MOTOROLA

# Mobile Workstation 520™
# Model F5203

*Commercial, Government and*
*Industrial Solutions Sector*

## Application Developer’s Guide

**98-08901C31-O**

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# Contents

# About This Guide

## Scope

The Mobile Workstation 520™ (MW-520) is a standard mobile computer with a Pentium II or Pentium III ® processor which runs Microsoft Windows 95®, Windows 98®, Windows NT® 4.0 or Windows 2000®. The MW-520 can include an embedded wireless network device (optional).

The application programmer can use any Windows programmer workbench. Typical programmer workbenches are:

- Visual C/C++®, Microsoft®
- Microsoft Foundation Class, Microsoft
- Visual Basic, Microsoft

## Disclaimer

The information included in this document is intended for planning application development. Despite our best efforts, some information may change. Motorola will try to keep you informed of any significant changes. This document carries no guarantee that the information contained herein is completely accurate.

## Intended Audience

This manual is intended for Original Equipment Manufacturer (OEM) and end user software application designers and integrators who require knowledge of the product programming interface.

## Related Documents

The following manuals provide additional information:

- *Mobile Workstation 520™ Model F5203 Owner's Manual*, 68P02959C55
- *Mobile Workstation 520™ Model F5203 Quick Reference Card*, 68P02959C56
- *Mobile Workstation 520™ Model F5203 Vehicle Installation Manual,* 68P02959C60
- *RPM500, Radio Portable Modem, Radio Service Software, User's Guide,* 68P02945C40
- *Software Specification – MultiKey/3434L Technical Reference* V 1.0 Phoenix Technologies, 1996.
- *APM BIOS Interface Specification*, Revision 1.2. Intel and Microsoft, 1993.
- *ACPI Specification* Revision 1.06, February 1999
- *Phoenix BIOS 4.0,* December 1998
- *Writing Windows Device Drivers*, Microsoft.
- *405i Communication Protocol, Native Mode* V 1.1.
- *Power Management Developers Reference*, PM SDR, Phoenix Technologies, 1995.

# MW-520 Description

## General

This chapter provides an introductory overview of the MW-520 workstation. Characteristics of the mechanical and electrical design and the basics of operation are briefly described.

When designing and optimizing applications for the MW-520, note the following:

- Although the application can be operated as a standard Windows application, it can also take advantage of services provided by the MW-520 enhanced Application Program Interface (API). These services are described in “Using Specific Hardware Features” on page 33.
- The design goal of the MW-520’s system software is to free the application from managing the MW-520 hardware. This allows applications to be developed on a desktop PC with more memory resources and a larger display. It also saves the programmer the effort of studying the hardware and the Basic Input/Output System (BIOS), and of developing the software needed to manage them. See “System Software” on page 9 for more information.

## Specifications

**Table 1**
MW-520 Features & Specification

| Feature | | Basic MW-520 Specifications |
|---|---|---|
| Processor | | Intel® Pentium® II 333 MHz; Pentium III 500 MHz |
| Internal Memory | | 64 MB RAM expandable to 128 MB |
| LCD | | Color VGA |
| | Resolution: | 640 x 480 |
| | Colors: | 256,000 Colors |
| | Type: | Active Matrix |
| Communications/Expansion | | |
| | Serial: | 1 with 16550 UART support |
| | Parallel: | 1 with ECP/EPP support |
| | Video: | Analog VGA |
| | PC Card Slots: | Two Type II or One Type III Card Bus Slots |
| | USB Slot: | One |
| | IDB Slot: | One |
| Mass Storage | | |
| | Hard Disk: | 4.8 GB or larger |
| Keyboard | | |
| | Main: | QWERTY, 84 keys total, 12 function keys, spill-resistant |
| | Pointing Device: | Integrated Touch-Pad |
| | Display: | 6 illuminated function keys |
| Radio Communications (800 MHz) | | Optional Private DataTAC, IDEN |

## Data Exchange Network

The MW-520 typically communicates over a radio data network consisting of a central (host) computer that runs messaging and form-generation software, a radio network control processor, and remote base stations with a general communications controller.

This network configuration enables messages to be transmitted and received quickly and accurately, and ensures the availability of information when and where it is needed. This also means that the MW-520 user can download and edit forms located on the host computer, regardless of the user's location.

Through the use of several base stations, a single frequency can be reused for wide area coverage. This allows different messages to be transmitted simultaneously to different workstations.

## Hardware Description

MW-520 is a terminal product for private and shared markets. The mobile device supports data entry via a keyboard, touchpad and touchscreen (optional).
It consists of three separate interconnected components: processor unit, display unit, and keyboard.

# The Processor Unit

## The Front Panel

The main power switch, the reset button and the PC-Card slot are located on the front panel of the processor.

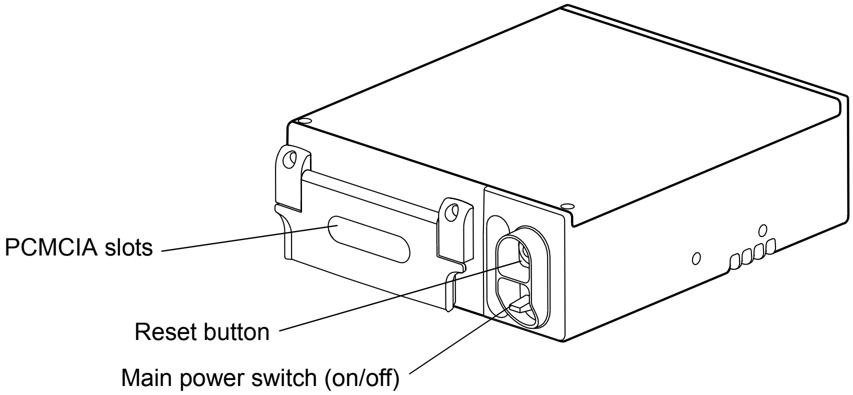


**Figure 1**
Front View of the Processor

Main Power Switch — Connects/disconnects the terminal power supply from the vehicle’s battery.

Reset Button — Generates a hardware reset.

Card Bus slot — The MW-520 features a slot for installing two PC-Card (32-bit) Type II cards or one Type III card. A cover protects the PC-card slot against severe environment conditions.

The Card Bus slot is also compatible with older PCMCIA cards (16 bit).

## The Back Panel

All device and communication connectors are located on the back panel of the processor.

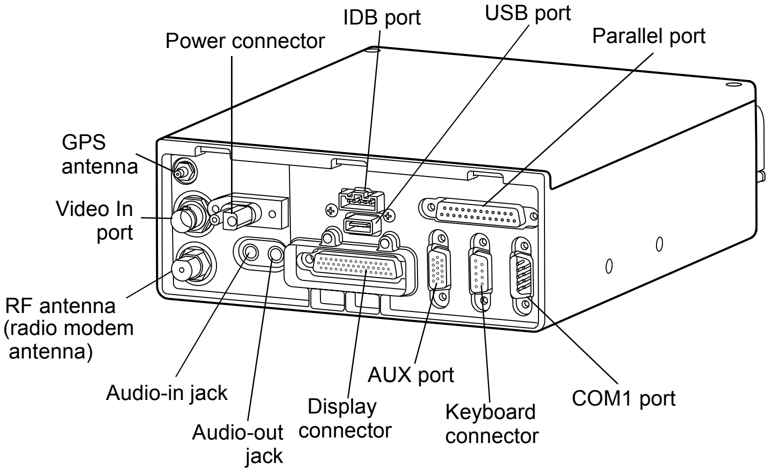


**Figure 2**
Processor Peripheral Ports

You can attach peripheral devices to these connectors, as follows:

| | |
|---|---|
| Parallel port | A 25-pin port for parallel devices such as a parallel printer. |
| Serial port | A 9-pin port for serial devices such as a serial printer.<br>*If the device has a 25-pin connector, use a 25-to-9 pin serial adapter.* |
| Audio connectors | An audio-in jack for an external microphone.<br>An audio-out jack for an external 5W speaker. |
| Auxiliary port | A 15-pin connector for an external monitor.<br>*Plug the interface cable of an external monitor into this port and then plug the monitor power cord into a grounded outlet.* |
| USB port | A port for USB devices such as a USB floppy disk. |
| IDB port | A port for connection of the in-vehicle bus. |
| Video In port | A port for connection of an external video source. |

## The Display Unit

The display unit is a color, active-matrix LCD. The display includes seven pre-defined buttons and six user-defined buttons.

The pre-defined buttons are:

- Power
- Suspend/Resume
- Backlight On/Off
- Brightness
- Volume On/Off (mute)
- Emergency

The Emergency button is located in the lower left corner of the display unit. It can only be used if the application supports its functionality.

The other buttons are located near the LCD, adjacent to the respective LEDs.

The Suspend button is a toggle switch.

In Suspend mode the display is turned off, and the electrical circuits enter a power saving mode. When MW-520 wakes-up from Suspend mode, the previous terminal state is restored (previous display, LED indications, etc.).

The display unit can use a touch screen (optional).

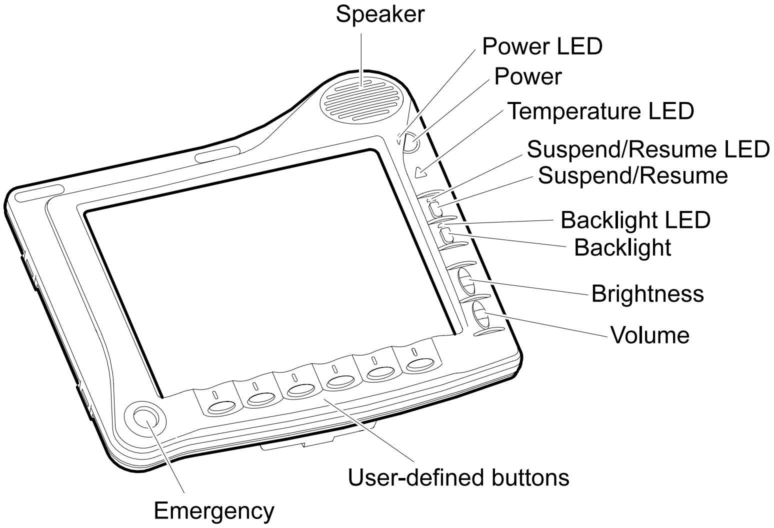


**Figure 3**
Display Unit

**Table 2**
Display Buttons Functionality

| Control/Indicator | Function |
|---|---|
| Power | Turns the MW-520 on or off. |
| Power LED | Power on/off indication;<br>Blinks when the battery is low. |
| Temperature LED | Extreme temperature conditions indication. |
| Suspend/Resume | Toggles between suspend and resume. |
| Suspend/Resume LED | Suspend indication. |
| Backlight | Backlight on/off. Adjust backlight level, using the Brightness button. |
| Backlight LED | Backlight on/off or faulty processor indication. |
| Brightness | Increases/decreases brightness level. |
| Volume | Increases/decreases speaker’s volume level (if both buttons have been pressed, the sound will be muted or audible). |
| User-defined | Carries out a specific function, according to the specific user application. |
| Emergency | Sends an emergency message to the RF host computer. (This key’s functionality depends on its definition in each user system and the active application.) |

## Battery

MW-520 is externally powered from the 12V vehicle battery. A Lithium backup battery maintains the system configuration and time.

## Microphone, Sound Blaster, and Speaker

One of the MW-520’s main features is its integrated data and voice communication capability.

The workstation has an internal speaker located on the display unit. The speaker is used for various audio alert signals.

The processor unit includes a Windows compatible sound card and external microphone and speaker jacks.

The microphone and the speaker can also be used for future two-way voice communication, text-to-speech, and voice recognition applications.

# System Software

## BIOS

The MW-520 system setup program is Phoenix BIOS 4.06, developed by Phoenix Technologies Ltd. for mobile Pentium II based computers.

The BIOS enables running Windows® 95, Windows® 98, Windows® 2000 and Windows NT® 4.0 on the MW-520 platform. It also provides hardware initialization, system boot, power management, APM 1.2 or ACPI, Plug & Play registry data-base, and other features.

The BIOS setup is a program that configures the MW-520 hardware according to individual needs and saves the configuration into the CMOS memory (see *Mobile Workstation 520, Owner's Manual* for more information).

## Operating System

MW-520 may run the following operating systems:

- Windows 95 OSR 2.5
- Windows 98
- Windows NT 4.0
- Windows 2000

A full set of `.CAB` files for these operating systems is saved under `C:\SETUP`. Use this directory if you need additional drivers.

Note

At least 32 MB of RAM are required for the Windows NT 4.O operating system configuration.
At least 64 MB or RAM are recommended for the Windows 2000 operating system configuration.

### Windows 95

To verify Plug & Play operation in the BIOS setup, enter the Advanced Setup menu, and set the `Installed O/S` option to `Windows` (default). To support special hardware features, Windows 95 includes additional files that were added by Motorola to support the workstation's special abilities.

Caution

When adding new applications to the hard drive, please be careful not to remove these files, as this can cause your system to malfunction.

To support I/O devices shared interrupts with Windows 95, perform the following modification in the `SYSTEM.INI` file:

```
[386enh]
ComIrqSharing=true
```

### HWAPP.INI file

This file is contained in all the system software configurations of Windows.
It contains different parameters that are used by the driver that handles the special hardware and software of the MW-520.

**Table 3**
HWAPP.INI Parameters

| Parameter | Options | Description |
|---|---|---|
| `Logger_On` | 1=Enable<br>0=Disable | Enables/disables the MW-520 logging utility |
| `Radio_On` | 1=ON<br>0=OFF | Defines the internal radio modem status |

If the application failed to read the `HWAPP.INI` file, the default parameters will be loaded. These parameters are:.

| | |
|---|---|
| `Logger_On=0` | Disable |
| `Radio_On=1` | ON |

## Windows NT, Windows 2000

### HWAPP Registry

Windows NT and Windows 2000 parameters are saved in the Registry data-base. The MW-520 Registry keys are located in the following registry folder:

```
My Computer/Hkey_Local_Machine/Software/MW-520/HWDRIVER
```

The HWDRIVER includes the following parameters:

**Table 4**
HWDRIVER Parameters

| Parameter | Data | Description |
|---|---|---|
| `BatteryManagement` | 0×00000001 | These values are displayed but cannot be effectively changed. |
| `TemperatureManagement` | 0×00000001 | |
| `BatteryOffDelay` | 0×000000b4 | |
| `TemperatureOffDelay` | 0×000000b4 | |
| `SpeakerBarDelay` | 0×00000003 | |
| `RadioOn` | 0×00000001 | Defines the internal radio modem status |
| `Logger_On` | 00000001 | Enables/disables the MW520 logging utility |
| `InitOverTempDelay`* | 00000014 | Maximal acceptable duration of CCFL critical temperature (shutdown if time has elapsed) |
| `LastBrightness`* | 0000000c | Brightness level of the last login |
| `LimitedLCDTemp1`* | 0000003c | First upper limit for CCFL temperature (locking manual access in critical case) |
| `LimitedLCDTemp2`* | 0000004b | Low bound for CCFL temperature (restoring manual access) |
| `NormalLCDTemp1`* | 00000041 | Second upper limit for CCFL temperature (shutdown if critical) |
| `NormalLCDTemp2`* | 0000004b | Second upper limit for CCFL temperature (by default the same as LimitedLCDTemp2) |
| `CCFLTimerDelay`* | 00000002 | Delay for CCFL temperature check polling |
| `ShutdownTime`* | 00000003 | Duration of shutdown process (in case of critical CCFL temperature) |

* Relevant only for MW-520s with a 1000 Nit display.

If the application fails to read the HWDRIVER, the default parameters will be loaded.

# PC Configuration

The MW-520 mobile workstation consists of three separate interconnected components: processor, display unit, and keyboard.

Figure 4 describes the MW-520 components and their interfaces.

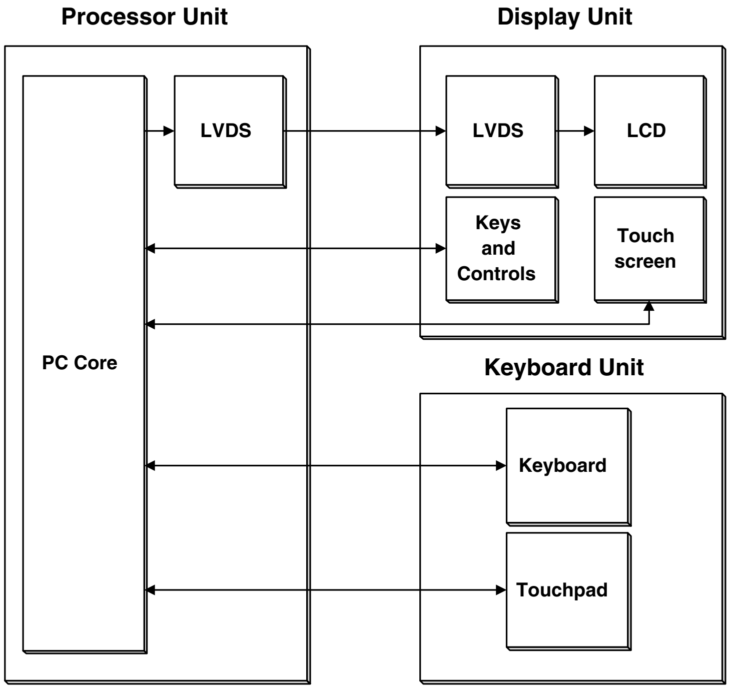


**Figure 4**
MW-520 Three Unit Model

The MW-520 PC architecture is illustrated in Figure 5 . It contains the devices listed below:

| | |
|---|---|
| Processor | EMC-2 (Pentium II MMX 333 Or Pentium III 500 MHz) |
| ChipSet | Intel 82371EB (443BX and PIIX4E) |
| Level 2 cache | 512KB |
| SDRAM | 32 MB (1 × 4M × 64 bit)<br>64 MB (1 × 8M × 64 bit)<br>128MB (1 × 16M × 64bit)<br>256MB (1 × 256M × 64bit) |
| Keyboard controller | Hitachi H647343416 |
| VGA controller | 69000 (CHIPS) + 2Mb RAM |
| PC-Card controller | PCI1225 (Texas Instruments) |
| COM1, COM2 | Super I/O National PC87338/PC97338 |
| COM3, COM4 | National PC16550 (2 items) |
| BIOS Flash | Intel flash 4Mb - E28F400B5-T60 (Intel) |
| Sound controller | Solo - 1E (ESS) |
| USB | (Part of PIIX4E) |
| Temperature controller | LM77 |
| Touchscreen | Elo™ Resistive Digitizer |
| Video capturing | Enhanced Video Input Processor (EVIP) SAA7111A |

The MW-520 computer is based on the Intel EMC-2 Module that includes a mobile Pentium II or Pentium III CPU chips, and 512KB second level cache.

PCI and ISA buses are used for peripheral device connection.

PC-Card, VGA, IDE and sound controllers are connected to the PCI bus.

The following devices are connected to the ISA bus:

- the BIOS flash chip
- the keyboard controller
- the super I/O chip (two UARTs, parallel port and floppy disk controller)
- two auxiliary UARTs
- the touchscreen (via UART)
- the processor unit ASIC.

The MW-520 PC architecture complies with Microsoft PC99 requirements.

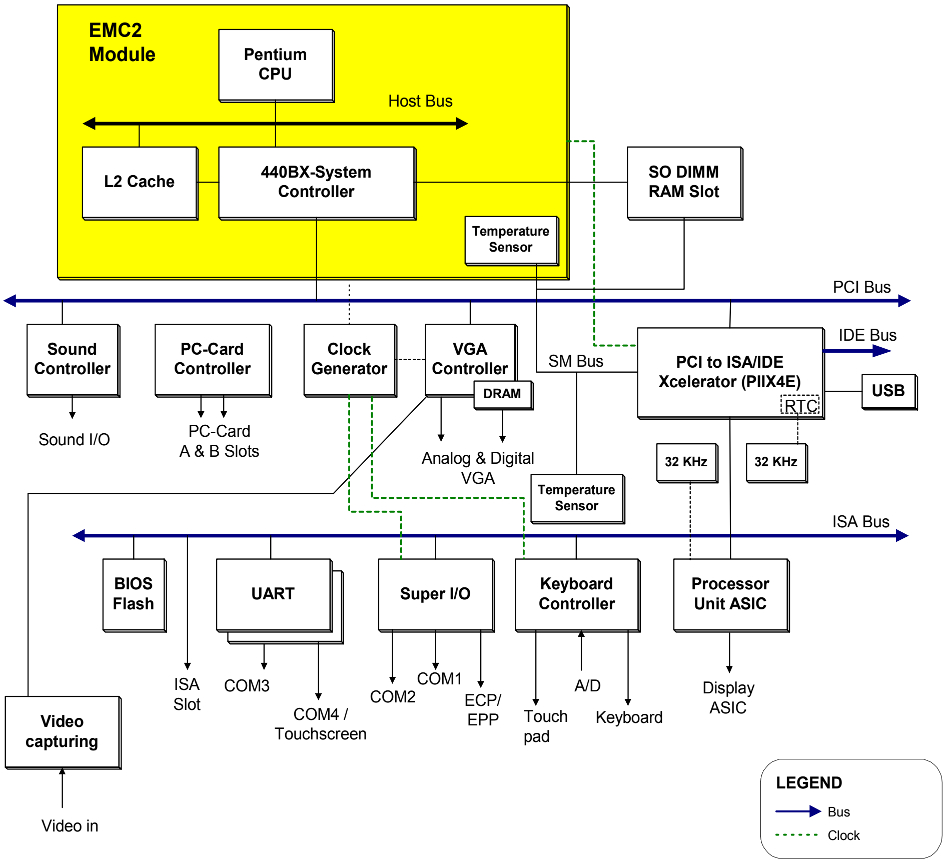


**Figure 5**
MW-520 PC Architecture

# Logic Control and Addressing

This section includes maps of upper memory blocks, I/O addresses, and interrupts.

## Upper Memory Blocks

**Table 5**
UMB Map

| Address (hex) | Task | Comments |
|---|---|---|
| A0000-BFFFF | Video memory | |
| C0000-CAFFF | VGA BIOS | |
| CB000-CFFFF | PCM boot BIOS | |
| D0000-D7FFF | PCMCIA services | Used for power management |
| D8000-DFFFF | PCMCIA services | BIOS area in SMM mode |
| E0000-FFFFF | SYSTEM BIOS areas | |
| EA000-EBFFF | ESCD (PNP/DMI configuration) | Part of system BIOS area |
| EC000-EFFFF | BIOS boot block | Part of system BIOS area |
| F0000-FFFFF | BIOS | Part of system BIOS area |

# I/O Map

**Table 6**
I/O Map

| Address (Hex) | Width | FUNCTION |
|---|---|---|
| 0000-000F | 8-bit | DMAC-1 |
| 0020 | 8-bit | PM2_CTRL register |
| 0020-0021 | 8-bit | PIC-1 |
| 0040-0043 | 8-bit | TIMER |
| 0048-004B | 8-bit | TIMER |
| 0060 | 8-bit | Reset X-bus, IRQ12/M and IRQ1 |
| 0061 | 8-bit | NMI status and control, speaker |
| 0064 | 8-bit | Keyboard Controller |
| 0070 | 8-bit | CMOS Index and NMI enable |
| 0071 | 8-bit | RTC data |
| 0078-0079 | 8-bit | Reserved |
| 0080 | 8-bit | BIOS Port 80 [debug port] |
| 0081-008F | 8-bit | DMA1/DMA2 page register |
| 00A0-00A1 | 8-bit | PIC-2 |
| 00B2-00B3 | 8-bit | Advanced PM control (PCI bus only) |
| 00C0-00DE | 8-bit | DMAC-2 |
| 00F0 | 8-bit | Co-processor error |
| 0100-011F | 8-bit | Processor unit ASIC PORTS |
| 0170-0177 | 8-bit | Channel  2 IDE |
| 01F0-01F7 | 8-bit | Channel  1 IDE |
| 0200-0207 | 8-bit | Legacy joystick port (does not exist) |
| 0220-022F | 8-bit | Sound controller |
| 0240-024F | 8-bit | Sound controller |
| 02E8-02EF | 8-bit | COM4 [GPS] |
| 02F8-02FF | 8-bit | COM2 |
| 0300-0301 | 8-bit | Sound controller |
| 0308-030F | 8-bit | Free (but will still be locked by the BIOS) |
| 0330-0335 | 8-bit | Sound controller |
| 0378-037F | 8-bit | Parallel port |
| 0388-038D | 8-bit | Sound controller |
| 0398-0399 | 8-bit | Super I/O |
| 03B4-03B5 | 16-bit | Video |
| 03BA | 16-bit | Video |
| 03C0-03CA | 8-bit | Video |

**Table 6**
I/O Map (Continued)

| Address (Hex) | Width | FUNCTION |
|---|---|---|
| 03CC | 8-bit | Video |
| 03CE-03CF | 8-bit | Video |
| 03D4-03D5 | 8-bit | Video |
| 03DA | 8-bit | Video |
| 03E0-03E1 | 8-bit | PCMCIA Controller |
| 03E4-03E5 | 8-bit | PCMCIA Controller |
| 03E8-03EF | 8-bit | COM3 [Radio] |
| 03F0-03F5 | 8-bit | Primary diskette controller (not used) |
| 03F6 | 8-bit | Primary IDE channel command port |
| 03F7 | 8-bit | Primary floppy channel command port |
| 03F8-03FF | 8-bit | COM1 |
| 04D0-04D1 | 8-bit | PIC-1/PIC-2 IRQ edge/level control |
| 0CF8-0CFC | 16-bit | PCI configuration space |
| 0CF8 | 32-bit | CONFADD register (PCI Rg) |
| 0CFC | 32-bit | CONFDATA register (PCI Rg) |
| 0CF9 | 8-bit | Reset control (PCI bus only) |

For details of the 82431TX System Controller's register map, see [8a], pages 21-22.
For details of the 82371AB PCI-to-ISA/IDE XCelerator register map, see [8b], pages 43-46.

## SMBus Interface

**Table 7**
SMBus Device Address

| Device | Address |
|---|---|
| EMC (Thermal Sensor MMO (Intel)) | 0x9C |
| SDRAM Buffer | 0000 |
| Temperature Sensor (LM77) | 0x90 |

## Interrupts and DMA Channels Map

The devices use the Interrupts as defined in the following tables:

**Table 8**
PCI INT Line Definitions

| PCI IRQ | Devices |
|---|---|
| INT A | PC Card Controller (1) + Sound Controller (1) |
| INT B | PC Card Controller (2) + VGA Controller |
| INT C | Free |
| INT D | USB |

**Table 9**
Interrupt Map

| IRQ | Source |
|---|---|
| IRQ 15 | Processor unit ASIC |
| IRQ 14 | IDE hard disk |
| IRQ 13 | Floating point exception |
| IRQ 12 | Mouse |
| IRQ 11 | ISA PCMCIA cards |
| IRQ 10 | PCI IRQ Resource |
| IRQ 9 | Redirected IRQ2 + SMI |
| IRQ 8 | RTC |
| IRQ 7 | LPT 1 |
| IRQ 6 | Floppy drive (not used) |
| IRQ 5 | PCI IRQ Resource |
| IRQ 4 | COM1 (external), COM3 (radio) |
| IRQ 3 | COM2 (GPS), COM4 (digitizer) |
| IRQ 2 | Second internal interrupt controller |
| IRQ 1 | Keyboard controller |
| IRQ 0 | Timer |

⚠ **Caution**

COM1/COM3 use IRQ4 and COM/2COM4 use IRQ3 in sharing mode. Please take this feature into consideration when making a high speed device connection.

**Note**

IRQ 5 and 10 will be used for PCI devices, and will be allocated dynamically. Usually, the sound controller and the card bus controller will be allocated to IRQ5.

**Table 10**
Channel Map

| Channel | Source |
|---|---|
| DMA 0 | Free (can be used by PCI devices) |
| DMA 1 | Parallel Port (ECP mode) |
| DMA 2 | Free (can be used by PCI devices) |
| DMA 3 | Free (can be used by PCI devices) |
| DMA 4 | Direct memory access controller |
| DMA 5 | Free (can be used by PCI devices) |
| DMA 6 | Free (can be used by PCI devices) |
| DMA 7 | Free (can be used by PCI devices) |

# Power Management

## APM 1.2 System State Machine

The APM 1.2 System State Machine defines the states of all components in the system.

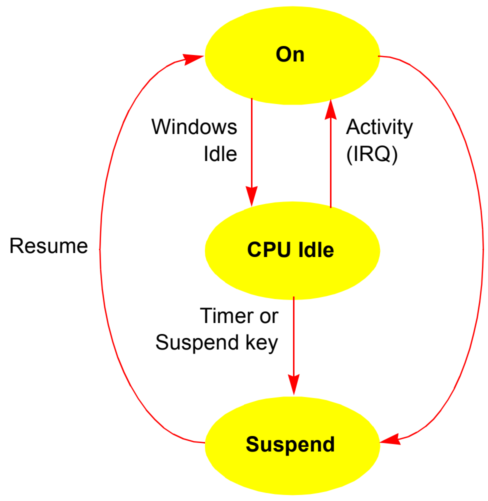


**Figure 6**
System State Machine

The machine contains three states: On, CPU Idle, and Suspend. All local *Standby* modes are canceled.

**Table 11**
State Definitions

| Phoenix | Functionality |
|---|---|
| On | All devices on, full clock |
| CPU idle | All devices On, reduced clock |
| Suspend (to RAM) | Display and Disk power down<br>Stop Clock, DRAM refresh mode |
| Suspend (to Disk) | Memory contents written to disk; power off |

# ACPI

The MW-520 supports ACPI for Windows 98 and Windows 2000, using a standard ACPI system with a number of extensions:

- At state S4, power is preserved for most devices.
  At state S5 the power is Off.
- Battery handling is similar to standard battery handling, providing a battery low notification. However, in case of a "Low" event, the battery power level is set to 100% or 5%.
- The MW-520 includes three temperature sensors designed to protect the system from overheating and causing the CPU to throttle. If the temperature rises above the determined "Suspend" level, the system is suspended (see below for more details).

## Sleeping State

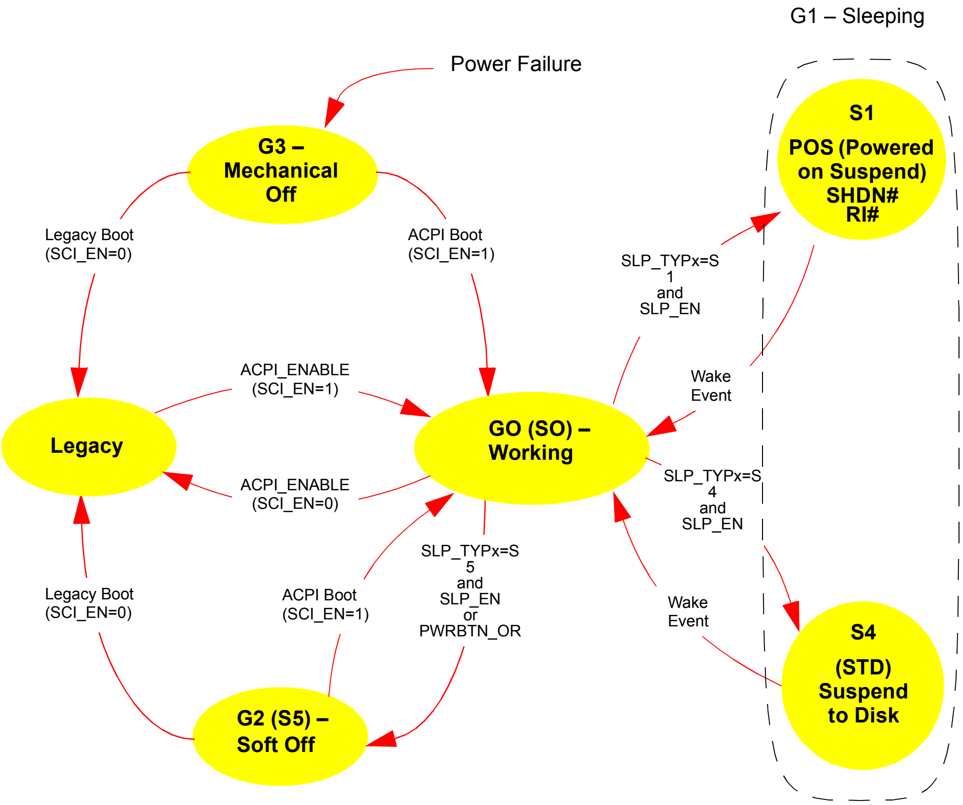


**Figure 7**
Sleeping State Chart

## Table 12
Device States

| Device/State | D0 | D1 | D2 | D3 | Controlled by |
|---|---|---|---|---|---|
| Hard Disk | ON (working state)* | Not supported | Not supported | Standby<br>(hard disk stopped) | PIIX4E<br>(IDE Controller) |
| VGA Controller | ON (working state)* | Not supported | Not supported | Device off + LVDS closed† | |
| Sound Controller | ON (working state)* | Not supported | Embedded DSP is halted & analog functions are off | D2 and oscillator off<br>(PCI bus stopped) | |
| PC Card | ON (working state)* | Not supported | Device at intermediate state (RI_OUT available) | Off state<br>(PCI bus stopped and no RI_OUT) | Card Bus Controller |
| Com 1 | ON (working state)* | Not supported | Not supported | Closed (buffer 1 closed) | SHDN#1<br>Super I/O |
| Com 2 | ON (working state)* | Not supported | Not supported | Closed (buffer 2 closed) | SHDN#1<br>Super I/O |
| Com 3 | ON (working state)* | Not supported | Not supported | Not supported | – |
| Com 4 | ON (working state)* | Not supported | Not supported | Not supported | – |
| LPT | ON (working state)* | Not supported | Not supported | Closed (Via Super I/O depend on Com 1&2) | Super I/O |
| USB | ON (working state)* | Not supported | Not supported | USB port suspended | PIIX4E (USB controller) |
| Radio Modem | ON (working state)* | Not supported | Not supported | Radio off | ASIC RPM_OFF bit |
| GPS | ON (working state)* | Not supported | Not supported | GPS off | ASIC GPS_OFF |

* The device is open/closed depending on the OS decision (when not used with a specific device, it can be closed)
† The LVDS is closed by the hardware when the VGA controller is off.

| Device/State | C0 | Throttling* | C1 | C2 | C3 | Controlled By |
|---|---|---|---|---|---|---|
| CPU | 100% speed | 50% Or 25% | Clock stopped | Not supported | Not supported | PIIX4E (stop clock) |

* The throttling state is controlled by the PIIX4E and activated in hot conditions

## MW-520 Temperature Control Mechanism

Model 5203 contains a new temperature control mechanism, based on CPU internal clock throttling. The new mechanism is valid for all operating systems, and has several advantages:

- The clock-throttling enables reduction of the CPU heat in high temperature conditions. In most applications, the CPU performance degradation is negligible.
- The throttling thresholds are software-adjustable.
- At very high temperature conditions, the MW-520 will usually enter Suspend state, instead of shutting down. This enables the MW-520 to continue receiving messages even if, for instance, the unit was left working in a parked car on a very hot day.

**Working Unit:**

- At 38°C, the CPU frequency will be reduced to 50%.
- At 45°C, the CPU frequency will be reduced to 25% and the red temperature led will start blinking.
- At 55°C, the MW-520 will enter Suspend State.
- At 65°C, the MW-520 will shut down.

**Power ON:**

- At up to 55°C, the unit will start up at full speed.
- At up to 60°C, the unit will start up at 50% CPU frequency.
- At up to 65°C, the unit will start up at 25% CPU frequency.
- If powered on at 70°C, the unit will immediately enter Suspend state.
- The unit will not power on at 75°C or above.

**Note**

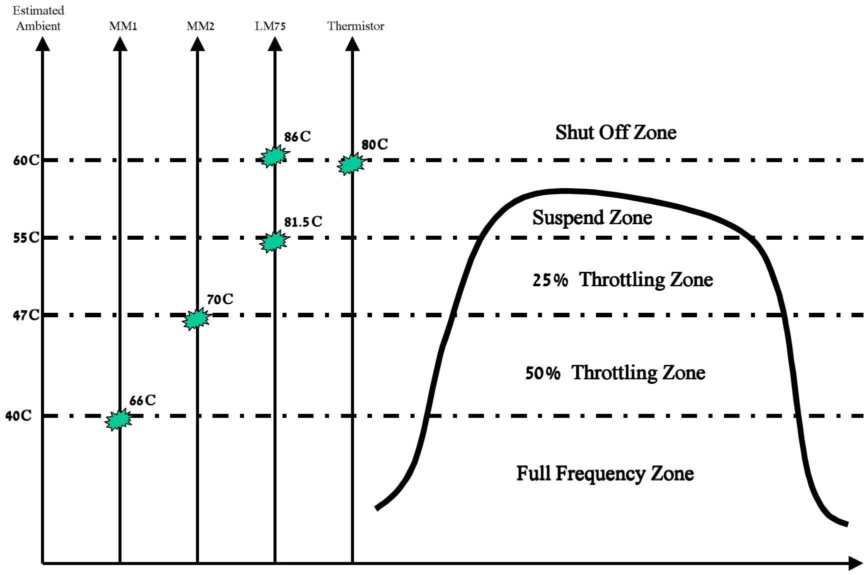
The temperature thresholds are defined according to the internal temperature, therefore the ambient temperature tolerance is ± 2C

Decisions regarding the CPU clock states are based on internal temperatures within the CPU housing, measured by four sensors inside the CPU housing:

- LM75 is a sensor located on the main board. This sensor is responsible for the Suspend threshold and for the software shut off sequence, and its level can be adjusted using the relevant software.
- MM1 is a sensor located on the EMC2 module (Pentium module). This sensor is responsible for the first 50% throttling, and its level can be adjusted using the relevant software.

- MM2 is a sensor located on the EMC2 module too. This sensor is responsible for the second 25% throttling, and its level can be adjusted using the relevant software.
- The thermistor located on the main board (identical to the sensor which was responsible for the temperature mechanism in previous MW-520 phases). This sensor is responsible for hardware shutdown (in case of software hang), and for the red temperature led activity. This sensor is not S/W adjustable.

The temperature control mechanism is described in the following chart:



# Windows System Power Management Events

Any of the following events will resume the MW-520 from Suspend mode:

- Resume key pressed
- Key pressed
- COM1, COM3 ring indicator
- Touch screen display
- Emergency key pressed.

The Windows software informs the application about a power management event over a `WM_POWER` message. Use a `WM_POWER BROADCAST` message for 32-bit applications. Use a `WM_POWER` message for 16-bit applications.

## WM_POWERBROADCAST

The `WM_POWERBROADCAST` message is sent by Windows to a 32-bit application to notify it of power-management events.

```
WM_PowerEvent = (DWORD) wParam;
dwData = (DWORD) 1Param;
```

### Parameters

*dwPowerEvent*

Event notification message. This parameter can be one of the following values:

| Value | Meaning |
|---|---|
| `PBT_APMBATTERYLOW` | Battery power is low. |
| `PBT_APMOEMEVENT` | OEM-defined event occurred.* |
| `PBT_APMPOWERSTATUSCHANGE` | Power status has changed.* |
| `PBT_APMQUERYSUSPEND` | Request for permission to suspend. |
| `PBT_APMQUERYSUSPENDFAIL` | Suspension request denied. |
| `PBT_APMRESUMECRITICAL` | Operation resuming after critical suspension. |
| `PBT_APMRESUMESUSPEND` | Operation resuming after suspension. |
| `PBT_APMSUSPEND` | System is suspending operation. |

* Not supported by MW-520 BIOS and irrelevant to the application.

*dwData*

Function-specific data. For most messages, this parameter is reserved and not used. However, if *wParam* is one of the resume notifications (`PBT_RESUME`), the *IParam* parameter can specify the `PBTF_APMRESUMEFROMFAILURE` flag. This flag indicates that a suspend operation failed after the `PBT_APMSUSPEND` message was sent.

### Return Values

Return `TRUE` to grant a request.

Request `BROADCAST_QUERY_DENY` to deny a request.

## WM_POWER

The `WM_POWER` message is sent when the system is about to enter Suspend mode.

```
WM_POWER
fwPowerEvt = wParam; // power-event notification message
```

### Parameters

*fwPowerEvt*

Value of *wParam*. Specifies a power-event notification message. This parameter can be one of the following values:

| **Value** | **Meaning** |
|---|---|
| `PWR_CRITICALRESUME` | Indicates that the system is resuming operation after entering Suspend mode without first sending a `PWR_SUSPENDREQUEST` notification message to the application. An application should perform any necessary recovery actions. |
| `PWR_SUSPENDREQUEST` | Indicates that the system is about to enter Suspend mode. |
| `PWR_SUSPENDRESUME` | Indicates that the system is resuming operation after having entered Suspend mode normally, that is, the system sent a `PWR_SUSPENDREQUEST` notification message to the application before the system was suspended. An application should perform any necessary recovery actions. |

### Return Values

The value an application returns depends on the value of the *wParam* parameter. If *wParam* is `PWR_SUSPENDREQUEST`, the return value is `PWR_FAIL` to prevent the system from entering the suspended state; otherwise, it is `PWR_OK`. If *wParam* is `PWR_SUSPENDRESUME` or `PWR_CRITICALRESUME`, the return value is zero.

## PBT_APMRESUMESUSPEND

The `PBT_APMRESUMESUSPEND` message is sent as a notification that the system has resumed operation after being suspended. A window receives this message through the `WM_POWERBROADCAST` message.

```
dwData = (DWORD) 1Param;
```

### Parameters

*dwData*

Reserved; must be 0.

### Return Values

No return value.

### Remarks

Applications may receive this message at any time without a preceding PBT_APMSUSPEND message.

## PBT_APMSUSPEND

The PBT_APMSUSPEND is sent immediately before the computer is suspended. This message is typically sent when all applications and installable drivers have returned TRUE to a previous PBT_APMQUERYSUSPEND message. A window receives this message through the WM_POWERBROADCAST message.

```
dwData = (DWORD) 1Param;
```

### Parameters

*dwData*

Reserved; must be 0.

### Return Values

No return value.

### Remarks

An application should process this message by completing all tasks necessary to save data. This message may also be sent, without a prior PBT_APMQUERYSUSPEND message, if an application or device driver uses the **SetSystemPowerState** function to force suspension.

**Note**

Windows NT includes the APM2.0 utility, which adds APM support to the Windows NT system.

See Microsoft MSDN for additional information about Power Management events.

# Suspend

The MW-520 supports two suspend modes: Suspend to RAM and Suspend to Disk.

In Suspend to RAM mode, the memory switches to “self refresh” mode, all system clocks are stopped, and all devices switch to StandBy.

In Suspend to Disk mode, the memory content and essential register values are written to the hard disk, and then the power is switched off.

When the system restarts, the BIOS knows that the last time the MW-520 was powered off this was in the course of a suspend to disk action. The necessary devices are initialized and the saved registers and memory content are restored. Resuming after “Suspend to Disk” takes longer than “Suspend to Ram”, but the power consumption is much lower.

## Enabling Suspend to Disk

In order to cause the MW-520 to use the Suspend to Disk mode, you must create a special partition that will be used by the BIOS for saving the system data.

1. Run the `Phdisk.exe` utility (located in `c:\setup\util`).
2. At the command mode (Use Exit to Dos), use the `phdisk/create/partition` command to create the Save to Disk partition.
3. Restart the computer.

**Note**

If you are using Windows NT, you cannot run Phdisk in the Command window. Copy the Phdisk to a bootable SRAM card or to a bootable floppy, and boot the computer. You will then be able to use Phdisk to create the new partition.

Windows 2000 supports a new method called Hibernate (this is similar to Suspend to Disk but operates under OS control).
To enable Hibernate, click the Power Management icon on the control panel, select the Hibernate tab and enable this option (no additional steps are necessary).

## Switching to Suspend to Disk Mode

1. Once the Save to Disk partition has been created, press the F2 key at BIOS startup to open the BIOS setup utility.
2. From the Power menu, select Suspend.
3. Select Suspend to Disk and Save & Exit.

## Executing the Suspend

From the Windows Start menu, select the Suspend button

*or*

Exit windows to suspend or Suspend time out

The system initiates the Suspend action. A progress bar indicates that the memory content is being written to the disk, and when completed, the computer is powered off.

# PCMCIA Configuration

## Configuring PCMCIA Cards in Windows NT

When you have Windows NT as your operating system, the Phoenix Card Executive for NT is automatically loaded onto your hard drive. The Card Executive configures the PCMCIA card properly each time it is inserted in MW-520.

It is recommended to insert Ethernet cards before running Windows NT and remove the cards after Windows shutdown. Card Executive enables Modems, ATA and SRAM cards “hot insertion” mode, i.e., inserting and removing the cards while Windows NT are running.

Whenever you insert a PCMCIA card in your workstation for the first time, the *PCMCIA IDE Driver Parameters* appears on the screen. To configure a PCMCIA card:

1. Set the IRQ Level parameter to `IRQ 11`.
2. Set the I/O Port Address to `Auto`.
3. Press *Continue.*
   A prompt for configuration completed appears on the screen.

# Using Specific Hardware Features

## Software Development Tools

Microsoft Visual C++ development kit was used by the MW-520 engineering team during product development. No special restrictions apply to the software development tools for its applications.

The Application Program Interface (API) library and *include* files are located on your hard disk as follows:

```
C:\HWDRIVER\HWEVNT.LIB (16-bit)   HWEVNT.H
C:\HWDRIVER\HWEVNT32.LIB (32-bit) HWEVNT32.H
```

## Hardware Access API

This API is supported by Windows 95 and 98 for backward compatibility purposes only.

### User Application's Connection Mechanism

The MW-520 hardware access software contains an application, a DLL and a VxD driver. Figure 8 describes the hardware access software modules and their interfaces. `HWAPP.INI` is a system parameter text file.

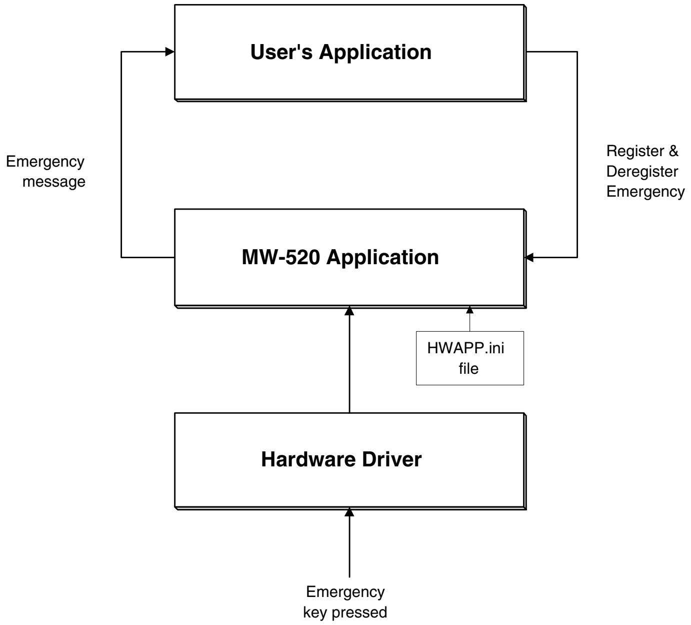


**Figure 8**
Hardware Access Software

When the Emergency key is pressed, an interrupt that modifies the MW-520 application is generated. The MW-520 application notifies the user's applications registered for an emergency event. The registration mechanism is described in the following section.

## Emergency Event Registration

The Windows user application can be registered to receive the MW-520 emergency events. The registration process is as follows:

1. Activate the `Register_Emg` function call from the user’s application (see API for details). Its output is the registration status.
2. If an emergency occurred, the message defined by the user’s application is sent to it.

If the registered application is not activated, the `DeRegister_Emg` application should be activated.

Following is a C-code example of emergency registration/deregistration:

```
long FAR PASCAL_EXPORT Wnd Proc
    (HWND hwnd,
     UINT message
     UINT wParam
     UINT lParam
{
.
.
.
switch (message)
    {
    case WM_CREATE
        .
        .
        .
        Register_Emg (hwnd, MY_MSG_NUMBER);
        .
        .
        .
        break;
        case WM_DESTROY:
        .
        .
        .
        Deregister_Emg (hwnd);
        Break;
    }
}
```

## Power Off Event Registration

The duration until the MW-520 is shut down may be used for several purposes, for example, sending de-registration messages by the TX application. The registration process of the application is similar to the emergency registration.

1. Activate the `RegisterSysEvent` function call with the event parameter `POWER_OFF` (see API for details). Its output is the registration status.
2. If a `POWER_OFF` event occurs, the message defined by the user’s application is sent to the application.

If the registered application is not activated, the `DeRegisterSysEvent` application should be activated before closing the user’s application.

**Note**

With ACPI systems, the application should register to Windows Power Off event and not this event.

## Win 32 Hardware Access API

### Register_Emg

`WORD WINAPI Register_Emg32` (HWND hwnd, UINT uiMsg)

*Purpose* Opens the emergency session.

*Input* hwnd: Window handle of the emergency session.
uiMsg: The message number used for notification.

*Output* None.

*Returned Value* `EMG_SUCCESS` or `EMG_FAILURE`, depending on the number of registered applications.

### DeRegister_Emg

`WORD WINAPI DeRegister_Emg32` (HWND hwnd) `Register_Emg`

*Purpose* Closes the emergency session.

*Input* hwnd: Window handle of the emergency session.

*Output* None.

*Returned Value* `EMG_SUCCESS`

### RegisterSysEvent

`WORD APIENTRY RegisterSysEvent32` (HWND hwnd, UINT uiMsg, WORD event)

*Purpose* Registers the application to get notification for the system events.

*Input* hwnd: Specifies the handle of any user application.
uiMsg: The message number used for notification.

| | |
|---|---|
| `EMERGENCY` | `0x0100` |
| `POWER_OFF` | `0x0080` |

*Output* event, pointer to actual system event status.

*Returned Value* 1 – ok, 0 – fail

### DeRegisterSysEvent

```
WORD FAR PASCAL _export    DeRegisterSysEvent32 (HWND hwnd)
```

| | |
|---|---|
| *Purpose* | De-registers the system event session. |
| *Input* | hwnd: specifies the handle of the user application. |
| *Output* | None. |
| *Returned Value* | 1 – ok, 0 – fail |

**Note**

Run all developed applications from the Windows NT/Windows 95 Start menu.

## Driver Wide Communication API

### ReadLCDTemp

`BOOL APIENTRY ReadLCDTemp` (float *temperature)

| | |
|---|---|
| *Purpose* | Reads the LCD temperature from LCD ASIC. |
| *Input* | None |
| *Output* | float *data. (volts) |
| *Returned Value* | 1 – ok, 0 – fail |

### ReadBrightnessLevelStep

`BOOL APIENTRY ReadBrightnessLevelStep` (int *BrighnessLevel)

| | |
|---|---|
| *Purpose* | Reads the brightness level from LCD ASIC. |
| *Input* | None |
| *Output* | UINT *BrighnessLevel. (step) |
| *Returned Value* | 1 – ok, 0 – fail |

### SetBrightnessLevelStep

`BOOL APIENTRY SetBrightnessLevelStep` (int delta_step)

| | |
|---|---|
| *Purpose* | Sets the brightness level from LCD ASIC. |
| *Input* | int delta (range -32, +32) in steps |
| *Output* | None |
| *Returned Value* | 1 – ok, 0 – fail |

### SetBrightnessLock

`BOOL APIENTRY SetBrightnessLock` (BOOL value)

| | |
|---|---|
| *Purpose* | Sets the brightness control in LCD ASIC |
| *Input* | BOOL value : TRUE – lock, FALSE – unlock |
| *Output* | None |

### ReadBrightnessLock

`BOOL APIENTRY ReadBrightnessLock` (void)

| | |
|---|---|
| *Purpose* | Reads the brightness lock value in LCD ASIC. |
| *Input* | BOOL value : TRUE – lock, FALSE – unlock |
| *Output* | None |
| *Returned Value* | BOOL value : TRUE – locked, FALSE – unlocked |

### ReadLCDVersion

`BOOL APIENTRY ReadLCDVersion` (DWORD *data)

| | |
|---|---|
| *Purpose* | Reads the LCD version LCD ASIC. |
| *Input* | None |
| *Output* | DWORD *data (version number) |
| *Returned Value* | 1 – ok, 0 – fail |

# 16-bit API

(Not recommended, available for backward compatibility purposes support only)

### Register_Emg

`WORD FAR PASCAL _export Register_Emg` (WORD hwnd, UINT uiMsg)

*Purpose* Opens the emergency session.

*Input* hwnd: Window handle of the emergency session.
uiMsg: The message number used for notification.

*Output* None.

*Returned Value* `EMG_SUCCESS` or `EMG_FAILURE` depending on the number of registered applications.

### DeRegister_Emg

`WORD FAR PASCAL _export DeRegister_Emg` (WORD hwnd)

*Purpose* Closes the emergency session.

*Input* hwnd: Window handle of the emergency session.

*Output* None.

*Returned Value* EMG_SUCCESS.

### RegisterSysEvent

`WORD FAR PASCAL _export RegisterSysEvent` (WORD hwnd, UINT uiMsg, WORD event)

*Purpose* Registers the application to get notification for the system events.

*Input* hwnd: Specifies the handle of any user application.
uiMsg: The message number is used for notification.

| | |
|---|---|
| EMERGENCY | 0×0100 |
| POWER_OFF | 0×0080 |

*Output* event, pointer to actual system event status

*Returned Value* 1 – ok, 0 – fail

### DeRegisterSysEvent

`WORD FAR PASCAL _export DeRegisterSysEvent` (WORD hwnd)

*Purpose* De-registers the system event session.

*Input* hwnd: specifies the handle of the user application.

*Output* None.

*Returned Value* 1 – ok, 0 – fail

**Note**

The MW-520 software (HWDriver and application) allows running 16-bit applications on 32-bit software under Windows 95. The THUNK mechanism is used to implement this feature. When using THUNK during applications' development, some restrictions should be taken into consideration. For more information on THUNK, see Microsoft Visual C++ on-line help and Microsoft Development Network Knowledge data base.

# User-Defined Buttons

The six user-defined buttons located on the display unit use scan codes `64h` through `69h`, from left to right. These scan codes are not used by any other keys on the keyboard.

To modify these codes and load them at system boot use the `C:\MATRIX\MATRIX.EXE` utility.

**Note**

The MATRIX utility enables you to modify the user-defined buttons scan codes to keyboard scan codes alone.
This is not relevant to Windows NT or Windows 2000.

To modify the scan codes, perform the following steps:

1. Run `MATRIX.EXE`.
2. Press F2 to modify.
3. Follow the instructions on the screen.
4. Press the user-defined button and see what key it simulates. If this is not the required key, press the button again. Another key will be simulated.
5. Press F6 to save the matrix configuration in an `.MTX` file.
6. Add the following line to the `AUTOEXEC.BAT`:
   ```
   C:\MATRIX\MATRIX.EXE C:\MATRIX\XXX.MTX
   ```
7. Reboot the MW-520.

# Main Peripherals

## General

The following peripheral devices may be attached to the MW-520 connectors:

- mobile printers
- external speaker
- serial RS-232 communication devices
- DATATAC® radio
- IDEN® radio
- Standard GPS
- Any standard USB drive
- IDB vehicle bus standard

## The MW-520 External Ports

The MW-520 serial external port supports a full set of RS-232 lines. The MW-520 includes one external port (COM1), and additional serial ports can be added by using USB serial converters.

## DATATAC Radio

### Creating a Radio Application

Using the standard interface for RF communication, you can choose to communicate directly with the MW-520 internal modem which is a standard serial device, running on COM3, with a default of 8 bits, no parity, 9600 baud interface. Options such as handshaking are selectable through the Native Mode interface. The only difference in the software interface is the COM3 base address, which is 03E8H, and the COM3 IRQ, which is IRQ4. By using Native Mode, you take on the responsibility of respecting all conventions of the Native Mode protocol and must personally address any contention between multiple applications (if there are any). For more information, refer to the *Native Mode Interface Reference Manual*, 68P04014C90.

When the MW-520 is in Suspend, the RF modem will usually be powered up in Receive mode. In order to prevent data loss when an outbound message arrives while the system is in Suspend (wake-up from Suspend can take 5 seconds), it is recommended to deassert the DTR line before Suspend.

The radio application/driver can detect the Suspend event by waiting for the Windows `PWR_SUSPENDREQUEST` message. When the Suspend request occurs, the radio application should notify the modem to stop transferring data (deassert

DTR, or switching the modem to transparent mode). If the application receives a `PWR_SUSPENDREQUEST` message during data transferring, it is recommended to reject the request in order to prevent data loss. When Resume occurs, it should notify the modem to continue (assert DTR, or switch the modem to Native mode).

The MW-520 resumes from Suspend mode when an RI signal is received from an external radio-modem connected to COM1, or from the internal radio-modem connected to COM3 (resume occurs on the RI falling edge). The modem sends an RI signal only when the DTR line is deasserted.

**Note**

Ensure that your application is power management aware and compatible with Microsoft Power Management API.

The RF-modem power-on can be controlled automatically via Windows start-up by an MW-520 HWAPP application (the power-on option is the default option).

### Any Modem that Supports DTR Functionality

When the MW-520 enters Suspend state, the DTR is inactivated.
When the MW-520 is resumed from the Suspend state, an application should activate the DTR when it is ready to receive incoming data from the RF-modem.

The required sequence when resuming from Suspend:

1. Get the Windows message `PWR_SUSPENDRESSUME`.
2. Assert DTR.
3. Return with `PWR_OK` from the window procedure.

# Acronyms and Abbreviations

| | |
|---|---|
| ACPI | Advanced Configuration and Power management Interface |
| API | Application Program Interface |
| ASIC | Application Specific Integrated Circuit |
| BIOS | Basic Input/Output System |
| CMOS | Complementary Metal-Oxide Semiconductor |
| CPU | Central Processing Unit |
| DDE | Dynamic Data Exchange |
| DMA | Direct Memory Access |
| DRAM | Dynamic Random Access Memory |
| DTE | Data Terminal Equipment |
| DTR | Data Terminal Ready |
| IDB | Integrated Data Base |
| IDE | Integrated Drive Electronics |
| I/O | Input/Output |
| IRQ | Interrupt ReQuest |
| ISA | Industry Standard Architecture |
| LCD | Liquid Crystal Display |
| LED | Light Emitting Diode |
| MWCS | MagicPipe™ Wireless CommStack |
| OEM | Original Equipment Manufacturer |
| PCI | Peripheral Component Interconnect |
| PCMCIA | Personal Computer Memory Card International Association |
| RAM | Random Access Memory |
| RF | Radio Frequency |
| RI | Ring Indicator |
| UART | Universal Asynchronous Receiver Transmitter |
| USB | Universal Serial Bus |
| VGA | Video Graphics Array |
| VRM | Vehicular Radio Modem |

# Glossary

| | |
|---|---|
| Application | A computer program used to perform a specific work. |
| API | The interface between application programs and the network software. |
| ASIC | A chip which can be readily customized for a given application. |
| BIOS | Software for transferring information between elements such as memory, screen and disk. |
| Bus | A communication channel carrying signals from any device used by the system to another device. For example, data being transferred to and from a hard disk travels on a bus. |
| CARD_BUS slot | A socket into which the CARD_BUS is inserted. |
| CMOS | The memory that stores the configuration you establish by running the computer's setup program. CMOS memory uses very little power and stores the information even when the computer is turned off. |
| COM Port | COM stands for communication. COM ports are the serial ports of the MW-520. |
| DDE | A Microsoft protocol that allows Windows applications to communicate using a client/server model. |
| Device driver | A program that controls how software communicates with a physical device (for example, a mouse, memory, or a printer). |
| DMA | A method that allows a peripheral device to directly read or write to memory, without the time delay of going through the CPU. |
| DOS | A software that supervises computer's operation, including handling I/O. |
| Drive | A hierarchical organization of directories, stored on a disk. |
| DTR | An RS-232 control signal used by a terminal to tell a modem that it is ready to receive data. |
| Emergency key | An orange key - although it can be any key - that is configured to send emergency information to Dispatch. |

Hard disk
A large-capacity data-storage device that is installed inside the MW-520.

IDE
A hard drive with a built-in controller.

ISA bus
A computer's bus is the hardware system it uses to transfer information between the different hardware elements of the computer. The ISA bus is the most common form of bus.

OEM
Supplier who makes equipment for sale by a third party. The equipment is usually disguised by the third party with his own labels.

Operating System
A program that supervises the computer's operation, including handling I/O.

PCI bus
A 32-bit local bus that provides connections for 32-bit add-in boards. The bus operates at an external clock speed of the microprocessor (up to 33 MHz). PCI devices are configured automatically by the system.

PCMCIA slot
Either of the two sockets on the processor into which the PCMCIA cards are placed.

RAM
A portion of the system's memory that is designed as a temporary storage area for data and programs. RAM includes conventional and extended memory.

RI
A modem signal which indicates that a remote modem has called (literally, "the phone is ringing").

UART
An integrated circuit which takes a character of data (eight bits in parallel), and transmits each bit serially over an asynchronous communication channel. It also accepts asynchronous data and provides a character to the device in which the UART is installed.

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