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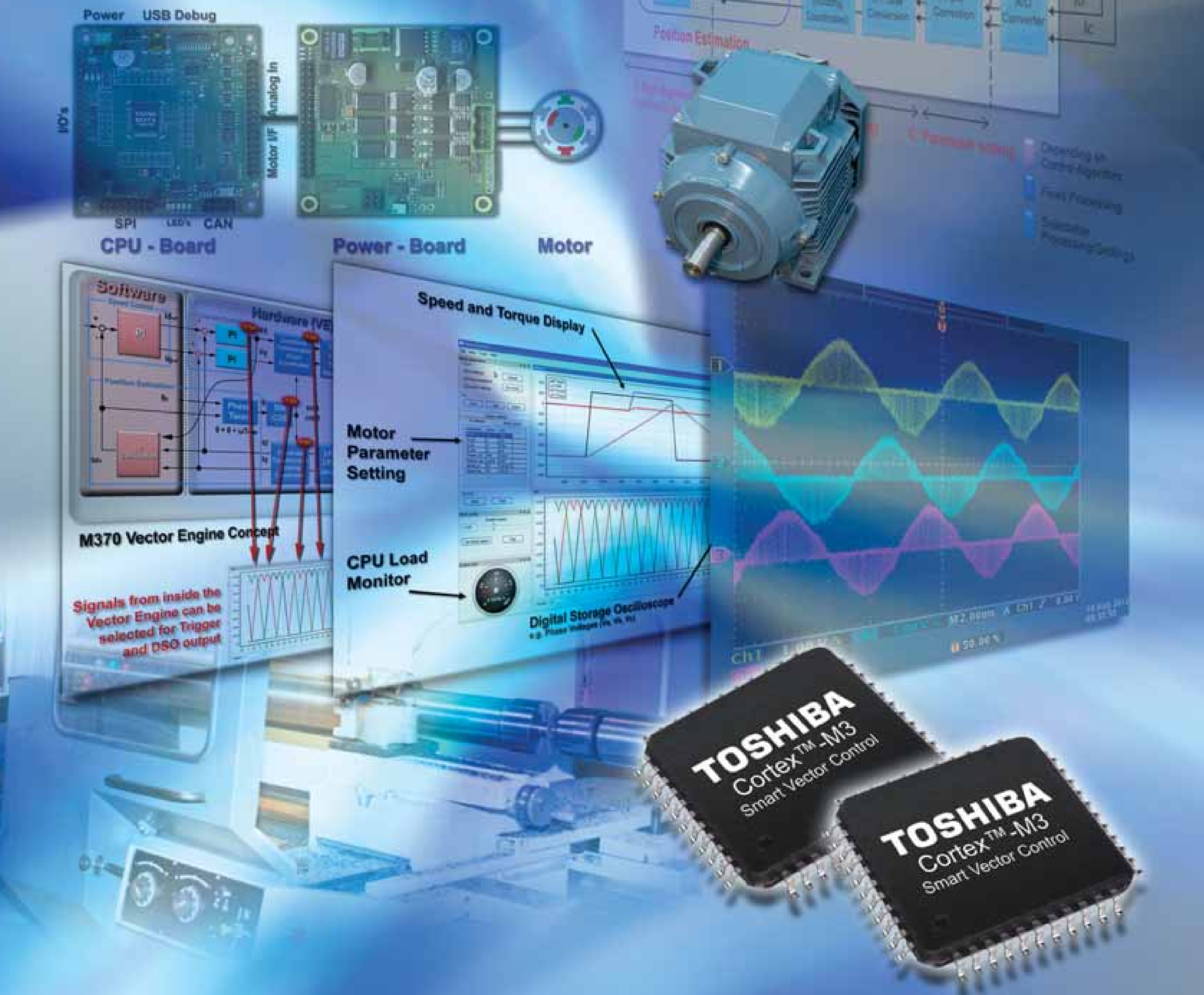

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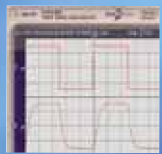
Embedded Design



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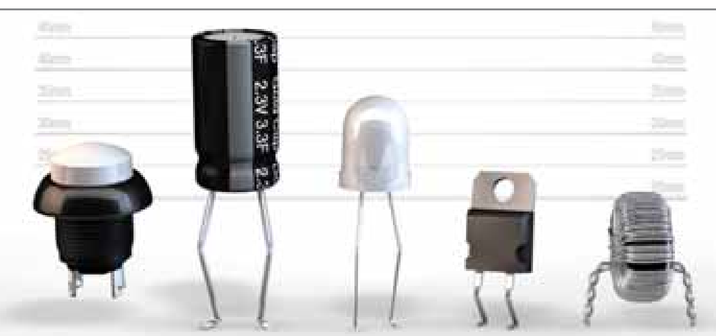

TRENDS IN INTERCONNECT TECHNOLOGY IN 2013

> ***As interconnects and systems get smaller, thermal considerations such as power, dissipation and hot spots become increasingly challenging to the product designer***

Year 2013 will be the year that electronics design shrinks even further. Engineers across the globe will find that now more than ever PCBs will be increasingly challenging to design due to the increased density and thermal issues brought on by miniaturization.

The ever-increasing volume of electronics built into the cars we drive, the server farms that power our daily networking, the medical devices in our hospitals, and even the elevators in our offices, is driving demand for smaller, more functional electronics. In turn however, smaller and smarter means more complex, particularly in the case of PCB interconnects, which are essential in connecting all the electronic components and systems together.

As smartphones and tablets pile on functionality and shrink in size, there's a greater need for higher layer count and denser interconnects. Industries such as telecommunications, medical and industrial electronics all require interconnects with increased functionality, smaller footprints and greater robustness.

According to a recent study from IBM, 2.5 quintillion bytes of data are created every day; and it's not just the amount of data, but the transfer speed too – just a few years ago bandwidth was 8GB and now it is pushing 25GB in speed. The telecom, networking and cloud computing companies that process and serve up this data are partnering with manufacturers like Sanmina to help design and produce interconnects that can transfer the enormous amount of data at faster speeds with fewer errors.

The Facebooks and Googles of this world don't want to add more server towers to their computing farms but more speed and functionality, which means interconnects with higher layer counts. What used to be a four or six layer interconnect is now a 10, 12, 14 layer interconnect and this trend will only intensify in the future. But, with that kind of density come design and manufacturing challenges.

For example, as layer counts increase the boards naturally become thicker, individual cores or material substrates become thinner and less reliable in terms of physical movement. There are many more signal traces on the boards, which can create challenges in registration and issues with thermal expansion when materials don't move at the same rate. The diameter size of the holes has been significantly reduced, while the number of holes increasing from 15,000 up to 100,000+, which means higher densities, although it also allows for smaller form-factors or more components. As interconnects and systems get smaller, thermal considerations such as power, dissipation and hot spots become increasingly challenging to the product designer.

These issues have required a change in the types of materials used on interconnects. The industry is moving beyond just using conventional FR4. Most of the change is geared toward the raw materials, like resin, glass fabrics and copper, as well as hybrid constructions that utilize multiple types of laminates in one PCB. Spread glass is becoming popular again because it has more consistent rates of signal speeds. We are also looking at material types that function differently. Some layers of an interconnect may require high-speed materials, while other parts might only require FR4, or a combination of materials on different layers.

Another reason for the move to hybrids is to lower costs as high-speed laminates can be 15 times the cost of standard materials. Another important change is the move to lead-free assemblies in order to conform with international standards for eco-friendly materials.

At Sanmina we've found that our customers require more complex PCBs. One of our industrial automation customers used to have 10 or 15 control stations on a line, now they want only one or two stations, which means their boards have to be that much more intelligent and robust.

We expect this trend toward more complex PCBs to continue to intensify. Therefore, design engineers must ensure they have the expertise required for reliable manufacturing of PCBs on a much smaller scale. So long as this is done effectively, new innovations and the evolution of existing products will be able to survive and thrive in an increasingly complex and competitive world.

By Robert O'Rourke, Senior VP of Business Development for EMEA at Sanmina

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WORLD'S FIRST IDE INCORPORATING CODE METRICS AND MISRA-C CODE ANALYSIS FEATURES

Integrated software development tools provider Atollic has released the latest version of its integrated development environment (IDE), Atollic TrueSTUDIO, that supports the MISRA-C:2004 coding standard. The company says it is the world's first embedded IDE to include such features as standard.

By using the built-in code metrics analysis tools, developers can easily measure important statistics like code complexity or commenting level of the source code. This empowers developers by providing them with the necessary tools to rewrite and improve their code. For example, reliability and maintainability is typically improved if overly complex C functions are refactored or rewritten into simpler coding style.

By following the MISRA-C coding standard, developers can better tackle the challenges often associated with using the C language and are guided to improve code portability, maintainability and application reliability. Atollic TrueSTUDIO v3.3 follows the MISRA-C coding standard more rigorously than most other tools on the market, so embedded developers can be assured their code is validated to the highest standards possible.

"By incorporating professional code analysis features as standard within Atollic TrueSTUDIO we are able to offer the most feature-rich ARM development tool on the market", says Magnus Unemyr, Vice President of Sales and Marketing at Atollic. "No other C/C++ IDE provides as equally integrated solution with features for multicore debugging, improved code quality, promoting team collaboration and increased developer efficiency, thus accelerating ARM development to a new level of productivity."

Atollic TrueSTUDIO also provides a rich GUI for visualization and navigation of the MISRA-C and code metrics analysis results, including a report generator that produces test reports in a variety of popular file formats.

With Atollic TrueSTUDIO v3.3 embedded developers now have the capability to code, compile, debug and perform source code analysis within a single development environment. Such comprehensive features facilitate a highly efficient and productive environment for embedded developers.

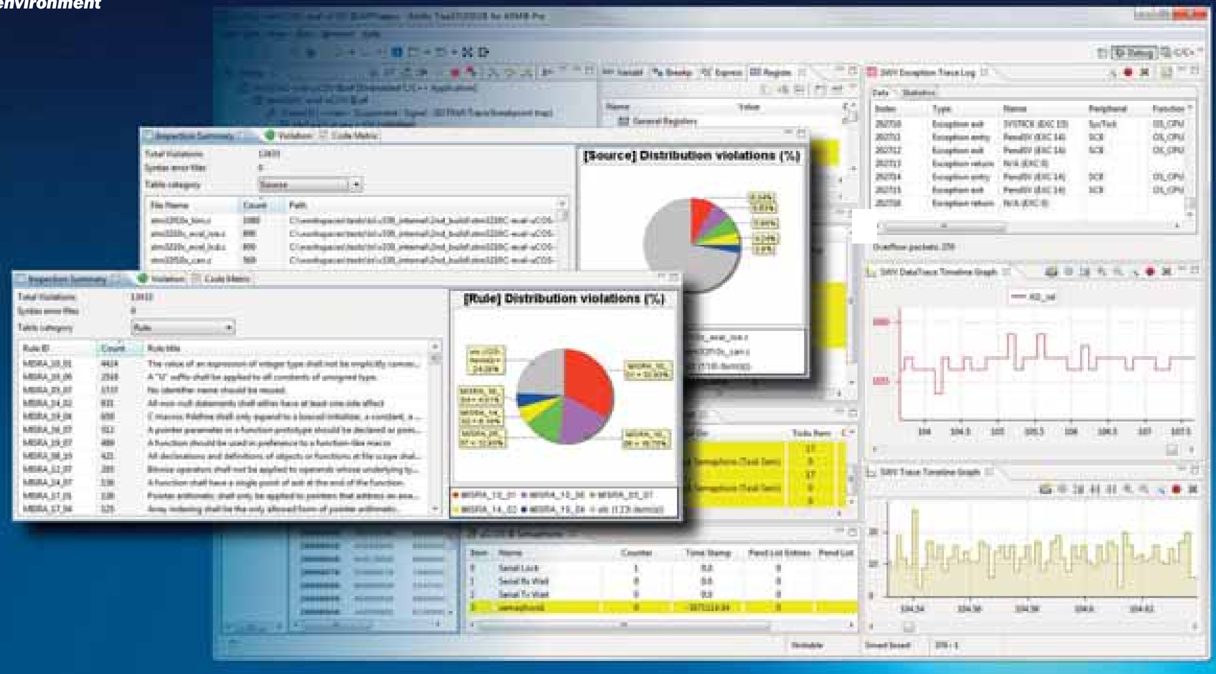
In addition to incorporating the inspection and analysis tools, Atollic TrueSTUDIO v3.3 now also includes native support for kernel-aware debugging of embedded applications developed using one of the world's most popular commercial real-time kernels, Micrium's uC/OS-III.

TrueSTUDIO's debugger provides docking windows that indicate the internal RTOS state during debugging. This provides highly informative insights into task control blocks (TCBs), semaphores, mutexes, timers and more.

"Building kernel awareness into TrueSTUDIO provides a clear snapshot of the health and performance of the application from the kernel's point-of-view," said Jean Labrosse, Founder, President and CEO of Micrium. "At a glance, you can see which tasks are running, what portion of the CPU is used by each task, how much stack space is used by each task, which task is waiting for a semaphore and more. Kernel awareness helps the engineer take full advantage of the rich feature set of our uC/OS-III when designing and optimizing their design."

TrueSTUDIO v3.3 now offers a wide range of microcontroller targets including devices from Energy Micro, STMicroelectronics, Toshiba, NXP and Infineon.

TrueSTUDIO v3.3 developers can code, compile, debug and perform source code analysis within a single development environment



SMART ENGINEERING IN MOTION

Energy efficiency and environmental sustainability through intelligent motor control

By Roland Gehrmann and Frank Malik, Toshiba Electronics Europe

New techniques for variable speed motion control (built around increasingly cost-effective brushless DC and permanent magnet synchronous motors) greatly improve system efficiency compared with the unsophisticated 'on/off' schemes of conventional inductive motors. These intelligent motor control designs optimise motor speed, direction, torque and acceleration to specific load conditions – minimising power consumption and creating opportunities to deploy smaller, 'greener' motors. Key issues for the engineer are choosing the motor control methodology to achieve maximum efficiency and selecting technologies that simplify implementation of complex drive electronics.

- Logic and software for drive signals and high level control (e.g. start-up sequencing, fault handling)
- Power blocks consisting of rectifier and MOSFET- or IGBT-based inverter stage
- Gate drive circuitry
- Sensored /sensorless feedback to ascertain rotor position
- Circuit protection and isolation

Intelligent power devices (IPDs), MOSFETs and IGBTs with very low on resistance ratings (RDS(ON)) are helping to reduce power consumption in these inverter-type applications, but it is the way the motor is driven that offers the most benefits in terms of efficiency and sustainability.

BLDC MOTOR EFFICIENCY IS CLOSELY LINKED TO THE COMMUTATION METHOD EMPLOYED.

The most common techniques are trapezoidal control and sinusoidal control. However, a third method, Field Oriented Control (FOC) or vector control overcomes the poor low-speed accuracy of trapezoidal control and the high-speed inefficiency of sinusoidal control. By manipulating motor currents and voltages with reference to the rotor's direct and quadrature axes, FOC maintains a constant stator field in quadrature with the rotor field. Sensed stator currents are translated into rotor direct (D) and quadrature (Q) components by a transform function and compared with zero and 'requested torque' respectively. Resulting error signals are proportionally integrated, generating signals in the D-Q reference plane that are then transformed into the stator domain to generate the PWM signal for each stator phase. Because PI (proportional-integral) inputs are constant, FOC maintains high efficiency at all rotor speeds regardless of limitations on PI-controller bandwidth.

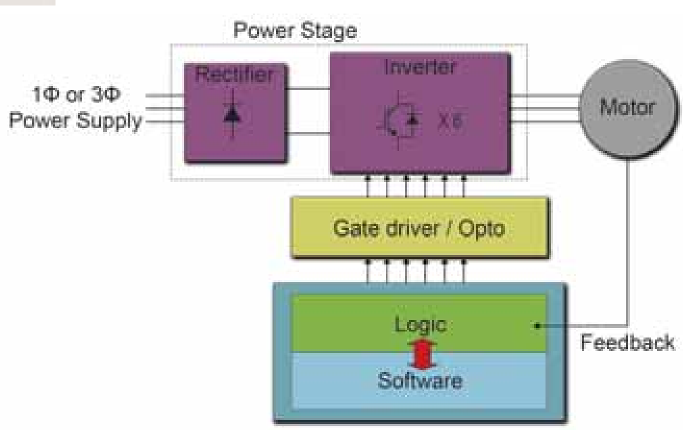


Figure 1: Block Diagram of Typical Intelligent Motor Control System

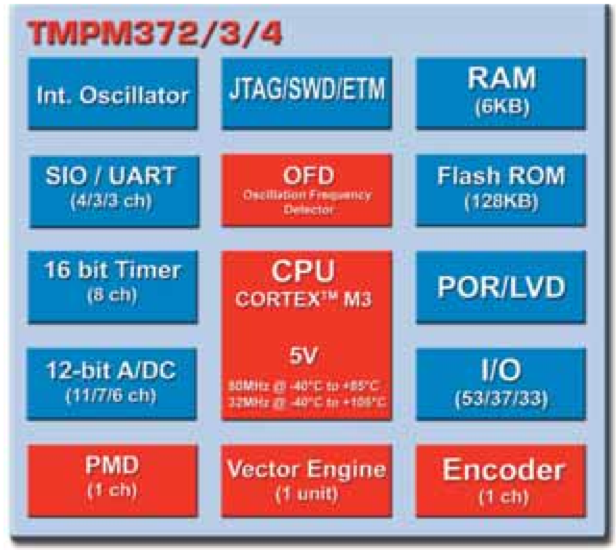


Figure 2: Motor Control Microcontroller

FOC control also places less stress on the motor, improving application reliability and impacting environmental sustainability by extending time between motor replacements.

SOFTWARE, HARDWARE, OR BOTH?

For maximum efficiency and optimum performance commutation schemes demand rapid execution of the key sensing, conversion, comparison, integration, transformation and waveform generation functions. Because traditional software implementations place significant overheads on CPUs – not to mention consuming significant resources for coding during development – there are strong arguments for implementing key functions in hardware. However, while freeing up the host processor a dedicated hardware approach can leave little room for design flexibility and limit effective re-use of proprietary IP. Now, however, a new breed of microcontrollers with dedicated motor control functions provides a 'third way' through a firmware-based approach that allows designers to choose the percentage of control managed by hardware and software.

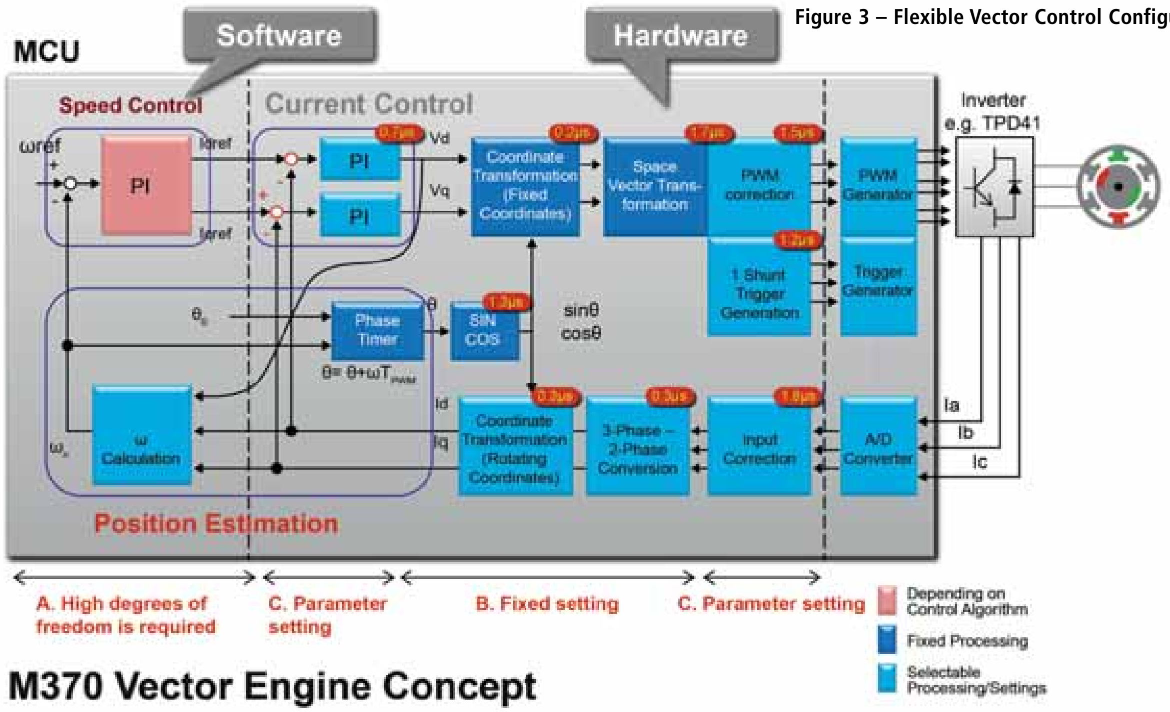
The question, therefore, moves from whether a software or hardware route is preferred to which microcontroller will do the best job. Key considerations will be performance, code efficiency and capacity to handle functions beyond the motor control, built in functionality and peripherals and compatibility with existing IP.

It should be noted that with today's dedicated motor control microcontrollers clock speed and/or MIPS ratings are not an indicator of optimum motor control performance. For FOC schemes, for instance, engineers must understand total runtime for the motor control loop, including execution time for PI control, 'Clarke and Park' transformations, position estimations and, possibly, sensor measurement.

Consider Toshiba's TMPM37x motor microcontrollers (Figure 2) for 3-phase BLDC motors which are built on an 80MHz/100MIPS ARM Cortex™-M3 core and feature dedicated FOC capabilities including PMD (Programmable Motor Drive) block and VE (Vector Engine).

The PMD block incorporates the 3-phase PWM generator, dead-time controller, protection circuit and ADC timing network. Developers can combine functions from this block with proprietary motor control IP or use

Figure 3 – Flexible Vector Control Configuration



the Vector Engine to handle some or all of the FOC control. Within the VE a scheduler for event and priority control, a calculation core and decoder, an operation unit, a MAC unit and vector control modules handle processing of the 3-phase current input from the microcontroller's ADC and perform the FOC algorithm. Using the PMD and VE together, only a few simple register settings are needed to manage all motor control functions including speed control, position estimation and 3-phase PWM generation at 16-bit resolution. Figure 3 illustrates the flexibility of this vector control configuration.

Using the VE, total runtime for the control loop is just 14μs (5μs for the position estimation and speed control calculations handled by the CPU and 9μs for FOC calculations). This is significantly faster than typical software FOC and is just 54% of the execution time of a competitive micro operating at 100MHz/165MIPS. This shorter execution time allows the motor to run at higher RPM while the slower processor clock speed demands less energy.

The superior performance and efficiency are due to the implementation of the PMD and VE blocks, not least the fact that Toshiba's approach delivers the same level of accuracy as the higher speed device without needing an FPU. In addition, at just under 4000 bytes, the code required is little more than half that of the FPU-based alternative.

BEYOND COMPONENTS

As well as device suitability, assessing the support 'eco-system' is also important. Even with dedicated hardware intelligent motor control presents significant challenges and the quality of tools and support significantly impacts ease and speed of implementation. Availability of reference designs and 'starter kits' for evaluation, prototyping and testing should be considered, as should access to third party tools. The latter is greatly helped by choosing microcontrollers with non-proprietary architectures. The ARM Cortex-M3 core mentioned earlier, for example, is a 'de-facto' industry standard and development environments from companies such as Atollic, IAR and Keil are readily available.

A recent addition to the intelligent motor control development 'toolbox' is PC-based software offering intuitive, graphical user interfaces (GUIs) for setting up and visualising motor behaviour. By helping designers optimise motor designs these software tools support deployment of more efficient designs.

As an example consider the 'Motormind' PC software illustrated in Figure 4. Working in conjunction with a suitable evaluation board, Motormind allows engineers to transfer key parameters to a target microcontroller (e.g. pole pairs, current settings, rotational information, acceleration and encoder details) and modify system settings including PI control, deadtime, PWM frequency and shutdown/start-up behaviour. Because the motor can run immediately with the new settings without software recompilation custom motor set-up is possible within an hour and values can be changed in real time as required. The software provides various views - including a speed and torque display, a 'statistics view' and a CPU load monitor – that allow designers to observe in real time how modifying various motor control parameters effects motor behaviour, MCU performance and efficiency during acceleration, operation at target speed, and deceleration. In addition an integrated μDSO capability allows designers to quickly identify and resolve bugs and problems during prototyping and testing.

**Roland Gehrmann is TEE's manager for Consumer and Industrial IC Marketing and Frank Malik is the company's engineering manager for Motor Control Solutions
Toshiba Website: www.toshiba-components.com**

Figure 4: MotorMind PC Software

I’ve Paid for Every Milliwatt

MYK DORMER IS A SENIOR RF DESIGN ENGINEER AT RADIOMETRIX LTD
WWW.RADIOMETRIX.COM

“Low power radio” is an often used term and in various places has been formally defined (see Box below), but what do we actually, practically, mean by it? How much power is “low”?

In the majority of simple European 433MHz band applications the equipment runs at the statutory 10mW (maximum) power level. In the 868MHz band different sub-bands allow 1, 5 and 10mW levels. Internationally we find a further range of 10mW (occasionally 25mW) allocations. This leads to a certain level of assumption that 10mW (or something near it) is a universal rule.

Unfortunately, matters aren’t that simple. There is a second class of longer range, higher performance allocations found throughout the world where a much higher 500mW power output level is the norm. For example: the European high power sub-band at 869.4-869.65MHz, the 458MHz industrial allocation in the UK or the 1 watt band at 865-867MHz in India.

This difference is not so much of a problem in practice, as higher and lower power units are, by their nature, intended for very different applications, and the users are well acquainted with the specific application details (provision of adequate peak power capacity, aerial locations, safety concerns).

Problems begin when the user decides that the link range “isn’t quite right” and buys an RF power meter, instead of investigating the aerials, the ambient RF noise environment or looking at the propagation path. Then it’s a quick measurement, followed by a furious complaint to the supplier that the “500mW radio is only outputting 450mW!”

The thing is: nothing is wrong in the circumstances described above. The power meter is accurate and in calibration (a good RF power meter can now be had for under £1000, and I would encourage low power radio users to invest in one), but the radio is operating well within specifications, too. The problem is with our perceptions.

> *Unfortunately, matters aren’t that simple; there is a second class of longer range, higher performance allocations found throughout the world where a much higher 500mW power output level is the norm*

In RF engineering we are accustomed to measuring power by two very different scales: simple linear “watts” (or milliwatts, microwatts or whatever) and the logarithmic “dBm” scale, where the power in dBm is 10 x log (power in mW). There is nothing strange about this “double standard”. Linear power is useful when thinking in terms of power consumption, efficiency, or thermal dissipation. Logarithmic scaling is useful when the extremely wide range of signal strengths found in radio design (often well over 150dB) have to be conveniently expressed.

Unfortunately, it’s possible to get tripped up by this linear vs logarithmic issue. For example:

10mW is 10dBm. Lose a dB of power, and that 9dBm is (about) 8mW.

8mW versus 10mW sounds like almost no difference ... 2mW isn’t much, is it?!

500mW is 27dBm. Take away a dB and we’re at 26dBm. That’s (just under) 400mW.

400mW versus 500mW feels like a hell of a difference. That fall of 100mW looks like a lot of power to go missing, but it’s still only one dB difference in this case.

In our earlier example that “450mW” power level is 26.47dBm, only 0.47dB less than 500mW.

0.47dB is not a significant difference. Receiver sensitivities vary by more than that, unit to unit. Propagation path loss will change by much more due to rain, or large vehicle movements. 0.47dB is in the same order as the absolute level accuracy of signal generators and power meters (even though resolution is better). At 450MHz, a one meter length of typical RG58C laboratory test cable has a loss of 0.47dB.

I could go on, but the point I am making is that the gut-feel reaction that low power radio users experience when measuring 500mW transmitters, compared to the far more common 10mW units, is in all likelihood wrong.

Acquire RF test equipment? Yes. Test your modules (instead of taking the makers’ claims at face value)? Definitely yes...but then ground your reactions to those tests with an appreciation of what those result figures actually mean. ●

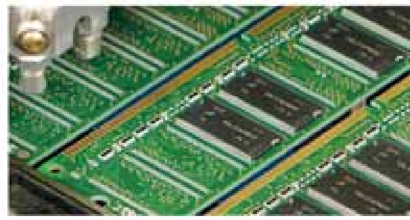
“LOW POWER” RADIO DEFINITIONS

THE COMMON EUROPEAN EN300-220 SPECIFICATION COVERS POWER LEVELS UP TO 500MW (IN CERTAIN APPROPRIATE BANDS).

Radios operating in the US 915MHz unlicensed band can use up to 1 watt (if appropriate spectrum spreading criteria are met), while their VHF MURS allocation allows 2 watts.

Amateur radio “QRP” operation is commonly taken to mean a power level of 5 watts or less, although a further category “QRPp” is taken to mean operation below 1 watt.

Micron Phase Change Memory



XJTAG programming solution helps Micron to market advanced non-volatile memories

Micron Phase Change Memory is a groundbreaking new memory technology from global semiconductor innovator Micron Technology. When perfecting it, the development team partnered with XJTAG to create a solution suitable for programming in production or in the laboratory. XJTAG drew on XJFlash, its successful Flash-programming solution, to program PCM at the highest possible speed.

Micron Phase Change Memory (PCM) is an innovative new non-volatile technology capable of matching the best read and write performance of alternatives such as NAND/NOR Flash, DRAM, and EEPROM. It has low read latency, similar to NOR Flash, and matches the read bandwidth of DRAM. The write speed is comparable to that of NAND Flash, with the added advantage that no separate erase cycle is required.

"PCM is a compelling new memory technology that combines the best attributes found in NOR, NAND and DRAM," says Jeff Bader, senior director of marketing for Micron's embedded group.

To complete development, Micron PCM's designers needed an effective solution enabling customers to program the new devices in a laboratory or at high speed on a production line. The nature of the technology called for in-system programming, because PCM chips are programmed after reflow soldering.

In-system programming is commonly used with Non-Volatile Memory (NVM) such as Flash, to boot-up and test boards during manufacture, program completed products, and apply software updates in the field. Most boundary scan test systems are able to perform in-system programming of Flash through the JTAG (IEEE 1149.1) connection.

Depending on the device types, JTAG chain length and TCK clock frequency, programming non-volatile memory using a JTAG connection can often take 60 µs or longer for a single write cycle. At this rate the programming time for a 128 Mbit Flash can be over eight minutes. Hence in-system programming via JTAG has traditionally been most effective only with very small data images.

The XJTAG boundary scan system, however, can program Flash much more quickly thanks to its unique XJFlash capability. XJFlash overcomes the bandwidth limitations of the JTAG serial interface and is able to program the chip at the practical maximum speed, provided there is an FPGA or CPU on the target board and this is connected to the JTAG chain correctly. For a comparable 128 Mbit device, XJFlash can reduce the total programming time to less than 20 seconds, with an average write-cycle time of under 2 µs.

Building on the IP contained within XJFlash, XJTAG engineers also achieved programming times better than 20 seconds for similar PCM chips. This is close to the typical programming time specified by Micron. "Because PCM is a new technology, it is imperative that we build a strong ecosystem of support to further customer adoption. We are pleased with the work XJTAG has done in building a programming solution, enabling PCM to be easily deployed in a production environment," adds Jeff Bader.

With this enhancement to the XJTAG system now adding in-system programming for Micron PCM devices, with the shortest possible programming time, engineers designing complex boards containing BGA, FPGA and NVM devices can avoid using a separate programmer and use the XJTAG system to debug, test and program their designs throughout the product lifecycle.

A white paper explaining high speed programming of non-volatile memories is available from the XJTAG website at www.xjtag.com.

opinion

Jeff Bader
Senior Director of Marketing
Micron Technology Inc.

"PCM is a compelling new memory technology that combines the best attributes found in NOR, NAND and DRAM. Because PCM is a new technology, it is imperative that we build a strong ecosystem of support to further customer adoption."

"We are pleased with the work XJTAG has done in building a programming solution, enabling PCM to be easily deployed in a production environment."

Data Bank

Micron

Company	Micron Technology, HQ USA
Nature of business	A world leading provider of advanced semiconductor solutions
Main product	Manufactures and markets a full range of DRAM, NAND and NOR flash memory, as well as other innovative memory technologies, packaging solutions and semiconductor systems
Customers	Leading-edge computing, consumer, networking, embedded and mobile product manufacturers
Locations	Boise, Idaho, USA. Facilities in the Americas, Europe, Middle East, Asia
Web site	www.micron.com

USING FLOWCODE IN GRAPHICAL EMBEDDED SYSTEM PROGRAMMING

PROFESSOR DOGAN IBRAHIM OF THE NEAR EAST UNIVERSITY IN CYPRUS DESCRIBES THE ADVANTAGES OF USING FLOWCODE AS A GRAPHICAL PROGRAMMING LANGUAGE IN EMBEDDED SYSTEM DESIGN

Traditionally microprocessor- and microcontroller-based systems were programmed using the assembly language of the target processor. This required very detailed knowledge of the internal architecture of the target processor.

Unfortunately, different manufacturers had developed processors with totally different and incompatible architectures. As a result, the assembly language program created for one processor could not run on a processor from a different manufacturer. The programmer had to learn a new assembly language if there was a need to change the processor used. This approach resulted in great loss of development time and proved costly, especially in large and complex projects.

Programming Languages

A new era started in embedded programming with the introduction of high-level languages in this field. BASIC was the first language available for embedded programming.

Although the use of BASIC has been simplified, most BASIC languages are unstructured, and this led to the development of programs which were difficult to maintain. Most programs created using BASIC included many unstructured statements such as "goto". In addition, most versions of the BASIC language are interpretive and, thus, the speed of execution is slow and not acceptable in real-time applications.

PASCAL was the next high-level language introduced for embedded programming. Although the classic PASCAL is traditionally a very powerful and structured language, it has never been accepted as a programming language for embedded systems for various reasons, such as lack of low-level bit manipulation operations for microprocessor applications. Many versions of PASCAL have been introduced to offer additional non-standard features to make the language more attractive to embedded programmers.

Most embedded systems are currently programmed using a variant of the "C" language. "C" is a highly structured programming language, offering powerful low-level bit manipulation operations needed in embedded system applications. Although the early "C" languages for

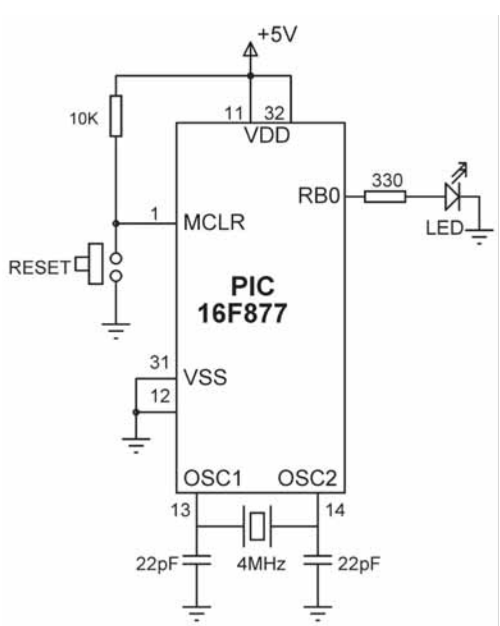


Figure 1: Circuit diagram of the project

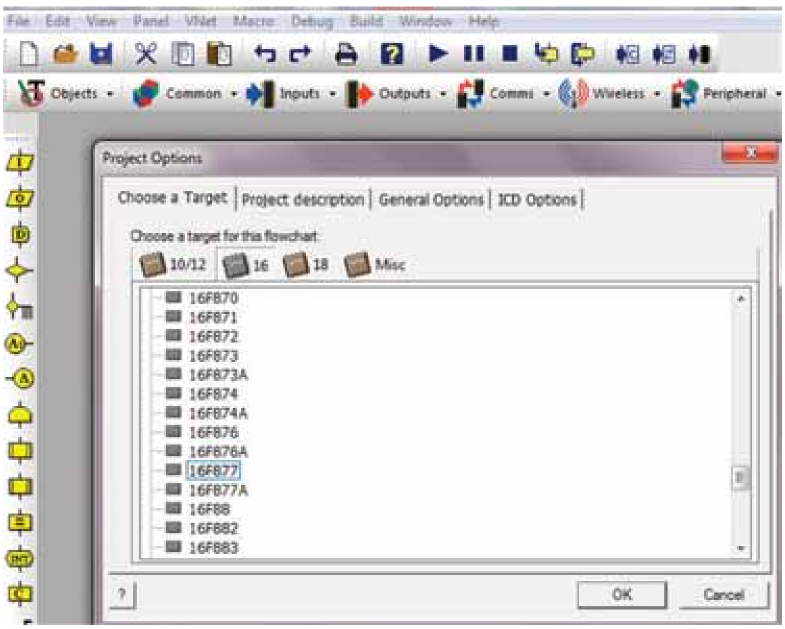


Figure 2: Select the processor type

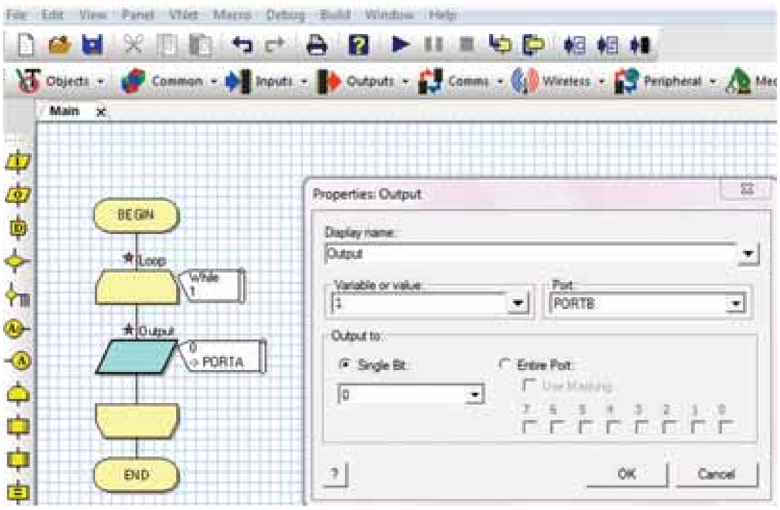


Figure 3: Insert a loop and an output pin

embedded systems were rather limited and lacked floating-point operations, currently these languages are extremely rich, offering many built-in libraries and functions for mathematical and peripheral support. Some examples of "C" languages for embedded systems are: mikroC Pro (www.mikroe.com), Hi-TECH C (www.htsoft.com), MPLAB C (www.microchip.com), CCS C (www.ccsinfo.com), and so on.

Flowcode is a graphical programming language developed mainly for embedded system programming, which can be implemented directly from the flowcharts developed during the design specification phase

Developing Embedded Systems

The development of an embedded system requires both hardware and software components. The hardware is designed and built either from the first principles or from development kits used to shorten development time. It is highly recommended that the programming process follows a top-down approach. Documents in the form of *Functional Specification*, *Design Specification* and *Test Specification* should all be prepared and accepted by all the parties involved before the actual coding process starts.

The functional specification is generally a high-level document that describes the required functionality of the system and includes topics such as input, processing and output descriptions. The design specification is a low-level document that usually describes how the various software modules fit together to form the final system.

Various design tools, such as flowcharts, Program Description Language (PDL), Unified Modeling Language (UML) and so on are used to describe the operation or the algorithm of the software in detail. The actual coding then becomes an easy task as it simply consists of implementing the algorithm as a program. The test specification should describe in detail how the overall program and its various parts should be tested.

Flowcode is a graphical programming language developed mainly for embedded system programming, which can be implemented directly from the flowcharts developed during the design specification phase. Flowcode has the great advantage that it allows those with little or no programming experience to develop complex embedded system projects using flowchart descriptions of the algorithm to be implemented. Once the flowchart is complete, Flowcode can be instructed to generate "C" code automatically, which then can be compiled and loaded to the program memory of the target processor.

This article is a short introduction to Flowcode and it describes the basic features of this graphical programming language. In addition, a simple example project is given based on the Flowcode to show how easy it is to use this tool.

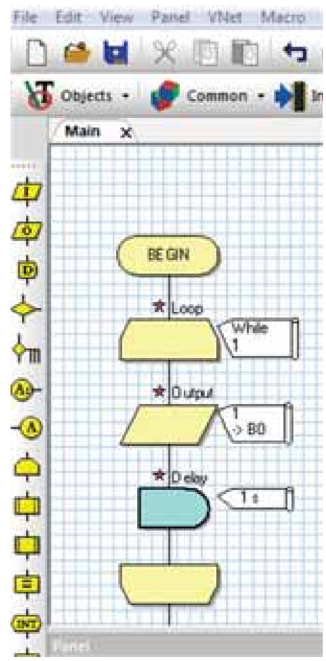


Figure 4: Insert one-second delay after turning the port pin ON

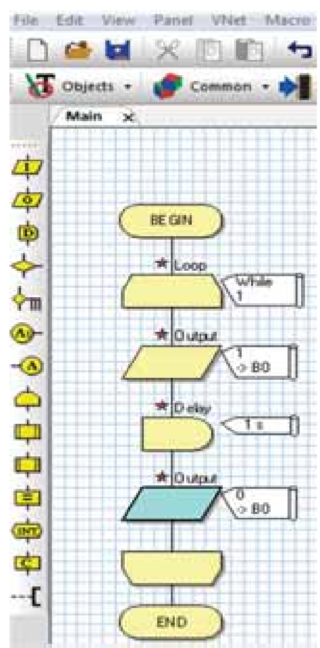


Figure 5: Insert an Output block and turn off the port pin

Flowcode

Flowcode was developed by Matrix Multimedia Ltd (www.matrixmulti-media.com) and is currently used in more than 1,200 schools, colleges and universities throughout the world in the teaching of electronics, microcontrollers, automotive technology and more.

Flowcode is also used in industry for quick design of electronic control systems. The software is available in 20 languages worldwide, supporting a wide range of microcontrollers, including the PIC microcontroller, dsPIC/PIC24, AVR/Arduino and the ARM series.

The latest release of Flowcode is version 5, offering the following features:

- Supporting communication systems such as Bluetooth, CAN, GPS, GSM, IrDA, RS232, RS485 and more.
- Supporting components such as ADC, LED, LCD, GLCD, 7-segment display, keypad, switch and more.
- Supporting automotive products such as accelerometers, rotary encoders, stepper motors, servo systems and more.
- In-Circuit debugging tools.
- Direct support for E-block hardware components.
- Support for virtual networks.
- Support for processor interrupts.

The benefits of using Flowcode can be summarized as follows:

- Quick design of microcontroller-based systems.
- Open architecture, allowing to view the generated "C" and assembler code and customize them if necessary.
- Processor independence, allowing a Flowcode developed for one type of processor to be easily transferred to another type.
- Easy program development and simulation by using the built-in icons to create an embedded system.
- 'What you see is what you get' design where the program simulated on the screen actually runs on the target processor.
- Flowcode is supported by a large amount of books, tutorials and web based courseware.

Embedded System Design with Flowcode

A typical embedded system design with Flowcode is carried out by the following steps:

- **Design**: The required program is created by using the built-in drag-and-drop icons to draw the flowchart of the required algorithm. After drawing the flowchart on the screen, Flowcode will automatically generate the "C" (and assembly) code required. This code can be viewed, edited and customized as needed.
- **Simulate**: The required components, switches or sensors can be placed on the simulation panel using the easy drag-and-drop method. The program can then be simulated either at full speed or icon by icon. Program variables and the state of various peripheral components can be observed during the simulation to verify correct operation of the program.
- **Test**: The generated program is compiled and then downloaded to the target system. The in-circuit test feature can be used to see the program working on the screen and also on the actual hardware.
- **Deploy**: The generated code is downloaded to the target system's microcontroller to test its operation together with the attached peripheral devices. This step requires a compatible microcontroller programmer device.

The flowchart created by the programmer is converted into "C" code by

> After drawing the flowchart on the screen, Flowcode will automatically generate the "C" (and assembly) code of the required application

Flowcode, using the C2C compiler. The code is then translated into a Hex machine code file using Microchip's MPASM assembler. This Hex code can then be loaded to the program memory of the target microcontroller using any third-party microcontroller programmer device or development board, such as the easyPIC7 (mikroElektronika), Pickit 3 (Microchip), ICD-U64 (Custom Computer Services) and so on.

Flowcode Licensing Options

There are several licensing options for Flowcode software. The 2K code-size-limited free version supports only PIC microcontrollers with limited icons and limited functionality. The Home version costs around £49 and offers 4K code size, supporting all types of microcontrollers (PIC/AVR/ARM), but again with limited functionality. Flowcode Pro costs around £199 and offers unlimited code size with support for all processors and with full functionality. In addition, general purpose 10- and 50-concurrent-user licenses and rental licenses are available for people involved in education. There are also various other license upgrade options.

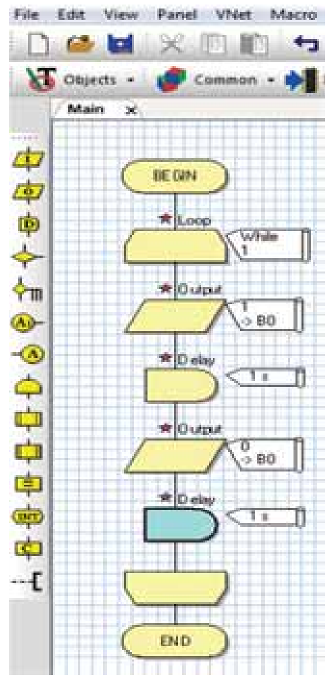


Figure 6: Insert one-second delay block after turning OFF the port pin

Example Project Using Flowcode

An example simple project is given in this section to show how Flowcode can be used to create and simulate a program. In this example, an LED is connected to port pin RB0 (bit 0 of PORT B) of a PIC16F877 microcontroller and Flowcode is used to create a flowchart of a program to flash the LED at a rate of one second, i.e. the LED turns ON and OFF at one second intervals. The circuit diagram of the project is shown in Figure 1. An LED is connected to port pin RB0 through a 330 ohm current limiting resistor. Clock pulses are provided by a 4MHz external crystal with two capacitors.

Assuming that Flowcode is already installed, the steps to create the required "C" program are given below:

1. Activate the Flowcode program and select the processor type as shown in Figure 2.
2. Use the icons on the left side to insert a loop between the BEGIN-END

blocks. Then insert an Output block inside the created loop and set the properties of this block so that logic 1 is sent to bit 0 of PORT B as shown in Figure 3.

3. Insert a Delay block after turning the port pin ON as shown in Figure 4. Set the delay property to 1 second.

4. Insert another Output block after the delay block and turn OFF the port pin, as shown in Figure 5.

5. Insert another one-second Delay-block after turning the port pin OFF, as shown in Figure 6.

6. Compile the flowchart to create the "C" code by clicking Build -> Compile to "C" from the top drop down menu. The generated "C" code can be viewed by clicking Build -> View C. Part of the generated "C" code is shown in Figure 7. This code can be optimized or modified to be compatible with the C compiler used (if C2C is not the preferred compiler).

```
//Loop
 //Loop: While 1
 while (1)
 {

 //Output
 //Output: 1 -> B0
 trisb = trisb & 0xFE;
 if ((1))
 portb = (portb & 0xFE) | 0x01;
 else
 portb = portb & 0xFE;

 //Delay
 //Delay: 1 s
 delay_s(1);

 //Output
 //Output: 0 -> B0
 trisb = trisb & 0xFE;
 if ((0))
 portb = (portb & 0xFE) | 0x01;
 else
 portb = portb & 0xFE;

 //Delay
 //Delay: 1 s
 delay_s(1);
 }
 mainendloop: goto mainendloop;
}
```

Figure 7: Part of the generated C code

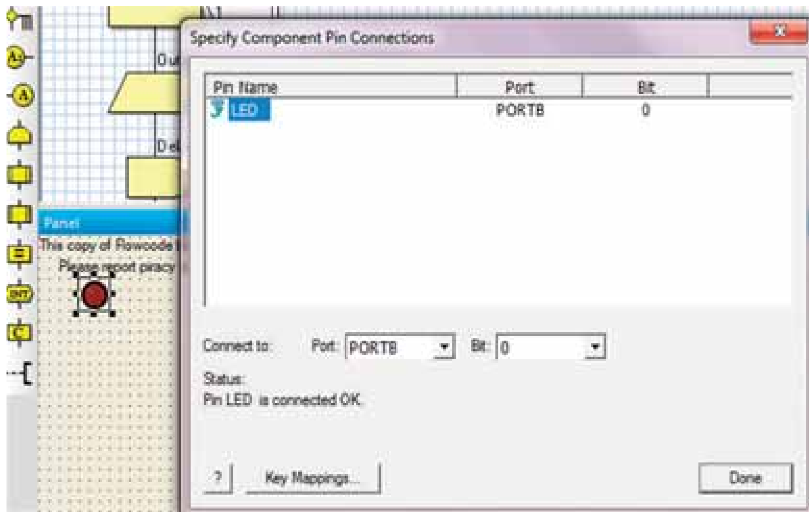


Figure 8: Set the LED connections property

It is interesting to note that the generated code is very efficient and, also, includes comments. The code can be modified if required to be compatible with the default "C" compiler used for the project. For example, in the above code the one-second delay is created by using the statement *delay_s(1)*. In mikroC Pro language however a one-second delay is created by the statement *Delay_Ms(1000)*.

Simulation

After the program is compiled successfully we can simulate the overall system using Flowcode's graphical built-in simulation tools. In addition to accessing the program variables and microcontroller registers, the simulation tools include a large number of virtual peripheral devices such as LED, LCD, GLCD, keypad, switch, stepper motor, accelerometer, GPS and more. Users can toggle switches, enter values using the keypad, output text to the LCD, draw graphs on the GLCD, read data from the accelerometer, operate the stepper motor and so on.

The steps for simulating the above project:

- Click the *Outputs* icon on the top drop-down menu and select an LED. The LED will automatically be placed on the simulation panel at the bottom of the screen.
- Right-click on the LED and set the *Connections* property to PORT B, bit 0, as shown in Figure 8. This step will connect the LED to port pin RB0 of the microcontroller.
- Click the Run icon on the top drop-down menu. You should see the LED in the simulation panel flashing as required.
- If satisfied with the simulation results, the generated Hex code can be downloaded to program memory of the target microcontroller for the final test.

Note that the project details, such as the clock frequency, simulation speed and the microcontroller internal configuration can all be changed from the *Project Options* window (accessed by clicking *Build -> Project Options* from the top drop-down menu).

This is a very simple project. The Flowcode software is a very powerful embedded system programming tool supporting many software and hardware elements such as loops, decision blocks, delays, macros, interrupts, virtual components and modules. Flowcode is excellent for those who are not front-line programmers but want to create microcontroller-based applications in relatively short time. Additionally, Flowcode provides quite powerful peripheral support and interrupt handling features which can be very useful to those starting out to learn such features from the first principles. Users can easily learn advanced programming and peripheral control concepts by creating various flowcharts using the tool and then analyzing the generated "C" code. ●

EFFICIENCY IMPROVEMENTS WITH INDUSTRIAL SERVERS

SILENT INDUSTRIAL SERVERS ARE HIGH-END PRODUCTS FOR MANY DIFFERENT MARKETS AND THEY DIFFER SIGNIFICANTLY FROM STANDARD SERVER OFFERINGS. SO WHAT DIFFERENCES CAN OEMS EXPECT TODAY, ASKS **GÜNTHER DUMSKY**, DIRECTOR OF PRODUCT MANAGEMENT AT KONTRON IN GERMANY

Industrial servers are generally characterized by their high level of data processing capacity, paired with their robust build and long-term availability. However, this type of design presents a problem as with high performance comes high power loss, and this is why a great deal of development effort has to be invested in the realization of efficient cooling infrastructures.

One result of these efforts in the past is sophisticated wind channels that circulate air through the server housing past individual hotspots. But with this type of cooling came the unwanted side effects such as higher costs and noisier systems which impeded manned operations.

Embedded hardware manufacturers have taken on the task of eliminating these undesired side effects and launched silent industrial servers, which not only meet classical industrial requirements but also guarantee near-silent operation. Developing these systems required extensive know-how to avoid noise and vibration. Such systems offered whisper-quiet 35dB and delivered a convincing performance over a long period of time. As such they are still used, even in sound studios, which is a very demanding application.

Fortunately, embedded engineers have now succeeded in making these systems even quieter. Since the first Silent Server generations had been introduced, embedded engineers have constantly tried to improve them even further, including their ergonomics, configurability and robustness.

> Swapping just the fans can quickly add up to 30 to 60 minutes of service time. What's more, while the swap is being carried out the systems are normally off-line, which means production downtimes

Little Things Can Make a Big Difference

Compared to standard servers, industrial servers often offer a whole range of detailed improvements. Take for example the system chassis: it comes with identical mechanical dimensions but with a more robust design. This has been achieved by optimizing the locking mechanism of the structural components. Customers profit from improved shock and vibration resistance which now even meet the high standards of the transportation and defence markets.

Other improvements include hot-swappability of the chassis fans, which now can be exchanged from the front, making maintenance more convenient and minimal. This also results in improved heat discharge as a result of the components being positioned more efficiently within the housing so that depending on the processor the temperature range can be extended to 0°C to +60°C.

In addition, engineers have succeeded in reducing the size of the integrated power supply; 2U industrial servers in particular profit from this. Two redundant power supplies can be stacked on top of each other to increase system availability. If this is not required, the free space can be used for additional storage media, increasing flexibility. In addition, the integrated power supplies are designed for higher performance and now fulfill the standard which certifies higher efficiency.

A further feature is that the supply voltage has been extended to meet industrial voltage ranges and now optionally supports 24 or 48VDC ex works. Not only have improvements been made inside the housing, the housing design itself has been optimized. Next to the

Figure 1: 19-inch industrial silent servers are available in different configurations

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even when the power goes off

Preserve what's most important to you

Reliable power backup for 24/7 availability

Whether DVRing your favorite show, updating your Facebook status, or playing a live network game, you depend on your home electronics every day, all day. That's why APC by Schneider Electric™ has designed battery backup solutions that protect the constant availability and connectivity you expect... and depend on.

Peace-of-mind protection on two levels

When the power goes out, our popular Back-UPS™ units go to work. They instantly switch your home technologies to emergency power, allowing you to work through brief power outages or safely shut down your systems so you won't lose valuable files—such as digital photos and media libraries. They also feature surge outlets to guard your electronics and data from 'dirty' power and damaging power surges—even lightning. So you get two levels of protection in every APC Back-UPS unit!

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Our Back-UPS units protect your home office, digital living and home media applications, notebook computers, DVRs, and gaming application. And since we now offer energy-efficient models that reduce electricity costs through unique power-saving outlets, you can realize true energy savings regardless of the applications you're backing up. Throughout your home, the APC Back-UPS is the cost-saving insurance you need to stay up and running and reliably safeguarded from both unpredictable power and wasteful energy drains.

Keep your electronics up and your energy use down!

ES Series

The ever-popular ES models are priced affordably yet provide enough extended runtime to allow you to work through short and medium power outages. Some power-saving models have been designed to actively reduce energy costs.

The energy-efficient ES Series

The new ES boasts innovative power-saving outlets, which automatically shut off power to unused devices when your electronics are turned off or asleep, eliminating wasteful electricity drains.

BE 700G-UK

- 8 outlets • 405 watts / 700 VA
- Up to 80 minutes runtime
- Telephone/network protection

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Figure 2: The component layout facilitates obstacle-free air circulation for efficient and quiet system cooling

standard version with IP20 protection, as an option the housing is available with IP52 protection, which makes it more resistant to dust and water.

Condition Monitoring Improves Availability

To further enhance the availability, some industrial servers come with condition-monitoring tools that can alert service personnel to an impending failure of the fan. As such, a swap can be pre-empted or performed ‘on demand’ during operation, eliminating the risk of the systems turning themselves off. By using its own API, such a continuous monitoring system can directly access the respective status parameters of the boards, systems and servers and deliver service technicians status data as parametrizable alarm events via SMS, SNMP, e-mail or on-site as acoustic and/or optical signals.

These are just a few of the improvements to recent industrial server generations which continue to offer established features such as extensive modularity and great scalability in terms of performance, peripheral attachment and chassis size. However, all these features can be useless if there is no long-term availability support installed. Thus, the major service that differentiates standard servers from industrial servers is the ability of a vendor to offer long-term availability support with lifecycle management – not only for serial products but also for individual customer configurations.

This holds true for any necessary upgrades and patches, even if components have been replaced during the lifecycle. The result is an all-inclusive, carefree package for customers, which not only covers the development and configuration phase but accompanies the product throughout its lifecycle, minimizing customer involvement. ●

HOT-SWAPPING FOR HARSH ENVIRONMENTS

INDUSTRIAL SERVER CONFIGURATIONS DIFFER FROM STANDARD SERVERS IN SEVERAL WAYS. ONE EXAMPLE IS THAT THE FANS ARE EASILY ACCESSIBLE FROM THE FRONT AND CAN BE SWAPPED WHILE THE SYSTEM IS UP AND RUNNING (HOT-SWAP). If any maintenance is required, precious service time and costs can be saved thanks to this new design; as swapping standard fans in a 19-inch server means that the server first has to be shut down, cables have to be removed from the back so the chassis can be pulled out of the rack and opened. So swapping just the fans can quickly add up to 30 to 60 minutes of service time. What’s more, while the swap is being carried out the systems are normally off-line, which means production downtimes.

Accessing and swapping the fans from the front – while the system is still up and running – takes roughly two minutes and due to this the availability of servers can be increased significantly. This is an especially important feature for applications in harsh environmental conditions where six-monthly or yearly maintenance intervals are the norm – even when ultra-robust industrial fans are deployed. So within its lifecycle of over five years, the total cost of ownership can quickly be reduced by anything up to a four-figured amount, which pays off very quickly in comparison to other systems.

PRECISION SIGNAL VIEWING

The need for seeing additional current and voltage detail is increasing. Many scope users want better ability to see small signal changes on a large signal (high dynamic range measurements). Power rails, biomedical technology developed to interact with human physiology, high-energy physics experiments that produce small pulses, and mobile devices where power consumption in sleep mode is critical, drive the need to see signal detail as small as just a few millivolt or milliamps.

Viewing signal detail of this amplitude can be challenging due to resolution levels and noise. Traditionally scopes have been designed with 8 bits of resolution that yield 256 quantization levels (28). This limits the smallest vertical resolution to full scale divided by 256. Seeing changes less than amount is impossible. In addition, signals coming into the scope include front-end noise that is added to the signal with the result stored to the scope's memory. This noise masks signal detail making it impossible to see changes that are smaller than the scope's noise. Need precision signal viewing? Consider one or more of the following to help you see additional signal detail.

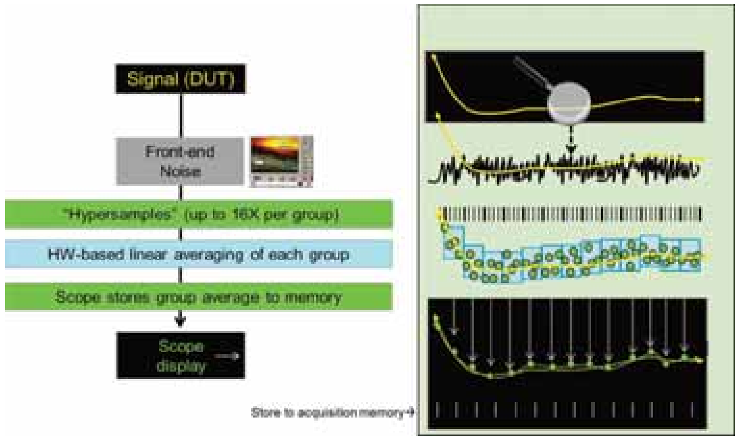


Figure 1: High-res mode enables better viewing of signal detail. Agilent's Infiniium 9000 H uses as version of this called hypersampling to achieve up to 12 bits of resolution with 3 times less noise than 8-bits of equivalent bandwidth. The scopes use an ADC that continually oversamples while hardware averages groups of hypersamples to reduce overall noise before samples are stored to memory. The result? The ability to see vertical signal detail 8-bit scopes don't show.

GET A SCOPE WITH 12 BITS OF RESOLUTION

Several oscilloscope vendors now offer scopes with 12-bits of resolution and range in bandwidth from 250 MHz up to 2 GHz. For a scope set to a full scale vertical value of 800 mV for example, an 8-bit scope will achieve a resolution of 3mV while a scope with 12 bits of yield resolution 195 uV. The increased resolution enables the oscilloscope to more precisely plot signal detail.

As scope vendors increase resolution levels, they also need to reduce noise in order to allow the scope to take advantage of the additional resolution. Today's scopes with 12-bits of resolution deliver roughly three times lower than 8-bit scopes of equivalent bandwidth.

PUT YOUR SCOPE IN HIGH-RES MODE

High-res mode causes the scope to oversample and digitally filter the output of the ADC to achieve more bits of resolution. Perhaps the most important attribute of high-res mode is its ability to reduce overall scope noise. For this reason, some scope vendors now have scopes natively locked into high-res mode to achieve higher bits of resolution and lower noise. Agilent's Infiniium 9000 H-Series uses an ADC that samples dramatically faster than would be needed for scopes with bandwidths offered by the series. The company calls this technique hypersampling. Each group of hypersamples is averaged and stored to acquisition memory. As hypersampling runs much faster than the needed sample rate, this technique allows the scope to achieve up to 12-bits of resolution with 3 times lower noise than 8-bit oscilloscopes of equivalent bandwidth

USE PROBES WITH HIGHER DYNAMIC RANGE

Probes and cables add another dimension to viewing small signals. Active probes typically use the 50 Ω signal paths for scope channels and these paths have slightly lower noise than their 1 MΩ signal path counterparts. New probe technology goes further to enable precision viewing of small currents. As an example, Agilent N2820A current probe lets users see current down to 50 uA. It achieves this result by an architecture that uses sense resistor technology with 2 gain paths from the probe's amplifier. One path shows the normal current view a user would see while the othercircuit clamps around a small vertical area and enables the scope to use its full vertical range on a small clamped zoom area.

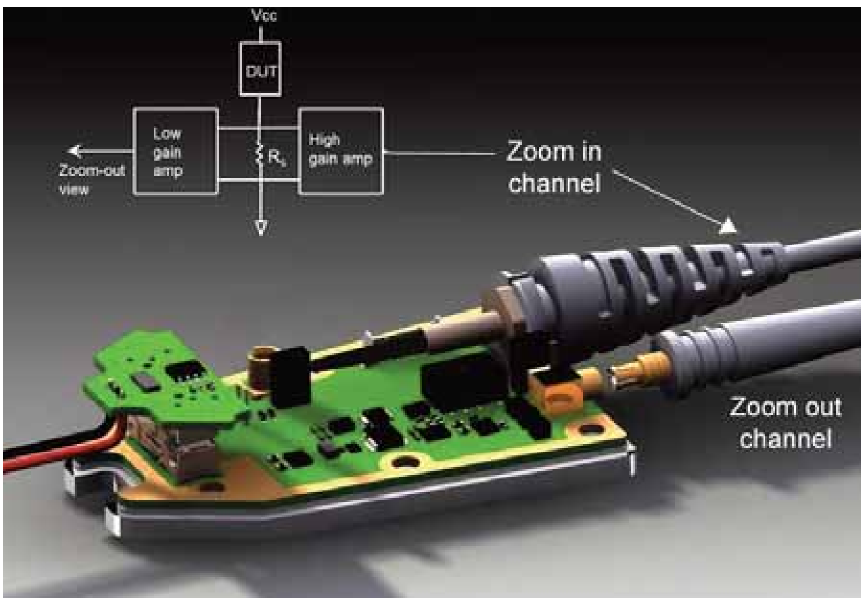


Figure 2. Your probe can assist in seeing additional signal detail. For example, Agilent's N2870A current probe uses sense resistor technology to increase measurement accuracy. The probe's amplifies uses a high-gain path to give the user a "zoomed-in" view on one scope channel, while a "zoomed-out" scope channel connects to a low-gain path. This approach produced the world's most sensitive current probe with the ability to see currents as low as 50 uA.

DESIGNING LOW NOISE PRE-AMPLIFIERS

MAURIZIO DI PAOLO EMILIO AND ALESSANDRO MORGIA PRESENT THE DESIGN OF A LOW-NOISE PREAMPLIFIER FOR ELECTRONIC APPLICATIONS

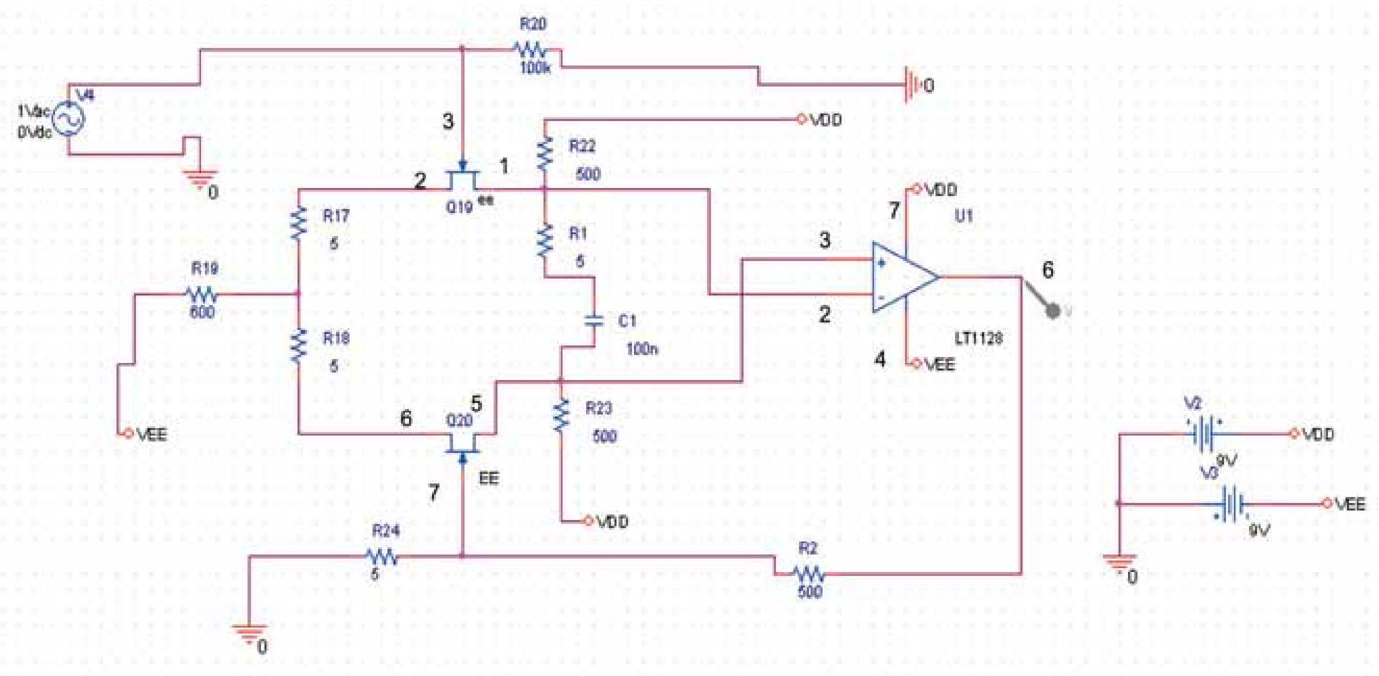


Figure 1: Low noise pre-amplifier

A low-noise amplifier (LNA) is an electronic amplifier used to amplify very weak analog signals, such as signals captured by an antenna. The LNA normally is close to the detection device to reduce losses in the feedline. This active antenna arrangement is frequently used in microwave systems like GPS, as coaxial cable feedlines are very lossy at microwave frequencies; for example a loss of 10% in a few meters of cable would cause 10% degradation in the signal-to-noise ratio (SNR).

In this article we propose a simple pre-amplifier with background noise of 0.8nV/√Hz @ 1kHz. Its circuit diagram is shown in Figure 1. The main components are LT1128 from Linear Technology and JFET IF3602 from InterFET Corporation.

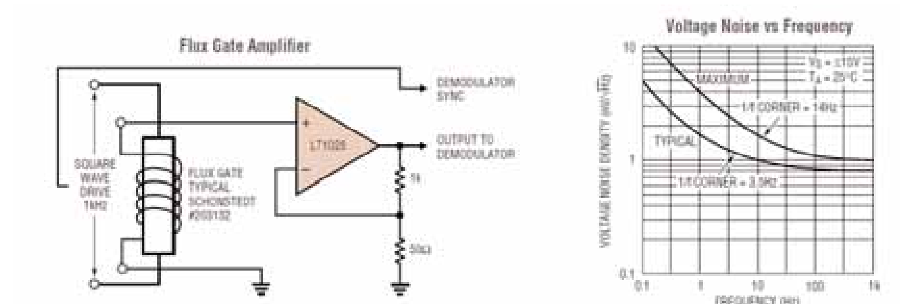


Figure 2: Voltage noise LT1128

LT1128 and IF3602

LT1128 (see Figures 2 and 3) is an operational amplifier with the following main characteristics:

- Noise voltage: 0.85nV/√Hz @ 1kHz
- Bandwidth: 13MHz
- Slew Rate: 5V/uS
- Offset Voltage: 40uV.

The IF3602 (see Figure 4) is a dual-N JFET used as the input stage for the operational amplifier. The JFET is a field effect transistor (FET), considered as the 'middle ground' between the bipolar junction transistor (BJT) and the MOSFET.

The operational amplifier is one of the most commonly used linear ICs. Thanks to large scale production its price has dropped to very low levels, making it convenient to use in almost every possible application.

An operational amplifier ("op-amp") is a DC-coupled high-gain electronic voltage

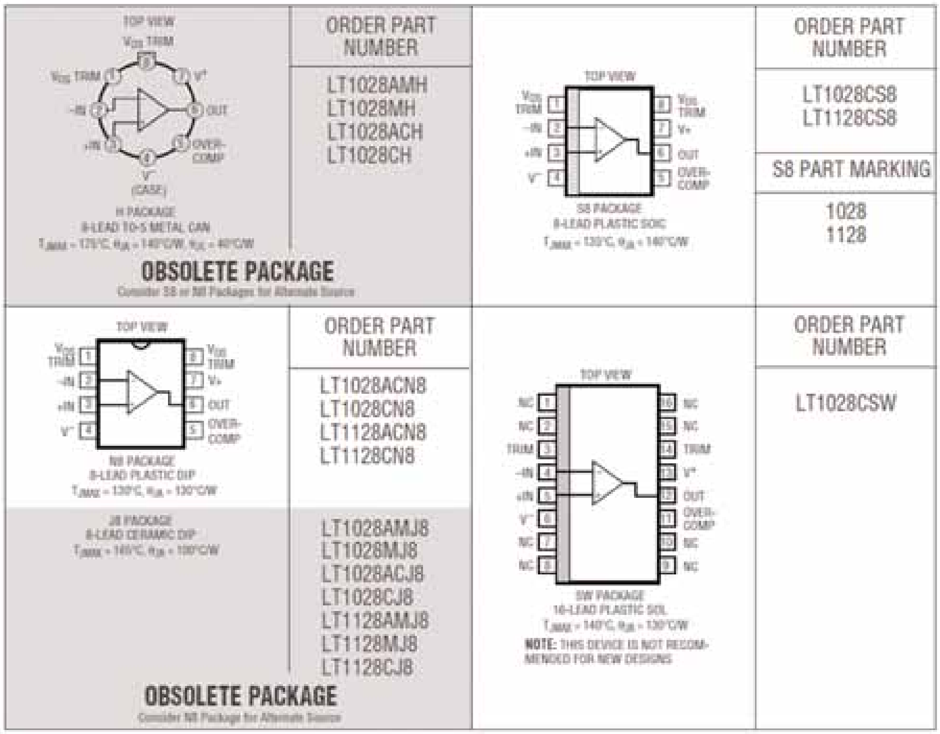


Figure 3: LT1128's pinouts

amplifier with a differential input and, usually, a single-ended output. An op-amp produces an output voltage that is typically hundreds or thousands times larger than the voltage difference between its input terminals.

The op-amp is a type of differential amplifier (Figure 5). Other types include the fully differential amplifier, which is similar to the op-amp but with two outputs; the instrumentation amplifier is usually built from three op-amps; the isolation amplifier is similar to the instrumentation amplifier, but with tolerance to common-mode voltages that would destroy an ordinary op-amp; and the negative feedback amplifier, usually built from one or more op-amps and a resistive feedback network.

The amplifier's differential inputs consist of a +V input and a -V input, and ideally the op-amp amplifies only the difference in voltage between the two, which is the differential input voltage.

An operational amplifier can be realized with bipolar junction transistors (BJT, as in the case of the LT1128) or a MOSFET, which work at higher frequencies, with a higher input impedance and lower energy consumption.

Differential Circuit

The differential structure is used mainly where it is necessary to amplify the difference of two signals, eliminating the undesired components common to the two inputs. In this way, eventual DC components superimposed on the input signal such as, for example, thermal drift can be eliminated at the output. The block diagram of a differential amplifier is shown in Figure 6.

We can define differential gain as $A_d = A_2 - A_1$ and gain common-mode as $A_c = A_1 + A_2/2$. An important parameter is the Common Mode Rejection Ratio (CMRR), used to measure the performance of the differential amplifier. It is defined as the ratio between the voltage gain of differential mode and the voltage gain of the common mode.

The suggested differential circuit is shown in Figure 7. In this case the gain of the common mode is about $R_D/2R_1+R_s+r_s$, whereas that of the differential mode is about R_d/R_s+r_s.

At 25°C free air temperature:		IF3602			Process NJ3600L	
Static Electrical Characteristics		Min	Max	Unit	Test Conditions	
Gate Source Breakdown Voltage	$V_{(BR)GSS}$	– 20		V	$I_G = -1\ \mu A$, $V_{DS} = 0V$	
Gate Reverse Current	I_{GSS}		– 0.5	nA	$V_{GS} = -10V$, $V_{DS} = 0V$	
Gate Source Cutoff Voltage	$V_{GS(OFF)}$	– 0.35	– 3	V	$V_{DS} = 10V$, $I_D = 0.5\ nA$	
Drain Saturation Current (Pulsed)	I_{DSS}	30		mA	$V_{DS} = 10V$, $V_{GS} = 0V$	
Dynamic Electrical Characteristics		Typ				
Common Source Forward Transconductance	g_{fs}	750		mS	$V_{DS} = 10V$, $V_{GS} = 0V$	f = 1 kHz
Common Source Input Capacitance	C_{iss}	300		pF	$V_{DS} = 0V$, $V_{GS} = -4V$	f = 1 MHz
Common Source Reverse Transfer Capacitance	C_{rss}	200		pF	$V_{DS} = 0V$, $V_{GS} = -4V$	f = 1 MHz
Equivalent Short Circuit Input Noise Voltage	e_N	0.3		nV/√Hz	$V_{DG} = 3V$, $I_D = 5\ mA$	f = 100 Hz
		Max				
Differential Gate Source Voltage	$\lvert V_{GS1} - V_{GS2} \rvert$	100		mV	$V_{DS} = 10V$, $V_{GS} = 0V$	

Figure 4: IF3602

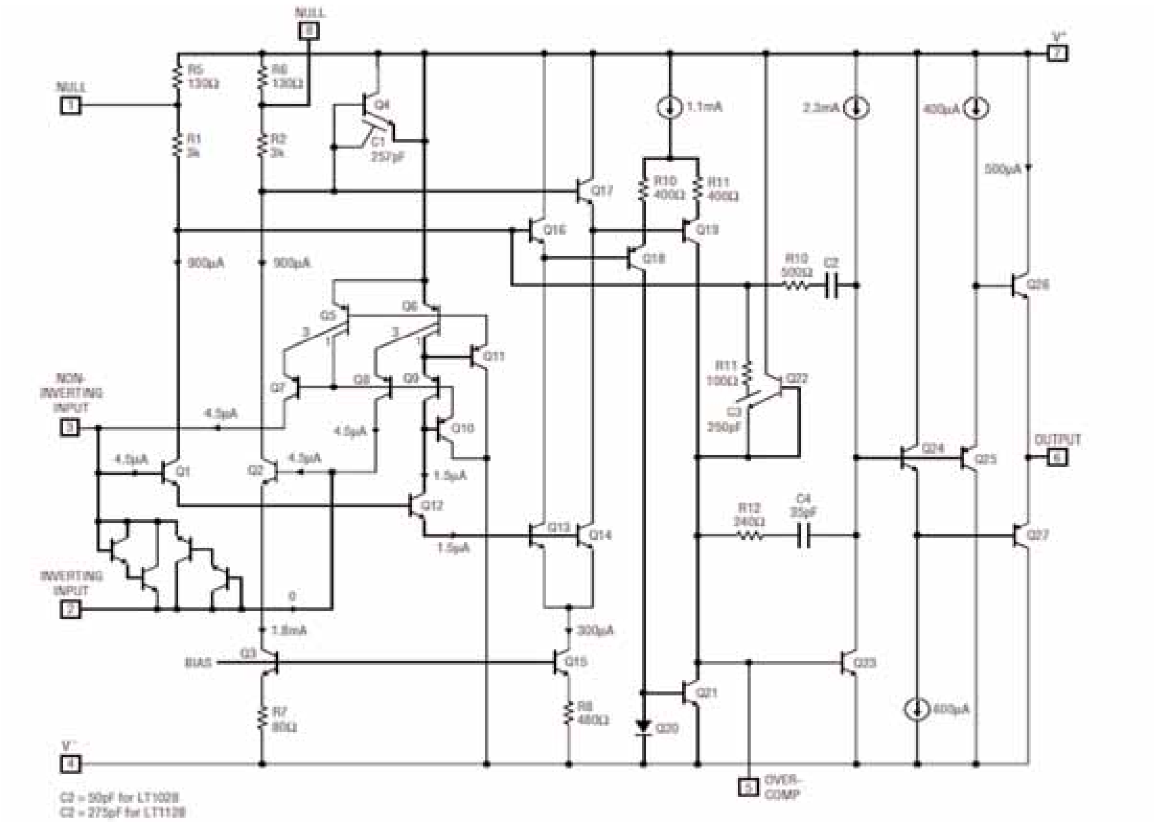


Figure 5: The internal structure of the LT1128

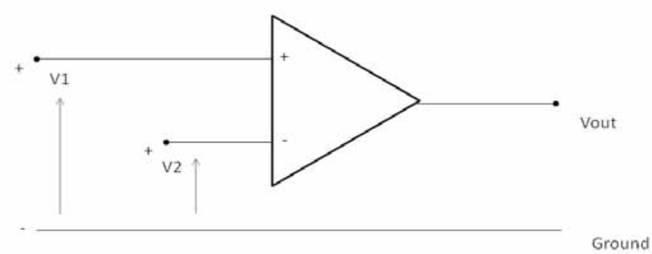


Figure 6: Differential amplifier

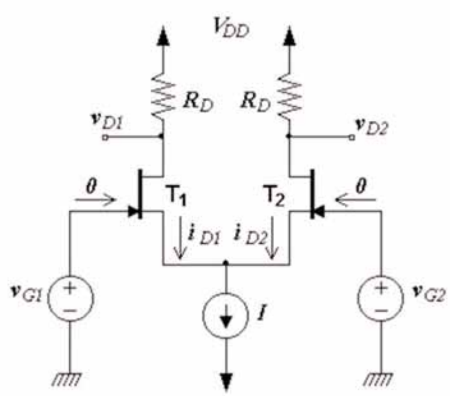


Figure 7: Differential circuit (JFET)

Circuit Analysis

We've analyzed the circuit in Figure 1 with a P-spice simulator. We separately considered two main approaches:

- The network R1-C1;
- The network of the feedback resistor.

The feedback resistor has been regulated to obtain a gain of about 100. The maximum gain that the circuit can achieve is about 200. It is not recommended to use a potentiometer for adjusting the gain as it introduces noise to the system (see Figure 10).

The R1-C1 setup can be used for adjusting the bandwidth of the system. Using varying values for R1 and a fixed capacitance of 10nF for C1 produces a series of frequency response curves (see Figure 8). Similar tests are performed with R1 fixed at 10 ohms, and varying the value of C1 (Figure 9). This makes the system very flexible; see the frequency responses in Figures 11-13. The response curve of the system as function of the noise is shown in Figure 10.

The amplifier has some inherent noise (due to current and voltage) which is by nature random, aperiodic and uncorrelated and typically has Gaussian distribution. Gaussian distribution is also called normal distribution, and is considered the most prominent probability distribution in statistics.

In Figure 14 we suggest the PCB layout of a circuit that uses SMD components for the mini pre-amplifier.

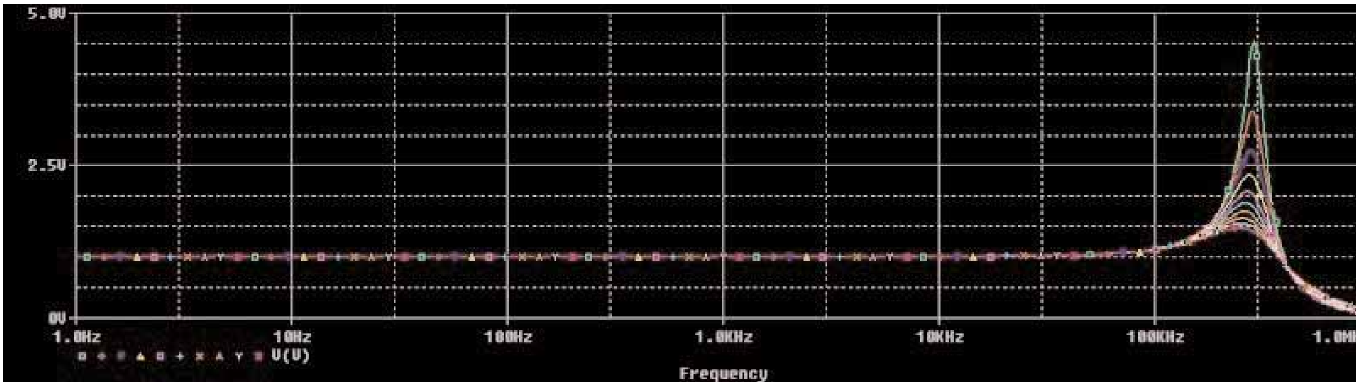


Figure 8: Frequency response: R1 variable and C1 fixed

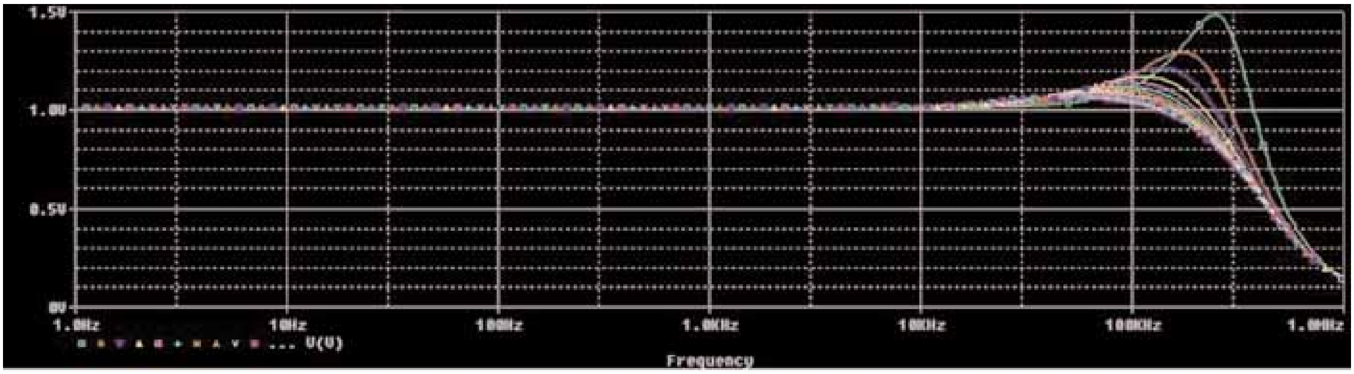


Figure 9: Frequency response: fixed R1 and variable C1

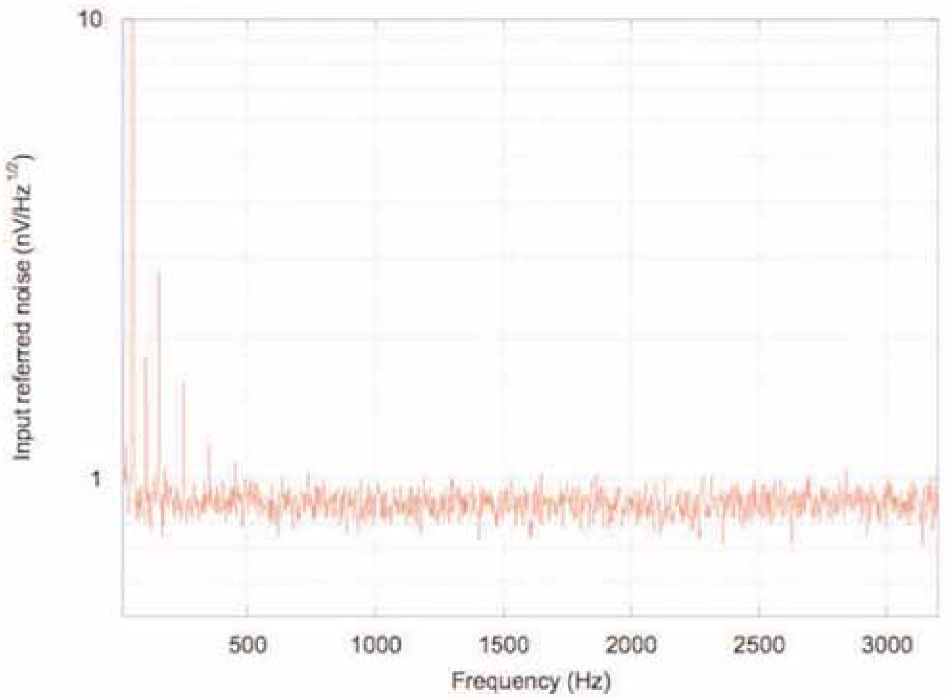


Figure 10: System noise

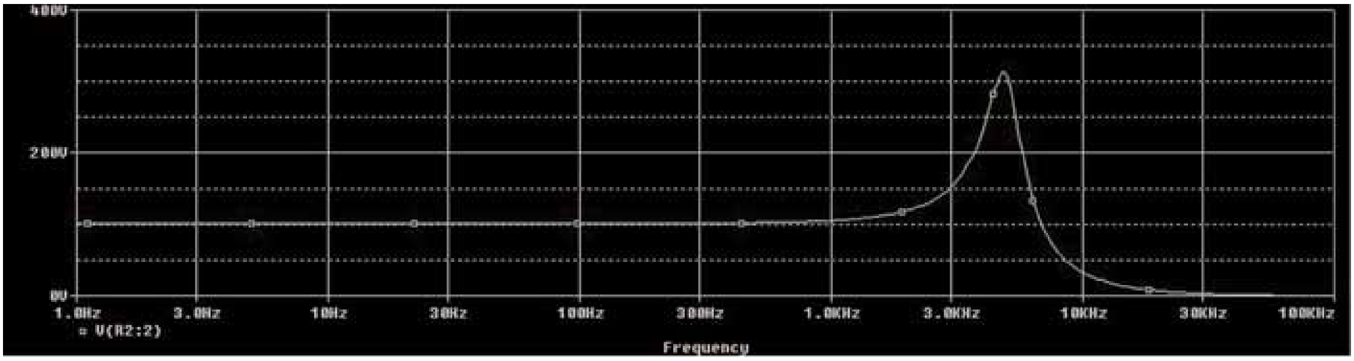


Figure 11: Frequency response: R1 = 15Ω, C1 = 100nF (G = 100)

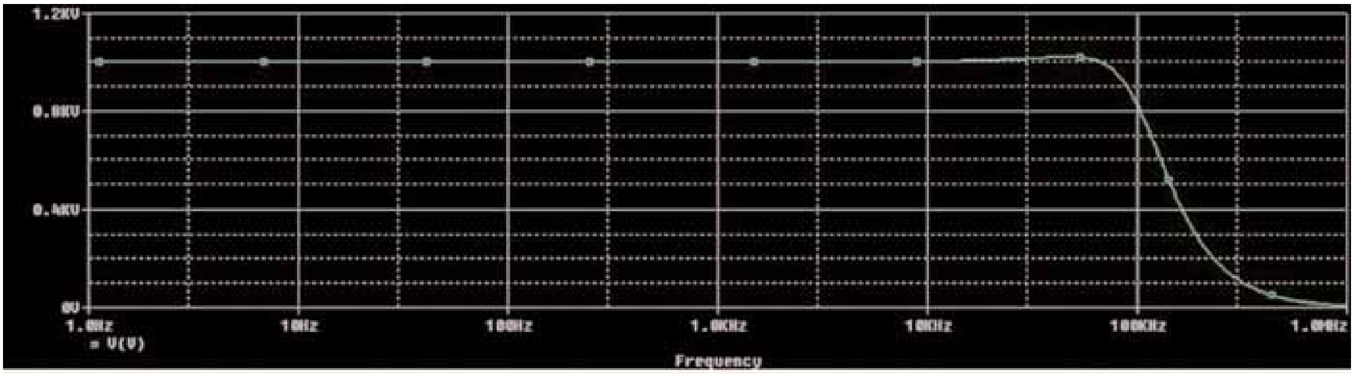


Figure 12: Frequency response: R1 = 100Ω, C1 = 10nF (G = 100)

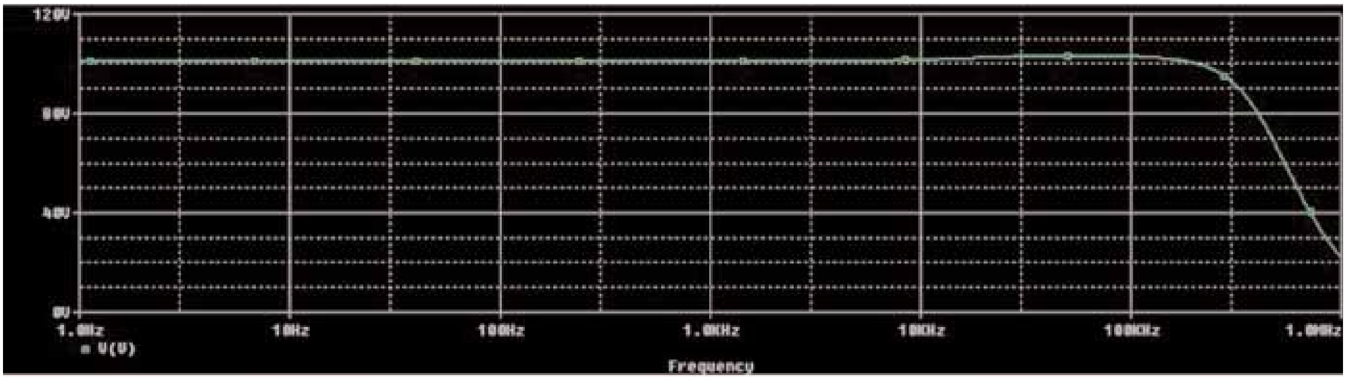


Figure 13: Frequency response: R1 = 1kΩ, C1 = 10nF (G = 100)

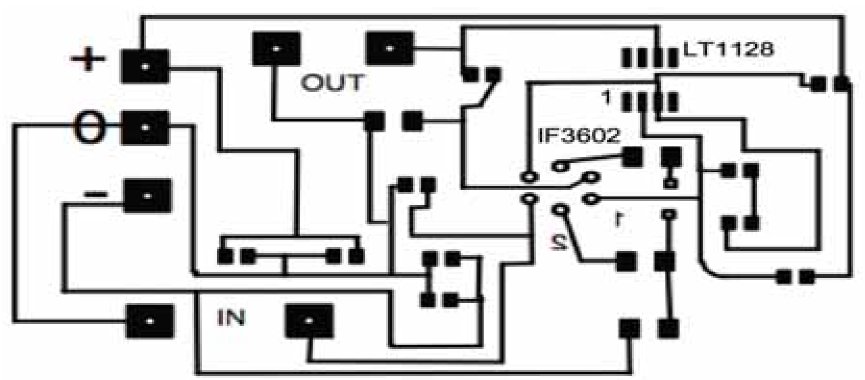


Figure 14: PCB

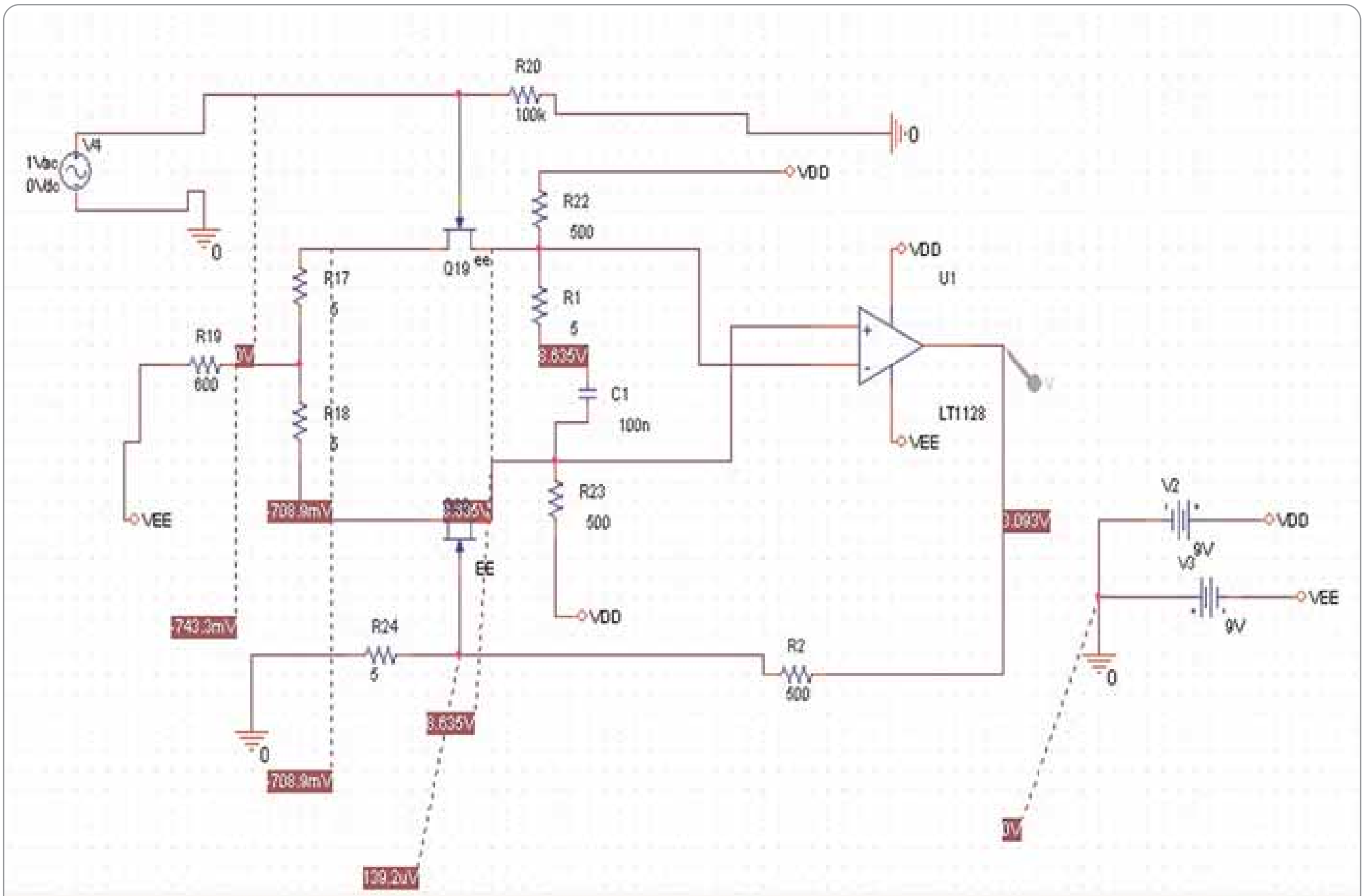


Figure 15: Simulation of the circuit: values of voltages and currents

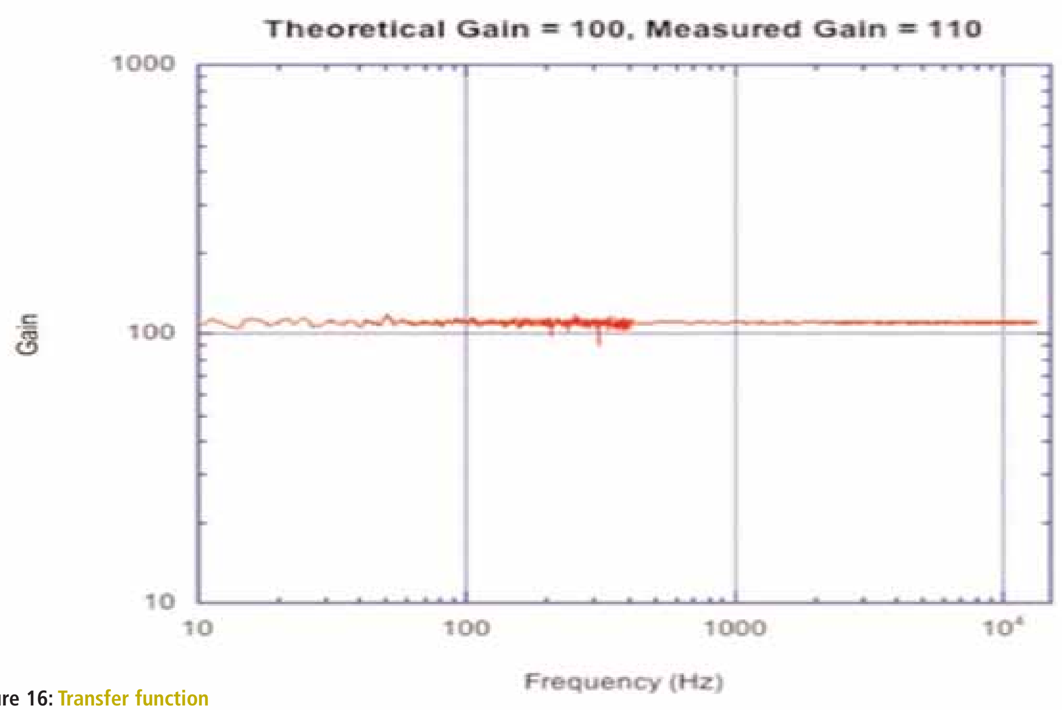


Figure 16: Transfer function

AUDIO AMPLIFIER DESIGN FUNDAMENTALS

WANGERI HARRISON KAGUONGO OF JOMO KENYATTA UNIVERSITY OF AGRICULTURE AND TECHNOLOGY IN NAIROBI, KENYA, EXPLAINS A DESIGN TECHNIQUE FOR AN AUDIO AMPLIFIER TO DELIVER THE REQUIRED CURRENT AT ANY VOLUME LEVEL BEFORE CLIPPING AT LOADS OF LESS THAN 2Ω

Some audio amplifiers distort the sound significantly once you crank up the volume. There are many reasons for this, including inadequate power supply and poor output stages. The focus of this article is on designing good audio amplifiers with near-rail-to-rail low distortion signal swing.

It is well known that the current gain of a transistor varies with the current flowing through it and the voltage across it. Thus when using transistors in an amplifier design one must consider the current gains at all volume levels.

The designs presented here try to be as simple as possible while optimizing best overall performance. The transfer and operational properties of transistors have necessitated the use of negative feedback to provide load and signal level independent performance. The power supply voltage for the main amplifier is ±40VDC.

Preamplifier

Figure 1 depicts the preamplifier, which is op-amp based; any op-amp of choice can be used. The power supply can be either regulated (preferred) or unregulated.

The volume control is provided so the preamplifier can be run at higher levels if necessary, to overcome environmental noises such as RF interference and interconnecting cable artefacts.

The op-amp X2 ensures that we still have the current capability to properly drive a transistor-based input stage for the main audio amplifier without its base current distorting the input signal.

Input Stage

Figure 2 shows the input stage, incorporating the current source Q5. The bias current is 2.3mA, suitable for most input voltage levels and differential input transistor current gains. Bias current is held constant by voltage reference D15. This reduces distortion, especially for an unregulated power supply.

The input stage also includes the differential amplifier Q1, Q2. It features emitter degeneration for a more linear response taking into account switching delays and back emf.

C3 is strategically placed to ensure that the amplifier rejects as much noise as possible. R4 and R5 set the gain; C1 provides high frequency feedback; R28 protects the preamplifier from oscillation; and C13 and C2 ensure that only AC gets amplified. The values of R29 and R4 can be selected in consideration of differential amplifier base currents, the amplifier rail-to-rail voltage swing and Johnson–Nyquist noise.

This input stage is optimized so the differential amplifier base currents have minimal effect on the input and feedback signals, further reducing distortion.

Voltage Amplification And VBE Multiplier

Figure 3 is the voltage gain stage, featuring a current source Q14 that supplies 6.9mA. This current should be around four times the base current required by the output stage at maximum voltage output and current to allow near-rail positive voltage swings without causing differential

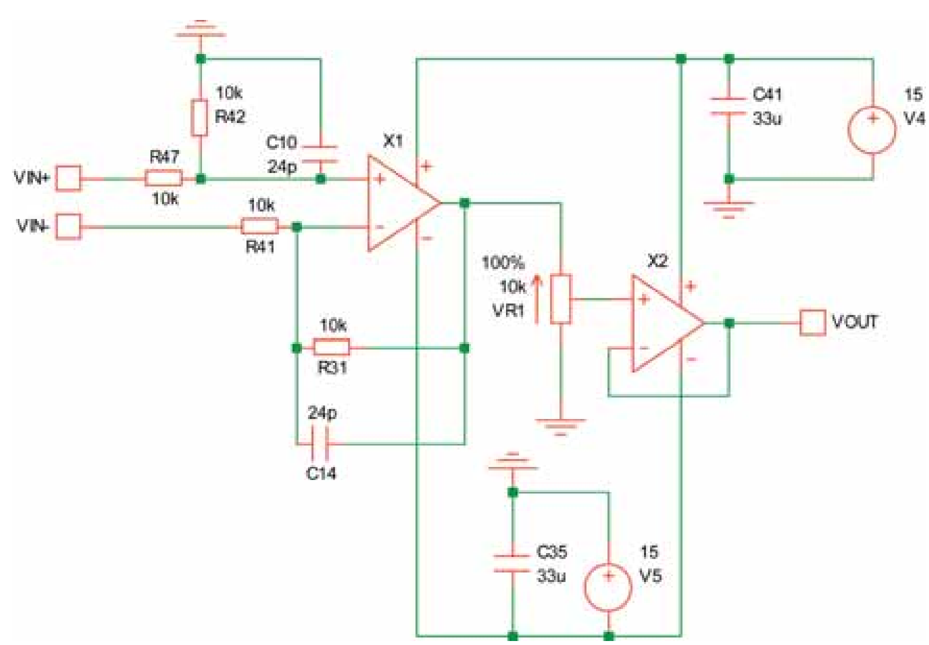


Figure 1: Preamplifier circuit

amplifier and VAS switch-off.

The resistors for the VBE multiplier Q18 are optimized for the current flowing across it. C4 and C9 provide high frequency stability. Q6 must be able to sink enough current to allow near-rail negative voltage swings while not switching off differential amplifier and VAS. Q6 is MPSW42.

> The amplifier measures up well and will deliver the required current at any volume level before clipping, at loads of less than ohms

However, as the voltage swings approach either rail, the current gain of the current source and the current sink will be reduced and this will affect how far that rail-to-rail swing can go. Q18 may be installed on a heat sink to provide thermal current tracking.

Output Stage

Figure 4 is the output stage. It is a three-stage emitter follower for class B operation. Bias current was set at 50mA per output device. The amplifier schematic can be seen in Figure 5.

The simulated THD into 2-ohm load at 1 Watt is as follows:

20kHz	**0.03%**
1kHz	**0.01%**
100Hz	**0.009%**
20Hz	**0.01%**

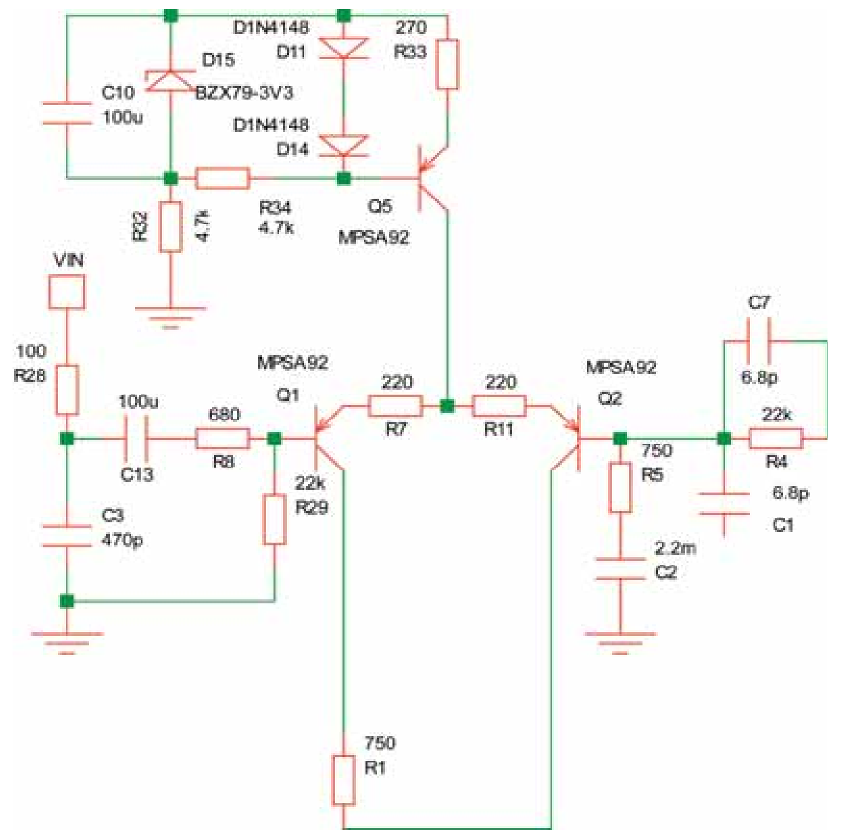


Figure 2: Input stage

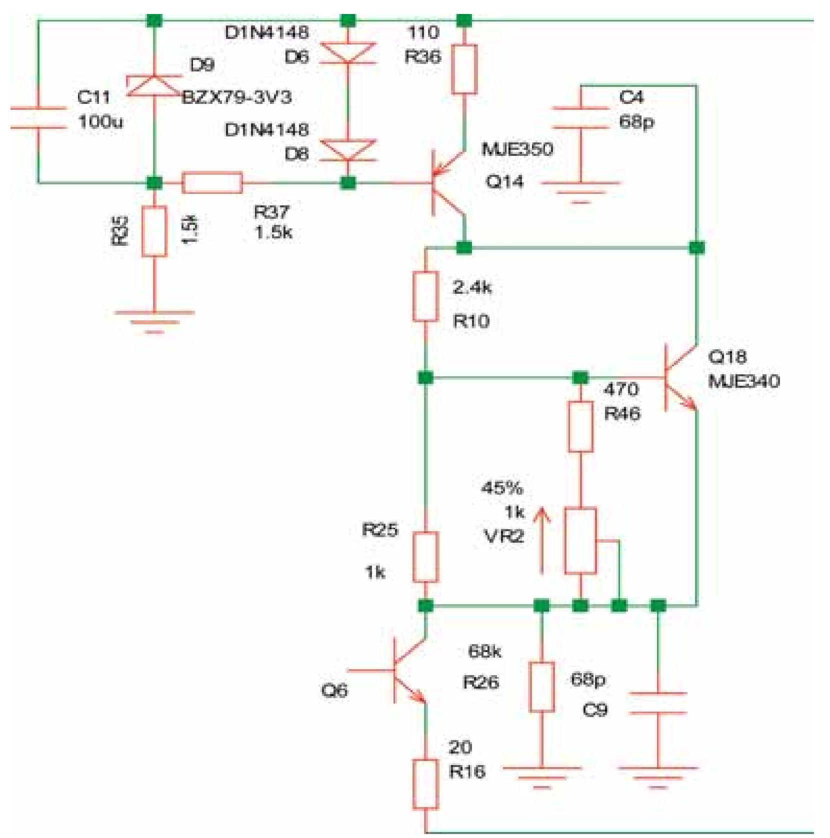


Figure 3: Voltage gain

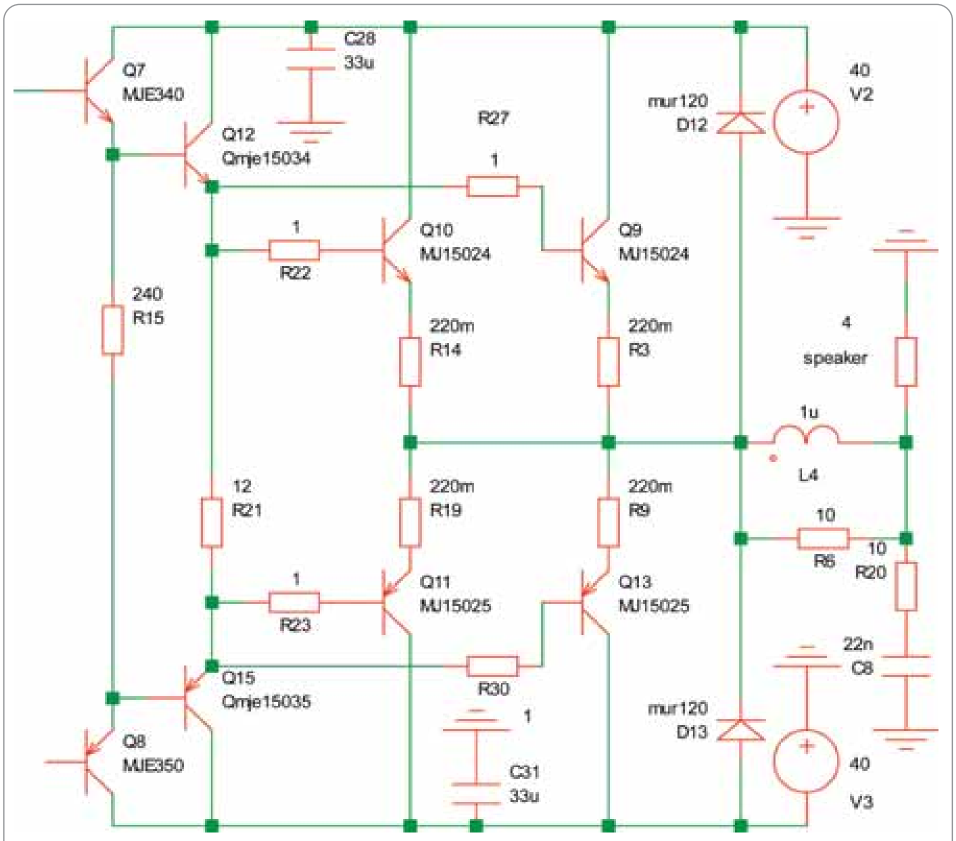


Figure 4: Output stage

Figure 6 shows a basic unregulated power supply – a 35A rectifier bridge will do. The required DC voltage is ±40V. If the mains AC power supply is RF rich, then a mains-rated 10nF capacitor should be placed across the transformer primary.

Results

Software simulation was done using SIMetrix/SIMPLIS and NI Multisim 11. The simulated results for the main amplifier are as provided in Figures 7-9 for a 4Ω load. The amplifier output devices were biased at 50mA.

C2 in Figure 5 can be scaled down to reduce the phase shift in Figure 7 towards direct current (DC) as well as the increased noise in Figure 8 towards DC.

The amplifier measures up well and will deliver the required current at any volume level before clipping at loads of less than 2Ω. This amplifier clips near the rail and thus provides the maximum power possible with the provided power supply. ●

Diagrams continue over the next few pages.

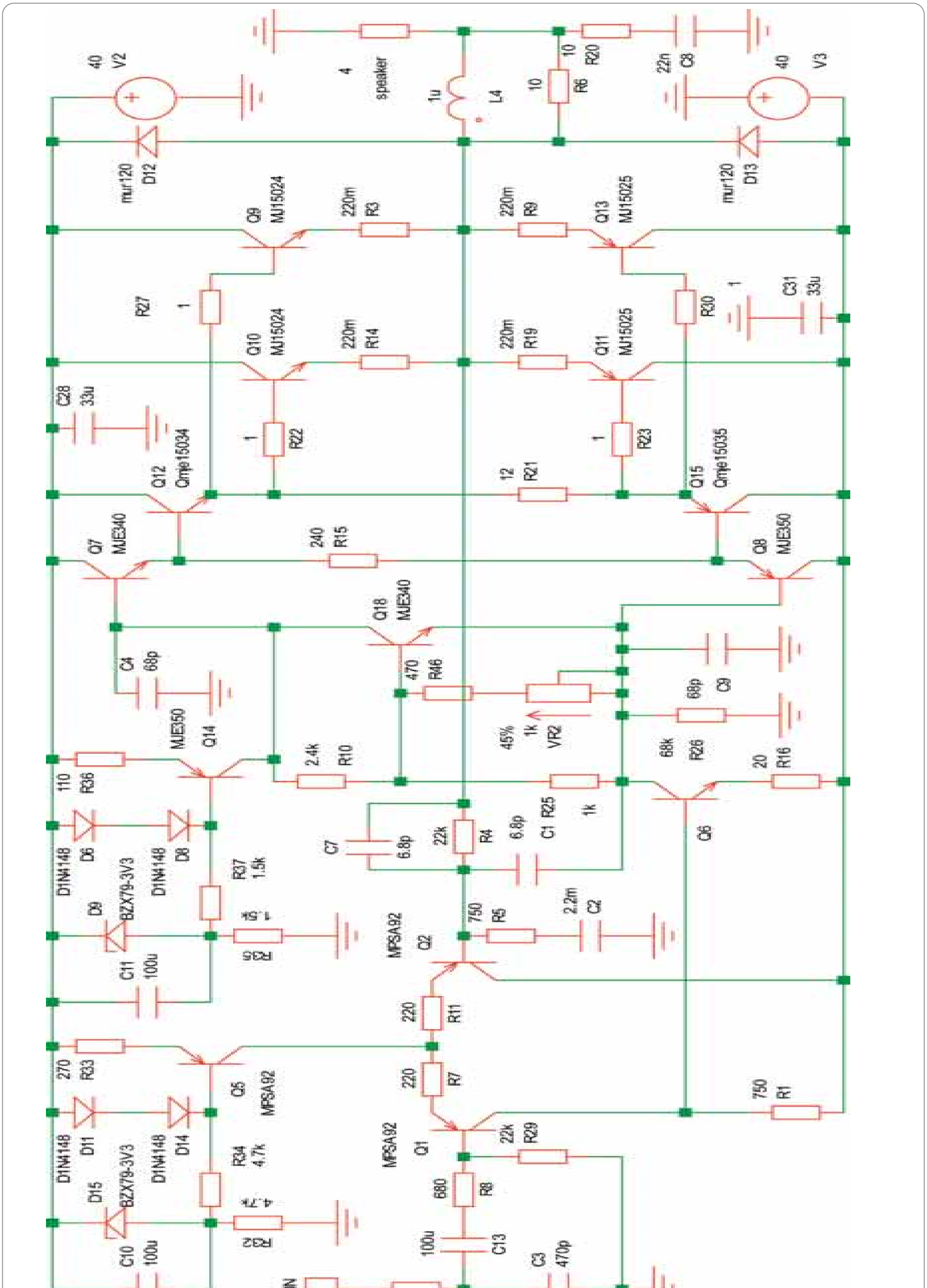


Figure 5: Amplifier schematic

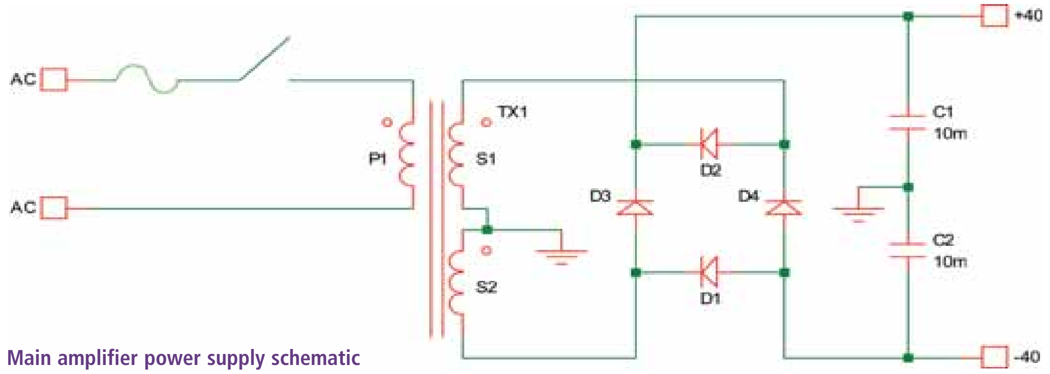


Figure 6: Main amplifier power supply schematic

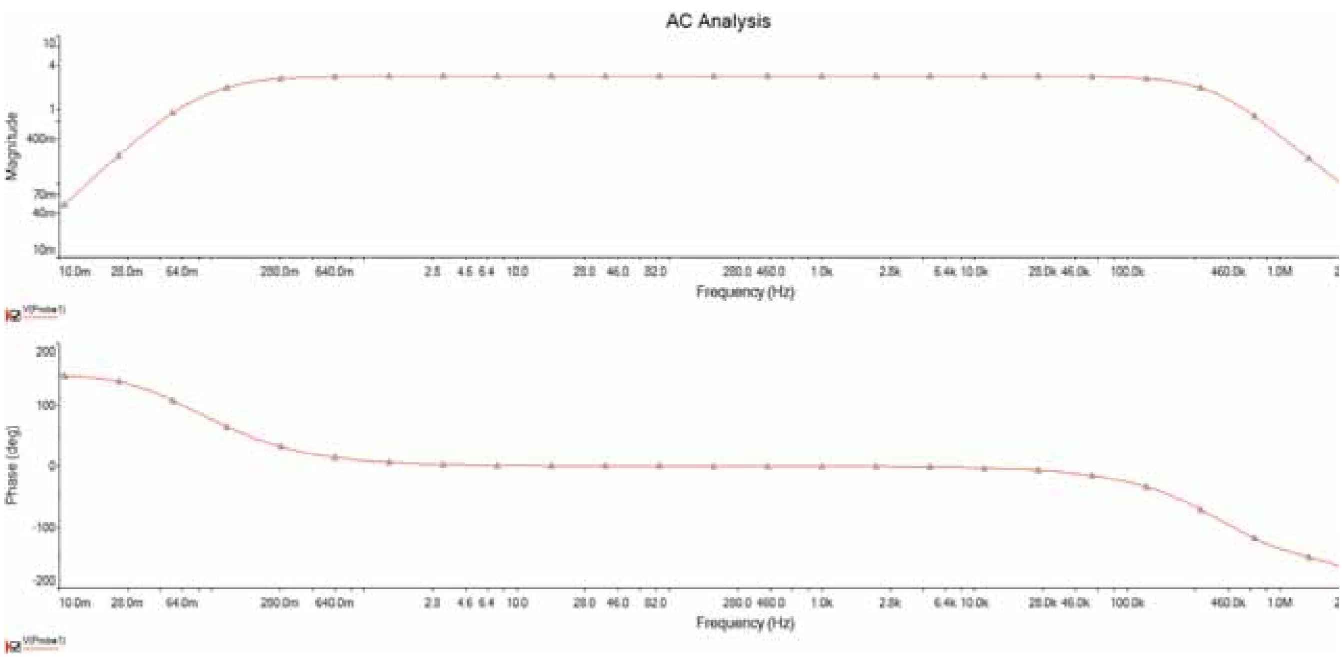


Figure 7: Bandwidth of main amplifier

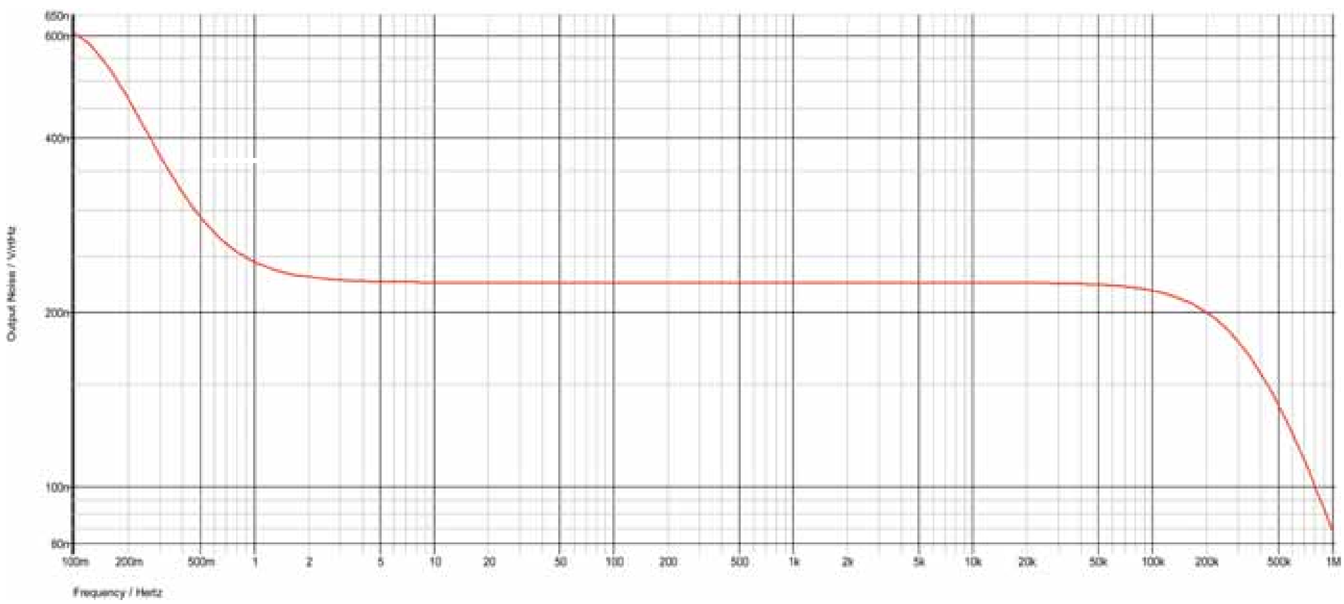


Figure 8: Noise analysis

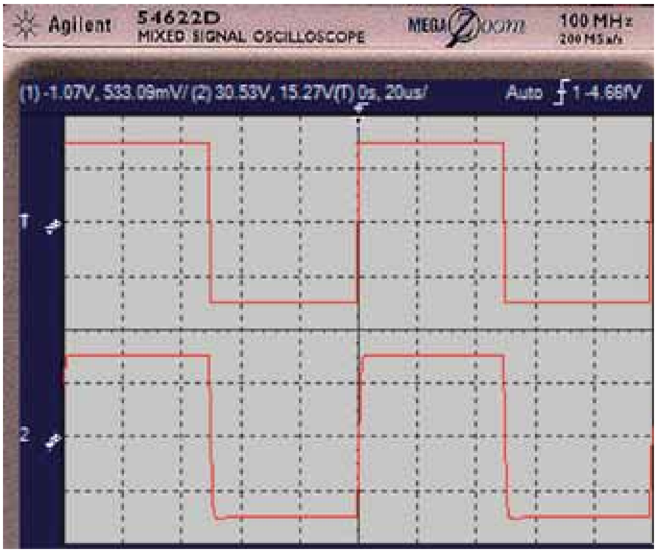


Figure 9(a): 10kHz square wave without L4 and R6 on 1Ohm 2uF load

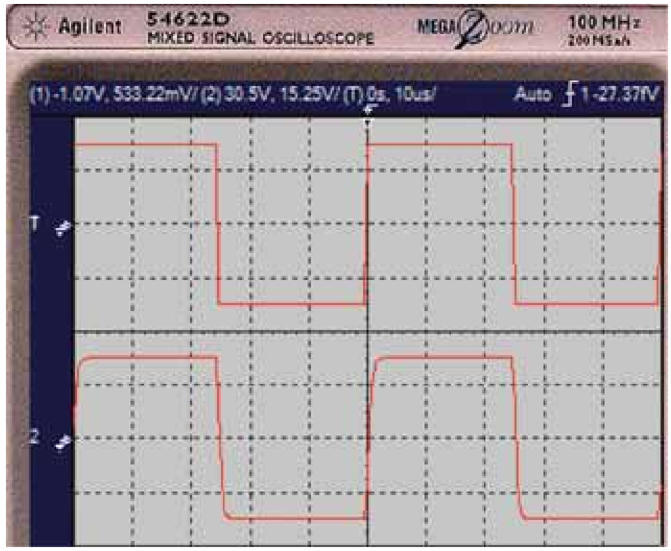


Figure 9(b): 20kHz square wave on 4Ω load

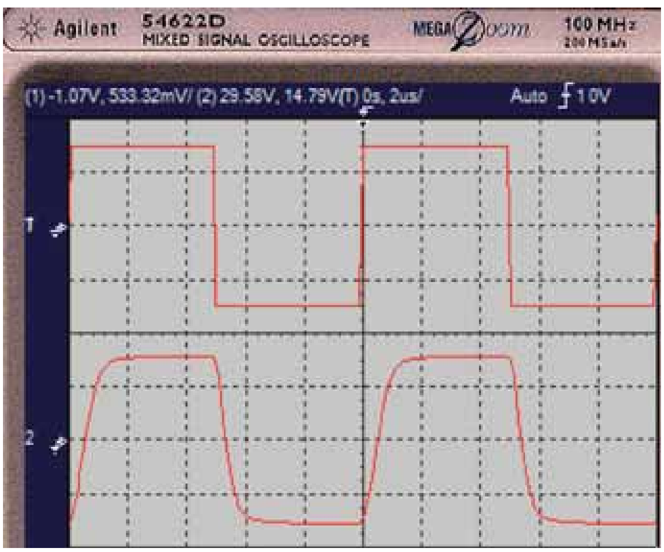


Figure 10(a): 100kHz square wave without load

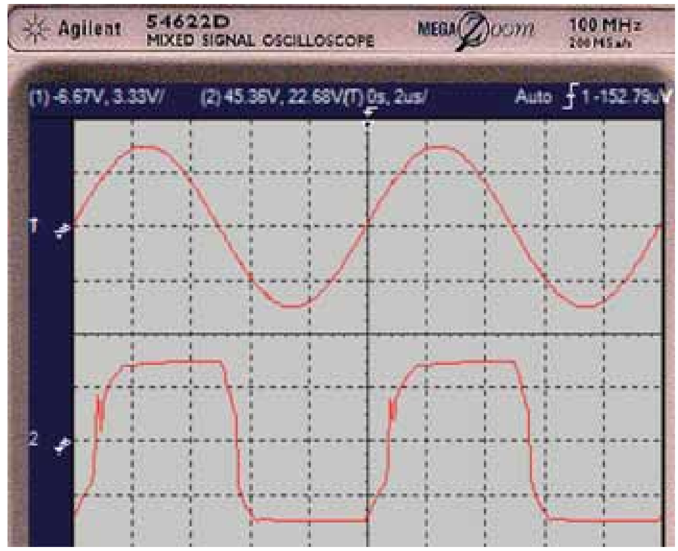


Figure 10(b): 100kHz sine wave clipping at 5V input

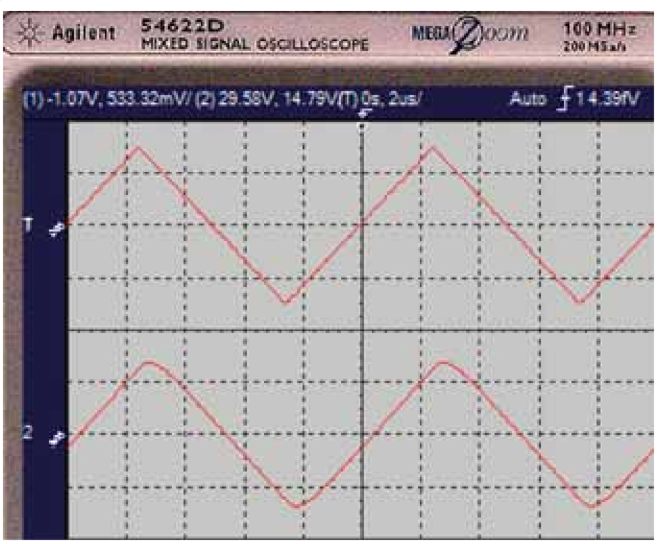


Figure 11(a): 100kHz triangle wave at 4Ω

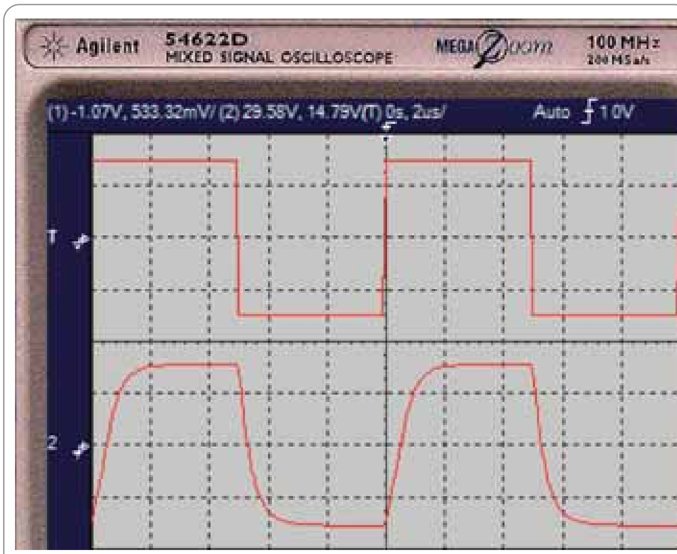


Figure 11(b): 100kHz square wave at 4Ω

WEI CHEN FROM THE SCHOOL OF COMPUTER SCIENCE AND TECHNOLOGY, AND **LI YI** FROM THE INDUSTRIAL ENGINEERING ENGINEERING SCIENCE PRESENT A STUDY OF AN EMBEDDED

Embedded Solution for Brushless DC Motor Control

Brushless direct current motors (BLDC) are a type of DC motors that do not use brushes for commutation but are electronically commutated. Since BLDC motors do not use brushes they have longer operating life and noiseless operation.

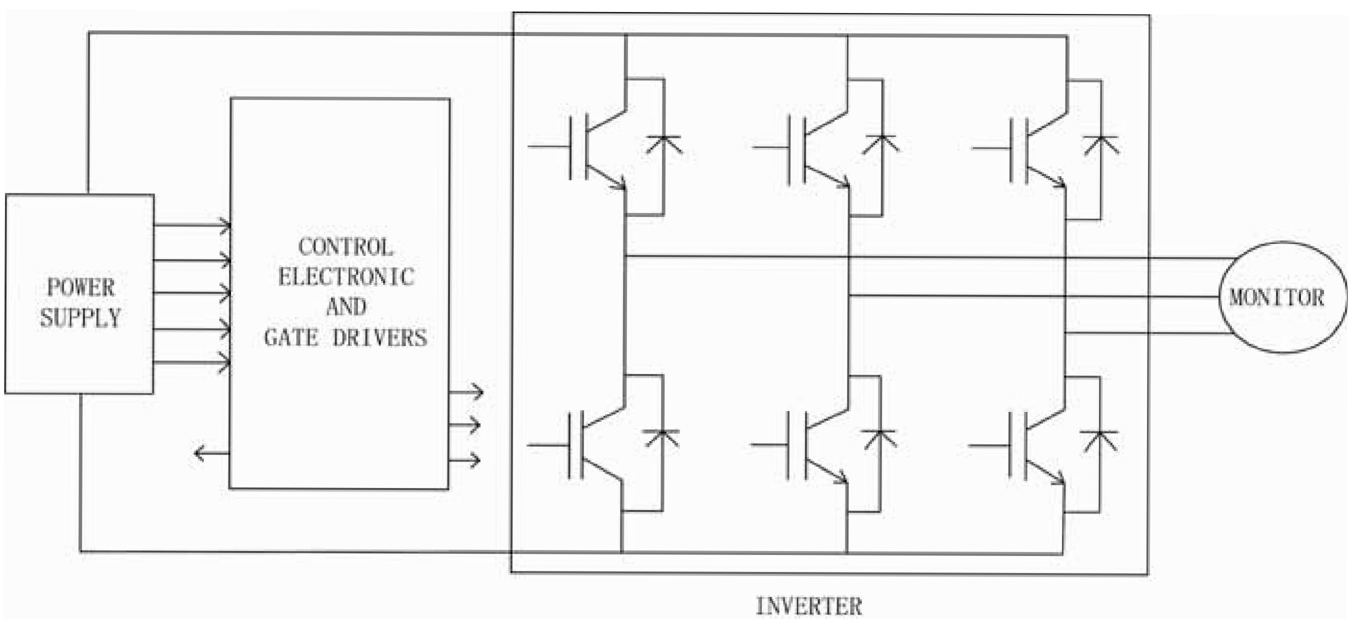
For BLDC motors the ratio between the torque and the size of the motor is high. This feature makes BLDC motors suitable for applications where space and weight are critical. Some other characteristics of BLDC motors include higher speed, better speed versus torque characteristics and high dynamic response. They are used in several industry fields: appliances, automotive, aerospace, consumer, medical, industrial automation equipment and instrumentation.

For BLDC motor control there are analog solutions, integrated solutions and digital control solutions. Most integrated circuits (IC) manufacturers offer analog ICs for BLDC motor control. There are also integrated control solutions that allow the customization of the control algorithm from a PC, using a graphical user interface. The highest flexibility can be achieved by implementing the control algorithm on a microcontroller or a Digital Signal Controller (DSC).

The analog control solution is a low cost one, but with a reduced degree of flexibility. The parameters of the control algorithm can be changed by adjusting external electronic components. In order to achieve high flexibility at low cost, a digital control solution based on a cheap microcontroller must be used. This article presents a control algorithm which can be implemented on a low-cost microcontroller.

Texas Instruments, Renesas and Microchip offer digital control solutions tailored for their processors. However, this article presents a general control solution that can be used with any microcontroller with the minimum required hardware peripherals.

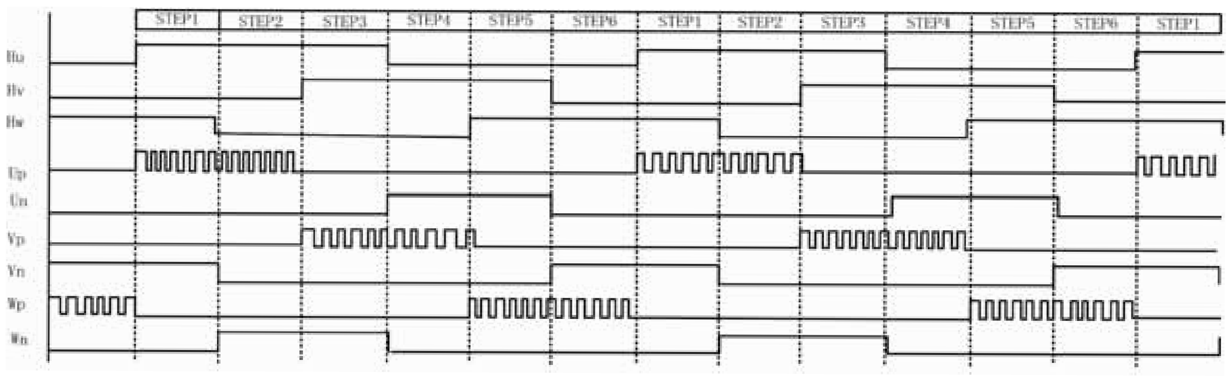
Figure 1: Inverter topology



TECHNOLOGY AT THE CHINA UNIVERSITY OF MINING AND TRAINING CENTRE AT THE SHANGHAI UNIVERSITY OF SOLUTION METHOD OF BRUSHLESS DC MOTOR CONTROL

THIS NEW REGULAR FEATURE COVERS ISSUES RELATED TO CHINESE RESEARCH AND DEVELOPMENT (R&D)

Figure 2: Upper modulation technique



Hardware Topology

Commutation of the BLDC motor is done electronically and as such it is important to know the position of the rotor. For this reason BLDC motors have Hall sensors embedded in their stators. The Hall sensors generate a high or low signal when the N or S rotor magnetic pole passes nearby. Based on the sequence of signals coming from the Hall sensors the designer defines the commutation sequence. According to the sequence certain windings of the motor have to be controlled. Figure 1 shows the basic inverter topology for driving a three-phase BLDC motor.

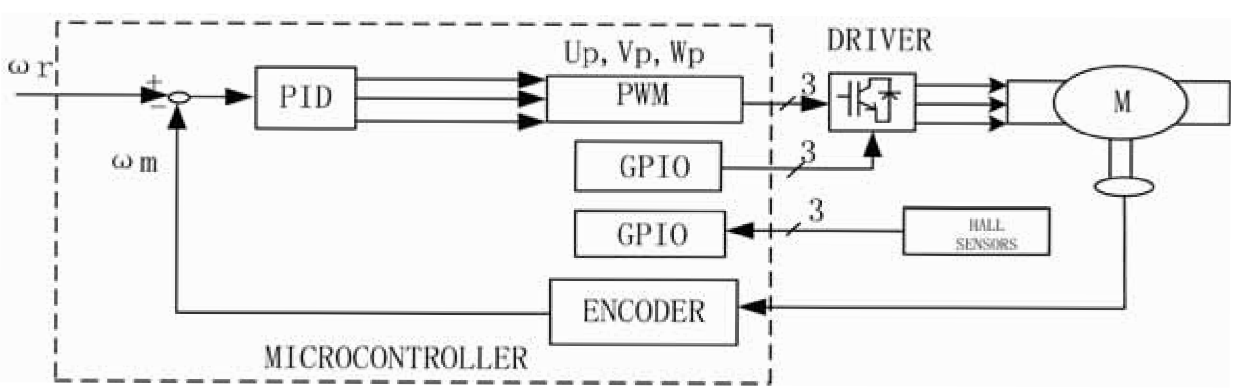
Modulation Methods

There are various modulation methods for controlling inverter drives: upper modulation, lower modulation, rotating modulation, or balanced modulation. Here we present upper modulation which is most suited to implement on a low-cost microcontroller.

Figure 2 shows an example of the upper modulation waveforms and Hall sensors' signals, H_W, H_V and H_U. They respectively correspond to the three phases of the motor *U, V, W*. U_P, V_P and W_P represent the upper transistors of the three-phase bridge corresponding to the three phases of the motor *U, V, W* respectively; while U_N, V_N and W_N represent the lower transistors of the three phase bridge similarly.

The block diagram of a closed loop control system for BLDC motor control is presented in Figure 3. For applications that require high accuracy of the measured speed an encoder must be used. Based on the reference and measured speed, the PID controller

Figure 3: Closed loop control diagram



computes the duty cycle for the PWM control signals.

Hardware Requirements

In order to control the three-phase bridge using the upper modulation technique, the microcontroller must be able to generate three PWM signals and it must have a timer or a PWM module capable of generating them. The upper modulation technique also requires three enable/disable signals which can be generated using three GPIO pins.

The BLDC motor must be commutated electronically, so it is important to know the position of its rotor. For this reason Hall sensors are embedded in the stator. Their signals are applied to three external hardware interrupts pins, so the microcontroller can commutate the motor. Another critical requirement is that the microcontroller have three hardware interrupts pins. If an encoder is used for speed measurement, two additional timer input pins are required for the signals generated by it.

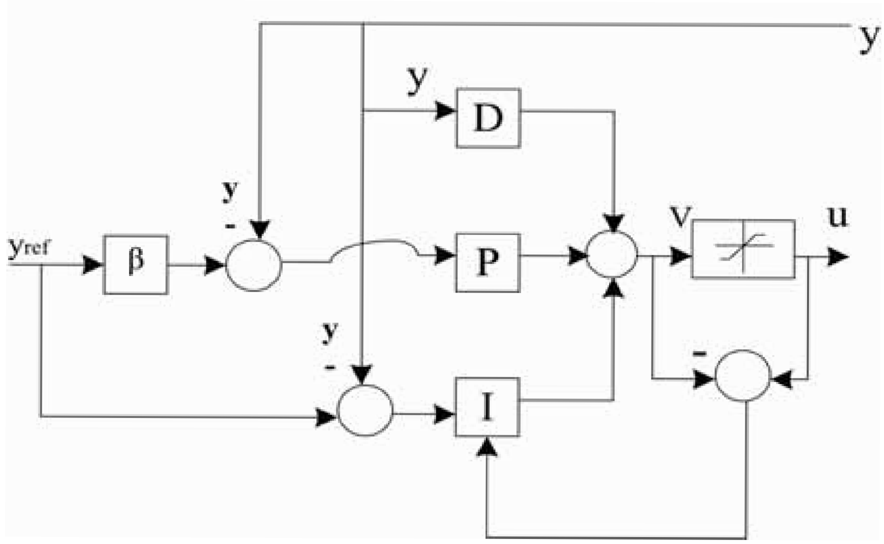
An important feature that must be implemented in every embedded for motor control system is overcurrent protection. This requires an analog-to-digital converter or an analog comparator must be used. If an overcurrent condition is detected, the motor is then stopped by disabling the PWM signals.

PID Controller

Here we present a PID tuning method and a closed loop control algorithm with a PID controller.

Hall Sensor Signals (H_W H_V H_U)	Active transistors	
1	U_P	W_N
2	V_P	U_N
3	V_P	W_N
4	W_P	V_N
5	U_P	V_N
6	W_P	U_N

Figure 4: The structure of the PID controller



The standard equation of a PID controller is presented as:

$$u(t)=K_p\left(\varepsilon(t)+\frac{1}{T_i}\int_0^t \varepsilon(\tau)d\tau+T_d\frac{d\varepsilon(t)}{dt}\right)$$

where

$$\varepsilon(t)=y_{ref}(t)-y(t)$$

is the error signal, y_{ref} is the reference signal and y is the output of the process.

In time several modifications have been made to the standard PID controller structure. A pure derivative gives a very large amplification of measurement noise. Therefore, the gain of the derivative must be limited, by low-pass filtering the derivative term, resulting in a limited gain N at high frequencies. A fraction β of the reference signal acts on the proportional part, while the derivative component acts only on the output of the process. The structure of the PID controller with integrator anti-windup is shown in Figure 4.

Taking into consideration the above remarks, the PID algorithm can be described by the following equations:

$$P(n)=K_p(\beta y_{ref}(n)-y(n)),\ D(n)=\alpha_d D(n-1)+\beta_d(y(n-1)-y(n)),\ v(n)=P(n)+I(n)+D(n)$$

and:

$$I(n+1)=I(n)+\beta_i(y_{ref}(n)-y(n))+\beta_t(u(n)-v(n)),$$

where:

$$\alpha_d=T_d/(T_d+Nh),\ \beta_d=(K_pT_dN)/(T_d+Nh),$$

$$\beta_i=K_pT_s/T_i,\ \beta_t=T_s/T_t$$

These equations were used for implementation of the PID algorithm on the microcontroller using C language.

Figure 5: Block diagram of a system with relay and dead time

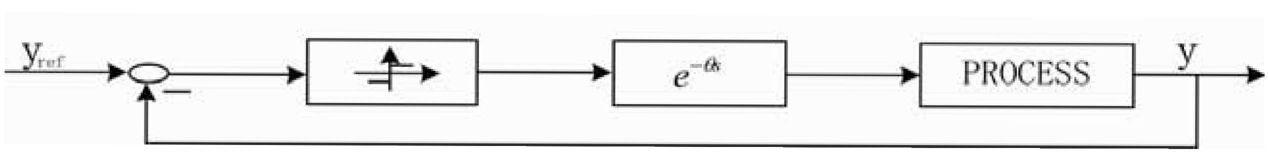


Figure 6: Limit cycle of the BLDC motor

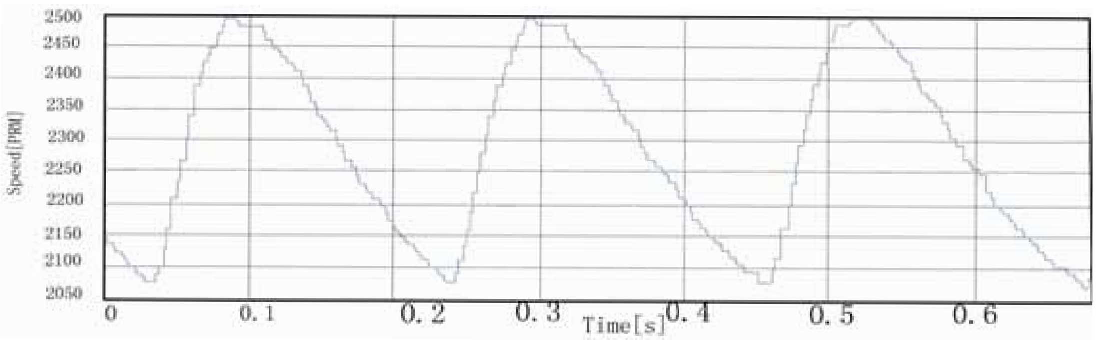


Figure 7: Motor response with a PID controller

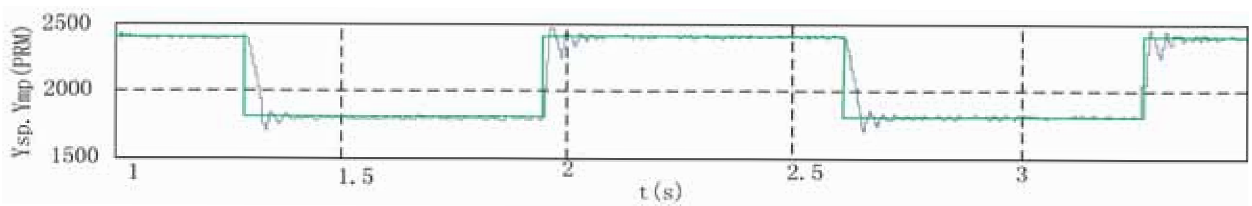
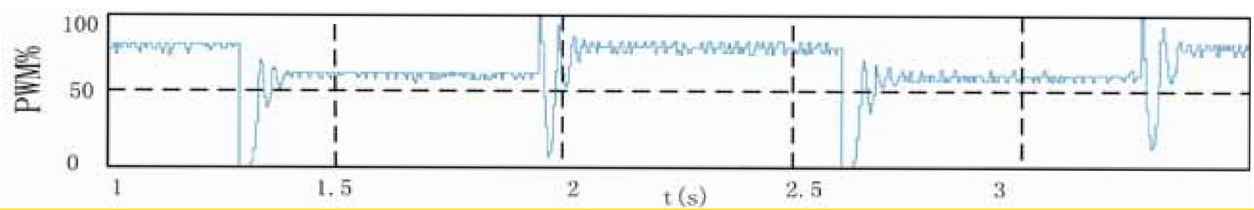


Figure 8: PWM command signal



Controller Tuning

Chen and More proposed a robust method for tuning controllers. The method is based on the condition that phases the Bode plot at a specified frequency w_c (referred to as "tangent frequency") at the point where the sensitivity circle touching the Nyquist curve is flat, which implies that the system is more robust to gain variations. Here we present a new tuning rule which gives a new relationship between T_i and T_d instead of the equation $T_i = 4T_d$ proposed in the modified Ziegler-Nichols methods.

After initial selection of the tangent frequency w_c and of the tangent phase y_m using an iterative algorithm the phase $\angle P(jw_c)$ and the modulus of the system transfer function $|P(jw_c)|$ of the process can be estimated. The derivative of the phase of the open loop system $s_p(w_c)$ can be approximated by Bode's Integral:

$$s_p(w_c) = \angle P(jw_c) + (2/\pi)\left(\ln|K_g| - \ln|P(jw_c)|\right),$$

where: $$|K_g| = P(0)$$

is the static gain of the process.

The equations for determining the parameters of the PID controller are as follows:

$$K_p = \cos(\gamma_m) / \left|P(jw_c)\sqrt{1+\tan^2(\Phi)}\right|,\ T_i = 2/\omega_c\left(s_p(\omega_c) + \tan(\Phi) + \tan^2(\Phi)s_p(\omega_c)\right),$$
$$T_d = \left(-T_i w_c + 2s_p(\omega_c) + \sqrt{\Delta}\right) / \left(2s_p(\omega_c) w_c^2 T_i\right),$$

where: $$\Phi = \gamma_m - \angle P(jw_c)$$
and: $$\Delta = T_i^2 w_c^2 - 8s_p(w_c)T_i w_c - 4T_i^2 w_c^2 s_p^2(w_c)$$

In order to estimate the phase and the value of system transfer function of the process at the desired frequency, a closed loop system with relay and time delay must be implemented (see Figure 5).

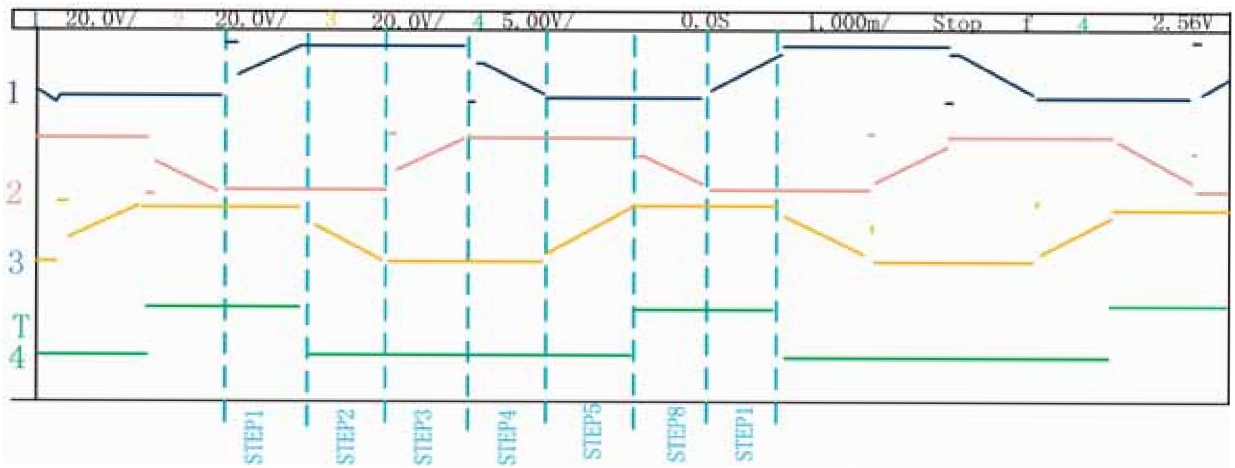


Figure 9: Motor phase voltages during commutation

The iterative algorithm described in detail is implemented in order to tune the parameters of the PID controller. The frequency of oscillation caused by the relay can be changed by introducing an artificial dead time on the direct path. Starting with the selected tangent frequency and using an iterative method, the dead time corresponding to the desired frequency is determined.

The selection of the value for w_c depends on the dynamic of the process for which the controller must be tuned. For most processes there is an interval for the selection of w_c in order to realize the flat phase condition. If this interval is not known the initial selection for w_c can be the cutoff frequency.

The desired frequency is computed using the relation:

$$\omega_n = 2\pi/T_u,$$

where T_u represents the ultimate period, which is determined from the limit cycle. The modulus value of system's transfer function is estimated using the relation $|P(jw_n)| = 1/K_u$, where K_u is the ultimate gain. The phase is computed using the relation:

$$\angle P(j\omega_n) = -\pi + \omega_n\theta,$$

where θ represents the dead time for which the desired frequency is obtained.

Application Example

Based on the foregoing statement, a whole solution is built. A Renesas M32C87 processor a member of the M16C microcontroller family is used for BLDC motor control. The microcontroller has these peripherals: two timers to generate the PWM signals, external hardware interrupts pins, up to eighty input pins and an encoder interface. A Hurst-Emerson motor is used.

On the shaft of the motor an Agilent HEDS-5500 encoder. The integrated power module IRAMS10UP60A is used as the motor drive, optimized for electronic motor control. The limit cycle corresponding to the desired frequency is presented in Figure 6. It is transferred in real-time from the microcontroller using the CAN interface of the microcontroller and a USB to CAN converter on the PC side.

From the obtained limit cycle the phase and the module of the process are estimated and s_p is computed using the above equations.

Figure 7 is the step response of the BLDC motor to a rectangular reference signal, with the computed PID controller, and Figure 8 is the duty cycle of the control PWM signal in percent.

The motor phase voltages during commutation are presented in Figure 9, where the six commutation steps can be observed.

INFO

THIS WORK WAS SUPPORTED BY THE NATIONAL NATURAL SCIENCE FOUNDATION OF CHINA (Grant No. 51104157), the PhD Programs Foundation of Ministry of Education of China (Grant No. 20110095120008) and the Fundamental Research Funds for the Central Universities (Grant No. 2011QNA30)

THIS IS A MONTHLY COLUMN COVERING ISSUES RELATED TO TEST AND MEASUREMENT (T&M)

Another Way Around The Disappearing Test Access

BY **REG WALLER**, EUROPEAN DIRECTOR, ASSET INTERTECH INC

In the previous few issues, I've been discussing non-intrusive board test technologies for testing memory devices soldered to circuit boards. Boundary scan test (based on the IEEE 1149.1 JTAG standard) is another method that does not rely on placing a test probe on the board, as oscilloscopes, in-circuit test (ICT) systems and other test technologies do. But before I get to boundary scan, I should mention why non-intrusive test methods are so important these days.

Just in case you haven't noticed, test pads – those tiny metal spots on the surface of circuit boards where test probes are placed in order to test the board – are disappearing right before our eyes. There are plenty of good reasons for this. For one, the pads simply wreak havoc on the high-speed data traversing the chip-to-chip buses on the board. It seems that placing a probe on a pad causes errors and distortions in the signalling on the buses, and the mere presence of a pad can cause problems on these high-speed buses. This means miscommunications and re-transmissions, which degrade bus speeds and make you wonder why you have a high-speed bus in the first place. So test access through test pads is disappearing and that's not good for external probe-based testers. We're getting around this predicament with non-intrusive test methods like boundary scan that are largely internal to the board since they utilize embedded instrumentation in chips.

Now, boundary scan isn't just any run-of-the-mill non-intrusive test technology. In fact, it's probably the mother of all non-intrusive test technologies. Many of the other non-intrusive test technologies exploit the boundary-scan infrastructure in chips and on circuit boards to do what they do.

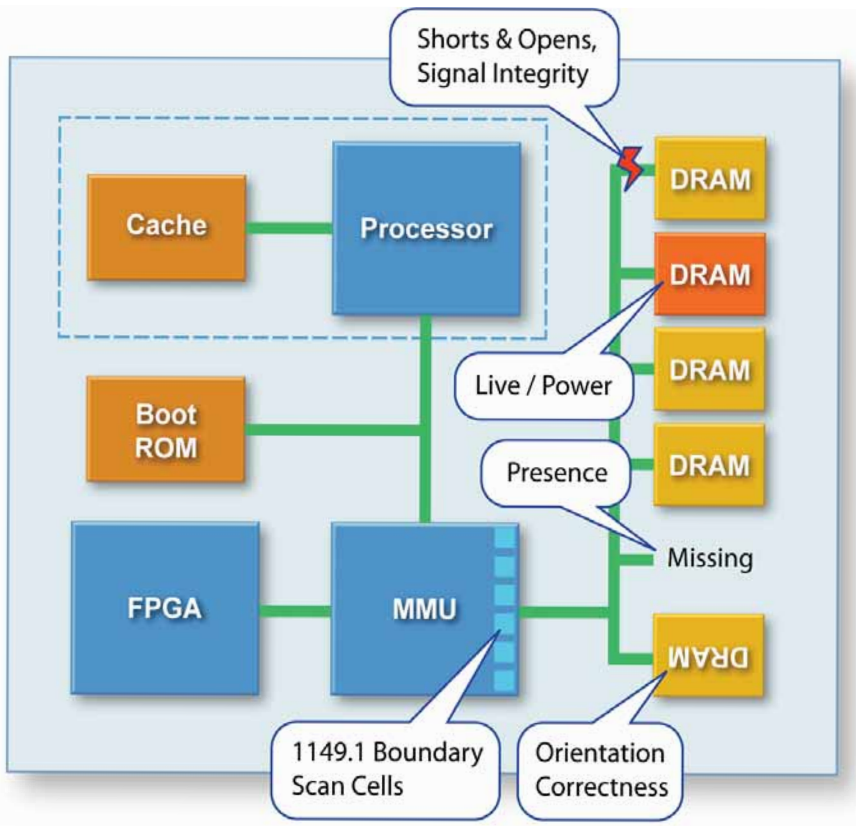


Figure 1: Boundary scan can test a variety of aspects in addition to shorts and opens

Boundary Scan And Memory Test

Even though memory devices by and large do not conform to the boundary-scan standard, we can still test the interconnects or buses that lead to the memories with it. And it's a good thing we can, as it turns out boundary scan is sometimes the only way to test them. All this non-conformance to the standard means that memory devices don't have boundary scan's Test Access Port (TAP) or certain registers on-chip. But as long as a memory device is connected to another one that supports boundary scan, such as the memory management unit (MMU) in Figure 1, then boundary scan can be used to test the on-board memory.

Figure 1 shows that in addition to shorts and opens on the interconnects to memory, boundary scan can test other aspects of the memory devices including: Does the memory device have power? Is a memory device missing? Is an incorrect type of memory installed where it shouldn't be? Is the orientation of the memory device incorrect?

> *Just in case you haven't noticed, test pads are disappearing right before our eyes*

These aspects and others are part of a definition of test coverage that's been adopted by the International Electronics Manufacturing Initiative (iNEMI). Maybe a definition for test coverage doesn't keep you up at night, but it is important because if you can't define it, then you're going to have a tough time quantifying it. And everyone wants to say they have 100 percent coverage.

Complementary Memory Test Technologies

When it comes to memory test, boundary-scan test (BST) and the other non-intrusive test technologies, such as processor-controlled test (PCT) and FPGA-controlled test (FCT), complement each other very well as each has its own set of strengths. Although test application times lengthen for boundary scan because tests can only run as fast as the slowest boundary-scan test clock chip on a scan chain, memory tests still take only seconds. In fact, some tools have automated test capabilities which generate complex and intelligent test patterns to shorten the process for you and isolate the exact location of faults.

At the end of the day, the non-intrusive memory test methods, including boundary scan, give you a better chance of tracking down those memory failures. And then there are those cases during prototype test or board bring-up in the lab, on the production floor and in the field, when boundary scan might be your only alternative. That's when its value shines. ●

INEMI

THE DEFINITION OF TEST COVERAGE ADOPTED BY THE INTERNATIONAL ELECTRONICS MANUFACTURING INITIATIVE (INEMI) AND MORE ABOUT IT CAN BE FOUND ON: http://blog.asset-intertech.com/test_data_out/2010/07/ inemi_pcolasoqfam.html)

Data Acquisition System Design: The Considerations

IN THIS SERIES **MAURIZIO DI PAOLO EMILIO**, TELECOMMUNICATIONS ENGINEER, SOFTWARE DEVELOPER AND DESIGNER OF ELECTRONIC SYSTEMS, PRESENTS A TUTORIAL ON DATA ACQUISITION SYSTEM DESIGN

A data acquisition (DAQ) system can be defined as a set of electronic systems, with the following functions:

- **Input:** processing and conversion of analog signals into digital format using converters (ADCs). The data is then transferred to a computer for display, storage and analysis.
- **Processing:** conversion to analog format, using converters (DACs). The analog control signals are used to control a system or process.

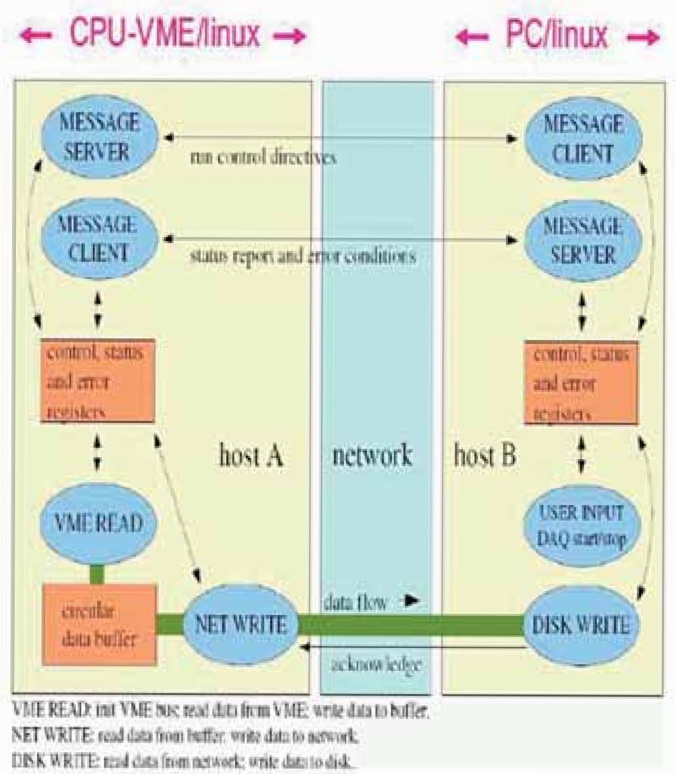


Figure 1: Software architecture

- **Input of digital signals**, which contain information from a system or process.
- **Output of digital control signals**.

In general DAQ hardware is the interface between the analog signal and a PC. It could be in the form of a module which can be connected to a computer via a serial or USB port for example, or a card connected to a slot in the mother board, such as PCI or PCI Express for example.

One other main component of the DAQ system is the software, which facilitates the DAQ hardware to work with a PC. This software (see Figure 1) can be written in a variety of languages (for example C) and for a particular application. Alternatively a number of proprietary data acquisition software packages are also available, including from National Instruments such as its LabView software.

Usually DAQ software is composed of a text-based user interface (TUI) consisting of an ASCII configuration file and a graphics user interface (GUI) available by means of a Web browser. Both interfaces permit DAQ management and customization without the need to recompile the sources, thus granting full acquisition control to the least experienced programmer. The configuration file is written in a high-level language (meta language) and is easily modified by the operator.

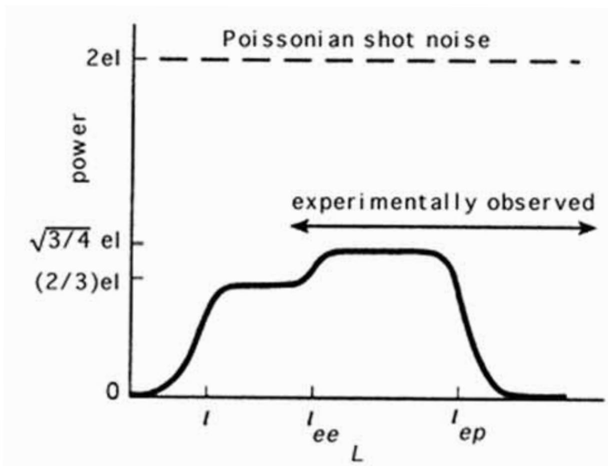
The GUI works at a higher level with respect to the ASCII configuration file and helps the operator compile the configuration file and control the acquisition. Use of the Web interface does not require any knowledge of the configuration file syntax and avoids "grammatical" errors. It is up to the operator to choose the TUI or the GUI when modifying the DAQ setup.

In addition, how the elements are wired in the data acquisition system is very important. Field wiring is the physical connection from the transducers/sensors to the data acquisition hardware. When the signal conditioning and/or data acquisition hardware are located away from the PC, then it is necessary to use field wiring that provides the physical link. In this case it is very important to estimate the effects of external noise, especially in industrial environments. Noise is a random fluctuation in the electrical signal and can be generated by various electronic devices.

In communication systems noise is an undesired random disturbance in a useful information signal, introduced before or after the detector. Johnson-Nyquist noise (thermal noise) is unavoidable as it's generated by the motion of the electrons themselves inside the electrical conductor, which happens regardless of any applied voltage. Thermal noise is approximately a white noise: the amplitude of the signal has very nearly a Gaussian probability density function.

Shot noise (Figure 2) in electronic devices consists of unavoidable random statistical fluctuations of the current in a conductor. Moreover, Flicker noise, also known as 1/f noise, is a signal or process with a frequency spectrum that falls off steadily into the higher frequencies, with a pink spectrum. It occurs in almost all electronic devices, resulting from a variety of causes, though always related to a direct current. ●

Figure 2: Shot noise



Avionics Europe

20-21 February 2013,

Hall 4, MOC Event Centre, Munich, Germany

Avionics Europe is the first port of call for avionics professionals, and according to event organizers, February 20-21, 2013, will mark the largest year yet for the event. With a floor size almost double that of 2012's show, an in-depth conference and free forums and presentations on the show floor, Avionics Europe will provide attendees a key opportunity to update knowledge and skills, understand the evolution in the industry and prepare for the future.

According to event director Ernesto Burden: "Avionics Europe's conference advisory board of visionary talent from some of the most important companies and organizations in the industry, along with conference director Courtney Howard, have moulded a truly 'can't miss' conference. That combined with the exciting, doubled show floor, forums and networking opportunities mean Avionics Europe 2013 is simply indispensable for anyone who needs to understand what's coming next in global avionics."

Avionics Europe will showcase leading and state-of-the-art technologies and products displayed by approximately 80 exhibitors from around the world.

The Conference

Avionics Europe has long been positioned as a nexus where some of the biggest names in the industry tackle that evolution in discussion, analysis and looking to the future. The conference programme is designed to deliver high quality content to avionics engineers, technicians, project managers, R&D consultants, systems integrators and pilots. It will offer contributions from key companies, including Airbus, Boeing, Honeywell, Rockwell Collins, Thales Avionics and many more, and it will present the latest perspectives from across the industry. Some of the luminaries presenting at the event include the opening keynote speakers from SESAR, Lufthansa and Airbus Military:

- Patrick Ky, Executive Director of the SESAR Joint Undertaking;
- Captain Sascha Unterbarnscheidt, Captain A320 and Director Ops Support, Lufthansa, Germany;

- Alejandro Jimenez Garzon, Head of Platform Systems, Airbus Military, France.

Among the other presenters are:

- Pierre Magro, Head of Avionics Product Line, Airbus Customer Services, Airbus, France;
- Petr Gotthard, Sr. Scientist, Honeywell Aerospace, Czech Republic;
- Patrick Huyck, Systems Certification Manger, Green Hills Software;
- Rick Farnworth, Navigation Specialist, EuroControl, France;
- John Law, Head Surveillance and Code Coordination Unit, EuroControl, Belguim;
- Barry Reynor, Program Manager, Europe Rockwell Collins, USA;
- Okko Bleeker, Director, R&D Europe, Rockwell Collins, The Netherlands.

Presentations this year will include, along with many others:

- Six Techniques for DO-178C Compliance, LDRA;
- Enforcing Predictability on Multicore COTS Platforms through the Hypervisor Layer, Thales;
- HUD PFD for Future Flight Decks, Rockwell Collins.

Supported By Leading Organisations

Avionics Europe enjoys the full support of leading industry organisations, including BavAIRia, the Association of European Airlines, SESAR Joint Undertaking, EuroControl, EUROCAE, German Society for Aeronautics and Astronautics (DGLR), Technical University of Munich and Royal Aeronautical Society (RAeS).

The Association of European Airlines, SESAR JU and EuroControl will also host and provide forums to update the industry on progress on policies and standards, with EUROCAE and the DGLR and RAeS also hosting forums for the avionics industry professionals.

If avionics touches your business, you cannot afford to miss Avionics Europe. The event will enable you to make important connections that are key to success in global avionics industry.

To view complete conference schedule or download the show guide visit: ***http://www.avionics-event.com/conference.html***

embedded world Exhibition & Conference

26-28 February 2013,

Exhibition Centre Nuremberg

embedded world 2013 Exhibition & Conference ... it's a smarter world

The embedded world Exhibition & Conference is the world's biggest event of its kind for the international embedded community.

"The embedded world Conference is Europe's top gathering for all embedded system developers. It is also the mirror and flagship of a community that more than almost any other has become the innovation driver for a whole society. The smartest minds from industry and science reveal their knowledge and share their experiences to promote the sector and so master the global challenges," said Professor Matthias Sturm, Chairman of the Steering Board of the embedded world Conference.

Embedded technologies are everywhere: cars, data and telecommunication systems, industrial and consumer electronics, military systems and aerospace, so the interest this event generates is not surprising. In 2012 over 870 exhibitors presented some 22,300 visitors the full range of products for embedded technologies, from hardware and software, to tools, services and more. This year these figures are expected to be exceeded.

"The embedded world Exhibition & Conference is growing continuously and rapidly in the same way that the embedded sector is gaining in importance – the embedded community can look forward to a record event," said Alexander Mattausch, Exhibition Manager of embedded world.

Each year embedded world features prominent industry figures, and this year embedded systems specialists will have the opportunity to meet and hear from Professor Nicholas McGuire or Dr David Kalinsky.

"These [industry] figures have given the embedded world Conference a face, weight, spirit and know-how at a high professional standard for years. Stuart McClure, President and CEO of Cylance, opens embedded world on the first day with his keynote on safety and security," said Mattausch.

Event Details

As usual embedded world will be held at the Exhibition Centre Nuremberg, and this year – its eleventh – it takes place Tuesday to Thursday, 26-28 February 2013.

Many exhibitors have already registered, and there are also many bookings for the pavilion from young innovative companies – former as well as new exhibitors.

"Pavilions are already registered from France, the USA and Serbia, which increases the international share to 30%," said Mattausch. "The demand for the M2M Area and the M2M Pavilion is excellent, so we have planned an extra area for 2013. The electronic displays segment is also attracting a great response."

The embedded world Conference 2013

This year's conference focus is on safety, security and ultra-low power.

"The main themes this year are *'Safety and Security of Embedded Systems'* and *'Development of Ultra Low Power Applications'*, both key themes that currently concern the sector and will become real challenges particularly in the future," said Sturm.

"I would also like to mention *'Embedded System Design Automation'* (ESDA). This will provide in-depth coverage of methods that will succeed in shortening the development time of embedded systems drastically and reduce the error rate again – an important and pioneering issue that will be tackled at the conference for the first time in an extra session."

More information about the programme for the embedded world Conference 2013 and registration is available at: **www.embedded-world.eu**

In addition to its key themes, the embedded world Conference 2013 focuses on:

- Multicore
- Cryptography and Embedded Security
- Managing Embedded System Development and Life Cycle
- Software Development in High Level Languages
- Internet Technology
- M2M

Swissbit at embedded world 2013: Storage Solutions For All Industrial Applications

Swissbit AG will be presenting its industrial DRAM and flash storage solutions in all common technologies and formats at the embedded world fair (hall 1, stand 524). Highlight at the stand will be its brand new X-500 Series Industrial SATA II SSD with up to 512GB. The 2.5"-storage solution combines a data rate of up to 260MB/sec on SATA II and an impressive 15.000 IOPS with 4k random accesses and special features such as TRIM, the ATA security protocol, a temperature sensor and the in-field update. Additionally, the S.M.A.R.T. (Self-Monitoring, Analysis and Reporting Technology) protocol with lifetime monitoring and a BCH-ECC (error correction code) ensures absolute reliability with the power fail protected X-500 series.

The Swissbit portfolio includes DRAM modules manufactured using the COB (Chip-On-Board) and SMT methods supporting DRAM, SDRAM, DDR, DDR2 and DDR3 technologies.

www.swissbit.com
Hall 1, Stand 524

IQD Launches Very High Frequency OCXO Reference Clock For Converter Applications

IQD's new IQOV-150 series OCXO satisfies the growing demand for low phase noise reference clocks for Analogue-to-Digital Conversion (ADC) and Digital-to-Analogue Conversion (DAC), especially for very fast measurements and high-speed data transfer.

Available at frequencies up to 1.2GHz, the new design is based on an internal high-frequency OCXO combined with additional frequency multiplication and special filtering to achieve very low phase noise down to -160dBc/Hz @ 100kHz. Frequency stability is ±0.5ppm (parts per million) over the operating temperature range of -20 to +60°C along with a pulling capability of ±3ppm minimum. Working off a supply voltage of 12 Volts, the IQOV-150 offers Sinewave output of 0 to 13dBm into 50ohms.

www.iqdfrequencyproducts.com
Hall 1, Stand 152

Toshiba to Showcase Its Latest Smart Metering Embedded Control Devices and Tools

At embedded world 2013 Toshiba Electronics Europe (TEE) will launch new devices and development tools designed to simplify and speed embedded motor control implementations in industrial control and home appliance applications. Visitors will also be able to see microcontrollers dedicated to reducing the component count of domestic, commercial and industrial smart metering applications.

Among the devices on show will be the latest family of ultra-miniature ARM Cortex-M3 microcontrollers that combine on-board FOC (Field Oriented Control) capabilities with dedicated peripherals and functions that reduce system development time. Smart meter microcontrollers will include devices built around the ARM Cortex-M0 32-bit core that replace traditional two-chip analogue front end (AFE) and processor implementation with a single chip.

www.toshiba-components.com
Hall 4, Stand 534

Apacer: SATA 3.0 storage solutions at Embedded World 2013

Apacer will be presenting its industrial DRAM solutions and its full range of industry-leading industrial solid state drives, or SSDs, at embedded world 2013. One of the hightlights will be Apacer's newly launched SATA 3.0 products: SAFD 25S-M, mSATA S1-M & SAFD 18S5-M.

The Apacer SAFD 25S-M is a high-end SSD targeted at cloud-based applications, featuring outstanding efficiency and performance, based on high IOPs and a large storage capacity of 512GB.

The Apacer SAFD 25S-M adopts the SATA 3.0 (6Gb/s) interface, achieving twice the processing capacity of preceding SATA II interfaces. This SSD boasts a maximum sequential speed of 555/550 MB/s and IOPs of up to 60K.

http://eu.apacer.com/
Hall 1, Stand 507

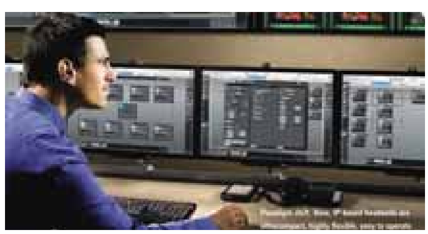
Rohde & Schwarz To Present Enhanced Oscilloscope Portfolio At Embedded World 2013

Rohde & Schwarz significantly expanded its oscilloscope portfolio in 2012 with new bandwidths, mixed-signal analysis and options for testing USB interfaces, CAN LIN buses and audio signals. At the embedded world 2013 event (hall 4, booth 112) the company will present its latest applications, two new probes and other products.

The R&S RT-ZS60 active voltage probe is the perfect solution for any task requiring single-ended measurements of signal integrity. The R&S RT-ZS60 is the market's first compact, single-ended 6GHz probe that can handle tests on high-speed interfaces such as DDR memory modules or general analyses for A&D, research or consumer electronics for example.

The R&S RT-ZD01 active differential high-voltage probe offers customers the benefits of a selectable measurement range.

www.rohde-schwarz.com
Hall 4, Stand 112



congatec's COM Express Reference Board at Embedded World

congatec AG will show its new reference board for video wall system design at embedded world in Hall 1, Stand 350. Video wall systems increasingly rely on high-quality videos and (3D) graphics and as such require a maximum number of graphics interfaces. The congatec reference board offers up to nine independent DisplayPort connectors in combination with an MXM graphics module and a COM Express CPU module. Both are equipped with AMD technology, and provide concentrated graphics and computing power.

The video wall baseboard reference platform is based on the new COM Express specification 2.1 for Pin-out Type 6 making it ideal for new designs. Displays can also be connected via additional VGA or LVDS ports. Besides graphical interfaces, the new video wall baseboard includes a wide range of important ports for embedded applications such as 2x Gbit Ethernet, 4x SATA, 2x USB 3.0, 4x USB 2.0, High Definition Audio and a 19V power supply for standard notebooks.

www.congatec.com
Hall 1, Stand 350

High-Definition Oscilloscopes with Highest Bandwidth and Deepest Memory in Their Class

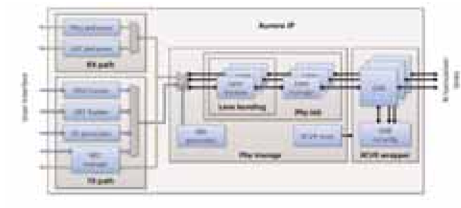
Agilent Technologies has introduced the Infiniium 9000 H-Series high-definition oscilloscopes, consisting of four new models that come in bandwidths of 250MHz, 500MHz, 1GHz and 2GHz. They offer up to 12-bit vertical resolution, which represents 16 times the quantization levels of traditional oscilloscopes with 8 bits of resolution.

These scopes also include the industry's deepest standard memory of up to 100Mpts per channel.

As probing systems also induce measurement noise, Agilent has developed a new series of low-noise probes specifically designed to allow engineers to view and analyze small-current signals. The new N2820A and N2821A AC/DC current probes offer the industry's highest sensitivity to 50uA, with a maximum current range of 5A. These probes work in cooperation with the new oscilloscopes to offer the industry's most sensitive current measurements. The higher sensitivity is especially useful for measuring current consumption of battery-powered mobile devices or integrated circuits.

www.agilent.com

REFLEX CES INTRODUCES INDUSTRY'S FIRST AURORA-LIKE IP CORE



Reflex CES, a provider of custom embedded and complex systems, released its Reflex CES Aurora-like IP core based on Altera FPGAs. The core enables interoperability between Xilinx Virtex-6 LXT, Altera Stratix IV and Stratix V GX FPGAs.

The Reflex CES Aurora-like IP core offers the freedom to choose the best FPGA technology and accelerate time-to-market for embedded military and telecommunications/networking applications. It offers a fully compliant implementation of the Xilinx Aurora 8B/10B scalable, link-layer protocol for high-speed serial communication and allows communication between FPGAs through a backplane.

Based on the Aurora 8B/10B, an open standard protocol used to transport data with higher connectivity performance for chip-to-chip and board-to-board architecture, the Reflex CES Aurora-like IP core allows designers to move data from point-to-point across one to sixteen serial lanes at 3.125Gbps. The core offers user flow control, native flow control, immediate and completion mode and modules to convert interfaces to and from streaming Advanced eXtensible Interfaces (AXI).

www.reflexces.com/en/

COMPACT DIP4 PHOTORELAYS WITH 5000V ISOLATION

Toshiba Electronics Europe (TEE) has announced a new series of photorelays that provide a minimum input-to-output isolation voltage of 5000Vrms (AC, 1 min) for reinforced insulation. Devices in the TLP220 series are supplied in a compact DIP4 package that measures just 7.6mm x 4.6mm x 3.7mm. Clearance and creepage distances are 7mm as standard.

The new photorelays suit designs where engineers want to replace a mechanical relay with an optically-isolated part to meet reinforced insulation safety requirements. Target applications include smart meters, factory automation systems, test and measurement equipment, security systems and gaming and entertainment products.

www.toshiba-components.com

HOTSHOE FAST-MATE, RELIABLE CONNECTOR FAMILY NOW RATED TO IP68

Harwin has launched an IP68-rated version of its HotShoe connector technology which enables rapid and simple connection.

Available in standard 8-, 12- and 16-way versions, HotShoe connectors employ spring-loaded contacts which maintain a positive contact force against the mating half of the connector, ensuring reliable connection even under the most demanding conditions. HotShoe connectors have always provided a high degree of resistance to dust, water and chemical ingress – the new IP68 versions are also dust tight and provide protection against total and continuous submersion in water to a depth of 1.5 meters for two hours.

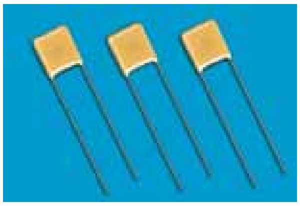
Fabricated using highly durable plastics, HotShoe connectors are very robust, ensuring continued reliability throughout a product's entire lifecycle. HotShoe connectors are suitable for harsh environment applications and are suitable for portable equipment where separate battery modules are used, for data transfer docking stations, and for battery charging and data communications equipment. Other applications include thermal imaging cameras, in-vehicle detachable equipment and hand-held scanners.

www.harwin.co.uk

N1500 Super Dielectric Option For High-Voltage MLC Radial Leaded Capacitors

AVX Corporation has added an N1500 super dielectric option to its high-voltage, multilayer ceramic (MLC), radial leaded capacitor series. An extension of the SV Series, the new N1500 super dielectric capacitors take up less board space and offer higher capacitance values than comparable C0G dielectric capacitors, and are ideally suited for applications including snubbers in high-frequency power converters, resonators in SMPS, AC line filtering and high-voltage coupling/DC blocking.

The new N1500 dielectric SV Series capacitors feature a capacitance range of 100pF to 0.47µF with tolerances of ±5%, ±10% and 20%, a voltage range of 600-5000V, and a maximum dissipation factor of 0.15%. The operating temperature range for the series is -55°C to +125°C. Additionally, a Hi-Rel screening option (100% Group A testing per MIL-PRF-49467) is available.



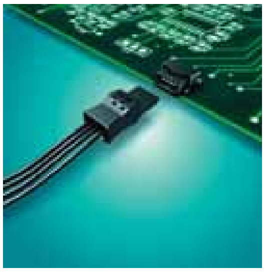
AVX's high-voltage SV Series MLC radial leaded capacitors are coated with high insulation resistance and high dielectric strength epoxy, which eliminates the possibility of arc flashover.

www.avx.com

har-flexicon: Tool-Free Individual Conductor Wiring With 1.27mm Spacing

har-flexicon from the Harting Technology Group is a miniaturised individual conductor PCB connection technology featuring 1.27mm spacing and ideally suited to field assembly.

Consisting of a pluggable SMD terminal block, with IDC wire connection, *har*-flexicon allows the rapid, tool-less termination of single wires directly on to a PCB, with the benefits of low processing costs, compatibility with automatic SMT mounting and reflow soldering process, and a high level of rigidity with large-area SMT fixings.



Flexible individual conductor wiring of industrial devices with PCBs as their key component is one of the principal requirements of modern device technology. Because sensor/actuator subassemblies need to be connected on site rapidly, PCB connection technology must continue to be universally applicable. These challenges are addressed by *har*-flexicon, which offers flexibility in the connection of I/O signals with tool-less individual conductor wiring, allowing on-site assembly in the field.

www.harting.com

NEW UPDATED PWM CONTROLLERS OFFER SIZE AND COST BENEFITS

Advanced Power Electronics Corp (USA), a Taiwanese manufacturer of MOS power semiconductors for DC-DC power conversion applications, has updated two of its most popular PWM controllers to provide customers with space saving and more cost-effective devices without sacrificing performance and reliability.

The APE3061 PWM controller is now available in a small 8-lead DFN package, reducing package size down from 5 x 6mm (SO-8) to 3 x 3mm, without any negative impacts on power handling capability. The new APE3061GN3-HF-3 component supports input voltages from 3V up to 24V and is designed to drive an external N-channel MOSFET.

The output voltage is dependent on the external N-MOSFET and is programmable using an internal reference voltage of 1.0V and external resistors connected as a voltage divider. The controller benefits from built-in enable and thermal shutdown functions. Switching frequency is fixed, around 500kHz, allowing for easy filtering and low noise.

www.a-powerusa.com

HIGHLY PROGRAMMABLE HALL-EFFECT SWITCH WITH ADVANCED PROGRAMMING ALGORITHM

New from Allegro MicroSystems Europe is A1128 – a field-programmable, unipolar Hall-effect switch designed for use in high-temperature automotive and industrial applications, particularly those involving proximity sensing with ferromagnetic targets.

The new device uses a chopper-stabilisation technique to eliminate the offset inherent in single-element devices, and incorporates an advanced programming algorithm to simplify the customer's end-of-line process. It also has a high programming resolution for tighter magnetic switch points.

External programming is used to set the magnetic operating point while the hysteresis remains fixed. This advanced feature allows optimisation of the sensor IC switch point, and can drastically reduce the effects of mechanical placement tolerances found in end-user production environments. Other programmable parameters include output polarity and output fall time for reduced EMI in automotive applications.

The proprietary dynamic offset cancellation technique, with an internal high-frequency clock, reduces the residual offset voltage, which is normally caused by device overmoulding, temperature dependencies and thermal stress.

www.allegromicro.com

Hypertac Presents Its New Compact Design M12 Series

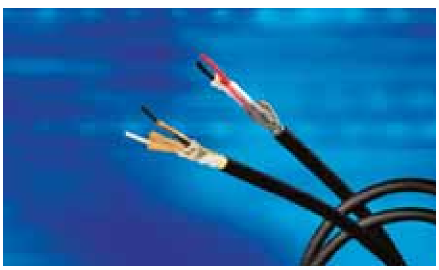
Hypertac has responded to the challenge of miniaturization of systems, equipment and components by introducing a new range of M12 style connectors incorporating a number of innovative features. The new M12 Series implements the higher requirements for overall system functionality within a very compact design and at the same time includes the considerable advantages of hyperboloid contact technology.

Hypertac's M12 Series comprises 3, 4, 5 and 8 way contact positions, with options for over-moulded or free assembly and straight or 90-degree versions to meet all the recognized standards and industry norms.

A floating female hyperboloid crimp socket within a robust connector insulator and shell provides the benefit of this anti-vibration

arrangement which ensures a safe and secure connection for all signals. Additional benefits are realized by the provision of easy handling and rapid contact assembly with a unique sideways clip insulator design.

www.hypertac.com



BELDEN UNVEILS NEW BENCHMARK-SETTING MICROPHONE CABLES

Belden has extended its award-winning line of broadcast products in the EMEA region with the launch of two Brilliance microphone cables that are setting new benchmarks in strength and digital audio performance. Brilliance 1776 – Belden's strongest microphone cable to date, and compact digital microphone cable Brilliance 2221 – the finest performing digital cable available, offer maximum toughness and flexibility for analog and digital applications.

Brilliance 1776 is a super-strong analog microphone cable that withstands the rough handling and constant use of studio and live environments. It is the strongest microphone cable ever manufactured by Belden, featuring minimum pull strength of 113kg. It is engineered with high strength custom alloy conductors and a tough EPDM rubber jacket. Brilliance 1776 is available as cost saving put-ups of 75 meters (250 feet).

www.belden.com

Universal Active Light Sensor Interface From Melexis

The MLX75030 from Melexis is a universal active light sensor interface which has been designed to allow easy implementation of robust multi-channel, close range optical sensing systems into difficult operational environments. It incorporates four independent simultaneously operating light measurement channels; two taking care of reflection and the other two for ambient light measurement. This makes the device highly optimized for inclusion in human-machine interfaces (HMI) requiring proximity detection or touchless gesture recognition in environments subject to wide variation in background lighting levels, especially in automotive infotainment systems, white goods and consumer electronics devices.

This IC features two active light reflection measurement channels with integrated ambient light suppression. The active light sensing section is complemented by two logarithmic current sensors which can measure the photocurrent signal from externally connected photodiodes for ambient light sensing. Internal control logic, configurable user registers and SPI communication enable simple, programmable operation.

www.melexis.com

COMPACT NEW OCXO MEETS DEMANDING SSB PHASE NOISE REQUIREMENTS

New from Link Microtek is a compact 100MHz OCXO that has been specifically designed to address the need for a high-frequency standard reference with low SSB (single sideband) phase noise.

Manufactured by MtronPTI, the XO5085 device has an SC-cut quartz resonator at its core and exhibits better frequency stability, lower ageing rates and lower SSB phase noise than OCXOs employing AT-cut resonators.

The new OCXO also provides a better design choice than the traditional technique of up-converting from a 10MHz OCXO as that approach tends to cause significant degradation in phase-noise performance and reduce the overall signal-to-noise ratio of the system.

Phase noise for the XO5085 is specified as -100dBc @ 10Hz offset and -170dBc @ 10kHz offset. It is a 12V device with a maximum steady-state power consumption of 1.5W and an operating temperature range of 0 to 80degC.

www.linkmicrotek.com

PIC10F222-I/P	0.35	PIC16F1934-I/PT	0.93
PIC12F508-I/SN	0.26	PIC16F1939-I/PT	1.21
PIC12F508-I/P	0.31	PIC18F1220-I/SO	1.35
PIC12F629-I/SN	0.42	PIC18F4520-I/PT	2.21
PIC12F675-I/SN	0.43	PIC18F8720-I/PT	5.12
PIC12F683-I/SN	0.55	PIC18F8722-I/PT	4.35
PIC16F616-I/P	0.66	PIC18F45K22-I/PT	1.25
PIC16F630-I/P	0.49	PIC18F67K22-I/PT	2.11
PIC16F648A-I/P	0.97	ATMEGA8A-16PU	0.81
PIC16F690-I/SS	0.78	ATMEGA8-16AU	0.79
PIC16F690-I/SO	0.85	ATMEGA48A-AU	0.71
PIC16F877A-I/PT	2.31	ATMEGA64A-AU	2.21
PIC16F818-I/SO	0.94	ATMEGA88PA-MU	0.68
PIC16F883-I/SP	0.98	ATMEGA128A-AU	2.89
PIC16F883-I/SO	0.82	27C256B-10F1	1.78
PIC16F886-I/SP	1.08	27C512-10F1	1.95
PIC16F886-I/SO	0.98	27C2001-10F1	2.71
PIC16F887-I/PT	1.16	27C4001-10F1	2.95
PIC16F1823-I/P	0.68	M4A5-32/32-10VNC	2.65
PIC16F1827-I/SO	0.65	M4A5-128/64-10VNC	4.85
PIC16F1933-I/SS	0.72	MAX232CPE+	0.61

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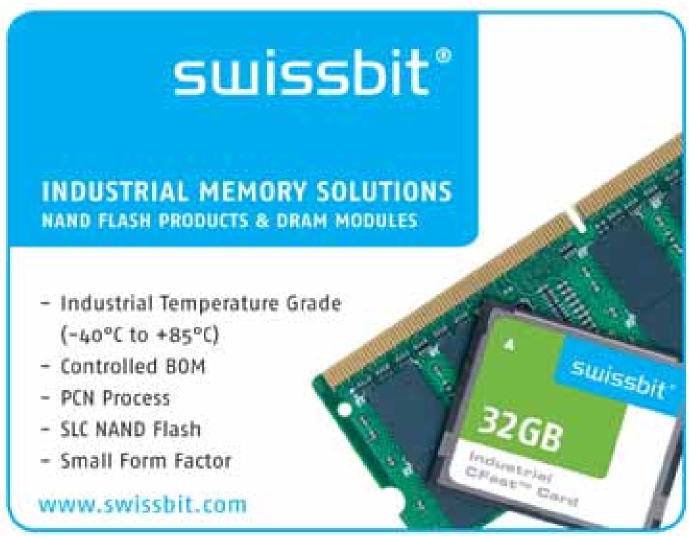

eyeSIGHT ANNOUNCES WORLD'S FIRST ANDROID SET-TOP BOX WITH GESTURE CONTROL

Gesture recognition company eyeSight Mobile Technologies in conjunction with Korean specialist smart set-top box (STB) company Innodigital has released the world's first Android smart set-top box with integrated gesture recognition technology. The nTobeBox from Innodigital transforms any standard television into a SmartTV that can be used for watching TV programmes, streaming content, downloading and using apps, making video calls, surfing the Internet and more. eyeSight's gesture control technology allows users comprehensive control over every aspect of Innodigital's set-top box. Using a combination of simple hand gestures and hand tracking enabling virtual mouse control, users can easily perform any function that can be accessed using the device's remote control.

The experience has proven intuitive and seamless, and eyeSight predicts many users will simply find gesture control to be the easiest, most natural way to use their Innodigital box.

"We're really happy to be working in co-operation with Innodigital to produce something remarkable; the world's first STB with integrated gesture control," said Gideon Shmuel, CEO of eyeSight. "The groundbreaking user experience we've brought to this Innodigital product will help it stand head-and-shoulders above its competition; eyeSight's advanced machine vision algorithms allow for natural, intuitive gestures, making our technology the number one choice for OEMs looking to provide their customers with a user experience which is a true enhancement compared to the current interaction methods."

IVOR CATT, Engineer and Scientist, UK: This idea, that I could control my TV by movement of my hand rather than a control box, is yet another example of the way electronics will give us more and more sophisticated control over our environment. I hope this is not a case of publicity being used in desperation at the failure of the product unless it gets more funding.

PROFESSOR DR DOGAN IBRAHIM, Near East University in Nicosia, Cyprus: Gesture-controlled TV box is definitely the way forward. No more the need to search for the remote control unit, just wave your hand. Gesture recognition will find many other uses in the home, such as with the domestic appliances, and will change peoples' relationship and interactions with electronic devices. Well done eyeSight and Innodigital!

JAN DIDDEN, Audio Expert and Publisher of Linear Audio, UK: Gesture control is an interesting development that has been going on for some time now, perhaps starting with the Wii type series of controllers. About a decade ago the world seemed poised for voice control in all walks of daily life. After the Lernhout & Hauspie debacle, that voice (pun intended) appears to be much quieter these days although not totally silent.

One of the issues with voice recognition is the need to 'learn' the pronunciation of commands by the user. This means that you cannot just walk into a room and utter any voice command to your equipment – it has first to get acquainted with you. Presumably, control gestures would also vary from one individual to another. I wonder if there's also a learning stage involved.

Once you master voluntary gestures, what about involuntary, or unconscious body language? Top tennis players interpret their opponent's body language to know what the return will be like even before the opponent starts his swing. A computerized system with that kind of gesture recognition might become an unbeatable tennis player.

I predict a boom for sign language courses!

BARRY MCKEOWN, RF and Microwave Engineer in the Defence Industry, and Director of Datod Ltd, UK: EyeSight or eyeSore? There are four types of human physiological real-time constraints: muscular, audio, visual and tactile. All can be overcome though no-one has successfully integrated all four into a real-time system; this objective could be one of the drivers for 5G technologies. The constraint driver for this technology is the vast differences in human hand-to-eye coordination between sportspeople, pianists through to the old, infirm and disabled. The initial choice of SmartTV is a natural evolution of game consoles, but I would prefer to await Apple entering this marketplace to see whether a universal human computer is making progress.

Gesture-controlled TV box is definitely the way forward. No more the need to search for the remote control unit, just wave your hand

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