

Your Data on the Internet: 5 Ways

Over the last few years, the Internet has become a more common way of accessing and sharing data from measurement sites. One question we are often asked here at Campbell Scientific is, "How can I put my data on the web?" Our answer? "Well, it depends." There are many approaches for accomplishing this, and the nature of each project may make one method more suitable than another. The goal of this article is to give you a quick overview of each method and guide you to a solution that could work for you.

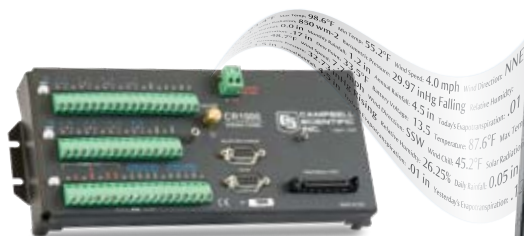
The different options described below require various levels of IT or web-development support. This could include providing file and FTP access, configuring web servers and firewalls, and working with HTML or other Internet technologies.

Datalogger as Web Server

Our CR1000 and CR3000 dataloggers have a built-in TCP/IP stack and, when assigned an IP address using our NL115 Ethernet Interface, they can serve web pages, just like a web server. A default page generated by the datalogger provides basic links to the most recent data, but additional web pages can be created using HTML, JavaScript, CSS, and Flash, providing the ability to customize the output to a high degree. Using a datalogger as a web server is not for high-traffic sites, but it still provides a good, low-cost way of publishing your data to the Internet.

Java Software Development Kit

This SDK allows a developer to use the Java programming language to write applications or applets that communicate directly with PakBus®



dataloggers. These applets can then be served via a third-party web server or an IP-enabled datalogger's built-in web server (similar to the approach above). Java applets or applications can be used to display data in a web browser and even provide some control capability.

RTMC Pro

Using our Windows-based RTMC Pro software, you can create screens using charts, graphs, gauges, dials, and other visual elements that display your data. RTMC Pro can be set up to automatically output these screens as image files on a user-defined interval. An entire screen can be saved as one file, or broken into its individual display components. These image files can then be integrated into a website and served via a third-party web server. RTMC Pro provides a variety of data display elements that can be customized (e.g., color, size, placement) to help display your data exactly how you want. Exporting entire screens can minimize web development efforts. On the other hand, exporting individual components requires more web development, but provides more flexibility.

RTMC Web Server

For this method, you create an RTMC or RTMC Pro project similar to the previous method, but use the RTMC Web Server to deliver your pages, rather than a third-party



web server. You create a web page simply by developing an RTMC project and running it under the RTMC Web Server. This method requires no knowledge of HTML, since the RTMC Web Server takes care of everything. It even updates an existing page as new data is retrieved from the datalogger.

Vista Data Vision

Vista Data Vision (VDV) is a Windows-based software solution developed by Measurement Systems (formerly Vista Engineering). It imports ASCII data files collected from the datalogger into a MySQL database and includes tools for displaying that data. With the data in a database, VDV offers a dynamic solution for filtering, comparing, and sorting data on the fly. Both standard and pro versions of VDV allow you to post data to the Internet. The pro version supports more measurement sites and allows some screen customization. Customer technical support for VDV software comes entirely from Measurement Systems.

For help with any of these methods, see the corresponding product manuals or talk to one of our application engineers at 435-753-2342.



We Make Instruments

Paul Campbell, President

ties of marketing and engineering. About half of Campbell Scientific's employees work in production, with their hands on the products at various stages of manufacture. All other employees think about what the product is, or who will use it, or how it is to be used. My comments are focused on those whose hands actually build the products you use.

One of the keys to good manufacturing is identifying the processes needed. The primary processes supported by Campbell Scientific include:

- Sheet metal fabrication
- Machining
- Welding and brazing
- Circuit-board assembly
- Soldering
- Mechanical assembly
- Potting
- Cabling and wiring
- Calibration and test
- Packing for shipment

Each process has unique requirements for operator skill, tools, and materials. When the company started nearly 35 years ago, we engaged in many different manufacturing processes because we were limited by the lack of local contract manufacturers who specialized in just one or

two processes. It is unusual today to find so many processes supported in one company. While we do buy some products already made and job out some processes such as plating and painting, we seek to maintain our commitment to depth in manufacturing with the following benefits:

- Responsiveness to unique customer requirements
- Flexibility to make a broad range of products
- Quality control with better visibility of the root cause of faults and potential faults
- Timely preventive and corrective actions with improving quality
- Direct manufacturability feedback to engineering

I recall early in my career resolving that Campbell Scientific would build world-class instruments. If you see something that falls short of your expectations, I welcome your feedback. We take pride in the craftsmanship with which our instruments are made. I am pleased to express to you, our customers, on behalf of those working in production at Campbell Scientific, a heart-felt desire that your experience with our products will be positive.

When I am asked what Campbell Scientific does by someone unfamiliar with the business, I have found that the simple reply, "We make instruments," satisfies the cursory curiosity of an initial inquiry. However, there is more to manufacturing instruments than meets the eye, and in this article I would like to offer some perspective on Campbell Scientific's approach to manufacturing and the value that our manufacturing brings to you, our customers.

To manufacture means to make or assemble from raw materials by means of labor and machinery a product suitable for use. In a broad sense, it encompasses everything Campbell Scientific does as an organization, but in a more focused sense, it distinguishes the activities of production within the business from the activi-



Our numerically controlled pick-and-place machine (left) is used to manufacture printed-circuit assemblies. The numerically controlled multi-station turret punch (right) is used to manufacture precision sheet-metal chassis and mounts.

Manufacturing at Campbell Scientific

Gary Swanson, Vice President of Operations

Campbell Scientific has always had the philosophy of building our own products and developing our capability to do so. From the beginning there was an attitude that “we can do it.” The board of directors has consistently supported the purchase of equipment to develop good processes. Exceptions have been made for parts that can be produced for less using a particular piece of equipment that we do not own or that is outside of our core competencies. In those cases, we’ve developed good supplier relationships to get high-quality parts in reasonable time for a good value. Some specific products or processes that we do partner with suppliers on are bare printed circuit boards and anodizing, plating, and powder-coat painting of our fabricated metal parts.

We are characterized as a discrete manufacturer of high-mix/low-volume, highly reliable products. Over time, we have gotten deeply involved in system integration and other value-added services. More of our customers want a complete system that we configure and integrate for them. Outsourcing this type of work is just not practical, nor would it save money. There is also a high dependence on long-term, skilled employees—many of whom have been with the company for over 20 years.

A third of our products are either configured to order, built to order, assembled to order, or even engineered to order—or they are otherwise custom or nonstandard products specified by application engineers. The rest

of the products can be made ahead of receiving the customer order: built to stock. We also build some products or subassemblies for affiliated companies.

We carry an inventory of over 15,000 unique part numbers. Planning is done with the aid of an enterprise resource planning (ERP) system by a team of people trying to anticipate the needs of customers. We strive to have parts available and many products or subassemblies made in advance of the customer order. Building high-quality products is always the main goal.

Production is divided into work units concentrating on their areas of responsibility and keeping their processes in control. Employees are also widely cross-trained for better response to product demand. The various work units focus on:

- Receiving, inspection, and inventory
- Surface-mount electronic assembly of printed circuit boards
- Sensor and cable assembly
- Final mechanical assembly
- System assembly
- Metal fabrication
- Electronics testing
- Shipping

Lean-manufacturing principles like pull scheduling, work cells, single-piece flow, and inventory at the point of use are also implemented. Work orders are issued and a quality system is followed.

Many industrial processes are used: soldering, cleaning, potting, molding, conformal coating, precision



metal forming, machining, and welding of stainless steel, aluminum, and cold-rolled steel.

A team of experienced planning, scheduling, and purchasing professionals is responsible for getting the correct component parts delivered in time to build products in anticipation of customer orders. Everyone is involved to coordinate the production plan with actual customer demand. We do everything we can to ship high-quality products to our customers on time.

Manufacturing Vision Statement

We in the Manufacturing Department strive to meet both internal and external customers' expectations in a professional manner. Our objectives for 2008 are:

- Build good quality products, measured through testing of those products and adherence to our quality system.
- Provide on-time shipment to customer orders, measured each week and reported in management meeting.
- Strive to complete work orders on time, measured and reported each week in the production supervisors meeting.

ISO 9001:2000 Certification Achieved



We're pleased to announce that earlier this year we achieved ISO 9001:2000 certification.

This means that our quality-management system has been verified by an independent auditor to meet the ISO 9001:2000 standards.

We have always maintained quality as a priority in product design and manufacturing. Years of compliance to international quality-manage-

ment standards provided a seamless transition to our recent registration.

Over the last 34 years of business operation, we've felt a sense of pride as we've heard about our products performing reliably over extended periods of time or surviving catastrophic events. We are committed to maintaining high-quality products for years to come.



Flood Warning

Campbell Scientific provides measurement and control systems across a wide variety of disciplines, including both research and day-to-day applications. Flood-warning projects are similar to many other applications we support in that they require continuous remote monitoring, low power consumption, system reliability in adverse conditions, accurate measurements, and telemetry to communicate data to a base station. Because of the life-impacting nature of the data from flood-warning systems, real-time communication capabilities are especially important. We offer three different types of systems for flood-warning applications.

Alert Stations

In the 1970s, the National Weather Service developed a protocol for flood-warning applications called ALERT (Automated Local Evaluation in Real Time). A standard ALERT system measures rainfall and water level and transmits data via a specific protocol to a base station. The system usually consists of sensors, datalogger, transmitter, and mounting standpipe. Our dataloggers easily meet the requirements for these systems, with specialized ALERT operating systems and excellent sensor compatibility. The programmable nature of our dataloggers means that stations can easily be upgraded without replacing hardware—something that will come in handy when the new ALERT-2 protocol is released. We can also upgrade older stations, even those from

other manufacturers, with the latest datalogger and transmitter, allowing reuse of sensors, standpipes, or enclosures.

Hybrid Alert Stations

Often the capabilities of a standard ALERT station aren't enough. Our hybrid stations remedy this by integrating additional sensors and two-way communication peripherals.

These additional capabilities can lead to collaboration between organizations, which can help keep costs down. Additional measurements that could be of interest include water quality, soil water content, or meteorological parameters.

Two-way communication provides the following advantages for remote monitoring applications:

- Retries of missed packets
- Diagnostics
- Clock synching
- Reprogramming from the base station
- Historical data collection (no holes in the data)
- Interactive control capability
- Voice modem call-out of alarms

Custom Flood-Warning Stations

Custom flood-warning systems take advantage of two-way RF communications and our network management software, LoggerNet. A LoggerNet-based system allows multiple sites to be polled each second. As the data is collected, LoggerNet clients can access it from LANs or via

the Internet, making data available to multiple users/agencies. Smart, remotely-configurable repeaters can provide an adaptable network for stations in the same general area. The main third-party ALERT software, DIADvisor, has a client that links DIADvisor to the LoggerNet server, allowing data from a custom flood-warning network to mesh with a traditional ALERT warning system.

Over the years, our products have been used for all three types of flood-warning systems. With the many options available to us, we have the flexibility to create systems that meet each project's needs. We'll soon be releasing a new integrated ALERT enclosure that will simplify system configuration even more. Watch for it at campbellsci.com/flood-warning.

Measurements

Typical

- Rainfall
- Water level
- Flow rate

Optional

- Temperature
- Wind speed
- pH / ORP
- Wind direction
- Conductivity
- Relative humidity
- Turbidity
- Solar radiation
- Dissolved Oxygen
- Soil water content

Control

- Alarms
- Phone callouts
- Road signs
- Emails

Enhanced Climate Monitoring in California

Climate and its variations have a huge effect on the trillion-dollar economy of California. The Desert Research Institute's Western Regional Climate Center is installing weather stations around the state to add to knowledge of climate in the state, and disseminate this information for public, policy, and technical use. Other organizations interested in climate research have also joined the project.

The new weather stations take advantage of the CR1000 datalogger's reliability, low power use, and measurement flexibility. The stations measure temperature, precipitation, wind speed and direction, relative humidity, solar radiation, snow depth, and soil temperature. This project represents a great leap forward for climate study in this area. To learn more, please visit campbellsci.com/california-network.



Susie Mine Cleanup in Montana

Near the ghost town of Rimini, Montana, is the abandoned Susie Mine. The Susie mine has significantly high acid drainage, polluted with arsenic and heavy metals. Because this threatens water sources for Helena, Montana, the mine area is a federal Superfund cleanup site.

At this remote site, MSE Technology Applications installed inside the mine a process to remove heavy met-

als prior to discharging into Tenmile Creek. MSE also needed to monitor and record pH, temperature, flow, and oxygen level in the mine. MSE integrated a Campbell Scientific CR1000 datalogger into the system, along with meteor-burst telemetry to transmit data long distances. The system has survived Rocky Mountain cold, wind, and snow and has never lost data. See campbellsci.com/susie-mine.

Utah Town Gets Flood Warning System

In the past, home and business owners along the creek that comes from Mantua Reservoir, near Brigham City, Utah, had very little warning concerning high water flowing down the creek. To remedy this, Intermountain Environmental, Inc., (IEI) designed and installed a hybrid flood warning system featuring CR800 dataloggers and RF450 radios. The system notifies emergency personnel of the possibil-

ity of flooding or of dangerous water levels in the creek.

IEI installed three measurement stations, plus a base station with a voice modem. The base station requests the water-level, flow, or rain data from each station every minute. If there are flood conditions, the system notifies emergency personnel with a voice response. Read more about this system at campbellsci.com/brigham-city-flood.



Water Quality at New Zealand Coal Mine

High-grade coal has been mined on the West Coast of New Zealand since the 1870s. To meet stringent environmental requirements, mine operator Solid Energy contracted with Scott Technical Instruments Ltd. to continuously monitor water quality at 14 sites. The resulting network of measurement stations transmits live data to a base office for management and compliance purposes. The system also

automatically controls a lime-dosing plant to regulate the pH of the nearby Mangatini stream.

There were difficulties: annual rainfall is about 236 in., and the terrain is rugged. The systems include CR850 dataloggers from Campbell Scientific at the core, with RF450 spread-spectrum radios and LoggerNet software. For more information, please visit campbellsci.com/new-zealand-mine.



In June of this year, the Board of Directors created the office of Vice President of Research, and named Larry Jacobsen to that position. Company President Paul Campbell noted that a key to success is matching technology to customer needs. "Attention to strategic product development has been a shared responsibility among several key people in the organization," says Paul. "Larry's experience, interests, and capabilities provide a

New VP at Campbell Scientific

natural fit to improve the company's leadership in this area."

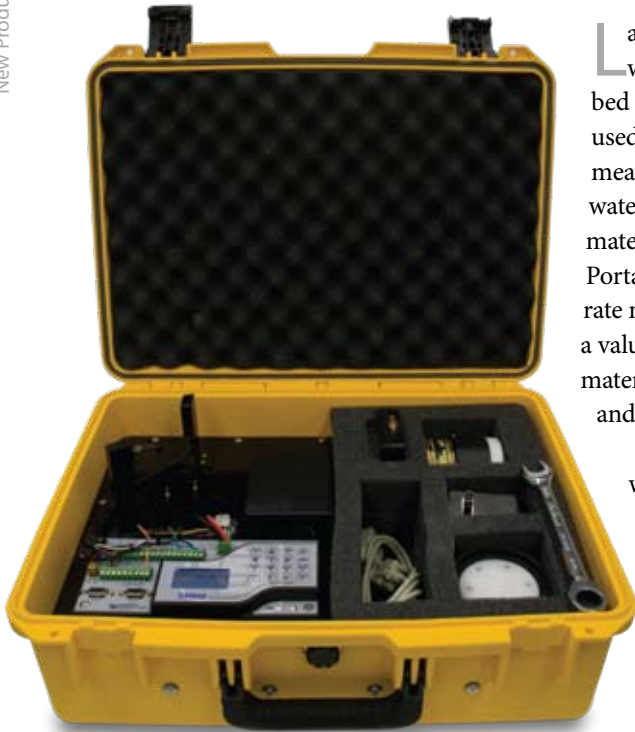
Larry came to Campbell Scientific from the Space Dynamics Laboratory in 1992. Since then, he has consistently developed products that propel the company into new fields of measurement technology. He was the principal designer of the CSAT3 3-D Sonic Anemometer (an important advance for our surface-flux systems) and helped us take great strides in signal processing with spectral analyzers by developing the CR9052 modules for the CR9000X, and the AVW200 for vibrating-wire measurements.

Paul notes, "Larry has a natural ability for effective communication." Larry has published technical articles and given presentations communicating advanced knowledge in his field—recently sharing principles of spectral analysis of vibrating-wire measurements at a conference.

From Larry's perspective, "If you are an instrumentation engineer like me, then it's a good day to be alive." He sees the world needing more good and meaningful measurements, and Campbell Scientific has the chance to develop new technologies to make those measurements. He says, "Sometimes a better way to make measurements involves something old and something new." He applied this philosophy as the key inventor of the AVW200, which brought a quantum leap in improved accuracy and reduced noise to traditional vibrating-wire measurements.

The new VP will have a dual role, incorporating a lot of customer interaction with his engineering duties. Again, from Paul Campbell, "I am confident that customers will benefit from Larry's more direct involvement with them in the short term, and from a continuation of application-relevant products in the future through his leadership."

DOT600 Roadbed Water Content Meter



Later this year Campbell Scientific will release the DOT600 Roadbed Water Content Meter. It will be used in construction applications to measure volumetric and gravimetric water content of samples of earthen material in roadbeds and foundations. Portability, along with quick and accurate measurements, make the DOT600 a valuable tool for evaluating roadbed material both at the construction site and in the soil-test lab.

To make a measurement with the DOT600, the operator fills the sample chamber with soil and weighs it on the built-in scale to get a wet sample weight. The operator then compresses the soil in the chamber and triggers a measurement. The measure-



Sample chamber and compression cap.

ment result includes gravimetric and volumetric water contents, wet and dry bulk densities, sample volume, and applied force. Approximate time for one measurement is 90 seconds.

Measurement results, plus general logging information such as site and sample identification, name of person taking the measurement, and project name, are written as records to a file that can be easily downloaded to a computer and imported into a spreadsheet. A rugged carrying case and rechargeable battery make the DOT600 completely portable.

New Closed-Path EC System

The CPEC100 is a closed-path eddy-covariance (EC) flux system for long-term monitoring of atmosphere-biosphere exchanges of carbon dioxide, momentum, water vapor, and heat. The turn-key system capitalizes on Campbell Scientific's 15-plus years of developing, manufacturing, and operating atmospheric sampling systems for measuring trace gases. It uses miniature valves mounted on an innovative, custom-designed, compact manifold to perform automatic, on-site zero and span calibrations at the system operating



ing pressure to ensure accurate gas concentration measurements. A CR3000 Micrologger®

collects data from the LI-COR LI-7000 CO₂ and H₂O Analyzer, CSAT3 3-D Sonic Anemometer, and other meteorological sensors. The Micrologger saves all the raw time-series data on a CompactFlash card for later analysis, computes real-time fluxes, and controls the automatic zero and span of the analyzer. A manual water-vapor span is done on site with a dew-point generator. Remote telecommunication options enable monitoring and collecting real-time fluxes and diagnostics.

The CPEC100 draws sample air into the analyzer using an intake tube and diaphragm pump. A critical flow orifice, located at the intake, reduces the pressure in the intake tubing to about half an atmosphere. This reduced pressure increases the flow rate within the intake tubing, improving the system's response to high-frequency varia-



tions of gas concentration and helps ensure accurate flux measurements. The reduced pressure also minimizes condensation within the tubing and

(continued on page 8)

New Calibration Wizard

LoggerNet 3.3 and higher and all versions of RTDAQ now include a calibration wizard that facilitates real-time, nonintrusive calibration of sensors. The wizard walks users through each step of the calibration process. The calibration wizard is available for our CR800, CR850, CR1000, CR3000, CR5000, and CR9000X dataloggers.

Customers with LoggerNet versions 3.0 to 3.2 can receive the wizard, at no charge, by downloading the LoggerNet patch from our website. Customers with LoggerNet version 2.x can get the wizard by purchasing the LoggerNet/U upgrade.



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RF500M: A More Flexible Radio Modem

Campbell Scientific's RF500M brings a higher level of flexibility to RF communication with its wide compatibility and multi-role capability. This new modem is for PakBus® networks with UHF/VHF frequency band radios. It works with Midland radios (i.e., RF310, RF312, RF313), DataRadio radios, or any radio and modem combination that outputs a demodulated byte stream via RS-232.

The RF500M supports point-to-point and point-to-multipoint communications. It can serve as a field modem connected to a datalogger, as a standalone repeater not connected to a datalogger, or as a base-station modem connected to a computer. The RF500M is even compatible with other telemetry devices, including our phone modems, digital cellular modems, and Ethernet links, which allows the distance between the datalogger and PC to be extended.

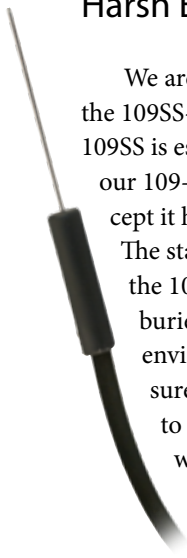
The RF500M increases polling speeds and reduces overall current drain by using a time-division polling protocol that avoids all collisions within a network. The overall current drain can be further reduced by having the datalogger predefine the data tables that are collected. This also increases the network speed.

Another benefit of the RF500M is that its operating system and RF ID can be configured through software instead of hardware modifications.



Temperature Probe for Harsh Environments

We are adding a new thermistor, the 109SS-L, to our product line. The 109SS is essentially the same probe as our 109-L Temperature Probe, except it has a stainless-steel housing. The stainless-steel housing allows the 109SS to be submerged or buried in harsh, corrosive, or hot environments. The 109SS measures temperature from -50° to $+70^{\circ}\text{C}$, and is compatible with most currently-available dataloggers.



Java PakBus® Software Development Kit (SDK)

With the Java PakBus® Software Development Kit (SDK), a software developer can create Java applications or applets that use the PakBus protocol to directly communicate with dataloggers in a PakBus network. The applets can run in the datalogger and allow users to control the network and retrieve data via a web browser. The Java PakBus SDK does not access or communicate with LoggerNet or any other software, and is a good option for developers who do not want to use Microsoft Windows products.

New Digital Cellular Modems

The RavenXT-series digital cellular modems have replaced the Raven100, Raven105, and Raven110. The new modems provide similar functionality to their predecessors, but they have an SMA antenna connector instead of a TNC connector. The RavenXT-series modems are smaller, lighter, and cost less than the old Raven100-series modems.



New Decontamination Requirement for RMAs

In the interest of protecting the health and safety of our employees, we've added a new requirement to our RMA process. (An RMA is a Return Merchandise Authorization.) All sensors used in water- and soil-related applications, configured weather systems, or any other products exposed to hazardous materials, must be decontaminated prior to returning them to Campbell Scientific for calibration, repair, or other service. A new form, *Declaration of Hazardous Material and*

Decontamination, must be completed and returned with the products. This form is available on our website at campbellsci.com/repair. Any returns that arrive without this form completed will not be processed. If the form is not received within three days of product receipt, or incomplete, the product will be returned at the sender's expense.

We apologize for any inconvenience this may cause, but hope you understand and support our commitment to employee health and safety.

A2LA/NVLAP Certified Calibrations Now Available

Campbell Scientific has recently partnered with a laboratory accredited by the National Voluntary Laboratory Accreditation Program (NVLAP) to better serve those who require calibration services offered by a laboratory accredited under the ISO 17025 standard. This service is currently available

for the CR1000, CR800, CR850, and CR23X dataloggers. Other dataloggers will be added soon. This process is in addition to our own calibration services and requires an additional lead time of at least 3 weeks. Each calibrated datalogger is returned with a certificate from the accredited lab.

New Closed-Path EC System (continued from page 7)

reduces the interaction of water vapor with the tubing walls.

Campbell Scientific has been an innovator of micrometeorological measurements since 1980, when we assembled our first datalogger-based

open-path eddy-covariance system for measuring evaporation. The CPEC100 is a continuation of our efforts to design and produce quality micrometeorological systems.

Calendar

September

- 03-05 National Rural Intelligent Transportation System
Anchorage, AK
- 07-11 Association of State Dam Safety Officials
Indian Wells, CA
- 17-20 U.S. Committee on Irrigation and Drainage
Portland, OR
- 21-27 International Snow Science Workshop
Whistler, BC, Canada
- 22-24 MINExpo
Las Vegas, NV

October

- 05-09 Joint ASA/GSA/SSSA/CSSA/GCAGS//HGS
Houston, TX
- 22-24 Automotive Testing Expo
Novi, MI

November

- 02-04 International Irrigation Assoc.
Anaheim, CA
- 27-29 Meteorex
St. Petersburg, Russia

December

- 11-13 Performance Racing Industry
Orlando, FL
- 15-19 American Geophysical Union
San Francisco, CA

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



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