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New Digital Signal Controllers Simplify Motor Control, Power Conversion Designs

Microchip Technology's Motor Control & Power Conversion family of dsPIC™ Digital Signal Controllers provides an easy-to-use solution for applications requiring motor control. The eight new devices combine a high performance 16-bit Flash microcontroller, rich peripherals, and a fully implemented digital signal processor (DSP) onto a single-chip digital signal controller that allows engineers to work in a familiar microcontroller design environment.

The dsPIC30FXXXX Motor Control & Power Conversion family features a 6- or 8-channel motor control pulse-width modulation (PWM) module, a 10-bit high-speed (500K samples per second) analog-to-digital (ADC) converter, quadrature encoder interface (QEI), output compare units, input compare units and communication peripherals. These devices are ideally suited for any motor control or power conversion application, including sensorless brushless DC motors, switched reluctance motors, induction motors, uninterruptible power supplies and power inverters. Some variants include a CAN module, which is widely used for communications in automotive and industrial control applications.

With a non-pipelined performance of 30 MIPS, these digital signal controllers feature up to 144 Kbytes of Flash program memory space and up to 8K bytes of data space. The 2.5-5.5 operating voltage appeals to many microcontroller applications that remain at 5 volts (while many DSPs are restricted to 3.3 supply voltage maximum). Devices are planned in 28-, 40-, 64- and 80-pin packages.

Combining a DSP with a high performance 16-bit microcontroller produces a tightly coupled, single-chip single-instruction stream solution for embedded systems designs. The DSP engine features a high speed 16-bit by 16-bit multiplier, two 40-bit (optionally) saturating accumulators and a 16-bit bi-directional barrel shifter (with up to a 40-bit value). Independent address generation units (AGUs) enable concurrent fetches of two operands for most of the DSP class of instructions.

Motor Control PWM Module

The dsPIC motor control PWM module is optimized for applications, such as 3-phase AC induction motors, 3-phase brushless DC motors, and switched reluctance motors. The motor control PWM module has either 6 or 8 output pins and 3 or 4 PWM generators, depending upon the device. The output pins may be configured as complementary output pairs or as independent outputs.

Critical PWM operating parameters, such as output polarity, are programmed in non-volatile memory for safety. The non-volatile options reduce the risk of placing the PWM outputs in a state that might damage the power devices connected to the peripheral.

The PWM module has a dual dead time unit that is used to eliminate 'shoot-through' current conduction in complementary power transistors that drive the load. Two programmable dead times allow the user to optimize the design for different switching times of the upper and lower transistors in a complementary output pair.

Two hardware fault shutdown pins are available that place the PWM pins in pre-determined states without intervention from the CPU. These pins may be used for catastrophic failures or hardware braking inputs.

10-bit High Speed A/D Converter
Voltages and currents in a motion control application must be obtained quickly to minimize time lags in the control loop. The 10-bit, high-speed A/D converter can convert at 500K samples per second, and up to four input samples may be acquired simultaneously to eliminate phase delay between multiphase current or voltage samples. A/D conversions can be automatically scheduled at a specific point in the PWM cycle using the MCPWM special event trigger.

Quadrature Encoder Interface (QEI)
The QEI provides a simple interface to incremental optical encoders and allows the user to obtain signed velocity and relative rotor position information from the motor or mechanical system. The QEI module accepts the A, B, and index connections from the incremental encoder and stores the accumulated count pulses in a dedicated 16-bit timebase. Velocity and position information can be measured at x2 or x4 resolution. The QEI can be used as a spare 16-bit timer for sensorless motors and other applications.

Other Motor Control Peripherals
Extra PWM outputs are often needed for applications, such as active power factor correction (PFC) and motor braking. The Output Compare units may be configured as general purpose PWM outputs. Each compare register is double buffered so that the PWM duty cycle can be changed without glitches. In addition, the Output Compare units can generate PWM signals of arbitrary phase relationship and one of the pins can be assigned as a shutdown input controlling other output compare units.

Every device in the dsPIC Motor Control & Power Conversion family contains 4-8 Input Capture units. The capture units can be used to measure velocity from a tachometer wheel or reading hall effect sensor outputs for brushless DC motor commutation. All motor control variants in the dsPIC device family contain an SPI™ interface, I²C™, interface, and 1 or 2 UARTS.

PRICING & AVAILABILITY

The Motor Control & Power Conversion family of dsPIC devices is expected to range from $5-$14 each in 5,000-unit quantities.

Beta sampling of the first devices is planned for first quarter 2002. General product sampling and hardware development tools are planned for second quarter 2002. Software development tools are available in beta versions today with a full release expected in January 2002. Volume production for dsPIC devices starts in fourth quarter 2002.

The datasheets may be viewed at www.microchip.com/dsPIC.

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