386EX LCD PANEL-PC

Technical Manual

taskit GmbH

Seelenbinderstr. 33

D-12555 Berlin

Germany

Tel. +49(0)30 / 611295-0

Fax +49(0)30 / 611295-10

Table of Contents

1. LCD Panel-PC Overview

1.1. CPU

- Intel 386EX embedded processor
- 25 or 33 MHz

1.2. Memory

- 1MB SRAM
- RAM may be supported by external battery during power off
- 1MB, 2MB, 4MB or 8MB flash memory, mostly for writable flash disk, but also configurable for direct addressing by application programs.
- 256 bytes EEPROM, available to applications

1.3. Operating System

- PC-compatible BIOS
- Datalight ROM-DOS or Microsoft DOS (e.g. Version 6.22 or higher)

1.4. Interfaces

Serial Interfaces	5 serial interfaces total, of these, 2 with RS232 (COM1 and COM4), the others 5V level. Two serial interfaces are 8250-compatible (COM1 and COM4). Two are 16C550-compatible (COM2 and COM3) -- in other words equipped with 16-byte FIFOs. COM4 has only the data lines (RXD and TXD), but no handshake lines. The fifth serial interface is part of the keyboard controller and not PC-compatible. It could be addressed PC-compatibly with BIOS functions (at present, however, this has not been implemented).
Parallel Interface	EPP/ECP-capable
LCD Connection	for LCDs in ¼-VGA format (320x240 pixel), e.g. Hitachi LMG6912RPFC, Seiko SED1335 LCD controllers LCD contrast adjustment via software High-voltage production for the LCD's CCFL backlight
Floppy Disk	Connection for standard floppy-disk drives
Hard-Disk Connection	for 2.5" hard drives and/or CompactFlash
I2C bus	(without BIOS implementation at this time)
Keyboard Controller	with connection for PC keyboard and 8x8 matrix keyboard (with BIOS-Int 16h support), DIN and PS2 connectors for PC keyboard
Touchscreen	
PIF-Bus Connection	for flat ribbon cable and compatible PIF cards.
Voltage Regulator	for supply voltage (5V), input 7..40V unregulated, connection via screw clips
5V Output	power supply for peripherals

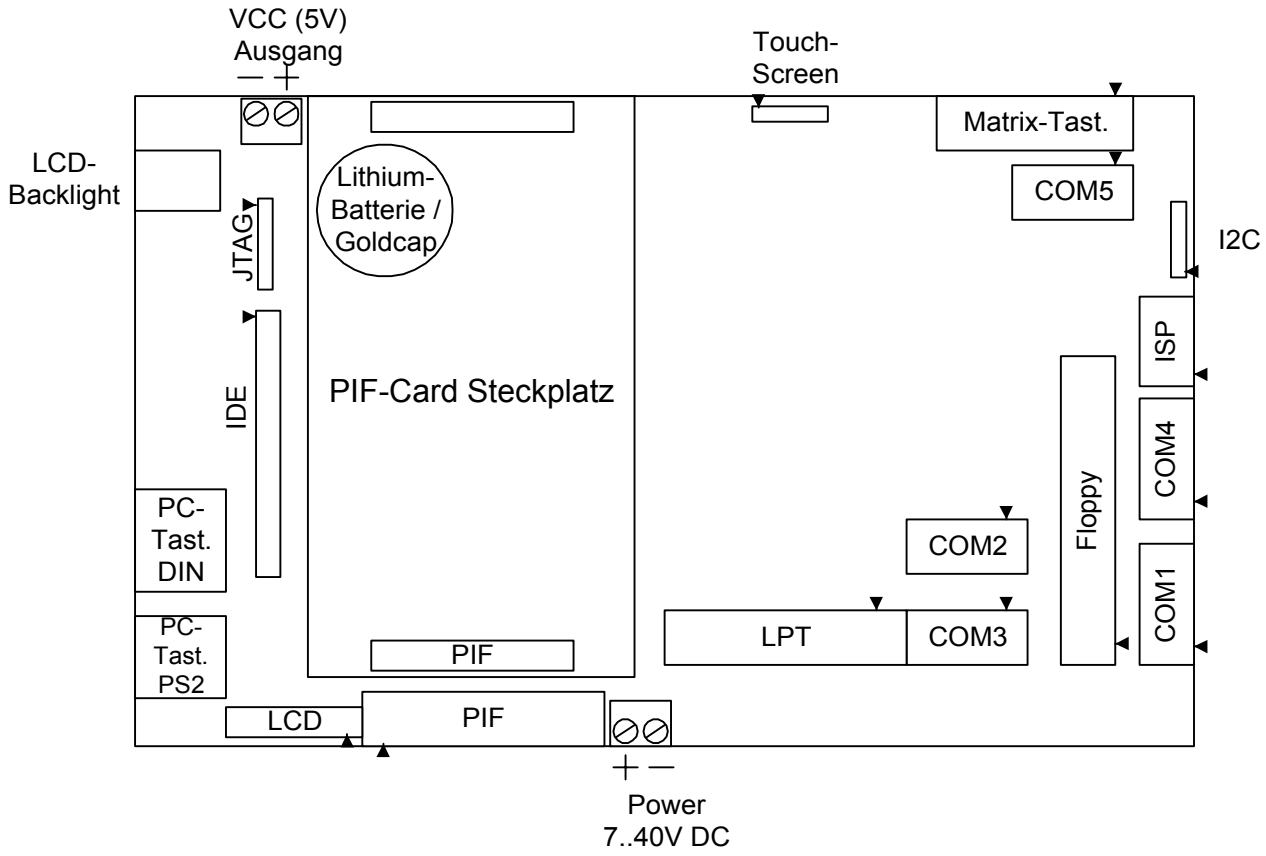
1.5. On-Board Units

Real-time clock (with battery backup), supply voltage monitoring (triggers NMI when the unregulated supply voltage drops off)

1.6. Mechanics

Assembly into 3HE rack (19") possible
LCD can be mounted directly on the card (e.g., Hitachi LMG6912)
Board size, 175x109 mm

2. Overview Diagram



3. Start-Up

3.1. 386EX Panel-PC DOS Prompt

From the DOS prompt you can use the LCD Panel-PC like a normal DOS PC. The LCD Panel-PC makes two drives available. Drive **C:** is the flash disk, drive **B:** is a RAM disk. These can be accessed like PC drives.

3.2. Programming

The LCD Panel-PC can be programmed like any other DOS PC with all the usual DOS compilers, e.g., Borland and Microsoft C, Pascal or Basic.

The procedure for developing a program is thus quite simple. Since the drives of the PC are shown by the terminal program as drives of the Panel-PC, the developer can start his or her program file on the development PC directly by DOS command, or copy the file to the flash disk and start it from there.

A starter kit containing a developer board, power supply and the necessary software makes it easy to put the Panel-PC to use.

3.3. Terminal Program VTERM

The terminal program VTERM is found in the "Utilities" subdirectory. This can be started without additional parameters. In this case, COM1 is designated for connecting the development PC to the Panel-PC. To use a COM port other than COM1, you can indicate this on the command line (e.g. vterm –c2). In VTERM can you select a new COM port by pressing ALT-C. ALT-H gives you an overview of the program's commands.

In contrast to other, universal terminal programs, VTERM offers the possibility of mapping to remote drives over the serial interface. For this, VTERM interprets the appropriate commands of the remote driver on the Panel-PC.

Turn on the 386EX Panel-PC. Assuming the settings are correct, you will observe the BIOS booting. After the memory test, DOS is booted, and you arrive at the Panel-PC DOS prompt.

3.4. Access to Host Drives with RDRIVE

The driver RDRIVE.EXE permits mapping of another PC's drives as drives of the Panel-PC, as in a network. Since the normal DOS file functions can also be used for the host drives, data communication to the host is substantially simplified.

Access to the host PC's drives works only in connection with the **VTERM** terminal program**.**

The following DOS commands can be executed at the DOS prompt or in an AUTOEXEC.BAT or other batch file.

The remote driver is started by the call

```
RDRIVE
```

or

```
RDRIVE   -c<com x>
```

COM1 is set as the default interface. Other serial interfaces can be indicated with the <com x> parameter. In the event that RDRIVE has already been started, the driver must first be removed from memory via the command

```
RDRIVE -u
```

Drives and directories on the host PC can be mapped to drives or drive letters of the Panel-PC with the RMAP program. For example, the command

```
RMAP /LOCAL=D /REMOTE=C
```

makes drive C: of the host PC available as drive D: of the Panel-PC. The local drive letter should not already be mapped to another drive.

There is no set rule as to which letters must be used in which order. Network drives can also be mapped as remote drives.

Subdirectories of a remote drive can also be mapped as local drives:

```
RMAP /LOCAL=E  /REMOTE=C:\Programs\Files386
```

The assignments can be overwritten at any time, or can be deleted by indicating the local drive letter:

```
RMAP   /LOCAL=D
```

The command RMAP without parameters returns a list of current drive assignments.

The program RMCWD.EXE automatically maps the directory from which Vterm was started to the indicated drive letter. For example,

```
RMCWD  E:
```

ensures that when one switches to drive E: on the Panel-PC one finds oneself in the Vterm home directory on the host PC.

The MAP.BAT file delivered with the Panel-PC on the flash disk contains examples for using the commands above.

4. BIOS Setup

The BIOS setup menu is called by pressing the "S" key during the boot process.

The setup screen appears on both the LCD and the terminal-program screen. The latter can be extended by pressing "F1", which displays additional Help texts.

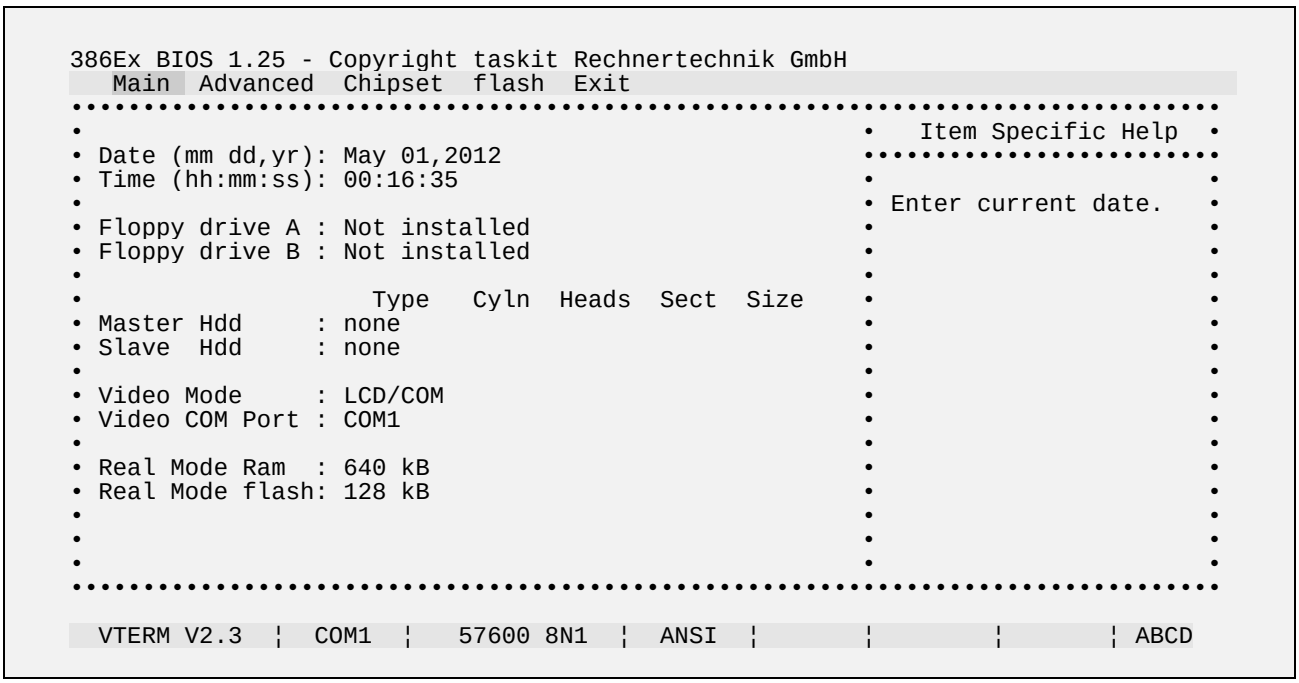
Note: By changing setup values, the Panel-PC can be configured to disable all external access. In this case, the default setup values can be restored by setting the PIF-bus interrupt line to low (pin 25 of the X17 PIF plug, e.g. with a jumper between pin 25 and pin 26). Incorrect settings can be reset in this way.

If this method does not succeed (e.g., because the BIOS was deleted by a faulty update), the BIOS must be reloaded via the JTAG interface (see the description of the JTAG.EXE program in the "PC Programs" chapter).

The BIOS Setup contains extensive configuration options for memory partitioning, serial interfaces and I/O ports, in addition to functions for loading ROM-DOS or BIOS updates, and saving to or deleting from the flash disk.

The Panel-PC BIOS is configured for communication via the first serial interface (COM1). The baud rate is the standard 57600 baud. Various settings for memory partitioning and interfaces can be made in the BIOS Setup.

4.1. Main BIOS Setup



Date and Time: Setting the real-time clock (RTC). These values remain after power-down only if a lithium battery is installed.

Floppy drive: if a floppy disk drive is attached, it must be entered here.

Master HDD / Slave HDD: If a hard drive or CompactFlash module is attached, they must be entered here. For existing hard drives and CompactFlash modules, "LBA" or "CHS" is registered here. For media that is not yet formatted it doesn't matter which value is selected. However, "LBA" and "CHS" are not compatible after formatting; once selected, the value for the medium concerned must be maintained. The on-board flash disk is not registered here.

Video Mode: Sets whether outputs from BIOS and DOS should be sent to the LCD, a serial interface, both, or neither.

Video COM Port: Sets the serial interface via which the BIOS Setup as well as the ROM-DOS ("CON" device) are to be addressed. **Note:** if "none" or a non-existent interface is set here, then neither the Setup nor the DOS prompt can be accessed after the next start-up. This is occasionally useful, in order to prevent unauthorized accesses to the Panel-PC.

Real Mode RAM / Real Mode flash: Sets how much of the flash and/or RAM memory is to be made available in the lowest MB of the CPU's address space. This storage area is then accessible in the 386EX CPU's real mode. Possible settings:

for RAM: 256 kB, 512 kB, 640 kB, 768 kB;

for Flash: 128 kB, 256 kB, 512 kB.

The sum of both values cannot exceed 1MB. RAM is always accessible starting at address 0; the flash memory immediately below 100000h (1MB). Default values are 128KB flash and 640KB RAM. Larger values for RAM make sense, among other reasons, if more DOS main memory is needed. On the other hand, if a larger flash disk is needed, then an accordingly smaller value must be set. The memory range of the RAM disk may not overlap with the DOS memory.

4.2. Advanced BIOS Setup

```
386Ex BIOS 1.25 - Copyright taskit Rechnertechnik GmbH
Main  Advanced  Chipset  flash  Exit
•••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••
•                                                    •   Item Specific Help  •
• Power on messages        : Enabled                 •••••••••••••••••••••••••
• System Configuration Box : Enabled                 •                       •
• Display "Hit <S>..."     : Enabled                 • Show power on         •
• Wait For Key on Error    : Enabled                 • messages on screen.   •
• Keyboard layout          : German                  •                       •
• Fast Boot                : Disabled                •                       •
• Boot Sequence            : A: C:                   •                       •
• Ide Block Transfer       : Disabled                •                       •
• Swap Hdd 0 and 1         : Disabled                •                       •
• Write Protect Hdd        : none                    •                       •
• Ramdisk size             : disabled                •                       •
• Lcd Orientation          : standard                •                       •
• Lcd Bitmap               : Disabled                •                       •
• flash FAT monitoring     : Enabled                 •                       •
•                                                    •                       •
•                                                    •                       •
•                                                    •                       •
•                                                    •                       •
•••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••

VTERM V2.3  ¦  COM1  ¦   57600 8N1  ¦  ANSI  ¦       ¦       ¦       ¦ ABCD
```

Power-on messages: When set to "disabled," the copyright notice, RAM test messages and BIOS configuration box are suppressed when booting. Instead BIOS shows only the message "Booting..." and DOS shows only "Starting ROM-DOS...".

System Configuration Box: Display of the System Configuration Box at boot time can be suppressed here.

Display "Hit <S>..." : The appearance of this message at boot time can be suppressed here.

Wait For Key on Error: In the event that a hard drive registered in Setup is missing or does not function, the BIOS continues with the boot process and asks the user to press a key. One can then start Setup by pressing "S". Switching this option off does not make sense if ROM DOS is booted, since this stops the computer with an error message.

Keyboard Layout: Sets whether the BIOS interprets an attached keyboard according to German or American (US) layout. This has no affect on a terminal program's key assignment.

Fast Boot: BIOS conducts a shortened RAM test (to save time when booting).

Boot Sequence: The sequence in which BIOS looks for boot disks. Four settings are possible:

A:
C:
C:, A:
A:, C:

This functions only when no ROM-DOS is active.

Ide Block Transfer:

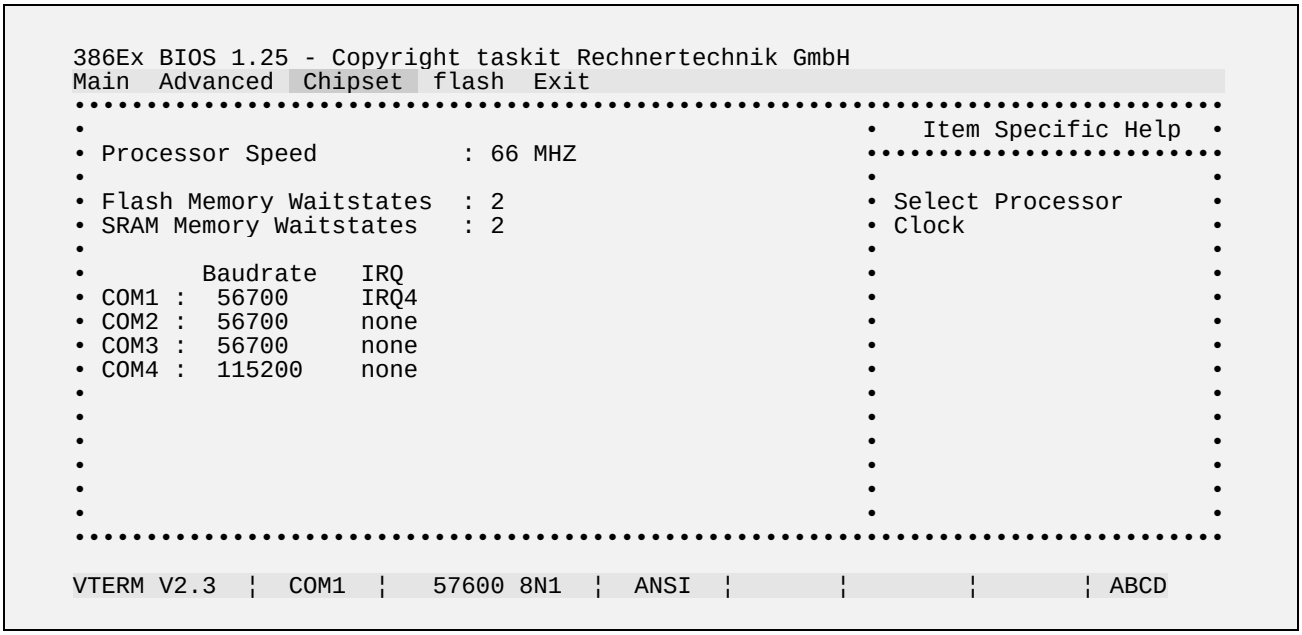
Swap Hdd 0 and 1: Exchanges the drive letters C and D (DOS) and the drive numbers 80h and 81h (for BIOS Int 13h). If only one hard drive (or CompactFlash) is attached, the on-board flash disk becomes drive C: (No. 80h) and the hard drive becomes drive D: (No. 81h). If two hard drives are attached, the hard drive set as Slave becomes drive C: and the Master becomes drive D:. The on-board flash disk is then drive E: (No. 82h). Since drive C: or A: is booted, the flash disk can no longer be booted when two hard drives are present.

Write Protect Hdd : Write protection can be set for drive C:, drive D:, or both. Thereafter write accesses by the BIOS are not possible, though writing is still possible via direct memory addressing.

RAM Disk Size : Sets the size of the RAM disk in extended memory. The RAM disk is initialized automatically by the BIOS after reset and can be addressed as drive A: (if no ROM disk is available, otherwise drive B:). If the SRAM has battery backup, contents of the RAM disk remain after shut-down. In this case the re-initialization is omitted by the BIOS. Changes in the RAM configuration (menu option "Real Mode Mem") lead to the re-initialization of the RAM disk (and thus the deletion of data on it) upon restart.

flash FS FAT monitoring : "FAT monitoring" by the BIOS effects a substantial speed increase of the flash file system for the on-board flash disk. This functions, though, only under DOS. When using another operating system, FAT monitoring must be turned off.

4.3. Chipset BIOS Setup



Processor Speed: The values 66 MHz, 60 MHz, 50 MHz, 33 MHz, 25 MHz, 20 MHz and 8 MHz can be set as the oscillator frequency for the CPU clock. The nominal CPU clock speed, which determines command times and benchmarks, is half of this frequency (the 386EX CPU divides the oscillator clock internally by two).

SRAM and flash Wait States: The default settings should not normally be changed. If however a CPU clock rate under 33 MHz is used (by changing "Processor Speed"), then another value can be set. This is calculated as follows:

$$n > t_R * f_{CPU} - 1$$

This means:

t_R = RAM/flash access time (as per data sheet)
n = Number of wait states
f_{CPU} = Oscillator frequency / 2 (≤ 33 MHz)

For t_R = 55 ns and f_{CPU} = 33 MHz …
$t_R * f_{CPU} - 1 = 0.815$
The next-larger whole value for n is 1. Thus 55ns RAM works with 1 wait state.

For t_R = 70 ns and f_{CPU} = 33 MHz ...
$t_R * f_{CPU} - 1 = 1.31$
Thus for 70 ns RAM two wait states must be set.

For t_R = 120 ns and f_{CPU} = 33 MHz ...
$t_R * f_{CPU} - 1 = 2.93$
Thus for 120 ns flash three wait states must be set.

For t_R = 90 ns and f_{CPU} = 33 MHz …
$t_R * f_{CPU} - 1 = 1.97$
Thus for 90 ns flash two wait states must be set.

Particularly with flash memory, shorter settings can sometimes be used without noticeable disturbances. Nevertheless, trouble-free operation is no longer ensured. This applies above all to operation at higher temperatures. In addition, such a setting outside of the component specifications can work well with some flash cards and not with others of the same brand (depending on individual variations and manufacturing lots).

COM Baudrate, IRQ: Sets the baud rate for the serial interface. Possible values are 115200, 57600, 38400, 19200, 9600, 4800, 2400, 1200, 600, 300 and 150 baud.

The settings refer only to the BIOS functions responsible for the serial interfaces (INT 14h). The setup values are ineffective in the case of direct program access to the serial interface registers.

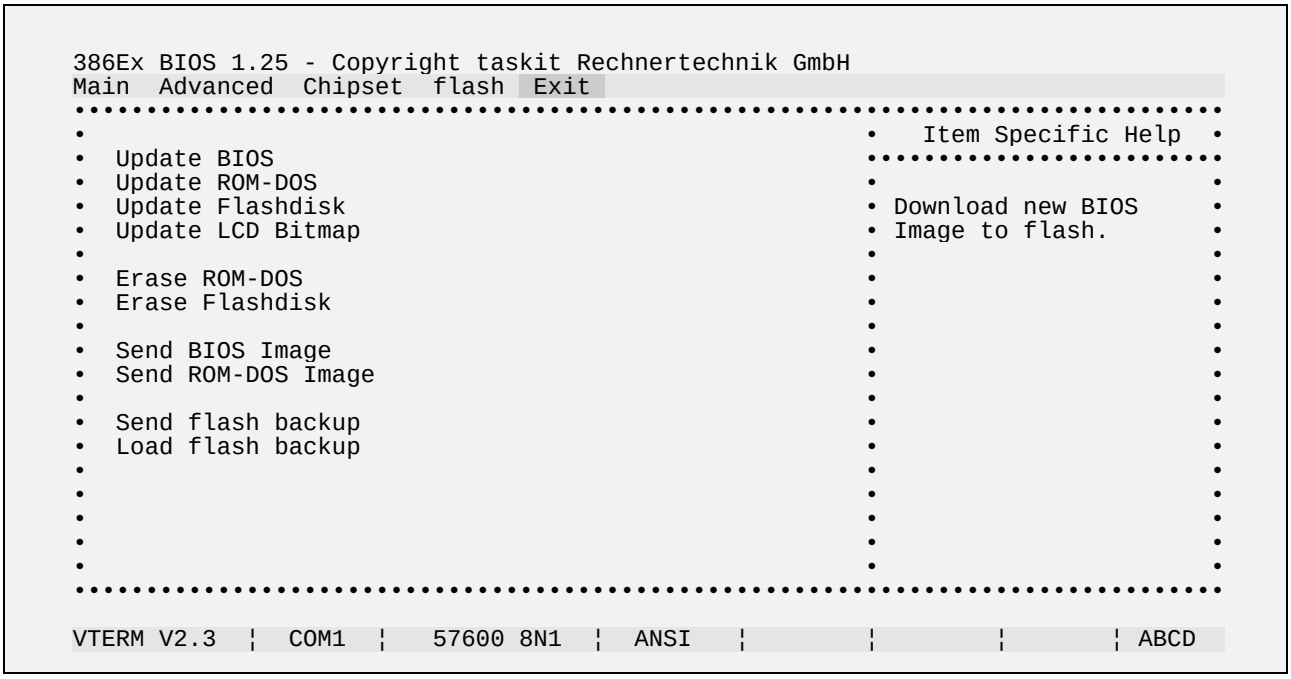
On a PC the BIOS functions of INT 14h normally do not use an interrupt. Using an interrupt does however increase the data throughput, since the application program does not have to permanently query the serial interface for new data. Therefore for each interface an IRQ is accounted for as an option. According to the standard settings, an IRQ is active only for the first serial interface. When using an IRQ, a 1024-byte RAM buffer is furnished for the respective interface.

Note: Some restrictions apply when allocating an IRQ to a serial port: COM1 may only use IRQ4, while COM4 may only use IRQ3. If IRQ3 or IRQ4 are used this way, they are no longer available for COM2 or COM3. The serial ports COM2 and COM3 can share one IRQ line, while COM1 and COM4 cannot.

IRQ settings which do not comply with these restriction may be entered in the setup menu but are not stored by the BIOS.

Please remind that COM2 and COM3 use a 16 byte Fifo, while COM1 and COM4 do not have a Fifo.

4.4. "flash" BIOS Setup

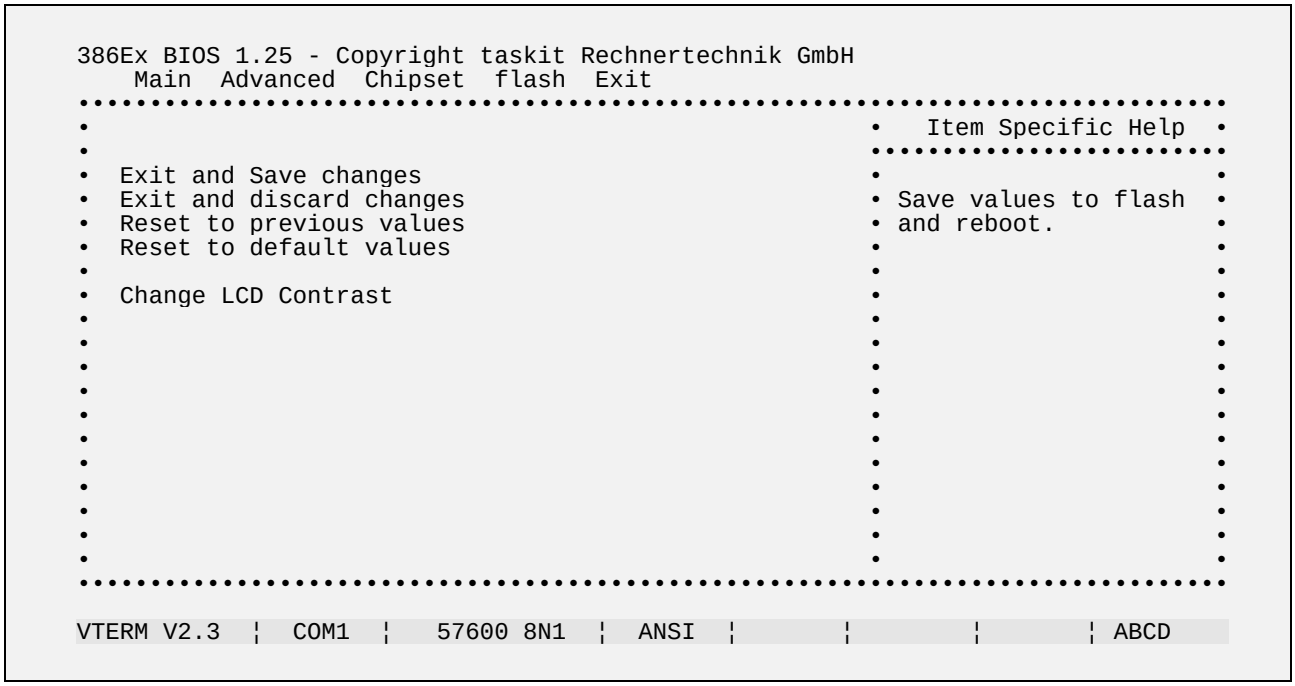


Update BIOS / ROM-DOS: Load a new version of the BIOS or ROM-DOS. **Note:** During the BIOS or ROM-DOS update a continuous power supply must be ensured until the update is concluded. In the event of a power failure during the update (and an accompanying reset), the BIOS is usually deleted, and rebooting is no longer possible. In this case, the computer can only be accessed via the JTAG interface. The BIOS can be restored with the program JTAG.EXE and a suitable cable.

Update Flashdisk: The Panel-PC's on-board flash disk can be completely reconfigured here. All data previously on the flash disk is thereby erased. A special image file containing all the necessary files (in particular command.com, as well as the relevant application programs) is needed for loading the flash disk. Example files can be found on the provided disk. New image files can be created with the "flashhdd.exe" tool (see description elsewhere).

LCD Bitmap: Any bitmap graphic can be displayed during booting instead of the BIOS and DOS boot messages; the graphic is loaded with this function. For programming reasons a normal bit-map appears vertically inverted. It should thus be stored with the image likewise vertically flopped. This can be done with the Windows program "Paintbrush," for example. 240x320 pixels is the recommended size. The setting "LCD Orientation" in the Main Setup does not influence display of the bitmap. If a 180° rotation is desired, this must likewise be considered when creating the bitmap.

4.5. "Exit" BIOS Setup



Exit and Save changes: Save the chosen settings and re-start.

Exit and discard changes: Restart without saving the changed settings.

Reset to previous values: Reset the settings to the original values.

Reset to default values: Reset the settings to the default values.

Change LCD contrast: Edit the LCD contrast settings. After pressing "Return," you can change the LCD contrast with the "+" and "-" keys. Changes are saved immediately.

5. PIF Bus

5.1. Overview

The PIF bus is a simple 8-bit extension bus for connecting peripheral cards to the Panel-PC. The bus architecture is derived from the interfaces of various LCDs (although their plug allocations are not uniform). Thus LCDs using the Toshiba T6963C controller can even be operated directly on the PIF bus.

The address space consists of 64 I/O addresses. However, it is not 6 address lines that are used, but 4 chip-select lines and 4 address lines. Of the chip-select lines, only one is ever active (1-of-4 code). Thus 16 I/O addresses are assigned to each chip select. This principle simplifies address decoding.

In many cases, address coding is completely unnecessary. For instance, the well-known PIO component 82C55 can be operated directly on the PIF bus by using the signals /CS0, /RD, /WR, A0, A1, the data lines and the operating voltage. Thus of the 16 addresses that belong to chip select 0 (/CS0), effectively only four would be used, although all 16 are occupied. This "wasting" of addresses is not an issue in many systems (those which need little in the way of peripherals), and simplifies the design.

Important are the active-low read (/RD) and write lines (/WR), of which exactly one is active for each PIF bus access, according to whether it is a read or a write cycle. The data lines are sampled in each case on the **rising** edge, thus toward the end of the bus cycle.

5.2. Hardware Design for the PIF Bus

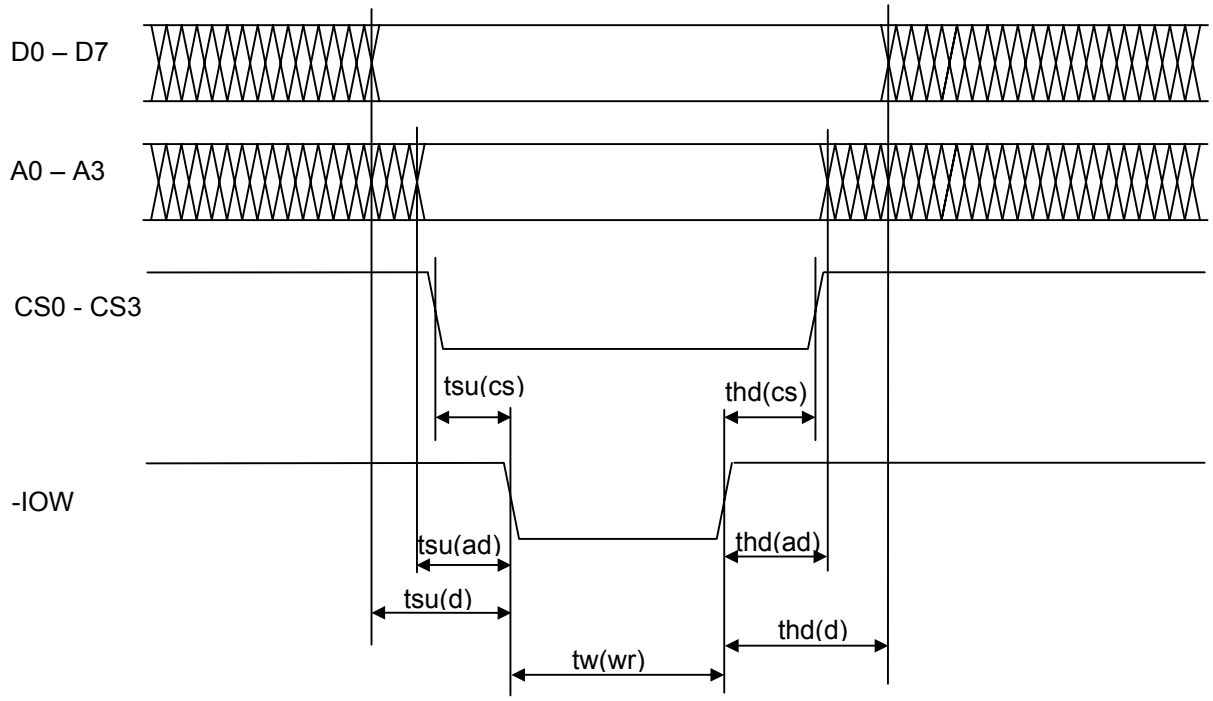
The following points must be considered when developing hardware for connecting to the PIF bus.

1. Access to PIF peripherals is through I/O commands. Memory-mapped accesses are not possible.
2. The PIF bus's four address lines correspond to the lowest four address lines of the CPU bus. They can therefore take on any offset value from 0 to 0Fh.
3. Exactly one chip-select line is active (low) for each valid PIF-bus access.
4. The four chip-select lines are decoded from address lines A4 and A5 of the CPU bus. They correspond therefore to offset values of 0h, 10h, 20h and 30h.
5. The base address of the PIF bus is added to the offset values mentioned. For the Panel-PC this is 300h. Other CPU cards may differ.
6. Exactly one of the signals /RD and /WR is active (low) during a valid PIF bus access. The peripheral must evaluate these signals as well as the chip select signals, otherwise incorrect bus cycles can occur.
7. The data lines are sampled during both reading and writing on the rising edge of the /RD or /WR signal. The address, data and chip-select lines become invalid only few nanoseconds after the rising edge of /RD or /WR (hold times greater than 0 are not guaranteed). The falling edges of /RD and /WR come shortly after data lines, address lines and chip selects are valid.
8. Ready Signal: This signal is output by peripheral hardware, in order to extend PIF bus cycles. Data, addresses and chip selects remain valid until the peripheral releases the ready signal (switches to high impedance).

5.3. PIF-Bus Signals

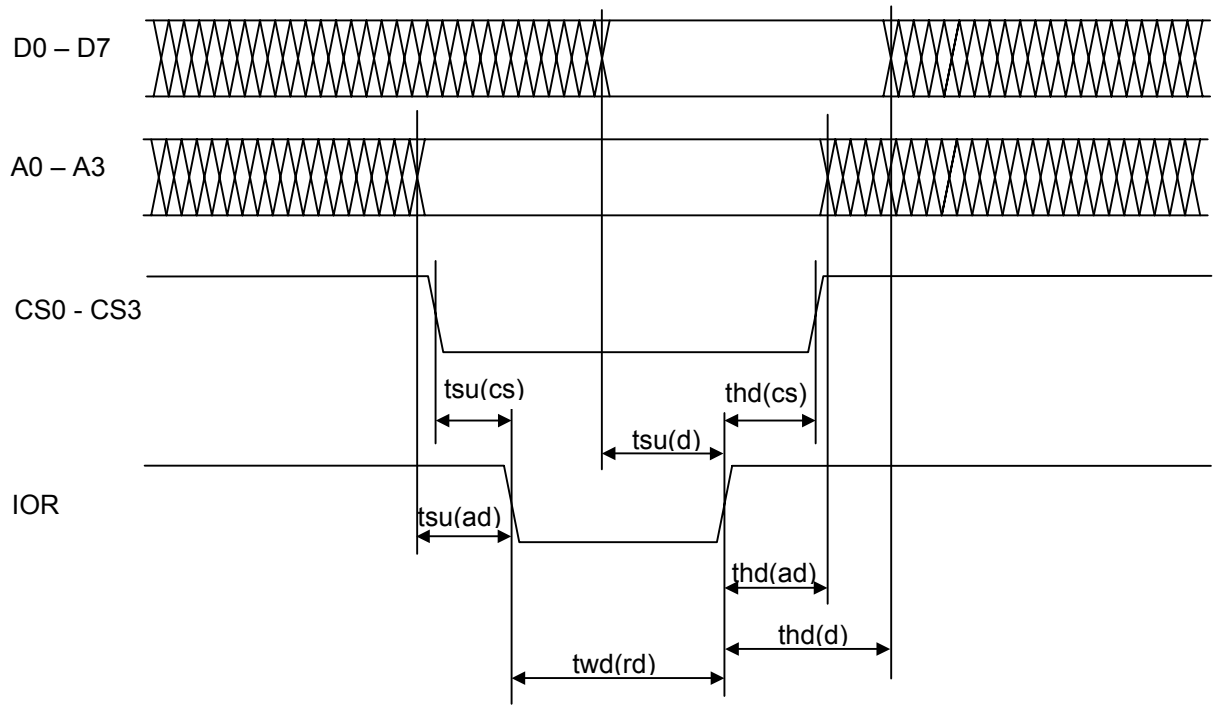
Signal	Pin #	I/O	Active	Description
D0 ... D7	11 ... 18	I/O	high	Data lines
/CS0 ... /CS3	7, 22, 23, 24	O	low	Chip selects. With each bus cycle, exactly one chip select is active.
A0 ... A3	8, 9, 20, 21	O	high	Address lines
/RD	6	O	low	Read signal. Active with each read access.
/WR	5	O	low	Write signal. Active with each write access.
/RESET	10	O	low	Reset signal. This is the buffered output signal of the Panel-PC's MAX690 reset generator. (See relevant section.)
/INT	25	I	low	Interrupt request. On the Panel-PC this signal is sent inverted to IRQ5. It has a 10kOhm pull-up resistance.
READY	19	I	high	Ready: serves for the lengthening of PIF bus cycles by peripherals (low = emergency ready). The bus cycle is only terminated by the CPU when the ready signal is again high.
VCC	3			5V power supply
VEE	4			Reserved
GND	1, 2, 26			Ground (negative connection for the supply voltage)

5.4. PIF-Bus Timing (Write)



tsu(cs)	Chip Select setup time	-CS low to –IOW low	> 50 ns
thd(cs)	Chip Select hold time	–IOW high to –CS high	> 0 ns
tsu(ad)	Address setup time	A0..A3 valid to –IOW low	> 50 ns
thd(ad)	Address hold time	A0..A3 valid after –IOW high	> 0 ns
tsu(d)	Data setup time	D0..D7 valid to –IOW low	> 50 ns
thd(d)	Data hold time	D0..D7 valid after –IOW high	> 0 ns
tw(wr)	Write pulse width	–IOW low to -IOW high	> 350 ns

5.5. PIF-Bus-Timing (Read)



tsu(cs)	Chip Select setup time	-CS low to –IOR low	> 20 ns
thd(cs)	Chip Select hold time	-IOR high to –CS high	> 0 ns
tsu(ad)	Address setup time	A0..A3 valid to –IOR low	> 20 ns
thd(ad)	Address hold time	A0..A3 valid after –IOR high	> 0 ns
tsu(d)	Data setup time	D0..D7 valid to –IOR low	> 20 ns
thd(d)	Data hold time	D0..D7 valid after –IOR high	> 0 ns
tw(rd)	Read pulse width	-IOR low to -IOR high	> 350 ns

6. PC Programs

6.1. VTERM

VTERM.EXE is the standard terminal program for the Panel-PC and thus the most appropriate connection to the Panel-PC during software development.

6.1.1. Command-Line Parameters

VTERM can be called with the following command-line parameters:

-? : Overview of command-line parameters
-b(baud): Set data transmission rate
-c(1-4) : Choose serial port
-m : Select black/white display
-o : Open log file
-t(AHT) : Select terminal emulation

6.1.2. VTERM Commands

The following keys have functions defined:

ALT-B : Set data transmission rate
ALT-C : Choose serial port
ALT-D : Assign remote drive
ALT-E : Turn local ECHO on/off
ALT-F : Set handshake
ALT-H : Help
ALT-O : Open/close log file
ALT-P : Set data transmission parameter
ALT-R : Receive file
ALT-S : Send file
ALT-T : Set terminal emulation
ALT-W : Save settings
ALT-X : Exit VTERM
ALT-Y : Clear screen
ALT-Z : DOS command

In addition to the usual terminal functions (output to the screen, input over the host PC keyboard, and file transfer), VTERM permits direct access from the Panel-PC to drives of the host PC with help of the RDRIVE TSR program.

6.1.3. File Transfer with VTERM

Apart from file transmission via RDRIVE, which run automatically, VTERM must be instructed explicitly to start other kinds of file transfers.

This particularly affects file transfers by the BIOS Setup (flash update/backup) and communication with XSEND and XLOAD. Sending or receiving a file in VTERM is started with ALT-R or ALT-S, respectively. VTERM then asks for a transmission protocol and a file name.

Transmission to the MicroPC generally takes place via Xmodem protocol, therefore VTERM must also be set to Xmodem. Then one enters the name of the file to be sent, or the name of the file to be received. (Xmodem does not transfer the file name).

6.2. FLASHHDD

Flashhdd.exe is used to create a flash image file based on the contents of any directory. This file is then transferred via BIOS setup. Its contents constitute drive C: of the MicroPC. In order to be able to boot DOS, the affected directory must contain at least the file command.com.

Call:

FLASHHDD [/B<n>] [/S<m>] [/ V][/?] <*Source Directory*> *[<Destination File>]*

Options:

/B<n>	n = Number of blocks (default 14).
/S<m>	m = Block size in kB (64 if equipped with only one Flash IC, otherwise 128)
/ V	Verbose (Show files and folders)
/?	Help
/M	MS-DOS compatible flash-disk format (include MS-DOS system files)

The maximum value for n depends on the configuration, as per the following table:

Total capacity	Flash ICs equipped	n
1 MB	1	14
2 MB	1	29
2 MB	2	14
4 MB	1	61
4 MB	2	30
8 MB	2	62

Exceeding the maximum value for n should be avoided, since DOS computes the capacity from the boot sector of the Flash disk. If DOS computes more capacity than is physically present, a BIOS error will occur when DOS attempts to access non-existing sectors, leading to a system hang.

Make sure that the target file is not inadvertently in the source directory (to avoid recursion errors).

6.3. JTAG

This program serves for reloading the BIOS via the JTAG interface. A special cable is necessary for this, which is attached to the parallel interface of the host PC. The cable's 10-pin socket is attached to the 5-pin X5 pin row on the Panel-PC board. Pin 1 of the cable points to Elko C12. The odd pins of the socket remain free. The cable should not be placed near the IC19 high voltage converter, since this could disturb transmission.

Before loading the BIOS, the appropriate flash memory range must be erased. This is done with the menu option "Erase flash Sector". Enter F0000 as the address. The BIOS file BIOS.ABS must be in the same directory as JTAG.EXE. After the start of the program the message

```
JTAG-Connection     :     OK
Checking ID-Code    :     OK
```

must appear. If an error message ("JTAG Connection failed") appears instead, the following points should be reviewed:

- Is the correct PC parallel port set? This can be given on the command line (-L1, -L2 etc.).
- Is the Panel-PC's power supply turned on?
- Is the JTAG cable connected correctly? (see above)

If the JTAG interface functions, loading of the BIOS can be started with menu option 5 (Download BIOS). Afterward, the BIOS should re-boot the Panel-PC. Subsequently, the ROM-DOS must still be re-loaded via the Setup, since it is deleted during the BIOS update via JTAG (see description of BIOS Setup).

6.4. Bin2hex

BIN2HEX is a program for converting a binary file (e.g. ".COM" file) to an Intel Hex86 file.

6.5. Hex2bin

HEX2BIN generates a binary file from an Intel Hex86 file.

7. Panel-PC Programs

7.1. Mapping Remote Drives with RDRIVE, RMAP und RMCWD

RDRIVE enables integration of host PC drives as drives of the Panel-PC. The program is made resident after loading. Files can then be transferred to and from the host PC just like over a network, e.g. by the “copy” command. This is the Panel-PC’s standard technique for transmitting files. In addition, programs can be loaded directly from the host PC, without first copying them to a local MicroPC drive.

Call: ***RDRIVE*** *[-?] [-c<n>] [-u]*

-?	: Help
-c<1..4>	: select COM port 1 to 4 (default: COM1)
-u	: erases RDRIVE designations from RAM

In order to change the serial interface with -c, RDRIVE must be cleared beforehand with -u.

With the program RMAP, drives and directories of the host PC can be mapped as drives of the MicroPC. LOCAL designates the Panel-PC drive letters to use, and REMOTE designates the host PC drive or directory.

RMAP */LOCAL=D /REMOTE=C*

for example makes the host PC’s C: drive available as drive D: of the Panel-PC. There is no firm rule as to which letter should be used in which order, independent of whether the remote drives are local drives of the host PC or network drives.

Mapping directories is just as easy:

RMAP */LOCAL=E /REMOTE=C:\Programs\Files386*

The assignments can be overwritten at any time or can be deleted by indicating the local drive letter:

RMAP */LOCAL=D*

The command RMAP alone gives a list of current drive assignments.

The program RMCWD.EXE automatically assigns the indicated drive letter to the directory from which Vterm was started.

7.2. XLOAD

XLOAD.COM is a simple program for transferring files from the host PC to the flash disk or RAM. The transmission protocol Xmodem is used. After the call

xload *[com port] file*

Xload waits until the data transfer is started on the host side.

7.3. XSEND

XSEND.COM is a simple program for transferring files from the Panel-PC to the host. The transmission protocol Xmodem is used. After the call

xsend *[com port] file*

receipt must be started on the host side.

7.4. ZTRANS

ZTRANS.EXE offers extended functionality beyond Xsend and Xload, in particular the transmission of the file name as well as the transmission of several files with one command. The underlying protocol is Zmodem. This is not supported by VTERM. A Zmodem-capable terminal program (e.g. Windows HyperTerminal) must be used instead, or Ztrans must also be started on the host.

Call: ***ztrans*** *[/R] [/Bn] [/Cn] [/?] <file(s)>*

Options:

/R	Receive instead of send

/Bn	Set baud rate
/Cn	Select interface
/?	Help

Wildcards are possible in <*file(s)*>.

7.5. MATRIX

MATRIX.EXE permits assigning arbitrary key codes to a matrix keyboard. The program can also be used for changing an already existing key assignment.

MATRIX.EXE is best used with a PC keyboard attached to the Panel-PC. First, the program prompts you for the SHIFT key assignment. Then further assignments are made by pressing the key on the matrix keyboard and then – on the PC keyboard – pressing the key to be assigned.

The key assignment is stored in a file named MKBD.COM. After restart of the computer the new key assignment is activated by starting this program. The call can, of course, be made in AUTOEXEC.BAT.

8. Libraries

8.1. Special Functions

These include functions for the following purposes:

- Linear access to the flash memory (without consideration for the flash file system; thus to be employed with caution)
- Activation and resetting of the Watchdog
- Reading of the serial number
- Voltage monitoring by means of NMI
- Setting of clock rate, stopping of the CPU
- EEPROM reading and writing
- LCD contrast settings
- Settings for matrix keyboard
- Touchscreen

The above functions are part of the BIOS and use Int 15h as the programming interface. For C programs the PANELPC.C file must also be compiled and linked.

8.2. Graphic Functions

Since the Panel-PC's LCD controller is not PC-compatible, various basic graphic routines are provided in the libraries GRF_B.LIB (for Borland C), GRF_M.LIB (for Microsoft C) and GRFLIB.TPU (Turbo-Pascal).

The functions are designed to use normal PC display output when Panel-PC programs are started on a normal PC. This simplifies the testing of user applications.

9. BIOS Reference

9.1. INT 10h - Video Service

9.1.1. INT 10h Function 00h - Set Video Mode

Call: AH = 00h
AL = Video Mode

Return: none

Description: Used on the Panel-PC for producing the default screen condition (to clear the screen, as well as to switch into text mode, if graphic mode was active).

9.1.2. INT 10h Function 02h - Set cursor position

Call: AH = 02h
DH = line
DL = column

Return: none

Description: Changes the cursor position.

9.1.3. INT 10h Function 03h - Get current cursor position

Call: AH = 03h

Return: AX = 00h
DH = line
DL = column

Description: Queries the current cursor position.

9.1.4. INT 10h Function 06h - Scroll current page up

Call: AH = 06h
AL = number of lines (0 = clear entire screen)
BH = color attribute for new lines
CH/CL = upper left corner of the display area
DH/DL = lower right corner the display area

Return: none

Description: Shifts a text screen range upward.

9.1.5. INT 10h Function 07h - Scroll current page down

Call: AH = 07h

Return: none

Description: Not implemented on the Panel-PC.

9.1.6. INT 10h Function 09h - Write Char/Attribute to Screen

Call:
AH = 09h
AL = character
BL = color attribute
CX = number of characters

Return: none

Description: The character is output CX times with the indicated color attribute. The cursor position is not changed. Differently than on a normal PC, the color attribute applies to all following output of functions 00h, 0Ah and 0Eh.

9.1.7. INT 10h Function 0Ah - Write character to screen

Call:
AH = 0Ah
AL = character
CX = number of characters

Return: none

Description: The character is output CX times. The cursor position is not changed.

9.1.8. INT 10h Function 0Eh - Write Teletype to screen

Call:
AH = 0Eh
AL = character

Return: none

Description: The character in AL is output, whereby control characters such as CR, LF, FF, and BS are interpreted. This is the fastest way to send a character, since escape sequences do not have to be sent.

9.2. INT 11h - Equipment Check Service

Call: none

Return: AX = contents of 40:10h

Bits 15 -14	= Number of printers
Bits 13 - 12	= Reserved
Bits 11 - 9	= Number of diskettes
Bit 8	= Reserved
Bits 5 - 4	= Video mode
Bit 3	= Reserved
Bit 2	= Mouse installed
Bit 1	= Coprocessor
Bit 0	= Boot disk available

Description: This function returns the contents of memory cell 40:10h.

9.3. INT 12h - Memory size

Call: none

Return: AX = contents of 40:13h

Description: This function returns the contents of memory cell 40:13h. This indicates available memory in kilobytes.

9.4. INT 13h - Disk Services

Since the Panel-PC flash disk is organized like a hard drive, the following also applies to it.

9.4.1. INT 13h Function 01h - Read Disk Status

Call:	AH	= 01h
	DL	= drive (0 or 1)
Return:	AH	= 0 no error = otherwise error code
	CF	= 0 no error = 1 error
Description:	Reads out the last error code and resets it.	

9.4.2. INT 13h Function 02h - Read Disk Sectors

Call:	AH	= 02h
	AL	= Number of sectors
	CH	= Track
	CL	= Sector
	DH	= Head
	DL	= Drive (0 or 1)
	ES:BX	= Pointer to sector buffer
Return:	AH	= 0 no error = otherwise error code
	AL	= number of sectors read
	CF	= 0 no error = 1 error
Description:	Reads the given number of sectors into a buffer.	

9.4.3. INT 13h Function 03h - Write Disk Sectors

Call:	AH	= 03h
	AL	= Number of sectors
	CH	= Track
	CL	= Sector
	DH	= Head
	DL	= Drive (0 or 1)
	ES:BX	= Pointer to sector buffer
Return:	AH	= 0 no error = otherwise error code
	AL	= Number of sectors written
	CF	= 0 no error = 1 error
Description:	Writes the given number of sectors to the drive. This function is only valid for the RAM disk.	

9.4.4. INT 13h Function 08h - Read Drive Parameter

Call:	AH	= 08h
	DL	= Drive (0 or 1)
Return:	AX	= 0
	CH	= last track
	CL	= last sector
	DH	= number of heads
	DL	= bumber of drives installed
	ES:DI	= pointer to Diskette Parameter Table
	CF	= 0 no error
		= 1 error

Description: This function returns a drive's parameters.

9.5. INT 14h - Serial Services

9.5.1. INT 14h Function 00h - Initialize Serial Adapter

Call: AH = 00h
AL = Parameter
Bits 7 - 5 = Baud rate
000 - 110 baud
001 - 150 baud
010 - 300 baud
011 - 600 baud
100 - 1200 baud
101 - 2400 baud
110 - 4800 baud
111 - 9600 baud
Bits 4 - 3 = Parity
00 - None
01 - Odd
10 - None
11 - Even
Bit 2 = Stop bits
0 - 1 Stop bit
1 - 2 Stop bits
Bit 1 - 0 = Data length
10 - 7 Bits
11 - 8 Bits
DX = Com Port (0 - 3)

Return: AH = Line status

Description: A COM port can be initialized with this function. Only valid for COM2 to COM4.

9.5.2. INT 14h Function 01h - Send Character

Call: AH = 01h
AL = Character to send
DX = Com port (0 - 3)

Return: AL = Sent character
AH = Line status
Bit 7 = 1 Timeout error
Bit 6 = 1 Transmit shift register empty
Bit 5 = 1 Transmit buffer register empty
Bit 4 = 1 Break
Bit 3 = 1 Framing error
Bit 2 = 1 Parity error
Bit 1 = 1 Overrun error
Bit 0 = 1 Data ready

Description: Sends a character.

9.5.3. INT 14h Function 02h - Receive Character

Call:
AH = 02h
DX = Com Port (0 - 3)

Return:
AL = Received character
AH = Line status

Bit 7	= 1 Timeout error
Bit 6	= 1 Transmitter shift register empty
Bit 5	= 1 Transmitter hold register empty
Bit 4	= 1 Break
Bit 3	= 1 Framing error
Bit 2	= 1 Parity error
Bit 1	= 1 Overrun error
Bit 0	= 1 Receive data ready

Description: Receives a character. A timeout occurs after approx. 1 second. The serial interfaces are operated with interrupts or in polling mode depending upon the setting in the BIOS Setup.

9.5.4. INT 14h Function 03h - Com Port Status

Call:
AH = 03h
DX = Com port (0 - 3)

Return:
AH = Line status

Bit 7	= 1 Timeout error
Bit 6	= 1 Shift register empty
Bit 5	= 1 TxD register empty
Bit 4	= 1 Break
Bit 3	= 1 Framing error
Bit 2	= 1 Parity error
Bit 1	= 1 Overrun error
Bit 0	= 1 Data ready

Description: Queries the status of a Com port.

9.5.5. INT 14h Function 04h - Extended Init

Call:

AH	= 04h	
BH	= Parity	
	00h	= no parity
	01h	= odd parity
	02h	= even parity
BL	- Stop bits	
	00h	= 1 stop bit
	01h	= 2 stop bits
CH	- Data length	
	02h	= 7 bits
	03h	= 8 bits
CL	- Baud rate	
	00h	= 110 baud
	01h	= 150 baud
	02h	= 300 baud
	03h	= 600 baud
	04h	= 1200 baud
	05h	= 2400 baud
	06h	= 4800 baud
	07h	= 9600 baud
	08h	= 19200 baud
	09h	= 38400 baud
	0Ah	= 57600 baud
	0Bh	= 115200 baud
DX	= Com Port (0 - 3)	

Return: AH = Line status

Description: Initialization of a serial interface. This function permits higher baud rates than Function 00h.

9.6. INT 15h - System Services

9.6.1. INT 15h Function 24h - A20 Gate Control

9.6.2. INT 15h Function 87h - Move Memory Block

9.6.3. INT 15h Function C0h - Get System Config Table

Call: AH = C0h

Return:

AH	= 00h
ES:BX	= Address of System Config Table

Description: This function returns the address of the System Configuration Table.

9.7. INT 15h Function C3h - Functions Specific to the Panel-PC

9.7.1. INT 15h Function C301h – Activate Watchdog

Call: AH = C3h
AL = 01h
BL = time constant for Watchdog in timer ticks (integer, multiple of 55 ms)

Return: none

Description: After this function is called, the Watchdog must be reset within the given time constant; otherwise a reset is generated.

9.7.2. INT 15h Function C302h – Reset Watchdog

Call: AH = C3h
AL = 02h

Return: none

Description: Calling this function prevents the Watchdog from resetting the Panel-PC for the duration of the Watchdog's time constant (see Function C301).

9.7.3. INT 15h Function C303h – Disable NMI

Call: AH = C3h
AL = 03h

Return: none

Description: Prevents the call of an NMI (Non-Maskable Interrupt). An NMI can be triggered on the Panel-PC only by the MAX933 power supervisor chip (IC5). This indicates an unstable supply voltage has fallen below a certain threshold.

9.7.4. INT 15h Funktion C304h – Activate NMI

Call: AH = C3h
AL = 04h

Return: none

Description: Makes NMI calls possible. When the Panel-PC boots, NMI is at first disabled and can be enabled by a user program.

9.7.5. INT 15h Function C312h – Put CPU in Idle Mode

Call: AH = C3h
AL = 12h
DL = *Speed*

Description: The 386EX's internal peripherals (timers and UARTs in particular) keep running. Return from idle mode is only through hardware interrupt.

9.7.6. INT 15h Function C313h – Put CPU in Stop Mode

Call: AH = C3h
AL = 13h

Description: The 386EX's internal peripherals are stopped. Return from stop mode is only by external hardware interrupt (thus by interrupts from the timers, COM1 or COM2, or through additional peripherals attached to the Panel-PC via the PIF bus or I/O connections).

9.7.7. INT 15h Function C320h – Read EEPROM

Call: AH = C3h
AL = 20h
BH = Address in EEPROM

Return: AL = Data byte

Description: This function reads the EEPROM data byte at the given address.

9.7.8. INT 15h Function C321h – Write EEPROM

Call: AH = C3h
AL = 21h
BH = Address in EEPROM
BL = Data byte

Description: This function writes a data byte to the EEPROM at the given address.

9.7.9. INT 15h Function C330h – Query Digital Serial Number

Call: AH = C3h
AL = 30h
ES:BX = Far pointer to the six bytes in RAM where the serial number function is stored

Return: Serial number

Description: This function reads the six bytes of the Panel-PC's serial number IC. Each instance of the serial number IC is programmed by the manufacturer with its own unique serial number.

9.7.10. INT 15h Function C342h – Adjust LCD Contrast Darker

Call: AH = C3h
AL = 42h

Return: none

9.7.11. INT 15h Function C343h – Adjust LCD Contrast Brighter

Call: AH = C3h
AL = 43h

Return: none

9.7.12. INT 15h Function C350h – Deactivate Matrix Keyboard

Call: AH = C3h
AL = 50h

Return: none

9.7.13. INT 15h Function C350h – Activate Matrix Keyboard

Call: AH = C3h
AL = 51h

Return: none

9.7.14. INT 15h Function C351h – Matrix Keyboard: Get Allocation Table

Call:	AH	= C3h
	AL	= 52h
Return:	ES:BX	= Pointer to Keyboard Table

9.7.15. INT 15h Function C352h - Matrix Keyboard: Set Allocation Table

Call:	AH	= C3h
	AL	= 53h
	ES:BX	= Pointer to Keyboard Table
Return:	none	

9.7.16. INT 15h Function C360h – Activate Touch Panel

Call:	AH	= C3h
	AL	= 60h
Return:	none	

9.7.17. INT 15h Function C361h - Deactivate Touch Panel

Call:	AH	= C3h
	AL	= 61h
Return:	none	

9.7.18. INT 15h Function C362h – Touch Panel: Test if Pressed

Call:	AH	= C3h
	AL	= 62h
Return:	AL	= 0 Touch Panel not pressed
	AL	≠ 0Touch Panel pressed

9.7.19. INT 15h Function C363h – Read Touch Panel

Call:	AH	= C3h
	AL	= 63h
Return:	AX	= X value
	BX	= Y value

9.7.20. INT 15h Function C364h – Read Touch-Panel Average

Call:	AH	= C3h
	AL	= 64h
Return:	AX	= X value
	BX	= Y value

Description: In order to obtain a higher accuracy in reading the touch panel, this function returns the average value of 16 consecutive read operations.

9.8. INT 16h - Keyboard Service

9.8.1. INT 16h Function 00h – Read Keyboard Input

Call:	AH	= 00h
Return:	AH	= Scan-code extended keys
	AL	= Key value
Description:	This function reads in a key. Only some extended keys are supported, since ANSI escape sequences are used (see appendix).	

9.8.2. INT 16h Function 01h – Read Keyboard Status

Call:	AH	= 01h
Return:	ZF	= 1 – No character available
		= 0 – Character available
Description:	Ascertains whether a character is in the keyboard buffer. Unlike on a normal PC, the character itself is not returned.	

9.9. INT 17h – Parallel Service

9.9.1. INT 17h Function 00h – Print Character

Call:	AH	= 00h
	AL	= Character
	DX	= LPT port (0 - 2)
Return:	AH	= Printer status
	Bit 7	= 1 Printer not in use
	Bit 6	= 1 Acknowledgment
	Bit 5	= 1 Out of paper
	Bit 4	= 1 Printer selected
	Bit 3	= 1 Printer error
	Bit 2 - 1	= Reserved
	Bit 0	= Timeout error
Description:	Prints a character.	

9.9.2. INT 17h Function 01h - Initialize Printer

Call:	AH	= 01h
	DX	= LPT Port (0 - 2)
Return:	AH	= Printer status
	Bit 7	= 1 Printer not in use
	Bit 6	= 1 Acknowledgment
	Bit 5	= 1 Out of paper
	Bit 4	= 1 Printer selected
	Bit 3	= 1 Printer error
	Bit 2 - 1	= Reserved
	Bit 0	= Timeout error
Description:	Resets the printer.	

9.9.3. INT 17h Function 02h - Get Printer Status

Call:	AH	= 02h
	DX	= LPT Port (0 - 2)
Return:	AH	= Printer status
	Bit 7	= 1 Printer not in use
	Bit 6	= 1 Acknowledgment
	Bit 5	= 1 Out of Paper
	Bit 4	= 1 Printer selected
	Bit 3	= 1 Printer error
	Bit 2 - 1	= Reserved
	Bit 0	= Timeout error

Description: Returns the status of the printer.

9.10. INT 18h - Boot Failure

Description: This function is triggered after an unsuccessful boot attempt.

9.11. INT 19h - Boot System

Description: This function is triggered after a complete initialization of the BIOS. It attempts to boot from a diskette, and to start the operating system. If this fails, an INT 18h is carried out.

9.12. INT 1Ah - Time of Day Service

9.12.1. INT 1Ah Function 00h – Read System Timer

Call:	AH	= 00h
Return:	AH	= 00h
	AL	= 24h Overrun flag
	CX:DX	= System ticks since midnight

Description: Reads the system timer, which is incremented 18.2 times per second.

9.12.2. INT 1Ah Function 01h – Set System Timer

Call:	AH	= 01h
	CX:DX	= System ticks since midnight
Return:	AH	= 00h

Description: Sets the system timer, which is incremented 18.2 times per second.

9.12.3. INT 1Ah Function 02h – Read Real Time Clock

Call:	AH	= 02h
Return:	AH	= 00h
	AL	= Hours BCD
	CH	= Hours in BCD
	CL	= Minutes in BCD
	DH	= Seconds in BCD

Description: Reads the RTC when available.

9.12.4. INT 1Ah Function 03h – Set Real Time Clock

Call:
AH = 03h
AL = Hours in BCD
CH = Hours in BCD
CL = Minutes in BCD
DH = Seconds in BCD

Return: AH = 00h

Description: Sets the RTC when available.

9.12.5. INT 1Ah Function 04h – Read RTC Date

Call: AH = 04h

Return:
CH = Century (19 or 20)
CL = Year
DH = Month
DL = Day

Description: Reads the date from the RTC when available.

9.12.6. INT 1Ah Function 05h – Set RTC Date

Call:
AH = 05h
CH = Century (19 or 20)
CL = Year
DH = Month
DL = Day

Return: none

Description: Sets the date for the RTC when available.

9.12.7. INT 1Ah Function 06h – Set / Enable RTC Interrupt

Call:
AH = 06h
CH = Hour
CL = Minute
DH = Second

Return: Carry flag = 0: O.K.

Carry flag = 1: Battery is empty or an interrupt is already programmed.

Description: The real-time clock generates an interrupt at the programmed time on the same day. This is an impulse of approximately 10…40ms duration. The user program can set the 4Ah interrupt vector to a function of the program, which will then be called every time the RTC IRQ is activated. If this interrupt is only used to return from power-down mode, linking of the 4Ah interrupt is not necessary.

The values for hour, minute and second must be coded in BCD. Only one single interrupt time is valid at any time. If an interrupt time is already programmed, it must first be disabled with Function 07h.

9.12.8. INT 1Ah Function 07h – Disable RTC Interrupt

Call: AH =07h

Return: none

Description: This function deletes a programmed interrupt time. RTC interrupts will no longer be generated. This function must also be called whenever you wish to change the interrupt time. Only after calling this function can you program a new time with function 06h.

9.12.9. INT 1Ah Function 08h – Synchronize System Timer

Call: AH - 08h

Return: none

Description: Synchronizes the system timer to the contents of the Real-Time Clock.

9.13. INT 1Bh to 1Fh

These interrupt vectors point not to an executable function, but to various BIOS tables.

9.14. INT 5Fh – flash Services

9.14.1. INT 5Fh Function 00h – Erase flash Block

Call:
AH = 00h
DX:DI = 32-Bit Block start address
= 32-Bit flash start address + 20000h * Block-No.
or = 32-Bit flash start address + 10000h * Block-No.
depending upon whether one or two flash ICs are equipped.

Return:
Carry flag = 0: no error
Carry flag = 1: error

Description: (See also Function 02h). Deletes a 128kB or 64kB flash block.

9.14.2. INT 5Fh Function 01h – Read flash Block

Call:
AH = 01h
DX:DI = 32-bit source address (first byte to be read)
= flash start address + 20000h*Block-No.+ Offset
ES:BX = Target address
CX = Number of bytes to be read

Return:
Carry-Flag = 0: No error
Carry-Flag = 1: Error

Description: "Offset" indicates the start address relative to the beginning of the block. The source address is a 32-bit address since the flash memory is addressed in protected mode. The target address (in RAM) is an address in real mode, thus in the form *Segment:Offset*. The flash start address depends on the configuration: 1 MB: 3F00000h, 2 MB: 3E00000h, 4 MB: 3C00000h, 8 MB: 3800000h. If only one flash component is equipped, the source address must be given as 10000h instead of 20000h, since the blocks are then only 64KB in size.

9.14.3. INT 5Fh Function 02h – flash Write Block

Call:
AH = 02h
DX:DI = 32-bit target address
ES:BX = Source address
CX = Number of bytes to be written

Return:
Carry Flag = 0: No error
Carry Flag = 1: Error

Description: (See also Function 02h). This function does not execute an erase operation. If the range to be written is not clear, the function returns an error.

9.14.4. INT 5Fh Function 03h – flash Erase and Write Block

Call:
AH = 03h
DX:DI = 32-bit target address
ES:BX = Source address
CX = Number of bytes to be written

Return:
Carry Flag = 0: No error
Carry Flag = 1: Error

Description:
(See also Function 02h). The affected flash block is erased before being written to.

9.14.5. INT 5Fh Function 04h – Read flash Chip and Manufacturer ID

Call:
AH = 04h
DX:DI = 32-bit source address = 03F0:0000
ES:BX = Target address

Return:
Carry Flag = 0: No error
Carry Flag = 1: Error

Description:
Reads out the flash-IC's ID code.
29F032: 41
29F016: AD
29F080: D5
29F800: 22D6
29F160:
29F320:
Manufacturer: AMD: 01

10. Connectors on the Panel-PC Circuit Board

10.1. Overview

No.	Description	Connector	Remark
X1	PIF bus	26-pin female header (socket connector)	PIF-card slot
X2	PIF card I/O	26-pin female header	PIF-card slot
X3	COM1	10-pin shroud male header	RS232
X4	COM4	10-pin shroud male header	RS232
X5	JTAG interface	6-pin single pin row	for Service/Diagnostic
X6	I2C bus	4-pin single pin row	
X7	IDE (2.5" hard drive)	44-pin pin row	2mm spacing
X8	Diskette drive	34-pin shroud male header	
X9	LPT (printer)	26-pin shroud male header	
X10	COM2	10-pin shroud male header	TTL-level
X11	COM3	10-pin shroud male header	TTL-level
X12	ISP interface	6-pin shroud male header	for Service/Diagnostic
X13	Power supply	Screw clamps	5V output for peripherals
X14	LCD	14-pin flat ribbon cable slot	1.25mm spacing
X15	COM5	10-pin shroud male header	TTL-level
X17	PIF bus	26-pin shroud male header	for external PIF cards
X18	High voltage for LCD backlight	4-pin single pin-row	
X19	Keyboard socket	Mini-DIN or PS2	
X21	Keyboard socket	5-pin DIN-socket	
X22	Unregulated power supply	Screw clamps	DC 7...40V
X23	Power supply (5V)	4-pin single pin-row	for external backlight converter
X24	Matrix keyboard	20-pin shroud male header	

10.2. PIF (X1 and X17)

Pin	Signal	Pin	Signal
1	GND	2	GND
3	VCC	4	n. c.
5	/WR	6	/RD
7	/CS0	8	A0
9	A1	10	/Reset
11	D0	12	D1
13	D2	14	D3
15	D4	16	D5
17	D6	18	D7
19	/Ready	20	A2
21	A3	22	/CS1
23	/CS2	24	/CS3
25	/INT	26	GND

10.3. PIF Card I/O (X2)

Pin	Signal	Pin	Signal
1	VCC	2	/DSR COM1
3	/RI COM1	4	RxD COM1
5	TxD COM1	6	/DTR COM1
7	/RTS COM1	8	/CTS COM1
9	/DCD COM1	10	GND
11	Timer 2 Gate	12	Timer 2 Out
13	Timer 2 Clock	14	Timer 1 Out or I/O
15	IRQ9	16	IRQ13 or Timer 1 Clock
17	Timer 0 Out or I/O	18	Clock-Out (66MHz)
19	/RTC-Interrupt	20	IRQ1 or I/O
21	IRQ6 or I/O	22	IRQ7 or I/O
23	VUNST	24	VBATT
25	/Reset (unbuffered)	26	GND

10.4. COM 1 (X3) and COM4 (X4) – RS232 Level

Pin	Signal	Pin	Signal
1	/DCD	2	/DSR
3	RXD	4	/RTS
5	TXD	6	/CTS
7	/DTR	8	/RI
9	GND	10	GND

This pinout corresponds to the mechanical arrangement of a DSUB-9 connector. Therefore a suitable adaptor cable can be easily made using the insulation displacement version of a DSUB connector and a flat ribbon cable. Note: many typical PC adaptor cables use a one-to-one correlation to the pin numbering instead, which will not work in our case due to the different numbering scheme of the DSUB connector.

10.5. COM 2 (X10) and COM3 (X11) – TTL Level

Pin	Signal	Pin	Signal
1	VCC	2	/DSR
3	/RI	4	RXD
5	TXD	6	/DTR
7	/RTS	8	/CTS
9	/DCD	10	GND

The pinout corresponds to that of taskit's IF modules.

10.6. Matrix Keyboard (X24)

Pin	Signal	Pin	Signal
1	GND	2	VCC
3	Row 8	4	Row 7
5	Row 6	6	Row 5
7	Row 4	8	Row 3
9	Row 2	10	Row 1
11	Column A	12	Column B
13	Column C	14	Column D
15	Column E	16	Column F
17	Column G	18	Column H
19	GND	20	VCC

10.7. I2C Bus (X6)

Pin	Signal
1	VCC
2	SDA
3	SCL
4	GND

10.8. Touch Screen (X16)

Pin	Signal
1	Y-
2	Y+
3	X-
4	X+

10.9. LCD (X14)

Pin	Signal
1	XD0
2	XD1
3	XD2
4	XD3
5	YDIS
6	YD
7	n.c.
8	LP
9	XSCL
10	VDD (VCC, 5V)
11	VSS (GND)
12	VEE (-22V)
13	V0 (Contrast Reg.)
14	VSS (GND)

10.10. LCD-Backlight (X18)

Pin	Signal
1	Backlight A
2	n.c.
3	n.c.
4	Backlight B

Note: The LCD Backlight connection carries high voltage (about 1000V at 40 kHz in no-load operation). Because of the high frequency and low output power, this is actually harmless. Contact should be avoided nevertheless.

10.11. JTAG

PIN	Signal
1	VCC
2	TDI
3	TDO
4	TCK
5	TMS
6	GND

11. I/O-Adressen

Port Address	Function
000h - 00Fh	DMA Controller *
020h - 021h	1. Interrupt Controller (Master)
022h - 023h	386EX Control Register
040h - 043h	Timer
080h - 083h	DMA Page Register *
092h	A20-Gate, CPU Reset
0A0 - 0A1	2. Interrupt Controller (Slave)
1F0h - 1FFh	Harddisk Controller (IDE)
220h - 22Fh	Config Register (administered by BIOS)
230h - 23Fh	LCD Controller (SED1335FOA)
2F8h - 2FFh	COM2
300h - 30Fh	PIF CS0
310h - 31Fh	PIF CS1
320h - 32Fh	PIF CS2
330h - 33Fh	PIF CS3
378h – 37Fh	LPT (SPP/EPP)
3E8h – 3EFh	COM3
3F0h - 3F7h	Floppy Controller
3F8h - 3FFh	COM1
400h – 4FFh	LPT (ECP)
F000h – FFFFh	386EX Peripherals
F8F8h – F8FFh	COM4 *
F870h	I/O-Port Input
F872h	I/O-Port Output

* COM4's "incompatible" I/O address results from the fact that, as part of the 386EX processor, it can use only this or the address 2f8h (chip-internal definition). The address 2f8h should however remain reserved for one of the two more efficient interfaces of the SMC37C669 multi I/O controller.

12. Interrupt Table

Vector	Address	Use	Source
00	0000	Divide by Zero Exception	386EX core
01	0004	Single Step Trap	386EX core
02	0008	Non-Maskable Interrupt (NMI)	external hardware
03	000C	Breakpoint Trap	386EX core
04	0010	Overflow Exception	386EX core
05	0014	Bounds Fault Exception	386EX core
06	0018	Invalid Opcode Exception	386EX core
07	001C	Coprocessor Unavailable Exception	386EX core
08	0020	IRQ0 - Timer 0 (System Timer)	386EX peripherals
09	0024	IRQ1 – Touch Panel or PIF I/O	external hardware
0A	0028	Reserved	BIOS
0B	002C	IRQ3 – COM2 or COM4	386EX peripherals
0C	0030	IRQ4 – COM1	386EX peripherals
0D	0034	IRQ5 – PIF bus	external hardware
0E	0038	IRQ6 – Diskette Controller or PIF I/O	external hardware
0F	003C	IRQ7 – COM3 or LPT or PIF I/O otherwise Spurious Interrupt	external hardware / 386EX peripherals
10	0040	Video Functions	BIOS
11	0044	Equipment Check	BIOS
12	0048	RAM Size	BIOS
13	004C	Disk	BIOS
14	0050	COM	BIOS
15	0054	Special Panel-PC Functions	BIOS
16	0058	Keyboard	BIOS
17	005C	LPT	BIOS
18	0060	Boot failure	BIOS
19	0064	Boot loader	BIOS
1A	0068	Date/Time	BIOS
1B	006C	Reserved	BIOS
1C	0070	Timer 0 User Function	BIOS
1D	0074	Reserved	BIOS
1E	0078	Disk Parameter Table	BIOS
1F	007C	Reserved	BIOS
20 - 3F	0080 - 00FC	Reserved for BIOS	DOS
40 – 49	0100 - 0124	Reserved for BIOS	BIOS
4A	0128	RTC User Function	BIOS
4B – 5E	012C - 0178	Reserved for BIOS	BIOS
5F	017C	flash Functions	BIOS
60-6F	0180-01BC	available	available for use
70	01C0	IRQ8 – Real-time Clock (RTC)	external hardware
71	01C4	IRQ9 – Keyboard Controller	external hardware
72	01C8	IRQ10 – Timer 1	386EX peripherals
73	01CC	IRQ11 – Timer 2	386EX peripherals
74	01D0	IRQ12 – DMA	386EX peripherals
75	01D4	IRQ13 – available for use	external hardware
76	01D8	IRQ14 – DIE	external hardware
77	01DC	IRQ15 – 386EX Watchdog Timer	386EX peripherals
78-FF	01E0-03FC	available	available for use

13. Default I/O Addresses

of PIF Cards and PIF Modules

Chip Select	I/O Address	PIF Module or PIF Card		
CS0	300 301 302 303 304 305 306 307 308 309 30A 30B	PIF-IDE	PIF-SDISK	
	30C 30D 30E 30F	PIF-SIO/LPT LPT		
CS1	310 311 312 313	PIF-PIO		
	314 315 316 317	PIF-ADC12/6CH		
	318 319 31A 31B	PIF-LCD-BASE LCD-PIO		
	31C 31D 31E 31F	PIF-LCD-BASE KEY-PIO		

Default I/O Addresses of PIF Cards and PIF Modules (cont.)

<table>
<tr><td rowspan="16">CS2</td><td>320
321</td><td rowspan="2">PIF-SIO</td><td rowspan="10"></td><td rowspan="16">PIF-Ethernet</td></tr>
<tr><td>322
323</td><td rowspan="2"></td></tr>
<tr><td>324
325
326
327</td><td rowspan="3">PIF-TIMER</td></tr>
<tr><td>328
329</td><td rowspan="2">PIF-LPT</td></tr>
<tr><td>32A
32B</td><td rowspan="3"></td></tr>
<tr><td>32C</td><td rowspan="4">PIF-TIMER-I/O</td></tr>
<tr><td>32D</td><td>PIF-I/O-24V</td></tr>
<tr><td>32E</td><td>PIF-RELAIS/230VAC</td></tr>
<tr><td>32F</td><td>PIF-RELAIS/24VDC</td></tr>
</table>

<table>
<tr><td rowspan="16">CS3</td><td>330
331
332
333
334
335
336
337</td><td rowspan="8">PIF-SIO/LPT
SIO-1 = COM4</td><td rowspan="8"></td><td rowspan="16">PIF-Ethernet</td></tr>
<tr><td>338
339</td><td rowspan="8">PIF-SIO/LPT
SIO-0 = COM3</td><td>PIF-LPT</td></tr>
<tr><td>33A
33B
33C
33D
33E
33F</td><td rowspan="7"></td></tr>
</table>