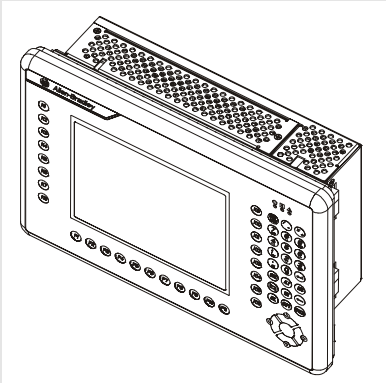
Allen-Bradley

6182 Industrial Computer Software Development Kit

User Manual



Important User Information

Solid state equipment has operational characteristics differing from those of electromechanical equipment. "Safety Guidelines for the Application, Installation, and Maintenance of Solid State Controls" (Publication SGI-1.1) describes some important differences between solid state equipment and hard-wired electromechanical devices. Because of this difference, and because of the wide variety of uses for solid state equipment, all persons responsible for applying this equipment must satisfy themselves that each intended application of this equipment is acceptable.

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Throughout this manual, we use notes to make you aware of safety considerations.

ATTENTION: Identifies information about practices or circumstances that can lead to personal injury or death, property damage, or economic loss.

Important: Identifies information that is especially important for successful application and understanding of the product.

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Using this Manual

Read this preface to familiarize yourself with the rest of the manual. The preface covers the following topics:

- who should use this manual
- the purpose of the manual
- contents of the manual
- conventions used in this manual
- Allen-Bradley support

Who Should Use This Manual

Use this manual if you are responsible for developing application software to run on the 6182 Windows CE Industrial Computer.

Purpose of this Manual

This manual is a user guide for the Software Development Kit for the 6182 Windows CE Industrial Computer. It gives an overview of the system and provides detailed information about the contents of the software development kit.

Contents of this Manual

Chapter	Title	Contents
	Preface	Describes the purpose, background, and scope of this manual. Also specifies the intended audience.
1	Introduction to the RAC6182	Provides an overview of the 6182 Computer and describes the hardware and operating system software.
2	Developing CE Drivers and Applications for the RAC6182	Provides general guidelines for programmers. Provides detailed procedures for setting up the development system and installing the RAC6182 SDK.
3	RAC6182 CE SDK	Provides an overview of the 6182 CE SDK.
4	RAC6182-Specific Extensions to the CE API	Provides detailed descriptions of the 6182 functions.
Appendix A		Provides file lists, memory usage information, instructions for using an external debug monitor.

Manual Conventions

The following conventions are used throughout this manual:

- Bulleted lists such as this one provide information, not procedural steps.
- Numbered lists provide sequential steps or hierarchical information.

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Contact your local Allen-Bradley representative for:

- sales and order support
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- warranty support
- support service agreements

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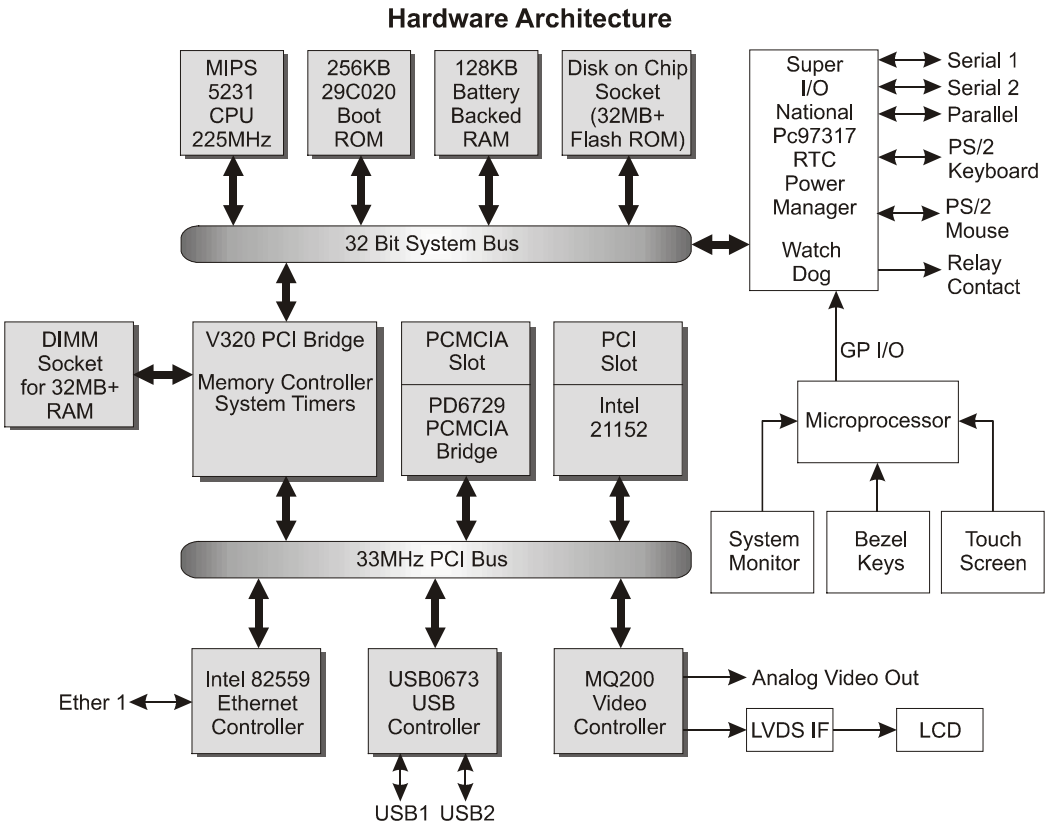
If you need to contact Allen-Bradley for technical assistance, please review the information in the System Troubleshooting chapter first. Then call your local Allen-Bradley representative or contact Allen-Bradley technical support at (440) 646-5800.

For additional product information and a description of the technical services available, visit the Rockwell Automation/Allen-Bradley Internet site at http://www.ab.com.

Introduction to the RAC6182

Hardware Architecture



CPU

The system processor is a QED RM5231 embodying the popular MIPS 4300 RISC architecture. The RM5231 has a 225MHz clock speed, 64-bit internal registers and a built in floating point unit.

The system processor communicates directly with various memory devices, a V320 bus controller, and a super I/O controller by way of a 32-bit system address and data bus.

The V320 bus controller manages system dynamic RAM for the 5231. It also provides a bridge from the system bus to the PCI bus. In addition, it provides system timers.

System Timers

At least one (and in some cases, depending on the hardware revision level, more than one) programmable hardware timer is available at the application layer.

Memory Devices

Disk-On-Chip Flash ROM

The Disk-On-Chip device (commonly called the “DOC”) is a flash ROM (32MB to 256MB, field upgradable) that emulates a disk device. The Disk-On-Chip device has two partitions or logical storage areas. One partition provides non-volatile storage for the Windows CE operating system image. The other partition supports a FAT16 (DOS compatible) file system, in which application programs and data can be stored.

Boot ROM

The boot code resides in a 256KB boot ROM. The boot code includes a “Boot Loader” that loads the Windows CE image from the Disk-On-Chip into DRAM at system startup.

The boot ROM is segmented into two 128K blocks, each of which contains boot code. A jumper on the CPU board (J2) selects between the 2 blocks. The lower block (selected when the jumper is across pins 1 and 2) contains the primary boot code. The upper block (selected when the jumper is across pins 2 and 3) contains boot code with debug support. The upper block boot code performs extended power on self testing (POST), disables restoration of user persistent registry items, and enables debug output on COM2.

DRAM

The RAC6182 uses industry standard 3.3V, PC100 and SPD compliant, non-ECC dynamic RAM, packaged in a DIMM. The DIMM may be 32MB to 256 MB, and is field upgradable. The DRAM provides a fast access volatile storage space for data and program code.

The Operating System uses part of the RAM for a RAMDISK and the other part for normal system memory. The RAMDISK portion is known as the Object Store and provides specialized storage for the Windows CE Registry and Windows CE system databases. The Windows CE Control Panel System Properties tool has a slider control that allows a user to determine how the RAM is allocated between RAMDISK Storage and system memory. The slider control is factory set for a 50/50 split. Application programs can control RAM allocation with the Windows CE system call SetSystemMemoryDivision (see Microsoft’s documentation of the CE API for details).

Retentive Memory (Battery Backed RAM)

A 128 KB non-volatile memory provides application accessible storage for state information and data logging operations. A Lithium battery with a 10-year shelf life provides for long term data retention. It is recommended that applications using the retentive memory monitor battery voltage; this is easily done with system calls to the RAC6182's hardware monitor. If the battery voltage should start to decline, the battery should be replaced. Battery replacement is facilitated by the presence of a "super-cap", which provides sufficient current to sustain the memory data for up to eight hours following a power down of the system.

Super I/O

The National PC97317 super I/O chip provides several key functions.

PS/2 Keyboard and Mouse Ports

The super I/O chip provides two PS/2 ports to support connection of an external keyboard and/or mouse.

Serial Ports

The super I/O chip provides two 16550A compatible serial ports. The CE operating system identifies these ports as COM1 and COM2. Applications can control both COM ports via standard WIN32 API function calls.

COM1 is provided with a DB9 connector and supports RS232 (TXD, RXD, RTS, CTS) and RS422/485 (TX422+, TX422-, RX422+, RX422-) signaling at standard communication data rates up to 115 Kbps. The configuration (RS-232/RS-422/485) for this port is software-selectable. COM1 serves as the primary serial port for application use; it remains available to applications for serial I/O even when debug mode is enabled.

COM2 is provided with a DB9 connector and supports "standard" RS232 signaling only. COM2 may serve either as an application RS232 port or as a debugging port. When the operating system is in debugging mode it will output debug messages to COM2 port. An application developer or device tester can utilize these messages to determine the current state of the operating system, or to identify problems such as device failures or application exceptions.

Parallel Port

The super I/O chip provides one bi-directional parallel port to support connection of a local printer or other peripheral device.

Real Time Clock

The super I/O chip provides a Real Time Clock which keeps the system date and time.

Watch Dog

The super I/O chip provides a watchdog timer that can be used to trigger a system reset.

At system initialization, the watchdog is disabled. It can be enabled by an application. Once the watchdog is enabled, one or more applications must periodically “tag” (restart) it to prevent it from timing out. If the watchdog times out, a system reset (warm-boot) is initiated. Once the system has been restarted, an application can inquire about the event that caused the restart and learn that the watchdog timed out. A condition code indicating this remains latched and detectable by software until it is cleared by a cold-boot.

The watchdog timer has a maximum resolution of 1 msec.

GP I/O Subsystem

The super I/O chip provides a bridge between the system bus and a general purpose I/O bus. This general purpose I/O bus supports several additional devices.

Relay Output

A relay output is provided for application level control of an external device.

Hardware Monitor

An application accessible hardware monitor provides real-time temperature, voltage and battery monitoring. Thresholds for warnings can be established by application programs. Applications also have access to the system LEDs.

Keypad

Certain configurations of the RAC6182 provide function keys, a numeric keypad and cursor control keys integrated into the front bezel. The number of function keys can vary. Some function keys are re-legendable.

Extended software support for the bezel keypad is provided with the RAC6182 Windows CE operating system in the form of a keypad handler DLL. The keypad handler intercepts and operates on codes produced by the keypad driver before passing them tot he application with current focus. The keypad handler can optionally re-map keys (assign different virtual key codes) and effect specialized processing such as the generation of key macros (strings of virtual key codes) or the launching of a new program from single key strokes. The standard

keypad handler can be replaced by a custom keypad handler to provide special key code mappings.

Touch Screen

An integral, resistive analog touch screen with a serial controller provides mouse-like operator input. The touch screen is a factory installed option associated with an integral display.

PCI Subsystem

The V320 chip provides a bridge between the 32-bit system address/data bus and the PCI bus. Several devices are attached to the PCI bus.

Display Controller

An MQ200 video controller, configured as device z on PCI bus 0, supports bezel mounted LCDs as well as external monitors. The MQ200 provides 2 MB of video RAM.

Table A
Display Options

	Integral 8” Diagonal Display*	Integral 12” Diagonal Display*	External Monitor
Type	STN LCD with LVDS digital interface	TFT LCD with LVDS digital interface	Any type, with VGA/HD-15 analog interface
Resolution	640x480 (VGA)	800x600 (SVGA)	up to 1024x768 (XGA)
Color Depth(s)	256, 64K or 16M	256, 64K or 16M	256, 64K or 16M at <= 800x600, 256 or 64K at 1024x768

*The bezel mounted LCD display is a factory installed option.

USB Ports

A USB0672 USB Controller Chip, configured as device x on PCI bus 0, provides basic OHCI host support for up to two USB peripheral devices. This basic support will facilitate use of various USB keyboards, printers, bar code readers, etc. when the appropriate device specific drivers are available.

On-board Ethernet

An Intel 82559 Fast Ethernet Multifunction Controller, configured as device x on PCI bus 0, provides Ethernet communications support via one 10/100-BaseT RJ45 port.

PCMCIA Slots

A PCMCIA slot connector supports 2 Type II PC Cards or 1 Type III PC Card. The PC Cards can be memory or I/O devices. The system supports concurrent operation of PC Cards as follows: One for memory

expansion and one for communications; one or two for memory expansion; one or two for communications.

PCI Slot

One half-length PCI slot provides an expansion capability for communication and I/O. The PCI slot can accommodate a large assortment of specialized and commercially available PCI add-in cards when suitable drivers are available. The device installed in the PCI slot will be device x on PCI bus 1.

Software Architecture

RAC6182 Windows CE OS

The initial release of the RAC6182 provided Windows CE Version 2.12 with the latest service packs. Currently, the RAC6182 is provided with Windows CE V3.0

The system software includes the following components:

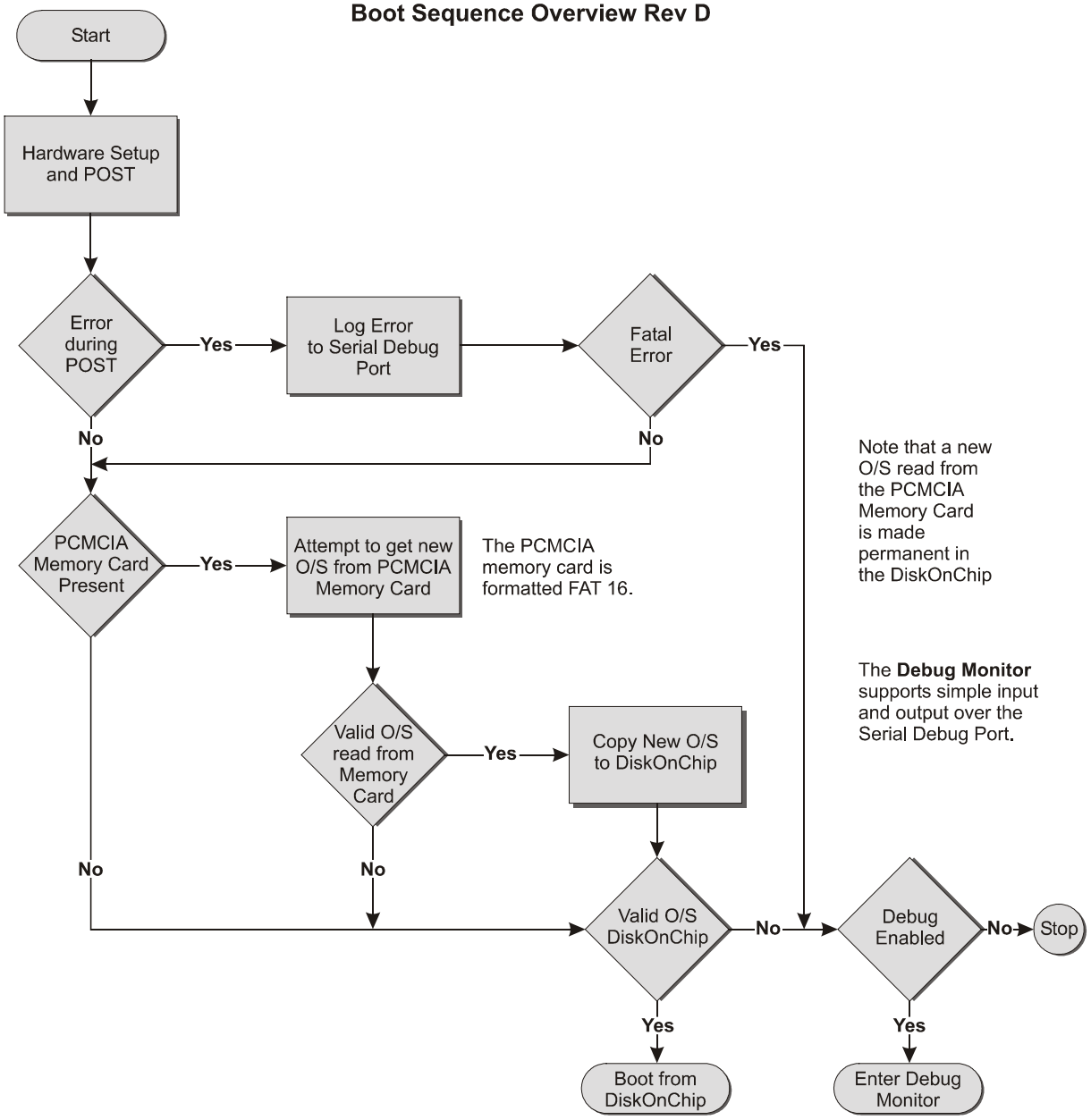
- Hardware Initialization and Boot Loader, situated in the boot ROM
- Windows CE Kernel with adaptations (Hardware Adaptation Layer customized for the RAC6182 hardware, Built-in ISRs), situated in the boot image stored in the operating system partition of the Disk-On-Chip
- Windows CE Default Registry, which is part of the boot image. (A persistent registry, containing information relative to specific configurations, is maintained in the file system and merged with the default registry at boot.)
- Windows CE Modules and Device Drivers (File system support, ...), implemented as part of the boot image or as files (dlls, exes, etc.) stored in the FAT16 partition of the Disk-On-Chip
- GUI Desktop Shell, implemented
- Control Panel and System Configuration/View Tools

Boot Sequence

The boot code in the Boot ROM gets control of the microprocessor at power-on, initializes the hardware, performs power-on self-tests (POST), and moves the compressed Windows CE operating system image from the boot partition of the Disk-On-Chip persistent storage device into DRAM. Several seconds are required for the decompression and copy operation. Finally, the boot loader jumps to the start address of the Windows CE image and control passes to the Windows CE operating system. Windows CE then loads drivers, including the driver for the Disk-On-Chip FAT16 file system (on the “storage card” partition), restores the registry, establishes the video modes, and finally loads the start-up applications into memory and runs them.

The operating system image that is loaded resides in the operating system partition of the Disk-On-Chip device. However, before loading the Disk-On-Chip boot image, the boot code checks for the presence of a PCMCIA memory device that is capable of supplying a boot image. The flow diagram that follows describes the boot sequence.

Boot Sequence Overview Rev D



Hardware Initialization

The boot code first initializes the CPU and V320 system controller; it then tests video RAM, which it needs to use for stack and heap until the system DRAM is fully available. If debug is enabled, the debug serial port is initialized and a 1 second delay is introduced to give the baud rate

generator time to stabilize. Finally, system DRAM is tested. In the interest of reducing boot time, this test is limited to an address check; no attempt is made to identify bit errors at given addresses.

Tests for Boot Devices

When hardware testing has been completed, the boot code starts looking for PCMCIA devices capable of supplying a compressed operating system image.

The boot code first checks for the presence of a PCMCIA ATA memory device. If it finds such a device with a FAT16 file system containing a file recognizable by its name as a compressed boot image, it will attempt to use that image. The image will be tested for validity. If valid it will be used to overwrite any existing image on the Disk-On-Chip. Operating system loading will then commence.

Note: The boot process configures the PCI controller and any NE2000 Ethernet device in the PCI slot to the extent that, after boot, applications will be able to obtain necessary address and interrupt information by querying the device. This basic POST setup does not necessarily configure all configuration space registers such a device may use. Though many PCI devices will not need any other configuration space registers configured after boot, some have special power-management or other registers to configure. These registers vary widely by card and should be setup by application after boot using Win API calls to access PCI configuration space.

Load of Compressed Operating System

The boot code reads the compressed operating system image from the Disk-On-Chip operating system partition, decompresses it and loads it into memory. (It loads the executable operating system code into program memory and a default system registry into the RAMDISK section of memory.) Control then passes to the operating system image in memory.

"Cold Boot"

The operating system begins a "cold boot" by loading the driver for the FAT file system on the Disk-On-Chip.

It then attempts to find the primary persistent registry file. If this file is not present, it attempts to find the backup persistent registry file. If no persistent registry file is found, system boot continues with the default registry already in memory.

If a persistent registry file is found, the system merges the default operating system registry and this saved persistent registry, saved persistent registry items taking precedence.

"Warm Boot"

After the registry merge, a "warm boot" is begun. Control passes to the operating system kernel, which can now use the registry image to initialize various subsystems. The file system drivers, the graphical subsystem drivers, serial, network, PS/2, USB, and other device drivers are loaded and initialized.

The Windows CE Registry

The Windows CE Registry contains application and system configuration data. The Control Panel provides the user interfaces for managing the system settings that are configurable by the user. Applications access the Registry via the Win32 API. Application developers can manipulate the registry using the tools in Microsoft's Widows CE Toolkit for Visual C++ 6.0, Windows CE Toolkit for Visual Basic 6.0 or Windows Embedded Tools V3.0.

The default Registry resides in the operating system image in the Disk-On-Chip. During runtime, the Registry is loaded into and resides in RAM in the Object Store (RAMDISK).

When the system is powered-on, the registry is restored from Flash Memory to DRAM during "cold boot".

At system shutdown, a persistent copy of the registry is written to flash memory by a FlushRegistry() operation. Likewise, when the built-in Control Panel application, used to manage system settings, is closed, a persistent copy of the registry is written using a FlushRegistry() call. FlushRegistry() may also be called by an application.

Table B
Registry Files

File Name	Description
\storage card\Registry.rlz	Primary persistent Registry file
\storage card\regbak.rlz	Backup persistent Registry file
\storage card\regtemp.rlz	Temporary persistent Registry file

These files are accessed by RegistryFlush and other operating system functions. Applications should never access them directly. The primary and backup persistent Registry files have the read-only, hidden, and system attribute bits set to prevent accidental corruption or deletion by application.

The only time these files should be deliberately touched is during a condition of suspected Registry corruption, wherein, the user decides to revert to the default Registry. Deleting both files and restarting will revert to the default Registry.

The operating system boot process is responsible for merging the default operating system Registry keys with the keys from the persistent Registry. If the same keys exist, preference is given to the persistent registry file. A few default keys are exceptions to this rule and are bypassed during the merge; e.g. the O/S version number is acquired from the O/S image.

The process of merging default and persistent registry information allows operating system upgrades to add new registry keys and values and have these be used in addition to any saved registry state. Since the saved registry information has precedence, users' saved registry keys for control panel applets and other operating system items will be maintained even in the case of operating system upgrades.

On the other hand, the priority given to persistent registry information over default operating system registry information makes it possible for applications or users to cause problems with operating system startup by changing the wrong registry keys. When manipulating the RAC6182's CE Registry applications and users should exercise the same degree of caution that would required in the case of a Windows 9x or NT device.

Important: Since some applications and drivers only read the Registry at start-up, some registry changes made by applications will have no effect until the RAC6182 is re-started.

Policies for When Registry Flushing Occurs

Control panel applets supplied with the operating system have been customized to automatically flush the registry upon exiting the applet. This allows users to change typical control panel settings such as network, device name, screen saver, etc. and have these be flushed without having to manually issue a registry flush to save these. Since the flush occurs on applet exit as an optimization, users just need to remember to close the applet after making changes for the automatic flush to occur. Due to the inner workings of the applets, it is not feasible to only flush on applet close if a value was changed, so a flush occurs on applet close even if no registry values were actually altered.

Other applications such as Internet Explorer, remote networking, and any third-party packaged applications are not customizable in this fashion and hence changes they make to the registry will not be persistent until some other application flushes the registry. To address this, two features of the operating system are present.

First, an executable regflush.exe supplied with the system may be manually executed by a user at any time to flush the registry to persistent storage; this application simply calls RegistryFlush(). Second, upon a controlled shutdown requested by an application through the power/shutdown driver results in an automatic flush of the registry after applications have signaled that their cleanup is complete and before the hardware is actually shutdown or reset.

During an uncontrolled shutdown (i.e. hard-power down), the system does not have enough time to flush the registry to persistent storage. Therefore, the registry must have been flushed by one of the means described above or else changes to the registry since the last flush will be lost. It is recommended that the controlled shutdown procedure be used for shutdown even if other registry flushing by applications is in place.

Local File Systems

The RAC6182 Windows CE operating system provides support for two separate local file systems. A DOS compatible FAT16 file system is implemented in one of the two Disk-On-Chip partitions; accordingly, its files are persistent. A RAM file system (RAMDISK or Object Store) is implemented in that part of the system DRAM reserved for it. The files in the RAM file system are not persistent.

The FAT16 and RAM file systems can be viewed and manipulated by the Windows Explorer utility. Within the Windows Explorer, these systems appear as parts of one larger system. That is, they appear as directories under “My Computer”. The FAT16 file system appears as “\Storage Card”, while the RAM file system includes several directories, including the most important, the “\Windows” directory, where system binaries are stored.

Table C
RAM File System

Directory	Description
\Temp	Not used
\My Documents	Not used
\Program Files	Contains links (shortcuts) to certain system executables
\Program Files \Communications	Contains links (shortcuts) to certain system executables
\Windows	Contains system executables (*.exe), dynamic link libraries (*.dll), fonts (*.ttf), etc. making up the Windows CE operating system
\Windows\Programs	Contains links (shortcuts) to certain executables in \Windows
\Windows\Programs\ Communication	Contains links (shortcuts) to certain executables in \Windows
\Windows\Desktop	Contains links (shortcuts) that define the contents of the Windows Desktop
\Windows\Favorites	Not used
\Windows\Fonts	Not used
\Windows\Recent	Not used
\Windows\Startup	Not used

The FAT16 (persistent) file system, "\Storage Card", is organized as follows:

Table D
FAT16 File System

Directory	Description
\Storage Card	Contains backups of the system registry and the system exceptions log. Applications should be stored here or in subdirectories created here.
\Storage Card\Temp	
\Storage Card\Windows\Desktop	Contains links to certain system executables
\Storage Card\Windows\ Programs	Contains links to certain system executables

Input Device Handlers

Touch Screen

The RAC6182's display can be equipped with a high resolution resistive touch screen. The Windows CE operating system incorporates a driver for the touch screen.

A user interface is provided to enable touch screen configuration and calibration. Touch screen calibration values are stored in the registry.

Keyboards

The RAC6182 is designed to take key input from multiple sources. Support is present in the operating system for a standard PS/2 keyboard, a standard USB keyboard, and a bezel keypad. The key input drivers are designed to permit any one of these devices to function alone and to permit a bezel keypad to function together with a PS/2 or USB keyboard.

Note: There is no support for both a PS/2 and a USB keyboard simultaneously connected

The PS/2 and USB keyboards can be individually enabled or disabled using control panel applets.

The Windows CE architecture dictates that one keyboard device and one only may be loaded by the GWES.EXE subsystem, and that this device will be responsible for the default mappings of scan codes to virtual keys, virtual keys to virtual keys, and virtual keys to Unicode characters.

Other keyboard devices are supported as device drivers loaded by DEVICE.EXE. These drivers submit virtual keys to the primary keyboard driver and use its mapping capability. Multiple key input devices share modifier (SHIFT, CONTROL, ALT) states.

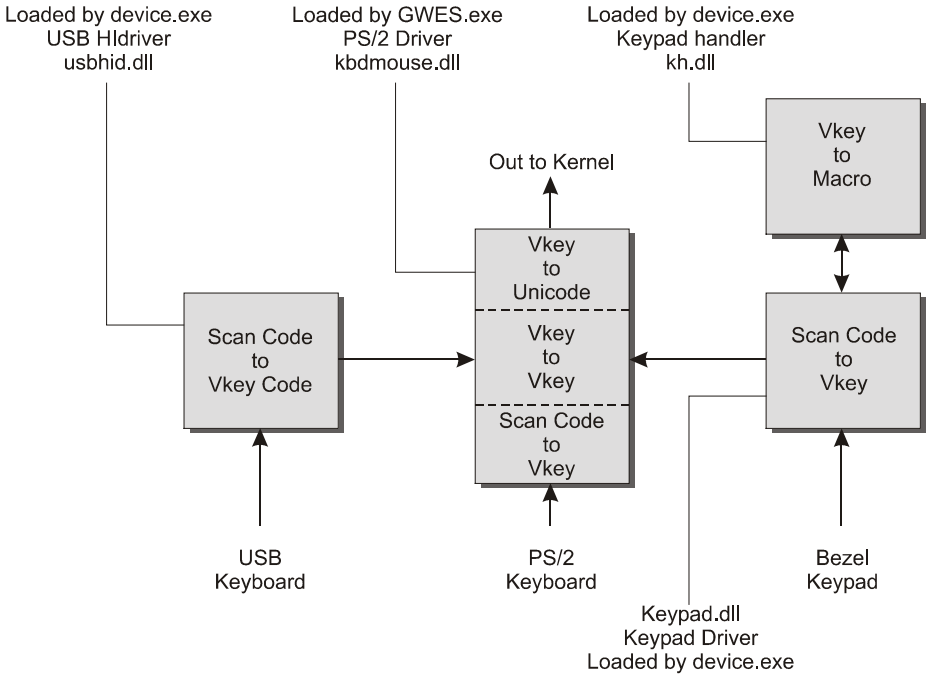
The primary (GWES) driver in the RAC6182 is the driver that handles the PS/2 keyboard and mouse ports. The USB keyboard and keypad drivers are dependent upon this driver for high level key input processing. The following table identifies the various drivers that constitute the keyboard input subsystem.

Table E
Drivers for the Keyboard Input Subsystem

Driver	Description
\windows\kbdmouse.dll	PS/2 keyboard and mouse driver, loaded by GWES.EXE at startup. Responsible for low level PS/2 related items and scan code to virtual key mappings for the PS/2 keyboard. Responsible for default virtual key to virtual key mappings based on modifier keys and for virtual key to Unicode mappings, for all key input devices.

Driver	Description
\windows\usbhid.dll	USB Human Interface Device driver, loaded by DEVICE.EXE upon insertion of a USB Human Interface Device. Handles USB keyboard and mouse. Responsible for low-level USB related items and scan code to virtual key mappings for USB keyboard. Submits virtual key codes to kbdmouse.dll.
\windows\keypad.dll	RAC6182 specific keypad driver, loaded by DEVICE.EXE at startup. Handles low-level keypad input and scan code to virtual key mapping. Submits virtual keys to Rockwell supplied keypad handler for mapping and submits virtual keys to kbdmouse.dll for virtual key to Unicode mappings.
\windows\khstub.dll	Keypad handler stub. This DLL is loaded by keypad.dll if no Rockwell supplied keypad handler is present. The stub returns a default scan code to virtual key mapping table for one current model of keypad and defers all virtual key mapping to the kbdmouse.dll driver.
\storage card\kh.dll	Rockwell supplied keypad handler, loaded by keypad.dll on boot. Responsible for mapping virtual keys from the keypad into other virtual keys, macros, or other actions. Any virtual keys returned by the keypad handler's mappings will still use kbdmouse.dll for mapping virtual keys into Unicode. The name of this file may be overridden with an alternate keypad handler name via a registry key. If key [HKEY_LOCAL_MACHINE\Drivers\BuiltIn\Keypad] contains a REG_SZ value named "KeypadHandlerName", its value will instead be used when loading the keypad handler.

The following figure schematizes the functional relations between the various drivers in the keyboard subsystem.



As can be seen from the table and the accompanying schematic, the functions of the RAC6182 bezel keypad are supported by two separate software components: a keypad driver, and a keypad handler.

Keypad Driver

The keypad driver supports low level functions associated with standard keyboards (e.g., generation of auto-repeat sequences, mappings of scan codes to Windows virtual key codes, etc.) and a number of Rockwell proprietary features:

Support for multiple types of keypads. Different keypads may have different scan code to virtual key mappings.

Support for non-standard keys, for example, the programmable function keys K1 – K16 and the +* key (unshifted press results in a ‘+’, shifted press results in a ‘*’).

Support for mapping single key presses into multiple key macros at the virtual key level.

Support for assignment of special functions to key operations by application programs.

Support for a ‘single-key’ mode, in which keystrokes are processed one at a time. Following an initial key-down event, any other key-down or key-events will be ignored until the key-up event corresponding to the initial key-down event has been detected and processed.

Support for a ‘hold-off’ mode, in which successive strokes of a given key occurring within a given time period will be ignored.

After the keypad driver is loaded by device.exe at system start-up, it attempts to read the keypad ID from the bezel EEPROM. If it does not find a valid ID, it exits. Otherwise, using the keypad ID, the driver locates an entry in the CE system registry that points to the current scan code to virtual code translation table for the keypad.

The keypad driver then attempts to load the keypad handler and verify that it supports a set of callback functions that the driver requires it to have. If the keypad handler dynamic link library is not present or does not contain all the necessary callback functions, a default keypad handler stub is loaded. This handler stub implements all the necessary callbacks and information for mapping one particular model of keypad, but it cannot handle changing key mappings, macros, actions, or other models of keypad.

When a key on the keypad is pressed or released, the keypad processor sends two codes to the keypad driver. One code is a scan code corresponding to the key pressed or released; the other is an event code identifying the type of event (key up or key down). Using the current translation table, the driver converts the scan code into a Windows Virtual key code. The driver maintains the modifier, auto-repeat, and multiple-keys states.

The driver does additional processing of key events to determine if these events meet the conditions of repeat mode, hold-off mode or single-key mode, provided these modes are enabled.

Once it has finished its low level processing, the driver calls the keypad handler function KhTranslateVkey(), passing the virtual key code to this function. The keypad handler returns an array of translated virtual code(s).

Finally, the driver calls a Win32 API function kbd_event() to pass the key events to the GWES keyboard driver.

Keypad Handler

The Rockwell supplied keypad handler is an optional software component that can be replaced with a stub or with another keypad handler designed for a specific application. The handler operates on Windows Virtual Key codes supplied by the keypad driver. It can

perform translations of Virtual Key codes before the keypad driver passes these codes to the main keyboard driver for final processing. Thus, it functions as an intermediate processor between the keypad driver and the main keyboard driver.

The keypad handler maintains its own key mapping and attribute tables separate from those maintained by the keypad driver. It can maintain these tables, in the system registry, system file storage, or wherever else the implementer of the keypad handler chooses. Although these mapping and attribute tables will be used by the driver, they are placed under the control of the handler to facilitate changes in mapping or attribute information and to facilitate the support of various keypads. With this scheme, new features and functions can be accommodated without modifications to the driver or other operating system level modules.

The handler also maintains global configuration data for the keypad, including auto-repeat settings, single key and hold off mode settings, etc.

The keypad handler is loaded and initialized by the keypad driver, and the handler must be able to respond to an initial query from the driver for its key mapping and attribute information.

Once the handler has been initialized by the driver, it is ready to accept additional calls from the driver to map any incoming virtual key down presses or releases that are currently valid (subject to the constraints of hold off and single key mode, which are enforced by the driver). The keypad handler may perform some action based on the key code passed (for example, it may launch an application), it may expand a key code into a sequence of codes (implementing a macro definition), it may filter the code, re-map it, etc. Alternatively, it may defer mapping of the virtual key to the normal keyboard driver.

In addition to being called back for key presses, the keypad handler will be called back when the global configuration settings for the keypad driver are changed. The keypad handler or some other application may change the settings of the keypad driver using the streams interface to be discussed later. When this occurs, the keypad handler is called back to ensure that it is aware of the changes.

Registry keys used by KHSTUB.EXE

The operating system includes a simple keypad handler stub which may be used when the more sophisticated capabilities in the Rockwell handler are not required. This stub defers all mapping from the virtual key level up to the main keyboard driver. The registry keys khstub uses to obtain keypad mapping and other information are documented here in case application developers wish to use the same keys.

Global key setting information is listed here by key and value.

```
[HKEY_LOCAL_MACHINE\Drivers\BuiltIn\Keypad\Params\TypematicRepeat]
    "Enabled"       REG_DWORD which is 1 for enabled, 0 for disabled
    "RepeatDelay"   REG_DWORD of initial repeat delay in ms.
    "RepeatRate"    REG_DWORD of subsequent repeat delay in ms.
[HKEY_LOCAL_MACHINE\Drivers\BuiltIn\Keypad\Params\SingleKeyMode]
    "Enabled"       REG_DWORD which is 1 for enabled, 0 for disabled
    "AbortEnabled"  REG_DWORD which is 1 for enabled, 0 for disabled
[HKEY_LOCAL_MACHINE\Drivers\BuiltIn\Keypad\Params\HoldoffMode]
    "Enabled"       REG_DWORD which is 1 for enabled, 0 for disabled
    "HoldoffTime"   REG_DWORD of time in ms. for key hold-off
```

Keypad ID specific items include scan code to virtual key mappings and the attribute flags. The key name contains the keypad ID printed as a %04X value to reference the correct keypad mappings. The value names contain the scan code number printed as a %02X value. A sample for a keypad with ID 0x0A5C is given here.

```
[HKEY_LOCAL_MACHINE\Drivers\BuiltIn\Keypad\Keypads\0A5C]
    "VirtualKey00"  REG_DWORD giving the virtual key code for scan code 0x00
    "Attributes00"  REG_DWORD giving the key attributes for scan code 0x00
    "VirtualKey6A"  REG_DWORD giving the virtual key code for scan code 0x6A
    "Attributes6A"  REG_DWORD giving the key attributes for scan code 0x6A
```

Bezel ID EEPROM

The bezel EEPROM provides a total of 256 bytes of non-volatile storage. The first 128 bytes are reserved for use by the CE operating system. The remaining 128 bytes are available for use by application programs.

The bezel EEPROM is used by the operating system to identify components of the bezel and traits specific to that bezel. These components and traits may vary from unit to unit and so are appropriately kept with the bezel. This allows interchange of bezels without reprogramming or recalibration. The bezel configuration information stored in this EEPROM is used by three major CE subsystems: the video driver, the touch screen driver, and the keypad driver.

Video Data

The video driver uses a 16 bit value in the bezel EEPROM to identify the LCD by model. This ID is used to reference an area of registry for settings used for any LCD panel of that model, such as resolution, interface type, and panel timings.

The video driver also stores minimum and maximum values for contrast and brightness in the bezel EEPROM. These values define limit values presented on the control panel. They are stored in the EEPROM rather than registry since individual panels of the same model may have variances that require individual adjustments based on experimental data.

The current contrast and brightness values are individual user preferences rather than traits of the panel, so are stored in registry rather than in the bezel EEPROM. However, if the registry contrast or brightness value is not present or not in the min/max range specified for the panel by the bezel EEPROM data, a default value is used from the bezel EEPROM.

Touch screen data

The touch screen driver uses a 16 bit value in the bezel EEPROM to identify the model of touch screen. This is used to determine what type of touch screen interface and decoding logic to use. Also, the bezel EEPROM is used to store touch calibration data, since calibration data will be specific to particular touch screens even of the same model.

Keypad data

The keypad driver uses a 16 bit value in the bezel EEPROM to identify the model of the keypad. This ID is used to determine what keypad scan code to virtual key mapping information is obtained from the keypad handler for the driver to use in decoding keys.

Layout of the Bezel EEPROM

The following table shows the layout of the bezel EEPROM. Assignments within the lower 128 bytes (system area) are subject to change. However, the upper 128 bytes (beginning at offset 0x80) are guaranteed to be available for use by applications needing non-volatile storage.

Table F
Layout of the Bezel EEPROM

Addresses (Hex)	Purpose
0x00-0x01	16 bit CRC of the remainder of bezel EEPROM data
0x02-0x0F	Reserved for future system use
0x10-0x11	Touch screen ID (0=4 wire res, 1=5 wire res, 0xffff = none)
0x12-0x13	Magic cookie to tell if calibration data is valid
0x14-0x1F	Reserved for future touch screen driver use
0x20-0x2F	Touch screen calibration information
0x30-0x31	Keypad ID (0 = 56 key pad, 1 = 84 key pad, 0xffff = no keypad)
0x32-0x3F	Reserved for future keypad driver use
0x40-0x41	LCD panel ID (0 = 7” STN, 1 = 12” TFT, 0xffff = no LCD)
0x42	Minimum allowable contrast for this particular panel
0x43	Maximum allowable contrast for this particular panel
0x44	Default contrast for this particular panel if registry contrast is invalid
0x45	Minimum allowable brightness for this particular panel
0x46	Maximum allowable brightness for this particular panel
0x47	Default brightness for this particular panel if registry brightness is invalid
0x48-0x5F	Reserved for future video driver use
0x60-0x7F	Reserved for future operating system use
0x80-0xFF	Application area. Will not be used by operating system

PCI Bus

PCI bus 0 contains the onboard Ethernet, video, USB, and PCMCIA controllers.

PCI bus 1 contains the PCI slot. From a PCI configuration standpoint, the virtual slot number of a device plugged in the slot is 1.

The operating system supports basic configuration, interrupt control, memory management and IO access for PCI cards plugged into this slot. The operating system does not support bus-mastering by the PCI slot device.

PCMCIA

New or upgraded components of application programs and the operating system can be copied from the PCMCIA memory card to Disk-On-Chip flash memory to replace and upgrade the existing components.

In the Windows Explorer, the PCMCIA Memory Card will show up as an icon named "\Storage Card2".

Application Run Time Environment

Path

The notion of a path to executable files is much the same as with any other Windows or DOS system. However, unlike other systems, which refer to an environment variable for path settings, Windows CE utilizes a registry entry. Thus, the path can be set only by editing the value of the registry key \HKLM\Loader\SystemPath. Note the use of spaces to separate items in the path list, as in the following example:

"\storage card\bin\ \storage card\ \ storage card2\bin\ \storage card2\ . . ."

Launching Applications At Start-Up

The Widows CE Registry entries at key HKLM\init determine the programs that are started during system initialization, and the order in which they are started. The Windows CE Platform Builder development tool (not part of the Windows CE Toolkits for Visual C++ 6.0 and Visual Basic 6.0) is used to establish these Registry entries.

Table G
RAC6182 Launch Order

Sequence	Program or File	Description
Launch10	shell.exe	Start the shell
Launch20	device.exe	Load and start the device drivers
Launch30	postdevice.exe	Start post device driver processing . . .
Depend30	14 00	when device.exe signals complete
Launch40	gwes.exe	Start graphics and events subsystems . . .
Depend40	1e 00	when postdevice.exe signals complete
Launch50	explorer.exe	Start Windows Explorer . . .
Depend50	14 00 28 00	when device.exe and gwes.exe complete startup
Launch90	(an OEM executable)	Start OEM executable…
Depend90	1e 00 28 00	when postdevice.exe and gwes.exe complete startup

Launch90 provides a launch point at startup for an OEM that assures that the device drivers, TCP/IP, registry and GUI functions are up and running.

Explorer is launched during initialization because it handles the GUI shell, taskbar, running items in \windows\startup, etc. Unlike other executable files, Windows Explorer does not properly signal that it has

completed startup, so dependencies should not be placed directly on explorer.exe. Consequently, the start menu, taskbar, etc. may still be drawing when oemstartup.exe is called.

Although there is a \windows\startup folder in the file system, the placement of a shortcut in this folder in order to start the associated application automatically at system startup is not recommended. The folder \windows\startup is RAM based, and its contents will not persist from one operating session to the next.

The solution is to place shortcuts in \Storage Card\Windows or in a directory under it. In a normal system initialization sequence, everything in \Storage Card\Windows\ (in the persistent file system), including subdirectories and their contents, is copied to \Windows (in the RAM filesystem) following the startup of gwes.exe. This copy operation is not performed only when the system has been placed in diagnostic mode, either by the installation of a jumper on the system board (see information about the boot ROM elsewhere in this manual), or by an application, using a call to the system function rm_SetParameter (see the description of this function elsewhere in this manual).

Process Priorities

All executable files start in user mode. Any application can change to kernel mode or back with the Windows CE SetKMode() call. The only known exception is nk.exe, which is started first and doesn't follow the same rules.

System Shutdown

The system supports a soft reset and provides a shut-down indicator in non-volatile memory.

Developing CE Drivers and Applications for the RAC6182

General Considerations

There are two general considerations for developing drivers and applications for the RAC6182:

Distributing and installing applications

Persistence considerations

Application Distribution and Installation

Application programs for the RAC6182 will consist of EXE and DLL files that will reside in the FAT partition of the Disk-On-Chip. They will be installed much like applications for Windows desktop operating systems.

Typically, a RAC6182 CE application will be distributed as a package containing the run-time components, in compressed form, and an executable "installation script" that manages the installation process. When the installation script (typically "Setup.exe") is run, the run-time components will be decompressed and moved to their assigned folder(s), desktop icons and start menu entries will be created, and the system registry will be edited to register the application's components and associated parameters. Finally, an uninstall script will be created and saved.

Microsoft's InstallShield tool is recommended for packaging applications for distribution. This tool alleviates some of the difficulties associated with the development of installation scripts and imposes a familiar "look and feel" on the installation process.

The application developer should give some thought to the means to be used for distributing the installation script. Generally, there are two means available: CDROM and the internet.

Installing the Application

Once the user has obtained an installation script by one of these methods and the script resides on the user's local desktop PC, he or she may use any of three methods to install the application on the RAC6182.

Perform a remote installation by running the script on a PC host that is connected to the RAC6182 using Data Exchange.

Copy the script from a PC host using Data Exchange or from a PCMCIA ATA memory card to the "\storage card\" folder on the RAC6182 and run the script on the RAC6182.

Run the script directly from a PCMCIA ATA memory card on the RAC6182.

Remote Installations

The install package can be quite large and the decompression process can consume high levels of memory, so remote installation is an attractive option. Data Exchange, using CeAppMgr.exe on the host PC and WCEload.exe on the RAC6182, supports remote installation.

Application Upgrades

The application developer should make appropriate provisions for issuing application upgrades from the beginning, adopting good practice for source version control, bug reporting, etc. When upgrades are required, typically by the desire to add new features or to implement bug fixes, decisions will have to be made relating to the notification of users and the distribution of the upgrades. Considerations for the distribution and installation of application upgrades are exactly the same as those discussed above for initial distribution and installation.

Persistence Considerations

Installation of a new application program on the RAC6182 typically adds a new icon to the Windows CE Desktop and sometimes a new entry in the Start Menu, in order to enable the user to launch the new program or to launch it automatically. Shortcuts in the folder "\Windows\Desktop" create the Icons on the desktop. Shortcuts and subfolders in the folder "\Windows\Programs" form the Start Menu. A shortcut in the folder "\Windows\Startup" will automatically launch a program at startup. A control panel applet that was added by an application has a file extension *.CPL and resides in the folder "\Windows.

All this appears very Windows-like and ordinary until one considers that the "\Windows" folder is effectively a RAM disk that is recreated when cold-started; i.e. it is not persistent. When the operating system boots it creates a new file system including "\Windows" and that effectively removes all traces of the end-user applications that once existed. With that in mind, special considerations are necessary for applications on the

RAC6182 and all similar embedded devices since the Icons, the Start Menu, and application-provided Control Panel Applets must be re-created at startup.

The solution is to place shortcuts in \Storage Card\Windows or in a directory under it. In a normal system initialization sequence, everything in \Storage Card\Windows\ (in the persistent file system), including subdirectories and their contents, is copied to \Windows (in the RAM filesystem) following the startup of gwes.exe. (For further information see "Launching Applications At Start-Up" above.)

Setting Up the Development System

Typically, development will take place on an x86 machine running a Microsoft Win32 operating system and Microsoft cross development tools. The development system will be connected to the target RAC6182 by Ethernet or serial link, and MIPS binary files generated on the development system will be downloaded to the target for testing and debugging.

While for the most part the Microsoft development tools will run on Windows 95, Windows 98 and Windows 2000, certain special functions, like emulation of the target platform on the x86 host, are available to the developer only with Windows NT 4.0.

Application development can be carried out using either C/C++ or Basic. Note that the C/C++ development system normally produces MIPS binaries that are directly executable on the RAC6182, while the Basic development system produces application code modules (.vb files) that must be run with the help of a Basic interpreter on the RAC6182. The Basic development system includes an application installer that bundles the application code module with the interpreter (consisting of MIPS executables) so that all the components necessary for program execution will be properly installed on the RAC6182. Device driver developers should plan to use C/C++.

Setting Up the Host Machine for C/C++ Development

First, Microsoft Windows CE Services (Active Sync) must be installed on the host system. This package provides utilities needed to download applications to the RAC6182 and to support a number of remote development tools. Windows CE Services is provided on CDROM with the RAC6182. The RAC6182 User's Manual (Chapter 14) contains detailed information about installation.

Next, the following Microsoft development tools must be installed on the host system, in the order given:

Microsoft Visual C++ 6.0 (from Visual Studio 6.0, Professional or Enterprise Edition)

Windows CE Toolkit for Visual C++ 6.0

Platform SDK for H/PC – MIPSFP (from Windows CE Toolkit for Visual C++ 6.0)

Or,

Embedded Visual C++ 6.0 (from Microsoft Embedded Visual Tools 3.0)

Platform SDK for H/PC – MIPSFP (from Microsoft Embedded Visual Tools 3.0)

Note: The user of the Windows CE Toolkit for Visual C++ 6.0 should note that a special configuration step is necessary to work around a known limitation of that package. (See configuration details below.)

While the Windows CE Toolkit for Visual C++ 6.0 is an extension of the Visual C++ 6.0 tool from Visual Studio and depends upon it, Embedded Visual C++ 6.0 is a stand-alone tool that does not require the installation of Visual C++ 6.0 from Visual Studio. However, Embedded Visual C++ 6.0 supports development for CE platforms only, and not for Windows desktop operating systems. Developers contemplating ports to CE of applications written originally for Windows desktop operating systems will probably want the support for both CE and desktop OS development that is available with Visual C++ 6.0 extended with the Windows CE Toolkit.

On the other hand, Microsoft Embedded Visual Tools 3.0 is available without charge, except for a nominal shipping and handling charge. Accordingly, it is an economical tool for developers of new CE only applications.

Finally, while Embedded Visual Tools 3.0 is not integrated with Visual Studio's tools, it can co-exist with these tools.

Device driver developers should consider also installing the Microsoft Windows CE Platform Builder, which contains support for kernel level CE development that is not found in the other toolkits. However, Platform builder is not necessary for most driver development work.

Details of the installation procedures are beyond the scope of this manual. Please follow the instructions provided by Microsoft.

Finally, the RAC6182 SDK should be installed. (See detailed instructions below.)

Setting Up the Host Machine for Basic Development

First, Microsoft Windows CE Services (Active Sync) must be installed on the host system. This package provides utilities needed to download applications to the RAC6182, and to support a number of remote development tools. Windows CE Services is provided on CDROM with the RAC6182. The RAC6182 User's Manual (Chapter 14) contains detailed information about installation.

Next, the following Microsoft tools must be installed on the development platform in the order given:

Microsoft Visual Basic 6.0 (from Visual Studio 6.0, Professional or Enterprise Edition)

Windows CE Toolkit for Visual Basic 6.0

Platform SDK for H/PC - MIPSFP (from Windows CE Toolkit for Visual Basic 6.0)

Or,

Embedded Visual Basic (from Microsoft Embedded Visual Tools 3.0)

Platform SDK for H/PC - MIPSFP (from Microsoft Embedded Visual Tools 3.0)

Note: While the Windows CE Toolkit for Visual Basic 6.0 is an extension of the Visual Basic 6.0 tool from Visual Studio and depends upon it, Embedded Visual Basic is a stand-alone tool that does not require the installation of Visual Basic 6.0 from Visual Studio. However, Embedded Visual Basic supports development for CE platforms only, and not for Windows desktop operating systems. Developers contemplating ports to CE of applications written originally for Windows desktop operating systems will probably want the support for both CE and desktop OS development that is available with Visual Basic 6.0 extended with the Windows CE Toolkit.

On the other hand, Microsoft Embedded Visual Tools 3.0 is available without charge, except for a nominal shipping and handling charge. Accordingly, it is an economical tool for developers of new CE only applications.

Finally, while Embedded Visual Tools 3.0 is not integrated with Visual Studio's tools, it can co-exist with these tools.

Details of the installation procedures are beyond the scope of this manual. Please follow the instructions provided by Microsoft.

Finally, install the RAC6182 SDK.

Installing the RAC6182 SDK

Installing the RAC6182 SDK is the final step in setting up the development system.

The RAC6182 SDK is provided on CDROM. The CDROM contains two different development kits, one for the RAC6182 with CE V2.12, and one for the RAC6182 with CE V3.0. Either of these development kits may be installed separately. Most users will want to install the SDK for CE V3.0.

Before installing the SDK for CE V3.0, it is recommended that any existing installation of the SDK for CE V2.12 be removed. All RAC6182s with CE V2.12 can be easily upgraded to CE V3.0. Applications developed to run on V2.12 should port to V3.0 without difficulty, and all subsequent development can proceed on V3.0.

Each development kit includes two executable files, one containing an SDK for Visual C++ and the other containing an SDK for Visual Basic. Both can be installed on the same machine if desired; however, it is not necessary to install both.

The following installation instructions pertain to the SDK for CE V3.0. The procedure for installing the CE V2.12 SDK is similar.

To install, insert the RAC6182 CDROM in the host machine's CDROM drive (normally drive D:) and from the Windows GUI issue the following instructions:

Start Run D:\Win CE 3.0\RAC6182VB-2.00.exe (for Visual Basic installation)

or

Start Run D:\Win CE 3.0\RAC6182VC-2.00.exe (for Visual C++ installation)

The installer will be prompted for acceptance of a license agreement. Following that, the SDK should install itself automatically on the host machine without further operator intervention. When installation is complete the following message should appear: "The SDK was successfully installed". The installer must press the "Done" button in the install window to exit.

The RAC6182 SDK CDROM contains the following additional files:

VBSDKReadme.txt - Information about the Visual Basic SDK

VCSDKReadme.txt - Information about the Visual C++ SDK

6182api.txt - Visual Basic function definitions file

Configuration

After installing the SDK for CE V2.12, some special configuration is required. This applies only to the SDK for CE V2.12. The following steps are not required for the CE V3.0 SDK.

Users of Embedded Visual C++ will want to set up some directories immediately after installing the RAC6182 SDK. In the Embedded Visual C++ IDE

Under Tools Options Directories Include Files

Add c:\Windows CE Tools\WCE212\RAC6182\User Files\Vc\Inc

Under Tools Options Directories Library Files

Add c:\Windows CE Tools\WCE212\RAC6182\User Files\Vc\Lib\mipsfp

Users of Windows CE Toolkit for Visual C++ 6.0 will want to set up the following directories immediately after installing the RAC6182 SDK. In the Visual C++ IDE

Under Tools Options Directories Executable Files

Change c:\Windows CE Tools\WCE212\bin

TO c:\Windows CE Tools\WCE211\bin

Under Tools Options Directories Include Files

Add c:\Windows CE Tools\WCE212\RAC6182\User Files\Vc\Inc

Under Tools Options Directories Library Files

Add c:\Windows CE Tools\WCE212\RAC6182\User Files\Vc\Lib\mipsfp

No special configuration is necessary for Embedded Visual Basic.

RAC6182 CE SDK

Overview

The RAC6182 SDK provides developers with access to an extensive set of functions that are specific to the RAC6182 hardware and constitute extensions of the standard Windows CE API. These functions, like the standard Windows CE functions, are implemented in the C language and can be called directly from C or C++ programs.

Basic programs can also call these functions. However, Basic programs must declare the functions in the proper form before invoking them. For example, a Basic program might contain the following

```
` Basic declaration of the C library function Watchdog_Tag()
Const WATCHDOG_OK = &0
Declare Function Watchdog_Tag Lib "watchdog.lib" Alias "Watchdog_Tag"
(ByVal dwTimeout As Long) As Long
....
` Invocation of the function
if (Watchdog_Tag(3000) equ WATCHDOG_OK) then
` do something
endif
```

A file called “6182api.txt” is included in the RAC6182 SDK. This file includes Basic declarations for all the constants, data structures and functions associated with the RAC6182 SDK C language libraries. Basic programmers can copy declarations from this file into their programs as needed, just as they can copy the declarations for the standard CE functions from a Microsoft provided file called “winceapi.txt”.

C/C++ language developers should note that the headers included the RAC6182 SDK contain conditionals that allow them to be included in C and C++ modules without modification. A C++ program should include a #define __cplusplus directive prior to an #include <sdk_header> directive, or else the __cplusplus macro should be defined on the compiler command line. Users of the Microsoft Visual C++ 6.0 IDE will not have to make any special provisions in their programs, since this IDE makes C++ is default for a new project and defines this macro for them.

On the other hand, users of this IDE who wish to write in standard C should keep in mind that this default situation will require all standard C modules to be conditionally bracketed in the same way that the headers in the SDK are bracketed. For example:

```
#ifdef __cplusplus
extern "C" {
#endif

/*  C code goes here */

#ifdef __cplusplus
}
#endif
```

Files in the C/C++ Development Kit

Table H
Files in the C/C++ Development Kit

Component	C Header	Static Library	Dynamic Library (Part of the OS)
Aux Microcontroller	atmelapi.h	ATMEL.lib	atmel.dll
Bezel EEPROM	bezeleeprom.h	BEZEL.lib	bezel.dll
PCI Subsystem	Ceddk.h	ceddk.lib	ceddk.dll
CE Shell	shlobj.h	ceshell.lib	ceshell.dll
Digital Outputs	DiagnosticOutputAPI.h	DiagnosticOutput.lib	DiagnosticOutput.dll
Voltage and Temperature Monitor	HardwareMonitorAPI.h	HardwareMonitor.lib	HardwareMonitor.dll
Keypad Driver	KeypadAPI.h		keypad.dll
Keypad Handler	khapi.h		kh.dll , khstub.dll
Misc. System	miscsystem.h	MISCSYSTEM.lib	miscsystem.dll
LEDs	nledapi.h	(none required)	coredll.dll
Operating System	OSUpdateAPI.h	OSUPdate.lib	OSUpdate.dll
Serial Ports	othersdk.h		coredll.dll
Keypad Mapping	RAC6182OEMVkeys.h		
Registry	regflush.h		coredll.dll
Battery Backed RAM	RetentiveMemAPI.h	RetentiveMem.lib	RetentiveMem.dll
System Timers	usertimers.h	usertimers.lib	usertimers.dll
Watchdog Timer	watchdog.h	watchdog.lib	

RAC6182-Specific Extensions to the CE API

Functions for Digital Output Control

The functions described in this section provide application level access to all digital outputs on the RAC6182 via a common interface. The digital outputs include four diagnostic outputs on pins A, B, C and D of header J10 on the system board, and a relay output, with contacts terminated at connector J16, which accessible from the rear of the RAC6182.

These functions allow getting, setting, and toggling of outputs, either individually or simultaneously.

These functions are prototyped in the c header file DiagnosticOutputAPI.h. This file also defines macros for bit masks to be used to access individual outputs. These bit masks may be ORed for simultaneous access of multiple outputs.

do_ReadPort

This function reads digital outputs. It is prototyped in DiagnosticOutputAPI.h.

Syntax

```
#include <Windows.h>
#include <DiagnosticOutputAPI.h>

BOOL do_ReadPort(UCHAR *pucData)
```

Remarks

pucData is a pointer to a caller allocated UCHAR variable in which current settings of all discrete outputs are to be stored. Settings of individual outputs are accessible via bit masks defined as macros in the header file. These masks are to be applied (separately or bitwise ORed together) to the variable following the call to this function.

Note that the relay contacts are normally closed (i.e., closed when the relay is not energized). Thus, when the relay output is set to 1 or TRUE, the contacts will be open and vice versa.

Macro	Digital Output
MASK_DIAG_PIN_A	J10, pin A (no external access)
MASK_DIAG_PIN_B	J10, pin B (no external access)
MASK_DIAG_PIN_C	J10, pin C (no external access)

Macro	Digital Output
MASK_DIAG_PIN_D	J10, pin D (no external access)
MASK_RELAY_PIN	J16 (Relay, contacts NC)

Return Value

TRUE if read operation was successful, else FALSE.

Portability

This function is specific to the RAC6182 hardware.

Example

```
#include <Windows.h>
#include <DiagnosticOutputAPI.h>

int main(void)
{
UCHAR pucData;
char buffer[256];

if (do_ReadPort(&pucData))
      printf("Relay is %s\n", (pucData &
                  MASK_RELAY_PIN) ? "open" : "closed");
else printf("Error reading digital outputs\n");

return(0);
}
```

See Also

do_WritePort

do_WritePort

This function writes digital output. It is prototyped in DiagnosticOutputAPI.h.

Syntax

```
#include <Windows.h>
#include <DiagnosticOutputAPI.h>

BOOL do_WritePort(UCHAR ucMask, UCHAR ucData)
```

Remarks

ucMask is a bit mask that determines which outputs are modified. If the mask bit for a given output is set to 1, that output will be modified to reflect the corresponding bit in ucData; otherwise the output will not be modified, regardless of the setting of the corresponding bit in ucData.

Note that the relay contacts are normally closed (i.e., closed when the relay is not energized). Thus, when the relay output is set to 1 or TRUE, the contacts will be open and vice versa.

The following macros can be used (separately or bitwise ORed together) to evaluate ucMask.

Macro	Digital Output
MASK_DIAG_PIN_A	J10, pin A (no external access)
MASK_DIAG_PIN_B	J10, pin B (no external access)
MASK_DIAG_PIN_C	J10, pin C (no external access)
MASK_DIAG_PIN_D	J10, pin D (no external access)
MASK_RELAY_PIN	J16 (Relay – contacts NC)

Return Value

TRUE if write operation was successful, else FALSE.

Portability

This function is specific to the RAC6182 hardware.

Example

```
#include <DiagnosticOutputAPI.h>
#include <stdio.h>

int main(void)
{
UCHAR ucData = 0xff;

if (do_WritePort(MASK_RELAY_PIN, ucData))
      printf("Relay %s\n", (MASK_RELAY_PIN & ucData) ? "closed" : "opened");
else printf("Error changing relay state\n");

return(0);
}
```

See Also

do_SetBits, do_ClearBits, do_ToggleBits

do_SetBits

This function sets digital outputs. It is prototyped in DiagnosticOutputAPI.h.

Syntax

```
#include <Windows.h>
#include <DiagnosticOutputAPI.h>

BOOL do_SetBits(UCHAR ucMask)
```

Remarks

This function sets any output whose bit is 1 in ucMask to logic TRUE. For the relay output, logic TRUE is equivalent to closed; for TTL outputs, it is equivalent to TTL high level. All pins whose bit is 0 in ucMask are left unchanged.

Note that the relay contacts are normally closed (i.e., closed when the relay is not energized). Thus, when the relay output is set to 1 or TRUE, the contacts will be open and vice versa.

The following macros may be used (separately or bitwise ORed together) to evaluate ucMask:

Macro	Digital Output
MASK_DIAG_PIN_A	J10, pin A (no external access)
MASK_DIAG_PIN_B	J10, pin B (no external access)
MASK_DIAG_PIN_C	J10, pin C (no external access)
MASK_DIAG_PIN_D	J10, pin D (no external access)
MASK_RELAY_PIN	J16 (Relay – contacts NC)

Return Value

TRUE if read operation was successful, else FALSE.

Portability

This function is specific to the RAC6182 hardware.

See Also

do_ClearBits, do_ToggleBits, do_WritePort

do_ClearBits

This function clears digital outputs. It is prototyped in DiagnosticOutputAPI.h.

Syntax

```
#include <Windows.h>
#include <DiagnosticOutputAPI.h>

BOOL do_ClearBits(UCHAR ucMask)
```

Remarks

This function clears any output whose corresponding bit in ucMask is 1 to a logic FALSE. For the relay output, FALSE is equivalent to open; for TTL outputs, it is equivalent to a low level. All outputs whose bits in ucMask are 0 are left unchanged.

Note that the relay contacts are normally closed (i.e., closed when the relay is not energized). Thus, when the relay output is set to 1 or TRUE, the contacts will be open and vice versa.

The following macros may be used (separately or bitwise ORed together) to evaluate ucMask:

Macro	Digital Output
MASK_DIAG_PIN_A	J10, pin A (no external access)
MASK_DIAG_PIN_B	J10, pin B (no external access)
MASK_DIAG_PIN_C	J10, pin C (no external access)
MASK_DIAG_PIN_D	J10, pin D (no external access)
MASK_RELAY_PIN	J16 (Relay – contacts NC)

Return Value

TRUE if read operation was successful, else FALSE.

Portability

This function is specific to the RAC6182 hardware.

See Also

do_SetBits, do_ToggleBits, do_WritePort

do_ToggleBits

This function toggles digital outputs. It is prototyped in DiagnosticOutputAPI.h.

Syntax

```
#include <Windows.h>
#include <DiagnosticOutputAPI.h>

BOOL do_ToggleBits(UCHAR ucMask)
```

Remarks

Outputs corresponding to bits in ucMask that are set to 1 are toggled. For any output whose bit is 1 in ucMask, if its previous output was TRUE (closed or high) it will be set FALSE (open or low) and vice-versa. All pins whose bit is 0 in ucMask are left unchanged.

Note that the relay contacts are normally closed (i.e., closed when the relay is not energized). Thus, when the relay output is set to 1 or TRUE, the contacts will be open and vice versa.

The following macros may be used (separately or bitwise ORed together) to evaluate ucMask:

Macro	Digital Output
MASK_DIAG_PIN_A	J10, pin A (no external access)
MASK_DIAG_PIN_B	J10, pin B (no external access)
MASK_DIAG_PIN_C	J10, pin C (no external access)
MASK_DIAG_PIN_D	J10, pin D (no external access)
MASK_RELAY_PIN	J16 (Relay – contacts NC)

Return Value

TRUE if read operation was successful, else FALSE.

Portability

This function is specific to the RAC6182 hardware.

See Also

do_SetBits, do_ClearBits, do_WritePort

Functions to Read from and Write to the Bezel EEPROM

The bezel EEPROM provides a total of 256 bytes of non-volatile storage. The first 128 bytes (at offsets 0x00 through 0x7f) are reserved for use by the CE operating system and built-in device drivers (specifically, those drivers that handle devices attached to the bezel, namely the keypad, touch screen and display). The remaining 128 bytes (at offsets 0x80 through 0xff) are reserved for future use.

The functions described in this section can be called by applications to read the system area of the EEPROM (for example, in order to get the keypad identifier, at offset 0x30).

be_GetBezelEEPROMParameter

This function gets EEPROM access mode and CRC status. It is prototyped in bezeleeprom.h.

Syntax

```
#include <Windows.h>
#include <bezeleeprom.h>

DWORD be_GetBezelEEPROMParameter(DWORD dwParameter, DWORD
    *pdwData)
```

Remarks

Mode or status information is written to *pdwData, depending on the value of dwParameter. dwParameter may be evaluated with one of the following macros:

Macro	Description
BEZEL_EEPROM_ PARAMETER_USE_ CRC	Get the current CRC mode. The value of *pdwData will be 0 if CRC mode is disabled, or 1 if CRC mode is enabled. When CRC mode is enabled, the the16-bit check value stored at offset 0x00 is protected and only the EEPROM contents beginning at offset 0x02 may be read or written. The CRC value at 0x00 is updated when new data are written. Read and write functions return CRC error codes in case of CRC errors. The RAC6182 always boots with CRC mode enabled. When CRC mode is disabled the entire bezel EEPROM is accessible for reading or writing. The first write of new data will invalidate the CRC value at 0x00. However, functions will not return CRC error codes unless CRC mode is again enabled. Thereafter, reads and writes will return CRC error codes until the CRC value is recalculated.
BEZEL_EEPROM_ PARAMETER_CRC_ VALID	Get the current state of the CRC check value. The value of *pdwData will be 0 if the 16-bit CRC value stored at offset 0x00 of the EEPROM is invalid, and to 1 if it is valid. This is the case whether CRC mode is enabled or disabled.

Return Value

The possible return values are represented by the following macros, defined in bezeleeprom.h:

Macro	Description
BEZEL_EEPROM_OK	EEPROM present, arguments valid, function completed successfully.
BEZEL_EEPROM_ DEVICE_NOT_ PRESENT	No EEPROM detected – either bezel not present or EEPROM on it not functioning.
BEZEL_EEPROM_ INVALID_ PARAMETER	Bad parameter passed to function, for example a NULL pointer or an address out of range.
BEZEL_EEPROM_ INVALID_CRC	CRC mode is enabled and the CRC on the EEPROM is currently invalid.

Portability

This function is specific to the RAC6182 hardware.

be_SetBezelEEPROMParameter

This function sets bezel EEPROM access mode or CRC value. It is prototyped in bezeleeprom.h.

Syntax

```
#include <Windows.h>
#include <bezeleeprom.h>

DWORD be_SetBezelEEPROMParameter(DWORD dwParameter, DWORD
    *pdwData)
```

Remarks

Sets access mode or recalculates CRC, depending on dwParameter and the value of *pdwData. dwParameter may be evaluated using one of the following macros:

Macro	Description
BEZEL_EEPROM_ PARAMETER_USE_ CRC	Set CRC mode. If the value of *pdwData is 1, CRC mode is enabled. If the value of *pdwData is 0, CRC mode is disabled. When CRC mode is enabled, the the16-bit check value stored at offset 0x00 is protected and only the EEPROM contents beginning at offset 0x02 may be read or written. The CRC value at 0x00 is updated when new data are written. Read and write functions return CRC error codes in case of CRC errors. The RAC6182 always boots with CRC mode enabled. When CRC mode is disabled the entire bezel EEPROM is accessible for reading or writing. The first write of new data will invalidate the CRC value at 0x00. However, functions will not return CRC error codes unless CRC mode is again enabled. Thereafter, reads and writes will return CRC error codes until the CRC value is recalculated.
BEZEL_EEPROM_ PARAMETER_CRC_ VALID	Recalculate the CRC value. If the value of *pdwData is 1, the 16-bit CRC value stored at offset 0x00 of the EEPROM is recalculated. This is the case whether CRC mode is enabled or disabled. If the value of *pdwData is 0, there is no action.

Return Value

The possible return values are represented by the following macros, defined in bezeleeprom.h:

Macro	Description
BEZEL_EEPROM_OK	EEPROM present, arguments valid, function completed successfully.
BEZEL_EEPROM_ DEVICE_NOT_ PRESENT	No EEPROM detected – either bezel not present or EEPROM on it not functioning.
BEZEL_EEPROM_ INVALID_ PARAMETER	Bad parameter passed to function, for example a NULL pointer or an address out of range.
BEZEL_EEPROM_ INVALID_CRC	CRC mode is enabled and the CRC on the EEPROM is currently invalid.

Portability

This function is specific to the RAC6182 hardware.

be_ReadBezelEEPROM

This function reads bezel EEPROM. It is prototyped in bezeleeprom.h.

Syntax

```
#include <Windows.h>
#include <bezeleeprom.h>

DWORD be_ReadBezelEEPROM(DWORD dwAdress, DWORD dwLength, UCHAR
    *pucData)
```

Remarks

Reads dwLength bytes starting at offset dwAddress in the EEPROM into a caller allocated buffer beginning at pucData. All reads are implicitly mutexed.

When CRC mode is enabled, EEPROM contents are accessible for reading beginning at offset 0x02. When the CRC is currently invalid, any read will still return the raw data at the requested locations, but will return BEZEL_EEPROM_INVALID_CRC error.

When CRC mode is disabled the entire bezel EEPROM is accessible for reading. Reading any location will never result in the return of a BEZEL_EEPROM_INVALID_CRC error, regardless of the validity of the CRC value.

Return Value

The possible return values are represented by the following macros, defined in bezeleeprom.h:

Macro	Description
BEZEL_EEPROM_OK	EEPROM present, arguments valid, function completed successfully.
BEZEL_EEPROM_ DEVICE_NOT_ PRESENT	No EEPROM detected – either bezel not present or EEPROM on it not functioning.
BEZEL_EEPROM_ INVALID_ PARAMETER	Bad parameter passed to function, for example a NULL pointer or an address out of range.
BEZEL_EEPROM_ INVALID_CRC	CRC mode is enabled and the CRC on the EEPROM is currently invalid.

Portability

This function is specific to the RAC6182 hardware.

be_WriteBezelEEPROM

This function (prototyped in bezeleeprom.h) is intended for use by operating system developers only. Rockwell Automation recommends against and does not support use of this function in application programs or user implemented device drivers.

ATTENTION: Improper use of this function could result in disruption of critical system level data.

Function for Watchdog Timer Control

The RAC6182 incorporates a watchdog device to allow automatic reset in case of an application error that involves the application's loss of control over the hardware. Immediately following system initialization, the watchdog device is disabled. It is enabled when an application issues an initial Watchdog_Tag call. Once enabled, the watchdog device must be tagged periodically by the issuance of additional tags calls to reset the timer in the device; otherwise, the timer will time out. If a timeout occurs, it is assumed that the application or some underlying software has lost control, and the system is reset.

An application can set the time allowed between watchdog tags and can enable or disable the device by calling the function described in this section.

Watchdog_Tag

This function tags the watchdog timer. It is prototyped in watchdog.h.

Syntax

```
#include <Windows.h>
#include <watchdog.h>

DWORD Watchdog_Tag(DWORD dwTimeout)
```

Remarks

If the value of dwTimeout is 0, the watchdog timeout value is not changed, but if the timer is running, it is reset (tagged).

If the value of dwTimeout is 0xffffffff, the watchdog timer is disabled. If the watchdog is disabled, calling Watchdog_Tag with dwTimeout set to 0 will always return WATCHDOG_TIMEOUT_FAILED as no current watchdog timeout value is defined.

If the value of dwTimeout is other than 0 and 0xffffffff, it is taken to represent the time, in milliseconds, than must elapse before the watchdog will trigger a system reset. If possible, the timer is reset to this value and

started, but if the value of dwTimeout is out of range for the hardware implementation of the timer, the timeout setting of the watchdog is left unmodified and WATCHDOG_TIMEOUT_FAILED is returned. Values of dwTimeout over 5000 should never be used, because they cannot be guaranteed to be within range for a given hardware implementation. At the time of writing, the maximum timeout period supported by the hardware is 3478 msec.

The hardware implementation of the watchdog timer is such that the timer's precision varies with the timeout value specified. For dwTimeout <= 13, the precision is 1 msec and the accuracy will be within +7/-4% of the specified period. For dwTimeout > 13, the precision is 13.64 msec; that is, actual values are always equal to or within +13.64 msec of the specified values. Accuracy will be within +7/-4% for the actual period, i.e., the specified period rounded up to the next 13.64 msec increment.

Return Value

The possible return values are represented by the following macros defined in watchdog.h:

Macro	Description
WATCHDOG_OK	Tag or setting of new timeout value succeeded.
WATCHDOG_NOT_ PRESENT	Low-level communication with watchdog device failed.
WATCHDOG_ TIMEOUT_FAILED	Timeout value out of range.

Portability

This function is specific to the RAC6182 hardware.

Functions for Use in Custom Keypad Handlers

The functions described in this section should never be called by an application program. These are functions that must be implemented in a keypad handler if the handler is to interact properly with the system keypad driver (keypad.dll). The driver is the only software module that should call them.

A keypad handler for the RAC6182 is responsible for mapping virtual key codes supplied by the keypad driver to other virtual key codes, to macro virtual key sequences, etc. and passing the results back to the driver, which sends them on to the main keyboard driver for final processing.

These handler functions are already given a general purpose implementation in Rockwell's keypad handler (kh.dll), and a default implementation in Rockwell's handler stub (khstubb.dll).

A custom handler might implement these functions in a different way. However, these functions are subject to redefinition. Accordingly, Rockwell Automation currently recommends against and does not support customer implementations of these functions.

KhInitialize

Rockwell Automation currently recommends against and does not support customer implementation of this function.

KhDeinitialize

Rockwell Automation currently recommends against and does not support customer implementation of this function.

KhGetKeyAttributeTable

Rockwell Automation currently recommends against and does not support customer implementation of this function.

KhGetGlobalKeySettings

Rockwell Automation currently recommends against and does not support customer implementation of this function.

KhSetGlobalKeySettings

Rockwell Automation currently recommends against and does not support customer implementation of this function.

KhTranslateVKey

Rockwell Automation currently recommends against and does not support customer implementation of this function.

Streams Interface for Keypad Driver Control

The keypad related macros and special IOCTLs defined in KeypadAPI.h are intended for use by system developers only. Rockwell recommends against and does not support their use by customers.

Standard I/O streams functions called with these special constants as arguments provide a means for the calling software module to control the system keypad driver (keypad.dll). The software module that utilizes this means is the system keypad handler (kh.dll).

Streams Interface for Touchscreen Control

The macros and special IOCTLs defined in atmelapi.h are intended for use by system developers only. Rockwell recommends against and does not support their use by customers.

Standard I/O streams functions called with these special constants as arguments provide a means for the calling software module to control the system touch screen controller. The software module that utilizes this means is the system control panel.

Functions for LED Control

Three LEDs are available on the RAC6182 and may be accessed by applications.

LED 0 – Warning LED. This LED is toggled on and off during the boot process and is set to off at the end of boot. After boot it is not used by any operating system components and is available for use by an application to signal warning conditions.

LED 1 – NUMLOCK LED. The keypad driver in the operating system controls this LED. When first loaded, the driver assumes the default state of NUMLOCK on and accordingly turns this LED on. The driver will set or clear this LED upon change of the keypad NUMLOCK state. This LED is application accessible, but its use by applications is not recommended except the RAC6182 is configured without a keypad.

LED 2 – Power LED. This LED is toggled on and off during the boot process and is left on at the end of boot. The operating system does not use this LED after boot. This LED is application accessible, but its use by applications is not recommended except possibly in a power fail/brownout condition.

NLedGetDeviceInfo

This function gets the LED Status Information.

Syntax

```
#include <Windows.h>
#include <nledapi.h>

BOOL NLedGetDeviceInfo(UINT nInfoId, void *pOutput)
```

Remarks

Use this function to request information about the system LEDs.

Information that is accessible with this function includes the number of LEDs installed, the capabilities of each installed LED, and the current settings for each installed LED. In general, an LED may be in one of three states: on, off, or blinking. The on and off states can be obtained without any special ado, but the blinking state can be obtained only by specifying the values of adjustable parameters that determine the blink rate and duty cycle Thus, the capabilities information accessible with this function relates to the adjustability of blink parameters. The settings information relates to the basic state and to the additional settings that determine blink rate and duty cycle.

Note that for blink to be possible, at least two of the following parameters must be adjustable: on time, off time, total cycle time (the sum of on and off times.) As of this writing, the capabilities of the RAC6182 LEDs include adjustability of only one of these parameters. Therefore, intrinsic blink is not available. However, it is still possible to make the LEDs blink using NLedSedDevice to toggle between the “on” and “off” states at an interval determined by a separate timer such as is available with the RAC6182 user timer functions.

Note: Do not confuse this function with NLedDriverGetDeviceInfo() described in the Microsoft CE documentation, which is a kernel level function, not callable by applications.

nInfoId may be evaluated with one of the following macros defined in nleddrv.h (included by nledapi.h):

Macro	Description

NLED_COUNT_ INFO_ID	Use to request the number of LEDs installed.
	pOutput should point to a caller allocated structure defined (in nleddrv.h) as follows:
	struct NLED_COUNT_INFO {
	UINT cLeds; // Count of LEDs
	};

Macro	Description

NLED_SUPPORTS_ INFO_ID	Use to request capability information about any one of the LEDs in the system.
	pOutput should point to a caller allocated structure defined (in nleddrv.h) as follows:
	struct NLED_SUPPORTS_INFO {
	UINT LedNum;
	LONG lCycleAdjust; Granularity (usec)
	BOOL fAdjustTotalCycleTime;
	BOOL fAdjustOnTime;
	BOOL fAdjustOffTime;
	BOOL fMetaCycleOn;
	BOOL fMetaCycleOff;
	};
	Prior to calling this function, the individual LED for which information is sought must be selected by evaluating LedNum using one of the following macros (defined in nledapi.h):
	ID_WARNING_LED
	ID_NUMLOCK_LED
	ID_POWER_LED
	When the function returns the other members of the structure will contain information about the LED's capabilities. For Booleans, TRUE means that the parameter is adjustable with a NLedSetDevice call. lCycleAdjust is the resolution of the timer (in usec) that controls blink-on and blink-off.

NLED_SETTINGS_ INFO_ID	Use to request current settings of any one of the LEDs in the system.
	pOutput should point to a caller allocated structure defined (in nleddrv.h) as follows:
	struct NLED_SETTINGS_INFO {
	UINT LedNum;
	INT OffOnBlink; // 0=off, 1=on, 2=blink
	LONG TotalCycleTime; // (usec)
	LONG OnTime; // blink-on time(usec)
	LONG OffTime; // blink-off time(usec)
	INT MetaCycleOn; // num blink-on cycles
	INT MetaCycleOff; // numblink-off cycles
	};
	Prior to calling this function, the LED for which setting information is sought must be selected. This is done by evaluating LedNum using one of the following macros (defined in nledapi.h):
	ID_WARNING_LED
	ID_NUMLOCK_LED
	ID_POWER_LED
	When the function returns, current settings will be stored in the corresponding members of the NLED_SETTINGS_INFO structure.

Return Value

One of the following: TRUE or FALSE.

Portability

The arguments to this function are specific to the RAC6182 hardware.

NledSetDevice

This function sets the LEDs.

Syntax

```
#include <Windows.h>
#include <nledapi.h>

BOOL NLedSetDevice(UINT nDeviceId, void *pInput)
```

Remarks

Use this function to set the operating states of the system LEDs.

Note: Before calling this function, it is a good idea to issue a calls to the NLedGetDeviceInfo function to verify the presence of the LED of interest and to get its capabilities. As of this writing, RAC6182s with integrated LCDs are equipped with three front panel LEDs which have only “on” and “off” capabilities.

Note: Do not confuse this function with NLedDriverSetDevice() described in the Microsoft CE documentation, which is a kernel level function, not callable by applications.

nInfoId must be evaluated with the NLED_SETTINGS_INFO_ID macro defined in nleddrv.h (included by nledapi.h).

pInput must point to a caller allocated structure, defined in nleddrv.h as follows:

```
struct NLED_SETTINGS_INFO {
  UINT LedNum;
  INT OffOnBlink;  // 0=off, 1=on, 2=blink
  LONG TotalCycleTime;  // (usec)
  LONG OnTime;  // blink-on time(usec)
  LONG OffTime;  // blink-off time(usec)
  INT MetaCycleOn; // num blink-on cycles
  INT MetaCycleOff;  // numblink-off cycles
};
```

Prior to calling this function, the LED that is to be set must be selected. This is done by evaluating LedNum using one of the following macros (defined in nledapi.h):

```
ID_WARNING_LED
ID_NUMLOCK_LED
ID_POWER_LED
```

Other parameters should be set, based on capabilities for the LED in question obtained with an NLedGedDeviceInfo call.

Return Value

One of the following: TRUE or FALSE.

Portability

The arguments to this function are specific to the RAC6182 hardware.

Functions for Use in PCI Device Drivers

The functions necessary to access PCI configuration space, map PCI memory or IO space, and handle interrupts on the PCI card are HAL (Hardware Abstraction Layer) calls and several other CE-specific Win32 calls. The basic operation of these calls is already documented by

Microsoft, so this document will focus just on RAC6182 specific features or limitations and recommended usage in application level code or user mode device drivers.

ceddk.h and ceddk.lib must be used for compilation and linking in addition to the default libraries.

HalTranslateBusAddress

This function translates the PCI Bus Address.

Syntax

```
#include <Windows.h>
#include <ceddk.h>

BOOL HalTranslateBusAddress(
      INTERFACE_TYPE InterfaceType,
      ULONG BusNumber,
      PHYSICAL_ADDRESS BusAddress,
      PULONG AddressSpace,
      PHYSICAL_ADDRESS TranslatedAddress
)
```

Remarks

HalTranslateBusAddress() converts a PCI memory or IO space address into a physical address which may be used to map virtual address space to the memory or IO using MmMapIoSpace().

Parameter	Description
InterfaceType	PCIBus is the only allowed
BusNumber	The RAC6182 PCI slot is on bus 1.
BusAddress	must have its upper 32 bits equal to 0, and lower 32 bits the PCI memory or IO space address obtained from the PCI address space registers. Values from PCI address space registers should have the non-address bits such as I/O, prefetch, etc. masked off before being put in the lower part of BusAddress
AddressSpace	set to 0 for memory, 1 for IO.
Translated Address	If parameters are valid, the function will return with a value usable by MmMapIoSpace().

Return Value

One of the following: TRUE or FALSE.

Portability

The arguments to this function are specific to the RAC6182 hardware.

HalGetBusDataByOffset

This function gets the PCI Bus Data by offset.

Syntax

```
#include <Windows.h>
#include <ceddk.h>

ULONG HalGetBusDataByOffset(
      BUS_DATA_TYPE BusDataType,
      ULONG BusNumber,
      ULONG SlotNumber,
      PVOID Buffer,
      ULONG Offset,
      ULONG Length
      )
```

Remarks

HalGetBusDataByOffset() retrieves PCI configuration space information, such as addresses and interrupt information, for a PCI device.

Parameter	Description
BusDataType	PCIConfiguration
BusNumber	The RAC6182 PCI slot is on bus 1.
SlotNumber	
Buffer	
Offset	
Length	

Return Value

Portability

The arguments to this function are specific to the RAC6182 hardware.

HalSetBusDataByOffset

This function sets the PCI Bus Data by offset.

Syntax

```
#include <Windows.h>
#include <ceddk.h>

ULONG HalSetBusDataByOffset(
    BUS_DATA_TYPE BusDataType,
    ULONG BusNumber,
    ULONG SlotNumber,
    PVOID Buffer,
    ULONG Offset,
    ULONG Length
    )
```

Remarks

HalSetBusDataByOffset() sets PCI configuration space information. This function should be used only to set device-specific configuration information.

Parameter	Description
BusDataType	PCIConfiguration
BusNumber	The RAC6182 PCI slot is on bus 1.
SlotNumber	The RAC6182 PCI slot number is 1.
Buffer	
Offset	
Length	

Return Value

One of the following:

Portability

The arguments to this function are specific to the RAC6182 hardware.

MmMapIoSpace

This function maps the PCI IO space.

Syntax

```
#include <Windows.h>
#include <ceddk.h>

PVOID MmMapIoSpace(
      PHYSICAL_ADDRESS PhysicalAddress,
      ULONG NumberOfBytes,
      BOOLEAN CacheEnable
     )
```

Remarks

MmMapIoSpace() maps a physical address range into a virtual address range usable by an application. This function should be used on PCI memory or IO range information obtained with HalGetBusDataByOffset() and translated with HalTranslateBusAddress().

Parameter	Description
PhysicalAddress	
NumberOfBytes	
CacheEnable	

InterruptInitialize

This function initializes the PCI interrupt.

Syntax

```
#include <Windows.h>
#include <ceddk.h>

BOOL InterruptInitialize(
      DWORD idInt,
      HANDLE hEvent,
      LPVOID pvData,
      DWORD cbData
     )
```

Remarks

InterruptInitialize() associates a virtual interrupt number with an application created event so that the application can use WaitFor*() functions to wait for the interrupt to occur. For RAC6182, the virtual interrupt is obtained from the PCI configuration space interrupt register

(offset 0x0C) using HalGetBusDataByOffset(). The PCI slot interrupt is disabled until this function is called.

Portability

The argument to this function is specific to the RAC6182 hardware.

InterruptDisable

This function disables the PCI interrupt.

Syntax

```
#include <Windows.h>
#include <ceddk.h>

VOID InterruptDisable ( DWORD idInt )
```

Remarks

InterruptDisable() disables the virtual interrupt.

Return Value

One of the following:

Portability

The argument to this function is specific to the RAC6182 hardware.

InterruptDone

This function cleans up after the PCI interrupt.

Syntax

```
#include <Windows.h>
#include <ceddk.h>

VOID InterruptDone ( DWORD idInt )
```

Remarks

InterruptDone() signals that the application which registered for the virtual interrupt using InterruptInitialize() is done handling the interrupt. The interrupt is reenabled when InterruptDone() is called.

Return Value

One of the following:

Portability

The argument to this function is specific to the RAC6182 hardware.

Sample Code for a Simple PCI Slot Device

This code assumes a simple device with one memory address space size 4K configured at PCI configuration offset 0x10 and one IO address space size 16K configured at PCI configuration offset 0x14. It has a power management register at offset 0x40 that must be set to bring the device out of power down mode. The device periodically interrupts us to print data or tell us it has died.

```
#include <windows.h>
#include <ceddk.h>

// values currently defined for RAC6182.
// these will be provided in a pcislot.h file
#define PCI_SLOT_BUS_NUMBER             1
#define PCI_SLOT_DEVICE_NUMBER  1

// bogus items for our simple card
#define CARD_VENDOR_ID                  0x1234
#define CARD_DEVICE_ID                  0x5678
#define CARD_POWER_MGMT_ON              0x00000001
#define CARD_MEMORY_SIZE        (4*1024)
#define CARD_IO_SIZE                    (16*1024)
#define CARD_SIGNAL_DEAD        0xDEAD

int main(void)
{
    PCI_COMMON_CONFIG PCIConfig;
    HANDLE waitevent;
    DWORD interrupt;
    PHYSICAL_ADDRESS pa,pa2;
    volatile UCHAR *IOSpace;
    volatile UCHAR *MemSpace;
    ULONG value;

    NKDbgPrintfW(TEXT("PCI card sample\n"));
    if(HalGetBusDataByOffset(PCIConfiguration,PCI_SLOT_BUS_NUMBER,
PCI_SLOT_DEVICE_NUMBER,&PCIConfig,0,sizeof(PCIConfig)) !=
sizeof(PCIConfig)) {
NKDbgPrintfW(TEXT("failed to get PCI slot config info\n"));
return(-1);
    }
    // check that our card is present
    if(PCIConfig.VendorID!=CARD_VENDOR_ID ||
PCIConfig.DeviceID!=CARD_DEVICE_ID) {
NKDbgPrintfW(TEXT("vendor %04x device %04x not our card\n"),
    PCIConfig.VendorID,PCIConfig.DeviceID);
return(-1);
    }
    // power on to our bogus card to demonstrate a device-specific config
    // space write
    value=CARD_POWER_MGMT_ON;
    if(HalSetBusDataByOffset(PCIConfiguration,PCI_SLOT_BUS_NUMBER,
            PCI_SLOT_DEVICE_NUMBER,&value,0x40,sizeof(value))!=
            sizeof(value)) {
```

```
                NKDbgPrintfW(TEXT("failed to set device specific PCI config
    value\n"));
                return(-1);
    }
    // get virtual interrupt #
    interrupt=PCIConfig.u.type0.InterruptLine;
    // can use manual reset or named event if desired
    waitevent=CreateEvent(NULL,FALSE,FALSE,NULL);
    if(!waitevent || waitevent==INVALID_HANDLE_VALUE) {
                NKDbgPrintfW(TEXT("failed createevent()\n"));
                return(-1);
    }
    if(!InterruptInitialize(interrupt,waitevent,NULL,0)) {
                NKDbgPrintfW(TEXT("failed claiming interrupt %d\n"),interrupt);
                return(-1);
    }
    // handle 1st address space – 4K memory
    pa.HighPart=0;
    pa.LowPart=PCIConfig.u.type0.BaseAddresses[0]&
PCI_ADDRESS_MEMORY_ADDRESS_MASK);
    value=0;
    if(!HalTranslateBusAddress(PCIBus,PCI_SLOT_BUS_NUMBER,pa,&value,&pa
    2)) {
                NKDbgPrintfW(TEXT("failed translating mem address\n"));
                return(-1);
    }
    if(!(MemSpace=MmMapIoSpace(pa2,CARD_MEMORY_SIZE,FALSE))) {
                NKDbgPrintfW(TEXT("failed mapping mem address\n"));
                return(-1);
    }
    // handle 2nd address space – 16K IO
    pa.HighPart=0;
    pa.LowPart=PCIConfig.u.type0.BaseAddresses[1]&
PCI_ADDRESS_IO_ADDRESS_MASK);
    value=1;
    if(!HalTranslateBusAddress(PCIBus,PCI_SLOT_BUS_NUMBER,pa,&value,&pa2))
    {
                NKDbgPrintfW(TEXT("failed translating io address\n"));
                return(-1);
    }
    if(!(IOSpace=MmMapIoSpace(pa2,CARD_MEMORY_SIZE,FALSE))) {
                NKDbgPrintfW(TEXT("failed mapping IO address\n"));
                return(-1);
    }
    // everything mapped and initialized OK, now we become an interrupt
    handler
    while(1) {
                value=WaitForSingleObject(waitevent,1000);
                if(value==WAIT_TIMEOUT) {
                            NKDbgPrintfW(TEXT("<yawn!>\n"));
                            // do not InterruptDone() on a time out or if event other
                            // than the interrupt-associated event triggered
                } else if(value==WAIT_OBJECT_0) {
                            // interrupt occurred on PCI slot device
                            if(*(ULONG *)MemSpace==CARD_SIGNAL_DEAD ||
                                        *(ULONG *)IOSpace==CARD_SIGNAL_DEAD) {
                                        // demonstrate InterruptDisable()
                                        NKDbgPrintfW(TEXT("card dead\n"));
                                        InterruptDisable(interrupt);
```

```
                    return(0);
                }
                NKDbgPrintfW(TEXT("card said mem %08x IO %08x\n"),
                    *(ULONG *)MemSpace,
                    *(ULONG *)IOSpace);
                // done processing interrupt, reenable and wait again
                InterruptDone(interrupt);
            } else {
                NKDbgPrintfW(TEXT("waitforsingleobject failed\n"));
                return(-1);
            }
        }
    }
```

Functions for OS Update

The functions prototyped in osupdateapi.h are intended for use by system developers only. Rockwell Automation recommends against and does not support use of these functions in applications and device drivers.

Methods for updating the RAC6182 operating system software are discussed in the RAC6182 User's Manual.

osu_UpdateOSFromFile

Rockwell Automation recommends against and does not support use of this function.

osu_RemoteUpdateOSFromRAM

Rockwell Automation recommends against and does not support use of this function.

Function for Registry Flush

A RAC6182 has a Windows CE registry which is stored in the RAM of the device. Since RAM data are valid only while the RAC6182 is powered on, a persistent backup of the registry is maintained on the Disk-On-Chip

The Windows CE operating system does not automatically flush the registry in RAM to persistent storage, therefore if registry settings are changed by an application, the application should invoke a FlushRegistry operation to ensure that the settings will persist from one operating session to another.

Note: Because of the relatively large amount of time required to flush the registry to flash, it is highly recommended that applications adding or changing registry information complete a set of changes before issuing a flush rather than attempting to flush after every single update.

FlushRegistry

This function is the Flush Registry. It is prototyped in regflush.h.

Syntax

```
#include <Windows.h>
#include <regflush.h>

BOOL RegistryFlush(void)
```

Remarks

This function is defined as a macro in regflush.h. This function commands the operating system to flush the entire registry to the persistent registry storage. The procedure that occurs when this API is invoked is as follows:

1. The entire registry information is collected from Windows CE.
2. This information is compressed to save space, and also results in a time savings when going to flash memory such as the Disk-On-Chip.
3. Any existing temporary persistent registry file is deleted.
4. The temporary persistent registry file is created and the compressed registry information written out.
5. Any existing backup persistent registry file is deleted.
6. Any existing primary persistent registry file is moved to the backup persistent registry file.
7. The temporary persistent registry file is moved to the primary persistent registry file and has its attributes set to read-only, hidden, and system.

The function does not return unless there is an error or the flush is successfully completed. Any fatal errors such as failing to allocate enough working RAM, failing to create or write the temporary persistent registry file or failure to move this file to be the primary persistent registry file will result in failure of the function. File system errors will result if the Disk-On-Chip is not properly formatted, has been corrupted, or does not have enough space free.

The registry flush procedure requires 512K+2*(compressed registry size) bytes of RAM be free as working space for storing and compressing the registry. The Disk-On-Chip file-system needs to have (compressed registry size rounded up to nearest cluster size) bytes free for registry flush to succeed. Typical registry size for the base operating system are on the order of 128K-160K uncompressed which compresses very well to 32K-40K. Registry keys added by applications will certainly increase

the overall size and the nature of the content may also affect compressibility.

Time involved to flush the registry varies based on size of the registry, and can also vary based on state of the Disk-On-Chip (e.g. if flash sectors need erased and written this takes significantly longer than just writing to previously erased flash sectors). For the registry in the base operating system time to flush has been seen to vary between 100 to 500 ms. The time to write to the Disk-On-Chip is by far the dominant factor; reading the registry from CE into working RAM and compressing it typically takes less than 10-20 ms. of this time. Larger registry sizes due to key additions by applications can be expected to vary in a higher range of time for a registry flush to complete.

Return Value

TRUE if successful, otherwise FALSE

Portability

This function is specific to the RAC6182 hardware.

Function to Adjust Allocation of DRAM

SetSystemMemoryDivision

This function sets the amount of DRAM allocated to system. It is prototyped in othersdk.h.

Syntax

```
#include <Windows.h>
#include <othersdk.h>

DWORD SetSystemMemoryDivision(DWORD dwStorePages)
```

Remarks

This function is called by an application to set the amount of DRAM allocated to the system.

Total DRAM installed can be obtained with a call to rm_GetParameter(), using RM_PARAMETER_PHYSICAL_MEMORY_SIZE as the first argument (see description below). This memory is divided into two logical partitions, one for the Object Store (RAMDISK), and one for system memory. The memory available for the Object Store will be the total amount of memory less the amount allocated to the system.

dwStorePages the number of 4KB pages to be allocated to the system.

Important: Windows CE V2.12 could exhibit problems if more than 32MB of DRAM is allocated to the system.

Return Value

TRUE if successful, otherwise FALSE.

Portability

This function is specific to the RAC6182 hardware.

Functions to Get/Set Misc Parameters

The functions described here may be called by an application program to get or set the values of certain system parameters.

The following table enumerates currently defined parameters that can be accessed with these functions. Type of data, minimum size, and whether set, get, or both are allowed are given. This table may be expanded in the future to add new parameter types without adding new functions.

Table I
Get/Set Misc Parameters

Parameter	Macro Identifier	Get or Set	Type	Size (Bytes)
Physical Memory Size	RM_PARAMETER_PHYSICAL_MEMORY_SIZE	Get	DWORD	4
Pointer to Cached Physical Memory	RM_PARAMETER_PHYSICAL_MEMORY_CACHED_POINTER	Get	void *	4
Pointer to Uncached Physical Memory	RM_PARAMETER_PHYSICAL_MEMORY_UNCACHED_POINTER	Get	void *	4
CPU Speed (Hz)	RM_PARAMETER_CPU_SPEED_HZ	Get	DWORD	4
Windows CE Version	RM_PARAMETER_WINDOWS_CE_VERSION	Get	WCHAR	80 x 2
Operating System Boot Image Version	RM_PARAMETER_OS_FIRMWARE_VERSION	Get	WCHAR	80 x 2
Boot ROM Firmware Version	RM_PARAMETER_BOOTROM_FIRMWARE_VERSION	Get	WCHAR	80 x 2
Aux Micro-controller Firmware Version	RM_PARAMETER_MICROCONTROLLER_FIRMWARE_VERSION	Get	WCHAR	80 x 2

Parameter	Macro Identifier	Get or Set	Type	Size (Bytes)
Debug output on COM2	RM_PARAMETER_ENABLE_SERIAL_DEBUG_ON_BOOT	Both	BOOL	4
LCD Brightness	RM_PARAMETER_LCD_BRIGHTNESS	Both	DWORD	4
LCD Contrast	RM_PARAMETER_LCD_CONTRAST	Both	DWORD	4
MAC Addr of on board Ethernet	RM_PARAMETER_ONBOARD_ETHERNET_MAC_ADDRESS	Get	UCHAR	6
Cursor Status	RM_PARAMETER_CURSOR_ENABLED	Both	BOOL	4
Debug output on COM2	RM_PARAMETER_ENABLE_SERIAL_DEBUG	Both	BOOL	4
Memory pointer	RM_PARAMETER_PHYSICAL_ADDRESS (CE V3.0 SDK only)	Get	void *	4

GetParameter

This function gets parameters. It is prototyped in miscsystem.h.

Syntax

```
#include <Windows.h>
#include <miscsystem.h>

DWORD rm_GetParameter(DWORD dwParameter, DWORD *dwSize, VOID
    *pvData)
```

Remarks

dwParameter may be evaluated with any one of the following macros defined in miscsystem.h in order to select the system parameter value to be retrieved:

RM_PARAMETER_PHYSICAL_MEMORY_SIZE

RM_PARAMETER_PHYSICAL_MEMORY_CACHED_POINTER

RM_PARAMETER_PHYSICAL_MEMORY_UNCACHED_POINTER

RM_PARAMETER_CPU_SPEED_HZ

RM_PARAMETER_WINDOWS_CE_VERSION

RM_PARAMETER_OS_FIRMWARE_VERSION

RM_PARAMETER_BOOTROM_FIRMWARE_VERSION

RM_PARAMETER_MICROCONTROLLER_FIRMWARE_VERSION

RM_PARAMETER_ENABLE_SERIAL_DEBUG_ON_BOOT

RM_PARAMETER_LCD_BRIGHTNESS

RM_PARAMETER_LCD_CONTRAST

RM_PARAMETER_ONBOARD_ETHERNET_MAC_ADDRESS

RM_PARAMETER_CURSOR_ENABLED

RM_PARAMETER_ENABLE_SERIAL_DEBUG

RM_PARAMETER_PHYSICAL_ADDRESS (CE V3.0 only)

dwSize is a pointer to a caller allocated DWORD whose value will represent the number of bytes at pvData.

pvData is a pointer to a caller allocated buffer which will contain information related to the current settings for the selected parameter. The buffer must be large enough to contain the information requested and must be aligned as required. For example, if a request for a parameter will result in *pvData being filled with a DWORD value, *pvData must be DWORD aligned. Please refer to the table in the introduction to this section of the manual for the data types associated with the various readable parameters.

Return Value

One of the following:

RM_ERROR_OK - Parameter valid, size large enough, succeeded

RM_ERROR_INVALID_PARAMETER - Bad dwParameter or NULL dwSize or pvData

RM_ERROR_INVALID_BUFFER_SIZE - Buffer size too small for requested parameter

Portability

The arguments to this function are specific to the RAC6182 hardware.

SetParameter

This function sets parameters. It is prototyped in miscsystem.h.

Syntax

```
#include <Windows.h>
#include <miscsystem.h>

DWORD rm_SetParameter(DWORD dwParameter, DWORD *dwSize, VOID
    *pvData)
```

Remarks

dwParameter may be evaluated with any one of the following macros defined in miscsystem.h in order to select the system parameter to be set:

RM_PARAMETER_ENABLE_SERIAL_DEBUG_ON_BOOT

RM_PARAMETER_LCD_BRIGHTNESS

RM_PARAMETER_LCD_CONTRAST

RM_PARAMETER_CURSOR_ENABLED

RM_PARAMETER_ENABLE_SERIAL_DEBUG

RM_PARAMETER_PHYSICAL_ADDRESS (CE V3.0 only)

dwSize is a pointer to a caller allocated DWORD. *dwSize should be evaluated with sizeof(<type_of_parameter>) or with the size in bytes of the parameter type as indicated in the table at the beginning of this section. When the function returns, the value of *dwSize will indicates the actual number of bytes from pvData used to set the selected parameter.

pvData is a pointer to a caller allocated buffer containing the setting data to be applied to the selected parameter. The buffer must be sized and aligned according to the type of the data. For example, if *pvData will be filled with a DWORD value, it must be DWORD aligned. Please refer to the table in the introduction to this section of the manual for details.

Return Value

One of the following:

RM_ERROR_OK - Parameter valid, size large enough, succeeded

RM_ERROR_INVALID_PARAMETER - Bad dwParameter or NULL dwSize or pvData

RM_ERROR_INVALID_BUFFER_SIZE - Buffer size too small for requested parameter

Portability

The arguments to this function are specific to the RAC6182 hardware.

Functions for Accessing System Timers

The hardware of the RAC6182 has provides a number of timers of varying precision, flexibility, and range. Some of these timers may be used for other operating-system level purposes such as reschedule timer interrupts, PWM for LCD panels, RS485 implementation, etc. However, at least one of these timers is guaranteed to be available for general purpose use to application programs.

Since the number of timers is only guaranteed to be at least one and RAC6182 supports the possibility of multiple applications executing, applications should use the timer APIs along with a fallback to less precise Sleep() or busy-wait timing if timers are not available for their usage.

UserTimerGetNumberOfTimers

This function gets the number of available timers. It is prototyped in usertimers.h.

Syntax

```
#include <Windows.h>
#include <usertimers.h>

DWORD UserTimerGetNumberOfTimers(void)
```

Remarks

Returns total number of application accessible timers on the system.

Return Value

Total number of application accessible timers available.

Portability

This function is specific to the RAC6182 hardware.

See Also

UserTimerClaim

UserTimerClaim

This function claims, or releases, access to user timers. It is prototyped in usertimers.h.

Syntax

```
#include <Windows.h>
#include <usertimers.h>

DWORD UserTimerClaim(DWORD TimerNumber,BOOL Claim)
```

Remarks

This function is used to claim or release exclusive access to a specific timer. A timer must be claimed before any function taking a TimerNumber as a parameter can be used. A timer must be released to allow any other application to claim and use the timer.

Parameter	Description
TimerNumber	TimerNumber is 0 based (i.e. if 2 timers are present on the system, they are timer #0 and timer #1).
Claim	Claim is TRUE to claim access to a timer, FALSE to release it.

Return Value

Possible return values are represented by macros defined in usertimers.h:

USER_TIMER_OK - Successfully claimed or released timer

USER_TIMER_INVALID_TIMER - Timer number not present on system

USER_TIMER_NOT_CLAIMED - Another application already claimed the timer so this application could not claim it

USER_TIMER_ALREADY_CLAIMED - This application has already claimed this timer

Portability

This function is specific to the RAC6182 hardware.

See Also

UserTimerGetNumberOfTimers

UserTimerRequestFrequency

This function sets the frequency of user timers. It is prototyped in usertimers.h.

Syntax

```
#include <Windows.h>
#include <usertimers.h>

DWORD UserTimerRequestFrequency(DWORD TimerNumber,DWORD
    *Frequency)
```

Remarks

Requests that the timer use a frequency as close as possible to a specified frequency for its count. Hardware timer capabilities vary significantly, so there may only be one or certain gradations of real frequencies possible.

Applications must check the *Frequency returned and use it in their counter calculations.

Note: As of this writing, RAC6182 user timers operate at a fixed frequency of 75MHz. Thus, attempts to adjust the timers to frequencies other than 75MHz will not be effective. However, the timers' frequencies may become adjustable in future releases of the RAC6182, and no guarantee can be made that the timers will always have a fundamental frequency of 75MHz.

ATTENTION: This function has unpredictable results if called when the timer is running.

Parameter	Description
TimerNumber	Number of a timer previously claimed.
Frequency	Pointer to an application allocated DWORD containing the frequency (in Hz) to which the timer is to be set. When the function is successful, it changes *Frequency to the actual value used.

Return Value

Possible return values are represented by macros defined in usertimers.h:

USER_TIMER_OK - Successfully claimed or released timer

USER_TIMER_INVALID_TIMER - Timer number not present on system

USER_TIMER_NOT_CLAIMED - Another application already has claimed the timer so this application could not claim it

USER_TIMER_INVALID_PARAMETER - Invalid value

Portability

This function is specific to the RAC6182 hardware.

See Also

UserTimerClaim and UserTimerSet

UserTimerSet

This function sets the count of user timer and start timing. It is prototyped in usertimers.h.

Syntax

```
#include <Windows.h>
#include <usertimers.h>

DWORD UserTimerSet(DWORD TimerNumber,DWORD Count)
```

Remarks

Sets the timer to a given countdown value and starts the timer. The frequency of the count is the last frequency returned from UserTimerRequestFrequency. The countdown stops at 0 and the timer is triggered.

Any count in progress is aborted by this function.

Parameter	Description
TimerNumber	Number of a timer previously claimed.
Count	Number of ticks before a timeout is triggered. The range may vary depending on the hardware implementation of the counter.

Return Value

Possible return values are represented by macros defined in usertimers.h:

USER_TIMER_OK - Successfully claimed or released timer

USER_TIMER_INVALID_TIMER - Timer number not present on system

USER_TIMER_NOT_CLAIMED - Another application already has claimed the timer so this application could not claim it

USER_TIMER_SET_FAILED - Unable to set timer

USER_TIMER_INVALID_PARAMETER - Invalid value

Portability

This function is specific to the RAC6182 hardware.

UserTimerStop

This function stops the user timer. It is prototyped in usertimers.h.

Syntax

```
#include <Windows.h>
#include <usertimers.h>

DWORD UserTimerStop(DWORD TimerNumber)
```

Remarks

Aborts any currently active countdown in the timer specified by TimerNumber. TimerNumber must refer to a previously claimed timer.

Return Value

Possible return values are represented by macros defined in usertimers.h.:

USER_TIMER_OK - Successfully claimed or released timer

USER_TIMER_INVALID_TIMER - Timer number not present on system

USER_TIMER_NOT_CLAIMED - Another application already has claimed the timer so this application could not claim it

USER_TIMER_NOT_RUNNING - Timer not running

Portability

This function is specific to the RAC6182 hardware

See Also

UserTimerSet

UserTimerGetValue

This function gets the count of user timer. It is prototyped in usertimers.h.

Syntax

```
#include <Windows.h>
#include <usertimers.h>

DWORD UserTimerGetValue(DWORD TimerNumber, DWORD *Count)
```

Remarks

Requests the current countdown value of an active timer.

Parameter	Description
TimerNumber	Number of a previously claimed timer.
Count	Pointer to a DWORD allocated by the caller in which the current count will be stored.

Return Value

Possible return values are represented by macros defined in usertimers.h:

USER_TIMER_OK - Successfully claimed or released timer

USER_TIMER_INVALID_TIMER - Timer number not present on system

USER_TIMER_NOT_CLAIMED - Another application already has claimed the timer so this application could not claim it

USER_TIMER_INVALID_PARAMETER - Invalid value

USER_TIMER_NOT_RUNNING - Timer not running

Portability

This function is specific to the RAC6182 hardware.

UserTimerGetWaitEvent

This function registers to receive notification of timeout event. It is prototyped in usertimers.h.

Syntax

```
#include <usertimers.h>

DWORD UserTimerGetWaitEvent(DWORD TimerNumber,BOOL ManualReset,
    HANDLE *WaitEvent)
```

Remarks

Creates an event handle in *WaitEvent which may be used in a WaitForSingleObject() or WaitForMultipleObjects() call. This event is set whenever the timer counts down to zero, allowing interrupt driven timer handling.

Parameter	Description
TimerNumber	Number of a previously claimed timer.
ManualReset	
WaitEvent	Pointer to a caller allocated HANDLE, in which an event handle will be stored.

Return Value

Possible return values are represented by macros defined in usertimers.h:

USER_TIMER_OK - Successfully claimed or released timer

USER_TIMER_INVALID_TIMER - Timer number not present on system

USER_TIMER_NOT_CLAIMED - Another application already has claimed the timer so this application could not claim it

USER_TIMER_INVALID_PARAMETER - Invalid value

Portability

This function is specific to the RAC6182 hardware.

Functions for Accessing the Hardware Monitor

The RAC6182 platform provides a hardware monitor driver that can be called by applications to monitor the status of various board parameters, to set "warning levels", for these parameters, and to receive warning event signals when values of the monitored parameters fall outside the warning levels. In addition, functions for power-fail monitoring, board reset and reboot are provided here.

The parameters that can be monitored are:

12-Volt power supply voltage

5-Volt power supply voltage

3.3-Volt power supply voltage

3-Volt battery voltage

Board temperature

Power fail

Note that some of the monitored parameters are of fundamentally different types. Therefore the units of the parameters, will vary according to the parameter being monitored. For example, when an application sets the warning levels for the 5V-power supply monitor, the units of the levels specified in HardwareMonitor API functions will be Volts. However, when an application sets board temperature warning levels, the application must specified temperature in degrees Celsius. Parameter units are described in more detail below for each API function.

The functions exported by the HardwareMonitor driver are listed below.

hm_GetMonitorLevel

This function gets the value of monitored parameter. It is prototyped in HardwareMonitorAPI.h.

Syntax

```
#include <Windows.h>
#include <HardwareMonitorAPI.h>

BOOL hm_GetMonitorLevel (DWORD dwMonitorID, double *plfMonitorLevel)
```

Remarks

This function queries the hardware monitor for the value of the parameter specified with dwMonitorID. The value is returned as a double precision float in *plfMonitorLevel. The units vary depending on the parameter.

Note that there are no readable values associated with the power fail monitor.

Parameter	Description
dwMonitorID	ID of monitored parameter whose current value is being queried. Note that only one monitored parameter can be specified. Possible values are represented by macros defined in HardwareMonitorAPI.h as follows: MONITOR_ID_SUPPLY_3V MONITOR_ID_SUPPLY_5V MONITOR_ID_SUPPLY_12V MONITOR_ID_SUPPLY_BATTERY MONITOR_ID_TEMPERATURE_BOARD
plfMonitorLevel	Pointer to an application-allocated double precision floating point value which will receive the specified monitor's current level. Power supply values are given in units of voltage. Temperature values are given in units of degrees Celsius.

Return Value

Returns TRUE if the query succeeded. FALSE is returned if the query failed.

Portability

This function is specific to the RAC6182 hardware.

See Also

hm_GetMonitorWarningLevels and hm_SetMonitorWarningLevels

hm_GetMonitorWarningLevels

This function gets warning levels for monitored parameter. It is prototyped in HardwareMonitorAPI.h.

Syntax

```
#include <Windows.h>
#include <HardwareMonitorAPI.h>

BOOL hm_GetMonitorWarningLevels (DWORD dwMonitorID, double
    *plfUpperWarningLevel, double *plfLowerWarningLevel)
```

Remarks

This function queries the current warning levels defined for the parameter specified with dwMonitorID. Upper and lower warning levels specify the upper and lower bounds of the monitored parameter during normal operation. If the parameter deviates from the defined operating bounds, it will enter the "warning state".

Power fail is special in that it only has a lower warning level. lfUpperWarningLevel will be the value of the macro MONITOR_WARNING_LEVEL_UNDEFINED.

Parameter	Description
dwMonitorID	ID of monitored parameter whose warning levels are being set. monitored parameter can be specified. Note that only one monitor ID can be specified. Possible values are represented by macros defined in HardwareMonitorAPI.h as follows: MONITOR_ID_SUPPLY_3V MONITOR_ID_SUPPLY_5V MONITOR_ID_SUPPLY_12V MONITOR_ID_SUPPLY_BATTERY MONITOR_ID_TEMPERATURE_BOARD MONITOR_ID_POWER_FAIL
plfUpperWarningLevel	Pointer to an application-allocated double-precision floating point where the current upper limit value will be written. The value represents volts or degrees Celsius, depending on the specified parameter. MONITOR_WARNING_LEVEL_UNDEFINED, a macro defined in HardwareMonitorAPI.h, will be written if the upper level bound has not been defined and will not be used to determine if the monitor has entered the warning state.

Parameter	Description
plfLowerWarningLevel	Pointer to an application-allocated double-precision floating point where the current lower limit value will be written. The value represents volts or degrees Celsius, depending on the specified parameter. MONITOR_WARNING_LEVEL_UNDEFINED, a macro defined in HardwareMonitorAPI.h, will be written if the upper level bound has not been defined and will not be used to determine if the monitor has entered the warning state.

Return Value

Returns TRUE if the warning levels were successfully queried. Returns FALSE on failure.

Portability

This function is specific to the RAC6182 hardware.

See Also

hm_SetMonitorWarningLevels

hm_SetMonitorWarningLevels

This function sets warning levels for monitored parameter. It is prototyped in HardwareMonitorAPI.h.

Syntax

```
#include <Windows.h>
#include <HardwareMonitorAPI.h>

BOOL hm_SetMonitorWarningLevels (DWORD dwMonitorID, double
    lfUpperWarningLevel, double lfLowerWarningLevel)
```

Remarks

This function sets upper and lower "warning levels" the parameter specified with dwMonitorID. Upper and lower warning levels specify the upper and lower bounds of the monitored parameter during normal operation. If the parameter deviates from the specified operating bounds, it will enter the "warning state".

The power fail monitor is a 12V supply monitor, but separate from the regular 12V supply monitor. It is special in that it is used not merely to trigger a warning, but also to initiate a system shutdown in case the 12V line drops below the warning level. The power fail monitor has only a lower warning level. If setting levels for power fail, the macro MONITOR_WARNING_LEVEL_UNDEFINED should be used to evaluate lfUpperWarningLevel.

ATTENTION: When power fail lower warning level is set, and the 12V supply subsequently drops below that level, the system will enter a warning state, but it will also begin an irreversible shut down. Care should be taken not to set regular 12-Volt low warning level lower than the power fail level; otherwise, it will not be possible to detect a warning in case the 12V drops below its lower level. Also, care must be taken not to set the power fail level higher than the current 12-Volt level; otherwise, the system will immediately enter the power fail shutdown state.

Parameter	Description
dwMonitorID	ID of monitored parameter whose limits are being set. Note that only one monitored parameter can be specified. Possible values are represented by macros defined in HardwareMonitorAPI.h as follows: MONITOR_ID_SUPPLY_3V MONITOR_ID_SUPPLY_5V MONITOR_ID_SUPPLY_12V MONITOR_ID_SUPPLY_BATTERY MONITOR_ID_TEMPERATURE_BOARD MONITOR_ID_POWER_FAIL
lfUpperWarningLevel	Double precision floating point level defining the upper bound of the parameter during normal operation. The given value represents voltage or degrees Celsius, depending on the specified parameter. If MONITOR_WARNING_LEVEL_UNDEFINED, a macro defined in HardwareMonitorAPI.h, is specified, the upper level bound will be undefined and not used to determine if the monitor enters the warning state.
lfLowerWarningLevel	Double precision floating point level defining the lower bound of the monitor parameter during normal operation. The given value represents volts or degrees Celsius, depending on the specified parameter. If MONITOR_WARNING_LEVEL_UNDEFINED, a macro defined in HardwareMonitorAPI.h, is specified, the lower level bound will be undefined and not used to determine if the monitor enters the warning state.

Return Value

Returns TRUE if the warning levels were successfully set. Returns FALSE on failure.

Portability

This function is specific to the RAC6182 hardware.

See Also

hm_GetMonitorWarningLevels

hm_RegisterMonitorWarningEvent

This function registers to receive a warning of a parameter out-of-limit. It is prototyped in HardwareMonitorAPI.h.

Syntax

```
#include <Windows.h>
#include <HardwareMonitorAPI.h>

BOOL hm_RegisterMonitorWarningEvent (DWORD dwMonitorIDMask, HANDLE
    *phEventHandle)
```

Remarks

An application that needs to be notified when one or more monitor parameters enter the warning state should register for an event with this function. The caller specifies, via dwMonitorIDMask, what parameters should be used to trigger a warning event when their values exceed warning levels. An event handle is passed to the caller in *phEventHandle.

Note: It is possible to set an event for power fail (to trigger some clean up before system shutdown), but this event must be a separate event from that used for general warnings.

If this function succeeds, the caller can wait for the event using one of the standard Win32 WaitForxxx() functions. Once the event is triggered and the caller's thread falls through the WaitForxxx() function, the caller can determine which monitor sources are currently in the warning state via the function hm_GetMonitorWarnings. If any of the monitor sources in question are still in a warning state, the caller can act accordingly.

Note that monitor parameters will vary with time, and may oscillate about a defined upper or lower warning level for a short period. Therefore, when a warning state event has been triggered, the calling application should poll the warning status of any monitor sources of concern (using hm_GetMonitorWarnings) for a while to ensure that the monitor source remains in a warning state before acting. Note also that, to avoid oscillating events due to a lack of input hysteresis, the hardware monitor driver will not signal an event when a monitor source leaves the warning state. Applications must poll the device's warning state to determine when/if it resumes normal operation.

The phEventHandle returned by this function is a standard Win32 auto-reset event handle. However, an application should NOT close the handle using the handle using the Win32 CloseHandle function. Instead the application should close the handle and unregister the event using the hm_UnregisterMonitorWarningEvent function.

Parameter	Description
dwMonitorIDMask	Bitmask combination of all of the monitor sources that will trigger the returned event when entering the warning state. MONITOR_ID_SUPPLY_3V MONITOR_ID_SUPPLY_5V MONITOR_ID_SUPPLY_12V MONITOR_ID_SUPPLY_BATTERY MONITOR_ID_TEMPERATURE_BOARD MONITOR_ID_POWER_FAIL
phEventHandle	Pointer to an application-allocated HANDLE.

Return Value

Returns TRUE if the monitor warning event has been successfully registered. Returns FALSE on failure.

Portability

This function is specific to the RAC6182 hardware.

See Also

hm_UnregisterMonitorWarningEvent

hm_UnregisterMonitorWarningEvent

This function cancels the registration for a warning of a parameter out-of-limit. It is prototyped in HardwareMonitorAPI.h.

Syntax

```
#include <Windows.h>
#include <HardwareMonitorAPI.h>

BOOL hm_UnregisterMonitorWarningEvent (HANDLE hEventHandle)
```

Remarks

This function unregisters and frees a warning state notification event that had previously been created using hm_RegisterMonitorWarningEvent. This function will automatically free hEventHandle, so the application should not attempt to free it with CloseHandle.

Parameter	Description
hEventHandle	Handle of the previously registered warning event that is now being unregistered and freed.

Return Value

Returns TRUE if the monitor warning event has been successfully unregistered. Returns FALSE on failure.

Portability

This function is specific to the RAC6182 hardware.

See Also

hm_RegisterMonitorWarningEvent

hm_GetMonitorWarnings

This function gets warnings. It is prototyped in HardwareMonitorAPI.h.

Syntax

```
#include <Windows.h>
#include <HardwareMonitorAPI.h>

BOOL hm_GetMonitorWarnings (DWORD *pdwMonitorID)
```

Remarks

This function returns a bitwise OR'd combination of all monitor sources that are currently in the warning state. Note that this function does not latch any previous warning states that may have previously triggered warning notification events. Therefore, if a monitor source enters a warning state and triggers a notification event, it is possible that the monitor has left the warning state before an application calls this function.

Note: A system shutdown on account of a power failure cannot be sensed via this call. When the system is in the power fail shutdown state, communication with the microcontroller that this function uses to get monitor levels is already shutdown. To sense power fail an application must use hm_RegisterMonitorWarningEvent to register an event with the power fail monitor.

Parameter	Description
pdwMonitorID	Pointer to an application-allocated DWORD that will receive a bitmask combination of all monitor sources currently in the warning state. The following macros defined in HardwareMonitorAPI.h can be used to test for specific parameters: MONITOR_ID_SUPPLY_3V MONITOR_ID_SUPPLY_5V MONITOR_ID_SUPPLY_12V MONITOR_ID_SUPPLY_BATTERY MONITOR_ID_TEMPERATURE_BOARD

Return Value

Returns TRUE if the function succeeds. Returns FALSE on failure.

Portability

This function is specific to the RAC6182 hardware.

hm_RebootBoard

This function reboots the system. It is prototyped in HardwareMonitorAPI.h.

Syntax

```
#include <Windows.h>
#include <HardwareMonitorAPI.h>

BOOL hm_RebootBoard (void)
```

Remarks

This function performs a reboot the RAC6182 board. The reboot reason code is set, caches are flushed, and a full reboot is performed, including reset of hardware chips. Applications should use this function instead of alternatives such as using KernelIoControl to reset the board.

Return Value

Returns FALSE on failure. Function will not return on success as the board will reset.

Portability

This function is specific to the RAC6182 hardware.

hm_GetBootReason

This function gets the reason for last boot. It is prototyped in HardwareMonitorAPI.h.

Syntax

```
#include <Windows.h>
#include <HardwareMonitorAPI.h>

DWORD hm_GetBootReason (void)
```

Remarks

This function returns a DWORD representing the reason the board was last booted. Magic cookies and intelligent selection of default cases are used to distinguish as many scenarios as possible. However, the method relies on the probability that DRAM will hold a value for 10s of milliseconds without refresh, and on other such factors. Accordingly, the returned value cannot be guaranteed to be correct, especially in cases of very brief power interruptions.

Return Value

Return values are represented by macros defined in HardwareMonitorAPI.h.

Macro	Description
BOOT_REASON_ UNTRAPPED	Board was reset after a power-up boot, not by a user or operating system call, but most likely by the watchdog.
BOOT_REASON_ COLD_POWER_ CYCLE	Board went through a normal power-up boot.
BOOT_REASON_ POWER_DOWN_ CLEAN	Board was previously powered down when power fail monitor level was set, and either no applications were registered for power down event handling, or all applications registered completed their shutdown activities and signaled this to the operating system.
BOOT_REASON_ POWER_DOWN_ DIRTY	Board was previously power down when power fail monitor level was set, but at least one application registered for a power down event did not signal that it completed its shutdown activities.
BOOT_REASON_ WARM_UNDEFINED	Board was reset for an unknown reason
BOOT_REASON_ WARM_REQUESTED	Board was reset by an application call to hm_RebootBoard.
BOOT_REASON_ WARM_INTERNAL	Board was reset by some operating system operation

Portability

This function is specific to the RAC6182 hardware.

Functions for Accessing Retentive Memory

The RAC6182 software includes a Retentive Memory driver that can be called by applications to read and write to the RAC6182's battery-backed RAM. The driver is implemented as a dynamic link library ().

Retentive Memory driver functions available to applications include functions to lock and unlock the battery-backed RAM. When an application holds a lock on this RAM, no other application can read or write data. There are also functions that allow applications to verify memory contents using a checksum.

The functions exported by the RetentiveMem driver are listed below.

RetMemLock

This function locks retentive memory. It is prototyped in RetentiveMemAPI.h.

Syntax

```
#include <Windows.h>
#include <RetentiveMemAPI.h>

BOOL RetMemLock(DWORD dwTimeout)
```

Remarks

This function locks the entire retentive memory (battery-backed RAM), preventing other applications from reading and writing. An application must have the lock on retentive memory before any other retentive memory function will complete successfully; thus, this function should always be called, and its return value checked, before any other function retentive memory function is called.

Parameter	Description
DwTimeout	Number of milliseconds to wait for lock before failing.

Return Value

Returns TRUE if the lock request succeeded. Returns FALSE if the lock request failed because another application did not release the lock within dwTimeout milliseconds.

Portability

This function is specific to the RAC6182 hardware.

See Also

RetMemUnlock

RetMemUnlock

This function unlocks retentive memory. It is prototyped in RetentiveMemAPI.h.

Syntax

```
#include <Windows.h>
#include <RetentiveMemAPI.h>

BOOL RetMemUnlock (void)
```

Remarks

The application should always call this function to release a lock on retentive memory before exiting.

Return Value

Returns TRUE if the lock is released. Returns FALSE on failure.

Portability

This function is specific to the RAC6182 hardware.

See Also

RetMemLock

RetMemWrite

This function writes to retentive memory. It is prototyped in RetentiveMemAPI.h.

Syntax

```
#include <Windows.h>
#include <RetentiveMemAPI.h>

DWORD RetMemWrite (DWORD dwOffset, DWORD dwLength, BYTE *pbtBuffer)
```

Remarks

This function copies dwLength bytes of data from a user data buffer to a specific area in retentive memory. If less than dwLength bytes are available to be written, the number of available bytes are copied. In this case, the number of bytes returned will be less than dwLength. If another process has the memory locked, no bytes will be written and the return value will be 0.

The total amount of available memory is represented by the macro RET_MEM_MEMORY_SIZE, defined in RetentiveMemAPI.h.

Parameter	Description
dwOffset	Starting offset in RAM at which data will be written. Offset 0 is the first byte of RAM.
dwLength	Number of bytes to be written.
pbtBuffer	Pointer to a buffer containing data to be written to the RAM.

Return Value

Returns the total number of bytes actually written

Portability

This function is specific to the RAC6182 hardware.

See Also

RetMemRead

RetMemRead

This function reads retentive memory. It is prototyped in RetentiveMemAPI.h.

Syntax

```
#include <Windows.h>
#include <RetentiveMemAPI.h>

DWORD RetMemRead (DWORD dwOffset, DWORD dwLength, BYTE *pbtBuffer)
```

Remarks

This function copies dwLength bytes of data from an area of retentive memory into a user data buffer. The number of bytes actually read is returned. If fewer than dwLength bytes are available, the value returned will be less than dwLength. If another process has the memory locked, no bytes will be read and the return value will be 0.

The total amount of available memory (in bytes) is given by the macro RET_MEM_MEMORY_SIZE, defined in RetentiveMemAPI.h.

Parameter	Description
dwOffset	Starting offset in RAM of data to be read. Offset 0 is the first byte of RAM.
dwLength	Number of bytes to be read.
pbtBuffer	Pointer to the beginning of a buffer to be filled with data from RAM.

Return Value

Returns the number of bytes actually read.

Portability

This function is specific to the RAC6182 hardware.

See Also

RetMemWrite

RetMemVerifyMemory

This function verifies retentive memory. It is prototyped in RetentiveMemAPI.h.

Syntax

```
#include <Windows.h>
#include <RetentiveMemAPI.h>

BOOL RetMemVerifyMemory (void)
```

Remarks

This function calculates the checksum of retentive memory and compares it to the master checksum. If the two values do not match, the function returns FALSE, indicating the existence of corrupt data in the memory. If the two values match, the function returns TRUE, indicating that data are valid.

This function does not rewrite the master checksum; therefore, successive calls to this function will return the same result.

Applications should call this function before reading from or writing to the battery-backed RAM, to verify that its data are valid The caller must hold a lock on the RAM in order to use this function.

Return Value

Returns TRUE if the calculated checksum matches the master checksum. Returns FALSE if the checksums do not match or if another application has locked memory.

Portability

This function is specific to the RAC6182 hardware.

See Also

RetMemCalculateChecksum

RetMemCalculateChecksum

This function calculates retentive memory checksum. It is prototyped in RetentiveMemAPI.h.

Syntax

```
#include <Windows.h>
#include <RetentiveMemAPI.h>

BOOL RetMemCalculateChecksum (void)
```

Remarks

This function recalculates the checksum of retentive memory and writes it as the master checksum.

ATTENTION: If any data in the retentive memory are corrupt, as indicated by a return of FALSE from a call to RetMemVerifyMemory, the corruptions should be repaired before calling this function. Any data in the memory that are corrupt at the time this function is called will remain corrupt, and the recalculated master checksum based on the corrupt data will render the corruptions invisible to subsequent calls of RetMemVerifyMemory.

If the caller cannot repair corruptions, because they have to do with data maintained by other applications, the caller should at least ensure that all other applications are informed that their data may not be valid prior to issuing this call. Otherwise, some applications might interpret bad data as if it were good.

Return Value

Returns TRUE if the checksum is recalculated. Returns FALSE if another process has locked memory.

Portability

This function is specific to the RAC6182 hardware.

See Also

RetMemVerifyMemory

Streams Interface for Serial Ports

Applications can utilize the RAC6182 platform's serial ports via the standard WIN32 API's "File I/O" interface. A complete description of the File I/O interface is outside the scope of this document. Users are referred to the Microsoft Win32 SDK documentation for additional information. However, some of the arguments needed by the File I/O functions for serial port control are specific to the RAC6182. These arguments are represented by macros defined in the c header file othersdk.h, and are treated here in detail.

DeviceIoControl

This function accesses the serial port. It is prototyped in Winbase.h (included in Windows.h).

Syntax

```
#include <Windows.h>
#include <othersdk.h>

BOOL DeviceIoControl(
      HANDLE hDevice,
      DWORD dwIOControlCode,
      LPVOID lpInBuffer,
      DWORD nInBufferSize,
      LPVOID lpOutBuffer,
      DWORD nOutBufferSize,
      LPDWORD lpBytesReturned,
      LPOVERLAPPED lpOverlapped
     )
```

Remarks

See the documentation in the Microsoft Windows CE development kit for additional information.

Parameter	Description
hDevice	Handle to device (returned by CreateFile)
dwIOControlCode	Evaluate with one of the macros defined in othersdk.h. (See macro descriptions that follow.)
lpInBuffer	Pointer to input data buffer. Used for set operations
nInBufferSize	Size of input data buffer. Used for set operations.
lpOutBuffer	Pointer to output data buffer. Used for get operations.
nOutBufferSize	Size of output data buffer. Used for get operations.
lpBytesReturned	Pointer to count of bytes returned
lpOverlapped	Pointer to overlapped information (NULL for CE)

Macro	Description
IOCTL_SERIAL_SET_PORT_MODE	Sets the electrical interface for the specified serial port. Note that only COM1 supports switching electrical interfaces. lpInBuffer should point to a caller allocated WORD containing the code for the desired electrical interface. The possible codes are represented by the following macros defined in othersdk.h: SERIAL_MODE_RS232 SERIAL_MODE_RS485 SERIAL_MODE_RS422 nInBufferSize should be sizeof(WORD).
IOCTL_SERIAL_QUERY_PORT_MODE	Returns the current electrical interface setup for the specified serial port. lpOutBuffer should point to a caller allocated WORD where the code for the current mode will be stored. The value of *lpOutBuffer can be decoded by comparison with one of the following macros: SERIAL_MODE_RS232 SERIAL_MODE_RS485 SERIAL_MODE_RS422 nOutBufferSize should be sizeof(WORD).
IOCTL_SERIAL_ENABLE_TX_FIFO	Enable the transmit FIFO buffer for the specified serial port. Note that this is a 16 byte buffer. lpInBuffer should point to a caller allocated BOOL, which should contain TRUE or FALSE as required to enable or disable the FIFO. nInBufferSize should be sizeof(BOOL).
IOCTL_SERIAL_ENABLE_RX_FIFO	Enable the receiver FIFO buffer for the specified serial port. Note that this is a 16 byte buffer. LpInBuffer should point to a caller allocated BOOL, which should contain TRUE or FALSE as required to enable or disable the FIFO. NInBufferSize should be sizeof(BOOL).
IOCTL_SERIAL_SET_TX_FIFO_WATERMARK	Do not use. Not supported on RAC6182.
IOCTL_SERIAL_SET_RX_FIFO_WATERMARK	Do not use. Not supported on RAC6182.
IOCTL_SERIAL_QUERY_TX_FIFO_COUNT	Do not use. Not supported on RAC6182.
IOCTL_SERIAL_QUERY_RX_FIFO_COUNT	Do not use. Not supported on RAC6182.
IOCTL_SERIAL_SET_COUNTRY_CODE	Do not use. Not supported on RAC6182.
IOCTL_SERIAL_QUERY_COUNTRY_CODE	Do not use. Not supported on RAC6182.

Macro	Description
IOCTL_SERIAL_GET _CABLE_STATUS	Do not use. Not supported on RAC6182.

Portability

The arguments to this function are specific to the RAC6182 hardware

Application Interface to Output Debug Messages

The RAC6182 provides support for an external debug monitor connected at the second serial port (COM2). Normally, the second serial port is configured as a standard communications port; in this case, it does not handle system debug messages, which, if generated, are discarded. However, this port can be specially set up to pass system debug messages to an external device; in this case, the second serial port becomes unavailable to applications for normal communications use. Details for the setup of the port are given in an appendix to this manual.

A debug monitor can be very useful for Windows CE operating system developers, since it can capture debug messages emitted by the operating system by way of a serial port, even before all Windows CE services, including display services, are operational.

Application developers can also make use of these facilities, provided their programs written to produce debug output via the NKDbgPrintfW() function described below. However, since the use of an external debug monitor requires a special configuration of the RAC6182, it is recommended that the use of external debug output be limited to logging fatal or unusual error conditions. If an application developer believes a fatal error is occurring, the RAC6182 can be set up to pass error messages that might allow him or her to diagnose the problem more easily.

When debug mode is enabled, applications should not open COM2 or they will interfere with debug output messages. When debug mode is not enabled, all debug output is silently ignored and COM2 is available for general application use.

NKDbgPrintfW

This function generates output to an external debug monitor. It is prototyped in dbgapi.h.

Syntax

```
#include <Windows.h>
#include <dbgapi.h>

void NKDbgPrintfW(LPWSTR lpszFmt, ...)
```

Remarks

This is a var-args function similar to any of the printf() family, which takes a Unicode formatting string and zero or more other arguments. dbgapi.h defines macros RETAILMSG() and DEBUGMSG() which may be useful in setting up conditional debug outputs.

Return Value

Nothing

Portability

This function is specific to the RAC6182 hardware.

Appendix A

Operating System Files

Table J
Operating System Files

System Executables in Windows	Function
async.asy (ActiveSync)	
cmd.exe	
control.exe	
ctlpnl.exe	Control Panel
explorer.exe (Windows Explorer)	Windows Explorer
flashavr.exe	
format.exe	
iesample.exe (Internet Explorer)	
LocalOSUpdate.exe	
osmonitor.exe	
pegterm.exe (Terminal)	
ping.exe	
rapisvr.exe	
regflush.exe	Saves RAM based registry to persistent storage
remnet.exe (Remote Networking)	
repllog.exe (PC Link)	Used to establish communications with a host f
rnaapp.exe	
wplayer.exe	
system dynamic link libraries in \Windows	
IECEExt.dll	
mlang.dll	
mscefile.dll	
mshtml.dll	
rsabase.dll	
shdocvw.dll	
shlwapi.dll	
urlmon.dll	
wininet.dll	

System Executables in Windows	Function
system icons	
cplmain.cpl	

Memory Usage

Table K
RAM Usage

Component	Memory Usage
RAM FS space - Core OS components (kernel, networking, drivers)	4.0 MB
RAM FS space - Windows desktop (commctrl, explorer, ctl panel, fonts)	3.0 MB
RAM FS space – Internet explorer (browser object, HTML, javascript)	5.0 MB
Reserved/global variable area used by drivers, kernel	64 KB
Network DMA buffers	128 KB
USB DMA buffers, private memory	32 KB
Heap and stack used by core OS components	1.0 MB
Heap and stack used by Windows desktop components	1.0 MB
Heap and stack used by Internet Explorer	varies greatly

Table L
Flash (Disk on Chip) Usage

Component	Memory Usage
Core OS + Windows desktop= 7.0M* 2/3 for LZ compression	4.7MB
Core OS + desktop+IE=12.0M*2/3 for LZ compression	8.0MB
Space for compressed non-volatile registry (2 1.0M areas for safety)	2.0MB

Connecting an External Debug Monitor

The RAC6182 provides support for an external debug monitor connected at the second serial port.

A debug monitor can be very useful for Windows CE operating system developers, since it can capture debug messages emitted by the operating system by way of a serial port, even before all Windows CE services, including display services, are operational.

Application developers can also make use of these facilities, provided their programs written to produce debug output via the NKDbgPrintfW() function described elsewhere in this manual.

In order to cause the operating system to direct debug information emitted via this function to the second serial port, it is necessary to perform either one of the following setups:

- Set the debug jumper associated with the boot ROM on the system circuit board
- Set the system debug flag (by means of a program that calls the system function rm_SetParameter)

Once the system has been set up to use COM2 as the debug port, it is necessary to connect an external debug monitor to this port. Any display device with a serial interface can be used as a monitor. However, the most common choice will be a desktop computer running Windows and a Windows communications application such as Hyperterminal.

The RAC6182 should be connected to the debug monitor using a null modem cable. (But note that it might be necessary to install a jumper at the serial port connector that attaches to the RAC6182.)

The monitor device should be set up for serial communications as follows:

- 57,600 Baud
- 8 Data Bits
- No Parity
- 1 Stop Bit
- Hardware Flow Control

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