A. **Purpose**
   1. This Manual Part recommends guidelines for design criteria and operating parameters for monitoring of grade crossing warning systems.
   2. Devices discussed herein shall provide one or more of the following capabilities:
      a. Data recorder function
      b. Data analyzer function
      c. Remote reporting function

B. **General**
   1. Devices provide information regarding operation of the grade crossing warning system either through the historical recording of such events, the communication of such events, or both.
   2. Manufacturer should provide sufficient documentation of hardware and software where applicable to install, program, interpret diagnostic messages and utilize the device.
   5. Devices shall conform to Manual Part 1.5.15 Recommended Practice for Electrical Interfaces between Signal, Train Control and Grade Crossing Equipment.
   6. Devices that store operational and/or event data should have the capability to retain data during loss of power.
   7. Devices that provide a data recorder function should:
      a. Be able to identify each recorded event to an output device.
      b. Be able to monitor site status and log the time of day and date when changes in status occur.
      c. Have the capacity to store a minimum of 24 hours of recorded events under normal operation.
   8. Devices that provide a data analyzer function should:
a. Be able to derive alarm conditions based on user-defined criteria, which include digital input changes of state and/or analog input levels that violate thresholds.

b. Be able to output the history of recorded events to a human interface device upon a local or remote request.

c. Be able to provide control of non-vital outputs in response to user-defined criteria.

9. Devices that provide a remote reporting function should:

a. Be able to transmit the alarm and/or event conditions to a central office host system or other destination over a communication network.

b. Have the ability to receive acknowledgement indications from receiving nodes to assure successful reporting of alarm and/or event information.

c. Be able to respond to local or remote requests for data.

d. Contain an address sufficient to uniquely identify its location (i.e. DOT number, ATCS location, milepost, and subdivision).

C. Environment

Devices shall conform to Manual Part 11.5.1 Recommended Environmental Requirements for Electrical and Electronic Railroad Signal System Equipment, Class C.

D. Mechanical Design

1. Stand-alone devices should be housed in an enclosure suitable for shelf, backboard or Electronic Industries Alliance (EIA) rack mounting for installation in a signal enclosure.

2. Devices should be plug or terminal connected to facilitate testing and maintenance.

E. Communications Design

1. Devices should provide communication ports sufficient for local and remote communications. Such ports shall comply with industry accepted communication interface standards.

2. Devices should maintain a historical record of commands and communications between the remote and the host locations, regardless of the mode of operation. If outfitted with communication capability, the device should notify the host when it detects an alarm condition and also when the alarm is cleared.
3. Following acknowledgement of receipt of data by the host, re-transmission of that alarm should be suppressed for a programmable period of time.

4. Devices that communicate remotely using public or shared communication networks (e.g. modem with dial telephone or circuit switched cellular networks) should provide the following:
   a. Network interface circuitry where necessary to comply with FCC Part 68C requirements.
   b. Automatic dial/automatic answer operations supporting both pulse and tone dialing to a repertoire of dialed numbers.
   c. Anti-streaming measures whereby the modem will be disconnected if the device attempts to transmit for longer than a designated time period.
   d. Abort and call retry functions to maximize efficient use of the communication network.
   e. Security provisions to protect against unauthorized use or access to either the remote or local node.
   f. Call timing provisions to prevent multiple device contentions due to simultaneous call retry attempts.

5. Devices that communicate remotely using shared public or private data communication networks (i.e. cellular data, RF networks, and broadband) should provide the following:
   a. Compliance with industry accepted network communication interfaces and protocols at points of user interface outside the link layer of the network (e.g. TCP/IP, UDP, HTML, SMTP, etc.)
   b. Communication timeout and retry provisions to assure delivery of data to and from remote equipment.
   c. Periodic communications events (i.e. health status) to assure ongoing network integrity and alert functions should such events indicate a network failure or an inconclusive network status.
   d. Security provisions to protect against unauthorized use or access to either the remote or local node.

F. **Electrical Design**

1. Devices should be designed to minimize current consumption.

2. Devices shall be fused to prevent drawing excessive current in the event of a failure.
3. Digital input resistance shall be 2,000 to 15,000 ohms, unless clearly indicated within device documentation.

4. Under all conditions, device analog and digital inputs shall not be capable of providing electrical energy into the circuit being monitored and shall be isolated from any other input or output (See Manual Part 11.5.1 Recommended Environmental Requirements for Electrical and Electronic Railroad Signal System Equipment).

5. Devices that have analog inputs should be able to monitor or log status of voltage sources (i.e. control battery and operating battery). Devices should provide input hysteresis or time integration sufficient to minimize false triggering of event or alarm status.

6. Devices that provide the capability to monitor incandescent light circuits should detect the failure of one or more flashing light units (see Manual Part 3.2.35 Recommended Design Criteria for Electric Light Unit for Grade Crossing Signals Including Light Emitting Units and Incandescent Lamps) even with changes in lighting supply voltage.

7. Devices that provide non-vital controllable relays should include dry form C contacts. Contacts should be rated at 3 A at 30 vdc and 3 A at 250 vac rms inductive. Devices that provide non-vital open collector outputs should be able to sink a minimum of 50 mA.

8. If more than one connector is used and the inadvertent misconnection could damage the equipment or cause malfunction, the connectors should be keyed.

9. Devices that contain a 24 hour real time clock and calendar should provide a minimum resolution of 1 second. The clock should not drift more than 30 seconds per month.

10. Devices that contain a real time clock should accept time settings locally, sent by the host, or across a communication network.

G. Operation

1. When evaluating the condition of each input channel, devices should provide multiple sampling or time integration to verify input state.

2. On power-up/reset, devices should perform self-diagnostics and if successful, the devices should indicate locally and/or report to the host as being on-line and operational.

3. Device diagnostics should periodically verify the functionality and should include diagnostics of the communication network if the device is so outfitted. The device should continue to monitor and respond to status changes while diagnostics are being performed.
4. Devices should contain a watchdog timer which requires continuous servicing by the program to allow the device to continue operating. Should the watchdog time expire, the device should attempt to reset itself.

5. Devices should be supplied with internal or externally operable setup and configuration capabilities allowing the user to program the device and its behavior, and to allow operation to be exercised or simulated in order to verify proper setup.

6. Utilizing current draw as a method to monitor LED light units to determine a light-out condition may not be effective due to the wide variability encountered between different manufacturers' light units.