Industrie**funkuhren**

hopf
Elektronik *GmbH*

Technical Manual

GPS Satellite Clock

Model 6021GPS

ENGLISH

Version: 06.01 – 07.03.2012

Valid for Devices 6021GPS with FIRMWARE   Version: **06.xx**
and REMOTE-SOFTWARE   Version: **06.xx**

Version number (Firmware / Manual)

THE FIRST TWO DIGITS OF THE VERSION NUMBER OF THE TECHNICAL MANUAL AND THE FIRST TWO DIGITS OF THE FIRMWARE VERSION MUST **COMPLY WITH EACH OTHER**. THEY INDICATE THE FUNCTIONAL CORRELATION BETWEEN DEVICE AND TECHNICAL MANUAL.

THE DIGITS AFTER THE POINT IN THE VERSION NUMBER INDICATE CORRECTIONS IN THE FIRMWARE / MANUAL THAT ARE OF NO SIGNIFICANCE FOR THE FUNCTION.

Downloading Technical Manuals

All current manuals of our products are available free of charge via our homepage on the Internet.

Homepage: http://www.hopf.com

E-mail: info@hopf.com

Symbols and Characters

Operational Reliability

Disregard may cause damages to persons or material.

Functionality

Disregard may impact function of system/device.

Information

Notes and Information.

Safety regulations

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

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

Safety of the device

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

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

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

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

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

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

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

CE-Conformity

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

Therefore the device bears the CE identification marking
(CE = Communautés Européennes = European communities)

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

Contents   Page

1   General

The *hopf* Board 6021GPS is a further development of the DCF77 Radio-controlled Clock Board 6021. The highly accurate synchronization of the Board takes place via the GPS satellite system, which is available worldwide.

The dimensions of the switching boards correspond to the standard format for Euro-boards with 3U/4HP front panel (**U = Height Unit / HP = Horizontal Pitch**) for installation in 19" racks:

Some of the board's basic functions:

- Synchronization can be realized with only **one satellite**

- Simple operation using **remote software**

- Remote interface on the front panel (RS232 format)

- **Status LEDs** on the front panel

- **Status output** via two relays (dry contact) for power and synchronization

- **Serial interfaces** (RS232 and RS422 formats) – only in 19" versions

- **High freewheel accuracy** through GPS-supported regulation of the internal quartz base

- **Potential isolation** of the GPS antenna circuit

- Completely **maintenance-free** system

- **SyncOFF timer** (reception failure bypassing) for operation free of fault messages - even in difficult reception conditions

- Redundant **multiple validation of the synchronization signal** for fault-free and leap-free signal evaluation

- Maintenance-free, buffered **back-up clock** for three days

Software supplied:

- Remote software for PC
  for Windows 98SE, NT, 2000 and XP operating systems

Accessories supplied:

- Serial programming cable (2m, 9-pole socket to 9-pole socket)

Moreover based on customized applications the GPS synchronized clock 6021GPS can be integrated into a DIN rail housing with an AC or DC power supply unit. The customized unit configuration and the appropriate outputs and features are stated in the related manual.

> **i**   Not all functions that can be parametrised are always available for the different hardware versions of 6021GPS.
> The available functions and their appropriate physical outputs are stated in this or rather the device-specific manual.

2   Hardware

This chapter describes the different hardware versions and details of the board 6021GPS.

2.1   19" Version (3U/4HP)

2.1.1   Front Panel

Status (LEDs + Optical Coupler)	
3-pole Connector	
Pin	**Signal**
1	Collector
2	n.c.
3	Emitter
LED	**Meaning**
RD	Status LED red
GN	Status LED green

GPS Antenna	
BNC connector	
GPS	Antenna Input

Remote	
LED	**Meaning**
Rx	LED green - reception of serial data
Tx	Led yellow - transmission of serial data
9-pole SUB-D connector	
Pin	**Signal**
1	n.c.
2	RS232c (V.24) RXD
3	RS232c (V.24) TXD
4	n.c.
5	GND
6	n.c.
7	n.c.
8	n.c.
9	n.c.

n.c. = not connected

2.1.1.1 Voltage Feed

The voltage feed takes place via the Board's VG-ledge.

2.1.1.2 Serial Time String Output

The Board 6021GPS has serial interfaces **without** handshake lines for transmitting time information. Data exchange can take place via RS232c (V.24) or RS422 (V.11) signal level. The interfaces may be used, for example, to transmit time telegrams to other computers.

The serial time string is transmitted via the Board's VG-ledge.

2.1.2   Assignment of the VG ledge 64-pole
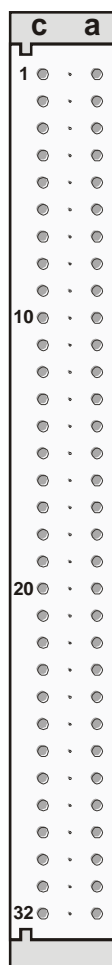
Connector, DIN41612, 64-pin VG male

Pin	c	a	Pin
1	n.c.	n.c.	1
2	n.c.	RS232c (V.24) TXD	2
3	n.c.	RS232c (V.24) RXD	3
4	n.c.	n.c.	4
5	n.c.	n.c.	5
6	n.c.	n.c.	6
7	n.c.	GND	7
8	n.c.	n.c.	8
9	n.c.	GND	9
10	n.c.	RS422 (V.11) $-\text{TXD}^{\text{L}}$	10
11	n.c.	RS422 (V.11) $+\text{TXD}^{\text{H}}$	11
12	n.c.	RS422 (V.11) $-\text{RXD}^{\text{L}}$	12
13	n.c.	RS422 (V.11) $+\text{RXD}^{\text{H}}$	13
14	n.c.	GND	14
15	n.c.	DCF77 Pulse^{L}	15
16	n.c.	DCF77 Pulse^{H}	16
17	n.c.	n.c.	17
18	n.c.	n.c.	18
19	n.c.	n.c.	19
20	n.c.	n.c.	20
21	n.c.	n.c.	21
22	n.c.	n.c.	22
23	n.c.	n.c.	23
24	n.c.	n.c.	24
25	n.c.	n.c.	25
26	n.c.	n.c.	26
27	n.c.	n.c.	27
28	n.c.	n.c.	28
29	n.c.	n.c.	29
30	n.c.	n.c.	30
31	GND	GND	31
32	+5V DC	+5V DC	32

Table title: Connector, DIN 41612, 64-pin VG male

n.c. = not connected

Row **b** = not connected

L **RS422 (V.11) low active**
H **RS422 (V.11) high active**

2.2 Version for DIN Rail Mounting

2.2.1 Frontpanel

Status (LEDs + Optical Coupler)	
3-pole Connector	
Pin	**Signal**
1	Collector
2	n.c.
3	Emitter
LED	**Meaning**
RD	Status LED red
GN	Status LED green

GPS Antenna	
BNC connector	
GPS	Antenna Input

Remote	
LED	**Meaning**
Rx	LED green - reception of serial data
Tx	Led yellow - transmission of serial data
9-pole SUB-D connector	
Pin	**Signal**
1	n.c.
2	RS232c (V.24) RXD
3	RS232c (V.24) TXD
4	n.c.
5	GND
6	n.c.
7	n.c.
8	n.c.
9	n.c.

n.c. = not connected

2.2.1.1 Voltage Feed

The voltage feed takes place via the integrated power supply in the device.

2.3 Front Panel Connections

2.3.1 GPS Antenna Connection

The coaxial cable of the GPS antenna equipment is connected to the BNC socket marked **"GPS Antenna"** on the front panel. Further specifications concerning the installation of the antenna equipment, such as cable lengths and cable types, can be found in the document titled "GPS Antenna Equipment".

2.3.1.1 Status LEDs

The status LEDs on the front panel signal the Board's current (synchronization) status. The meanings of the LEDs are as follows:

LED Red	LED Green	Status	STATUS Code
Off	ON	**Sync** (radio-synchronous) with quartz regulation	**SYNC**
Off	Flashing	**Sync** (radio-synchronous) - SyncOFF timer running	**SYOF**
Flashing	ON	**Sync** (radio-synchronous) – simulation mode	**SYSI**
Flashing	Flashing	**Quartz** - SyncON timer running	**QUON**
ON	ON	**Quartz** – time was set via synchronization source	**QUEX**
ON	Flashing	**Quartz** – time set manually or after reset	**QUSE**
ON	**Off**	**No valid time**	**INVA**
Off	**Off**	No operating voltage / faulty	---

2.3.1.2 Status Optical Coupler

The status optical coupler provides a potential isolated switching contact for monitoring the Board's synchronization status.

Status output via 3-pole terminal with selection of the desired system status at which reporting is to be activated:

Optical coupler:

- Selected status or better achieved   – Optical coupler switched through
- Selected status not achieved   – Optical coupler blocked

The desired reporting status is set via the remote software.

2.3.1.3 Remote Interface

The connection to a PC's RS232 serial interface is made by means of the KA6870 interface cable supplied.

The remote interface for the configuration of the Board is located on the front panel of the Board. The transmission line (Tx) and reception line (Rx) have status LEDs which signal the activity on the respective interface line.

No further configuration of this remote interface is necessary.

2.4   Back-up Clock

The Board has a maintenance-free back-up clock. This back-up clock buffers the time information for up to 3 days following a power failure.

After a power failure lasting less than 3 days, the clock starts with the internal back-up clock information unless valid time information was available beforehand.

3 Remote Software

This Chapter describes the operation and functionality of the remote software for the Board 6021GPS.

3.1 General

The remote software is divided into various sectors and functionalities:

- Setting and status of **remote communication**
- **Time** – time and status information and parameters for the calculation of time
- **GPS** – GPS display and parameters
- **Status OC** – parameterization of the status OC
- **Serial Port** – parameterization of the serial time string output
- **PCID** – base and configuration data of the Board 6021GPS
- **DCF77 Pulse –** parameterization of the output for a DCF77 pulse (1Hz)
- **Cyclic Pulses –** parameterization of the output for a cyclic pulse
- **Info** – programme version / contact data for the **_hopf_** company / `Uninstall Program` button
- **RESET** and **DEFAULT** setting

> ⚠ After changing parameters a reset must be execute.

3.2 Installation / Uninstallation

The remote software is in a single file with the following name:

'Remote6021GPS_v0400.exe'.

3.2.1 Operating Systems

The remote software for the Board 6021GPS is suitable for the following operating systems:

- **Windows 98SE**
- **Windows NT**
- **Windows 2000**
- **Windows XP**

3.2.2 Installation

It is **_not necessary to install_** the **'Remote6021GPS_v0400.exe'** programme. The programme is simply copied to the folder on the hard disk from which it is to be started.

3.2.3 Uninstalling the Board

Entries take place in the registry while the programme is running. These entries are removed when the programme is uninstalled using the `Uninstall Program` button in the Info-window.

The user must then delete the **'Remote6021GPS_v0400.exe'** programme manually.

3.3 Create Remote Connection

After a connection has been made between the remote interface of the Board 6021GPS and a free serial interface on the PC, the PC COM port used must be set up in the remote software.

After activating the `Connect` button, the remote software attempts to build a connection to the Board 6021GPS. The status element changes colour dependent on the respective connection status.
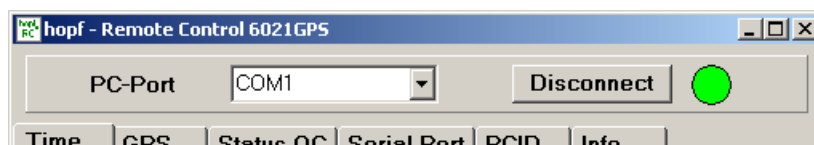
3.3.1 PC Port

The desired/used serial port of the PC is selected here.

Value range

PC Port	PC Port: COM1 ... COM49 directly selectable. Input COM1 ... COM9999 possible!

3.3.2 Connect / Disconnect

The `Connect` button is activated in order to make the remote serial connection with the Board 6021GPS.

After the interface has been successfully initialized, the `Disconnect` button is displayed, by means of which the PC's interface can be re-enabled for other programmes without exiting the programme.

3.3.3 Remote Connection Status

The status display for the remote connection is located next to the `Connect` / `Disconnect` button. The element changes colour dependent on the current status of the connection.

GREEN   Connection established with Board 6021GPS (device has responded).

YELLOW   PC interface initialized but no response received from Board 6021GPS.

GREY   The interface on the PC is not available or is being used by another programme. A message is also displayed.

The colour field also turns **YELLOW** if the serial connection is interrupted during operation.

3.4 Operation / Display

3.4.1 General Colour Scheme

Each combination of script and background colour defines the meaning of the respective display.

Black text on light grey background	⇨ Labelling of fields etc.
Black text on white background	⇨ Data from the PC
Grey text on white background	⇨ Non-modifiable data received from device
Green text on white background	⇨ Data received from device / confirmed
Yellow text on grey background	⇨ Transmitted data (waiting for response)
Red text on white background	⇨ Modified data not (yet) transmitted
Black text on red background	⇨ Error message (if error present)
Black text on green background	⇨ Active timer

3.4.2 Function Button

Various function buttons are available in the programme.

3.4.2.1 RESET Button

This button is used to trigger a hardware reset of the Board. This leads to a defined restart of the Board's microcontroller.

i	This function has no effect on the fail-safe stored data

3.4.2.2 SET DEFAULT Button

After activating the ⌐ **Set Default** ⌐ button and an additional security inquiry the settings of Board 6021GPS are set to the following values:

1.   Deletion of the current leap second information

2.   Time settings

- Time offset   = **+00.00**

- Changeover points of time:

    Commencement of summer time   = **deactivated**

    End of summer time   = **deactivated**

- SyncON / SyncOFF timeout   = **0000** / **0002** (minutes)

3.   GPS settings

- GPS position:

    Longitude   = **E 000° 00' 0000**

    Latitude   = **N 00° 00' 0000**

- GPS reception mode   = **Position-fix**

4.   Status optical coupler

ZZZZ (synchronization status)   = **SYNC**

5.   Time string output

hopf Standard String (6021)

- 8 data bits

- No parity

- 1 stop bit

- 9600 baud

- Local time

- Transmit with control characters

- <CR><LF>

- Data string without second forerun

- (last) control character immediately

- Output every second

After the Board has been reset to the DEFAULT values, the GPS receiver requires up to 13 minutes of satellite reception to determine the correct leap second information from the GPS data. The Board 6021GPS can only re-synchronize after this has been done.

The following message appears on the error display during this period:

GPS receiver is waiting for leap second data

3.4.2.3 SET Button

The manual changes in the remote software fields are sent to the Board by means of the
`Set` button. The colour of the script changes from RED to GREEN when the data has
been transferred successfully.

3.4.2.4 REFRESH Button

The respective data is polled or read again from the Board 6021GPS by means of the
`Refresh` button.

3.5   Info Window

The Info Window is displayed directly after programme start-up. This contains:

- The current remote software programme information (version and date)

- The contact data for the **hopf** Company

- The Uninstall button `Uninstall Program`
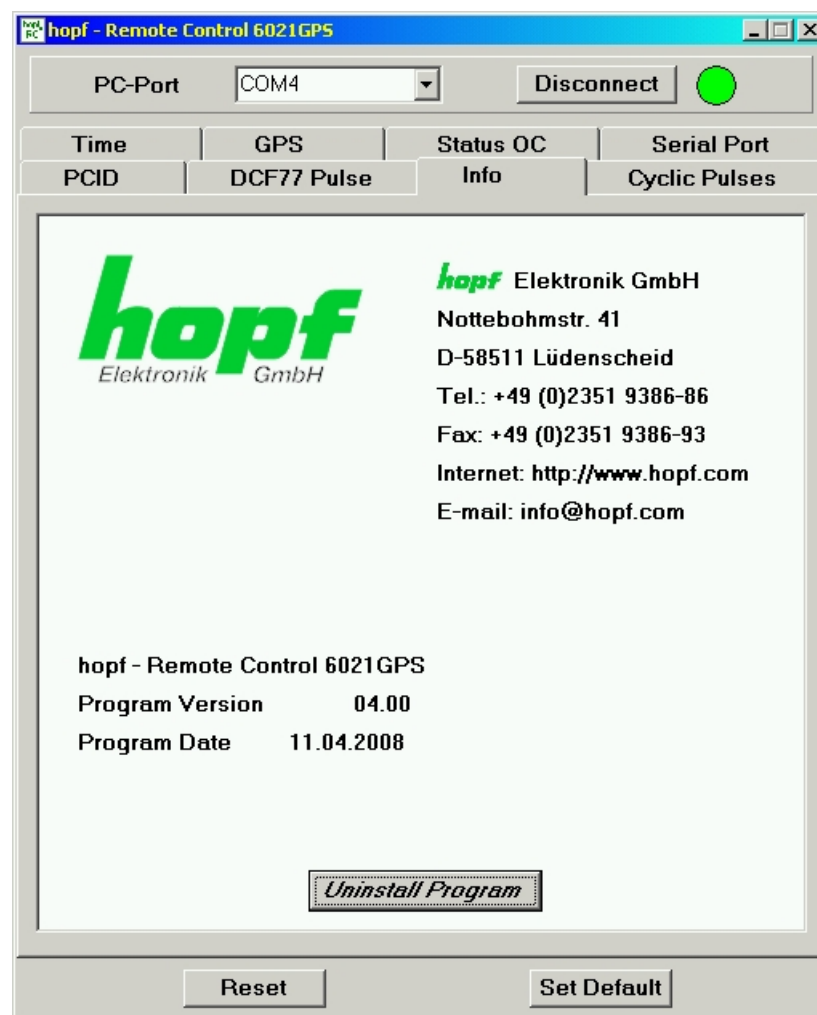
3.6   Time Window

All of the time and status information of the Board 6021GPS is displayed or set in the Time window.

⚠ After changing parameters a reset must be execute.

3.6.1 Time

All of the current time information/status is displayed under the Time tag.
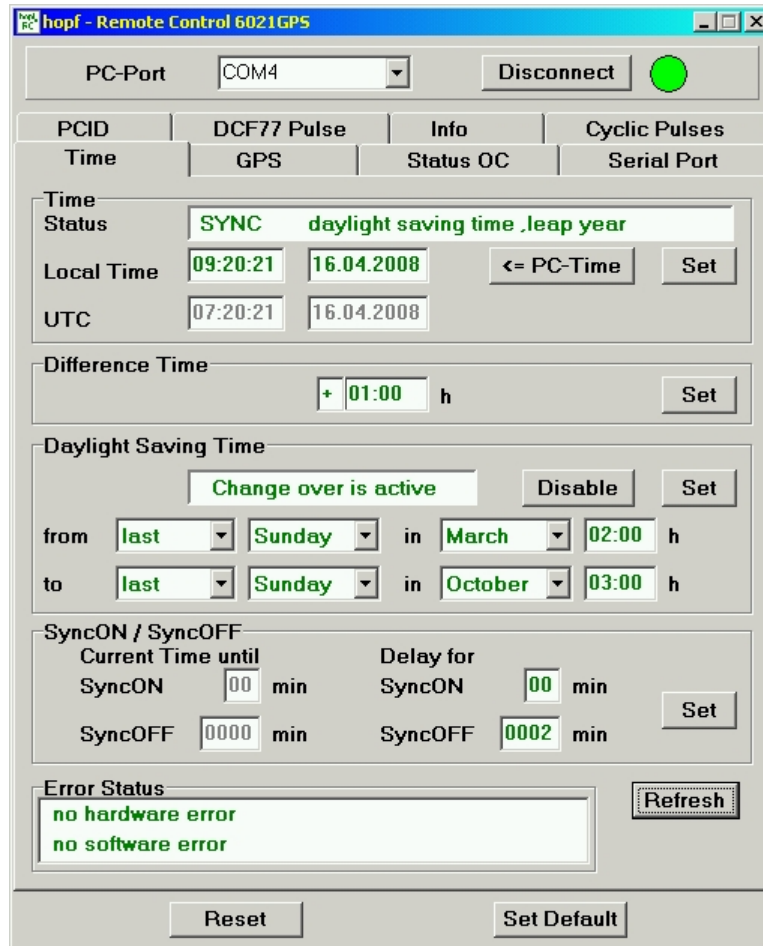
The ⟨= PC-Time ⟩ button can be used to set the new time information in accordance with the current PC time.

Value range

Optical Coupler Status	SYNC	Time synchronized + Quartz control started/running
	SYOF	Time synchronized + SyncOFF running
	SYSI	Time synchronized as simulation mode (without actual GPS reception)
	QUON	Quartz/crystal time + SyncON running
	QUEX	Quartz/crystal time (in freewheel after synchronization failure ⇨ Board was already synchronized)
	QUSE	Quartz/crystal time after reset or manual setting
	INVA	Invalid time

Time Zones (announcement)	standard time (standard time/winter time)
	announced standard time to DST (summer time announcement)
	daylight saving time (summer time)
	announced DST to standard time (announcement standard time/winter time)
Additional Time Status	blank ⇨ not available
	leap second
	announced leap second

Local Time / UTC

Hour	00 ... 23
Minute	00 ... 59
Second	00 ... 59
Day	01 ... 31
Month	01 ... 12
Year	2000 ... 2099

3.6.2 Time Offset

This function is used to input the time offset between the local standard time (winter time) and the world time (UTC time). The operational sign designates the direction in which the local standard time varies from the world time.

Value range

Operational sign	+ or -
Hours	00 ... 13 – **max. +/- 13:00h**
Minutes	00 ... 59

The operational sign designates the direction in which the local time varies from the world time:

> **'+'** corresponds to east of the null meridian (Greenwich)
>
> **'-'** corresponds to west of the null meridian (Greenwich)

As most countries of the world select their time offset in whole hours the input is also in steps of one hour:

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

However, some countries operate with smaller time steps; thus minute-by-minute entry is also possible:

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

> ⚠ The time offset always relates to the **local standard time (winter time)**, even if commissioning or the input of the time offset takes place during the summer time.

Example for Germany:

UTC	Local Time	Time Offset to be set:	Comment
13:00:00	14:00:00 **(winter time)**	+01:00	
13:00:00	15:00:00 **(summer time)**	+01:00	The time difference of two hours is made up of: +01:00h time offset and +01:00h for the summer time offset (changeover points of time must be set for this purpose).

3.6.3 Daylight Saving Time (Summer Time)

This input is used to define the points of time at which the changeover to summer time or winter time occurs during the course of the year. The hour, day-of-the-week, week and month at which the ST/WT changeover (summer time / winter time) is to take place are designated here.

The parameters are selected in such a way that the changeover can take place at any point of time.

The **Disable** button is to be activated if the ST/WT changeover is **not** required. The message **"change over is inactive"** is displayed in the status line as confirmation. The Board then only works with the standard time (winter time) set through the time offset.

Value range

Status line	change over is active / change over is inactive
Week	first ... fourth, last
Day	Monday ... Sunday
Month	January ... December
Hour	00 ... 23
Minute	00

! Sometimes the setting of the 5th Weekday in December, can lead to erroneous results and is therefore not permitted!

The meanings of the individual items of the input fields are as follows:

the **number of the day-of-the-week in the month** on which the changeover is to take place	1 ... 4 ⇨ 1.-4. day-of-the-week last ⇨ last day-of-the-week in the month
the **day-of-the-week** on which the changeover is to take place	Monday ... Sunday
the **month** in which the changeover is to take place	January ... December
the **hour** at which the changeover is to take place	00 ... 23 hours

Input example for Germany (CET/CEST)

WT (CET) ⇨ **ST (CEST)** at 2 a.m. on the last Sunday in March.

Input: from **last Sunday** in **March 02:00**

Changeover WT (Standard / Winter Time) ⇨ ST (Summer Time)

local time	UTC	difference UTC ⇨ local time
01:59:58 h	00:59:58 h	+1 hour
01:59:59 h	00:59:59 h	+1 hour
03:00:00 h	01:00:00 h	+2 hours
03:00:01 h	01:00:01 h	+2 hours

ST (CEST) ⇨ **WT (CET)** at 3 a.m. on the last Sunday in October.

Input: to **last Sunday** in **October 03:00**

Changeover ST (Summer Time) ⇨ WT (Standard / Winter Time)

local time	UTC	difference UTC ⇨ local time
02:59:58 h	00:59:58 h	+2 hours
02:59:59 h	00:59:59 h	+2 hours
02:00:00 h	01:00:00 h	+1 hour
02:00:01 h	01:00:01 h	+1 hour

3.6.4 SyncON / SyncOFF

These timers can be used to delay the change of status from QUARTZ to SYNC (SyncON) and from SYNC to QUARTZ (SyncOFF).

The **SyncOFF** timer serves to provide reception failure bypassing for operation free of fault messages in difficult reception conditions.
In the event of a synchronization source reception failure (GPS in this instance), the re-synchronization of the system to quartz status (C) is delayed by the set value. The system continues to run in synchronization status (R) on the internally regulated, highly accurate quartz base during this period.

This setting depends primarily on the desired freewheel accuracy.

<u>Example freewheel accuracy calculation</u>

In order to calculate the maximum value to be set for the SyncOFF timer, the desired minimum system accuracy is divided by the freewheel accuracy value of the quartz. If, for example, the freewheel accuracy is 1x10E-6 and the desired minimum system accuracy is 5msec. the following calculation results:

$$0.005s / 1x10E\text{-}6 = 5000s = \textbf{83 minutes 20 seconds}$$

⇨ The **max**. value to be set for the SyncOFF timer is thus **83 minutes**.

The **SyncON** timer serves on systems operating on a highly accurate, regulated quartz base to ensure that the system does not synchronize before the quartz base has been accurately regulated. This timer should be set to **00 as standard** on the Board 6021 GPS.

Value range

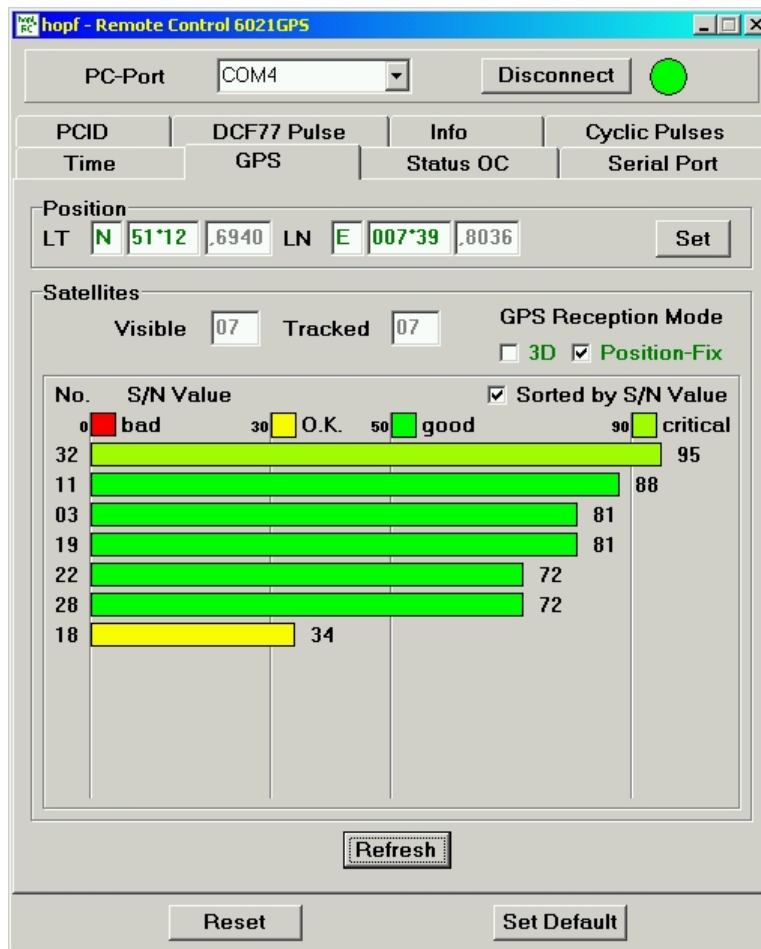| SyncON	00 ... 30 min
SyncOFF	0000 ... 1440 min

3.6.5 Error Status

The Board 6021GPS is capable of identifying various problems as they occur and transmitting a corresponding message. A preliminary check can be made here in the event of problems with the Board or faulty synchronization.

Value range

no hardware error	No hardware error
Crystal frequency out of limits	Quartz frequency out of limits
FRAM defect	FRAM fault
RTC not present or defect	Back-up clock not available or faulty
GPS-Receiver defect	GPS receiver fault
no software error	No software error
no valid year available	No valid year
GPS-Receiver is waiting for leap second data	GPS receiver is waiting for leap-second data
receiving discontinuity in GPS week	Faulty data received in GPS week
no valid Position in Position fix mode	No valid data for position in Position-fix mode

3.7 GPS Window

All of the data/inputs related to GPS reception are displayed or entered in this window.

3.7.1 Position

This function is used to enter the equipment's geographical position. It is useful on first commissioning and shortens the time required for the first synchronization of the GPS receiver.

The latitude and longitude positions are entered in degrees and minutes.

The operational signs for longitude are:

E   East of the null meridian (Greenwich)
W   West of the null meridian (Greenwich)

The operational signs for latitude are:

N   Northern hemisphere
S   Southern hemisphere

The latitude position is entered first (LT = Latitude) under **P GG°MM** whereby the meanings are as follows:

P	N or S, North or South	
GG	Degrees of **latitude** from	00 - 90
MM	Minutes of **latitude** from	00 - 59

The longitude position is then entered (LN = Longitude) under **p GGG°MM** whereby the meanings are as follows:

p	E or W, East or West	
GGG	Degrees of **longitude** from	000 - 180
MM	Minutes of **longitude** from	00 - 59

The position of **hopf** Elektronik GmbH is given in the above example.

In order to speed up the synchronization of the GPS receiver it is sufficient if the position is entered to an accuracy of 1-2 degrees.

A **0** should be entered in all places if the position is unknown.

Value range

Value range LT = Latitude / LN = Longitude:

Direction	W = West / E = East
	S = South / N = North
Degree of **LT**	00 ... 180 – **max. 180°00**
Degree of **LN**	00 ... 90 – **max. 90°00**
Minutes	00 ... 59

3.7.2 Satellites

The information about the available satellites is output in this field.

Value range

Visible	00	GPS receiver has not detected any satellite data yet
	01 … xx	Number of satellites theoretically visible at the current time and position
Tracked	0 ... 12	Number of satellites tracked by the GPS receiver
Satellite Number	01 … xx	Satellite number
S/N Value	0 … 100	Signal / noise ratio (measure of signal quality)

> If one or more satellites are permanently displaying values over 90, this may cause reception failures due to over-modulation of the GPS receiver.

3.7.3 3D / Position-fix (GPS Mode)

3D Evaluation

The accuracy of the time evaluation is defined by the exact positional calculation of the installation location. A minimum of four satellites is required for this calculation (3D evaluation). The signal transmission times to several satellites are defined from the calculated position and the exact second mark is produced from their mean value.

Position-fix Evaluation

In the Position-fix mode the System can be synchronized with only one received satellite. In this case the accuracy depends heavily on the exact entry of the installation position location. The second mark is then calculated on the basis of the position entered. If four or more satellites are received in Position-fix mode then the evaluation switches automatically into 3D mode for this time period and calculates the exact position. By this means the accuracy of the Position-fix evaluation increases to the accuracy of the 3D evaluation.

When the position is entered to ±1 minute degree the accuracy of the second mark is already better than ±20μsec.

Position-fix Evaluation Features	3D Evaluation Features
- Clock can synchronize with only one received satellite. - Accuracy depends on the exact entry of the position. - If four or more satellites are received in this mode then the evaluation switches automatically into 3D mode for this time period and calculates the exact position. - The antenna can also be installed in locations from where less than ¼ of the sky is visible.	- The System can not be synchronized if less than four satellites are received. - The position is calculated automatically. - The accuracy of the synchronization is increased by the exact calculation of position. - The antenna usually requires more than ¼ free visibility of the sky.

3.8 Status OC Window

The output of the status optical coupler (on the front panel of Board 6021GPS) can be configured with the aid of this function.
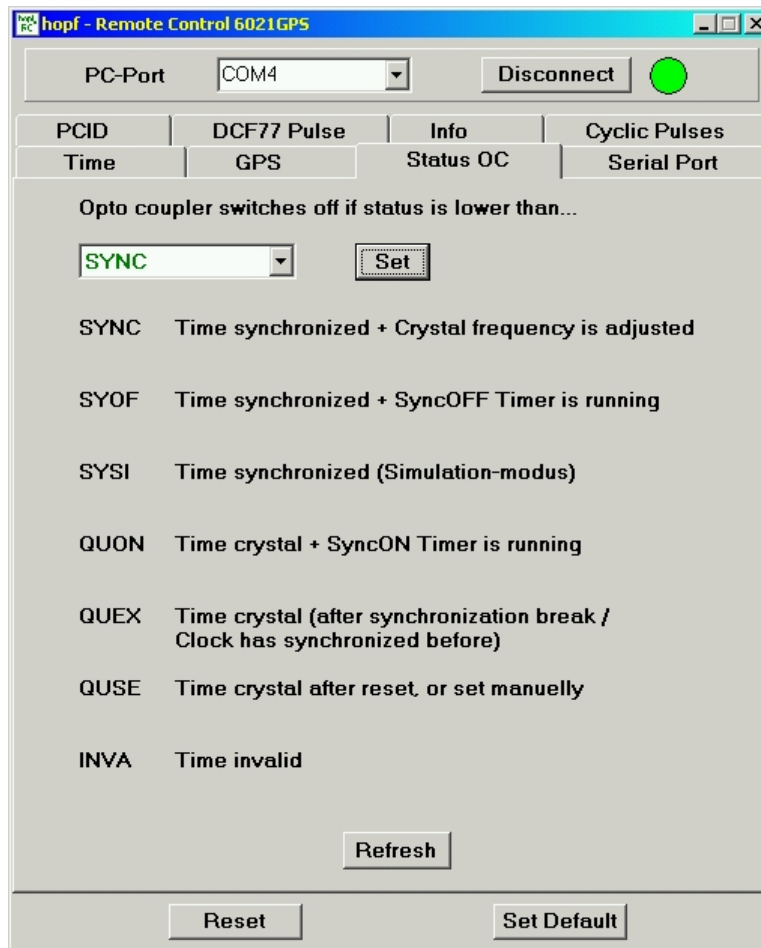
After changing parameters a reset must be execute.

The time statuses are listed in this window in rising quality from bottom to top.

Optical coupler:

- Selected status or better achieved — Optical coupler switched through
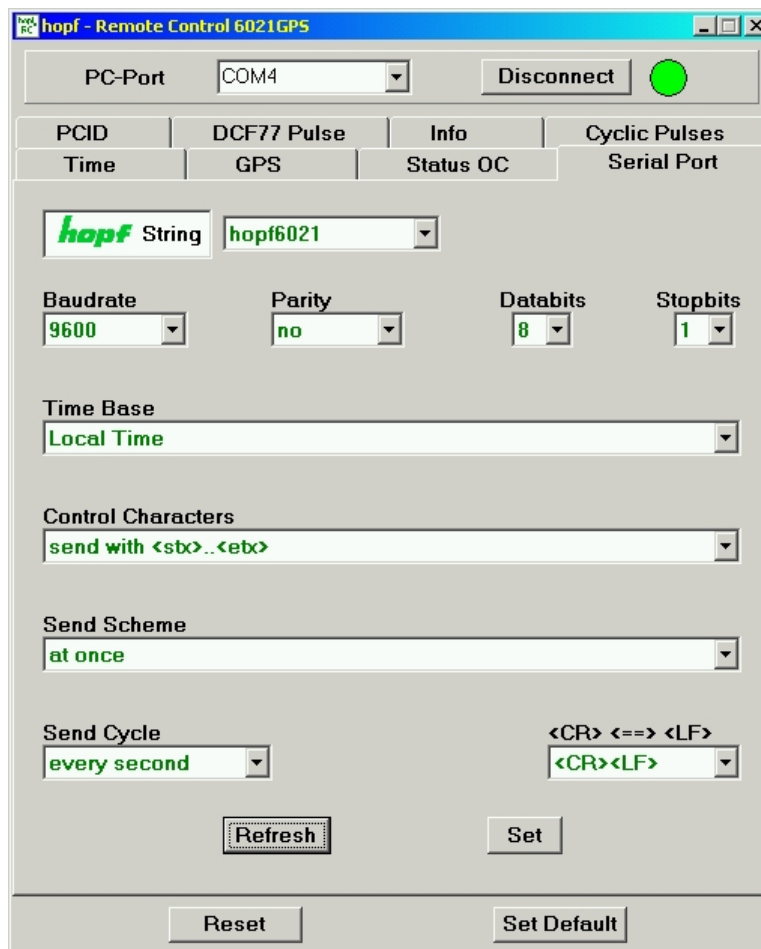- Selected status not achieved — Optical coupler blocked

Value range

Optical Coupler Status	SYNC	Time synchronized + Quartz regulation started/running
	SYOF	Time synchronized + SyncOFF running
	SYSI	Time synchronized as simulation mode (without actual GPS reception)
	QUON	Quartz/Crystal time + SyncON running
	QUEX	Quartz/Crystal time (in freewheel after synchronization failure ⇨ Board was already synchronized)
	QUSE	Quartz/Crystal time after reset or manual setting
	INVA	Invalid time

3.9 Serial Port Window

The Board has a serial interface **without** handshake lines. Data exchange can take place via RS232 (V.24) or RS422 (V.11) signal level. The interface may be used, for example, for the transmission of time telegrams to other computers. ^

The serial time string output on the VG-ledge is configured in this window.

After changing parameters a reset must be execute.

3.9.1 Serial Interface Parameters

The parameterization and mode of operation of the serial time interface is described here.

3.9.1.1 Data String

Data String	*hopf* Standard String (6021)

3.9.1.2 Baud Rate

Baud Rate	1200
	4800
	9600
	19200

3.9.1.3 Parity

Parity	no
	even
	odd

3.9.1.4 Data Bits

Data Bits	7
	8

3.9.1.5 Stop bits

Stop Bits	1
	2

3.9.1.6 Time Base

Time Base	UTC
	Standard Time
	Local Time

3.9.1.7 Control Characters

Control Characters	send with <stx> … <etx> (with control characters)
	send without <stx> … <etx> (without control characters)

3.9.1.8 Send Scheme

Send Scheme	at once		
	at once	with second forerun	
	at once	with second forerun	<etx> at second change
	with delay	with second forerun	<etx> at second change

3.9.1.8.1 Data String Transmission Points of Time
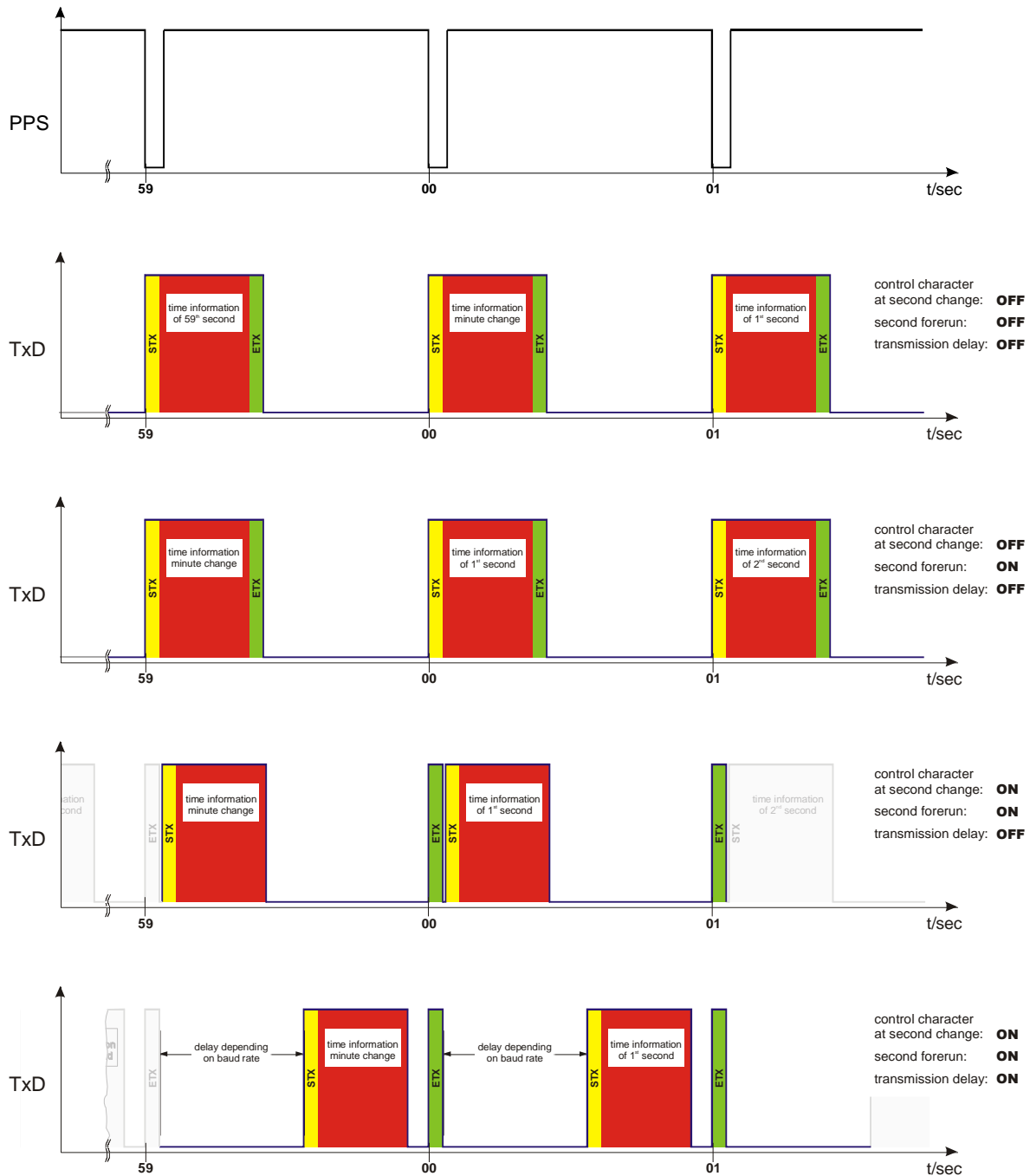
STX ⇨ Start of Text

ETX ⇨ End of Text

3.9.1.9 Delayed Transmission

The last character of the data string is transmitted directly at the second change and immediately thereafter the new data string, which is valid for the next second change, is transmitted with the setting **"<etx> at second change"**. This can be interpreted as an error on some computers with a high working load. With function **"with delay"**, transmission of the new data string can be delayed dependent on the baud rate.

Example:

Baud rate 9600 baud

Milliseconds	With delay	Without delay
000	End character (ETX)	End character (ETX)
002	–	New data string
025	–	End new data string
930	New data string	–
955	End 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 new data string
810	New data string	–
913	End new data string	–
000	End character (ETX)	End character (ETX)

3.9.1.10 Send Cycle

Send Cycle	every second
	every minute
	every hour
	on request only

3.9.1.11 Change of <CR> <==> <LF>

<CR> <= => <LF>	<CR><LF>
	<LF><CR>

3.9.2 Serial Transmission Data Format

The data is transmitted in ASCII as BCD values and can be presented with any terminal program (TERMINAL.EXE under Windows for example). The following control characters, among others, from the ASCII character set are used in the construction of the data string:

$20 = 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 separately (see data string construction).

3.9.3 *hopf* Standard String (6021)

Below the *hopf* Standard String is described.

3.9.3.1 Specified Settings

Automatic:	no
Required:	no
Blocked:	no

3.9.3.2 Structure

Character No.	Meaning	Hex-Value
1	STX (start of text)	$02
2	status (internal clock status)	$30-39, $41-46
3	day of the week (1=Monday ... 7=Sunday) for UTC time bit 3 is set to 1 in the day of the week	$31-37
4	tens hour	$30-32
5	unit hour	$30-39
6	tens minute	$30-35
7	unit minute	$30-39
8	tens second	$30-36
9	unit second	$30-39
10	tens day	$30-33
11	unit day	$30-39
12	tens month	$30-31
13	unit month	$30-39
14	tens year	$30-39
15	unit year	$30-39
16	LF (line feed)	$0A
17	CR (carriage return)	$0D
18	ETX (end of text)	$03

3.9.3.3 Status

The second and the third ASCII-character contain the status and the day of the week.
The status is decoded binary.

	b3	b2	b1	b0		Meaning
Status:	x	x	x	0		no announcement hour
	x	x	x	1		announcement (ST-WT-ST)
	x	x	0	x		standard time (WT)
	x	x	1	x		daylight saving time (ST)
	0	0	x	x		time / date invalid
	0	1	x	x		crystal operation
	1	0	x	x		radio operation
	1	1	x	x		radio operation (high accuracy)

Day of the Week:	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

Status	operation mode	time	announcement SZ-WZ-SZ
0 = 0000	time invalid	winter	no announcement
1 = 0001	time invalid	winter	announcement
2 = 0010	time invalid	summer	no announcement
3 = 0011	time invalid	summer	announcement
4 = 0100	quartz	winter	no announcement
5 = 0101	quartz	winter	announcement
6 = 0110	quartz	summer	no announcement
7 = 0111	quartz	summer	announcement
8 = 1000	radio	winter	no announcement
9 = 1001	radio	winter	announcement
A = 1010	radio	summer	no announcement
B = 1011	radio	summer	announcement
C = 1100	radio	winter	no announcement
D = 1101	radio	winter	announcement
E = 1110	radio	summer	no announcement
F = 1111	radio	summer	announcement

3.9.3.4 Example

(STX)E4123456180702(LF)(CR)(ETX)

- It is Thursday 18.07.2002 - 12:34:56 o'clock.
- radio operation (high accuracy)
- daylight saving time
- no announcement
- ( ) - ASCII-control characters e.g. (STX)

3.9.3.5 Serial Requests with ASCII Characters

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

- ASCII **"D"** - for Time / Date (Local Time)
- ASCII **"G"** - for Time / Date (UTC Time)

The System answers within 1msec. with the corresponding data string.

Since this is often too fast for the requesting computer, it is also possible to realize a response delay in 10msec. steps on request via software. For the delayed transmission of the data string, the requesting computer transmits the lower case letters "**d**, **g**" to the clock with a two position multiplication factor.

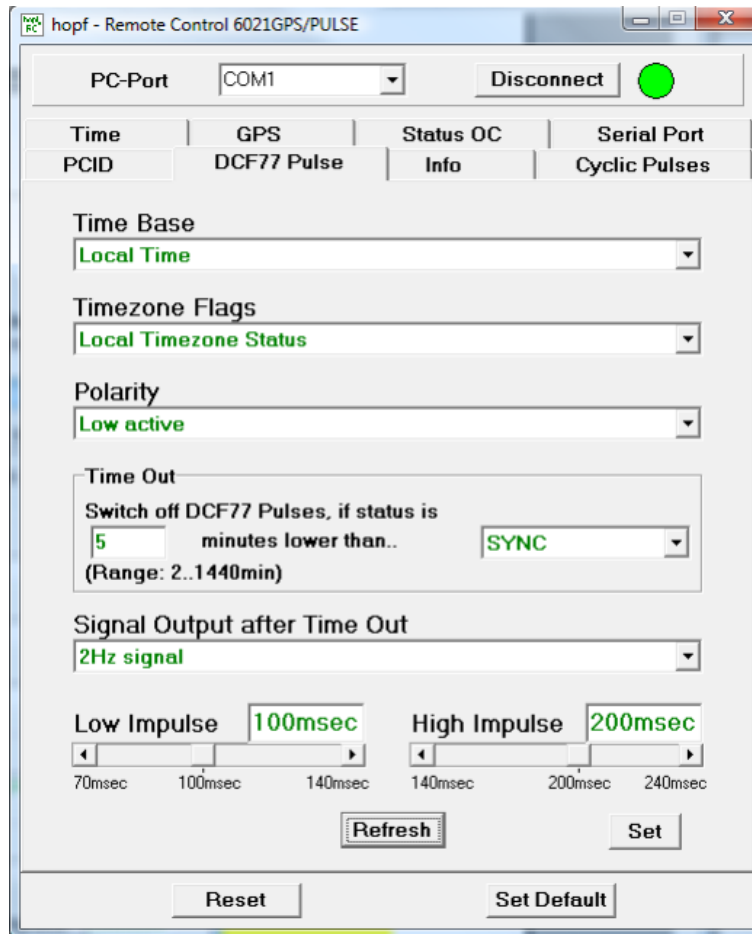The clock interprets the multiplication factor as a hexadecimal value.

Example:

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

The clock transmits the Time / Date (UTC Time) data string after approx. 2550 milliseconds.

3.10 DCF77 Pulses Window

The DCF77 pulse transmitted over the VG ledge (for pin assignment see ***Section 2.1.2 Assignment of the VG ledge 64-pole***) can be parameterized in this menu.

After changing parameters a reset must be execute.

3.10.1 Time Base of the Transmitted DCF77 Pulse

Time Base	Local Time
	Standard Time
	UTC

In general the local time is set as the base. This time leaps forward/back 1 hour on each summer/winter time changeover. The standard or UTC time must be selected as the base if this automatic ST/WT changeover is suppressed.

When setting standard time (winter time), the time offset to local summer time is minus 1 hour. Standard time runs continuously throughout the whole year.

When setting UTC, the world time (formerly GMT) is used as the time base. This time base also runs continuously throughout the whole year. The time offset to standard time can vary by ±12 hours depending on where in the world the equipment is installed.

Changes in settings only become active on the next minute change.

3.10.2 Time Zone Status Transmitted in the DCF77 Pulse

Time Status	Local Time Status
	Always Standard (Winter) Time Status
	Always DST (Summer) Time Status
	No Time Zone Status (Neither Winter Nor Summer Time; For UTC)

The current time zone is transmitted in the DCF77 pulse in coded form. Thus a connected receiver can detect whether winter or summer time is currently prevailing. The output of this time zone coding is automatically pre-set by way of the selection made in *Section 3.10.1*

Time Base of the Transmitted DCF77 Pulse. If you require an output that differs from this time zone bit you can set this is this menu.

Local Time Status	The time zone bits are transmitted according to the current time zone (winter or summer time). The transmitted time is the current local time.
Always Standard Time Status	The time zone coding permanently transmits winter time, even if summer time is currently prevailing. The transmitted time is the current local time. Imminent time zone changes are not announced.
Always DST Time Status	The time zone coding permanently transmits summer time, even if winter time is currently prevailing. The transmitted time is the current local time. Imminent time zone changes are not announced.
No Time Zone Status	Both time zone bits are set to 0 (neither winter nor summer time). The transmitted time is the current local time. Imminent time zone changes are not announced.

> ⚠ The time zone status is automatically pre-set on a change of time base.
>
> Manual changes to the time zone status can cause false timestamps or time leaps.
>
> **Example:**
> It is summer time. "Local Time" was selected as the time base for the DCF77 pulse. The Time Zone Status is set to "Always Standard Time Status". The connected receiver will now display the current local time with the status "**winter time**" instead of summer time. If the receiver also calculates the UTC time this will then be displayed incorrectly (one hour too many).

Changes in settings only become active on the next minute change.

3.10.3 Polarity of the Transmitted DCF77 pulse

Polarity (TTL)	High active
	Low active

The polarity of the transmitted DCF77 pulse is reversed under this menu item. In the "high active" setting the polarity of the DCF77 pulse output corresponds to the data in *Section 2.1.2 Assignment of the VG ledge 64-pole*. The signal output is inverted in the "low active" setting.

Changes in settings only become active on the next minute change.

3.10.4 Status-Dependent Pulse Output (Time Out)

The DCF77-Sim.-Signal does not include and synchronisation status. In case of loss of radio-synchronisation of board 6021GPS and ongoing output of simulated DCF77 pulse the status of connected clock systems cannot be identified. For this reason and based on a too low status of board 6021GPS the DCF77 pulse is no longer output or rahter modulated by a 2Hz-pulse.

In order to bridge reception failures of board 6021GPS or running in test mode without synchronization the duration of DCF77 pulse output after reception failure can be set via the "time out"-value. The time delay can be set between two(2) minutes and 24 hours.

The delay time depends on the required accuracy of the connected subsystem, see *Chapter 3.10.7 Adjusting the Pulse Length of the DCF77 Pulse - Low Impulse*.

Conditions for DCF77 pulse output:

The DCF77 pulse is transmitted when:

- the current synchronization status is the same as or better than the selected status

- the required synchronization status is reached and the set "time out" has not yet expired

The DCF77 pulse is not transmitted when:

- the selected status has not yet been attained

- the required synchronization status is reached at least once and after leaving the "time out" has expired

<u>**Range of values**</u>

The synchronization status is presented from the bottom up with increasing quality.

synchronisation status		
	SYNC	Time synchronized + quartz control started/running
	SYOF	Time synchronized + SyncOFF running
	SYSI	Time synchronized as simulation mode (with no actual GPS reception)
	QUON	Quartz/crystal time + SyncON running
	QUEX	Quartz/crystal time (in freewheel after synchronization failure ⇨ Board was already synchronized)
	QUSE	Quartz/crystal time after reset or manually set
	INVA	Invalid time

3.10.5 Signal after Time Out - Signal Output in the event of a Fault

Fault signal	2 Hz signal
	No signal

Using this menu item the interference reaction of the DCF77 pulse can be controlled unless the system status is lower than the reference value.

2 Hz signal   If the status of board 6021GPS is lower than the reference value, a 2Hz signal instead of the DCF77 pulse is provided.

No signal   If the status of board 6021GPS is lower than the reference value there is no signal output.

i	Transmission of a 2Hz pulse in the event of a fault allows the connected devices to monitor for line breakage.

3.10.6 Sample Calculation of the Accuracy of the DCF77 Pulse

- For the purpose of this example the accuracy of the internal quartz base is assumed to be ± 1*10E-6

- Minimum accuracy required: **5ms**

- **5ms / (1 x 10E-6) = 5000s = 83 minutes 20 seconds**

⇨ The value to be set for **'time out'** must be **83 minutes maximum**

3.10.7 Adjusting the Pulse Length of the DCF77 Pulse - Low Impulse

The antennae of some radio clocks produced by other manufacturers falsify the duration of the reduction and for this reason the downstream receiver is adjusted to other pulse lengths. With the aid of the "Low Impulse" setting the DCF77 pulse output can be adjusted on such a receiver.

The adjustment range is: 70ms to 140ms. The **standard** is **100ms.**

Changes in settings only become active on the next minute change.

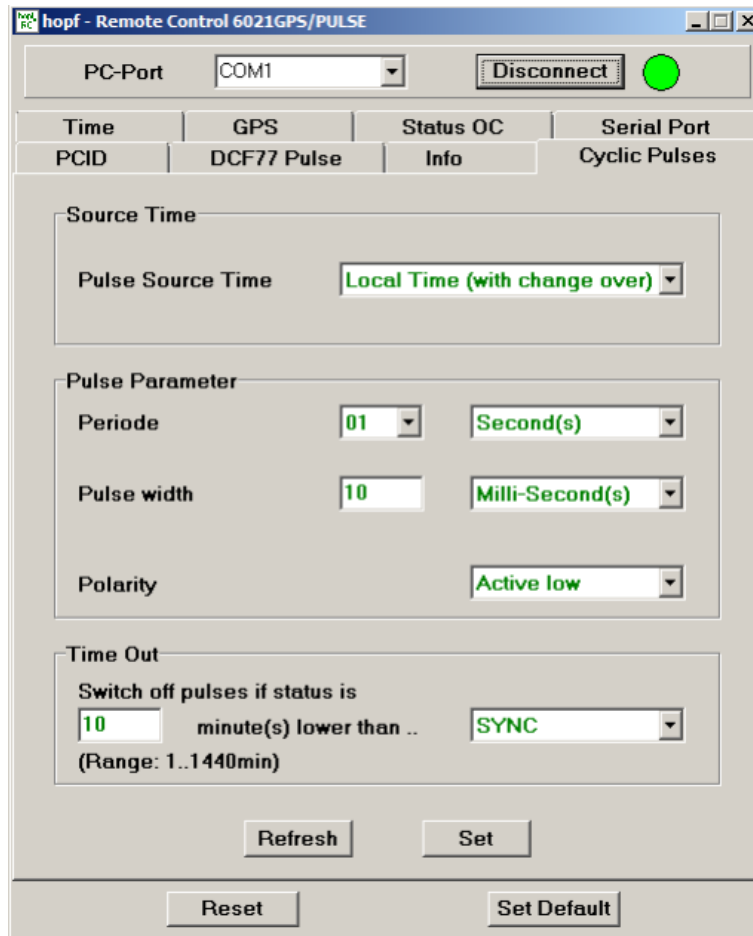## 3.10.8 Adjusting the Pulse Length of the DCF77 Pulse - High Impulse

The antennae of some radio clocks produced by other manufacturers falsify the duration of the reduction and for this reason the downstream receiver is adjusted to other pulse lengths. With the aid of the "High Impulse" setting the DCF77 pulse output can be adjusted on such a receiver.

The adjustment range is: 140ms to 240ms. The **standard** is **200ms.**

Changes in settings only become active on the next minute change.

3.11 Cyclic Pulses Window

This menu serves to configure the "Cyclic Pulses" function of the 6021GPS module.

> ⚠️ After changing parameters a reset must be execute.

After setting the parameter a reset for complete takeover must be issued!

3.11.1 Time Zone Selection (Pulse Source Time)

The following time zones are available for selection:

- Local time
- Standard time
- UTC

This setting is required when, for example, a day pulse which is dependent on the set time offset is to be transmitted and summer time may occur in the time zones at different times.

3.11.2 Pulse Parameters

This section serves to configure the following pulse parameters:

- Cycle
- Pulse length
- Polarity of the transmitted pulse

3.11.2.1 Cycle

This section serves to select the pulse to be transmitted. Possible pulses are:

- Pulses every second: every 1, 2, 3, 4, 5, 6, 10, 12, 15, 20 or 30 seconds
- Pulses every minute: every 1, 2, 3, 4, 5, 6, 10, 12, 15, 20 or 30 minutes
- Pulses every hour: every 1, 2, 3, 4, 6, 8, 12 or 24 hours

3.11.2.2 Pulse Width

This section serves to select the pulse width to be transmitted. Basically it is possible to specify the pulse width in milliseconds or seconds.

Possible **pulse widths** when the length is determined **in milliseconds**:

- Minimum: 10ms
- Maximum: Cycle minus 10ms, when cycle ≤1min; otherwise 65535ms.

Possible **pulse widts** when the length is determined **in seconds**:

- Minimum: 1s
- Maximum: Cycle minus 1s, when cycle ≤ 12h; otherwise 65535s.

> $\mathbf{i}$ The pulse width can only be set in milliseconds when the cycle width is 1s.

3.11.2.3 Polarity

This section serves to select the polarity of the pulse to be transmitted. The signal can be *high-active* or *low-active*.

3.11.3 Status-Dependent Pulse Output (Time Out)

The pulse output is dependent on the synchronization status. The synchronization status from which the pulse output takes place is defined in the selection fields. The "time out" value is also adjustable between 1 minute and 24 hours.

Conditions for pulse transmission:

The pulse is transmitted when:

- the current synchronization status is the same as or better than the selected status
- the required synchronization status is reached and the set "time out" has not yet expired

The pulse is not transmitted when:

- the selected status has not yet been attained
- the required synchronization status was reached at least once, and after it leaves the "Time Out" expired.
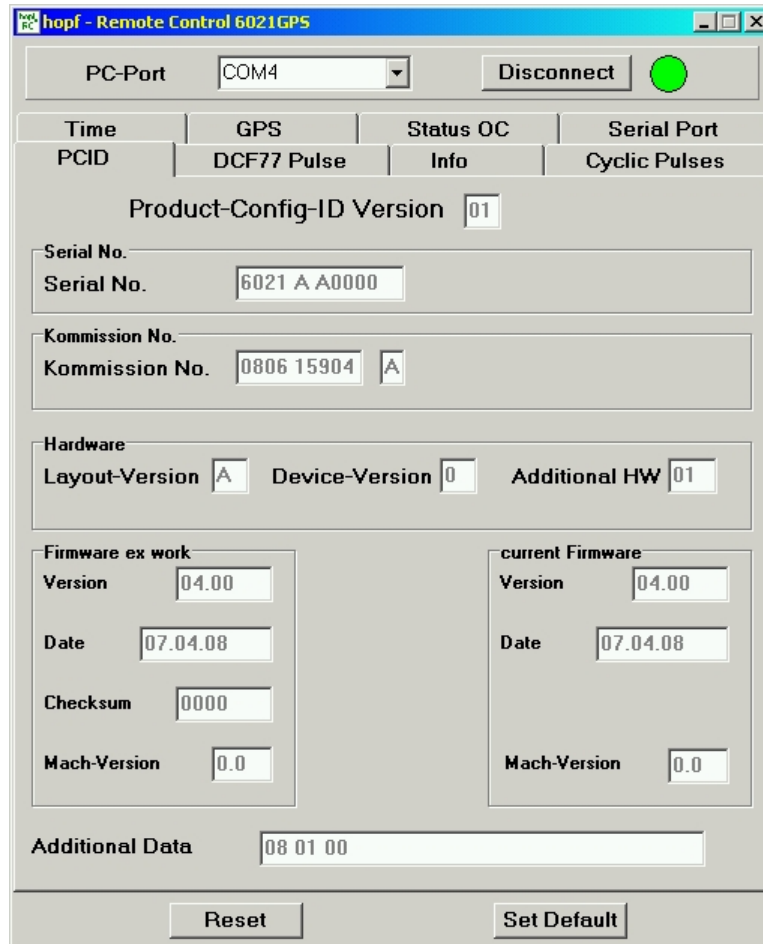
<u>Range of values</u>

The synchronization status is presented from the bottom up with increasing quality.

Pulse output status		
	SYNC	Time synchronized + quartz control started/running
	SYOF	Time synchronized + SyncOFF running
	SYSI	Time synchronized as simulation mode (with no actual GPS reception)
	QUON	Quartz/crystal time + SyncON running
	QUEX	Quartz/crystal time (in freewheel after synchronization failure ⇨ Board was already synchronized)
	QUSE	Quartz/crystal time after reset or manually set
	INVA	Invalid time

3.12 PCID Window

This window contains the base information concerning the Board's hardware and software configuration.

This data should be available in cases where it is necessary for the **hopf** Company to provide technical support or should be sent to **hopf** in the form of a screenshot.

4 Fault Analysis / Troubleshooting

Various indicators are available on the Board 6021GPS for presentation of the system status and problem analysis. This status information can also be used to monitor the clock system by means of a higher level management system.

Faults occurring are displayed or output via various elements.

4.1 Fault Scenarios

This Chapter describes various fault scenarios which provide an initial analysis of the problem to the user. This also provides assistance in describing the fault when making contact with the *hopf* support team.

4.1.1 Complete Failure

Description

- The status LED's on the front panel are off

Cause / Solution

- Equipment is switched off
- Power supply has failed
- Power supply unit is defective

4.1.2 No GPS Reception / No Synchronization

Description

- **SY**xx is not displayed on the status display of the time window in the remote software
- The status LED's on the front panel do not signal any **SY**xx status
- Quartz status is output in the serial time string

Cause / Solution

- System was not initialized correctly or initialization was incomplete

The following describes various effects and their possible causes in the case of a non-synchronizing system:

Case 1:

Effect: No satellite appears on the display after first installation and **00** is displayed under **V**.

Possible faults:

- The antenna cable is too long
- An incorrect type of cable was used for the antenna cable length
- The antenna cable is faulty
- The antenna cable is not connected
- The antenna is faulty
- The lightning protector is faulty

Case 2:

Effect: There are 7 satellites within the range of visibility (**V=07**) but only a maximum of 2 are displayed. However, the values of these satellites are 50 or higher.

Possible fault:

- The visibility range of the antenna to the sky is restricted and the Board is set to 3D reception mode.

Case 3:

Effect: 9 satellites in the range of visibility (**V=09**), 6 satellites appear on the display. The signal to noise ratios are all less than 30. The equipment does not synchronize.

Possible faults:

- The cable is too long
- An incorrect type of cable was used for the length of the antenna equipment
- The BNC sockets are not mounted correctly
- The cable is kinked or broken
- Indirect lightning protection has been irreversibly damaged due to excess voltage
- Faulty antenna

Case 4:

Effect: The equipment was working well previously but there has been no reception for several days. There are 7 satellites in the range of visibility (**V=7**). However, no satellite is displayed.

Possible faults:

- The cable is damaged.
- There was excess voltage on the antenna equipment and the lightning protection is damaged.
- The antenna is faulty.
- The receiver on the Board 6021GPS is faulty.
- A constructional change has had an effect on the antenna equipment (e.g. shading of the antenna due to subsequent building work or the subsequent laying of cables with high alternating fields in the close vicinity of the antenna cable)
- Electronic devices with an interference effect on the GPS signal have been put into operation in the vicinity of the GPS antenna equipment or receiver (e.g. pager transmitter)

Further information on the subject of the GPS antenna equipment can be found in the document titled "GPS Antenna Equipment".

4.1.3 No Serial Output or Serial Output Incorrect

Description

- The connected systems are not receiving a serial string or
- The connected systems are receiving serial strings with a time which is at variance with the system

Cause / Solution

- The serial interfaces are not configured correctly (e.g. transmit on request only, UTC output, incorrect baud rate etc.).
- The connection to the serial interfaces is not correct (e.g. TxD and RxD lines transposed).

4.1.4 Incorrect Time Output

Description – Local Time

- **Local time** transmitted is at variance with the actual local time

Cause / Solution

- UTC/Local time offset not set or set incorrectly
- ST/WT changeover points of time not set or set incorrectly
- Time was set manually, system running in quartz mode
- Time has drifted as the system has been running in quartz mode for a lengthy period

Description - UTC Time

- **UTC time** transmitted is at variance with the actual UTC time

Cause / Solution

- Time has drifted as the system has been running in quartz mode for a lengthy period
- Time was set manually, system running in quartz mode
  Cause of incorrect UTC time when setting manually: incorrect local time entered (the local time must always be entered when setting)
  or the system was configured incorrectly (time offset, ST/WT changeover)

4.1.5 No ST/WT Changeover

Description

- "daylight saving time" (summer time) does not appear on the display
- The bit for "daylight saving time" (summer time) is not set under status in the data strings.

Cause / Solution

- Changeover points of time not set or set incorrectly
- Output/display was configured for UTC and not local time

4.2 Support from the *hopf* Company

Should the System demonstrate error descriptions other than those listed in *Chapter 4.1 Fault Scenarios*, please contact Support at *hopf* Elektronik GmbH with an exact description of the fault and the following information:

- Serial number of the board

- Screenshot of the PCID and TIME window of the remote software if possible

- Occurrence of the error during commissioning or operation

- Exact error description

- In the case of GPS reception/synchronization problems ⇨ description of the antenna equipment used:

  o Components used (antenna, indirect lightning protector, etc.)

  o Cable type used

  o Total length of the antenna equipment

  o Sequence of components and cable lengths between the components

  o Antenna installation position (e.g. signal shading by building)

Please write to the following E-mail address with the above information:

support@hopf.com

> Providing a detailed description of the error and the information listed above avoids the need for additional clarification and leads to faster processing by our Support team.

5   Maintenance / Care

The Board is generally maintenance-free. The following points should be noted if it is necessary to clean the receiver board.

The following **must not** be used to clean the receiver board:

- Fluids

- Cleaning agents containing solvents

- Cleaning agents containing acids

- Abrasive media

The use of such cleaning agents or media could damage the receiver board.

Do not use a wet cloth to clean the board.
There is the danger of an electric shock.

To clean the receiver board use a cloth that is:

- Antistatic

- Soft

- Non-fabric

- Damp

6   Technical Data

General Data	
Operation:	Via remote software
Protection Class of the board:	IP00
Dimensions:	Euro-Board 160mm x 100mm with 3U/4HP front panel
Voltage Supply:	5V DC ± 5% (via VG ledge)
Power Consumption:	approx. 230mA
Maintenance-free buffering of the internal back-up clock:	3 days
MTBF:	> 400,000 hours
Weight:	approx. 0,2kg

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

Accuracy	
Internal PPS pulse on GPS reception:	< ± 250ns
VCO control of the internal quartz base:	± 0.1ppm, after 30min GPS reception
Freewheel accuracy:	± 0.1ppm after at least 1 hour GPS reception / T = +20°C • Drift for T = +20°C (constant): - after 1h: 0.36msec. - after 24h: 8.64msec.
Internal back-up clock	± 25ppm / for T = +10°C to +50°C

Signal Outputs	
Full-duplex serial interfaces **for time information** (without handshake):	Via VG ledge in RS232 and RS422 level
Full-duplex serial interfaces **for remote access** (without handshake):	Via 9-pole SUB-D (male) connector in the front panel (in RS232 level)
Status Optical Coupler:	Via 3-pole stackable screw terminal Resistive circuit-breaking capacity: max. 50mA / 80V DC

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

Synchronization time:	• Cold start: 5min - 30min
	  (first initialization without position input)
	• Warm start: < 1min
	  (voltage failure < 3 days)

Antenna connection:	• Via BNC socket • For active antennas, Ub = 5V DC • Antenna power fed via Board 6842 BNC socket

Special production:

Modifications can be made to hardware and software in accordance with customer specifications.

i	The *hopf* Company reserves the right to modify hardware and software at any time.

7 Appendix

7.1 GPS (Global Positioning System)

Satellites circumnavigate the earth about twice per day at an altitude of approximately 20,000 km, on 6 different courses and at different angles.

The GPS system was developed based on 18 satellites with 3 replacement satellites. In order to prevent short-term gaps in coverage the number was increased during development to 21 satellites with 3 replacement satellites. Above any point on the skyline, therefore, there are always between 6 and 11 satellites visible. Highly precise atomic clocks are on board every satellite (accuracy min. $1*10^{-12}$).

A base frequency of 10.23 MHz is taken from the atomic clocks. The two carrier frequencies used, L1 and L2, are produced from this base frequency.

- Transmission frequency L1 = 154 * Base frequency = 1575.42 MHz
- Transmission frequency L2 = 120 * Base frequency = 1227.60 MHz

Each satellite sends all important navigation and system data by modulation on these two carrier frequencies. In the public domain, data transmitted on L1 frequency may be evaluated. The precise time can be calculated from this data by defining the position via the antenna.

The GPS antenna receives the signals of all satellites that are within sighting range above the skyline and forwards them to the GPS receiver via a coaxial cable. 4 satellites are required for continuous time evaluation.

hopf GPS radio-controlled clocks have a **Position-fix function** for difficult antenna positions that do not permit continuous reception from 4 satellites (where satellite signals may be screened by surrounding buildings or in mountain valleys, for example). This function also permits synchronization with only one satellite.

Time calculation

The GPS receiver calculates world time UTC (Universal Coordinated Time) from GPS world time (GPS-UTC) radiated by the satellite, by subtracting the leap seconds; at present (status: January 1999) world time is running 13 seconds behind GPS-UTC time. The difference is not constant and changes with the insertion of leap seconds.

The current standard time for the respective time zone is calculated by the addition of a time offset to the UTC time. The time offset is the time difference between UTC time and the time zone in which the clock system is situated, is set in the clock system by the user during commissioning of the clock.

Any ST/WT changeover that is due in the time zone is carried out via a switching function that is to be configured in the clock system.

Advantages/Disadvantages GPS:

+ High accuracy
+ High security against interference
+ Worldwide application possible
+ High security against failure (terrestrial transmitters are often switched off when bad weather conditions prevail at the transmission location)
+ High independent clock accuracy
− Outdoor antenna required
− Limited antenna cable lengths