Technical Description

DCF77-System
4465

Safety information

The safety regulations and technical data are important for the smooth running of the devices and the protection of people and equipment. Strict compliance with these regulations is required. In case of non-compliance with these regulations the guarantee and warranty claims for the device and possible consequential damage expire.

Safety of the Devices

The production of this device follows the latest technological standards and safety regulations.

The device must not be assembled by anyone but trained personnel. Please make sure that all the connected cables are laid and fixed properly. The device is to be run with the supply voltage stated on the identification plate only.

Only trained personnel or specialists may operate the device.

Repair on opened devices must not be carried out by anyone but specially trained staff or by the **hopf** company.

If the maintenance work requires the opening of a device or if a fuse needs changing the device must be separated from all voltage supplies.

If there are reasons to believe that the operational safety can no longer be guaranteed the device must be taken out of service and labelled accordingly. The safety may be impaired when the device does not operate properly or if it is obviously damaged.

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1 Brief Information Model 4465

- potential free antenna circuit
- all settings can be parametered via serial interface
- all outputs potential free

We supply you with the snap-in module with DCF77[1] antenna, 10 m antenna cable, 2 m programming cable and configuration software on a 3.5" disc.

The DCF77 radio controlled clock 4465 is most suitable for synchronising industrial processes. The serial interface identifies up to 16 different protocols which are used to synchronise devices by different producers (Siemens, ABB, IBM, H+B, Sun, Digital).

Three built-in optical couplers can, with freely programmable pulses, be used to control SPS or measuring processes. Every optical coupler can carry out one of five output programmes, whereby either cyclic pulses are generated or status information is present at the outputs.

A simulated antenna signal is available to other DCF77 systems.

The following outputs are available:

- serial RS232/RS422 interface (standard)
- serial interface RS232 with TTY interface or PPS-pulse (option)
- DCF77-simulated antenna output
- optical coupler outputs

1.1 Functioning of the DCF77 Transmitter

The DCF77 time code transmitter broadcasts a time signal and time code information on the long wave range of 77.5 kHz. The time information is set to 25% of the standard value by lowering the carrier amplitude (amplitude modulation). The beginning of a lowering marks the beginning of a second. The lowering takes 0.1 sec for a logical "0" and 0.2 sec for a logical "1".

After the 20th second of every minute the BCD values for minutes, hours, day of the week, month and year are transmitted. As synchronisation marker the 59th second is not lowered.

During the first 20 seconds various information like announcement of a changeover, announcement of a leap second and the information of the current time zone are transmitted as unchecked bits.

The broadcasted amplitude does not drop immediately to the 25% value. Due to the high resonant quality of the antenna this values is reached after 600 - 800 μsec.

The inaccuracy of the broadcasted carrier frequency is:

average on 1 day	$< 1 * 10^{-12}$
average over 100 days	$< 1 * 10^{-13}$

As the carrier frequency and the control of the lowering of the carrier have the same source, the above inaccuracy also applies to the beginning of the lowering of the second marker.

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[1] DCF77   = (D) German - (C) Long wave signal - (F) Frankfurt a.M. - (77) Frequency

1.2 Functioning of the DCF77-Decoding

There are 3 independent clocks in the basic system, a DCF77-clock, a crystal clock and a back-up clock. Once the voltage supply is connected, the back-up clock is loaded into the crystal clock, so that a complete time information is instantly available. If the circuit board is without voltage for more than 3 days the time is not taken from the back-up clock because of a deviation of several seconds. The system starts up with naughts in all digits of time and date. The status of the time information is then set to invalid.

The time signal reaches an integrated controllable amplifier via the potential free selective input circuit. The control range is at least 70 dB. The micro-processor uses pulse-width modulation to control the amplification. The pulse width is a measure for the signal field strength at the installation location. The bigger the pulse width the smaller the signal field strength.

There is a an inertialess AM/FM converter behind the signal amplifier. The basic frequency of the FM is about 500Hz when the DCF77-signal is not lowered. When the second is lowered to 25% of the amplitude the FM is also lowered by 25%.

The processor measures the pulse width of every FM frequency oscillation and stores it with the crystal clock in milliseconds. It is traced retrospectively from which oscillation point the pulse width changed. This point is interpreted as the DCF77-second marker.

The achievable accuracy is close to one pulse width - i.e. about ± 2 msec.

The time information is calculated from the position of the different DCF77-second lowerings. At the same time the calculated DCF77-second markers are compared to the internal crystal clock second markers over the span of 1 minute. Tendencies are noticed, e.g. on average the calculated DCF77-second marker is earlier than in the previous minute, i.e. the clock is running slow.

The control values deducted from there are used to adjust the crystal frequency of the VCO and also to adjust the difference of the second marker by ± 10ppm.

Therefore the crystal frequency can be adjusted to ± 2ppm accuracy for the free-running of the clock. It also levels out other distorting influences on the crystal e.g. ageing, temperature influence etc. so that the accuracy stays constant for the whole life span of the system.

The pulse width of the FM-frequency is also used to control the amplification. The average value of the longest and the shortest pulse width must be 25% apart within one second. If the gap between the two values is bigger than 25%, the DCF77-signal has increased - the amplification can therefore be lowered.

After every minute it is checked whether the parity bits in the last read-in DCF77-data string were o.k., whether the data string is one minute ahead of the previous data string. If all parameter are o.k. the time information is taken over into the crystal clock and into the back-up clock. This is indicated in the status by setting the radio bit. If one parameter is not o.k. the whole minute is not decoded, indicated by taking back the radio bit in the status.

The first synchronisation requires 3 subsequent correct minute decodings. The 1st minute is used to synchronise the minute marker, the 2nd and 3rd minutes are used to find the difference between two subsequent DCF77-decoder data strings.

1.3 Sources of Interference

The time code is transmitted in the long-wave-range produced by amplitude modulation, it can therefore be easily disturbed and interfered with. There are many different external sources of interference like e.g. corona discharges at high-voltage lines, atmospheric turbulences i.e. thunderstorms on the way to the receiver. In case of a thunderstorm near the location of the transmitter the broadcasting is stopped for the time of the thunderstorm. This may take several hours.

Internal disturbances on the location of the receiver are usually caused by engines,screens, monitors, switching contacts, shields etc. The place for the antenna must therefore be selected with utmost care.

Apart from the correct choice of the antenna location to suppress disturbances the other possibility is the use of narrow-band receivers.

PLEASE NOTE : NARROW-BAND RECEPTION AND ACCURACY EXCLUDE EACH OTHER.

In case of industrial use we advise avoiding internal disturbances completely by installing an outdoor antenna. This also excludes possible disturbances caused by devices which may be installed at a later date.

1.4 Accuracy of the DCF77-Decoding

Regarding the DCF77-signal we must distinguish between short-term and long-term accuracy. Where the decoded second marker is concerned the usual decoding technique may allow deviations of + 5 to + 150 msec from the absolute time marker. This depends mainly on the antenna and on the used signal filters and detection. Narrow-band antennas and very narrow-band crystal filters are used to suppress disturbances. This causes a long final oscillation time when the signal is lowered. The rectification used to create the pulse delays the accuracy even further.

The accuracy suffices completely for clocks in private homes, where the long-term accuracy is of interest. After one year the second deviation is only + 5 to + 150 msec.

For industrial operations these deviations are often not tolerable. The antenna and also the receiver must be of wide-band design to achieve more precise second markers. Values ranging between + 5 to + 15 msec require band widths of about 4 kHz for the antenna. But this means on the other hand that the antenna sends considerably more disturbances to the electronics and the receiving electronics often cannot decode a minute cycle. Comparing them with the clocks for the home use this liability to disturbances is erroneously interpreted as lack of sensitivity.

As a rule:

Short-term accuracy and high disturbance immunity exclude each other in DCF77.

To achieve an acceptable accuracy from the DCF77-signal we use antennas with a band width of 4 kHz and not the usual reception technique with a straight-on receiver. We transform the amplitude modulated signal from the antenna, as described above, inertialessly into a frequency modulated signal. The achievable accuracy compared to the DCF77-signal lowering at the installation location of the antenna is here about one FM pulse width, i.e. about, ± 2msec.

Further inaccuracy can be caused by the transmission time between sender and receiver.

In case of sole ground wave reception, if the distance is constant it is possible to calculate a constant value. The reception side is not able to influence time fluctuations in case of sky waves. Due to variation in height of the reflecting and deviating level of the ionosphere, differences in height have a direct influence on time deviations. The same applies to the cross-over section of ground and sky waves. This section is not constant but it varies between 600 to 1200 km from the location of the transmitter during the course of the day. This may cause additional time fluctuations of about some milliseconds at permanent locations.

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2 Set-up of the Hardware

2.1 Voltage Supply

The system is supplied with 18-60 V DC. Before connecting the voltage please check that the voltage and polarity are correct. As the snap-in module is internally completely potential-free, the earthing screw on the rear side must be turned to the required potential.

> **PLEASE NOTE :** IN CASE OF A NOT GROUNDED HOUSING THE RECEIPTION CAN BE IMPAIRED!

- Wrong poling of the operating voltage does not destroy the module.
- The set-up must not be carried out by anyone but qualified personnel.

2.2 Installation of the Antenna

2.2.1 Usable Types of Antennas

Only **hopf** antennas or antenna distributors should be connected to **hopf** radio controlled clocks. This guarantees the best match with the receiver.

- FG443600   indoor antenna
- **hopf** antenna distributor / lightning protection

We supply further antennas for the outdoor installation in difficult reception situations.

- FG441700   Outdoor antenna for pole installation with angled bracket
- FG441800   Outdoor antenna for flat roof installation and for wall installation
- FG442000   Outdoor antenna for pole installation without bracket
- FG443700   Outdoor antenna for non-directional reception

2.2.2 Alignment of the Antenna and DCF77 Signal Analysis

All **hopf** antennas are active antennas of directional character except for the non-directional antenna 4437. They must therefore be directed to the DCF77 transmitter. The transmitter is located in Mainflingen near Frankfurt on the Main.

The indoor antenna 4436 is placed at a right angle to the transmission direction and the outdoor antenna has to be turned so that the direction bar underneath the antenna housing faces Frankfurt.

If the direction Frankfurt is unknown when aligning the antenna foot, the antenna alignment programme can be called up to help.

Our portable DCF77-signal analysis device can be supplied to customers to help in the search for the best location for the installation of the antenna.

2.2.3 Indirect Lightning Protection

In case of outdoor antennas we advise using an indirect lightning protection to avoid overvoltages caused by lightning. The device can also be supplied in combination with a 4-times amplifier.

- FG444000   indirect lightning protection
- FG444400   indirect lightning protection with 4-times antenna amplifier

2.2.4 Coaxial Cable Installation

The supplied coaxial cable connects the antenna to the clock.

> **PLEASE NOTE :** DO NOT LAY THE ANTENNA CABLE NEXT TO OTHER HF-, CONTROL OR POWER CABLES.

2.3 Default Button in the Front Panel

To find the pre-set time press the button on the front panel. It must be pressed for about 10 sec until the status LED stops shining. After releasing the button the following settings will be restored in the clock:

Delivered status

- baud-rate 9600 baud
- 8 data bit
- 1 stop bit
- no parity bit
- transmission data string (6021)
- with control characters (STX/ETX)
- without second advance
- transmission every second

2.4 Status LED of the DCF77-Simulation

The green LED indicates the status of the DCF77 simulation. An LED flashing at 1 Hz intervals indicates the output of a valid simulation. When the LED flashes at 2Hz intervals no valid simulation is put out.

2.5 Control LED C1-C3

The LED's C1-C3 indicate the switching status of the three optical couplers. A lit LED indicates that the corresponding optical coupler is switched active.

2.6 DCF77-Simulation

The BNC connector "**DCF-SIM**" enables the user to synchronise other DCF77 radio controlled clocks. The simulated DCF77 signal is put out in the DCF77 reception mode (sytembyte, bit 7 = on) about 1 minute after the clock was synchronised by the DCF77 antenna signal.

If the clock returns to crystal operation, due to e.g. reception errors, the output of the DCF77 signal is kept up for the pre-set simulation period. If within this time span the clock is not radio synchronised again the output of the valid DCF77-sim signal (i.e. includes time information) stops. Instead, depending on the setting of the system byte, either an unmodulated (77.5kHz sinus) signal or a signal modulated by 2Hz is putout.

In the crystal mode of the clock (systembyte, bit 7 = off) the DCF77 signal is permanently put out (infinite simulation) regardless of the set simulation period. The output starts on the next minute change after a system time is entered or after the system byte is switched over, bit 7 in the status off. In the crystal mode it is possible to synchronise other DCF77 radio controlled clocks with the time and date information which is set in module 4465 (e.g. year 2000 test).

3 Set-up via Remote Software

All the settings on the device are carried out by means of the supplied software (**DCF_4465.EXE**) via the serial interface .

3.1 System Requirements for the Remote Software

The programme requires a PC / notebook with a free serial interface (COM1 or COM2) and the operating system Microsoft Windows from 3.x, 95, or NT. Before the start of any data transmission the software checks if there is a free COM-port.

3.2 Hints for the Installation of the Remote Software

The software is supplied on a 3.5 inch disc and should be copied into its own directory in the remote computer (PC) (e.g. **C:\HOPF4465**). The supplied serial interface cable must be connected between the computer and the DCF77-system. Then the software is ready for operation. When the voltage supply and the antenna are connected the programme can be started.
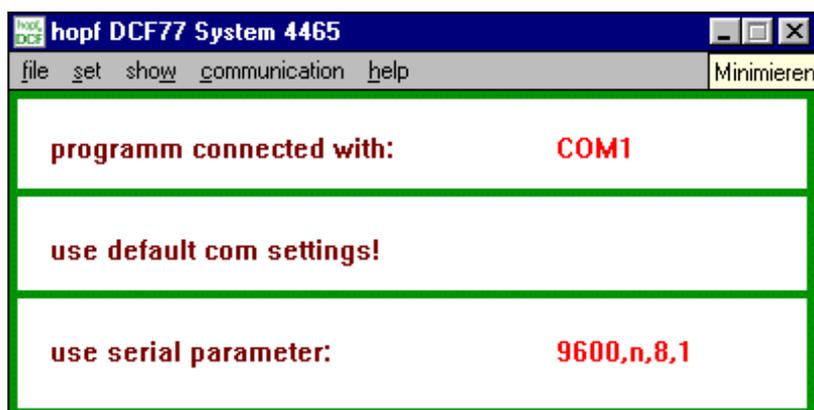
The software automatically finds the **first** free COM-port and shows the connection by clicking on **"programm connected with"** in the main window of the application. Also the actual parameters for the serial communication and the possible used file is displayed.

In the main window of the application you will find all the Windows user elements like pull-down menu, switches etc. You can operate the software either by mouse or by the key-pad of your computer.

We advise Windows beginners to teach themselves using the Windows teaching programme. Start the teaching programme in the programme manager or explorer under the menu item **Help**. You can find further instructions on how to use Window applications in your Microsoft Windows manual.

3.3 What You Should Know

During the first installation **DCF_4465.EXE** (the file DCF_INIT.INI must be missing!) sets the transmission parameter in the PC for the communication with the DCF77-device to the following values.

- baud-rate 9600 baud
- data bit 8
- stop bit 1
- parity bit no

These values must also be activated in the clock (status as delivered). The status as delivered can also be reached by pressing the reset button (see pt. **Releasing a reset**).

The changing of the parameter in the clock also requires changing the setting of the COM-port of your computer. Therefore changed parameters are stored in a text file, so that they are available after a new call-up of the programme.

The file is in the same directory as the programme **DCF_4465.EXE** and it is called :

DCF_INIT.INI

If necessary this file can also be edited manually. But the settings must correspond with the values of the clock.

Structure of the file **DCF_INIT.INI**:

```
[serial parameter]
string=9600,N,8,1
Port=COM1
```

Only the part of the parameter **String** = may be altered

example:

```
old        9600,N,8,1
new        19200,E,7,2
```

The programme works with these settings when the file is stored and **DCF_4465.EXE** restarted.

In case of doubt you can delete the file **DCF_INIT.INI**. The programme then starts with the above standard settings.

You can save and load your individual settings in the menu **"communication"** under the point **"load com setting / save com setting"**. The programme stores the initialising file for user configurations with the affix ***.CST**. These files can be edited manually according to the above described Init-file. Once a CST file is loaded, the programme automatically takes over the new settings and shows them in the main window.

4 Functions of the Remote Software

The functions of the software are divided into initialising (SET), supervision (SHOW) and communication (COMMUNICATION). In the present version the output of values on a printer has not been realised yet (FILE..PRINT).

(SET) functions initialising the DCF77-receiver

(SET) functions setting the optical coupler outputs

(SHOW) functions supervising the DCF77-receiver

(COMMUNICATION) functions configuring the serial interface

(COMMUNICATION) functions configuring the data string mode byte 1

(COMMUNICATION) functions selection of data string with mode byte 2

4.1 Initialising the DCF77-Receiver

The initialising function makes the set-up of the clock easier.

- entry of the current local time
- alignment of the antenna
- entry of the difference time UTC-local
- entry of the points of changeover for daylight saving time and standard time (only possible in quartz mode)
- release a reset of the clock

4.1.1 Setting Time and Date

This function can be used to set the time valid for that location.

You will find the set-time function under the menu item **"set"** and the entry **"time and date"**. Then the **"set time and date"** dialogue appears. The programme automatically takes over the time set in the computer into the editing field of the dialogue.

You can change the time by moving the scroll bar next to the displays. After setting the correct time, start the transmission to the clock with the **"send"** switch. In the status field **"transmit buffer"** the data string which was transmitted to the clock appears. When the transmission is successful the same data string is shown in the **"receive buffer"**

4.1.2 *Entering the Points of Changeover*

It is only possible to enter the changeover points in crystal mode. If you enter the changeover dates in the DCF77-receiver mode the entered values are set to "0" on the next minute change.

You find the set points of changeover function under the menu item **"set"** and the entry **"change over date"**. The dialogue **"change over settings"** appears**.**

Before activating the dialogue the current settings are read from the clock and displayed in the editing field. After setting the mark in the field '**active settled daylight saving time**' the points of time are entered here when during the course of the year daylight saving- or standard time for this location are changed over. Hours and month are entered separately for **start of daylight saving time** (summer time) and **start of standard time** (winter time).

> **PLEASE NOTE :** THE CHANGEOVER OF DAYLIGHT SAVING / STANDARD TIME IS SENT BY THE DCF77 TRANSMITTER. THEREFORE, NO CHANGEOVER POINTS CAN BE SET IN THE MODE DCF77-CLOCK. NAUGHTS MUST BE ENTERED IF NO CHANGEOVER POINT IS DESIRED.

After the entry of the data use the **"send"** switch to start the transmission to the clock. The pop-up window tells us that the information has been taken over by the clock.

4.1.3 *Setting the Difference UTC/Local*

This function serves to enter the time difference between the local time and the world-time (UTC time).

The difference time is entered in hours and minutes, extended by the information whether the location lies to the east or west of the 0 longitude (Greenwich).

> **e.g. West 08:00** for the USA and Canada (Pacific Time)
>
> **e.g. East 09.30** for Adelaide Australia
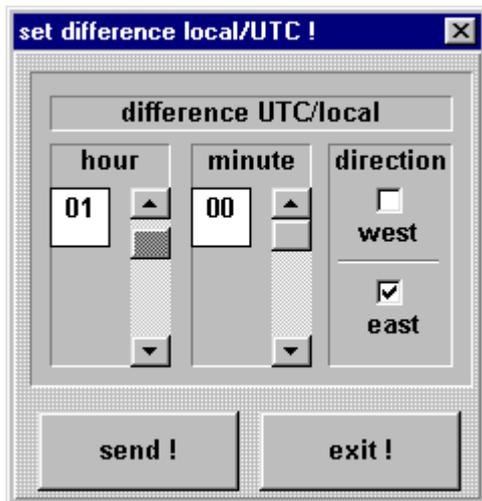
You find the set-difference time function under the menu item **"set"** and the entry **"difference local/UTC"**. The **"set difference local/UTC"** dialogue appears.

Enter the current data into the fields for hour and minute by moving the scroll bar. Click at the correct field for the direction (West/East).

After entering the data use the **"send"** switch to start the transmission to the clock.

A pop-up window appears indicating that the information has been taken over by the clock.

4.1.4 *DCF77-Simulation and Sync-Bit*

The output of the DCF77-simulation and of the radio-bit (see pulse output mode 2 and status information in the serial data strings) are configured under this menu item.

The transmitter DCF77 broadcasts a data string, which transmits the time information at one bit per second. The 100 or 200 msec long pulses (lowering of the amplitude) codes the digital information (0/1). The narrow-band antennas of some radio controlled clocks falsify the duration of the lowering and therefore the following receiver is adjusted to other pulse duration's.

The width of the low-high pulses for the DCF77-simulation can be adjusted to the operation with such strange products. You find the **"DCF77-simulation and sync. bit"** dialogue under the **"set"** menu. After the selection the shown dialogue box is displayed.

The lengths for low- and high pulse times of the DCF77-simulation are selected in the group window **"pulse length"**. The scroll bar **"time out after xx minutes"** can be used to switch off the output of the simulation when changing into crystal operation after the set time (2-254 minutes). This setting only concerns the output of the simulated DCF77 signal in the DCF77-clock-mode of the system. In the crystal mode the simulation is put out constantly regardless of the set simulation time.

> **PLEASE NOTE :** IF THE VALUE IS SET TO 255, THE SIMULATION RUNS CONTINUOUSLY ALSO WHEN THE CLOCK IS NOT RADIO-SYNCHRONOUS.

These settings have an effect on the DCF77-simulation via the BNC connector on the front panel and on a possibly set DCF77-simulation to the optical coupler and on the status LED in the front panel.

The scroll bar in the group **"sync bit settings"** can be used to delay the transfer of information **"radio"** (changeover from radio to crystal operation) by 2-254 minutes. When the value is 255 minutes the information **"radio"** is always transmitted. The clock have to be synchronous once. This method has an effect on the transmission of the synchronisation status in the put out data strings of the serial interface and on a possibly set radio bit at the optical couplers.

The possibility to delay the switch-off of the DCF77-simulation and radio bit serves to bridge small reception gaps, where the clock module 4465 does not fall short of the required accuracy due to its internal control.

Example:

If an accuracy of more than 10 msec is required, the second pulse produced at the output must not deviate from the absolute time mark by more than ± 10 msec. In case of a maximum crystal drift (2ppm) in free-running situation, this value would be reached after 10.000/2 = 5.000 seconds. Signalling of the crystal operation would not be necessary until 83 minutes have elapsed.

4.1.5 Setting the Optical Coupler Outputs

The clock module contains three optical coupler outputs which can fulfil different tasks. You find the **"pulse output"** dialogue under the **"set"** menu. Once selected this dialogue box is displayed. The current setting for the according output is shown when you click the check-box for optical couplers 1-3 in the top left corner of the dialogue.
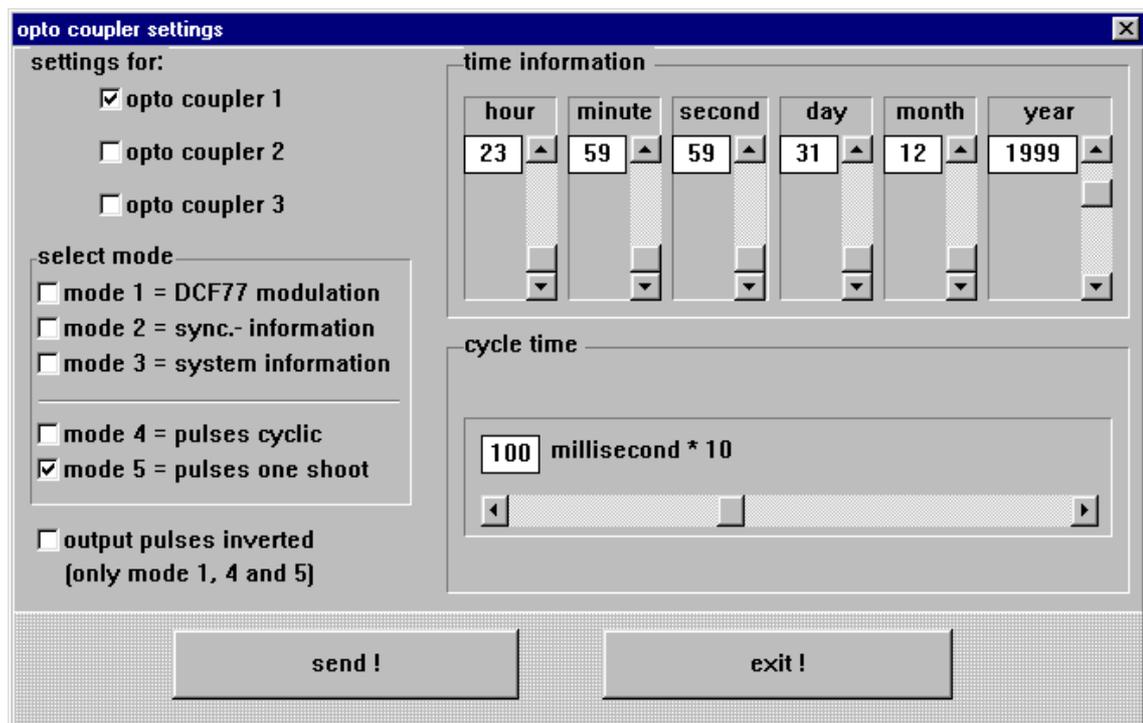
The different functions are called modes and selected in the group window **"select mode"**. Only one setting each can be selected. Depending on the selected function (mode), either the time information in the group window **"time information"** or the value for the pulse width can be set in the window **"cycle time"**.

If no times are set for the selected mode, **"xxx"** appears in all the editing fields. The pulses can be put out invertedly in the modes 1, 4 and 5 by activating the checkbox **"output pulses inverted"**. This function does not make sense in the modes 2 and 3 because a voltage failure causes a wrong message at the outputs. A detailed description of the modes is given in the following paragraphs.

4.1.5.1 DCF77-Simulation (Mode 1)

The local time information is put out as DCF77-simulation in a data string at the according optical coupler. This setting serves the synchronisation of further DCF77-radio controlled clocks with 1 Hz pulse input e.g. *hopf* 6036. The signal can also be put out invertedly. The settings for time information and cycle time are deactivated.

> **PLEASE NOTE :** IF REQUIRED, THE DCF77 SIMULATION CAN OPERATE AT 5 MVSS UNDER LOAD (AT PRESENT IT MUST STILL BE REQUESTED SEPARATELY).

4.1.5.2 Information about the Synchronisation (Mode 2)

In case of this setting the internal clock status (radio bit) is shown at the output. If the optical coupler is switched active the clock module receives radio signals. A drop of the signal means crystal operation.

Please pay attention to the best setting of a delayed changeover of radio- to crystal operation in the dialogue **"DCF77-Simulation and radio bit"** below.

4.1.5.3 Alarm Message (Mode 3)

In this mode the output is switched active when voltage is supplied. In case of errors or failures the signal drops, signalling an alarm.

4.1.5.4 Cyclic Pulses within 24 hours (Mode 4)

In this mode cyclic pulses with changeable pulse band are produced at the output. The following pulse intervals are possible.

- every 1, 2, 3, 4, 6, 8, 12, 24 hours
- every 1, 2, 3, 4, 5, 6, 10, 12, 15, 20, 30 minutes
- every 1, 2, 3, 4, 5, 6, 10, 12, 15, 20, 30 seconds

The setting 24 hour pulse interval requires the entry of naughts in all data positions in the group **"time information"**. The pulse duration is selectable in the range of 10-2550 msec in steps of 10 msec. The pulse duration should not be longer than the cycle time, because in that case the output stays permanently switched active. The signal output can be inverted.

4.1.5.5 Pulse per Day or Date (Mode 5)

This mode produces either a single pulse each day at the output or a single switching time depending on the date at the output. The output time of the pulse can be set by the scroll bars of the group **"time information"**. If you select **"00"** in the fields **"day"** and **"month"** the optical coupler switches actively to the adjusted time every day.

The pulse duration is selectable in the range of 10-2550 msec in steps of 10 msec. The signal output can be inverted.

4.1.6 *Alignment of the Antenna*

After the installation of the antenna(the arrow on the plate of the antenna points to Frankfurt /Main) it normally takes no more than 5 minutes for the clock to be synchronised. In most cases the clock is synchronised within this time span.

This programme function helps to remove reception problems. We recommend 800x600 pixel for the screen.

Start the programme by **" antenna alignment"** in the menu **set.**

Under the entry **"adjustments"** use the commands **"grid positive"** or. **"grid negative"** and **"line width +/-"** to visually alter the display of the antenna values.

The programme depicts the incoming DCF77-signal as oscillogram. In case of the standard baud-rate of 9600 baud, about 3 second pulses are shown on the monitor. Halving the baud-rate to 4800 doubles the shown second pulses.

On every second change the signal is to drop to 20% (wave trough). The ideal reception position (max. wave trough) is found by slowly turning the antenna. The reception suffices when the second pulse is displayed without any disturbance and when the value of the DCF77-dip exceeds ca. 150 (top right corner of the menu bar).

After the start of the programme the amplification of the DCF77-signal is re-adjusted. Depending on the local field strength this process takes about 20-30 seconds. The screen shows the DCF77-signal oscillogram with a dip on every second change (see picture). The newly set amplification is maintained during the alignment programme.

If the antenna is now turned from the set position the received field strength decreases, expressed by the diminishing signal dip on the screen. The antenna is turned by exactly 90° from the minimal position to its ideal position.

The picture shows a faultless reception. The signal dips are distinct.
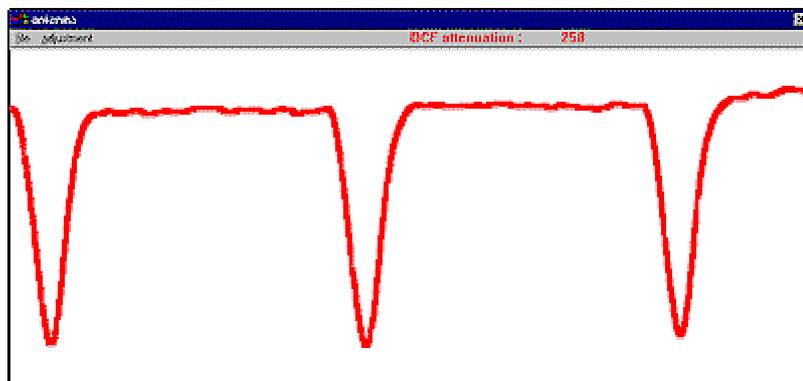
PLEASE NOTE : MONITORS AND TVS DISTURB THE RECEPTION. THE ANTENNA SHOULD THERE-FORE BE INSTALLED 5-10 M AWAY FROM THESE SOURCES OF INTERFERENCE.

4.1.7 *Settings of the System Byte*

System Byte

System byte setting

	on	off
bit 8	○	◉
bit 7	◉	○
bit 6	○	◉
bit 5	○	◉
bit 4	○	◉
bit 3	○	◉
bit 2	○	◉
bit 1	○	◉

send   **exit**
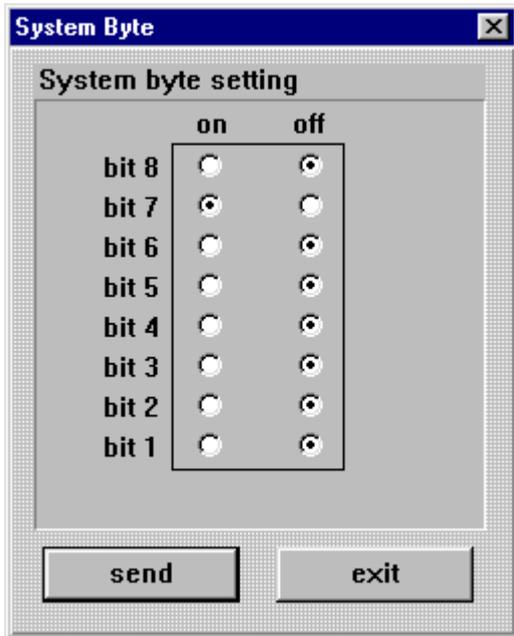
This function is used to switch internal pro-gramme functions on and off. You'll find the settings of the system byte under the menu item **"set"** and the entry **"system byte"**. The **"System byte"** dialogue appears show-ing the present bit positions in the clock.

Pressing the **"send"** button causes the data to be taken over into the clock.

A pop-up window confirms the reception of the data in the clock. The settings shown when the system byte dialogue is called up are the same as the stored configuration in the clock.

Bit No.:8	Bit No.:7	operating mode
off	off	mode 1, operating as crystal clock
off	on	mode 2, operating as DCF77-clock CET
on	off	mode 3, DCF77-clock world-wide

Bit No.:	on	off
6	DCF77-simulation on	DCF77-simulation off
5	IRIG-base UTC	IRIG-base local time
4	DCF77-simulation	DCF77-simulation
3	DCF77-simulation	DCF77-simulation
2	output unmodulated signal for invalid DCF77- sim signal	output 2Hz modulated signal for invalid DCF77 - sim signal
1	DCF77-simulation pulse	pps (second pulse)

4.1.7.1 *Operating Mode of the Clock*

These two bits determine the operating mode of the clock. Pre-set by our company is the following:

Bit 8 = off and Bit 7 = on = mode 2 operating as DCF77 clock CET

In **Mode 1** (bit8 and 7 =off) the clock works as a crystal clock only, i.e. there is no DCF77 decoding even with a connected antenna. In the crystal mode the DCF77 simulation is infinite, i.e. a simulated signal is put out via the **"DCF-SIM"** connector regardless of the set time-out for the DCF77 simulation.

Mode 3 is used when the clock operates in a time zone other than CET. It is possible to set a different time zone by means of the function **"Set difference UTC/Local"**.

4.1.7.2 *DCF77-Simulation*

The DCF77 antenna simulation at the BNC-connector can be switched on or off by bit 6.

The bit should be switched off if the simulation is not needed. Thereby, the reception sensitivity will be increased.

The DCF77 pulse-simulation via the optical coupler outputs is not influenced by this bit.

4.1.7.3 *IRIG-B Time Base*

In the system version time output via IRIG-signals the time base can be chosen between local time and UTC:

    Bit 5 = off   Time base is the local time
    Bit 5 = on   Time base is UTC

4.1.7.4 *DCF77-Simulation Settings*

Bit 3 and 4 are used to chose different time bases for the DCF77-simulation.

Bit 4	Bit 3	
off	off	in the simulated DCF77-data string **local time** is used as time basis. The time zone bits change according to the standard or daylight-saving time. The time zone changeover is announced 1 hour before.
off	on	in the simulated DCF77-data string the local **standard time** is used as the time basis, the standard time is continuously transmitted in the time zone bits. There is no information of a changeover.
on	off	in the simulated DCF77-data string UTC is transmitted as time basis. The time zone bits should normally contain the UTC information. As many DCF77 decoding programmes interpret this as an error the time zone bit is transmitted as standard time if UTC is set.
on	on	identical to bit 4,3 = off (standard)

4.1.7.5 *Setting Bit 2*

If the simulated DCF77-signal is invalid (i.e. without time information), a by 2 Hz modulated signal is put out instead. If bit 2 is set, an unmodulated 77.5 kHz sinus signal is put out instead.

> **PLEASE NOTE :** THE OUTPUT OF THE VALID DCF77-SIM SIGNAL IS NOT AFFECTED BY THIS SETTING.

4.1.7.6 *Setting Bit 1*

The serial interface RS422 can also be used as a pulse output. But this requires another plug-in board (module 6872).

The output can generate either a second pulse or generate the simulated DCF77-pulse signal.

4.1.8 *Reset*

This function can release a hardware reset of the clock system. Under the menu item **"set"** you'll find the entry **"reset clock"**. The **"Reset DCF77 receiver"** dialogue appears. Pressing the **"send"** switch releases a reset of the clock. This action is confirmed in the **"receive buffer"** by the message **"reset activated"**.

4.2 Supervision of the DCF77-Receiver (Show Menu)

Use this function to display the internal clock data.

4.2.1 Time and Date

The function to display the time is activated by the menu item **"show"** under the entry **"time/date".** The menu is divided into **"local"** and **"UTC"** time. Depending on your choice the **"show time and date dialog"** appears with the according information. The time is requested anew every 200 msec.

4.2.2 Points of Changeover

The function to show the points of changeover is activated by the menu item **"show"** and the entry **"change over date"**. The **"show change over date"** dialogue appears with the according information.

4.2.3 Difference Local-UTC

The function to show the difference time is activated by the menu item **"show"** an the entry **"difference Local/UTC"**. The **"difference Local/UTC"** dialogue appears with the according information.

The data are requested only once and then displayed.

4.2.4 DCF77-Simulation and Sync-Bit

The values set under pt. 4.1.4."DCF77 simulation and sync.bit can be called up here.

4.2.5 Firmware Revision

The program position and the date of programming of the connected devices can be read under this menu item in the "show" menu.

4.3 Configuration of the Serial Interface (communication)

The satellite radio controlled clock is equipped with a serial interface. The data can be exchanged via RS232c (V.24) signal level (optional RS422 (V.11) or TTY). The interface can be used to transmit time data strings to other computers. The *hopf* 6021, 5500, 5050, SINEC H1, IBM Sysplex Timer, T-String, Siemens MADAM S and Leitch Time code Generator data strings are supported as standard time data strings. Customised data strings are available.

4.3.1 Interface Parameter

You find the setting for baud-rate, data bit, stop bit and parity bit by selecting the menu **"communication"** and **"serial parameter"**. The interface-parameter-dialogue appears.
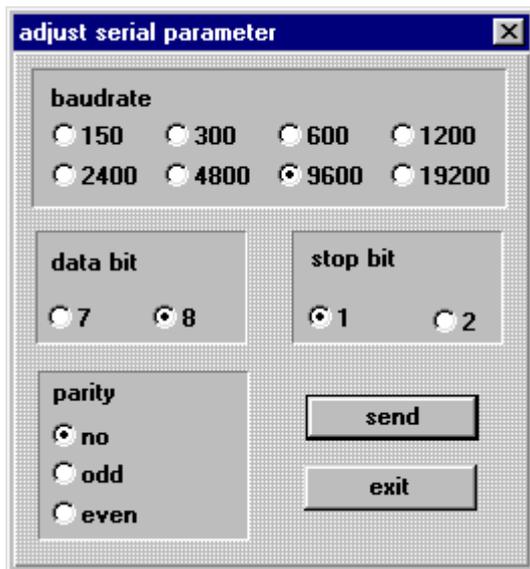
Confirm your entry by pressing the **"send"** key. The new parameters are taken over into the clock. When the data are taken over the following information is shown in the dialogue window:

serial parameter

change

from:	PAR: 09600,N,8,1
to:	PAR: 19200,N,7,2

completing the setting.

In case of a successful transfer of data the new parameter are also set in the remote computer. If the standard settings are altered ,the changed parameter are stored in a file "**DCF_INIT.INI**" by the remote software and taken over from there whenever the system is booted.

> **PLEASE NOTE :** BY USING THE INTERFACE BOARD VERSION 3 (RS232/TTY) A BAUD RATE HIGHER THAN 9600 BAUD CAN'T BE GUARANTEED.

In case of problems with the transfer the following information appears in the dialogue window after 15 seconds:

DCF77-System did not accept serial parameter

Please refer to pt 5.1 "Possible Errors in the Transmission with DCF4465.EXE" for help.

4.3.2 *Configuration of the Data String (Mode Byte 1)*

The time information received via DCF77 can be put out via the interface in different data strings including the internal status of the clock. This enables the user to synchronise connected computer systems with the atom-precise time. It is possible to choose the transmission point of time, the string structure and the used control characters by click in the **mode byte setting dialogue.**
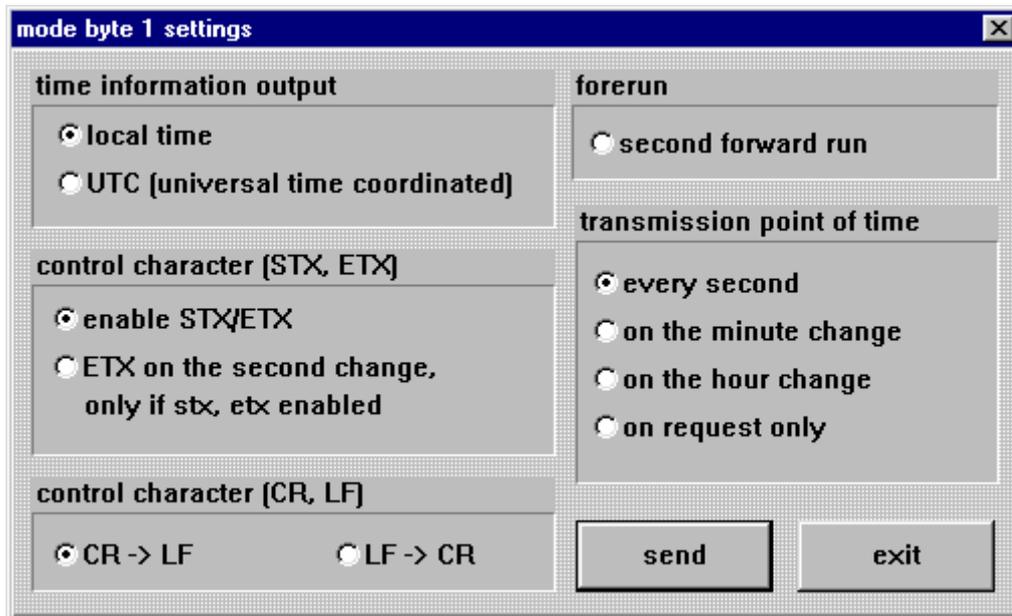
You find the set-function for the **"mode byte 1"** by selecting the menu **"communication"** and **"mode byte 1"**. The mode byte dialogue appears with the current settings in the clock.

You can configure the output system to your specifications. Start the transmission with the **"SEND"** button. When the data have been accepted a dialogue window appears with the following information:

> **mode byte configuration**
>
> change from: MOD:1,0,1,1,0,0,0,0
>
> to: MOD:1,1,1,1,1,0,0,0

completing the setting. If problems occur with the transmission a dialogue window appears after 15 seconds with this information:

> **DCF77-System did not accept serial parameter**

In this case refer to pt 5.1 "Possible Errors in the Transmission with DCF4465.EXE" for help.

Below possible settings are described.

PLEASE NOTE : THE INTERFACE OUTPUT OF THE SERIAL INTERFACE IS BLOCKED FOR 15 SECONDS AFTER EVERY TRANSMISSION OF DATA TO THE CLOCK.

4.3.2.1 Local Time or UTC

The time basis used in the output data string is chosen in the group **"time information output".** If you select **"local time"** the time information (UTC ± difference time) including a possibly existing daylight saving time offset is putout. If you chose **"UTC"** the output data string is set to **UTC (universal time co-ordinated)** world-time.

If time and date are indicated via the remote software the serial interface puts out the **TIM** data string of the clock. It is the same data string which is transmitted to the clock when setting time and date.

4.3.2.2 Control Characters STX/ETX and On-Time Marker

If the checkbox **"enable STX/ETX"** is activated in the group **"control character"**, so **STX (0x02)** at the beginning and **ETX (0x03)** is added at the end. When the setting **"ETX on the second change"** was activated, the final character ETX is transmitted exactly on the next second change. This mechanism serves to calculate the time in the computer which is to be synchronised.

Example :

The setting **8 Bit, no Parity, 1 stop bit** means that 10 bits are sent for the transmission of one character. At **9600 Baud** a character therefore needs about 1 msec for the transfer. The decoding computer must therefore add this value plus the delay time for the received character to establish the internal time.

4.3.2.3 Control Characters CR and LF

The output of the control characters **CR** (carriage return) and **LF** (line feed) can be exchanged in the group **"control character CR/LF".**

4.3.2.4 Second Advance of the Serial Output

If you activate the setting in the group **"forerun"** the data string is put out with a second advance. This setting is helpful in connection with the transmission of the final character **ETX on the second change** because the data string becomes valid when the ETX arrives.

4.3.2.5 Synchronisation Point of Time

In the group **"transmission point of time"** select the output point of time for the data string. The following settings are possible:

- **every second** = on the second change
- **on the minute change**
- **on the hour change**
- **on request only**

4.3.3 Selection of Data String (mode byte 2)

You find the set-function for the **"mode byte 2"** by selecting the menu **"communication"** and **"mode byte 2"**. The mode byte dialogue appears with the current setting of the clock.
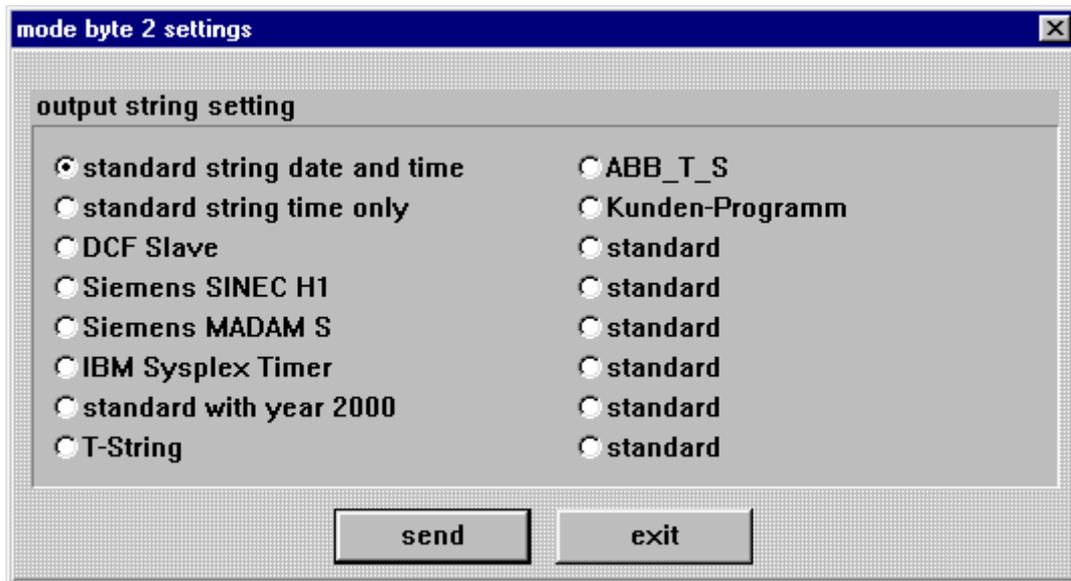
Click at the according checkbox for the data string you want and start the transmission to the clock with the **"send"** switch. When the data have been accepted a dialogue window appears with the information:

mode byte configuration
change   from: MO1:1,0,1,1,0,0,0,0
           to: MO1:1,1,1,1,1,0,0,0

completing the setting. Data strings operating with fixed settings for parameter and data string configurations also give the information that these settings have been carried out.

Parameter settings changed
mode byte 1 changed

If there were any problems with the transmission a dialogue window appears after about 15 sec. stating:

DCF77-System did not accept serial parameter

In this case please refer to pt. 5.1 "Possible Errors in the Transmission with DCF4465.EXE".

5 Signal and Data Output

5.1 Possible Errors in the Transmission with DCF4465.EXE

Check if the connection cable PC-clock has a defect. There must be a connection between the following signals:

PC	clock
TxD	RxD
RxD	TxD
GND	GND

Check whether the connection cable is connected to the interface as named by DCF_4465.EXE

Check whether the set transmission parameter of the clock corresponds with those of the computer. If there is a file DCF_INIT.INI it must be deleted and the standard transmission parameter must be initialised by pressing the reset switch for 10 seconds.

also see pt. **What you should know.**

5.2 Data Format of the Serial Transmission

The data are sent in ASCII as BCD values and can be shown by any terminal programme. (example TERMINAL.EXE under Windows).The following control characters from the ASCII range are possibly used in the structure of the data string:

$20 = Space
$0D = CR (carriage return)
$0A = LF (line feed)
$02 = STX (start of text)
$03 = ETX (end of text)

PLEASE NOTE : THE STATUS VALUES ARE TO BE DECODED SEPARATELY (SEE STRING STRUCTURE).

5.3 Serial Request

5.3.1 Serial Request with ASCII - Characters (applies to standard data strings)

The ASCII characters enable the user to put out the data string on request. The following characters release a transmission:

> ASCII "U" – for time (local time)
> ASCII "D" – for time / date (local time)
> ASCII "G" – for time / date (UTC-time)

The system answers with the according data string within 1 msec.

As this is often too fast for the requesting computer, it is possible to delay the answer in steps of 10 msec when requesting via software. The small letters "u, d, g" together with a two-digit multiplication factor are transmitted by the requesting computer to the clock to delay the transmission of the data string.

The multiplication factor is interpreted as hexadecimal value by the clock.

Example :

The computer transmits   **ASCII u05**   (Hex 75, 30, 35)
After 50 milliseconds the clock answers with the data string time only (local time).

The computer transmits   **ASCII gFF**   (Hex 67, 46, 46)
After 2550 milliseconds the clock answers with the data string time / date (UTC time).

5.3.2 Serial Request in MADAM-S

When the output MADAM-S is set the output on request can be activated only with the character sequence:

> **:ZSYS:**
> or   **:WILA:**

> **PLEASE NOTE :** MODE BYTE 1 SHOULD BE SET FOR OUTPUT ON REQUEST, OTHERWISE A CURRENT CYCLIC OUTPUT MAY DELAY THE ANSWER.

5.4 Irig-Signals

There can either be IRIG-B or IRIG-E data strings put out. The choice can not be made by the customer but has to be indicated when ordering.

IRIG-B and IRIG-E signal

At the BNC connector "IRIG-B" (IRIG-E) of the version IRIG-B (IRIG-E) an IRIG-B (IRIG-E) signal with a frequency of 1 kHz will be put out. The amplitude is fixed on $2V_{ss}$ at 600 Ohm. The rate of the amplitude carrier is 1:3. The minimum connecting resistance should not be less than 50 Ohm. The amplitude goes to 1.8 V_{ss} at 50 Ohm.

The IRIG-B (IRIG-E) pulse in TTL pulse can be taken from pin 4 at the 9-pole SUB-D connector. The basis time for IRIG-B (IRIG-E) output can be chosen with bit 2 of the system byte.

Bit 5 = off local time
Bit 5 = on UTC

The time rate is 1 second with IRIG-B and 10 seconds with IRIG-E.

> **PLEASE NOTE :** IRIG-B SIGNAL JITTER < ± 86 µSEC/SEC

Available IRIG-B Outputs (via IRIG-Standard 200-98):

- analogue signal by BNC-connector: B123
- digital signal (TTL-level) by 9-pole SUB-D connector: B003

Detailed Description of IRIG-B Format can be found on this web page:

http://tecnet0.jcte.jcs.mil/RCC/manuals/200/index.html

Recommended Cable Types for IRIG-B Transmission:

analogue signal: RG 59 for standard length up to 30m

hopf Triax cable for long distances

TTL-Signal: paired cable, shielded

Cable length for IRIG-B transmission (reference data):

Analogue signal: about 30m with RG 59

about 300m with **hopf** Triax cable, 2. shielding single sided at ground

TTL signal: about 300m with paired cable, shielded, shielding single sided at ground

Cable length for the IRIG-B transmission are depending upon the factor of shielding of the cable and the redundancy of the evaluating device.

6 Data Strings

6.1 General Information on the Data Output of 4465

The control characters STX and ETX are transmitted only if the output **"enable control character"** was set in the **mode byte 1**. Otherwise there are no control characters.

In case of the setting ETX on the second change there is, depending on the baud-rate, a gap in transmission of up to 970 msec. Please take this into consideration when programming a time-out on the side of the receiver.

The output of the control characters CR and LF can be interchanged in all data strings by **mode byte 1.**

The transmitted data strings are compatible with the data strings of the following *hopf* radio controlled clock boards

- board 6020/6021   standard with control characters
- board 6025/6027   standard with control characters (string 6021 only)
- board 6840/6841   standard with control characters
- board 6870   standard with control characters
- board 7200/7201   standard with control characters
- board 7220/7221   standard with control characters
- board 7240/7245   standard with control characters

6.2 Structure of the Data String 4465/6021 Time and Date

character no.	meaning	
1	STX (Start of Text)	
2	Status (internal status of the clock)	; see 6.2.2
3	day of the week (1= Monday...7=Sunday)	; see 6.2.2
	In case of 'UTC-time' bit 3 in the day of the week is set to 1	
4	tens hours	
5	unit hours	
6	tens minutes	
7	unit minutes	
8	tens seconds	
9	unit seconds	
10	tens day	
11	unit day	
12	tens month	
13	unit month	
14	tens year	
15	unit year	
16	LF (Line Feed)	; see 6.1
17	CR (Carriage Return)	; see 6.1
18	ETX (End of Text)	

6.2.1 Structure of the Data String 4465/6021 Time Only

character no.	meaning	
1	STX (Start of Text)	
2	tens hours	
3	unit hours	
4	tens minutes	
5	unit minutes	
6	tens seconds	
7	unit seconds	
8	LF (line feed)	; see 6.1
9	CR (carriage return)	; see 6.1
10	ETX (end of text)	

6.2.2 *Status and Day of the Week Nibble in the Data String 4465/6021 Standard*

The second and the third ASCII character in the data string contain the status and the day of the week. The status is decoded binaurally. Structure of these characters:

	b3	b2	b1	b0	meaning
status nibble:	x	x	x	0	no announcement hour
	x	x	x	1	announcement (ST-WT-ST)
	x	x	0	x	standard time (WT)
	x	x	1	x	daylight saving time (ST)
	0	0	x	x	time/date invalid
	0	1	x	x	crystal operation
	1	0	x	x	radio operation
	1	1	x	x	radio operation (high accuracy)
day of the week nibble:	0	x	x	x	CEST/CET
	1	x	x	x	UTC-time
	x	0	0	1	Monday
	x	0	1	0	Tuesday
	x	0	1	1	Wednesday
	x	1	0	0	Thursday
	x	1	0	1	Friday
	x	1	1	0	Saturday
	x	1	1	1	Sunday

6.2.3 *Example of a Transmitted Data String 4465/6021 (Standard)*

(STX)E3123456170496(LF)(CR)(ETX)

radio operation (high accuracy)
daylight saving time
no announcement
It is Wednesday 17.04.96 - 12:34:56 h.
( ) - ASCII-control characters e.g.(STX)

6.3 Structure of the Data String DCF-Slave

The following data string is used to synchronise _hopf_ DCF-slave systems. The only difference to the standard data string 4465 / 6021 is the status byte.

character no.	meaning	value (value range)	
1	STX (start of text)	$02	
2	status	$30-39,$41-46	; see 6.3.1
3	day of the week	$31-37	; see 6.3.1
4	tens hour	$30-32	
5	unit hour	$30-39	
6	tens minute	$30-35	
7	unit minute	$30-39	
8	tens second	$30-36	
9	unit second	$30-39	
10	tens day	$30-33	
11	unit day	$30-39	
12	tens month	$30-31	
13	unit month	$30-39	
14	tens year	$30-39	
15	unit year	$30-39	
16	LF (line feed)	$0A	; see 6.1
17	CR (carriage Return)	$0D	; see 6.1
18	ETX (end of text)	$03	

6.3.1 Status in the Data String DCF-Slave

	b3	b2	b1	b0	meaning
status nibble:	x	x	x	0	no announcement hour
	x	x	x	1	announcement (ST-WT-ST)
	x	x	0	x	standard time (WT)
	x	x	1	x	daylight saving time (ST)
	x	0	x	x	no announcement leap second
	x	1	x	x	announcement leap second
	0	x	x	x	radio operation
	1	x	x	x	radio operation (high accuracy)
day of the week nibble:	0	0	0	1	Monday
	0	0	1	0	Tuesday
	0	0	1	1	Wednesday
	0	1	0	0	Thursday
	0	1	0	1	Friday
	0	1	1	0	Saturday
	0	1	1	1	Sunday

6.3.2 Example of a Transmitted Data String DCF-Slave

(STX)83123456030196(LF)(CR)(ETX)

Radio operation, no announcement, standard time
It is Wednesday 03.01.96 - 12:34:56 h

6.3.3 Setting

The following setting is required for the synchronisation of the *hopf* slave systems:

- output every minute
- output second advance
- ETX on the second change

This setting guarantees the best adjustment of the time basis in the slave systems.

6.4 Data String SINEC H1

The control characters STX and ETX are transmitted only if the output is set „enable control characters". Otherwise there are no control characters. In case of the setting **"setting ETX delayed"** the last character (ETX) is transmitted exactly on the next second change.

This string can be requested by ASCII "?".

character no.	meaning	value (value range)
1	STX (start of text)	$02
2	"D" ASCII D	$44
3	":" colon	$3A
4	tens day	$30-33
5	unit day	$30-39
6	"." point	$2E
7	tens month	$30-31
8	unit month	$30-39
9	"." point	$2E
10	tens year	$30-39
11	unit year	$30-39
12	";" semicolon	$3B
13	"T" ASCII T	$54
14	":" colon	$3A
15	day of the week	$31-37
16	";" semicolon	$3B
17	"U" ASCII U	$55
18	":" colon	$3A
19	tens hours	$30-32
20	unit hours	$30-39
21	"." point	$2E
22	tens minute	$30-35
23	unit minute	$30-39
24	"." point	$2E
25	tens seconds	$30-36
26	unit seconds	$30-39
27	";" semicolon	$3B
28	"#" or space	$23 / $20
29	"*" or space	$2A / $20
30	"S" or space	$53 / $20
31	"!" or space	$21 / $20
32	ETX (end of text)	$03

6.4.1 *Status in the Data String SINEC H1*

The characters 28-31 in the data string SINEC H1 give information about the synchronisation status of the clock.

meaning of the following:

character no.: 28 = "#"   no radio synchronisation after reset, time invalid
                     space   radio synchronisation after reset, clock at least in crystal operation

character no.: 29 = "*"   time from the internal crystal
                     space   time from radio reception

character no.: 30 = "S"   daylight saving time
                     space   standard time

character no.: 31 = "!"   announcement of a W/S or S/W changeover
                     space   no announcement

6.4.2 *Example of a Transmitted Data String SINEC H1*

(STX)D:03.01.96;T:3;U:12.34.56; _ _ _ _ (ETX)   (_) = Space

radio operation, no announcement, standard time
It is Wednesday 03.01.96 - 12:34:56 h

6.5 Structure of the Data String MADAM-S

The structure of the data string depends on the request string. If the superior computer (PROMEA-MX) requests with the following string

:ZSYS:

the clock answers with the following data string:

character no.	meaning	value (value range)	
1	STX (start of text)	$02	
2	: colon	$3A	
3	Z ASCII Z	$5A	
4	S ASCII S	$53	
5	Y ASCII Y	$59	
6	S ASCII S	$53	
7	: colon	$3A	
8	status of the changeover	$00, 01, 7F	; see 6.5.2
9	time scale ident.	$30-33	
10	day of the week	$31-37	
11	tens year	$30-39	
12	unit year	$30-39	
13	tens month	$30-31	
14	unit month	$30-39	
15	tens day	$30-33	
16	unit day	$30-39	
17	tens hour	$30-32	
18	unit hour	$30-39	
19	tens minute	$30-35	
20	unit minute	$30-39	
21	tens second	$30-35	
22	unit second	$30-39	
23	CR (carriage return)	$0D	; see 6.1
24	LF (line feed)	$0A	; see 6.1
25	ETX (end of text)	$03	

If the superior computer (PROMEA-MX) requests using the string

      :WILA:

the clock answers with the following data string:

character no.	meaning	value (value range)	
1	STX (start of text)	$02	
2	: colon	$3A	
3	W ASCII W	$57	
4	I ASCII I	$49	
5	L ASCII L	$4C	
6	A ASCII A	$41	
7	: colon	$3A	
8	status	$00, 01, 7F	; see 6.5.2
9	time scale ident.	$30-33	
10	day of the week	$31-37	
11	tens year	$30-39	
12	unit year	$30-39	
13	tens month	$30-31	
14	unit month	$30-39	
15	tens day	$30-33	
16	unit day	$30-39	
17	tens hour	$30-32	
18	unit hour	$30-39	
19	tens minute	$30-35	
20	unit minute	$30-39	
21	tens second	$30-35	
22	unit second	$30-39	
23	CR (carriage Return)	$0D	; see 6.1
24	LF (line feed)	$0A	; see 6.1
25	ETX (end of text)	$03	

6.5.1 _Required Setting for Output MADAM-S_

The synchronisation mechanism for the out put MADAM-S requires the following setting :

- output on the minute change
- output with second advance
- output ETX on the second change
- output with control characters
- output CR/LF

6.5.2 *Meaning of the Status Nibble in the Data String MADAM-S*

Announcement of a changeover (8. byte of the transmission)

This byte can have the following values :

Nul (Hex 00)	no announcement
SOH (Hex 01)	announcement changeover
	daylight saving time- / standard time
	standard time- / daylight saving time
DEL (Hex 7F)	no radio controlled time available

time scale identification (9.byte of the transmission)

ASCII 0 (Hex 30)	standard time
ASCII 1 (Hex 31)	daylight saving time + announcement
ASCII 3 (Hex 33)	daylight saving time

The day of the week nibble can take the value ASCII 1 (Hex 31 ⇔ MO) to ASCII 7 (Hex 37 ⇔ SO). In case of an invalid time the byte is transmitted with ASCII 0 (Hex 30).

6.6 Data String IBM 9037 Sysplex Timer

The protocol in the device must be selected to synchronise the IBM 9037 Sysplex Timer. The 9037 expects the time every second at its input. The following setting is required: 9600 baud, 8 data bit, parity odd, 1 stop bit, transmission on request, without advance and without control characters.

The Sysplex Timer transmits the ASCII character "C" when switched on to he connected radio controlled clock which causes the below listed protocol to be put out automatically every second.

The setting UTC or local time is optional.

character no.	meaning	value (value range)	
1	SOH (start of header)	$02	
2	hundred current day of year	$30-33	
3	tens current day of year	$30-39	
4	unit current day of year	$30-39	
5	":" colon	$3A	
6	tens hour	$30-32	
7	unit hour	$30-39	
8	" : " colon	3A	
9	tens minute	$30-35	
10	unit minute	$30-39	
11	" : " colon	3A	
12	tens second	$30-35	
13	unit second	$30-39	
14	quality identifier	$20, 41, 42, 43, 58	
15	CR (carriage return)	$0D	; see 6.1
16	LF (line feed)	$0A	; see 6.1

6.6.1 Status in the Data String Sysplex Timer

Character 14 informs us about the synchronisation status of the clock. Below the possible values and their meaning are listed.

"?"	=	question mark	=	no radio controlled time
" "	=	Space	=	radio controlled time at hand
"A"	=	Hex 41	=	crystal operation for more than 20 minutes
"B"	=	Hex 42	=	crystal operation for more than 41 minutes
"C"	=	Hex 43	=	crystal operation for more than 416 minutes
"X"	=	Hex 58	=	crystal operation for more than 4160 minutes

6.6.2 Example of a Transmitted Data String Sysplex Timer

(SOH)050:12:34:56 _ (CR) (LF)   (_) = Space

radio operation, 12:34:56 h, 50. day of the year

6.7 Structure of Data String 4465/6021 String 2000

The structure of the data string is the same as the standard string 4465/6021 and differs only in the data positions century tens and unit.

This string can be requested by "D", "G" or "U".

character no.	meaning	
1	STX (start of text)	
2	Status (internal status of the clock)	; see 6.7.1
3	day of the week (1=Monday... 7=Sunday)	; see 6.7.1
	In case of UTC time bit 3 is set to 1 in the day of the week	
4	tens hour	
5	unit hour	
6	tens minutes	
7	unit minutes	
8	tens seconds	
9	unit seconds	
10	tens day	
11	unit day	
12	tens month	
13	unit month	
14	tens century	
15	unit century	
16	tens year	
17	unit year	
18	LF (line feed)	; see 6.1
19	CR (carriage return)	; see 6.1
20	ETX (end of text)	

6.7.1 Data String 2000 Status-and Day of the Week Nibble

The second and the third ASCII character contain the status and the day of the week. The status is decoded binaurally. Structure of these characters:

	b3	b2	b1	b0	meaning
status nibble:	x	x	x	0	no announcement hour
	x	x	x	1	announcement (ST-WT-ST)
	x	x	0	x	standard time (WT)
	x	x	1	x	daylight saving time (ST)
	0	0	x	x	time/date invalid
	0	1	x	x	crystal operation
	1	0	x	x	radio operation
	1	1	x	x	radio operation (high accuracy)
day of the week nibble:	0	x	x	x	CEST/ CET
	1	x	x	x	UTC - time
	x	0	0	1	Monday
	x	0	1	0	Tuesday
	x	0	1	1	Wednesday
	x	1	0	0	Thursday
	x	1	0	1	Friday
	x	1	1	0	Saturday
	x	1	1	1	Sunday

6.7.2 Example of a Transmitted Data String 2000

(STX)E312345603011996(LF)(CR)(ETX)

radio operation (high accuracy)
daylight saving time
no announcement
It is Wednesday 03.01.1996 - 12:34:56 h.
( ) - ASCII-control characters e.g. (STX)

6.8 Data String T-String

The T-String can be transmitted with all modes (e.g. **forerun** or **"last control character on the second change"**).

This string can be requested by ASCII "T".

character no.	meaning	value (value range)	
1	"T" ASCII T	$54	
2	":" colon	$3A	
3	tens year	$30-39	
4	unit year	$30-39	
5	":" colon	$3A	
6	tens month	$30-31	
7	unit month	$30-39	
8	":" colon	$3A	
9	tens day	$30-33	
10	unit day	$30-39	
11	":" colon	$3A	
12	tens day of the week	$30	
13	unit day of the week	$31-37	
14	":" colon	$3A	
15	tens hour	$30-32	
16	unit hour	$30-39	
17	":" colon	$3A	
18	tens minute	$30-35	
19	unit minute	$30-39	
20	":" colon	$3A	
21	tens seconds	$30-36	
22	unit seconds	$30-39	
23	CR (carriage return)	$0D	; see 6.1
24	LF (line feed)	$0A	; see 6.1

6.8.1 Example of a Transmitted Data String T-String

T:96:01:03:03:12:34:56(CR)(LF)

It is Wednesday 03.01.96 - 12:34:56h

6.9 Data String ABB_S_T

The data string ABB_S_T contains the same transmitted values as the T-string. It is switched on via mode byte 2.

Selecting the string sets the transmission parameter to the following values:

- 4800 baud
- 7 bit word length
- parity odd
- 2 stop bits
- output: every minute

6.10 Data String TimeServ for Windows NT Computers

The same protocol as described under **"Sysplex Timer"** is used to synchronise a PC with the operating system Windows NT from 3.51. The data output requires the following settings:

- data string Sysplex Timer
- transmission every second
- 9600 baud
- 8 data bit
- no parity
- 1 stop bit
- without second advance
- without control characters
- transmit UTC

The installation on the NT-computer requires the programme package **"TimeServ"** (is included in the delivery of Windows NT Resourcekit) or free download from the Microsoft Internet page:

ftp://ftp.microsoft.com/bussys/winnt/winnt-public/reskit/nt40

The required settings for the PC software can be downloaded from the *hopf* homepage:

http://www.hopf-time.com

6.11   Data String for NTP (Network Time Protocol)

NTP or xNTP is programme package to synchronise different computers and operating systems or levels with network support. It is the standard for the Internet protocol TCP/IP (RFC-1305). Source code and documentation are available as freeware in the Internet under the following address:

http://www.eecis.udel.edu/~ntp/index.html

Binary files for the IBM operating system AIX are available on our homepage:

http://www.hopf-time.com

NTP supports the **hopf** standard protocol as described under **"data string 4465/6021".** The following settings are required on the clock board:

baud rate:	9600 baud
	8 data bit
	parity No
	1 stop bit
transmission mode :	data string 4465/6021
	UTC as time basis
	with second advance
	with control characters (STX...ETX)
	LF..CR
	with ETX on the second change (On Time Marker)
	output time and date
	transmission every second

7 Interface and Clamp Terminal

7.1 Setting the Clock by Serial Interface

Time and date can also be set via the serial interface. This requires the following data string.

character no.	meaning	value (value range)
1	"S" (for setting time)	$53
2	tens hour	$30-32
3	unit hour	$30-39
4	tens minute	$30-35
5	unit minute	$30-39
6	tens second	$30-35
7	unit second	$30-39
8	tens day	$30-33
9	unit day	$30-39
10	tens month	$30-31
11	unit month	$30-39
12	tens year	$30-39
13	unit year	$30-39
14	day of the week	$31-37
15	CR (carriage return)	$0D

The calculation of Daylight Saving Time or Standard Time is done automatically depending on the actual settings of the changeover dates.

Example of a transmission :

>S1234561404993CR<   for Wednesday 14.04.99, 12:34:56

7.2 Pin Allocation of the 9-Pole SUB-D Connector

The allocation of the interface is available in five different versions. The interface version is marked on the type plate under pt. "interface ver."

The serial interface signals are put out via a potential separation at the 9-pole SUB-D connector.

7.2.1 Version 1 - Standard Allocation RS232 and RS422

9-pole SUB-D connector pin no.	name of signal
1	GND
2	RxD (receive data) RS232
3	TxD (transmit data) RS232
4	
5	GND
6	TxD (transmit data) RS422
7	/TxD (transmit data) RS422
8	RxD (receive data) RS422
9	/RxD (receive data) RS422

7.2.2 Version 2 - RS232 / RS232

9-pole SUB-D connector pin no.	name of signal
1	GND
2	RxD (receive data) RS232
3	TxD (transmit data) RS232
4	
5	GND
6	TxD (transmit data) RS232
7	
8	RxD (receive data) RS232
9	

7.2.3 Version 3 - RS232 / TTY

9-pole SUB-D connector pin no.	name of signal
1	GND
2	RxD (receive data) RS232
3	TxD (transmit data) RS232
4	
5	GND
6	TTY out –
7	TTY in –
8	TTY out +
9	TTY in +

> **PLEASE NOTE :** BY USING THE INTERFACE BOARD VERSION 3 (RS232/TTY) A BAUD RATE HIGHER THAN 9600 BAUD CAN'T BE GUARANTEED.

7.2.4 Version 4 - PPS Pulse / DCF77 Time

9-pole SUB-D connector pin no.	name of signal
1	GND
2	RxD (receive data) RS232
3	TxD (transmit data) RS232
4	
5	GND
6	PPS pulse or DCF77 time (s. 4.1.7 System Byte Bit 1)
7	/PPS pulse or /DCF77 time (s. 4.1.7 System Byte Bit 1)
8	
9	

7.2.5 Version 5 - IRIG-B wih RS232 and RS422

9-pole SUB-D Connector Pin No.	Signal Description
1	GND
2	RxD (receive data) RS232
3	TxD (transmit data) RS232
4	IRIG-B Time
5	GND
6	TxD (transmit data) RS422
7	/TxD (transmit data) RS422
8	RxD (receive data) RS422
9	/RxD (receive data) RS422

7.3 Allocation of the Screw Terminals

X1

+Vin   –Vin
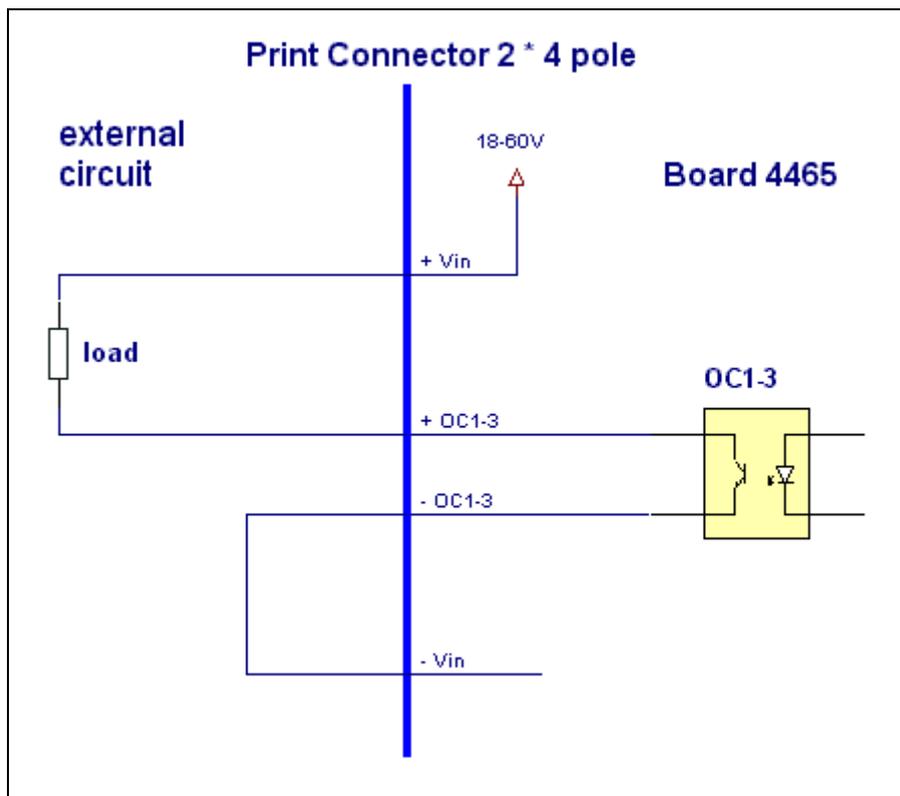+OC3   –OC3
+OC2   –OC2
+OC1   –OC1
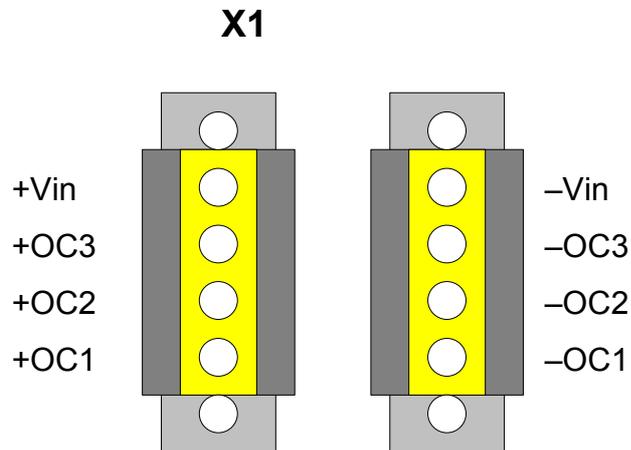
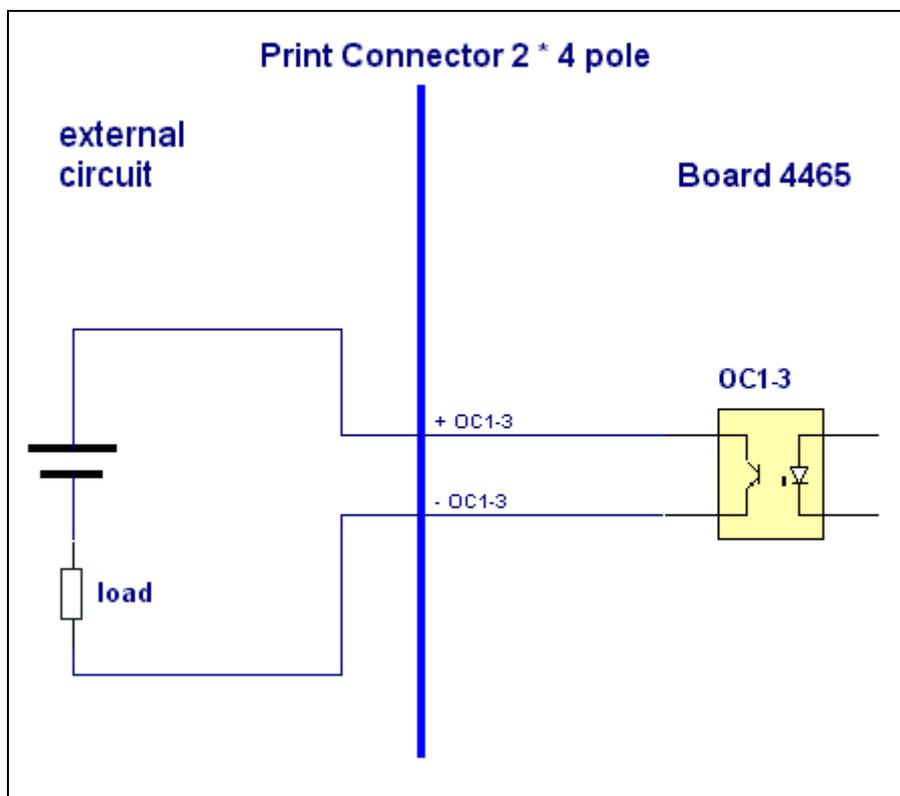### 7.3.1 Example of Connection of an Optical Coupler

active, positive pulse
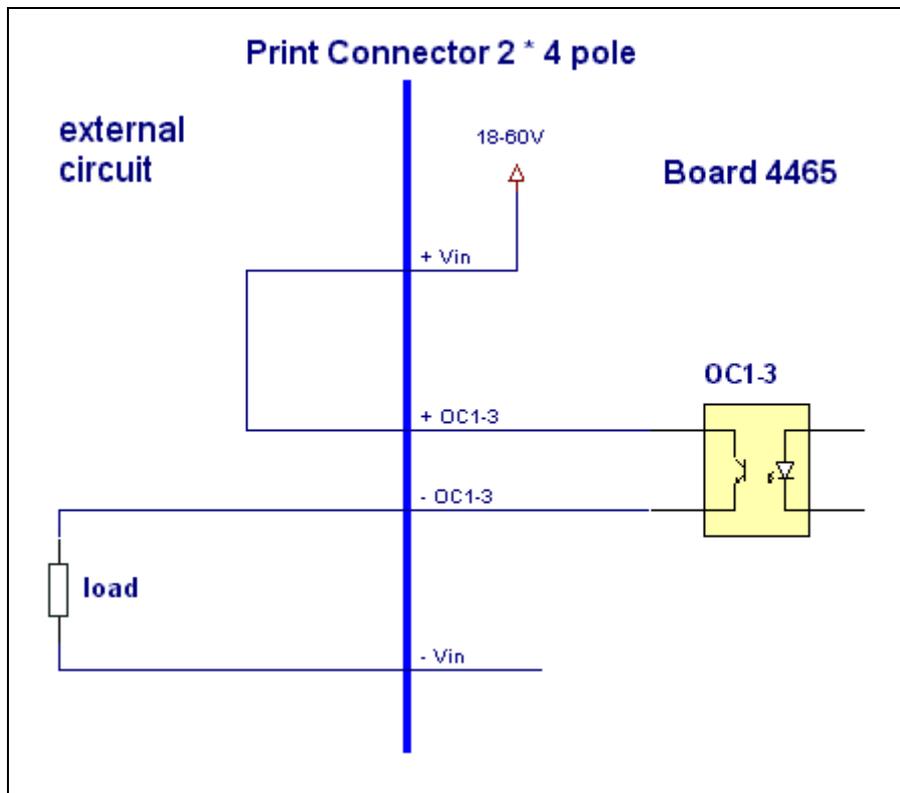
active, negative pulse

passive, positive pulse

8 Technical Data

8.1 Base System

operating voltage:	18 - 60V DC
consumption:	4 VA
temperature range:	0 to 70° C

accuracy

second deviation (internal):	± 2 msec from the DCF77-signal at the location of the receiver antenna
VCO-control (crystal):	better than ± 2 ppm
free wheeling characteristics:	better than ± 2 ppm at constant temperature between 0 … 50°C
back-up clock:	± 25 ppm at + 10 to + 50° C
jitter of the second marker:	< 10 μsec
IRIG-B Signal Jitter:	< ± 86 µsec/sec
second adjustment:	soft (max. ± 10 ppm)

8.2 DCF77-Receiver

antenna input circuit

potential separation:	500V DC
input impedance:	ca. 50 Ω
input sensitivity:	< 40 μV

DCF77-decoding

automatic amplification control:	70 dB
decoding:	AM/FM-conversion

8.3 Signal Output

DCF77-simulation

DCF77-simulation output:	5 mV$_{ss}$ at 50 Ω

Optical coupler

difference in voltage:	60V DC
switching current:	20 mA
signal delay at I=20mA, 1m cable length, 90% / 10% signal amplitude	
on-time:	5 µsec
down-time:	30 µsec
pulse accuracy absolute to the internal second marker:	± 1 msec

tailor-made products

Hard-and software alterations according to customer specifications and standards are available.

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