CAMPBELL SCIENTIFIC®

WHEN MEASUREMENTS MATTER

Geotechnical & Structural

Measurement Systems for Research and Industry

CAMPBELL SCIENTIFIC®
WHEN MEASUREMENTS MATTER

GEOTECHNICAL MONITORING

Slope Stability, Dam Safety, Roadway, Railway, Tunnel, Excavation Stability

Campbell Scientific provides turn-key systems and components for Geotechnical Monitoring systems worldwide. Our clients include industry leaders like Geokon, RST, DGSI, URS, Fugro, the Tennessee Valley Authority, State and National government agencies, international energy and mining firms, and others. Our vibrating wire measurement systems are rapidly becoming a standard worldwide due to their robust and unique diagnostics, their accuracy, and their ruggedness. Systems are configurable for applications requiring any combination and quantity of vibrating wire, analog, digital, serial, and combined sensors in networks.

APPLICATIONS

	Measurements	*Sensor Types*	*Sensors*	*Dataloggers*	*Peripherals*	*Description*
Dam Safety 	Pore water pressure, tilt, acceleration, settlement, temperature, weather, crack monitoring, corrosion, hydrology, water level and flow, soil moisture	Vibrating wire, 4 to 20 mA, analog voltage, digital voltage, pulse, serial	Piezometers, pressure sensors, tiltmeters, inclinometers, bridge measurements, strain gages, crack meters, flow meters, corrosion, PRT, ShapeAccelArray, thermistor, thermocouple, Time Domain Reflectometry	CR6, CR3000	AVW200, AM16/32B, AM25T, CDM-VW300, RF401A, MD485, TDR100, satellite and cellular modems	Our systems monitor dams worldwide storing data on site or transmitting it back to a central location. We will work with you to develop a robust measurement and data management system
Slope Stability 	Pore water pressure, tilt, acceleration, settlement, temperature, weather, crack monitoring, soil moisture	Vibrating wire, 4 to 20 mA, analog voltage, digital voltage, pulse, serial	Piezometers, tiltmeters, inclinometers, strain gages, crack meters, robotic total station, Time Domain Reflectometry, ShapeAccelArrays	CR6, CR3000	AVW200, AM16/32B, AM25T, CDM-VW300, RF401A, MD485, TDR100, satellite and cellular modems	Our systems monitor slope movement in safety and mission critical applications to protect water and oil pipelines, mines, and roadways. Systems can be configured with alarms to provide early warning to managers.
Roadway and Railway Monitoring 	Soil moisture, crack monitoring, settlement, load, vibration	Vibrating wire, 4 to 20 mA, analog voltage, digital voltage, pulse, serial	inclinometers, strain gages, crack meters, Time Domain Reflectometry	CR6, CR3000, CR9000X	AVW200, AM16/32B, AM25T, CDM-VW300, RF401A, MD485, TDR100, satellite and cellular modems	Our systems are used to monitor pavement performance, rockfall, subsidence, road weather, and other parameters worldwide.

More info: **geotech@campbellsci.co.uk**
campbellsci.eu/geotechnical-systems

	Measurements	Sensor Types	Sensors	Dataloggers	Peripherals	Description
Mining 	Tailings dam stability, excavation stability, soft rock (coal) mining, machinery, temperature, weather, lightning, safety, pore water pressure, tilt, acceleration, settlement, crack monitoring, corrosion, hydrology, water level and flow, water quality, soil moisture, gas, LEL	Vibrating wire, 4 to 20 mA, analog voltage, digital voltage, pulse, serial	Piezometers, pressure sensors, tiltmeters, inclinometers, bridge measurements, strain gauges, crack meters, flow meters, corrosion, ShapeAccelArrays, PRT, Thermistor, Thermocouple, Time Domain Reflectometry	CR6, CR3000, CR9000X	AVW200, AM16/32B, AM25T, CDM-VW300, RF401A, MD485, TDR100, satellite and cellular modems	Our systems monitor mines worldwide storing data on site or transmitting it back to a central location. We will work with you to develop a robust measurement and data management system
Excavation and Tunneling 	Tilt, movement, temperature, train, crack monitoring, pressure, soil moisture, corrosion	Vibrating wire, 4 to 20 mA, analog voltage, digital voltage, pulse, serial	Inclinometers, strain gauges, crack meters, Time Domain Reflectometry, ShapeAccelArrays	CR6, CR1000, CR3000	AVW200, AM16/32B, AM25T, CDM-VW300, RF401A, MD485, TDR100, satellite and cellular modems	Tunneling monitoring systems fit in limited enclosure space. Onboard vibrating wire and analog data can be transmitted back to data collection points via wired or wireless communications

Geotechnical Case Studies

Campbell Scientific systems have helped a variety of organizations reach their goals. The following are some geotechnical case studies:

Seepage at the Wolf Creek Dam is monitored by 81 vibrating-wire transducers, our CR1000 dataloggers, and AVW206 vibrating-wire interfaces. All data is transmitted over a spread-spectrum IP radio network. The dam consists of a concrete hydroelectric dam and an earthfilled embankment structure.

www.campbellsci.eu/wolf-creek

In South Korea, Campbell Scientific gear measured water content in a road bed to test anti-freezing methods that prevent road damage. Our monitoring system enabled Korea Expressway Corporation (KEC) to continuously monitor 45 test sites; and to assess, over time, the effectiveness of an antifreezing layer in preventing winter damage to KEC's expressways.

www.campbellsci.eu/korea-road

Campbell Scientific equipment was used to monitor the construction of London's Heathrow Express Rail Link. Reliable and accurate structural monitoring is especially critical since 12 km of the tunnel runs close to historical sites such as Big Ben, Westminster Bridge, and Canary Wharf.

www.campbellsci.eu/london-excavation

For the Susie Mine cleanup in Montana, Campbell Scientific equipment was used to monitor drainage before it flowed into the water sources for Helena, Montana. This data-acquisition system has stood up through grueling Rocky Mountain weather, and has never lost data.

www.campbellsci.eu/susie-mine

In Del Mar, California, our TDR system is used to monitor dangerous slope movement at three segments of railway track above coastal bluffs. The TDR system includes our dataloggers, SDMX50 TDR multiplexers, TDR100 reflectometers, and horizontal coaxial cable sensors installed along high-concern segments of the track.

www.campbellsci.eu/slope-monitor

In Del Mar, California, a tractor-mounted trencher installed coaxial cable for monitoring slope stability using our TDR system.

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WHEN MEASUREMENTS MATTER

Bridge Monitoring

Data Acquisition for Reliable, Stand-Alone Bridge Monitoring

Campbell Scientific data-acquisition systems can support a variety of bridge monitoring projects ranging from simple beam-fatigue analysis, and structural mechanics research, to continuous monitoring of large, complex structures for performance and safety. Over the years, our systems have monitored structures, ranging from local traffic to internationally known critical bridges. Campbell Scientific is committed to providing quality instrumentation and support.

Custom Systems

Most of the systems we sell are customized. Tell us what you need and we'll help you configure a system that meets your exact needs.

Dataloggers

We offer a range of dataloggers, from the most basic system with just a few channels to expandable systems that measure thousands of sensors. Our new vibrating wire loggers provide the highest quality vibrating wire measurements in the industry. Non-volatile data storage and a battery-backed clock ensure data capture and integrity. The control functions of our dataloggers allow them to sound alarms and control devices based on time or measured conditions.

Sensors

The versatility of our systems begins with sensor compatibility—they can measure virtually every commercially available sensor—allowing them to be used in a variety of ways for a variety of measurements. Our dataloggers have many channel types and programmable inputs including vibrating wire, analog (single-ended and differential), pulse counters, switched excitation, continuous analog output, digital I/O, and anti-aliasing filter. Our dataloggers have input resolutions to 0.16 microvolts, allowing strain measurements with a resolution of a single micro-strain.

Typical Sensors

- Vibrating-wire strain gauges
- Strain meters
- Vibrating-strip sensors
- Inclinometers
- Crack and joint sensors
- Tilt sensors
- Piezoresistive accelerometers
- Piezoelectric accelerometers
- Capacitive accelerometers
- Borehole accelerometer
- Force balance accelerometers
- Weather
- Foil strain gauges (in quarter-, half-,or full-bridge strain configurations)
- Camera

Vibrating Wire Interfaces

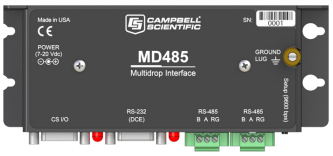
In addition to our vibrating wire loggers, Campbell Scientific's AVW200-series interface modules and CDM-VW300-series Dynamic Vibrating Wire Analyzers allow the measurement of vibrating-wire strain gages, pressure transducers, piezometers, tiltmeters, crackmeters, and load cells. The CDM-VW300 -series is the only true dynamic vibrating wire interface in the world.

Both the AVW200-series and the CDM-VW300-series interfaces use a spectral-interpolation approach that provides superior noise immunity and measurement resolution compared to the time-domain period averaging approach. The AVW200-series devices are optimal for systems that exclusively require measurement rates slower than 1 Hz. The CDM-VW300-series devices, are appropriate when measuring sensors at rates from 1 to 333.3 Hz.

More info: **geotech@campbellsci.co.uk**
campbellsci.eu/bridge-monitoring

Communications

Telecommunication options include short-haul, telephone (land-line, voice-synthesized, and cellular), radio frequency, multidrop, and satellite. Onsite communication options include direct connection to a laptop, CompactFlash cards, Wi-Fi, and field displays.



Software

Our Windows-based software simplifies datalogger programming, data retrieval, and report generation. The datalogger program can be modified at any time to accommodate different sensor configurations or new data processing requirements. Software provides automated alarm and communication functions.

Representative Projects

- James Joyce Bridge—Dublin, Ireland
- Bronx Whitestone Bridge—New York, NY
- Brooklyn Bridge—New York, NY
- Verrazano Narrows Bridge—New York, NY
- Williamsburg Bridge—New York, NY
- Throgs Neck Bridge—New York, NY
- Medway Bridge—Kent, UK
- Menai Bridge—North Wales
- Confederation Bridge—Prince Edward Island, Canada
- I-83 Ramp—Harrisburg, PA
- Birmingham Bridge—Pittsburgh, PA
- Sawmill Run Bridge—Pittsburgh, PA
- Neville Island Bridge—Pittsburgh, PA
- SR 33 Bridge—Easton, PA
- Girard Point Bridge—Philadelphia, PA
- Church Street Bridge—Melbourne, Australia
- David Trumpy Bridge—Queensland, Australia
- 15 Mile Creek Bridge—The Dalles, OR
- I-5 Mckenzie Bridge—Eugene, OR
- Willamette River Bridge—Willamette, OR
- I-64 over Kanawha River—Charleston, WV
- AMTRAK Susquehanna River Bridge—Perryville, MD

Bridge Monitoring Case Studies

Campbell Scientific systems have helped a variety of organizations reach their goals.

Campbell Scientific equipment was used as part of a structural health monitoring (SHM) program to facilitate the maintenance and performance monitoring of the Fremont Bridge.

Campbell Scientific system monitored thermal loading effects on bridge tie girders for the Fremont Bridge in Portland Oregon. A network of our dataloggers performed calculations on the collected data and communicated with the system via an RF450 radio network. From the extensive data that was collected, the engineers were able to prioritize their retrofitting efforts for the Fremont Bridge.

www.campbellsci.eu/fremont-bridge

Our gear monitors bridge stresses while widening of the Huey P. Long Bridge in New Orleans, Louisiana. This bridge is instrumented with an array of 827 static and dynamic strain gages that measure axial and bending load effects on 433 truss members. Campbell Scientific's AVW206 Vibrating Wire Interface allowed the many vibrating wire sensors to be measured without losing data due to noise, and permitted an accelerated construction schedule.

www.campbellsci.eu/louisiana-bridge

Campbell Scientific's CR1000 dataloggers monitor a lift span and counterweight system for the Interstate 5 Bridge near Portland, Oregon. The dataloggers collect structural performance data that is automatically loaded into a database and presented to the bridge engineers over a computer network. This allows the engineers to evaluate lift event data, enabling them to make quick decisions regarding the ongoing safe operation.

www.campbellsci.eu/i5-bridge

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Dam Monitoring —Structural

Data Acquisition for Reliable, Stand-Alone Dam Monitoring

Data Acquisition Systems for Dams

Dataloggers
- Monitor
- Control

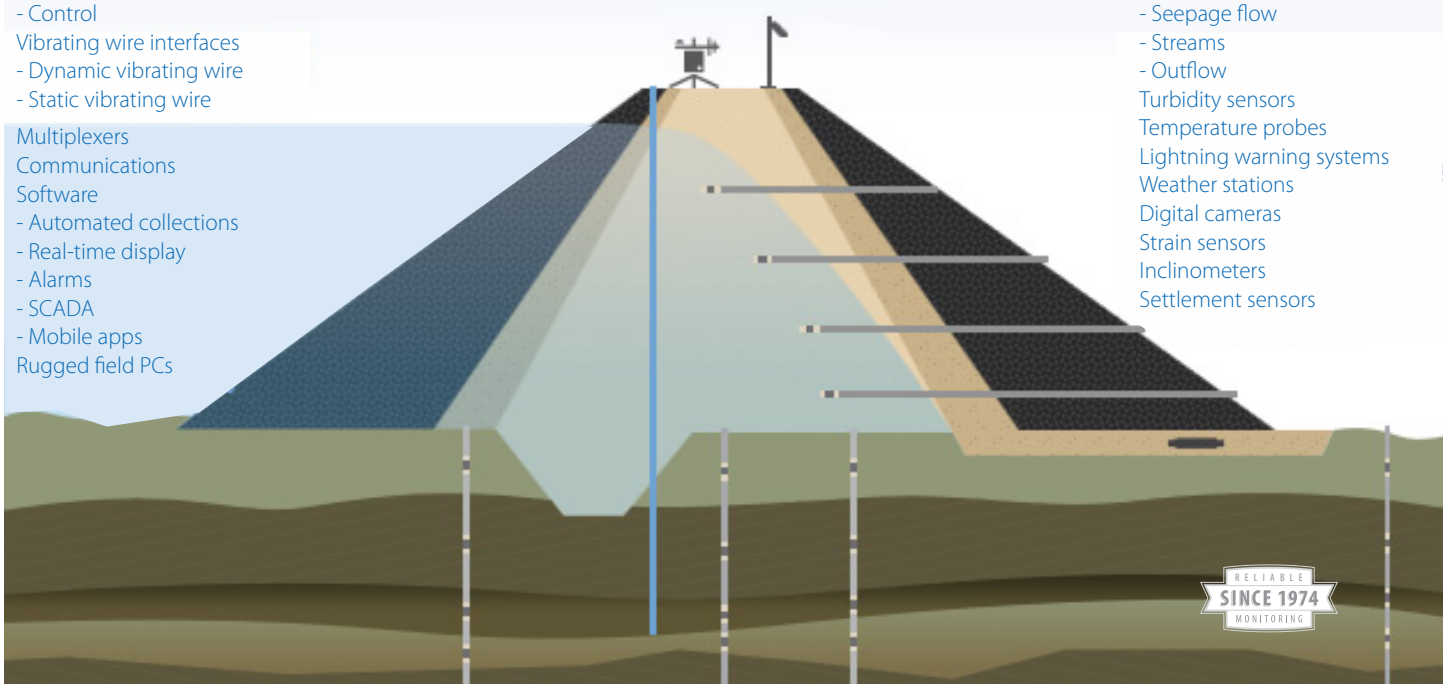
Vibrating wire interfaces
- Dynamic vibrating wire
- Static vibrating wire

Multiplexers
Communications
Software
- Automated collections
- Real-time display
- Alarms
- SCADA
- Mobile apps

Rugged field PCs

Pressure Transducers
- Reservoir level
- Seepage flow
- Streams
- Outflow

Turbidity sensors
Temperature probes
Lightning warning systems
Weather stations
Digital cameras
Strain sensors
Inclinometers
Settlement sensors



Campbell Scientific data-acquisition systems can accommodate any structural dam-monitoring project. Our systems can measure tilt, convergence, displacement, strain, load, vibration, and overburden, as well as any other phenomenon that can affect dam structural integrity. Our systems are compatible with a wide variety of sensors and communication peripherals to fit your exact needs. They are rugged, have low-power consumption, and are adaptable to the harshest, most remote environments.

Custom Systems

We offer a variety of products that can be used to create custom Dam Monitoring—Structural systems. Please don't hesitate to let us help you configure a full system that meets your exact needs.

Dataloggers

We offer a range of dataloggers, from the most basic system with just a few channels to expandable systems that measure hundreds of channels. Scan rates can be programmed from a few hours to 100,000 times per second, depending on the datalogger model. Measurement types, processing algorithms, and recording intervals are also programmable. On-board processing instruction sets allow data reduction in the field.

The control functions of our dataloggers combined with their programmability allow them to sound alarms, actuate electrical devices, or shut down equipment based on time or measured conditions.

Campbell Scientific equipment monitors seepage at the Wolf Creek Dam. The dam consists of a concrete hydroelectric dam and an earth-filled embankment structure.

More info: **geotech@campbellsci.co.uk**
campbellsci.eu/dam-monitoring-structural

Vibrating Wire Interfaces

Campbell Scientific's AVW200-series interface modules and CDM-VW300-series Dynamic Vibrating Wire Analyzers allow the measurement of vibrating-wire strain gages, pressure transducers, piezometers, tiltmeters, crackmeters, and load cells. These sensors are often used for dam safety monitoring applications because of their stability, accuracy, and durability.

Both the AVW200-series and the CDM-VW300-series interfaces use a spectral-interpolation approach that provides superior noise immunity and measurement resolution compared to the time-domain period averaging approach. The AVW200-series devices are optimal for systems that exclusively require measurement rates slower than 1 Hz. The CDM-VW300-series devices, are appropriate when measuring sensors at rates from 1 to 333.3 Hz.

CDM-VW305

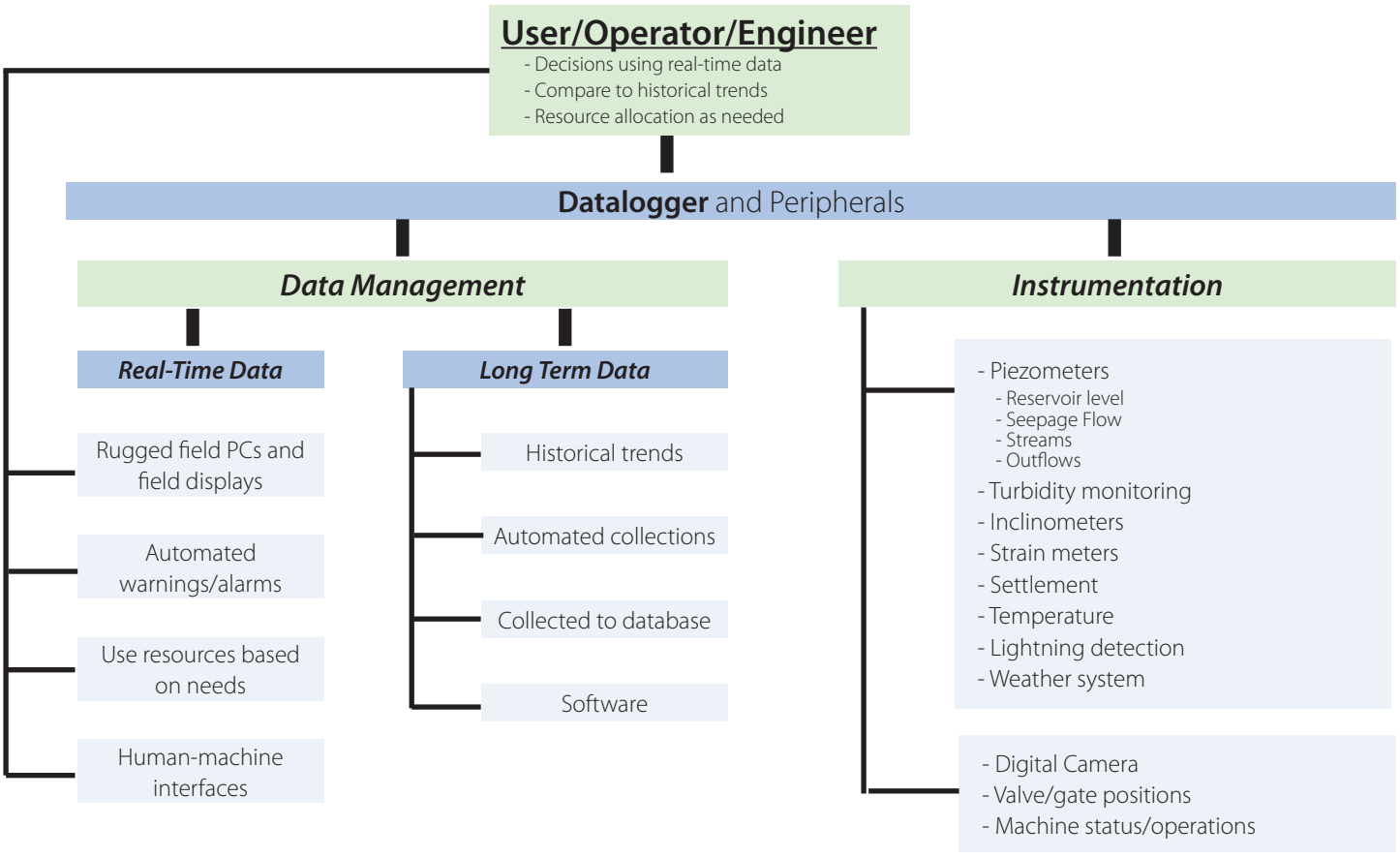
AVW211

Sensors

The versatility of our systems begins with sensor compatibility—they can measure virtually every commercially available sensor—allowing them to be used in a variety of ways for a variety of measurements. Our dataloggers have many channel types and programmable inputs including analog (single-ended and differential), pulse counters, switched excitation, continuous analog output, digital I/O, and anti-aliasing filter.

Communications

The availability of multiple communications options for retrieving, storing, and displaying data also allows systems to be customized to meet exact needs. Onsite communication options include direct connection to a laptop, CompactFlash cards, Wi-Fi, and field displays. Telecommunication options include short-haul, telephone, radio frequency, multidrop, and satellite. Voice-synthesized modems are available, so the system can actually call and tell you what is happening.



CAMPBELL SCIENTIFIC®
WHEN MEASUREMENTS MATTER

Mining

Automated Measurement and Control Systems

Our products are used worldwide in mining operations to keep people safe and mines open. Campbell Scientific systems are versatile, rugged, and reliable; have low power consumption; and are designed for harsh, remote locations or unsafe conditions not suitable for personnel.

Examples include slope stability analysis, weather monitoring, lightning warning, environmental compliance (air and water quality), dam and tailings monitoring, mine ventilation, equipment performance, and roof and shaft stability. All of these can be integrated into a network with data output to GIS or analysis.

Data Acquisition, Retrieval, and Communication

Reliable data can be used to make prompt decisions that reduce risk and liability; promote health and safety; efficiently manage equipment, sites, or multiple assets; and ensure environmental compliance.

Our automated measurement and control systems are capable of measuring virtually every commercially available sensor, then processing, storing, and transmitting the data to your cell phone, field office, or corporate headquarters. Data can be communicated through radios, cellular modems, satellite modems, local networks, and the Internet. This accessibility allows for easy viewing and informed decision making in response to changing conditions.

Alarms and controls are easily integrated so you can suspend operations, move equipment, evacuate an area, or resume work. Systems can be programmed to send alarms or report site conditions by calling out to computers, phones, radios, or pagers.

Applications

Slope stability analysis

Slope stability data can be acquired from known problem areas or a network of measurement and control systems strategically positioned around a mine. Common parameters used by our systems to monitor slope movement include lateral displacement, water level and flow, tilt, soil moisture, crack monitoring, and precipitation.

www.campbellsci.eu/slope-stability

Weather monitoring

Weather stations provide data that can be used to keep mining operations running when conditions warrant and to shut down when people and equipment need to be protected. Weather stations are often used to monitor wind speed and direction, air temperature, precipitation, barometric pressure, and relative humidity.

www.campbellsci.eu/weather-climate

Lightning warning

Lightning warning systems provide real-time data used to trigger shutdowns or evacuations during pre-strike conditions, as well as to identify resume-work conditions when the danger of a lightning strike has passed. Visual, email, text, and audio alarms are available to promote precautionary actions that can save lives and prevent equipment damage. Lightning warning systems are capable of measuring electric fields, lightning strikes, temperature, relative humidity, wind speed and direction, solar radiation, GPS time sync, barometric pressure, and precipitation.

www.campbellsci.eu/lightning

Environmental compliance (air and water quality)

In surface and underground mining operations, there are often multiple air and water quality conditions that must be monitored to ensure compliance with environmental regulatory requirements.

Air quality and pollution monitoring systems automate data collection and reporting processes by measuring solar radiation, gases, particulates, atmospheric stability class, and other required parameters.

www.campbellsci.eu/air-quality

Regardless of salinity level, pollution level, or other harsh environmental conditions, our water quality monitoring and control systems are reliable. These systems measure all relevant parameters, including pH, conductivity, temperature, turbidity, dissolved oxygen, level, flow, and discharge. Specified time, event, or measured conditions can automatically trigger a water quality system to control various devices, such as pumps, mixers, valves, and gates.

www.campbellsci.eu/water-quality

Other applications

Our versatile measurement and control systems are used in a variety of mining applications, including the following:

- Dam and tailings monitoring systems measure water level, flow, and turbidity; slope stability; and air and water quality
- Mine ventilation systems measure barometric pressure, air temperature, relative humidity, and air velocity.
- Equipment performance systems keep mining equipment operating at peak performance levels by monitoring temperature, pressure, RPM, velocity, power, acceleration, position, torque, and strain.
- Roof and shaft stability systems are used to warn of possible cave-in conditions by monitoring changing conditions, cracks, and load distribution.

Mining Case Studies

Campbell Scientific systems have helped a variety of organizations reach their goals. The following are some mining case studies:

For the Montana acid rock application, our equipment characterize soil water content and temperature changes in the reclaimed materials.

Schafer & Associates of Bozeman, Montana are using Campbell Scientific instrumentation to monitor the performance of Acid Rock Drainage (ARD) caps. ARD occurs when water and oxygen react with waste rock from hard rock metal mining.

www.campbellsci.eu/acid-rock-drainage

Fourteen sites in the West Coast of New Zealand contain Campbell Scientific equipment that continuously monitor water quality in coal-mine runoff. Live data is transmitted to a base office for both management and compliance purposes, and to automatically control a lime-dosing plant to raise the pH of the Mangatini stream to ecologically viable conditions.

www.campbellsci.eu/new-zealand-mine

Campbell Scientific's CS110 Electric Field Monitor protects workers at a high-elevation gold mine in Peru. During the lightning storm season, evacuations are frequent, but the system allows work to recommence as soon as conditions are safe again.

www.campbellsci.eu/peru-lightning

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Structural Health Monitoring

Products for Long-Term, Stand-Alone Structural Monitoring

Campbell Scientific data acquisition systems' versatile capabilities make them ideal for structural health monitoring. Our dataloggers applications range from simple beam fatigue analysis, to structural mechanics research, to continuous monitoring of large, complex structures. Campbell systems provide remote, unattended, portable monitoring for highway overpasses, roads, buildings, retaining walls, bridges, and amusement park rides. They make reliable structural measurements, even in harsh environments.

Custom Systems

Most of the systems we sell are customized. Tell us what you need and we'll help you configure a system that meets your exact needs.

Dataloggers

We offer a range of dataloggers, from the most basic system with just a few channels to expandable systems that measure hundreds of channels. Scan rates can be programmed from a few hours to 100,000 times per second, depending on the datalogger model. Non-volatile data storage and a battery-backed clock ensure data capture and integrity.

The control functions of our dataloggers allow them to sound alarms and control devices based on time or measured conditions.

Sensors

The versatility of our systems begins with sensor compatibility—they can measure virtually every commercially available sensor—allowing them to be used in a variety of ways for a variety of measurements. Our dataloggers have many channel types and programmable inputs including analog (single-ended and differential), pulse counters, switched excitation, continuous analog output, digital I/O, and anti-aliasing filter. Our dataloggers have input resolutions to 0.16 microvolts, allowing strain measurements with a resolution of a single micro-strain.

Typical Sensors

- Strain meters
- Foil strain gauges (in quarter-, half-,or full-bridge strain configurations)
- Vibrating-wire strain gauges
- Vibrating-strip sensors
- Inclinometers
- Crack and joint sensors
- Tilt sensors
- Piezoresistive accelerometers
- Piezoelectric accelerometers
- Capacitive accelerometers
- Borehole accelerometer
- Force balance accelerometers

More info: **geotech@campbellsci.co.uk**
campbellsci.eu/structural-health-monitoring

Communications

The availability of multiple communications options for retrieving, storing, and displaying data also allows systems to be customized to meet exact needs. Onsite communication options include direct connection to a laptop, CompactFlash cards, Wi-Fi, and field displays. Telecommunication options include short-haul, telephone (land-line, voice-synthesized, and cellular), radio frequency, multidrop, and satellite.

Software

Our Windows-based software simplifies datalogger programming, data retrieval, and report generation. The datalogger program can be modified at any time to accommodate different sensor configurations or new data processing requirements.

Structural Case Studies

Our structural systems have helped a variety of organizations reach their goals. The following are a couple of these:

Campbell Scientific dataloggers were used to monitor structural cracks, soil moisture, and weather conditions in support of preserving the Castillo de San Marcos, St. Augustine, Florida..

www.campbellsci.eu/castillo-de-san-mar

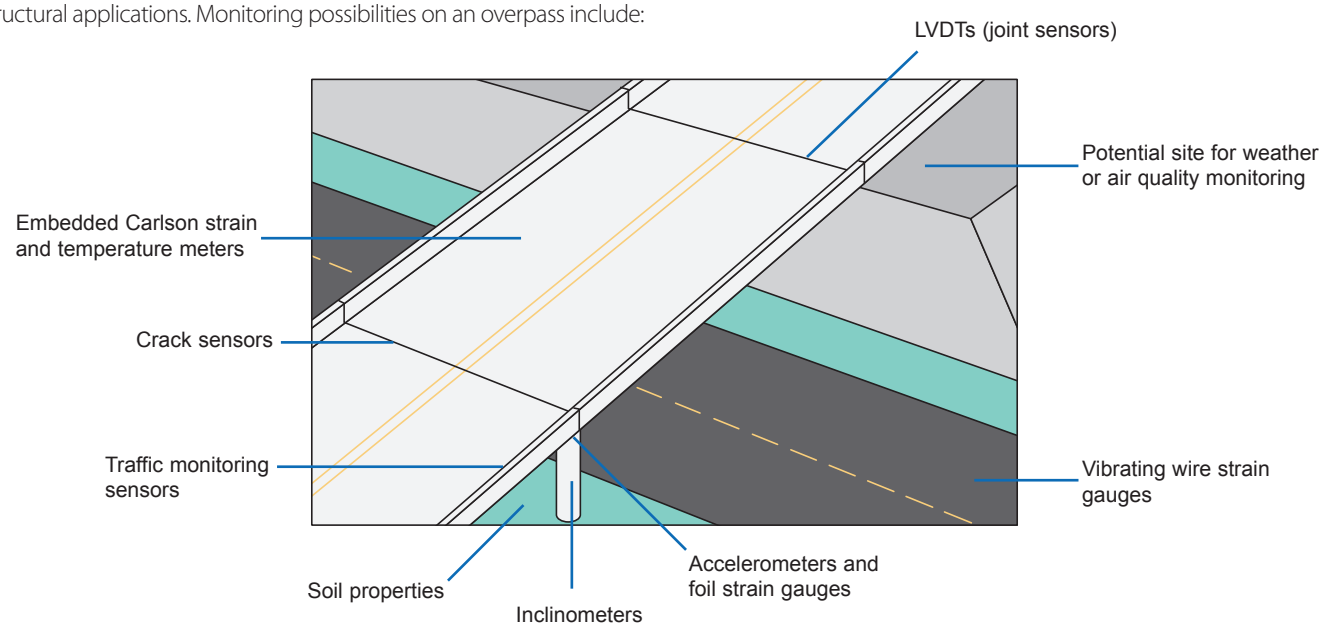
Campbell gear was used to study the performance of concrete floors in large warehouses and distribution centers. To do this, our dataloggers monitored vibrating wire strain gages that were cast into test slabs at a major Bookers site in Northampton, UK.

www.campbellsci.eu/concrete-performance

Campbell Scientific dataloggers can provide remote, unattended monitoring of buildings, overpasses, amusement park rides, roads, and retaining walls.

Example Application: Structural Monitoring of an Overpass

Campbell Scientific's monitoring systems are used for a variety of structural applications. Monitoring possibilities on an overpass include:



CAMPBELL SCIENTIFIC
WHEN MEASUREMENTS MATTER

DATALOGGERS

Also known as Data Loggers, Data Recorders, & RTUs

Rugged, reliable, and ready for any application

RELIABLE SINCE 1974 MONITORING

Dataloggers are the heart of a data acquisition system. They measure sensors at a specific scan rate, process data, store the data, and initiate telecommunications. Our dataloggers also have control capabilities allowing them to respond to specific site conditions by opening flood gates, turning fans off/on, etc. All our dataloggers share similar measurement and programming capabilities. Selection of the appropriate datalogger depends mainly on the type, number, precision, and speed of measurements required.

MAJOR SPECIFICATIONS

		Channels	*Input Voltage Range*	*Analog Voltage Resolution*	*A/D Bits*	*Maximum ScanRate*
CR6* | Innovative Vibrating Wire Powerfully versatile multi-tool for data acquisition; onboard vibrating-wire measurement **CR6** **The number of measurements listed in the Channels column assumes all of the U and/or C channels are configured for that type of measurement.*		12 universal (U) and 4 control (C) terminals are programmable to measure up to: • 12 SE analog inputs • 6 DF analog inputs • 16 pulses • 12 voltage switched excitation • 12 current switched excitation • 2 RS-232 • 2 RS-485 • 16 I/Os, • 8 SDI-12	±5000 mV	to 80 nV	24	1 kHz
CR800 | Smaller, Simpler Research-grade power for smaller installations **CR800**		Analog: 6 SE or 3 DF Pulse: 2 Switched Excitation: 2 voltage Digital: 4 I/O or 2 RS-232	±5000 mV	to 0.33 µV	13	100 Hz
CR1000 | Rugged Versatility Multipurpose monitoring and control **CR1000**		Analog: 16 SE or 8 DF Pulse: 2 Switched Excitation: 3 voltage Digital: 8 I/O or 4 RS-232	±5000 mV	to 0.33 µV	13	100 Hz
CR3000 | Fast, Compact Supports complex installations, built-in keyboard and display **CR3000**		Analog: 28 SE or 14 DF Pulse: 4 Switched Excitation: 4 voltage 3 current Digital: 3 SDM, I/O, or 4 RS-232 Continuous Analog Output: 2	±5000 mV	to 0.33 µV	16	100 Hz
CR9000X | Fastest Modular, customizable for demanding research applications **CR9000X**		Analog: 28 SE or 14 DF per CR9050, CR9051E, or CR9055(E) Pulse: 12 per CR9071 Switched Excitation: 10 voltage per CR9060 Digital: 1 SDM, 8 outputs per CR9060 or 16 I/Os per CR9071 Continuous Analog Output: 6 per CR9060	±5 w/CR9050 or CR9051E, ±50 w/ CR9055(E), ±60 w/CR9058E	to 1.6 µV	16	100 kHz

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info: **geotech@campbellsci.co.uk**
campbellsci.eu/dataloggers

CAMPBELL SCIENTIFIC
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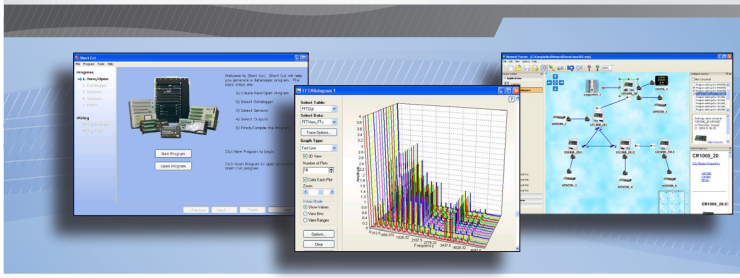
STARTER & DATALOGGER SUPPORT SOFTWARE

For datalogger programming, communications, and data display

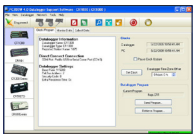
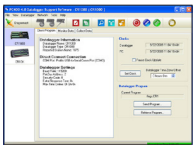
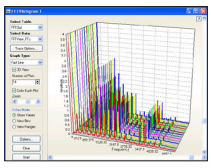


Rugged, Reliable, and Ready for any Application

RELIABLE SINCE 1974 MONITORING

Our datalogger support software packages support datalogger programming, communications between datalogger and PC, and to varied extents, real-time and historical data monitoring. They allow a customer to support a single station or an entire datalogger network.

MAJOR SPECIFICATIONS

	Software Level	Contemporary Dataloggers Supported	Communications Supported	Other Products Supported	Scheduled Data Collection Supported	Data Display Supported
SCWin | Short Cut Program Generator for Windows Download free of charge 	Entry	CR6, CR200X-series, CR800, CR850, CR1000, CR3000, CR5000, CR9000X	N/A (program generator only)	over 100 sensors (including generic measurements), multiplexers, AVW200-series Vibrating Wire Interfaces, ET107	N/A (program generator only)	N/A (program generator only)
PC200W | Datalogger Starter Software Basic tools, download free of charge 	Entry	CR6, CR200X-series, CR800, CR850, CR1000, CR3000, CR5000, CR9000X	direct connect	PC cards, CompactFlash cards, microSD cards	no	numeric, simple, line graph
PC400 | Datalogger Support Software Easy Setup with powerful tools and editors 	entry to intermediate	CR6, CR200X-series, CR800, CR850, CR1000, CR3000, CR5000, CR9000X	direct connect, Ethernet, short-haul, phone modems (land-line, cellular, voice synthesized), RF transceivers (UHF, VHF, and spread spectrum), multidrop modems	most commercially available sensors, SDM devices, multiplexers, relays, vibrating wire interfaces, ET107, CompactFlash cards, microSD cards, PC cards s	no	numeric, simple, line graph
LoggerNet | Datalogger Support Software Easy Setup with powerful tools and editors 	intermediate to advanced	CR6, CR200X-series, CR800, CR850, CR1000, CR3000, CR5000, CR9000X	direct connect, Ethernet, short-haul, phone modems (land-line, cellular, voice synthesized), RF transceivers (UHF, VHF, and spread spectrum), multidrop modems Combinations of communication devices supported	most commercially available sensors, SDM devices, multiplexers, relays, vibrating wire interfaces, ET107, CompactFlash cards, microSD cards, PC cards	yes	numeric, graphical, Boolean data objects
RTDAQ | Real-Time Data Acquisition Software 	intermediate to advanced	CR6, CR800, CR850, CR1000, CR3000, CR5000, CR9000X	direct connect, Ethernet, short-haul, phone modems (land-line, cellular, voice synthesized), RF transceivers (UHF, VHF, and spread spectrum), multidrop modems	most commercially available sensors, SDM devices, multiplexers, relays, vibrating wire interfaces, ET107, CompactFlash cards, microSD cards, PC cards	no	numeric, graphical, Boolean data objects

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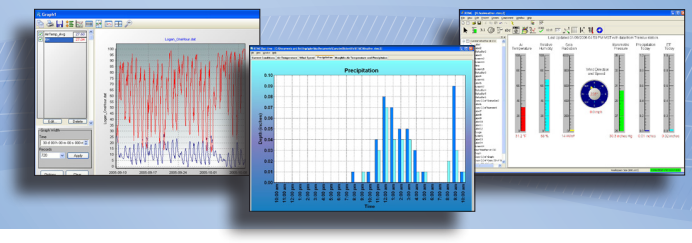
WHEN MEASUREMENTS MATTER

DATA GRAPHICS & ANALYSIS SOFTWARE

For data display

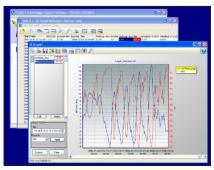
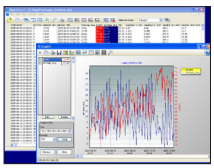
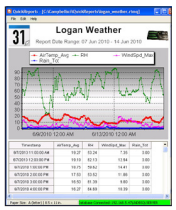
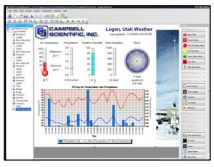
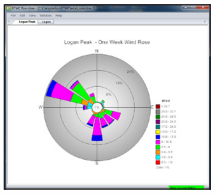


Rugged, Reliable, and Ready for any Application

RELIABLE SINCE 1974 MONITORING

These software packages are designed to display data retrieved from Campbell Scientific dataloggers. The data is displayed in graphical formats such as strip charts, dials, scatter plots, and meters, as well as digital values. Several of these packages also include alarms.

MAJOR SPECIFICATIONS

		Purchased Separately	*Design Goal*	*Real-Time Updates*	*Alarms*	*Designer Tool Kit*
View | Simple Line Graphs and Data Display		no (included in PC200W and PC400)	quick and simple viewer for data files	no (historic only)	none	one table and graph
View Pro | Graphical and Tabular Data Display		no (included in LoggerNet and RTDAQ)	graphically appealing, flexible, powerful	no (historic only)	none	tables, graphs with multiple traces, FFTs, histograms
QuickReports | Graphical and Tabular Data Display		no (included in LNDB)	simple report generator using an LNDB database	no (historic only)	none	tables, graphs with multiple traces
RTMC | Real-Time Monitoring and Control Software		no (included in RTDAQ, LoggerNet, LoggerNet Admin, LoggerNetData)	starter software, simple, yet graphically appealing	yes	real-time, visual, audible	alarms, COM check, gauges, charts, images, labels, digital displays, set points, sliders, status bars, table displays, time displays, switches
RTMC Pro | Real-Time Monitoring and Control Software, Professional		yes (as an enhancement to RTMC)	graphically appealing, flexible, powerful	yes	real-time, visual, audible, multilevel alarms possible, alarm log, launch programs, email notifications	all the tools included in RTMC, as well as additional alarm types, switches, layout components, hot spots launch commands, FTP file transfer, run cora commands, xy chart, oscilloscopes

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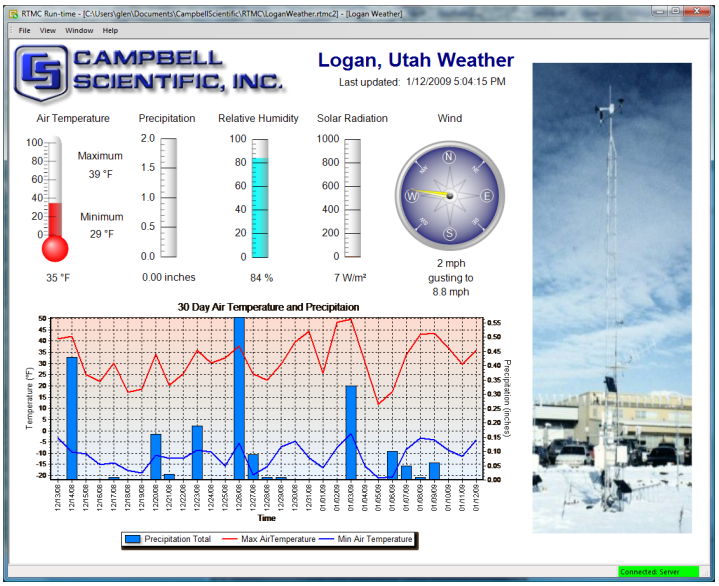
RTMC Run-Time (RTMCRT)



RTMC projects developed in RTMC Development or RTMC Pro are run using RTMC Run-Time. RTMC Run-Time is included with LoggerNet, LoggerNetAdmin, RTDAQ, and RTMC Pro. Additional RTMC Run-Time versions can be purchased separately and installed on computers that are networked to a LoggerNet computer. This allows remote PCs to display data in a graphical format from a LoggerNet server.

As LoggerNet collects data from the datalogger, the displays in RTMC Run-Time are automatically updated. RTMC Run-Time also allows the user to change public variable values or input locations, as well as toggle ports/flags if those capabilities were enabled in the RTMC project during development.

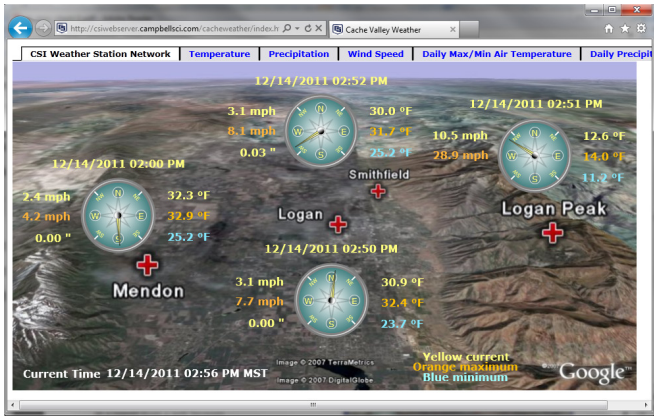
The RTMC Run-Time and CSI Web Server clients run projects created in RTMC Development or RTMC Pro. RTMC Development is bundled with LoggerNet, LoggerNet Data, and RTDAQ.

CSI Web Server

The CSI Web Server is included with RTMC Pro and can also be purchased separately. It allows you to view your RTMC projects using a web browser. You can also change input locations and public variable values, toggle ports/flags, and browse through historical report data from a web browser.

The CSI Web Server includes a CSI Web Server Administrator and a Web Publisher. The CSI Web Server Administrator allows you to configure the web server, check the status of the web server, set up user accounts and passwords, and easily browse to sites running on the web server. The Web Publisher allows you to publish your RTMC project to either a PC website using the CSI Web Server or to an HTTP enabled datalogger.

A CSI Web Server trial is included with the RTMC Pro trial version. To receive this fully-functional 30-day trial version, go to www.campbellsci.eu/downloads.



CSI Web Server was used to simultaneously display data from multiple dataloggers on one web page.

CSI Web Server for Linux

CSI Web Server for Linux provides a solution for those who want to run the CSI Web Server in a Linux environment. The package includes a Linux version of the CSI Web Server and a Windows version of the Web Publisher. The Web Publisher is installed on a Windows machine and used to publish RTMC projects to the Linux-based CSI Web Server. CSI Web Server for Linux includes a Debian distribution and two RPM distributions—Red Hat and SUSE.

Requirements and Certificates

- PC Operating System: Windows 8, 7 (32 and 64 bit), Vista, or XP
- Military Certificate of Networthiness (CoN):
  - RTMC Pro 4.0 is certified as Cert #201416753.
  - RTMC Pro 4.x is certified as an upgrade to 4.0 and has ASC CoN ID 12272
  - Expires 1/21/2017

RTMC Run-Time version 4.2 and CSI Web Server are optimized for using projects created with the RTMC 4.2 development tools (RTMC Development or RTMC Pro). Although RTMC Run-Time version 4.2 and CSI Web Server can use projects from version 2.5 or 3.2 development tools, the run-time display or web display may look different than what's expected. For best performance, RTMC version 4.2 development tools should be used to develop projects for RTMC Run-Time version 4.2 and CSI Web Server.

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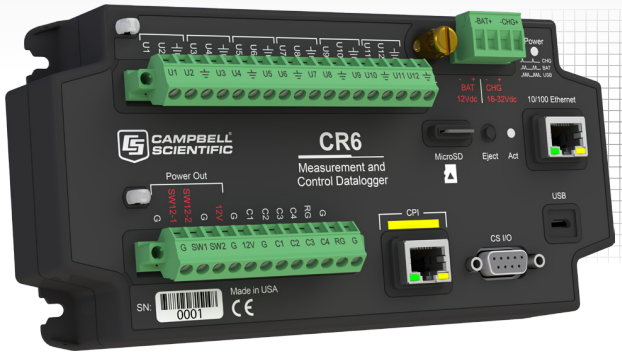
WHEN MEASUREMENTS MATTER

CR6-Series

Measurement and Control Datalogger



Vibrating-Wire Datalogger

Innovative design and countless applications

Overview

The CR6-series measurement and control datalogger is a powerful core component for your data acquisition system. We combined the best features of all our dataloggers and added faster communications, low power requirements, built in USB, compact size, and improved analog input accuracy and resolution. The CR6 series also introduces our new universal (U) terminal—an ingenious way for allowing virtually any sensor, analog digital or smart, to be connected to any U terminal. This is also our first multipurpose datalogger capable of doing static vibrating-wire measurements. With the CDM-VW300, dynamically it measures any vibrating-wire gage.

Benefits and Features

- Powerfully versatile, multi-tool of data acquisition
- U terminals configurable to what you want them to be: analog or digital, input, or output
- Static vibrating wire measurements using our patented spectral analysis
- Surge and over-voltage protection on all terminals
- Flexible power input from solar panel, dc power supply, 12 V battery, USB
- Onboard communication via Ethernet 10/100
- Wiring made easy through removable terminal block
- MicroSD card drive for extended memory requirements
- Serial sensors support with RS-232 and RS-485 native
- CPI for hosting Campbell high speed sensors and distributed modules (CDM)
- Programmable with CRBasic or SCWin program generator, completely PakBus compatible
- Shared operating system (OS) with the popular CRBasic CR1000 and CR3000 dataloggers

Specifications

- **CPU:** 32 bit with hardware FPU, running at 100 MHz
- **Internal Memory:** 4 MB SRAM for data storage, 6 MB flash for OS, 1 MB serial flash (CPU) for program files
- **MicroSD Drive** for extended data storage up to 16 GB
- **Clock Accuracy:** ±3 min per year, optional GPS correction to 10 µs
- **USB micro B** for direct connection to PC (limited power source during configuration), 2.0 full speed, 12 Mbps
- **10/100 Ethernet RJ45** for LAN connection
- **CS I/O port** for connection to Campbell Scientific modems and displays
- **CPI port** for terminal expansion using Campbell Distributed modules (CDM)
- **Battery terminal pair** for regulated 12 V power input or rechargeable 12 V VRLA for UPS mode
- **Charge terminal pair** for 16 to 32 V from dc power converter or 12 or 24 V solar panel
- **Two switched 12 V terminals** for powering sensors or communication devices, 1100 mA @ 20°C
- **Continuous 12 V terminal**

Info: **geotech@campbellsci.co.uk**
www.campbellsci.eu/cr6

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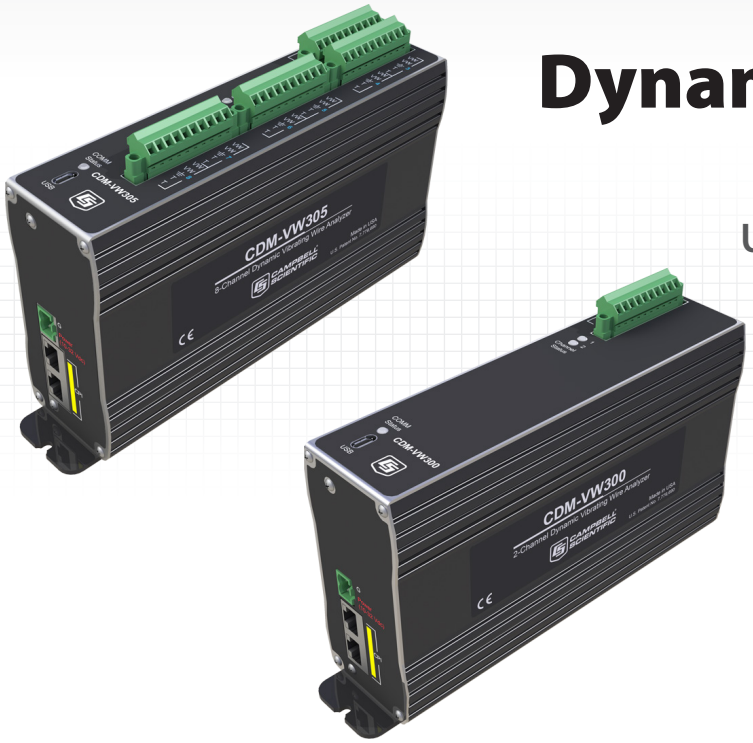
CDM-VW300 Series

Dynamic Vibrating-Wire Measurement Modules



Dynamic vibrating-wire measurements

Uses patented VSPECT™ technology for noise immunity and industry-leading quality[a]

Overview

The CDM-VW300 and CDM-VW305 modules are designed to interface with standard single-coil circuit vibrating-wire sensors such as strain gages, load cells, pressure transducers, crackmeters, and tiltmeters. They provide dynamic measurements at rates of 20 to 333 Hz for these sensors. The CDM-VW300 is the two-channel version and the CDM-VW305 is the eight-channel version.

These modules use an excitation mechanism that maintains the vibrating-wire sensor in a continuously vibrating state. The module measures the resonant frequency of the wire between excitations using the patented vibrating-wire spectral-analysis technology (VSPECT™). VSPECT provides very fine measurement resolution and also limits the influence of external noise by discriminating between signal and noise based on frequency content.

Benefits and Features

- Interfaces to standard single-coil vibrating-wire sensors
- Two or eight simultaneously sampled channels per module; synchronizable across multiple modules
- Dynamic measurement rates of 20 to 333 Hz
- Static measurement at 1 Hz made simultaneously with the dynamic measurement
- Spectral interpolation approach provides superior noise immunity and measurement resolution compared to time-domain period-averaging approach
- Excitation method provides frequent low-energy pulses to maintain a continuous resonant vibration in the sensor
- Thermistor input for each vibrating-wire channel is sampled at 1 Hz
- Datalogger communications via CPI
- User configurable, onboard post-processing of the data including frequency output conversion, temperature conversion, and rainflow histogram collection

[a]The dynamic vibrating-wire measurement technique is protected under U.S. Patent No. 8,671,758, and the vibrating-wire spectral-analysis technology (VSPECT™) is protected under U.S. Patent No. 7,779,690.

questions & quotes: **geotech@campbellsci.co.uk**
www.campbellsci.eu/cdms

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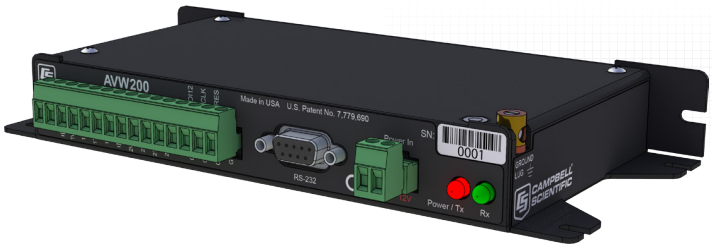
AVW200 Series

Vibrating-Wire Modules

Greatly Reduces Signal Noise

Uses Patented Vibrating-Wire Spectral-Analysis Technology[a] (VSPECT™) for Better Readings



Overview

Campbell Scientific's AVW200-series interface modules allow the measurement of vibrating-wire strain gages, pressure transducers, piezometers, tiltmeters, crackmeters, and load cells. These sensors are used in a wide variety of structural, hydrological, and geotechnical applications because of their stability, accuracy, and durability.

Benefits and Features

- Provides better measurements by significantly reducing incorrect readings caused by noise sources
- Self-checking diagnostics such as vibrating element signal strength, signal-to-noise ratio, vibrating-element signal decay ratio, and incorrect signal response give continual feedback on sensor condition
- High resolution—less than 0.001 Hz (industry standard is 0.1 Hz)
- Low current drain
- Interfaces both temperature and frequency measurements from vibrating-wire sensors
- Interfaces two vibrating-wire sensors; more sensors may be connected if an AM16/32B multiplexer is used
- Supports standalone capability by using a wireless model (AVW206, AVW211, AVW216)

VSPECT Description

VSPECT POWERED

To provide better vibrating-wire measurements, Campbell Scientific developed the vibrating-wire spectral-analysis technology (VSPECT). This innovative, patented technology delivers the most accurate measurement for vibrating-wire sensors. VSPECT observes the incoming sensor signal, performs a Fourier transform and a spectral analysis (transforming the time series into individual sinusoidal components in the frequency spectrum), and determines the sensor frequency by identifying the largest signal in the acceptable range and disregarding noise.

Models/Datalogger Communications

All of the models can communicate with the datalogger using RS-232 or SDI-12. Three of the models also include an internal spread spectrum radio that allows them to communicate wirelessly.

Model	Where Used	Power	Frequency	Communicates With
AVW200	not applicable (base model)			
AVW206	U.S., Canada	250 mW[b]	910 to 918 MHz	RF401A, RF401, or RF430
AVW211	Australia, New Zealand	250 mW[b]	920 to 928 MHz	RF411A, RF411, or RF431
AVW216[c]	many countries worldwide	50 mW	2.450 to 2.482 GHz	RF416[c] or RF432[c]

[a]*The VSPECT technology is protected under U.S. Patent No. 7,779,690.*

[b]*Older AVW206 modules (serial # < 11224) and older AVW211 modules (serial # < 11676) had 100 mW radios. Newer modules that have 250 mW radios must use OS 5 or higher for their operating system.*

[c]*Purchase of this product is not recommended for new networks deployed in the European Union (EU) that may require future expansion. This and other RF compatible products will not be available for sale in Europe after 1/1/2015 due to changes in EU legislation.*

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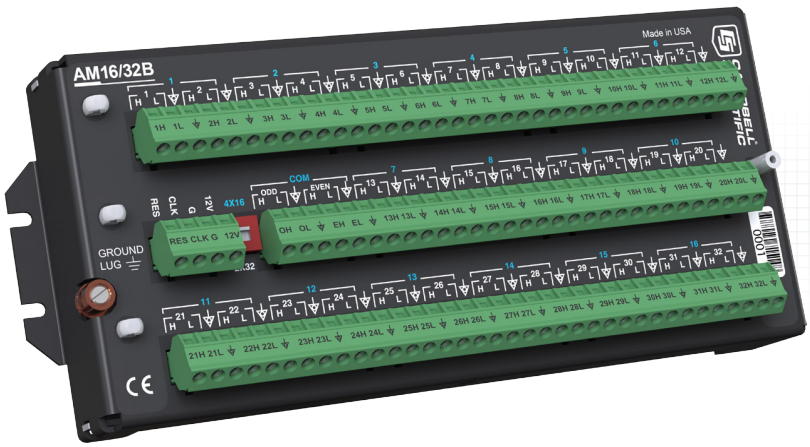
AM16/32B

16- or 32-Channel Relay Multiplexer

Greatly Increases Sensor Capacity

Connects many sensors to a single datalogger



Overview

The AM16/32B multiplexer significantly increases the number of sensors that can be measured by a Campbell Scientific datalogger. It multiplexes 16 groups of four lines (a total of 64 lines) through four common (COM) terminals. Alternatively, a manual switch setting allows the AM16/32B to multiplex 32 groups of two lines (also a total of 64 lines) through two COM terminals.

Benefits and Features

- Significantly increases the number of sensors the datalogger can measure
- Multiplexes up to 32 sensors at a time
- Supports many types of sensors including thermistors, potentiometers, strain gages, vibrating wires, reflectometers, and soil moisture blocks
- Eliminates the requirement for dc blocking capacitors for gypsum soil moisture blocks, significantly reducing sensor cost
- Decreases the cost of cabling individual sensors on long wire runs
- Allows a relay address to be used to go directly to a specific channel—reducing power consumption and wear on the relay switches
- Protects the equipment from electrical surges by including gas tubes on all of the inputs and having a ground lug
- Prevents sensor-cable damage by providing strain relief for sensor leads and independent routing for sensor shield lines

Power Considerations

The AM16/32B draws less than 210 µA quiescent, 6 mA active—so power considerations are heavily tied to the percentage of time in quiescent versus active states. Use of a relay address can reduce power consumption by minimizing the time spent in an active state. In most applications, the datalogger's sealed rechargeable power supply should be more than sufficient; the datalogger's alkaline power supply can be used in applications where the multiplexer is activated infrequently

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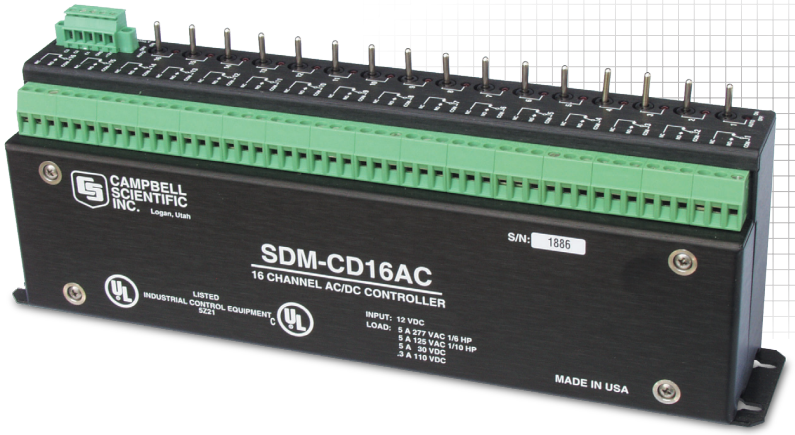
WHEN MEASUREMENTS MATTER

SDM-CD16AC

16-Channel AC/DC Relay Controller



Greatly Expands Control Capacity

Use multiple modules for up to 256 control ports

Overview

The SDM-CD16AC allows a Campbell Scientific datalogger to automatically activate external ac or dc devices such as motors, pumps, heaters, valves, and fans. This ac/dc relay controller has 16 ports for connecting the ac or dc devices. Each port can be controlled automatically by the datalogger's program or controlled manually with an override toggle switch.

Benefits and Features

- Allows the datalogger to automatically turn devices on or off when a threshold (e.g., temperature, water depth) has been reached
- Enables up to 16 SDM-CD16ACs to be addressed, so that up to 256 ports can be controlled from the first three datalogger control ports
- Includes LEDs that indicate when a port is active
- Provides a manual override for each port
- UL/CUL approved product

Technical Description

The SDM-CD16AC has toggle switches that provides three positions: ON and OFF for manual override, and AUTO for datalogger control. In the ON position, the common (COM) and normally open (NO) contacts are closed. In the OFF position, the normally open contact is open. In the AUTO position, the state of the relay is controlled by the SDM command issued through the datalogger's control ports or SDM terminal.

SDM Operation

The SDM-CD16AC is a synchronously addressed datalogger peripheral. Datalogger control ports 1, 2, and 3 are used to address the SDM-CD16AC, then clock out the desired state of each of the 16 control ports. Up to 16 SDM-CD16ACs may be addressed, making it possible to control a maximum of 256 ports from the first three datalogger control ports.