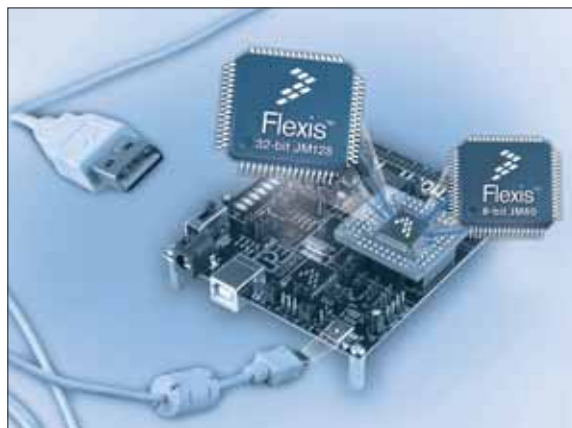


Energy management and connectivity are driving the microcontroller market

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The drive towards improved energy efficiency across all markets and applications and the need for connectivity results in designers needing to fully rethink their choice of microcontroller and overall system to tackle both needs.



■ With the current global emphasis on environmental protection, energy efficiency and sustainable resource management, the designers of all applications are being affected by customer pressure and new legislation from governments to reduce cost and conserve resources. These pressures are resulting in an increased focus on end application designs aimed at minimizing power consumption, reducing scrap and eliminating downtime.

Embedded control and standard connectivity options, wired or wireless, provide a means of enabling greater productivity via remote monitors and mobile access to view data and control systems. An example of the impact the connected world can make is efficient remote monitoring of a patient's health, meaning in many cases patients won't need to take the time to travel to visit the doctor in person. For example, consider a patient who is having his blood pressure monitored daily. By using a portable blood pressure monitor, the patient can monitor blood pressure effortlessly. Then that data can be downloaded and recorded on a home PC using a Universal Serial Bus (USB) connection. From there it could be sent to the doctor via the Internet for review.

The USB standard is playing a major part in the move to better connectivity. It is already a standard connection used in PCs and portable de-

vices, such as digital still cameras, video cameras, mobile phones, mp3 players, mass storage devices, etc. The demand for these peripheral consumer applications continues to grow. In the consumer market USB will find its way into other applications, such as gaming and leisure equipment, communications devices like DSL modems and other home applications, such as personal video recorders (PVRs) and set-top boxes, among others.

Within the broader industrial markets, the growth of USB as a common interface standard is well underway. Some of the key sub-segments in the industrial market where uptake of USB has already begun include building and factory automation systems, security systems and the medical market. A big part of the growth in the industrial sector can be attributed to the growth in human machine interface technology, which allows more effective monitoring and control in the industrial applications. USB-enabled technology is needed to allow peripheral connections to these new HMI enabled applications so data can be uploaded, downloaded and shared effectively. Some typical applications for USB in the industrial world include: data loggers to upload new data to remote terminals or to record data from remote devices; applications where USB-to-serial bridges are required to upgrade standard serial interfaces so they can interface with new standards; to enable

plug-and-play wireless solutions for applications that need to connect over greater distances. The examples highlighted above are but a few of the possible applications for USB devices in the industrial and consumer world. In 2006 USB-enabled device shipments reached 2.2 billion units, and in 2011 it is forecast to reach 4.0 billion (source: In-Stat, USB 2007: Wireless has finally arrived). Note: within the consumer market we include PCs, PC peripherals, consumer leisure equipment (e.g. gaming stations, TV, STB, etc) and communications applications, such as mobile phones and DSL modems and gateways.

There have been three active specifications: 1) USB1.0, which was the original specification; 2) USB1.1; and 3) USB2.0. The USB1.0 specification is all but obsolete now. The major point to note is that USB1.1 delivers low-speed and full-speed operation to support the USB A and USB B connectors. USB2.0 is a superset of the 1.1 specification that introduced high-speed operation and the small Mini A and Mini B form factors. USB On-the-Go (OTG) and power management specifications were both added at later dates as supplements to the USB2.0 specification. See table 1.0 for a summary of the specifications. The USB Mini A/B form factor emerged with the USB OTG addendum to enable portable devices, such as digital cameras and phones, to be able to dynamically configure



CMX USB stack

as either host or device in a connective partnership. For a quick snapshot of the USB specification, see table 1.0.

Within a USB network there are two roles. The first and most crucial role is that of the host. The host will identify the device and should be able to specify the nature of the connection. The device will typically be there to input data to the host. In any given network there can only be one single host, but that host can support up to 127 devices in a tiered topology.

The drive toward increased energy management and connectivity translates into a greater need for more performance and functionality from the embedded microcontroller at the heart of the application. This demand is pushing some designs up the microcontroller food chain. With the reduced costs giving increased access of 32-bit microcontrollers, what would traditionally be considered to be 8-bit MCU applications are migrating up the performance path. In other instances suppliers are looking for existing 8-bit suppliers to provide additional performance and functionality within their existing 8-bit architecture.

The choice for the designer in this instance is not an easy one. Do you look to gain additional performance and functionality from your existing 8-bit architecture, a product that the designer is familiar with and has developed with in the past, but may not fully meet the needs of the application? Or do you move to a 32-bit architecture, which is just as cost effective and can guarantee the performance and functionality required in the application but is a completely new, more complicated, architecture that pushes up the program memory requirements and code size?

The choice is not as easy as some 32-bit microcontroller suppliers would have you believe, especially when moving to a completely new 32-bit architecture. Designers that make the leap are faced with a completely new instruction set, different design methodology, new peripherals with no backwards compatibility, new tools licenses or a completely new tool chain. On the other hand, while remaining in the 8-bit world is altogether more comfortable, lingering questions remain around the ability of 8-bit architecture to meet the application's demands. Fully investigating the benefits and drawbacks of 8-bit takes time, effort and money.

To help make the choice easier for designers, Freescale has launched a new series of micro-



Low-cost development system designed for demonstrating, evaluating, and debugging

controllers. The Flexis series comprises the industry's first 8- and 32-bit compatible MCUs. With the Flexis series, developers always have 8-bit and 32-bit options that are fully pin compatible as well as offering full peripheral compatibility and hardware and software tools compatibility. The only difference is the core. A big benefit is that with Flexis MCUs, the designer has the ability to fully evaluate both the typical 8-bit option and the higher performance 32-bit option before deciding on the best part for the application. The 8-bit part offers cost and power savings whereby the 32-bit delivers higher performance and integration, as well as a continued migration path in the other 32-bit microcontrollers from Freescale. Alternatively the scalability that this series delivers means that in instances where designers required to develop a series of end applications with differing cost and feature levels can implement the Flexis series across that range of products. The 8-bit Flexis family is based on the S08 core from Freescale that runs up to 50MHz core / 25MHz bus. The 32-bit Flexis family is based on the ColdFire® Version 1 (V1) core that runs up to 50MHz core / 25MHz bus. Note: The 32-bit V1ColdFire core is designed to achieve twelve times the throughput of the S08 core.

On top of the devices' pin and peripheral compatibility, developers also do not need to worry about changing tools suites. Freescale's CodeWarrior IDE provides a single IDE for both the 8-bit part and the 32-bit part. CodeWarrior provides a single integrated tool suite designed to get you on the design fast track with RS08, HC(S)08 and V1 ColdFire members of the Freescale Controller Continuum. The IDE goes beyond basic code generation and debugging—it provides built-in features and utilities so you can deliver better quality products to market faster. More than 100 example projects are available to assist in your design efforts. Using the New Project Wizard, you can create a working project in as few as seven mouse clicks. And when market requirements change mid-project, the MCU Change Wizard allows you to re-target the project to a new microcontroller in as few as four mouse clicks. You choose the new microcontroller and the default connection, and the IDE automatically reconfigures your project for the new microcontroller with the correct build tools (compiler, assembler, linker) and the appropriate support files (header files, libraries, and linker files). For projects switching between 8-bit and 32-bit Flexis series MCUs, this is the extent of the porting effort.

To address the growing demand for greater efficiency in battery, portable and power-sensitive applications, such as remote drive units in heating, ventilation and air conditioning systems or remote fire detection/sprinkler systems in fire

Spec	Data Rate and Performance	Applications	Notes
USB 1.1 Low-speed USB 2.0 Low-speed	1.5 Mbps / 10-100 Kbps	Keyboard, mouse, joystick	Low cost but limited performance; type and number of endpoints are limited
USB 1.1 Full-speed USB 2.0 Full-speed	12 Mbps / 5-10 Mbps	Printers, audio devices, floppy drives, Phones, Audio devices (MP3 players) & other portable devices	Moderate performance; guaranteed latency; guaranteed bandwidth
USB 2.0 High-speed	480 Mbps / 25-400 Mbps	Video, storage, imaging	Vast bandwidth improvements

Table 1. USB specification overview

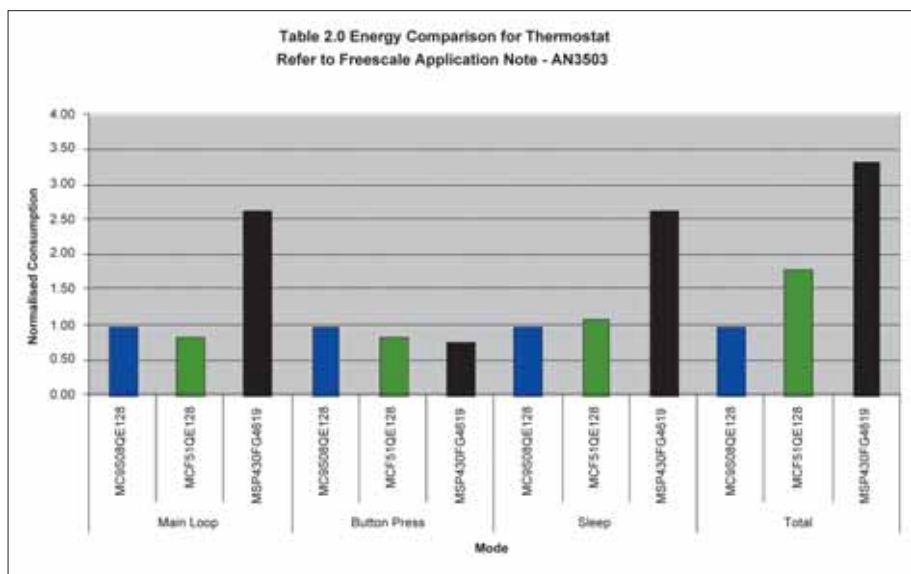


Table 2. Energy comparison for Thermostat. (Refer to Freescale Application note AN3503)

and security systems, Freescale has launched the first of the Flexis QE family. It provides an industry benchmark for low power consumption numbers:

- Run – 17mA (8-bit S08 Core) and 33mA (32-bit V1 ColdFire Core)
- Wait – 4.1mA
- Low Power Run – 9/21uA (8-bit S08 core) and 19/50uA (32-bit V1 ColdFire core)
- Low Power Wait – 5uA
- Stop3 – 450nA
- Stop2 – 370nA

The Flexis family supports a rich feature set that includes serial communications interfaces, timers, analogue circuitry and system security to meet the needs of a broad range of applications.

To address the need for USB connectivity and the growth in portable applications and peripherals in the consumer and industrial markets, Freescale launched the Flexis JM family at Embedded World Trade Show in Nuremberg. Again, this family delivers the benefits of the Flexis series by offering an 8-bit S08-based product and a fully compatible 32-bit V1 ColdFire product. The 8-bit MC9S08JM features full speed USB device, providing a quick and easy way to standardize serial communications in industrial and consumer applications. The 32-bit JM128 microcontroller features USB OTG, providing flexible control and connectivity options, enabling USB host or USB device. All JM devices feature an integrated transceiver that helps you save money, time and board space by eliminating components.

Freescale offers a stand alone, complimentary, USB stack that helps you get running in minutes. This stack is also available for all USB MCUs in the Controller Continuum. A full

support and training ecosystem of reference designs, application notes, software examples (boot loader, HID mouse, bridge application, data logger, and demo PC GUI) and web casts helps customers get started quickly. See diagram 1.0 to view functions supported within the complimentary USB Stack from Freescale.

The 8-Bit MC9S08JM family offers options with up to 60Kbytes of flash memory, and up to 4Kbytes of RAM. It is supported in 32LQFP, 44LQFP, 44QFN, 64 QFP and 64LQFP package options. The 32-bit MCF51JM family starts at 64Kbytes and goes up to 128Kbytes of flash memory, with up to 16Kbytes of RAM. It is supported in 80LQFP, 64LQFP, 64QFP and 44LQFP package options. The Flexis JM family supports an advanced feature set that includes a rich suite of communications peripherals (2xSCI, 2xSPI, IIC), a 12-bit analog-to-digital converter, analog comparator, two independent timer modules and a real-time clock. In addition to this base feature set, the 32-bit MCF51JM128 offers a cryptographic acceleration unit and a CAN module, both of which are increasingly used in a variety of industrial applications.

The background debugging system and on-chip in-circuit emulation (ICE) with real-time bus capture capability provide a single wire debugging and emulation interface that eliminates the need for expensive emulation tools. Starting up development with this device is extremely simple and inexpensive with a low-cost development board (DEMOJM) and CodeWarrior Special Edition. A single, common CodeWarrior development tool suite supporting both the S08 and ColdFire devices, along with training and documentation, gets the customer on the design fast track. ■