

The

A newsletter for the customers of
Campbell Scientific, Inc.

CAMPBELLUPDATE

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Lightning Warning—The Best of Both Worlds

CS110 Electric Field Meter Combines with Strike Guard

Campbell Scientific and Wxline have teamed up to combine the CS110 Electric Field Meter and the Strike Guard® lightning detection system to satisfy the most demanding lightning hazard warning applications. The CS110/Strike Guard system provides the user with both continuous electric field measurements and comprehensive lightning detection information. Results are displayed on custom RTMC screens at local and remote locations.

The CS110 measures the electric field induced at the ground by clouds located within a 5- to 7-mile radius of the sensor, from which the potential for lightning can be forecast. In contrast to traditional rotating-vane electric field meters, the CS110 incorporates a reciprocating shutter to intermittently expose a sensing electrode to external electric fields. The reciprocating approach allows for a direct electrical connection to the shutter instead of a problematic rotating contact. The fully closed shutter position on the CS110 also provides a zero-field reference for each measurement cycle, providing for DC error correction.

Strike Guard is an optical-coincidence lightning sensor that detects cloud and cloud-to-ground lightning within a 20-mile radius. Strike information is classified in three range categories as lightning detected within 5 miles, 10 miles, and 20 miles. The optical-coincidence approach requires a characteristic optical signal to coincide with a characteristic magnetic-field-change signal to report lightning.

The CS110/Strike Guard system combines the advantages of two complementary lightning-warning technologies into a single package for complete lightning-threat measurement and analysis. The CS110 reports electric fields associated with local thunderstorm development, providing a warning prior to hazardous discharges. The

Strike Guard reports lightning discharges out to 20 miles, providing a comfortable warning time for incoming storms. This yields a robust lightning-hazard warning system, similar to those in use at many major airports.

The CS110/Strike Guard system is mounted on a tripod or single pole and can be solar powered. Fiber-optic or radio links offer enhanced reliability compared to hard-wire communication in a lightning environment.

For each application, the user defines lightning alarm and all-clear conditions based on elec-

tric field thresholds and strike detection information. Numerous user-selected notification options are available for signaling the crossing of alarm and all-clear thresholds, including:

- Email notification
- Local audible notification
- Web-based display
- PC-based alarming
- Local stackable light beacons

The wireless WAVE® sirens and strobes from Wxline are ideal for notification across larger areas, such as parks, golf courses, industrial complexes, military installations, airports, and sports fields.



Message from the President



Application Engineering Provides a Human Touch

by Paul Campbell

At the main offices of Campbell Scientific, there is a staff of about 35 application engineers (AEs) who are mainly responsible for helping customers with technical problems.

They are engaged in the following activities:

- Responding to technical questions and requests for assistance
- Recommending products and services
- Configuring systems
- Training
- Writing or debugging datalogger programs
- Customizing PC support software screens
- Testing products and systems
- Writing or reviewing manuals

It has been the company's policy to include the cost of a basic level of these services in the price of equipment that customers purchase, with additional services available at a reasonable cost. The AEs add value to our customers' experience with Campbell Scientific equipment, but it is a daunting task to keep abreast of the many products and markets served by the company. For this reason, they are divided into groups to focus on industrial, water resource, and environmental mar-

kets. There is also a group of our AEs focused on PC software support issues.

Automated assistance is available through our Web site covering basic principles of electromechanical measurement, product specifications, system configuration, and a plethora of products, setups, and services. Information at www.campbellsci.com helps with:

- Product literature and specifications
- Application notes
- Case studies by application or solution
- Links to related products and services
- Links to consultants and integrators offering more specialized or local service
- White papers on measurement techniques
- Downloads of updated software and operating systems
- Operator manuals

We appreciate the opportunity to serve you and hope that you will find effective solutions to your measurement problems through your experience using Campbell Scientific products. We work diligently to provide a high level of competent technical support for your assistance. Furthermore, the AEs and all the staff at Campbell Scientific seek to do business in a friendly and professional manner. For your next project, please give us a call or contact us through info@campbellsci.com.

CR1000 Data on the Internet—It's Magic!

by Ryan Campbell

Whether for email, shopping, work, or entertainment, most people deal with the Internet on a daily basis; nevertheless, the average person knows very little about the elusive workings of this complex system. That is why I initially found the task of making my CR1000's data available on an Internet web page overwhelming, if not impossible. However, after talking with application engineers and others at Campbell Scientific, I discovered that the task could be made incredibly easy by using the NL115 Ethernet Interface and CompactFlash® module.

Beginning with a traditional hardware setup (i.e., CR1000 directly connected to a PC with a serial RS-232 cable, power supply, etc.), I obtained an NL115 module, which I connected to the CR1000's peripheral port. The NL115 has a 10BaseT Ethernet port that I connected to a local Ethernet hub. Next, I used my computer and Campbell Scientific's Device Configuration Utility software to enter in the datalogger's IP address, the subnet mask, and the IP Gateway. These three values are used for addressing the datalogger and were obtained from my network administrator. Finally, I used LoggerNet's Setup Screen to add the IP port and enter its address (all of the detailed setup instructions can be found in the NL115 manual).

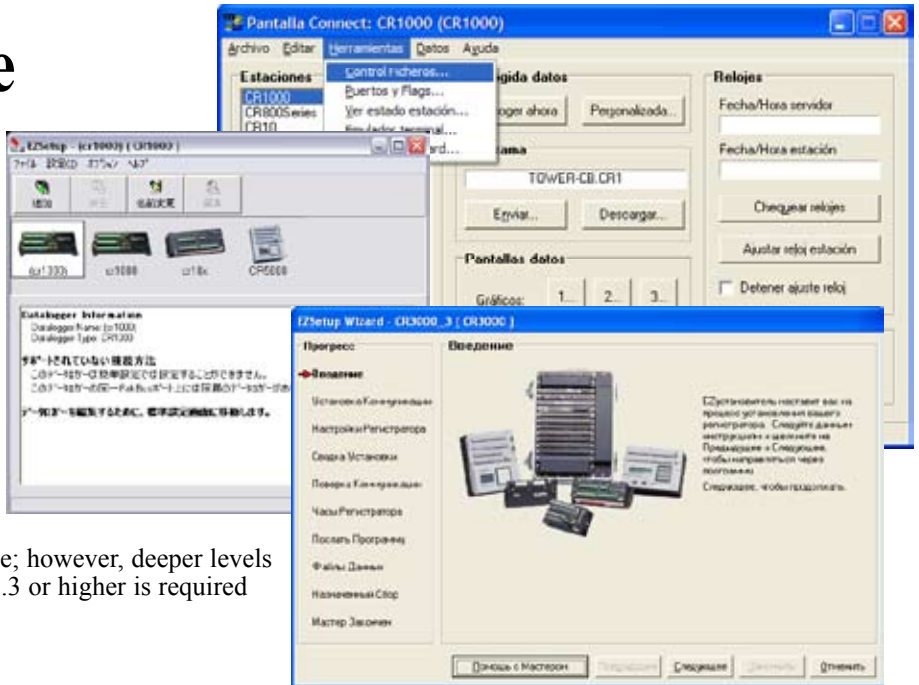
As in a traditional setup, I wrote a program with CRBasic and sent it to the datalogger using LoggerNet's Connect Screen. I checked and confirmed that the program was running properly. Up to this point, all setup operations and communications had been done through the direct RS-232 connection. I then closed down LoggerNet and crossed my fingers that everything had been done correctly. I was now ready to attempt Ethernet communication.

I launched my Internet browser and keyed in my CR1000's IP address. To my delight, a Web site with the heading *CR1000 Datalogger Home Page*, popped up along with a list of data tables. All the tables that I had defined in my program were shown, and each one reported the most recently logged results. I almost couldn't believe how easy and fast the whole process was, and I found myself thinking what so many others have said about the Internet: "It must be magic. . . ."

Ryan is a chemistry student at Utah State University who works part-time at CSI.

Foreign Language Versions of LoggerNet

LoggerNet language files are now available in Spanish, Japanese, and Russian; French, German, Korean, and Chinese will be added in the future. Please visit us at <http://www.campbellsci.com/downloads> and select "Software Language Files" to obtain the new files. They're easy to install and you can easily switch from one language to another. The files allow command choices to be displayed in the language of choice; however, deeper levels of the software remain in English. LoggerNet 3.3 or higher is required to run the language files.



WindSonic1 Added

We have added the WindSonic1 (RS-232 output), manufactured by Gill Instruments, to our product line. The WindSonic1 joins the WindSonic4 (SDI-12 output) as a two-dimensional ultrasonic anemometer for measuring wind speed and direction. The WindSonic1 is a cost-competitive, low-power (264 mW),



unheated, no-moving-part (zero-maintenance) alternative to traditional mechanical wind measurement sensors.

The WindSonic1 is configured at Campbell Scientific for use with the CR800/850, CR1000, or CR3000. With the CR800/850, up to two WindSonic1 sensors can be measured at 2 Hz. On the CR1000 or CR3000, up to four WindSonic1 sensors can be measured at 2 Hz. The sensors are measured using the SerialInRecord() instruction and the datalogger's UART serial ports (each composed of two control ports).

The WindSonic1 is available with cable lengths up to 50 feet. Longer distances between sensor and datalogger can be achieved with two RAD SRM-5A short-haul modems and the HUB-SDMS junction box. Although more expensive, the WindSonic4 will remain available for those who require or prefer it.

Training Offered

Campbell Scientific offers comprehensive training courses on our dataloggers and software. Visit our Web site at www.campbellsci.com/training to see the current schedule and register on line. These courses emphasize datalogger programming and use hands-on exercises to reinforce concepts.

Each training course is taught by experienced Campbell Scientific application engineers. Class size is limited to ensure personalized instruction and assistance. Course fees include a training manual and the use of a datalogger, computer, and sensors. Lunch is provided on all course days, and there will be a tour of Campbell Scientific's facilities as time permits.

If you have questions about which course will best meet your needs, please contact an application engineer. We can also help you arrange a self-study course or a customized course at your location.

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The CAMPBELLUPDATE

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CAMPBELL SCIENTIFIC, INC.
WHEN MEASUREMENTS MATTER

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Leaf Wetness Sensor From Decagon Devices



Innovative and easy-to-use, the new LWS Dielectric Leaf Wetness Sensor enables accurate and affordable leaf wetness monitoring. Many fungal and bacterial diseases affect plants only when moisture is present on the leaf surface. The LWS manufactured by Decagon Devices detects the presence of wetness on a leaf's surface, enabling researchers and producers to forecast disease and protect plant canopies.

How It Works

The LWS approximates the thermal mass and radiative properties of leaves to closely mimic the wetness state of a real leaf. The way it works is simple: if the canopy is wet, the sensor is wet; if the canopy is dry, the sensor is dry. The LWS measures the dielectric constant of the top of the sensor. The dielectric constants of water (80) and ice (5) are higher than air (1), so the sensor can determine the presence or absence of wetness using this method. Measurements can be logged at user-defined intervals to determine the duration of wetness on the canopy.

Sensor Benefits

Because the Leaf Wetness Sensor measures the dielectric constant, moisture does not need to bridge electrical traces for the sensor to detect moisture: the presence of water or ice anywhere on the sensor surface will be detected. Unlike our 237 sensor, it requires no painting nor user calibration, and it can detect ice presence.

New Calibration Certificates

CR9000X and AM25T

Campbell Scientific now offers documented calibration certificates, at time of purchase, for the CR9000X datalogger, most CR9000X analog modules, and the AM25T multiplexer. These calibration certificates are NIST traceable and the products are tested to the calibration standards outlined in ISO 17025. Whether you purchase the calibration documents or not, all new CR9000X systems and AM25T multiplexers manufactured by Campbell Scientific meet our published specifications.

LoggerNet for Linux

Campbell Scientific has often been asked if we have a version of our datalogger support software that runs on a Linux platform. We're happy to announce that a Linux version has been released.

Our LoggerNet for Linux package (LNLinux) includes a Linux version of the LoggerNet server and a copy of LoggerNet Remote. LoggerNet Remote is run on a computer with a Microsoft® operating system (NT, 2000, or XP) and is used to set up and manage the LoggerNet server. LoggerNet for Linux runs on a computer with Linux installed. It handles all communication and data collection with the dataloggers—the collected data is stored on the Linux computer. Together, these two systems offer a solution for those who wish to run in a Linux environment.

The LoggerNet for Linux disk contains two RPM distributions—Fedora Core 5 and CentOS 4.3.

DCP200 GOES Data Collection Platform

Campbell Scientific's DCP200 is a GOES data collection platform (DCP) designed specifically for stream stage, water quality, and rainfall applications. The system measures sensors, processes measurements, then transmits data to a receiving station via the GOES system. The TX312 transmitter supports data transmission rates of 100, 300, and 1200 bps. Because clock accuracy is critically important for GOES satellite telemetry, the TX312 includes a robust, TCXO-based real-time clock and a GPS receiver.



Benefits and Features

- Up to 28 days of operation between GPS fixes
- Automatic GPS correction of clock and oscillator
- NESDIS-certified transmitter that complies with high-data-rate (HDR) specifications
- Makes SDI-12, single-ended analog, pulse, switch closure, and bridge measurements

DCP200 Package

- CR295 Datalogger
- 11 dBi RHCP (crossed) Yagi Antenna, mounting bracket, and cable
- TX312 GOES satellite transmitter
- 16" x 18" enclosure
- TX312 support software
- 24 Ahr battery pack and regulator
- GPS antenna, cable, and mounting hardware
- 20 W solar panel

Railway Alert System

*Campbell Scientific
TDR systems monitor slope
movement of bluffs on
California coast*



The North County Transit District (NCTD) of San Diego County, California, determined that three segments of railway track above coastal bluffs in Del Mar should be monitored for dangerous slope movement. This led to the development of a continuous monitoring system along 1000 meters of track. Because of the length to be monitored, the use of conventional single-point monitoring systems such as multiple tiltmeters or in-place inclinometers (IPIs) was impractical. Bluff failure could occur anywhere along the track, so the use of single-point instruments would require a large number of sensors and monitors. Instead, it was proposed to install horizontal time-domain reflectometry (TDR) coaxial cable sensors along high-concern segments of the track.

The TDR monitoring system works similarly to radar. It uses a coaxial cable as a sensor, with any slope movement deforming or shearing the cable at the location of movement. When a voltage pulse from a reflectometer encounters a deformation, or the end of the sensor, the amount of reflected energy is proportional to the extent of the deformation. The reflectometer accurately determines the location of the deformation and the relative extent of movement as noted by the magnitude of the reflection.

Site Description

The monitored area consisted of coastal bluffs prone to erosion and relatively small block failures. The bluffs were about 15 meters above the beach. Railroad tracks along the bluffs ranged from as little as 6 meters to as much as 30 meters from the edge of the bluff.

Although the bluffs appeared stable, there had been some erosion problems that required soldier-pile walls, drainage enhancements, and shotcrete reinforcement. In addition, about fifty years earlier one segment of the bluff had failed, causing the wreck of a freight train.

The bluffs are made up of relatively strong (but fractured and jointed) sandstone and soft and erodible siltstone. Wave action and a significant amount of ground water from landscape irrigation contributed to weakening and softening of the siltstone. The result was the undermining of the sandstone, followed by local coastal bluff failure.

APPLICATION AT A GLANCE

Application type:

Time-domain reflectometry (TDR) monitoring of slope stability

Project area:

San Diego, California

Author:

William F. Kane, PhD

Contracting agency:

San Diego County

Dataloggers:

CR23X, CR10X

Communication links:

Multidrop interface, telephone

Measured parameter:

Slope movement

Continued on next page

Continued from previous page



The construction crew digs trenches for sensor cables.

Instrumentation Overview

The remote data acquisition equipment included dataloggers, multiplexers, and communication devices. In addition, software was necessary to program and interact with the datalogger. TDR is a relatively new approach to monitoring slope movement. Originally developed to locate breaks and faults in communication and power lines, this technology uses coaxial cable as the sensor and a time domain reflectometer for measurement.

A multiplexer was used to allow multiple sensors to be attached to a single datalogger. The multiplexer is wired to a single set of ports on the datalogger. The data is collected sequentially by the logger. Multiplexers can even be multiplexed to each other, creating the ability to read a large number of instruments.

Monitoring System Design

The monitoring system consisted of a central control and monitoring unit and three TDR monitoring stations. The central monitoring unit checked the status of each monitoring station and controlled the alert notification function of the system. The TDR monitoring stations each polled two TDR sensor cables for cable deformation or break.

At each monitoring station were a Campbell Scientific CR10X datalogger, SDMX50 TDR multiplexer, and TDR100 reflectometer. The datalogger polled two horizontal TDR cables every four minutes and compared the reflected waveform to a baseline signature. If the reflected data indicated a deformed or broken cable, an alert signal consisting of 5 Vdc was applied to a wire monitored by the CR23X Micrologger® at the central control and monitoring unit. There, an automated telephone dialer notified railway personnel of possible bluff movement. Personnel could then contact the system by telephone and determine the location of the cable deformation so that a safety inspection of the bluff and track could be made.

The datalogger was capable of distinguishing between a low-level alert (deformed cable indicating small movement), and a high-level alert (sheared cable and possible large magnitude

slope failure). TDR sensor cables were routed under the tracks and installed parallel to the tracks in a shallow trench. The cables were enclosed in a cement/sand grout to ensure deformation should a slope movement occur. A total of approximately 1000 meters of sensor cable was installed.

Telecommunications

Each datalogger was connected to a Campbell Scientific MD9 multidrop interface. RG59 coaxial cable was used to connect these network nodes. At the central monitoring station, an additional MD9 accessed the network dataloggers through the telephone line.

In addition to the modem, three autodialers also used the telephone line. When activated, the dialers called up to eight telephone numbers and delivered an alert message applicable to the type of action required.

Construction

Coaxial sensor cables were installed using a tractor-mounted trencher. Trenches were cut 0.7 meter deep parallel to the tracks about 4 meters from the track center line between the track and the bluff edge. A 50 millimeter layer of lean concrete was placed on the bottom of the trench and the sensor cable was laid on top. An additional 0.3 meter of concrete was placed on top of the cable. After the concrete set, the remainder of the trench was backfilled with compacted fill.



TDR cables are buried parallel to the track in a layer of concrete.

Innovative Technical Application

To the knowledge of the author, this project represents the largest single application to date of TDR slope monitoring with movement alerting capability. A major benefit of the alerting feature was the ability of each monitoring station to call up to eight different phone numbers to notify personnel of a possible failure condition. Each of the three dialers was dedicated to one of the remote monitoring stations. For example, a sensor deformation on Remote Monitoring Station 2 would trigger calls to eight individuals to alert them of a possible slope movement in the vicinity of Station 2. In addition, the extent of the area monitored has excellent potential for safeguarding railroads and highways wherever they are threatened by dangerous slope movements.

More Flexible Displays with RTMC Pro

Many LoggerNet users are familiar with RTMC (Real-Time Monitoring and Control) software that is included with LoggerNet. They've come to appreciate the flexibility of this easy-to-use software package that lets them analyze their data on screen by displaying variables and final storage data in the form of graphs, dials, status bars, visual alarms, and tables. A good thing is now even better.

RTMC Pro is an enhanced version of RTMC. It includes more powerful alarm capabilities such as rate of change and multistate alarms, as well as the ability to send a message to an email address on an alarm event. The new Command components let you run or open a file, execute CoraScript commands (LoggerNet's command-line utility), or insert HTML hotspots. Other new components include a logarithmic gauge and status bar, a wind rose, an oscilloscope, and an XY chart. Couple these features with more layout components and the ability to save a snapshot of the current display to an image file, and you'll be creating even better displays for your computer or images for displaying on a Web site.

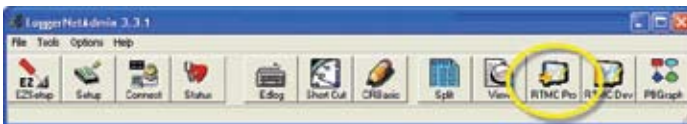
RTMC Pro is purchased separately from LoggerNet. When it is installed, a button is added to the LoggerNet toolbar so that it can be opened easily from within the LoggerNet application. The standard version of RTMC is still installed and available, and the RTMC Run-Time product supports both versions. Please note that projects developed in, or converted to, RTMC Pro cannot be opened in standard RTMC. However, when an RTMC project is opened in RTMC Pro and subse-



RTMC Pro includes multistate, text, and email alarm capabilities.

quently saved, you will be prompted for a new file name upon saving. This helps to ensure your original file is still available for use in RTMC if desired.

Our goal is for RTMC and RTMC Pro to support the graphics needs of all our clients who require data displays. To that end, we will begin phasing out our other data display products, such as ViewDAQ and RTDM. Visit www.campbellsci.com/rtrmcpro for more information and a link to our demo version of RTMC Pro.



A button for RTMC Pro is added to the LoggerNet toolbar.

CR510 No Longer Available

We have removed the CR510 and CR510-2M dataloggers from our product line. Our CR800 and CR850 dataloggers are the ideal replacement for CR510 customers who require research-grade performance in a small package. Besides supporting all of the CR510 capabilities, the CR800-series dataloggers are compatible with channel expansion peripherals and thermocouples, can measure intelligent serial sensors without using an SDM-SIO4, and use PakBus®. CR510 programs may be converted to CR800 programs using the Transformer tool, which is included in LoggerNet and PC400 software.

Alternatively, CR510 customers may use one of our CR200-series dataloggers—our smallest, lowest cost dataloggers. The CR200-series dataloggers are intended for customers who will be measuring only one or two simple sensors. They are not compatible with expansion peripherals.

Please note that Campbell Scientific will continue to provide technical support for the CR510. We will service the CR510 as long as replacement parts are available.



Depending on your application, we recommend the CR800-series or CR200-series dataloggers in place of the CR510.

Default Settings to Change in Some Peripherals

Historically, on dataloggers such as the CR10X that used mixed-array data storage, the CS I/O port accommodated mostly modem-enabled (ME) peripherals. More recently, the CS I/O port (on dataloggers such as the CR1000, which now use table data storage and the PakBus® communication protocol) can support both ME and newer synchronous-device-communication (SDC) addresses, which greatly enhance device communication. More peripherals can be connected to the datalogger and data is transferred much faster.

For peripherals that can work in either mode, the transition from an ME device to an SDC device requires that you change settings in the peripheral. Some of our newer peripherals will have SDC mode as their default setting beginning in March. Therefore, if you will be connecting one of these devices to our

historic dataloggers, you may need to modify the default settings before they will work properly. For most peripherals, you can easily change the settings of your existing peripherals by using the Device Configuration software utility (DevConfig) or by changing a jumper or dip switch setting. DevConfig is included with LoggerNet, PC400, or PC200W, and is available as a download from our Web site.

Peripherals that can be configured for ME or SDC modes using DevConfig include the NL100, RF401 (and variations), MD485, SC-USB, and SC105. One of our new peripherals, the COM220, is configured using an internal dip switch. By incorporating this capability within the devices, peripherals can be migrated into systems using newer dataloggers.

CAMPBELL SCIENTIFIC CALENDAR

| Date | Event | Location |
|-----------------|--|--------------------|
| January | | |
| 15-18 | American Meteorological Society | San Antonio, TX |
| 17-19 | Four States Irrigation Council | Fort Collins, CO |
| February | | |
| 04-06 | DistribuTECH | San Diego, CA |
| 13-15 | World Ag Expo | Tulare, CA |
| 15-17 | Fish Farming | Orange Beach, AL |
| 20-22 | SEM IMAC | Orlando, FL |
| 22-24 | Golf Industry Show | Anaheim, CA |
| 26-28 | Intermountain Harvesting Energy Summit | Salt Lake City, UT |
| 26-01 | Aquaculture 2007 | San Antonio, TX |
| 27-02 | Rural Water Association of Utah | St. George, UT |
| March | | |
| 08-11 | Electronic House Expo—Spring | Orlando, FL |
| 19-22 | New Mexico Rural Water Assoc. Conf. | Albuquerque, NM |
| 29-01 | National Science Teachers Association | St. Louis, MO |
| April | | |
| 16-19 | Western Snow Conference | Kona, HI |
| June | | |
| 03-06 | WindPower | Los Angeles, CA |
| 11-14 | National Hydrologic Warning Council | Savanna, GA |
| 17-20 | ASABE Annual International Meeting | Minneapolis, MN |
| 26-28 | Air, Waste Management Association | Pittsburg, PA |

Visit our web site for training class schedules and additional listings.

