# ***Technical Description***

Satellite Clock System 7001GPS

with Control Board 7020

## Safety information

The safety regulations and technical data are important for the smooth running of the devices and the protection of people and equipment. Strict compliance with these regulations is required. In case of non-compliance with these regulations the guarantee and warranty claims for the device expire. There is no liability for possible consequential damages.

## Safety of the Devices

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

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

Only trained personnel or specialists may operate the device.

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

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

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

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# 1 Brief 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 synchronization 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

***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 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 convertor for the power display in MW

# 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 synchronized through different time code sources such as DCF77, GPS, IRIG-B[2] or serial data strings.

Additionally, the combination of 2 time code sources is possible in order to increase data security (cp. system status 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 synchronizing 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 synchronize 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.

[2] not implemented yet

## 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 synchronization source DCF77 pulse, DCF77 antenna or serial interface

# 3 Description of system

## 3.1.1 Display

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

```
hopf-Elektronik MASTER-CLOCK
VERSION 02.00 25/MAR/2002
```

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]9,9 E-07 –[11]

The individual positions have the following meaning:

[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.
This notification is made approx. 1 hour before the changeover.

Position 3 `--X` **"A"** Notification of leap second

This information is given approx. 1 hour before the second is inserted.

Description of system

**e.g. GPS Master System GPS_M**

Further system abbreviations are under Input System Status

[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:

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

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

[9] In this position the quartz accuracy is displayed with which the internal clock operates. The display starts with **9,9 E-07** with standard quartz and with **9,9 E-10** when using oven-stabilized quartz.

[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

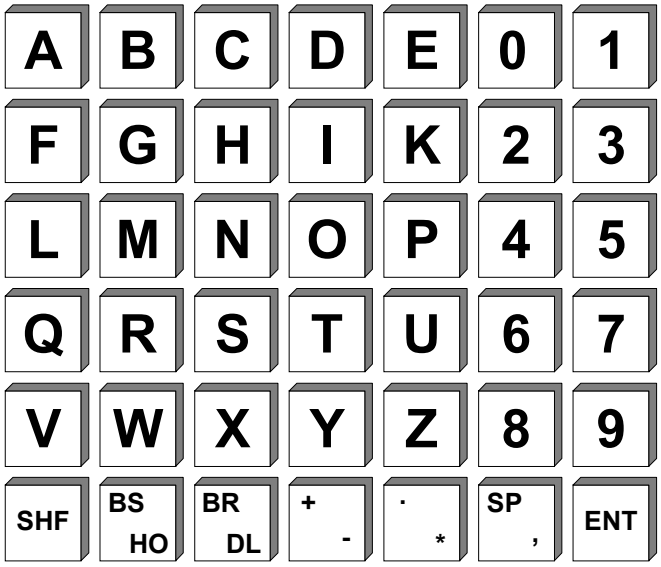
### *3.1.2 Standard display*

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

# 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

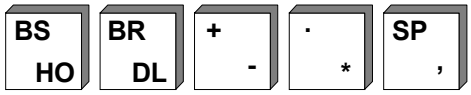



## 4.2 Key functions

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

**0 ... 9** Entering figures

**SHF** Shift function for following keys:




**BS** BS = BACKSPACE, delete last input

**HO** HO = Home, delete complete line

**BR** BR = BREAK, cancel all key controls

**DL** 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"

***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[3] 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. |

[3] for display protection the display can be set to switch automatically to blank (see input system status)

### 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 **"BR"**eak 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.

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.

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

### 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 synchronization 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 |

### 4.3.5 Control Byte

Valid for all systems

With the control byte the synchronization source for the master Clock System is selected and the display control is set.

Selection frame:

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

Input frame:

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

The individual bits have the following meaning:

| | | | | | |
|---|---|---|---|---|---|
| **B7** | | | | | Unassigned at present |
| **B6** | | | | | Unassigned at present |
| **B5** | **B4** | | | | **Description** |
| 0 | 0 | | | | The display is turned on continuously |
| 0 | 1 | | | | The display is reduced to approx.1/4 of its normal brightness |
| 1 | 0 | | | | The display is switched off, one small point moves across the display |
| 1 | 1 | | | | The display is switched off, one small point moves across the display; in addition the display is reduced to approx.1/4 of its normal brightness |
| **B3** | **B2** | **B1** | **B0** | **Abbrev.** | **Description** |
| 0 | 0 | 0 | 0 | QUARZ | Quartz clock, synchronization only from the quartz generator on the board |
| 0 | 0 | 0 | 1 | QUARZ+ | Quartz clock, synchronization only from the quartz generator on the board, the accuracy of the quartz generator is checked and regulated by the second pulse on the system bus. A further 7020 board in the system can then be considered as an independent pulse source. |
| 0 | 0 | 1 | 0 | DCF_T | Synchronization via a DCF77 pulse |
| 0 | 0 | 1 | 1 | DCF_A | Synchronization via a DCF77 receiver |
| 0 | 1 | 0 | 0 | MA_SL | Synchronization via a serial Master/Slave data string from a further ***hopf*** system |
| 0 | 1 | 0 | 1 | GPS-M | Synchronization via a GPS receiver |
| 0 | 1 | 1 | 0 | DCF_T+ | Synchronization via a DCF77pulse + synchronization via a serial Master/Slave data string from a further ***hopf*** system |
| 0 | 1 | 1 | 1 | DCF_A+ | Synchronization via a DCF77 receiver + synchronization via a serial Master/Slave data string from a further ***hopf*** system |
| 1 | 0 | 0 | 0 | GPS_M+ | Synchronization via a GPS receiver + synchronization via a serial Master/Slave data string from a further ***hopf*** system |

### Display control

With **Bit 5 a**nd **Bit 4** the blanking of the display can be controlled. In this way it is possible to delay the loss in brightness of the display (see table)

If, when blanked, an input key is pressed, then a re-initialisation of the display to standard output with normal brightness begins. This status remains for approx. 4 minutes after the last keypad input.

### Selection of Master Clock System

With **Bits 3, 2, 1, 0** the synchronization source for the system is selected. The appropriate system abbreviation appears in the display (see table).

All other settings of Bits 0-3 show **ERROR** in the display instead of the system abbreviation.

| | |
|---|---|
| **Please Note:** | AFTER CHANGING THE SYNCHRONISZTION SOURCE WITH BITS 0-3 A MASTER RESET IS ALWAYS EXECUTED AUTOMATICALLY BY ACTIVATING THE **"ENT"** AND **"BR"** KEYS. |

### Security Master Clock

Systems with a plus symbol, with the exception of Quartz+, require 2 independent synchronization sources for synchronization. Both sets of time information must agree with regard to the time and with additional information such as time zone, notifications of changeovers etc., otherwise there can be no synchronization of the internal clock system and at the same time an error message will be made. These systems can be used for simple TIME-PROOF applications.

### 4.3.6 System byte

Valid for all systems

With the system byte functions can be switched on/off in various programmes.

Selection frame:

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

Input frame:

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

The individual bits have the following meaning:

| B7 | Description |
|---|---|
| 0 | Position-fixed evaluation |
| 1 | 3D evaluation |
| **B6** | **Description** |
| 0 | Standard synchronization procedure |
| 1 | Special synchronization procedure |
| **B5** | Unassigned at present |
| **B4** | Unassigned at present |
| **B3** | Unassigned at present |
| **B2** | Unassigned at present |
| **B1** | Unassigned at present |
| **B0** | **Description** |
| 0 | Setting the notification bit via the synchronization source |
| 1 | Setting the notification bit via the synchronization source or via the change-over times entered |

#### 4.3.6.1 Bit 7 3D / Position-fixed time evaluation

Valid for all GPS systems

With Bit 7 in the system byte it is possible to select between 3D and position-fixed evaluation:

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

The accuracy of the time evaluation is determined by the exact position calculation of the location. For this calculation it is necessary to have reception from at least 4 satellites (3D evaluation). With the calculated position the signal running time to several satellites are defined and from their average value the exact second mark is created. The second mark in this 3D mode has an accuracy of ± 1 µsec.

In many cases it is sufficient, with stationary installations, to have a poorer evaluation of the second mark, e.g. to several milliseconds. In the position-fixed mode the accuracy depends mainly on the exact input of the location. The calculation of the second mark is then made with a satellite which is being received and the position entered. When entering a position with a minute accuracy the accuracy of the second mark is then better than ± 20 µsec. When the input is even more accurate then it is possible to achieve a value of ± 1 µsec again.

The advantage of the position-fixed mode is that the clock can be synchronized with only one received satellite. The antenna can be installed in places where less than a quarter of the sky is visible.

In many cases it is possible to install the antenna inside near the window (short cable, no lightning protection). If 4 satellites can be received in this mode, then the evaluation jumps automatically into 3D mode and calculates the exact position. In this way the accuracy increases with one satellite to ± 1 µsec.

The accuracy details relate to the comparison with the 3D version.

The second marks of a system in position-fixed mode change by max. ± 1 µsec.

#### 4.3.6.2 Bit 6

With this bit the status of the system is controlled on synchronization.

Bit 6 = 0 normal **synchronization procedure**

The synchronization of the internal quartz clock takes place every minute if the synchronization source or sources have valid information. After failure of the synchronization source the synchronization of the internal quartz clock is soft as long as the period of failure is less than 4 hours; if the period of failure is more than 4 hours then synchronization is hard.

Soft synchronization means that the time is adopted with the second accuracy and the milliseconds are slowly adjusted.

Hard synchronization means that the time is adopted at once with millisecond accuracy.

A time leap in seconds is dealt with separately.

Bit 6 = 1 **Special synchronization procedure**

The special synchronization procedure is the same as the normal procedure. Additionally, however, a second time leap is monitored. Before the internal clock adopts the new time information, the difference between the internal clock and the synchronization clock is calculated. If the difference is greater than 1 second, then the internal clock is synchronized but the status of the clock is set to invalid.

This is shown with "-" in the display for the internal status of the clock system. At the same time the level is changed from "Low" to "High" at pin 19b. For this Bit 0 in filter byte 1 must be set. Since synchronization only takes place at the minute change of the external synchronization source, then the error message will only be shown at this time.

Connected systems can reject synchronization with this information. In this way it is possible to avoid a reverse leap in time.

The special synchronization procedure should be used to provide greater security with 2 synchronization sources.

#### *4.3.6.3 Bit 5 to Bit 1*

Bit 5 to Bit 1 are not yet assigned.

#### *4.3.6.4 Bit 0*

Valid for all DCF77 systems

With Bit 0 the notification bit for the time zone changeover can be set if there is no DCF77 synchronization.

Bit 0 = 0 notification bit for time zone changeover is only set by the synchronization source

Bit 0 = 1 notification bit for time zone changeover is set by the synchronization source or by the entered changeover times if there is interference with the synchronization source. In this way a guarantee is given that a time changeover will always be carried out even when there is interference with the DCF77 signal for longer than one hour.

### 4.3.7 Synchronization status

Valid for all synchronization systems

With this sub-function it is possible to control the switching on/off of the synchronization 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 synchronization must be available through the source before the synchronization bit is switched on. For this display this means when the status changes from **(C)**rystal to **(R)**eception. 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-synchronized systems. With GPS-synchronized 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 synchronization bit should be switched back if no synchronization is supplied by the source. A value which is beneficial for DCF77 synchronized 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 synchronization 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.

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 synchronization 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 synchronization of the basic system fails.

The time depends on the required accuracy of the sub-system. For DCF77-synchronized systems the time should be set to about 55 minutes, for GPS-synchronized 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 synchronization |
| 1 | DCF77 simulation output permanent |
| **B0** | **Description** |
| 0 | When there is interference or no synchronization or T_OUT has finished there is no reduction in amplitude or pulse output |
| 1 | When there is interference or no synchronization 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 synchronization of the master clock system.

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

Bit 1 = 1 the DCF77 simulation is emitted permanently

#### *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 synchronization or **T-OUT** has finished, there is no reduction in amplitude or pulse output.

Bit 0 = 1 when there is interference, no synchronization 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 Filter

Valid for all systems

At present there are 10 individual error bits on the board (see error bytes). These can be combined in one common error report. With the error filter input it is possible to select which individual errors start a full report.

A logical **"1"** switches the corresponding error bit to total report. With a logical **"0"** the corresponding error bit is suppressed.

Selection frame:

```
ERROR-FILTER Y/N
```

Input frame:

```
F-BYTE 1 >00000000< F-BYTE 2 >00000000<
NEW IN 1 >_ <        NEW IN 2 >         <
```

The significance of the individual error bits is described under **"SHOW ERROR BYTES"**.

### 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.

Top 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.

Selection frame:

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

Input frame:

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

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

#### 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 =-> <-
```

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 (LAN) Y/N
  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< > . . <
```

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 |

**Please Note:** BEFORE THE SYNCHRONOUS LINE TIME IS SET, STOPPING THE SYNCHRONOUS LINE IS RECOMMENDED.

### 4.4.2 BOARD 7270 (LAN)

Selection frame:

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

With this function the most important network time server parameters of the 7270 LAN board can be queried and/or re-set. Further information can be found in the technical description for 7270.

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

1. Input frame:

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

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

- 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.

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 description for 7270. 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"**.

**Please Note:** 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)->
```

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 synchronized with the system time. This is done by entering **R**(eset) and **"ENT"**er. In this the time difference is set to **00:00:00,000**.

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

## 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"**eak 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.

### 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 synchronize 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 synchronization. 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** |

#### 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 synchronized, 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

### 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 is shown.

### 4.5.5 Error Bytes

Valid for all systems

On the board 10 single error bits are set at present which can be combined into one common error message with the aid of the error filter input. The set-up of an error bit is delayed by approx. 4 minutes to fade out any sporadic error. This does not however mean that, for internal signal processing, a sporadic error is also faded out for 4 minutes.

A logical **"1"** shows that there is an error.

Selection frame:

```
SHOW ERROR-BYTES Y/N
```

Display frame:

```
ERROR-BYTE 1 >00000000<
ERROR-BYTE 2 >00000000<
```

The individual error bits have the following significance:

#### 4.5.5.1 Error byte 1

On the board the time-defining quartz is integrated into a VCO[4] circuit. The output frequency of the VCO is controlled via a DAC[5].

| | |
|---|---|
| **B7** | Unassigned at present |
| **B6** | Unassigned at present |
| **B5** | Unassigned at present |
| **B4** | Unassigned at present |
| **B3** | Unassigned at present |
| **B2** | **Description** |
| 0 / 1 | Bit 2 goes from logical **"0"** to logical **"1"** when the upper limit of the DAC is reached and no further frequency steps upwards are possible. |
| **B1** | **Description** |
| 0 / 1 | Bit 1 goes from logical **"0"** to logical **"1"** when the upper limit of the DAC is reached and no further frequency steps downwards are possible. |
| **B0** | **Description** |
| 0 / 1 | Bit 0 goes from logical **"0"** to logical **"1"** when the system is no longer synchronized 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 synchronization source and therefore there is a leap in time. Bit 6 in the system byte must be set to **"1"**. |

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

#### 4.5.5.2 Errorbyte 2

| B7 | Description |
|---|---|
| 0 / 1 | Bit 7 goes from logical **"0"** to logical **"1"** if there has been an error in comparison of the synchronization sources in system status setting **DCF_A+**. In this setting synchronization is via the DCF77 antenna input and via a serial data string. If the time information varies then there is an error message. |
| **B6** | **Description** |
| 0 / 1 | Bit 6 goes from logical **"0"** to logical **"1"** if there has been an error in comparison of the synchronization sources in system status setting **DCF_T+**. In this setting synchronization is via the DCF77 pulse input and via a serial data string. If the time information varies then there is an error message. |
| **B5** | **Description** |
| 0 / 1 | Bit 5 goes from logical **"0"** to logical **"1"** if there has been an error in comparison of the synchronization sources in system status setting **GPS_M+**. In this setting synchronization is via GPS receiver and via a serial data string. If the time information varies then there is an error message. |
| **B4** | **Description** |
| 0 / 1 | Bit 4 goes from logical **"0"** to logical **"1"** if the serial synchronization string of a second synchronization source reports crystal operation. |
| **B3** | **Description** |
| 0 / 1 | Bit 3 goes from logical **"0"** to logical **"1"** if the serial synchronization string has been read incorrectly or is no longer available. |
| **B2** | **Description** |
| 0/1 | Bit 2 goes form logical **"0"** to logical **"1"** if the system no longer has any reception via the antenna input when in **DCFA** mode. |
| **B1** | **Description** |
| 0 / 1 | Bit 1 goes from logical **"0"** to logical **"1**" if the system receives no or only mutilated DCF77 pulses when in **"DCF_T"**-Mode. |
| **B0** | **Description** |
| 0 / 1 | Bit 1 goes from logical **"0"** to logical **"1"** if the system has no GPS reception in **"GPS_M"** mode. |

## 4.6 Monitor

Valid for all systems

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

## 4.7 Prog-Reset

Valid for all systems

After input of **(R)**eset 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 **(M)**aster-Reset this sub-function carries out a hardware reset of the complete system. All boards are started again.

# 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 |
| 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 synchronization 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 9,6 kbaud the time delay for reception is approx. 1.1 msec. This time delay is taken into consideration in ***hopf*** systems which are synchronized 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..

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 | Value(range) | |
|---|---|---|---|
| 1 | STX (start of text) | $02 | |
| 2 | status | $30-39, $41-46 | ; see 5.1.2.1 |
| 3 | day of week | $31-37 | ; see 5.1.2.1 |
| 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 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 | |

### 5.1.2.1 Status in Data string Master-Slave

| | b3 | b2 | b1 | b0 | Meaning |
|---|---|---|---|---|---|
| **Status nibble:** | x | x | x | 0 | No notification hour |
| | x | x | x | 1 | Notification(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.

# 6 Technical Data Basic system

| | | |
|---|---|---|
| **Operating voltage** | Standard: | 230 V AC +10% -15% |
| | Option: | 120 V AC +10% -15%<br>80 V DC (60 V - 120 V)<br>48 V DC (36 V - 72 V)<br>24 V DC (18 V - 36 V) |
| Power consumption when fully equipped: | | 50 VA |
| **Display:** | | VFD display 2x40-digit |
| Display mode: | | alphanumerical |
| Height of characters: | | 5 mm |
| Colour: | | green |
| **Keypad:** | | 42 keys |

| | |
|---|---|
| **Accuracy:** | |
| Standard quartz | ± 10 *10E-6 without control |
| After control with | |
| - DCF77pulse | ± 1 *10E-6 |
| - DCF77antenna | ± 2 *10E-6 |
| - Master/Slave-String | ± 1 *10E-6 |
| - GPS | ± 0,05 *10E-6 |
| **Oven-stabilized Quartz** | ± 2 * 10 E-8 without control |
| After control with | |
| - DCF77pulse | ± 0,5 *10 E-8 |
| - DCF77antenna | ± 1 * 10 E-8 ppm |
| - Master/Slave-String | ± 0,5 *10E-8 |
| - GPS | ± 2 * 10 E-11 |

The accuracy values apply to the freerun of the system. During synchronization all the systems adopt the long-term accuracy of the synchronization sources.

| | |
|---|---|
| **Emergency clock accuracy:** | ± 25ppm at 25°C |
| Maintenance-free emergency clock buffering | 3 days |

***Special requirements:***

Hard- and software modifications according to customer specifications

**Please Note:** ***HOPF*** RESERVES THE RIGHT TO MODIFY HARD- AND SOFTWARE AT ANY TIME.