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MAXIMUM IMPACT!

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MAR/APR 2017

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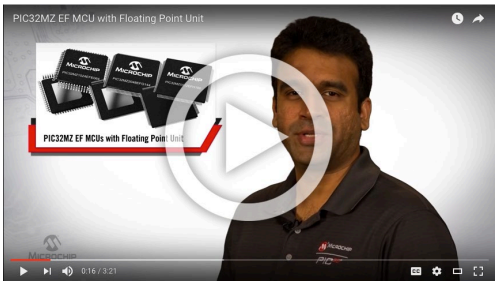
FEATURED VIDEO



PIC32MZ EF MCU with Floating Point Unit

Making Good Progress

Just under a year ago, Microchip completed its acquisition of Atmel Corporation. Over the intervening months, Microchip employees around the globe have been working tirelessly to support the integration process. Much of this activity is taking place in the background as we continue to deliver our technologies, products and support to customers. However, some of our most recent accomplishments are more visible to the outside world, and we wanted to share this news with you.

The process of blending two large websites that both offer a vast amount of technical content is a huge undertaking. After much planning and reorganization of the structure and importing of content, our web team recently launched a major update to the Microchip website. You can now go to **www.microchip.com** to discover how the former Atmel products have been added to our existing products and applications areas. You can also search for a specific device or document and use the "Design Support" link to get answers using our many resources or submit an online ticket to request assistance from our applications support team. Since a website is always evolving, expect to see additional improvements and refinements as we continue with this major integration project.

Other exciting news is that, for the first time, customers of products such as AVR® and SAM microcontrollers and their related development tools can now purchase them directly from the manufacturer. All former Atmel products are now available on **microchipDIRECT**, our full-service online store. Offering the largest available inventory of our products and complete 24/7 support, microchipDIRECT now delivers an extended product line to meet the needs of even more customers worldwide. Check it out today!

Our efforts to maximize our support and bring you information on our latest products and technologies during this journey will continue until the integration process is complete. Be sure to follow us on our newly combined social media accounts to get updates. We've also rebranded the "Atmel Makes" accounts to "Microchip Makes" to continue sharing cool projects and innovative designs with the maker community.

As always, we would be happy to get your feedback on MicroSolutions. Feel free to email us at **MSFeedback@microchip.com**.

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MAXIMUM IMPACT

Create Compelling Graphical User Interfaces to Make Your Product Stand Out

Free Visual Design Tools and Graphics Libraries Simplify the Design of PIC32 MCU-Based GUI Applications

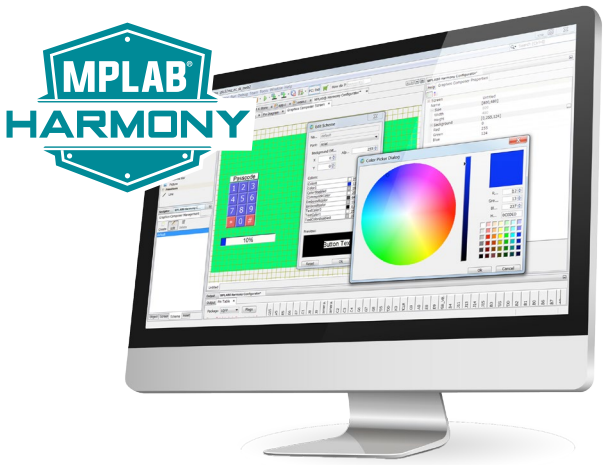
In today's competitive marketplace, an easy-to-use and well-designed Graphical User Interface (GUI) can often be the primary driver in brand recognition and customer preference for a specific product. However, most developers don't have any graphic design experience and sometimes lack the tools they need to create compelling GUIs. With our **Visual Design Tools**, we now make it easy for you to develop professional-looking GUIs for your 32-bit PIC® MCU-based embedded design without needing any special training or design skills.

This industry-leading complement of comprehensive visual GUI development tools, software graphics libraries and hardware tools is supported by the free **MPLAB® Harmony** software framework and offers you the choice of using two best-in-class tools: MPLAB Harmony Graphics Composer and SEGGER emWin Pro Library.

(continued on page 5)

MPLAB Harmony Graphics Composer

A modern and flexible GUI composer tool that can be used in designs that use PIC32 microcontrollers, MPLAB Harmony Graphics Composer (MHGC) is free and available through **MPLAB Harmony Configurator** and **MPLAB X Integrated Development Environment (IDE)**. It works in conjunction with the MPLAB Harmony Graphics Library and your own custom graphic assets to help you develop professional-looking GUIs without writing a single piece of code. It takes care of all configuration requirements and generates the necessary source code. MHGC's intuitive, user-friendly interface lets you easily import images and fonts and add them into your project. The tool also allows you to add, delete, move, scale and configure objects within the application. These objects can be interactive—including sliders, dials and buttons—without any need for you to understand the underlying graphics code.



If you have used MPLAB Harmony v.1x to create GUIs in the past, you should note that the latest release, MPLAB Harmony v2.02, incorporates a completely new graphics library and offers you even more features and advantages in creating GUIs. A migration guide is provided within MPLAB Harmony v2.02 that will assist you in enabling your designs in the new framework. Download the **Migration FAQs** for additional information or contact your nearest **Microchip sales office** if you need more assistance.

Industry's First GUI Tool for Configuring Your Own Display

The new Display Manager is the industry's first GUI-based tool for prototyping new and non-standard displays that are not supported in MPLAB Harmony. It brings relevant configuration settings to one screen to speed up the prototyping of new displays, cutting your development time from weeks to hours. It also offers seamless conversion of datasheet timing values to simulated timing waveforms. The adaptive LCC graphics driver supports standard and non-standard display resolutions and aspect ratios, lowering the barrier of entry for novice graphics developers.

MHGC Highlights

- Go from concept to glass in minutes without writing a single line of code
- Configure projects for your GUI requirements
- Drag and drop widgets and objects directly into the design with WYSIWYG design simplicity
- Extend your brand by importing custom images
- Design directly for MPLAB Harmony Graphics Primitive Library

SEGGER emWIN Pro

If you prefer, you may choose to use **SEGGER emWin Pro** as your graphics library and take advantage of its robust offering of widgets and shape drawings for applications that operate with a graphical LCD. It is RTOS independent, requires only an ANSI-compliant C compiler and enables you to take advantage of the SEGGER development tool chain and utilities. This library is available within MPLAB Harmony under license and available for free for use with our 16- and 32-bit PIC® MCUs and 16-bit dsPIC® Digital Signal Controllers (DSCs). Documentation and some demonstration examples are also available to assist you with your GUI development.

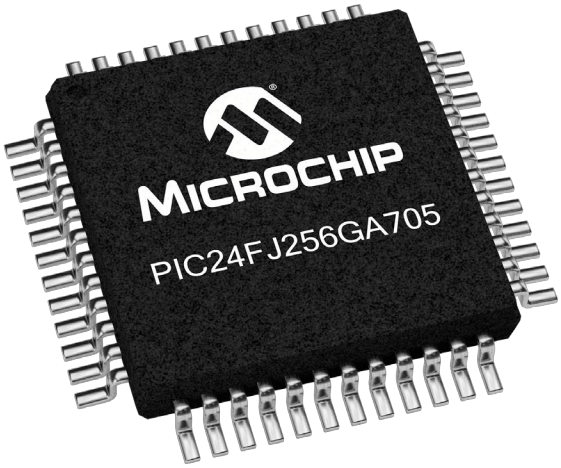
Ready to Create?

To help jumpstart your GUI development, our **Multimedia Expansion Board II** (DM320005-2) is a highly integrated, compact and flexible platform that works with our **PIC32MZ Embedded Connectivity with FPU (EF) Starter Kit**. It features a 4.3" WQVGA PCAP touch display, an on-board 24-bit stereo audio codec, a VGA camera, an 802.11 b/g wireless module, a Bluetooth® HCI transceiver, a temperature sensor, a microSD slot and an analog accelerometer.

If you're ready to give your next GUI design the maximum impact, simply download MPLAB Harmony software framework and MPLAB Harmony Graphics Composer MPLAB X plug in for free from the **MPLAB Harmony web page**. You will find a number of other helpful resources there too, including training materials, documentation and information on third-party tools and support to make it even easier to get started.

Tight Fit?

New 16-bit PIC® MCUs Deliver More Program Memory for Space-Constrained Designs



Low-Power and Low-Cost PIC24 "GA7" Family Meets Challenges of Designing for the Internet of Things and Other Applications

With such a vast assortment of microcontrollers (MCUs) available on the market today, designers of many of the latest high-performance and space-constrained applications face the challenge of finding the right MCU to meet all their requirements. While cost is always a factor, today's designers are also looking for devices that offer a wide range of features, low power consumption and more program memory in smaller pin count packages.

As the lowest-cost 256 KB Flash memory 16-bit MCUs available today, devices in our new 16-bit **PIC24 "GA7" family** provide a broad peripheral feature set and enhanced computation performance to enable extremely cost-effective designs for Internet of Things (IoT) sensor nodes, portable medical devices and industrial control applications. Their low-power modes include multiple sleep modes—down to 190 nA—to greatly decrease power consumption for extended battery life in portable applications at a fraction of the cost of previous solutions. These new devices also offer up to 256 KB Flash and 16 KB RAM and are available in 28, 44 and 48 pin count package options, some as small as 4 × 4 mm.

The new PIC24 "GA7" family offers an easy migration path if your application has outgrown its 8-bit PIC18 MCU platform.

Products in the PIC24 "GA7" family support Core Independent Peripherals (CIPs) such as Configurable Logic Cell (CLC), Multi-output Capture Compare Pulse Width Modulation (MCCP) module and Direct Memory Access (DMA), which allow you to accomplish tasks in hardware while freeing up the central processing unit (CPU) to do other tasks or go to sleep. These MCUs also feature a robust peripheral set including a 12-bit, 200 ksps Analog-to-Digital Converter (ADC), up to seven timers and two Universal Asynchronous Receiver/Transmitters (UARTs).

If your application has outgrown its 8-bit PIC18 MCU platform but does not require the numerical processing power of a Digital Signal Processor (DSP), then the new PIC24 "GA7" family offers an easy migration path. This extends the ability of applications to grow from the relatively simple to the powerful and complex. Regardless of the memory size, all devices share the same rich set of peripherals, allowing for a smooth migration path as applications grow and evolve.

Development Support

The new PIC24 "GA7" family is supported by the **Explorer 16/32 Development Board** (DM240001-2) as well as the new **PIC24FJ256GA705 Plug-In Module** (MA240039) which plugs

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into the Explorer 16/32 board for easy evaluation and development. You can also speed up your development by leveraging the "GA7" family's compatibility with our established software development platforms including **MPLAB® Code Configurator** (MCC), **MPLAB X IDE** and **MPLAB XC16 Compiler**.

The PIC24 "GA7" devices are also supported by **MPLAB Xpress Cloud-Based IDE**, which is an online development environment containing the most popular features of MPLAB X IDE. MPLAB Xpress incorporates the latest version of MPLAB Code Configurator, which enables you to automatically generate initialization and application C code using a graphical interface and pin map. Best of all, MPLAB Xpress IDE is free, and can be accessed from any Internet-connected computer, anywhere in the world.

NEW PRODUCTS

The PIC24 "GA7" family is available in 64 KB, 128 KB and 256 KB Flash variants with 28-pin, 44-pin and 48-pin packaging options. All devices are currently available from **microchipDIRECT** or from **Microchip's worldwide distribution network**.

Want More Information?

Visit the website at:

www.microchip.com/PIC24FJ256GA705

UPCOMING TRADESHOWS

Microchip Technology will be hitting the road in the coming weeks. We invite you to visit us at the following events to get a hands-on experience with out innovative products and latest technologies and to discuss your requirements in person with our expert staff. Mention you saw this ad and we'll give you a special gift at the show.

MARCH

Strategies in Light
February 28–March 2, 2017
Anaheim, CA

ECEDHA
March 19–20, 2017
Miramar Beach, FL

APEC
March 27–29, 2017
Tampa, FL

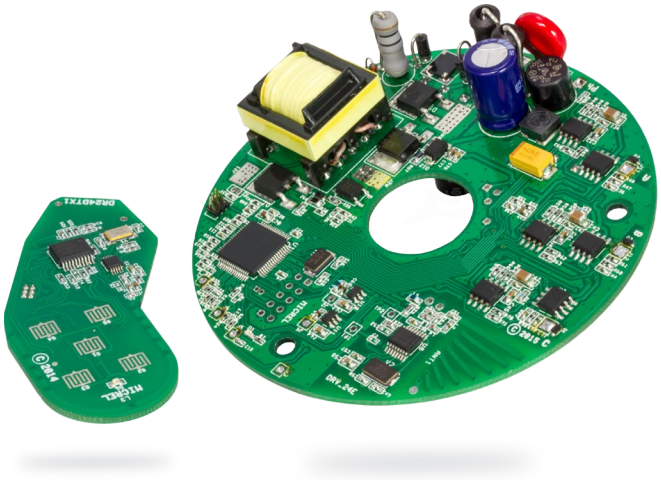
APRIL

Space Symposium
April 3–6, 2017
Colorado Springs, CO

IoT Developers Conference
April 26–27, 2017
Santa Clara, CA

Keeping You Cool

Designing a Cost-Effective, Energy-Efficient Fan with a Brushless DC Motor



Reference Design Features High-Performance dsPIC33 DSC and Wireless Connectivity for Remote Control Capability

Widely used in homes, businesses and industrial facilities, ceiling fans work in tandem with centralized air conditioning systems to circulate the air, helping to maintain a comfortable room temperature. In developing countries located in areas where the outdoor temperature can exceed 40°C, ceiling fans are sometimes the only way to keep a room cool. In many cases, multiple fans are used in a room. They might be running for 24 hours a day and driven at very high RPM rates to maximize the cooling effect. With the typical AC fan drawing approximately 100W, this can result in significant power consumption and high costs for the end user.

What if there was a way to drive a fan so that it could do the same amount of work using a quarter of the power? Our BLDC Fan Reference Design demonstrates how you can drive a fan at 300 RPM and only draw 25W, about the same amount of power that an LED bulb requires. This demo uses a Brushless DC (BLDC) motor and an electronic commutator to drive the motor. The commutator consists of active devices, such as the microcontroller and a power stage to drive the motor and power management devices to regulate power and connectivity devices.

Our BLDC Fan Reference Design demonstrates how you can drive a fan at 300 RPM and only draw 25W.

The **dsPIC33EP32MC202** is a 16-bit Digital Signal Controller (DSC) that features a 70 MIPS core with integrated DSP and enhanced on-chip peripherals. It enables the design of high-performance, precision motor control systems that are more energy efficient, offer quieter operation and have a great range and extended life.

> The dsPIC33EP32MC202 enables the design of high-performance, precision motor control systems that are more energy efficient.

Wireless connectivity is implemented via our Sub-GHz **MICRF220** receiver and **MICRF112** transmitter. The antenna is a PCB routing that is perfectly tuned to get the best reception despite being enclosed within a metal case. In this demo, the RF transmitter transmits at 433 MHz to offer a range of more than 20 meters. The design also includes our **MIC38HC44** AC/DC controller to convert the line AC voltage to 24V DC. This circuit uses a low-cost and highly efficient flyback topology.

(continued on page 9)

Passive Power-Factor Correction (PFC) is implemented to keep the power factor above 0.9, even during low-power conditions. Since the fan's DC motor runs on 24V, it is also easy to convert the design to run from a solar panel.

The motor commutator is a three-phase power stage controlled by the dsPIC33EP32MC202. This circuit uses three of our **MIC4605** 85V half-bridge MOSFET drivers and six MOSFETs to perform the six-step commutation that is required. The 85V operating voltage provides the flexibility to use 48V, 36V and even 12V motors. Since the MIC4605 needs biased voltage to drive the MOSFET, we used an **MIC4684** synchronous buck regulator with internal MOSFETs and adjustable current limit. This device provides 12V DC voltage to ensure the lowest $R_{DS(ON)}$ from the MOSFET, resulting in the highest power efficiency. The current limit allowed us to use the smallest inductor which reduces the BOM cost.

Since the dsPIC33EP32MC202 draws very low power, the 3.3V supply voltage can easily be driven from the 12V supply rail with our **MIC5235** low dropout regulator. This device requires a very small footprint and only an input and output capacitor, while also offering reverse current protection and polarity protection.

This BLDC Fan Reference Design is just one example of many motor control applications that can benefit from Microchip's complete ecosystem of solutions and development tools. Most of the same circuitry can be used for developing e-bikes, kitchen appliances, HVAC and many other motor-driven applications. Visit our **BLDC Motor Design Center** to learn more about our resources to help you design low-power, low-cost appliances and other products.

Want More Information?

Visit the website at:

www.microchip.com/BLDCmotor

Enjoy the Ride

Powering Infotainment Systems in Luxury and Ultra-High-End Sports Cars

Automotive designers around the world continue to turn to Media Oriented Systems Transport (MOST®) technology to enable high-quality, multi-channel digital audio streaming and high-bandwidth infotainment systems in their vehicle platforms. In fact, one of the most technologically advanced sports coupes in the world features MOST technology for powering the vehicle's premium surround sound audio and infotainment system. Pagani Automobili's Huayra BC supercar is using the OS81050 Intelligent Network Interface Controllers (INIC) to transport video, audio, packet and control data throughout the vehicle. **More information.**

Aston Martin Lagonda has been utilizing MOST technology for many years and has smoothly migrated from MOST25 to MOST150 technology for their latest vehicle. The DB11 is the first Aston Martin car to have its infotainment system based on OS81110 INICs, which offer dedicated, application-specific hardware interfaces to simplify data communication and meet Aston Martin's high quality standards for in-vehicle infotainment. **More information.**

MOST technology enables the deployment of a large variety of automotive premium surround sound audio systems and driver information systems such as full digital instrument clusters and heads-up displays. Audi has been using MOST150 technology for many years, deploying it in their best-selling A4 sedans, the Q7 SUV and TT coupé models. Their latest compact SUV model, the Q2, also employs MOST150 technology, utilizing our OS81110 and OS81118 INICs. **More information.**

Over the years, Daimler AG has contributed to the specification work on the MOST150 coaxial physical layer as a member of the MOST Cooperation physical layer working group. Since the MOST150 standard meets its future requirements, Daimler plans to use the OS81118 INIC with integrated coaxial transceiver as its next-generation infotainment platform. Daimler expects to significantly reduce costs by moving to coaxial cabling, while retaining all the benefits of their current MOST150-based systems and leveraging their existing designs for fast time to market. **More information.**

On the leading edge of the latest innovations in MOST technology, Microchip is the one-stop shop for approved MOST solutions. Visit our **MOST Technology Design Center** to learn more about high-bandwidth automotive multimedia networking.

Your Success is Our Success

Microchip Offers Award-Winning Technology and Expertise to Secure Your Internet of Things Design

In the fast-paced race to innovation, developers of solutions for the Internet of Things (IoT) can't afford to lose time in any aspect of their development process. One of the most time-intensive design challenges they face is the implementation of hardware-based security for the "things" that connect to the cloud. But the need for this type of security is real, as demonstrated in the high-profile Distributed Denial of Service (DDoS) attack that occurred in October 2016, taking down several major websites. The hackers were able to access the network via the software used in some home-based routers and surveillance cameras.

Our cover story for the **November/December 2016 issue of MicroSolutions** discussed how Microchip has recently collaborated with Amazon Web Services (AWS) to develop an end-to-end security solution for devices that connect to AWS IoT. Our **ATECC508-AWS** security co-processor adds a high level of security, simplifies the supply chain and is now one of the fastest and easiest ways to connect your design to AWS IoT. This device was recently honored with a **CES 2017 Innovation Award** in the Embedded Technologies category and it also was selected by the editors of Electronic Products as one of the winners of their **2016 Product of the Year Award**.

AWS IoT and the ATECC508-AWS device naturally complement each other with comprehensive mutual authentication security capabilities. The device removes the complexity of provisioning and storing private keys into hardware designs. It also has strong resistance against environmental and physical tampering including countermeasures against expert intrusion attempts. In addition, the device features a high-quality random number generator, the internal generation of secure unique keys and the ability to seamlessly accommodate various production flows in the most cost-effective manner. To ease your design phase, we offer the **Zero Touch Secure Provisioning Kit for AWS IoT** (AT88CKECC-AWS-XSTK) that allows you to seamlessly connect to the AWS platform while complying with AWS IoT's mutual authentication security model.

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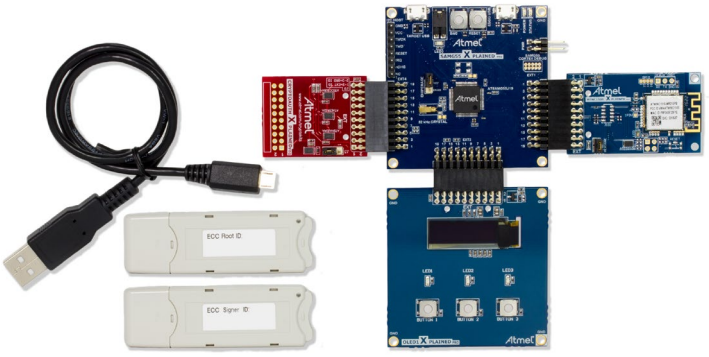
IoT COMPETENCY



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We are also pleased to announce that we have become an **APN Advanced Technology partner with IoT Competency** under the "Edge" category. With this designation, we are recognized as having proven technology and expertise to enable you to quickly and easily connect your embedded system to the AWS IoT. Our development kits and their preconfigured firmware reduce the complexity of developing your innovative ideas so you can successfully bring your product to market faster.

If you are ready to get started, visit our **Internet of Things Design Center** to discover how Microchip and our trusted IoT Platform Partners provide you with flexible, end-to-end solutions that will fit the requirements of your cloud design.

DESIGN CORNER

So Many Choices

CMOS vs. Bipolar Operational Amplifiers: Which is Best for My Application?

Today's system designer has many choices when it comes to selecting operational amplifiers (op amps). The three largest op amp manufacturers collectively have over sixteen hundred products from which to choose, and that doesn't include specialty amplifiers. How does one go about sorting through this overwhelming number of devices? One way to start narrowing down the options is to select the proper process technology. Most manufacturers clearly label an op amp as CMOS, bipolar or even BiCMOS, but what does this mean with regard to the actual application?

Power Consumption

CMOS is known for lower power consumption, as the transistors only draw current when switching states. However, this power advantage is only true for slower amplifiers. As the bandwidth increases, a CMOS amplifier's current increases dramatically, and soon draws more current then a comparable bipolar amplifier. Because of the exponentially increasing current in order for CMOS to achieve high speeds, bipolar op amps are typically better suited for high-bandwidth, high-slewing applications. For lower-bandwidth applications, CMOS amplifiers can still provide power advantages.

Noise Performance

In terms of flicker or 1/f noise, CMOS transistors have worse low-frequency noise than bipolar transistors. At low frequencies, this noise is dominated by irregularities in the conduction path and noise due to the bias currents within the transistors. In a bipolar transistor, the conduction path is buried down inside the silicon. On a CMOS transistor, the current flow is near the surface, making it susceptible to defects in the surface of the silicon, which increases the low-frequency noise. At higher frequencies, 1/f noise is negligible as the white noise from other sources begins to dominate. CMOS transistors have a lower transconductance relative to similarly sized bipolar transistors, which results in higher broadband noise. In general, bipolar op amps hold an inherent advantage over CMOS when it comes to noise performance.

Voltage Offset

Another important amplifier specification is input offset voltage. This error voltage can vary from microvolts up to millivolts and is highly dependent upon how well-matched the input transistors are. Bipolar transistors inherently offer better matching, resulting in lower offset voltages for a given architecture. Some manufactures compensate for this inherent mismatch by using laser trimming, fuses or even EPROM. These techniques can improve an amplifier's performance significantly, regardless of the process technology. Better matching also results in less voltage-offset drift over temperature, which is also an important consideration in many applications.

Price/Packaging

Historically, CMOS is known as a more cost-effective technology. This is mainly due to traditionally lower wafer costs, driven by the high volume of CMOS logic chips. Despite the lower wafer

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costs, for a given current capability, CMOS transistors take up more silicon area then bipolar transistors, resulting in a larger silicon dice. So, even though the wafer costs may be lower, there are less die per wafer, thus negating the cost benefit. In the end, the cost structure of these two process technologies is very similar.

A larger silicon solution also limits a manufacturer's packaging options. This can be a significant limitation, as system designers are constantly tasked with placing more performance and functionality into smaller and smaller form factors. Several packages, such as those with Ball Grid Arrays (BGAs) and leadless packages, help address this situation.

Input Bias Current

All amplifiers have a specification called input bias current. This is the amount of current flow into the inputs of an amplifier to bias the input transistors. This current can be thought of as leakage current, but is referred to as bias current when on the inputs of an amplifier. This bias current can range from picoamperes to hundreds of nanoamperes. Amplifiers with a CMOS input stage generally have less bias current when compared to an amplifier with bipolar input transistors, typically around 1 pA, while bipolar transistors can be orders of magnitude higher. This bias current is converted into a voltage through the input resistance of the circuitry and will end up resulting in an error voltage at the output of the amplifier. The less bias current the better, and in this regard CMOS has a distinct advantage.

Which Process is Best for Amplifiers?

This is a question that has been debated in the past and is expected to continue to be a point of discussion for years to come. Bipolar amplifiers are grounded in history, but CMOS amplifiers offer some inherent advantages. BiCMOS processes are the relative newcomers to the field, but this hybrid technology takes the best of both worlds and provides superior performance at a price point that is becoming more and more competitive.

So in the end the answer to the question of which process is better for amplifiers is, "It depends." You need to evaluate the function of the amplifier in your system and then determine which specifications are most critical. There is no universal amplifier or process technology that addresses all of the many applications in which op amps are found. This is why manufacturers will continue to provide a multitude of amplifiers on a variety of process technologies. It is up to you to determine which one is best for the given application. Visit our **Operational Amplifiers Design Center** to learn about our portfolio of products.

Python® Programming for Embedded Design

Facing the Software Challenges of the Internet of Things

Contributed by Zerynth

As we enter the Industry 4.0 era, the Internet of Things (IoT) will play a significant role in enabling automation and data exchange in manufacturing and other technologies. It facilitates the connection and data exchange between physical devices and applications to link real-life entities with the virtual world. During this period of exponential growth for the IoT, established designers and innovative startups are introducing disruptive technologies to the market. Embedded technologies based on connectivity/low-power modules and 32-bit microcontrollers are rapidly improving in terms of performance and unit costs.

The barriers to entry into this new technological environment are high. As the need for embedded programming to support the latest IoT designs grows, companies are finding it challenging to locate embedded engineers with the right knowledge and skills. This is not a new dynamic for the ICT sector. Ten years ago, server setup and programming was daunting to all but a few highly talented programmers. Today, setting up a server can be accomplished by almost anyone with moderate skills in computer science. This shift was due to a set of new technologies that decreased the complexity of server configuration and programming. Virtualization is now easily accessible with Docker™ computer software, while server-side applications are programmable in JavaScript, the language known by the majority of cloud connectivity developers.

Following this philosophy, Zerynth®, a Microchip Authorized Design Partner, reaches beyond professional embedded and IoT developers to also offer high-level programmers and product designers a complete set of high-quality embedded development tools for mobile and cloud integration. This enormous crowd of professionals is skilled in using the Python programming language to develop the firmware for the next big thing. Zerynth is the middleware for smart devices, IoT and Industry 4.0 applications. In other words, it is the “Android™ for the embedded world,” supporting applications in manufacturing, retail, robotics, home automation and all other market sectors where the IoT will play the leading role.

Zerynth tools manage clock and register configuration, allowing designers to focus on implementing value-added features and functions in their IoT solutions. Highly skilled embedded engineers can optimize these solutions without wasting precious time in rewriting basic code with every new project. This is made possible by the modular set of software tools that form the Zerynth Stack, which currently supports several Microchip MCUs, including SAM3X8 and SAMD21 devices, with support for PIC32 devices coming soon.

ZERYNTH®
Your Ideas. Embedded

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The Zerynth Stack consists of these components:

- **Zerynth Virtual Machine (VM):** a multi-threaded real-time OS that provides real hardware independence, allowing code reuse on a wide range of 32-bit MCUs. The VM supports most high-level Python features like modules, classes, multi-threading, callback, timers and exceptions. It also allows you to use custom hardware-related features like interrupts, PWM and digital I/O. RTOS threads written in C can exist alongside the VM, allowing for a mixed C/Python real-time environment.
- **Zerynth Studio (IDE and Toolchain):** an open-source, browser-based IDE (also available as Command Line Interface) that provides a platform for developing your Python or hybrid C/Python code and managing your boards. It includes a compiler, debugger and an editor, as well as tutorials and example projects for an easy learning experience.
- **Zerynth Connector:** a device manager compatible with many cloud providers (e.g., Microsoft® Azure®, IBM® Bluemix®, Amazon AWS), exposing a simple API-based interface for data gathering, actuation and mobile integration.
- **Zerynth APP:** a general-purpose interface for all network- or Bluetooth®-powered Zerynth objects that turns any mobile device into the controller and display for smart objects and IoT systems. You do not need to write any separate code for Android or iOS® systems.

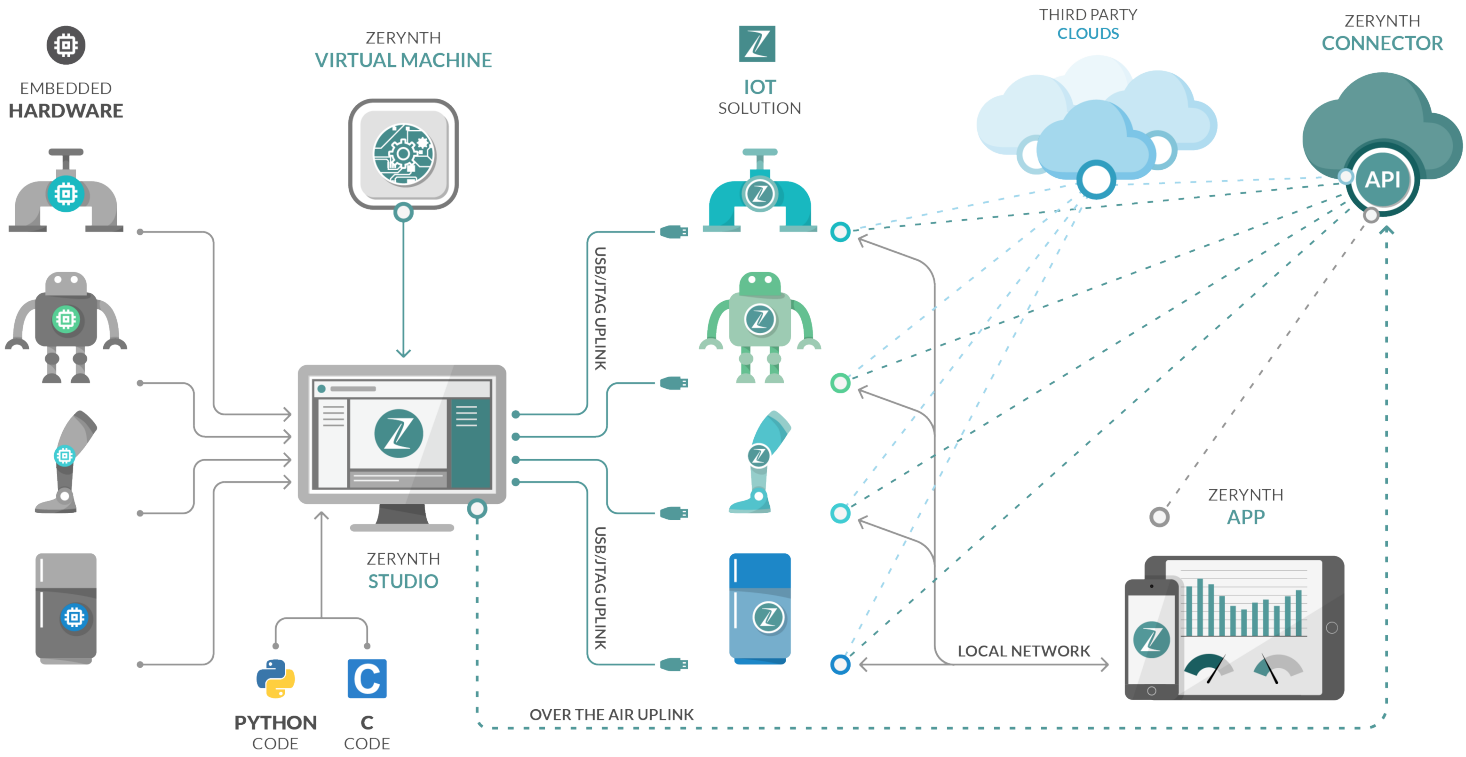

Figure 1: The Zerynth Stack allows you to connect your solution to a number of third-party cloud providers.

The advantages of programming with Zerynth include:

- Coding in Python or Hybrid C/Python with a multi-threaded real-time OS that requires a footprint of just 60–80K of Flash and 3–5K RAM
- Development of flexible, scalable and customizable IoT solutions with reduced development time and high reliability
- Cloud connection with the architectures that best fit with your needs
- Code reuse from your prototype, based on a Microchip MCU development board, to your industrial-grade solution, using Zerynth Virtual Machine (see Figure 2)

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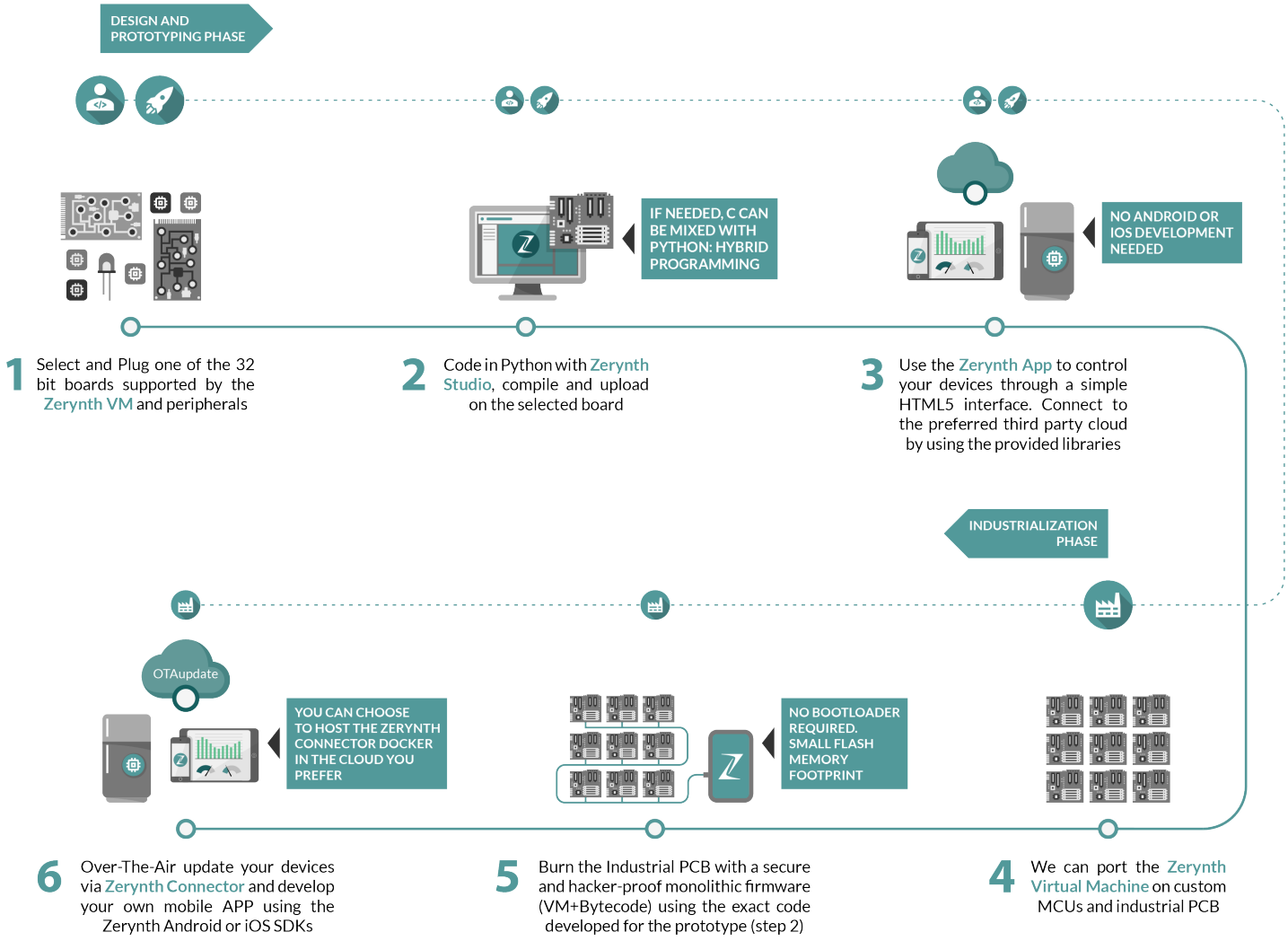

Figure 2: The Zerynth workflow from prototyping to production and update (over-the-air included)

As shown in Figure 3, a MikroElektronika **Flip and Click board** based on a SAM3X MCU has been used with Microchip's **RN2483 LoRa® 433/868 MHz modem** for the development of a temperature and humidity distributed logging network. The firmware is just 30 lines of Python code, as shown in Figure 4 on the next page. Data sent to the LoRa-based **The Things Network** server has been forwarded to the Zerynth Connector and is shown on a map-based web dashboard implemented with few lines of HTML and JavaScript (see Figure 5 on the next page).

If you'd like to get started with using Python programming for your IoT project, the Zerynth development environment can be downloaded for free at **www.zerynth.com**. The Zerynth Studio PRO version is also available to enable professional features including power saving, selectable RTOS, over-the-air updates of the firmware and hardware-driven secured firmware burned on the device at industrial volumes.

Figure 3: Mikroelektronika Flip and Click board mounted with the RN2483 LoRa® 433/868 MHz modem

(continued on page 18)

```
import streams
from Y.rn2483 import rn2483
from X.hts221 import hts221

streams.serial()

try:
   rst = D16
   appeui = "XXXXXXXXXXX" #TTN app ID
   appkey = "XXXXXXXXXXX" #TTN app key
   print("joining LoRa demo app...")
   if not rn2483.init(SERIAL1, appeui, appkey, rst):
       print("denied :(")
       raise Exception

   lat, lng = 43.65, 10.43 #device position

   temp_hum = hts221.HTS221( I2C1,D31 )
   for i in range(4):
       pinMode(LED1 + i, OUTPUT)
       digitalWrite(LED1 + i, LOW)

   while True:
       temp, hum = temp_hum.get_temp_humidity()
       print('temp: ', temp, 'hum: ', hum)
       print('lat: ', lat, 'lng: ', lng)
       data = bytearray(9)
       data[0:2] = bytearray([ int(temp) + 127, int((temp - int(temp)) * 100) ])
       data[2:4] = bytearray([ int(hum) + 127, int((hum - int(hum)) * 100) ])
       data[4:6] = bytearray([ int(lat) + 127, int((lat - int(lat)) * 100) ])
       data[6:8] = bytearray([ int(lng) + 127, int((lng - int(lng)) * 100) ])
       r = rn2483.tx_uncnf(data)
       if type(r) == PTUPLE:
           if r[1][0] == 120:
               for i in range(4):
                   pinToggle(LED1 + i)
       sleep(30000)
except Exception as e:
   print(e)
```

Figure 4: Python code for temperature and humidity distributed logging network

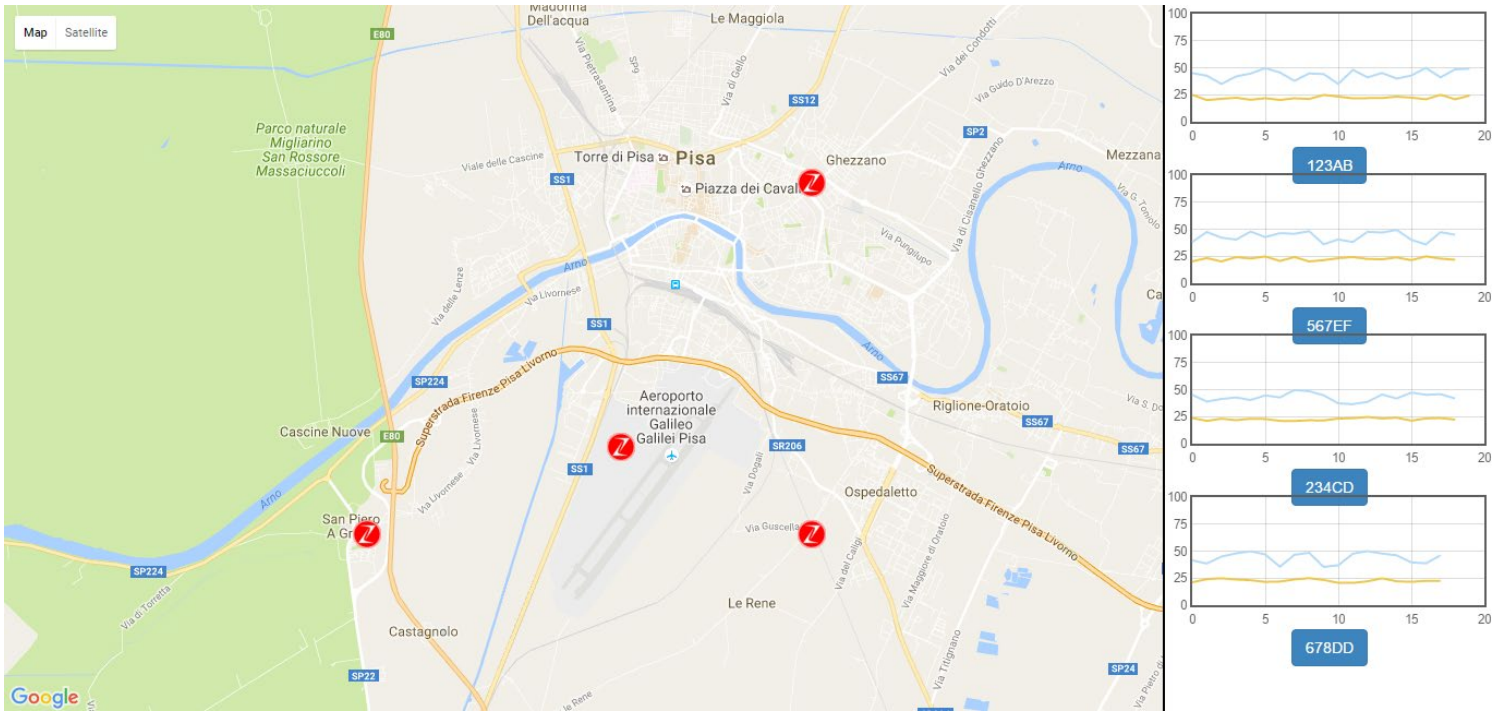

Figure 5: Map-based monitoring dashboard showing the positions of the nodes; selecting node icons opens a sidebar to display temperature and humidity charts

Professional Tools for Professional Results

SOMNIUM and Microchip Solutions for Optimized C/C++ Software Development

Contributed by SOMNIUM Technologies

Microchip's 32-bit SAM microcontrollers are designed to deliver performance, power efficiency and ease of use. Microchip provides a full range of software tools including the **Atmel Studio** C/C++ software development environment and the award-winning **Atmel START** innovative online tool for intuitive, graphical configuration of embedded software projects.

Combining Microchip's SAM 32-bit microcontrollers and software solutions with professional development tools from SOMNIUM® Technologies can provide even more benefits to help you get to market faster with your design fully optimized for cost, performance and energy.

Which IDE? You Decide!

SOMNIUM has teamed up with Microchip to offer SOMNIUM DRT products for developers seeking professional tools. Two DRT products are available for Microchip's SAM 32-bit microcontrollers:

SOMNIUM DRT Atmel Studio Extension – Enhances the Microsoft Windows®-hosted Atmel Studio Integrated Development Platform (IDP) to provide superior-quality C and C++ code generation. By providing an alternate toolchain, DRT seamlessly replaces the default GNU tools included with Atmel Studio to make SOMNIUM's patented resequencing optimizations available with no source code changes required.

- Build smaller, faster, more energy efficient software without changing your development environment—no source code changes required! Just select DRT as the toolchain

- Latest C/C++ language support, including C++ exception handling
- Full technical support direct from SOMNIUM's customer engineering team

SOMNIUM DRT, Cortex®-M IDE – SOMNIUM's advanced Eclipse-based IDE provides a choice of host operating system environments and offers the same patented code generation as the DRT Atmel Studio Extension, plus state-of-the-art embedded debug tools.

- Available on Windows, Linux® and macOS® operating systems
- Full compatibility with existing Atmel Studio and Atmel START projects - automatic project import
- Smallest, fastest, most energy-efficient code
- Latest C/C++ language support, including C++ exception handling
- State-of-the-art debug and trace (including live memory view without breakpointing) and SWO trace
- Full technical support direct from SOMNIUM's customer engineering team

(continued on page 20)

Advanced Code Generation

Memory is the bottleneck in embedded systems. It affects the cost of the chip, its performance and its energy consumption. To break this bottleneck, DRT uses SOMNIUM's patent-protected resequencing technology. DRT combines full, industry-standard GNU compatibility with commercial-quality functional correctness, size, performance and energy.

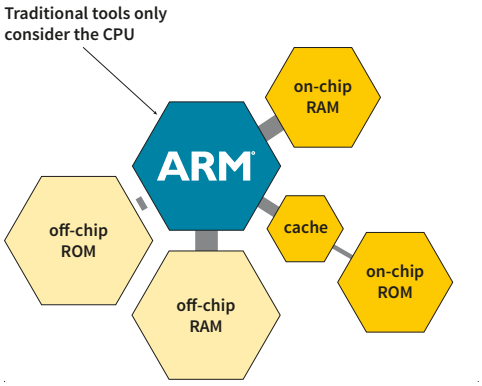

Figure 1: SOMNIUM® DRT optimizes for the whole system

Quality

DRT uses SOMNIUM's GNU-compatible tools that are fully debugged, bug-fixed and tested via commercial validation suites used for other certified ISO26262 tools. Unlike other vendors' proprietary compilers, DRT supports the latest C and C++ features, including C11 ISO/IEC 9899:2011, GNU99 and C++14/GNU++14. We take quality seriously so you can be sure that each release of DRT generates correct code with smaller, faster, more optimal results than the previous version.

Smallest, Fastest, Lowest Energy

Other commercial products freeload on the vanilla GNU ARM Launchpad tools. SOMNIUM's engineering team consists of experts in GNU internals and maintains tools for leading semiconductor vendors. DRT offers full GNU compatibility combined with patented resequencing linker and libraries to optimize your code to save memory and energy while delivering higher performance. Over 2,500 unique Atmel Software Framework examples built using DRT at -Os (optimize for size) show an average ROM reduction of 32% compared to vanilla GNU tools used in other products.

We play fair and do not put "benchmark special" defeat-devices in our products to change their behavior in the presence of known tests. We don't alter the benchmark source code, and we always use the same tool options to get an honest and fair comparison. We are members of the Embedded Microprocessor Benchmark Consortium (EEMBC®) Automotive subcommittee and use the CoreMark® benchmark to demonstrate that DRT not only reduces ROM and RAM usage, it also improves energy efficiency and performance.

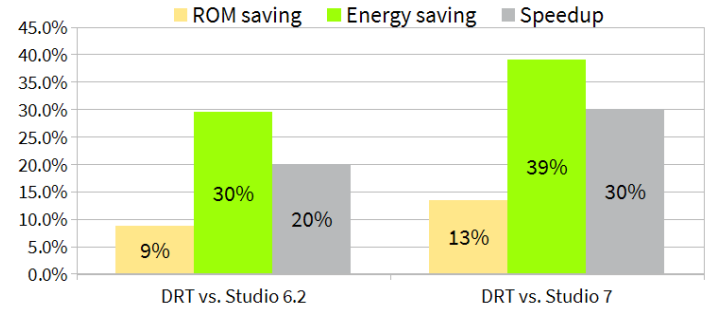

Figure 2: Comparing DRT to GNU tools in Atmel Studio – EEMBC® CoreMark® results for SAMD21 MCUs @ 48 MHz

The ASF SAMD21 USB CDC demo proves that DRT combines industry-standard code generation with a code size that is smaller than that of vanilla GNU and proprietary compilers from other vendors.

	ROM			RAM		
	KBytes	DRT saving (% and bytes)		KBytes	DRT saving (% and bytes)	
DRT	8.5	n/a	n/a	10.4	n/a	n/a
Atmel STUDIO	9.7	13.6%	1188	10.4	0.0%	0
IAR	9.6	12.6%	1103	10.3	-0.3%	-32

Figure 3: Comparison of ROM and RAM usage using DRT, Atmel Studio and IAR Embedded Workbench

Object Analyzer

DRT automatically optimizes your software, but it can be useful to understand where precious ROM and RAM resources are being used and how the usage changes as you develop your application. Rather than providing a dumb "GUI" version of the GNU objdump tool, DRT provides a unique object analyzer which compares multiple files, matching up the symbols so you can easily see and understand variations among different versions of your software.

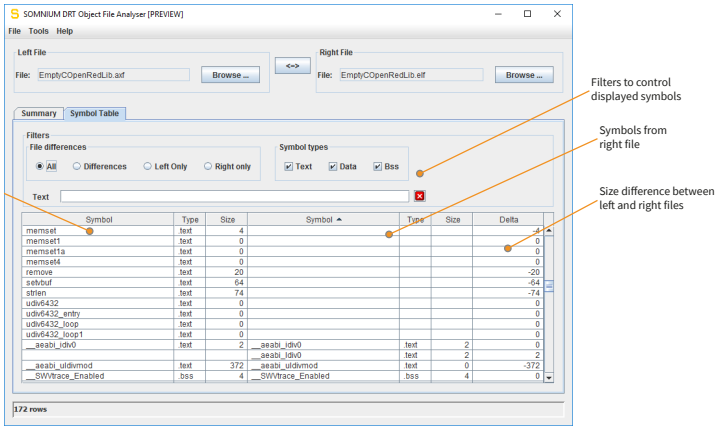

Figure 4: DRT Object File Analyzer

(continued on page 21)

Advanced IDE

SOMNIUM DRT Cortex-M IDE is a complete product using SOMNIUM's customized, industry-standard Eclipse platform, extended and simplified for ease of use and high productivity.

Unlike other vendors, we proudly modify the Eclipse sources, maintaining industry compatibility while fixing bugs and adding features to give you the IDE you deserve, not the one you inherit from uncurated Eclipse sources. DRT's IDE includes unique and easy-to-use New Project Wizards, a Quick Launch Bar for single-click debug, the QuickFix framework to automatically detect and correct project settings and a lightweight C/C++ static analysis tool to find and correct source code bugs.

Multi-platform – DRT is the only professional product available on Windows, Linux and macOS operating systems. DRT's unique QuickFix feature includes host operating system file-name checks so your projects can be moved seamlessly between your choice of host platforms, automatically.

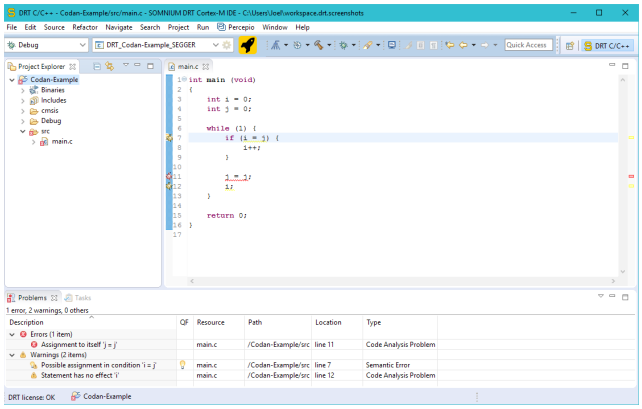

Figure 5: Lightweight C/C++ static analysis

Project Importer – DRT's unique project importer makes it easy to migrate your existing projects from Atmel Studio and import projects from Atmel START automatically. This makes it simple to migrate from existing tools to DRT's IDE and to benefit from Microchip's latest device support in Atmel START.

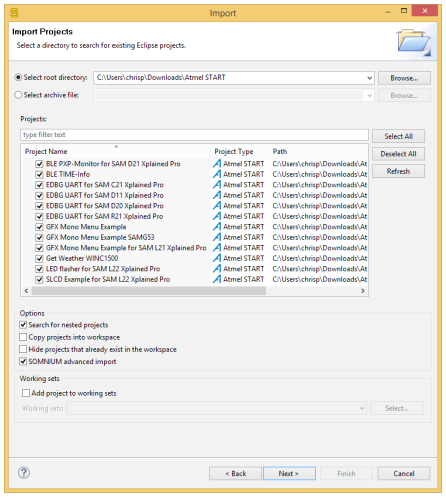

Figure 6: Project importer window in DRT

Debugging is Hard – Software systems are complex and debugging is hard. This is especially true for embedded systems where there may be real-time constraints on when data is received or sent, the timing of interrupts and so on. This means that traditional techniques, such as breakpoints or changing to code to print out state information, cannot be used because they will drastically change the timing and, therefore, the behavior of the program.

DRT offers advanced embedded debug, even for resource-constrained devices. The features provided in the DRT IDE are easy to use and don't require knowledge of the debug hardware. DRT takes care of them and configures everything required to give you an easy-to-use set of features. DRT supports PEMicro and Segger debug adaptors, including support for Microchip evaluation boards.

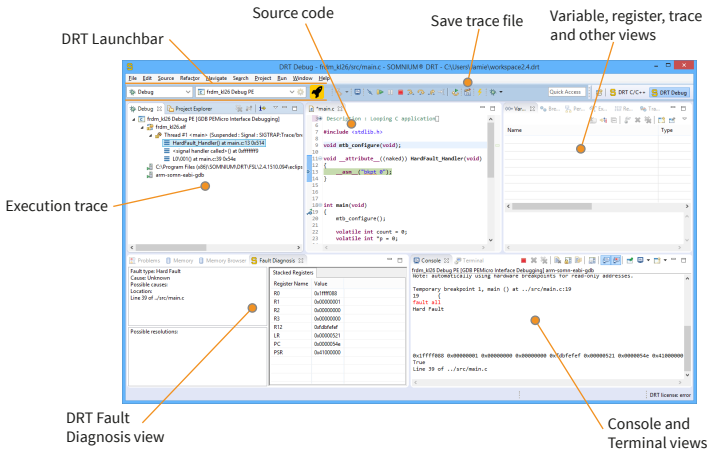

Figure 7: Multiple views available in DRT Debug

DRT's live memory view lets you access memory and variables while your program executes, without the need for breakpoints, so you can debug your hard, real-time, deeply embedded system. This is a hugely powerful feature, allowing you to see "continuous" streams of values such as data from sensors not just single values at a fixed point in time.

Program flow is often determined by asynchronous events, for example interrupts and exceptions. Sometimes it would be nice to step back through the code to see what the processor was doing before it got to its current state. DRT supports Cortex M0+ MTB trace to automatically configure and extract program trace so you can see exactly how your code's control flow behaves: how it reached a fault, or a breakpoint, or any point at which you want to extract the trace.

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When unexpected errors cause the program to behave unpredictably, such as writing to an invalid area of memory or executing an illegal instruction, it can be difficult to debug the cause. The ARM® architecture includes an exception mechanism to trap such faults. This is a powerful feature, but it can be difficult to understand the available information. DRT also includes a fault analysis tool that automatically decodes and explains ARM faults, letting you navigate to the source of the fault simply and quickly.

DRT's debugger also allows you to inspect the state of threads, mutexes and other objects in FreeRTOS. This feature allows you to inspect the state of the RTOS and doesn't require any additional code to be inserted into the RTOS itself. DRT also works with Eclipse plug-ins to support RTOS debug, allowing you to see this state in a visual form.

Efficient development of RTOS-based firmware requires good understanding of the execution, timing and interactions between RTOS tasks, interrupts and the operating system kernel. DRT provides close integration with Percepio Tracealyzer and includes a free-of-charge, feature-limited version. This offers 25+ graphical views into the runtime world that give amazing insight during debugging, validation, optimization, documentation and training.

Benefits of Professional Tools

Using SOMNIUM DRT will save you time and money. The combination of industry-standard compatibility, validated quality and patented code generation makes SOMNIUM DRT unique. DRT's close integration with Microchip's software ecosystem makes it easy for you to produce faster, more energy-efficient code to help you build the best embedded system design, while DRT's advanced debug features help you quickly find and fix bugs. Full technical support is available directly from SOMNIUM's team of tools experts.

If you would like to try DRT and see the benefits it can bring to your embedded system design, free-of-charge trials of DRT products and more information can be found at **www.somniumtech.com**. You can also see a demonstration of DRT in action by visiting SOMNIUM at Hall 4, Stand 4-170, or Microchip at Hall 1, Stand 1-500 at Embedded World 2017, March 14-17, in Nuremberg Germany.

Join SOMNIUM for a webinar on software development on Microchip's ARM-Cortex M based SAM devices using SOMNIUM DRT C/C++ development tools. We will guide you through the features and benefits of SOMNIUM DRT Atmel Studio Extension and the Cortex-M IDE, and give a complete demonstration of both products including DRT's advanced real-time embedded RTOS-aware debugging. This webinar will be offered on March 28 and March 29. For more information and to register, visit **www.somniumtech.com/webinar**.

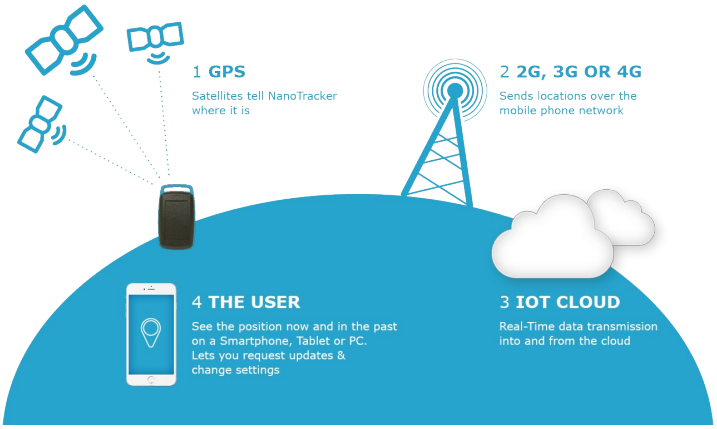
Where Are You?

Wearables for Worker Safety in the Oil and Gas Industry

Contributed by Round Solutions GmbH and Co. KG

The global oil and gas industry is very lucrative and well known for providing relatively high wages to its workers. While the industry has been an economic boon in many oil- and gas-producing regions, it comes at a cost: workers face many safety hazards that can lead to disabling or fatal injuries. Since the 1990s, the fatality rate has been **seven times higher** than the average for all other industries.

Some of the principal hazards that oil and gas industry workers face include being struck by objects, getting caught between or inside something, fires and explosions, falls, getting trapped in confined spaces and chemical exposure. Worker safety is a matter of serious concern, and new technological developments are emerging to provide better protection with the goal of reducing the risk of fatal accidents on the job.



The NonoTracker from Round Solutions offers advanced GPS technology

Wearable Technology for Location Tracking

As recently as ten years ago, GPS trackers were large, clunky devices found in vehicles. As technology has improved, the size of usable GPS devices has decreased dramatically, while their accuracy and reliability has improved. Today, GPS can be incorporated into devices small enough to be worn on one's wrist or even finger.

This advancement in GPS technology is clearly evident in the Round Solutions **NanoTracker**, a battery-powered wearable device that is about the size of a piece of candy. Measuring a mere 40 × 20 × 3.5 mm, the NanoTracker is one of the smallest GPS and 3G tracking devices available on the market today, but within its tiny package lies an impressive range of functions.

The NanoTracker not only detects the wearer's location via GPS, but it also offers several alarm functions that can be implemented to suit the needs of the specific application. It is equipped with a panic button that can be activated in an emergency to summon assistance. Geofencing is used to create an alert when the wearer leaves a predefined geographic area. Its integrated accelerometer monitors movement and if none is detected in the period of time that is set, the device automatically transmits an emergency call.

Designed to be carried in a pocket or on a key ring, the NanoTracker is suitable for a variety of everyday applications. Its rugged, long-lasting battery can last up to four days before

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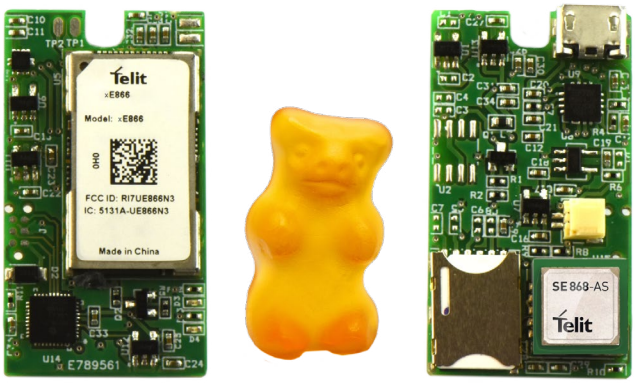
being recharged via USB, and its support for a wide range of temperatures makes it suitable for outdoor use in challenging climates.



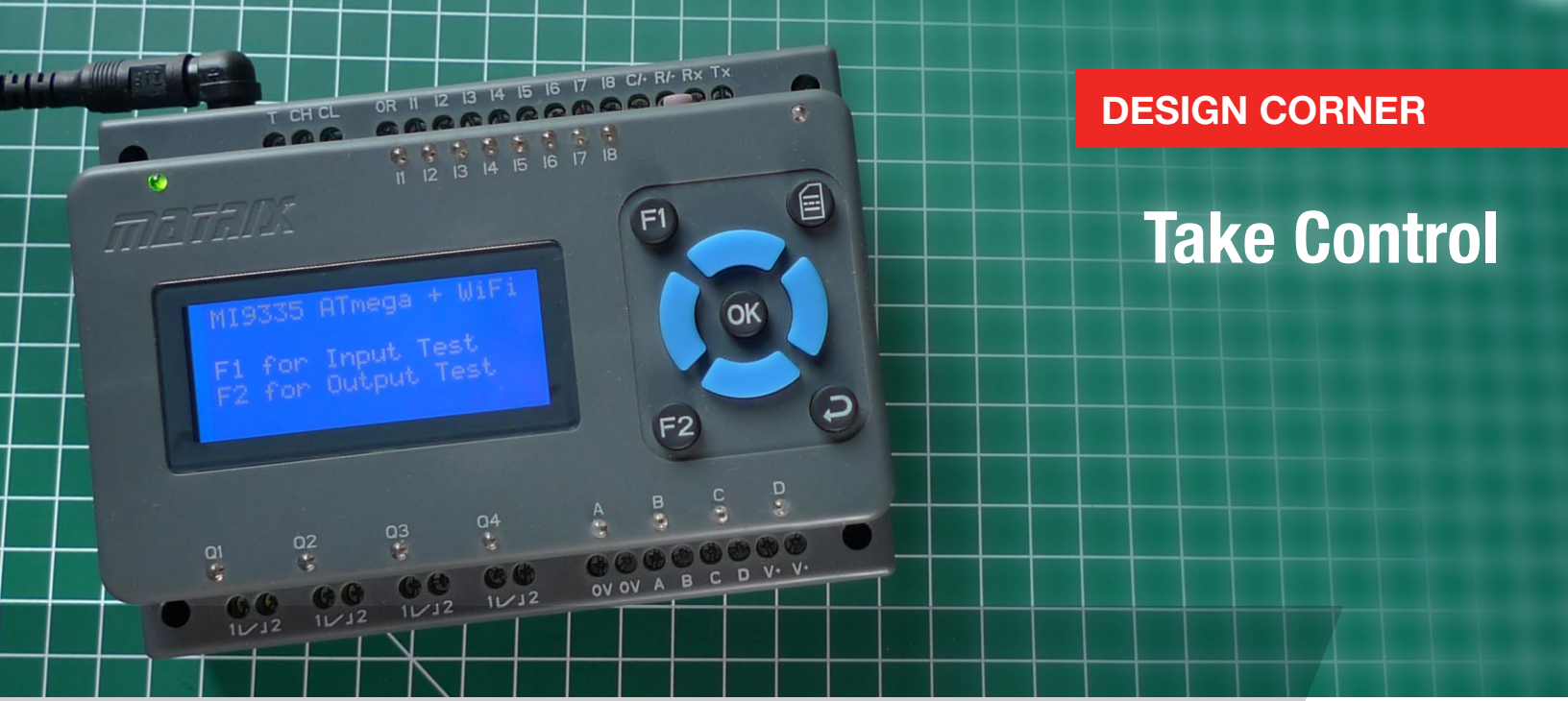
Not much larger than a piece of candy, the NanoTracker features a PIC18FK22 microcontroller

An 8-bit **PIC18F46K22** microcontroller (MCU) from Microchip is at the heart of the NanoTracker. This tiny MCU features eXtreme Low Power (XLP) technology, which improves the NanoTracker's battery life by 20%. Its compact size and combination of Core Independent Peripherals and analog features make it an ideal solution for use in miniaturized devices. Microchip's **MPLAB® Code Configurator** enables quick and professional development of source code for the PIC® MCU to suit a wide range of tracking applications.

A Lifeline in a Hazardous Industry

In the dangerous world of oil and gas production, a wearable device like the NanoTracker could be the difference between life and death. Its panic button could save the life of a worker who has become trapped, or it could immediately alert other personnel in case of a fire or chemical spill. If a worker accidentally wanders into an unsafe area on an oil rig or in a refinery plant, the geofencing capability alerts both the worker and the job supervisors. These are only examples of the myriad of possibilities for using NanoTracker. The new technologies that NanoTracker offers can help improve the safety and working conditions in many other industries.

For more information on Round Solutions products and services and to learn how to add wearable tracking to your application, visit **www.roundsolutions.com**.



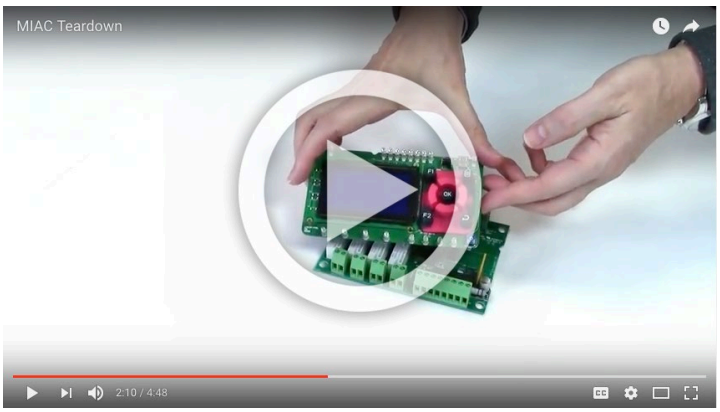
Take Control

Rugged, Programmable Controllers Take Designs from Prototyping to Professional Real-World Applications

Contributed by Matrix TSL

If you are active in teaching or designing electronics, you are probably well aware that a gap exists between developing prototypes and then transforming them into real-world industrial applications. While students, hobbyists and hackers have access to an overwhelming number of resources to bring their concepts to life more easily—the Raspberry Pi® and many boards based on the open-source Ardunio® protyping platform come to mind—there are few comparable solutions for the professional market. Electronic engineers developing rugged, industrial applications have been lacking a solution that could be easily programmed using C code or software like **Flowcode**.

Enter the **MIAC**, a fully specified industrial electronic controller designed to operate with typical industrial control voltages, offering 0-10V inputs, up to 24V motor outputs and 240V switching relays. It also includes serial interfaces for RS232, RS485 and CAN bus communications. The MIAC blends the ruggedness and power of a Programmable Logic Controller (PLC) with the flexibility and ease of microcontroller programming using your choice of development environment, from Flowcode to MPLAB® X IDE to even the Arduino IDE. Devices in the MIAC family are being used by a number of professional and private developers around the globe who are creating applications for a variety of markets.



MIAC Teardown Video

The 8-bit PIC® MCU-based MIAC was introduced several years ago, providing electronic engineers with a sensible, yet powerful controller that could be programmed in their choice of language. However, many users asked for a rugged industrial MIAC that offered a greater variety of controllers and development platforms to meet their requirements. To meet this demand, the MIAC family has recently been expanded to now include 16-bit dsPIC® DSC and Arduino-compatible AVR® MCU versions, with optional Bluetooth® and Wi-Fi® connectivity available. The following is a list of the MIAC controllers that incorporate Microchip microcontrollers.

(continued on page 26)

MIAC Version	Microcontroller	Part Number
8-bit PIC® MCUs	PIC18F4550	MI0235
16-bit dsPIC® DSCs	dsPIC33EP256MU806	MI5809
16-bit dsPIC DSCs with Wi-Fi®	dsPIC33EP256MU806	MI8615
16-bit dsPIC DSCs with Bluetooth®	dsPIC33EP256MU806	MI8759
Arduino® Compatible	ATmega1281	MI5466
Arduino Compatible with Wi-Fi	ATmega1281	MI9335
Arduino Compatible with Bluetooth	ATmega1281	MI3449

A 16-bit dsPIC® DSC MIAC automates key tasks for an independent source of mains power in Australia.

Flowcode and the MIAC

Flowcode 7, the flowchart-based IDE from Matrix, offers extensive support for all versions of the MIAC, making it even easier than before to construct a project or application for this rugged, programmable controller. Flowcode offers you the added advantage of simulating your application on screen for sanity checking and proof-of-design purposes before deploying your code to your MIAC hardware.

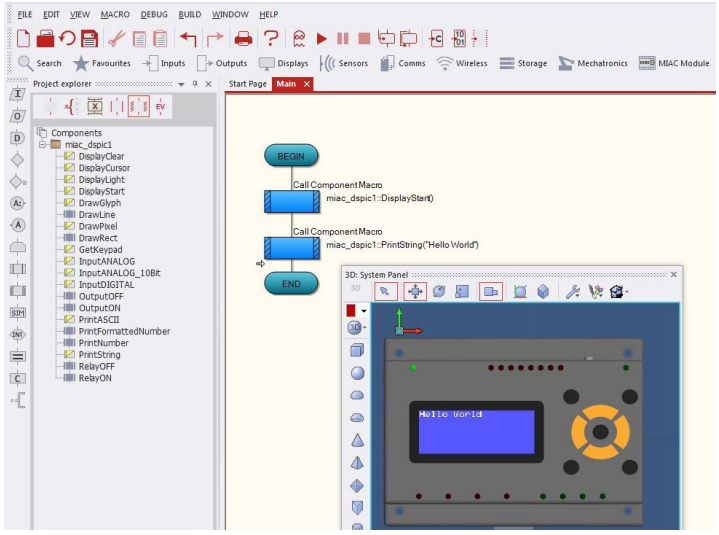


Figure 1: Simple Flowcode "Hello World" application with on-screen simulation

Figure 1 illustrates a new project using a MIAC (dsPIC DSC) as the target device. It shows how a "DisplayStart" and "PrintString" icon can be easily dragged from the Components list window on the left side of the screen to the workspace in order to build a flowchart for this simple application. When the "Play" icon in the toolbar is clicked, the software will run an on-screen simulation of the program. After simulation is complete and your program is ready for deployment to the MIAC, you just need to connect the MIAC to your laptop or PC using a USB cable and click the "Compile to Chip" icon.

Flowcode 7 Input/Output Demonstration

On the **MIAC Resources page**, you'll find Flowcode example programs that you can download for your choice of MIAC. The "InputOutput" example program demonstrates how to use the MIAC's basic inputs and outputs. The first thing you will see is a menu option screen. Press the F1 key to select the inputs test screen or the F2 key to select the outputs test screen. The inputs test screen displays all eight inputs as voltages. The outputs test screen allows you to use the right and left keys to select any output, and the up and down keys to turn the output on and off. The back key returns you to the menu. This example program shows how simple the keypad on the MIAC controller is to use.

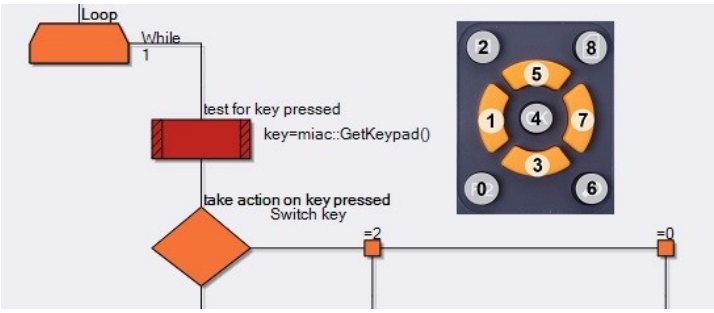


Figure 2: Testing MIAC "GetKeypad" function in Flowcode 7

In the section of the flowchart shown in Figure 2, the "GetKeypad" function returns a key value. This key value is then used to switch program flow. The value of the key returned is dependent upon which keypad is pressed, as shown in the inset keypad map. The switch in the flowchart compares the key value with 2 for the F1 keypad and with 0 for the F2 keypad.

It is also just as easy to use the MIAC's interfaces, like the analog inputs. In the section of the flowchart shown in Figure 3, the value of the Analog-to-Digital Converter (ADC) is being

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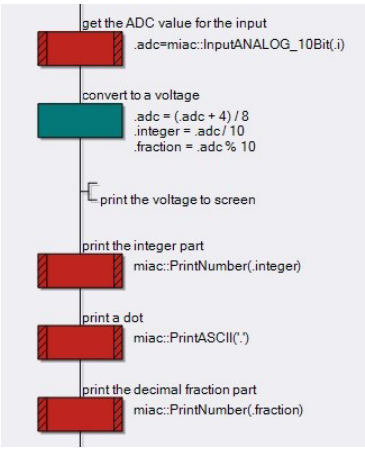
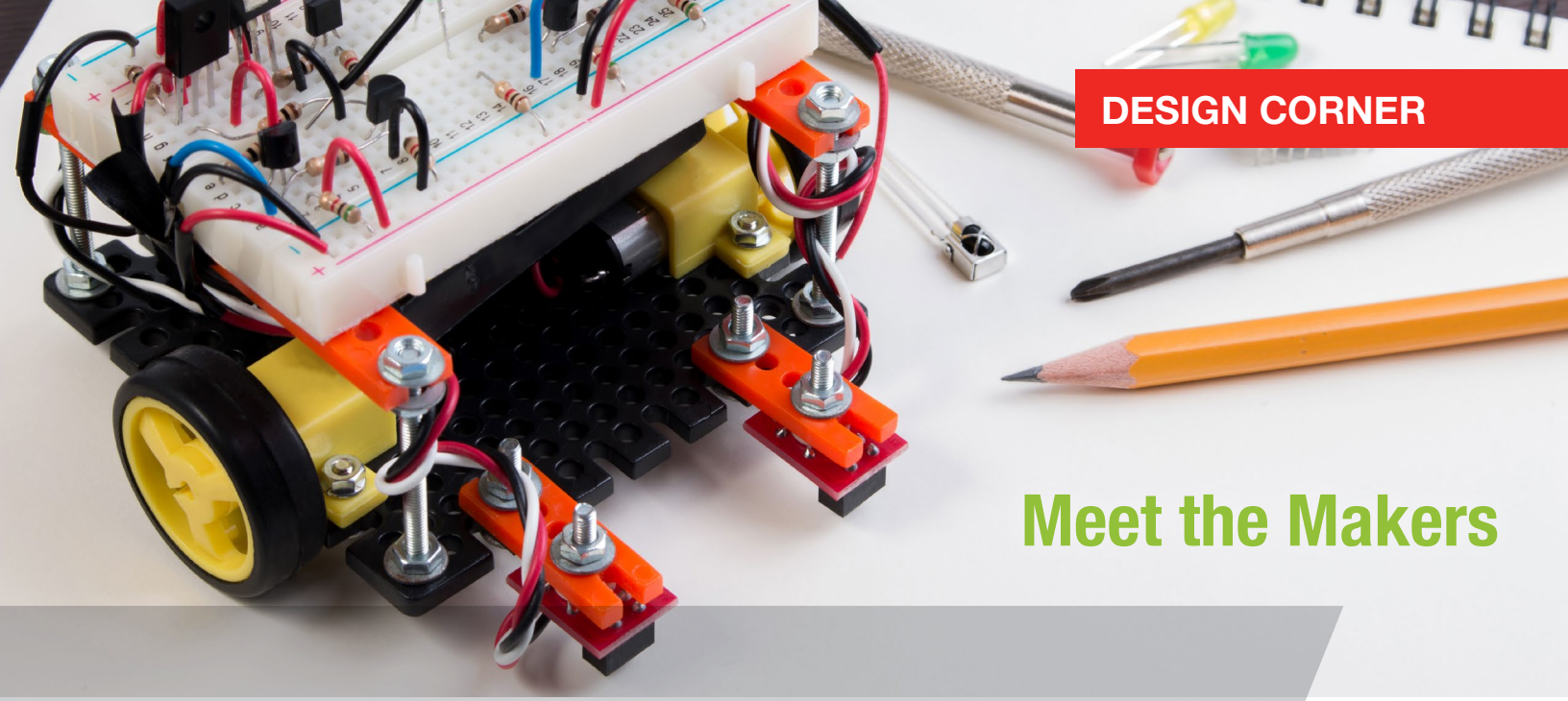


Figure 3: Converting the ADC value to display a voltage in numerical format

read for input channel 'i', where 'i' is a number between 1 and 8. The integer value "adc" is then converted into a voltage value, with one decimal place precision. The integer and fraction part of the voltage are then printed to the MIAC's screen with a decimal point separator. This is a code-efficient way to display the voltage. You can also use floating point numbers, as Flowcode supports these too.

These are just a couple of examples of how the Flowcode design environment can make it easy to leverage the features and capabilities of the MIAC industrial controller. Visit the **Matrix TSL website** to learn more and purchase the MIAC device of your choice.



Meet the Makers

Innovative Projects Using Microchip Devices Go from Concept to Prototype to Real Money Makers

With crowdfunding increasingly becoming a successful method for startups and individuals to raise funds, a significant number of creative technology projects have successfully transitioned from the Maker world to become viable products. Some are designed to make life easier or better, some serve the educational world and others are just intended for pure fun. We are excited to see that many of these innovative designs use our PIC®, AVR® or SAM MCUs and possibly some of our other devices. Here are some exceptional projects that caught our attention recently that we thought you'd enjoy as much as we do.

QuadBot 3D-Printable, Programmable Walking Robot

Approaching the world of robotics can be intimidating to those just starting out. EngiMate is aiming to change that with their Arduino® compatible robot, **QuadBot**. With an ATmega32U4 MCU at its heart, this engaging, crab-like robot is intended to be fairly easy to set up, yet it can also be expanded for use by experienced Makers. The open source, 3D-printed QuadBot is designed for users of any skill level. Beginners can configure their companion with graphical blocks, while more advanced users can customize and modify their device, from its 3D design down to a single line of C++ code.

The aptly named QuadBoard serves as the mechanical frame for QuadBot. In addition to its Arduino compatibility, it packs a number of features including 5V and 3.3V regulation for external sensors, a USB port for battery charging and programming, LiPo charging circuitry, eight smart RGB LEDs, a motor driver for up to 16 motors, universal motor mount holes and plug-in headers.

So what exactly can QuadBot do? Well, for starters it can walk, dance, light up, follow you around, avoid obstacles and play songs. As with many other Kickstarter campaigns, EngiMate offers the robot in various forms ranging from a low-cost Maker kit for those with access to a 3D printer to a full version complete with Bluetooth® connectivity.

The project was developed by Jack Scott-Reeve and Josh Elijah, who graduated with master's degrees from the University of Manchester's School of Electrical and Electronic Engineering. They are now looking ahead to their startup's future, following its successful crowdfunding efforts which garnered almost £50,000 from 375 backers.

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Go from Zero to Guitar Hero in One Minute with Fret Zeppelin

Who hasn't dreamed of becoming a rock star? Unfortunately, the biggest—and most critical—hurdle is picking up the guitar and learning how to strum. But what if there was a way to learn how to shred like the greats in under 60 seconds? That's now a reality thanks to Edge Tech Labs' **Fret Zeppelin**, an electric guitar coach that helps players learn quickly and intuitively without the constant distraction of books, videos or sheet music.

Designed to transform more traditional teaching methods, Fret Zeppelin features a slim design so it is easily installed on any standard guitar just above the frets. It uses AVR MCU-driven, color-changing LEDs to signal finger placement for any note, scale, chord or song. And, once you're proficient at playing your favorite tunes, those LEDs can be used to create fun light shows.

The Fret Zeppelin pairs with an accompanying Android™ or iOS® app, which can be used to show a song's chords, display tabs, program the lights and even tune a guitar.

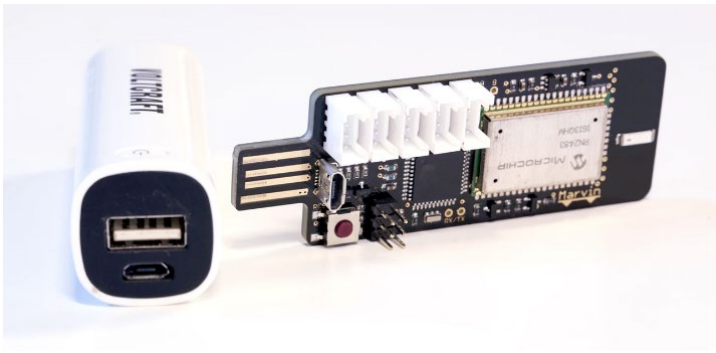
At the time of writing this summary, 774 backers for Fret Zeppelin had almost tripled the $48,000 goal, making this cool project a huge hit.

Have You Met Marvin, a Plug-and-Play IoT Development Board?

Created by the Rotterdam-based RDM Makerspace team, **Marvin** is a plug-and-play development board for rapid Internet of Things (IoT) prototyping. It is intended to provide an easy-to-use first step in developing projects that leverage the low-power, long-range LoRa® wireless networking technology that is rapidly becoming a significant player in the IoT landscape.

Marvin is equipped with the same core as the popular Arduino Leonardo—the mighty ATmega32U4 MCU—along with an RN2483 LoRa module for sending data on compatible 868 MHz European networks, such as the KPN LoRa network, the Belgium Proximus network and The Things Network. It is even compatible with Grove sensors.

The team successfully ended its Kickstarter campaign back in December, with €23,185 pledged by 178 IoT enthusiasts.



LittleArm 2C is a Mini Arduino Robot Arm for STEM Education

A prime example of a Maker taking an idea from the workbench and turning it into an actual product, the **Little Arm 2C** met its crowdfunding goal in under a week. In 2016, Slant Concepts founder Gabe Bentz built a small robotic arm using an Arduino Uno and his 3D printer. After receiving numerous requests from fellow do-it-yourselfers to turn it into a kit, Bentz did just that.

The latest version, LittleArm 2C, was brought to life using an Arduino Nano (powered by an ATmega328 MCU), with hopes of introducing more children to the STEM disciplines. According to the campaign summary, the "C" stands for several concepts. The design is clean with no rough edges or wires "flapping out in the breeze." Also, the LittleArm 2C is easy enough for a 6 year old to put together with adult supervision and is practically child proof. Also, although there might be some electrical or software expansions in the future, the design is essentially complete.

The robotic arm can programmed from scratch using either the Arduino IDE or graphical tools like BlocklyDuino, and features a Bluetooth module so it can be trained using LittleArm's smart-phone and desktop app. Resources are available on the LittleArm website to enable the learning experience. The LittleArm 2C is available as a kit that can be assembled in about 15–30 minutes, or fully assembled to get started with the fun right away.

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Open-Source Tiny-TS Synthesizer Fits in the Palm of Your Hand

We've seen plenty pocket-sized synthesizers in the past, but Jan Ostman's creation may be the smallest playable one yet. No larger than a credit card, **Tiny-TS** is an open-source device with a one-octave capacitive touch keyboard.

The synth includes an ATmega328 MCU for its brain, audio/CV/gate outputs and six parameters adjustable by a series of potentiometers: DCO (coarse pitch and double), DCF (filter peak and ENVmod) and ENV (attack and release affecting amplitude).

If you're intrigued by this mini music maker, you're not alone. Tiny-TS attracted the interest of nearly 150 backers on Kickstarter who helped to more than double the funding for this project.

This is just a small sampling of the many projects we encounter as we search the various Maker and hacker channels. If you found these examples interesting, stay tuned to future issues of MicroSolutions to meet more Makers and learn about their amazing projects.

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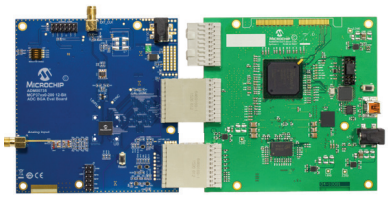

12-bit 200 Msps ADC BGA Board with High-Speed Pipeline ADC Data Capture Card (ADM00735 and ADM00506)

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