Technical Description

PC radio controlled clock
6039 DCF77

hopf
Elektronik   GmbH

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.

hopf Elektronik

Nottebohmstr. 41	58511 Lüdenscheid
Postfach 1847	58468 Lüdenscheid

Tel.:	++49 (0)2351 / 9386-86
Fax:	++49 (0)2351 / 9386-93

Internet:	http://www.hopf.com
e-mail:	info@hopf.com

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1 In general

1.1.1 Brief Description Model 6039 DCF77

The board is synchronised by the longwave transmitter DCF77 near Mainflingen (FFM) and therefore achieves an internal accuracy of ± 2 msec.

1.1.1.1 Communication Channels

- 32-Bit-PCI-Bus interface for computer communication
- RS232 interface to synchronise external computers
- 3 freely programmable pulse outputs
- IRIG-B output

1.1.1.2 Features

- potential free antenna circuit
- back-up clock with maintenance free memory
- DCF77 reception analysis

1.1.1.3 Supplied Software:

- service programme for setting all parameter in the clock board
- Windows NT/2000 driver
- Windows 95/98 driver
- SYNCUPDT.EXE: Service programme for setting all parameter in SYNCPROC.EXE
- SYNCPROC.EXE: Synchchronisation programme for Windows 95/98

1.1.1.4 Available Options:

- NTP (Network Time Protocol)
- Linux driver (under construction)

1.1.1.5 Function of the DCF77 Transmitter

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

During a minute the BCD values for the minutes, hours, day of the week, month and year are transmitted after the 20th second. Being the synchronisation marker the 59th second is not lowered.

Various information like the announcement of a changeover, announcement of a leap second and the information about the current time zone are transmitted as unchecked bit during the first 20 seconds.

The emitted amplitude does not immediately drop to the 25%-value. Because of the resonance quality of the antenna this value is reached after 0.6 - 0.8 msec.

The inaccuracy of the transmitted carrier frequency

- averages over the period of 1 day $< 1* 10\text{-}12$
- averages over the period of 100 days $< 1* 10\text{-}13$

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

2 Hardware installation

2.1.1 Installation of the Radio Controlled Clock

Before the radio controlled clock is installed the computer and all connected devices must be switched off. In case of an ATX-device you have to switch off the power supply. After opening the housing of the computer the clock is pushed into a free extension slot (32-Bit-PCI Slot). It is ready for operation once the antenna is connected.

When pushing in the board please make sure that it does not touch another board in the PC after installation.

After the start the PCI-BIOS of the computer automatically gives a memory address to the radio controlled clock. An interrupt line is not required. The user does not have to carry out further settings because the supplied programmes automatically recognise the set address.

2.1.2 Installation of the antenna

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
- FG442000 Outdoor antenna for pole installation without bracket
- FG443700 Outdoor antenna for non-directional reception

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 should therefore be directed to the DCF77 transmitter which is situated in Mainflingen near Frankfurt am Main. The power supply for the antenna is supplied by the board.

The arrow underneath the antenna housing of both antenna types (indoor and outdoor) has to point to Frankfurt.

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

Our portable DCF77 signal analysis device can be supplied to customers to help in searching for the best location for the antenna.

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 distributor.

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

Coaxial Cable Installation

The supplied coaxial cable connects the antenna to the clock.

Do not lay the antenna cable next to other HF-, control or power cables.

The following guidelines must be strictly observed:

- the bend radius of the coaxial cable must never be less than 10cm
- the sheath of the cable must not be damaged in any way
- the cable must not be crimped

3 Software installation

3.1.1 Windows 95/98 Drivers

Windows 95 Service Release 1, 2 and 2.5, Windows 98

After inserting the board into the computer and starting Windows a new PCI device has been found for which drivers are needed.

Hardware

The needed driver can be found on the CD (6039 driver disk) in the directory "DRIVER_9X". There you must install the INF-file to integrate the board into the system. You can cancel the following dialogue to restart the system because you also have to install the software.

The installation can be checked in the system control under device manager. There must be an entry **hclk6039** with the sub-directory **hopf Elektronik Clock Device**.

Two memories should be listed under resources. The clock does not need IRQ-, DMA-line or I/O-Port addresses.

Software

To install the software the file SETUP6039.EXE must be executed. After starting the program you can first choose the installation language and then the type of model.

This only effects the installed documentation. The program itself recognizes the type of model.

Please follow the installation instructions. Normally, the service software "hopf6039" will be installed in the directory "programs" onto the hard-disk of the pc. Hereunder the directory "hopf PCI board 6039 DCF77" with the particular sub-directories will be created.

The system must be restarted at the end of installation in order to take effect on all changes.

You have access to all necessary programs and documentation by selecting "run/programs/hopf PCI board 6039 DCF77".

The clock is now ready for operation and can be set and checked by means of the service program **HOPF6039.EXE**. For automatic synchronisation of the pc the program **SYNCPROG.EXE** has been added to the autostart group. This program can be configured by the **SYNCUPD.EXE**.

3.1.2 Windows NT/2000 Drivers

Windows NT from version 3.51, 4.0 with Service Release 1-6:

The new board won't be automatically regonized under Windows NT. The perfect operation of the board is guaranteed by the correct installation of the software.

You can check the correct installation by finding the following entry in the registry:

HKEY_LOCAL_MACHINE/SYSTEM/CurrentControlSet/Services /hclk6039

Once the clock board is installed successfully the following entry is written in the list of devices of the system control:

"hopf radio clock hardware started".

Windows 2000:

After the board has been plugged into the PC and starting Windows, the system finds a new PCI-Device and asks for the appropriate drivers.

Hardware

The driver for the new board is on the CD (6039 driver disk) in the directory **"DRIVER_2000"**. There the INF-file has to be selected so that the boad can be integrated into the system. The subsequent demand to restart the system can be ignored due to the fact that the software for the board has not been installed yet.

The installation can be checked in the device manager, in which an entry **Time Synchronization Devices GPS/DCF77** with the subdirectory **ATLSoft Driver for hopf 6039 PCIClock** must exist.

Software

The installation of the software is realized analog to Windows 95/98. Under Windows NT/2000 the service **"hopfserv"** is installed additionally.

Once the installation is finished, the system must be restarted in oder to guarantee the acceptance of all amendments.

The clock is ready for operation and can be set and ckecked by the service program **HOPF6039.EXE**. The computer is synchronised by the service **HOPFSERV.EXE**.

3.1.3 Uninstalling the Software

The software can be uninstalled via the point software under system control. Alternatively you can execute the **UNWISE.EXE** from the installation directory.

4 Service Programm

4.1.1 Administration of the Clock Board

The program **HOPF6039.EXE** serves to set up and control the clock board. You can carry out the following tasks:

- setting time and date
- align the antenna
- setting the time zones
- programming the changeover process for daylight saving time
- programming the pulse outputs
- setting the IRIG-B outputs
- setting the RS232 outputs
- DCF77 simulation and sync.-bit
- version, system byte
- reset

The respective data can be set and controlled in all the following fields of the service software.

The displayed values correspond with the current settings of the board 6039.

When different values have been entered the send-key must always be pressed to transfer the data to the clock.

The new values are taken over partly after the next minute change.

When the settings on the board have been altered a reset must be carried out after the next minute change.

4.1.2 Setting time and date

The dialogue "Select new Time and Date" is used to enter the local time information. The calculation of UTC depends on the entered difference time. A possibly approaching daylight saving time is indicated on the next minute change. The date is marked by clicking at the respective data in the calendar and transferred - together with the set time information - to the clock after using the send-key.

By clicking the month filed with the left mouse button a fly-out menu appears where the wanted month can be selected. As well by clicking the year flied with the left mouse button the wanted year can be selected. Pressing the right mouse button in the calendar field you can jump to the actual date.

On the next minute change the entered data are taken over into the back-up clock. They are read from there after every reset or voltage failure. When the voltage failure takes more than 3 days the values of the back-up clock are ignored.

4.1.2.1 Radio clock information

The internal time information (Local and UTC) is shown here.

Local time = UTC + (difference with the correct sign) + possibly daylight saving time offset.

4.1.2.2 Display system Status Byte

radio	crystal	**synchronisation bits**
off	off	time invalid
off	on	clock in crystal operation
on	off	radio controlled operation basic accuracy
on	on	radio controlled operation high accuracy

announce	announcement bit leap second
standard	standard time active

daylight	daylight saving time active
announce	announcement bit daylight saving time / standard time

n.a.	not used at present
done	changeover done (internal only)

4.1.3 Antenna Alignment

The programme depicts the received DCF77 signal as oscillogram.

After the installation of the antenna it normally takes no more than 5 minutes for the clock to be synchronised (the arrow on the antenna plate points to Frankfurt/Main). The clock will be synchronised in most of the cases.

By means of the switch "start antenna alignment" the best antenna position can be found.

After the start of the programme the amplification of the DCF77 signal is readjusted. This process takes between 20-30 seconds depending on the local field strength. The monitor shows the DCF77-signal-oscillogram with a lowering of the signal on every second change (see picture). The newly adjusted amplification is kept for the length of the alignment process (red curve).

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.

If the antenna is now turned from the set position the received field strength decreases, expressed by the diminishing signal dip on the screen.

When the antenna is dejusted by exactly 90° the DCF77 signal must have disappeared. 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.
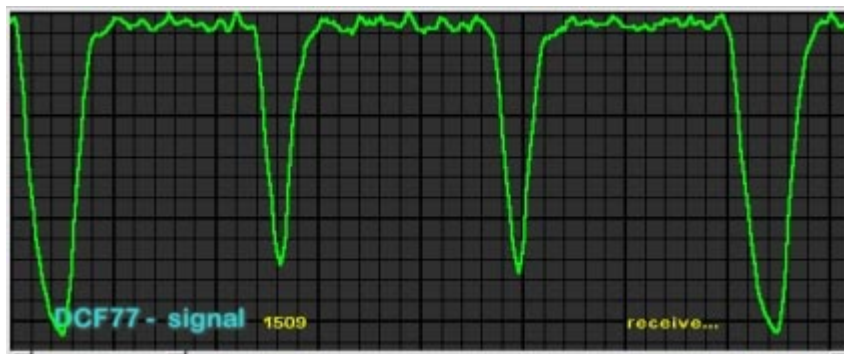
Monitors and TVs disturb the reception. The antenna should therefore be installed 5-10m away from these sources of interference

This pictures shows an interrupted reception. A reception is not possible with this signal.
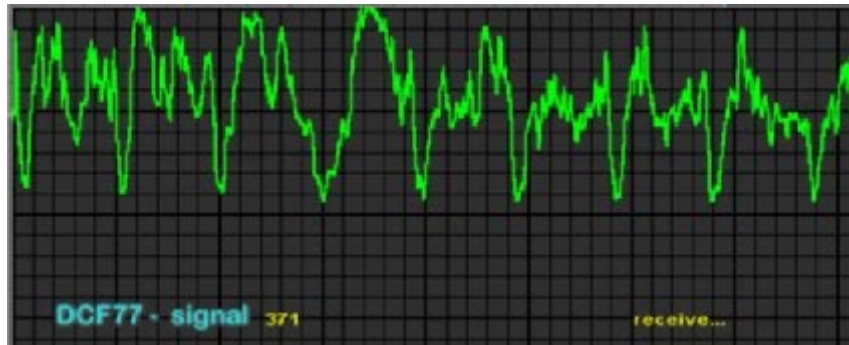

4.1.4 Timezone (Set Difference Time UTC/local)

The clock can operate in a time zone which is different to the one broadcasted by DCF77. Depending on the setting in the system byte the received time is only used for the calculation of UTC (Universal Time Co-ordinated). The UTC time is found by means of the offset stated in this dialogue (see also system byte).

The difference to **UTC** (Universal Time Co-ordinated) is entered in hours and minutes. The entry **[east]** or **[west]** determines the direction of the time offset.

Example:

Moscow Local Time differs by 02.00h east

Lissabon Local Time differs by 00.00h west

The difference between UTC and Local Time remains constant. When the daylight saving time is activated the clock adds one hour offset to the Local Time.

When the entry is completed the UTC time is calculated anew by finding the difference to the current local time. As the clock status is set to naught, you must enter time and date again after the difference time is set, or wait for a new synchronisation of the clock.

The top half of the window shows the current settings of the computer and also the set timezone.

4.1.5 Daylight Saving Time (Setting the changeover to daylight saving time)

When the clock is in the DCF77-sim mode or in the slave-clock mode outside the area of CEST the clock can operate with a different summertime from the one which is transmitted by DCF77.

In this mode the points of changeover of the local time to daylight saving time can be set. For setting these values activate the field "Automatically set Daylight Saving Time".

The line **start day** states when the daylight saving time is to start. The line **end day** states the point when the daylight saving time ends. Changeovers can take place either on the first, second, third, fourth or last day of the month. Additionally a time in hours and minutes is required.

When the values are entered the "Send to Clock" key must be used.

The exact date of the changeover is calculated from the entered values on the next minute change.

These values are automatically calculated for the following years and shown in the field "change over date".

If a changeover is not wanted deactivate the field "Automatically set Daylight Saving Time".

4.1.6 Parametering interface RS232

The radio controlled clock is equipped with a serial interface RS232c (V.24). The interface can be used to transmit time data strings to other computers.

The time information received from the DCF77 transmitter can be put out via interfaces in various data strings which include the internal status of the clock. This enables the user to synchronise connected computer systems with the atom precise time. The required outputs, the time information and the control characters and the data strings can be selected by means of this dialogue.

This menu offers the possibility to view and alter the configuration of the serial interface and of the data string.

The data are transmitted in ASCII as BCD values and can be shown by means of any terminal program (example: TERMINAL.EXE under Windows). The following control characters of the ASCII set of characters are possibly used in the data string.

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

After the entry the [send to clock] key must be used, which transfers the new parameter into the clock. When the parameter have successfully been transferred the data with the current setting appear in the dialogue field after some seconds. The changes parameters will take effect after the next minute change or a reset.

Now the setting is completed.

At present the filed "Serial out 2" is without any function.

4.1.7 Pulse Outputs

The clock module has three pulse outputs and optionally one IRIG-B output (see pin connections in the appendix).

The pulse outputs are freely programmable.

Functions of the pulse outputs:

- DCF77- simulation
- DCF77- simulation inverted

The local time information is put out in a data string as DCF77 simulation at the respective pulse output. This setting is used to synchronise other radio controlled clocks with 1 Hz pulse input like e.g. hopf 6036, 4980. The signal can also be put out invertedly. The settings for time information and cycle time have been deactivated.

- Cyclic pulses within 24 hours
- Cyclic pulses within 24 hours inverted

In this mode cyclic pulses with adjustable pulse width are produced at the output. The following pulse sequences 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 entries for day, month and year are switched off. The pulse duration can be selected in steps of 10 msec between 10-2550 msec. The pulse duration should not exceed the cycle time, because the outputs would be permanently switched active. The signal output can be inverted.

- Pulse per day or date (mode pulse one shot)
- Pulse per day or date inverted (mode pulse one shot inverted)

This mode produces either one pulse per day or one switching depending on the date at the output. The point of time for the output of the pulse is set in the fields (hour, minute, second). If "**00**" is selected for **"day"** and **"month"** the output is switched active at the set time every day. Otherwise it is switched through on the set date only.

The pulse duration can be set between 10 and 2550 msec in steps of 10 msec. The signal output can be inverted.

The synchronisation status can also be checked by the LED on the front panel (when the LED flashes in a cycle of 2Hz it means that the clock is in crystal operation. If the LED flashes every second it means that the clock is in radio controlled operation).

- System information

If the board is in operation the output is switched through ground. In off-line mode the output is of high impedance.

- Synchronisation information

If the radio bit is set, the output will be connected through ground. In case of a reception fault or after a time-out the output will be of high impedance.

4.1.8 IRIG-B Output

An **IRIG-B** signal is put out at the top BNC-connector (**I**nter-**R**ange **I**nstrumentation **G**roup standard time distribution signal **B**).

This signal, widely used in USA, is used to synchronise audio or video devices. But also some computer systems like **SUN SPARCstation** have **IRIG-B** inputs. The carrier frequency is 1 kHz. The amplitude is fixed to 2 Vss at 600 Ohm. The keying ratio of the carrier dip is 1:3. The minimum connection resistance must not drop below 50 Ohm. At 50 Ohm the amplitude drops to approx. 1.8 Vss.

The switches "UTC" and "local time" are used to select the time basis for the IRIG-B output.

binary seconds = off (not implemented at present)

Afnor-Code (not implemented at present)

4.1.9 DCF77 Pulse / Sync.-Bit

The output of the DCF77 simulation and of the radio bit are configured under this menu item.

The transmitter DCF77 broadcasts a data string which transmits the time information at the rate of 1 bit per second. The 100 or 200 msec long pulses (lowering of the amplitude) code the digital information (0/1). The narrow-band antennas of some radio controlled clocks distort the duration of the lowering and the receiver connected on load side is therefore adjusted to different pulse lengths.

This dialogue can be used to adjust the width of the low- and high pulses for the DCF77 simulation.

When "**DCF77 time out after [minutes]**" is set the output of the DCF77 simulation change into crystal operation can be switched off after the set time (2-254 minutes).

i.e. even when the radio reception is disturbed the DCF77-simulation is put out for the length of the set period. Therefore it is possible to continue operating connected devices during short failures.

If the value is 255 the simulation is not switched off (continuous simulation). This setting has an effect on a possibly set DCF77 simulation to the optical coupler and on the status LED in the front panel.

It is possible to delay the transfer of the information "**radio**" (change from radio to crystal operation) by about 2-254 minutes by means of the scroller in the group "**Sync-Bit Time Out after [minutes]**". If 225 minutes are selected the information "**radio**" is constantly passed on. This mechanism effects the transmission of the synchronisation status in the putout data strings of the serial interface and effects also possibly set radio bit (sync. information) at the optical couplers.

4.1.10 Version, System Byte

This dialogue shows the settings of the system byte and the software version of the clock board. Here the important operating modes of the clock are set. The bit positions have the following meaning at present:

b2	b1	b0	operating mode	meaning
0	0	0	crystal clock	no synchronisation by pulse or antenna difference time and changeover permitted
0	0	1	DCF77-master in the CEST area	reception via antenna difference time and changeover fixed
0	1	0	DCF77-Sim outside the CEST area	reception via antenna difference time and changeover permitted
0	1	1	slave clock byDCF77-pulse	like DCF77-master in the CEST area
1	0	0	slave clock by DCF77-pulse	like DCF77-Sim outside the CEST area

Bit 3 = 0   no function at present

Bit 3 = 1   no function at present

Bit 4 = 0   DCF77-Simulation = Local Time

Bit 4 = 1   DCF77-Simulation = Universal Time Co-ordinated (UTC)

It is possible to use low-active and high-active pulses in case of a clock synchronisation by the DCF77 pulse input. The identification takes place automatically.

This system byte serves to switch individual programmes / customised solutions.

4.1.11 Reset

This function is used to release a reset of the clock. When settings are changed and entered a reset must be carried out after the next minute change.

5 PC synchronisation

5.1.1 Synchronisation under Windows 95/98

The computer is synchronised after "**SYNCPROG.EXE**" is started in pre-set intervals of 60 seconds. After the program start a green clock symbol appears in the status line in the bottom left corner next to the system time. A double click on this symbol displays the status window of "**SYNCPROG.EXE**". Here you will see the conditions under which your computer is synchronised:

- Date/time: current time of the clock board for the synchronisation with the computer.

- Difference time: relative measure for the time error of a real-time application under Windows 95/98, and it should not exceed about ± 20 msec when the cycle time is 60 seconds. Windows 95/98 has no means to adjust the internal time, we therefore advise using the operating system Windows NT with the according clock drivers for time critical applications.

- Status information in hex is the hexadecimal clock status. You will find a more detailed description in the manual of your clock board.

- Announcement daylight saving time and leap second is the announcement of the clock board of a timezone changeover or the insertion of a leap second. The program uses this mechanism to synchronise the system instantly in case of a changeover.

You will find a menu from where you can stop the synchronisation process or fade out the status window by clicking at the clock symbol with the right mouse button or under "**adjustments**" in the menu bar of the status window.

After a restart of the program the computer is set once. It is not synchronised unless the built-in clock boards indicates at least a valid crystal time.

The accuracy of the synchronisation depends on the selected cycle time and on the operating system - under Windows 95/98 systems about ± 55 msec and under Windows NT ± 1 msec.

The radio controlled clock is synchronised with the local time. The following information are read from the clock and passed on to the operating system:
- local time
- offset UTC/local
- daylight saving time active

Important: The entry **"changeover clock automatically from daylight saving to standard time"** under timezone in the dialogue "set time" must be deactivated. These settings are taken over by **SYNCPROG.EXE**.

5.1.1.1 Changing the Setting of SYNCPROG.EXE

When first started, the synchronisation program "**SYNCPROG.EXE**" is initialised automatically with the standard values:

- synchronisation every 60 seconds

- synchronisation also in crystal operation

- program not started by Windows

Use the command **Set-up SyncProg** to alter the setting according to your requirements:

- **enable autostart** - when this option is active "**SYNCPROG.EXE**" starts automatically whenever Windows is started.

- **synchronize if radio** - when this option is active, synchronisation is done in radio operation only

- **synchronisation cycle time** - in this field you can determine the synchronisation intervals in the format STD:MIN:SEC

The checkbox "**synchronisation active**" shows if SyncProg is presently active.

5.1.2 Synchronisation under Windows NT/2000

HOPFSERV.EXE is a Windows NT and Windows 2000 Service to set the system time by means of a hopf_radio controlled clock 6039. The program uses the SystemAdjustCounter (mechanism to speed up the clock of the computer in steps of 100 nsec) for synchronisation, which avoids a hard setting of the clock time and the continuity of the internal time scale remains (important for applications which work with time stamps like e.g. SQL data base).

5.1.2.1 Configuration/settings

The service is configured by means of the file **HOPFSERV.INI**. The file can be edited by any ASCII Editor and it offers the following settings:

Synchronisation in crystal operation

- **StatusQ = TRUE** System is also synchronised in the crystal operation of the clock board

- **StatusQ = FALSE** System is not synchronised in the crystal operation of the clock board

Status messages in the event-logfile

- **Report = TRUE** messages are put out

- **Report = FALSE** no output

<u>The following messages are always put out:</u>

clock sync.-service start normal! start message

<u>The following messages are put out only if (Report = TRUE):</u>

"clock sync.-service running with crystal time greater x Min." clock has not had any reception for x minutes
"settime: Date xx.xx.xxxx Time: xx:xx.xxx Sta:xx" system was synchronised hard with stated time, this message should appear only after the service is started.

The entries can be viewed by means of the Evenlog Viewer.

<u>message of reception failure</u>

- AlarmTime = x (at least. 1 minute, up to 65535 minutes)

- If no value is entered here message is given after 30 minutes

HOPFSERV.EXE must be updated after every alteration. Please start the batch file **HOPFSERVSTOP.BAT** to delete the service. Afterwards reinstall the service with the batch file **HOPFSERVSTART.BAT**. These batch files enable you to uninstall and to install **HOPFSERV.EXE** only. You can check the correct installation by noting the entry **HOPFSERV** in the registry under

HKEY_LOCAL_MACHINE/SYSTEM/CurrentControlSet/Services.

After this process either the service must be activated again in the system control or the computer must be rebooted.

5.1.2.2 Synchronisation

The local time of the radio controlled clock is used for the synchronisation. The following information are taken from the clock and transferred to the operating system.

- UTC
- offset UTC/local
- daylight saving time active

IMPORTANT: In the dialogue "set time" of the computer the entry "**automatic changeover of clock to daylight saving/standard time**" under timezone must be activated. These settings are not done by **HOPFSERV.EXE**.

The clock system is synchronised by the clock board under the following circum-stances:

- the clock must have a valid time

- The clock of the computer is set hard only after booting/synchronisation after that the system time is adjusted by way of SystemAdjustmentCounter in steps of 100 nsec (fuzzy control)

When the computer time is altered manually it may therefore take several minutes before the synchronisation process carries out another hard setting of the computer.

If the time is set under Windows NT 3.51 the time must be set down to the seconds.

6 RS232 interface

6.1.1 RS232 interface standard data string

Some data strings are supported as standard time data strings:

- hopf_6021
- hopf_6021 with year 2000
- Siemens SINEC H1
- T-String
- Master/Slave

Customised data strings are available on request.
At present only the data string **"hopf 6021"** is implemented.

Serial Request:

This function is not available at present.

6.1.2 Data String 6021 Time and Date

character no.	meaning
1	STX (Start of Text)
2	Status (internal status of the clock)
3	day of the week (1= Monday...7=Sunday)
	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)
17	CR (Carriage Return)
18	ETX (End of Text)

6.1.3 Data String 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)
9	CR (Carriage Return)
10	ETX (End of Text)

6.1.3.1 Status and Day of the Week Nibble in the String 6021

The second and the third ASCII character in the data string contain the status and the day of the week. The status is decoded binarily. 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	Moday
	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

6.1.3.2 Example of a Transmitted Data String 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)

6.1.4 Data String 6021 String 2000

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

character no.:	meaning
1	STX (start of text)
2	Status (internal status of the clock)
3	day of the week (1=Monday ... 7=Sunday)
	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)
19	CR (carriage return)
20	ETX (end of text)

6.1.4.1 Status in the Data String 2000

The second and the third ASCII character in the data string contain the status and the
day of the week. The status is decoded binarily. 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

6.1.4.2 Example of a Transmitted Data String 2000

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

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

6.1.5 Data String SINEC H1

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

In this data string the transmission of the ASCII "?" releases an output.

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

6.1.5.1 Status in the Data String SINEC H1

The characters 28-31 in the data string SINEC H1 give information about the synchro-nisation 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 op-eration
character no.: 29 "*"		time from the internal crystal of the clock
	space	time from radio reception
character no.: 30 "S"		summertime
	space	wintertime
character no.: 31 "!"		announcement of a W/S or S/W changeover
	space	no announcement

6.1.5.2 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

6.1.6 Data String T-String

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

The data string can be requested with the character "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
24	LF (line feed)	$0A

6.1.6.1 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

6.1.7 Master/Slave-String

The master/slave string serves to synchronise slave systems with the time data of the master system up to an accuracy of ± 0.5msec. The difference to the DCF-slave string is that the difference time to UTC is included.

The difference time is transmitted in hours and minutes after the year. The transmission is done in BCD. The difference time may be up to ± 11.59 h.

The sign is shown as the highest bit in the hours.

    logic "1" = local time before UTC
    logic "0" = local time after UTC

Example:

    90.00 difference time + 10.00 h
    01.30 difference time -01.30 h

The complete data string is structured as follows:

character no.:	meaning	value (value range)
1	STX (start of text)	$02
2	Status	$30-39, $41-46
3	day of the week	$31-37
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	tens diff.-time + sign. h.	$30,$31,$38,$39
17	unit diff.-time hours	$30-39
18	tens diff. time minutes	$30-35
19	unit diff. time minutes	$30-39
20	LF (line feed)	$0A
21	CR (carriage return)	$0D
22	ETX (end of text)	$03

6.1.7.1 Status in the Data String Master-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 of leap second
	x	1	x	x	announcement of leap second
	0	x	x	x	crystal operation
	1	x	x	x	radio operation
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

6.1.7.2 Example of Transmitted Data String Master-Slave

(STX)831234560301968230(LF)(CR)(ETX)

- radio operation
- no announcement
- standard time
- It is Wednesday 03.01.96 - 12:34:56 h
- The difference time to UTC is + 2.30 h.

6.1.7.3 Setting

The following setting is required for the synchronisation of hopf_slave systems:

- output every minute
- output second advance
- output with control characters
- ETX on the second change
- 9600 baud, 8 bit, 1 stop bit, no parity
- LF, CR

This setting guarantees the best control of the time basis in the slave systems of more than ± 1 msec and the adjustment of the crystal for the free running operation to ± 1 ppm.

7 Settings

7.1.1 Time Zone

The time basis is selected in the field "**Time Zone**". When "**local time**" is selected, the time information (UTC ± difference time) including a possible summer time offset is put out. When "**UTC**" is selected the output data string is set to **UTC (universal time co-ordinated)**.

7.1.2 Transmission Point

The point of the output of the data string is selected in the group "**transmission point**". The following settings are possible:

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

7.1.3 Baudrate

In this dialogue field you can set-up the baud rate between 150 an 19200 baud.

7.1.4 Data Bit Length

In this dialogue field you have the choice of 7 or 8 data bits.

7.1.5 Stop Bit

In this dialogue field the number of stop bits are set.

7.1.6 Parity Bit

In this field you choose either even, odd or no parity bit.

7.1.7 Forerun

When the setting "yes" in the group "forerun" is activated the data string is put out with one second advance. This setting is favourable in particular in connection with the transmission "**as on time marker**", because at that time when this character arrives the present data string becomes valid. In that way you can exactly synchronise connected devices.

7.1.8 Control Character

Depending on the settings an **STX (0x02)** is added to the output data string at the beginning and an **ETX (0x03)** at the end. When the setting "**as on time marker**" has been activated the last character ETX is transmitted exactly on the edge of the next second change. If the setting "**as on time marker with delay**" is selected, the data string is sent with a delay depending on the baud rate. This procedure serves to calculate precisely the time in the computer which is to be synchronised.

Example:

In case of the setting **8 Bit, no Parity, 1 stop bit** the transmission of one character takes exactly 10 bit. At **9600 baud** a character takes about 1 msec for the transfer. The decoding computer must add this value as an offset to the latent time which is needed to react to the received time, to find its internal time.

Please note:

Some standard data strings do not contain ETX and STX. In these cases, if "as on time marker" is set, the last character is transmitted on the second change (e.g. T-String last character LF).

7.1.9 Control Character (CR/LF)

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

7.1.10 Front Panel

Front panel and pin-assignment of the 9-pole SUB-D connector
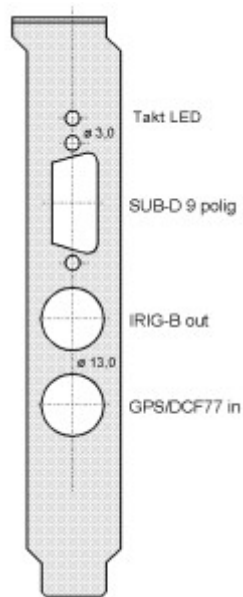
assignment SUB-D 9 pole

1	DCF77 pulse In
2	RS232 RxD
3	RS232 TxD
4	1 second
5	GND
6	1 kHz
7	pulse 1 (TTL)
8	pulse 2 (TTL)
9	pulse 3 (TTL)

7.1.11 Abbreviations

GPS	Global positioning system
DCF77	(D) German - (C) long wave signal - (F) Frankfurt a.M. - (77) frequency
UTC	Universal time co-ordinated
MEZ	central European time
GMT	Greenwich mean time
NTP	Network time protocol

7.1.12 Possible Errors

Error reception

After the installation even after several hours no valid time is displayed

Possible causes - Transmission

- The time code is transmitted in the longwave range by amplitude modulation.
  Therefore it can easily be disturbed. There are many external sources of dis-
  turbance i.e. corona discharges at high voltage lines, atmospheric distur-
  bances like thunderstorms on the way to the receiver. In case of a thunder-
  storm near the transmitter the transmission is interrupted for the length of the
  storm. This may take several hours.

Possible causes by starting operation

- the antenna is not optimal aimed at Mainflingen near by Frankfurt a. M.
- the cable is too long
- the BNC connectors are badly assembled
- the cable is crimped or bent
- the cable has the wrong impedance

Possible causes after successful installation

- the cable is damaged
- lightning has struck or the lightning protection has a defect
- the antenna has a defect
- the receiver has a defect
- the voltage supply is interrupted

Error PCI-Bus

If the service programme gives the message: "**no clock board found**" despite the fact
that the computer is equipped with it, or if some data points take false values please
check the following:

- is the board placed correctly in the PCI-bus slot
- are the contacts of the board soiled

7.1.13 Technical Data

General

PC board for the PCI bus

Voltage supply for the board:	+ 5 V DC / 0,31 A ± 5 % via PC bus
Temperature range:	0 - 50° C for the specified data
	0 - 70° C with reduced free-running characteristics
MTBF:	appr. 150,000 h

Receiver (Processor controlled AM / FM receiver DCF77)

Input impedance receiver:	< 50 Ohm
Sensitivity:	40 µV

Antenna

Antenna types:	see DCF77 accessories
Antenna cable length:	max. 500 m antenna cable RG59
Voltage supply for the antenna:	5 V DC over the antenna cable potential free

Accuracy

DCF77 reception:	± 2 msec.
Free-running characteristics:	± 2 ppm after VCO control at a constant temperature between +10°C and +50°C
Back-up clock:	± 25 ppm from +10°C to +50°C

Interfaces

- 1 serial interface RS232
- 3 variable pulse output in TTL level
- IRIG-B output: carrier 1kHz, 2 Vss at 50 ohm
- 1 kHz time in TTL level
- DCF77 time input

Serial interface parameter

Baud rates:	150 - 9,600 baud
Stopbit:	1 bit / 2 bit
Word length:	7 bit / 8 bit
Parity:	no, even or odd