

TRAFFIC SIGNAL / STREETLIGHTING DESIGN GUIDELINES

The following are general guidelines for traffic signal and streetlight installations in the City of North Vancouver. Work shall meet or exceed MMCD 2009 Specifications - Platinum Book and all applicable National and Provincial code requirements.

DRAWINGS

Traffic Signal Drawings to include Civil, Electrical and Profile information no larger than ANSI D size. Drawings to include:

- Existing and Proposed curbs and lane lines
- Phasing Diagram and pre-emption sequence
- Loop Detector Assignments
- Table of intersection light levels
- Approved Product List
- Signal Cable colour code, for all types of cable used
- Contents of all conduits

ELECTRICAL SERVICE

- Service Bases and Pole Mounts are preferred to kiosks where possible
- Powder coat finish to match poles
- West Coast Electric WCE 60 MUNI-STL for Streetlight Services
- WCE 100 MUNI-TCP for Signal/Streetlight Services
- WCE STL3301 for Pole Mount Streetlight Services
- WCE TCP5301 for Pole Mount Signal and Streetlight Services

UNINTERRUPTED POWER SUPPLY

- Required for all signals
- Segregated by its own breaker
- Cabinet Heater not included in UPS circuit
- Alpha FXM1100 48V, c/w Battery Cable Kit, Rack mount kit, 4x 195 XTV batteries. Batteries
- The battery Cable Kit to be with Integrated Alpha Guard
- S6 natural aluminum enclosure with Generator door, bolt-on to side of cabinet. Service pad to be provided. S6 cabinet should be powder coated gray.
- Cabinet heater should be separated from the UPS.
- The XTV and HP (or equivalent) batteries are required to provide following benefits:
 - Non-spillable, non-hazardous rating. Safe to transport vs UN2794 rating for GXL

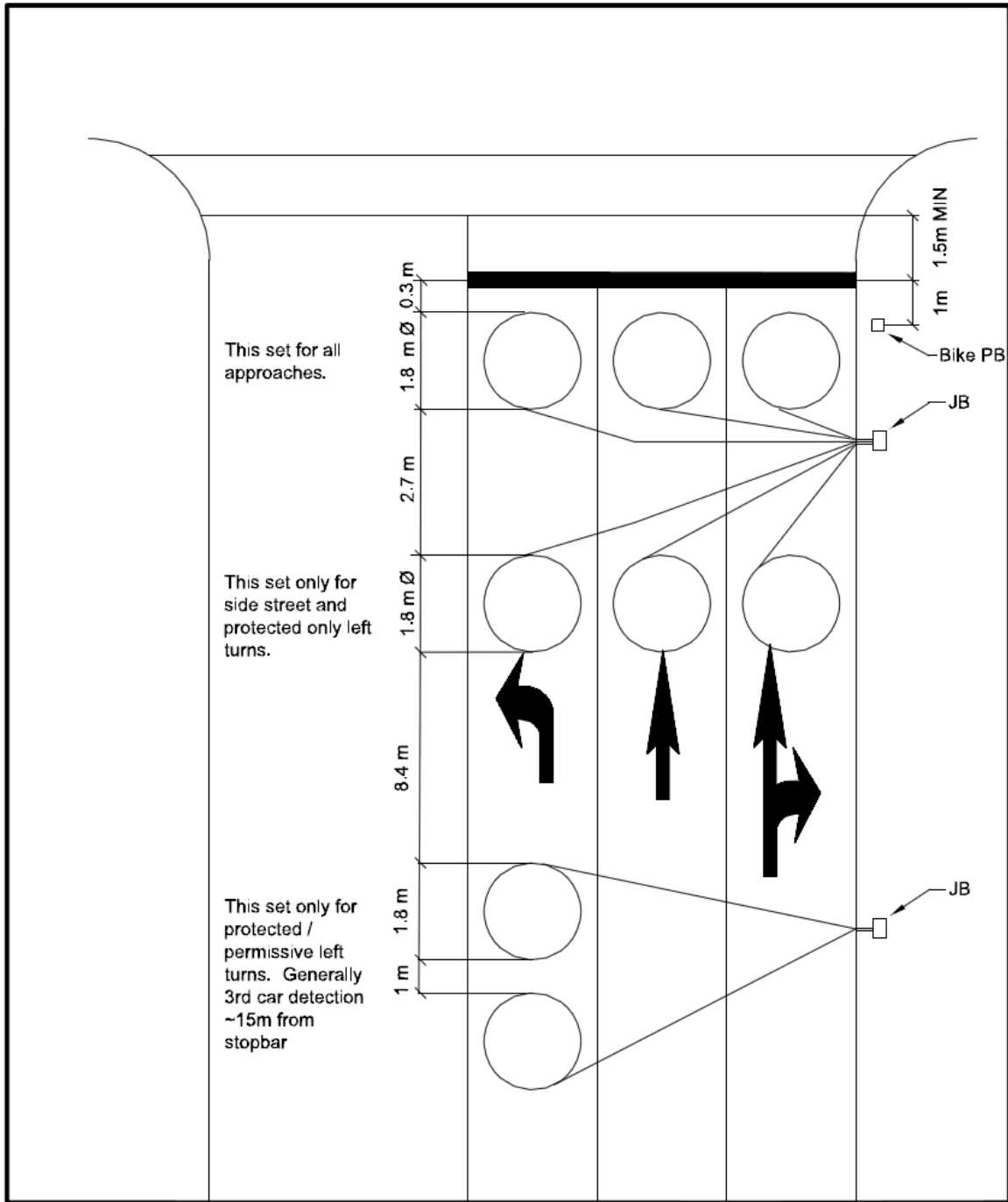
- 4-year warranty for XTV and HP in approved countries outside North America vs. 2-year warranty for GXL
- Up to 4% improvement in amp-hour capacity over GXL (C/20 Rate)
- Up to 9% or 20 minutes improvement in Outside Plant CATV runtime minutes over GXL
- Same dimensions – in order to physically fit in current GXL applications
- Improved float design life; 2-year improvement over current GXL design
- The batteries should be created for float service applications in non-temperature controlled environments.
- The UPS system should include a Battery Charge Management System (BCMS) such as Alpha Guard (or equivalent) in order to enable following:
 - Extends battery life
 - Replace single batteries, not the entire string
 - Spreads charge voltage equally across batteries
 - Compensates for battery differences as they age
 - Optional status-monitoring communications-interface modules
 - Safe unattended operation designed to CSA C22.2 No. 107.1 and UL 1778 Standards
- The AlphaGuard (or equivalent BCMS) should employ a Charge Management Technology (CMT) to shuttle excess charge current to batteries requiring a greater charge, and is to be contained in a small plastic enclosure that installs directly on top of one the batteries in the string. A short service cable should connect the AlphaGuard to each of the batteries in the string. Both 36VDC (3 battery) and 48VDC (4 battery) should be available. One AlphaGuard to be required per string. The AlphaGuard is to be configured with the optional voltage sense cabling and interface module (DSM, ESM, EDSM or External DOCSIS®) to allow the AlphaGuard to interface with a status-monitoring module. Two AlphaGuard modules can be connected to an interface module.

COMMUNICATIONS

- Communications to be via 24C single mode fiber optic cable. Where this is impractical and has been agreed to by the City’s representative, Intuicom Nitro 5.8Ghz wireless communications can be substituted.
- In-ground vaults for communications to be Channell SGLB2436 or Type 66
- A 3” conduit shall be provided from the cabinet to the vault and from the vault along the extents of all new curb and sidewalk, alongside existing 2” where existing. Traceable pull tape required in all comm. conduits. All comm. conduit shall terminate in a vault.
- Ethernet switches to be iS5 iTS12GP-8PGRJ45-4GSFP c/w DIN rail mount power supply (1 new switch iS5 iTS12GP-8PGRJ45-4GSFP, 1 SFP Module, and 1 new Power Converter. These devices are necessary to enable the communicate on work. They can be purchased from the [BC distributor Smart Cities \(contact is Warren \[warren@smartcityits.com\]\(mailto:warren@smartcityits.com\)\)](#).
- Where any works are performed in the vicinity of existing fiber optics, a post-construction inspection of the communications conduit will be required at contractor’s expens

DETECTION

- Cyclist pushbuttons to be Polara Bulldog (non-latching) provided on all minor street approaches, button plate to be white with black graphics
- Polara iNavigator 2-Wire System to be used for the APS. Audible pedestrian buttons are required at all intersections and to be Polara Navigator 2 wire model, with iCCU-S. Separate, individual neutrals are required for each button.
- Vehicle detector loops to be 1.8m round style arranged as shown on next page
- Video detection when specified to be Autoscope/Econolite – video detection specs to be confirmed with Traffic Engineer or Transportation Technologist. Optimum mounting height 12m. Loop stubs and junction boxes still to be provided as detailed on next page.



THE CITY OF NORTH VANCOUVER

DES: DW	ENG: DM	DETECTOR LOOP DIMENSIONS TYPICAL	Drwg No. LOOPDIM
DRN: DW	DATE: 03-Oct-15		SHEET No.
CHK: PG	SCALE: N.T.S.		1 OF 1

SIGNS AND MARKINGS

- All overhead signs to have safety cable
- New traffic signal installations to have 'New Signal in Operation' signs installed on each primary pole and advanced 'Signal Ahead' signs installed for each approach prior to startup
- Double sided overhead street name signs will be supplied by the City of North Vancouver, double sided hangers to be supplied and installed by the contractor
- Overhead signs (i.e. street name tabs and other overhead traffic signs) to have Greenlight hangers and safety cables
- Markings to be thermoplastic, signage to be diamond grade

JUNCTION BOXES AND CONDUIT

- Traffic Signal and Streetlighting boxes to be concrete type 37, 66 or 67 with steel lids stamped Traffic Signal, Streetlighting, or Comm. as appropriate
- No fuses shall be placed in a junction box
- Conduits shall enter box from the bottom
- Conduits shall have bell ends installed
- Drainage through the bottom is required, conduit openings to be higher than drain
- Conduit stub-outs shall terminate in a junction box

POLES

- Poles to be galvanized and powder coated black, unless otherwise specified

ELECTRICAL WIRING

Solid or stranded copper traffic signal cable to be used per E7.13 (platinum). Identifiers on conductor insulation to be resistant to wear or removal. All cable and conductors shall be CSA approved.

SIGNAL HEAD DISPLAYS

To be 300 mm incandescent look LED displays. Red, amber, and green balls and bi-modal arrows to be clear. All LED modules shall be of a single brand. Housings to be polycarbonate black. Each through lane to have a primary signal head display. In addition to the primary and secondary, a new tertiary signal head to be added (right-hand side) where possible.

Side of pole fastening hardware to be aluminum tubular arms, elbows and universal pole plate using 3/4" wide Band-It. All hardware to be black. Signal cable used in side-of-pole installations to be installed with Entrance Cap. See MMCD dwg. E5.3 (platinum).

Overhead displays to be mounted with CAN-BRAC cable clamp mounting hardware. All primary vehicle signal heads to be equipped with yellow backboards and three inch (76 mm) wide

fluorescent yellow diamond grade retro-reflective tape around perimeter of backboard on side facing the controlled traffic.

Countdown Pedestrian heads to be 300 mm square LED displays stacked vertically. Housings to be installed using 3/4" wide Band-It and appropriate aluminum brackets. Signal cable to be installed with Entrance Cap see MMCD dwg. E5.3 (platinum).

STREET LIGHTING – REFER TO DOCUMENT 1590859 FOR UPDATED STREET LIGHTING DESIGN GUIDELINE

SIGNAL CONTROLLER AND MMU PROGRAMMING

Traffic signal controller - McCain's ATC eX2 TS2 Type 1 controllers NEMA

If cabinet is supplied by contractor, Controller and MMU data key programming to be coordinated by designer – City staff to be contacted by contractor for final approval of the product.

SPECIAL CROSSWALKS / RRFB

RRFB systems to be JSF 120V AC and have MUTCD IA-11 compliant flash pattern.

Special Crosswalk controller to be Novax PXO-II controller combined with Polara Bulldog push buttons, with button plate to be white with black graphics.

TRAFFIC SIGNAL CONTROLLER CABINET

- Cabinet to be Extended M-Type
- City to be contacted for electronic image of the cabinet wrapping
- Service pad to be provided
- A 3" wide x 1/4" thick neoprene gasket shall be installed between the signal cabinet and the concrete base. The outside perimeter of the signal cabinet and concrete base joint shall be sealed with silicone sealant. Duct seal to be applied to conduits inside signal cabinet.
- Controller to be a McCain ATCex NEMA with Omni software
- Load switches supplied shall have indicators for inputs and outputs, 1 load switch per phase +1 spare
- An ethernet port shall be provided
- A bolt-on resistance heater shall be provided and controlled by a thermostat fed from a non-UPS powered circuit
- A cabinet exhaust fan shall be provided and controlled by a thermostat fed from the UPS circuit
- The Power Distribution Assembly shall include 2x model 204 flashers

- Each input assembly (2 required) shall include, 12x model 222 vehicle detector modules, 2x model 242 DC isolators
- 1x GFCI and 1x non-GFCI receptacle shall be supplied
- Door switches for detector and pedestrian inputs, signal ON/OFF, Flash/Auto, Stop Time and Advance shall be provided
- Emergency Vehicle pre-emption equipment is required for all signals and is to be Novax eMVPod, programming and testing by Novax.

TRAFFIC SIGNAL CABINET DETAILS

1. Introduction

- This specification outlines our requirements for NEMA TS2 Type 1 modular cabinet assemblies. The complete cabinet assembly shall be pre-approved by the City and manufactured by an ISO certified company. Factory QPS inspection based on CSA model code SPE-1000 for the field evaluation of electrical equipment shall be performed and the cabinet labeled. The complete assembly will be supplied direct from the manufacturer and tested under full load per documented ISO procedures.
- The cabinet assembly shall meet, as a minimum, all applicable sections of the NEMA TS2-2003 Standard Publication (or newer) version. Where differences occur, this specification shall govern. The MXX cabinet assembly shall include a 16 position 16 channel main panel complete with two (2) bus interface units, twelve (12) dual indication load switch, one (1) flasher, four (4) flash relay, One (1) 16 channel NEMA TS2 detector rack complete with one (1) bus interface unit, One (1) 8 channel NEMA TS2 detector rack complete with one (1) bus interface unit, (1) 2 position hardwired GPS rack, NEMA TS2 power supply and cabinet auxiliary power supply.
- UPS, GPS, Controller, Detection and Pre-emption equipment is not included. This specification sets forth the minimum requirements for a TS2 Type 1 traffic control modular cabinet assembly. The cabinet assembly shall meet, as a minimum, all applicable sections of the NEMA Standard Publication No. TS2-2003. Where differences occur, this specification shall govern.

2. Cabinet Design and Construction

- 2.1. The cabinet shall be constructed from type 5052-H32 aluminum with a minimum thickness of 0.125 inches.
- 2.2. The cabinet shall be designed and manufactured with materials that will allow rigid mounting, whether intended for pole, base or pedestal mounting. The cabinet must not flex on its mount.
 - 2.2.1. A rain channel shall be incorporated into the design of the main door opening to prevent liquids from entering the enclosure. The cabinet door opening must be a minimum of 80 percent of the front surface of the cabinet. A stiffener plate shall be welded across the inside of the main door to prevent flexing.
 - 2.2.2. The top of the cabinet shall incorporate a 1-inch slope toward the rear to prevent rain accumulation.
- 2.3. Unless otherwise specified, the cabinet shall be supplied with a grey exterior and white interior finish. Sufficient care shall be taken in handling to ensure that scratches are minimized. All surfaces shall be free from weld flash. Welds shall be smooth, neatly formed,

free from cracks, blowholes and other irregularities. All sharp edges shall be ground smooth.

- 2.4. Where painted cabinets are specified, the exterior shall be degreased and primed with a spray applied iron phosphate coat- equivalent to a four-stage iron phosphate coat prior to painting. The final coat shall consist of a powder coat paint (TGIC or equivalent) applied with a minimum thickness of 2 mils.
- 2.5. All seams shall be sealed with RTV sealant or equivalent material on the interior of the cabinet. **TRAFFIC CABINET EQUIPMENT AND SPECIFICATIONS**
- 2.6. All cabinets shall be supplied with a minimum of three removable shelf manufactured from 5052-H32 aluminum with the top 2 shelves moved up 3 inches from their regular position to allow more room on the 3rd shelf. The shelf shall be a minimum of 10 inches deep.
- 2.7. The shelf shall have horizontal slots at the rear and vertical slots at the front of the turned down side flange. The shelf shall be installed by first inserting the rear edge of the shelf on the cabinet rear sidewall mounting studs, then lowering the shelf on the front sidewall mounting studs. The shelf shall be held in place by a nylon tie-wrap inserted through holes on the front edge of the shelf and around the front sidewall mounting studs.
- 2.8. An aluminum sliding computer shelf and document enclosure shall be provided under the bottom shelf and a collapsible/lockable computer shelf mounted on the left door.
- 2.9. The front edge of the shelf shall have holes punched every 6 inches to accommodate tie-wrapping of cables/harnesses.
- 2.10. A minimum of two set of vertical pre-punched channels shall be mounted on each interior wall of the cabinet for the purpose of mounting the cabinet components. The holes shall be spaced every ½”.
- 2.11. The main door and police door-in-door shall close against a weatherproof and dust-proof, closed-cell neoprene gasket seal. The gasket material for the main door shall be a minimum of 0.250 inches thick by 1.00 inch wide. The gasket material for the police door shall be a minimum of 0.250 inches thick by 0.500 inches wide. The gaskets shall be permanently bonded to the cabinet.
- 2.12. The lower section of the cabinet shall be equipped with a louvered air entrance. The air inlet shall be large enough to allow sufficient air flow per the rated fan capacity. Louvers must satisfy the NEMA rod entry test for 3R ventilated enclosures. A non-corrosive, vermin- and insect-proof, removable air filter shall be secured to the air entrance. The filter shall fit snugly against the cabinet door wall.
- 2.12.1 A Fram filter model# CA4767 or Beck and Arnley equivalent shall be firmly secured to a one-piece combination summer/winter vent plate. The vent plate shall be supplied complete with gasket and provide a tight seal against the door lovers by 4 nylon lock wing nuts.
- 2.13. The roof of the cabinet shall incorporate an exhaust plenum with a vent screen. Perforations in the vent screen shall not exceed 0.125 inches in diameter.
- 2.14. The main door on a size 3 or larger cabinet shall be equipped with a three-point latching mechanism.
- 2.15. The handle on the main door of the cabinet shall be manufactured from cast aluminum or stainless steel. The handle shall include a hasp for the attachment of an optional padlock. The cabinet door handle shall rotate counter-clockwise to open. The handle shall not extend beyond the perimeter of the main door at any time. The lock assembly shall be positioned so

that the handle shall not cause any interference with the key when opening the cabinet door.

- 2.16. The main door hinge shall be a one-piece, continuous piano hinge with a stainless-steel pin running the entire length of the door. The hinge shall be attached in such a manner that no rivets or bolts are exposed.
 - 2.17. The main door shall include a mechanism capable of holding the door open at approximately 90, 145, and 165 degrees under windy conditions. The main door of a size 3, or 4 cabinet shall include a mechanism capable of holding the door open at approximately 90 and 165 degrees under windy conditions. May be provided with two doors, one front, one back.
 - 2.18. The main door shall be equipped with a Corbin tumbler lock number 1548-1 or exact equivalent. Minimum of two keys shall be supplied. TRAFFIC CABINET EQUIPMENT AND SPECIFICATIONS
 - 2.19. The police door-in-door shall be provided with a treasury type lock Corbin No. R357SGS or exact equivalent and has a minimum of one key.
 - 2.20. All base mounted cabinets require anchor bolts to properly secure the cabinet to its base. The cabinet flange for securing the anchor bolts shall not protrude outward from the bottom of the cabinet. When a size 3, 4, or 5 cabinet is base mounted, two anchor bolts shall be required for proper installation. Size 6 and 7 cabinets, four anchor bolts shall be required for proper installation.
 - 2.21. Each MXX cabinet shall be of sufficient size to accommodate all equipment. At a minimum, the minimal cabinet size is as follows:
 - • 76" H x 30" W x 17" D
 - 3.4. All load switch and flash transfer relay socket reference designators shall be silk-screen labeled on the front and rear of the main panel to match drawing designations. Socket pins shall be marked for reference on the rear of the panel.
 - 2.22. Main door shall incorporate a shroud to cover the filtered louvered openings as appropriate for the design. The assembly is secured on the interior of the door over the filtered Louvers. The Shroud is louvered downward and matches the door louvers.
 - 2.23. All enclosures must be constructed, approved and marked in accordance with the requirements for Type 1 Industrial Control Panel Enclosures contained in UL 508A, the Standard for Industrial Control Panels. Enclosure must meet NEMA 3R rating requirements and be marked with UL approval sticker.
3. Terminals and Facilities/Main Panel Design and Construction
- 3.1. The main panel shall be constructed from 5052-H32 brushed aluminum of 0.125 inches minimum thickness and installed to minimize flexing when plug-in components are installed.
 - 3.2. All main panels are provided with a mounting mechanism which allows easy access to all wiring on the rear of the panel. Lowering of the main panel can be accomplished without the use of hand tools. Complete removal can be accomplished by the use of simple hand tools.
 - 3.3. The terminals and facilities shall be available as a minimum in the following configurations:
 - a. Configuration #3 - Twelve load switch sockets with fused advanced warning x2 (Part number CK631G60 - 8 ph. 12 Pos. 16ch, Fused, adv. warning x 2), six flash transfer relay sockets, one flasher socket, 2- BIU sockets, one 16-channel detector rack with one BIU, and one Type-16 MMU TRAFFIC CABINET EQUIPMENT AND SPECIFICATIONS

- 3.4. All load switch and flash transfer relay socket reference designators shall be silk-screen labeled on the front and rear of the main panel to match drawing designations. Socket pins shall be marked for reference on the rear of the panel.
- 3.5. A maximum of eight load switch sockets may be positioned horizontally or stacked in two rows on the main panel. Main panels requiring more than eight load switch sockets shall be mounted in one horizontal row.
- 3.6. All load switches shall be supported by a bracket, extending at least half the length of the load switch.
- 3.7. The 4- and 8- load switch position main panels shall have all field wires contained within one or two row(s) of horizontally mounted terminal blocks.
- 3.8. The 12- and 16-load switch position main panels shall have all field wires contained on two rows of horizontally mounted terminal blocks. The upper row shall be wired for the pedestrian and overlap field terminations. The lower row shall be reserved for phase one through phase eight vehicle field terminations.
- 3.9. As an alternate a 12 or 16 position horizontal main panel and field terminal configuration may be used.
- 3.10. All field output circuits shall be terminated on a non-fused barrier type terminal block with a minimum rating of 10 amps.
- 3.11. All field input/output (I/O) terminals shall be identified by permanent alphanumeric labels. All labels shall use standard nomenclature per the NEMA TS2 specification.
- 3.12. It shall be possible to flash either the yellow or red indication on any vehicle movement and to change from one color indication to the other by use of a screwdriver.
- 3.13. Field terminal blocks shall be wired to use four positions per vehicle or overlap phase (green, yellow, and red, flash). It shall not be necessary to de-buss field terminal blocks for flash programming.
- 3.14. The main panel shall contain at least one flasher socket (silk screen labeled) capable of operating a 15-amp, 2-pole, NEMA solid-state flasher. The flasher shall be supported by a bracket, extending at least half its length.
- 3.15. One RC network shall be wired in parallel with each group of three flash-transfer relays and any other relay coils.
- 3.16. All logic-level, NEMA-controller and Malfunction Management Unit input and output terminations on the main panel shall be permanently labeled. Cabinet prints shall identify the function of each terminal position.
- 3.17. At a minimum, three 20-position terminal blocks shall be provided at the top of the main panel to provide access to the controller unit's programmable and non-programmable I/O. Terminal blocks for DC signal interfacing shall have a number 6-32 x 7/32-inch screw as minimum.
- 3.18. All main panel wiring shall conform to the following wire size and color:
 - • Green/Walk load switch output - brown wire - 14 gauge
 - • Yellow load switch output - yellow wire - 14 gauge
 - • Red/Don't Walk load switch - red wire output - 14 gauge
 - • MMU (other than AC power) - violet wire - 22 gauge
 - • Controller I/O - blue wire - 22 gauge
 - • AC Line (power panel to - black wire main panel) - 8 / 10 gauge
 - • AC Line (main panel) - black wire - 10 gauge
 - • AC Neutral (power panel to - white wire main panel) - 8 / 10 gauge

- • AC Neutral (main panel) - white wire - 10 gauge
- • Earth ground (power panel) - green wire - 8 gauge
- • Logic ground - gray wire - 22 gauge
- • Flash programming - Orange wire
- • Flasher terminal - Black wire red or yellow field terminal - 14 gauge
- 3.19. All wiring, 14 AWG and smaller, shall conform to MIL-W-16878/1, type B/N, 600V, 19-strand tinned copper. The wire shall have a minimum of 0.010 inches thick PVC insulation with clear nylon jacket and rated to 105 degrees Celsius. All 12 AWG and larger wire shall have UL listed THHN/THWN 90 degrees Celsius, 600V, 0.020 inches thick PVC insulation and clear nylon jacketed.
- 3.20. Connecting cables shall be sleeved in a braided nylon mesh or poly-jacketed. The use of exposed tie-wraps or interwoven cables is unacceptable.
- 3.21. All Terminals and Facilities configurations shall be provided with BIU wiring assignments consistent with NEMA TS2-1998 specifications.
- 3.22. All Terminals and Facilities configurations shall be provided with sufficient RS-485 Port 1 communication cables to allow for the intended operation of that cabinet. Each communication cable connector shall be a 15-pin metal shell D subminiature type. The cable shall be a shielded cable suitable for RS-485 communications.
- 3.23. All main panels shall be pre-wired for a Type-16 Malfunction Management Unit.
- 3.24. All wiring shall be neat in appearance. All cabinet wiring shall be continuous from its point of origin to its termination point. Butt type connections/splices are not acceptable.
- 3.25. All connecting cables and wire runs shall be secured by mechanical clamps. Stick-on type clamps are not acceptable.
- 3.26. The grounding system in the cabinet shall be divided into three separate circuits (AC Neutral, Earth Ground, and Logic Ground). These ground circuits shall be connected together at a single point as outlined in the NEMA TS2 Standard.
- 3.27. The main panel shall incorporate a relay, designated as K1, to remove +24 VDC from the common side of the load switches when the intersection is placed into mechanical flash. The relay shall have a momentary pushbutton to apply power to the load switch inputs for ease of troubleshooting. The relay shall have a momentary pushbutton to apply power to the load switch inputs for ease of troubleshooting.
- 3.28. All pedestrian push button inputs from the field to the controller shall be opto-isolated through the BIU and operate at 12 VAC.
- 3.29. All wire (size 16 AWG or smaller) at solder joints shall be hooked or looped around the eyelet or terminal block post prior to soldering to ensure circuit integrity. Lap joint soldering is not acceptable.
- 3.30. Ten (10) stainless steel shorting clips shall be included for use in unused flash transfer relay or load switch sockets.
- 3.31. All 120VAC field signal output terminal blocks shall be covered with Lexan type polycarbonate for safety.
- 3.32. Controller power harness adaptor shall be included to allow for use of a TS2 Type 2 controller. This 10 pin MS to 55 pin MS connectors will connect to the TS2 Type 1 controller power harness.
- 3.33. A 4 position Marathon terminal block model 1504STD shall be supplied to provide spare filtered 120VAC. It will be mounted on an aluminum plate, complete with Lexan type polycarbonate cover, 4-amp inline fuse and holder and positions labeled.

4. Power Panel Design and Construction

- 4.1. The power panel shall integrate into the main panel and be located on the lower right portion of the cabinet. The power panel shall be wired to provide the necessary filtered power to the load switches, flasher(s), and power bus assembly. The power components shall be equipped with a removable plastic front cover for technician protection. The design will allow a technician to access the main and auxiliary breakers without removing the protective front cover.
- 4.2. The power panel portion of the main panel shall include the following components:
 - a) A minimum of a 40-amp main breaker for 12- or 16- position cabinets or a minimum of a 30-amp breaker for 4- or 8-position cabinets. This breaker shall supply power to the controller, MMU, signals, cabinet power supply and auxiliary panels. Breakers shall be at minimum, a thermal magnetic type, U.L. listed for HACR service, with a minimum of 10,000-amp interrupting capacity.
 - b) A minimum of one (1) 15-amp auxiliary breaker. This breaker shall supply power to the fan, light and GFI utility outlet.
 - c) An EDCO model SHP-300-10 or exact approved equivalent surge arrester.
 - d) A 50-amp, 125 VAC radio interference line filter.
 - e) A normally-open, 75-amp, Solid State Signal buss relay. The SSR shall be a Crydom Model # HA4875H or approved equal.
 - f) A minimum of one (1) 8-position neutral bus bar capable of connecting three #12 wires per position.
 - g) A minimum of one (1) 6-position ground bus bar capable of connecting three #12 wires per position.
 - h) A minimum of one (1) NEMA type 5-15R GFI utility outlet.

5. Power Bus Assembly

- 5.1. The power bus assembly shall be manufactured from 0.090", 5052-H32 aluminum. It shall provide filtered power for the controller, malfunction management unit, cabinet power supply, and all auxiliary equipment. It shall include the SDLC Bus connecting cables wired into a surface-mounted terminal block. As an alternate SDLC Bus connections may be made via an SDLC Hub Assembly.
- 5.2. The Power Bus Assembly shall house the following components:
 - a. A minimum of three and a maximum of six power connectors.
 - b. Two terminal strips to hardwire the power connections.
 - c. SDLC terminal block with pre-wired cables or SDLC Hub Assembly
- 5.3. All cabinet equipment requiring filtered power to operate shall be connected to the power bus assembly by an AMP/TYCO type connector or approved equivalent. The Power Bus Assembly shall house a minimum of three and a maximum of six AMP/TYCO type power connectors and two terminal strips to hardwire the power connections.
- 5.4. A SDLC Hub Assembly shall include a minimum of six (6) SDLC harnesses (maximum of eight) each with a metal D-Subminiature Female 15 pin (DB15) AMP connector on both ends complete with rubber grommet to provide a tight seal against the wire insulation. A

compression type terminal block shall be included to allow additional SDLC harness to be hardwired.

6. Auxiliary Cabinet Equipment

- 6.1. The cabinet shall be provided with a thermostatically controlled (adjustable between 55-160 degrees Fahrenheit) ventilation fan in the top of the cabinet plenum. The fan plate shall be removable with the use of simple hand tools for serviceability. A minimum of one exhaust fan shall be provided. The fan shall be a ball bearing type fan and shall be capable of drawing a minimum of 100 cubic feet of air per minute. The Fan/Thermostat assembly shall be connected to the Power panel by means of a 4-position plug-in cable.
- 6.2. Four (4) 150watt silicone film heaters complete with aluminum mounting plate will be supplied.
- 6.3. Stego model# ZR-011 dual heater/fan thermostat shall be supplied. One (1) exhaust fan complete with a metal safety shield shall be provided. The fans shall be a ball bearing type and shall be capable of drawing a minimum of 100 cubic feet of air per minute (CFM).
- 6.4. LED cabinet lighting shall be provided with two (2) strips connected to a NC cabinet door micro switch. One strip located at the cabinet top and under the second shelf, Dialight model CL2-CF-TC2 or approved equivalent.
- 6.5. A resealable print pouch shall be mounted to the door of the cabinet. The pouch shall be of sufficient size to accommodate one complete set of folded cabinet prints.
- 6.6. A minimum of two sets of complete and accurate cabinet drawings shall be supplied with each cabinet.

7. Vehicle Detection

- 7.1. A minimum of one Loop Detector Rack shall be provided in each cabinet. Detector racks shall be available in two configurations. These configurations shall be integrated on top left side portion of the main panel.
 - a. Configuration #1 - Shall support up to eight channels of loop detection (either four 2 channel detectors or two 4 channel detectors), two 2-channel preemption devices, and one BIU. This configuration shall be included as a standard on the 8-position main panel assembly.
 - b. Configuration #2 - Shall support up to 16 channels of loop detection (either eight 2 channel detectors or four 4 channel detectors), two 2-channel preemption devices and one BIU. This configuration shall be included as a standard on the 12 or 16 position main panel assembly. TRAFFIC CABINET EQUIPMENT AND SPECIFICATIONS
- 7.2. Detector rack BIU mounting shall be an integral part of the detector rack.
- 7.3. All BIU rack connectors shall have jumper address pins corresponding to the requirements of the TS2 specification. The jumpers may be moved to change the address of any individual rack. The address pins shall control the BIU mode of operation. BIUs shall be capable of being interchanged with no additional programming.
- 7.4. Each cabinet shall contain detector interface panels for the purpose of connecting field loops and Loop Detector Racks. The panels shall be manufactured from FR4 G10 fiberglass, 0.062 inches thick, with a minimum of 2 oz. of copper for all traces.
- 7.5. One 8-position interface panel shall be provided for an 8-channel rack cabinet and one 16-position interface panel shall be provided for a 16-channel rack cabinet. The interface panel shall be secured to a mounting plate and attached to the left wall of the cabinet.

- 7.6. Each interface panel shall allow for the connection of eight or sixteen independent field loops. A ground bus terminal shall be provided between each loop pair terminal to provide a termination for the loop lead-in cable ground wire.
 - 7.7. Each interface panel shall provide a 10-position terminal block to terminate the field wires for up to two 2-channel preemption devices.
 - 7.8. Lightning protection device mounting holes shall be provided to accommodate an Edco SRA-16C, or Edco SRA-6, or Edco LCA-6, or a varistor lightning protection device. Lightning protection devices shall not be provided unless specifically called for in the special provisions of this specification.
 - 7.9. A cable consisting of 20 AWG twisted pair wires shall be provided to enable connection to and from the panel to a detector rack. The twisted pair wires shall be color coded red and white wire.
 - 7.10. All termination points shall be identified by a unique number and silk screened on the panel.
 - 7.11. Each detector rack shall accommodate rack mountable preemption devices such as EMTRAC or Opticom.
 - 7.12. Each detector rack shall be powered by the cabinet power supply and be connected to the power bus assembly by means of a 12-pin Molex Robotic type connector Model# 54332-1270 or exact equivalent.
8. Cabinet Test Switches and Police Panel
- 8.1. A test switch panel shall be mounted on the inside of the main door. The test switch panel shall provide as a minimum the following:
 - a. SIGNALS ON/OFF SWITCH - In the OFF position, power shall be removed from signal heads in the intersection. The controller shall continue to operate. When in the OFF position, the MMU shall not conflict or require reset.
 - b. AUTO/FLASH SWITCH - When in the flash position, power shall be maintained to the controller and the intersection shall be placed in flash. The controller shall not be stop timed when in flash. Wired according to NEMA-TS2-2003 the MMU forces the controller to initiate the start-up sequence when existing flash.
 - c. STOP TIME SWITCH - When applied, the controller shall be stop timed in the current interval.
 - d. CONTROL EQUIPMENT POWER ON/OFF - This switch shall control the controller, MMU, and cabinet power supply AC power. i. Momentary test push buttons for all vehicle and pedestrian inputs to the controller are not required. The TS2 controller to be provided with the cabinet assembly shall provide vehicular and pedestrian call inputs from its keyboard while in the standard status display.
 - 8.2. The police door switch panel shall contain the following:
 - a. SIGNALS ON/OFF SWITCH - In the OFF position, power shall be removed from signal heads in the intersection. The controller shall continue to operate. When in the OFF position, the MMU shall not conflict or require reset.
 - b. AUTO/FLASH SWITCH - When in the flash position, power shall be maintained to the controller and the intersection shall be placed in flash. The controller shall be stop timed when in flash. Wired according to NEMA-TS2-1998 the MMU forces the controller to initiate the start-up sequence when exiting flash.
 - c. AUTO/MANUAL SWITCH - Cabinet wiring shall include provisions for an AUTO/MANUAL switch and a momentary push button or hand cord. The AUTO/MANUAL switch and push

button or hand cord shall not be provided unless it is called for in the CUSTOMER SPECIFICATION.

- d. COORD/FREE SWITCH - Cabinet wiring shall include provisions for COORD/FREE switch. The COORD/FREE switch shall not be provided unless it is called for in the CUSTOMER SPECIFICATION. TRAFFIC CABINET EQUIPMENT AND SPECIFICATIONS
- 8.3. All toggle type switches shall be heavy duty and rated 15 amps minimum. Single- or double-pole switches may be provided, as required.
- 8.4. Any exposed terminals or switch solder points shall be covered with a non-flexible shield to prevent accidental contact.
- 8.5. All switch functions must be permanently and clearly labeled.
- 8.6. All wire routed to the police door-in-door and test switch push button panel shall be adequately protected against damage from repetitive opening and closing of the main door.
- 8.7. All test switch panel wiring shall be connected to the main panel via a 50-pin Molex Robotic type connector Model# 54332-5001, or exact equivalent.
- 8.8. Wiring from the main panel to the test switch panel shall be connected to the switch panel via an AMP/TYCO type connector or approved equivalent
- 8.9. 12 main door test switches Test On/Off/Momentary mini switch (veh + ped + preempt). 9.1.1. Twelve (12) Load switches shall be solid state and shall conform to the requirements of Section 6.2 of the NEMA TS2 Standard.
- 9. Auxiliary Devices
 - Load Switches
 - 9.1.1. Twelve (12) Load switches shall be solid state and shall conform to the requirements of Section 6.2 of the NEMA TS2 Standard.
 - 9.1.2. Signal load switches shall have a minimum rating of 10 amperes at 120 VAC for an incandescent lamp load.
 - 9.1.3. The front of the load switch shall be provided with three indicators to show the input signal from the controller to the load switch.
 - 9.1.4. Load switches shall be dedicated per phase. The use of load switches for other partial phases is not acceptable.
 - 9.1.5. The full complement of load switches shall be supplied with each cabinet to allow for maximum phase utilization for which the cabinet is designed.
 - Flashers
 - 9.1.6. One (1) flasher shall be solid state and shall conform to the requirements of section 6.3 of the NEMA TS2 Standard.
 - 9.1.7. Flashing of field circuits for the purpose of intersection flash shall be accomplished by a separate flasher.
 - 9.1.8. The flasher shall be rated at 15 amperes, double pole with a nominal flash rate of 60 FPM.
 - Flash Transfer Relays
 - 9.1.9. Two (2) flash transfer relays shall meet the requirements of Section 6.4 of the NEMA TS2 Standard.
 - 9.1.10. The coil of the flash transfer relay must be de-energized for flash operation.
 - 9.1.11. The full complement of relays shall be supplied with each cabinet to allow for maximum phase utilization for which the cabinet is designed.
 - Malfunction Management Units (MMU)

- 9.1.12. Each cabinet assembly shall be supplied with one MMU as defined by the requirements of Section 4 of the NEMA TS2 Standard.
 - 9.1.13. Malfunction Management Units shall be a Type 16. The MMU shall be Econolite Control Products, Inc. Model MMU 16ch LCD & I.P. (EDI MMU16LEIP-E-CAN) or approved equal.
 - Bus Interface Units (BIU) TRAFFIC CABINET EQUIPMENT AND SPECIFICATIONS
 - 9.1.14. Two (2) BIU's shall meet the requirements of Section 8 of the NEMA TS2 Standard.
 - 9.1.15. The full complement of Econolite Control Products, Inc. Model 32860G1 Bus Interface Units shall be supplied with each cabinet to allow for maximum phase and function utilization for which the cabinet is designed.
 - 9.1.16. Each Bus Interface Unit shall include power on, transmit and valid data indicators. All indicators shall be LEDs.
 - Cabinet Power Supply
 - 9.1.17. One (1) cabinet 2 Amp power supply shall meet the requirements of Section 5.3.5 of the NEMA TS2 Standard.
 - 9.1.18. The cabinet power supply shall provide LED indicators for the line frequency, 12 VDC, 12 VAC, and 24 VDC outputs.
 - 9.1.19. The cabinet power supply shall provide (on the front panel) jack plugs for access to the +24 VDC for test purposes.
 - 9.1.20. One Econolite Control Products, Inc. Model 1084-003 (EDI – PS-200-E) cabinet power supply shall be supplied with each cabinet assembly and shall be wired directly to the Power Bus Assembly via a 12-pin Molex Robotic type connector Model# 54332-1270 or exact equivalent.
10. Testing and Warranty
- 10.1.1. Each controller and cabinet assembly shall be tested as a complete entity under signal load for a minimum of 48 hours.
 - 10.1.2. Each assembly shall be delivered with a signed document detailing the cabinet final tests performed.
 - 10.1.3. The cabinet shall be assembled and tested by the controller manufacturer or authorized local distributor to ensure proper component integration and operation.
 - 10.1.4. The controller and Malfunction Management Unit shall be warranted by the manufacturer against mechanical and electrical defects for a period of two years from date of shipment. The manufacturer's warranty shall be supplied in writing with each cabinet and controller. Second party extended warranties are not acceptable.
 - 10.1.5. The cabinet assembly and all other components shall be warranted for a period of one year from date of shipment.
 - 10.1.6. Any defects shall be corrected by the manufacturer or supplier at no cost to the owner