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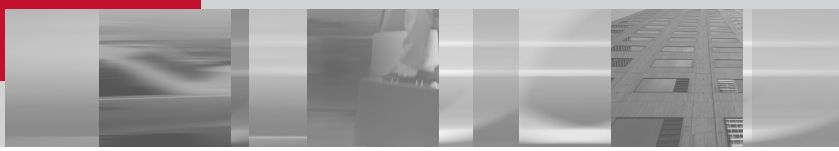
The Enterprise Mobility Company™



MAY 2004 ▸ WHITE PAPER

MC9000: Best-Practice Power Management Techniques Deliver Maximum Battery Efficiency

Executive Summary

Peak battery performance in mobile computing devices is obtained through a combination of user practices and application setup, as well as power management techniques and features implemented by the device manufacturer. Users can control the more obvious factors, such as using the backlight only when needed. But there are many areas end-users cannot control. For example, users are often unable to control power management functionality within hardware features or software applications. Manufacturers, however, can elect to implement a wide variety of power management features within the device to control and conserve battery power consumption.

What can be controlled by the device manufacturer, and what are today's best practice power management techniques? This white paper answers these questions by taking an in-depth look at Symbol's new ground-breaking power management architecture, which defines Symbol as a key technology leader in the area of power management within enterprise mobility.

Designed from the Ground Up for Outstanding Power Management Functionality

Symbol's new power management architecture is designed from the ground up to provide an unsurpassed level of power management to support today's demanding enterprise applications. At the core of the new architecture is Microsoft's Windows CE operating system and Intel's XScale® processor. Minor enhancements to the leading handheld operating system, the power management capabilities of the low-power XScale processor, and power-saving hardware components combine to form a solid foundation for the new power management architecture, which is designed to:

- Deliver low power consumption regardless of device state (run, idle or suspend)
- Independently control power to all internal peripherals—including the duration that the peripheral is powered on as well as the power that is consumed
- Protect against data loss in all possible states, including low power, suspend/resume, warm boot and critical power failures

Minimal Power Consumption in Any State

Power consumption is minimized regardless of power mode—run, idle or suspend. 'Run' mode consumes the most power—the display is powered on and the processor is actively executing instructions and processing information. In 'idle' mode, the display is powered on, but since the device is not processing information, it is placed into a low power mode until a status change requiring a return to run mode is detected. In the 'suspend' state, the device appears to be powered down completely with no display, but is actually still drawing minimal power to conserve data in memory.

The Symbol power management architecture not only optimizes each of these modes, but is also designed to allow devices to spend as much time as possible in the idle state for maximum power conservation. For example, in idle mode, Symbol powers down clocks and other power consuming elements until a change in status is signaled by an 'interrupt', such as the press of a key or selection of a menu item from a touch-screen. An 'interrupt' will instantly—and imperceptibly—return the device to run mode. However, in many competitive devices, software must poll periodically to determine if status has changed (for example, detection of power status change when plugged in to AC power)—and the polling itself requires a transition to run mode. Through the implementation and use of 'interrupts', Symbol power management architecture provides a higher level of power management control—and consumption.

Symbol's Value-Add Power Management Driver: Exceptional Control of Peripherals and More

Symbol proprietary power management driver enables applications to be programmed to achieve an exceptional level of awareness and control of peripheral devices and their states, significantly increasing power conservation by powering down devices when not in use. For example, audio circuitry is only enabled when an audio file (for example, a .wav file) is played. Once the file has been processed, the audio circuitry is powered down.

In addition, the power management driver enables exceptional control of the 'suspend' mode. 'Wake-up' sources can be individually enabled or disabled by both source and type. For example, devices in the suspend state due to a timeout from lack of use can be programmed to automatically power up to the run state when a scan trigger or other action is performed. But devices powered down via the 'power' key can be programmed to allow activation only via the 'power' key. This would eliminate the chance that devices could be unintentionally activated out of suspend mode, and begin to draw power.

Power-Saving Hardware Components

Symbol optimizes power wherever possible with efficient hardware components, including:

Power Micro

The Power Micro is a dedicated extremely low-power processor that performs power management functions, significantly reducing power consumption, freeing the

MC9000 Series Mobile Computers

Symbol's MC9000 mobile computers incorporate the new power management architecture, offering outstanding power efficiency.

higher-powered X-Scale processor to spend more time in idle mode.

Display Backlight
The display backlight is powered by an LED array, which draws less current than the CCFL tube technology typically used in competing devices. In addition, the default is set to maximize battery time (though the default can be modified as needed).

Keyboard Backlight
The keyboards enable the use of an electro luminescent (EL) light instead of the LED typically found in competitive devices. The EL light draws less current—yet yields higher levels of illumination.

Imager and Bar Code Scan Engines
Symbol's power management architecture enables an exceptional level of integration with Symbol's SE 4400 imager and laser bar code scan engines. The devices are automatically powered down when not in use, where other imagers and bar code scanners are likely to draw power when not in use. In addition, the CCD Technology utilized in Symbol's SE 4400 imager reduces the overall device power consumption during a decode session. The illumination LED is powered on only when the photo detectors are exposed (i.e. when the shutter is open)—approximately 2 ms in a typical room light ambient environment). The illumination remains off during the rest of the frame (typically 33 ms at 30 frames/sec). In competitive CMOS Imager-based products, the shutter remains open with detectors exposed during the read out, requiring illumination for the complete frame time (33 ms). As a result of this difference in power management, Symbol's SE 4400 delivers exceptional power efficiency—competitive CMOS Imager-based products consume over 17 times the power (33 ms vs 2 ms) for decode sessions.

Data Loss Protection

The Power Micro also works in conjunction with Symbol's custom ASIC (Application-Specific Integrated Circuit—a chip designed for a specific application), providing several levels of redundancy to identify low battery conditions and ensure data is preserved under any condition. Data integrity features include:

- Battery levels set to ensure RAM data is always preserved
- A battery eject switch, which provides a warning to a terminal that enables the device to cleanly save data in RAM, close files and suspend before power is interrupted during a battery change

Results

The MC9000 Series employs Symbol's new power management architecture and recently underwent an Independent Battery Life test for PocketPC devices, with extraordinary results:

- General battery life increased from 32% to as much as 120% (over prior generation Symbol devices)
- Idle mode required 66% less power than a leading and comparatively priced competitive device
- At a set profile, a fully charged battery lasted 23 hours—over twice that of a leading and comparatively priced competitive device, which lasted 11.4 hours

Summary

Symbol's ground-breaking new power management architecture utilizes and extends industry standards, providing an unsurpassed granular level of control of peripheral power, data protection and battery life. This comprehensive system view has produced an architecture that enables optimized power management practices—and delivers a new level of power efficiency in Symbol's MC9000 Series.

About Symbol Technologies

Symbol Technologies, Inc., The Enterprise Mobility Company™, delivers solutions that capture, move and manage information in real time, from the point of activity to the point of decision. Symbol solutions integrate advanced data capture technology, ruggedized mobile computers, wireless infrastructure, enabling software and high-ROI applications from our business partners and Symbol Enterprise Mobility Services. Symbol enterprise mobility solutions increase business productivity and velocity, reduce costs and realize competitive advantage for the world's leading retailers, transportation and logistics companies and manufacturers as well as government agencies and providers of healthcare, hospitality and security. More information is available at **www.symbol.com**

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