

# City of Los Angeles



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## Model 357i Advanced Transportation Controller (ATC) Cabinet Specification

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## **Section 1**

### **ATC Cabinet Components**

#### **1.1 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 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.

#### **1.2 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.

#### **1.3 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 12 Vac or 24 Vdc.

The SIU outputs shall be rated at 150 mA continuous sink current. Each output shall provide a 500 mA typical current limit and shall be rated to 50 V 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.

#### **1.4 Model 2220 Auxiliary Display Unit (ADU)**

The ADU shall install in a 1U height 19" rack space 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.

#### **1.5 Model 2217 Cabinet Power Supply (CPS)**

The CPS is a card style rack mounted high efficiency switching power supply. The CPS shall provide a regulated 24VDC output and a 48VDC output. The CPS shall provide output regulation across changes in AC Line voltage and output load over the full operating temperature range of -34C to +74C. The CPS 24VDC output shall be protected against voltage transients by a 1500 Watt suppressor. The CPS shall be equipped with a LED AC Line indicator to display input status and fuse integrity and two green LED indicators to display output status and fuse integrity for each DC output. The CPS shall be rated at 120 Watts, 48 Vdc @ 1 Amp and 24 Vdc @ 3 Amp.

#### **1.7 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 120 Vac @ 5 Amp. The coil of the HDFTR shall be rated at 48 Vdc. The HDFTR shall have an LED indicator to display contact transfer position.

### **1.8 Main Contactor (MC)**

The MC shall be mercury free and shall be rated at 120 Vac @ 60 Amp. The coil of the MC shall be rated at 48 Vdc. The MC shall be equipped with input indicator and shall have SPST- N.O. contacts.

### **1.9 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 12-position Beau 5412 connector. The unit shall be rated at continuous service current of 15 Amp and maximum clamp voltage of 390 Vac. The unit shall filter noise and spike from 10 KHz to 25 MHz and shall have a peak surge current of 48 KA.

### **1.10 HDSP 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 or approved equal. The unit shall be able to protect 6 circuits. The device operating voltage shall be 120 Vac and clamping voltage shall be 340 Vac. The unit dimensions shall be 2" H x 0.7" W x 2" D.

### **1.11 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 or approved equal connector. The unit shall be able to protect 6 circuits. The device operating voltage shall be 75 Vac and clamping voltage shall be 130 Vdc. The device dimensions shall be 2" H x 0.7" W x 1.2" D.



## **Section 2**

### **Model 357i ATC Cabinet General Requirements**

#### **2.1 General Requirements**

The cabinet shall adhere to the following requirements:

- 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.
- The cabinet shall be capable of Cabinet Flash signal operation in the absence of any of the following assemblies: Combo Input and Output Assembly, Cabinet Power Supply, and Controller.
- 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 Combo Input and Output Assembly.
- High-voltage components (over 50 V) shall be protected from incidental contact per NEC.
- 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.
- All circuit breakers located on the rack shall have covers to prevent accidental tripping.
- All Assemblies shall be modular with pluggable cabling.
- 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.
- Door switches shall be powered by 48 Vdc.
- Wire raceway shall be integrated as part of the cabinet allowing for neat internal and field wiring.
- All equipment in the cabinet shall be clearly and permanently labeled.
- 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.
- 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.
- Each cabinet shall include City of Los Angeles identification. The name "City of Los Angeles" shall be molded, cast, or scribed in 0.250 inch letters on the outside, top center area of the front cabinet door.

## **Section 3**

### **Model 357i ATC Cabinet Specification**

#### **3.1 General**

This specification describes the 120 Vac High Voltage (HV) Model 357i Advanced Transportation Controller (ATC) Cabinet ("the cabinet") for City of Los Angeles. 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), Combo Input and Output Assembly, Combo Field Input and Output Termination Assembly and Communication Panel.

#### **3.2 Cabinet Housing**

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

- Enclosure & Doors
- Gasketing
- Lifting Eyes & External Bolt Heads
- Door Latch & Lock
- Ventilation
- EIA Rails
- Door Hinges & Catches
- Police Panel
- Aluminum Surfaces

##### **3.2.1 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 cabinet shall be 35.50 inch tall, 20.68 inch wide and 17.88 inch deep.

##### **3.2.2 Material Thickness**

The enclosure, doors, lifting eyes, police panel door and all supports welded to the enclosure and doors 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.

##### **3.2.3 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.

### **3.2.4 Aluminum Surface Protection**

The aluminum surface shall be shall be LADOT Anti-Graffiti Paint.

#### **3.2.4.1 Anti-Graffiti Paint**

If Anti-Graffiti Paint is requested, each stage in the process shall be as follows:

- Perform treatment with a moderately acidic, liquid cleaner concentrate for thorough cleaning.
- Clean water rinse from reverse osmosis system (< 2500 PPM).
- Clean water rinse from reverse osmosis system (< 500 PPM).
- Apply a conversion coating to form an excellent base for bonding powder to parts and producing good resistance to corrosion.
- Clean water rinse from reverse osmosis system (< 800 PPM).
- Clean water rinse from reverse osmosis system to decrease any solids on surfaces (< 100 PPM).
- Final seal rinse to enhance corrosion resistance.
- Convey through a dry-off oven at a cycle of 10 to 20 minutes at 380° F. This eliminates any trapped water and gases in the parts.
- Apply polyester dry powder at 90,000 volts for maximum mil transfer. Thickness of the powder coating shall nominally be 2 to 5 mils.
- Convey into the cure oven for a thermal setting [cure] cycle of 10 to 20 minutes at 380 - 425° F.

The City, at its option, may require the winning the Vendor to submit written certification of compliance to the requirements listed in this section of the specification.

### **3.2.5 Enclosure Door Frames and Door Seals**

The enclosure door frames shall be hemmed on all four sides and shall have strikers to hold tension on, and to form a firm seal between, the door gasketing 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).

### **3.2.6 Gasketing**

Gasketing 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 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.

### **3.2.7 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.

### **3.2.8 Door Latches and Lock Mechanism**

Each door shall be equipped with a removable hex handle and "U" handle.

The latching mechanism shall be a three-point draw type. When the door is closed and latched, the door shall be locked. 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 inch (+/- 0.03125 inches) into the latch cam area. A seal shall be provided to prevent dust or water entry through the lock opening.

### **3.2.9 Locks & Keys**

The locks shall be BEST type. One key shall be supplied with each lock. The keys shall be removable in the locked position only. The locks shall have rectangular, spacing loaded bolts.

The bolt shall have a 0.281 inch throw and shall be 0.75 inch wide by 0.375 inch thick. Tolerance is 0.035 inch. A swing away cover shall be placed over the key entrance to protect the lock mechanism. The lock shall be mounted in the center.

Best Lock numbers are:

- Right Hand - 5L6RL3XA7559-606
- Left Hand - 5L6RL4X47559-606

Each cabinet will be supplied with two (2) locks, each with a "LA-1" core, keyed alike. LA-1 Keys and Core Keys shall be supplied separately, the quantity will be specified at the time of each purchase order. Contractor cores must be available upon request through the parts contract.

### **3.2.10 Cam**

The center latch cam shall be fabricated of a minimum thickness of 0.104 inch stainless-steel. The cam shall be structured to only allow the door to open when the handle is moved toward the center of the door.

### **3.2.11 Hinges**

Three stainless steel hinges shall be provided to bolt the enclosure to the doors.

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 components are mounted on the door.

### **3.2.12 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 0.250 inch stainless steel 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.

### **3.2.13 Police Panel**

A police panel assembly shall be provided to allow limited control access. The panel door shall be equipped with a lock and master police key. 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 357i ATC Cabinet shall have one switch provided and labeled "SIGNALS ON - OFF" and one switch provided and labeled "FLASH - AUTO".

### **3.2.14 Rack Cage**

The EIA rack shall consist of two continuous, adjustable equipment mounting angles. The mounting angle nominal thickness shall be 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. Clearance between rails for mounting assemblies shall be 17.75 inch.

### **3.2.15 Housing Ventilation**

Housing ventilation shall including intake, exhaust, filtration, and a thermostat controlled fan.

#### **3.2.15.1 Intake & Filter**

The louvered vent depth shall be a maximum of 0.25 inch. A removable and reusable air filter shall be housed behind the door vents. The filter filtration area shall cover the vent opening area. A filter shell shall be provided that fits over the filter providing mechanical support for the filter.

This shell shall be louvered to direct the incoming air downward. The shell sides and top shall be bent over a minimum of 0.25 inch to house the filter. The filter resident in its shell shall be held firmly in place with a bottom trough and spring loaded upper clamp. No incoming air shall bypass the filter. The bottom filter shall be formed into a waterproof sump with drain holes to the outside housing. The filter shall be 15 inch wide by 8 inch high by 1 inch thick. The filter shall be an ECO-AIR Product E35S or equal. The intake (including filter with shell) and exhaust areas shall pass a minimum of 60 cubic feet of air per minute.

### **3.2.15.2 Fan**

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. The fan shall be mounted within the housing and protected with a finger guard. The fan should be powered by 24 Vdc and shall be equipped with fan test switch.

### **3.2.16 Cabinet Light**

The cabinet shall be equipped with an LED light, activated by door switches. The LED light shall have a manual switch and fuse.

## **3.3 Cabinet Assemblies**

### **3.3.1 Combo Input and Output Assembly**

The Combo Input and Output Assembly shall be a 19-inch rack mounted assembly and shall house four Model 2202-HV High-Density Switch Pack / Flasher Units (HDSP/FU) and either a 2-channel or a 4-channel half width device, up to four detection modules providing a maximum of 16 channels. Two resident Model 2218 Serial Interface Units (SIU) shall provide interface and control via SB1/SB2.

The Combo Input and Output Assembly shall house one CMUip-2212-HV Cabinet Monitor Unit (CMUip), Main Contactor, Stop Time Switch, Flash / Auto Switch, four Opto Switches, four Circuit Breakers and Momentary 24 Vdc Bypass Switch.

### **3.3.2 Combo Field Input and Output Termination Assembly**

The Combo Field Input and Output Termination Assembly shall be coupled with the Combo Input and Output Assembly and shall house four HDFTRs. Each HDFTR position shall be labeled with the number of its associated HDSP (1-4). Flash Program Blocks (FPB) shall be provided to control and select the color (red, yellow, or dark) during cabinet Flash mode. Each FPB position shall be labeled with the number of its associated channel (1-8).

The Combo Field Input and Output Termination Assembly shall be provided with eight, 6-position Phoenix Contact terminal block model number 1804946 plugs and 1861196 sockets or approved equal. Each Load Terminal Block receptacle shall be labeled with the number of its associated channel (1-8). 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).

The Field Input and Output Termination Assembly shall have positions for landing 16, two-wire inputs and their associated earth ground wires. The Combo Field Input and Output Termination Assembly shall have positions for 8 Detection Module Suppressors.

HDSP Suppressors and Detection Module Suppressors shall be supplied with the cabinet if procurement requires.

### **3.3.3 Service Assembly**

The Service Assembly shall be modular and mounted across the EIA rails. It shall house: one HDFU, Cabinet Power Supply, Cabinet Filter-Suppressor HESO HE1750R or approved equal, GFCI, Convenient Outlets, five Circuit Breakers, four HDFU output fuses, AC+ raw terminal block and one 6-postion TBS terminal with BBS landing provision.

### **3.3.4 SB1/SB2 and DC Power Bus**

SB1/SB2 and DC Power Bus shall be embedded into the Service Assembly to accommodate interconnection between the assemblies.

### **3.3.5 AC Clean Power Bus**

The AC Clean Power Bus shall be embedded into the Service Assembly to provide Clean Power for the Controller Unit, Cabinet Power Supply and detection modules.

### **3.3.6 Communication Panel**

#### **3.3.6.1 Communications Cable Terminal Block (CTB-1)**

Communications Cable Terminal Blocks shall be quick-connected blocks consisting of 25 horizontal rows of six (6) clips per row, mounted in a molded self-extinguishing plastic case. The horizontal rows of six (6) clips shall be divided into two (2) sets of three (3) electrically common clips. The two (2) sets of three (3) clips shall be connected by a bridge clip. These blocks, commonly referred to "66B Type" blocks, shall terminate 25 pairs of 20 through 24 AWG solid unstripped conductors. The blocks shall be equipped with integral fanning strips and an enclosed back to prevent grounding of clips to the panel.

#### **3.3.6.2 Termination Block (CTB-2)**

A four (4) position, double row, closed back design terminal block, **Kulka** part No. 671-GP-04 or equivalent, labeled CTB-2 shall be mounted on the Communications Termination Panel. The strip shall be rated at 15 Amps and shall be provided with 6-32 by 0.250 inch nickel plated brass binder head screws.

#### **3.3.6.3 C-20 Termination Block (CTB-3)**

A four (4) position, double row, closed back design terminal block, **Kulka** part No. 671-GP-04 or equivalent, labeled CTB-3 shall be mounted on the Communications Termination Panel. The strip shall be rated at 15 Amps and shall be provided with 6-32 by 0.250 inch nickel plated brass binder head screws.

#### **3.3.6.4 Over-Voltage Protection**

An over voltage surge protector shall be provided for each active communications cable pair (Audio-In pair, and Audio-Out pair) terminating at CTB-2 and CTB-3. Protectors shall be of the Three-Electrode Gas Tube type, and shall have the following ratings:

- Impulse Life (1,000 Amp, 10/1000 waveshape at one minute intervals each direction, with 500 Amps on each side to ground simultaneously): 1,000 surges minimum, 2,500 surges typical.
- AC Discharge Current, 11 cycles, 60 Hz: 400 Amps RMS, 200 Amps on each side to ground simultaneously
- Maximum Single Impulse Discharge Current, 8/20 waveshape: 40 kA maximum, 20 kA/side simultaneously
- Capacitance: Line-ground = 4 pf, Line-line = 2 pf
- DC Holdover: 180 VDC typical at 200 mA, 150 VDC minimum
- DC Arc Voltage: 30 volts typical
- Glow to Arc Transition Current: 1.0 Amp typical
- Transition Time: 0.5 microseconds maximum
- Line-Ground Impulse Breakdown Voltage at 10 kV/sec: 1000 volts maximum average

#### **3.3.6.5 Insulation Resistance**

1,000 megohms minimum at 100 VDC (line-ground). The protectors shall be encapsulated, and shall be equipped with minimum 2 inches long, spade lug tipped leads. Maximum size of each protector shall be 0.5 x 0.5 x 2.0 -inches. The grounding lead shall be attached to the panel's grounding stud.

#### **3.3.6.6 Grounding Stud**

A grounding stud shall be provided. The stud shall extend through the panel. The over voltage protection devices' ground leads shall be attached to the stud on the front side of the panel. A No. 8 AWG copper conductor shall connect to the stud on the back side of the panel, and shall connect to the cabinet's Equipment Grounding Bus.

#### **3.3.6.7 C2P Harness and Connector**

4-conductor jacketed cables shall each be attached to terminal blocks CTB-2 and CTB-3 with soldered ring lugs. The cables shall terminate with a standard C2P and C20P connectors, and shall be routed through the cabinet, 2 feet in length to reach the back of the 2070 Controller Unit, when the unit is installed in the equipment rack.



#### **3.3.6.8 Feed-Through Opening**

A feed-through openings, complete with protective grommets, shall be provided on the panel to protect the C2P and C20P harnesses. A strain relief device shall also be provided for each.

#### **3.3.6.9 Cable-Tie Openings**

Six (6) 0.250 inch diameter holes shall be provided for installation of cable ties.

#### **3.3.6.10 Allen Tel Distribution Ring**

Allen Tel Distribution Ring model #GB 13 or equivalent shall be installed at the bottom of the panel CTB-1.

#### **3.3.6.11 Attachment to Equipment Rack**

The panel shall be securely attached to the equipment rack using mounting keyholes sized to facilitate removal of the panel without removing the mounting screws.

### **3.4 Components requirements**

#### **3.4.1 Combo Input and Output Assembly Components Requirements**

- (4 each) Model 2202-HV HDSP
- (2 each) Model 2218 SIU
- (1 each) Model 2212-HV CMUip
- (TBD\*) 4-channel half-width Detection Module
- (TBD\*) Model 244L

\* Quantity per each procurement requirement

#### **3.4.2 Combo Field Input and Output Termination Assembly Components Requirements**

- (4 each) Model 21H HDFTR
- (4 each) HDSP Suppressor
- (8 each) Detection Module Suppressor
- (8 each) Red Flash Program Block
- (2 each) Yellow Flash Program Block
- (2 each) White Flash Program Block

#### **3.4.3 Service Assembly Components Requirements**

- (1 each) Model 2202-HV HDFU
- (1 each) Cabinet Suppressor-Filter

- (1 each) Model 2217 Cabinet Power Supply (CPS)

#### **3.4.4 Cabinet Components Requirements**

- (1 each) Model 2220 ADU
- (1 each) Mounting Hardware

### 3.5 Model 357i ATC Cabinet I/O Assignments

357i ATC Cabinet (rev. 7-6-2016)											
Combo Input/output Modules											
		Ch1/2	Ch3/4	Ch5/6	Ch7/8	SIU 1	Ch1/2	Ch3/4	Ch5/6	Ch7/8	SIU 9
		HDSP1	HDSP2	HDSP3	HDSP4		4-ch	4-ch	4-ch	4-ch	
		R	R	R	R		Input	Input	Input	Input	
		Y	Y	Y	Y		Card	Card	Card	Card	
SIU 9	CMU	G	G	G	G	SIU 1	Ch-1	Ch-1	Ch-1	Ch-1	SIU 9
Opto 1&2		R	R	R	R		Ch-2	Ch-2	Ch-2	Ch-2	
Opro 3&4		Y	Y	Y	Y		Ch-3	Ch-3	Ch-3	Ch-3	
		G	G	G	G		Ch-4	Ch-4	Ch-4	Ch-4	
* Can be assigned to any phase, ped or overlap											
CMU Channel (Ch) Assignments											
		HDSP1	HDSP2	HDSP3	HDSP4						
	CMU	Ch-1	Ch-3	Ch-5	Ch-7						
		Ch-1	Ch-3	Ch-5	Ch-7						
		Ch-1	Ch-3	Ch-5	Ch-7						
		Ch-2	Ch-4	Ch-6	Ch-8						
		Ch-2	Ch-4	Ch-6	Ch-8						
		Ch-2	Ch-4	Ch-6	Ch-8						
SIU 1 Output Assignments (CU SIU Address = 1)											
		HDSP1	HDSP2	HDSP3	HDSP4						
		IO 0	IO 6	IO 12	IO 18						
		IO 1	IO 7	IO 13	IO 19						
		IO 2	IO 8	IO 14	IO 20	SIU 1					
		IO 3	IO 9	IO 15	IO 21						
		IO 4	IO 10	IO 16	IO 22						
		IO 5	IO 11	IO 17	IO 23						
SIU 9 Input Assignments (CU SIU Address = 9)											
							4-Ch	4-Ch	4-Ch	4-Ch	
							Input	Input	Input	Input	
							Card	Card	Card	Card	
							IO 6	IO 10	IO 14	IO 18	SIU 9
							IO 7	IO 11	IO 15	IO 19	
							IO 8	IO 12	IO 16	IO 20	
							IO 9	IO 13	IO 17	IO 21	

Model 357i ATC Cabinet I/O Assignments

## **Section 4**

### **ATC Cabinet Electrical, Environmental and Testing Requirements**

#### **4.1 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.

#### **4.2 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.

#### **4.3 Inspection**

A visual and physical inspection shall include mechanical, dimensional and assembly conformance of all parts of this specification.

#### **4.4 Environmental and Electrical**

All components shall properly operate within the following limits unless otherwise noted:

- Applied Line Voltage: 90 to 135 Vac
- Frequency: 60 (+/-3.0) Hertz
- Humidity: 5% to 95%
- Ambient Temperature: -34.6 °F to +165.2 °F
- Shock - Test per Specification MIL-STD-810G Method 516.6
- Vibration - per Specification MIL-STD-810G Method 514.6

#### **4.5 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.

#### **4.6 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.

#### **4.7 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 25 µF capacitor charged to  $\pm 2,000$  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  $68\text{ }^{\circ}\text{F} \pm 41\text{ }^{\circ}\text{F}$  and at  $120 (\pm 12)\text{ Vac}$ .

## **4.8 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  $\pm$ 41 °F and at 120 (+/-12) Vac.

## **4.9 UL Requirements**

Equipment shall comply only with the requirements of UL Bulletin of Research No. 23, "Rain Tests of Electrical Equipment."

## **4.10 Normal Operation**

All equipment shall continue normal operation when subjected to the following:

### **4.10.1 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.

### **4.10.2 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.

### **4.10.3 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.

### **4.10.4 Humidity and Ambient Temperature**

The relative humidity and ambient temperature values in the following table shall not be exceeded.

Ambient Temperature/ Dry Bulb (in 0F)	Relative Humidity (in percent)	Ambient Temperature/ Wet Bulb (in 0F)
-34.6 to 33.98	10	1.04 to 108.86
33.98 to 114.8	95	108.86
119.84	70	108.86
129.92	50	108.86
140	38	108.86
149.72	28	108.86
160.16	21	108.86
165.2	18	108.86

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

#### 4.11 QC / Final Test

A complete QC / final test report shall be supplied with the Model 357i ATC Cabinet. The test report shall indicate the name of the tester and shall be signed by a responsible manager.

#### 4.12 Quality Control Procedure & Test Report

The quality control procedure and test report format shall be supplied to the Engineer or approval within 15 days following the award of the contract. The quality control procedure shall include the following:

- Acceptance testing of all supplied components
- Physical and functional testing of all modules and items
- A minimum 100-hour burn-in of all equipment
- Physical and functional testing of all items

#### 4.13 Cabinet Print

Wiring diagram sheets for the cabinet shall be furnished in a weatherproof plastic pouch placed in the cabinet. Cabinet wiring diagrams shall be on non-fading.

#### 4.13 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 the following table:

Section	Description
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

## Section 5

### Drawings

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	SB1 RXC+	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		20B	
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	AC+ raw
31A	EQ gnd	31B	
32A		32B	AC- raw

5.1 - Model 2212-HV Cabinet Monitor Unit (CMUip) Connector  
(DIN 4161264 Header Type)



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			

## 5.2 - SB1/SB2 Connector (DB 25)

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

## 5.3 - Serial Bus 3 (RJ-45) Connector

<i>Pin</i>	<i>A (Bottom Row)</i>	<i>C (Middle Row)</i>	<i>E (Top Row)</i>
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

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

<i>Pin</i>	<i>A (Bottom Row)</i>	<i>C (Middle Row)</i>	<i>E (Top Row)</i>
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

5.5 - Model 2202-HV High-Density Flasher Unit (HDFU) Connector  
(DIN 41612 Type E series, 48-pin 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	LINESYNC -
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

## 5.6 - Model 2218 Serial Interface Unit (SIU) Connector

Pin	Function
1	Chassis Ground
2	AC- Neutral
3	AC+ Power
4	24VDC Ground
5	+24VDC Output
6	48VDC Ground
7	+48VDC Output

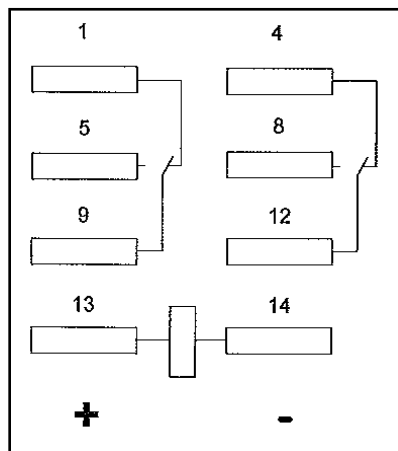
## 5.7 - Model 2217 Cabinet Power Supply (CPS) Connector (Phoenix Contact #1776553)

Circuit Breakers Definitions
Service Assembly (SA) MAIN Circuit Breaker (CB) controls power to the entire ATCC
Service Assembly CLEAN POWER CB controls power to CU, CPS & detection modules
Service Assembly RAW PWR/GFCI CB controls Raw Power and GFCI
Service Assembly HDFU CB controls power to HDFU
Service Assembly Combo I/O CB controls power to HDSPs

## 5.8 - Switches Definitions

Circuit Breakers Definitions
FDS (Front Door Switch) to notify the CMU when Front Door is open
RDS (Rear Door Switch) to notify the CMU when Rear Door is open
FLS (Front Light Switch) to turn on the Front cabinet Light
RLS (Rear Light Switch) to turn on the Rear cabinet Light
Fan Test to verify Fan operation
"24 VDC BYPASS" Switch when pressed, energizes the 24 Vdc to the HDSPs during Flash Mode
Opto 1-4 place calls into Input Assembly SIU Opto Input 1-4

## 5.9 - Circuit Breakers Definitions



## 5.10 - Model 21H High-Density Flash Transfer Relay (HDFTR) Pin-outs

## Section 6

### Glossary of Terms

A	Ampere
AC	120 Volts AC, 60 Hertz
AC-	120 Volts AC, 60 Hertz grounded return to the power source
AC+	120 Volts AC, 60 Hertz ungrounded power source
ADU	Auxiliary Display Unit
ATC	Advanced Transportation Controller
AWG	American Wire Gauge
C	Celsius
CB	Circuit Breaker
Ch	Channel
CMU	Cabinet Monitor Unit
CMUip	Cabinet Monitor Unit - Internet Protocol
CPS	Cabinet Power Supply
D	Depth
DIN	Deutsche Industrie Norm
DOT	Department of Transportation
EG	Equipment Ground
EIA	Electronic Industries Association
F	Fahrenheit
FITA	Field Input Termination Assembly
FOTA	Field Output Termination Assembly
FPB	Flash Program Block
GFCI	Ground Fault Circuit Interrupter
H	Height
HDFTR	High-Density Flash Transfer Relay
HDSP	High-Density Switch Pack
HDSP/FU	High-Density Switch Pack / Flasher Unit
HDFU	High-Density Flasher Unit
HV	High-Voltage
I/O	Input /Output
IA	Input Assembly
In	Inch
iP	Internet Protocol
K	Kilo
KA	Kilo Ampere
Kbs	kilobit per Second
KHz	Kilo Hertz
lbs	Pounds
LED	Light Emitting Diode

LV	Low-Voltage
M	Mega
mA	milliampere
MHz	Mega Hertz
mm	millimeter
mph	mile per hour
ms	millisecond
N.C.	Normally Closed
N.O.	Normally Open
NA	Not Assigned
NEC	National Electric Code
OA	Output Assembly
Opto	Opto Isolator
OVA	Overlap A
OVB	Overlap B
OVC	Overlap C
OVD	Overlap D
PCB	Printed Circuit Board
Ped	Pedestrian
Ph	Phase
QC	Quality Control
RMS	Root Mean Square
Rx	Received
RYG	Red Yellow Green
SA	Service Assembly
SB	Serial Bus
SB1	Serial Bus 1
SB2	Serial Bus 2
SB3	Serial Bus 3
SDLC	Synchronous Data Link Control
SIU	Serial Interface Unit
SPST	Single Pole Single Throw
TBD	To Be Determined
Tx	Transmit
U	Rack Unit
UL	Underwriter's Laboratories, Inc.
V	Voltage
Vac	Voltage Alternate Current
Vdc	Voltage Direct Current
W	Width