Industriefunkuhren

hopf
Elektronik GmbH

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Technical Manual

GPS Sync Module

Model 8021GPS

ENGLISH

Version: 05.00 – 23.04.2014

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Valid for Devices 8021GPS with FIRMWARE   Version: **05.xx**
and REMOTE-SOFTWARE   Version: **05.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 2004/108/EC "Electromagnetic compatibility" and 2006/95/EC "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.

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1 General

The *hopf* Sync Module 8021GPS is a GPS Module for the reception and evaluation of GPS signals for high-precision signal generation and output of time information. In combination with other hardware output modules, rack vesions and power supplies the module can be "custom-tailored" set-up and used for various applications. The configuration of the GPS settings and the signal generation is made via the serial remote interface.

Some of the Sync Modules 8021GPS 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 optical coupler** on the front panel

- **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 XP, VISTA, Windows 7 operating systems

Accessories supplied:

- Serial programming cable KA6870 (2m, 9-pole socket to 9-pole socket) to connect to a PC.

As the Module 8021GPS is supplied in system build-ups, the build-up of the unit and the system-specific connections and signal outputs are documented in the accompanying manual.

> **i** Not all signal outputs parameterizable via the remote are always available as physical outputs for the different system variants.
>
> The available functions and their appropriate physical outputs are stated in device-specific manual.

2 Hardware

This chapter describes the connections and LED elements of the Sync Module 8021GPS.

2.1 Example: Front Panel for DIN Rail Mounting
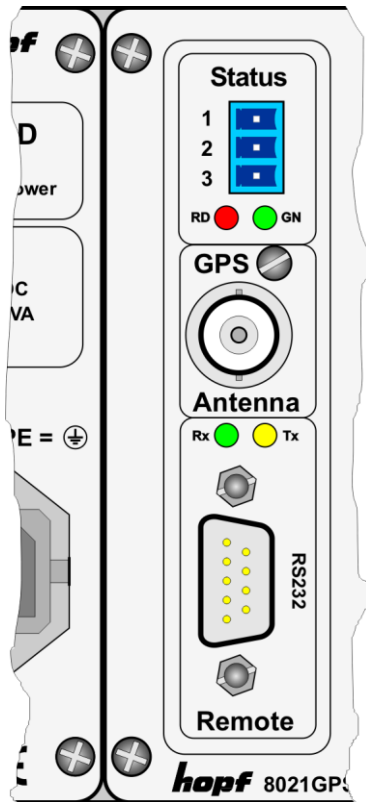
Status (LEDs + Optical Coupler)	
3-pole Connector	
Pin	**Signal**
1	Collector (+)
2	n.c.
3	Emitter (-)
LED	**Meaning**
RD	Status LED red
GN	Status LED green

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 Front Panel Connections

2.2.1 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".

2.2.2 Status LEDs

The status LEDs on the front panel signal the module'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	---

2.2.3 Status Optical Coupler

The status optical coupler provides a potential isolated switching contact for monitoring the modules synchronization status.

Function:

Status output via 3-pole terminal with selection of the desired synchronisation 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.

2.2.4 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 module is located on its front panel. 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.

2.3 Back-up Clock

The module 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.

2.4 Voltage Feed

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

2.5 Further Signal Outputs

Further available signal outputs of the respective system are stated in the accompanying manual of the specific-device.

3 Remote Software

This Chapter describes the operation and functionality of the remote software for the Sync Module 8021GPS.

3.1 General

The remote software is divided into various sectors and functionalities:

- Setting and status of **remote communication**

- **Info** – programme version / contact data for the *hopf* company /
  `Uninstall Program` button

- **Time** – time and status information and parameters for the calculation of time

- **GPS** – GPS display and parameters

- **Sync Status OC** – parameterization of the status optical coupler

- **DCF77 - 01** – parameterization of the output for a DCF77 pulse (1Hz)

- **IRIG-B - 01** – parameterization of the output for a IRIG-B signal

- **Cyclic Pulses - 01** – parameterization of the output for a cyclic pulse

- **Module Info** – base and configuration data of the Sync Module 8021GPS

- **RESET** and **DEFAULT** activation

3.2 Installation / Uninstallation

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

'Remote8021GPS_v0500.exe'.

3.2.1 Operating Systems

The remote software for the Sync Module 8021GPS is suitable for the following operating systems:

- **Windows XP**
- **Windows VISTA**
- **Windows 7**

3.2.2 Installation

It is *not necessary to install* the **'Remote8021GPS_v0500.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 tab.

The user must then delete the **'Remote8021GPS_v0500.exe'** programme manually.

3.3 Create Remote Connection

After a connection has been made via the serial programming cable KA6870 between the remote interface of the Sync Module 8021GPS 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 Sync Module 8021GPS. The status element changes colour dependent on the respective connection status.
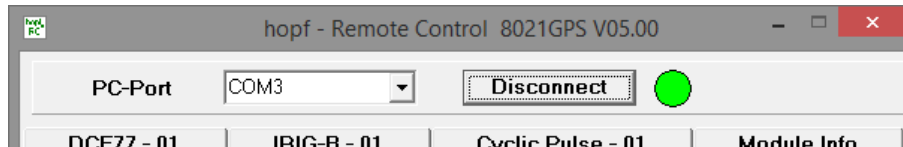
3.3.1 PC Port

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 Sync Module 8021GPS.

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 Sync Module 8021GPS (module has responded).

YELLOW   PC interface initialized but no response received from Sync Module 8021GPS.

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	⇨ Labeling 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.

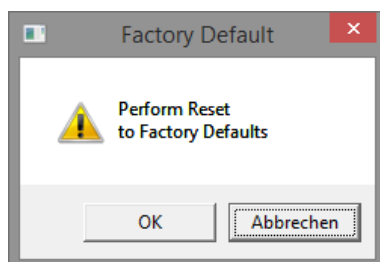#### 3.4.2.1 RESET Button
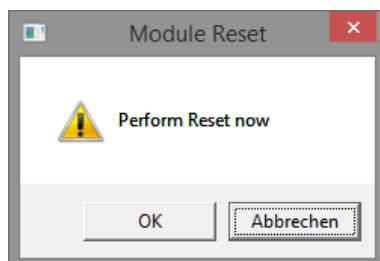
This button is used to trigger a hardware reset of the module. This leads to a defined restart of the modules microcontroller.

> **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 Sync Module 8021GPS are set to the following values:

1. **Deletion of the current leap second information**

2. **Time settings**

   - Difference time   = Not initially set by the user
   - Changeover points of time: = Not initially set by the user
   - SyncON / SyncOFF timeout   = **0000** / **0055** (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**

   - Synchronization status OK   = **SYNC**

5. **DCF77 - 01**

   - Time basis   = **Local**
   - Signal output for fault   = **2Hz pulse**
   - Minimum sysnchronisation status
     for a signal output   = **QUSE**
   - Value for a TimeOFF Timer   = **0**
   - Special Configuration S1-S8   = **All deactivated**

6. **IRIG-B - 01**

   - IRIG-B - Format   = **B007/B127 (Time / Year / Second of day)**
   - Time basis   = **Local**
   - Minimum sysnchronisation status
     for a signal output   = **QUSE**
   - Value for a TimeOFF Timer   = **0**
   - Special Configuration S1-S8   = **All deactivated**

7. **Cyclic Pulse - 01**

   - Interval for cyclic pulse   = **1 second**
   - Pulse duration   = **50msec**
   - Time basis   = **Local**
   - Minimum sysnchronisation status
     for a signal output   = **QUSE**
   - Value for a TimeOFF Timer   = **0**
   - Special Configuration S1-S8   = **All deactivated**

> After the module has been reset to the DEFAULT values, the GPS receiver requires after the initial setting of the difference time and the daylight saving changeover times up to 13 minutes of continuous satellite reception to determine the correct leap second information from the GPS data. The Module 8021GPS can only synchronize after this has been done.
>
> The following message appears on the error display during this period:
>
> **GPS-Receiver in raw data mode – no synchronization**

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 Sync Module 8021GPS by means of the `Refresh` button.

3.5 Info – Tab

The Info Tab is displayed directly after programme start-up. It contains:

- The current remote software programme information (version and date)
- The contact data for the *hopf* Company
- The Uninstall button `Uninstall Program`
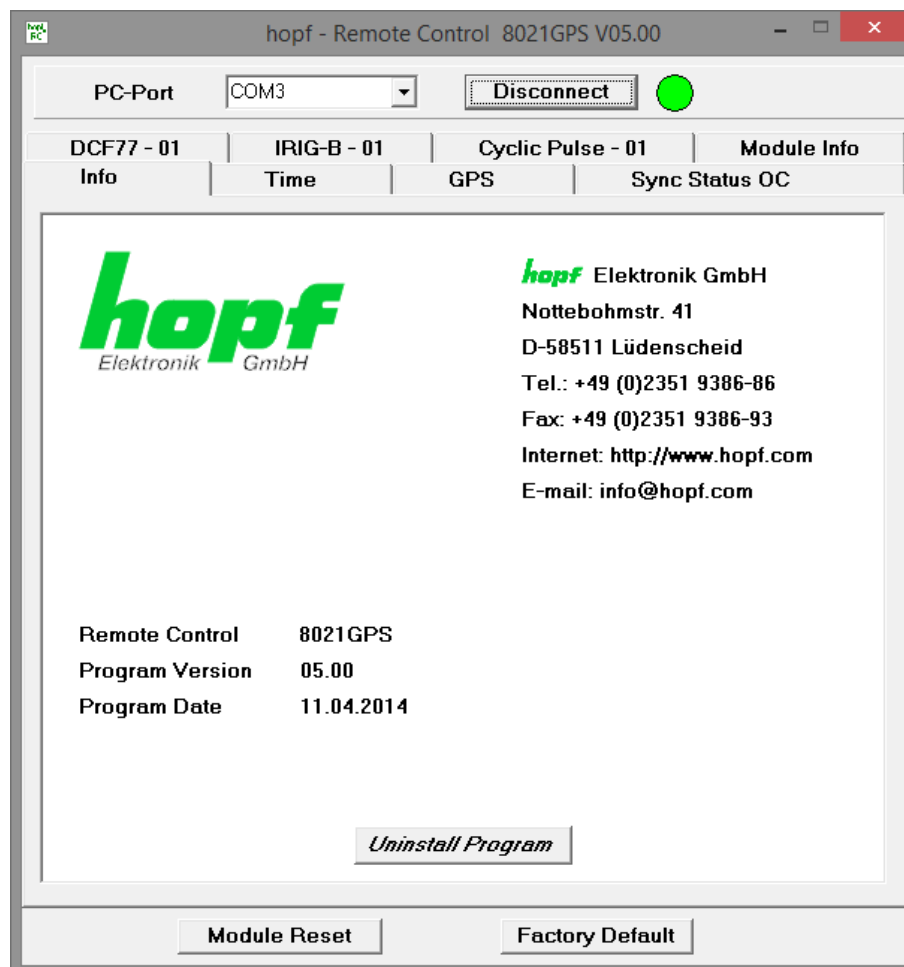
3.6 Time – Tab

All of the time and status information of the Sync Module 8021GPS is displayed or set in the Time tab.

3.6.1 Time

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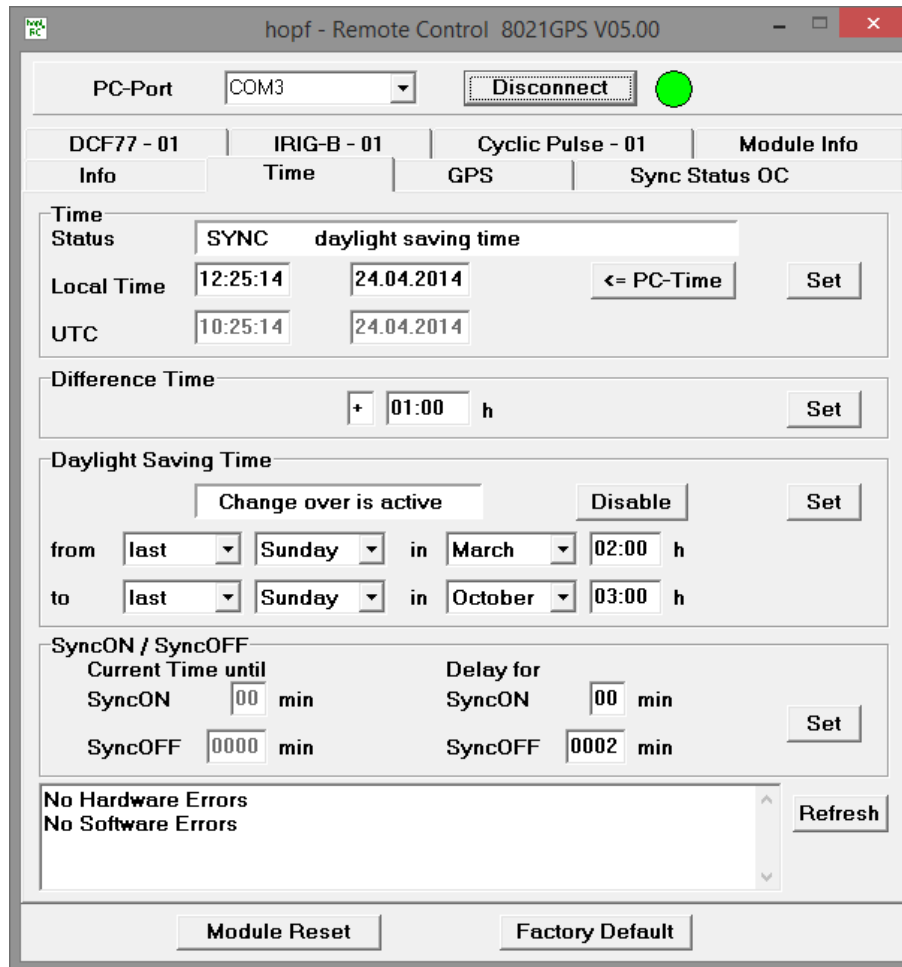
The <= PC-Time button can be used to set the new time information in accordance with the current PC time.

> A new date/time information can only be set if valid values for the difference time and the daylight saving time are stored (that means black text on white background).

Value range

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 defines the times of the on/off setting of the summer time during the course of the year, if wished. 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 last day-of-the-week 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 Timer) and from SYNC to QUARTZ (SyncOFF Timer).

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 (QUEX) is delayed by the set value. The system continues to run in synchronous status (SYOF) on the internally regulated, highly accurate quartz base during this period.

This setting depends primarily on the desired freewheel accuracy.

Example freewheel accuracy calculation

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 Sync Module 8021 GPS.

Value range

SyncON	00 ... 30 min
SyncOFF	0002 ... 1440 min

3.6.5 Error Status

The Sync Modul 8021GPS is capable of identifying various problems as they occur and transmitting a corresponding message. A distinction is made between software and hardware failures. A preliminary check can be made here by the user in the event of problems with the module or faulty synchronization.

Overview Software Errors

- **General Module error (PCID)**

    If this error occurs even after a Power down, the device is damaged.

- **GPS receiver initialization active**

    This condition might last for max. 1 minute after particular actions.

- **Missing data for Time Zone Offset**

    Difference time (Time Zone Offset) must be an initial entry by the user.

    Otherwise there is no synchronization of Module 8021GPS.

- **Missing or incomplete data for daylight saving time (DST)**

    The switchover times for summer/winter time must be initially set / disabled by the user.

    Otherwise there is no synchronization of Module 8021GPS.

- **SPIO setting error**

  If this error occurs even after a voltage reset, the support team of company *hopf* needs to be contacted for further actions.

Overview Hardware Errors

- **Adjustment of internal quartz frequency error**

  Problems with the internal quartz regulation of the Module 8021GPS have occurred. So the specified accuracy of the Sync Source cannot be guaranteed anymore.

- **Antenna circuit shorted**

  The Module 8021GPS has detected a short circuit in the antenna system. The antenna system should be checked.

- **Antenna circuit open**

  The Module 8021GPS has detected an open antenna input. The antenna system should be checked.

- **FRAM error**

  If this error occurs even after a voltage reset, the support team of company *hopf* needs to be contacted for further actions.

- **RTC error**

  If this error occurs even after a Power down, the internal backup clock is damaged. So there is no valid time information available after switching on the device or after a reset of the Module.

- **GPS receiver communication error**

  If this error occurs even after a Power-Reset, the support team of company *hopf* needs to be contacted for further actions.
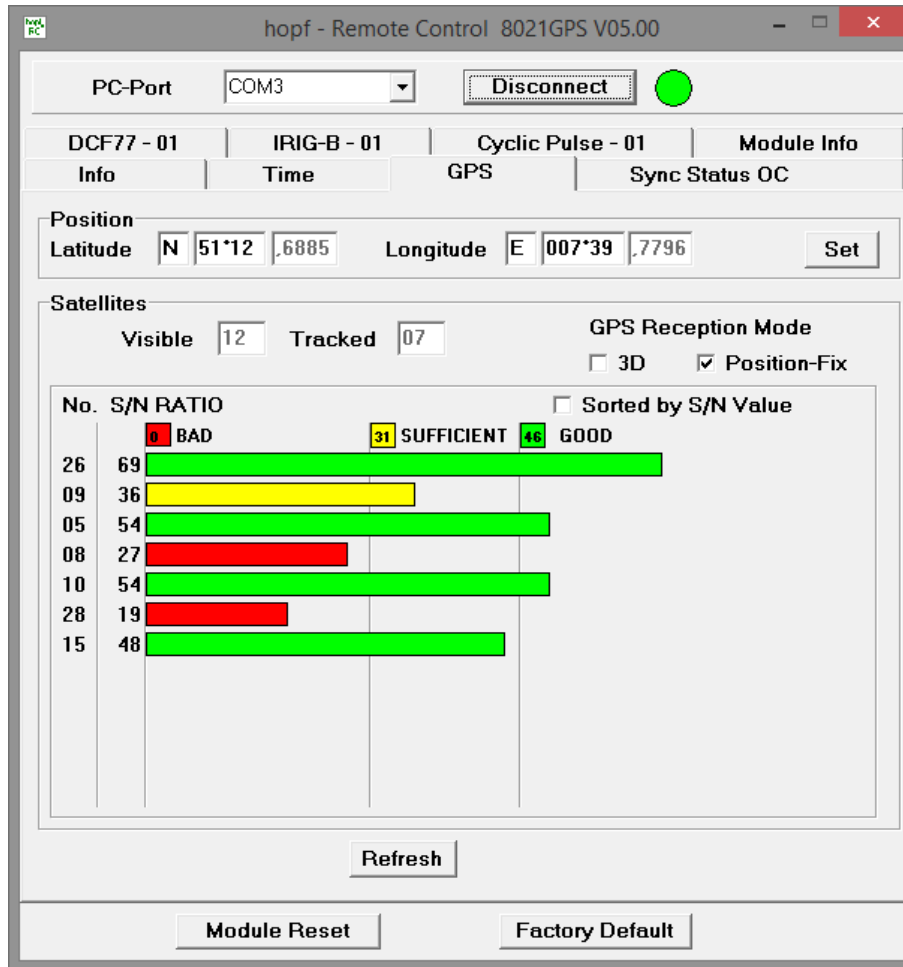
- **GPS receiver in raw data mode – no synchronization**

  If this condition is indicated, the GPS receiver requires special data from the GPS signal for which it needs up to 13 minutes signal reception of satellites. Only then the Module 8021GPS can be synchronized.

  This happens e.g. after resetting the Sync Source parameters to factory default values.

3.7   GPS – Tab

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

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 Latitude / Longitude:

Direction	W = West / E = East S = South / N = North
Degree of **Latitude**	00 ... 90 – **max. 90°00**
Degree of **Longitude**	00 ... 180 – **max. 180°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 Sync Status OC – Tab

The output of the sync status optical coupler (on the front panel of Sync Module 8021GPS) can be configured with the aid of this function.
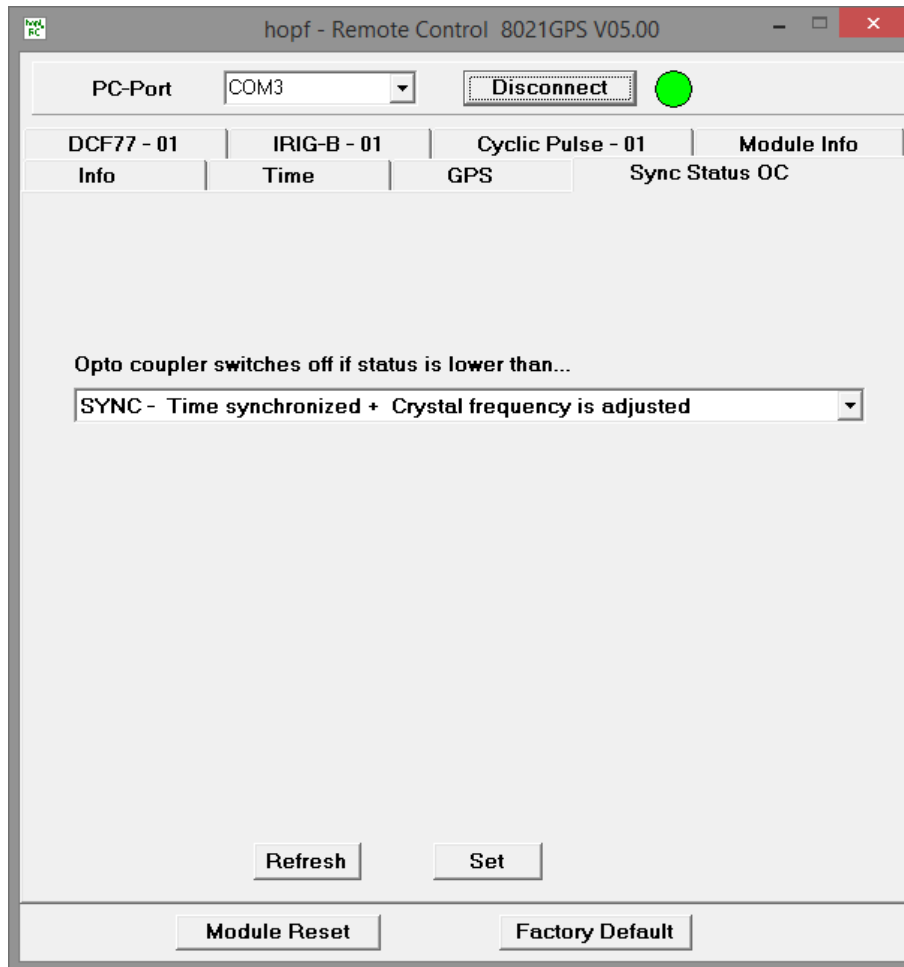
The time status are listed in this tab in rising quality from bottom to top.

Optical coupler:

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

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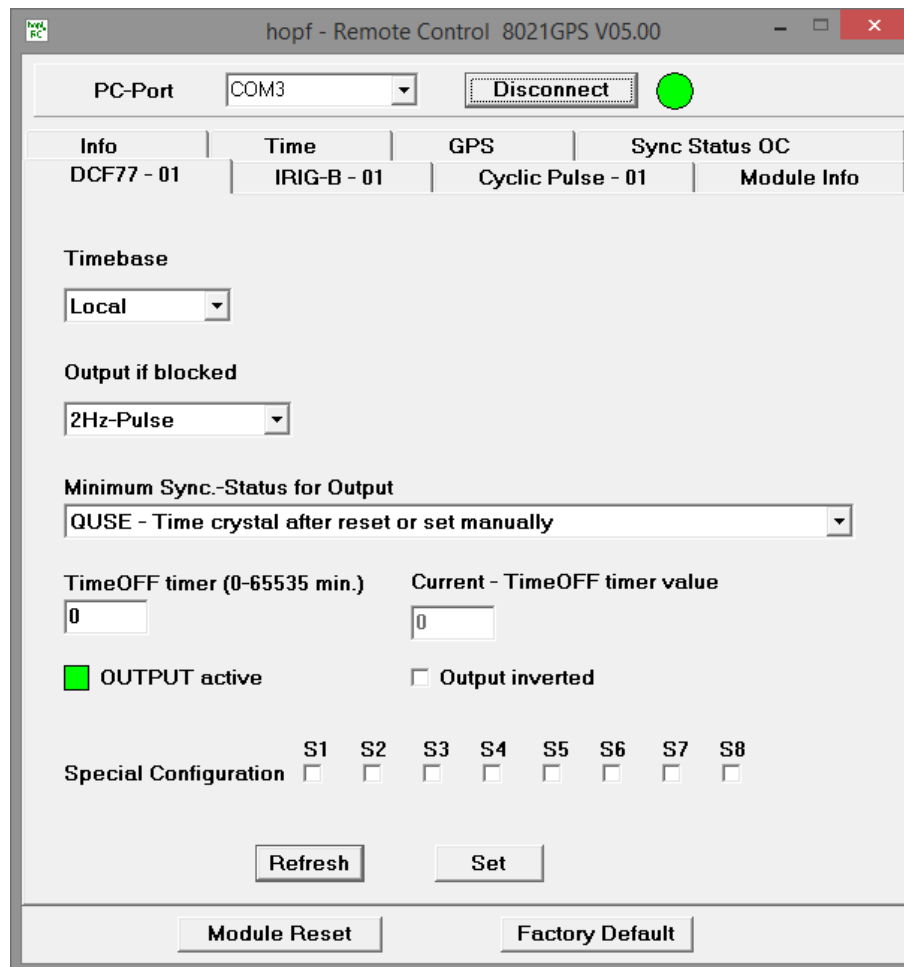
Optical Coupler Status	SYNC	Time synchronized + Quartz regulation started/running
	SYOF	Time synchronized + SyncOFF running
	SYSI	Time synchronized as simulation mode (without actual GPS reception)
	QUON	Quartz/Crystal time + SyncON running
	QUEX	Quartz/Crystal time (in freewheel after synchronization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

3.9 DCF77 - 01 – Tab

The signal generation for the output of a DCF77 pulse (1Hz) can be paramterized in this menue.

> **i** For the output of this signal an additional hardware (at system level) is required (see system manual if applicable).

3.9.1 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 shall be suppressed.

When setting standard time (winter time), the time offset to local summer time is minus 1 hour. Standard time runs continuously (without time leap) throughout the whole year.

When setting UTC, the world time (formerly GMT) is used as the time base. This time base also runs continuously (without time leap) throughout the whole year.

3.9.2 Output is blocked - Signal Output in the event of a Fault

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

Fault signal	**2 Hz Signal:** If the status of module 8021GPS is lower than the reference value, a 2Hz signal instead of the DCF77 pulse is provided.
	No signal If the status of module 8021GPS is lower than the reference value there is <u>no</u> signal output.

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

3.9.3 Minimum Sync.-Status - Status-Dependent Pulse Output

The signal output can be adjusted only to be generated when the Sync Module 8021GPS has reached a minimum synchronization status. As soon as this minimum synchronization status drops below this value during operation, the signal output stops unless the TimeOFF Timer has been set greater than 0. In this case the output is done for the duration of the TimeOFF Timer despite the minimum synchronization status for the output falls below the set value.

Range of Sync.-Status

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

<u>Value range TimeOFF timer = 0 to 65635min.</u>

3.9.4 Status of the Signal Output

The status of the output is stated via a display element with various colours and texts.

GREEN	OUTPUT active	–	There is a signal output
YELLOW	OUTPUT + TimeOFF active	–	Thre is a signal output for the duration of the TimeOFF Timer
RED	OUTPUT blocked	–	There is no signal output

3.9.5 Output inverted – Polarity of the output DCF77 Pulse

All outputs stated in the system manuals of the according devices are related to the DEFAULT setting: Output not inverted.

If nevertheless an inverting of the signal should be wished this can be reached by enabling this function.

3.9.6 Special Configuration

The system manual of the according device documents this setting, in so far it is used.
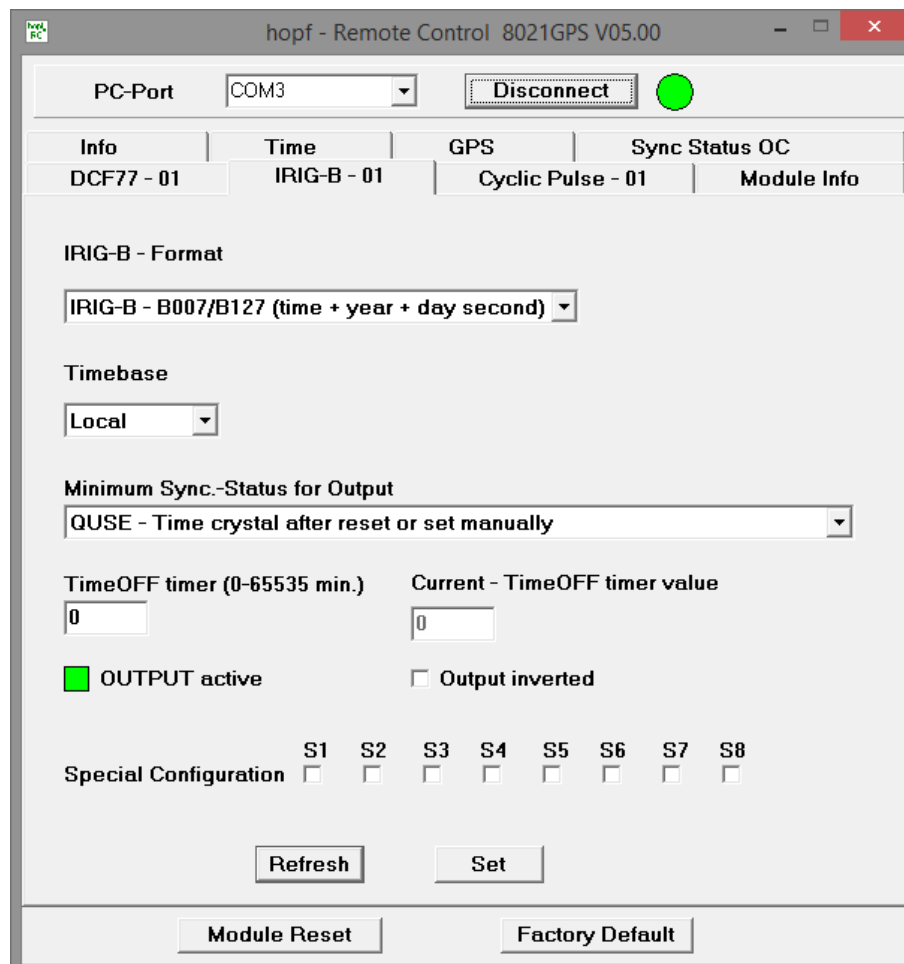
Otherwise for S1-S8 the DEFAULT-setting (all disabled) should not be changed due to compatibility reasons.

3.10 IRIG-B - 01 – Register

The signal generation for the output of an IRIG-B signal can be parameterized in this menue.

> **i** For the output of this signal an additional hardware (at system level) is required (see system manual if applicable).

3.10.1 Selection of the IRIG-B Format

There is a selection between different IRIG-B protocols for the output posible.

Following protocols are available:

Selection of Output Format IRIG-B / IEEE C37.118 / AFNOR
IRIG-B / B007+B127 (time, year, second of the day)
IRIG-B / B003+B123(time, second of the day)
IRIG-B / B006+B126 (time, year)
IRIG-B / B002+B122 (time)
IEEE C37.118 (previously IEEE 1344)
AFNOR NF S87-500

3.10.2 Timebase – Timebase of the output IRIG-B Signal

Timebase	Local (Local time)
	Standard (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 shall be suppressed.

When setting standard time (winter time), the time offset to local summer time is minus 1 hour. Standard time runs continuously (without time leap) throughout the whole year.

When setting UTC, the world time (formerly GMT) is used as the time base. This time base also runs continuously (without time leap) throughout the whole year.

3.10.3 Minimum Sync.-Status - Status-Dependent Pulse Output

The signal output can be adjusted only to be generated when the Sync Module 8021GPS has reached a minimum synchronization status. As soon as this minimum synchronization status drops below this value during operation, the signal output stops unless the TimeOFF Timer has been set greater than 0. In this case the output the output is done for the duration of the TimeOFF Timer despite the minimum synchronization status for the output falls below the set value.

Range of Sync.-Status

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

Value range TimeOFF timer = 0 to 65635min.

3.10.4 Status of the Signal Output

The status of the output is stated via a display element with various colours and texts.

GREEN	OUTPUT active	–	There is a signal output
YELLOW	OUTPUT + TimeOFF active	–	There is still a signal output for the duration of the TimeOFF Timer
RED	OUTPUT blocked	–	There is no signal output

3.10.5 Output inverted – Polarity of the output IRIG-B Signal

All outputs stated in the system manuals of the according devices are related to the DEFAULT setting: Output not inverted.

If nevertheless an inverting of the signal should be wished this can be reached by enabling this function.

> ⚠ This only applies to digital IRIG-B signals. Analog outputs are not affected by this and <u>cannot</u> be inverted.

3.10.6 Special Configuration

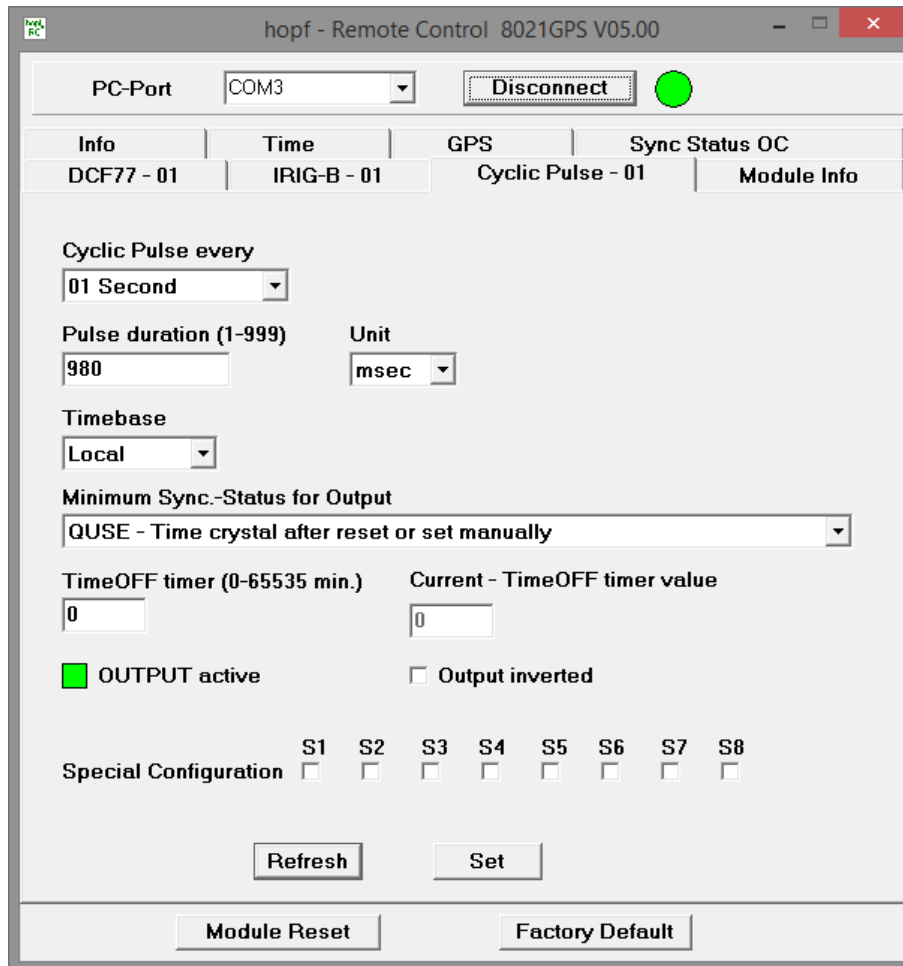The system manual of the according device documents this setting, in so far it is used.

Otherwise for S1-S8 the DEFAULT-setting (all disabled) should not be changed due to compatibility reasons.

3.11   Cyclic Pulse - 01 – Tab

The signal generation for the output of cyclic pulses can be paramaterized in this menue.

> **i** For the output of this signal an additional hardware (at system level) is required (see system manual if applicable).

3.11.1 Cyclic Pulse every

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 Pulse duration

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 <u>values</u> for the **pulse duration**:

- Minimum: 1
- Maximum: 999

Possible values (Unit) for the **pulse duration**:

- Second (sec)
- Millisecond (msec)

	After certain inputs automatic corrections of the inputs are made:
i	• Value > 999 are automatically corrected to 999.
	• The pulse lengths <u>must</u> be at least 20msec shorter that the pulse interval because otherwise the data are not adopted.

3.11.3 Time Base of the Transmitted Cyclic 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 shall be suppressed.

When setting standard time (winter time), the time offset to local summer time is minus 1 hour. Standard time runs continuously (without time leap) throughout the whole year.

When setting UTC, the world time (formerly GMT) is used as the time base. This time base also runs continuously (without time leap) throughout the whole year.

	The setting is required in case e.g. the day pulse should be given out that depends on the adjusted difference time and a potential summer time in the time zone at different times.
i	

3.11.4 Minimum Sync.-Status - Status-Dependent Pulse Output

The signal output can be adjusted only to be generated when the Sync Module 8021GPS has reached a minimum synchronization status. As soon as this minimum synchronization status drops below this value during operation, the signal output stops unless the TimeOFF Timer has been set greater than 0. In this case the output the output is done for the duration of the TimeOFF Timer despite the minimum synchronization status for the output falls below the set value.

Range of Sync.-Status

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

Value range TimeOFF timer = 0 to 65635min.

3.11.5 Status of the Signal Output

The status of the output is stated via a display element with various colours and texts.

GREEN	OUTPUT active	– There is a signal output
YELLOW	OUTPUT + TimeOFF active	– Thre is a signal output for the duration of the TimeOFF Timer
RED	OUTPUT blocked	– There is no signal output

3.11.6 Output inverted – Polariy of the output Cyclic Pulse

All outputs stated in the system manuals of the according devices are related to the DEFAULT setting: Output not inverted.

If nevertheless an inverting of the signal should be wished this can be reached by enabling this function.

> ⚠ This only applies to digital IRIG-B signals. Analog outputs are not affected by this and cannot be inverted.
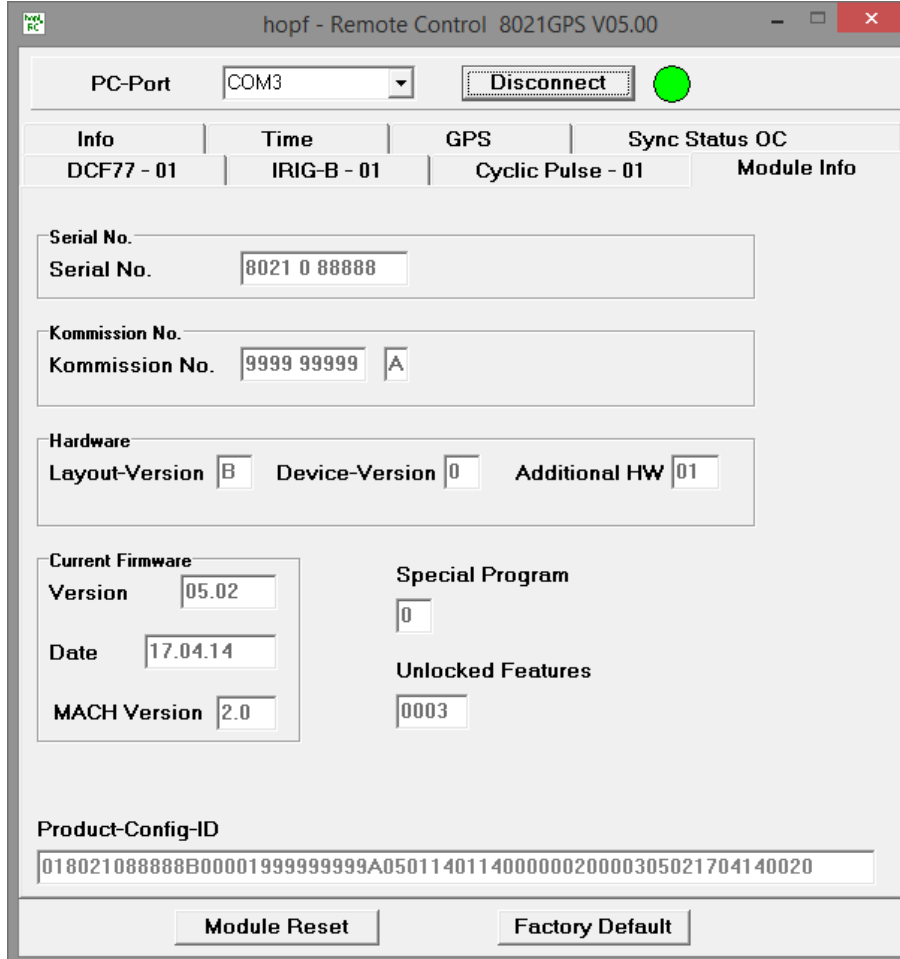
3.11.7 Special Configuration

The system manual of the according device documents this setting, in so far it is used.

Otherwise for S1-S8 the DEFAULT-setting (all disabled) should not be changed due to compatibility reasons.

3.12 Module Info – Tab

This tab contains the base information concerning the modules 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 Sync Module 8021GPS 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 tab in the remote software
- The status LED's on the front panel do not signal any **SY**xx status

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 indirect 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 in the GPS tab. 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 module is set to 3D reception mode.

Case 3:

Effect: 9 satellites in the range of visibility (**V=09**), 6 satellites appear in the GPS tab. The signal to noise ratios are all less than 30. The module 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
- The indirect lightning protector is faulty
- Faulty antenna

Case 4:

Effect: The module 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 GPS receiver on the Sync Module 8021GPS 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 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)

4.1.4 No ST/WT Changeover

Description

- "daylight saving time" (summer time) does not appear on the display
- The "daylight saving time" (summer time) is not set under status in the output protocol.

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 device

- Screenshot of the Module Info - tab and TIME - tab 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 module is generally maintenance-free. The following points should be noted if it is necessary to clean the module/device.

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

- Fluids
- Cleaning agents containing solvents
- Cleaning agents containing acids
- Abrasive media

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

To clean the system use a cloth that is:

- Antistatic
- Soft
- Non-fabric
- Damp

6   Technical Data

General Data – Module only	
Operation:	Via remote software
Protection Class:	IP00
Voltage Supply:	5V DC ± 5% (device internal)
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. 95%, not condensed

Accuracy	
Internal PPS pulse on GPS reception (after 30min. GPS reception):	< ± 100ns
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 (constant)

Module - Signal Outputs	
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, U_b = 5V DC • Antenna power fed via BNC socket of the module

Special production:

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

> 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.

<u>**Time calculation**</u>

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: March 2014) world time is running 16 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.

<u>**Advantages/Disadvantages GPS:**</u>

- **+** 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