

Technical Information

Operating Instructions

**DCF77 PCI509**

## **Impressum**

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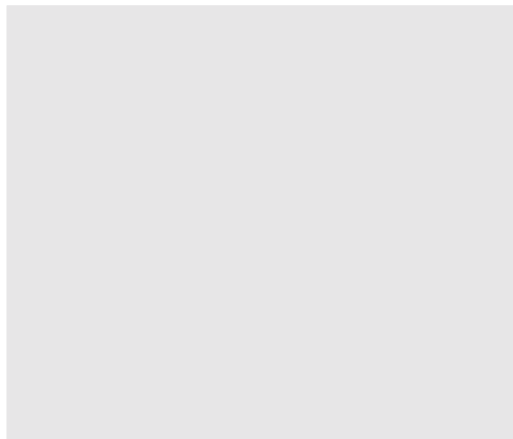
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**Driver Diskette for DOS/Windows**



## General Information about DCF77

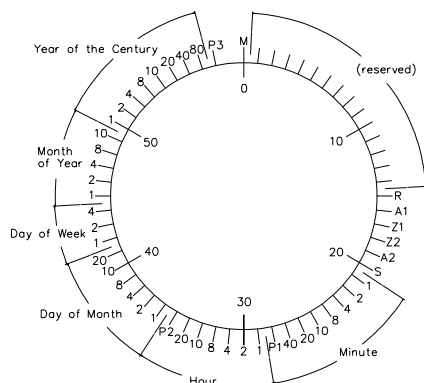
The radio clocks made by Meinberg receive the signal from the long wave transmitter DCF77. This long wave transmitter installed in Mainflingen near Frankfurt/Germany transmits the reference time of the Federal Republic of Germany. This time reference is either the Central European Time (Mittleuropäische Zeit, MEZ) or the Central European Summer Time (Mittleuropäische Sommerzeit, MESZ). The transmitter is controlled by the atomic clock plant at the Federal Physical Technical Institute (PTB) in Braunschweig/Germany and transmits the current time of day, date of month and day of week in coded second pulses. Once every minute the complete time information is available.

At the beginning of every second the amplitude of the high precision 77.5 kHz carrier frequency is lowered by 75% for a period of 0.1 or 0.2 sec. The length of these time marks represent a binary coding scheme using the short time mark for logical zeroes and the long time mark for logical ones. The information on the current date and time as well as some parity and status bits can be decoded from the time marks of the 15th up to the 58th second every minute. The absence of any time mark at the 59th second of a minute signals that a new minute will begin with the next time mark.

Our radio clocks decode the highly accurate information on date and time within a wide range around Germany. So some of our clocks are installed in Bilbao/Spain as well as in the city of Umeå in northern Sweden - fully satisfying the requirements of the users. The radio clocks automatically switch to summertime and back. The reception of the time information is free of charge and does not need to be registered.

Generally it is important to position the antenna in an optimal way. It should be mounted at least 30 centimeters away from the clock unit and from solid steel. The antenna should be aligned at a right angle to the direction of the transmitter (Frankfurt).

**Figure: Decoding Scheme**



M	Start of Minute (0.1 sec)
R	RF Transmission via secondary antenna
A1	Announcement of a change in daylight saving
Z1, Z2	Time zone identification
	Z1,Z2 = 0,1: Daylight saving disabled
	Z1,Z2 = 1,0: Daylight saving enabled
A2	Announcement of a leap second
S	Start of time code information (0.2 sec)
P1, P2, P3	Even parity bits

## **Overview**

The radio clock PCI509 is designed to operate in computers with PCI bus. An external ferrit antenna makes the signal from DCF77 available to the on-board long wave receiver. The demodulated time marks are decoded by the clock's microprocessor. If no errors are detected in the current time message an additional plausibility check against the previous time message is performed. If that plausibility check passes, too, the buffered real time clock on the board is synchronized corresponding to the decoded time and date. Optionally, the decoded date and time information can be converted to another time zone. The time zone setting can be modified using the monitor program. The current setting is saved permanently on the radio clock board.

Software running on the computer can read out the date/time/status and some more information. Access to the board is made via writing to/reading from I/O ports. It is possible but not necessary to let the board generate periodic hardware interrupts on the computer bus.

Utility programs supplied with the boards include PCPSDRV.COM, a resident driver (TSR) for DOS/Windows that keeps the computer's system time synchronous to the board time and PCPSINFO.EXE, a status display which simplifies installation. Drivers for OS/2, Windows NT, or NetWare can be ordered separately.

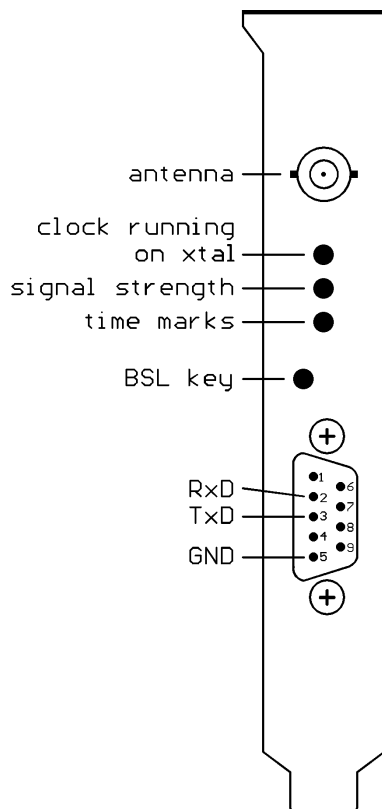
## **Pulse Outputs**

The radio clock PCI509 generates pulses whenever a new second (P\_SEC) or a new minute (P\_MIN) begins. The P\_SEC pulse is available with TTL level (0/+5V) and RS-232 level (-3..12V/+3..12V), the P\_MIN signal with TTL level only. If required, DIL switches can be set up to direct each of the pulses to a corresponding pin of the 9 pin connector in the rear panel.

## Connectors and LEDs in the rear panel

The rear panel includes the antenna connector, three status LEDs, the BSL button, and a 9 pin sub D connector (see figure below). The LEDs let the user check for proper receiver operation. The upper, red LED is on if the clock is running on xtal. This LED can only change when the minute changes (seconds increment from 59 to 0). The brightness of the LED in the middle depends on the strength of the RF signal. The

lower, green LED should be blinking exactly once per second corresponding to the time marks from DCF77. If this LED flashes there is some electrical noise around which prevents the receiver from decoding the time marks and synchronizing. All information given by these LEDs is also available via the monitor program.



The BSL button behind the hole in the slot cover activates the clock's boot strap loader if the clock's firmware shall be updated.

The 9 pin sub D connector is wired to the radio clock's serial port. Pin assignment can be seen from the figure beside. This port can **not** be used as serial port for the computer. Instead, the clock uses the port to send out Meinberg's standard time string in order to control an external display or some other external device. The string is sent out once per second, once per minute or if requested by an incoming ASCII '?'. Is also possible to change the radio clock's board time by sending such a string towards the clock.

Transmission speed, framing, and mode of operation can be modified using the program PCPS-INFO. The string format is described in the section 'Technical Specifications' at the end of this manual.

## Pin Assignments of the 9 Pin Connector

When the clock is being shipped, only the signals needed for the serial port are gated to their pins at the 9 pin connector. If another signal shall be available outside the computer, the corresponding lever of the DIL switch on the board must be set to the **ON** position to connect that signal to its associated pin.

**Whenever an additional signal is connected through to the rear panel, special care must be taken to the configuration of the cable used with the connector. If pins with TTL level and RS-232 levels are connected to each other, the circuits on the board may be damaged.**

The table below shows the assignments of the 9 pin connector and the corresponding levers of the DIL switch:

Pin	Signal	SWITCH
1	+5V	1
2	RxD in (RS-232)	--
3	TxD out (RS-232)	--
4	P_MIN out (TTL)	5
5	GND	--
6	(reserved)	--
7	P_SEC out (RS-232)	3
8	P_SEC out (TTL)	4
9	(reserved)	--

The signals which have no lever of the DIL switch assigned are hard wired to the pins of the connector. All levers of the DIL switch which are not listed in the table are reserved and should remain in the **OFF** position.

## Installing the PCI509 in your Computer

Every PCI board is a plug&play board. After power-up, the computer's BIOS assigns resources like I/O ports and interrupt lines to the board, the user does not need to take care of the assignments. The programs shipped with the board retrieve the settings from the BIOS.

The computer has to be turned off and its case must be opened. The radio clock can be installed in any PCI slot not used yet. The rear plane must be removed before the board can be carefully plugged in. The computer's case should be closed again and the antenna connected to the PCI509's coaxial plug at its rear. After the computer has been restarted, the utility PCPSINFO.EXE should be run in order to position the antenna (see below).



## **Files on the Diskette shipped with the Board**

DATEIEN.TXT	this list of files in German language
LIESMICH.TXT	last changes/modifications in German language
FILES.TXT	this list of files in English
README.TXT	llast changes/modifications in English
PCPSDRV.COM	resident driver (TSR), keeps computer time synchronized with board time
PCPSINFO.EXE	shows the board's and the TSR's status continuously
PPPSTIME.EXE	sets the system time once, does not stay in memory
DRV.EXE	temporarily disables the resident driver
DISP.EXE	enables or disables the permanent date/time window
POSXY.EXE	positions the permanent date/time window on the screen
COLOR.EXE	sets the screen attribute of the permanent date/time window
@6AAC.ADF	Adapter Description File (required for PS31 only)

## **Support for other Operating Systems**

Drivers for the operating systems listed below are optionally available:

**IBM OS/2 v2.1 and above**

**Novell NetWare v3.11 and above**

**Microsoft Windows NT v3.51 and above**

## **Copying the distributed Software to the Hard Disk**

When the computer has come up after power on the utility programs should be copied from the shipped diskette to a subdirectory on the hard disk. Assume the current drive is C: and the new subdirectory is to be created on the current drive, create that subdirectory (e.g. called MEINBERG) using the command

```
MD \MEINBERG
```

from the DOS command line. Make the new subdirectory the current one using the command

```
CD \MEINBERG
```

If the utility diskette is inserted in drive A: use the following command to copy the files and subdirectories from the diskette to the hard disk:

```
XCOPY A:*. * /S
```

## **Using PCPSINFO.EXE**

After the board has been installed in the computer the program **PCPSINFO.EXE** should be run in order to see if the board has been properly installed. This program can display its messages in English or in German language and the date and time in formats used in the USA, the UK, or Germany. The default language and formats used are derived from the DOS country code at startup. If automatic language detection does not yield the desired result, you can force a language and date/time format using a command line parameter or by pressing a function key when the program is running. The command syntax is shown below:

```
PCPSINFO [C:xx] [MONO] [?]
```

Usage of the command line parameters is described below:

**C:xx** Country code override. The default country code to be used is derived from the COUNTRY=... entry in the CONFIG.SYS file.  
xx may be set to 49 (Germany, 24h clock, dd.mm.yy), 44 (U.K, 12h clock, dd/mm/yy) or 1 (USA, 12h clock, mm-dd-yy).

- MONO** Force monochrome display even if color display installed. May increase the readability on LC displays often used with laptops.
- ?** Displays a message how to setup port address and how to use the program. Output can be redirected to printer ( append ">LPT1" to the command line) or file (append ">filename").

All the command line parameters are optional. In most cases the program is started simply by entering **PCPSINFO**. If the board can installed successfully, the screen displays information similar to figure shown below:


```

Meinberg PCPSINFO v4.0 (DOS)                                     11.10.00
Resident Driver                                               11:44:40
-----
Software rev.: PCPSDRV v3.5 (c) Meinberg 2000
User Int.:      61h      Date/Time read:      We, 10-11-2000 11:44:40.27
BUSY Flag:      OFF
DISP Flag:      ON      Tick Reload:      182
Set RTC direct: NO      Tick Counter:      60
-----

Radio Clock
-----
Eprom ID: PCI509 v1.01 (c) Meinberg 2000      Timezone: CET/CEST
S/N:      10000100
Type:     PCI509      Date/Time:      We, 10-11-2000 11:44:40.31 CEST
I/O Port: B400h, B000h      Last sync.:      We, 10-11-2000 11:44:00.00

Status:      ■ Synchronized after last RESET
              ■ Clock is synchronized
              ■ Daylight saving enabled

Serial:      4800,8N1,1 sec

Mod: Signal:
 
-----
Alt-X Exit  Alt-H Help  F1 Sprache  F2 Sound ON  F3 Setup

```

The upper part of the screen shows information about the resident driver (if the driver has been installed). These information include the **ID string of the resident driver** with the driver revision number, the **number of the software interrupt** used to control the resident driver and the **last recent date/time** the driver has read from the board. The number of the user interrupt is determined automatically when the resident driver is installed. It is not affected by the hardware interrupt configured by jumpers.

The **BUSY flag** controls the driver's right to access the board. If the flag is set to **OFF** the driver is allowed to access the board, if it is **ON**, access is inhibited. This flag can be changed from the command line using the utility DRV.EXE or by pressing the **key B** in PCPSINFO. The flag **DISP** affects the resident driver's feature displaying the permanent date/time window on the screen (upper right corner in the screenshot above). It can be altered using the utility DISP.EXE from the command line or by pressing the **key D**. The flag **Set RTC direct** enables the driver to write directly to the computer's real time clock. This feature is required in some special environments only; see the description of PCPSDRV.COM below. The **Tick Counter** counts the

times the driver has been activated by the computer's periodic timer tick interrupt. If this counter is down to zero, the computer's system time is set and the counter is reloaded to the **Tick Reload** value. The tick reload is derived from the update cycle parameter given in the command line when PCPSDRV.COM is installed. The system timer generates 18.2 interrupt per second, so the reload value in the figure above (182) corresponds to an update cycle of 10 seconds.

The lower part of the screen gives information about the board installed in the computer: The **Eprom's ID string**, the **serial number** and **type of the board** and the **port addresses** used by the radio clock. The field labeled **Serial:** shows transmission speed, framing and mode of operation which have been configured for the radio clock's serial interface. The serial interface transmits the date/time/status string known from other Meinberg radio clocks.

The field labeled **Date/Time:** displays the radio clock's current date and time. The line **Last Sync:** shows the time last synchronization has been achieved. If the clock can receive the time signal without errors this field is updated once every minute.

The board's current state is shown in the field **Status:**. The first line shows whether the clock has ever been synchronized with DCF77 since the last power-up or board reset. If there are transient distortions the clock can be temporarily running on XTAL for some minutes which is indicated by the second line. The third line indicates whether daylight saving is currently in effect or not.

The **signal bar** is useful to install the antenna. For best results the antenna should be mounted at least 1 meter from the computer and from solid metal parts. The length of the bar is derived from the receiver's AGC voltage. Because this voltage is limited with a strong signal, the best way to align the antenna is to turn it **slowly** until the bar shows minimum signal, then turn it exactly by 90 degrees to yield the maximum signal.

Exact time marks are much more important than a long signal bar, so the small field labeled **Mod:** reflects the time marks demodulated from the RF signal. This indicator should blink exactly once per second without intermediate flashes. Pressing the key F2 enables the computer's speaker whenever the Mod: field is on.

If the **key F3** is pressed, the **Setup** menu is displayed which lets the user modify some configuration parameters. Depending on the features of the clock it is possible to change the radio clock's date, time, and time zone, the serial port parameters, or some options which are used with GPS clocks only.

Pressing both the keys **Alt** and **X** simultaneously lets this program terminate.

## The resident driver for DOS/Windows

The resident driver PCPSDRV.COM runs with DOS version 2.11 or greater and Windows 3.x. It uses only about 1500 bytes of memory and periodically synchronizes the computer's system time to the board time. Additionally, the driver is able to display the board's time continuously in a window on the text screen. This feature can be enabled and controlled by some of the utility programs (see next chapter).

In order to avoid conflicts accessing the board the driver should not be installed or be temporarily disabled using the utility DRV.EXE if user-written software accesses the board.

If the driver has to be installed every boot time, it should be called from the AUTOEXEC.BAT which should reside in the root directory of the boot drive. Assuming the driver file can be found in the directory MEINBERG on drive C:, a command line like that shown below should be added to the AUTOEXEC.BAT using any text editor:

```
C:\MEINBERG\PCPSDRV [U:xxxx] [I] [R]
```

The optional parameter **U:xxxx** can be used to set the time span to be used for the periodical update of the system time. Valid numbers for xxxx are 1 to 3600 (seconds). If this parameter is omitted the time span defaults to 1800 seconds (= 30 minutes).

The parameter **I** must be given in the command line if the driver shall modify the computer's time just after being installed. In the default case the computer's system time will only be modified when the clock has synchronized at least once after power-up (Status: Synchronized after last Reset). If the clock has to work in an electrically noisy environment or with very low RF signal it can't synchronize very often and it could be recommended that the computer's time is synchronized with the PC32's time before the clock has synchronized with DCF77 (the PC32 offers a more exact time than the computer's system time even when running on XTAL).

The last parameter **R** tells the resident driver to set the real time clock in AT compatible computers directly. This is only required if the DOS/BIOS interrupts which modify the computer's time are redirected by other applications as on Novell Netware 2.xx file servers. In the default case this parameter should not be used in order to minimize the execution time of the resident driver.

If the file AUTOEXEC.BAT does not exist in the root directory yet it can be created using any text editor software or entering the sequence of commands below:

```
COPY CON: AUTOEXEC.BAT  
C:\MEINBERG\PCPSDRV U:10 I  
^Z
```

^Z: Press the keys "CTRL" and "Z" simultaneously.

The command line of the example above installs the driver using the default I/O port base of 300h. The computer's system time will be corrected every ten seconds even if the clock has not synchronized with DCF77.

## **Controlling the Resident Driver**

If the resident driver **PCPSDRV.COM** has been installed, some of the utility programs can be used to control the way it works. The programs described below show a few help lines when they are called without command line parameters.

**DRV.EXE** temporarily disables the resident driver's access to the board.  
Command: DRV ON or DRV OFF  
Default: enabled

**DISP.EXE** enables or disables the date/time window on the screen.  
Command: DISP ON or DISP OFF  
Default: disabled

**COLOR.EXE** sets up the screen attribute of the date/time window  
Command: COLOR fg bg  
with fg and bg the color numbers of the foreground/background  
Default: white characters on black

**POSXY.EXE** sets up the screen position of the date/time window.  
Command: POSXY column row  
Default: upper right corner of the screen

Using these utilities, you can enable or disable the date/time window only when special applications are run.

## Technical Specifications

RECEIVER:	Direct conversion quadrature receiver with automatic gain control Bandwidth: approx. 20Hz
ANTENNA:	Active external ferrite antenna in a plastic case Length of the cable: up to more than 100m  Standard: BNC type connector, 5m of RG174 cable  Outdoor: N type connector, RG58 cable
RF AMPLITUDE, MODULATION:	Indicated by LED and on-screen by utility program
TIMECODE CHECK:	Parity and consistency checking over a period of two minutes RF distortions indicated by both LED and a bit of the status register Without RF signal the clock runs on XTAL with an accuracy of $10^{-6}$ (after 1 day of synchronization)
BATTERY BACKUP:	Lithium battery or Gold Cap when the computer is turned off, the on-board RTC keeps the time based on XTAL for more than 10 years (lithium battery) rsp. 150 hours (gold cap)
RELIABILITY OF OPERATION:	Microprocessor supervisory circuit provides watchdog timer, power supply monitoring and backup-battery switchover
SYSTEM BUS INTERFACE:	compatible to PCI specifications

## CONFIGURABLE

TIME ZONES: Central European Time CET/CEST (default), always CET (no daylight saving time), UTC, East European Time EET/EEST (CET/CEST + 1h)

## SERIAL

INTERFACE: Transmission Speed: 300 through 9600 Baud

Framing: 8N1, 7E2, 8N2, or 8E1

Mode of Operation: send string per second, per minute, after request '?' received

Output String: Meinberg standard time string (described below)

## POWER

REQUIREMENT: +5V @ 80mA

## PHYSICAL

DIMENSION: short PCI expansion board

## AMBIENT

TEMPERATURE: 0 ... 70°C

HUMIDITY: max. 85 %



## **Replacing the Lithium Battery**

The life time of the lithium battery on the board is at least 10 years. If the need arises to replace the battery, the following should be noted:

### **ATTENTION!**

**Danger of explosion in case of inadequate replacement of the lithium battery. Only identical batteries or batteries recommended by the manufacturer must be used for replacement. The waste battery must be disposed as proposed by the manufacturer of the battery.**

## **CE Label**



This device conforms to the directive 89/336/EEG on the approximation of the laws of the Member States of the European Community relating to electromagnetic compatibility.

## Format of the Meinberg Standard Time String

The Meinberg Standard Time String is a sequence of 32 ASCII characters starting with the STX (start-of-text) character and ending with the ETX (end-of-text) character. The format is:

**<STX>D:*dd.mm.yy*;T:*w*;U:*hh.mm.ss*;uvxy<ETX>**

The letters printed in *italics* are replaced by ASCII numbers whereas the other characters are part of the time string. The groups of characters as defined below:

**<STX>** Start-Of-Text (ASCII code 02h)

*dd.mm.yy* the current date:

*dd* day of month (01..31)

*mm* month (01..12)

*yy* year of the century (00..99)

*w* the day of the week (1..7, 1 = Monday)

*hh.mm.ss* the current time:

*hh* hours (00..23)

*mm* minutes (00..59)

*ss* seconds (00..59, or 60 while leap second)

*uv* clock status characters:

*u*: ‘#’ clock has not synchronized after reset  
‘ ‘ (space, 20h) clock has synchronized after reset

*v*: different for DCF77 or GPS receivers:

‘\*’ DCF77 clock currently runs on XTAL  
GPS receiver has not checked its position

‘ ‘ (space, 20h) DCF77 clock is sync'd with transmitter  
GPS receiver has determined its position

*x* time zone indicator:

‘U’ UTC Universal Time Coordinated, formerly GMT

‘ ‘ MEZ European Standard Time, daylight saving disabled

‘S’ MESZ European Summertime, daylight saving enabled

*y* announcement of discontinuity of time, enabled during last hour before discontinuity comes in effect:

‘!’ announcement of start or end of daylight saving time

‘A’ announcement of leap second insertion

‘ ‘ (space, 20h) nothing announced

**<ETX>** End-Of-Text (ASCII code 03h)

# PCI509 Component Layout

