1. Traffic Signal Controller and Cabinet, Fully Actuated 8-Phase, Item SPV.0060.###.

A Description

This special provision describes providing traffic signal controllers as shown on the plans and as hereinafter provided.

Submit a Certification of Compliance from the signal vendor, the contractor, or the company that wired the cabinet certifying that the cabinet and equipment as furnished, conform to the plan and specifications. Ensure that the certificate of compliance is on the letterhead stationery, signed by an authorized officer of the company, and notarized. Submit a copy to the engineer.

It is the responsibility of the contractor or his designee that all functions within the controller, cabinet, switches, and other timing parameters, and that all electrical and electronics components are in proper working condition. In addition, it is the responsibility of the contractor or his designee to ensure it meets the plan and the specifications, and shall demonstrate this to the engineer or his designee at the field location.

After mounting the cabinet on the cabinet foundation, connect all the field wiring inside the controller cabinet and test the signal circuits for correct operation. Connect and test the signal circuits outside the controller cabinet as directed by the engineer. Connecting and testing signal circuits shall be considered part of this item of work.

The delivered cabinet at the intersection shall perform in accordance to the standard specifications, the plan details, and special provisions once the field wiring is connected. It shall also be the responsibility of the contractor to have the person responsible for wiring the cabinet present at the location when the field wiring is connected to the cabinet wiring. In addition, the contractor assumes liability for any damage or damage due to malfunctions or improper wiring.

The controller shall be a fully traffic actuated, solid state, digital microprocessor controller, capable of providing the number and sequence of phases, overlaps, and any special logic as described herein and shown on the accompanying plan. The controller will match the manufacturer and model of recently installed controllers being used in the city of Mauston.

The controller shall be fully programmed and shall be mounted in a control cabinet to operate as a complete and functioning intersection traffic signal control system. The equipment items included shall be, but not necessarily limited to, cabinet, microprocessor controller, monitor, detector amplifiers, power supply, power distribution panel, interior cabinet wiring, and other associated electrical and electronic equipment interior to the control cabinet that is necessary to provide the type of operation described in these specifications.

Provide dual ring, programmable for both single and dual entry concurrent timing, eight-phase frame or equivalent. Provide volume density and pedestrian timing for all phases. MUTCD flashing capability shall be provided. All controls shall be in accordance to the accompanying plans and with NEMA Standards Publication No. TSl‑1976 including Revisions No. 1 and No. 2.

The intersection controller unit shall be capable of up to 8-phase operation plus four programmable overlaps regardless of whether preemption, coordination or the special programming is used. Wire the intersection cabinet for a minimum of twelve and include six 3-circuit load switches.

B Electrical and Operational Aspects

B.1 Buffering

Internally buffer all logic circuit inputs to withstand transients and noise, such as might result from normal usage, without damage to any mechanism components.

B.2 Timing Features

All controller timing parameters shall be fully programmable from the front panel using switches and/or keyboard inputs, and memory storage features shall be nonvolatile under power off conditions for at least 30 days. The locking, nonlocking detection mode and recall switches shall also be accessible on the front panel.

B.3 Minimum Green Timing

The passage timer shall time concurrently with the minimum green timer, so that the duration of the minimum green time is directly adjustable and is independent of the passage time setting.

B.4 Dual Ring Timing

In the dual ring application, no more than two phases shall be permitted to time concurrently, and no more than one phase per ring. The controller shall provide barrier protection against concurrent timing of two conflicting phases; no phases assigned to one side of the barrier shall be permitted to time concurrently, if a conflict will occur. The controller shall service calls on a single entry basis, and both rings shall cross the barrier simultaneously in accordance to the following logic: (a) Phases timing concurrently shall terminate simultaneously if both have a gap out due to excessive time between actuations. (b) Phases timing concurrently shall terminate simultaneously if both have a maximum time out. (c) In the event that one phase has not achieved a gap out or maximum time out, the other gapped out phase shall be permitted to leave the gapped out condition and retime an extension when an actuation is received.

B.5 Manual (Police) Control

If manual control is used, actuation of the manual control shall permit manual advance of the Walk, Pedestrian Clearance, and Green interval terminations only. Manual termination of Yellow or All Red clearance intervals shall not be permitted.

B.6 Red Revert

Provide an adjustable red revert control to assure adequate red display when recycling a phase during call-away or red rest mode operation. A call for service to a different phase shall be preceded by an all-red clearance interval, as programmed.

B.7 Coordination

The controller shall be capable of operation in progressive coordination systems and mutual coordination and shall contain, but not be limited to, the following external inputs, with all functions brought out:

|  |  |
| --- | --- |
| Vehicle/Pedestrian Detectors per phase | Pedestrian Omit per phase |
| Phase Omit per phase | Hold per phase |
| Omit Red Clearance per ring | Internal Maximum Inhibit per ring |
| Maximum II per ring | Red rest per ring |
| Stop Timing per ring | Force-Off per ring |
| Select Minimum Recall per controller | Manual Control per controller |
| Semi-Mode per controller | External Start per controller |

B.8 Minimum Safe Timings Control

Controllers shall not accept any operator input or stored timing parameters that would result in intervals shorter than the following: yellow clearance - 3.0 seconds; minimum walk - 4.0 seconds; minimum pedestrian clearance - 6.0 seconds. At the beginning of each of the above intervals, the controller shall check the previously stored data against these minimums. If an operator attempts to load an incorrect timing parameter, the controller unit shall output a unique error code on the front panel display. As an alternate to minimum timing control, a coded keyboard entry security feature may be provided.

B.9 Indicator Lights and Switches

Provide indicator lights to show the status of each signal phase on. Indicator lights shall also be used to show interval status, phase termination information, and presence of vehicular and pedestrian calls for each phase. Also provide an indicator light to show the status of the backup battery charging circuit for future use.

The controller shall have an on off switch and fuse for AC power.

B.10 Data Display

If keyboard entry is supplied, the front panel shall contain a display panel consisting of LED display characters. The face of the display shall be scratch, chemical, and solvent resistant. In the case of writing data or parameters into the controller, there shall be a visual indication that the data has been accepted. The number of characters shall be adequate to read or write all data and parameters in decimal format together with a data descriptor in either alpha numeric format, or thumbwheel switch display.

B.11 Diagnostic Program

A diagnostic program shall be prepared by the manufacturer of the controller unit that will demonstrate the proper operation of all the inputs, outputs, controls and indicators in the controller, and shall have visual conformation on the front panel. The diagnostic program shall be either resident in the controller or furnished as a separate plug in module. A flow chart and listing of the diagnostic routine shall be furnished with the controller unit.

B.12 Maintenance of Controller

For ease of service, the controller shall be divided to a minimum of the following separate circuit boards:

1. CPU/Memory

2. Input/Output

3. Front Panel

4. Power Supply

Each board must be easily removable without requirements for special tools.

The microprocessor supplied shall be the type that has a Fluke Pod that is compatible.

All electronic components must be removable by a PACE (model PPS-5) solder station and all integrated chips over 20 pins must be on sockets.

C Monitoring

Provide a NEMA PLUS monitor with all components and circuitry, independent to the controller and having the capacity to handle a minimum of 12 channels. The monitor shall detect conflicting indications, controller voltage drops, and the absence of reds as follows:

1. Conflicting indications shall cause the monitor to place the intersection in a flashing mode of operation. The monitor shall maintain the flashing mode until manually reset, regardless of 110 VAC power to the conflict monitor.

2. The +24 VDC cabinet power source shall be monitored by the conflict monitor. If that voltage drops to an unsatisfactory level, the monitor shall cause the controller to revert to flashing mode. Upon resumption of normal voltages, the controller shall resume normal stop and go operation without the necessity of manual resetting.

3. The absence of any required red signal voltage at the field connection terminals in the controller assembly shall cause the monitor to place the intersection in a flashing mode of operation. The monitor shall maintain the flashing mode until manually reset.

4. After power interruption (exceeding 457 +/- 25 milliseconds) to the controller assembly a flashing period (4 to 10 seconds adjustable) shall precede the startup (initialization) sequence. This feature can be resident in either the monitor or the controller.

5. The flash circuit shall be wired in a failsafe manner so that the intersection will revert to and remain in flashing mode whenever and for as long as either the controller mechanism or the monitor is disconnected.

6. Indicator lights shall be: a) an indicator for each channel shall be provided with latch status of failure, b) +24V light inputs, c) conflict light, d) conflict monitor power light and program board ajar light, e) power interrupt after failure light, f) red failure light.

7. G or W vs. Y signals on the same channel: This function shall be enabled on a per unit basis. When enabled, the conflict monitor shall be capable of monitoring for green or walk versus yellow indications active on one channel. It shall be recognized as a failure if the condition exits for 850 +/- 150 milliseconds. This failure shall always be considered a latched failure when enabled.

8. G, W, or Y vs. R signals on the same channel: Enable this function on a per channel basis. When enabled, the conflict monitor shall be capable of monitoring for green or walk or yellow versus red indications active on one channel. It shall be recognized as a failure if the condition exists for 850 ±150 milliseconds. This failure shall always be considered a latched failure when enabled.

D Terminal Facilities

Terminal facilities shall consist of all devices external to the controller unit that are necessary to complete the intersection control. Terminal facilities supplied shall be protected by dual 30-amp circuit breakers. The dual 30-amp breakers shall feed an evenly split signal bus supplied through bus relays and radio interference line filters. Bus relays, in all cases, shall be mercury type contractors and shall not be jack mounted. Terminal facilities shall also include applicable load switch panels of sufficient capacity to accommodate 8 vehicle phases, 4 pedestrian phases, and 4 overlap phases and shall include a minimum of 6 solid state 3 circuit load switches with visual indicators. Flash transfer relays and two double circuit flashers shall also be provided. The internal wiring in the load switch panels shall be insulated wiring of sufficient size or the individual outputs fused so that the wiring will not be damaged by shorted output light circuits. Printed circuits in the load switch panels will not be acceptable.

Use terminal strips to terminate controller cable, signal head cables and vehicle and pedestrian detector cables. Terminate all controller inputs and outputs on an interface panel. All interface and output terminal connections shall be the screw down type.

Fuse all interconnect terminal facilities to incoming lines.

E Cabinet Switches

Locate the following switches inside the cabinet on a maintenance panel:

a. Controller On/Off

b. Cabinet Light

c. Stop Time (Three Position)

|  |  |  |
| --- | --- | --- |
| Position | Label Switch | Function |
| Upper | Stop Time | Place stop time on the controller |
| Center | Run | Remove the stop time input to the controller |
| Lower | Normal | Connects the Monitor to the controller stop time input |

Provide switches for all vehicle phases and all even pedestrian phases.

Locate the following switches behind the Police access door:

a. Signal/Off

b. Flash/Normal

The above switches shall function as follows:

 Signal Off

 Flash Signals Flash Signals Dark

 Normal Signals Normal Signals Dark

Manual Detector Operation. Provide three position switches external to the controller that will permit manual detector calls and manual detector disconnect for each phase independently. The switches shall be spring loaded and shall rest in the center (non‑operative) position. The switches shall be appropriately labeled and shall operate as follows:

|  |  |  |
| --- | --- | --- |
| Upper Position: | Spring loaded: | Disconnect detector |
| Center Position: | Normal detector operation |  |
| Lower Position: | Spring loaded: | Test call is placed to controller. |

F Cabinet and Cabinet Equipment

Furnish the controller completely housed in a door-in-door ground mounted (without anchor bolts) metal cabinet of minimum size 1115 mm wide, 685 mm deep, and 1495 mm high.

Provide a cabinet of clean-cut design and appearance. The size of the cabinet shall be such as to provide ample space for housing the controller, and all of the associated electrical devices which are to be furnished with the controller, together with any other auxiliary devices herein specified.

All cabinets shall have the following:

1. A 15-amp circuit breaker for auxiliary equipment.

2. A 2-pole 20-amp circuit breaker for street lighting, photo eye, and contactor.

3. A valve type surge protector, as manufactured by Joslyn, catalog #L9200-10; General Electric, catalog #9L15DCB002; or approved equal, shall be mounted internally within the traffic signal cabinet and shall be connected across the load terminals of the circuit breakers. A General Electric Varistor, catalog #V130PA20A, shall be installed at the load terminals of each circuit breaker from the hot line to the grounded current carrying neutral conductor.

4. Incandescent light socket.

5. Solid state jack mounted NEMA flasher(s) with visual indicators and completely wired base, rated for at least 10 amps per circuit at 74 degrees C.

6. Control switches, including controller power switch, stop time switch, cabinet light switch, and emergency flash switch.

7. All switches specified in Section C-8 and F.

8. Necessary fuses and circuit breakers.

9. All wiring harnesses including detector harnesses. Loop detector harness connector shall be MS-3106B018-lS fully wired terminals I and J which shall go to separate isolated terminals. One loop harness shall be provided for each of the phases (i.e. 01 - 08).

10. **Duplex power receptacle**.

A 120 VAC 20 amp, NEMA 5-20R GFl convenience outlet shall be mounted in each cabinet for energizing equipment or tools. The outlet shall be fuse protected.

11. **Radio interference filter**.

Each control cabinet shall be equipped with a single radio interference suppressor of sufficient ampere rating to handle the load requirements. The RIS shall be installed at the input power point. It shall minimize interference in both the broadcast and the aircraft frequencies, and shall provide a maximum attenuation of 50DB over a frequency range of from 200KHZ to 75MHZ, when used in connection with normal installations. The radio interference suppressor shall be hermetically sealed in a substantial metal case that shall be filled with a suitable insulating compound. The terminals shall be nickel-plated brass studs of sufficient external length to provide space to connect two No. 8 AWG wires and shall be so mounted that they cannot be turned in the case. Ungrounded terminals shall be properly insulated from each other, and shall maintain a surface leakage distance of not less than 6.35 mm between any exposed current conductor and any other metallic parts. The terminals shall have an insulation factor of 100-200 megohms dependent upon external conditions. The RIS shall not be rated less than 35 amperes. The RIS shall be designed for operation on 115 VAC +/- 10%, 60HZ, single-phase circuits, and shall meet the standards of UL and Radio Manufacturer's Association.

12. **Cabinet grounding**.

In all controller cabinets and auxiliary cabinets, the AC common, the logic ground, and the chassis ground shall be isolated from each other the same as detailed by NEMA Standard.

13. **Suppressors**.

Each 120 VAC circuit that serves as inductive device, such as a pan motor or a mechanical relay, shall have a suppressor to protect the controller's solid state devices from excessive voltage surges. Such suppressors shall be in addition to the surge protector at the input power point.

All conductors in the cabinet shall be number 22 AWG or larger, with a minimum of 19 strands, and conforming to military specifications, Mil-W-16878D, Type B or D, vinyl nylon jacket, 600 volt, 105 degree C. All cabinets shall be factory wired.

The cabinet shall provide weather protection and forced ventilation, air filters and heaters, with adjustable thermostat switches, and comply with the environmental and operating standards outlined in NEMA Specification TSI-1-1976. The cabinet shall provide reasonable vandalism protection. Provide access doors that have latches and a Corbin lock, dust cap, and key change IR6380. The small door shall be provided with standard police locks. The heater supplied shall have adjustable thermostat setting which varies from 0 degrees to 40 degrees Celsius.

Forced Ventilation. Ventilate the controller cabinet containing solid-state equipment by means of a 120 VAC, 60HZ, tube axiac compact type fan. The fans free delivery airflow shall be greater than 2.83 cubic meter per minute. The magnetic field of fan motor shall not affect the performance of control equipment. The fan bearings shall operate freely. The fan unit shall not crack, creep, warp or have bearing failure within a 7 year duty cycle. The maximum noise level shall be less than 40 decibels. The fan unit shall be corrosion resistant. The thermostat's turn on setting shall be adjustable from 32 to 49 degrees Celsius. The fan shall run until the cabinet temperature decrease to approximately 17 degrees C. below the turn on temperature setting. The fan shall be fused.

Provide metal shelves to support the controller and external equipment. The controller shall be located on the top shelf and not less than 965 mm above the bottom of the cabinet. There shall be a minimum of 250 mm vertical height for detector units.

Locate buss and flash transfer relays, flashers, load switches, circuit breakers, and interference filters on a standard panel consistent with the intersection plan. Design shall facilitate field inspection and maintenance accessibility without excessive disassembly or special tools.

Prime all inside and outside surfaces of the cabinet inside and outside surfaces with phosphate treatment and primer. After priming, give all exterior surfaces a minimum of two coats of rust resistant silver grey enamel; interior surfaces shall be furnished with rust resistant high gloss white enamel.

Neatly fold and cap any cables, wires, or circuits that are not being used. These wires shall be neatly tied and stowed away in or on the terminal facilities.

Terminal facilities arrangement shall be in a fashion so that trouble shooting of load bay or behind the load bay can be accomplished with simple tools. This means that the load bay will be hinged so that it can be dropped down for ease of maintenance. There will be sufficient slack in the load bay wiring to allow for dropping the load bay.

Protect all control cables, i.e., detector harnesses, controller harnesses, harnesses which connect manual/vehicle detector switches, by a nylon jacket or provide equivalent protection to prevent any contact with cabinet metal shelves, doors and any other sharp corners.

If any branch circuit wiring or control wiring does not conform to the wire specifications, the supplier will be considered as not meeting the specifications and proper corrective action will be exercised against the supplier.

Provide a 4 input PED isolation circuit to isolate controller logic ground from the field wiring. Outputs from the PED isolator shall be connected to phases 2,4,6,8.

G Solid State Load Switches

Load switches shall meet the requirements of NEMA TSl-Part 5 for three circuit load switches.

Each load switch shall contain three individually replaceable, molded case, solid state relay modules. Each relay module shall utilize optical isolation between the control and the load circuits. The module shall have the functions and terminal assignments as specified in NEMA TSl-Part 5.

Each panel of load switches shall either be rack mounted or shall have a switch support bracket extending across the entire length of the switch panel.

The load bay arrangement from left to right in the cabinet shall be as described below:

1. Vehicular Phasing shall be groups first - 0l, 02, 03, 04, 05, 06, 07, 08.

2. Pedestrian Phasing shall be followed second - 02, 04, 06, 08.

3. Any other special phasing shall be grouped last.

H Equipment List and Drawings

Submit detailed shop drawings of the control cabinet, equipment layout drawings and wiring diagrams of all equipment installed in the controller cabinet to the owner or their representative for approval. Two sets of cabinet wiring diagrams shall be contained in a heavy duty clear plastic envelope mounted on the inside of the front door.

At the time of delivery, furnish one set of instruction manuals and an itemized price list for each type of equipment, their subassemblies, and their replacement parts. The instruction book shall include the following information: a) Table of Contents, b) operating procedure, c) step-by-step maintenance and troubleshooting information for the entire assembly, d) circuit wiring diagrams, e) pictorial diagrams of parts locations, f) parts numbers, and g) theory of operation. The instructional manuals shall include itemized parts lists. The itemized parts lists shall include the manufacturer's name and parts number for all components (such as IC', diodes, switches, relays, etc.) used in each piece of equipment. The list shall include cross references to parts numbers of other manufacturers who make the same replacement parts.

I Warranty

The contractor shall certify that the equipment meets the required specification and shall supply a complete catalog description. The following documents shall also be provided.

1. A supplier’s warranty statement that stipulates that equipment to be supplied shall be warranted for two years from the date of purchase.

2. Operations manuals.

3. Maintenance manuals.

4. Schematic diagrams.

5. Component and equipment locations within the cabinet.

If a malfunction in the controller unit, or its auxiliary equipment occurs during the warranty period, the supplier shall, within 24 hours after notification (excluding Saturday and Sunday), furnish a like controller unit module, or auxiliary equipment, for use while the warranted unit is being repaired. The isolation of any malfunction during the warranty period shall be the responsibility of the supplier. After the supplier has repaired and returned the equipment, the owner or their representative shall then return the spare component to the supplier.

J Preemption

J.1 General

These specifications detail a preemptor program for use with 2 through 8-phase-actuated controller.

The preemptor shall be capable of being adaptable to meet the various types of applications such as railroad, fire station, and bridge preempts.

The preemptor shall be internal to the controller and shall not alter controller capability or interchangeability under normal operation. The preemptor shall be completely programmable by the user.

J.2 Preempt Program

Preempt Registration. The preempt call input shall initialize preempt registration and start preempt sequence unless a priority call input is activated which would treat the current controller preemptions state as normal operation and reinitiate call registration.

Preempt Delay. As soon as the preempt call is registered the preempt delay will begin timing unless preempt delay is set zero or preempt delay omit was active during preempt call registration. Delay shall be programmable from 0 to 255 seconds minimum.

As soon as preempt delay is timed out, current running phases not next to be common in preempt sequence are cleared. If the running phases are green and must be cleared, special programmable values of minimum green, walk and pedestrian intervals will time normal times. Concurrently a special preempt clearance is generated. This clearance is designed for advance track signals and any overlaps that may be green and require yellow clearance.

Entry Clearance Phase(s) Select. Two sequential phases or phase pairs shall be available to be run as programmable fixed time intervals as an entry sequence. Two entry options shall be available, each programmable. The entry sequence shall be capable of being omitted entirely.

Dwell Sequence. After the entry sequence, the preemptor shall enter the dwell sequence. During the dwell sequence the controller shall cycle between selected phases on a pre-timed or actuated basis. Pedestrian phasing may be normal or omitted entirely. When the dwell sequence is entered, a preempt dwell output shall be generated. The preemptor shall remain in dwell for the length of the dwell extension timer which shall be capable of being held in reset by the preempt call input. Dwell extension shall be omittable by setting the timer to zero.

Exit Sequence. After leaving dwell, the controller shall enter one or two programmed exit phases(s) or phase pairs sequences. The sequence will time programmed minimum green and place a vehicle call on all phases not omitted. After timing exit phase minimum green the controller shall time and sequence normally.

K Time Base Coordination

These specifications detail a Time Base Coordinator program for use with 2 through 8-phase actuated controller.

The units shall allow traffic control equipment to be coordinated without requiring the use of interconnection cables. The units shall coordinate traffic control equipment based on signals from a precise time base which will allow output control signals to be changed at the proper pre-programmed time to achieve the coordinated operation of an intersection with other intersections or the desired operation of an isolated intersection. The coordinators may also use a programmer for a master intersection controller which in turn is interconnected with secondary intersection controllers. The units shall also be capable of providing a command for MUTCD flash, and shall allow a full year program to be initiated and carried out without the necessity of field adjustment for anticipated special events, etc.

The time base coordinator shall be internal to the controller and shall not alter controller capability or interchangeability under normal operation. The time base coordinator shall be completely programmable by the user.

L Loop Detector Amplifiers

Provide a 16 Channel Detector Rack and Power Supply compatible with microwave detector units.

M Controller Operation

Consistent with customary trade practices, the manufacturer shall furnish a warranty for all electrical or mechanical equipment described herein. The contractor shall turn such warranty over to the owner for potential dealing with the guarantor.

If the contractor is the guarantor, he specifically waives the requirements of Section 289.14(2), Wisconsin Statutes, and agrees as a condition of the contract that the owner may maintain an action against him at any time during the warranty period for recovery of damages which the state may have sustained by reason of the failure of the contractor to comply with the provisions of the warranty provided to the owner.

During the installation and testing of the controller, the contractor shall provide, at his own expense, a competent representative to oversee, direct and manage the installation and testing of the controller. In the final stages of the installation and testing, the manufacturer's representative shall be available at the job site for consultation until such time as the controller operation is tested and accepted.

If a malfunction in the controller unit or its auxiliary equipment occurs during the warranty period, the supplier shall, within 24 hours after notification (excluding Saturday and Sunday), furnish a like controller unit, module, or auxiliary equipment, for use while the warranted unit is being repaired. The isolation of any malfunction and the repair and/or replacement of any device within the warranty period shall be the responsibility of the supplier. After the supplier has repaired and returned the equipment, the county shall return the spare component to the supplier.

N Measurement

The department will measure Traffic Signal Controller and Cabinet, Fully Actuated 8-Phase, as each unit of work, acceptably completed.

O Payment

The department will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER DESCRIPTION UNIT

SPV.0060.### Traffic Signal Controller and Cabinet Fully Actuated 8-Phase EACH

Payment is full compensation for providing the signal controller and conflict monitor together with cabinet, switches for flashing operation, and fittings as are necessary to assure that the controller will perform the said functions.

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