MORE POWER TO YOU

BATTERY
FULL

USB POWER DELIVERY CONTROLLERS USE SINGLE CABLE
TO DELIVER 100W OF POWER AND TRANSMIT USB DATA

Contents

EDITOR'S NOTE

There's a Tool for That

Did you know that Microchip provides over 900 different development tools? We realize that designing applications comes with many challenges, so we offer an assortment of software and hardware components to make it easier for our customers to develop projects that use Microchip devices. We want to do all that we can to make your design a success.

For developing embedded systems using our PIC® microcontrollers, we offer software like the MPLAB® X Integrated Development Environment, MPLAB XC compilers, debuggers/emulators, design libraries and sample code. From starter kits for beginners to highly functional application-specific development kits, our hardware tools support a wide range of our products. We provide extensive documentation, video tutorials, online training and support and other resources to go along with our tools. On top of that, we also work with trusted third party tool providers, leveraging their particular areas of expertise to offer you additional design support.

How can you find the right development tools for your next project? Our website offers you several different ways to do this. Check your product's page and you should find the related development tools listed there. You can also use our Development Tools Selector (DTS), which allows you to view development tools through a graphical user interface (GUI) with filter and search capabilities to easily find the development tools associated with your product. Our development tools are also available for sale from microchipDIRECT, which also has powerful search capabilities.

So, when you need help with your next project, you can count on Microchip to offer you the right tools to help get the job done.

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

Find us on these social channels:

[Facebook] [Twitter] [YouTube] [LinkedIn] [Flickr]

More Power to You

New Family of USB Power Delivery Controllers Features Industry-Standard Power Delivery and Battery Charging Protocol

UPD100X Increases Overall System Performance Capabilities in Latest Consumer Devices

Use a single USB cable for data and to simultaneously deliver up to 100W of power from a single, standard USB port.

Each new generation of consumer products has presented connectivity challenges. The USB ecosystem has had to evolve to meet user expectations for faster access to data and easier connections to peripheral devices. Microchip is committed to improving the consumer's entire USB experience and offers an assortment of devices developed to ease the implementation of USB connectivity in a wide range of applications.

Today's smaller and more portable consumer products offer the dual challenge of transmitting data and battery charging via the USB port. To address this need, we've recently introduced our **UPD100X** family of USB power delivery (UPD) controllers which feature an industry-standard power delivery and battery charging protocol. These controllers allow a single USB cable to be used for data and to simultaneously deliver up to 100W of power from a single, standard USB port. This is 40 times the power available with USB 2.0, allowing you to dynamically allocate this power to fast battery charging and system power in your product's design.

The first device in the family, the UPD1001, is a highly flexible and configurable solution. It supports the five USB-IF standard UPD power profiles, plus an additional 25 UPD-compliant profiles, for a total of 30 profiles supported by a single chip. This will allow you to select the optimum power profiles to meet your specific application requirements. Simple configuration is achieved by strapping the two configuration select pins on the UPD1001. A multitude of configurations are available to provide utmost flexibility. Integrated quad-banks of one-time programmable memory allow for further system customization without the need of any external memory components.
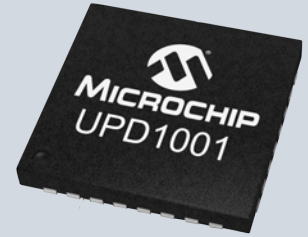
A total of 30 UPD power profiles are supported by a single chip.

The UPD100X family serves a wide range of applications. In the consumer market, it can be used in notebooks, printers and accessories, docking stations, mobile devices and battery chargers. It also will support computers and handheld devices used for industrial applications, and in the automotive market it is well-suited for head units, break-out boxes and USB battery chargers. Development with the UPD1001 is supported by the UPD1001 Evaluation Kit (EVB-UPD1001).

If you'd like to learn more about how the UPD100X devices can help you deliver 100W of power while transmitting USB data over a single cable of connectivity in your next product, contact your local **Microchip sales office**.

Driving Down Costs

MCP8063 Motor Driver is Automotive AEC-Q100 Qualified, Highly Integrated and Compact; Provides High Performance and High Current
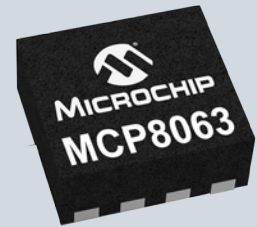
World's First 1.5 Ampere, Three-Phase Brushless DC, Sinusoidal Motor Driver in a 4 x 4 mm Package with the AEC-Q100 Quality Certification

The MCP8063 includes safety features such as thermal shutdown, over-current limiting and lock-up protection.

Designers of a broad range of motor applications in markets such as the automotive, IT, industrial and home-appliance sectors are faced with increasing regulatory and consumer demands for continued reductions in cost, space, noise and power consumption while also having to deliver better performance and safety.

To effectively solve these design challenges, the MCP8063 is a highly integrated, cost-effective, automotive AEC-Q100-qualified motor driver that delivers superior performance in a small, 8-pin, 4 x 4 mm DFN package. It is also the world's first motor driver to combine all of these features with 1.5A peak phase current for the 180-degree sinusoidal drive of a variety of three-phase brushless DC motor and fan applications. This integration reduces cost and PCB area, and the high sinusoidal-drive performance provides high efficiency, low acoustic noise and low mechanical vibration for energy savings and quiet operation.

This integration reduces cost and PCB area.

Additionally, the MCP8063 includes safety features such as thermal shutdown, over-current limiting and lock-up protection while also providing a wide operating temperature range of −40 to +125° Celsius. It also supports the sensorless driving of BLDC motors, which eliminates the cost and space of a Hall sensor.

The MCP8063 motor driver works stand-alone or in conjunction with our large portfolio of PIC® microcontrollers and dsPIC® digital signal controllers. This offers a high degree of flexibility for everything from simple voltage control to closed-loop motor speed control using high-performance algorithms, such as sinusoidal sensorless drive.

Development Support

To assist you in your project development, the MCP8063 12V 3-Phase BLDC Sensorless Fan Controller Demo Kit (ADM00575) includes a user-friendly configuration GUI to enable development with the new MCP8063 motor driver. We also offer a full range of development solutions, including firmware, algorithms, application notes, development tools, evaluation boards and reference designs in our Motor Control and Drive Design Center.
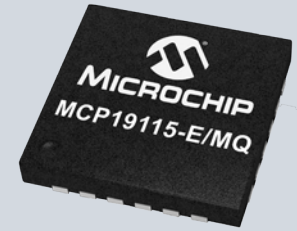
Our new MCP8063 provides a complete single-chip solution at attractive price points for your three-phase, brushless DC applications. It is available now for purchase from Microchip's worldwide distribution network or it can be ordered from microchipDIRECT.

Flexible Power Topology Design

MCP19114/5 Family Provides Flexible, Analog-based Solution for DC/DC Power-Conversion Applications

Introducing the Latest Additions to Microchip's Portfolio of Digitally Enhanced Power Analog Controllers with Integrated MCU

The MCP19114/19115 offer cost-efficient adjustability in a high-performance power conversion solution.

Devices in our Digitally-Enhanced Power Analog portfolio combine a high-performance analog PWM controller with a small, low-power, fully functional 8-bit microcontroller (MCU). Together they offer a fast and highly efficient solution typical of analog controllers with the configurability only found in high-end digital controllers. These products support configurable, high-efficiency power-conversion designs across a broad array of consumer and automotive applications.

With the introduction of the MCP19114 and MCP19115 devices, our diverse range of intelligent DC/DC power-conversion solutions grows to include controllers supporting flyback, boost and SEPIC topologies. These latest devices introduce a step-up PWM-controller and low-side MOSFET driver architecture, with a mid-voltage LDO and fully-functional MCU, all integrated into a small, high-density power package. This solution continues to offer the power conversion performance typical of an analog-based controller, with the flexibility approaching a fully-digital power conversion solution.

The MCP19114 and MCP19115 hybrid digital-analog control solutions offer the speed and responsiveness expected of

These devices operate across wide operating voltage ranges.

a high-performance analog control loop; the flexibility expected of a digital MCU; operate across wide operating voltage ranges; support conventional 5, 12, and 24V rails; and meet automotive load dump requirements. They support operation up to 42V, and have integrated MOSFET drivers configured for step-up applications. As the latest devices to use our highly flexible and highly configurable, DC/DC PWM controller technology, they continue to expand the capabilities of high-efficiency analog solutions, enabling new levels of flexibility and optimization, in a very small footprint.

Development Support

The MCP19114 Flyback Standalone Evaluation Board (ADM00578) offers a flyback design supporting 0V to 50V output from an 8V to 14V input. Our full suite of development tools support the MCP19114 and MCP19115 power controllers, including the MPLAB® X Integrated Development Environment (IDE), PICkit™ 3 (PG164130), PICkit Serial Analyzer (DV164122), and the MPLAB XC8 Compiler.

If you'd like to use the MCP19114 or MCP19115 in your next DC/DC power-conversion design, they can be purchased from Microchip's worldwide distribution network or ordered from microchipDIRECT.

Memory for Old and New

New SPD EEPROM Device Is Designed to Meet New DDR4 Standard for PCs and Laptops

34AA04 4Kb I²C™ Serial Presence Detect (SPD) EEPROM Also Supports Older DDR2/3 Platforms

The 34AA04 is JEDEC JC42.4 (EE1004-v) SPD compliant for the next generation of DDR4 SDRAM modules.

Under development for several years, Double Data Rate 4 (DDR4) memory will benefit a variety of applications including servers, PCs and laptops. It will allow significantly better performance while decreasing power consumption. Over the years, we have supported the DRAM market with Serial Presence Detect (SPD) EEPROMs in prior DDR1, DDR2 and DDR3 platforms. We have recently introduced the 34AA04, a new 4 Kb I²C SPD EEPROM device which is specifically designed to work with t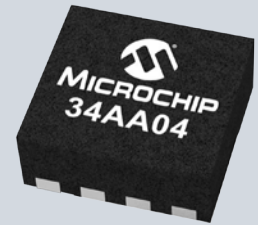he next generation of DDR4 SDRAM modules used in high-speed PCs and laptops, while also providing support for older DDR2 and DDR3 platforms.
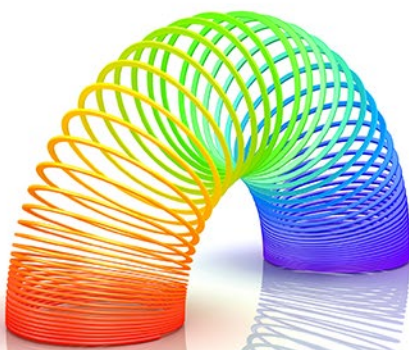
The 34AA04 is JEDEC JC42.4 (EE1004-v) SPD compliant and is capable of operation across a broad voltage range (1.7V to 3.6V). It includes reversible software write protection for

The 34AA04 is capable of operation across a broad voltage range.

each of four independent 128 x 8-bit blocks and supports a new SMBus compatible bus time out. The device features a page write capability of up to 16 bytes of data and three address pins allow up to eight devices on the same bus.

The 34AA04 serves a wide range of applications including those in the cost-competitive PC, laptop and graphic card markets. To ensure backward compatibility with existing DDR2 and DDR3 SPD EEPROMs, the memory array of the 34AA04 is divided into two separate 256-byte banks to overlay with the architecture of older SPD EEPROM devices.

The 34AA04 devices are available in 8-pin SOIC, TDFN, UDFN, TSSOP and PDIP packages. You can purchase them from Microchip's worldwide distribution network or they can be ordered from microchipDIRECT.

Code Storage

SST38VF6401B 64-Mbit Parallel Flash Memory Device Is Manufactured on Advanced Process Technology

Delivers Ultra Fast Performance and Rich Security Features for Embedded Applications
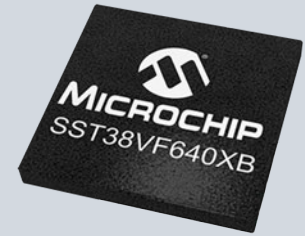
The SST38VF6401B offers high performance with flexible read and write options.

Reinforcing our steadfast commitment to deliver code storage solutions to automotive, industrial and consumer markets, we recently introduced a new parallel Flash memory device—the SST38VF6401B. It is a 4M x16 CMOS Advanced Multi-Purpose Flash Plus (Advanced MPF+) device manufactured with our high-performance CMOS SuperFlash® technology, a split-gate cell design and thick-oxide tunneling injector for better reliability and manufacturability. This device conforms to JEDEC standard pin assignments for x16 memories.

With an operating voltage range from 2.7 to 3.6V, fast read and program times, and advanced protection features this parallel Flash memory device excels in a variety of applications. The memory is partitioned into uniform 32 KWord and non-uniform 8 KWord blocks, offering flexible erase capabilities and seamless partitioning for program code and data.

The SST38VF6401B parallel Flash device offers high performance with flexible read and write options, including random read access time of 70 ns, page read access time of 25 ns, erasing sectors and blocks as fast as 18 ms, erasing the entire Flash memory chip in 40 ms, and a word-programming time of 7 µs, write-buffer programming time of 1.75 µs, typical. The device offers superior reliability of 100,000 endurance cycles, typical, and greater than 100 years of data retention. The active read current of these devices is only 25 mA, typical, at 5 MHz, and standby current is only 5 µA, typical. The SST38VF6401B also provides various levels of protection and security features such as Security-ID, hardware boot-block protection, individual block protection, password protection, and irreversible block locking.

This parallel Flash memory device excels in a variety of applications.

Developed for a broad range of applications—including those in the consumer, automotive and industrial markets—the SST38VF6401B is well-suited for end products such as set-top boxes, multi-functional printers, digital televisions, as well as audio, video and infotainment products for automobiles. It can also be used in networking and industrial applications, such as gateways, switches and industrial control equipment.

The SST38VF6401B devices are available in 48-pin TSOP and 48-ball TFBGA packages. You can purchase them from Microchip's worldwide distribution network or they can be ordered from microchipDIRECT.

Energy-Efficient e-Paper Design

New Electronic Paper Display Development Kit Is Driven by eXtreme Low Power PIC® MCU

The EPD PICtail™ Plus Daughter Board assists with the development of electronic paper displays (EPDs).

Electronic paper, or e-paper, applications mimic the appearance of ordinary ink on paper for a wide range of use cases. They feature high contrast for visibility in direct light and—because they only consume power to update the screen content, not to display it—their low power operation results in longer battery life. Electronic paper displays (EPDs) are thin, light and easy to integrate into your product's design.

We have recently collaborated with Pervasive Displays Inc. (PDI), a designer and manufacturer of electronic paper modules for commercial and industrial display applications, to offer a new e-paper development kit that enables the display of both graphics and text. The EPD PICtail™ Plus Daughter Board (S0000AS0T3) connects to our Explorer 16 Development Board (DM240001) via our standard PICtail Plus connector to assist with your development of EPDs.

The board comes with 1.44", 2" and 2.7" EPD panels. While any PIC24 or PIC32 PIM will work with the Explorer 16 board, we recommend that you use the PIC24FJ128GA310 General Purpose PIM (MA240029) to complete this evaluation setup. As one of our eXtreme Low Power (XLP) PIC MCUs, the

The board comes with 1.44", 2" and 2.7" EPD panels.

PIC24FJ128GA310 offers the best combination of low power with the memory needed for this type of application and will extend the battery life of your e-paper display application.

The Microchip Graphics Library allows you to customize graphics on the display using a selection of graphical objects such as buttons and sliders. It also offers multiple fonts and languages and free source code for rapid prototyping.

A sample MPLAB® X IDE project provides an open source driving waveform, including global update and partial update capability with a command interface to update content on the EPD panel without a graphic display controller or timing control board. The demonstration programs include menu button, draw square and circle, bar chart, HVAC control panel and medical electrocardiogram (ECG), which supports updating button, slider, static text, picture and several other objects locally.

Get started creating your new, low-power e-paper application today. The EPD PICtail Plus Daughter Board is being sold by Pervasive Displays. Visit the Pervasive Displays website for purchasing information or to download the User's Guide and source code.

Get More Peripherals

Microstick Plus Development Board Gives You More Options to Learn PIC® MCU Programming
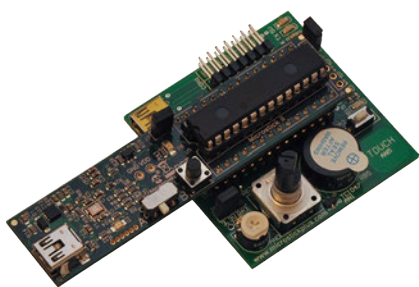
Just insert your Microstick board into the Microstick Plus Development board and you can begin programming right away.

Our Microstick and Microstick II boards are flexible, portable, USB-powered development platforms that are smaller than a stick of gum. They offer an easy-to-use and economical development environment for our 16- and 32-bit microcontrollers (MCUs) and digital signal controllers (DSCs).

The low-cost Microstick for dsPIC33F and PIC24H (DM330013) is used with our 16-bit PIC® MCUs and dsPIC® DSCs. The Microstick II (DM330013-2) is a next-generation board that supports all 3.3V PIC24FJ, PIC24E, PIC24H, dsPIC33, and PIC32 28-pin SPDIP packaged devices.

Microstick boards can be used stand-alone or plugged into a prototyping board for extremely flexible development. However, since they are designed to work with a breadboard, they contain only one test LED and no extra peripherals to add functionality.

If you are looking for an out-of-the-box, ready-to-use breadboard solution for use with a Microstick for dsPIC33F and PIC24H or a Microstick II board, check out the new Microstick Plus Development Board (TCAD001), developed by our 3rd Party Tool Provider, ChipCAD. This compact board offers you a cost-effective way to add the following peripheral devices to your Microstick platform to enhance your learning experience:

- Four user LEDs (two red and two blue)
- Standard pushbutton and capacitive touch button
- Potentiometer and rotary encoder
- MCP2551 CAN transceiver
- MCP2200 USB-UART converter
- MCP1525 2.5V reference voltage
- TC1047A analog temp sensor
- 32.768 kHz clock crystal
- Piezo buzzer (up to 4 kHz)

It comes with free code examples.

The board needs no external power supply. Devices which require 3.3V power supply can be powered via the I/O pin of the Microstick board or via the USB connector. Devices which require 5V power supply are powered through the USB connector.

The Microstick Plus Development Board comes with free code examples which can be downloaded from ChipCAD's website. With its low cost and multiple peripherals, it can provide a valuable and challenging learning experience for beginner to advanced programmers. Visit microchipDIRECT to purchase the Microstick Plus Development Board.

Save all Spring
with the Dev Tool Deals
Up to **50%** off

A Bouquet of Savings

Spring is easing into summer, but we still have another month of Development Tools Deals to help decorate your design projects. These special sale prices will be available on microchipdirect.com from June 1 through June 30, 2014. Simply add the item to your cart and apply the coupon code during checkout. These are limited time offers so act quickly to get your savings while the deals are still available and supplies last.

MCP2210 Evaluation Kit
microchipDIRECT Coupon Code: TP1423

The MCP2210 Evaluation Kit (ADM00421) demonstrates how to use the MCP2210 USB-to-SPI chip in several real-life applications. It contains an MCP2210 Breakout Module Board, an MCP2210 SPI Slave Motherboard and a mini-USB cable, and it's on sale for $19.99, a 33% savings.

PIC32 I/O Expansion Board
microchipDIRECT Coupon Code: TP1424
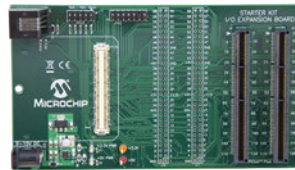
If you are using a Microchip Starter Kit or Starter Board, the PIC32 I/O Expansion Board (DM320002) provides you with full access to MCU signals for attaching prototype circuits or monitoring signals with logic probes. Additional debug headers allow you to connect JTAG tools or Microchip tools using the 2-wire (ICSP) interface. The board can also connect to PICtail™ Plus daughter cards. Get yours for $44.99 and save almost 40% off the regular price.

MRF89XAM9A PICtail/PICtail Plus Daughter Board
microchipDIRECT Coupon Code: TP1425

Targeted for MiWi™ development environment and other proprietary wireless protocol applications, the MRF89XAM9A is a perfect solution for low-cost, low-power, complete embedded wireless applications. The MRF89XAM9A PICtail/PICtail Plus Daughter Board (AC164138-2) can be plugged into many of our demonstration and development boards. Get a great deal of 50% off the regular price and buy it today for just $19.99.

MICRO Solutions

Wireless Remote Control Development Kit - 915 MHz

microchipDIRECT Coupon Code: TP1426
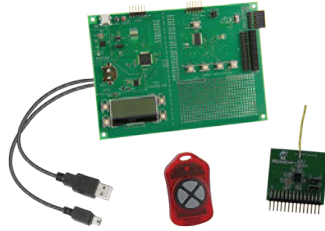
The **Wireless Security Remote Control Development Kit** (DM182017-3) will help you develop wireless security remote control applications using the KEELOQ® Classic and KEELOQ AES protocols. The kit contains a four-button key fob transmitter based on the PIC12LF1840T39A and a receiver PICtail™ daughter board—both tuned to the 915 MHz frequency—as well as an Embedded Security Development Board. Save $50.00 and get your kit for $99.99.

CLASS B
SAFETY SOFTWARE LIBRARY

UL 1998/IEC 60730 Solutions

- 8-, 16- and 32-bit libraries
- VDE tested libraries
- Optimized for timing critical applications
- Reduced time to market

Bite-Size Click Boards Give Designers Food For Thought
Contributed by MikroElektronika

Hello Designer. Have you been searching for the perfect expansion board? Perhaps as you've been looking you've found a gap in today's market for the products you need. This is understandable, as most manufacturers tend to focus on compactness, variety, compatibility, or affordability, but rarely offer all four of these features in one solution. Well we have great news for you. We'd love to present you to **MikroElektronika's** delicious line of click boards—just the expansion boards you have been looking for!

Click boards offer a range of modules from sensors to displays, audio to motor control, **communication to fiber optics, and many others for that matter. Because of their small size and** sheer variety, they're a bit like those appetizing bite-size snacks served at cocktail parties. While not edible, they'll certainly provide engineers, hobbyists and makers with lots of food for thought.
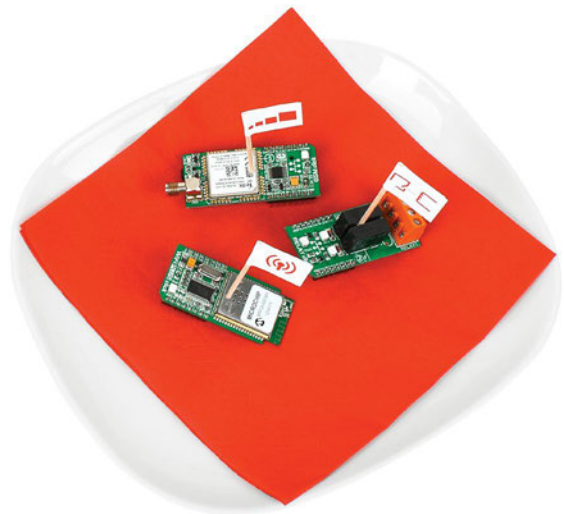
MikroElektronika
DEVELOPMENT TOOLS | COMPILERS | BOOKS

Intended to inspire creativity, click boards get their name from that inner jolt you feel when an idea appears out of nowhere in your mind—when all of the sudden it just clicks. These little boards combine just the right features you need so you can focus on developing your ideas and projects. A large set of ready-to-use examples are provided by MikroElektronika to help you get started.

You can choose from more than 70 click boards, most of them based on Microchip's top-selling modules including Wi-Fi®, Bluetooth®, ADC, Ethernet and ZigBee®. More exotic options include a thunder-detection click board and the new 'SpeakUp' speech-recognition click board. For ease of use and experimentation, they all share a standardized mikroBUS pinout which is compatible with a wide range of systems and tools.

MikroBUS host sockets are found on many of MikroElektronika's development boards—the EasyPIC v7 being a classic example. There's also a line of simple shields that bring click board connectivity to the Raspberry Pi® and other popular development platforms. Independent developers are also jumping in. There's a mikroBUS.NET team working on making click boards compatible with Microsoft's .NET framework.

Not only are click boards compact, but they come in a variety of flavors, they're compatible with a wide variety of boards, and last—but certainly not least—click boards are affordable. The most popular ones cost between $25 and $50. Visit microchipDIRECT.com to get a taste of the assortment of click boards that are now available for purchase there, shown in the list below.
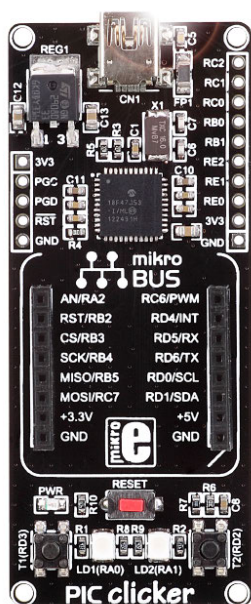
Device	Product Description	List Price
TMIK023	PIC Clicker	$19.00
TMIK024	ADC Click	$24.00
TMIK020	Bluetooth Click	$42.00
TMIK026	DAC Click	$18.00
TMIK025	DIGI POT Click	$16.90
TMIK028	GPS Click with Active GPS Antenna	$58.90
TMIK027	GSM Click with GSM Antenna (right angle)	$55.90
TMIK029	RELAY Click	$18.00
TMIK019	WiFi Plus Click	$45.00

MikroElektronika Click Boards Available from microchipDIRECT

How Safe is Your Home Appliance Design?

Simplifying Meeting IEC 60730 Requirements for Class B Safety

Modern home appliances have made once tedious tasks simple to accomplish. What once took hours of exertion can now be accomplished with a few presses of a button. Modern appliances are in large part electronically controlled. Electronic controls enable higher efficiencies, additional functionality and improved usability. But what happens if something goes wrong?

Safety specifications, such as IEC 60355, are used to ensure manufacturers have designed their products to operate safely. IEC 60355 defines safety standards from a whole appliance standpoint. IEC 60730 is referenced by IEC 60355 and covers electronic controls in appliances. Currently IEC 60730 is a safety standard that is mandatory for products sold in Europe, and widespread adoption is likely. IEC 60730 Annex H defines safety requirements for electronic controls.

Our Class B Safety Software Library provides low-level software routines that simplify meeting IEC 60730 requirements for Class B Safety in your new home appliance design. Each Microchip product family—PIC16, PIC18, PIC24, dsPIC DSC and PIC32—has functions specifically designed to work efficiently with the available resources. Application Note AN1229 describes the Application Programming Interface (API) functions that are available in the Class B Safety Software Library and how to incorporate them into your project. While these routines were designed to meet Class B requirements, they can be used in other applications to ensure safe operations.

	MCU Circuit Component	Fault/Error
1	CPU Registers	Stuck
2	Program Counter	Stuck
3	Interrupt handling and execution	No interrupts or too many interrupts
4	Clock Frequency	Clock failure or incorrect frequency
5	Memory testing (Flash/EEPROM)	All single bit faults
6	Memory testing (RAM)	DC fault

Table 1 - Components Covered by the Class B Safety Software Library

MICRO Solutions

There are several advantages to using the Class B Safety Software Library. First, it reduces development time. Each function has been optimized and thoroughly tested based on each architecture and available resources. Second, it reduces the time and cost required to certify the end appliance. You can provide a test certificate to the testing agency so that you do not need to retest the requirements covered by the Class B Safety Software Library. Third, our team of application engineers can provide guidance on how to effectively implement software safety in your home appliance design.

We offer many other resources to assist with your home appliance design challenges. Visit our Home Appliance page or send us an email at class-b@microchip.com.

For the Best Performance use
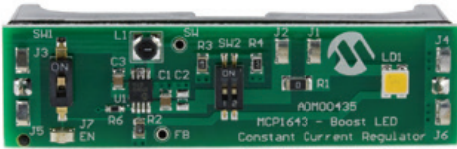
In high performance, compact LED designs such as Microchip's MCP1643 LED demo board, *Energizer*® Ultimate Lithium, the world's longest lasting AA battery in high-tech devices, provides superior performance in an AA or AAA form factor.

Superior Performance for Battery Powered LED Applications

The world's longest lasting AA battery in high-tech devices, *Energizer*® Ultimate Lithium, will last up to 4× longer* in the Microchip MCP1643 LED demo board when used in the bright mode.

Hours

- ■ Alkaline
- ■ NiMH (2300 mAh)
- ■ Ultimate Lithium

Hours
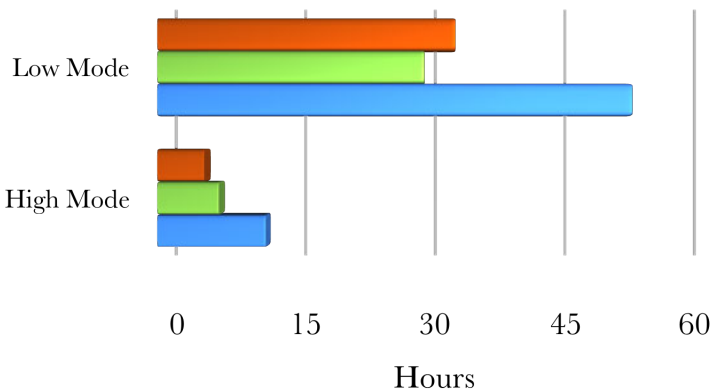
Performance in Extreme Temperatures

In High Mode, *Energizer*® Ultimate Lithium AA will last up to 5x longer than alkaline at 0°C and up to 10x longer at −20°C
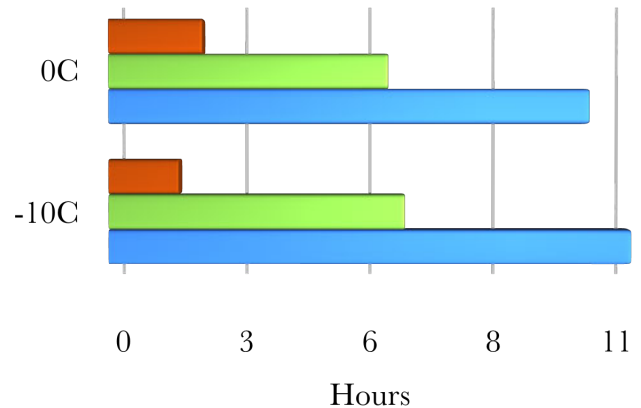
Additional Features

- Holds power for up to **20 years**
- **Weighs 33% less** than alkaline
- **Leak Proof** Design

For help with all your battery-related questions, contact *Energizer* Application Support at:

Application.Support@Energizer.com • data.energizer.com

What's on Your Mind?
chipKIT™ Support for Open Brain-Computer Interface Platform

Back in 2011, neither Conor Russomanno nor Joel Murphy had any idea that brain waves were going to define their future work. They met at the Parsons the New School for Design in New York, where Conor was a master's student in the Design & Technology program and Joel was teaching Physical Computing 1. Through a series of events, they ended up collaborating together to create OpenBCI, an open-source, low-cost electroencephalography (EEG) system. This customizable and fully open brain-computer interface platform provides anyone with a computer access to high-quality brain wave data. It was developed for scientists, engineers, designers, makers and others who are interested in furthering the understanding of the brain.
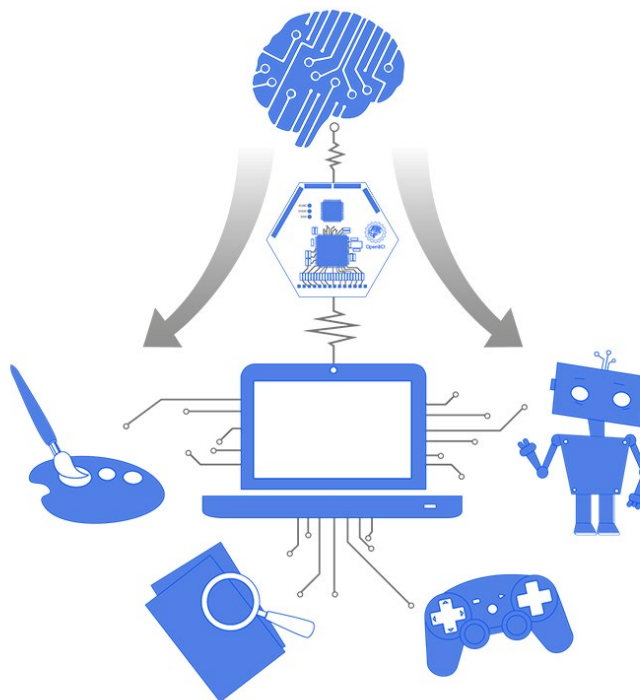
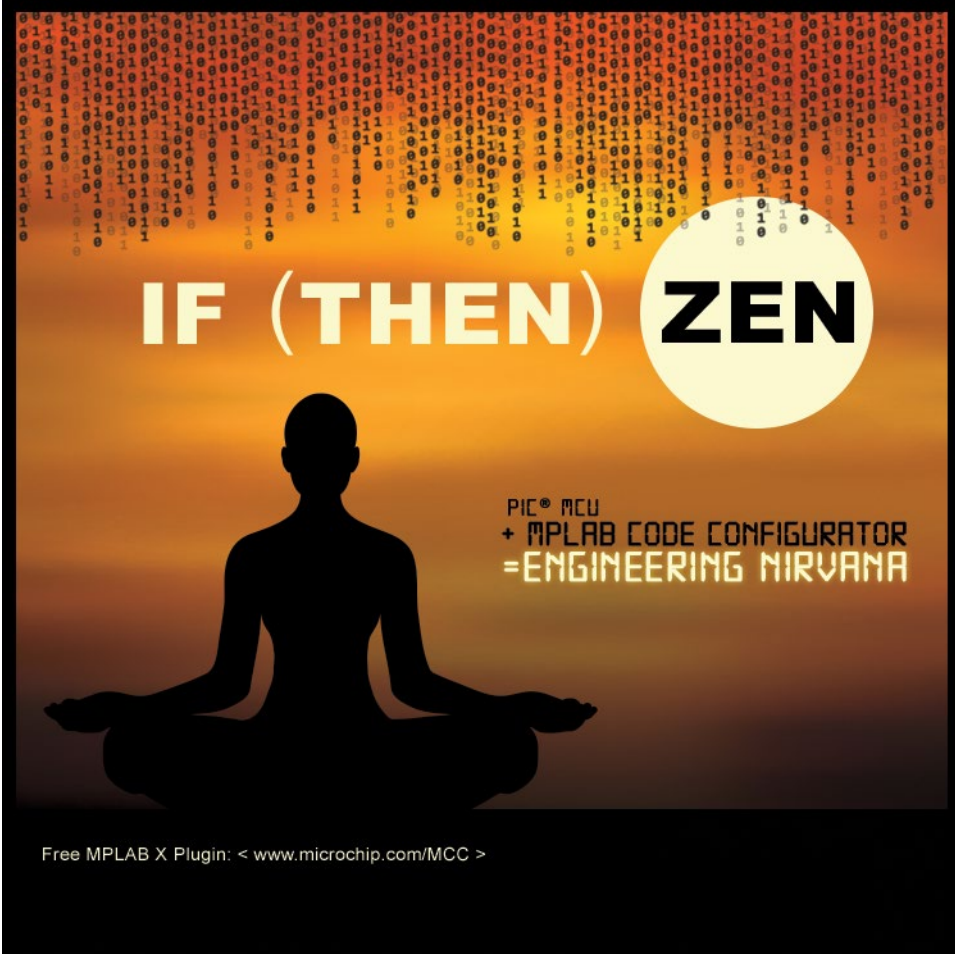*Figure 1 - OpenBCI Supports a Range of Brain-Computer Applications*

They introduced OpenBCI at the 2013 World Maker Faire New York. Attendees couldn't believe the ease with which they could not only see, but control their brain waves. Based on the overwhelming feedback, Conor and Joel spent the next three months preparing for a Kickstarter launch. Contributors would be supporting the effort to make the existing OpenBCI hardware ready for mass production and available to the general public, as well as joining the OpenBCI community to help develop a vast range of potential applications for brain-computer interfacing. Project backers who contributed at the higher levels would receive an OpenBCI board as part of their reward.

The OpenBCI board incorporates a reprogrammable microcontroller. For their reward board, backers were given the option of selecting a board based either on the 8-bit Atmel ATmega328 with an Arduino™ bootloader or on our 32-bit PIC32MX250F128 with a chipKIT™ bootloader. The chipKIT option has been recommended to the backers that are using—or plan to use—the additional Daisy-Chain Kit, as it offers a more powerful internal hardware design and is capable of faster data rates at higher channel counts.

The Kickstarter project was successfully funded in January, and now Conor and Joel are working to deliver technology that is highly functional, customizable and well-documented. They are committed to keeping OpenBCI open-source and making the platform equal parts learning and making, since this is how they arrived at their current destination. They encourage all makers to join the fun and start hacking OpenBCI by signing up to receive their own boards on the OpenBCI waitlist. You can also visit their Kickstarter page to learn more about this fascinating project.

IF (THEN) ZEN

PIC® MCU
+ MPLAB CODE CONFIGURATOR
=ENGINEERING NIRVANA

Free MPLAB X Plugin: < www.microchip.com/MCC >

Record, Edit and Re-Play CAN Bus Activity
Contributed by Total Phase, Inc.

Did you know that the Komodo CAN Duo Interface (TTP100008) from Total Phase, Inc., gives you the ability to record activity on the CAN bus and export the trace in a format that you can edit and modify? Once you've done that, you can replay the modified data to simulate changes to your system. This feature is specific to the Komodo CAN Duo Interface, given the fact that it is a two-channel device.

To use this feature, connect your Komodo CAN Duo Interface to your CAN system and to your analysis PC. Launch both the Data Center Software and the Komodo GUI Software. Connect to the device in both pieces of software. The dual channels on the Komodo interface allow it to connect to both the Komodo GUI and Data Center Software simultaneously.

In the Data Center Software, start the capture. In the Komodo GUI, configure the data you want to send in Active CAN Mode, or using our Activity Board connect to the Activity Board mode and hit Play. As data is sent across the CAN bus via the Komodo GUI, the Data Center Software passively monitors and captures all of the CAN data.

Once you have collected the information you want to replay, hit Stop in both pieces of software. In the Data Center Software, export the data to a Komodo GUI Batch File (.kba). This creates an editable file that you can modify and load into the Komodo GUI Software via Batch Mode to replay data on the system. This allows you to simulate changes on your system.

The "Sending CAN Messages From Komodo Duo Interface Channel and Monitoring It With The Other Channel Using Komodo GUI and Data Center" knowledge base article provides instructions for setting up the software components of the Komodo CAN Duo Interface.

The Komodo CAN Duo Interface (TTP100008) is available from **microchipDIRECT**. Total Phase is a leading provider of embedded systems development tools for engineers all over the world. For more information, visit **www.totalphase.com**.

Building Blocks for PIC32MZ Family of MCUs
Application Development with Fixed Point DSP Library

Introduced six months ago, **MPLAB® Harmony** is a flexible, abstracted, fully integrated firmware development environment for PIC32 microcontrollers. It enables robust framework development of interoperable RTOS-friendly libraries with quick and extensive Microchip support for third party software integration. MPLAB Harmony includes a set of peripheral libraries, middleware, drivers and system services that are readily accessible for application development

The Fixed Point DSP Library is middleware which contains building block functions for developing digital signal processing algorithms. This library supports the Q15 and Q31 fractional data formats, which are integer fixed point data types that represent floating point values. The functions are implemented in efficient assembly specifically targeted at the DSP extensions in this core family. The library makes these functions available in a simple C-callable structure. Functions included in the Fixed Point DSP Library include complex math, vector math, matrix math, digital filters and transforms. In many cases, these functions require specific data structures to operate, which are detailed in the header file and examples. Some functions in the library also take advantage of the floating point math library. See Table 1 on the next page for additional details.

Key Features:
- C-Callable DSP functions optimized in assembly
- Digital filtering structures including parallel and series (cascade) Infinite Impulse Response (IIR) biquad functions
- Vector manipulation (reverse, shift, inverse), comparison and statistics functions
- The PIC32 DSP Library provides functions including the following:
  - 16- and 32-bit vector basic math, trigonometric and power functions
  - Vector RMS, power, max/min, mean, dot product
  - Complex math
  - Matrix math

- Finite Impulse Response (FIR) filters, decimation, interpolation
- Infinite Impulse Response (IIR) filters with different biquad architectures
- Least Mean Squares (LMS) filter
- 16- and 32-bit Fast Fourier Transforms (FFTs), inverse FFT
- Six different windowing functions, each 16- and 32-bit
- Quick support functions for numerical transforms

The Fixed Point DSP Library is available for the **PIC32MZ** family of microcontrollers. The library was created from optimized assembly routines written specifically for the MIPS microAptiv CPU core. It is a superset of the original PIC32 Microcontroller DSP library, which is still offered with the MPLAB XC32 compiler. The library has been improved to contain more than 90 functions, and will continue to grow to meet future requirements of PIC32 MCUs.

Function	Details	Clock Cycles (Operating from Instruction Cache)	Completion Time (µs) @ 200 MHz (PIC32MZXXX)
IIR Filter (Biquad Transposed Direct Form 2)	Serial processing 16-bit daya through pipeline 8-stage serial filter	198	0.99
FIR Interpolation Filter	32-bit, 8 inputs, 6 taps, 3× interpolation	1048	5.24
FIR Decimation Filter	32-bit, 5 taps, decimation rate 3, 8 outputs	1002	5.01
Complex FFT	64-point, 16-bit data	3546	17.73
Complex FFT	128-point, 16-bit data	8066	40.3
Complex FFT	256-point, 16-bit data	18866	94.3
Complex FFT	512-point, 16-bit data	67354	366
Matrix Add	32-bit, each matrix 4 × 4 elements	246	1.23
Matrix Transpose	32-bit, 4 × 4 matrix	152	0.76
Vector Maximum	16-bit, 8-element vector	64	0.32
Vector RMS	16-bit, 8-element vector	370	1.85
Vector Dot Product	16-bit, 8-element vector	102	0.51
Vector Power (Sum of Squares)	16-bit, 8-element vector	78	0.39
Vector Variance	16-bit, 8-element vector	192	0.96
Vector Standard Deviation	16-bit, 8-element vector	444	2.22
Complex Dot Product	32-bit	24	0.12

Table 1 - Fixed Point DSP Library Functions

Look Before You Leap

Ultra-bright LED Indicator System for Extreme Sports Athletes Uses PIC® MCU

Extreme sports athletes are all too familiar with the dangers they face while participating in the activities they enjoy. Just one mistimed move or minor distraction can lead to disaster. Because these athletes are passionate about their sports, they also love to share the thrill via video. However, checking on a helmet-mounted camera's status once the action has started is almost impossible. Trying to determine if the camera is turned on, if the record button has been pressed, if the memory card has been inserted or if the right mode has been set can seriously jeopardize an athlete's safety.

The members of the team at Hypoxic, a Microchip Design Partner, are skydivers themselves who understand the challenges of action sports. They create innovative, industry-leading skydiving products, and have recently introduced a solution to help extreme athletes film their activities more safely. Turned On is a simple, intuitive, hard-wired, indication system for the GoPro® HERO3 and HERO3+ line of cameras, which are used extensively for action videos. Turned On is a hardware and software solution that plugs into the back of a GoPro camera and uses three ultra-bright LEDs which can be positioned within the athlete's range of peripheral vision to indicate the camera's status. Blue indicates "standby," red indicates "record" and yellow indicates "warning/error."

Hypoxic chose the PIC12F1840 for this project because of its low power consumption, cost, and plethora of powerful modules. According to Hypoxic's founder, Mark "Trunk" Kirschenbaum, "For a small, niche based company, the re-purposing your design investment is key. Because of the configurability of the PIC12F1840, we can completely re-productize Turned On to other high profit, niche markets with minimal engineering cost."

A Turned On Kickstarter campaign was just successfully funded to cover initial production costs and to add engineering staff to support product development. You'll find more details about Turned On there.

Adding Connectivity to Your Design

Microchip offers support for a variety of wired and wireless communication protocols, including peripheral devices and solutions that are integrated with a PIC® Microcontroller (MCU).

Wireless connectivity options include Wi-Fi®, Bluetooth®, 802.15.4/ ZigBee® and our proprietary MiWi™ wireless networking protocol. Other connectivity protocols supported include USB (device, host, OTG and hubs), Ethernet, CAN, LIN, IrDA® and RS-485.

All of these protocols are supported with free software libraries, low-cost development platforms and free samples.
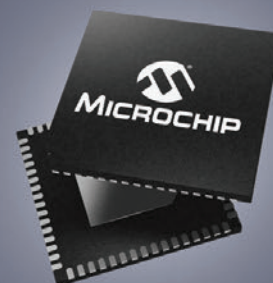
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microchip.com/connectivity