-efficiency switching power supply shall generate all required internal voltages. All supply voltages shall be regulated. Failure of the internal power supply to provide proper operating voltages shall force the output Relay to the de-energized "fault" state, enable the Stop-Time output, and illuminate the DIAGNOSTIC indicator.

2) A user replaceable slow blow fuse shall be provided for the AC Line input. The unit shall be operational over the AC Line voltage range of 75 VAC to 135 VAC.

18.5.3.5 Internal Clock

1) The monitor shall contain an internal clock/calendar that shall maintain the same accuracy as the ASTC controller.

2) The internal clock shall maintain its time and date without power for at least 30 days.

3) The mechanism used to support the local clock shall have a minimum of 10 year shelf life.

4) Clock accuracy shall be a minimum of +-.005% at 25C and no worse than +/- .02% over the entire operating temperature range without line power; the CMU clock shall track the line frequency when power is present; noise, short dropouts, and transients on the power line shall not cause the clock to drift. .

18.5.3.6 EIA/TIA-232 Interface

The EIA/TIA-232 port interface electronics shall be electrically isolated from all monitor electronics except chassis ground.

18.5.3.7 Configuration Parameters

User-programmed configuration settings shall be selected using PCB mounted switches or jumpers. Designs requiring a Personal Computer (PC) to program or verify the configuration parameters is not acceptable. User-programmed configuration settings which are transferred to memory shall be stored in a programmable read-only memory (PROM or EEPROM). Designs using a battery to maintain configuration data shall not be acceptable.

18.5.3.8 Field Terminal Inputs

All 120 VAC field terminal inputs shall provide an input impedance of 150K $\pm$50K ohms and be terminated with a discrete resistor having a power dissipation rating of 0.5 Watts or greater.

18.5.3.9 Component Specifications

All electrical components used in the Signal Monitor shall be rated by the component manufacturer to operate beyond the full unit operating temperature range of -34^{o} C to +74^{o} C.

18.5.3.10 Printed Circuit Boards

All printed circuit boards shall meet the requirements of the *California Traffic Signal Control Equipment Specifications*, January 1989, plus the following requirements to enhance reliability:

1) All plated-through holes and exposed circuit traces shall be plated with solder.
2) Both sides of the printed circuit board shall be covered with a solder mask material.
3) The circuit reference designation for all components and the polarity of all capacitors and diodes shall be clearly marked adjacent to the component. Pin #1 for all integrated circuit packages shall be designated on both sides of all printed circuit boards.
4) All electrical mating surfaces shall be gold plated.
5) All printed circuit board assemblies shall be coated on both sides with a clear moisture-proof and fungus-proof sealant.
6) All components and wire harnesses shall be mounted to the PCB using plated holes. "Piggy back" connections or jumper wires shall not be acceptable.

19 Management Information Base (MIB)

The central system uses the MIB to configure the ASTC database. It includes both the pre-timed and the actuated data objects along with custom objects for the special functionality such as the configurable input-output functions, IP address management, TSP messages, time management, PED overlaps, flashing yellow arrow, etc.

The MIB is available for inspection and will be made available to the CONTRACTOR electronically at the time of award.