Technical Description

GPS Satellite Clock
6842

Elektronik *GmbH*

Safety information

The Safety Instructions and Technical Data serve to ensure trouble-free operation and protection of operating personnel and equipment. Strict compliance with these instructions is therefore necessary.

Failure to comply with these Safety Instructions will VOID the Warranty and any claims made under its terms.

Further no liability will be assumed by *hopf* Elektronik GmbH, for ensuing consequential damages, resulting from non-compliance.

Safety of the Devices

This instrument has been manufactured in accordance with the latest technological standards and acknowledged safety regulations.

The instrument should only be operated and maintained by properly trained and qualified technical personnel.

Please ensure that all cable connections are laid and fixed in position correctly. The instrument should only be operated with the supply voltage indicated on the identification plate. Note that multiple input power options exist (factory installed).

If an instrument must be opened for repair, this should only be carried out by technicians or engineers with corresponding qualifications or by *hopf* Elektronik GmbH company, or its representatives.

If the maintenance work requires the opening of a device or if a fuse needs changing, the device must first be disconnected from all power 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 labeled accordingly.

The safety may be impaired when the device does not operate properly or if it is obviously damaged. Contact your local *hopf* Elektronik GmbH representative for required action.

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1 Brief Description Model 6842

The circuit board 6842 is a further development of the satellite radio controlled clock system 6840. When built into a system it can execute extended functions i.e. controlling a LAN-connection etc.

The measurements of the circuit boards correspond to the euro-format 100 mm x 160 mm. Particular care has been taken of the following features.

- potential separate antenna circuit
- no line length loss due to feeding in of indirect lightning protection
- antenna cable up to 150 m by simple cascading of an amplifier without own voltage supply into the antenna cable
- all settings can be parametered by serial interface

The device is configured by means of a key-pad on the front panel of the board by simple menu selection. The voltage supply and the signal transfer occur at a 64-pole VG-strip (DIN 41612 a/c inserted).

The voltage supply +5V DC / 1A is required.

At the exit the following signals are at hand:

- 1 PPS-pulse on TTL level
- 1 kHz square signal on TTL level
- 2 independent serial interfaces with handshake lines in RS232 and RS422 hardware
- 1 optical interface for either plastic or optical fibre
- DCF77[1] simulation
- variable pulse width for the DCF77 simulation

Board 6842G10

This identification number can be used to order this board as a spare part for the following radio controlled clock systems.

SYTEM 6842G01

Stand-alone system built in a ½ 19" module. As a standard it requires 230/120 V AC, further voltage supplies are possible on request.

System 6842G02

System in a ½ 19" wall housing as stand-alone system. A standard 230/120V AC voltage supply is needed, other voltage supplies are possible on request.

System 6842G03

Stand-alone system built in a ½ 19" table top housing. As a standard it requires 230/120 V AC voltage supply, further voltage supplies are possible on request.

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[1] DCF77 = (D) German - (C) long wave signal - (F) Frankfurt - (77) 77,5 kHz

2 <u>*Introduction*</u>

The *hopf* radio- / crystal clock systems well proved since 1975 have been extended by the GPS[2] receiver unit 6842, thus enabling the world wide use of this time base at highest precision level.

The time base is synchronised by the globally installed satellite-navigation system GPS. At a height of about 20 000 km satellites circle around the earth on different orbits and angles twice a day. On board each satellite there are high-precision atomic-clocks (precision min. 1x 10E-12). GPS reception units receive orbit position and GPS world time from as many satellites as possible. From these values the position of the receiver is calculated. Once the position is identified the delay time of the received GPS world time is calculated. The precision of the time depends above all on the quality of the position identification.

The world time UTC[3] is found by subtracting the leap seconds from the GPS-world time (GPS-UTC); at present (1994) the world time lags 8 seconds behind the GPS-UTC. The difference varies, depending on the insertion of leap seconds. It is possible for any point in the world to enter, by means of the system key pad, the difference to the UTC-time and the regional time changeover points for summer/winter time. Therefore a high precision local time is available for further use.

Various well-tried communication channels like:

- 2 serial RS232 interface
- 2 serial RS422 interface
- 1 kHz frequency output TTL-level
- PPS-pulse TTL-level
- DCF77 simulation of the local or UTC time to control further *hopf* radio controlled clocks
- optional fibre optic interface

are available.

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[2] GPS = Global Position System
[3] UTC = Universal Time Co-ordinated

3 Set-up

- connect voltage
- switch on voltage supply
- connect the GPS antenna
- enter local time
- enter time difference
- enter position   (not absolutely necessary)
- enter point of changeover **S ⇨ D**   (not absolutely necessary)
- enter point of changeover **D ⇨ S**   (not absolutely necessary)
- release program reset
- view time difference
- view position
- view point of changeover **S ⇨ D**
- view point of changeover **D ⇨ S**
- release master reset

3.1 Voltage Supply

The system is available with different voltage supplies. Therefore please take note of the right voltage and polarity when connecting the power supply.

The standard voltages available are:

for stand alone systems

- 230 V AC +10%, -15%
- 120 V AC +10%, -15%

Other voltage supplies are available on request

Please Note: SET-UP BY QUALIFIED PERSONNEL ONLY.

3.2 Antenna Installation

The connection to the antenna system is made by the female connector marked **"GPS-In"**.

The correct installation of the antenna system can be found in the **Appendix GPS** (General System Information GPS).

3.3 Set-up Base System

After supplying the correct operating voltage the device or the board is switched on and runs independently. The required settings can be entered by means of the key-pad.

3.3.1 Display

In case of the first set-up or after 3 days without voltage supply the following picture is displayed on the 2 x 16 digit LCD display:

LOC.-T: [1] 00:00:00
[2] S - C   [3] - -   [4] - - / - - - / - - - -

The positions have the following meaning:

[1] **LOC.-T:**   **00:00:00**

Here the local time is displayed.

[2] status display: If the standard output is the UTC-display,
UTC: appears instead of **LOC.-T:,**

position 1 **X--**   **"S"** for **s**tandard time

"D" for summer time (**d**aylight time)

position 2 **-X-**   **"A"** announcement of changeover to a different time zone. The announcement occurs one hour before the time zone changeover.

position 3 **--X**   Display of the internal status of the clock system:

"C" =   the clock system runs on crystal operation.

"r" =   the clock system is running GPS synchronously but without seconds and crystal adjustment control

"R" =   the clock system runs on GPS reception at highest accuracy and output of the PPS-pulse (R = radio).

[3] Display of the days of the week abbreviated:

MO - TU - WE - TH - FR - SA - SU

[4] Display of the date:

day / short form of month / year

The lighting of the display is switched on as soon as the voltage supply is connected or a key is pressed. If the key- pad is not used for any entries for 4 minutes the lighting switches itself off again. Thus ensuring a longer life of the display.

3.3.2 Standard Display

After a power cut (< 3 days), the display starts with the internally continued back-up clock information.

4 Key-Pad

1	2	3	4	+
5	6	7	8	-
9	0	A	B	BS
C	D	E	F	BR
N	W	S	Y	ENT
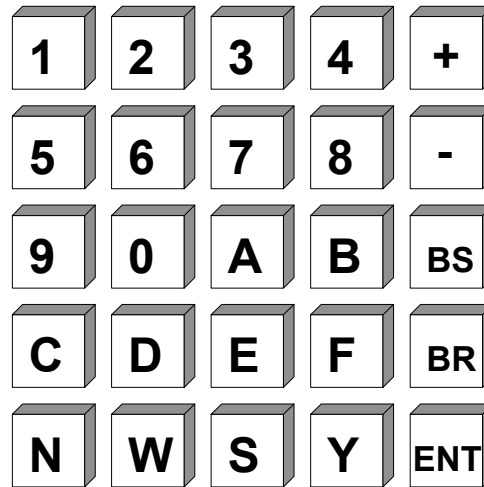
4.1 Key Functions

+/- = entry of sign of numbers

BS = BACKSPACE, deletes the last entry

BR = BREAK, stops all key controls

ENT = ENTER, activates the key pad and takes over entered values

4.1.1 Key-Pad Entry / System Control

The main menu is activated by pressing **"ENT"**.

The display changes from showing the time information to displaying the main menu, where at present 4 entry or control modes can be selected. The mode wanted is found by entering the according digit.

Start-picture:

SET = 1 SHOW = 2
S.CLOCK = 3 INI = 4

The modes have the following meaning:

SET: input of set functions like time/date, position, time offset etc.

SHOW: selection of display functions like time difference, position etc.

S.CLOCK: input of set functions like start, stop and pulse of synchronous clock

INI: initialising functions - these functions are required mainly by the production. They serve to set supervision times and pulse widths.

4.2 SET-Functions

When the number 1 is entered the program returns to the set-functions. The program is structured as a user guidance. All the sub-functions are shown on display and selected by

"Y"   = yes or turned down by

"N"   = no

any key but **"Y"** and **"BR"** is read as no.

When **"N"** is selected the next sub-function is displayed. At present the following set functions can be chosen.

4.2.1 Time/Date Entry

selection picture

SET TIME Y / N _

entry picture

TIME: HH:mm:ss

d.DD/MM/YY.Z

This entry function can set the local time. The entry has two lines and must be complete. Leading naughts must also be entered.

The positions have the following meaning:

Input	1. step	**HH**	=	hour	range	from 00 - 23
	2. step	**mm**	=	minute	"	from 00 - 59
	3. step	**ss**	=	seconds	"	from 00 - 59
	4. step	**d**	=	day of the week	"	from 1-7
				1 for Monday...7 for Sunday		
	5. step	**DD**	=	day	range	from 01 - 31
	6. step	**MM**	=	month	"	from 01 - 12
	7. step	**YYYY**	=	year	"	from 1990 - 2089

All entries are taken over by pressing the **"ENT"** key.

If the entry is plausible, the time is taken over into the system, otherwise the information **"INPUT-ERROR"** is shown for 3 seconds. The set-function is left at **"INPUT-ERROR"**, the standard picture is displayed again. To continue the entry any key but **"Y"** and **"BR"** may be pressed.

BReak leaves the set program. The standard picture reappears.

Please Note:	IN COUNTRIES WHICH CHANGE THEIR TIME-ZONE DURING THE COURSE OF THE YEAR THE CHANGEOVER TIMES MUST BE ENTERED. (SEE 4.2.3)

4.2.2 Time Difference

selection picture

SET DIF.-TIME Y/N _

entry picture

DIF-TIME: _

By means of this function the time difference between the local standard time and the world time (UTC time) is entered. The sign indicates in which direction the local standard time deviates from the world time.

Generally:

+ means east
– means west of the 0 meridian.

As most countries in the world chose their time difference in full hours, the entry is made in hour steps.

e.g. **+ 05:00**; - **11:00**

Some countries though have shorter time steps. Here minutes can be entered.

e.g. **+ 05:30**; - **8:45**

Please Note: THE TIME DIFFERENCE ALWAYS REFERS TO THE **LOCAL STANDARD TIME**, EVEN IF THE SET-UP OR ENTRY OF THE TIME DIFFERENCE OCCURS DURING THE SUMMER TIME.

4.2.3 Time Zone Changeover

Some countries in the world, depending on the season, have two time zones - a standard time (also called winter time) and a summer time. The summer time has a time offset of +1 hour compared to the standard time. The exact change over date for the current year is calculated by means of the entered parameters. The parameters allow a change over to any point of time. The user is informed by the **show**-function where the exact date is stated. If the country has no time zone changeover, naughts are entered in all positions.

selection picture

for daylight saving/standard time changeover

SET CHANGE-OVER
DATE D→ S Y/N

(**D**aylight saving time ⇨ **S**tandard time)

for the standard/daylight saving time changeover

SET CHANGE-OVER
DATE D→ S Y/N

(**S**tandard time ⇨ **D**aylight saving time)

entry picture

D → S hh/d/w/MM
>

S → D hh/d/w/MM
>

The entries have the following meaning

hh = the hour when the changeover is due

00 ... 23 h

d = the day of the week when the changeover is due

1 = Monday ... 7 = Sunday

w = the number of the day of the month when the changeover is due

1 ... 4 day of the week   e.g. 1 ... 4 th Sunday in the month

5 last day of the week e.g. last Sunday in the month

MM = the month when the changeover is due

The entry is completed by ENT.

4.2.4 Position

selection picture

SET Position
Y/N _

By means of this function the geographic position of the unit is entered. This function helps at first set-up, because it shortens the initialising of the GPS receiver, but it is not essential.

entry picture

LT._

Longitude and latitudes are entered with degrees and minutes starting with the sign for the latitude:

N = northern hemisphere
S = southern hemisphere

then degrees and minutes are entered, (two digits each), and 4 digits after the minutes.

entry picture

LT.N51°12,3651
LT._

The longitude entry starts with:

E = east of the 0 meridian
W = west of the 0 meridian,

then follows the entry for degrees - three digits - and after the separation point the minute entry follows (- two digits -) plus 4 digits after the minutes.

e.g. **N51°12.3651**
E007°37.8426

When **"ENT"** is pressed all entries are taken over.

For a faster synchronisation the GPS receiver only needs the entry of the approximate position. For the precise position in the above example the following entry would suffice:

N50°00.0000
E006°00.0000

4.2.5 Status and Pulse Output

There is a programmable output available at the connector strip (pin 8c) which can be assigned with status or pulse messages.

The programming is done by entering a byte. The programming is requested by the following picture:

SET STATUS- OR
PULS-OUTPUT Y/N

Entering (**Y**)es the entry picture appears

BIT   7654 3210

Only a "0" or a "1" can be set for the individual bits in the second line."1" is to be regarded as switch-on function. As there is only one output available only one "1" may be set in the byte. In case of several "1" statuses the function for the lowest bit is implemented.

The bits have the following meaning for the switching of the output to GND.

Bit 7	free	
Bit 6	free	
Bit 5	DCF77 pulse (time base: UTC)	
Bit 4	daily pulse (24 o'clock)	on-period 1 s
Bit 3	hour pulse	on-period 1 s
Bit 2	minute pulse	on-period 1 s
Bit 1	second marker	on-period 250 msec
Bit 0	status radio operation	

4.2.6 System Byte

The individual bits in the system byte can be used to switch on/off functions. At present no bit is in use.

4.2.7 Serial-Interface-Parameter

For each of the two interfaces the parameters like baud rate, parity etc. and the modes can be entered separately. The following selection pictures appear.

4.2.8 Selection Picture Parameter of Serial Interface

SET COM 0 SERIAL	or	SET COM 1 SERIAL	or	SET OPTICAL TRNS
PARAMETER Y/N _		PARAMETER Y/N _		PARAMETER Y/N _

see point 6: Parametering of the serial interfaces.

4.2.9 Setting Modebyte 1 Selection

selection picture

SET COM 0	or	SET COM 1	or	SET OPTICAL TRNS
MODE_1 Y/N _		MODE_1 Y/N _		MODE_1 Y/N _

4.2.10 Setting Modebyte 2 Selection

selection picture

SET COM 0	or	SET COM 1	or	SET OPTICAL TRNS
MODE_2 Y/N _		MODE_2 Y/N _		MODE_1 Y/N _

4.2.11 Selecting Display and DCF77-Simulation

For the display and the DCF77-simulation either local or UTC time can be selected.

selection picture

SET TIME-OUTPUTS
DISPLAY/DCF Y/N _

entry picture

LOC.-T = 0 UTC = 1
DISPLAY / DCF:

This can only be changed as a whole, the following combinations are possible:

display	DCF77-simulation	
LOC.-TIME	LOC.-TIME	0 / 0
LOC.-TIME	UTC.-TIME	0 / 1
UTC.-TIME	LOC.-TIME	1 / 0
UTC.-TIME	UTC.-TIME	1 / 1

4.2.12 LAN-IP-Addresses (Optional)

When the system is extended by one or two LAN-boards the LAN-IP address and another control bit can be entered via the key-pad.

For further information please see description LAN-board 7270

4.2.13 Frequency Input (Optional)

If a frequency output board is added to the system this function can be used to enter the frequency between 1 Hz to 10 MHz in steps of 1 Hz. The input mode is described in the description for the board 7530.

4.2.14 *Key-Word*

The entry via key-pad can be protected from unauthorised access by a 4-digit key-word. There is no key-word entered by our company. The customer must set it himself in the **"SET"**-menu.

selection picture

> **SET KEY-WORD**
> **Y/N**

After entering (**Y**)es the display shows the entry picture.

entry picture

> **KEY-WORD >_**

Now a 4-digit number can be entered as key-word except for the sequence

> **KEY-WORD >0 0 0 0**

because this sequence **deletes** the set key-word.

> **Please Note:** PLEASE KEEP THE KEY-WORD IN A SAFE BUT KNOWN PLACE.

In case the key-word is lost the circuit board must be returned to our company to be re-programmed.

The key-word is active the next time you turn to the menu.

When a menu item is selected you will be asked for the key-word.

> **KEY-WORD >_**

Every entry of a digit is indicated by a * and an arrow completes the entry after the fourth digit.

> **KEY-WORD >* * * *<**

"ENT" confirms the key-word. If the key-word is correct the according menu item is displayed.

In case of a false entry the following is displayed for 5 seconds

> **WRONG KEY-WORD**

After the 2nd false entry the following is displayed for 5 seconds

> **WRONG KEY-WORD**
> **! LAST CHANCE !**

After the 3rd false entry the following is displayed for 5 seconds

WRONG KEY-WORD

and when trying to restart the menu

KEY-PAD
SWITCHED OFF

is displayed.

The entry is blocked for 4 hours. Even rebooting the system does not affect the blocking period.

The system is still fully functional. After 4 minutes the display returns automatically or by pressing the **(BR)** key to the display of the time.

4.2.15 *Data Security*

All the entry data of points 4.2.2 - 4.2.13 are checked for plausibility and then stored in a voltage fail-safe EEPROM after the next minute change. To check the values a **program reset** or a **master reset** must be executed so that the stored values in the EEPROM are reread into the main memory.

4.3 Checking the Entered Values

To check the entered values or those updated by the GPS receiver, the **SHOW**-function is called up.

After jumping to the display of the main menu by pressing **"ENT"** the number **2** is entered. The first **SHOW** selection picture appears.

The **SHOW**-function can be interrupted by **"BR"** = break at any time.

4.3.1 Time Difference

This functions allows to view the actual time difference between the local time and UTC time.

selection picture

SHOW DIF.-TIME
Y/N _

After pressing **"Y"** the time difference is displayed e.g. as follows:

DIF.-TIME: +02:00 _

If **"N"** or any other key except **"Y"** and **"BR"** is entered the display jumps to the next selection picture.

4.3.2 Time Zone Changeover S ⇨ D

This function shows the point of changeover from standard time (winter time) to daylight time (summer time).

selection picture

SHOW CHANGE-OVER
S ⇨ D Y/N _

After pressing the **Y**es key the following is displayed.:

TIME: 02.00.00
7.29/03/1998 S>D

The changeover will be (was) on Sunday 29. March 1998 at 02.00 o'clock

4.3.3 Time Zone Changeover D ⇨ S

This function shows the point of changeover from daylight time (summer time) to standard time (winter time).

selection picture

SHOW CHANGE-OVER
D ⇨ S Y/N _

After pressing the **Y**es key the following is displayed:

TIME: 03.00.00
7.25/10/1998 D>S

The changeover will take place on Sunday 25th October 1998 at 03.00 o'clock .

4.3.4 *Position*

By means of this function the entered or the GPS updated position is displayed. 4 decimal points of the position minutes are displayed. GPS updates the position every second.

selection picture

SHOW POSITION
Y/N _

display

e.g. **LT. N51°12.6878'**

LN. E007°39.8032'   (position of *hopf* company in Lüdenscheid)

LT = latitude, **LN** = longitude

4.3.5 *Status and Pulse Output*

This function serves to show the programming byte for the output at Pin 8c of the VG strip.

request picture

SHOW STATUS- AND
PULS-OUTPUT Y/N

After entering (**Y**)es the following is displayed:

Bit 7 6 5 4 3 2 1 0
**   0 0 0 0 0 1 0 0**

This means that at output 8c a minute pulse is programmed.

4.3.6 Satellite Display

To synchronise the device with UTC, 4 satellites within the view range of the antenna are necessary. At best 9-10 satellites are within the view range of the antenna, out of which 6 can be received parallel.

By means of the menu choice

SHOW SATELLITES
Y/N _

the number of satellites within view, the number of received satellites and the relative measure for the reception power are displayed.

This function is particularly helpful during the installation of the device. After the menu item has been selected the following picture appears on display

V   :   :
**   :   :**

Under **(V)**isible the number of satellites visible for the ideal antenna position on this location is shown. This is a theoretical value.

Six satellites can be received but only four satellites can be shown in the display. Therefore the display switches over every five seconds.

The number before the colon is the satellite-pseudo-random-number. The satellites are not numbered 1, 2, 3 etc. but they have a pseudo random number under which the satellites broadcast their information. In case of a satellite failure a spare satellite can be activated under the same number.

The number after the colon stands for the signal-noise-ratio as relative figure. This can range between 0-255.

After the first installation it can take up to 1 hour before anything is written in the picture, depending on the start information the system receives (see programming time, position) and on the antenna position e.g. only half the sky within view.

If there are values in the system the display can look as follows:

V   05:137   17:043
07   :   :

7 satellites are in the theoretically visible range. The GPS receiver receives satellite 05 at a signal/noise ratio of 137 and satellite 17 at a signal/noise ratio of 43.

This number does not suffice for a synchronisation with UTC.

In case of a bad signal/noise ratio the value ranges between	**10 - 30**
In case of a sufficient signal/noise ratio the values range between	**30 - 70**
In case of a good signal/noise ratio the values range between	**> 70**

> **Please Note:** TO AVOID ERRORS IN THE MENU SELECTION, LEAVE THIS FUNCTION ONLY BY THE **"BR"** KEY.

4.3.7 Error Interpretation

Errors in the reception system can be recognised by means of the display picture of the satellites.

Example 1

No satellite appears in the display even after several hours after the first installation.

Possible faults:

- the antenna cable has a defect
- the antenna cable is not connected
- the antenna has a defect
- the lightning protection has a defect

Example 2

There are 7 satellites in the view range, but only up to 2 appear on the display.

Fault

- the visible range of the antenna is too small.

Example 3

9 satellites appear within the view range, 6 are received but the system does not synchronise because the signal/noise ratios all range between 10-25.

Possible faults:

- the cable is too long
- the BNC-connectors are badly assembled
- the cable is crimped or bent
- the cable have the wrong impedance

Example 4

The system has run perfectly so far. 7 satellites appear in the view range, none are tracked, the system has been running without reception for several days.

Possible faults:

- the cable has been damaged
- a flash of lightning has occurred and the lightning protection has a defect
- the antenna has a defect
- the receiver has a defect
- the voltage supply has a defect

4.3.8 *Error Byte*

To speed up the error analysis faulty functions or chips are shown in a bit in this error byte. A logic "0" means that the function or chip is o.k.. A logic "1" indicates that there is a fault.

At present the following bits in the error byte are in use:

Bit 7 = free
Bit 6 = free
Bit 5 = free
Bit 4 = free
Bit 3 = free
Bit 2 = free
Bit 1 = error in the GPS week-counter
Bit 0 = error in the calculation of the difference between local time and UTC

4.3.9 *Further SHOW-Functions*

There are further SHOW-functions e.g.

SHOW COM_1 SERIAL
PARAMETER Y/N   **etc.**

This is self-explanatory.

4.4 Initialising Functions

These ini-functions can be used to call up different tests during the set-up or to check internal functions. These functions are pre-set by the company.

The following entry sequence puts you into the initialising program. Pressing the key **"ENT"** shows the menu selection picture (see Pt. 4.1.1). Entering the digit **"4"** activates the functions of the initialising programs.

Entering break "**BR**" returns you to the standard display.

Several functions are available for the customer.

4.4.1 Delay of the Status Change

The display also shows in the serial data strings whether the system is synchronised by GPS or whether it is running on internal crystal basis. In connected devices this information is often used for error messages. To avoid a short interruption of the reception being interpreted as an error, the status change from reception to crystal basis can be delayed. The delay period can be set from 2-255 minutes.

Both viewing and changing the time is carried out in the same display picture by means of the following call-up.

TIME-OUT FOR STA-
TUS-CHANGE Y/N

Entering **"Y"** calls up the display picture:

STATUS CHANGE
AFTER > xxx < MIN

The xxx are replaced by the presently valid delay period.

The key **"+"** increases the time and **"–"** diminishes it.

When you leave the programme by means of the key **"BR"** the value displayed last is stored in a non-volatile memory.

4.4.2 Delaying the Time Out of the DCF77-Simulation

The start of the DCF77 antenna signal requires at least one previous synchronisation of the system with GPS, which guarantees the according accuracy of the signal. After that the DCF77-simulation continues running even after a GPS-synchronisation failure.

An error might not be detected by a connected device. Therefore the DCF77-signal is put out disturbed after a GPS-synchronisation failure. To avoid every short GPS-receiving disturbance to cause an immediate DCF77-signal disturbance, it is possible to delay the beginning of the disturbance.

The delay time can be set from 2 - 254 minutes. In case of 255 minutes a simulation is always carried out. Therefore a DCF77-simulation can be made for any other time entered via the key-pad. Usually this setting is used to test time depending functions in the connected devices. Please make sure that the antenna has been removed for this case, because the synchronisation via the antenna overwrites the time entered manually.

Both viewing and altering the time is carried out in the same display screen by means of the following call-up:

> **TIME-OUT FOR DCF-**
> **SIMULATION Y/N**

Entering **"Y"** calls up the display screen.

> **DCF-SIM STOP**
> **AFTER > xxx < MIN**

The presently valid delay time replaces the >xxx<.

The key **"+"** increases the time and **"–"** diminishes it.

When you leave the programme by means of the key **"BR"** the last displayed value is stored in a non-volatile memory.

4.4.3 *DCF77-Pulse Width*

In the DCF77 time data string the time information is transmitted in the BCD format. A logic 1 equals the pulse duration of 200 msec and a logic 0 equals 100 msec. Some manufacturers do not comply to this rule and give out shorter pulses e.g. 160 msec. for logic 1 and 70 msec. for logic 0. The pulse width can be altered so that these devices can be synchronised.

The display picture, used both for viewing as well as altering, is called up by the following command:

> **SET DCF**
> **HIGH-PULS Y/N**

Entering **"Y"** shows the following picture:

> **DCF HIGH-PULS**
> **>xxx< MSEC**

xxx are replaced by the pulse duration valid at present.

By means of the key **"+"** the pulse is increased and by **"–"** it is diminished.

When the program is left by the key Break **"BR"** the value displayed last is stored in a non-volatile memory.

The call-up to set the low-pulse follows the same pattern.

The high-pulse can vary between 150-250 msec. and the low-pulse can vary between 50-150 msec.

4.4.4 _Time Decoding 3D / Position fix_

The accuracy of the time decoding depends on how accurately the position of the operational location is calculated. At least 4 satellites are required (3D decoding). From the calculated position the transit time of the signal to several satellites is found and the second marker is produced from the average transit times. The 3D decoding mode allows the second marker to have an accuracy of ± 1 µsec.

In case of a fixed position quite often a less substantial decoding of the second marker suffices e.g. up to some milliseconds. In the position-fix mode the accuracy depends mainly on the precise entry of the position of the location of the installation. The calculation of the second marker already starts with one satellite and the entered position. An entry of the position to ± 1 minute degree achieves an accuracy of the second marker better than ± 20 µsec. An even more precise entry can achieve a value of ± 1 µsec.

The position-fix mode has the advantage that the clock synchronises with only one satellite. The antenna may be installed somewhere where less than ¼ of the sky is visible.

Often it is possible to install the antenna indoors at the window (short cable, no lightning protection). If 4 satellites are visible in this mode, the decoding jumps automatically into the 3D mode and calculates the exact position improving the accuracy to ± 1 µsec. for one satellite.

The following entry sequence set the modes

selection picture

SET POS. FIX / 3-D
ACCURACY Y/N

Entering **"Y"** shows the currently set mode

For position-fix decoding it is:

ACT. IS POS.FIX
FOR 3-D PUSH +

The accuracy can be changed to 3D by entering +.

The 3D decoding displays:

ACT. IS 3-D FOR
POS.FIX PUSH -

The variable accuracy can be changed to position fix by entering - (minus).

4.4.5 *Program-Reset*

With this function the program counter will be set back to the beginning. After jumping into the menu-picture by pressing **"ENT"** the Ini-range of functions is activated by digit 4. The first picture for the Ini-functions appears. After pressing any key except **"Y"** or **"BR"** several times the following option frame appears.

PROGRAMM RESET

Y/N _

After pressing **"Y"** the program-reset will be executed. The program jumps back to the beginning of the program. Other functions are not carried out.

4.4.6 *Master Reset*

The selection is done through the following picture:

MASTER RESET

Y/N _

After pressing **"Y"** the master-reset will be executed. The reset-connection of the board will be set to zero for a short time. Thereby all other modules in the system are set to zero and the program jumps back to the beginning of the program.

4.5 Summary Key Pad

- the menu is activated by pressing the **ENT** key.
- selection of functions by **1** to **4**
- switch to standard picture by **BR**eak
- end of entries by **ENT**er
- selection of individual functions by **Y**es
- pass function by No or any other key except **BR**eak and **Y**es.
- plausibility errors are indicated by **INPUT-ERROR**, new selection and entry is required.

4.5.1 Set Functions

valence

C	thousand	**T**	tens
D	hundred	**S**	unit
N	post decimal digit		

- local time

HOUR	T	H	0 - 2
HOUR	S	H	0 - 9
.			
MINUTE	T	m	0 - 5
MINUTE	S	m	0 - 9
.			
SECOND	T	s	0 - 5
SECOND	S	s	0 - 9
.			
.			
day of the week		d	1 - 7
.			
DAY	T	D	0 - 3
DAY	S	D	0 - 9
.			
MONTH	T	M	0 - 1
MONTH	S	M	0 - 9
.			
.			
YEAR	C	Y	1 - 2
YEAR	D	Y	0 - 9
YEAR	T	Y	0 - 9
YEAR	S	Y	0 - 9
.			

- TIME-OFFSET

sign ±	+ or -
tens digit hour	0 - 1
unit digit hour	0 - 9
.	
tens digit minute	0-5
unit digit minute	0-9

  point of time zone changeover
  data string as local time

- position

  latitude

sign	P	N or S	
degree	T	G	0 - 8
degree	S	C	0 - 9
.			
minute	T	M	0 - 5
minute	S	M	0 - 9
.			
post decimal pos.	N		0-9
post decimal pos.	N		0-9
post decimal pos.	N		0-9
post decimal pos.	N		0-9

  longitude

sign	P	E or W	
degree	H	G	0 - 1
degree	T	G	0 - 9
degree	S	C	0 - 9
.			
minute	T	M	0 - 5
minute	S	M	0 - 9
.			
post decimal pos.	N		0-9
post decimal pos.	N		0-9
post decimal pos.	N		0-9
post decimal pos.	N		0-9

4.6 Display Functions

- time-offset
- standard / daylight change-over
- daylight / standard change-over
- position
- satellite
- interface parameter
- interface mode byte
- LAN-IP address and control byte
- control of frequency board
- control of display
- pulse and status output
- system byte
- error byte

4.7 Control of Synchronous Clocks

If the circuit board 6842 is used in a sub-system with synchronous clock lines, these lines are controlled via menu pt. 3.

Up to 4 lines can be managed by the board (see description board 7406).

After menu pt.3 is called up, the selection picture for the number of the synchronous clock appears.

> **SLAVE CLOCK NO.**
> **1 - 4 >**

Entering number 1-4 selects the according synchronous clock line. This number is kept in all subsequent pictures.

To control the synchronous clock line the following points are available.

4.7.1 Viewing Synchronous Clock

This command shows all information about the synchronous clock.

selection picture

> **SLAVE CLOCK NO: x**
> **SHOW Y/N**

x = number of synchronous clock line

When **"Y"** is entered the status picture of the synchronous clocks is shown.

e.g.
> **SC.x R: 15.43.17**
> **3,0 s 19/01/98**

or
> **SC.x S: 15.45.18**
> **3,0 s 19/01/98**

x	=		stands for the selected synchronous clock line
R	=	**R**un	the synchronous clock is running
S	=	**S**top	the synchronous clock has stopped
			15.43.17 and 15.45.18 is the time of the synchronous clock
			15.43.18 19/01/98 date of the synchronous clock day/month/year

The display will be actualised every 5 seconds.

When pressing "**BR**" the display will be stopped and pressing "**ENT**" allows the change into the next menu.

4.7.2 Setting the Synchronous Clock

After commissioning or after repair works to the synchronous clock line the clocks must be up-dated to the current time.

selection picture

> **SLAVE CLOCK NO.x**
> **SET Y/N**

The entry picture appears once **"Y"** is entered.

> **SC.-NO. x SET TIME**
> **>**

The time shown by the **synchronous clocks** is now entered in **HR : MI : SE**, ended by **ENT**. The date is added automatically. The complete data string is now transmitted to the according synchronous clock. If this clock was stopped before this entry automatically starts the clock again. A master reset of the system also releases an automatic start of the clocks.

Please note the following: If synchronous clocks with 12 or 24 hour clocks are used together the time of the 24 hour clock must be entered.

4.7.3 Start/Stop Synchronous Clock

In case of commissioning or repairing the synchronous clock we advise stopping the clock line first.

All the clocks must be set mechanically to the same time in case of commissioning. Then following pt.5.2 puts the clock into operation.

The repair of a synchronous clock e.g. exchange of a clock, requires the mechanical setting of the exchanged clock to the time of the other clocks to put the line back into operation.

selection picture

> **SLAVE CLOCK NO.x**
> **RUN /STOP Y/N**

Entering **"Y"** shows the selection picture

> **SLAVE CLOCK NO.x**
> **RUN = + STOP = --**

+ = Start of the line
– = stopping the line

Completing the entry by ENT not necessary

4.7.4 *Synchronous Lines Pulse Time*

The analogue synchronous clocks need a pole-alternating setting pulse varying in length depending on the size. This pulse can be set individually for every line between 0.1 s and 3.1 s. The pulse break corresponds with the pulse duration so that a pulse cycle is twice as long as the adjusted pulse duration.

Selection picture

> **SLAVE CLOCK NO.x**
> **SET PULS Y/N**

The following entry picture appears once **"Y"** is entered

> **S.CLOCK x PULS**
> **IN=+/- > 3,0 < sec**

At present the valid pulse is up to 3.1 seconds long. It can be increased by + or diminished by - in steps of 0.1 sec.

The pulses are stored in a fail-safe memory. Completing the entry by **ENT** is not required.

When pressing "**BR**" the display will be stopped and pressing "**ENT**" allows the change into the next menu.

5 Configuration

5.1 Configuration of the Serial Interfaces

The clock is equipped with two serial interfaces with handshake lines, which can be set independently. Data can be exchanged via the RS232c (V.24) and RS422 (V.11) signal level. These interfaces can be used for the transmission of time data strings to other computers.

There is also an optical serial interface without handshake with plastic or optical fibre lines available for transmission.

Various data strings are available. Customised data strings are available on request. The following settings can be done individually for every serial interface.

5.2 Parameter of the Serial Transmission

The interface is parametered by means of the key pad. The setting for baud rate, data bit, stop bit and parity is reached by pressing the **[ENT]** key and selecting the **"SET"** function. In the selection dialogue the entry for **COM0**, **COM1** or **optical interface** must be chosen. Only the interface **0** is described below. The same settings apply to the interface **1** and for the optical interface.

- **[ENT]** - key
- **"1"** for "SET - functions"
- select "SET COM0 SERIAL PARAMETER Y/N"
- **"Y"**

The interface - parameter - dialogue appears on LCD-display showing:

    B:_

Here the baud rate must be entered as a five digit numeric value. The following entries are possible:

- 19200   for 19.200 baud
- 09600   for 9.600 baud
- 04800   for 4.800 baud
- 02400   for 2.400 baud
- 01200   for 1.200 baud
- 00600   for 600 baud
- 00300   for 300 baud
- 00150   for 150 baud

After the entry of the last digit the following message is displayed:

W:_

Here the number of data bit for the transmission must be entered. Possible entries are:

- 8   for 8 data bit
- 7   for 7 data bit

After the entry of the digit for the number of data bits the following message is displayed:

P:_

Here the type of parity bit for the transmission must be entered. Possible entries are:

- N   for no parity
- E   for parity even
- 0   for parity odd

The following message is displayed:

S:_

Here the number of stop bits for the transmission must be chosen:

- 1   for 1 stop bit
- 2   for 2 stop bit

Finally the release for the handshake lines RTS and CTS appears:

HS:_

The following can be entered here

- N   data transmission **without** handshake
- Y   data transmission **with** handshake

After the entry of the number of stop bits the key **[ENT]** must be pressed, which causes a plausibility check of all entries. If all the entries are plausible the settings are taken over.

Please Note:	IN CASE OF A FAULTY ENTRY YOU CAN USE THE KEY **[BS]** (BACKSPACE) TO RETURN TO THE PREVIOUS EDITING FIELD AND REWRITE IT.

5.3 Configuration of the Data String (Modebyte)

The time information received via satellite can be put out via the interface in a data string stating the internal clock status. This enables the user to synchronise connected computers with the atom accurate time. The read out point of time, the string structure and the used control characters can be chosen by entering the according **modebyte 1 and 2**.

You reach the set function for the **modebyte** via the following keys:

- **[ENT]** key
- **"1"** for "SET functions"
- selection of "SET COM0
  MODE 1 / 2 Y/N"
- **"Y"**

The input mask for the **modebyte** appears:

     BIT   7654 3210

The LCD cursor is now under the bit position 7. Every bit is like a switch by means of which the mode of the serial interface can be set. Depending on the required mode of the serial interface either

        0 = switch off

or   1 = switch on

must be entered under every bit position. The meaning of every bit position (switch) is explained in the chapters below.

5.3.1 Local Time or UTC in the Serial Output with Mode Byte 1

bit position 7	time zone
on	local time
off	UTC (Universal Time Co-ordinated)

5.3.2 Second Advance of Serial Output with Mode Byte 1

bit position 6	second advance
off	with second advance
on	without second advance

5.3.3 Bit 5

bit position 5	
off	free
on	free

5.3.4 *Last Control Character as On-Time-Mark with Modebyte 1*

In this setting the last control characters (see string structure) can be transmitted on the marker of the next second change.

bit position 4	control character on the second change
off	with control character on second change
on	without control character on second change

5.3.5 *Control Character CR and LF with Modebyte 1*

This switch is used to exchange the characters CR and LF.

bit position 3	control characters CR and LF
off	LF / CR
on	CR / LF

5.3.6 *Delayed Transmission*

In the setting "control characters on the second change" the last character of the data string is transmitted on the second change and straight afterwards the string which is valid for the new second change. This may cause error messages in computers under heavy load. Bit position 2 can be used to delay the transmission of the data string depending on the baudrate.

Example:

Baudrate 9600 Baud

Milliseconds	delayed	not delayed
000	final character (ETX)	final character (ETX)
002	–	new data string
025	–	end of new data string
930	new data string	-
955	end of new data string	–
000	final character (ETX)	final character (ETX)

Baudrate 2400 Baud

Milliseconds	delayed	not delayed
000	final character (ETX)	final character (ETX)
002	–	new data string
105	–	end of new data string
810	new data string	-
913	end of new data string	–
000	final character (ETX)	final character (ETX)

bit position 2	delayed transmission
off	with delay
on	without delay

5.3.7 *Synchronisation Point with Modebyte 1*

Bit 1	Bit 0	point of transmission
off	off	transmission every second
off	on	transmission on the minute change
on	off	transmission on the hour change
on	on	transmission on request only

5.3.8 *Selection of Data String with Modebyte 2*

This modebyte serves to set the putout data string. At present only bit position 0-3 are in function, the other bits are reserved for later extensions.

Bit position				structure of data string
3	2	1	0	
off	off	off	off	*hopf* Standard String (6021)
off	off	off	on	*hopf* 2000 - 4 digit year output
off	off	on	off	*hopf* Master/Slave-String
off	off	on	on	Siemens SINEC H1
off	on	off	off	T-String
off	on	off	on	IBM Sysplex-Timer Model 1 + 2
off	on	on	off	ALOHA Data String
off	on	on	on	SINEC H1 Extended
on	off	off	off	NMEA - GPRMC
on	off	off	on	SAT-1703 Time String

5.4 Data Format of the Serial Transmission

The data are transmitted as BCD values in ASCII and can be displayed by every terminal pro-gramme (e.g. TERMINAL.EXE under Windows). The following control characters from the AS-CII set of characters are used in the data string if necessary.

- $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 MUST BE DECODED SEPARATELY (SEE DATA STRING STRUC-TURE).

5.5 Serial Request

The requests of data strings which are not listed in this chapter are described with the data strings.

5.5.1 Serial Requests with ASCII Characters (Standard and Standard 2000)

The user can start a data string output using a control character. These control characters are:

- ASCII **"D"** -- for time/date (local time)
- ASCII **"G"** -- for UTC time/date

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

This is often too fast for the requesting computer. It is therefore possible to delay the answer in 10 msec. steps by software in case of request. To delay the transmission of the data string the small letters "d,g" are transmitted to the clock by the requesting computer with a two digit multi-plication factor.

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

Example:

The computer sends **ASCII gFF** (Hex 67, 46, 46)
The clock sends the data string UTC time/date after approx. 2550 milliseconds.

6 Data Strings

6.1 General Information about the Serial Data Output of the Board 6842

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

In all the data strings it is possible to exchange the control characters CR and LF by means of **mode byte 1**.

The transmitted data strings are compatible with the data strings of the following *hopf* radio controlled clocks.

- board 6020/6021   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
- board 6840/6841   standard with control characters
- system 4465   standard with control characters
- system 6870   standard with control characters

6.2 Structure of the Hopf Standard Data String

character no.	meaning
1	STX (start of text)
2	status (internal clock status)
3	day of the week (1=Monday...7=Sunday)
	for UTC time bit 3 is set to 1 in the day of the week
4	hour tens digit
5	hour unit digit
6	minute tens digit
7	minute unit digit
8	second tens digit
9	second unit digit
10	day tens digit
11	day unit digit
12	month tens digit
13	month unit digit
14	year tens digit
15	year unit digit
16	LF (line feed)
17	CR (carriage return)
18	ETX (end of text)

6.2.1 *Status and Day of the Week Nibble in the Hopf Standard Data String*

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

	b3	b2	b1	b0	meaning
status nibble:	x	x	x	0	no announcement hour
	x	x	x	1	announcement hour (ST-WT-ST)
	x	x	0	x	winter 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 (basic 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

6.2.2 *Example of a Transmitted Hopf Standard Data String*

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

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

6.3 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.

The data string can be requested by **"?"** and **"T"**.

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

6.3.1 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

6.3.2 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

6.4 Hopf Standard Data String String 2000

The structure of the data string is the same as the standard string and differs only in as much as the year is transmitted with 4 digits.

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)

6.4.1 *Data String 2000 Status- and Day of the Week Nibble*

The second and third ASCII-characters 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

6.4.2 *Example of a Transmitted Data String 2000*

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

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

6.5 Data String T-String

The T-string can be transmitted in all modes (e.g. **forerun** or **last control characters on the second change**).

The data string can be requested by "**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

6.5.1 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

6.6 *Master/Slave-String*

This master /slave string can be used to synchronise slave systems with the time data of the master system up to an accuracy of ± 0.5 msec. It differs from the DCF-slave-string in as much as the UTC time is included in the transmission.

The difference time is transmitted in hours and minutes following 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.
81.30	difference time	+ 01.30 h

The whole data string shows the following structure:

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 hour	$30$31,$38,$39
17	unit diff.time + hour	$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

6.6.1 *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 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

6.6.2 *Example of a 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 to UTC is +2.30 hours

6.6.3 *Settings*

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

- output every minute
- output second advance
- ETX on the second change
- 9600 baud, 8 bit, 1 stop bit, no parity

According setting for modebyte 1: **1000 0101**

Under this setting the time base is controlled perfectly in the slave systems.

Please Note:	FOR SPECIAL APPLICATIONS THE OUTPUT OF THE UTC TIME CAN BE ACTIVATED IN MODEBYTE 1.

6.7 Data String IBM 9037 Sysplex Timer

This data string is used to synchronise the IBM 9037 Sysplex Timer. The 9037 expects the time at its output every second. The following settings are required:

9600 baud, 8 data bit, parity odd, 1 stop bit, transmission on request without second advance and control characters.

When the Sysplex Timer is switched on it transmits the ASCII character "C" to the connected radio controlled clock, so that the protocol in the table below is put out automatically every second.

The setting UTC or local time are 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
16	LF (line feed)	$ 0A

6.7.1 Status in the Data String Sysplex Timer

Character number 14 informs about the synchronisation status of the clock. Possible values and their meaning are listed below.

"?"	=	question mark	=	no radio controlled time at hand
" "	=	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

6.7.2 Example of a Transmitted Data String Sysplex Timer

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

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

6.8 Data String ALOHA

The ALOAH data string refers to the data string IBM 9037 Sysplex Timer. All settings like transmission parameters and points of transmission can be set freely.

Except for the following points all settings are possible:

- **CR** and **LF** can't be swapped
- the output of the last character (**LF**) is <u>not</u> possible at the second change

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
16	LF (line feed)	$ 0A

6.8.1 Status in the Data String ALOHA

Character number 14 informs about the synchronisation status of the clock. Possible values and their meaning are listed below.

"?"	=	question mark	=	no radio controlled time at hand
" "	=	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

6.8.2 Example of a Transmitted Data String ALOHA

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

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

6.9 SINEC H1 Extended

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.

The data string can be requested by **"?"** and **"T"**.

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", "U" or space	$53 / $55 / $20
31	"!", "A" or space	$21 / $41 / $20
32	ETX (end of text)	$03

6.9.1 Status in the Data String SINEC H1 Extended

The characters 28-31 in the data string SINEC H1 Extended 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
                    "U"   UTC (see chapter 5.3.1)
                    space   standard time

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

6.9.2 Example of a Transmitted Data String SINEC H1 Extended

(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

6.10 NMEA - GPRMC

The full NMEA data string GPRMC contains the position-, rate- and time data (UTC) calculated by the GPS receiver. The different information is separated in the data string by a comma. Only a comma is set if an information is not available.

character no.:	meaning	value (value range)
1	$ string start	$24
2	"G" ASCII G	$47
3	"P" ASCII P	$50
4	"R" ASCII R	$52
5	"M" ASCII M	$4D
6	"C" ASCII C	$43
7	"," comma as separation	$2C
8	tens hour	$30-32
9	unit hour	$30-39
10	tens minute	$30-35
11	unit minute	$30-39
12	tens second	$30-35
13	unit second	$30-39
14	"." point as separation	$2E
15	tenth second	$30-39
16	hundredth second	$30-39
17	"," comma as separation	$2C
18	"A" ASCII A	$41
19	"," comma as separation	$2C
20	"," comma as separation	$2C
21	"," comma as separation	$2C
22	"," comma as separation	$2C
23	"," comma as separation	$2C
24	"," comma as separation	$2C
25	"," comma as separation	$2C
26	tens day	$30-33
27	unit day	$30-39
28	tens month	$30-31
29	unit month	$30-39
30	tens year	$30-39
31	unit year	$30-39
32	"," comma as separation	$2C
33	"," comma as separation	$2C
34	"*" string limitation	$2A
35	tens checksum	$30-39
36	unit checksum	$30-39
37	CR (carriage return)	$0D
38	LF (line feed)	$0A

All information will be transmitted as ASCII characters.

The checksum will be calculated from the XOR function of all transmitted ASCII characters between $ and *.

The following settings must be done on the board:

- baud rate = 4800 baud
- word length = 8 bit
- stop bit = 1
- parity = no parity
- transmission point = every second
- forerun off
- ETX immediately
- transmission delay off
- time base = UTC

6.10.1 Status

No status contained in data string NMEA GPRMC.

6.10.2 Example

$GPRMC,101640.00,A,,,,,,,150904,,*03 <CR><LF>

- It is the 15.09.2004
- 10:16:40 o'clock and 00 hundredth seconds
- checksum 03

6.11 *SAT-1703 Time String*

All modes can be transmitted with the SAT-1703 Time String (e.g. with forerun or end character at second change).

The SAT-1703 Time String can also be sent on request. The point of transmission will be set to "transmission on request". The SAT-1703 Time String can be requested with ASCII-character **"?"**.

character no.:	meaning	value (value range)
1	STX (start of text)	$02
2	tens Tag	$30-33
3	unit Tag	$30-39
4	"."	$2E
5	tens month	$30-31
6	unit month	$30-39
7	"."	$2E
8	tens year	$30-39
9	unit year	$30-39
10	"/"	$2F
11	unit day of the week	$31-37
12	"/"	$2F
13	tens hours	$30-32
14	unit hours	$30-39
15	":"	$3A
16	tens minutes	$30-35
17	unit minutes	$30-39
18	":"	$3A
19	tens seconds	$30-35
20	unit seconds	$30-39
21	"M" or "M" or "U"	$4D, $4D, $55
22	"E" or "E" or "T" (Standard time, daylight saving	$45, $45, $54
23	"Z" or "S" or "C" time or UTC)	$5A, $53, $43
24	" " or "Z" or " "	$20, $5A, $20
25	" " ($20 ⇨ synchronized) or "*" ($2A ⇨ not synchronized)	$20 $2A
26	" " ($20 ⇨ no announcement) or "!" ($21 ⇨ announcement of a W/S- or S/W-changeover)	$20 $21
27	CR (carriage return)	$0D
28	LF (line feed)	$0A
29	ETX	$03

6.11.1 *Example*

(STX)18.07.02/4/02:34:45UTC_ _ _ (CR)(LF)(ETX)

- It is Thursday 18.07.2002 - 02:34:45 o'clock UTC
- The System is synchronized by GPS

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7 Pin Allocation of Serial Interfaces

7.1 Pin Allocation of the 25 pole SUB-D female Connector COM 0

25-pole SUB-D female connector - pin no.	allocation			64-pole VG-strip pin no.
1		free		free
2	TxD	(transmit data)	RS232c	2a
3	RxD	(receive data)	RS232c	3a
4	RTS	(ready to send)	RS232c	4a
5	CTS	(clear to send)	RS232c	5a
6		free		free
7	0V	GND		7a
8		free		free
9		free		free
10		free		free
11	TxD	(transmit data)	RS422	10a
12	/TxD	(transmit data)	RS422	11a
13		free		free
14		free		free
15		free		free
16		free		free
17		free		free
18		free		free
19		free		free
20		free		free
21		free		free
22	RxD	(receive data)	RS422	12a
23	/RxD	(receive data)	RS422	13a
24		free		free
25		free		free

7.2 Pin Allocation of the 9 pole SUB-D female Connector COM 1

9-pole SUB-D female connector - pin no.	allocation			64-pole VG-strip pin no.
1	GND			7c
2	TxD	(transmit data)	RS232c	2c
3	RxD	(receive data)	RS232c	3c
4	/RxD	(receive data)	RS422	13c
5	RxD	(receive data)	RS422	12c
6	RTS	(ready to send)	RS232c	4c
7	CTS	(clear to send)	RS232c	5c
8	TxD	(transmit data)	RS422	10c
9	/TxD	(transmit data)	RS422	11c

8 Technical Data System 6842 GPS

General Data	
Operation:	Via keypad and LCD-Display (illuminated)
Housing protection class:	IP20
Protection class:	I, with PE connection.
Housing construction:	Sheet steel / aluminium, closed
Housing dimensions:	19" system, ½ 19" system, table top housing, wall housing (3U / 84HP, depth 243 mm)
Cooling:	passive cooling ⇨ attend aeration (convection): upside and below system 1U at least to the next device.
Display:	• LCD-Display 2x 16 digit, illuminated behind • Character height 5mm • Display type: alphanumeric
Keypad:	20 keys
MTBF (Base Board 6842):	> 300,000 hours
Weight:	approx. 3kg (depending of system extension)

Environmental Conditions		
Temperature range:	Operation:	0°C to +55°C
	Storage:	-20°C to +75°C
Humidity:		Max. 90%, not condensed

Power Supply	
Standard:	120/230V AC +10% -15% / 30VA
Option:	48V DC (36V - 72V) / 30VA
	24V DC (18V - 36V) / 30VA
	other power supplies on request
Power consumption:	Depending on power supply, system extensions and power rating (see type plate)

Back-up Clock	
Accuracy:	± 25ppm at +10°C to +50°C
Buffering (maintenance free):	3 days

CE compliant in accordance with EMC Directive 89/336/EEC and Low Voltage Directive 73/23/EEC	
Safety / Low Voltage Directive:	DIN EN 60950-1:2001 + A11 + Corrigendum
EMC (Electromagnetic Compatibility) / Interference Resistance:	EN 610000-4-2 /-3 /-4 /-5 /-6 /-11 EN 61000-3-2 /-3, EN 61000-6-2 /-4
Interference radiation / voltage	EN 55022 Class B

GPS Data	
Receiver type:	12 channel phase tracking receiver, C/A code
Evaluation:	L1 frequency (1575.42MHz)
Sensitivity:	-143dB

Synchronization time:	• Cold start: 5min - 30min (first initialization without position input) • Warm start: < 1min (voltage failure < 3 days)
Antenna connection:	• Via BNC socket • For active antennas, Ub = 5V DC • Antenna power fed via Board 6842 BNC socket

Accuracy (absolute to UTC ⇨ transmitted from GPS)	
Internal PPS pulse by GPS sync:	< ± 250ns (95%)
VCO control of internal crystal:	< ± 0,1ppm, after 30 min. GPS reception
Free running accuracy (after min. 4 hours continuously synchronization):	< ± 0,1ppm / T = +20°C • Drift for T = +20°C (constant): - after 1h: < ± 0,36msec
Internal Back-up clock	± 25ppm / for T = +10°C to +50°C

Signal Outputs (internal, System-Bus)		
PPS pulse / system bus	• Signal level: • Accuracy: • Pulse duration:	TTL (5V) like int. **PPS pulse** 2.. 20ms / ± 5ms
DCF77 pulse / system bus (time base: local / UTC)	• Signal level TTL (5V) • Accuracy: • Offset to internal PPS: • Pulse duration tolerance:	like int. **PPS pulse** ± 5µs ± 2ms
IMPO (Status / pulse output):	• Signal level:	TTL (5V)
DCF77 pulse, (time base: UTC)	• Accuracy: • Offset to internal PPS: • Pulse duration tolerance:	± 3µs + 19µs / ± 2µs ± 2ms
Status pulse	• Accuracy:	± 5ms
Second pulse	• Accuracy: • Pulse duration:	± 5ms 250msec / ± 2ms
Minute/Hour/Day pulse	• Accuracy: • Pulse duration:	± 5ms 1sec / ± 2ms

Signal Outputs (external)	
Serial full duplex interface (independently):	Via 9 and 25-pole SUB-D male connector • COM 0: RS232 und RS422 • COM 1: RS232 und RS422
DCF77 antenna simulation (77,5kHz):	Via BNC bush • Signal level: 3-5mV$_{ss}$ at 50Ω • Carrier frequency: 77,5kHz ± 25ppm • Accuracy: like int. **DCF77 pulse**

(1) Generating PPS and 1kHz the systems crystal frequency is the leading dimension and also deciding for the systems accuracy.

special requirements: hard- and software alterations according to customer specifications are possible

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