microSOLUTIONS FEB 2009

In This Issue...

8-bit PIC® MCU Architectures

With over 400 microcontrollers in its product portfolio, Microchip can provide solutions for the entire performance range of 8-bit MCUs. Microchip offers flexible memory technologies, easy-to-use development tools, comprehensive technical documentation and design support with a worldwide sales and distribution network. Customers have made PIC® microcontrollers a worldwide standard with over 6 billion microcontrollers shipped and more than 600,000 development systems delivered since 1990.

#1 in 8-bit Microcontrollers® • www.microchip.com/8bit • Microchip Technology Inc.

	Baseline Architecture	Mid-range Architecture	Enhanced Mid-range Architecture	PIC18 Architecture
Pin count	6 – 40	8 – 64	8 – 64	18 – 100
Interrupts	No	Single Interrupt Capability	Single Interrupt Capability with Hardware Context Save	Multiple Interrupt Capability with Hardware Context Save
Operating Performance	5 MIPS	5 MIPS	8 MIPS	10 – 16 MIPS
Instructions	33, 12-bit instructions	35, 14-bit instructions	49, 14-bit instructions	75 - 83, 16-bit instructions
Program Memory	Up to 3 KB	Up to 14 KB	Up to 56 KB	Up to 128 KB
Data Memory	Up to 138 Bytes	Up to 368 Bytes	Up to 4 KB	Up to 4 KB
Features	• Smallest Form Factor • Lowest Cost • Ideal For Battery Operated or Space Constrained Applications • Easy to Learn & Use	• Optimal cost-to-performance ratio • Integrated Peripherals including SPI, I²C™, UART, LCD, ADC	• C-code Optimized • Enhanced 16 Level Hardware Stack • Enhanced Indirect Addressing • Reduced Interrupt Latency • Simplified Memory Map	• 32 Level Deep Stack, 8x8 hardware Multiplier • C Code optimized • Advanced Peripherals Including CAN, USB, Ethernet, Touch Sensing, and LCD Drivers
Families	Includes **PIC10**, **PIC12** and**PIC16**	Includes **PIC12** and **PIC16**	Includes **PIC12F1XXX & PIC16F1XXX**	**PIC18 J-series** for cost-sensitive applications with high levels of integration **PIC18 K-series** for low power, high-performance applications

For more information, visit http://www.microchip.com/8bit

Build Higher Levels of Functionality into Your Cost-sensitive Applications

Building upon Microchip's leadership in 8-bit microcontrollers, the **PIC16F72X** Family (**PIC16F/726/724/723/722**) is a versatile, general-purpose product line that enhances the usability and features of any end-product while keeping costs low. The PIC16F72X Family provides a general purpose approach to bringing a higher level of intelligence and reliability into cost sensitive applications including; interactive toys or consumer products such as electric tooth brushes and blenders. With flexible product options and low cost, PIC16F72X allows for increased application functionality while minimizing BOM costs.

The addition of the integrated (yet selectable) **mTouch™ Capacitive Sensing Module** allows customers to further distinguish their products. The mTouch Sensing Solution peripheral makes it easy to add proximity sensing or capacitive touch-sensing user interfaces in place of mechanical buttons or switches. Additionally, the mTouch peripheral can operate while the device is in "sleep mode" with a total power consumption of <10 µA, bringing further power savings to the user. When designing cell phones, home appliances or thermostats – mTouch technology provides an inexpensive, reliable and aesthetically pleasing interface.

The 28- and 40-pin PIC16F72X Family have an operating voltage range of 1.8-5.5V, with the low-power PIC16LF72X variants offering lower standby and other power consumption specifi cations from 1.8-3.6V. All feature a 16 MHz internal oscillator; up to 14 Analog-to-Digital Converter (ADC) channels; communication interfaces (SPI, I²C™, AUSART) and two Capture/Compare/PWM (CCP) modules; plus the mTouch Capacitive Sensing Module peripheral. These highly integrated devices are well-suited for a wide range of general-purpose applications in the appliance, industrial, consumer electronic and many other markets. All variations feature a Timer1 Gate that runs from the internal 16 MHz oscillator, providing ease in conditional event counting and measurements. With up to 14 ADC channels, two CCP modules and communication peripherals, these PIC® microcontrollers increase design flexibility with the ability to interface with external devices such as environmental sensors, as well as provide additional system control and monitoring.

The **PIC16F722/3/6** and **PIC16LF722/3/6** MCUs are available in 28-pin SPDIP, SOIC, SSOP and QFN packages; with prices starting at $0.91 each in 10,000-unit quantities. The **PIC16F724/7** and **PIC16LF724/7** MCUs are available in 40-pin PDIP, TQFP and QFN packages; with prices starting at $1.34 each in 10,000-unit quantities.

For additional information, visit www.microchip.com/8bit

The PICDEM™ Touch Sense 1 Development Board and Diagnostic Tool provides a platform to introduce users to Microchip's Capacitive mTouch™ Sensing Solutions. This board is a completely sealed application example using three different touch sensor configurations in the form of a directional pad, Keypad and Slider section. A factory programmed firmware application provides the user immediate access to all of the board's features through the use of the accompanying Windows® based Diagnostic Tool and PICkit™ Serial Analyzer. The Diagnostic Tool provides the user a platform to analyze application critical information in "real-time" as it relates to touch sensor behavior.

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Bootloading from a Thumb Drive

As applications grow in complexity and size it becomes increasingly important to have an easy way to update the application firmware while it is in the field. Often this is done by connecting the device to a computer and loading the new firmware. This sometimes requires custom software on the computer. While this method is acceptable in some applications, it is not ideal, impractical, or even impossible in others. Take for example a firmware update that is required for a large appliance or for a unit that is installed into a wall. Moving these units to a computer could be impossible. A laptop might work in some situations but is not always available.

The introduction of Microchip's USB OTG-capable parts introduces a new form of bootloading that can offer a new, more user friendly way of loading firmware. The new firmware can be downloaded from the internet, copied onto a thumb drive, and then the firmware on the target can be updated by just plugging the thumb drive into the target application. An end user can now easily update that large appliance or wall mounted unit by just plugging in a thumb drive into the device. Most households have a thumb drive available. For those that don't, the price of thumb drive has dropped to $5 or less, making it an affordable way to provide firmware updates. Even households that may not have a PC at home can update their firmware by downloading the files from a computer either at work or in a public library and bring them home. The operating system of the computer is also now eliminated as a factor of providing support for the bootloader. Concerns about cross-platform functionality are virtually eliminated.

While the thumb drive bootloader does require more code size than some other bootloaders (24 Kbytes typical), it provides an easy-to-use and mobile bootloading solution. The thumb drive bootloader and example applications are free to download and are available in the **MCHPFSUSB v2.3.1** installation found at **www.microchip.com/usb** for **PIC24F** and at **http://forum.microchip.com/tm.aspx?m=382076** for 32-bit **PIC32 MCUs**. The devices offer 64 KB to 512 KB of Flash, 16 KB to 32 KB of RAM, and from 64 pin to 100 pin packages.

More About the USB Framework for PIC18, PIC24 & PIC32

Microchip has USB software to support USB on 8-bit, 16-bit and 32-bit MCUs. This software is royalty-free source code and also includes example projects.

The 8-bit PIC18 family supports USB device mode. The 16-bit and 32-bit products with USB support device mode as well as embedded host and On-The-Go. All product families support up to full-speed operation (12 Mbps).

Download the USB framework which includes USB firmware for the microcontroller as well as a USB device driver for the PC which allows the PC to treat the microcontroller as a USB device from **www.microchip.com/usb**. Classes supported include HID and CDC.

TCP/IP Networking: Internet Radio Using OLED Display and MP3 Audio Decoder

Internet Radios are defined as a hardware device that receives and plays audio from Internet Radio stations or a user's PC. The audio is streamed to the radio using MPEG-1 Audio Layer 3 (MP3), Windows® Media Audio (WMA) or Advanced Audio Coding (AAC) compressed audio formats. The "radio stations" range anywhere from public AM or FM radio stations that broadcast over the air as well as on the Internet, to University radio stations down to any individual wishing to create their own radio station.

The idea of an Internet Radio is not a new idea. You can buy commercially available Internet Radios, ranging in price from $129 US to $400 US, from companies such as Barix™, Logitech™/Slim Devices, Roku™ Labs and Philips® . Most of these make the connection using wired Ethernet; some have a wireless connection.

The focus of **Application Note AN1128** is to show how to create a low-cost Internet Radio that connects to SHOUTcast servers and plays MP3 audio. The hardware uses the **PIC18F67J60** microcontroller with integrated 10Base-T MAC and PHY and an external MP3 audio decoder. It also uses two 23K256 serial SRAM devices for buffering. The software uses the standard Microchip TCP/IP Stack with external serial SRAM buffering to ease the streaming of compressed audio data to the MP3 decoder. Figure 1 shows a picture of the **Internet Radio Demonstration Board** (DM183033). Figure 2 shows the block diagram for the Internet Radio design used in this application note.

FIGURE 1: INTERNET RADIO DEMONSTRATION BOARD

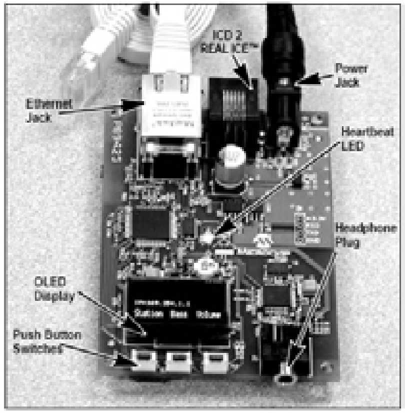
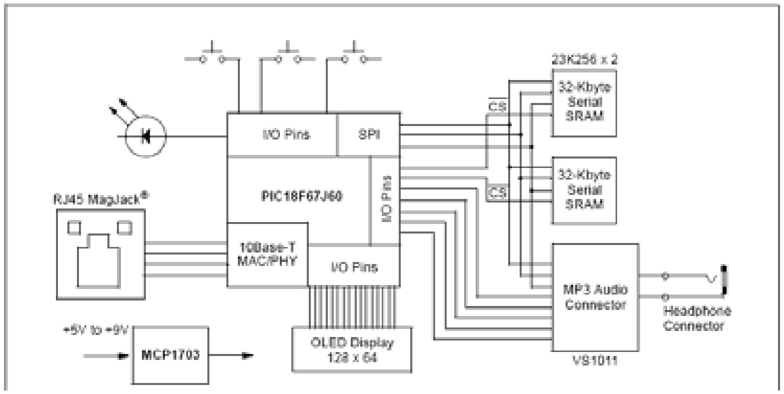


FIGURE 2: INTERNET RADIO BLOCK DIAGRAM



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PIC32 Boot Flash: Expand Your Memory Without Impacting System Cost

Contributed by Sean Justice, Microchip Technology Inc.

One of the best kept secrets of the PIC32 is the existence of an additional 12 kBytes of Flash memory called the "boot Flash." Traditionally the boot Flash is used for storing startup code, the interrupt exception table, and during the development stage the debug executive resides here. With a simple modification to the linker script, you can place routines and constant data into boot Flash thus expanding the program memory of the PIC32 MCU. For example, a part with 128 kbytes of Flash memory actually has 140 kbytes available. This is available on all available PIC32 MCUs.

This document illustrates how to add approximately half the boot Flash memory for application code. The remaining portion of the boot Flash contains the startup code and interrupt vector table.

First, create a fictitious MPLAB® project named `boot_flash`. In the project directory there are two linker script files `procdefs.ld` and `elf32pic32mx.ld`. The linker script, `procdefs.ld`, defines the memory regions of the part and `elf32pic32mx.ld` places the code and data into those regions. You must include `elf32pic32mx.ld` in the project's linker script folder. Double check that `procdefs.ld` has the correct memory sections defined for your part.

To place the routines and data into the boot Flash, you need to add the `section` attribute. The `section` attribute will place a routine or data into a section that is defined in the `elf32pic32mx.ld` linker script.

1) In the source file `main.c`, the routine "`foo`" is placed in the "`extra_prgm_mem`" section (**Figure 1**) using the `section` attribute.
2) In `elf32pic32mx.ld`, the "`extra_prgm_mem`" section is placed in the boot Flash section of memory (**Figure 2**).
3) After compiling the `boot_flash` project, the map file, `boot_flash.map`, shows that the routine "`foo`" is located at memory address 0x9FC00670, which is located in the boot Flash (**Figure 3**).

By using the attribute, `section`, and a custom linker script, you can place routines and data into PIC32MX boot Flash, effectively expanding the available program memory with out changing parts. For additional PIC32 technical documents, visit **http://www.microchip.com/pic32documents**.

```
 **********************************************************************
 * File Description:
 *
 * HTTP Server Appilcation
 *
 * Change History:
 * Name          Date             Changes
 **********************************************************************/
#include "PIC32Config.h"
#include <plib.h>

int main(void)
{
    while(1)
    {

    }

    return -1;
}

void __attribute__ ((section ("extra_prgm_mem"))) foo (void)
{
    // set PORT B to outputs
    mPORTBSetPinsDigitalOut(BIT_0 | BIT_1 | BIT_2);
}
```

Figure 1

```
.extra_prgm_mem :
{
   *(extra_prgm_mem)
} >kseg0_boot_mem
```

Figure 2

```
*(extra_prgm_mem)
extra_prgm_mem
                0x9fc00670      0x38 main.o
                0x9fc00670           foo
```

Figure 3

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PIC32™ DESIGN CHALLENGE

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The first phase of the contest generated 396 abstracts, of which 126 designs were selected to develop their hardware for Phase 2. The Top 32 contestants moved on to Phase 3 to complete their software design. Now, the Top 8 contestants will have an additional few months to polish their current design and source code with on-going input/help from the community and suggestions from the 3 judges and other experts.

Starting March 16, 2009, community members will finalize their votes, and the top 5 designers will be flown to the Embedded Systems Conference 2009 in Silicon Valley where the judges will cast their votes live on April 1. The judges' and community votes will be combined, the final winners will be announced live at the event, and prizes will be awarded.

The 2008 PIC32 Design Challenge's Ultimate Embedded Designer will win a fantastic home theatre system, including a 57" 1080p LCD TV and Bose® Lifestyle V20 System worth over $8000! Second and third place winners will also receive great prizes. See prize and contest rules and regulations for complete details!

YOU can win weekly prizes just for being a part of the community!

You can rate and vote on each contestant's design according to the design value criteria, post blogs and participate in the member forums. You can also post comments and suggestions in the contestant blogs and profiles to help them advance their designs. Join today at www.myPIC32.com.

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MCP6V01 Thermocouple Auto-Zeroed Reference Design

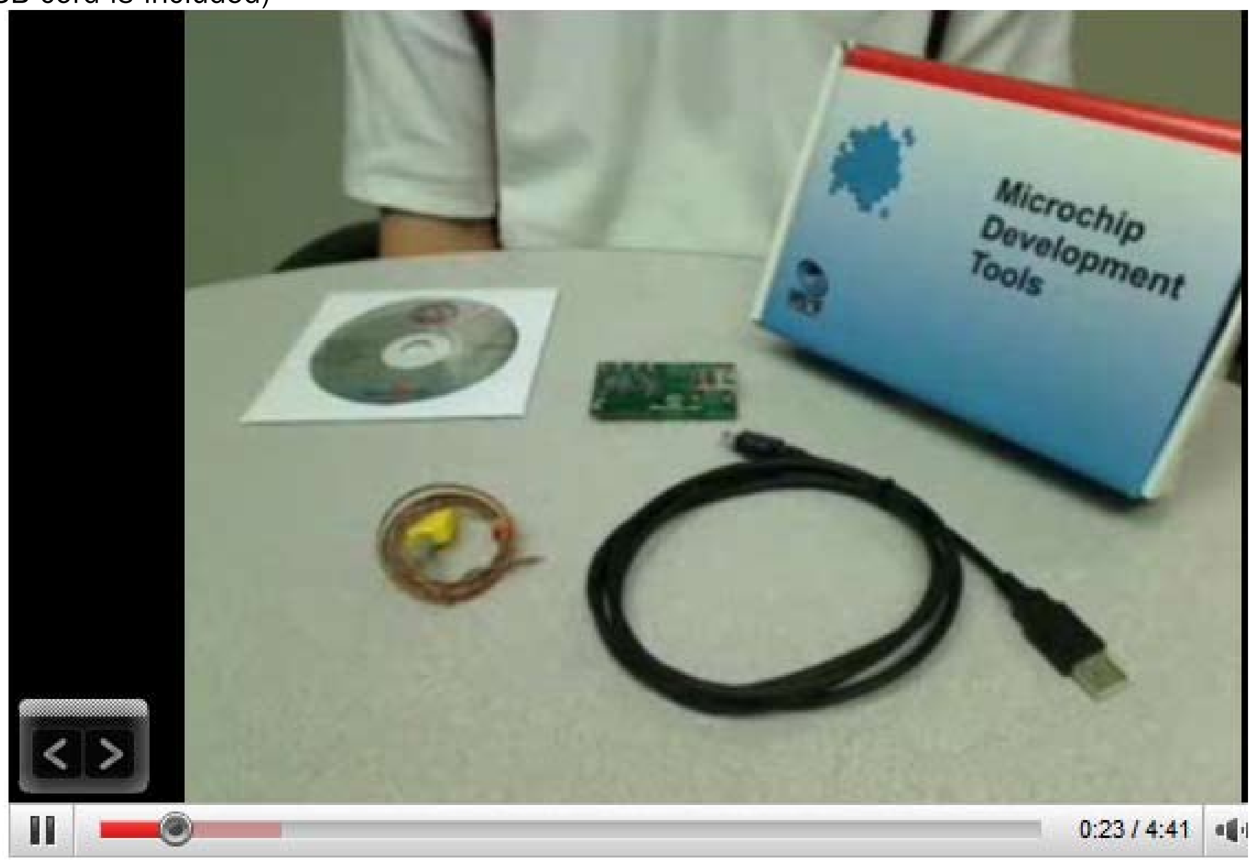
Part Number: MCP6V01RD-TCPL

The MCP6V01 Thermocouple Auto-Zeroed Reference Design demonstrates how to use a difference amplifier system to measure electromotive force (EMF) voltage at the cold junction of a thermocouple in order to accurately measure the temperature at the hot junction. This can be done by using the MCP6V01 auto-zeroed op amp because of its ultra low offset voltage (Vos) and high common mode rejection ratio (CMRR).

Features:

- Uses the MCP6V01 auto-zero op amp as a difference amplifier to condition the thermocouple signal
- Interfaces to a K-type thermocouple (included) to sense temperature
- Can monitor temperatures from -100°C to 1000°C
- Uses the MCP9800 digital temperature sensor for cold junction compensation
- Interfaces directly to a PC via a USB interface (USB cord is included)

Available now for $50.00



See it in action on YouTube!

http://www.youtube.com/watch?v=vTlg_MOb3Qg

For more information, visit http://www.microchip.com/stellent/idcplg?IdcService=SS_GET_PAGE&nodeId=1406&dDocName=en535981

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The Integration of Non-Volatile Memory into Digital-to-Analog Converters

Digital-to-Analog Converters and digital potentiometers are often used for system calibration or to dynamically control system parameters. Digipots have become a ubiquitous upgrade to variable resistors, rheostats and mechanical potentiometers. However, there are situations where a digipot is insufficient. For example, accurate motor control or sensor applications require the higher resolution capabilities of DACs. A DAC also contains an output amplifier, allowing it to drive low impedance loads and supply greater output currents.

Benefits of Non-Volatile Memory

Conventional DAC devices store configuration bits and input data in volatile memory. This data stored in the volatile memory is lost when the device loses operating power and consequently the data must be reprogrammed again from an accompanying MCU. If the DAC is used to provide a reference voltage for another device, losing the DAC output during power failure can jeopardize the functionality of the entire application.

Therefore the integration of non-volatile memory, or EEPROM, can be a valuable add-on feature. The MCP4725 DAC is part of a new generation of the DAC devices from Microchip Technology that integrate EEPROM for configuration register data and I²C™ address bits. Microchip's EEPROM technology guarantees 1,000,000 write cycles, which is a significant reliability improvement when compared to mechanical potentiometers.

In the event of power down or power loss the configuration data is automatically reloaded from the EEPROM to the DAC register when the DAC is next powered up. There is no need to wait for programming data from a microcontroller. This saves microcontroller resources and thus power. Standalone systems are even enabled; in applications where the output does not need to change connections to the microcontroller can be entirely severed.

A specialized communications protocol allows the configuration data to be stored either to the EEPROM or to the DAC register separately, or to both simultaneously.

DAC Applications

In many applications the DAC is used as a supporting device for the functionality of another device in the system. Figure 3 shows an example of circuit that digitally controls the set point of a sensor output detector. The low cost 12-bit MCP4725 DAC controls the trip voltage of the comparator giving the sensor intelligence.

The trip voltage related to the output voltage of the DAC by the equation,

Eq.1 $$V_{TRIP} = V_{OUT}\left(\frac{R_2}{R_1 + R_2}\right),$$

and

Eq. 2 $$V_{OUT} = \frac{(V_D \times D_n)}{4096},$$

where Dn is the input code.

The I²C serial interface circuit shown in the dotted box is not needed if the output voltage, VOUT, does not need to be programmed in real time. The MCP4725 DAC can be programmed in production thus saving microcontroller I/O pins.

Conclusion

Whether a DAC is needed for set-point or offset trimming, dynamic calibration or closed loop control, integrated EEPROM is a low-cost feature that can provide much flexibility and benefit to the designer. Reduction in microcontroller overhead, power consumption, and cost can be achieved by using non-volatile DACs, such as the MCP4725 DAC.

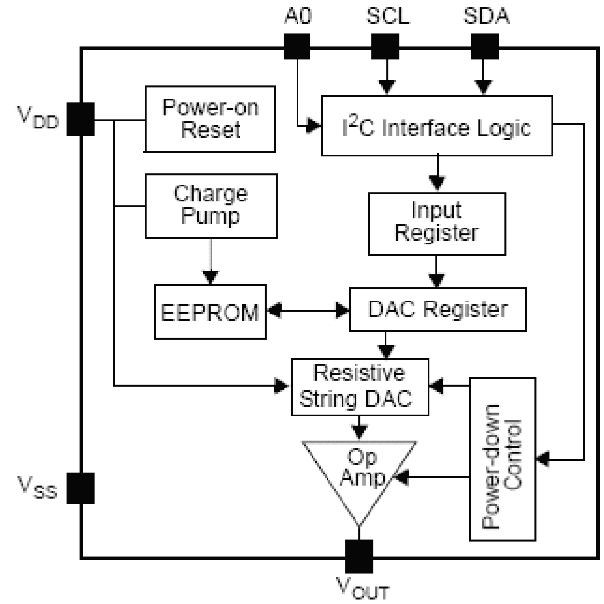
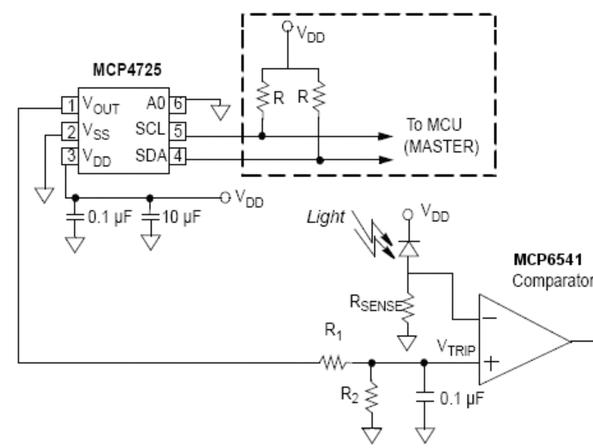


Figure 1 (above): MCP4725 non-volatile DAC block diagram with single channel voltage output

Figure 2 (below): Offset control of the sensor detector



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Microchip Technology Expands Support for Motor Control With New Tools and Libraries

The **dsPICDEM™ MCLV Development Board** (part # DM330021) is a new low-voltage Brushless DC (BLDC) motor-control development platform supporting the dsPIC33F family of motor control dsPIC® Digital Signal Controllers (DSCs). It provides a cost-effective method for evaluating and developing sensored or sensorless BLDC and Permanent Magnet Synchronous Motor (PMSM) control applications. The board is available now for $150.00 and contains a three-phase inverter bridge circuit. This circuit drives a BLDC or PMSM motor using different control techniques, without requiring any additional hardware. The dsPICDEM MCLV board is capable of controlling motors rated up to 48V and 15 Amps, and supports multiple communication channels, such as USB, CAN, LIN and RS-232. It employs a processor-differentiated Plug-In Module (PIM) strategy to support a variety of dsPIC33F motor-control DSCs with different memory and pin configurations. A **dsPIC33FJ32MC204** Plug-in Module (32 KB Flash and 44 pins) is included with the dsPICDEM MCLV Development Board.

Additionally, Microchip announced two new motor-control software solutions. One shows how Power Factor Correction (PFC) algorithms can be combined with sensorless motor-control algorithms on a single chip. The second software solution demonstrates how to run an AC Induction Motor (ACIM) faster than its rated speed for a class of applications, to lower cost, save space or reduce weight. Both are available today for free at **http://www.microchip.com/DSCMOTOR**

Power Factor Correction plus Sensorless Motor Control on a single chip

The worldwide demand for improved power quality standards is driving the trend to add PFC to line-powered motor control applications. Power quality can be enhanced by implementing PFC, and efficient control of a motor can be realized using sensorless Field Oriented Control (FOC) techniques. Both can be achieved by integrating PFC and sensorless FOC algorithms on a single dsPIC DSC. Microchip's **Application Note AN1208** describes the process of integrating these two complex functions in a PMSM application. This application note also lists the necessary hardware requirements, and provides the guidelines to optimize the development procedure. Source code is provided for dsPIC30F and dsPIC33F DSCs, along with the application note, on Microchip's Web site at **http://www.microchip.com/DSCMOTOR**.

Sensorless Field-Oriented Control of an AC Induction Motor using Field Weakening

This algorithm provides high torque at low speed and high performance, with lower torque at extended speed. It is ideal for applications such as washing machines, automotive traction control, or any ACIM application that wishes to optimize torque per amp above the rated speed or constant torque region of an ACIM. The strategy is described in Microchip's **Application Note AN1206**, which provides source code for the dsPIC30F and dsPIC33F DSCs.

Enhancements to the MPLAB® IDE

To reduce motor-control development time, users can now tune motor parameters in real time, completely eliminating the "stop motor/build/reprogram/run motor" development cycle. The graphical Data Monitor and Control Interface (DMCI) in **MPLAB IDE Version 8.15** has been enhanced to include a Real-Time Data Monitor (RTDM) function. DMCI enhanced with RTDM provides a graphical method to input and adjust motor parameters in real time and immediately see the effect, without halting the application. A serial USB or UART cable supports bi-directional information transfers between the host PC and the target dsPIC DSC. This tool is useful for modifying software parameters and visualizing historical data during debug sessions, so that the motor's dynamic response can be analyzed. The MPLAB IDE Version 8.15 can be downloaded for free, today, at **http://www.microchip.com/mplab**.

More resources and information on all of Microchip's motor control solutions can be found at **http://www.microchip.com/motor**.

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Application Note AN885: Brushless DC (BLDC) Motor Fundamentals

Author: Padmaraja Yedamale, Microchip Technology Inc.

Brushless Direct Current (BLDC) motors are one of the motor types rapidly gaining popularity. BLDC motors are used in applications such as Appliances, Automotive, Aerospace, Consumer, Medical, Industrial Automation Equipment and Instrumentation.

As the name implies, BLDC motors do not use brushes for commutation; instead, they are electronically commutated.

BLDC motors have many advantages over brushed DC motors and induction motors. A few of these are:

- Better speed versus torque characteristics
- High dynamic response
- High efficiency
- Long operating life
- Noiseless operation
- Higher speed ranges

In addition, the ratio of torque delivered to the size of the motor is higher, making it useful in applications where space and weight are critical factors.

This application note discusses in detail the construction, working principle, characteristics and typical applications of BLDC motors.

CONSTRUCTION AND OPERATING

PRINCIPLE BLDC motors are a type of synchronous motor. This means the magnetic field generated by the stator and the magnetic field generated by the rotor rotate at the same frequency. BLDC motors do not experience the "slip" that is normally seen in induction motors.

BLDC motors come in single-phase, 2-phase and 3-phase configurations. Corresponding to its type, the stator has the same number of windings. Out of these, 3-phase motors are the most popular and widely used.

This application note focuses on 3-phase motors.

Stator

The stator of a BLDC motor consists of stacked steel laminations with windings placed in the slots that are axially cut along the inner periphery. Traditionally, the stator resembles that of an induction motor; however, the windings are distributed in a different manner. Most BLDC motors have three stator windings connected in star fashion. Each of these windings are constructed with numerous coils interconnected to form a winding. One or more coils are placed in the slots, and they are interconnected to make a winding. Each of these windings are distributed over the stator periphery to form an even numbers of poles.

There are two types of stator windings variants: trapezoidal and sinusoidal motors. This differentiation is made on the basis of the interconnection of coils in the stator windings to give the different types of back Electromotive Force (EMF).

As their names indicate, the trapezoidal motor gives a back EMF in trapezoidal fashion and the sinusoidal motor's back EMF is sinusoidal. In addition to the back EMF, the phase current also has trapezoidal and sinusoidal variations in the respective types of motor. This makes the torque output by a sinusoidal motor smoother than that of a trapezoidal motor. However, this comes with an extra cost, as the sinusoidal motors take extra winding interconnections because of the coils distribution on the stator periphery, thereby increasing the copper intake by the stator windings.

Depending upon the control power supply capability, the motor with the correct voltage rating of the stator can be chosen. Forty-eight volts, or less voltage rated motors are used in automotive, robotics, small arm movements and so on. Motors with 100 volts, or higher ratings, are used in appliances, automation and in industrial applications.

Rotor

The rotor is made of permanent magnet and can vary from two to eight pole pairs with alternate North (N) and South (S) poles.

Based on the required magnetic field density in the rotor, the proper magnetic material is chosen to make the rotor. Ferrite magnets are traditionally used to make permanent magnets. As the technology advances, rare earth alloy magnets are gaining popularity. The ferrite magnets are less expensive but they have the disadvantage of low flux density for a given volume. In contrast, the alloy material has high magnetic density per volume and enables the rotor to compress further for the same torque. Also, these alloy magnets improve the size-to-weight ratio and give higher torque for the same size motor using ferrite magnets.

Download the rest of this application note at
http://ww1.microchip.com/downloads/en/AppNotes/00885a.pdf

For more information on this topic, visit http://www.microchip.com/DSCmotor

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Microchip Recognized for Leadership and Innovation

EDN magazine named the **USB PIC® microcontrollers** to their 2008 "Hot 100" list of the most significant new electronic products, in the "Processors & Tools" category. Microchip has the industry's most comprehensive portfolio of 8-, 16- and 32-bit USB MCUs, supported by a broad offering of USB software stacks for the device, embedded host and on-the-go protocols. All of these stacks are offered for free download at **http://www.microchip.com/USB**.

EE Times recently honored three Microchip devices with the distinction of being the quarter's "Ultimate Products," as nominated by the publication's editors and selected by its readership. Microchip's **PIC32 family of 32-bit microcontrollers** was chosen in the "Processors & Memory" category, while its **MCP4725 digital-to-analog converter** was elected in the "Analog ICs" area. In the "RF & Microwave" category, readers preferred Microchip's **MRF24J40MA FCC-certified radio-frequency transceiver module**.

The Golden Mousetrap Awards from Design News recognize engineering innovation and creativity in product design. Adding to the honor it received from EE Times, the magazine's editors selected the MCP4725 digital-to-analog converter as the winner in their "Analog Control" category. And, several of Microchip's microcontrollers were named finalists, including the PIC32 family of 32-bit MCUs and members of the market-leading 8-bit PIC MCU family.

The PIC32 was also a runner up in ECN Magazine's 2008 Reader Choice Tech Awards in the "Integrated Circuits" category. Readers vote on the top five products in each category, as selected by ECN's editors.

In the area of business excellence, Microchip was again selected as one of the Phoenix Business Journal's "2008 Best Places to Work in the Valley." For the second year in a row, the award places Microchip among the top-30 large companies (250+ employees) to work for in Arizona because it creates an engaged and supportive workforce.

Microchip was also designated by the Chandler Chamber of Commerce as a CHANDLER 100 company for 2008, in the category of companies with over $6 million in revenue. This designation recognizes companies that are strong contributors to Chandler Arizona's economic and employment base.

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- Brushed DC Motor Basics
- Control System Design for Power Converters
- Introduction to the Green Hills Software MULTI® Debugger (Part 1)
- Introduction to the Green Hills Software MULTI® Debugger (Part 2)
- MPLAB® Starter Kit for Serial Memory Products
- PIC32 Execution Pipeline
- PIC32 DMA Module
- PIC32 Pre-Fetch Cache Module
- Serial EEPROM Overview

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Be sure to check out Dave Robins from Intrepid Control Systems Inc., as he presents class ESC-460: **Failsafe High Speed FAT32 Embedded Data-logging to SDcards** at ESC Silicon Valley 2009. This class features PIC® microcontrollers!

Robins is president and founder of Intrepid Control Systems, Inc. (**www.intrepidcs.com**), which has been providing embedded electronics tools globally for over 14 years. These applications have mainly focused on embedded serial data buses such as CAN, LIN, FlexRay, I²C™, XCP, SPI and UART.

This presentation describes a technique of data logging to an SDCard. This technique retains all the advantages of the FAT32 compatibility but at the same time increasing logging speed and reducing processor overhead suitable for data loggers with no or very primitive OSes. Also, this technique provides safety against issues that plague data logger systems using FAT32. The result is a robust data logging system that uses a small amount of processor Flash but provides a high amount of customer value.

What will you learn?

- More about FAT32 and why it is both desirable and problematic for embedded systems
- Techniques to work around problematic issues
- Techniques to get the most speed using SDcards in data logging applications
- Useful tools

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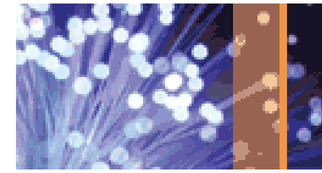
Technical training will be offered in Booth 416. Details to come at **http://www.microchip.com/ESC**

KEYNOTE ADDRESS

Microchip's CEO Steve Sanghi will present a keynote address ar ESC on Wednesday, April 1, 9:30 am - 10:30 am

A recipient of the Arizona Entrepreneur of the Year award, Mr. Sanghi led Microchip Technology Inc. to fiscal success and industry prominence. He is co-author of the book "Driving Excellence: How the Aggregate System Turned Microchip Technology from a Failing Company to a Market Leader (Wiley; April 2006)," which details winning strategies for technology companies.

sensors expo
& conference



Join Youbok Lee, Ph.D., Technical Staff Engineer in Microchip's Analog and Interface Products Division as he presents...

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Interface Circuit Requirements to Reduce Noise in Sensor Applications

Wednesday, June 10, 2009
11:00 AM - 11:40 AM

Delta-Sigma Analog-to-Digital Converters (ADCs) are based upon the over-sampling principle of input signals. For example, the over-sampling ratio for an 18-bit Delta-Sigma ADC can be as high as a few thousand. A higher over-sampling ratio means a higher number of averaging input signals, resulting in a higher signal-to-noise ratio. Some high-performance Delta-Sigma ADCs include an internal Programmable Gain Amplifier (PGA) which allows the ADC to convert a very weak input signal with high resolution. With a high over-sampling ratio and this onboard PGA, these types of ADCs are suitable for sensor applications where the sensor output-signal level is weak relative to the noise level. This presentation will demonstrate methods for reducing noise in sensor applications using the latest Delta-Sigma ADCs, presenting design examples to show how to design sensor-interface circuits to reduce noise in temperature, flow, pressure and weigh-scale measurement applications.

Join Youbok Lee, Ph.D., Technical Staff Engineer in Microchip's Analog and Interface Products Division and Steven Bible, Applications Engineering Manager in Microchip's Radio Frequency (RF) Products Division as they present...

Sensor Interface Design for Secure Wireless Remote Sensing

Wednesday, June 10, 2009
2:30 PM - 3:10 PM

This presentation will demonstrate the requirements of sensor interfaces for rapid and secure monitoring of temperature, pressure and humidity over wireless networks. Design examples will be presented involving a microcontroller, and RF circuits interfacing to sensors will be presented. Power consumption versus data integrity over the various data formats for wireless sensor applications will be provided.

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Looking to Enhance Your Embedded Control Designs?

In tough economic times, companies often look for ways to trim expenses as a means to cope with a downturn in sales. One of the areas often targeted for cutbacks is employee training. There is not only the direct cost of the training to contend with, but also travel expenses and time an employee spends away from the job. During this challenging business climate, however, competitive pressures and technology change don't stop and it is training that can help a company be better positioned to take advantage of the potential upswing.

Microchip, with its global network of Regional Training Centers (RTCs) and third-party training partners, is here to help companies stay competitive with cost-effective, local training. To help companies deal with issues of travel expense and time, classes are given not only in Microchip's facilities, but are also taken on the road. Customized customer premise sessions can be scheduled offering the most convenience. Time away can be managed more efficiently with the flexibility of half or full day class sessions.

Call one of Microchip's RTCs and ask one of our experienced Technical Training Engineers how Microchip can help you with your training investment.

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This support is not limited to Microchip's broad line of 8-bit microcontrollers, but also includes the growing line of analog products, 16-bit microcontrollers and digital signal controllers and 32-bit microcontrollers. If your design could use a boost, let a Design Partner help you get to market faster with Microchip.

Microchip now makes it easier than ever to help you identify an authorized Design Partner to assist you on your next embedded control design. Our Design Partner web site has undergone a complete transformation to help you quickly identify the right partner for your needs. You can now perform a parametric search based on a variety of sorts, including expertise, speciality and location. You can then browse through each Design Partner's resume to aid in your selection.

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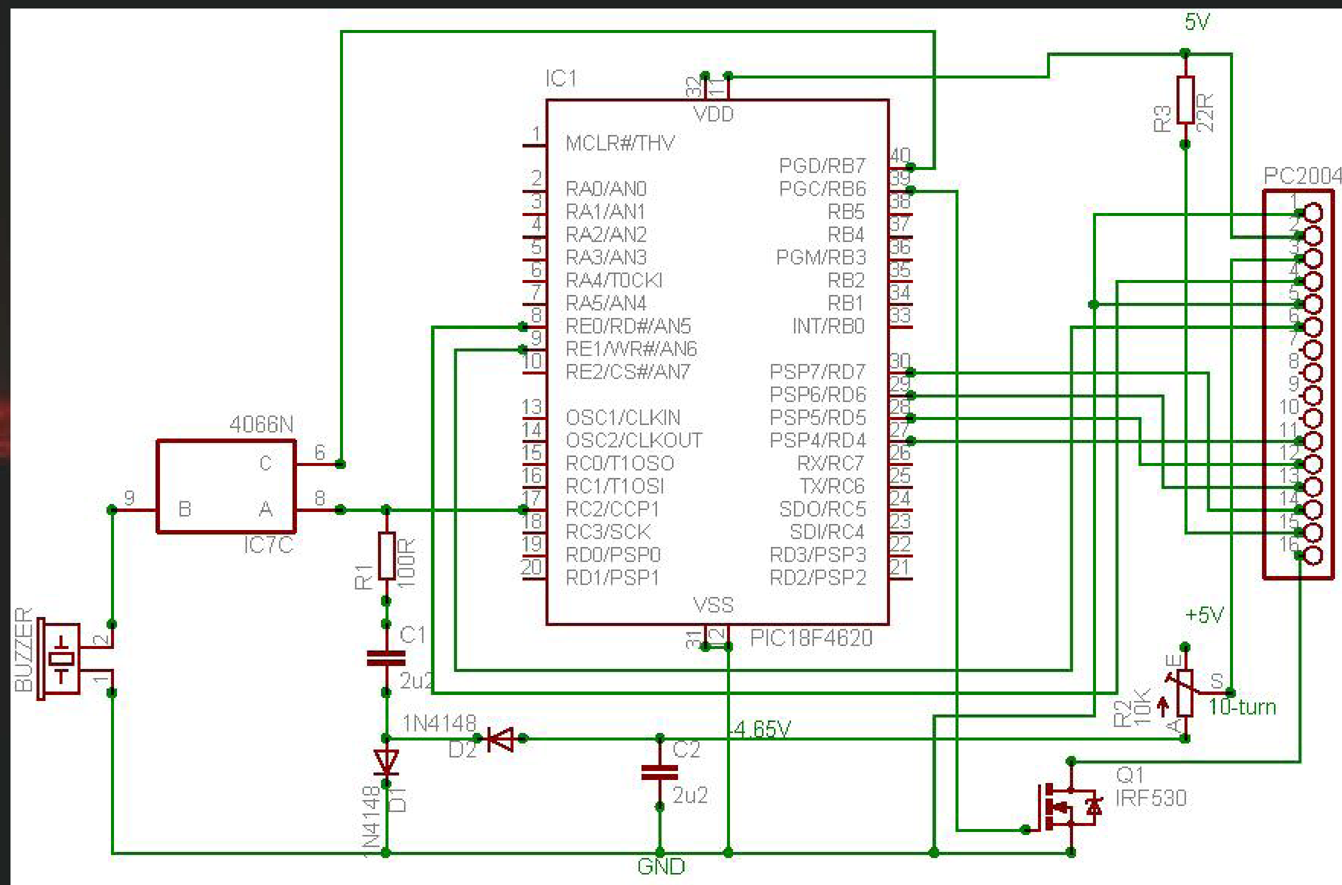
MICROCHIP

This Month's Wiki:

Negative Supply for Cheaper LCDs

ICwiki

Some of the cheaper LCDs expect a bias supply that can be below-zero volts. If you are using a MAX232 chip, or similar, it is a no-brainer to steal some of the -ve supply on the MAX232. When you don't use a MAX232 another solution must be found. One make a simple charge pump using the PICs CCP1 PWM output (at a frequency of about 2 Khz) to supply the negative bias. Image LCDNegBias.jpg shows an example of this. (Together with it's use as a beeper) The negative voltage acheived using two diodes was -4.65V on my setup.



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To view this entire entry, visit http://www.microchip.com/wiki/Wiki.aspx?WikiID=111&

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WHAT'S *New* IN MICROCHIP LITERATURE?

Visit our **Technical Documentation** page on www.microchip.com to view the documents.

Doc. Type	Doc. Title	DS No.
Application Note	PIC16F627 Low-Frequency Magnetic Transmitter Design	00232B
	Tire Pressure Monitoring (TPM) System	00238C
	Magnetic Tuning of Resonant Sensors and Methods for Increasing Sensitivity	00832B
	TCP/IP Networking Internet Radio Using OLED Display and MP3 Audio Decoder	01128A
	Recommended Usage of Microchip SPI SRAM Devices	01245B
	How to Create Widgets in Microchip Graphics Library	01246A
	ECAN™ Operation with DMA on dsPIC33F and PIC24H Devices App Note	01249A
Data Sheet	24XX64 64K I²C™ Data Sheet	21189M
	23A256 Data Sheet	22100C
	24A640 Data Sheet	22126B
	24VL014H Half-Array Write-Protect Data Sheet	22129A
	24VL024/24VL025 2K I2C Serial EEPROM Data Sheet	22130A
	25LCXXX 8K-256K SPI Data Sheet	22131A
	PIC16F526 Data Sheet	41326B
Errata	PIC12F510/16F506 Data Sheet Errata	80268E
	PIC18F6390/6490/8390/8490 Rev. C0 Silicon Errata	80346B
	PIC18F24K20 Rev. A Silicon Errata	80366D
	PIC24FJ256GB110 Family Rev. A3 Silicon Errata	80369D
	PIC18F2220/2320/4220/4320 Rev. C1 Silicon Errata	80396B
FRM Section	PIC24F Family Reference Manual, Section 38. Oscillator with 500 kHz Low-Power FRC	39726A
	PIC24F Family Reference Manual, Section 39. Power-Saving Features with Deep Sleep	39727A
	PIC24F Family Reference Manual, Sect. 40. Reset with Programmable BOR	39728A
	dsPIC33F FRM Section 34. Comparator	70212B
	dsPIC30F FRM Section 33. Device Configuration (Part II)	70271B
	PIC24H FRM Section 34. Comparator	70305B
Packaging Specification	Packaging Specification	00049AX
User's Guide	PICkit™ 3 Debug Express User's Guide	41370B
	MATLAB/Simulink Device Blocksets for dsPIC DSCs	51771B
	PICkit™ 3 User's Guide	51795A
Programming Specification	PIC18F6XJXX/8XJXX Flash Microcontroller Programming Specification	39644J
	PIC18F1XK50/LF1XK50 Flash Programming Specification	41342B

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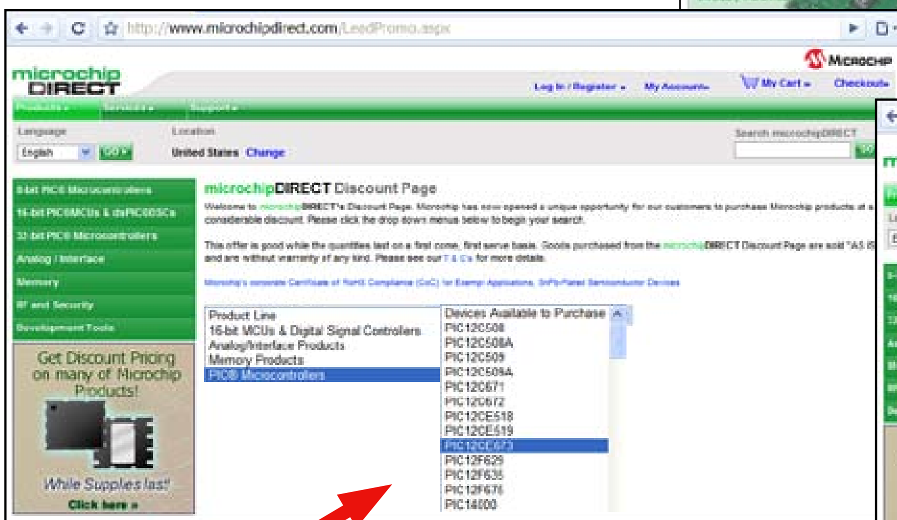

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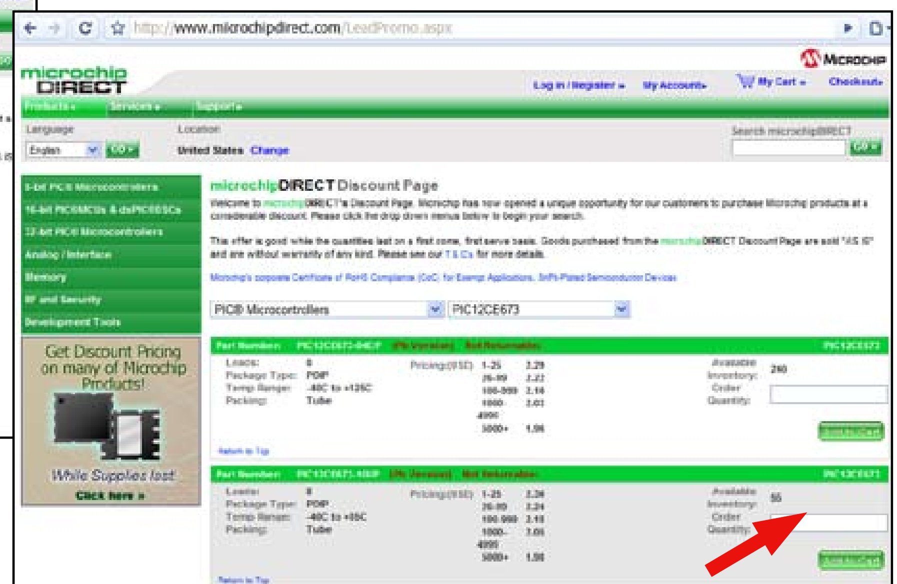

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