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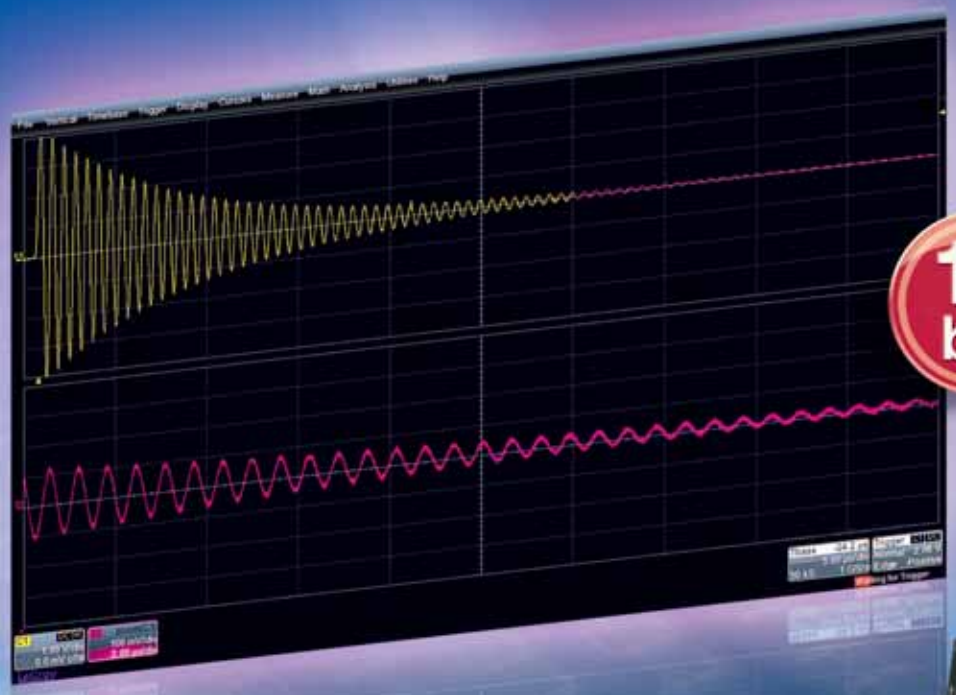

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FEATURES

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WHAT IF FLOSS WAS THE FUTURE OF SOFTWARE INNOVATION?

At AdaCore FLOSS (Freely Licensed Open Source Software) has been our bread and butter for around the last 20 years. It's unsurprising then that we'd champion it, but the engineering world's perception of FLOSS software is something which has been completely transformed in recent years.

In the early 90s, the general impression of FLOSS as an approach to software development was that it was out of the ordinary and challenged conventional thought. In fact, the naysayers thought that it wouldn't hold enough interest to recruit widespread membership from engineers and developers. How has the open source community gone from that to being as strong as it is today?

To understand the ethos of the FLOSS and Free Software communities we need to look at how they came about. To rekindle the spirit of cooperation and openness that existed in the software community in the 60s and 70s, Richard Stallman created the GNU project in 1983 to create a free software system. In doing so Richard Stallman created the Free Software movement and the Free Software Foundation (FSF). In addition to being the organisational sponsor of the GNU project, the FSF mission is to "preserve, protect and promote the freedom to use, study, copy, modify, and redistribute computer software, and to defend the rights of Free Software users".

More than just an open license (e.g. GPL), the FLOSS movement is a philosophy. Communities have been created where individuals and companies share the common vision and goal of advancing a technology for the benefit of all. Projects have blossomed due to the synergy created by openly sharing software and ideas. The FSF/UNESCO Free Software directory contains nearly 7,000 packages from visible projects such as GCC (the GNU Compiler Collection) to Gnome (the GNU desktop). The SourceForge site alone hosts nearly 260,000 projects created by 2.7 million developers leading to more than 2 million downloads a day according to their website.

Over the past decade, we have seen an explosion in the number and importance of research projects, both at national and European levels. Companies have realised that by mutualising development they can gain important gains in terms of product positioning and costs whilst benefitting from a cross-fertilisation of ideas, often from different industries. More than this, industries (that traditionally have very long critical software development cycles due to their nature and that of their products) are seeing the advantages in developing FLOSS products through funded research projects. A FLOSS tool supported by a community rather than an individual company or, worse still internally, not only ensures longevity and flexibility down the line but means the company can focus its resources on its core competences.

> ***Industries are seeing the advantages in developing FLOSS products through funded research projects***

A good example of this is the Gene-Auto project an open-source modelling toolset for real-time embedded systems. The Gene-Auto toolset was developed as a result of an ITEA project by a European consortium with partners from France, Estonia, Belgium and Israel. Several major actors in the automotive, avionics and space industries, as well as academic institutions and tool vendors/service providers, were involved. Clearly, the industrial partners are not in the business of developing modelling tools, they build planes, satellites and cars. Through the project they have been able to share the effort of developing a FLOSS toolset that all will benefit from and all will support.

For AdaCore, the Ada programming language provides an example of how and why the image of FLOSS has changed. Ada started in the early 80s with the potential of becoming the only major language of its category (procedural languages) and yet in the late 90s, it was seen as a decaying language that would be soon replaced completely by C++ and Java. It is now considered as one of the best languages of its kind for the niche market of long-lived, complex applications with stringent safety and security needs (Aerospace, Air traffic Management, Defence, Space, etc.).

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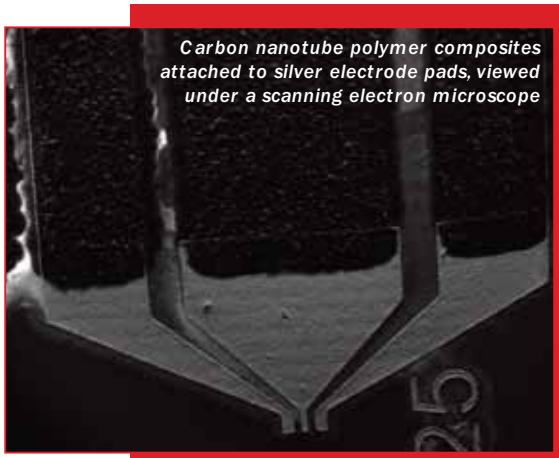


Carbon nanotube polymer composites attached to silver electrode pads, viewed under a scanning electron microscope

BREAKTHROUGH IN LOW LOSS, HIGH-FREQUENCY CARBON NANOTUBE ELECTRONICS

A collaboration between researchers at the University of Surrey's Advanced Technology Institute and the Faculty of Mechatronics of Warsaw University of Technology in Poland has confirmed that low electrical loss at frequencies of up to 220GHz are possible in screen-printed carbon nanotube polymer composites. Producing such low electrical loss materials potentially opens up to new types of high-frequency, large-area electronic devices.

A carbon nanotube (CNT) is a rolled up sheet of graphene that has a diameter of only a few nanometers, but despite its small size it has outstanding properties such as high strength and an ability to carry a very high electrical current.

Building upon previous EPSRC-funded research in carbon nanotube polymer composite electronics, this study shows that CNT composites have electrical losses of less than 0.3dB/mm over a wide frequency range. Embedding CNTs in a polymer, in this case PMMA, allows accurate control of the nanotube content and control over the conductive phase of the composite that was screen-printed into co-planar waveguides to produce structures tens of millimeters in length. Using a screen printing technology allows for ease of scalability for production and relaxes many of the constraints found in high-end manufacturing techniques. Possible applications include new types of microwave mixers, phase shifters and antennas.

"Understanding what controls the conduction at the nanometer scale in these new materials can lead to the development of new high-frequency carbon-nanotube based electronics," said Dr David Carey from the Advanced Technology Institute at the University of Surrey.

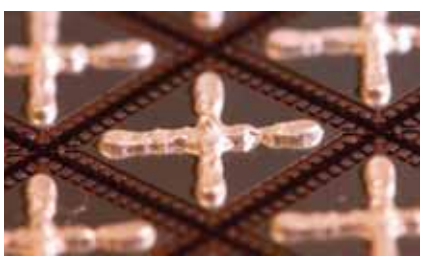
Henkel Introduces "Revolutionary" Pressureless Silver Sintering Technology

Breaking new ground in materials innovation, Henkel Electronic Materials has announced its success with a revolutionary silver (Ag) sintering technology that enables high volume production of modern power packages in a process that does not require pressure.

In its market debut, Henkel's Ag sintering capability has been designed into Ablestik SSP2000, a high reliability die attach material well suited for use with power modules such as IGBTs and high power LED products.

Sintering is a process in which particles are joined together by heating the material in a sintering furnace below its melting point until there is particle adhesion. Conventional Ag sintering is achieved by applying both heat and pressure to the material, or device, until the metal joint is formed. The drawback to the pressure application technique in semiconductor packaging is its volume limitation, as devices must be processed individually on capital-intensive die bonding systems.

With Ablestik SSP2000, because the silver particles are joined via a unique surface tension mechanism, the pressure requirement is eliminated and the material can be cured in a standard batch oven at a temperature as low as 200ºC. In addition, Ablestik SSP2000 can be processed on standard die bonding systems, eliminating the need to reinvest in specialist equipment and making the transition from existing materials simple, fast and cost-effective.



With Ablestik SSP2000 the pressure requirement is eliminated and the material can be cured in a standard batch oven at a temperature of 200ºC

"The ability to now exponentially increase UPH from traditional silver sintering techniques at roughly 30 units per hour to a remarkable 6,000 units per hour with the Henkel technology is incredible," says Henkel's Dr. Michael Todd, Vice-President of Product Development and Engineering.

While high UPH is a central advantage of Ablestik SSP2000, even more notable is the material's thermal resistance and reliability. In power cycle-testing where solder failed at 200 cycles, Henkel's Ag sintering technology was able to reach more than 2,000 cycles before the first failure. For high power devices such as IGBTs, that presents tremendous latitude compared to traditional solutions.

SHARE YOUR VIEWS WITH THE ENGINEERING COMMUNITY

Electronics World has launched a new blog and forum section on www.electronicsworld.co.uk. Readers who responded to our survey last summer told us that they wanted to see more comments and experiences from other readers. "We hope our readers will use this new section to interact with each other and share their ideas," said Louise Nicholls, Marketing Manager at Electronics World.

In the Forum, we will post all readers' letters that appear in the print issue so that you can respond and share your views immediately online.

In Barry's Blog, our new independent blogger Barry McKeown, an RF and Microwave Engineer, will be regularly writing about the most anticipated and talked-about subjects of interest to the electronics engineering community. Barry has already written challenging pieces on spectrum trading liberalisation, Ofcom, the GMSA Congress, femtocells and more. If you haven't seen it yet please visit the website and let us know what you think by commenting.

Visit www.electronicsworld.co.uk/blog to join the conversation.

New IEEE Standard Establishes Globally Relevant Smart Grid Interoperability Reference Model

The IEEE has ratified a widely anticipated standard providing alternative approaches and best practices for Smart Grid work around the world. The IEEE Standards Association (IEEE-SA) has achieved an important milestone with the approval of the IEEE 2030TM – IEEE Guide for Smart Grid Interoperability of Energy Technology and Information Technology Operation with the Electric Power System (EPS), End-Use Applications and Loads.

This establishes a globally relevant Smart Grid interoperability reference model and knowledge base that can be used by utilities that are developing their infrastructure roadmaps, by manufacturers who are planning Smart Grid systems and applications, by scientists who are conducting research, by governments who are crafting regulations and by standards development organizations (SDOs) who are writing additional standards for Smart Grid.

The IEEE 2030 Working Group and final balloting process had diverse global representation, with participation from countries all over the world.

"Volunteers from around the world addressed ways to integrate their respective technologies as well as the technical vocabularies, business cycles and capitalization structures into the framework," said Dick Delusion, IEEE 2030 Working Group chair. "The participants in this process successfully avoided the barriers that often result when countries, companies and industries pursue individual and potentially incompatible approaches to technologies that have global relevance."

Work has started on Three IEEE 2030 extensions:

IEEE P2030.1TM – Guide for Electric-Sourced Transportation Infrastructure **– is intended to establish guidelines that can be used by utilities, manufacturers, transportation providers, infrastructure developers and end users of electric-sourced vehicles and related support infrastructure in addressing applications for road-based personal and mass transportation.**

IEEE P2030.2TM – Guide for the Interoperability of Energy Storage Systems Integrated with the Electric Power Infrastructure **– is intended to help users achieve greater understanding of energy storage systems by defining interoperability characteristics of various system topologies and to illustrate how discrete and hybrid systems may be successfully integrated with and used compatibly as part of the electric power infrastructure.**

IEEE P2030.3TM – Standard for Test Procedures for Electric Energy Storage Equipment and Systems for Electric Power Systems Applications **– is intended to establish a standard for test procedures around verifying conformance of storage equipment and systems to storage interconnection standards.**

For additional information go to http://grouper.ieee.org/groups/scc21/2030/2030_index.html.

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Mouser remains steadfast in having the newest semiconductors and electronic components ready for immediate delivery. Easily accessible on Mouser.com, the distributor offers more than 1,700 Product Knowledge Center training sites on the newest products, technologies, solutions and applications. Each PKC training site houses a wealth of information, including datasheets, mechanical drawings, block diagrams, product videos, and educational resources, enabling design engineers to conduct research into detailed technical information at their own pace, using a variety of media. Mouser ship product orders the same-day from their state-of-the-art, AS9120A certified distribution facility. "European purchasing professionals can have confidence that they are designing in the newest products utilizing the most advanced technologies." says Mark Burr-Lonnon, Mouser Vice President of EMEA Business.

Mark Burr-Lonnon, Mouser Vice President of EMEA Business

Semiconductors continue to be one of Mouser's leading specialties. The distributor supplies the latest semiconductor solutions from the world's leading innovators. "At Mouser, we see semiconductors as the key enabling technology," Burr-Lonnon explains. "Semiconductors are the number one technological and industrial driver for new design."

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Instrumental to Mouser's European success is its worldwide local support, backed by a growing number of European Customer Service Centres, including a new flagship office in Munich, Germany, staffed with local service representatives that provide the very best customer service. Mouser has local branches in the UK, Italy, France, Czech Republic, Spain, and Israel, and brand new offices opened this Fall in Sweden and The Netherlands.

Mouser approaches business differently than its competitors. At Mouser, design engineers have 24/7 access to the newest products through a variety of sales channels, MouserMobile, Mouser.com, traditional, enhanced and Mobile Compatible catalogues and 19 sales branches. Having multiple sales channels ensures the newest products are always easily accessible, regardless of where the customer happens to be.

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"Mouser.com hosts over 1,700 Product Knowledge Center training sites complete with detailed information, application notes and key features on products and technologies," Burr-Lonnon explains. "We even go a step further by providing early identification of components considered obsolete or Not Recommended for New Designs (NRND), plus we provide a Project Manager tool with automatic reorder, BOM import capabilities, and automatic order confirmation."

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RoHS recast-status of development kits

GARY NEVISON, HEAD OF LEGISLATION AT FARNELL EUROPE, LOOKS AT THE 'FINE PRINT' OF EVALUATION AND DEVELOPMENT BOARDS BEING THE SUBJECT OF ROHS-TYPE SUBSTANCE RESTRICTIONS

The RoHS directive status of development kits and evaluation boards has always been unclear and hotly debated within the electronics industry, with no legally binding decisions being made. The German government decided many years ago that printed circuit boards sold separately to users, for example to increase computer memory or add new functions to PCs, would be regarded as separate products within the scope of the RoHS and WEEE directives, even though they do not have their own enclosures or a separate power supply. All other EU States now have the same opinion.

The RoHS directive's scope is electrical and electronic equipment that falls in categories 1-7 and 10 of the WEEE directive. There is no requirement for products to have their own enclosures and they can use any power source including batteries, USB cables, etc. The RoHS directive does not limit its scope except that the product should depend on electricity to function and so, clearly, single PCBs sold, loaned or given separately to users will be in scope if their main functions are in one of the eight RoHS categories.

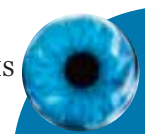
The only published guidance on development kits and evaluation boards is available from the UK RoHS enforcement body NMO. This states:

"Semiconductor Evaluation Boards:

The term Evaluation boards covers a broad range of products from some fairly simple products to fully-integrated complex systems. In most cases an evaluation board is effectively a single board computer allowing connection of peripherals and/or input devices to facilitate the programming and testing of chips. Therefore, most evaluation boards are included under Category 3 IT Equipment of the WEEE directive and must therefore comply with RoHS. On rare occasions these boards may be considered consumables and fall outside the scope of RoHS as described in the commission FAQs."

This implies that most types of evaluation boards are effectively single board computers and so are in category 3 of the WEEE directive. This is correct for any product whose main function is IT and these will be in scope of the RoHS directive. It is clear, therefore, that any development board that is intended to be used to program ICs will be in scope. NMO admit that some evaluation boards will not be in category 3, although they mention only those that are consumables as examples of those that will be outside scope.

Many evaluation boards provide information as their main function and so are in scope of RoHS, but there will be some exceptions. Category 3 is specifically "information technology and telecommunications equipment" and as such not simply the provision of "information". An example is providing the time that would be obtained by an electrically-powered clock (regarded as category 4), or a measurement instrument (these provide information on temperature, etc.) which would be in category 9 and so (currently) excluded from RoHS. Evaluation boards are available, for example, for designing lithium battery charger circuits. These have no IT function (hence not category 3) and are not intended to charge lithium batteries (not category 6 – tools). In fact, there does not appear to be any WEEE category that is appropriate for this type of evaluation board.



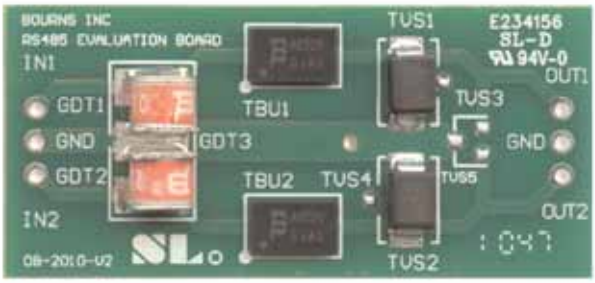
For more information visit the Farnell website at: www.farnell.co.uk

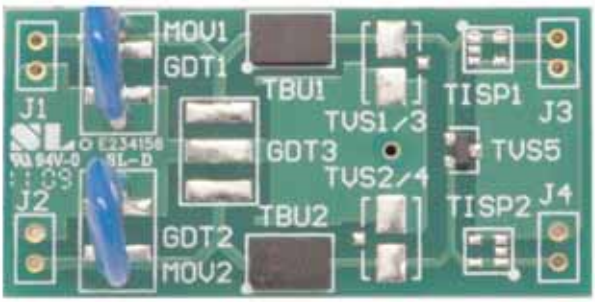
> *In most cases an evaluation board is effectively a single board computer allowing connection of peripherals and/or input devices to facilitate the programming and testing of chips*

Effect of RoHS Recast on Status

The scope of the RoHS directive will become an "open scope", which means that all electrical equipment is in scope unless it is specifically excluded. A new exclusion states "equipment specifically designed solely for the purposes of research and development only made available on a business to business basis". This intends to exclude development and evaluation boards as these are only for research purposes, although types that are sold to students (B2C) or used for education (i.e. not R&D) would not be excluded.

There is RoHS-type substance restriction legislation in a growing number of countries worldwide, including in several US States. These existing and planned substance restrictions apply to a more limited scope than EU RoHS and none yet include development or evaluation boards.





Many single PCBs supplied as evaluation boards will be in the original scope of RoHS. To determine whether they are currently in scope of EU-RoHS after the recast or not, it will be necessary to review each type of board on a case-by-case basis to determine if they are designed solely for R&D purposes and will be used only by businesses, otherwise they will be in scope

Within Scope

In conclusion: many single PCBs supplied as evaluation boards will be in the original scope of RoHS, especially if they have an IT function, as most types do, but the scope will change to specifically exclude these. To determine if a development board is currently in scope of EU-RoHS after the recast, it will be necessary to review each type of board on a case by case basis. This will help distinguish if boards are designed solely for R&D purposes and will be used only by businesses, otherwise they will be in scope. Where there is any doubt, only the courts can give a legally-binding opinion. Evaluation and development boards are not subject to RoHS-type substance restrictions anywhere outside the EU. ●

The difficult we do immediately; The impossible takes a little longer

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In an ideal world every project would have sufficient resources assigned to it and would have a completion date based entirely on the time required to diligently complete every necessary stage.

Now stop laughing, wipe your eyes and read on!

Unlike in an ideal world, resources are often limited and, far more significantly, the times allowed are frequently much shorter than the task at hand would ideally require. Marketers want to get new, attractive products into the catalogue as quickly as possible, and customers want custom designs as quickly as "off the shelf" parts. There is always pressure and most of the time it can be at an acceptable level. Properly organised project planning will always include an engineering input and time scales are (or should be) reasonably negotiable, with the ultimate engineering "big gun" threat of an inferior, untested or unreliable design as a consequence of too much haste keeping things on an even keel.

The problem is that, every so often a job will come along that simply does not have any flexibility in its insanely short completion time-scale at all. These are jobs that don't look remotely possible (in the time) but which, for a variety of reasons, cannot be negotiated back to sanity. (While incidental to finding a solution, these reasons can include: customers who have trapped themselves in impossible delivery promises; replacement of earlier designs for which orders are held but which cannot be manufactured, either because of component unavailability or design defect; desperate financial situations requiring immediate sales revenue; or simple managerial maliciousness).

So, when presented with one of these poisoned chalices, what can an engineer do?

> *Test time is something you should never compromise on, but the pressure will be on to do just that*

The most important thing is to remember that every design is a trade off, and if time is to be reduced, then something else has to give way.

Assigning extra manpower to a project should allow faster completion (assuming management overheads are covered, and that the task is sufficiently divisible), as will greater financial resources (permitting faster sub-contractor turnaround times and more sophisticated and abundant equipment). Unfortunately, such 'brute force' approaches compromise the eventual profitability of the task, with the risk of rendering the whole exercise financially futile. Furthermore, in a small company such resources are rarely, if ever, available.

Design-based approaches can frequently shorten completion times more efficiently. With particular reference to the low power wireless area I am most familiar with, such methods include:

- Negotiate relaxations on as many other parameters as you can. Increasing the physical size will simplify PCB layout and relax other design strictures. Higher power consumption allows simpler – and cheaper – circuits. Relaxation of weight restrictions might allow a simple linear transformer to replace a complicated switch-mode. There are many other examples.
- Study the specification parameters and design to meet them with a sufficient margin. Not to exceed them by an order of magnitude. Resist the temptation to include new features. (If nothing else, they add test-time).
- Reuse circuitry you are very familiar with. This is not the time to try a new, more elegant configuration or part. If possible, reuse the PCB layout (or as close as possible) from earlier, successful designs as well.
- By the same token, avoid circuits that you have previously had problems with, even if those problems were overcome in previous instances. (A marginally stable stage is not

something to be wrestling with if time is short).

- Choose parts that you know you have stock of. Do not risk an unexpectedly long lead time for a new component.
- Use modular construction where you can. If possible use complete modules or sub-assemblies you already manufacture; for example, a good low power transmitter can be the local oscillator for a new receiver. This can even allow parts of your design to be manufactured and tested while you simultaneously work on other elements.
- Over-design. Include extra decoupling and extra inter-stage matching parts. Add plenty of shielding and screening. Use robust connectors, large heat sinks and allow plenty of "reserve" power capacity. Assume worst case, not average, performance from your components.
- Use more trimmers than you would usually allow, and plenty of test points to make stage-by-stage debugging easier. You will probably be doing this task yourself, and it is unlikely that you will be able to afford the time to design production ready test jigs.

Beyond the design process there are a few other things that must be considered.

Test time is something you should never compromise on, but the pressure will be on to do just that. Consider enlisting the end user's help by issuing the early units as "beta versions" and conducting some of your testing in co-operation with the customer (this can be very wasteful of man-hours, but will bring the "apparent" release data forward).

Once a "rush job" has started it is necessary to treat every hour as golden. Interruptions, diversions and delays must be shunned, and other tasks sidelined or postponed until the "number one priority" task is totally finished (this will make for unpopularity in the workplace but it is the only way to succeed).

Finally, the most difficult subject involved in this sort of project: absolute personal workload. Most engineers work a contracted 37-40 hour week, and most of us regularly exceed these hours. It is possible to work much longer hours (on extreme rush jobs I have seen engineers work round-the-clock, sometimes for several days), but this must be a tool of last resort:

1. The longer you work without proper rest, the worse your judgement will become and the more frequent your errors. Long hours spent at the bench in the night are probably more productively spent asleep. Beyond mental exhaustion there are other less obvious costs, as family time is lost, holidays postponed and favourite pass-times abandoned. Even if the engineers themselves do not realise it, others will see the changes. Eventually, a real negative impact on health and well-being will result.
2. Designs produced under this sort of high pressure regime are inherently inferior to those produced through "proper" engineering processes. They are necessarily limited, inelegant and lack real innovation. Often they are under-tested and unreliable. Any company relying on this sort of rush-job design process will (in fairly short order) be left with a catalogue of inflexible, obsolescent products and burnt-out, demoralised technical staff.
3. There is no reward. Once you have completed one project in record time you will not get a well earned rest, or more fulfilling work. Your managers will assume you can continue to work at the accelerated rate permanently, and you will find future project plans will be proportionally shortened while you become "too valuable to promote".

This is a slippery slope. Be very careful on it.

STAYING CONNECTED

DAVID PHILLIPS, MANAGING DIRECTOR OF BINDER UK, DISCUSSES THE MOST IMPORTANT ASPECTS OF CONNECTOR DESIGN


Binder M9 connector range

When designing in any type of connector there are some basic choices to be made concerning its electrical and physical attributes – these are both directly related and fundamental to connector choice.

The current, voltage and the number of contacts, together with the cable diameter and level of shielding required, all have a direct influence on the connector choice as do the physical characteristics relating to how the connector will be terminated, the method of mating and the space available – both inside and outside the product.

A common mistake made by many designers is leaving the connector selection to the last minute. Choosing a connector should be made as early in the design process as possible and failure to do so can lead to the engineer being left with a compromise solution that will detract from product performance and cost-effectiveness.

Voltage Grading of Connectors

The connectors' rated voltage and impulse voltage or overvoltage capability are defined according to IEC60664-1 '*Insulation coordination for equipment within low-voltage systems*'. This is a basic safety standard to achieve insulation coordination specifying clearances, creepage distances and solid insulation, taking into account the voltage stress and surge, together with the expected degree of pollution.

> A common mistake made by many designers is leaving the connector selection to the last minute


Binder series 720


Binder M9 connectors

Insulator materials are graded by their comparative tracking index (CTI) that indicates the electrical breakdown or tracking properties of the material, while overvoltage requirements are divided into three distinct categories:

(1) Low voltage installations where no overvoltage occurs;
(2) Where switching overvoltages need to be considered, such as those experienced in household appliances; and
(3) Dependant circuits such as relays, switches and other devices.

The expected pollution around the connector is divided into four degrees:

(1) No conductive pollution found inside a device;
(2) Non-conductive pollution and temporary condensation, such as that experienced by household appliances;
(3) Conductive pollution that may be, for example, experienced with machine tools; and
(4) Persistent conductive pollution caused by dust, rain or snow on public transport vehicles and other applications in demanding environments.

These factors will determine clearance and creepage distances (as shown in Figure 1) needed to establish the physical dimensions of the connector.

Current-Carrying Capacity

This denotes the current that can be carried continuously and simultaneously through all contacts and is determined by testing to IEC60512-3.

With increasing requirements from equipment manufacturers for shielding EMI, more and more applications call for shielded cable systems that require connectors with good shielding characteristics

The rated current is always at a specified temperature, as the current-carrying capacity is limited by the thermal properties of the conductor and the insulating materials as the sum of the ambient temperature and that created by the current flow must not exceed the upper temperature limit of the connector. This means that the current-carrying capacity is not a fixed value but decreases with increasing ambient temperatures.

This relationship between current, the created temperature rise and ambient temperature is depicted in a de-rating curve (Figure 2). In practice it is unlikely that all contacts are loaded simultaneously with the rated current and, therefore, subject to testing, some contacts may carry a higher current.

Shielding, Electromagnetic Compatibility (EMC)

With increasing requirements from equipment manufacturers for shielding against electromagnetic interference (EMI), more and more applications call for shielded cable systems that require connectors with good shielding characteristics. For optimum results 360º shielding is required and, as shielding attenuation in dB is dependent on frequency, such connectors will have a high attenuation over a large frequency band as shown by the Binder M9 connectors (Figure 3).

Standards of Ingress Protection

IEC60529 classifies the degrees of protection against access outside influences such as dust, foreign objects, moisture and water. The IP rating is split with the first number (0-6) denoting resistance to solid objects and dust, and the second number (0-9K) denoting resistance to water.

Typically, industrial connectors are rated IP65 and above, with many being IP67 for temporary immersion in water or the ultimate IP69K protection from high-pressure water and steam cleaning. A popular misconception is that IP68 is a norm that can be compared across applications; in fact, IP68 means constant immersion in water to an agreed test between manufacturer and user.

Contacts and Termination Methods

Contact strength, spring properties, electrical conductivity and operating temperature are defined by the materials used. High quality connectors use copper alloys for contacts, brass for pins and phosphor bronze for sockets, as these ensure good strength, conductivity and temperature stability. Phosphor bronze also displays excellent spring capabilities. In addition, gold or silver plating provide high levels of conductivity and corrosion resistance and ensure over 500 mating cycles. Gold plating also provides a contact resistance of 3mΩ or less, making the connectors particularly suitable for low voltage applications in the mA range.

The method of terminating the cable also needs careful consideration and will depend on the application and

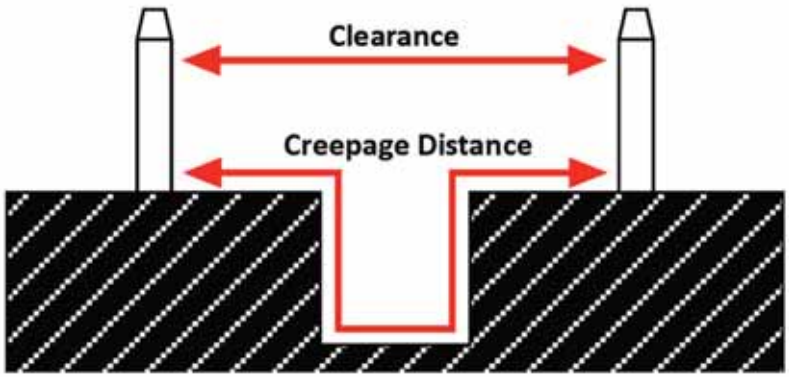

Figure 1: Clearance and creepage distance

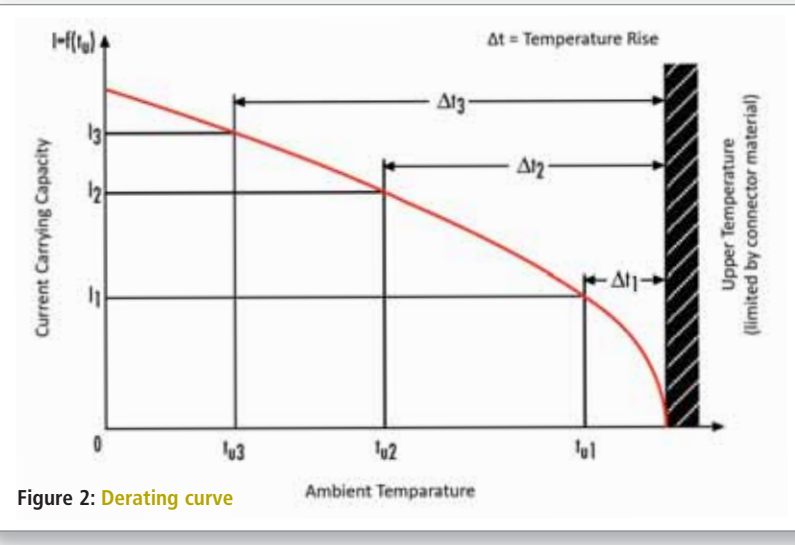

Figure 2: Derating curve

Figure 3: Attenuation curve for Binder M9 connectors

production quantities. While solder terminations provide the most secure and best electrical joint they require skilled operators; whereas crimp terminations provide a fast and simple method but require expensive crimp tools; screw termination provides the best solution for field wiring. In the end, it is really a question of 'horses for courses'!

Connector Materials

Good quality metal connectors are manufactured from brass for its strength and good machining ability. To reduce cost and weight, die-cast zinc or an aluminium alloy are becoming more commonly used, while for corrosion resistance and aesthetics, metal parts can be nickel, chromium plated or anodised. A nickel plating of between eight to 10 microns offers good protection and for more demanding applications stainless steel should be considered.

The trend now is towards low cost, light and robust, all plastic, connectors like Binder's series 620 and 720, where polyamide is the preferred material, being tough, non-abrasive and resistant to solvents and temperatures up to 120°C.

For its insulating properties, excellent chemical resistance, dimensional and temperature stability up to 85°C contact carriers and inserts should be manufactured from polybutylene terephthalate (PBT).

Mating Systems

How often the connector will be mated and the IP requirements will have a major influence on the type of mating system, and the chosen method will have a big impact on connector cost.

Snap-in connectors provide quick and simple mating and are generally the lowest cost solution. Recent developments have allowed for these to be now rated up to IP67 thus providing an economic solution with high performance, while bayonet connectors offer a more secure mating, although the design means they are usually restricted to IP40.

Metal push-pull connectors can be expensive. However, the trend towards plastic versions has helped to reduce cost and provides a quick-mating IP67 connector with some protection against accidental unmating.

Screw connectors provide the ultimate protection against accidental unmating and have excellent IP performance but, on the downside, they are generally the most expensive type of connector, especially the metal versions.

Made to Measure

On some occasions the best solution for a particular application may not exist as a standard product and a special connector may need to be developed. The earlier the connector manufacturer is involved in the design the more effective and cost-effective the solution is likely to be. A bespoke solution may be achieved by customising a standard connector or designing a totally customised product. The latter not only provides the optimum solution but also gives the customer the protection of owning the intellectual property of the design.

Making the Best of It

Often considered as an afterthought, the connector is a vital component in any system. A connector that is the right size, has the correct electrical characteristics, uses the best method of termination and mating for the application, and is protected to the required level will optimise the performance and cost-effectiveness of any system.

And finally, it must not be forgotten that, as with all components within any system, a connector has not only to be the correct product technically but it has to be maintained, serviced and supported wherever it may be used and should be designed accordingly. ●

ABOUT BINDER:

BASED IN HEMEL HEMPSTEAD, BINDER UK was formed in January 2009 and is a subsidiary of German connector manufacturer Franz Binder GmbH

MINIATURIZATION, RELIABILITY, COST AND PERFORMANCE,
SUITABLE FOR THE MEDICAL ENVIRONMENT

BILL NEUKOMM, VP OF SALES AND MARKETING AT HARWIN NORTH AMERICA, EXPLAINS HOW THE CONNECTOR INDUSTRY RESPONDS TO DEMANDS OF THE NEW, DYNAMIC, MEDICAL ELECTRONICS SECTOR

Developments within the field of medical electronics are focused heavily on miniaturization and reliability. Size matters because of complexity and the trend towards portability and even wearability.

Reliability is an obvious requirement, but one which is harder to guarantee if equipment is being used by patients remotely in their own homes or where electrical interference may be experienced. Interconnection has been thought of – sometimes literally – as the weak link, but it need not be that way, as long as the correct system is chosen.

Driving Trends

Demand from hospitals, doctors and an increasingly educated public for more function and increased portability has driven the improvement of surgical, diagnosis and monitoring equipment. The second trend driving equipment improvements is shorter hospital stays (from the need to free up hospital beds and, according to research, patients recover more quickly at home following hospital treatment). Therefore one can find greater use of technology in doctors' surgeries, radiology examination offices and outpatient clinics where patients are offered medical services, varying from blood analysis and endoscope-related procedures to minimally invasive ultrasound procedures in smaller localized facilities. The new-generation equipment often requires data-intensive imaging and probes or sensors that directly contact the patient and may be exposed to corrosive fluids.

As a result of this move towards a more dynamic medical service system, there is an ongoing demand for smaller, more portable, more capable equipment that can serve both practitioner and patient better and at a lower cost. To achieve this reliably, every portion of the equipment design must be considered carefully. Connectors and interconnect systems exist to serve every application. However, connectors that are fit-for-purpose in cost-conscious consumer goods with a limited life, or used in equipment that operates only in benign conditions will not suit demanding applications. Neither will they necessarily be small enough for the latest medical applications nor capable of operating securely in an electrically-noisy environment. On the other hand, traditional 'hi-rel' connectors are often bulky and cannot always handle the high density, high signal-speeds that are increasingly required by advanced medical systems – certainly they will be too expensive for many medical applications.

It appears that a gap is opening up between cheap and small but relatively limited performance connector systems and highly reliable military style devices that are, so far, bulky and expensive. However, this is set to change with recent developments to the Datamate family of hi-rel connectors manufactured by Harwin.

> 'Hi-rel' connectors are often bulky and cannot always handle the high density, high signal-speeds that are increasingly required by advanced medical systems

Harwin's Datamate Solution

Harwin's high reliability Datamate range is a 2mm pitch cable-to-cable, cable-to-board and board-to-board connector family. Datamate's patented contact design features a stamped, four-fingered, gold-plated beryllium copper clip with highly stressed contact beams. The clips reside in the female half of the connector clasping around the pins tightly, ensuring the integrity of electrical connection even under severe conditions.

Now Harwin has extended Datamate to include miniature, lightweight, mixed-technology versions. Mix-Tek Datamate range offers a multitude of configurations for signal, power and/or coax, effectively allowing the customer to configure their own Datamate connector, specific to their application, by mixing and matching the required signal, power and/or coax contacts up to a maximum of 50 low frequency contacts or 12 special (coax and power) contacts. Miniature Mix-Tek connectors feature power contacts rated for use at up to 20 amps. Signal contacts are rated at up to 3 amps; coax contacts are rated at 50 ohms.

Addressing signal speed, Harwin has just submitted Datamate for independent testing which confirmed that the connector family performs well enough at high speed to make it suitable for many USB 2.0 designs – although marginally outside the spec. These results open up a whole new range of

The Mix-Tek Datamate range offers a multitude of configurations for signal, power and/or coax, suitable for the medical environment:

markets for Datamate – and potentially for USB 2.0. Whereas previously if designers had wanted a hi-rel USB 2.0 connection they would have needed to tool special fixtures or housings and maybe select a custom connector, now (in most instances) they can use the appropriate Datamate device – potentially even running power, fibre optic or coax signals through the same device – while guaranteeing secure data transmission in the most extreme of operating conditions.

Electrical Shielding

In a further development, Harwin has developed single-piece, machined metal backshells for the Datamate range to provide electrical screening against RFI and EMI interference. Datamate S-Tek is industry's lowest cost, shielded hi-rel connector, and its launch means that Datamate, well-proven in harsh environments, can now be considered for I/O applications as well as PCB-mount designs.

Manufactured in aluminum alloy and nickel plated for electrical performance and corrosion resistance, when used in conjunction with the relevant J-Tek Datamate connectors and metal braid, Datamate S-Tek backshells ensure full 360-degree electrical shielding. Designed to attach to a wide variety of standard metallic braids using industry standard tools, the backshells enable the shield braid to be connected through the backshell to the PCB ground plane.

Available in female cable-to-PCB-mount and female cable-to-panel-mount configurations in a range of sizes including 6, 10, 14, 20 and 26 positions, the backshells also provide excellent design flexibility. Delivering 55/125/56 (-55 to +125degC, 56-day damp heat steady state) performance levels, the new backshells are mechanically strong and easily assembled using industry standard tooling. The Datamate J-Tek connectors also feature jackscrews for added mating security.

This combination of screening, security and performance means that Datamate S-Tek connectors and backshells will suit many applications in the medical market where electrical noise is, or may be, present.

Various different Datamate connectors are already being used by manufacturers of medical equipment in applications from blood pressure monitoring to imaging and on to micro-surgery to reduce size and cost without compromising performance and reliability. ●

MIX-TEK OPTIONS

CONNECTORS ARE OPTIONALLY AVAILABLE WITH QUICK-MATE 101LOK OR JACKSCREW TERMINATIONS FOR ADDED SECURITY IN APPLICATIONS THAT REQUIRE EXTRA CONTACT SECURITY.

They are available in Male PC Tail, Female Crimp, Male Crimp and Female PC Tail options. Mouldings are polarized and have a UL94V-0 rating. Mix-Tek connectors comply with the international standards including MIL-C-55302 and CECC 75101-008.

HOW TO TERMINATE A POWERLOCK CONNECTOR

DUNCAN LOVERIDGE, EUROPEAN PRODUCT MANAGER FROM PEI-GENESIS, PREPARES THIS HOW-TO APPLICATION INFORMATION ON HOW TO SUCCESSFULLY TERMINATE CABLES INTO POWERLOCK CONNECTORS

PowerLock connector range

With the 2012 Summer Olympics quickly approaching, London will need temporary power to support the demands of such a large-scale event. Temporary power will be required across 39 venues in seven different physical locations. This power will be provided by generators at each venue and will be distributed using more than 500 miles of cable.

For this type of public and high-publicity use, a generator manufacturer's connector of choice is ITT Cannon's PowerLock, which offers the ultimate in safety and reliability under the most severe operating conditions and is approved to VDE and EC standards. In addition, PowerLock offers the following specifications:

Current Rating	**400A and 660A Continuous**
Operating Voltage	**1000V AC / 1500V DC**
Test Voltage	**4500V AC**
Short Circuit Rating	**16kA for 1s, 34kA peak**
Insulation Resistance	**> 5000 Mohm**
Contact Resistance	**< 0.1mOhm**
Vibration	**10-2000Hz/15g**
Operating Temperature	**-30 to +125 degrees C**
Ingress Protection	**IP67 when mated**
Flammability	**UL94-VO**
RoHS	**Compliant**

> Effective cable termination is a common question fielded by product managers at PEI-Genesis

Effective cable termination is a common question fielded by product managers at PEI-Genesis. This how-to guide will provide application information for electricians and engineers on how to successfully terminate cables into PowerLock connectors.

Due to the very wide range of cables available in the market today, the type of cable and the termination method will need to ensure a satisfactory result when terminating PowerLock connectors.

The final application and the current will dictate connector choice. The PowerLock range is available with 400A and 660A contacts. The 400A brass contacts offer the standard set-screw termination suitable for 120mm² conductors. For smaller conductors a range of reduction sleeves is available, all the way down to 25mm² cable. The 660A copper contacts are crimped using industry-standard crimping tools and dies, with a range of contacts available for cables from 35mm² to 300mm².

IP67 sealing can be achieved using the cable glands fitted onto the line connectors. Four different sizes are available, covering a range of cables with outside diameters from 15mm to 38mm. The drain connectors are fitted with a secondary locking pin which engages once the mating source connector is coupled. Once coupled, in order to uncouple the mated pair of connectors a special release key is required, or as an alternative, sliding collar can be factory-fitted to the source connector.

Crimp Termination

It is essential to use ITT Cannon's recommended crimp tool C130 and the appropriate dies to ensure a satisfactory crimp.

The crimp die type and size are some of the most important aspects of the crimping operation in order to achieve a

satisfactory crimped joint. The recommended Crimp Assembly Tools are:

- Cable Stripper
- Soft hammer/Press
- Strap Wrench
- Crimping Tool - ITT or Kompress

The Double Crimp

The recommended method is to double-crimp, although single crimps may be suitable for smaller cables. Each crimp should be aligned at 90° to one another and positioned centrally within the contact crimp area. If a single crimp is used, the crimp should be positioned centrally within the 35mm area, as shown in Figure 1.

Recommended Assembly Procedure

1. Remove the cable gland from the insulator and remove the contact.

2. Slide the cable gland onto the cable being terminated.

3. Carefully strip back the cable insulation by 42mm, taking care not to damage any conductor stranding.

4. Insert the conductor stranding into the crimp bucket at the rear of the contact. Ensure that the cable is straight within a distance of 1 metre of the crimping location, so that the individual cable wire strands are not distorted or displaced due to bending. With the crimping tool, crimp the contact twice (as shown in Figure 1), making sure that the cable is being forced into the contact and that cable conductor is visible through the inspection hole.

5. Examine the crimped joint to ensure that the crimp is satisfactory. All conductor strands must be contained within the crimped area.

6. Following crimping, any deformed contact material between the crimp dies that prevents the contact assembly from fitting into the insulator assembly should be removed, in line with normal working practices.

7. Fit the crimped contact into the insulator and visually align the cotter pin holes.

8. Fit the cotter pin, tapered end first, into the insulator/contact using a press or a soft hammer. Note that the cotter pin should be used only once. Re-using the cotter pin will invalidate the IP67 rating.

9. Ensure that the cotter pin is visible from both sides of the assembly after fitting and is flush/sub-flush with the insulator.

10. Screw the cable gland into the insulator, tightening to a torque of 7.9Nm minimum.

11. Finally, inspect the overall assembly.

Set Screw Termination *Recommended Assembly Procedure*

1. Remove the cable gland from the insulator and take out the contact.

2. Slide the cable gland onto the cable.

3. Carefully strip back the cable insulation by ~ 33mm, taking care not to damage any conductor stranding.

4. Select the appropriate reduction sleeves and slide on in sequence over the exposed stranding.
All sleeves down to the size recommended for the cable in use should be used, i.e. for the 35mm² cable the R120, R95, R70, R50 and R35 sleeves should all be used.
The sleeves fit inside one another to give a gradual reduction in diameter. The flared end of the sleeves should be against the cable insulation.

5. Slide the cable and reduction sleeves into the rear of the contact, ensuring that they are fully seated inside the contact.
Using a 5mm A/F Allen key, tighten the set screws to the appropriate torque setting.

6. Fit the contact into the front insulator and visually align the cotter pin holes.

7. Fit the cotter pin, tapered end first, into the insulator/contact using a press or a soft hammer.

8. Ensure that the cotter pin is visible from both sides of the assembly after fitting and is flush/sub-flush with the insulator.

9. Screw the cable gland into the insulator, tightening to a torque of 7.9Nm minimum.

10. Finally, inspect the overall assembly. ●

Figure 1: Double crimp

Figure 2: Showing stripped cable alongside reduction sleeve

Figure 3: Showing reduction sleeve fitted

Figure 4: Showing contact with set screws fitted over cable and reduction sleeves (mm)

THOMAS GANTNER, PRODUCT MANAGER FOR CABLE ASSEMBLIES AT YAMAICHI ELECTRONICS, DISCUSSES CABLE ASSEMBLY

PROCESS FLOW FOR CABLE ASSEMBLIES

Simple but decisive, the weakest link in a chain determines its strength. Even the most elaborate and innovative devices require the appropriate connection to function. Cable assemblies create these connections and thus are as important as the devices themselves. But often the device is developed first and only afterwards the way is defined how it communicates with it's peripherals. In turn this means that cable assemblies are realised in the short term and often have to be adapted to very special customer needs.

Moreover, the diversity of cable assemblies has nearly no limits. Numerous electrical connection technologies, cables and connectors for many different applications and exposures result in even more possible combinations. Many hidden details and malfunction sources hide behind a seemingly simple product. Therefore, the condition for the optimal design and the smooth realisation of cable assemblies is technical know-how, appropriate equipment, a network of sources of supply for material and information, experience, stable processes, complete documentation, flexibility and motivation. The challenge is to react flexibly and fast to the customer requirements. The selection of the right components, together with good management of the technically demanding processing, enables the assembler to find the best solution for the customer's application.

Tasks and Applications

The main tasks of cable assemblies are data transmission and/or power transmission.

The following criteria decide mainly on the selection of the components:

- Functionality: power supply and/or data transmission;
- Environmental conditions: temperatures, mechanical stress, movements and vibrations, magnetic or electrical fields, liquids and hazardous substances etc;
- Physical data: voltage, current, frequency respectively data transfer rates;
- Applications;
- Number of pieces.

Regarding applications based on copper cable, mainly two technologies are used: flat cables or round cables. Flat cables mostly have limited mechanical toughness and are designed mainly for the usage inside a device housing. Internal cables are subject to almost the same conditions during the whole product life cycle. Mechanical stress is reduced to a minimum or completely avoided. It is only important that the temperature of the cable surroundings in the case does not become too high. Yet for special applications, e.g. where high bending cycles are required, special types of flat cables can be used.

Due to the high automation level and the mostly high number of pieces cable assemblies with flat cables are comparatively low priced.

The main application area of round cables is the interconnection of various devices or of devices with networks or power supplies. Here the product range goes from two-sidedly attached single wires to complex and widely ramified cable harnesses with hundreds of connectors. Of course there are also applications with lower requirements, e.g. inside of cable channels. But often there are very special systems in harsh industrial environments which have to ensure durable and reliable signal transmissions and/or power supply.

The development and definition of the cable assembly is made in close cooperation with the customer. A smooth cooperation of all

Yamaichi cable examples

YAMAICHI ELECTRONICS DEUTSCHLAND USES SPECIAL SOFTWARE TO ENSURE OPTIMAL MANAGEMENT OF THE CABLE ASSEMBLY DEVELOPMENT.

Thus engineering, production, purchase, sales and product management are strongly committed to the project right from the start. The following sub-projects are processed step-by-step:

- **Definition of the technical specifications:**
  - **what is the target of the customer, what are the tasks and problems;**
  - **exact definition of all requirements;**
  - **which solutions are possible, which alternatives are available.**
- **Request for quotation and price calculation, including preparation of drawings and design:**
  - **Calculation of the material usage;**
  - **Calculation of the labour cost;**
  - **Quotation preparation including estimation of the time-frame (delivery time);**
  - **Preparation of drawings and following drawing approval;**
  - **Perhaps new development of connector systems.**
- **Sample manufacturing**

Only with the approval of pre-series samples it is possible to reach absolute control over the selection of the components and the customer-oriented processing. The prompt availability of such samples often decides the course of the project. The one who responds flexibly and convinces with high-quality samples, wins the tender.

PROJECT HANDLING BY YAMAICHI

departments and short decision making processes are particularly important. Effective communication between the departments and teamwork are key to success.

Initial samples should in no case be considered as necessary evil as they have a key advantage for the customer and the manufacturer. When the serial production starts, the manufacturer can benefit from the documentation and already made experiences from the initial sample production. Because even for experienced cable assemblers, possible optimizations often become obvious only during the production stage.

Initial Sample Testing and Documentation

After the sample assembly comes the initial sample testing. All relevant parameters are measured and documented. Besides the standard measurements of cable assemblies (conductivity test, short-circuit test, insulation test, dimensions control, visual inspection), other special tests can be conducted according to the requirements of the customer (vibration, climate, salt spray, UV resistance, water resistance etc.) in order to qualify the product for its future application.

To ensure the quality of the contacts pull-off forces can be measured and cross sections or non-destructive computer tomography scans can be analysed. Now it is imperative to agree upon frame contracts with the customer and the suppliers in order to fulfil the future delivery commitments. In the agreements it is also important to conserve some tolerances for customer requests for modification, as the forecast often cannot be determined exactly. Long lasting supplier partnerships are of considerable benefit in this context. Meanwhile the staff assignment and the machine availability have to be coordinated for the assembly to be able to respond to incoming orders as quickly as possible.

Volume Production

When the drawings are approved by the customer and the initial samples adequately tested and improved, the volume assembly can start. At this point the benefits of the first sampling become noticeable to the assembler. The documentation, the procedure instructions and the process parameters are already at hand. Possibly occurring difficulties, bottlenecks in the assembly and shortage in material can now be identified and improvements carried out. It is then possible to provide serial parts at short notice.

Whereas the assembly of flat cables is highly automatable with IDC (Insulation Displacement Connectors/Technology), only limited automation is possible for round cables. Only the raw cable cutting can rather be done with fully automated machinery. All other procedures still require precise manual work. ●

Yamaichi in-house development Y-Con series

WORK STEPS FOR ROUND CABLE ASSEMBLIES

Cutting of raw cable
This is a fully automated step that depends primarily on the compliance with the length tolerances and the precision of the cuts. A badly cut wire considerably increases the labour costs of the assembly because inaccurate cuts definitely complicate the mounting of the crimp contact or the tin coating. Frequently other pre-assembly steps are now integrated in this process, e.g. the cable stripping or the printing of the article and serial number onto the cable.

The pre-assembly
Cutting of the braid, separation of the discrete wires (in case of twisted pair wire), removal of filling material, preparation of the discrete wires (stripping and tin-coating) – all these steps cannot be automated to this day. The skill and expertise of an experienced operator remain irreplaceable. The operators dexterity is extremely important to meet the high quality standards and the short time targets. Therefore, one of the deciding factors of success – in addition to the technical aspects – is also an elaborate staff management which is based upon satisfied, motivated, qualified and long-term employees and their dedicated customer service orientation.

Contacting
Here, three common methods can be distinguished: soldering, crimping and IDC. The automation level can reach up to 100% for IDC flat cable as well as single-wire cable assemblies with crimp contacts. The crimping process of multi-core cable assemblies can be realised with a semi-automatic crimping machine. The contacts are fed automatically. The stranded wire is introduced into the device manually by an operator. As soon as the crimp position is reached, the crimp is activated.
Most of the semi and fully automatic machines feature a crimp force control function. It detects irregularities in the process immediately and, thus, a constantly high quality is ensured. Yet, still, the manual crimping and soldering mean cost-intensive handwork. And there is also a much higher risk of errors (short-circuits and configuration) due to stranded wires sticking out, or due to wrong contact configurations. Understandable working instructions, professional personnel and equipment, zero-defect bonuses and adequate control devices during the assembly certainly help to minimise the risk to a large extent. These tools and mechanisms have to undergo a continuous quality improvement process.

Moulding
Moulding is a highly automatable process step, which begins with investments and a long optimisation process. At first the development department has to draught a design concept that ensures ideal physical and stereoscopic conditions. Thereafter the suitable negative has to be crafted, i.e. the injection-moulding tools. Finally the injection moulding machine has to be adjusted. Temperature, pressure, material, injection quantity etc. are only some of the parameters that must be coordinated to reach optimal results. The experience and know-how are again the core job characteristics for moulding. Once the settings of this process are stable and their documentation complete, usually the process is very reliable and runs over a longer period.

Overmoulded covers vs assembled cable hoods
For small to medium quantities the common solution are mountable hoods which are assembled in the last assembly step. The technical difference between the assembled hood and the overmoulded cover substantially lies in the ability for the assembled system to be disassembled at any time. All other aspects like mechanical protection, strain relief and EMI protection can be achieved with both versions. The overmoulding is particularly advantageous for higher volumes and special optical or geometrical requests. Depending on the material prices for mountable hoods the costs for investment in moulding development, tools, material and manufacturing sometimes can already be amortised from 1,000 pieces upwards.

Testing
In the worst case short-circuits or wrong pin assignments can paralyse whole assembly lines or spoil expensive equipment and machinery. High contact resistances under load at the contact points possibly lead to overheating and acute fire danger. In addition there is life risk when insulation errors with power supply lines occur. Therefore it is vital to test meticulously all these parameters, not only for safety-related reasons but also for economical reasons. Once the testing parameters are specified and the fitting test adapter at hand, time and effort are certainly low. Even test reports and the documentation of each individual cable assembly are only a matter of the adequate equipment.

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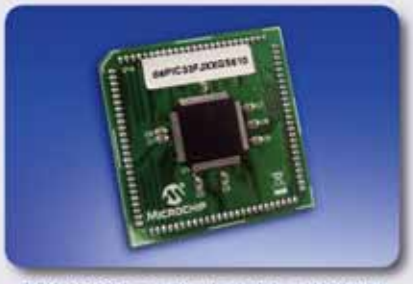

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MICROCHIP

DO YOU UNDERSTAND 'ETHERNET EXTENDERS'?

DAVID EVANS, PRODUCT DEVELOPMENT MANAGER AT AMPLICON, DISCUSSES ETHERNET EXTENDERS AND THEIR BENEFITS

Ethernet extenders currently occupy a unique position in the IP networking world. However, they have not become mainstream, are not well known or understood but have the potential to save companies thousands of pounds in cabling and installation costs. In this article, we discuss the practical use of Ethernet extenders and highlight their ability to save you money or make previously impossible tasks a reality.

Installers, system integrators and OEM manufacturers could combine a little imagination with the concepts in this article to find innovation for their future product or service offering.

Ethernet extenders use DSL (Digital Subscriber Line) technology to extend Ethernet links up to 10km over a single pair of low-grade copper wires. The units operate transparently as part of an Ethernet network with no drivers to install or complex set-up procedures. All 'IP' traffic that could be sent across a standard patch cable can be sent across an Ethernet extender link.

Physically, an Ethernet extender comprises of a small metal or plastic box with an RJ45 Ethernet connection, a DC input for power and a screw terminal or RJ11/45 for connecting to the twisted-pair copper connection. Many installers prefer the screw terminal connection to avoid crimping cables in the field.

Enclosures are either standalone, DIN-rail or panel mounted and are available in standard and extended operating temperature variants. To keep costs low, installers often use a wide temperature variant in the field connecting back to a standard temperature model in the air-conditioned office.

> Ethernet extenders are cost-effective alternatives to more complicated and expensive wiring installations such as CAT5 cable

Figure 1: Ethernet extenders

Operation

The concept of using a pair of copper wires to deliver high bandwidth data has been driven by the home broadband market. If you have an ADSL modem or router at home, you are already using the technology that underpins the operation of Ethernet extenders. In a domestic environment, DSL is used to carry IP traffic from your home router to the DSLAM (Digital Subscriber Line Access Multiplier) at your local telephone exchange. As a rule, the closer you live to the exchange, the faster the broadband service you can receive. DSL technology's evolution has been sculpted by the primary limiting factor in the home broadband setup – the telephone line. Many lines have been in place for decades with variable quality of connection and typically just a single pair of wires over which to deliver bi-directional data. Based on these constraints, communications experts continue to refine the capabilities of DSL giving rise to very fast broadband connections and as a bi-product of this mass market, very fast Ethernet extenders.

Modern Ethernet extenders often use the VDSL or SHDSL variants of Digital Subscriber Line technology to deliver data rates up to 50Mbps and distances of up to 10km. It is important to note that there is always a trade off between line-rate (data rate) and distance so it is not currently possible to achieve 50Mbps at 10km. Table 1 shows the capabilities of a typical VDSL extender. Note that SHDSL variants would be used to achieve greater distances at lower line rates.

The Benefits of Ethernet extenders

Ethernet extenders can eliminate the need for installing expensive switches and CAT5 cable. Ethernet extenders use copper twisted-pair cables to transparently send packets to a peered LAN or IP based device up to 10km away.

Data rate	Distance
1Mbps	1,900m
3Mbps	1,800m
5Mbps	1,600m
10Mbps	1,400m
15Mbps	1,200m
20Mbps	1,000m
25Mbps	800m
30Mbps	700m
40Mbps	600m
50Mbps	300m

Table 1: The capabilities of a typical VDSL extender

While networks typically deploy Ethernet extenders within a limited geographical area, this area need not be limited to one building. Ethernet extenders can create effective bridged-Ethernet connections across streets or over a college or enterprise campus and between Ethernet LANs or devices up to five miles apart.

Ethernet extenders maintain a list of MAC addresses that are 'local' to the device in much the same way as a layer 2 switch does. This means that traffic that does not need to be sent across the DSL link is not transmitted thus conserving bandwidth. Most Ethernet extenders are also capable of extending VLAN and QoS schemes.

Ethernet extenders are cost-effective alternatives to more complicated and expensive wiring installations such as CAT5 cable. Ethernet extenders are plug-and-play devices that can be quickly installed to take advantage of existing copper twisted-pair network infrastructure. Depending on the required data rate, some Ethernet extender models can increase the distance of an Ethernet link extension up to 10km.

Some extenders feature Auto-rate adaptation to ensure the highest speed possible across long and electrically noisy cable runs. Extenders with auto-rate adaptation can be set for multiple data rates and require no difficult configuration when connecting to LANs at different distances.

The main commercial advantage of Ethernet extenders is the saving in cost of cable, installation time and network infrastructure equipment. If you can remove these costs from your quote but a competitor cannot, you're chances of winning a project bid are greatly increased.

Applications

The potential to save money using Ethernet extenders becomes very apparent when they are used instead of a fibre-optic link or a wireless bridge. An old pair of telephone wires or some defunct RS485 cabling from a security camera can suddenly become a very precious commodity on a site that requires long-range Ethernet connections. Even in simple applications where a run of CAT5 cable exceeds the 100m distance limit for Ethernet, Ethernet extenders can be deployed to save the cost of signal repeaters, power supplies and associated housings for the equipment.

BMS Systems

One of the main early adopters of this technology is the building controls sector. BMS system controllers were traditionally connected together using RS485 cabling to provide slow but reliable site-wide communication. With the transition to Ethernet-based controllers and general convergence on IP-based systems in industry, many system integrators found themselves having to re-install a communication network based on CAT5(E) cabling to support

ELVIS LIVES ON

DOWN IN MEMPHIS, THE OPULENT FORMER RESIDENCE OF A CERTAIN LEGENDARY ROCK STAR IS MORE THAN A MERE TOURIST ATTRACTION. For many adoring fans, this historic estate serves as a memorial shrine to the late celebrity. The mansion has become a museum, and devotees often make "The King's" former "castle" a destination for pilgrimage.

With the advent of virtual technology, today's cyber-fans can even use the Internet to keep a watchful eye on the old home turf of their dearly departed idol.

For a monthly fee, members of the celebrity's online club can view live and in real-time what their hero used to see from his bedroom window in Memphis, Tennessee. The website features live shots from a web-enabled camera, aimed from the star's bedroom window at the estate front lawn.

Yet things weren't always this way. When the museum's network administrator first made plans to install the webcam in the mansion's bedroom window, he discovered it was beyond reach. The nearest Ethernet port on the Museum's LAN was more than 107m away. But the Ethernet technology limits the distance of each segment to 100m over standard CAT5 cable.

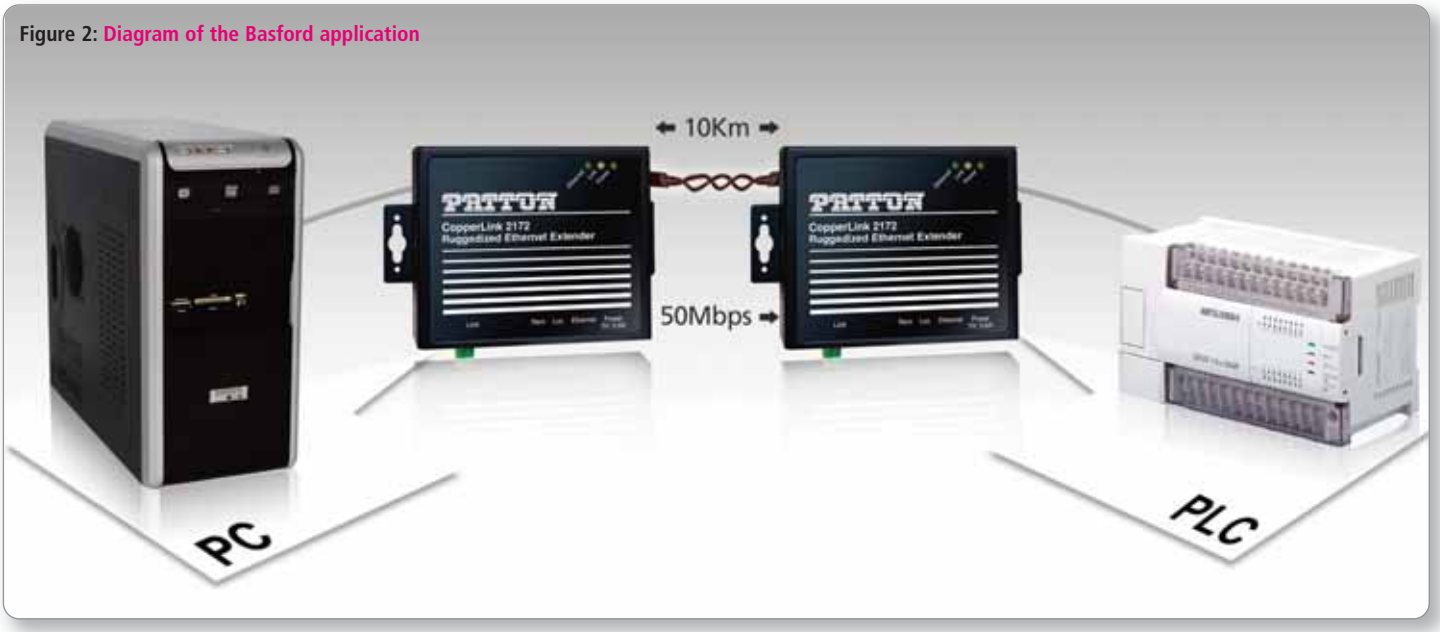
Ripping up the former star's bedroom to install CAT5 or fibre-optic cables was completely out of the question. Construction on the premises would break local planning rules in addition to violating the memorial museum's policies. The technical team needed an innovative solution, one that could reach beyond Ethernet distance limitations while transcending the physical constraints of traditional Ethernet media. The network administrator considered deploying a wireless link. Yet testing showed electromagnetic interference from nearby equipment would make the radio-frequency connection unacceptably unstable.

By installing Ethernet extenders he could use the existing telephone wiring already installed through the mansion to create an Ethernet link to the webcam. Just plug each Ethernet extender into the nearest phone socket. Within days the new webcam was up and running.

And so it is star worshippers in the cyber world can still view with adoration his virtual living lawn – thanks to Ethernet extenders!

Ripping up the former star's bedroom to install CAT5 or fibre-optic cables was completely out of the question

Figure 2: Diagram of the Basford application



high-speed Ethernet links. By using Ethernet extenders, existing RS485 cables can be used giving a system integrator a huge commercial advantage over a competitor whose bid contains a substantial 'cable installation' fee.

IP CCTV systems

A common element of large CCTV systems is the PTZ camera – a camera with pan, tilt and zoom control allowing the operator to move the focal point to wherever surveillance coverage is needed. For many years, PTZ control was achieved using protocols based on 2-wire RS485 links.

As the CCTV market moves to IP-based systems, these existing 2-wire links are a perfect transmission medium for use in conjunction with Ethernet extenders.

This means that no new cable needs to be installed and the wires can now be used to deliver PTZ, audio and video – three elements of a pair of wires that could previously only carry one!

Transportation

Road and rail systems are becoming increasingly intelligent with more real-time data being captured and displayed to improve the quality and efficiency of the traveller's experience. The transport sector is another that has been moving to an Ethernet and TCP/IP-based architecture and Ethernet extenders are very well suited to the long linear shape of roads and railways. Many transportation subsystems such as VMS signs, intercoms and passenger information displays are now using Ethernet extenders to lower the cost of implementation compared with fibre-optic and wireless links.

Factory Automation

Many PLCs have used RS485 based 2-wire fieldbus protocols such as Modbus to communicate process data with other PLCs and SCADA systems. This gives rise to a huge installed base of 2-wire cabling that can be leveraged by Ethernet extenders.

Not only can these links be used for data communication between PLCs, but other devices such as VoIP phones, wireless access points and IP cameras will also be able to take advantage of the upgraded network infrastructure.

A recent example of Ethernet extender use in conjunction with PLCs is highlighted by the team at Basford Plant Ltd – a company specialising in design, manufacture and installation of concrete batching plant and associated equipment.

Basford's engineers were required to implement a concrete batching system based around a Mitsubishi PLC with an Ethernet interface. The control PC was located in the site office some 400m away from the batching system. Installing fibre to connect PC and PLC would have been costly and complicated so an Ethernet extender solution was chosen instead. A pair of Model 2172s was deployed in conjunction with 400m of CAT5 cable to provide a 40Mbps Ethernet link quickly and very cost-effectively.

Innovative

Ethernet extenders represent a very innovative application of DSL technology ideally suited to industrial applications affected by the migration from serial to Ethernet-based communications.

Due to their niche market and somewhat intangible nature, remarkably few people are aware of their capabilities despite the fact that they can massively reduce cabling, installation and hardware costs when deployed in appropriate projects. ●

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IF YOU WOULD LIKE TO LEARN MORE ABOUT ETHERNET EXTENDERS

visit www.amplicon.com or watch a video demonstration at the following web address: http://www.amplicon.com/tv/product7.cfm

AUTOMOTIVE BUSES

PROFESSOR DR. DOGAN IBRAHIM OF THE NEAR EAST UNIVERSITY IN CYPRUS DESCRIBES THE FEATURES OF VARIOUS AUTOMOTIVE BUS SYSTEMS AND EXPLAINS THE DESIGN OF A TWO-NODE CAN BUS BASED PROJECT

Vehicles are highly complex machines, incorporating many mechanical and electronic parts. The number of electronic components used in them has increased drastically in recent years, especially with the move towards greater safety, comfort and performance. This has had a direct impact on connecting these electronic components in such a way that they can communicate reliably, safely and in real-time.

Today automotive electronic systems contain many sensors, actuators, monitoring units and entertainment and navigation systems that are distributed and embedded in different parts of a vehicle. It is estimated that in a typical modern passenger car over 70 electronic control units are used, exchanging over 2500 signals, and this number is increasing with increased complexity.

In the past, automotive manufacturers connected various electronic devices in vehicles using point-to-point wiring systems. Hundreds of wires were running at different parts of the vehicle. Consequently, the wiring was bulky, heavy, expensive, and it was difficult to trace an electronic fault. There was no central co-ordination between different parts of the electronics, as most electronic parts were controlled locally and independent of the others. Maintenance and repair of the vehicle electronics was extremely difficult as in many cases it was not easy to locate and change a faulty component. Figure 1 shows a traditional old style vehicle electronic wiring system.

As the complexity of the vehicle electronics had grown by many factors, it had become difficult for the manufacturers to design safe and reliable electronic systems based on the old traditional methods. The current requirements could not be met with lots of wires running between sensors, actuators and an electronic control unit. The solution was to network the various electronic modules in a vehicle with a high performance network, thus eliminating the messy wiring, increasing the reliability and reducing the maintenance costs.

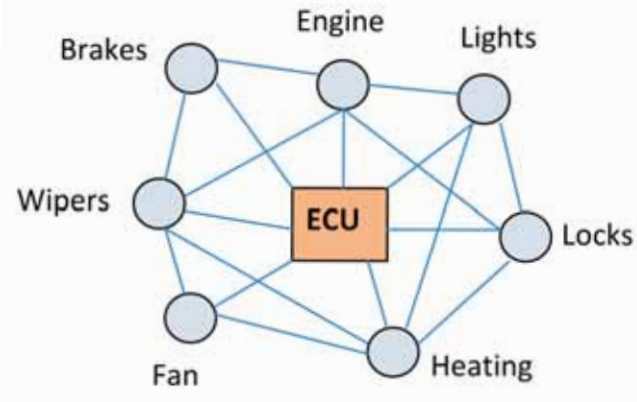

Figure 1: Old style vehicle electronic wiring

This is why it had become necessary to design a network-based electronic system where the electronic modules could easily be attached to a network and then controlled from a central intelligent unit (e.g. the Engine Control Unit). This resulted in an "intelligent" car where many sensors and actuators are used to sense the environment and perform many functions. One example is the automatic turning on the lights when it becomes dark or when the car goes through a tunnel. Other examples are the automatic operation of the wipers when the rain starts, in-car climate control, and so on.

One of the advantages of a network-based system is that it is relatively easy to trace and detect a faulty electronic module. In addition, the wiring is a lot simpler to lay out and easier to maintain. For example, by communicating with the central intelligent unit one can tell whether or not the overall electronics system is healthy, and if not, the faulty modules can easily be detected and replaced.

A networked system also allows the various modules on the bus to communicate with each other and exchange information if required. For example, the intelligence unit can receive the engine temperature value from the temperature sensor module. This temperature can then be displayed on an electronic dashboard. Should the temperature be too high, appropriate messages can be sent to responsible parts of the engine and corrective measures can be taken. Figure 2 shows a modern vehicle wiring where a bus system is used to interconnect the electronic modules to a central intelligence unit.

Vehicle Bus Systems

The vehicle bus systems (or networks) were classified in 1994 by the Society of Automotive Engineers (SAE). According to this classification, bus systems are classified based on their bandwidth and main functions of the bus system. The classification divides bus networks into four: Class A, Class B, Class C and Class D.

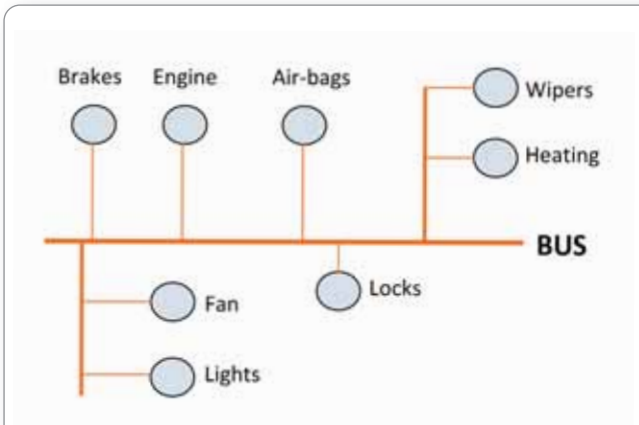

Figure 2: Modern vehicle electronic wiring

- Class A networks are low-speed, low-cost networks with data rates less than 10kbps. These systems are mainly used in car body electronics such as the door lock systems.
- Class B networks operate between 10kbps and 125kbps and are used for information exchange, e.g. instrument cluster, vehicle speed and so on.
- Class C networks operate between 125kbps and 1Mbps, and are used in a wide range of applications, such as engine control, brakes, steering control and so on.
- Class D networks operate above 1Mbps and they are used mainly for telematics applications such as navigation, video, audio and so on.

There are many automotive bus systems, some developed by vehicle manufacturers on their own, and some developed jointly with other vehicle manufacturers, as well as with semiconductor manufacturers. A list of the commonly used vehicle bus systems is:

- CAN
- LIN
- FlexRay
- MOST
- ByteFlight
- SAE J1850
- Intellibus.

Table 1 shows the basic features of different bus systems.

- The CAN (Controller Area Network) bus was originally developed by Bosch in 1980s for in-vehicle networks. CAN is a serial two-wire multi-master bus that is one of the most widely used automotive buses today. The physical layer of CAN consists of a pair of twisted cables. CAN provides reliable, robust and fast communication up to 1Mbps (with 40m bus length). Since its introduction CAN has become an international in-vehicle network standard and has been adopted by the automotive industry. CAN is Class C type medium speed network.
- The LIN (Local Interconnect) bus specification was initially defined by a consortium consisting of BMW, Audi, Volvo, VW, Motorola, Volcano and DaimlerChrysler. This is a low-cost, low-speed bus used mainly in body/comfort electronics. The bus operates at 20kbps and consists of a single wire, where the vehicle chassis provides the return signal. A single master, multiple slave architecture is used where in a typical application the master broadcasts a message asking for data and the slave with the correct message header sends that. LIN bus is used in applications where the implementation of CAN would be too expensive. Typical application areas of LIN bus include heating control, sun-roof control, wiper motors, key-locking mechanism and so on. LIN is Class A type low-speed network.
- FlexRay was initially developed by BMW and DaimlerCrysler in 1999 as a fast, efficient and error-free automotive bus system. FlexRay is suited to real-time, high-speed applications as it supports a bandwidth of up to 10Mbps. Both electrical and optical transmission medium can be used. FlexRay is mainly used in safety critical applications and in real-time high-speed engine control. Flexray is based on the TDMA (Time Division Multiple Access) mechanism where each device on the bus has a fixed slot allocated to it. TDMA is a deterministic bus access mechanism as it is known when a device on the bus will respond. FlexRay is Class D type high-speed network.

Bus	Class	Max Data Rate	Physical	Application
CAN	B,C	1 Mbps (at 40m)	Twisted pair	Body, engine
LIN	A	10 Kbps	Single wire	Body, comfort
FlexRay	D	10 Mbps	Electrical/optical	Engine, safety
MOST	D	25 Mbps	Optical	Multimedia, navigation
ByteFlight	D	10 Mbps	Optical	Safety
SAE J1850	B	41.6/10.4 Kbps	Single/differential	Body, comfort
Intellibus	D	15 Mbps	Twisted pair	Body, engine, safety

Table 1: Commonly used automotive bus systems

- The MOST (Media Oriented Systems Transport) bus is mainly used in automotive telemetric and multimedia applications, such as audio control, video, navigation, communication and so on. The initial MOST network was developed by BMW and DaimlerChrysler in 1998 and is currently used in BMW cars. MOST supports very high bandwidth, using an optical medium for data transmission and communicating using the TDM/CSMA (Time Division Multiplex/Carrier Sense Multiple Access) protocol. MOST is a Class D type high-speed network.
- Byteflight has been developed by BMW for use in high-safety related applications such as automotive and avionic systems. The bus offers 10Mbps bandwidth. Byteflight is based on FTDMA (Flexible Time Division Multiple Access) protocol and combines both event-controlled (e.g. CAN) and time-controlled protocols to guarantee deterministic latencies for high-priority messages. Byteflight supports various network protocols in a mixed bus environment. For example, CAN bus and Byteflight

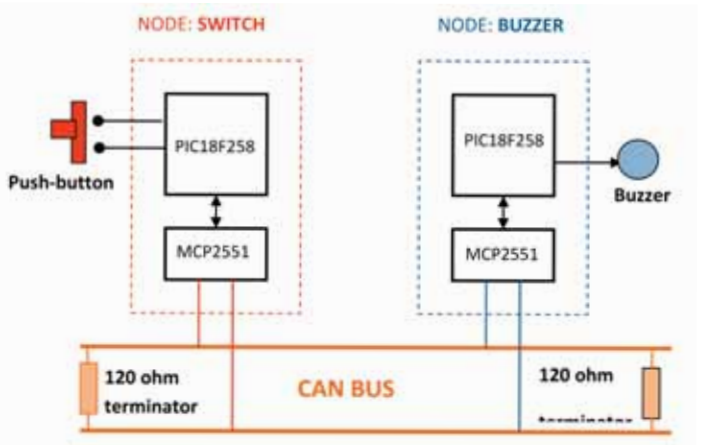

Figure 3: Block diagram of the project

After the speech signal has been framed, each frame is multiplied by a windowing function in order to remove the edge effects and the discontinuities at the edges of the signal

can co-exist and can communicate in the same environment. Special controllers are used to transfer data between Byteflight and other bus systems. Byteflight is a Class D type high-speed network.

- SAE J1850 (or J1850) was developed in 1994. This standard has been widely used in cars such as GM, Chrysler and Ford. J1850 bus is used for diagnostics and data sharing applications. There are two versions of this standard: PWM (Pulse Width Modulation) with 41.6kbps using two-wire differential physical layer, and VPW (Variable Pulse Width) with 10.4kbps using single-wire physical layer. The two standards are incompatible with each other. The J1850 protocol is frame-based and uses CSMA/CR arbitration. J1850 standard is a Class B type low-speed network.
- Intellibus is a high-speed bus offering up to 15Mbps bandwidth. It was initially conceived by Boeing to reduce the wiring complexity associated in distributed systems in aerospace applications. It is a low-cost bus, allowing a large number of sensors to be connected. Intellibus is used in automotive electronics, process control, automation, avionics, medical fields and in several other fields. The network is of type Class D.

Microcontroller-Based CAN Bus Project

Since CAN is currently the most widely used automotive bus, here's a design of a very simple CAN-bus based project using microcontrollers, and with two nodes. As shown in the block diagram in Figure 3, node SWITCH has a push-button switch and node BUZZER has a buzzer connected to their ports respectively. When the push-button switch is pressed, a message will be sent to the other node where the buzzer will be turned ON.

As shown in Figure 2, the physical layer of the CAN bus consists of a pair of twisted wires, terminated with 120-ohm resistors at each end of the bus. In this project PIC18F258 type microcontrollers (www.microchip.com) are used at each node as they support the CAN interface. The microcontrollers are connected to the bus using MCP2551 type bus transceivers.

The transceivers provide the correct signal levels on the bus and enable messages to be transmitted and sent over the bus. Data on CAN bus is differential where the bus specifies two logical states: dominant and recessive. Figure 4 shows the state of signals on the bus. The recessive state is logic "1" and at this state the differential voltage on the bus (i.e. Vdiff = CAN_H – CAN_L) is ideally 0V (ideally CAN_H = CAN_L = 2.5V). In practice the recessive differential output voltage is less than 0.05V at a bus transmitter output device. The dominant state is logic "0" and at this state the differential voltage on the bus (i.e. Vdiff = CAN_H – CAN_L) is ideally 2V (ideally CAN_H = 3.5V and CAN_L = 1.5V). In practice the dominant differential output voltage is between 1.5V and 3.0V.

The output of a CAN transceiver circuit is usually in open-collector (e.g. TTL logic) or in open-drain (e.g. CMOS logic) format. When several such devices are connected to a bus, the net logic state of the bus is defined by the logical "AND" of the device outputs ("Wired AND"). When several nodes on the bus attempt to transmit at the same time, bus arbitration logic is used to grant access to a single node on the bus. When there is arbitration on the bus, a dominant bit state always wins out over a recessive bit state.

Messages on the CAN bus are sent and received using 'frames'. A frame is like a packet in a TCP/IP type network where the actual data is encapsulated with control data. There are four message frames in CAN:

- **Data Frame:** Defines the data transfer between nodes.
- **Remote Frame:** Used by a node to request transmission of a message (i.e. data) from another node.
- **Error Frame:** Any node on the bus can send an error frame to signal an error condition.
- **Overload Frame:** This frame is used by a receiving node to indicate that it is not yet ready to receive frames.

There are two types of CAN protocols: 2.0A and 2.0B. CAN 2.0A is the earlier standard with 11 bits of identifier (see Arbitration Field), while CAN 2.0B is the new extended protocol with 29 bits of identifier. 2.0B controllers are completely backward-compatible with the 2.0A controllers and can receive and transmit messages in either format. The Data Frame is the most important frame and we will look at it in more detail.

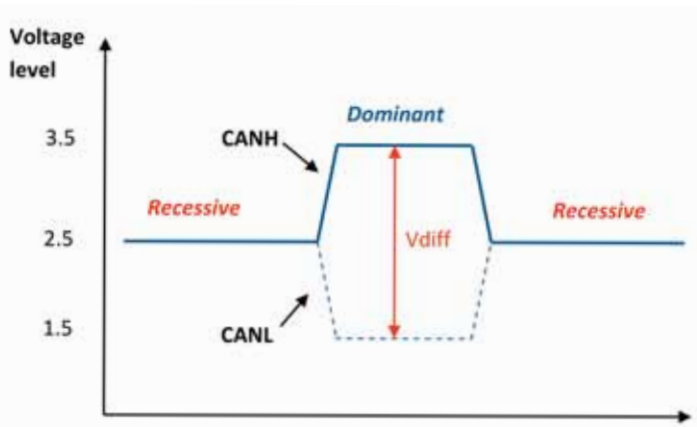

Figure 4: CAN bus signal levels

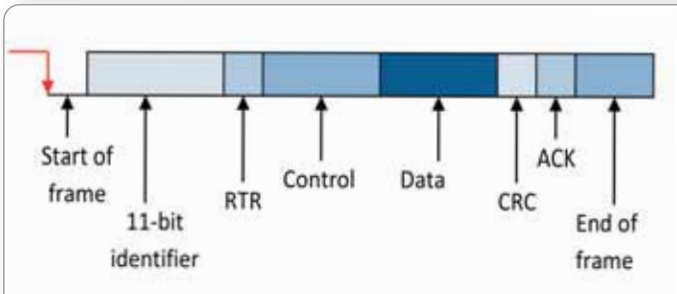

Figure 5: Standard data frame

Data Frame

The data frame is used by the transmitting device to send data to receiving devices on the bus, and this is the most important frame handled by the user. The data frame can be sent in response to a request, or it can be sent whenever it is required to send the value of some parameter to other nodes on the bus (e.g. the temperature can be sent at periodic intervals).

Figure 5 shows structure of the data frame. The bus is normally idle. Then, a standard data frame starts with the start of frame (SOF) bit, which is followed by an 11-bit identifier and the remote transmission request (RTR) bit. The control field is 6-bits wide and indicates how many bytes of data are in the data field. The data field can be 0 to 8 bytes and it contains the actual data to be sent. The data field is followed by the 16-bit checksum (CRC) field which checks whether or not the received bit sequence is corrupted. The ACK field is 2-bits wide and is used by the transmitting node to receive acknowledgement of a valid frame from any receiver. The end of message is indicated by a 7-bit end

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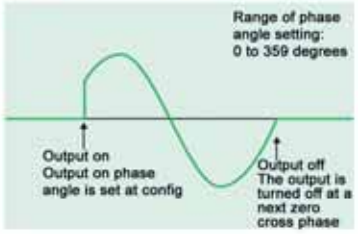
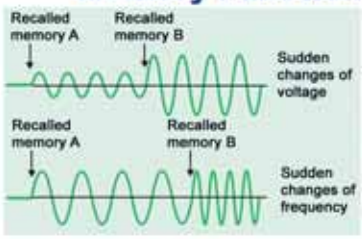
Output on phase angle



Memory Function



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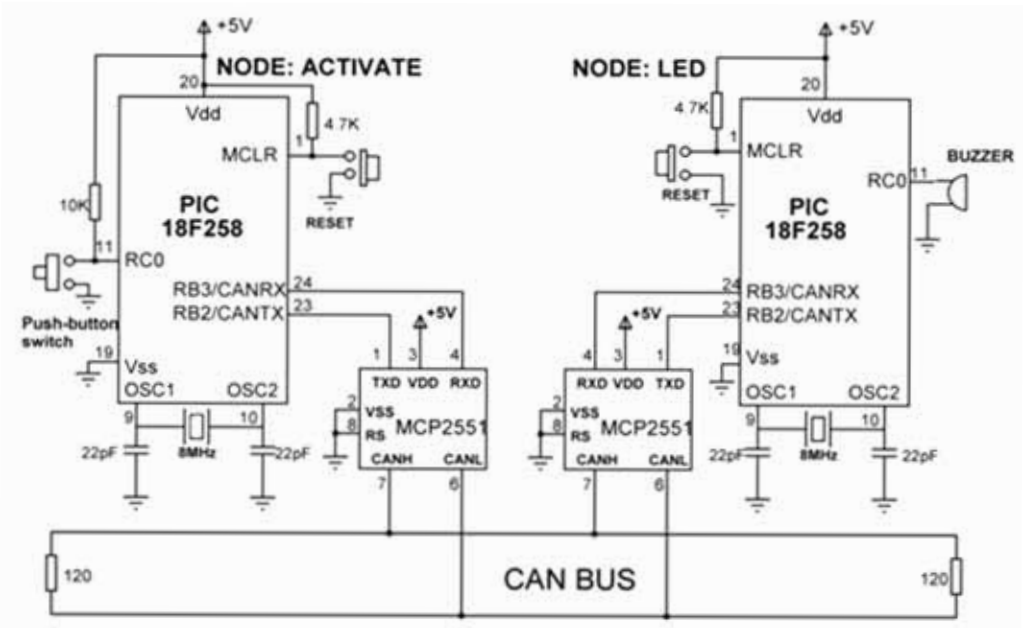

Figure 6: Circuit diagram of the project

of frame (EOF) field. Successive frames must be separated by at least 3-bit times, called the interframe space.

Start Of Frame (SOF)

The start of frame field is 1-bit and it indicates the beginning of a data frame, sent while the bus is in idle state.

Arbitration Field

The arbitration field of a standard data frame is 12-bits wide and it consists of the following two components:

- 11-bit identifier
- 1-bit Remote Transmission request (RTR).

The 11-bit identifier is used to identify messages on the bus. Different devices can send messages with different identifiers. For example, a temperature sensor device can send a message with an identifier of 20, while a pressure sensor can send a message with an identifier of 25. The receiving nodes have acceptance filters and by programming these filters we can accept or reject messages with given identifier numbers. A data frame with a lower identifier has a higher message priority and such a message is granted the bus access by the arbitration mechanism.

Arbitration is used to resolve bus conflicts that occur when several devices at once start sending messages on the bus. During the arbitration phase, each transmitting device transmits its identifier and compares it with the existing level on the bus. If the levels are equal, the device continues to transmit its identifier. If the device detects a dominant level on the bus while it is trying to transmit a recessive level, it quits transmitting and becomes a receiving device. After arbitration only one transmitter is left on the bus and this transmitter continues to send the remainder of its frame bits.

Node: SWITCH (ID = 3)	Node: BUZZER (ID = 5)
Configure I/O ports	Configure I/O ports
Define timing parameters	Define timing parameters
Initialize CAN module	Initialize CAN module
Set mode to CONFIG	Set mode to CONFIG
Set Mask bits to 1's	Set mask bits to 1's
Set acceptance filter to 3	Set acceptance filter to 5
Set mode to NORMAL	Set mode to NORMAL
DO FOREVER	**DO FOREVER**
Get push-button state	Read push-button state
Send push-button state to ID 5	**IF** state = 0 **THEN**
Wait 1 second	Turn OFF BUZZER
ENDDO	**ELSEIF** state = 1 **THEN**
	Turn ON BUZZER
	ENDIF
	Wait 100 ms
	ENDDO

Figure 7: Operation of the project

RTR Field

The 1-bit RTR field indicates the transmission of a data frame (RTR = 0), or a Remote Request Frame (RTR = 1). This field, together with the identifier bits, forms the arbitration field.

Control Field

The control field is 6-bits wide and consists of the IDE (Identifier Extension) bit, a reserved bit (r0) and 3 DLC (Data Length Code) bits.

Data Field

The data field contains the actual data of the message. The data size can vary from 0 to 8 bytes. The data is transmitted with the MSB byte first.

CRC Field

The CRC field is used to check the frame for a possible transmission error and consists of 15-bit CRC sequence, and 1-bit recessive CRC delimiter.

ACK Field

The ACK field consists of 1-bit ACK, and 1-bit recessive delimiter.

End of Frame Field (EOF)

This is a 7-bit field consisting of 7 recessive bits. The data frame is always terminated by this field.

The Project Hardware

The circuit diagram of the project is shown in Figure 6. Node SWITCH consists of a PIC18F258 microcontroller with built-in CAN module and an MCP2551 CAN bus transceiver chip. Pins CANH and CANL of the transceiver chip are connected to the CAN

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```
void main()
{
   unsigned char push_button, sdata[8];
   unsigned short config_flag, send_flag;
   char SJW, BRP, Phase_Seg1, Phase_Seg2, Prop_Seg;
   long BUZZER_ID, SWITCH_ID, mask;
//
// Message identifiers of nodes and I/O directions
//
    BUZZER_ID = 5;                          // Message id of node BUZZER
    SWITCH_ID = 3;                          // Message id of node SWITCH
    TRISC = 1;                              // RC0 is input
    TRISB = 0x08;                           // RB2 is output, RB3 is input
//
// CAN BUS timing parameters
//
   SJW = 3;
   BRP = 8;
   Phase_Seg1 = 3;
   Phase_Seg2 = 3;
   Prop_Seg = 1;
//
// CAN module configuration
//
   config_flag = _CAN_CONFIG_SAMPLE_THRICE      &
                 _CAN_CONFIG_PHSEG2_PRG_ON      &
                 _CAN_CONFIG_STD_MSG            &
                 _CAN_CONFIG_DBL_BUFFER_ON      &
                 _CAN_CONFIG_VALID_XTD_MSG      &
                 _CAN_CONFIG_LINE_FILTER_OFF;

   send_flag = _CAN_TX_PRIORITY_0               &
               _CAN_TX_XTD_FRAME                &
               _CAN_TX_NO_RTR_FRAME;
//
// Initialize CAN module and set config mode
//
   CANInitialize(SJW, BRP, Phase_Seg1, Phase_Seg2, Prop_Seg, config_flag);
   CANSetOperationMode(_CAN_MODE_CONFIG, 0xFF);
   mask = -1;
//
// Set all MASK1 and MASK1 bits to 1's
//
   CANSetMask(_CAN_MASK_B1, mask, _CAN_CONFIG_XTD_MSG);
   CANSetMask(_CAN_MASK_B2, mask, _CAN_CONFIG_XTD_MSG);
//
// Set id of filter B2_F3 to 3 (SWITCH_ID) and set CAN to NORMAL mode
//
   CANSetFilter(_CAN_FILTER_B2_F3, SWITCH_ID, _CAN_CONFIG_XTD_MSG);
   CANSetOperationMode(_CAN_MODE_NORMAL, 0xFF);
//
// SCAN the push-button switch every second and send its value to node BUZZER.
// If the push-button switch is pressed a "1" will be sent to node BUZZER, otherwise
// a "0" will be sent. Node BUZZER will turn ON its buzzer if it receives a "1".
//
   for(;;)                                  // Endless loop
   {
        push_button = PORTC.F0;             // Get button state
        if(push_button != 0)
                sdata[0] = '1';             // If pressed
        else
                sdata[0] = '0';             // If not pressed

        CANWrite(BUZZER_ID, sdata, 1, send_flag);    // Send button state
        Delay_Ms(1000);                     // Wait 1 second
   }
}
```

Figure 8: Node SWITCH code

```
void main()
{
   unsigned char push_button, rd,flag, read_flag, rdata[8];
   unsigned short config_flag, len;
   char SJW, BRP, Phase_Seg1, Phase_Seg2, Prop_Seg;
   long BUZZER_ID, SWITCH_ID, id, mask;
//
// Set message identifiers of nodes and configure I/O directions
//
    BUZZER_ID = 5;                          // Message id of node BUZZER
    SWITCH_ID = 3;                          // Message id of node SWITCH
    TRISC = 0;                              // RC0 is output (buzzer port)
    TRISB = 0x08;                           // RB2 is output, RB3 is input
//
// CAN BUS timing parameters
//
   SJW = 3;
   BRP = 8;
   Phase_Seg1 = 3;
   Phase_Seg2 = 3;
   Prop_Seg = 1;
//
// Configuration
//
   config_flag = _CAN_CONFIG_SAMPLE_THRICE      &
                 _CAN_CONFIG_PHSEG2_PRG_ON      &
                 _CAN_CONFIG_STD_MSG            &
                 _CAN_CONFIG_DBL_BUFFER_ON      &
                 _CAN_CONFIG_VALID_XTD_MSG      &
                 _CAN_CONFIG_LINE_FILTER_OFF;

    Read_flag = 0;
//
// Initialize CAN module and set CONFIG mode
//
   CANInitialize(SJW, BRP, Phase_Seg1, Phase_Seg2, Prop_Seg, config_flag);
   CANSetOperationMode(_CAN_MODE_CONFIG, 0xFF);
   mask = -1;
//
// Set all MASK1 and MASK2 bits to 1's
//
   CANSetMask(_CAN_MASK_B1, mask, _CAN_CONFIG_XTD_MSG);
   CANSetMask(_CAN_MASK_B2, mask, _CAN_CONFIG_XTD_MSG);
//
// Set id of filter B2_F3 to 5 (BUZZER_ID) and CAN mode to NORMAL
//
   CANSetFilter(_CAN_FILTER_B2_F3, BUZZER_ID,  _CAN_CONFIG_XTD_MSG);
   CANSetOperationMode(_CAN_MODE_NORMAL, 0xFF);
//
// Read the single character sent by node SWITCH. If this character is 0, turn OFF
// the buzzer, otherwise turn ON the buzzer. Turn OFF the buzzer to start with
//
   PORTC.F0 = 0;                            // Turn OFF buzzer

   for(;;)                                  // Endless loop
   {
       rd_flag = CANRead(&id, rdata, &len, &read_flag);     // Read data on bus

       if(rd_flag != 0 && id == BUZZER_ID)                  // Check message ID
       {
           if(rdata[0] = '0')
                   PORTC.F0 = 0;                            // Turn OFF BUZZER
           else if(rdata[0] == '1')
                   PORTC.F0 = 1;                            // Turn ON BUZZER
       }
       Delay_Ms(100);                                       // Wait 100 ms
   }
}                                           // end of program
```

Figure 9: Node BUZZER code

'CONTROLLER AREA NETWORK PROJECTS' BOOK

MORE CAN BUS PROJECTS

More details about the CAN bus and CAN bus based projects can be obtained from Dogan Ibrahim's book entitled 'Controller Area Network Projects'.
The book is written for students, practicing engineers, hobbyists and for everyone else who may be interested to learn more about the CAN bus and its applications, but it assumes that the reader has some knowledge of basic electronics.
Knowledge of the C programming language will be useful in later chapters of the book, and familiarity with at least one member of the PIC series of microcontrollers will be an advantage, especially if the reader intends to develop microcontroller-based projects using the CAN bus.

bus, which is terminated with 120-ohm resistors at both ends. The microcontroller is operated from an 8MHz crystal. The MCLR pin is connected to an external reset button.

When the push-button switch is not pressed, pin RC0 of the microcontroller is at logic 1. When the switch is pressed, this pin goes to logic 0 and this change is detected in the software.

Node BUZZER is also based on the PIC18F258 microcontroller with built-in CAN module and an MCP2551 transceiver chip. As with the other node, the microcontroller is operated from an 8MHz crystal. A small buzzer is connected to port pin RC0 of the microcontroller that sounds when logic 1 is applied to this port pin.

Construction of the Project

The project was constructed using the mikroElektronika CAN Communication Kit (www.mikroe.com). This kit consists of two easyPIC6 type development boards, two bus transceiver modules and a twisted pair cable to act as the bus. The kit makes the CAN bus project development an easy task as far as the hardware is concerned. All the user has to do is connect the two boards with the supplied twisted cable, and insert terminating resistors at both ends. The rest of the project is the software development.

The Project Software

The project code was developed using the mikroC Pro language (www.mikroe.com). mikroC Pro includes a rich set of library functions for developing programs based on peripherals such as RS232, USB, CAN, I2C, RS485, LCD, SD card, keyboard and so on. The operation of the project is described in Figure 7. Nodes SWITCH and BUZZER are given identifier numbers 3 and 5 respectively. After configuring the I/O ports, initializing the CAN module, and setting the acceptance filters, node SWITCH gets the push-button state every second and sends it to node BUZZER. Node BUZZER reads the push-button state over the CAN bus and turns ON the buzzer if the state is set.

Code for node SWITCH and BUZZER are shown in Figure 8 and Figure 9 respectively.

USING A DIFFERENTIAL I/O AMPLIFIER IN SINGLE-ENDED APPLICATIONS

BY **GLEN BRISEBOIS**, LINEAR TECHNOLOGY

Recent advances in low-voltage silicon germanium and BiCMOS processes have allowed the design and production of very high speed amplifiers. Because the processes are low voltage, most of the amplifier designs have incorporated differential inputs and outputs to regain and maximize total output signal swing. Since many low-voltage applications are single-ended, the questions arise: "How can I use a differential I/O amplifier in a single-ended application?" and "What are the implications of such use?". This article addresses some of the practical implications and demonstrates specific single-ended applications using the 3GHz gain-bandwidth LTC6406 differential I/O amplifier.

The common mode output voltage can be anywhere and still result in a "zero" differential input voltage because the feedback is symmetric

Op-Amp Structure

A conventional op-amp has two differential inputs and an output. The gain is nominally infinite, but control is maintained by virtue of feedback from the output to the negative "inverting" input. The output does not go to infinity, but rather the differential input is kept to zero (divided by infinity, as it were). The usefulness, variety and beauty of conventional op-amp applications are well documented, yet still appear inexhaustible. Fully differential op-amps have been less well explored.

Figure 1 shows a differential op-amp with four feedback resistors. In this case the differential gain is still nominally infinite, and the inputs kept together by feedback, but this is not adequate to dictate the output voltages. The reason is that the common mode output voltage can be anywhere and still result in a "zero" differential input voltage because the feedback is symmetric. Therefore, for any fully differential I/O amplifier, there is always another control voltage to dictate the output common mode voltage. This is the purpose of the VOCM pin, and explains why fully differential amplifiers are at least 5-pin devices (not including supply pins) rather than 4-pin devices. The differential gain equation is VOUT(DM) = VIN(DM) • R2/R1. The common mode output voltage is forced internally to the voltage applied at VOCM.

One final observation is that there is no longer a single inverting input: both inputs are inverting and non-inverting depending on which output is considered. For the purposes of circuit analysis, the inputs are labelled with "+" and "–" in the conventional manner and one output receives a dot, denoting it as the inverted output for the "+" input.

Anybody familiar with conventional op-amps knows that non-inverting applications have inherently high input impedance at the non-inverting input, approaching GΩ or even TΩ. But in the case of the fully differential op-amp in Figure 1, there is feedback to both inputs, so there is no high impedance node. Fortunately this difficulty can be overcome.

Simple Single-Ended Connection of a Fully Differential Op-amp

Figure 2 shows the LTC6406 connected as a single-ended op-amp. Only one of the outputs has been fed back and only one of the inputs receives feedback. The other input is now high impedance.

The LTC6406 works fine in this circuit and still provides a differential output. However, a simple thought experiment reveals one of the downsides of this configuration. Imagine that all of the inputs and outputs are sitting at 1.2V, including VOCM. Now imagine that the VOCM pin is driven an additional 0.1V higher. The only output that can move is VOUT– because VOUT+ must remain equal to VIN, so in order to move the common mode output higher by 100mV the amplifier has to move the VOUT– output a total of 200mV higher. That's a 200mV differential output shift due to a 100mV VOCM shift. This illustrates the

Figure 1: Fully differential I/O amplifier showing two outputs and an additional V_{OCM} pin

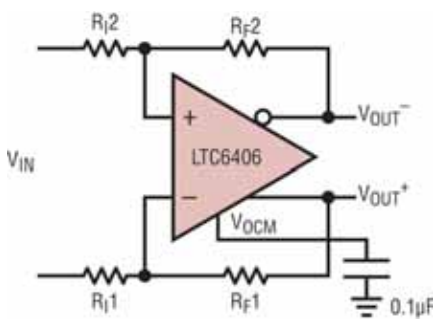


Figure 2: Feedback is single-ended only. This circuit is stable, with a Hi-Z input like the conventional op-amp. The closed loop output (V_{OUT}^+ in this case) is low noise. Output is best taken single-ended from the closed loop output, providing a 3dB bandwidth of 1.2GHz. The open loop output ($V_{OUT}^–$) has a noise gain of two from V_{OCM}, but is well behaved to about 300MHz, above which it has significant passband ripple

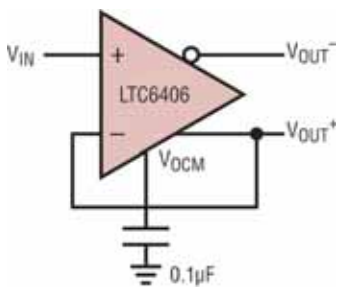


Figure 3: Transimpedance amplifier. Ultralow noise JFET buffers the current noise of the bipolar LTC6406 input. Trim the pot for 0V differential output under no-light conditions

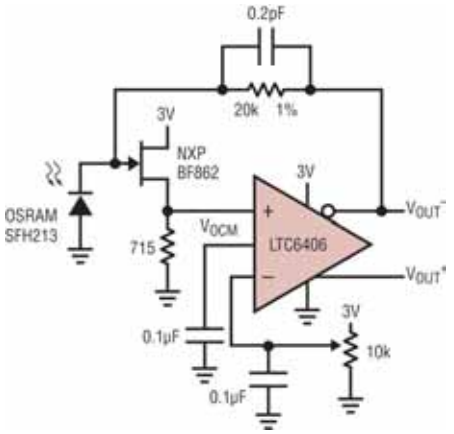
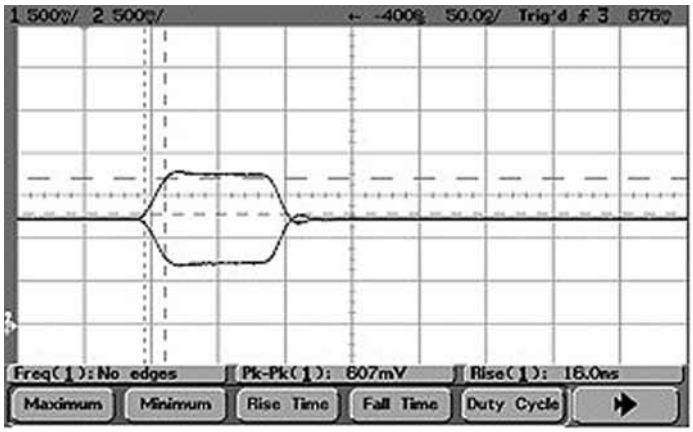


Figure 4: Time domain response measurements show that the total output noise on 20MHz bandwidth gives 0.8mV$_{RMS}$ on V$_{OUT}$+ and 1.1mV$_{RMS}$ on V$_{OUT}$–



fact that single-ended feedback around a fully differential amplifier introduces a noise gain of two from the VOCM pin to the "open" output. In order to avoid this noise, simply do not use that output, resulting in a fully single-ended application. Or, you can take the slight noise penalty and use both outputs.

A Single-Ended Transimpedance Amplifier

Figure 3 shows the LTC6406 connected as a single-ended transimpedance amplifier with 20kΩ of transimpedance gain. The BF862 JFET buffers the LTC6406 input, drastically reducing the effects of its bipolar input transistor current noise. The VGS of the JFET is now included as an offset, but this is typically 0.6V so the circuit still functions well on a 3V single supply and the offset can be dialled out with the 10k potentiometer. The time domain response is shown in Figure 4. Total output noise on 20MHz bandwidth measurements shows 0.8mVRMS on VOUT+ and 1.1mVRMS on VOUT–. Taken differentially, the transimpedance gain is 40kΩ.

New families of fully differential op-amps like the LTC6406 offer unprecedented bandwidths. Fortunately, these op-amps can also function well in single-ended and 100% feedback applications. ●

An optimized architecture for low-cost GSM/GPS tracking boxes

IN THIS SECTION, WHICH WILL BE PUBLISHED EVERY QUARTER, SIERRA WIRELESS AUTHORS WILL PREPARE 'HOW TO' TYPE ARTICLES RELATED TO THE DESIGN AND DEVELOPMENT OF WIRELESS SYSTEMS

Aftermarket tracking boxes are cellular devices that let drivers add a variety of connected services, such as navigation with concierge assistance, stolen vehicle tracking, fleet management services and speed camera alerts to their existing vehicles. They also provide a way for insurance companies to deliver usage-based insurance, with tools that monitor driving patterns and help assess risk and prevent fraud.

With today's highly integrated hardware technology and ready-to-use software libraries, designers can develop tracking boxes that deliver advanced functionality in a smaller form-factor and at a significantly lower cost.

Sierra Wireless offers an architecture that lets designers find the right balance between price and performance. The approach combines wireless and GPS modules with an RTOS and a dedicated Location software library, and can be implemented with or without a host processor.

The GPS functionality is provided by the AirPrime GPS module XM0110, a ready-to-use solution optimized for use with AirPrime wireless modules. Based on CSR's SiRFstarIV GPS, the module is a high-sensitivity device that offers tracking rating of -163dBm, navigation rating of -160dBm, and acquisition rating of -158dBm aided and -148dBm autonomous. It connects directly to the wireless module's UART serial interface

Based on CSR's SiRFstarIV GPS, the module is a high-sensitivity device that offers tracking rating of -163dBm, navigation rating of -160dBm, and acquisition rating of -158dBm aided and -148dBm autonomous

AirPrime Wireless Modules

For the wireless portion of the design, there are a number of field-proven AirPrime wireless modules to choose from. GSM is a good choice, since a tracking box typically has minimal requirements for bandwidth. All AirPrime modules are equipped with an RTOS that lets developers create applications in standard ANSI C/C++. The RTOS has been in widespread use for more than a decade and has been proven in several million deployments worldwide.

or I2C bus, and can share its power supply.

There are several low-power options, so designers can create the best trade-off between highest GPS performance and lowest total system power consumption. The module is also fully upgradable over the air, so the host software and GPS firmware can stay current.

The GPS module is driven by the wireless module through a serial interface and a few GPIOs. The only external component required is a GPS antenna, either active or passive.

The GPS module is supported by an off-the-shelf software library that has dedicated APIs for a full range of GPS functions. Beyond the basic operations for obtaining location data, the module supports Assisted GPS (A-GPS) functions that provide several additional benefits, including a faster time-to-first-fix (TTFF), better fixes in poor GPS signal conditions and increased position accuracy.

To defend against criminals and improve reception, the GPS module supports anti-jamming. Thieves and hijackers may use frequency-jamming devices that make the vehicle harder to track. The GPS module is able to remove the white noise caused by jamming devices, so it continues to receive positioning data even in a jammed environment. Jamming removal also helps improve reception in noisy environments and in rural areas, where there are more frequencies to contend with.

With or Without an External Host Processor

The wireless and GPS modules can be used in combination with an external host processor, or they can be configured to operate on their own, without a host.

With an External Host Processor

Figure 1 shows a system that uses an external host processor. This is a quick-to-configure option that lets designers complete their system without

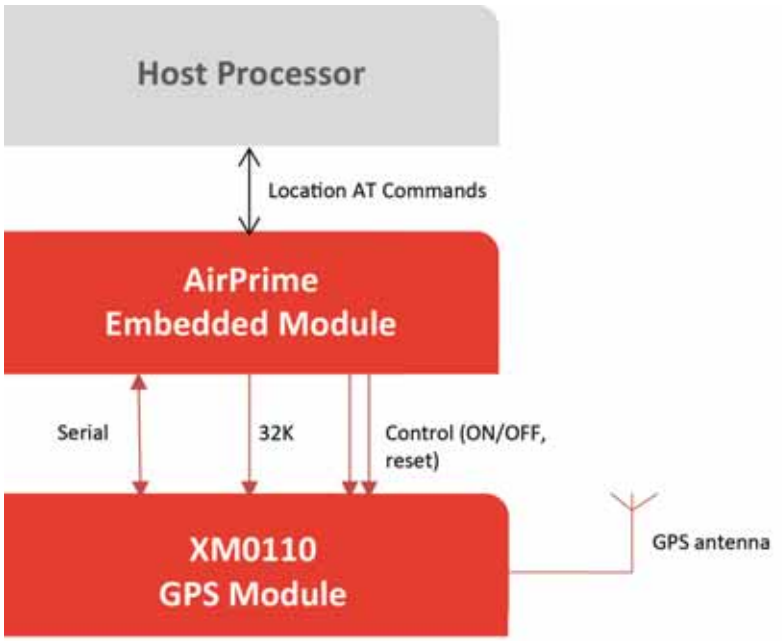


Figure 1: Tracking box application with external host processor

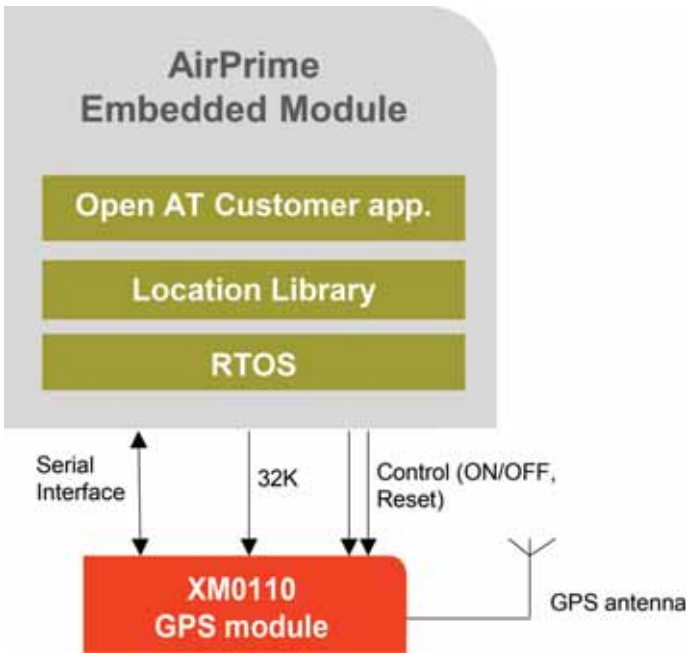


Figure 2: Tracking box application without external host processor

significant code development. The code runs on the host processor, as usual, and executes AT commands familiar to designers who've worked with GSM.

Without an External Host Processor

Figure 2 shows a system that eliminates the external host processor. This is a more compact option that can produce a design small enough to fit in a wristwatch. Also, since there's no additional processor, memory, or run-time for the OS, this is a less expensive option that can also deliver faster performance. Code is loaded directly into the module, so the design is still easy to execute. And, because the RTOS and GPS library are already ported to the hardware modules, the bill of materials remains low. Adding software elements to the design doesn't add to the overall cost.

In both cases, with or without the external host, designers use Developer Studio, a complete set of development tools that includes an Eclipse-based IDE and enables streamlined, efficient development. With Developer Studio, designers use a single environment to learn, code, debug, compile, download, trace, and monitor. Sample applications and a range of readily available building blocks are also available. ●

CASE STUDIES

SEVERAL DESIGNS THAT USE THE TWO-MODULE APPROACH ARE ALREADY AVAILABLE ON THE MARKET.

One company, based in the United States, has introduced a compact unit that can provide drivers with such services as incident alert, emergency call, roadside assistance, stolen vehicle tracking, navigation, with concierge assistance, as well as a variety of driving data and diagnostics information. The solution also forms the basis for usage-based insurance, which provides comprehensive tools to monitor driving patterns and driver behaviour, and to better assess risk.

Another company, in South Africa, has introduced a series of devices for stolen vehicle retrieval (SVR) and fleet management. All use the two-module approach with varying levels of software options and hardware add-ons.

At the low end, there is a backup SVR system that spends most of its time in a sleep state, unconnected to the GSM network, so it uses very little power and makes it harder for thieves and hijackers to locate primary SVR systems. A more advanced SVR system is capable of buffering and streaming GPS position, heading, and speed data. The design also includes early warning theft triggers based on movement, vehicle alarm and ignition inputs.

For fleet management, the company has modified the design to include an external accelerometer, which supports accident detection and analysis of driving style. Other features include wireless driver identification for up to 32 unique drivers, fuel level monitoring, immobilization of the vehicle, additional driving style inputs ("riding" the clutch, over-revving), and two-way voice communications with the driver. Finally, by adding dual CANBus connectivity to the design, the company can leverage the in-vehicle network (IVN) to provide an even wider array of features for fleet management.

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Turning Down the Volume on Electrical Noise Ensures More Accurate Nano Measurements

OVER THE NEXT SEVERAL ISSUES OF ELECTRONICS WORLD MAGAZINE, **JONATHAN TUCKER**, CHAIRMAN, IEEE NANOTECHNOLOGY COUNCIL STANDARDS COMMITTEE, WILL PRESENT THIS TUTORIAL ON THE TEST AND MEASUREMENT ASSOCIATED WITH NANOTECHNOLOGY

Measurement topology has an impact on electrical noise, which is the ultimate limitation on measurement sensitivity and accuracy. For low-impedance voltage measurements with a current source, the measurement circuits will be sensitive to DUT voltage noise and impedance. For macroscopic devices, such as a resistor, the Johnson noise voltage at room temperature (270K) is expressed as:

$$V_n = \sqrt{(4kTBR)}$$

where **k = Boltzmann's constant**
T = Absolute temperature of the source in degrees Kelvin
B = Noise bandwidth in Hertz
R = Resistance of the source in ohms
which can be further simplified to:

$$V_n = 6.5\times10^{-10}\sqrt{(BR)}$$

This equation shows that as DUT resistance (R) decreases, the Johnson voltage noise generated by the DUT also decreases. Conversely, high-impedance devices stimulated with a voltage source are limited by current measurement noise. The Johnson current noise of a resistor at 270K is:

$$I_n = 6.5\times10^{-10}\left[\sqrt{(BR)}/R\right]$$

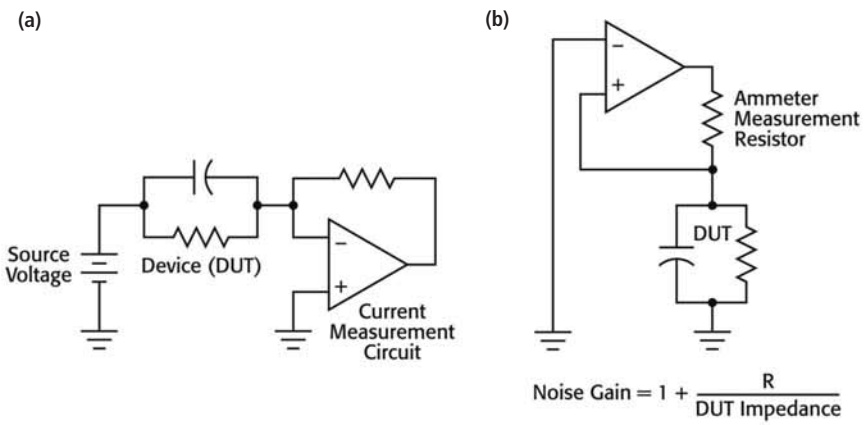


Figure 1: (a) Circuit model for the source voltage/measure current technique; (b) Modified model illustrating the noise gain (op-amp noise "gained up") when the DUT impedance is low compared to the measurement impedance

indicating that the noise goes down as DUT resistance increases.

For all particle sizes, in addition to Johnson noise, there could be a noise gain associated with the measurement topology chosen. Noise gain is a parasitic amplification of the noise of the measurement system that is not present when the correct measurement topology is chosen. For example, consider a source voltage/measure current topology. An operational amplifier is used in many current measurement (ammeter) circuits, as shown in Figure 1.

To minimize noise gain, the ammeter circuit must operate at a low gain with respect to its non-inverting input terminal. ●

When measuring high impedance (> 10,000 ohms) devices, the source voltage/measure current technique is best

FURTHER READING

FOR MORE ON ULTRA-LOW CURRENT MEASUREMENT TECHNIQUES DOWNLOAD
"Counting Electrons: How to Measure Currents in the Attoampere Range" from the website

New M8 Connector Simplifies Termination

The already extensive range of Binder Series 768 M8 connectors has been enhanced with the introduction of a new version that has screw terminations with improved contact geometry and pin number markings that simplifies termination of the screw contacts.

Series 768 is a three or four pole connector rated at 4A with screw termination for wires up to 0.5mm^2 (AWG 20) and handles cables up to 5mm in diameter.

The gold plated contacts ensure a mating cycle in excess of 100 and are IP67 when mated. Applications include drives and controls, sensors and automation equipment.

Based in Hemel Hempstead, Binder UK is a subsidiary of Franz Binder GmbH, the highly successful manufacturer of circular and other connector products that serves instrumentation, sensor, automation, medical devices and industrial equipment markets.

www.binder-connector.co.uk

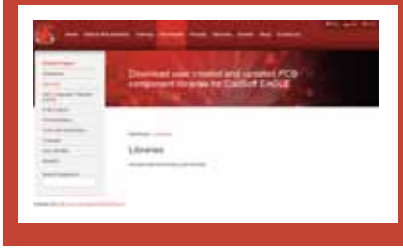
EAGLE OFFERS NEW COMPONENT LIBRARIES FROM WURTH ELECTRONICS MIDCOM

CadSoft Computer GmbH, a part of Premier Farnell plc, has paired with Wurth Electronics Midcom, a company owned by Würth Elektronik, to release its EAGLE part library that includes drawings for their standard magnetics lines and, also, for all the Speedy and Standard package styles used in custom designs. With worldwide presence through Würth's technical sales force it supports product design from concept to manufacture, regardless of location.

The library includes a standard Magnetics library containing standard packages, new product offerings and Speedy Design Service parts along with basic part information with datasheet links.

The Wurth library can be integrated into EAGLE and is a ready to use tool to optimise customer's productivity. Besides that many more third party PCB component libraries, design projects and User Language Programs (ULPs) for feature enhancement, such as simulation, 3D-visualisation, data export and import are available through the CadSoft website.

www.cadsoftusa.com/downloads/libraries/



PICKERING INTERFACES INTRODUCES NEW RANGE OF MICROWAVE PXI SWITCH SOLUTIONS

Pickering Interfaces is expanding its range of 3U PXI Microwave switch solutions with the introduction of the 40-784.

The 40-784 supports one or two microwave switches in just two slots of 3U PXI and is available in two configurations and three frequency ranges. The available configurations are unterminated 4-way (SP4T) and 6-way (SP6T) multiplexers. Each configuration is available with a 6GHz, 26.5GHz or 40GHz specified frequency range.

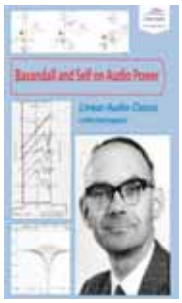
All versions offer excellent VSWR and insertion loss performance. The 6GHz/26.5GHz configurations feature extended life of 10 million operations per position.

The 2-slot PXI occupancy allows test system designers to provide dense solutions to solve dense microwave switching problems. The 40-784 can be supported by any PXI-compliant 3U PXI chassis and is supported by Pickering Interfaces Modular LXI chassis for applications requiring Ethernet-based control.

www.pickeringtest.com

New Publication: Baxandall and Self on Audio Power

Linear Audio, the tech audio publisher from The Netherlands, has released a new publication: '*Baxandall and Self on Audio Power*', a 120-page reprint of classical Wireless World articles on audio power amplification by Self and Baxandall from 1978 to 1994. The collection includes a 35-page previously unpublished personal communication on the subject from Peter Baxandall.



Baxandall and Self on Audio Power has three sections: one contains Peter Baxandall's six Wireless World articles from 1978/1979. These focus on feedback and stability in power amplifiers, and give an overview of the issues and solutions on the making of a very linear and stable power amplifier.

Section Two is Douglas Self's series of eight articles from Wireless World 1993/1994. These articles focus on the various types of distortion in power amplifiers and how to minimize each of them. This is the article series that resulted in the 'Blameless Amplifier' concept.

Section Three consists of Peter's comments on Douglas's articles, and contains many hand-drawn graphs and schematics.

www.linearaudio.net

ENTRY LEVEL MODEL OF HAMEG'S SPECTRUM ANALYZER HMS SERIES

The new 1GHz HMS1000E (economy) from Hameg is a successor to the HM5510 instrument. It is also a part of Hameg's HMS series but at only 1,950€.

It has a compact case, a 16.5cm large TFT screen, three USB ports for connecting USB sticks, printers and for remote control. Features such as eight markers, including delta and noise markers, diverse peak functions, simple operation and low menu depth were taken from the HMS series. The HMS1000E is also equipped with auto, min, max, peak, sample, rms detectors and built-in AM and FM demodulators (internal loudspeaker and headset output).

Compared to its predecessor HM5510, the resolution bandwidths were extended to six in total, RBW's of 10kHz to 1MHz are available in one to three steps. Not to forget the extended range of possible video bandwidths from 1kHz to 1MHz compared to the HM5510. The HMS1000E user can thus solve considerably more measuring tasks and faster too.

www.hameg.com

TEVISIO – THE MAGNIFIER THAT SUPPORTS THE MOST DEMANDING VISUAL TASKS

With its sleek, modern design, the new LED magnifier luminaire TEVISIO from Waldmann offers exceptional flexibility through innovative mounting technology as well as high visual quality, supporting even the most demanding visual tasks.
Tevisio uses 48 multichip LEDs to produce the ultimate combination of efficiency and light quality, in addition to 40% energy savings when compared to conventional magnifier luminaires with the same high optical performance. At a lighting intensity of up to 6,000 lux, its power consumption is a mere 14 watts.

The LEDs have a colour temperature of 4,000K and offer a high colour rendering index of Ra = 90, which offers the best prerequisites for recognising colours and colour differences under the magnifying glass. Moreover, the reflector technology provides a very good light distribution that delivers homogeneous light, with soft transitions and no disturbing shadows to the work area.

www.waldmann.com

Increased Protection Two-Wire Hall-Effect Latch

New from Allegro MicroSystems Europe is the A1244 a two-wire Hall-effect latch featuring on-chip transient protection and a Zener clamp to protect against overvoltage conditions on the supply line.

The new device, which is programmed at the factory to optimise the magnetic switch point accuracy, uses the same patented high-frequency, 4-phase, chopper-stabilisation technique that is used on the company's complementary family of unipolar switches. This results in lower noise on the output, less switch-point variation over temperature and faster settling times.

The improvement in noise and switch-point drift allows the device to realise much better switching accuracy, which means better switching repeatability. Moreover, the improved high-voltage transient protection allows the A1244 to survive the conditions specified in ISO 7637-2 and 40V load dump.

Allegro's advanced BiCMOS wafer fabrication process is used to achieve magnetic stability over temperature and to eliminate the offset inherent in single-element devices when exposed to harsh application environments.

www.allegromicro.com

KONTRON ETX 3.0 COMPUTER-ON-MODULE ETX-OH EXTENDS APPLICATION LIFECYCLES

At the SPS/IPC/DRIVES trade show in Nuremberg, Kontron (Hall 7, stand 306) has announced the new ETX 3.0 Computer-on-Module ETX-OH with AMD's highly integrated, energy-efficient embedded G-Series Accelerated Processing Units (APU). With its powerful 64-bit multi-core processor technology and programmable graphics unit that supports DirectX11 on one die, the Kontron ETX-OH is an ideal solution for applications that require increased graphic capabilities and provides a simplified migration path for systems that utilize legacy modules.

The latest addition to the Kontron ETX 3.0 Computer-on-Module family is based on the AMD A55E controller hub, and covers a wide performance range with the AMD T40E, T40R, T52R and T56N single- and dual-core processors in order to address exact application requirements. The Kontron ETX-OH offers superior HD graphics capabilities with support for the latest 3D graphics with DirectX 11 and OpenGL 4.1. It also enables brilliant and smooth playback of high resolution BluRay and video streams of up to 1080p.

www.kontron.com/etx

ULTRA-MINIATURE, ISOLATED COUPLERS DRIVE IGBTS AT EXTENDED TEMPERATURES

Toshiba Electronics Europe (TEE) has launched two new ultra-miniature IGBT/MOSFET Gate drive photocouplers that offer guaranteed performance at temperatures ranging from -40°C to 125°C.

The TLP700H and TLP701H are supplied in SDIP6 packaging and are designed to directly drive IGBTs and power MOSFETs without the need for additional components. Maximum peak output current ratings are ±2.0A for the TLP700H and ±0.6A for the TLP701H. Despite their size (mounting area is just half that of a DIP8 package) each device offers a minimum withstand voltage of 5000Vrms. This allows designers to address the re-inforced isolation requirements demanded for international safety certification.

The new TLP700H and TLP701H couplers feature buffer logic type totem pole outputs and incorporate internal noise shields to provide minimum guaranteed common mode transient immunities of ±20kV/µs and ±15kV/µs respectively. Low maximum supply currents – 3mA for the TLP700H and 2mA in the case of the TLP701H – help to keep power consumption to a minimum.

www.toshiba-components.com

LBA LOW PRESSURE SENSORS OFFER SPECIAL VERSIONS FOR RESPIRATION APPLICATIONS

Sensortechnics's LBA series offers differential low pressure sensors based on thermal mass flow measurement of air through a micro-flow channel integrated within the silicon sensor chip. The sensors are ideal for differential pressure flow measurement where the pressure drop across a flow element is a measure of the volumetric flow rate.

For high performance medical respiratory devices it is essential to detect very small flows around the zero flow point while additionally being able to measure full scale flows of several hundreds of l/min. For these demanding requirements Sensortechnics now offers special versions of its LBA sensors with increased resolution of 0.01% in the lower pressure range and at the same time high dynamic ranges greater than 10,000.

The LBA sensors feature an innovative MEMS construction which integrates the micro-flow channel and fully analogue CMOS signal conditioning within the silicon sensor chip.

www.sensortechnics.com/lba-d

Microchip Launches Sinusoidal, Sensorless, 3-Phase BLDC Fan Motor Driver

Microchip announces the expansion of its portfolio with the MTD6505, the industry's first and only standalone, resistor-programmable driver that enables the selection of multiple back-EMF coefficient ranges. This unique feature allows engineers to design for a wide variety of 3-phase BLDC fan characteristics with a single cost-effective and flexible device, thus saving time and money by standardising multiple product lines on one driver and very few external components. Additionally, the low-cost driver comes in a 3 x 3 mm UDFN package with a 0.5mm thickness for space-constrained applications.

To enable high energy efficiency and quiet operation with low acoustic noise and mechanical vibration, the MTD6505 includes a 180-degree sinusoidal drive. Being a sensorless driver means that the MTD6505 eliminates the need for an external Hall-Effect sensor, reducing both cost and board space.

The new MTD6505 3-Phase BLDC Sensorless Fan Controller Demonstration Board (ADM00345) is also available now for $59.99.

www.microchip.com/get/2B02

SINGLE OUTPUT AC/DC POWER SUPPLIES PROVIDE 800W FROM 1U CASE

A new series of AC/DC power supplies announced by Powersolve are single output units designed to provide up to 800W from a low profile 1U high metal case. There are seven models in the PAE800 series all of which feature a 90-264VAC input voltage range with active PFC and forced active current sharing for parallel operation.

Models in the PAE800 series offer single outputs, programmable between 0% and 105%, of 12V, 15V, 24V, 30V, 36V, 48V and 60VDC. Output current is also programmable between 0% and 105%. Efficiency levels are high at 93%. A +5V, 0.5A standby output is also provided. Operating temperature range is -25ºC to +60ºC.

The new units offer protection against overload, over voltage, over temperature and short circuit, while fault conditions are displayed using intelligent LEDs. Remote on/off, remote sense and power good signals ease system integration.

www.powersolve.co.uk

UK MADE CUSTOM RF CONNECTORS DELIVERED IN SEVEN WEEKS

Intelliconnect (Europe) Ltd, the UK-based manufacturer of RF connectors, offers one of the widest ranges of standard coaxial, triaxial and waterproof connectors available worldwide. In addition, its extensive design experience and UK-sourced components allows Intelliconnect to offer an unrivalled custom connector design service.

Custom designs take many forms; from the modification of a standard product to provide bespoke termination, extended operating frequency range, special plating or different case material (such as stainless steel) through to a completely new design as with the Intelliconnect ABMS connector for cochlear implants.

Turnaround time for delivery of a custom designed product from Intelliconnect is a remarkably short seven weeks from the customer's approval of the design drawing, no matter how complex. Such is the confidence that Intelliconnect can fulfil all of its customer's requirements satisfactorily, no design or NRE (non-recurring engineering) charges are requested and no MOQ (minimum order quantity) is required.

www.intelliconnect.co.uk

NEW ARCHER 1.27MM PIN HEADERS FROM HARWIN STOCKED, READY FOR RAPID DELIVERY

Harwin has announced that its M52 2.54 x 1.27mm pin header range – part of its Archer board-to-board connector system – is now available ex-stock, rather than being produced to order based on a customer's selected pin height.

Available in through-board and SMT styles, many standard pin lengths can now be shipped immediately, increasing design flexibility.

This versatile, cost-effective connector system offers good performance and is intermateable with other similar systems. It is ideally suited to applications including test & measurement, robotics, industrial, handheld and medical equipment. SMT versions are available on tape & reel packaging for automated assembly.

Archer headers and sockets feature a dual point of contact design for reliability. They enable product miniaturisation without sacrificing ruggedness or performance.

Free samples and CAD models are available on-line at:

www.harwin.com/archer

HIGH-DENSITY PHD38999 CONNECTORS FROM ITT ICS PASS HARSH QUALIFICATION TEST

ITT Interconnect Solutions has announced that its PHD38999 connector which utilises its tunable size 22 fibre-optic termini has passed a series of harsh environment tests included in industry-standard M38999 specifications. These connections systems are used in demanding defence and aerospace applications, including vision systems, flight connectors and control systems.

ITT's PHD38999 connector, utilising its unique size 22 termini, successfully passed comprehensive Design Verification Testing (DVT), including meeting stringent specifications for mating repeatability, temperature cycling, vibration, mechanical shock, humidity and mating durability. ITT ICS PHD38999 connectors offer high density of up to 50 channels per square inch. Further innovative benefits of PHD38999 interconnects include removable sleeve inserts which allow direct end face access for terminus cleaning and inspection. As PHD terminus retention is via ITT's patented Little Caesar contact retention clip technology, there is unparalleled flexibility for installing, servicing, cleaning and repairing single optical channels.

www.ittcannon.com

Avnet Abacus Signs Pan-European Deal with Murata for Components

Avnet Abacus, one of Europe's leading interconnect, passive, electromechanical and power distributors, has announced that it has signed a Pan-European franchise agreement with Murata covering the Japanese manufacturer's broad range of innovative passive products. The agreement builds on a 20-year relationship between the two companies. Previously, Avnet Abacus has covered selected European territories for Murata passives and has held a Pan-European agreement for the company's power solutions products. This extended agreement further enhances Avnet Abacus's position as a leading distributor of Murata products.

Avnet Abacus is particularly enthusiastic about introducing Murata's innovative ceramic based components to a wider European design engineering audience.

"We recognise Murata's global leadership in ceramic-based electronic components. Our particular focus will be on the application and design in of new products such as SMD Pyroelectric Infra Red sensors, AMR Sensors, Microblower, timing devices and metal T-cap ranges," said Alan Jermyn, VP European Marketing at Avnet-Abacus.

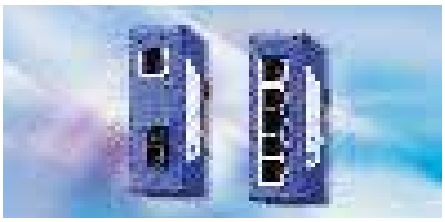
www.avnet-abacus.eu

Belden introduces three new SPIDER PD switches from its Hirschmann Range

Belden has added three new unmanaged low-cost switches from the SPIDER series to its Hirschmann product range. These switches support Fast Ethernet (10/100Mbps) and have either five twisted-pair ports (SPIDER 5TX PD EEC) or one twisted-pair port and one fiberoptic port for multimode (SPIDER 1TX/1FX-MM PD EEC) or singlemode optical fiber (SPIDER 1TX/1FX-SM PD EEC). Other features include industrial protection class IP30, a strong metal housing and an extended temperature range from -40°C to +70°C. Since all versions are powered via PoE there is no need for a separate power supply or even a socket. These switches can therefore be used wherever a PoE port is available, thus allowing flexible network expansion, with additional ports for data transmission via copper cable or – for large distances or where there are strong electromagnetic fields – fiberoptic uplinks.

These switches meet all relevant industry standards and have an E13 registration (motor vehicles).

www.hirschmann.com



Mouser Offers 1700 PKC Training Sites

Mouser Electronics, a design engineering resource and global distributor for semiconductors and electronic components, now offers over 1700 Product Knowledge Center (PKC) training sites focusing on the newest products and technologies.

The Product Knowledge Centres are designed to educate electronic design engineers on the features, advantages and applications of the newest products in every category from industry leading manufacturers. Each centre training site houses a wealth of information, including datasheets, mechanical drawings, block diagrams, product videos and additional resources enabling design engineers to conduct research into detailed technical information at their own pace, using a variety of media.

To view all of Mouser's Product Knowledge Center training sites visit:

www.mouser.com/knowledge

CAMDENBOSS LAUNCHES NEW WIRE-TO-BOARD CONNECTORS

CamdenBoss has launched two new series of wire-to-board connectors that provide solid and reliable connections at low cost.

The new Minipower and Micropower connectors are priced to offer significant savings and direct compatibility compared with existing leading brands on the market and are manufactured using the highest quality materials. Both ranges offer single and double row connectors up to 24 poles with fully insulated housings. Polarised to avoid inverted connection, Minipower and Micropower receptacle housings feature a friction lock for positive mating and male headers have locking ears for panel mounting applications.

Minipower connectors are 4.2mm pitch and are rated for applications up to 9A. The connectors comprise male and female crimp terminals fitted into their respective housings to create wire-to-wire connections. By using PCB mounting headers and female housings with crimp terminals, wire-to-board connections can be achieved. Straight and right-angle headers are available.

www.camdenboss.com

OFFICIAL FIGURES SHOW RISE IN APPRENTICESHIPS

Figures released from the Department for Business, Innovation and Skills (BIS) show apprenticeships on the increase, with 442,700 courses beginning in the 2010/11 academic year. However, concerns abound about the future of apprenticeships as businesses evaluate their training spend.

"The steady increase in the number of people beginning apprenticeships is encouraging, but worryingly, some businesses plan to reduce the number of apprentices they take on next year. If the number of available apprenticeships was to regress over the next year, the skills picture and the jobs market would be severely tarnished," said Sarah Thwaites, Deputy Chief Executive of Financial Skills Partnership.

"In order for young people to continue to secure jobs in their chosen profession, there must be a wider range of courses, opportunities and career entry routes available from schools, colleges, universities, training providers and employers. This will address the changing landscape in further and higher education and take into account the different ways people are embarking on the career ladder."

In order for young people to continue to secure jobs in their chosen profession, there must be a wider range of courses, opportunities and career entry routes

PROFESSOR DR DOGAN IBRAHIM, Near East University in Nicosia, Cyprus: It is highly interesting and pleasing to learn that apprenticeships have been on the increase in the 2010/11 academic year. What is also interesting is that the majority of students in the apprenticeship programme were adult learners, being aged 25 and over, and intermediate level apprenticeship starts were the highest. It is important in this hard economic climate that young people are given opportunities to join apprenticeship schemes to enable them secure jobs in their chosen profession. Perhaps the government should encourage the businesses to increase apprentices they take on by providing financial aid for selected courses and training programmes.

BARRY MCKEOWN, RF and Microwave Engineer in the Defence Industry, and Director of Datod Ltd, UK: Any rise in apprenticeships is to be welcomed. Essentially this avenue was nearly closed off by the Baker/Clark rush to expand the University system, and especially the recent nonsense of attempting to give 50% of the population degrees. Has this policy produced proportionately an expansion of engineers and scientists? This situation arose from a fundamental misunderstanding of the difference between education and training. Ironically, it took Eric Schmidt to point out that at school we train pupils to operate ICT software packages instead of educating them to produce software before the government took notice! A balance needs to be struck.

IVOR CATT, Engineer and Scientist, UK: Fifty years ago the IEE (now IET) said a graduate engineer was not a real engineer until he did a shortened "apprenticeship". Also, while at Cambridge studying general engineering I was required to go to companies during the summer to get some practical experience. Thus, at the highest level, the practical was respected. However, lower down, the aim of every parent, with government encouragement, was to make sure their sons maintained the family class-based image by never actually doing anything, but only sitting behind a desk shuffling paper for fifty years. Having been a tradesman in the RAF, I respected the activity of actually doing something. In contrast, the last straw was when Blair said 50% of youth should go to university, fitting them for office jobs. The class-based lack of respect for apprenticeships and those who did things was reinforced. In contrast, from my work as a tradesman I had developed respect for doing things, which could be sophisticated work, for instance in electronics.

This truth, that the real work is at the bench and not at the desk, is somewhat undermined in the case of hi hi-tec, where I ended up. I lost patience with the IEE idea of "graduate apprenticeship" after a year, but that was the special case of hi-tec, which is largely desk based.

MAURIZIO DI PAOLO EMILIO, Telecommunications Engineer, Italy: An apprenticeship is two different things: It's a Job, but it is also a School. Mostly, though, it's a great opportunity. An apprenticeship is a good way to prepare oneself for the future with on-the-job training in a highly-skilled career. Apprenticeships are only offered for jobs that are clearly recognized and valued throughout an industry.

It is clear that apprenticeships are going to become a route that more and more job seekers will follow in the future.

Apprenticeships can be demanding but they are very rewarding. Also, because you acquire skills that employers really want, you'll be giving yourself a wide choice of paths in your career.

If you are interested in becoming a member of our panel and comment on new developments and technologies within the electronics sector please register your interest with the editor by writing to Svetlana.josifovska@stjohnpatrick.com

NEW EW FORUM AND BLOG

Comments and letters we receive at Electronics World will also be placed in our newly-launched forum section on www.electronicsworld.co.uk. You can respond and share your views immediately online.

In addition, as our latest online offering, we introduce Barry's Blog, where Barry McKeown is our new blogger. Barry is already a well-known member of our panel of commentators on this page. He will now write regularly online about the most anticipated and talked-about subjects of interest to the electronics engineering community.

Visit www.electronicsworld.co.uk/blog to join the conversation.

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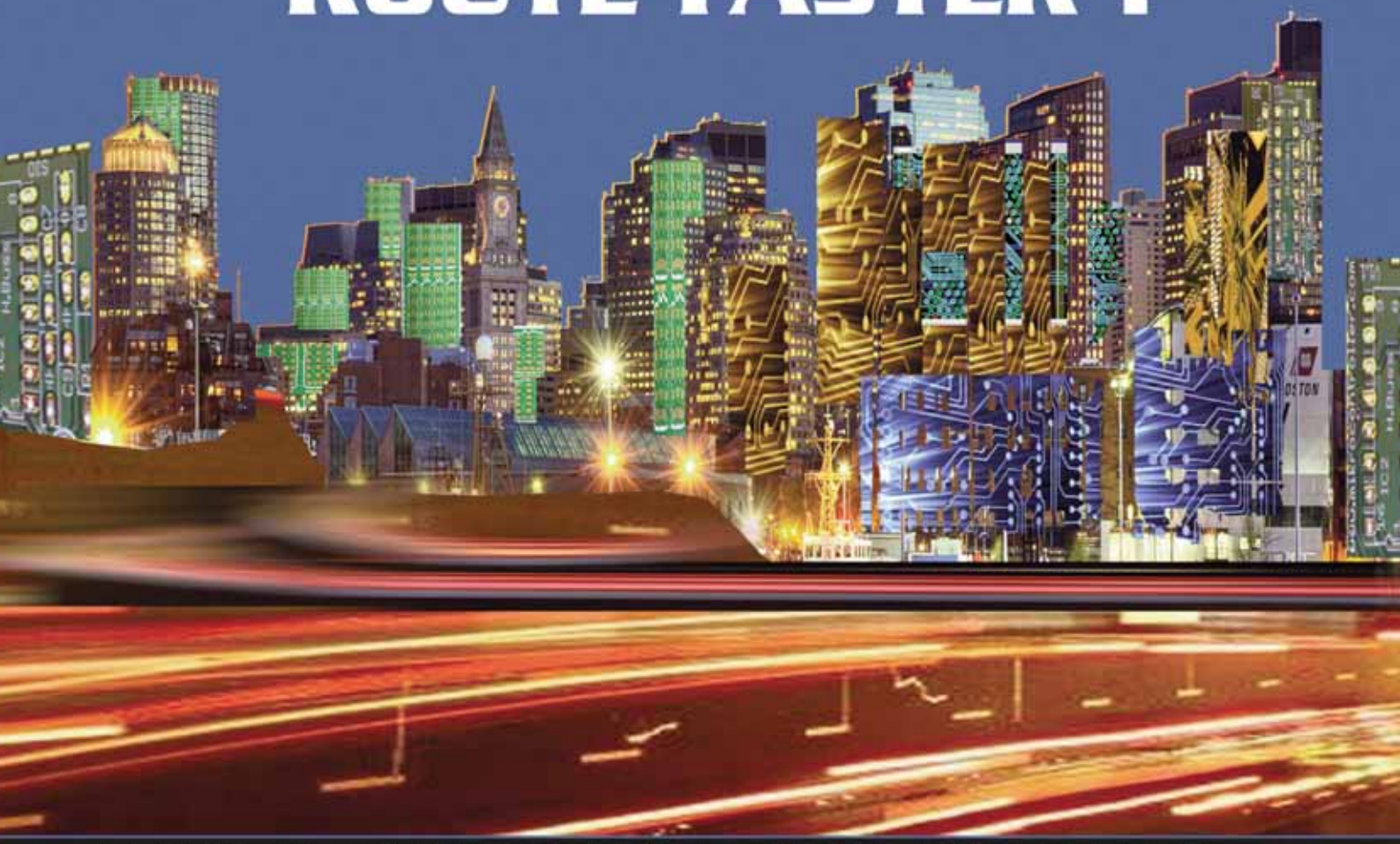

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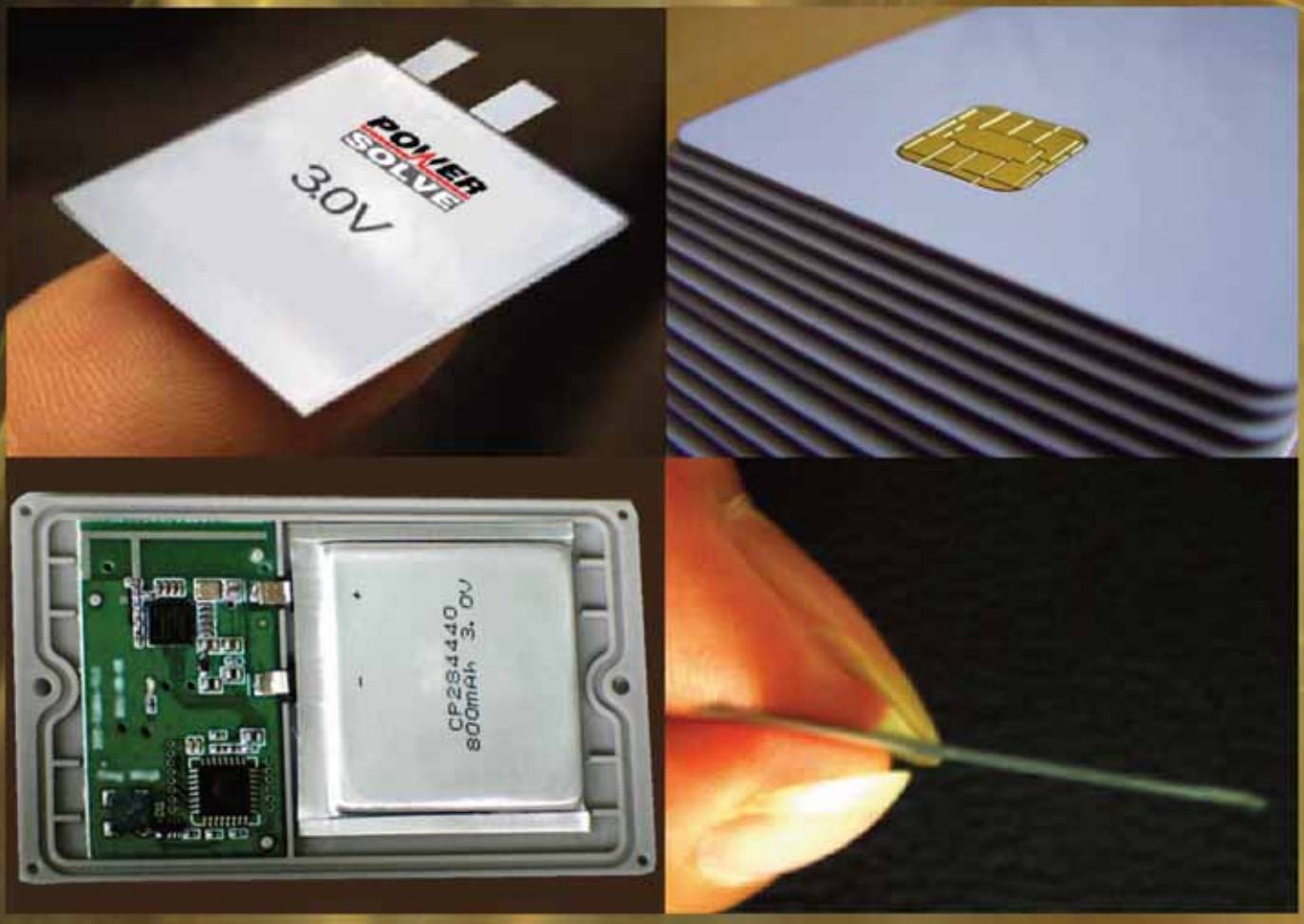

Powersolve has recently announced the CP Series of Lithium Polymer thin cells which are primary laminated aluminium thin foil batteries with a nominal 3V DC output. These cells can be manufactured down to 0.40mm thick and are very light weight. There are a number of standard sizes available but custom versions can be made in various sizes to suit customer applications. Standard versions are available from 16mAh up to 3000mAh. They have a very low self discharge rate of around 1% per annum and have a 10 year shelf life. Operating temperature is -40 to +85°C. They are explosion proof and are a completely safe design. Applications include smart cards, asset tracking tags, electronic tracking systems, smoke detectors, medical equipment, etc, etc.

POWER SOLVE

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www.powersolve.co.uk