

TEXAS DEPARTMENT OF TRANSPORTATION
DEPARTMENTAL SPECIFICATION
TO-4056
NEMA TS 2 MALFUNCTION MANAGEMENT UNIT (MMU)

1.0 SCOPE

- 1.1 This specification sets forth the minimum requirements for a shelf-mountable, 16 channel, solid-state malfunction management unit (MMU). The MMU shall meet, as a minimum, Section 4 of the NEMA Standards Publication TS 2-2003. Where differences occur, this specification shall govern.

2.0 DESIGN REQUIREMENTS

- 2.2 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 are added to correct board layout errors are not acceptable.
- 2.3 All inner contacts (ICs) with 16 or more pins shall be mounted in machine tooled sockets. All sockets shall have two-piece, machined contacts and closed end construction too eliminate solder wicking. The outer sleeve shall be brass with tin or gold plating and tapered to allow easy IC 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. Other high quality sockets may be acceptable but must have prior approval of the Traffic Operations Division Signal Operations Engineer. Sockets meeting alternate specifications shall be submitted in writing with the solicitation. Zero insertion force sockets will not be allowed.
- 2.4 The design shall allow for removal or replacement of a circuit board without unplugging or removing other circuit boards.
- 2.5 The unit shall be designed so that one side of each board can be completely accessible for troubleshooting and testing the unit while it is still operating. This may be accomplished with extender boards or cables. This need apply to only one circuit board at a time.
- 2.6 One set of extender boards, if required to meet Paragraph 2.5 above, for every 10 MMUs ordered or portion thereof shall be provided with the purchase order.
- 2.7 No more than two circuit boards shall be attached to each other to constitute a circuit assembly. Attaching hardware shall use captive nuts or other acceptable method to secure the boards together. Alternate methods shall be submitted in writing with the solicitation. The boards shall be designed so the purchaser can test and operate the controller unit with the boards separated.

- 2.8 If this specification is used to support the purchase of a complete controller assembly, the unused red circuits shall be connected to the AC line in the controller cabinet.
- 2.9 The MMU shall be pre-programmed according to Table 2-1.

Table 2-1

Channel	Load Switch	Phase
Channel 1	Load Switch 1	Phase 1 Vehicle
Channel 2	Load Switch 2	Phase 2 Vehicle
Channel 3	Load Switch 3	Phase 3 Vehicle
Channel 4	Load Switch 4	Phase 4 Vehicle
Channel 5	Load Switch 5	Phase 5 Vehicle
Channel 6	Load Switch 6	Phase 6 Vehicle
Channel 7	Load Switch 7	Phase 7 Vehicle
Channel 8	Load Switch 8	Phase 8 Vehicle

- 2.10 Provide an MMU that displays by LCD or other approved graphics display, the active or inactive state of each circuit on all 16 channels. An icon must be used representing the red (Don't Walk), yellow, and green (Walk) circuit for each channel.

The MMU must be capable of monitoring FYA operation as defined by the MUTCD and still provide standard NEMA TS 2 monitoring functions.

- 2.11 Each MMU shall have a unique serial number that is permanently and neatly displayed on the face of the unit. If this serial number is not on the face of the unit, then an additional temporary label that is neatly printed or typed shall be affixed to the MMU face.
- 2.12 Each MMU shall be provided with a programming card meeting the requirements of NEMA TS 2.

3.0 DOCUMENTATION

- 3.1 Each MMU 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's layout on circuit board(s).

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

4.0 WARRANTY

4.1 The MMU shall be warranted against any failure due to workmanship or material defects within the first 60 months of field operation.

5.0 MEASUREMENT

5.1 Measurement shall be made of each MMU as specified in the solicitation.