

**TEXAS DEPARTMENT OF TRANSPORTATION
DEPARTMENTAL SPECIFICATION
TO-3041
FLASHER CONTROLLER ASSEMBLY**

1.0 DESCRIPTION

This specification describes the minimum acceptable requirements for a Flasher Controller Assembly which includes a weatherproof cabinet, a Solid State Two Circuit Flasher, a Solid State Time Clock, and other specified accessory equipment.

2.0 CABINET

2.1 This section of the specification describes the minimum acceptable design requirements for a weatherproof flasher cabinet that will house a Solid State Two Circuit Flasher, a Solid State Time Clock, and other specified accessory equipment.

2.2 Design Requirements

2.2.1 The cabinet shall be of sheet aluminum with a minimum thickness of .125 inches, or cast aluminum alloy. The outside dimensions of the cabinet shall be 14 inches wide by 16 inches high by 10 inches deep with the door closed. All dimensions shall be plus or minus 3 inches.

2.2.2 The cabinet shall have a hinged door equipped with a gasket to insure a weatherproof and dustproof seal when the door is closed and locked. The door hinge shall be made of stainless steel, aluminum, or other non-rusting alloy. The hinge pin shall be made of stainless steel. The hinge pin shall be spot welded at the top of the hinge.

2.2.3 The door shall be provided with a police lock, installed as an integral part of the door. One brass key shall be provided with each cabinet. The keyhole shall have a metal keyhole cover, to prevent the entry of water and dust, that allows easy access.

2.2.4 The cabinet shall be provided with three 3/4 inch Myers hubs or exact equivalent. Two hubs shall be mounted on the top. The mounting position of the two top hubs shall be such that the 3/4 inch hole centers are 1.25 inches from the back of the cabinet. The top two holes shall also be positioned about the centerline that bisects the width of the cabinet. The spacing between the two holes shall be a minimum of 1.5 inches. The third hub shall be provided for mounting on the bottom of the cabinet,

however, the mounting hole shall not be cut. All hubs shall have a gasket and all mounted hub gasket seals shall be watertight.

2.2.5 A solderless connector, for size 6 AWG wire, shall be bolted to the inside bottom of the cabinet for grounding purposes.

2.2.6 The cabinet shall have two 3/4 inch stainless steel brackets for strap type mounting on a wood or metal pole. Cabinets shall be shipped with the brackets mounted on the back of the cabinet.

2.2.7 The cabinet shall be provided with vent openings to allow adequate convection cooling of the electronic components. These vents shall be so located and designed to prevent the entry of water and screened to minimize the infiltration of dust and insects. Screen material shall have openings no larger than .0125 sq. in.

2.2.8 The cabinet shall be completely weatherproofed to prevent the entry of water. All unwelded seams shall be sealed with a clear or aluminum colored weather-seal compound.

2.2.9 All exposed hardware including screws, bolts, rivets, hubs, etc., shall be tamper resistant.

2.2.10 A back panel shall be mounted on inside of the cabinet. All wiring and accessory equipment, including a flasher, shall be mounted on the back panel. The panel shall be sized and positioned inside the cabinet to allow clearance for the two top mounted hubs and the field wiring that must be passed through them. The back panel shall also allow for clearance for the mounting of the third hub in the bottom center of the cabinet.

2.2.11 The back panel shall provide for the mounting of a maximum size, two circuit, NEMA flasher. The maximum dimensions of the flasher are specified under Section 8, "Solid State Flasher," of the NEMA Standards Publication TS 1-1989. The flasher must be easy to remove and replace. A support bracket shall be provided for horizontal mounting.

2.2.12 The flasher mating connector shall be as specified under Section 8 of the NEMA Standards Publication TS 1-1989.

2.2.13 The back panel shall provide for mounting of a solid state time clock with maximum overall outside housing dimensions of 10.25 inches high by 6.25 inches wide by 7.5 inches deep. The mounting holes shall be configured as an inverted "T". The bottom two holes shall be 2.3125 inches +/- 0.05 inch apart from center to center. The top hole shall be 3 inches +/- 0.05 inch from the top of the cabinet. The center of the top hole shall be 5.75 inches +/- 0.05 inch above the horizontal line formed by connecting the centers of the two bottom holes. The top hole shall be positioned so that a line drawn vertically through it bisects the horizontal line. Each screw hole shall be drilled and tapped for an 8-32

screw.

2.3 Accessory Equipment

2.3.1 The cabinet shall be able to be used either as a flasher only, or as a flasher with time clock.

2.3.2 The cabinet shall be equipped with a ten section barrier terminal block with double 8 - 32 X 5/16" binder head screw terminals or larger. The terminals shall be wired and labeled as follows:

A. Terminals 1 - 4 shall be neutral and shall have wireless connectors between them. Terminal 1 shall be for line neutral, and shall have a solderless connector for a size 6 AWG wire.

B. Terminal 5 shall be line in and shall have a solderless connector for a size 6 AWG wire.

C. Terminal 6 shall be flasher hot.

D. Terminal 7 - 8 shall be flasher out 1.

E. Terminal 9 - 10 shall be flasher out 2.

2.3.3 The 6 pin mating connector for the flasher shall be wired as described under Section 8 of the NEMA Standards Publication TS 1-1989.

2.3.4 All components shall be properly wired, and the wiring, shall be neatly and firmly routed and tied with cable ties or other such wire fasteners.

2.3.5 The two load terminals of the flasher shall have fused receptacles and 8 Amp fuses.

2.3.6 A single pole thermal circuit breaker shall be installed on the "line" or service side of the cabinet. The circuit breaker shall be rated for 20 Amps at 120 Volts AC. The breaker shall be a Square "D" QUO 150 Series, GE THQC 1150L, Westinghouse QC1050, or equivalent.

2.3.7 The load side of the 20 Amp circuit breaker shall be protected by a solid state lightning arrester approved by the Traffic Operations Division Signal Operations Engineer.

2.3.8 All exposed AC wiring and connections except the terminal block shall be protected with a nonconductive cover to prevent accidental contact by service personnel.

3.0 TWO CIRCUIT SOLID STATE FLASHER

3.1 This section of the specification describes the minimum acceptable design requirements for a

solid state, two circuit flasher.

3.2 Electrical and Physical Characteristics

3.2.1 The flasher shall meet the electrical and physical characteristics described in Section 8 of the NEMA Standards Publication TS 1-1989.

3.2.2 The two circuit flasher shall be of solid state design and contain no electro-mechanical devices.

3.2.3 The voltage range shall be 95 to 135 Volts AC. The nominal voltage shall be 120 Volts AC. The operating frequency range shall be 60 Hz +/- 3.0 Hz.

3.2.4 The two circuit solid state flasher shall be designed to operate as specified at any ambient temperature range from -30EF to +165EF.

3.2.5 The flasher shall be so constructed that each component may be readily replaced if needed.

3.2.6 The flasher shall be a Type III (dual circuit rated at 15 Amps per circuit) unit.

4.0 SOLID STATE TIME CLOCK

4.1 This section of the specification describes the minimum acceptable requirements for an electronic time clock that can automatically change the operation of a traffic signal at predetermined times.

4.2 Design Requirements

4.2.1 The time clock shall have a day program for each day of the week.

4.2.2 The day program shall have at least six on and six off events per day. Each of these events shall consist of a time in hours and minutes and an output state (on or off). An on/off event shall control a clock output that activates a single pole, double throw relay circuit. "On" and "Off" shall refer to the normally open contact of the relay.

4.2.3 The time clock shall have 10 special event day program. Each special event day program shall be designated by the date in month, day, and year format. Each special event day program shall consist of all the same elements as a day program.

4.2.4 The time clock shall have a holiday feature that will skip a period specified by a starting date and an ending date. The starting and ending dates shall entered in month/day of month format. If the

ending date is earlier than the starting date then the skip period shall be from the starting date to the ending date of next year (eg. December 24 to January 1). There shall be a minimum of 10 separate holiday programs.

4.2.5 The time clock shall have a digital time-of-day display in hours and minutes of 12 or 24 hour periods. A 12 hour clock shall have an AM-PM indicator. It shall also have a display which clearly indicates the day of the week. The month and year shall be programmable but need not be displayed except when programming.

4.2.6 Liquid Crystal Displays (LCD) are required. The LCD's shall be visible over a temperature range from -10 C to +74 C. All displays shall have a rated minimum lifetime of 10 years.

4.2.7 On/off events shall be easily programmable from the face of the clock via pushbuttons or keyboard entry.

4.2.8 The clock shall be capable of being set to the correct time of day to the nearest minute.

4.2.9 A separate indicator shall be provided to indicate whether the output is on or off.

4.2.10 The output shall have manual on/off control independent of the time clock programming.

4.2.11 The output shall remain in the last state programmed until the next programmed event changes the output state or the output is changed by the manual on/off control or if the current day program is disabled.

4.2.12 The time clock shall automatically switch to and from daylight savings time. This feature shall be enabled or disabled manually by keyboard entry.

4.2.13 The time clock shall have a download feature to transfer all information to another time clock. The transfer shall be through a connector located on the front of the time clock.

4.2.14 One transfer cable shall be supplied for each two time clocks ordered with a minimum of one cable supplied.

4.2.15 The time clock shall be capable of operating using either a 120 volt A.C. or 12 volt D.C. power supply.

4.2.16 Using an A.C. power supply, the time clock shall operate over a voltage range of 95 to 135 volts A.C. The nominal voltage shall be 120 volts A.C. at an operating frequency of 60 Hz +/- 3.0 Hz. The time-base shall be derived from the 60 Hz line frequency during normal operation. The time clock

shall be designed to operate as specified at any ambient temperature range from -30 F to +165 F. Normal operation accuracy shall be equal to the 60 Hz line frequency.

4.2.17 Using a D.C. power supply, the clock shall operate over a voltage range of 11 to 14.5 volts D.C. and maintain an accuracy of 0.02% over the entire ambient temperature range from -30 F to +165 F.

4.2.18 The time clock shall have a power backup capacitor which shall power the timer for at least 48 continuous hours during the loss of A.C. power. During loss of power the time clock shall generate its own internal time-base. The clock accuracy while operating on the internal time-base shall be within 0.02% over the entire ambient temperature range from -30 F to +165 F.

4.2.19 During back-up operation all displays and outputs shall be disabled.

4.2.20 The time clock shall operate correctly and accurately regardless of mounting orientation.

4.2.21 The entire time clock shall be completely wired and equipped with an AMP 206036-1 (16 pin male) connector mounted on the clock housing and an adaptor cable with an AMP 206037-1 (16 pin female) connector. Each wire of the adaptor cable shall be 18 AWG stranded copper 24 inches long. The connectors shall have pin and color assignments as follows:

PIN	FUNCTION	ADAPTOR CABLE WIRE COLOR
1	A.C. POSITIVE	BLACK
2	A.C. NEUTRAL	WHITE
3	CHASSIS GROUND	GREEN
4	RELAY 1 NORMALLY OPEN	RED
5	RELAY 1 NORMALLY CLOSED	YELLOW
10	RELAY 1 COMMON	WHITE/YELLOW
11	D.C. POSITIVE	WHITE/RED
12	D.C. NEGATIVE	WHITE/BLACK

4.2.22 The output relay shall have a normally open, normally closed and common terminal, and these terminals shall be clearly identified. The relay shall be rated at a minimum of 10 Amps, resistive load, at 120 volts A.C.

4.2.23 The time clock shall be enclosed in a dust resistant housing. The housing door shall expose all adjustments when it is open. The housing shall have an inverted "T" screw hole mount. The bottom two holes shall be 2 5/16 inches apart from center to center. The top hole shall be 5.75 inches from its center perpendicular to the line connecting the bottom holes at their centers. The top hole shall be 1 to 1.5 inches from the top of the box. The maximum overall outside

dimension of the clocks's housing shall be 10.25 inches high by 6.25 inches wide by 7.5 inches deep.

4.2.24 The time clock shall be completely solid state with the exception of the output relay.

4.2.25 A power loss indication shall be provided. The indication shall be activate upon restoration of A.C. power, or activated only if the A.C. power interruption is of sufficient length to allow the capacitor to discharge or adversely affect the time keeping and memory. The indication shall be reset with a pushbutton switch or by keyboard activation.

4.2.26 When A.C. power is restored the clock shall resume operation with the event that would be currently in effect had there no power failure.

4.2.27 All components shall be amply derated with regard to heat dissipating capacity and rated voltage so that with maximum ambient temperature and maximum applied voltage, material shortening of life or shift in value shall not occur. The design life of the components under 24 hours per day operating conditions in their circuit application shall not be less than 10 years.

4.2.28 Components shall be mounted on printed circuit boards. All printed circuit boards shall be made from NEMA grade-10 epoxy glass or equivalent, with two ounces or more copper track. 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 are added to correct board layout errors are not acceptable.

4.2.29 The time clock shall be designed so that the printed circuit boards can be taken apart without desoldering.

4.2.30 All components shall be mounted in such a way that signal technicians may replace any one defective component. Circuits shall not be enclosed in epoxy or by other methods to prevent repair and servicing by the TxDOT.

4.2.31 All components (including transistors, resistors, diodes, capacitors, and integrated circuits) shall be available to TxDOT through at least two suppliers of solid state devices. Successful bidders may be required to supply a list of sources for those components which the TxDOT cannot verify the existence of multiple vendors.

4.2.32 The time clock shall provide a fuse and a transient protection device such as a varistor, on the incoming power line to protect the time clock from line voltage surges as described in NEMA Standards Publication TS 1-1989, paragraph TS 1-2.1.8.

4.2.33 The vendor shall provide one spare set of proprietary components including IC's and programmed PROM's for every ten time clocks purchased with a minimum of one set per order.

4.2.34 All IC's with 14 or more pins and all proprietary components shall be mounted in high reliability, high contact force sockets. The sockets shall have thermoplastic bodies meeting UL Specification 94V-0. Any other IC sockets supplied shall also meet the above requirements.

4.2.35 Data entry shall be executed through use of a telephone type keypad (numbers 0 through 9 displayed).

5.0 DOCUMENTATION REQUIREMENTS

5.1 There shall be one cabinet wiring diagram supplied with each flasher cabinet. The diagram shall be placed inside each cabinet. Separate shipment of the diagram is not acceptable.

5.2 Each solid state two circuit flasher shall be provided with one each of the following documentation:

A. Complete and accurate schematic diagram.

B. Complete parts list including names of vendors for parts not identified by universal part numbers such as JEDEC, RETMA, or EIA.

C. Pictorial of component layout on circuit board.

Bidders shall be prepared to furnish a copy of certification to NEMA specifications upon request.

5.3 Each solid state time clock shall be provided with one each of the following documentation:

A. Complete and accurate schematic diagram.

B. Set of operating instructions.

C. Pictorial of the electronic circuit component layout.

D. Pictorial of the time clock assembly.

E. Complete parts list including names of vendors for parts not identified by universal part numbers such as JEDEC, RETMA, or EIA.

6.0 SHIPMENT/DELIVERY

6.1 Flasher cabinets shall be shipped as groups stacked and strapped on pallets or individually boxed.

6.2 Each clock shall be individually boxed.

6.3 Each flasher shall be individually boxed.

6.4 If the clock is provided as part of a flasher cabinet assembly, the clock adaptor cable shall be delivered neatly wired into the cabinet.

7.0 WARRANTY

7.1 The supplier shall provide a warranty against any defect in material or workmanship for a period of two years from the date of final acceptance by the TxDOT.

8.0 MEASUREMENT

8.1 Measurement shall be made of each flasher cabinet, time clock, flasher, or complete assembly as specified in the Invitation for bids.