

**TREQ<sup>®</sup>-M4**  
**MOBILE DATA TERMINAL MANUAL**

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Manual updated 23 March 2011.

## **FCC Compliance Information**

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

Any modification to the TREQ-M4 (including changes to the recommended antenna configuration) that are not expressly approved by Beijer Electronics could void the user's authority to operate the TREQ-M4.

Additionally, the TREQ-M4 may contain the following FCC module-certified components depending on product configuration: AU792U07A31817, AU792U09D24824, AU792U04A22740, or Q72WLC300GRS.

## Notes

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## CHAPTER 1

# INTRODUCTION

---

The TREQ®-M4 mobile data terminal is a rugged yet economical graphic terminal for use in a wide range of commercial mobile applications. It has been designed with a robust set of industrial-grade features and options.

- Windows® Embedded CE 6.0 operating system
- Marvell® PXA300 processor (ARMV5TE) with Intel XScale™ technology running at 624 MHz
- 2 Gbytes non-volatile storage (with support for larger capacities)
- 128 Mbytes of DDR SDRAM
- Bright 109 mm (4.3") TFT color WQVGA (480 x 272) display with 600 nit brightness
- Analog-resistive touch screen
- Four lighted programmable elastomeric function keys
- Built-in speaker and built-in jack for external speaker connection
- Permanent integral cable with strain relief (customizable)
- Tough automotive grade polycarbonate housing
- Custom logo and/or custom keypad text/symbols (optional)
- Stud pattern on the back of the case for industry-standard mounts
- Two USB 2.0 full speed host ports
- Support for standard USB keyboards, mice, and memory devices
- Two serial ports: one EIA-232/422 (software configurable) and one EIA-232 serial port
- One additional USB host port in cable (optional)
- 10/100Base-T wired Ethernet
- Bluetooth for convenient wireless connectivity (optional)

- Three-track magnetic card reader for rapid data processing (optional)
- Wide operating temperature of -20 to 70 °C, storage temperature of -40 to 85 °C
- 6 to 32 VDC input voltage range
- Built-in protection from power transients and spikes (SAE J1455 compliant)
- Support for application development with industry standard tools such as Microsoft® Visual Studio 2005 and 2008
- Optional TREQ-M4 Developer's Kit that includes: TREQ-M4, Break Out Box (BOB), power supply, USB memory drive, null modem cable, USB-to-serial converter, RAM mount, user guide, and software development kit

## CHAPTER 2

# PRODUCT DESCRIPTION AND ARCHITECTURE

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## 2.1 Hardware

### 2.1.1 User Interface

#### **Display**

The TREQ-M4 features a TFT color WQVGA (480 x 272 pixels) LCD display, 109 mm (4.3") diagonal size. The display's high brightness (600 nit) offers excellent daylight readability.

#### **Touch Screen**

A clear analog-resistive touch screen covers the entire display area and can be used for most input.

#### **Keypad**

There are four lighted, tactile elastomeric keys. Green LEDs provide high brightness back lighting with adjustable intensity. The keys can be independently programmed to perform separate tasks as desired.

Text and/or symbols on the elastomeric keypad may be customized during manufacturing.

#### **Magnetic Card Reader**

A three-track, bidirectional magnetic card reader is an optional feature on the TREQ-M4. The card reader meets ANSI/ISO/AAMVA standards.

#### **External Peripherals**

Two full-speed USB ports are available on the back of the TREQ-M4. A third USB port in the integral cable is optional. These ports can be used to add many other devices, such as a keyboard, mouse, or 802.11 wireless Ethernet device.

### 2.1.2 Processor

The processor in the TREQ-M4 is the Marvell PXA300 processor (ARMV5TE), incorporating Intel XScale technology running at 624 MHz.


### 2.1.3 System and Application Memory

#### **DRAM**

The TREQ-M4 includes 128 Mbytes of DDR SDRAM volatile memory with a maximum bandwidth of 520 Mbytes per second.

#### **Flash**

The TREQ-M4 uses an internal 2 Gbytes flash to hold the main Windows CE image and provide non-volatile storage for user applications and data.

**NOTE**  *The terminal may be customized with a larger capacity flash. Contact Beijer Electronics technical support at <http://www.beijerelectronicsinc.com/support/contact/?type=tech> for more information.*

### 2.1.4 Serial Communications

The TREQ-M4 has two serial ports, designated COM1 and COM2, that can communicate up to 3.6 MBaud. Refer to [Chapter 9, “Mechanical”](#) for serial port pinout data.

The COM1 serial port can be configured in software to your choice of EIA-232 with hardware flow control (supporting RX, TX, RTS, and CTS) or EIA-422. COM2 is an EIA-232 port without hardware flow control (RX and TX only) and is not configurable.

The TREQ-M4 also has two powered (500 mA per port) full-speed USB host ports that are USB 2.0 compliant. The ports are located on the back of the unit. The TREQ-M4 may be optionally configured to support a third USB port in the integral cable. For this configuration, power is shared between the top-most port on the back of the unit and the port in the integral cable.

### 2.1.5 Network

The TREQ-M4 has an internal 10/100Base-T wired Ethernet adapter for network communications.

### 2.1.6 Speaker

The TREQ-M4 includes an internally mounted 20 x 40 mm speaker, providing the ability to play a variety of audio, including audible feedback, warnings, messages, and media clips. A speaker jack on the back of the unit provides the option of an external speaker. The internal speaker is disabled when an external speaker is attached. The speaker jack output is amplified (it is not a line-out signal).

### 2.1.7 Bluetooth

An internal Bluetooth option is available for convenient wireless connectivity. The TREQ-M4 Bluetooth option is class 2, v2.0 compliant and supports the following profiles: GAP, GOEP, SPP, DUN, FTP, HID, HFP, HSP, HID, LAP, ODD, PAN. Example applications that utilize some of these profiles are: virtual serial port, keyboard/mouse interface, and personal area network.

### 2.1.8 Power Supply

The TREQ-M4 has a 6- to 32-volt input range and can be powered directly from a 12- or 24-volt power supply. The terminal includes circuitry to protect against normal variations such as transients and spikes (SAEJ1455 compliant).

The TREQ-M4 can operate on a supply voltage as low as six volts in order to withstand occasional voltage dips. These can occur, for example, due to the effects of cold cranking ignition on a vehicle battery. Attached USB devices and the speaker (internal or external) will temporarily lose power and the display backlight may dim (in order to save power) as the supply voltage dips below about seven volts. TREQ-M4 driver software will restore these functions as the input voltage stabilizes to a higher voltage. A low input voltage detection circuit provides the capability for the operating system to notify application software of a reduction and restoration of input supply voltage level. Refer to [section 6.3.3, “EMP \(Emergency Power\)”](#) for more details.

### 2.1.9 Housing


The TREQ-M4 housing is made of a tough, automotive grade polycarbonate that is designed to withstand everyday use in commercial mobile environments.

A two-bolt stud pattern on the back of the case allows installation of the TREQ-M4 using industry-standard mounts such as RAM Mount products.

A custom logo may be pad printed on the front of the case during manufacturing. The standard options for pad printing are the TREQ-M4 logo or no printing (blank).

### 2.1.10 Integral Cable

The TREQ-M4 integral cable includes power, ground, and signals for two serial ports and one Ethernet/optional USB port. The cable is two meters in length and terminates with a female DB15 connector. Refer to [section 9.2, “Integral Cable”](#) for pinout and connection information.

**NOTE**  *Your cable configuration may be customized with a different length and connector type. Contact Beijer Electronics technical support at <http://www.beijerelectronicsinc.com/support/contact/?type=tech> with cable connector issues.*

### 2.1.11 Developer’s Kit

The TREQ-M4 Developer’s Kit includes all of the hardware and software tools necessary for developing applications on the TREQ-M4 mobile data terminal. These include the following:

- Break Out Box with power supply  
This device is used to power the TREQ-M4 and provide serial and Ethernet and/or USB host communications connections to the TREQ-M4. Refer to [Chapter 6, “Application Development”](#) for more information on setting up the TREQ-M4 to debug and develop applications over an Ethernet connection. Refer to [section 9.3, “Break Out Box \(BOB\) Pinouts”](#) for pinout and connection information.
- USB to serial converter and null modem serial cable  
These items can be used to set up an ActiveSync® connection between the TREQ-M4 and a PC. An ActiveSync connection can be used to download and debug applications written for

the TREQ-M4. Refer to [Chapter 6, “Application Development”](#) and [Chapter 5, “Connect to a PC Via ActiveSync”](#) for additional information.

- USB memory drive  
This device may be inserted into one of the TREQ-M4’s USB ports and used as an external hard disk. The drive contains the TREQ-M4 user guide, software development kit (SDK), and demo application source code.

The SDK provides support for developing applications for the TREQ-M4 in the form of libraries and header files. Refer to [section 6.2.2, “SDK Installation”](#) for more information on the software development kit.

Source code and a Microsoft Visual Studio 2008 solution are provided for the demo application preinstalled on TREQ-M4 terminals with the Developer’s Kit. The demo is a .NET-based application that is written in C# and provides several examples of how to interface with the TREQ-M4 hardware.

- RAM mount  
Refer to the “Getting Started” insert included with the TREQ-M4 Developer’s Kit for a drawing and quick start instructions.

## 2.2 Software

### 2.2.1 Bootloader

The TREQ-M4 has a bootloader application that executes on boot-up, loads the Windows CE kernel into memory, and boots the kernel. The bootloader initializes the keypad backlight to half intensity while the Windows CE kernel is loading. Other than the green LEDs, there is no indication that the bootloader is executing—the screen is black and the speaker is silent. The TREQ-M4 has a typical 10- to 20-second boot time. Refer to [section 10.1.2, “Bootloader”](#) for information on upgrading the bootloader.

### 2.2.2 Windows CE

The TREQ-M4 runs the Windows Embedded CE 6.0 operating system. Windows CE is a resource-constrained and scalable version of Microsoft Windows for embedded hardware that offers broad support for third-party application development, software, and hardware.

The TREQ-M4 utilizes the Core or Professional (optional) version of Windows CE that includes application support libraries, graphical shell (Windows Explorer), and other items. The Core version does not include Windows Media Player (codecs are included) and Internet Explorer. The graphical shell contains program management and control panel routines. Following are some of the components that are included with the TREQ-M4. For a complete list, refer to the document available from the following website:  
<http://www.microsoft.com/windowembedded/en-us/products/windowsce/component-library.mspx>



- Active Template Library
- Microsoft Foundation Classes
- .NET Compact Framework v3.5
- ActiveSync
- Local Area Networking
- Wide Area Networking
- Peer-to-Peer Networking
- Power Management
- Hive-based (persistent) Registry
- Direct Draw video graphics engine
- Command Shell
- Graphical Shell
- Soft Keyboard

Windows CE on the TREQ-M4 uses about 21 Mbytes of disk space in the form of an image file named NK.BIN in the `\HardDisk` directory. This file contains all of the above components and the code required to set up and operate TREQ-M4 hardware (device drivers). The operating system may need to be upgraded for future releases. See [Chapter 10, “Technical Support”](#) for details on how to upgrade the TREQ-M4 system package.

### 2.2.3 Device Drivers

The TREQ-M4 contains hardware peripherals that require additional support beyond that provided by Windows CE to set up and operate. Beijer Electronics provides software device drivers for these peripherals as part of the standard operating system installation. Following is a list of some peripherals requiring Beijer Electronics-provided support.

- LCD display
- Display and keypad backlight
- Audio codec/controller
- Touch screen
- Integrated keypad
- Serial ports

- Ethernet interface
- USB host ports
- Low input voltage detection
- Power management
- Real time clock

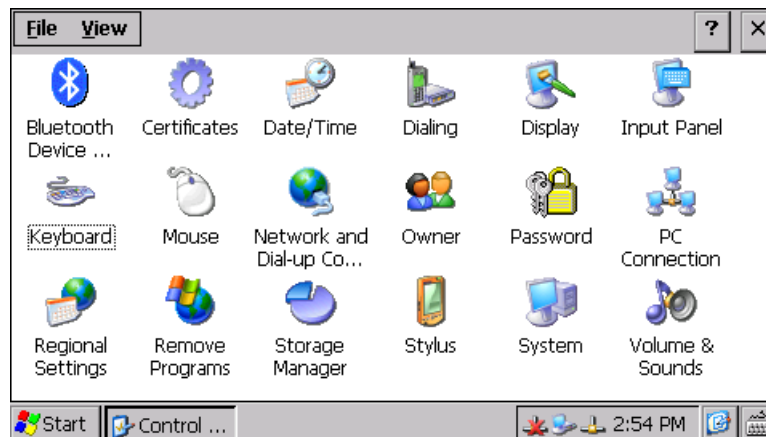
Device drivers are included in the operating system as dynamically linked libraries. They are loaded and initialized at boot-up and provide run-time interfaces for application programming.

A standard driver application interface allows you to dynamically configure the hardware without detailed knowledge about the components. For example, you can set the display and keypad backlight intensities and re-map the keypad key functions. See [Chapter 6, “Application Development”](#) for details on the device driver program interfaces and how they can be used in user applications.

## 2.2.4 System Settings

Control panel applets provide a graphical user interface for controlling some of the TREQ-M4 hardware peripherals. These applets utilize the device driver interfaces described in the previous section. Display the control panel in Windows CE by tapping the Start menu and then **Settings, Control Panel** (see Figure 1, “Windows CE Control Panel”).

The TREQ Panel desktop shortcut provides a convenient central location to access most of the commonly used hardware controls. Refer to [Chapter 4, “System Settings”](#) for detailed information about the TREQ Panel and other control panel applets that control the TREQ-M4 hardware.



*Figure 1*  
*Windows CE Control Panel*

### 2.2.5 Applications

Windows CE comes with several user applications (see section 2.2.2, “Windows CE”). In addition, there are a variety of utility applications available with Windows CE. These applications are located either in the \Windows directory or on the flash drive. Beijer Electronics provides applications to supplement the Windows CE applications, including *RegEditCE.exe* for editing the registry. These applications are located on the flash drive. In addition, you can write your own applications for the TREQ-M4. These applications must be compiled for Windows CE running on an ARM platform. See Chapter 6, “Application Development” for application development setup instructions and code samples.

The TREQ-M4 Developer’s Kit includes a special application called “TREQ Demo” (see Figure 2, “TREQ Demo Application”). You can access the demo from a desktop shortcut. TREQ Demo can be downloaded from <http://www.beijerelectronicsinc.com> and installed on any TREQ-M4. This application highlights some of the hardware and software capabilities of the TREQ-M4 and illustrates the potential for user applications. TREQ Demo is a .NET-based C# Smart Device application compiled with Microsoft Visual Studio 2008.



Figure 2  
TREQ Demo Application

Notes

## CHAPTER 3

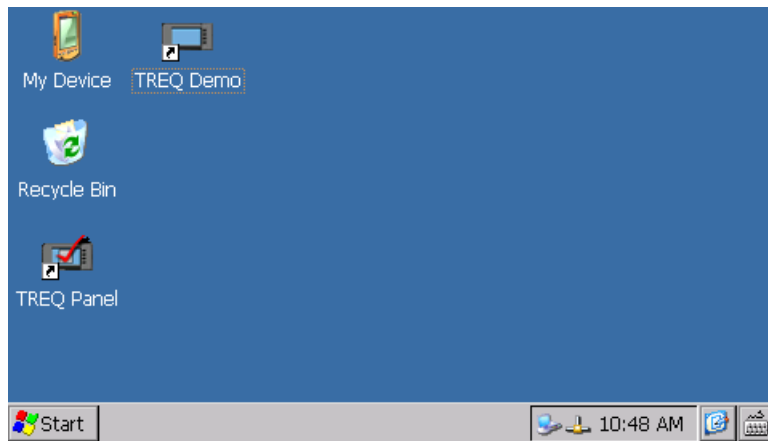
# GETTING STARTED

---

### 3.1 Power On/Off/Reset

#### 3.1.1 Turn On the TREQ-M4

To turn on the TREQ-M4, attach the integral cable connector to a power source. The TREQ-M4 boots and loads the operating system, as shown below.



*Figure 3*  
*Windows CE Desktop*

Icons for software your company has installed may be displayed next to those shown above.

To use the TREQ-M4, press the keys on the TREQ-M4 frame, or tap the touch keys on the touch screen.

Refer to [section 3.2, “Touch Screen”](#) for information on using the touch screen.

Refer to [section 3.3, “Function Keys”](#) for information on using the function keys.

#### 3.1.2 Turn Off the TREQ-M4

You can use one of three methods to turn off the TREQ-M4, as follows:

- Hold down the bottom-most (fourth from the top) keypad key for five seconds. Press the same key again to turn it back on.
- Disconnect the integral cable from the power source. Reconnect the cable to the power source to power the unit back on.

- If you have a Developer's Kit with a Break Out Box, set the power switch on the Break Out Box to the “off” position. Set it to the “on” position to power the unit back on.

When the TREQ-M4 is powered off, information in the Windows CE registry and any data stored on the internal flash hard-disk (*\HardDisk*) is retained. However, the Windows CE file system root folder is RAM-based and will be lost. Consequently, any information that must be retained must be stored under the *\HardDisk* and *\USBHardDisk* folders. To avoid losing data, make sure you close any open applications and back up data to a persistent storage location before powering off the TREQ-M4. **Corruption will occur if data is being written to files located on *\HardDisk* or *\USBHardDisk* during a loss of power.**

### 3.1.3 Reset the TREQ-M4

Reset the TREQ-M4 if the operating system stops operating. Press and hold the bottom-most (fourth from the top) keypad key for five seconds. Release the key, and momentarily press it again to boot. If the TREQ-M4 does not restart, verify that the integral cable is fully seated and has power.

## 3.2 Touch Screen

### 3.2.1 Touch Screen Care

Use only your fingertip or a stylus to tap the touch screen. Other objects (such as either end of a pencil) will damage the transparent film or plastic backing. Use a light touch, just hard enough for the screen to respond.


To clean the touch screen, moisten a soft cloth with water or a window cleaner such as Windex®. Then gently wipe the screen clean with the cloth. Do not spray liquid directly on the touch screen.

### 3.2.2 Touch Screen Use

When you tap or press on the TREQ-M4 touch screen, it responds with a clicking sound. Tap on an icon (e.g., “My Device”) to highlight and select the item. Tap twice (double-tap) on an icon to open the item or start the program.

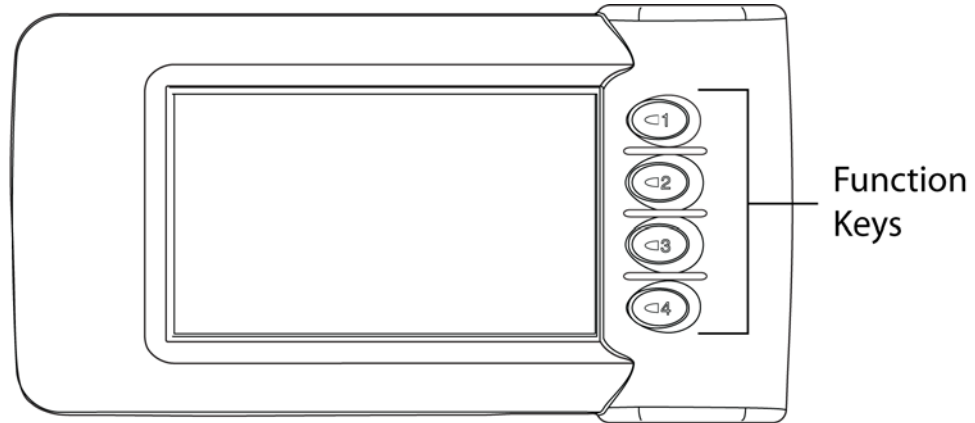
Tap **[Start]** to display the Windows Start menu, which gives you access to all system functions and programs. Any of the menu options with right-pointing arrows will open a sub-menu. Tap once on an option to display its sub-menu. For example, tap **Programs**, and a sub-menu of all user programs loaded on your TREQ-M4 is displayed.

Tap the screen background to close the Start menu, or tap **[Start]** again.

**NOTE**  *If you are having problems selecting functions on the touch screen, you may need to recalibrate the touch screen. Refer to [section 4.1.1.2, “Recalibrate” on page 18](#) for information.*

### 3.3 Function Keys

The TREQ-M4 has four function keys, as shown below.



*Figure 4*  
*TREQ-M4 Function Keys*

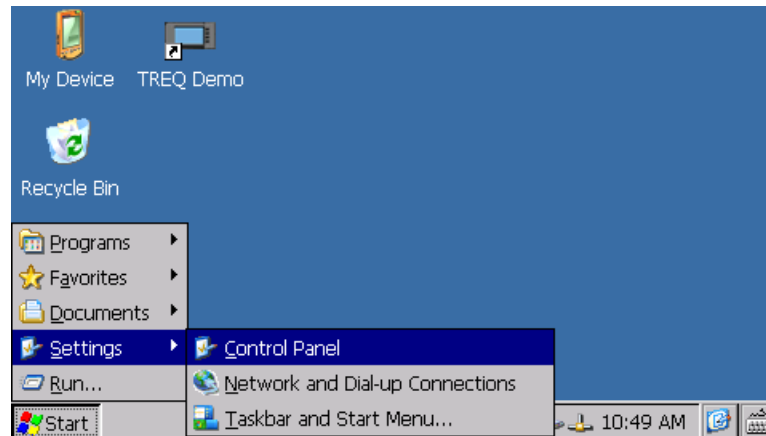
The function keys are mapped by default to the keyboard keys F1, F2, F3, and ESC (top to bottom). The bottom-most key can be used to power off or reset the TREQ-M4. Refer to [section 3.1.2, “Turn Off the TREQ-M4”](#) and [section 3.1.3, “Reset the TREQ-M4.”](#) The keys may be mapped to any keyboard or mouse (cursor control) function. In addition, keys may be mapped to launch applications or initiate a sequence of actions. You can modify the Windows CE registry or write a program to set the keypad mappings. Refer to [section 6.3.1, “Keypad”](#) for more details.

The function keys may be configured for a normal and a shifted state. The shifted state provides a mechanism to quickly switch between two sets of mappings. The keypad state can be changed programmatically (refer to [section 6.3.1](#) for details on the keypad driver API). The `\HardDisk\bin\KeyShiftCE.exe` utility is a sample application that switches the keypad state. The function keys are mapped by default in the shifted state to launch Windows Explorer (top-most key) and the keyboard keys “b” through “d.”

Autorepeat is disabled by default for these keys.

### 3.4 System Settings

To access the system settings (calibration, double-click (double-tap), backlight, keyboard, TREQ panel, date/time, volume and sounds, and more) through the Windows CE control panel, select **Start**, **Settings**, and **Control Panel** as shown below.



*Figure 5*  
*Windows CE Start Menu*

Refer to [Chapter 4, “System Settings”](#) for information on the control panel settings.

### 3.5 Install Third-Party or Custom Software


You can install any software application on the TREQ-M4 that is compatible with Windows CE, has been compiled for the ARM platform, and does not exceed the system requirements of your TREQ-M4. You can download it from a network or the Internet (depending on your interface setup), or you can use ActiveSync (refer to [Chapter 5, “Connect to a PC Via ActiveSync”](#) for information).


Third-party software applications are typically packaged in a Microsoft CAB file format, which are then packaged in a PC-side installer executable or Microsoft MSI file. The bare CAB files can be copied to the TREQ-M4 and installed manually, or the MSI file can be executed on a PC and the included CAB file downloaded and installed via ActiveSync.

For applications installed via ActiveSync, execute the downloaded installation file from Windows Explorer on a PC. The application installer should automatically launch ActiveSync, download a CAB file to the TREQ-M4, and initiate installation of the CAB file on the TREQ-M4.

A CAB file can be downloaded directly to the TREQ-M4 without ActiveSync. For this type of installation, double-tap the CAB file from a Windows Explorer session on the TREQ-M4 to initiate the installation process.



**NOTE**  *It is recommended that the destination of the CAB file installation files be in the HardDisk directory because that storage location is on the internal persistent storage, otherwise the installation will be lost after a power cycle. See [section 3.1.2, “Turn Off the TREQ-M4”](#) for more details.*

**NOTE**  *See [section 10.1.1, “Operating System”](#) on page 81 for information about UpgradeCE.exe, a Beijer Electronics package manager program that can be used similarly to the Windows CE CAB installer. UpgradeCE.exe software application packages and settings are retained even after system firmware upgrades.*

### 3.6 Run Third-Party Software

Third-party or custom software installed on the TREQ-M4 may be listed in the Start menu under “Programs.” Tap a program name in the menu to run the program.

A program may also have an icon on the desktop. If so, double-tap the icon to start the program.

### 3.7 Build Your Own Software

You can write your own applications and program your own key functions (for the function keys on the TREQ-M4) using Microsoft programming tools. Refer to [Chapter 6, “Application Development”](#) for more information.

Notes

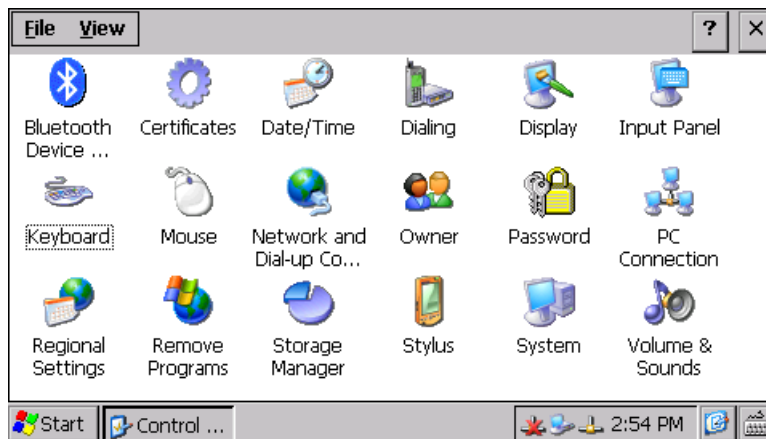
## CHAPTER 4

# SYSTEM SETTINGS

---

### 4.1 Control Panel

Many of the system settings can be adjusted through the Windows CE control panel. To access the control panel, select **Start, Settings, and Control Panel**.



*Figure 6*  
*Windows CE Control Panel*

Applets on the control panel that are used to configure TREQ-M4 settings include the following (see Figure 6, “Windows CE Control Panel”):

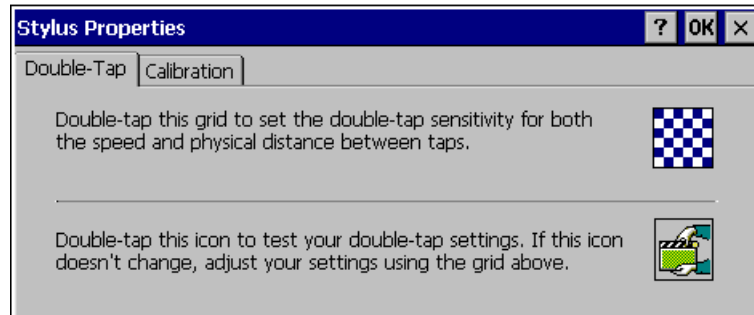
- Stylus
- PC Connection
- Keyboard
- Date/Time
- Volume and Sounds
- Network and Dial-up Connections
- Storage Manager
- Bluetooth Device Manager

#### 4.1.1 Stylus

Use the Stylus applet to set the double-tap speed and spacing or to recalibrate the touch screen. You should recalibrate any time it becomes difficult to make selections or to double-tap items on the screen. Double-tap the **Stylus** icon on the control panel, and the Stylus Properties dialog box is displayed.

#### 4.1.1.1 Double-Tap

To set the speed and distance between double-taps, tap the **Double-Tap** tab, as shown below.



*Figure 7*  
*Stylus Properties, Double-Tap*

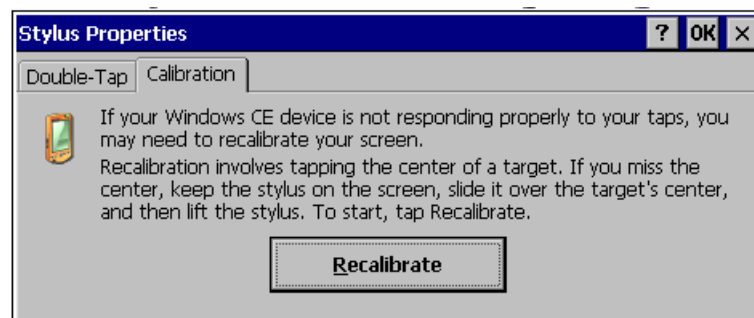
On the checkered grid at the top, tap the grid twice (double-tap) using a tap speed that is comfortable for you. The tap speed should be quick, but not so quick that it becomes difficult to do.

Below the checkered grid is an image of a “director’s” sign. Double-tap on the image to test your new setting. The top of the sign should lift up or drop down with each double-tap. If it does not, reset the double-tap action on the checkered grid.

You can keep resetting the double-tap until it is right for you. Tap **[OK]** to save any changes and exit. Tap **[X]** to exit the dialog box without saving.

#### 4.1.1.2 Recalibrate

To recalibrate the touch screen, tap the **Calibration** tab, as shown below.



*Figure 8*  
*Stylus Properties, Calibration*

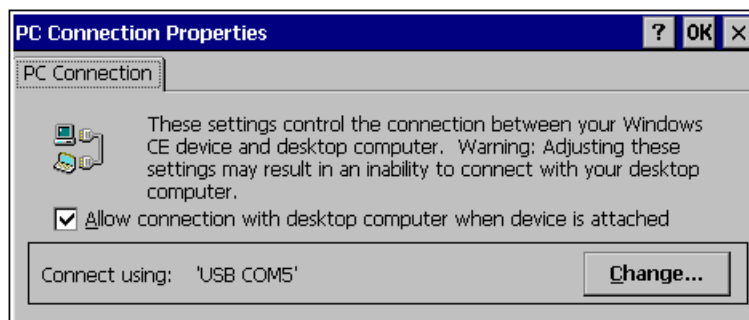
Tap **[Recalibrate]**, and a large “+” symbol is displayed on the screen. Tap and hold briefly as close to the center of the symbol as possible. When you lift the stylus, the symbol moves to another location on the screen. Tap and hold the center of the symbol again; lift the stylus, and the symbol moves again. In order to fully calibrate the touch screen, you must continue this

process until you have tapped the center of the symbol five times. These five taps are used to calculate the horizontal and vertical offset parameters of the touch screen. If the symbol continues to move after the fifth tap, the calibration was unsuccessful and you must repeat the five taps. An unsuccessful calibration results when the offset calculated for one calibration point differs from another. If the calibration is successful, the “+” symbol is no longer visible. Tap the touch screen one more time, or press **[Enter]**, to save the calibration settings.

Touch screen calibration data is stored in the persistent registry (see [section 4.3, “Registry”](#) for more information). After the unit has been calibrated once, the calibration data is retained between re-boots. The touch screen calibration screen automatically appears when you boot the unit if there is no calibration data present in the registry.

### 4.1.2 PC Connection

Use the PC Connection control panel applet to enable or disable remote connections with a desktop PC (ActiveSync). Refer to [Chapter 5, “Connect to a PC Via ActiveSync” on page 35](#) for more information about setting up an ActiveSync connection. Select the checkbox labeled, “Allow connection with desktop computer when device is attached” to enable remote PC connections with the TREQ-M4 (see [Figure 9, “PC Connection Properties”](#)).



*Figure 9  
PC Connection Properties*

The default device used for remote connection is the USB-to-serial converter, which appears in Windows CE as the serial port device on COM5 (“USB COM5”).

Tap **[OK]** to save any changes and exit. Tap **[X]** to exit the dialog box without saving.

### 4.1.3 Keyboard

Use the Keyboard applet to set the repeat delay and repeat rate for keyboard keys. These parameters apply to any connected USB keyboard as well as the TREQ-M4 keypad buttons. Double-tap the **Keyboard** icon on the control panel, and the Keyboard Properties dialog box is displayed, as shown below.



Figure 10  
Keyboard Properties

#### Enable Character Repeat

Select this option to turn the key repeat feature on or off. If “on,” a key entry repeats if you hold down the key on the keyboard or keypad. Keypad keys have individual controls for repeat enable/disable (refer to [section 6.3.1, “Keypad” on page 49](#)). All keypad repeats are disabled if this checkbox is not selected.

#### Repeat Delay

If you enabled “character repeat,” use this function to select the delay time that you want between when a key is pressed and when it begins to repeat automatically. Tap and hold the slider and slide it up or down the slider bar to set the delay, or tap the left or right arrow button at the ends of the slider bar to move by smaller increments.

#### Repeat Rate

If you enabled “character repeat,” use this function to select the time that you want between each repeat when a key begins to repeat automatically. Tap and hold the slider and slide it up or down the slider bar to set the delay, or tap the left or right arrow button at the ends of the slider bar to move by smaller increments.

Tap in the data entry box at the bottom of the dialog box, and press a key to test the repeat delay and repeat rate. You can reset the delay and rate until the settings are right for you.

Tap **[OK]** to save any changes and exit. Tap **[X]** to exit the dialog box without saving.

#### 4.1.4 Date/Time

Use this applet to set the time and date on the TREQ-M4. Tap the **Date/Time** icon on the control panel, or tap the clock on the task bar (see Figure 11, “Date/Time Properties”).

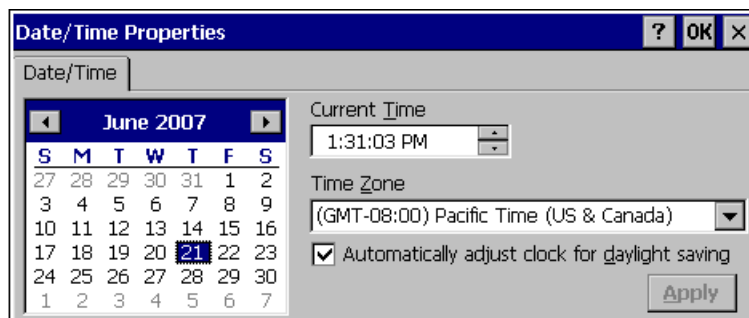


Figure 11  
Date/Time Properties

To change the year, continuously change the month to successive or prior months until the desired year is reached. Alternatively, tap the year display, and type the year using the on-screen soft keyboard or an attached USB keyboard.


To change the month, tap the left-pointing arrow at the top of the calendar to select the previous month, or tap the right-pointing arrow to select the next month. Alternatively, tap the month display, and select the desired month from the pop-up list.

To select a date in a month, tap the date in the calendar.

To change the time, in the “Current Time” box, tap the hour, minute, or AM/PM position to select it, then tap the selection arrows to increase or decrease the number. Alternatively, tap the time display to select the hours, minutes, seconds, or “AM/PM” field, and enter the time using the on-screen soft keyboard or an attached USB keyboard.

To select a different time zone, tap the drop-down arrow for the “Time Zone” box and then tap the correct time zone in the drop-down list.

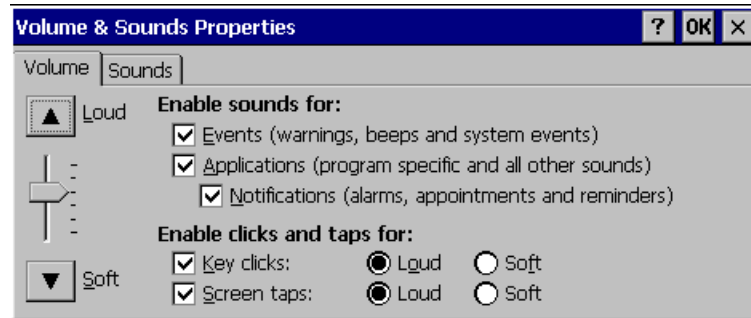
The checkbox “Automatically adjust clock for daylight saving” is selected by default. If the TREQ-M4 will be used in an area that does not follow daylight savings time, deselect this option.

**NOTE**  *The TREQ-M4 has been updated to be compliant with the latest dates for daylight savings time changes (per the U.S. daylight savings time zones and dates change for 2008).*

Tap **[Apply]** to apply changes in the settings without exiting the dialog box. Tap **[OK]** to apply the changes and exit. Tap **[X]** to exit the dialog box without saving your settings.

### 4.1.5 Volume and Sounds

Use this applet to adjust the volume of system responses and to specify for which screen actions the TREQ-M4 will respond with a sound. Tap the **Volume & Sounds** icon on the control panel to display the Volume & Sounds Properties dialog box, as shown below.



*Figure 12*  
*Volume & Sounds Properties*

To enable sounds and adjust the volume, tap the Volume tab.

#### Enable sounds for:

##### Events

If you want a sound emitted when the system gives a warning or a system event occurs, select this option.

##### Applications

If you want sounds generated by programs, select this option.

##### Notifications

If you want sounds emitted for alarms, appointments, and reminders, select this option.

#### Enable clicks and taps for:

##### Key clicks

Select this option if you want to hear clicks when you press a key on either the keypad or an external keyboard. If you select key clicks, also select whether you want the click sound to be **Loud** or **Soft**.

##### Screen taps

Select this option if you want to hear a sound when you tap the screen. If you select this option, also select whether you want the tap sound to be **Loud** or **Soft**.

#### System Volume

Use the slider at the left-hand side of the dialog box to select the overall volume of system sounds. Tap and hold the slider and slide it up or down the slider bar to adjust the sounds louder or softer, or tap the **Soft** or **Loud** arrows to adjust it in smaller increments. A sound is emitted as you make each adjustment so you can monitor the setting.



Tap **[OK]** to save the settings and exit the dialog box. Tap **[X]** to exit the dialog box without saving your settings.

#### 4.1.6 Network and Dial-up Connections

The Network and Dial-up Connections control panel applet launches a Network Connections application (see Figure 13), which is used to set up and configure remote connections. An icon is created for each connection (connectoid). Once configured, the connectoid can be launched to initiate the remote connection.

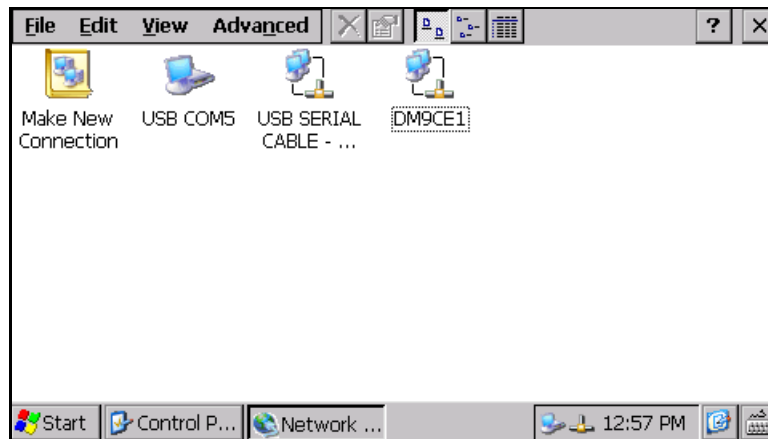


Figure 13  
Network Connections

The default connectoids for TREQ-M4 remote connections are USB COM5 and DM9CE1. The USB COM5 connection uses a USB-to-serial converter to establish a new serial port (COM5), which is used for ActiveSync communication. The DM9CE1 connection uses the internal 10/100 Ethernet adapter to provide a standard TCP/IP interface.

The USB COM5 connection is automatic. Once an ActiveSync connection is established, a new connectoid appears to reflect the new connection: USB SERIAL CABLE – COM5. The properties of this connection indicate the IP address of the TREQ-M4 for this connection.

The DM9CE1 connection automatically obtains IP configuration (address, subnet mask, and gateway) if DHCP is enabled. Right-click, or select **File, Properties** from the menu for the DM9CE1 connectoid to configure DHCP or static values, as well as name servers for this connection. DHCP is enabled by default.

Running ipconfig from the command shell (**Start, Programs, Command Prompt**) lists detailed information for the TREQ-M4 network connections.

**NOTE**  *The DM9CE1 connection is functional only for units with cable configurations that support Ethernet. Refer to [section 9.2, “Integral Cable”](#) for integral cable specifications.*

### 4.1.7 Storage Manager

Use the Storage Manager applet to administer the TREQ-M4’s internal and external storage devices. The contents of the *HardDisk* directory are located on an internal SD or MMC interface NAND flash device. The contents of *\USBHardDisk*, *\USBHardDisk2*, and so on, are located on external USB memory drives. These devices may be formatted, scanned, and defragmented using the Storage Manager utility.

Figure 14 shows the Storage Manager applet on a TREQ-M4 with an SD-type internal flash memory.

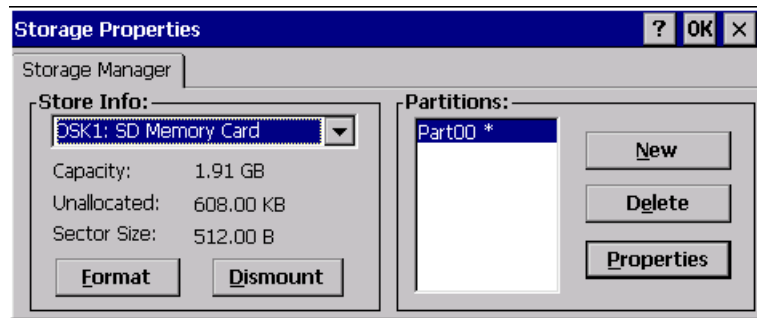


Figure 14  
Storage Properties, Internal Flash Drive

Figure 15 shows the Storage Manager applet on a TREQ-M4 with a USB memory drive inserted.

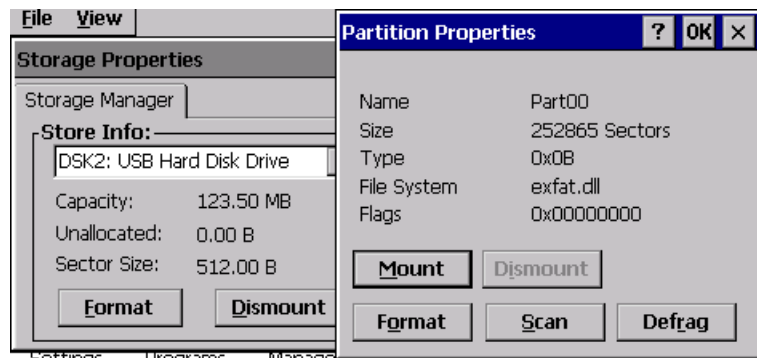


Figure 15  
Storage Properties, USB Drive

Figure 16 shows the results of a scan disk operation on the internal flash storage device.

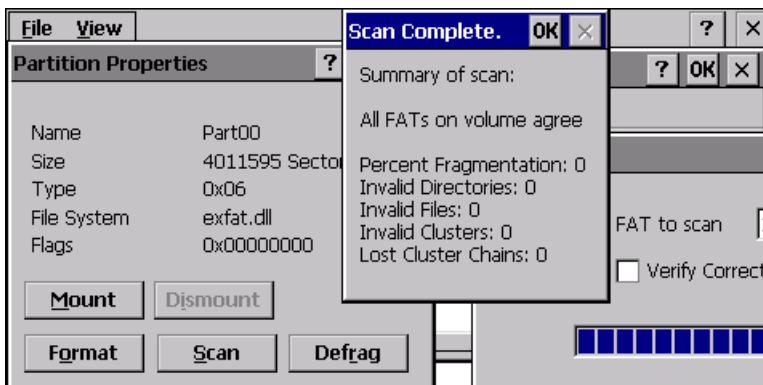


Figure 16  
Storage Properties, Internal Flash Drive Scan Disk

The storage device must be dismounted before formatting, scanning, or defragmenting. For the internal flash device, it is recommended that these operations be performed only from the recovery Windows CE image (refer to [section 10.2, “System Backup and Recovery”](#)). The main Windows CE operating system image actively accesses files on the internal flash device. This access is interrupted by storage administration operations. Re-mounting the device will fail, and it must be rebooted to return it to a working state.

Figure 17 shows the Storage Manager’s Format dialog box launched from the recovery image for the internal flash storage. The “Start” button used to initiate the format operation is below the viewable area of the screen due to the dialog box size. You can use an attached USB keyboard or on-screen soft keyboard to initiate the format. Press the <Tab> key to cycle the active focus or simply press <Enter> to start as the “Start” button will be activated by default.

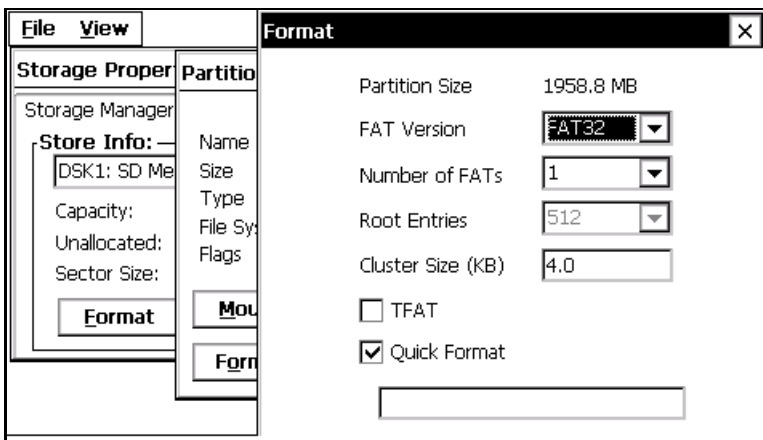




Figure 17  
Storage Properties, Format Drive

FAT32 Quick Format is recommended for reformatting operations on the internal storage. Sometimes a full format may be desired, but allow several minutes for completion. Note that the eXFAT format option is selected by default; FAT32 must be manually selected from the drop-down box.

**WARNING**  Use caution when formatting the internal flash device! The result will be a complete loss of user data, user applications, and main operating system package. A recovery procedure will be required to restore the TREQ-M4 to a usable state. Refer to [section 10.2, “System Backup and Recovery”](#) for more information.

**NOTE**  Beijer Electronics recommends that the partition configuration be left intact for storage devices. Do not remove partitions or create new partitions as this may cause data on the devices to be irretrievable.

### 4.1.8 Bluetooth Manager

If the TREQ-M4 is configured with the Bluetooth option, the Bluetooth Manager applet is a simple utility that can be used to scan for other Bluetooth devices. Figure 18 shows the results of a scan that includes several services from the same cell phone.

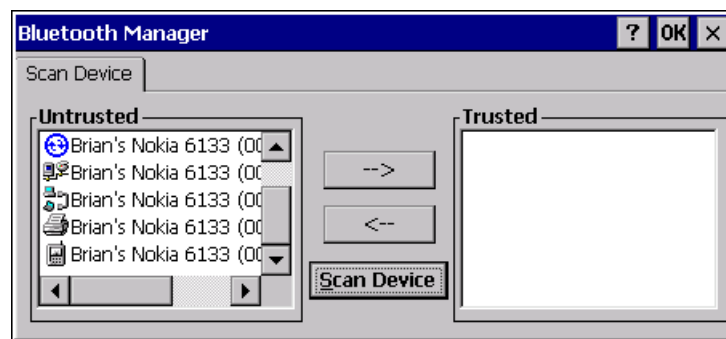


Figure 18  
Bluetooth Manager

To pair Bluetooth devices, select a device in the “Untrusted” box, and click [-->] to move it to the “Trusted” box. The pairing process is mutual; the other Bluetooth devices must consider the TREQ-M4 a trusted device to complete the pairing.

Tap [OK] to save any changes and exit. Tap [X] to exit the dialog box without saving.

Refer to [section 7.5, “Bluetooth”](#) for more information on managing TREQ-M4 Bluetooth device connections.

## 4.2 TREQ Panel

The TREQ panel provides quick access to all of the TREQ-M4 hardware controls, including those for the display and keypad backlight, touch screen, speaker, keypad, and power saving/screen saver modes.

To open the TREQ Panel (see Figure 19, “TREQ Panel”), tap the desktop shortcut.

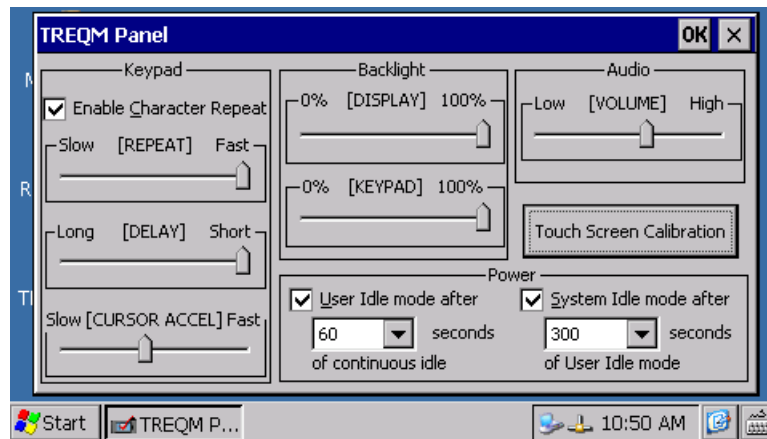


Figure 19  
TREQ Panel

Tap **[OK]** to save any changes and exit. Tap **[X]** to exit the dialog box without saving.

### 4.2.1 Keypad

The Enable Character Repeat, Repeat, and Delay controls are identical to those found in the Keyboard Control Panel applet. Refer to [section 4.1.3, “Keyboard”](#) for more information on these controls.

The keypad keys may be optionally mapped to mouse/cursor functions as described in [section 3.3, “Function Keys”](#) and [section 6.3.1, “Keypad”](#). The Cursor Acceleration control affects the mouse pointer acceleration when it is controlled from a keypad key that is mapped for that function. Tap and hold the slider to increase or decrease the acceleration. Increased acceleration reduces the time required for the cursor to traverse a distance as the keypad key is held, but also reduces the cursor accuracy.

### 4.2.2 Backlight Intensity

Use the Backlight controls to adjust the intensity of the display and keypad backlight. Tap and hold the slider and slide it up or down the slider bar to set the intensity from 0 to 100%.

### 4.2.3 Audio

Tap and hold the slider to increase or decrease the speaker volume. Use this control for more precision for the volume setting than the Volume and Sounds Control Panel applet provides.

### 4.2.4 Touch Screen

Tap the Touch Screen Calibration button to initiate the calibration procedure. Refer to [section 4.1.1.2, “Recalibrate”](#) for more details.

### 4.2.5 Power States

The power saving controls affect the transition times from full on to User Idle and System Idle power states when the TREQ-M4 is not in use. In User Idle mode, the display and keypad backlight intensities are dimmed to a low level. In System Idle mode, they are disabled. Touch screen or USB keyboard/mouse activity will cause the TREQ-M4 to transition out of an idle state. Refer to [section 6.3.4, “Power”](#) for more details about the TREQ-M4 power states.

Tap the drop-down arrow for the User Idle or System Idle settings to select the number of seconds or minutes after which the TREQ-M4 will enter the selected power mode. The User Idle and System Idle time-outs can be adjusted to a continuous range of time values by typing a number in the drop-down box or via a programmatic interface (refer to [section 6.3.4, “Power”](#)).

Disable the transition to User Idle or System Idle power states by removing the checkmark from the “User Idle mode after” or “System Idle mode after” check boxes, respectively. You can also type **0** in either drop-down box to disable the transition.

Disabling the User Idle mode transition automatically disables the System Idle transition, regardless of the System Idle time-out or check box. Set the User Idle mode transition time-out to one second to skip the User Idle and transition directly to System Idle.

## 4.3 Registry

Windows CE uses a registry to store system settings and run-time configuration data. The TREQ-M4 supports a hive-based registry, meaning that the settings in the registry are maintained between power cycles. The hive registry is stored in special system files on the internal flash hard-disk. The memory resident registry is periodically (every few seconds) written to the hive files. You can modify the registry in several ways.

- Windows CE provides an API (RegOpenKeyEx or RegQueryValueEx) and a C++ wrapper class (CReg via creg.hxx provided in the TREQ-M4 SDK) for use in applications as a programmatic interface.
- You can run the *RegEditCE.exe* registry editing application on the TREQ-M4.

- Microsoft Visual Studio 2008 and Microsoft Visual Studio 2005 each come with a suite of remote debugging tools, including remote registry editors. Refer to [Chapter 6, “Application Development”](#) for information on setting up a host PC to use these tools.


## 4.4 File System Filter

Certain system files included on the internal flash hard-disk are critical to the functioning of the TREQ-M4 terminal. In order to reduce the possibility of accidental deletion or corruption, Beijer Electronics has developed and installed a file system filter, which is a special device driver that prevents write access to a list of files specified in a registry key. The default contents of this registry key are as follows:

```
[HKEY_LOCAL_MACHINE\System\StorageManager\LockFiles]
"Lock"=dword:00000001
"Files"=multi_sz:"\\HardDisk\\nk.bin",
  "\\HardDisk\\bin\\boot.bat",
  "\\HardDisk\\bin\\ftdi_ser.dll",
  "\\HardDisk\\system.mfs",
  "\\HardDisk\\MFS"
```

The file system filter can be enabled or disabled by setting or clearing, respectively, the “Lock” registry value. The “Files” multi-string registry value contains the list of locked files and directories. Directories in the list are locked along with all sub-files and subdirectories.

One example of the reason for the file system filter is that if the `\\HardDisk\\nk.bin` file—the Windows CE operating system image—is corrupted or deleted, the TREQ-M4 will not boot or will boot to a recovery image. This filter protects against inadvertent delete operations.

**NOTE**  *The TREQ-M4 has been provided with a boot recovery image. When booted to the recovery image, you can restore the `nk.bin` file or other lost files (refer to [section 10.2, “System Backup and Recovery”](#) for more details on emergency recovery).*

One example of the reason for this filter is the `\\HardDisk\\nk.bin` file, which is the Windows CE operating system image. If this file is corrupted or deleted, the TREQ-M4 will not boot or will boot a recovery image. When booted to the recovery image, you can restore the `nk.bin` file or other lost files (refer to [section 10.2, “System Backup and Recovery”](#) for more details on emergency recovery).

The `\\HardDisk\\bin\\LockCE.exe` program can be used from a command prompt shell to lock or unlock the files/directories in the list. LockCE 0 unlocks; LockCE 1 locks.

## 4.5 System Path

The default Windows CE system path on the TREQ-M4 is `\Windows;\HardDisk\bin;\HardDisk\fonts`. Windows will search the `\Windows` directory first, then the `\HardDisk\bin` directory for executables and supporting dynamically-linked libraries. For example, when `explorer.exe` is executed from the root directory in the command shell, Windows will find `\Windows\explorer.exe`.

The system path can be modified via a registry setting. Following is an example of the registry key in which two directories have been added to the default path.

```
[HKEY_LOCAL_MACHINE\Loader]
  "SystemPath"=multi_sz:"\\HardDisk\\bin\\",
                    "\\HardDisk\\fonts\\"
                    "\\HardDisk\\Programs\\"
                    "\\Temp\\"
```

## 4.6 Boot-up Configuration

There are two methods of configuring the TREQ-M4 to automatically launch applications or scripts at boot time.

The first method of auto-launching applications is managed by a program called `BootUpCE.exe` that is launched when Windows CE boots. `BootUpCE` initiates touch screen calibration (if necessary), then launches a command shell and executes a batch file: `\HardDisk\bin\boot.bat`. This batch file can be used to launch an application or run a custom boot-up script. For example, to launch `WinVerCE` after boot, `boot.bat` should look something like the following:

```
@echo Launching WinVerCE
start \HardDisk\bin\WinVerCE.exe
```

Because `\HardDisk\bin\boot.bat` is on the locked files list (refer to [section 4.4, "File System Filter"](#)), it must be unlocked before writing a modified version.

The second and more advanced method of configuring Windows CE to launch one or more applications in a specific order uses the `[HKEY_LOCAL_MACHINE\Init]` registry key. The following MSDN articles describe this method in detail.

<http://msdn.microsoft.com/en-us/library/aa913970.aspx>  
<http://msdn.microsoft.com/en-us/library/aa448482.aspx>





### 4.7.2 Beijer Electronics

Applications written and provided by Beijer Electronics include the following:

Application	Description	Path
CleanHiveCE	Causes the persistent registry to revert to factory defaults. Reboot TREQ-M4 after executing.	\HardDisk\bin\CleanHiveCE.exe
KeyShiftCE	Toggles the “shifted” state of the keypad (refer to <a href="#">section 6.3.1, “Keypad” on page 49</a> )	\HardDisk\bin\KeyShiftCE.exe
LockCE	Locks/unlocks protected files (refer to <a href="#">section 4.4, “File System Filter”</a> ). Single command line parameter either 0 (unlock) or 1 (lock).	\HardDisk\bin\LockCE.exe
MinTermCE	Serial port console and test program.	\HardDisk\bin\MinTermCE.exe
PolygonsCE	Display test program.	\HardDisk\bin\PolygonsCE.exe
QeditCE	Small, simple graphical editor	\HardDisk\bin\QeditCE.exe
RegEditCE	Local registry editor tool (similar to Remote Registry Editor).	\HardDisk\bin\RegEditCE.exe
SleepCE	Causes a delay of N milliseconds for the calling batch file where the number N is passed to the program as a command line parameter.	\HardDisk\bin\SleepCE.exe
TREQ Demo	Application written to demonstrate TREQ-M4 functionality and features. Source code provided for this application upon request to demonstrate application development for the TREQ-M4, including custom device driver interfaces.	\HardDisk\demo\M4Demo.exe
TREQMPanelCE	Refer to <a href="#">section 4.2, “TREQ Panel.”</a>	\HardDisk\bin\TREQMPanelCE.exe
WinVerCE	Displays the current version of the Windows CE kernel, firmware, and release date.	\HardDisk\bin\WinVerCE.exe
WaitForAPIsCE [WinCE API enum value or values]	Causes the calling process to delay execution until the specified Windows CE application programming interfaces are ready, e.g., SH_SHELL(21) and SH_WMGR(17). Multiple APIs may be specified, separated by spaces.	\HardDisk\bin\WaitForAPIsCE.exe

Application	Description	Path
qbtM4.exe	Bluetooth device service discovery, scanning, and signal strength test utility.	\HardDisk\bin\Bluetooth\qbtM4.exe
BTAGMicVolCE.exe	Opens Bluetooth Audio Gateway and allows the headset microphone volume to be changed.	\HardDisk\bin\Bluetooth\ BTAGMicVolCE.exe
WaveRecCE.exe	Records 5 seconds of audio from the default wave device and saves it to the file <i>1.wav</i> in the <i>MyDevice</i> folder.	\HardDisk\bin\WaveRecCE.exe
RecSndCE.exe	Records 5 seconds of audio from the selected wave device and then plays it back to another selected wave device.	\HardDisk\bin\ RecSndCE.exe

Notes

## CHAPTER 5

# CONNECT TO A PC VIA ACTIVESYNC

---

### 5.1 Introduction

You can use Microsoft ActiveSync to communicate directly between the TREQ-M4 and a PC computer. To set up an ActiveSync connection between your TREQ-M4 and a PC computer, do the following:

- Connect a null modem serial cable to the TREQ-M4 and to the PC. Be sure to turn off power to both devices before connecting the cable (see [section 5.2, “Connect the Serial Cable”](#)).
- Load ActiveSync on the PC to which the TREQ-M4 will be connected (see [section 5.3, “Download/Install ActiveSync”](#)).
- Verify that the baud rate on the TREQ-M4 is optimal for the cable length (see [section 5.4, “Set the TREQ-M4 Baud Rate”](#)).
- Start ActiveSync on the PC and on the TREQ-M4 (see [section 5.5, “Connect the PC and TREQ-M4”](#)).

### 5.2 Connect the Serial Cable

You need to use a “null modem” RS232 serial cable to make an ActiveSync connection between a PC and the TREQ-M4. You can also use a standard serial cable with a null modem adapter. The TREQ-M4 connection uses a female DB9 connector. Verify the serial connection used by the PC.

Following are the DB9 pin assignments for the TREQ-M4 connector. Verify that the serial cable and/or null modem adapter has all of the following pin connections as all of the listed RS232 signals are required by ActiveSync.

RS232 Signal	First DB9 Pin #	Second DB9 Pin #
DCD	1	4
RX	2	3
TX	3	2
DTR	4	1 and 6
GND	5	5
DSR	6	4
RTS	7	8
CTS	8	7
RI	9	no connection

For best results, the cable should not exceed six feet in length for communications at 115200 baud.

The serial cable is wired symmetrically—either end of the cable can be connected to the TREQ-M4 (assuming the connectors match). Connect one end of the serial cable to COM5 on the TREQ-M4. COM5 is available via the USB-to-serial converter. Connect the other end of the serial cable to a free port on the PC. If possible, note the name of the port you use (e.g., COM1, COM2, etc.). Refer to Figure 20, “ActiveSync Connections.”

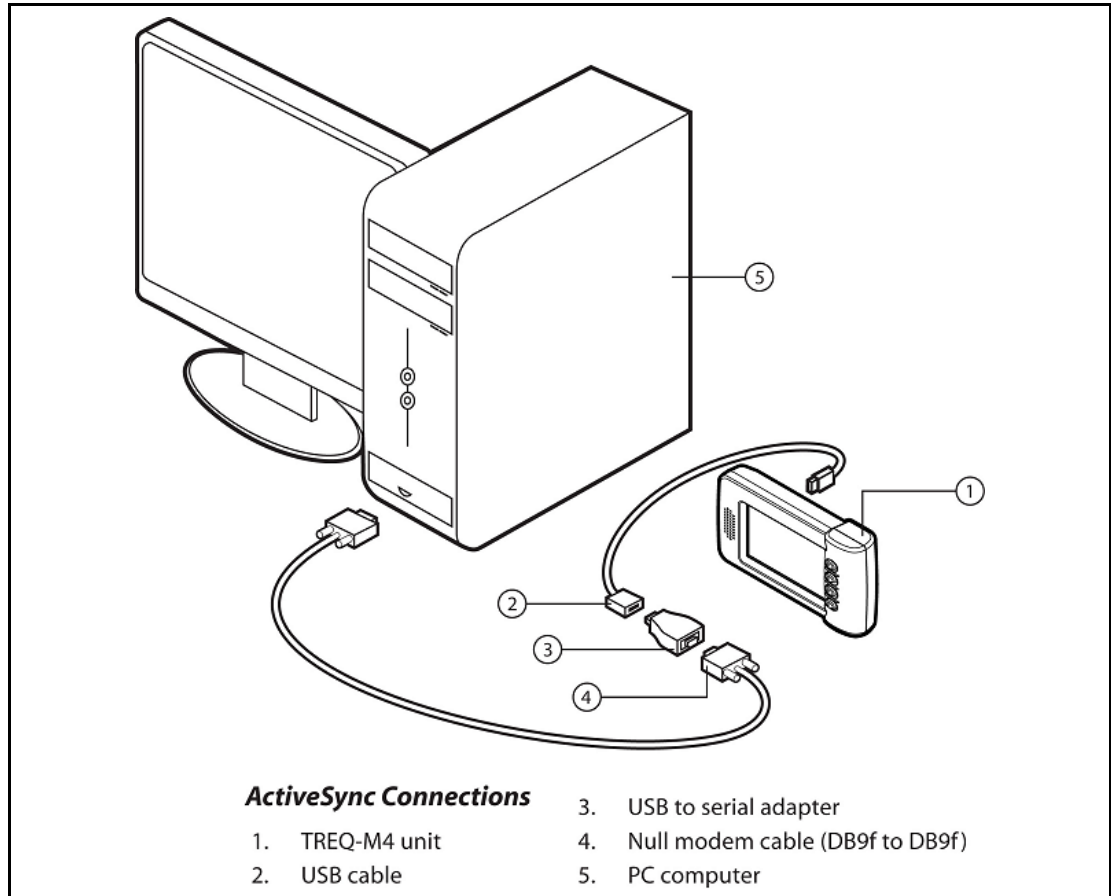



Figure 20  
ActiveSync Connections

**NOTE**  The USB extension cable (item 2 in Figure 20) is not strictly required, although it makes the USB-to-serial adapter/TREQ-M4 connection more convenient.

### 5.3 Download/Install ActiveSync

Download ActiveSync from the Microsoft website and install it on your PC as follows.


1. On your PC, open your Web browser, and navigate to the Microsoft Download Center at <http://www.microsoft.com/downloads/Search.aspx?displaylang=en>.

2. Type **ActiveSync** in the search box and begin the search.
3. ActiveSync 4.2 and 4.5 are the two latest versions as of January 2009. Both will work with the TREQ-M4. Follow the appropriate link and download the desired version.
4. Install ActiveSync on your PC by executing the downloaded installer file or executable and following the instructions.
5. When the installation is finished, ActiveSync automatically launches the “Get Connected” wizard that will search the PC’s serial ports for a connection. If you are not ready to connect to the TREQ-M4, cancel this option.

## 5.4 Set the TREQ-M4 Baud Rate

The baud rate is the rate at which data is sent between the PC and the TREQ-M4. Normally, you will want to set the baud rate to the highest rate supported by your hardware and cable length (see [section 5.2, “Connect the Serial Cable”](#) for cable length restrictions).

When connected, ActiveSync identifies the baud rate used by the TREQ-M4. The default baud rate for the TREQ-M4 ports is 115200 bps.

**NOTE**  *If you have communication problems with an ActiveSync connection, try selecting a slower baud rate.*

To verify or change the baud rate for the TREQ-M4, do the following on the TREQ-M4.

1. Tap **[Start]** to display the Start menu, then tap **Settings** and **Network & Dial-up Connections**. The Network Connections dialog box is displayed.
2. Tap **USB COM5**. Select **File, Properties** from the menu.
3. Tap **[Configure]**.
4. To change the baud rate, tap the down arrow to display a list of possible settings, and tap the baud rate that you want to use.

## 5.5 Connect the PC and TREQ-M4

With the cable connected (see [section 5.2, “Connect the Serial Cable”](#)) and ActiveSync installed on your PC (see [section 5.3, “Download/Install ActiveSync”](#)), do the following to establish a connection between the PC and the TREQ-M4.

1. On your PC, start ActiveSync.
2. Open the File menu, and select **Get Connected**, or select **Connection Settings** and then click **[Connect]**.

3. Click **[Next]**. The TREQ-M4 automatically responds to the PC's ActiveSync connection request. (See Figure 21, "ActiveSync, Get Connected.")

The first time you connect, the PC scans all available serial ports for the ActiveSync connection, which can take some time. For this reason, the TREQ-M4 or the PC may time out before the connection is found. It is typical to have to re-run one or both ActiveSync programs a few times before they find each other. This is especially true if your PC has several serial ports. Once ActiveSync identifies the port, all future connections will occur quickly.

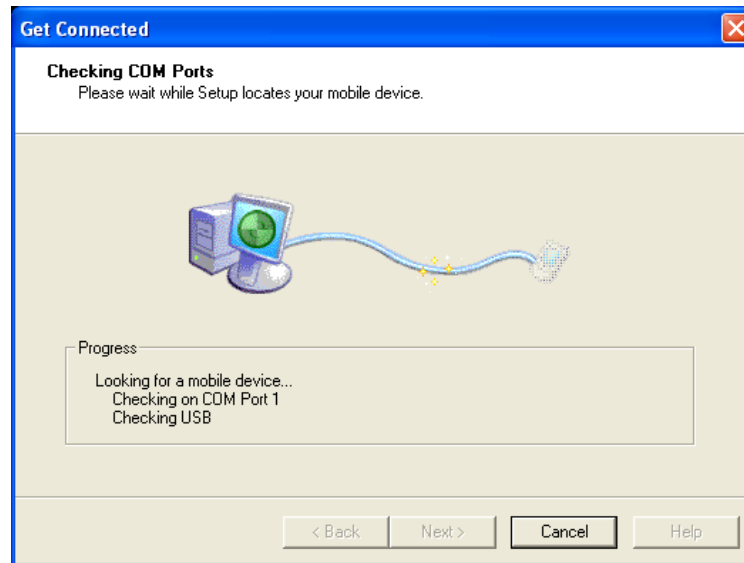



Figure 21  
ActiveSync, Get Connected

**NOTE**  If you know to which serial port on the PC the TREQ-M4 is connected, you can select the port in ActiveSync on the PC and save the scanning time. Refer to [section 5.5.1, "Select the COM Port Manually."](#)

When the "Connecting to Host" message appears on the TREQ-M4, the ActiveSync window on the PC displays "Connecting....."

4. When the ActiveSync connection is established, the PC displays a window titled "New Partnership" (see Figure 22, "ActiveSync Partnership"). Typically, you should select **No** and then click **[Next]**.





Figure 22  
ActiveSync Partnership

The ActiveSync window then displays “Connected” (see Figure 23, “ActiveSync, Connected”).

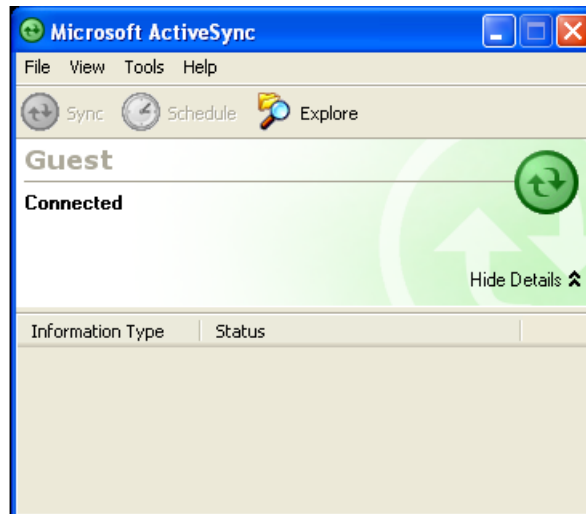


Figure 23  
ActiveSync, Connected

5. You can now browse the TREQ-M4 file system by selecting the **Explore** icon or the **Explore** option on the PC’s ActiveSync File menu (see Figure 24, “ActiveSync, Explore Device”).

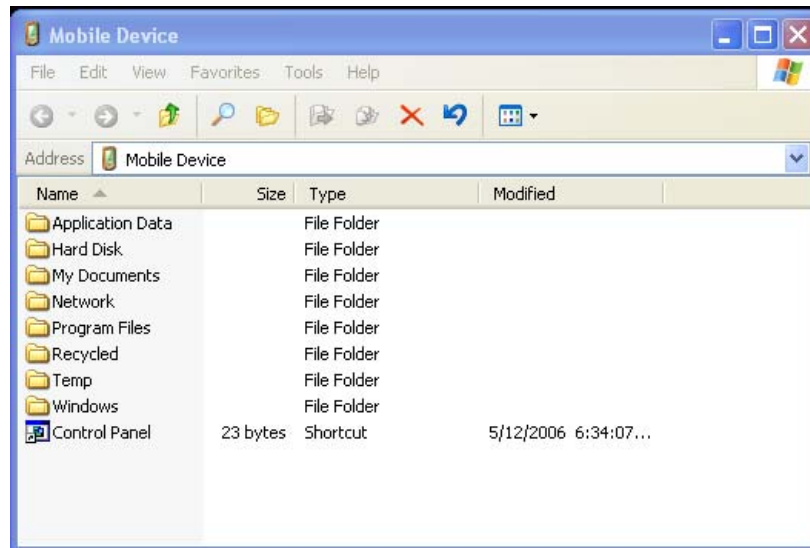


Figure 24  
ActiveSync, Explore Device

### 5.5.1 Select the COM Port Manually

You can save scanning time during the initial connection if you know to which serial port on the PC the TREQ-M4 is connected. Do the following to select the port.

1. In the ActiveSync program on the PC, select the **Connection Settings** option on the File menu (see Figure 25, “ActiveSync, Connection Settings”).

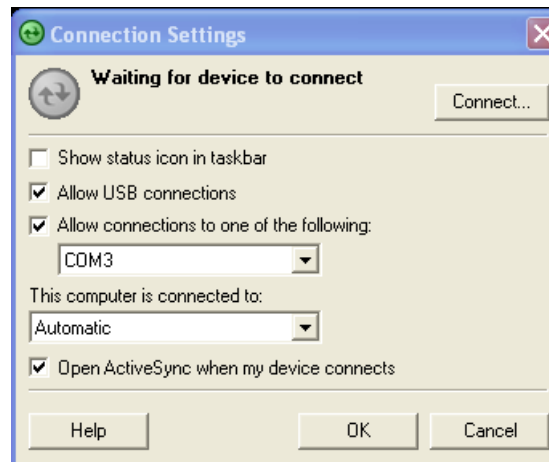


Figure 25  
ActiveSync, Connection Settings

2. Enable the “Allow connections to one of the following:” option, and select the appropriate COM port.
3. Tap **[OK]** to save the settings.

## CHAPTER 6

# APPLICATION DEVELOPMENT

---

### 6.1 Introduction

This chapter describes the process of developing and debugging applications for the TREQ-M4 and assumes familiarity with the C programming language and Windows application remote debugging procedures. (If necessary, consult the Microsoft MSDN library for a refresher on remote debugging.) This information is intended for integrators and application developers as a guide in setting up the TREQ-M4 for application development and as a reference for programmatic interfaces (API) to software drivers for various terminal peripherals.

The TREQ-M4 is a Windows CE-based computer with specialized hardware peripherals that make it suitable for vehicular applications. Application development and debugging procedures for the TREQ-M4, as well as the software driver API, are similar to other Windows CE-based devices. This chapter provides instructions and references for TREQ-M4-specific functionality. For example, the TREQ-M4 has a serial port, but the serial port driver interface is not documented in this manual because the interface is a standard, well-known API.

#### 6.1.1 Glossary

**API**

Application Program Interface

**SDK**

Software Development Kit

**IDE**

Integrated Development Environment

#### 6.1.2 Related Documents

- Microsoft Visual Studio 2005 MSDN Library
- Microsoft Visual Studio 2008 MSDN Library
- Windows Embedded CE 6.0 Documentation  
<http://msdn.microsoft.com/en-us/library/bb159115.aspx>
- Shared Windows Mobile 6 and Windows Embedded CE 6.0 Library  
<http://msdn.microsoft.com/en-us/library/bb158484.aspx>

## 6.2 Setup

### 6.2.1 Prerequisites

The following are required before setting up the TREQ-M4 for application development. Either an Ethernet or Serial connection is required (both are included here for completeness).

**Ethernet connection:**

The host can communicate with the TREQ-M4 during a remote debugging session over an Ethernet network. The TREQ-M4 should be connected to the same network and on the same subnet as the host.

The network can be established using either the internal 10/100 Ethernet adapter or an external USB adapter. Use the DM9CE1 connectoid to configure the internal Ethernet connection (refer to [section 4.1.6, “Network and Dial-up Connections”](#)). Use the Windows CE Wireless Zero Configuration tool that automatically launches when the USB WiFi adapter is inserted to configure the wireless Ethernet connection (refer to [section 7.2, “Wireless Ethernet”](#)). Use the AX887721 connectoid to configure the USB-to-wired Ethernet adapter (refer to [section 7.3, “Ethernet \(over USB\)”](#)).

**Serial connection:**

The host can communicate with the TREQ-M4 during a remote debugging session via ActiveSync over a serial connection. The connection must be a “full” serial port, meaning that all of the following serial protocol signals must be connected to and supported by the host PC: RX, TX, RTS, CTS, DTR, DSR, and DCD. The TREQ-M4 Developer’s Kit includes a USB-to-serial converter that can be used for the ActiveSync connection.

**Software Development Kit:**

The SDK is an MSI installable file distributed by Beijer Electronics. The SDK should be installed so that the host IDE knows how to connect to the TREQ-M4. The SDK also provides headers and libraries that correspond to the available services and features included in the TREQ-M4 Windows CE image.

**Integrated Development Environment:**

Microsoft Visual Studio 2005 and/or Microsoft Visual Studio 2008 should be installed as a development environment for the TREQ-M4 application. These programs are used to compile and remotely debug the application. The latest service packs and updates for these Microsoft programs must be installed.

### 6.2.2 SDK Installation

The latest Software Development Kit is available from the Beijer Electronics website (<http://www.beijerelectronicsinc.com>). The SDK and Windows CE image release dates should match to ensure that all features and services in the image correspond to those offered in the SDK. Use the latest available SDK version if the release date of the most recent Windows CE image supersedes that of the SDK.

To install the SDK on your PC host, download the *.msi* file from the Beijer Electronics website, right-click the file name, and select **Install**. After the installation is complete, verify that “TREQ-M4” appears in the Tools, Connect to Device dialog box in Microsoft Visual Studio 2005 and Microsoft Visual Studio 2008.

## 6.2.3 Target Setup

### 6.2.3.1 ActiveSync

You can use the ActiveSync protocol to establish a remote debugging connection with the Integrated Development Environment. Refer to [Chapter 5, “Connect to a PC Via ActiveSync”](#) for ActiveSync setup instructions.

### 6.2.3.2 Manual Server

If you do not use ActiveSync, you must set up a manual Ethernet client server on the TREQ-M4. You must configure this server to respond to debug or download connection requests from the host PC's IDE. ActiveSync has the advantage of easier setup because the IP address of the target is negotiated automatically; however, it also uses a slower connection over the serial port.

At a TREQ-M4 command prompt window, navigate to `\HardDisk\bin\client`. Instructions for using *conmanclient2.exe* and *cmaccept.exe* can be found online at [http://msdn2.microsoft.com/en-us/library/ms228708\(VS.80\).aspx](http://msdn2.microsoft.com/en-us/library/ms228708(VS.80).aspx). These instructions apply to both Microsoft Visual Studio 2005 and Microsoft Visual Studio 2008.

## 6.2.4 Microsoft Visual Studio 2005/2008

Take the following steps to configure Visual Studio to connect with the TREQ-M4 target. (Refer to Figure 26, “TREQ-M4 Device Connection with Visual Studio.”)

1. From the Visual Studio Tools menu, select **Options, Device Tools, Devices**.
2. Select **TREQ-M4** from the “Show devices for platform” drop-down box. “TREQ-M4 ARMV4I Device” should be the only device listed in the “Devices” box.
3. Select **Properties**.
4. From the “Default output location on device” drop-down box, select the desired location for deploying the Visual Studio project executables and libraries. Select **Root folder** if you want to download to `\HardDisk`. The path to the directory in the root location is specified in the Visual Studio Project Properties dialog box.
5. Click **[Configure]**.
6. If using ActiveSync, select **Obtain an IP address automatically using ActiveSync**.

If using the ConMan Ethernet client (manual server), select **Use specific IP address**, and type in the IP address of the TREQ-M4. Detailed instructions are available online at [http://msdn2.microsoft.com/en-us/library/ms228708\(VS.80\).aspx](http://msdn2.microsoft.com/en-us/library/ms228708(VS.80).aspx).

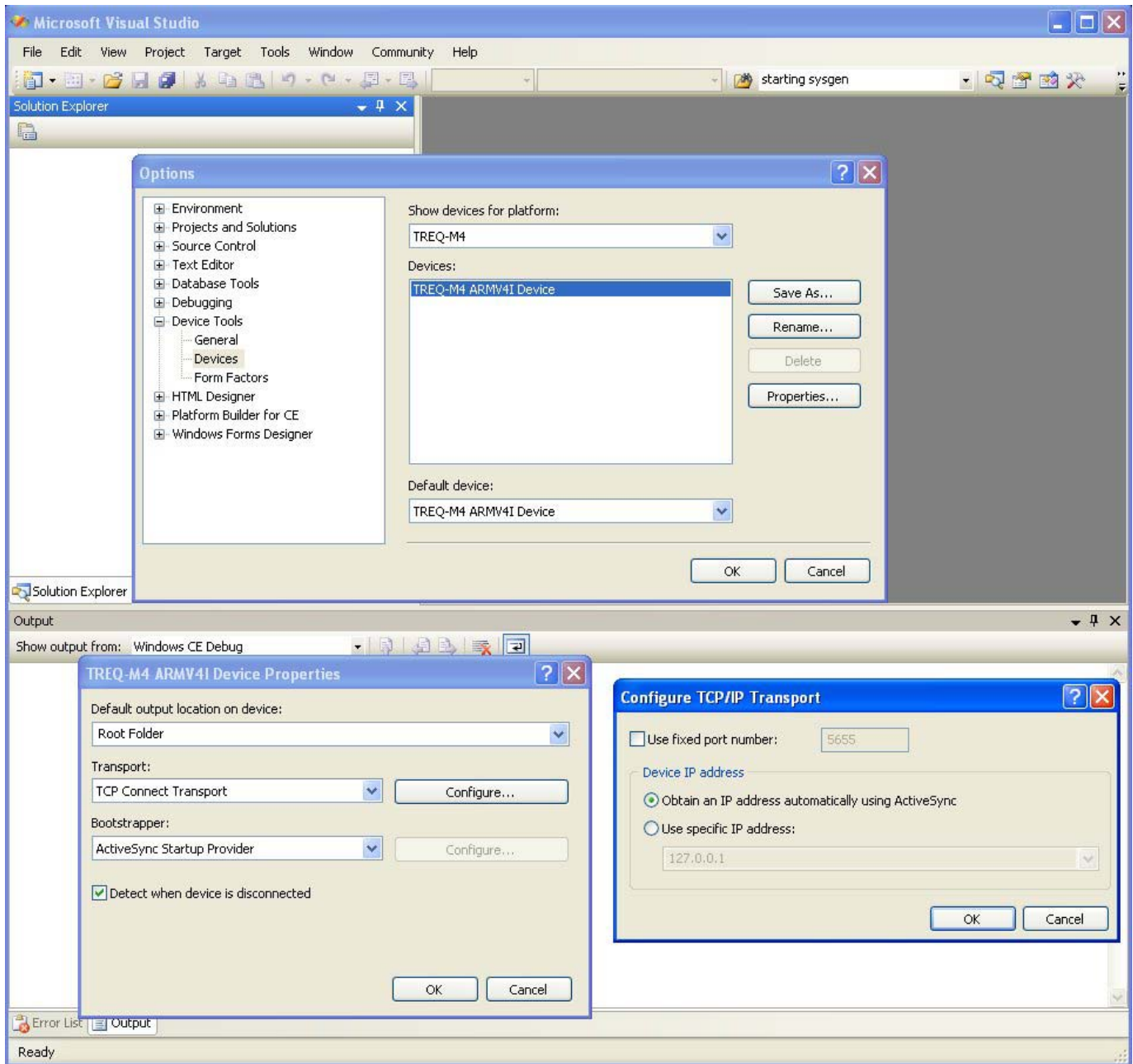


Figure 26  
TREQ-M4 Device Connection with Visual Studio

7. Verify the device connection. From the Tools menu, select **Connect to Device**. Refer to Figure 27.

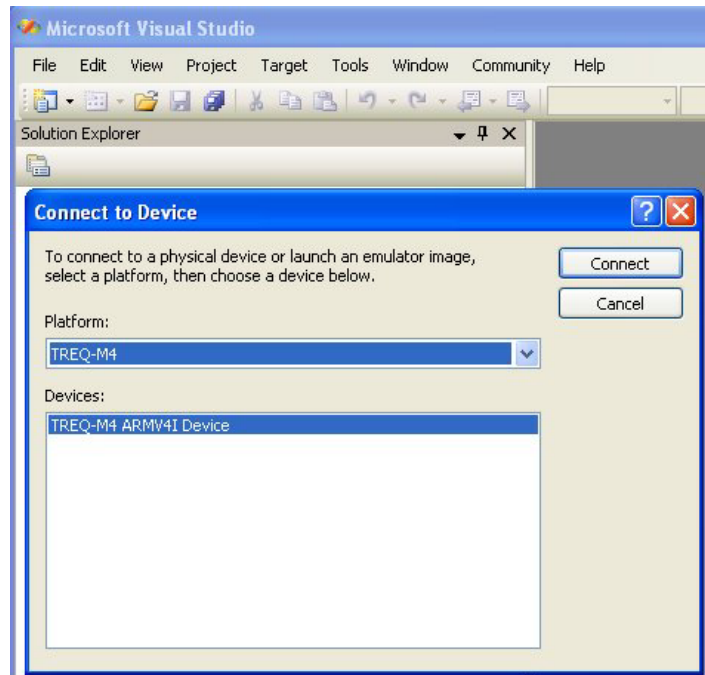


Figure 27  
Visual Studio, Connect to TREQ-M4 Device

8. Make sure the selected platform is “TREQ-M4,” and the device is “TREQ-M4 ARMV4I Device.”

The status bar at the bottom of the Visual Studio workspace window should indicate a successful connection.

You can use Visual Studio to construct sample native and managed applications to test the Build, Deploy, and Debug process. Take the following steps.

#### 6.2.4.1 Native

1. From the Visual Studio File menu, select **New Project**.
2. Select **Visual C++, Smart Device, and MFC Smart Device Application** in the window on the right.
3. Select a directory for the project, and click **[OK]**.
4. Click **[Next]**. Move the “TREQ-M4 SDK” to the “Selected SDKs” column. It should be the *only* selected SDK (move any others to the left).
5. Continue to configure the application with the next few dialog boxes as desired.

6. Enable the Device toolbar from the View, Toolbars menu.
7. Make sure that the “Target Device” drop-down list shows “TREQ-M4 ARMV4I Device.” If not, click **[Device Options]** (next to the drop-down list), and select **TREQ-M4** from the “Show devices for platform” drop-down list.
8. Right-click the project from the Solution Explorer window, and select **Properties** to bring up the Property Pages for the project.
9. In Configuration Properties, Debugging and Deployment, set the Remote Executable and Remote Directory parameters, respectively (see Figure 28). These parameters determine the path in the TREQ-M4 file system where the executable will be deployed and executed.

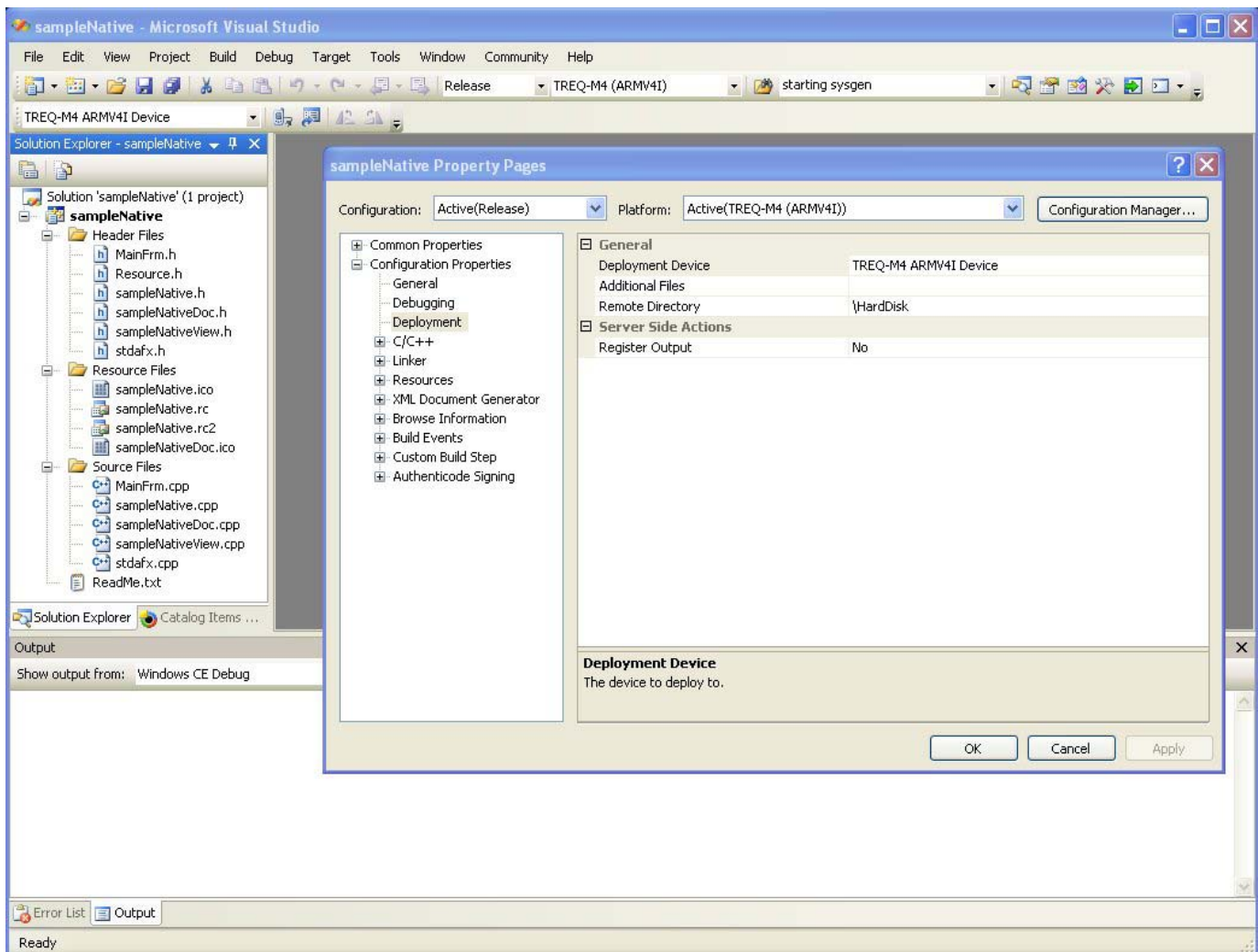


Figure 28  
Visual Studio, Native Project Properties



### 6.2.4.2 Managed

The TREQ-M4 comes with the .NET Compact Framework v3.5 pre-installed. Most applications targeting the .NET Compact Framework v2.0 are compatible with v3.5.

Visual Studio 2005 will deploy, install, and debug with the .NET Compact Framework v2.0 by default, if “Deploy the latest version of the .NET Compact Framework” is checked (see Figure 29). Uncheck this box to debug with the preinstalled version (v3.5). Visual Studio 2005 does not have an option to deploy and install v3.5.

Visual Studio 2008 offers a selection between v2.0 and v3.5 at the time of project creation (refer to step 2 below). If “Deploy the latest version of the .NET Compact Framework” is checked (see Figure 29), Visual Studio will deploy, install, and debug with the selected version.

1. From the Visual Studio File menu, select **New Project**.
2. In Visual Studio 2005, select **Other Languages, Visual C#, Smart Device, Windows CE 5.0**, and **Device Application** in the window on the right.

In Visual Studio 2008, select **Visual C#, Smart Device**, and **Smart Device Project** in the window on the right. In the “Add New Smart Device Project” dialog box, select **Windows CE** as the target platform, the desired .NET Compact Framework version (v3.5 is installed by default on the TREQ-M4), and **Device Application** from Templates.

3. Select a directory for the project, and click **[OK]**.
4. Enable the Device toolbar from the View, Toolbars menu.
5. Make sure that the “Target Device” drop-down list shows “TREQ-M4 ARMV4I Device.” If not, click **[Device Options]** (next to the drop-down list), and select **TREQ-M4** from the “Show devices for platform” drop-down list.
6. Right-click the project from the Solution Explorer window, and select **Properties** to bring up the Property Pages for the project.
7. In Devices, select **TREQ-M4 ARMV4I Device** from the Target device drop-down list.
8. In Devices, select the desired Output file folder (see Figure 29, “Visual Studio, Managed Project Properties”). This parameter determines the path in the TREQ-M4 file system where the executable will be deployed and executed.

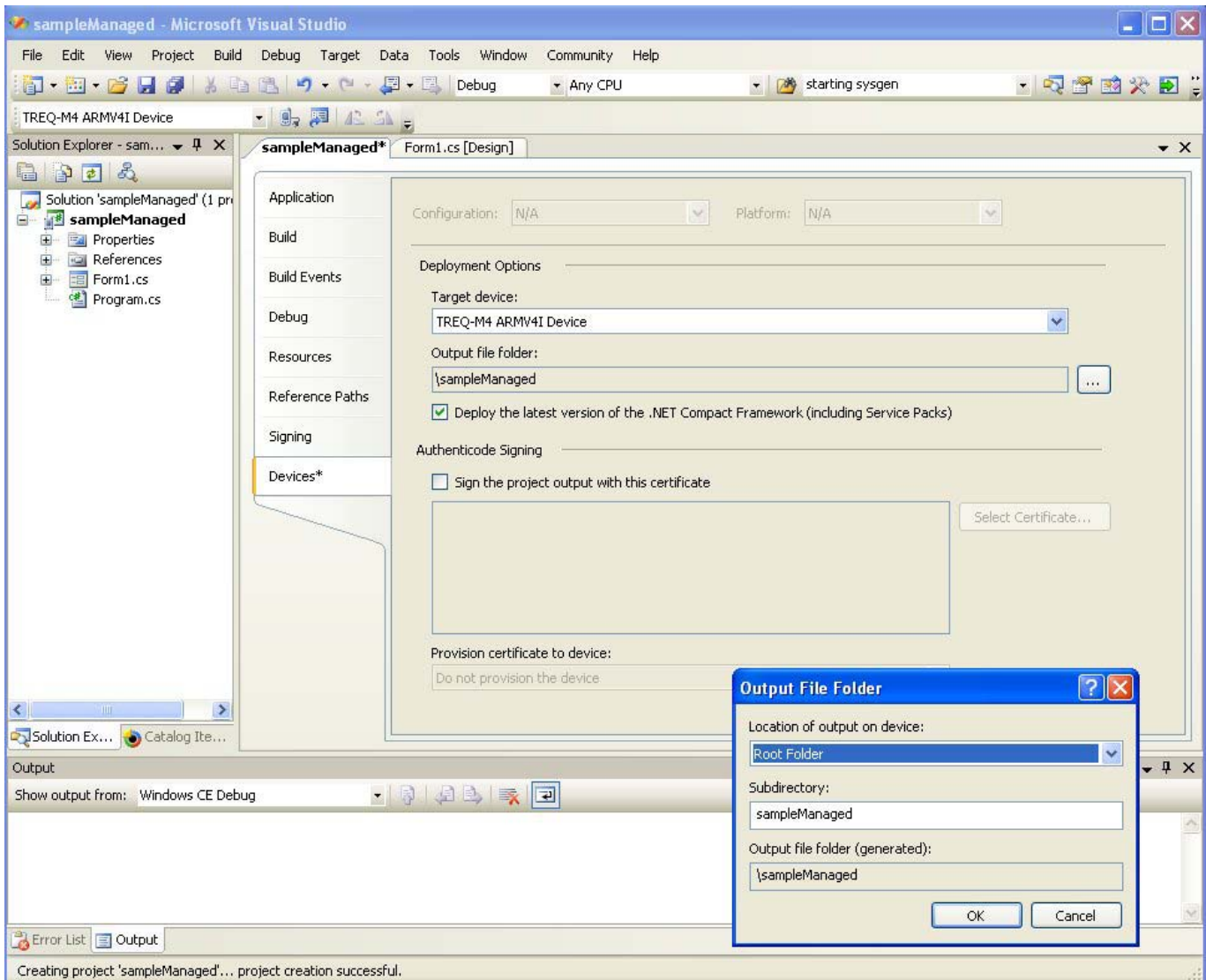


Figure 29  
Visual Studio, Managed Project Properties

### 6.2.5 Remote Tools

Microsoft provides several remote tools with the Visual Studio 2005 and Visual Studio 2008 installation, such as Remote Registry Editor and Remote Zoom In (for screen capture). These tools work over an established remote debugging connection. Follow the procedures outlined in sections 6.2.1 through 6.2.3 to set up this connection.

Note that there may be a delay the first time a remote tool requests to connect to the TREQ-M4 target. The platform manager framework copies required libraries and executables for running the remote tool during this time. Subsequent connection requests will not have this delay unless the TREQ-M4 has been rebooted since the last request.

Refer to the following MSDN links for additional information about the Microsoft remote tools: <http://msdn.microsoft.com/en-us/library/aa935548.aspx>  
<http://msdn.microsoft.com/en-us/library/aa935675.aspx>


## 6.3 Software Drivers

Software access and control of specialized hardware peripherals on the TREQ-M4 are provided through device driver and registry interfaces. These interfaces utilize the standard Windows stream driver API (e.g., CreateFile, WriteFile, ReadFile, and DeviceIoControl) and registry access API (RegOpenKeyEx, RegQueryValueEx, etc.). Most TREQ-M4 peripherals do not fit the typical model for stream devices that transfer large amounts of data, thus the traditional operations like read and write are not supported. The primary access and control mechanism is the DeviceIoControl function, which provides flexibility via custom IOCTL codes. Refer to Microsoft documentation for a detailed description of the driver and registry API functions.

The following sections outline the behavior, supported IOCTL codes, and registry keys/values for each peripheral.

IOCTL codes are described in the form of sample C code and in-line comments. The inputs and outputs of each IOCTL are described. Sample calls are provided to illustrate proper usage for each IOCTL. IOCTL defines and enumeration values for input and output parameters to the DeviceIoControl function are described in the file *TreqPublic.h* that is included in the software development kit distribution (`\Program Files\Windows CE Tools\wce600\TREQ-M4\Include\Armv4i\TreqPublic.h`). For example, the keypad button key defines are listed in this header file. The sample code below references *TreqPublic.h* as appropriate.

Registry keys/values are listed in a standard [key] “value” format. These keys/values may be queried or set programmatically via the registry access API or by using a utility program like *RegEditCE.exe* (refer to [section 4.7.2, “Beijer Electronics” on page 32](#)).

**NOTE**  *The code in the following sections is included “as is” for illustration purposes only. It is recommended that the application developer check the return value for success or failure of device driver API calls.*

### 6.3.1 Keypad

The keypad driver initiates scans of four elastomeric function keys and reports presses to the GWES (graphical, window, and events) Windows CE subsystem. Single and multiple simultaneous presses are supported.

Auto-repeat is supported, including variable initial delay and repeat rate. These parameters apply globally to all keys in the built-in keypad and to any externally connected USB keyboard and can be set via keypad driver DeviceIoControl calls or via the Keyboard control panel applet (refer to [section 4.1.3, “Keyboard” on page 20](#)). Although repeat rate and initial delay are global, auto-repeat enable/disable is selectable per key via DeviceIoControl calls to the keypad driver.

Each key can be individually assigned a virtual key code. Supported virtual key codes include all Windows CE standard supported codes (defined in *winuser.h*, found in the TREQ-M4 SDK distribution located at `\Program Files\Windows CE Tools\wce600\TREQ-M4\Include\Armv4i`) as well as custom codes enabling the assignment of mouse clicks and movements and the ability to launch applications and define key sequences. Key codes are assigned via DeviceIoControl calls to the keypad driver. **Independent control of a press vs. a release key code is not supported; all actions occur on a press (as opposed to a key release).** Refer to [section 3.3, “Function Keys”](#) for default key mappings.

When assigned the appropriate key code (e.g., `VK_RUN_APP` or `VK_SEQ`), a key can launch an application defined by a string that is set via a DeviceIoControl call to the keypad driver. The application is always launched on a key press.

When assigned the appropriate key code (e.g., `VK_MOUSE_LEFT` or `VK_MOUSE_LEFT-CLICK`) a key can control mouse cursor movement or simulate a mouse button click. If repeat is enabled for that key, and a mouse movement code is assigned, holding down that key causes the mouse to move and then accelerate. The longer the key is held, the greater the acceleration. The acceleration factor can be set via DeviceIoControl calls to the keypad driver.

The keypad driver implements a shifted and non-shifted state. This should not be confused with the use of the SHIFT key (`VK_SHIFT`). The shift state applies globally to all keys and can be enabled/disabled via DeviceIoControl calls to the keypad driver. A shifted state allows a second set of key code assignments that can be quickly enabled or disabled via a single driver call. The program *KeyShiftCE.exe* is a sample application that toggles the keypad shift state (refer to [section 4.7.2, “Beijer Electronics” on page 32](#)). Every key and shifted key has its own set of repeat and extended data storage (path or sequence information), so shifting the keys provides a complete new set of keys. When the shift state is changed, any keys being held down will be “released” by the driver before the state change occurs (this prevents a stuck-down key state because held keys are not re-registered as new presses in the new shift state).

Key sequences are distinctive. No mouse commands may be embedded in a key sequence, and the repeat flag does not work for a key inside a sequence. Instead, key sequences have a flag indicator to indicate whether or not to release the current key and all previous keys that were down. Not specifying the release flag simply means that the release will occur when the key goes up. To use auto-repeat with a sequence, mark the `VK_SEQ` identifier (the first key) as auto repeat. Besides the normal `VK_keys` given by WinCE, a `VK_RUN_APP` may be embedded in a key sequence. Using the `VK_RUN_APP` in a sequence always causes a release for previous keys in the sequence, regardless of whether or not the release flag was specified.

#### API, described via code examples:

```
HANDLE hDevice;
hDevice = CreateFile(TEXT("KEY1:"), GENERIC_READ, 0, NULL, OPEN_EXISTING, 0, NULL);
WORD key = TREQ_KEY0; // See TreqPublic.h for key defines
WORD keyCode = VK_RETURN; // See TreqPublic.h for key code defines
// Use keyCode |= TREQ_KEY_REPEAT; to enable repeat for key,
// otherwise it is disabled
DWORD keyIn = (keyCode << 16) | key;
```

```

// set key mapping and repeat
DeviceIoControl(hDevice, IOCTL_KEYPAD_SET_KEY, &keyIn, sizeof(keyIn),
                NULL, 0, NULL, NULL);
// get key mapping and repeat
DeviceIoControl(hDevice, IOCTL_KEYPAD_GET_KEY, &key, sizeof(key),
                &keyCode, sizeof(keyCode), NULL, NULL);
BOOL bRepeat = (keyCode & TREQ_KEY_REPEAT) != 0; // get repeat state

// Set shift state to "on" to access shifted key set
// Once in shift mode, set and get key will access the shifted set
int shift = 1;
DeviceIoControl(hDevice, IOCTL_KEYPAD_SET_SHIFT, &shift, sizeof(shift),
                NULL, 0, NULL, NULL);
// get shift state
DeviceIoControl(hDevice, IOCTL_KEYPAD_GET_SHIFT, NULL, 0,
                &shift, sizeof(shift), NULL, NULL);

// set cursor key acceleration
// applies only when mouse cursor key codes are used
int accel = 5; // 0 to TREQ_KEY_MAX_ACCEL, defined in TreqGLPublic.h
DeviceIoControl(hDevice, IOCTL_KEYPAD_SET_ACCEL, &accel, sizeof(accel),
                NULL, 0, NULL, NULL);
// get cursor key acceleration
DeviceIoControl(hDevice, IOCTL_KEYPAD_GET_ACCEL, NULL, 0,
                &accel, sizeof(accel), NULL, NULL);

// set and get the path to an executable program or a sequence of keys
// executed when the key is pressed (requires a VK_RUN_APP or VK_SEQ keycode)
// runApp launches MinTermCE.exe
// string initializer includes null terminator
WCHAR runApp[] = { TREQ_KEY0, VK_RUN_APP, TEXT("\\HardDisk\\bin\\MinTermCE.exe") };
// VK_0 thru VK_9 are the same as ASCII '0' thru '9' (0x30 - 0x39)
enum { VK_0=0x30, VK_1, VK_2, VK_3, VK_4, VK_5, VK_6, VK_7, VK_8, VK_9 };
// VK_A thru VK_Z are the same as ASCII 'A' thru 'Z' (0x41 - 0x5A)
enum { VK_A=0x41, VK_B, VK_C, VK_D, VK_E, VK_F, VK_G, VK_H,
      VK_I,   VK_J, VK_K, VK_L, VK_M, VK_N, VK_O, VK_P,
      VK_Q,   VK_R, VK_S, VK_T, VK_U, VK_V, VK_W, VK_X,
      VK_Y,   VK_Z };

// runSeq launches MinTermCE.exe, then types "done"
// Can't use string initializer when data follows the path in
// the sequence (compiler limitation)
WCHAR runSeq[] = { TREQ_KEY1, VK_SEQ | TREQ_KEY_REPEAT, VK_RUN_APP,
                  '\\', 'H', 'a', 'r', 'd', 'D', 'i', 's', 'k',
                  '\\', 'b', 'i', 'n',
                  '\\', 'M', 'i', 'n', 'T', 'e', 'r', 'm', 'C', 'E',
                  '.', 'e', 'x', 'e', 0, // must null terminate!
                  VK_D, VK_O, VK_N, VK_E | TREQ_KEY_RELEASE };

// otherSeq types "Hello World" followed by a return, and repeats
WCHAR otherSeq[] = { TREQ_KEY2, VK_SEQ | TREQ_KEY_REPEAT, VK_LSHIFT,
                    VK_H | TREQ_KEY_RELEASE, VK_E, VK_L, VK_L, VK_O,
                    VK_SPACE, VK_LSHIFT,
                    VK_W | TREQ_KEY_RELEASE, VK_O, VK_R, VK_L, VK_D,
                    VK_RETURN | TREQ_KEY_RELEASE };
DWORD seqNumBytes = sizeof(runApp); // num bytes, including NULL terminator

DeviceIoControl(hDevice, IOCTL_KEYPAD_SET_KEY, runApp, seqNumBytes,
                NULL, 0, NULL, NULL);
seqNumBytes = sizeof(runSeq);
DeviceIoControl(hDevice, IOCTL_KEYPAD_SET_KEY, runSeq, seqNumBytes,
                NULL, 0, NULL, NULL);

```

```

seqNumBytes = sizeof(otherSeq);
DeviceIoControl(hDevice, IOCTL_KEYPAD_SET_KEY, otherSeq, seqNumBytes,
               NULL, 0, NULL, NULL);

// find length of key data sequence for key 1
// To get returned length: retDataNumBytes/sizeof(WCHAR)
// Must pass at least a WORD to the output buffer to get the initial code:
// keyCode will be set to VK_SEQ if it is a sequence
key = TREQ_KEY1;
DWORD retDataNumBytes = 0;
DeviceIoControl(hDevice, IOCTL_KEYPAD_GET_KEY, &key, sizeof(key),
               &keyCode, sizeof(keyCode), &retDataNumBytes, NULL);

// sequence string returned in retData
// num bytes in retData returned in retPathNumBytes
// To get returned length: retDataNumBytes/sizeof(WCHAR)
WCHAR *retData = new WCHAR[retDataNumBytes/sizeof(WCHAR)];
DeviceIoControl(hDevice, IOCTL_KEYPAD_GET_KEY, &key, sizeof(key),
               retData, retDataNumBytes, NULL, NULL);

// set auto repeat delay and rate (global)
#include <keybd.h> // from SDK, for struct defn
// all int32 struct members, only first 2 matter
// delay is in ms
// repeat rate is in keys/sec
KBDI_AUTOREPEAT_INFO ai = { delay, repeatRate, 0, 0 };
DeviceIoControl(hDevice, IOCTL_KBD_SET_AUTOREPEAT, &ai, sizeof(ai),
               NULL, 0, NULL, NULL);

CloseHandle(hDevice);

```

**Example registry settings:**

This example shows the registry key settings for key 0 and cursor acceleration. To adjust another key, change the 0 to the number of the desired key (0 through 3).

```

[HKEY_LOCAL_MACHINE\Drivers\BuiltIn\KEYPAD]
"CursorAccel" = dword:5
"Key0" = dword:200 ; VK_RUN_APP
"Key0Shift" = dword:201 ; VK_SEQ
"Key0Repeat" = dword:0
"Key0ShiftRepeat" = dword:0
"Key0Ext" = hex: 65,00, 78,00, 70,00, 6c,00, 6f,00, 72,00, 65,00, 72,00,
  2e,00, 65,00, 78,00, 65,00, 00,00 ; run explorer.exe
"Key0ShiftExt" = hex: 45,00, 58,00, 50,00, 4c,00, 4f,00, 52,00, 45,00,
  52,00, 6e,00, 45,00, 58,00, 45,80 ; type explorer.exe (key release at end)

```

Changes to these registry settings take effect only after a reboot.

**6.3.2 Backlight**

The backlight driver is responsible for enabling/disabling and setting the intensity levels of the display and keypad backlights. The user may control these operations programmatically or via a user interface.

The intensities of the display and keypad can be independently controlled via driver DeviceIoControl calls. The TREQ Panel application also includes slider controls for these settings (refer to [section 4.2, “TREQ Panel”](#)).

The Windows CE power manager contains timers that can be used to enable power-down and/or power-off modes for the display and keypad backlight after a specified time has elapsed. The power-down and power-off modes correspond to User Idle and System Idle system power states. Set timers for User Idle and System Idle state transitions via driver DeviceIoControl calls, the TREQ Panel application (refer to [section 4.2.5, “Power States”](#) for more information on TREQ Panel power state controls), or registry values. Set the power state timer values to 0 to disable transition to User Idle and/or System Idle states. Disabling transition to User Idle also prevents transition to System Idle. To retain the System Idle transition, set the User Idle timer to one second. The state transition timers are cumulative; in other words, the System Idle transition will occur only after both the User Idle and System Idle timers expire.

A transition to User Idle causes both the display and keypad backlights to dim to the specified intensity. This intensity level can be set via a DeviceIoControl call. Any user activity will cause the power manager to transition out of User Idle to a full on state, and thus restore the prior backlight intensity levels. Examples of user activity are pressing the touch screen or keypad, or using a USB mouse or keyboard (specifically, when the event defined in the [HKLM\System\GWE\ActivityEvent] registry key is signaled).

A transition to System Idle causes the display backlight, keypad backlight, and the LCD display to be disabled. Any user activity will cause the power manager to transition out of System Idle to a full on state, and thus restore the prior backlight intensity levels.

#### API, described via code examples:

```
HANDLE hDevice;
hDevice = CreateFile(TEXT("BLT1:"), GENERIC_READ, 0, NULL,
                    OPEN_EXISTING, 0, NULL);

// set/get backlight intensity
int intensity = 80; // 0 to 100%
DeviceIoControl(hDevice, IOCTL_BACKLIGHT_SET_INTENSITY,
                &intensity, sizeof(intensity), NULL, 0, NULL, NULL);
DeviceIoControl(hDevice, IOCTL_BACKLIGHT_GET_INTENSITY,
                NULL, 0, &intensity, sizeof(intensity), NULL, NULL);

// set/get keypad backlight intensity
intensity = 80; // 0 to 100%
DeviceIoControl(hDevice, IOCTL_BACKLIGHT_KEYPAD_SET_INTENSITY,
                &intensity, sizeof(intensity), NULL, 0, NULL, NULL);
DeviceIoControl(hDevice, IOCTL_BACKLIGHT_KEYPAD_GET_INTENSITY,
                NULL, 0, &intensity, sizeof(intensity), NULL, NULL);

// set/get keypad AND display backlight power-down intensity
intensity = 15; // 0 to 100%
DeviceIoControl(hDevice, IOCTL_BACKLIGHT_POWERDOWN_SET_INTENSITY,
                &intensity, sizeof(intensity), NULL, 0, NULL, NULL);
DeviceIoControl(hDevice, IOCTL_BACKLIGHT_POWERDOWN_GET_INTENSITY,
                NULL, 0, &intensity, sizeof(intensity), NULL, NULL);
```

```

// set or get the backlight power down or power off timeout value
int pwrTime; // seconds
// set power down (User Idle transition timer)
DeviceIoControl(hDevice, IOCTL_BACKLIGHT_SET_POWERDOWN,
                &pwrTime, sizeof(pwrTime), NULL, 0, NULL, NULL);
DeviceIoControl(hDevice, IOCTL_BACKLIGHT_GET_POWERDOWN,
                NULL, 0, &pwrTime, sizeof(pwrTime), NULL, NULL);
// set power off (System Idle transition timer)
DeviceIoControl(hDevice, IOCTL_BACKLIGHT_SET_POWEROFF,
                &pwrTime, sizeof(pwrTime), NULL, 0, NULL, NULL);
DeviceIoControl(hDevice, IOCTL_BACKLIGHT_GET_POWEROFF,
                NULL, 0, &pwrTime, sizeof(pwrTime), NULL, NULL);

CloseHandle(hDevice);

```

### Example registry settings:

Following are the defaults for the prototype unit.

```

[HKEY_LOCAL_MACHINE\Drivers\BuiltIn\Backlight]
    "BacklightIntensity"=dword:00000064      ; 100%
    "BacklightKeypadIntensity"=dword:00000064 ; 100%
    "BacklightPowerDownIntensity"=dword:2    ; 2% ; used for UserIdle

[HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Control\Power\Timeouts]
    "ACUserIdle"=dword:3C      ; sec from last user activity 0x3c=60s
    "ACSystemIdle"=dword:12C  ; sec from start of UserIdle 0x12c=300s=5min

```


Changes to these registry settings take effect only after a reboot.

### 6.3.3 EMP (Emergency Power)

The EMP driver is responsible for responding to low input voltage and voltage recovery events from the TREQ-M4's input voltage detection circuitry and reporting them to the system (refer to [section 2.1.8, "Power Supply"](#)). The USB and audio (internal and external) functions will be disabled while the TREQ-M4's input voltage is too low. Applications listening to EMP driver events can respond to the loss of these functions and can be notified when the voltage returns to normal operating range.

There are two voltage thresholds and two corresponding operating system events generated, as follows:

- Main Power Low – the input voltage drops below a threshold that is typically between six and seven volts.
- Main Power High – the input voltage has risen above the Main Power Low threshold plus an additional hysteresis band of about one volt (i.e., the event will be triggered when the voltage rises above about eight volts).

**NOTE**  *The Main Power High event is not generated during boot as the system powers up.*



In order to avoid race conditions with regulated voltage supplies, the Main Power High event can be signaled no sooner than a minimum wait time after a preceding Main Power Low event, provided that the voltage has increased past the threshold. The minimum wait time is 500 milliseconds by default and is configurable with a registry setting (StableTimeForUp; see “Example registry setting” below). After a Main Power Low event occurs, a check is made every 100 milliseconds to determine whether the input voltage has satisfied the conditions for signaling a Main Power High event. The Main Power High event is signaled if this check is positive for the minimum wait time (e.g., five times for 500 ms).

The EMP driver may take measures to reduce power consumption as the input voltage drops. In response to a Main Power Low event, the EMP driver causes the keypad and display backlight to dim, depending on the value of a registry setting (LowPowerState; see “Example registry setting” below). The dimmed intensity can be set via a DeviceIoControl call to the backlight driver for power down intensity (refer to [section 6.3.2, “Backlight”](#)). Audio and USB host functions will be reset when the input voltage level is too low to maintain regulated power to these circuits. Only a Main Power High event will return the unit to its state prior to experiencing power failure events.

Windows CE power notifications are generated to signal the occurrence of the Main Power Low and Main Power High events. The RequestPowerNotifications function can be used with a message queue to register to receive EMP event notifications. The EMP driver generates messages of type PBT\_TRANSITION in a POWER\_BROADCAST structure. The Flags member of this structure is set to a power state enumeration defined in TreqPublic.h. The Power Manager knows nothing of these custom states; they are only used in the power notification process (e.g., GetSystemPowerState() will never return POWER\_STATE\_MAIN\_PWR\_LOW).

#### API, described via code examples:

```
// Sample code to be run from a separate thread for
// monitoring power failure events

UCHAR buf[QUEUE_SIZE];
HANDLE hNotifications = NULL, hReadMsgQ = NULL;
MSGQUEUEOPTIONS msgOptions = { 0 };
DWORD dwBytesInQueue, dwFlags;
PPower_BROADCAST pB = (PPower_BROADCAST)buf;

// Create a message queue for Power Manager notifications.
msgOptions.dwSize = sizeof(MSGQUEUEOPTIONS);
msgOptions.dwFlags = 0;
msgOptions.dwMaxMessages = QUEUE_ENTRIES;
msgOptions.cbMaxMessage = sizeof(POWER_BROADCAST) + MAX_NAMELEN;
msgOptions.bReadAccess = TRUE;

// Check return value for NULL
hReadMsgQ = CreateMsgQueue(NULL, &msgOptions);

// Request Power notifications, check return value for NULL
hNotifications = RequestPowerNotifications(hReadMsgQ, PBT_TRANSITION);

while (TRUE) {
```

```

dwBytesInQueue = dwFlags = 0;
memset(buf, 0, QUEUE_SIZE);

// Read message from queue. Check for 0 return value
if (!ReadMsgQueue(hReadMsgQ, buf, QUEUE_SIZE,
    &dwBytesInQueue, INFINITE, &dwFlags)) {
    break; // error with ReadMsgQueue
}

if (dwBytesInQueue < sizeof(POWER_BROADCAST)) {
    // error: not enough bytes received
    break;
}
if (PBT_TRANSITION == pB->Message) {
    switch (POWER_STATE(pB->Flags)) {
    case POWER_STATE_MAIN_PWR_LOW:
        // Main Power Low event received
        break;
    case POWER_STATE_MAIN_PWR_HIGH:
        // Main Power High event received
        break;
    default:
        break;
    }
    break;
}
} // while(TRUE)

StopPowerNotifications(hNotifications);
CloseMsgQueue(hReadMsgQ);

```

**Example registry setting:**

Following are the defaults for the prototype unit.

```

[HKEY_LOCAL_MACHINE\Drivers\BuiltIn\EMP]
"LowPowerState" = dword:0 ; Backlight driver state: D0:0, D1:1,..., D4
; For Backlight driver: D0=on D1=dim D2=D3=D4=off
"StableTimeForUp" = dword:1F4 ; 500ms -- time before re-enabling devices

```

Changes to these registry settings take effect only after a reboot.

**6.3.4 Power**

The Power Management driver can be used to control power state transitions for the TREQ-M4 system or for specific peripherals. User applications may use the Windows CE Power Management API (e.g., the `SetSystemPowerState`, `SetDevicePower`, and `DevicePowerNotify` functions) to control and set system or device power states. The power states for the system are specified via specific strings, for example, "useridle." The power states for peripherals are specified with the Windows CE power state enumerations D0 – D4.

Refer to the Power Management functions documentation on MSDN (<http://msdn.microsoft.com/en-us/library/aa909892.aspx>), the pm.h header file that is included

in the SDK (*\Program Files\Windows CE Tools\wce600\TREQ-M4\Include \Armv4i\pm.h*), and the CEDEVICE\_POWER\_STATE enumeration at <http://msdn.microsoft.com/en-us/library/bb201981.aspx>.

The following table shows the available TREQ-M4 system power states, specified as both strings and enumerations (when available).

State	Description
“on”, POWER_STATE_ON	Full power mode. All peripherals fully powered and enabled. The power manager may still cause the system to transition to a low power idle mode during periods of reduced and no activity.
“useridle”, POWER_STATE_USERIDLE	Reduced/low power mode. Display backlight and keypad backlight are dimmed. The TREQ-M4 consumes about one-half the power required when in the “on” state.
“systemidle”, POWER_STATE_IDLE	Reduced/low power mode. LCD, display backlight, and keypad backlight are disabled. The TREQ-M4 consumes about one-third to one-half the power required when in the “on” state.
“suspend”, “resuming”, POWER_STATE_SUPEND	Not supported. Using this parameter with the SetSystemPowerState function will have no effect and will return failure.
“off”, “shutdown”, POWER_STATE_OFF	Causes an orderly shutdown of the TREQ-M4, followed by a soft reboot.
“reboot”, “coldreboot”, POWER_STATE_RESET	Causes an orderly shutdown of the TREQ-M4, followed by a soft reboot.

The following are examples illustrating how to put the system and backlight, display, and USB peripheral devices into a specific power state.

```
// Be sure to check return values for Power Management functions
#include <pm.h>

#define BACKLIGHT_DEVICE_NAME PMCLASS_GENERIC_DEVICE TEXT("\\BLT1:")
#define DISPLAY_DEVICE_NAME PMCLASS_DISPLAY TEXT("\\zylonite_lcd")
#define USB_DEVICE_NAME PMCLASS_GENERIC_DEVICE TEXT("\\HCD1:")
DWORD dwDummy;
CEDEVICE_POWER_STATE cps;
TCHAR buf[50];

//////////
// System

// Get system power state
GetSystemPowerState(buf, 50, &dwDummy);
// buf contains the current power state string, e.g. "on"
```

```
// Perform a soft reset using the Power Manager API
// These two calls do the same thing
SetSystemPowerState("reboot", 0, 0x0);
SetSystemPowerState(NULL, POWER_STATE_RESET, 0x0);

// Put the TREQ-M4 system in the system idle state, then
// go back to the on state
SetSystemPowerState("systemidle", 0, 0x0);
SetSystemPowerState("on", 0, 0x0);

//////////
// Peripherals
// Backlight
// cps will have the current state
GetDevicePower(BACKLIGHT_DEVICE_NAME, POWER_NAME, &cps)
// Set the backlight driver's power state to D2 "standby" state.
// The backlight is dimmed, but not off in D2
SetDevicePower(BACKLIGHT_DEVICE_NAME, POWER_NAME, D2);

// Display
// cps will have the current state
GetDevicePower(DISPLAY_DEVICE_NAME, POWER_NAME, &cps)
// Set the display driver's power state to D4 "off" state,
// which turns the display off.
SetDevicePower(DISPLAY_DEVICE_NAME, POWER_NAME, D4);

// USB
// cps will have the current state
GetDevicePower(USB_DEVICE_NAME, POWER_NAME, &cps)
// Set the USB driver's power state to D4 "off" state,
// which disables bus power to any connected USB devices.
SetDevicePower(USB_DEVICE_NAME, POWER_NAME, D0);
```

### 6.3.5 Serial Ports

Refer to the following MSDN website regarding programming serial connections for information about and examples of the Windows CE serial port API:

<http://msdn.microsoft.com/en-us/library/aa913128.aspx>.

The serial port driver uses the stream driver interface. COM1, COM2, and COM5 drivers have port names of COM1:, COM2:, and COM5:, which can be passed to the CreateFile function to open these ports. COM5 is a virtual COM port that is available when a USB-to-serial converter is attached.

The MinTermCE.exe is a simple terminal program (refer to [section 4.7.2](#)) that can be used to test communications over the TREQ-M4 serial ports.

### 6.3.6 Network

Windows CE provides a standard API called Winsock for programming with TCP/IP-based network connections. Network connections are available for multiple interfaces and peripherals on the TREQ-M4, such as internal 10/100Base-T wired Ethernet, external USB-to-wired

Ethernet adapter, external USB to WiFi adapter, and internal Bluetooth Personal Area Network adapter. Refer to [section 4.1.6, “Network and Dial-up Connections”](#) and [Chapter 7, “Optional Peripherals”](#) for additional information on these interfaces and peripherals.

Refer to the following MSDN articles for detailed information and programming reference for the Winsock Windows CE API:

<http://msdn.microsoft.com/en-us/library/aa926807.aspx>

<http://msdn.microsoft.com/en-us/library/aa925696.aspx>

Refer to the following MSDN article for Winsock programming samples:

<http://msdn.microsoft.com/en-us/library/aa916375.aspx>

Following are some MSDN articles describing networking, connectivity, and using sockets with the .NET Compact Framework:

<http://msdn.microsoft.com/en-us/library/8y3swehx.aspx>

<http://msdn.microsoft.com/en-us/library/b6xa24z5.aspx>

Notes

## CHAPTER 7

# OPTIONAL PERIPHERALS

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### 7.1 USB

USB mass storage devices may be accessed programmatically via the standard C file I/O routines (e.g., fopen, fwrite, etc.) or the Windows API functions: CreateFile, ReadFile, WriteFile, and so on. Refer to the documents listed in [section 6.1.2, “Related Documents”](#) for more information.

The USB-to-serial converter used for the ActiveSync connection described in [Chapter 5, “Connect to a PC Via ActiveSync”](#) is an optional USB peripheral. This device uses an FTDI chipset for the USB to serial conversion. The TREQ-M4 includes driver support for this chipset. USB-to-serial converters with other chipsets are not natively supported and will require additional third-party Windows CE drivers. The standard COM port interface described in [section 6.3.5, “Serial Ports”](#) can be used to interface with this device.

Many other optional USB device peripherals may be attached to the TREQ-M4. Beijer Electronics supports mass storage, USB-to-serial converter, keyboard/mouse human interface, and hub devices. Wired Ethernet and 802.11b/g WiFi adapters are also supported (refer to [section 7.2](#) and [section 7.3](#)). Other devices may be attached and used provided there are available Windows CE 6.0 drivers that will run on an ARM platform. APIs for these devices must be provided by a third party or from custom drivers.

### 7.2 Wireless Ethernet

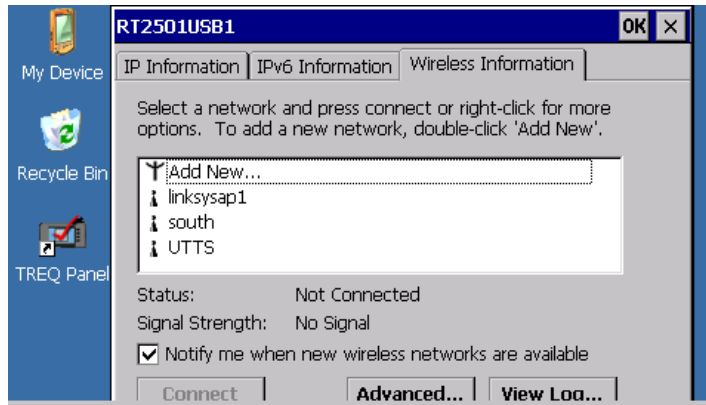
The TREQ-M4 provides 802.11b/g wireless Ethernet capability via an external USB WiFi adapter: Xterasys model XN-3135G. For more information about the adapter refer to: <http://www.xterasys.com/product/xn3135g.htm>. This device utilizes the Ralink RT2501USB chipset.

Drivers for this device are included in the TREQ-M4 file distribution. Other USB WiFi devices that include the same Ralink chipset may work with the Xterasys drivers on the TREQ-M4.

Windows CE provides a programmatic interface for using the WiFi adapter via the Winsock API. Refer to [section 6.3.6, “Network”](#) for more information on Winsock.

Wireless Ethernet adapter configuration in Windows CE is provided by the Wireless Zero Configuration service. For more information about this service refer to: <http://msdn.microsoft.com/en-us/library/aa916223.aspx>.

Figure 30 illustrates the Wireless Zero Configuration after the USB WiFi adapter has been inserted.

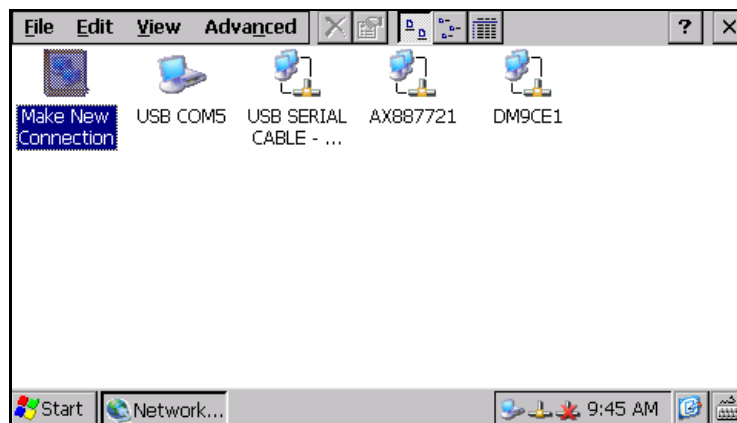


*Figure 30  
Wireless Zero Configuration*

### 7.3 Ethernet (over USB)

The TREQ-M4 supports USB-to-wired Ethernet adapters based on the ASIX AX88772 chipset. Drivers for devices based on this chipset are included in the file distribution. Nintendo® Wii™ USB LAN adapters based on the AX88772 chipset will work with the TREQ-M4.

When the adapter is inserted, the TREQ-M4 will display a new connectoid labeled AX887721 in the Network and Dial-up Connections dialog box (see Figure 13, “Network Connections”). This new Ethernet connection may be managed in the same way as the DM9CE1 internal Ethernet connection. Refer to [section 4.1.6, “Network and Dial-up Connections”](#) for more details.



*Figure 31  
Network Connections, New Connectoids*



## 7.4 Magnetic Card Reader

The TREQ-M4’s card reader device is bidirectional: a card is read by sliding it either forward or backward.

The card reader provides input to Windows CE via keyboard emulation. Characters encoded on a one, two, or three magnetic stripe card are sent in the form of Windows messages to an application as if the same characters were typed on a USB keyboard. Applications need only to receive and decode the virtual key codes sent via the WM\_KEYDOWN message as the card is swiped.

Refer to the following MSDN article for more information on the WM\_KEYDOWN message: <http://msdn.microsoft.com/en-us/library/aa921842.aspx>.


**CAUTION**  *If a key is pressed on a USB keyboard that is connected to the TREQ-M4 while the card reader is transmitting characters, the data from the card reader may get corrupted.*

Figure 32 illustrates how the QEditCE.exe program intercepted and displayed a sequence of six swipes of a magnetic card. The last few characters may differ depending on the direction of the swipe.

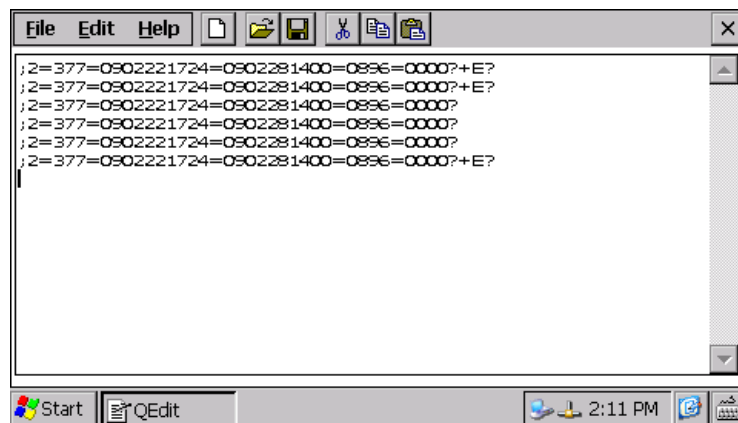


Figure 32  
Magnetic Card Swipe Example

## 7.5 Bluetooth

The TREQ-M4 provides several connectivity options when configured with the Bluetooth option and paired with another Bluetooth device. Virtual serial port, personal area network, human interface device, and headset connectivity options are described in detail in this section. These options have some native application support that allows use and testing of the Bluetooth connection. Other options are available via APIs and Bluetooth Profiles provided by Windows CE. Refer to the following MSDN articles for more information about these topics: <http://msdn.microsoft.com/en-us/library/aa916530.aspx> <http://msdn.microsoft.com/en-us/library/aa915866.aspx>

7.5.1 Pairing

Use the Bluetooth Manager Control Panel applet to pair Bluetooth devices (refer to section 4.1.8, “Bluetooth Manager”).

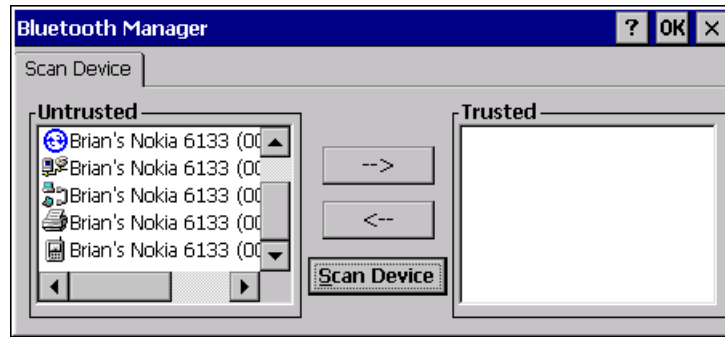


Figure 33  
Bluetooth Manager

Initiate pairing as follows.

1. Select one of the “Untrusted” entries, and then press --> to move the selected device to the “Trusted” window. A prompt appears asking if you need to authenticate the device with which you are trying to pair.
2. First try pairing with a device without authenticating. Tap **[No]** at the prompt. If successful, the pairing operation will finish by adding the device entry to the “Trusted” window.
3. Now try to pair with authentication by tapping **[Yes]** when prompted for authentication. A PIN code dialog box appears as shown in Figure 34. This is the security code that is used for authentication and encryption with the other Bluetooth device.

In the example illustrated, a USB to Bluetooth adapter was used on the PC to pair with a TREQ-M4 terminal.

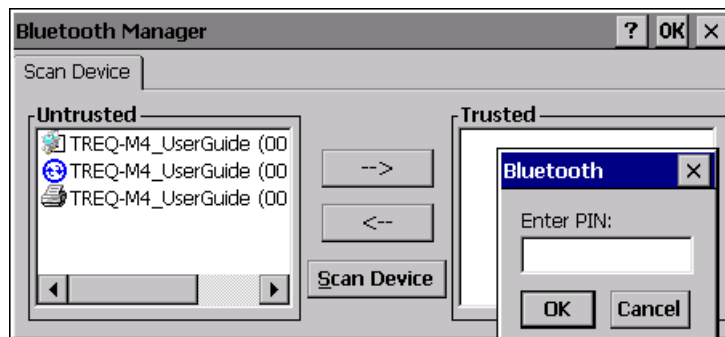


Figure 34  
Bluetooth Manager Requesting Pairing Authentication

4. Enter a code of your choice. It is recommended to use at least eight random characters. The device with which you are trying to pair should open a similar dialog box prompting for a security code.

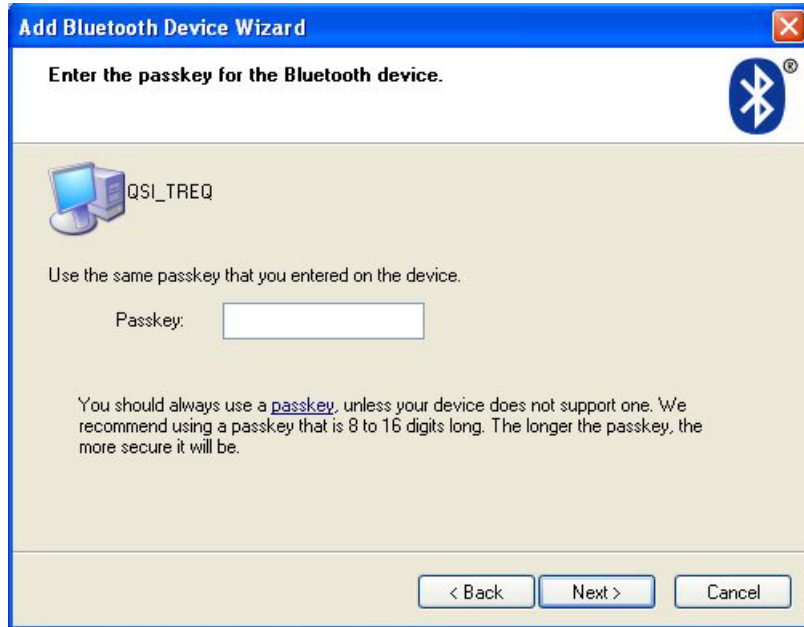


Figure 35  
PC Requesting Pairing Authentication

5. Enter the same code on the remote device immediately. The two devices should be paired at this point. Pairing is confirmed when the Bluetooth Manager moves the “Untrusted” device to the “Trusted” window.

### 7.5.2 qbtM4

Beijer Electronics provides a utility called *qbtM4.exe* (refer to [section 4.7.2, “Beijer Electronics”](#)) that can be used for a number of Bluetooth troubleshooting and development tasks involving service discovery and scanning operations. This application also contains a built-in test feature that may be used for characterizing throughput and signal strength when the application is executed on two connected TREQ-M4 terminals. Figure 36 shows the qbtM4 application after running device and service scans. In this example, the TREQ-M4 has detected a USB Bluetooth adapter on a PC advertising a serial port service.

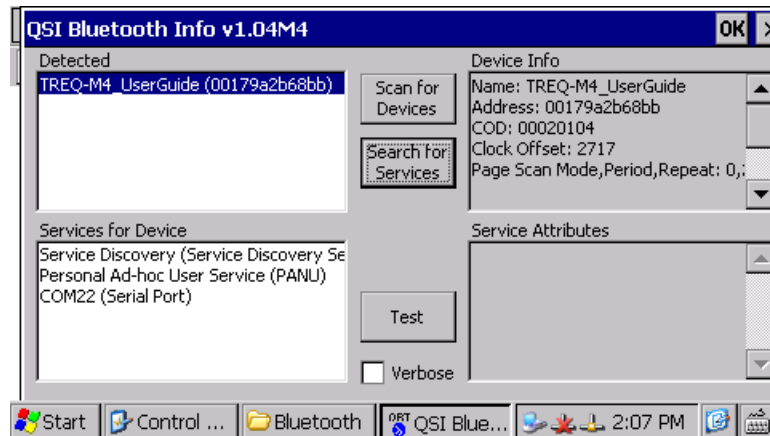


Figure 36  
*qbtM4 Bluetooth Utility Application*

To test throughput and signal strength, do the following.

1. On one TREQ-M4 terminal, start the *qbtM4.exe* application.
2. Perform a scan by tapping **[Scan for Devices]**.
3. Highlight the other terminal in the “Detected” window, and then tap **[Test]**. The Bluetooth Connection Test control panel is displayed.
4. Follow the same steps on another TREQ-M4 terminal by scanning and selecting the first terminal and then opening the Bluetooth Connection Test control panel.
5. Once both units are ready to start the connection test, configure one of the units to operate as a server by tapping the **[Server/Client]** toggle button until “Server” appears.
6. Tap **[Connect]**.
7. Configure the remaining terminal as a client by tapping **[Server/Client]** until “Client” appears.
8. Tap **[Connect]** on the client terminal.

Figure 37 shows the Connection Test and Test Settings dialog boxes.

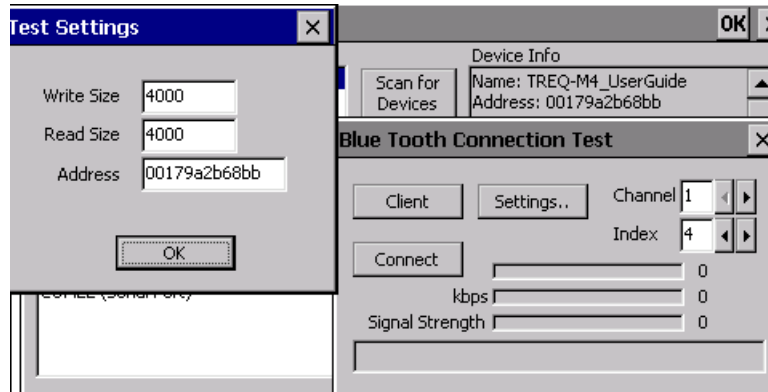


Figure 37  
qbtM4 Connection Test and Test Settings

As the connection test runs, the received signal strength (RSSI) and throughput are displayed in both bar graph and decimal form. The Test Settings dialog box allows configuration of the data block transfer size. The default is a four Kbyte payload.

### 7.5.3 Virtual Serial Port

The TREQ-M4’s Bluetooth device can be used to establish a virtual serial port connection with another Bluetooth device (such as a PC with a Bluetooth adapter).

1. First scan and pair with a remote device that supports the serial port profile. The serial port service is identified by an icon consisting of a blue circle enclosing two arrows that appear to chase one another.
2. After moving this service to the “Trusted” window in the Bluetooth Manager, right-click on the service, and select the **Active** option from the resulting menu (see Figure 38). This registers a virtual com port or Bluetooth serial port on the terminal, and it assigns the new serial port a device name with the prefix BSP. At this point, the index associated with this prefix is unknown to the user.

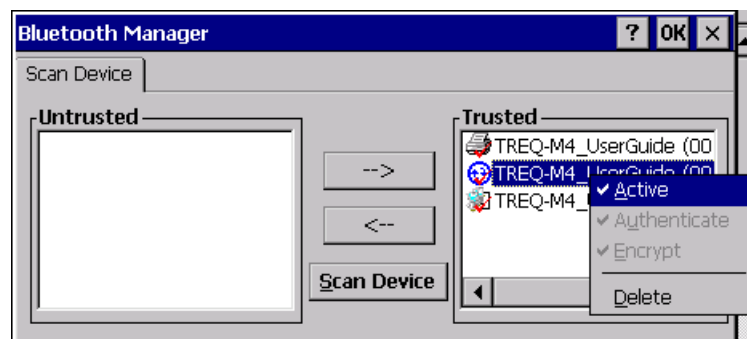


Figure 38  
Activate Bluetooth Serial Port Service

3. Launch the MinTermCE program on the TREQ-M4 (refer to [section 4.7.2, “Beijer Electronics”](#)).
4. Select a new serial port from the COM Port drop-down list that starts with “BSP.” The Bluetooth Manager does not identify which index is assigned to the new virtual serial port (suffix). If this is the first Bluetooth serial port created on the device, the index is one, thus the desired port would be “BSP1.” You will need to use trial-and-error in MinTermCE to find the correct Bluetooth serial port because invalid ports cause an error. Figure 39 shows an active virtual serial port connection using MinTermCE.

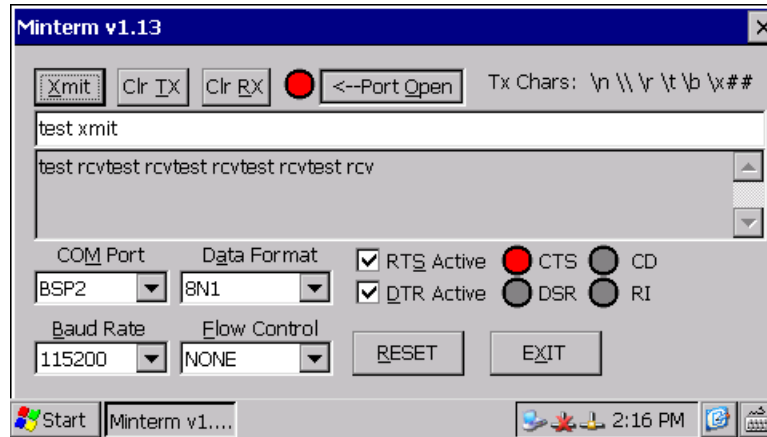


Figure 39  
Bluetooth Virtual Serial Port Connection in MinTermCE

You can also check the `HKEY_LOCAL_MACHINE\Drivers\Active` registry keys for a “BSP#” device to determine the correct port. Figure 40 shows how the RegEditCE program (see [section 4.7.2, “Beijer Electronics”](#)) can be used to check these keys.

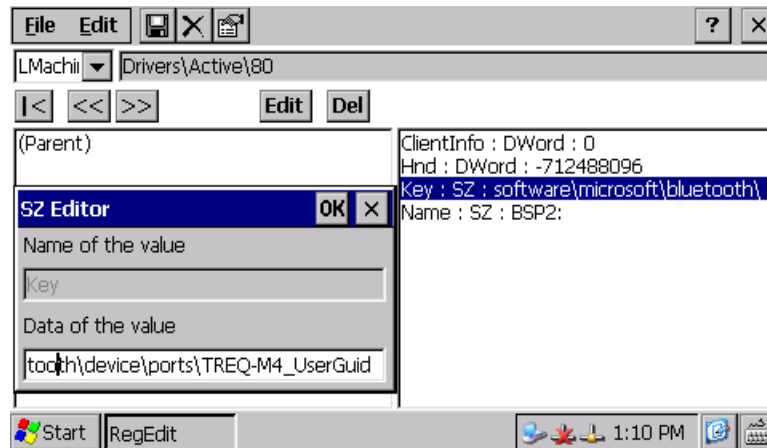


Figure 40  
Examining Active Driver Registry Keys With RegEditCE

5. After selecting the correct serial port in MinTermCE, activate the port by pressing the **Port Open** icon. This connects the serial port service of the terminal with the serial port service

of the remote device. Follow the steps required by the remote device to accept the virtual serial port connection.

6. Open a terminal emulator on the remote device (such as HyperTerm on a PC), and select the proper serial port for the remote device’s Bluetooth serial port.
7. Once the terminal emulator is connected, type some test messages and send them to the terminal. Do the same on the terminal to ensure that the terminal can both send and receive messages over the Bluetooth serial port. Figure 41 shows an example session from a terminal emulation program running on a PC’s Bluetooth serial port (COM22).

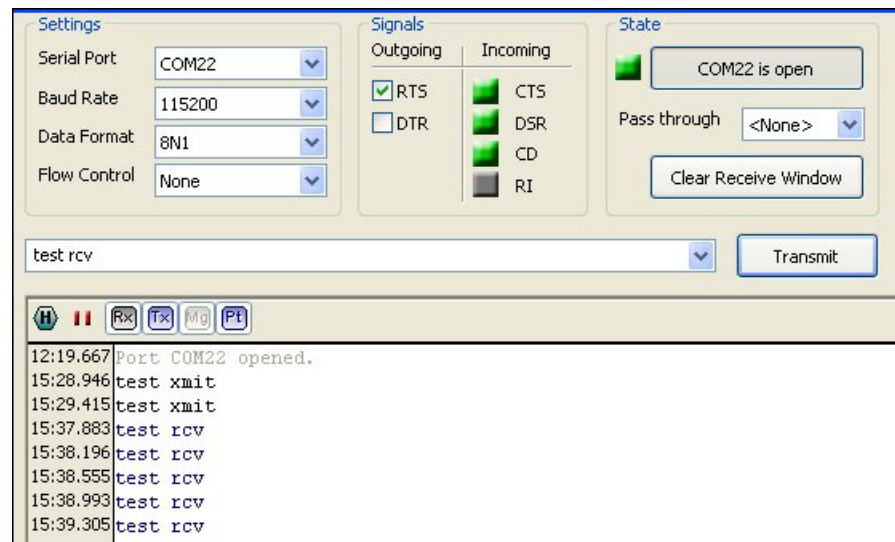


Figure 41  
Bluetooth PC Virtual Serial Port Connection

Without a specialized application, the terminal will only act as a client that initiates these Bluetooth serial port connections.

The standard COM port interface described in [section 6.3.5, “Serial Ports”](#) can be used to programmatically interface with the Bluetooth serial port device. Use BSP#: as the driver port name instead of COM#:

### 7.5.4 Personal Area Network

The TREQ-M4’s Bluetooth device can be used to establish a Personal Area Network (PAN) connection with another Bluetooth device (such as a PC with a Bluetooth adapter).

1. First scan and pair with a remote device that supports the Personal Area Networking profile. The PAN service is identified by an icon consisting of two PC monitors with a drawn wire connection.

2. After moving this service to the “Trusted” window in the Bluetooth Manager, right-click the service, and select the **Active** option from the resulting menu (see the third service icon in Figure 38 above). This registers a new network connection with Windows CE.
3. The Network and Dial-up Connections Control Panel applet contains an additional connectoid called “BTPAN1” that reflects the newly registered network connection. Use the Properties dialog box for this connectoid to set IP configuration parameters. Refer to [section 4.1.6, “Network and Dial-up Connections”](#) for a description of this Control Panel applet and instructions on how to set up IP configuration parameters. Figure 42 illustrates the Properties for the Bluetooth connectoid and some sample IP parameters. This example shows a connection with a static IP address.

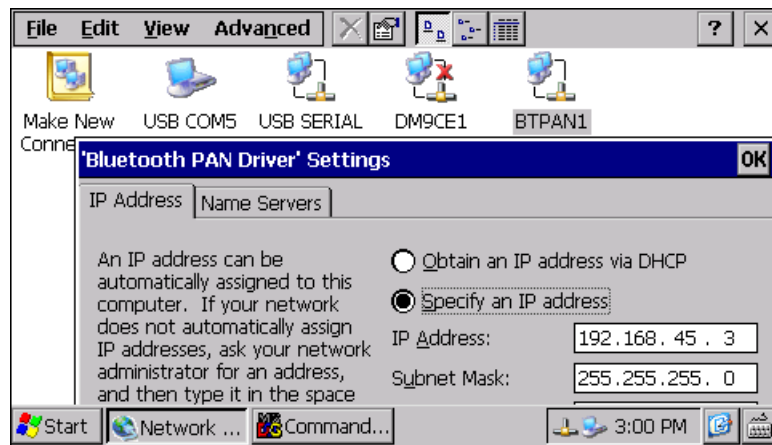


Figure 42  
Bluetooth Connectoid IP Configuration

4. Follow a similar setup on the paired device. On a PC running Windows XP, use the Bluetooth Network Connections dialog box to set up IP configuration parameters. This dialog box is accessible from the Network Connections Control Panel application. Figure 43 illustrates this setup. This example shows a connection with a static IP address that is on the same subnet as the TREQ-M4 device.



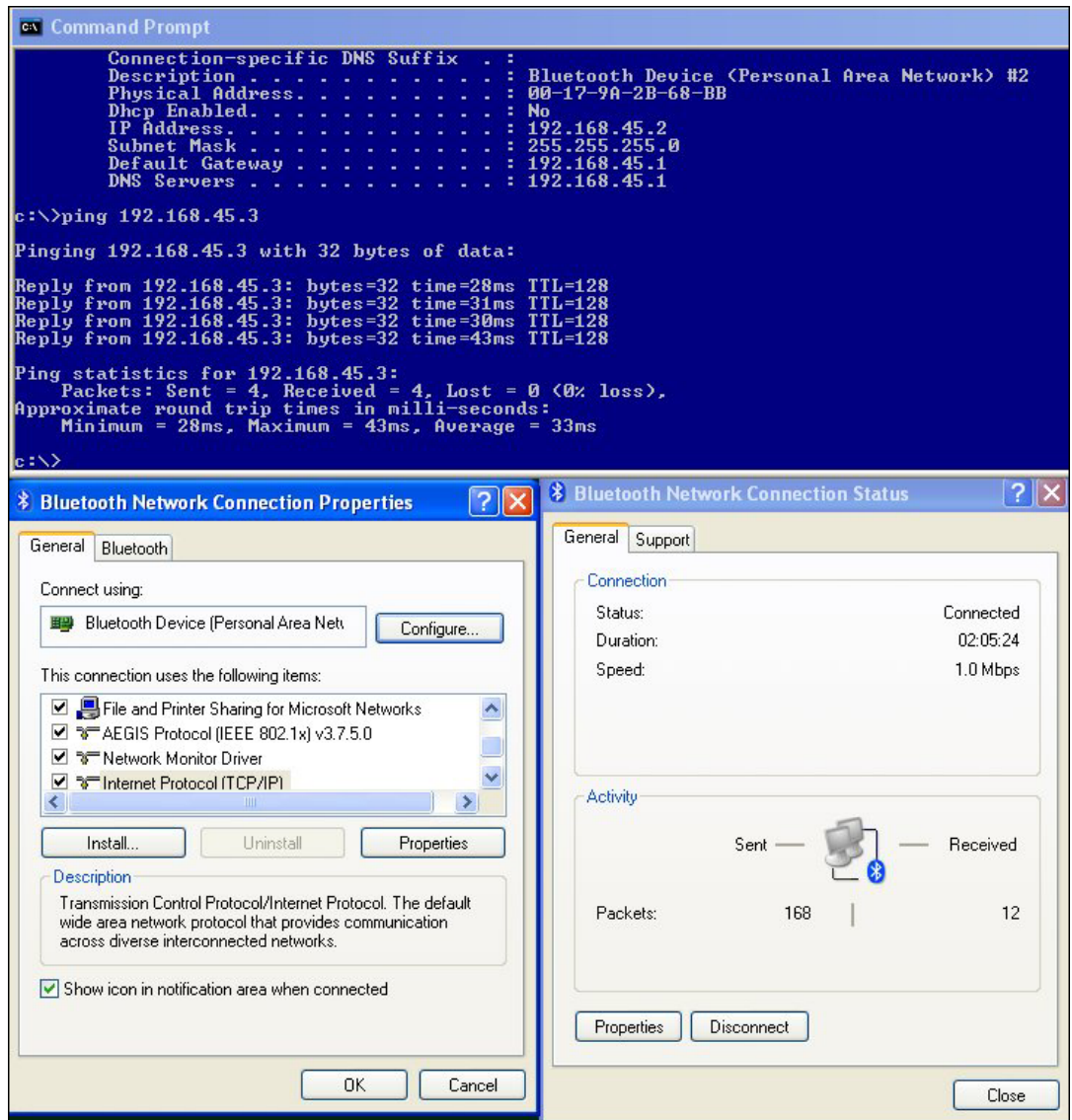
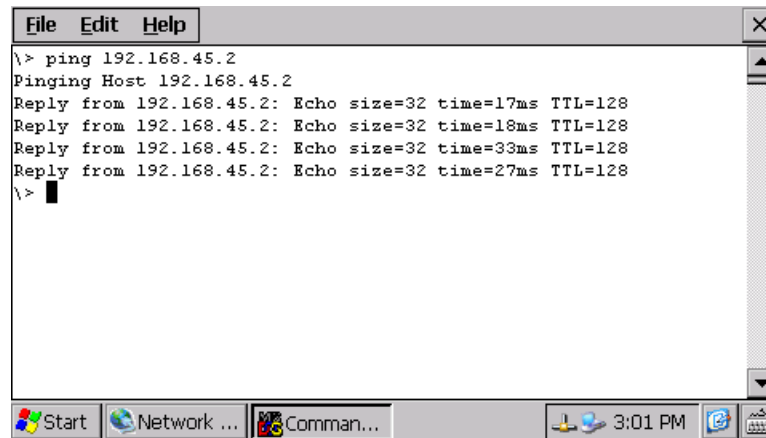


Figure 43  
Bluetooth PC Connection IP Configuration and Ping Test

5. Use the ping program to test the PAN connection. Figures 43 and 44 show a successful ping test.



```
File Edit Help
\> ping 192.168.45.2
Pinging Host 192.168.45.2
Reply from 192.168.45.2: Echo size=32 time=17ms TTL=128
Reply from 192.168.45.2: Echo size=32 time=18ms TTL=128
Reply from 192.168.45.2: Echo size=32 time=33ms TTL=128
Reply from 192.168.45.2: Echo size=32 time=27ms TTL=128
\>
```

Figure 44  
Ping Test of the PAN Connection on the TREQ-M4

The standard Winsock API can be used to programmatically interface with paired Bluetooth devices over a PAN connection. Refer to [section 6.3.6, “Network”](#) for more details.

### 7.5.5 Human Interface Device

The TREQ-M4’s Bluetooth device can be used to support Bluetooth-enabled mice, keyboards, and other Human Interface Devices (HID).

1. First enable a keyboard and mouse for discovery, and then perform a scan operation in the Bluetooth Manager. This scan should produce entries in the “Untrusted” window.
2. Pair with the HID devices by selecting them one at a time and moving them to the “Trusted” window.

During the pairing operation, the selection of whether or not to use authentication will depend on the keyboard or mouse that is being paired. The behavior of these devices varies. This is because there is no method for entering a security code of your choice on the remote device. Often, these devices will have some means for providing a secure authentication but the TREQ-M4 may not support this. If you are unsure, use an unauthenticated pairing procedure.

3. Once paired, right-click on the device in the “Trusted” window of the Bluetooth Manager and select **Active**. This should perform the operations needed to use the service specified by the entry in the “Trusted” window. Perform these steps for each HID device.
4. Move the mouse, or type on the keyboard to ensure that the Bluetooth devices are working properly with the TREQ-M4.

### 7.5.6 Headset Profile

The TREQ-M4's Bluetooth device can be used with audio headsets that support the Bluetooth Headset Profile (HSP).

1. First enable a headset for discovery, and then perform a scan operation in the Bluetooth Manager. This scan should produce entries in the "Untrusted" window.
2. Pair with the HSP device by selecting it and moving it to the "Trusted" window.

During the pairing operation, the selection of whether or not to use authentication will depend on the headset that is being paired. The behavior of these devices varies. This is because there is no method for entering a security code of your choice on the remote device. Often, these devices will have some means for providing a secure authentication but the TREQ-M4 may not support this. If you are unsure, use an unauthenticated pairing procedure.

3. Once paired, right-click on the device in the "Trusted" window of the Bluetooth Manager and select **Active**. This will perform the operations needed to use the service specified by the entry in the "Trusted" window. Perform these steps for the HSP device you wish to use.
4. On the TREQ-M4 terminal, start the *BTAGMicVolCE.exe* application (refer to [section 4.7.2, "Beijer Electronics"](#)), which will open the Bluetooth Audio Gateway and allow you to change the headset microphone volume. The headset microphone volume ranges from 0 to 15 and the suggested setting is a value of 7 or less.
5. You can now record the audio from the headset to a file on the TREQ-M4 (default output is *1.wav* saved to the *MyDevice* folder) by running the application *WaveRecCE.exe* or *RecSndCE.exe*, both of which are described in [section 4.7.2, "Beijer Electronics."](#) *RecSndCE.exe* will record up to 5 seconds of audio on the TREQ-M4 and then play it back through the speaker if the "In Device" box on *RecSndCE* is set to 0, and it will play back through the headset if the "In Device" box is set to 1.

Notes

## CHAPTER 8

# SPECIFICATIONS

---

<b>Display</b>	
TFT color WQVGA LCD display, 65,536 colors	
Size:	109 mm (4.3") diagonal 95 mm x 54 mm "live area"
Pixels:	480 x 272 (WQVGA)
Dot pitch:	0.19 mm
Lighting:	LED
	Brightness is software controllable
Touch screen:	Analog resistive

<b>Interface</b>	
Serial ports:	Two ports; one EIA-232/422 software configurable, one EIA-232
USB ports:	Two USB 2.0 full-speed host ports
Ethernet/USB (optional):	10/100Base-T wired Ethernet or third USB port
Bluetooth (optional):	Class 2, v2.0 compliant; supported profiles GAP, GOEP, SPP, DUN, FTP, HID, HFP, HSP, HID, LAP, ODD, PAN
Magnetic card reader (optional):	Three tracks, bidirectional

<b>Audio</b>	
Speaker:	1 W 8 ohm speaker on front of unit
External speaker jack:	3.5 mm Tip Ring Sleeve jack, mono output

<b>Physical</b>	
Two-bolt stud-mount	
Size:	167 x 90 x 37 mm
Mass:	0.46 kg

<b>Environmental</b>	
Temperature:	Operating -20 to 70 °C
	Storage -40 to 85 °C
Humidity:	0 to 95% non-condensing
Vibration:	10 to 1500 Hz, 4 g RMS
Shock:	40 g, 11 ms, any axis

<b>Environmental (continued)</b>	
Electrical transient and noise:	As specified in J1455 standard
ESD 8 kV contact, 15 k V air discharge on all surfaces	

<b>Power</b>	
Input voltage range:	6 to 32 VDC (exceeds J1455)
Average power consumption:	3–5 Watts (400 mA @ 12 VDC)

<b>CPU</b>	
ARM Architecture V5TE Marvell PXA300 with Intel XScale technology	
Speed:	624 MHz
Cache:	32 Kbytes instruction cache, 32 Kbytes data cache

<b>Memory</b>	
DDR SDRAM:	128 Mbytes standard, 16 bit wide bus, 130 Mhz => 520 Mbytes/s transfer rate
Non-volatile storage:	2 Gbytes standard

<b>Software</b>	
Operating system:	Microsoft Windows Embedded CE version 6.0 R2 Core or Professional (optional)

<b>Customizing</b>
<p>Pad-printed logo may be customized with minimum order.</p> <p>Text or symbols on the elastomeric keypad may be customized with minimum order.</p> <p>Custom configurations available with setup fee and minimum order quantity.</p>

<b>Certification</b>
FCC Part 15, Class A
CE

CHAPTER 9  
MECHANICAL

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9.1 Layout and Dimensions

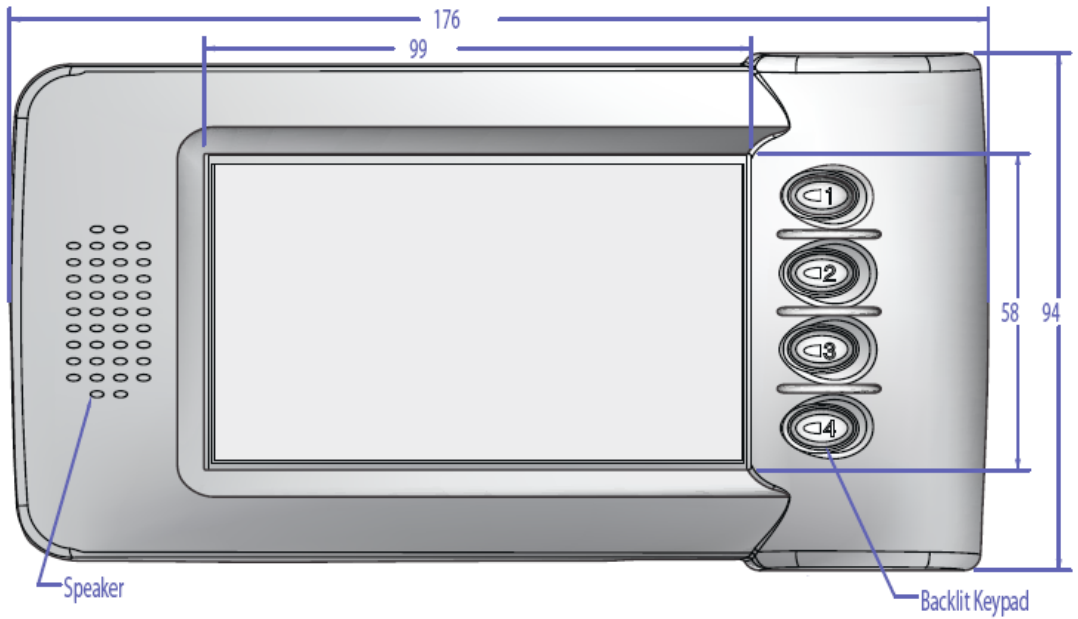


Figure 45  
TREQ-M4 Front View

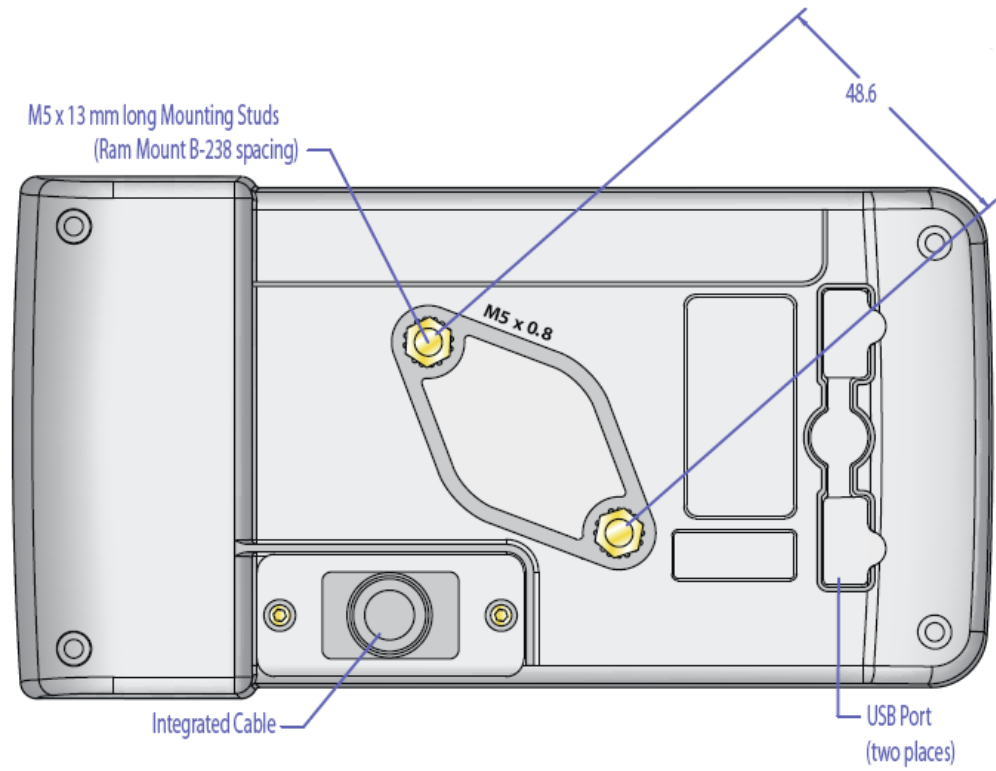


Figure 46  
TREQ-M4 Back View

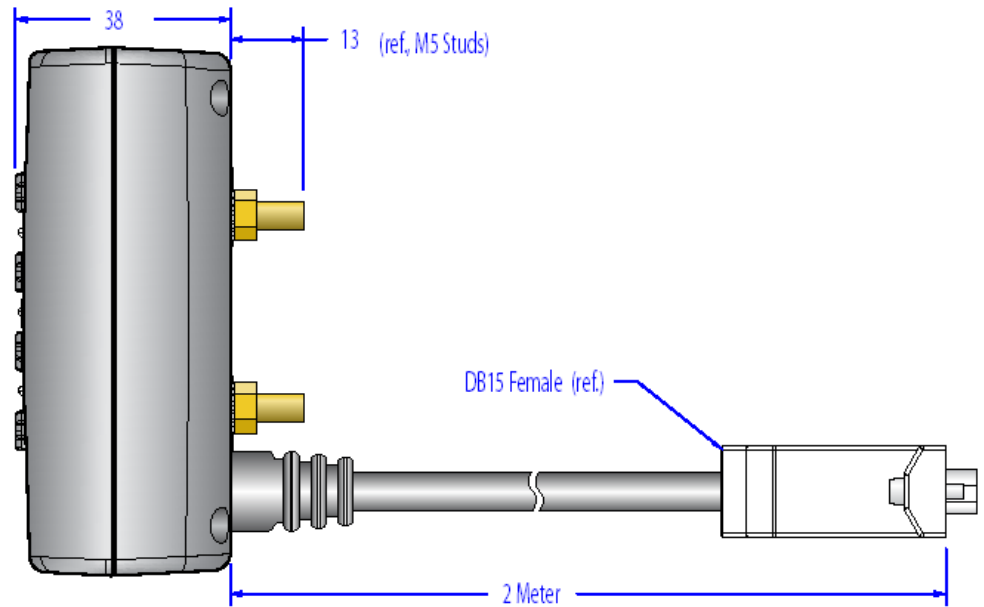
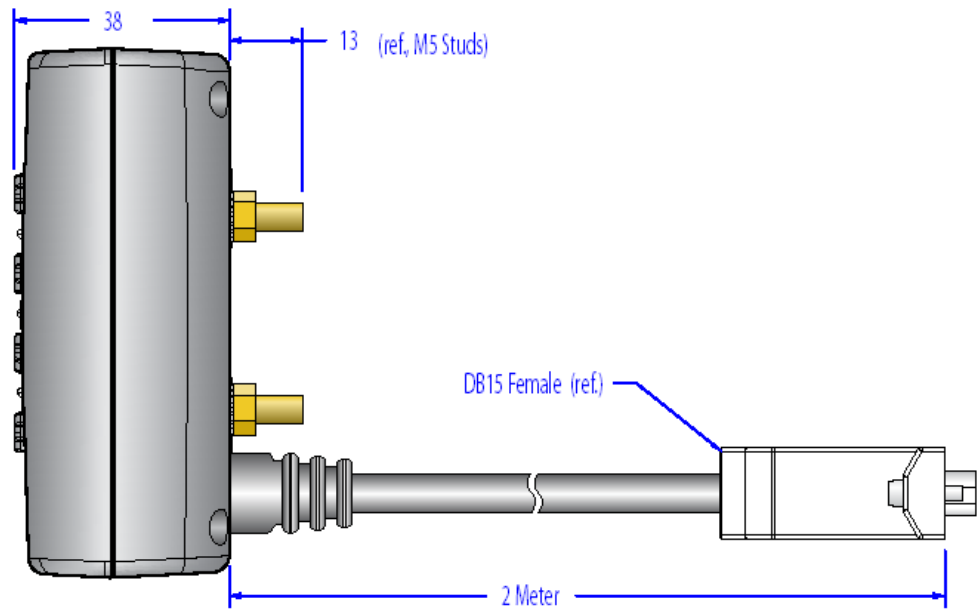


Figure 47  
TREQ-M4 Side View




9.2 Integral Cable



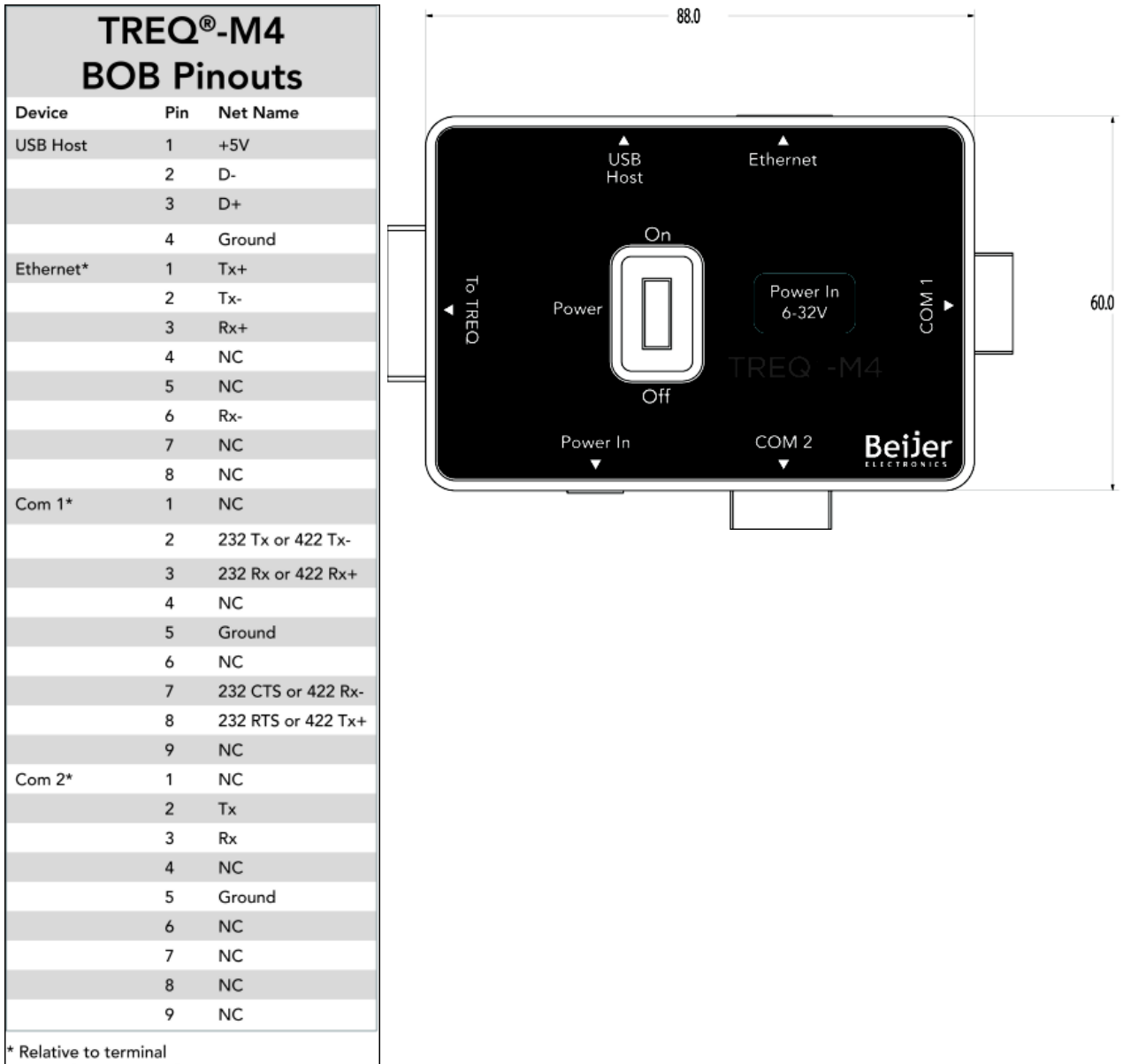
Female DB15	Wire Color	Function	Option
1	Green/Black	Ground	
2	none	Drain Ground	
3	White/Red	COM2 232 Tx*	
4	Black	COM1 232 Tx or 422 Tx-*	
5	White	COM1 232 RTS or 422 Tx+*	
6	Orange	Eth Rx+*	USB Host Power
7	Yellow	Eth Tx+*	USB Host D+
8	Violet	Power	
9	Brown	Power	
10	Green	COM1 232 Rx or 422 Rx+*	
11	Red	COM1 232 CTS or 422 Rx-*	
12	White/Green	COM2 232 Rx*	
13	Grey	Eth Rx-*	USB Host Ground
14	Blue	Eth Tx-*	USB Host D-
15	Red/Black	Ground	

\* Relative to terminal

Figure 48  
TREQ-M4 Integral Cable

**NOTE**  Your cable configuration may be customized with a different connector type. Contact Beijer Electronics technical support at <http://www.beijerelectronicsinc.com/support/contact/?type=tech> if you have cable connector questions.

**9.3 Break Out Box (BOB) Pinouts**



*Figure 49  
TREQ-M4 BOB Pinouts*

Power is applied with a coaxial plug with negative ground polarity (positive voltage on the center conductor and ground on the barrel). The Developer’s Kit includes a 12V wall mount power supply with compatible coaxial plug (2.1 mm inside, 5.5 mm outside diameter).

**NOTE** *The Break Out Box may have a USB Host or Ethernet connector, but not both.*

### 10.1 Software Upgrades

This section provides instructions to install future software releases for the TREQ-M4. You can obtain the latest releases of TREQ-M4 firmware and Windows CE operating system software from either of the following Beijer Electronics websites:

<http://www.beijerelectronicsinc.com/support/files>  
<http://www.beijerelectronicsinc.com/engfiles/treq.php>

A USB keyboard is required for the following upgrade operations.

#### 10.1.1 Operating System

The TREQ-M4 Windows CE-based operating system is contained in an image file called *NK.bin*. This file is packaged along with several other files and directories to form a system package distribution. The TREQ-M4 has an internal flash-based hard drive that is programmed at the factory with the system package distribution. Periodically, Beijer Electronics creates new versions of the operating system image (*NK.bin*), other files/directories in the distribution, or the directory structure of the distribution. Revisions to any of these results in a new release of the system package distribution. Upgrading the system package is the only way to install new versions of items in the package, including the operating system image.

Beijer Electronics has developed an update and package manager application called *UpgradeCE.exe*. This program can be used to upgrade the system package with updates from the Beijer Electronics website, as well as to install custom application packages. One advantage of using *UpgradeCE.exe* rather than a CAB file or other update/install method is that registry settings are preserved, even after installation of a new operating system image (normally, installing a new *NK.bin* causes registry settings to revert to factory defaults).

For more information about CAB files and the wceload process refer to the following website:  
<http://msdn.microsoft.com/en-us/library/aa924383.aspx>.

For detailed information about UpgradeCE.exe, refer to the following website:  
<http://www.beijerelectronicsinc.com/engfiles/TREQ/Apps/UpgradeCE.html>.

The *WinVerCE.exe* utility (refer to [section 4.7.2, “Beijer Electronics” on page 32](#)) can be used to determine the current system package version. Run *WinVerCE.exe* from the Start Menu on the TREQ-M4 task bar in the Beijer Electronics shortcut folder. The “Project Version” and “Build Date” fields indicate the version and build date of the system package, respectively (see [Figure 50, “WinVerCE”](#)). These fields are updated when a new version of the system package is installed. “Kernel Version” refers to the Windows CE kernel version and license level.




Figure 50  
WinVerCE

To upgrade the TREQ-M4 system package, take the following steps:

1. Download the latest system package zip file. This file is available from two locations on the Beijer Electronics website: <http://www.beijerelectronicsinc.com/support/files/> or <http://www.beijerelectronicsinc.com/engfiles/treq.php>.

The latter includes previous images and other items for download in addition to the latest system package zip file.

The zip file contains the latest version of *UpgradeCE.exe*, the system package distribution, and release notes.

**NOTE**  *Be sure to read the release notes for the system package distribution! It is important to be aware of changes to the system that could potentially affect applications and general behavior before upgrading. The release notes are located next to the zip file on the <http://www.beijerelectronicsinc.com/engfiles/treq.php> website.*

2. Unzip the system package zip file to a USB memory drive. Retain any directory structure.
3. Make sure the TREQ-M4 is powered on and any applications are closed.
4. Insert the USB memory drive and attach a USB keyboard to the TREQ-M4. Make sure these are the only USB devices attached.
5. Open a command prompt window and type:  
**cd \usbharddisk**  
**UpgradeCE**

This will initiate the system package upgrade process. (Refer to Figure 51, “System Package Upgrade.”) UpgradeCE displays a status line for each file in the package, indicating whether that file is up-to-date or needs to be updated. Larger files that need to be updated (e.g., *NK.bin*) will take longer and display multiple status lines indicating copy progress.

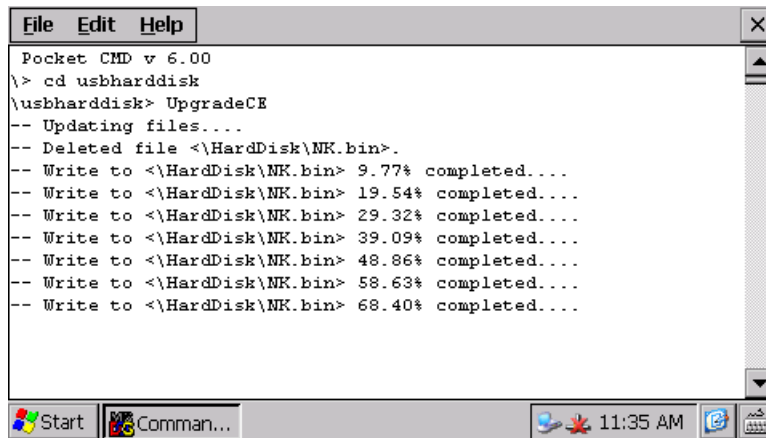


Figure 51  
System Package Upgrade

6. Once complete, UpgradeCE will indicate success and ask for confirmation to reboot. (See Figure 52, “System Package Upgrade Complete.”) Answer **y** or **n**. The installation is not complete and UpgradeCE is disabled for further upgrades until after a reboot.

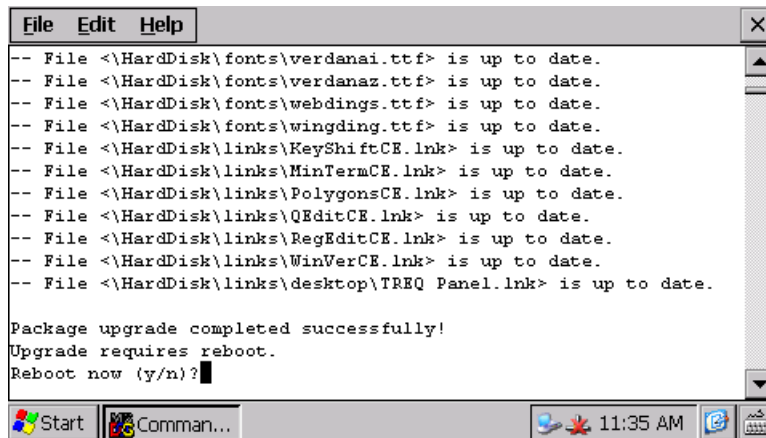



Figure 52  
System Package Upgrade Complete

UpgradeCE will request a reboot only if files requiring an update are in use or if the *NK.bin* operating system image needs to be updated. It is common for the *NK.bin* image to require updating in system package upgrades.

7. After rebooting the TREQ-M4, run the *WinVerCE.exe* program to verify that the system package was successfully upgraded.

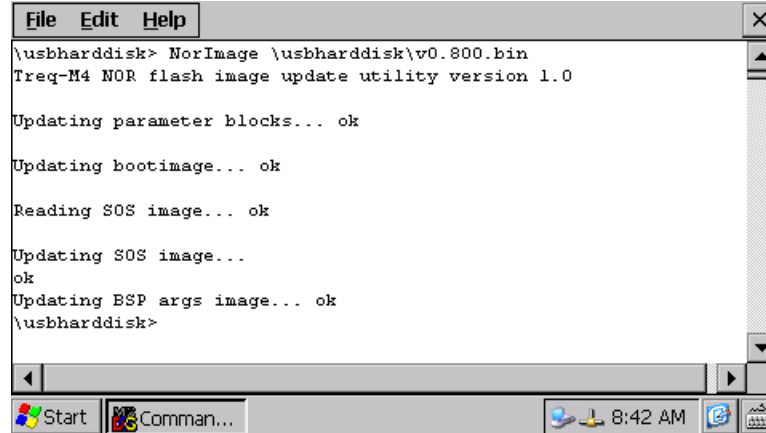
### 10.1.2 Bootloader

**IMPORTANT**  *This procedure should not be attempted without the guidance of a Beijer Electronics technical support engineer, and could render the TREQ-M4 nonfunctional if done improperly.*

The TREQ-M4 bootloader upgrade procedure involves reprogramming an internal NOR flash device with a 16 Mbytes binary image file. The image file contains both the bootloader for the Windows CE kernel as well as a Windows CE recovery image (also referred to as the SOS—Small Operating System—image). A Windows CE utility provided by Beijer Electronics can be used to upgrade the image file, according to the following procedure.

1. Obtain the latest bootloader image file and update utility from Beijer Electronics technical support (<http://www.beijerelectronicsinc.com/support/contact/?type=tech>).
2. Copy the image file and update utility files to a blank USB memory drive.
3. Open a command prompt window and type:  
**cd \usbharddisk**  
**NorImage \usbharddisk\<image file name>**
4. Wait for the upgrade to finish. It should take several minutes to complete.

Figure 53 shows an example upgrade procedure.



```
File Edit Help
\usbharddisk> NorImage \usbharddisk\v0.800.bin
Treq-M4 NOR flash image update utility version 1.0

Updating parameter blocks... ok

Updating bootimage... ok

Reading SOS image... ok

Updating SOS image...
ok
Updating BSP args image... ok
\usbharddisk>
```

*Figure 53  
Bootloader Upgrade Procedure*

5. Reboot for the new image to take effect.
6. Verify that the new image has been programmed by loading the recovery Windows CE image and executing `\HardDisk\bin\WinVerCE.exe` (refer to [section 10.2, “System Backup and Recovery”](#) for the procedure for booting to the recovery image). This program displays the recovery image version. Note that this version does not necessarily match the bootloader image file version.

## 10.2 System Backup and Recovery

The TREQ-M4 contains a special recovery image known as the SOS (Small Operating System) image. This is a stripped down version of the main Windows CE operating system. It is loaded into a separate non-volatile flash location (NOR flash) to reduce its susceptibility to corruption-causing events and to provide a method for administering the main non-volatile storage (NAND flash). The SOS Windows CE image can access, but does not use or depend on, the NAND flash storage (where the main Windows CE image is stored). The SOS image also provides access to inserted USB memory devices (similar to the main image). Thus the SOS image allows for backing up the main flash storage to a USB device as well as restoring the main flash storage from a USB device.

If the main Windows CE operating system (or any other system critical file that prevents proper booting) becomes corrupted, you will be able to access and repair the corruption by booting to the recovery image. In addition, if the bootloader detects a boot failure of the main operating system image due to a corruption, it will automatically boot the recovery image.

To manually boot the TREQ-M4 to the SOS image, hold down the first and third keypad keys for about five seconds while power is applied. If main power cannot easily be removed and reapplied, use the reset procedure described in [section 3.1.3, “Reset the TREQ-M4.”](#) Hold down the fourth keypad key for five seconds until the unit shuts off, release the key, then momentarily press the key again to boot while holding down the first and third keys.

The SOS image will always boot to the touch screen calibration screen, even if it has been calibrated on a previous boot. This is because the SOS maintains no persistent registry (or other) information. Calibrate the touch screen to proceed to the recovery image desktop (see Figure 54). Pressing the ESC key on a USB keyboard, or momentarily pressing the fourth keypad key, (mapped to ESC by default) will bypass the touch calibration screen.

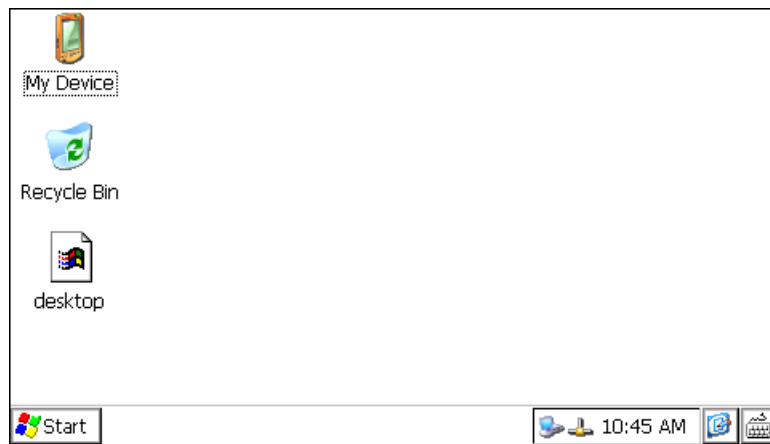


Figure 54  
Recovery Image Desktop

The Windows CE display color scheme for the recovery image is high contrast with a white background to help distinguish the recovery from the main image. The Windows Explorer

view options have also been set to show hidden files in order to aid backup operations (see Figure 55).

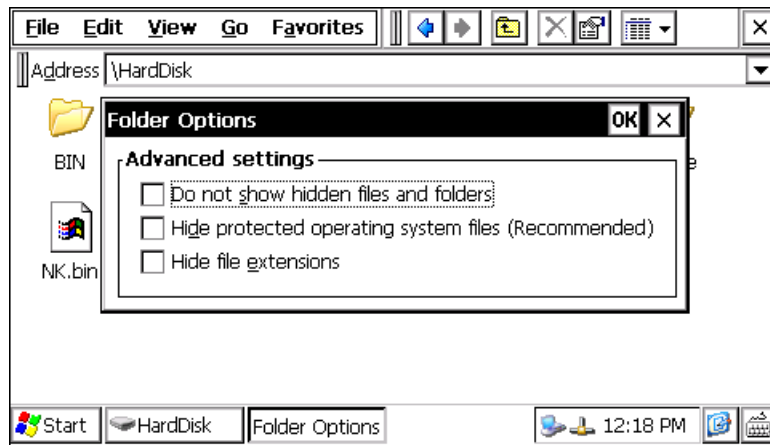


Figure 55  
Windows Explorer View Options

To backup the main flash storage, take the following steps.

1. Boot to the recovery image and calibrate the touch screen
2. Insert an empty USB memory drive and verify that USBHardDisk appears in Windows Explorer.
3. Ensure that the Windows Explorer view options have been set as shown in Figure 55.
4. Use Windows Explorer to select and copy all of the files from *\HardDisk* and paste to *\USBHardDisk*. Figure 56 illustrates the select and copy operation.

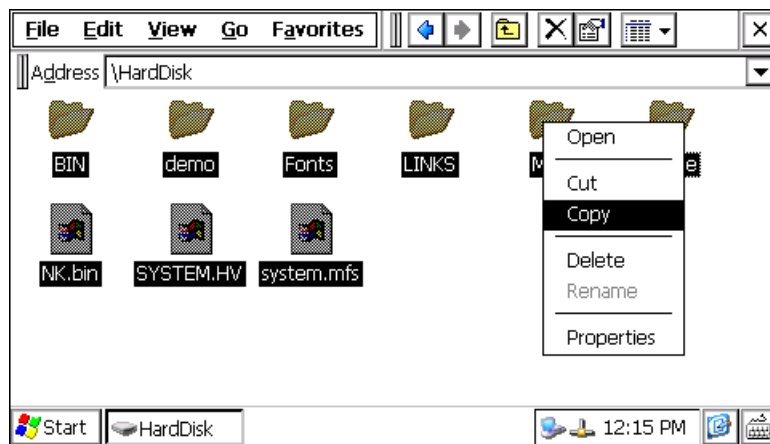



Figure 56  
Select and Copy Operation



To restore the main flash storage, take the following steps.

1. Insert a USB memory drive that contains files generated from the backup procedure (described above).
2. Verify that USBHardDisk appears in Windows Explorer and that its contents are the main storage backup files (e.g., *NK.bin*, *system.hv*, and other files)
3. Ensure that the Windows Explorer view options have been set as shown in Figure 55.
4. Use Windows Explorer to select and delete all files from *\HardDisk*.
5. Optional step: Use the Storage Manager, Control Panel applet to administer the main flash storage. The flash may be reformatted, scanned, and/or defragmented with this Windows CE utility to help treat corruption of the file system tables. Incorrect file sizes and remaining free space are two indications of this kind of corruption. Refer to [section 4.1.7, “Storage Manager”](#) for more details.
6. Copy all files and directories from *\USBHardDisk* and paste to *\HardDisk*.
7. Reboot and verify that the main image boots and loads the correct application.
8. Recalibrate the touch screen using the Stylus, Control Panel applet (refer to [section 4.1.1.2, “Recalibrate”](#)). This is necessary because the main flash backup files may have been obtained from a different TREQ-M4. Each TREQ-M4 touch screen requires custom calibration, thus the correct calibration data must be regenerated for the unit being restored.

**NOTE**  *Beijer Electronics recommends creating a backup copy of the main flash storage using this procedure after end user applications are installed and configured. This will reduce time and effort spent trying to restore units that encounter corruption issues.*

Notes