

Wanco® Pole-Mount Radar-Speed Signs



Owner's Manual
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1 Introduction

1.1 Read before using

This is the owner's manual for Wanco® pole-mounted radar-speed signs. For your safety and protection from injury, carefully read, understand, and observe all instructions in this manual. Always read all instructions before performing a procedure.

Keep this manual in a convenient location for easy reference when operating or servicing the speed sign. Additional and replacement manuals are available from the factory (see Section 1.5, "Where to obtain service," page 4).

If you have questions regarding this product, please contact Wanco Service or Sales using the information in Section 1.5, page 4.

1.2 Sign models

Two models of Wanco pole-mounted radar-speed signs are covered by this instruction manual: a small model, intended for use in neighborhoods and towns; and a large model, intended for use on highways. Both models are functionally the same. Differences between the two models are listed in Table 1-1.

Table 1-1. Speed sign model comparison

Model	Unique features
Small display	13-inch characters 12 pixels wide by 10 pixels high One character board (display module)
Large display	26-inch characters 24 pixels wide by 20 pixels high Four character boards (display modules)

1.3 Principles of operation

Although installations vary, most configurations include the following components:

- Radar-speed sign cabinet
- Control box
- Mounting hardware

Additionally, your configuration might include a solar panel, battery and battery box, caution beacons, a regulatory speed-limit sign, or other equipment.

The speed-sign cabinet comprises electronics, a full-matrix LED display, and a sign above the display that reads, "YOUR SPEED." A clear, polycarbonate-resin thermoplastic window protects the display from the elements.

A radar head inside the sign cabinet points in the same direction as the sign, and measures the speed of oncoming traffic. When a motorist exceeds the user-configured speed limit, the display flashes the vehicle's speed.

Controls for the speed sign are located in a weathertight enclosure. This control box houses electronics and a control panel for configuring the sign's behavior. The control box is latched with two keyed locks. When locked, it is essentially tamper-resistant.

If the speed sign is not hard-wired to an AC power supply, then it is powered by batteries, which are charged using a solar panel and automated charging system. (For an overview of the charging system, see Section 5.5, page 29). These components and the rest of your speed-sign system must all be installed on a pole and wired together. Installation instructions are provided in Section 3, page 7.

1.4 Applications

1.4.1 Traffic calming

By far the most common application of Wanco radar-speed signs is for traffic calming in locations where motorists regularly travel at unsafe speeds over the posted speed limit. Common areas in which the signs are installed include school zones, neighborhoods, and remote locations.

Factors to consider when deploying a Wanco radar-speed sign include:

- Road characteristics, grade, alignment, and sight distance
- The pace of traffic
- Roadside development and environment
- Parking practices and pedestrian activity
- Reported crash experience for the preceding 12-month period

The radar-speed sign should be used in conjunction with regulatory speed limit signs, but should not be considered a replacement for a speed limit sign.

1.4.2

Sign behavior

The U.S. Department of Transportation's *Manual on Uniform Traffic Control Devices* (MUTCD), which defines the standards for traffic control devices on all public streets and private roads open to public traffic, specifies that temporary traffic control "... should be designed on the assumption that drivers will only reduce their speeds if they clearly perceive a need to do so."*

Wanco radar-speed signs address this assumption by providing real-time response. While the sign remains blank prior to a vehicle's approach, drivers are suddenly and instantly presented with their speed, rendered in bright amber LEDs against a black contrasting background, as they near the sign.

Speeding drivers are presented with their speed as it quickly and continuously flashes on and off until they slow down. Studies have shown that motorists generally respond to this type of display by decreasing their speed.

Drivers traveling at excessive speeds may also be presented with an excessive speed message, which flashes quickly and continuously until they slow down. The full-matrix LED display on the Wanco radar-speed sign is capable of displaying both text and symbols, which can be configured (at the factory or after installation) for display at excessive speeds.

For excessive-speed display, symbols might be preferable to an English-language message or a flashing speed. Some drivers, when confronted with a changeable speed display that reacts to their speed, will "challenge" the sign by speeding up. Symbols discourage this behavior by replacing the driver's speed with a symbolic message.

1.4.3

School zones

Distracted driving is a leading cause of accidents involving pedestrians, and children are particularly at risk. Municipalities deploy radar-speed signs in school zones, where children are regularly in danger from moving vehicles.

For school zones, the speed sign should be located in advance of the school grounds, school crossing, or other school-related activities. With higher speed limits, more distance is required between the sign and the targeted area.

Consider also that the sign will attract drivers' attention, briefly taking their focus from the road. To protect pedestrians, adequate distance is required for drivers to react to the sign by slowing down and returning their attention to the road ahead.

When installed in school zones, speed signs are often accompanied by flashing caution beacons. Beacons can be integrated with the Wanco speed sign as optional auxiliary equipment (see Section 4.4, "Auxiliary devices," page 22).

*MUTCD, December 2009 ed., Sect. 6B.01, ¶107 2.A.

1.4.4 Neighborhoods

Police departments and municipalities make use of radar-speed signs to help deter speeding in residential neighborhoods. Drivers who speed often do so habitually. Radar-speed signs act as a reminder of the speed limit by providing real-time feedback to speeding motorists.

In neighborhoods, radar-speed signs are often deployed on streets with little traffic, where traffic regularly travels at speeds above the legal limit, and where outdoor activity makes pedestrian safety a particular concern.

1.4.5 Work zones

When a work zone will be in place for an extended period, DOTs may choose to install a pole-mount radar-speed sign rather than using a temporary, trailer-mounted sign.

DOTs and contractors use speed signs for warning drivers to slow down when approaching a work zone. Road work creates a safety hazard for pedestrians, drivers, and workers on the road, and workers are particularly vulnerable to oncoming traffic.

The MUTCD specifically mentions the danger for workers, explaining that road work presents changes in road conditions “that are unexpected by the road user. This creates an even higher degree of vulnerability for workers on or near the roadway.” The MUTCD also states, “. . . devices that get the road user’s attention and provide positive direction are of particular importance.”*

Radar-speed signs are usually positioned well in advance of the work zone, warning of a significantly reduced speed limit. When used in combination with “ROAD WORK AHEAD” signs, the speed signs can be particularly effective for slowing drivers.

1.5 Where to obtain service

Contact our service department using the following information:

Wanco Inc.
5870 Tennyson Street
Arvada, Colorado 80003 USA

303-427-5700
fax 303-427-5725

www.wanco.com
info@wanco.com

*MUTCD, December 2009 ed., Sect. 6D.03, ¶1 & 2.

2 Safety

2.1 General safety



⚠ CAUTION

Improper use of equipment could result in serious injury.

Prior to using or servicing this product, carefully read, understand, and observe all instructions in this manual.



⚠ CAUTION

Crush hazard.

When operating or working on the radar-speed sign, keep hands and body parts clear of pinch points.

2.2 Service safety



⚠ CAUTION

Adverse weather conditions can cause equipment damage and injury.

Whenever possible, perform maintenance in calm, dry weather.

Before servicing or performing maintenance on the speed sign, take necessary precautions to ensure the safety of service personnel.

- Never perform even routine service unless all electrical components are shut down:
 - Ensure all speed sign power circuits are shut off.
 - Disconnect cable from negative (-) terminal on battery, then disconnect the positive (+) cable.
- If the ground around the pole is damp or wet, allow it to dry before servicing the sign.
- Do not service the sign if your clothing or skin is wet.
- Do not service the sign in rain, snow, wind, or other poor weather conditions.
- Always be aware of traffic when performing roadside maintenance.

3 Installation

3.1 Overview

All electronic components in your speed-sign system must be installed on a pole and wired together.

- Recommendations for locating, orienting, and mounting the system are provided below and on the pages that follow.
- Wiring instructions are provided in Section 3.5, page 10.
- Testing procedures are provided in Section 3.6, page 13.

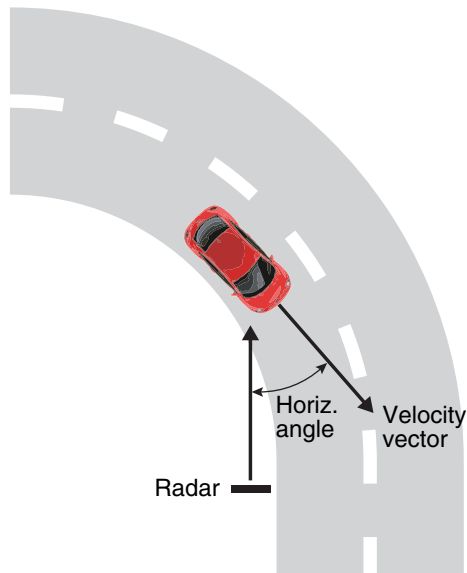
The radar-speed sign, control box, and solar panel come with mounting hardware that allow you to install them together on a round pole. For installation on other types of poles, you must substitute your own mounting hardware. Other components that may be included, such as caution beacons and regulatory signs, may also require user-supplied hardware for installation.

3.2 Selecting a location

To ensure proper operation, choose an appropriate location for the sign. A poor location will inhibit or prevent the sign from functioning properly.

- For the speed sign's radar to measure vehicle speed accurately, do not locate the sign at a sharp curve in the road. See Figure 3-1.
- An optimal location provides the radar with a line-of-sight from 500 to 1000 feet (155 to 310 meters), which allows ample time for the speed to appear on the display and for motorists to read and react to it. See Section 3.3.
- Fog, rain, snow, and blowing dust can reduce the detection distance from motorists to the speed display. Allow for possible weather conditions when selecting a location.
- If the speed sign will be powered by batteries, which are charged using a solar panel and automated charging system: for the speed sign's solar charging system to function properly, locate the solar panel where it will be exposed to full sunlight during daylight hours. Do not locate the solar panel where the sun will be obstructed, such as under a tree or in the shadow of a building.

Figure 3-1. Angular interference



The cosine effect causes the speed display to indicate a speed that is lower than the vehicle’s actual speed. This occurs when the target vehicle’s path is at an angle to the radar, including conditions such as the vehicle traveling on a curve or hill. As the angle between the radar beam and the target vehicle increases, the displayed speed decreases (see table, below).

Ideally, an angle of zero degrees is preferable (i.e., the vehicle is traveling directly at the radar beam), because the displayed speed is the actual target vehicle speed. In all applications, however, the radar device is always at a slight angle to the target vehicle.

Effect on displayed speed of horizontal angle between radar and path of vehicle

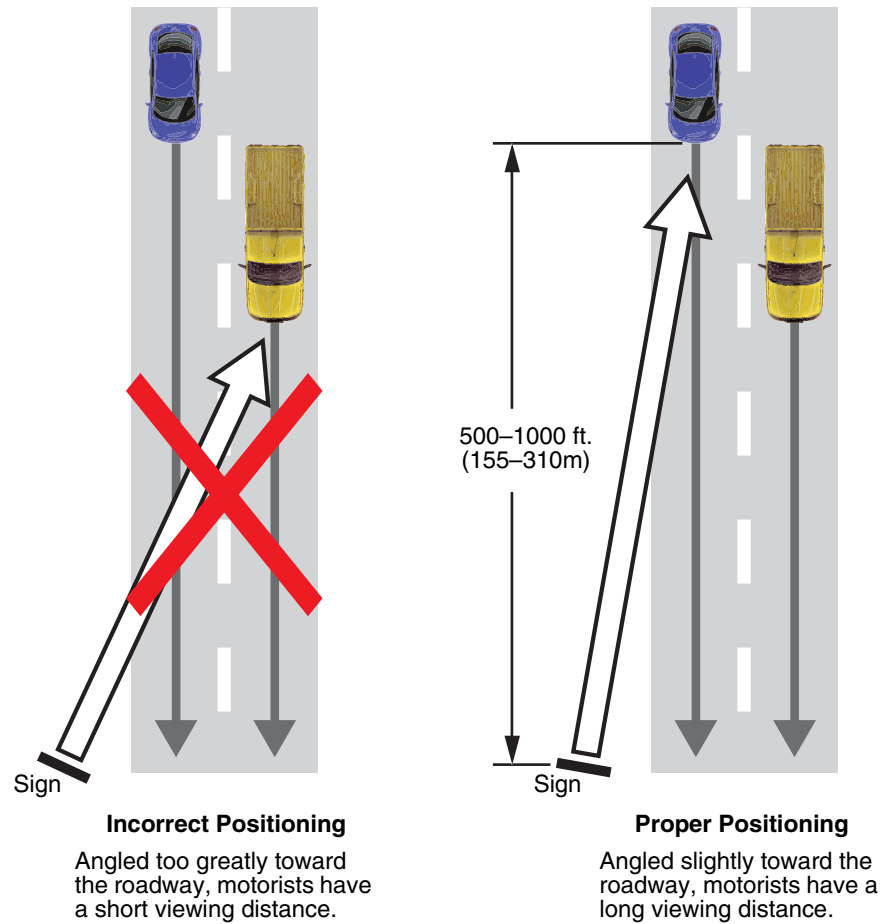
	Horizontal angle							
	5°	10°	15°	20°	30°	45°	60°	90°
Actual speed*	Displayed speed*							
30	30	30	29	28	26	21	15	0
40	40	39	39	38	35	28	20	0
50	50	49	48	47	43	35	25	0
60	60	59	58	56	52	42	30	0
70	70	69	68	66	61	49	35	0
80	80	79	77	75	69	57	40	0
90	90	89	87	85	78	64	45	0
100	100	98	97	94	87	71	50	0
110	110	108	106	103	95	78	55	0
120	120	118	116	113	104	85	60	0

*Speed in any unit of measure.

3.3 Positioning the speed display

The angle of the sign to the roadway is important for viewing by motorists. Proper positioning ensures motorists have the best chance of seeing and reacting to the sign.

- Optimal positioning provides the radar with a line-of-sight from 500 to 1000 feet (155 to 310 meters), which allows ample time for the speed to appear on the display and for motorists to read and react it.
- Angle the sign slightly toward the roadway, as indicated in Figure 3-2.
 - ❑ Too great an angle creates a short viewing distance, and does not allow motorists enough time to see the speed display.
 - ❑ A slight angle provides a long viewing distance, and gives motorists plenty of time to see the speed display.
- For information about the limitations of positioning the sign along a curve or hill in the road, see Section 3.2.

Figure 3-2. Positioning the sign

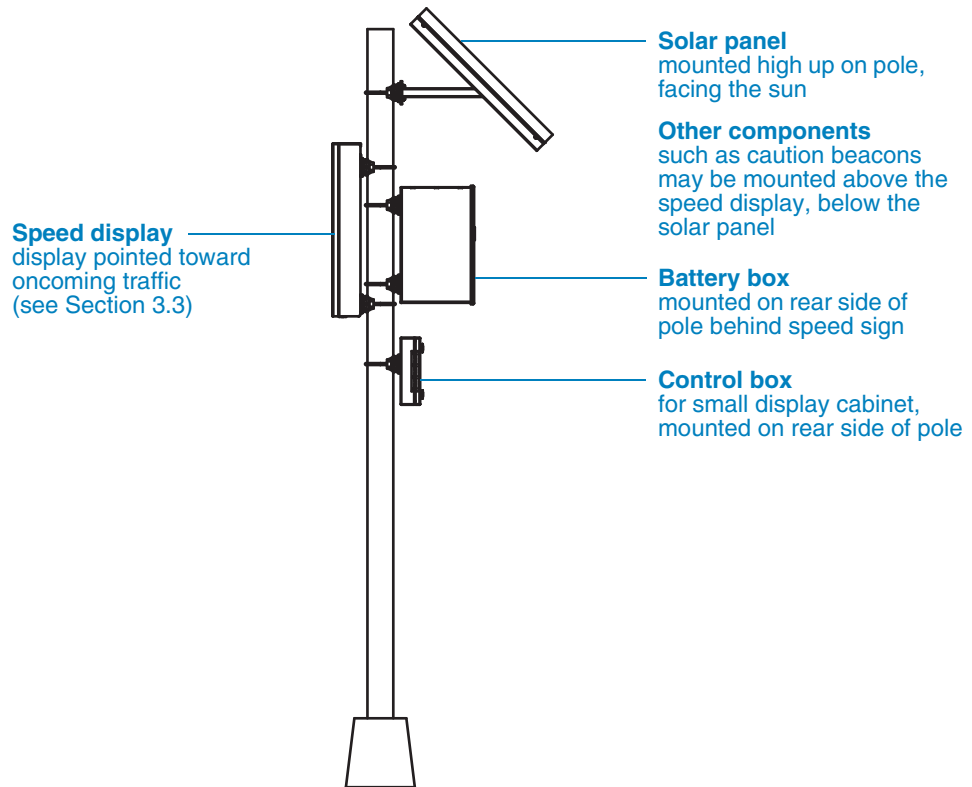
3.4

Installation on a pole

The location and orientation of each component on the pole should be based on your common practices. You may use the illustration in Figure 3-3 as a guide for installing your speed-sign system on a pole.

- Ensure the pole's location meets the requirements in Section 3.2.
- Ensure the sign's orientation on the pole meets the requirements in Section 3.3.
- Wire the system's components together as described in Section 3.5.

Figure 3-3. Installation on a pole



3.5

Wiring

3.5.1

Overview

- Wiring connections inside the speed display cabinet are made at the factory. It is not necessary to make any additional wiring connections inside the display cabinet.
- Wires that come out the back of the display cabinet are labeled to indicate their proper connections. Route all wires to the locations indicated.
- Connections inside the control box are made to the back of the selector board. To access the selector board, use the instructions in Section 3.5.2.
- Make additional connections at the solar panel and inside the battery box as necessary.
- Route all wiring in accordance with your standard or typical installation procedures.

3.5.2 Wiring at the selector board

The selector board (Figure 3-4) includes switches, which allow for configuration of the speed sign behavior, and wiring connections.

To access the selector board:

1. Access the control panel and set the operating mode to OFF.

The control panel is located inside the control box, behind a weathertight cover that is latched with two key-operated locking mechanisms. Each keyhole is protected by a plastic cover. To open the control-box cover, pull the tabs on both plastic keyhole covers to reveal the keyholes, then insert and rotate the key in each keyhole to release both locks.
2. Disconnect power:
 - If the speed sign is hard-wired to an AC power supply, disconnect power to the sign according to your standard procedures.
 - If the speed sign is powered by batteries, access the battery box and remove the inline fuse (see Figure 3-5).
3. Expose the back of the selector board:
 - a. Four screws hold the control panel in place. Use a Phillips-head screwdriver to remove all four screws.
 - b. Gently rotate the top of the panel downward. Electrical wiring that is attached to the back of the board can be damaged with too much force. Do not turn the board left or right.
4. Referring to Figure 3-4, and being careful to avoid using too much force, make wiring connections as follows:
 - a. Plug in the system communications connector.
 - b. Plug in the low-voltage LED connector.
 - c. Plug in the system power connector.
5. Reinstall the control panel assembly in the control box:
 - a. Carefully tilt the control panel up, into its proper upright position.
 - b. Align the holes in the control panel to the threaded holes in the back of the control box, then reinstall the four screws you removed in Step 3.
6. Reconnect power:
 - If the speed sign is hard-wired to an AC power supply, reconnect power to the sign according to your standard procedures.
 - If the speed sign is powered by batteries, access the battery box and reinstall the inline fuse (see Figure 3-5).

Figure 3-4. Selector board

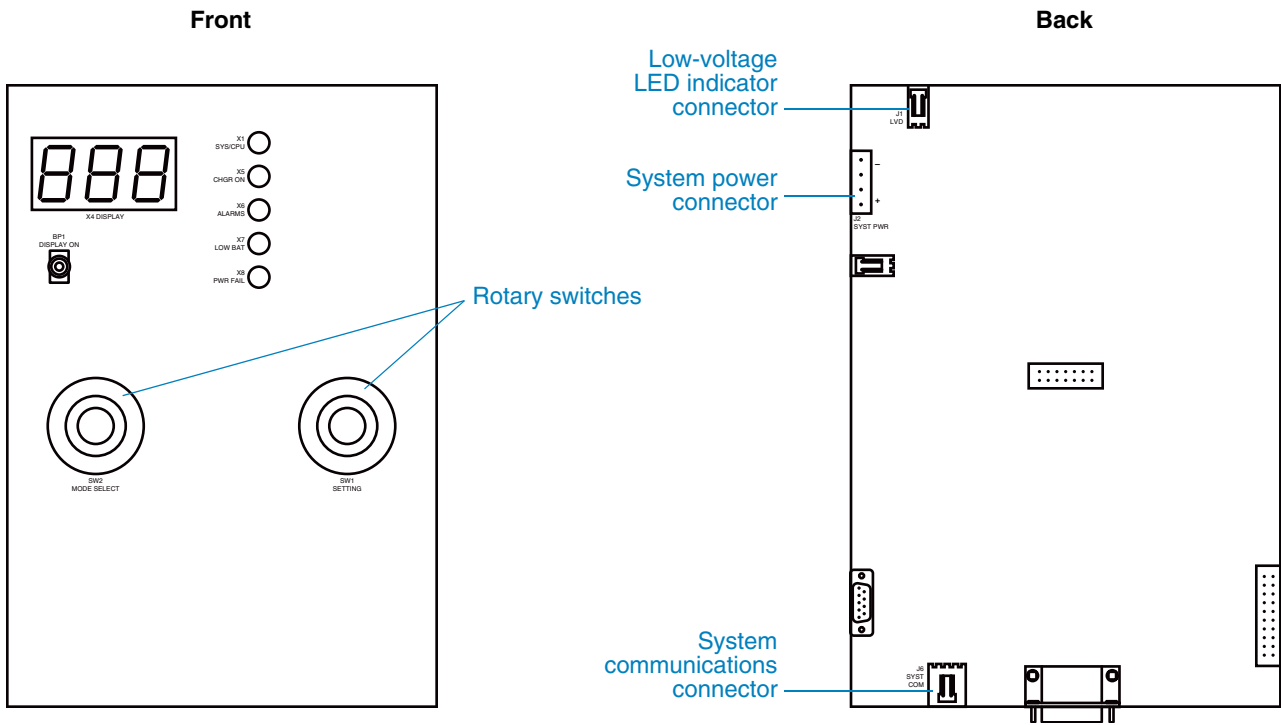
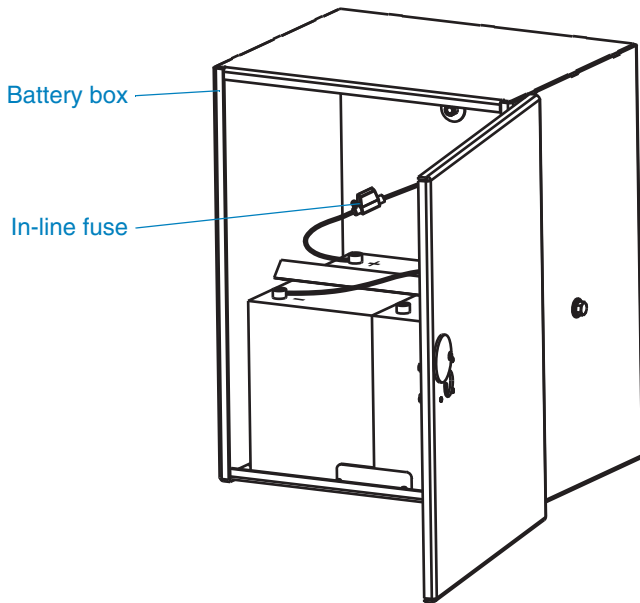


Figure 3-5. In-line fuse



3.6

Testing

After making all wiring connections, the system should be tested for proper operation. To test the system:

1. At the control panel, set the operating mode to STATUS.
2. Ensure all functions are working properly by observing status indicators. Status indicators and troubleshooting information are described in Section 5, page 25.
3. Test the radar for proper operation:
 - a. At the control panel, set the operating mode to RADAR SETUP.
 - b. As traffic approaches the sign, watch the LED display on the control panel, then the speed display. Vehicle speeds should register for approaching traffic up to 1000 feet (315 meters) away.
 - If the speed display functions but vehicle speeds appear to be wrong, it might be necessary to adjust the angle of the sign in relation to the road. See Section 3.2, page 7.
 - If there is no traffic, use the tuning fork (provided) as described in Section 5.4, page 28.
 - If the speed display functions as expected, proceed to Step 4.
 - If the radar appears to be malfunctioning, see Section 5.4, page 28.
4. At the control panel, turn on the speed display by selecting a normal operating mode. See Section 4, page 15.

4 Operation

4.1 Using the control panel

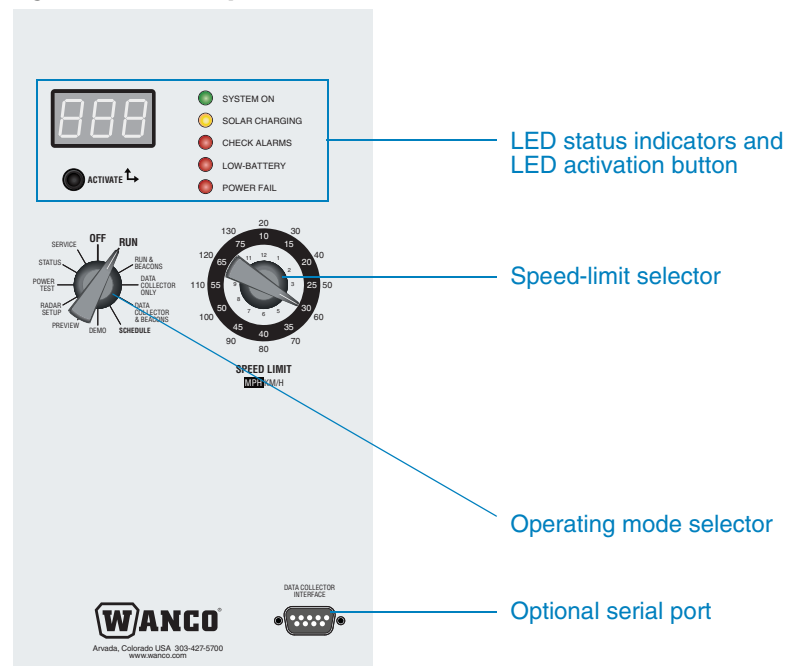
The speed sign control panel is located inside the control box, behind a weathertight cover that is latched with two key-operated locking mechanisms. Each keyhole is protected by a plastic cover. To open the control-box cover, pull the tabs on both plastic keyhole covers to reveal the keyholes, then insert and rotate the key in each keyhole to release both locks.

The control panel (Figure 4-1) includes:

- A 3-digit LED status display that provides a variety of operating information
- Green, yellow, and red LEDs that indicate operating status
- A button that activates the LED display and colored LEDs after they have “timed out”
- Rotary switches for selecting the operating mode and speed limit
- A serial port (optional) for downloading data from the optional Wanco Traffic Data Collector

After using the control panel, ensure the control box cover is closed and locked.

Figure 4-1. Control panel



4.1.1 Status LEDs

During operation, status LEDs on the control panel indicate the system’s operating status, as described in Table 4-1.

- To save power, the LEDs will “time out.” If all LEDs are off, press the ACTIVATE button.
- For alarm codes and troubleshooting, see Section 5, page 25.

Table 4-1. Status conditions

Indicator	Condition	Status
3-digit LED status display	Speed or alarm code	While the system is functioning properly, typically indicates vehicle speed; in diagnostics mode, indicates alarm codes or system variables
SYSTEM ON	On	Radar and speed display are powered on and ready
SOLAR CHARGING	On	Solar charging system actively charging batteries
	Off	Solar charging system not charging batteries
	Blinking	Battery charging complete
CHECK ALARMS	On	System requires attention (see Section 5.2.3, page 26)
LOW BATTERY	On	Batteries require charging immediately
POWER FAIL	On	Batteries charge fell below minimum charge voltage, system automatically shut down

4.1.2 Selector switches

The control panel includes two rotary switches that control system behavior (see Figure 4-1):

- The left rotary switch selects the operating mode.
- The right rotary switch sets the speed limit.
- The speed limit applies only when the left rotary switch is set to a normal operating mode.

Mode selector

The operating mode selector allows the speed sign to be switched off or set for normal operation, demonstration, diagnostics, or servicing.

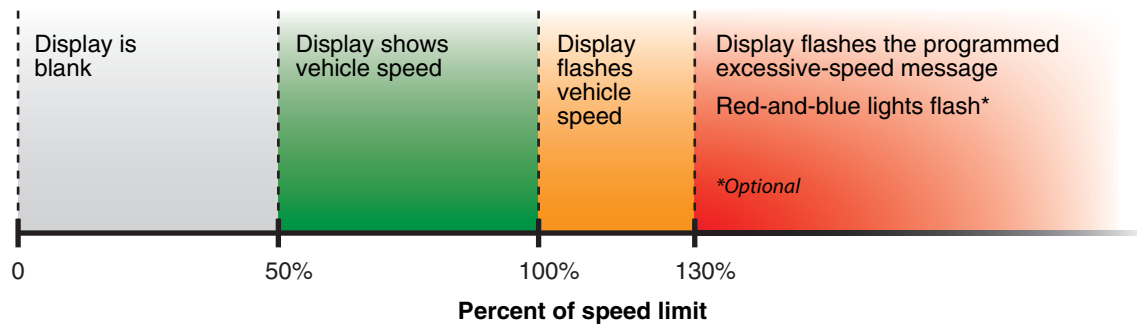
Operating modes are described in Section 4.2.

Speed limit selector

The speed limit selector sets the speed limit during normal operation, and may perform additional functions in various operating modes.

During normal operation, this selector should be set for the desired speed limit. Choose from 10 to 75 miles per hour in 5 mph increments, or from 20 to 130 kilometers per hour in 10 km/h increments. The choice of units is made using DIP switches on the systems board (see Section 6.2.5, page 36).

The selection made with the speed limit selector determines speed display behavior, as illustrated in Figure 4-2.

Figure 4-2. Speed display behavior

4.1.3 Serial port

The serial port is used when connecting a laptop computer to the speed sign, for downloading data from the optional Wanco Traffic Data Collector (see Section 4.4.3, page 22).

4.2 Operating modes

Operating modes are summarized in Table 4-2. See below for details.

4.2.1 All modes

If your system is hard-wired to a commercial power supply, power to the system is on in all operating modes, even in the Off mode.

If your system is powered by batteries, the charging system is active in all operating modes, even in the Off mode. While the solar panel is exposed to sunlight, it provides a charge to the batteries. To learn more, see Section 5.5, “Charging system,” page 29.

The optional Wanco Traffic Data Collector, if installed, is on in all operating modes except the Off mode. To learn more, see Section 4.4.3, “Traffic data collector,” page 22.

The status LEDs on the control panel are active in all operating modes, and the appropriate LEDs light up to indicate a specific condition (an active alarm, low battery voltage, etc.). If all LEDs are off, then they have “timed out” to conserve power. Press the **ACTIVATE** button to see the status LEDs. For details about status conditions indicated by the LEDs, see Section 5.2, “Status LEDs,” page 25.

4.2.2 Off mode

When the speed sign is not in use, it should be in the Off mode.

In the Off mode, the speed display is off and remains blank, the radar and all auxiliary devices except the data collector are off.

On the control panel, the 3-digit LED status display and status LEDs are off. When the **ACTIVATE** button is pressed, the status display shows “OFF” and the appropriate status LEDs are lit.

Table 4-2. Operating modes summary**Normal operation modes**

Mode	Radar	Charging system*	Speed display	Flasher†	Caution beacons	Data collector	3-digit LED status display
Off	Off	Active	Off	Off	Off	Off	"OFF"
Run	On	Active	Vehicle speed and excessive-speed messages	On	Off	On	User-selected speed limit
Run & Beacons	On	Active	Vehicle speed and excessive-speed messages	On	On	On	User-selected speed limit with dots (e.g., "5.0")
Data Collector Only	Off	Active	Off	Off	Off	On	"CLA"
Data Collector & Beacons	Off	Active	Off	Off	On	On	"C.L.A."
Schedule	‡	Active	Vehicle speed and excessive-speed messages based on programmed schedule‡	On	‡	‡	"Sch"

Demonstration modes

Mode	Radar	Charging system*	Speed display	Flasher†	Caution beacons	Data collector	3-digit LED status display
Demo	Off	Active	Cycles through 1-, 2-, and 3-digit speeds, excessive-speed messages, then repeats	On	Off	On	"[d]"
Preview	Off	Active	Cycles through available excessive-speed messages	Off	Off	On	"[P]"

Testing and servicing modes

Mode	Radar	Charging system*	Speed display	Flasher†	Caution beacons	Data collector	3-digit LED status display
Radar Setup	On	Active	Vehicle speed, independent of speed limit setting	Off	Off	On	Vehicle speed
Power Test	Off	Active	All LEDs lit at fixed brightness, independent of input from photocells	On	On	On	System (AC or battery) voltage
Status	On	Active	Cycles through system status variables	Off	Off	On	System status information
Service	Off	Active	First letters of the alphabet	Off	Off	On	"[S]"

*For battery-powered systems.

†When flashers are on, they activate (flash) during excessive speed conditions; otherwise, they are not lit.

‡Timer controlled.

4.2.3 Run mode

The Run mode is the normal operating mode.

In the Run mode, the speed sign and all installed auxiliary devices are on, and should function as expected. The speed display is fully functional, and behaves as illustrated in Figure 4-2, page 17, based on the position of the speed limit selector on the control panel.

DIP switches determine the unit of measure for the displayed speed (mph or km/h) and the displayed excessive-speed message. These settings can be changed by accessing the systems board (see Section 6.2.5, page 36). For more information about excessive-speed messages, see “Sign behavior” on page 3 and “Preview mode” on page 20.

On the control panel, the 3-digit LED status display shows the user-selected speed limit. The SYSTEM ON LED is lit, and the other status LEDs are lit if applicable.

4.2.4 Run & Beacons mode

The Run & Beacons mode has all the system functionality and behavior of the Run mode, but also activates optional caution beacons if they are installed. The beacons flash when activated by the approach of an oncoming vehicle.

On the control panel, 3-digit LED status display shows the user-selected speed limit with three dots (such as “.5.0.”). The SYSTEM ON LED is lit, and the other status LEDs are lit if applicable.

4.2.5 Data Collector Only mode

The Wanco Traffic Data Collector is an optional, auxiliary device that can be installed as part of the speed-sign system. Your system may or may not include this device. For more information, see Section 4.4.3, page 22.

In the Data Collector Only mode, the speed display is off and remains blank, the radar and all auxiliary devices except the data collector are off.

On the control panel, the 3-digit LED status display shows “CLA” or, if communication with the data collector fails, “Err”. The SYSTEM ON LED is lit, and the other status LEDs are lit if applicable.

4.2.6 Data Collector & Beacons mode

The Data Collector & Beacons mode has all the system functionality and behavior of the Data Collector Only mode, but also activates optional caution beacons if they are installed. The beacons flash when activated by the approach of an oncoming vehicle.

On the control panel, the 3-digit LED status display shows “C.L.A.” (with three dots) or, if communication with the data collector fails, “E.r.r.” The SYSTEM ON LED is lit, and the other status LEDs are lit if applicable.

4.2.7 **Schedule mode**

The Schedule mode uses an optional, auxiliary device that can be installed as part of the speed-sign system. Your system may or may not include this device. For more information, see Section 4.4.4, page 23.

In the Schedule mode, the system's run mode and speed limit are controlled by the optional scheduling software; the speed limit selector has no effect. The speed display, radar, and all auxiliary devices including the data collector are controlled by the software.

On the control panel, the 3-digit LED status display shows "Sch". The SYSTEM ON LED is lit, and the other status LEDs are lit if applicable.

4.2.8 **Demo mode**

The Demo mode demonstrates the most common functions of the speed sign, and can be used for verifying these functions are working properly.

In the Demo mode, the radar and connected auxiliary devices are off, except the optional flashers and data collector. The speed display is on and cycles through preprogrammed sample speeds, followed by excessive-speed messages. When the excessive-speed messages appear, the red-and-blue flashers will flash, if installed. This cycle repeats continuously while in Demo mode.

On the control panel, the 3-digit LED status display shows "[d]". The SYSTEM ON LED is lit, and the other status LEDs are lit if applicable.

4.2.9 **Preview mode**

The Preview mode is used for viewing available excessive-speed messages and other test patterns, one at a time, regardless of the message that has been configured with DIP switches on the systems board (Section 6.2.5, page 36).

In the Preview mode, the radar is on, but all auxiliary devices except the data collector are off. The speed display is on and shows one excessive-speed message, which can be changed by rotating the speed limit selector. When the speed limit selector is in the "0" position, the display is blank.

On the control panel, the 3-digit LED status display shows "[P]". The SYSTEM ON LED is lit, and the other status LEDs are lit if applicable.

4.2.10 Radar Setup mode

The Radar Setup mode is used for verifying proper operation of the speed sign.

In the Radar Setup mode, the radar is on, but all connected auxiliary devices except the data collector are off. The speed display is on and shows the speed of passing vehicles. Excessive-speed messages do not appear, regardless of the user-selected speed limit setting.

On the control panel, the 3-digit LED status display shows the actual speed detected by the radar. The SYSTEM ON LED is lit, and the other status LEDs are lit if applicable.

IMPORTANT

In Radar Setup mode, the power drain is significant. If your system is powered by batteries, to avoid a power failure, do not leave the sign in the Radar Setup mode for extended periods.

4.2.11 Power Test mode

The Power Test mode is used for performing diagnostics on the power system.

In the Power Test mode, the radar is off, but all connected auxiliary devices are on. The speed display has all LEDs on, lit at a fixed brightness independent of input from the photocells. If any LEDs are not lit, replace the display module (see Section 6.2.6, page 42).

On the control panel, the 3-digit LED status display shows the system (AC or battery) voltage. If the voltage is lower than expected, see Section 5.5, page 29, for troubleshooting. The SYSTEM ON LED is lit, and the other status LEDs are lit if applicable.

4.2.12 Status mode

The Status mode is used for performing diagnostics on the electrical system and sensors. For information about status conditions, see Section 5.2, page 25.

In the Status mode, the radar is on, but all connected auxiliary devices except the data collector are off. The speed display cycles through five sets of system status variables. Additional system parameters can be shown by rotating the speed limit selector.

On the control panel, the 3-digit LED status display shows a user-selected system status variable. The selection is made using the speed limit selector. The SYSTEM ON LED is lit, and the other status LEDs are lit if applicable.

4.2.13 Service mode

The Service mode is used for servicing the speed display modules. For maintenance information, see Section 6, page 31.

In the Service mode, the radar and all auxiliary devices except the data collector are off. The speed display shows the first letters of the alphabet.

On the control panel, the 3-digit LED status display shows “[S]”. The SYSTEM ON LED is lit, and the other status LEDs are lit if applicable.

4.3 Speed display configuration options

The speed display shows vehicle speed in either miles per hour (mph) or kilometers per hour (km/h). Additionally, when a vehicle is traveling at an excessive speed, the display shows a preprogrammed message.

The units of measure and the excessive-speed messages are configured with DIP switches on the systems board, and can be changed if necessary.

- For more information about excessive-speed messages, see “Sign behavior” on page 3.
- For more information about the systems board, see Section 6.2.5, page 36.

4.4 Auxiliary devices

4.4.1 Red-and-blue flashers

For applications where increased attention to the speed sign is desired, red-and-blue flashers are available as an option. When the speed display shows the excessive speed message, these lights flash in an alternating pattern, like the lights on a police car, drawing the motorist’s attention to the sign.

The flashers are located inside the display cabinet, at the top of the display.

4.4.2 Caution beacons

Wanco caution beacons feature bright, amber LED lights that attract motorists’ attention. Installed with a radar-speed display, single beacons flash on and off when the sign is on or at programmed times using the optional scheduler. Dual beacons alternate flashing (one is on while the other is off).

Caution beacons are typically installed above the speed display or a regulatory speed limit sign, wired into the same power system as the speed display.

4.4.3 Traffic data collector

The Wanco Traffic Data Classifier System collects and analyzes traffic flow. The system includes a data collector and traffic analyzer software. The data collector is a non-intrusive device that uses side-firing radar to capture traffic volume by recording vehicle speed, direction, and length, along with the time and date. The data can be downloaded to a computer for analysis using software that is provided with the device. The data collector is installed on the bottom of the radar-speed display cabinet.

The traffic data collector is installed as an optional component, wired into the same power system as the speed display. Power to the data collector is controlled using the mode selector on the speed display control panel.

A serial port on the control panel is used for connecting a laptop computer to the speed sign for downloading data from the traffic data collector.

4.4.4

Scheduler

For applications that require system operation based on a timetable, the optional scheduler provides programming capability. Using its software, you can program the speed display and other components so that the system runs automatically.

For example, a sign in a school zone can be programmed for a slower speed during school hours than for the rest of the day, and could have caution beacons flashing only during school hours.

In addition to controlling operating modes and connected devices, the scheduler also allows for timed operation at specific times of day, on specific days of the week, and during specific times of year.

5 Troubleshooting

5.1 Safety

When servicing the system, follow the safety requirements in Section 2, page 5.

5.2 Status LEDs

During operation, status LEDs on the control panel indicate the system's operating condition.

- To save power, the LEDs will "time out." If all LEDs are off, press the **ACTIVATE** button.
- If no LEDs light after pressing the **ACTIVATE** button, check the power cable between the systems board (Section 6.2.5, page 36) and the selector board (Section 6.2.7, page 46).

5.2.1 Status display

The 3-digit LED status display shows a variety of operating information based on the operating mode. See Table 5-1.

In the Status mode, the status display on the control panel (as well as the speed display) shows various system variables based on the position of the speed limit selector. See Figure 5-1 and Table 5-2.

Table 5-1. Operating information on 3-digit LED status display

Operating mode	Shown on display
Off	"OFF"
Run	User-selected speed limit
Run & Beacons	User-selected speed limit with dots (e.g., ".5.0.")
Data Collector Only	"CLA" (operating) or "Err" (communication failure)
Data Collector & Beacons	"C.L.A." (operating) or "E.r.r." (communication failure)
Demo	"[d]"
Preview	"[P]"
Radar Setup	Vehicle speed
Power Test	System voltage
Status	System status variable (see Table 5-2)
Service	"[S]"

Figure 5-1. Speed limit selector

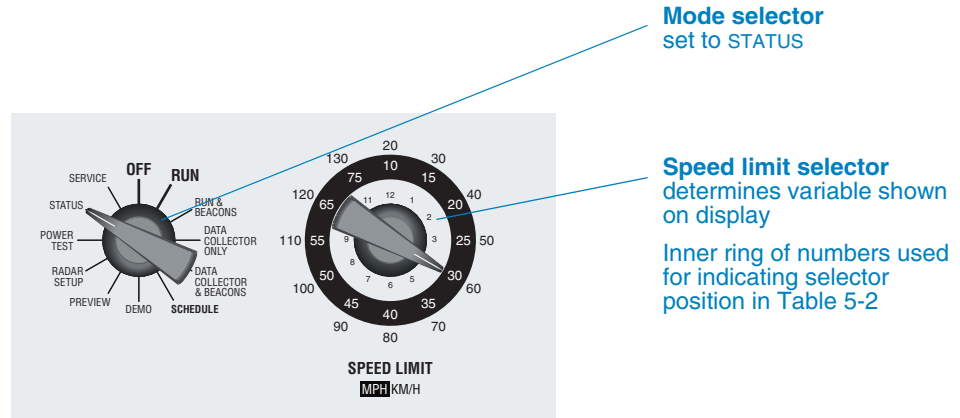


Table 5-2. Variables shown on LED status display

Selector position	Variable	Description	In-system value
1	v.DispBd	Display board version	varies
2	v.SysBd	Systems board version	varies
3	v.SelBd	Selector board version	varies
4	Pr	Rear photocell	0 to 100 (%), 3 to 90 typical
5	Pf	Front photocell	0 to 100 (%), 3 to 90 typical
6	Br	Display brightness	0 to 100 (%), 0 to 50 typical
7	Alarms	Alarm codes	see Section 5.2.3
8	Vsolar	Solar voltage	0 to 21 (VDC)
9	Vbttv	Battery voltage	12 to 13.75 (VDC)
10	Isolar	Solar current to batteries	0 to 5 (A)
11	Isys	System current	0 to 3.00 (A)
12	Ts	Display cabinet temperature	0 to 165 (°F) or -17.8 to 73.9 (°C)*

*Unit of measure based on speed units: if mph, temperature is Fahrenheit; if km/h, then Celsius.

5.2.2

Status indicator lights

The red, yellow, and green LEDs on the control panel indicate the status conditions described in Table 5-3.

5.2.3

Alarm codes

When the CHECK ALARMS indicator on the control panel is lit, alarm codes are available for viewing. Alarms are used during diagnostics, to identify components or systems that may be causing a problem.

To check alarms, set the operating mode to STATUS and rotate the speed limit selector to position 7. The 3-digit LED display on the control panel will show one of the alarm codes listed in Table 5-4.

Table 5-3. Status conditions

Indicator	Condition	Status	Troubleshooting instructions
SYSTEM ON	On	Radar and speed display are powered	—
SOLAR CHARGING	On	Solar charging system actively charging batteries	—
	Off	Solar charging system not charging batteries	see Section 5.5.2, page 29
	Blinking	Battery charging complete	—
CHECK ALARMS	On	System requires attention	see Section 5.2.3
LOW BATTERY	On	Batteries require charging immediately	see Section 5.5.3, page 30
POWER FAIL	On	Battery charge fell below minimum charge voltage, system automatically shut down	see Section 5.6, page 30

Table 5-4. Alarm codes

Alarm code*	Component or system	Status	Troubleshooting instructions
01	Display bd	LED character panel (display module) may have failed	see Section 6.2.6, page 42
02	A/D 12C	Analog/digital converter chip requires attention	contact the factory
04	Tc	Systems board temperature is too high	contact the factory
08	Solar	Solar charging system not functioning	see Section 5.5.2, page 29
10	Radar	Radar or radar wiring connections failed	see Section 5.4, page 28
20	Ts comm	Temperature sensor communications failure	contact the factory
40	Ts bad	Display cabinet temperature too high	contact the factory
80	Ts critical	Display cabinet temperature critically high	contact the factory

*Alarm codes are hexadecimal values. Codes not listed above are combinations of two or more codes (e.g., code 21 = codes 01 and 20).

5.3 Rotary switches

If either rotary switch on the control panel appears to be malfunctioning (i.e., if the operating mode or speed limit does not change after rotating the corresponding switch), the problem may be that the switch is dirty or broken.

To clean a rotary switch, remove the selector board from the control panel (see Section 6.2.7, page 46) and clean the switch if it is dirty. If the problem persists, the switch may be broken. Contact the factory for a replacement selector board.

If your system includes the optional scheduler (see Section 4.2.7, “Schedule mode,” page 20), and the mode selector is set to SCHEDULE, then the scheduler controls the operating mode and the speed limit, and the speed limit selector does not function.

5.4 Radar

Test the radar for proper functioning using the tuning fork provided with the speed display.

IMPORTANT

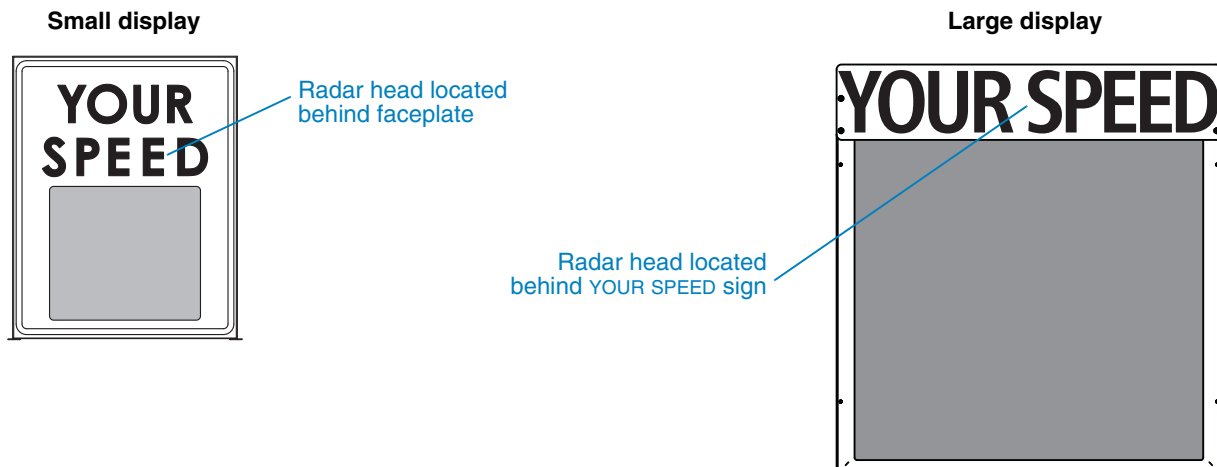
Avoid striking the tuning fork too hard or its frequency will change, making the radar test invalid. A light tap on a hard surface is all that is necessary.

- The standard tuning fork shipped by the factory is calibrated for 55 mph. When tapped and held in front of the radar head, the sign should display 55 mph (86 km/h). An optional tuning fork is available from the factory that is calibrated to 33.2 mph (53 km/h).
- If the tuning fork appears to be damaged, or has dents or deep scratches, it may no longer vibrate at the proper frequency. A damaged tuning fork should be replaced by contacting the factory (see Section 1.5, "Where to obtain service," page 4).

To test the radar:

1. Lightly tap the tuning fork on a hard surface, such as a pole or mounting bracket. (To avoid damaging the finish on the sign, do not tap the tuning fork on the sign.)
2. Hold the tuning fork approximately 6 to 10 inches (15 to 25 cm) in front of the radar head (see Figure 5-2), and view the speed on the display. It should show 55 (mph) or 86 (km/h).
 - When holding the tuning fork in front of the radar head, do not move it side to side or wave it in front of the radar head.
 - If the display does not read 55 or 86, the radar or the tuning fork may need to be replaced.
 - If the radar does not respond, check wiring connections at the systems board (see Section 6.2.5, page 36).

Figure 5-2. Radar head location



5.5 Charging system

5.5.1 Overview

If the speed sign is not hard-wired to an AC power supply, then it is powered by batteries, which are charged using a solar panel and automated charging system. A typical system uses two 6-volt batteries that provide 225 amp-hours of runtime. Other battery configurations are also available.

The charging system runs continuously and keeps the batteries fully charged. It automatically detects when the batteries are fully charged and will not overcharge them.

A low-voltage-disconnect circuit detects when the battery charge falls below 11.2 volts DC, and shuts down the system to prevent damage to the batteries and electronics. If the optional traffic data collector is installed, the low-voltage-disconnect circuit shuts down power to the data collector when the battery charge falls below 10.7 volts DC.

5.5.2 Solar charging

For the solar charging system to function properly, the solar panel must be exposed to full sunlight during daylight hours. The solar panel must be kept clean and unobstructed.

When the solar charging system is functioning properly in a locale with bright, sunny days, the batteries should power the speed display indefinitely. With cloudy skies or stormy weather, the batteries should power the display for 15 to 20 days without intervention. If the batteries are not lasting at least this long, one or more of the following conditions may be true:

- The solar panel is not receiving enough sunlight to charge the batteries fully. Ensure the solar panel is exposed to full sunlight and is not obstructed.
- One or more batteries need to be replaced. Batteries that are more than three years old should be replaced. Check the batteries.
- The solar panel is dirty. When necessary, clean the solar panel with a soft cloth or sponge and a cleaning solution of mild detergent and warm water.
- The solar panel is broken. Check the panel for damage. If there is no visible damage, check the diodes inside the junction box on the back of the solar panel.

5.5.3

Batteries

When the LOW BATTERY indicator on the control panel is lit, complete power failure is imminent and the batteries should be charged immediately. The batteries are fully charged when their voltage is 12.65 VDC.

The cause of a low battery warning can include:

- The solar charging system is not charging the battery. See Section 5.5.2.
- A cable connection is loose. Check battery terminals.
- Batteries have not been charging for a long enough time. Ensure charging is taking place, then wait and check the status LED again.
- One or more batteries need to be replaced. Batteries that are more than three years old should be replaced. Check the batteries.

For battery charging instructions, see Section 6.3.2, page 48.

5.6

Power failure

When the POWER FAIL indicator on the control panel is lit, a complete power failure has occurred and the system has stopped functioning. A power failure can occur for any of the reasons described above.

6 Maintenance

6.1 General maintenance

When performing any maintenance on the system, follow the safety requirements in Section 2, page 5.

The following items should be checked regularly:

- Inspect display cabinet window for damage.
- If status LEDs indicate a problem, see Section 5.2, page 25.

Repair or replace worn and damaged components immediately. Never use any equipment that is damaged or in need of repair.

CAUTION



During maintenance, adverse weather conditions can cause equipment damage and injury.

Whenever possible, perform maintenance in calm, dry weather.

6.2 Display cabinet

6.2.1 Small display cabinet cover panel

The display cabinet protects electronics housed inside the cabinet. The cover panel on the small display slides upward and can be removed for servicing.

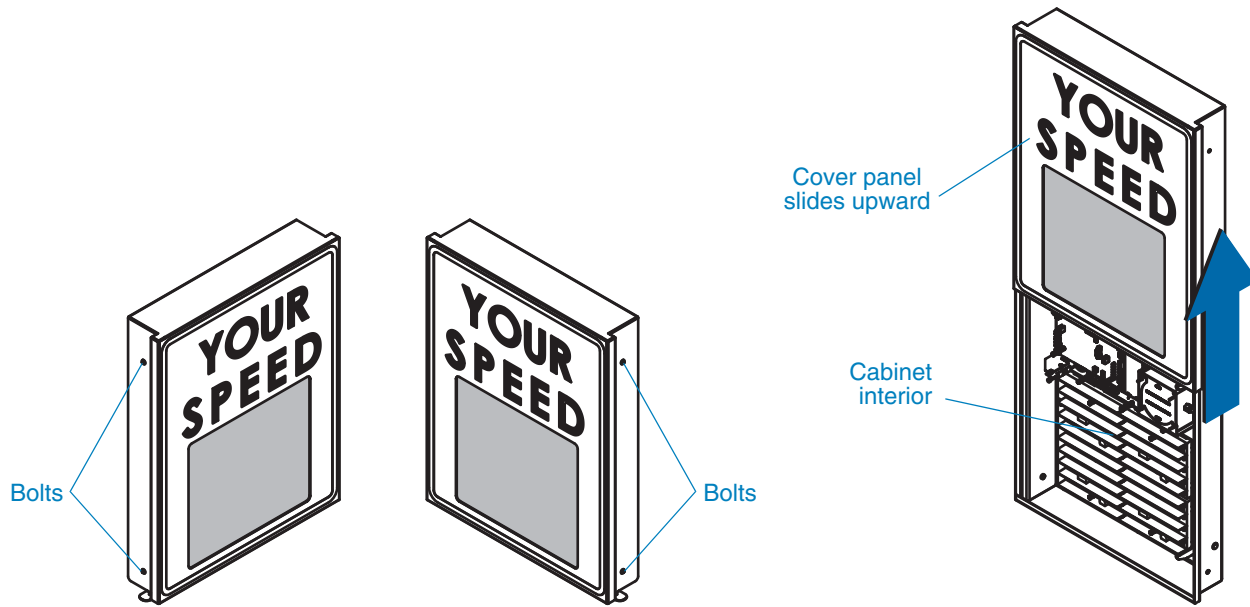
- The cover panel holds a clear, polycarbonate-resin, thermoplastic window. During use, the window will become dirty and require cleaning (see Section 6.2.3).
- Ensure the cover panel is bolted closed when the equipment is not being serviced.

To open the display cabinet front panel, refer to Figure 6-1 and follow these steps:

1. Follow the safety requirements in Section 2, page 5.
2. Remove the four bolts that hold the front panel in place.
3. Slide the front panel upward until the catch on the inside of the cabinet drops down, then lower the front panel to rest on the catch.
4. If desired, slide the front panel up and off the display cabinet for full access to the cabinet interior.

To close the display cabinet front panel, raise it until it is clear of the catch, then press the catch upward, back into the cabinet, and lower the front panel. Repeat this procedure for the second catch, which is located near the bottom of the cabinet.

Figure 6-1. Small display cabinet cover panel



6.2.2 Large display cabinet door

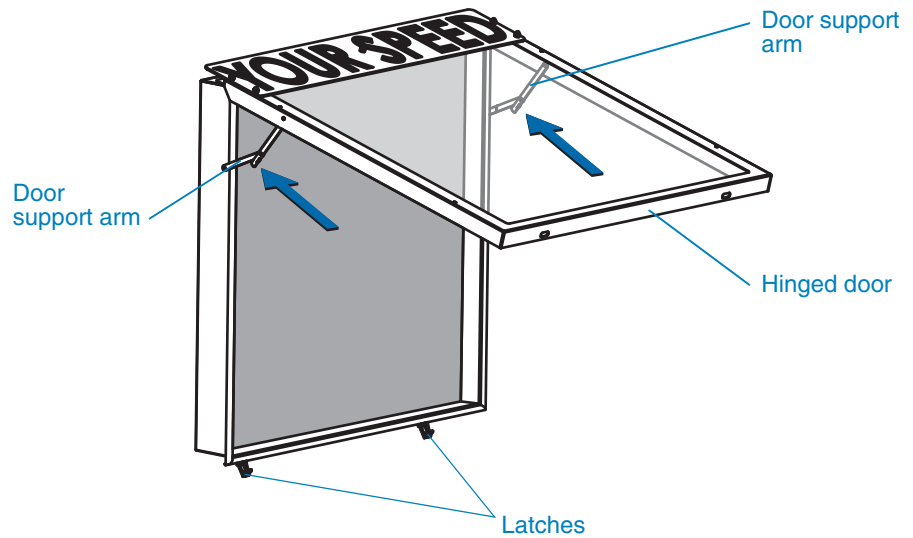
The display cabinet protects electronics housed inside the cabinet. The door on the large display is hinged at the top and latched at the bottom, and can be opened for servicing.

- The door frame holds a clear, polycarbonate-resin, thermoplastic window. During use, the window will become dirty and require cleaning (see Section 6.2.3).
- A gasket between the door frame and the display cabinet can become worn over time. The gasket is important for sealing the cabinet against the weather, and should be replaced if damaged.
- Ensure the cabinet door is closed and latched when the equipment is not being serviced.

To open the display cabinet door panel, refer to Figure 6-2 and follow these instructions:

1. Follow the safety requirements in Section 2, page 5.
2. Release the latches on the underside of the display cabinet. If a padlock is in place, remove the padlock.
3. The door is hinged at the top. To open the door, pull the bottom of the door away from the cabinet.
4. Lift the door as far as possible, then press upward on the center of each door support arm until it locks in place and holds the door open.

To close the display cabinet door, hold the door open with one hand and press downward on the center of each door support arm until it releases. Gently close the door, then latch both latches.

Figure 6-2. Large display cabinet door

6.2.3

Polycarbonate window

The speed-display LED character panels (display modules) are protected by a clear, polycarbonate-resin, thermoplastic window, which occasionally needs cleaning.

To clean the window:

1. Follow the safety requirements in Section 2, page 5.
2. For the small display, remove the display front panel (see Section 6.2.1, page 31). For the large display, open the cabinet door (see Section 6.2.2, page 32).
3. Follow these guidelines:
 - Use a cleaning solution of mild soap and warm water. If necessary, commercial cleaning solutions, such as Formula 409®, are acceptable. Do not use chemical or industrial cleaning solutions.
 - Use a sponge or soft cloth and clean the window gently, using care not to scratch the surface. Do not use a brush or squeegee.
 - To prevent spotting or streaking, dry surface with a soft cloth or moist sponge.

6.2.4

Photocells

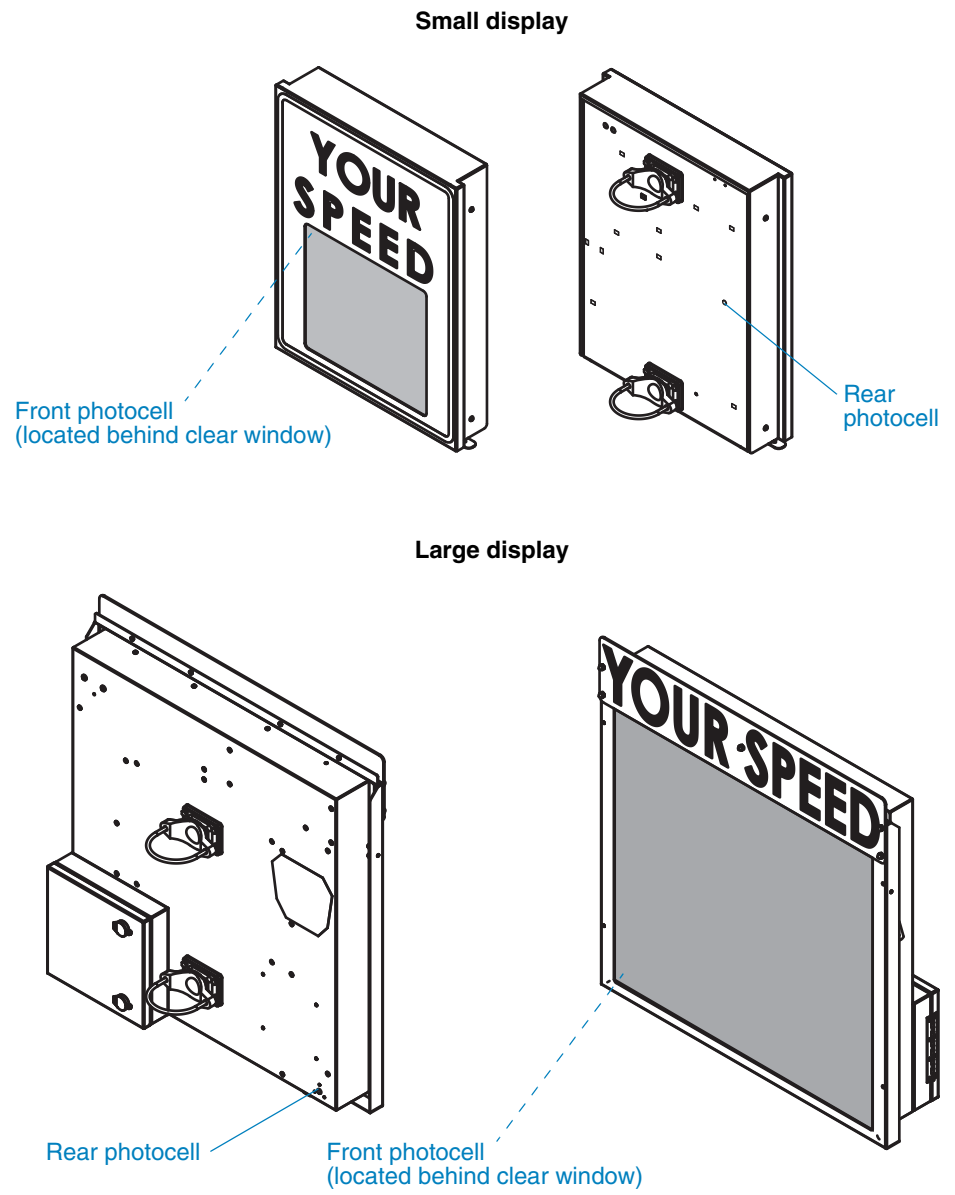
The speed-display is equipped with two photocells, which are used for controlling the brightness of the display.

- If the display appears to be abnormally dim, one or both photocells may be blocked or defective.
- If the display appears to be abnormally bright, one or both photocells may have short-circuited or become damaged.

To check or replace the photocells:

1. Follow the safety requirements in Section 2, page 5.
2. Access the control panel and set the operating mode to STATUS. In the Status mode, the speed display cycles through several status conditions, including display brightness based on input from the photocells.
3. Locate the photocells inside the display cabinet (see Figure 6-3). The front photocell is inside the cabinet, behind the clear window. To access this photocell, open the cover panel (see Section 6.2, page 31).
4. If either the front or rear photocell appears to be dirty or otherwise obstructed, clear it or clean it with a soft, damp cloth. For the front photocell, clean the window if necessary.
5. While watching the display, block all light from the photocells by holding a thick rag, work gloves, or any opaque object over both photocells.
 - Do not use your hands or a piece of paper to block the light.
 - As the display cycles through various status conditions, with light blocked from reaching the photocells, the PHOTO values should be at or near zero (indicating no light and full dimming of the display).
6. While watching the display, shine a flashlight at the front photocell, then at the rear photocell.
 - As the display cycles through various status conditions, with light shining directly into the front photocell, the top PHOTO value should be at or near 100 (indicating bright light and full brightness of the display).
 - With light shining directly into the rear photocell, the bottom PHOTO value should be at or near 100 (indicating bright light and full brightness of the display).

Figure 6-3. Photocell locations



7. If, when performing the previous two steps, the PHOTO values do not indicate full dimming and full brightness, then one or both photocells may be damaged or defective. To replace the photocells:
 - a. At the control box, set the operating mode to OFF.
 - b. With the display cabinet front panel open, access the circuit board on which the photocells are mounted.
 - c. A locking tab on the front of the photocell wiring connector keeps the connector attached to the circuit board. Remove the connector from the board by pushing the locking tab toward the connector, then pulling the plug sideways, away from the board.
 - d. Remove the screws that hold the circuit board in place, then remove the board and set it aside.
 - e. Insert the replacement photocell circuit board into place, attach it with the screws, and connect the photocell wiring by installing the wiring connector to the board.
8. At the control box, set the operating mode to STATUS.
9. Repeat Steps 5 and 6.
 - If the photocell numbers on the display change as expected, the new photocells are correctly installed.
 - If the numbers do not change as expected, check the wiring connection at the photocell circuit board. If the connection is secure, check the other end of the wiring at the systems board (see Section 6.2.5).
 - If all wiring connections are secure and the photocells do not appear to be working correctly, contact the factory (see Section 1.5, "Where to obtain service," page 4).
10. If working on the small display, close the display cabinet cover panel (see Section 6.2.1, page 31). If working on the large display, close and latch the display cabinet door (see Section 6.2.2, page 32).

6.2.5

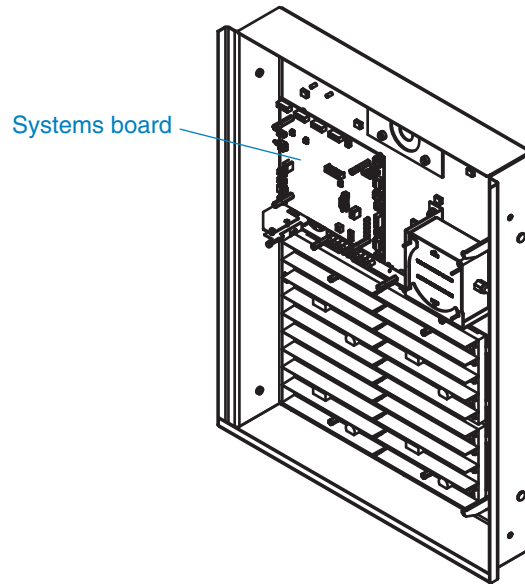
Systems board

The systems board includes wiring connections and switches that allow for additional configuration of the speed sign and its behavior. Although the factory establishes all the settings necessary for proper operation, based on customer specifications, it is sometimes necessary to access the systems board.

Accessing the systems board in the small display cabinet

In the small display cabinet, the systems board is located inside the cabinet, above the display module (see Figure 6-4). To access the systems board:

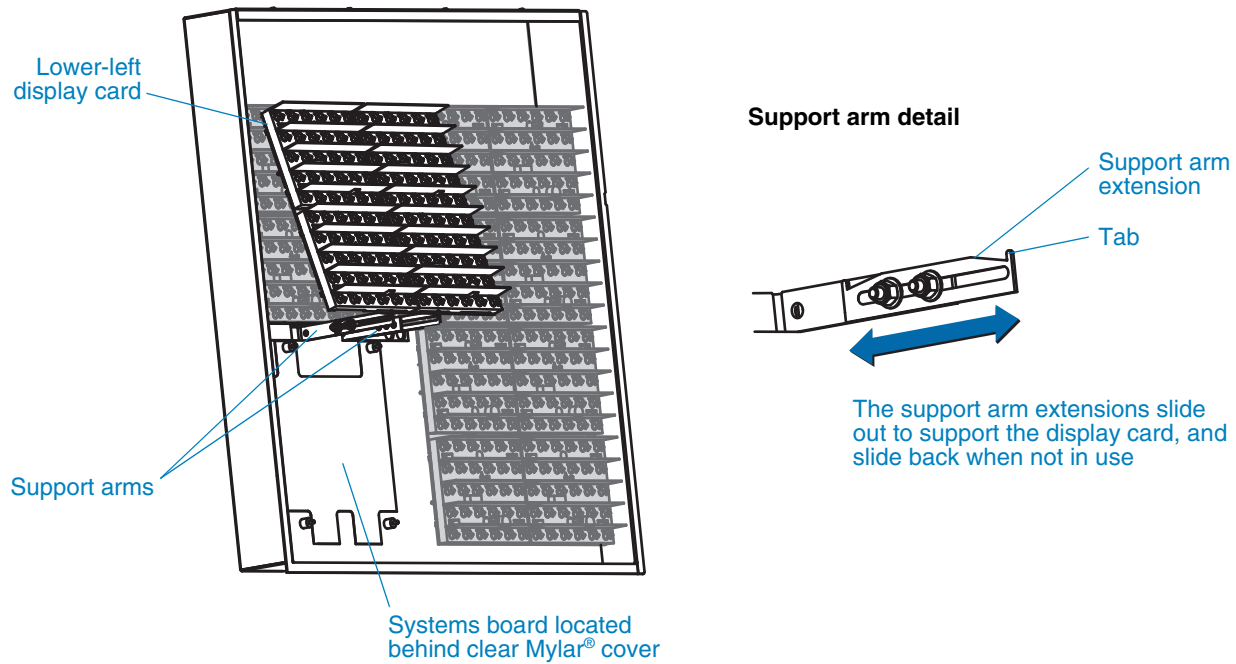
1. Follow the safety requirements in Section 2, page 5.
2. Access the control panel and set the operating mode to OFF.
3. Open or remove the display cabinet cover panel (see Section 6.2.1, page 31).

Figure 6-4. Systems board in small display cabinet**Accessing the systems board in the large display cabinet**

In the large display cabinet, the systems board is located inside the cabinet, behind the lower-left display module. To access the systems board:

1. Follow the safety requirements in Section 2, page 5.
2. Access the control panel and set the operating mode to OFF.
3. Open the display cabinet door (Section 6.2.2, page 32).
4. Remove the lower-left display module:
 - a. Locate the four retaining nuts that hold the module in place and remove the nuts using the supplied nut wrench or a 5/16-inch nut driver.
 - b. Carefully pull the display module away from and out of the cabinet. Electrical wiring that is attached to the back of the module can be damaged with too much force. Do not disconnect any wiring.
 - c. While holding the display module, locate the two hinged support arms indicated in Figure 6-5. Swing the arms outward and pull the extensions out all the way.
 - d. Place the bottom of the lower-left display module so that the tabs on the support arm extensions fit into the slots on bottom of the module. Then lean the top edge of the module against the upper-left display module as illustrated in Figure 6-4.
 - Ensure the support arms are spaced so that the display module is securely positioned and will not slide off or tip forward.
 - The systems board is located behind the clear Mylar® cover.

Figure 6-5. Systems board in large display cabinet



DIP switches

DIP switches on the systems board provide a variety of settings for the speed display:

KPH/MPH	Configures the units of measure for the speed limit display
A, B, and C	Configure the speed display's excessive speed message
D	Overrides the brightness control for photocells
DNLD/UPLD	Used for diagnostics and system software upgrades

- DIP switches on the systems board are called out in Figure 6-6.
- DIP switch settings are described in Table 6-1.

Figure 6-6. DIP switches on the systems board

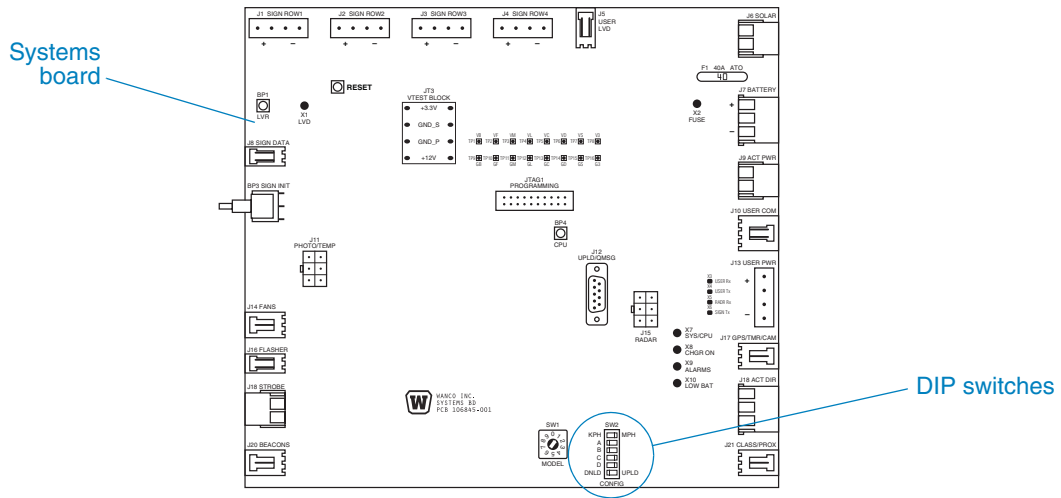


Table 6-1. DIP switch settings

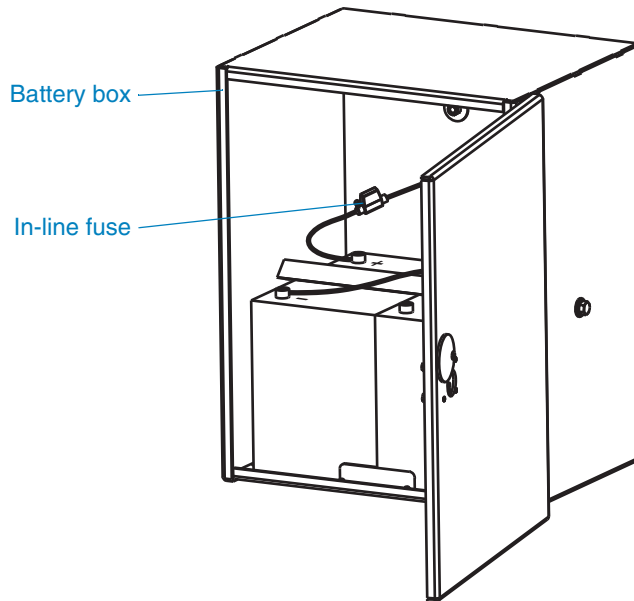
	Switch	Setting	Description
Units of measure	KPH/MPH	<input type="checkbox"/> <input type="checkbox"/>	km/h Vehicle speed is displayed in kilometers per hour (km/h)
	KPH/MPH	<input type="checkbox"/> <input checked="" type="checkbox"/>	mph Vehicle speed is displayed in miles per hour (mph)
Excessive speed message (see "Preview mode" on page 20)	A	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	blank When vehicle exceeds 130% of set speed limit, speed display is blank
	B	<input type="checkbox"/> <input checked="" type="checkbox"/> <input type="checkbox"/>	SLO When vehicle exceeds 130% of set speed limit, SLO message is displayed
	C	<input type="checkbox"/> <input type="checkbox"/> <input checked="" type="checkbox"/>	☹ When vehicle exceeds 130% of set speed limit, frowning face symbol is displayed
	A	<input type="checkbox"/> <input checked="" type="checkbox"/> <input type="checkbox"/>	⚠ When vehicle exceeds 130% of set speed limit, exclamation point symbol is displayed
	B	<input type="checkbox"/> <input checked="" type="checkbox"/> <input checked="" type="checkbox"/>	◇ When vehicle exceeds 130% of set speed limit, diamond symbol is displayed
	C	<input type="checkbox"/> <input type="checkbox"/> <input checked="" type="checkbox"/>	— When vehicle exceeds 130% of set speed limit, bar symbol is displayed
	A	<input type="checkbox"/> <input checked="" type="checkbox"/> <input type="checkbox"/>	⋮ When vehicle exceeds 130% of set speed limit, four corners symbol is displayed
	B	<input type="checkbox"/> <input checked="" type="checkbox"/> <input checked="" type="checkbox"/>	alternating ◇ and ◇ When vehicle exceeds 130% of set speed limit, alternating double diamond symbols are displayed
Display brightness	D	<input type="checkbox"/> <input checked="" type="checkbox"/>	100% Speed display brightness is set to 100% in DEMO mode
	D	<input type="checkbox"/> <input type="checkbox"/> <input checked="" type="checkbox"/>	photocell Brightness of speed display is controlled by photocells in all operating modes
Serial communications	DNLD/UPLD	<input type="checkbox"/> <input type="checkbox"/>	download Serial port on control panel can be used for downloading system data for diagnostics
	DNLD/UPLD	<input type="checkbox"/> <input checked="" type="checkbox"/>	upload Serial port on control panel can be used for uploading software upgrades to the system

Replacing the systems board

If the systems board malfunctions or is damaged, it may be necessary to replace it. To replace the systems board:

1. Follow the safety requirements in Section 2, page 5.
2. Access the control panel and set the operating mode to OFF.
3. Disconnect power:
 - If the speed sign is hard-wired to an AC power supply, disconnect power to the sign according to your standard procedures.
 - If the speed sign is powered by batteries, access the battery box and remove the inline fuse (see Figure 6-7).
4. Access the systems board as described on page 36 for the small cabinet or page 37 for the large cabinet.
5. Remove the systems board:
 - a. One at a time, remove each wiring connection from the systems board. Mark each set of wires as you remove them, so you will know where to reconnect them when installing the replacement systems board.
 - b. When all the wiring has been disconnected, locate and remove the four nuts that hold the systems board in place.
 - c. Remove the systems board from the display cabinet and place it into a pink or red anti-static bag for shipment back to the factory.

Figure 6-7. In-line fuse



6. Install the replacement systems board:
 - a. Prepare the replacement systems board by setting switches to the desired positions, matching the settings on the old systems board or using the information in “DIP switches” on page 38.
 - b. Locate rotary switch SW1 (Model), to the left of the DIP switches, and set it to position 1.
 - c. Place the replacement systems board into position in the display cabinet and install it using the four nuts you removed in Step 5.
 - d. One at a time, make each wiring connection to the systems board using the wiring you marked in Step 5. Use care to make each connection at the proper location. (For a diagram of the systems board with all wiring connections called out, see Figure 6-13, page 51.)
7. Reconnect power:
 - If the speed sign is hard-wired to an AC power supply, reconnect power to the sign according to your standard procedures.
 - If the speed sign is powered by batteries, access the battery box and reinstall the inline fuse (see Figure 6-7).
8. Looking at the systems board, verify the green LED marked “X7 SYS/CPU” is blinking.
9. At the control panel, set the operating mode to STATUS.
10. Verify the speed display is showing the system status variables correctly (see Section 5.2, page 25). Verify all variables that are shown.
11. If working on the small display, skip to Step 12. Otherwise, for the large display, restore the display cabinet and sign to operating condition as follows:
 - a. At the control box, set the operating mode to OFF.
 - b. Lift the display module off the support arms, slide the arm extensions all the way inward, and swing the arms back into their stored positions.
 - c. Position the lower-left display module in its proper place, in front of the systems board, using care not to pinch the wiring behind the module.
 - d. Using the supplied nut wrench or a 5/16-inch nut driver, install and tighten the four nuts that hold the module in place.
12. Test the radar to ensure it is functioning correctly (see Section 5.4, page 28).
13. If working on the small display, close the display cabinet cover panel (see Section 6.2.1, page 31). If working on the large display, close and latch the display cabinet door (see Section 6.2.2, page 32).

6.2.6 Display module

The speed display's LED character panels (display modules) can be replaced when damaged or if LEDs fail to light. The small display has one module; the large display has four modules.

Initialization

After installing a display module, it must be initialized so that it will display the proper LED sequence. Each module has an address embedded in its program chip; initialization sets the address, and is therefore required each time a module is installed.

Wiring problems

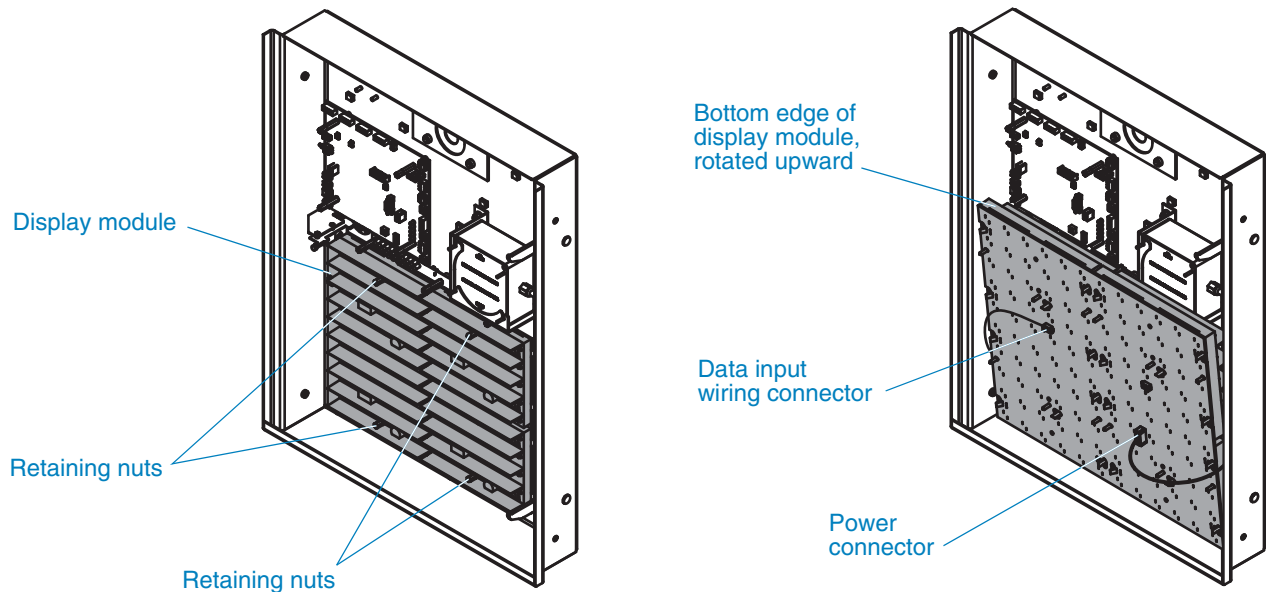
If no LEDs on a display module will light (i.e., the module appears not to be working), the cause could be faulty wiring or a wiring connection. To troubleshoot for a wiring problem, use the instructions below to access the module and check its wiring connections before removing the module.

Replacing the display module

Before replacing the display module, check for wiring problems as described above.

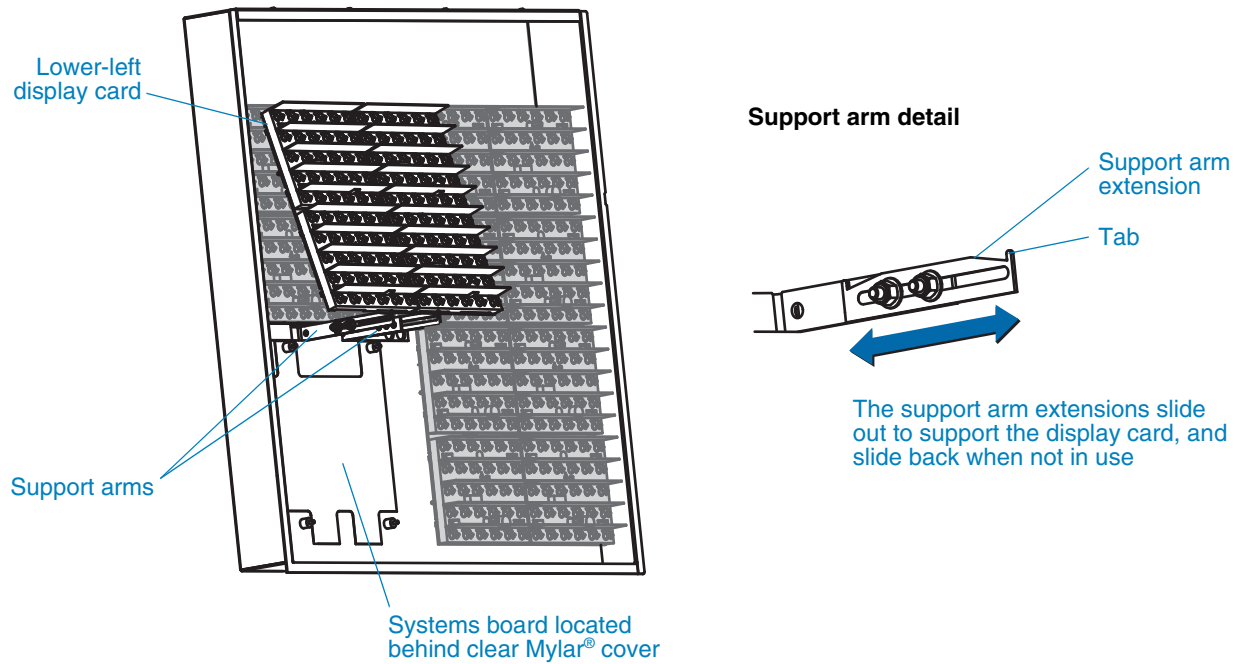
To replace a display module, follow these steps:

1. Follow the safety requirements in Section 2, page 5.
2. Access the control panel and set the operating mode to OFF.
3. Open the display cabinet (see Section 6.2, page 31).
4. Remove the desired display module (the small display has only one; the large display has four):
 - a. Locate the four retaining nuts that hold the module in place (see Figure 6-8).
 - b. Using the supplied nut wrench or a 5/16-inch nut driver, remove the four nuts.
 - c. Carefully pull the display module away from and out of the cabinet. Electrical wiring that is attached to the back of the module can be damaged with too much force.
 - d. To expose the wiring connections on back of the module, gently rotate the bottom of the module upward. Do not turn the board left or right.
 - e. Being careful to avoid using too much force, first unplug the power connector by pulling it straight out, away from the display module. Then unplug the data input wires by pushing the locking tab down and pulling the plug sideways, away from the connector.
 - f. If working in the large display cabinet, unplug the data output wires by pushing the locking tab down and pulling the plug sideways. (The lower-right display module does not have an output wiring connection.)
 - g. Set the old display module aside.

Figure 6-8. Display module

5. Install the replacement display module:
 - a. While holding the replacement module upside-down with its back facing you (in this position, the arrow on back of the module points down), attach the data input wires, then the power connector.
 - b. Carefully rotate the module so it is right-side up with the back of the module facing the cabinet (in this position, the arrow on back of the module points up, indicating the top of the module). Use care to avoid tangling or pulling on the wires.
 - c. If the module is in the lower-left position in the large display cabinet, skip to Step 6; otherwise, position the module in place in the cabinet, using care not to pinch the wiring behind the module.
 - d. Using the supplied nut wrench or a 5/16-inch nut driver, install and tighten the four retaining nuts that hold the module in place.
6. If working in the small display cabinet, skip to Step 7; otherwise, for the large display, position the lower-left module for access to the systems board:
 - a. If the replacement module is in the lower-left position in the cabinet, locate the two hinged support arms indicated in Figure 6-9; otherwise, remove the lower-left display module as described above (but *do not* disconnect its wiring), then locate the support arms.
 - b. Swing the arms outward and pull the arm extensions out all the way.
 - c. Place the bottom of the lower-left display module so that the tabs on the arm extensions fit into the slots on bottom of the module. Then lean the top edge of the module against the upper-left display module as illustrated in Figure 6-9.
 - d. Ensure the support arms are spaced so that the display module is securely positioned and will not slide off or tip forward.

Figure 6-9. Support arms and systems board in large display cabinet



7. Use the systems board to initialize the new display module:
 - Figure 6-9 indicates the location of the systems board in the large display cabinet.
 - Figure 6-10 indicates the location of the systems board in the small display cabinet.
 - a. At the control panel, set the operating mode to SERVICE.
 - b. Locate the white initialize button (labeled “BP3 SIGN INIT”) on the left side of the systems board (see Figure 6-11).
 - c. Press and hold the initialize button and observe the status LEDs on the systems board. After approximately 5 seconds, the LEDs will flash in sequence, indicating the display module initialization sequence is complete.
 - d. Release the button.
8. If working in the small display cabinet, skip to Step 9; otherwise, for the large display, install the lower-left module as follows:
 - a. Lift the display module off the support arms, slide the arm extensions all the way inward, and swing the arms back into their stored positions.
 - b. Position the lower-left display module in its proper place, in front of the systems board, using care not to pinch the wiring behind the module.
 - c. Using the supplied nut wrench or a 5/16-inch nut driver, install and tighten the four nuts that hold the module in place.
9. Restore the sign to operating condition:
 - a. At the control box, set the operating mode to OFF.
 - b. Close the display cabinet cover panel or door (see Section 6.2, page 31).

Figure 6-10. Systems board in small display cabinet

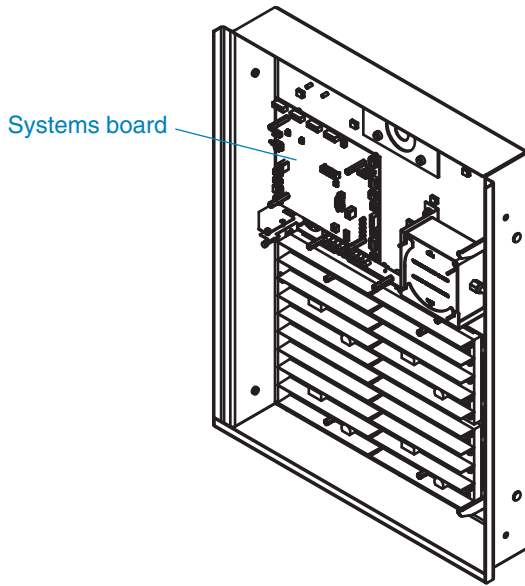
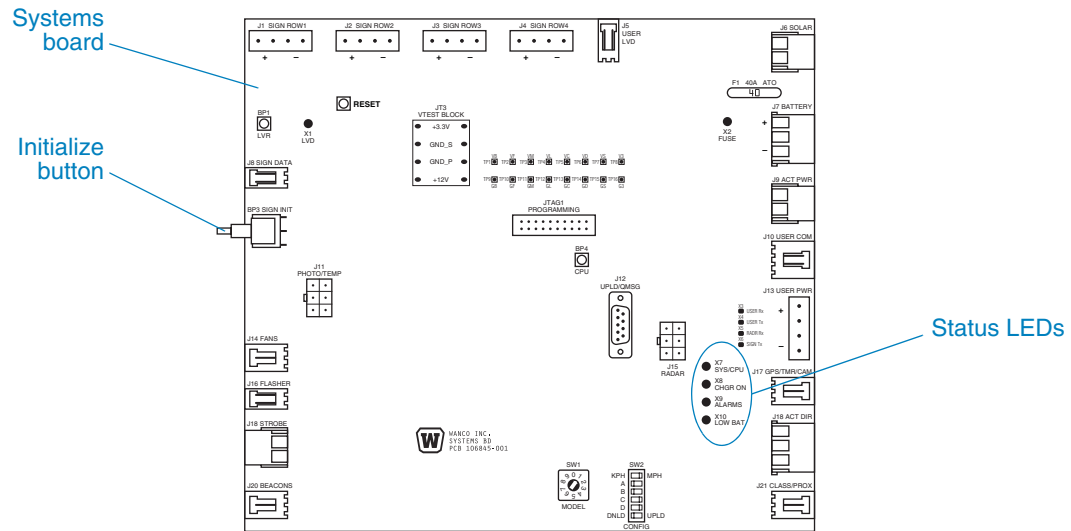


Figure 6-11. Initialize button and status LEDs on the systems board



6.2.7

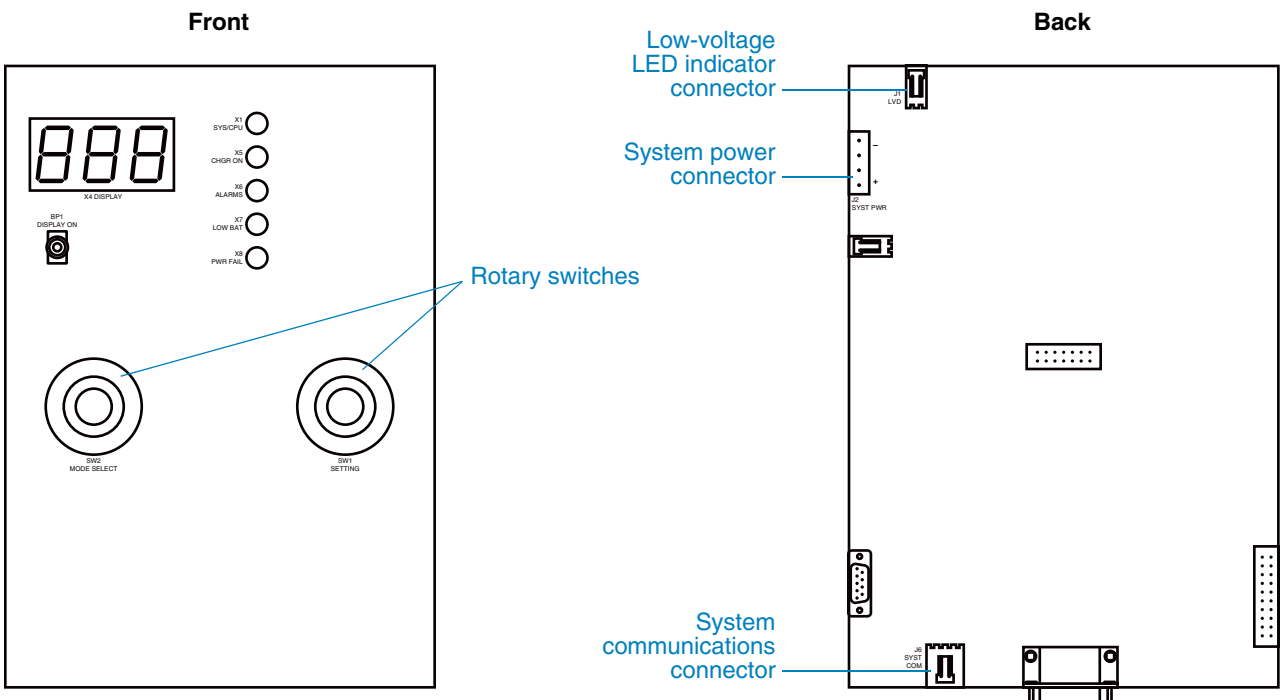
Selector board

The selector board includes switches that allow for configuration of the speed sign behavior, and wiring connections. It is located inside the control box, behind the control panel.

There are no serviceable components on the selector board; if it fails, it must be replaced. To replace the selector board:

1. Follow the safety requirements in Section 2, page 5.
2. Access the control panel and set the operating mode to OFF.
3. Disconnect power:
 - If the speed sign is hard-wired to an AC power supply, disconnect power to the sign according to your standard procedures.
 - If the speed sign is powered by batteries, access the battery box and remove the inline fuse (see Figure 6-7, page 40).
4. Disconnect the control panel wiring:
 - a. Four screws hold the control panel in place. Use a Phillips-head screwdriver to remove all four screws.
 - b. To expose the wiring connections on back of the selector board, gently rotate the top of the panel downward. Electrical wiring that is attached to the back of the board can be damaged with too much force. Do not turn the board left or right.
 - c. Refer to Figure 6-12 and, being careful to avoid using too much force, unplug the system power connector by pulling it straight out, away from the board. Then unplug the low-voltage LED wires by pushing down on the locking tab and pulling the plug sideways, away from the connector. Repeat for the system communications wires, pulling that plug toward you, away from the connector.
5. Carefully remove the control panel from the control box and place it face up on a clean, dry surface.
6. Detach the selector board from the control panel:
 - a. Using a small slotted screwdriver, remove the two knobs from the rotary switches by loosening the set screw on each knob, located on the wide end of the knob (opposite of the pointer end) and pulling the knobs off the switches.
 - b. Using a wrench or pliers, loosen and then remove the two hex nuts that hold the rotary switches and the selector board to the control panel.
 - c. Lift the control panel away from the selector board.
7. Place the old selector board in a pink or red anti-static bag for shipment back to the factory.

Figure 6-12. Selector board



8. Install the new selector board on the control panel:
 - a. Fit the rotary switches on the new board into the holes in the control panel.
 - b. Attach the board to the panel by threading the two hex nuts onto the switches. Tighten each nut with a wrench or pliers, just past hand-tight.
 - c. Insert the two knobs onto the rotary switches and tighten their set screws.
9. Install the control panel assembly in the control box:
 - a. With the control panel face down, rest its bottom edge in the control box.
 - b. Taking care not to drop the control panel, make wiring connections to the back of the selector board.
 - c. Carefully tilt the control panel up, into its proper upright position.
 - d. Align the holes in the panel to the threaded holes in the back of the control box, then reinstall the four screws you removed in Step 4.
10. Reconnect power:
 - If the speed sign is hard-wired to an AC power supply, reconnect power to the sign according to your standard procedures.
 - If the speed sign is powered by batteries, access the battery box and reinstall the inline fuse (see Figure 6-7, page 40).
11. At the control panel, set the operating mode to STATUS, and ensure all functions are working properly.
12. Close and lock the control box.

6.3 Charging system

6.3.1 Solar panel

For the solar charging system to function properly, the solar panel must be exposed to full sunlight during daylight hours.

The solar panel must be kept clean and unobstructed:

- When necessary, clean the solar panel with a soft cloth or sponge and a cleaning solution of mild detergent and warm water.
- If a shadow or any obstruction blocks even a portion of any of the solar panel, charging will be negatively affected and a significantly longer charge time will be necessary.

6.3.2 Batteries

Although the solar charging system helps maintain battery health by keeping batteries fully charged when there is sun, and by shutting down power automatically before full discharge, regular maintenance is necessary for the batteries to function properly and for long battery life.

Safety



DANGER

Explosive gases can cause blindness and severe injury.

When working on or near batteries:

- Wear eye protection
- Prevent sparks and open flames
- No smoking anywhere in the vicinity
- Keep children clear of the area



DANGER

Sulfuric acid can cause blindness and severe burns.

- Use caution when working on or near batteries
- Avoid contact with skin, face, and eyes
- Keep out of reach of children
- Upon contact, seek medical help immediately

- Even when batteries are not in operation, self-discharge generates hydrogen gas that can explode. Always store and work on batteries in a well ventilated area.
- Always wear proper eye, face, and hand protection when working on or near batteries.
- Keep all sparks, flames, and cigarettes away from batteries at all times.
- Never lean over batteries when testing or charging.

- To prevent short circuits and sparks, exercise caution when working with metallic tools or conductors near batteries.
- To reduce the risk of sparks, ensure connectors make good contact with battery terminals. Replace cables that appear suspicious or have visible cracks or bare wires.
- To lengthen battery life and prevent freezing, always keep batteries fully charged.

Charging

During the first year of operation, battery voltage should be checked monthly, to ensure the charging system is keeping the batteries charged. This is because solar charging that appears to be working during one season may fall short during different season, particularly for an untried installation location. To ensure uninterrupted operation during periods of less than full sun and in winter, battery voltage should be checked weekly. After the first year of operation, battery voltage should be checked at least once per season.

If the battery voltage is low because the charging system is not able to charge the batteries fully, the solar panel may need to be reoriented or relocated. For information about the solar charging system, see Section 5.5, page 29.

To check the battery voltage and determine charging requirements:

1. Observe battery safety precautions (see "Safety" on page 48).
2. Verify battery cables are disconnected and terminals are clean.
3. Using a DC voltmeter or multimeter, measure and record the DC voltage at each battery terminal.
4. If the voltage varies between batteries, recharge the batteries and perform the test again, or obtain appropriate test equipment from the battery manufacturer and follow the manufacturer's instructions.
5. Refer to Table 6-2 to determine the battery charge requirements based on the measured voltage.

Cleaning

- Observe battery safety precautions (see "Safety" on page 48).
- Keep batteries clean, avoiding accumulation of dust, dirt, and grime.
- To clean batteries, use a solution of 50% baking soda and 50% water. Do not allow cleaning solution or other material to enter battery cells. After cleaning, rinse batteries with clean water and allow to dry thoroughly.
- At least once a year, visually inspect terminals and cables for signs of corrosion, especially in hot temperatures.

Table 6-2. Battery charge requirements

Charge level,%	Open-circuit voltage, volts		Approx. required charge time, hrs.	
	6V batt.	12V batt.	5A	10A
100	6.37	12.73	0	0
95	6.34	12.68	3	1
90	6.31	12.62	5	2
85	6.28	12.56	8	4
80	6.25	12.50	10	5
75	6.22	12.44	13	6
70	6.19	12.37	16	8
65	6.16	12.31	18	9
60	6.12	12.24	21	10
55	6.09	12.17	23	12
50	6.05	12.10	26	13
45	6.37	12.03	28	14
40	6.34	11.96	31	16
35	5.95	11.89	34	17
30	5.91	11.81	36	18
25	5.87	11.74	39	19
20	5.83	11.66	41	21
15	5.79	11.59	44	22
10	5.75	11.51	47	23
5	—	—	—	—
0	—	—	—	—

Notes

1. Determine the battery charge level from voltage test readings.
2. If charge level is above 70%, no charging is required. If charge level is below 10%, the battery may need replacing. Otherwise, determine the required charge time from the table. For charging with a Wanco battery charger, use the 5-amp column for a 4-battery system, and the 10-amp column for a 2-battery system.

6.4 Wiring

- Many wiring connections are made at the systems board, illustrated in Figure 6-13. For additional information about the systems board, see Section 6.2.5, page 36.
- For a comprehensive wiring diagram of the small display, see Figure 6-14.
- For a comprehensive wiring diagram of the large display, see Figure 6-15.

6.5 Replacement parts

For replacement parts, see the illustrations and parts lists on the following pages, or contact the Wanco Service Department (see Section 1.5, “Where to obtain service,” page 4).

Figure 6-13. Systems board wiring connections

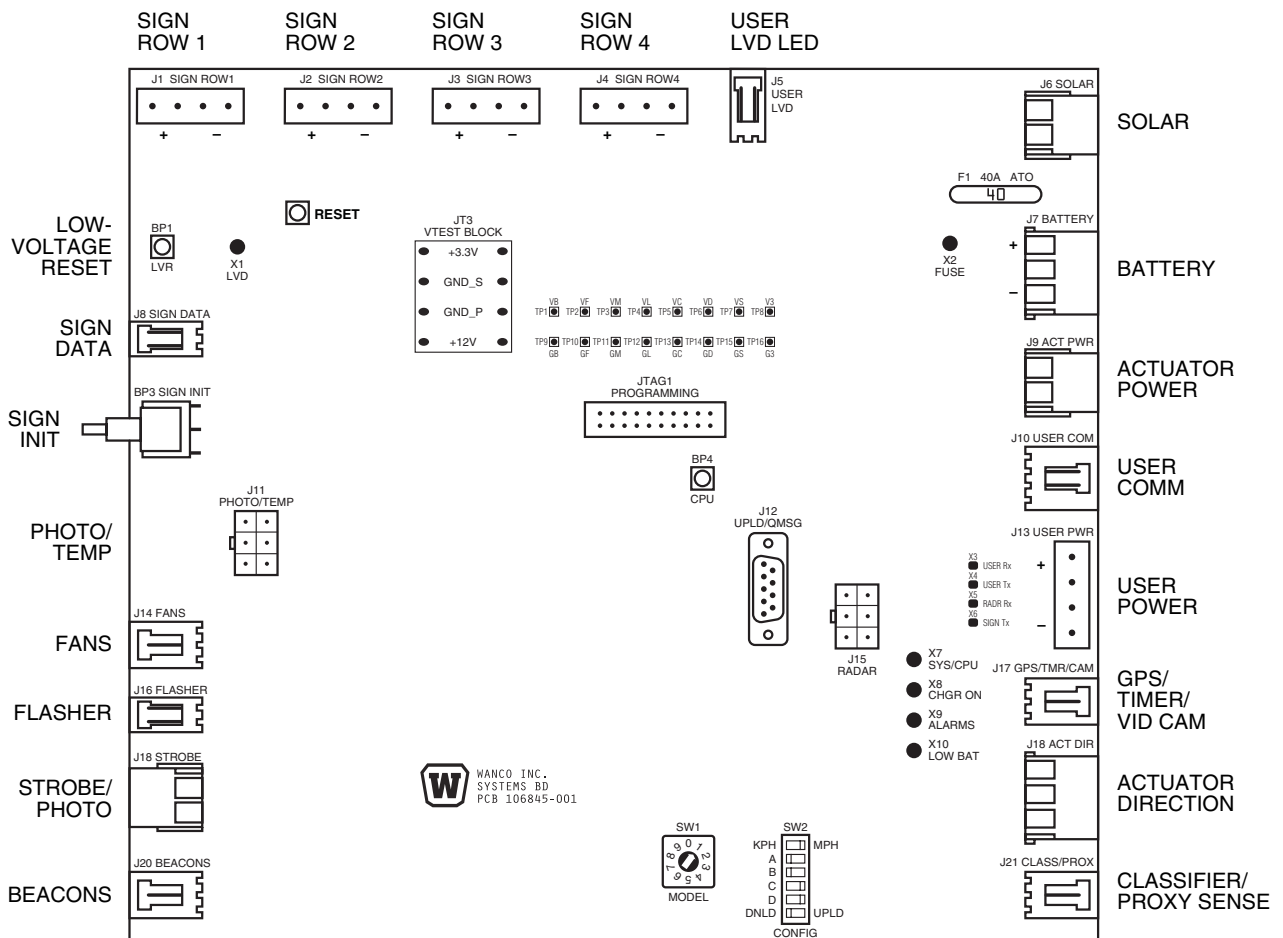
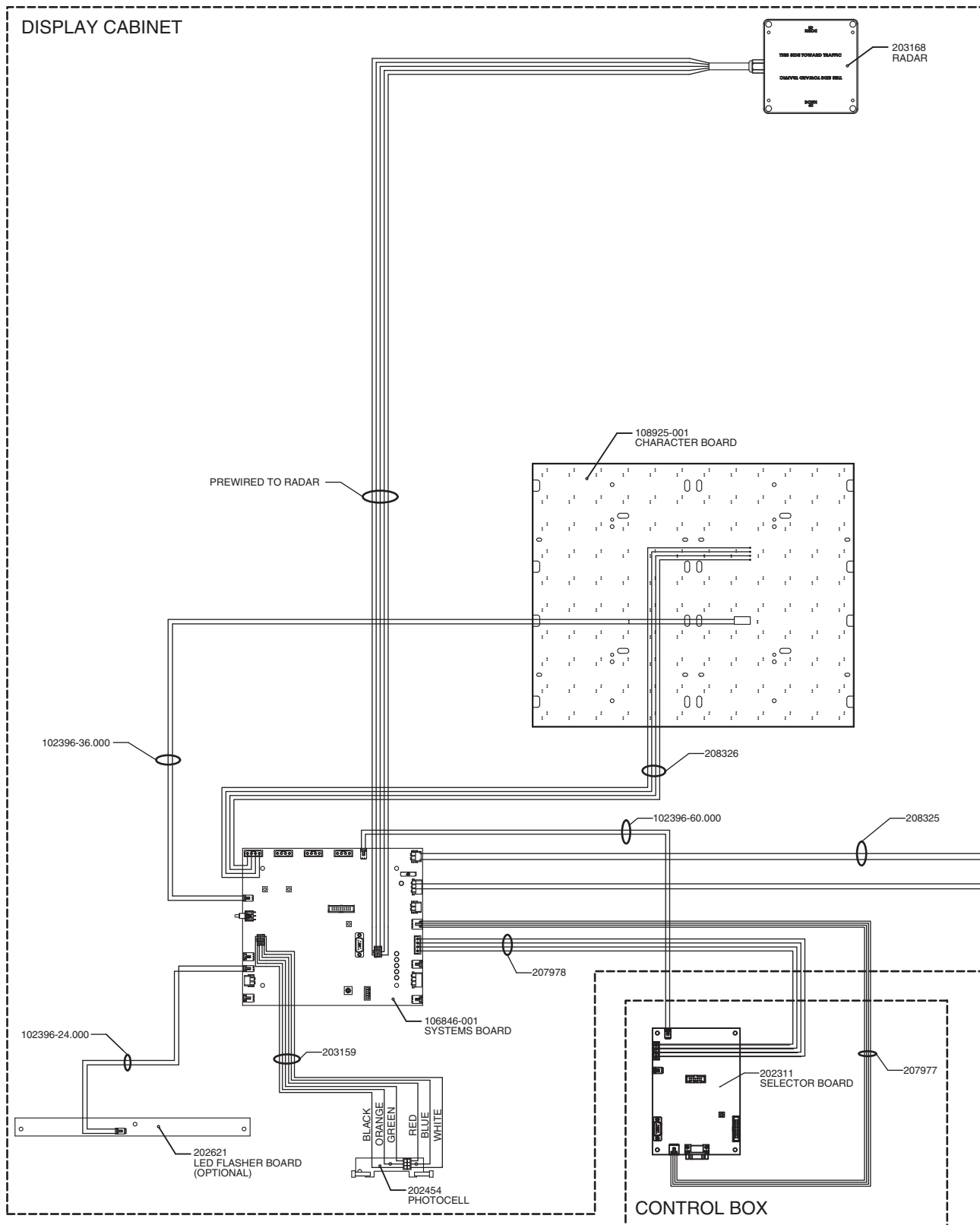


Figure 6-14. Wiring diagram, small display



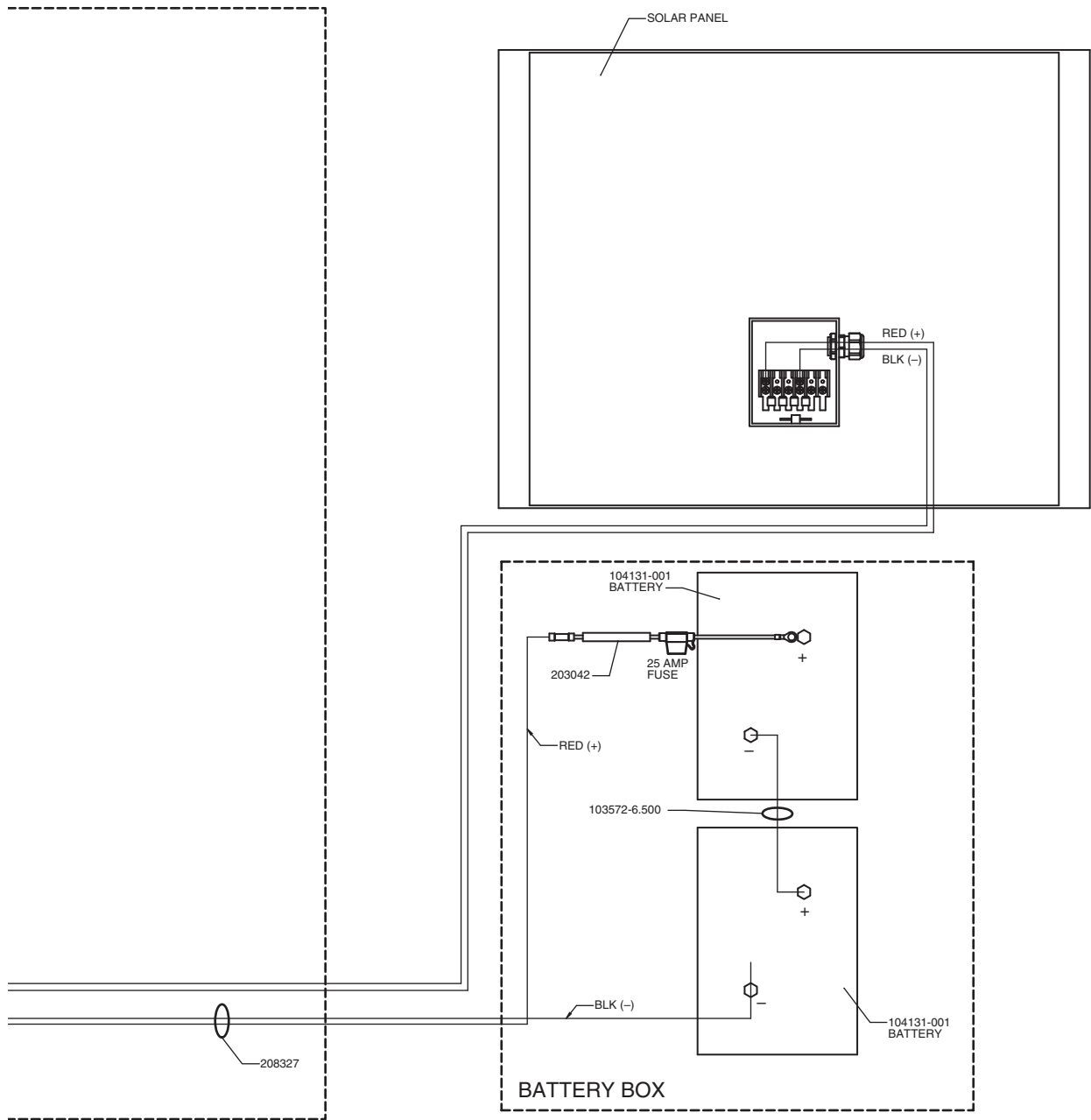
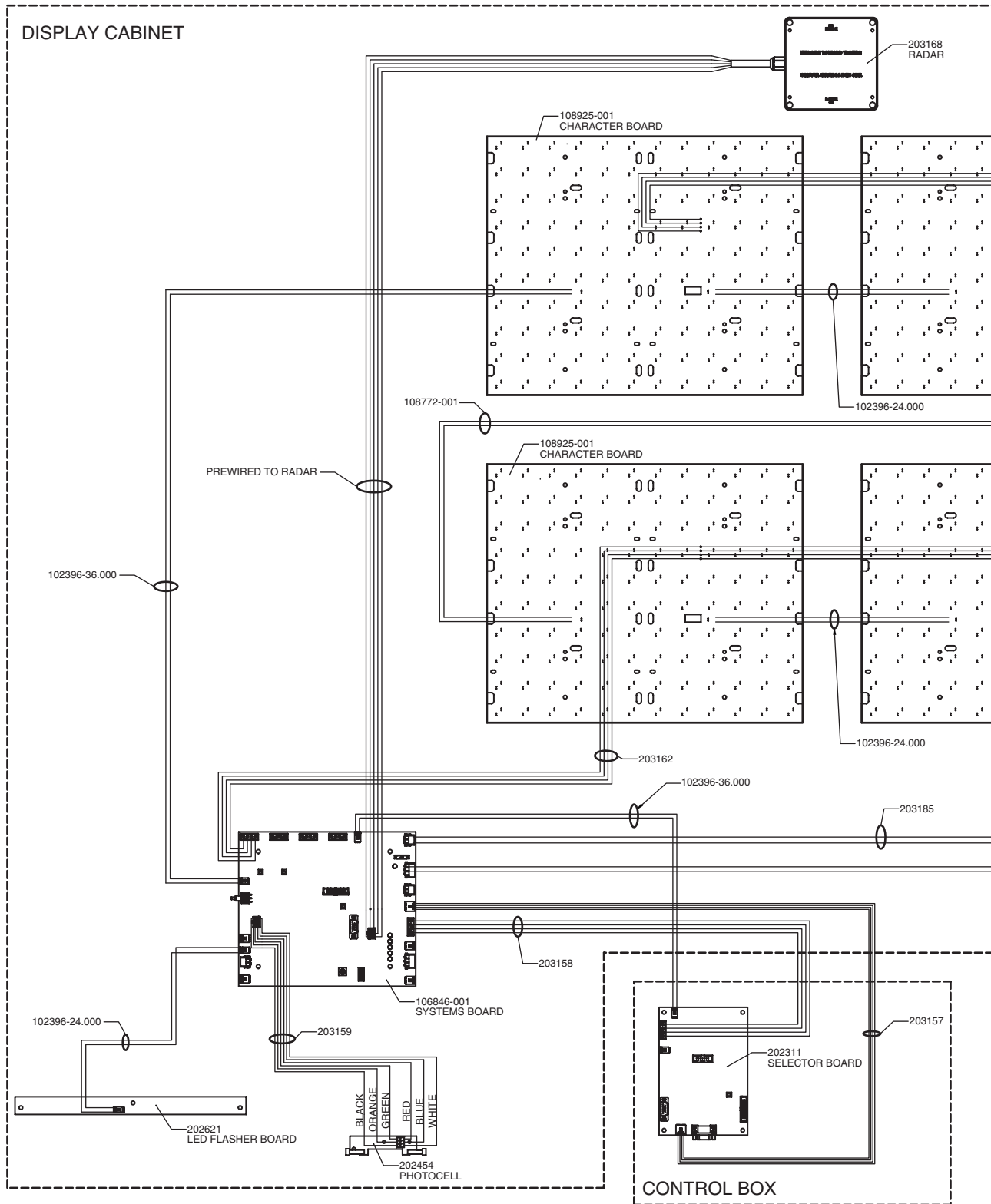


Figure 6-15. Wiring diagram, large display



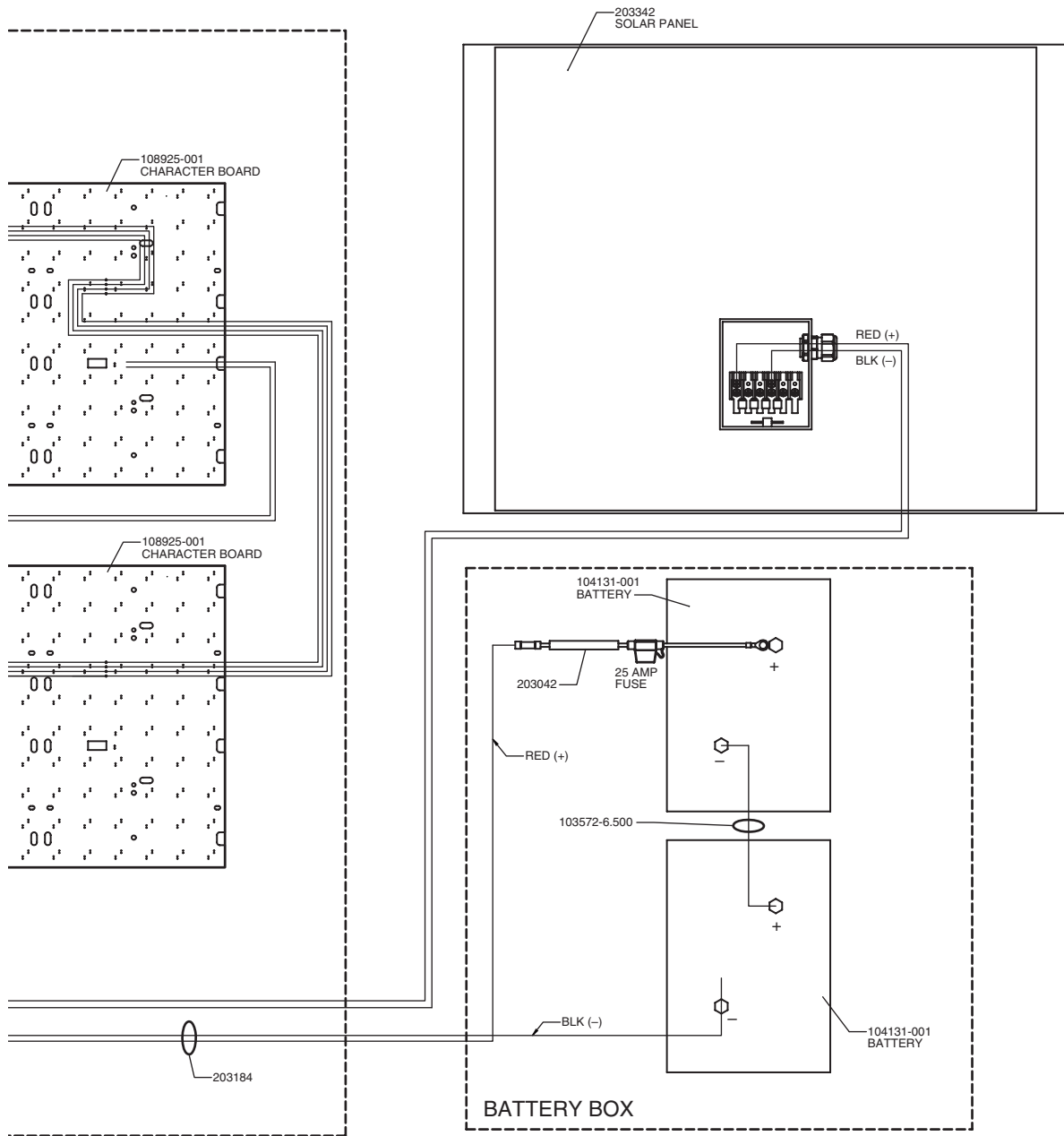


Figure 6-16. Small display cabinet cover-panel, exploded view

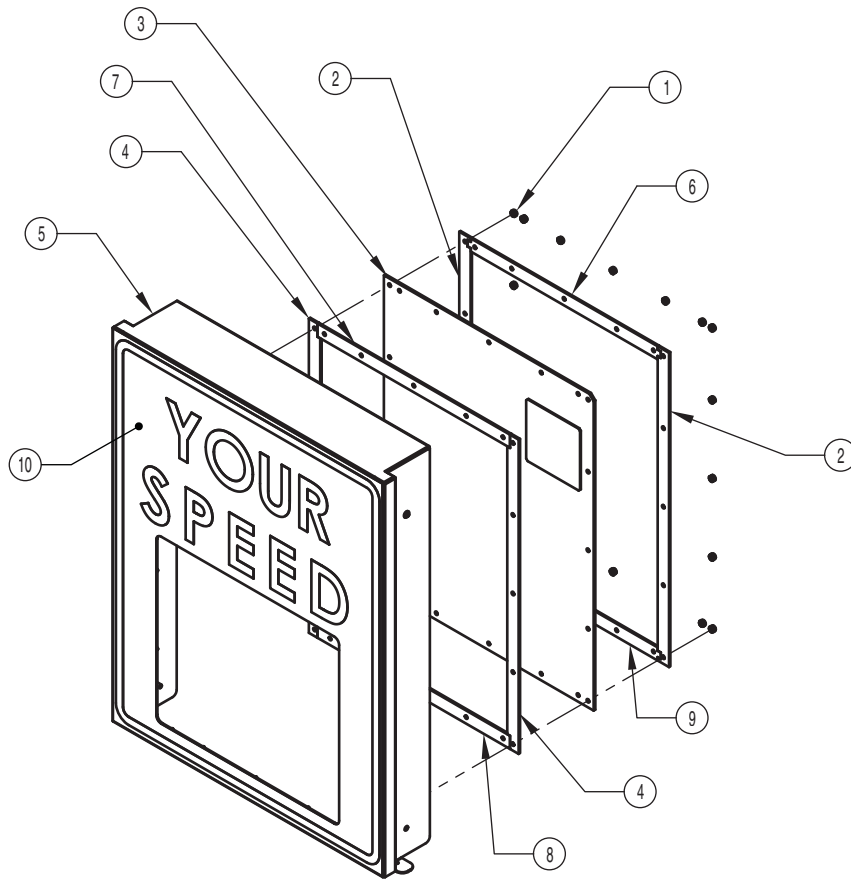


Table 6-3. Small display cabinet cover-panel parts list

Item No.	Part No.	Description	Qty.
1	101721-001	Hex nut, nylon insert lock #10-32	20
2	206367-P	Window retainer, vertical	2
3	206369	Window cover	1
4	206668	Window gasket, vertical	2
5	206931-P	Front cover	1
6	207727-P	Window retainer, top	1
7	207728	Window gasket, top	1
8	207741	Window gasket, bottom	1
9	207742-P	Window retainer, bottom	1
10	206530	"YOUR SPEED" decal	1

Figure 6-17. Small display cabinet interior, exploded view

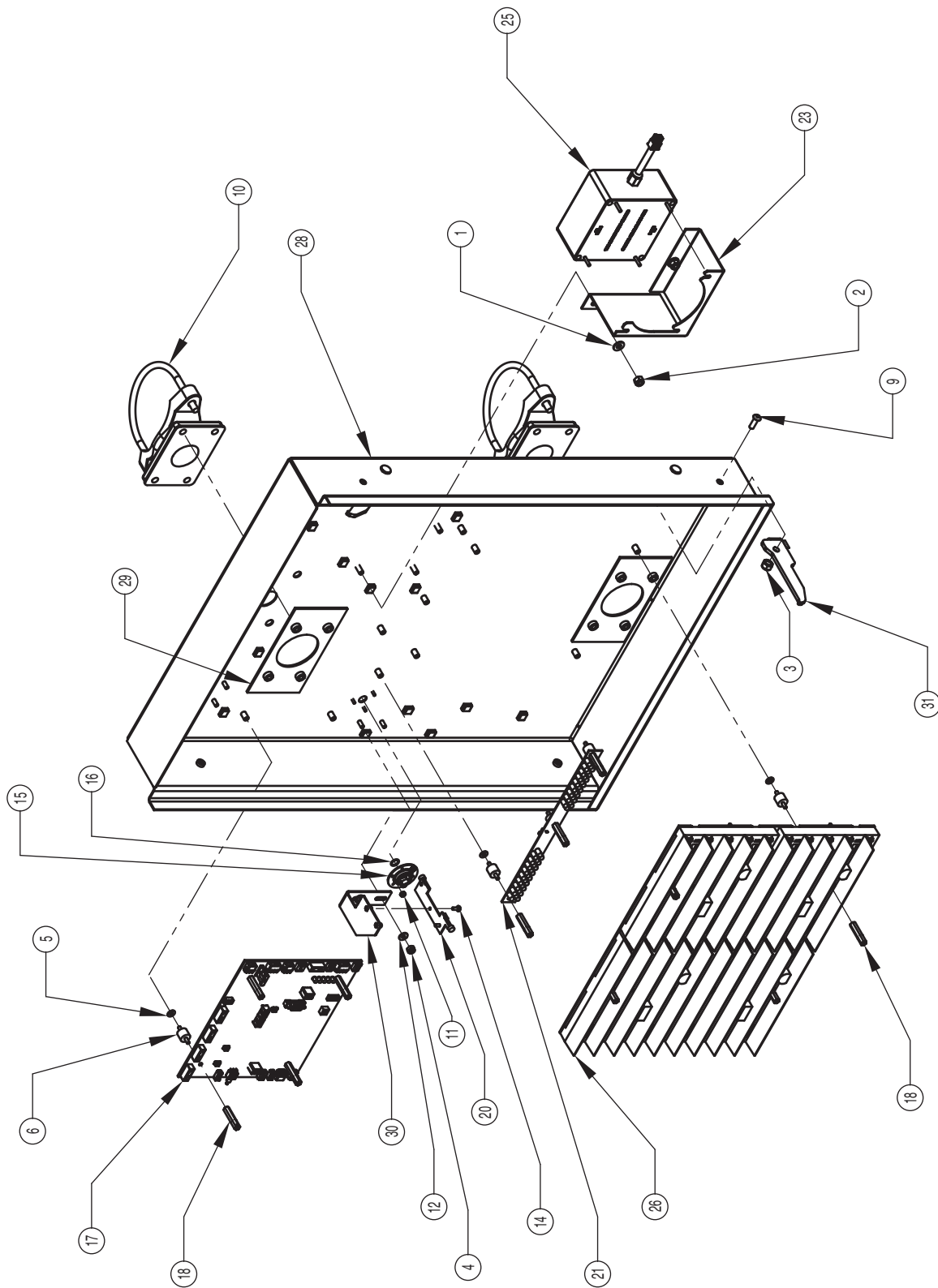


Table 6-4. Small display cabinet interior parts list

Item No.	Part No.	Description	Qty.
1	100236-001	Flat washer, 1/4"	3
2	100238-001	Hex nut, nylon insert lock 1/4-20	3
3	100239-001	Hex nut, nylon insert lock 5/16-18	2
4	101489-001	Hex nut, nylon insert lock #10-24	2
5	101491-001	Flat washer, #8	10
6	102314-001	Vibration mount for LED display module	11
7	102396-24.000	Data cable, 22/2 wire × 24" (not shown)	1
8	102396-36.000	Data cable, 22/2 wire × 36" (not shown)	1
9	103505-002	Button-head screw, 1/4-20 × 3/4"	4
10	103791-001	Mounting kit for 4.5"-diameter pole	2
11	103828-001	Keps nut, #4-40	3
12	104855-001	Flat washer, #10	2
14	105686-001	Pan-head sems screw, #6-32 UNC × 3/8"	2
15	106111-001	Photocell holder	1
16	106302-001	O-ring	1
17	106846-001	PCB, systems board	1
18	107557-001	Nut, #8-32	11
20	202454	Photocell	1
21	202621	Red-blue flasher assembly	1
23	203043-P	Radar bracket	1
24	203159	Photocell cable assembly, 12"	1
25	203168	Wanco radar head	1
26	204071	LED display module, 9"	1
28	206424-P	Small speed display cabinet	1
29	206669-P	Mounting plate	2
30	206695-P	Photocell bracket	1
31	207725-P	Stop lever	2
33	208326	Data cable (not shown)	1
34	208327	Power cable (not shown)	1

Figure 6-18. Control-box for small display, exploded view

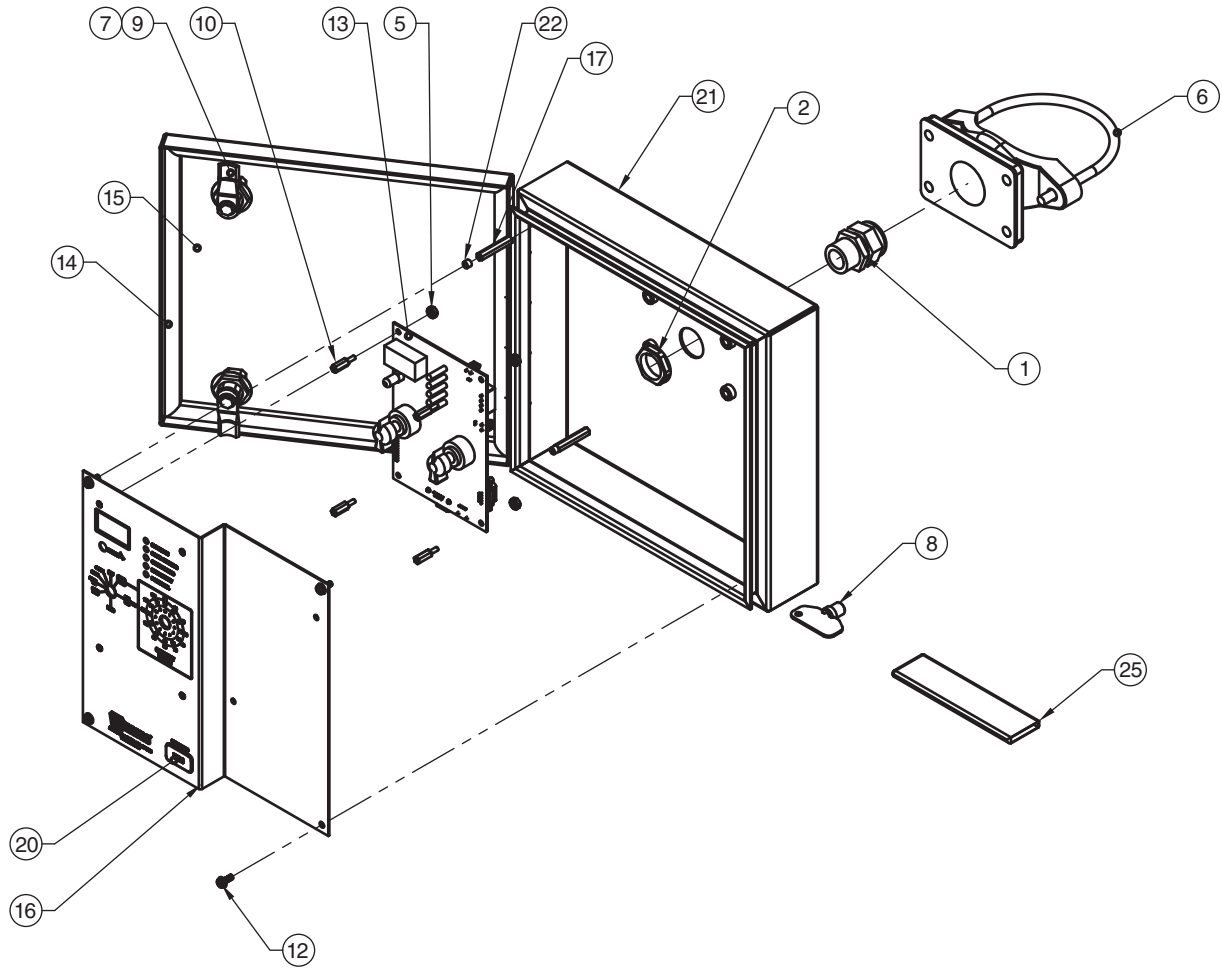


Table 6-5. Control-box for small display, parts list

Item No.	Part No.	Description	Qty.
1	100135-001	Cord grip, 3/4" NPT	1
2	100135-002	Locknut, 3/4" NPT	1
3	102396-60.000	Data cable, 22/2 wire x 60" (not shown)	1
5	103534-001	Keys nut, #8-32	4
6	103791-001	Mounting kit for 4.5"-diameter pole	1
7	104221-001	Cam latch	2
8	104222-001	Key for cam latch	2
9	104223-001	Cam latch seal	2
10	104234-001	Standoff, 8-32 x 5/8"	4
12	106363-001	Pan-head sems screw, #8-32 UNC x 1/2"	4
13	202311	PCB, selector board	1
14	203047	Door gasket	1
15	203049-P	Control box door	1
16	203059	Control panel	1
17	203096	Standoff, 8-32 x 1 1/2"	2
20	203229	Plug, DB9 hole	1
21	206365-P	Control box	1
22	206667	Round spacer, .166 x .250 x .188L	2
23	207977	Data cable (not shown)	1
24	207978	Power cable (not shown)	1
25	108743-001	Wanco tuning fork, 55 mph	1

Table 6-6. Large display cabinet parts list

Item No.	Part No.	Description	Qty.
1	102033-001	Lid support, right side	1
2	102033-002	Lid support, left side	1
3	104417-001	Liquid-tight plug, 7/8" diameter	1
4	104828-001	Rubber bumper	1
5	106111-001	Photocell holder	1
6	106302-001	O-ring	1
7	106846-001	PCB, systems board	1
8	108427-001	Snap bushing	1
9	108743-001	Wanco tuning fork, 55 mph	1
10	204071	LED display module, 9"	4
11	202454	Photocell	1
12	202621	Red-blue flasher assembly	1
13	203027-P2	Interior bracket, top/bottom	2
14	203028-P2	Photocell bracket	1
15	203030	"YOUR SPEED" sign	1
16	203031	Display cabinet window	1
17	203032	Speed display door latch	2
18	203033	Display cabinet gasket	1
19	203034-P2	Window bumper bracket	1
20	203035-P3	Display cabinet door hinge	1
22	203039-P2	Interior center, top/bottom	1
23	203041-P2	Door frame	1
24	203043-P2	Radar bracket	1
25	202311	PCB, selector board	1
26	203096	Standoff, 8-32 × 1 1/2"	2
27	203047	Door gasket	1
28	203049-P3	Control box door	1
29	104221-001	Cam latch	2
—	104222-001	Key for cam latch (not shown)	2
30	203059	Control panel	1
31	203052-P3	Control box	1
32	203053	Control box rear gasket	1
33	203091	Control box grommet	1
34	203168	Wanco radar head	1
35	203341	Polyester cover for systems board	1
36	102314-001	Vibration mount for LED display module	16
37	203061	Vibration mount for systems board	4
39	204194-P2	Swing arm extension	2
40	204195-P2	Swing arm	2
41	103810-001	Acorn nut, 1/4-20	5
42	104234-001	Standoff, 8-32 × 5/8"	4
43	104448-028	Button-head screw, #10-32 × 1/4"	8
44	100207-019	Hex screw, 1/4-20 × 5"	2
45	107557-001	Nut, #8-32	16
46	103791-001	Mounting kit for 4.5"-diameter pole	2
47	206669-P	Mounting plate	2

Figure 6-20. Solar panel assembly, exploded view

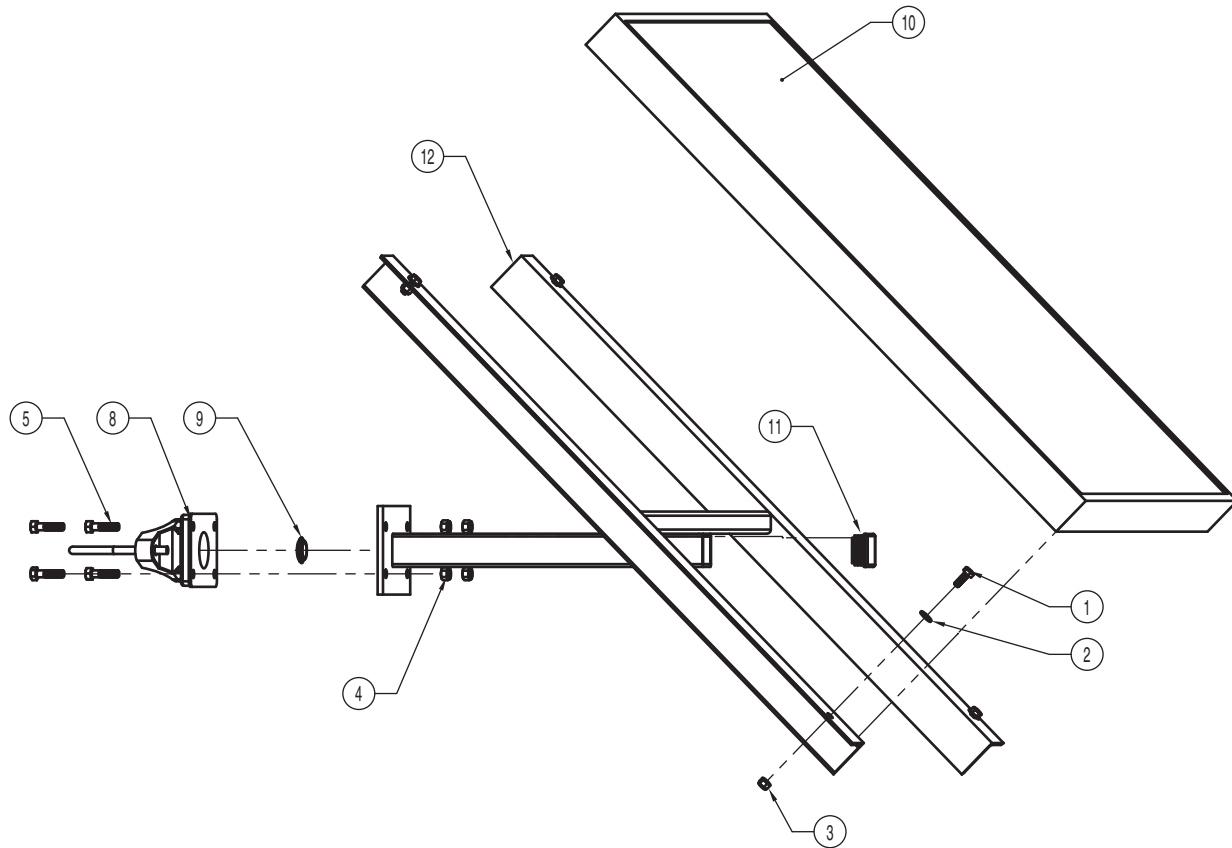


Table 6-7. Solar panel assembly parts list

Item No.	Part No.	Description	Qty.
1	100207-002	Hex screw, 1/4-20 x 3/4"	4
2	100236-001	Flat washer, 1/4"	8
3	100238-001	Hex nut, nylon insert lock 1/4-20	4
4	100239-001	Hex nut, nylon insert lock 5/16-18	4
5	100627-004	Hex screw, 5/16-18 x 1 1/4"	4
6	102533-001	Fully insulated female connector, quick-disconnect for 14-16 AWG wire	1
7	103260-001	Fully insulated male connector, quick-disconnect for 14-16 AWG wire	1
8	103791-001	Mounting kit for 4.5"-diameter pole	1
9	108334-001	Plug for 7/8"-diameter hole	1
10	202484	Solar panel assembly, 65-watt	1
11	203155	Plug for 1 1/2" sq. steel tube	1
12	207038-P	Mounting bracket for 65-watt solar panel	1



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