THE ELECTRON

THE QUARTERLY NEWSLETTER OF THE INSTITUTION OF ELECTRONICS

Issue 25: Spring 2015

NATIONAL ELECTRONICS WEEK

National Electronics Week, the UK's annual dedicated exhibition for electronics professionals, took place at The National Exhibition Centre in Birmingham on 21st. and 22nd. April.

As last year the event was divided into four streams: Design and Test, Embedded and Software, Components and Power, and Production and EMS.

The Embedded and Software stream featured 'The Embedded Masterclass' with presentations that included 'The Internet of Things requires a User-Centric HMI' by Jason Williams of Altia; 'Managing Product and Software Development to support long-term Maintenance and Optimal Code re-use for Product Variants' by Fergus Duncan of Bitwise; and 'Controlling Deviations in a MISRA Environment' by Fergus Bolger, Chief Technology Officer for Programming Research.

In Components and Power, The Electronic Components Supply Network (ESCN) seminar stream included 'Just say no - Counterfeit avoidance in the Electronics Component Market' by ESCN Chairman Adam Fletcher; 'The Geyer Y-Quartz App - a new analysing Tool for your Android Device' by Graham Coleman, UK Sales Executive for Geyer Electronic UK Limited; 'Touch and Input Sensing - 3D Gesture Controller' by Tony O'Byrne, Corporate Applications Manager for Microchip Technology (he explained that that the MGC Controller family enables the detection of gestures by the user and to track a movement, with interaction with a device becoming as simple and intuitive as a wave of the hand - the Controller family enables single chip gesture solutions with no host processing needed for embedded usage); 'Project Gecko - High Performance Miniature PCB Connectors' by Graham Cunningham, Project Manager of Harwin plc; 'Legislation impacting the Electronics Components Markets and Customers' by Ashley Barron, Legislative Specialist for Farnell; 'The Internet of Things and Industry 4.0' by Gavin Stoppell, SNI Application Manager for Harting Limited; 'The Mouser Development Tools Centre' (focusing on the MultiSim Blue Component Evaluator and Simulation Design Tool) by Mark Patrick, Supplier Marketing Manager - EMEA for Mouser Electronics; and 'Global Electronic Components Markets - An Update and Review' by Aubrey Dunford, Managing Partner for Europartners Consultants.

The Production and EMS stream centred around the NPL and Smart Group Printing and Assembly Automatic Optical Inspection Experience with seminars on topics such as 'Selecting a Solder Paste Inspection System to improve Yield', 'Automated Inspection for Future Technology', 'Solder Paste Printing Failure - Causes and Cures' and 'Stencil Design for High Reliability Applications'.

In addition to the above The Vehicle Electronics Conference included a Keynote Address from Tim Armitage, Associate Director of Arup, on 'The UK Autodrive Project'. There were also presentations on 'Building Timing Correctness for ISO26262 ECU Software' by Andrew Coombes of Rapita Systems; 'Verification and Testing - a necessary Evil for ISO26262 Compliance?' by Jim Thomas of Test and Verification Solutions; and 'The Recovery of Energy from Car Exhaust Pipe Surfaces' by David Wood, Linzi Dodd, David Etor and Claudio Balocco of Durham University.

The exhibition features just under 100 exhibitors.

MOUSER SPONSORS ALL- ELECTRIC RACING CAR

Exhibitors Mouser Electronics have announced that they are to sponsor the China Racing Formula - E Team in the new Federal International de L'Automobile (FIA) global racing series Formula E, which features cars that are powered exclusively by electricity.

Mouser will be in sponsorship with its partners Molex and Vishay Intertechnology.

Formula - E represents a vision for the future for the motor sports industry, serving as a framework for R and D around the electric vehicle and a method by which to increase general interest and promote sustainability in these types of cars.

Todd McAtee, Vice-President of Mouser Business Development (Americas) states:

"Since every advanced sophisticated component that goes into a race car is all about precision and gaining a performance edge out on the track, auto racing is the perfect vehicle to build top of mind awareness for Mouser and its industry lead partners. It's particularly exciting for us and our supplier partners that these new all-electric race cars are paving the way for future automotive technologies."

Mouser is an award-winning authorised semiconductor and electronic component distributor focusing on the rapid introduction of new products and technologies to electronic design engineers and buyers. Mouser.com features over 4 million products online from more than 500 manufacturers and houses an industry-first interactive catalogue, data sheets, supplier-specific reference designs, application notes, technical design information and engineering tools.

Further information may be obtained from Mouser Electronics, Artisan Building, Suite C, First Floor, Hillbottom Road, High Wycombe, Buckinghamshire HP12 4HJ. Telephone: 01494 467 490. Email: uk@mouser.com

OPTIMISING REAL-TIME OPERATING SYSTEM SELECTION IN VEHICLES

Mark Pitchford of Lynx Software Technologies gave a presentation entitled 'Using a POSIX Compliant RTOS to improve hard real-time Performance and minimise glass-to-glass Latency in ADAS and IVI Applications'.

This presentation focused on the increasing demands currently being placed on automotive operating systems. The closed radios and media players are long gone and now over 100 microprocessors and sophisticated digital systems are utilised, with Advanced Driver Assistance Systems placing substantial demands on automotive electronics. A major consequence of this is that the choice of operating systems is becoming increasingly significant.

Mr. Pitchford explained that it is likely that any particular vehicle system will include a number of different operating systems. POSIX defines a set of standard operating systems Advanced Performance Indicators (APIs).

He argued that using several operating system APIs results in a fragmented and inflexible skill base.

Linux is the most associated with POSIX compliance, with scheduling based on a 'fairness' policy as opposed to a pre-emptive, priority based scheduler. There are, however, times when hard real-time matters, especially when latency and jitter are key, with a prime example being 'glass-to-glass' latency. This defines the camera-to-display delay and in ADAS applications it is the 'sensor-to-receiver' delay. Also of importance is the 'litter' associated with the system, that is the variation in the delay.

The presentation emphasised the fact that minimisation of latency and jitter requires response times that are both optimal and predictable, and that scheduling on the basis of a 'fairness' policy does not lend itself to this.

The solution that was advocated was that of the Separation Kernel Hypervisor, which provides a means to take advantage of multicore processors. The Separation Kernel Hypervisor can host a number of subjects.

The Separation Kernel Hypervisor can both address the real-time issue and provide support for the optimal operating system.

Boot times in a real-time operating system that is purpose built for embedded systems are known to be quicker than for generic Linux systems and were therefore recommended, with the Separation Kernel Hypervisor advocated to optimise RTOS selection without a resulting hardware proliferation.

The conclusion was that using Linux and a POSIX compliant RTOS should be complementary rather than mutually exclusive.

About Lynx

Every day millions of people worldwide are touched by products that rely on Lynx Software Technologies, from Internet and phone communications to airline flight-control systems to office automation and medical devices. Lynx Software Technologies software provides the hidden intelligence that empowers, protects and secures.

Further details may be obtained from Lynx Software Technologies, 855 Embedded Way, San Jose, California CA 95138-1018 USA. Email: inside@lynx.com

INTELLIGENT SMALL CONTROLLERS FOR THE AUTOMOTIVE SECTOR

Exhibitors Wurth Elektronik have introduced the Nano ICCS and Micro ICCS intelligent small controllers for the automotive sector. They are designed so that developers will have an intelligent and reliable solution for realising standard functions such as toggle, time delay and impulse functions as well as complex special functions.

The Nano ICCS and Micro ICCS are robust, shockproof and temperature resistant and both have an e1 licence that enables them to meet the elevated requirements for use in vehicles.

The main difference between them is in their task-solving capabilities, the Nano ICCS being used for the control of simple functions such as switching off lighting with a delay, whilst the Micro ICCS has more inputs and outputs and is used to solve complex problems such as monitoring the values of parameters like temperature, frequency, current or voltage.

In order to make program development easier a development tool, the ICCS SDK Classic, is offered so that developers can develop programs for the ICCS small controllers on their own and without complex programs.

More information is available from Wurth Elektronik, 8th. Floor, Building 8, Exchange Quay, Salford, Manchester M5 3EJ. Telephone: 0161 872 0431. Email: sales-online@we-online.com

LED CURRENT CONTROL AND MODULATION DIMMING

LED lighting has become increasingly popular as a result of its ability to provide high luminescence with a long life, high efficiency and relatively low cost. As a result the subject of controlling and driving LEDs has become a popular subject, especially with regard to the challenge of avoiding flicker.

Flicker (also known as 'banding') is a visual interference effect that arises as a result of the switching frequency of the LED. The 'off-time' of the LED is critical and varies according to the application, but

the flicker fusion threshold needs to be no more than 20 microseconds when viewed with cameras if the effect is to be avoided.

The dimming level of the LEDs is essentially related to the average on-time of the modulation so, by definition, as the dimming level is reduced the off-time will increase along with the potential for banding. A further consideration is that the LED drivers used might require a minimum on-time as defined in their data sheet. The result is that it is necessary on the one hand to consider the minimum on-time to meet the specification of the LED driver, whilst on the other hand it is necessary to consider the minimum off-time due to flicker. Communication interfaces and efficiency considerations add to the problem.

An LED luminaire differs from its conventional incandescent equivalent in that it requires electronic control gear, which may be integrated into the 'light engine' as with LED replacements for light bulbs, or else separate. The electronic control gear may include an AC-DC stage, but it will always have a DC-DC stage to drive the LED. In addition there may be a communication interface such as DALI to facilitate 'smart lighting'. There may also be more than one LED string in the 'light engine' which may need to be controlled independently.

Within the electronic control gear the DC-DC stage is of particular interest and for this exhibitors Hitex (UK) Limited have developed the XMC1000 series of controllers.

There are derivatives of the Infineon XMC1000 Cortex Mo microcontrollers that include a peripheral dedicated to the control of LEDs (Brightness and Colour Control Unit). This uses pulse density modulation to control the intensities of up to nine independent LED strings. In addition there are three dimming engines which can be flexibly assigned to the nine channels to provide exponential dimming.

The characteristics of the human eye demand that exponential control is applied so that the transitions appear natural. Pulse density modulation control of the outputs allows for higher frequencies which means that flicker can be avoided even if the LEDs are viewed with high definition cameras.

The Brightness and Colour Control Unit outputs can be routed to the output pins of the microcontrollers and in turn connected to external LED drivers, but alternatively the outputs can be internally connected to the timer units within the XMC1000 (CCU4 or CCU8) as part of an efficient high speed, low cost LED driver. In this configuration the only external component required is an inverted buck circuit in which a sense resistor is used to sample the LED current and compare it with a reference to detect the peak current. The internal analogue comparators of the microcontrollers connect to the timer unit to trigger a fixed off-time for the MOSFET in the buck circuit.

In order to improve the efficiency of the circuit the ripple of the LED current can be reduced by adjusting the MOSFET off-time (by changing the CCU compare value) as well as the inductor size.

The flexible configurations and interoperability of the microcontroller peripherals enable the interconnections to suffer very little from propagation delay and require very little user code once initialised. This results in a system that switches at up to 3MHz and provides an average constant current.

The reference circuit used on the evaluation board is configured for 700mA, but if the external components are changed then several Amps is achievable.

The result is a system in which the LEDs can be dimmed to a low level with no flicker even when viewed with HD cameras.

More details are available from Hitex (UK) Limited, University of Warwick Science Park, Coventry CV4 7HS. Telephone: 024 7669 2066. Email: sales@hitex.co.uk

ELECTRONIC ASSEMBLIES STANDARDS REVISED

Three electronics assemblies have been revised:

(i) IPC/WHMA-A-620 'Requirements and Acceptance of Cable and Wire Harness Assemblies' (the only industry consensus standard of its kind).

(ii) IPCJ-STD-001F 'Requirements for Soldered Electrical and Electronic Assemblies' (recognised worldwide as the sole industry consensus standard for soldering processes and materials)

(iii) IPC-A-610F 'Acceptability of Electronic Assemblies' (a post-assembly acceptance standard used to ensure that electronic assemblies meet acceptance requirements).

The first of these standards contains 19 chapters covering wire prep, soldering to terminals, crimping of stamped-and-formed and machine contacts, ultrasonic welding, connectors, marking, coax/bias cables, wrapping/lacing, shielding, assembly and wire wrap terminations.

Revisions cover molding and potting, splicing, crimp contacts without insulation support, inline insulation displacement connectors, connectorisation, rigid and conformable cable, flexible sleeving, broomstitching and testing.

Revisions to the other two standards include:

* Requirements added for two new SMT terminations, namely P-style terminations and Butt/I terminations - Solder charged terminations.

* Revised Class 2 plated-through hole vertical solder fill requirements.

* Revised void criteria for BGA/CSP components

* Revised Class 2 flux activity criteria.

* Revised soldering requirements for plastic SMT components.

* Expanded conformal coating section.

* Revised appendices to IPCJ-STD-001 incorporating guidelines for soldering tools and equipment and objective evidence on material compatibility.

More information is available from The IPC Training Centre, Hill Farm, Church Lane, Ford End, Chelmsford, Essex CM3 1LH. Telephone: 01245 237 083. Email: info@rework.co.uk

WiFi FOR LOW POWER APPLICATIONS

WiFi was designed as a desktop technology for streaming data to an access point and its architecture was therefore not constructed for low power applications. Modern silicon and advanced software architectures have, however, enabled power consumption to be reduced to the point where it has become viable. The higher performance of access point chips and new standards such as 802.11ac are also playing their part, allowing more devices to be attached to the network with the increase in performance being used to reduce the power.

In the *Electronic Specifier* Embedded World 2015 Exhibition and Conference Supplement Josh Mickolio, Product Manager RF for Digi-Key explains how the power in WiFi for the Internet of Things (IoT) may be addressed:

'Unlike streaming applications, sensor and control data in the IoT is bursty, which means a WiFi chip only needs to operate less than 5 per cent of the time to send data and, unlike Bluetooth, it doesn't need to set up a link. As the latest chips from developers such as Broadcom, Microchip and Atmel are also designed with ultra low power "listening" sleep modes, the chip can be quiescent for 95 per cent or even 99 per cent of the time, only waking up if there is data to send or control instructions coming in'.

System architects can also make use of higher performance links and by using a higher speed link(100 Mbit/s for 11n or even 433 Mbit/s for an 11ac channel) the chip can send data in a shorter time and shut down more quickly, so using less energy.

New standards such as 11ac also help to counteract interference from other networks and other equipment, which was a problem with WiFi. There is a limited number of channels available at 2.4GHz for 11b, 11g and 11n, and with a large network with many thousands of devices interference is common, but with any one device only trying to transmit for a short length of time it is less likely to interfere with another device nearby.

The author states further:

'Modern design techniques have improved the interference protection and newer coding schemes also reduce the interference . This is also important with other equipment - microwave ovens radiate at the same 2.4GHz frequency creating more interference. 801.ac operating at 5GHZ with 80MHz channels avoids many of these issues, providing the higher data rates (headline figures up to 1Gbit/s) and minimising the effects of other networks.'

But this brings new challenges:

'Designing a radio front end at 2.4GHz is not trivial and it is significantly more difficult at 5GHz. Good antenna design with minimal switching losses means a good link budget, which allows the node to transmit at lower power. This can allow the node to operate effectively at a longer range, reducing the number of nodes that are needed and reducing the cost and complexity of the network.'

The 5GHz networks can lead to lower power through higher data rates, but the penetration is also lower, meaning that either links are shorter for the same power or that more devices are required. Additionally, the design of antenna systems for 5GHz 11ac networks is different to that for the 2.4GHz versions. These issues are addressed through a new generation of low power modules that match single chip transceivers with optimised antenna design to provide the best possible link budget.

The next version of 11ac will use channels as wide as 160MHz, which will provide more opportunity for spread spectrum implementations that are more robust still against interference.

A point-to-point version of WiFi (WiFi Direct) will allow nodes to be interrogated or linked directly without having to go across the network, potentially simplifying the network architecture and software by reducing the number of access points and reducing the power. Chip designers Atmel are now including WiFi Direct in transceivers for industrial applications.

For more information contact digikey.co.uk or telephone 0800 587 0991.

NATIONAL VIDEOGAME ARCADE GETS RASPBERRY PI

The National Videogame Arcade in Nottingham has received a donation of 300 Raspberry Pi credit card sized computers from RS Components.

The new Raspberries will be used for lighting control and as part of 'Introduction to Raspberry Pi' workshops for school groups.

The National Videogame Arcade is the world's first permanent cultural centre for videogames with a video games hub with themed galleries, a changing programme of interactive exhibitions and an educational programme across the National Curriculum. It will pioneer new forms of creative engagement with technology.

THE ARTIFICIAL LEAF

Scientists at The California Institute of Technology have successfully developed an artificial leaf that can mimic the ability of plants to convert sunlight and water into fuel. This will enable water molecules to be split so as to release oxygen and non-polluting hydrogen that can be stored to produce electricity.

Previous attempts to replicate photosynthesis have required two electrodes (photoanode and photocathode) combined with a plastic membrane. The photoanode oxidised water molecules with sunlight and generated oxygen along with protons and electrons. The photocathode then recombined the protons and electrons to form hydrogen. There was a problem, however, because these electrodes have to be made of semiconductors such as silicon or gallium arsenide, which corrode when exposed to water.

In order to address the problem a protective coating could be used, typically of titanium dioxide, but the researchers opted for nickel oxide and managed to reduce the required protective layers of the photoanode from two to one. This enabled a wider range of materials to be used for the construction of the artificial leaf without sacrificing stability and efficiency.

Creation of the leaf involved colliding argon atoms into a pellet of nickel atoms at high speed in an oxygen rich environment. Nickel fragments from the pellet then reacted with the oxygen to produce an oxidised form of nickel.

When the resultant film is applied onto a semiconductor safe, efficient solar fuel generators could be rolled out onto a roof leading to lower manufacturing and maintenance costs than is currently possible with conventional solar panels.

A longer description is provided in the article 'Thin Film Technology makes Artificial Leaves more robust' by Katia Moskvitch in *Engineering and Technology* journal, Volume 10, Issue 3, April 2015.

FIRST ESCO ANNUAL REPORT

The Electronic Systems Council (ESCO) was launched in June 2013 with the publication of a report setting out the size and scale of the UK electronic systems sector and a vision for the future. It put electronic systems on the map by describing the significant contribution of the industry, accounting for 5.4 per cent of GDP and employing 850,000.

This paved the way for the first meeting of the Council in September 2013, and a collection of achievements in 2014, which are detailed in ESCO's first annual report, with Foreword by Co-Chairman Warren East CBE, and Executive Summary by Chief Executive Sarah Macken.

Developments have included:

* Building the first UK Industry 4.0 demonstrator, based at The Manufacturing Technology Centre, which is the culmination of the work by the Industrial Automation Workstream (an initiative providing a practical platform for UK electronic systems companies to advance new technology).

* Consolidation of the success of the UK Electronic Skills Foundation (a unique public/private partnership that provides work placements and bursaries for electrical and electronic under-graduates).

* Encouraging Ofcom to explore which parts of the spectrum can be made available for the IoT).

* Meeting with the Office for Life Sciences, which has responsibility for championing biotechnology and the pharmaceutical and medical industries in the UK, to explore the opportunities to improve health service delivery in the med-tech and e-health arena.

* Working to advance an automotive-demonstrator to provide an opportunity for UK companies to test how electronic systems interact with transport infrastructure, including exploring the technology required to develop driverless cars in the UK.

Copies of the report 'Electronic Systems A Plan for Growth: One Year on' may be obtained from info@esco.org.uk

EMBEDDED DATABASES FOR SMART ELECTRICITY

Electricity generating companies are turning increasingly to wind, solar and tidal power to replace fossil fuels and nuclear power, but integrating these assets into the supply grid has presented new challenges because generating capacity is dependent on variable wind speed, sun levels and water flow.

In Issue 12 of *Process Engineering Control and Maintenance* Steiner Saude, CEO of database technology specialists Raima Inc. of Seattle explains how embedded databases are helping to make grids smarter:

'Within a grid it is usual that the various power generation sites are somewhat distant from one another and also some distance from the controlling operations centre. Therefore control of the generating site must be achievable remotely. Options for a large-scale re-building of the power delivery infrastructure are limited; instead innovative new technologies that convert existing grids into smart flexible solutions that can be implemented over time seem to be the way forward.'

To this end Raima and its partner companies have created a microgrid control solution based on National Instruments' CompactRIO hardware. The software runs on embedded controllers that are deployed at key points on the grid, distributing intelligence and decentralised decision-making to the remote devices and distributed energy resources.

The objective is to create a platform for securely managing power flow, peak load, distributed generation and other energy assets using real-time data collection, analytics and control on a distributed intelligence network, pushing the decision-making out into the network, increasing the fault-tolerance of the system.

Each device that is deployed to the network exhibits key features such as high-speed data capture, data logging, event detection, protocol translation (including Modbus, DNP3, IEC61850 and other custom protocols), custom control processing, custom control algorithm deployment processing, built-in security, and remote device management. The open architecture also allows expansion of the system and ensures interoperability.

Fundamental to the design is embedded database technology. The core of the solution is a secure distributed data management system in which each remote device stores its own local data in an internal encrypted database. The data from each device can be configured to flow up to a higher storage capacity device installed at a substation, operations centre or other major node within the grid.

With NI CompactRIO embedded controllers NI LabView software is used for most of the embedded development to be deployed on VxWorks and Linux® based operating systems.

As many grid operators run Windows there is a need for a cross-platform, highly flexible database solution that also supports encryption. For this an embedded database with a native LabVIEW API-Raima Database API for LabVIEW, implemented with RDM Embedded 12, is used. This provides a database management solution that is specifically designed for applications deployed on NI CompactRIO and NI Single-Board devices.

Stand-alone operation is possible since the database resides in the LabVIEW data directory. It offers extended functionality to share data between multiple targets, whether sharing information between NI Compact RIO devices or outside computers.

The Raima Database API for LabVIEW provides programmers with a quick and straightforward way to design data management functionality into their software applications.

National Instruments were exhibitors at National Electronics Week and may be contacted at Measurement House, Newbury Business Park, London Road, Newbury, Berkshire RG14 2PZ. Telephone: 01635 523 545. Email: info.uk@ni.com

NEW BARCODE SCANNING LOGGING THERMOMETER

TME Electronics have launched a new Barcode Scanning Logging Thermometer, the MM7100 ThermoBarScan, which represents a breakthrough in hand held temperature measurement.

Using high accuracy temperature measurement in combination with its own barcode reader, the new device can not just record the temperature, time and date of each measurement, but also scan user-set barcodes in order to identify every product or test point.

Up to 1000 separate measurements can be stored on the instrument at any one time before downloading on to a PC, which is easily achieved using free open-source software so as to create a unique cost effective solution.

The MM7100 is compatible with all standard thermocouple temperature sensors and probes, and customers can choose between a Bluetooth and a USB interface. The user is also offered a choice of programming alarm limits for individual targets/locations, global alarms for all temperature test points, and specially designed safe alarm limits, for example for legionella.

Users can also choose their own remedial action recommendations, which display whenever an alarm limit is exceeded.

Added value features provide detailed information to support Hazard Analysis Critical Control Point (HACCP)and ensure due diligence.

A large screen displays instant feedback on each temperature measurement and scrolling buttons allow previous measurements to be analysed. There is also an option to log a temperature without a barcode scan.

The new device retails at £425.

Further information may be obtained from sales@tmelectronics.co.uk

THE FUTURE OF THE INDUSTRIAL CONNECTOR

The concepts involved in Industry 4.0 have resulted in industrial networks based on cyber-physical systems advancing considerably, and consequently the scope of duties performed by industrial connectors is also changing. For example, specialised connectors are required that not only have to transmit electricity reliably and without error, but also relay data and information in real-time.

The decentralisation and modularisation of production systems is at the heart of Industry 4.0, which has created a need for industrial-grade connection technology to link the various modules and control cabinets that it requires. This means that:

(i) The robustness of the components used in the respective manufacturing environment must be ensured and meet the appropriate level of protection.

(ii) The need to alter the communication within a plant will have a direct impact on the number of mating cycles.

With Industry 4.0 connectors cease to be purely an installation-related feature and increasingly become multi-use components that must be repeatedly plugged in, disconnected and locked on a daily basis.

In order to meet this requirement industrial connector inserts and housings have been designed to permit up to 10,000 mating cycles.

With sub-functions in industrial control systems moving away from centrally organised control in the switch cabinet, decentralised control systems are needed that operate without a centrally located hub.

Up to now, when data has had to be transmitted between subsystems, intelligent connectors and switches have been used to construct corresponding topologies, but with industry 4.0 all lifelines (data, signals and power) will come into play creating a need for smart power networks that go beyond pure communication and integrate functions such as power management into the switch.

Industry 4.0 involves turning passive components, that is, objects that have traditionally functioned in a purely mechanical manner, into intelligent ones. Components like Han industrial connectors are thus being equipped with RFID technology, ID modules and sensors so as to make them 'smart objects'. Integrated management systems are being added to the individual modules to perform diagnoses of the interlinking transmission paths and to monitor individual modules. As an example, using appropriate sensors, parameters such as moisture level, temperature and current within a connector can be monitored as an aid to safety.

In order to ensure optimum error-free transmission in real-time between devices a pre-assembled cable capable of maximum performance is needed as well as the connector. This need has been addressed by utilising optical transmission technology, which is less sensitive to interference and therefore suitable for long transmission distances and high data transfer rates. The high flexibility of fibre optics also goes hand in hand with the needs of Industry 4.0 and allows uninterrupted diagnoses to detect any installation errors or material fatigue.

A further development is the 'smart power network' concept, which makes it possible to map the communication and diagnostic functions to the power supply. This again facilitates the development of the 'intelligent connector' where the relevant electronics are integrated within the body of the device.

This article is based on a round table discussion with contributions by Andre Beneke, Dimitrios Charisiadis, Harmuth Scmidt and Kilian Scmale, all directors or senior managers with Harting. The discussion is published in full in Harting's *Technology Newsletter*, tec.news, Issue 27, November 2014. For further details telephone 01604 827 500 or visit www.HARTING.co.uk

INNOVATIVE FAILURE ANALYSIS FOR TRANSFORMERS

In the *Electrical Review* Transformer Technology Supplement (May 2015) Johannes Berthold, Director of the Burs Transformer Station in Austria, and Michael Kruger, Head of Engineering Services for Primary Assets at Omicron Electronics, explain how an innovative failure analysis method has been developed for transformers using a completely new measurement procedure.

The new procedure involved taking frequency-dependent measurements of short-circuit impedances, an approach first developed in 2001 by Hydro Quebec, which used short-circuiting of one side of the transformer (e.g. tertiary winding) and then measurement of the short-circuit impedance from the other side (e.g. high voltage winding).

This concept is not new, but new aspects were introduced. The first of these was that the measurement was not taken at the usual frequency of 50/60 Hz, but at a broader frequency range, with the curves for the three phases compared with each other. Another was that the impedance was broken down into effective resistance (real part) and reactance (imaginary part) for the evaluation. For this it was necessary both for the impedance value to be determined from the voltage and current and for the angles to be measured with high accuracy.

The measurement required a powerful source that was capable of supplying the necessary voltage over a wide frequency range, as well as special testing equipment for the measurement of complex impedances. Omicron's CPC100 was well suited for this purpose since its power amplifier was capable of generating frequencies from 15Hz to 400Hz and its measuring electronics are not only capable of measuring voltages and currents to a high degree of accuracy, but also the accompanying phase angles. This compact testing device therefore possesses all of the functions that are necessary for this new measuring process.

The real part of the short-circuit impedance is highly frequency dependent. At low frequencies of just a few Hertz the real part is determined by the winding resistances. At high frequencies, however, the losses in the gaps between the windings also play an important role. This is also the reason why this measurement is used when strands of windings connected in parallel are suspected of shorting one another. These strands are normally insulated from one another to prevent circular currents, but if this insulation fails high circular currents can occur that can ultimately completely destroy a transformer.

Since this measurement method evaluates the losses in the gap it has been termed the Frequency Response of Stray Losses (FRSL) method.

In addition the frequency response of the short-circuit impedance's reactance was measured and a plot made of the short-circuit inductance relative to frequency. In the test specimen the value of the U phase was found to be completely different from the V and W phases at low frequencies, but at higher frequencies the skin effect forces the magnetic flux toward the surface of the iron core. This explains why the short-circuit inductance is similar to that of the V and W phases at higher frequencies.

These measurement procedures now allow the extent of damage in defective transformers to be assessed accurately and are envisaged to have major implications for making repair or replace decisions with regard to transformers in the power generating industry.

Further details may be obtained by visiting www.omicron.at

TOP MARKS FOR CUSTOM INTERCONNECT HAND SOLDERING

A regular feature of National Electronics Week is the annual hand soldering competition, in which, for the second year in succession, Custom Interconnect Limited of Andover in Hampshire claimed both first and second prize.

This year Philip Smith and Andy Smith were first and second respectively.

In the competition, which was sponsored by the journal *SMT Today* and eTEK Europe, competitors had to hand assemble components onto a pcb containing surface mount components and pin through hole components, including five pitched components.

The competition ran over both days of the event and competitors were judged on the quality of production and workmanship standards and practices.