Technical Description

GPS Satellite Controlled Clock

6841

hopf

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1 Brief Description Model 6841

The ***hopf*** system 6841 is a further development of the satellite radio controlled clock system 6840. There are various electric and mechanical extension units available. The measurements of the circuit boards correspond to the euro-format 100 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

SYSTEM 6841G10

This system is situated in a 20TE plug-in cassette for 19"/3HE systems. The device is configured by means of a key-pad on the front panel of the board by simple menu selection. The voltage is supplied and the signal is transferred through a 64-pole VG-strip (DIN 41612 a/c inserted).

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

At the output 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
- DCF77[1] simulation
- Variable pulse settings for the DCF77-simulation

SYSTEM 6841G11

Stand-alone system built in a ½ 19" rack. A standard 230/120V AC voltage supply is needed, other voltage supplies are possible on request.

SYSTEM 6841G12

The plug-in cassette is built into 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 6841G13

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

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

2 Introduction

The ***hopf*** radio- / crystal clock systems, well proved since 1975, have been extended by the GPS[1] receiver unit 6841, 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 (see picture in the appendix). On board each satellite there is a high precision atomic-clock (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[2] 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:

- serial RS232 interface
- serial RS422 interface
- frequency output
- PPS-pulse

are available. Also a DCF77-simulation of the local and UTC-time is integrated for the possible control of all ***hopf*** clocks.

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

3 Set-up

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%

for plug-in cassettes

- + 5V/1A DC, +/-5%

Other voltage supplies are available on request.

Please note : Set-up by qualified personnel only.

3.2 Antenna Installation

To guarantee a GPS-reception as constant as possible the antenna must have free "view" of the whole horizon. The dimensional design of the antenna enables it to cover satellites from 10° above the horizon. To decode position and time a "view" to 4 satellites is necessary. If the view of the sky is hidden by buildings the GPS receiver cannot decode the exact time. It waits for 4 satellites to move into "view", which might take up to 4 hours in the case of an unfavourable satellite constellation. The antenna should therefore be installed in the highest roof position (see diagram in the appendix).

3.3 Coaxial Cable Installation

The antenna is connected to the base unit by the included coaxial cable. A coaxial coupling connects cable and antenna in the antenna plate foot. To lay the cable, the coupling may be disconnected by opening the screw at the antenna foot and lifting the foot.

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

The leakage from these cables could, because of the extremely low received power, interfere with the GPS reception.

The cable is connected to the base unit at the connector **"GPS in"** of the packaged module. The antenna cable is up to 25m long (with special cable up to 50m). If the cable is longer than 25m (or 50m) up to 150m you need a GPS cable-amplifier.

Please note : The laying of the cable has to be carried out with utmost care.

Please ensure that:

- 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

One critical point is also the previously installed BNC-male connectors. Please remove the protection after having laid the cable.

3.4 Reception Frequencies

The satellite transmits two frequencies:

L1 at 1575.42 MHz and L2 at 1227.6 MHz

L1 can be used for civil purposes. The received power is about - 160 dB. The antenna contains a pre-amplifier which boosts the received satellite frequency by + 20 dB.

3.5 Set-up Base System

After supplying the correct operating voltage the device or the board is switched on.

In case of the version without key-pad and display the required settings can also be carried out using some service software (**GPS_INIT.EXE**) via the serial interface. It needs a PC/notebook with a free serial interface and the operating system Microsoft Windows from 3.x, 95, NT.

Please note : A description for the service software is in the appendix 6841G00 remote software.

3.5.1 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 UTC-display is the standard output, **UTC:** appears instead of **LOC.-T:**,

position 1 **X—** **"S"** for standard time
"D" for daylight saving time (daylight 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 (C = crystal).
- **"r"** = the clock system is running GPS synchronously but without seconds and crystal adjustment control (see also pt.4.5.1)
- **"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 - DI - MI - DO - FR - SA - SO **(MO - TU - WE - TH - FR - SA - SU)**

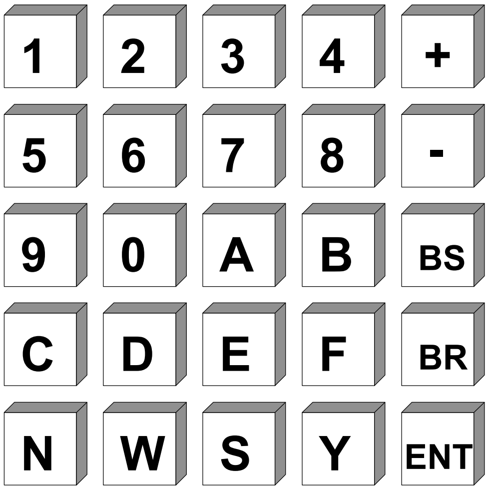
[4] Display of the date:
day / abbreviation of month / year

The illumination 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 illumination switches itself off again.

3.5.2 Standard Display

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

4 Key-Pad



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 enters values

4.1.1 Key-Pad Entry / System Control

The key pad is activated by pressing **"ENT"**.

The display jumps from the standard picture, display of the time information, into the start picture to the key-pad or system control. 3 input or control modes can be selected at present. By entering the according numbers the key entry jumps to the according mode.

Start-picture:

SET = 1 **SHOW = 2**
INI = 3

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

4.2 SET-Functions

When the figure 1 is entered the programme returns to the set-functions. The programme 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/YYYY

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**	= second	"	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**	= years	"	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 programme. The standard picture reappears.

Please note : The changeover dates must be entered for those countries which change their timezone during the course of the year (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 it is :

- \+ 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 hourly 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 daylight saving time.

4.2.3 Time Zone Changeover

In some countries on earth there are, depending on the season, two time zones - standard time (also called wintertime) and daylight saving time. The daylight saving time has a time offset of +1 h compared to the standard time. The precise dates of changeover for the current year are calculated automatically from the entered parameter. The parameter have been chosen so that the changeover can take place at any point of time. To check the entered dates the **Show**-functions can be opened. If the particular country does not have time zone changeovers naughts must be entered in all data positions.

selection picture

for daylight saving /wintertime changeover	for winter/daylight saving time changeover
SET CHANGE-OVER **DATE D → S Y/N**	**SET CHANGE-OVER** **DATE S → D Y/N**
(**D**ay-light-saving-time⇨**S**tandard-time)	(**S**tandard-time ⇨ **D**ay-light saving time)

entry picture

D → S hh/d/w/MM **>**	**S → D hh/d/w/MM** **>**

The individual entries have the following meaning

hh = the hour when the changeover is to take place
00 ... 23 h

d = the day of the week when the changeover is to take place
1 = Monday ... 7 = Sunday

w = the first, second .. weekday in the month when the changeover is to take place
1 ... 4 day of the week e.g. 1st ... 4th Sunday in the month
5 last day of the week e.g. last Sunday in the month

MM = the month when the changeover is to take place

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
LN._

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

A programmable output is available at the connector (pin 8c) which can be used for status or pulse messages.
The programming requires the entry of one byte. The programming is called up with the following picture:

SET STATUS- OR
PULS-OUTPUT Y/N

Entering (**Y**)es calls up the entry picture

BIT 7654 3210

Only a "0" or a "1"for the individual bits may be entered in the second line, where "1" is to be regarded as lock-on function. As there is only an output available, nothing but one "1" may be set in the byte. In case of several "1" conditions the function for the lowest bit is carried out.

The bits have the following meaning for the switching of the output after 0.

Bit 7	free	
Bit 6	free	
Bit 5	free	
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 different bits in the system byte can be used to switch functions on /off. At present none of the bits are used.

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 Interfaces

SET COM0 SERIAL	or	**SET COM1 SERIAL**
PARAMER Y/N		**PARAMETER Y/N**

see point 6: Parameter of the Serial Transmission

4.2.9 Setting Modebyte 1 Selection

selection picture

SET COM 0	or	**SET COM1**
MODE_1 Y/N_		**MODE_1 Y/N_**

see point 7 "Configuration of the Data String (Mode byte)"

4.2.10 Setting Mode Byte 2 Selection

selection picture

SET COM 0	**or**	**SET COM 1**
MODE_2 Y/N _		**MODE_2 Y/N _**

see point 7 "Configuration of the Data String (Mode byte)"

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 Data Security

All the entry data of points 4.2.2 - 4.2.4 are checked for plausibility and then stored in a voltage fail-safe EEPROM. To check the values a **p**rogramme **r**eset or a **m**aster **r**eset is carried out so that the stored values in the EEPROM are reread into the working memory.

4.2.13 Entry of Frequency (option)

When the system is extended by a frequency output, this function can be used to set the frequency between 1 Hz to 10 MHz in steps of 1 Hz.

selection picture

SET FREQUENCY
Y/N

If (**Y**)es the following entry picture is shown

FREQUENCY
>   <

8 digits of the wanted frequency must be entered starting with 10MHz.

e.g.	10 MHz	1 Hz
	FREQUENCY	FREQUENCY
	>10.000.000< Hz	>00.000.001< Hz

The points between the digits and the limiting arrows help to read the figures, they are added automatically during the entry.

The entry is completed by **ENT**.

The set frequency is stored in a fail-safe memory. The entry and the memory can be checked in the SHOW-menu.

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 key-pad basic picture by pressing **"ENT"** the figure **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 current time difference between the local time and UTC time.

selection picture

SHOW DIF.-TIME
Y/N _

After pressing **"Y"** the time difference is displayed 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 D ⇨ S

This function shows the point of changeover from **d**aylight time (summer time) to **s**tandard 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 takes/took place on Sunday 25th September 1998 at 03.00 o'clock .

4.3.3 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 98 at 02.00 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 is used to display the programming byte for the output at pin 8c on the VG-ledge.

selection picture

SHOW STATUS- AND
PULS-OUTPUT Y/N

Entering (**Y**)es calls up the following display for example:

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

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

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 optimal antenna position on this location is shown.

Six satellites can be received but only four satellites can be shown in the display. Therefore the display switch 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 in dB. This can lie 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 - 140**

Please note : To avoid errors in the menu selection,do not use any key but **"BR"** to leave this function.

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

Faulty functions or chips are shown in the error byte in a bit for a faster error analysis. A logic "0" shows that the function or the chip are o.k. A logic "1" shows that there is an error.

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

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

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 programme. Pressing the key **"ENT"** shows the menu selection picture(see Pt. 4.1.1). Entering the digit **"3"** activates the functions of the initialising programmes.

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 reception interruption 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 logical 1 equals the pulse duration of 200 msec and a logical 0 equals 100 msec. Some makes do not comply to this rule and give out shorter pulses e.g. 160 msec for logical 1 and 70 msec for logical 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 programme 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 starts with one satellite and the entered position already. An entry of the position to ± 1 minute degree achieves an accuracy of the second marker better than ± 20 µsec. An entry even more precise can achieve the value ± 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 against 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:

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

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

The 3D decoding displays:

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

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

4.4.5 Programme-Reset

With this function the programme counter will be set back. After jumping into the menu-picture by pressing **"ENT"** the **I**ni-range of functions is activated by digit **3**. The first picture for the **I**ni-functions appears.

PROGRAMM RESET

Y/N _

After pressing **"Y"** the **p**rogramme-**r**eset will be executed. The programme jumps back to the beginning of the programme. Other functions are not carried out.

4.4.6 Master Reset

The selection occur by the following picture:

MASTER RESET

Y/N _

After pressing **"Y"** the **m**aster-**r**eset 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 programme jumps back to the beginning of the programme.

4.5 Summary Key Pad

- the key pad is activated by pressing the **ENT** key.
- selection of functions by **1** to **3**
- switch to standard picture by **BR**eak
- end of entries by **ENT**er
- selection of individual functions by **Y**es
- pass function by **N**o 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 valence

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 position		N	0 - 9
post decimal position		N	0 - 9
post decimal position		N	0 - 9
post decimal position		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 position		N	0-9
post decimal position		N	0-9
post decimal position		N	0-9
post decimal position		N	0-9

4.6 Display Functions

- time-offset
- standard / daylight change-over
- daylight / standard change-over
- position
- satellite
- interface parameter
- interface mode byte
- display control
- pulse and status output
- system byte
- error byte

4.7 Set-up

- connect the GPS antenna
- connect voltage
- switch on voltage supply
- 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)
- cause programme reset
- view time difference
- view position
- view point of changeover **S** ⇨ **D**
- view point of changeover **D** ⇨ **S**
- cause master reset

5 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.

As a standard time data string the ***hopf*** 6021, Siemens MADAM-S and SINEC H1, IBM Sysplex and ABB T-string data strings are supported by control signals. Customised data strings are available on request. The following settings can be carried out separately for each serial interface.

6 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** or **COM1** must be chosen. Only the interface **0** is described below. The same settings apply to the interface **1**.

- **[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

After the entry 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.

7 Configuration of the Data String (Mode byte)

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 **mode byte 1 and 2**.

You reach the set function for the **mode byte** via the following keys:

- **[Enter]**
- **"1"** for "SET functions"
- selection of "SET COM 0
- MODE 1 / 2 Y/N"
- **"Y"**

The input mask for the **mode byte** 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.

7.1 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)

7.2 Second Advance of Serial Output with Mode Byte 1

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

7.3 Transmission with Control Characters STX/ETX with Mode Byte 1

This setting only applies to data strings which have control characters as delimiters (see string structure of the respective string).

Bit position 5	transmission with control characters
off	with control characters
on	without control characters

7.4 Last Control Character as On-Time-Mark with Mode Byte 1

When this setting has been activated and also the transmission with control characters (STX/ETX) has been selected, the final character (see string structure) is transmitted on the marker of the next second change.

Bit position 4	control character on the second change only if selected with control character
off	with control characters on second change
on	without control characters on second change

7.5 Control Characters CR and LF with Mode Byte 1

This switch can be used to change the order of CR and LF.

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

7.6 Delayed Transmission

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

example:

baud rate 9600 baud

milliseconds	with delay	without delay
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)

baud rate 2400 baud

milliseconds	with delay	without delay
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

7.7 Synchronisation Point of Time with Mode Byte 1

bit 1	bit 0	transmission point of time
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

7.8 Selecting the Data String with Mode Byte 2

This mode byte sets the putout data string. At present only the bit positions 0-3 and 7 have a function, the other bits are planned for future extensions.

Bit 7 = on:

Instead of the data string 6841 time-date (with year 2000 / with checksum) the data string 6841 time only is put out. If the request is done by D, d, G, g the according data string is answered.

bit position				string structure
3	2	1	0	
off	off	off	off	standard data string 6841 (6021 compatible)
off	off	off	on	standard data string 6841 (6021) time only
off	off	on	off	DCF-slave
off	off	on	on	Siemens SINEC H1
off	on	off	off	Siemens Madam-S
off	on	off	on	IBM Sysplex Timer
off	on	on	off	standard data string 6841 (6021) with year 2000
off	on	on	on	T-string
on	off	off	off	ABB_S_T-string
on	off	off	on	NGTS-string
on	off	on	off	master/slave-string
on	off	on	on	AEG-ffm-string (6021 & checksum)
on	on	off	off	PCZ 77 Uhrzeit /Datum
on	on	off	on	PCZ 77 Uhrzeit
on	on	on	off	CCSDS-string
on	on	on	on	at present standard data string 6841 (6021)

7.9 Data Format of the Serial Transmission

The data are transmitted as BCD values in ASCII and can be displayed by every terminal programme (e.g. TERMINAL.EXE under Windows). The following control characters from the ASCII 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 structure).

7.10 Serial Request

The request of strings which are not listed in this chapter is described in the chapter for the data strings.

7.10.1 Serial Request with ASCII Characters (6021 standard)

The user is able to put out the data string by means of an ASCII character. The following characters release a transmission of the string 6021:

- ASCII "U" - for time (Local-Time)
- ASCII "D" - for time / date (Local-Time)
- ASCII "G" - for time / date (UTC-Time)

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 steps of 10 msec in case of a request via software. To achieve the delayed transmission of the data string the requesting computer transmits the small letters "u, d, g" combined with a two digit multiplication factor to the clock.

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

Example :

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

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

7.10.2 Serial Request with String 2000

All standard requests will be answered.

If the date is included it will be put out in 4 digits (Format: String 2000).

7.10.3 Serial Request with AEG-ffm

All standard requests will be answered.

If the date is put out the checksum is also included (format: AEG-ffm).

Exception to the possibilities described in the previous chapter:

ASCII g The clock transmits immediately the UTC time in the format: "time only (without date)".

7.10.4 Serial Request with String 6841 Time only

All standard questions are answered the string **time only**! If the date should be included one of the previous strings must be set, and bit 7 must be set in the mode byte 2 of the interface (see chapter: selection of data string with mode byte 2).

7.10.5 Serial Requests in MADAM- S

In case of MADAM-S output compatible, the output on request only can be activated by the following character sequence only

:ZSYS:

or **:WILA:**

Please note : In case of output on request it should be set in the mode-byte 1, otherwise an active cyclic output can cause a delay in the answer.

8 Data Strings

8.1 General Information about the Serial Data Output of the 6841

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

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 6025/6027 standard with control characters (string 6021 only)
- 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
- board 4465 standard with control characters

8.2 Structure of the Data String 6841/6021 Time and Date (standard)

character no.	meaning	
1	STX (start of text)	
2	status (internal clock status)	; see pt. 8.2.1
3	day of the week (1=Monday...7=Sunday) for UTC time bit 3 is set to 1 in the day of the week	; see pt. 8.2.1
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)	; see 8.1
17	CR (carriage return)	; see 8.1
18	ETX (end of text)	

8.2.1 Status and Day of the Week Nibble in the Data String 6841/6021

The second and the third ASCII-characters contain the status and the day of the week. The status is decoded binarily. The 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	quartz 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

8.2.2 Example of Data String 6841/6021

(STX)E3132958230793(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)

8.2.3 Data String 6841/6021 Time only

character no.	meaning	
1	STX (start of text)	
2	hour tens digit	
3	hour unit digit	
4	minute tens digit	
5	minute unit digit	
6	second tens digit	
7	second unit digit	
8	LF (line feed)	;see 8.1
9	CR (carriage return)	;see 8.1
10	ETX (end of text)	

8.3 Structure of the Data String DCF-Slave

The following data string is used to synchronise **hopf** DCF-slave systems. The only difference to the standard data string 7001 / 6021 is the status byte.

character no.	meaning	value (value range)	
1	STX (start of text)	$02	
2	status	$30-39,$41-46	;see 8.3.1
3	day of the week	$31-37	;see 8.3.1
4	tens - hour	$30-32	
5	unit - hour	$30-39	
6	tens- minute	$30-35	
7	unit - minute	$30-39	
8	tens - second	$30-36	
9	unit - second	$30-39	
10	tens - day	$30-33	
11	unit - day	$30-39	
12	tens - month	$30-31	
13	unit - month	$30-39	
14	tens - year	$30-39	
15	unit - year	$30-39	
16	LF (line feed)	$0A	; see 8.1
17	CR (carriage Return)	$0D	; see 8.1
18	ETX (end of text)	$03	

8.3.1 Status in the Data String DCF-Slave

	b3	b2	b1	b0	meaning
status nibble:	x	x	x	0	no announcement hour
	x	x	x	1	announcement (ST-WT-ST)
	x	x	0	x	standard time (WT)
	x	x	1	x	daylight saving time(ST)
	x	0	x	x	no announcement leap second
	x	1	x	x	announcement leap second
	0	1	x	x	quartz operation
	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

8.3.2 Example of a transmitted Data String DCF Slave

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

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

8.3.3 Setting

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

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

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

8.4 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 string can be requested by **"?"**.

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	; see 8.4.1
29	"*" or space	$2A / $20	; see 8.4.1
30	"S" or space	$53 / $20	; see 8.4.1
31	"!" or space	$21 / $20	; see 8.4.1
32	ETX (end of text)	$03	

8.4.1 Status in the Data String SINEC- H1

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

meaning of the following:

character no.:28 =	"#"	no radio synchronisation after reset, time invalid
	space	radio synchronisation after reset, clock at least in crystal operation
character no.: 29 =	"*"	time from the internal crystal
	space	time from radio reception
character no.: 30 =	"S"	daylight saving time
	space	standard time
character no.: 31 =	"!"	announcement of a W/S or S/W changeover
	space	no announcement

8.4.2 Example of a Transmitted Data String SINEC H1

(STX)D:03.01.96;T:1;U:12.34.56; _ _ _ _ (ETX) ( ) = Space

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

8.5 Structure of the Data String MADAM-S

The structure depends on the request string. When the superior computer (PROMEA-MX) requests with the string:

:ZSYS:

The clock answers with the following data string:

character no.	meaning		value (value range)	
1	STX (start of text)		$02	
2	:	colon	$3A	
3	Z	ASCII Z	$5A	
4	S	ASCII S	$53	
5	Y	ASCII Y	$59	
6	S	ASCII S	$53	
7	:	colon	$3A	
8	status of the changeover		$00, 01, 7F	; see 8.5.1
9	time scale identification		$30-33	
10	day of the week		$31-37	
11	tens - year		$30-39	
12	unit year		$30-39	
13	tens month		$30-31	
14	unit month		$30-39	
15	tens day		$30-33	
16	unit day		$30-39	
17	tens hour		$30-32	
18	unit hour		$30-39	
19	tens minute		$30-35	
20	unit- minute		$30-39	
21	tens second		$30-35	
22	unit second		$30-39	
23	CR (carriage return)		$0D	; see 8.1
24	LF (line feed)		$0A	; see 8.1
25	ETX (end of text)		$03	

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

:WILA:

the clock answers with the following data string

character no.	meaning		value (value range)	
1	STX (start of text)		$02	
2	:	colon	$3A	
3	W	ASCII W	$57	
4	I	ASCII I	$49	
5	L	ASCII L	$4C	
6	A	ASCII A	$41	
7	:	colon	$3A	
8	status		$00, 01, 7F	; see 8.5.1
9	time scale ident.		$30-33	
10	day of the week		$31-37	
11	tens year		$30-39	
12	unit year		$30-39	
13	tens month		$30-31	
14	unit month		$30-39	
15	tens day		$30-33	
16	unit day		$30-39	
17	tens hour		$30-32	
18	unit hour		$30-39	
19	tens minute		$30-35	
20	unit minute		$30-39	
21	tens second		$30-35	
22	unit second		$30-39	
23	CR (carriage Return)		$0D	; see 8.1
24	LF (line feed)		$0A	; see 8.1
25	ETX (end of text)		$03	

8.5.1 Meaning of the Status Nibble in the Data String MADAM-S

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

This byte can have the following values:

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

Time scale ident. (9th byte of the transmission)

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

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

8.5.2 Required Setting for Output MADAM-S

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

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

8.6 Data String IBM 9037 Sysplex Timer

This protocol must be selected 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 without 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)	$01	
2	hundred current day of year	$30-33	
3	tens current day of year	$30-39	
4	unit current day of year	$30-39	
5	":" colon	$3A	
6	tens hour	$30-32	
7	unit hour	$30-39	
8	" : " colon	$3A	
9	tens minute	$30-35	
10	unit minute	$30-39	
11	" : " colon	$3A	
12	tens second	$30-35	
13	unit second	$30-39	
14	quality identifier	$20,41,42,43,58	
15	CR (carriage return)	$0D	; see 8.1
16	LF (line feed)	$0A	; see 8.1

8.6.1 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

8.6.2 Example of a Transmitted Data String Sysplex Timer

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

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

8.7 Structure of Data String 6841/6021 String 2000

The structure of the data string is the same as the standard string 6870/6021 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)	; see 8.7.1
3	day of the week (1=Monday ... 7=Sunday)	; see 8.7.1
	In case of UTC time bit 3 is set to 1 in the day of the week	
4	tens hour	
5	unit hour	
6	tens minutes	
7	unit minutes	
8	tens seconds	
9	unit seconds	
10	tens day	
11	unit day	
12	tens month	
13	unit month	
14	tens century	
15	unit century	
16	tens year	
17	unit year	
18	LF (line feed)	; see 8.1
19	CR (carriage return)	; see 8.1
20	ETX (end of text)	

8.7.1 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 binarily. Structure of these characters:

	b3	b2	b1	b0	meaning
status nibble:	x	x	x	0	no announcement hour
	x	x	x	1	announcement (SZ-WZ-SZ)
	x	x	0	x	standard time (WZ)
	x	x	1	x	daylight saving time (SZ)
	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

8.7.2 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)

8.8 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

8.8.1 Example of a Transmitted Data String T-String

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

It is Wednesday 03.01.96 - 12:34:56h

8.9 Data String ABB_S_T

The data string ABB_S_T corresponds with the T-string in the transmitted values. It is switched on via mode byte 2.

Selecting the string also sets the transmission parameters to the following values:

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

8.10 Data String TimeServ for Windows NT Computers

The synchronisation of a PC with the operating system Windows NT from 3.51 uses the same protocol as described under pt. "**Sysplex Timer**". The required setting for the data output are as follows:

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

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

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

The required settings for the PC software can be downloaded from the ***hopf*** Internet page .

http://www.hopf-time.com

8.11 Data String for NTP (Network Time Protocol)

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

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

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

http://www.hopf-time.com

NTP supports the ***hopf*** standard protocol as described under **"data string 6841/6021"**. The following settings are required on the clock board:

baud rate:	9600 baud 8 data bit parity no 1 stop bit
transmission mode :	data string 6841/6021 UTC as time basis with second advance with control characters (STX...ETX) LF..CR with ETX on the second change (On Time Marker) output time and date transmission every second

8.12 Data String NGTS-String

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

As a rule this string is transmitted in the 59th second with the data of the minute change. The exact synchronisation in the connected computer requires an additional minute pulse from one of the optical couplers.

character no.	meaning	value (value range)
1	"T" ASCII T	$54
3	tens year	$30-39
4	unit year	$30-39
6	tens month	$30-31
7	unit month	$30-39
9	tens day	$30-33
10	unit day	$30-39
13	unit day of the week	$31-37
15	tens hours	$30-32
16	unit hours	$30-39
18	tens minutes	$30-35
19	unit minutes	$30-39
22	Status (0, 1)	$30-31 (30 ⇨ Local Time, 31 ⇨ UTC)
23	CR (carriage return)	$0D
24	LF (line feed)	$0A

8.12.1 Example of a Transmitted Data String NGTS

T960103312340(CR)(LF)

It is Wednesday 03.01.96 - 12:34 h

8.13 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.

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	; see 8.13.1
3	day of the week	$31-37	; see 8.13.1
4	tens hour	$30-32	
5	unit hour	$30-39	
6	tens minute	$30-35	
7	unit minute	$30-39	
8	tens second	$30-36	
9	unit second	$30-39	
10	tens day	$30-33	
11	unit day	$30-39	
12	tens month	$30-31	
13	unit month	$30-39	
14	tens year	$30-39	
15	unit year	$30-39	
16	tens diff.time + sign hour	$30,$31,$38,$39	
17	unit diff.time + sign hour	$30-39	
18	tens diff. time minutes	$30-35	
19	unit diff. time minutes	$30-39	
20	CR (carriage Return)	$0D	; see 8.1
21	LF (line feed)	$0A	; see 8.1
22	ETX (end of text)	$03	

8.13.1 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

8.13.2 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

8.13.3 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

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

8.14 Data String AEG-FFM

This format is identical with the standard string 6021 except for the added checksum.

The ASCII-character "g" is not as in other strings, used for the request of "UTC time and date" but for "UTC time without date"!

8.14.1 Structure of Data String AEG-FFM Time and Date

character no.	meaning	value (value range)	
1	STX (start of text)	$02	
2	status	$30-39, $41-46	; see 8.14.3
3	day of the week (1=Mo ... 7=Su)	$31-37	; see 8.14.3
4	tens hours	$30-32	
5	unit hours	$30-39	
6	tens minutes	$30-35	
7	unit minutes	$30-39	
8	tens seconds	$30-36	
9	unit seconds	$30-39	
10	tens day	$30-33	
11	unit day	$30-39	
12	tens month	$30-31	
13	unit month	$30-39	
14	tens year	$30-39	
15	unit year	$30-39	
16	LF (line feed)	$0A	; see 8.1
17	CR (carriage return)	$0D	; see 8.1
18	ETX (end of text)	$03	
19	checksum H - Nibble	$30-39, $41-46	; see 8.14.2
20	checksum L - Nibble	$30-39, $41-46	; see 8.14.2

8.14.2 Structure of the Checksum in the Data String Date / Time

The checksum is the result of binary adding up of all the transmitted ASCII characters. The check byte is transmitted as two ASCII characters straight after ETX.

8.14.3 Statusbyte in the Data String AEG-FFM

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

	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	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

8.14.4 Example of a Transmitted Data String

(STX) C4134434180399 (LF) (CR) (ETX) 04

crystal operation
daylight saving time
no announcement
It is Thursday 18.03.99 - 13:44:34
( ) - ASCII-control characters e.g. (STX)

8.15 Data String 5050 H&B (PCZ 77)

This data string is compatible with the data string of the board 6830.

The "Hartmann & Braun" internal identifier of the clock is **PCZ 77**.

The following parameters must be set on the interface.

- baud rate : 1200
- word length : 7 Bit
- parity : even
- stop bit : 1
- handshake : no
- string output : every minute
- timing : 1 second forerun
- sequence of control character : <CR> <LF>
- back-to-normal : at the minute change

8.15.1 Structure of Data String 5050 H&B Time and Date

character no.	meaning	
1	tens hours	
2	unit hours	
3	space	
4	tens minutes	
5	unit minutes	
6	space	
7	tens seconds	
8	unit seconds	
9	space	
10	tens days	
11	unit days	
12	space	
13	tens month	
14	unit month	
15	space	
16	tens years	
17	unit years	
18	space	
19	status	; see 8.15.3
20	day of the week	; see 8.15.3
21	CR (carriage return)	; see 8.1
22	LF (Line Feed)	; see 8.1

8.15.2 Structure of Data String 5050 H&B Time only

character no.	meaning	
1	Tens hours	
2	unit hours	
3	space	
4	tens minutes	
5	unit minutes	
6	space	
7	tens seconds	
8	unit seconds	
9	space	
10	CR (carriage return)	; see 8.1
11	LF line feed)	; see 8.1

8.15.3 Status and Day of the Week Nibble

	b3	b2	b1	b0	meaning
status nibble:	x	x	x	0	radio operation
	x	x	x	1	crystal operation
	x	x	1	x	announcement (WT-ST-WT)
	x	x	0	x	no announcement
	x	0	x	x	MEZ (UTC + 1h)
	x	1	x	x	MESZ (UTC + 2h)
	1	0	0	x	UTC
day of the week nibble:	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

8.15.4 Example of a Transmitted Data String

12 34 56 03 01 96 03(CR) ... (LF)

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

8.16 Structure of Data String CCSDS

The time code is supplied in the so called CCSDS(Day Segment Time Code, UTC). It consists of the following dates, which are described hexadecimally at first.

Day Field (Byte 1-3)

Byte 1	Byte 1, Bit 0 = LSB
Byte 2	
Byte 3	Byte 3, Bit 7 = MSB

P Field

Byte 4	contains binary "0100 0100"

ms of Day Field

Byte 5	Byte 5, Bit 0 = LSB
Byte 6	
Byte 7	
Byte 8	Byte 8, Bit 7 = MSB

- "Day Field" contains the number of days since the 01.01.1958,this day beeing the day=0 (01.01.1958 = day 0).
- "P Field" depicts the constant „ 0100 0100" binarily.
- "ms of Day Field" contains the milliseconds of a day , but only the whole seconds are shown in milliseconds**.**

Setting mode byte 2 for the CCSDS string automatically activates the following settings in mode byte 1:

- time base UTC for string output CCSDS
- with second advance
- with control character
- with control character on second change
- LF/CR

All the data are displayed hexadecimally. As the radio controlled clock uses the ASCII characters for the transmission, the time code is divided into nibbles.

The following characters are used:

nibble (hex)	ASCII-character	value in hex
0	0	$30
1	1	$31
2	2	$32
3	3	$33
4	4	$34
5	5	$35
6	6	$36
7	7	$37
8	8	$38
9	9	$39
A	:	$3A
B	;	$3B
C	<	$3C
D	=	$3D
E	>	$3E
F	?	$3F

The following table shows the transmission format. The bytes are distributed as follows:

N1 = BIT 0-3 of Byte x
N2 = BIT 4-7 of Byte x

Data string:

character no.	meaning
1	STX (start of text)
2	N1 Byte 1
3	N2 Byte 1
4	N1 Byte 2
5	N2 Byte 2
6	N1 Byte 3
7	N2 Byte 3
8	N1 Byte 4
9	N2 Byte 4
10	N1 Byte 5
11	N2 Byte 5
12	N1 Byte 6
13	N2 Byte 6
14	N1 Byte 7
15	N2 Byte 7
16	N1 Byte 8
17	N2 Byte 8
18	LF (line feed)
19	CR (carriage return)
20	ETX (end of text)

9 Pin Allocation of Serial Interfaces

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

25-pole SUB-D 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

9.2 Pin Assignment of the 9 pole SUB-D Connector COM 1

9-pole SUB-D 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

10 Technical Data Basic System

operating voltage:	standard:	230V AC + 10% - 15%
	option:	120V AC + 10% - 15%
		110V DC (60V - 120V)
		60V DC (38 V - 75V)
		24V DC (18 V - 36V)
power consumption device fully equipped:		50 VA
display:		LCD-display 2x16 digits
type of display:		alphanumeric
height of digits:		5 mm
crystal accuracy:		± 0.02 ppm
		after GPS control and constant temperature
back-up clock accuracy:		± 25 ppm at 25 ° C
back-up clock buffering maintenance free:		3 days
key-pad:		25 keys

10.1 Technical Data GPS -Receiver

Type of receiver		6 channel phase-tracking receiver
decoding:		L1 frequency 1,575.42 MHz, C/A-Code
sensitivity:		-143 dB
synchronisation time	cold start:	30 min. - 4 h.
		(first installation without position data)
	warm start:	ca. 1 min.
		(voltage failure < 3 days)
accuracy of the PPS-pulse:		± 1 microsecond (95%)
temperature range:		0 ... 60° C

10.2 Technical Data Antenna

type of antenna:	micro-strip-antenna
mid-frequency:	1,575.42 MHz
band width:	10 MHz
antenna amplifier	
voltage supply:	+5 V ± 0,5 V (via antenna cable)
impedance:	50 Ohm
power amplifier:	20 dB
length of cable:	max. 25 m - with special cable 50 m
	max. 150 m with power amplifier
temperature range:	-30°C to +85°C

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

Please note : The ***hopf*** company withholds the right to any alterations in hard- and software. The names IBM, Siemens, Windows etc. used in this document are registered trade names of the according companies.

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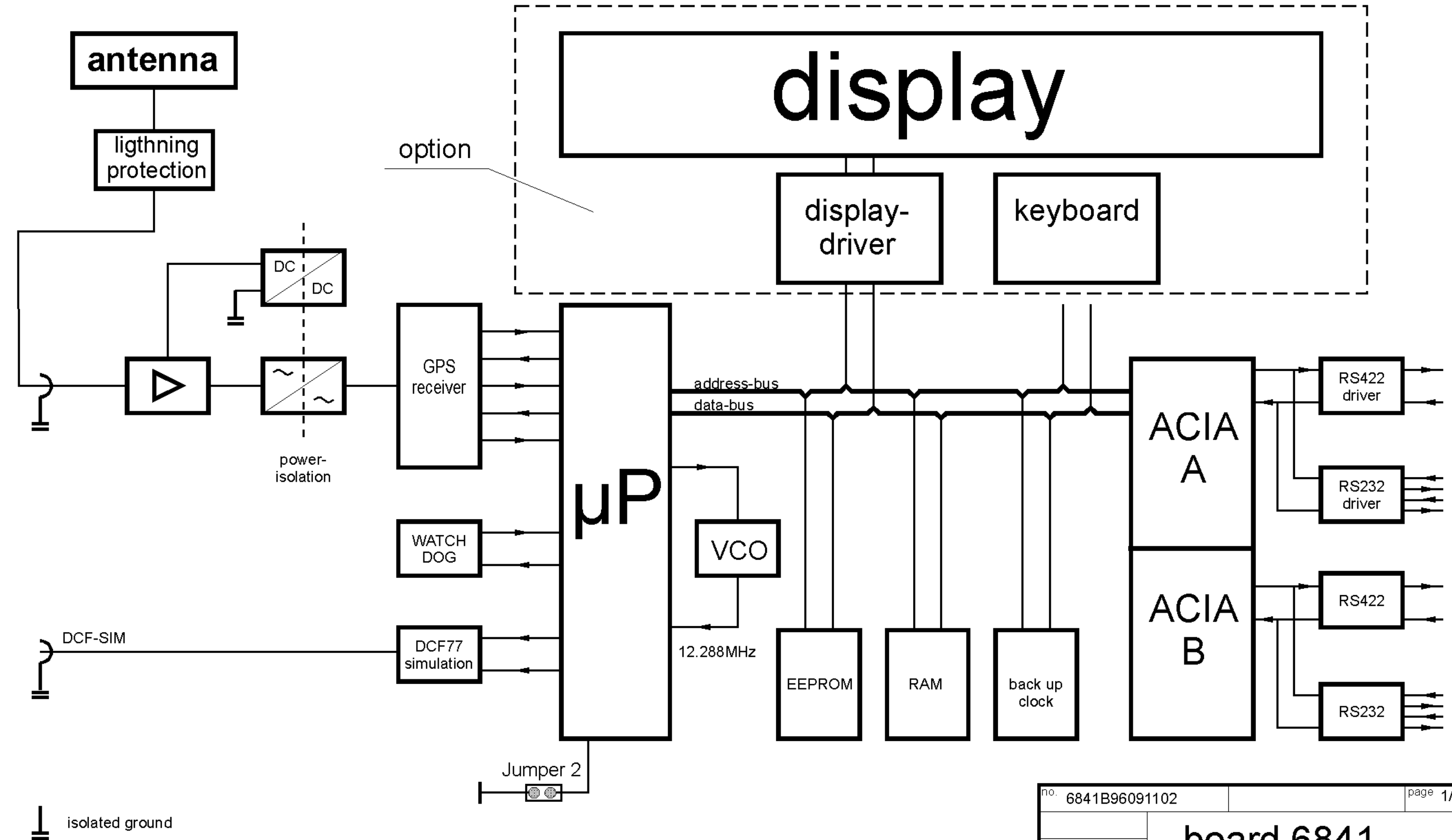

standard settings ex works:

9600 baud, 8 bit, no parity, 1 stopbit

no. 6841B96091102		page 1/1
board 6841		
date 11.09.96	System	
name Vollmer		
size A4		

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