A. Purpose

This Manual Part recommends functional/operating guidelines for solid-state grade crossing warning device controllers to directly operate grade crossing warning devices and appliances.

B. General

1. System shall consist of a solid-state controller unit which is a system actuated from a control output of a signal vital relay or solid state train detection device and directly operates flashing lights, gates and pedestrian bell(s) at a grade crossing. Other warning devices may be operated by the controller subject to availability of the proper interface.

2. System should be designed to operate without requirement for external vital control relays.


4. Manufacturer shall provide sufficient documentation of system hardware, software (when applicable) and quality control to adequately demonstrate proper performance of all apparatus designated as vital, in all modes of operation.

5. System shall be protected against lightning and other voltage surges in input, output and power supply leads when installed in conjunction with external surge protection as described in Manual Part 11.2.1, Recommended General Practices for Electrical Surge Protection for Signal Systems and manufacturer’s recommendations.


7. System shall conform to Manual Part 1.5.15, Recommended Practice for Electrical Interfaces between Signal, Train Control and Grade Crossing Equipment.
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Device shall conform to Manual Part 1.5.10, Recommended Instructions for Painting and Protective Coatings where applicable for paint and painting.

System shall conform to requirements set forth in Federal Communications Commission Part 15 for spurious RF emissions.

C. Environment


D. Mechanical Design

1. Solid state controller System should be housed in a metal enclosure suitable for shelf, backboard or Electronic Industries Alliance (EIA) rack mounting for installation in a wayside signal instrument housing housed using one of the following form factors:
   a. An enclosure suitable for shelf, backboard, or rack mounting.
   b. A module designed to plug into a train detection system.
   c. As a component within a grade crossing warning system network.

2. System packaging should utilize field replaceable plug or terminal connected modules to facilitate testing and maintenance.

3. Electrical and/or mechanical keying of plug-in modules shall be employed to prevent unsafe operation due to incorrect substitution of modules. Identification of plug-in modules and their respective location should be provided.

4. All field replaceable solid state controller modules of the same type should be interchangeable without adversely affecting location-specific programming disarrangement of the system.

5. All connections to external safety critical apparatus and dc power should conform to Manual Parts in Section 14.1, Recommended Wire Connectors, Terminals, except for interconnection of units by a dedicated cable provided by the manufacturer.
E. Electrical Design

1. System, with suitable power supply and accessories, should provide the following outputs to drive crossing warning devices:
   a. Three-wire alternately flashing lamp drive(s) shall provide a minimum 12.0 volts to operate nominal 10-volt signal flashing light signals lamps with load rating specified by manufacturer.
   b. Steady energy lamp drive(s) from two or three wires of the three wire flashing lamp light circuit shall provide a minimum 12.0 volts to operate nominal 10-volt gate arm tip lamps with load rating specified by manufacturer.
   c. When energized, gate control output(s) shall produce a minimum of 11.0 volts dc at 4.0 amps. When de-energized, gate control output shall not exceed 1.0 volt dc.
   d. Pedestrian bell drive(s) shall provide a minimum of 2.0 amps at a minimum nominal 11.0 volts dc.
   e. Lamp drive outputs shall be capable of operating incandescent, LED or combinations of both light units.

2. When equipped for gate control, system shall have a gate position (GP) input. When GP circuit voltage falls below the Input Zero Threshold, flashing lamp and gate arm tip lamp circuits shall operate as specified in E.1.a and E.1.b.

3. In the event of a failure that would impair the system from responding to control and GP input signals, the controller shall provide the following mode of operation:
   a. Flashing lamp power is applied as specified in E.1.a and E.1.b to all lamp outputs.
   b. Gate control output is de-energized as specified in E.1.c. (only in the event of control input failure, not GP failure).

4. System shall be designed such that no single component failure can result in an activation failure. Any component failure which could result in an activation failure because of successive component failures shall result in warning device activation.
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System should have a diagnostic output or indication, which will provide a nominal 12 volts at 500-ma minimum to indicate system is operating normally.

6. A means should be provided or specified by the manufacturer to field adjust individual lamp and pedestrian bell voltages to levels required by the railroad.

F. Software Design (where applicable)

1. Vital system design, including software, shall conform to Manual Section 17, Quality Principles.

2. All executive and vital system software, including all self-checks, shall be installed in the system in a manner that will prevent unintentional changes by the user.

3. Location-specific vital software configuration data should be programmable by the user and shall be stored in non-volatile memory.

4. System shall automatically reset and should attempt a restart after a condition causing system shutdown is eliminated.

5. System shall operate as described in E.3 until self-initialization software and hardware tests have been completed to determine that the system is operating properly and as designed.

6. Processor based systems should have internal diagnostics to permit troubleshooting.

G. Operation

1. System control logic for crossing warning operation to include:

   a. Alternate flashing lamp and pedestrian bell outputs shall energize no more than 1.0 sec. after control inputs are de-energized.

   b. Alternating lamp-flashing rate shall should be adjustable in the range of 35 to 65 times per minute. See Manual Part 3.1.1, Recommended Functional/Operating Guidelines for Grade Crossing Warning Devices, Item E.1.a.

   c. The "on" time of each flashing lamp output shall be within 10% of the other and the total "on" time of both outputs in a cycle to be not less than 96% of total time cycle.
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Where gate control is provided, gate control output shall de-energize no less than 3.0 sec. after flashing lamp activation. Gate delay time should be field adjustable in one second increments to a maximum of 99 sec. Gate delay for entrance gates may be eliminated if the control input is de-energized during the time the gate is raising.

2. Means should be provided to manually operate either side of flashing lamp pair continuously (one lamp on, one lamp off within the pair), for lamp voltage adjustment and/or light alignment. De-energizing the control input (on approach of a train) during manual operation shall flash one or both sets of lamps.

H. Application

1. In order to increase the probability that at least 50% of the lamps are functioning as intended in the unlikely event of a failure of a pair of lamp driver outputs, two or more independent pairs of lamp outputs should be provided in the installed system. The individual outputs shall be connected in accordance with the manufacturer’s instructions. Cross wiring may be utilized so that no single output pair operates both lights on a single crossarm (See Figure 3125-1 below). Where individual units having a single output pair are installed, a minimum of two units should be installed.
Figure 3125-1—Cross-Wiring with No Single Output Pairs Operating Both Lights on a Single Crossarm