

Industriefunkuhren



Technical Manual

GPS Satellite Controlled Clock

Model 6880

ENGLISH

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Valid for 6880 units with FIRMWARE Version: **01.xx**

Version Numbers (Firmware / Specification)

THE FIRST TWO POSITIONS OF THE VERSION NUMBER OF THE TECHNICAL MANUAL AND THE FIRST TWO POSITIONS OF THE FIRMWARE VERSION OF THE HARDWARE **MUST MATCH!**

THE POSITIONS AFTER THE DECIMAL POINT IN THE VERSION NUMBER INDICATE ONLY MINOR CORRECTIONS TO THE FIRMWARE / MANUAL AND ARE NOT OF OPERATIONAL SIGNIFICANCE.

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Symbols and Characters



Operating safety

Non-observance can lead to personal or material damage.



Functionality

Non-observance can impair the operation of the system or device.



Information

Instructions and information.



Safety instructions

The safety specifications and technical data serve to provide fault-free operation of the equipment and the protection of people and material objects. Consequently observance and compliance is absolutely essential. Non-compliance renders any claim for guarantee or warranty of the equipment void. No liability is accepted for any consequential damage.



Equipment safety

This equipment was manufactured using state-of-the-art technology and in accordance with recognised safety regulations.

Mounting of the equipment must only be carried out by trained specialist personnel. Care should be taken to ensure that all connected cables are laid and fixed correctly. The equipment may only be operated with the power supply voltage stated on the nameplate.

The equipment may only be operated by instructed personnel or skilled staff.

Repairs to opened units may only be carried out by appropriately trained specialist personnel or by the **hopf** Elektronik company.

The equipment must be disconnected from all voltage sources prior to working on an opened unit or changing a fuse.

If there are reasons to believe that faultless operational safety can no longer be guaranteed, the unit should be taken out of service and identified accordingly. Safety may be impaired if, for example, the equipment does not function as specified or if it is visibly damaged.

CE-Conformity



This equipment meets the requirements of the EC Directive 89/336/EC "Electromagnetic Compatibility" and 73/23/EC "Low Voltage Directive".

For this purpose the equipment carries CE marking (CE=Communauté Européenne or European Community)

CE indicates to inspection authorities that the product conforms to the requirements of the EC Directive – particularly in relation to health protection and safety of the user and consumer – and may be traded freely in the common market.

Contents		Page
1	Short Description Model 6880.....	9
2	Introduction	10
3	Quick Installation.....	10
4	Commissioning.....	11
4.1	Power supply.....	11
4.2	Reception frequencies	11
4.3	Default key "DEF" on the front panel	11
4.4	LED "CLK".....	11
4.5	Control LED L+ and L-	11
4.6	Relay LED "K"	11
4.7	Commissioning the base system	12
4.7.1	Display	12
4.7.2	Standard display	12
5	Keypad	13
5.1	Key functions.....	13
5.1.1	Keypad entries / system control.....	13
5.1.2	Permissible data ranges for data entry	14
5.2	SET functions.....	15
5.2.1	Time / date entry	15
5.2.2	Time difference	16
5.2.3	Time zone changeover	16
5.2.4	Position	17
5.2.5	Serial interface parameters.....	18
5.2.6	Selection screen parameters of the serial interfaces.....	18
5.2.7	Set mode byte 1 selection.....	18
5.2.8	Set mode byte 2 selection.....	18
5.2.9	Status and pulse output	19
5.2.10	Selection of the display and DCF77 simulation	19
5.2.11	System status.....	20
5.2.12	Data security	20
5.3	Controlling the input data	21
5.3.1	Time difference	21
5.3.2	Time zone changeover D \Rightarrow S	21
5.3.3	Time zone changeover S \Rightarrow D	21
5.3.4	Position	22
5.3.5	Satellite display	22
5.3.6	Error byte	23
5.3.7	Error interpretation	24
5.3.8	Further SHOW functions.....	24

5.4	Relay switch conditions	25
5.4.1	Deactivate relay output	25
5.4.2	Activate system status relay output	25
5.4.3	Activate cyclical relay output within 24 hours	26
5.4.4	Activate non-cyclical relay output.....	26
5.4.4.1	Displaying and deleting non-cyclical relay switches	27
5.4.4.2	Setting non-cyclical relay switch times.....	28
5.4.4.3	Examples of non-cyclical switch time programming	31
5.5	Controlling slave clocks	34
5.5.1	View slave line	34
5.5.2	Start/stop slave line.....	34
5.5.3	Set slave lines	35
5.5.4	Slave line pulse time	35
5.5.5	Slave line control byte	36
5.5.5.1	Set slave line control byte	36
5.5.5.2	View slave line control byte.....	36
5.6	Incorrect polarity.....	37
5.7	Initialisation functions	37
5.7.1	Status change delay.....	37
5.7.2	Switch-off delay for DCF77 simulation.....	37
5.7.3	DCF77 pulse width.....	38
5.7.4	Time evaluation 3D / position fix	39
5.7.5	Execute programme reset.....	39
5.7.6	Execute master reset.	40
5.8	Keypad summary	40
5.9	Display functions	40
6	Configuration.....	41
6.1	Configuration of the serial interfaces	41
6.2	Parameters of the serial transfer.....	41
6.3	Configuration of the data telegram (mode byte)	42
6.3.1	Local time or UTC in the serial output with mode byte 1	43
6.3.2	Second forerun of the serial output with mode byte 1	43
6.3.3	Bit 5 without function	43
6.3.4	Last control character as on-time mark with mode byte 1	43
6.3.5	Control characters CR and LF with mode byte 1	43
6.3.6	Send delay	44
6.3.7	Transmission point of time with mode byte 1	44
6.3.8	Telegram selection with mode byte 2	44
6.4	Data format of the serial data transfer	45
6.5	Serial enquiries	45
6.5.1	Serial enquiry with ASCII characters (standard and standard 2000).....	45
7	Data Telegrams.....	46
7.1	Construction of the hopf standard telegram	46
7.1.1	Status and weekday nibble in the hopf standard telegram	47
7.1.2	Example of a sent hopf standard telegram	47

7.2	Standard hopf data telegram string 2000.....	48
7.2.1	Data telegram 2000 status and weekday nibble.....	49
7.2.2	Example of a sent data string 2000.....	49
7.3	Data telegram SINEC H1.....	50
7.3.1	Status in the SINEC H1 data telegram.....	51
7.3.2	Example of a sent SINEC H1 data string.....	51
7.4	Data telegram T-string.....	52
7.4.1	Example of a sent T-string data string.....	52
7.5	Master/Slave string.....	53
7.5.1	Status in the Master-Slave data telegram.....	54
7.5.2	Example of a sent Master-Slave data string.....	54
7.5.3	Setting.....	54
8	Interface and screw terminals.....	55
8.1	Assignment of the 9-pole SUB-D connector.....	55
8.1.1	Version 1 – Standard assignment RS232 and RS422.....	55
8.1.2	Version 2 - RS232 / RS232.....	55
8.1.3	Version 3 - RS232 / TTY.....	55
8.1.4	Version 4 - RS232 and PPS pulse / DCF77 pulse.....	56
8.1.5	Version 5 - IRIG-B with RS232 and RS422.....	56
8.2	Assignment of the screw terminals.....	57
9	Technical Data Base System.....	58

1 Short Description Model 6880

On the **GPS Master Clock System 6880** particular attention was paid to the following features:

- Potential-separated GPS antenna circuit
- No line length losses due to the integration of indirect lightning protection

The 6880 system is configured by simple menu selection via a keypad on the front panel.

The following signals are available at the output:

- 1 kHz frequency output / TTL-level (option)
- PPS-pulse / TTL-level (option)
- DCF77-simulation of the local or UTC-time to control additional **hopf** radio controlled clocks
- IRIG-B time code output
- DCF77¹ simulation output (see appendix DCF77)
- Variable pulse width setting for DCF77-simulation
- 1 minute slave line or 2 DCF77 time code lines
- Programmable cyclical and non-cyclical relay changeover switch
- Optical coupler input for external synchronisation (option)
- Two independent serial interfaces without handshake lines, with the following physical variants:
 - RS232 / RS422 (standard)
 - RS232 / RS232
 - RS232 / TTY passive
 - RS232 / PPS / DCF77 pulse
 - IRIG-B / RS232 and RS422

The **GPS Master Clock System 6880** is used to control clocks with pole-changing minute pulses (max. 200 mA, 24V DC).

Synchronisation of the system takes place using the globally installed **GPS** Satellite Navigation System.

Additional systems can also be synchronised via the serial interfaces.

The system is configured via the built-in keypad.

A relay with changeover contacts is available for the output of cyclical and non-cyclical pulses.

The time difference to UTC as well as regional changeover times for summer / winter time can be entered for any location in the world.

An integrated DCF77-simulation of the local time is designed to facilitate the synchronisation of additional DCF77 clocks, so that well-proven system installations can be synchronised by this means without modification.

¹ DCF77 = (D) German - (C) Long wave signal - (F) Frankfurt - (77) 77.5 kHz

2 Introduction

The **hopf** range of radio controlled / quartz clock systems, established since 1975, has been extended by the GPS¹ 6880 Receiver. This makes possible the worldwide application of this time base with the highest precision.

The time base is synchronised using the globally installed **GPS** Satellite Navigation System. Satellites circumnavigate the earth twice per day at an altitude of approximately 20.000 km, on different courses and at different angles (see illustration in the appendix). On board each satellite are highly precise atomic clocks (accuracy min. $1 \times 10E-12$). The GPS-Receiver receives course positions as well as a GPS world time from as many satellites as possible. First, this data is used to define the position of the Receiver. Once the position is known, the current time can then be determined from the received GPS world time, from one satellite. The accuracy of the time is therefore dependent primarily on the quality of the position definition.

World time UTC² is calculated from the GPS world time (GPS-UTC) by subtraction of the leap seconds, at present (status 1994) world time is running eight seconds behind GPS-UTC. The difference is not constant; it changes respectively with the incorporation of leap seconds. The difference to UTC-time as well as regional changeover times for summer / winter time can be entered via the system keypad for any location on earth. Thus the highly precise local time is available for further processing.

3 Quick Installation

- Connect the GPS antenna
- Connect the voltage
- Switch the voltage on
- Input the local time
- Input the time difference
- Input the position (not necessarily required)
- Input the changeover time **S** ⇒ **D** (not necessarily required)
- Input the changeover time **D** ⇒ **S** (not necessarily required)
- Activate programme reset
- View the time difference
- View the position
- View the changeover time **S** ⇒ **D**
- View the changeover time **D** ⇒ **S**
- Activate Master reset

¹ GPS = Global Positioning System

² UTC = Universal Time Coordinated

4 Commissioning

4.1 Power supply

The system as standard should be operated with the following power supply:

- 24V DC +/- 25%

On connecting the power supply care should be taken to ensure that the voltage level and polarity are correct.



Commissioning may only be carried out by specialist personnel.

4.2 Reception frequencies

The satellites emit two frequencies:

- L1 at 1.575.42 MHz
- L2 at 1.227.60 MHz

The frequency L1 is approved for civil use. The received output is approximately -160 dB. The antenna has a preamplifier, which boosts the received satellite frequencies by +20 dB.

4.3 Default key "DEF" on the front panel

The "DEF" key on the front panel has no function.

4.4 LED "CLK"

The green LED on the front panel signals the synchronisation status of the clock.

Flashing in the 2 Hz pulse means "Clock running in quartz mode". This condition is displayed after switching the clock on and when the timeout time for the radio communication bit is exceeded (see heading DCF77-simulation) during reception interference.

In radio controlled operation the CLK-LED flashes in the 1Hz pulse (DCF77 pulse).

4.5 Control LED L+ and L-

The switch status of the slave line is displayed with the LED L+ und L-. The flashing of an LED signals that the corresponding pulse (positive or negative) is being emitted.

4.6 Relay LED "K"

The switch status of the relay is displayed with the LED "K". The flashing of the LED signals closure of the **COM** and **NO** contacts or opening of the **COM** and **NC** contacts.

4.7 Commissioning the base system

By applying the correct operating voltage the base system is switched on and runs independently. The necessary settings can now be made via the keypad.

4.7.1 Display

The following screen appears on the 2x16 position LCD display on the first commissioning or after a minimum of 3 days without voltage:

```

1LT: 00:00:00 2S-C
3-- --/---/-----

```

The individual positions have the following meaning:

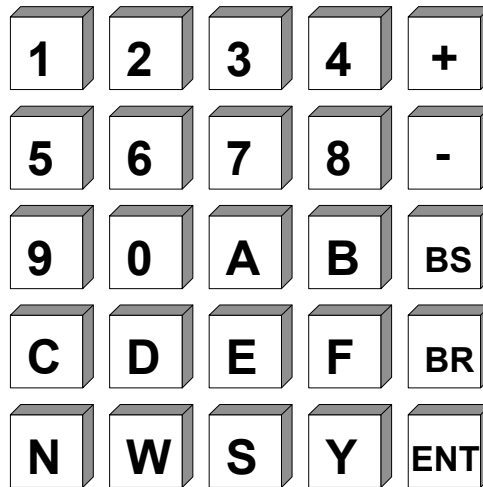
- ¹ **LT**: 00:00:00
The local time is displayed in these fields.
- ² Status display: If UTC display was selected as the standard output, then the identification code **UTC**: appears instead of **LT**:
Position 1 **x--** "**S**" for winter time (**S**tandard Time)
"**D**" for Summer time (**D**aylight Time)
Position 2 **-x-** "**A**" announcement of the changeover to another time zone.
This announcement takes place 1 hour before the time zone change.
Position 3 **--x** Display of the internal status of the system:
"**C**" = the clock system is running in quartz mode (C=Crystal).
"**r**" = the clock system is running in GPS-synchronous mode but without second and quartz readjustment
"**R**" = The clock system is running in GPS-reception mode with the highest accuracy and output of the PPS pulse (radio).
- ³ Display of the weekday in the English identifier code:
MO - TU - WE - TH - FR - SA - SU
- ⁴ Display of the date:
Day / Month Identification Code / Year

The display lighting switches on when the operating voltage is applied or when a key is activated. If there is no entry via the keypad for 4 minutes then the lighting switches off again, thereby guaranteeing longer display life.

4.7.2 Standard display

After a voltage failure (< 3 days), the display starts with the internally supplied emergency clock information.

5 Keypad



5.1 Key functions

+/-	Entry of the numerical data signs.
BS	BACKSPACE, deletion of the last entry.
BR	BREAK, interruption of all menu controllers.
ENT	ENTER, activation of the keypad and transfer of the entered data.

5.1.1 Keypad entries / system control

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

The display jumps from the standard screen, display of the time information, into the start screen for keypad control or system control. At present 5 input or control modes are available for selection on this screen. By entering the relevant numeral the keypad entry jumps into the corresponding mode.

Start screen:

SET = 1 SHW = 2 SM = 3
S.CLK = 4 INI = 5

The individual modes have the following meaning:

SET:	Input of the set function such as time / date, position, time offset etc.
SHW:	Selection of display functions such as time difference, position, interface parameters etc.
S.CLK:	Functions of the slave clock controller: show, pulse width, stop / start etc.
SM:	Set and display function for cyclical and non-cyclical relay output
INI:	Initialisation functions – these functions are required mainly in the factory. They serve to set monitoring times and pulse widths.

5.1.2 Permissible data ranges for data entry

T: Thousands **Z** Tens
H: Hundreds **E** Units
N: Decimal places

Local Time

HOUR	Z	H	0 - 2
HOUR	E	H	0 - 9
.			
MINUTE	Z	m	0 - 5
MINUTE	E	m	0 - 9
.			
SECOND	Z	s	0 - 5
SECOND	E	s	0 - 9
.			
.			
Weekday		d	1 - 7
.			
DAY	Z	D	0 - 3
DAY	E	D	0 - 9
.			
MONTH	Z	M	0 - 1
MONTH	E	M	0 - 9
.			
YEAR	T	Y	1 - 2
YEAR	H	Y	0 - 9
YEAR	Z	Y	0 - 9
YEAR	E	Y	0 - 9
.			

Time Offset

Sign ±		+ or -
Tens hours		0 - 1
Unit hour		0 - 9
.		
Tens minutes		0 - 5
Unit minute		0 - 9

Position

Latitude			
Sign	P	N or S	
Degree	Z	G	0 - 8
Degree	E	C	0 - 9
.			
Minute	Z	M	0 - 5
Minute	E	M	0 - 9
.			
Decimal place	N		0 - 9
Decimal place	N		0 - 9
Decimal place	N		0 - 9
Decimal place	N		0 - 9
Longitude			
Sign	P	E or W	
Degree	H	G	0 - 1
Degree	Z	G	0 - 9
Degree	E	C	0 - 9
.			
Minute	Z	M	0 - 5
Minute	E	M	0 - 9
.			
Decimal place	N		0 - 9
Decimal place	N		0 - 9
Decimal place	N		0 - 9
Decimal place	N		0 - 9

5.2 SET functions

By entering the numeral **1** the programme jumps into the Set Functions zone. The programme is constructed on the basis of operator guidance. The individual sub-functions are output on the display and

selected with **"Y"** = yes or
declined with **"N"** = no

Every other key except **"Y"** and **"BR"** is interpreted as "no".

By entering **"N"** the next sub-function is displayed, at present the following set functions can be selected.

5.2.1 Time / date entry

Selection screen:

SET TIME Y / N _

Input screen:

**TIME: HH:mm:ss
 d.DD/MM/YY.Z**

The local time is set with this input function. The entry takes place on two lines and must be complete. In addition it is also necessary to enter preceding zeros.

The individual positions have the following meaning:

Input	1. Step	HH	=	Hour	Range	from 00 - 23
	2. "	mm	=	Minute	"	from 00 - 59
	3. "	ss	=	Second	"	from 00 - 59
	4. "	d	=	Weekday	"	from 1- 7
				1 corresponds to Monday ... 7 corresponds to Sunday		
	5. "	DD	=	Day	Range	from 01 - 31
	6. "	MM	=	Month	"	from 01 - 12
	7. "	YYYY	=	Year	"	from 1990 - 2089

All entries are accepted with the **"ENT"** key.

If the entry is plausible then this time is accepted in the system, otherwise the **"INPUT ERROR"** message appears for 3 seconds. On **"INPUT ERROR"** the set function is exited and the standard screen reappears in the display. If it is required to make further entries then any key, except **"Y"** and **"BR"**, can be pressed to continue the input programme.

With **BR**Break the set programme is exited. The standard screen reappears.



For countries that change their time zone in the course of the year the changeover dates must be entered (see 5.3.3).

5.2.2 Time difference

Selection screen:

SET DIF.-TIME Y/N _

Input screen:

DIF-TIME: _

The time difference between the local standard time and the world time (UTC-time) is input with this function. The sign indicates the direction in which the local standard time deviates from the world time.

The following is valid:

- + corresponds to east of the zero meridian
- corresponds to west of the zero meridian

Since most countries of the world count their time difference in full hours entry also takes place in steps of one hour:

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

Some countries operate with smaller time steps; therefore the entry of minutes is enabled:

e.g. **+ 05:30** or **- 08:45**



The time difference always refers to the **local winter time**, even if commissioning or differential entry takes place during summer time.

5.2.3 Time zone changeover

In some countries of the world, dependent on the time of year, two time zones are available – a standard time (also known as winter time) and a summer time. Summer time has a time offset of +1 hour to the standard time. The exact changeover date for the current year is calculated automatically from the parameters entered. The parameters are selected in such a way that the changeover can take place at any point in time. For control purposes the exact date is given in the **Show** functions. If there is no time zone changeover in the country then a zero must be entered in all input positions.

Selection screen:

For summer/winter time changeover

SET CHANGE-OVER
DATE D → S Y/N

(Daylight saving time ⇔ Standard-time)

For winter/summer time changeover

SET CHANGE-OVER
DATE S → D Y/N

(Standard-time ⇔ Daylight saving time)

The entry for **longitude** begins with:

- E** = East of the zero meridian
- W** = West of the zero meridian

Then the degrees are entered to 3 positions and after the separators the minutes are entered (2 positions), as well as 4 places after the minutes:

e.g. **LT.N51°12.3651**
LN.E007°37.8426

All entries are accepted with the "**ENT**" key.

The GPS-Receiver only requires the approximate position for fast synchronisation. The following entry would be sufficient for the precise position given in the above example: (**LT**: latitude, **LN**: longitude)

LT.N50°00.0000
LN.E006°00.0000

5.2.5 Serial interface parameters

The parameters, such as baud rate, parity etc., as well as the mode can be entered for each of the two interfaces. The following selection screens appear:

Supply condition:

- Baud rate 9600 baud
- 8 data bits
- 1 stop bit
- No parity
- Send string (6021)
- With control characters (STX/ETX)
- Without second forerun
- Send every second

5.2.6 Selection screen parameters of the serial interfaces

SET COM 0 SERIAL or **SET COM 1 SERIAL**
PARAMETER Y/N _ **PARAMETER Y/N _**

see Section: 6.2 Parameters of the serial transfer

5.2.7 Set mode byte 1 selection

SET COM 0 or **SET COM 1**
MODE_1 Y/N _ **MODE_1 Y/N _**

see Section: 6.3 Configuration of the data telegram (mode byte)

5.2.8 Set mode byte 2 selection

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

See Section: 6.3 Configuration of the data telegram (mode byte)

5.2.9 Status and pulse output

A programmable output is available as an option on the 9 pole SUB-D connector.



To activate this function please contact **hopf** Elektronik GmbH. The output pin and level are dependent on the interface installed.

Programming takes place by entering a byte in the following selection screen:

**SET STATUS- OR
PULS-OUTPUT Y/N**

If (Y)es is entered the following input screen appears:

BIT 7654 3210

—

A "0" or a "1" can then be set for the individual bits in the second line. The bits have the following meaning:

Bit 7 free
 Bit 6 free
 Bit 5 free
 Bit 4 0/1 IRIG-B output local time or UTC

Bit 3	Bit 2	Bit 1	Bit 0	Description
0	0	0	0	System status (Radio/Quartz operation, error)
0	0	0	1	(PPS) second mark Switch on time approx. 200 msec
0	0	1	0	DCF77 fine pulse (not yet implemented)

5.2.10 Selection of the display and DCF77 simulation

Selection can be made between local and UTC-time both for the display and the DCF77-simulation.

Selection screen:

**SET TIME-OUTPUTS
DISPLAY/DCF Y/N**

Input screen:

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

The selection can only be changed in its entirety. The following combinations are possible:

Display	DCF77-Simulation	
LOC.-TIME	LOC.-TIME	0 / 0
LOC.-TIME	UTC.-TIME	0 / 1
UTC.-TIME	LOC.-TIME	1 / 0
UTC.-TIME	UTC.-TIME	1 / 1

5.2.11 System status

Various base settings such as synchronisation mode can be set with this entry (only in the optional slave configuration).

Selection screen:

**SET SYSTEM
STATUS Y/N**

By entering "Y" the following input screen appears:

BIT 7654 3210

—

The individual status bits can now be set via the keypad with the keys "0" and "1" and, after entry of all bits, can be accepted into the system in a fail-safe manner by pressing the "ENT" key. The individual bits have the following meaning:

Bit 7 free
Bit 6 free
Bit 5 free
Bit 4 free

Bit 3	Bit 2	Bit 1	Bit 0	Synchronisation via
0	0	0	0	DCF77 reception CET [option]
0	0	0	1	DCF77 reception not CET [option]
0	0	1	0	DCF77 pulse input (CET) [on enquiry]
0	0	1	1	DCF77 pulse input (not CET) [on enquiry]
0	1	0	0	RS232 (Master/Slave String) [on enquiry]



These settings are only valid for slave versions (option).

5.2.12 Data security

All input data for Sections 4.2.2 - 4.2.10 as well as slave line data and relay switch times are checked for plausibility and then saved to an **EEPROM** in a voltage fail-safe manner. A **Programme Reset** or **Master Reset** is to be carried out to check this data. In this way the data saved on the **EEPROM** is read back to the memory.

5.3 Controlling the input data

The **SHOW** function is called up to control the input data or the data updated by the GPS-Receiver.

After jumping to the keypad base screen using the "**ENT**" key the numeral **2** is entered. The first **SHOW** enquiry screen appears.

The **SHOW** function can be exited at any time by pressing the "**BR**" = BREAK key.

5.3.1 Time difference

The actual time difference between the local time and the UTC-time can be viewed with this function.

Selection screen:

```
SHOW DIF.- TIME
Y/N _
```

After activating the Yes key the time difference appears, e.g. with the following screen:

```
DIF-TIME: +02:00 _
```

If "**N**" or any key other than "**Y**" and "**BR**" is pressed then the display jumps to the next enquiry screen.

5.3.2 Time zone changeover D ⇔ S

This function shows the changeover time from Daylight time (summer time) to Standard time (winter time).

Selection screen:

```
SHOW CHANGE_OVER
D ⇔ S Y/N _
```

After activating the Yes key the following display appears (example):

```
TIME: 03.00.00
7.25/10/1998 D>S
```

Changeover took place on Sunday, 25th October 1998 at 03.00 o'clock.

5.3.3 Time zone changeover S ⇔ D

This function shows the changeover time from Standard time (winter time) to Daylight time (summer time).

Selection screen:

```
SHOW CHANGE_OVER
S ⇔ D Y/N _
```

After activating the Yes key the following screen appears (example):

```
TIME: 02:00:00
7.29/03/1998 S>D
```

The changeover took place on Sunday, 29th March 1998 at 02.00 o'clock.

5.3.4 Position

The input position or the position updated via GPS is displayed using this function. The position minutes are shown to 4 decimal places. The position is updated by GPS every second.

Selection screen:

SHOW POSITION

Y/N _

Display screen:

e.g. **LT. N51°12.6878'**

LN. E007°39.8032'

(Position of **hopf** Elektronik in Lüdenscheid)

LT = latitude, LN = longitude

5.3.5 Satellite display

4 satellites require to be in the visibility of the antenna in order to synchronise the equipment via GPS. In the optimum condition 9-10 satellites are in the antenna's visibility range, of which 8 satellites can be received in parallel.



If due to the circumstances of the location 4 satellites can not be received and thereby synchronisation can not be achieved, then the GPS Clock 6880 can be transferred into a Position Fixed mode, in which synchronisation operates with less than 4 satellites. See Section 5.7.4 Time evaluation 3D / position fix for more details.

The menu screen

SHOW SATELLITES

Y/N _

shows how many satellites lie in the visibility range, which satellites are being received and a relative measurement of the quality of reception. This facility is particularly helpful when installing the equipment. After selecting this menu header the following screen appears on the display:

```
V      :      :
      :      :
      :      :
```

Under (**V**)isible there then appears the number of satellites that are visible for the optimum antenna position in this location.

Eight satellites can be received, of which four can be simultaneously presented on the display. The display therefore switches every 5 seconds to another viewing level.

The number prior to the colon is the Satellite-Pseudo-Random-Number. The satellites are not identified with 1, 2, 3 etc. but with the Pseudo-Random-Number under which the satellite emits its information. If one satellite fails a reserve satellite can be activated under the same number.

The number after the colon gives the signal/noise ratio as a relative quantity. This can fluctuate between 0 - 255.

After the first installation it can take up to one hour before anything is written on the display screen. This is dependent on the start information (see programming time, position) as well as the antenna position, e.g. only half visibility range of the sky.

If the reception data is available in the system then a display screen such as the following may be shown:

```
V      05 : 137   17 : 043
07      :       :
```

7 satellites are present in the theoretically visible range, of which Satellite 05 with a relative signal to noise ratio of 137 and Satellite 17 with a ratio of 43 were captured by the GPS-Receiver.

The quantity is insufficient for synchronisation with GPS.

For poor signal/noise ratios the data lies between	10 - 30
For satisfactory to good signal/noise ratios the data lies between	30 - 70
For very good signal/noise ratios the data is	> 70



This function should only be exited using the **BR** key, since otherwise errors can occur in the continuation of the menu.

5.3.6 Error byte

Faulty functions or modules for fast error analysis with one bit are displayed in the error byte. Logic "0" shows that the function is in order. Logic "1" shows that a malfunction is present.

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

- Bit 7 = free
- Bit 6 = free
- Bit 5 = free
- Bit 4 = free
- Bit 3 = free
- Bit 2 = free
- Bit 1 = Error in the GPS week counter
- Bit 0 = Error in the time difference calculation local time to UTC

5.3.7 Error interpretation

Errors in the reception system can be identified with the satellite display screen.

Example 1

After the first installation no satellite appears on the display even after several hours.

Possible errors:

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

Example 2

7 satellites are in the possible range of visibility but a maximum of 2 appear on the display screen.

Error

- The visibility range from the antenna to the sky is too small

Example 3

Nine satellites appear in the range of visibility. Six are captured but the installation does not synchronise because the signal to noise ratios all lie between 10-25.

Possible errors:

- The cable is too long
- The BNC connector is incorrectly mounted
- The cable is crimped or broken
- The cable has an incorrect impedance value

Example 4

The equipment gave trouble free operation until now. 7 satellites appear in the visibility range but none is captured – the installation has not been receiving for several days.

Possible errors:

- The cable has been damaged
- There was a lightning strike and the lightning detector is defective
- Antenna defective
- Receiver defective
- Power supply defective

5.3.8 Further SHOW functions

Further SHOW functions are available, such as:

SHOW COM_1 SERIAL
PARAMETER Y/N etc.

These functions will not be described further since they are self-explanatory.

5.4 Relay switch conditions

After calling up the menu header **SM = 3** the following selection screen is output:

Selection screen:

ACTIVE STATUS: 2
N=0 A=1 C=2 AC=3

Relay control modes are offered for selection on this screen. By entering the relevant number the corresponding relay function is activated and accepted in the system. The next menu is then switched through.

The active relay output status is displayed on the upper line.

The following relay statuses can be set:

N : Deactivate relay output
S : Activate system status output (Radio/Quartz operation, error)
C : Activate output of cyclical pulses
AC : Activate output of non-cyclical pulses

5.4.1 Deactivate relay output

After activating the **"0"** key the relay switch status is deleted and the relay output is deactivated. The following screen appears for 3 seconds and the relay set function is exited.

Output screen:

NO RELAY
OUTPUT

The relay is put out of operation in this mode.

5.4.2 Activate system status relay output

After activating the **"1"** key the relay switch mode is updated and the relay output is activated. The following screen appears for 3 seconds and the relay set function is exited.

Output screen:

RELAY OUTPUT:
SYSTEMALARM

In this setting the relay is used to output the system status:

- System is **radio controlled** :
Relay is activated
(**COM** and **NO** contacts are closed resp. **COM** and **NC** contacts open)
- System is **quartz** or another error has occurred (e.g. voltage failure):
Relay is not activated
(**COM** and **NO** contacts are open resp. **COM** and **NC** contacts closed)

5.4.3 Activate cyclical relay output within 24 hours

After activating the "2" key the relay switch mode and the relay output are reactivated. It is switched into the set function of the cyclical output.

In this setting cyclical relay switching with settable switch duration is produced at the output. The following cycle intervals are possible:

Every 1, 2, 3, 4, 5, 6, 10, 12, 15, 20, 30 minutes

Every 1, 2, 3, 4, 6, 8, 12, 24 hours

Output screen 1:

CYCLE hh:mm
>00:01< +/-

The desired cycle is selected with the "+" and "-" keys and the entry is confirmed with "ENT" and switched over to the next set function (set cycle duration).

Output screen 2:

CYCLE DURATION
>01,0< sec +/-

The **cycle duration** is selectable in the range from **0.5 - 10 seconds** in steps of **0.5 Sec.**

The desired cycle is selected using the "+" and "-" keys. The entry is confirmed by pressing "ENT" and the system changes over to the previous set function (set cycle).

The "ENT" key can be used to switch between both set menus.

This function is ended with the "BR" key. The set data is accepted into the system and stored in a fail-safe manner such that it can be automatically loaded and output by the system after a voltage failure.

5.4.4 Activate non-cyclical relay output

After activating the "3" key the relay switch mode and the relay output are updated and the system is redirected to the function menu of the non-cyclical relay switch times.

In this setting cyclical switching of the relay is produced with settable on and off times at the output. It is possible to programme max. 32 switch times.

Day switch time output depends on the date range (01. Jan. - 31. Dec.) and a defined mode. The modes are constructed hierarchically from the highest-ranking to the lowest-ranking mode. A high-ranking mode invalidates all lower-ranking modes such that no further modes are permissible on this day.

- **Mode 6** = Suppress the date ranges *(highest priority)*
- **Mode 5** = Single day of the year
- **Mode 4** = Single day of the month
- **Mode 3** = Single day of the week 1 - 7 (Monday - Sunday)
- **Mode 2** = Monday to Friday
- **Mode 1** = Daily in the set date range *(lowest priority)*

5.4.4.1 Displaying and deleting non-cyclical relay switches

Switch times that have already been programmed can be displayed in this menu and deleted if necessary.

If no switch times have been entered yet (switch time memory is empty) then the execution of this function is not possible.

Selection screen:

SHOW or CLEAR
ACYCLIC PULS Y/N

After entering "Y" the 1st display screen appears, sorted by mode and line number.

Display screen 1:

L00 M:5 **L00 M:1 DAY:00**
DATE:28/02 > **D:01/01-31/12 >**

The following information can be obtained from this display screen:

L : Switch time line number for easier orientation. The line number is newly assigned each time after a change.
M : Switch mode
DAY : Switch day
DATE or D : Switch date or switch date range

With the "ENT" key the display of switch-on and switch-off times of the relevant switch line is reached.

Display screen 2:

L00 on 16:00:00
off 16:01:00<

The following information can be obtained from this display screen:

L : Corresponding switch time line number for easier orientation. The line number is newly assigned each time after a change.
on : Switch-on time (hh:mm:ss)
off : Switch-off time (hh:mm:ss)

By further pressing the "ENT" key it is possible to switch between the two display screens.

The next or previous switch time line can be output using the "+" and "-" keys.

The switch time in the corresponding line is deleted with the "C" key (clear).

This menu can only be exited with the "BR" key. Sorting of the switch times is initiated hereby, if necessary. The switch times are sorted hierarchically according to mode, from highest to lowest-ranking. At the same time the line numbers are reassigned.

5.4.4.2 Setting non-cyclical relay switch times

This menu serves for programming the switch times.

In order to execute different switch conditions 6 different modes are available for selection:

- **Mode 1** = Switch on each weekday (daily)
- **Mode 2** = Switch only on work days
- **Mode 3** = Switch on specific work days
- **Mode 4** = Switch on specific days of the month
- **Mode 5** = Switch on a specific date
- **Mode 6** = Suppress switching during a specific time period

Selection screen:

**SET ACYCLIC
PULSE Y/N**

After entering "Y" the following display screen appears with the following line number. The line numbers are continuously assigned by the system automatically.

Display screen:

L00 M:_

Here the mode is to be input as a numerical value (see section 5.4.4 Activate non-cyclical relay output) for possible entries.

After entering the numerals **1 ... 4** or **6** for the mode the output screen on the display is completed with the day information.

Display screen:

L00 M:4 DAY:_

Here the switch day must be entered to two positions. Depending on the mode the following should be noted:

- **M=1** or **2** ⇒ Switch day is not evaluated but must be entered during the programming of switch times, e.g. 00
- **M=3** ⇒ Switch day is the same as a day in the week: 01...07 (Monday... Sunday)
- **M=4** ⇒ Switch day is the same as a day in the month: 01...30/31 (or 28/29 in Feb.)

After entering the last number for the switch day the output screen is further completed for the switch day.

Display screen:

L00 M:4 DAY:25

D: _

The valid date range for the switch time must be given here (e.g. **12/05-24/05**). The display is completed after every entry such that the date range is entered in accordance with the following example:

from **Day/Month** to **Day/Month**

After the date range has been entered completely

Display screen:

L00 M:4 DAY:25

D:12/05-24/05 >

the entry must be confirmed with the **"ENT"** key in order to enable further entries.

By entering the numeral **5** for the mode the output screen on the display is completed with the date information:

Display screen:

L00 M:5

DATE:12/05 >

The valid date (e.g. **12/05**) for the switch time is entered here in accordance with the following example: **Day/Month**.

After the date range has been entered completely the entry must be confirmed with the **"ENT"** key in order to enable further entries for the switch-on and switch-off times. When programming in Mode **6** the switch time entry is skipped.

Display screen:

L00 on _

Here the valid switch-on time must be given on the upper line of the display (e.g. **12:05:05**) and the switch-off time on the lower line. The time entry is made in accordance with the following example:

Hour/Minute/Second

Display screen:

L00 on 12:05:05

off 12:05:30<

After the last entry the "ENT" key is to be pressed in order to carry out a plausibility test of the total input. If the entry is valid the new settings are accepted and the system proceeds to the entry of the next switch time.

Implausible time entries are not permitted. The following limit tolerances apply:

- $[00 \leq \text{Hour} \leq 23]$ $[00 \leq \text{Minute} \leq 59]$ $[00 \leq \text{Second} \leq 59]$
- The switch-on time is to be selected as less than or equal to the switch-off time.



If errors are made during the inputting of data the previous editing field can be reselected and rewritten by pressing the **[BS]** (Backspace) key.

If an error is detected in the plausibility test then the data is not accepted and the following message is output:

Display screen:

INPUT ERROR

If the switch time memory is full then the set function for non-cyclical switching is not possible. The following message is output to the display:

Display screen:

MEMORY IS FULL

In order to programme other switch times, switch times that are no longer required should be deleted (see Section 5.4.4.1 Displaying and deleting non-cyclical relay switches).

5.4.4.3 Examples of non-cyclical switch time programming

1. Example:

- Switch on every weekday (daily) ---> Mode: 1
- Switch on any desired day (e.g.: 00) 00
- In the period from 1 May to 25 May 01/05-25/05
- Switch-on time: 08:00:00
- Switch-off time: 08:00:30

2. Example:

- Switch on working days only Mode: 2
- Switch on any desired day (e.g.: 00) 00
- In the period from 1 January to 31 December 01/01-31/12
- Switch-on time: 00:00:00
- Switch-off time: 23:59:59

3. Example:

- Switch on specific weekdays Mode: 3
- Switch on Wednesday Day: 3
- In the period from 1 July to 31 October 01/07-31/10
- Switch-on time: 13:55:00
- Switch-off time: 15:05:00

4. Example:

- Switch on specific days of the month Mode: 4
- Switch on 15th day of month Day: 15
- In the period from 1 February to 30 June 01/02-30/06
- Switch-on time: 08:30:00
- Switch-off time: 18:55:00

5. Example:

- Switch on a specific date Mode: 5
- On 29 February 29/02
- Switch-on time: 00:00:00
- Switch-off time: 23:59:59

6. Example:

- Suppress switching during works holiday Mode: 6
- In the period from 17 June to 1 July 17/06-01/07

- Suppress at **Christmas** from **24.12** to **31.12** and from **01.01** to **03.01**

Screen 1

L	<u>0</u>	<u>3</u>			M	:	<u>6</u>												
	D	:	2	4	/	1	2	-	3	1	/	1	2						>

Screen 1

L	<u>0</u>	<u>4</u>			M	:	<u>6</u>												
	D	:	0	1	/	0	1	-	0	3	/	0	1						>

- Suppress at **Easter** from **21.04** to **24.04**

Screen 1

L	<u>0</u>	<u>5</u>			M	:	<u>6</u>												
	D	:	2	1	/	0	4	-	2	4	/	0	4						>

- Suppress during **Works Holidays** from **23.07** to **13.08**

Screen 1

L	<u>0</u>	<u>6</u>			M	:	<u>6</u>												
	D	:	2	3	/	0	7	-	1	3	/	0	8						>

- Suppress on the following **Public Holidays**: **1 May**, **3 October**, **1 November**

Screen 1

L	<u>0</u>	<u>7</u>			M	:	<u>6</u>												
	D	:	0	1	/	0	5	-	0	1	/	0	5						>

Screen 1

L	<u>0</u>	<u>8</u>			M	:	<u>6</u>												
	D	:	0	3	/	1	0	-	0	3	/	1	0						>

Screen 1

L	<u>0</u>	<u>9</u>			M	:	<u>6</u>												
	D	:	0	1	/	1	1	-	0	1	/	1	1						>

Alternatively Public Holidays can also be suppressed in Mode 5

Screen 1

L	<u>1</u>	<u>0</u>			M	:	<u>5</u>												
	D	:	<u>0</u>	<u>1</u>	/	<u>0</u>	<u>5</u>												>

Screen 2

L	<u>1</u>	<u>0</u>			o	n			1	0	:	1	5	:	0	0			
					o	f	f		1	0	:	1	5	:	0	0			>

5.5 Controlling slave clocks

After calling up menu header 4 (S. CLK = 4) the following items are available:

5.5.1 View slave line

All the information about the slave line is displayed in this menu.

Selection screen:

SLAVE CLOCK
SHOW Y/N

After entering "Y" the status screen of the slave lines is shown:

e.g.

SC. R: 15:43:17
1.5 s 19/01/98

or

SC. S: 15:45:18
1.5 s 19/01/98

R = **Run** The slave line is running
S = **Stop** The slave line is stopped

The times of the slave line are **15:43:17** and **15:45:18**, the pulse duration is 1.5 seconds.
The date of the slave line is **19/01/98** Day/Month/Year

The display is updated every 3 seconds.

The display is ended with "**BR**" and can be changed to the next menu header by pressing "**ENT**".

5.5.2 Start/stop slave line

It is recommended to stop the clock line first when commissioning or repairing the equipment.

When commissioning all clocks must be mechanically set to the same time. Thereafter the line is put into operation in accordance with Section 5.5.3 .

On a repair to the slave line, e.g. if it is only necessary to replace one clock, the replacement clock is to be set mechanically to the same time as the other clocks and the line is to be put into operation with Start.

Selection screen:

SLAVE CLOCK
RUN/STOP Y/N

After entering "Y" the following selection screen appears:

SLAVE CLOCK
RUN = + STOP = -

+ = Start of the line
- = Stop of the line

It is not necessary to confirm the entry by pressing "ENT". Pressing the "ENT" key calls up the next menu heading.

5.5.3 Set slave lines

During commissioning or after a repair to the slave line the slave line must be set to the current time.

Selection screen:

SLAVE CLOCK
SET Y/N

After entering "Y" the following entry screen appears:

S.CLOCK SET TIME
 >_

The time which is displayed on the **Slave Line Clocks** is now entered in **HH : MM : SS** and confirmed with "ENT". The date is added automatically. With this entry there follows an automatic start-up of the minute line, if this had previously been stopped. Automatic start-up takes place in the same way following a master reset of the system.



If there is a mixture of 12 and 24 hour clocks on the slave line the time of the 24 hour clocks is to be entered.

5.5.4 Slave line pulse time

The analogue slave clocks require a different length control pulse that is dependent on size. This pulse can be set for each line individually between 0.1 s and 3.2 s.

Selection screen:

SLAVE CLOCK
SET PULS Y/N

After entering "Y" the following entry screen appears (example):

S.CLOCK PULS
IN=+/- >3.0< sec

The pulse duration that is currently valid is 3.0 seconds. This can be set higher or lower in steps of 0.1 sec. by using the "+" or "-" keys. The pulse duration data is stored in a fail-safe manner.

The display is ended with "BR" and by pressing "ENT" the system changes to the next menu header.

5.5.5 Slave line control byte

The control byte serves to set either pole-changing or DCF77 time code operation as well as to set diverse modes for pole-changing operation.

5.5.5.1 Set slave line control byte

Selection screen:

**SET S.CLOCK-
CTRL.-BYTE Y/N**

After entering "Y" the following input screen appears (example):

BIT 7654 3210
 —

The bits have the following meaning:

Bit 7	0	Output of pole-changing pulse operation
	1	Output of 2x DCF77 time code lines
Bit 6		Free
Bit 5		Free
Bit 4		Free
Bit 3	0	12h-mode for pole-changing pulse operation
	1	24h-mode for pole-changing pulse operation
Bit 2	0	Stop on Summer-Wintertime changeover for pole-changing pulse operation
	1	Forerun on Summer-Wintertime changeover for pole-changing pulse operation
Bit 1		Free
Bit 0		Free

In the second line logic "0" or "1" can be set for the individual bits.

By pressing "**BR**" the display is ended without accepting the data and by pressing "**ENT**" the data is accepted and the system changes to the next menu header.

5.5.5.2 View slave line control byte

Selection screen:

**SHOW S.CLOCK-
CTRL.-BYTE Y/N**

After entering "Y" the current setting of the control byte is displayed.

Example:

BIT 7654 3210
 0000 0100

The display is ended with "**BR**" and with "**ENT**" the system changes to the next menu header.

5.6 Incorrect polarity

The most common error is the incorrect polarity of individual clocks or of the entire slave clock chain for pole-changing pulse operation.

Symptom:

Individual clocks or the entire clock line run one second behind the actual time. Even if the line in question is stopped the faulty clocks are still one second late.

Solution:

- Stop the slave line via the menu
- Change the connection(s) of the clocks (chain) concerned and manually adjust the hands to the time of the other clocks
- Read the time from the slave line and enter as the new slave line time in the menu

5.7 Initialisation functions

After entering the menu display with the **"ENT"** key the **INI** function zone is activated with the numeral **5**. The 1st selection screen for the **INI** functions appears.

5.7.1 Status change delay

Both the display and the serial data strings show whether the system is synchronised with GPS or is running in internal quartz mode. This information is commonly called upon in the connected devices for error reporting. In order that a short break in reception is not interpreted as an error the status change for reception on quartz basis can be delayed. The delay time can be set between 2 - 255 minutes.

Viewing as well as changing the time takes place on the same display screen by means of the following call-up:

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

By entering **"Y"** the following display screen appears:

**STATUS CHANGE
AFTER > xxx < MIN**

The currently valid delay time is overlaid on the **xxx** positions. The time is increased with the **"+"** key and decreased with the **"-"** key.

When exiting the menu using the **"BR"** key the last displayed value is stored in a fail-safe manner.

5.7.2 Switch-off delay for DCF77 simulation

In order to start the DCF77 antenna simulation it is necessary for the system to have been GPS-synchronised at least once because only then is the corresponding accuracy of the signal given. After this the DCF77 simulation can continue to function even when there is a GPS-synchronisation failure.

The delay time between GPS-reception failure and DCF77 simulation switch-off can be set from 2-254 minutes under this menu header. After this time if there is still a reception error then no further valid DCF77 signal is emitted. The connected devices are no longer synchronised and can therefore trigger a error message.

With a setting of 255 minutes continuous DCF77 simulation takes place even without GPS reception. This setting is therefore suitable for testing connected systems or for when the clock is to be operated as a quartz clock.

Both viewing and changing the delay time take place under the same display screen via the following call-up:

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

By entering "Y" the following display screen appears:

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

The currently valid delay time is overlaid on the **xxx** positions. The time is increased with the "+" key and decreased with the "-" key.

When exiting the menu using the "BR" key the last displayed value is stored in a fail-safe manner.

5.7.3 DCF77 pulse width

In the DCF77 time telegram the time information is transmitted in BCD format. In this case logic 1 corresponds to a pulse duration of 200 msec and logic 0 corresponds to 100 msec. Some makes of product do not observe this rule and emit shortened pulses, e.g. 160 msec for logic 1 and 70 msec for logic 0. In order that these devices may also be synchronised the pulse width is settable.

Viewing as well as changing the pulse width takes place in the same display screen via the following call-up:

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

By entering "Y" the following display screen appears:

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

The currently valid pulse length is overlaid on the **xxx** positions. The pulse is increased with the "+" key and decreased with the "-" key.

When exiting the menu using the "BR" key the last displayed value is stored in a fail-safe manner. The call-up for setting the low pulse takes place in a similar manner.

The **High Pulse** can be varied between **150-250 msec** and the **Low Pulse** between **50-150 msec**.

5.7.4 Time evaluation 3D / position fix

The accuracy of the time evaluation is defined by the exact positional calculation of the installation location. A minimum of 4 satellites is required for this calculation (3D-evaluation). The signal runtime to several satellites is determined from the calculated position and the precise second mark is produced from their mean value. The second mark in this **3D**-evaluation mode has an accuracy of $\pm 1 \mu\text{sec}$.

In many cases for stationary installations a poor second mark evaluation is sufficient, e.g. up to several milliseconds. The accuracy depends fundamentally on the exact entry of the position of the installation location. The second mark is calculated with one satellite and the entered position.

When entering the position at up to ± 1 minute degree the accuracy of the second mark is already better than $\pm 20 \mu\text{sec}$. Where the entry is even more accurate the value of $\pm 1 \mu\text{sec}$ can be achieved.

The advantage of the Position-Fix mode is that the clock is synchronised with only one satellite. The antenna can be installed in locations where less than $\frac{1}{4}$ 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 automatically jumps into 3D mode and calculates the exact position, thereby the accuracy with one satellite is increased back to $\pm 1 \mu\text{sec}$.

The modes are set as follows:

Selection screen:

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

By entering "Y" the currently set mode appears on the display.

On the Position-Fix evaluation this is:

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

The evaluation can be changed over to 3D with the "+" sign.

On the 3D evaluation the following appears:

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

The evaluation can be changed over to Position-Fix with the "-" sign.

5.7.5 Execute programme reset

The programme counter is set to the beginning with this function.

After entering the menu screen with the "ENT" key the INI function zone is activated with the numeral **5**. The selection screens for the INI functions appear. The programme reset selection takes place via the following screen:

PROGRAMM RESET
Y/N _

After entering "Y" the **Programme Reset** is executed. The programme jumps back to the programme start. Other functions are not executed.

5.7.6 Execute master reset.

Selection is made via the following screen:

```
MASTER RESET
Y/N _
```

After entering "Y" a **Master Reset** is executed. In this case the reset line on the board is set to zero for a short time. In this way all other building blocks in the system are set to zero and the programme jumps back to the start.

5.8 Keypad summary

- The menu is activated by pressing the **ENT**er key.
- Selection of the function zones from **1** to **5**
- Break of an entry or switchover to standard screen with **BR**eak
- Completion of entries with **ENT**er
- Selection of an individual function with **Yes**
- Onward-switching of the function with **No** or any other key except **BR**eak and **Yes**
- Plausibility errors are identified by **INPUT-ERROR**, renewed selection and entry are required

5.9 Display functions

- Time offset
- Daylight / Standard changeover
- Standard / Daylight changeover
- Position
- Satellites
- Interface parameters
- Interface mode byte
- Display control
- Pulse and status output
- System byte
- Error byte

6 Configuration

6.1 Configuration of the serial interfaces

The satellite-controlled clock is equipped with two independently adjustable serial interfaces without handshake lines. Data exchange can take place via RS232 (V.24) or RS422 (V.11) signal level. The interfaces can be used to transfer time telegrams to other computers.

Various data telegrams are available. Customer specific telegrams are available on enquiry. The following settings can be put in place separately for each serial interface.

6.2 Parameters of the serial transfer

The interface parameters are set via the keypad. The settings for baud rate, data bit, stop bit and parity are set by pressing the [ENT] key and selecting the "SET" function. In the selection dialogue the entry must be selected for **COM0** or **COM1**. Interface **0** is described in the following. The same settings apply similarly to **1**.

- [Enter] key
- "1" for "SET functions"
- Selection of "SET COM0 SERIAL PARAMETER Y/N"
- "Y"

The interface parameters dialogue appears in the LCD display with the following message:

B: _

Here the baud rate must be entered as a five position numerical value. Possible inputs are:

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

After entering the last number for the baud rate the following message appears in the display:

W: _

The quantity of data bits for the data transfer must be given here. Possible settings are:

- 8 for 8 data bits
- 7 for 7 data bits

After entering the number for the quantity of data bits the following message appears in the display:

P: _

Here the type of the parity bit for the data transfer must be given. Possible settings are:

- N for no parity bit
- E for even parity
- O for odd parity

After entering the parity function the following message appears in the display:

S: _

The number of stop bits for the data transfer must be selected here:

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

Finally the enable function for the handshake lines RTS and CTS appears:

HS: _

The following can be entered here:

- N Data transfer **without** handshake
- Y Data transfer **with** handshake

“N” should be entered here because handshake data transfer is not supported. The **[ENT]** key must be pressed after the last entry. In this way a plausibility test of the complete entry is undertaken. If the entry is valid the new settings are accepted.



In the case of incorrect entries the previous editing field can be reselected and rewritten by pressing the **[BS]** (Backspace) key.

6.3 Configuration of the data telegram (mode byte)

The time information received via satellite can be output via the interfaces in various data telegrams with information about the internal status of the clock. In this way the user can synchronise connected computers to the exact time. The respective desired output time, string construction and the control characters used can be selected by means of specification in **mode byte 1 and 2**.

The set function for the **mode bytes** is reached through the following key combination:

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

The entry mask appears for the **mode byte**:

BIT 7654 3210

The LCD cursor is now under bit position 7. Each bit is to be understood as a switch with which the settings are made in the operating type (mode) of the serial interface. Depending on the desired operating type of the serial interface the following entries should be made under the bit positions:

0 - for switch-off

1 - for switch-on

The meaning of the individual bit positions (switches) is described in the following sections.

6.3.1 Local time or UTC in the serial output with mode byte 1

Bit Position 7	Time Zone
on	Local time
off	UTC (Universal Time Coordinated)

6.3.2 Second forerun of the serial output with mode byte 1

Bit Position 6	Second Forerun
off	With second forerun
on	Without second forerun

6.3.3 Bit 5 without function

Bit Position 5	
off	free
on	free

6.3.4 Last control character as on-time mark with mode byte 1

With this setting the last control character can be sent exactly to the flank of the next second change (see telegram construction).

Bit Position 4	Control Character for Second Change
off	With control character for second change
on	Without control character for second change

6.3.5 Control characters CR and LF with mode byte 1

The character sequence CR and LF can be changed with this switch.

Bit Position 3	Control Characters CR and LF
off	LF/CR
on	CR/LF

6.3.6 Send delay

With the setting "Control characters for second change" the last character of the data string is sent directly to the second change and immediately thereafter the new data string is sent, which is valid for the next second change. This can lead to error interpretations for some computers with a high load. With bit position 2 the transmission of the new data string can be delayed dependent on the baud rate.

Bit Position 2	Send Delay
off	With send delay
on	Without send delay

Example:

Baud rate 9600 Baud:

Milliseconds	with delay	without delay
000	End character (ETX)	End character (ETX)
002	–	New data string
025	–	End of new data string
930	New data string	–
955	End of new data string	–
000	End character (ETX)	End character (ETX)

Baud rate 2400 Baud

Milliseconds	with delay	without delay
000	End character (ETX)	End character (ETX)
002	–	New data string
105	–	End of new data string
810	New data string	–
913	End of new data string	–
000	End character (ETX)	End character (ETX)

6.3.7 Transmission point of time with mode byte 1

Bit 1	Bit 0	Send Time
off	off	Send every second
off	on	Send on minute change
on	off	Send on hour change
on	on	Send on enquiry only

6.3.8 Telegram selection with mode byte 2

The output data string is set with this mode byte. At present only bit positions 0-3 have any function, the remaining bits are planned for later extensions.

Bit Position				Telegram
3	2	1	0	
off	off	off	off	Standard hopf telegram
off	off	off	on	Standard hopf with year number 4-position
off	off	on	off	DCF-Master/Slave telegram
off	off	on	on	Siemens SINEC H1
off	on	off	off	T-String

6.4 Data format of the serial data transfer

The data is sent in ASCII-format as BCD data and can be presented with any terminal programme (example TERMINAL.EXE under Windows). The following control characters from the ASCII-character set may be used in the telegram construction:

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



Status values are to be evaluated specially (see telegram construction).

6.5 Serial enquiries

Telegram enquiries that are not outlined in this section are described under the data telegrams heading.

6.5.1 Serial enquiry with ASCII characters (standard and standard 2000)

The data telegram can also be output by the user on enquiry by means of an ASCII character. The following characters trigger a transfer of the standard string:

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

The system responds on the second change with the corresponding data string. It is possible to achieve a response delay of 10 msec on enquiry via software. For the delayed transmission of the data string the lower-case letters "d, g" are transferred from the enquiring computer to the clock with a two position multiplication factor. The multiplication factor is interpreted by the clock as a hexadecimal value.

Example:

The computer transmits: **ASCII gFF** (Hex 67, 46, 46).

The clock sends the time / date telegram (UTC time) after 2550 milliseconds.

7 Data Telegrams

General remarks regarding the serial data output of the 6880 board

When setting ETX to the second change according to the baud rate there arises a break in the data transfer of up to 970 msec. Please take note of this when programming a timeout on the reception side.

For all data strings the output of control characters CR and LF can be changed with **mode byte 1**.

7.1 Construction of the *hopf* standard telegram

<u>Character No.:</u>	<u>Meaning</u>	
1	STX (start of text)	
2	Status (internal status of the clock)	; see 7.1.1
3	Weekday (1=Monday ... 7=Sunday)	; see 7.1.1
	With UTC time bit 3 in the weekday is set to 1	
4	Tens hours	
5	Unit hours	
6	Tens minutes	
7	Unit minutes	
8	Tens seconds	
9	Unit seconds	
10	Tens days	
11	Unit day	
12	Tens months	
13	Unit month	
14	Tens years	
15	Unit year	
16	LF (Line Feed)	; see 6.3.5
17	CR (Carriage Return)	; see 6.3.5
18	ETX (End of Text)	

7.1.1 Status and weekday nibble in the *hopf* standard telegram

The second and third ASCII-characters in the telegram contain the status and the weekday. Binary status evaluation is carried out. Construction of these characters:

	b3	b2	b1	b0	Meaning
Status nibble:	x	x	x	0	No announcement hour
	x	x	x	1	Announcement (ST-WT-ST)
	x	x	0	x	Wintertime ¹ (WT)
	x	x	1	x	Summertime ² (ST)
	0	0	x	x	Time/date invalid
	0	1	x	x	Quartz operation
	1	0	x	x	Radio controlled operation
	1	1	x	x	Radio controlled operation (high accuracy)
Weekday nibble:	0	x	x	x	CEST/CET
	1	x	x	x	UTC time
	x	0	0	1	Monday
	x	0	1	0	Tuesday
	x	0	1	1	Wednesday
	x	1	0	0	Thursday
	x	1	0	1	Friday
	x	1	1	0	Saturday
	x	1	1	1	Sunday

7.1.2 Example of a sent *hopf* standard telegram

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

- Radio controlled operation (high accuracy)
- Summertime
- No announcement
- It is Wednesday 17.04.96 - 12:34:56 hours
- () - ASCII-control characters e.g. (STX)

¹ Wintertime = Standard Time

² Summertime = Daylight Saving Time

7.2 Standard *hopf* data telegram string 2000

The construction of the telegram is identical to the standard string. The only difference is in the transfer of the year in 4 positions.

<u>Character No.:</u>	<u>Meaning</u>	
1	STX (start of text)	
2	Status (internal status of the clock)	; see 7.2.1
3	Weekday (1=Monday ... 7=Sunday)	; see 7.2.1
	With UTC time bit 3 in the weekday is set to 1	
4	Tens hours	
5	Unit hours	
6	Tens minutes	
7	Unit minutes	
8	Tens seconds	
9	Unit seconds	
10	Tens days	
11	Unit day	
12	Tens months	
13	Unit month	
14	Tens century	
15	Unit century	
16	Tens years	
17	Unit year	
18	LF (Line Feed)	; see 6.3.5
19	CR (Carriage Return)	; see 6.3.5
20	ETX (End of Text)	

7.2.1 Data telegram 2000 status and weekday nibble

The second and third ASCII-characters contain the status and the weekday. Binary status evaluation is carried out. Construction of these characters:

	b3	b2	b1	b0	Meaning
Status nibble:	x	x	x	0	No announcement hour
	x	x	x	1	Announcement (ST-WT-ST)
	x	x	0	x	Wintertime (WT)
	x	x	1	x	Summertime (ST)
	0	0	x	x	Time/date invalid
	0	1	x	x	Quartz operation
	1	0	x	x	Radio controlled operation
	1	1	x	x	Radio controlled operation (high accuracy)
Weekday nibble:	0	x	x	x	CEST/CET
	1	x	x	x	UTC time
	x	0	0	1	Monday
	x	0	1	0	Tuesday
	x	0	1	1	Wednesday
	x	1	0	0	Thursday
	x	1	0	1	Friday
	x	1	1	0	Saturday
	x	1	1	1	Sunday

7.2.2 Example of a sent data string 2000

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

- Radio controlled operation (high accuracy)
- Summertime
- No announcement
- It is Wednesday 03.01.1996 - 12:34:56 hours
- () - ASCII-control characters e.g. (STX)

7.3 Data telegram SINEC H1

The control characters STX and ETX are only transferred if the output "with control characters" has been set. Otherwise these control characters are omitted. With the setting "ETX delayed" the last character (ETX) is transferred exactly on the next second change.

The data string can be interrogated with "?" and "T".

Character No.:	Meaning	Value (value range)	
1	STX (start of text)	\$02	
2	"D" ASCII D	\$44	
3	":" colon	\$3A	
4	Tens day	\$30-33	
5	Unit day	\$30-39	
6	"." Full stop	\$2E	
7	Tens month	\$30-31	
8	Unit month	\$30-39	
9	"." Full stop	\$2E	
10	Tens year	\$30-39	
11	Units year	\$30-39	
12	":" Semi colon	\$3B	
13	"T" ASCII T	\$54	
14	":" Colon	\$3A	
15	Weekday	\$31-37	
16	":" Semi colon	\$3B	
17	"U" ASCII U	\$55	
18	":" Colon	\$3A	
19	Tens hours	\$30-32	
20	Unit hours	\$30-39	
21	"." Full stop	\$2E	
22	Tens minutes	\$30-35	
23	Unit minutes	\$30-39	
24	"." Full stop	\$2E	
25	Tens seconds	\$30-36	
26	Unit seconds	\$30-39	
27	":" Semi colon	\$3B	
28	"#" or space	\$23 / \$20	; see 7.3.1
29	"*" or space	\$2A / \$20	; see 7.3.1
30	"S" or space	\$53 / \$20	; see 7.3.1
31	!" or space	\$21 / \$20	; see 7.3.1
32	ETX (end of text)	\$03	

7.3.1 Status in the SINEC H1 data telegram

Characters 28-31 in the SINEC H1 data telegram provide information about the synchronisation status of the clock.

The meanings are as follows:

Character No.: 28 =	"#"	No radio synchronisation after reset, time invalid
	Space	Radio synchronisation after reset, clock min. in quartz mode
Character No.: 29 =	"**"	Time from clock's internal quartz
	Space	Time via radio reception
Character No.: 30 =	"S"	Summertime
	Space	Wintertime
Character No.: 31 =	"!"	Announcement of a W/S or S/W changeover
	Space	No announcement

7.3.2 Example of a sent SINEC H1 data string

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

- Radio controlled operation
- No announcement
- Wintertime
- It is Wednesday 03.01.96 - 12:34:56 hours

7.4 Data telegram T-string

The T-String can be sent with all modes (e.g. with forerun or end character on second change). The data string can be interrogated with "T".

Character No.:	Meaning	Value (value range)
1	"T" ASCII T	\$54
2	":" Colon	\$3A
3	Tens year	\$30-39
4	Unit year	\$30-39
5	":" Colon	\$3A
6	Tens month	\$30-31
7	Unit month	\$30-39
8	":" Colon	\$3A
9	Tens day	\$30-33
10	Unit day	\$30-39
11	":" Colon	\$3A
12	Tens weekday	\$30
13	Unit weekday	\$31-37
14	":" Colon	\$3A
15	Tens hours	\$30-32
16	Unit hours	\$30-39
17	":" Colon	\$3A
18	Tens minutes	\$30-35
19	Unit minutes	\$30-39
20	":" Colon	\$3A
21	Tens seconds	\$30-36
22	Unit seconds	\$30-39
23	CR (carriage return)	\$0D
24	LF (line feed)	\$0A

7.4.1 Example of a sent T-string data string

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

- It is Wednesday 03.01.96 - 12:34:56 hours

7.5 Master/Slave string

With the Master/Slave string slave systems can be synchronised with the time data of the master system to an accuracy of ± 0.5 . The time difference to UTC is included and sent in the data string.

After the year the time difference in hours and minutes is sent. Data transfer takes place in BCD. The time difference can be max. ± 11.59 hours.

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

Logic "1" = local time in front of UTC

Logic "0" = local time behind UTC

Example:

90.00	Time difference	+ 10.00 hours
01.30	Time difference	- 01.30 hours
81.30	Time difference	+ 01.30 hours

The complete data string is constructed as follows:

Character No.:	Meaning	Value (value range)	
1	STX (start of text)	\$02	
2	Status	\$30-39, \$41-46	; see 7.5.1
3	Weekday	\$31-37	; see 7.5.1
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. + hour sign	\$30,\$31,\$38,\$39	
17	Unit time diff. hours	\$30-39	
18	Tens time diff. minutes	\$30-35	
19	Unit time diff. minutes	\$30-39	
20	LF (line feed)	\$0A	; see 6.3.5
21	CR (carriage return)	\$0D	; see 6.3.5
22	ETX (end of text)	\$03	

7.5.1 Status in the Master-Slave data telegram

	b3	b2	b1	b0	Meaning
Status nibble:	x	x	x	0	No announcement hour
	x	x	x	1	Announcement (ST-WT-ST)
	x	x	0	x	Wintertime (WT)
	x	x	1	x	Summertime (ST)
	x	0	x	x	No announcement switch second
	x	1	x	x	Announcement switch second
	0	x	x	x	Radio controlled operation
	1	x	x	x	Radio controlled operation (high accuracy)
Weekday 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

7.5.2 Example of a sent Master-Slave data string

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

- Radio controlled operation
- No announcement
- Wintertime
- Wednesday, 03.01.96, 12:34:56 hours
- The time difference to UTC is + 2.30 hours

7.5.3 Setting

To synchronise the **hopf** slave systems the following setting must be maintained:

- Output every minute
- Output second forerun
- ETX at second change
- 9600 baud, 8 bit, 1 stop bit, no parity

With these settings there is optimum control of the time base in the slave systems.

8 Interface and screw terminals

8.1 Assignment of the 9-pole SUB-D connector

The assignment of the interface is available in six different versions. The interface version is identified on the nameplate under the heading "interface ver.".

The serial interface signals are emitted via a potential separation on the 9-pole SUB-D connector.

8.1.1 Version 1 – Standard assignment RS232 and RS422

9-pole SUB-D Connector Pin No.	Signal Identification	
1	GND	
2	RxD (receive data) RS232	COM 0
3	TxD (transmit data) RS232	COM 0
4		
5	GND	
6	+TxD ¹ (transmit data) RS422	COM 1
7	-TxD ² (transmit data) RS422	COM 1
8	+RxD ¹ (receive data) RS422	COM 1
9	-RxD ² (receive data) RS422	COM 1

8.1.2 Version 2 - RS232 / RS232

9-pole SUB-D Connector Pin No.	Signal Identification	
1	GND	
2	RxD (receive data) RS232	COM 0
3	TxD (transmit data) RS232	COM 0
4		
5	GND	
6	TxD (transmit data) RS232	COM 1
7		
8	RxD (receive data) RS232	COM 1
9		

8.1.3 Version 3 - RS232 / TTY

9-pole SUB-D Connector Pin No.	Signal Identification	
1	GND	
2	RxD (receive data) RS232	COM 0
3	TxD (transmit data) RS232	COM 0
4		
5	GND	
6	TTY out +	COM 1
7	TTY out -	COM 1
8	TTY in +	COM 1
9	TTY in -	COM 1

¹ high active

² low active

8.1.4 Version 4 - RS232 and PPS pulse / DCF77 pulse

9 pole SUB-D Connector Pin No.	Signal Identification	
1	GND	
2	RxD (receive data) RS232	COM 0
3	TxD (transmit data) RS232	COM 0
4		
5	GND	
6	PPS or DCF77 pulse (see Section 5.2.9)	
7	/PPS or /DCF77 pulse (see section 5.2.9)	
8		
9		

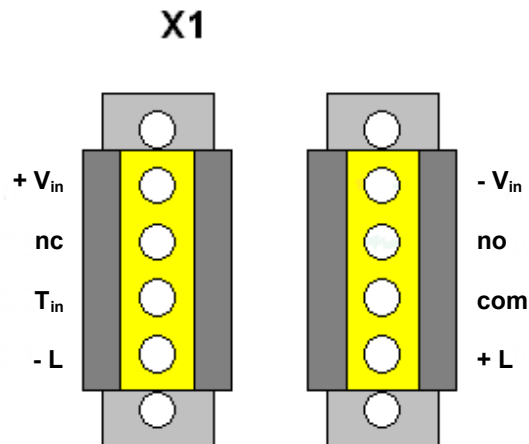
8.1.5 Version 5 - IRIG-B with RS232 and RS422

9-pole SUB-D Connector Pin No.	Signal Identification	
1	GND	
2	RxD (receive data) RS232	COM 0
3	TxD (transmit data) RS232	COM 0
4	IRIG-B pulse	
5	GND	
6	+TxD ¹ (transmit data) RS422	COM 1
7	-TxD ² (transmit data) RS422	COM 1
8	+RxD ¹ (receive data) RS422	COM 1
9	-RxD ² (receive data) RS422	COM 1

¹ high active

² low active

8.2 Assignment of the screw terminals



- +V_{in} , -V_{in}** : Power supply 24 V
- n.c.** : Relay contact, maker
- n.o.** : Relay contact, breaker
- com** : Common relay contact
- L, +L** : 1 minute line or 2 DCF77 time code lines (24 V)
- T_{in}** : DCF77 pulse entry (pull-up for open collector output)

9 Technical Data Base System

General

Snap-in module with display and keypad: 105 x 198 x 74 mm (W x H x D)

Power supply of the system:
(=line voltage for slave clocks) 18 - 72V DC

Temperature range: 0 - 50°C for the specific data
0 - 70°C with declining freerunning characteristics

MTBF: approx. 150.000 hours

GPS-Receiver: 8-channel C / A code receiver
(for models 6880GXX)

Evaluation: L1 frequency 1.575.42 MHz, C/A-code

Sensitivity: -134 dBm lock-in sensitivity
-143 dBm Release sensitivity

Synchronisation time:

Cold start: 30 min. - 4 hours (first installation without positional data)

Warm start: approx. 1 min. (voltage failure < 3 days)

Voltage supply for the antenna: 5V DC via the antenna cable

Accuracy GPS models:

PPS pulse (internal): ± 300 nsec.

VCO control: ± 0.1 ppm, after 1/2 hour continuous GPS-reception

Freerunning characteristic: ± 0.1 ppm, after VCO control at constant temperature between +10°C and +50°C.

Backup clock: ± 25 ppm from +10°C to +50°C

Accuracy Quartz Models:

Freerunning characteristic: ± 10 ppm between +10°C and +50°C

Interfaces:

2 independent interfaces with the following physical variants without handshake:

- RS232 / RS422 (standard)
- RS232 / RS232
- RS232 / TTY passive
- RS232 / PPS / DCF77 pulse
- RS232 / RS422 / IRIG-B pulse

Serial interface parameters:

- Baud rate: 300 - 19.200 Bd
- Stop bit: 1 / 2 Bit
- Word length: 7 / 8 Bit
- Parity: none, even or uneven parity

Output ports (potential-separated):

- 1 line for max. 24V DC / 200 mA as minute or DCF77 time code line
- 1 relay for different applications. Switching power 24V DC / 1 A Ohm load
- Analogue outputs (dependent on order type)
 - DCF77 antenna simulation (77.5 kHz): approx. 3 ... 10 mV_{ss}
 - IRIG-B with 1 kHz carrier 2 V_{ss} to 50 Ohms, modulation 3:1

Special production:

Hardware and software modifications can be made to customer specifications

Extra components:

see GPS accessories



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