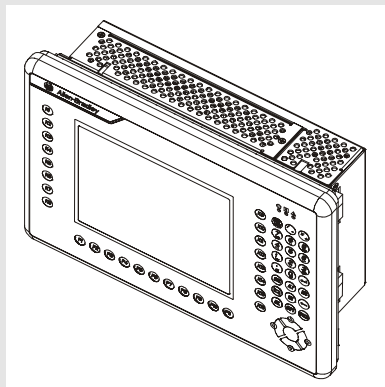




Allen-Bradley

*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.

In no event will Rockwell Automation be responsible or liable for indirect or consequential damages resulting from the use or application of this equipment.

The examples and diagrams in this manual are included solely for illustrative purposes. Because of the many variables and requirements associated with any particular installation, Rockwell Automation cannot assume responsibility or liability for actual use based on the examples and diagrams.

No patent liability is assumed by Rockwell Automation with respect to use of the information, circuits, equipment, or software described in this manual.

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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.

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:

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

/* C code goes here */

#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	<p>Get the current CRC mode. The value of <code>*pdwData</code> will be 0 if CRC mode is disabled, or 1 if CRC mode is enabled.</p> <p>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.</p> <p>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.</p>
BEZEL_EEPROM_PARAMETER_CRC_VALID	<p>Get the current state of the CRC check value. The value of <code>*pdwData</code> 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.</p>

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	<p>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.</p> <p>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.</p> <p>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.</p>
BEZEL_EEPROM_PARAMETER_CRC_VALID	<p>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.</p>

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 dwAddress, 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_WriteBezeEEPROM

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, that 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` \leq 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
<code>WATCHDOG_OK</code>	Tag or setting of new timeout value succeeded.
<code>WATCHDOG_NOT_PRESENT</code>	Low-level communication with watchdog device failed.
<code>WATCHDOG_TIMEOUT_FAILED</code>	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: <pre>struct NLED_COUNT_INFO { UINT cLeds; // Count of LEDs };</pre>

Macro	Description
NLED_SUPPORTS_INFO_ID	<p>Use to request capability information about any one of the LEDs in the system.</p> <p>pOutput should point to a caller allocated structure defined (in nleddrv.h) as follows:</p> <pre> struct NLED_SUPPORTS_INFO { UINT LedNum; LONG ICycleAdjust; Granularity (usec) BOOL fAdjustTotalCycleTime; BOOL fAdjustOnTime; BOOL fAdjustOffTime; BOOL fMetaCycleOn; BOOL fMetaCycleOff; }; </pre> <p>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):</p> <pre> ID_WARNING_LED ID_NUMLOCK_LED ID_POWER_LED </pre> <p>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. ICycleAdjust is the resolution of the timer (in usec) that controls blink-on and blink-off.</p>
NLED_SETTINGS_INFO_ID	<p>Use to request current settings of any one of the LEDs in the system.</p> <p>pOutput should point to a caller allocated structure defined (in nleddrv.h) as follows:</p> <pre> 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 }; </pre> <p>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):</p> <pre> ID_WARNING_LED ID_NUMLOCK_LED ID_POWER_LED </pre> <p>When the function returns, current settings will be stored in the corresponding members of the NLED_SETTINGS_INFO structure.</p>

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 call 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.

`nInFold` 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 `NLedGetDeviceInfo` 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:

Sample Code for a Simple PCI Slot Device

Portability

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

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 $512K + 2 * (\text{compressed registry size})$ 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 Microcontroller 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 indicate 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 specify 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. IfUpperWarningLevel 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
pflLowerWarningLevel	<p>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.</p> <p>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.</p>

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
IfUpperWarningLevel	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.
IfLowerWarningLevel	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
<code>dwMonitorIDMask</code>	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
<code>phEventHandle</code>	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
<code>hEventHandle</code>	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	<p>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:</p> <p>MONITOR_ID_SUPPLY_3V MONITOR_ID_SUPPLY_5V MONITOR_ID_SUPPLY_12V MONITOR_ID_SUPPLY_BATTERY MONITOR_ID_TEMPERATURE_BOARD</p>

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	<p>Sets the electrical interface for the specified serial port. Note that only COM1 supports switching electrical interfaces.</p> <p>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:</p> <p style="padding-left: 40px;">SERIAL_MODE_RS232 SERIAL_MODE_RS485 SERIAL_MODE_RS422</p> <p>nInBufferSize should be sizeof(WORD).</p>
IOCTL_SERIAL_QUERY_PORT_MODE	<p>Returns the current electrical interface setup for the specified serial port.</p> <p>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:</p> <p style="padding-left: 40px;">SERIAL_MODE_RS232 SERIAL_MODE_RS485 SERIAL_MODE_RS422</p> <p>nOutBufferSize should be sizeof(WORD).</p>
IOCTL_SERIAL_ENABLE_TX_FIFO	<p>Enable the transmit FIFO buffer for the specified serial port. Note that this is a 16 byte buffer.</p> <p>lpInBuffer should point to a caller allocated BOOL, which should contain TRUE or FALSE as required to enable or disable the FIFO.</p> <p>nInBufferSize should be sizeof(BOOL).</p>
IOCTL_SERIAL_ENABLE_RX_FIFO	<p>Enable the receiver FIFO buffer for the specified serial port. Note that this is a 16 byte buffer.</p> <p>lpInBuffer should point to a caller allocated BOOL, which should contain TRUE or FALSE as required to enable or disable the FIFO.</p> <p>nInBufferSize should be sizeof(BOOL).</p>
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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