

**GENERIC SERVICE  
VARIABLE SPEED LIMIT SIGNS  
VS-5000 SERIES**  
DISPLAY MANUAL

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DD3907919  
Rev 0



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# Table of Contents

<b>1 Introduction</b> .....	<b>1</b>
How to Use This Manual .....	1
General Summary .....	2
Operation .....	2
<b>2 Component Description and Theory of Operation</b> .....	<b>3</b>
Sign Controller.....	3
LED Modules .....	4
LED Diagnostics.....	4
Power Supplies .....	4
Cooling .....	4
Light Sensors .....	4
<b>3 Mechanical Installation</b> .....	<b>5</b>
Lifting the Sign .....	5
Mounting Methods .....	5
<b>4 Electrical Installation</b> .....	<b>6</b>
Getting Started .....	6
Conduit .....	6
Grounding .....	6
Power Installation.....	7
Sign Communication .....	7
Default Speeds .....	7
Conduit Sealing .....	7
First Time Turn On .....	7
<b>5 Maintenance and Troubleshooting</b> ..	<b>8</b>
Getting Started .....	8
Service and Diagnostics .....	8
Sign Controller Replacement.....	8
Accessing the Internal Components .....	9
Replacing a Module .....	9
Replacing a Power Supply .....	9
Ventilation Systems (With Fans and Filters) .....	10
Replacing a Ventilation Fan.....	10
Routine/Preventative Maintenance ....	11
<b>Sign Cabinet Inspection</b> .....	<b>11</b>
<b>Sign Controller</b> .....	<b>11</b>
<b>Structural Inspection</b> .....	<b>11</b>
<b>Photo Sensor Assembly Inspection</b> ....	<b>11</b>
<b>LED Cleaning</b> .....	<b>11</b>
<b>Ventilation System Inspection</b> .....	<b>11</b>
Routine/Preventative Maintenance Checklist .....	12
Troubleshooting of the Variable Speed Limit Sign .....	12
<b>6 Replacement Parts and Repair &amp; Exchange Programs</b> .....	<b>14</b>
Daktronics Exchange and Repair and Return Programs .....	14
<b>Exchange Program</b> .....	<b>14</b>
<b>Before Contacting Daktronics</b> .....	<b>14</b>
Repair & Return Program.....	15
<b>Shipping Address</b> .....	<b>16</b>
<b>E-mail</b> .....	<b>16</b>

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# 1 Introduction

## How to Use This Manual

This manual provides installation, maintenance, and troubleshooting information for the Daktronics VS-5000 series Vanguard® Variable Speed Limit Signs (VSLs) and their components.

For information regarding safety, installation, operation, or service of this system, please refer to the telephone numbers listed on the cover page of this manual.

The manual is divided into the following sections:

- **Introduction** covers information needed to use this manual. Take time to read the entire introduction as it explains concepts used throughout the manual.
- **Component Description and Theory of Operation** includes information about components within Daktronics variable speed limit signs.
- **Mechanical Installation** explains mechanical installation information for the sign.
- **Electrical Installation** explains electrical installation information for the sign.
- **Maintenance and Troubleshooting** provides maintenance and troubleshooting information for Daktronics variable speed limit signs and the sign controller.
- **Repair and Exchange Programs** provides instructions on how to use the Repair or Exchange programs.
- **Glossary** defines terms and phrases used in this manual.

Daktronics identifies manuals by the DD or ED number located on the cover page of each manual. For example, this manual is referred to as **DD3907919**.

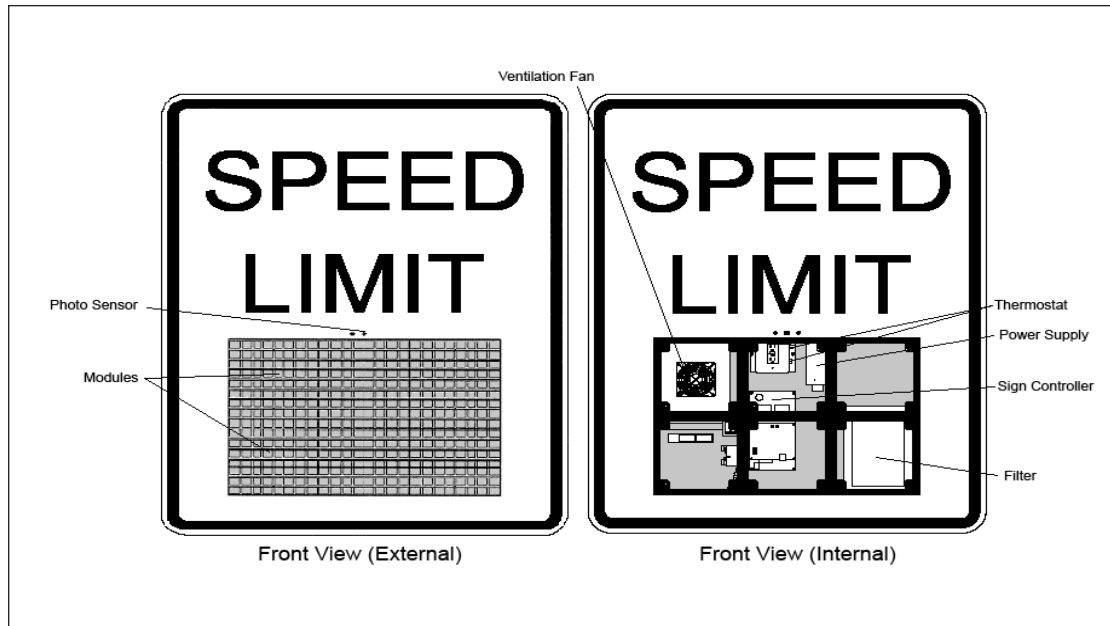
The serial number and model numbers can be found on the ID label, located on the sign. This label looks similar to **Figure 1**. When calling Daktronics Customer Service, please have this information available to ensure the request is serviced as quickly as possible.



**Figure 1:** Sign ID Label

Daktronics signs are built for long life and require little maintenance. However, from time to time, certain sign components need replacing. Refer to the **Daktronics Exchange and Repair and Return Programs (p.14)** if any component needs replacing, repairing, or ordering.

## General Summary



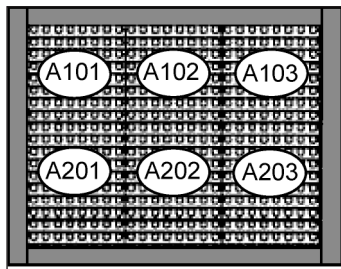
**Figure 2:** VS-5220-2-18-W

The Daktronics variable speed limit signs consist of an aluminum cabinet containing LED modules. Refer to **Figure 2**. The sign controller inside the sign operates the modules.

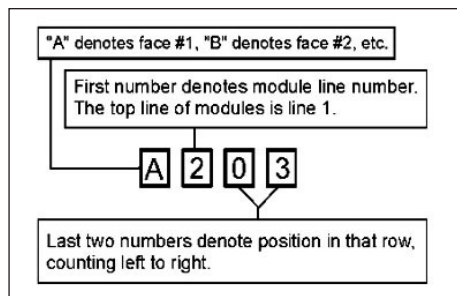
## Operation

The central control software allows the DMS operator to check the status of the signs and to control all messages.

A module is the building block of the Daktronics sign. By placing modules side by side and on top of one another, a sign of any size can be designed and built. Individual modules are easily removed from the sign if required. **Figure 3** illustrates how Daktronics numbers modules on a sign. **Figure 4** breaks down the module numbering method.



**Figure 3:** Example Module Numbering— Front View



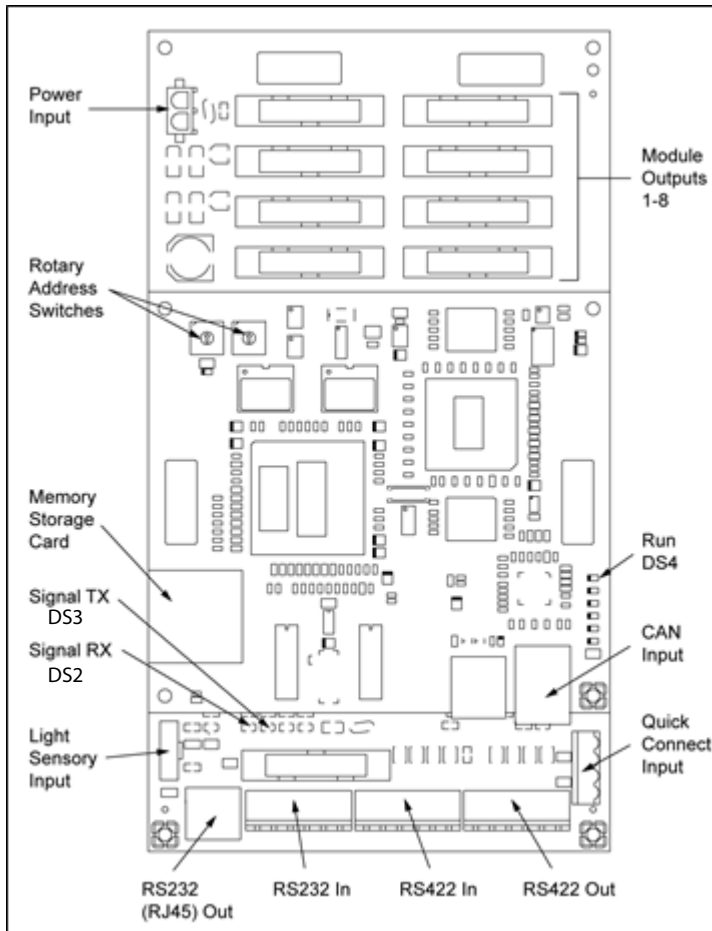
**Figure 4:** Module Numbering

## 2 Component Description and Theory of Operation

### Sign Controller

The sign controller is the component that receives communication from the computer and then sends data to the modules. **Figure 5** illustrates a sign controller.

Red diagnostic LEDs are located at various places on the controller. The following table details some essential LEDs to monitor and the information each LED provides. The LED name and number are noted in **Figure 5**.



**Figure 5:** Controller Component Layout

Figure Label	LED Number	Operation
Run	DS4	Steady FLASH about once per second indicates controller is working properly.
Send signal (Signal TX)	DS3	OFF is the normal state. FLASH when transmitting communication to the computer.
Receive signal (Signal RX)	DS2	OFF is the normal state. FLASH when receiving communication from the computer.

## LED Modules

The LED modules consist of a display panel and clusters of LEDs. Each module contains 64 clusters of LEDs, and each cluster is referred to as a pixel. The pixels create the digits seen on the sign. The module receives data packets from the sign controller and then turns on and off and sets the dimming level of the module's pixels appropriately.

## LED Diagnostics

A pixel test can be performed to test each pixel in the sign for proper operation. The Pixel Test in the Vanguard® Central Controller software performs the check and monitors the results. Refer to **Vanguard® Software Help File [F1]**.

## Power Supplies

The power supply mounts to the cabinet truss behind module A102. The power supply provides the necessary voltage to the LED modules and sign controller.

## Cooling

An exhaust fan and filtered air intake vent are mounted on the back of the sign for cooling during warm weather. The fan turns on during warm weather to circulate the air behind the LED modules. A thermostat inside the sign controls the fan.

## Light Sensors

The light sensor consists of one (1) photocell at one location. The sensed lighting conditions are converted to signals that transmit to the sign controller through the CAN lines. The sign controller then adjusts the LED brightness levels appropriately.

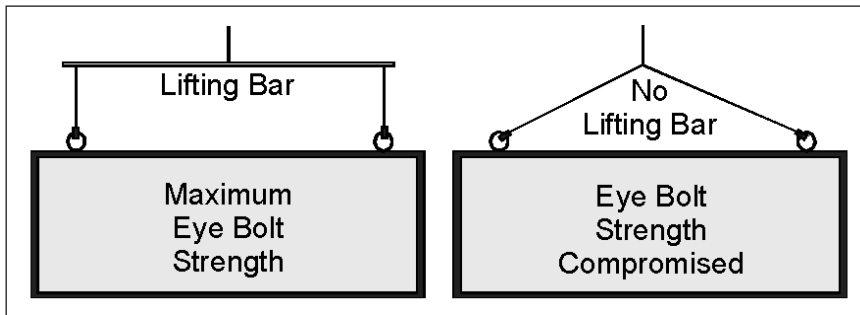


## 3 Mechanical Installation

### Lifting the Sign

The top of the sign is equipped with eyebolts used to lift the unit. Take care to ensure the rated load of the eyebolts is not exceeded.

**Figure 6** illustrates possible lifting methods for the sign. The recommended lifting method is shown on the left, with the lifting bar. If lifting the sign without the lifting bar (as shown on the right) make sure to maintain at least a 45° lifting angle.



**Figure 6:** Lifting the Sign

Use every lifting point provided. Do not attempt to permanently support the sign by the eyebolts.

### Mounting Methods

Securely mount each sign to a suitable mounting structure, provided by others. Have each mounting structure inspected by a qualified structural engineer.

Daktronics is not responsible for the structural integrity of support structures and mounting methods provided by others. Use mounting hardware appropriate to support the weight of the sign.

Once the sign is installed:

1. Inspect the top and sides of the sign for any holes that may allow moisture to enter the sign.
2. Plug and seal any openings that may allow water to enter the sign with silicone or another waterproof sealant.

## 4 Electrical Installation

### Getting Started

Daktronics recommends that a separate circuit be run to the electronic display(s) to isolate it and prevent any issues that could be caused by line voltage fluctuations or high frequency noise on the power line caused by other types of equipment. A separate circuit also makes display maintenance and troubleshooting easier. Daktronics assumes no liability for any issues caused by line voltage fluctuations or other improper power conditions if these recommendations are not followed.

Only qualified individuals should terminate power and signal cable within this Daktronics display.

The Daktronics engineering staff must approve any changes made to the display. Before altering the display, submit detailed drawings for the proposed modifications to the Daktronics engineering staff for evaluation and approval, or the warranty will be void.

### Conduit

Daktronics does not include conduit. Possible power and signal entrances are designated on the shop drawing. Separate conduit must be used to route the following:

- Power
- Signal

To prepare for power and signal entrance:

1. Remove the bottom three modules, using a  $\frac{1}{8}$ " hex head wrench. Refer to **Accessing the Internal Components (p.9)** for module removal steps.
2. Clear the area for drilling. Choose area free of wired components.
3. Make a separate pilot hole in the back or side of the enclosure for power and signal.

**Note:** Before drilling, be aware of the location of internal components.

Ensure none of the internal components are damaged. Attach the conduit and route power and signal cables. Use watertight connections where the conduit enters the display cabinet.

### Grounding

All components of a display system—including but not limited to displays, control equipment, and connected peripheral equipment—must be electrically grounded. Only qualified individuals may perform electrical work, including verification of ground resistance. Daktronics is not responsible for improper grounding or damage incurred as a result of improper grounding.

Grounding methods must meet the provisions of all applicable local and national codes. Inspect and verify all grounding methods meet the provisions of all applicable local and national codes.

Proper grounding is necessary for reliable equipment operation and general electrical safety. Failure to properly ground the display system may void the warranty, disrupt operation, damage equipment, and cause bodily harm or death.

## Power Installation

Connect a 15 Amp, 120 VAC, two-wire plus earth ground power source to the terminal blocks within the sign. Terminate the Line and Neutral wires to the terminal block; terminate Ground to the provided ground bar.

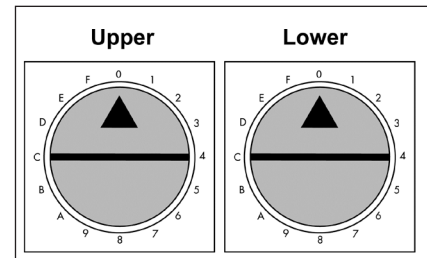
## Sign Communication

If a point-to-point communication system is used for all the signs in the system (for example, a laptop computer connected directly to the sign controller), set the sign address to the same number in each sign, preferably address 1.

If a multi-drop network is used for communication with multiple signs in the system (for example, a fiber-optic drop and repeat network), the sign address must be set to a unique address for each sign.

The rotary switches set the hardware address that the software uses to identify the particular display. When replacing a controller board, set the rotary switches on the new controller to the same address as the replaced controller. Each controller in a network needs a unique address. Refer to **Figure 7**.

To set the rotary address switches, rotate them counter-clockwise until the arrow points to the desired number. The display's power must be turned off and then turned back on to activate the test mode or to change an address.



**Figure 7:** Rotary Address Switch

**Note:** Setting both rotary switches to address 0 activates Test Mode. Turn the display's power off and back on to activate testing.

## Default Speeds

The VSLs has default speeds loaded onto the sign controller. Both changeable and permanent messages are loaded with speeds ranging from 5 to 180, in increments of five. To display these default messages, refer to the **Vanguard® Software Help File [F1]**.

## Conduit Sealing

Fill the ends of the conduit entering the signs with duct seal.

## First Time Turn On

After the sign and all other VSLs site equipment are installed, the site must be tested according to the field test procedure for the sign site. This ensures all equipment is installed properly and is operational. If a field test procedure is not available, call Daktronics Transportation Customer Service to obtain a copy.

## 5 Maintenance and Troubleshooting

### Getting Started

- Disconnect power before performing any repair or maintenance work on the signs.
- Only qualified service personnel should access internal sign electronics.
- Daktronics engineering staff must approve any changes made to the signs. If making modifications to the signs, submit detailed drawings to the Daktronics engineering staff for evaluation and approval or the warranty will be void.

### Service and Diagnostics

The following sections address servicing of the following sign components:

- Modules
- Sign controller
- +9 V power supplies
- Ventilation fans and filters
- Beacons
- Thermostat
- Photo sensor

The tools required to service the sign include:

- Small Phillips screwdriver
- Small flat screwdriver
- $\frac{1}{8}$ " hex head wrench
- Medium Phillips screwdriver
- Medium flat screwdriver
- Nutdriver set

### Sign Controller Replacement

Complete the following steps to replace a controller in the display. Required tools include a  $\frac{1}{8}$ " hex wrench and a  $\frac{5}{16}$ " nut driver.

1. Turn off power to the display.
2. Remove the module directly in front of the controller. Refer to **Figure 2** for the exact location.
3. Disconnect the power plug from J5.
4. Remove all power and signal connections from the board. Label the cables as they are removed to ensure proper replacement.
5. Remove the six nuts holding the board in place using a  $\frac{5}{16}$ " nut driver.

6. Take note of the rotary address on the sign controller and ensure the address on the replacement board is the same. Refer to **Figure 7**.
7. To install the new controller, replace the six nuts holding it to the display back. Reconnect power and signal cables. Turn on power, observing the boot-up sequence, and then note that the LED in the lower-right corner shows power.

## Accessing the Internal Components

Remove the appropriate module to access the interior sign components, referring to **Figure 2**. Latches at the bottom and/or top of each module secure it to the sign cabinet.

To remove a module:

1. Using a  $\frac{1}{8}$ " hex head wrench, loosen the two latches securing the module.
2. Carefully remove the module from the sign. The interior sign components are now accessible.

## Replacing a Module

Remove the desired module for service; refer to **Accessing the Internal Components (p.9)**. If a module requires replacement:

1. Disconnect power to the sign.
2. Remove the module to service, referring to **Accessing the Internal Components (p.9)**.
3. Press the locking tabs of the white 4-pin power connector to release it. Release the ribbon cable for signal.
4. Remove the signal connector from the back of the module

To install the new or repaired module:

1. Plug the 4-pin power connector into the back of the module.

**Note:** This is a "keyed" connector; it only fits together one way. Do not force the connection.

2. Position the new module and secure it using a  $\frac{1}{8}$ " hex head wrench. Be sure the module is secure.
3. Turn on power to the sign.
4. Test the modules.

## Replacing a Power Supply

To replace or adjust the voltage of the sign's power supply, perform the following steps:

1. Locate the failed power supply. To locate the failed power supply, refer to **Figure 2**.
2. Remove and disconnect the module in front of the power supply.
3. Reconnect the signal cable to the back of the module.
4. Remove the bottom mounting screw from the failed power supply being adjusted or replaced. Then rotate the bottom of the power supply toward you.
5. If replacing a power supply, continue on to **Step 6**; if only adjusting the voltage on the power supply, skip to **Step 8**.

6. Before removing all wires from the power supply, label each wire as to where they attach. After removing the wires, remove the top mounting screw from the failed power supply.
7. Replace the failed power supply with the new power supply by performing these steps in reverse.
8. Locate the voltage adjustment screw.
9. Make sure the voltmeter is set to DC voltage, and then connect the negative (black) meter lead to V- (negative) on the power supply. Connect the positive (red) meter lead to V+ (positive) on the power supply.
10. Using the voltage adjustment screw, set the power supply to 9.5 (+/- 0.01) V DC.
11. If the power supply is set correctly, remove the meter leads from the power supply. Then rotate the power supply back to its original position and replace the bottom mounting screw.

## Ventilation Systems (With Fans and Filters)

Each time a ventilation fan assembly is opened, perform the following:

- Check the fan blades for dirt and debris. Clean the fan blades to maintain the fan's efficiency and to ensure proper cooling. If the fan blades have a large accumulation of dirt and debris, change the filters more often.
- Spin the fan blades with a pen or pencil to ensure the bearings are free and the fan is balanced.
- Push the black button near GFCI outlet to check if the fans activate.

To check the operation of the fans:

- Check the filters every year. Clean the filters with water and a mild detergent, such as dish soap.
- Compressed air can be used to clean the filter provided the nozzle is held at least 6" away from the filter, the pressure is no greater than 60 psi, and the air is blown through the filter opposite the airflow direction as indicated by the arrow stamped on the filter frame.

If the fan does not turn or does not operate smoothly, replace it.

## Replacing a Ventilation Fan

The ventilation fan is mounted behind the LED modules. If a fan fails, follow the instructions below to remove and replace it:

1. Turn off power to the sign.
2. Disconnect the fan's power cord.
3. Remove the hardware securing the fan guard and fan to the fan bracket and remove the fan.
4. Attach the new fan to the bracket and secure it using existing hardware.

**Note:** Take note of the airflow orientation when attaching the new fan. Air should be flowing out of the sign.

5. Reconnect power to the fan and to the sign.
6. Test the fan momentarily to be sure it runs properly.

## Routine/Preventative Maintenance

The service intervals listed in this section are recommendations. These service intervals can be adjusted if necessary due to special considerations. Contact Daktronics Customer Service for recommendations based upon specific conditions.

### Sign Cabinet Inspection

At least once every year:

- Check for evidence of water intrusion in the sign, (i.e., water stain marks).
- Check for any leaks that may have developed. Seal them with a silicone sealant or another suitable sealer.
- Inspect all module gaskets for tears, missing pieces, etc. Replace as necessary.
- Check the drain holes in the bottom of the cabinet to ensure they are unobstructed.

### Sign Controller

At least once every year:

- Ensure all connectors are secure and the cables are not damaged in any way.
- Check the operation of the sign controller.

### Structural Inspection

At least once every year:

- Inspect the mounting structure thoroughly for signs of corrosion, loose bolts, and overall stability.
- Check the connections of the earth-ground wires, if accessible.

### Photo Sensor Assembly Inspection

At least once every year:

- Inspect the light sensor assembly for foreign material that could obstruct airflow around the photo sensors.
- Clear away any foreign material.

### LED Cleaning

If needed, clean the LEDs with a damp cloth or a soft brush. Do not spray cleaner directly onto the LEDs. The frequency the LEDs need cleaning depends on site conditions.

### Ventilation System Inspection

At least once every year check that all the fans run.

To do this, note the setting on the cooling thermostat and then turn it clockwise until the fans turn on. Make sure all fans are running. Press the black button to test the thermostat.

After opening the intake fan assembly, check the fan blades for dirt and debris. If the fan blades have a large accumulation of dirt and debris, change the filters more often. Keep the fan blades clean to maintain fan efficiency and ensure proper cooling. Next, spin the fan blades with a pen or pencil to ensure the bearings are free and the fan is still in balance.

Check and clean filter as necessary.

## Routine/Preventative Maintenance Checklist

Refer to the instructions in each step above. One copy of the following table can be filled out for each sign.

### Sign Location:

Maintenance Item	Monthly Remote Diagnostics	1 yr.	As Needed	Dates Performed and Initials		
Connections are Secure		X				
Sign Enclosure Inspection		X				
Structural Inspection		X				
Photo Sensor Inspection		X				
Face Panel Cleaning			X			
LED Cleaning			X			
Venilation System Inspection		X				
Internal Hardware Tight		X				
LED & Electronic Test	X					

## Troubleshooting of the Variable Speed Limit Sign

Contact your local service representative or Daktronics Customer Service at the number listed on the cover of this manual for further troubleshooting assistance.

Problem Observed	Possible Cause	Solution
No LEDs will light and the sign controller will not communicate with the central controller.	No power.	Check that the sign has power.
	Sign controller or modem is bad.	Refer to <b>Sign Controller Replacement (p.8)</b> .
No LEDs will light, but the central controller is communicating with the sign controller.	No power at the sign.	Check that the circuit breakers and power supply in the traffic cabinet are on and not tripped.
	Sign controller is bad or not connected to the sign.	Refer to <b>Sign Controller Replacement (p.8)</b> .
One module is "dead"—no LEDs will light.	4-pin connector unplugged at module.	Plug in connector.
	Terminal is bad or not fully seated in 4-pin plug at module, or wire is bad.	Inspect all wires and terminals for 4-pin plug. Repair as needed.
One module is garbled, too bright, too dim, erratic, etc.	Terminal is bad or not fully seated in ribbon cable plug at module, or wire is bad.	Inspect all wires and terminals for ribbon cable plug. Repair as needed.



One pixel will not light.	Terminal is bad or not fully seated in plug at module, or wire is bad.	Repair as needed.
	The module is bad.	Replace failed module.
One pixel will not turn off.	The module is bad.	Replace failed module.
Ventilation fan is not running.	Temperature inside the sign is lower than the thermostat setting.	This is not a problem.
	The thermostat or its wiring is bad.	Repair as needed.
	Fan is bad.	Replace fan.
Ventilation fan is running continuously.	Temperature inside the sign exceeds the thermostat setting.	This is not a problem.
	The thermostat is stuck on or the wiring is shorted.	Replace the thermostat or repair wiring.
LED brightness is wrong—entire sign is too bright or too dim.	Light sensor assembly is obstructed.	Clear obstruction.
	One or more wires or terminals in the light/temp control cable are misplaced, open or shorted to other wires or the frame in sign, sign controller, or control cable from sign to sign controller.	Repair as needed.
	Operator error—light sensor is not enabled or levels are set incorrectly.	Correct settings.
	Light sensor PCB is bad.	Replace light sensor.
	Sign controller is bad.	Refer to <b>Sign Controller Replacement (p.8)</b> .

## 6 Replacement Parts and Repair & Exchange Programs

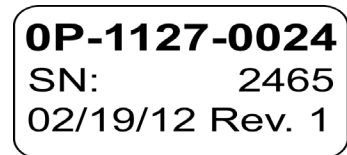
The following labeling formats might be found on various Daktronics drawings:

- “TB\_” denotes a termination block for power or signal cable.
- “F\_” denotes a fuse.
- “J\_” denotes a power or signal jack.
- “P\_” denotes a power or signal plug for the opposite jack.

Daktronics part numbers are commonly found on drawings. Those part numbers can be used when requesting replacement parts from Daktronics Customer Service. Take note of the following part number formats.

- “OP-\_\_\_\_-\_\_\_\_” denotes an individual circuit board.
- “OA-\_\_\_\_-\_\_\_\_” denotes an assembly. An assembly can be a single circuit board or a collection of components that function together, usually mounted on a single plate or in a single enclosure.

Most circuit boards and components within this sign carry a label that lists the part number of the unit. If a circuit board or assembly is not listed in the replacement parts list, use the label to order a replacement. A typical label is shown in **Figure 8**. The part number is in bold.



*Figure 8: Typical Label*

### Daktronics Exchange and Repair and Return Programs

To serve customers' repair and maintenance needs, Daktronics offers both an Exchange Program and a Repair & Return Program.

#### Exchange Program

Daktronics unique Exchange Program is a quick service for replacing key parts in need of repair. If a part requires repair or replacement, Daktronics sends the customer a replacement, and the customer sends the defective part to Daktronics. This decreases display downtime.

#### Before Contacting Daktronics

Identify these important part numbers:

Display Serial Number:

Display Model Number:

Contract Number:

Date Installed:

Location of Sign (Mile Marker Number):

Daktronics Customer ID Number:

To participate in the Exchange Program, follow these steps.

**1. Call Daktronics Customer Service:**

Market Description	Customer Service Number
Department of Transportation, mass transits, airports, parking facilities	800-833-3157

**2. When the new exchange part is received, mail the old part to Daktronics.**

If the replacement part fixes the problem, send in the problem part which is being replaced.

- a. Package the old part in the same shipping materials in which the replacement part arrived.
- b. Fill out and attach the enclosed UPS shipping document.
- c. Ship the part to Daktronics.

**3. A charge will be made for the replacement part immediately, unless a qualifying service agreement is in place.** In most circumstances, the replacement part will be invoiced at the time it is shipped.

**4. If the replacement part does not solve the problem, return the part within 30 working days or the full purchase price will be charged.**

If, after the exchange is made the equipment is still defective, please contact Customer Service immediately. Daktronics expects immediate return of an exchange part if it does not solve the problem. The company also reserves the right to refuse parts that have been damaged due to acts of nature or causes other than normal wear and tear.

## Repair & Return Program

For items not subject to exchange, Daktronics offers a Repair & Return Program. To send a part for repair, follow these steps:

**1. Call or fax Daktronics Customer Service:**

Refer to the appropriate market number in the chart listed on the previous page.  
Fax: 605-692-0145

**2. Receive a case number before shipping.**

To receive a case number, contact a services coordinator via phone, email, or by creating a [MySupport](#) account on the Daktronics website. This expedites repair of the part.

**3. Package and pad the item carefully to prevent damage during shipment.**

Electronic components, such as printed circuit boards, should be placed in an antistatic bag before boxing. Daktronics does not recommend using packing peanuts when shipping.

**4. Enclose:**

- your name
- address
- phone number
- the case number
- a clear description of symptoms

## **Shipping Address**

Daktronics Customer Service

Case # \_\_\_\_\_

331 32nd Ave

Brookings, SD 57006

## **E-mail**

transportationhelp@daktronics.com

# Glossary

**Central Control Software:** A software system that can control signs remotely. This software contains a message studio, schedule studio, a sign manager, and other tools that configure signs and networks for an Intelligent Transportation System.

**Column:** Vertical line of pixels.

**Light Emitting Diode (LED):** Low-energy, high-intensity lighting units. LED signs present high resolution for distinct text. Multiple, closely-spaced LEDs form a pixel on the VMS display.

**Line:** Horizontal row of modules.

**Matrix:** Visible display area on a sign, measured in rows and columns of pixels.

**Module:** Contains an array of LED pixels. Modules are placed next to each other to form the matrix of the display. The module has power input, signal input, and signal output connectors.

**PCB:** Printed Circuit Board.

**Pixel:** Group of LEDs that turn on and off as a single unit. Multiple pixels are evenly spaced throughout the face of the sign and are turned on or off to form the characters and graphics that make up the content of the displayed message.

**Power Supply:** A component that converts incoming alternating current (AC) power to direct current (DC) power, required by several components within the sign.

**Row:** Horizontal line of pixels.

**Serial Port:** Connector on the back of the control computer. The serial port controls the sign network through either a 9- or a 25-pin serial connector.

**Sign Address:** An identification number assigned to each sign of a network, set by rotary switches on the sign controller. The control software uses the addresses to locate and communicate with each sign. Signs on the same network cannot have the same address.

**Sign Controller:** The component receiving communication from the central control software and sending that data to the display modules.

**Vanguard®:** Daktronics-trademarked name for variable message signs and the software that operates them.

**VSLs:** Variable Speed Limit Sign.