

The IEEE Instrumentation & Measurement Magazine
December 2015 Issue

The Power of Calibration

Editorial

Superheroes

Wendy Van Moer

Superman, the Green Lantern, Thor, Antman, Ironman We all have our superhero!
The biggest hero in the world of instrumentation and measurement is by far Mr. Calibration! Mr. Calibration rules the instrumentation and measurement world. Why? Simply because the quality of your instruments and measurements depends on the quality of your calibration!

Every day we meet Mr. Calibration. Not only in our professional life, but also in our daily life. Every time you want to bake cookies, Mr. Calibration is present.

In order to develop and apply a calibration procedure, you need to master the basics of calibration. In this issue, you will learn the ‘why’ and ‘how’ of a good calibration written by our expert in the field Prof. Alessandro Ferrero.

Once you master all of the calibration details, you can apply them to your own application field. Sensors, high power, microwave, camera vision, and many more, they all need a good calibration. Our experts will show you the power of calibration, no matter what application field we consider.

Since this is our last issue of 2015, I would like to take the opportunity to wish you all Happy Holidays and a super 2016 full of happiness and joy! Enjoy the cookies!
See you next year!

Groetjes,
Wendy

President's Message

Moving Forward with High Expectations

Reza Zoughi

Dear I&M Society members and colleagues,

Another year has passed, and I share my last President's message with you. It has certainly been an honor and privilege to serve the I&M Society in the capacity of the President for two years. I had the good fortune of working with many great people in our AdCom, the Society and within the various IEEE entities. These experiences and friendships, for which I am most grateful, will last a lifetime. Starting in 2016, the I&M Society will be led by our new President, Professor Ruth Dyer, and an AdCom with several new faces. Knowing these colleagues gives me a sense of happiness and excitement about our future. I wish to briefly share some of what we accomplished in 2015.

Publications – Our two primary publications, namely the *Transactions* and the *I&M Magazine* are doing extremely well. Most, if not all, of the metrics indicating content quality and timeliness continue to improve for both. The *Transactions* is now one of the most desirable venues in which to publish papers related to instrumentation and measurement. The significant changes that have been implemented in the way the *I&M Magazine* is run have definitely paid off.

Conferences – Finally, we implemented a paper submission (as opposed to an extended abstract) process for all of our financially-sponsored conferences. The most critical implementation was for I2MTC 2015 in Pisa, Italy. Through the hard work of many people involved in this endeavor, we can claim this to have been a resounding success, despite some challenges and pains on the way to achieve this! What was learned in 2015 has been shared with those involved in organizing I2MTC 2016 in Taipei, Taiwan. We expect another successful meeting, invite all of you to submit your papers as soon as possible, and hope to see many of you in Taipei in May 2016.

Education – Our educational activities are among the best and highly-regarded in all of IEEE. This year we received a larger than normal number of Graduate Fellowship applications. Through a relatively unique budgetary situation (in 2015) we were able to fully fund *five* Graduate Fellowships and the two usually-funded Faculty Course Development awards. These are two of the most important awards of the Society, and their impact on many students' academic lives has been and remain significant. Our Distinguished Lecturer program remains strong, active and well-utilized. In 2015, we added three new distinguished lecturers to the list of

our active lecturers. I2MTC Tutorials continue to be well-attended and successful, receiving high praise from the attendees.

Membership – Our Membership Development Committee remains active and responsive to the needs of our members. As in the past, we held a Chapter Summit at the I2MTC 2015. This committee has been very active in energizing activities among our members and chapters in all regions through the Chapter Support Program. As in the past year, we have paid particular attention to Regions 9 and 10. We are excited about holding the next I2MTC in Taipei and look forward to a significant contingency of attendees from all countries in Region 10.

Technical and Standards Activities Committee – As I stated in my message last year, we continue to revise, revamp, stimulate and engage our Technical Committees and to ensure that they serve the purpose for which they were established and that they remain active and continually engage their members. To this end and under the leadership of Mr. Jorge Daher, we have moved forward on this important initiative. Since my last message we have closed ten inactive TCs and have been proactive in requiring that TCs be cognizant of their mission to the Society and the profession. It appears that these expectations are being addressed, and we are noticing some positive changes in this respect and hope for more to come.

As I said in my last message, we have come a long way, and still have a ways to go. I close by repeating part of my previous message that: “the AdCom is here to help you and facilitate processes that bring tangible, useful and *high-quality* services to our members. Please keep in touch; you are the Society and we need to hear from you as to how we are doing and what more we can do, and better. I look forward to working with the AdCom, all of our members and the IEEE to continue bringing *quality* to all aspects of our Society.”

Finally, I wish to thank the AdCom for allowing me to give back to the Society through my sincere and heartfelt desire to serve our Society. I share a picture of the AdCom members who were present at our Spring AdCom meeting in Pisa (in conjunction with I2MTC 2015). By the way, after looking at this picture I think there is a lesson in photography and that is not putting someone as short as I among three tall persons!

Best wishes.

Cheers,

Reza

Article Summaries

The Pillars of Metrology

(Summary)

Alessandro Ferrero

In this article, the author discusses the connection between measurement uncertainty, calibration and metrological traceability. These three concepts are the three pillars that hold metrology, since, the only way to obtain a useful *measurement result* from a useless *indication* is to evaluate and express the uncertainty associated to that indication through a proper and metrologically traceable calibration. This is the only way to obtain confidence intervals, about the measured value, and ensure that they contain the measurand value with the specified coverage probability. In simple words, only the application of these three concepts allows us to trust as an acceptable measurement result the *wrong* indication of an instrument.

This summary includes text from the conclusion of the article.

Traceable Calibrations of Rogowski Coils at High AC Currents

(Summary)

Branislav Djokic'

This article provides an overview of Rogowski coils and their use for measurement of high ac steady-state, transient, and pulsed currents. The most important design techniques are addressed and recent developments in the calibrations of Rogowski coils at power line frequencies, audio frequencies up to 10 kHz, and at high pulsed currents are presented. The fundamental metrological concepts of measurement uncertainties and traceability are linked to the calibrations. Traceable high-accuracy calibrations of Rogowski coils at steady-state ac currents, at power frequencies and audio frequencies up to 10 kHz, are described, as well as the calibrations of Rogowski coils and weld current meters at high pulsed currents for resistance welding that have been recently developed at NRC Canada.

This summary includes text from conclusion of the article.

Camera Calibration and Pose Estimation from Planes

(Summary)

Hamid Bazargani and Robert Laganière

Camera calibration plays a key role in every computer vision application dealing with the problems of recovering a camera's geometry with respect to a 3D world reference, making 3D measurement in a captured scene or extracting 3D data from observed objects. These problems emerge in various applications such as structure from motion, robotics, augmented reality, 3D object recognition, and Simultaneous Localization and Mapping (SLAM). In this article, the authors review some techniques proposed in the literature to parameterize camera metric information, also referred to as camera calibration techniques. They illustrate the use of calibrated cameras by describing two application examples involving camera pose estimation and distance estimation.

This summary includes text from introduction of the article.

Calibration of Low-cost Triaxial Inertial Sensors

(Summary)

Jan Rohac, Martin Sipos, and Jakub Simanuk

Accelerometers (ACCs) and gyroscopes (gyros) are commonly known as inertial sensors and their orthogonal triads generally form an inertial measurement unit (IMU) used as a core means of a navigation system. A typical process of the IMU calibration usually estimates scale-factors, orthogonality or misalignment errors, and offsets of both triads. These parameters compose the so-called sensor error model (SEM). This paper provides a thorough description of a MEMS-based IMU calibration process and implementation tips for its proper, but still cost-effective, realization without any specialized and expensive means. The authors explain how their work draws on the experience of previous contributions concerning ACC and gyro calibration methods and approaches that have been published. In the case of ACC calibration, they use a gravity-based calibration method so it requires measurements of 3-axes ACC outputs under static conditions tilted into the number of different orientations followed by a numerical estimation of the SEM.

This summary includes text from introduction of the article.

Traceable Measurements of Electrical Impedance

(Summary)

Luca Callegaro

Traceable electrical impedance measurements require a careful definition of the measurand and calibrated meter. In this paper, the author discusses how the new SI links the impedance units to

the fundamental constants of nature, the Planck constant and the electron charge. The practical realization of these units is possible with a solid-state quantum phenomenon, the quantum Hall effect. Impedance metrology research is now focusing on graphene devices, where the effect is observed at temperatures and magnetic fields reachable with a small tabletop experiment and in digital impedance bridges and simulators that allow the realization of compact and automated traceability chains for meter calibrations suitable for an implementation in the industrial environment, such as calibration centers.

This summary includes text from conclusion of the article.

Drilling Fluid Processing: Preparation, Maintenance and Continuous Conditioning (Summary)

Fionn Iversen and Thomas Geehan

This paper provides an overview of the operation of drilling fluids at the rig site, giving insight to those less versed in the art of drilling oil and gas wells. Fluid processing at the rig site is currently a prime target for higher levels of mechanization and process control, leading towards automation. The drilling fluids' composition influences its properties and dynamic behaviour, and the various drilling fluid components and additives all have specific purposes related to the drilling process. The process of drilling fluid preparation and mixing on the drilling rig is described, and the means of maintaining suitable properties during the drilling process are discussed. Means and requirements are presented for enabling continuous conditioning of the drilling fluid to suit the variations in the wellbore and formation, pointing out current challenges in measurement, instrumentation, mechanization, and control that need to be solved.

This summary includes text from introduction of the article.

Columns

Legal Metrology

The Story of the Right Measurement that Caused Injustice and the Wrong Measurement that Did Justice; How to Explain the Importance of Metrology to Lawyers and Judges

(Summary)

Alessandro Ferrero and Veronica Scotti

Metrology tells us very clearly and very humbly that, due to the inaccuracy with which we can describe the measurand – that is the quantity we want to measure – and the unavoidable imperfection of the employed measurement methods and systems, even the most accurate and expensive ones, the value we obtain is only an approximation, more or less accurate, of the measurand value we would like to know. However, science must be understood and mastered, to get useful results instead of gross mistakes, as in the 2003 Scotland Yard criminal case presented in the article. An important branch of science is metrology, and it has become an important part of forensic science too.

This summary includes text from the article.

Basic Metrology

A New Approach to the Kelvin (Summary)

Michael de Podesta

Besides being a world-class metrologist, Michael de Podesta is passionate about the wider issue of creating a scientifically savvy population able to form sensible views about topics such as global warming, nuclear energy, depletion of global resources and so on which will greatly affect succeeding generations. In this article, he discusses the forthcoming 2018 re-definition of the International System of Units (SI). Although it usually focuses on the resolution of the long-standing ‘kilogram problem,’ the author explains that there will also be significant changes in the definition of other units and indeed, in the very concept of a ‘unit.’ He presents specifically the proposed changes in the definition of the unit of temperature, the kelvin.

This summary includes text from the article.

Future Trends in I&M

Uncertainty: Words on the Loose (Summary)

Roberto Tinarelli

The guest author of this column recounts experiences teaching students that the result of a measurement depends on both random and systematic effects. He explains how young scientists agree that performing several measurements of the same quantity and considering the mean value helps in reducing the random effects. However, due to an ever-present limited number of measurements, the random effects cannot be totally deleted, and hence the result must be

provided as an interval instead of a simple number. As a result, each instrument, under a specific condition and with respect to a reference, has an error, which must be evaluated and that the error may go from one value to another one, thus defining an interval within which the *true* value of the measurand falls.

This summary was written by K. Virostek and includes text from the article.

Life after Graduation

Volunteer
(Summary)

J. Max Cortner

The author discusses that readers should not forget to volunteer during their careers and how it is worth the effort. He presents specific opportunities for readers to contribute to the Instrument and Measurement Society community: Local chapter leaders organize meetings that allow members to network with their technical community and provide technical programs for member development. Small teams who increase the scale of these exchanges and networks to an international level lead conferences and workshops. Finally, the Administrative Committee, or AdCom, consists of volunteers who integrate the efforts of many volunteers to multiply the benefits worldwide.

This summary was written by K. Virostek and includes text from the article.

Departments

Chapter Report

Chapter Chair Summit 2015

Sergio Rapuano

We held the third Chapter Chair Summit in the Centro Congressi of Pisa, Italy, on May 11, 2015. As in past years, the Summit was a parallel event of the IEEE International Instrumentation and Measurement Technical Conference (I2MTC) and held one day in advance of the conference in the same venue.

The chapters of IMS have been consistently increasing in number during the last two years, reaching 53 active chapters and six student branch chapters by May 2015. The highest increase came from Region 10, the Asia Pacific Region. The increase rate is growing, especially in the student branch chapters. For the third consecutive year, the number of chapter chairs attending the summit increased, and this year there were 11 present, seven of whom were attending for the first time. Representatives of all of the IEEE regions except the USA came to Pisa.

IMS President Reza Zoughi opened the Summit and the Chapter Chair Liaison Sergio Rapuano led the Summit activities. The agenda of the 2015 Summit was even more intensive than the previous years, with more interaction with Administrative Committee members and Society Committees. This year activities were divided into four main parts: a discussion about the outcomes of the Summit 2014, a roundtable about the hot topics for chapters and the Society, a discussion with the Society officers from different IMS standing committees, and a presentation of the chapter best practices followed by a general discussion. The main discussion occurred during the round table on hot topics for the Society and chapters, and included the new Chapter Outreach Program, the chapter funding opportunities, and the involvement of students in the technical and membership activities. The chairs provided useful feedback, comments and suggestions that, as in the previous years, the AdCom will discuss in their meetings and will help shape IMS policy for the future.

Max Cortner, the VP Education, represented the Education Committee. Mihaela Albu, the former VP Technical Activities, represented the Technical Activities and Standards Committee. Alessandro Ferrero, Editor-in-Chief of *IEEE Transactions on Instrumentation and Measurement*, represented the Publications Committee.

The chapter chairs represented in Pisa took time to show and discuss their significant activities. The attendees acknowledged several best practices and at the end of this session, the chapter chairs prepared a list of best practices to use as a guideline for their colleagues.

The print article includes a photograph from the event.

New Products

Robert Goldberg

Please send all "New Products" information to:

Robert M. Goldberg
1360 Clifton Ave.
PMB 336
Clifton, NJ 07012 USA

E-mail: r.goldberg@ieee.org

Thermography Camera System

Sierra-Olympic Technologies announces the new, longwave infrared (LWIR) CX640 Thermography Camera. The high-value imaging system features a 640 x 480 uncooled imaging array with 17 μm pixels that operates in the 8 to 14 μm spectrum. It is specially designed for use in process monitoring, machine vision, benchtop, laboratory, and OEM applications.

Well suited for a variety of radiometric imaging tasks, the CX640 features onboard thermography capabilities with onscreen display of temperature data points presented on the NTSC/PAL analog video signal. Radiometric measurements range from -20 °C to 650 °C. Communication to the camera is achieved via either RS-485 or Ethernet with the camera displaying temperature information of up to ten spots, as well as two user-defined regions-of-interest (ROIs) with temperature triggered hardware alarms.

The camera comes complete with a thermography analysis package for Windows XP/7/8 machines and has Ethernet data out. The CX640 with a 2x and 4x digital zoom, is ideal for benchtop thermographic analysis applications in education, government, R&D, and industry. The CX640 joins the previously introduced CX320 cameras; both can be specified with a variety of focal lengths ranging from 8 mm for very wide field-of-view (FOV) applications to 100 mm for narrow FOV, distant scenes. All lenses are F1.0 for maximum sensitivity.

More information on the high-performance thermography system is available online at www.sierraolympic.com.

Data Logger Utilizes FPGA Technology

Delphin's new Expert Logger data logger combines advanced measurement technology with the latest communications features.

This new universal datalogger is available in three versions capable of processing 16, 32 or 46 analog input channels. Up to 8 digital inputs/outputs and an SDI-12 interface are also available.

Access stored data via USB, wireless LAN interfaces, or remote cellular connection to the Internet via UMTS/LTE. Delphin's new Expert Logger utilizes FPGA technology enabling it to process up to 46 analog input channels at both low and high sampling rates. Measurement data is accurately acquired, independently stored, and transmitted to the internet or a PC for in-depth evaluation via USB, LAN, WLAN or LTE.

It's easy to configure the Delphin Expert Logger from your PC. Users can quickly connect sensors to the Expert Logger using its plug-in screw terminals and a chart showing channel arrangement. All analog inputs are galvanically isolated from each other. The device's 24-bit A/D converter ensures fast, precision sampling rates of up to 50 measurements per second per channel.

The device's internal software channels enable online evaluation of measurements and the logging of relevant data for later in-depth analysis. Using limit values, users can switch digital outputs or have the datalogger automatically send emails. Able to operate in standalone mode using batteries, rechargeable or solar panels, these dataloggers are also equipped with an energy-saving 'Sleep function.'

All Expert Loggers are equipped with an internal 4 GB memory that can independently store up to 100 million measurements with date and time stamps. Users can extend storage capacity as needed via external USB or LAN storage (NAS). Online measurement data or the contents of the data memory can be transmitted over the Internet via the integrated WLAN or UMTS module.

The Expert Logger comes complete with ProfiSignal Go software included free with delivery. ProfiSignal Go can be used to portray measurement data in trends and to carry out detailed analyses. This popular software also enables fast ASCII exporting of measurement data for MS Excel™ or for conversion into TDM format.

For further information on the new Delphin Expert Logger, visit www.DataLoggerInc.com.

Precision Power Analyzer

Yokogawa Meters & Instruments announces its latest Precision Power Analyzer, the Model WT3000E, offering power measurement accuracy of 0.01% of reading + 0.03% of range. This

new addition to Yokogawa's digital power analyzer product line offers innovative measurement functions which benefit the engineer with electrical power measurements. It is the ideal measurement solution for testing Product Efficiency, and the design of Inverters, Motor Drives, Lighting Systems, Uninterruptible Power Supplies, Transformer Testing, Aircraft Power Systems, and other power conversion devices.

The WT3000E offers two types of Input Elements. The Low Current element provides selectable input ranges of 5, 10, 20, 50, 100, 200 and 500 mA and 1 and 2 Amps. The High Current element provides selectable ranges of 0.5, 1, 2, 5, 10, 20 and 30 Amps. Both offer eight selectable voltage ranges from 15 to 1000 Volts. From one to four input elements can be installed with any combination of Low and High current versions. Measurements of Crest Factors of up to 300 are possible. This is very important in dealing with power electronic circuits.

The WT3000E has a voltage and current bandwidth of 1 MHz, which means it can display the tenth harmonic of a 100- kHz switching power supply and higher harmonics for lower switching speeds.

Many of today's power conversion circuits use energy saving switching techniques. These can cause highly distorted voltage or current waveforms with high harmonic content. To measure these waveforms accurately, the WT3000E uses high resolution sixteen bit Analog to Digital converters.

Two new measurement functions are provided as standard with the WT3000E. The Delta Calculation function allows users to calculate the individual phase voltages, Line-to-Neutral, from the Line-to-Line voltages measured in a three-phase three-wire system. The Cycle-by-Cycle Measurement function lets you list the measurement parameters of voltage, current and active power for each cycle in a time series to capture fluctuating transient power.

With its large high resolution 8.4 inch TFT LCD display, it is simple to set up and display up to nine different pages of measurement items in formats such as Numeric, Waveforms, Harmonic spectrum Bar Graphs and Trends. In addition a Vector display is available for Voltage and Current phase Analysis.

For further information about the WT3000E, please visit:

<http://tmi.yokogawa.com/products/digital-poweranalyzers/digital-power-analyzers/precision-poweranalyzer-wt3000e/>.

High-Fidelity PCIe Digitizers

Keysight Technologies, Inc. announces the availability of the high-fidelity digitizer application option for its U5303A 12-bit PCIe® digitizer.

The new BB1 application option provides enhanced performance by:

- Compensating the analog-to-digital converter (ADC) and the front-end distortion
- Minimizing the interleaf spurs
- Reducing the overall noise bandwidth

This results in highly improved and uniform measurement fidelity across the useful bandwidth, which greatly benefits RF and wireless frequency domain measurements. The digitizer's post processing compensation also delivers better spuriousfree dynamic range (SFDR) and intermodulation product (IMx) specifications.

This high-fidelity digitizer allows customers to select one of the five available settings that best fit their applications, from 1.6 GS/s with 650 MHz instantaneous bandwidth, down to 100 MS/s with 50 MHz instantaneous bandwidth. The achievable data acquisition length is up to 64 MSamples per channel. By adding processing capability within the driver, the U5303A ADC card option BB1, coupled with the data analysis software, enables a broad set of RF and wireless measurements, such as error vector magnitude and intermodulation distortion.

Information about the product is available at www.keysight.com/find/U5303A.

Auto-Test Functionality for Motorola XTS® and XTL™ Series Radios

Cobham AvComm, formerly Aeroflex AvComm business unit, has announced automated test and alignment support for Motorola XTS and XTL Series Radios. Cobham AvComm's latest product, the 8800S Digital Radio Test Set, is equipped with the application that fully automates radio testing and alignment. This ensures optimum radio performance in significantly less time, minimizing service and support costs for the end users and dealers.

Automated test and alignment software is a major breakthrough in radio test technology. End users of the 8800S can eliminate the computer and can confidently test and align their radios by the push of a button. Cobham AvComm is a licensee of the control command technology from Motorola, and currently provides a wide range of features for a number of Motorola radio technologies, including Project 25 and HPD®.

For more information, please visit www.aeroflex.com.

Industrial Measurement Software

Hexagon Metrology has unveiled PC-DMIS 2015, the newest version of their software for the collection, evaluation and management of measurement data. PC-DMIS is the flagship software package for Hexagon Metrology measurement devices and a range of other measurement equipment in the marketplace. This new release offers significant improvements for the inspection of point cloud data captured during scanning operations. Other enhancements have been developed for the tools, workflow and overall user experience.

In this updated release, many improvements have been made to enhance the user experience, including a redesigned execution timer that is more accurate and respects partial execution. Improved probe animation increases offline programming efficiency. A new QuickGD&T selection speeds measurement routine building by creating all necessary features, datum definitions and dimensions with a single click.

Point cloud tools have also been upgraded to provide a simulation of the scan stripe for DCC CMMs, ensuring full target area exposure. The meshing tool now allows real-time data meshing during the scanning process, dramatically speeding up reverse engineering projects. Also included in PC-DMIS 2015 is a new cross-section tool, which creates deviation annotations directly in the graphics display for quick reference as well as archive reporting.

Other product highlights include new and improved sheet metal inspection tools for AutoFeatures to boost accuracy and reliability for complex geometries. PC-DMIS 2015 also introduces a new measurement strategy for optical CMMs, which provides measure-as-you-go functionality for measuring features that are too large to fit in the “Live View” field-of-view. With the new strategy active, users simply generate alternate active and void targets with multiple, quick-and-easy mouse clicks, while ignoring areas of non-interest.

PC-DMIS 2015 is now available for download. More information is available through local Hexagon Metrology commercial operations and dealers at www.hexagonmetrology.us.

High-Density PXI Solid State Multiplexer

Pickering Interfaces has introduced a new Versatile High-Density PXI Solid State Multiplexer. This new PXI Solid State Multiplexer (model 40-681) features a wide range of selectable switching configurations and the versatility of its architecture allows all multiplexer banks to be inter-linked and common connections used as extra signal inputs programmatically.

This multiplexer is especially useful where a high-density MUX array is required that can adapt to different test configuration for different test targets or where a test system may need to be reconfigured in the future.

The use of high performance solid-state relays ensures that the 40-681 MUX has a long service life even when hot switching into capacitive loads.

It can sustain 1.5 A for 100 ms on hot or cold switching. This module is supported by Pickering's new eBIRST switching system test tool. These tools simplify switching system fault-finding by quickly testing the system and identifying the faulty relays. Once identified, the tools then display a graphical representation of the switching system's PCB assembly, highlighting the relays that need to be replaced.

For more information on signal switching and conditioning products or sales contacts please visit www.pickeringtest.com.

High Range, High Resolution Miniature Accelerometer

Designed for measuring vibration on small objects where mass loading and accuracy are a concern, PCB Piezotronics' new Model 352A57 miniature accelerometer weighs only 1.3 grams and is TEDS enabled.

This sensor also offers a 2.5 mV/g output over a wide 2000-g dynamic range along with a low noise resolution of 0.001 grams. These characteristics are ideal in satellite component ground vibration testing for sine, random and shaker shock applications without the need to change out accelerometers for different measuring ranges.

Model 352A57 is also hermetically sealed making it suitable for low outgassing thermal vacuum chamber environments. The new Model 352A57 incorporates a shear mode ceramic element and an ICP® internal electronic design that provides a low noise, low impedance output while at the same time minimizing base strain and transverse sensitivity. The accelerometer has a side mounted 5-44 electrical coaxial connector and adhesive mounting.

The IEEE P1451.4 standard in the TEDS feature self-identifies the accelerometer and describes the type, operation and its attributes, making it extremely easy for the user to track. Examples of the data contained are manufacturer, model number, serial number, calibration date, sensitivity, frequency reference, high pass frequency, phase inversion, sensing axis, measurement ID and user data.

Please visit www.pcb.com for more information.

Ethernet & PoE Digital/Analog I/O Modules Now Available in Embeddable OEM Versions

Sealevel Systems, Inc. has released the eI/O™ family of Ethernet digital I/O solutions for embedded OEM applications. It is suited for commercial and industrial computing applications requiring an embedded Ethernet I/ solution, eI/O OEM modules provide system designers with a compact, low-cost monitor and control alternative for a variety of applications including process control, facility management, security, and broadcast automation.

Available in six I/O configurations, eI/O OEM modules include Reed, Form C or solid-state relays; optically isolated or dry-contact inputs; as well as A/D functionality. I/O connections are simplified via removable 3.5 mm terminal blocks that are compatible with 16-30 AWG field wiring.

Optional spring-clamp terminal blocks are available as accessories. eI/O OEM modules are available as Class 0 (IEEE 802.3af-2003) Power over Ethernet devices that allows power and data to be transferred over a single CAT5 cable, thus eliminating the need for an external power supply. Alternately, choose modules powered by your 9-30 VDC source.

Input power on DC modules is via a removable springclamp terminal block, requiring no tools and simplifying field installation. A variety of optional Sealevel power supplies are available.

Communicate with eI/O modules using industry standard Modbus TCP protocol or Sealevel SeaMAX software. The SeaMAX software suite supports the eI/O family and is designed to work with third party applications via the SeaMAX API. Sealevel's SeaMAX software drivers and utilities make installation and operation easy using Microsoft® Windows operating systems.

Standard operating temperature range of eI/O OEM modules is 0 °C to 70 °C and extended temperature range (-40 °C to +85 °C) is optional.

For more information, visit www.sealevel.com.

Reach High Power Levels with Next Generation Femtosecond Fiber Lasers

The FemtoFiber ultra NIR from TOPTICA is a costeffective, turnkey laser system that provides femtosecond laser pulses of more than 500 mW average power and an excellent beam quality. It is a powerful solution for applications in nonlinear microscopy like effective two-photon excitation of fluorescent proteins and SHG based contrast mechanisms, as well as micro-lithography. Experiments in fundamental physics will also benefit from the high output power of the laser. It provides pulses with a spectrum centered at 780 nm and a duration below 150 fs.

The system integrates a patented SESAM-mode-locked fiber-ring oscillator and a new high-power fiber amplifier. Polarization maintaining, active fibers are used in order to maintain the highest reliability levels. Based on a fundamental wavelength of 1560 nm with a repetition rate of 80 MHz for oscillator and amplifier, the FemtoFiber ultra NIR uses a frequency-doubling stage, which converts the amplified output spectrum to 780 nm. Due to a highly efficient frequency-conversion process, more than 500 mW average power is available at 780 nm with a clean TEM00-mode free-space output.

The laser requires no water-cooling for a stable operation. It can be controlled easily via Ethernet connection with a simple GUI that enables user-friendly access to all laser parameters. The FemtoFiber ultra NIR is the first member of TOPTICA's third generation of ultrafast fiber lasers. This "ultra"-series contains an improved concept for laser and electronics, combined with the fresh look and feel of a new silver housing.

TOPTICA's FemtoFiber ultra NIR provides powerful femtosecond pulses of more than 500 mW and less than 150 fs at 780 nm.

Specifications:

- Center wavelength: 780 nm
- Pulse duration: < 150 fs
- Laser output power: > 500 mW
- Repetition rate: 80 MHz
- Output coupling: Free space
- Footprint: 22 x 38 cm²
- Communication via Ethernet

Find more information at www.toptica.com.

Waveguide Detectors Cover Frequency Ranges from 26.5 to 110 GHz

Pasternack rolls out a brand new collection of high performance zero biased waveguide detectors that exhibit optimum performance in Ka, Q, U, V, E and W frequency bands. These waveguide detectors are widely deployed in various aerospace, defense and commercial wireless applications used in instrumentation, power detection, power monitoring, direct detection receivers, high frequency communications, radar, SATCOM, point-to-point radio, telecom, data links and R&D.

Pasternack's latest release of waveguide detectors consists of 6 unique models covering a broad frequency range of 26.5 GHz to 110 GHz. The input ports use popular waveguide sizes ranging from WR-28 to WR-10, while the video output ports utilize SMA female connectors. The detector circuits use high performance GaAs Schottky Barrier Beam lead diodes with extremely low junction capacitance. These designs perform with minimal sensitivity variation resulting in a flat frequency response across the entire waveguide band.

The new waveguide detectors from Pasternack are all zero biased, so no external DC bias or mechanical tuning is required. The package designs utilize rugged steel construction and are thermally stable. Integrated waveguide connectors make the outline extremely compact.

Performance is guaranteed over 0 °C to +50 °C. These detectors offer negative output voltage polarity for a variety of applications. Typical voltage sensitivity levels range from -600 mV/mW to -3000 mV/mW.

For detailed information on these products, please visit: <http://www.pasternack.com/pages/RF-Microwave-and-Millimeter-Wave-Products/waveguide-detectors.html>.

Laser Measurement Sensor Now Available in Analog Models

Banner Engineering has announced that its Q4X laser distance sensor is now available with analog output. Featuring 4-20 mA and 0-10 V output options, the Q4X analog models expand the variety of applications Banner's Q4X laser distance sensor can solve, including part positioning, roll diameter, loop control and thickness/height verification.

Providing continuous measurement and versatile sensing performance, Q4X analog sensors provide resolution as small as 0.15 mm and cover up to a 300 mm range. The sensors deliver reliable measurement regardless of color or reflectivity of target object or background.

The Q4X analog offers a simplified user experience with analog (V or mA) or distance (mm) readout from the highly visible, angled four-digit display that is easily viewed from multiple vantage points. The Q4X also offers intuitive user setup utilizing three tactile buttons conveniently located below the display.

For use in wet and high pressure environments, the Q4X is constructed with robust housing rated to IP69K. Durable FDA-grade stainless steel resists mechanical impact, over tightening and extreme vibration.

For more information on the Q4X laser sensor, visit www.bannerengineering.com.