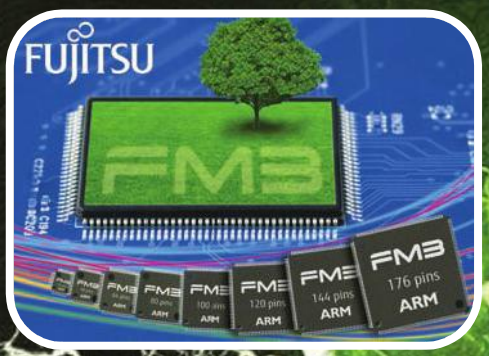
Time is of the essence



Simon Bliss, Senior Field Application Engineer & Manuel Schreiner, Junior Application Engineer at **Fujitsu** explore how modern MCUs are boosting the control of power consumption in embedded system applications

Historically, designers have focussed on worst case conditions when considering power supply system design. To this end, the use-case of highest system performance has dominated the provision of power for the system.

With the drive to reduce energy consumption it is necessary to pay attention to power consumption of embedded systems when they are in inactive states as well. With the diversity of applications, engineers also have to cater for frugal power consumption when the system is inactive.

In the most common-place low power applications, power is sourced from batteries. Typical low power applications can be synchronised and charged via USB. For synchronisation, high processing performance is required, but when operating in stand-alone mode, power management is significant. For these case performance power consumption must be dynamically scalable via run-time.

For low power the whole embedded system must be considered, yet the microcontroller plays a big part of it. Intelligent power management is required to reach the best compromise between low power and performance.

A microcontroller can contribute new features to legacy (existing) and new products, in addition to the power management of an application.

Designs have to cater for frugality of power consumption in both dynamic and power down use cases; yet also recover from the low power mode within time constraints of the wake-up stimulus. Thus the context of low power need not necessarily mean using the lowest power consumption of a microcontroller. Low power must be determined by the operating conditions during all use cases of the application - over a longer time frame.

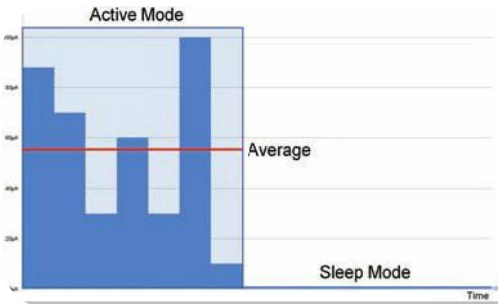


Figure 1: Intelligent power management over a longer time frame

It is essential that performance scalability is considered in low power applications. Intelligent peripherals help to decrease performance requirements and to process operations without intervention of the user application code.

In response, companies such as Fujitsu are developing solutions for different application areas with devices such as its 8FX and FM3 product lines. With the latter devices a range of serial interfaces is provided including CAN, USB and Ethernet, and user configurable USART/I²C/SPI. Code memory comprises high endurance, high speed flash technologies.

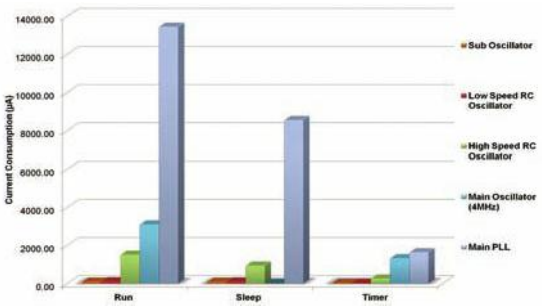


Figure 2: Selectable clock sources for optimal combination of best performance and power consumption proportion

To make it easier for selection the company has characterised the line-up into three groups. The standard and high performance groups are capable of operation over a voltage range from 2.7V up to 5.5V; with the group designed for low power operation selected to a voltage range from 1.65 to 3.6 volts.

Those in the most power frugal category are classed as low leakage devices. Even taking into account that they are designed for energy efficiency, an operating voltage range from 1.8V to 5.5V has been achieved.

Special features of this series for low-power applications include embedded RTC, embedded LCD controller, low voltage detection unit and EEPROM emulation by Flash memory.

The flash memory, to 1MByte, is capable of zero wait state access up to 60MHz operation. Also, the high performance group are able to operate up to 144MHz where an integrated 16kBytes trace buffer memory supports access without wait states.

Programming of the Flash is efficient, and secure. Connection for programming is under the designer's control, but can be via serial port, JTAG, USB or a customised implementation. Should the device Flash memory become corrupted, it is possible for the designer to allow the built-in Burn-in ROM code to over-right the Flash contents.

For cost critical applications, The company has developed its 8FX 8-Bit microcontrollers with low power features, plus analogue hardware such as on-chip OP-Amps and comparators.

Both device families mentioned here implement scalable dynamic clock selection. They also can be driven by five different clock sources: Two external - Sub-Clock Crystal and Main-Clock Crystal, also on-chip Sub RC Oscillator, Main RC Oscillator and PLL. So the microcontrollers are capable of reaching a high level - combination of best performance and power consumption proportion for widely varying applications. Users also have the ability to change the proportions during runtime.

In addition to the flexible scalable clock selection particularly for the low power devices, several supplementary low power modes are offered. Beside different sleep modes, special RTC modes and stop modes help to consume between 2µA and down to, below 1µA. Also for these modes, peripherals and RAM can be disabled to consume lowest power.

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