MISSOURI DEPARTMENT OF TRANSPORTATION

SPECIFICATIONS

TYPE 170E SIGNAL CONTROLLER

CABINETS

Controller Cabinets shall be 0.125 inch reinforced shell aluminum alloy, and be of clean-cut design and appearance. The cabinets to be furnished shall be in accordance with the "Traffic Signal Control Specifications"; Published by the State of California, Business, Transportation & Housing Agency: Department of Transportation (CALTRANS), dated January, 1989, and all current Addenda and Revisions. Further, the equipment shall meet the following Specifications. In case of conflict, the Department Specifications shall govern.

Bids shall provide a certification that the equipment proposed is included on the most current QPL of CALTRANS and MoDOT Approved Products List. Exception: Department specific equipment, that is not defined in the CALTRANS specification is exempt from this QPL requirement.

Only items on the latest revision of the Missouri Department of Transportation Approved Products List for Traffic Signals and Highway Lighting Equipment will be accepted. The attached Traffic Controller Assembly Equipment List shall be completed and returned with the bids.

The additional requirements for the model 332 and the model 336S stretched or any other cabinet assemblies to be supplied by the bidder are as follows. Supplier must be approved for model 332 cabinet. All cabinets shall exhibit a "bare" aluminum finish and the Police door shall be made of the same finished material as the rest of the cabinet. The handles for each door shall swing outward. All main cabinet doors shall accept a NO. 2 Corbin Key. Two sets of keys shall be supplied with each cabinet. All cabinet assemblies shall be supplied with a Power Distribution Assembly Number 2, (PDA#2). The 336S stretched cabinet shall be provided with the standard "M" base adapter attached to the cabinet and anchor bolts. If any auxiliary output file is specified, the C5 connections shall be included.

Each cabinet shall include two (2) fluorescent lighting fixtures mounted inside the front and back portion of the cabinet. These fixtures shall include a cool white lamp with protective cover and shall operate by a normal power UL listed ballast. A door actuated switch shall be installed to turn on the cabinet light when the door is open. Each switch should work each individual light.

The police panel door shall contain one DPST toggle switch which shall be labeled FLASH/AUTOMATIC and may be used to switch output control from the switch packs to the flash unit and vice versa. This shall be the only control switch accessible from the police panel.

All output field conductors shall be terminated in the cabinet on a one piece copper 600 volt heavy duty mechanical screw connector offset tang assembly. Each mechanical screw connector shall accommodate up to four No. 12 AWG conductors. Each clamp shall be captive to the contact screw and the screw captive to the contact. Field wiring shall not be spade lugged. The A.C. neutral buss and chassis ground buss shall be a 17 position solid copper neutral bar with set screws that allows the wires to be attached without tang or spade assemblies.

The output file shall be hand wired, no printed circuit boards shall be allowed except for red fail monitoring. The back of the load switch bay and the conflict monitor bay shall be enclosed to prevent any wires interfering with plugging in of components.

A 420 auxiliary output file shall be required when called for on the plans or if more than 12 load switches are required. This file shall meet the latest CALTRANS Specifications.

I and J input files shall be provided unless otherwise specified.

All cables shall be located and secured so that they do not interfere with the removal of the controller or the opening of the controller front panel.

A removable and replaceable furnace type fiberglass filter shall be housed behind the door vents. The filter filtration area shall cover the vent openings. A filter shell shall be provided that fits over the filter providing mechanical support for the filter. The shell shall be louvered to direct the incoming air downward.

A diagnostic cabinet test program complete with documentation will be provided for each 10 or less cabinets ordered.

PULL OUT DRAWER

A pull-out, hinged-top drawer, having sliding tracks, with lockout and quick-disconnect feature, such as a Vent-Rak Retractable Writing Shelf, #D-4090-13 or equivalent. The pull-out drawer shall extend a minimum of 14 inches in order to facilitate removal of the processor by providing the processor with an aluminum platform covered by a formica-type chemical-proof plastic sheet while the rear connector is being removed. It shall be possible to lift this hinged platform in order to gain access to the interior of the drawer. Minimum interior dimensions of the drawer shall be 1 inch high, 13 inches deep, and 16 inches wide. The drawer shall be capable of supporting a 40 pound controller when fully extended. Drawer shall be mounted immediately below the controller assembly.

SURGE PROTECTION

Each cabinet shall be provided with devices to protect the control equipment from surges and over voltages. This shall include incoming power lines, the Input File, the Output File, and communication lines.

All input file inputs shall be protected with a 30V MOV with (30 Joule rating). The output of all load switch outputs shall be protected with a 150V MOV (80 Joule Rating). The MOV's shall be connected from the AC positive field terminal to the chassis ground. The output MOV's shall be mounted on the field terminal side of the output assembly.

For the 332A cabinet, appropriate input surge protection shall be mounted on the Lower Input Termination Panel (LIP). The power distribution assembly (PDA#2) of each controller cabinet shall include a surge protection unit on the AC Service Input. The protector shall be installed between the applied line voltage and earth ground. The surge protector shall be capable of reducing the effect of lightning transient voltages applied to the AC line. The protection device shall be a two stage series parallel device, and shall be an SHA 1210. (Refer to MoDOT approved product list) It shall include the following features and functions:

Maximum AC line voltage: 140 VAC

Twenty pulses of peak current, each of which will rise in 8 microseconds and fall in 20 microseconds to 1/2 the peak: 20000 Amperes.

The protector shall be provided with the following terminals:

Main line (AC line first stage terminal).

Main Neutral (AC Neutral input terminal).

Equipment Line Out (AC Line second stage output terminal, 10 Amps.).

Equipment Neutral Out (Neutral terminal to protected equipment).

GND (Earth connection).

The Main AC line in and the Equipment Line out terminals shall be separated by a 200 Microhenry (minimum) inductor rated to handle 10 Amp AC Service. The first stage clamp shall be between Main Line and Ground terminals.

The second stage clamp shall be between Equipment Line out and Equipment Neutral.

The protector for the first and second stage clamp must have a MOV or similar solid state device rated at 20KA and be of a completely solid stage design (i.e. no gas discharge tubes allowed).

The Main Neutral and Equipment Neutral Out shall be connected together internally and shall have an MOV similar solid state device or gas discharge tubes rated at 20 KA between Main Neutral and Ground terminals.

Peak clamp voltage: 350 Volts at 20 KA (Voltage measured between Equipment Line Out and Equipment Neutral Out terminals. Current applied between Main Line and Ground Terminals with Ground and Main Neutral terminals externally tied together). Voltage shall never exceed 350 volts.

The Protector shall be epoxy encapsulated in a flame retardant material.

Continuous service current, 10 Amps at 120 VAC RMS.

The Equipment Line Out shall provide power to the
Type 170 and to the 24V power supply.

Communications line protector for incoming and outgoing communication lines shall be EDCO part #PC642C-008 or equivalent with mounting connector #PCB1B or equivalent. If fiber or radio communications are specified these communications line protectors are not required.

CABINET ACCESSORIES

Model 222 Loop Detector Amplifiers. The loop detector amplifier units shall be as specified in the CALTRANS Specifications. The quantity of units shall be as described on the plans or traffic signal controller order form.

Model 242 D.C. Isolator. The D.C. isolators shall be the Model 242 as specified in the CALTRANS Specifications. A minimum of (1) shall be supplied. Additional quantities of units shall be needed for actuated pedestrian, preemption or as described on the plans or traffic signal controller order form.

Model 200 Load Switch. The load switch shall be the Model 200 as specified in the CALTRANS Specifications. The quantity of units shall be as described on the plans or traffic signal controller order form.

Model 204 Flasher. The flashers shall be the Model 204 as specified in the CALTRANS Specifications. Each cabinet shall be supplied with two (2) model 204 flashers.

Model 252 A.C. Isolator. The A.C. isolators shall be the Model 252 as specified in the CALTRANS Specifications. The quantity of units shall be as described on the plans or traffic signal controller order form.

Model 430 Flash Transfer Relay. The flash transfer unit shall be the Model 430 as specified in the CALTRANS Specifications. Each cabinet shall be supplied with four (4) model 430 flash transfer relays (2 additional model 430 flash transfer relays when a 420 auxiliary is shown on plans).

Model 400 Modem. The quantity of units shall be as described on the plans or traffic signal controller order form.

Model SM 2400 Modem. The quantity of units shall be as described on the plans or traffic signal controller order form.

Computer Cable. The cable will consist of both male and female amp connectors as described in addendum 8 section 2-5-6 C2, C20, C30 and C40 Detail Dated November 19, 1993, of Caltrans Traffic Signal Control Specifications dated January 1989. The female connector of the cable will be located in the front of the cabinet and extend past the front edge of the rack a minimum of .5 inches and a maximum of 1 inch. The male connector will be on the cable end and will be in the back of the cabinet. This cable will extend 14 inches along the side of the rack with a minimum of 12 inches free that can be used to plug into any of the 170E's four ports. The cable will consist of one wire connecting the like pin in the other connector starting with A and ending with R. The wire should be 20 gauge (one cable shall be supplied for each cabinet). The mounting of this cable or any switch shall not interfere in a any way with the installation or removal of the controller. If the cable is mounted within the pull out drawer any hole that is drilled in the drawer shall be equipped with a rubber grommet to protect the cable and shall have enough slack to prevent binding of the cable.

MODEL 210 CONFLICT MONITOR

Each cabinet shall be supplied with a Model 210 Conflict Monitor as specified in the CALTRANS specification and addenda as follows:

> The conflict monitor shall be capable of monitoring for the absence of voltage on all of the inputs of a channel (defined here as red, yellow, and green). If an input is not present on at least one input of a channel at all times, the unit shall begin timing the duration of this condition. If this condition exists for less than 700 milliseconds, the unit shall not trigger, if this condition exist for more than 1000 milliseconds, the unit shall trigger as if a conflict had occurred, causing the intersection to transfer immediately into a flashing mode, and stop-time to be applied to the controller, a red signal shall require the presence of a minimum of 60 (+/-10) volts ac to satisfy the requirements of a red indication.
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> A connector and terminal assembly designated as P20 (Magnum P/N 722120 or equivalent) for monitoring the absence of red shall be an integral part of the output file. The connector shall terminate and be compatible with the cable and connector of a Type 170 conflict monitor unit (CMU), capable of monitoring the absence of

red. The pin assignments of the P20 connector and terminal assembly shall be provided with the cabinet plans. The OP20 connector shall be physically alike to the cable and connector of a Type 170 CMU to prevent the absence of red cable connector from being inserted into the P20 connector 180 degrees out of alignment. Programming of the unused red channels shall be accomplished via jumpers. These jumpers shall cause 115 VAC to be applied to any and all unused red monitoring channels. These jumpers and their respective attachment points shall be part of the output file.

TYPE 170E MICROCOMPUTER SIGNAL CONTROLLER

Except as herein modified, the Microcomputer 170E controller shall conform to the CALTRANS TRAFFIC SIGNALS CONTROL EQUIPMENT SPECIFICATIONS as published January, 1989, with the exception that Chapter 2, and details related to the Model 170 controller unit, are superseded by addendum 8, dated November 1993, which are herein incorporated by reference and form a part of this Specification as follows:

This controller shall be fully compatible with the software specified on the plans.

The C2, C20, C30 and C40 connectors shall be amp standard.

One spare set of internal printed circuit boards shall be furnished with each controller unit. This includes, but is not limited to, the power supply, front panel, I/O, CPU and modem if specified.

If fiber optics are specified, a fiber optic modem shall be supplied.

Diagnostic Test Program. For each 10 or less Model 170E controllers purchased, the bidder shall provide a Diagnostic Test Program Prom Chip that shall test the operation of the Model 170E controller units, including but not limited to, internal memory, the Program Module,
the real-time clock, input-output circuitry, the modem, and the display and keyboard. The program shall be capable of operating with an external CRT (provided by others), and with controller keypad entries and displays. Full documentation on the program shall be included. The software shall be configured to work on a 412C prom module.

A copy of the CALTRANS specifications will be supplied by the state at the request of the contractor.

PROM MODULE

Each Model 170E controller unit shall be furnished with one (1) Program Module, Model 412C as specified in the CALTRANS Specification, dated January, 1989 and all addendum's up to and including addendum 8, including back up lithium battery, and real time clock adjuster circuit, 1 Dallas 1225 chip, two 6264 ram chips.

SOFTWARE

DISTRICT 4

The most recent revision of Wapiti W41KS or W70SM shall be mounted on the prom module and configured accordingly.

DISTRICT 8

The prom module shall be configured for Bitran software.

EQUIPMENT TESTING

Controllers and cabinets purchased under this contract shall be tested for conformance to CALTRANS, "Traffic Signal Control Equipment Specifications" dated January 1989 and the latest addenda. Testing may be done by an independent laboratory if the manufacturer does not have sufficient facilities to carry out the testing. A copy of the test results for all equipment purchased shall be supplied by the manufacturer.

Each Model 170E controller unit shall be tested over a temperature range of minus 34 to plus 74 degrees Celsius. Proper operation of the unit shall be verified at both temperature extremes and at ambient. This testing is not a substitute for any quality control testing or final inspection testing normally performed, it is a process to be carried out prior to final inspection.

Environmental chamber(s) shall have provision for remotely controlling the Model 170E controller being tested. Proper operation of the equipment shall be verified at minus 34, plus 74 degrees Celsius and ambient. Cold and hot soak times shall be sufficient to allow all components in the device to reach the temperatures desires. A minimum soak time of three hours shall be used for all testing.

A representative of the agency may travel to the testing site to verify that the environmental testing is being carried out properly and to observe manufacturing practices at the factory.

The manufacturer shall submit a proposed testing procedure and schedule 30 days in advance for evaluation by the Agency. Test procedures, environmental chambers, automatic test equipment, display boards, power supplies, and controls shall be described in detail. A "dry run" should be carried out in order to work out any problems with the test procedure. Any problems should be resolved before the arrival of the representative of the Agency.

Minimum test requirements are given below. The manufacturer is free to suggest additional tests or variations on the test given below. Any changes should be described in the testing proposal.

Cabinet. Cabinets shall be tested at ambient conditions only. An automatic or semi-automatic method of checking cabinet wiring between equipment harnesses and field connections is required.

Controllers. Controller shall pass the following test at least 5 times at each temperature extreme and ambient.

Recovery from a short power interrupt of approximately 500 milliseconds.

Recovery from a long power interrupt of approximately 5 seconds.

Front panel displays should be visible from a window in the environmental chamber. Signal outputs shall be brought out of the chamber to display board if controllers cannot be directly observed.

The vendor shall provide a method of testing controller inputs and outputs. Diagnostic software and wraparound connector for controller harnesses may be used. If diagnostic software is not used, outputs shall be brought out to a display board. Inputs may be paralleled to each controller.

CONFLICT MONITOR TEST CABLE

To facilitate testing of the conflict monitor by maintenance crews, one additional connector cable shall be furnished by the manufacturer and installed in each cabinet. This cable shall be four feet in length, utilizing #18 wire to connect a 36 pin plug to back panel terminals as indicated below:

Receptable Circuit		Terminal Phase
1		1 G
2		1 Y
3		2 G
4		2 Y
5		3 G
6		3 Y
7		4 G
8		4 Y
9		5 G
10		5 Y
11		6 G
12		6 Y
13		7 G
14		7 Y
15		8 G
16		8 Y
17		2 Walk
18		6 Walk
19		4 Walk
20		8 Walk
21	Circuits used only in a 322A	1 Aux G
22	Cabinet W/Auxiliary Output File	1 Aux Y
23		3 Aux G
24		3 Aux Y
25		5 Aux G
26		5 Aux Y
27		6 Aux G
28		6 Aux Y
29		I14-W Stop Time
30		DC Ground
31		Monitor Reset
32		DC Ground
33		2 Aux G
34		2 Aux Y
35		4 Aux G
36		4 Aux Y

Connector cable shall utilize a 36 circuit polarized nylon Waldom Molex type receptacle (part number 03-06-1361) using 0.062" female terminals made of 70/30 spring tempered tin-plated brass 0.010" thick with contact of resistance 0.0025 ohm mV, drop of 2.5 mV at 1 amp with 250 volts 4 amps maximum per circuit. This connector cable "free floats" in the front bottom 6 inches of the cabinet and is not used in the normal operation of the controller. A moisture proof cap shall be provided to prevent the accumulation of moisture on the plug terminals. This cap shall remain attached to the connector when the cable is in use.