

RS-422 Communication Manual

Installation, Maintenance
& Troubleshooting

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DAKTRONICS, INC.

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Introduction

The typical system consists of a Windows based personal computer running Venus 1500 software and one or more displays. In addition, some means of signal connection must be used to relay signal between the computer and the display. Six network types are available: RS-232, RS-422, Modem, Fiber Optic, Radio, and Ethernet. Up to 240 displays can exist on one network.

The purpose of this manual is to explain those items that are unique to an RS-422 communication system, including the installation and possible servicing requirements. In addition, the manual will discuss the possible ways of connecting signal between displays for multiple display systems.

Network Concepts

System/Cable Requirements

RS-422 (EIA/TIA-422-B) is a standard communication interface that utilizes a differential balanced transmission scheme. The main advantage of RS422 is the longer cable length that is possible. A signal converter is needed to convert the computer's RS-232 to RS-422.

The cable required for an RS-422 signal is a 4-conductor shielded cable (Daktronics part number W-1234, Manhattan number M4473). This shielded cable consists of paired wires. They should not be subjected to mechanical flexing after installation. This cable is not for direct burial and should have one of the following routings:

- In dedicated, metallic conduit
- Inside buildings – if cable is not in conduit, keep away from interference signals.

With interference signals, such as power conductors, intercom, etc., typically a two-foot separation is required. The maximum length of an RS-422 signal cable is 4,000 feet (approximately 1.22km) from the signal converter to the signal termination enclosure at the display.

Component Identification

RS-232: RS-232 is a standard PC communication type with a maximum cable length of 25 feet (approximately 7.6 meters). The signal output of a computer is RS-232, and when used with an RS-422 system a signal converter is required.

RS-422: RS-422 is a standard differential communication type with a maximum cable length of 4000 feet (approximately 1.2 kilometers).

Serial Port: An actual serial port is required for direct connections from the computer to the signal converter.

Note: Certain USB adapters create an “actual” serial port and others create “virtual” ports. The Venus 1500 software will not recognize a virtual port. Therefore, the use of a USB adaptor is not supported by Daktronics.

Signal Converter: The signal converter, shown in **Figure 1**, is a Daktronics supplied unit that converts the data from RS-232 to RS-422 signal. The signal converter is connected to the control PC via straight through serial cable.

Venus 1500: Daktronics designed, Windows® based software used to create and edit messages on the display. Refer to the Venus 1500 Software manual, **ED-13530**, for software operation.

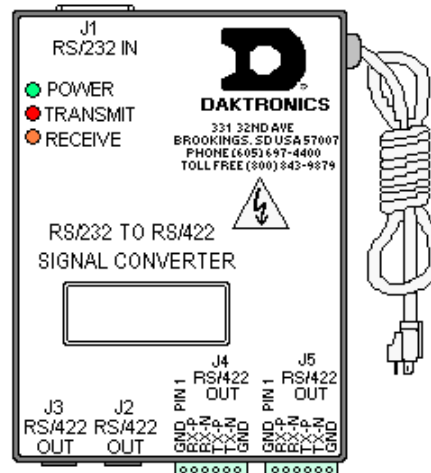


Figure 1: RS-232 to RS-422 Signal Converter

Installation

Reference Drawings:

System Riser Diagram, Comm. Box, RS422, QC **Drawing A-211754**



Servicing to be done by qualified service personnel only.

Important Notes:

- Only components listed and explained in this manual may be replaced.
DO NOT REPLACE ANY INTERNAL FUSES.
- The power cord serves as the disconnect device; the socket outlet must be installed near the equipment and must be easily accessible.
- Never install telephone wiring during a lightning storm.
- Avoid using a telephone (other than cordless type) during an electrical storm. There may be a remote risk of electrical shock from lightning.
- To reduce the risk of fire, use only 26 AWG or larger telecommunication line cord.
- Never touch uninsulated telephone wires or terminals unless telephone line has been disconnected at the network interface.
- This product is to be used with UL and c-UL computers.

An RS-422 controlled display requires the following connections:

1. The control computer connects to the signal converter (0A-1127-0255) through a DB9 to DB25 serial cable (W-1249).
2. From the signal converter, cable is run to the surge suppressor assembly in a weather resistant enclosure at the display, as shown in **Figure 2**. (In certain cases the display may have been ordered with the surge board mounted in the display. In those cases, the terminations will be the same.)
3. The cable from the signal converter to the display, must be routed through conduit. **Do not** run signal and display power through the same conduit. Refer to **Drawing A-211754** for system layout.

Note: The cable from the signal termination enclosure to the display can be routed through conduit, through the display pole or should be secured to protect it from weather or vandalism.

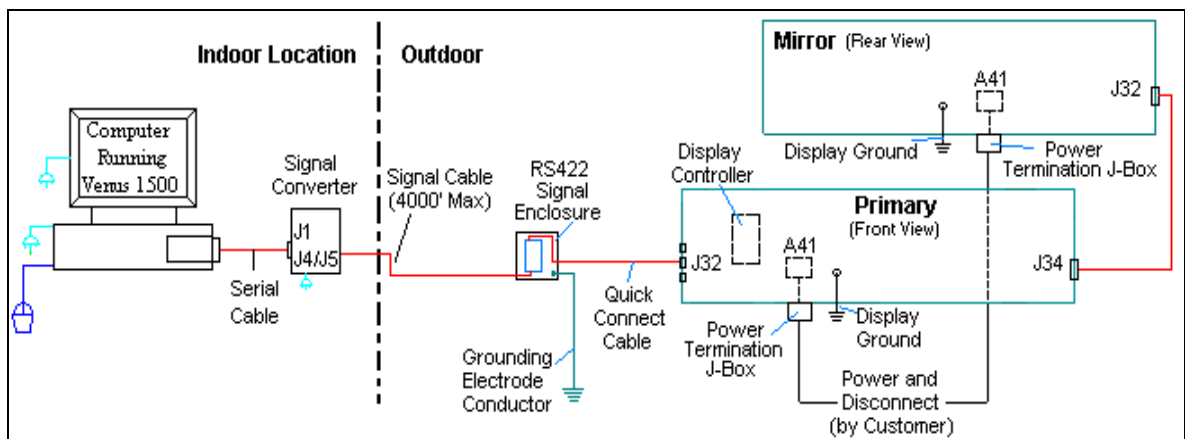


Figure 2: RS-422 Display Layout

Complete the following steps to mount the signal termination enclosure:

1. Mount the signal termination enclosure within 30 feet of the display.
2. Route signal from the signal converter to the watertight enclosure at the base of the display.
3. Connect the 4-conductor shielded cable to either J4 or J5 on the signal converter and to TB1 on the surge suppressor (0P-1146-0031) in the enclosure as shown in **Figure 3** and the provided table. The cable is pinned one-to-one.
4. Connect the quick connect cable from the signal termination enclosure to the primary display. Connect the cable to the green jack, J32, middle, labeled RS 422/ETHERNET IN.
5. Ground the RS422 signal termination enclosure with the provided grounding cable.

6. **For displays with an internal surge board only:** Route cable through conduit into the back of the display, being careful not to damage any interior components. Make the connections to the surge board as normal.

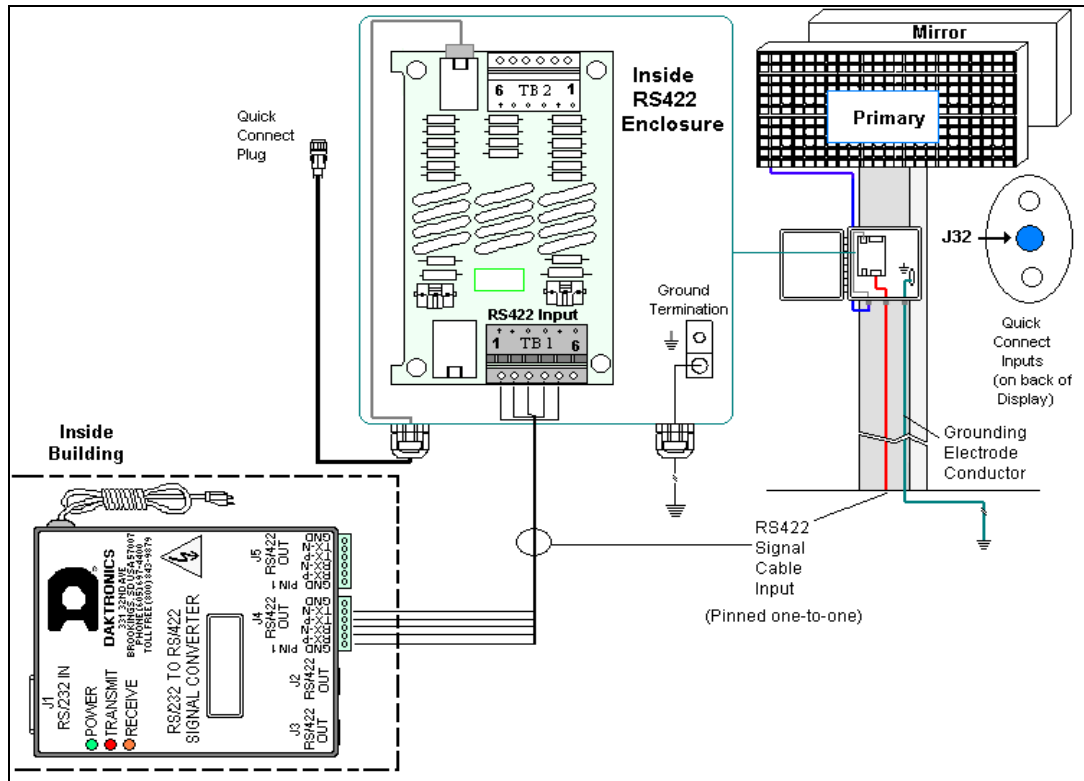


Figure 3: Signal Converter to Surge Board Assembly Enclosure

Signal Converter to Surge Board Assembly		
Signal Converter (J4/J5)	Field Cabling	Surge Board Assembly TB1 (RS422 IN)
Pin 1 (GND)	Shield	Pin 1 (NC)
Pin 2 (RX-P)	Red	Pin 2 (TX-P)
Pin 3 (RX-N)	Black	Pin 3 (TX-N)
Pin 4 (TX-P)	Green	Pin 4 (RX-P)
Pin 5 (TX-N)	White	Pin 5 (RX-N)
Pin 6 (GND)		Pin 6 (NC)

Complete the following steps to mount the signal converter:

1. Mount the signal converter at an interior location.
2. Mount the signal converter within close proximity to a standard 120 VAC grounded electrical outlet.
3. Use #10 round head wood screws to mount the device on a wall stud (if possible).
4. If a wall stud cannot be used for mounting, use wall anchors that are appropriate for the wall material.
5. Use the keyhole slots on the rear of the signal converter to mount the device.

Signal Termination Between Displays

Reference Drawings:

Controller II, Galaxy, 8-conn, J1087.....**Drawing B-204771**

Primary - Mirror

Most displays are shipped as either a single Primary display or two displays in a 2V, Primary – Mirror configuration.

The Primary - Mirror (2V) quick connect cable (W-1503) is used to terminate signal between two displays. The six-foot cable goes from the Signal OUT (J34) on the primary display to Signal IN (J32) on the mirror display as shown below.

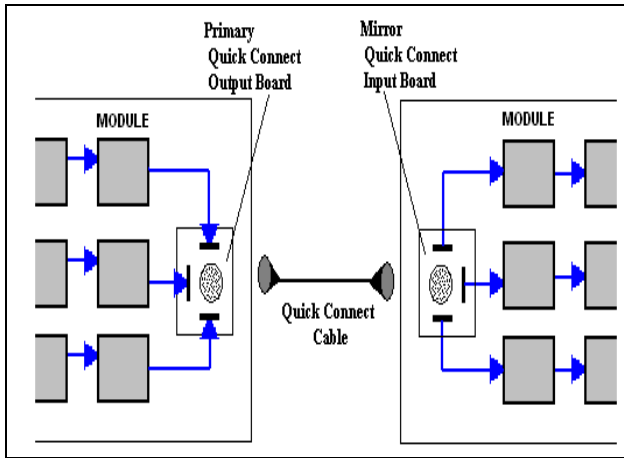


Figure 4: Quick-connect Cable



Figure 5: Display Interconnection

Primary – Primary

If this location requires two displays that cannot be mounted back-to-back, two primary displays will need to be installed. In that case the following connections will need to be made:

1. Open the display, as explained in **Section 4.4** of the display manual, and locate the controller panel for these displays.
2. Route the cable through conduit from the back of the first primary display to the back of the second primary display. Use one of the knockouts for access, being careful not to damage any internal components
3. Use either a 4-pair signal cable or two 4-conductor, shielded cables to connect both the signal and the temperature sensor information between displays.
4. The signal cable will connect from TB3 out on the first primary display to either:
 - a. A surge board at TB1 in a second primary display
 - b. (or) To TB2 on the controller in the second primary display.
 - c. **Note:** In either case the connections are flipped. See the table below and **Drawing B-204771** for connections on both displays.
 - d. In **Figure 6**, the signal connections between two controllers are shown.
 - e. See the instructions for the Optional Temperature Sensor in the appendix of the display manual for connections that need to be made for the temperature sensor termination.

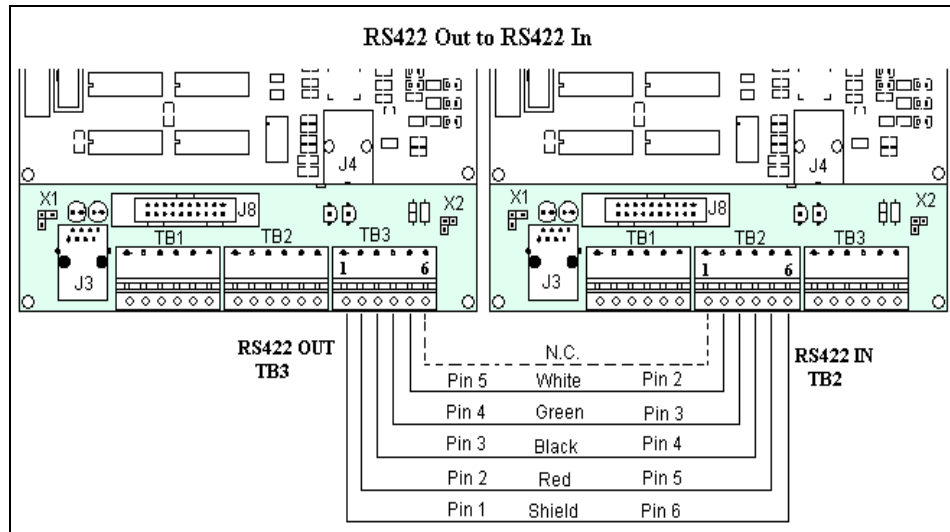


Figure 6: Interconnection from Primary to Primary

Primary-to-Primary Interconnection

Primary RS422 OUT (TB3)	Field Cabling	Primary RS422 IN (TB2)
Pin 1 (GND)	Shield	Pin 6 (GND)
Pin 2 (D2OUT-N)	Red	Pin 5 (D1IN-N)
Pin 3 (D2OUT-P)	Black	Pin 4 (D1IN-P)
Pin 4 (D2IN-N)	Green	Pin 3 (D1OUT-N)
Pin 5 (D2IN-P)	White	Pin 2 (D1OUT-P)
Pin 6 (Shield)		Pin 1 (Shield)

Replacement of the Surge Board

The surge suppressor is an inline device that is used to filter the RS-422 data line. It suppresses surges down to a low voltage in order to protect the display controller's RS-422 input.

The surge suppressor included with the display, is located inside the RS422 signal termination enclosure mounted at the display. (In certain cases the display may have been ordered with the surge board mounted in the display. The following directions are also true for those installations.)

1. To replace the surge suppressor (0P-1146-0031), first disconnect the signal connections (refer to **Figure 7**).

Note: Carefully remove the terminal block from TB1. **Do not** remove the individual wires.

2. The surge suppressor is held in place with four nuts. Carefully remove them using a 5/16" nut driver.

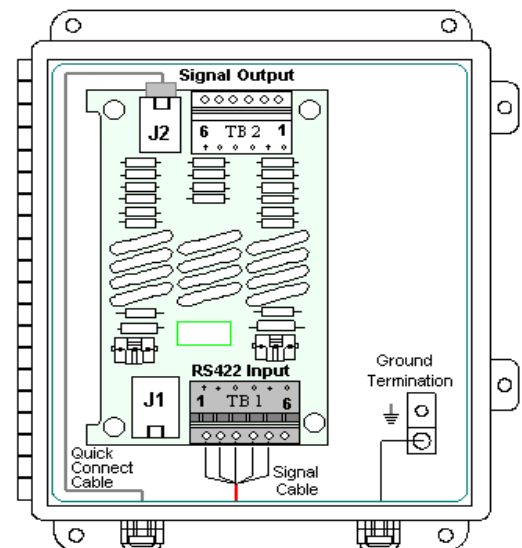


Figure 7: RS-422 Surge Suppressor

3. Install the new surge suppressor, replace the nuts, and reconnect signal cables.

The surge suppressor must be firmly connected to the enclosure, and the enclosure must be properly grounded in order to be effective. The mounting hardware used to secure the surge suppressor is sufficient grounding if it is properly fastened.

Alternate Location Installation

Reference Drawings:

Schem; Primary Signal, Internal, with QC **Drawing B-206146**

Note: If the display was originally ordered with the surge board internally installed, these connections have already been completed.

If necessary, the surge suppressor assembly can be moved from the signal termination enclosure and located in the display. The surge suppressor will then be mounted on standoffs either next to the controller board or in the left end of the display. The following connections will need to be made for the surge suppressor to operate in the display:

1. Route the signal cable through conduit to the back of the display. Use one of the knockouts for access, being careful not to damage any internal components.
2. Connect from the signal converter to the surge suppressor as previously described for the RS-422 installation.
3. Connect the 4-conductor shielded signal cable (Daktronics part number W-1234) to the surge suppressor at TB1.
4. Signal connects from TB2 on the surge suppressor to TB2 on the controller using a 4-conductor shielded cable. Signal is pinned one to one. See table below.
5. See **Figure 8** below and **Drawing B-206146** for signal connections in the display.

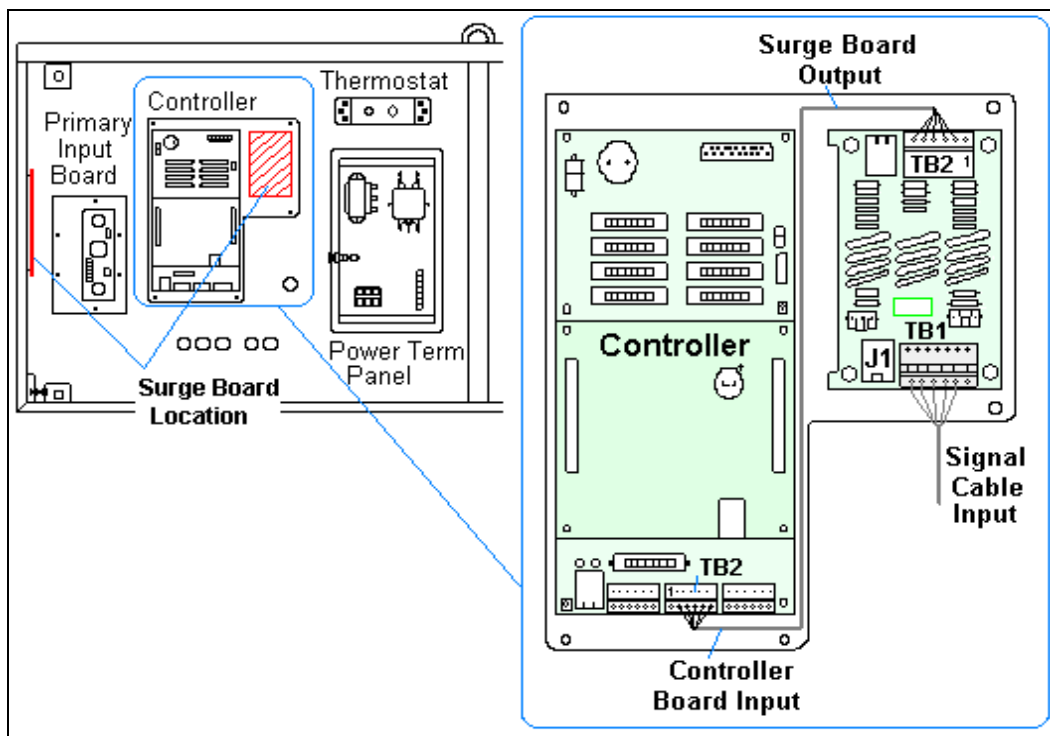


Figure 8: Relocating the Surge Board in Display

Surge Board Assembly to Controller		
Surge Board TB2 (RS422 Out)	Field Cabling	Controller TB2 (RS422 In)
Pin 1 (GND)		Pin 1 (GND)
Pin 2 (RX-P)	Red	Pin 2 (OUT-P)
Pin 3 (RX-N)	Black	Pin 3 (OUT-N)
Pin 4 (TX-P)	Green	Pin 4 (IN-P)
Pin 5 (TX-N)	White	Pin 5 (IN-N)
Pin 6 (GND)	Shield	Pin 6 (GND)

Troubleshooting

Signal Converter

The following table gives the typical state of the signal converter when the LEDs are either on or off. Refer to **Figure 9** on next page for an illustration of the signal converter and the locations of the various components.

LED Indicators	Typical States		Troubleshooting
Power	ON	Signal Converter (SC) is receiving Power	
	OFF	SC is not receiving power Internal 1 AMP fuse is bad	Replace SC
TX	On Steady	SC is not connected to a serial port	Connect to open computer COM port
		1. Serial port or serial cable is bad 2. Computer COM port in sleep mode	1. Try another port or replace serial cable 2. Communicate to display mode
	OFF Steady	Normal state, SC is not transmitting data	
	Brief Flicker	SC is transmitting data	
RX	ON Steady	1. Field Cabling between SC and display is bad 2. Connected to display output jack or terminated incorrectly 3. Bad COM port on display controller	1. Eliminate cabling by disconnecting wire/cable from SC to display controller 2. Check connections and terminations 3. Eliminate by disconnecting wire/cable to display controller
	OFF Steady	Normal state, SC is not receiving data	
	Brief Flicker	SC is receiving data	
TX/RX	ON Steady	(If serial cable is connected) Bad SC	Replace SC

Signal Converter (0A-1127-0255)

The following tables list the jack pin-outs for a wire signal converter:

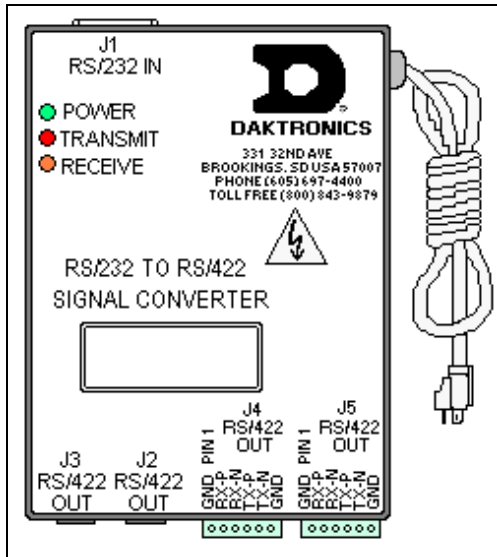


Figure 9: RS-232/RS-422 Signal Converter

J1 – 25 Pin DB-F	
PIN	OPERATION
2	TX-P (out)
3	RX-P (in)
7	GND

J2 and J3 – RJ/45	
PIN	OPERATION
1	GND
2	TX-N (out)
3	TX-P (out)
4	RX-N (in)
5	RX-P (in)
6	GND

J4 and J5 – Phoenix	
PIN	OPERATION
1	GND
2	RX-P (in)
3	RX-N (in)
4	TX-P (out)
5	TX-N (out)
6	GND

RS-422 Loop-Back Test (Outdoor Displays)

Note: This test should be performed with only one jack at a time. Do not connect a loop-back to more than one jack at a time.

Serial Cable (W-1249)

To complete the test, the serial cable must be plugged into the signal converter. This table lists the pin connections when using a serial cable (Daktronics part# W-1249) below.

DB9-F	DB25-F
Pin 3 – TX	Pin 2 – TX
Pin 2 – RX	Pin 3 – RX
Pin 5 – GND	Pin 7 - GND

Loop-Back Test: To perform a loop-back, for testing purposes only, use the spare plug in the signal converter and connect the following using copper conductor jumpers. Refer to **Figure 10** on the right. (To eliminate the display, pull out the phoenix plug with the signal wires connected into it.)

J2 and J3	OR	J4 and J5
(Pin 5) TX-N to (Pin 3) RX-N		(Pin 2) RX-P to (Pin 4) TX-P
(Pin 4) TX-P to (Pin 2) RX-P		(Pin 3) RX-N to (Pin 5) TX-N

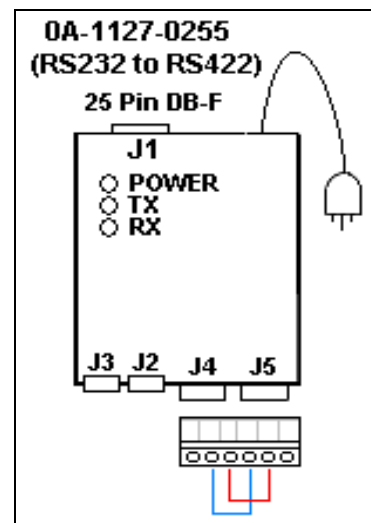


Figure 10: Jumpers at RS-232/RS-422 Signal Converter

When the wires are connected, perform the loop-back test using the Venus 1500 software as described in **Conducting the Venus 1500 Software Test**

This test can also be done at the signal termination enclosure on the surge board assembly, as shown in **Figure 11** at left, or at the controller board input. In either case, the wires coming from the signal converter must remain connected, and the jumpers will be inserted along with them. (**Leave the plug disconnected from the surge board when conducting the test.**)

TB1 - RS422 In	
(Pin 4) RX-P to	(Pin 2) TX-P
(Pin 5) RX-N to	(Pin 3) TX-N

When the wires are connected, perform the loop-back test using the Venus 1500 software as described in **Conducting the Venus 1500 Software Test**

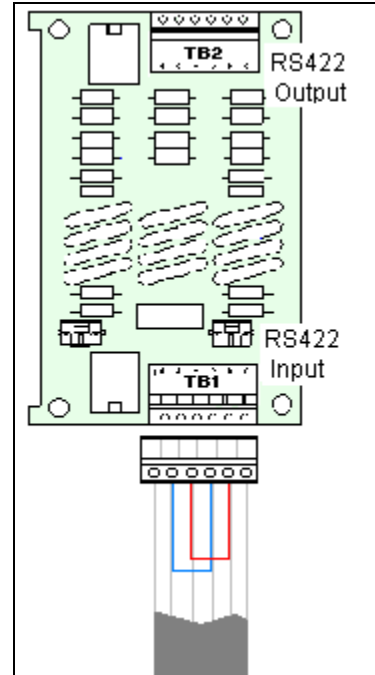
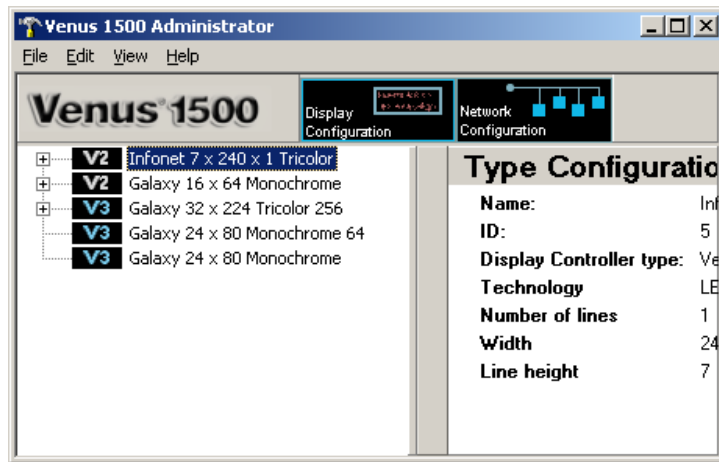


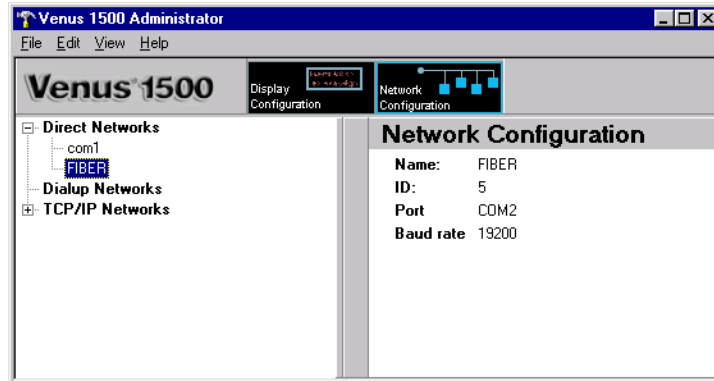
Figure 11: Jumpers at Surge Board

Conducting the Venus 1500 Software Test

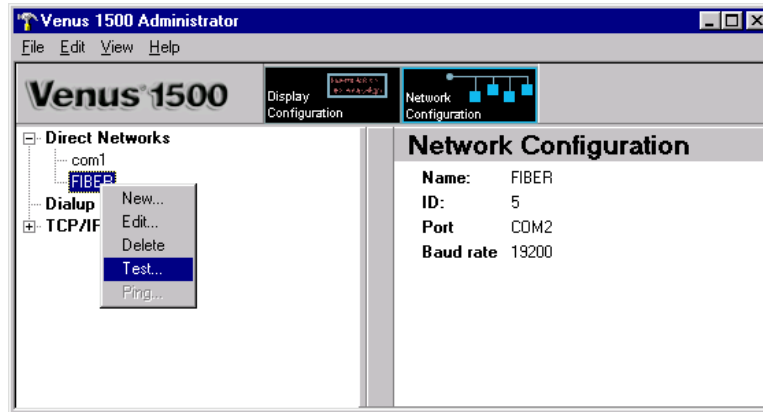
1. Open Venus 1500 Administrator.



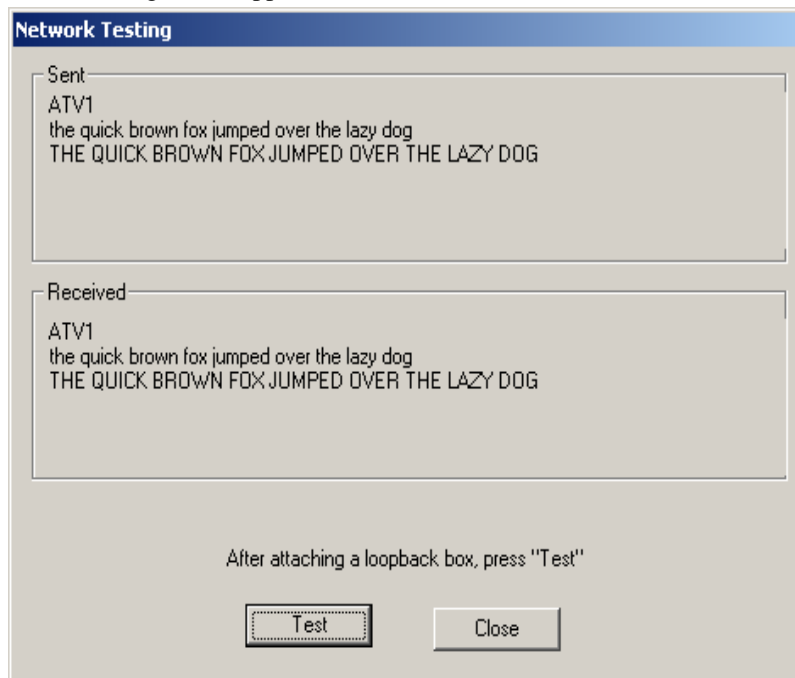
- Click on Network Configuration and open the direct network by clicking on the [+] in front of Direct Network.



- Right-click on the network to be tested and select **Test** from the menu.



- The following screen appears. Click [Test].



5. If the Transmit LED on the signal converter flickers, the signal is getting to the signal converter. That means that the correct Com port is being used. However, if it does not flicker, either a software or hardware problem has occurred with the computer.
6. If the same message appears in the *Received* box as in the *Sent* box, the loop-back test was successful, implying that the cable is good to that point.
7. If *No Response* appears in the *Received* box, the test failed due to one of the following problems:
 - a. An incorrect computer COM port is being used or the USB port is not configured as a “serial” port. (If the Transmit LED flickered, this was not the problem.)
 - b. Communication problem: The wire or the terminations are bad.
 - c. A problem occurred while conducting the test:
 - The serial cable to the signal converter is bad or not plugged in.
 - The signal converter is not plugged in.
8. If the message says *It appears as if this port has a modem attached*, the modem will need to be moved or a different COM port should be used.

After the test is complete:

1. Remove the wire jumpers and make sure terminations are correct.
2. Run the test again, without the jumpers, and the test should fail.
3. Use Venus 1500 Display Manager to get status to ensure communication now works correctly.

Replacement Parts List

The following table contains some of the items that may need to be replaced over a period of time. Many of the parts have their part numbers on labels affixed to them.

To prevent theft, Daktronics recommends purchasing a lockable cabinet to store manuals and replacement/spare parts.

Part Description	Part Number
Signal Converter RS-232/RS-422	0A-1127-0255
RS-422 Signal Termination Enclosure (Comm. Box)	0A-1229-0105
Surge Suppressor, RS422	0P-1146-0031
RS-422, 6 pos RJ11 to 10 pos QC, 30 ft.	W-1504
Serial Cable, DB9-F to DB25-M, 6 ft.	W-1249
Two pair, 22 AWG, stranded, shielded cable	W-1234
Interconnect Cable; 31-pin male to 31-pin male, 6', QC	W-1503
Quick Connect Interface, Input, w/Ethernet	0P-1229-2004
31-pin, Quick Connect Input/Output Board	0P-1229-2005

Appendix A: Reference Drawings

Controller II, Galaxy, 8-conn, J1087	Drawing B-204771
Schem; Primary Signal, Internal, with QC	Drawing B-206146
System Riser Diagram, Comm. Box, RS422, QC	Drawing A-211754