SPECIFICATIONS
FOR
TRAFFIC
SIGNAL CONTROLLER
CABINETS & EQUIPMENT
BQ1512

Rev. 1 - 03/25/10
Doc#BDPS-FRM-118

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SECTION 1

GENERAL PROVISIONS

INTRODUCTION: The City of Dallas (City) is requesting bids for the purchase of Type 33x Series Traffic Signal Control Equipment. The term of the contract shall be three (3) years. During this period of time, orders will be issued for equipment as needed.

QUANTITIY ESTIMATES: Bid sheet quantities are estimates based on previous usage. Actual quantities may vary. The City will not be responsible for any anticipated profits or losses by any Contractor based on estimated purchases.

BID PRICE: The prices bid shall remain firm for the entire term of the master agreement. Bid prices shall be inclusive, including but not limited to production, shipping, handling, and delivery. No additional charges will be allowed.

BID AWARD: The City intends to award by group to the lowest responsive and responsible bidder meeting specifications by group. The City reserves the right to award by the method that is most advantageous to the City.

PRE-BID CONFERENCE: A pre-bid conference will be held on the time, date and location as listed on the Bid Signature sheet. Attendance is recommended but not required; however, this pre-bid conference is the scheduled time for vendors to ask questions pertaining to the bid. Vendors are encouraged to attend the pre-bid conference and provide input regarding the specifications and discuss any questions with the user department's representative(s). This will be the only contact between the bidder and the user departments during the bidding process. All correspondence shall go through the Buyer.

BID INFORMATION: Sealed bids shall be delivered in person, by courier or via mail to the Business Development and Procurement Services office located at 1500 Marilla, 3FN, Dallas, TX 75201, by 2:00 pm on the specified bid due date. Bids received after 2:00 pm on the specified date will not be accepted and will be returned to the bidder unopened. All submissions should include the following outside of the sealed box or envelope: project name and number BQ1512 Type 33x Cabinets, firm name, address, telephone number, and designated contact person regarding the submission. Vendors should submit one (1) original, two (2) copies and one (1) electronic copy (flash drive or CD only) of the bid submission, including an Excel version of the bid sheet with bid prices and all other documents PDF formats.

SUBMISSION OF QUESTIONS: Questions should be submitted in writing no later than three (3) days following the pre-bid meeting, unless otherwise instructed by the buyer. Please reference the RFB number BQ1512 in the subject line, company name and representative name on all correspondence to the City.

Questions and administration of this RFB is:

Terra Green, Buyer III
terra.green@dallascityhall.com

ERROR & OMISSIONS: Bidders are expected to examine all documents that make up the bid solicitation. Bidders shall promptly notify the buyer of any omission, ambiguity, inconsistency or error that they may discover upon examination of the solicitation documents. Bidders should use the complete bid solicitation to prepare bid submittals. The City assumes no responsibility for any errors or misrepresentations that result from the use of incomplete bid solicitations.

BID SECURITY: A check, money order, original bid bond, or original letter of credit in the amount of $100 shall be submitted along with your bid package. Bids received without a bid security will be deemed non-responsive.

DELIVERY: Successful bidder(s) shall be required to make delivery within a maximum of forty-five (45) calendar days, after receipt of any individual order, during the term of the agreement. Deliveries shall be made to the Department of Street Services, located at 3204 Canton Street. **Contractor(s) shall notify the Warehouse Staff at 214-670-5725 at least 24 hours prior to delivery of material. Deliveries shall be made between the hours of 9 AM and 3 PM, Monday – Friday.**

Partial shipments are acceptable, but the order shall not be considered complete until such time as the total number of items ordered have been received.

TERMINATION OF AGREEMENT: This contract may be terminated by the City, at its option, upon thirty (30) days notice in writing. If the materials furnished do not conform to the standards set forth herein and on the attached Bid sheet; or if the deliveries and servicing of this contract do not conform to the requirements detailed herein.

INVOICE REQUIREMENTS: All invoices shall contain the following:

- The City Delivery Order (DO) number.
- The date of the Delivery Order.
- The date of delivery.
- Description of the item(s) provided.
- The unit cost and extended cost of each item.
- The total cost.

Invoices shall be sent to the address below:

City of Dallas
Department of Street Services
Attn: Accounts Payable
3204 Canton
Dallas, TX 75226

COMMUNICATIONS: The need for quick and clear responses to inquiries is essential to the City. Therefore, written correspondence from the City shall be answered within three (3) business days, and phone calls from the City shall be responded to within one (1) business day.

REFERENCES: Within three days after request by the City and at no cost to the City, bidders shall provide five references, with complete contact information, of current users of equipment similar to the equipment being bid. These references shall be familiar with the equipment and the equipment shall currently be in use, and shall have been continuously in use for at least the past three years.

Any deviations from the Specifications shall be approved by the City. The City will be the sole judge as to the acceptability of any bid product.

SECTION 2
CHAPTER 1

GENERAL SPECIFICATIONS

CHAPTER 1: GENERAL SPECIFICATIONS

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1.1 SCOPE: This Chapter defines the general requirements applicable to all equipment specified in this document. The intent of this specification is to establish the minimum acceptable electrical, mechanical, design, and performance requirements within which all equipment shall operate satisfactorily and reliably. All items supplied shall be new and unused.

1.2 GENERAL REQUIREMENTS: All equipment furnished under these Specifications shall be of solid state design. Use of vacuum or gaseous tubes or electro-mechanical devices within the equipment is not acceptable unless otherwise indicated. Refer to Appendix C for a glossary of terms used in this specification.

The Cityreserves the right to bid any and all components individually outside of this agreement when deemed in the best interest of the City, and/or where State or Federal participation requires that such components be purchased on a separate competitive bid basis.

1.3 SPECIFICATION PRIORITIES: In case of conflict, the individual chapter shall govern over the PLANS and DRAWINGS, and the PLANS and DRAWINGS shall govern over CHAPTER 1, GENERAL REQUIREMENTS.

1.4 SPECIFICATION COMPLIANCE: All traffic signal control assemblies and associated hardware shall be inspected and evaluated for compliance with the following specifications:

- Underwriters Laboratories, Inc. (UL)
- Electronic Industries Association (EIA)
- National Electrical Code (NEC)
- American Society of Testing and Materials (ASTM)
- American National Standards Institute (ANSI)
- National Electrical Manufacturers Association (NEMA)

1.5 MANUFACTURER CERTIFICATION REQUIREMENTS: The City of Dallas Department of Street Services is an ISO-certified Department. As such, the awarded Contractor shall provide equipment manufactured by a supplier certified under ISO-9001, Quality Management. A copy of the Contractor’s current ISO-9001 certification shall be included with the Contractor’s bid documents at the time of bid.

1.6 CODE REQUIREMENTS: Traffic controls, parts, and accessories shall meet the following codes wherever applicable:

- Radio Manufacturer's Association

- National Electrical Code
- Manual of Uniform Traffic Control Devices
- ANSI Code
- NEMA
- ASTM
- ASA
- Federal
- State of Texas
- City of Dallas Department of Street Services

In the event of conflict, the City'sServices Specifications for Traffic Signals and Street Lighting shall prevail.

The City remains the sole judge on the ability of each device to meet specifications.

1.7 DOCUMENTATION: Manufacturer's Manuals for Conflict Monitors shall be included with each conflict monitor supplied, along with a copy of the conflict monitor's certification. Refer to the Conflict Monitor section of these specifications for additional requirements.

Two manuals shall be supplied with each Model 332, 336S, and/or 337 Cabinets at the time of delivery. Each cabinet manual shall include the following:

- General Description
- General Characteristics
- Installation
- Adjustments
- Theory of Operation
- Systems Description (Include block diagram).
- Detailed Description of Circuit Operation.
- Maintenance
    - Preventive Maintenance.
    - Trouble Analysis.
    - Trouble Shooting Sequence Chart.
    - Wave forms.
    - Voltage Measurements.
    - Alignment Procedures.
- Technical Information:
  Technical information in the form of manufacturer's published data sheets for all medium and large scale integrated circuits.
- Parts List:
  Parts List (to include circuit and board designation, part type and class, power rating and component manufacturer, and original manufacturer's part number).
- Electrical Interconnection Drawing.
- Schematic and Logic Diagram.

- Drawings & Diagrams:
  Assembly drawings and a pictorial diagram showing physical locations and identification of each component.
- Serial & Revision Numbers:
  The serial numbers and revision numbers of equipment covered by manuals shall be printed on the front cover of the manuals.
- Controller Cabinet Schematic Drawings:
  A cabinet wiring diagram for the model 332, 336S, and 337 cabinets will be shown on two D size drawings. One of the drawings will show all field terminals i.e.(Loop cables, Signal cable, AC+ line). The other drawing will show the rest of the components. The wiring diagram will be large enough to show all field connections, allowing City staff to pencil-in location-specific details.

Cabinet manuals shall be printed in a font of Arial or Times New Roman, 10 point minimum, on 8.5 by 11 inch paper. Schematics, layouts, parts lists and plan details may be on 11 by 17 inch sheets, but the sheets shall be neatly folded to 8.5 by 11 inch size. Font requirements for oversized sheets are waived, though text shall be legible on the 11 by 17 inch sheets. Manuals shall be bound in durable covers, and shall suffer no degradation when subjected to normal cabinet temperature testing as described in this specification.

The Contractor shall include electronic versions of the proposed cabinet manual(s) and the Controller Cabinet Schematic Drawings in PDF format at the time of bid submission.

Prior to final printing, three copies of a preliminary draft of all manuals shall be submitted to the City of Dallas Department of Street Services, Transportation Field Operations for approval.

No less than two (2) copies of manufacturer documentation for individual components included on the bid form shall be supplied with any single order (i.e., load switches, detector cards, etc.).

Note: Updated documentation shall be provided for ANY and ALL design changes or modifications to equipment, circuits, or components supplied to the City of Dallas Street Services.

Notification of proposed changes to equipment supplied under this contract shall be made by letter, with support documentation to follow within 30 calendar days of the proposed change in materials.

1.8 ACCEPTANCE TESTING: Upon notification by the City, the successful low bidder shall supply 1 cabinet of each type (Model 332, 336S, and 337) for acceptance testing. Satisfactory completion of acceptance testing will be a prerequisite to formal acceptance of the Contractor's bid. The test cabinet units will remain the property of the Contractor during and after acceptance testing.

All equipment supplied by the Contractor for acceptance testing by the City shall be in complete conformance with all Specifications and Special Provisions referenced in this document. Final authority over the acceptability of the sample units with regard to the interpretation of these Specifications shall reside with the City of Dallas. The Contractor shall be responsible for removing test equipment from the testing laboratory.

Five (5) copies of a User's Manual for test cabinet assemblies shall be provided with the sample unit The User's Manual shall describe operation of all components included in the Sample Unit.

Four (4) sets of cabinet wiring diagrams shall be provided with the Sample Unit. Detailed equipment layout drawings and wiring diagrams of all equipment installed in the cabinet shall be submitted for approval prior to production.

Rejection of the sample unit during acceptance testing will be grounds for rejection of the Contractor's bid, and the Contractor shall be responsible for removal of all rejected equipment from the City of Dallas Street Services testing facilities. The City of Dallas Department of Street Services reserves the right, at any time during the term of the contract, to reject any piece of equipment that fails to meet testing requirements or specifications. It is the Contractor's responsibility to rectify any and all discrepancies. In the event that the Contractor proposes changes to supplied equipment, the Contractor shall submit new sample units for acceptance testing.

The City may, at its option, return all affected equipment, including Stock equipment, to the Contractor for full credit, or exchange for newly acceptance-tested units.

Any and all expenses incurred as a result of equipment being rejected during the term of the contract shall be borne by the Contractor, including any penalties resulting from project delays.

1.9 INTERCHANGEABILITY: The following assemblies and their respective associated devices shall electrically and mechanically intermated and shall be compatible with each other:

ASSEMBLIES	ASSOCIATED DEVICES	
Output Files	Switch Pack	Model 200
	Monitor Unit	Per Chapter 4
	Relay	Model 430 Heavy Duty
Input File	Detectors	Model 222, 222LRT, 224, 622, E2C
	Isolators	Model 242, 252, 255
Power Distribution Assembly	Flasher Unit	Model 204

Relay Model 430 Heavy Duty

1.10 INDICATORS AND CHARACTER DISPLAYS: All indicators and character displays shall have a +45 degrees cone of visibility with its axis perpendicular to the front panel. All indicators and character displays shall be readily visible at a radius of up to 4 feet within the cone of visibility when the indicator is subjected to 9,000 footcandles of white light with the light source at 45 (+/-2) degrees to the front panel. If characters are not self-luminous, illumination shall be provided for viewing in low levels of ambient light. Indicators supplied on equipment requiring handles shall be mounted such that a horizontal clearance of 15 degrees minimum shall be provided for models 210, 222, 242, 252, and 255 as well as a clearance of 30 degrees minimum for Models 200 and 204.

All indicators and character displays shall have a rated life of 100,000 hours minimum.

Liquid Crystal Displays (LCD) shall operate at temperatures of -20 degrees to 70 degrees Celsius without loss of visibility or bleeding.

1.11 CONNECTORS:

All connectors shall be keyed to prevent improper insertion of the wrong connector or PCB.

The TYPE 25 Connector shall be a 25 contact AMP HDP - 20 Connector or equal with gold on nickel plated contacts. The female mating connector with socket contacts is designated TYPE 25S and the male mating connector with pin contacts is designated TYPE 25P. The TYPE 25P Connector shall be provided with lock spring clips for latching to its mating connector.

The TYPE T Connector shall be a single row, 10 position, feed through terminal block. The terminal block shall be a barrier type with 6-32, 0.25 inch, or longer, nickel plated brass binder head screws. Each terminal shall be permanently identified as to its function.

The mating connectors shall be designated as the connector number and male/female relationship such as C1P (plug or PCB edge connector) and C1S (socket).

<u>Connectors C1, C2, C20, C30, C40, C4, C5, and C6</u>

Pin and socket contacts for Connectors C1, C2, C20, C30, C40, C4, C5, and C6 shall be beryllium copper construction subplated with 0.00005 inch nickel and plated with 0.00003 inch gold. Pin diameter shall be 0.062 inch. Connectors shall have the following number of contacts:

C1 - 104 contacts
C2 - 14 contacts
C4 - 37 contacts
C5 & C6 - 24 contacts

All pin and socket connectors of C1, C2, C20, C30, C40, C4, C5, and C6 shall use the AMP #601105-1 or #91002-1 contact insertion tool, and the AMP #305183 contact extraction tool.

Connector C1 and C2 blocks shall be constructed of phenolic or equal and shall have an insulation resistance of 5000 megohms. The contacts shall be secured in the blocks with stainless steel springs.

Connector C1 and C2 corner guides shall be stainless steel. The guide pins shall be 1.097 inches in length and the guide sockets 0.625 inch in length.

Connector C4, C5, and C6 shall be circular plastic type with quick connect/disconnect capability and thread assist, positive detent coupling. The connectors shall be UL listed Glass Filled Nylon, 94 V-1 Rated, heat stabilized, fire resistant.

PCB Connectors

PCB edge connectors shall have bifurcated gold plated contacts.

The PCB connector shall meet or exceed the following:

Operating Voltage:	600 VAC (RMS) at sea level
Current Rating:	5 amperes
Insulation Resistance:	5,000 megohms
Contact Material:	Copper alloy plated with 0.00005 inch of nickel and 0.000015 inch of gold
Contact Resistance:	0.006 ohm maximum

The PCB 22/44 Connector shall have 22 independent contacts per side, dual-sided with 0.156 inch contact centers.

The PCB 28/56 Connector shall have 28 independent contacts per side, dual-sided with 0.156 inch contact centers.

The PCB 36/72 Connector shall have 36 independent contacts per side, dual-sided with 0.1 inch contact centers.

There will be no PCB connectors in the cabinet which are of the insulation displacement type except for the P20 cable.

1.12 PACKAGING: Each item delivered shall be individually packed in its own shipping container. When loose styrofoam is used for packing the item, the item shall be sealed in a plastic bag to prevent direct contact with the styrofoam.

1.13 METALS:

Aluminum Sheet shall be Type 5052-H32 ASTM designation B209.

Aluminum Rod, Bar and Extruded shall be Type 6061-T6, or equal.

Sheet aluminum for all racks, side panels, and controller shall be .080".

Stainless Steel sheet shall be annealed or one-quarter-hard complying with the ASTM Designation: A666 for Type 304, Grades A or B, stainless steel sheet.

Cold Rolled Steel Sheet, Rod, Bar and Extruded shall be Type 1018/1020. All cold roll steel shall be plated. All plating shall be either cadmium plating meeting the requirements of Federal Specification QQ-P-416C, Type 2 Class 1 or zinc plating meeting the requirements of Federal Specification QQ-Z-325B, Type 2 Class

All sharp edges and corners shall be rounded and deburred.

1.14 COMPONENTS:

a. GENERAL: All components shall be second sourced and shall be of such design, fabrication, nomenclature, or other identification as to be purchased from a wholesale electronics distributor, or from the component manufacturer, except as follows:

When a component is of such special design that it precludes the purchase of identical components from any wholesale electronics distributor or component manufacturer, one spare duplicate component shall be furnished with each 20, or fraction thereof, components used.

Circuit design shall be such that all components of the same generic type, regardless of manufacturer, shall function equally in accordance with the specifications.

No component shall be operated above 80% of it's maximum rated voltage, current or power ratings. Digital components shall not be operated more than 3% above their nominal voltage, current, or power ratings.

No component shall be provided where the manufactured date is 2 years older than the contract award date. The design life of all components, operating for 24 hours a day in their circuit application, shall be 10 years or longer.

All discrete components, such as resistors, capacitors, diodes, transistors, and integrated circuits shall be individually replaceable. Components shall be arranged so they are easily accessible for testing and maintenance. Encapsulation of 2 or more discrete components into circuit modules is prohibited, except for transient suppression circuits, resistor networks, diode arrays, solid state switches, optical isolators and transistor arrays.

The Contractor shall submit detailed engineering technical data on all components at the request of the Engineer. A letter from the component manufacturer shall be submitted with the detailed engineering data when the proposed application of the component alters the technical data. The letter shall certify that the component application meets specification requirements.

b. CAPACITORS:

- The DC and AC voltage ratings as well as the dissipation factor of a capacitor shall exceed the worst case design parameters of the circuitry by 150%.
- A capacitor which may be damaged by shock or vibration shall be supported mechanically by a clamp or fastener.
- Capacitor encasement shall be resistant to cracking, peeling, and discoloration.
- All capacitors shall be insulated and shall be marked with their capacitance value and working voltage.
- Electrolytic capacitors shall not be used for capacitance values of less than 1.0 microfarad and shall be marked with polarity.
- All non-electrolytic capacitors of less than 1uf value SHALL NOT be of the Ceramic Disk type.

c. POTENTIOMETERS:

- Potentiometers with ratings from 1 to 2 watts shall be equivalent to Military Type RV4.
- No potentiometers less than 1 watt rating shall be used (except for trimmer type function).
- The power rating of any potentiometer shall be at least 100% greater than the maximum power requirements of the circuit.

- All trimmer potentiometers shall have 10 turns minimum.

d. RESISTORS:

- Fixed carbon film, deposited carbon, or composition insulated resistors shall conform to the performance requirements of Military Specifications: MIL-R-11F or MIL-R-22684.
- All resistors shall be insulated and shall be marked with their resistance value. Resistance values shall be indicated by the EIA color codes.
- Resistor tolerance shall not exceed 5%
- The value of the resistors shall not vary by more than 5% between -37 degrees and 74 degrees Celsius.
- Resistors that have a rating exceeding 2 watts shall not be used unless special ventilation or heat sinking is provided. They shall be insulated from the PCB.

e. SEMICONDUCTOR DEVICES:

- All solid state devices, except LEDs, shall be of the silicon type.
- All transistors, integrated circuits, and diodes shall be a standard type listed by EIA and clearly identifiable.
- All metal oxide semiconductor components shall contain circuitry to protect their inputs and outputs against damage due to high static voltages or electrical fields.
- The pin "1" location of all sockets shall be properly marked on the PCB adjacent to each socket.

f. TRANSFORMERS AND INDUCTORS:

- All power transformers and inductors shall have the manufacturer's name or logo and part number clearly and legibly printed on the case or laminations.
- All transformers and inductors shall have their windings insulated and shall be protected to exclude moisture.
- All transformer and inductor leads shall be color coded with an approved EIA color code or identified in a manner to facilitate proper installation.

g. CIRCUIT BREAKERS (10 AMPERES OR GREATER):

- Circuit breakers shall be listed by UL or ETL. The trip and frame sizes shall be plainly marked (marked on the breaker by the manufacturer), and the ampere rating shall be visible from the front of the breaker. All circuit breakers (30 amperes or greater) shall be quick-break on either automatic or manual operation. Contacts shall be silver alloy and enclosed in an arc quenching chamber. Overload tripping shall not be influenced by an ambient air temperature range of from -18 degrees to 50 degrees Celsius. Minimum interrupting capacity shall be 5,000 amperes, RMS.

- Circuit breakers shall be the trip-free type.

- Multi-pole breakers shall not be the "mechanically ganged" type.

h. SWITCHES:

- DIP - Dual-in-package, quick snap switch(es) shall be rated for a minimum of 30,000 operations per position at 50 ma, 30 VDC. The switch contact resistance shall be 100 milliohms maximum at 2 ma, 30 VDC. The contacts shall be gold over brass (or silver). The switch shall be rated for a minimum of 40,000 operations.

- LOGIC - The switch contacts shall be rated for a minimum of one ampere resistive load at 120 VAC or 28 VDC and shall be silver over brass (or equal). The switch shall be rated for a minimum of 40,000 operations.

- CONTROL - The switch contacts shall be rated for a minimum of five ampere resistive load at 120 VAC or 28 VDC and shall be gold over brass (or equal). The switch shall be rated for a minimum of 40,000 operations.

- POWER - Ratings shall be the same as CONTROL except the contact rating shall be a minimum of ten amperes at 125 VAC.

1.15 MECHANICAL REQUIREMENTS:

a. ASSEMBLIES: All assemblies shall be easily replaceable and incorporate plug-in capability for their associated devices or PCBs with the following exceptions:

- The cabinet power supply.
- Motherboard assemblies.

Assemblies shall be provided with 2 NYLON guides for each plug-in PCB or associated device (except relays). The guides shall extend to within 0.75 inch from the face of either the socket or connector and front edge of the assembly. The nylon guides shall be securely attached to the file or assembly chassis.

b. PRINTED CIRCUIT BOARDS:

- No components, traces, brackets, obstructions shall be within 0.125 inch of the board edge (guide edges).

- The manufacturer's name or logo, model number, serial number, and circuit issue or revision number shall appear and be readily visible on all items. Placement of this information for modules such as the Monitor Unit, 222, 242, & 252 Modules shall be on the PCB.

c. WORKMANSHIP: Workmanship shall be in accordance with the highest industry standards.

d. MODEL NUMBERS:

- The manufacturer's model number, serial number and circuit issue or revision number shall appear on the rear panel of all equipment and modules supplied.

- In addition to any assignment of model numbers by the manufacturer, a model number assigned in the table below shall be displayed on the front panel in bold type, at least 0.25 inch high.

MODEL #	TITLE
200	SWITCH PACK
204	FLASHER UNIT
222	LOOP SENSOR UNIT
242	DC ISOLATOR
252	AC ISOLATOR
255	AC ISOLATOR (Railroad ONLY)
2EC	LOOP SENSOR (Digital)
602LM	LOOP SENSOR (High Sensitivity)
2018KCLip	MONITOR UNIT

e. CONNECTORS:

- All PCB connectors mounted on a motherboard shall be mechanically secured to the chassis or frame of the unit.

- All screw type fasteners shall utilize locking devices or locking compounds except for finger screws which shall be captive.

f. TOLERANCES: The following tolerances shall apply, except as specifically shown on the plans or in these specifications:

Sheet Metal	+/- 0.0525 inch
PCB	+/ -0.010 inch
Edge Guides	+/- 0.015 inch

1.16 ENGINEERING REQUIREMENTS:

a. HUMAN ENGINEERING: To the highest degree practicable, the unit shall be engineered for simplicity and ease of operation and maintenance. This shall include the following:

- No more than 2 potentiometers, controls or switches may be mounted concentrically. Knobs for such devices shall have diameters in a ratio of 2:1 outer to inner. The outer knob shall have a diameter of at least 1 inch.
- Knobs shall be of large enough diameter (at least 0.5 inch diameter) and of great enough separation (at least 0.5 inch edge to edge) to assure ease of adjustment without disturbance of adjacent knobs.
- All fuses and flash transfer relays shall be easily accessible and shall be replaceable without the use of any tools.
- PCBs shall slide smoothly in their guides while being inserted into or removed from the frame and shall fit snugly into the plug-in PCB connectors.
- PCBs shall require a force no less than 5 pounds or greater than 50 pounds for insertion or removal.

b. DESIGN ENGINEERING: The following practices shall be employed in the design of solid state equipment circuitry:

- The design shall be inherently temperature compensated to prevent abnormal operation. The circuit design shall include such compensation as is necessary to overcome adverse effects due to temperature and/or humidity in the specified environmental range(s).
- For reasons of personal safety, the design shall be such as to protect personnel from any and all dangerous voltages.
- Generated Noise - No item, component or subassembly shall emit a noise level exceeding the peak level of 55 dBa when measured at a distance of one meter away from its surface.

1.17 PRINTED CIRCUIT BOARD REQUIREMENTS:

a. DEFINITIONS: Definitions for the purpose of this section on PCBs shall be taken from MIL-STD-429 and any current addendum.

b. DESIGN:

- All single-board modules shall be vertically mounted.
- All contacts on PCBs shall be plated with a minimum thickness of 0.000030 inch gold over a minimum thickness of 0.000075 inch nickel.
- PCB design shall be such that components may be removed and replaced without damage to boards, traces, or tracks.

c. FABRICATION: Fabrication of PCBs shall be in compliance with Military Specification: MIL-P-13949, except as follows:

- Only NEMA FR-4 glass cloth base epoxy resin copper clad laminates 0.0626 inch minimum thickness shall be used. Intercomponent wiring shall be by laminated copper clad track having a minimum weight of 2 ounces per square foot with adequate cross section for current to be carried. All copper track shall be plated or soldered to provide complete coverage of all exposed copper track. Jumper wires will not be permitted, except from plated-through padded holes to an external component or for designed function selection with the jumper insulated and as short as possible.
- Section 3.3.3 of Military Specification: MIL-P-13949E shall read "Pits and Dents. Grade of Pits and Dents shall be of Grade B quality (3.3.3.2) or better."
- Section 3.3 of Military Specification: MIL-P-13949 shall be omitted.
- Section 3.4 of Military Specification: MIL-P-13949 shall read "Warp or Twist. Class of permissible warp or twist shall be Class A (Table II) or better."
- Sections 4.2 through 6.6 of Military Specification: MIL-P-13949 (inclusive) shall be omitted except as referenced in previous sections of this specification.
- The fabrication of PCBs and the mounting of parts and assemblies thereon shall conform to Military Specification: MIL-STD-275E, except as follows:

- All semiconductor devices required to dissipate more than 250 mw or any case temperature that is 10 degrees Celsius above ambient shall be mounted with spacers or transipads to prevent direct contact with the PCB.
- When completed, all residual flux shall be removed from the PCB.
- The resistance between any 2 isolated, independent conductor paths shall be at least 100 megohms when a 500 VDC potential is applied.
- All PCBs shall be coated with a moisture resistant coating with ultra-violet tracer.
- Where less than 0.25 inch lateral separation is provided between the PCB (or the components of a PCB) and any metal surface, a 0.03125 (-0.0 to 0.0156) inch thick mylar (polyester) plastic cover shall be provided on the metal to protect the PCB.

d. MOUNTING: Each PCB connector edge shall be chamfered at 30 degrees from board side planes. The key slots shall also be chamfered so that the connector keys are not extracted upon removal of board or jammed upon insertion. The key slots shall be 0.045 (+/- 0.005) inch for 0.1 inch spacing and 0.055 (+/- 0.005) inch for 0.156 inch spacing.

e. SOLDERING:

- Hand soldering shall comply with Military Specification: MIL-P-55110.
- Automatic flow soldering shall conform to the following conditions:
  - Constant speed conveyor system.
  - Conveyor speed shall be the optimum to minimize solder peaks or points which form at component terminals.
  - Temperature shall be controlled to within +/- 8 degrees Celsius of the optimum temperature.
  - The soldering process shall result in the complete coverage of all copper runs, joints, and terminals with solder except that which is covered by an electroplating process.
  - Wherever clinching is not used, a method of holding the components in the proper position for the flow process shall be provided.

- If exposure to the temperature bath is of such a time-temperature duration, as to come within 80% of any component's maximum specified time-temperature exposure, that component shall be hand soldered to the PCB after the flow process has been completed.

1.18 QUALITY CONTROL REQUIREMENTS: The following measures shall be taken by the Contractor during the production process to insure a high standard of quality:

a. COMPONENTS: All components shall be lot sampled to assure a consistent high conformance standard to the design specification of the unit.

b. SUBASSEMBLIES OR MODULES: Visual inspections shall be performed on all modules, printed circuits, and subassemblies to determine any physical defects such as cracking, scaling, poor fastening, incorrect component values, etc.

c. ELECTRICAL TESTING: Complete electrical testing shall be performed on each module, printed circuit or subassembly to determine its compliance with the manufacturer's design function.

d. INSPECTION: Housing, chassis, and connection terminals shall be inspected for mechanical sturdiness, and harnessing to sockets shall be electrically tested for proper wiring sequence.

e. ASSEMBLED UNITS: The completely assembled unit shall be subjected to a full environmental cycling and operational test. The unit shall be visually and physically inspected to assure proper placement, mounting, and compatibility of subassemblies.

f. PREDELIVERY REPAIR: The procedures listed below shall be followed in repair of equipment before shipment:

- Any defects or deficiencies found by the inspection system involving mechanical structure or wiring shall be returned through the manufacturing process or special repair process for correction.

- Defects in PCBs or electronic circuit components shall be specially treated as follows:

  - A PCB may be flow soldered a second time if copper runs and joints are not satisfactorily coated on the first run.

  - Under no circumstances shall a PCB be flow soldered more than twice.

  - Hand soldering may be used for printed circuit repair.

1.19 ELECTRICAL AND ENVIRONMENTAL TESTING REQUIREMENTS:

a. GENERAL: The general procedures and equipment used in the evaluation of the cabinet, and auxiliary equipment are a minimum guide and should not limit the testing and inspection to ensure compliance of the equipment with these specifications.

These test procedures shall be followed by the Contractor who shall certify that he has conducted inspection and testing in accordance with these specifications.

b. INSPECTION: A visual and physical inspection shall include mechanical, dimensional, and assembly conformance of all parts of these specifications which can be checked visually or manually with simple measuring devices.

c. ELECTRICAL: All components shall operate properly within the following limits:

- Applied Line Voltage: 90 to 135 VAC
- Frequency: 60 (+/- 3.0) Hertz

All circuits unless otherwise noted, shall commence operation at or below 90 VAC as the applied voltage is raised from 50 VAC to 90 VAC at a rate of 2 (+/- 0.5) volts per second.

All equipment, when housed within its associated cabinet, shall be unaffected by transient voltages normally experienced on commercial power lines. Equipment purchased separately from a complete cabinet assembly unit under this contract shall be tested by the Contractor for compliance with these specifications prior to shipment to the City of Dallas. Testing of components shall include the following:

- The power line surge protection (including the cabinet protection and that internal to the equipment) shall enable the equipment being tested nondestructively to withstand and operate normally following the discharge of a 25 microfarad capacitor, charged to plus and minus 2,000 volts, applied directly across the AC line (applied at the Cabinet Service Terminal Block) at a rate of once every 10 seconds for a maximum of 50 occurrences per test. The unit under test will be operated at 20 degrees (+/- 5 degrees) Celsius and at 120 (+/- 12) VAC.
- Power from a commercial power source applied at Cabinet Service Terminal Block.
- Equipment properly housed and connected within a test Cabinet matching these specifications.
- The Cabinet Power Surge Protectors deactivated or removed.

- The equipment shall withstand (nondestructive) and operate normally when one discharge pulse of plus or minus 300 volts is synchronously added to the AC power at the Cabinet Service Terminal Block 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 20 degrees (+/- 5 degrees) Celsius and at 120 (+/- 12) VAC.

- Within the circuit of any device, module or PCB, electrical isolation shall be provided between DC logic ground, equipment ground and the AC grounded conductor. The DC logic ground and equipment ground shall be electrically isolated from the AC grounded conductor and from each other by 500 megohms, minimum, when tested at the input terminals with 500 VDC.

- All equipment shall be capable of normal operation following opening and closing of contacts in series with the applied voltage to the cabinet at a rate of 30 openings and closings per minute for a period of 2 minutes in duration.

- All equipment shall resume normal operation following a period of at least 5 hours at -37 degrees Celsius, when 90 VAC is applied to the input terminals of the cabinet.

d. ENVIRONMENTAL: All components shall properly operate within the following limits:

- Ambient Temperature: 0 degrees to 55 degrees Celsius.

- Humidity: 5 to 95 percent, 1.1 degrees C to 46.0 degrees C.

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

AMBIENT TEMPERATURE
VERSUS
RELATIVE HUMIDITY
AT BAROMETRIC PRESSURES
(29.92 In. Hg.)

Ambient Temperature Dry Bulb (in degree C)	Relative Humidity (in percent)	Ambient Temperature Wet Bulb (in degree C)
1.1 to 46.0	95	42.7
48.8	70	42.7
54.4	50	42.7

60.0	38	42.7
65.4	28	42.7
71.2	21	42.7
74	18	42.7

- Shock Test - per Military Specification: MIL-STD-810D Method 516.1
- Vibration - per Military Specification: MIL-STD-810D Method 514.1, equipment class G (Common Carrier)
- Cabinets shall comply with the requirements of UL Bulletin of Research No. 23, "Rain Tests of Electrical Equipment".
- All equipment shall continue normal operation when subjected to the following:
- Low Temperature Test: With the item functioning at a line voltage of 90 VAC in its intended operation, the ambient temperature shall be lowered from 20 degrees Celsius to 0 degrees Celsius at a rate of not more than 18 degrees Celsius per hour. The item shall be cycled at 0 degrees Celsius for a minimum of 5 hours and then returned to 20 degrees Celsius at the same rate. The test shall be repeated with the line voltage at 135 VAC.
- High Temperature Test: With the item functioning at a line voltage of 90 VAC in its intended operation, the ambient temperature shall be raised from 20 degrees Celsius to 55 degrees Celsius at a rate of not more than 18 degrees Celsius per hour. The item shall be cycled at 55 degrees Celsius for a minimum of 5 hours and then returned to 20 degrees Celsius at the same rate. The test shall be repeated with the line voltage at 135 VAC.

1.20 TRAINING

Within thirty (30) days after award of this contract, the local representative of the Contractor(s) shall provide at least four (4) hours of on-site, hands-on training. This training shall cover but not be limited to how to prepare the equipment for field deployment, a description of the various modules in the cabinet, and cabinet wiring familiarization.

Within six (6) months after award of this contract, the Contractor of Group 1 (Traffic Signal Controller Cabinet Assembly Units) on the Bid Form shall provide at least twenty-four (16) hours of factory authorized training (two 8-hour training sessions) on the Type 33x cabinets and components supplied under this contract.

This training shall cover but not be limited to the following:

- Cabinet Theory of Operation
- Similarities and Differences Between Cabinet Models (332, 336S, 337)

- Cabinet Preparation
- Preventive Maintenance
- Troubleshooting
- Detailed O&M Procedures for Cabinet Components (including Conflict Monitor, Detectors, Isolators, etc.)

  Note: This training shall take place over two 8-hour days, however the curriculum shall consist of 16 hours of training, not 8 hours of training presented two times. The majority of training time should concentrate on in-depth troubleshooting and repair.

Within six (6) months after award of this contract, the Contractor of Group 2, Line 7 (Conflict Monitor) on the Bid Sheet shall provide at least eight (8) hours of factory authorized training (one 8-hour training session) on the Conflict Monitors supplied under this contract.

This training shall cover but not be limited to the following:

- Theory of Operation
- Certification Requirements
- Conflict Monitor Testing
- Programming of DataKeys
- Communication Confiiguration
- Troubleshooting

The Contractor(s) shall submit to the City a detailed course outline, training material, and resumes of the instructors at least 14 days prior to the scheduled course(s). The instructor(s) shall be certified as IMS Level 3 and have at least one year of field experience in the equipment to be provided under this contract. The City shall approve the Contractor's choice of instructor(s) and reserves the right to review and require changes to the training content.

All training courses shall be conducted at the Field Operation Shop located at 3204 Canton Street, Dallas, Texas.

The Contractor shall video record the entire training and provide to the City 3 copies of a DVD of the course(s) for later use at no additional cost.

SECTION 2
CHAPTER 2

MODEL 200 SWITCHPACKS AND MODEL 204 FLASHER MODULES

CHAPTER 2:
MODEL 200 SWITCHPACKS
AND
MODEL 204 FLASHER MODULES

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2.1 GENERAL REQUIREMENTS MODEL 200 SWITCHPACK

- The Switch Pack Unit shall be a plug in device of solid state design.
- The module chassis shall provide rigid unit support for connector mounting, PCB support, module alignment and insertion/removal. It shall provide Triac heat sinking, and shall be made of metal suitable to meet support and environmental requirements. Where electrical isolation protection is the only requirement, plastic insulation material may be used in lieu of metal.
- The front panel of the module shall be labeled with the manufacturer's name and the appropriate model number.
- Each switch shall have the capability of switching any current from 0.05 to 25 amperes (AC) of tungsten lamp load or gas-tubing transformer load over a voltage range of 90 to 135 volts at 60 hertz and a temperature of 70 degrees C.
- Each switch shall turn ON within +/- 5 degrees of the zero voltage point of the AC sinusoidal line, and shall turn OFF within +/- 5 degrees of the zero current point of the alternating current sinusoidal line. After power restoration, the zero voltage turn ON may be within +/- 10 degrees of the zero voltage point only during the first half cycle of line voltage during which an input signal is applied.
- Turn ON and OFF shall be within 8.33 ms following application or removal of the logic signal, respectively. The circuitry required to provide zero point switching shall be contained within the solid state switch pack.
- Each switch shall be designed for a minimum of 30 million operations while switching a tungsten filament load of 1,000 watts at 70 degrees Celsius.
- Each switch shall have 50 megohms minimum DC resistance from the output to earth ground.
- Each switch shall have a one cycle surge rating of 175 amperes RMS and a one second surge rating of 40 amperes RMS.
- Each switch shall be capable of withstanding a peak inverse voltage of 500 volts at 70 degrees C and no more than 20 ma leakage.

2.2 ELECTRICAL REQUIREMENTS MODEL 200 SWITCHPACK

- The input circuit of each switch shall have reverse polarity protection up to 30 VDC.

- The resistance between the AC+ input terminal and the AC+ output terminal of each switch shall be 15,000 ohms, minimum, when the switch is in the open position. The output current from the switch through the load when the load switch is in the OFF state shall not exceed 10 milliamperes.

- Solid state switches may utilize encapsulated components.

- The input drive shall not be required to sink more than 15 MA per switch at 24 VDC.

- Each switch shall have isolation between input DC control and AC to lights output circuit of 2,000 volts DC, or better, and 10,000 megohms DC. The unit shall also have 50 million ohms DC resistance from the output to earth ground.

- Each switch shall be so isolated so that line transients or switch failure will not adversely affect the controller unit.

- A LOW state input (negative true logic) from the controller unit (saturated npn transistor, 0 to +6 VDC) shall cause the switch to be energized. A HIGH state input (cutoff NPN transistor, 16 VDC or greater) shall cause the switch to de-energize. The state transition (conducting to nonconducting or vice versa) shall occur between 6 and 16 VDC.

- The incoming logic signal shall not sink more than 15 ma nor be subjected to more than 30 VDC.

- The module shall not draw more than 45 ma at +16 VDC or greater from the cabinet power supply with all switches ON.

- Each switch shall have an OFF state dv/dt rating of 100 volts per us or greater.

- All indicator lights shall be water clear, Ultra Bright, T-1 3/4 package LEDs, General Instruments, MK9160 (Red), or equivalent.

2.3 MECHANICAL REQUIREMENTS MODEL 200 SWITCHPACK

- The length dimension of the switch pack from the plug connector surface to the front panel of the switch pack (location of indicators) shall be 7.375 (+0.125) inches. The switch pack shall be no wider than 1.75 inches and no higher than 4.2 inches. The switch pack shall be provided with a connector Cinch Jones Type #P2412 SB, or equivalent.

- A dust resistant, metal enclosure, suitably protected against corrosion, shall be provided to enclose all electrical parts of the switch pack.

- The front panel of the switch pack shall be provided with three L.E.D. indicators to indicate the INPUT to the Switch Pack. Indicators shall be labeled and

mounted as follows: "Red" at top, "Yellow" in middle, and "Green" at bottom when switch is installed. Indicators shall be vertically centered on the switch pack front panel. The front panel shall also be labeled with the manufacturer's name or symbol and the model number 200.

- Switch pack control circuitry and switches shall be readily accessible by the use of a screwdriver or common wrench. Only one type of screw head end (slotted or phillips) shall be used throughout. It shall not be possible to bow any surface of the switch pack during assembly with a screwdriver or common wrench by more than .050 of an inch.

- Each switch pack shall be so constructed that persons inserting or removing the switch pack will not be exposed to any parts having live voltage, and will not be required to insert hands or fingers into the Cabinet Output File. A metal handle or gripping device shall be attached to the front of each switch pack.

- The switch pack shall be so constructed that its lower surface will be no more than 2.100 inches below the centerline of the connector configuration and that no part will extend more than 0.900 inches to the left and 1.100 inches to the right of the centerline of the connector pin configuration.

- Continuous guide edges shall be provided on the switch pack as shown on the Plans.

- The connector plug contact tails shall be solder hook or eye styles only. PCB (soldered to the PCB) and quick connect connections styles are not allowed.

- The Plug Connector shall be a BEAU P-5412-LAB or equal.

2.4 GENERAL REQUIREMENTS MODEL 204 FLASHER UNIT

- The Flasher Unit shall be a plug in device containing a flasher control circuit and solid state switches. This unit will be used for alternate opening and closing connections between the applied power and the traffic signal lamps during flashing operation.

2.5 FUNCTIONAL REQUIREMENTS MODEL 204 FLASHER UNIT

- The Model 204 Flasher Unit shall have an internal power supply for logic and control.

- The Model 204 Flasher Unit shall commence flashing operation when AC power is applied to the input terminals.

- The Model 204 Flasher Unit shall provide fifty to sixty flashes per minute with a 50 percent duty cycle.

- The Model 204 Flasher Unit shall be a modular plug-in device containing a flasher control circuit and 2 solid state switches. Its function shall be to alternately open and close connections between the applied power and an external Traffic Signal lamp load during intersection flashing operation.

2.6 ELECTRICAL REQUIREMENTS MODEL 204

- The Model 204 Flasher Unit shall contain two solid state switches and draw its power from the input AC line.

- Each solid state output switch of the unit shall have an OFF state dv/dt rating of 200 volts per microsecond or better.

- Each output switch shall be capable of withstanding a peak inverse voltage of 500 volts.

- Each output switch shall be capable of switching any current from 0.03 to 25 amperes of tungsten lamp load at 120 volts, 60 Hertz, or 10 amperes at a power factor of 0.85 and at 70 degrees Celsius.

- Each output switch shall turn on within plus or minus 5 degrees of the zero voltage point of the AC sinusoidal line, and shall turn off within plus or minus 5 degrees of the zero current point of the alternating current sinusoidal line. The zero voltage turn on may be within plus or minus 10 degrees of the zero voltage point only during the first half cycle of line voltage during which an input control signal is applied.

- The output switches shall have a mean time between failure of 30 million operations or greater when switching a tungsten filament load of 1000 watts per switch.

- Each circuit shall be designed to operate in an open circuit (without load) condition for a minimum of 10 years.

- The output switches shall have a one cycle surge rating of 175 amperes RMS, of 247.5 amperes peak and a one second surge rating of 40 amperes RMS.

- The output switches shall have isolation between input and output of 2000 VDC or better and 10,000 megohms DC. The unit shall also have 50 million ohms DC resistance from output to earth ground.

- Indicators shall be mounted on the Flasher Unit to indicate when each input to the power switching device is on and off.

- All indicator lights shall be water clear, Ultra Bright, T-1 3/4 package LEDs, General Instruments, MK9160 (Red), or equivalent.

- The module shall generate its own internal DC power from the AC line for logic and control.

- The module shall commence flashing operation when AC power is applied to the module.

- A surge arrestor shall be provided between AC+ (pin 11) and Flasher Out (pins 7 & 8). The surge arrestor shall be capable of reducing the effects of a transient voltage applied to the field signal circuits, and shall have the following ratings:

    - Recurrent peak voltage: 212 Volts
    - Energy rating, maximum: 50 Joules
    - Power dissipation, average: 0.85 Watt
    - Peak current for pulses less than 6 us: 2000 Amperes
    - Standby current: less than 1 ma

2.7 MECHANICAL REQUIREMENTS MODEL 204 FLASHER MODULE

- The dimensions of the Flasher Unit shall be the same as shown on the plans for the Model 200 Switch Pack.

- The Flasher Unit shall be constructed so that its lower surface will be 2.100 inches to 2.100 +0.05 inches below the centerline and so that no part will extend more than 0.850 inch to the left or more than 1.050 inches to the right of the centerline of the connector configuration.

- When the Flasher Unit is in place, no electrically energized parts shall be exposed.

- A metal handle or gripping device shall be provided on the front panel of the Flasher Unit.

- The interior of the Flasher Unit shall be readily accessible by the use of a screw driver or wrench.

- Edge guides shall be provided on the Flasher Unit.

- All electrical connections into and out of the Flasher Unit shall be through a multi terminal connector, Cinch Jones Type #P 2406 SB or equivalent. The connector shall be rigidly fixed to the rear or base of the Flasher Unit.

- The Flasher Unit shall intermate with a Beau Type #S5406 or equivalent connector as shown on the Plans.

- The Plug Connector shall be a BEAU P-5406-LAB or equal.

SECTION 2
CHAPTER 3

CONFLICT MONITOR UNIT (CMU)

CHAPTER 3:
CONFLICT MONITOR UNIT (CMU)

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3.1 CONFLICT MONITOR UNIT GENERAL REQUIREMENTS

Note: The City of Dallas Department of Street Services exclusively utilizes the Model 2018KCLip Conflict Monitor Unit manufactured by Eberle Design, Incorporated. To ensure compatibility with the City of Dallas Traffic Signal System, No Substitutions will be allowed for this item. The technical specifications included herein are for reference purposes only.

- Proposed Conflict Monitor Unit to be provided under this contract shall meet or exceed all CalTrans TEES 2009 requirements at the time of bid opening.

- The City of Dallas Department of Street Services remains the sole judge on the ability of each device to meet specifications.

- This specification establishes minimum standards for Conflict Monitoring Devices designed for use in Model 332, 336S, and 337 Traffic Signal Controller Cabinets as specified by the City of Dallas Department of Street Services.

- All indicator lights shall be water clear, Ultra Bright, T-1 package LEDs, General Instruments, HLMP-1340 (Red), HLMP-1440 (Yellow), HLMP 1540 (Green), or equivalent.

- A GREEN A.C. power indicator light shall be mounted and labeled (AC PWR) on the front panel.

- The monitor shall not use the 24VDC power supply being sensed to run any of its internal circuitry.

- A Watchdog Timer, Conflict or +24VDC failure, shall only cause their respective indicator lights to display.

- A power failure shall not result in resetting the monitor unit. The monitor once triggered by detection of any failure (Watchdog Timer, Conflict or +24VDC) shall remain in that state until a Reset Command is issued. Reset is issued only by the Front Panel Control Switch or by the External Test Reset Input.

- The Conflict Monitor Unit is designed to monitor Green, Yellow, and Red AC circuits at the output terminals in Traffic Signal cabinets. In addition, the cabinet +24VDC supply, and the Traffic signal controller Watchdog Timer output are also monitored. These signals are processed by the Monitor Unit circuitry, and if a failure is determined to have occurred, a relay output contact closure (FAILED state) places the cabinet and intersection in flashing operation.

- All monitored field output voltages shall be measured as true RMS responsive (up to 3KHZ) to both positive and negative alternations of the sine wave and the full cycle.

- The front panel shall not flex so that insertion or removal of the unit does not cause damage to the LED's.

- FAILED State Output Circuits:

    - An electro-mechanical relay shall be used to provide an output circuit during a FAILED state. The relay contacts shall be normally closed (FAILED state). In a NON-FAILED state (relay coil energized), the contacts shall be open. The function of this output circuit is to energize the cabinet Power Relay Coils and transfer field outputs from the Output File Switch Pack outputs to the Flasher Unit outputs during a FAILED state.

    - The relay contacts shall be rated for a minimum of 3 amperes at 120 VAC and 100,000 operations. Contact opening/closing time shall be 30ms or less.

    - A second output circuit (Stop Time input to the controller unit) shall be provided to sink an NPN Open Collector Transistor upon FAILED state. The transistor shall be rated to sink a minimum of 50 ma at up to 30 VDC. A blocking diode shall be provided on the transistor output to prevent it from sourcing power into the controller unit.

- Monitor Unit Reset: A momentary SPST control switch labeled "RESET" shall be provided on the unit front panel to reset the monitor unit circuitry to a Non - FAILED state. The switch shall be so positioned on the front panel that the switch can be operated while gripping the front panel handle.

- Input Impedance for all monitored AC inputs shall be 235(+/-50)K ohms.

- Pins 24 and 25 shall be connected together on the monitor PCB at their connector fingers and be capable of carrying one ampere at +24 VDC.

- The monitor shall be designed to monitor an intersection with up to four approaches using the four section FYA movement outlined by the NCHRP Research Project 3-54 on Protected/Permissive signal displays with Flashing Yellow Arrows.

- Labeling on the front panel shall be pre-approved by the City

- Communications to the City of Dallas TMC shall be through a 10/100 Ethernet port.

3.2 CONFLICT MONITOR UNIT FUNCTIONAL REQUIREMENTS

- The monitor shall be fully operational over a voltage range of 75 VAC to 135 VAC. It shall be designed to monitor Red, Solid Yellow, Flashing Yellow, and

Green circuits, on up to 18 Channels, on a per-channel basis, selectable by the user.

- WDT Circuitry shall be provided to monitor a controller unit output line state routed to the monitor unit at its assigned pin. The WDT Circuitry shall sense any line state change and the time between the last change. No state change for 1.0 +/- 0.1 seconds shall cause a FAILED state. The timer shall reset at each state change in a NON-FAILED state.

- Voltages appearing at the channel inputs shall be analyzed and acted upon regardless of their phase relationship to the AC line voltage.

- The Conflict Monitor shall sense and respond to Conflicts and +24 VDC failures WHENEVER the AC line voltage is within the 75 VAC to 135 VAC operating range of the Monitor.

- Means shall be provided to selectively inhibit monitoring of Yellow inputs.

- In the event that the Monitor senses a fault, followed by a loss of operating voltage, the initial Failure Status shall be retained in memory and redisplayed after restoration of power.

- The conflict monitor shall be designed to monitor Red circuits, the sequence of the outputs, and determine Multiple Output failure and Lack-of-Output failure for flashing yellow and flash red arrow left turn operation. The flashing yellow and red left turn displays will operate as described in the Texas Manual on Uniform Traffic Control Devices.

- The monitor shall be capable of simultaneously monitoring any possible combination of Protected Only, Standard Display, “Dallas” Display, Flashing Yellow Arrow, and/or Flashing Red Arrow displays for up to four movements.

- The conflict monitor shall be capable of monitoring outputs across two separate channels for Flashing Yellow and Flashing Red displays. Each channel will operate the part of the flashing yellow or flashing red arrow display.

- The conflict monitor shall be capable of operating a Flashing Yellow Arrow display in “compact mode”, by utilizing a pedestrian yellow output. The monitor shall be capable of monitoring the pedestrian yellow output as one dindication in a Flashing Yellow or Flashing Red signal display.

- Means shall be provided to review status of the Green, Yellow, and Red inputs of all channels, at the time the fault was latched without any external device. Power loss shall not affect the retention of this data. View of these statuses shall be pre-approved by the City.

- Except as otherwise noted in this Chapter, once the Monitor is LATCHED in a fault condition for any reason, it shall REMAIN LATCHED, even through a power fail/recovery, until a RESET is issued by the front panel reset switch, or by the

external test reset line. (Refer to Brownout/Power Fail Recovery requirements included in this Chapter for definitions of errors that are NOT LATCHED.)

- It shall be possible to unplug the Monitor from the cabinet, and/or plug it in, without placing the cabinet into Latched Flash operation (providing the cabinet door remains open).

- If a microprocessor is used in the Monitor design, its program shall be written so that:

    - Integrity tests of the checksum type shall be performed periodically on EACH memory cell of EACH memory device, relevant to each device type. The timing of these checks shall be pre-approved by the City.

    - Hardware external to the microprocessor circuits shall be employed to constantly sense proper microprocessor operation.

    - If a fault is detected with the microprocessor, or with the integrity tests, the Monitor shall trigger a latched fault, and a front panel indicator shall latch ON to indicate an INTERNAL FAILURE.

    - A complete sampling of all channel inputs constitutes a SET of samples. A minimum of three SETS of samples shall be completed, per half-cycle, between 70 degrees and 110 degrees following the zero-crossing point of the AC line waveform.

- Front Panel Indicators: In addition to the 18 R, Y, & G indicators for channel inputs, the unit shall have front panel indicators to provide status and failure detection information. The AC POWER indicator shall be GREEN. All other indicators shall be RED. The indicators should be labeled but not limited to provide the information described below:

    AC POWER: Shall illuminate when the incoming AC Line Voltage exceeds 98 (+/- 2) VAC, and shall FLASH at a 2 Hz rate if the line voltage drops below 93 (+/- 2) VAC.

    VDC FAILED: Shall illuminate when the Monitor has detected a 24 VDC failure.

    WDT ERROR: Shall illuminate when an error has been detected in the traffic signal controller watchdog output. Shall FLASH at a 1/2 Hz rate WHENEVER the Watchdog monitoring circuit is DISABLED.

    CONFLICT: Shall illuminate when a conflicting signal condition has been detected. Active inputs shall be displayed on the channel indicators.

    DIAGNOSTIC: Shall illuminate to indicate a failure of the Monitor Microprocessor. (required only if a Microprocessor is used).

RED FAIL: Shall illuminate when the Monitor detects that there is NO INPUT on ANY of the RYG inputs on any monitored channel. The failing channel shall be displayed on the channel indicators. The indicator shall be marked RYG.

DUAL INDICATION: Shall illuminate when the Monitor detects an INPUT ON MORE THAN ONE of the inputs that comprise a monitored channel. The failing channel shall be displayed on the channel indicators.

CLEARANCE ERROR: Shall illuminate when the Monitor detects that a yellow did not follow a green, (green/red sequence error), or if yellow timing was less than a selected minimum. The failing channel shall be displayed on the channel indicators.

- Monitor Unit Card Edge Connector (P6) Pin Assignments:

PIN	FUNCTION	PIN	FUNCTION
1	Channel 2 Green	A	Channel 2 Yellow
2	Channel 13 Green	B	Channel 6 Green
3	Channel 6 Yellow	C	Channel 15 Green
4	Channel 4 Green	D	Channel 4 Yellow
5	Channel 14 Green	E	Channel 8 Green
6	Channel 8 Yellow	F	Channel 16 Green
7	Channel 5 Green	H	Channel 5 Yellow
8	Channel 13 Yellow	J	Channel 1 Green
9	Channel 1 Yellow	K	Channel 15 Yellow
10	Channel 7 Green	L	Channel 7 Yellow
1	Channel 14 Yellow	M	Channel 3 Green
12	Channel 3 Yellow	N	Channel 16 Yellow
13	Channel 9 Green	O	Channel 17 Yellow
14	Channel 17 Green	R	Channel 10 Green
15	Channel 11 Yellow	S	Channel 11 Green
16	Channel 9 Yellow	T	Channel 18 Yellow
17	Channel 18 Green	U	Channel 10 Yellow
--	--	--	--
18	Channel 12 Yellow	V	Channel 12 Green
19	Channel 17 Red	W	Channel 18 Red
20	Chassis Ground	X	Not Assigned
21	AC –	Y	DC GROUND
22	Watchdog Timer	Z	External Reset
23	+24 VDC	AA	+24 VDC
24	Tied to Pin 25	BB	Stop Time (Output)
25	Tied to Pin 24	CC	Not Assigned
26	Not Assigned	DD	Not Assigned
27	Output Switch, Side #3	EE	Output Switch, Side #2
28	Output Switch, Side #1	FF	AC+

-- Slotted for keying between Pins 17 and 18 (Pins U and V)

- The watchdog, stop time, external reset, and 24V monitor input circuits shall be isolated from the conflict monitor internal power supply. Where the cabinet 24VDC power supply is used to power these circuits, it shall be conditioned to provide proper sense circuit operation, even under low voltage or high ripple conditions.

- Watchdog Timer: This function monitors an output from the traffic signal controller. The controller should toggle its output at a 200 msec rate. This function may be disabled by a switch on the circuit board. If disabled the Watchdog LED shall flash at a .5HZ rate. The Watchdog Circuitry shall sense the incoming AC line voltage, and when a Brownout / Power failure is sensed, the Watchdog shall be INHIBITED. (See section on Brownout / Power Failure for additional information). This line shall not be used for communication purposes.

- Red Monitoring Connector: A connector, (3M - 3428-5302, with two 3518 polarizing keys, or equivalent), shall be mounted on the Monitor front panel. Another connector of the same type, designated P20, is mounted near the rear of the cabinet output file. These connectors are joined by a ribbon cable 42 (+/- 6) inches in length, provided with each unit. The pin assignments of the P20 connector and terminal assembly shall be as shown below. Any P20 connector incorporating variations or additions to this specification shall be submitted to the City of Dallas Street Services for approval prior to delivery of the sample unit.

  Keying shall be between pins 3 & 5, and 17 & 19. (the odd numbered pins are on one side, and the even pins are on the other). The P20 connector and the CMU connector shall be keyed physically alike to prevent the Red Monitoring cable from being inserted into the P20 180 degrees out of alignment.

  Red Interface Connector (P1) Pin Assignments:

PIN	FUNCTION	PIN	FUNCTION
1	CHAN 15 RED	11	CHANNEL 9 RED
2	CHAN 16 RED	12	CHANNEL 8 RED
3	CHAN 14 RED	13	CHANNEL 7 RED
4	* CHASSIS GND	14	CHANNEL 6 RED
5	CHAN 13 RED	15	CHANNEL 5 RED
6	SPECIAL FUNCT # 2	16	CHANNEL 4 RED
7	CHAN 12 RED	17	CHANNEL 3 RED
8	* SPECIAL FUNCT # 1	18	CHANNEL 2 RED
9	CHAN 10 RED	19	CHANNEL 1 RED
10	CHAN 11 RED	20	RED ENABLE

- Red Enable Input: Pin 20 of the Red Monitoring Connector (P1) shall provide the Red Enable input to the monitor. When the Red Monitoring Connector is disconnected, or Red Enable is not present, the Monitor shall latch in the faulted "RED FAIL" state. When enabled, all normal Monitor functions shall become active.

  It shall not be possible to unplug the Red Monitoring Connector, P20, or plug it in, without placing the cabinet into Flash operation.

- "SPECIAL FUNCTION 1" and "SPECIAL FUNCTION 2" INPUTS: Means shall be provided to select either a PRESENCE of, or LACK of AC+ to enable these inputs.

  - PIN 8, (Special Function 1): Shall provide an AC input to the monitor, which will DISABLE the Lack-of-Output function for SELECTED CHANNELS. (e.g. during Railroad Preempt)

  - PIN 6, (Special Function 2): Reserved for future use.

3.3 CONFLICT MONITOR UNIT ELECTRICAL REQUIREMENTS:

The monitor shall be fully operational over a voltage range of 75 VAC to 135 VAC.

Chassis Ground and AC- shall be isolated from one another.

Monitored AC Inputs: The following levels and times refer to full wave, positive half-wave and negative half-wave inputs:

Green Signal Inputs	(no detect)	less than 15 Vrms*
	(detect)	greater than 25 Vrms*
Yellow signal Inputs	(no detect)	less than 15 Vrms*
	(detect)	greater than 25 Vrms*
Red Signal Inputs	(no detect)	less than 50 Vrms
	(detect)	greater than 70 Vrms
Red Enable Input	(no detect)	less than 50 Vrms
	(detect)	greater than 70 Vrms
Special Function Inputs	(no detect)	less than 50 Vrms
	(detect)	greater than 70 Vrms
Watchdog Enable	(enable)	greater than 103 _+2 Vrms
(AC level)	(disable)	less than 98 _+2 Vrms
LEDguard Low Threshold Signal Inputs	(no detect)	less than 15 Vrms
	(detect)	greater than 25 Vrms
LEDguard High Threshold Signal Inputs	(no detect)	less than 50 Vrms
	(detect)	greater than 70 Vrms
AC Line 2010 Brown-out	(drop out)	98 _+2 Vrms
AC Line 2010 Brown-out	(restore)	103 _+2 Vrms
AC Line 201E Brown-out	(drop out)	92 _+2 Vrms
AC Line 201E Brown-out	(restore)	98 _+2 Vrms

* Positive or negative half wave input

Monitored DC Inputs:

+24VDC Input	(fault)	less than +18 Vdc
	(no fault)	greater than +22 Vdc
External Reset Input	(TRUE)	less than 3.5 Vdc
	(FALSE)	greater than 8.5 Vdc
Watchdog Input	(TRUE)	less than 3.5 Vdc
	(FALSE)	greater than 8.5 Vdc

Outputs:

Relay Output	
AC Contact Rating	3A @ 120 Vac
DC Contact Rating	3A @ 30 Vdc
Stop Time Output	50 mA @ 30 Vdc

Timing Functions:

Conflict	(no fault)	less than 200 milliseconds
	(fault)	greater than 500 milliseconds
	(typical)	350 milliseconds
VDC Failed	(no fault)	less than 200 milliseconds
	(fault)	greater than 500 milliseconds
	(typical)	400 milliseconds
Watchdog (1.0 sec)	(no fault)	less than 900 milliseconds
	(fault)	greater than 1100 milliseconds
	(typical)	1000 milliseconds
Watchdog (1.5 sec)	(no fault)	less than 1400 milliseconds
	(fault)	greater than 1600 milliseconds
	(typical)	1500 milliseconds
Red Fail (RYG)	(no fault)	less than 700 milliseconds
	(fault)	greater than 1000 milliseconds
	(typical)	850 milliseconds
Red Fail 2010 (RYG)	(no fault)	less than 1200 milliseconds
	(fault)	greater than 1500 milliseconds
	(typical)	1350 milliseconds
Dual Indication	(no fault)	less than 200 milliseconds
	(fault)	greater than 500 milliseconds
	(typical)	400 milliseconds
Dual Indication (long)	(no fault)	less than 700 milliseconds
	(fault)	greater than 1000 milliseconds
	(typical)	850 milliseconds
Clearance (minimum yellow)	(no fault)	greater than 2.8 seconds
	(fault)	less than 2.6 seconds
AC Line 2010 Brown-out	(drop out)	400 _+50 milliseconds
	(restore)	400 _+50 milliseconds
AC Line 210E Brown-out	(drop out)	80 _+17 milliseconds
	(restore)	80 _+17 milliseconds
Minimum flash after restore		6.0 _+ 0.5 seconds
Maximum flash after restore		10.0 _+ 0.5 seconds
Watchdog (2010)	(disable)	400 _+50 milliseconds
	(enable)	400 _+50 milliseconds
Watchdog (210E)	(disable)	80 _+17 milliseconds
	(enable)	80 _+17 milliseconds

- Brownout/Power Fail Recovery: The Conflict Monitor shall determine that a Brownout has occurred if the incoming AC line voltage drops below the user-programmed threshold as indicated in the Monitored AC Input section. Brownout conditions greater than the user-selected duration shall place the monitor in a failed non latching mode. This condition shall last at least 4.25 seconds. While in a brownout condition, the monitor shall not latch in any condition other than a conflict. Recovery to normal monitoring operation shall occur when the incoming AC line voltage rises above the user-selected threshold, providing NO OTHER Failures have been recorded. A minimum hysteresis of Five (5) volts shall be maintained between the INHIBIT voltage level (as the AC line voltage is reduced) and the ENABLE voltage level (as the AC line voltage is raised).

3.4 CONFLICT MONITOR PROGRAMMING

Programming of the Conflict Monitor shall be through a nonvolatile memory (Monitor Datakey). Programming shall not be via jumpers, diode cards, or DIP switches.

Each Conflict Monitor Unit supplied under this contract shall be provided with one (1) EA Monitorkey (EDI Part # 495-4000) for programming the Conflict Monitor Unit.

The USB device required for programming the Monitorkey is included on the bid form. Specifications for this device are available the conflict monitor manufacturer. This device shall be provided only when specifically ordered by the City.

3.5 CONFLICT MONITOR COMMUNICATION: The conflict monitor unit shall be capable of communicating with the traffic signal controller, central traffic management system, and/or a PC via an on-board RJ45 port. The Conflict Monitor shall be capable of passing real-time status of outputs and/or fault states when connected to monitor-supported software.

SECTION 2
CHAPTER 4

Model 222, 622, and 2EC Loop Sensors
Model 242 D/C Isolators
Model252 A/C Isolators
Model 255 A/C RR Isolators

CHAPTER 4:
MODEL 222, ,LM622, & 2EC LOOP SENSORS and 242 DC, 252 AC, & 255 RxR ISOLATORS

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4.1 GENERAL REQUIREMENTS LOOP SENSORS: Three models of Loop Sensors are to be provided under this contract:

A. Model 222 Loop Sensor (2 Channel)
- 8 Selectable Sensitivity Settings
- 4 Selectable Frequency Settings
- 3 Modes of Operation
- Dip-switch front panel

B. Model LM622 Loop Sensor (2 Channel)
- 15 Selectable Sensitivity Settings
- 4 Selectable Frequency Settings
- 3 Modes of Operation
- Dip-switch front panel

C. Model Oracle 2EC Loop Sensor (2 Channel)
- 20 Selectable Sensitivity Settings
- 8 Selectable Frequency Settings
- 3 Modes of Operation
- Backlit LCD Front-panel Display with toggle switches
- On-board loop diagnostic software

Note: Loop Sensors are not to be included as part of standard City of Dallas Cabinet Unit Assemblies under this contract. Loop Sensors will be purchased on an as-needed basis under this contract. Refer to Chapter 5 of these specifications and the Bid Form for additional information.

- Each sensor unit channel shall be operationally independent.

- The sensors shall be units containing two channels, which plug into the Standard Input File. Each sensor channel shall be independent and shall provide isolation between "field" input circuits and the controller unit input circuits.

- The loop sensor shall be of solid state design. The method of detection shall be based upon a design which shall provide reliable operation.

- Each sensor unit channel shall draw no more than 100 ma from the +24 VDC cabinet power supply and shall be insensitive to 700 millivolts RMS ripple on the incoming +24 VDC line.

- The sensor unit front panel shall be provided with a hand pull to facilitate insertion and removal from the input file.

- Each sensor unit channel shall have a front panel mounted indicator to provide visual indication of true output. The indicator shall be on the output to the controller side. All control switches shall be mounted on the front panel.

- All indicator lights shall be water clear, Ultra Bright, T-1 3/4 package LEDs, General Instruments, MK9160 (Red), or equivalent.

- Model 2EC Loop Sensors shall additionally have a backlit LCD Display.

- A valid channel input shall cause a channel ground true output of a minimum 100 ms duration.

- A switch or switch position shall be provided to disable the output of each channel on an individual basis.

- The numbered and lettered sides of the PCB connector shall be commonly assigned.

4.2 FUNCTIONAL REQUIREMENTS LOOP SENSORS:

a. **GENERAL DESCRIPTION:** The purpose of this specification is to outline performance and design requirements for two channel inductive loop sensors that are compatible with, and intermate with the standard Input Files in Model 332, 336S and 337 Traffic Signal Cabinets. The unit(s) shall be of solid state design, and shall respond to changes in the inductance of the sensor loop/lead-in combination connected to its loop input terminals. When such inductance changes are of sufficient magnitude, the unit shall produce an output signal in response to vehicles passing over, or remaining within vehicle loops embedded in the roadway.

b. OPERATIONAL SPECIFICATIONS:

- Each detector channel shall be operationally independent, and capable of detecting all types of Texas licensed motor vehicles when connected to a loop/lead-in configuration as described below.

- The detector unit shall be mounted on a edge-connected, printed circuit board that has a conformal coating for environmental protection.

- An open or faulted loop shall cause the detector channel to output a constant signal, regardless of mode selected, unless the loops sensor is in the “off” or “disabled” state.

- Detector units shall comply with all performance requirements of this specification when connected to an inductance (loop plus lead-in) of from 30 to 1000 microhenries.

- Selection of frequency, sensitivity, and mode shall be completely independent for each detector channel.

- Loop inputs to each channel shall be transformer isolated.

- Each detector channel output shall be an opto-isolated NPN open collector transistor capable of sinking 50 milliamperes at 30 volts. This output shall be compatible with Model 170/2070/ATC Controller inputs.

- Tuning for each detector channel shall be automatic, and designed so that environment and/or applied power drift, shall not cause an actuation.

- Each individual channel shall have a minimum of 3 switch selectable operating frequencies.

- Each detector channel shall respond to an inductance change of 0.02 percent over the inductance range when connected to the following three-turn loop configurations.

- Each detector channel shall be equipped with at least three front panel selectable sensitivity settings to accomplish functional, electrical, operational and environmental requirements of this specification, with the following configurations:

    - Single 6' by 6' loop with a 250 foot lead-in cable.

    - Single 6' by 6' loop with a 1000 foot lead-in cable.

    - Four 6' by 6' loops connected in series/parallel with a 250 foot lead-in cable.

    - Four 6' by 6' loops connected in series with a 1000 foot lead-in cable.

- Each detector channel, when PRESENCE mode and LOWEST sensitivity are selected, shall respond to a nominal loop inductance change between 0.15 percent and 0.4 percent while connected to the above loop configurations. This setting shall NOT respond to an inductance change of less than 0.1 percent. In the Presence Mode, when the change is removed, the output shall become an open circuit within 20 milliseconds.

- The detector channel shall not detect vehicles, moving or stopped, at distances of 3 feet or more from the perimeter of any of the loop configurations listed above.

- All sensitivity settings shall not differ more than +/-40 percent from the nominal value chosen.

- Each detector channel shall have two switch selectable modes of operation: Pulse and Presence.

    - Pulse Mode: In the pulse mode, each new vehicle presence within the zone of detection shall initiate one detector channel output pulse of 125± 25 milliseconds in duration. Should a vehicle remain in a portion of the zone of detection for a period in excess of two seconds, the detector

channel shall automatically "tune out" the presence of the vehicle. The channel shall then be capable of detecting another vehicle entering the same zone of detection within three seconds from when the pulse output was generated in response to the first vehicle. Response time of the detector channel, when LOWEST sensitivity is selected, shall be less than 20 milliseconds. Response time of the detector channel, when HIGHEST sensitivity is selected, shall be less than 250 milliseconds.

- Presence Mode: In the presence mode, the detector channel shall recover to normal sensitivity within one second after termination of vehicle presence in the zone of detection, regardless of the duration of the presence. Response time of the detector channel, when LOWEST sensitivity is selected, shall be less than 20 milliseconds. Response time of the detector channel, when HIGHEST sensitivity is selected, shall be less than 250 milliseconds.

- With the sensitivity setting at its HIGHEST level, a vehicle that is within the zone of detection shall be detected for a minimum of three minutes when the inductance change is 0.02 percent, and a minimum of ten minutes when the vehicle causes a 0.06 percent inductance change.

- With the sensitivity setting at its LOWEST level, a vehicle causing a one percent or greater change in loop inductance shall be detected for a minimum of four minutes.

4.3 ELECTRICAL REQUIREMENTS LOOP SENSORS:

- **APPLICATION OF POWER:** The detector channels shall be fully operational within 30 seconds after the application of power.

- **INTERFERENCE:** The separate channels contained within a given unit shall include means to prevent cross-talk with one another.

- **CROSS-TALK:** Each unit shall include means to prevent cross-talk with other modules. If the prevention means is manual, the control for it shall be located on the front panel of the unit. No additional external wiring shall be required to implement the prevention means.

- **LIGHTNING PROTECTION:** Lightning Protection shall be included within the detector unit.

  - 10 microfarad capacitor (charged to ± 1,000 volts) directly across the loop input terminals, with no loop load present.

  - Each unit shall be able to withstand, without damage, the discharge of a 10 microfarad capacitor (charged to ± 2,000 volts) directly across either the detector input inductance pins or between either detector input inductance pins and earth ground. For purposes of this test, the detector

chassis shall be grounded and the detector input pins shall have a dummy resistive load attached equal to 5.0 ohms.

- **TRACKING RATE:** The detector shall be capable of compensating or tracking for an environmental change up to 0.001 percent change in inductance per second.

- **TRACKING RANGE:** The sensor unit shall be capable of normal operation as the input inductance is changed +/- 5.0% from the quiescent tuning point regardless of internal circuit drift.

- **TEMPERATURE CHANGE:** The operation of the sensor unit shall not be affected by changes in the inductance and/or capacitance of the environmental changes with the rate of temperature change not exceeding 1 degree Celsius per 3 minutes. The opening or closing of the controller cabinet door with a temperature differential of up to 18 degrees Celsius between the inside and outside air shall not affect the proper operation of the sensor unit.

- **RESET:** The detector unit shall respond to a ground reset signal of 15 microseconds or longer and begin normal operation within 2 seconds after the reset command.

- **BOARD EDGE CONNECTOR PIN ASSIGNMENT:** The numbered and lettered sides of the PCB connector shall be commonly assigned.

Pin	Function	Pin	Function
A	DC Ground	M	AC-
B	+24 VDC	---	
---		N	AC+
C	Detector Reset	P*	Loop #3 Input
R*	Loop #3 Input		
D	Loop #1 Input	S*	Output #3 (C)
		T*	Output #3 (E)
E	Loop #1 Input	U*	Loop #4 Input
F	Output #1 (C)	V*	Loop #4 Input
H	Output #1 (E)	W	Output #2 (C)
J	Loop #2 Input	X	Output #2 (E)
K	Loop #2 Input	Y*	Output #4 (C)
L	Chassis Ground	Z*	Output #4 (E)

* Denotes spare terminals on the 2 - channel unit
--- Slotted for Keying
(C) Collector
(E) Emitter

4.4 GENERAL REQUIREMENTS ISOLATORS:

- Each isolator channel shall be operationally independent.

- The isolators are units containing two channels which plug into the Standard Input File. Each isolation channel shall be independent and shall provide isolation between either 24 VDC or 120 volt A.C. input circuits and the controller unit input circuits.as defined herein.

- The isolator shall be of solid state design. The method of detection shall be based upon a design which shall provide reliable operation.

- The isolator front panel shall be provided with a handle to facilitate insertion and removal from the input file.

- Each channel shall have a front panel mounted test switch to simulate a valid input. The test switch shall be located after the input isolation and prior to any of the timing circuits. The test switch shall be a three position toggle type with "on", "off" and "momentary on" positions. The contacts shall be gold plated and capable of reliably switching circuit current.

- Each isolator channel output shall be an opto-isolated NPN Open Collector capable of sinking 50 ma at 30 VDC. The output shall be compatible with the controller unit inputs.

- A valid channel input shall cause a channel ground true output of a minimum 100 ms duration.

- The sensing element shall operate and interface successfully with an associated City of Dallas Department of Street Services sensing unit or element.

- The output transistor shall switch from the OFF state to the ON state in a period equal to or less than 20 microseconds. The transistor shall switch from the ON state to the OFF state in a period equal to or less than 20 microoseconds.

- The numbered and lettered sides of the PCB connector shall be commonly assigned.

- All indicator lights shall be water clear, Ultra Bright, T-1 3/4 package LEDs, General Instruments, MK9160 (Red), or equivalent.

4.5 FUNCTIONAL REQUIREMENTS 242 DC ISOLATOR:

- The isolator shall be mounted on an edge connected printed circuit board.

- Each isolation channel shall have a front panel mounted "test" switch to simulate a valid input to the isolation channel. The test switch shall be located after the input isolation and prior to any of the timing circuits. The test switch shall be a single pole double throw, three position switch; momentary ON, OFF and maintained ON positions.

- Board Edge Connector Pin Assignment:

Pin	Function	Pin	Function
A	DC Ground	M	AC-
B	+24 VDC	---	
---		N	AC+
C	Detector Reset	P*	Loop #3 Input
		R*	Loop #3 Input
D	Loop #1 Input	S*	Output #3 (C)
		T*	Output #3 (E)
E	Loop #1 Input	U*	Loop #4 Input
F	Output #1 (C)	V*	Loop #4 Input
H	Output #1 (E)	W	Output #2 (C)
J	Loop #2 Input	X	Output #2 (E)
K	Loop #2 Input	Y*	Output #4 (C)
L	Chassis Ground	Z*	Output #4 (E)

  * Denotes spare terminals on the 2 - channel unit
  --- Slotted for Keying
  (C) Collector
  (E) Emitter

- The isolator shall have an internal power supply which shall supply +24 Volts DC to the field input side of the isolation channels. The Model 242 Isolator shall not draw more than 100ma per channel from the cabinet AC power, (1.25 watts per channel).

- The edge connector contacts shall be either silver or coin silver with gold over nickel plate rated for 5 amperes at 120 Volts AC.

- Each isolator channel shall have a front panel mounted LED indicator to provide visual indication of the status of the opto coupled output transistor. The indicator shall be "ON" when the output transistor is in the saturated state and the indicator shall be "OFF" when the output transistor is in the non-conducting state.

- Each isolation channel output shall be an opto-isolated NPN open collector capable of sinking 50 milliamperes at 30 volts. This output shall be compatible with the Model 170 Controller Unit. Each isolation channel shall present ground true logic to the controller unit inputs.

- Front panel of the isolator shall be labeled as to model number "242" and title "DC ISOLATOR". Channels shall be labeled as "CH 1" for the upper channel and "CH 2" for the lower channel.

- A channel contact closure input of 5 ms or less shall not cause an output. An input duration of 25 ms or greater shall cause an output of 100 milliseconds minimum duration. An input duration between 5 ms and 25 ms may or may not

cause an output. The channel input shall reset within 25 ms after opening of either field contact or test switch.

- Power Failure or Restoration shall not cause an output to the Controller Unit.

4.6 ELECTRICAL REQUIREMENTS 242 ISOLATOR:

- Each isolation channel field input shall be turned on (true) when a contact closure causes an input voltage of less than 8 volts DC, and shall be turned off (false) when the contact opening causes the input voltage to exceed 12 volts DC. Each input shall deliver no less than 15 nor more than 40 milliamperes to an electrical contact closure or short from the power supply.

- The minimum isolation shall be 1000 megohms and 2,500 volts DC from input to output.

- LIGHTNING PROTECTION: Lightning protection shall be integral with the Isolator. The protection shall enable the isolator to withstand the discharge of a 10 microfarad capacitor charged to +1000 volts directly across the input pins with no load present. The protection shall enable the isolator to withstand the discharge of a 10 microfarad capacitor charged to +2000 volts directly across either the input pins or from either side of the input pins to equipment ground. The input pins shall have a dummy resistive load attached equal to 5.0 ohms.

4.7 FUNCTIONAL REQUIREMENTS 252 AC ISOLATOR:

- The Isolator shall be mounted on an edge connected printed circuit board.

- The Model 252 Isolator shall not draw more than 100ma per channel from the cabinet +24 VDC power supply, (1.25 watts per channel).

- Front panel of the isolator shall be labeled as to model number "252" and title "AC ISOLATOR". Channels shall be labeled as "CH 1" for the upper channel and "CH 2" for the lower channel.

- Each channel shall have a front panel mounted test switch to simulate a valid input. The test switch shall be located after the input isolation and prior to any of the timing circuits. The test switch shall be a three position toggle type with "on", "off" and "momentary on" positions. The contacts shall be gold plated and capable of reliably switching circuit current.

- The output transistor shall switch from the "off" state to the "on" state in a period equal to or less than 20 microseconds. The transistor shall switch from the "on" state to the "off" state in a period equal to or less than 20 microseconds.

- Each isolator channel shall have a front panel mounted LED indicator to provide visual indication of the status of the opto-coupled output transistor. The indicator

shall be "ON" when the output transistor is in the saturated state and the indicator shall be "OFF" when the output transistor is in the non-conducting state.

- Input Output Conditions: Refer to the following truth table for the relationship between the "A.C. input voltage", "front panel test switch", "front panel indicator" and the "output transistor":

A.C. INPUT VOLTAGE	TEST SWITCH	OUTPUT INDICATOR	TRANSISTOR
GREATER THAN 83 +/- 3 VOLTS	OFF	ON	ON
GREATER THAN 83 +/- 3 VOLTS	ON	ON	ON
LESS THAN 67 +/- 3 VOLTS	ON	ON	ON
LESS THAN 67 +/- 3 VOLTS	OFF	OFF	OFF

- Connector Pin Assignment:

PIN	FUNCTION	PIN	FUNCTION
A	DC Ground	N	AC (+) 120 V
B	+24	P	N/A
C	N/A	R	N/A
D	Input #1	S	N/A
E	Input #1Common	T	N/A
F	Output #1 (C)	U	N/A
H	Output #1 (E)	V	N/A
J	Input #2	W	Output #2 (C)
K	Input #2 Common	X	Output #2 (E)
L	Chassis Ground	Z	N/A
M	AC ( ) 120 V		

( ) Slotted for Keying
(C) Collector
(E) Emitter

- The input circuit shall be provided with hysterisis such that switching for the increasing voltage occurs when the input exceeds 83 +/ 3 VAC and switching for the decreasing voltage occurs when the voltage drops below 67 +/ 3 VAC. No

switching shall occur when the voltage is in the hysterisis band. (i.e. between 70 and 80 volts)

- Each isolation channel shall be turned ON, OUTPUT TRUE, when the input voltage exceeds 83 +/ 3 VAC for a period of 150 +/ 50 milliseconds.

- Each isolation channel shall be turned OFF, OUTPUT FALSE, when the input voltage falls below 67 +/ 3 VAC for a period of 150 +/ 50 milliseconds.

- A valid input to the isolation channel shall cause a channel output of 100 milliseconds minimum duration.

4.8 ELECTRICAL REQUIREMENTS 252 AC ISOLATOR:

- The input impedance of each input shall not be less than 8K ohms nor greater than 12K ohms at 60 HZ.

- INPUT TRANSIENT PROTECTION: Each channel input shall withstand, without damage, the discharge of a 10 microfarad capacitor charged to +/ 1000 volts, when connected directly to the open input pins. Each channel shall withstand, without damage, the discharge of a 10 microfarad capacitor charged to +/ 2000 volts, when connected between either input pin and equipment ground.

- The minimum isolation between input pins and output pins shall be 1000 megohm at 500 volts.

- Each 252 AC isolator channel shall draw no more than 100 ma from the +24 VDC cabinet power supply and shall be insensitive to 700 millivolts RMS ripple on the incoming +24 VDC line.

4.9 FUNCTIONAL REQUIREMENTS 255 RxR ISOLATOR UNIT:

- The Isolator shall be mounted on an edge connected printed circuit board.

- The Model 255 Isolator shall not draw more than 100ma per channel from the cabinet +24 VDC power supply, (1.25 watts per channel).

- Front panel of the isolator shall be labeled as to model number "255" and title "RxR ISOLATOR". Channels shall be labeled as "CH 1" for the upper channel and "CH 2" for the lower channel.

- Each channel shall have a front panel mounted test switch to simulate a valid input. The test switch shall be located after the input isolation and prior to any of the timing circuits. The test switch shall be a three position toggle type with "on", "off" and "momentary on" positions. The contacts shall be gold plated and capable of reliably switching circuit current.

- The output transistor shall switch from the "off" state to the "on" state in a period equal to or less than 20 microseconds. The transistor shall switch from the "on" state to the "off" state in a period equal to or less than 20 microseconds.

- Each isolator channel shall have a front panel mounted LED indicator to provide visual indication of the status of the opto-coupled output transistor. The indicator shall be "ON" when the output transistor is in the saturated state and the indicator shall be "OFF" when the output transistor is in the non-conducting state.

- Input Output Conditions: Refer to the following truth table for the relationship between the "A.C. input voltage", "front panel test switch", "front panel indicator" and the "output transistor":

A.C. INPUT VOLTAGE	TEST SWITCH	OUTPUT INDICATOR	TRANSISTOR
GREATER THAN 83 +/- 3 VOLTS	OFF	OFF	OFF
GREATER THAN 83 +/- 3 VOLTS	ON	ON	ON
LESS THAN 67 +/- 3 VOLTS	OFF	ON	ON
LESS THAN 67 +/- 3 VOLTS	ON	ON	ON

- Connector Pin Assignment:

PIN	FUNCTION	PIN	FUNCTION
A	DC Ground	M	AC (-) 120 V
B	+24	---	
---		N	AC (+) 120 V
C	N/A	P	N/A
D	Input #1	R	N/A
E	Input #1 Common	S	N/A
F	Output #1 (C)	T	N/A
H	Output #1 (E)	U	N/A
J	Input #2	N/A	
K	Input #2 Common	W	Output #2 (C)
L	Chassis Ground	X	Output #2 (E)
		Z	N/A

(---) Slotted for Keying
(C) Collector

(E) Emitter

- The input circuit shall be provided with hysterisis such that switching for the increasing voltage occurs when the input exceeds 83 +/ 3 VAC and switching for the decreasing voltage occurs when the voltage drops below 67 +/ 3 VAC. No switching shall occur when the voltage is in the hysterisis band. (i.e. between 70 and 80 volts)

- Each isolation channel output shall be turned OFF, OUTPUT FALSE, when the input voltage exceeds 83 +/ 3 VAC for a period of 150 +/ 50 milliseconds.

- Each isolation channel output shall be turned ON, OUTPUT TRUE, when the input voltage falls below 67 +/ 3 VAC for a period of 150 +/ 50 milliseconds.

- A valid input to the isolation channel shall cause a channel output of 100 milliseconds minimum duration.

4.10 ELECTRICAL REQUIREMENTS 255 RxR ISOLATOR UNIT

- The input impedance of each input shall not be less than 8K ohms nor greater than 12K ohms at 60 HZ.

- INPUT TRANSIENT PROTECTION: Each channel input shall withstand, without damage, the discharge of a 10 microfarad capacitor charged to +/ 1000 volts, when connected directly to the open input pins. Each channel shall withstand, without damage, the discharge of a 10 microfarad capacitor charged to +/ 2000 volts, when connected between either input pin and equipment ground.

- The minimum isolation between input pins and output pins shall be 10 megohms at 500 volts.

SECTION 2
CHAPTER 5

TYPE 332 TRAFFIC SIGNAL CONTROLLER CABINET ASSEMBLY UNITS

(BIG D MODEL)

CHAPTER 5:
TYPE 332 TRAFFIC SIGNAL CONTROLLER CABINET ASSEMBLY UNITS (BIG D MODEL)

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TYPE 332 TRAFFIC SIGNAL CONTROLLER CABINET ASSEMBLY UNITS (BIG D MODEL)

5.1 GENERAL REQUIREMENTS:

- The cabinet shall be rainproof, with dimensions and design style as shown on the plans. The cabinet top shall be "crowned" a minimum of one half inch to prevent standing water. Crown measurement is from cabinet top center to edge.

- Each cabinet shall include City of Dallas identification on the outside of the front door and the inside of the rear door. The name "City of Dallas" shall be welded to the cabinet on the front door and on the inside of the rear door the name "City of Dallas" with the serial number of the cabinet shall be welded.

- The controller cabinet assembly shall be provided with a full complement of standard equipment, including, but not limited to:

    - Input Files I and J
    - Two (2) Model 252 AC isolators.
    - Six (6) Model 242 DC isolators
    - The Power Distribution Assembly #2 (Modified)
    - Output File
    - Auxiliary Output File
    - Drawer Shelf
    - Static Shelf
    - Interior Raceways
    - All related wiring and terminal facilities as described in the Specifications.

- The Output File shall be provided with:

    - One (1) 18-Channel Conflict Monitor Unit (2018 KCLip)
    - Four (4) Flash Transfer Relays
    - One (1) Isolation Relay
    - One (1) Logic Relay
    - Twelve (12) Model 200 Solid State Switch Packs

- The Power Distribution Assembly shall be provided with:

    - Two (2) Power Relays
    - Four (4) Model 204 Flashers
    - One (1) Model 206L High-efficiency Power supply
    - No fewer than 2 rear-side non-GFI Duplex Receptacles
    - 1 EA front-side GFI Duplex Receptacle

- The following equipment shall be completely removable from the cabinet without removing any other equipment and using only a screwdriver:

  - 24 VDC Power Supply Assembly
  - Power Distribution Assembly
  - Input File
  - Output File
  - Monitor Unit Assembly
  - Cabinet Light Assembly

- All fuses, circuit breakers, switches, (except fan fuse) and indicators shall be readily visible and accessible when the front door is open.

- The cabinet shall be delivered mounted on a plywood board shipping pallet. The pallet shall be bolted to the cabinet base. The cabinet shall be enclosed in a slipover cardboard packing shell.

- All equipment in the cabinet shall be clearly and permanently labeled. Marker strips shall be located immediately below the item they are to identify and shall be clearly visible with the items installed. Marker strips shall be made of a material that can be easily and legibly written on using a pencil or ballpoint pen.

- Resistor capacitor transient suppression shall be provided at all AC relay sockets (across relay coils), the fan, and the cabinet light door switch.

- A leakage resistor, which permits 3 to 8 VDC to be applied to the heavy duty relay coil, shall be installed across the terminals of each relay socket to overcome any residual magnetism.

5.2 MATERIAL AND STRUCTURE:

- All assemblies shall be mounted either on the cage mounting rails per cabinet model detail or on shelves installed within the cabinet.

- All bolts, nuts, washers, screws (size 8 or larger), hinges and hinge pins that are subject to corrosion shall be stainless steel unless otherwise specified. In areas where corrosion resistance is not a factor, plated steel hardware may be acceptable.

- All conductors, terminal, and parts that may be hazardous to maintenance personnel shall be protected with suitable insulating material.

- The cabinet and doors shall be fabricated from 0.125 inch minimum thickness sheet aluminum. All exterior seams for cabinet and doors shall be continuously welded. All exterior welds shall be smooth. All edges shall be filed to a radius of 0.03125 inch minimum.

- The welding of the corners, sides and top of the cabinet shall be watertight and of equal or greater thickness than the base metal after the grinding and smoothing

is completed. All construction shall be free of dents, scratches, weld burn through and abrasions harmful to the strength and general appearance.

- Cabinets fabricated from aluminum sheet shall conform to the requirements of ASTM Designation: B 209 for 5052 H32 aluminum sheet.

- Welding on aluminum cabinets shall be done by the gas metal arc (Mig) or gas tungsten arc (Tig) process using bare aluminum welding electrodes. Electrodes shall conform to the requirements of the American Welding Society (AWS) A5.10 for ER5356 aluminum alloy bare welding electrodes.

- Procedures, welders and welding operators for welding on aluminum shall be qualified in accordance with the requirements of AWS B3.0, "Welding Procedure and Performance Qualification" and to the practices recommended in AWS C5.6.

5.3 DOORS:

- The cabinet shall have a front and a rear door, each equipped with a lock. When each door is closed and latched, the door shall be locked. The latching handles shall have provision for padlocking in the closed position. The operating handle shall be stainless steel with 7.5 inch handle and .500 inch minimum stainless steel shank. The handle shall open to the right out away from the cabinet on the front door, and to the left out away from the cabinet on the rear door.

- The cabinet door frames shall be double flanged out on all four sides and shall be provided with strikers to hold tension on and form a firm seal between door gasketing and cabinet door frames. The flange width shall be a minimum of one inch, measured from the flange front edge to the housing inside surface. The cabinet door openings shall be a minimum 22 inches wide by 56.5 inches high as shown on the plans.

- Means shall be provided on the front door to hang two (2) separate plastic envelopes, which are to be supplied and installed by the Contractor. The envelopes shall be the side opening "zip" type, fabricated of heavy duty clear plastic, measuring 10 x 14 (+/ 1.0) inches. Two (2) 3/8 inch (hole size) brass grommets shall be mounted on each envelope, spaced 12 5/8 inches center to center. The hanging apparatus and plastic envelopes shall be located so as not to interfere with the latching mechanism and air filter on the cabinet front door. The envelope hanging method shall be designed such that gusts of wind cannot blow the envelope off the door.

5.4 LOCKS:

Cabinet locks shall be solid brass Corbin No. 2 lock. One key shall be supplied with each lock. The keys shall be removable in the locked position only. The locks shall have rectangular, spring loaded bolts. The bolts shall have a 0.281

inch throw and shall be 0.75 inch wide by 0.375 inch thick (tolerance is +/-0.035 inch).

5.5 LATCHES:

- The latching mechanism shall be a three point draw roller type. The center catch and pushrods shall be plated. The pushrods shall be turned edgewise at the outward supports and have a cross section of 0.25 inch by 0.75 inch minimum. Supports shall be 0.105 inches minimum, and of the same material as specified for the housing. Rollers shall have a minimum diameter of 0.875 inch and shall be equipped with ball bearings and nylon wheels. The center catch shall be fabricated of 0.1875 inch plated steel, minimum. The City will accept aluminum latch components.

5.6 HINGES:

- Each door shall be equipped with four (4) two bolt hinges, minimum 3.5 inches long. Each hinge shall have a fixed pin. Front and rear doors shall be provided with catches to hold the door open at both 90 and 180(+10) degrees. The catches shall be 0.375 inch diameter minimum, plated steel rods. Hinges shall be of the same material as the housing. Hinge pins and bolts shall be made of stainless steel. The hinges shall be bolted to the enclosure and welded to the door. Hinge pins shall be welded at each end to form a cap and the welds filed or ground smooth. The pins and bolts shall be covered by the door edge and not accessible when the door is closed.

5.7 LIFTING EYES:

- The cabinet shall be provided with two removable lifting eyes to be used when placing the cabinet on the pedestal. The lifting eyes shall be located to provide reasonable balance when the cabinet is lifted. Each eye opening shall have a minimum diameter of 1 inch and shall be capable of lifting 1000 pounds. All dimensions shall be as shown on the Plans. The lifting eye mounts shall be mechanically designed to eliminate any possibility of water entry into the cabinet. The lifting screws shall be Button Head Steel Socket Screws or Stainless Steel Carriage Bolts.

5.8 AIR INTAKE:

- The front door shall be provided with a louvered air intake. A disposable cotton/synthetic fiber filter shall be housed behind the intake (refer to appendix A for filter specification). The filter's working area shall cover the intake opening

area and be held firmly in place with bottom and side brackets and a spring loaded upper clamp. The filter supports shall be so structured that no incoming air shall bypass the filter.

- The bottom filter bracket shall be formed into a waterproof sump with drain holes to the outside. The louvered intake shall be constructed such that a stream of water from an impulse type sprinkler will not enter the housing.

5.9 POLICE PANEL:

- A police panel is not required and will not be wired.

- The exterior cabinet shell shall not have a police panel door.

5.10 RAILS:

- A standard EIA 19 inch rack cage shall be installed inside the housing for mounting of the controller unit and cabinet assemblies. The EIA rack portion of the cage shall consist of 2 pairs of continuous, adjustable equipment mounting angles; angles are to be a minimum of 53 inches in height, 0.1345 inch nominal thickness plated steel tapped with 10 32 threads with EIA universal spacing. The angle shall comply with standard EIA RE 310 B and shall be supported top and bottom by welded support angles to form a cage. The cage shall be attached to each side of the cabinet at four (4) points, two (2) at the top and two (2) at the bottom of the rails. Cage support mounting angles shall be provided on either side level with the bottom edge of the door opening to provide both horizontal support and bolt attachment.

- Clearance between rails for mounting assemblies shall be 17.75 inches. The distance between the front surface of the front mounting rail pair to the front surface of the rear mounting rail pair shall be 20 +/ 0.10 inches.

- Two plated supporting angles extending from the front to the back rails shall be supplied to support the controller unit. The angles shall be designed to support a minimum of 50 pounds each. The horizontal side of each angle shall be a minimum of three (3) inches. The angles shall be mounted 17.5 inches from the top of the rail cage and shall be adjustable vertically.

- A 1.5 inch tall drawer with top hinged cover shall be rack mounted as part of the controller support brackets. The drawer shall be capable of supporting 50 pounds in the extended position.

- A vented static shelf for placing equipment shall be rack mounted in a position as to be above the controller. The shelf shall be a minimum of 12 inches deep measured from the front of the rack, and shall be securely attached to both the

front and rear rails. The shelf shall be formed of a corrosion resistant metal, and shall be free of sharp edges.

- A cable raceway shall be provided on each side of the cabinet between the rack and the cabinet shell for the passage of cabling from the front to the rear of the cabinet. Each raceway shall be firmly secured to the rack, and of sufficient dimension to allow passage of cables with standard RS-232 serial connectors.

5.11 GASKETING :

- Gasketing shall be provided on all door openings and shall be dust tight. Gaskets shall be 0.25 inch minimum thickness closed cell neoprene and shall be permanently bonded to the metal. The mating surface of the gasketing shall be covered with a silicone lubricant to prevent sticking to the mating surface. Should a substance other than a silicone lubricant be employed, the Supplier shall submit a sample to the City for testing and evaluation. No cabinets employing the new substance shall be shipped without the prior written approval of the City.

5.12 FAN AND EXHAUST VENT:

- Each cabinet shall be equipped with one electric fan with ball or roller bearings and a capacity of at least 100 CFM. Fan guards shall be provided to prevent accidental injury to servicing personnel.

- The fan shall be mounted within the cabinet and vented out of the cabinet above the top of the door openings.

- The fan shall be thermostatically controlled and shall be manually adjustable to turn on between 33 degrees C. and 65 degrees C. with a differential of not more than 6 degrees C. between automatic turn on and turn off. The cabinet fan circuit shall be fused at 125% of the ampacity of the fan motor.

- The intake and exhaust areas (including filter) shall pass a minimum of 60 cubic feet of air per minute.

- The exhaust vent shall be so designed as to prevent water from entering the cabinet interior.

5.13 INPUT FILE:

- The input file shall be wired and connected as shown on the plans. The wiring harnesses from the Field Input Terminal Blocks to the rear of the Input File from the detector inputs shall have lugs on both ends that have been crimped and soldered. The file shall utilize no more than 5.25 inches of EIA rack height. The file shall intermate with and support fourteen (14) two channel loop detector units. The file shall allow air circulation through the top and bottom of the assembly.

- The file shall provide a 22 pin, single readout PC edge connector centered vertically for each two channel detector. The edge connectors shall be double sided having contacts on 0.156 inch centers with the number and letter sides of each pin shorted internally. Pins D, E, F, J, K, L and W shall be brought out to an 8 position terminal block on the back of the file. The output emitters shall be common grounded with the ground terminating at TB15, position 4.

- The input file shall have PC card guides both top and bottom. The Card guides shall begin 1.0 +0.5 inches from the front face of the file. The input file shall be provided with marker strips above and below the isolators and detectors in the file in order to identify them.

- The door open switch shall be connected to I-11 upper, connector C1, pin 80.

5.14 OUTPUT FILE:

- Card guides (top and bottom) shall be provided to support the switch packs and monitor unit.

- The Output File shall be provided with marker strips to identify switch packs in the file. The marker strips shall be made of a material that can be easily and legibly written on using a pencil or ballpoint pen. Marker strips shall be located immediately below the switchpack they are to identify.

- Switch pack connectors, monitor unit connectors and flash transfer relay sockets shall be accessible, via a hinged swing down rear panel, from the back of the output file without the use of tools.

- Field wire terminal blocks shall be mounted vertically on the back of the assembly. The 3 terminal blocks shall be the 12 terminal type. (A description of the block is found in Section 5.25 of these specifications.)

- Labeling on the panel shall include the load switch designation.

- Output files and one-hundred twenty volt alternating current circuits shall be hand-wired; Printed circuit boards will not be acceptable for current carrying circuits.

- The monitor unit compartment including the housed monitor unit exclusive of handle shall extend no farther than 1.25 inches in front of the 19 inch rack front surface. The switch pack socket connector front surface shall be no more than 8.5 inches in depth from the front surface of the output file. (This allows use of a common mother board for switch packs and monitor unit.)

- The output file shall utilize 10.5 inches of rack height and shall contain 12 Model 200 switch packs, four flash relays, and the monitor unit. Four flash relays and 1 monitor unit shall be furnished with each output file. The depth of the assembly shall not exceed 14.5 inches from the front cabinet rails including terminal blocks and relays.

- The controller unit outputs to the output file shall be connected through connector C4.

- The cabinet shall be hardwired to flash all red.

- The monitor connector shall be a rigidly supported printed circuit board edge connector, having 2 rows of 28/56 independent double readout bifurcated contacts on 0.156 inch centers. The connector shall intermate with the Model 210 Monitor Unit.

- It shall be possible to remove the monitoring device without causing the intersection to go into flashing operation. The cabinet shall be wired so that with the front cabinet door closed and with the monitor unit removed, the intersection shall go into flashing operation. The cabinet shall contain a conspicuous warning against operation with the monitor unit removed.

- The monitor unit connector shall be wired in accordance with the pin assignment shown on the Plans.

- A connector and terminal assembly designated as P20 (Magnum P/N 722120 or equivalent) for monitoring the absence of red shall be an integral part of the output file. The connector shall intermate and be compatible with the cable and connector of a 210 CMU capable of monitoring the absence of red. The pin assignments of the P20 connector and terminal assembly shall be as shown on the Plans. Any P20 incorporating variations or additions to this Specification shall be submitted to the City for approval prior to delivery of the sample unit.

- The P20 connector and the CMU connector shall be keyed physically alike to prevent the absence of red cable connector from being inserted into P20 180 degrees out of alignment.

- The flash relay shall be a heavy duty type per Section 5.19. It shall be energized only when the signals are in flashing operation. The flash relay shall transfer field outputs from switch pack output to flash control. Transfer of the flash relay circuit to flash control shall not interrupt the operation of the controller unit.

- A Capacitor shall be used for loading. Capacitors shall be provided on the rear side of the output file positions listed. There will be one (1) resistor per channel connected to separate points on the AC- terminal strip as indicated:
    - Phase 2,4,6,8 walk, don't walk.

5.15 AUXILIARY FILE:

- The Auxiliary Output File shall comply with electrical and mechanical plans and consist of the following:
    - Six (6) model 200 Switch Packs
    - Two (2) Flash Transfer Relays
    - A C-5 connector Amp part No. 206838-1
    - Three six position terminal strips for field wire connection.
    - One seven position terminal strip for cabinet connection.
    - Field termination points for R, Y, and G outputs for Channels 9 through 12, 17, and 18 shall be clearly identified on the back panel of the auxiliary file. (i.e. CH9 R, CH 9 Y, CH 9 G)

5.16 POWER DISTRIBUTION ASSEMBLY #2 (MODIFIED):

- The power distribution assembly shall be furnished and mounted on the EIA 19 inch rack utilizing no more than 7 inches of rack height. All equipment shall be readily accessible for ease of replacement. The depth of the assembly including terminal blocks shall not exceed 10 inches.

- The following equipment shall be provided with the power distribution assembly:
    - Equipment receptacle (accessible from the front panel)
    - Controller Unit Duplex Receptacles (both on the back panel)
    - Main Circuit Breaker
    - Six Pole Signal Bus Circuit Breaker
    - Two Pole Flash Bus Circuit Breaker
    - Equipment circuit Breaker
    - Heavy duty relays (replacing mercury contactor)
    - Auto/Flash Switch
    - Flash Relay (Heavy Duty Type) and Socket
    - Flasher Unit Sockets
    - Model 204 Flasher Units
    - Flash Indicator Light

- 1 Model 206L (or approved equal) High Efficiency Power Supply

- The main circuit breaker shall be rated for 50 amperes at 120VAC. The Signal Bus Circuit Breakers shall be rated for 15 amperes at 120VAC and the Flash Bus Breakers for 20 amperes at 120VAC.

- The (4) signal bus circuit breakers shall not be mechanically ganged. The opening of any one or more of the four signal breakers shall initiate a "flash transfer" and only those breakers that opened shall indicate so. The circuit breakers shall be of the same type as Potter and Brumfield single pole, 15 ampere, AC voltage, 50/60 hertz, curve 3 type breakers that have the auxiliary switch feature or equivalent.

- The circuit breaker(s) for the equipment receptacles shall be for 15 amperes at 120VAC. Rating of breakers shall be shown on face of breaker or handle. Breaker function shall be labeled below breakers on the front panel.

- Equipment receptacles shall be NEMA 5 15R duplex type and the first receptacle in the circuit shall have ground fault circuit interruption as defined in the National Electrical Code. Circuit interruption shall occur on 6 ma of ground fault current and shall not occur on less than 4 ma of ground fault current.

- An "Auto/Flash" switch shall be provided which, when placed in "Flash" position (down), shall energize the heavy duty relays. When the switch is placed in the "Auto" position (up) the switch packs shall control the signal indications. The switch shall be a single pole, single throw toggle switch rated for 15 amperes at 120VAC mounted to the front of the cabinet.

- A lamp labeled "Flash Operation" shall be provided on the front panel of the assembly. The lamp shall be driven from the Flasher Unit Output through Transfer Relay Circuit No. 1.

- The Controller Unit receptacles shall be hospital grade NEMA 5 15R mounted on the back panel of the assembly.

- Terminal blocks shall be provided and mounted on the back panel of the assembly. The blocks shall be of the type specified for signal field wire terminal blocks. All conductors from the power distribution assembly routed to the cabinet wiring shall be connected to the terminal block on the common side, except for the AC power conductor between the service terminal block and main circuit breaker. All internal wiring terminating at the blocks shall be connected to the opposite side of the blocks. Terminal position assignments shall be as shown on the Plans.

5.17 POWER SUPPLY ASSEMBLY:

a. Electrical Requirements: A power supply shall be provided to supply +24 VDC to the Input and Output Files for use by their associated devices. The power supply shall be of high-efficiency switching design. Ferro-resonating designs are not allowed under this contract. The power supply shall have components conforming to the following requirements:

- Line Regulation: Two percent from 95 to 135 VAC at 60 hertz, plus an additional 1.6 percent for each one percent deviation in frequency.
- Load Regulation: Two percent from one to five amperes with a maximum temperature rise of 30 degrees C above ambient.
- Design Voltage: +24 +0.5 VDC at full load and 30 degree C with 115 VAC input line
- Maximum No Load Voltage: Shall not exceed +27 VDC.
- Full Load Current: Five amperes, minimum.
- Ripple Noise: Two volts peak to peak and 500 millivolts RMS at full load.
- Line Voltage: 95 to 135 VAC.
- Efficiency: 65 percent, minimum.
- Minimum Voltage: 22.8 VDC

b. The assembly shall be furnished and mounted on the EIA 19 inch rack utilizing no more that 7 inches of rack height and having a maximum depth of 5.5 inches from the front surface of the front rails including rear terminal blocks.

c. The front panel shall include but not be limited to:

- All fuses or circuit breakers properly labeled.
- Power On Indicator for D.C. output, labeled "24 VDC".
- Power On Indicator for A.C. input, labeled "AC Power".
- Test points or meter for monitoring the output D.C. voltages.

d. The Power Indicator, labeled "24 VDC PWR", shall be a 24 VDC lamp, Dialight 507 Series LED Cartridge, Type 507-4761-3331-500 with Dialight Datalamp Cartridge Holder Type 508-8738-504, or City-approved equal. The lamp shall be tied across the power supply output on the fused side.

e. The test points shall be banana jacks and shall be connected in parallel with the power indicator. They shall be labeled by polarity with the positive jack red in color and the negative jack black in color.

f. The Power Supply fuses shall protect the input (AC) and output (DC) circuitry of the power supply. The fuses shall be rated at 125 percent of the full load current in their respective circuits.

g. The power supply assembly including terminals shall be protected to prevent accidental contact with energized parts.

h. The power supply cage and transformer shall be securely braced with nylon strapping to minimize the possibility of damage in transit.

i. The Power Indicator, Labeled "AC Power", shall be a 120 volt ac lamp, Dialight 507 Series Neon Cartridge Type 507-4537-0937-640 with Dialight Datalamp Holder Type 508-8745-504, or City-approved equal . The lamp shall be tied to the fuse holder and after the fuse.

5.18 HEAVY DUTY RELAY:

- Heavy duty relays shall be Midland Ross 136-62T3A5 or approved equal. Flash transfer relays shall be Struthers-Dunn 21ACPX-2/21XBXP-120VAC or approved equal. Isolation Relay (IR) shall be McCain Part M14911 or approved equal. Logic Relay (LR) shall be McCain Part M14912 or approved equal.

5.19 SIDE PANELS:

- Two panels shall be provided and mounted on the EIA rack parallel to the cabinet sides as shown on the Plans.

- In viewing from the back door, the left side panel shall be designated as the "Input Panel" and the right side panel shall be designated as the "Service Panel".

- All input field terminal blocks for detector field cables and other input conductors, except service conductors, shall be mounted on the "Input Panel".

5.20 CONNECTORS:

- Connector C1P shall contain 104 pin contacts and shall intermit with Connector C1S mounted on the controller unit chassis. Corner guide pins for Connector C1P shall be stainless steel and shall be 1.097 inches in length. Corner guide socket assemblies shall be stainless steel and shall be 0.625 inch in length.

- Connector C4 shall contain 37 contacts and shall be the circular plastic type with quick connect/disconnect capability and thread assist, positive detent coupling. The Plug connector C4P shall be mounted on the output file. Contact assignments are shown on the Plans.

- Connector C5 shall contain 24 contacts and shall be the circular plastic type with quick connect/disconnect capability and thread assist, positive detent coupling. The Plug Connector C5 shall be mounted on the input file. Contact assignments are shown on the plans.

- Connector blocks for Connector C1 pin and socket connectors shall be constructed of diallyl phthalate or better. Contacts shall be secured in the blocks with springs of stainless steel.

- All wires terminating in connectors, unless otherwise noted, shall be crimped or soldered. Any other type of connectors shall be approved by the City of Dallas prior to submitting the sample unit.

- Data or signal carrying connectors shall have redundant areas of contact that will insure a contact resistance of 123 milliohms maximum at a rating of 3.0 amps of current.

- Power carrying connectors shall have redundant areas of contact that will ensure 12 milliohms maximum of contact resistance at 15 amps of current.

- All connectors shall have an operating temperature range of 55 to 105 degrees C.

- Some method of internal or external keying shall be present in every connector. If any two (2) or more connectors in an assembly are of the same type, all such connectors shall be keyed differently and shall be permanently labeled in a way that will identify their correct interconnection.

5.21 CABINET WIRING DIAGRAM

- Four sets of non-fading (comparable to Xerox 2080) cabinet wiring diagrams (drawn large enough to accommodate all penciled in modifications, including all penciled in field connections) shall be supplied with each cabinet. The diagrams shall be non-proprietary. They shall identify all circuits in such a manner as to be readily interpreted with sources and terminations.

- The cabinet drawing shall show complete, on a single plan sheet, the C 1 listing and the Input File assignment per the C1 pin assignment table included in Appendix C of these specifications, and the component layout in an elevation view (as viewed from the rear of the cabinet with the left and right cabinet walls shown in their relative positions).

- The diagrams shall be placed in the plastic envelope on the front door of each cabinet assembly delivered under this contract.

- Detailed equipment layout scale drawings and wiring diagrams of all equipment installed in the cabinet shall be submitted for approval prior to production. Review and/or approval does not lessen the Contractor's responsibility to meet the specifications.

5.22 CONDUCTORS:

- Conductors used in cabinet wiring shall terminate with properly sized spring spade type terminals or shall be soldered to a through panel solder lug on the rear side of the terminal block. All crimp style connectors shall be applied with a

power tool which prevents opening of the handles until the crimp is completed. Crimp type connectors shall not be used on solid wires within any assembly unless they are soldered.

- Conductors in the controller cabinet between the service terminals and the signal bus breakers including the chassis ground conductor to the Power Distribution Assembly shall be No. 8 or larger.

- The loop detector lead in, from the field terminals in the cabinet to the sensor unit rack connector shall be a cable containing two No. 22, or larger, conductors, with a minimum of seven strands. The connections at each end of the cable shall be soldered as well as crimped. Each conductor shall be insulated with either (1) a minimum of 10 mils of polyvinyl chloride and 2 mils of nylon, or (2) a minimum of 14 mils of polyethylene or polypropylene. The conductors shall be twisted and the twisted pair shall be protected with a shield. The shield or a stranded tinned copper drain wire shall be connected to a terminal on the input file terminal block. This input terminal shall be connected to the equipment grounding bus through a single conductor. The cable shall be provided with a polyethylene or polyvinyl chloride outer jacket with a minimum thickness of 20 mils, or with a chrome vinyl outer jacket with a minimum thickness of 25 mils.

- All conductors shall be labeled. Labels attached to each end of the conductor shall identify the destination of the other end of the conductor.

- All conductors used in the controller cabinet shall conform to the following code requirements:

    - The grounded conductors of AC circuits shall be identified by a continuous white color.
    - The equipment grounding conductors shall be identified by a solid green color or by a continuous green color with one or more yellow stripes.

    - The DC logic ground conductors shall be identified by a solid white color with a red stripe.

    - The ungrounded conductors shall be identified by any color not specified above.

- All cabinet wiring harnesses shall be neat, firm and routed to minimize crosstalk and electrical interference. Printed circuit motherboards are to be used where possible to eliminate or reduce cabinet wiring.

- Wiring containing AC shall be routed and bundled separately or shielded separately from all logic voltage control circuits.

- Cabling shall be routed to prevent conductors from being in contact with metal edges whenever possible. If cabling shall be in contact with metal edges, those edges shall be covered with a nylon (or equivalent) non abrasive, smooth shield.

Cabling shall be arranged so that any removable assembly may be removed without disturbing conductors not associated with that assembly.

- All conductors, terminals or parts, which could be hazardous to maintenance personnel shall be protected with suitable insulating material.

- Within the cabinet wiring, the DC logic ground and equipment ground shall be electrically isolated from the AC grounded conductor and each other by 500 megohms when tested at 250 VDC, with the power line surge protector disconnected.

- Conductors from connector C1 to the input files shall be of sufficient length to allow any conductor to be connected to any detector output terminal (positions S, F, W).

- The AC copper terminal bus shall not be grounded to the cabinet or connected to the logic ground and shall provide a minimum of 10 terminals for connection to field conductors. Nylon screws with a minimum diameter of 0.25 inches shall be used for securing the bus to the service panel.

- An equipment grounding (earth ground) bus shall be provided in each cabinet. The bus shall be copper and grounded to the cabinet.

- One side of the load side of the cabinet power supply shall be connected to the DC logic ground bus using a No. 14, or larger, stranded copper wire.

- The DC ground bus shall be located on the input panel as shown on the plans.

- A No. 8, or larger, copper conductor shall be connected between equipment ground bus and rack rails.

5.23 CABINET LIGHT:

- Each 332 cabinet shall be equipped with two (2) LED lighting fixtures, 1 each mounted inside the top front and back portion of the cabinet. The fixture shall be mounted in a way for easy removal. A door actuated switch shall be installed to turn the cabinet light on when the front door is opened. The door switch shall be on a separate circuit by itself; and used only to turn on the cabinet light. A second door switch shall be installed on the rear door to turn on the rear cabinet light. The rear door switch shall be on the same circuit as the front door switch. Cabinet lights shall be AVA Technology Silver Series, Model US2324, or approved equal.

5.24 CABINET VERIFICATION PROGRAM:

- Not Required. The Contractor shall provide certification that a verification program was run and passed for each Cabinet Assembly delivered under this Contract. 2 copies of this certification shall be included in the cabinet drawer at the time of shipment.

5.25 TERMINAL BLOCKS:

- Terminal blocks shall be provided for terminating field conductors. They shall be readily accessible through the cabinet rear door and shall be rated for 20 amperes at 600 Volts RMS, minimum.

- The terminal blocks for detector field conductors, auxiliary field wires and control wires shall be the heavy duty barrier type and shall be provided with 10 32 by 7/16 inch nickel plated brass binder head screws and nickel plated brass inserts.

- The terminal blocks for field wires to the signal indications, power distribution assembly and the required unused position shall be the barrier type and shall be provided with 10 32 by 7/16 inch nickel plated brass binder head screw and nickel plated brass inserts.

- The terminal blocks for the input file and power supply shall be the barrier type and shall be provided with 8 32 by 7/16 inch nickel plated brass binder head screws and nickel plated brass inserts.

- The terminals of the power line service terminal block shall be labeled "L1" and "AC ", and shall be covered with a clear insulating material to prevent inadvertent contact. Terminating lugs large enough to accommodate No. 2 conductors shall be furnished for the service terminal block. The terminal block shall be rated for 50 amperes at 600 volts peak, minimum.

5.26 POWER LINE SURGE PROTECTORS:

- The cabinet shall be equipped with only brand “Surrestor sha-1210” surge arrestor/surge protector No substitutes will be accepted.

- Radio interference suppressors (Potter 5004-0401) adequate in number to filter the power for the cabinet shall be wired in after the main circuit breaker. The RIf shall be designed to minimize interference in the broadcast and aircraft frequency bands and shall meet the standards of UL and EIA specifications.

5.27 TRANSIENT SUPPRESSION:

- Transient suppression circuits shall be provided at the relay bases (across relay coils), fan and cabinet light door switch.

5.28 LOOP DETECTOR LIGHTNING PROTECTION:

- For all detector field terminals there shall be 1 "EDCO Surrestor SRA-6LCB" protectors provided and installed. This includes all loop input terminals, not just those going to detector cards.

5.29 COMMUNICATIONS TERMINATION PANEL:

- Not Required.

SECTION 2
CHAPTER 6

TYPE 336S TRAFFIC SIGNAL CONTROLLER CABINET ASSEMBLY UNITS

(BIG D MODEL)

CHAPTER 6:
TYPE 336S TRAFFIC SIGNAL CONTROLLER CABINET ASSEMBLY UNITS (BIG D MODEL)

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TYPE 336S TRAFFIC SIGNAL CONTROLLER CABINET ASSEMBLY UNITS (BIG D MODEL)

6.1 GENERAL REQUIREMENTS:

- The cabinet shall be rainproof, with dimensions and design style as shown on the plans. The cabinet top shall be "crowned" a minimum of one half inch to prevent standing water. Crown measurement is from cabinet top center to edge.

- Each cabinet shall include City of Dallas identification on the outside of the front door and the inside of the rear door. The name "City of Dallas" shall be welded to the cabinet on the front door and on the inside of the rear door the name "City of Dallas" with the serial number of the cabinet shall be welded.

- The controller cabinet assembly shall be provided with a full complement of standard equipment, including, but not limited to:

    - One (1) 2½" LB with cover and Mounting hardware(2-2½" x 4" all thread nipples, 4-2½" conduit locknuts, lazy susan ground clamp)
    - Input File I
    - One (1) Model 252 AC isolators.
    - Four (4) Model 242 DC isolators.
    - The Power Distribution Assembly #2 (Modified)
    - The Output File
    - Interior Raceways
    - All related wiring and terminal facilities as described in the Specifications.

- The Output File shall be provided with:

    - One (1) Conflict Monitor Unit (2018 KCLip)
    - Four (4) Flash Transfer Relays
    - One (1) Isolation Relay
    - One (1) Logic Relay
    - Twelve (12) Model 200 Solid State Switch Packs

- The Power Distribution Assembly shall be provided with:

    - Two (2) Power Relays
    - Four (4) Model 204 Flashers
    - One (1) Model 206L High-efficiency Power supply
    - No fewer than 2 rear-side non-GFI Duplex Receptacles
    - 1 EA front-side GFI Duplex Receptacle

- The following equipment shall be completely removable from the cabinet without removing any other equipment and using only a screwdriver:

    - 24 VDC Power Supply Assembly
    - Power Distribution Assembly
    - Input File
    - Output File
    - Conflict Monitor Unit Assembly
    - Cabinet Light Assembly

- All fuses, circuit breakers, switches, (except fan fuse) and indicators shall be readily visible and accessible when the front door is open.

- The cabinet shall be delivered mounted on a plywood board shipping pallet. The pallet shall be bolted to the cabinet base. The cabinet shall be enclosed in a slipover cardboard packing shell.

- All equipment in the cabinet shall be clearly and permanently labeled. Marker strips shall be located immediately below the item they are to identify and shall be clearly visible with the items installed.
- Marker strips shall be made of a material that can be easily and legibly written on using a pencil or ballpoint pen.

- Resistor capacitor transient suppression shall be provided at all AC relay sockets (across relay coils), the fan, and the cabinet light door switch.

- A leakage resistor, which permits 3 to 8 VDC to be applied to the heavy duty relay coil, shall be installed across the terminals of each relay socket to overcome any residual magnetism.

6.2 MATERIAL AND STRUCTURE:

- All assemblies shall be mounted either on the cage mounting rails per cabinet model detail or on shelves installed within the cabinet.

- All bolts, nuts, washers, screws (size 8 or larger), hinges and hinge pins that are subject to corrosion shall be stainless steel unless otherwise specified. In areas where corrosion resistance is not a factor, plated steel hardware may be acceptable.

- All conductors, terminal, and parts that may be hazardous to maintenance personnel shall be protected with suitable insulating material.

- The cabinet and doors shall be fabricated from 0.125 inch minimum thickness sheet aluminum. All exterior seams for cabinet and doors shall be continuously welded. All exterior welds shall be smooth. All edges shall be filed to a radius of 0.03125 inch minimum.

- The welding of the corners, sides and top of the cabinet shall be watertight and of equal or greater thickness than the base metal after the grinding and smoothing is completed. All construction shall be free of dents, scratches, weld burn through and abrasions harmful to the strength and general appearance.

- Cabinets fabricated from aluminum sheet shall conform to the requirements of ASTM Designation: B 209 for 5052 H32 aluminum sheet.

- Welding on aluminum cabinets shall be done by the gas metal arc (Mig) or gas tungsten arc (Tig) process using bare aluminum welding electrodes. Electrodes shall conform to the requirements of the American Welding Society (AWS) A5.10 for ER5356 aluminum alloy bare welding electrodes.

- Procedures, welders and welding operators for welding on aluminum shall be qualified in accordance with the requirements of AWS B3.0, "Welding Procedure and Performance Qualification" and to the practices recommended in AWS C5.6.

6.3 DOORS:

- The cabinet shall have a front and a rear door, each equipped with a lock. When each door is closed and latched, the door shall be locked. The latching handles shall have provision for padlocking in the closed position. The operating handle shall be stainless steel with 7.5 inch handle and .500 inch minimum stainless steel shank. The handle shall open to the right out away from the cabinet on the front door, and to the left out away from the cabinet on the rear door.

- The cabinet door frames shall be double flanged out on all four sides and shall be provided with strikers to hold tension on and form a firm seal between door gasketing and cabinet door frames. The flange width shall be a minimum of one inch, measured from the flange front edge to the housing inside surface. The cabinet door openings shall be a minimum 22 inches wide by 40 inches high as shown on the plans.

- Means shall be provided on the front door to hang two (2) separate plastic envelopes, which are to be supplied and installed by the Contractor. The envelopes shall be the side opening "zip" type, fabricated of heavy duty clear plastic, measuring 10 x 14 (+/ 1.0) inches. Two (2) 3/8 inch (hole size) brass grommets shall be mounted on each envelope, spaced 12 5/8 inches center to center. The hanging apparatus and plastic envelopes shall be located so as not to interfere with the latching mechanism and air filter on the cabinet front door. The envelope hanging method shall be designed such that gusts of wind cannot blow the envelope off the door.

6.4 LOCKS:

- Cabinet locks shall be Corbin no. 2. One key shall be supplied with each lock. The keys shall be removable in the locked position only. The locks shall have

rectangular, spring loaded bolts. The bolts shall have a 0.281 inch throw and shall be 0.75 inch wide by 0.375 inch thick (tolerance is +/-0.035 inch).

6.5 LATCHES:

- The latching mechanism shall be a three point draw roller type. The center catch and pushrods shall be plated. The pushrods shall be turned edgewise at the outward supports and have a cross section of 0.25 inch by 0.75 inch minimum. Supports shall be 0.105 inches minimum, and of the same material as specified for the housing. Rollers shall have a minimum diameter of 0.875 inch and shall be equipped with ball bearings and nylon wheels. The center catch shall be fabricated of 0.1875 inch plated steel, minimum. The City will accept aluminum latch components.

6.6 HINGES:

- Each door shall be equipped with three (3) two bolt hinges, minimum 3.5 inches long. Each hinge shall have a fixed pin. Front and rear doors shall be provided with catches to hold the door open at both 90 and 180(+10) degrees. The catches shall be 0.375 inch diameter minimum, plated steel rods. Hinges shall be of the same material as the housing. Hinge pins and bolts shall be made of stainless steel. The hinges shall be bolted to the enclosure and welded to the door. Hinge pins shall be welded at each end to form a cap and the welds filed or ground smooth. The pins and bolts shall be covered by the door edge and not accessible when the door is closed.

6.7 LIFTING EYES:

- The cabinet shall be provided with two removable lifting eyes to be used when placing the cabinet on the pedestal. The lifting eyes shall be located to provide reasonable balance when the cabinet is lifted. Each eye opening shall have a minimum diameter of 1 inch and shall be capable of lifting 1000 pounds. All dimensions shall be as shown on the Plans. The lifting eye mounts shall be mechanically designed to eliminate any possibility of water entry into the cabinet. The lifting screws shall be Button Head Steel Socket Screws or Stainless Steel Carriage Bolts.

6.8 AIR INTAKE:

- The front door shall be provided with a louvered air intake. A disposable cotton/synthetic fiber filter shall be housed behind the intake (refer to appendix A for filter specification). The filter's working area shall cover the intake opening area and be held firmly in place with bottom and side brackets and a spring loaded upper clamp. The filter supports shall be so structured that no incoming air shall bypass the filter.

- The bottom filter bracket shall be formed into a waterproof sump with drain holes to the outside. The louvered intake shall be constructed such that a stream of water from an impulse type sprinkler will not enter the housing.

6. 9 POLICE PANEL:

- A police panel is not required and will not be wired.

- The exterior cabinet shell shall not have a police panel door.

6.10 RAILS:

- A standard EIA 19 inch rack cage shall be installed inside the housing for mounting of the controller unit and cabinet assemblies. The EIA rack portion of the cage shall consist of 2 pairs of continuous, adjustable equipment mounting angles; angles are to be a minimum of 38 inches in height, 0.1345 inch nominal thickness plated steel tapped with 10 32 threads with EIA universal spacing. The angle shall comply with standard EIA RE 310 B and shall be supported top and bottom by welded support angles to form a cage. The cage shall be attached to each side of the cabinet at four (4) points, two (2) at the top and two (2) at the bottom of the rails. Cage support mounting angles shall be provided on either side level with the bottom edge of the door opening to provide both horizontal support and bolt attachment.

- Clearance between rails for mounting assemblies shall be 17.75 inches. The distance between the front surface of the front mounting rail pair to the front surface of the rear mounting rail pair shall be 20 +/ 0.10 inches.

- Two plated supporting angles extending from the front to the back rails shall be supplied to support the controller unit. The angles shall be designed to support a minimum of 50 pounds each. The horizontal side of each angle shall be a minimum of three (3) inches. The angles shall be mounted 17.5 inches from the top of the rail cage and shall be adjustable vertically.

- A 1.5 inch tall drawer with top hinged cover shall be rack mounted as part of the controller support brackets. The drawer shall be capable of supporting 50 pounds in the extended position.

6.11 MOUNTING:

- The cabinet will come equipped with a bolt on bottom plate.

- The right side will be braced and reinforced for pole mounting and will come with 2 pole mounting brackets installed on the hinge side.

- Each cabinet shall be provided with an LB type Killark OLB-7 and OL-780 cover or equivalent. Mounting hardware shall consist of 1 (one) 3" all thread nipple 2 1/2", 1 (one) 4" nipple and either a 1/2" thick plate (tapped for the nipple) or a 2 1/2" hub.

6.12 GASKETING:

- Gasketing shall be provided on all door openings and shall be dust tight. Gaskets shall be 0.25 inch minimum thickness closed cell neoprene and shall be permanently bonded to the metal. The mating surface of the gasketing shall be covered with a silicone lubricant to prevent sticking to the mating surface. Should a substance other than a silicone lubricant be employed, the Supplier shall submit a sample to the City for testing and evaluation. No cabinets employing the new substance shall be shipped without the prior written approval of the City.

6.13 FAN AND EXHAUST VENT:

- Each cabinet shall be equipped with one electric fan with ball or roller bearings and a capacity of at least 100 CFM. Fan guards shall be provided to prevent accidental injury to servicing personnel.

- One fan shall be mounted within the cabinet and vented out of the cabinet above the top of the door openings.

- The fan shall be thermostatically controlled and shall be manually adjustable to turn on between 33 degrees C. and 65 degrees C. with a differential of not more than 6 degrees C. between automatic turn on and turn off. The cabinet fan circuit shall be fused at 125% of the ampacity of the fan motor.

- The intake and exhaust areas (including filter)shall pass a minimum of 60 cubic feet of air per minute.

- The exhaust vent shall be so designed as to prevent water from entering the cabinet interior.

6.14 INPUT FILE:

- The input file shall be wired and connected as shown on the plans. The wiring harnesses from the Field Input Terminal Blocks to the rear of the Input File from the detector inputs shall have lugs on both ends that have been crimped and soldered. The file shall utilize no more than 5.25 inches of EIA rack height. The file shall intermate with and support fourteen (14) two channel loop detector units. The file shall allow air circulation through the top and bottom of the assembly.

- The file shall provide a 22 pin, single readout PC edge connector centered vertically for each two channel detector. The edge connectors shall be double sided having contacts on 0.156 inch centers with the number and letter sides of each pin shorted internally. Pins D, E, F, J, K, L and W shall be brought out to an 8 position terminal block on the back of the file. The output emitters shall be common grounded with the ground terminating at TB15, position 4.

- The input file shall have PC card guides both top and bottom. The Card guides shall begin 1.0 +0.5 inches from the front face of the file. The input file shall be provided with marker strips above and below the isolators and detectors in the file in order to identify them.

- The door open switch shall be connected to I-11.

6.15 OUTPUT FILE:

- Card guides (top and bottom) shall be provided to support the switch packs and monitor unit.

- The Output File shall be provided with marker strips to identify switch packs in the file. The marker strips shall be made of a material that can be easily and legibly written on using a pencil or ballpoint pen. Marker strips shall be located immediately below the switchpack they are to identify.

- Switch pack connectors, monitor unit connectors, flash transfer relay sockets and flash programming connectors shall be accessible, via a hinged swing down rear panel, from the back of the output file without the use of tools.

- Field wire terminal blocks shall be mounted vertically on the back of the assembly. The 3 terminal blocks shall be the 12 terminal type. (A description of the block is found in Section 6.26 of these specifications.)

- The labeling on the field terminals shall include the load switch designation.

- Output files and one-hundred twenty volt alternating current circuits shall be hand-wired; Printed circuit boards will not be acceptable for current carrying circuits.

- The monitor unit compartment including the housed monitor unit exclusive of handle shall extend no farther than 1.25 inches in front of the 19 inch rack front surface. The switch pack socket connector front surface shall be no more than 8.5 inches in depth from the front surface of the output file. (This allows use of a common motherboard for switch packs and monitor unit.)

- The output file shall utilize 10.5 inches of rack height and shall contain 12 Model 200 switch packs, four flash relays, and the monitor unit. Four flash relays and 1 monitor unit shall be furnished with each output file. The depth of the assembly

shall not exceed 14.5 inches from the front cabinet rails including terminal blocks and relays.

- The controller unit outputs to the output file shall be connected through connector C4.

- The cabinet shall be hardwired to flash all red.

- The monitor connector shall be a rigidly supported printed circuit board edge connector, having 2 rows of 28/56 independent double readout bifurcated contacts on 0.156 inch centers. The connector shall intermate with the Conflict Monitor Unit.

- It shall be possible to remove the monitoring device without causing the intersection to go into flashing operation. The cabinet shall be wired so that with the front cabinet door closed and with the monitor unit removed, the intersection shall go into flashing operation. The cabinet shall contain a conspicuous warning against operation with the monitor unit removed.

- The monitor unit connector shall be wired in accordance with the pin assignment shown on the Plans.

- A connector and terminal assembly designated as P20 (Magnum P/N 722120 or equivalent) for monitoring the absence of red shall be an integral part of the output file. The connector shall intermate and be compatible with the cable and connector of a 210 CMU capable of monitoring the absence of red. The pin assignments of the P20 connector and terminal assembly shall be as shown on the Plans. Any P20 incorporating variations or additions to this Specification shall be submitted to the City for approval prior to delivery of the sample unit.

- The P20 connector and the CMU connector shall be keyed physically alike to prevent the absence of red cable connector from being inserted into P20 180 degrees out of alignment.

- The flash relay shall be a heavy duty type per Section 5.19. It shall be energized only when the signals are in flashing operation. The flash relay shall transfer field outputs from switch pack output to flash control. Transfer of the flash relay circuit to flash control shall not interrupt the operation of the controller unit.

- A Capacitor shall be used for loading. Capacitors shall be provided on the rear side of the output file positions listed. There will be one (1) resistor per channel connected to separate points on the AC- terminal strip as indicated:

    - Phase 2,4,6,8 walk, don’t walk.

6.16 AUXILIARY FILE:

- An Auxiliary Output File is not required in Type 336S Cabinets under this Contract.

6.17 POWER DISTRIBUTION ASSEMBLY #2 (MODIFIED):

- The power distribution assembly shall be furnished and mounted on the EIA 19 inch rack utilizing no more than 7 inches of rack height. All equipment shall be readily accessible for ease of replacement. The depth of the assembly including terminal blocks shall not exceed 10 inches.

- The following equipment shall be provided with the power distribution assembly:

    - Equipment receptacle (accessible from the front panel)
    - Controller Unit Duplex Receptacles (both on the back panel)
    - Main Circuit Breaker
    - Six Pole Signal Bus Circuit Breaker
    - Two Pole Flash Bus Circuit Breaker
    - Equipment circuit Breaker
    - Heavy duty relays (replacing mercury contactor)
    - Auto/Flash Switch
    - Flash Relay (Heavy Duty Type) and Socket
    - Flasher Unit Sockets
    - Model 204 Flasher Units
    - Flash Indicator Light
    - 1 Model 206L (or approved equal) High Efficiency Power Supply

- The main circuit breaker shall be rated for 50 amperes at 120VAC. The Signal Bus Circuit Breakers shall be rated for 15 amperes at 120VAC and the Flash Bus Breakers for 20 amperes at 120VAC.

- The (4) signal bus circuit breakers shall not be mechanically ganged. The opening of any one or more of the four signal breakers shall initiate a "flash transfer" and only those breakers that opened shall indicate so. The circuit breakers shall be of the same type as Potter and Brumfield single pole, 15 ampere, AC voltage, 50/60 hertz, curve 3 type breakers that have the auxiliary switch feature or equivalent.

- The circuit breaker(s) for the equipment receptacles shall be for 15 amperes at 120VAC. Rating of breakers shall be shown on face of breaker or handle. Breaker function shall be labeled below breakers on the front panel.

- Equipment receptacles shall be NEMA 5 15R duplex type and the first receptacle in the circuit shall have ground fault circuit interruption as defined in the National Electrical Code. Circuit interruption shall occur on 6 ma of ground fault current and shall not occur on less than 4 ma of ground fault current.

- An "Auto/Flash" switch shall be provided which, when placed in "Flash" position (down), shall energize the heavy duty relays. When the switch is placed in the

"Auto" position (up) the switch packs shall control the signal indications. The switch shall be a single pole, single throw toggle switch rated for 15 amperes at 120VAC mounted to the front of the cabinet.

- A lamp labeled "Flash Operation" shall be provided on the front panel of the assembly. The lamp shall be driven from the Flasher Unit Output through Transfer Relay Circuit No. 1.

- The Controller Unit receptacles shall be hospital grade NEMA 5 15R mounted on the back panel of the assembly.

- Terminal blocks shall be provided and mounted on the back panel of the assembly. The blocks shall be of the type specified for signal field wire terminal blocks. All conductors from the power distribution assembly routed to the cabinet wiring shall be connected to the terminal block on the common side, except for the AC power conductor between the service terminal block and main circuit breaker. All internal wiring terminating at the blocks shall be connected to the opposite side of the blocks. Terminal position assignments shall be as shown on the Plans.

6.18 POWER SUPPLY ASSEMBLY:

a. Electrical Requirements: A power supply shall be provided to supply +24 VDC to the Input and Output Files for use by their associated devices. The power supply shall be of high-efficiency switching design. Ferro-resonating designs are not allowed under this contract. The power supply shall have components conforming to the following requirements:

    - Line Regulation: Two percent from 95 to 135 VAC at 60 hertz, plus an additional 1.6 percent for each one percent deviation in frequency.
    - Load Regulation: Two percent from one to five amperes with a maximum temperature rise of 30 degrees C above ambient.
    - Design Voltage: +24 +0.5 VDC at full load and 30 degree C with 115 VAC input line
    - Maximum No Load Voltage: Shall not exceed +27 VDC.
    - Full Load Current: Five amperes, minimum.
    - Ripple Noise: Two volts peak to peak and 500 millivolts RMS at full load.
    - Line Voltage: 95 to 135 VAC.
    - Efficiency: 65 percent, minimum.
    - Minimum Voltage: 22.8 VDC

b. The assembly shall be furnished and mounted on the EIA 19 inch rack utilizing no more than 7 inches of rack height and having a maximum depth of 5.5 inches from the front surface of the front rails including rear terminal blocks.

c. The front panel shall include but not be limited to:

    - All fuses or circuit breakers properly labeled.

- Power On Indicator for D.C. output, labeled "24 VDC".
- Power On Indicator for A.C. input, labeled "AC Power".
- Test points or meter for monitoring the output D.C. voltages.

d. The Power Indicator, labeled "24 VDC PWR", shall be a 24 VDC lamp, Dialight 507 Series LED Cartridge, Type 507-4761-3331-500 with Dialight Datalamp Cartridge Holder Type 508-8738-504, or City-approved equal. The lamp shall be tied across the power supply output on the fused side.

e. The test points shall be banana jacks and shall be connected in parallel with the power indicator. They shall be labeled by polarity with the positive jack red in color and the negative jack black in color.

f. The Power Supply fuses shall protect the input (AC) and output (DC) circuitry of the power supply. The fuses shall be rated at 125 percent of the full load current in their respective circuits.

g. The power supply assembly including terminals shall be protected to prevent accidental contact with energized parts.

h. The power supply cage and transformer shall be securely braced with nylon strapping to minimize the possibility of damage in transit.

i. The Power Indicator, Labeled "AC Power", shall be a 120 volt ac lamp, Dialight 507 Series Neon Cartridge Type 507-4537-0937-640 with Dialight Datalamp Holder Type 508-8745-504, or City-approved equal . The lamp shall be tied to the fuse holder and after the fuse.

6.19 HEAVY DUTY RELAY:

- Heavy duty relays shall be Midland Ross 136-62T3A5 or approved equal. Flash transfer relays shall be Struthers-Dunn 21ACPX-2/21XBXP-120VAC or approved equal. Isolation Relay (IR) shall be McCain Part M14911 or approved equal. Logic Relay (LR) shall be McCain Part M14912 or approved equal.

6.20 SIDE PANELS:

Two panels shall be provided and mounted on the EIA rack parallel to the cabinet sides as shown on the Plans.

6.21 CONNECTORS:

- Connector C1P shall contain 104 pin contacts and shall intermate with Connector C1S mounted on the controller unit chassis. Corner guide pins for Connector C1P shall be stainless steel and shall be 1.097 inches in length. Corner guide socket assemblies shall be stainless steel and shall be 0.625 inch in length.

- Connector C4 shall contain 37 contacts and shall be the circular plastic type with quick connect/disconnect capability and thread assist, positive detent coupling. The Plug connector C4P shall be mounted on the output file. Contact assignments are shown on the Plans.

- Connector C5 shall contain 24 contacts and shall be the circular plastic type with quick connect/disconnect capability and thread assist, positive detent coupling. The Plug Connector C5 shall be mounted on the input file. Contact assignments are shown on the plans.

- Connector blocks for Connector C1 pin and socket connectors shall be constructed of diallyl phthalate or better. Contacts shall be secured in the blocks with springs of stainless steel.

- All wires terminating in connectors, unless otherwise noted, shall be crimped or soldered. Any other type of connectors shall be approved by the City of Dallas prior to submitting the sample unit.

- Data or signal carrying connectors shall have redundant areas of contact that will insure a contact resistance of 123 milliohms maximum at a rating of 3.0 amps of current.

- Power carrying connectors shall have redundant areas of contact that will insure 12 milliohms maximum of contact resistance at 15 amps of current.

- All connectors shall have an operating temperature range of -55 to 105 degrees C.

- Some method of internal or external keying shall be present in every connector. If any two (2) or more connectors in an assembly are of the same type, all such connectors shall be keyed differently and shall be permanently labeled in a way that will identify their correct interconnection.

6.22 CABINET WIRING DIAGRAM:

- Four sets of non-fading (comparable to Xerox 2080) cabinet wiring diagrams shall be supplied with each cabinet. The diagrams shall be non-proprietary. They shall identify all circuits in such a manner as to be readily interpreted with sources and terminations.

- The cabinet drawing shall show complete, on a single plan sheet, the C 1 listing and the Input File assignment per the C1 pin assignment table included in Appendix C of these specifications, and the component layout in an elevation view (as viewed from the rear of the cabinet with the left and right cabinet walls shown in their relative positions).

- The diagrams shall be placed in the plastic envelope on the front door of each cabinet assembly delivered under this contract.

- Detailed equipment layout scale drawings and wiring diagrams of all equipment installed in the cabinet shall be submitted for approval prior to production. Review and/or approval does not lessen the Contractor's responsibility to meet the specifications.

6.23 CONDUCTORS:

- Conductors used in cabinet wiring shall terminate with properly sized spring spade type terminals or shall be soldered to a through panel solder lug on the rear side of the terminal block. All crimp style connectors shall be applied with a power tool which prevents opening of the handles until the crimp is completed. Crimp type connectors shall not be used on solid wires within any assembly unless they are soldered.

- Conductors in the controller cabinet between the service terminals and the signal bus breakers including the chassis ground conductor to the Power Distribution Assembly shall be No. 8 or larger.

- The loop detector lead in, from the field terminals in the cabinet to the sensor unit rack connector shall be a cable containing two No. 22, or larger, conductors, with a minimum of seven strands. The connections at each end of the cable shall be soldered as well as crimped. Each conductor shall be insulated with either (1) a minimum of 10 mils of polyvinylchloride and 2 mils of nylon, or (2) a minimum of 14 mils of polyethylene or polypropylene. The conductors shall be twisted and the twisted pair shall be protected with a shield. The shield or a stranded tinned copper drain wire shall be connected to a terminal on the input file terminal block. This input terminal shall be connected to the equipment grounding bus through a single conductor. The cable shall be provided with a polyethylene or polyvinyl chloride outer jacket with a minimum thickness of 20 mils, or with a chrome vinyl outer jacket with a minimum thickness of 25 mils.

- All conductors, except those which can be readily traced, shall be labeled. Labels attached to each end of the conductor shall identify the destination of the other end of the conductor.

- All conductors used in the controller cabinet shall conform to the following code requirements:

    - The grounded conductors of AC circuits shall be identified by a continuous white color.
    - The equipment grounding conductors shall be identified by a solid green color or by a continuous green color with one or more yellow stripes.
    - The DC logic ground conductors shall be identified by a solid white color with a red stripe.
    - The ungrounded conductors shall be identified by any color not specified above.

- All cabinet wiring harnesses shall be neat, firm and routed to minimize crosstalk and electrical interference. Printed circuit motherboards are to be used where possible to eliminate or reduce cabinet wiring.

- Wiring containing AC shall be routed and bundled separately or shielded separately from all logic voltage control circuits.

- Cabling shall be routed to prevent conductors from being in contact with metal edges whenever possible. If cabling shall be in contact with metal edges, those edges shall be covered with a nylon (or equivalent) non-abrasive, smooth shield. Cabling shall be arranged so that any removable assembly may be removed without disturbing conductors not associated with that assembly.

- All conductors, terminals or parts which could be hazardous to maintenance personnel shall be protected with suitable insulating material.

- Within the cabinet wiring, the DC logic ground and equipment ground shall be electrically isolated from the AC grounded conductor and each other by 500 megohms when tested at 250 VDC, with the power line surge protector disconnected.

- Conductors from connector C1 to the input files shall be of sufficient length to allow any conductor to be connected to any detector output terminal (positions S, F, W).

- The AC copper terminal bus shall not be grounded to the cabinet or connected to the logic ground and shall provide a minimum of 10 terminals for connection to field conductors. Nylon screws with a minimum diameter of 0.25 inches shall be used for securing the bus to the service panel.

- An equipment grounding (earth ground) bus shall be provided in each cabinet. The bus shall be copper and grounded to the cabinet.

- side of the load side of the cabinet power supply shall be connected to the DC logic ground bus using a No. 14, or larger, stranded copper wire.

- The DC ground bus shall be located on the input panel as shown on the plans.

- A No. 8, or larger, copper conductor shall be connected between equipment ground bus and rack rails.

- All AC- ground busses shall be wired with a minimum of No. 12 stranded wire including load resistor busses.

6.24 CABINET LIGHT:

- Each 336S cabinet shall be equipped with two (2) LED lighting fixtures mounted inside the top front and back portion of the cabinet. The fixture shall be mounted in a way for easy removal. A door actuated switch shall be installed to turn the

cabinet light on when the front door is opened. The door switch shall be on a separate circuit by itself; and used only to turn on the cabinet light. A second door switch shall be installed on the rear door to turn on the rear cabinet light. The rear door switch shall be on the same circuit as the front door switch. Cabinet lights shall be AVA Technology Silver Series, Model US2324, or approved equal.

6.25 CABINET VERIFICATION PROGRAM:

- Not Required. The Contractor shall provide certification that a verification program was run and passed for each Cabinet Assembly delivered under this Contract. 2 copies of this certification shall be included in the cabinet drawer at the time of shipment.

6.26 TERMINAL BLOCKS:

- Terminal blocks shall be provided for terminating field conductors. They shall be readily accessible through the cabinet rear door and shall be rated for 20 amperes at 600 Volts RMS, minimum.

- The terminal blocks for detector field conductors, auxiliary field wires and control wires shall be the heavy duty barrier type and shall be provided with 10 32 by 7/16 inch nickel plated brass binder head screws and nickel plated brass inserts.

- The terminal blocks for field wires to the signal indications, power distribution assembly and the required unused position shall be the barrier type and shall be provided with 10 32 by 7/16 inch nickel plated brass binder head screw and nickel plated brass inserts.

- The terminal blocks for the input file and power supply shall be the barrier type and shall be provided with 8 32 by 7/16 inch nickel plated brass binder head screws and nickel plated brass inserts.

- The terminals of the power line service terminal block shall be labeled "L1" and "AC ", and shall be covered with a clear insulating material to prevent inadvertent contact. Terminating lugs large enough to accommodate No. 2 conductors shall be furnished for the service terminal block. The terminal block shall be rated for 50 amperes at 600 volts peak, minimum.

6.27 POWER LINE SURGE PROTECTORS:

- The cabinet shall be equipped with only brand “Surrestor sha-1210” surge arrestor/surge protector. No substitutes will be accepted.

- Radio interference suppressors (Potter 5004-0401) adequate in number to filter the power for the cabinet shall be wired in after the main circuit breaker. The RIF

shall be designed to minimize interference in the broadcast and aircraft frequency bands and shall meet the standards of UL and EIA specifications.

6.28 TRANSIENT SUPPRESSION:

- Transient suppression circuits shall be provided at the relay bases (across relay coils), fan and cabinet light door switch.

6.29 LOOP DETECTOR LIGHTNING PROTECTION:

- For all detector field terminals there shall be 1 "EDCO Surrestor SRA-6LCB" protectors provided and installed. This includes all loop input terminals, not just those going to detector cards.

6.30 COMMUNICATIONS TERMINATION PANEL:

- Not required.

SECTION 2
CHAPTER 7

TYPE 337 TRAFFIC SIGNAL CONTROLLER CABINET ASSEMBLY UNITS

(BIG D MODEL)

CHAPTER 7:
TYPE 337 TRAFFIC SIGNAL CONTROLLER CABINET ASSEMBLY UNITS (BIG D MODEL)

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TYPE 337 TRAFFIC SIGNAL CONTROLLER CABINET ASSEMBLY UNITS (BIG D MODEL)

7.1 GENERAL REQUIREMENTS:

- The cabinet shall be a rainproof, outdoor, pedestal mounted type with dimensions as shown on the plans. The cabinet top shall be "crowned" a minimum of one quarter inch to prevent standing water. Crown measurement is from cabinet top center to edge.

- Each cabinet shall include City of Dallas identification on the outside of the front door and the inside of the rear door. The name "City of Dallas" shall be welded to the cabinet on the front door and on the inside of the rear door the name "City of Dallas" with the serial number of the cabinet shall be welded.

- The controller cabinet assembly shall be provided with a full complement of standard equipment, including, but not limited to:

    - One (1) 2½" LB Assembly
    - Two (2) Model 204 Flashers
    - Three (3) Flash transfer relays(Per. 7.18)
    - One (1) Flash Relay
    - Two (2) Bandable Mounting brackets
    - One (1) Model 252 AC isolators
    - Two (2) Model 242 DC isolators
    - Six (6) Model 200 Switchpacks

- All equipment requiring identification shall be clearly and "permanently" labeled (silkscreening preferred).

- Whenever feasible, cabling from the PDA, Input, and output files to any terminals or connectors shall be routed between the cabinet wall and the rack assembly side panels.

7.2 MATERIAL AND STRUCTURE:

- All assemblies shall be mounted either on the cage mounting rails per cabinet model detail or on shelves installed within the cabinet.

- All bolts, nuts, washers, screws (size 8 or larger), hinges and hinge pins that are subject to corrosion shall be stainless steel unless otherwise specified. In areas where corrosion resistance is not a factor, plated steel hardware may be acceptable.

- All conductors, terminal, and parts that may be hazardous to maintenance personnel shall be protected with suitable insulating material.

- The cabinet and doors shall be fabricated from 0.125 inch minimum thickness sheet aluminum. All exterior seams for cabinet and doors shall be continuously welded. All exterior welds shall be smooth. All edges shall be filed to a radius of 0.030 inch minimum.

- The welding of the corners, sides and top of the cabinet shall be watertight and of equal or greater thickness than the base metal after the grinding and smoothing is completed. All construction shall be free of dents, scratches, weld burn through and abrasions harmful to the strength and general appearance.

- The bottom of the cabinet shall be reinforced in such a manner as to provide solid support for the entire weight of the cabinet assembly, fully equipped, on a pedestal mount slipfitter. Reinforcing shall consist of two 4.5 inch x 3/4 inch support channels, opened face down, welded across the bottom front and rear of the cabinet, and extending from side to side. In addition, a 5 inch square slipfitter mounting support bracket shall be installed and welded to the two support channels. Four 1/8 inch drain holes shall be provided through the lowest surface of the cabinet bottoms as shown in the Plans. Any bottom support configuration other than that specified shall be approved by the City. The cabinet base shall accommodate a standard 4 inch pedestal slipfitter.

- Cabinets fabricated from aluminum sheet shall conform to the requirements of ASTM Designation: B 209 for 5052 H32 aluminum sheet.

- Welding on aluminum cabinets shall be done by the gas metal arc (Mig) or gas tungsten arc (Tig) process using bare aluminum welding electrodes. Electrodes shall conform to the requirements of the American Welding Society (AWS) A5.10 for ER5356 aluminum alloy bare welding electrodes.

- Procedures, welders and welding operators for welding on aluminum shall be qualified in accordance with the requirements of AWS B3.0, "Welding Procedure and Performance Qualification" and to the practices recommended in AWS C5.7.

7.3 MOUNTING:

- The right side will be braced and reinforced for pole mounting and will come with 2 bandable pole mounting brackets.

- Each cabinet shall be provided with an LB type Killark OLB-7 and OL-780 cover or equivalent. Mounting hardware shall consist of 1 (one) 3" all thread nipple 2 1/2", 1 (one) 4" nipple and either a 1/2" thick plate (tapped for the nipple) or a 2 1/2" hub.

7.4 DOORS:

- The cabinet shall have a front and a rear door, each equipped with a lock. When each door is closed and latched, the door shall be locked. The latching handles

shall have provision for padlocking in the closed position. The operating handle shall be cast aluminum or stainless steel with 7.5 inch handle and .500 inch minimum shank. The handle shall open to the right away from the cabinet on the front door, and to the left away from the cabinet on the rear door. The cabinet door frame shall provide strikers to hold tension and form a firm seal between door gasketing and cabinet door frame. Doors shall be fitted to ensure a maximum gap between door flange and cabinet side of 0.125 inches. The cabinet door opening shall be a minimum 19.6 inches wide x 34.6 inches high.

- The cabinet doors shall be reinforced with "L" channels 0.0625 inch minimum thickness by 0.500 inch height and width. This channel shall be installed on all door perimeters as close to the gaskets as practical and shall not interfere with closing of the door or any equipment in the EIA mounting Rack. Door reinforcement other than that specified above, shall be approved by the City prior to being delivered in the sample unit.

- Means shall be provided on the front and rear doors to hang a plastic envelope, which are to be supplied and installed by the Contractor. The envelopes shall be the side opening "zip" type, fabricated of heavy duty clear plastic, measuring 10 x 14 (+/ 1.0)inches. Two (2) 3/8 inch (hole size) brass grommets shall be mounted on each envelope, spaced 12 5/8 inches center to center. The envelope installed on the front door shall not cover the police panel and shall open towards the locking mechanism.

- Cabinet locks shall be solid brass Corbin No. 2 lock. One key shall be supplied with each lock. The keys shall be removable in the locked position only. The locks shall have rectangular, spring loaded bolts. The bolts shall have a 0.281 inch throw and shall be 0.75 inch wide by 0.375 inch thick (tolerance is +/-0.035 inch).

7.5 LATCHES:

- The latching mechanism shall be a three point type. The center catch and pushrods shall be stainless steel. Pushrods shall be 0.375 inch diameter minimum and shall be supported within 1.5 inches of their respective striker. The center catch shall be fabricated of 0.074 inch, minimum thickness, stainless steel. Details of alternative designs shall be submitted for review and approval by the City prior to fabrication of cabinets.

7.6 HINGES:

- Each door's hinging shall be either a continuous hinge or three butt hinges. Each hinge shall have a fixed pin. Front and rear doors shall be provided with catches to hold the door open at 90 degrees, plus or minus 10 degrees. The catches shall be 0.25 inch diameter, minimum stainless steel. Additionally, provision shall be made to ensure that it would require a conscious act on the part of the person opening the door to open it more than 90 degrees. Door hinges and pins shall be made of stainless steel. The hinges shall be bolted to the cabinet. Hinge bolts

shall not be accessible to vandals. Hinge pins shall be welded top and bottom on each hinge. The racks shall be orientated in a manner so that the monitor unit will be located on the hinged side of the door.

7.7 AIR INTAKE:

- Each cabinet shall be provided with a louvered air intake in the front door with A disposable cotton/synthetic fiber filter housed behind the intake (refer to appendix A for filter specification) to provide a minimum of 20 square inches of flow area. The filter's working area shall cover the intake opening and shall be held firmly in place by a bottom bracket and an upper spring or spring loaded clamp.

- The bottom filter bracket shall be formed into a waterproof sump with drain holes to the outside. The louvered intake shall be designed and constructed such that a stream of water from a pressure head, such as an impulse or other type sprinkler, will not enter the cabinet.

7.8 POLICE PANEL:

- A police panel is not required and will not be wired.

- The exterior cabinet shell shall not have a police panel door.

7.9 RAILS:

- Rails shall be provided, both front and rear, as an integral part of the cabinet. Rails shall extend the full height of the cabinet and shall conform to dimensional requirements of Standard EIA RS 310 C,except equipment mounting holes shall be provided with 10 32 threads and shall be located to secure equipment provided as shown on the plans.

- Two plated supporting angles shall be supplied to support the controller unit. The angles shall be designed to support a minimum of 50 pounds each. The horizontal side of each angle shall be a minimum of three (3) inches and the length a minimum of eleven (11) inches.

7.10 GASKETING:

- Gasketing shall be provided on all door openings and shall be dust tight. Gaskets shall be 0.25 inch minimum thickness closed cell neoprene and shall be permanently bonded to the metal. The mating surface of the gasketing shall be covered with a silicone lubricant to prevent sticking to the mating surface. Should a substance other than a silicone lubricant be employed, the Supplier shall submit a sample to the City for testing and evaluation. No cabinets

employing the new substance shall be shipped without the prior written approval of the City.

7.11 FAN AND EXHAUST VENT:

- Each cabinet shall be equipped with one electric fan with ball or roller bearings and a capacity of at least 100 CFM. Fan guards shall be provided to prevent accidental injury to servicing personnel.

- One fan shall be mounted within the cabinet directly above the controller unit power supply and vented near the top of the cabinet, through a grill arrangement incorporated in the right side of the cabinet when viewed from the front door.

- The fan shall be thermostatically controlled and shall be manually adjustable to turn on between 33 degrees C. and 65 degrees C. with a differential of not more than 6 degrees C. between automatic turn on and turn off. The cabinet fan circuit shall be fused at 125% of the ampacity of the fan motor.

- The intake and exhaust areas (including filter)shall pass a minimum of 50 cubic feet of air per minute. The exhaust vent shall be so designed as to prevent water from entering the cabinet interior. All exhaust vent seams, between the vent housing and the cabinet, shall be continuously welded.

7.12 RACK ASSEMBLY:

- The Rack Assembly shall be self-supporting with side panels extending to the bottom support channels of the cabinet and shall allow a minimum free space beneath the lowest horizontal surface and between the side panels of 17 inches wide x 15 inches deep x 9 inches high with both cabinet doors closed. The assembly shall be equipped with mounting "ears" to allow mounting in rails. Overall width of the assembly shall conform to Standard EIA RS 310 C.

- The Rack Assembly shall be fabricated and mounted according to the dimensions shown on the Plans.

- The Rack Assembly shall provide a space which shall intermate with and support a Model 204 flasher. The flasher shall be wired as shown on the Plans, with its load balanced among switch packs 1 through 7.

- An Auto Flash switch shall be provided for use by Maintenance Personnel. The switch shall be located as shown on the Plans.

- A Maintenance Interlock Switch (MIS), MFG. Cherry P/N 50KX Series E 23, shall be provided to supply emergency power to the flasher and flash transfer relays in the event that the Power Distribution Assembly is removed.

- This shall be accomplished in a manner which prevents the application of emergency power unless the maintenance Auto Flash switch is in the Flash position. Emergency power to the flasher and transfer relays shall be independently fused.

- The Rack Assembly shall provide a receptacle which shall intermate with and support the Power Distribution Assembly (PDA). The receptacle shall be equipped with a connector (BEAU SG 5413 ABT or equiv.). Dimensions for the receptacle and location and pin assignments for the connector shall be as shown on the plans. Means shall be provided to secure the PDA.

- The front face of all plug in assemblies shall be flush with the front face of the Rack Assembly. The sole exception shall be the Flash Relay, which may be mounted with its socket on the same plane as the flash transfer relay sockets.

- The front face of the Rack Assembly may be inset from the mounting rails a maximum of ½ inch.

- The Rack Assembly depth shall not exceed 13 inches from the front surface of the front mounting rails.

- he Assembly shall allow air circulation from bottom to top.

- Field wire terminal blocks and bus bars shall be mounted on the back panel of the assembly. The three signal output terminal blocks shall be mounted vertically and shall be the six position type. The power line service terminal block and bus bars shall be mounted as shown on the plans. Other designs shall be approved by the City prior to submitting the Sample Unit.

- The rear panel shall be hinged to allow it to swing down and provide access to terminals, relays and connections as detailed elsewhere in these Specifications and on the Plans.

- The Rack Assembly shall provide for an Input File subassembly and an Output File subassembly, both of which shall be integral to the Rack Assembly as shown on the Plans and specified in detail under separate headings.

7.13 INPUT FILE:

- The wiring harnesses from the Field Input Terminal Blocks to the rear of the Input File from the detector inputs shall have lugs on both ends that have been crimped and soldered. The Input File shall intermate with and support eleven (11) two channel loop detector units. The file shall utilize no more than 5.25 inches of rack height.

- The input file shall provide card guides (top and bottom) and a 22 pin single readout edge connector centered vertically for each detector unit. The card

guide shall begin .725 +.250 inches back from the front of the file. The file shall allow air circulation through the top and bottom of the assembly.

- Pins D,E,J & K on each edge connector shall be wired to the field terminals to provide for two loop detector channels or one magnetometer channel.

- Loop #1 and #2 output collectors and emitters (pins F, H, W and X) for each slot shall terminate on a terminal block mounted on the rear of the input file and shall connect to the proper controller unit inputs in the Connector C1S wiring harness. Common grounding of output emitters will be permitted.

- The input file shall be connected as shown on the Plans.

- The edge connectors shall be double sided connectors with the numbered side shorted to its respective lettered side internally.

- The input shall be provided with marker strips to identify items in the file. The marker strips shall be made of a material that can be easily and legibly written on using a pencil or ballpoint pen. Marker strips shall be located immediately above and below the item they are to identify.

- The door open switch shall be connected to I-9 upper, C-1, pin 80.

7.14 OUTPUT FILE:

- Card guides shall be provided to support the switch packs and monitor unit.

- The Output File shall be capable of containing six (6) Model 200 switch packs, three (3) Model 430 flash transfer relays, one (1) Model 210 monitor unit and one (1) Flash Relay.

- The Output File shall be provided with marker strips to identify items in the file. The marker strips shall be made of a 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.

- The labeling on the field terminal shall include the load switch designation.

- Output files and one-hundred twenty volt alternating current circuits shall be hand-wired; Printed circuit boards will not be acceptable for current carrying circuits.

- Switch pack, flash transfer relay and monitor unit sockets shall be accessible from the back of the file without the use of tools.

- The controller unit outputs to the Output File shall be connected through Connector C4.

- The red and yellow signal circuits of all vehicle switch packs shall be available at a Molex Type 1375 receptacle which shall intermate with a Molex Type 1375 plug to allow flash programming. Plug connectors, with programming jumpers, shall be furnished for each circuit to allow red, yellow or pedestrian flash programming. Requirements are: 6 red and 3 pedestrian. Connectors shall be readily accessible without the removal of any other equipment.

- Plug pins shall be crimped and soldered.

- The monitor unit connector shall be a rigidly supported printed circuit board edge connector, having two rows of 28/56 independent double readout bifurcated contacts on 0.156 inch centers. The CMU connector shall be mounted on a printed circuit board that provides the capability of changing the channel assignments by wire jumper. Jumper wires shall be installed to enable the pedestrian switch pack centers to be used as shown on the plans. The connector shall intermate with the monitor unit.

- It shall be possible to remove the monitor unit without causing the intersection to go into flashing operation. The cabinet shall be wired so that with the front door closed and the monitor unit removed, the intersection shall go into flashing operation. The cabinet shall contain a conspicuous warning against operation with the monitor unit removed.

- A connector and terminal assembly designated as P20 (MFG. Magnum P/N 722120 or equivalent) for monitoring the absence of red shall be an integral part of the output file. The connector shall intermate and be compatible with the cable and connector of a type 210 CMU capable of monitoring the absence of red. The pin assignments of the P20 connector and terminal assembly shall be as shown on the plans. Any P20 incorporating variations or additions to this specification shall be submitted to the City for approval prior to delivery of the sample unit.

- The P20 connector and the CMU connector shall be keyed physically alike to prevent the absence of red cable connector from being inserted into the P20 180 degrees out of alignment.

- A capacitor shall be used for loading. Capacitors shall be provided on the rear side of the output file positions listed:

    - Phase 2,4 walk and don’t walk.

    - Phase 1,3 red yellow green

7.15 POWER DISTRIBUTION ASSEMBLY (PDA):

- The PDA shall not have any protrusions (screwheads, rivets, etc.) extending beyond the outer surface of the side and back panels, except for the pins on the Cinch Jones connector. The PDA shall be electrically and mechanically interchangeable with any model 337 cabinet assembly unit.

- The PDA shall be furnished and installed in the Rack assembly. Maximum dimensions are 12.05 inches wide by 3.90 inches high by 7.240 inches deep. The top and bottom of the PDA shall be open faced without any mounting support plates of any size obstructing air flow.

- The PDA shall be equipped with a connector to intermate with its associated connector in the Rack Assembly. Pin assignments shall be as shown on the plans.

- The following equipment shall be provided with the PDA:

    - Main Circuit Breaker
    - Equipment Circuit Breaker
    - Signals Circuit Breaker
    - Flasher Circuit Breaker
    - 24 VDC Power Supply
    - Power Relay and socket
- 1 Auto Flash Switch
- 1 Signals Off Switch
- 1 Power Indicator labeled "24 VDC PWR"
- 1 Flash Indicator
    - Test Points
    - Power Supply Fuses (AC and DC)

- All circuit breakers shall be rated for 120 Volts AC with the following ampacity ratings:

Main	30 amperes
*Signals	25 amperes
*Flasher	20 amperes
Equipment	15 amperes

  *The Signal and Flasher circuit breakers shall have the Potter and Brumfield "Curve 3" type operating characteristics.

- The "Auto Flash" switch, when placed in "Flash" position, shall energize the Power Relay coil and apply stop time to the controller. When the switch is placed in the "Auto" (up) position the switch packs shall control the signal indications. The switch shall be a double pole, single throw switch rated for 15 amperes at 120 volts AC.

- The Signals OFF switch, when placed in the "OFF" position (down), shall energize the Power Relay coil and interrupt power to the flasher. The switch shall be a three pole double throw switch rated for 15 amperes at 120 volts AC. Two of the three poles shall be tied in parallel to provide sufficient switching capacity for flasher power.

- The Power Indicator, labeled "24 VDC PWR", shall be a 24 VDC lamp tied across the Power supply output on the fused side.

- The Flash Indicator shall be a 120 VAC lamp tied across the Power Relay coil.

- The Power Relay shall be as shown on the plans. When the relay is energized, it shall interrupt power to the switch packs.

- The Power Supply shall be of ferro resonant design having no active components and shall conform to the following requirements:

    - Line Regulation: Two percent from 95 to 135 VAC to 60 hertz, plus an additional 1.6 percent for each one percent deviation in frequency.

    - Load Regulation: Five percent from 1 to 3 amperes with a maximum temperature rise of 30 degrees C above ambient temperature.

    - Design Voltage: +24 +/ 0.3 volts DC at half load and 40 degrees C. No load voltage shall not exceed +27 VDC.

    - Full Load Current: Three amperes, minimum.

    - Ripple Noise: 2 volts peak to peak and 500 millivolts RMS at full load.

    - Line Voltage: 95 to 135 VAC.

    - Efficiency: 60 percent, minimum.

    - Minimum Voltage : 22.8 VDC

    - The Test Points shall be banana jacks and shall be connected in parallel with the Power Indicator. They shall be labeled by polarity with the positive jack red in color and the negative jack black in color.

    - The Power Supply Fuses shall protect the input (AC) and output (DC) circuitry of the Power Supply. The fuses shall be rated at 125 percent of the full load current in their respective circuits.

    - The Power Supply Fuses shall protect the input (AC) and output (DC) circuitry of the Power Supply. The fuses shall be rated at 125 percent of the full load current in their respective circuits.

7.16 FLASH TRANSFER RELAY:

- A Leakage resistor, which shall permit a small amount of current to pass through the coil if the contacts should remain closed after the coil circuit is opened, shall

be installed across the relay socket to overcome the effects of residual magnetism.

- The coil of the flash transfer relay shall be energized only when the signals are in flashing operation.

- The flash transfer relay shall transfer switch pack output to flash control. Transfer of the flash transfer relay to flash control shall not prohibit the operation of the controller unit.

7.17 SPECIAL PURPOSE RELAYS:

- The flash Relay shall be normally energized by the Power Relay output and, when de energized, shall apply power to the Flash Transfer Relay coils. The Flash Relay shall be P&B KRP11 style, DPDT or equivalent.

- The Isolation Relay shall energize with the flash transfer relays and provide an input to the controller unit's "Flash Sense" input during flash operation. The relay shall be P&B R10 style, DPDT or equivalent.

- The Logic Relay shall be energized as long as the monitor unit remains plugged in. When de energized, it shall provide continuity between the front door switch and the power relay coil, energizing the power relay in the event the door is closed while the monitor unit is removed.

- The Remote Flash Relay, when energized by a logic ground signal from the controller unit or external source, shall energize the Power Relay.

- Both the logic Relay and Remote Flash Relay shall be P&B KUP style, DPDT or equivalent.

7.18 OUTLET PANEL:

- An Outlet Panel shall be provided at a convenient location. It shall contain the following:

    - Equipment Receptacle
    - Controller Receptacle
    - Terminal Block (TB1)

- The Equipment Receptacle shall be NEMA 5 15R duplex type and shall have ground fault circuit interruption as defined in the National Electrical Code. Circuit interruption shall occur on six milliamperes of ground fault current and shall not occur on less than four milliamperes of ground fault current.

- The Controller Receptacle shall be a NEMA type 5 15R.

- TB1 shall be a 6 position double row terminal block and shall be wired as shown on the plans.

7.19 CONNECTORS:

- Connector C1P shall contain 104 pin contact positions and shall intermate with Connector C1S mounted on the controller chassis. Corner guide pins for connector C1P shall be stainless steel and shall be 1.097 inches in length. Corner guide socket assemblies shall be stainless steel and shall be 0.625 inches in length.

- Connector C4 shall contain 24 contacts and shall be the circular plastic type with quick connect/disconnect capability and thread assist, positive detent coupling. The plug Connector C4 shall be mounted on the Rack Assembly. Contact assignments are shown on the plans.

- Connector blocks for Connector C1 pin and socket connectors shall be constructed of diallyl phthalate or better. Contacts shall be secured in the blocks with springs of stainless steel.

- All wires terminating in connectors, unless otherwise noted, shall be crimped or soldered. Any other Type of connectors shall be approved by the City of Dallas prior to submitting the sample unit.

- Data or signal carrying connectors shall have redundant areas of contact that will insure a contact resistance of 12 milliohms maximum at a rating of 3.0 amperes of current.

- Power carrying connectors shall have redundant areas of contact that will insure 12 milliohms maximum of contact resistance at 15 amperes of current.

- All connectors shall have a operating temperature range of 55 C to 105 C.

- Some method of internal or external keying shall be present in every connector. If any two (2) or more connectors in an assembly are of the same type, all such connectors shall be keyed differently and shall be permanently labeled in a way that will identify their correct interconnection.

7.20 CABINET LIGHT:

- Each 337 cabinet shall be equipped with two (2) LED lighting fixtures mounted inside the top front and back portion of the cabinet. The fixture shall be mounted in a way for easy removal. A door actuated switch shall be installed to turn the cabinet light on when the front door is opened. The door switch shall be on a

separate circuit by itself; and used only to turn on the cabinet light. A second door switch shall be installed on the rear door to turn on the rear cabinet light. The rear door switch shall be on the same circuit as the front door switch. Cabinet lights shall be AVA Technology Silver Series, Model US2324, or approved equal.

7.21 CABINET WIRING DIAGRAM:

- Four sets of non-fading cabinet wiring diagrams shall be supplied with each cabinet. The diagrams shall be non-proprietary. They shall identify all circuits in such a manner as to be readily interpreted with sources and terminations. The cabinet drawing shall show complete, on a single plan sheet, the C 1 listing as included in Appendix C of these specifications.

- The diagrams shall be placed in the plastic envelope on the front door (see Section 7.2.5 of this Specification).

- Detailed equipment layout scale drawings and wiring diagrams of all equipment installed in the cabinet shall be submitted for approval prior to production. Review and/or approval does not lessen the Contractor's responsibility to meet the specifications.

7.22 CABINET VERIFICATION PROGRAM:

- Not Required. The Contractor shall provide certification that a verification program was run and passed for each Cabinet Assembly delivered under this Contract. 2 copies of this certification shall be included in the cabinet drawer at the time of shipment.

7.23 CONDUCTORS:

- Conductors in the controller cabinet between the service terminals and the switch pack power bus shall be No. 10, or larger.

- All conductors used in the controller cabinet shall be No. 22, or larger, with a minimum of 19 strands. Conductors shall conform to Military Specification: MIL W 16878D, Type B or better. The insulation shall have a minimum thickness of 10 mils and shall be nylon jacketed polyvinyl chloride except that conductors No. 14 and larger may be UL Type THHN, with a minimum of seven strands.

- The loop detector lead in, from the field terminals in the cabinet to the sensor unit rack connector, shall be a cable containing two No. 22, or larger, conductors with a minimum of seven strands. Each conductor shall be insulated with either (1) a minimum of 10 mils of polyvinyl chloride and 2 mils of nylon, or (2) a minimum of 14 mils of polyethylene or polypropylene. The conductors shall be twisted and

the twisted pair shall be protected with a shield. The shield or a stranded tinned copper drain wire shall be connected to a terminal on the input file terminal block. This input terminal shall be connected to the equipment grounding bus through a single conductor. The cable shall be provided with a polyethylene or polyvinyl chloride outer jacket with a minimum thickness of 20 mils, or with a chrome vinyl outer jacket with a minimum thickness of 25 mils.

- All conductors, except those which can be readily traced, shall be labeled. Labels attached to each end of the conductor shall identify the destination of the other end of the conductor.

- All conductors used in the controller cabinet shall conform to the following color code requirements:

    - The grounded conductors of AC circuits shall be identified by a continuous white color.
    - The equipment grounding conductors shall be identified by a continuous green color or by a continuous green color with one or more yellow stripes.
    - The DC logic ground conductors shall be identified by a solid white color with a red stripe.
    - The ungrounded conductors shall be identified by any color not specified above.

- All cabinet wiring harnesses shall be neat, firm and routed to minimize crosstalk and electrical interference.

- Wiring containing AC shall be routed and bundled separately or shielded separately from all logic voltage control circuits.

- Cabling shall be routed to prevent conductors from being in contact with metal edges whenever possible. If cabling shall be in contact with metal edges, those edges shall be covered with a nylon or similar non-abrasive, smooth shield. Cabling shall be arranged so that any removable assembly may be removed without disturbing conductors not associated with that assembly.

- All conductors, terminals or parts, which could be hazardous to maintenance personnel shall be protected with suitable insulating material.

- Within the cabinet wiring, the DC logic ground and equipment ground shall be electrically isolated from the AC grounded conductor and each other by 500 megohms when tested at 250 volts DC, with the power line surge protector disconnected.

- Conductors from Connector C1 to the Input Files shall be of sufficient length to allow any conductor to be connected to any detector output terminal.

- The AC copper terminal bus shall not be grounded to the cabinet or connected to logic ground and shall provide a minimum of 8 terminals for connection of field conductors.

- An equipment grounding (earth ground) bus shall be provided in each cabinet. The bus shall be copper and grounded to the cabinet.

- All AC- ground busses shall be wired with a minimum of No. 12 stranded wire including load resistor busses.

7.24 TERMINAL BLOCKS:

- Terminal blocks shall be provided for terminating field conductors.

- The terminal blocks for detector field conductors, auxiliary field wires and control wires shall be the barrier type with marker strips and shall be provided with 8 32 by 7/16 inch minimum nickel plated brass binder head screws and inserts.

- The terminal blocks for field wires to the signal indications and for service connections shall be the barrier type with marker strips and shall be provided with 10 32 by 7/16 inch nickel plated brass binder head screws and inserts.

- The terminal blocks shall be readily accessible through the cabinet rear door and shall be rated for 30 amperes at 600 volts, minimum.

- The terminal blocks for the Input File shall be the barrier type and shall be provided with 8 32 by 5/16 inch nickel plated brass binder head screws and inserts. They shall be rated for 20 amperes at 600 volts, minimum.

- Terminal block TB01 shall be as specified for the Input File terminal blocks.

7.25 POWER LINE SURGE PROTECTORS:

- The cabinet shall be equipped with only brand “Surrestor sha-1210” surge arrestor/surge protector. No substitutes will be accepted.

- Radio interference suppressors (Potter 5004-0401) adequate in number to filter the power for the cabinet shall be wired in after the main circuit breaker. The RIF shall be designed to minimize interference in the broadcast and aircraft frequency bands and shall meet the standards of UL and EIA specifications.

7.26 TRANSIENT SUPPRESSION:

- Transient suppression circuits shall be provided at the Relay bases (across relay coils), the fan, and the cabinet light door switch.

7.27 LOOP DETECTOR LIGHTNING PROTECTION:

- For all detector field terminals there shall be 1 "EDCO Surrestor SRA-6LCB" protectors provided and installed. This includes all loop input terminals, not just those going to detector cards.

7.28 COMMUNICATIONS TERMINATION PANEL: Each Model 337 Cabinet shall be provided with a Communications Termination Panel, which provides a mounting location for communications cable termination blocks, over voltage protection devices, and the termination points for the C2P harness and connector.

a. Panel Construction

The panel shall be fabricated of 0.125 inch sheet aluminum, and shall have the dimensions shown on the Plans.

The panel shall be drilled and tapped as necessary to mount the terminal blocks and other attachments described below, as well as to mount the panel to the rack within the cabinet. Sharp edges and burrs caused by the cutting or drilling process shall be removed.

Corners shall be rounded with a 3/4 inch radius.

b. Communications Cable Termination Block (CTB 1):

Communications Cable Termination Blocks shall be quick-connected blocks consisting of 24 horizontal rows of eight clips per row. The horizontal rows of eight (8) clips shall be divided into two sets of four (4) electrically common clips. The two sets of four shall be connected with a bridge clip. It shall be mounted in a molded self-extinguishing plastic case. These blocks, commonly referred to as "66B" blocks, shall terminate 12 pairs of No. 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. The block shall be mounted on the panel, as shown on the Plans.

c. Active Pairs Termination Block (CTB 2):

A six position dual screw, closed back barrier strip shall be mounted on the Communications Termination Panel, as shown on the Plans. The strip shall be rated at 15 amperes, and shall be provided with 6 32 x 1/4 inch nickel plated brass binder head screws.

d. Test Point Termination Block (CTB 3):

An eight position single screw, closed back barrier strip shall be mounted on the Communications Termination Panel, as shown on the Plans. The strip shall be rated at 15 amperes and shall be provided with 6 32 x 1/4 inch nickel plated brass binder head screws.

e. Over voltage Protection:

An over voltage surge protector shall be provided on each of the three active communications cable pairs (the Voice Pair, Audio In Pair, and Audio Out Pair) terminating in the cabinet. The protectors shall be installed on the Active Pairs Termination Block (CTB 2).

Protectors shall be of a Three Electrode Gas Tube type, and shall have the following ratings:

- Impulse Life (1000 amp, 10/1000 waveshape at one minute intervals each direction, with 500 amp on each side to ground simultaneously): 1000 surges minimum, 2500 surges typical.
- AC Discharge Current, 11 cycles, 60 HZ: 400 amp rms, 200 amp 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.
- Insulation Resistance: 1000 megohms minimum at 100 VDC (line ground).

The protectors shall be encapsulated, and shall be equipped with spade lug tipped leads, two inches long minimum. Maximum size of each protector shall be ½ x ½ inch x 2 inches. The grounding lead shall be attached to the panel's grounding stud.

f. Grounding Stud:

A grounding stud shall be provided on each panel. 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.

g. C2P Harness and Connector:

A 12 conductor jacketed cable shall be attached to terminal blocks CTB 2 and CTB 3 with ring lugs, as shown on the Plans. The cable shall terminate in a standard C2P connector, and shall be routed through the cabinet and be of sufficient length to reach the C2S connector on the back of the Controller Unit, when the unit is installed in the equipment rack.

h. Cable Tie Openings:

Two 1/4 inch diameter holes shall be provided, as shown on the Plans, for future installation of cable ties.

i. Attachment to Cabinet:

The panel shall be securely attached to the rack assembly left side panel, as shown on the Plans.

APPENDIX A

CABINET AIR FILTERS

APPENDIX A

A. AIR FILTERS FOR 332, 336S & 337 CABINET ASSEMBLIES

1. PURPOSE

The purpose of this appendix is to describe the minimum acceptable design and operating requirements for a 332, 336S and 337 cabinet air filter, to be used with the Department of Transportation's traffic control equipment.

2. DIMENSIONS

a. 332 CABINET

The overall dimensions of a 332 cabinet filter shall be:

Height = 12 inches X Length 16 inches with a tolerance of plus zero inches/minus 1/2 inches on each dimension

Width = 1 inch plus zero inches/minus 1/8 inches tolerance

The filter shall have a minimum of four-hundred thirty square inches of media area.

b. 337 CABINET

The overall dimensions of a 337 cabinet filter shall be:

Height = 8 inches X Length fifteen inches with a tolerance of plus zero inches/minus 1/2 inches on each dimension

Width = 1 inch plus zero inches/minus 1/8 inches tolerance

The filter shall have a minimum of two-hundred fifty square inches of media area.

c. 336S CABINET

The overall dimensions of a 336S cabinet filter shall be the same as for the 337 cabinet.

d. CONSTRUCTION

(1) The filter shall be constructed of non-woven cotton/synthetic fibers, twenty-five (25) to thirty-five (35) percent efficient per ASHRAE test standard 52-76.

e. MEDIA SUPPORT

The media shall be continuously laminated to an expanded metal aluminum grid on the air leaving side.

f. PLEAT DESIGN

The media material shall be radial wedge pleated, thereby allowing total media usage.

g. MEDIA FRAME

The enclosing frame shall be constructed from moisture-resistant chipboard. The entire unit shall be sealed to insure a positive media-to-frame bond, eliminating any possibility of air bypass.

h. UNDERWRITERS LABORATORIES RATING

The filter shall be Underwriters Laboratory rated as a Class II filter unit per U.L. Standard 900.

i. IDENTIFICATION

Each filter shall be printed with manufacturer's name and location, air flow direction, nominal and actual size, and UL Class II rating.

j. INSPECTION

Bidders may be required to furnish, for inspection and test prior to purchase, a sample of the filter offered. Final authority over acceptance of the sample filter with regard to the interpretation of this specification shall reside with the City of Dallas.

APPENDIX B

TRAFFIC SIGNAL CONTROLLER CABINET

SCHEMATIC PLANS

APPENDIX C

C1 CONNECTOR PIN ASSIGNMENT TABLE

TABLE 1-1: C1 PIN ASSIGNMENTS

FROM C1 OUTPUT			TO C1 INPUT			FROM C1 OUTPUT			TO C1 INPUT		
PIN	PORT	BIT	PIN	PORT	BIT	PIN	PORT	BIT	PIN	PORT	BIT
2	5001	1	39	5001	1	35	5005	1	67	5005	1
3	5001	2	40	5001	2	36	5005	2	68	5005	2
4	5001	3	41	5001	3	37	5005	3	69	5005	3
5	5001	4	42	5001	4	38	5005	4	70	5005	4
6	5001	5	43	5001	5	100	5005	5	71	5005	5
7	5001	6	44	5001	6	101	5005	6	72	5005	6
8	5001	7	45	5001	7	102	5005	7	73	5005	7
9	5001	8	46	5001	8	103	5005	8	74	5005	8
10	5002	1	47	5002	1	83	5006	1	75	5006	1
11	5002	2	48	5002	2	84	5006	2	76	5006	2
12	5002	3	49	5002	3	85	5006	3	77	5006	3
13	5002	4	50	5002	4	86	5006	4	78	5006	4
15	5002	5	51	5002	5	87	5006	5	79	5006	5
16	5002	6	52	5002	6	88	5006	6	80	5006	6
17	5002	7	53	5002	7	89	5006	7	81	5006	7
18	5002	8	54	5002	8	90	5006	8	82	5006	8
19	5003	1	55	5003	1	91	5007	1	75	5006	1
20	5003	2	56	5003	2	93	5007	2	76	5006	2
21	5003	3	57	5003	3	94	5007	3	77	5006	3
22	5003	4	58	5003	4	95	5007	4	78	5006	4
23	5003	5	59	5003	5	96	5007	5	79	5006	5
24	5003	6	60	5003	6	97	5007	6	80	5006	6
25	5003	7	61	5003	7	98	5007	7	81	5006	7
26	5003	8	62	5003	8	99	5007	8	82	5006	8
27	5004	1	55			1	LOGIC GND		63	5004	5
28	5004	2	56								
29	5004	3	57			14	LOGIC GND		64	5004	6
30	5004	4	58								
31	5004	5	59			92	LOGIC GND		65	5004	7
32	5004	6	60								
33	5004	7	61			104	LOGIC GND		66	5004	8
34	5004	8	62								

APPENDIX D

GLOSSARY

Wherever the following terms or abbreviations are used, the intent and meaning shall be interpreted as follows:

AC - Alternating Current.

AC+ - 120 Volts AC, 60 Hertz ungrounded power source.

AC- - 120 Volts AC, 60 Hertz grounded return to the power source.

ANSI - American National Standards Institute.

Assembly - A complete machine, structure or unit of a machine that was manufactured by fitting together parts and/or modules.

ASTM - American Society for Testing and Materials.

AWG - American Wire Gage.

C - Celsius.

Cabinet - An outdoor enclosure for housing the controller unit and associated equipment.

Certificate of Compliance - A certificate signed by the manufacturer of the material or the manufacturer of assembled materials stating that the materials involved comply in all respects with the requirements of the specifications.

Channel - An information path from a discrete input to a discrete output.

City - The City of Dallas

Component - A component shall be defined as any electrical or electronic device.

Contractor - The person or persons, manufacturer, firm, partnership, corporation, Contractor, or combination thereof, who have entered into a contract with the City of Dallas Department of Transportation, as party or parties of the second part or his or their legal representative.

Controller Unit - That portion of the controller assembly devoted to the operational control of the logic decisions programmed into the assembly.

Db - Decibel.

dBa - Decibels above reference noise, adjusted.

DC - Direct Current.

Devices - Conforming to function, pin out, electrical and operating parameter requirements, access times and Interface parameters of the specified device. Interpretation shall be in the judgment of the Engineer.

EG - Equipment Ground

Engineer - The City of Dallas Department of Street Services, Transportation Operations engineer.

Equal - Connectors: complying to physical dimensions, contact/pin material, plating and method of connection.

ETL - Electrical Testing Laboratories, Inc.

Hz - Hertz.

I.D. - Identification.

Jumper - A means of connecting/disconnecting two or more conductive points by soldering/desoldering a conductive wire jumper.

Laboratory - The established laboratory of the City of Dallas or other laboratories authorized by the City to test materials involved in the contract.

LED - Light Emitting Diode.

ma - Milliampere.

Module - A functional unit that plugs into an assembly.

ms - Millisecond.

mw - Milliwatt.

NA - Presently not assigned. Cannot be used by the contractor for other purposes.

NEMA - National Electrical Manufacturer's Association.

NETA - National Electrical Testing Association, Inc.

N.C. - Normally closed contact.

N.O. - Normally open contact.

ns - Nanosecond.

PCB - Printed Circuit Board.

ppm - Parts per million.

Second Sourced - Produced by more than one manufacturer.

STATE - State of Texas.

SW - switch.

Thumb Screw Device - A 8-32 retractable screw fastener with projecting stainless steel screw, spring and natural aluminum knob finish (SOUTHCO #47-62-301-XX or equal)

ua - Microampere.

UL - Underwriter's Laboratories, Inc.

us - Microsecond.

VAC - Voltage Alternating Current.

VDC - Voltage Direct Current.

Watchdog Timer (WDT) - A monitoring circuit, external to the Controller Unit, which senses a Controller Unit Output Line.

XX - Manufacturer's option