



VWANALYZER

VIBRATING WIRE ANALYZER

Made in USA



- VSPECT** Quality
- PDF Reports
- Field Ready

10/2019
manual pn: 31913



Meet the Vibrating Wire Analyzer

The **VWANALYZER** is a field-ready device to quickly measure a sensor, save data, and communicate results with custom PDF reports and spreadsheet output. Measurements are geo-located with the integrated GPS allowing the VWA to verify locations and lead the user to the sensor locations. The large color display and VSPECT™ technology¹ create confidence of getting the best measurement possible both in the field and in the office. **VWANALYZER**, when measurements matter.

¹Protected under U. S. Patent No. 7,779,690

Caution

- WARNING:** Disconnect power from active automated systems prior to connecting and measuring a sensor with a VWA on the automated system
- CAUTION:** Avoid direct contact with water (IP-62)
- CAUTION:** Store and transport in the protective case
- CAUTION:** Measurements are not pressure or temperature compensated
- CAUTION:** Do not force measurement cable connection; cable fits one way
- CAUTION:** Hold the device properly, do not hang/carry from measurement cable

Downloads

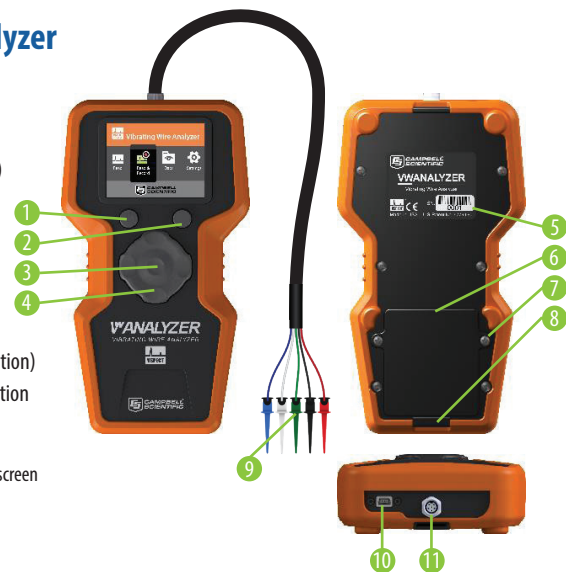
Visit www.campbellsci.com/vwanalyzer to download:

- VwProjects software
- Updated operating system (updated Sensor Library)
- Manual (this document)

QUICK TOUR

Vibrating Wire Analyzer

- Power¹, left soft key²
- Right soft key²
- Enter/select³
- Menu navigation arrows (4)
- Serial number (SN)
- Battery door
- Battery door screws (2)
- Elastic strap connection (2)
- Measurement cable
- USB port (computer connection)
- Measurement cable connection

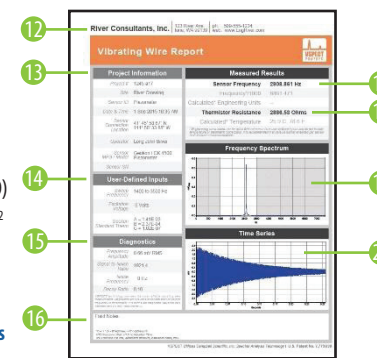


- Hold (2–3 s) to turn off
- Soft keys select the displayed screen option (when present)
- Selects the highlighted option

PDF Reports

- User specific title¹
- Project Information¹
- User-Defined Inputs
- VSPECT Diagnostics²
- Field Notes
- Sensor Frequency
- Resistance (Thermistor/RTD)
- Frequency Spectrum graph²
- Time Series graph²

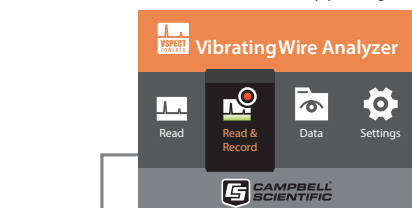
- Entered manually or with a computer. See the **VwProjects** section for details.
- The **VSPECT Measurement** section explains how to use and understand VSPECT data.



FIELD

Operation

- Turn on the VWA**
 - Install/replace batteries as needed (5-AA) ⁶
 - Push power button ¹
- Select/Create User**
 - Link user information to specific measurements
- Note:**
 - User information is documented on PDF reports
- Connect Sensor (if measuring)**
 - Connect measurement cable ¹¹. Keyed connector, do not force.
 - Match sensor and measurement cable colors ⁹. See **Wiring Guide**
- Navigate the Main Menu**
 - Return to the **Main Menu** by pushing the left soft key ¹ several times.



- Read:** Measure a sensor quickly. **Data is NOT saved.**
- Read & Record:** Measure a sensor. **Data is saved.** See **Read & Record.**
- Data:** Export data to CSV file, or view saved data. See **Data Retrieval.**
- Settings:** Change system, measurement, or power settings.

Tips:

- Return to the **Main Menu** by pushing the left soft key ¹ several times.
- Carry spare batteries (5-AA) in the carrying case.
- A continuous measurement can display engineering units when linked to a site or sensor with an engineering unit conversion applied.
- Leave 1–2 mm of exposed sensor wire on data logger/multiplexer wiring for VWA connection ⁹. Always disconnect automated system power prior to VWA connection.

Definitions:

- Sensor:** An individual vibrating wire sensor. A VWA can store up to 880 unique sensors (40 sites, 22 sensors/site).
- Site:** A project or geographic location containing up to 22 sensors.
- User:** Operator name and information.

Wiring Guide

VWA Cable ⁹		Common Sensor Cable Colors ¹		Sensor Description
-RED	-ONG			
Red ²	Orange ²	Red	or Orange	Vibrating wire gage
Black ²	Orange ²	Black	or White w/Orange	Vibrating wire gage
Green ²	Blue ²	Green	or Blue	Therm/RTD
White ²	Blue ²	White	or White w/Blue	Therm/RTD
Blue	Yellow	Bare/Clear		Drain wire

¹ If sensor wiring does not match the table, refer to the sensor manufacturer manual to determine the vibrating wire gage wires. Some sensors may not have a thermistor or RTD (temperature measurement).

² Vibrating wires are interchangeable (black and red instead of red and black); thermistor wires are similarly interchangeable.

Read & Record

- There are three options to save data when using **Read & Record**.
- Use **Single** when sensors won't be repeatedly measured in the future (installation record, baseline reading, troubleshooting).
 - Use **Site/Sensor** when sensors will be repeatedly measured and data needs to be linked to a site. Site and sensor data is viewable in the field for historical comparison.
 - Continuous** measures a single sensor at a user defined interval ranging from 1 second to 15 minutes. Used for documenting installations, live field testing (push-in-piezometer, well pump test, sensor response, etc.), and for troubleshooting.

Notes:

- Users can view all data. Sites are not user specific.
- See **Measurement Screens** for an explanation of displayed measurement results.
- Sites, sensors, and users can be created and edited either on the VWA, or with **VwProjects**.

OFFICE

Data Retrieval

Transfer files to a computer from the VWA using the USB port ¹⁰. Measurement data collected with the **Read & Record** option is saved as a printable report (PDF) and/or a raw data file (CSV). A PDF file communicates results quickly and professionally. CSV files can collect multiple sensors (site) in a single file for additional spreadsheet analysis and reporting.

- Export CSV files (optional)**
 - Navigate to the **Main Menu**. See **Operation**.
 - Select **Data**.
 - Choose from **Single**, **Site/Sensor**, or **Continuous** options.
 - Choose and **Export** CSV files.

- Connect VWA to a computer with USB**

- Connect a computer to the VWA ¹⁰ with a USB cable.
- Power is supplied through the USB-computer connection.

- Copy files to computer**

- Find the USB flash memory device (VWA) on the computer.
- Data files are stored in either the **PDF Reports** or **CSV Data** folder.
- Copy files to the computer.

- PDF Reports**
 - Ready to print PDF reports
 - Field documentation

- CSV Data**
 - Multiple sensors or sites in one file
 - Spreadsheet analysis

- Eject VWA from computer**

- Eject the VWA from the computer prior to disconnecting the USB cable.

VwProjects

VwProjects is a free software package for easier setup of sites, sensors, and users with a computer. **VwProjects** can be downloaded and installed from the VWA memory or from the internet, see **Downloads**.

Use **VwProjects** to create and edit a project file that contains information about sites, sensors, and users. Project files can be used to back up or transfer information to other VWA devices. See **Using VwProjects** for details about creating, editing, and transferring project files.

Notes:

- A project file contains information about sites, sensors, and users. Measurement data is saved in the PDF and CSV files, and is NOT saved or transferred in a project file.
- You can preview a report title block ¹² when creating or editing a user in **VwProjects**.

File Types

The following files are created or used with the VWA. Files are transferred with a USB connection (see **Data Retrieval**).

- PDF: **Measurement Reports** created using **Read & Record**.
- CSV: Created by the VWA with **Read & Record**, use for further spreadsheet analysis; see **Data Retrieval**.
- VWA: A project file contains information about users, sites, and sensors. Created in the VWA or with **VwProjects**.
- OBJ: Operating system file, created by Campbell Scientific. See **Downloads**.



Equipment Inspection

Upon arrival, and before each use, inspect for the following items:

- VwAnalyzer
- USB cable
- Measurement cable
- Carrying case
- Phillips screwdriver
- Hand strap
- Manual
- 5-AA batteries

Warranty & Service

- Warranted for one (1) year, www.campbellsci.com/terms
- For repair: www.campbellsci.com/repair
- For assistance: www.campbellsci.com/contact#dir

Overview

The VWA uses patented VSPECT™ technology for the most reliable vibrating wire measurement available. The VWA converts measurements to engineering units, generates a printable PDF report, and saves a CSV summary file. The graphical display allows sensor output and operation to be confirmed. VSPECT technology eliminates disruptive noise interference and provides sensor diagnostics for the best measurement possible. VSPECT noise immunity allows gages that are otherwise unreadable to be evaluated with confidence.

A project file maintains site and sensor information for 40 unique sites with 22 sensors per site. Site and sensor locations are geolocated, allowing the internal GPS to walk a user directly to the sensor. Site, sensor, and user information can be created or edited on the device or with a computer using the free **VwProjects** software.

Specifications

Vibrating wire measurement	
Resolution:	0.001 Hz RMS
Speed:	1 second (fastest)
Excitation:	2V, 5V, 12V (user selectable)
Accuracy:	±0.005% of reading
Method:	VSPECT (Vibrating Wire Spectral Analysis), U.S. Patent No. 7,779,690
Temperature (resistance) measurement	
Resolution:	0.01 Ω RMS
Accuracy:	±0.15% of reading
General information	
Memory:	1,700 site/sensor measurements (most recent ²) 40 unique sites, 22 sensors per site 240 single measurements (most recent ²) 16,500 continuous measurements (most recent ²) 80 MB USB memory (PDF, CSV, VWA, and other files ³)
GPS:	± 5m (16.4 ft) typical; ± 1 ms time sync (WGS 84 Datum)
Battery type/life:	5-AA (1.5 V)/20 hours continuous use
Weight:	0.34 kg (0.75 lb)
Dimensions:	200 x 100 x 58 mm (7.9 x 3.9 x 2.3 in)
Compliance:	CE, RoHS
Operating Temp:	(-20 to 70 °C)
Enclosure:	IP62
EU Declaration of Conformity:	www.campbellsci.com/vwanalyzer

¹Non-volatile memory stores data, reports, and project files

²When memory is full, new data will overwrite the oldest data

³Memory managed by users, files will need to be deleted/transferred when full

Operating System

A new operating system (OS) may be installed to update features or the sensor library. Back up all data and the project file prior to working with the OS. A factory reset is done from **System Settings**.

OS update procedure:

1. Download obj file
2. Connect VWA to computer using USB
3. Back up files/data (see [Using VwProjects](#))
4. Save .obj file to root
5. Unplug USB
6. Cycle power with power button ①
7. Verify OS



WARNING: A factory reset deletes all data.

Temperature Measurement

Most vibrating wire sensors have a resistance (thermistor/RTD) measurement to calculate sensor temperature. When a sensor is selected with the sensor library, the equation and conversion coefficients are automatically selected for the manufacturer specific vibrating wire sensor. Users can view or create custom temperature calculations in **Measurement Settings**. When using **Read, Options** can be selected to quickly choose a temperature conversion.

VSPECT Measurement

VSPECT™ provides the best vibrating wire measurement available. Sensor frequency is easily identified while filtering out environmental and electrical noise that affects the quality of other vibrating wire readers. VSPECT™ provides measurement diagnostics to understand sensor response, installation quality, and identify incorrect wiring or damaged sensors.

Output and Diagnostics

Sensor Frequency¹ (Hz)

Frequency is the basic signal from a vibrating wire sensor. The frequency can be converted into engineering units (pressure, displacement, etc.) and is identified as the largest measured amplitude signal within the frequency sweep.

Sensor Amplitude² (mV RMS)

Signal strength from the vibrating wire sensor. Amplitude varies and is affected by the sensor type, excitation strength (adjustable), and sensor cable length.

Signal-to-Noise Ratio² (unitless)

The signal-to-noise ratio is calculated as sensor signal amplitude divided by the largest noise amplitude within the sweep frequency. A low signal-to-noise ratio indicates a weak sensor signal or a noisy environment.

Noise Frequency² (Hz)

The largest amplitude noise signal within the frequency sweep.

Decay Ratio² (Hz)

Signal attenuation; how quickly the signal strength decreases.

Thermistor/RTD Resistance¹ (ohms)

Used to calculate sensor temperature and correct for thermal effects³.

¹Frequency and resistance are measured values

²Diagnostic values used to describe the quality of the frequency measurement

³The VWA measures the sensor temperature (when present); post processing is required for thermal and barometric corrections. An automated data acquisition system (ex. Campbell Scientific CR6) with an integrated barometer can apply temperature and pressure corrections.

Warning Thresholds

Measurement warning thresholds can be set in **Measurement Settings**. Thresholds provide a warning for questionable measurements (incorrect wiring or damaged sensors). When a threshold is crossed, the alarm can display a brief list of field troubleshooting tips.

Amplitude

The default is 0.10 (mV RMS), intended to identify weak signals for additional review.

Signal-to-Noise Ratio

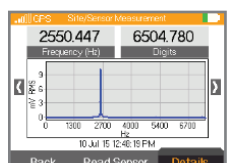
The default is 5.0 (unitless), intended to identify extreme noise environments for additional review.

Data records normally when a threshold is crossed. It is the responsibility of the user to exercise engineering judgment with thresholds, graphs, and additional diagnostics to determine if the measurement is acceptable.

Note: A frequency sweep ②⑤ excites frequencies within the expected frequency response range of the sensor. See the sensor manual for an expected frequency operating range.

Measurement Screens

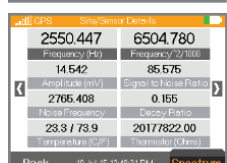
When a sensor is measured, four screens display the results, the right soft key ② is used to advance to the next screen.



1st Screen – Measurement

Summary screen setup by the user

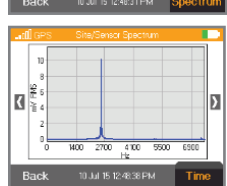
- User selectable summary boxes (frequency, digits, B-units, temperature, ohms)
- Spectrum graph (optional)
- Change settings in **Measurement Settings**



2nd Screen – Details

Metadata including diagnostics

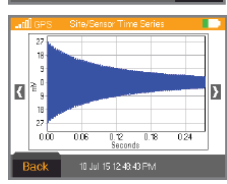
Tip: On-screen side arrows allow historic data comparison



3rd Screen – Frequency Spectrum

Frequency spectrum graph

- Sensor signal is defined as the largest signal within the frequency sweep range
- Visually compare the sensor signal to noise signals



4th Screen – Time Series

Time series graph

- Visually see the raw input signal

Measurement Graphs

The following two sets of graphs illustrate the use of VSPECT™ to identify a sensor signal in a quiet and noisy environment. Both graphs were created from VWA reports using the same sensor. Fig. 1 was measured in an electrically quiet environment, while Fig. 2 was measured in an electrically noisy environment (AC power) similar to what can be seen in a field environment (power lines, motors, radio signals, etc.). The time series on Fig. 1 shows a relatively clean signal ②④ that is clearly identified ②② on the frequency spectrum ②①. The time series ②⑧ on Fig. 2 shows the influence of the noise. ②⑨ Vibrating wire readers that only use the time series ②⑧ to determine the frequency may report an incorrect frequency as a result of noise. The frequency spectrum (VSPECT™) filters the noise ②⑥ and easily identifies the sensor signal ②⑦. VSPECT™ provides noise immunity by correctly identifying the sensor signal and ignoring the influence of electrical noise that commonly affects time-domain-based vibrating wire readers.

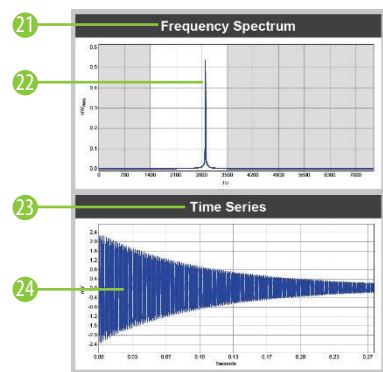


Figure 1: Vibrating Wire Signal

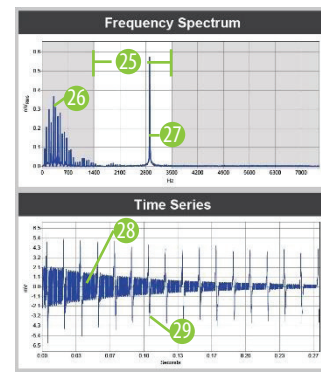


Figure 2: Vibrating Wire Signal With Noise

- ②① The Frequency Spectrum graph shows signals with respect to frequency (VSPECT™)
- ②② The sensor signal is determined as the largest signal within the frequency sweep
- ②③ The Time Series graph shows raw signals observed with respect to time
- ②④ A time series with minimal noise influence
- ②⑤ The frequency sweep is shown as the white area on the graph, only signals within the frequency sweep will be considered as a possible sensor signal
- ②⑥ Noise is identified and ignored
- ②⑦ A sensor signal is easily identified even when noise is present in the measurement
- ②⑧ A time series with observable noise
- ②⑨ Noise in the time series

Sensor Library

The sensor library contains preprogrammed sensors from common vibrating wire sensor manufacturers. The library can be accessed on the VWA or with **VwProjects** when a new sensor is created or edited using **Site/Sensor**. Use of the sensor library enables:

- Manufacturer-recommended sweep frequencies
- Field conversion from frequency to engineering units
- Sensor specific calibration inputs

Notes:

- Engineering units reported are NOT corrected for temperature or barometric pressure
- Temperature is calculated with manufacturer specific conversions, see **Temperature Measurement**
- A **Continuous** measurement can graph the sensor response in engineering units when linked to a sensor with calibration values applied
- Calibration inputs are unit specific to match manufacturer calibration sheets. When the selected output units are different than manufacturer calibration units, an automatic unit conversion will be applied

Measurement Reports

Printable PDF measurement reports are saved when using **Read & Record**. There are two types of measurement reports:

Single Measurement Report

Created when a measurement is performed from **Site/Sensor** or **Single** read. Use as field documentation, baseline reading, or installation record.

Continuous Measurement Report

Optionally created with **Continuous** read. Use for monitoring changing field conditions, or during installation (push-in piezometer, well pump test, sensor response, etc.).

Using VwProjects

Project Files

A project file contains site, sensor, and user information. Project files can be shared between VWAs.

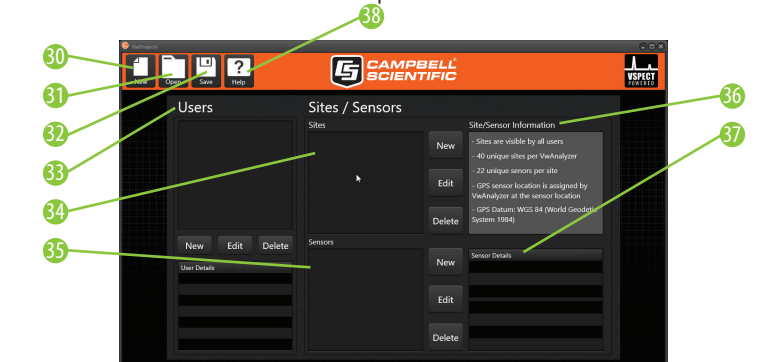
A project file can be used to:

- Back up site, sensor, and user information
- Transfer project file data to another VWA device
- Create or edit a project file on a computer with VwProjects
- Import/export project file in **System Settings** (see steps below)
- Maintain up to 20 users per VWA
- Maintain up to 880 unique sensors (40 sites, 22 sensors/site per VWA)

Note: A project file contains information about sites, sensors, and users. Measurement data is saved in the PDF and CSV files, and is NOT saved or transferred in a project file.

VwProjects

VwProjects uses a computer to easily create and edit project files. The software can create a new project file ③① or open an existing project file ③① created from a VWA or a computer. The following screenshot illustrates the various buttons and capabilities of the software:



- ③① Create a **New** project file
- ③② **Open** an existing project file
- ③③ **Save** the current project file
- ③④ Create and edit **Users**
- ③⑤ Create and edit **Sensors**
- ③⑥ **Site/Sensor Information**
- ③⑦ **Sensor Details**
- ③⑧ **Open software Help** file

Note: When saving a project file on the VWA or computer ③②, there are two save file options:

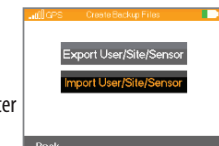
- **Append File:** New or changed information will be added or updated on the VWA.
- **Overwrite/ Backup file:** When loaded to a VWA, all the old information will be erased and overwritten with the new project file information.

Loading a project file to a VWA

1. Connect to a computer with USB cable (see **Data Retrieval**)
2. Copy the project file from the computer to the USB memory of the VWA
3. Disconnect USB cable
4. Select **Settings**, then **System**, then **Project Files**
5. Select **Import User/Site/Sensor**

Exporting a project file from a VWA

1. Select **Settings**, then **System**, then **Project Files**
2. Select **Export User/Site/Sensor**
3. Select **Append File** or **Overwrite File**
4. Follow the on-screen prompts to copy the file to a computer
5. Disconnect the USB cable



GPS and Time Zone

The integrated, non-survey grade GPS is used to update the internal clock and provide approximate location data for reports.

Select **System Settings** to adjust the GPS time to your location or turn off the GPS. The time can be manually set when the GPS is turned off. Daylight Saving Time can be applied as needed.