

SECTION 34 41 13 (Rev. 1)  
(Modified December 31, 2019)

TRAFFIC SIGNALS, CONTROLLER, AND CABINET

PART 1 - GENERAL

1.1 DESCRIPTION

- A. The section covers most work related to traffic signals including signal heads, field wiring, conduits, signal controller, cabinet assemblies, battery back-up systems, and red-light running cameras. Installation and testing specifications are included in Part 3: Execution for some of the equipment.
- B. The Contractor shall perform all traffic signal and related work shown on the Drawings in accordance with the workmanship requirements of SSDPWSF Part 6 and related sections and 2018 Caltrans Standard Specifications (CTSS) Sections 86 and 87.

1.2 OTHER SECTIONS WITH RELATED WORK

- A. Section 01 55 26 – Traffic Control
- B. Section 31 23 33 – Trenching and Backfilling
- C. Section 34 41 14 – Communications Network and ITS Equipment
- D. Section 26 04 00 – Electrical General Provisions
- E. Section 26 05 00 – Electrical Materials and Methods
- F. Section 26 56 19 – Roadway Lighting

1.3 EFFECT OF CHANGE ORDERS

In the event that a time extension is granted or agreed upon due to a change order to this contract, the Contractor shall be required to complete, switchover, and/or turn on all traffic signals that are not directly affected by the change order within the original Contract Time specified in Section 00 73 02 Contract Time and Liquidated Damages of this Project Manual. In such a case, the original Contract Time would create a milestone date for completion of signal work not directly affected by the change order.

1.4 PROCUREMENT OF TRAFFIC SIGNAL EQUIPMENT, NO TIME EXTENSIONS

No extension of contract time will be granted to the Contractor due to late delivery of traffic signal equipment. For this purpose, traffic signal equipment shall include all poles (Muni, traffic signal, street light, etc.) and all materials listed in Part 2 Products of this Section and Section 34 41 14. This specific provision for traffic signal equipment supersedes the definition for Unavoidable Delay in the General Conditions, subparagraph 7.02A.1 of this Project Manual. Inability of Contractor to procure these materials will not be considered an Unavoidable Delay, and no time extension will be granted therefore.

1.5 SUBMITTALS

- A. General
  - 1. Furnish submittals for work included in this Section per the requirements of Section 01 33 00 Submittals except as modified or added to in this Section. See

Section 01 33 00 for definitions of “shop drawings”, “product data”, and “samples”.

2. Submittals are only necessary for products which are being procured through this contract.

B. Product Data and Shop Drawings

Submit seven copies of product data or shop drawings for all products in this Section including but not limited to the following items within the time allowance provided in Appendix B, Table 1. Submit all copies to the BCM Engineer, 30 Van Ness Avenue, 5<sup>th</sup> Floor, San Francisco, CA 94102.

1. Traffic signal controller, cabinets, and network equipment. Cabinet and wiring diagrams shall be provided on paper and on a computer disc in AutoCAD format. The cabinet diagram shall include all details and dimensions of the cabinet enclosure, door, shelves, and internal features.
2. Conduit (GRS, PVC, and HDPE), pull boxes, conductors, vehicle signal heads, pedestrian signal heads, signal mounting assemblies (framework and mounting hardware), poles, mast arms, push buttons, loop sealants, conduit, pull tape, pull boxes, conduit/duct plugs and caps, LED signal modules, and paint.
3. Concrete mix design for foundation concrete.

C. Samples

All samples shall be submitted within the time allowance provided in Appendix B, Table 1.

1. Submit to the BCM Engineer 3 samples of each of the following items (each size and/or type): All conductors (loop wire, UF wire, THW wire, other), pedestrian push button tape (yellow), electrical conduit, and paint (dry). Submittals shall include a cover sheet and copy of appropriate specifications section. Deliver to BCM Engineer at 30 Van Ness Avenue, 5<sup>th</sup> Floor, San Francisco, CA 94102.
2. Submit one sample for each of the following signal assemblies (heads, framework, and all mounting hardware) within the time allowance provided in Appendix B, Table 1:
  - a. 3S12” signal assembly with LED units; and
  - b. Pedestrian head assembly.
    - i. The 3S12” head shall include red, yellow and green LED units; an SV-1-T mounting and u-bolts as required to mount on a street light pole. The 3S12” head shall include mast arm mounting hardware. LED arrow unit samples shall also be submitted if they are part of the Contract work. The pedestrian head shall include a SP-1 mounting and u-bolts as required to mount on a 10-foot 1-A pole. The sample framework shall be submitted with the required zinc primer paint applied to cut pipe threads, but no other paint applied.
    - ii. If a contract does not include a 12-inch and/or pedestrian signal head, then the contractor is not required to submit the relative sample. If the sample signal head configurations and mounting types specified above are not appropriate for a particular contract, they may be changed with the approval of the Traffic Engineer.
    - iii. No signal assemblies shall be installed until the samples are accepted by the Traffic Engineer. The City shall inspect samples within the time allowance provided in Appendix B, Table 1. Signal assembly samples shall become the property of SFMTA and shall be paid as a bid item.
3. The signal assembly samples shall be submitted to the SFMTA Traffic Signal Shop at 2650 Bayshore Boulevard, Daly City, CA 94014 with one copy of the accepted product data or shop drawings for each. The samples shall be tagged to identify the project name and contractor. To coordinate delivery, the

4. Contractor shall contact one of the SFMTA Traffic Signal Shop supervisors at (415) 550-2736 at least two (2) working days before the proposed delivery date. Accompanying all sample submittals, the Contractor shall submit a transmittal letter with invoice for a Signal Shop Supervisor to review and sign. The Signal Shop Supervisor(s) shall not be expected to create invoices for the submittals. The Contractor shall forward a copy of the signed invoice to the BCM Engineer at 30 Van Ness Avenue, 5<sup>th</sup> Floor, San Francisco, CA, 94102.
  5. Deliveries will only be accepted between 8:00 A.M. and 2:00 P.M. on weekdays. The Contractor shall be responsible for unloading and placement of the samples as directed by the SFMTA Traffic Signal Shop supervisor.
- D. Purchase Orders
- Submit two (2) copies of Contractor's purchase orders for signal heads, mounting assemblies, poles, mast arms, and pedestrian push buttons to the BCM Engineer within the time allowance provided in Appendix B, Table 1. Purchase orders shall indicate Suppliers/Manufacturers confirmed delivery dates of each item listed above on respective supplier letterhead.
- E. Special Notes
- Equipment installed before the required submittals are accepted by the City is subject to rejection.
- F. Sign Inventory Form
- The Contractor shall submit a Sign Inventory Form to be used as the official sign inventory record. The form is to be submitted by the Contractor as part of the Traffic Control Plan prior to the start of any contract field work. The Sign Inventory Form is included in this Project Manual as Appendix A to this Section. Sign Inventory Forms are required for each intersection corner that included any pole or traffic signal work. Sign Inventory Forms shall accurately reflect all existing traffic control, street name, and other City signs at the required corners including approximately 25' along each sidewalk approaching the corner. See Article 3.5 of this section for additional details.

## 1.6 CONTRACTOR'S MINIMUM EXPERIENCE AND QUALIFICATIONS

- A. The Contractor or its listed subcontractor or its key team members performing the traffic signal work for this contract shall have a current and active class A General Engineering Contractor or C-10 Electrical Specialty license, and have satisfactorily completed projects with Traffic Signal work that are similar in size and complexity to that of the Contract with the following minimum requirements:
1. Three projects in the last 5 years with each project having Traffic Signal work worth \$250,000 or more; or,
  2. Two projects in the last 5 years with each project having Traffic Signal work worth \$500,000 or more.
  3. The Contractor and its subcontractors are advised that the City considers the proper classification for employees who perform all electrical work associated with the installation of underground fed traffic signals to be that of Electrician: Inside Wireman.
- B. Refer to Section 00 45 13 Request for Qualifications for more information.

## PART 2 – PRODUCTS

### 2.1 VEHICLE SIGNAL HEADS

- A. Vehicle signal faces shall be in accordance with the 2018 CTSS, adopted on October 19, 2018, Section 86-1.02R(4), "VEHICLE SIGNAL FACES," through Section 86-1.02R(4)(a)(ii), "Programmed Visibility Vehicle Signal Faces," inclusive, except as amended as follows:
1. Programmed visibility signals shall be delivered with no dimmer modules installed. Units shall be delivered with dimmer module receptacle sealed (water tight) or without receptacle.
  2. Signal section housing shall be dye cast aluminum, equipped with stainless steel hardware and neoprene door gasket. The signal shall have tunnel visors, glass lens, and Alzak reflectors with cast aluminum reflector rings. Sockets are to be held by a bail, have four (4) position adjustments, and leads shall be wired directly to the terminal block with one (1) Sta-Kon or quick disconnect. No quick disconnect shall be directly on the socket. Signal shall have matching green, amber and red sockets. Terminal block shall be mounted in yellow section only.
  3. The signal door lip, where it closes against the housing, shall be a minimum 7/16-inch thick for 8-inch signals and 1/2 inch for 12-inch signals.
  4. The shape of each signal face section housing or housing door without back plate shall be square when viewed from the front.
  5. Signal doors shall open 180 degrees. The 12-inch shall have only two (2) latches.
  6. 12" vehicle signal LED's shall comply with current Type 1 LED signal modules specifications from the Institute of Transportation Engineers ("Vehicle Traffic Control Signal Heads: Light Emitting Diode (LED) Circular Signal Supplement", ITE Publication No. ST-052-E, June 2005) and Caltrans ("Purchase Specification, Light Emitting Diode (LED) Signal Modules", dated February 28, 2007) with the following provisions:
    - a. The manufacturer shall submit reports from Intertek ETL that certify full compliance of LED signal modules to the referenced ITE specifications across the temperature range of -40 degrees centigrade to +74 degrees centigrade for all colors. Evidence of full compliance to all required testing methods, procedures, and sections as outlined in the above ITE document Figure 2, design Qualification Testing Flow Chart must be included without any exceptions, changes, or omissions. The manufacturer must also submit a data sheet showing the exact catalog number of the items submitted on the bid and the Independent Lab report must show the full qualification of this catalog number.
    - b. All modules are to be water tight and resist wicking water into the housing where wires or terminals penetrate the housing. Each unit shall be sealed by use of an O-ring gasket compressed radially or have a lens permanently sealed in production. Screwed on front lenses are not allowed.
    - c. All modules shall have a visual appearance similar to an incandescent lamp. They shall have a smooth, uniform, non-pixelated appearance. The LED module shall use Hi Flux LED's as a centralized light source. No 5mm LED's shall be used.
    - d. All modules shall be warranted for 5 years. The warranty must include workmanship, materials, and the modules must maintain minimum luminance intensity as per the ITE VTCSH-LED Circular Signal Supplement 4.1.1 for all colors throughout the warranty period.
    - e. LED modules must maintain 70% of the initial lumen intensity after 100,000 hours of operation.
    - f. All modules on-board circuitry shall include voltage surge protection to withstand high-repetition noise transients and low-repetition, high-energy transients as stated in NEMA Standard TS-2-2003 section 2.1.8. In addition, the module shall comply with the following standards: 1) IEC 1000-4-5, ANSI/IEEE C62.41.2-2002 at 3KV with a 2 ohm source

- impedance, and 2) IEC 1000-4-12 & ANSI/IEEE C62.41.2-2002 at 6KV, 30 Ohms, 200A, and 100 kHz ring wave.
  - g. For uniformity of appearance the unlit lens shall be the color of the LED output and the manufacturer must comply to the specifications for all three colors in both 8" and 12" sizes.
  - h. To insure reliable signal operation over the warranty period and that the device is not overdriving an insufficient number of LED's each module shall have the following minimum number of LED's by size & color: 12" Red -8 LED's, 12" Yellow -21 LED's, 12" Green -8 LED's, 8" Red -4 LED's, 8" Yellow -14 LED's, and 8" Green -4 LED's. This is in addition to photometric requirements in the ITE VTCSH-LED Circular Signal Supplement 4.1.1
7. 12" vehicle signal arrow LED's shall comply with current Type 1 LED vehicle signal arrows modules specifications from the Institute of Transportation Engineers: ("Vehicle Traffic Control Signal Heads: Light Emitting Diode (LED) Vehicle Arrow Traffic Signal Supplement", ITE Publication No. ST-054, January 2008) and Caltrans ("Purchase Specification, Light Emitting Diode (LED) Signal Modules", dated February 28, 2007) with the following provisions:
- a. The manufacturer shall submit reports from Intertek ETL that certify full compliance of LED signal modules to the referenced ITE specifications across the temperature range of -40 degrees centigrade to +74 degrees centigrade for all colors. Evidence of full compliance to all required testing methods, procedures, and sections as outlined in the above ITE document Figure 2, design Qualification Testing Flow Chart must be included without any exceptions, changes, or omissions. The manufacturer must also submit a data sheet showing the exact catalog number of the items submitted on the bid and the Independent Lab report must show the full qualification of this catalog number.
  - b. All modules are to be water tight and resist wicking water into the housing where wires or terminals penetrate the housing. Each unit shall be sealed by use of an O-ring gasket compressed radially or have a lens permanently sealed in production. Screwed on front lenses are not allowed.
  - c. All modules shall have a visual appearance similar to an incandescent lamp. They shall have a smooth, uniform, non-pixelated appearance.
  - d. All modules shall be warranted for 5 years. The warranty must cover workmanship, materials, and the modules must maintain minimum luminance intensity as per the ITE VTCSH-LED Vehicle Arrow Traffic Signal Modules specification for all colors throughout the warranty period.
  - e. LED modules must maintain 70% of the initial lumen intensity after 100,000 hours of operation.
  - f. All modules on-board circuitry shall include voltage surge protection to withstand high-repetition noise transients and low-repetition, high-energy transients as stated in NEMA Standard TS-2-2003 section 2.1.8. In addition, the module shall comply with the following standards: 1) IEC 1000-4-5, ANSI/IEEE C62.41.2-2002 at 3KV with a 2 ohm source impedance, and 2) IEC 1000-4-12 & ANSI/IEEE C62.41.2-2002 at 6KV, 30 Ohms, 200A, and 100 kHz ring wave.
  - g. For uniformity of appearance the unlit lens shall be the color of the LED output and the manufacturer must comply with the specifications for all three colors.
8. Testing and warranty information for LED vehicle modules shall be submitted as follows:

- a. Manufacturer's testing data shall be submitted to SFMTA's Traffic Engineer, 1 South Van Ness Avenue, 7<sup>th</sup> Floor, SF CA 94103-5417, not Caltrans (overrides Caltrans LED specification sections 9.4.2.1 and 9.4.2.2).
  - b. All warranty documentation shall be given to SFMTA's Traffic Engineer, 1 South Van Ness Avenue, 7<sup>th</sup> Floor, SF CA 94103-5417 (overrides Caltrans LED specification section 10).
  - c. All units shall meet one of the following conditions:
    - i. Model shall be on the Caltrans pre-qualified product list of LED Traffic Signal Modules, or
    - ii. Manufacturer shall provide verification that the submitted model(s) have been submitted to and tested by an independent testing lab, and that the submitted model has passed all tests as identified in the Caltrans LED specifications and these contract documents (see item 1 above).
9. Conductors to the end terminal of lamp receptacles shall be with insulation color-coded red, yellow and one of the following: Black, blue or brown.
  10. The visor bolt pattern on the signal head housing shall match the bolt pattern of heads and visor stocked by the SFMTA Signal Shop as follows:  
8 and 7/8 inches center-to-center for 8-inch heads  
12 and 5/8 inches center-to-center for 12-inch heads.
  11. No vehicle signal heads shall be considered pre-accepted by the City. Some signal heads manufactured by Traffic Parts, Inc and McCain Traffic Supply have demonstrated the ability to meet the City's specifications in the past. It is the Contractor's responsibility to demonstrate that each traffic signal head meets or exceeds the City's requirements as set forth in this Section. In order for a manufacturer other than those specified above to be considered for acceptance, a working sample must be submitted to the City's Traffic Signal Division for a minimum of one year for installation and field testing prior to being allowed for use on any of the traffic signals within the City.

## 2.2 LOUVERS AND VISORS

### A. Not Used

## 2.3 PEDESTRIAN SIGNALS

- A. Pedestrian signals shall conform to Section 86-1.02S(3) "Pedestrian Signal Faces" of the 2018 CTSS, adopted on October 19, 2018 and shall be Type A, Hand/Walking Person, Symbol. Pedestrian signal housing including the door shall be dye cast aluminum.
- B. Front screen shall be egg-crate type and a visor shall not be required.
  1. The egg-crate grid screen can be plastic or metallic.
  2. The door frame and egg-crate grid screen shall be separate units, with the egg-crate screen being easy to remove and replace.
- C. Countdown Pedestrian Signal Module (Combination Raised Hand and Walking Person with Two Digit Countdown Timer) shall be of the LED type. Countdown pedestrian signal LED module shall comply with current LED pedestrian signal modules specifications from the Institute of Transportation Engineers ("Pedestrian Traffic Control Signal Indicators: Light Emitting Diode (LED) Signal Modules", ITE Publication No. ST-055-E, dated August 4, 2010) and Caltrans ("Purchase Specification, Light Emitting Diode (LED) Signal Modules (Combination Pedestrian Signal)", dated February 28, 2007) with the following provisions:

1. The manufacturer shall submit reports from the 3<sup>rd</sup> party independent lab reports that certify full compliance of LED signal modules to these specifications across the temperature range of -40 degrees centigrade to +74 degrees centigrade for both colors. Evidence of full compliance to all required testing methods, procedures, and sections as outlined in the above ITE document Attachment 2, Design Qualification Testing Flow Chart must be included without any exceptions, changes, or omissions. The manufacturer must also submit a data sheet showing the exact catalog number of the items submitted on the bid and the Independent Lab report must show the full qualification of this catalog number.
2. LED modules must be CIL series part numbers or other approved by the City and County of San Francisco prior to bid advertisement.
3. LED modules must fit in Caltrans standard pedestrian housings.
4. All modules shall have a visual appearance similar to an incandescent lamp. They shall have a smooth, uniform, non-pixelated appearance. Hand and Person icons are to appear solid. No outline icons are allowed.
5. The module shall display the correct countdown display when a Walking/Person follows a Flashing Red/Hand without an intervening display of Solid Red/Hand.
6. The module shall countdown through Flashing Red/Hand only. No mode switch is to be provided which could enable other countdown display choices.
7. All modules are to be water tight and resist wicking water into the housing where wires or terminals penetrate the housing.
8. All modules on-board circuitry shall include voltage surge protection to withstand high-repetition noise transients and low-repetition, high-energy transients as stated in NEMA Standard TS-2-2003 section 2.1.8. In addition, the module shall comply with the following standards: 1) IEC 1000-4-5, ANSI/IEEE C62.41.2-2002 at 3KV with a 2 ohm source impedance, and 2) IEC 1000-4-12 & ANSI/IEEE C62.41.2-2002 at 6KV, 30 Ohms, 200A, and 100 kHz ring wave.
9. Conductors shall be 1 meter (3.3 ft) in length, with fully insulated female quick disconnect terminals attached to a 6.35 mm (.25") tab, and conform to Section 86-1.02S(3), "Pedestrian Signal Faces", of the 2018 CTSS, adopted on October 19, 2018. (Additional information to Caltrans LED pedestrian specification section 2.7)
10. LED timer shall count down the duration of the "Flashing Raised Hand" phase. Timer shall start at the beginning of the "Flashing Raised Hand" signal phase and blank out after the end of the "Flashing Raised Hand" signal phase.
11. The LED timer shall have a dipswitch, which shall enable or disable the countdown display.
12. The countdown display shall be two digits, and the numbers 00 to 99 on the numerical display shall have a minimum height of 180 mm (7 inches) and shall be Portland Orange in color.
13. The reflector shall be removed.
14. The countdown timer shall utilize the standard 3 field wire configuration found in a typical pedestrian signal head; a neutral wire, a hot wire for the walking man, and a hot wire for the solid/flashing hand.
15. When Solid Fill Pedestrian Signal Face is displayed, both the raised hand and the walking man indications shall be formed with an array of LEDs such that the indications provide a filled-in/solid appearance.
16. The countdown display shall be able to countdown 2 or more times in the same "GREEN" phase.
17. There shall be user selectable display modes, including the option to have numbers of countdown display remain solid (i.e. not flash) during the flashing red hand.
18. After initial power up when the countdown module requires 2 to 3 signal cycles to "learn" the programmed countdown, the countdown portion of the display shall remain blank.

- D. Testing and warranty information for countdown pedestrian signal LED modules shall be processed as follows:
1. Test units and manufacturer's testing data shall be submitted to SFMTA's Traffic Engineer, 1 South Van Ness Avenue, 7<sup>th</sup> Floor, SF CA 94103-5417, not Caltrans (overrides Caltrans LED specification sections 4.4.2.1 and 4.4.2.2).
  2. All warranty documentation shall be given to SFMTA's Traffic Engineer, 1 South Van Ness Avenue, 7<sup>th</sup> Floor, SF CA 94103-5417 (overrides Caltrans LED pedestrian signals specification section 5).
  3. All units shall meet one of the following conditions:
    - a. Model shall be on the Caltrans pre-qualified product list of LED Traffic Signal Modules, or
    - b. Manufacturer shall provide verification that the submitted model(s) have been submitted to and tested by an independent testing lab, and that the submitted model has passed all tests as identified in the Caltrans LED specifications and these contract documents (see item 1 above).

## 2.4 PEDESTRIAN PUSH BUTTONS

- A. Not Used

## 2.5 PEDESTRIAN PUSH BUTTON POST

- A. Pedestrian push button posts shall be installed in accordance with the 2018 CTSP ES-7A, adopted on October 19, 2018.
- B. The post shall be bonded to a point directly behind the station sign.

## 2.6 ACCESSIBLE PEDESTRIAN SIGNALS

- A. Not Used

## 2.7 RECTANGULAR RAPID FLASHING BEACON (RRFB)

- A. Not Used

## 2.8 SIGNAL MOUNTING ASSEMBLIES

- A. Signal mounting shall be constructed as per applicable details shown on SFMTA's STR-7025 and the 2018 CTSP ES- 4A, ES-4B, ES-4C, ES-4D and ES-4E, adopted on October 19, 2018, as applicable; except as superseded by other contract plans or as needed to accommodate special mounting configurations. All signal frames shall consist of 1- 1/2-inch standard steel pipe and fittings, shall be hot-dip galvanized before assembly, with the exception of bronze terminal compartment, bronze slip fitter, bronze plumbizers, and bronze pole clamps (ears and hubs), and shall be watertight and free of sharp edges or protrusions which might damage conductor insulation. Before assembly, any cut pipe threads shall be coated with zinc primer paint as specified in Section 87-1.03B, "Conduit Installation," of the 2018 CTSS, adopted October 19, 2018.
- B. For poles that are between 11- 1/2-inch and 15- 1/2-inch in diameter, larger ears, hubs, and U-bolts must be used; called Long Hub with reinforced ears. The Long Hub with reinforced ears assembly shall vary depending upon the diameter of the pole but they all shall be powder coated, galvanized, and fabricated with ductile iron. The Long Hub shall be 196.85mm long, 44.45mm wide, have a 16.51mm open slot to fit the reinforced ears, and have a 1-1/2" NPT threaded hole in the middle in order to fit the signal mounting framework. The Long Hub shall be flat on one side and curved on the other in order to fit

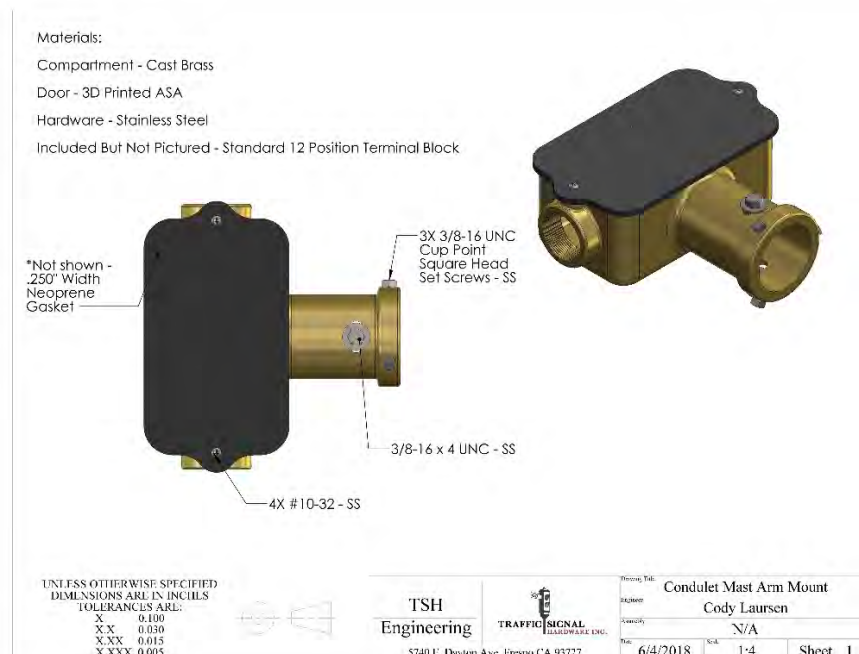


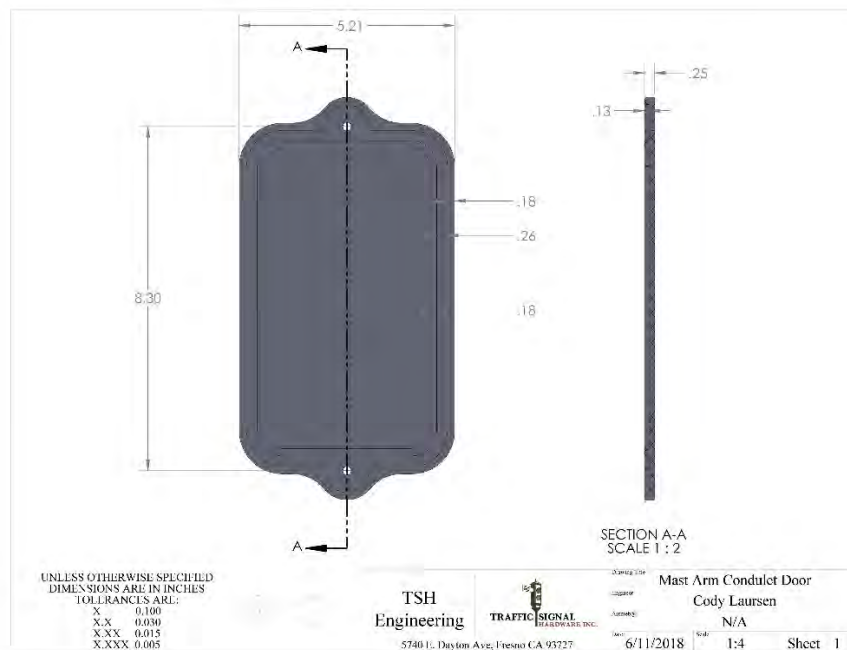
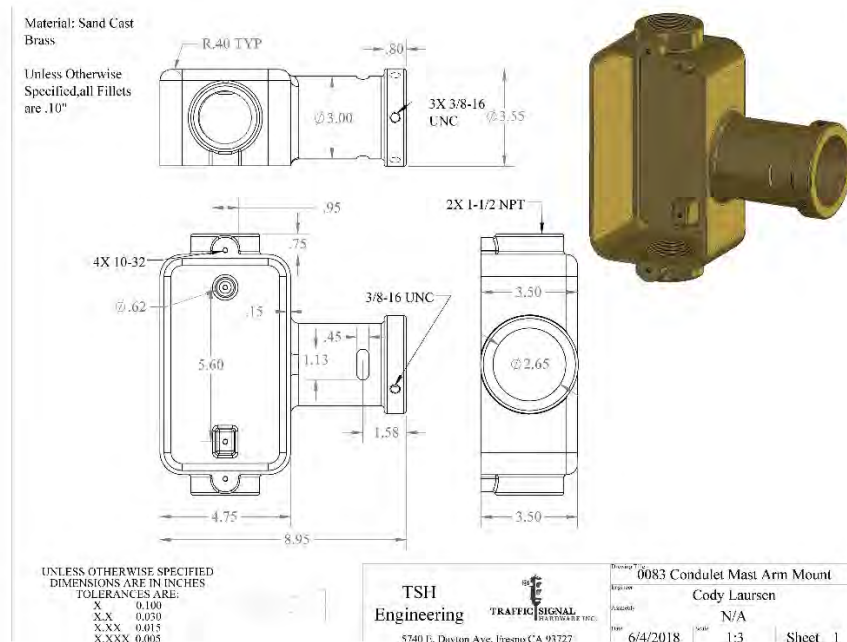
around large diameter poles. The radius of curvature shall be 305.75mm. For poles that are between 11- ½-inch and 12-1/2-inch in diameter, a short, reinforced ear shall be used. For poles that are between 12- ½-inch and 15-1/2-inch in diameter, a long, reinforced ear shall be used.

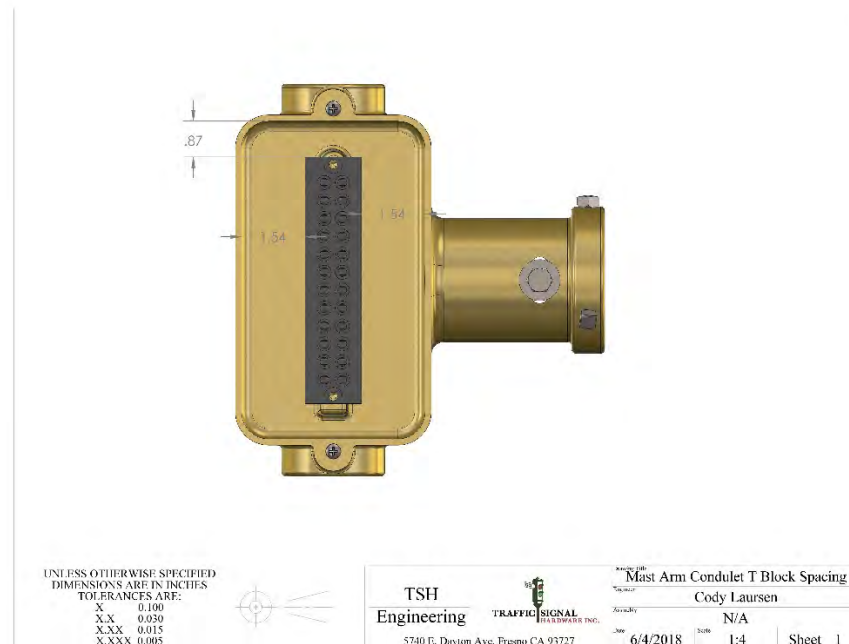
- C. Each U-bolt type pole clamp shall consist of a cast bronze pole plate drilled and tapped for 1-1/2-inch pipe thread, a hot-dip galvanized 1/2-inch U-bolt to fit the perimeter of the pole and oversized galvanized nuts and SAE washers. Portions of the pole plate shall be hinged for adapting the plate to various pole contours and shall be equipped with bolt openings through which the ends of the U-bolt shall be installed. U-bolt threads shall extend beyond the face of the nut at least ¼ inch and no more than 1-1/2 inches.
- D. A galvanized steel washer (2-11/16-inch O.D., 1- 15/16-inch I.D., 18 GA.) and a neoprene washer (2-11/16-inch O.D., 1-15/16-inch I.D., 1/8-inch thick) shall be furnished and installed at the top of each signal on the outside of the signal housing. The neoprene washer shall be next to the signal housing with the galvanized steel washer above. If the signal supplier provides signal heads with the washers installed on the inside, the Contractor shall move the washers to the outside as described above. Signal housings shall be attached to fittings by use of hex head lock nipples. When tops of signal housings are not attached to framework, the hole shall be closed with an ornamental cap, lock nut, metal washer and neoprene washer. After all adjustments have been made and all connections are fully tightened, duct sealing compound shall be applied externally to all joints at the top of the signal to make it watertight.
- E. The Contractor shall drill a wiring entry hole on pole for the bottom clamp of each side-mounted signal bracket and for each pedestrian push button station for all internally wired poles without such suitable entry holes. Core drill "hole saw" shall be used for all holes drilling on concrete poles. Care shall be taken not to damage or cut the existing reinforcing steel inside the concrete standard. Part of reinforcing steel exposed during drilling shall be painted with corrosion resistant paint as soon as possible and on the same day. The height for pedestrian signal is 7 feet and for traffic signal is 10 feet from the bottom of framework to sidewalk grade (i.e. 10 feet, 6 inches above street grade) unless otherwise noted. The vertical axis of each signal shall be truly vertical when installation is complete. Duct seal shall be applied at the bottom clamp of side-mounted signal brackets to help seal the wiring entry hole.
- F. The Contractor shall mount all signals parallel to the centerline of the pole they are mounted on. For all tops mounted signals with terminal compartments, the terminal compartment door shall be oriented to face the curb to provide for street access. For all side-mounted signals, the terminal compartment shall be oriented to face away from the curb to provide for sidewalk access.
- G. All set screws and back plate attachment screws shall be stainless steel. Plumbizer thru bolts, nuts, and washers shall be galvanized. Setscrews in slip fitters shall have square heads.
- H. Terminal compartment door screws shall be stainless steel and be ¾ inch in length.
- I. In cases where a top mounted signal assembly is required on existing Marbelite traffic signal poles, the existing pole top adapter is to be reused. If setscrews are seized, blowtorch heat shall be applied to loosen.
- J. The contractor shall apply an anti-seize compound to the threads of the following signal assembly items:
  - 1. All square headed set screws used to secure framework.

2. The two screws used to secure the terminal block inside the terminal compartment.
3. Chase nipples on top and bottom of all signal heads.
4. The two terminal compartments cover screws.
5. The hand hole cover screws on all poles.

K. For the MAC mast arm mounting, the terminal compartment shall comply with the drawings below dated 6/4/2018 and 6/11/2018. Moreover, as an exception to the other paragraphs in this "Signal Mounting Assemblies" section, the MAC mounting's terminal compartment shall be made of sand cast brass, with a standard 12-position terminal block. The terminal compartment door shall be made of 3-D printed acrylic styrene acrylonitrile with a 0.25" width neoprene gasket. The door shall face the pole. In the event of an end tenon, the door shall open on the same side as the signal head door opening.







## 2.9 TRAFFIC SIGNAL POLES

- A. The traffic signal poles shall comply with 2018 CTSS and 2018 CTSP dated October 19, 2018 as applicable with the following exceptions:
1. The location of pole handholes is not on the downstream side of traffic.
  2. Handholes are to be installed on the side NOT facing the roadway (i.e. furthest from the roadway or 180 degrees from the roadway). For combination luminaire and signal mast arm poles such as Caltrans Standard poles Type 17, 17A, 19, 19A, 24, 24A, etc., a second handhole shall be installed on the side 180 degrees from the mast arm connection to the pole.
  3. The centerline of the second handhole shall be 9 inches above the centerline of the mast arm connection. All other relevant details for the second handhole (such as reinforcement ring, handhold cover, bolt, etc.) are the same as the handhole near the base of the pole.
  4. Each pole and each mast arm shall be made from one piece of steel. Splicing or welding of multiple sheets of steel to form a single pole or mast arm shall not be permitted.
- B. Anchor bolts shall extend no less than  $\frac{3}{4}$  inch and no greater than  $1\frac{1}{4}$  inch beyond the face on the nut, as shown on ES-7M Detail A of the 2018 CTSP, adopted on October 19, 2018. Anchor bolts shall not be cut.

## 2.10 TRAFFIC SIGNAL FOUNDATIONS

- A. All concrete work related to traffic signal work shall be cast in place.
- B. Concrete for foundations shall conform to Section 800.11 of SSDPWSF Class 6-3000-  $\frac{3}{4}$ , Section 90-2 of the 2018 CTSS, adopted on October 19, 2018 "Minor Concrete," and these Special Provisions. Concrete shall contain not less than 564 pounds of cement per cubic yard, unless noted otherwise on contract drawings. See Section 26 05 00.

- C. The Contractor is advised that existing pole foundations vary in size and shape. They may be as deep as 9 ft and as wide as 5 ft. There may be existing conduits embedded in the foundation. If the pole removed is a MUNI pole, the Contractor shall remove pole foundation to 5 ft or deeper as required to accommodate the new pole foundation and fill the cavity with slurry.

## 2.11 TRAFFIC CONTROLLER UNIT

The traffic controller specification is divided into four sections:

- Section 1: General Equipment Specifications
- Section 2: Products
- Section 3: Performance Testing
- Section 4: Warranty

A. Section 1: General Equipment Specifications

1. Specification Outline

The traffic signal controller shall be Type 2070LXN2, a controller that meets design and operation standards for the City and County of San Francisco, San Francisco Municipal Transportation Agency (SFMTA). The 2070LXN2 controller must be fully integrated with Four Dimension Traffic's D4 Traffic Signal Software licensed to the SFMTA. The SFMTA has an existing sitewide license of the D4 software that will be installed by the City on the new controllers. The proposed controller must be 100% compatible with D4 and have a proven track record of at least 50 deployments with this software at the time of submittal.

The Linux controller shall come preloaded with the following services that automatically load at start-up: SSH, FTP and Telnet. No other processes or services that utilize the Ethernet port shall be enabled. The controller must be in 100% compliance with the ATC Version 5.2b (or later). Additionally, the software tool-chain that supports the application development on the supplied controller must also be provided. This tool-chain should contain all necessary development tools (compilers, linkers, etc.) and libraries for generating applications that are 100% compatible with the controller.

All bidders shall include a certification letter from Fourth Dimension Traffic (on company letterhead) as evidence that the proposed controller is 100% compatible with the D4 Traffic Signal Software. The letter must be addressed to the City and County of San Francisco, referencing the "Invitation To Bid" number (the "ITSF" number), contain current dating, and original signature from an authorized representative of Fourth Dimension Traffic.

2. Manufacturing, Material and Design Practices

It is intended that the manufacturer, in the selection of components, will use material and design practices that are the best available in the industry for the type of operating conditions to which the unit will be subjected. All 2070LXN2 Controller parts, equipment and accessories shall conform in strength, quality of material and workmanship to recognized industry standards.

3. Alternates

When the name of a manufacturer, brand or make, with or without model number, is used in describing any item in this specification, bids for similar articles will be considered unless otherwise stated. Bidders may also propose items of equivalent features or manufacturer's updated part or part number.

Purchasing shall be the sole judge as to whether such alternate articles are acceptable. Unless bidder states to the contrary, articles offered will be assumed to be the specific article named in this specification. If not offering the specific article named, bidder should enclose with its bid, full information, specifications and descriptive data on items offered. Purchasing reserves the right to permit deviations from the specifications if any article offered is substantially in accord with Purchasing's specifications and is deemed by Purchasing to be of as good quality and as fully satisfactory for its intended use, Bidder is responsible for identifying any deviations from Purchasing's specifications. Bidders should not assume an alternate offered is an approved equal. The City will evaluate the alternate and inform the bidder if the alternate is acceptable. Purchasing must approve all alternates.

4. Generalities  
To allow for manufacturer's specific designs and insure a level of competitiveness, we have left certain areas of our specifications general by design. In such cases, the items being referred to may be general, but adherence to the requested end product and /or result must be met. This is especially important in areas where critical dimensions, capacities, grades of steel, etc. are specified. In the cases where the word **SHALL** is used, **no substitution will be allowed.**
5. Applicable Documents and Certifications  
Specifications on the following pages are written with the intent to comply with all applicable documents and certifications, but the final responsibility to comply shall rest with the vendor and not the City and County of San Francisco. The successful bidder shall adhere to the standards set forth by the following agency:
  - a. March 12, 2009 TEES (Transportation Electrical Equipment Specification)  
<https://dot.ca.gov/-/media/dot-media/programs/traffic-operations/documents/f0019527-tees2009-a11y.pdf>
  - b. California Department of Transportation (Caltrans) Standards
6. Demonstrations  
The City reserves the option to request, and the bidder shall agree to provide, an "on the job demonstration and evaluation" for the City's Traffic Signal Shop personnel before acceptance of contract in the event performance of unit proposed is not familiar to the City. If requested by the City, a demonstrator unit shall be made available prior to award and provided at no additional cost to the City. Time and number of hours required for such evaluation shall be as determined by the City.
7. Wiring Routing and Hardware Requirements  
All wiring shall have adequate protective covers wherever there is a possibility of contact with any other components. Separators shall be used where applicable. No tape or adhesive fasteners will be accepted. All wiring shall be routed to be clear of all heat sources and shall be protected from any present or potential source of snags, abrasions or sharp edges.
8. Delivery Requirements  
The delivery schedule is set at not more than 60 calendar days. This unit should be delivered and be ready for service within the stated time range. If the 2070 controller being bid meets all other requirements of the specification, but cannot meet the specified time allotted for delivery, this discrepancy shall be stated upon the bid return.
9. Contract Amendment

Any changes made to the specifications after the order is issued shall be approved by the Purchaser prior to the incorporation of the changes. Any work performed prior to the City's issuance of a written amendment to the order will be done at the risk of the vendor with the possibility of delayed acceptance and payment of the cabinets.

10. Bidder's Qualifications

- a. The SFMTA currently owns city wide license for Fourth Dimension Traffic's "D4 Traffic Signal Software". The only controller manufacturer that has successfully and fully integrated with current D4 software is McCain. The only controller accepted at this time is McCain Controllers or approved that is equal to or better than the controller specified in this bid.
- b. Performance testing of 2 (two) sample controllers shall be required by the SFMTA Traffic Signal Shop within 3 (three) days of contract award. If either sample controller fails to meet these specifications, all units shall be rejected. In this case, the vendor shall make arrangements and pay all shipping costs for the return of the sample controllers. See section 3 (three) for sample controller requirements and testing procedure.
- c. Purchasing reserves the right, when evaluating bids, to consider factors other than bid prices. Such factors include but are not limited to:
  - i. The manufacturer's track record for meeting these specifications, especially in regards to workmanship and on-time delivery.
  - ii. Adequacy of bidder's service department (equipment and personnel) where support would be provided and where warranty and other repair work would be performed.
- d. If successful bidder is not the manufacturer, bidder shall furnish a manufacturer's written guarantee that the manufacturer's warranty and service will be passed on to the city.

11. Bidder's Compliance and Exceptions

All exceptions shall be stated no matter how seemingly minor. Bidders shall indicate compliance with each section and line item specifications as required, in the line spaces provided by marking with a "Y" for yes. If the bidder is offering an alternate of equal or superior status to the line item specification, bidder will indicate by marking with an "E" for exception on each line item. The bidder must then reference each item exception and explain the exception taken and the proposed alternate on the Bid Exception Sheets.

**\*\*Bids which do not include confirmation of each section and line item as required, will be deemed to take exception to such bid requirements, which may result in the bid being deemed non-responsive. If exceptions are taken, Bid Exception Sheets must be returned with the submitted bids.**

**IMPORTANT: If a single vendor is submitting multiple bids, the vendor shall submit a completed set of specs for each individual bid. Multiple bids that are submitted as one bid package will not be acceptable.**

B. Section 2: Products

1. Description

This section describes the 2070LXN2 Controller, a controller that meets design and operation standards for the City and County of San Francisco Municipal Transportation Agency (SFMTA).

The SFMTA has an existing site-wide license for Fourth Dimension Traffic's "D4

Traffic Signal Software". The only controller manufacturer that has successfully and fully integrated with current D4 software is McCain. The only controller accepted at this time is McCain's Controllers or approved equal that is equal to or better than the controller specified in this bid. Alternate controllers must be 100% compatible with the Fourth Dimension Traffic's D4 Traffic Signal Software.

This section is for the controller only.

2. 2070LXN2 Controller and Detailed Item Descriptions

a. 2070LXN2 Controller

Each controller shall be in compliance with the March 12, 2009 TEES (Transportation Electrical Equipment Specification). Units provided shall meet Caltrans standards. Upon request from the purchaser, one complete set of certified test results shall be submitted within ten (10) days from date of notice as evidence of full compliance with all applicable standards from TEES (dated March 12, 2009) and Caltrans. Controller composition shall be defined as: *(numbers below are Caltrans model numbers, assigned by Caltrans)*

- i. 2070LXN2 chassis
- ii. 2070-1C CPU Module (See Section 2.11.B.2.b for compliance and requirements)
- iii. 2070-2B I/O module
- iv. 2070-3B front panel module
- v. 2070-4NA power supply module
- vi. 2070-7A module
- vii. Two 2070-2N modules shall be supplied with the two sample controllers. These (2) 2070-2N boards shall be retained by the SFMTA Traffic Signal Shop as part of the successful contract award. In the event of non-compliance by the Contractor, the (2) 2070-2N boards will be returned. All costs associated with the return of the boards shall be at the sole expense of the Contractor.

b. Components and Features

The controllers shall have the following components and features:

- i. Operate in accordance with NEMA TS2/Type 1 specifications.
- ii. Operates via the SDLC connector
- iii. 2070LXN2 chassis
- iv. 2070-1C module (CPU module). 2070-1C module shall:
  - A. Come preloaded with one of the following configurations (that will automatically load at start-up):
    1. SSH/SCP
    2. FTP and Telnet
  - B. Must NOT come preloaded with any processes (other than SSH, FTP or Telnet) that utilize an Ethernet port (i.e. web server, etc.)
  - C. Supplies the following drivers, all of which operate simultaneously and in full duplex:
    1. /dev/sp1
    2. /dev/sp2
    3. /dev/sp3s (153.6 Kbps by default)
    4. /dev/sp4 or /dev/console
    5. /dev/sp5s (614.2 Kbps by default)
    6. /dev/sp6 (38.4 Kbps by default)
  - D. Supplies drivers for the following peripherals:
    1. USB flash drive
    2. 2070 Datakey
  - E. Must be integrated with Fourth Dimension Traffic's D4



Traffic Signal Software. This integration requirement may be met by compliance with all of the following:

1. The 2070-1C module must be in 100% compliance with the ATC version 5.2 (or later) and the 2009 TEES specifications;
2. Delivery of a software toolchain that supports application development on the supplied 2070-1C module. This toolchain should contain all necessary development tools (compilers, linkers etc.) and libraries for generating applications that are 100% compatible with software already resident on the 2070 – 1C module
- v. 2070-2B, Field I/O module
- vi. 2070-3B Front Panel Assembly (8 line x 40 character display, 2 keypads)
- vii. 2070-4NA, 10 AMP power supply (for future addition of VME cage assembly)
- viii. 2070-7A Serial modem module
- ix. All unused slots shall be covered by blank plates.

#### C. Performance Testing

##### 1. Traffic Signal Controller Burn-in Test

- i. Required to pass a 72 hour burn-in test conducted by SFMTA:
- ii. Vendor shall supply two complete sample 2070LXN2 controller compositions consisting of
  - A. 2070LXN2 chassis
  - B. 2070-3B module
  - C. 2070-4NA module
  - D. 2070-1C module
  - E. 2070-2N module, shall ship in the original manufacturing packaging.
  - F. 2070-2B module
  - G. 2070-7A modules
- iii. Controllers must run in a TS2-Type 1 cabinet (consisting of 2 T/F BIUs, 1 Detector BIU and MMU) for the duration of the test with zero SDLC response errors.
- iv. Controllers must run in an ATC 352i cabinet (consisting of one single 16 position output assembly, one 24 channel input assembly and a CMU) for the duration of the test with zero serial bus and SDLC response errors.
- v. Controllers must run in an ATC 350i cabinet (consisting of 16 or 32-channel output assembly, 24 or 48-channel input assemblies and a CMU) for the duration of the test with zero serial bus and SDLC response errors.
- vi. Controllers will be exercised with Ethernet communication (once-per-second AB3418 polling messages) for the duration of the test.
- vii. Controllers will be connected to a Garmin GPS receiver via serial port connection for the duration of the test.

#### D. Warranty

Contractor shall provide phone technical support with a response time of 2 hours or less during vendor's normal business hours. This technical support shall be at no additional cost during the life of the warranty period. The technical support shall be provided by qualified personnel with extensive knowledge of the firmware and hardware characteristics of the controllers provided in this contract.

The controllers shall be guaranteed against defective materials or workmanship for a 24-month period (from date of each delivery). Contractor shall be responsible for reimbursing City forces for any time and material utilized to make necessary field trouble calls due to defective controllers and/or related hardware modules during the warranty period. Units that are identified as being defective before the warranty has expired shall be replaced within 14 calendar days from date of notice. Contractor shall be responsible for all costs, including shipping, incurred by SFMTA for all units that are installed at an intersection and fail as a result of warranty covered failure within the warranty period.

Prior to delivery, the controller shall be tested by the manufacturer or authorized local distributor to ensure proper operation.

The manufacturer shall provide one complete set of certified test results as evidence that the controllers has met all quality assurance tests.

**BID EXCEPTION SHEETS**Return with Bid if any exceptions are taken

Please Note: All exceptions to the City's bid requirements must be listed on the sheets provided. Only those exceptions that are listed on the sheets provided will be evaluated. Any material exceptions may result in the rejection of the bid and the bidder will not receive further consideration.

\*Section Title, Line Number, & Page Number: \_\_\_\_\_

Description: \_\_\_\_\_

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## 2.12 TRAFFIC SIGNAL CABINET - TYPE MSF65-ATC, MSF75-ATC, 352i-ATC, 350i-ATC

The cabinet specification is divided into nine sections:

- Section 1: Overall Specification Requirements
- Section 2: ATC Cabinet Components
- Section 3: General Requirements
- Section 4: ATC Cabinet Specification
- Section 5: ATC Cabinet Electrical, Environmental and Testing Requirements
- Section 6: Tables and Drawings
- Section 7: Warranty and Support
- Section 8: Shipping / Palletizing
- Section 9: Glossary of Terms

### A. Section 1: Overall Specification Requirements

#### 1. Specification Outline

This specification describes the City and County of San Francisco Municipal Transportation Agency's 120VAC High Voltage (HV) Advanced Transportation Controller Cabinet (ATC) Model MSF65-ATC, Model MSF75-ATC, Model 352i-ATC and Model 350i-ATC.

The SFMTA ATC 120VAC High Voltage (HV) Cabinet shall be delivered complete with all equipment and accessories necessary for safe and efficient operation. The SFMTA ATC 120VAC High Voltage (HV) Cabinet shall be ready for immediate job site operation within the City and County of San Francisco.

#### 2. Manufacturing, Material and Design Practices

It is intended that the manufacturer, in the selection of components, will use material and design practices that are the best available in the industry for the type of operating conditions to which the unit will be subjected. All SFMTA Model MSF65-ATC, MSF75-ATC, 352i-ATC and 350i-ATC cabinet parts, equipment and accessories shall conform in strength, quality of material and workmanship to recognized industry standards.

#### 3. Alternates

When the name of a manufacturer, brand or make, with or without model number, is used in describing any item in this specification, bids for similar articles will be considered unless otherwise stated. Bidders may also propose items of equivalent features or manufacturer's updated part or part number. Purchasing shall be the sole judge as to whether such alternate articles are acceptable. Unless bidder states to the contrary, articles offered will be assumed to be the specific article named in this specification. If not offering the specific article named, bidder should enclose with its bid, full information, specifications and descriptive data on items offered. Purchasing reserves the right to permit deviations from the specifications if any article offered is substantially in accord with Purchasing's specifications and is deemed by Purchasing to be of as good quality and as fully satisfactory for its intended use. Bidder is responsible for identifying any deviations from Purchasing's specifications. Bidders should not assume an alternate offered is an approved equal. The City will evaluate the alternate and inform the bidder if the alternate is acceptable. Purchasing must approve all alternates.

#### 4. Generalities

To allow for manufacturer's specific designs, and insure a level of competitiveness, we have left certain areas of our specifications general by

design. In such cases, the items being referred to may be general, but adherence to the requested end product and or result must be met. This is especially important in areas where critical dimensions, capacities, grades of steel, etc. are specified. In the cases where the word SHALL is used, no substitution will be allowed.

5. **Applicable Documents and Certifications**  
Specifications are written with the intent to comply with all applicable documents, industry standard and certifications, but the final responsibility to comply shall solely rest with the successfully bidder and not the City and County of San Francisco and the San Francisco Municipal Transportation Agency (SFMTA). The successful bidder shall adhere to the standards set forth by the joint committee of American Association of State Highway and Transportation Officials (AASHTO), the Institute of Transportation Engineers (ITE), the National Electrical Manufacturers Association (NEMA) and meet Underwriters Laboratories UL 3R Certification.
6. **Demonstrations**  
The City reserves the option to request an "on the job demonstration and evaluation" for San Francisco Municipal Transportation Agency (SFMTA), Traffic Signal Shop personnel before acceptance of contract in the event performance of unit proposed is not familiar to the City. Bidder shall receive written notification from the purchaser, granting said bidder ten (10) working days from date of notice to provide a unit for demonstration and evaluation at no additional cost to the City and County of San Francisco and the San Francisco Municipal Transportation Agency (SFMTA). The length of time required for the demonstration and evaluation shall be determined by the personnel of the Traffic Signal Shop, SFMTA.
7. **Wiring Routing and Hardware Requirements**  
All wiring shall have adequate protective covers wherever there is a possibility of contact with any other components. Separators shall be used where applicable. No tape or adhesive fasteners will be accepted. All wiring shall be routed to be clear of all heat sources and shall be protected from any present or potential source of snags, abrasions or sharp edges.
8. **Delivery Requirements**  
The delivery schedule is set at not more than 60 calendar days. The unit should be delivered and be ready for service within the stated time range. If the SFMTA Model MSF65-ATC, MSF75-ATC, 352i-ATC and 350i-ATC cabinet being bid meets all other requirements of the specification, but cannot meet the specified time allotted for delivery, this discrepancy shall be stated upon the bid return. All units shall be ready for immediate job site operation within the City and County of San Francisco.
9. **Contract Amendment**  
Any changes made to the specifications after the order is issued solely as a result of obsolete cabinet component part or parts shall be approved by the Purchaser prior to the incorporation of the changes. Any work performed prior to the City's issuance of a written amendment to the order will be done at the risk of the vendor with the possibility of delayed acceptance and payment of the cabinets.
10. **Bidder's Qualifications**  
Performance testing of a sample cabinet assembly shall be required by the SFMTA Traffic Signal Shop following contract award. If the sample cabinet fails

to meet standard practice workmanship and specification below, the units shall be rejected.

When evaluating bids, Purchasing reserves the right to consider factors other than bid prices. Such factors include but are not limited to:

- a. The manufacturer's track record for meeting the specifications below, especially in regards to workmanship and on-time delivery.
- b. Adequacy of bidder's service department (equipment and personnel) where support would be provided and where warranty and other repair work would be performed.
- c. If successful bidder is not the manufacturer, bidder shall furnish a manufacturer's written guarantee that the manufacturer's warranty and service will be passed on to the City.

11. Bidder's Compliance and Exceptions

All exceptions shall be stated no matter how seemingly minor. Bidders shall indicate compliance with each section and line item specifications as required, in the line spaces provided by marking with a "Y" for yes. If the bidder is offering an alternate of equal or superior status to the line item specification, bidder will indicate by marking with an "E" for exception on each line item. The bidder must then reference each item exception and explain the exception taken and the proposed alternate on the Bid Exception Sheets.

**\*\*Bids which do not include confirmation of each section and line item as required, will be deemed to take exception to such bid requirements, which may result in the bid being deemed non-responsive. If exceptions are taken, Bid Exception Sheets must be returned with the submitted bids.**

**IMPORTANT: If a single vendor is submitting multiple bids, the vendor shall submit a completed set of specs for each individual bid. Multiple bids that are submitted as one bid package will not be accepted.**

B. Section 2: ATC Cabinet Components

1. Model 2202-HV High-Density Switch Pack / Flasher Unit (HDSP-FU)  
The HDSP-FU shall be compact, pluggable, modular PCB-based, and equipped with DIN connector. The HDSP-FU shall be compatible with ultra-low power LED signal heads and it shall have a current monitoring feature for each output of each channel. The HDSP-FU shall use real-time standardized high-speed Serial Bus #3 (SB3) communications with the Cabinet Monitor Unit to send a complete set of RMS voltage and load current measurements. The HDSP-FU shall be 4.5" H x 6.5" D and shall be equipped with a handle, reset push button switch, six RYG LED indicators, four flasher LED indicators, one power LED indicator and two Rx/Tx LED indicators. The HDSP-FU can function as either a switch pack (HDSP) or as a flasher unit (HDFU). When installed in the Output Assembly, the High-Density Switch Pack (HDSP) shall provide two RYG channels of operation (6 outputs). When installed in the Service Assembly, the High-Density Flasher Unit (HDFU) shall function as a four-output flasher. The load switch shall be EBERLE Design INC. Model 2202-HV High-Density Switch Pack / Flasher Unit.
2. Model 2212-HV Cabinet Monitor Unit (CMUip)  
The Cabinet Monitor Unit (CMUip) shall be compact, pluggable and modular. The CMUip shall use real-time standardized 614.4 Kbs SDLC communications with the ATC to transfer command and response data on Serial Bus #1 (SB1). The CMUip shall be capable of monitoring up to 32 physical switch pack channels

(RYG) and shall have optional four virtual channels. The CMUip shall provide a Flasher Alarm feature. The CMUip shall analyze the ATC output commands and field input status to isolate the failure source by channel and color. The CMUip configuration programming shall be provided by an interchangeable Datakey nonvolatile memory device. This rugged key shall store all CMUip configuration parameters and shall eliminate programming using jumpers, diodes, or DIP switches. The CMUip shall maintain a nonvolatile event log recording the complete intersection status as well as time stamped previous fault events, AC Line events, configuration changes, monitor resets, cabinet temperature and true RMS voltages and currents for all field inputs. The signal sequence history log stored in nonvolatile memory graphically shall display up to 30 seconds of signal status prior to the fault trigger event with 50 ms resolution to ease diagnosing of intermittent and transient faults. The Cabinet Monitor Unit shall be EBERLE Design INC. Model CMUip-2212-HV.

3. Model 2218 Serial Interface Unit (SIU)

The Model 2218 Serial Interface Unit (SIU) shall be a compact, pluggable and modular. The SIU shall use real-time standardized 614.4 Kbs SDLC communications with the ATC to transfer command and response data on Serial Bus #1 (SB1). The SIU shall be equipped with 54 programmable input/out pins, four optically isolated input pins, one line sync reference input pin and 4 address select input pins. The optically isolated inputs shall work with either 12VAC or 24VDC.

The SIU outputs shall be rated at 150 mA continuous sink current. Each output shall provide a 500mA typical current limit and shall be rated to 50V and utilize a voltage clamp for inductive transient protection. The SIU shall be equipped with a front panel LED indicator that can report the current SIU assembly address assignment of the SIU for cabinet configuration verification. The SIU shall be EBERLE Design INC. Model SIU-2218.

4. Model 2220 Auxiliary Display Unit (ADU)

The ADU shall install in a 1U height 19" rack space as illustrated on [Drawing 7: Auxiliary Display Unit in Section 6](#) and shall provide a menu driven user interface to the enhanced features of the CMUip monitor including the built-in Diagnostic Wizard. The ADU shall provide 32 channels of Red, Yellow and Green LED indicators that display full intersection status and 32 Blue fault status LED indicators shall identify faulty channels. The ADU shall provide proper electrical termination to SB3. The ADU shall have a 4 line by 20-character menu driven liquid crystal display with backlight and heater. The ADU built-in Diagnostic Wizard shall automatically pinpoint faulty signals and offers trouble-shooting guidance and automatically isolate and identify problems. The ADU shall be equipped with Event Logging displaying the CMUip time-stamped nonvolatile event log records with the complete intersection status as well as AC Line events, monitor resets, temperature and true RMS voltages and currents. The ADU unit shall be EBERLE Design INC. Model ADU-2220. Install ADU as per applicable ATC Cabinet Model as illustrated on the Cabinet Layout Diagrams on pages [74](#), [80](#), [86](#) and [88](#).

5. Model 2216-24 Cabinet Power Supply (CPS)

The CPS shall install in a 1U height 19" rack space as illustrated [Drawing 8: Cabinet Power Supply on page 56](#). The CPS shall be rated at 168 Watts, 48VDC @ 2 Amp and 24VDC @ 8 Amp. The CPS shall have power factor corrected features and shall ensure a full load power factor of 0.98 or better, reducing peak AC Line input current and associated stress on wiring. The CPS shall use modern switching technology and shall provide full output regulation across changes in AC Line voltage and output load over the full operating



temperature range of -34°C to +74°C without the need for a fan. The CPS shall have separate green LED indicators that display AC input status, DC output status and associated fuse integrity. The CPS outputs shall be fused for over-current protection and shall be protected against voltage transients by a 1500-Watt suppressor. The CPS shall be EBERLE Design INC. Model 2216-24. Install CPS as per applicable ATC Cabinet Model as illustrated on the Cabinet Layout Diagrams on pages 76, 82, 86 and 88.

6. **Monitor Key Programming Tool**  
The Programming Tool provides the capability to Read and Write data from the CMUip Datakey device. The MonitorKey software shall be compatible with the CMUip-2212. The Monitor Key Programming Tool shall be EBERLE Design INC.
7. **Model 21H High-Density Flash Transfer Relay (HDFTR)**  
The HDFTR shall have a hermetically sealed cover and shall be moisture proof. The HDFTR shall be filled with dry nitrogen to protect contacts from corrosion and to prevent condensation. The HDFTR shall have a shock/impact resistant metal can cover with solid and bend proof pins. The HDFTR contacts shall be rated at 120VAC @ 10 Amp. The coil of the HDFTR shall be rated at 48VDC. The HDFTR shall have an LED indicator to display contact transfer position. The HDFTR shall be STRUTHERS-DUNN Model 21XBHL-48VDC.
8. **Main Contactor (MC)**  
The MC shall be mercury free and shall be rated at 120VAC @ 60 Amp. The coil of the MC shall be rated at 48VDC. The MC shall be equipped with input indicator and shall have SPST- N.O. contacts. Main Contactor shall be Struthers-Dunn 428AXXL-48VDC.
9. **Cabinet Suppressor-Filter**  
The cabinet shall be equipped with a Cabinet Suppressor-Filter. The unit shall incorporate the use of warning and failure indicators and shall have a dry relay contact remote sensing circuit. The unit shall be modular and pluggable with a 6-position Beau 5406 connector. The unit shall be rated at continuous service current of 15 Amps and maximum clamp voltage of 390VAC. The unit shall filter noise and spike from 10 KHz to 25 MHz and shall have a peak surge current of 48 KA. The Cabinet Suppressor Filter shall be HESCO HE1750R.
10. **High-Density Switch Pack Suppressor**  
The HDSP Suppressor shall be modular and pluggable. The unit shall be epoxy encapsulated and equipped with 9-position 5.08 mm Phoenix Contact connector. The unit shall be able to protect 6 circuits. The device operating voltage shall be 120VAC and clamping voltage shall be 340VAC.  
  
The unit dimensions shall be 2" H x 0.7" W x 2" D. The HDSP Suppressor shall be Edco model MPA-303-9.
11. **Detection Module Suppressor**  
The Detection Module Suppressor shall be modular and pluggable. The unit shall be epoxy encapsulated and equipped with 6-position 5.08 mm Phoenix Contact. The unit shall be able to protect 6 circuits. The device operating voltage shall be 75VAC and clamping voltage shall be 130VDC.  
  
The device dimensions shall be 2" H x 0.7" W x 1.2" D. The Detection Module Suppressor shall be Edco MRA-6LC-6.

C. Section 3: General Requirements

The cabinet shall adhere to the following requirements:

1. The assemblies shall be completely removable from or installable in the cabinet without removing any other equipment and using only a standard slotted or Phillips screwdriver.
2. The cabinet shall be capable of Cabinet Flash signal operation in the absence of any of the following assemblies: Input Assembly, Output Assembly, Cabinet Power Supply, and Controller.
3. A momentary push button shall be provided that, when pressed, energizes the 24 VDC to the HDSPs during Flash Mode. The button shall be labeled "24 VDC BYPASS" and shall be located on the front of the Output Assembly.
4. High-voltage components (over 50 Volts) shall be protected from incidental contact per NEC.
5. All fuses, circuit breakers, switches (except police panel switches) and indicators shall be readily visible and accessible from the area accessed by opening the front door.
6. All circuit breakers located on the rack shall have covers to prevent accidental tripping.
7. All Assemblies shall be modular with pluggable cabling.
8. The ventilation fans shall be fastened to the cabinet via two thumb screws and shall not be fastened in a manner that requires any tools for removal or installation.
9. Door switches shall be powered by 48 VDC.
10. Wire raceway shall be integrated as part of the cabinet allowing for neat internal and field wiring.
11. All equipment in the cabinet shall be clearly and permanently labeled.
12. The marker strips shall be made of material that can be easily and legibly written on using a pencil or ballpoint pen. Marker strips shall be located immediately below the item they are to identify and must be clearly visible with the items installed.
13. Guides (top and bottom) shall be provided for assembly plug-in units. The guides shall begin 0.50 inch from the assembly front panel face.

D. Section 4: ATC Cabinet Specification

1. General  
This section describes the 120 VAC High Voltage (HV) Model MSF65, MSF75, 352i and 350i Advanced Transportation Controller (ATC) Cabinet ("the cabinet") for City and County of San Francisco SFMTA. The ATC Cabinet family is a modular, serially-interconnected cabinet architecture that is designed to fulfill a variety of transportation applications.

The cabinet shall include: Service Assembly (SA), Input Assembly (IA), Output Assembly (OA), SB1/SB2 and DC/Clean Power Bus, Field Input Termination Assembly (FITA), Field Output Termination Assembly (FOTA), SFMTA Field Output Termination Assembly, GARMIN GPS Antenna and GARMIN GPS Communication Panel.

This section is for the cabinet only. The 2070 LXN2 controller and ZincFive Battery Backup System will be provided from other sources.

2. Cabinet Housing

The housings shall include, but not be limited to, the following:

- Enclosure
- Doors

- Gasket
  - Lifting Eyes & External Bolt Heads
  - Latches & Locks
  - Ventilation
  - Hinges and Door Catches
  - Police Panel
  - Cage Supports and Mounting
- a. Housing Construction
- The housing shall be rainproof. It shall have front and rear doors, each equipped with a lock and handle. The enclosure top shall be crowned to prevent standing water. The ATC Model cabinet housing dimensions (Tolerance  $\pm \frac{1}{4}$ " ) shall be in accordance to the following diagrams in Section 6:
- i. [Drawing 24: MSF65-ATC Cabinet Housing Detail](#)
  - ii. [Drawing 30: MSF75-ATC Cabinet Housing Detail](#)
  - iii. [Drawing 36: 352i-ATC Cabinet Housing Detail](#)
  - iv. [Drawing 39: 350i-ATC Cabinet Housing Detail](#)
- b. Material Thickness
- The enclosure, doors, lifting eyes, gasket channels, police panel door, spacer supports and all supports welded to the enclosure and doors shall be fabricated of 0.125 inch minimum thickness aluminum sheet. The filter shell, filter trough, fan support and police panel enclosure shall be fabricated of 0.080 inch minimum thickness aluminum sheet. The spacer supports shall have the option to use 0.059 inch minimum stainless steel sheet.
- c. Welds
- All exterior seams for enclosure and doors shall be continuously welded and shall be smooth. All edges shall be filled to a radius of 0.03125 inch minimum. Exterior cabinet welds shall be done by gas Tungsten arc TIG process only. ER5356 aluminum alloy bare welding electrodes conforming to AWS A5.10 requirements shall be used for welding on aluminum. Procedures, welders and welding operators shall conform to the requirements and practices in AWS B3.0 and C5.6 for aluminum. Internal cabinet welds shall be done by gas metal arc MIG or gas Tungsten arc TIG process.
- d. Cabinet Finish
- The exterior shall be powder coated forest green Cardinal Industrial Product's #T007-GN16 at a minimum thickness of 2 mils over prime coating. Then apply a final top coat of Coval Anti-Graffiti Coat for metal surfaces by Coval Molecular Coatings Inc. The interior shall be powder coated white Cardinal Industrial Product's #T009-WH11 at a minimum thickness of 2 mils. All surfaces, burrs, and welds to be cleaned and smoothed before painting.
- e. Enclosure Door Frames and Door Seals
- The enclosure door frames shall be double-flanged out on all four sides and shall have strikers to hold tension on, and to form a firm seal between the door gasket and the frame. The dimension between the door edge and the enclosure external surface when the door is closed and locked shall be 0.156 inch (+/-0.08 inches).
- f. Gaskets
- Gaskets shall be provided on all door openings and shall be dust-tight. Gaskets shall be 0.25 inches minimum thickness closed cell neoprene or silicone (BOYD R- 108480 or approved equal) and shall be permanently bonded to the metal. A gasket top and side channels shall be provided to

support the top gasket on the door to prevent gasket gravitational fatigue.

g. Lifting Eyes and Exterior Bolt Heads

The housing shall be provided with 2 lifting eyes for placing the cabinet on its foundation. Each eye opening shall have a minimum diameter of 0.75 inch. Each eye shall be able to support the weight load of 1000 lbs. All bolt heads shall be tamperproof type.

h. Door Latches and Locks

i. Door

MSF65-ATC and MSF75-ATC cabinets shall have twin doors on the front and twin doors on the rear of the cabinet as illustrated in Section 6, [Drawing 24: MSF65-ATC Cabinet Housing Detail](#) and [Drawing 30: MSF75-ATC Cabinet Housing Detail](#), respectively. The front and rear door on the right shall be equipped with a three-point latching mechanism with nylon rollers at the top and bottom. The front door on the right shall have Louvered Air Vent with Filter Retainer Bracket.

352i-ATC cabinet shall have one door on the front and rear of the cabinet as illustrated in Section 6, [Drawing 36: 352i-ATC Cabinet Housing Detail on page 84](#). The front door on the right shall have Louvered Air Vent with Filter Retainer Bracket.

350-ATC cabinet shall have twin door on the front and twin door on rear of the cabinet as illustrated in Section 6, [Drawing 39: 350i-ATC Cabinet Housing Detail on page 87](#). The front door on the left shall have Louvered Air Vent with Filter Retainer Bracket.

ii. Latching Handles

The latching handles shall have provision for padlocking in the closed position. Each handle shall be 0.75 in minimum diameter stainless steel with a minimum 0.5 in shank. The padlocking attachment shall be placed at 4.0 in from the handle shank center to clear the lock and key. An additional 4.0 in minimum gripping length shall be provided.

iii. Latching Mechanism

The latching mechanism shall be a three-point draw roller type. The pushrods shall be turned edgewise at the outward supports and have a cross section of 0.25 in thick by 0.75 in wide, minimum.

iv. Locks and Handles

When the door is closed and latched, the door shall be locked. MSF65-ATC and MSF75-ATC locks and handles shall be on the left side of the right front door and left side of the right rear door. 352i-ATC locks and handles shall be on the right side of the front door and left side of the rear door. 350i-ATC locks and handle shall be on the left side of the front right door, on the right side of the front left door, on the left side of the rear door and right side of the rear left door. The lock and lock support shall be rigidly mounted on the door. In the locked position, the bolt throw shall extend a minimum of  $0.25 \pm 0.03125$  in into the latch Cam area. A seal shall be provided to prevent dust or water entry through the lock opening.

v. Locks

- The locks shall be Corbin 2 type. One key shall be supplied with each lock. The keys shall be removable in the locked position only.
- vi. Bolts  
The locks shall have rectangular, spring-loaded bolts. The bolts shall have a 0.281 in throw and shall be 0.75 in wide by 0.75 in thick (tolerance is  $\pm 0.035$  in).
  - vii. Center Latch Cam  
The center latch cam shall be fabricated of a minimum thickness 0.1875 in steel or aluminum. The bolt surface shall horizontally cover the cam thickness. The cam shall be structured to only allow the door to open when the handle is moved toward the center of the door.
  - viii. Rollers  
Rollers shall have a minimum diameter of 0.875 in with nylon wheels and steel ball bearings.
  - ix. Hinges  
MSF65-ATC and MSF75-ATC Cabinets: Doors shall have a heavy-duty gauge continuous hinge with a 3/16" minimum diameter stainless steel hinge pin. The hinge pin shall be secured with 1/4-20 stainless steel carriage bolts and stainless steel lock nuts.

352i-ATC and 350i-ATC Cabinets: Doors shall have heavy-duty stainless steel hinges (two bolts per leaf) shall be provided to bolt the enclosure to the doors. Each door shall have four hinges per door. Each hinge shall be 3.5 inch minimum length and have a fixed pin. The pin ends shall be welded to hinge and ground smooth. The pins and bolts shall be covered by the door edge and not accessible when the door is closed.

- A ground strap between the door and the main cabinet housing shall be required when 120 VAC devices are mounted on the door.
- x. Door Catches  
Front and rear doors shall be provided with catches to hold the door open at both 90 and 165 (+/-10) Degrees. The catch minimum diameter shall be 0.375 inch aluminum rods. The catches must be capable of holding the door open at 90 degrees in a 60 mph wind acting at an angle perpendicular to the plane of the door.
  - i. Police Panel  
As illustrated on each of the ATC Cabinet Model's Layout Diagram in Section 6, a police panel assembly shall be provided to allow limited control access. The police door shall include a gasket to prevent entry of moisture or dust and the panel door shall be equipped with a lock and master police key (SM-200). The front and back of the panel shall be enclosed with a rigid metal covering so that no parts having live voltage are exposed. The panel assembly shall have a drain to prevent water from collecting within the assembly. The drain shall be channeled to the outside.

The Police Panel shall include the following control switches:

- i. SIGNALS ON/OFF Switch: When in the SIGNALS OFF position, power shall be removed from all signal heads at the intersection. The CMU shall not fault or require reset.
- ii. FLASH / AUTO
- iii. MANUAL CONTROL ENABLE ON / OFF switch.
- iv. Receptacle for the INTERVAL ADVANCE cord shall be provided. An INTERVAL ADVANCE cord, six feet in length, shall be provided.

All switches shall be adequately labeled and shall be equipped with Toggle Switch safety cover.

j. Rack Cage

A standard rack cage shall be installed inside the housing for mounting of the ATC and cabinet assemblies. The EIA rack portion of the cage shall consist of four continuous, adjustable equipment mounting angles. The mounting angle nominal thickness shall be minimum 10-gauge plated steel. The mounting angles shall be tapped with 10-32 threads with EIA universal spacing. The mounting angle shall comply with standard EIA-310-B and shall be supported at the top and bottom by either welded or bolted support angles to form a cage. The mounting angles shall provide holes to mount the side panels. Rack Cages dimensions shall comply per the following ATC Cabinet Model Drawings in Section 6:

- A. [Drawing 25: MSF65-ATC Cage Assembly](#)
- B. [Drawing 31: MSF75-ATC Cage Assembly](#)
- C. [Drawing 37: 352i-ATC & 350i-ATC Cabinet Cage Assembly](#)

i. Cage Connection

The cage shall be bolted to the cabinet at four points via the housing cage supports and four points via associated spacer brackets (top and bottom).

ii. Cage Location

The cage shall be centered within the cabinet door opening(s).

iii. Cage Mounting Supports

Cage mounting supports shall be provided on either side, level with the bottom edge of the door opening, for horizontal support and bolt attachment; side cage supports provided for the bracket cage supports; and bracket cage support attachments.

iv. Clearance between Rails

MSF65-ATC and MSF75-ATC clearance between rails for mounting assemblies shall be Left Cage 17.75 inch, Right Cage 11.44 inch.

352i-ATC and 350i-ATC clearance between rails for mounting assemblies shall be 17.75 inch.

k. Housing Ventilation

i. Intake & Filter

The right front door on MSF65-ATC, the right front door on MSF75-ATC, the left front door on 350i-ATC cabinet and the 352i-ATC cabinet front door shall have a:

- A. Louvered Air Vent as illustrated in Section 6, [Drawing 22: MSF65 & 75 ATC Cabinet Door Air Filter Retainer Bracket](#) and [Drawing 23: 352i / 350i ATC Cabinet Door Air Filter Retainer Bracket](#)
- B. 352i & 350i ATC cabinet, provide gasket around the air intake surface where the filter sits against the door and

- filter retainer bracket to avoid unfiltered air thru the intake and into the cabinet.
- C. Provide installed one Flanders PrecisionAire Model ST55R-1216, Ring Panel Air Filter with each cabinet.
  - ii. Fans  
Each electric fan shall be equipped with ball or roller bearings and shall have a minimum capacity of 100 cubic feet of free air delivery per minute. MSF65, MSF75 and 352i ATC shall be equipped with one fan, 350i-ATC shall be equipped with two fans mounted within the housing and protected with a finger guard. A Fan Test switch shall be provided.
  - iii. Temperature Controlling  
The fans shall be thermostatically controlled and shall be manually adjustable to turn on between 32° Fahrenheit and 140° Fahrenheit with a differential of not more than 20 Fahrenheit between automatic turn on and off. The fan circuit shall be protected at 125% of the fan motor ampacity. The manual adjustment shall be graded in 20 Fahrenheit increment scale. The Thermostat shall be an Omega KT01101141900 or approved equal. Set fan thermostat to come on at 105° Fahrenheit or 40.5° Celsius.
  - I. Cabinet Lights  
MSF65-ATC, MSF75-ATC and 352i-ATC cabinet shall be equipped with front and rear LED light fixtures activated by door switches and equipped with fuses. 350i-ATC cabinet shall be equipped with four LED light fixtures activated by door switches and equipped with fuses, one LED fixture in the front and one the back for each housing cage.
3. ATC Cabinet Assemblies:
- a. Output Assembly (16-Channel)  
As illustrated in Section 6, [Drawing 11: 16-Channel Output Assembly](#) on page 59, the Output Assembly shall be a 3U high rack mounted assembly. The Output Assembly shall accommodate eight Model 2202-HV High-Density Switch Pack / Flasher Units (HDSP/FU), providing 48 output circuits.  
The Output Assembly shall accommodate one Model 2218 Serial Interface Unit (SIU) to provide interface and control via system SB1/SB2. The Output Assembly shall accommodate one Model 2212-HV Cabinet Monitor Unit (CMUp), Main Contactor, Stop Time Switch, Flash / Auto Switch, four Circuit Breakers and Momentary 24VDC Bypass Switch.
  - b. Output Assembly (32-Channel)  
As illustrated in Section 6, [Drawing 12: 32-Channel Output Assembly](#) on page 60, the Output Assembly shall be a 6U high rack mounted assembly. The Output Assembly shall house sixteen Model 2202-HV High-Density Switch Pack / Flasher Units (HDSP/FU) and shall provide ninety six output circuits. The Output Assembly shall accommodate two Model 2218 Serial Interface Units (SIU) to provide interface and control via system SB1/SB2. The Output Assembly shall house one model 2212-HV Cabinet Monitor Unit (CMUp), the Main Contactor, Stop Time Switch, Flash / Auto Switch, eight Circuit Breakers and Momentary 24VDC Bypass Switch.
  - c. Field Output Termination Assembly (16-Channel)  
As illustrated in Section 6, [Drawing 17: Field Output Termination Assembly \(FOTA\)](#), the 16-Channel Field Output Termination Assembly shall be coupled with the 16-Channel Output Assembly and shall house eight Model 21H High-Density Flash Transfer Relays (HDFTR). The

HDFTRs and Flash Program Blocks (FPB) shall be provided to control and select the color (red, yellow, or dark) during ATC Cabinet flash mode. HDSP Suppressors shall be provided at the field terminals for the protection of the HDSP. Each HDFTR position shall be labeled with the number of its associated HDSP (1-16). Each FPB position shall be labeled with the number of its associated channel (1-16).

The Field Output Termination Assembly shall be provided with 16, 6-position Phoenix Contact terminal block model number 18-04-94-6 plugs and 18-61-19-6 sockets or approved equal. Each Load Terminal Block receptacle shall be labeled with the number of its associated channel (1-16). Additional labels shall be provided to clearly indicate which terminals correspond to the red, yellow, and green switch pack outputs. The color of these labels shall match the color of their associated output (red, yellow, or green).

One Field Output Termination Assembly shall be provided with each 16-channel cabinet, while two Field Output Termination Assemblies shall be provided with each 32 Channel Output Assembly.

The 16-Channel Field Output Termination Assembly shall be mounted across the EIA rails and it shall swing down to provide access to the HDSP Suppressors.

d. Input Assembly (24-Channel)

As illustrated in Section 6, [Drawing 9: Input Assembly](#), the Input Assembly shall be a 3U high rack mounted assembly providing twelve slots of 22/44 pin PCB sockets. One Model 2218 Serial Interface Unit (SIU) shall be provided and mated to a DIN 96-pin connector. The SIU shall provide interface and control between the Controller and the input devices via system SB1/SB2. The Input Assembly shall house either 2-channel or 4-channel detection modules. The Input Assembly shall house twelve 2-channel detection modules, or six 4-channel detection modules, or a combination of 2 & 4 channel detection modules up to 24 channels. The Input Assembly shall be equipped with an Opto Input Card. The Opto Input Card shall be equipped with four LED indicators and four toggle switches. Activation of the switch 1-4 shall place a call into SIU Opto 1-4 input respectively.

e. Input Assembly (48-Channel)

The Input Assembly shall be a 3U high rack mounted assembly providing twelve slots of 22/44 pin PCB sockets. Two Model 2218 Serial Interface Units (SIU) shall be provided and mated to two DIN 96-pin connectors. The SIU shall provide interface and control between the Controller and the detection modules via system SB1/SB2. The Input Assembly shall house either a 2-channel or a 4-channel half width device, up to twelve detection modules providing a maximum of 48 channels.

f. Field Input Termination Assembly (24-Channel)

As illustrated in Section 6, [Drawing 21: Field Input Terminal Panel Assembly](#), the 24-Channel Field Input Termination Assembly shall be coupled with the 24-Channel Input Assembly and shall have enough terminal positions for landing 24, two-wire inputs and their associated earth ground wires. The Field Input Termination Assembly shall have positions for 12 Detection Module Suppressors. The Detection Module Suppressors shall be supplied with the cabinet if procurement requires. Mount this panel as illustrated on MSF65-ATC, MSF75-ATC, 352i-ATC and 350i-ATC Cabinet Layout Diagram in Section 6.

Two 24-Channel Field Input Termination Assembly shall be coupled with the 48-Channel Input Assembly.

g. Service Assembly (1-HDFU)



- As illustrated in Section 6, [Drawing 13: 1-HDFU Service Assembly](#), the Service Assembly shall be modular and shall be mounted as illustrated on the applicable ATC Model's Cabinet Layout Diagrams in Section 6. It shall house: one Model 2204-HV High-Density Switch Pack / Flasher Units (HDSP/FU), Cabinet Suppressor-Filter, BBS landing wire terminals, GFCI, one convenience outlet NEMA 15-5 format, four HDFU output fuses, five Circuit Breakers and a Raw AC+ terminal block having 5 screw terminals.
- h. Service Assembly (2-HDFU)  
As illustrated in Section 6, [Drawing 14: 2-HDFU Service Assembly](#), the Service Assembly shall be modular and shall be mounted as illustrated in Section 6, [Drawing 40: 350i-ATC Cabinet Layout Diagram](#). It shall house: two Model 2202-HV High-Density Switch Pack / Flasher Units (HDSP/FU), Cabinet Suppressor-Filter, BBS landing wire terminals, GFCI, one convenience outlet NEMA 15-5 format, eight HDFU output fuses, six Circuit Breakers and a Raw AC+ terminal block having 5 screw terminals.
- i. 120VAC Service Terminal Block Assembly  
Provide Marathon CAT#1423570 Panel Mount Barrier Terminal Block assembly for 120VAC Service as illustrated in Section 6, [Drawing 15: 120VAC Service Assembly](#) and shall be mounted as illustrated on the applicable Cabinet Layout Diagrams in Section 6.
- j. ATC Cabinet Serial Bus #1/Serial Bus #2 (SB1/SB2) and DC/Clean Power Bus  
As illustrated in Section 6, [Drawing 20: ATC Cabinet Bus Assembly](#) SB1/SB2 and DC/Clean Power Bus shall include eight DB25 d-submodular socket connectors to interconnect the SB1/SB2 communication ports of the assemblies and Controller. It shall include a termination circuit at the end of the connections (S8) to prevent radio frequency signal reflection. It shall include one Phoenix Contact plug block or approved equal to bring the DC power to the Bus; such power shall be distributed to the ATC Cabinet Assemblies through seven Phoenix Contact receptacle blocks or approved equal. The copper traces for the DC voltages shall support at least 10 Amp.  
The AC Clean Power Bus shall also include eight NEMA 5-15 receptacles, to provide AC Clean Power to the ATC Cabinet Assemblies, the Controller and Cabinet Power Supply.  
SB1/SB2 and DC/Clean Power Bus shall be mounted across the EIA rails and it shall swing down to provide access to the back of the assemblies mounted in the opposite side. Mount this panel as illustrated in Section 6:
- i. [Drawing 28: MSF65-ATC Cabinet Layout Diagram Sheet 3 of 4](#)
- ii. [Drawing 34: MSF75-ATC Cabinet Layout Diagram Sheet 3 of 4](#)
- iii. [Drawing 38: 352i-ATC Cabinet Layout Diagram](#)
- iv. [Drawing 40: 350i-ATC Cabinet Layout Diagram](#)
- k. Drawer Shelf Unit  
As illustrated in Section 6, [Drawing 10: Drawer Assembly](#), a telescopic slide out drawer to storage document shall be provided. The Drawer Shelf Unit shall be mounted across the EIA rails and shall have a non-conductive top, locking provision when fully extended and lip or handle for pulling. Drawer Shelf Unit shall be mounted as illustrated on the applicable Cabinet Layout Diagrams in Section 6.
- l. SFMTA Field Output Termination Assembly

Provide SFMTA Field Output Termination Panel with the following requirements:

- i. The panel shall be made of .090, 5052 H32 aluminum material as per Section 6, [Drawing 18: MSF65/75 ATC SFMTA Field Output Termination Panel](#) for model MSF65/75 ATC or [Drawing 19: 352i and 350i – ATC Cabinet Field Termination Assembly](#) for model 352i/350i ATC Cabinet.
  - ii. Field Output Termination Panel shall be mounted at the bottom of the rack as illustrated on each of the ATC Cabinet Model's Layout Diagram in Section 6.
  - iii. The panel shall have 2 rows of 42 blocks. Blocks shall be color coded from left to right, 2 red (GRR6), 2 yellow (GRY6), 2 green (GRG6) this would be LS-1. Repeat this pattern thru to LS-16.
  - iv. Use NEMA Type Terminal Blocks Class 9080 (type GR6).
  - v. Mount Blocks on din 3 9080 MH3\*\* or Phoenix Contact NS 35/7, 5 Perforated – 0801733 or Allen Bradley 199-DR1/DR2.
  - vi. Use end barrier GM6B.
  - vii. Use Screw on end clamp (MHA10).
  - viii. Use blank vinyl marking strip (9080 GH220) with marking strip end plug (9080 GH60) and leave marking strip blank.
  - ix. The panel shall have 25 Position AC Neutral Buss.
  - x. Silkscreen panel as illustrated on the detailed drawing per SFMTA Cabinet Model MSF65-ATC, MSF75-ATC, 352i-ATC and 350i-ATC.
  - xi. Use 2 pole jumpers (9080 GH72) for continuity of Phase colors. Install cabinet wiring and 2 pole jumpers (9080 GH72), on the top side of the terminal blocks. And install the jumper portion of the 9080 GH72 facing the din rail.
  - xii. Load Switch driver wiring to the Field Output Termination Panel shall be 20 AWG stranded copper wire. Use TE Connectivity Part # 34294 Male Blade Nylon Insulated or approved equal prior to termination. See wiring assignment details on SFMTA Cabinet Model MSF65-ATC, MSF75-ATC, 352i-ATC and 350i-ATC.
  - xiii. The wiring from the Output Assemblies to the Field Output Termination Panels must be labeled with permanent markings showing load switches that are attached to the Field Output Termination Panels.
- m. Garmin GPS
- Each cabinet shall include one (1) Garmin GPS units, model GPS 19 x HVS, Garmin part # 010-01010-00 installed by cabinet manufacturer per the following instructions:
- i. Section 2.13.D.3.m.i. (GARMIN GPS Communication Panel (GPSCP))
  - ii. Section 2.13.D.3.m.ii. (GARMIN GPS Antenna Installation)
  - iii. Section 6, [Drawing 1: Garmin GPS Communication Panel Wiring Detail](#)
  - iv. For each SFMTA ATC Cabinet Model depicted, mount GARMIN GPS antenna externally as illustrated on the following diagrams in Section 6:
    - A. [Drawing 2: \(MSF65 / MSF75\)-ATC Garmin GPS Antenna Mounting Layout Diagram](#)
    - B. [Drawing 3: 352i-ATC Garmin GPS Antenna Mounting Layout Diagram](#)
    - C. [Drawing 4: 350i-ATC Garmin GPS Antenna Mounting Layout Diagram](#)

- v. Garmin GPS Communication Panel (GPSCP)  
Garmin GPS Communication Panel shall have the following key components:
- A. Provide Printed Circuit Board equipped with two 9 pin D-sub female sockets with screw locks and a 1 Amp Circuit Breaker as illustrated on GARMIN GPS Antenna Mounting and Wiring Detail Drawing. The Printed Circuit Board and Circuit Breaker shall be panel mounted. The panel shall be made of 0.090, 5052 H32 aluminum material. Mount this panel per Cabinet Layout Diagram depicted as per relevant ATC cabinet model.
  - B. The 1 Amp Circuit Breaker rated for 24VDC power shall be IDEC NC1V-1100-1AA din rail mount. GARMIN supplied fuse shall not be used.  $\pm 24\text{VDC}$  power shall be brought to the GARMIN GPS Communication Panel from cabinet  $\pm 24\text{VDC}$  Power Bus using 16 AWG Red and Black stranded wire. Label this Circuit Breaker as CB-GPS and Printed Circuit Board as GPSCP.
  - C. CB-GPS shall feed  $+24\text{VDC}$  to the Printed Circuit Board. Printed Circuit Board shall contain power terminal blocks for  $\pm 24\text{VDC}$  Power Input as follows:
    - 1. One terminal for  $+24\text{VDC}$  power.  $+24\text{VDC}$  terminal shall have circuit traces connected to Pin 2 of both 9 Pin D-sub female sockets.
    - 2. One terminal for  $-24\text{VDC}$  (Logic Ground).  $-24\text{VDC}$  terminal shall have circuit traces connected to Pin 2, 4, and 7 of both 9 Pin D-sub female sockets.
  - D. The 9 Pin D-sub sockets shall have gold plated soldered terminals. All D-sub female terminals on the Printed Circuit Board Pin #1 circuit trace are wired in parallel as are Pins 2, 3, 4, 5, 6, 7, 8, and 9.
  - E. Provide two NEMA approved DB9 Male Connector with screw locks serial cables using GARMIN supplied cables. For wiring details refer to Section 6, [Drawing 1: Garmin GPS Communication Panel DB9 Pinout](#)
  - F. The two serial cables with DB9 connectors shall be provided with the following requirements:
    - 1. GPS Communication Panel serial connection to 2070-7A Module. One end of the serial cable shall connect to 2070-7A Module and the other end shall connect to GARMIN GPS Communication Panel.
    - 2. GPS Communication Panel serial connection to GARMIN GPS Antenna. One end of the GPS 19x NEMA 0183 HVS Power/Data connector cable shall connect to GARMIN GPS Antenna. The other end of the cable with DB9 Male connector shall connect to GARMIN GPS Communication Panel.
    - 3. The D-sub sockets shall have gold plated soldered or crimped terminals with back-shells.

- G. GARMIN Communication Panel Assembly shall conform to:
  - 1. Section 6, [Drawing 6: ATC GARMIN GPS Communication Assembly](#)
  - 2. Install GARMIN Communication Panel Assembly as per applicable Model of ATC Cabinet Layout Diagram per Section 6.
- vi. Garmin GPS Antenna Installation  
GARMIN GPS Antenna shall be installed as follows:
  - A. Install GARMIN GPS Antenna as per GARMIN 19xHVS Installation Manual instructions for surface mounting GPS 19xHVS antenna. In addition to the mounting instruction, apply a bead of sealant to the "surface mount bracket" before and after installation of GARMIN antenna. Apply sealant around the base of the antenna where it meets the cabinet surface. Use "DAP® DYNAFLEX 230® Premium Indoor/Outdoor Sealant – Clear".
  - B. Paint GARMIN GPS Antenna to match cabinet exterior color as per Section 2.13.D.2.d (Cabinet Finish).
  - C. Do not prime or use anti-graffiti coat.
- 4. Door Switch Assembly  
Provide front and rear door switches. The CMU shall monitor the DOOR SWITCH FRONT and DOOR SWITCH REAR inputs.
- 5. 35 mm Din Rail  
Each cabinet shall include 35mm Din Rail mounted as per following:
  - a. MSF65-ATC: provide two 35mm din rail, each installed centered between each shelf clearance, mounted with support brackets from the front to the rear cage EIA rail on the right side of the right cage when viewed from the front of the cabinet.
  - b. MSF75-ATC: provide two 35mm din rail, each installed centered between each shelf clearance, mounted with support brackets from the front to the rear cage EIA rail on the right side of the right cage when viewed from the front of the cabinet.
  - c. 352i-ATC: install 35mm din rail approximately 30" from the bottom of the cage, to the front and rear cage EIA rail with support brackets on the right side of the cabinet when viewed from the rear of the cabinet.
  - d. 350i-ATC: install 35mm din rail approximately 24" from the bottom of the cage, to the front and rear cage EIA rail with support brackets on the right side of the left cage when viewed from the rear of the cabinet.
- 6. MSF65-ATC & MSF75-ATC ZincFive UPStealth Battery Backup System Battery Supports  
Provide ZincFive battery support as per Section 6, [Drawing 16: MSF65 & MSF75 – ATC Accessories Shelf, Battery Shelf and Battery Support](#) and mount the battery supports as illustrated in Section 6, [Drawing 28: MSF65-ATC Cabinet Layout Diagram Sheet 3 of 4](#) and [Drawing 34: MSF75-ATC Cabinet Layout Diagram Sheet 3 of 4](#).
- 7. Traffic Signal Cabinet Configuration and Components  
The ATC Cabinet shall consist of the following Assemblies and Components installed as per the following Tables and Drawings as illustrated in Section 6:

- a. [Table 3: Model 352i/MSF65/MSF75 ATC Cabinet I/O Assignments](#)
- b. [Table 4: ATC Cabinet IO Assignment \(Input Assembly\)](#)
- c. [Table 5: Model 2212-HV CMUip](#)
- d. [Table 6: SB1/SB2 Connector \(DB 25\)](#)
- e. [Table 7: Serial Bus 3 \(RJ-45\) Connector](#)
- f. [Table 8: Model 2202-HV High-Density Switch Pack \(HDSP\) Connector](#)
- g. [Table 10: Model 2218 Serial Interface Unit \(SIU\) Connector](#)
- h. [Table 11: Model 2216-24 Cabinet Power Supply \(CPS\) Connector](#)
- i. [Table 12: Switches Definitions](#)
- j. [Table 13: Circuit Breakers Definitions](#)
- k. [Table 14: SFMTA Model MSF65-ATC Cabinet Configuration](#)
- l. [Drawing 18: MSF65/75 ATC SFMTA Field Output Termination Panel](#)
- m. [Drawing 24: MSF65-ATC Cabinet Housing Detail](#)
- n. [Drawing 25: MSF65-ATC Cage Assembly](#)
- o. [Drawing 26: MSF65-ATC Cabinet Layout Diagram Sheet 1 of 4](#)
- p. [Drawing 27: MSF65-ATC Cabinet Layout Diagram Sheet 2 of 4](#)
- q. [Drawing 28: MSF65-ATC Cabinet Layout Diagram Sheet 3 of 4](#)
- r. [Drawing 29: MSF65-ATC Cabinet Layout Diagram Sheet 4 of 4](#)
- s. [Table 15: SFMTA Model MSF75-ATC Cabinet Configuration](#)
- t. [Drawing 30: MSF75-ATC Cabinet Housing Detail](#)
- u. [Drawing 31: MSF75-ATC Cage Assembly](#)
- v. [Drawing 32: MSF75-ATC Cabinet Layout Diagram Sheet 1 of 4](#)
- w. [Drawing 33: MSF75-ATC Cabinet Layout Diagram Sheet 2 of 4](#)
- x. [Drawing 34: MSF75-ATC Cabinet Layout Diagram Sheet 3 of 4](#)
- y. [Drawing 35: MSF75-ATC Cabinet Layout Diagram Sheet 4 of 4](#)
- z. [Table 16: SFMTA Model 352i-ATC Cabinet Configuration](#)
- aa. [Drawing 19: 352i and 350i – ATC Cabinet Field Termination Assembly](#)
- bb. [Drawing 36: 352i-ATC Cabinet Housing Detail](#)
- cc. [Drawing 37: 352i-ATC & 350i-ATC Cabinet Cage Assembly](#)
- dd. [Drawing 38: 352i-ATC Cabinet Layout Diagram](#)
- ee. [Table 17: SFMTA Model 350i-ATC Cabinet Configuration](#)
- ff. [Drawing 39: 350i-ATC Cabinet Housing Detail](#)
- gg. [Drawing 40: 350i-ATC Cabinet Layout Diagram](#)

In order to avoid various cabinet manufacturer's unique wiring diagrams and labeling conventions, the Wiring Diagram and wire labels shall conform to the following Cabinet Wiring Diagrams in Section 6:

- hh. [Drawing 41: MSF65, MSF75 & 352i ATCC Wiring Diagram Sheet 1 of 2](#)
- ii. [Drawing 42: MSF65, MSF75 & 352i ATCC Wiring Diagram Sheet 2 of 2](#)
- jj. [Drawing 43: 350i-ATC Cabinet Wiring Diagram Sheet 1 of 3](#)
- kk. [Drawing 44: 350i-ATC Cabinet Wiring Diagram Sheet 2 of 3](#)
- ll. [Drawing 45: 350i-ATC Cabinet Wiring Diagram Sheet 3 of 3](#)

#### E. Section 5: ATC Cabinet Electrical, Environmental and Testing Requirements

##### 1. General

The requirements called out in this specification dealing with equipment evaluation are a minimum guide and shall not limit the testing and inspection to ensure compliance.

##### a. Certification

These test procedures shall be followed by the manufacturers who shall certify that they have conducted inspection and testing in accordance with this specification.

2.     **Inspection**  
A visual and physical inspection shall include mechanical, dimensional and assembly conformance of all parts of this specification.
3.     **Environmental and Electrical**  
All components shall properly operate within the following limits unless otherwise noted:
  - a.       Applied Line Voltage: 90 to 135 Vac
  - b.       Frequency: 60 (+/-3.0) Hertz
  - c.       Humidity: 5% to 95%
  - d.       Ambient Temperature: -34.6 °F to +165.2 °F
  - e.       Shock - Test per Specification MIL-STD-810G Method 516.6
  - f.       Vibration - per Specification MIL-STD-810G Method 514.6
4.     **Commencement Operation**  
All circuits, unless otherwise noted, shall commence operation at or below 90 VAC as the applied voltage is raised from 50 to 90 Vac at a rate of 2 (+/-0.5) volts / second.
5.     **Equipment Compliance**  
All equipment shall be unaffected by transient voltages normally experienced on commercial power lines. Where applicable, equipment purchased separately from the cabinet (which normally is resident) will be tested for compliance.
6.     **Power Line Surge Protection**  
The power line surge protection shall enable the equipment being tested to withstand (Non-destructive) and operate normally following the discharge of a 25µF capacitor charged to ± 2,000 volts, applied directly across the incoming AC line at a rate of once every 10 seconds for a maximum of 50 occurrences per test. The unit under test will be operated at 68°F ± 41°F and at 120 (±12) Vac.
7.     **Operating**  
The equipment shall withstand (Non-destructive) and operate normally when one discharge pulse of plus or minus 300 volts is synchronously added to its incoming AC power line and moved uniformly over the full wave across 360 degrees or stay at any point of Line Cycle once every second. Peak noise power shall be 5 kilowatts with a pulse rise time of 500 ns. The unit under test will be operated at 68 °F ±41 °F and at 120 (+/-12) Vac.
8.     **UL Requirements**  
Equipment shall comply only with the requirements of UL Bulletin of Research No. 23, "Rain Tests of Electrical Equipment."
9.     **Normal Operation**  
All equipment shall continue normal operation when subjected to the following:
  - a.       Low Temperature Test  
With the item functioning at a line voltage over Electrical Range the Device in its intended operation, the ambient temperature shall be lowered from 68 °F to 34.6 °F at a rate of not more than 64.4 °F per hour. The item shall be cycled at -34.6 °F for a minimum of 5 hours and then returned to 68 °F at the same rate.



- b. High Temperature Test  
With the item functioning at a line voltage over Electrical Range the Device in its intended operation, the ambient temperature shall be raised from 68 °F to 165.2 °F at a rate of not more than 64.4 °F per hour. The item shall be cycled at 165.2 °F for 5 hours and then returned to 68 °F at the same rate. The test shall be repeated with the line voltage at 135 Vac.
  - c. Normal Operation  
All equipment shall resume normal operation following a period of at least 5 hours at -34.6 °F and less than 10 percent humidity and at least 5 hours at 165.2 °F and 22% humidity, when 90 Vac is applied to the incoming AC.
  - d. Humidity and Ambient Temperature  
Values in Section 6, [Table 1: Humidity and Ambient Temperature](#) shall not be exceeded.
10. QC / Final Test  
A complete QC / final test report shall be supplied with each ATC Cabinet. The test report shall indicate the name of the tester and shall be signed by a responsible manager.
11. Quality Control Procedure & Test Report  
The quality control procedure and test report format shall be supplied to the SFMTA's Traffic Signal Shop personnel or approval within 15 days following the award of the contract. The quality control procedure shall include the following:
- a. Acceptance testing of all supplied components
  - b. Physical and functional testing of all modules and items
  - c. A minimum 100-hour burn-in of all equipment
  - d. Physical and functional testing of all items
12. Cabinet Print  
Cabinet wiring and cabinet layout diagrams shall be provided as follows:
- a. Two printed sets (dimensions 24"x36"), folded to finished size of 8 ½" X 11" placed inside the Drawer Assembly. Cabinet wiring diagrams shall be on non-fading.
  - b. On Compact Disk or USB Flash Drive in CAD and PDF format.
13. Manual  
One copy of manual documentation shall be supplied for each item purchased. The manual shall be printed on 8.5 in by 11 in paper, with the exception that schematics, layouts, parts lists and plan details may be on 11 in by 17 in sheets, with each sheet neatly folded to 8.5 in by 11 in size. The manual shall be formatted per Section 6, [Table 2 \(Manual\)](#)

## F. Section 6: Tables and Drawings

**Table 1: Humidity and Ambient Temperature**

Ambient Temperature/ Dry Bulb (in °F)	Relative Humidity (in percent)	Ambient Temperature/ Wet Bulb (in °F)
-34.6 °F to 33.98 °F	10%	1.04 °F to 108.86 °F
33.98 °F to 114.8 °F	95%	108.86 °F
119.84 °F	70%	108.86 °F
129.92 °F	50%	108.86 °F
140 °F	38%	108.86 °F
149.72 °F	28%	108.86 °F
160.16 °F	21%	108.86 °F
165.2 °F	18%	108.86 °F

Ambient Temperature versus Relative Humidity @ Barometric Pressure (29.92 In. Hg.)

**Table 2: Manual**

Section	Description
N/A	N/A Table of Contents
1.	Glossary
2.	General Description
3.	General Characteristics
4.	Installation
5.	Adjustments
6.	Theory of Operation
	6a. Systems Description (include block diagram)
	6b. Detailed Description of Circuit Operation
7.	Maintenance
	7a. Preventive Maintenance
	7b. Trouble Analysis
	7c. Trouble Shooting Sequence Chart
	7d. Wave Forms
	7e. Voltage Measurements
	7f. Alignment Procedures
8.	Parts List (include circuit and board designation, part type and class, power rating, component manufacturer, mechanical part manufacturer, data specification sheets for special design components and original manufacturer's part number)
9.	Electrical Interconnection Details & Drawings
10.	Schematic and Logic Diagram
11.	Assembly Drawings and a pictorial diagram showing physical locations and identification of each component or part



**Table 3: Model 352i/MSF65/MSF75 ATC Cabinet I/O Assignments**

ATC Cabinet 16-Channel (CH) Output Assembly								
Controller Phase/Overlap/Pedestrian Assignments								
CH1/2	CH3/4	CH5/6	CH7/8	CH9/10	CH11/12	CH13/14	CH15/16	SIU 1
HDSP1	HDSP2	HDSP3	HDSP4	HDSP5	HDSP6	HDSP7	HDSP8	
R	R	R	R	R	R	R	R	
Y	Y	Y	Y	Y	Y	Y	Y	
G	G	G	G	G	G	G	G	
R	R	R	R	R	R	R	R	
Y	Y	Y	Y	Y	Y	Y	Y	
G	G	G	G	G	G	G	G	
CMU Channel (CH) Assignments								
HDSP1	HDSP2	HDSP3	HDSP4	HDSP5	HDSP6	HDSP7	HDSP8	SIU 1
CH-1	CH-3	CH-5	CH-7	CH-9	CH-11	CH-13	CH-15	
CH-1	CH-3	CH-5	CH-7	CH-9	CH-11	CH-13	CH-15	
CH-1	CH-3	CH-5	CH-7	CH-9	CH-11	CH-13	CH-15	
CH-2	CH-4	CH-6	CH-8	CH-10	CH-12	CH-14	CH-16	
CH-2	CH-4	CH-6	CH-8	CH-10	CH-12	CH-14	CH-16	
CH-2	CH-4	CH-6	CH-8	CH-10	CH-12	CH-14	CH-16	
SIU Output (IO) Assignments								
HDSP1	HDSP2	HDSP3	HDSP4	HDSP5	HDSP6	HDSP7	HDSP8	SIU 1
IO 0	IO 6	IO 12	IO 18	IO 24	IO 30	IO 36	IO 42	
IO 1	IO 7	IO 13	IO 19	IO 25	IO 31	IO 37	IO 43	
IO 2	IO 8	IO 14	IO 20	IO 26	IO 32	IO 38	IO 44	
IO 3	IO 9	IO 15	IO 21	IO 27	IO 33	IO 39	IO 47	
IO 4	IO 10	IO 16	IO 22	IO 28	IO 34	IO 40	IO 48	
IO 5	IO 11	IO 17	IO 23	IO 29	IO 35	IO 41	IO 49	
HDSP Addresses								
HDSP1	HDSP2	HDSP3	HDSP4	HDSP5	HDSP6	HDSP7	HDSP8	SIU 1
0 (00000)	1 (00001)	2 (00010)	3 (00011)	4 (00100)	5 (00101)	6 (00110)	7 (00111)	SIU 1
Model 352i/MSF65/MSF75 ATC Cabinet I/O Assignments (Output Assembly)								

**Table 4:ATC Cabinet IO Assignment (Input Assembly)**

ATC Cabinet 24-Channel Input Assembly #1												
SIU Input (IO) Assignments												
2-CH Card	2-CH Card	2-CH Card	2-CH Card	2-CH Card	2-CH Card	2-CH Card	2-CH Card	2-CH Card	2-CH Card	2-CH Card	2-CH Card	SIU 9
IO 6	IO 8	IO 10	IO 12	IO 14	IO 16	IO 18	IO 20	IO 22	IO 24	IO 26	IO 28	
IO 7	IO 9	IO 11	IO 13	IO 15	IO 17	IO 19	IO 21	IO 23	IO 25	IO 27	IO 29	
	*IO 6	*IO 8	*IO 10	*IO 12	*IO 14	*IO 16	*IO 18	*IO 20	*IO 22	*IO 24	*IO 26	
	*IO 7	*IO 9	*IO 11	*IO 13	*IO 15	*IO 17	*IO 19	*IO 21	*IO 23	*IO 25	*IO 27	
SIU Input (CH) Assignments												
2-CH Card	2-CH Card	2-CH Card	2-CH Card	2-CH Card	2-CH Card	2-CH Card	2-CH Card	2-CH Card	2-CH Card	2-CH Card	2-CH Card	SIU 9
CH-1	CH-3	CH-5	CH-7	CH-9	CH-11	CH-13	CH-15	CH-17	CH-19	CH-21	CH-23	
CH-2	CH-4	CH-6	CH-8	CH-10	CH-12	CH-14	CH-16	CH-18	CH-20	CH-22	CH-24	
	*CH-1	*CH-3	*CH-5	*CH-7	*CH-9	*CH-11	*CH-13	*CH-15	*CH-17	*CH-19	*CH-21	
	*CH-2	*CH-4	*CH-6	*CH-8	*CH-10	*CH-12	*CH-14	*CH-16	*CH-18	*CH-20	*CH-22	

\* If 4-Channel (CH) device being used

ATC Cabinet 24-Channel Input Assembly #2												
SIU Input (IO) Assignments												
2-CH Card	2-CH Card	2-CH Card	2-CH Card	2-CH Card	2-CH Card	2-CH Card	2-CH Card	2-CH Card	2-CH Card	2-CH Card	2-CH Card	SIU 10
IO 6	IO 8	IO 10	IO 12	IO 14	IO 16	IO 18	IO 20	IO 22	IO 24	IO 26	IO 28	
IO 7	IO 9	IO 11	IO 13	IO 15	IO 17	IO 19	IO 21	IO 23	IO 25	IO 27	IO 29	
	*IO 6	*IO 8	*IO 10	*IO 12	*IO 14	*IO 16	*IO 18	*IO 20	*IO 22	*IO 24	*IO 26	
	*IO 7	*IO 9	*IO 11	*IO 13	*IO 15	*IO 17	*IO 19	*IO 21	*IO 23	*IO 25	*IO 27	
SIU Input (CH) Assignments												
2-CH Card	2-CH Card	2-CH Card	2-CH Card	2-CH Card	2-CH Card	2-CH Card	2-CH Card	2-CH Card	2-CH Card	2-CH Card	2-CH Card	SIU 10
CH-1	CH-3	CH-5	CH-7	CH-9	CH-11	CH-13	CH-15	CH-17	CH-19	CH-21	CH-23	
CH-2	CH-4	CH-6	CH-8	CH-10	CH-12	CH-14	CH-16	CH-18	CH-20	CH-22	CH-24	
	*CH-1	*CH-3	*CH-5	*CH-7	*CH-9	*CH-11	*CH-13	*CH-15	*CH-17	*CH-19	*CH-21	
	*CH-2	*CH-4	*CH-6	*CH-8	*CH-10	*CH-12	*CH-14	*CH-16	*CH-18	*CH-20	*CH-22	

\* If 4-Channel (CH) device being used

**Table 5: Model 2212-HV CMUip**

Pin	FUNCTION	Pin	FUNCTION
1A	+24vdc	1B	
2A	+12vdc	2B	ExtReset in
3A	DC gnd	3B	
4A		4B	
5A		5B	
6A		6B	
7A	SB1 TXD+	7B	SB1 TXD-
8A	SB1 RXD+	8B	SB1 RXD-
9A	SB1 TXC+	9B	SB1 TXC-
10A	SB1RXC+	10B	SB1 RXC-
11A		11B	
12A		12B	
13A		13B	
14A		14B	
15A	LineSync+	15B	LineSync-
16A	NReset+	16B	Nreset-
17A	PwrDwn+	17B	PwrDwn-
18A	SB3 TX+	18B	SB3 TX-
19A	SB3 RX+	19B	SB3 RX-
20A	SB3 TXC+	20B	SB3 TXC-
21A	LF status	21B	LF status
22A	LF status out	22B	LF status out
23A	signals ON	23B	
24A	MC coil	24B	
25A	MC sec	25B	
26A	FTR coil	26B	
27A	FDS	27B	
28A	RDS	28B	
29A		29B	
30a		30B	+48VDC
31A	EQ gnd	31B	
32A	FUNCTION	32B	DC- bus

**Table 6: SB1/SB2 Connector (DB 25)**

PIN #	AT THE CONTROLLER	AT THE SIU	PIN #	AT THE CONTROLLER	AT THE SIU
1	SB1 TXD+	SB1 RXD+	14	SB1 TXD-	SB1 RXD-
2	SB1 RXD+	SB1 TXD+	15	SB1 RXD-	SB1 TXD-
3	SB1 TXC+	SB1 RXC+	16	SB1 TXC-	SB1 RXC-
4	SB1 RXC+	SB1 TXC+	17	SB1 RXC-	SB1 TXC-
5	SB2 TXD+	SB2 RXD+	18	SB2 TXD-	SB2 RXD-
6	SB2 RXD+	SB2 TXD+	19	SB2 RXD-	SB2 TXD-
7	SB2 TXC+	SB2 RXC+	20	SB2 TXC-	SB2 RXC-
8	SB2 RXC+	SB2 TXC+	21	SB2 RXC-	SB2 TXC-
9	LINE SYNC+	LINE SYNC+	22	LINE SYNC-	LINE SYNC+
10	NRESET+	NRESET+	23	NRESET-	NRESET-
11	PWR DWN+		24	PWR DWN-	
12	+5VDC ISO		25	EQ GND	
13	ISO GND	DC GND			

**Table 7: Serial Bus 3 (RJ-45) Connector**

PIN	FUNCTION
1	Reserved
2	Reserved
3	Neutral (AC- Raw)
4	RxDATA +
5	RxDATA -
6	Neutral ( AC- Raw)
7	TxDATA +
8	TxDATA -

**Table 8: Model 2202-HV High-Density Switch Pack (HDSP) Connector****(DIN 41612 Type E series, 48-pin connector)**

PIN	A (Bottom Row)	C (Middle Row)	E (Top Row)
2	CH 1 Red In	CH 1 Yellow In	CH 1 Green In
4	CH 2 Red In	CH 2 Yellow In	CH 2 Green In
6	+24VDC	DC Ground	Address 4
8	Equipment Ground	Neutral	Neutral
10	SB #3 Rx+	SB #3 Tx+	Address Common
12	SB #3 Rx-	SB #3 Tx-	Address 3
14	Address 0	Address 1	Address 2
16	CH 1 Red Sense	CH 1 Red Out	CH 1 Red Out
18	CH 1 Yellow Sense	CH 1 Yellow Out	CH 1 Yellow Out
20	CH 1 Green Sense	CH 1 Green Out	CH 1 Green Out
22	CH 2 Red Sense	CH 2 Red Out	CH 2 Red Out
24	CH 2 Yellow Sense	CH 2 Yellow Out	CH 2 Yellow Out
26	CH 2 Green Sense	CH 2 Green Out	CH 2 Green Out
28	LV+ Signal	LV+ Signal	LV+ Signal
30	HV+ Signal	HV+ Signal	HV+ Signal
32	LV+ MAINS	Neutral	HV+ MAINS

**Table 9: Model 2202-HV High-Density Flasher Unit (HDFU) Connector****(DIN 41612 Type E series, 48-pin connector)**

PIN	A (Bottom Row)	C (Middle Row)	E (Top Row)
2	Reserved	Reserved	CH 1 Aux In
4	CH 2 Aux In	Reserved	Reserved
6	+24VDC	DC Ground	Address 4
8	Equipment Ground	Neutral	Neutral
10	SB #3 Rx+	SB #3 Tx+	Address Common
12	SB #3 Rx-	SB #3 Tx-	Address 3
14	Address 0	Address 1	Address 2
16	FL#1-1 Sense	FL#1-1 Out	FL#1-1 Out
18	FL#1-2 Sense	FL#1-2 Out	FL#1-2 Out
20	CH 1 Aux Sense	CH 1 Aux Out	CH 1 Aux Out
22	CH 2 Aux Sense	CH 2 Aux Out	CH 2 Aux Out
24	FL#2-1 Sense	FL#2-1 Out	FL#2-1 Out
26	FL#2-2 Sense	FL#2-2 Out	FL#2-2 Out
28	LV+ Signal	LV+ Signal	LV+ Signal
30	HV+ Signal	HV+ Signal	HV+ Signal
32	LV+ MAINS	Neutral	HV+ MAINS

**Table 10: Model 2218 Serial Interface Unit (SIU) Connector**

Pin	Description	Pin	Description	Pin	Description
A1	+24 VDC in	B1	+24 VDC in	C1	Input / Output 47
A2	Input / Output 0	B2	Input / Output 1	C2	Input / Output 48
A3	Input / Output 2	B3	Input / Output 3	C3	Input / Output 49
A4	Input / Output 4	B4	Input / Output 5	C4	Input / Output 50
A5	Input / Output 6	B5	Input / Output 7	C5	Input / Output 51
A6	Input / Output 8	B6	Input / Output 9	C6	Input / Output 52
A7	Input / Output 10	B7	Input / Output 11	C7	Input / Output 53
A8	Input / Output 12	B8	Input / Output 13	C8	SB1 TxD +
A9	Input / Output 14	B9	Input / Output 15	C9	SB1 TxD -
A10	Input / Output 16	B10	Input / Output 17	C10	SB1 RxD +
A11	Input / Output 18	B11	Input / Output 19	C11	SB1 RxD -
A12	Input / Output 20	B12	Input / Output 21	C12	SB1 TxC +
A13	Input / Output 22	B13	Input / Output 23	C13	SB1 TxC -
A14	Input / Output 24	B14	Input / Output 25	C14	SB1 RxC +
A15	Input / Output 26	B15	Input / Output 27	C15	SB1 RxC -
A16	Input / Output 28	B16	Input / Output 29	C16	LINESYNC +
A17	Input / Output 30	B17	Input / Output 31	C17	LINE SYNC -
A18	Input / Output 32	B18	Input / Output 33	C18	NRESET +
A19	Input / Output 34	B19	Input / Output 35	C19	NRESET -
A20	Input / Output 36	B20	Input / Output 37	C20	ASSEMBLY ADR
A21	Input / Output 38	B21	Input / Output 39	C21	INBUS RTS
A22	Input / Output 40	B22	Input / Output 41	C22	SB2 TxD +
A23	Input / Output 42	B23	Input / Output 43	C23	SB2 TxD -
A24	Input / Output 44	B24	Input / Output 45	C24	SB2 RxD +
A25	Input / Output 46	B25	Opto Input 1	C25	SB2 RxD -
A26	Opto Input 2	B26	Opto Input 3	C26	SB2 TxC +
A27	Opto Input 4	B27	Opto Input Ground	C27	SB2 TxC -
A28	Address - 0	B28	Address - 1	C28	SB2 RxC +
A29	Address - 2	B29	Address - 3	C29	SB2 RxC -
A30	INBUS TxD	B30	INBUS RxD	C30	INBUS TxC
A31	Equipment Ground	B31	AC Line Reference	C31	INBUS RxC
A32	24 VDC Ground	B32	24 VDC Ground	C32	SIU/BIU

**Table 11: Model 2216-24 Cabinet Power Supply (CPS) Connector****(Phoenix Contact #1825161)**

Pin	Function
1	+48VDC
2	48VDC Ground**
3	+24VDC
4	+12VDC (PS-2216-2412 only)
5	24/12 VDC Ground
6	Chassis Ground

**Table 12: Switches Definitions**

Manual Control Enable (MCE) switch places call into the CU and activates stop time
Interval Adv. switch advances the CU when MCE is on
FDS (Front Door Switch) 1 or 2 to notify the CMU when Front Door is open
RDS (Rear Door Switch) 1 or 2 to notify the CMU when Rear Door is open
FLS (Front Light Switch) 1 or 2 to turn on the Front cabinet Light
RLS (Rear Light Switch) 1 or 2 to turn on the Rear cabinet Light
Fan Test 1 or 2 to verify if the Fans work

**Table 13: Circuit Breakers Definitions**

Service Assembly (SA) MAIN Circuit Breaker (CB) controls power to the entire ATCC
SA CLEAN POWER CB controls power to PMU
SA RAW PWR/GFCI/FAN/LIGHTS CB controls power to outlets , GFCI, fans and lights
SA HDFU1 CB controls power to SA HDSP-FU1
SA HDFU2 CB controls power to SA HDSP-FU2
SA OUTPUT ASSEMBLY (OA) CB controls power to OA
OA CB1 controls power to HDSP1 & 2
OA CB2 controls power to HDSP3 & 4
OA CB3 controls power to HDSP5 & 6
OA CB4 controls power to HDSP7 & 8
OA CB5 controls power to HDSP9 & 10
OA CB6 controls power to HDSP11 & 12
OA CB7 controls power to HDSP13 & 14
OA CB8 control s power to HDSP15 & 16