Allen-Bradley

Software Development Kit

2711P

User Manual

Rockwell Automation

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 available from your local Rockwell Automation sales office or online at http://literature.rockwellautomation.com) describes some important differences between solid state equipment and hard-wired electromechanical devices. Because of this difference, and also because of the wide variety of uses for solid state equipment, all persons responsible for applying this equipment must satisfy themselves that each intended application of this equipment is acceptable.

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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, Inc. cannot assume responsibility or liability for actual use based on the examples and diagrams.

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

WARNING ⚠	Identifies information about practices or circumstances that can cause an explosion in a hazardous environment, which may lead to personal injury or death, property damage, or economic loss.
IMPORTANT	Identifies information that is critical for successful application and understanding of the product.
ATTENTION ⚠	Identifies information about practices or circumstances that can lead to personal injury or death, property damage, or economic loss. Attentions help you identify a hazard, avoid a hazard, and recognize the consequence
SHOCK HAZARD ⚠	Labels may be on or inside the equipment, for example, a drive or motor, to alert people that dangerous voltage may be present.
BURN HAZARD ⚠	Labels may be on or inside the equipment, for example, a drive or motor, to alert people that surfaces may reach dangerous temperatures.

Using this Manual

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

- Intended audience
- Purpose of the manual
- Manual conventions
- Additional resources

Intended Audience

Use this manual if you are responsible for developing application software to run on the PanelView Plus CE device.

Purpose of this Manual

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

Manual Conventions

The following conventions are used throughout this manual:

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

Additional Resources

For additional information, refer to these publications, that you can download from:

http://literature.rockwellautomation.com.

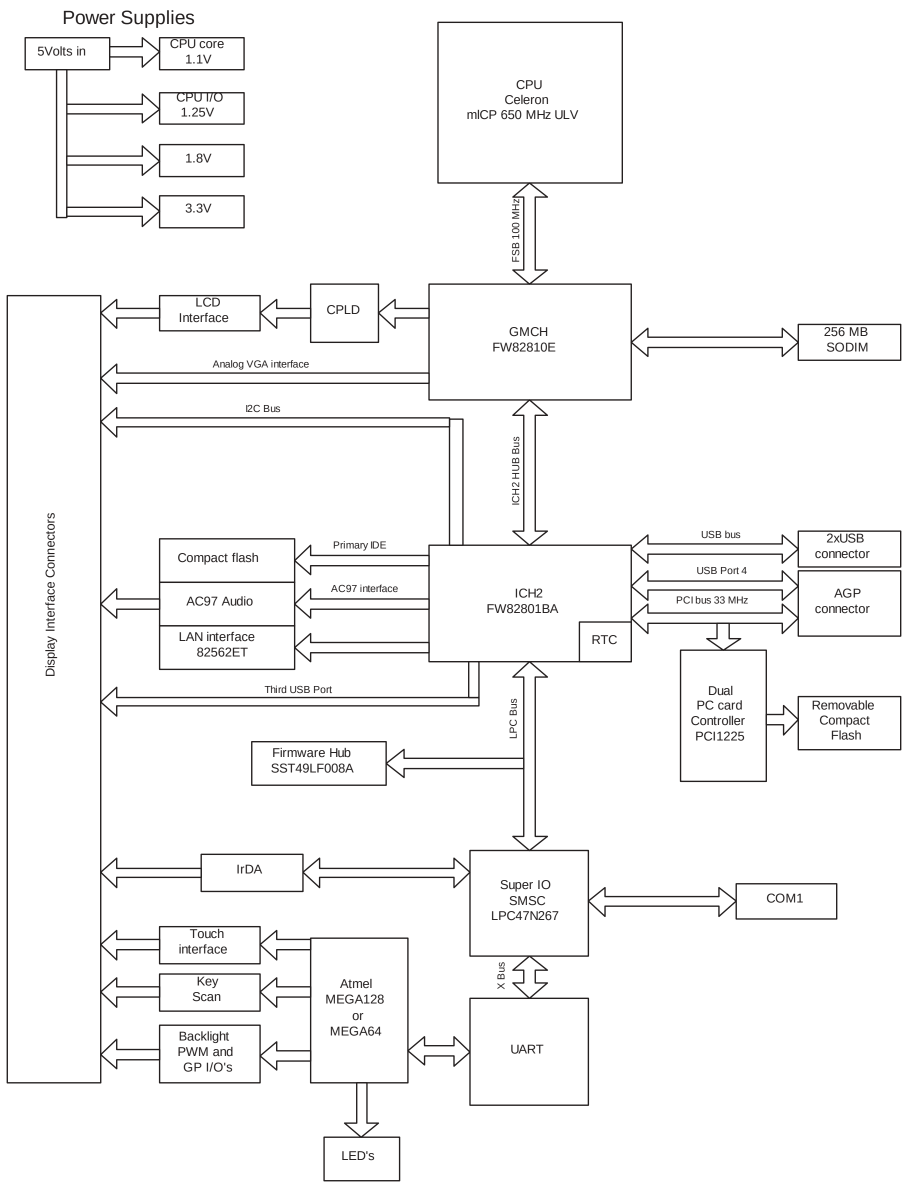
Resource	Description
PanelView Plus User Manual, publication 2711P-UM001	Provides an overview of the PanelView Plus and PanelView Plus CE terminals. Also provides information and procedures on how to install, operate, replace components, connect other devices, and troubleshoot the terminals.
Wiring and Grounding Guidelines for PanelView Plus Terminals Technical Data, publication 2711P-TD001	Provides grounding and wiring guidelines for PanelView Plus terminals.

Introduction to the PanelView Plus CE Terminal

This chapter provides an overview of the PanelView Plus CE terminals, including the hardware and software architecture.

Hardware Architecture

Functional Block Diagram



CPU

The system processor is an Intel mlCP 650MHz, ultra low-voltage Celeron processor (P/N RJ80530VY650256) with 100 MHz front side bus. There is 32k (16k instruction and 16k write-back data) of L1 cache memory and 256k of L2 cache memory integrated on the Celeron processor. The thermal design allows for a maximum ambient temperature of 55C without the use of a fan.

The primary support chipset is the 82810E Graphics And Memory Controller Hub (GMCH) commonly referred to as the Eight-Ten-E. The GMCH provides the interfaces between the CPU, system memory, graphics displays, and downstream system I/O logic, including the PCI bus. It integrates a system bus controller, 2D/3D graphics accelerator, SDRAM controller, and an interface to a 82801BA I/O Controller Hub (ICH2).

Memory Devices

There are three types of memory devices: Compact Flash ROM, BootROM, and DRAM.

Compact Flash ROM

The logic board has two Type 2 Compact Flash connectors, one internal and one external.

The internal connector is on the primary IDE interface and supports the power requirements defined by the CompactFlash+ specification. The internal CF “slot” is not hot-pluggable and supports only 3.3V CF devices. The internal CF slot is populated at the factory and is organized into 3 partitions as follows:

1. The compressed image of the Win CE operating system.
2. The compressed image of the persistent Win CE registry.
3. The FAT file system, presented as the volume named “\Storage Card”

Only the fat file system is directly accessible to an application program via standard Win32 file operations; e.g ReadFile().

The external CF connector is controlled by a PCMCIA controller on the PCI bus and is hot-pluggable and supports both 5V and 3.3V CF devices. The external CF device is presented as the FAT volume named "\Storage Card2". The external connector is accessible via a slot in the chassis and provides a convenient way to transport files to/from the PanelView Plus CE device. Additionally, programs can be run from the external CF device and it can extend the integral, non-volatile storage areas of the system.

Boot ROM

The boot code resides in a 1Mbyte 82802AB Firmware Hub (FWH). The code within the FWH is split into two sections. The first section is referred to as the Basic Boot Code (BBC) and is 196Kbytes in size and is not field programmable. The function of this code is to provide an immutable code area for the initial start-up of the system. The second section is referred to as the Extended Boot Code (EBC) and is re-programmable. The EBC performs extended power-on self-testing (POST), and initializes the system and readies it for the Win CE OS. Much of the support for the manufacturing environment resides in the EBC in the form of a Test Monitor.

Start-up is a sequential, and largely single-threaded operation. BBC loads an existing or new EBC, and the EBC initializes the system and loads an existing or new Win CE OS.

DRAM

The PanelView Plus CE device uses industry standard 3.3V, PC100/133 compliant, non-ECC, no-parity, dynamic RAM, packaged in a 144-pin SO-DIMM. The DRAM comes in 64 MB, 128 MB, and 256 MB modules and is field upgradable. The RAM provides a fast-access, volatile storage space for data and program code during run-time.

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

Input/Output

An INTEL 82801BA I/O CONTROLLER HUB (ICH2) provides an interface between the CPU/Memory/Graphics logic, the PCI bus and the I/O devices.

The main features integrated into the ICH2 are:

- 10/100BaseT Ethernet
- Dual UHCI USB host controllers support 2 downstream ports each
- Two IDE Interfaces.
- PCI Bridge
- LPC Interface to the LPC47N267 Super I/O Controller (SIO) and the Firmware Hub
- RTC embedded
- AC97 Interface

LAN Interface

10/100Mb Ethernet functionality is integrated within the ICH2. The PHY is an Intel 82562ET that is wired to an RJ-45 connector. A green LED indicates a good connection. A yellow LED indicates that the transmitter is active.

USB Ports

The ICH2 has 2 USB host controllers, which support both full 12MHz, and sub-channel 1.5MHz speeds. The 2 external USB ports come from the primary host controller. The secondary host controller is wired to the display interface connector and the PCI connector for future usage. They are unsupported in the current product. All USB ports support 500mA per port on the Vcc.

The USB port is capable of supporting a variety of peripheral devices, for example keyboards, printers, bar code readers, and storage devices. The platform supports:

- USB HID Class - Keyboard, mouse, bar code reader
- USB Printer Class - PCL compatible printers
- USB Storage Class - Flash drives

IDE

The primary IDE channel of the ICH2 supports the internal Compact Flash card. The secondary channel is unused.

PCI

The PanelView Plus CE device uses a PCI bus for expanding it communications options and may support other card types in the future. The PCI interface supports a communication option that is accessible via a slot on the back chassis of the Logic Module. A half-slot PCI card is housed in a separate communication module that attaches to the backside of the Logic Module. The connector to the communications module is actually an AGP connector to fit the space available, but the pinouts and signaling are PCI. The ICH2 provides an external PCI interface that supports 5V, 33MHz, 32 bit, version 2.2, standard-PC, PCI cards. The external PCI interface is bus 1.

The PCMCIA controller for the external CF and NVRAM is also on the PCI bus.

Real-time Clock

The ICH2 provides an RTC with standard PC clock/calendar functionality. The battery is a socketed CR2032 or equivalent. Sufficient hold-up capacitance exists on the battery circuit to allow 2 minutes to remove the old battery and replace it with the new one. This will prevent configuration data from being lost during battery replacement. The design provides 46ppm accuracy without trimming in manufacturing

Integral with the RTC is a small section of battery-backed, non-volatile CMOS that supports several board level parameters including the clock/calendar.

Serial Port

Signals from the SIO are optically isolated and routed to an external standard 9 pin male D-type connector to provide a 16550A compatible serial port. The port is configured as DCE and is known to CE as COM1. The pin-outs are identical to PanelView standard products, so existing cables should be compatible.

In addition to supporting serial communications, the port is a useful and convenient debugging tool wherein an application developer or tester can utilize the port to display debug text messages to determine the current state of the operating system, or to identify problems such as device failures or application exceptions.

ATMEL Microcontroller

An Atmel 8-bit microcontroller is a coprocessor to provide an 8x8 keypad scanner, 4, 5, and 8-wire touchscreen interface, high-speed timer, watchdog and to monitor the Celeron die temperature and shut down the Celeron if the die temperature reaches its maximum temperature rating. Additionally, the ATMEL plays a role in resetting the system and controlling the display module backlight.

Watch Dog

The watchdog timer will trigger a system reset in the event the system or an application loses control. The watchdog hardware is always enabled and is tagged by the watchdog system service periodically every 500 ms. One or more applications can register with the watchdog service wherein the application must periodically tag (restart) it to prevent it from timing out. If the watchdog times out, a system reset (warm-boot) is initiated. Once the system has been restarted, an application can inquire about the event that caused the restart and learn that the watchdog timed out.

System Timer

A single 50-µs, high-resolution programmable hardware timer is available to an application program.

Hardware Monitor

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

Keypad

Certain configurations of the PanelView Plus CE device provide function keys, a numeric keypad and cursor control keys integrated into the front bezel. The number of function keys can vary. Some function keys are relegendable. The keypad handler provides extended software support. The keypad handler intercepts and operates on codes produced by the keypad driver before passing them to the application with current focus. The keypad handler can optionally re-map keys (assign different virtual key codes) and effect specialized processing such as the generation of key macros (strings of virtual key codes) or the launching of a program from a single key press.

Touch Screen

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

Display Controller

The Intel 82810E integrates a powerful 64-bit graphics accelerator engine for Bit Block Transfer (BitBLT), hardware cursor, and other graphic intensive functions common to windowing environments. Superior performance is achieved through a direct 32-bit interface to the PCI-Local bus.

VGA (640 x 480), SVGA (800 x 600) and XGA (1024 x 768) flat panel screen resolutions at 8 bit indexed, 16 bits or 24 bits per pixel at 60hz scan rates are supported.

Software Architecture

This section provides information on the PanelView Plus CE software.

Windows CE OS Overview

Windows CE.NET 4.1 with the latest service packs is the PanelView Plus CE operating system.

The system software includes the following major components:

- Boot Loaders. The boot loaders consist of the Basic Boot Code (BBC) and Extended Boot Code (EBC) and reside in the firmware hub.
- Windows CE Kernel OS, CE Modules and device drivers with custom adaptations and enhancements for the PanelView Plus CE hardware and functional requirements. These components reside in a binary partition on the internal CF card as a compressed binary image. The Windows CE Kernel OS provides a Default Registry. The CE modules include the Windows Explorer desktop and shell and the Control Panel for configuring the device.
- Persistent Windows CE Registry, containing information relative to specific application configurations. This component resides in a separate binary partition on the internal CF card. If the Persistent Registry does not exist, then the Default Registry is used.

- PanelView Plus CE components are a collection of applications and associated system elements such as Internet Explorer and Terminal Server Client that reside in the FAT partition of the internal CF card. The PanelView Plus CE components are non-essential and can be removed if unwanted or to free up additional space on \Storage Card. The PanelView Plus CE components and the installation program (InstallFromStorageCard.exe) are distributed on the Accessories CD, P/N 77159-951-55.

Boot and Startup Sequence

The Basic Boot Code (BBC) in the read-only section of the firmware hub gets control when the system comes out of reset. The BBC is simply a boot loader for the Extended Boot Code (EBC). As such, BBC tests and sets up RAM, then initializes the serial port and optionally the Ethernet if BBC Ethernet-boot (eboot) is enabled, and then looks for a download of a new EBC on either the serial port or Ethernet. Either the BBC receives and loads a new EBC into RAM, or copies an existing EBC from the read/write section of the firmware hub into RAM. Once a new and validated EBC is in RAM, it is copied into the firmware hub where it replaces the existing EBC and is ready for the next startup. Control is passed to the EBC in RAM.

The Extended Boot Code (EBC) continues hardware initialization, and reads information from the Display Module about the type of display, touchscreen and keypad. Video and the backlight are initialized and the first startup text messages appear on the display. POST tests and optionally Extended Diagnostics are performed. POST testing deals with essential features such as RAM, stuck touch/key and dead battery. A POST failure is reported by an error code on the display.

If EBC Ethernet-boot (eboot) is enabled, then EBC requests download of a new OS via the Ethernet. If a new OS arrives, it is copied to RAM; otherwise, EBC looks at the external CompactFlash card for a file named SYSTEM.BIN and copies it to RAM if one exists. If a new and valid OS resides in RAM, it is copied to a special partition on the internal CompactFlash card where it replaces the existing OS and is ready for the next startup. If not a new OS, then the existing OS is copied from the internal CompactFlash card into RAM. Ultimately control is passed to the Win CE OS in RAM.

The Win CE OS establishes the page tables and the virtual memory system, enables interrupts, initializes the system clock and timers, and completes the initialization of RAM. The Kernel and File System are started. If the Persistent Win CE Registry exists in a special partition on the internal CompactFlash it is copied into RAM; otherwise, the

Default Registry that was extracted from the OS is used. Device drivers are loaded, files are copied from \Storage Card\Windows\* to \Windows*. Once the file system is running, the OS looks for newer versions of the EBC and ATMEL firmware that are distributed in the file system, and if they exist, the EBC and/or ATMEL firmware is automatically updated. The screen saver is started, the Explorer desktop shell is started, and shortcuts in \Windows\RunOnce and \Windows\Startup are executed to launch user applications.

The Windows CE Registry

The Windows CE Registry contains application and system configuration data. The Default Registry resides within the operating system image and is the native state of the Registry before any applications are loaded. The Persistent Registry resides within a special partition on the internal CompactFlash card and is the aggregate of all application and user changes. The Control Panel provides the user interfaces for managing the system settings that are configurable by the user. Applications access the Registry programmatically via the Win32 API.

At start-up, the Persistent Registry is loaded into and resides in RAM in a special area sometimes referred to as the Object Store. If a valid Persistent Registry does not exist, then the Default Registry is loaded. Since the run-time Registry is in RAM and is volatile, any changes to the Registry must be committed (flushed) to the Persistent Registry

TIP The Default Registry is not the same as the out-of-box condition, because application programs are actually loaded during final assembly of the product. The Default Registry is associated with the OS that originated it and shares the identifying OS version level at the key [HKLM]\Ident\RegistryVersion.

Restoring the Default Registry

There are times when it is necessary to remove the Persistent Registry and restore the Default Registry. There are 2 methods for achieving the Default Registry:

1. Startup in the Safe Mode by pressing the Default and Reset buttons on the right side of the chassis.

   See the User Manual for details. The Safe Mode ignores the Persistent Registry and uses the Default Registry. Note that the Persistent Registry is not altered and returns on the next startup; unless, the Default Registry is flushed. If flushed, the Default Registry replaces the Persistent Registry. Normally, flushing the Registry while in Safe Mode is undesirable because the Persistent Registry is lost.

2. Remove the Persistent Registry and force a retreat to the Default Registry.

   The system parameter RM_PARAMETER_PERSISTENT_REGISTRY_PRESENT allows an application to delete the Persistent Registry. Note that until rebooted, the Registry in RAM remains unchanged, so flushing the Registry will effectively cancel the delete action. Normally, a reboot immediately follows the call to delete the Registry. The program RestoreRegistry.exe that is distributed on the Accessory CD utilizes this system parameter.

When manipulating the Registry, applications and users should exercise the same degree of caution that would be required of a Windows NT/2000/XP system. Errant changes to the Registry can have disastrous consequences, such as when device drivers are involved. The Safe Mode provides a means to recover.

Registry Flushing

A specialized service runs continuously in the background and monitors the Registry for changes every 2.5 seconds. Registry changes may occur programmatically or by a User via Control Panel. When a change is detected, the Registry is automatically flushed. This mechanism is sometimes referred to as lazy flush since no other action is required. Alternatively, the Registry can be persisted explicitly and immediately by calling DeviceIoControl() with CTL_SYSMON_FLUSH_REGISTRY. This is recommended whenever a shutdown might occur before the lazy flush can confidently store away the Registry changes.

When the device is started in Safe Mode, the background service that monitors the Registry for changes is suspended.

File Systems

The Windows CE operating system supports a DOS/Windows compatible FAT file system that is implemented in a FAT partition on the internal CompactFlash card, on the external CompactFlash card, and a RAM file system that is implemented in system DRAM. Unlike the CompactFlash, the RAM-based files are not persistent and are reconstructed at every start-up. The RAM-based file system provides the system root at the folder named My Computer. The file system can be viewed and manipulated by the Windows Explorer utility and DOS-like commands within the CMD shell. The CompactFlash files appear at the root as the folders named \Storage Card and \Storage Card2.

RAM File System

The RAM file system includes most of the known, standard Windows folders, such as \Program Files, and most importantly, the \Windows directory, where much of the system code and behavior resides at runtime. The RAM-based file system is organized as follows:

RAM File System

Directory	Description
\Temp	Not used
\My Documents	Not used
\Program Files	Contains links (shortcuts) to certain system Executables
\Windows	The Windows CE operating system – for example, system executables (*.exe), dynamic link libraries (*.dll), fonts (*.ttf)
\Windows\Programs	Links (shortcuts) to specific executables. The links appear at Start Menu > Programs
\Windows\Help	Links (shortcuts) to the Help System
\Windows\Desktop	Links (shortcuts) to specific executables. The links define the contents of the Windows Desktop
\Windows\Favorites	Not used
\Windows\Fonts	Fonts in addition to the default font.

RAM File System

Directory	Description
\Windows\Recent	Not used
\Windows\Startup	Links (shortcuts) to specific executables that are automatically launched at startup.
\Windows\RunOnce	A folder that contains links (shortcuts) to specific executables that are automatically launched at startup, and are then deleted. Consequently, these links and this folder are executed only one-time (run once).

The startup process copies all folders and their contents from \Storage Card\Windows\* to \Windows*. The net effect is to re-construct the desktop, start menus, and control panel with OEM or user content. Shortcuts that are copied to \Windows\Sartup or \Windows\RunOnce will be launched by the initial instance of the shell program. Additionally, the folder \Storage Card\Windows\RunOnce is deleted so that the RunOnce startup actions, in fact, only occur one time.

Input Devices

The PanelView Plus CE has a number of input devices.

Touch Screen

The PanelView Plus CE display can be equipped with a high-resolution resistive touch screen. The Windows CE operating system incorporates a driver for the touch screen. A user interface is provided to enable touch screen configuration and calibration. Touch screen calibration values are stored in the registry.

Keyboard/Keypad

The PanelView Plus CE device is designed to take key press input from multiple sources. Support is present in the operating system for a USB keyboard, and/or an optional keypad on the Display Module. The device drivers permit either device to function alone or in combination.

Drivers for the Keyboard/Keypad/Touchscreen

Driver	Description
touch.dll kbdmouse.dll	Loaded by GWES.EXE at startup. Responsible for low level Keyboard/keypad related items and scan code to virtual key mappings for the keyboard. Responsible for default virtual key to virtual key mappings based on modifier keys and for virtual key mappings, for both key input devices.
USBHID.dll mouhid.dll kbdhid.dll	USB Human Interface Device drivers, loaded by DEVICE.EXE upon insertion/existence of a USB Human Interface Device. Handles USB keyboard and mouse. Responsible for low-level USB related items and scan code to virtual key mappings for USB keyboard. Submits virtual key codes to Keybddrv.dll.
keypad.dll	PanelView Plus CE specific keypad driver that is loaded by DEVICE.EXE at startup. Handles low-level keypad input and scan code to virtual key mapping. Submits virtual keys to Rockwell supplied keypad handler for mapping and submits virtual keys to Keybddrv.dll for virtual key mappings.
khstub.dll	Keypad handler stub. This driver DLL is loaded by keypad.dll if no Rockwell supplied keypad handler is present. The stub returns a default scan code to virtual key mapping table for the current keypad and defers virtual key mapping to the Keybddrv.dll
\storage card\kh.dll	Rockwell supplied keypad handler, loaded by keypad.dll. Responsible for mapping virtual keys from the keypad into other virtual keys, macros, or other actions. Virtual keys returned by the keypad handler's mappings use Keybddrv.dll for mapping virtual keys. The name of this file may be overridden with an alternate keypad handler name via a registry key. If key [HKEY_LOCAL_MACHINE\Drivers\BuiltIn\Keypad] contains a REG_SZ value named KeypadHandlerName, its value will instead be used when loading the keypad handler.

The Display Module keypad is supported by two separate software components: a keypad driver, and a keypad handler.

Keypad Driver

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

- Support for multiple types of keypads. Different keypads may have different scan code to virtual key mappings.
- Support for non-standard keys, for example, the programmable function K keys and the ALT-arrows keys for Home, End PageUp and PageDown.
- Support for mapping single key presses into multiple key macros at the virtual key level.

- Support for assignment of special functions to key operations by application programs.
- Support for a single-key mode, in which keystrokes are processed one at a time. Following an initial key-down event, any other keydown or key-events will be ignored until the key-up event corresponding to the initial key-down event has been detected and processed.
- Support for a hold-off mode, in which successive strokes of a given key occurring within a given time period will be ignored.

When the keypad driver is loaded by device.exe at system start-up, it reads the keypad ID from the Display Module. If it does not find a valid keypad ID, it concludes that there is no keypad and exits. Otherwise, using the keypad ID, the driver locates an entry in the CE system registry that points to the current scan code to virtual code translation table for the keypad. The keypad driver then attempts to load the keypad handler and verify that it supports a set of callback functions that the driver requires it to have. If the keypad handler dynamic link library is not present or does not contain all the necessary callback functions, a default keypad handler stub is loaded. This handler stub implements all the necessary callbacks and information for mapping the keypad.

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

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

Once it has finished its low level processing, the driver calls the keypad handler function KhTranslateVkey(), passing the virtual key code to this function. The keypad handler returns an array of translated virtual code(s). Finally, the driver calls a Win32 API function kbd_event() to pass the key events to the main keyboard driver, Keybddrv.dll.

Keypad Handler

The Rockwell Automation supplied keypad handler is an optional software component that can be replaced with a stub or with another keypad handler designed for a specific application. The handler operates on Windows Virtual Key codes supplied by the keypad driver. It can perform translations of Virtual Key codes before the keypad driver passes these codes to the main keyboard driver for final processing. Thus, it functions as an intermediate processor between the keypad driver and the main keyboard driver.

The keypad handler maintains its own key mapping and attribute tables separate from those maintained by the keypad driver. It can maintain these tables, in the system registry, system file storage, or wherever else the implementers of the keypad handler choose. Although the driver will use these mapping and attribute tables, they are placed under the control of the handler to facilitate changes in mapping or attribute information and to facilitate the support of various keypads. With this scheme, new features and functions can be accommodated without modifications to the driver or other operating system level modules. The handler also maintains global configuration data for the keypad, including auto-repeat settings, single key, and hold-off mode settings.

The keypad handler is loaded and initialized by the keypad driver, and the handler must be able to respond to an initial query from the driver for its key mapping and attribute information. Once the driver has initialized the handler, the handler is ready to accept additional calls from the driver to map any incoming virtual key down presses or releases that are currently valid (subject to the constraints of hold-off and single key mode, which are enforced by the driver). The keypad handler may perform some action based on the key code passed (for example, it may launch an application), it may expand a key code into a sequence of codes (implementing a macro definition), it may filter the code and re-map it. Alternatively, it may defer mapping of the virtual key to the normal keyboard driver. In addition to being called back for key presses, the keypad handler will be called back when the global configuration settings for the keypad driver are changed. The keypad handler or some other application may change the settings of the keypad driver using the streams interface to be discussed later. When this occurs, the keypad handler is called back to ensure that it is aware of the changes.

Registry keys used by KHSTUB.EXE

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

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

[HKEY_LOCAL_MACHINE\Drivers\BuiltIn\Keypad\Params\TypematicRepeat]

Enabled REG_DWORD which is 1 for enabled, 0 for disabled

RepeatDelay REG_DWORD of initial repeat delay in ms.

RepeatRate REG_DWORD of subsequent repeat delay in ms.

[HKEY_LOCAL_MACHINE\Drivers\BuiltIn\Keypad\Params\SingleKeyMode]

Enabled REG_DWORD which is 1 for enabled, 0 for disabled

AbortEnabled REG_DWORD which is 1 for enabled, 0 for disabled

[HKEY_LOCAL_MACHINE\Drivers\BuiltIn\Keypad\Params\HoldoffMode]

Enabled REG_DWORD which is 1 for enabled, 0 for disabled

HoldoffTime REG_DWORD of time in ms. for key hold-off

Display Module EEPROM

The Display Module stores its configuration information within its non-volatile memory commonly referred to as the Bezel EEPROM. The configuration information is loaded when the Display Module is manufactured and is used by the video driver, the touch screen driver, and the keypad driver. The EEPROM information is used by the operating system to identify the components of the Display Module such as the keypad, the touchscreen and the display. Also identified are specific characteristics of each component such as the number of function keys, the touch technology type and the resolution and size of the display. The components and characteristics vary from unit to unit and so are appropriately kept with the Display Module, which allows for interchange of Display Module without reprogramming the Logic Module.

An application program should not require direct access to the Display Module configuration information. As such the Bezel EEPROM API are not published in this Manual. Much of the configuration information is either conveniently and appropriately mirrored in the Registry or accessible via a System Parameter.

PCI Bus

The PCI bus supports the PCMCIA controllers and the external PCI expansion slot. From a PCI configuration standpoint, the virtual slot number of a device plugged in the slot is 1. The operating system supports basic configuration, interrupt control, memory management and IO access for PCI cards plugged into this slot. The operating system does not support bus-mastering by the PCI slot device.

PCMCIA

New or upgraded application programs and/or the operating system can be copied from the PCMCIA memory card to the internal CompactFlash to replace and/or upgrade the existing components.

The PCMCIA device is hot-pluggable and a CompactFlash card in the external slot shows up instantly as \Storage Card2. Furthermore, the system shell is constantly monitoring the external slot for card insertions and arrival of a program named AutoRun.exe. Whenever, an AutoRun program is presented to the system, the program is immediately executed from \Storage Card2. This is a convenient, yet powerful feature, wherein any program (re)named AutoRun.exe that resides on a CompactFlash card can be executed on PanelView Plus CE device simply by plugging in the card.

Run Time Environment

Path

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

\storage card\bin\ \storage card2\bin\

Launching Applications At Start-Up

The Widows CE Registry entries at key [HKLM]\init determine the operating system programs that are started during system initialization, and the order in which they are started. The Windows CE Platform Builder development tool is used to establish these Registry entries.

PanelView Plus CE Operating System Launch Order

Sequence	Program or File	Description
Launch20	device.exe	Load and start the device drivers
Launch30 Depend30	gwes.exe 14 00	Start graphics and events subsystem …when device.exe is complete
Launch40 Depend40	Postgwes.exe 14 00 1E 00	Copy \Storage Card\Windows\* …when device.exe and gwes.exe are complete
Launch60 Depend60	Services.exe 14 00	Load and start System Services …when Device.exe is complete
Launch75 Depend75	PVPIdentify.exe 28 00	Establish Product Identification …when PostGwes.exe is complete
Launch80 Depend80	hardwareMonitor.exe 28 00	Start Hardware Monitoring …when PostGwes.exe signals complete
Launch85 Depend85	PVPStart.exe 4B 00	Start Explorer Shell …when PVPIdentify.exe is complete

PVPStart.exe launches Explorer during initialization, which then handles the Window GUI, shell, taskbar, and launches the shortcuts in \windows\startup, etc. Unlike other executable files, Windows Explorer does not properly signal that it has completed startup, so dependencies can not be placed directly on Explorer.exe. Consequently, the start menu, taskbar, etc. may still be drawing when the content of the \windows\startup folder is executed.

[HKLM]\init should be reserved for the operating system. The Shell using shortcuts in the \Windows\Startup folder should launch applications. The folder \windows\startup is RAM based, so its contents will not persist from one operating session to the next. The solution is to place shortcuts in \Storage Card\Windows\Startup. In a normal system initialization sequence, everything in \Storage Card\Windows\* is copied to \Windows by Postgwes.exe in the startup order.

This copy operation is not performed when the system is in Safe Mode.

Process Priorities

All executable files start in user mode. Any application can change to kernel mode or back with the Windows CE SetKMode() call.

Developing CE Applications

Overview

This chapter covers topics on developing CE applications for the 2711P PanelView Plus CE device:

- Distribution and installation
- Persistency considerations
- Set up of the development system

Application Distribution and Installation

Application programs for the PanelView Plus CE device will consist of EXE and DLL files that will reside in the FAT partition of the internal CompactFlash card; for example, \Storage Card. They will be installed much like applications for Windows desktop operating systems.

Typically, a CE application will be distributed as a.cab file install package containing the run-time components, in compressed form, and an executable installation script that manages the installation process.

When the installation package is run, the run-time components are decompressed and moved to their assigned folders, desktop icons and start menu entries are created, and the system registry is edited to register the application's components and associated parameters. Finally, an uninstall script is created and saved.

A program such as the CAB Wizard or InstallShield tool is recommended for packaging applications for distribution. These tools alleviate some of the difficulties associated with the development of installation scripts and imposes a familiar look and feel on the installation process. The application developer should give some thought to the means to be used for distributing the installation script. Generally, there are two means available: CDROM and the internet.

Installing the Application

Once the user has obtained an installation package and it resides on the user's desktop PC, he or she may use any of three methods to install the application on the PanelView Plus CE device.

- Perform a remote installation by running the package on a PC host that is connected to the PanelView Plus CE device by using ActiveSync.
- Copy the package from a PC host using ActiveSync or from a CompactFlash memory card to the \storage card\ folder on the PanelView Plus CE device and run the package on the PanelView Plus CE device.
- Run the package directly from an external CompactFlash memory card on the PanelView Plus CE device.

Remote Installations

The install package can be quite large and decompression can consume high levels of memory, so remote installation is an attractive option. ActiveSync will support remote installation using CeAppMgr.exe on the host PC and WCEload.exe on the PanelView Plus CE device.

Application Upgrades

The application developer should make appropriate provisions for issuing application upgrades from the beginning, adopting good practice for source version control and bug reporting. 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.

Persistency Considerations

Installation of a new application program on the PanelView Plus CE device typically adds a new icon to the Windows Desktop and sometimes a new entry in the Start Menu. 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 at startup; for example. 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 PanelView Plus CE device and all similar embedded devices since the Icons, the Start Menu, and application-provided Control Panel Applets must be recreated at startup.

The solution is to place user-added content 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 file system).

Set up the Development System

Typically, development will take place on an x86 machine running a Microsoft Win32 operating system and Microsoft cross development tools. Ethernet or serial link will connect the development system to the target PanelView Plus CE device, and x86 binary files generated on the development system will be downloaded to the target for testing and debugging.

Follow these steps to set up the development system:

1. Install Microsoft ActiveSync software on the host system.

   This utility is needed to download applications to the PanelView Plus CE device and supports several helpful remote development tools. ActiveSync 3.7 is available for download from Microsoft at http://www.microsoft.com/downloads/.

2. Install Microsoft embedded Visual C++ 4.0 software.

   This is the development environment for building Windows CE.NET applications using C/C++, the Win 32 API and MFC. eMbedded Visual C++ 4.0 is available for download from Microsoft at http://www.microsoft.com/downloads/ or can be purchased on CD from the Microsoft Evaluation and Resource Center at http://microsoft.order-5.com/trialstore/.

3. Install the PanelView Plus CE Software Development Kit (SDK) that is distributed on the Accessory CD, Part Number 77159-951-55.

   a. Load the CD, browse to the Software Development Kit folder.

   b. Install the package named pvplusceSDK.msi.

   TIP If the VersaView SDK is installed it must first be manually removed.

   Go to Start > Settings > Control Panel > Add/Remove Programs to verify if the VersaView SDK is installed. Manually remove the SDK if it is installed.

Microsoft Embedded Visual C++ 4.0 is available without charge, except for a nominal shipping and handling charge. Accordingly, it is a highly economical tool for developers of CE application programs.

Device driver developers should also consider installing Microsoft Windows CE Platform Builder 4.1, which has extensive 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 and readme files that are provided with the respective products and CDs.

PanelView Plus CE SDK

Overview

The PanelView Plus CE SDK provides developers with access to an extensive set of functions that are specific to the PanelView Plus CE hardware and extend 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.

ATTENTION

The use of undocumented functions and features is strongly discouraged.

Version Management

Each release of the PanelView Plus CE SDK and the operating system has a version number. The version number is in the form of xx.yy.zzz where xx is the major release, yy is the minor release and zzz is the build number.

The installed SDK is named PVPlusCE SDK for CE 4.1. The SDK version number is presented in the Support Info that is viewable in Control Panel Add/Remove Program. The operating system version is available in System Properties in the Control Panel.

It is important that the SDK is both current and aligned with the operating system. The policy for ensuring compatibility relies on the major release number: A major release of the SDK supports all versions of the operating system that have the same major release number. For example, SDK version 02.00.020 is compatible with operating system version 02.yy.zzz since both are at major release number 02.

TIP

A new SDK is not released with every release of the platform binary.

Visual Basic .NET

Microsoft Visual Studio .NET 2003 is the PC development environment for Visual Basic .NET applications for Win CE .NET. Visual Studio .NET 2003 can be purchased from Microsoft at http://msdn.microsoft.com/vstudio/.

The VB .NET execution environment on the device is the .NET Compact Framework. Visual Studio .NET packages and distributes the .NET Compact Framework as a .cab file.

ATTENTION

The .NET Compact Framework is not installed on the PanelView Plus CE device. It is the responsibility of the VB .NET application developer to provide an installation package for both the VB .NET application and the .NET Compact Framework.

Both developers and end-users should insure that the .NET Compact Framework that is installed on the device is the same as that which was used to develop and test the VB .NET application.

Lastly, there are several essential DLLs that are distributed on the Accessory CD, Part Number 77159-951-55. Run InstallFromActiveSync.exe from the CD to install the file set named DLLs needed by .NET.

PanelView Plus CE-Specific Extensions to the WinCE API

Overview

This chapter covers these topics:

- Watchdog control
- Hardware watchdog
- Software watchdog
- System parameters
- System timers
- Hardware monitor
- Keypad
- System event log
- Recommended PanelView Plus CE mechanisms

Watchdog Control

The watchdog is a monitor mechanism that automatically resets the system when there is a loss of control. The hardware watchdog is enabled by default and must be periodically tagged to keep the entire system alive. The action of tagging or kicking a watchdog is a widely used method to insure that system control is intact.

The watchdog service is a DLL and is responsible for tagging the hardware watchdog. An application can check into the watchdog service and register itself such that the watchdog service must be periodically tagged by the application. This latter behavior is referred to as the software watchdog. Once enabled by an application, the software watchdog service must be periodically tagged by the application; otherwise, a timeout occurs and it is assumed that the application or some underlying software has lost control. Consequently, an action is initiated that terminates the application or resets the entire system.

If an application chooses to use the watchdog service, then the application is also responsible for constructing itself such that some protection is afforded by the Watchdog. The Watchdog knows when an application has failed to tag it at the prescribed rate, nothing more. That is the definition of **loss of control** within this context, and there are cases such as tagging the Watchdog too early which are undetected.

Hardware Watchdog

Watchdog_Tag

The function combines the ability to enable or disable the hardware watchdog, tag the watchdog and to optionally set a new timeout value in the watchdog timer register. It is used in a separate thread within the watchdog service DLL. Normally, this function would not be used by an application (exe).

DWORD Watchdog_Tag(DWORD dwTimeout)

Parameters:

dwTimeout

- A value of 0 tags (restarts) the watchdog timer and leaves the timeout unchanged.
- A value of MAXDWORD (0xFFFFFFFF) disables the watchdog.
- Any other value that is within the range of the timer (50 to 5000), enables the watchdog and sets the timeout in milliseconds.

Return Values:

Hardware Watchdog - Return Codes

Value	Description
WATCHDOG_OK	The Watchdog function was successful
WATCHDOG_NOT_PRESENT	Communication with watchdog device failed
WATCHDOG_TIMEOUT_FAILED	Watchdog was tagged, but the requested timeout value was not set.

Remarks:

If the hardware watchdog is disabled, calling Watchdog_Tag(0) will always return WATCHDOG_TIMEOUT_FAILED as no current watchdog timeout value is defined.

If Watchdog_Tag() is called with a timeout value that is out of the range of the timer then the timeout value currently being used by the watchdog is left unmodified and WATCHDOG_TIMEOUT_FAILED is returned. The range of the hardware watchdog timer is 50 to 5,000 milliseconds.

Portability:

Same as the 2711P.

Requirements:

Runs On	Version	Defined In	Link To
PanelView Plus CE RAC6182	All	watchdog.h	watchdog.lib

Software Watchdog

These functions are used by applications (exes) to register themselves for watchdog monitoring and to tag the software watchdog.

Watchdog_SW_TagEx

This function registers an application thread for monitoring by the software watchdog. The function creates a new instance of the software monitor for the caller thread, sets the timeout value and defines what happens when a timeout occurs.

```
DWORD Watchdog_SW_TagEx (DWORD *pdwWDTagID,
DWORD dwTimeout, DWORD dwTimeoutAction)
```

Parameters:

pdwWDTagID

A pointer to the Watchdog Tag ID value. The watchdog service returns the value to the caller. The caller should initially set the value to USE_THREAD_ID when it wants to register a new thread into the watchdog service. The caller should use the returned value for all subsequent calls to the watchdog monitor that it was assigned.

dwTimeout

Timeout in milliseconds. This parameter must be one of the following values:

Software Watchdog Timeout Values

Value	Description
WATCHDOG_KICK (Value = 0)	Tags (restarts) the watchdog indicating that the process is active.
50 – 5000 milliseconds	The watchdog timeout in milliseconds. Once the watchdog is activated, the caller must tag the watchdog monitor before a timeout occurs.
WATCHDOG_DISABLE (Value = MAXDWORD)	Stops the instance of the software watchdog that corresponds to the Watchdog Tag ID.

dwTimeoutAction

Determines what action is taken when a timeout occurs. This parameter must be one of the following values:

Software Watchdog Timeout Actions

Value	Description
WATCHDOG_SYSRESET	Reset the system.
WATCHDOG_APP_STOP	Stop the process. The system will continue to operate.
WATCHDOG_TIMEOUT_PROMPT	This is an attribute of the actions: WATCHDOG_SYSRESET, or WATCHDOG_APP_STOP. When OR'd with one of these flags, a prompt will be displayed on the user screen. The prompt must be acknowledged before the action proceeds.

Return Values:

Software Watchdog - Return Codes

Value	Description
WATCHDOG_OK	Success. The watchdog was tagged and/or a new timeout was set.
WATCHDOG_NOT_PRESENT	Communication with the watchdog could NOT be established.
WATCHDOG_TIMEOUT_FAILED	The new requested timeout could not be set. The watchdog was not tagged.
WATCHDOG_INVALID_PARAMETER	An invalid parameter was passed to the interface. The watchdog was not tagged.

Remarks:

The function Watchdog_SW_TagEx() is initially called by the thread (USE_THREAD_ID) that wants to be monitored by the software watchdog. The watchdog service determines the thread ID of the caller, starts a unique dedicated monitor and returns a new WDTagID. The caller should use the returned WDTagID for all subsequent calls such as tagging or stopping the watchdog monitor or changing the timeout. This mechanism permits multiple threads in the same process to be monitored.

The process is terminated when the timeout action is WATCHDOG_APP_STOP and a timeout occurs for one of the threads in a monitored process. The Software Monitor sends a WM_CLOSE message to the process and if the process does not terminate within 10 seconds, the process is terminated by a call to TerminateProcess() that terminates the process and all of its threads.

The system is reset when the timeout action is WATCHDOG_SYSRESET and a timeout occurs for one of the threads in a monitored process.

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

If the value of dwTimeout is WATCHDOG_DISABLE, then the watchdog is disabled.   A thread that is being monitored must disable the watchdog before it terminates; otherwise a timeout occurs and the timeout action is performed.

If the value of dwTimeout is within the range 50 to 5000, it is taken to represent the time in milliseconds that elapse before a timeout and consequential actions occur. The timer is reset to this value and started, but if the value of dwTimeout is out of range, the timeout setting is left unmodified, the watchdog is not tagged and WATCHDOG_TIMEOUT_FAILED is returned.

The resolution of the high priority thread that watches over the software tags is 50 milliseconds.

Portability:

The RAC6182 does not have a Software Watchdog.

Requirements:

Runs On	Version	Defined In
PanelView Plus CE	All	wdapi.h

Watchdog_SW_Tag

This function tags the software watchdog timer.

> DWORD Watchdog_SW_Tag (DWORD dwWDTagID, DWORD dwTimeout)

Parameters:

dwWDTagID

The Watchdog Tag ID that was assigned by Watchdog_SW_TagEx.

dwTimeout

Timeout in milliseconds. Same as Table .

Return Values:

Same as Table .

Remarks:

Once the application is registered for watchdog monitoring, the application typically calls Watchdog_SW_Tag () with dwTimeout set to WATCHDOG_KICK unless the caller wants to change the timeout.

The resolution of the high priority thread that watches over the software tags is 50 milliseconds.

Portability:

The RAC6182 does not have a Software Watchdog.

Requirements:

Runs On	**Version**	**Defined In**
PanelView Plus CE	All	wdapi.h

System Parameters

The system maintains information about the system. An application program can use the functions described here to read or write the system parameters.

System Parameters and Data Types

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

System Parameters

Parameter	Macro Identifier	Get or Set	Type	Size (Bytes)	Portability
RAM Memory Size	RM_PARAMETER_PHYSICAL_MEMORY_SIZE	Get	DWORD	4	RAC6182 PanelView Plus CE
CPU Speed	RM_PARAMETER_CPU_SPEED_HZ	Get	DWORD	4	RAC6182 PanelView Plus CE
Windows CE Version	RM_PARAMETER_WINDOWS_CE_VERSION	Get	WCHAR[80]	80 X 2	RAC6182 PanelView Plus CE
Win CE Firmware Build Version	RM_PARAMETER_OS_FIRMWARE_VERSION	Get	WCHAR[80]	80 X 2	RAC6182 PanelView Plus CE
Firmware Version	RM_PARAMETER_MICROCONTROLLER_ FIRMWARE_VERSION	Get	WCHAR[80]	80 X 2	RAC6182 PanelView Plus CE
Enables Serial Debug Messages on Startup/Boot	RM_PARAMETER_ENABLE_SERIAL_DEBUG_ ON_BOOT	Both	BOOL	4	RAC6182 PanelView Plus CE
LCD Brightness	RM_PARAMETER_LCD_BRIGHTNESS	Both	DWORD	4	RAC6182 PanelView Plus CE
MAC ID of on board Ethernet	RM_PARAMETER_ON_BOARD_ ETHERNET_MAC_ADDRESS	Get	UCHAR[6]	6	RAC6182 PanelView Plus CE
Remove mouse cursor from display	RM_PARAMETER_CURSOR_ENABLED	Both	BOOL	4	RAC6182 PanelView Plus CE
Enables Serial Debug Messages on Startup/Boot	RM_PARAMETER_ENABLE_SERIAL_DEBUG	Both	BOOL	4	RAC6182 PanelView Plus CE
Converts virtual to physical address	RM_PARAMETER_PHYSICAL_ADDRESS	Get	PUCHAR	4	RAC6182 PanelView Plus CE
Version of BBC	RM_PARAMETER_BBC_VERSION	Get	DWORD	4	PanelView Plus CE
Version of EBC	RM_PARAMETER_EBC_VERSION	Get	DWORD	4	PanelView Plus CE
Display ON Time	RM_PARAMETER_DISPLAY_ON_TIME	Get	DWORD	4	PanelView Plus CE
Terminal ON Time	RM_PARAMETER_TERMINAL_ON_TIME	Get	DWORD	4	PanelView Plus CE
Long POST mask	RM_PARAMETER_POST_SELECTIONS	Both	UCHAR[16]	16	PanelView Plus CE
Disable User Interfaces	RM_PARAMETER_DISABLE_USER_INPUT	Set	BOOL	4	PanelView Plus CE

System Parameters

Parameter	Macro Identifier	Get or Set	Type	Size (Bytes)	Portability
Backlight Status	RM_PARAMETER_BACKLIGHT_STATUS	Get	BOOL	4	PanelView Plus CE
Enable BBC E-Boot	RM_PARAMETER_ENABLE_BBC_EBOOT	Set	BOOL	4	PanelView Plus CE
Enable EBC E-Boot	RM_PARAMETER_ENABLE_EBC_EBOOT	Set	BOOL	4	PanelView Plus CE
CIP Serial Number	RM_PARAMETER_CIP_SERIAL_NUMBER	Get	DWORD	4	PanelView Plus CE
Persistent Registry	RM_PARAMETER_PERSISTENT_REGISTRY_ PRESENT	Both	DWORD	4	PanelView Plus CE
Screensaver Brightness	RM_PARAMETER_SCREENSAVER_ BRIGHTNESS	Both	DWORD	4	PanelView Plus CE
Temperature Sensor	RM_PARAMETER_BEZEL_TEMPERATURE_ SENSOR_IS_WORKING	Get	BOOL	4	PanelView Plus CE
Safe Mode Switch	RM_PARAMETER_FACTORY_DEFAULTS	Get	BOOL	4	PanelView Plus CE
Logic Board Revision	RM_PARAMETER_BOARD_REVISION	Get	DWORD	4	PanelView Plus CE

Remarks:

The functions use a model that is similar to device IOCTLs. Functions take a parameter, the size of data, and a generic buffer. The contents of the buffer depend on the parameter. The actual size of data that is Set/Get is returned along with a return code and data.

```
DWORDrm_Get/SetParameter(DWORD dwParameter, DWORD
*dwSize,VOID *pvData);
```

The *dwSize parameter passed in indicates the space available in pvData for a Get or the space of valid data to use for a Set. Upon success, *dwSize is returned containing the actual amount of data returned in the buffer for a Get, or the amount of data from the buffer used for a Set.

The pvData must point to a buffer of large enough size and of correct size. Parameters which use *pvData as aligned types (e.g. as pointing to a DWORD or a pointer) must follow the alignment restrictions of these types. For example, if getting a parameter where *pvData will be filled with a DWORD value, pvData must be DWORD aligned.

- RM_PARAMETER_DISABLE_USER_INPUT

  This parameter prohibits user input via the touchscreen, keypad and keyboard. This parameter permits an application to immediately disable user input when the display is lost due to a back light failure.

- RM_PARAMETER_BACKLIGHT_STATUS

  This parameter permits an application to monitor the status of the display backlight. When the value is 0, indicating no current flow, the application must check the brightness setting. If LCD_BRIGHTNESS is non-zero, then the display is ON and failed.

- RM_PARAMETER_ENABLE_BBC_EBOOT
- RM_PARAMETER_ENABLE_EBC_EBOOT

  These parameters permit an application to disable or enable E-Boots at startup. The parameters are maintained in CMOS to permit exchanges between the OS and non-OS startup code.

- RM_PARAMETER_DISPLAY_ON_TIME

  This parameter reads and writes the display on time. The resolution is 30 minutes and the value is stored in the bezel EEPROM.

- RM_PARAMETER_TERMINAL_ON_TIME

  This parameter reads and writes the terminal on time. The resolution is 30 minutes and the value is stored in the ATMEL EEPROM.

- RM_PARAMETER_ CIP_SERIAL_NUMBER

  This parameter reads the CIP Serial Number. Each vendor is responsible for guaranteeing the uniqueness of the serial number across all of its devices. The value is stored in the MAC EEPROM and is written via the JTAG interface during Manufacturing.

- RM_PARAMETER_PERSISTENT_REGISTRY_PRESENT

  An application can delete the persistent registry by setting this parameter to FALSE. The absence of a persistent registry restores the system to its original state on the next boot. Applications can poll this parameter to determine if a persistent registry exists. When TRUE, indicates that a persistent WinCE registry exists in the binary partition of the Compact Flash.

- RM_PARAMETER_FACTORY_DEFAULTS

  This parameter reads the state of the “default” or “safe mode” switch. TRUE is returned if the switch was pressed and the system was started in the “default” or “safe” state.

- RM_PARAMETER_BOARD_REVISION

  This parameter reads the logic board revision number, which is managed by a set of 4 pull-up resistors on the board. The revision number is returned as a simple integer in the range 0 to 15.

  Most system parameters are only used to obtain the return value on get or pass the argument value on set. An exception is RM_PARAMETER_PHYSICAL_ADDRESS as follows:

- RM_PARAMETER_PHYSICAL_ADDRESS

  This parameter allows getting the physical address corresponding to a virtual address valid in the current process space. Because of this, the parameter should be passed in pointing to the desired virtual address. Upon successful return this value will be replaced with the physical address.

Read or Write System Parameters

These functions permit an application to read or write the System Parameters.

rm_GetParameter

This function gets a System Parameter.

```
DWORD rm_GetParameter (DWORD dwParameter, DWORD
*pdwSize, VOID *pvData);
```

Parameters:

dwParameter

This parameter must be one of the values in Table .

pdwSize

A pointer to a passed value that indicates the number of bytes in the buffer, pvData.   Upon success, dwSize returns the number of bytes actually returned in the buffer.

pvData

A pointer to a buffer.

Return Values:

Get/Set System Parameter - Return Codes

Value	Description
RM_ERROR_OK	Success
RM_ERROR_INVALID_PARAMETER	Bad dwParameter, or NULL dwSize or pvData
RM_ERROR_INVALID_BUFFER_SIZE	Buffer size too small for requested parameter.

Remarks:

The buffer at *pvData 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 Table above for the data types associated with the various readable parameters.

Portability:

Please refer to Table above for an enumeration of which parameters are supported on the platforms.

Requirements:

Runs On	Version	Defined In	Link To
PanelView Plus CE RAC6182	All	Miscsystem.h	Miscsystem.lib

rm_SetParameter

This function sets a System Parameter.

```
DWORD rm_SetParameter (DWORD dwParameter, DWORD
*pdwSize, VOID *pvData);
```

Parameters:

dwParameter

This parameter must be one of the values in System Parameters on page 42.

pdwSize

A pointer to a caller allocated DWORD whose value represents the number of bytes at pvData. Upon success, dwSize returns the number of bytes from the buffer used for a set.

pvData

A pointer to a caller allocated buffer, which contains the data values for the selected parameter.

Return Values:

Return values are common for both Set and Get functions. See Get/Set System Parameter - Return Codes above.

Remarks:

The buffer at *pvData must be large enough to contain the information requested and must be aligned as required. For example, if the data in *pvData is expected to be a DWORD value, then *pvData MUST be DWORD aligned.

Please refer to System Parameters on page 42 for the data types associated with the various writeable parameters.

Portability:

Please refer to System Parameters above for an enumeration of which parameters are supported on the platforms.

Requirements:

Runs On	**Version**	**Defined In**	**Link To**
PanelView Plus CE RAC6182	All	Miscsystem.h	Miscsystem.lib

System Timers

The platform hardware provides timers of varying precision, flexibility, and range. Some of these timers may be used for other operating-system level purposes such as the reschedule timer interrupt. However, one or more timers are available for general-purpose use to application programs. The timers are typically called user timers and can be configured for one-shot or periodic operation.

A timer number identifies a specific timer. When requesting a timer, the range of timer numbers is from 0 to MAX_TIMER_NUMBER. In addition to timer numbers of this range, critical and non-critical timers can be requested. Critical timers commit a physical resource and provide very high resolution. Non critical timers share a physical timer. Currently, there is 1 critical timer and MAX_TIMER_NUMBER non-critical timers. The attribute USERTIMER_CRITICAL requests a critical timer. Throughout this API, USERTIMER_CRITICAL must be or'd with the timer number for a critical timer. Resolution of non-critical timers is 1ms, accuracy +1/- 0ms. Critical timer resolution is 50us, +50/-0 us. MAX_TIMER_NUMBER is implementation-dependent but is guaranteed to be 15 minimum.

Configure Timer Functions

These functions permit an application to determine how many timers are supported on the system and to claim a specific timer. Once claimed, the timer is configured, run and eventually released.

UserTimerGetNumberOfTimers

This function gets the number of available timers on the system.

```
DWORD UserTimerGetNumberOfTimers (void);
```

Return Value:

Total number of application accessible timers available on the system. This includes the critical and non-critical timers. The range is 0 to MAX_TIMER_NUMBER.

Remarks:

Returns the number of timers on the system that are available to the application. The number returned is the total for ALL applications. If an application uses a timer, the number of timers available for another application is one less.

Portability:

This function is specific to PanelView Plus CE or the RAC6182.

Requirements:

Runs On	Version	Defined In	Link To
PanelView Plus CE RAC6182	All	usertimers.h	usertimers.lib

UserTimerClaim

This function is used to claim or release exclusive access to a specific timer.

DWORD UserTimerClaim (DWORD dwTimerNumber, BOOL bClaim);

Parameters:

dwTimerNumber

The Timer Number is 0 based; i.e., if 2 timers are present on the system, they are timer 0 and timer 1. When specifying a critical timer, the flag USERTIMER_CRITICAL must be or'd with the Timer Number. The range is 0 to MAX_TIMER_NUMBER.

bClaim

TRUE to claim access to a timer, and FALSE to release it.

Return Values:

UserTimerClaim - Return Codes

Value	Description
USER_TIMER_OK	Successfully claimed or released timer.
USER_TIMER_INVALID_TIMER	The timer number is not valid for the 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.

Remarks:

A timer must be claimed for any other function that takes a TimerNumber as a parameter to be used. A timer must be released to allow any other application to claim and use the timer.

The mechanism will support a system that has multiple critical timers.

When releasing a timer, any handle created from UserTimerGetWaitEvent() is closed by this operation. The user should not close the handle.

Portability:

The RAC6182 does not have a critical timer; hence the attribute USERTIMER_CRITICAL is not supported on the RAC6182.

Requirements:

Runs On	Version	Defined In	Link To
PanelView Plus CE RAC6182	All	usertimers.h	usertimers.lib

UserTimerRequestFrequency

This function sets the frequency of a claimed timer.

```
DWORD UserTimerRequestFrequency (DWORD
dwTimerNumber, DWORD *pdwFrequency);
```

Parameters:

dwTimerNumber

The Timer Number is 0 based; i.e., if 2 timers are present on the system, they are timer 0 and timer 1. When specifying a critical timer, the flag USERTIMER_CRITICAL must be or’d with the Timer Number. The range is 0 to MAX_TIMER_NUMBER.

pdwFrequency

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. The *Frequency may differ from the initial value due to resolution issues in the hardware timer. Valid values range from 1 – 20,000 HZ for the Critical Timer and 1 – 1,000 HZ for the non-Critical Timers.

Return Values:

UserTimerRequestFrequency - Return Codes

Value	Description
USER_TIMER_OK	The timer has been set to the closest possible frequency, and the actual frequency used is returned at pdwFrequency
USER_TIMER_INVALID_TIMER	The timer number is not valid for the system.
USER_TIMER_INVALID_PARAMETER	The requested frequency is NULL or out of range.
USER_TIMER_NOT_CLAIMED	This application has not claimed this timer.

Remarks:

Applications must check the frequency returned and use it in their counter calculations. The frequency cannot be set once the timer has been started.

Portability:

This function is specific to the PanelView Plus CE or the RAC6182.

Requirements:

Runs On	Version	Defined In	Link To
PanelView Plus CE RAC6182	All	usertimers.h	usertimers.lib

UserTimerGetWaitEvent

This function registers the application to receive notification of the timeout event.

```
DWORD UserTimerGetWaitEvent (DWORD dwTimerNumber,
BOOL bManualReset, HANDLE *phWaitEvent);
```

Parameters:

dwTimerNumber

The Timer Number is 0 based; i.e., if 2 timers are present on the system, they are timer 0 and timer 1. When specifying a critical timer, the flag USERTIMER_CRITICAL must be or'd with the Timer Number. The range is 0 to MAX_TIMER_NUMBER.

bManualReset

Configures how the event is handled when responding to a Wait….() operation. The bManualReset parameter specifies whether the event object automatically resets itself from a signaled state to a non-signaled state or whether it will require a manual reset.

Consult the Win32 documentation on CreateEvent() for further details.

phWaitEvent

Pointer to a caller allocated HANDLE, in which an event handle will be stored. NOTE: The handle to the *phWaitEvent should not be closed by the user. Releasing the timer releases the event handle.

Return Values:

UserTimerGetWaitEvent - Return Codes

Value	Description
USER_TIMER_OK	Successfully created the event handle.
USER_TIMER_INVALID_TIMER	The timer number is not valid for the system.
USER_TIMER_INVALID_PARAMETER	WaitEvent is NULL or a fatal event creation failure occurred.
USER_TIMER_NOT_CLAIMED	This application has not claimed this timer.

Remarks:

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

Calling this API a second time with the same timer number and the same state for bManualReset will result in the API returning the same handle as was provided on the first call. If the state of bManualReset is different, the API will fail.

Portability:

This function is specific to the PanelView Plus CE or the RAC6182.

Requirements:

Runs On	Version	Defined In	Link To
PanelView Plus CE RAC6182	All	usertimers.h	usertimers.lib

Run Timer Functions

These functions permit an application to start and stop the timer, and to set the countdown value.

UserTimerSet

This function sets the count of a claimed timer and start timing the countdown.

```
DWORD UserTimerSet (DWORD dwTimerNumber, DWORD
dwCount);
```

Parameters:

dwTimerNumber

The Timer Number is 0 based; i.e., if 2 timers are present on the system, they are timer 0 and timer 1. When specifying a critical timer, the flag USERTIMER_CRITICAL must be or'd with the Timer Number. The range is 0 to MAX_TIMER_NUMBER.

dwCount

A DWORD value that sets the countdown value and starts the timer. The frequency of the timer is the last frequency returned from UserTimerRequestFrequency(). The countdown stops and the timer is triggered at 0.

Return Values:

UserTimerSet - Return Codes

Value	Description
USER_TIMER_OK	The countdown was set and the timer started.
USER_TIMER_INVALID_TIMER	The timer number is not valid for the system.
USER_TIMER_INVALID_PARAMETER	dwCount was 0.
USER_TIMER_NOT_CLAIMED	This application has not claimed this timer.
USER_TIMER_SET_FAILED	Unable to set countdown value.

Remarks:

This function provides “one-shot” behavior. The application must restart the timer if “periodic” behavior is desired. See UserTimerSetEx() below.

Any count in progress is aborted by this function.

USER_TIMER_SET_FAILED indicates that the count may be beyond the hardware capabilities of the timers and may be out of range, or the frequency had not been set.

Portability:

This function is specific to the PanelView Plus CE or the RAC6182.

Requirements:

Runs On	Version	Defined In	Link To
PanelView Plus CE RAC6182	All	usertimers.h	usertimers.lib

UserTimerSetEx

This function sets the count of a claimed timer and start timing the countdown.

```
DWORD UserTImerSetEx (DWORD dwTimerNumber, DWORD
dwCount, DWORD dwMode)
```

Parameters:

dwTimerNumber

The Timer Number is 0 based; i.e., if 2 timers are present on the system, they are timer 0 and timer 1. When specifying a critical timer, the flag USERTIMER_CRITICAL must be or'd with the Timer Number. The range is 0 to MAX_TIMER_NUMBER.

dwCount

A DWORD value that sets the countdown value and starts the timer. The frequency of the timer is the last frequency returned from UserTimerRequestFrequency().

dwMode

When FALSE (zero), the timer operates as a one shot. Otherwise, when TRUE (non zero), the timer operates in periodic mode.

Return Values:

Same as Table .

Remarks:

This API is an extension of the UserTimerSet() function in that it allows the timer to be configured for periodic or one-shot operation.

Any count in progress is aborted by this function.

USER_TIMER_SET_FAILED indicates that the count may be beyond the hardware capabilities of the timers and may be out of range, or the frequency had not been set.

Portability:

This function is specific to the PanelView Plus CE.

Requirements:

Runs On	Version	Defined In	Link To
PanelView Plus CE	All	usertimers.h	usertimers.lib

UserTimerGetValue

This function gets the count of a running timer.

```
DWORD UserTimerGetValue (DWORD dwTimerNumber,
DWORD *pdwCount);
```

Parameters:

dwTimerNumber

The Timer Number is 0 based; i.e., if 2 timers are present on the system, they are timer 0 and timer 1. When specifying a critical timer, the flag USERTIMER_CRITICAL must be or'd with the Timer Number. The range is 0 to MAX_TIMER_NUMBER.

pdwCount

A Pointer to a caller allocated DWORD where the current count will be returned.

Return Values:

UserTimerGetValue - Return Codes

Value	Description
USER_TIMER_OK	The timer was running and the count value was successfully returned.
USER_TIMER_INVALID_TIMER	The timer number is not valid for the system.
USER_TIMER_INVALID_PARAMETER	pdwCount was NULL; i.e. a bad pointer.
USER_TIMER_NOT_CLAIMED	This application has not claimed this timer.
USER_TIMER_NOT_RUNNING	The timer was not running.

Remarks:

Obtains the current countdown value of an active timer. The timer continues to run.

Portability:

This function is specific to the PanelView Plus CE or the RAC6182.

Requirements:

Runs On	Version	Defined In	Link To
PanelView Plus CE RAC6182	All	usertimers.h	usertimers.lib

UserTimerStop

This function stops a claimed timer.

DWORD UserTimerStop (DWORD dwTimerNumber);

Parameters:

dwTimerNumber

The Timer Number is 0 based; i.e., if 2 timers are present on the system, they are timer 0 and timer 1. When specifying a critical timer, the flag USERTIMER_CRITICAL must be or'd with the Timer Number. The range is 0 to MAX_TIMER_NUMBER.

Return Values:

UserTImerStop - Return Codes

Value	Description
USER_TIMER_OK	The timer was running and was stopped.
USER_TIMER_INVALID_TIMER	The timer number is not valid for the system.
USER_TIMER_NOT_CLAIMED	This application has not claimed this timer.
USER_TIMER_NOT_RUNNING	The timer was not running.

Remarks:

Stops an active countdown in the timer specified by dwTimerNumber

Portability:

This function is specific to the PanelView Plus CE or the RAC6182.

Requirements:

Runs On	Version	Defined In	Link To
PanelView Plus CE RAC6182	All	usertimers.h	usertimers.lib

Hardware Monitor

The PanelView Plus CE platform provides a hardware monitor driver that can be called by applications to monitor the status of various board parameters. In addition, the hardware monitor provides functions to Reboot the board and to query the last reboot reason.

Hardware Monitor Parameters

These platform parameters are monitored by the HardwareMonitor driver.

- 3-Volt battery voltage
- CPU Temperature
- Display Temperature

Note that 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 3V-battery voltage, the units of the levels specified in HardwareMonitor API functions will be Volts. However, when an application sets display temperature warning levels, the application must specify temperature in degrees Celsius. Parameter units are shown Table and described in more detail below for each API function.

Hardware Monitor Parameters

Parameter	Description	Units
MONITOR_ID_BATTERY_VOLTAGE	Monitor the battery voltage that powers the NVRAM and the RTC.	Volts
MONITOR_ID_CPU_TEMPERATURE	Monitor the CPU temperature.	Degrees Celsius
MONITOR_ID_DISPLAY_TEMPERATURE	Monitor the display module (LCD) temperature.	Degrees Celsius

Hardware Monitor Functions

These functions permit an application to set the warning levels and register for a warning event. When the event occurs the application can read the current value of the monitored parameters.

hm_RegisterMonitorWarningEvent

This function registers an application to receive a warning event when a monitored parameter is above the upper level or below the lower level bounds.

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

Parameters:

dwMonitorIDMask

Bitmask combination of the Table that will return an event to the application when any parameter enters the warning state.

phEventHandle

Pointer to an application-allocated HANDLE.

Return Values:

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

Remarks:

Applications that need to be notified when one or more monitored parameters enter the warning state should register for an event with this function. The application specifies in dwMonitorIDMask what monitored parameters should signal an event when entering the warning state. If this function succeeds, the event handle is returned to the caller in *phEventHandle and the application can wait on the event using one of the standard Win32 WaitForxxx() functions. Once the event is triggered and the application's thread fall through the WaitForxxx() condition, the application can determine which parameter is currently in the warning state using the function hm_GetMonitorWarnings(). If any parameter is still in a warning state, the application can act accordingly.

Note that registering a warning event will not trigger the event if the monitor is already in the warning state. Applications should either register their events with **hm_RegisterMonitorWarningEvent()** before setting the warning levels with **hm_SetMonitorWarningLevels()**, or should check using **hm_GetMonitorLevel()** whether the desired monitor parameter is in range before waiting on the event returned from **hm_RegisterMonitorWarningEvent()**.

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

Portability:

The function prototype is the same as the RAC6182. However, the MONITOR _ID parameters are different between the platforms.

Requirements:

Runs On	Version	Defined In	Link To
PanelView Plus CE RAC6182	All	HardwareMonitorAPI.h	HardwareMonitor.lib

hm_UnregisterMonitorWarningEvent

This function cancels the Hardware Monitor registration.

```
BOOL hm_UnregisterMonitorWarningEvent (HANDLE
hEventHandle);
```

Parameters:

hEventHandle

The HANDLE that was returned by hm_RegisterMonitorWarningEvent().

Return Values:

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

Remarks:

This function unregisters and frees a warning 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.

Portability:

The function prototype is the same as the RAC6182. However, the MONITOR _ID parameters are different between the platforms.

Requirements:

Runs On	Version	Defined In	Link To
PanelView Plus CE RAC6182	All	HardwareMonitorAPI.h	HardwareMonitor.lib

hm_GetMonitorWarnings

This function gets a bitmask indication of which monitored parameters are in the warning state.

```
BOOL hm_GetMonitorWarnings (DWORD *pdwMonitorID);
```

Parameters:

pdwMonitorID

Pointer to an application-allocated DWORD that returns a bit mask combination of all monitored parameters currently in the warning state.

Return Values:

Returns TRUE if the function has been successful; otherwise returns FALSE on failure.

Remarks:

This function returns a bit wise Or'd combination of all monitored parameters 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 monitored parameter enters a warning state and triggers a notification event, it is possible that the parameter has left the warning state before an application calls this function.

Portability:

The function prototype is the same as the RAC6182. However, the MONITOR _ID parameters are different between the platforms.

Requirements:

Runs On	Version	Defined In	Link To
PanelView Plus CE RAC6182	All	HardwareMonitorAPI.h	HardwareMonitor.lib

hm_GetMonitorLevel

This function gets the current value of a specific monitored parameter.

```
BOOL hm_GetMonitorLevel (DWORD dwMonitorID, DOUBLE
*plfCurrentValue);
```

Parameters:

dwMonitorID

A value from Table .

plfCurrentValue

Pointer to an application-allocated DOUBLE that returns the current value for the parameter specified by dwMonitorID.

Return Values:

Returns TRUE if the function is successful; otherwise returns FALSE on failure.

Remarks:

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) to ensure that the monitor source remains in a warning state before acting. Note also that to avoid oscillating events, due to lots 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.

Portability:

The function prototype is the same as the RAC6182. However, the MONITOR _ID parameters are different between the platforms.

Requirements:

Runs On	Version	Defined In	Link To
PanelView Plus CE RAC6182	All	HardwareMonitorAPI.h	HardwareMonitor.lib

hm_SetMonitorWarningLevels

This function sets the high and low warning levels for a specific monitored parameter.

```
BOOL hm_SetMonitorWarningLevels (DWORD dwMonitorID,
DOUBLE IfUpperWarningLevel, DOUBLE IfLowerWarningLevel);
```

Parameters:

dwMonitorID

A value from Table .

lfUpperWarningLevel

Double precision floating-point value that defines the upper bound of the monitor parameter during normal operation. If *MONITOR_WARNING_LEVEL_UNDEFINED* is specified, the upper bound is undefined and not used to determine if the parameter enters the warning state. This is a requirement for some parameters. See Remarks.

lfLowerWarningLevel

Double precision floating-point value that defines the lower bound of the monitor parameter during normal operation. If MONITOR_WARNING_LEVEL_UNDEFINED is specified, the lower bound is undefined and not used to determine if the parameter enters the warning state. This is a requirement for some parameters. See Remarks.

Return Values:

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

Remarks:

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 enters the warning state. Upper and lower warning levels are set by default and can be altered using this function.

The monitor level specified in **lfUpperWarningLevel** and **lfLowerWarningLevele** varies depending on the type of parameter being monitored.

See Hardware Monitor Parameters for type/units.

The upper warning level for MONITOR_ID_BATTERY_VOLTAGE must be MONITOR_WARNING_LEVEL_UNDEFINED.

The lower warning level for MONITOR_ID_CPU_TEMPERATURE must be MONITOR_WARNING_LEVEL_UNDEFINED.

Portability:

The function prototype is the same as the RAC6182. However, the MONITOR _ID parameters are different between the platforms.

Requirements:

Runs On	Version	Defined In	Link To
PanelView Plus CE RAC6182	All	HardwareMonitorAPI.h	HardwareMonitor.lib

hm_GetMonitorWarningLevels

This function gets the high and low warning levels for a specific monitored parameter.

```
BOOL hm_GetMonitorWarningLevels (DWORD dwMonitorID,
DOUBLE *plfUpperWarningLevel, DOUIBLE
*plfLowerWarningLevel);
```

Parameters:

dwMonitorID

A value from Table .

lfUpperWarningLevel

A pointer to a double precision floating-point value that returns the upper bound of the monitor parameter during normal operation. Some parameters return MONITOR_WARNING_LEVEL_UNDEFINED to indicate that the upper bound is undefined and not used to determine if the parameter enters the warning state. See Remarks.

lfLowerWarningLevel

A pointer to a double precision floating-point value that defines the lower bound of the monitor parameter during normal operation. Some parameters return MONITOR_WARNING_LEVEL_UNDEFINED to indicate that the lower bound is undefined and not used to determine if the parameter enters the warning state. This is a requirement for some parameters. See Remarks.

Return Values:

Returns TRUE if the warning levels were successfully returned; otherwise, FALSE on failure.

Remarks:

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 enters the warning state. Upper and lower warning levels are set by default or by hm_SetMonitorWarningLevels () and can be obtained using this function.

The monitor level specified in **lfUpperWarningLevel** and **lfLowerWarningLevele** varies depending on the type of parameter being monitored.

See Hardware Monitor Parameters for type/units.

The upper warning level for MONITOR_ID_BATTERY_VOLTAGE is always MONITOR_WARNING_LEVEL_UNDEFINED.

The lower warning level for MONITOR_ID_CPU_TEMPERATURE is always MONITOR_WARNING_LEVEL_UNDEFINED.

Portability:

The function prototype is the same as the RAC6182. However, the MONITOR _ID parameters are different between the platforms.

Requirements:

Runs On	Version	Defined In	Link To
PanelView Plus CE RAC6182	All	HardwareMonitorAPI.h	HardwareMonitor.lib

Shutdown and Re-Boot Functions

These functions permit an application to boot the system and determine how the system was last shutdown.

hm_RebootBoard

This function reboots the system.

```
BOOL hm_RebootBoard (void);
```

Return Values:

Returns FALSE on failure. Function will not return on success, because the board will reset immediately.

Remarks:

This function performs a reboot of the 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.

Portability:

This function is specific to PanelView Plus CE and the RAC6182 hardware.

Requirements:

Runs On	**Version**	**Defined In**	**Link To**
PanelView Plus CE RAC6182	All	HardwareMonitorAPI.h	HardwareMonitor.lib

hm_GetBootReason

This function gets the reason for the last boot.

```
DWORD hm_GetBootReason (void);
```

Return Values:

hm_GetBootReason - Return Codes

Value	Description
BOOT_REASON_ WARM_REQUESTED	The System was reset by **hm_RebootBoard()**. Possibly called by the Software Watchdog.
BOOT_REASON_ WARM_INTERNAL	The System was reset by some operating system operation, such as the boot ROM, or a firmware update that required a reboot.
BOOT_REASON_ WATCHDOG	The hardware watchdog reset the System. Possible causes are a software or hardware failure.
BOOT_REASON_ COLD_POWER_CYCLE	The board was powered down and the system was rebooted after enough time for RAM to discharge.
BOOT_REASON_ UNKNOWN	The System was reset but the reason is unknown. Possible causes are a software or hardware failure, or simply power down during boot, or an extremely brief power outage wherein memory endures.
BOOT_REASON_RESET_ BUTTON_OR_BROWNOUT	The System has been rebooted. The board reset button was pressed or the power supply dropped below an acceptable voltage level.
BOOT_REASON_ CPU_TOO_HOT	The CPU temperature was too high and the system was shutdown by the CPU temperature sensor. Possible causes are a failure of the heat sink or an extremely high ambient temperature.

Remarks:

The watchdog register and some non-volatile codes in CMOS support the Last Boot Reason. An application can use this function to determine its startup behavior based on how the system was last shutdown.

Portability:

This function is specific to PanelView Plus CE and the RAC6182 hardware. Some of the return codes are different between the platforms.

Requirements:

Runs On	Version	Defined In	Link To
PanelView Plus CE RAC6182	All	HardwareMonitorAPI.h	HardwareMonitor.lib

Keypad

These functions support front panel connected keypads and the interface to the Rockwell supplied keypad handler.

Keypad Overview

PanelView Plus CE keypads are intended to function with many of the same features as normal keyboards, such as supporting typical modifier mappings of standard keys and supporting configurable auto-repeat functionality. In addition, the keypad functionality has some Rockwell proprietary features:

- Support for multiple types of keypads based on an identifier in the EEPROM. Different keypads may have different scan code to virtual key mappings.
- Non-standard keys. For example, K1-K16 programmable function keys or the unique navigation keys formed by the simultaneous press of ALT with an Up, Down, Left, Right arrow key. These are non-standard for a keyboard, but are present on the PanelView Plus CE keypad.
- Support for mapping single key presses into multiple key macros at the virtual key level.
- Support for other behavior on key presses such as running programs.
- A 'single-key' mode where holding down a key of a certain type may prevent other types of key presses from being handled.
- A 'hold-off' mode where after a key is released, further presses of it will be ignored for some amount of time.

These features are non-standard keyboard behaviors, so an extension to the keypad driver is required. Also, the high degree of configurability needed for keypads, macros, functions, etc. means even further flexibility by calling up to a higher level keypad handler outside of the operating system layer.

Keypad Driver/Handler Overview

The keypad driver and its companion keypad handler form a system that addresses the following system design goals:

- The operating system contains a keypad driver. The keypad driver handles low-level interface, system wide functions; i.e. determining the model of keypad device, interfacing to the keypad device to obtain scan codes and up/down status, mapping from scan code to virtual key, auto-repeat, single-key, and hold-off functionality.
- The keypad handler handles higher level mappings and anything requiring greater flexibility and extensibility, such as mapping virtual keys to other virtual keys, multiple virtual key macros, memory allocation, storage and configuration of mapping tables used by the keypad driver, and setting global configuration options used by the driver.
- The Keypad driver loads the keypad handler and communicates with the handler via callback functions with defined names.
- The Keypad handler or any other application may also interface with the keypad driver with streams interface calls to configure or query it.
- The Keypad driver handles the cases when no keypad or no keypad handler is present.
- The Keypad handler may defer responsibility for performing virtual key mappings to the keyboard driver, which will perform normal modifier mappings as it would for a keyboard.
- The Driver/Handler system allows changes to keypad scan code to virtual key mappings or individual key attributes without requiring operating system updates.
- The Driver/Handler system allows the addition of new keypad models without requiring operating system updates.

Keypad Driver Streams Interface

If the keypad driver successfully loads on boot, control of the keypad driver by the keypad handler or other applications is accomplished by a streams driver interface. This means that the driver is opened by getting a HANDLE to it using a standard CreateFile() call. The device name to open is defined in keypadapi.h as KEYPAD_DRIVER_PREFIX. Once an application has opened a HANDLE to the keypad driver in this manner, it may then control or query the keypad driver using DeviceIoControl() with IOCTLs defined for the keypad driver. The supported IOCTLs and their parameters are as follows.

- IOCTL_KPD_SET_TYPEMATIC_PARAMS

  This sets the typematic rate – whether auto-repeat is enabled and if so, the delay and repeat period in milliseconds. This information is maintained for the keypad independently of the keyboard auto-repeat settings, so is not controlled by nor does it affect the settings under control panel, keyboard. This IOCTL requires an input buffer of a PKPD_PARAM_TYPEMATIC of size sizeof(KPD_PARAM_TYPEMATIC).

- IOCTL_KPD_QUERY_TYPEMATIC_PARAMS

  This gets the current typematic rate information for the keypad. This IOCTL requires an output buffer of a PKPD_PARAM_TYPEMATIC of size sizeof(PD_PARAM_TYPEMATIC).

- IOCTL_KPD_SET_SINGLE_KEY_MODE

  This sets the single key mode information. It requires an input buffer of a PKPD_PARAM_SINGLE_KEY_MODE of size sizeof(KPD_PARAM_SINGLE_KEY_MODE).

- IOCTL_KPD_QUERY_SINGLE_KEY_MODE

  This gets the current single key mode information. It requires an output buffer of a PKPD_PARAM_SINGLE_KEY_MODE of size sizeof(KPD_PARAM_SINGLE_KEY_MODE).

- IOCTL_KPD_SET_HOLD_OFF_MODE

  This sets the key hold-off mode. It requires an input buffer of a PKPD_PARAM_HOLD_OFF_MODE of size sizeof(KPD_PARAM_HOLD_OFF_MODE).

- IOCTL_KPD_QUERY_HOLD_OFF_MODE

  This gets the key hold-off mode. It requires an output buffer of a PKPD_PARAM_HOLD_OFF_MODE of size sizeof(KPD_PARAM_HOLD_OFF_MODE).

Portability:

This function is specific to the RAC6182 and the PanelView Plus CE.

Requirements:

Runs On	Version	Defined In	Link To
PanelView Plus CE RAC6182	All	keypadapi.h khapi.h RAC6182OEMVKeys.h	

Registry Keys for Keypad Driver/Handler Interface

The operating system provides a simple keypad handler stub, which may be used in cases where custom behavior such as application launch and macros are not necessary. This stub provides simple scan code to virtual code mapping and global setting information from the registry, and defers all mapping from the virtual key level up to the keyboard driver's default mappings. The registry keys khstub uses to obtain keypad mapping and other information are documented here in case keypad handler and keypad configuration application developers wish to use the same keys. It is not necessary to do so, but will probably prove to be a convenience.

Note that if a registry entry is not found, khstub uses the following defaults:

- Typematic repeat enabled, initial delay 500ms, repeat delay 33ms
- Single-key mode disabled
- Hold-off mode disabled

These defaults are specific to khstub so another keypad handler implementation may do this differently.

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

- [HKEY_LOCAL_MACHINE\Drivers\BuiltIn\Keypad\Params\TypematicRepeat]

  Enabled REG_DWORD which is 1 for enabled, 0 for disabled

  RepeatDelay REG_DWORD of initial repeat delay in ms.

  RepeatRate REG_DWORD of subsequent repeat delay in ms.

- [HKEY_LOCAL_MACHINE\Drivers\BuiltIn\Keypad\Params\SingleKeyMode]

  Enabled REG_DWORD which is 1 for enabled, 0 for disabled

  AbortEnabled REG_DWORD which is 1 for enabled, 0 for disabled

- [HKEY_LOCAL_MACHINE\Drivers\BuiltIn\Keypad\Params\HoldoffMode]

  Enabled REG_DWORD which is 1 for enabled, 0 for disabled

  HoldoffTime REG_DWORD of time in ms. for key hold-off

System Event Log

The PanelView Plus CE platform provides a System Event Log wherein applications can record system Events that are viewable in the Hardware Monitor Properties applet in Control Panel. An Event can be any condition that may be of interest to the user. In the PanelView Plus CE, the Event log is implemented as the file \storage card\Event.Log and as such is supported by all the standard file amenities. It is fixed in size by EVENT_LOG_MAX_RECORDS and holds at least 32 of the most recently logged Events. The Event Log object wraps the Event Log such that applications need not be concerned about creating, opening or closing the file.

Event Data Structure

This structure describes the System Event Record.

```
typedef struct Event_record {

UINT nIndex;

UINT nType;

SYSTEMTIME LocalTime;

TCHAR szDescription[MAX_DESCRIPTION];

} EVENT;
```

Members

nIndex

The record index.

nType

Event Type

Event Types

Value	Description
EVENT_UNUSED	Event record is empty; i.e. unused.
EVENT_WARNING	Event is a warning condition; e.g. low battery.
EVENT_ERROR	Event is an error condition; CPU Over-temperature.
EVENT_INFO	Event is information only; e.g. Last Boot Reason

LocalTime

Time and Date Stamp

szDescription

A text string that describes the Event.

Log New Event

This function writes a new Event to the Event Log.

```
void LogNew Event(LPCTSTR szEventDescription, int
nEventType);
```

Parameters:

szEventDescription

A pointer to a text string that describes the Event.

nEventType

This parameter must be one of the values in Table .

Remarks:

The Event is written to the system Event Log and becomes the latest Event. When the Log is full, the latest Event simply over-writes the oldest one

Portability:

This function is specific to the PanelView Plus CE.

Requirements:

Runs On	Version	Defined In	Link To
PanelView Plus CE	All	EventLog.h	EventLog.lib

Clear Event Log

This function clears all Events from the Event log.

```
BOOL ClearEvents (void);
```

Return Values:

Returns TRUE if the Event Log was cleared successfully; otherwise, returns FALSE.

Remarks:

All Events are set to the EVENT_UNUSED type.

Portability:

This function is specific to the PanelView Plus CE.

Requirements:

Runs On	Version	Defined In	Link To
PanelView Plus CE	All	EventLog.h	EventLog.lib

Get Last Event

This function reads the last or newest Event from the Event log.

```
DWORD GetLastEvent (EVENT *pEvent);
```

Parameters:

pEvent

A pointer to an EVENT structure.

Return Values:

GetLastEvent - Return Codes

Value	Description
EVENT_SUCCESS	The last; i.e. the most recent, Event was read successfully and returned to the EVENT structure.
EVENT_ FILE_EMPTY	No Event was returned The Event log is empty.
EVENT_FAIL	No Event was returned. The operation failed.

Remarks:

This function is typically used to establish the starting position for an iteration loop that traverses the Event Long in the newest to oldest direction; for example, last to first.

After establishing the starting position with this function, use GetNextEvent() in a iteration loop with direction set to **PRIOR**. The time/date stamps will be descending.

Portability:

This function is specific to the PanelView Plus CE.

Requirements:

Runs On	Version	Defined In	Link To
PanelView Plus CE	All	EventLog.h	EventLog.lib

Get First Event

This function reads the first or oldest Event from the Event log.

```
DWORD GetFirstEvent (EVENT*pEvent);
```

Parameters:

pEvent

A pointer to an EVENT structure.

Return Values:

GetFirstEvent - Return Codes

Value	Description
EVENT_SUCCESS	The first or oldest Event was read successfully and returned to the structure at pEvent.
EVENT_ FILE_EMPTY	No Event was returned The Event log is empty.
EVENT_FAIL	No Event was returned. The operation failed.

Remarks:

This function is typically used to establish the starting position for an iteration loop that traverses the Event Long in the oldest to newest direction; i.e. first to last.

Use GetNextEvent() in a iteration loop with direction set to **AFTER**. The time/date stamps will be ascending.

Portability:

This function is specific to the PanelView Plus CE.

Requirements:

Runs On	Version	Defined In	Link To
PanelView Plus CE	All	EventLog.h	EventLog.lib

Get Next Event

This function reads the “next” Event from the Event Log in a specified direction. This function permits an application to traverse the Event Log in an ordered fashion. If the Event Log is traversed such that the record after the end or the record before the first is sought then EVENT_EOF will be returned.

```
DWORD GetNextEvent (UINT nIndex, UINT nDirection, EVENT
*pEvent);
```

Parameters:

nIndex

The index to an Event record in the Event Log.

nDirection

Determines the direction for locating the “next” record in the Event Log. This parameter must be one of the following values:

Event Types

Value	Description
PRIOR	Get the Event that occurred immediately **prior** to Event[nIndex]. The returned Event will have an earlier time stamp than the Event at nIndex.
AFTER	Get the Event that occurred immediately **after** Event[nIndex]. The returned Event will have an later time stamp than the Event at nIndex.

pEvent

A pointer to an EVENT structure.

Return Values:

GetNextEvent - Return Codes

Value	Description
EVENT_SUCCESS	The Event was read successfully and returned to the structure at pEvent.
EVENT_EOF	No Event was returned The record index is at the end of the file or at an empty Event.
EVENT_FAIL	No Event was returned. The operation failed.

Remarks:

This first time GetNextEvent() is called, the parameter nIndex is typically the index to the Event that was returned by calling GetFirstEvent() or GetLastEvent(). Subsequent calls should provide the index that was returned in the preceding call to GetNextEvent().

If the return code is EVENT_SUCCESS, the next Event in the specified direction was returned to the Event structure at pEvent.

EVENT_EOF is returned when the Event Log has determined that it is at the end of the file. An empty record is interpreted as the end of file.

Is it recommended that GetFirstEvent()or GetLastEvent() always be called before entering an iteration loop using GetNextEvent(); otherwise, the starting index will be misplaced. Another consideration is that an empty Event Log returns EVENT_EOF; whereas, GetFirstEvent() or GetLastEvent() will properly return EVENT_FILE_EMPTY when the file is empty.

Portability:

This function is specific to the PanelView Plus CE.

Requirements:

Runs On	Version	Defined In	Link To
PanelView Plus CE	All	EventLog.h	EventLog.lib

Recommended PanelView Plus CE Mechanisms

These Win32 mechanisms have specific utility or packaging for the PanelView Plus CE platform. Some are simply not handled properly by the Platform Builder exporter and the PanelView Plus CE header file is described here for convenience.

Disable Keypad Handler

The PanelView Plus CE device supports a mechanism known as the keypad handler that permits the F-keys and K-keys on the keypad to be remapped to emulate alternate keys and/or multiple key presses. Refer to Keypad Overview on page 69. An application or a dialog that relies on unmapped keys should send a window message to the keypad handler to turn off the keypad mappings. Subsequently, the keypad handler can be re-enabled using a similar message.

Remarks

Call RegisterWindowMessage() with the value WM_ KEYPAD_HANDLER.

Call SendNotifyMessage() with the message identifier that was returned from RegisterWindowMessage() to disable and then to enable keypad mappings.

The first parameter enables keypad mappings when TRUE and disables the mappings when FALSE. The second parameter is ignored.

Restarting the system will restart the keypad handler, which enables the keypad mappings.

Behavior of the fixed (non-programmable) keys is unaffected.

The following code snip illustrates the mechanism:

```
UINT msgID =
RegisterWindowMessage(WM_KEYPAD_HANDLER);

// This dialog requires an unmapped keypad. Turn off the
keypad handler

SendNotifyMessage( HWND_BROADCAST, msgID, FALSE, 0 );
```

// Turn on the keypad handler.

SendNotifyMessage(HWND_BROADCAST, msgID, TRUE,0);

WM_KEYPAD_HANDLER is defined in othersdk.h in the PanelView Plus CE SDK.

Lock Pages

This Win32 function locks into memory the specified region of the virtual address space of the process, ensuring that subsequent access to the region does not incur a page fault.

```
BOOL LockPages (LPVOID lpvAddress, DWORD cbSize,
PDWORD pPFNs, int fOptions);
```

Where fOpions are one of the following:

```
LOCKFLAG_WRITE       // write access required

LOCKFLAG_QUERY_ONLY   0x002 // query only, page in but
don't lock

LOCKFLAG_READ       // read access required (as opposed to
page

 present but PAGE_NOACCESS)
```

Remarks

Platform Builder does not properly export the definitions. Use othersdk.h in the PanelView Plus CE SDK.

UnLock Pages

This Win32 function unlocks a specified range of pages in the virtual address space of a process, enabling the system to swap the pages out if necessary.

```
BOOL UnlockPages (LPVOID lpvAddress, DWORD cbSize);
```

Remarks

Platform Builder does not properly export the definition. Use othersdk.h in the PanelView Plus CE SDK.

SetSystemMemoryDivision

This Win CE function sets the amount of DRAM allocated to the system.

```
DWORD SetSystemMemoryDivision (DWORD dwStorePages);
```

Remarks

Total DRAM installed can be obtained with a call to rm_GetParameter() using RM_PARAMETER_PHYSICAL_MEMORY_SIZE as the first argument. 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. The number of 4KB pages to be allocated to the system is specified by dwStorePages.

Device Drivers

Overview

This chapter provides an overview of developing a device driver and sample code.

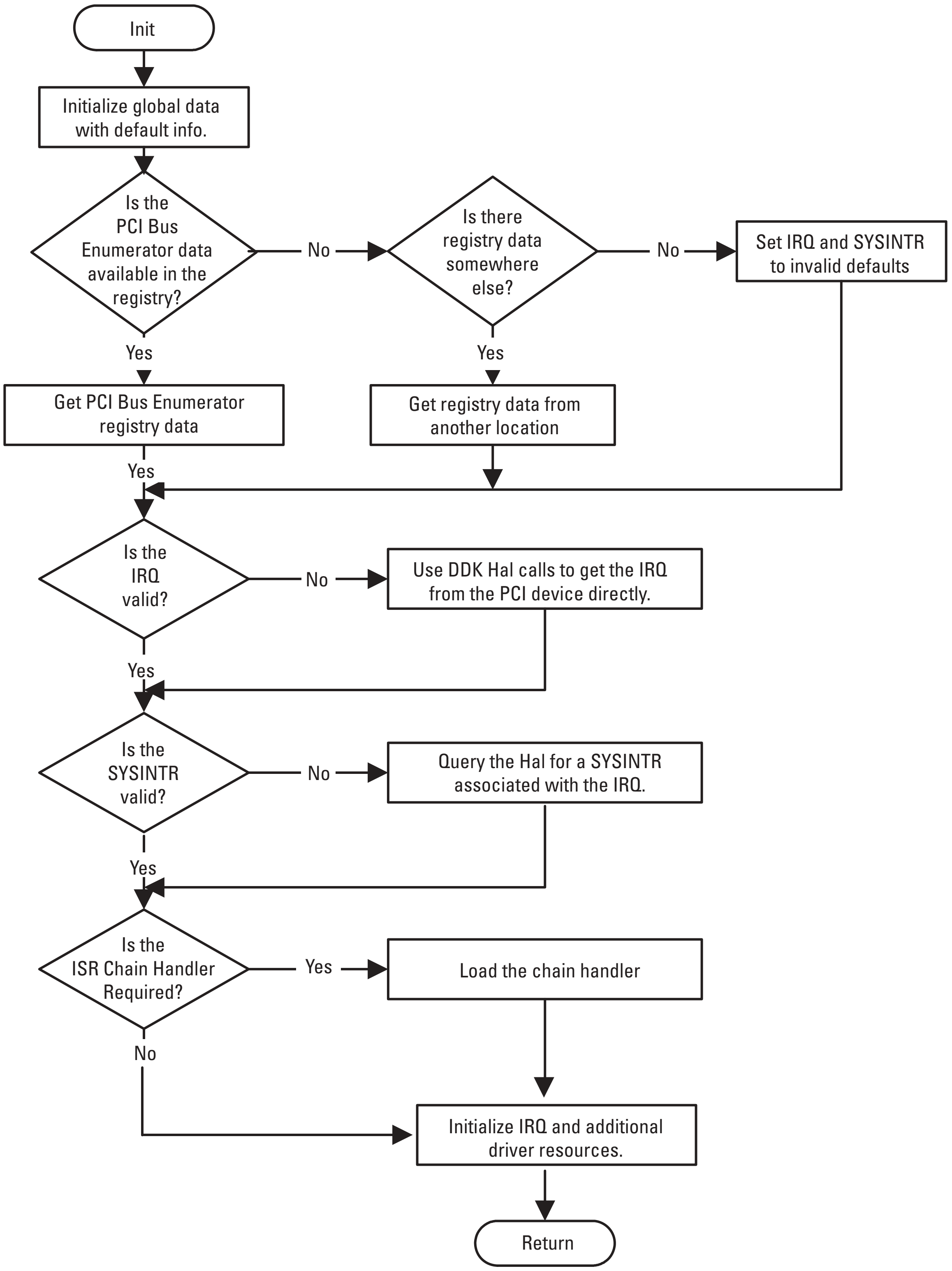
Developing a Device Driver

This discussion considers a device driver that implements the Win CE standard stream driver interface. Ideally, the stream driver interface should be the only interface used by applications, services, COM servers, and other drivers to communicate with hardware. Furthermore, a device driver is the only supported interface to the hardware.

The following discussion and code samples provide preferred methods for driver development. In an ever-changing CE OS landscape, using these recommended methods should help maintain compatibility with future platform releases.

It is recommended that the PCI or ISA bus enumerators be used to get configuration data for PCI or ISA devices. These enumerators collect configuration data from the device and deposit it in the registry. Using helper functions from the Driver Development Kit (DDK) the configuration information is easily obtained from the registry. Additionally these enumerators also manage the IO and Resource space, which helps protect your driver and hardware from access by other modules.

The following flow chart illustrates the preferred method for driver initialization.


Init
Initialize global data with default info.
Is the PCI Bus Enumerator data available in the registry?
No
Is there registry data somewhere else?
No
Set IRQ and SYSINTR to invalid defaults
Yes
Get PCI Bus Enumerator registry data
Yes
Get registry data from another location
Yes
Is the IRQ valid?
No
Use DDK Hal calls to get the IRQ from the PCI device directly.
Yes
Is the SYSINTR valid?
No
Query the Hal for a SYSINTR associated with the IRQ.
Yes
Is the ISR Chain Handler Required?
Yes
Load the chain handler
No
Initialize IRQ and additional driver resources.
Return

Sample Code

The code sample describes the preferred process for driver initialization and provides a good starting point that can be used as a model for actual production code. Though this code will compile, none of the constant data is valid for any real device, they are just placeholders for a developer to replace with proper values. Additionally, this driver only implements the XXX_Init and XXX_Deinit entry points.

The sample driver code illustrates several methods to obtain IRQ and SYSINTR data from the platform. When all other sources are exhausted this implementation will finally use pre-defined, hard-coded values. A driver that uses this method is more easily migrated to platforms that do not support specific features. For example; if the platform does not have a PCI bus enumerator, but does support the DDK Hal PCI functions, this driver implementation would still be able to get the needed configuration data. Then when the platform is changed and the PCI bus enumerator is supported, no re-design of the driver is needed.

```
//////////////////////////////////////////////////////////////////////
//
// File: driver.c
//
// Example of the preferred initialization processes used in
// CE platform stream based device driver development.
//
//////////////////////////////////////////////////////////////////////

#include <windows.h>
#include <pkfuncs.h>
#include <ceddk.h>
#include <ddkreg.h>
#include <nkintr.h>
#include <giisr.h>

//////////////////////////////////////////////////////////////////////
//
// USAGE Build switches
//
// Defining DRV_USE_IO will use x86 port IO instructions when needed.
// Defining DRV_USE_PCI will invoke PCI DDK calls to assist initialization.
// Defining DEV_USE_ISR will cause the driver to attempt to
// initialize a Chained ISR handler.
//
//////////////////////////////////////////////////////////////////////
```

```
#define DRV_USE_IO              // set to use port IO
#define DRV_USE_PCI             // set to use PCI DDK
#define DRV_USE_ISR             // set to invoke ISR handler

//////////////////////////////////////////////////////////////////////
//
// GIISR constants
//
// Refer to Microsoft documentation on the GIISR chain handler DLL for a
// detailed description of these parameters
//
// NOTE: these are example values.
//
//////////////////////////////////////////////////////////////////////

#define DRV_PORT_ADDR      0xb0000000
#define DRV_PORT_SIZE      sizeof(DWORD)
#define DRV_IRQ            0x1
#define DRV_SYSINTR        0x10
#if defined (DRV_USE_PCI)
#define DRV_VENDOR_ID      0x1010
#define DRV_DEVICE_ID      0x0101

//////////////////////////////////////////////////////////////////////
//
// PCI constants
//
// Refer to Microsoft documentation on PCI device drivers for a
// detailed description of these parameters
//
// NOTE: these are example values.
//
//////////////////////////////////////////////////////////////////////

#define DRV_DEVICE_NUM    1
#define DRV_FUNC_NUM      0
#define DRV_BUS_NUM       0
#endif // defined (DRV_USE_PCI)
#define DRV_INTSTAT_PENDING 0x1

//////////////////////////////////////////////////////////////////////
//
// DEBUG ZONE constants
//
// Refer to Microsoft documentation on DEBUG ZONES for a
// detailed description of these parameters
//
//////////////////////////////////////////////////////////////////////

#define ZONE_INIT         DEBUGZONE(0)
#define ZONE_FUNC         DEBUGZONE(13)
#define ZONE_WARN         DEBUGZONE(14)
#define ZONE_ERROR        DEBUGZONE(15)

//
// Macro used to call the HAL IOCTL to get a SYSINTR
// assigned to a IRQ (can be used to create the assignment also)
//
#define REQUEST_SYSINTR(i,s) \
   \
   KernelIoControl(IOCTL_HAL_REQUEST_SYSINTR, \
               (PVOID)&i,sizeof(i),(PVOID)&s, \
               sizeof(s),NULL)
//
// DEBUG zone text labels use by the platform debugger
//
#ifdef DEBUG
DBGPARAM dpCurSettings = {
   TEXT("TestDrv"), {
   TEXT("Init"),TEXT(""),TEXT("Stats"),TEXT(""),
   TEXT(""),TEXT(""),TEXT(""),TEXT(""),
   TEXT(""),TEXT(""),TEXT(""),TEXT(""),
   TEXT(""),TEXT("Function"),TEXT("Warning"),TEXT("Error") },
   0x00000000
};
#endif

//////////////////////////////////////////////////////////////////////
//
// Example driver global data structure
//
// This structure is used to store information for this DLLs instance
// only. All driver CreateFile() calls create separate "Open"
// instances. The driver should be written so that each of these
// open instances should be able to access the global instance data.
//
//////////////////////////////////////////////////////////////////////

typedef struct
{
   BOOL bExitThread;
   GIISR_INFO Gii;
   DDKISRINFO Dii;
   HANDLE hEvent;
   HANDLE hThread;
   DWORD dwThreadId;
#if defined(DRV_USE_ISR)
   HANDLE hIsrHandler;
#endif // defined(DRV_USE_ISR)
#if defined(DRV_USE_PCI)
   DDKWINDOWINFO Dwi;
   DDKPCIINFO Dpi;
#endif // defined(DRV_USE_PCI)
} DRV_DATA, *PDRV_DATA;

//////////////////////////////////////////////////////////////////////
//
// Function Prototypes
//
//////////////////////////////////////////////////////////////////////

#if defined(DRV_USE_PCI)
static BOOL
PciFindDevice(
  LPCTSTR szBaseInstance,
  USHORT VendorId,
  USHORT DeviceId,
  PDDKWINDOWINFO pdwi,
  PDDKISRINFO pdii,
  PDDKPCIINFO pdpi
  );
#endif // defined(DRV_USE_PCI)

DRV_Deinit(
    DWORD hDeviceContext
);

static DWORD WINAPI
IstThreadProc(
    LPVOID lpParameter
);

///////////////////////////////////////////////////////////////////////
//
// DRV_Init()
//
// Refer to Microsoft documentation on Device Driver Development for a
// detailed description of this function and its parameters.
//
// NOTE: This function will attempt to initialize a NOP driver that
// will be referred to as "DRV:". If a non-recoverable error occurs
// during the INIT phase this function will call DRV_Deinit(). This
// function is safe to call multiple times. This is done to insure
// proper driver cleanup.
//
///////////////////////////////////////////////////////////////////////

DWORD
DRV_Init(
    DWORD dwContext
)
{
#if defined(DRV_USE_PCI)
    DWORD dwErr;
#endif // defined(DRV_USE_PCI)
    PDRV_DATA pDrvData = NULL;
    DEBUGMSG(ZONE_FUNC, (TEXT("DRV_Init+\r\n")));

    //
    // first, create a memory block to store this drivers' global instance data
    //
    if (NULL == (pDrvData = (PDRV_DATA)LocalAlloc(LMEM_FIXED | LMEM_ZEROINIT,
                                            sizeof(DRV_DATA))))
    {
        ERRORMSG(1,(_T("DRV_Init: LocalAlloc failed!\r\n")));
        DEBUGMSG(ZONE_FUNC, (TEXT("DRV_Init-\r\n")));

        return (0);
    }

    //
    // fill in global info
    //
    pDrvData->bExitThread = FALSE;
    pDrvData->hEvent = INVALID_HANDLE_VALUE;
    pDrvData->hThread = INVALID_HANDLE_VALUE;
    pDrvData->Gii.SysIntr = 0;
    pDrvData->Gii.CheckPort = TRUE;
#if defined(DRV_USE_IO)
    pDrvData->Gii.PortIsIO = TRUE;
#else // defined(DRV_USE_IO)
    pDrvData->Gii.PortIsIO = FALSE;
#endif // defined(DRV_USE_IO)
#if defined(DRV_USE_ISR)
    pDrvData->Gii.UseMaskReg = FALSE;
    pDrvData->Gii.PortAddr = DRV_PORT_ADDR;
    pDrvData->Gii.PortSize = DRV_PORT_SIZE;
    pDrvData->Gii.Mask = DRV_INTSTAT_PENDING;
#endif // defined(DRV_USE_ISR)

#if defined(DRV_USE_PCI)

     //
    // Find the PCI devices driver information placed in
    // the registry by the PCIBus enumerator.
    //
    if (!(dwErr = PciFindDevice((TCHAR *)dwContext,
                              DRV_VENDOR_ID,
                              DRV_DEVICE_ID,
                              &pDrvData->Dwi,
                              &pDrvData->Dii,
                              &pDrvData->Dpi)))
    {
        ERRORMSG(1,(_T("DRV_Init: call to PciFindDevice() failed [0x%08x]!\r\n"),dwErr));
        DEBUGMSG(ZONE_FUNC, (TEXT("DRV_Init-\r\n")));
        DRV_Deinit((DWORD)pDrvData);

        return (0);
    }
#else // defined(DRV_USE_PCI)

    //
    // Here you may want to load registry values from
    // another location
    //

#endif // defined(DRV_USE_PCI)

    //
    // If the IRQ value has not been set yet, try
    // alternate methods to setting it.
    //
    if (0 == pDrvData->Dii.dwIrq)
    {
#if defined(DRV_USE_PCI)
        PCI_COMMON_CONFIG Pcc;
        PCI_SLOT_NUMBER Sn;
        DWORD dwLength;
#endif // defined(DRV_USE_PCI)

        // Set a default value from a constant.
        //
        pDrvData->Dii.dwIrq = DRV_IRQ;

#if defined(DRV_USE_PCI)
```

```
        //
        // Attempt to use lower level DDK function to get
        // information directly from the PCI controller.
        //

        ////////////////////////////////////////////////////
        //
        // Normally you would code a loop here that would be
        // used to search the PCI Bus for the desired device,
        // but for this example we are just going to assume
        // we know the BUS, Slot and Function number.
        //
        ////////////////////////////////////////////////////

        Sn.u.bits.DeviceNumber = DRV_DEVICE_NUM;
        Sn.u.bits.FunctionNumber = DRV_FUNC_NUM;

        // DDK call to query for PCI information
        dwLength = HalGetBusDataByOffset(PCIConfiguration, DRV_BUS_NUM,
                            Sn.u.AsULONG,
                            &Pcc, 0,
                              sizeof(PCI_COMMON_CONFIG));

        //
        // check to see if the call was successful
        //
        if (sizeof(PCI_COMMON_CONFIG) == dwLength)
        {
            pDrvData->Dii.dwIrq = Pcc.u.type2.InterruptLine;
        }
        else
        {
            DEBUGMSG(ZONE_INIT,(_T("DRV_Init: HalGetBusDataByOffset()")
                        _T(" call failed!\r\n")));
        }

#endif // defined(DRV_USE_PCI)
    }

    //
    // If the SYSINTR has not been assigned yet, try and ask the HAL
    // if it has or can assign a SYSINTR for you.
    //
    if (0 == pDrvData->Gii.SysIntr)
    {
        if (!REQUEST_SYSINTR(pDrvData->Dii.dwIrq,pDrvData->Gii.SysIntr))
        {
            pDrvData->Gii.SysIntr = DRV_SYSINTR;
        }
    }
```

```
#if defined(DRV_USE_ISR)

   //
   // If a DLL name was not assigned yet, just default the name for
   // use with the Microsoft GIISR chain handler.
   //
   if (NULL == pDrvData->Dii.szIsrDll)
   {
      _tcscpy(pDrvData->Dii.szIsrDll,_T("giisr.dll"));
   }

   //
   // If a ISRHandler name was not assigned yet, just default the name for
   // use with the Microsoft GIISR chain handler.
   //
   if (NULL == pDrvData->Dii.szIsrHandler)
   {
      _tcscpy(pDrvData->Dii.szIsrHandler,_T("IsrHandler"));
   }

   //
   // Install ISR handler if there is one
   //
   pDrvData->hIsrHandler = LoadIntChainHandler(pDrvData->Dii.szIsrDll,
                                       pDrvData->Dii.szIsrHandler,
                                       (BYTE)pDrvData->Dii.dwIrq);

   if (INVALID_HANDLE_VALUE == pDrvData->hIsrHandler)
   {
      ERRORMSG(1,(_T("DRV_Init: Couldn't install ISR handler!\r\n")));
      DEBUGMSG(ZONE_FUNC, (TEXT("DRV_Init-\r\n")));
      DRV_Deinit((DWORD)pDrvData);

      return (0);
   }

   ////////////////////////////////////////////////////////////////////////
   //
   // Communicate with the chain handler and pass to it the info needed to
   // detect a IRQ intended for this device.
   //
   // NOTE: This code assumes the chain handler conforms to the exact same
   //      interface as the GIISR.
   //
///////////////////////////////////////////////////////////////////////////
   if (!KernelLibIoControl(pDrvData->hIsrHandler, IOCTL_GIISR_INFO,
                     &pDrvData->Gii, sizeof(GIISR_INFO), NULL, 0, NULL))
   {
      ERRORMSG(1,(_T("DRV_Init: KernelLibIoControl call failed!\r\n")));
      DEBUGMSG(ZONE_FUNC, (TEXT("DRV_Init-\r\n")));
      DRV_Deinit((DWORD)pDrvData);

      return (0);
   }
#endif // defined(DRV_USE_ISR)

   //
   // Create the IST event.
   //
```

```
    if (INVALID_HANDLE_VALUE == (pDrvData->hEvent = CreateEvent(NULL,FALSE,FALSE,NULL)))
    {
        ERRORMSG(1,(TEXT("DRV_Init: CreateEvent call failed.\r\n")));
        DEBUGMSG(ZONE_FUNC, (TEXT("DRV_Init-\r\n")));
        DRV_Deinit((DWORD)pDrvData);

        return (0);
    }

    //
    // Now initialize the interrupt so that the kernel starts sending
    // events for this IRQ
    //
    if (!InterruptInitialize(pDrvData->Gii.SysIntr,pDrvData->hEvent,NULL,0))
    {
        ERRORMSG(1,(TEXT("DRV_Init: InterruptInitialize call failed.\r\n")));
        DEBUGMSG(ZONE_FUNC, (TEXT("DRV_Init-\r\n")));
        DRV_Deinit((DWORD)pDrvData);

        return (0);
    }

    //
    // Create the IST thread.
    //
    if (INVALID_HANDLE_VALUE ==
        (pDrvData->hThread = CreateThread(NULL,0,IstThreadProc,pDrvData,
                                          0,&pDrvData->dwThreadId)))
    {
        ERRORMSG(1,(TEXT("DRV_Init: CreateThread() call failed.\r\n")));
        DEBUGMSG(ZONE_FUNC, (TEXT("DRV_Init-\r\n")));
        DRV_Deinit((DWORD)pDrvData);

        return (0);
    }

    DEBUGMSG(ZONE_FUNC, (TEXT("DRV_Init-\r\n")));

    return ((DWORD)pDrvData);
}

/////////////////////////////////////////////////////////////////////
//
// DRV_Deinit()
//
// Refer to Microsoft documentation on Device Driver Development for a
// detailed description of this function and its parameters
//
/////////////////////////////////////////////////////////////////////
BOOL
DRV_Deinit(
    DWORD hDeviceContext
)
{
    PDRV_DATA pDrvData = (PDRV_DATA)hDeviceContext;

    DEBUGMSG(ZONE_FUNC, (TEXT("DRV_Deinit+\r\n")));
    //
    // If the pointer is invalid, just return
    //
    if (0 == hDeviceContext)
    {
        DEBUGMSG(ZONE_FUNC, (TEXT("DRV_Deinit-\r\n")));
        return (FALSE);
    }

    //
    // If the SYSINTR value is still valid
    // disable the IST connection
    //
    if (0 != pDrvData->Gii.SysIntr)
    {
        InterruptDisable(pDrvData->Gii.SysIntr);
        pDrvData->Gii.SysIntr = 0;
    }

#if defined(DRV_USE_ISR)
    //
    // Free the chain handler
    //
    // WARNING: this may not unload the actual DLL
    //          refer to Microsoft documentation on chain handlers
    //
    if (INVALID_HANDLE_VALUE != pDrvData->hIsrHandler)
    {
        FreeIntChainHandler(pDrvData->hIsrHandler);
        pDrvData->hIsrHandler = INVALID_HANDLE_VALUE;
    }
#endif // defined(DRV_USE_ISR)

    //
    // If the Thread is assumed to still be running,
    // try and stop it nicely,
    // or terminate it if it is possible.
    //
    if (INVALID_HANDLE_VALUE != pDrvData->hThread)
    {
        pDrvData->bExitThread = TRUE;

        if (INVALID_HANDLE_VALUE != pDrvData->hEvent)
            SetEvent(pDrvData->hEvent);

        if (WAIT_OBJECT_0 != WaitForSingleObject(pDrvData->hThread,1000))
            TerminateThread(pDrvData->hThread,0);

        CloseHandle(pDrvData->hThread);
        pDrvData->hThread = INVALID_HANDLE_VALUE;
    }

    //
    // close the event handle
    //
    if (INVALID_HANDLE_VALUE != pDrvData->hEvent)
    {
        CloseHandle(pDrvData->hEvent);
        pDrvData->hEvent = INVALID_HANDLE_VALUE;
    }

    //
    //  release the allocated global memory
    //
    if (NULL != pDrvData)

    {
        LocalFree((HLOCAL)pDrvData);
        pDrvData = INVALID_HANDLE_VALUE;
    }

    DEBUGMSG(ZONE_FUNC,(_T("DRV_Deinit-\r\n")));

    return (TRUE);
}

#if defined(DRV_USE_PCI)
////////////////////////////////////////////////////////////////////
//
// PciFindDevice()
//
// Groups the DDK calls to simplify the interface
//
////////////////////////////////////////////////////////////////////
BOOL
PciFindDevice(
  LPCTSTR szBaseInstance,
  USHORT VendorId,
  USHORT DeviceId,
  PDDKWINDOWINFO pdwi,
  PDDKISRINFO pdii,
  PDDKPCIINFO pdpi
  )
{
    BOOL FnRetVal = FALSE;  // Return value for this function.
    HKEY hkInstance;
    DWORD dwStatus;

     DEBUGMSG(ZONE_FUNC, (TEXT("PciFindDevice+\r\n")));

    ////////////////////////////////////////////////////////
    //
    // read the registry to get our PCI instance information
    //
    ////////////////////////////////////////////////////////
    dwStatus = RegOpenKeyEx(HKEY_LOCAL_MACHINE, szBaseInstance,
                        0, 0, &hkInstance);

    if (dwStatus == ERROR_SUCCESS)
    {
        pdwi->cbSize = sizeof(*pdwi);
        dwStatus = DDKReg_GetWindowInfo(hkInstance, pdwi);

                if (dwStatus == ERROR_SUCCESS)
        {
            pdpi->cbSize = sizeof(*pdpi);
            dwStatus = DDKReg_GetPciInfo(hkInstance, pdpi);
        }
        if (dwStatus == ERROR_SUCCESS)
        {
            pdii->cbSize = sizeof(*pdii);
            dwStatus = DDKReg_GetIsrInfo(hkInstance, pdii);
        }

        RegCloseKey(hkInstance);
    }
    else
        ERRORMSG(1,(_T("PciFindDevice: call to RegOpenKeyEx() failed! ")
                _T("[0x%08x]\r\n"),GetLastError()));

        // check the registry information
    if (dwStatus == ERROR_SUCCESS)
    {
        if ((pdpi->dwWhichIds &
            (PCIIDM_VENDORID | PCIIDM_DEVICEID)) !=
            (PCIIDM_VENDORID | PCIIDM_DEVICEID))
        {
            ERRORMSG(1,(_T("PciFindDevice: Invalid dwWhichIds!\r\n")));
            dwStatus = ERROR_INVALID_DATA;
        }
        else if(pdpi->idVals[PCIID_VENDORID] !=
                VendorId || pdpi->idVals[PCIID_DEVICEID] != DeviceId)
        {
            ERRORMSG(1,(_T("PciFindDevice: Invalid VendorId!\r\n")));
            dwStatus = ERROR_INVALID_DATA;
        }
        else if(pdwi->dwNumMemWindows < 2)
        {
            ERRORMSG(1,(_T("PciFindDevice: Invalid dwNumMemWindows!\r\n")));
            dwStatus = ERROR_INVALID_DATA;
        }
        else if(pdii->dwSysintr ==
                SYSINTR_NOP && pdii->dwIrq == IRQ_UNSPECIFIED)
        {
            ERRORMSG(1,(_T("PciFindDevice: Invalid dwSysintr AND dwIrq!\r\n")));
            dwStatus = ERROR_INVALID_DATA;
        }
    }
    //
    // did we get everything we need?
    //
    if (dwStatus == ERROR_SUCCESS)
        FnRetVal = TRUE;

    DEBUGMSG(ZONE_FUNC, (TEXT("PciFindDevice-\r\n")));

    return (FnRetVal);
}
#endif // defined(DRV_USE_PCI)

////////////////////////////////////////////////////////////////////
//
// IstThreadProc()
//
// An example of a IST
```

```
//
////////////////////////////////////////////////////////////////////

DWORD WINAPI
IstThreadProc(
    LPVOID lpParameter
)
{
    PDRV_DATA pDrvData = (PDRV_DATA)lpParameter;
    DWORD dwRet;

    DEBUGMSG(ZONE_FUNC, (TEXT("IstThreadProc+\r\n")));

    while ((dwRet = WaitForSingleObject(pDrvData->hEvent,INFINITE)) != WAIT_FAILED)
    {
        if (dwRet == WAIT_OBJECT_0)
        {    if (pDrvData->bExitThread)
                break;

            RETAILMSG(1,(_T("IstThreadProc: IST HAS FIRED!\r\n")));

            InterruptDone(pDrvData->Gii.SysIntr);
        }
    }

    DEBUGMSG(ZONE_FUNC,(_T("IstThreadProc-\r\n")));

    return (TRUE);
}
```

For a detailed explanation of the stream driver interface and how to load a stream driver refer to the Microsoft documentation for stream driver development.

Messages

Serial Debug Messages

The boot loaders and WinCE support a Debug Monitor that, when enabled, will emit trace messages on the serial port.

The Debug Monitor uses the following COM port parameters:

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

Any display device with a serial interface set to the above parameters can be used to view the messages. The recommended cable is an Allen-Bradley 2706-NC13 or equivalent. On a Windows desktop computer, a communications utility such as HyperTerminal is a good choice. The start-up operations emit a large volume of messages and are a good opportunity to experience the debug monitor.

Serial Debug Messages can be enabled or disabled using the Miscellaneous System API call rm_SetParameter(). For example:

```
    // Turn on Serial Debug
rm_SetParameter(RM_PARAMETER_ENABLE_SERIAL_DEBUG,
    &dwSize,
    pvData);

    // Make it persistent on Boot

rm_SetParameter(RM_PARAMETER_ENABLE_SERIAL_DEBUG_O
N_BOOT,
    &dwSize,
    pvData);
```

Alternatively, the ability to control the Serial Debug Option is packaged in a standalone program named DebugOptions.exe that is distributed in the Utilities folder on the PanelView Plus CE Accessories CD, P/N 77159-951-55.

Within an application, debug output is easily implemented by including the dbgapi.h header file and using NKDbgPrintfW(LPWSTR lpszFmt, …).

Exception Debug Messages

PanelView Plus CE supports an exception handler named crashlog.exe that dumps exception debug messages to a text file at \Storage Card\Exceptions.log

To enable the Exception Logger, run the program named DebugOptions.exe that is distributed in the Utilities folder on the PanelView Plus CE Accessories CD, Part Number 77159-951-55. The exception logger will run in the background until an exception occurs that is not handled by the application.

C++ Name Mangling

In C++, name decoration or mangling is necessary to resolve ambiguities that arise in C++ from having overloaded C++ functions with the same name but different parameters. The compiler generates a string that contains an undecorated (literal) name followed by a string of characters that the compiler and linker use to retain type information. Thus, the declarations are made type-safe even though the names are the same.

When linking a C library into a C++ program, a link error LNK2001: unresolved external symbol **int __cdecl FuncName(unsigned long)** (?FuncName@@YAHK@Z) occurs because the mangled function name, with the decorator @@YAHK@Z after the real function name is incompatible with the C name. The workaround is to explicitly tell the compiler not to mangle the function name. You can force it to treat the name as a straight C-style name (no mangling) by using extern C to prototype the function as follows:

```
extern C BOOL FuncName(DWORD);
```

The header files have the logic to declare all the prototypes as extern C if __cplusplus is defined, which embedded Visual C++ 3.0 should treat as being defined if compiling a C++ file. If you have trouble, check your eVC settings or manually add a prototype with the extern C so that the name is not mangled and it can link.

Path

The notion of path is much the same as any other Windows or DOS system. WinCE searches the following path for a module:

1. The .EXE launch directory
2. The windows (\windows) directory
3. The root (\) directory
4. An OEM-dependent directory defined by the registry key **SystemPath**

The key **\HKLM\Loader\SystemPath** in the Windows CE Registry to specify a search path to use with the **LoadLibrary** and **CreateProcess** functions.

For Example:

> \storage card\bin\ \storage card\ \ storage card2\bin\ \storage card2\ \storage card3\bin\ \storage card3\ is the default path.

Error Codes

Whenever a program reports a failure, a numeric code is frequently provided.

For example:

```
KeyPad: Unable to load external '\Storage Card\Platform\kh.dll'
keypad
handler [1150]. Loading stub…
```

Typically the number is returned by GetLastError(). A good starting point in the failure analysis would be a scan for the number in the file WINERROR.H, which contains a complete list of the Win 32 API error codes. The file is found at:

```
...\Windows CE Tools\wce410\PanelViewPlusCE\Include\X86
```

Alternatively, use Error Lookup in the Tools command in Microsoft eMbedded Visual C++ 4.0.

Rockwell Automation Support

Rockwell Automation provides technical information on the Web to assist you in using its products. At http://support.rockwellautomation.com, you can find technical manuals, a knowledge base of FAQs, technical and application notes, sample code and links to software service packs, and a MySupport feature that you can customize to make the best use of these tools.

For an additional level of technical phone support for installation, configuration, and troubleshooting, we offer TechConnect Support programs. For more information, contact your local distributor or Rockwell Automation representative, or visit http://support.rockwellautomation.com.

Installation Assistance

If you experience a problem with a hardware module within the first 24 hours of installation, please review the information that's contained in this manual. You can also contact a special Customer Support number for initial help in getting your module up and running.

United States	1.440.646.3223 Monday – Friday, 8am – 5pm EST
Outside United States	Please contact your local Rockwell Automation representative for any technical support issues.

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