



Wireless External Data Interface (WEDI-4)

P/N: ASM1024-600

USER MANUAL

Revision 1.0

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Introduction

The SVC 4 channel Wireless External Data Interface (WEDI-4) is a companion product to the Spectra Vista i-Series of spectroradiometers. The WEDI-4 provides a platform to wirelessly inject data from the built-in Li-Cor PAR sensor, as well as data from external sensors, into the scan data acquired by the spectroradiometer.



Figure 1 WEDI-4 Top View Showing Built-In PAR Sensor



Figure 2 WEDI-4 Side View Showing External Sensor Inputs – Pyranometer (SPN-1), and Thermistor (T)

The WEDI-4 provides a cost effective method to monitor and record data from sensors, while acquiring high-quality spectral data with the SVC i-Series spectroradiometers. The i-Series

spectroradiometers incorporate a second Bluetooth radio, which can receive data from sensors connected to the WEDI-4.

The external sensors and WEDI-4 can be placed near the area of interest as the spectroradiometer is moved from target to target. By using just the PAR Sensor (supplied with the WEDI-4) the instrument operator can be alerted to changes in downwelling irradiance and take action to avoid collecting erroneous data. The i-Series instruments record the external sensor data for each measurement.

The i-Series spectroradiometer operator is immediately aware of changes to downwelling sensor signal, and can take the appropriate action.

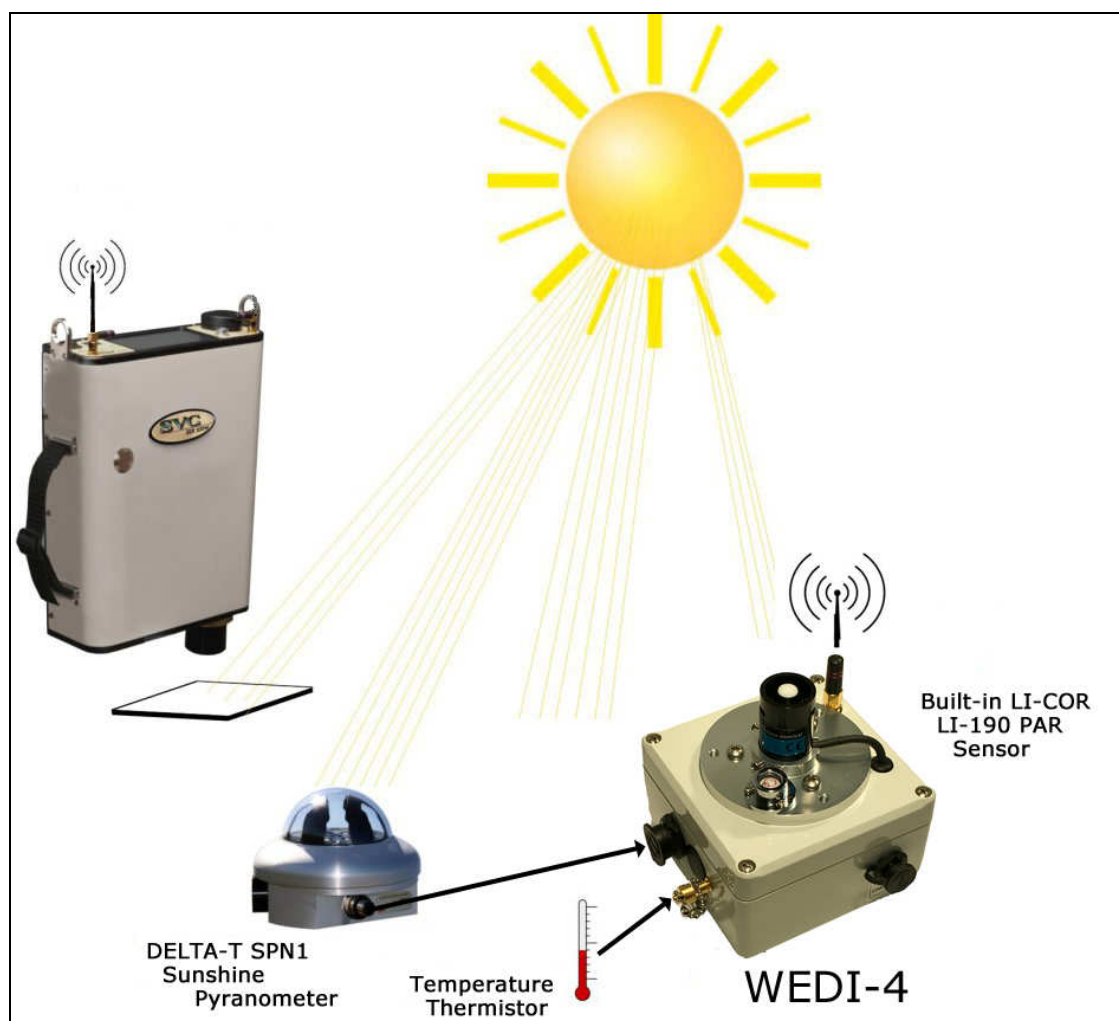


Figure 3 Using The WEDI-4 In The Field With Various Sensors

Note that the antenna located on the upper right side of i-Series rear panel is the one used to communicate with the WEDI-4. When not in use, it is recommended that the External Data Bluetooth Antenna be removed and replaced with the cap furnished with the instrument.

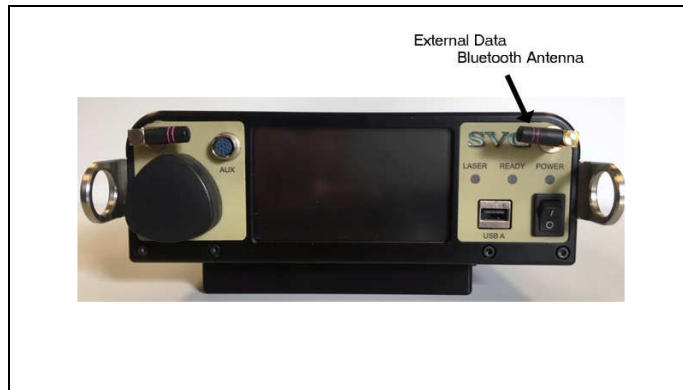


Figure 4 i-Series External Data Bluetooth Antenna Location

For best results, the WEDI-4 may be mounted on a tripod using its built-in $\frac{1}{4}$ -20 bottom mount, as shown below.



Figure 5 WEDI-4 Mounted Securely To A Tripod

Controls And Indicators

Power Switch

The power switch is of type push-on / push-off, with an LED indicator mounted in the center of the round power switch push button.

Firmly press the power switch once to turn power on, and press again to turn power off.



Figure 6 WEDI-4 Power Switch

LED/Audio Beeper

The WEDI-4 uses an internal audio beeper and power switch mounted LED to indicate the following conditions:

At power-up:

The unit emits a single 1 second beep to indicate that power has been applied, and that the firmware has successfully started. The LED lights and stays on solid to indicate sufficient battery voltage to run the device.

When the Bluetooth radio connection with the paired i-Series instrument has failed:

The unit emits a 1 second beep every 10 seconds until the connection to the instrument has been restored.

When the battery voltage is low:

The unit emits a 0.5 second beep every 2 seconds, and flashes the power switch LED. When this occurs, the WEDI-4 should be turned off until it the battery can be recharged. **Failure to turn off the unit under low-battery conditions will reduce the lifetime of the battery.**

Pairing WEDI-4 With Your Instrument

The WEDI-4 uses a Bluetooth radio to wirelessly send sensor data to the i-Series instrument. Prior to using the WEDI-4, this Bluetooth radio must be paired with a specific i-Series instrument. This pairing process only needs to be performed once, as the i-Series instrument remembers the paired device across power cycles.

Each WEDI-4 has a unique 12 character hexadecimal Bluetooth address. This unique address appears on a tag located on the bottom of each WEDI-4 chassis, as shown below:



Figure 7 WEDI-4 Unique Bluetooth Address Tag, Chassis Bottom

The pairing process uses the i-Series PC Data Acquisition Software to configure the WEDI-4 Bluetooth address into the i-Series instrument.

Once the PC Data Acquisition Software is started and connected to the i-Series instrument, use the software's "Control->Setup External Data..." dialog to begin the pairing process (shown below).

Set the "External Data Source" field and "Bluetooth Address" field according to your model instrument and your unique WEDI-4 Bluetooth address, and press the "Update Instrument" button to send the address to the instrument.

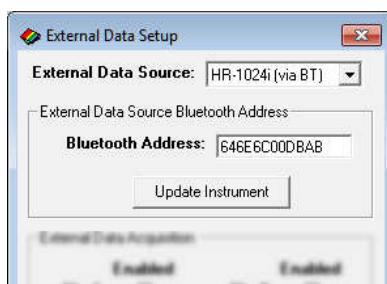


Figure 8 PC Software Pairing

Over on the i-Series instrument LCD (setup screen #4, EXTERN DATA), the Bluetooth Address should now match the one just sent from the PC software. See below:

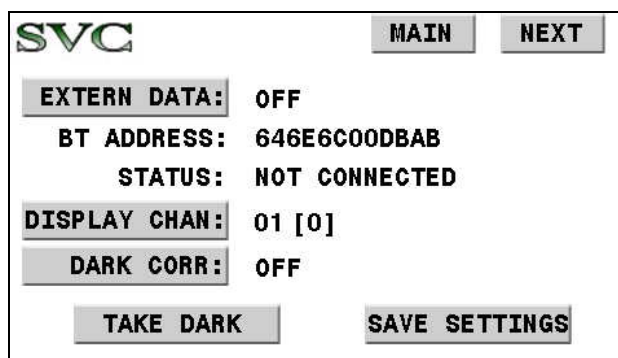


Figure 9 LCD Pairing Process, Before Turning On The WEDI-4

To complete the pairing process:

- Press the “**EXTERN DATA:**” button on the LCD to changes its state to “**ON**”.
- Press the power switch on the WEDI-4 to turn the unit ON.

Once turned on and connected, the instrument’s LCD screen should change its “**STATUS:**” field to “**CONNECTED, DATA OK**” as shown below: This indicates a successful pairing, with data streaming from the WEDI-4 to the i-Series instrument.

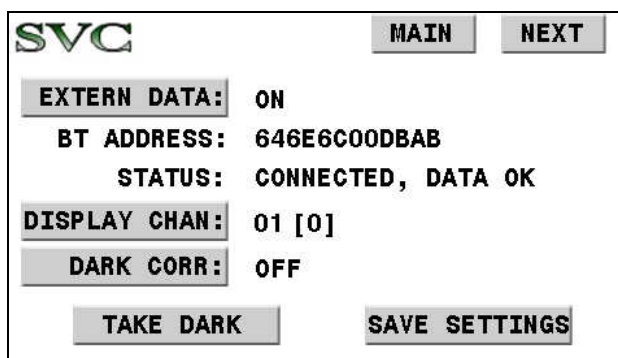


Figure 10 LCD Pairing Process, Completed

Once the pairing is complete, press the “**SAVE SETTINGS**” button. This will cause the i-Series instrument to automatically attempt to re-connect to the WEDI-4 every time the instrument is powered up. It will also automatically select channel 1 as the current display channel.

If the LCD shows any other **STATUS** after the above steps, then check:

- That the Bluetooth Address as found on the bottom of the WEDI-4 chassis was entered correctly.
- Check/charge the WEDI-4 battery; it may be low.
- Ensure that the External Data BT Antenna, located to the right of the instrument’s LCD display, has been installed.

WEDI-4 Usage – Stand-Alone Mode

In stand-alone mode, the instrument's main LCD screen displays the relative amplitude of the currently selected WEDI-4 display channel ("DISPLAY CHAN:" in the external data setup screen) with respect to its amplitude at the time of the last reference scan. In this way, the instrument operator is always aware of whether the downwelling radiance (for example) has changed since the last reference was taken.

The main LCD screen has an area labeled "EXT" that, once an initial reference scan has been acquired, displays the percentage change in any WEDI-4 channel since the time of the last reference.

Prior to the initial reference scan, the "EXT" field displays the string "REF", indicating that no initial reference scan has been acquired yet. So the instrument is waiting for the initial reference. See below:

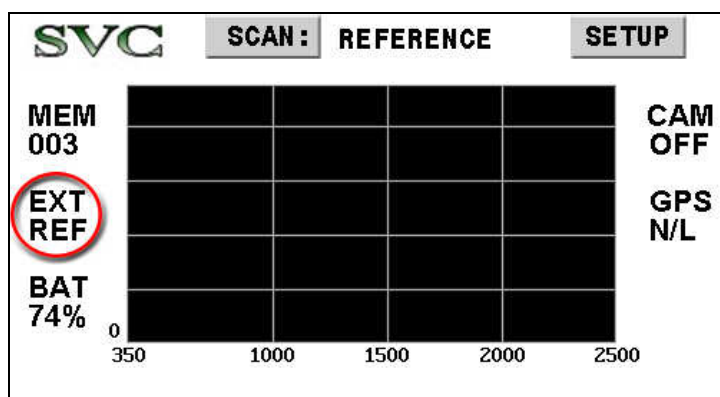


Figure 11 Waiting for the Initial Reference Scan

Note that the "EXT" field will also display "OFF" if the "EXTERN DATA" field mentioned earlier in the setup screen has been set to "OFF". In addition, the "EXT" field will display "N/C" if no connection exists between the instrument and the WEDI-4.

After the initial reference scan, the "EXT" field will display a constantly updating percentage-change value for the selected "DISPLAY CHAN".

For example, the Li-Cor LI-190 PAR sensor is built-in to the WEDI-4. This sensor corresponds to display channel 1 (see Appendix A for a complete mapping from WEDI-4 inputs to display channels).

In this example, with the LCD setup screen "DISP CHAN:" set to channel 1, the "EXT" field on the main LCD display will track downwelling radiance as a percentage of reference in real time for the operator.

In this case, the "EXT" value on the screen below shows that the current downwelling radiance is 3% less than at the time that the reference scan was taken:

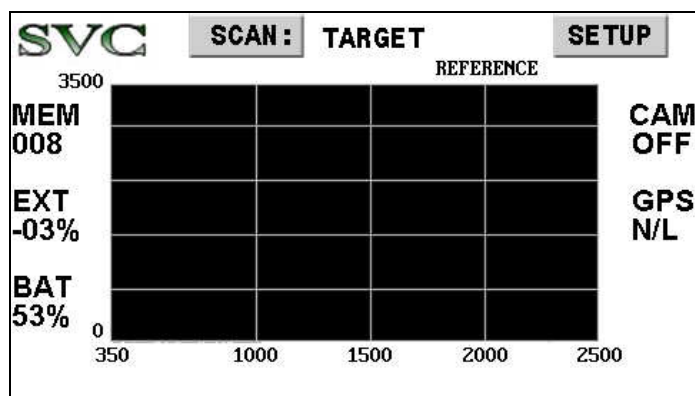


Figure 12 LCD Indicating Downwelling Radiance Is Currently Down 3 Percent vs Reference

The “EXT” value on the following screen indicates that the current downwelling radiance is 10 percent greater than at the time that the reference scan was taken:

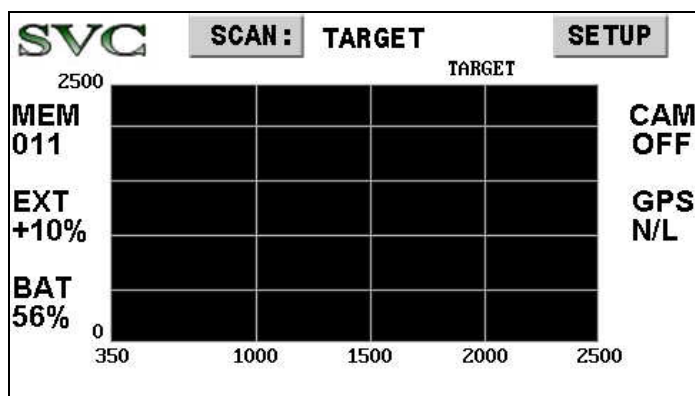


Figure 13 LCD Indicating Downwelling Radiance Is Currently Up 10 Percent vs Reference

When the “EXT” field indicates that the current downwelling conditions have changed too much, then the target scan should perhaps be delayed (possibly to allow clouds to move from the sun). Alternately, a new reference scan might be acquired.

WEDI-4 Usage – PC Mode

In PC data acquisition mode, the i-Series Window PC software is used to acquire scans from the instrument.

After connecting the software to the i-Series instrument, use the software’s “Control->Setup External Data...” dialog (shown below) to enable and set up the correct external data channels.

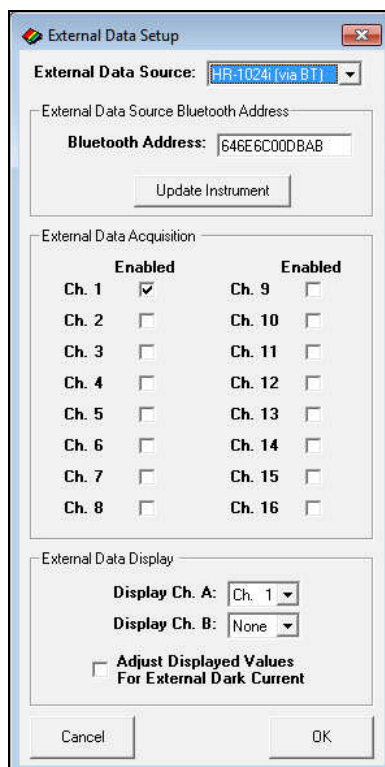


Figure 14 PC Software WEDI Controls Example

In the example above, the WEDI-4 controls are set as follows:

- “External Data Acquisition” has selected only channel 1 (the Li-Cor LI-190 PAR sensor input; see Appendix A) of the 16 possible channels as containing valid data; this is noted in any resulting SIG files in the header’s “external data mask=” field. [See the i-Series User Manual for more details on external data and SIG file header fields for more information].
- “External Data Display” has enabled and selected channel 1 data for display and calculations on the PC software’s main screen. [See below for more information].
- “Adjust Displayed Values For External Dark Current” is un-checked. Each of the WEDI-4 channels may optionally require dark-current subtraction in order to produce values that are directly proportional to their corresponding input sensor voltages. In this example, the Li-Cor PAR sensor does not require dark correction for typical usage.

When set up as described above, two new data acquisition buttons now appear on the PC software’s main screen in the upper-left corner. These buttons are “Ext Data Dark” and “Ext Data Scan”.

In addition, a new dialog “External Data Display” appears in the PC software’s main screen in the lower-left corner. This dialog displays external data.

These new external data-related fields are shown below, and are then described in detail in the following paragraphs:

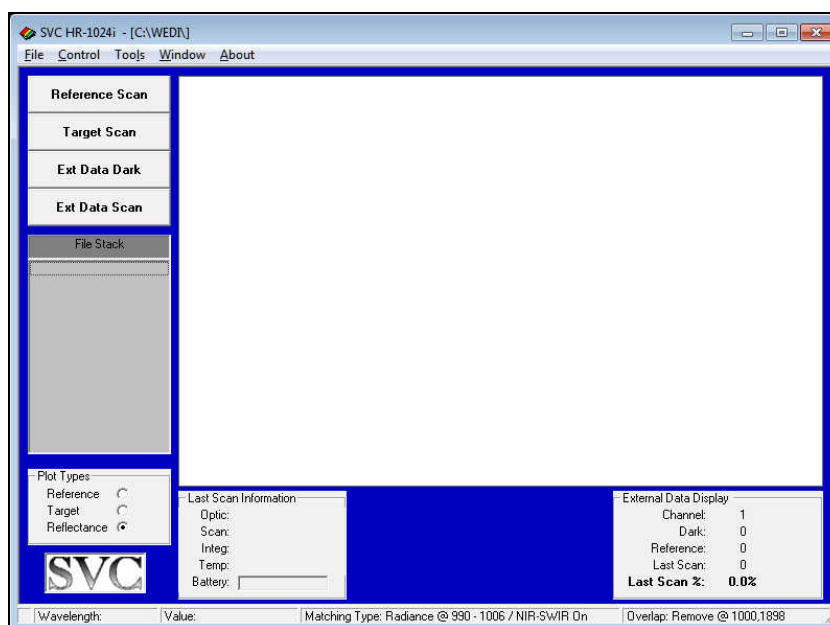


Figure 15 PC Software New Main Screen Buttons and External Data Display Fields

When the “Ext Data Dark” button is pressed, the PC software acquires and stores a single set of dark data values from the attached WEDI-4. These dark values will automatically be subtracted from all future scan data, if the “Adjust Displayed Values For External Dark Current” checkbox mentioned earlier is checked. Note that it is the operator’s responsibility to ensure that all sensors currently connected to the WEDI-4 are configured as “dark” at the time that this button is pressed.

The “Ext Data Dark” button need not ever be pressed if the WEDI-4 sensors do not require dark current correction.

When the “Ext Data Scan” button is pressed, the PC software acquires a single set of data values from the WEDI-4. If either display channel A or B is selected, the software also displays the selected data in the “External Data Display” box in the lower right.

Note that pressing either of these buttons does not result in new spectral data acquisition; only new WEDI-4 sensor data is acquired. The operator must still press either the “Reference Scan” or “Target Scan” buttons in order to acquire spectral data from the instrument.

For the example usage described below, continue to assume that the Li-Cor PAR sensor is attached to the WEDI-4 and its data appears on Display Channel 1.

The first step in taking advantage of the WEDI-4 in the field is, as always, to acquire a reference scan. This is done by pressing the software’s “REFERENCE SCAN” button. In this case, the “External Data Display” dialog is updated as follows:

External Data Display	
Channel:	1
Dark:	0
Reference:	10440
Last Scan:	0
Last Scan %:	0.0%

Figure 16 External Data Display After Reference Scan

This shows that the PAR sensor's downwelling radiance value was 10440 units during the most recent Reference Scan. The "Last Scan" indicates that we have not yet acquired any WEDI-4 sensor data associated with a Target Scan since our last Reference Scan.

Now, just prior to acquiring an actual Target Scan, the operator may first press the "Ext Data Scan" button, in order to test if the current downwelling radiance is still the same as it was during the most recent Reference Scan. This is shown below:

External Data Display	
Channel:	1
Dark:	0
Reference:	10440
Last Scan:	10433
Last Scan %:	99.9%

Figure 17 External Data Display After Ext Data Scan

This shows that the current downwelling radiance ("Last Scan Field") is 10433 units, or 99.9% when compared to what it was at the time of the last Reference Scan. So a Target Scan could be quickly acquired right now - a new Reference Scan is not required.

The "Last Scan" field is also updated whenever the Target Scan button is pressed. This allows the operator to immediately know when a Target Scan must be discarded, because downwelling radiance has changed too much. This situation is shown below:

External Data Display	
Channel:	1
Dark:	0
Reference:	10440
Last Scan:	8131
Last Scan %:	77.9%

Figure 18 External Data Display After Target Scan - Cloud Cover!

This shows that the target we just acquired had only 8131 downwelling radiance units, or 77.9% when compared to what it was during the prior Reference. This Target Scan may have to be discarded, since the absolute reflectance calculation from this target data will be incorrect due to the changed lighting conditions between the Reference and Target Scan.

In summary:

- The "Ext Data Scan" button immediately updates the "Last Scan %" field, which may be examined just prior to a target scan, in order to know whether conditions are still suitable for a new target.
- The "Target Scan" button also updates the "Last Scan %" field, which may be examined after a target scan to judge whether the target scan contains good spectral data, or should be discarded.

WEDI-4 Rechargeable Battery

The WEDI-4 operates from an internal 9.6V NiMH rechargeable battery. It is recommended that the battery be recharged prior to the start of each day of active data acquisition in the field to ensure a day's worth of uninterrupted field work.

Charging The Battery

With the WEDI-4 power turned off and the battery charger disconnected from the mains, remove the charging port cap and plug the battery charger into the WEDI-4 charging port.



Figure 19 WEDI-4 Battery Charging Port

Plug the battery charger into the mains. The LED on the charger turns RED while the battery is being charged, and turns GREEN when the battery is fully charged. It takes approximately 2 hours to fully charge a depleted battery.

Do not turn on the WEDI-4 power while its battery is being charged. The unit should stay in the OFF state whenever the battery charger is connected.



Figure 20 WEDI-4 Battery Charger

Checking Battery Voltage

The WEDI-4 will begin signaling a low-battery voltage warning (fast-beep and flashing power LED) when there is approximately 10 minutes of power remaining.

Once the low-battery warning begins, the operator must turn the unit's power off; otherwise, the overall useful lifetime of the battery may be reduced.

The following table shows the battery voltage versus charge condition:

WEDI-4 Charge Condition	Approximate Voltage
Fully Charged	> 11 Volts
Nominal	9.2 – 10.2 Volts
Low	< 9.2 Volts

Table 1 Battery Voltage vs. Charge State

The nominal voltage of the battery is 9.6V. The WEDI-4 will operate on voltages as low as 8.5V; however, it is recommended that the internal battery be recharged prior to each full data of use.

The actual battery voltage may be measured in two ways:

Check using an i-Series Instrument:

The WEDI-4 transmits its current battery voltage (in units of millivolts) on display channel 5.

By selecting external data display channel 5 on the paired i-Series instrument's LCD, the WEDI-4 battery level is displayed. See below.

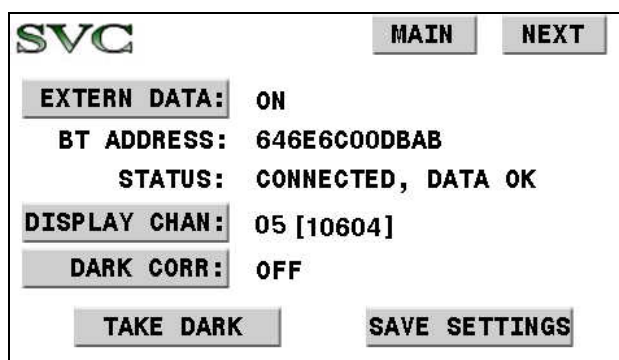


Figure 21 WEDI-4 Battery Voltage Displayed On Channel 5

In the example above, the current WEDI-4 battery voltage is 10604 millivolts, or 10.604 volts.

Check using a Voltmeter:

The voltage level of the WEDI-4 battery may be checked by turning the unit ON and placing a volt meter between pins 2 and 3 of the round SPN-1 connector located on the side of the chassis.

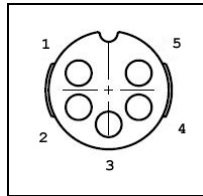


Figure 22 Battery Voltage Measurement - Across SPN-1 Connector Pins 2 and 3

Replacing the Battery

The rechargeable NiMH battery is considered a consumable item, which will need to be replaced over time, with usage. Replacement batteries may be ordered from Spectra Vista using part number CAB1024-504.

To replace the battery:

- Turn OFF the unit.
- Remove any external sensors that are attached to the unit.
- Loosen the 4 captured screws from the top of the unit and carefully remove the top cover. Note that there are wiring harnesses that will still attach the top cover to the lower chassis. It is NOT necessary to remove all of the wiring harnesses in order to replace the battery, just carefully set the top cover to the side of the lower chassis, as shown below:



Figure 23 Battery Replacement – Opening The Unit

- Remove the two-conductor RED/BLACK battery connector from the small PCB that is attached to the lid of the enclosure. The correct battery connector on the small PCB is marked “J2” and “BAT1”. See the close up photo of the bottom side of the unit lid.

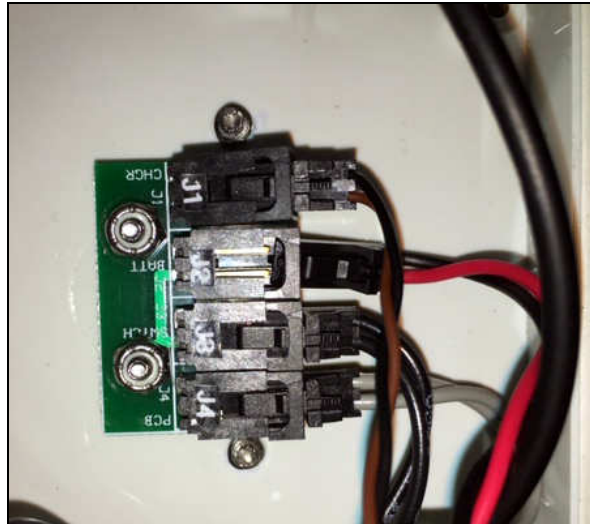


Figure 24 Battery Replacement - Connector J2 "BATT" Partially Removed

- Once J2 has been removed, the battery has been electrically disconnected from the unit, as shown below.



Figure 25 Battery Replacement - Old Battery Prepared For Removal

- The old battery is attached to the enclosure side wall with double-sided foam tape. Start the process of removing the battery by first carefully separating the old battery from the side wall of the enclosure. **DO NOT USE ANY METAL TOOLS FOR THIS OPERATION, as the battery may be damaged! If necessary, use a thin, stiff plastic tool to slowly work the battery loose from the side wall.**
- With the old battery removed, clean any remaining tape / glue from the side wall.

- Apply double-sided foam tape to the new battery. Do not apply excessive amounts of foam tape, only apply as much as shown below:

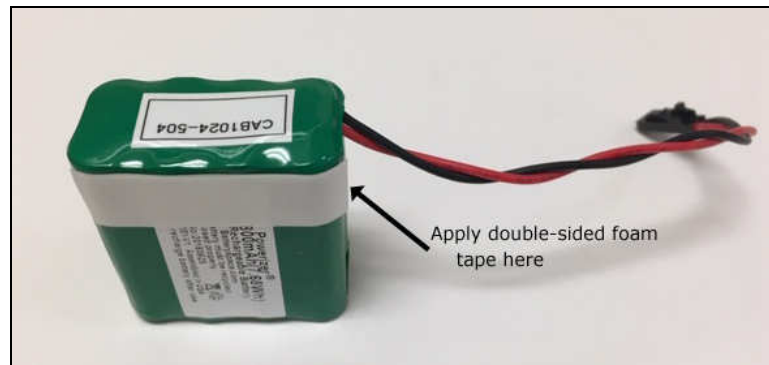


Figure 26 WEDI-4 Battery With Foam Tape Applied

- Remove the protective covering on the foam tape to expose the sticky adhesion surface
- Insert the new battery into the enclosure. Be sure to **insert the new battery fully into the bottom of the enclosure** before gently pressing the new battery into place against the enclosure side wall.
- Reconnect the 2-pin battery connector “J2” on the PCB mounted on the enclosure lid.
- Replace the top cover and re-install the 4 screws holding it in place. Do not over torque. Make sure that none of the wiring harnesses are pinched between the lid and the bottom half of the enclosure while securing the lid.
- Fully charge the new battery for at least 2 hours before use.
- Dispose of the old battery properly.

Configuration Options

The the WEDI-4 SMB connector is normally factory configured to accept a standard NTC Thermistor as a temperature input.

This input may alternately be configured to accept any sensor whose DC voltage output is within the range 0.0 to 4.0 volts. Contact the factory in order to change the thermistor input to accommodate a voltage input.

Also, the SPN-1 connector has two analog voltage input channels that may be re-purposed for any sensor whose DC voltage output is within the 0.0 to 4.0 volt range.

Specifications

Unit Size	4" long, 4" high, 2.5" deep 10.2 cm. long, 10.2 cm. high, 6.4 cm. deep
Unit Weight	1.25 lbs. (0.57 kg.)
Power Usage	Internal battery, 9.6 VDC nominal @ 20 mA
Battery	9.6V, 800mAh (7.7 Wh), Rechargeable NiMH SVC P/N CAB1024-504
Battery Run Time	Approx. 10 hours
Battery Charger	6-12 Cell Smart Charger, 700mA SVC P/N CHG000051
Battery Charge Time	Approx. 2 hours
Bluetooth Radio	Class 1, 100 mW, Approx. 100 m range
Supported Sensors	Li-Cor LI-190 PAR Sensor Delta-T SPN-1 Pyranometer Standard NTC Thermistor (10K @ 25C)
Environmental	Temperature: -10C to +40C Humidity: <90%, non-condensing
Cleaning	Wipe down exterior with soft, dry cloth only.

Appendix A – Hardware Description

The following table maps iSeries Spectrometer External Data display channels to WEDI-4 connector pins:

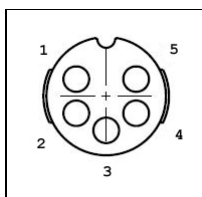
Display Channel	WEDI Connector / Pin Input	WEDI Amp Type / Gain	Notes
1	Built-in PAR Sensor	TI-Amp / x 100K	Li-Cor LI-190 Sun Sensor
2	SC SPN-1 / 4	V-Amp / ÷1	SPN-1, Diffuse Output
3	SC SPN-1 / 1	V-Amp / ÷1	SPN-1, Total Output
4	SMB / Center	Thermistor	Type NTC, 10K @ 25C, 5.0V/10K ref voltage
5	(none)	(none)	Battery Voltage (millivolts)

Notes: “SPN-1” refers to Delta-T Devices Ltd. Model SPN1 Pyranometer.
 “LI-COR” refers to Li-Cor Biosciences Inc. Model LI-190 Quantum Sensor.
 “SC” refers to Switchcraft female connector p/n EN3P5FX; mate is p/n EN3C5MX.

I/O: WEDI A/D Converter, Analog Input Range: 0.0 – 4.096 Volts
 External Data Channel, Digital Output Range: 0 – 16383 Counts

WARNING: Do not exceed 5.0 volts on any WEDI-4 sensor input pin!

SPN-1 Power/Ground/Signal Pins:



Switchcraft (SC) SPN-1 Connector EN3P5FX (Female) Pin Numbering

EN3P5FX Pin	SPN-1 Function
1	Total Signal Output
2	Sensor Power – Ground
3	Sensor Power – 9.6V Nominal
4	Diffuse Signal Output
5	Signal - Ground

Table 2 SPN-1 Connector Pin Assignments

Note that the WEDI-4 is designed to supply power to the SPN-1 sensor only; **do not attempt to power the SPN-1 internal heater from the WEDI-4 SPN-1 interface connector.**

WEDI-4 User Manual Document Revision Sheet

[illegible]