Industriefunkuhren

hopf Elektronik GmbH

Technical Manual

Satellite Clock System

Model 7001GPS

with Control Board 7020GPS

ENGLISH

Version: 08.00 – 13.09.2007

Valid for Devices 7001GPS with FIRMWARE Version: **08.xx**

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Version number (Firmware / Manual)

The first two digits of the version number of the technical Manual and the first two digits of the firmware version must **COMPLY WITH EACH OTHER**. They indicate the functional correlation between device and technical manual.

The digits after the point in the version number indicate corrections in the firmware / manual that are of no significance for the function.

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Symbols and Characters

Operational Reliability

Disregard may cause damages to persons or material.

Functionality

Disregard may impact function of system/device.

Information

Notes and Information.

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Safety regulations

The safety regulations and observance of the technical data serve to ensure trouble-free operation of the device and protection of persons and material. It is therefore of utmost importance to observe and compliance with these regulations.

If these are not complied with, then no claims may be made under the terms of the warranty. No liability will be assumed for any ensuing damage.

Safety of the device

This device has been manufactured in accordance with the latest technological standards and approved safety regulations

The device should only be put into operation by trained and qualified staff. Care must be taken that all cable connections are laid and fixed in position correctly. The device should only be operated with the voltage supply indicated on the identification label.

The device should only be operated by qualified staff or employees who have received specific instruction.

If a device must be opened for repair, this should only be carried out by employees with appropriate qualifications or by ***hopf*** Elektronik GmbH.

Before a device is opened or a fuse is changed all power supplies must be disconnected.

If there are reasons to believe that the operational safety can no longer be guaranteed the device must be taken out of service and labelled accordingly.

The safety may be impaired when the device does not operate properly or if it is obviously damaged.

CE-Conformity

This device fulfils the requirements of the EU directive 89/336/EWG "Electromagnetic compatibility" and 73/23/EWG "Low voltage equipment".

Therefore the device bears the CE identification marking (CE=Communauté Européenne)

CE = Communautes Europeénnes = European communities

The CE indicates to the controlling bodies that the product complies with the requirements of the EU directive - especially with regard to protection of health and safety for the operator and the user - and may be released for sale within the common markets.

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1 Brief Description of System 7001

The ***hopf*** System 7001 is a microprocessor system with a modular structure. Each main board within this Eurocard system has its own microprocessor. So time-critical tasks can be solved easily on the boards themselves. The modular concept enables individual configuration of systems according to customer specifications. Moreover this concept guarantees simple servicing.

Board 7020

This board replaces the 7015 Control Board and, as a control board, forms part of the basic version of the Master Clock System 7001. It has been prepared for the evaluation of different synchronisation sources such as DCF77, GPS, serial data strings or IRIG-B[1]. In addition it can be used for keypad- and display control and for bus communication with other boards in the system. It is equipped with the standard quartz pulse generator and can also be fitted with a oven-stabilized quartz generator to attain better freerunning properties.

Board 7112 / 7121

With the optical coupler or relay board 24 bits can be emitted potential-free. 8 potential-free inputs are available for output control. The optical coupler and relay boards are pin-compatible with each other.

- Board 7112 optical coupler board
- Board 7121 relay board

Board 7201

The serial interface board 7201 emits a data string either via an RS232c (V.24), RS422 (V.11) or a passive TTY interface. The transmission format and the method of output are adjusted on the DIP-switch on the board.

Board 7210

This board receives the transmission data string TxD from the main board 7200 / 7201 or 7220 / 7221 in TTL level and duplicates this via 4 x RS232-, 4 x RS422- and 4 x active or passive TTY interface.

Board 7221

On this serial interface board there is a full-duplex interface and 7 duplicated transmission data strings via RS232 and RS422 hardware.

Board 7245

On this board there is a serial full-duplex interface and 4 multipliers for the transmission line TxD. The interface hardware is designed for the RS232 and RS422 level. All the interfaces are set up potential-free to each other and to the subordinated logic. In addition there are 4 potential-free minute pulses.

Board 7265

On this board there are 4 analogue switches each with 4 inputs. Connected to these inputs are the signals IRIG-B 12x, IRIG-B 00x and PPS pulse created on the board itself and also an external input for the frequency boards 7530 and 7550. The inputs are switched through to the outputs via DIP switches. The output signals are at BNC connectors.

[1] not implemented yet

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Board 7270

On this board is an Ethernet interface 10BaseT or 10/100BaseT which serves as a 'Network Time Server' in local networks. Various configurations can be made via the keypad. Either NTP or SINEC-H1 string can be used as time protocols.

Board 7271

On this board is an Ethernet interface 10/100BaseT which serves as a 'Network Time Server' in local networks. NTP is used as time protocol [2].

Board 7317

On this board there are 4 potential-free DCF77 antenna simulations.

Board 7406

On this board are all the required modules for the output of 2 independent synchronous lines for pole-alternating pulse operation or DCF77 time code clocks.

Board 7515

On the network analysis board 7515 there is an independent microprocessor system for the following tasks.

- Calculation of network frequency
- Serial interface to large displays or superordinated computers
- Bus interface
- Calculation of network time
- Calculation of time difference in msec.
- Calculation of time difference network / system time in mHz
- AD converter for the power display in MW

[2] A variety of management and monitoring functions are available. Basic parameters can be programmed via the system keypad. An extended parameterisation can be executed via a web browser.

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2 Introduction

The ***hopf*** radio-controlled quartz clock system 7001, reliably proven since 1993, has now been equipped with a new base board (7020). It can be synchronised through different time code sources such as DCF77, GPS, IRIG-B[3] or serial data strings.

Additionally, the combination of 2 time code sources is possible in order to increase data security (see ***Chapter 4.3.6 System Byte***).

Together with the standard quartz generator the base board 7020 can also be equipped with a heat-stabilized quartz generator which can increase the freerunning accuracy of the system to 2 x 10E-11 when synchronising via GPS.

As a result of the above-mentioned features this system is suitable for use as a **Master Clock System.**

2.1 Power Supply

Since the system can be provided with a variety of power supply units, it is important, when connecting the voltage, to pay attention to the voltage level and the polarity.

The following voltage supplies are standard:

- 230 V AC +10%, -15% (Standard)
- 120 V AC +10%, -15% (Option)
- 80 V DC (60 V - 120 V) (Option)
- 48 V DC (36 V - 72 V) (Option)
- 24 V DC (18 V - 36 V) (Option)

Other voltage supplies are possible on request.

2.2 Antenna Installation

If GPS or DCF77 are to be used to synchronise the Master Clock System 7001, then it is necessary to install the correct antenna. More details can be found in the GPS or DCF77 appendix.

[3] not implemented yet

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2.3 Fast Commissioning

GPS Master Clock Systems

- Connect voltage
- Switch on voltage
- Enter local time (approx.)
- Enter time difference
- Enter switchover time **S** ⇨ **D**
- Enter switchover time **D** ⇨ **S**
- Enter system status **GPSM** or adjust **GPSM+**
- For **GPSM+** connect serial interface
- Connect GPS antenna
- Start master reset after approx. **10 minutes**

DCF77 Master Clock Systems

- Connect voltage
- Switch on voltage
- Enter time difference
- Enter switchover time **S** ⇨ **D** (not always necessary)
- Enter switchover time **D** ⇨ **S** (not always necessary)
- Select appropriate DCF77 system status
- Connect synchronisation source DCF77 pulse, DCF77 antenna or serial interface

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3 Description of System

3.1 Display

After switching on the following frame appears in the 2x40-digit VFD display:

```
hopf-Elektronik MASTER-CLOCK
VERSION 08.00 10/SEP/2007
```

This frame remains in the display for about 3 seconds.

Afterwards, when first commissioning or when the equipment has been in voltage-free status for at least 3 days, the following frame appears:

L.T:	[1]00:00:00	[2]– – / [3]– – / – – – / – – – –	[4]– – –		GPS_M --[10]	
UT:	[5]00:00:00	[6]– – / [7]– – / – – – / – – – –		[8]C	[9]0,0 E-00 –[11]	

The individual positions have the following meaning:

1. Row:

[1] **L-T :** 00:00:00

In these fields the local time is shown.

[2] Display of weekday abbreviations:

MO - TU - WE - TH - FR - SA - SU means (MO - DI - MI - DO - FR - SA - SO)

[3] Display of date:

day / abbreviation for month / year

[4] Status display:

Position 1 X--	**"D"**	for daylight saving time
	"S"	for standard time.
Position 2 -X-	**"A"**	Notification of changeover to another time zone. Notification is made approx. 1 hour before the changeover.
Position 3 --X	**"A"**	Notification of leap second Information is given approx. 1 hour before the sec. is inserted.

Description of system

e.g. GPS Master System GPS_M
Further system abbreviations see ***Chapter 4.3.5 Control Byte***

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2. Row

5-7 In these positions the UTC world time is displayed analogue to the local time display.

8 Display of internal status of the clock system (Time-/Synchronisation Status):

"-" = invalid time
"C"= the clock system operates in quartz mode (C = crystal).
"r" = the clock system operates synchronous to synchronisation source

"R"= the clock system operates synchronous to synchronisation source and the quartz generator is controlled

9 In this position the quartz accuracy is displayed with which the internal clock operates.

The starting value for quartz accuracy depends on operating mode, e.g. for GPS Master System **GPS_M**:

- **0,0 E-00** After switching on the system or a system reset the accuracy is shown with this value, as long as no synchronisation of the internal clock occurs.
- **9,9 E-07** with standard quartz (after first synchronisation of internal clock)
- **9,9 E-09** when using oven-stabilized quartz (after first synchronisation of internal clock)

10 In this position an **"E"** appears as soon as the error message is activated

11 After input of the keyword a **"K"** is displayed in this position

3.2 Standard Display

After a power failure of < 3 days the display starts with the internal backup clock information supplied.

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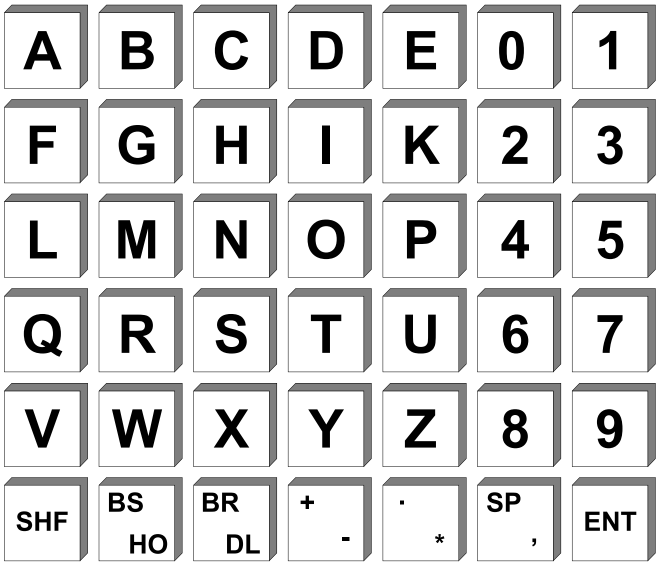
4 Keypad

The keypad consists of 42 keys, whereby there are 5 keys with double functions. The second function on the double-function keys is activated via the key **SHF** (SHIFT) and is only valid for the next key input.

4.1 Setup

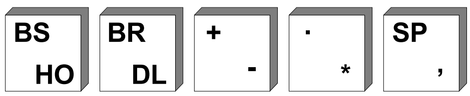


4.2 Key Functions

A ... Z Entering the alphabet in capital letters (with the exception of "J")

0 ... 9 Entering figures

SHF Shift function for following keys:



BS
HO
BS = BACKSPACE, delete last input
HO = Home, delete complete line

BR
DL
BR = BREAK, cancel all key controls
DL = Delete, not in use at present.

+
–
Entering symbols for figure values

.
*****
Entering a "dot" and "star"

SP
,
Entering a free display space.
Entering a "comma"

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Keypad entries / system control

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

The display changes over from the standard frame, display of time information, or from blanking[4] to the main menu.

Start frame:

```
SET:1 SHOW: 2 BOARDS:3 MON: 4
 PROG-RESET: R MASTER-RESET:M
```

The individual modes have the following meaning:

SET:	Enter or view set functions such as time/date, position, time offset etc.
SHOW:	View information **e.g.** satellite values
BOARDS:	Enter control functions for system extension boards
MON:	Monitor function, this function is only used in-plant.
PROG.-R:	By entering **"R"** in PROG.-R the programme is re-started on Board 7020.
MASTER-R:	By entering **"M"** a hardware master reset of the whole system is started. All boards in the system are resetted and re-started.

4.2.1 General Information for Input

When the appropriate figure or letter is entered the menu item requested appears or is executed (reset). The individual menu items are designed with user commands.

With key **"BR"** it is possible to leave the input menu at any time and at any position.

The sub-functions of the menu group are shown on the display and are

accepted with **"Y"** = Yes
or rejected with **"N"** = No.

When **"N"** is entered the next sub-function is displayed. When **"Y"** is entered the appropriate sub-function appears.

Some sub-functions display the old value input at the same time.

The cursor in the frame shows at which position the next input can be made.

Each input can be corrected with **"BS"** (Back Space).

Each new complete input must be finished with **"ENT"**. If no new input is made but **"ENT"** is pressed directly then the old value will be used.

If the input of only one piece of information is required then the display will return to the sub-function inquiry when **"ENT"** is pressed.

If several inputs are required then, after **"ENT"** is pressed the cursor switches to the next input position and only returns to the sub-function inquiry after the last input has been made.

[4] for display protection the display can be set to switch automatically to blank (see ***Chapter 4.3.5 Control Byte***)

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A false input symbol is either rejected immediately or checked for plausibility after **"ENT"** is pressed. Then an "**INPUT ERROR"** message appears. After this the display returns to the sub-function inquiry.

Not all the sub-function inquiries will always be needed or used. In the description, reference is made at the beginning of each sub-function to the Master Clock version with which these can be used. If such a function is called up by mistake, then this should be ended with **"BR**.

4.3 SET Functions

4.3.1 Time/Date Input

Valid for all systems

Selection frame:

```
INPUT TIME / DATE Y / N
hh.mm.ss DD.MM.YYYY
```

Input frame:

```
LOC.-TIME hh.mm.ss DD.MM.YYYY
        >_ . . . . <
```

Local time can be set with this input function. The input is in the second line between the arrows >...< and this input must be complete. For this purpose leading naughts must be used.

The individual positions have the following meaning:

hh	hour	range	from 00 - 23
mm	minute	— " —	from 00 - 59
ss	second	— " —	from 00 - 59
DD	day	range	from 01 - 31
MM	month	— " —	from 01 - 12
YYYY	year	— " —	from 2000 – 2099

4.3.2 Time Difference

Valid for all systems

Selection frame:

```
TIME OFFSET Y/N
```

Input frame:

```
TIME-OFFSET -> +01.00<- EAST=+ WEST=-
        >_   . <
```

With this function the time difference between local time and world time (UTC time) is entered. The symbol shows in which direction the local time deviates from world time.

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The general rule is:

- \+ means east of,
- \- means west of the Greenwich Meridian.

In the upper line the old value saved is displayed.

Since most countries in the world select their time difference in full hours, the input is also in steps of one hour.

e.g. + 05.00 ; - 11.00

However some countries move in time zone steps of half an hour. Here the input is completed with minutes.

e.g. + 05.30 ; - 08.30

4.3.3 Time Zone Changeover

Selection frame:

```
CHANGE-OVER DATE S - > D AND D -> S
S = STANDARD TIME D = DAYLIGHT TIME Y / N
```

Input frame:

```
S --> D hh.d.w.MM D -> S hh.d.w.MM
 - >_ . . . <- -> . . .      <
```

With this input it is possible to enter the points in time at which there is a changeover from daylight saving or standard time in the course of a year. The hour and the month at which the changeover should take place are entered. The exact times are calculated automatically from the date of the current year.

S ⇨ D the entered changeover time is valid for the changeover from **S**tandard time (winter time) to **D**aylight Saving Time (summer time)

D ⇨ S the entered changeover time is valid for the changeover from **D**aylight Saving Time (summer time) to **S**tandard time (winter time)

Both changeover times in the year can now be entered between the arrows.

If no Daylight Saving Time has been introduced at the location of the system or no changeover is required, then a 0 (zero) should be assigned to all these values, so that an **S** for standard time can be shown in the display as a time zone abbreviation. After the changeover times have been entered the Master Clock System calculates the exact changeover time to the nearest minute change and adopts these new values.

The individual inputs have the following meaning:

hh = the hour at which the changeover should take place 00 .. 23 h

d = the day of the week on which the changeover should take place

1 = Monday ... 7 = Sunday

w **=** shows in which week of the month the changeover should take place

1 ... 4 means 1 ... 4 week in the month

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

MM = the month in which the changeover should take place

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4.3.4 Position

Valid for all GPS systems

Selection frame:

```
Position LAT N/S LON E/W Y/N
 (N)orth (S)outh (E)ast (W)est
```

With this function the geographic location of the equipment is entered when synchronisation is via GPS. This function is useful when first commissioning, it shortens the re-initialisation of the GPS receiver. Input can be in very rough steps. An exact degree setting is not necessary.

Input frame:

```
LAT/LON P GG.MM p GGG.MM P=N/S p=E/W
 - >_ .       <-- > . <-
```

The input of latitude and longitude is in degrees and minutes.

The symbol for latitude is:

N	northern hemisphere
S	southern hemisphere

and for longitude:

E	east of the Greenwich Meridian
W	west of the Greenwich Meridian

First the latitude is entered under **P GG.MM**:

P	N or S, North or South
GG	latitude, degrees, from 00 - 89
MM	latitude, minutes, from 00 - 59

The longitude is entered under **p GGG.MM:**

p	E or W, East or West
GGG	longitude, degrees, from 000 - 179
MM	longitude, minutes, from 00 - 59

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4.3.5 Control Byte

Validity: all systems

The control byte is used to select the synchronisation source for the system 7001 and to set up the display control.

<u>Selection screen</u>

```
SET CONTROL BYTE Y/N
```

<u>Input screen</u>

```
OLD BYTE >00000001<
NEW BYTE >_ <
```

The function of the individual bits is as follows:

B7	Simulation of the synchronisation status "Radio"
0	Status of synchronisation is only set by the synchronisation source
1	Activating the operation mode `R_SIM` with simulation of the synchronisation status "Radio"
B6	**reserved**
0	reserved, default: '**0**'

B5	B4	display control
0	0	The display is permanently on.
0	1	The brightness of the display is reduced to approx. 1/4 of normal intensity.
1	0	The display is switched off. Only a moving dot is visible on the display.
1	1	The display is switched off. Only a moving dot is visible on the display. In addition, the brightness of the dot is reduced to 1/4 of normal intensity.

B3	B2	B1	B0	ID code	Synchronisation Source
0	0	0	0	QUARTZ	Quartz clock - synchronisation by quartz generator on board only.
0	0	0	1	QUARZ+	not implemented
0	0	1	0	DCF_T	Synchronisation via a DCF77 pulse.
0	0	1	1	DCF_A	not implemented
0	1	0	0	MA_SL	Synchronisation via a serial Master/Slave-String from another ***hopf*** system.
0	1	0	1	GPS_M	Synchronisation via a GPS receiver.
0	1	1	0	DCF_T+	Synchronisation via a DCF77 pulse + synchronisation via a serial Master/Slave-String from another ***hopf*** system.
0	1	1	1	DCF_A+	not implemented
1	0	0	0	GPS_M+	Synchronisation via a GPS receiver + synchronisation via a serial Master/Slave-String from another ***hopf*** system.

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4.3.5.1 Bit7: Simulation of the Synchronisation Status "Radio"

B7	Simulation of the synchronisation status "Radio"
0	Status of synchronisation is only set by the synchronisation source
1	Activating the operation mode `R_SIM` with simulation of the synchronisation status "Radio"

<u>Valid for all synchronisation modes</u>

When the **Control Byte Bit 7** is set to **1** the control board 7020 simulates the synchronisation status 'R'. This function is helpful in particular in testing configurations with no antenna or synchronisation source available when connected systems require a synchronisation status "Radio" for correct function.

The setting influences the following functions and components of the System 7001:

- Indication of the operation mode `R_SIM`
- Indication of the synchronisation status "Radio"
- Data output which depends on or contains the synchronisation status
- ERROR – message concerning the synchronisation status

<u>Overview system behaviour:</u>

Activating the **simulation of the synchronisation status „Radio"** (operation mode `R_SIM`)

Operation Mode	Time Status	System Behaviour
`QUARZ`	`Invalid`	• Operation mode `R_SIM` will not be activated. • The setting **Control Byte Bit 7** remains stored failsafe. That means after a system reset or similar the activation persists. • Operation mode `R_SIM` is activated only after setting a valid system time.
	`Valid`	• Operation mode `R_SIM` will be activated immediately and stored failsafe. • Operation mode `R_SIM` can only be deactivated with the setting **Control Byte Bit 7 = 0**.

`DCF_T`
`MA_SL`
`GPS_M`
`DCF_T+`
`GPS_M+`
	`Invalid`	• Operation mode `R_SIM` will not be activated..
		• The setting **Control Byte Bit 7** remains stored failsafe. That means after a system reset or similar the activation persists.
		• Operation mode `R_SIM` is activated only after setting a valid system time.

	`Valid`	• Operation mode `R_SIM` will be activated immediately. • Operation mode `R_SIM` will be automatically deactivated after 4 hours or after a system reset or similar.

While the synchronisation status is "R" time leaps may occur when the operation mode `R_SIM` is active:

- When the system time is set manually. The synchronisation status will not be reset in this case.
- At synchronisation via the connected synchronisation source (`GPS_M, DCF_T, MA_SL` etc.), when the system time deviates from the time of the synchronisation source.

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4.3.5.2 Bit6 - reserved

This bit is reserved and '**0**' must be entered.

4.3.5.3 Bit 5 and Bit 4: Display Control

Bit 5 and **Bit 4** control the blanking of the display. This feature can be used to delay the loss of brightness of the display (see Table).

If an input key is pressed during blanking the display is re-initialised with the standard output and normal brightness. This condition is maintained for approx. 4 minutes from the last key stroke.

4.3.5.4 Bit 3 to Bit 0: Selection of Synchronisation Source

The synchronisation source for the system 7001 is selected with **Bits 3, 2, 1,** and **0**. The corresponding identification code for the selected synchronisation source appears in the display (see ***Chapter 4.3.5 Control Byte***).

All other settings for Bits 3-0 not shown in the Table give an **ERROR** indication on the display in place of the system identifier and are not provided with a synchronisation mode.

A master reset is always carried out automatically after selection of the synchronisation source with Bits 3-0 and confirmation with the **"ENT"** key.

Safety system (in GPS M+ or DCF T+ sync. modes only)

The safety system requires 2 independent synchronisation sources for synchronisation. Both pieces of time information must be in agreement not only in respect of time but also as regards supplementary information such as time zone, switchover signalling bit etc., otherwise no internal clock system synchronisation takes place and an error message is output simultaneously. These systems can be used for simple TIME-PROOF applications.

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4.3.6 System Byte

Validity: all systems

Various system functions can be switched on and off with the system byte.

Selection screen

```
SET SYSTEM BYTE Y/N
```

Input screen

```
OLD BYTE >00000001<
NEW BYTE >_ <
```

The significance of the individual bits is as follows:

<table>
<tr><th colspan="2">B7</th><th>3D/Position-fix</th></tr>
<tr><td colspan="2">0</td><td>Position-fix evaluation.</td></tr>
<tr><td colspan="2">1</td><td>3D evaluation.</td></tr>
<tr><th colspan="2">B6</th><th>Synchronisation process</th></tr>
<tr><td colspan="2">0</td><td>Standard synchronisation process.</td></tr>
<tr><td colspan="2">1</td><td>Special synchronisation process / system time status becomes invalid (“–“) when the time difference between the internal clock and the synchronisation source is more than one second.</td></tr>
<tr><th colspan="2">B5</th><th>Error message / switch box control</th></tr>
<tr><td colspan="2">0</td><td>Common error message output on occurrence of a major or minor alarm event.</td></tr>
<tr><td colspan="2">1</td><td>Output control for switch box (5000 system).</td></tr>
<tr><th colspan="2">B4</th><th>Error message / PPS pulse output</th></tr>
<tr><td colspan="2">0</td><td>PPS pulse on the 9-pole SUB-D connector X1, pin 4.</td></tr>
<tr><td colspan="2">1</td><td>Common error message (major or minor alarm event) on the 9-pole SUB-D connector X1, pin 4.</td></tr>
<tr><th colspan="2">B3</th><th>Time base in the Master/Slave-String (e.g. when synchronising with sync. module 8023)</th></tr>
<tr><td colspan="2">0</td><td>The time base in the Master/Slave-String is local time (standard setting).</td></tr>
<tr><td colspan="2">1</td><td>The time base in the Master/Slave-String is UTC.</td></tr>
<tr><th colspan="2">B2</th><th>Evaluation of the Master/Slave-String</th></tr>
<tr><td colspan="2">0</td><td>Standard evaluation with all string information.</td></tr>
<tr><td colspan="2">1</td><td>Special evaluation for application with sync. module 8023.</td></tr>
<tr><th>Bit 1</th><th>Bit 0</th><th>Setting the signalling bit for Summertime-/ Wintertime switchover</th></tr>
<tr><td>0</td><td>0</td><td>Signalling bits are only set by the external source.</td></tr>
<tr><td>0</td><td>1</td><td>Signalling bits are set via the external source depending on the system status of the external source or via the internal switchover times:
• Signalling bits are set by the external source provided that this delivers valid time information.
• Signalling bits are set by the internal switchover times of the 7001 system when the external source is not available.</td></tr>
<tr><td>1</td><td>0</td><td>Signalling bits are only set in accordance with the internal switchover times of the 7001 system (e.g. required for synchronisation with sync. module 8023).</td></tr>
<tr><td>1</td><td>1</td><td>Signalling bits are only set via the internal switchover times of the 7001 system (e.g. required for synchronisation with sync. module 8023).</td></tr>
</table>

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4.3.6.1 Bit 7: 3D / Position-fix Time Evaluation (2 Options)

Validity: GPS systems

Bit 7 in the system byte is used to switch between 3D and Position-fix evaluation:

- Bit 7 = 0 Position-fix evaluation
- Bit 7 = 1 3D evaluation

The accuracy of the time evaluation is defined by the exact calculation of the installation position. In order to carry out this calculation (3D evaluation) it is necessary to receive information from at least 4 satellites. The signal runtime to several satellites is determined from the calculated position and the precise second mark is produced from their mean value. The accuracy of the second mark in this 3D evaluation mode is specified in the technical data.

In many cases for stationary installations a less precise evaluation of the second mark suffices, e.g. this can be inaccurate by up to several milliseconds. In Position-fix mode the accuracy fundamentally depends on the exact input of the installation position. The second mark is then calculated from the data from one received satellite and the input position. When inputting the position to minute accuracy, the accuracy of the second mark is already better than ± 20 µsec. When the input is even more precise values can be achieved in accordance with the technical specifications.

The advantage of the Position-fix mode is that the clock can be synchronised using the data from only one received satellite. The antenna can also be installed in locations where less than ¼ of the sky is visible.

In many cases the antenna can be mounted internally at the window (short cable, no lightning protection). If 4 satellites are available in this mode then the evaluation switches automatically into 3D mode and calculates the exact position. In this case, the accuracy with one satellite also increases to the value given in the technical data.

The accuracy data refer to the comparison with the 3D evaluation:

The second marks of a system in Position-fix mode deviate by max. ±1 µsec.

4.3.6.2 Bit 6: Recognition of Time Leaps during the Synchronisation Process

Bit 6 controls the status of the system during the synchronisation process.

Bit 6 = 0 normal synchronisation process, no recognition of time leaps

When synchronisation takes place after a lengthy failure of the synchronisation source (> 9 hours) an erroneous system time change can occur. In the normal synchronisation process (Bit 6 =0) no error message is output in this case. It is therefore not possible for connected systems to detect whether an erroneous system time change has taken place.

When a valid synchronisation signal is available (“R” status) the system clock is synchronised every minute. If synchronisation fails but is reinstated within 9 hours then the system clock is adjusted smoothly when synchronisation takes place again. This means that the milliseconds are adjusted slowly and there is no erroneous system time change. When synchronisation takes place after more than 9 hours then the system clock is synchronised fully including the millisecond range. An erroneous system time change is possible if the deviation is too great.

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Bit 6 = 1 Special synchronisation process, recognition of time leaps

This setting serves to recognise time leaps after lengthy failure of the synchronisation source (> 9 hours) and subsequent synchronisation. The special synchronisation process is provided primarily for use in the safety system. Only here is an error message output when a time mismatch occurs. In all other modes the synchronisation status is merely set to 'Invalid'.

In contrast to the normal synchronisation process, second leap monitoring takes place in the special synchronisation process. Before the internal quartz clock accepts the new time information the difference between the internal clock and the new time information is calculated.

If the difference is greater than 1 second then the new time information is written to the internal clock but the hour status is set to Invalid ("–" on the display).

With this information, connected systems can reject a synchronisation. In this way a backwards time leap can be avoided.

For additional security the special synchronisation process should only be carried out with two synchronisation sources.

4.3.6.3 Bit 5: Static/Dynamic Error Message

Bit 5 is used to differentiate between two different types of output. A common error message indicates whether a major or minor alarm is present. The switch box control output (5000 system) enables a differentiation between major and minor alarm in the switch box (see system 5000 technical manual, switch box). For error priority assignment (major, minor or non-masked) see ***Chapter 4.3.9 Error Priority***.

B5 = 0, Common error message

Error message outputs	**TTL signal** • VG strip 7020 board pin 17b • 9-pole SUB-D connector X1, pin 4 (see ***Chapter 4.3.6.4***)	**Optocoupler** • Collector VG strip 7020 board pin 18b • Emitter VG strip 7020 board pin 19b
No error	LOW level	Current flow
Error	HIGH level	No current flow

B5 = 1, Switch box control

Signal outputs	**TTL signal** • VG strip 7020 board pin 17b • 9-pole SUB-D connector X1, Pin (see ***Chapter 4.3.6.4***)	**Optocoupler** • Collector: VG strip 7020 board pin 18b • Emitter: VG strip 7020 board pin 19b
Non-masked error approx. 980/20 ms	HIGH/ LOW level	No current flow / current flow
Minor error approx. 20/980 ms	HIGH/ LOW level	No current flow / current flow
Major error	LOW level	Current

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4.3.6.4 Bit 4: Error Message or PPS to 9-pole SUB-D Connector X1, Switch Box Control

Selection can be made between the PPS output and the error message on the 9 pole SUB-D connector X1, pin 4 on the board front panel. In this way the error message is available to external units. This output serves especially to control the ***hopf*** switch box (5000 system). This system controls the switchover of two data sources on one output depending on the error status of two connected ***hopf*** 7001 systems with 7020 control board. In this way serial data strings, digital pulses and analogue signals can be switched.

Bit 4	Output to 9 pole SUB-D connector X1
0	PPS pulse output to 9 pole SUB-D connector X1 pin 4
1	Error message output to 9 pole SUB-D connector X1 pin 4

4.3.6.5 Bit 3: Master/Slave-String Time Base

Bit 3 sets whether UTC time or local time is transmitted in the received Master/Slave-String. This setting is only effective when Bit 2 in the SYSTEM BYTE (see ***Chapter 4.3.6.6 Bit 2: Master/Slave-String Evaluation***) is set to the special evaluation of the Master/Slave-String.

If this bit is set incorrectly (e.g. UTC time is received but the 7001 system is set to local time) then the 7001 system sets both the local time and the UTC time incorrectly!
In the example given the UTC time would be interpreted as local time and the UTC time would be calculated incorrectly as a result.

Bit 3= 0 - The time base in the Master/Slave-String is local time (standard setting):

When the master/slave-string is programmed with local time Bit 3 is set to 0, so that the 7001 system interprets the time information in the master/slave-string as local time and calculates the UTC time correctly by means of the internally set time differential and the switchover times (provided that these are activated via Bits 5 and 6 of the synchronisation settings byte (see ***Chapter 4.3.6.7 Bit 1 and Bit 0: Summertime-/ Wintertime Switchover Signalling*** Bit).

⇨ The received time is local time, UTC is a calculated time.

Bit 3 = 1 - The time base in the Master/Slave-String is UTC:

When the Master/Slave-String contains the UTC time Bit 2 is set to 1. In this case the time in the Master/Slave-String is interpreted as UTC time and the local time is calculated from this time information having regard to the internally set time differential and the switchover times (provided that these are activated via Bits 5 and 6 of the synchronisation settings byte (see ***Chapter 4.3.6.7 Bit 1 and Bit 0: Summertime-/ Wintertime Switchover Signalling*** Bit).

⇨ The received time is UTC time; local time is a calculated time.

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4.3.6.6 Bit 2: Master/Slave-String Evaluation

Bit 2 = 0 - Standard evaluation with other string information:

This setting should be selected when the 7001 system is to be synchronised directly with a Master/Slave-String (e.g. without module 8023). In this case all information contained in the master /slave string is evaluated, such as Summertime-/ Wintertime signalling bits, the time zone and the time difference to UTC.

In order for the signalling bit setting for Summertime-/ Wintertime switchover to function correctly and also for the time zone bit to be accepted, both Bits 1 and 0 in the SYSTEM BYTE must be set to "0" (see ***Chapter 4.3.6.7 Bit 1 and Bit 0: Summertime-/ Wintertime Switchover Signalling*** Bit)!

Bit 2 = 1 - Special evaluation for use with sync. module 8023:

Required setting for operating with module 8023. See technical specifications for Module 8023 for details.

4.3.6.7 Bit 1 and Bit 0: Summertime-/ Wintertime Switchover Signalling Bit

<u>Validity: DCF77 and Slave Systems</u>

Bit 1 selects **independently of the synchronisation source status -** whether the signalling bit for Summertime-/ Wintertime switchover is activated by the synchronisation source or by the internally set switchover times in the 7001 system.

Bit 0 selects **fundamentally** whether the switchover times are used only by the synchronisation source **or** only by the internally set switchover times in the 7001 system. The status of the synchronisation source remains unaffected.

In order to avoid an erroneous hour leap on a Summertime-/ Wintertime switchover, the time base of a source that transmits local time must execute the Summertime-/ Wintertime switchover in the same way.

The combinations of Bit 0 and Bit 1 therefore give the following **system behaviour**:

Bit 1	Bit 0	Setting the Summertime-/ Wintertime signalling bits
0	0	Signalling bits are set by the external source only.
0	1	Signalling bits are set via the external source depending on the system status of the external source **or** via the internal switchover times: • Signalling bits are set by the external source provided that this delivers valid time information. • Signalling bits are set by the internal switchover times of the 7001 system when the external source is not available.
1	0	Signalling bits are only set in accordance with the internal switchover times of the 7001 system (e.g. required for synchronisation with module 8023).
1	1	Signalling bits are only set via the internal switchover times of the 7001 system (e.g. required for synchronisation with module 8023).

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4.3.7 Switch on/off delay of the "Radio" Synchronisations Status

Valid for all synchronisation systems

With this sub-function it is possible to control the switching on/off of the synchronisation bit.

Selection frame:

```
SET TIME-OUT STATUS SYNCHRONISATION Y/N
```

Input frame:

```
SYNCHR.-STATUS ON/OFF AFTER: 000/055 MIN
NEW INPUT : _ / MIN
```

The old saved values are displayed in the upper line.

New values can be entered in the lower line.

Time for Synchr.-Status on

The value can be set between 000 and 255 minutes. This indicates how long synchronisation must be available through the source before the synchronisation bit is switched on. For this display this means when the status changes from Crystal **(C)** to Reception **(R)**. This status is emitted on the bus so that a serial board, for example, also emits this status in its data string.

This value should be set to 000 with DCF77-synchronised systems. With GPS-synchronised systems it is only an advantage to a value other than 000 if the oven-stabilized quartz is integrated on the board. The value should then be about 10 to 15 minutes in order to bridge the heating time of the quartz after switching on the system.

Time for Synchr.-Status off

The value can be set between 002 and 255 minutes. It indicates the period of time after which the synchronisation bit should be switched back if no synchronisation is supplied by the source. A value which is beneficial for DCF77 synchronised systems is about 55 min. With GPS systems the value can be set to 255. The setting is, first and foremost, dependent on the required freewheeling accuracy.

4.3.8 DCF77 Simulation

Valid for all systems

The Master Clock System simulates the DCF77 antenna and DCF77 pulse signal for synchronisation of other ***hopf*** or foreign systems.

With this sub-function the signal output can be controlled.

Selection frame:

```
SET DCF-SIMULATION Y/N
```

Input frame:

```
 H/L:200/100 T-OUT:055 STAT:00000010
INPUT:_ /    <MSEC >    <MIN >         <
```

The time information is transmitted completely within one minute at a rate of one bit/sec. The information is BCD-coded. A logical “0” is represented by 100 msec. and a logical “1” by 200 msec. amplitude reduction or pulse width (see DCF77 appendix).

The narrow-band antennas of some radio-controlled clocks from some foreign manufacturers falsify the length of the reduction, and, for this reason, the connected receiver is tuned to other pulse lengths.

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The pulse length can be selected under **H/L**.

For the **H** pulse between 140 - 240 msec., 200 msec. is standard
For the **L** pulse between 070 - 120 msec., 100 msec. is standard

T-OUT

It might happen that a synchronisation error in the master clock system is not recognized by connected sub-systems if the DCF77 signal which is emitted remains continuous.

With **T-OUT** it is possible to set the time delay between 4-255 minutes, from which time the DCF77 signal will no longer be emitted if the synchronisation of the basic system fails.

The time depends on the required accuracy of the sub-system. For DCF77-synchronised systems the time should be set to about 55 minutes, for GPS-synchronised systems it can be 255 minutes.

STAT

With the status byte the following controls can be made:

B7	Unassigned at present
B6	Unassigned at present
B5	Unassigned at present
B4	Unassigned at present
B3	Unassigned at present
B2	Unassigned at present
B1	**Description**
0	DCF77 simulation output dependent on T-OUT and synchronisation
1	DCF77 simulation output permanent
B0	**Description**
0	When there is interference or no synchronisation or T_OUT has finished there is no reduction in amplitude or pulse output
1	When there is interference or no synchronisation or T_OUT has finished, the amplitude and the pulse are modulated with approx. 2 Hz.

4.3.8.1 Bit 7 to Bit 2

Bit 7 to Bit 2 are not yet assigned.

4.3.8.2 Bit 1

With Bit 1 the DCF77 simulation can be emitted independent of **T-OUT** and the synchronisation of the master clock system.

Bit 1 = 0 the DCF77 simulation emitted depends on **T-OUT** and the synchronisation of the master clock system.
Bit 1 = 1 the DCF77 simulation is emitted permanently

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4.3.8.3 Bit 0

With Bit 0 it is possible to control the interference in signal output.

Bit 0 = 0 when there is interference or no synchronisation or **T-OUT** has finished, there is no reduction in amplitude or pulse output.

Bit 0 = 1 when there is interference, no synchronisation or **T-OUT** has finished, the amplitude and the pulse are modulated with 2 Hz. In this way any line interruption in connected equipment can be monitored.

4.3.9 Error Priority

Valid for all systems

Currently 10 single error bits (see ***Chapter 4.5.5 Error Monitoring***) are set on the board which can be summarized to an entire error message. The error priority enables the selection what single errors should initialize a total error message. The single errors can be ranged into 2 different priority levels, briefly in a high and a low level. In case the dynamic failure output is activated (see ***Chapter 4.3.6 System Byte***), the distinction between both failures in the output is possible, whereas this is not possible on static failure output. Both levels are considered as failures of high priority then.

<u>Selection frame:</u>

```
ERROR-PRIORITY Y/N
```

<u>Input frame:</u>

```
ERROR-NO 1-8 >H--L---H< 9-16 >LL------<   ( example )
NEW IN   1-8 >_        < 9-16 >        <
```

As a new input the error priorities can be chosen in a different way:

with the input of **'H'** - the high priority level
with the input of **'L'** - the low priority level
with the input von **'-'** - the failure is blanked out on the total failure message

The input is divided into 2 groups from error 1-8 and 9-16. Should there be no change in one of the groups, the old selection is adopted by the input of 'ENT'.

The significance of the individual error bits is described under **"ERROR MONITORING"** (see ***Chapter 4.5.5 Error Monitoring***).

4.3.10 Set Keyword

Valid for all systems

The master clock system can be protected from unauthorized modification of data with a keyword. The keyword consists of a 6-digit combination of figures except 000000.

To avoid delays during commissioning the keyword should not be set until commissioning has completely finished. The keyword should then be kept in a safe place.

<u>Selection frame:</u>

```
SET KEY-WORD Y/N
```

<u>Input frame:</u>

```
KEY-WORD     =->_   <
```

In the display the keyword chosen is shown with a **"K"**.

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4.3.10.1 Delete Keyword

To delete the keyword, the keyword must first be entered. The display then jumps to the main menu. Now the ”set“ menu is selected under sub-item **“set keyword Y/N”** and the new keyword **000000** is entered. To deactivate the keyword a master reset must be carried out after input.

4.3.10.2 Keyword query

When a keyword has been set then this is requested each time before moving into the main menu. The following frame appears in the display:

```
INPUT KEY-WORD > <
```

The 6-digit figure can now be entered. In the display a star **"*"** appears for each input.

```
INPUT KEY-WORD >****** <
```

When the figures have been entered correctly the display jumps to the main menu. Other inputs are made available. They remain available for about 4 minutes and with each keypad input this is set again to 4 minutes.

If the input is incorrect the following frame appears for approx. 3 seconds:

```
KEY-WORD WRONG
```

Before any further input can be made:

```
INPUT KEY-WORD > <
```

If, on a second attempt, an incorrect keyword is entered the following frame appears:

```
LAST INPUT KEY-WORD > <
```

3 entries are possible altogether. After the third incorrect input the keypad is locked for approx. 4 hours. The blocking period only comes to an end if the system remains switched on.

The following information appears in the display:

```
KEY-PAD SWITCHED OFF GENERATED BY
SEVERAL WRONG KEY-WORD INPUTS
```

In order to avoid unnecessary waiting periods the keyword should only be activated after first commissioning has been successfully completed.

4.3.10.3 Unlock

Valid for all systems

If the keyword is forgotten it is possible, on written request, to obtain a 6-digit **"UNLOCK"** password from ***hopf***. For this the displayed local time of the system (time and date) must be given, since the **"UNLOCK"** password changes every day.

To enter the password a complete invalid keyword input (wrong 3 times) must be carried out. When the start menu is selected again the following frame appears in the display:

```
UNLOCK KEY-WORD => <-
```


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When the password has been entered correctly the keyword is deleted. The following information appears:

```
KEY-WORD DELETED
PRESS BR(EAK) TO CONTINUE
```

If the input is incorrect the following is displayed:

```
INPUT ERROR
```

After 3 seconds the display jumps back to the UNLOCK input frame.

4.4 BOARDS

Integrated extension boards can be addressed via the menu item **BOARDS:3.** It is possible to change into a selection dialogue by using key **"3".**

At present the following extension boards can be configured via the system keypad or their configuration can be shown on the display.

- **BOARD 7406 (SYNC.-CLOCK) Y/N**
  Configure, stop and start the clock lines in pole-alternating pulse mode (pulse length, line time and status).
  With DCF77 Time Code clock lines only the line time is updated.
- **BOARD 7270 / 7271 / 7272 (LAN) Y/N** [5]
  Querying or configuring the 7270 LAN boards (control byte, network mask IP und Gateway address)
- **BOARD 7265 (IRIG-B ANALOG OUTPUT) Y/N**
  The function is not yet implemented.
- **BOARD 7515 (GRID-TIME) Y/N**
  The board 7515 is a measuring and monitoring board for network frequencies between 45 and 65 Hz. Via the menu the network frequencies, network time and (network) time difference can be queried and the time difference can be set to 0.

4.4.1 BOARD 7406 (SYNC.-CLOCK)

Selection frame:

```
BOARD 7406 (SYNC.-CLOCK) Y/N
```

With this function all the synchronous lines of the main clock board can be configured or the current synchronous line data can be queried. Further information can be found in the technical description for 7406.

Input frame:

```
S.-CLK No.:01 ST=R I=1.0 s T:11.50.41
NEW INPUT >_ < > < > . s< > . . <
```

[5] Board 7272 for further application

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In the first line of the display the data of the synchronous line which was last queried are shown: Synchronous line No. **S.-CLK No.:01**, synchronous line status **ST=R**(un), current pulse length **I=1.0 s** and the time **T:11.50.41**.

- *Input of synchronous line number:* if the data of the other synchronous lines are to be queried or changed the synchronous line number must be entered in the second line. The input of the number is in **two digits** in the range from **01..15**. If the input of the number is outside the permissible range an error message will appear.
  After input of the synchronous line number the first line in the display is updated accordingly, if the synchronous line entered is available within the system.
- *Input of synchronous line status:* here the input of S(top) can stop synchronous line pulse output or the input of R(un) can start synchronous line pulse output.
- *Input of synchronous line pulse length:* here the pulse length can be set in the range of 0.2 .. 3.0 seconds. If the input of the pulse length is outside the permissible range the minimal 0.2 or maximal 3.0 seconds pulse length is pre-set.
- *Input of synchronous line time:* here the synchronous line time is re-set. The synchronous line time is entered according to the **hh.mm.ss** format/sample, whereby the following inputs are possible:

hh	hour	range	from 00 - 23
mm	minute	— " —	from 00 - 59
ss	second	— " —	from 00 – 59

> Before the Synchronous line time is set, stopping the synchronous line is recommended.

4.4.2 BOARD 7270 / 7271 / 7272 (LAN)

<u>Selection frame:</u>

```
BOARD 7270 / 7271 / 7272 (LAN) Y/N
```

With this function the most important network time server parameters of the LAN board can be queried and/or re-set. Further information can be found in the technical board description.

Querying or setting takes place in two stages (two different input frames).

<u>1. Input frame:</u>

```
No:_:              :    .    .    .
NEW  >_             >   .    .    .   <
```

The LAN board no. is required here as the first input (<u>1st input frame</u>).

- The *input* of the LAN board number is as a single digit in the range 1..8. If a number outside the permissible range is entered an error message appears.

> Only one board number is assigned for each LAN board (independent of the board type).

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1. Input frame: (Example for LAN board no.1)

```
1 CB: 00000010 IP: 192.075.068.005
NEW  >_            >   .   .   .   <
```

After input of the LAN board number followed by **"ENT"**, the selection and evaluation of the data of the corresponding board takes place. These are shown into the first line of the display (1st input frame), if the board indicated is available within the system

In this section control byte (**CB**) and IP address (**IP**) can be entered.

- *Control byte input:* for the input only the figures**"0"** und **"1"** are permissible; the input is only bit by bit. The significance of the individual bits can be found in the technical board description. The input of the control byte is completed with **"ENT"**.
- *Input of the IP address:* this is entered in 4 groups, separated by a point (**.**), with 3 decimal figures between **0...255**.
  The input must be in **3 digits** (e.g.: 9 ⇨ 009).

After confirmation of the IP address with **"ENT"** then there is a change to the 2nd section of the parameter input.

2. Input frame: (Example for LAN board no.:1)

```
1 NM: 04 GW: 192.075.068.055
NEW  >_     >   .   .   .   <
```

In this section the network mask (**NM**) and Gateway address (**GW**) are entered.

- *Input of the network mask:* this is in **2 digits** in the range **00..32**. Input must be completed with **"ENT".**
- *Input of the gateway address:* this is done in the same way as for the IP address. The input must be completed with **"ENT"**.

After the final input the transmission to the LAN board must be confirmed with **"ENT"**er, in order to set off a re-initialisation.

4.4.3 BOARD 7265 (IRIG-B ANALOG OUTPUT)

This function is not yet implemented.

4.4.4 BOARD 7515 (GRID-TIME)

Selection frame:

```
BOARD 7515 (GRID-TIME) Y/N
```

With this function the network frequency analysis data can be called up by the 7515 network analysis board. Further information can be found in the technical description to 7515.

1. Input frame:

```
->_ NT:   :  :   dT:     :  :  ,
    ST:   :  :   F:    ,    Hz IN (R)->
```


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The board no. must be entered here as the first input (1. Input frame). The input of board no. is as a **single digit** in the range **1..4**. If a number outside the permissible range is entered an error message will appear.

1. Input frame: (Example for 7515 board no.:1)

```
->1 NT: 15:17:45 dT: + 00:00:00,009
    ST: 15:17:44 F: 50,003 Hz IN (R)->_
```

After input of the board no. the data of the corresponding 7515 network voltage analysis board are evaluated and shown in the display.

NT: 15:17:45	calculated network time (hh:mm:ss) from network voltage frequency
dT: + 00:00:00,009	calculated time difference from network voltage frequency (± hh:mm:ss,msec.)
ST: 15:17:44	current system time (hh:mm:ss)
F: 50,003 Hz	current network voltage frequency

With the second input the network time from the network voltage frequency of the corresponding 7515 network voltage analysis board can be synchronised with the system time. This is done by entering Reset **"R"** and Enter **"ENT"**. In this the time difference is set to **00:00:00,000**.

If synchronisation of the network time is neither necessary nor desired, this function can be ended with **"ENT"**.

4.5 Show Functions

4.5.1 General Information

All readouts which are a result of internal sources are displayed under this menu item, such as the satellite values with a GPS master clock system.

With **"BR"** it is possible to leave the Show menu at any time.

Not all the sub-functions are required or used. At the beginning of each show function details are given concerning the master clock versions with which these can be implemented. If such a not needed function is called up by mistake then this should be left via **"BR"**.

The sub-functions of the show menu are shown on the display and

can be selected with **"Y"** = yes
or rejected with **"N"** = no

When the input is **"N"** the next sub-function is displayed.

When the input is **"N"** the corresponding sub-function starts up.

With **"ENT“** the display for calling up the sub-function returns.

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4.5.2 Changeover Times

Valid for all systems

With this function the calculated changeover times for the current year can be viewed.

Selection frame:

```
SHOW CHANGE-OVER DATES Y/N
```

Display frame:

```
STANDARD → DAYLIGHT 02.00.00 31.MAR.2002
DAYLIGHT → STANDARD 03.00.00 27.OCT.2002
```

The changeover times for Central Europe in 2002 are shown as an example.

4.5.3 Satellite Values

Valid for GPS systems

To synchronise the GPS Master Clock System with UTC there must be 4 satellites visible within range of the antenna, if the system is set to 3D synchronisation. In the optimal situation there are 9-10 satellites within the visibility range of the antenna, 8 of which can be received parallel to each other. In position-fixed mode at least one satellite is required.

This sub-function shows how many satellites are theoretically within the visibility range, which satellites are received and a relative mass for reception performance. It is especially helpful to call this up when installing the equipment.

Selection frame:

```
SHOW SATELLITES Y/N
```

Display frame (Example):

```
V  T  SA/SI 05/72 09/78 30/54 06/38
10 05 SA/SI 25/72
```

The number of satellites which are visible at this location with the optimum positioning of the antenna is shown under **(V)**isible. During the first reception process or after a longer power failure the value at **(V)** is 00.

The number of satellites which can actually be tracked at present by the GPS receiver appear under **(T)**racked.

After **(SA)**tellite**/(SI)**gnal the number of the satellite appears together with the relative signal/noise ratio with which the satellite is tracked by the GPS receiver.

When the signal/noise ratio is bad	**10 - 30**
When the signal/noise ratio is adequate the values are	**30 - 50**
When the signal/noise ratio is good the values are	**50 - 100**

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4.5.3.1 Interpretation of Errors

With the display frame of the satellites errors in the receiving system can be identified.

Example 1: There is no satellite in the display even after several hours when the equipment is first installed.

Possible causes:

- the antenna cable is defective
- the antenna cable is not connected
- the antenna is defective
- the lightning protector is defective

Example 2: There are 7 satellites in the visibility range, but only a maximum of 2 appear in the display.

Possible cause:

- There is limited visibility of the sky from the antenna.

Example 3: There are 9 satellites in the visibility range, 6 have been traced, but the equipment is not synchronised, since the signal/noise ration is between 10-30.

Possible cause:

- The cable is too long
- The BNC connecter has been wrongly installed
- The cable is crushed or bent
- The cable has the wrong impedance value
- The conditions for reception are extremely bad (e.g. damp, heavy snowfall)

Example 4: Previously the equipment has functioned perfectly. 7 satellites appear in the visibility range but none is tracked - there has been no reception for several days.

Possible cause:

- The cable has been damaged
- There was a stroke of lightning and the lightning protector is defective
- Antenna defective
- Receiver defective
- Voltage supply unit defective

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4.5.4 Position Display

Valid for all GPS systems

With this sub-function the position entered and/or updated by GPS is displayed. Unlike the position input, the position display is extended by 4 decimal points with the position minutes. The position data are updated by GPS every second.

Selection frame:

```
POSITION Y/N
```

Display frame:

```
LATITUDE N 51 degr. 12,6898 min.
LONGITUDE E 007 degr. 39,8050 min.
```

In this example the position of ***hopf*** Elektronik GmbH is shown.

4.5.5 Error Monitoring

Valid for all systems

Currently 10 single error bits are set on the board which can be summarized to an entire error message by means of the error priority input.

The setting of a failure bit is delayed approximately 4 minutes in order to blank out sporadic failures. However, this does not mean that for the internal signal processing sporadic failures are also blanked out for 4 minutes.

A logical **'1'** indicates that there is a failure.

Underneath the failure message it is shown how the failure influences the total failure message.

Selection frame:

```
ERROR MONITORING Y/N
```

Display frame:

```
ERROR-NO 1-8 >00000000< 9-16 >00000000<
PRIORITY 1-8 >H--L---H< 9-16 >LL------<    ( example )
```

The various failure bits have the following meaning:

ERROR-1	Description
0 / 1	Bit 1 goes from logical **"0"** to logical **"1"** if the system has no GPS reception in **"GPS_M"** mode.
ERROR-2	**Description**
0 / 1	Bit 2 goes from logical **"0"** to logical **"1"** if the system receives no or only mutilated DCF77 pulses when in **"DCF_T"**-Mode.
ERROR-3	**Description**
0/1	Bit 3 goes form logical **"0"** to logical **"1"** if the system no longer has any reception via the antenna input when in **DCFA** mode.

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ERROR-4	**Description**
0 / 1	Bit 4 goes from logical **"0"** to logical **"1"** if the serial synchronisation string has been read incorrectly or is no longer available.
ERROR-5	**Description**
0 / 1	Bit 5 goes from logical **"0"** to logical **"1"** if the serial synchronisation string of a second synchronisation source reports crystal operation.
ERROR-6	**Description**
0 / 1	Bit 6 goes from logical **"0"** to logical **"1"** if there has been an error in comparison of the synchronisation sources in system status setting **GPS_M+**. In this setting synchronisation is via GPS receiver and via a serial data string. If the time information varies then there is an error message.
ERROR-7	**Description**
0 / 1	Bit 7 goes from logical **"0"** to logical **"1"** if there has been an error in comparison of the synchronisation sources in system status setting **DCF_T+**. In this setting synchronisation is via the DCF77 pulse input and via a serial data string. If the time information varies then there is an error message.
ERROR-8	**Description**
0 / 1	Bit 8 goes from logical **"0"** to logical **"1"** if there has been an error in comparison of the synchronisation sources in system status setting **DCF_A+**. In this setting synchronisation is via the DCF77 antenna input and via a serial data string. If the time information varies then there is an error message.
ERROR-9	**Description**
0 / 1	Bit 9 goes from logical **"0"** to logical **"1"** when the system is no longer synchronised and the time for the status "Off"-time has finished. This error bit should always be considered in the total error message. It is also set when the internal quartz clock deviates from the synchronisation source and therefore there is a leap in time. Bit 6 in the system byte must be set to **"1"**.
ERROR-10	**Description**
0 / 1	Bit 10 goes from logical **"0"** to logical **"1"** when the upper limit of the DAC is reached and no further frequency steps downwards are possible.
ERROR-11	**Description**
0 / 1	Bit 11 goes from logical **"0"** to logical **"1"** when the upper limit of the DAC is reached and no further frequency steps upwards are possible.
ERROR-12	unassigned at present
ERROR-13	unassigned at present
ERROR-14	unassigned at present
ERROR-15	unassigned at present
ERROR-16	unassigned at present

On the board the time-defining quartz is integrated into a VCO[6] circuit. The output frequency of the VCO is controlled via a DAC[7].

[6] VCO = **V**oltage **C**ontrolled **O**scillator
[7] DAC = **D**igital **A**nalog **C**onverter

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4.6 Monitor

Valid for all systems

This menu function is not described here in more detail. It is intended for ***hopf*** Elektronik GmbH. Uncontrolled implementation can lead to malfunctions in the system.

4.7 Prog-Reset

Valid for all systems

After input of Reset **"R"** this sub-function carries out a programme re-set on the board. The main function of this is to display programme version and dates.

4.8 Master Reset

Valid for all systems

After input of Master-Reset **"M"** this sub-function carries out a hardware reset of the complete system. All boards are started again.

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5 Board interfaces

The Master Board 7020 has different interfaces which are on the front panel or on the 96-pole VG ledge.

5.1 Serial Interface

Valid for all systems

In the front panel of the Master Board there is a 9-pole SUB-D male connector containing a RS232 and RS422 service interface.

The transmission parameters are fixed and cannot be changed.

- Baudrate 9600
- no parity
- 8 data bits
- 1 stop bit
- no handshake

5.1.1 Interface Allocation

The RS232 and RS422 pin allocation of the SUB-D male connector 9-pole

Pin	Signal
1	DCF77 pulse
2	RS232-RxD
3	RS232-TxD
4	PPS pulse / Error Message
5	GND
6	RS422-TXD
7	RS422-/TXD
8	RS422-RXD
9	RS422-/RXD

5.1.2 Standard Data Output RS232/RS422

The Master/Slave-String for synchronisation of other ***hopf*** systems is transmitted or received via the serial data output.

The data string is transmitted in the 59th second of every minute with a second advance of 1 second. The last character is transmitted exactly on the minute change and so switches to valid time. With a transmission rate of 9600 baud the time delay for reception is approx. 1.1 msec. This time delay is taken into consideration in ***hopf*** systems which are synchronised via a serial data string.

The transmission includes the complete time information of the local time. The time difference to UTC in hours and minutes is also transmitted. Transmission is in BCD. The maximum time difference is ±11.59 hrs..

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The operational symbol appears as the highest bit in the hours.

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

Example:

90.00	time difference	+ 10.00 hrs.
01.30	time difference	– 01.30 hrs.

The whole data string has the following structure:

Character no.	Meaning	Hex value
1	STX (start of text)	$02
2	status	$30-39, $41-46
3	day of 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 time diff.+ symbol hrs.	$30,$31,$38,$39
17	units time diff. hours	$30-39
18	tens time diff. minutes	$30-35
19	unit time diff. minutes	$30-39
20	LF (line feed)	$0A
21	CR (carriage return)	$0D
22	ETX (end of text)	$03

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5.1.2.1 Status in Data String Master-Slave

	b3	b2	b1	b0	Meaning
Status nibble:	x	x	x	0	No announcement hour
	x	x	x	1	Announcement (DST-ST-DST)
	x	x	0	x	Standard time (ST)
	x	x	1	x	Daylight saving time (DST)
	x	0	x	x	No announcement leap second
	x	1	x	x	Announcement leap second
	0	x	x	x	Quartz mode
	1	x	x	x	Radio-controlled mode
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

5.1.2.2 Example of a transmitted Data String Master-Slave

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

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

5.1.3 Programme Update

A programme update of the 7020 board is possible via the serial interface. For this function there is a separate description.

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6 Technical Data System 7001

General Data	
Housing:	Aluminium, closed
Housing dimensions:	19" System, 3U/84HP (132,5mm / 482,6mm), depth 230mm
Housing protection class:	IP20
Protection class:	I
Cooling:	passive cooling ⇨ attend convection: above and below system a minimum of 1 U to the next device.
Display: Optional:	VFD-Display: 2x40-digit (colour: green) Character height: 5mm; Display type: alphanumeric Status / Error LEDs
Keypad:	42 keys
Operation:	Via keypad and VFD-Display
MTBF (Basis Board 7020):	> 290.000 hours
Weight (Basis System):	Approx. 5kg (depends on system configuration level)

Environmental Conditions		
Temperature:	Operating:	0°C to +55°C
	Storage:	-20°C to +75°C
Humidity:		Max. 95%, not condensed

Operating Voltage	
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:	Depends on power supply and configuration level of system (see type plate)

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 voltage:	EN 55022 Class B

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

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Internal System Accuracy [1]

Synchronisation Source	**Standard Quartz**	**OCXO**
GPS		
Accuracy [2] (absolute)	< ± 100ns	< ± 100ns
Jitter / Stability [2] (averaged)	< ± 1 * 10^{-8} (τ = 1sec) < ± 5 * 10^{-9} (τ = 100sec)	< ± 6 * 10^{-9} (τ = 1sec) < ± 2 * 10^{-9} (τ = 100sec)
Freewheel Stability [2]	< ± 2 * 10^{-8} (at 1.day) (< ± 2ms / 1.day)	< ± 3 * 10^{-9} (at 1.day) [3] (< ± 0,3ms / 1.day)
DCF77 Pulse		
DCF77 pulse signal accuracy: < **± 300nsec**		
Accuracy [2] (absolute)	< ± 150ns	< ± 150ns
Jitter / Stability [2] (averaged)	< ± 1 * 10^{-8} (τ = 1sec) < ± 5 * 10^{-9} (τ = 100sec)	< ± 6 * 10^{-9} (τ = 1sec) < ± 4 * 10^{-9} (τ = 100sec)
Freewheel Stability [2]	< ± 2 * 10^{-8} (at 1.day) (< ± 2ms / 1.day)	< ± 5 * 10^{-9} (at 1.day) [3] (< ± 0,3ms / 1.day)
DCF77 pulse signal accuracy: ca. **± 1,2msec**		
Accuracy [2] (absolute) (to averaged input signal)	< ± 150µsec	< ± 150µsec
Jitter / Stability [2] (averaged)	< ± 1 * 10^{-5} (τ = 1sec) < ± 3 * 10^{-6} (τ = 100sec)	< ± 1 * 10^{-5} (τ = 1sec) < ± 2 * 10^{-6} (τ = 100sec)
Freewheel Stability [2]	< ± 1 * 10^{-7} (at 1.day)	< ± 5 * 10^{-8} (at 1.day) [3]
hopf Master/Slave String [4]		
Accuracy [2] (absolute) (to averaged input signal)	< ± 150µsec	< ± 150µsec
Jitter / Stability [2] (averaged)	< ± 5 * 10^{-6} (τ = 1sec) < ± 3 * 10^{-6} (τ = 100sec)	< ± 5 * 10^{-6} (τ = 1sec) < ± 3 * 10^{-6} (τ = 100sec)
Freewheel Stability [2]	< ± 1 * 10^{-7} (at 1.day)	< ± 5 * 10^{-8} (at 1.day) [3]
General Settings		
Aging	< ± 5 *10^{-6} / year	< ± 3 * 10^{-9} / day < ± 2 * 10^{-7} (in 1.year)

Comments:

(1) The system quartz frequency is the leading value to generate PPS pulses and 1kHz (msec). It is determining for the system accuracy.

(2) After a minimum of 4 hours continuously synchronisation at constant temperature.

(3) After a minimum of 15 days continuously operating at constant temperature.

(4) Master/Slave String accuracy **ETX** at second change by 9600Baud:
Offset: approx. +330µsec (to GPS-PPS), Jitter: ± 60µsec

τ: Capture time / Averaging time

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Signal Outputs	
Serial full duplex interface (without Handshake):	Via 9-poligen SUB-D male connector X1 • RS232 und RS422 • 9600 Baud, no parity, 8 data bit, 1 stop bit • Accuracy **ETX** at second change: Offset: +160µs / Jitter: ± 60µs
PPS Pulse	Via 9-poligen SUB-D male connector X1 • Signal level TTL (5V) • Pulse duration: 50ms / ± 5ms • Accuracy: same as **internal system accuracy**
DCF77 Pulse	Via 9-poligen SUB-D male connector X1 • Signal level TTL (5V) • Pulse duration: 100ms or 200ms / ± 5ms • Accuracy: same as **internal system accuracy**
DCF77 Antenna Simulation (77,5kHz):	Via BNC female connector • Signal level: V_{pp} = 10mV / RL = 50Ω • Carrier frequency: 77,5kHz ± 25ppm • Accuracy (**to DCF77 pulse**): Offset: +13µs / Jitter: ± 7µsec

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