Functional Specifications

For

Traffic Control Equipment

Questions/Comments Contact

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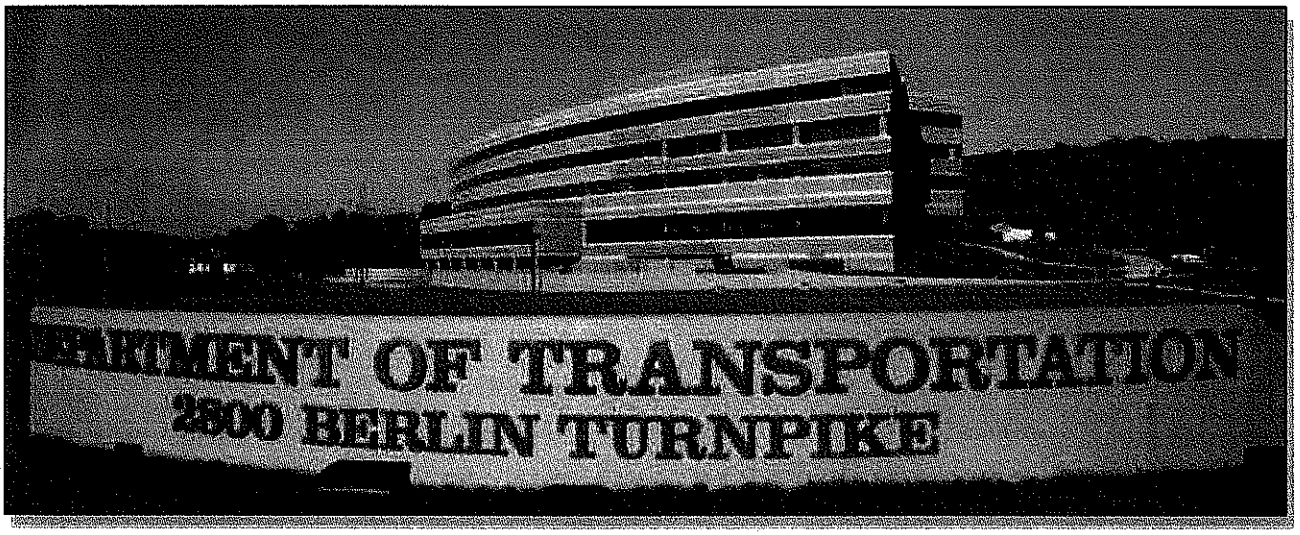
State Of Connecticut
Department Of Transportation
Bureau Of Engineering & Highway Operations

CONNECTICUT DEPARTMENT OF TRANSPORTATION

2012 - 2015



Functional Specifications For Traffic Control Equipment

SPECIFICATIONS FOR TRAFFIC CONTROL EQUIPMENT

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NOTICE TO BIDDERS:

1. Delivery dates are of extreme importance for equipment to be purchased under the terms of this contract. By submitting bids for various items on this contract, each bidder acknowledges that he accepts and agrees to the delivery dates indicated, and the following penalties may apply in the event that delivery dates are not met. It should be noted that these penalties may also be applied to the undelivered items in the event of partial delivery of any purchase order. Penalties are as follows.
   (a) The Department of Transportation will deduct one-half of one percent per day from the unit price of the item until such time as the item is received.
   (b) Failure to meet delivery dates shall be just cause for consideration of cancellation of contract. Failure to meet delivery dates does not necessarily constitute automatic termination of contract. The Department of Transportation shall consider all factors and will take action deemed to be in the best interests of the State. In the event that contract is canceled, the award shall revert to the second low bidder.
2. Delivery dates for these items will be 60-120 days after confirmation of purchase order.
3. The attached specifications are functional specifications for the purchasing of various traffic signal items on a bi-annual basis. The basis for award will be the unit price. Estimated quantities are not provided. However, it is anticipated that the materials purchased under the terms of this bid will be used to install not less then 25 eight phase cabinets and controllers during the life of contract.
4. The State of Connecticut may, with the consent of the contractor, extend this contract or any portion thereof for a one year period.

5. All bids will be reviewed by an Engineer from Office of Maintenance. Any exceptions taken to the specifications shall be considered allowed or disallowed when; in the opinion of the Engineer and subject to the approval of the Director of Purchasing, the best interest of the Department of Transportation, Bureau of Highways, is being served.

6. Awards for the traffic signal controllers and cabinets shall be made, after review, to the approved low bidder, on a sum total basis for each particular controller and cabinet. Purchases of controllers or cabinets from this bid will be made on an individual basis (controllers or cabinets.) Sum total awards will be made on the basis of adding the unit price for each type of traffic signal (i.e., 1 way 3 sections 203.2mm (8″), 1 way 3 sections 304.8mm (12″) 1 way 4 sections 203.2mm (8″), etc.). The awards for items 3C and 3D shall be made on the basis of adding the unit price for each item, and determining the total cost of the two items. All other items shall be awarded to the approved low bidder with regards to the totals indicated in the proposal schedule.

7. Each vendor shall submit their complete catalogs to become a part of their contract. The catalog shall be arranged in an orderly manner to include all equipment and parts for traffic signal installation and repair, i.e. modems, hardware, signals, I.C.'s transistors, controllers, cabinets, etc. The catalogs shall also include a CURRENT EFFECTIVE PRICE LIST. The vendor shall indicate the allowed discounts from list price to the Bureau of Highways for purchase of various types or groups of items in the catalog. No catalog item will be bid on a percentage above list price. List price or a discount from list price will be the only acceptable method of bidding catalog items. **Each bidder will submit five (5) complete sets of catalogs with price lists. All catalogs will have a table of contents and page numbers for identification and location of items being bid with the corresponding specification bid item number.**

   Failure to submit catalogs and price lists with the bid shall be cause for rejection of the bid.

8. **SAMPLES:** The Department may require samples on any new item bid. Some samples such as L.E.D Lamps may require an extended period for thorough testing.

9. In the event that an item is delivered that does not meet the specifications or is defective, the item shall be returned to the vendor for replacement. Ten percent (10%) of the bid price of the defective item shall be deducted from payment to the vendor for each defective item. All cost for replacement, shipping charges to the vendor, and returning to the Signal Laboratory shall be the responsibility of the vendor.

10. All items on this contract will be ordered in groups, as follows:

    (a) Controllers in groups of 20 or less

    (b) Signals as required

    (c) All other items as required

11. Delivery for various items shall be:

    (a) Standard controllers - 90 days after confirmation of purchase orders.

    (b) Signals - 60 days after confirmation of purchase orders.

    (c) All other items - 90 days after confirmation of purchase order.

12. Warranty: The manufacturer shall guarantee all equipment supplied for Sections 1,3,13,26, and 27 for a period of 24 months (unless otherwise noted). Items containing L.E.D. Lamps) will be guaranteed for a period of 60 months and perform to the minimum requirments of this specification for that 60 month period. All other items supplied under this specification shall have a minimum guarantee of twelve months which time shall commence from date of delivery. If a unit is found to be defective during the guarantee period, it will be the responsibility of the manufacturer to assume the cost of shipping to and from the factory at no cost to the State of Connecticut. In the event any equipment purchased by the State of Connecticut supplied to this specification, where ownership is transferred, this guarantee shall be transferred for the remainder of guarantee. **EACH ITEM PURCHASED SHALL BE IDENTIFIED WITH THE DATE AFFIXED SHOWING THE DELIVERY DATE FOR GUARANTEE PURPOSES.**

13. A meeting may be held between the apparent low bidder and Department of Transportation - Bureau of Highways personnel, before an award is made to

ascertain that the apparent low bidder is able to comply with the requirements of this contract.

14. Each bidder shall submit a separate catalog cut for each item bid. This is in order to identify the item for which the bid is intended. All item numbers must be clearly marked on each catalog cut submitted for bidding. Failure to do so may result in the rejection of the item submitted for the bid.

15. Each bidder shall supply equipment that is currently being produced. Notarized documentation from the manufacturer shall be supplied, if requested by the Department.

16. ALL Controllers, Conflict Monitors, Load Switches, Flashers and Detectors must meet or exceed NEMA test standards. (An independent test report may be requested for these items).

17. All controllers and conflict monitors purchased under this contract award shall be labeled by means of a metal plate, paint or stencil with the words "PROPERTY OF CONN. DOT"

18. NOTE: Some technical aspects of this specification may be left to the interpretation of the Engineer.

19. NEMA TEST REQUIREMENTS:

    A. Controller: Items #1B-1, 1C-1, 1D-1 and 1E-1 shall be tested in accordance with NEMA Standards Publication No. TS2-1992. The controller

    B. Conflict Monitors: The conflict monitor must perform satisfactorily to the following NEMA No. TS1-1989 test procedures.

    C. Load Switches: The load switch must perform satisfactory to the following NEMA No. TS1-1989 test procedures.

    D. Flashers: The flasher must perform satisfactorily to the following NEMA No.l TS1-1989 test procedures and descriptions

    E. Inductive Loop Detectors: Must meet all tests and description in section 15 of NEMA No. TS1-1989 for type 1 (single channel, shelf-mounted detector) devices.

NOTE: In addition to NEMA tests, the vendor shall also meet all requirements as stated in this specification. Except where noted, restrictions on minimum dollar or quantity amounts are prohibited and may be cause for rejection of bid award.

GENERAL REQUIREMENTS

(Applicable to all equipment supplied for this specification.)

The Department of Transportation shall be responsible for determining whether or not a particular item or model meets the requirements of this specification. The vendor shall be required to demonstrate the product's ability to meet the requirements of this specification. If the manufacturer has any questions pertaining to this specification, the Department of Transportation should be contacted before fabrication of any equipment.

Equipment supplied for this specification shall provide a satisfactory operation under normal operating conditions. Satisfactory operation is defined as a failure rate of less than 20% for each item supplied during a four (4) month period. Failure to meet this requirement shall result in loss of the contract award.

Each manufacturer shall provide pick-up and delivery of equipment returned for repair and covered by warranty shall be repaired and returned to the State of Connecticut within thirty (30) days from date of receipt of equipment by the vendor. If faulty equipment cannot be repaired within thirty (30) days, loan equipment must be supplied.

QUALITY ASSURANCE:

The vendor (or manufacturer) shall furnish a Materials Certificate conforming to the requirement stated herein below for all equipment supplied under this specification.

A Materials Certificate is a document certifying that the materials, components and equipment furnished, conform to all the requirements of the plans, specifications, and/or Purchase Order. The document shall also include the following information:

1. Purchase Order number under which material is purchased or supplied.
2. Name of organization to which materials is supplied.
3. Description of material.
4. Quantity of material represented by Certificate.
5. Means of identifying the assignment, such as label, marking, lot number, etc.
6. Date and method of shipment.

The Materials Certificate shall be signed by an authorized and responsible agent for the organization supplying, and it shall be NOTARIZED. A Materials Certificate shall accompany each delivery.

Steel span poles will require a manufacturer’s Certified Test Report in addition to the Materials Certificate provided by the supplier. The State of Connecticut Department of Transportation reserves the right to request samples and/or material composition.

Each bid item supplied under this specification must be accompanied by ten (10) manuals of operation and maintenance, including the following:

1. Operation
    a. General description
    b. General specification
    c. Installation
    d. Theory of operation
        1. Functional description
        2. Detailed circuit description
2. Maintenance
    a. Preventive maintenance
    b. Field trouble analysis
    c. Bench Trouble analysis
    d. Trouble shooting analysis chart
    e. Wave forms
    f. Voltage measurements
    g. Alignment
3. Parts List (To include circuit and board designations, part type and class, power rating and component manufacturer).
4. Electrical interconnection drawing
5. Schematics
6. Assembly drawings and a pictorial diagram showing physical locations and identification of each component.
7. Recent component price list

1 **PACKAGING:** Method of packing equipment shall consist of TWO units:

Example:	Box #1 Cabinet	Packed securely inside the cabinet shall be (Conflict monitor, flash relays, flashers, switch packs, UCF, prints, and any other Auxiliary equipment)
	Box #2 Controller	

NOTE: Box #1 must contain all required components, Incomplete orders will not be received.

All packages shipped under this contract shall be labeled on the outside of each individual package with the following: Equipment list, quantity, date of purchase and purchase order number.

TECHNICAL TRAINING

Each successful low bidder may be required to provide technical training for State personnel. The training program will be held at the state of Connecticut Traffic Signal Laboratory, 280 West Street, Rocky Hill, Connecticut. Each accepted low bidder shall supply a technical instructor for the number of hours listed in Table 1. (following page) Also, schematics and special test equipment shall be provided for demonstration purposes. Dates of instructions will be determined after acceptance of the bid. Manufacturers will not be required to perform this training unless their equipment is purchased under this contract by the State of Connecticut.

Course Outline:

1. General Description
    a. Basic Specifications
    b. Installation
    c. Basic Theory of Operation
2. Detailed Theory of Operation
    a. Functional Description
    b. Detailed Circuit Analysis
3. Maintenance
    a. Field Trouble Analysis
    b. Bench Trouble Analysis

Table 1

Section #	**Maximum Hours of Instruction**	**Number of Personnel**
1B through 1E	28	20
26A, 26B, 27A, 27B,	28	20

If a vendor is successful on two similar controller items, the maximum number of hours for the vendor to supply a technical instructor shall be as shown on table No.1.

Note: If there are any questions please contact Donald Assard or Mark Zampini at the Department of Transportation, Signal Laboratory (860)258-0346

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CONTROLLER SPECIFICATIONS

Description: This section shall consist of furnishing actuated controllers which shall be microprocessor based solid state units for controlling operation of traffic signals and all auxiliary equipment as specified here in.

The State of Connecticut Department of Transportation is requiring all controllers bid on this contract conform to the specifications for TS 2 type 2 1992 specifications with the exception of yellow phase clearance which shall have the settings of 0 - 25.5 seconds ; or meet the following and be approved by department engineers.

Purpose: The purpose of this specification is to set forth minimum design and operating requirements for digitally timed traffic actuated controllers.

Equipment: Equipment, as itemized in this proposal, shall operate as a unit providing the specified operation.

CONTROLLERS: FUNCTIONAL REQUIREMENTS

The controller shall encompass, but not be limited to functions such as initial, vehicle maximum, yellow, all red, walk and pedestrian intervals. All controllers will be supplied with internal modems for use in closed loop systems. Additionally all controllers will have a removable EEPROM sub module or Data Key technology for easy data transfer or department approved equal. All controllers must be supplied with correct software revision previously approved by department engineers. All controllers will be supplied with a Printed and Bound Operations /Maintenance manual containing circuit component schematics and programming instructions.

CONSISTENCY OF INTERVALS:

The controller shall be designed for use on 117 volt 60 cycle single phase alternating current, so that the length of any interval, portion or period shall not change by more than two (2) percent, if the A.C. supply voltage varies between the limits of 95 to 103 volts A.C. or the ambient temperature within the cabinet housing

the controller varies between -34.44 C (-30 F) and + 73.88 C (165 F). This performance shall be obtained without the use of any heater elements.

INTERVAL SETTING AND ADJUSTMENTS - Sections 1B-1 - 1E-1

All Traffic Controllers shall be the keyboard entry type. The front panel keypad shall facilitate the entry of interval timing. All timing entries shall be made via this keypad or by computer download without need to open the unit and without special tools.

CONTROLLER POWER SUPPLY (INTERNAL)

The power supply shall be designed to generate all voltages required for the operation of the controller. The power supply shall provide over current protection for all internal and external voltages.

There shall also be 24 VDC regulated external supply with current capabilities of 500 milliamperes continuously, with less than a 0.5 volt peak-to-peak ripple.

All connections to the power supply shall be by a printed circuit connector or through a mating connector.

CONTROLLER HOUSING:

The requirements in this specification are for controllers to be used at isolated intersections as well as at intersections in an interconnected traffic signal system. The controller shall be designed for continuous unattended operation. The inspection and testing of the controller, while in operation, shall be protected.

A single dust resistant metal enclosure, suitably protected against corrosion, shall be provided to enclose all electrical parts of the controller. Controller may also be housed in an injection molded, high impact polycarbonate case. All control switches, indicator lights, fuse holders, input-output connectors and other components required for the operation and adjustment of the controller shall be mounted on the front panels. All component parts and terminals shall be readily

accessible for adjustments, testing or service. The controller shall be designed for placement on a shelf.

CONSTRUCTION:

The main frame shall be completely equipped and wired for a full complement of plug-connected printed circuit assemblies so that no additional hardware or wiring is required. The front panel and all modules shall be positively fastened to the frame by means of a captive nut and bolt arrangement, but no special tools shall be required to remove or replace modules or plug-connector printed circuit boards.

Functional and/or phase operating circuits and their associated components shall be plug-in printed circuit assemblies, readily accessible from the front of the controller housing. Similar assemblies shall be individually interchangeable between controllers of the same model.

MARKING:

The front panels of the controller shall be engraved, silk-screened or suitably marked to indicate and identify the fuses, switches, keyboard controls, etc. so that the operation of the controller shall be readily apparent. All sub-assemblies shall also be suitably marked on the front panel with the model and serial number.

LIQUID CRYSTAL DISPLAY:

The display shall provide identification for each timing interval.

A. Minimum Initial Green

B. Walk

C. Pedestrian Clearance

D. Passage Time

E. Maximum Green

F. Vehicle Clearance (Yellow)

G. All Red

H. Rest

I. Maximum II

J. Hold

Each actuated phase shall have a vehicle call indicator which shall operate as follows:

With the actuated phase in the vehicle actuation memory locking mode, the screen shall identify when a vehicle call is registered. The steady display of this indication shall be terminated when the initial interval on the associated phase terminates. During the extendible or rest interval, the indication shall be displayed momentarily upon each vehicle actuation.

When in the vehicle actuation non-locking mode, the steady display shall be terminated when the vehicle leaves the detector area. The use of filament type indicators is not allowed in controllers.

PRINTED CIRCUIT ASSEMBLIES:

All printed circuit boards shall be made from NEMA FR-4 glass epoxy, or equivalent (Publication L1 1-1989 Industrial Laminated Thermosetting Products).

STANDARD FUNCTIONS:

All functions shall be accomplished within the controller housing. The controller shall encompass, but not be limited to all the following functions: minimum, all red, maximum green, yellow interval, walk, pedestrian clearance and recall.

MEMORY: (LOCK; NONLOCKING)

Vehicle detector actuations received by an actuated phase section when the red or yellow indication for the traffic phase is displayed, shall be remembered and shall cause the controller unit to provide right-of-way indications for that traffic phase at the next opportunity in the normal phase sequence. A means shall be provided to switch into non-lock mode of operation disabling the memory circuit.

Pedestrian push button actuations received by a phase section when the steady or flashing “DON’T WALK” indication for that traffic phase is displayed shall be remembered and shall cause the controller unit to provide “WALK” indications for

that traffic phase at the next opportunity in the normal phase sequence of the controller unit.

RECALL:

VEHICLE RECALL: Places a demand for vehicle service on a phase by registering a call while the phase is in its yellow and red intervals. Vehicle recall is selected on a per phase basis.

PED RECALL: Places a demand for pedestrian service on a phase by registering a call while the phase is in its ped clearance, yellow and red intervals. Ped recall is on a per phase basis.

MAX RECALL: Places a continuous vehicle call on a phase. Max recall is selected on a per phase basis. The Max timing must start at the beginning of the phase green interval.

HOLD:

Energizing the “HOLD” function of a phase selection shall hold the phase section in the rest condition, following guaranteed minimum time. Upon release from “HOLD” the phase selected shall remain at rest, or continue in normal operation. The HOLD function shall be provided for each vehicle phase. It shall be possible to manual the controller with the hold function activated.

FORCE OFF:

Energizing the “FORCE OFF” function shall permit termination of GREEN ONLY. Provided the phase green is in the extendable portion (IE minimum green has timed out). Termination shall operate in the same manner as maximum green period termination. All clearance intervals shall be timed as programmed. “FORCE OFF” command shall override the “HOLD” command. FORCE OFF shall be provided for each vehicle phase. FORCE OFF shall be provided for each ring.

STOP TIMING:

Energizing the “STOP TIMING” circuit of a phase timing circuit shall cause the controller unit to stop timing the interval in effect.

PHASE OMIT:

A “PHASE OMIT” special skip, when applied, shall cause the call on the selected phase to be ignored, skipped, or omitted in its normal phase rotation until this command is removed. “PHASE OMIT” shall be provided for each phase in controllers with three or more vehicle phases. The “PHASE OMIT” input shall be used to alter the normal phasing pattern of the controller.

MANUAL CIRCUIT:

A circuit to permit manual advancement of the controller through the green and walk intervals with the controller timing the clearances, with actuations placed on actuated phase.

PHASE SKIPPING ABILITY:

Any phase not called will be skipped during the sequence.

INITIALIZATION:

Places a vehicle and pedestrian call on all phases used upon power up of the controller. This function will also be capable of selecting the phase and interval (green, yellow, red) in which the controller will start its sequence.

POWER INTERRUPTION:

In the event of a power failure, not exceeding one-half of a second in duration, the controller shall continue in cyclic operation upon resumption of power. In the event of a power failure exceeding one-half of a second duration, or at such time as the controller is turned on, the signal operation shall be initiated

in the artery green without any conflicting indication and will place a call on all phases.

CHECK OUTPUT SIGNAL:

The outgoing check signal indicates the presence of vehicle and/or pedestrian call existing within the memory of this discrete phase, except in the associated phase green. The command level is a ground. This output shall be brought out to a terminal in the cabinet.

MAXIMUM II:

This command should cause the second maximum timing setting to be used in place of the normal maximum timing setting value. Maximum II must be associated with the controller. No external timers will be accepted. Maximum I and Maximum II timing circuits, when selected, must time completely independent of each other.

EXTERNAL START:

Upon energizing this function, the controller shall immediately advance to the programmed initialization interval and remain in the interval until external start signal is removed.

PEDESTRIAN TIMING

All phases shall have a concurrent pedestrian phase. (Walk and Flashing Don’t Walk). Each pedestrian movement shall have detector inputs, recall and memory circuits. The concurrent pedestrian time shall be capable of being programmed as an exclusive pedestrian phase in lieu of the vehicle-actuated portion of this phase.

PEDESTRIAN OMIT:

Input to inhibit the selection of a phase due to a pedestrian call on that phase (for exclusive pedestrian phases); shall also prohibit the servicing of a pedestrian call on any phase (when used with concurrent pedestrian timing). This input, when active, shall prevent the start of the pedestrian movement for that

phase. Activation of this input shall not affect a pedestrian movement in the process of timing. This function shall be inhibited when the phase is operating as a non-actuated phase in response to CALL to NON-ACTUATED mode.

LOAD SWITCH DRIVERS, PEDESTRIAN (THREE PER PHASE):

Provision of separate WALK, PED CLEARANCE and DON'T WALK outputs for each pedestrian movement. A circuit closure to LOGIC GROUND shall be maintained on at least one (1) of these (3) outputs at all times. The three inputs are intended to energize the appropriate pedestrian signal load switching circuit to result in a WALK, PED CLEARANCE or DON'T WALK indication for the duration of such required indication. The DON'T WALK output shall flash only during the PED CLEARANCE interval.

PHASE ON:

An output to indicate phase status. The PHASE ON output of a particular phase is activated during the GREEN, YELLOW and RED CLEARANCE intervals of that phase.

PHASE NEXT:

An output of a particular phase activated when the phase is committed to be next in sequence and remains present until the phase becomes active. The phase next to be serviced should be determined at the end of the GREEN interval of the terminating phase. If the decision cannot be made at the end of the GREEN interval, it shall not be made until after the end of the RED CLEARANCE interval.

RED REST:

Input to require rest in RED of all phases on a per ring basis by continuous application of an external signal. Registration of a serviceable conflicting call shall result in immediate advance from RED REST to GREEN of the demanding phase. Registration of a serviceable conflicting call before entry into the RED REST state, even with this signal applied, shall result in termination of the active phase and selection of the next phase in the normal manner and with appropriate clearances.

INHIBIT MAXIMUM TERMINATION:

An input to disable the maximum termination circuits of all phases in the selected timing ring. The input shall not inhibit the timing of MAXIMUM GREEN in the background.

OMIT RED CLEARANCE:

Input to cause omission of RED-CLEARANCE interval timing by application of this signal.

OUTPUTS

Coded Status Bits (3 Per Ring)

Code No.	**BIT LOGIC STATES**		
	C	B	A
0	+24V	+24V	+24V
1	+24V	+24V	0V
2	+24V	0V	+24V
3	+24V	0V	0V
4	0V	+24V	+24V
5	0V	+24V	0V
6	0V	0V	+24V
7	0V	0V	0V

One or more of the coded status bit states may be omitted from a normal cycle of operation. Only one of the above coded status codes shall be active at a time. The above coded status codes shall be active when the following conditions are present in the controller unit;

A. The active phase is in its Green interval and operating in the actuated mode.

Code 0	**Minimum Timing**	When timing the INITIAL WALK OR PEDESTRIAN CLEARANCE portions of the Green interval.
Code 1	**Extension Timing**	That portion of the Green interval following the completion of the minimum timings. (INITIAL PEDESTRIAN CLEARANCE) when timing an extension(s).
Code 2	**Maximum Timing**	That portion of the GREEN interval following the minimum timing INITIAL, WALK AND PEDESTRIAN CLEARANCE) when not timing an extension and the MAXIMUM GREEN timer is timing. (e.g., when the HOLD input is active).
Code 3	**Green**	That portion of the GREEN interval Rest when minimum timings (INITIAL, WALK AND PEDESTRIAN CLEARANCE) ARE

COMPLETE, passage timer IS TIMED OUT AND THE MAXIMUM GREEN TIMER IS EITHER TIMED OUT OR HAS NOT STARTED.

B. The active phase is in its Green interval and operating in the non actuated mode.

Code 0	**Walk Timing**	When timing the WALK portion of the Green interval (non-actuated State A).
Code 1	**Walk Hold**	When the WALK output is active, walk timing is complete and the HOLD input is active (non-actuated State B).
Code 2	**Pedestrian Clearance Timing**	When timing the PEDESTRIAN CLEARANCE interval or the remaining portion of MINIMUM GREEN (non-actuated State C).
Code 3	**Green Rest**	When the timing of Pedestrian and minimum green intervals are complete (non-actuated State D).

C. The active phase is not in its GREEN interval.

Code 4	**Yellow**	When timing the Yellow clearance
Code 5	**Red Clearance**	When timing the Red clearance
Code 6	**Red Rest**	When timing is complete and a RED indication is displayed
Code 7		Undefined

CHASSIS GROUND

Provision for independent connection of the chassis of the controller unit to cabinet ground. Must not be connected to LOGIC GROUND or AC COMMON within the controller unit

INTERVAL ADVANCE

A complete ON-OFF operation of this input shall cause immediate termination of the interval in process of timing. Where concurrent interval in process of timing exists, use of this input shall cause immediate termination of the interval which would terminate next without such actuation.

Phases without stored vehicle (or pedestrian) calls will be omitted from the resultant phase sequencing of the controller unit unless EXTERNAL MIN. RECALL TO ALL VEHICLE PHASES or MANUAL CONTROL ENABLE inputs are activated.

The controller unit shall select the next phase to service according to its normal sequence control method. If INTERVAL ADVANCE is activated during the GREEN interval and no serviceable call exists, the controller unit shall not advance beyond the applied: when the controller unit is displaying Green and WALK indications, the unit will advance to the state of displaying GREEN and PED CLEARANCE. If INTERVAL ADVANCE is applied when the unit is displaying GREEN and PED CLEARANCE, the unit will display a steady DON'T WALK indication and advance to the GREEN DWELL/SELECT state, from which it will immediately select a phase next and advance to the YELLOW subject to the presence of a serviceable conflicting call and the constraints of concurrent timing. **The INTERVAL ADVANCE will have a Pedestrian Clearnace Override Function that is programmable for the case of Pedestrian Countdown timmers. In this activated state the controller will not advance through the Pedestrian Clearance Interval and time the associated phase timing.**

If no pedestrian provision exist, application of the INTERVAL ADVANCE signal at any point in the GREEN interval will cause the unit to advance to the GREEN DWELL/SELECT state from which it will immediately select a phase next and advance to the YELLOW subject to the presence of a serviceable conflicting call and the constraints of concurrent timing.

INTERVAL ADVANCE may be used in conjunction with MANUAL CONTROL ENABLE to produce manual control of the unit with timed vehicle clearance intervals; or may be used in conjunction with STOP TIMING to advance through all intervals.

MANUAL CONTROL ENABLE

An input to place vehicle and pedestrian calls on all used phases, stop controller unit timing in all intervals except vehicle clearances, and inhibit the operation of INTERVAL ADVANCE during vehicle clearances.

When this function is used in conjunction with INTERVAL ADVANCE, the operation of the controller unit shall be as follows:

a. When concurrent pedestrian service is not provided, an activation to the INTERVAL ADVANCE will advance the controller unit to GREEN DWELL/SELECT, from which it will immediately select a phase next and advance to the YELLOW, subject to the constraints of concurrent timing.

b. When concurrent pedestrian service is provided two (2) sequential activations of the interval advance input shall be required to advance through a given GREEN interval. The first activation shall terminate the WALK interval, and second shall terminate the GREEN interval including the PEDESTRIAN CLEARANCE interval.

c. All vehicle clearance intervals are timed internally by the controller unit. Actuations of the INTERVAL ADVANCE input during vehicle clearance intervals shall have no effect on the controller unit.

CALL TO NON-ACTUATED MODE (2 PER UNIT)

Two inputs shall be provided which when activated shall cause any phase(s) appropriately programmed to operate in the NON-ACTUATED MODE.

The two inputs shall be designated CALL TO NON-ACTUATED MODE #1 and CALL TO NON-ACTUATED MODE #2. When both inputs are active, all phases programmed for NON-ACTUATED MODE shall operate in the NON-ACTUATED MODE as described in NEMA Standard Publication No.TS2-1992 section 3.5.3.2(3).

Only phases equipped for PED service shall be used for NON-ACTUATED MODE operation.

EXTERNAL MINIMUM RECALL TO ALL VEHICLE PHASES

Input to place a minimum recall on all vehicle phases.

INDICATING LAMPS DISABLE

Input to remove power from the controller unit indication. The controller unit may or may not employ this input.

TEST INPUT (2 PER UNIT)

Test input 2 per unit, for manufacturer's use only.

LOGIC GROUND

Voltage reference point and current return for controller unit input and output logic circuits. This input must not be connected to AC COMMON or CHASSIS GROUND within the controller unit.

CONTROLLER UNIT VOLTAGE MONITOR

An open collector output which is maintained true (low state) only as long as the voltages within the controller unit do not drop below predetermined levels required to provide normal operation.

FLASHING LOGIC OUTPUT

Alternating True/False logic output at 1 pulse per second repetition rate with 50% (±2%) duty cycle. In its FALSE state, this output shall be capable of providing 50 milliamperes of current. In its TRUE state, this output (like all other outputs) shall be capable of sinking 200 milliamperes. This output shall switch within 5 degrees of the zero crossover point of the A-C line.

RED REVERT

A provision within the controller unit whereby an adjustable (2-6 seconds)* minimum red indication will be timed following the YELLOW CLEARANCE interval and prior to the next display of GREEN on the same phase.

*Not less than two seconds and in increments no greater than one second.

PRIORITY OF INPUT FUNCTIONS

The priority of input functions shall be in the following order:

1. Power up
2. External Start
3. Phase Omit
4 Pedestrian Omit

5. Interval Advance

6. Stop Timing

7. Manual Control Enable*

8. Force Off

9. Hold

Each function in this list when activated, shall take precedence over and completely negates any functions below it.

*MANUAL CONTROL ENABLE conditions INTERVAL ADVANCE in certain circumstances.

OVERLAPS

Overlaps shall be provided from the controller in the manner listed below. To distinguish from basic phases, overlaps are designated alphabetically, A, B, C and D.

A. Overlap Generation

1. Four or More Phase Controller Units

   The generation of control for overlap signal indications for controller units expandable to four or more phases shall be programmable and internal to the controller unit and shall provide G-Y-R load switch drivers for each of four (4) overlap signals.

2. Clearance Timing

   The YELLOW CHANGE and RED CLEARANCE overlap signal shall be determined by the phase terminating the overlap.

B. Overlap Programming

Overlaps will be programmed via the keyboard, the use of external overlap boards will no longer be accepted.

All controllers shall include a minimum of 8 internally generated overlaps. Overlaps shall be designated alphabetically A, B, C, D, E, F, G and H.

The generation of control for overlaps shall provide **Green, Yellow** and **Red** load switch drivers for each of the overlap signals. Change and Clearance Timing...The yellow and the red clearance termination shall be determined by the phase terminating the overlap and / or an independent adjustment for each overlap signal.

VOLUME DENSITY FEATURES:

The features listed below must be incorporated in the controller timing functions for microprocessor keyboard entry controllers.

SECONDS PER ACTUATION:

Establishes the number of seconds by which each vehicle actuation increases variable initial from zero during the non-green time on the phase.

MAXIMUM ADDED INITIAL:

Establishes the limit of the variable initial.

TIME TO REDUCE:

Establishes time in which allowed gap is reduced from passage time value to minimum gap after time before reduction has expired.

TIME BEFORE REDUCTION:

Establishes a preset time before the allowable gap begins to reduce. Time before reduction begins with demand for service on a conflicting phase.

MINIMUM GAP:

Establishes minimum value to which allowed gap between actuation on phase with green can be reduced upon expiration of time to reduce.

EIGHT PHASE REQUIREMENTS:

(Supplementary to Standard Controller Requirements)

A. The controller will provide single and dual entry operation (in a dual-ring controller unit) in which one phase in each ring must be in service. If a call does not exist in a ring when it crosses the barrier, a phase is selected in that ring to be activated by the controller unit in a pre-determined manner. Variations of Ring and Barrier structures other then as shown on page 28 must be approved by department engineers

B. Single Entry: Single entry is a mode of operation (in a dual-ring controller unit) in which a phase in one ring can be selected and timed alone if there is no demand for service in a non-conflicting phase on the parallel ring.

NOTE: Dual entry and single entry shall be selected by use of the controller keyboard.

The controller must be capable of displaying both rings simultaneously. **One display that is switchable is unacceptable**.

The Controller shall be programmable for multiphase operation. It shall be possible by use of switches, or keyboard entry to program the four sequences illustrated in Fig. 2 <u>and an additional sequence that includes an exclusive pedestrian phase in a full quad configuration. This sequence will provide for the exclusive pedestrian phase to follow the artery phases, (phases 2 & 6).</u> Delivered controllers shall be pre-programmed to Fig. 2, Sequence #3.

Minimum gap time, set to zero by either keyboard controls or backup timing, shall be recognized as an invalid setting and shall not reduce the passage time.

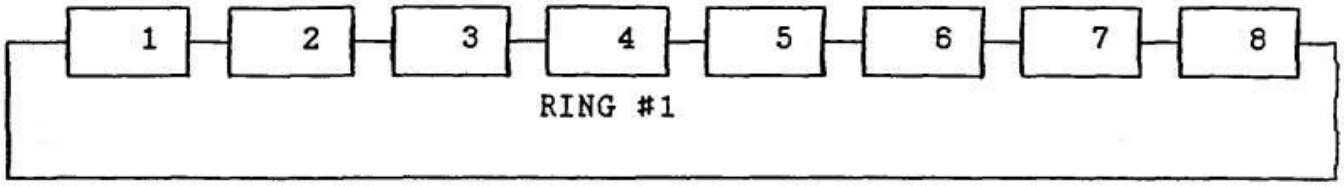
All data stored in memory shall be retained through use of EE prom or zero powered ram technology.

Controllers equipped with automatic indicator shut off circuit must keep the controller indicators on for a continuous period of 20 minutes without having to reset the indicator shut off circuit. No external input shall be used to meet this requirement. Controller displays shall be back-lit and legible day or night.

FIGURE #2

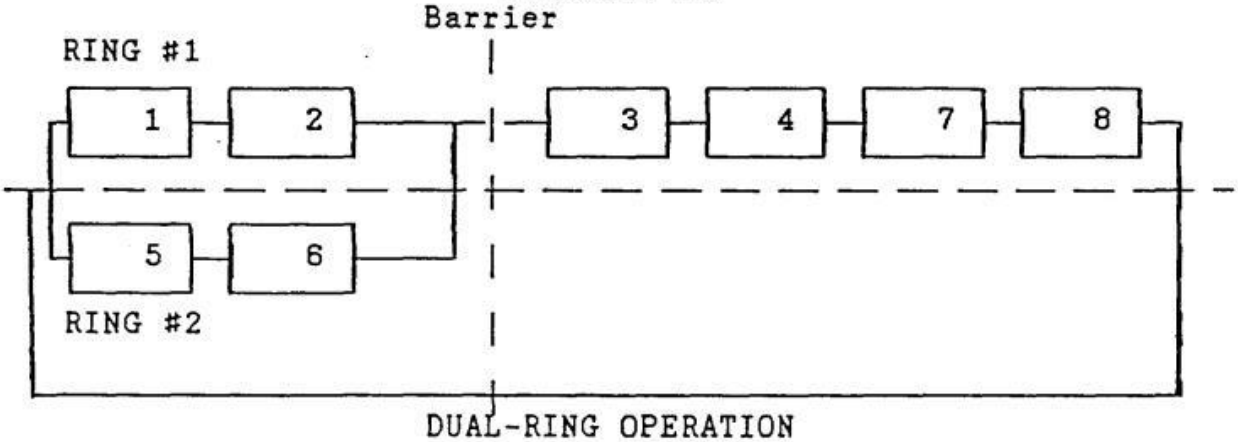
REQUIRED SEQUENCES OF OPERATION

SEQUENCE #1



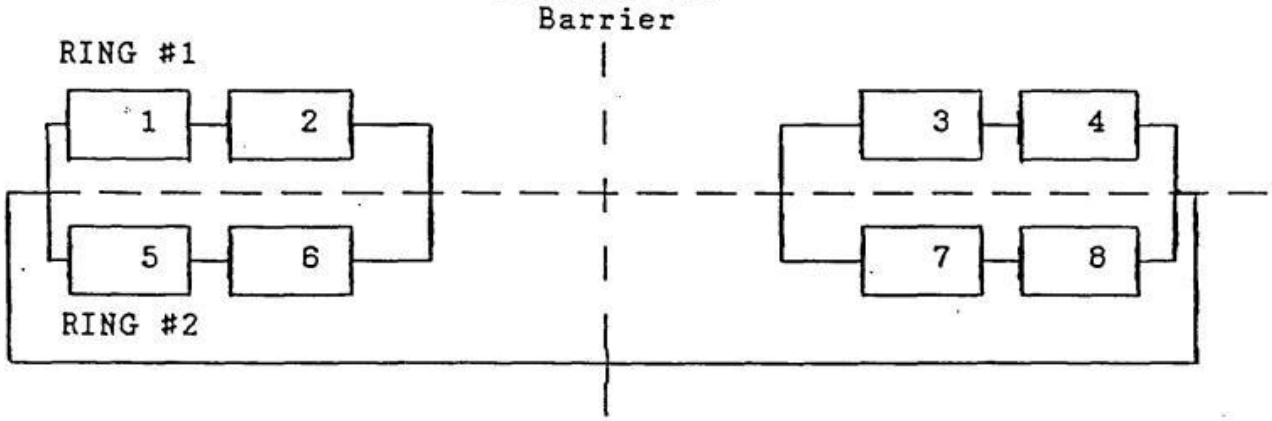
SINGLE-RING OPERATION

SEQUENCE #2



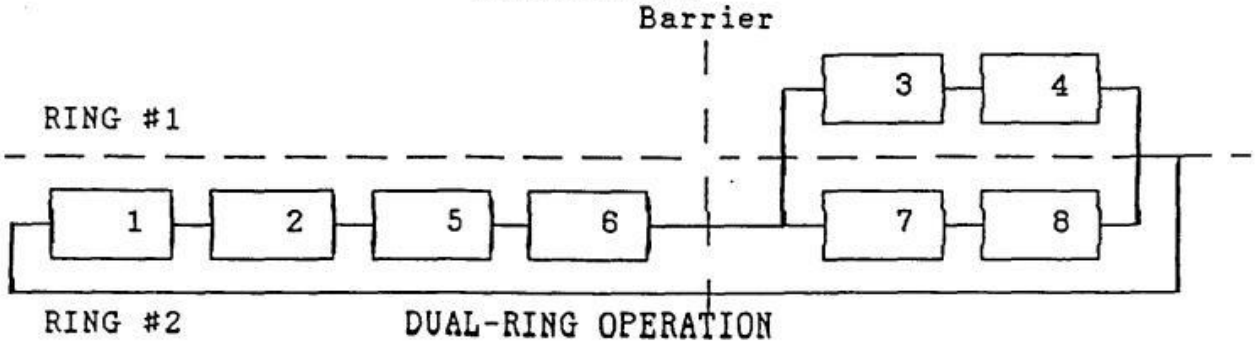
DUAL-RING OPERATION

SEQUENCE #3



QUAD LEFT TURN, DUAL RING OPERATION

SEQUENCE #4



DUAL-RING OPERATION

ITEM 1D-1

CONTROLLER (PREEMPTION TYPE)

The controller must be capable of a minimum of six preemptions and shall meet all requirements of the eight phase controller specifications. (As stated in item one of the Connecticut functional specifications for traffic equipment.)

The controller shall be of the **MENU DRIVEN TYPE** and be selectable for either fire or railroad preemption. Each preemptor must be capable of all the following features in capitalized bold print.

Standard **OVERLAP** operation shall apply during preemption operation. Programming capability for **PRIORITY or NON-PRIORITY** operation for all preemptions. Preemptors programmed as priority have highest priority. A priority preemptor call will override all other non-priority preemptors. Non priority preemptors will not override other preemptors (no hierarchy).

When preemption occurs the **CONTROLLER MUST BE CAPABLE OF IMEDIATLY ADVANCING OUT OF:**

A. ANY GREEN INCLUDING MINIMUM GREEN

B. ANY PEDESTRIAN PHASE INCLUDING WALK OR PEDESTRIAN CLEARANCE.

(No additional red or yellow clearance shall be allowed when exiting an exclusive walk phase)

C. ANY CLEARANCE PHASE INCLUDING TERMINATION OF OVERLAPS and go directly to the fire or railroad preemption Phase.

Preemption phases must be capable of either lock or non-lock inputs as follows.

DETECTOR LOCK: If during the delay time a preempt call is dropped then the preemptor will still be serviced.

DETECTOR NON-LOCK: If during the delay time a preempt call is dropped then the preemptor will not be serviced.

The controller must be able to time into, through and out of preemption during

MANUAL OPERATION.

The controller must be capable of **DELAY TIME**, that is the time between when the preempt call is received and the start of the preemption movement. Range: 0 -99 seconds.

The controller must be capable of selecting an **ALTERNATE PREEMPTION MINIMUM PEDESTRIAN CLEARANCE** time when preemption is initialized. All elapsed pedestrian clearance time will count as preemption minimum time. Range: 0 - 40 seconds. No added red or yellow clearance time will be allowed when exiting an exclusive Pedestrian phase.

The controller must be capable of timing an **ALTERNATE PREEMPTION MINIMUM GREEN** along with either **ALTERNATE YELLOW AND RED** or parent yellow and red interval times for phases that are timing when preemption is initialized. All elapsed green, yellow or red time will count as preemption minimum time. Range: green 1-40 seconds, yellow, .1 - 9.9 seconds, red .1 - 9.9 seconds. NOTE: **ALTERNATE PREEMPTION PEDESTRIAN MINIMUM CLEARANCE** time and **ALTERNATE PREEMPTION MINIMUM GREEN** time shall not be associated with each other but time independently. Also, **ALTERNATE PREEMPTION MINIMUM GREEN TIME** shall not be associated with the concurrent walk time in the phase. When going into preempt operation from any parent color and the associated overlaps need to be cleared the controller must time the complete phase yellow and red programmed in the controller. No added red or yellow clearance time will be allowed when exiting an exclusive Pedestrian phase.

TRACK CLEARANCE PHASE (for railroad preemption if desired).

The phase(s) that will be serviced immediately when railroad preemption begins. The track clearance phase will time the track clear green, yellow, and red interval before the controller is transferred to the hold phase. The controller must also be capable of **TWO SEQUENTIAL TRACK CLEARANCE PHASES** before the hold phase.

This will be allowed through the linking of preemptors two through six, to higher priority preemptors. Range: green 0 - 99 seconds, yellow 0 - 9.9 seconds, red 0 - 9.9 seconds.

HOLD PHASE: The hold phase will remain in effect during preemption until the preempt call is dropped. This phase green time will begin to time as soon as the phase is entered. The controller must be capable of timing yellow and red intervals

following the hold phase. Range: green 0 -99 seconds, yellow 0 -9.9 seconds, red 0 - 9.9 seconds.

EXIT PHASE: The phase(s) that will time following a preemption sequence.

EXIT CALL: The phase(s) that will have vehicle or ped calls for service when the preemption sequence is terminated.

SPECIAL REQUIREMENTS: When a phase other than one within the normal intersection sequence is used for preemption, and an active omit is applied to that phase, it shall not prevent the controller from cycling to it during preemption. Use of external circuitry is not acceptable to provide this operation.

CONTROLLER CABLE "D" CONNECTOR

The controller must have an input connector, or free hanging adapter cable capable of mating with a cabinet wire harness which uses an AMP 205842-1 type connector. The harness must be 1.82 meters (6 ft) in length, and pinned out as follows:

PIN	FUNCTION
1.	Preempt Input #1
2.	Preempt Input #2
3.	Preempt Input #3
4.	Preempt Input #4
5.	Preempt Input #5
6.	Preempt Input #6
7.	Preempt Output #1
8.	Preempt Output #2
9.	Preempt Output #3
10.	Preempt Output #4
11.	Preempt Output #5
12.	Preempt Output #6

NOTE: All inputs and outputs are logic ground levels

All harness wires must be labeled. One harness per controller must be supplied.

INTERFACE STANDARDS FOR FOUR-THROUGH EIGHT-PHASE SOLID-STATE TRAFFIC SIGNAL CONTROLLER UNITS

The standards in Part 3 respond to the needs for the interchangeability of solid-state controller units. They represent generally available traffic control equipment.

Interchangeability of equipment manufactured in conformance with these standards has been achieved by connector plug compatibility. With the objective of attaining compatibility with future equipment, these standards have been developed with significant consideration to the configurations which future equipment is likely to assume. Accordingly, provisions have been made for a number of additional input and output terminations so that compatibility with future designs can be obtained.

Part 3 defines interface requirements for solid-state vehicle-actuated controller units with input-output spares for future use.

TS 1-3.01 INTERFACE REQUIREMENTS

Input-output termination shall be provided for the functions described in Part 4.

If additional input-output terminations are required to allow for the inclusion of additional functional capabilities, such terminations shall be provided on an additional connector, which shall not be interchangeable with another connector on the face of the controller unit. The provision of these additional functional capabilities shall not modify the operating capabilities of the controller unit when the additional input-output connector is disconnected.

ELECTRICAL LIMITS OF INPUT-0UTPUT TERMINATIONS

A. Logic Levels

All logic signals shall be low state (nominal 0 volts) for the TRUE (active) state of all input and output terminations. Input-output terminations, when not activated, shall be internally biased to the FALSE state (+24 volts direct current).

B. Transient Immunity

The operation of the controller unit shall not be affected during operation by the application to any input or output terminal of pulses having a duration of 10 microseconds, a positive or negative amplitude of 300 volts, and a maximum repetition rate of 1 pulse per second using a pulse source having an output impedance of not less than 1000 ohms and not greater than 10,000 ohms.

C. Inputs

Inputs shall have the following characteristics:

1. Transition zone of input circuitry from “low” state to “high” state (and vice versa) shall occur between 6 and 16 volts.
2. A voltage between 0 and 6 volts shall be considered the “low” state.
3. A voltage greater than 16 volts shall be considered the “high” state.
4. External transition from “low” state to “high” state (and vice versa) shall be accomplished within 0.1 millisecond.
5. Over the voltage range 0 to 24 volts direct current (±2 volts), the maximum current “in” or “out” of any input control terminal shall be less that 10 milliamperes. Input impedance shall not exceed 11 Kilo Ohms to 24 volts direct current, nor shall the surge impedance be less than 100 ohms resistance.
6. Any input which dwells in a defined logic state for less than 0.25 milliseconds shall not be recognized. Any input signal which dwells in a defined logic state for more than 35 milliseconds shall be recognized, provided successive similar logic state transitions do not occur less than 135 milliseconds apart.

D. Outputs

Electrical outputs shall have the following characteristics:

1. **Regulated Output 24 volts DC for External Use**

   a. Positive output 24 volts (±2 volts) direct current regulated over an alternating current line voltage variation from 95 to 130 volts and from no-load to full-load.

   b. Current capability shall be 500 milliamperes continuously with less than a 0.5 volt peak-to-peak ripple.

2. **Output Circuits**

   a. Current sinking capability “low’ state (true) shall be at least 200 milliamperes for inductive loads.

   b. Any external steady-state voltage which is applied to the output terminal shall not exceed +30 volts direct current nor shall it cause a flow of more than 3 milliamperes into the terminal when the output is in the high state

   c. “Low” state = 0 to 4 volts.

   d. Maximum transition time = 0.1 millisecond.

   e. “High” state impedance shall not exceed 11 kilo ohms to 24 volts direct current.

   F. Any valid output signal shall dwell in a defined logic state for at least 50 milliseconds.

INPUTS AND NUMBER OF TERMINALS

Controller units shall have the following input functions and terminals as determined by the number of phases and rings in the controller unit.

		Number of Terminals Per Unit	
	FUNCTION	4∅	8∅
1.	Vehicle Detector (Per Phase)	4	8
2.	Pedestrian Detector Calls (Per Phase)	4	8
3.	AC + (Line Side)	1	1
4.	AC - (Common)	1	1
5.	Chassis Ground	1	1
6.	Logic Ground	1	1
7.	Force Off (Per Ring)	1	2
8.	Hold (Per Phase)	4	8
9.	Phase Omit (Per Phase)	4	8
10.	Stop Timing (Per Ring)	1	2
11.	Interval Advance (Per Unit)	1	1
12.	Manual Control Enable (Per Unit)	1	1
13.	Red Rest (Per Ring)	1	2
14.	Inhibit Max Termination (Per Ring)	1	2
15.	Call to Nonactuated Mode (2 Per Unit)	2	2
16.	External Min. Recall to All Vehicle Phases (Per Unit)	1	1
17.	Omit Red Clearance (Per Ring)	1	2
18.	Maximum II Selection (Per Ring)	1	2
19.	Indicator Lamp Control (Per Unit)	1	1
20.	Pedestrian Omit (Per Phase)	4	8
21.	Test Input (2 Per Unit)	2	2
22.	External Start (Per Unit)	1	1
23.	Pedestrian Recycle (Per Ring)	1	2
24.	Walk Rest Modifier (Per Unit)	1	1
	TOTAL NO. OF INPUTS	**41**	**68**

OUTPUTS AND NUMBER OF TERMINALS

FUNCTION	Number of Terminals Per Unit 4∅	8∅
1. Load Switch Drivers Basic Vehicle (G-Y-R, Per Phase)	12	24
2. Load Switch Drivers Pedestrian (W-PC-DW-Per Phase)	12	24
3. Load Switch Driver Overlap (G-Y-R, 4 Overlaps Maximum)	12	12
4. Check (Per Phase)	4	8
5. Phase on Logic (Per Phase)	4	8
6. Phase Next Logic (Per Phase)	4	8
7. Coded Status Bits (3 Per Ring)	3	6
8. Controller Unit Voltage Monitor (Per Unit)	1	1
9. Regulated 24 Volts DC for External Use	1	1
10. Flashing Logic Output	1	1
TOTAL NO. OF OUTPUTS	**54**	**93**

A. Connectors Used

1. Connector A shall inter mate with a MS3116 ()-22-55S
2. Connector B shall inter mate with a MS3116 ()-22-55P
3. Connector C shall inter mate with a MS3116 ()-24-61-P

NOTE: “Right Angle” connectors are not allowed on NEMA Controller Connector Cables. All cables are to be labeled as controller harness A, Controller B, Controller C or Controller D accordingly.

Controller Unit	Connector A	Connector B	Connector C
4 Phase use 8 Phase	X	X	X
5-8 Phase	X	X	X

B. Totals of TERMINATIONS

Connections	8∅	These space terminations are
Total No. Of Inputs	78	reserved exclusively for
Total No. Of Outputs	93	future assignment of
Reserved for 4∅ and 8∅	--	additional specific input -
Reserved for 8∅	--	output functions
Spares**	9	**Reserved to prevent
Reserved**	1	interchangeability with
TOTAL PINS REQUIRED	**171**	controller units conforming to
		earlier proposed NEMA pin
		assignment

C. Input-Output Connector Pin Terminations

Input-Output connector pin terminations shall be in accordance with The following.

IDENTIFICATION OF INPUT/OUTPUT PIN CONNECTOR TERMINATIONS

CONNECTOR A (4 and 8 Phase)

PIN	FUNCTION	PIN	FUNCTION
A	Reserved	a	Phase 1 Ped Clear
B	24 Volt DC External	b	Phase 2 Yellow
C	Voltage Monitor	c	Phase 2 Green
D	Phase 1 Red	d	Phase 2 Check
E	Phase 1 Don’t Walk	e	Phase 2 On
F	Phase 2 Red	f	Phase 1 Vehicle Call Det.
G	Phase 2 Don’t Walk	g	Phase 1 Ped Call Det.
H	Phase 2 Ped Clear	h	Phase 1 Hold
J	Phase 2 Walk	j	Force Off (1)
K	Phase 2 Vehicle Call Det.	k	External Min. Recall
L	Phase 2 Ped Call Det.	l	Manual Control Enable
M	Phase 2 Hold	m	Call To Non-Act I
N	Stop Timing (1)	n	Test Input A
P	Inhibit Max Term. (1)	p	AC - (Control)
R	External Start	q	Spare
S	Interval Advance	r	Control Status Bit-B
T	Lamp Control	s	Phase 1 Green
U	AC - (Common)	t	Phase 1 Walk
V	Chassis Ground	u	Phase 1 Check
W	Logic Ground	v	Phase 2 Ped Omit
X	Flashing Logic Out	w	Omit Red Clear (1)
Y	Control Status Bit - C	x	Red Rest Mode (1)
Z	Phase 1 Yellow	y	Spare 2

INPUT/OUTPUT PIN CONNECTOR TERMINATIONS

CONNECTOR A (4 and 8 Phase) Continued

PIN	FUNCTION
z	Call To Non-Act II
AA	Test Input B
BB	Walk Rest Mod.
CC	Control Status Bit 1 – A
DD	Phase 1 On
EE	Phase 1 Ped Omit
FF	Ped recycle
GG	Max II (1)
HH	Spare 3

IDENTIFICATION OF INPUT/OUTPUT PIN CONNECTOR TERMINATIONS

CONNECTOR B (8 Phase)

PIN	FUNCTION	PIN	FUNCTION
A	Phase 1 Next	a	Phase 3 Don’t Walk
B	Spare 1	b	Phase 4 Green
C	Phase 2 Next	c	Phase 4 Yellow
D	Phase 3 Green	d	Phase 4 Walk
E	Phase 3 Yellow	e	Phase 4 On
F	Phase 3 Red	f	Phase 4 Next
G	Phase 4 Red	g	Phase 4 Phase Omit
H	Phase 4 Ped Clear	h	Phase 4 Hold
J	Phase 4 Don’t Walk	I	Phase 3 Hold
K	Phase 4 Check	j	Phase 3 Ped Omit
L	Phase 4 vehicle Call Det.	k	Phase 6 Ped Omit
M	Phase 4 Ped Call Det.	m	Phase 7 Ped Omit
N	Phase 3 Veh Call Det.	n	Phase 8 Ped Omit
P	Phase 3 Ped Call Det.	p	Overlap A Yellow
R	Phase 3 Phase Omit	q	Overlap A Red
S	Phase 2 Phase Omit	r	Phase 3 Check
T	Phase 5 Ped Omit	s	Phase 3 On
U	Phase 1 Phase Omit	t	Phase 3 next
V	Ped Recycle (2)	u	Overlap D Red
W	Spare 2	v	Spare 4
X	Spare 3	w	Overlap D Green
Y	Phase 3 Walk	x	Phase 4 Ped Omit
Z	Phase 3 Ped Clear	y	Spare 5

INPUT/OUTPUT PIN CONNECTOR TERMINATION

CONNECTOR B (8 Phase) CONTINUED

z	Max II (2)
AA	Overlap A Green
BB	Overlap B Yellow
CC	Overlap B Red
DD	Overlap C Red
EE	Overlap D Yellow
FF	Overlap C Green
GG	Overlap B Green
HH	Overlap C Yellow

IDENTIFICATION OF INPUT/OUTPUT PIN CONNECTOR TERMINATIONS

CONNECTOR C (8 Phase)

PIN	FUNCTION	PIN	FUNCTION
A	Control Status Bit-A (2)	a	Inhibit Max Term. (2)
B	Control Status Bit-B (2)	b	Spare 1
C	Phase 8 Don’t Walk	c	Control Status Bit-C (2)
D	Phase 8 Red	d	Phase 8 Walk
E	Phase 7 Yellow	e	Phase 8 Yellow
F	Phase 7 Red	f	Phase 7 Green
G	Phase 6 Red	g	Phase 6 Green
H	Phase 5 Red	h	Phase 6 Yellow
J	Phase 5 Yellow	i	Phase 5 Green
K	Phase 5 Ped Clear	j	Phase 5 Walk
L	Phase 5 Don’t Walk	k	Phase 5 Check
M	Phase 5 Next	m	Phase 5 Hold
N	Phase 5 On	n	Phase 5 Phase Omit
P	Phase 5 Vehicle Call Det.	p	Phase 6 Hold
R	Phase 5 Ped Call Det	q	Phase 6 Phase Omit
S	Phase 6 Vehicle Call Det.	r	Phase 7 Phase Omit
T	Phase 6 Ped Call Det.	s	Phase 8 Phase Omit
U	Phase 7 Ped Call Det.	t	Phase 8 Vehicle Det.
V	Phase 7 Vehicle Call Det.	u	Red Rest Mode (2)
W	Phase 8 Ped Call Det.	v	Omit Red Clear (2)
X	Phase 8 Hold	w	Phase 8 Ped Clear
Y	Force Off (2)	x	Phase 8 Green
Z	Stop Timing (2)	y	Phase 7 Don’t Walk

INPUT/OUTPUT PIN CONNECTOR TERMINATIONS

CONNECTOR C (8 Phase) Continued

PIN	FUNCTION
z	Phase 6 Don’t Walk
AA	Phase 6 Ped Clear
BB	Phase 6 Check
CC	Phase 6 On
DD	Phase 6 Phase Next
EE	Phase 7 Hold
FF	Phase 8 Check
GG	Phase 8 Phase On
HH	Phase 8 Phase Next
II	Phase 7 Walk
KK	Phase 7 Ped Clear
LL	Phase 6 Walk
MM	Phase 7 Check
NN	Phase 7 Phase On
PP	Phase 7 Phase Next

Under no circumstances will any vendor use inputs or outputs such as Test A, Test B or those designated as spare under NEMA standards. If NEMA at some time does define and accept the operating characteristics of any of these inputs or outputs so that all members manufactured controllers conform to the same parameters, as defined, by NEMA, Consideration for acceptance and changes to this specification will be made.

N E M A
CONFLICT MONITORS

This CONFLICT MONITOR specification supersedes any references made to conflict monitors in the State of Connecticut functional specifications. Where a conflict does exist between specifications, this specification shall prevail. All traffic cabinets will include a department approved Enhanced Conflict Monitor which meets or exceeds NEMA TS1-1989 specifications.

Having 12 fully programmable input channels: 4∅ and 8∅ cabinets. Each channel consists of four 120 volt A.C. inputs - GREEN, YELLOW, WALK and RED.

BASIC CAPABILITY:

The CONFLICT MONITOR portion of the MONITOR unit shall be capable of monitoring conflicting signal indications at the field connection terminals in the controller assembly. For purpose of conflict determination, a signal or any of the GREEN, YELLOW, or WALK inputs associated with a channel shall be considered as the channel being in service.

It shall also detect the absence of any required RED signal voltage at the field connection terminals in the controller assembly. For this purpose, a signal on any of the GREEN, YELLOW, WALK, or RED inputs associated with a channel shall be considered as that channel being in service.

The VOLTAGE MONITOR portion of the MONITOR shall be capable of monitoring the CONTROLLER UNIT VOLTAGE MONITOR output which indicates satisfactory operating voltage in the controller unit and the +24 Volt D.C. inputs.

ACCESSIBILITY:

All operating circuitry and components within the MONITOR unit shall be readily accessible for maintenance

MATERIALS AND CONSTRUCTION OF PRINTED CIRCUIT ASSEMBLIES:

All printed circuit boards shall be made from NEMA FR-4 glass epoxy, or equivalent (Publication L1 1-1989 Industrial Laminated Thermosetting Products).

The unit shall be designed so that each component is identified by a circuit reference symbol. This identification may be affixed to the printed circuit board(s), the cover of the unit, or in an assembly drawing provided with the unit.

CONNECTORS:

All inputs and outputs, including power, shall enter the unit through front panel connectors. The connectors shall conform to the provisions of Military Specification MIL-C-26482. Connector pin terminations shall conform to the tabulation listed under Pin Assignments.

SIZE:

The overall dimensions of the MONITOR unit, including mating connector and harness, shall not exceed the following:

Type 12 114.3mm (4-1/2") W x 266.7mm (10-1/2") H x 279.4mm (11") D

POWER INPUTS:

The MONITOR units shall have the following inputs for the application of power:

1. AC+ (line side)

   The fused side of 120 Volts AC 60 Hz power source. This input shall be employed to generate the voltages required to operate the conflict monitoring logic.

2. AC- (common)

   The non-fused and non-switched return side of 120 Volts 60 Hz power source taken from the neutral (ground) output of AC power source.

This input shall be the reference signal for all traffic signal voltage sensing inputs. This input shall not be connected to LOGIC GROUND or CHASSIS GROUND within the MONITOR unit.

CHASSIS GROUND:

The MONITOR shall have an input terminal providing an independent connection to the chassis of the monitor unit. CHASSIS GROUND shall be electrically connected to the connector shell. This input shall not be connected to the LOGIC GROUND or AC- (common) within the MONITOR unit.

LOGIC GROUND:

A voltage reference point and current return for RESET input, CONTROLLER VOLTAGE MONITOR input, +24V MONITOR 1 input, +24V MONITOR 2 input and +24V MONITOR INHIBIT input logic circuits. This termination shall not be connected to either the AC- (common) or CHASSIS GROUND within the MONITOR unit.

SENSING OF TRAFFIC SIGNAL DISPLAYS:

Four inputs shall be provided for each channel to permit the monitoring of voltages at vehicle GREEN, YELLOW, RED and pedestrian WALK signal field terminals. The unit shall be designed so that it shall not be necessary to terminate unused GREEN, WALK and YELLOW signal sensing inputs provided that the impedance to AC+ of the connection to each of these inputs is less than the equivalent of 1500 Pico farads (pf) between the input lead and AC+ as measured at the input to the unit. When the circuit connected to the sensing input of the monitoring unit exhibits high impedance characteristics such as caused by dimmers or burned out bulbs, it may be necessary to place a low impedance device between the monitor unit input and AC- (common) external to the monitor unit.

A GREEN, YELLOW or WALK signal input shall be sensed when it exceeds 25 Volts AC and a signal input shall not be sensed when it is less than 15 Volts AC. Signals between 15 and 25 Volts AC may or may not be sensed. Both

positive and negative half wave signals shall be sensed. The RED MONITOR signal input shall require the presence of 60 (± 10) Volts AC at the field terminal to satisfy the requirements of RED signal indication.

CONFLICT MONITORING:

When voltages on any conflicting channels are present concurrently for 450 milliseconds, the CONFLICT MONITOR shall trigger. When two signals in conflict with one another are sensed concurrently for less than 200 milliseconds, the CONFLICT MONITOR shall not trigger.

Signals in conflict sensed for more than 200 milliseconds but less than 450 milliseconds may or may not cause the MONITOR to trigger.

When the CONFLICT MONITOR triggers, it shall cause two sets of isolated Form C relay contacts to transfer and these contacts shall remain in this state until the monitor is reset by the activation of a front panel control or the activation of the RESET input. Power interruption shall not reset the MONITOR when the MONITOR unit has been triggered by a conflict prior to the power interruption.

RED MONITORING:

The MONITOR shall be capable of monitoring for the absence of voltage on all of the inputs of a channel. If an output is not present on at least one input of a channel at all times, the monitor shall begin timing the duration of this condition. If this condition exists for more than 1000 milliseconds the MONITOR shall trigger.

If these conditions exist for more than 700 milliseconds, but less than 1000 milliseconds, the MONITOR may or may not trigger.

When the MONITOR triggers, it shall cause the output relay contacts to transfer. These contacts shall remain in this state until the monitor is reset by the activation of the front panel control or the activation of the

RESET input. **The monitor shall display the channel(s) in which the failure occurred until said reset.**

Power interruption shall not reset the MONITOR when the MONITOR unit has been triggered by detection of absence of RED.

VOLTAGE MONITORING:

The MONITOR shall include a VOLTAGE MONITOR capable of monitoring two +24 volt DC sources applied to its two +24 Volt MONITOR inputs and a true state signal applied to its CONTROLLER VOLTAGE MONITOR input. Absence of the proper voltage level at any of the inputs shall cause the VOLTAGE MONITOR to transfer the output contacts. Restoration of all proper voltage levels shall reset this VOLTAGE MONITOR.

+24 VOLT DC SUPPLY MONITOR:

A voltage greater than +22 Volts applied to both of the +24 VOLT MONITOR inputs shall be recognized by the monitor as adequate for proper operation of the controller assembly.

If only one +24 Volts DC supply is monitored, the two +24 VOLT MONITOR inputs should be jumped and connected to that +24 Volt DC supply.

A voltage less than +18 Volts DC applied to either of the +24 VOLT MONITOR inputs shall be recognized by the monitor as inadequate for proper operation of the controller assembly. This shall cause transfer of the output relay contacts.

Over the voltage range of 0 to +30 Volts DC the maximum current “in” or “out” of the +24 VOLT MONITOR input terminals shall be less 10 milliamperes. The input impedance to these terminals shall not exceed 11K ohms to 0 Volts DC (Logic Ground) and surge impedance shall not be less than 100 ohms.

+24 VOLT MONITOR INHIBIT (INPUT):

Application of a “true” (low) state to this input shall inhibit the operation of the two +24 VOLT MONITOR inputs.

CONTROLLER VOLTAGE MONITOR (0UTPUT):

The MONITOR shall include an input from the controller unit (CONTROLLER UNIT VOLTAGE MONITOR OUTPUT). Absence of the “true” (low) state on this input is an indication of improper operating voltages within the controller unit, and shall cause transfer of the MONITOR unit output relay contacts.

This input may be held in a low state (connected to LOGIC GROUND) for applications where this input is not available.

RESET:

Activation of the RESET push-button or the RESET input shall cause the two FORM C output contacts to transfer to the reset condition for the duration of either of these inputs. Removal of both of these inputs shall leave the MONITOR in the reset condition only if there are no signal conflicts, no red monitoring failure, and no voltage monitoring failures.

OUTPUT:

The output relay of the MONITOR unit shall have two sets of isolated Form C contacts. These relay contacts shall be capable of switching all loads in the ranges from 2 milliamperes at 18 Volts to at least 3 amperes at 135 Volts AC. The open circuit of the output relay shall be the circuits which are open when the MONITOR unit is in the “no conflict” state and all voltages are sufficient for proper operation of the controller assembly.

INDICATORS:

The minimum indicators shall be as follows and provided as part of the MONITOR unit:

A. Triggering of the CONFLICT/RED MONITOR.

B. Operation of the VOLTAGE MONITOR.

C. LIQUID CRYSTAL STATUS AND FIELD DISPLAY

A Liquid Crystal Display (LCD) will be provided to show monitor status and two icon based LCDs to show field signal channel and fault status. The display shall be easily read in all lighting conditions, and shall display full intersection signal status.

CONTROLS:

The MONITOR shall have a front panel control for manual reset.

OVERCURRENT PROTECTION:

The unit shall have a front panel mounted over current protection device in the 120 Volt AC+ input to the unit.

PROGRAMMING:

Type 12: The 12 channel input with 4 inputs per channel. These 12 channels are fully programmable for the specific application. MONITOR units which are fully programmable shall require a programming action to provide compatibility between channels. Programming must be accomplished by the following means: An interchangeable PROGRAMMING CARD, using a printed circuit board programmed through the use of soldered wire jumpers (Figure 3A and 3B) must be used.

CABINET INTERLOCK:

The unit shall have two (2) terminals internally connected (#30 AWG jumper) to indicate the presence of the MONITOR to the external circuitry. These terminals shall be identified as CABINET INTERLOCK A and CABINET INTERLOCK B.

RED MONITOR ENABLE:

Presence of AC+ at this input enables the MONITOR unit to detect the absence of RED indications. Absence of AC+ inhibits the detection of the absence of RED indications.

AC+ INPUT II:

This AC+ input to the MONITOR unit provides AC power for this unit. This input may also be used to terminate RED CHANNEL inputs. AC+ INPUT I is jumped internally to AC+ INPUT II, thereby providing the ability to use a MONITOR unit, conforming to Part 6, Section 2 in place of a MONITOR unit conforming to Part 6, Section 1, but not the reverse.

MINIMUM FLASHING INDICATION AFTER POWER INTERRUPTION TO CONTROLLER ASSEMBLY

The MONITOR unit shall include a means of monitoring the absence of AC+ input to the unit. When the duration of power interruption exceeds 475 ±(25) milliseconds, the MONITOR unit shall de-energize its OUTPUT RELAY which normally results in transfer of the signals to FLASHING INDICATION. The de-energized state of the output relay shall be maintained for a timed interval following restoration of power to the AC+ input. The duration of this interval shall be adjustable between the limits of four seconds and ten seconds with repeatability of one second and with maximum incremental adjustment of one second. Upon completion of the timing of this interval, the controller unit shall respond in its start up (initialization) sequence and the signalization shall return to its normal operation.

START-DELAY CONTROL:

The MONITOR unit shall include a means of monitoring the absence of AC+ input to the unit. When the duration of this power interruption exceeds 475 ±25 milliseconds, the unit shall de-energize its START-DELAY relay. The de-energized state of this relay shall be maintained during the power outage and for 2 1/2 + 1 second after restoration of power to the AC+ input.

The START-DELAY relay shall consist of a form C relay output contact. These relay contacts shall be capable of switching all loads in the range from 2 milliampers at 18 Volts DC to at least 3 amperes at 135 Volts AC.

Type 12 & Type 12Q Connector A Shall Mate with MS 3116 22-55 SZ

PIN	FUNCTION
A.	AC+ (jumped internally to AC+ II)
B.	Output Relay 1 Open
C.	Output Relay 2 Closed
D.	Channel 12 Green
E.	Channel 11 Green
F.	Channel 10 Green
G.	Channel 9 Green
H.	Channel 8 Green
J.	Channel 7 Green
K.	Channel 6 Green
L.	Channel 5 Green
M.	Channel 4 Green
N.	Channel 3 Green
P.	Channel 2 Green
R.	Channel 1 Green
S.	+24 Monitor I
T.	Logic Ground
U.	Chassis Ground
V.	AC-
W.	Output Relay 1 Common
X.	Output Relay 2 Common
Y.	Channel 12 Yellow
Z.	Channel 11 Yellow

PIN	FUNCTION
a.	Channel 10 Walk
b.	Channel 10 Yellow
c.	Channel 9 Yellow
d.	Channel 8 Yellow
e.	Channel 7 Yellow
f.	Channel 6 Yellow
g.	Channel 5 Yellow
h.	Channel 3 Yellow
i.	Channel 3 Walk
j.	Channel 2 Yellow
k.	Channel 1 Yellow
m.	Controller Voltage Monitor
n.	+24V Monitor Inhibit
p.	Output Relay 1 Closed
q.	Output Relay 2 Open
r.	Channel 12 Walk
s.	Channel 11 Walk
t.	Channel 9 Walk
u.	Channel 8 Walk
v.	Channel 7 Walk
w.	Channel 5 Walk
x.	Channel 4 Yellow
y.	Channel 2 Walk
Z.	Channel 1 Walk

PIN	FUNCTION
AA.	Spare 1
BB.	Reset
CC.	Cabinet Interlock A
DD.	Cabinet Interlock B
EE.	Channel 6 Walk
FF.	Channel 4 Walk
GG.	Spare 2
HH.	Spare 3

Type 12 and Type 12 Q Connector B Shall Mate with MS 3116 16-26 S

PIN	FUNCTION
A.	AC+ II Input
B.	Start-Delay Relay Common
C.	Start-Delay Relay Open
D.	Channel 12 Red
E.	Channel 11 Red
F.	Channel 9 Red
G.	Channel 8 Red
H.	Channel 6 Red
J.	Channel 6 Red
K.	Channel 5 Red
L.	Channel 4 Red
M.	Channel 2 Red
N.	Channel 1 Red
P.	Spare 1
R.	+24V Monitor II
S.	Spare 2
T.	Spare 3
U.	Start-Delay Relay Closed

PIN	FUNCTION
V.	Channel 10 Red
W.	Spare 4
X.	Spare 5
Y.	Spare 6
Z.	Channel 3 Red
a.	Red Enable
b.	Spare 7
c.	Spare 8

MONITORING WIRING - ALL TYPES:

All 120 V.A.C. signal inputs to the monitor (green, yellow, red and walk) will be placed on individual terminals. These terminals shall be front panel accessible and in turn shall be jumped to the appropriate signal load switch field terminals. The remainder of the conflict monitor inputs and outputs shall be wired to spare terminals as necessary to perform the required monitoring functions.

NOTE: “Right Angle” Connectors are not allowed on NEMA conflict Monitor Connector Cables. All cables will be labeled for identification purpose as to unit and harness number.

CONFLICT MONITOR PROGRAMMING BOARD

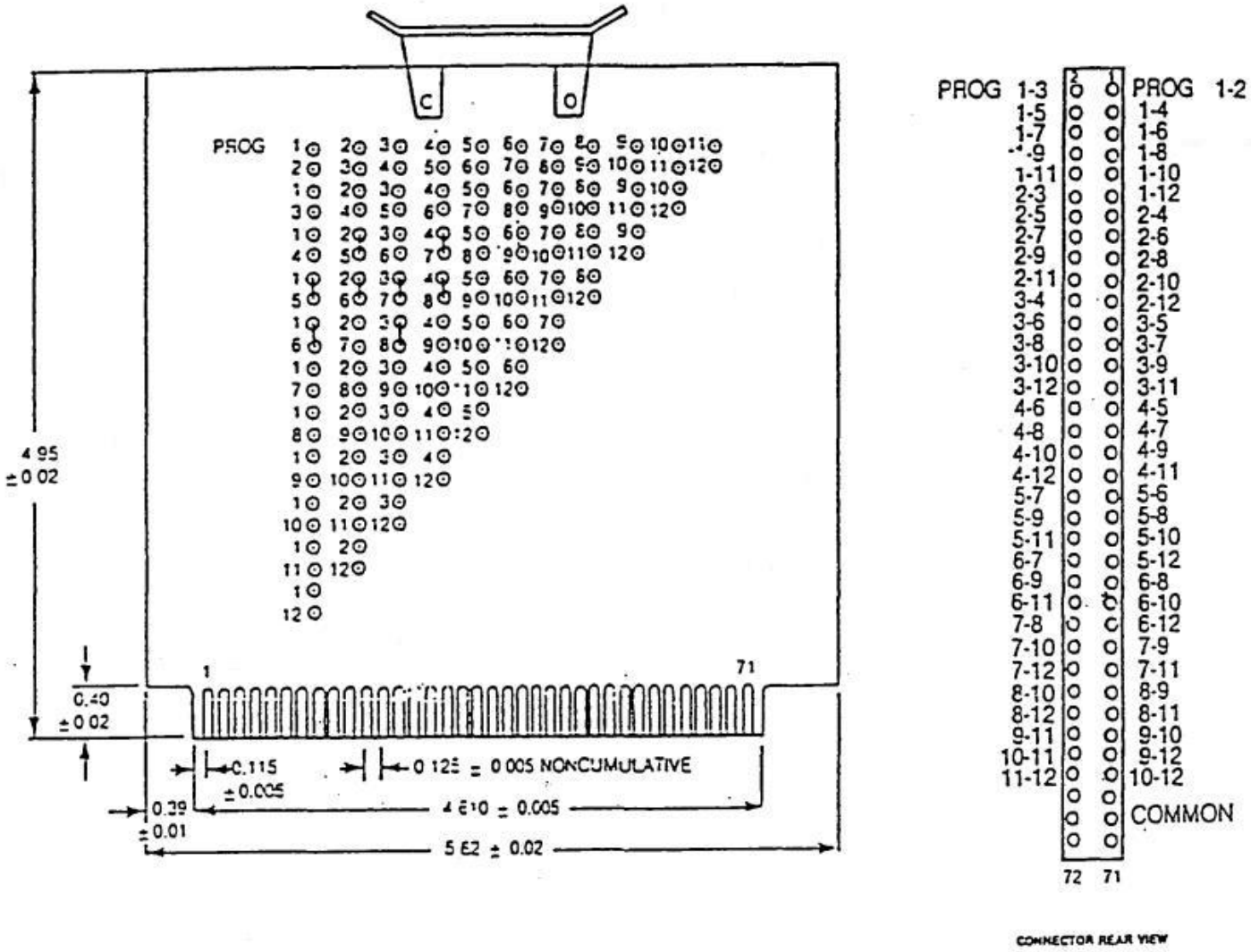


FIGURE #3

Notes:

1. The connector has 36 double readout positions at 0.125" corners.
2. The programming shown is for a standard NEMA 8 phase controller without overlaps. The 8 NEMA phases are phases 1 through 8 showing jumpers for the following combinations of compatible phases: 1 & 5, 1 & 6, 2 & 6, 3 & 7, 3 & 8, 4 & 7, 4 & 8.
3. The jumpers are #22 AWG bus wire, 0.2" long.
4. The handle is Vero #CH/C10037 or equivalent.
5. Material. FR4 0.062" thick.
6. There are 132, 0.043" diameter holes for programming jumpers.
7. One side of each jumper is brought out to the common pins 69 & 70.

Uniform Code Flash

An auxiliary shelf mounted control device external to the traffic controller shall be installed in the cabinet (supplied for all non-closed loop cabinets only) to permit time clock flash in accordance with the Manual on Uniform Traffic Control Devices, Part IV, Section 4B-18.

The change from flash to automatic is to be made at the beginning of the common major street green interval. Changes from automatic to flash are to be made at the end of side street all red interval.

Major Street Green Shall be as follows

4 phase => phase 2

8 phase => phase 2 and 6 (if applicable)

All wires in the UCF harness shall be connected to their own separate terminals in the cabinet, from these terminal connections, the necessary interface between the UCF and cabinet are to be made.

A toggle switch shall be provided on the internal side (Tech Panel) of the main cabinet door. This switch shall be a DPDT (on-on) type with its functions and labels as follows:

Up Position: Will allow the UCF to operate in its normal condition. It shall be labeled Normal Operation.

Down Position: Will disable the UCF from placing the Cabinet into a flash condition and also be capable of allowing the UCF to be disconnected from the cabinet while maintaining normal cabinet operation. Provisions must also be made on this switch to disconnect "Flash Command In" [Pin 4] from all devices external to the UCF unit. This position shall be labeled Inhibit UCF.

Another toggle switch shall be provided, this switch is to be mounted on the UCF device and will simulate a call for time clock flash to the UCF. This switch shall be labeled UCF Test.

The external MS connector on the UCF device shall be an AMP206838-1 Type Square Flange connector with pin designations as follows.

Pin No.	Function	Description
1	Gnd.	Gnd.
2	24 VDC	24 VDC from controller.
3	Chassis Gnd.	Chassis Gnd.
4	Flash Command In	Gnd signal input to activate UCF device.
5	Artery Phase On Input (Ring 1)	Major Street On output from controller.
6	Artery Phase On Input (Ring II)	Major Street On output from controller.
7	Command Out #1	Output from UCF to go to an active low state immediately upon receiving a “Flash Command In” call. This output shall remain active until “Flash Command In” signal is removed,
8	Spare	
9	Spare	
10	Spare	
11	N.O. Relay Contact (1)	NOTE: This relay shall energized when a call for flash is present and the controller sequences to the end of the side street all red interval
12	Com. Relay Contact (1)	
13	N.C. Relay Contact (1)	
14	N.O. Relay Contact (2)	
15	Com. Relay Contact (2)	
16	N.C. Relay Contact (2)	
17-24	Spare	

NOTE: THIS UNIT SHALL DRAW NO MORE THAN .250 mA

When Pin 4 (Flash Command In) to the UCF becomes active it shall take no longer than the sum total time of one complete sequence cycle to achieve a flash condition in the cabinet.

The UCF device shall have two L.E.D.'s mounted on the chassis. One L.E.D. will indicate when a call for flash is present in the UCF, it will be labeled "Flash Call In." The second L.E.D. will indicate when the UCF output to the flash relays is active. This indicator will be labeled "Flash Call Out."

SPECIFICATION FOR CABINET
TO HOUSE SOLID-STATE TRAFFIC CONTROL EQUIPMENT

SCOPE:

This specification defines the minimum detailed requirements applicable to cabinets. The intent of this specification is to set forth the minimum acceptable electrical and mechanical design requirements within which all equipment must operate satisfactorily and reliably.

CABINETS:

All equipment shall be housed within a weatherproof outdoor mounting cabinet, constructed of fabricated aluminum. Fabricated aluminum cabinets will be permitted providing they are rigid and have a minimum thickness of 3.17mm (.125 inches) (#11 gage)

Cabinets supplied to this specification shall contain the necessary space to house the maximum dimension of the control equipment intended to be housed within, also, usable space equal to or greater than the volume of the control equipment to house detectors and miscellaneous special equipment.

SUB-BASE:

All base mounted cabinets will come with a separate sub-base that mirrors the dimensions (and mounting holes) of the specified cabinet base. The sub-base shall extend the cabinet from 6 to 12 inches and be made from the same material with the same painting procedures as the provided cabinet. The sub-base shall be received uninstalled, but in the same order as the cabinet order and supplied with all associated hardware. All hardware (nuts and bolts) will be stainless steel fasteners.

SHELVES:

Each cabinet shall have two shelves that extend the complete width of the cabinet. Each shelf shall be adjustable in height with a minimum of 152.4mm (6”) of clearance between the upper and lower shelves.

DOORS:

The main door of all cabinets shall encompass substantially the full area of the front of the cabinet. All cabinets shall be furnished with full doors possessing securing brackets and an auxiliary door equipped with a covered lock for a police key. Police door keys will be of the longer type (nominal length 3.25 inches). The cabinet shall have the main door equipped with a special Conn-1 lock (tumbler-type). Two keys shall be furnished for each lock. When closed, both doors shall fit tightly to a neoprene gasket material. The door will be furnished with a pleated type air filter measuring either 14″ x 20″ or 14″ x 25″. A wire mesh or perforated metal outer screen will also be provided to block radio interference as well as preventing debree and pest entrance.

Door hinge pins shall be made of stainless steel. **Door hinges and securing brackets shall be bolted so doors may be changed without need to cut welds.**

VENTILATION:

Cabinets shall be equipped with an adequate ventilating system including electric fan having a capacity of at least 2.83 cubic meters per minute (100 cubic ft per min). A replaceable pleated filter with perforated metal screen shall be placed on the intake vent. (see door section this page)

Filter sizes are as follows:

Type “B” and “E” cabinets - 304.8mm (12″) x 406.4mm (16″) x 25.4mm (1″).

Type “C” and “D” cabinets - 355.6mm (14″) x 508mm (20″) x 25.4mm (1″).

The fan shall be mounted within a rain-snow and insect-tight housing. The fan shall be thermostatically controlled by an adjustable thermostat. The thermostat shall be mounted no higher than the door opening frame for ease of adjustment. The fan motor shall have a suppressor across it equal to or better than a .1 uf/47 ohm @ 600v. All points on thermostat and fan which 110VAC are present shall be insulated to prevent against electrical shock. The fan and cabinet ventilation holes are to be located so as to direct the bulk of the air flow throughout the entire cabinet and in particular over the controller unit.

PAINTING:

Cabinet exteriors shall be painted with a powder coat type material. The powder shall be applied using electrostatic method upon the chemically cleaned surface. Powdered plastic resins using an electro-static spray shall be bonded to the outside surfaces of the traffic cabinet assembly. The powder coating process shall utilize a dry painting process that combines the use of an electro-static application to fuse the dry paint to the surface. The dry paint shall be comprised of resins and pigments for color. The exterior color for cabinets shall be a department approved gray.

CLEANING:

All exterior surfaces shall be cleaned and prepared in a manner consistent with industry standards for sheet aluminum products prior to application of powder coating paint.

GENERAL CABINET WIRING REQUIREMENTS:

All wiring within the cabinet shall be neat and firm and in conformance with the current National Electrical Code. Insulation parts and wire insulation shall be of suitable materials and insulated for a minimum of 600 volts. Wire size shall be no smaller than No. 16 AWG stranded copper conductor, except that circuits having less than .25 amperes shall be No. 22 AWG or larger stranded copper conductor. All controller harnesses shall be fully covered with wire wrap or snakeskin type covers, and labeled as A, B, C, or D Harness accordingly. The back panel shall be easily dropped for repairs and wire inspection.

All wiring to the load switch panels shall be harnessed so that the panel may swing or pivot to facilitate field repairs on the back panel. Therefore, wires affixed to the cabinet and entering the load switch panel shall enter between the lower left and lower right corners.

All permanent mounted fixtures and appurtenances shall be attached with a nut and bolt, or a screw. Quick fasteners, such as rivets, are not permitted on any moving or load bearing appurtenances unless approved by department.

All relay, flasher and equipment jacks mounted in the cabinet shall be of the female type.

All controller equipment, appurtenances and terminals shall be arranged within the cabinet so that they will not upset the entrance, training and connection of the incoming conductors.

TERMINAL, DEFINITION OF: All termination points shall be Screw-type connection points on a barrier type block using a nickel plated brass or stainless steel screw and mounting plates. Pressure-type connectors or terminals designed for the insertion of stripped wire will not be accepted. All field terminals shall be heavy duty series and properly identified. There shall not be any duplicate numbers or identifying symbols.

All controller signal outputs shall be provided and brought to terminals. These terminals shall then be jumper connected to a separate terminal which will then feed each load switch input.

NOTE: All terminals must be front panel accessible.

Direct wiring from the controller harness to the load switch is not acceptable. All unused outputs shall be connected to spare terminals.

All equipment inputs and outputs shall be connected to accessible terminals and it shall not be necessary to remove any panels or equipment to make connections to these terminals, i.e., controller, load switches, conflict monitor, flasher, flash relays, coordination equipment, pre-emption equipment. All Conflict Monitor wires shall be brought out to spare terminals and then jumped to associated field terminals, direct wiring from conflict monitor to field terminals will not be accepted.

AC+ signal power shall be brought out to an accessible terminal. AC-, and Chassis Gnd. must be tied to common point in cabinet and grounded. The cabinet shall be wired such that the removal of two jumper wires will completely isolate all said grounds from one another.

All switches and momentary contact buttons shall be identified as to their functions.

Flash transfer relays are to be energized in normal operation and de-energized in flash operation.

The AC+ service wire shall be wired direct to the line side of the main circuit breaker. No connectors of any type shall be allowed between the AC+ service wire and the main circuit breaker. Cabinets shall be hard wired. Circuit board wiring will not be accepted.

THE FOLLOWING SHALL BE MOUNTED IN THE CABINET

40 Amp main circuit breaker for power supply lines.

30 Amp secondary circuit breaker for equipment power.

15 Amp circuit breaker for lamp receptacle and (non GFCI) type duplex convenience outlet (to be fed from load side of main breaker.

A Magnacraft W6275ASX-1 Solid State Cube type relay rated for an output of 75 amps at 240vac with an input range of 90-280vac or Department approved equivalent will be provided. Included will be a mounting bracket heat sink to adapt to existing mounting holes. Mercury relays will **not be** allowed.

A 120 volt (GFCI) duplex will be provided.

Ac Line Filter provided to protect equipment from malfunctions due to conducted interference coming into the equipment from the line, especially line to ground, noise and transients.

All points which 110VAC are present and are not recessed shall be insulated to prevent against electrical shock.

Surge Protection Minor Components:

One or more metal oxide varistors (MOV) shall be installed for surge protection as needed. All 110 VAC relays shall be provided with an R-C suppression network (.1 uf/47 ohms @ 600 V) on the coils. This item shall be a one piece molded plastic unit equal to a Quencharc 104 600v (molded blue)

One neutral buss bar with a minimum of 10 spare terminals shall be mounted on each side of the cabinet.

Terminals for conductors of traffic signal light cables. One terminal for each signal circuit.

Spare terminals to cabinet requirements.

Load Bay Panel -- There shall be mounted on the lower back of the cabinet a panel of sufficient size to accept the required number of load switches, flashers and flash relays, as specified in the cabinet requirements. The appropriate number of connectors for load switches, flashers and flash relays shall be mounted on this panel. All connectors mounted on the load bay panel shall be of the female type. All connectors shall be wired for all standard phase indications and four overlaps, as specified in the cabinet requirements. ALL CONNECTORS SHALL HAVE INPUTS AND OUTPUTS WIRED TO TERMINALS. The load bay panel shall be designed to provide a means of supporting the load switches and flasher to prevent them from vibrating out of their respective sockets. The load bay panel shall be hard wired (circuit board type panels will not be accepted). All connections to the load bay panel shall be direct wired with the appropriate AWG stranded wire size. Edge connectors will not be accepted.

Solid State Load Switches -- There shall be a sufficient number of solid state load switches provided to switch the required amount of circuits as specified in the cabinet requirements. The load switches shall be plug-in and external to the controller. The load switches shall conform to the latest NEMA publications. The internal construction of the load switch shall be of the optically-isolated, solid state relay type with the dimensions shown on Figure 5. Use of individually mounted discrete components is not permitted. Each load switch shall be rated for a minimum of 20 amps per load switch circuit with a de-rated circuit operation of 10 amps per load switch. Pedestrian and vehicle load switches shall be interchangeable. The load switch shall have three (3) light-emitting diodes (LED) mounted on the front panel. They shall be wired as follows: One for green, one for yellow, and one for red. The L.E.D.s shall be activated from the DC outputs of the controller. The load switch “triac cube” must be epoxy filled. Load currents must be carried on No. 16 AWG copper wire. The use of circuit boards to carry load currents is not allowed.

Solid State Flasher -- The flasher shall conform to the latest NEMA publication, TS-2 1992 Part 6.3, with the following additions:

Only Type 2 flashers will be accepted (dual circuit, 10 ampere per circuit). The output shall be from optically-isolated solid state relays of

the dimensions shown on Figure 4. The flasher shall have LED indicators connected to the output for visual reference. All wiring to the flasher shall be #12 AWG stranded or larger. The flasher “triac cube” must be epoxy filled. The switching circuitry of the flasher shall be mounted on a separate board. Load currents must be carried on No. 16 AWG copper wire. The use of a circuit board to carry load currents is not allowed.

Transfer Relays. (See figure 5)

A relay will be supplied to disconnect 24 VDC from the common side of all load switch packs during flash. The relay shall have a momentary push-button to apply power to the switch packs to aid in troubleshooting. This is for safety purposes, designed to prevent the intersection from flashing and displaying colors at the same time.

Connecting cables and harness, as required (circular M.S. type). Edge connectors will not be accepted. All wire connections on the cabinet door shall be made by means of a screw type, or solder terminal connectors, No printed circuit boards of any type will be allowed on the cabinet door.

A special switch which will place the traffic signal on “EMERGENCY FLASH” and disconnect all power to the controller. The switch will be readily accessible and identified. This switch is not to be confused with the normal flash switch located in the Auxiliary Door Panel (Police Door). This switch shall be mounted on the internal side of the main door.

Momentary Contact Buttons -- These shall be located on a panel mounted on the inside of the cabinet door. The buttons shall be used for registering calls on all vehicle and pedestrian phases, as specified in the cabinet requirements. It shall be possible to extend the GREEN intervals of the vehicle phases of the controller with these buttons. The buttons shall be physically protected from the contact with wires or other devices in the cabinet by means of recessing or attaching a hinged guard plate.

A panel accessed by the auxiliary door (Police Door) shall contain the following. A switch to control the change from automatic control to flashing operation and vice versa. The controller shall continue to operate when in flash from this switch.

A switch to control the change from automatic control to manual operation and vise versa. A manual cord not less than 1.82m 6ft long, equipped with a sealed weather proof covered hand switch, will also be provided and be accessible from the Police Door. MANUAL CONTROL will be accomplished by activation of the MANUAL CONTROL ENABLE circuit in conjunction with the interval advance circuit. The manual cord shall be connected to the cabinet door by use of a screw type connector. Plug in jack type connectors will not be accepted.

Signal On-Off Switch -- This switch shall activate a current carrying device for the signal loads. THIS SWITCH SHALL OVERRIDE ALL FLASH SWITCHES, DISCONNECTING POWER TO TRAFFIC AND PEDESTRIAN SIGNALS. The signal (On - OFF) switch shall not shut off the Controller Power. A cover shall be provided over the switches on the rear of the panel behind the auxiliary door.

A Heavy Plastic Envelope -- This envelope shall contain traffic plans, cabinet wiring diagrams, schematics, etc. The envelope shall be bolted to the inside of the cabinet door. The envelope shall be 304.8mm (12”) x 457.2mm (18”) or larger.

TOWN AND LOCATION:

The town and location shall be the town and street names on the traffic plan.

PROJECT NUMBER:

The project number shall be the state project under which the controller and cabinet are installed. When supplied for a development or under a permit other than a state project, that information shall be provided here. If purchased under the Department of Transportation annual bid, that shall be stated here as a substitute for the project number.

PURCHASE ORDER:

The purchase order shall be the number under which the Department of Transportation purchased the subject signal equipment through the annual bid.

CABINET MANUFACTURER:

The cabinet manufacture shall be the company that produced the cabinet. This may not necessarily be the company that produced the controller but a supplier to that company.

CONTROLLER MANUFACTURER:

The company name and address that produced the controller shall be furnished here along with the model number of the controller.

MANUFACTURING DATE:

The manufactured date shall be furnished here. This shall not be the ordered date, supplied date or the installed date.

CABINET SCHEMATIC IDENTIFICATION NUMBER:

The cabinet wiring diagrams identification number or numbers shall be recorded here. The identification number may be in any form the manufacturer desires; however, it must match the number on the schematics. It shall be possible to refer to this number to obtain accurate copies of the wiring diagrams from the manufacture at a later date.

SOLD BY:

The factory representative firm or local distributors name and address shall be furnished here. In addition the company or contractor directly responsible for installation of the D.O.T. annual bid shall be furnished here. The complete address of the company or companies shall be shown.

INTERSECTION NUMBER:

When possible this information shall also be supplied.

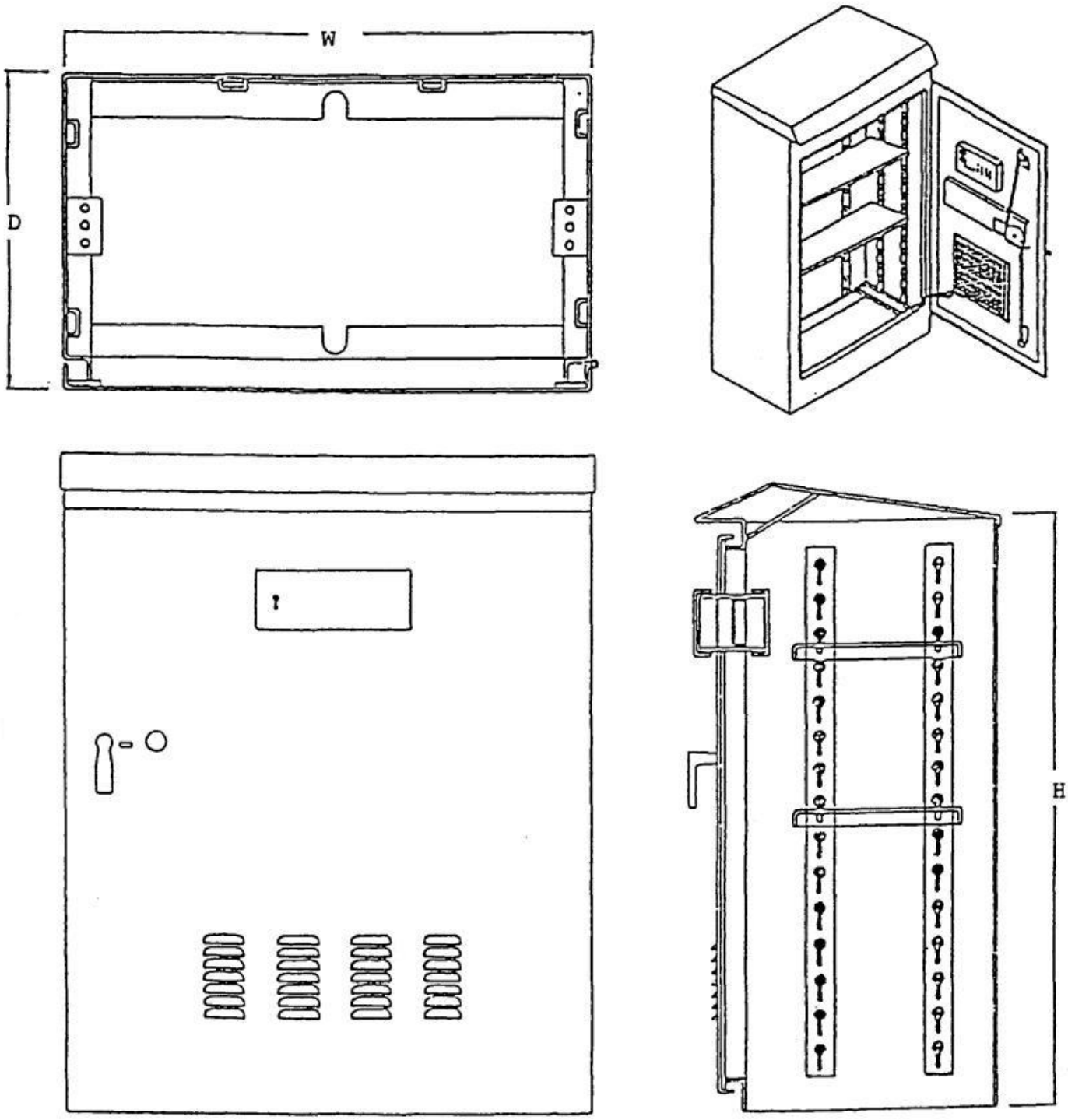


FIGURE #8

TYPICAL "B' CABINET

Item **“B” CABINET REQUIREMENTS**

4 Phase Base Mounted

DEPTH		WIDTH		HEIGHT		APPLICATION
Min.	Max.	Min.	Max.	Min.	Max.	
431.8mm	482.6mm	762mm	863mm	1321mm	1422mm	
(17″	to 19″)	(30″ to 34″)		(52″ to 56″)		4 Phase full actuated

Four (4) phase cabinets will be provided with a (8)phase preemption controller complete with all control, phase boards, relays, load switches, etc., necessary for four (4) phase operation even if two (2) phases are required on the traffic signal sequence and timing plan.

A fully wired and functional “D” harness with panel will be provided with all associated hardware defined below. All panels will be supplied with appropriate mounting hardware.

Test Buttons: Four functionally operational preempt test switches shall be mounted in section 4 of the cabinet layout. These switches must be the momentary on type, with one wired to call preempt #1 and labeled PREEMPT TEST #1, PreEmpts 2, 3 & 4 will be labeled and wired as appropriate. When a D harness is utilized a separate panel shall be included to perform the following functions. **Pre–Emption Returns**; all pre-emptions shall have (logic level low) returns wired to a spare terminal block.

Two relays will be supplied the first relay will be wired to remove AC+ from the optical pre-emption units during programmed flashing operation (if necessary or wired to spare terminals if not necessary). An additional relay with base shall be mounted in the upper quadrant of section 4 in the cabinet. These bases will be a Magnecraft type 70-169-1 8 pin octal industrial screw type terminal socket or equivalent. All terminals on Relay #1 & #2 bases shall be wired to a terminal block

within the same section. This terminal block will be labeled PE1 - PE22, and come wired with a switch which will supply / disconnect logic ground to PE-22.

One labeled “D” connector and harness shall be supplied and wired to the above mentioned (PE) terminal block located in section 4 of the cabinet. The connector shall be an AMP 205842-1 type connector and will be pinned out as follows:

CONNECTOR PIN	FUNCTION	TERMINAL BLOCK
1.	Preempt Input #1	PE-1
2.	Preempt Input #2	PE-2
3.	Preempt Input #3	PE-3
4.	Preempt Input #4	PE-4
5.	Preempt Input #5	PE-5
6.	Preempt Input #6	PE-6
7.	Preempt Output #1	PE-7
8.	Preempt Output #2	PE-8
9.	Preempt Output #3	PE-9
10.	Preempt Output #4	PE-10
11.	Preempt Output #5	PE-11
12.	Preempt Output #6	PE-12
13-68	NOT USED	

PREEMPT RELAY WIRING CHART

RELAY BASE TERMINAL NUMBER		
2.	Preempt relay 1 coil	PE-13
7.	Preempt relay 1 coil	PE-14
1.	Preempt relay 1 common	PE-15
3.	Preempt relay 1 N.O.	PE-16
4.	Preempt relay 1 N.C.	PE-17
2.	Relay #2 shall be	PE-18
7.	wired as needed to	PE-19

1.	disconnect Ac+ from	PE-20
3.	optical preemption	PE-21
4.	during programmed flash operation (if necessary).	PE-22

NOTE: All inputs and outputs are logic ground true levels. Wire harness must be 1.82M (6 ft) in length.. All harness wires must be #22 A.W.G.CONNECTOR TERMINAL

FIGURE #5

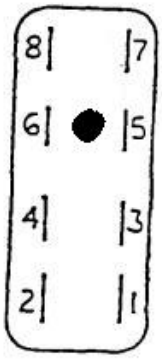
All 110 VAC Relays (flash, power and signal drive) shall meet the following requirements: No semi-conductors will be allowed in the coil circuit of this relay.

Base (Mounted In The Cabinet)

Venitron Beau Plug S-5408

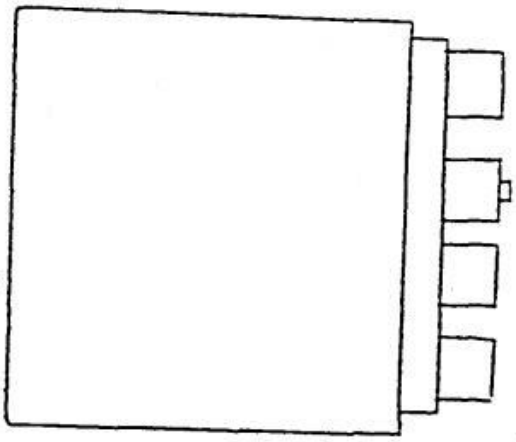
Socket or Equivalent

Contact Rating: 15 Amps @ 1750 VRMS



RELAY

Midland Ross, Midtex
136-62T3A1 or Equivalent
Housing: Plastic Enclosed
Coil: 120 VAC
Contacts: 3/8" Dia.
Silver Cadmium Oxide
Rating: 20 Amps @ 117 VAC Resistive
Plug: Venitron Beau Plug P-5408
or Equivalent



Contact No.	Relay Connection
1	Coil
2	Coil
3	Normally Closed Contact
4	Normally Closed Contact
5	Swinger Contact
6	Swinger Contact
7	Normally Open Contact
8	Normally Open Contact

Item **“B” CABINET**

4 phase base mounted

Section

Location (Refer to figure 9)	Components
1.	Controller, conflict monitor. door switch for lamp receptacle &controller indicators
2.	Uniform Code Flash Unit.
3.	Solid state load switch bases. A sufficient number to switch 24 individual solid state load switch circuits. 8 Solid state load switches shall be supplied. Wiring shall consist of 4 phase and OLA, OLB, OLC, OLD. Controller and other equipment terminal connections. The controller connector cables shall be N.E.M.A. connectors “A” “B” and “C” wired for 4 phase operation with all inputs and outputs wired to terminals. Signal Power Relays, flasher, and 4 flash relays. There shall be mounted and properly wired enough relays to switch 8 flash circuits.
4.	Included in this section shall be: A. 30 spare terminals. B. 1 neutral ground buss bar. C. 3 terminals with AC+ power. D. 3 terminals with AC-. E. 3 terminals with chassis ground. F. 3 terminals with controller logic

ground.

G. 1 terminal per phase vehicle call.

H. 1 terminal per phase ped call

I. 1 terminal per phase green output from load switch.

J. 1 terminal with flash call input.

K. 1 terminal with MAX 2 input.

5. Required number of circuit breakers, neutral ground buss, line filter, Solid State relay, and 110 VAC (GFCI) convenience output.

6. Detector test push buttons (4 vehicle and 4 pedestrian) special auto-flash switch, and UCF normal-inhibit switch.

TOP. lamp receptacle

NOTE: A minimum of 6 inches clearance from the cabinet base shall be provided for all components and terminals.

"B" CABINET LAYOUT AND COMPONENTS

REFER TO "B" CABINET COMPONENT LIST

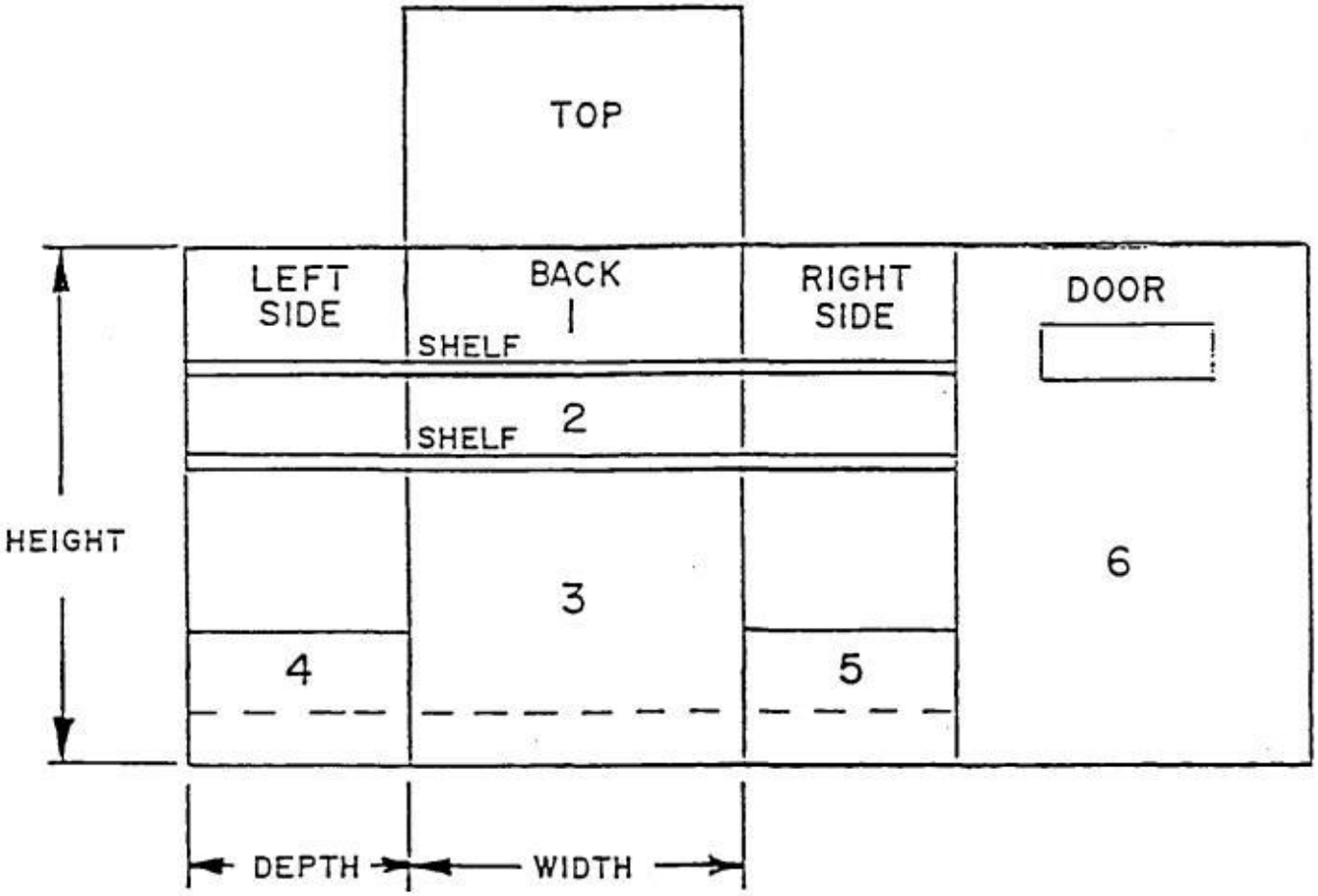


FIGURE #9

Item **“D” CABINET REQUIREMENTS**

8 phase Cabinet

DEPTH	WIDTH	HEIGHT	APPLICATION
Min. Max.	Min. Max.	Min. Max.	
635mm 686.8mm	1066.8mm 1143mm	1372mm 1473mm	
(25″ to 27″)	(42″ to 45″)	(54″ to 58″)	8 Phase full actuated

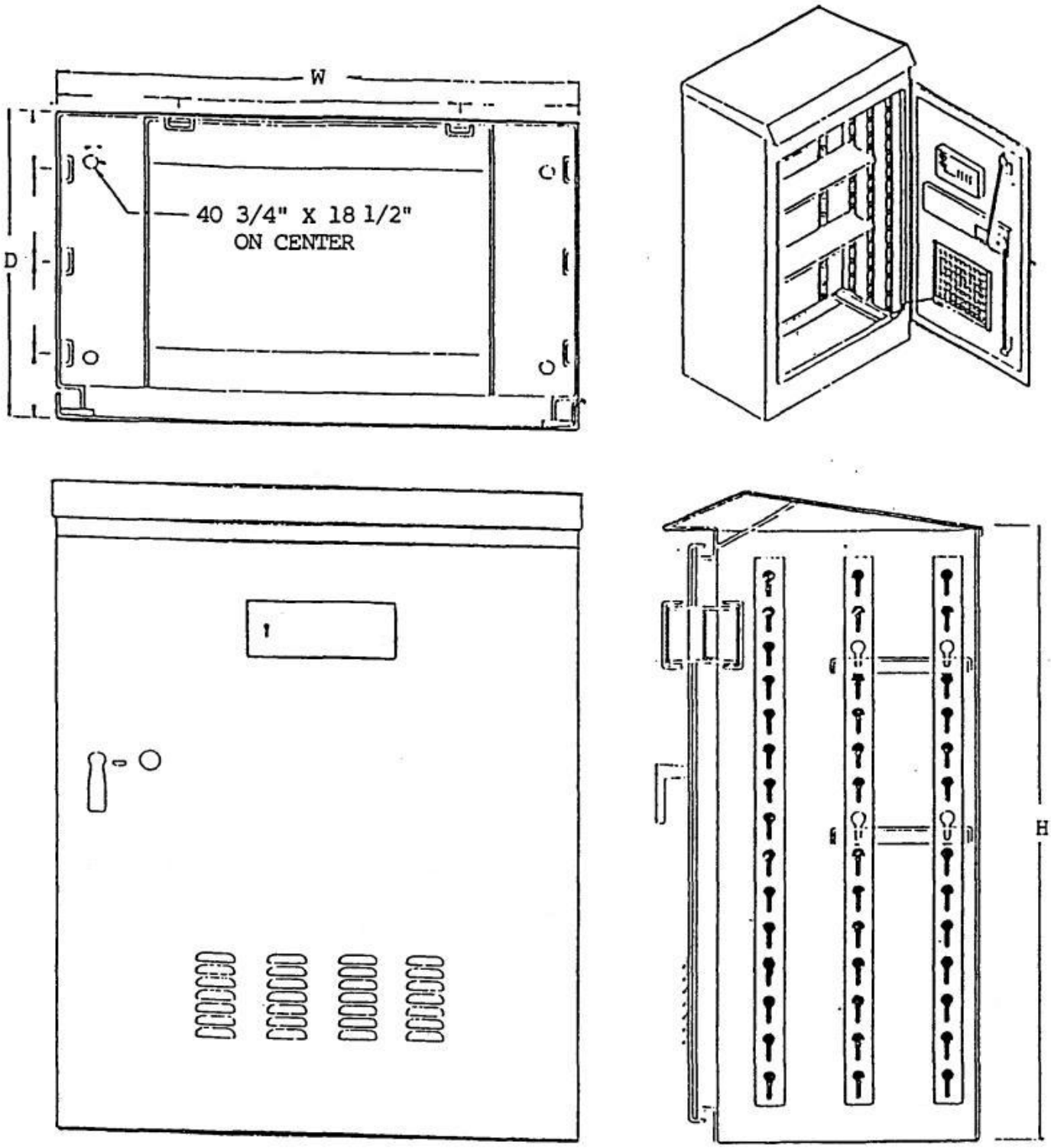


FIGURE #10

TYPICAL “D” CABINET

Item **“D” CABINET REQUIREMENTS**

8 Phase Cabinet

1. Controller, conflict monitor, door switch for lamp receptacle & controller indicators.
2. Uniform Code Flash unit.
3. Solid State load switch bases. A sufficient number to switch 36 individual solid state load switch circuits. 12 Solid state load switches. Signal power relay, dual circuit flasher, 6 flash relays. There shall be mounted and properly wired enough relays to switch 12 flash circuits. Controller input, output, and other equipment terminals connections. The controller connector cables shall be NEMA connectors A, B and C connected for 8 phase operation with all inputs and outputs wired to terminals. The harness shall be labeled A,B,C as appropriate.
4. Include in this section shall be:
   A. 45 spare terminals.
   B. 1 neutral ground buss bar.
   C. 3 terminals with AC+ power.
   D. 3 terminals with AC-.
   E. 3 terminals with chassis ground.
   F. 3 terminals with controller logic ground.

G. 1 terminal per phase vehicle call.

H. 1 terminal per phase ped call.

I. 1 terminal per phase green output from load switch.

J. 1 terminal with flash call input.

K. 1 terminal per MAX 2 input.

5. Required circuit breakers, line filter, signal power relay (solid state), and two (2) 110 VAC convenience outlets one (GFCI) and one non GFCI duplex.

6. Detector test push buttons (8 vehicle and 8 Pedestrian), special automatic-flash switch, UCF normal -inhibit switch, two door switches (for closed loop and light).

TOP. lamp receptacle, fan

NOTE: A minimum clearance of 152mm (6”) from the cabinet base shall be provided for all components and terminals.

”D” CABINET LAYOUT AND COMPONENTS

REFER TO “D” CABINET COMPONENT LIST

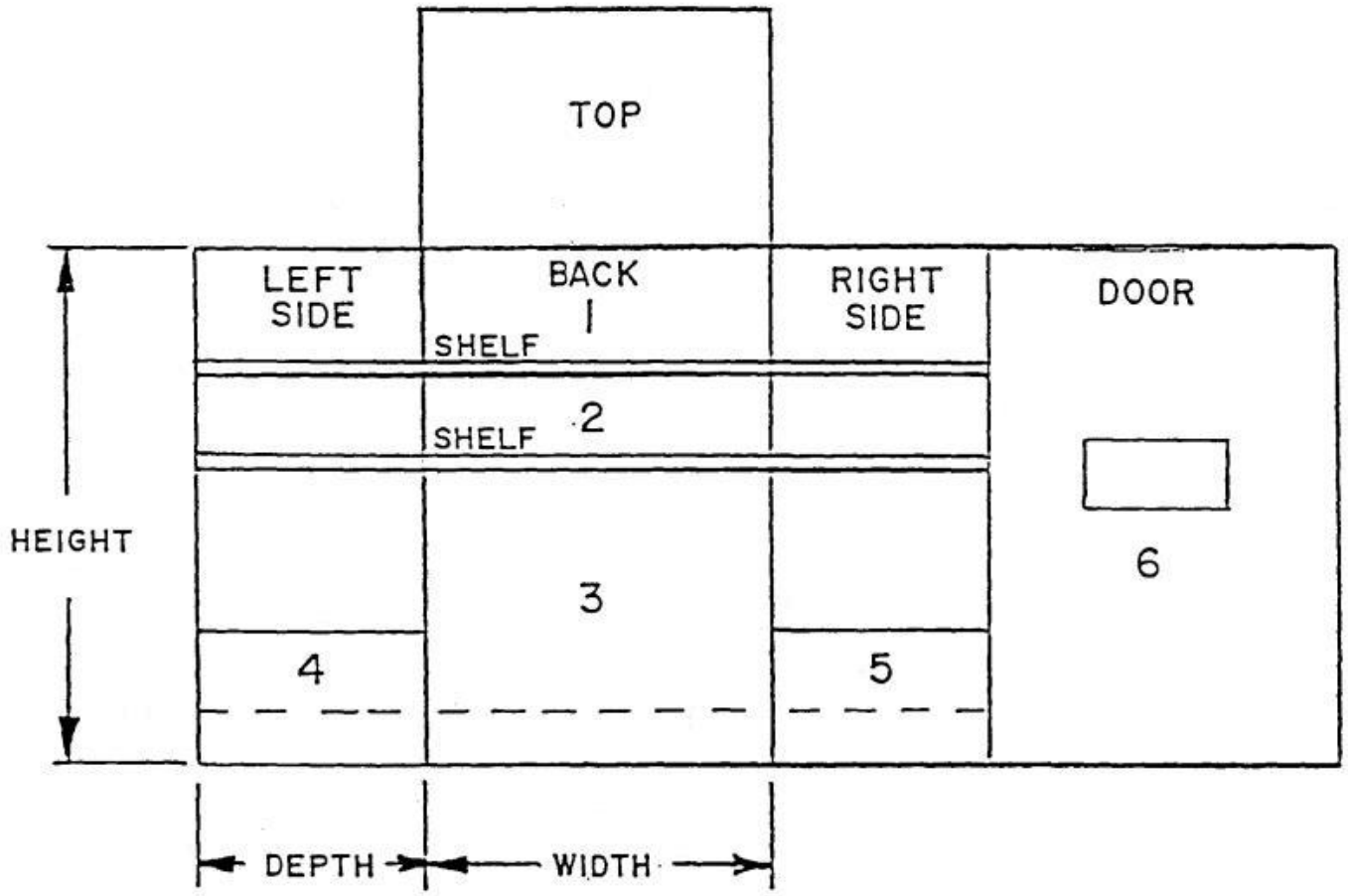


FIGURE #11

Item **“D” CABINET REQUIREMENTS (PREEMPTION TYPE)**

8 Phase Cabinet

NOTE:

All specifications pertaining to “C” type cabinets shall be applied to “D” type cabinets with the addition of the following:

Test Buttons: Four functionally operational preempt test switches shall be mounted in section 4 of the cabinet layout. These switches must be the momentary on type, with one wired to call preempt #1 and labeled PREEMPT TEST #1, Pre-Empts 2, 3 & 4 will be labeled and wired as appropriate. When a D harness is utilized a separate panel shall be included to perform the following functions. **Pre–Emption Returns**; all pre-emptions shall have (logic level low) returns wired to a spare terminal block.

Two relays will be supplied the first relay will be wired to remove AC+ from the optical pre-emption units during programmed flashing operation (if necessary or wired to spare terminals if not necessary). An additional relay with base shall be mounted in the upper quadrant of section 4 in the cabinet. These bases will be a Magnecraft type 70-169-1 8 pin octal industrial screw type terminal socket or equivalent. All terminals on Relay #1 & #2 bases shall be wired to a terminal block within the same section. This terminal block will be labeled PE1 - PE22, and come wired with a switch which will supply / disconnect logic ground to PE-22.

One labeled “D” connector and harness shall be supplied and wired to the above mentioned (PE) terminal block located in section 4 of the cabinet. The connector shall be an AMP 205842-1 type connector and will be pinned out as follows:

CONNECTOR PIN	FUNCTION	TERMINAL BLOCK
1.	Preempt Input #1	PE-1
2.	Preempt Input #2	PE-2
3.	Preempt Input #3	PE-3
4.	Preempt Input #4	PE-4
5.	Preempt Input #5	PE-5
6.	Preempt Input #6	PE-6

7.	Preempt Output #1	PE-7
8.	Preempt Output #2	PE-8
9.	Preempt Output #3	PE-9
10.	Preempt Output #4	PE-10
11.	Preempt Output #5	PE-11
12.	Preempt Output #6	PE-12
13-68	NOT USED	

PREEMPT RELAY WIRING CHART

RELAY BASE TERMINAL NUMBER		
2.	Preempt relay 1 coil	PE-13
7.	Preempt relay 1 coil	PE-14
1.	Preempt relay 1 common	PE-15
3.	Preempt relay 1 N.O.	PE-16
4.	Preempt relay 1 N.C.	PE-17
2.	Relay #2 shall be	PE-18
7.	wired as needed to	PE-19
1.	disconnect Ac+ from	PE-20
3.	optical preemption	PE-21
4.	during programmed	PE-22
	flash operation	
	(if necessary).	

NOTE: All inputs and outputs are logic ground true levels. Wire harness must be 1.82M (6 ft) in length. All harness wires must be #22 A.W.G.

Item **“E” CABINET REQUIREMENTS**

4 Phase Pedestal Mount

DEPTH		WIDTH		HEIGHT		APPLICATION
Min.	Max.	Min.	Max.	Min.	Max.	
685mm	482mm	762mm	812mm	1244mm	1321mm	
(27” to 19”)		(30” to 32”)		(49” to 52”)		4 Phase full actuated

Four (4) phase cabinets will be provided complete with all equipment stated on page 70 to 77. The controller supplied will be an (8) phase controller regardless of actual phases used.

A fully wired and functional “D” harness with panel will be provided with all associated hardware defined below. All panels will be supplied with appropriate mounting hardware.

Test Buttons: Four functionally operational preempt test switches shall be mounted in section 4 of the cabinet layout. These switches must be the momentary on type, with one wired to call preempt #1 and labeled PREEMPT TEST #1, Pre-Empts 2, 3 & 4 will be labeled and wired as appropriate. When a D harness is utilized a separate panel shall be included to perform the following functions. **Pre–Emption Returns**; all pre-emptions shall have (logic level low) returns wired to a spare terminal block.

Two relays will be supplied the first relay will be wired to remove AC+ from the optical pre-emption units during programmed flashing operation (if necessary or wired to spare terminals if not necessary). An additional relay with base shall be mounted in the upper quadrant of section 4 in the cabinet. These bases will be a Magnecraft type 70-169-1 8 pin octal industrial screw type terminal socket or equivalent. All terminals on Relay #1 & #2 bases shall be wired to a terminal block within the same section. This terminal block will be labeled PE1 - PE22, and come wired with a switch which will supply / disconnect logic ground to PE-22.

One labeled “D” connector and harness shall be supplied and wired to the above mentioned (PE) terminal block located in section 4 of the cabinet. The connector shall be an AMP 205842-1 type connector and will be pinned out as follows:

CONNECTOR PIN	FUNCTION	TERMINAL BLOCK
1.	Preempt Input #1	PE-1
2.	Preempt Input #2	PE-2
3.	Preempt Input #3	PE-3
4.	Preempt Input #4	PE-4
5.	Preempt Input #5	PE-5
6.	Preempt Input #6	PE-6
7.	Preempt Output #1	PE-7
8.	Preempt Output #2	PE-8
9.	Preempt Output #3	PE-9
10.	Preempt Output #4	PE-10
11.	Preempt Output #5	PE-11
12.	Preempt Output #6	PE-12
13-68	NOT USED	

PREEMPT RELAY WIRING CHART

RELAY BASE TERMINAL NUMBER		
2.	Preempt relay 1 coil	PE-13
7.	Preempt relay 1 coil	PE-14
1.	Preempt relay 1 common	PE-15
3.	Preempt relay 1 N.O.	PE-16
4.	Preempt relay 1 N.C.	PE-17
2.	Relay #2 shall be	PE-18
7.	wired as needed to	PE-19
1.	disconnect Ac+ from	PE-20
3.	optical preemption	PE-21
4.	during programmed	PE-22

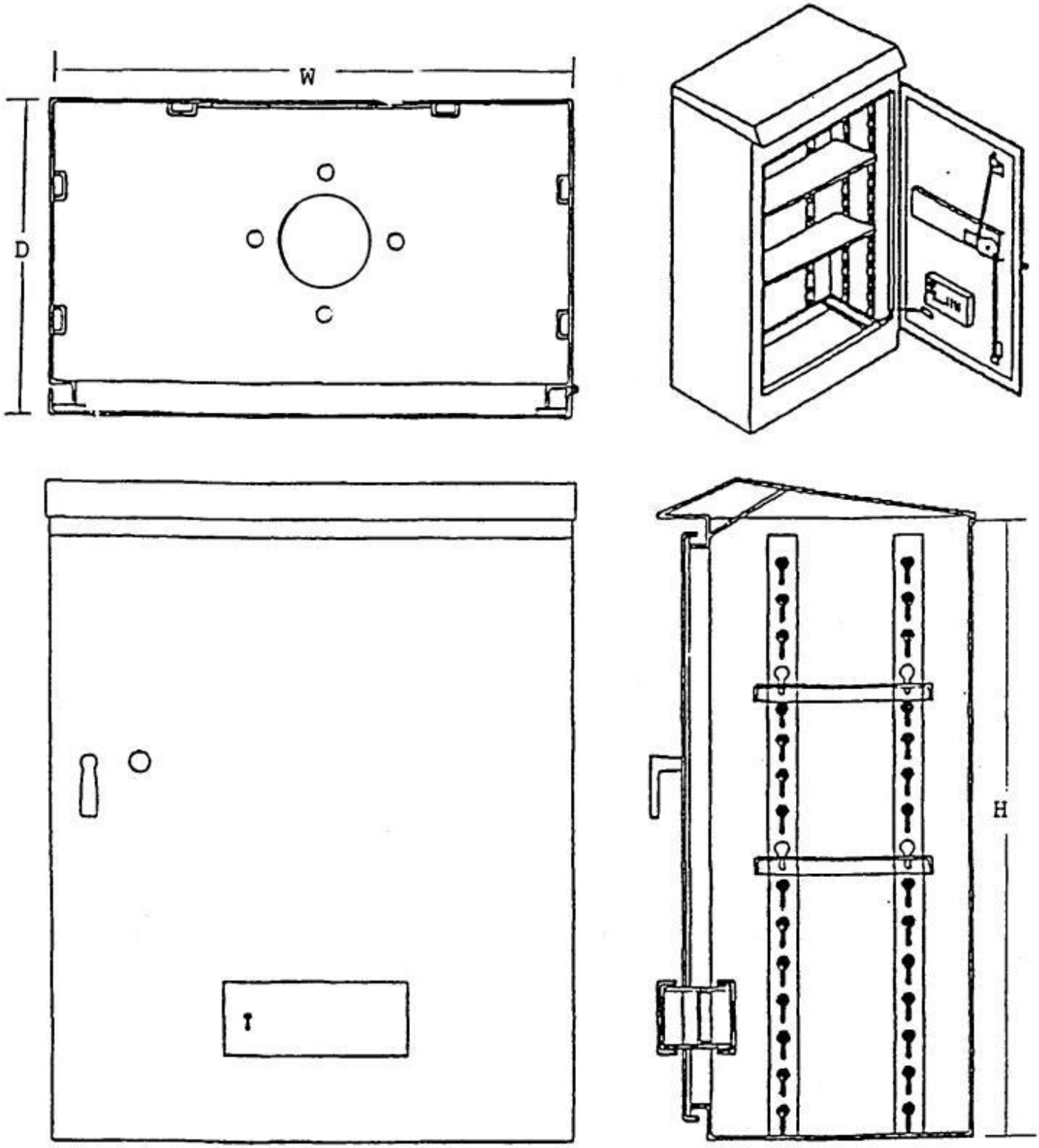
flash operation

(if necessary).

NOTE: All inputs and outputs are logic ground true levels. Wire harness must be 1.82M (6 ft) in length. All harness wires must be #22 A.W.G.

FIGURE #12

TYPICAL "E" CABINET



Item **“E” CABINET**

4 Phase Pedestal Mount

Section Location (Refer to Figure 13)	Components
1.	Controller, conflict monitor, door switch for lamp receptacle and controller indicators.
2.	Uniform Code Flash unit.
3.	Solid state load switch bases. A sufficient number to switch 24 individual solid state load switch circuits. 8 Solid state load switches. A sufficient number to switch 24 individual solid state load switch circuits. Wiring shall consist of 4 phases and OLA, OLB, OLC, OLD. Controller and other equipment terminal connections. The controller connector cables shall be N.E.M.A. connectors A and B wired for 4 phase operation with all inputs and outputs wired to terminals. Signal Power Relays, flasher, and flash relays. There shall be mounted and properly wired enough relays to switch 8 flash circuits.

4. Included in this section shall be:

A. 30 Spare terminals.

B. 1 neutral ground buss bar.

C. 3 terminals with AC+ power.

D. 3 terminals with AC-.

E. 3 terminals with chassis ground.

F. 3 terminals with controller logic ground.

G. 1 terminal per phase vehicle call.

H. 1 terminal per phase ped call.

I. 1 terminal per phase green output from load switch.

J. 1 terminal with flash call input.

K. 1 terminal with MAX 2 output.

5. Required number of circuit breakers, neutral ground buss, line filter, Solid State relay, and 110 VAC (GFCI) convenience output.

6. Detector test push buttons (4 vehicle and 4 pedestrian) special auto-flash switch, and UCF normal-inhibit switch.

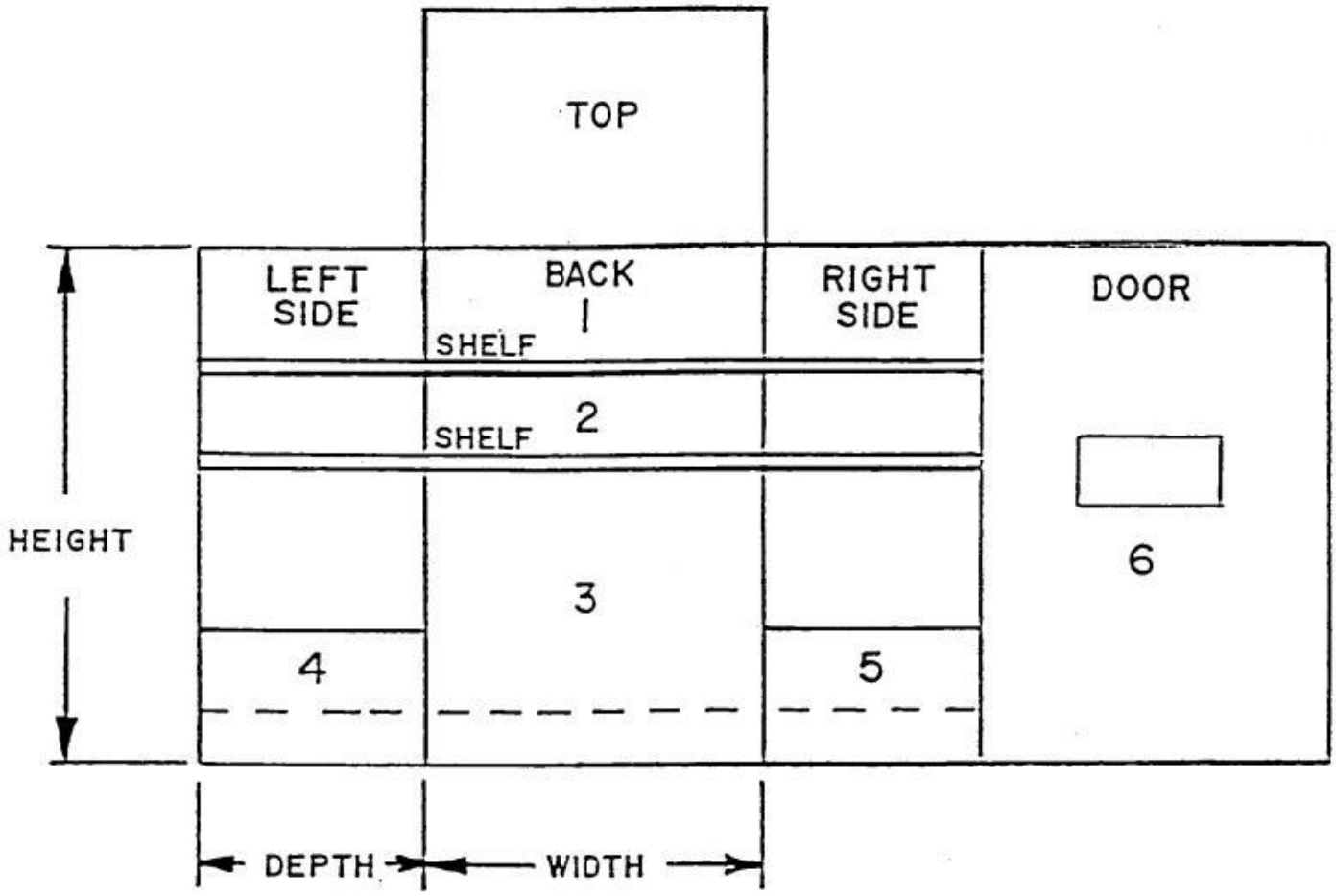
7. One steel pedestal adapter complete with hardware shall be supplied with each cabinet.

TOP. lamp receptacle, fan

Special Notes: A minimum of 50.8mm (2”) clearance from the cabinet base shall be provided for all components and terminals. The cabinet shall be constructed of fabricated aluminum and have a minimum thickness of 3.175mm (.125”) except the base which shall have a minimum thickness of 9.525mm [3/8 (.375”)]. Police door location shall be in upper half of the cabinet front door. A neatly finished and painted 101.6mm (4”) pedestal adapter shall be furnished with each cabinet.

”E” CABINET LAYOUT AND COMPONENTS

REFER TO “E” CABINET COMPONENT LIST



NOTE: SECTION 7 = CABINET BOTTOM

FIGURE #13

CABINET PRINTS:

All prints shall be 610mm x 914mm (24” x 36”)

Each sheet shall have the town and intersecting street names, exactly as shown on the traffic plan, also when possible the intersection number, located in the lower right corner. Included shall be the sheet number and the number of sheet in sequence.

Two (2) sheets are the maximum number permissible. Sheet No. 1 shall include the controller harness, conflict monitor harness, load switches, M.U.T.C.D. flash, fan, circuit breaker, fuse, standard flash and power relays, switches, all terminals including spares, and any other accessory or component required in Section 1 or 2 of the current Conn. D.O.T. annual specification. All harness connector connections must be shown, including coordination units, time clocks, preemptors and detectors. The harness connection diagrams must describe all numbers or letters of the connectors, their function, and where they terminate.

If accessory equipment other than those covered under Item 3 above is added and cannot be accommodated on Sheet No. 1, then it must be incorporated on Sheet No. 2.

Field Hook-up must be shown on Sheet 1 or 2 as a separate chart. Signals, detectors, and coordination, etc.

Face No.	G	A	R	Yellow Arrow	Green Arrow
1	202	203	204	227	226
2	206	207	208		

Detector

D1 Loop 211 - 212

D2 Mag 213 - 214

Coord

Offset 1 223

Offset 2 224

Special pertinent information such as: Conflict Monitor jumpers, controller start-up, overlap program, I.C. socket locations, etc. must be clearly shown on cabinet wiring diagrams.

All equipment (controller, conflict monitor, UCF, time clock, etc.) shall be identified by manufactures' model or part number. Relays, timers and etc. Shall have voltage rating, plug configuration and typical wiring shown on the prints.

Four sets of legible cabinet schematics and wiring diagrams of controller and all auxiliary equipment shall be supplied.

One comprehensive service manual for each type of controller, signal monitor, cord. Unit, flasher, detectors, etc. And a comprehensive parts list detailing all replaceable parts and components as to manufacturer's part number and commercially available part number shall be supplied.

All wires not shown as a line-to-line connection in the diagrams, shall be labeled at their origin and termination (point-to-point type schematic). Therefore, forward and reverse circuit tracing may be accomplished from any point.

Cabinet print wiring diagrams must match the actual cabinet wiring. Mark-overs or separate corrective lists will not be acceptable.

If you have any questions, please contact the Connecticut Department of Transportation.

SECTION 3 VEHICLE DETECTORS

ITEM 3B Loop Detector With Delay/Extend Option

ITEM 3B1 LCD Vehicle Loop Detector

ITEM 3C Magnetic Vehicle Amplifier with cable

ITEM 3D Magnetic Vehicle Detector non-compensated type

SECTION 3 B - LOOP VEHICLE DETECTOR WITH DELAY/EXTEND OPTION

DESCRIPTION:

This item shall consist of furnishing a loop vehicle detector amplifier and cable in accordance with the following requirements. Changing settings or functions shall be achieved by a front mounted switche or switches for program options. If program options are used, all program information will be stored in non-volatile memory and can only be changed by programming new settings (power loss will not result in default settings).

1. **Functional Requirements:**

The loop detector shall be an electronic device, capable of detecting the presence of a moving or parked vehicle; and the detection shall be accomplished by the presence of a parked or moving vehicle over a wire loop embedded in the roadway.

Loop Frequency: The detector shall be capable of selecting various operating frequencies by changing switch positions located on the front of the amplifier.

Sensitivity: Additional switches located on the front panel shall be capable of changing the sensitivity of the amplifier to compensate any loop/lead network and provide for an ideal operating range.

It shall be possible to select a minimum of the following modes of operation which shall function as follows:

(A) **Mode 1 - Pulse Detection** - The detector sensing unit shall detect a vehicle as slow as 0.1609 kilometers per hour (1/10 mph) entering the loop. If a vehicle stops over a portion of the loop such as waiting for a left turn, the remaining portion of the loop shall detect additional

vehicles passing over the unoccupied portion of the loop. The time for the remaining portion of the loop to become capable of detecting additional vehicles shall be no longer than the minimum time it takes for the next vehicle to pass over the loop.

(B) **Mode 2 - Long Detection** - The detector sensing unit shall detect a vehicle as slow as 0.1609 kilometers per hour (1/10 mph) entering the loop. When a vehicle remains over the loop or a portion thereof, the detector sensing unit shall cause detection to persist up to at least 10 minutes. After this period any vehicle passing over the unoccupied portion of the loop shall be detected.

2. Electrical Requirements:

The detector sensing unit shall operate on 115 volts, 60 cycles A.C. and shall draw not more than 15 watts. The unit shall contain an integral regulated power supply which will operate independent of line voltage variations between 100 and 135. The power supply shall be regulated by zener reference and series regulation and shall be fused. The detector shall operate properly at all temperatures between -34.44°c and 65.55°c (-30^{0}F. and +150^{0}F). An automatic frequency control feature and an automatic equalization feature shall be included in the detector to compensate for long term drift due to environmental changes. The detector shall be solid state with the exception of the output relay.

3. Mechanical Requirements:

The detector shall be housed in a durable finished fabricated sheet aluminum case. No special tool shall be required for removal of the cover. Removal of the cover shall provide access to the entire circuit and all components while the unit is connected and operating. The electrical connections of both the incoming and outgoing circuits shall be made by means of a suitable multi pin plug. The entire unit shall be replaced with a similar unit without the necessity of disconnecting and reconnecting individual wires leading therefrom. The plug receptacle shall be attached to one end of a connecting cable (included with the unit) at least 1829mm (72 inches) long. The plug connector shall not have split pins that can be spread apart during amplifier cable installation causing connection problems. The cable

shall be color coded as shown and all wires within the cable shall be a minimum # 22 A.W.G. stranded. The cable shall come with a preinstalled wiring harness cover for protection (loom type).

A switch mounted on the front of the detector unit shall be provided for selecting the mode of operation to be in effect. Also mounted on the front of the detector will be an indicator light which will register vehicle actuations.

PRINTS:

Two sets of component level electrical schematics and hook-up prints are to be supplied with each unit ordered.

DELAY OPERATION:

Delays output until vehicle presence has been sustained for the time selected. Call delay shall start counting when a vehicle enters the loop detection zone, and shall reset with each gap. Whenever a phase green input (pin j “Timer override”) signal is active, (110vac) timing shall be aborted and the call delay timer forced to zero. Timing range shall be 0 - 31 seconds in one second increments.

EXTENDED OPERATIONS:

Extends output for the time selected after the vehicle leaves the loop. Call Extension shall start counting when a vehicle leaves the detection zone, and shall reset with each detection. Timing range shall be 0 - 15.5 in 1/2 second increments.

SELECT SWITCH:

Front panel mounted to select or delete timer operation.

INDICATORS:

A call indication when a vehicle is detected.

An indicator showing if a loop has failed due to high or low inductance or if loop inductance has changed by more then 25%.

An indicator to display both an open and/or a shorted loop condition.

MS CABLE CONNECTOR 3106a-18-1S

PINS	COLOR	FUNCTIONS
A.	WHITE	110 VAC (Neut.)
B.	BROWN	Common relay, moving contact
C.	BLACK	110 VAC (Fused)
D.	RED	Loop
E.	ORANGE	Loop
F.	YELLOW	Relay contact closes with moving contact when detecting vehicle.
G.	BLUE	Relay contact, opens with moving contact when detecting vehicle.
H.	GREEN	Chassis Ground.
J.	GRAY	110 VAC Delay/Extend Override.
SHELL		Ground (Shall be connected to pin H in the connector.)

ITEM 3B1 LCD Vehicle Loop Detector

DESCRIPTION:

This item shall consist of furnishing a Liquid Crystal Display vehicle loop detector amplifier and cable in accordance with the following requirements. Changing settings or functions shall be achieved by front mounted switches with a LCD display for accessing program options. All program information will be stored in non-volatile memory and can only be changed by programming new settings (power loss will not result in default settings).

Display

The display will be back light and easily readable regardless of time of day or ambient conditions. The display will adequately indicate the staus of the following fucnctions as well as all programming options.

A call indication when a vehicle is detected.

A display of the loop inductance in microhenries

A display indicating the change of inductance when a vehicle entires the detection zone.

A display showing if a loop has failed due to high or low inductance or if loop inductance has changed by more then 25%.

A display to indicate both an open and/or a shorted loop condition.

Functional Requirements:

The loop detector shall be an electronic device, capable of detecting the presence of a moving or parked vehicle; and the detection shall be accomplished by the presence of a parked or moving vehicle over a wire loop embedded in the roadway.

Loop Frequency: The detector shall be capable of selecting various operating frequencies by changing software settings.

Sensitivity: Additional software options shall be capable of changing the sensitivity of the amplifier to compensate any loop/lead network and provide for an ideal operating range. A segmented bar graph shall be utilized to display the correct level of sensitivity.

It shall be possible to select a minimum of the following modes of operation which shall function as follows:

(A) **Mode 1 - Pulse Detection** - The detector sensing unit shall detect a vehicle as slow as 0.1609 kilometers per hour (1/10 mph) entering the loop. If a vehicle stops over a portion of the loop such as waiting for a left turn, the remaining portion of the loop shall detect additional vehicles passing over the unoccupied portion of the loop. The time for the remaining portion of the loop to become capable of detecting additional vehicles shall be no longer than the minimum time it takes for the next vehicle to pass over the loop.

(B) **Mode 2 - Long Detection** - The detector sensing unit shall detect a vehicle as slow as 0.1609 kilometers per hour (1/10 mph) entering the loop. When a vehicle remains over the loop or a portion thereof, the detector sensing unit shall cause detection to persist up to at least 10 minutes. After this period any vehicle passing over the unoccupied portion of the loop shall be detected.

Electrical Requirements:

The detector sensing unit shall operate on 115 volts, 60 cycles A.C. and shall draw not more than 15 watts. The unit shall contain an integral regulated power supply which will operate independent of line voltage variations between 100 and 135. The power supply shall be regulated by zener reference and series regulation and shall be fused. The detector shall operate properly at all temperatures between -34.44°c and 65.55°c (-30^{0}F. and +150^{0}F). An automatic frequency control feature and an automatic equalization feature shall be included in the detector to compensate for long term drift due to environmental changes. The detector shall be solid state with the exception of the output relay.

Mechanical Requirements:

The detector shall be housed in a durable finished fabricated sheet aluminum case. No special tool shall be required for removal of the cover. Removal of the cover shall provide access to the entire circuit and all components while the unit is connected and operating. The electrical connections of both the incoming and outgoing circuits shall be made by means of a suitable multi pin plug. The entire unit shall be replaced with a similar unit without the necessity of disconnecting

and reconnecting individual wires leading therefrom. The plug receptacle shall be attached to one end of a connecting cable (included with the unit) at least 1829mm (72 inches) long. The plug connector shall not have split pins that can be spread apart during amplifier cable installation causing connection problems. The cable shall be color coded as shown and all wires within the cable shall be a minimum # 22 A.W.G. stranded. The cable shall come with a preinstalled wiring harness cover for protection (loom type).

Also mounted on the front of the detector will be an indicator light which will register vehicle actuations.

PRINTS:

Two sets of component level electrical schematics and hook-up prints are to be supplied with each unit ordered.

DELAY OPERATION:

Delays output until vehicle presence has been sustained for the time selected. Call delay shall start counting when a vehicle enters the loop detection zone, and shall reset with each gap. Whenever a phase green input (pin j “Timer override”) signal is active, (110vac) timing shall be aborted and the call delay timer forced to zero. Timing range shall be 0 - 31 seconds in one second increments.

EXTENDED OPERATIONS:

Extends output for the time selected after the vehicle leaves the loop. Call Extension shall start counting when a vehicle leaves the detection zone, and shall reset with each detection. Timing range shall be 0 - 15.5 in 1/2 second increments.

MS CABLE CONNECTOR 3106a-18-1S

PINS	COLOR	FUNCTIONS
A.	WHITE	110 VAC (Neut.)
B.	BROWN	Common relay, moving contact
C.	BLACK	110 VAC (Fused)
D.	RED	Loop
E.	ORANGE	Loop
F.	YELLOW	Relay contact closes with moving contact when detecting vehicle.
G.	BLUE	Relay contact, opens with moving contact when detecting vehicle.
H.	GREEN	Chassis Ground.
J.	GRAY	110 VAC Delay/Extend Override.
SHELL		Ground (Shall be connected to pin H in the connector.)

Section 3C Magnetic Vehicle Amplifier with Cable
Section 3D Magnetic Vehicle Detector - Non-Compensated

The magnetic detector shall consume no power and shall contain no moving parts, and shall not be rendered inoperative or continuously operated by parked cars or other fixed iron objects such as road reinforcement, water or gas pipes, which may be within its zone of influence. Extremes of temperature or humidity shall not affect proper operation of the magnetic detector equipment. The detector shall be moisture proof and capable of withstanding all soil conditions without impairment to its efficiency. All coils shall be water-proofed by the vacuum impregnation process.

The magnetic detector shall have sufficient mechanical strength to withstand the transmitted shock of traffic without damage.

The detector, in combination with the magnetic detector amplifier, shall be capable of providing road coverage adjustable up to 4.572 meters (15 ft) from the detector, this coverage being subject to speed limitations approximately as follows, intermediate values being proportional.

(a) For 4.572 meters (15 ft) from the detector - speeds of 19.3 to 96.5 kilometers per hour (12 - 60 mph).

(b) For 3.04 meters (10 ft) from the detector - speeds of 12.8 to 96.54 kilometers per hour (8 to 60 mph).

(c) For 1.52 meters (5ft) or less from the detector - speeds of 6.43 to 96.5 kilometers per hour (4 to 60 mph).

The magnetic detector elements shall be housed in an appropriate non-ferrous case. The detector shall have an internal resistance of not more than 3,500 ohms and shall be designed for operation with magnetic detector amplifier of the solid state type.

Each detector shall be provided with rubber covered leads at least 10.6 meters (35ft) long.

The housing for the magnetic detector element shall be constructed of one piece corrosion resistant brass, aluminum or plastic.

The amplifier unit shall be fully solid state. All circuits shall be designed to provide stable operation within ambient temperature range of -34.41° to 73.88°

degrees Celsius (-30^{0}F. To + 165^{0}F). The magnetic detector amplifier unit shall be designed for operation on a nominal 120 volt 60 cycle, single phase A.C. supply.

The unit shall be housed in a durably finished fabricated sheet aluminum case. Removal of the unit from its case shall require the use of simple tools. When the unit is removed from the case, it shall be possible to gain access to the printed circuit panel and components. Electrical connections of both the incoming and outgoing circuits shall be made by means of a suitable plug. The unit shall be replaceable with a similar unit without the necessity of disconnecting or reconnecting individual wires leading therefrom. The plug shall be of protected male construction and rigidly fixed to the front of the unit. The mating plug receptacle shall attach to one end of a connecting cable (included with the unit) at least 1828.8 millimeters (72”) long. The other end of the connecting cable shall have color coded leads as shown. All cable wires shall be a minimum of No. 22 A.W.G. stranded.

The sensitivity of the unit shall be dial adjustable and continuous over the full range.

The registration of overlapping impulses from two detector amplifier units shall be ensured by the use of normally open and normally closed contacts provided on the output relay. Any contact that opens or closes in response to vehicle actuations shall be capable of making, breaking, and carrying three amperes at 120 volts A.C.

The front panel of the detector amplifier unit shall contain a “Detection Indicator Lamp” that will pulse as each actuation is registered.

Each manufacturer shall include in their proposal all warranties and guarantees with respect to materials, parts, workmanship, and performance of their product.

PRINTS:

Two sets of schematics and hook-up prints are to be supplied with each unit ordered.

Connector; Circular MS Type, Amphenol 18-8S or Equivalent

PIN	COLOR	FUNCTION
A.	GRAY ***	Detector -
B.	BROWN ***	Detector +
C.	BLACK	117 VAC (AC+)
D.		Spare
E.	BLUE	Relay common (Detector Common)
F.	PURPLE	Relay Normally Open (Detector Call)
G.	YELLOW	Relay Normally Closed
H.	WHITE	117 VAC (AC-)
Shell	BARE	Ground (Note: Minimum No. 18 A.W.G. Stranded)

***** NOTE:** White and Black may be used for pins A & B respectively if they are individual incased in separate cover.

SECTION 4
ADJUSTABLE TRAFFIC SIGNALS

Sections

4AS	1-Way 3-Section 8″ R, Y, G
4BS	1-Way 3-Section 12″ R, 8″ Y, 8″ G
4CS	1-Way 3-Section 12″ R, Y, G
4DS	1-Way 3-Section 12″ R, Y Green Arrow.

4AS-4DS 3-Sections use LED type signals for all colors.

4ES	1-Way 3-Section 12″ R, Yellow & Green Turn Arrows.
4FS	1-Way 4-Section 12″ R, Y, G, Green Turn Arrow.

4ES-4FS 3&4 Sections use LED type signals for all colors.

4L12RS	1-Way 1-Section 12″ Red LED type.
4L12YS	1-Way 1-Section 12″ Yellow LED type.
4LYAS	1-Way 1-Section 12″ Yellow Arrow LED type.
4LGAS	1-Way 1-Section 12″ Green Arrow LED type.
4LG/YAS	1-Way 1-Section 12″ Green/Yellow Arrows LED type.

ADJUSTABLE TRAFFIC SIGNALS (STANDARD)

GENERAL:

The components of a traffic control signal head assembly or unit shall conform to the I.T.E. requirements for Adjustable Face Traffic Control Signal head Standards Technical Report, Number 1 of latest issue.

Each signal head shall be of the adjustable, vertical type with the number and type of sections as specified and shall provide a light indication in one direction only and shall be adjustable through 360 degrees without removal from the mounting bracket. All signal heads shall be standard and shall contain three lamps arranged as follows: red top, yellow center, green bottom all will be L.E.D (TYPE) lamps. All signals will be supplied fully assembled including visors in individual stackable boxes.

HOUSING:

The signal head housing shall be made of a die cast aluminum alloy per A.S.T.M. Specification B-85-60. The Signal head housing shall consist of an assembly of three separate sections, expandable type, for vertical mounting substantially secured together in a water tight and rigid manner to form a unit of pleasing appearance. Each section shall house an individual optical unit. The signal head shall be so designed that sections may be added or removed from the head assembly by the use of simple tools.

The housing shall be a die casting, rigidly constructed with smooth outer surface. There shall be a round opening in the top and bottom of each head to receive a 38.1 millimeter (1-1/2”) supporting pipe frame. The portion of the housing section around the opening shall be reinforced and serrated or indexed so that serrated or equal fittings may be used to secure the housing.

The top and bottom of each section shall include such other openings as are necessary to accommodate fastening devices to hold sections together and such openings shall not admit foreign particles.

Each section shall be positively indexed with respect to an adjacent section to prevent misalignment. Each housing section shall be equipped with a door with an opening and fittings for the optical unit and visor.

The door shall be arranged for easy access to the optical components and wiring. It shall be hinged on its left side so that the door cannot be removed without the use of tools at two points and shall be provided with a simple, positive-acting door locking device which shall be made from stainless steel to assure tight closure. The housing or door shall be recessed to receive a gasket made of neoprene to provide a resilient seal between the door and housing. The gaskets will be secured with silcone into the door grove to prevent accidental removal or loss of weather integrity. The body and door of each housing section shall be of a die cast aluminum alloy and shall be clean, smooth, and free from flaws, cracks, blow holes, or other imperfections. The door locking device and visor fastening screws shall be made of stainless steel. All other terminal strips, screws, nuts, washers, hinge pins, latch parts, clips and parts used in the assembly of the signal housing shall be made of either naval brass, overdrew, phosphor bronze, stainless steel or approved equal. Each section of the housing shall be provided with the removable visor of not less than #16 U.S. gauge aluminum of the cap visor type. The CAP VISOR shall be painted a flat black on the inside to prevent reflection and must also eliminate sun phantom. The CAP VISOR shall fit snugly against the door and shall not permit any perceptible filtration of light between the door and the visor.

A terminal block shall be mounted inside at the back of the housing near or below center of the top section. The terminal blocks shall have five terminals to accommodate all field wires and lamp wires independently to the block with separate screws. Terminal block to be Kulka type 602 or equivalent with spade connectors.

OPTICAL DRIVE:

The optical unit shall consist of a self contained LED Lamp. The optical unit shall be readily accessible for maintenance. Lenses shall be CLEAR regardless of LED Lamp color and circular in shape, with visible diameter of 203 millimeter (8 in), or 304.8 millimeter (12 in), as required, and of such design as to give an

outward and downward distribution of light with a minimum above the horizontal. A lamp gasket shall be provided between the lamp and the signal door. The two ends of the lamp gasket shall be joined together by vulcanizing or other approved method.

Beam Color - meet ITE specifications.

Beam Intensity - meet ITE specifications, or Department approval. Yellow L.E.D intensity is required to be twice the ITE requirement for reds.

Beam Pattern - meet ITE pattern specification.

Traffic Lamps:

Each LED lamp shall have the word “Top” marked on its flange to indicate proper positioning of the lens in the door together with the trademark of the lens manufacturer and a label indicating conformance with the specifications set forth in the I.T.E. standards. The lens and its gasket shall provide weathertight and dust-tight construction. The gasket shall be of molded heat resistant neoprene.

LED Lamp removal shall be designed such that personnel can easily replace the lamp without the loss of hardware caused by short screws and weak tabs. Approval of fastening method will be at the discreation of the engineer.

Refer to the LED Lamp Sections 4L & 4LA for complete specefications.

L.E.D. lamps shall be **warranted** for a minimum of **five years**.

L.E.D. shall have **color coded 16 AWG wires** for identification of heads as follows,

RED L.E.D.’s	**RED** with **WHITE** neutral.
YELLOW L.E.D.’s	**YELLOW** with **WHITE** neutral.
GREEN L.E.D.’s	**GREEN or Brown** with **WHITE** neutral.

ARROWS

RED L.E.D. ARROWS	**RED/WHITE** with **WHITE** neutral.
YELLOW L.E.D. ARROWS	**YELLOW/WHITE** with **WHITE** neutral.
GREEN L.E.D. ARROWS	**GREEN/WHITE or Brown/White** with **WHITE** neutral.

GREEN/YELLOW L.E.D ARROWS **GREEN/WHITE or Brown/White** with **WHITE** neutral.
YELLOW/WHITE

Wires shall be terminated with Bowma-Crimp style forked spade lugs, 6-8 stud / 16-14 wire size. No quick connect or slide in male / female connections shall be accepted.

PAINTING:

Signals shall be painted with a powder coat type material. The powder shall be applied using electrostatic method upon the chemically cleaned surface. Powdered plastic resins using an electro-static spray shall be bonded to the outside surfaces of the traffic cabinet assembly. The powder coating process shall utilize a dry painting process that combines the use of an electro-static application to fuse the dry paint to the surface. The dry paint shall be comprised of resins and pigments for color. The color for signals shall be, Dark Green enamel federal # 14056 - and shall comply with Federal Specification.

CLEANING:

All exterior surfaces shall be cleaned and prepared in a manner consistent with industry standards for sheet aluminum products prior to application of powder coating paint.

VISORS:

The inside of the visors shall be coated with flat black and the outside Dark Green enamel federal # 14056.

Note: All visors shall be attached to the signal before shipment and shall be the “twist on type”, secured to the signal by four equidistant flat tabs screwed to the signal head by 10/32 x 3/4 screws.

SECTION 4L

L.E.D. TRAFFIC SIGNAL LAMPS CIRCULAR

4L12R 304.8 millimeter (12 in) RED

4L12Y 304.8 millimeter (12 in) YELLOW

4L12G 304.8 millimeter (12 in) GREEN

4L8R 203 millimeter (8 in) RED

4L8Y 203 millimeter (8 in) YELLOW

4L8G 203 millimeter (8 in) GREEN

GENERAL: All L.E.D Circular Ball Lamps shall meet the 2005 ITE VTCSH requirements. VTCSH Light Emitting Diode (LED) Circular Signal Supplement.

The Optical unit shall be certified as meeting the 2005 ITE Specifications by Intertek Testing Services Inc,(ETL Verified Mark)or another organization currently recognized by the Occupational Safety and Health Administration (OSHA) as a National Recognized Testing Laboratory (NRTL).

Addtionally a “Swing Test” will be performed by the department to ensure no significant dimming or blanking occurs, until the lamp is obscured by the visor. All L.E.D Lamps will be subjected to further field testing for reliable operation.

ELECTRICAL REQUIREMENTS:

Operating voltage 80 to 135 volts AC.

All L.E.D. Lamps shall adhere to the following maximum power requirements.

304.8 millimeters (12 inch) 16 watts or approved by department engineers.

203 millimeters (8 inch) 16 watts or approved by department engineers.

A filtered power supply engineered to electrically protect the LEDs and maintain a safe and reliable operation. All lamps shall be capable of flash operation with no restrictions or degradation of performance.

OPTICAL:

Beam Color - meet 2005 ITE specifications.

(**CLEAR LENS COVERS WILL BE** REQUIRED FOR ALL L.E.D Lamps)

MECHANICAL:

Diameter - fits all regular 203 or 304.8 millimeter (8 or 12 in) housings.

Material – meet 2005 ITE specifications.

Temperature / Environment meet ITE 2005 ITE requirements.

A neoprene gasket will be provided to maintain a resilient seal between the lens and housing.

The L.E.D. module shall be warranted for five years and perform to the requirements of the 2005 ITE specification for a minimum of 60 months.

L.E.D. lamps shall have **color coded 16 AWG wires** for identification of heads as follows,

RED L.E.D. Lamps	**RED** with **WHITE** neutral.
YELLOW L.E.D. Lamps	**YELLOW** with **WHITE** neutral.
GREEN L.E.D. Lamps	**GREEN or Brown** with **WHITE** neutral.

Wires shall be terminated with a Bowma-Crimp style forked spade lug, 6-8 stud / 16-14 wire size.

Wire Length: All solid L.E.D Lamps shall be supplied with a minimum of 40 inch pigtails.

NOTE: All types of L.E.D Lamps shall have a normal failure rate of less than 1%, failure rates higher may be cause for rejection.

Identification: All L.E.D Lamps shall have the Model# date of manufacturing and the power consumption identified on the backside. The model number shall end with the number of L.E.D’s used to comprise the unit as the last digits of the model number. Example if the unit is comprised of **3** L.E.D’s and the model number is x12y then the new model number shall read x12y**3.**

SECTION 4LA
Extended View
L.E.D. TRAFFIC SIGNAL LAMPS ARROWS

4LRA 304.8 millimeter (12 in) RED ARROW

4LYA 304.8 millimeter (12 in) YELLOW ARROW

4LGA 304.8 millimeter (12 in) GREEN ARROW

***4LG/YA** 304.8 millimeter (12in) GREEN/YELLOW ARROWS (COMBINATION)

* Not covered under 2007 ITE VTCSH requirements

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GENERAL: All L.E.D Arrow Lamps shall meet the 2007 ITE VTCSH requirements. VTCSH Light Emitting Diode (LED) Arrow Signal Supplement. The Optical unit shall be certified as meeting the 2007 ITE Specifications by Intertek Testing Services Inc,(ETL Verified Mark)or another organization currently recognized by the Occupational Safety and Health Administration (OSHA) as a National Recognized Testing Laboratory (NRTL).

A “Swing Test” will be performed by the department to ensure no significant dimming or blanking occurs, until the lamp is obscured by the visor. All L.E.D Lamps will be subjected to further field testing for reliable operation.

All LED Arrows shall be “Omni-Directional” so that any arrow may be oriented in a right, left or straight configuration without degradation of performance.

ELECTRICAL REQUIREMENTS:

Operating voltage 80 to 135 volts AC.

All L.E.D. lamps shall adhere to the following maximum power requirements.

304.8 millimeter (12 inch) 20 watts or approved by department engineers.

A filtered power supply engineered to electrically protect the LEDs and maintain a safe and reliable operation. All lamps shall be capable of flash operation with no restrictions or degradation of performance.

OPTICAL:

Beam Color - meet 2007 ITE specifications.

The arrow indication segment of the lens shall be clear.

MECHANICAL:

Diameter - fits all regular 304.8 millimeter (12 in) housings.

Material – meet 2007 ITE specifications.

Temperature/environment meet 2007 ITE specification.

A sealed weather proof enclosure that eliminates dirt contamination and allows for safe handling in all weather conditions.

A neoprene gasket will be provided to maintain a resilient seal between the lens and housing.

L.E.D. Arrow lamps shall be **warranted** for **five years.**

L.E.D. Arrow lamps shall meet the 2007 ITE specification minimum for five years.

L.E.D. Arrow lamps shall have **color coded 16 AWG wires** for identification of heads as follows,

RED L.E.D. ARROWS	**RED/WHITE** with **WHITE** neutral.
YELLOW L.E.D. ARROWS	**YELLOW/WHITE** with **WHITE** neutral.
GREEN L.E.D. ARROWS	**GREEN/WHITE** or **BROWN/WHITE** with **WHITE** neutral.
GREEN/YELLOW L.E.D ARROWS	**GREEN/WHITE or BROWN/WHITE, YELLOW/WHITE,** with **WHITE** neutral.

Wires shall be terminated with Bowma-Crimp style spade lugs, 6-8 stud / 16-14 wire size.

Wire Length: All arrows will be supplied with a minimum of 60 inch pigtails

NOTE: All types of L.E.D’s shall have a normal failure rate of less than 1%, failure rates higher may be cause for rejection.

Identification: All L.E.D arrow lamps shall have the Model#, date of manufacturing and the power consumption on the backside. The model number shall end with the

number of L.E.D’s used to comprise the unit as the last digits of the model number. Example if the unit is comprised of **3** L.E.D’s and the model number is x12y then the new model number shall read x12y**3.**

SECTION 5B

L.E.D. PEDESTRIAN SIGNAL (HAND/PERSON)

This specification covers minimum standards for a L.E.D Pedestrian Signal. The 16in.by 18in. optical section shall be configured so the display is side by side (no overlay will be accepted). The first displays the International Symbol of a Hand (Solid) for (“DON’T WALK”) when illuminated, then the display of the International Symbol of the Walking Person (Solid) for (“WALK”). Note: the use of an outline is not permitted, all symbols must be a solid display.

GENERAL REQUIREMENTS:

The signal shall use LED traffic signal lamps to display either the Hand Symbol in Portland Orange or, Walking Person symbol in White. All L.E.D lamps will be warranted for a period of five years. **The lamp shall meet the 2010 ITE Pedestrian Traffic Control Signal Indicators Specification and also be certified by Intertek Testing Services Inc,(ETL Verified Mark) or another organization currently recognized by the Occupational Safety and Health Administration (OSHA) as a National Recognized Testing Laboratory (NRTL**). The signal shall be one section and designed in conformance with 2009 M.U.T.C.D Section 4E.04.

HOUSING:

The dimensions of the signal shall not exceed 17 inches high by 19 inches wide by 10 inches deep. The housing shall be one piece aluminum die casting with openings in the top and bottom to permit mounting with 38.1 millimeters (1 1/2”) brackets. All terminal blocks shall be mounted as close to center as possible to prevent water corrosion. The portion of the housing section around the opening shall be reinforced and serrated or indexed so that serrated or equal fittings may be used to secure the housing.

DOORS:

The door shall be a one piece aluminum alloy casting. The door shall be attached to the housing by means of two stainless steel hinge pins.

VISORS:

Each signal shall be provided with an aluminum visor approximately seven inches long which shall encompass the top and sides of the signal face. The top of the visor shall have a downward tilt of approximately 3 1/2 degrees. The visor shall be blocked and formed and shall be not less than 1.27 millimeter (.050 in) thick and shall meet the minimum requirement of A.S.T.M. specifications. The inside of the visors shall be coated with flat black paint which shall meet or exceed DOD-P-15146 Formula 104.

Electrical Specifications:

Operating Voltage 80 to 135 volts

Power Requirements: maximum 15 watts per supply.

There shall be two separate power supplies, one for powering the Walking person icon and the other to power the upraised hand icon.

The supplies shall be a filtered power supply engineered to electrically protect the L.E.D’s and maintain a safe and reliable operation.

The lamp shall be capable of partial loss of L.E.D’s and still maintain message integrity. Input impedance at 60 Hz must satisfy all conflict monitor requirements.

OPTICAL:

The LED module shall have a visual appearance similar to that of an incandescent lamp (ie smooth and non-pixilated).

Beam Pattern - Meet ITE 2010 pattern Specifications.

Beam Intensity - Meet ITE 2010 specifications.

MISCELLANEOUS FITTINGS AND PARTS:

All exposed screws and fasteners shall be stainless steel. All interior screws, fasteners, and metal parts shall be stainless steel or non-ferrous and non-corrosive materials, or if ferrous materials are used they shall be protected against corrosion by cadmium plating. All plating shall meet the minimum requirements of Federal Specification QQ-P-416, Type II, Class A.

PAINTING:

Signals shall be painted with a powder coat type material. The powder shall be applied using electrostatic method upon the chemically cleaned surface. Powdered plastic resins using an electro-static spray shall be bonded to the outside surfaces of the pedestrian assembly. The powder coating process shall utilize a dry painting process that combines the use of an electro-static application to fuse the dry paint to the surface. The dry paint shall be comprised of resins and pigments for color. The color for the signal shall be, Dark Green enamel and shall comply with Federal Specifications.

CLEANING:

All exterior surfaces shall be cleaned and prepared in a manner consistent with industry standards for sheet aluminum products prior to application of powder coating paint.

Wiring:

Pedestrian Signals shall have color coded 16AWG wires for identification of circuits as follows:

Walk Indication: (Man)	Brown or Blue 16AWG.
Don’t Walk: (Hand)	Red or Orange 16AWG.
Ground:	White 16AWG.

Wires Shall be terminated with Bowma-Crimp style spade lugs, 6-8 studs / 16-14 wire size.

Wire Length: All signals shall be supplied with minimum 36inch pigtails

Identification: All L.E.D arrow lamps shall have the Model#, date of manufacturing and the power consumption on the backside. The model number shall end with the number of L.E.D's used to comprise the unit as the last digits of the model number. Example if the unit is comprised of **266** L.E.D's and the model number is x12y then the new model number shall read x12y**266.**

SECTION 5C

L.E.D. PEDESTRIAN LAMP

HAND/PERSON

This specification covers minimum standards for a L.E.D Pedestrian Hand/Person Lamp. This item will be used for replacement of existing L.E.D Pedestrian lamps or retrofitting older incandescent pedestrian signals. The replacement lamp will fit existing pedestrian signal housings as defined in section 5B.

The lamp shall meet the 2010 ITE Pedestrian Traffic Control Indicators Specification and also be certified by Intertek Testing Services Inc,(ETL Verified Mark) or another organization currently recognized by the Occupational Safety and Health Administration (OSHA) as a National Recognized Testing Laboratory (NRTL). The two optical systems shall be configured so the display (16”x18”)is side by side (no overlay will be accepted). The first displays the International Symbol of Hand (Solid) for (“DON’T WALK”) when illuminated and the second will display the International Symbol of the Walking Person (Solid) for (“WALK”). Note: the use of an outline is not permitted, all symbols must be a solid display.

The signal shall use LED traffic signal lamps to display either the Hand Symbol in Portland Orange or the Walking Person symbol in White. All L.E.D lamps will be warranted for a period of five years.

INSTALLATION

LED pedestrian signal modules shall not require special tools for installation. LED pedestrian signal modules shall fit into existing traffic housings without any modifications to the housing. The module shall be weather tight, fit securely in the housing and connect directly to existing wiring. The installation shall only require the removal of the existing optical unit components,i.e. lens, lamps, gaskets and reflector

Electrical Specifications:

Operating Voltage 80 to 135 volts

Power Requirements: 15 watt maximum.

There shall be two separate power supplies, one for powering the Walking Person icon and the other to power the upraised Hand icon.

The supplies shall be a filtered power supply engineered to electrically protect the L.E.D's and maintain a safe and reliable operation.

The lamp shall be capable of partial loss of L.E.D's and still maintain message integrity. Input impedance at 60 Hz must satisfy all conflict monitor requirements.

OPTICAL:

The LED module shall have a visual appearance similar to that of an incandescent lamp (ie smooth and non-pixilated).

Beam Pattern - Meet 2010 ITE pattern Specifications.

Beam Intensity - Meet 2010 ITE specifications.

Wiring:

Pedestrian Signals shall have color coded 16AWG wires for identification of circuits as follows:

Walk Indication: (Man)	Brown or Blue 16AWG.
Don't Walk: (Hand)	Red or Orange 16AWG.
Ground:	White 16AWG.

Wires Shall be terminated with Bowma-Crimp style spade lugs, 6-8 studs / 16-14 wire size.

Wire Length: All signals shall be supplied with minimum 36inch pigtails

Identification: All L.E.D arrow lamps shall have the Model#, date of manufacturing and the power consumption on the backside. The model number shall end with the

number of L.E.D’s used to comprise the unit as the last digits of the model number. Example if the unit is comprised of **266** L.E.D’s and the model number is x12y then the new model number shall read x12y**266.**

SECTION 5D

L.E.D. PEDESTRIAN SIGNAL WITH COUNTDOWN

This specification covers minimum standards for a L.E.D Pedestrian Signal with Countdown Timer Lamp. A one section display with two complete optical systems is required. The two optical systems shall be configured so the display is overlapping, 9 inch symbol Full “Hand” and “Person”. The first displays the International Symbol of Hand (Solid) for (“DON’T WALK”) when illuminated, then the display of International Symbol of the Walking Person (Solid) for (“WALK”). Note: the use of an outline is not permitted, all symbols must be a solid display. Two seven segment digits will be utilized for time display. The signal housing shall be in conformance with 2009 M.U.T.C.D Section 4E.04.

GENERAL REQUIREMENTS:

The lamp shall adhere to the 2010 ITE Pedestrian Traffic Control Signal Indicators Specification and also be certified by Intertek Testing Services Inc,(ETL Verified Mark) or another organization currently recognized by the Occupational Safety and Health Administration (OSHA) as a National Recognized Testing Laboratory (NRTL)_The signal shall use LED traffic signal lamps to display the Hand Symbol and Timer in Portland Orange or the Walking Person symbol in White. The displays are to be configured side by side All L.E.D lamps will be warranted for a period of five years.

HOUSING:

The signal housing shall be one section and designed in conformance with 2009 M.U.T.C.D Section 4E,04. The dimensions of the signal shall not exceed 17 inches high by 19 inches wide by 10 inches deep. The housing shall be one piece aluminum die casting with openings in the top and bottom to permit mounting with 38.1

millimeters (1 1/2”) brackets. All terminal blocks shall be mounted as close to center as possible to prevent water corrosion. The portion of the housing section around the opening shall be reinforced and serrated or indexed so that serrated or equal fittings may be used to secure the housing.

DOORS:

The door shall be a one piece aluminum alloy casting. The door shall be attached to the housing by means of two stainless steel hinge pins.

VISORS:

Each signal shall be provided with an aluminum visor approximately seven inches long which shall encompass the top and sides of the signal face. The top of the visor shall have a downward tilt of approximately 3 1/2 degrees. The visor shall be blocked and formed and shall be not less than 1.27 millimeter (.050 in) thick and shall meet the minimum requirement of A.S.T.M. specifications. The inside of the visors shall be coated with flat black paint which shall meet or exceed DOD-P-15146 Formula 104.

Electrical Specifications:

Operating Voltage 80 to 135 volts

Power Requirements: 15 watts

. There shall at least two power supplies, one for powering the walking Person icon and other(s) to power the upraised Hand icon and countdown timer. The supplies shall be a filtered power supply engineered to electrically protect the L.E.D’s and maintain a safe and reliable operation.

The lamp shall be capable of partial loss of L.E.D’s and still maintain message integrity. Input impedance at 60 Hz must satisfy all conflict monitor requirements.

OPTICAL:

The LED module shall have a visual appearance similar to that of an incandescent lamp (ie smooth and non-pixilated).

Beam Pattern - Meet ITE 2010 pattern specification.

Beam Intensity - Meet ITE 2010 specification.

MISCELLANEOUS FITTINGS AND PARTS:

All exposed screws and fasteners shall be stainless steel. All interior screws, fasteners, and metal parts shall be stainless steel or non-ferrous and non-corrosive materials, or if ferrous materials are used they shall be protected against corrosion by cadmium plating. All plating shall meet the minimum requirements of Federal Specification QQ-P-416, Type II, Class A.

PAINTING:

Signals shall be painted with a powder coat type material. The powder shall be applied using electrostatic method upon the chemically cleaned surface. Powdered plastic resins using an electro-static spray shall be bonded to the outside surfaces of the pedestrian assembly. The powder coating process shall utilize a dry painting process that combines the use of an electro-static application to fuse the dry paint to the surface. The dry paint shall be comprised of resins and pigments for color. The color for signals shall be Dark Green enamel and shall comply with Federal Specifications.

CLEANING:

All exterior surfaces shall be cleaned and prepared in a manner consistent with industry standards for sheet aluminum products prior to application of powder coating paint.

Wiring:

Pedestrian Signals shall have color coded 16AWG wires for identification of circuits as follows or department approved:

Walk Indication: (Person)	Brown or Blue 16AWG.
Don’t Walk: (Hand)	Red or Orange 16AWG.
Ground:	White 16AWG.

Wires Shall be terminated with Bowma-Crimp style spade lugs, 6-8 stud / 16-14 wire size.

Wire Length: All signals shall be supplied with minimum 36inch pigtails

Identification: All L.E.D arrow lamps shall have the Model#, date of manufacturing and the power consumption on the backside. The model number shall end with the number of L.E.D’s used to comprise the unit as the last digits of the model number. Example if the unit is comprised of **266** L.E.D’s and the model number is x12y then the new model number shall read x12y**266.**

SECTION 5E

L.E.D. PEDESTRIAN LAMP WITH COUNTDOWN

General

This specification covers minimum standards for a L.E.D Pedestrian Lamp with countdown. This item will be used for replacement of existing L.E.D Pedestrian Signal units or retrofitting older incandescent pedestrian signals. The replacement unit will fit existing pedestrian signal housings as defined in previous sections. **The lamp shall adhere to the 2010 ITE Pedestrian Traffic Control Signal Indicators Specification and also be certified by Intertek Testing Services Inc,(ETL Verified Mark) or another organization currently recognized by the Occupational Safety and Health Administration (OSHA) as a National Recognized Testing Laboratory (NRTL).All lamps shall be warranted for a period of five years.**

DISPLAY + ELECTRICAL

The countdown Pedestrian lamp shall meet section 4E.04 of the 2009 M.U.T.C.D. The lamp shall be a one section display (16”x18”) with two complete optical systems. The two optical systems shall be configured so the display is overlapping 9 inch symbol Full “Hand” and “Person”. The first displays the International Symbol of Hand (Solid) for (“DON’T WALK”) when illuminated, then the display of the International Symbol of the Walking Person (Solid) for (“WALK”**).** Note: the use of an outline is not permitted all symbols must be a solid display. The LED module shall have a visual appearance similar to that of an incandescent lamp (ie smooth and non-pixilated). Two seven segment digits will be utilized for the time display. The displays are to be configured side by side. The Hand and Timer shall be Portland orange while the person shall be white. There shall be separate power supplies, one for powering the walking person icon and the other(s) to power the upraised hand icon and countdown timer.

The supplies shall be a filtered power supply engineered to electrically protect the L.E.D’s and maintain a safe and reliable operation.

INSTALLATION

LED pedestrian and countdown LED lamps shall not require special tools for installation. LED pedestrian and countdown signal lamps shall fit into existing traffic housings without any modifications to the housing. The module shall be weather tight, fit securely in the housing and connect directly to existing wiring. The installation shall only require the removal of the existing optical unit components, i.e. lens, lamps, gaskets and reflector.

Wiring:

Pedestrian Signals shall have color coded 16AWG wires for identification of circuits as follows or department approved:

Walk Indication: (Person)	Brown or Blue 16AWG.
Don’t Walk: (Hand)	Red or Orange 16AWG.
Ground:	White 16AWG.

Wires Shall be terminated with Bowma-Crimp style spade lugs, 6-8 studs / 16-14 wire size.

Wire Length: All signals shall be supplied with minimum 36inch pigtails.

Identification: All L.E.D arrow lamps shall have the Model#, date of manufacturing and the power consumption on the backside. The model number shall end with the number of L.E.D’s used to comprise the unit as the last digits of the model number. Example if the unit is comprised of **266** L.E.D’s and the model number is x12y then the new model number shall read x12y**266.**

SECTION 6 PEDESTRIAN PUSH BUTTONS WITH SIGN MOUNTING.
SECTION 6A DISABILITIES COMPLIANCE PUSH BUTTON
POLE OR SURFACE MOUNTED

A. Disabilities Compliance Push Button Pole or Surface Type:

Pedestrian push buttons shall be of substantial tamper proof construction and shall consist of direct push type button with a single momentary normally open contact switch in die cast aluminum alloy housing to meet the requirements of A.S.T.M. Specifications B-85-85-84. The switch shall be rated at 10 amperes 125 Volts. The button control shall be raised or flush and a minimum of 50.8 millimeters (2 in) in the smallest dimension. It will require no more than 2.265 kilograms (5 lb) of force to activate the switch. The assembly shall be of weatherproof, freeze proof, and shockproof construction. Installation within the housing shall be designed so as to permit removal of the units from the housing for the purpose of inspection and maintenance.

Push button contacts shall be entirely insulated from the housing and operating buttons. The back of the mounting frame shall be designed to fit a 102 millimeter (4 in) standard pipe through a 304.8 millimeter (12 in) round pole with the removal of the special brackets provided for 102 millimeter (4 in) through 304.8 millimeter (12 in) poles. The back of the housing shall be flat to provide rigid installation. The assembly shall consist of a button housing and advisory sign mounting frame completely cast in one unit. Cable entry shall be through the back of the unit. A cable guide sleeve shall be provided to protect against water entering the button housing. The cover gasket shall be made of a neoprene rubber material. No cork gaskets will be allowed. This item shall include an advisory sign, 229 x 304.8 millimeter (9″ x 12″), the **message** to be specified (by the appropriate State of Connecticut catalogue numbers **31-0835** or **31-0838**) in ordering.

SIGN FRAME:

For each push button, the sign frame shall be constructed so that the outer edge of the sign will be flush with the frame to prevent vandalism. Each frame

shall have a solid back (no skeletal frames) to prevent road debris from accumulating behind the sign. The frame shall accommodate a 9 x 12 inch sign with two mounting holes on the vertical centerline on 6 inch centers. The frame shall have adjustable pole guides to facilitate sign mounting on 4.5 inch to 12 inch poles. The guides will be constructed of 1 inch x 1 inch L stock with a radius end for flush and secure mounting. The sign frame shall be secured with tamperproof stainless steel mounting screws on 6 inch centers. The frame and housing will be constructed of cast aluminum and finished as described below in the painting section. This product will be delivered fully assembled with the specified message sign and button secured to the bracket using the appropriate stainless steel fasteners.

PAINTING:

Signals an hardware shall be painted with a powder coat type material. The powder shall be applied using electrostatic method upon the chemically cleaned surface. Powdered plastic resins using an electro-static spray shall be bonded to the outside surfaces of the traffic cabinet assembly. The powder coating process shall utilize a dry painting process that combines the use of an electro-static application to fuse the dry paint to the surface. The dry paint shall be comprised of resins and pigments for color. The color for signals shall be, Dark Green enamel federal # 14056 - shall be traffic signal Dark Green exterior baking enamel and shall comply with Federal Specification TT-E-489. The color shall be No. 14056 according to Federal Standard No. 595.

CLEANING:

All exterior surfaces shall be cleaned and prepared in a manner consistent with industry standards for sheet aluminum products prior to application of powder coating paint.

SECTION 6 PEDESTRIAN PUSH BUTTONS WITH SIGN MOUNTING.

SECTION 6B DISABILITIES COMPLIANCE Minimal Movement (pressure sensitive) PUSH BUTTON POLE OR SURFACE MOUNTED

A. Disabilities Compliance Minimal Moving Push Button Pole or Surface Type:

This specification covers minimum standards for a minimal movement pressure sensitive pedestrian push button. The button shall be of tamper proof construction and shall consist of a minimal movement pressure sensitive push type button. The button shall be housed in a rugged cast aluminum housing. The switch shall be a Piezo Driven Solid State Switch, capable of operating in temperature ranges of -30 deg F to 165 deg F. Operating voltages shall be 12-24V AC or DC with an on resistance of 45 Ohms Typical. The operating life shall be greater then 100 million operations.

Upon activation of the switch a tone or “audible beep” shall be emitted and a visual conformation LED shall illuminate. The button control shall be raised or flush and a minimum of 50.8 millimeters (2 in) in the smallest dimension. It will require no more than 2.265 kilograms (5 lb) of force to activate the switch. The assembly shall be of weatherproof, freeze proof, and shockproof construction. Installation within the housing shall be designed so as to permit removal of the units from the housing for the purpose of inspection and maintenance.

Push button contacts shall be entirely insulated from the housing and operating buttons. The back of the mounting frame shall be designed to fit a 102 millimeter (4 in) standard pipe through a 304.8 millimeter (12 in) round pole with the removal of the special brackets provided for 102 millimeter (4 in) through 304.8 millimeter (12 in) poles. The back of the housing shall be flat to provide rigid installation. The assembly shall consist of a button housing and advisory sign mounting frame completely cast in one unit. Cable entry shall be through the back of the unit. A cable guide sleeve shall be provided to protect against water entering the button housing. The cover gasket shall be made of a neoprene rubber material. No cork gaskets will be allowed. This item shall include an advisory

sign, 229 x 304.8 millimeter (9″ x 12″), the **message** to be specified (by the appropriate State of Connecticut catalogue numbers **31-0835** or **31-0838**) in ordering.

SIGN FRAME:

For each push button, the sign frame shall be constructed so that the outer edge of the sign will be flush with the frame to prevent vandalism. Each frame shall have a solid back (no skeletal frames) to prevent road debris from accumulating behind the sign. The frame shall accommodate a 9 x 12 inch sign with two mounting holes on the vertical centerline on 6 inch centers. The frame shall have adjustable pole guides to facilitate sign mounting on 4.5 inch to 12 inch poles. The guides will be constructed of 1 inch x 1 inch L stock with a radius end for flush and secure mounting. The sign frame shall be secured with tamperproof stainless steel mounting screws on 6 inch centers. The frame and housing will be constructed of cast aluminum and finished as described below in the painting section. This product will be delivered fully assembled with the specified message sign and button secured to the bracket using the appropriate stainless steel fasteners.

PAINTING:

This item shall be painted with a powder coat type material. The powder shall be applied using electrostatic method upon the chemically cleaned surface. Powdered plastic resins using an electro-static spray shall be bonded to the outside surfaces of the traffic cabinet assembly. The powder coating process shall utilize a dry painting process that combines the use of an electro-static application to fuse the dry paint to the surface. The dry paint shall be comprised of resins and pigments for color. The color for signals shall be, Dark Green enamel federal # 14056 - shall be traffic signal Dark Green exterior baking enamel and shall comply with Federal Specification TT-E-489. The color shall be No. 14056 according to Federal Standard No. 595.

CLEANING:

All exterior surfaces shall be cleaned and prepared in a manner consistent with industry standards for sheet aluminum products prior to application of powder coating paint.

SECTION 7

ALUMINUM PEDESTALS

Item 7D	2.4 M (8’)	Aluminum less Pole Cap less Hardware
Item 7E	1.3 M (4’4”)	Aluminum with Pole Cap less Hardware
Item 7F	.914 M (3’)	Aluminum less Pole Cap less Hardware

ALUMINUM PEDESTALS

DESCRIPTION:

This item will consist of furnishing an aluminum pedestal standard to support traffic signals, pedestrian signals, pedestrian push buttons and controller cabinets in accordance with the following requirements.

MATERIALS:

1. Shaft: The shaft shall be made of 6063-T6 or 6005-T5 aluminum alloy as specified by the Aluminum Association, and shall be a seamless tube with a diameter of 114.3 to 152.4 millimeters (4 1/2″ to 6″) at the base and 114.3 millimeter (4 1/2″) minimum diameter at the top. The height of the pedestal shall be such to provide the various height requirements shown on the installation detail sheets. The shaft shall have a minimum wall thickness of 3.96 millimeters (.156″) and shall be void of welding except at the base which is permissible. The shaft shall be satin brush finished and each shaft shall be individually protected from scratches, dents and abrasions during handling and shipping.

2. Base: The base shall be a permanent mold casting of 356 aluminum alloy conforming to ASTM B-108 and shall be approximately 457 millimeters (18″) high, 330 millimeters (13″) square at the bottom and tapering to approximately 267 millimeters (10 1/2″) square at the top. The base shall be secured to the shaft by means of a circumferential fillet weld on the inside of the base top or by a tapered self locking threaded shaft with <u>two flush mounted stainless steel allen type set screws.</u> The base shall be provided with a cast aluminum door with approximate dimensions of 203 x 241 x 330 millimeters (8″ x 9 1/2″ x 13″) which shall be held in place by an approved locking device. Each base shall be provided with a grounding stud with stainless steel washers (2) and nut.

3. The base shall be a break-away design in such that if the pedestal is struck the foundation will remain intact.

4. The base shall be equipped with slotted feet set 90 degrees apart with a opening of no more than 31.7 millimeters (1 1/4 in), which will accept 15.8 or 19.1 millimeter (5/8″ or 3/4″) anchor bolts set at any bolt circle between 280 to 330 millimeters (11″ to 13″). All hardware on the pedestal shall be 304 stainless steel.

5. Hardware: The anchor bolts shall be ASTM A-136 steel rods hot dipped galvanized having a minimum tensile yield strength of (36,000 lbs per sq in) and shall be 15.8 or 19 millimeters (5/8″ or 3/4″) in diameter and 457 millimeters (18″) long with 102 millimeter (4″) right angles at one end.

6. Anchor Bolts: The anchor bolts ASTM-A-36 steel rods having a minimum tensile yield strength of (36,000 lbs per square inch) and shall be 15.8 or 19 millimeters (5/8″ or 3/4″) in diameter and 457 millimeters (18″) long with a 102 millimeter (4″) right angle leg at one end. There shall be a 15.8 millimeter (5/8″) - 10 NC thread 76.2 millimeters 3″ long at the other end. A hot dipped galvanized steel nut, lock washer and flat washer shall be provided with each anchor bolt. All galvanizing shall be ASTM A-153.

7. Test Bolt: Each order of pedestals requiring bolts shall have one extra bolt shipped for destructive testing. This bolt will not be returned.

8. Pole Cap: An ornamental cap of aluminum alloy shall be provided with each 1321 millimeter (4′4″) shaft. The cap shall be fastened to the shaft by means of a stainless steel screw.

9. The pedestal shall come fully assembled.

SECTION 9
FLASHER CABINETS

CABINET:

All equipment shall be housed within a weatherproof outdoor mounting cabinet constructed of fabricated aluminum. The cabinet shall be clean-cut in design and appearance.

Dimensions		Depth	Width	Height
	9A	304.8 - 381 mm (12”-15”)	355mm - 432mm (14”-17”)	610mm - 660mm (24”-26”)
	9B	152mm - 178mm (6”-7”)	254mm - 279mm (10”-11”)	330mm - 355mm (13”-14”)

DOORS:

The door shall encompass substantially the full area of the front of the cabinet. The door on the 9B shall be equipped with a police door lock and two (2) keys, the 9A shall have a Conn 1 tumbler type lock and two (2) keys provided for each cabinet. Door hinge pin shall be made of stainless steel.

MOUNTING HARDWARE:

Each “A” cabinet shall be furnished with a pedestal adapter for mounting. Type “B” cabinets will not require any mounting hardware.

VENTILATION:

Type “A” cabinets shall contain a suitably designed vent for the purpose of releasing any explosive gases which may enter the cabinet. The vent 38.1 millimeter (1 1/2”) shall be mounted on the top of the cabinet, venting at the bottom of the cabinet with a screen. Venting will not be required on Type “B” cabinets.

SOLID STATE FLASHER:

The flasher shall conform to the latest NEMA publication, Part 8, with the following additions: Only Type Two flashers will be accepted (dual circuit, 10 ampere per circuit). The output shall be from optically isolated solid state relays of the dimensions shown on figure 14. The flasher shall have L.E.D. indicators connected to the output for visual reference.

RADIO INTERFERENCE FILTER:

The radio interference filter shall be designed to operate on 15 amperes, 120 volts, 60 cycle A.C. and shall meet the standards of the Underwriters Laboratory and the Radio and Television Manufacturer’s Association.

OVERCURRENT PROTECTION:

A 10 ampere circuit breaker shall be mounted on one side of the cabinet.

WIRING:

All wiring shall be neat and firm and in conformance with the National Electrical Code. All flasher inputs and outputs shall be wired to a terminal block in the cabinet. All wiring shall be No. 14 AWG, THW stranded or equivalent.

PANEL:

Flasher jack panel to be of the female type.

PAINTING:

Cabinets shall be painted with a powder coat type material. The powder shall be applied using electrostatic method upon the chemically cleaned surface. Powdered plastic resins using an electro-static spray shall be bonded to the outside surfaces of the traffic cabinet assembly. The powder coating process shall utilize a dry painting process that combines the use of an electro-static application to fuse the dry paint to the surface. The dry paint shall be comprised of resins and pigments

for color. The color for cabinets shall be a department approved gray (iron glimmer or department approved).

CLEANING:

All exterior surfaces shall be cleaned and prepared in a manner consistent with industry standards for sheet aluminum products prior to application of powder coating paint.

SECTION 13
FOUR CIRCUIT SOLID STATE TIME CLOCK
WITH TIME BASE COORDINATION OPTION TC/TBC

This specification sets forth the minimum acceptable capabilities for a four circuit time clock with time base coordinator option. It is intended for use in traffic control applications and shall be of all solid state construction except for relay outputs. All components shall be made available to the purchaser for servicing for ten years after expiration of the manufacturer's warranty and shall be identified so that they may be purchased from industrial electronic suppliers.

The said unit shall not exceed 304 millimeters high x 127mm W x 127mm D (12″H x 5″W x 5″D).

13-1 Four Circuit Solid State Time Clock Cable

Interface to the power line and the controller device(s) shall be provided by means of a cable harness terminated in a secure connector. Length of the cable shall be 1828.8 millimeters (72″) or more, wire shall be a minimum 18 gauge with 600 volt insulation suitable for at least 90^{0}C. The unit shall be supplied complete with harness and bid as a total. The price bid shall consist of a bid for the clock unit and a separate bid for the clock harness combined for a total bid price.

The apparently successful bidder shall furnish written evidence that the unit proposed to be furnished has been tested by an independent testing lab and found to meet the environmental testing requirements for conditions found in the Continental United States. Such evidence shall be at least a copy of a letter from such testing lab.

TIMING AND ENVIRONMENT:

The TC/TBC shall operate on a nominal 115 VAC, 60 Hz power source, and shall operate satisfactorily between 95 and 135 VAC and from -30^0 to +70^{0}C. Timing shall be synchronous with the power line frequency.

POWER BACK-UP SYSTEM:

During the loss of power timing shall be maintained for 48 hours by a capacitive storage system or zero power RAM memory and a crystal oscillator with +.05% accuracy. **Batteries will not be accepted.** Programming steps shall be maintained indefinitely.

When the TC/TBC is operating on the back-up system the display shall be blanked and the output relays disabled to conserve back-up power. No time shall be gained or lost during changeover from 115 VAC to the back-up system and back to 115 VAC.

PROGRAMMING:

The TC/TBC shall be capable of 50 programming steps, or combinations of basic plans and steps. It shall not be necessary to enter programs in chronological order.

TC/TBC shall be capable of being programmed to turn on or off any output or outputs at any time of the day and day of the week, each output being totally independent of the other. When an output is programmed to be turned on or off, the switch action shall take place at zero second of the chosen minute, unless the clock is being used in the TBC mode, in which case a change of state at the yield point of the cycle would be permissible.

The TC/TBC shall have the ability to store 3 cycle lengths. Each cycle length shall be programmable from 30 to 254 seconds in 1 second increments.

The TC/TBC shall have the ability to store up to nine offset values, each offset shall be programmable from 0 to 254 seconds in one second increments.

The program of the TC/TBC shall allow any one or more offsets to be assigned to any one or more cycles.

The sync pulse (permissive period) must be capable of any pulse width within the selected cycle length. It shall be possible to edit or review all programming functions without affecting the operation of the TC/TBC.

Day Light Savings shall be programmable with the ability to change the period to any Week, Month combination with the following format Daylight Savings begins MM-WW Daylight Savings ends MM-WW.

OPERATION:

The TC/TBC shall be capable of displaying the following information

1. HH:MM:SS of current time
2. Cycle countdown (current).
3. Offset (current)

The TC/TBC must be able to maintain the time of day, stay in step, and sync with current models used by Conn. D.O.T.

The TC/TBC shall be capable of operating as a three output time clock with a forth circuit providing the coordination feature.

When the TC/TBC is used as a coordinator the fourth relay output shall remain energized until the sync output causes the relay to de-energize.

All relay outputs shall have an output rating of at least 10 amps at 115 VAC resistive load.

The time base coordinator shall have two methods of resyncing.

Manual Resync: Manual resync shall occur when the operator initiates The command from the TC/TBC keyboard.

Midnight Resync: This will provide from keyboard entry a means to resync the coordinator to midnight.

MANUAL OPERATION:

The TC/TBC shall have the capability of manually turning on or off any of the four relay outputs. The manual operation shall remain in effect until the next valid program step occurs. At that point the TC/TBC will release from manual control and revert to its internal program.

It shall be possible to program any TC/TBC and transfer that program to any other like TC/TBC by means of simple unit to unit cable. In the event an invalid transfer occurs, an error message shall be displayed alerting the operator. The transfer cable connection shall be accessible from the front of the TC/TBC. One transfer cable shall be supplied with purchase of TC/TBC.

DOCUMENTATION:

Included with each unit shall be one copy of the operation’s manual which shall contain programming and technical information, wiring diagrams, schematics, and hook-up prints.

AMP CONNECTOR # 206037-1

PIN NO.	ASSIGNMENT	WIRE COLOR
1	AC+ (LINE)	BLACK
2	AC- (LINE)	WHITE
3	CHASSIS GND	GREEN
4	SWITCH 1 COM	RED
10	SWITCH 1 NO	WHITE/YELLOW
5	SWITCH 1 NC	YELLOW
6	SWITCH 2 COM	WHITE/BROWN
7	SWITCH 2 NO	WHITE/VIOLET
16	SWITCH 2 NC	VIOLET
11	SWITCH 3 COM	GRAY
13	SWITCH 3 NO	WHITE/BLUE
12	SWITCH 3 NC	BLUE
9	SWITCH 4 COM	BROWN
15	SWITCH 4 NO	WHITE/ORANGE
14	SWITCH 4 NC	ORANGE

SECTION #26A

INTERNAL CLOSED LOOP LOCAL UNIT
TRAFFIC CONTROLLER FOR PEEK SOFTWARE

Notice to Vendor: Any changes to closed loop equipment currently used by the department must be approved by the Engineer or may be cause for rejection.

All new closed loop systems under review for approval by the department will need to meet the scrutiny of the Engineers interpretation of these specifications.

DESCRIPTION:

This Internal Closed Loop Local Unit (ICLLU) must be compatible with existing Transyt on street masters and software currently used by the Department of Transportation's Transyt Closed Loop System. The (ICLLU) shall be a microprocessor-based traffic controller/coordinator located in an on-street traffic signal cabinet. The ICLLU shall conform to TS2-1992 TYPE 2 NEMA traffic controller standards, (which retains the MSA, MSB, and MSC connectors for data exchange with the rear panel, providing a degree of downward compatibility). All external interface connectors will be located on the front panel of the ICLLU. The ICLLU shall be capable of operating both as a stand alone Time Base Coordination (TBC) traffic controller unit and as a controller within the Department's Peek / Transyt Closed Loop Traffic Signal System. In addition the ICLLU shall conform to all State of Connecticut functional specifications for solid state traffic controllers outlined in this issue, as well as being downward compatible with equipment conforming to the NEMA TS2-1992 Standards Publication.

FUNCTIONAL:

The ICLLU shall utilize the phase hold, force-off, omit, call to non-actuated, walk rest modifier and maximum inhibit functions as required. The ICLLU shall drop the appropriate phase hold outputs and issue a force-off for each utilized phase without the need for external interface circuitry.

THE ICLLU SHALL PROVIDE THE FOLLOWING FUNCTIONS:

(l).Monitor green, yellows, reds for eight(8) phases and eight(8)overlaps.

(2).Monitor a minimum of eight (8) walks and (8)don't walk phase outputs.

(3) Monitor actuation and record volume and other MOE data for sixteen (16) system detectors. Occupancy will be recorded during both the green period as well as during the entire cycle.

(4).Monitor actuation of eight (8) intersection detectors.

(5).Provide a minimum of six (6) timing plans each utilizing a different cycle, split plan and offset. All entries of item 5 shall be in seconds, not percentage. **Each timing plan shall consist of** one cycle length, programmable in five (5) second increments and having a duration of 30 to 255 seconds & eight (8) phases programmable from 0 to 255 seconds.

(6).Provide two variable permissive (yield) periods each programmable in seconds and having a duration of 1 to 100 percent of the cycle length, and an automatic permissive. These functions must be reviewed and accepted by Department Engineers.

(7).Provide a minimum of ten (10) day schedules, with 10 events (consisting of start time, stop time, and timing plan) per day schedule. It shall be possible to implement intersection flash and free operation in a day schedule.

(8).Provide a minimum of ten (10) week schedules.

(9).Provide a minimum of ten (10) special or holiday schedules.

(10).Operate in a local time-of-day (TOD) mode without the need for Closed Loop Master Unit (ICLMU); traffic responsive and local TOD modes when an ICLMU is used.

(11).Monitor intersection flash and free operation.

(12).Monitor six (6) separate preemption inputs (preempt 1 through preempt 6).

(13).Monitor opening and closing of cabinet door by means of a dedicated switch.

(14).Monitor activation and deactivation of manual control enable.

(15).Provide an alpha numeric data entry access code for security purpose.

(16).Provide a minimum of three (3) special function output (capable of being invoked by time-of-day or manual override selection and two (2) special function alarm inputs.

(17).Accept a central computer system override on a system or per intersection basis to any of the following: users selected plan, flash and free.

(18).Be capable of operating all signal phase sequences that are used by the Department of Transportation **[see pages 27 - 28 in this copy of the State of Connecticut Functional Specifications for Traffic Control Equipment]**

(19) Modems must be to current industry standards and approved by Department Engineers.

(20) Call back features must be capable of being selected/deselected from central computer as well as the keyboard. (*HAVE AN ON/OFF FEATURE, capable of disabling unit from dialing out).*

(21) Capable of selecting any combination of offset, cycle length and split times or a timing plan pattern, without restrictions of a matrix configuration through manual override operation for a minimum of 18 coordination plans.

(22) Adjustable permissive periods active only in coordinated phase.

(23) Ability to distribute unused time to subsequent phases.

(24) Ability to select central overrides for Max II and one (1) auxiliary output.

(25) Ability to override T.O.D. Free, with Cycle, Offset and Split times or timing plan pattern.

(26) Utilize a removable EE prom sub-module or data key technology for transferring sequence and intersection timing between controllers.

The ICLLU shall log the following error conditions, and report them to an attached ICLMU (if present) for transmittal to the central computer:

(1).Stuck Controller/ICLLU (i.e. not cycling).

(2).Coordination or synchronization failure.

(3).Unscheduled flashing operation.

(4).Manual Control Enable.

(5).Detector failures (absence of vehicle call, locked vehicle call erratic amplifier output)

TELEMETRY between the ICLMU and ICLLU's shall operate using a two-pair, full duplex hard wire interconnect cable. There shall not be any modems or components external to the ICLLU in the local traffic control cabinet that will achieve communications with the ICLMU. The ICLLU shall be capable of direct hookup via an interface port to a laptop computer in order to upload and download the ICLLU database and date/time using manufacturer's supplied software and central computer database.

ELECTRICAL:

The ICLLU shall operate on 115 VAC and be protected by a front mounted fuse. Database information shall be unaffected by power outages and stored in programmable ROM's a capacitive storage system or a nonvolatile RAM. The real time clock shall remain operational for a minimum of 48 hours in case of a power outage. Sufficient unit suppression shall be provided to protect against voltage spikes to the ICLLU. Adequate protection shall be furnished on the interconnect lines to protect against damage during electrical surges.

The ICLLU shall be shelf mounted. All database information including unit address shall be programmable using a built-in keyboard. The ICLLU shall include a built-in display that is readable in normal daylight and night time conditions. The display shall show all database keyboard entries and unit

functional operations, and consist of a minimum of two (2) lines, sixteen (16) characters per line.

DOCUMENTATION

Included with the documentation for each unit shall be one (1) copy of the operations manual that shall contain programming and technical information, wiring diagrams and schematics, hookup prints, parts list, and a troubleshooting guide.

SECTION #26B

INTERNAL CLOSED LOOP MASTER UNIT
COMPATIBLE WITH PEEK SOFTWARE

Notice to Vendor: Any changes to closed loop equipment currently used by the department must be approved by the Engineer or may be cause for rejection.

All new closed loop systems under review for approval by the department will need to meet the scrutiny of the Engineers interpretation of these specifications.

DESCRIPTION:

This Internal Closed Loop Master Unit (ICLMU) must be capable of communications to Internal Closed Loop Local Units (ICLLU's) as well as Closed Loop Software in use by the Connecticut Department of Transportation's Peek / Transyt Closed Loop Systems. The (ICLMU) shall be a stand-alone microprocessor-based device capable of supervising a minimum of twenty-four (24) Internal Closed Loop Local Units (ICLLU's) associated with NEMA traffic controllers. Located in a traffic signal cabinet, or at Central, the ICLMU shall serve as communications link between ICLLU's and the central computer control. The ICLMU shall be capable of directing ICLLU's to traffic responsive time-of-day and manual-override timing plans, as well as monitor/record/report ICLLU activity.

FUNCTIONAL

Master units will be NEMA (environmental) approved and shall perform the following Functions: Master units must be downward compatible to manufactures equipment produced in the past five years.

(1) Utilize a security code system to control remote user access. The security code shall be capable of being modified or deleted via the closed loop software program.

(2). Store traffic volume and other MOE data from a minimum of sixty-four (64) system detectors for a period of forty eight (48) hours

(3).Direct ICLLU’s to traffic responsive plans on a time-of-day basis by obtaining volume and occupancy data received from user selected system detectors and choosing the appropriate timing plan based upon user-defined thresholds. The ICLMU shall average five (5) to fifteen (15) minutes worth of volume counts to select an appropriate timing plan, and incorporate a volume smoothing factor to prevent erratic plan selection. The selection of timing plans shall be based upon directional traffic flow characteristics. A minimum of two (2)occupancy override plans shall be provided for selected system detectors. A clearly written description of the traffic responsive algorithm, including descriptions of all formulas and calculations performed by the ICLMU shall be submitted to the department upon request by the engineer for review as part of this item.

(4).Store a minimum of forty-eight (48) hours worth of status reports, traffic responsive pattern changes and failures per intersection.

(5).Upload and download of database information from the central computer to the ICLMU and ICLLU’s.

(6).Direct connection to laptop computer via an RS-232 port utilizing manufacturers latest closed loop software and existing database. The upload and download of ICLMU and ICLLU database information and monitoring of ICLLU functional operation shall be provided.

Telemetry between the ICLMU and ICLLU’s shall operate using a two-pair full duplex hard wire interconnect cable or fiber optic cable [For hardwire Systems *External modems or components in the master or local cabinet used to achieve communications with ICLLU’s is prohibited].*

Telemetry between the ICLMU and the central computer location shall be accomplished using a voice grade dial-up telephone line, located at the master traffic control cabinet. The Closed Loop Central Software shall be capable of communicating at a minimum of 2400 baud from the central computer(s) to the remote master sites through ConnDOT’s PBX telephone system.

ELECTRICAL:

The ICLMU shall operate on 115 VAC and be protected by a front mounted fuse. Database information shall be unaffected by power outages and stored in programmable ROM, capacitive storage system or nonvolatile RAM. Adequate protection shall be provided on the interconnect lines to prevent damage during electrical surges. Modem surge filters such as Tripplite Model MP or equivalent shall be provided to protect the dial-up modem from telephone line spikes. The ICLMU must be shelf mounted and include all cables, connectors and modems necessary to achieve communications with the ICLLU’s and the central computer. The ICLMU shall visually indicate the exchange of data between the ICLMU and ICLLU's. A built-in keyboard shall be provided to program all database parameters including unit address.

The ICLMU shall include a built-in display that is readable in normal daylight and night time conditions. The display shall show all database keyboard entries and unit functional operations. External interface connectors shall be located on the front panel of the ICLMU. Ten (10) foot harnesses equipped with locking-type connectors shall be labeled and supplied for interfacing purposes.

CLOSED LOOP SOFTWARE:

The latest version of the manufacturer’s closed loop computer software shall be provided as part of this item. The software package shall be functionally compatible with existing (Transyt 3800 EL Master Units and 3800 ELX Local Units) presently used for Peek / Transyt Closed Loop systems by the Connecticut Department of Transportation Office of Highway Operations. The Department of Transportation shall be able to use the software on any number of PC’s owned by the Department and make additional copies as needed for backup purposes. The software shall be reviewed by Highway Operations prior to acceptance of either this item or the Internal Closed Loop Local Unit.

SYSTEM COMPATIBILITY:

All software provided for the Closed Loop Traffic Control System shall be compatible with the latest Microsoft operating systems,Vista, XP and Windows 2000 systems with the specified configuration:

The software shall be capable of running in a stand alone computer system and in a client/server arrangement. The software shall run within the Office of Highway Operation's Microsoft Network server arrangement. The software shall provide the capability of thirty (30) multiple users and thirty (30) multiple workstations working simultaneously on a common database.

SYSTEM SECURITY:

The closed loop software program shall incorporate three levels of user access security defined as follows:

(1).This level shall include access to all user performed functions including the definition of user security privilege levels. It shall be possible to modify or delete remote ICLMU passwords from this security level.

(2).This 1evel is equal to 1evel 1 minus the ability to view or change user security privileges or ICLMU passwords.

(3).This level is equal to level 2 minus the ability to modify disk resident database or change the operation of field equipment or software. It shall allow “view only” access to the system and provide the ability to retrieve count and event log data from the ICLMU.

FUNCTIONAL OPERATION:

The closed loop software shall meet the following functional requirements:

(1).Provide a minimum of thirty (30) master controllers per central computer.

(2).Provide a minimum of twenty-four (24) intersections per master controller.

(3).Provide a minimum of eight (8) intersection detectors per intersection.

(4).Provide a minimum of eight (8) system detectors per intersection.

(5).Provide a minimum of one sixty-four (64) system detector (arterial) which shall report volume (VPH), occupancy (%) and speed data.

(6).Provide a minimum of six (6) timing plans per intersection, each utilizing a different split plan. All entries of requirement 6 shall be in seconds, not percentage.

Each timing plan shall consist of:

One cycle length, programmable in one second increments and having a duration of 30 to 255 seconds.

Eight (8) phase splits, programmable in one (1) second increments and having a duration of 0 to 255 seconds.

One (1) offset, programmable in one (1) second increments and having a duration of 0 to 255 seconds.

(7).Provide two (2) permissive periods per timing plan, programmed in seconds and having a duration of 1 to 100 percent of the cycle length.

(8).Provide a minimum of ten (10) day schedules per intersection.

(9).Provide a minimum of ten (10) events (start time, end time, and timing plan) per day schedule. The ability to implement intersection free and flash in a day schedule shall be provided.

(10).Provide a minimum of ten (10) week schedules per intersection,

(11).Provide a minimum of ten (10) special or holiday schedules per intersection.

(12).Provide a minimum of one (1) user-programmable special function output (both time-of-day and manual override selectable), and the ability to monitor and record the actuation of at least one special function input per intersection.

(13).Monitor the actuation and display of eight (8) walk phases.

(14) Provide the capability to operate all signal phase sequences used by the Connecticut Department of Transportation **[see page 27-28 in this copy of the State of Connecticut Functional Specifications for Traffic Control Equipment].**

(15).Operate on both the COMl and COM2 asynchronous communication ports, with the port assignment user definable.

(16). Permit the upload and download of database information (including ICLMU software revision level) and compare field and central computer database for any discrepancies. The ability to upload and download the current date and time shall also be provided.

The following reports and features shall be provided by the Closed Loop central software:

INTERSECTION STATUS: A real-time display of intersection performance which shall include intersection name, database number, communication address, status (free, on-line, ICLLU failure, flash, preemption, manual control enable), current timing plan, cycle length(in seconds), offset, phase returns (colors), walk returns and a cycle counter.

The screen shall also disp1ay the programmed and actual phase splits (in seconds), and the status of the ICLLU force-off output. The Intersection Status screen may be combined with the Graphics Program.

DETECTOR REPORT: Shall provide the status of system detectors as well as the most recently available volume, occupancy and speed data, in a graphic or table format. Any failed detectors shall be noted on the report. This routine shall also allow 15 minute and hourly volume, occupancy and speed data for all system detectors to be exported to an ASCII file.

ARTERIAL OR INTERSECTION EVENT REPORT: Shall provide the ability to retrieve and display recorded events from the ICLMU and from event logs stored on disk. An event description, date and time shall be shown. Reported events shall include master traffic responsive plan changes, ICLMU, ICLLU and controller malfunctions power failures, flash and free operation, preemption and special function input activation, central overrides, and communication failures.

SYSTEM/INTERSECTION OVERRIDE COMMAND: Shall provide the capability to manually override system operation from the central computer. Intersection Overrides shall include flash, free, time-of-day, traffic responsive, and a manual override plan. All overrides shall remain in effect until released from the central computer.

GRAPHICS PROGRAM: A real-time color graphics routine shall also be provided. It shall be VGA compatible 800 x 600 or higher, and shall enable an engineer to create customized intersection and arterial map-oriented displays, and save each display to a disk file.

Two types of graphics creation procedures shall be provided; an ASCII-based character graphic program and a high resolution vector-based program. This item shall include all software and hardware accessories necessary to draw, edit integrate and import graphic files for graphics use.

THE INTERSECTION GRAPHIC shall have the ability to display eight (8) phase returns (colors), eight (8) system detectors and eight (8) intersection detector actuation’s in real-time. The program shall provide an indication of the current intersection status (free, flash, on-line, preemption, failure), cycle counter, active timing plan, cycle length (in seconds) and a real-time clock display.

THE ARTERIAL MAP GRAPHIC shall disp1ay real-time arterial phase status (green, yellow or red) of at least twenty-four (24) intersections on a single screen. This screen will display a system wide green band or vehicle progression through the system. The graphic shall indicate the current status of each intersection.

PERCENTAGE OF SPLITS USED: A screen that shows a real time running display of phase utilization in percentage of the programmed split as well as the programmed split for visual comparison. This display will update with each cycle and display an average of phase utilization for a predetermined number of cycles. The display shall also include status of the current phase (R,Y,G,W) and the method of termination (F.O. GAP or Max).

SOFTWARE DATABASE: A menu-based routine shall be used to allow the input and modification of all database entries for the ICLMU and ICLLU using the same database input format for direct keyboard input. The central software menus shall mirror as near as possible that of the ICLMU and ICLLU keyboard entries. It shall be possible to upload and compare timings for the ICLMU and ICLLU, with any discrepancies highlighted or clearly noted on the screen.

EVENT REPORT AND LOG:

The central closed loop computer software shall utilize and include a means for logging system and intersection activity transmitted from the ICLMU. This feature shall be capable of reporting two types of information: a call-back report and a system event log. The operation of both reports shall be reviewed and accepted by the DOT Office of Highway Operations prior to acceptance of this item.

The ICLMU shall store a minimum of one (1) remote computer telephone number for call-back purposes, consisting of at least twelve (12) digits. An error detection/correction protocol shall be utilized to ensure that the call-back report and the system event log is correctly transmitted by the ICLMU and recorded by central computer. If a non-correctable error occurs during data transmission, the ICLMU shall repeatedly attempt to contact the central computer until the reception of the event information is verified by the computer. If the ICLMU is unable to contact the central computer, it shall continue to dial approximately every five (5) minutes until the event report is properly transmitted.

All call back features must be capable of being activated/deactivated from central computer as well as the keyboard and *HAVE AN ON/OFF FEATURE, capable of disabling unit from dialing out.*

THE CALL-BACK REPORT shall immediately transmit the following user selectable events (including date, time and intersection number) in a first-in, first-out order, The user shall be capable of disabling call-back reports events from the central computer on a per intersection or per master basis. All reports will be transmitted with a master number /description and local intersection number / description.

(1).ICLLU failure (including stuck controller).

(2).Coordination or synchronization failure.

(3).Unscheduled flashing and free operation (including conflict flash)

(4).Manual Control Enable.

(5).Activation of external special function inputs, preemption inputs and door open switch.

(6).ICLMU power restoration and ICLLU power failure and restoration.

(7). System traffic responsive pattern changes.

The data received by the central computer shall be capable of being stored in a disk file and logged on an attached printer. It shall provide a means for selecting the call-back events to be instantly printed, and those to be stored in the disk file. It shall be possible to disable the call-back function from the central computer location.

THE SYSTEM EVENT LOG: shall transmit a daily summary of non-critical event information, including T.O.D. flashing operation and detector errors, recorded by the ICLMU and sent at a user-specified hour once per day. The retrieval of the log information may be initiated either by the ICLMU or the central computer.

All events shall be user assigned, and logged on an attached printer and/or stored in a disk file if selected by the user.

The system event log shall also include activity for any of the above events if selected by the user, even if the event call-back report is disabled.

Detectors shall be monitored by the ICLMU for three types of failures; absence of call, constant (locked) call and erratic amplifier output (excessive actuation’s/chatter). The time limits for each setting shall be user programmable in one minute increments. If the time limit for any of these parameters is exceeded, then the ICLMU shall be capable of immediately transmitting the failure to central, or of sending it during the event log transmission. Volume reports shall be activated/deactivated for auto transmission to central on a daily basis and per system basis.

MISCELLANEOUS SYSTEM REQUIREMENTS:

For **every master** sold two modems will be supplied.

Included in this bid any equipment / cables needed to retrofit a cabinet into a "Master Cabinet" required to perform the following Master functions.

(2) Power switch that removes power from master unit.

(3) Mode switch: A two position switch that allows local intersections to run under master control in one position, and local time of day operation in the other.

A company representative may be required to successfully install and test, with Department Engineers approval the initial system purchased. This will include all hardware / software for the server a work station at H.O.C as well as one at the Signal Lab, a Field Master and Local units.

A company representative will be required to perform any software changes needed to correct an error in the operation of the central software and or field units. This includes but is not limited to Flash Prom revisions, this does not include enhancements requested by the Department.

DOCUMENTATION

The ICLMU documentation shall include one (1) copy of the operations manual which shall contain unit programming and technical information, closed loop software programming and operation, wiring diagrams and schematics, hookup prints and troubleshooting guide.

SECTION #26C {CABINET REQUIREMENTS}:

As part of this bid an eight (8) phase cabinet will be provided. This cabinet will conform to all specifications pertaining to “D” type cabinets and contain all hardware (Defined on pages 85-90) with the exception of the following: Additionally a fully functional and wired “D” harness with panel will be supplied. All panels will be supplied with appropriate hardware.

No UCF will be required.

No time clock will be required.

A relay will be supplied to disconnect 24 VDC from the common side of all load switch packs during flash. The relay shall have a momentary push-button to apply power to the switch packs to aid in troubleshooting. This is for safety purposes, designed to prevent the intersection from flashing and displaying colors at the same time.

Vehicle Detector Test Buttons: 16 buttons Pre wired as follows.

8 Phase Cabinets Shall have the first 8 test buttons wired to vehicle detector inputs 1 thru 8 on the back panel. Additional buttons shall be wired to vehicle detector inputs 9 thru 16. Labels for test buttons shall be as follows:

Detector Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
(**X** Denotes buttons)	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**
Phase Called:	1	2	3	4	5	6	7	8 (9 – 16 left unlabeled)								

<u>All closed Loop cabinets will include an Enhanced Conflict Monitor which meets or exceeds NEMA TS1-1989 specifications.</u>

SECTION #26D {4 PHASE CABINET REQUIREMENTS}

As part of this bid a four(4) phase cabinet will be provided . This cabinet will conform to all specifications pertaining to “B” type cabinets (Defined on pages 73-79) with the exception of the following:

No UCF will be required.

No time clock will be required.

Additional Cabinet Requirements:

A relay which will disconnect 24 VDC from the common side of all load switch packs during flash. The relay shall have a momentary push-button to apply power to the switch packs to aid in troubleshooting. This is for safety purposes, designed to prevent the intersection from flashing and displaying colors at the same time.

All required cables panels and associated hardware for preemption and coordination operation will be supplied. All panels will be supplied with appropriate mounting hardware.

Vehicle Detector Test Buttons: 12 buttons Pre wired as follows.

4 Phase Cabinets shall have the first 4 test buttons wired to vehicle detector inputs 1 thru 4 on the back panel. Additional buttons shall be wired to vehicle detector inputs 9 thru 16. Labels for test buttons shall be as follows.

Detector Number	1	2	3	4	9	10	11	12	13	14	15	16
(**X** Denotes buttons)	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**
Phase Called:	1	2	3	4	(9 –16 left unlabeled Lab will assign)							

SECTION #27A

INTERNAL CLOSED LOOP LOCAL UNIT

TRAFFIC CONTROLLER FOR NAZTEC SOFTWARE

Notice to Vendor: Any changes to closed loop equipment currently used by the department must be approved by the Engineer or may be cause for rejection.

All new closed loop systems under review for approval by the department will need to meet the scrutiny of the Engineers interpretation of these specifications.

DESCRIPTION:

This Internal Closed Loop Local Unit (ICLLU) must be compatible with existing Naztec on street masters and software currently used by the Department of Transportation's Naztec Closed Loop System. The (ICLLU) shall be a microprocessor-based traffic controller/coordinator located in an on-street traffic signal cabinet. The ICLLU shall conform to TS2-1992 TYPE 2 NEMA traffic controller standards, (which retains the MSA, MSB, and MSC connectors for data exchange with the rear panel, providing a degree of downward compatibility). All external interface connectors are to be located on the front panel of the ICLLU. The ICLLU will be capable of operating both as a stand alone Time Base Coordination (TBC)traffic controller unit and as a controller within the departments Naztec Closed Loop Traffic Signal System. In addition the ICLLU shall conform to all State of Connecticut functional specifications for solid state traffic controllers outlined in this issue, as well as being downward compatible with equipment conforming to the NEMA TS2-1992 Standards Publication.

FUNCTIONAL:

The ICLLU shall utilize the phase hold, force-off, omit, call to non-actuated ,walk rest modifier and maximum inhibit functions as required. The ICLLU shall drop the appropriate phase hold outputs and issue a force-off for each utilized phase without the need for external interface circuitry.

THE ICLLU SHALL PROVIDE THE FOLLOWING FUNCTIONS:

(l).Monitor green, yellows, reds for eight (8) phases and eight (8) overlaps.

(2).Monitor a minimum of eight (8) walks and (8) don't walk phase outputs.

(3) Monitor actuation and record volume and other MOE data for eight (8) system detectors. Occupancy will be recorded during both the green period as well as during the entire cycle.

(4).Monitor actuation of eight (8) intersection detectors.

(5).Provide a minimum of six (6) timing plans each utilizing a different cycle, split plan and offset. All entries of item 5 shall be in seconds, not percentage.

EACH TIMING PLAN SHALL CONSIST OF one cycle length, programmable in five (5) second increments and having a duration of 30 to 255 seconds eight (8) phases programmable from 0 to 255 seconds.

(6).Provide two variable permissive (yield) periods each programmable in seconds and having a duration of 1 to 100 percent of the cycle length, and an automatic permissive. These functions must be reviewed and accepted by Department Engineers.

(7).Provide a minimum of ten (10) days schedules, with 10 events (consisting of start time, stop time, and timing plan) per day schedule. It shall be possible to implement intersection flash and free operation in a day schedule.

(8).Provide a minimum of ten (10) week schedules.

(9).Provide a minimum of ten (10) special or holiday schedules.

(10).Operate in a local time-of-day (TOD) mode without the need for Closed Loop Master Unit (ICLMU), traffic responsive and local TOD modes when an ICLMU is used.

(11).Monitor intersection flash and free operation.

(12).Monitor six (6) separate ground-true preemption inputs (preempt 1 through preempt 6).

(13).Monitor opening and closing of cabinet door by means of a dedicated switch.

(14).Monitor activation and deactivation of manual control enable.

(15).Provide an alpha numeric data entry access code for security purpose.

(16).Provide a minimum of one (1) special function outputs (capable of being invoked by time-of-day or manual override selection) and one (1) special function input, all utilizing ground true type of operation

(17).Accept a central computer system override on a system or per intersection basis to any of the following: user selected plan, flash and free.

(18).Be capable of operating all signal phase sequences that are used by the Department of Transportation **[see pages 27 - 28 in this issue of the State of Connecticut Functional Specifications for Traffic Control Equipment]**

(19) Modems must be to current industry standards and approved by Department Engineers.

(20) All call back features must be capable of being selected/deselected from central computer as well as keyboard (*HAVE AN ON/OFF FEATURE, capable of disabling unit from dialing out).*

(21) Capable of selecting any combination of offset, cycle length and split times or a timing plan pattern, without restrictions of a matrix configuration through manual override operation for a minimum of 18 coordination plans.

(22) Adjustable permissive periods active only in coordinated phase.

(23) Ability to distribute unused time to subsequent phases.

(24) Ability to select central overrides for Max II, and two (2) auxiliary's outputs.

(25) Ability to override T.O.D. Free, with Cycle, Offset and Split times or

timing plan pattern.

(26) Utilize a removable EE prom sub-module or data key technology for transferring sequence and intersection timings between controllers.

The ICLLU shall log the following error conditions, and report them to an attached ICLMU (if present) for transmittal to the central computer:

(1).Stuck Controller/ICLLU (i.e. not cycling).

(2).Coordination or synchronization failure.

(3).Unscheduled flashing operation.

(4).Manual Control Enable.

(5).Detector failures (absence of vehicle call, locked vehicle call erratic amplifier output)

TELEMETRY between the ICLMU and ICLLU's shall operate using full duplex hard wire interconnect cable or fiber optic communication cable. Hardwire systems shall not require any modems or components external to the ICLLU in the local traffic control cabinet that will achieve communications with the ICLMU. The ICLLU shall be capable of direct hookup via an interface port to a laptop computer in order to upload and download the ICLLU database and date/time using manufacturer's supplied software and central computer database.

ELECTRICAL:

The ICLLU shall operate on 115 VAC and be protected by a front mounted fuse. Database information shall be unaffected by power outages and stored in programmable ROM's a capacitive storage system or a nonvolatile RAM. Batteries shall not be allowed for the retaining of database information. The real time clock shall remain operational for a minimum of 48 hours in case of a power outage. The 115 VAC inputs shall be optically isolated. Sufficient unit suppression shall be provided to protect against voltage spikes to the ICLLU. Adequate protection shall be furnished on the interconnect lines to protect

against damage during electrical surges.

The ICLLU shall be shelf mounted. All database information including unit address shall be programmable using a built-in keyboard. The ICLLU shall include a built-in display that is readable in normal daylight and night time conditions. The display shall show all database keyboard entries and unit functional operations, and consist of a minimum of two (2) lines, sixteen (16) characters per line.

DOCUMENTATION

Included with the documentation for each unit shall be one (1) copy of the operations manual which shall contain programming and technical information, wiring diagrams and schematics, hookup prints, parts list, and a troubleshooting guide.

SECTION #27B

INTERNAL CLOSED LOOP MASTER UNIT.

COMPATIBLE WITH NAZTEC SOFTWARE.

Notice to Vendor: Any changes to closed loop equipment currently used by the department must be approved by the Engineer or may be cause for rejection.

All new closed loop systems under review for approval by the department will need to meet the scrutiny of the Engineers interpretation of these specifications.

DESCRIPTION:

This Internal Closed Loop Master Unit (ICLMU) must be capable of communications to Internal Closed Loop Local Units (ICLLU's) as well as Closed Loop Software in use by the Connecticut Department of Transportation's Naztec Closed Loop Systems. The (ICLMU) shall be a stand-alone microprocessor-based device capable of supervising a minimum of twenty-four (24) Internal Closed Loop Local Units (ICLLU's) associated with NEMA traffic controllers. Located in either a traffic signal cabinet, or at the Highway operations Center. The ICLMU shall serve as communications link between ICLLU's and the central computer control. The ICLMU shall be capable of directing ICLLU's to traffic responsive time-of-day and manual-override timing plans, as well as monitor/record/report ICLLU activity.

FUNCTIONAL

Master units shall be NEMA (environmental)approved and shall perform the following Functions:

Master units must be downward compatible to manufactures equipment produced in the past five years.

(1) Utilize a security code system to control remote user access. The security code shall be capable of being modified or deleted via the closed loop software

program.

(2). Store traffic volume and other MOE data from a minimum of sixty-four (64) system detectors for a period of forty-eight (48) hours.

(3).Direct ICLLU’s to traffic responsive plans on a time-of-day basis by obtaining volume and occupancy data received from user selected system detectors and choosing the appropriate timing plan based upon user-defined thresholds. The ICLMU shall average five (5) to fifteen (15) minutes worth of volume counts to select an appropriate timing plan, and incorporate a volume smoothing factor to prevent erratic plan selection. The selection of timing plans shall be based upon directional traffic flow characteristics. A minimum of two (2) occupancy override plans shall be provided for selected system detectors. A clearly written description of the traffic responsive algorithm, including descriptions of all formulas and calculations performed by the ICLMU shall be submitted to the department upon request by the engineer for review as part of this item.

(4).Store a minimum of forty-eight (48) hours worth of status reports traffic responsive pattern changes and failures per intersection.

(5).Upload and download of database information from the central computer to the ICLMU and ICLLU’s.

(6).Direct connection to a laptop computer via an RS-232 port utilizing manufacturers latest closed loop software and existing database. The upload and download of ICLMU and ICLLU database information and monitoring of ICLLU functional operation shall be provided.

Telemetry between the ICLMU and ICLLU’s shall operate using a two-pair full duplex hard wire interconnect cable or fiber optic cable [*External modems or components in the master or local cabinet used to achieve communications with ICLLU’s is prohibited for hardwire systems.]*

Telemetry between the ICLMU and the central computer location shall be accomplished using a voice grade dial-up telephone line, located at the master traffic control cabinet. The Closed Loop Central Software shall be capable of communicating at a minimum of 9600 baud from the central computer(s) to the

remote master sites through ConnDOT’s PBX telephone system.

ELECTRICAL:

The ICLMU shall operate on 115 VAC and be protected by a front mounted fuse. Database information shall be unaffected by power outages and stored in programmable ROM, capacitive storage system or nonvolatile RAM. Adequate protection shall be provided on the interconnect lines to prevent damage during electrical surges. Modem surge filters such as Tripplite Model MP or equivalent shall be provided to protect the dial-up modem from telephone line spikes.
The ICLMU may be shelf mounted and include all necessary cables, connectors and modems necessary to achieve communications with the ICLLU’s and the central computer. The ICLMU shall visually indicate the exchange of data between the ICLMU and ICLLU's. A built-in keyboard shall be provided to program all database parameters including unit address.

The ICLMU shall include a built-in display that is readable in normal daylight and night time conditions. The display shall show all database keyboard entries and unit functional operations. External interface connectors shall be located on the front panel of the ICLMU. Ten (10) foot harnesses equipped with locking-type connectors shall be labeled and supplied for interfacing purposes.

CLOSED LOOP SOFTWARE:

The latest version of the manufacturer’s closed loop computer software shall be provided as part of this item. The software package shall be functionally compatible with existing Naztec software / hardware currently used by The Department of Transportation. The Department of Transportation shall be able to use the software on any number of PC’s owned by the Department and make additional copies as needed for backup purposes. The software shall be reviewed by Highway Operations prior to acceptance of either this item or the Internal Closed Loop Local Unit. One (1) master with three (3) locals shall also be

provided for testing purposes with no cost to the Department.

SYSTEM COMPATIBILITY:

All software provided for the Closed Loop Traffic Control System shall be compatible with the latest Microsoft operating systems,Vista, XP and Windows 2000 systems with the specified configuration:
The software shall be capable of running in a stand alone computer system and in a client/server arrangement. The software shall run within the Office of Highway Operation's Microsoft Network server arrangement. The software shall provide the capability of thirty (30) multiple users and thirty (30) multiple workstations working simultaneously on a common database.

SYSTEM SECURITY:

The closed loop software program shall provide a minimum of thirty (30) user passwords with the capabilities of varying user privileges as described below.
(1).This level shall include access to all user performed functions including the definition of user security privilege levels. It shall be possible to modify or delete remote ICLMU passwords from this security level.
(2).This 1evel is equal to 1evel 1 minus the ability to view or change user security privileges or ICLMU passwords.
(3).This level is equal to level 2 minus the ability to modify disk resident database or change the operation of field equipment or software. It shall allow “view only” access to the system and provide the ability to retrieve count and event log data from the ICLMU.

FUNCTIONAL OPERATION:

The closed loop software shall meet the following functional requirements:

(1)Provide a minimum of one-hundred(100) master controllers per central computer.

(2).Provide a minimum of twenty-four (24) intersections per master controller.

(3).Provide a minimum of eight (8) intersection detectors per intersection.

(4).Provide a minimum of eight (8) system detectors per intersection.

(5).Provide a minimum of sixty-four (64) system detector

(arterial) which shall report volume (VPH), occupancy (%) and speed data.

(6).Provide a minimum of six (6) timing plans per intersection, each utilizing a different split plan. All entries of requirement 6 shall be in seconds, not percentage.

Each timing plan shall consist of

One cycle length programmable in one second increments and having a duration of 30 to 255 seconds.

Eight (8) phase splits programmable in one (1) second increments and having a duration of 0 to 255 seconds.

One (1) offset, programmable in one (1) second increments and having a duration of 0 to 255 seconds.

(7).Provide three (3) permissive periods per timing plan, programmed in seconds, having a duration of 1 to 100 percent of the cycle length.

(8).Provide a minimum of ten (10) day schedules per intersection.

(9).Provide a minimum of ten (10) events (start time, end time, and timing plan) per day schedule. The ability to implement intersection free and flash in a day schedule shall be provided.

(10).Provide a minimum of ten (10) week schedules per intersection.

(11).Provide a minimum of ten (10) special or holiday schedules per intersection.

(12).Provide a minimum of one (1) user-programmable special function output

(both time-of-day and manual override selectable), and the ability to monitor and record the actuation of at least one special function input per intersection.

(13).Monitor the actuation and display of eight (8) walk phases.

(14) Provide the capability to operate all signal phase sequences used by the Connecticut Department of Transportation **[see page 27 and 28 in this issue of the State of Connecticut Functional Specifications for Traffic Control Equipment].**

(15).Operate on both the COMl and COM2 asynchronous communication ports, with the port assignment user definable.

(16). Permit the upload and download of database information including ICLMU software revision level and compare field and central computer database for any discrepancies. The ability to upload and download the current date and time shall also be provided.

The following reports and features shall be provided by the Closed Loop central software:

INTERSECTION STATUS: A real-time display of intersection performance which shall include intersection name, database number, communication address, status (free, on-line, ICLLU failure, flash, preemption, manual control enable), current timing plan, cycle length (in seconds), offset, phase returns (colors), walk returns and a cycle counter.

The screen shall also display the programmed and actual phase splits (in seconds), controller status bits and the status of the ICLLU force-off output. The Intersection Status screen may be combined with the Graphics Program.

DETECTOR REPORT: Shall provide the status of system detectors as well as the most recently available volume, occupancy and speed data, in a graphic or table format. Any failed detectors shall be noted on the report. This routine shall also allow 15 minute and hourly volume, occupancy and speed data for all system detectors to be exported to an ASCII file.

ARTERIAL OR INTERSECTION EVENT REPORT: Shall provide the ability to retrieve and display recorded events from the ICLMU and from event logs stored on disk. An event description, date and time shall be shown. Reported events shall include master traffic responsive plan changes, ICLMU, ICLLU and controller malfunctions power failures, flash and free operation, preemption and special function input activation, central overrides, and communication failures.

SYSTEM/INTERSECTION OVERRIDE COMMAND: Shall provide the capability to manually override system operation from the central computer either by system wide or selected individual intersections within a specific system. Intersection overrides shall include flash, free, time-of-day, traffic responsive, and a manual override plan. All overrides shall remain in effect until released from the central computer.

GRAPHICS PROGRAM A real-time color graphics routine shall also be provided. It shall be VGA compatible, and shall enable an engineer to create customized intersection and arterial map-oriented displays, and save each display to a disk file. Two types of graphics creation procedures shall be provided, an ASCII-based character graphic program and a high resolution vector-based program. This item shall include all software and hardware accessories necessary to draw, edit integrate and import graphic files for graphics use.

THE INTERSECTION GRAPHIC shall have the ability to display eight (8) phase returns (colors), eight (8) system detectors and sixteen (16) intersection detector actuation’s in real-time. All detectors will display vehicle activation’s in all phases, regardless of controller recall functions. The program shall provide an indication of the current intersection status (free, flash, on-line, preemption, failure), cycle counter, active timing plan, cycle length (in seconds) and a real-time clock display.

PERCENTAGE OF SPLIT USED: A screen that shows a real time running display of phase utilization in percentage of the programmed split as well as the programmed split for visual comparison. This display will update with each cycle and display an average of phase utilization for a predetermined number of cycles. The display shall also include status of the current phase (R,Y,G,W) and the method of termination (F.O. GAP or Max).

THE ARTERIAL MAP GRAPHIC: shall disp1ay real-time arterial phase status of at least twenty-four (24) intersections on a single screen. A real-time clock display and a cycle counter shall also be displayed. This screen shall display a system wide green band or vehicle progression through the system. The graphic shall indicate the current status of each intersection within the system with its corresponding cycle timer.

SOFTWARE DATABASE: A menu-based routine shall be used to allow the input and modification of all database entries for the ICLMU and ICLLU using the same database input format for direct keyboard input. The central software menus shall mirror as near as possible that of the ICLMU and ICLLU keyboard entries. It shall be possible to upload and compare timings for the ICLMU and ICLLU, with any discrepancies highlighted or clearly noted on the screen.

EVENT REPORT AND LOG: The central computer software shall utilize and include a means for logging system and intersection activity transmitted from the ICBM. This feature shall be capable of reporting two types of information: a call-back report and a system event log. The operation of both reports shall be reviewed and accepted by the DOT Office of Highway Operations prior to acceptance of this item. The ICLMU shall store a minimum of one (1) remote computer telephone number for call-back purposes, consisting of at least twelve (12) digits. An error detection/correction protocol shall be utilized to ensure that the call-back report and the system event log is correctly transmitted by the ICLMU and recorded by central computer. If a non-correctable error occurs during data transmission, the ICLMU shall repeatedly attempt to contact the central computer until the reception of the event information is verified by the computer. If the ICLMU is unable to contact the central computer, it shall continue to dial approximately every five (5) minutes until the event report is properly transmitted.

All call back features must be capable of being activated/deactivated from central computer as well as keyboard and HAVE A ON/OFF FEATURE, capable of disabling unit from dialing out).

THE CALL-BACK REPORT shall immediately transmit the following user selectable events (including date, time and intersection number)in a first-in, first-out order. All reports will include master number / identification description, and local number(s) / description (s). The user shall be capable of disabling any call-back report event from the central computer on a per intersection or per master basis. The call back reports will include but not be limited to the following reports, all accompanied by concise descriptions.

(1).ICLLU failure (including stuck controller).

(2).Coordination or synchronization failure.

(3).Unscheduled flashing and free operation (including conflict flash).

(4).Manual Control Enable

(5).Activation of external special function inputs, preemption inputs and door

open switch.

(6).ICLMU power restoration and ICLLU power failure and restoration.

(7). System traffic responsive pattern changes.

The data received by the central computer shall be capable of being stored in a disk file and logged on an attached printer. It shall provide a means for selecting the call-back events to be instantly printed, and those to be stored in the disk file. It shall be possible to disable the call-back function from the central computer location.

THE SYSTEM EVENT LOG shall transmit a daily summary of non critical event information, including T.O.D. flashing operation and detector errors, recorded by the ICLMU and sent at a user-specified hour once per day. The retrieval of the log information may be initiated either by the ICLMU or the central computer.

All events shall be user assigned, and logged on an attached printer and/or stored in a disk file if selected by the user. The system event log shall also include activity for any of the above events if selected by the user, even if the event call-back report is disabled.

Detectors shall be monitored by the ICLMU for three types of failures; absence of call, constant (locked) call and erratic amplifier output (excessive actuation’s/chatter). The time limits for each setting shall be user programmable in one minute increments. If the time limit for any of these parameters is exceeded, then the ICLMU shall be capable of immediately transmitting the failure to central, or of sending it during the event log transmission. Volume reports shall be activated/deactivated for auto transmission to central on a daily basis and per system basis.

MISCELLANEOUS SYSTEM REQUIREMENTS:

For **every master** sold two modems will be supplied.

"Master Cabinet" required to perform the following Master functions.

(1) Power switch that removes power from master unit.

(2) Mode switch: A two position switch that allows local intersections to run under master control in one position, and local time of day operation in the other.

(3) A company representative will be required to successfully install and test, with Department Engineers approval the initial system purchased. This will include all hardware / software for the server a work station at H.O.C as well as one at the Signal Lab, a Field Master and Local units.

A company representative may be required to perform any software changes needed to correct an error in the operation of the central software and or field units. This includes but is not limited to Flash Prom revisions, this does not include enhancements requested by the Department.

DOCUMENTATION

The ICLMU documentation shall include one (1) copy of the operations manual which shall contain: unit programming and technical information, central software programming and operation, wiring diagrams and schematics, hookup prints and troubleshooting guide.

SECTION #27C {8 PHASE CABINET REQUIREMENTS}:

As part of this bid an eight (8) phase cabinet will be provided. This cabinet will conform to all specifications pertaining to “D” type cabinets and contain all hardware (Defined on pages 78-84) with the exception of the following: Additionally a fully functional and wired “D” harness and panel will be supplied. All panels will be supplied with appropriate mounting hardware.

(1)Mode switch: A two position switch that allows local intersections to run under master control in one position, and local time of day operation in the other.

(2) No UCF will be required.

(3) No time clock will be required.

(4) A 24vdc relay pre-wired on pre-emption panel to disconnect logic ground from optical preemptors.

(5) A relay which will disconnect 24 VDC from the common side of all load switch packs during flash. The relay shall have a momentary push-button to apply power to the switch packs to aid in troubleshooting. This is for safety purposes, designed to prevent the intersection from flashing and displaying colors at the same time.

(6) Vehicle Detector Test Buttons: 16 buttons Pre wired as follows.

8 Phase Cabinets Shall have the first 8 test buttons wired to vehicle detector inputs 1 thru 8 on the back panel. Additional buttons shall be wired to vehicle detector inputs 9 thru 16. Labels for test buttons shall be as follows:

Detector Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
(**X** Denotes button)	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**
Phase Called:	1	2	3	4	5	6	7	8	(9 – 16 left unlabeled)							

(7) Cabinets will be equipped with an enhanced monitor supplied with all the appropriate harnesses pre wired to perform the following functions.

Naztec NM-512-E123 LCD NEMA TS1 Enhanced Conflict Monitor Specifications

1.0 Conflict Monitor Requirements

1.1 The conflict monitor shall meet the standards of NEMA Standard Publications TS1-1989, Section 6 for 12 channel types. The monitor shall also meet all environmental and transient specifications of NEMA TS1-1989, Section 2. A Type 12 conflict monitor having 12 fully programmable input channels shall be provided.

1.2 The conflict monitor will include the communications protocol to send messages through both a Naztec NEMA TS1 and TS2 type controller via an RS232 port located on the front panel of the unit to the Naztec Closed Loop System software. These reports shall be accessible through the Naztec Closed Loop System software on a report generation screen and also be capable of being printed from the system for maintenance information.

1.3 No circuit cuts shall be allowed on circuit boards in any of the equipment supplied. Any wire jumpers included on circuit boards shall be placed in plated through holes that are specifically designed to contain them. Jumpers that are tack soldered to circuit traces or that are added to correct board layout errors are not acceptable.

1.4 For easy maintenance, all I.C. chips will be mounted in sockets. Dual-in-line (DIP) devices shall be mounted in military specification sockets, Augat part #8xx-AG11D. All sockets shall have two-piece, machined contacts and closed end construction to eliminate solder wicking. The outer sleeve shall be brass with tin or gold plating and tapered to allow easy I.C. insertion. The inner contact shall be beryllium copper sub-plated with nickel and plated with gold. All sockets shall have thermoplastic bodies meeting UL Specification 94V-0. Each I.C. socket contact shall be plated with at least 50 microns of gold.

1.5 In addition to the above requirements, a back lighted LCD display shall be provided to indicate continuously when a channel is active due to green, yellow, red or walk inputs. It shall also continue to display the channels, which were active at the time of a conflict, until the conflict monitor is manually reset.

1.6 If the conflict was caused by a loss of red, the display array shall indicate loss of red.

1.7 If the conflict was caused by the voltage monitor, the display array shall indicate a voltage error.

1.8 The monitor shall conflict on a multiple indication within each phase (green-yellow, green-red, yellow-red). The display shall show which indications caused the conflict.

1.9 The monitor shall provide a programmable short yellow clearance indicator for each channel.

1.10 All monitors shall be programmable as called for in the NEMA Publications TS1-1989, Section 6.

1.11 Each conflict monitor will be supplied with a four- (4) foot RS232 cable with the appropriate connectors on each end.

1.12 When the line voltage is reduced to 90 V AC the conflict monitor Voltage Monitor Output shall cause the signal outputs to flash. Hysteresis shall be sufficient to prevent “pin-balling” of the outputs during gradual voltage recovery.

1.13 The monitor shall store a minimum of twenty (20) failures and thirty (30) power condition changes stamped by day, date, and time.

2.0 Communications

2.1 The conflict monitor shall generate a report that can be accessed from a central software package for each of the following items:

2.1.1 The configuration of the programming card.
2.1.2 The channels, which have the NEMA plus features, enabled.
2.1.3 A listing of the phases which are monitored for short yellow times.
2.1.4 Additionally, the conflict monitor shall store and report at least the last (20) twenty failures containing the information listed above when interrogated directly via the portable download/upload unit.

2.2 The report shall list at least the last (20) twenty failures from the monitor which shall contain the following:

2.2.1 Time of the occurrence of the failure.
2.2.2 The channels (Green, Yellow, Red, and Walk) that were active at the time of failures.
2.2.3 The status of the CVM input and the +24 volts 1 and 2 inputs.
2.2.4 The type of failure (conflict, switch failure, red failure, etc.)

2.3 The conflict monitor will be capable of transmitting (via RS-232 port) an ASCII report to the controller unit.

2.4 The conflict monitor shall provide three (3) reports for interrogation. The first is an ASCII record of all data entries and programming card configurations. The second is an ASCII formatted record of all failure and each power on/off cycle. The last twenty (20) of these failure records will be available in report form. The third report will be a sampling report and will contain the twenty (20) samples of all of the inputs to the conflict monitor. Each sample will be taken at 0.1 second intervals so that the last two (2) seconds of real-time outputs of the load switches can be viewed. This report shall also be accessible through the Naztec controller to the Naztec Closed Loop system software. Each of the reports will have the appropriate headings and will consist of ASCII lines of not greater than eighty (80) characters so that a clear presentation of the data can be viewed from the screen of a notebook using the standard ASCII character codes.

2.5 The monitor port shall be programmed in the following format:

2.5.1 Standard EIA RS-232 convention

2.5.2 Each word shall be eleven (11) bits long, eight (8) data bits, one (1) start bit, one (1) stop bit, no parity.

2.5.3 Programmable to 9600 baud.

2.5.4 The notebook and/or traffic controller unit will send a message of one byte to the monitor requesting each of the reports. After the one-byte message, the controller will issue an XON command to start the data flow. The data flow can be stopped with an XOFF command at any time. The data sent to the notebook and/or controller unit in response to the request message will be the ASCII report requested. The last byte sent by the monitor will be an EOT (End of Text-04H). If the controller issues an XOFF during a reporting request, the monitor will stop the data flow. If an XON is not issued within 30 seconds, the monitor will time out and set its pointer to the beginning of the report. The next XON will then start at the beginning of the requested report. A report will also perform the XOFF function to the conflict monitor.

Definitions of the request:

Request report 1	31H
Request report 2	32H
Request report 3	33H
XON (DC1)	11H
XOFF (DC3)	13H

3.0 Programming

3.1 Each channel shall have a programmable short Green monitor selectable in one (1) second increments.

3.2 Upon detection of a short Green, the monitor shall place the intersection controller in flash operation.

3.3 Programming shall be accomplished through a twenty- (20) position keyboard with the following keypad layout.

10 white keys – numbers 0-9.
6 gray keys – cursor controls
4 red keys – function controls

The keyboard shall be a true tactile feedback style operation with an operator response through positive touch feedback as well as an audible beeper.

An operator entry shall be provided that will disable the beeper output sound.

3.4 Programming shall be menu driven with easy to follow numbered menus visible in all lighting conditions through the utilization of a back lit display.

3.5 The display shall have a programmable automatic time-out feature with a range setting of 2 – 99 minute settings with a one- (1) minute resolution.

3.6 The operator shall be able to control the back lighting with an on/off selection mode available through the keyboard.

3.7 An active display shall provide the following:

AC line voltage

Record number of power disturbances
Last thirty (30) power up/down conditions
Power Surge, Dip, Over-Voltage conditions, Brown Out, Processor Start, Brown-Up
Power Down, Dropout, Normal

3.8 The NEMA TS1 Conflict monitor clock shall be Y2K compatible.

3.9 Leap Year correction shall be automatic, and Daylight Savings Time shall be programmable.

4.0 Documentation

4.1 The conflict monitor shall come with a complete instruction manual containing all schematics and circuit design layout.

4.2 A programming chart shall be supplied with each conflict monitor.

4.3 At the end user request, a copy of the NEMA test report from an independent lab shall be supplied at no charge to the requesting agency.

SECTION 27C1 (8 PHASE CABINET WITH RACK MOUNTED DETECTORS)

An additional item will be provided. This item will have all the requirements as **SECTION 27c** with the addition of rack mounted detection. The cabinet shall be provided with 16 detectors with 4 four channel detector cards. Delay and extension features will be achieved internally by the controller unit, not on the detector cards.

Each four channel detector card shall meet or exceed the requirements of Nema TS-1 standards and provide the following functions.

Automatic self-tuning and fifteen selectable sensitivity settings will be required, Crosstalk between adjacent loops will be minimized by selecting one of four different oscillator frequencies for each loop. Crosstalk between adjacent channels shall be eliminated by means of sequential scanning.

The detector shall be capable of operating in either the Presence Mode or Pulse Mode. Selectable

Two LED’s shall be provided per channel, the first labeled DET (DETECT LED) illuminates when a vehicle is on a loop. The second LED shall be labeled FLT (FAULT LED)and will provide an 8Hz, 2Hz, 1/2Hz and continuous-on mode to indicate loop shorted , opened, inductance change greater then 25% and watchdog reset, respectively.

The detectors shall be capable of turning any or all channels off by setting their respective sensitivity to zero.

The power supply shall be a shelf mounted, enclosed 24VDC power supply capable of supplying a minimum of 3.6 amperes. The supply shall be_durable aluminum casing and contain a common and 24VDC socket. The supply shall have an appropriate size Slo-Blo fuse to protect the 120vac input line. This fuse shall be accessible on the front panel. The front panel shall also provide an on off toggle switch and Power-On indicator.

(6)PEDESTRIAN DETECTOR ISOLATION: One (1) Two channel pedestrian isolation circuit board shall be provided. The card shall fit into the vehicle detector rack defined above. The dimensions shall follow the standard for a type 7 cards Section 15 in Nema TS-1 1989 Specifications. There shall be two circuits using optical and transformer isolation designed and tested for a minimum of 2500 volts D.C. between inputs and outputs. Each circuit will recognize a 5 millisecond closure between conductor pairs from pedestrian push buttons. Transient protection shall be on inputs and capable of a 10 microfarad capacitor charged to 2,000 volts to be discharged between input pins or between an input pin and chassis ground. When the input closure occurs this will provide a logic ground closure on the pedestrian call circuit for a minimum of 100 milliseconds, or the amount of time the pedestrian push button remains closed. Each board shall have a fused power supply. Output status indicators shall be located on the front panel for each channel. A three position test switch shall be provided on the front panel for each channel. The positions for the for mentioned switch shall be “ON” “OFF” and Momentary “ON”.

SECTION #27D {4 PHASE CABINET REQUIREMENTS}

As part of this bid a four(4) phase cabinet will be provided . This cabinet will conform to all specifications pertaining to “B” type cabinets (Defined on pages 87-91) with the exception of the following:

(1) Mode switch: A two position switch that allows local intersections to run under master control in one position, and local time of day operation in the other.

(2) No UCF will be required.

(3) No time clock will be required.

(4) A 24vdc relay pre-wired on pre-emption panel to disconnect logic ground from optical preemptors.

(5) Vehicle Detector Test Buttons: 12 buttons Pre wired as follows.

4 Phase Cabinets shall have the first 4 test buttons wired to vehicle detector inputs 1 thru 4 on the back panel. Additional buttons shall be wired to vehicle detector inputs 9 thru 16. Labels for test buttons shall be as follows.

Detector Number	1	2	3	4	9	10	11	12	13	14	15	16
(**X** denotes button)	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**
Phase Called:	1	2	3	4	(9 –16 left unlabeled Lab will assign)							

Additional Cabinet Requirements:

(1) A relay which will disconnect 24 VDC from the common side of all load switch packs during flash. The relay shall have a momentary push-button to apply power to the switch packs to aid in troubleshooting. This is for safety purposes, designed to prevent the intersection from flashing and displaying colors at the same time.

(2) All required cables panels and associated hardware for preemption and coordination operation will be supplied. All panels will be supplied with appropriate mounting hardware.

(3) A Naztec NM-512-E123 LCD NEMA TS1 Enhanced Conflict Monitor will be supplied with this item as defined in section 27C.