Technical Description

GPS Satellite Controlled Clock
6875

Elektronik GmbH

Safety information

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

Safety of the Devices

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

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

Only trained personnel or specialists may operate the device.

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

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

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

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1 General information

The 6875 radio-controlled clock is a universal GPS reception module with a highly accurate time reference developed for controlling industrial processes. The 6875 snap-in module for 35mm (DIN) track mounting is fitted with three **PhotoMOS signal relays**, an analogue and digital TTL output and up to four independent serial interfaces.

The PhotoMOS signal relay outputs can be used, for example, for the SPS or measuring process control. Following output modes are available:

- DCF77 pulse
- System status (radio-controlled or quartz)
- Status of the power supply on/off
- Cyclical pulses
- Non-cyclical pulses (1 pulse per day at a defined time, 1 pulse per year at a defined time and on a defined date)

The analogue output can be used to synchronize **DCF77** or **IRIG-B** systems.

The serial interfaces **COM0...COM3** are used for the output of different pulses and data strings. Each interface can be configured with *hopf* remote software.

The 6875 snap-in module has further features:

- Potential-free antenna circuit
- All outputs potential-free
- All settings can be parameterterd via the **COM0** serial interface
- **COM1** interface can be switched from RS232 to RS422 via configuration software
- switchable analogue output **IRIG-B / DCF77**

The following versions of the system are available (indicated on the identification label):

- FG6875G00 (GPS 6875 snap-in module basic version) with
    - 3 PhotoMOS pulse outputs
    - serial interface COM0: RS232
    - serial interface COM1: RS232/RS422
    - simulation output for DCF77 antenna simulation or IRIG-B 12x (x=0..3)
    - programming cable, remote software and technical documentation included
- FG6875G01 (6875 snap-in module) with
    - GPS 6875 snap-in module basic version FG6875G00
    - Serial interface COM2: optical output
- FG6875G02 (6875 snap-in module) with
    - GPS 6875 snap-in module basic version FG6875G00
    - Serial interface COM2: optical output
    - Serial interface COM3: optical output
- FG6875G03 (6875 snap-in module) with
    - GPS 6875 snap-in module basic version 6875
    - Serial interface COM2: optical output
    - Serial interface COM2: optical input

The configuration software on the CD supplied is available for the most common MS Windows, Linux and Sun Solaris operating systems (for more details see 4.1).

2 Quick installation

Synchronization is accelerated by initialising the GPS 6875 satellite clock when first putting into operation. It is not absolutely necessary to enter set-up values. However, without initialisation it may be several hours before the first signals are received.

For quick installation it is necessary to set the following set-up values in the GPS 6875 satellite controlled clock:

- Earth the device
- Connect the antenna
- Create communication between the PC and the remote-controlled clock
- Connect the power supply
- Install and start the remote software
- Set the current local time
- Ser the local time difference to UTC (local time - UTC)
- Set changeover dates
- Set the position data of the location; if this is not known then set an approximate value or set everything to zero
- Activate the reset of the clock after the next minute change
- Wait approx. 10 minutes to 4 hours before synchronizing the radio-controlled clock

The individual menu items of the programme are explained on the following pages.

3 Hardware

3.1 Front panel components

Connector X1	2 x 4 pole plug-in connectors (female) with codeable profile and threaded flange (corresponding connector (male) is included)
+Vin	Connection for positive potential of the power supply
–Vin	Connection for negative potential of the power supply
+OC3, +OC2, +OC1	PhotoMOS signal relay connection for positive voltage potential (Drain)
–OC3, –OC2, –OC1	PhotoMOS signal relay connection for negative voltage potential (Source)

Connector X2	9 pole SUB-D connector		
Pin No.:	Function		
1, 5	GND		
4	Digital output, TTL		
	COM0	**RS232**	
2	Receiving line	(RxD0)	
3	Transmission line	(TxD0)	
	COM1	**RS232**	**RS422**
6	Transmission line	TxD1	+TxD1[1]
7	Transmission line		–TxD1[2]
8	Receiving line	RxD1	–RxD1[2]
9	Receiving line		+RxD1[1]
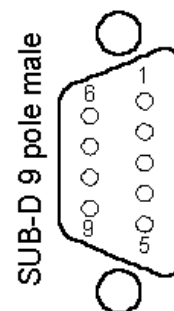
[1] high active
[2] low active

LED / Key	Function
CLK	**green**, indicates the synchronization status of the clock
C1-C3	**yellow**, indicates the switch status of the corresponding PhotoMOS signal relay
DEF key	(**DEF**)ault key for restoring the standard configuration

BNC connectors	
IRIG-B / DCF77-Out	analogue output for the output of the modulated **IRIG-B** or **DCF77** signal (BNC female connector)
GPS-In	input for **GPS** antenna (BNC connector)

Option	optical interfaces **COM2, COM3** (ST connection: bayonet)
FL 1	optical transmitter for serial interface COM2
FL 2	optical transmitter COM3 / optical receiver for serial interface COM2

3.2 Installation

3.2.1 Power supply

The power supply is connected via the 2 x 4-pole connectors, as supplied, with threaded flange, connections +**Vin** und -**Vin** on the connecting unit X1. The system is provided with a voltage of **18...72 VDC**..

The internal voltage supply of the 6875 snap-in module is potential-free. It must be earthed on the rear side of the housing via the screw as labelled, in order to compensate the potential difference between the ground potential of the housing and the earth.

Please Note:	ALTHOUGH THERE IS INTERNAL PROTECTION AGAINST WRONG POLING, ATTENTION MUST BE PAID TO THE CORRECT VOTLAGE AND POLARITY WHEN CONNECTING THE POWER. ONLY QUALIFIED STAFF SHOULD FIRST PUT THE EQUIPMENT INTO OPERATION.

3.2.2 Connecting the antenna

The antenna is connected via the *hopf* antenna cable to the **GPS-In** BNC connector (more information in the GPS appendix).

3.2.3 Installation of the configuration software

see 4.2.

3.3 Technical Data

General

Snap-in module dimensions of housing	width: 65 mm, height: 105 mm, depth: 130 mm
max. outer dimensions	width: 65 mm, height: 105 mm, depth: 155 mm

Power supply   min. 18 to max. 72 VDC

Output isolation	500V DC
typical / max. performance	3,5 VA / 4 VA
Temperature range	0...+ 50 °C with improved free wheeling characteristics
	0...+ 70 °C with restricted free wheeling characteristics
MTBF	> 295.000 hrs.

Accuracy (GPS Model)

PPS pulse (internal)	± 300 nsec
VCO control (internal time base)	± 0,1 ppm, after approx. ½ hr. continuous GPS reception
Free wheeling characteristics	± 0,05 ppm, after VCO control at a constant temperature +10...+50 °C
PPS drift depending on changes in power supply in free wheeling status	± 0,0002 ppm/V
PPS drift depending on changes in temperature in free wheeling status	± 0,16 ppm/°C, at constant Uin=24V and temperature radient of approx. 1,5°C/min

Accuracy (quartz model)

Free wheeling characteristics	± 0,5 ppm, after factory setting of VCO control at a constant temperature of +20°C
Drift	max. ±4 ppm/Year

Backup Clock

Accuracy	± 25 ppm from +10°C to +50°C
Backup (maintenance free)	min. 3 / typ. 10 / max. 15 days

Optical coupler

max. performance, capacity in Ohms	60V DC / 200 mA
Switch on/off delay	130 / 70 μsec. at 10 mA switch mode power supply
Output isolation	500V DC

DCF77 pulse   output at **COM1**,COM2 (**FL1**), COM3 (**FL2**), **TTL** (X2)

accuracy	same as internal PPS pulse
signal level	depending on output interface

DCF77 simulation output   output at BNC (IRIG-B / DCF77-Out)

accuracy	same as internal PPS pulse
carrier signal frequency	77.5 kHz ± 25 ppm
signal level	3...5 mV$_{pp}$ at 50 Ohm

Info: The IRIG-B Output is done by the **IRIG Standard 200-04**!

IRIG Time Code (digital)	output at **COM1**,**COM2** (FL1), COM3 (**FL2**), **TTL** (X2)
accuracy	same as internal PPS pulse
signal level	depending on output interface
IRIG Time Code Format	IRIG-B - B002 / B003 / B006 / B007, IEEE1344, AFNOR NFS 87-500
IRIG Time Code (analogue)	output at BNC (**IRIG-B / DCF77-Out**)
accuracy	same as internal PPS pulse
carrier signal jitter (1kHz)	± 2 µsec
signal level	ca. 2 V_{pp} (± 10%) at 50 Ohm
	ca. 2 V_{pp} (± 10%) at 600 Ohm
modulation ratio	3 : 1
IRIG Time Code Format	IRIG-B – B122 / B123 / B126 / B127, IEEE1344, AFNOR NFS 87-500
Interfaces: COM0, COM1	asynchronous, without handshake
Baud rate	300 - 19.200 Baud
Stop bit	1 / 2 bit
Word length	7 / 8 bit
Parity	no, even or odd
Line length	The line lengths depend on the type of line and the setting of the Baud rate.
Option:	optical interface, λ = 820 nm
Interfaces: COM2, COM3	asynchronous, without handshake, optical
Baud rate	300 - 19.200 Baud
Stop bit	1 / 2 bit
Word length	7 / 8 bit
Parity	no, even or odd
Optical transmitter: COM2 (FL 1), COM3 (FL 2)	Connection: ST series (bayonet)
Optical receiver: COM2 (FL 1)	
Wave length	λ = 820 nm
Cable types supported (multi-mode)	50/125 µm, 62.5/125 µm, 100/140 µm or 200 µm HCS ® fibre
GPS receiver	8 canal, C/A Code, code plus carrier tracking
Log-in sensitivity	-134 dBm
Log-out sensitivity	-143 dBm
Frequency range	L1 = 1575,42 MHz
Recording time	
Warm start	< 1 min. (backup max. 3 days)
Cold start	30 min. - 4 hrs. (1st installation without definition of position)
Accuracy	± 300 nsec
Temperature range	0...+ 60 °C

Additional components: see GPS accessories

Please Note:	SUBJECT TO ERRORS AND TECHNICAL MODIFICATIONS

4 Software

4.1 System requirements

The *hopf* 6875 configuration software is for configuration of a *hopf* 6875 radio-controlled clock via a serial interface. The serial interface cable included is connected between the computer (at the free serial interface) and the radio-controlled clock (**COM0**).

Depending on the platform the following system requirements are necessary for the remote software and/or the installation programme:

Windows

- Windows 95, 98, ME, NT, 2000, XP
- min. 32 MB RAM (128 MB recommended)
- min. 40 MB free hard disk memory
- screen resolution min. 640x480 (1024x768 recommended)

Linux

- RedHat 7.1, SuSE 7.2 or Debian 2.2R3
- glibc 2.x
- libstdc++-libc6.1-1.so.2
- X-Windows
- min. 32 MB RAM (128 MB recommended)
- min. 110 MB free hard disk memory
- screen resolution min. 640x480 (1024x768 recommended)

Solaris SPARC

- Solaris 8
- X-Windows
- min. 32 MB RAM (128 MB recommended)
- min. 75 MB free hard disk memory
- screen resolution min. 640x480 (1024x768 recommended)

Solaris x86

- Solaris (x86) 8
- X-Windows
- min. 32 MB RAM (128 MB recommended)
- min. 75 MB free hard disk memory
- screen resolution min. 640x480 (1024x768 recommended)

> **Please Note:** FOR PROBLEM-FREE EXECUTION THE INSTALLER AND/OR THE CONFIGURATION SOFTWARE REQUIRE ADMINISTRATOR OR ROOT RIGHTS FOR THE CORRESPONDING INTERFACE DEVICE.

4.2 *Installation of the remote software*

To install the remote software the installation programme/script must be started. This requires a graphic user interface:

Windows
6875_v01_03_Win32_install.exe

Linux
6875_v01_03_Linux_install.bin

Solaris SPARC
6875_v01_03_Solaris_SPARC_install.bin

Solaris x86
6875_v01_03_Solaris_x86_install.bin

Follow the instructions in the installation programme to complete the installation.

4.2.1 *Uninstalling the remote software*

Windows

The application can be uninstalled via system control:

- Start menu ⇨ Set-up ⇨ System control ⇨ Select software

- Select remote software and click add/remove ⇨ Uninstall-programme starts

- Follow the instructions in the uninstall-programme

Unix Platforms

The application can be removed via the uninstall-programme supplied (Uninstall6875) which is found in the corresponding subdirectory *UninstallerData*
(e.g. */opt/Hopf/6875/UninstallerData/Uninstall6875*).

4.2.2 *Start programme*

Windows

After installation has been completed in the chosen directory (e.g. C:\rogramme\Hopf\6875) the configuration software can be started by selecting the appropriate link (e.g. Start ⇨ Programme ⇨ Hopf ⇨ Hopf 6875).

Unix Platforms

After completing installation into the chosen directory (e.g. */opt/Hopf/6875*) the configuration software can be started via Startscript (*Hopf6875*) which can be found in the *bin*-directory (e.g. */opt/Hopf/6875/bin/Hopf6875*).

> **Please Note:** SINCE THE VALUES SHOWN ARE CONSTANTLY UPDATED, DELAYED REACTION TIMES IN THE INPUT FIELDS WITH MOUSE OR KEYBOARD ENTRIES ARE POSSIBLE WITH LESS POWERFUL SYSTEMS.

4.2.3 *Trouble shooting*

- If there is an initialisation error when the configuration software is started then the serial interface is either incorrectly configured or is being used by another programme.

- If a communication error arises during the execution of the configuration software, then the radio- controlled clock is incorrectly connected or another instrument is connected to the interface selected.

- If another programme is using the same serial interface as the configuration software (e.g. an NTP service), then this must be ended to ensure that the configuration software functions correctly.

- If the monitor resolution is low or some fonts are missing there may be slight distortion in the script of the configuration software. This does not however affect the functions.

- If during installation a JAVA VM version is selected which is already installed, then care must be taken that the minimum version is Java2 1.3. Usually we advise using or installing JAVA-Runtime as supplied.

- Information about possible errors specific to operating systems can be found in the corresponding readme-file as supplied.

If there are any questions or installation problems please contact the support team at Ruprecht & Partner OEG under the e-mail address: support-hopf@rdcs.at

Updated versions can be found on the website of Ruprecht & Partner OEG: http://www.rdcs.at/

4.3 Functions of the configuration software

4.3.1 General

The *hopf* 6875 configuration software is for convenient configuration of a *hopf* radio-controlled clock 6875 via an RS232 interface. All the parameters of the radio-controlled clock can be displayed or set via a graphic user interface. These are divided into categories (e.g. time zone, changeover time, serial parameters, etc.). Each of these categories is illustrated on a tab in the upper section of the window.

A click of the mouse activates a tab – the window with the corresponding details is switched up. This is divided into two areas: the current values and the values to be set. When a tab is selected, the current values of the radio-controlled clock are requested and displayed. In this case the values to be set correspond to the current values and can be changed by clicking the corresponding arrow fields or by manual input.

Activating the button "**SEND**" transmits the values to be set to the radio-controlled clock. If an error occurs a message is emitted, otherwise the current values are updated.

The software can be ended by activating the button "**END**".

4.3.2 Selecting the serial interface

The serial interface to which the radio-controlled clock is connected can only be selected when the programme is started.

Depending on the PC or operating system it may take some time to set up the selection window.
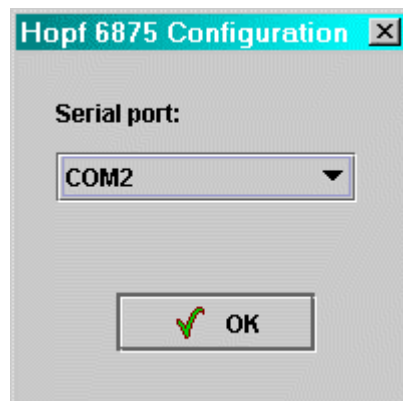
After selecting the appropriate interface the *hopf* 6875 configuration software will try to connect to the radio-controlled clock. If no connection can be made a corresponding message will appear. In this case please check that the cable is correct and/or that the cable is connected to the correct interfaces.

A new attempt to make a connection on the same interface can be made by selecting any other tab. If this is to be tried on another interface then the programme must be ended and re-started.

4.3.3 Changing the language

The language used in the software can be changed during operation by selecting the desired language in the selection menu on the left hand side of the window. This takes effect immediately after closing the selection window (perhaps with a slight delay, depending on the type of PC).

4.3.4 Information

In this section information about the software or contacts can be found in the info dialogue which is activated by clicking on the info button (on the right next to the button "help").
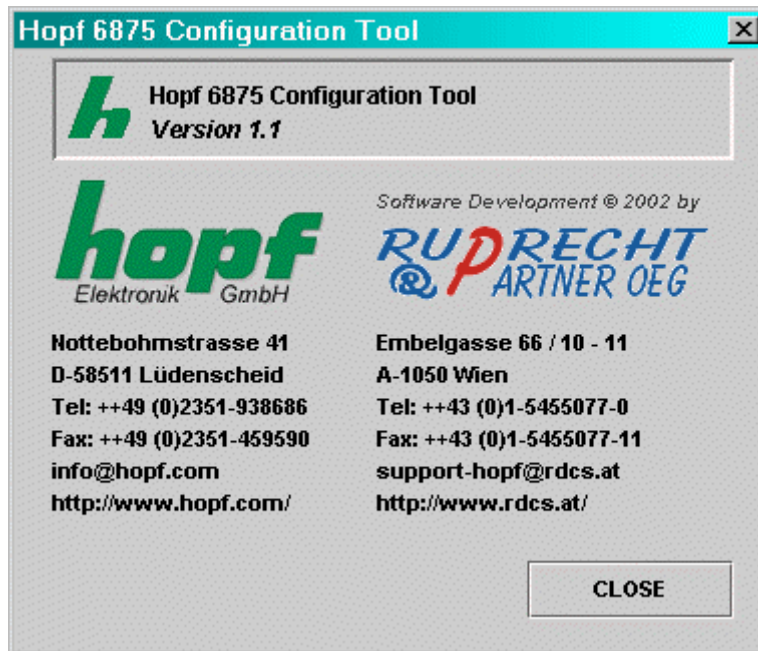
4.3.5 Extras

This section makes it possible to save a complete configuration of a radio-controlled clock in a configuration file (text file) or to load down from a configuration file and transmit to the radio-controlled clock.
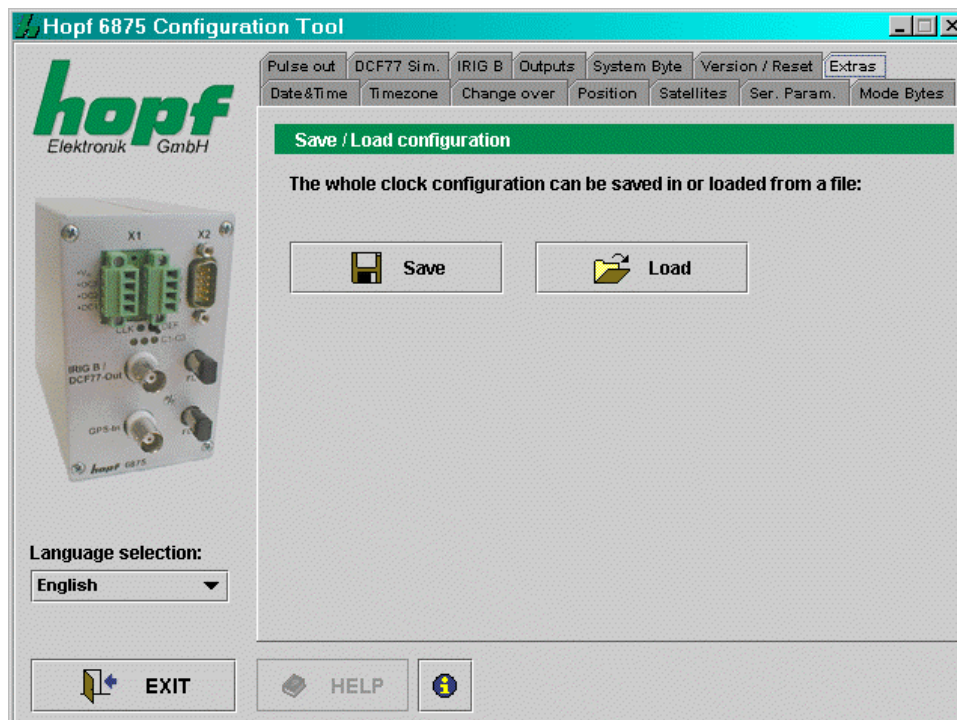
SAVE (IN A FILE)

Selecting the button "SAVE" opens a dialogue which enables selection of a target directory or indication of a file name. After the target directory or a file name has been defined the current configuration of the radio-controlled clock can be saved by selecting the button "SAVE". As soon as "SAVE" has finished, a confirmation dialogue appears which reports either success or error.

LAODING (FROM A FILE)

If a configuration is to be loaded which is already available or has already been saved then the button "LOAD" should be clicked. A dialogue appears in which the file to be loaded is selected. After selecting the file and confirming this with the button "OPEN" the following dialogue appears:

[LOAD DIALOGUE]

This dialogue shows in a well-structured form all the configuration data in the file which has been loaded. The left column contains the definition of the value, the middle column the actual value and the right column the status. If the status is "OK" (green), then this value is available – if not, then the status of this value is "ERROR" (red). If at least one value has the status "ERROR", the configuration cannot be transmitted to the radio-controlled clock. Otherwise the configuration shown can be transmitted to the radio-controlled clock by activating the button "SEND". This procedure can take some time and is confirmed after completion with a success or error message. The dialogue can be ended by selecting the button "CLOSE":

The button **"HELP"** is for activating online help – this contains all the information contained in this document and additional general information about GPS.

4.3.6 Date & Time

This section makes it possible to display and/or change values relating to date and time.
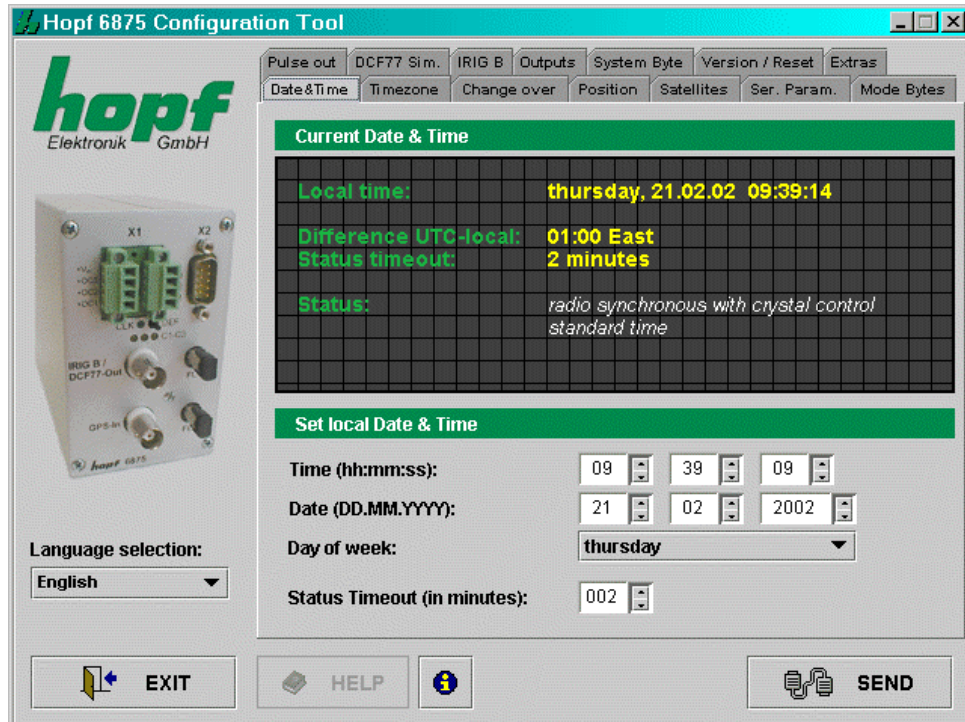
The following values are displayed or can be configured:

Day of the week, date, time:

Setting the day of the week, the date and the time is only necessary when commissioning the radio-controlled clock. In this case the configuration software checks the plausibility of the time and date values entered. Before transmission of the time to the radio-controlled clock the correct day of the week for the date entered is checked – if the day of the week entered differs from that which is calculated then a corresponding message will appear.

Time difference:

Shows the actual time difference between local time and UTC in hours and minutes.

In this section the value is for information purposes only and can only be changed in the section "Time Zone" (4.3.7).

Status Timeout:

Shows the time delay in minutes until the resetting of the radio-controlled bit in the time status. This value can be between 2 and 255 minutes.

<u>*Status:*</u>

Is made up of: s*ynchronization status* (e.g. quartz mode, radio-controlled mode, etc.) and actual *time status* (e.g. daylight saving, standard time, announcement of changeover etc.). It is for information purposes only and cannot be changed.

Synchronization status of the radio-controlled clock:

- invalid time of day
- quartz mode
- radio-controlled mode (without quartz frequency control)
- radio-controlled mode (with high accuracy / with quartz frequency control)

Time status for local time of day:

- standard time
- daylight saving time
- announcement of changeover
- announcement of leap second

4.3.7 *Time Zone*

In this section the time zone for the location of the radio-controlled clock can be displayed and adjusted. Setting the time difference is only necessary when commissioning.
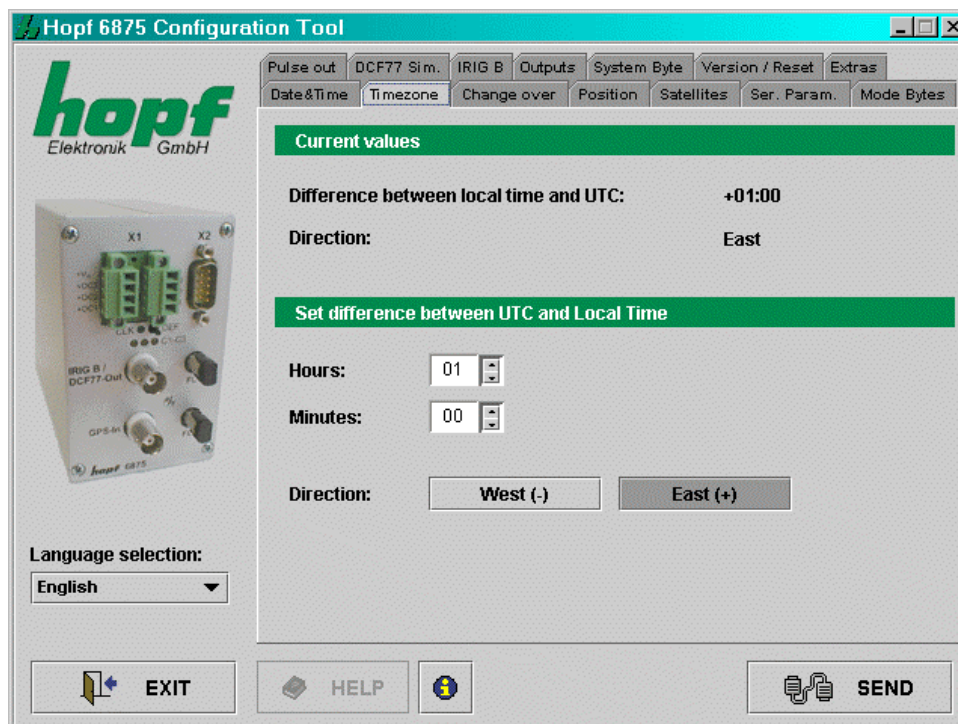
The time difference (country- or location- specific time offset to UTC, difference between local time and UTC) is made up of the following information:

Hour, minute and the information as to whether the location is west or east of the 0 meridian (Greenwich).

The configuration software checks the plausibility of the values entered.

Example:	**West (-)**	**08:00**	**USA and Canada (Pacific Time)**
	East (+)	**01:00**	**Germany**

4.3.8 *Changeover time/changeover point*

In this section the daylight saving/standard and standard/daylight saving changeover times can be displayed and changed.
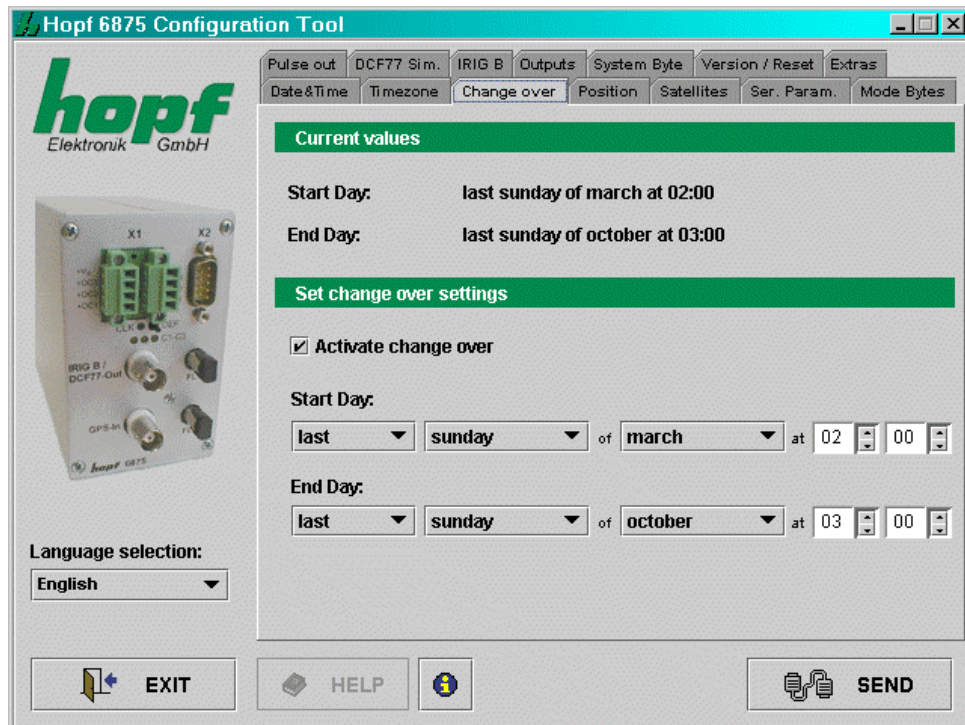
In order to set the changeover times the changeover function must first be activated. If no changeover is required this must be deactivated ⇨ time of day (local time) then runs in standard time status.

To set the changeover times the following information is required:

- *first, second, third, fourth or last day of the week in the month*
- *day of the week*
- *month*
- *time in hours and minutes*

4.3.9 *Position*

This section enables the display and setting of the geographical position of the radio-controlled clock.
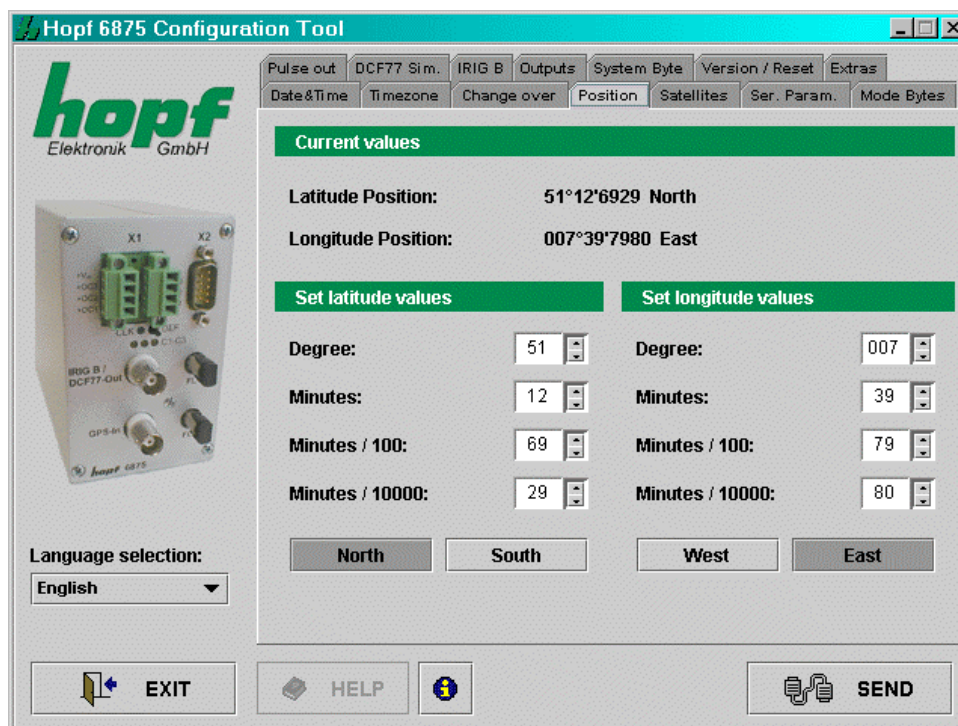
Setting the approximate location position (if known) shortens the time required for first initialisation of the GPS receiver in the radio-controlled clock.

The entries of latitude and longitude are in degrees, minutes, 1/100 und 1/10000 minutes and the following additional information concerning the geographical location:

Entry for latitude:

North	= northern hemisphere		
South	= southern hemisphere	*Example:*	**North 51°12,3651**

Entry for longitude:

East	= east of Greenwich meridian		
West	= west of Greenwich meridian	*Example:*	**East 007°37,8426**

For accelerated synchronization the GPS radio-controlled clock requires only the entry of the approximate location. For the exact position shown in the above example the following entry would suffice:

North   **50°00,0000**
East   **007°00,0000**

4.3.10 *Satellites*

This function enables display of the current satellite receiver quality as well as the configuration of the GPS reception mode. The following values (updated periodically) are shown:

- number of satellites visible at the given time
- reception quality as **S/N Ratio** (signal to noise ratio) for individual satellites
- evaluation mode for GPS satellite reception
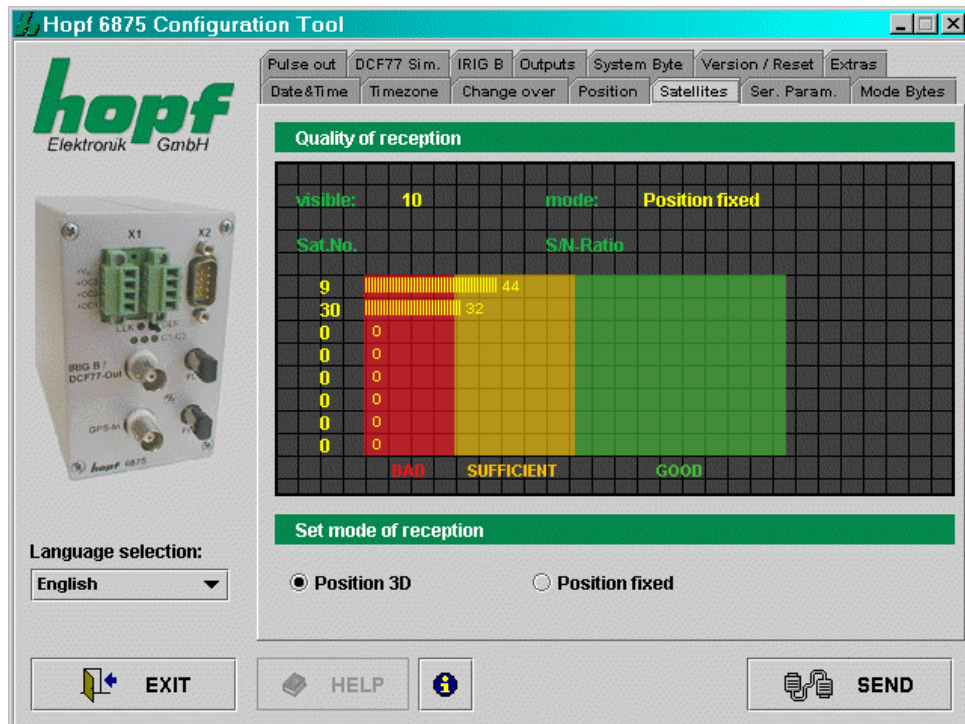
The GPS reception mode can be set to **3D** or *Position fixed.*

The accuracy of the time is determined by the accuracy of the calculation of the position of implementation of the clock. For this calculation reception from at least 4 satellites is necessary (GPS reception mode **3D**).

In the GPS reception mode *Position fixed* the accuracy depends considerably on the exact entry of the location of implementation. When entering the position up to ± 1 minute, the accuracy of the second mark is already better than ± 20 μsec.

Position fixed has the advantage that the GPS radio-controlled clock can be synchronized with one satellite only. The antenna can also be installed in locations where less than a quarter of the sky is visible. In many cases it is possible to mount the antenna indoors near the window (short cable lengths, no lightning protection).

If, in this mode, 4 satellites are available the evaluation jumps automatically to GPS reception mode **3D** and calculates the exact position.

4.3.11 System Byte

This section permits the configuration of additional internal system functions. These are activated and deactivated by the setting and resetting of a bit.
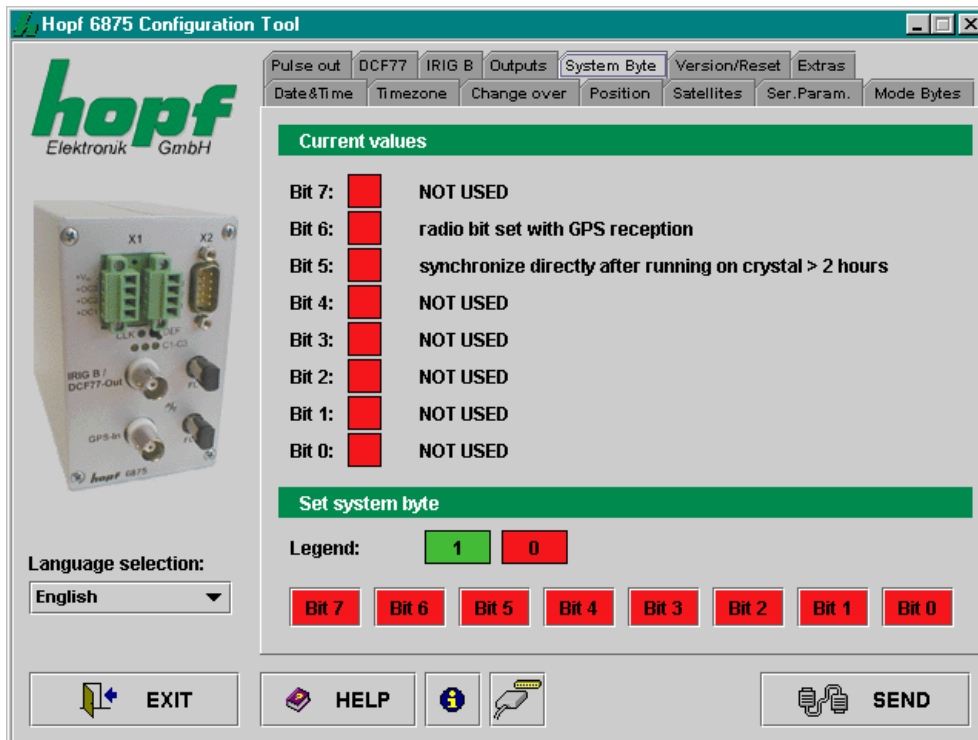
Each bit has two possible statuses: **IN (1)** and **OUT (0)**.

Default system byte configuration: Bit No.: 0 ... 7 = **OUT (0)**.

Bit No.:	IN (1)	OUT (0)
7	unassigned	unassigned
6	Permanent simulation of the time status "**radio synchronous** ..." even without valid GPS reception	Time status "**radio synchronous** ..." only set in case of valid GPS reception
5	direct synchronisation of the second and the millisecond with the exact GPS second mark (*)	direct synchronisation of the second and the millisecond with the exact GPS second mark only after 2 hours (*)
4	unassigned	unassigned
3	unassigned	unassigned
2	unassigned	unassigned
1	unassigned	unassigned
0	unassigned	unassigned

(*) Explanation referring to the function in system byte Bit-No.: 5:

- **Bit-No.: 5 = OUT (0):**

    - Crystal operation < 2 hours ⇨

      The internal second and millisecond mark are slowly adjusted to the GPS second mark after the GPS resynchronisation (without leap).

    - Crystal operation > 2 hours ⇨

      The internal second and millisecond mark are directly set to the GPS second mark after the GPS resynchronisation (leap of the internal second mark).

- **Bit-No.: 5 = IN (1):**

    - Crystal operation ⇨

      The internal second and millisecond mark are directly set to the GPS second mark after the GPS resynchronisation (leap of the internal second mark).

    - When **"Output in crystal operation is locked"** is activated, the signal output of **"IMP 1"** and **"IMP 2"** (see chapter **optical coupler**) will be carried out at the time status **"radio synchronous with crystal regulation"**. Depending on the accuracy demands for the application, the pulse output of the drifting pulses (based on the fluctuant environmental conditions, like e.g. temperature) will be locked or rather disconnected, if the GPS synchronisation fails.

4.3.12 *Serial Parameters*

This section permits display and modification of the transmission parameters of the serial interfaces of the radio-controlled clock.
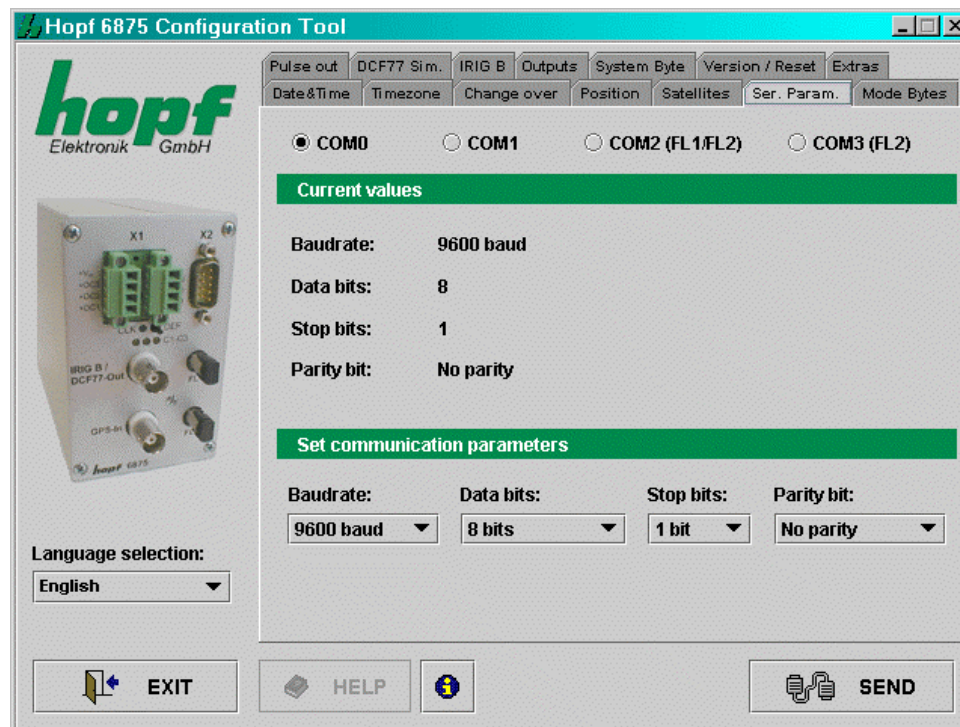
The selection of the interface to be configured is made in the upper part of the frame by clicking the appropriate interface [**COM0**, **COM1**, **COM2 (FL1/FL2)** und **COM3 (FL2)**]. The current values for the selected interface are requested and displayed. These values can be changed by selecting from the lists intended for this purpose.

The following serial parameters may be set:

Baud rate	input of the Baud rate: between **150**, **300**, **600**, **1200**, **2400**, **4800**, **9600** and **19200** Baud
Data bits	input of the word length: **8** or **7 Bit**
Stop bits	number of stop bits: **1** or **2**
Parity	parity input: **no**, **odd**, **even**

If the serial interface **COM0** of the clock has already been (previously) configured with different parameters (status ex works *<9600 baud, 8 data bits, 1 stop bit, no parity>*), then the configuration data must be adjusted accordingly so that communication is possible between the configuration software and the clock. The transmission parameters for the serial interface via which the configuration software is configured are stored in the configuration file *<settings.conf>*. This is found in the installation directory (Windows platforms) or in the directory <Installation directory>/etc/ (UNIX-Platforms).

Please Note: BY ACTIVATING THE **DEF KEY** (PRESSS FOR AT LEAST 10 SECONDS) ON THE FRONT PANEL OF THE CLOCK THE SERIAL PARAMETERS OF THE CLOCK ARE SET TO *<9600 BAUD, 8 DATA BITS, 1 STOP BIT, NO PARITY>*.

In order to set the transmission parameters for the serial interface in *<settings.conf>* to the following values *<9600 Baud, 8 data bits, 1 stop bit, no parity>* the following entries are required:

```
baudrate=9600
databits=8
stopbits=1
parity=N
```

4.3.13 *Mode bytes*

In this section the output strings of the serial interfaces are displayed and changed.
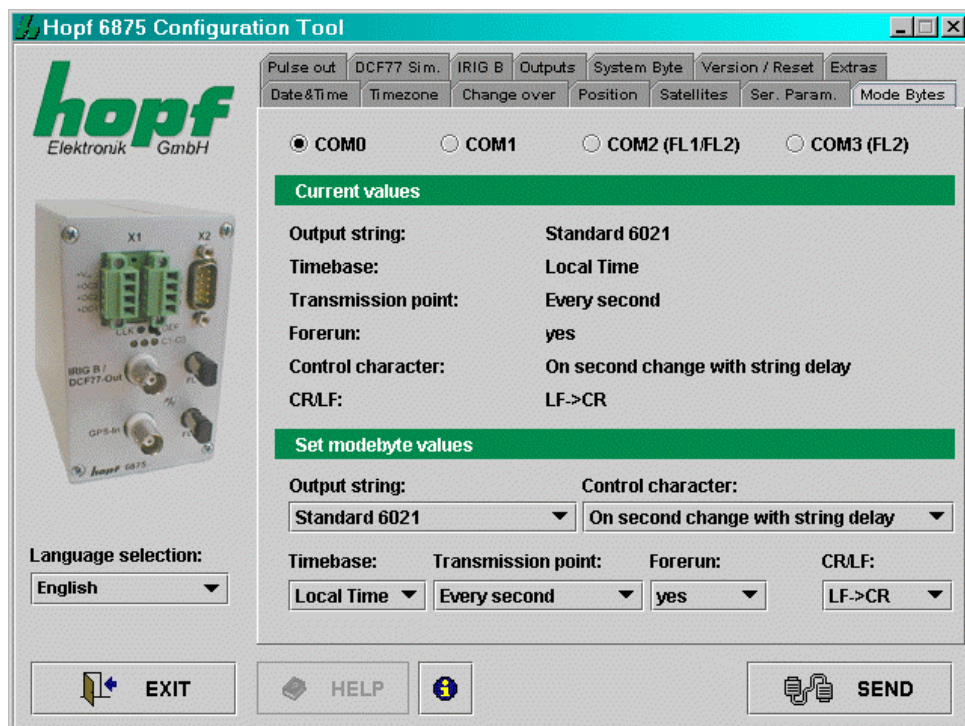
The serial interface to be configured is selected in 4.3.12.

There is a detailed description of the individual data strings in section 5.

The interface(s) designated for the output of the data strings as set must be indicated additionally in section 4.3.15.

Please Note:	THE ENTRIES "C01 CUSTOM STRING" TO "C16 CUSTOM STRING" IN THE SELECTION "TRANSMISSION STRING" ARE RESERVED FOR SPECIAL SOLUTIONS AND NORMALLY HAVE NO FUNCTION.

The following settings are possible:

Transmission string	Type of data string to be emitted:
	    Standard 6021,
	    Standard 6021 with year 2000,
	    Master/Slave,
	    Siemens Sinec H1,
	    T-String,
	    GPS2000,
	    SAT 1703 Time String,
	    SINEC H1 Ext.
	    IEC-103 (ASDU Typ 6)
	    NMEA 0183 - GPRMC (V3.00)
	    NMEA 0183 - GPZDA (V3.00)

Control character	Output of **ETX** control character in the data string:
	    Standard (direct, no delay),
	    At the second change (no delay) or
	    At the second change (with delay)

Time basis	Time basis for the data string: **Local time**, **UTC**

Transmission time	Output of the data string at the second change:
	    Each second
	    Each minute
	    Each hour
	    On request

Second forerun	Output of the data string with 1 second forerun: **no, yes**
CR / LF	Sequence for CR and LF: **CR->LF**, **LF->CR**

> Output of the string **IEC-103 (ASDU Type 6)** at interface **COM0** causes interruption of the remote connection when activating this string by default setting!
> The connection can be reconnected by parameterization EVEN-PARITY for the remote interface on the Host-System!

4.3.14 Optical coupler

This section enables the configuration of 3 PhotoMOS signal relay outputs and 2 additional pulses. The selection of the signal relay outputs to be configured ("**OK 1**", "**OK 2**" and "**OK 3**") and the pulses ("**IMP 1**" und "**IMP 2**") is made by clicking on the upper part of the frame.
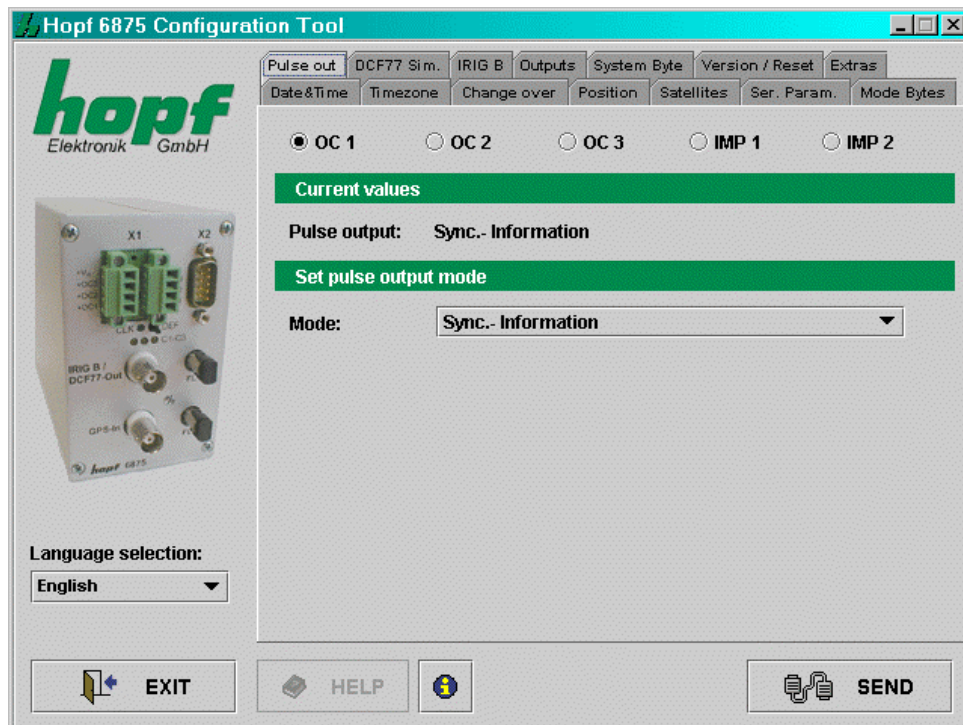
The current values for the selected output or pulse are requested and displayed. Depending on the **"Modus"** which has been set additional methods of configuration will appear or fade. The following modes are supported:

DCF77 (Mode 0)

In this setting the DCF77 pulse will be emitted at the appropriate output. This setting is used, for example, for the synchronization of further DCF77radio-controlled clocks with DCF77 pulse input such as *hopf* 6850. If desired this signal can be inverted. The settings for the DCF77 pulse are in the DCF77 menu and apply to all outputs emitting this.

Sync. Information (Mode 1)

In this setting the internal clock radio-control status is emitted at the corresponding output. If the PhotoMOs signal relay is switched through then the clock is in radio-controlled status. The lapsing of the signals indicates quartz mode. The signal output can not be inverted.

System Information (Mode 2)

In this mode the corresponding output is switched through when the power supply is set. If there is interference the signal lapses and hereby emits an alarm. The signal output cannot be inverted.

Cyclical output: within 24 hours (Mode 3)

In this mode cyclical pulses with an adjustable pulse width can be created on the corresponding output. The following pulse intervals are possible:

every 1, 2, 3, 4, 6, 8, 12 hours
every 1, 2, 3, 4, 5, 6 , 10, 12, 15, 20, 30 minutes
every 1, 2, 3, 4, 5, 6 , 10, 12, 15, 20, 30 seconds

The output time of the pulse is fixed by clicking with the mouse on the appropriate arrow filed in the input fields designated for this. A combination of hours, minutes and seconds is not allowed and is prevented by the software.

The pulse length can be selected in the range of **10- 2550 msec** in **10 msec** steps. The Pulse length should not exceed the cycle time, because then the output remains constantly switched through.

It is possible to invert the signal output.

Daily pulse (Mode 4)

This mode creates a single pulse per day at the time entered at the output. The output time of the pulse is fixed by clicking on the corresponding fields or by manual entry in the input fields designated for this purpose.

The entries for day, month and year are deactivated.

The pulse length can be selected in the range of **10- 2550 msec** in **10 msec** steps.

It is possible to invert the signal output.

Single pulse (Mode 5)

This mode creates a single pulse per time and date at the output.

This mode creates a single pulse at a defined point in time. The output time of the pulse is fixed by means of a mouse click on the corresponding arrow fields or by manual entry in the fields designated for this.

The pulse length can be selected in the range of **10- 2550 msec** in **10 msec** steps. It is possible to invert the signal output.

In the settings *Mode 2* and *3* it is of no benefit to invert the output, since, in the case of power failure, false information would be passed on to the outputs. In the following paragraphs there is an exact description of the individual modes.

By activating the checkbox **"Disable output in quartz mode"** it is possible, in the *modes 4* and *3,* to bind the pulses to the radio-controlled status, specially for **IMP 1** and **IMP 2**. That means that there is only a pulse output when the clock is in radio-controlled mode.

By deactivating the checkbox **"Disable output in quartz mode"** pulses are emitted in quartz mode.

Configuration for an inverted output of the pulses **IMP 1** and **IMP 2** takes place in the section "Outputs" in 4.3.15.

The settings for the individual PhotoMos signal relays are each transmitted individually to the radio-controlled clock.

4.3.15 *Outputs*

This section permits the shunting of output signals to the outputs of the radio-controlled clock.
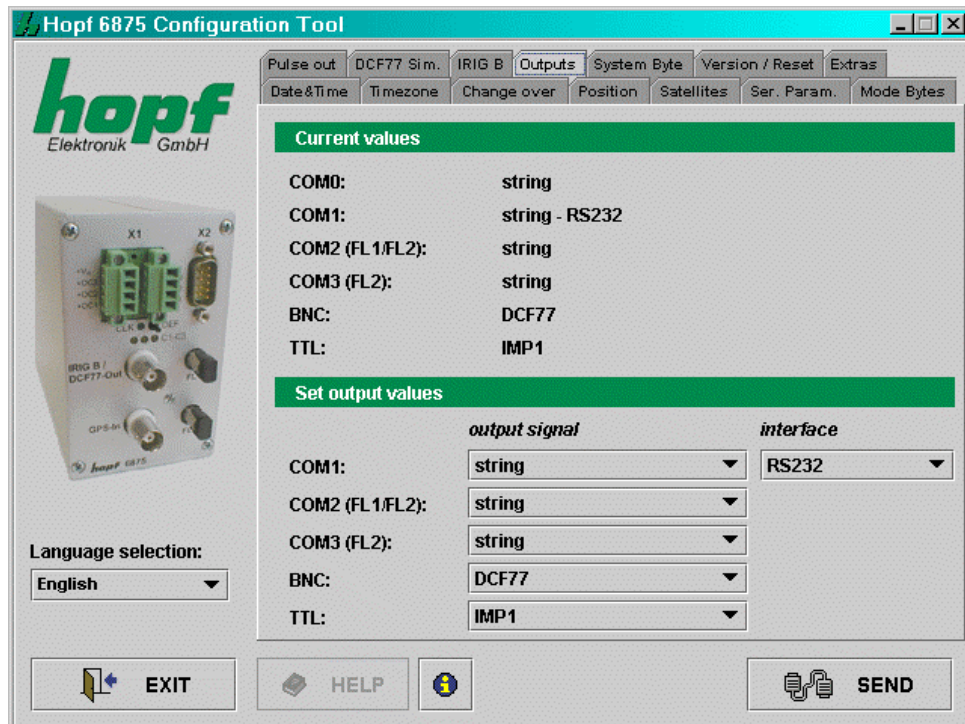
All the settings are made via selection lists.

Only the output of serial data strings is possible via the serial interface **COM0.** This is used mainly for the configuration of the equipment or as a synchronization source.

The outputs: **COM0**, **COM1**, **COM2 (FL1 / FL2)** and **COM3 (FL2)** are serial interfaces, the output **BNC** refers to the analogue output IRIG-B / DCF77-Out and **TTL** describes the digital TTL output on the connector X2.

Methods of configuring **COM1** (serial interface **COM1** in the radio-controlled clock):

- *Output signal*: **data string**, **IMP1** (pulse1), **IMP2** (pulse2), **IRIG-B** pulse
- *Interface*: **RS232**, **RS422 full-duplex**
- The output signals can also be emitted inversely

Methods of configuring **COM2** and **COM3** (optical serial interfaces):

- *Output signal*: **data string**, **IMP1** (pulse1), **IMP2** (pulse2), **IRIG-B** pulse
- The output signals can also be emitted inversely

Methods of configuring **BNC**:

- Output signal: **DCF77** simulation or **IRIG-B** signal generation

Methods of configuring **TTL** (digital **TTL** output in the radio-controlled clock):

- *Output signal*: **data string**, **IMP1** (pulse1), **IMP2** (pulse2), **IRIG-B** pulse
- The output signals can also be emitted inversely.

Please Note:	THE CONFIGURATION OF **IMP1** (PULSE1) AND **IMP2** (PULSE2) IS IN THE "OPTICAL COUPLER" MENU.

4.3.16 DCF77 Simulation

In this section settings can be made for the DCF77 simulation and the DCF77 pulse. These are global settings and are valid for all outputs which emit a DCF77 simulation or DCF77 pulse.
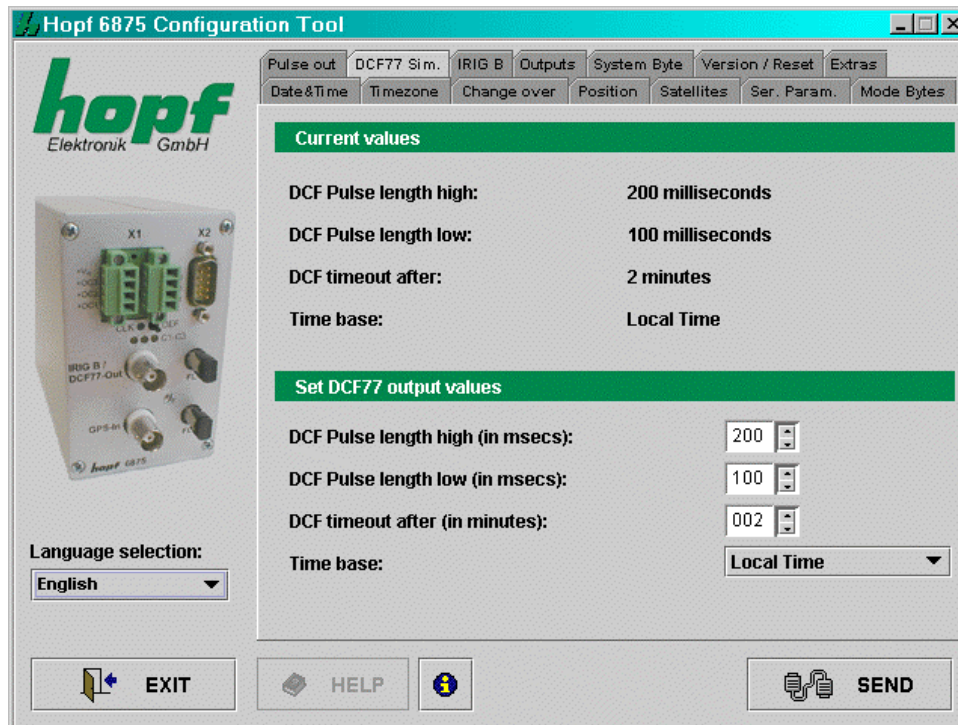
The outputs at which a DCF77 pulse is emitted can be indicated in 4.3.15.

The following entries are required for configuration:

- **Pulse length Highbit** in the range 140...240 msec (Standard: 200 msec)
- **Pulse length Lowbit** in the range 70...130 msec (Standard: 100 msec)
- **Delay for DCF77 switch-off** in the range 2...255 minutes (at 255 ⇨ ∞)
- **Time basis: local time or UTC**

The pulse lengths and the switch-off delays are determined by mouse click on the corresponding input fields or by manual entry, the time basis is entered via the selection list.

The value **"DCF77 timeout after"** indicates the delay time in minutes for the output of the DCF77 simulation or the DCF77 pulse when changing to quartz mode. If this value is set at 255 the DCF77 simulation and/or DCF77 pulse will be emitted permanently.

4.3.17 IRIG-B / IRIG Time Code

In this section the settings for the IRIG Time Code signal generation (analogue) are made.

These are global settings and are valid for the output of the analogous amplitude modulated signal (e.g. IRIG-B B12x) as well as for the digital pulse width modulated signal (e.g. IRIG-B B00x).

The 'analogue' IRIG Time Code is given out at the BNC-connector (IRIG-B). The outputs for IRIG Time Code (digital) can be configured as described in chapter 4.3.15.

IRIG Time Code Formats

The following formats of IRIG Time Code are available:

- o   IRIG-B - B002/B122   (time)
- o   IRIG-B - B003/B123   (time, seconds of day)
- o   IRIG-B - B006/B126   (time, year)
- o   IRIG-B - B007/B127   (time, year, seconds of day)
- o   IEEE1344
- o   AFNOR NFS 87-500

Info: The IRIG-B output is done by the **IRIG Standard 200-04**.

Time Base for IRIG Time Code

For special applications the time basis transmitted in the IRIG Time Code can be configured.

- o   Local Time
- o   UTC Time

Timeout for delayed Output Break

This value acts as bypass for the reception failure for the output break of the IRIG Time Code referring to delicate reception conditions.

With regard to a reception failure of the sync. source (here GPS) the turning off of the IRIG-B signal is delayed by the adjusted figure.

The value can be set between 002 and 255 minutes.

4.3.17.1 *IRIG Time Code Structure and Timing-Diagram*

The IRIG format consists of one time code with 74 bits and has a repeatability rate of one second. The bit frame is 10 msec. The rating of a bit is displayed by a pulse width modulation and is shown in multiples of a millisecond.

With analogue output the positive zero cycle of a sinus oscillation (carrier frequency 1000Hz) is modulated with the rising edge of the IRIG signal. The rate of modulation for the signal information of H/L level should be between 3:1 and 6:1. The Din-Rail Module 6870 distributes a modulation of 3:1.

To synchronize to the beginning of a second a neutral logic status is required which is called the identifier.

Logic 0 = 2 msec H-level
Logic 1 = 5 msec H-level
Identifier = 8 msec H-level
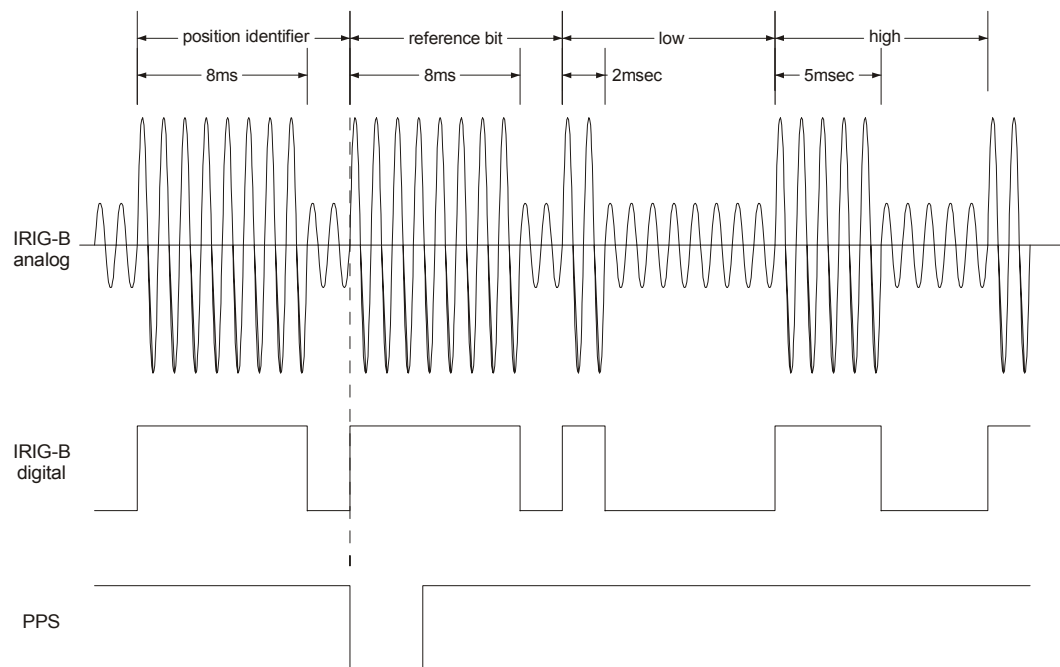
The 74 time code bits are divided into

30 bits for the BCD value of seconds, minutes, hours and the current day of year
27 bits for the input of control information
17 bits for the binary value of the current seconds of day

100 bit frames can be transmitted in one second. Unused bit frames are filled with a logical zero.

4.3.17.2 Format categories IRIG-Bxxx according to IRIG Standard 200-04

Signal output can be digital or analogue and also with different data content. The variations are indicated by attaching a three-digit combination of figures.

The figures have the following meaning:

Figure 1	0	= digital output
	1	= analogue output via carrier
Figure 2	0	= no carrier
	1	= carrier 100 Hz
	2	= carrier 1000 Hz
Figure 3	0	= time, second of day, control information
	1	= time, control information
	2	= time
	3	= time, second of day
	4	= time, year, second of day, control information
	5	= time, year, control information
	6	= time, year
	7	= time, year, second of day

e.g. **IRIG-B123** = analogue output, carrier 1000 Hz,
= data content time information and binary seconds of day

4.3.17.3 IRIG IEEE 1344-1995

This IRIG standard is based on IRIG Standard 200-89. Fixed data such as year, time offset etc. are assigned to the 27 bits of the control information field.

The IRIG Standard 200-89 is contained as subset in the IEEE1344.

4.3.17.4 AFNOR NFS 87-500

The AFNOR NFS 87-500 Code is similar to the IRIG Time Code Standard. It has been laid down by the French institute for standards and is based on the IRIG Standard 200-4.

The IRIG-B Standard 200-89 is contained as subset in the AFNOR NFS 87-500.

4.3.18 *Version / Reset*

Firmware information is shown in this section.
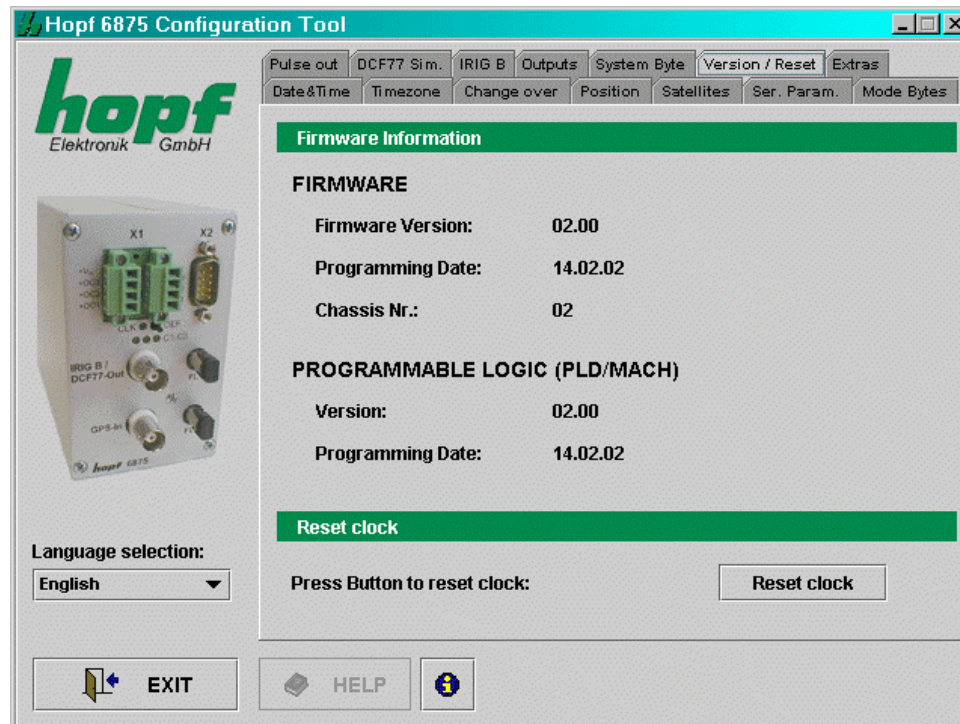
Reset clock

A restart of the clock is initiated by this function. The function does not change any of the set-tings made previously, in contrast to the **DEF** key in the front panel. A reset is necessary after inputs are completed in order to accelerate the first synchronization.

> **Please Note:** WHEN CHANGES HAVE BEEN MADE ON THE RADIO-CONTROLLED CLOCK IT IS AD-VISABLE TO WAIT FOR THE MINUTE CHANGE BEFORE SETTING UP RESET.

5 Data strings

5.1 General information on the serial data output of the 6875 board

When setting ETX to the second change a transmission gap occurs, depending on the Baud rate, of up to 970 msec. Please pay attention to this when programming timeout on the receiving side.

On all data strings the output of control character CR and LF can be exchanged with **mode-byte.**

The transmitted data string are compatible with the data strings of the following *hopf* clocks:

- Board 6020/6021   standard with control character
- Board 7200/7201   standard with control character
- Board 7220/7221   standard with control character
- Board 7240/7245   standard with control character
- Board 6840/6841   standard with control character
- System 4465   standard with control character
- System 6870   standard with control character

5.2 Set-up of the standard (hopf6021) string

character no.:	Meaning	Hex
1	STX (Start of Text)	$02
2	status (internal status of the clock)	$30-39, $41-46
3	day of the week (1=Monday ... 7=Sunday)	$31-37
	bit 3 in the day of the week is set to 1 with UTC	
4	tens hours	$30-32
5	unit hours	$30-39
6	tens minutes	$30-35
7	unit minutes	$30-39
8	tens seconds	$30-36
9	unit seconds	$30-39
10	tens days	$30-33
11	unit days	$30-39
12	tens months	$30-31
13	unit months	$30-39
14	tens years	$30-39
15	unit years	$30-39
16	LF (Line Feed)	$0A
17	CR (Carriage Return)	$0D
18	ETX (End of Text)	$03

5.2.1 *Status and day of the week nibble*

The second and third ASCII character in the string contain the status and the day of the week. The evaluation of the status is binary. Set-up of the characters:

	b3	b2	b1	b0	Meaning
Status nibble:	x	x	x	0	No announcement hour
	x	x	x	1	Announcement (DST-ST-DST)
	x	x	0	x	Standard time (ST)
	x	x	1	x	Daylight saving time (DST)
	0	0	x	x	Time/date invalid
	0	1	x	x	Quartz mode
	1	0	x	x	Radio-controlled mode
	1	1	x	x	Radio-controlled mode (high accuracy)
Day of the week nibble:	0	x	x	x	CEDST/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

Example: **(STX)E3123456170496(LF)(CR)(ETX)**

Radio-controlled mode (high accuracy)), daylight saving time, no announcement

It is Wednesday 17.04.96 - 12:34:56 hrs.

( ) – ASCII control characters e.g. (STX)

5.2.2 *Configuration for NTP (Network Time Protocol)*

NTP or also xNTP is a programme package for synchronizing different computer and operating systems with network support. It is the standard for Internet protocol TCP/IP (RFC-1305). Source code and documentation are available as freeware in the Internet under the following address: **http://www.ntp.org** or **http://www.eecis.udel.edu/~ntp/**

NTP supports the *hopf* protocol as described in section 5.2. The following settings are required in the clock board:

Transmission parameters: 9600 Baud, 8 data bits, no parity, 1 stop bit

Transmission mode: Standard 6021 (hopf6021, time and date), outputevery second, time basis: UTC, with second forerun, with ETX at the second change with control characters (STX...ETX), LF->CR

There are already pre-configured NTP packages for *hopf* radio-controlled clocks with serial interface. On the homepage of Ruprecht&Partner (OEG) (http://www.rdcs.at/) these are available for downloading for the following operating systems:

- RedHat Linux 7.1, SuSE Linux 7.2

- Solaris 8 (SPARC)

5.3 Data string: Standard (hopf6021) with year 2000

The structure of the data string is identical to the standard string. It differs only in the 4-digit transmission of the year.

Current char. no..:	Meaning
1	STX (Start of Text)
2	status (internal status of clock)
3	day of the week (1=Monday ... 7=Sunday)
	bit 3 in the day of the week is set to 1 with UTC time
4	tens hours
5	unit hours
6	tens minutes
7	unit minutes
8	tens seconds
9	unit seconds
10	tens days
11	unit days
12	tens months
13	unit months
14	tens centuries
15	unit centuries
16	tens years
17	unit years
18	LF (Line Feed)
19	CR (Carriage Return)
20	ETX (End of Text)

5.3.1 *Status and day of the week nibble*

The second and third ASCII characters in the string contain the status and the day of the week. The evaluation of the status is binary. Set-up of the characters:

	b3	b2	b1	b0	Meaning
Status nibble:	x	x	x	0	No announcement hour
	x	x	x	1	Announcement (DST-ST-DST)
	x	x	0	x	Standard time (ST)
	x	x	1	x	Daylight saving time (DST)
	0	0	x	x	Time/date invalid
	0	1	x	x	Quartz mode
	1	0	x	x	Radio-controlled mode
	1	1	x	x	Radio-controlled mode (high accuracy)
Day of the week nibble:	0	x	x	x	CEDST/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

Example: **(STX)E312345603011996(LF)(CR)(ETX)**

Radio-controlled mode (high accuracy), daylight saving time, no announcement

It is Wednesday 03.01.1996 - 12:34:56 hrs.

( ) – ASCII control characters e.g. (STX)

5.4 Data string SINEC H1

The control characters STX and ETX are only transmitted when the output is set "with control characters". Other wise these control characters do not apply. With the setting "ETX delayed" the last character (ETX) is transmitted at exactly the next second change.

The data string can be accessed with **"?"** and **"T".**

Current char. no.:	Meaning	Value (value range)
1	STX (start of text)	$02
2	"D" ASCII D	$44
3	":" colon	$3A
4	tens days	$30-33
5	unit days	$30-39
6	"." point	$2E
7	tens months	$30-31
8	unit months	$30-39
9	"." point	$2E
10	tens years	$30-39
11	unit years	$30-39
12	";" semi-colon	$3B
13	"T" ASCII T	$54
14	":" colon	$3A
15	day of the week	$31-37
16	";" semi-colon	$3B
17	"U" ASCII U	$55
18	":" colon	$3A
19	tens hours	$30-32
20	unit hours	$30-39
21	"." point	$2E
22	tens minutes	$30-35
23	unit minutes	$30-39
24	"." point	$2E
25	tens seconds	$30-36
26	unit seconds	$30-39
27	";" semi-colon	$3B
28	"#" or space	$23 / $20
29	"*" or space	$2A / $20
30	"S" or space	$53 / $20
31	"!" or space	$21 / $20
32	ETX (end of text)	$03

5.4.1 Status in data string SINEC H1

The characters 28-31 in the data string SINEC H1 provide information about the synchronization status of the clock.

The meanings are as follows::

Character no.: 28 = "#"   no radio-controlled synchronization after reset, time invalid

space   radio-controlled synchronization after reset, hrs and min in quartz mode

Character no.: 29 = "*"   time from the internal quartz crystal of the clock

space   time via radio-controlled reception

Character no.: 30 = "S"   "DST"   daylight saving time

space   "ST"   standard time

Character no.: 31 = "!"   announcing a changeover from ST/DST or DST/ST

space   no announcement

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

Radio-controlled mode, no announcement, standard time
It is Wednesday 03.01.96 - 12:34:56 hrs.

5.5 Data string T-String

The T-string can be transmitted with all modes (e.g. with forerun or final character at the second change).

The data string can be accessed with **"T".**

Current char. no.:	Meaning	Value (value range)
1	"T" ASCII T	$54
2	":" colon	$3A
3	tens years	$30-39
4	unit years	$30-39
5	":" colon	$3A
6	tens months	$30-31
7	unit months	$30-39
8	":" colon	$3A
9	tens days	$30-33
10	unit days	$30-39
11	":" colon	$3A
12	tens days of the week	$30
13	unit days of the week	$31-37
14	":" colon	$3A
15	tens hours	$30-32
16	unit hours	$30-39
17	":" colon	$3A
18	tens minutes	$30-35
19	unit minutes	$30-39
20	":" colon	$3A
21	tens seconds	$30-36
22	unit seconds	$30-39
23	CR (carriage return)	$0D
24	LF (line feed)	$0A

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

It is Wednesday 03.01.96 - 12:34:56 hrs.

5.6 Data string Master/Slave

With master/slave data strings slave systems can be synchronized to an accuracy of ± 0,5 msec with the time data of the master system. In the data sting the time difference to UTC is also transmitted.

After the year the time difference in hours and minutes is transmitted. The transmission is in BCD. The time difference may be up to ± 11.59 hrs.

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

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

Example :

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

The whole data string has the following structure:

Current char. no.:	Meaning	Value (value range)
1	STX (start of text)	$02
2	status	$30-39, $41-46
3	day of week	$31-37
4	tens hours	$30-32
5	unit hours	$30-39
6	tens minutes	$30-35
7	unit minutes	$30-39
8	tens seconds	$30-36
9	unit seconds	$30-39
10	tens days	$30-33
11	unit days	$30-39
12	tens months	$30-31
13	unit months	$30-39
14	tens years	$30-39
15	unit years	$30-39
16	time diff.10 + symbol	$30,$31,$38,$39
17	time diff. Unit hrs.	$30-39
18	time diff. 10 minutes	$30-35
19	time diff. Unit minutes	$30-39
20	LF (line feed)	$0A
21	CR (carriage return)	$0D
22	ETX (end of text)	$03

5.6.1 *Status in Data String Master/Slave*

	b3	b2	b1	b0	Meaning
Status nibble:	x	x	x	0	No announcement hour
	x	x	x	1	announcement (DST-ST-DST)
	x	x	0	x	Standard time (ST)
	x	x	1	x	Daylight saving time (DST)
	x	0	x	x	No announcement switchover second
	x	1	x	x	Announcement switchover second
	0	x	x	x	Quartz mode
	1	x	x	x	Radio-controlled mode (high accuracy))
Day of the week nibble:	0	0	0	1	Monday
	0	0	1	0	Tuesday
	0	0	1	1	Wednesday
	0	1	0	0	Thursday
	0	1	0	1	Friday
	0	1	1	0	Saturday
	0	1	1	1	Sunday

Example: **(STX)831234560301968230(LF)(CR)(ETX)**

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

5.6.2 *Setting*

To synchronize the **hopf** slave systems the following settings are required:

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

With these settings there is optimal control of the time basis in the slave systems.

Please Note:	THE OUTPUT OF UTC TIME CAN BE ACTIVATED FOR SPECIAL APPLICATIONS.

5.7 GPS2000 Data String

With the GPS2000 data string systems can be synchronized to an accuracy of ± 1 µsec with the time data of the master system.

The whole data string has the following structure:

Current char. no.:	Meaning	Value (value range)
1	SOH (start of header)	$01
2	hundreds day in the year	$30-33
3	tens day in the year	$30-39
4	unit day in the year	$30-39
5	: (colon)	$3A
6	tens hours	$30-39
7	unit hours	$30-36
8	: (colon)	$3A
9	tens minutes	$30-33
10	unit minutes	$30-39
11	: (colon)	$3A
12	tens seconds	$30-39
13	unit seconds	$30-39
14	time accuracy	$3F, $23, $2A, $2E, $20
15	CR (carriage return)	$0D
16	LF (line feed)	$0A

5.7.1 Time Accuracy in the GPS2000 Data String

Hex-value	ASCII-value	Description	Meaning, details of accuracy
$3F	?	question mark	Error greater than 1 msec
$23	#	double dagger	Error greater than 100 µsec
$2A	*	star	Error greater than 10 µsec
$2E	.	point	Error greater than 1 µsec
$20		space	Error greater than 1 µsec

Example: **(SOH)042:12:34:56*(CR)(LF)**

It is day of the year 42, 12:34:56 hrs., the system time inaccuracy is greater than 10 µsec.

5.7.2 Configuration for GPS2000 Data String

For exact synchronization of the equipment the following settings must are required:

For the first serial interface (e.g. COM0 in 6875)
- 9600 Baud, 8 bit, 1 stop bit, even parity
- Output every second
- Control characters: standard (direct, without delay)
- Time basis and second forerun as required
- Transmission time: every second
- CR -> LF

In addition the output of a second pulse is required at the 2nd RS232 serial interface. The pulse width is 10 msec. The falling edge is synchronized to the second mark.

The pulse must be configured separately (e.g. in 6875: IMP1 as cyclical output every second, pulse length 10 msec; emit IMP1 to COM1 as RS232).

5.8 Data String SAT 1703 Time String

The SAT 1703 Time String can be transmitted with all modes (e.g. with forerun or ETX to the second change).

The SAT 1703 Time String can also be transmitted on request. The point of transmission will be set to "transmission on request" and the data string can be requested by **"?"**.

5.8.1 Specified Settings

All parameter are free adjustable

- Baud rate: 9600 Baud
- Data bits: 8
- Stop bit(s):   1
- Parity: no
- Point of transmission: every second
- Second forerun: no
- Control character: yes
- CR/LF: CR ⇨ LF

5.8.2 Data String Structure

Character No.	Meaning	Hex-Value
1	STX (start of text)	$02
2	tens day	$30-33
3	unit day	$30-39
4	"."	$2E
5	tens month	$30-31
6	unit month	$30-39
7	"."	$2E
8	tens year	$30-39
9	unit year	$30-39
10	"/"	$2F
11	day of the week	$31-37
12	"/"	$2F
13	tens hour	$30-32
14	unit hour	$30-39
15	":"	$3A
16	tens minute	$30-35
17	unit minute	$30-39
18	":"	$3A
19	tens second	$30-35
20	unit second	$30-39

Character No.	Meaning		Hex-Value
21	"M" or "M" or "U"		$4D, $4D, $55
22	"E" or "E" or "T"	(standard time [CET], summer time [CEST] or UTC)	$45, $45, $54
23	"Z" or "S" or "C"		$5A, $53, $43
24	" " or "Z" or " "		$20, $5A, $20
25	" " ($20 ⇨ synchronous) or "*" ($2A ⇨ not synchronous)		$20 $2A
26	" " ($20 ⇨ no announcement) or "!" ($21 ⇨ announcement of S/D- or D/S-changeover)		$20 $21
27	CR (carriage return)		$0D
28	LF (line feed)		$0A
29	ETX		$03

5.8.3 Data String Example

(STX) `18.07.02/4/02:34:45UTC__` **(CR)(LF)(ETX)**

- It is Thursday 18.07.2002 - 02:34:45 o'clock UTC
- The clock is synchronised with GPS

5.9 SINEC H1 Extended

The SINEC H! Extended String can be transmitted with all modes (e.g. with forerun or ETX to the second change).

The SINE H1 Extended String can also be transmitted on request. The point of transmission will be set to "transmission on request" and the data string can be requested by **"?"**.

5.9.1 Data String Structure

character no.	meaning	value (value range)
1	STX (start of text)	$02
2	"D" ASCII D	$44
3	":" colon	$3A
4	tens day	$30-33
5	unit day	$30-39
6	"." point	$2E
7	tens month	$30-31
8	unit month	$30-39
9	"." point	$2E
10	tens year	$30-39
11	unit year	$30-39
12	";" semicolon	$3B
13	"T" ASCII T	$54
14	":" colon	$3A
15	day of the week	$31-37
16	";" semicolon	$3B
17	"U" ASCII U	$55
18	":" colon	$3A
19	tens hours	$30-32
20	unit hours	$30-39
21	"." point	$2E
22	tens minute	$30-35
23	unit minute	$30-39
24	"." point	$2E
25	tens seconds	$30-36
26	unit seconds	$30-39
27	";" semicolon	$3B
28	"#" or space	$23 / $20
29	"*" or space	$2A / $20
30	"S", "U" or space	$53 / $55 / $20
31	"!", "A" or space	$21 / $41 / $20
32	ETX (end of text)	$03

5.9.2 *Status*

The characters 28-31 in the data string SINEC H1 Extended give information about the synchronisation status of the clock.

meaning of the following:

character no.:28 = "#" no radio synchronisation after reset, time invalid
space radio synchronisation after reset, clock at least in crystal operation

character no.: 29 = "*" time from the internal crystal
space time from radio reception

character no.: 30 = "S" daylight saving time
"U" UTC
space standard time

character no.: 31 = "!" announcement of a W/S or S/W changeover
"A" announcement of a leap second
space no announcement

5.9.3 *Example of a Transmitted Data String*

(STX)D:03.01.96;T:3;U:12.34.56; _ _ _ _ (ETX)   (_) = Space

radio operation, no announcement, standard time
It is Wednesday 03.01.96 - 12:34:56 h

5.10 Data String IEC-103 (ASDU Type 6)

Reference: IEC60870-5-103

The following table shows the effect of special parameters:

Parameter	reference value	effect less	fixed	variable
Baud rate:	9600 baud			x
Data bits:	8		x	
Stop bit(s):	1			x
Parity:	even			x
Point of transmission:	every minute		x	
Character at second change	no		x	
Second advance	no		x	
Transmission delay	no		x	
Control Character	(without control character)	x		
CR/LF	(without control character)	x		
Init-String address area: 1 .. End Address	Initializing: Address 1 .. 254			x

Effect less parameters didn't have any effect to this string (e.g. no control characters are identified in the binary string)

5.10.1 Data String Structure IEC-103 (ASDU Type 6)

character no.	meaning	hex value
1	Start flag	68
2	Length of Information	0F
3	Repeated length of Information	0F
4	Start flag	68
5	Control field	44
6	Station address	FF
7	Frame Type identification	06
8	Variable structure identifier	81
9	Cause of transmission	08
10	Common address of ASDU	FF
11	Function type	FF
12	Information number	00
13	Milliseconds (Low octet)	0000-EA5F
14	Milliseconds (High octet)	
15	Minutes (0..59) + MSB = Invalid Flag	00-3B, 80-BB
16	Hours (0..23) + MSB = SU Summer time Flag	00-17, 80-97
17	Days (1-31)	01-1B
18	Months (1-12)	01-0C
19	Years (00..99)	00-63
20	Checksum (sum of fields 5 to 19 mod 256)	00-FF
21	End flag	16

MSB of minute: 1 = clock is not synchronous (time invalid or quartz)
                 0 = clock is synchronous
MSB of hour: 1 = daylight saving time
                 0 = standard time

The seconds are displayed in the value of the milliseconds.

Thus the millisecond value runs from 0 .. 59999 decimal or from 0000 .. EA5F hexadecimal.
(If output is set to the minute change this value is always 0)

The checksum is the sum of byte 5 to 19 Modulo 256.

5.10.2 Example of a Transmitted Data String

The length of the data string is fixed to 21 characters. All characters including special characters are allowed. Only binaurally values are transmitted.

The transmitted values are given out hexadecimal.:

<68><0f><0f><68><44><ff><06><81><08><ff><ff><00><00><00><05><08><11><87><09><fe><16>

Time is 08:05:00.000 at 17th July 2009 (daylight saving time)
The clock is synchronous.

5.10.3 Initialization String for IEC-103 (ASDU Type 6)

This string is sent with ascending address every second unless the minute change. The address is continuously repeated from 1 to a selectable value of maximal 254.

character no.	meaning	hex value
1	Start flag	10
2	Control field	47
3	IEC-Address	00-FF
4	Checksum (sum of fields 2 & 3 mod 256)	00-FF
5	End flag	16

5.10.4 Example of an Initialization String

The length of data string consists of 5 characters. All characters including special characters are allowed. Just binary values are sent.

The hexadecimal values of the transmitted characters are stated:

<10><47><01><48><<16>   (String initializes unit with the address 01)

<10><47><02><49><<16>

:

<10><47><FE><45><<16>   (String with maximal valid address)

The default setting is the initialization from 1 to maximal valid address hexadecimal FE (decimal 254).

5.11 *Data String NMEA 0183 - GPRMC (V3.00)*

The full NMEA format[3] 0183 GPRMC contains the position-, rate- and time data (UTC) calculated by the GPS receiver. The different information are separated in the data string by a comma. Only a comma is set if an information is not available.

Data String Format:

The below transmitted data string contains only the time information in UTC and the position in the following format:

```
$GPRMC,hhmmss.sss,A,llll.llll,a,yyyyy.yyyy,a,,,DDMMYY,,,A*HH<CR><LF>
```

All information are transmitted between the ASCII characters **"$"** and **"*"**, followed by two characters for the checksum (EXOR calculated characters between **"$"** and **"*"**). The hexadecimal values of the upper and lower 4 bits of the checksum are transferred into ASCII characters. The binary values **A-F** are transferred to the ASCII characters **"A"-"F"** (41h - 46h).

All information are transmitted as ASCII characters with 8 bit word length, 1 stop bit and no parity.

The structure of string contains the following information:

Information:	Format:	Description:
Time Base	"GP"	Time Base=GPS
String Identifier	"RMC"	**R**ecommended **M**inimum **I**nformation
Time	hh,mm,ss.sss	Hours, Minutes, Seconds & Milliseconds
Status (Character # 18)	"A" / "V"	"A" = synchronous: Status of the clock is "R" or "r" "V" = not synchronous: Status of the clock "-" or "C"
Position Width	llll.llll	Degree & Minute Decimal Point and Fractional Digits
Position Breite	"N" / "S"	Hemisphere: "N"=North, "S"=South
Position Length	YYYYY.YYYY	Degree & Minute Decimal Point and Fractional Digits
Position Length	"E" / "W"	Direction: "E"=East, "W"=West
Mode Indicator (Character # 56)	"A" / "N"	"A" = synchronous: Status of the clock is "R" or "r" "N" = not synchronous: Status of the clock is "-" or "C"

The following parameter have been fixed for the data transmission

- baud rate = 4800 baud
- word length = 8 bit
- stop bit = 1
- parity = no parity
- transmission point = every second
- second forerun off
- control character at second change off
- transmission delay off
- time base = UTC

---

[3] NMEA = National Marine Electronics Association

5.11.1 *Data String Structure*

character no.	meaning	value (value range)
1	"$" string start	$24
2	"G"	$47
3	"P"	$50
4	"R"	$52
5	"M"	$4D
6	"C"	$43
7	"," comma as separation	$2C
8	tens hour UTC-time	$30-32
9	unit hour	$30-39
10	tens minute	$30-35
11	unit minute	$30-39
12	tens second	$30-35
13	unit second	$30-39
14	"." point as separation	$2E
15	tenth second	$30-39
16	hundredth second	$30-39
17	"," comma as separation	$2C
18	"A" respectively "V" Status	$41, $56
19	"," comma as separation	$2C
20	tens width degree	$30-39
21	unit width degree	$30-39
22	tens width minute	$30-36
23	unit width minute	$30-39
24	"." point as separation	$2E
25	tenth width minute	$30-39
26	hundredth width minute	$30-39
27	thousandth width minute	$30-39
28	ten thousandth width minute	$30-39
29	"," comma as separation	$2C
30	"N" respectively "S"	$4E,$53
31	"," comma as separation	$2C
32	hundreds length degree	$30-31
33	tens length degree	$30-39
34	unit length degree	$30-39
35	tens length minute	$30-36
36	unit length minute	$30-39
37	"." point as separation	$2E
38	0.1^{th} length minute	$30-39
39	0.01^{th} length minute	$30-39
40	0.001^{th} length minute	$30-39
41	0.0001^{th} length minute	$30-39
42	"," comma as separation	$2C
43	"E" respectively "W"	$45,$57
44	"," comma as separation	$2C
45	"," comma as separation	$2C
46	"," comma as separation	$2C

47	tens day	$30-33
48	unit day	$30-39
49	tens month	$30-31
50	unit month	$30-39
51	tens year	$30-39
52	unit year	$30-39
53	"," comma as separation	$2C
54	"," comma as separation	$2C
55	"," comma as separation	$2C
56	"A" resp. "N" Mode-Indikator	$41,$4E
57	"*" limiting of data string	$2A
58	tens Checksum	$30-39
59	unit Checksum	$30-39
60	CR (carriage return)	$0D
61	LF (line feed)	$0A

5.11.2 *Example of a Transmitted Data String*

```
$GPRMC,065517.000,A,5112.7003,N,00739.7908,E,,,210809,,,A*64<cr><lf>
```

- It is Friday 21 August 2009 - 06:55:17h (UTC).
- The clock is synchronous ("r" or "R").
- The position of the antenna is   51°12,7003' latitude north
                         and   7°39,7908' longitude east
- The clock is synchronous ("r" or "R").

Examples of data strings, before, during and after inserting a any leap-second:

Leap-second turn of the year 2009->2010

```
$GPRMC,235958.00,A,5112.7003,N,00739.7908,E,,,311209,,,A*5E<cr><lf>
$GPRMC,235959.00,A,5112.7003,N,00739.7908,E,,,311209,,,A*5F<cr><lf>
$GPRMC,235960.00,A,5112.7003,N,00739.7908,E,,,311209,,,A*55<cr><lf>
$GPRMC,000000.00,A,5112.7003,N,00739.7908,E,,,010110,,,A*57<cr><lf>
$GPRMC,000001.00,A,5112.7003,N,00739.7908,E,,,010110,,,A*56<cr><lf>
$GPRMC,000002.00,A,5112.7003,N,00739.7908,E,,,010110,,,A*55<cr><lf>
```

5.12 *Data String NMEA 0183 - GPZDA (V3.00)*

The datagram expresses the time information in NMEA format[4] 0183. The structure matches the standard string ZDA Time & Date.

The below transmitted data string contains only the time information in UTC and the position in the following format:

$GPZDA,hhmmss,DD,MM,YYYY,hhh,mm*CC<CR><LF>

All information are transmitted between the ASCII characters **"$"** and **"*"**, followed by two characters for the checksum (EXOR calculated characters between "**$"** and **"*"**). The hexadecimal values of the upper and lower 4 bits of the checksum are transferred into ASCII characters. The binary values **A-F** are transferred to the ASCII characters **"A"-"F"** (41h - 46h).

All information are transmitted as ASCII characters with 8 bit word length, 1 stop bit and no parity.

The structure of string contains the following information:

Information:	Format:	Description:
Time Base	GP	Time Base=GPS
String Identifier	ZDA	String for Time & Date
Time	hhmmss	Hours, Minutes, Seconds
Date	DD,MM,YYYY	Day, Month, Year (4 digits)
Local Time	hhh,mm	Hours with pre-sign, Minutes

The following parameter have been fixed for the data transmission

- baud rate = 4800 baud
- word length = 8 bit
- stop bit = 1
- parity = no parity
- transmission point = every second
- second forerun off
- control character at second change off
- transmission delay off
- time base = UTC

---

[4] NMEA = National Marine Electronics Association

5.12.1 Data String Structure Time/Date

character no.	meaning	value (value range)
1	"$" string start	$24
2	"G" identifier time basis GPS	$47
3	"P"	$50
4	"Z" identifier time information data	$52
5	"D"	$4D
6	"A"	$43
7	"," comma as separation	$2C
8	tens hour (UTC)	$30-32
9	unit hour (UTC)	$30-39
10	tens minute (UTC)	$30-35
11	unit minute (UTC)	$30-39
12	tens second (UTC)	$30-35
13	unit second (UTC)	$30-39
14	"." comma as separation	$2C
15	tens day (UTC)	$30-33
16	unit day (UTC)	$30-39
17	"." comma as separation	$2C
18	tens month (UTC)	$30-31
19	unit month (UTC)	$30-39
20	"." comma as separation	$2C
21	thousands digit year (UTC)	$31-32
22	hundreds digit year (UTC)	$30, $39
23	tens year (UTC)	$30-39
24	unit year (UTC)	$30-39
25	"," comma as separation	$2C
26	"+" or "-" sign local time zone	$2B, $2D
27	tens hour (local time zone diff.)	$30-32
28	unit hour (local time zone diff.)	$30-39
29	"," comma as separation	$2C
30	tens minute (local time zone diff.)	$30-35
31	unit minute (local time zone diff.)	$30-39
32	"*" string limitation	$2A
33	checksum bit 7-4	$30-39, $41-46
34	checksum bit 3-0	$30-39, $41-46
35	CR (carriage return)	$0D
36	LF (line feed)	$0A

5.12.2 *Example of a Transmitted Data String*

`$GPZDA,123456,26,09,2003,-02,00*6C(CR)(LF)`

- Output UTC time
- It is Friday 26 September 2003 - 12:34:56h (UTC)
- Difference Time -2 hours (2 hours east)

   => *Local Time 14:34:56h*

Examples of data strings before, during and after the changeover:

Changeover summer time->winter time (in October 2009/ MEZ time zone)

```
$GPZDA,005957,25,10,2009,-02,00*64<cr><lf>
$GPZDA,005958,25,10,2009,-02,00*6B<cr><lf>
$GPZDA,005959,25,10,2009,-02,00*6A<cr><lf>
$GPZDA,010000,25,10,2009,-01,00*68<cr><lf>
$GPZDA,010001,25,10,2009,-01,00*69<cr><lf>
$GPZDA,010002,25,10,2009,-01,00*6A<cr><lf>
```

Examples of data strings before, during and after inserting of any leap-second:

Leap-second turn of the year 2009->2010 (MEZ time zone)

```
$GPZDA,235958,31,12,2009,-01,00*6E<cr><lf>
$GPZDA,235959,31,12,2009,-01,00*6F<cr><lf>
$GPZDA,235960,31,12,2009,-01,00*65<cr><lf>
$GPZDA,000000,01,01,2010,-01,00*67<cr><lf>
$GPZDA,000001,01,01,2010,-01,00*66<cr><lf>
$GPZDA,000002,01,01,2010,-01,00*65<cr><lf>
```
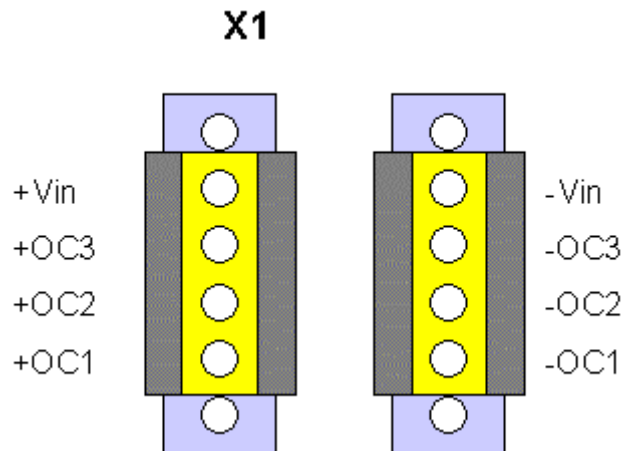
Examples of data strings before, during and after the changeover:

Changeover summer time->winter time (in March 2009/ MEZ time zone)

```
$GPZDA,005957,29,03,2009,-01,00*69<cr><lf>
$GPZDA,005958,29,03,2009,-01,00*66<cr><lf>
$GPZDA,005959,29,03,2009,-01,00*67<cr><lf>
$GPZDA,010000,29,03,2009,-02,00*65<cr><lf>
$GPZDA,010001,29,03,2009,-02,00*64<cr><lf>
$GPZDA,010002,29,03,2009,-02,00*67<cr><lf>
```
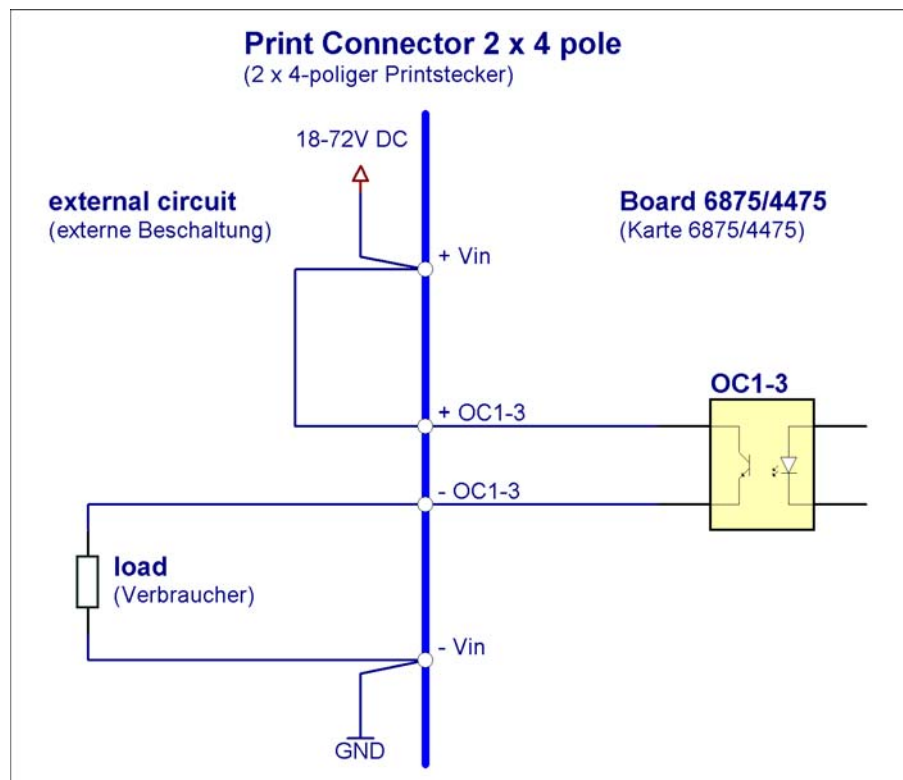
6 Examples of connections
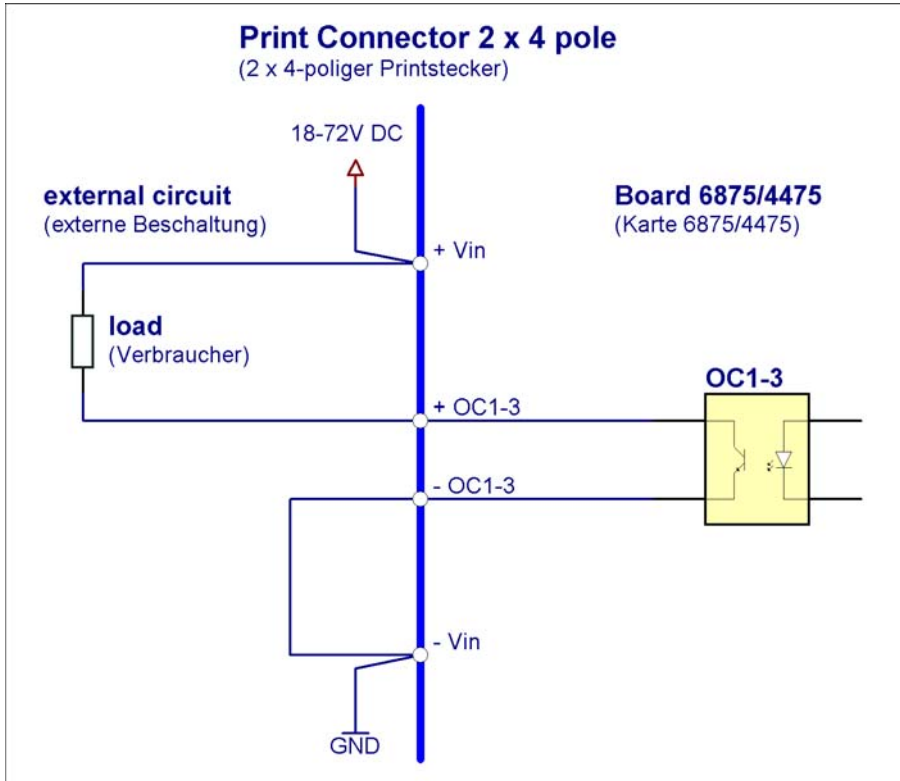
6.1 Assignment of the screw clips

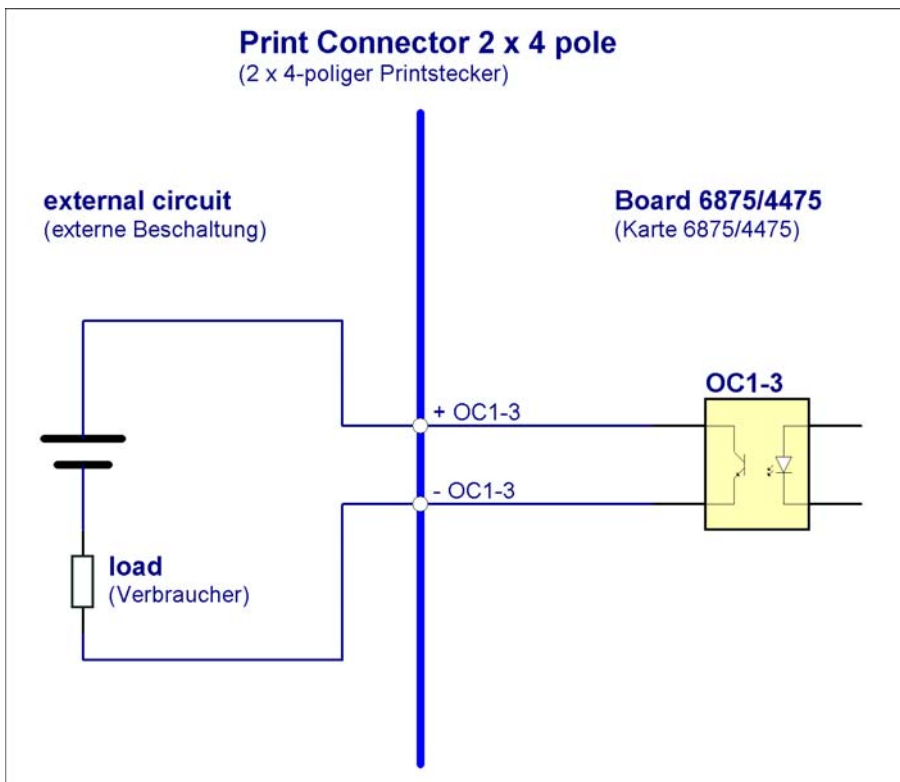### 6.1.1 Examples of connections for OC1-3

Active, positive pulse

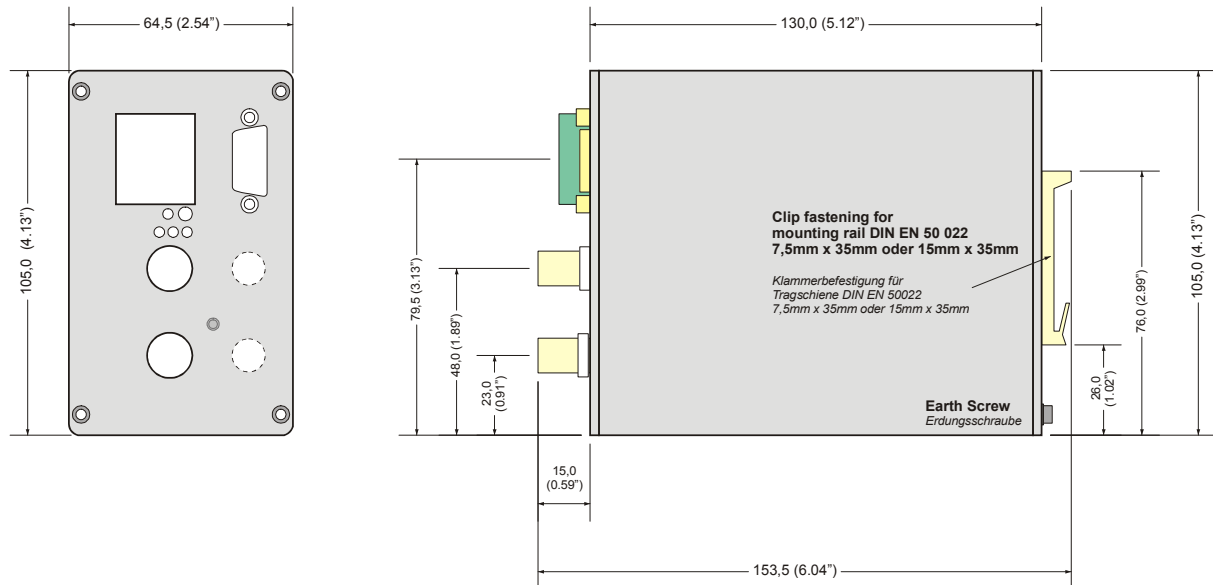### *Active, negative pulse*

Print Connector 2 x 4 pole
(2 x 4-poliger Printstecker)

18-72V DC

external circuit
(externe Beschaltung)

Board 6875/4475
(Karte 6875/4475)

+ Vin

load
(Verbraucher)

OC1-3

+ OC1-3

- OC1-3

- Vin

GND

Passive, positive pulse

Print Connector 2 x 4 pole
(2 x 4-poliger Printstecker)

external circuit
(externe Beschaltung)

Board 6875/4475
(Karte 6875/4475)

OC1-3

+ OC1-3

- OC1-3

load
(Verbraucher)

---

7 *Dimensions of Snap-in Module Housing*

8 *Glossary und Abbreviations*

UTC	Universal time coordinated
GPS	Global positioning system
DCF77	(D) Deutsches (C) Langwellensignal (F) Frankfurt a.M. (77) Frequenz in kHz *German longwave signal Frankfurt a.M. Frequency in kHz*
PPS	Pulse Per Second
Standard time	Standard time – *wintertime*
DST	Daylight Saving Time - *summertime*
IRIG-B	Inter-Range Instrumentation Group B
AFNOR	L'Association Française de Normalisation - Französische Gesellschaft für Normung *(French Standards Association)*
IEEE	Institute of Electrical and Electronics Engineers
FL	Fiber Optic Link