Industriefunkuhren

hopf Elektronik GmbH

Technical Manual

DCF77 Receiver Board

for ***hopf*** Clock Systems (19")

ENGLISH

Version: 01.01 – 24.08.2006

hopf Elektronik GmbH
Nottebohmstr. 41 • D-58511 Lüdenscheid • Tel.: +49 (0)2351 9386-86 • Fax: +49 (0)2351 9386-93 • Internet: http://www.hopf.com • E-Mail: info@hopf.com

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.

hopf Elektronik GmbH
Nottebohmstr. 41 • D-58511 Lüdenscheid • Tel.: +49 (0)2351 9386-86 • Fax: +49 (0)2351 9386-93 • Internet: http://www.hopf.com • E-Mail: info@hopf.com

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

CE

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

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

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

hopf Elektronik GmbH
Nottebohmstr. 41 • D-58511 Lüdenscheid • Tel.: +49 (0)2351 9386-86 • Fax: +49 (0)2351 9386-93 • Internet: http://www.hopf.com • E-Mail: info@hopf.com

Contents Page

1 General 7

2 Synchronisation with the DCF77 Signal 8

2.1 Synchronisation via DCF77 Antenna (CET Time Zone only) 8

2.2 Synchronisation with DCF77 Antenna Simulation (77.5kHz) 8

3 Front Panel 9

3.1 Status LEDs 9

3.2 Antenna Input 10

3.2.1 DCF77 Antenna 10

3.2.2 DCF77 Antenna Simulation (77.5kHz) 10

3.3 Pushbutton 10

3.3.1 Antenna Alignment Function 10

3.3.2 Board Reset 10

4 Operation in the CET Time Zone or WORLDWIDE 11

4.1 Summary of the Functions of the SW1 DIP-Switch 11

4.2 Operation in the CET Time Zone (Europe) 12

4.2.1 Setting for the CET Time Zone 12

4.2.2 SyncOFF Timer for Reception Failure Bypassing (CET mode only) 12

4.3 Operation in a Different Time Zone (Worldwide) 13

4.3.1 Configuration for Other Time Zones (Worldwide) 13

4.3.2 Setting the Time Offset for the ***hopf*** Master/Slave-String (Worldwide only) 13

5 Antenna Alignment 14

5.1 Alignment Procedure 14

5.2 Signal Quality 15

6 Resetting the Reception Board 15

7 Signal Output 16

7.1 DCF77 Pulse (1Hz) 16

7.1.1 DCF77 Pulse Output (1Hz) 16

7.1.2 Output in INVALID / QUARTZ Status 16

7.1.3 Output in RADIO Status 16

7.2 ***hopf*** Master/Slave-String 16

7.2.1 Output ***hopf*** Master/Slave String 17

7.2.2 Output by Status INVALID / QUARTZ 17

7.2.2.1 Output by Status RADIO 18

7.2.2.2 Status 19

7.2.2.3 Example 19

hopf Elektronik GmbH
Nottebohmstr. 41 • D-58511 Lüdenscheid • Tel.: +49 (0)2351 9386-86 • Fax: +49 (0)2351 9386-93 • Internet: http://www.hopf.com • E-Mail: info@hopf.com

8 System Indicators / Fault Analysis / Troubleshooting 20
8.1 Status and Fault Indicators 20
8.1.1 Status LED's 20
8.1.2 DCF77 Pulse (1Hz) 20
8.1.3 Serial Output 20
8.2 Fault Scenarios 20
8.2.1 Complete Failure 20
8.2.2 No DCF77 Reception / No Synchronisation 21
8.2.3 The connected Slave System is not synchronous 21
8.2.4 The connected Slave System synchronises with an incorrect time 22
8.2.4.1 Incorrect Local and UTC Time in the Slave System 22
8.2.4.2 Only UTC Time is incorrect in the Slave System 22
8.2.4.3 No Summertime/Wintertime Changeover in the Slave System 22
8.2.5 No DCF77 Pulse (1Hz) Output 23
8.2.6 No Output of the Serial ***hopf*** Master/Slave-String 23
8.3 Support from the ***hopf*** Company 23
9 Maintenance / Care 24
10 Assignment of the VG ledge 64-pole 25
11 Technical Data DCF77 Reception Board 26
12 Appendix 27
12.1 DCF77 (German Long-Wave Transmitter Frankfurt 77.5kHz) 27
12.1.1 DCF77 General 27
12.1.1.1 DCF77 Signal Structure 27
12.1.1.2 Advantages and Disadvantages DCF77 29
12.1.2 DCF77 Generation by ***hopf*** Clocks 29
12.1.2.1 DCF77 Signal Simulation (77.5kHz) 29
12.1.2.2 DCF77 Pulse (1Hz) 29

hopf Elektronik GmbH
Nottebohmstr. 41 • D-58511 Lüdenscheid • Tel.: +49 (0)2351 9386-86 • Fax: +49 (0)2351 9386-93 • Internet: http://www.hopf.com • E-Mail: info@hopf.com

1 General

The DCF77 Reception Board with 4HP/3U front panel is a Euro-board for installation in a clock system or 19" housing.

Some basic functions of the Reception Board:

- **Synchronisation** via the **DCF77 transmitter** in Frankfurt am Main / Germany
- Can operate as a **Slave System or Sub-Master Clock** - synchronisation takes place by means of a higher-level ***hopf*** radio-controlled clock system
- Automatic **Summertime/Wintertime changeover** via the DCF77 signal
- Time information output as **DCF77 Pulse (1Hz)** and ***hopf*** **Master/Slave-String**
- **Status LEDs** on the front panel
- **Potential isolation** of the DCF77 line circuit **(optional)**
- Totally **maintenance-free** system
- **SyncOFF timer** (reception failure bypassing) for operation free of fault messages - even in difficult reception conditions
- Redundant **multiple validation of the synchronisation signal** for fault-free and leap-free signal evaluation
- Integrated **Watchdog** circuit (automatic restart on programme error)

hopf Elektronik GmbH
Nottebohmstr. 41 • D-58511 Lüdenscheid • Tel.: +49 (0)2351 9386-86 • Fax: +49 (0)2351 9386-93 • Internet: http://www.hopf.com • E-Mail: info@hopf.com

2 Synchronisation with the DCF77 Signal

This chapter describes the various options available for synchronising the Reception Board.

For further information about the DCF77 signal, please see ***Chapter 12 DCF77 Antenna Equipment***.

2.1 Synchronisation via DCF77 Antenna (CET Time Zone only)

DCF77 antenna equipment, which is capable of receiving or distributing the original DCF77 time character signal, is required for this purpose.

When an antenna is used, the Reception Board is **always** synchronised with the CET/CEST time information.

In this case, **no** setting of the time offset or changeover points of time is required in the Reception Board. All information necessary to output the time information is transmitted with the synchronisation signal.

The setting **Operation in the CET Time Zone** automatically sets the UTC offset in the ***hopf*** Master/Slave-String to +1 hour.

2.2 Synchronisation with DCF77 Antenna Simulation (77.5kHz)

In this case, a clock system generates an analogue, amplitude-modulated carrier signal which a connected, standard DCF77 radio-controlled clock cannot differentiate from an "original" DCF77 signal received via an antenna.

DCF77 antenna simulation (77.5kHz) makes it possible to use time bases other than only CET/CEST for the signal to be simulated (e.g. Installation location: Asia with output of the DCF77 antenna simulation through a ***hopf*** GPS system).

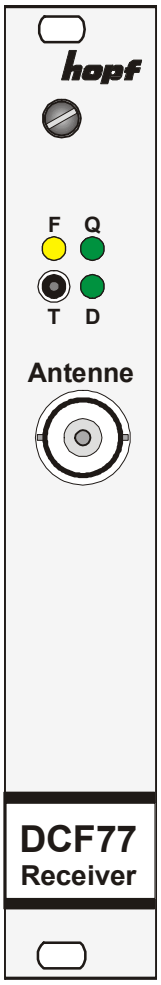
When using a time base other than CET, it is necessary to inform the clock system of the modified time offset between UTC and the local standard time.

For this purpose, the time offset of local standard time to UTC time is freely selectable in 15 minute steps under the setting **Operation in a Different Time Zone (Worldwide)**.

The changeover between summer and winter time also takes place via the synchronisation signal in this instance.

hopf Elektronik GmbH
Nottebohmstr. 41 • D-58511 Lüdenscheid • Tel.: +49 (0)2351 9386-86 • Fax: +49 (0)2351 9386-93 • Internet: http://www.hopf.com • E-Mail: info@hopf.com

3 Front Panel



LED Status Output		
label	**colour**	**function**
F	yellow	see chapter 3.1 Status LEDs
Q	green	see chapter 3.1 Status LEDs
D	green	see chapter 3.1 Status LEDs

pushbutton 'T'	
pressed	**function**
0-3 sec.	Antenna Alignment (see chapter 5)
>3 sec.	Resetting the Reception Board (see chapter 6)

antenna	
DCF77	antenna input

3.1 Status LEDs

The current status of the Board can be read by means of the LEDs on the front panel:

LED Q	LED F	LED D	Board Status	Meaning
OFF	OFF	OFF	Board switched off	
OFF	OFF	2Hz	INVALID time base	The Board has no time information
ON	OFF	2Hz	QUARTZ time base	The Board has detected an internal time base based on the DCF77 signal or has lost DCF77 reception
ON	ON	1Hz *	RADIO time base	The Board is synchronised via the DCF77 signal and the time information is being transmitted
1Hz	1Hz	1Hz	Align antenna	The Board is in the "Align Antenna" mode. No synchronisation of the Board takes place under this function
(all LED's flash after approx. 20 seconds in the second pulse)				

* (Begins one minute after attaining RADIO status)

hopf Elektronik GmbH
Nottebohmstr. 41 • D-58511 Lüdenscheid • Tel.: +49 (0)2351 9386-86 • Fax: +49 (0)2351 9386-93 • Internet: http://www.hopf.com • E-Mail: info@hopf.com

3.2 Antenna Input

The antenna input can be connected to either ***hopf*** antenna equipment or ***hopf*** DCF77 antenna simulation (77.5kHz) via a BNC connector.

3.2.1 DCF77 Antenna

The coaxial cable of the DCF77 antenna device is connected to the BNC socket marked **"Antenna"**.
Further specifications concerning the installation of the antenna equipment, such as cable lengths and cable types, can be found in the "DCF77 Antenna Equipment" document.

3.2.2 DCF77 Antenna Simulation (77.5kHz)

The coaxial cable of the DCF77 Antenna Simulation (77.5kHz) is connected to the BNC socket marked **"Antenna"**.

Type RG59 coaxial cable is recommended as standard for connections between ***hopf*** systems.

3.3 Pushbutton

The pushbutton has two different functions depending on the length of time for which it is activated.

The length of activation can be determined from the status LED's:

- Press pushbutton: All status indicators go out
- Pushbutton pressed for 1 sec.: LED F lights up
- Pushbutton pressed for 2 sec: LED Q lights up
- Pushbutton pressed for 3 sec: LED D lights up

3.3.1 Antenna Alignment Function

If the button is pressed for between 0 and 3 seconds, the antenna alignment function starts up. This is switched off automatically after approx. 10 minutes or by resetting the Board.

3.3.2 Board Reset

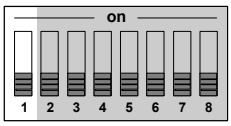
The Board is reset if the button is pressed for longer than 3 seconds.

hopf Elektronik GmbH
Nottebohmstr. 41 • D-58511 Lüdenscheid • Tel.: +49 (0)2351 9386-86 • Fax: +49 (0)2351 9386-93 • Internet: http://www.hopf.com • E-Mail: info@hopf.com

4 Operation in the CET Time Zone or WORLDWIDE

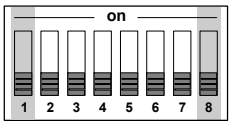
The Reception Board can be configured for operation in various time zones with the aid of a DIP-switch.

4.1 Summary of the Functions of the SW1 DIP-Switch



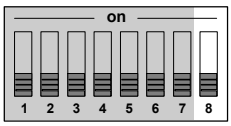
Operating Mode

Switch 1	Installation Location
ON	WORLDWIDE
OFF	CET/CEST (Europe)



Time Offset for *hopf* Master/Slave-String or SyncOFF Timer

Switch 2	Time Offset / SyncOFF
ON	15 minutes
OFF	0 minutes
Switch 3	**Time Offset / SyncOFF**
ON	30 minutes
OFF	0 minutes
Switch 4	**Time Offset / SyncOFF**
ON	1 hour
OFF	0 minutes
Switch 5	**Time Offset / SyncOFF**
ON	2 hours
OFF	0 minutes
Switch 6	**Time Offset / SyncOFF**
ON	4 hours
OFF	0 minutes
Switch 7	**Time Offset / SyncOFF**
ON	8 hours
OFF	0 minutes



Operational Signs for Time Offset (WORLDWIDE mode only)

Switch 8	Operational Sign
ON	Negative time offset (west)
OFF	Positive time offset (east)

Example for time output:

DIP-Switch SW1								Operating Mode	SyncOFF Timer	Time Offset
1	2	3	4	5	6	7	8			
ON	OFF	OFF	OFF	OFF	OFF	OFF	OFF	Worldwide	---	±0h
ON	OFF	OFF	OFF	ON	ON	OFF	OFF	Worldwide	---	+6h
ON	ON	OFF	ON	ON	OFF	ON	ON	Worldwide	---	-11:15h
OFF	OFF	ON	OFF	OFF	OFF	OFF	OFF	CET	30 minutes	+1h (fixed)
OFF	OFF	OFF	ON	ON	OFF	OFF	OFF	CET	3 hours	+1h (fixed)

hopf Elektronik GmbH
Nottebohmstr. 41 • D-58511 Lüdenscheid • Tel.: +49 (0)2351 9386-86 • Fax: +49 (0)2351 9386-93 • Internet: http://www.hopf.com • E-Mail: info@hopf.com

4.2 Operation in the CET Time Zone (Europe)

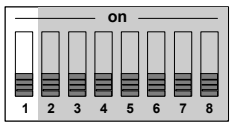
If the Board is configured for operation in the CET time zone, the time offset for the ***hopf*** Master/Slave-String is fixed and the ST/WT changeover is controlled by means of the information contained in the synchronisation signal.

Time offset: CET ⇨ UTC + 1h
(fixed at +1h) CEST ⇨ UTC + 1h +1h summertime offset

Changeover point of time + current time status (summer or wintertime) are taken from the synchronisation signal

As the Reception Board can be synchronised via a DCF77 antenna in this mode, a SyncOFF timer is provided by means of which reception failures caused by interference can be bypassed without the Reception Board switching into QUARTZ status and thereby leading to fault messages.

4.2.1 Setting for the CET Time Zone



DIP-Switch SW1 - Switch 1 = OFF

4.2.2 SyncOFF Timer for Reception Failure Bypassing (CET mode only)

DIP-Switch SW1 - Switches 2-7 ⇨ Bypass time

This value serves to bypass reception failure for operation free of fault messages in difficult reception conditions.

In the case of reception failure when synchronising via the DCF77 signal, the switching of the system synchronisation into QUARTZ status is delayed by the set value. During this time, the system continues to run in RADIO status on the internally regulated quartz basis.

This value can be adjusted between 0 minutes and15 hours and 45 minutes.
The time values selected via the DIP-switch are then added to the value for the SyncOFF timer (see ***Chapter 4.1 Summary of the Functions of the SW1***). The setting is primarily dependent on the freewheel accuracy required.

Freewheel accuracy calculation example

In order to calculate the maximum value to be set for the SyncOFF timer, the quartz's freewheel accuracy value is calculated in accordance with the required minimum accuracy of the system.

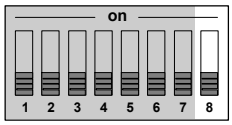
The accuracy of the internal quartz base is assumed to be ±2*10E-6 in this example. The required minimum accuracy is **10 msec.**

0.01s / (2 x 10E-6) = 5000s = **83 minutes 20 seconds**

hopf Elektronik GmbH
Nottebohmstr. 41 • D-58511 Lüdenscheid • Tel.: +49 (0)2351 9386-86 • Fax: +49 (0)2351 9386-93 • Internet: http://www.hopf.com • E-Mail: info@hopf.com

⇨ The **maximum** value which may be set for the SyncOFF timer is **83 minutes**

DIP-switch setting of 75 minutes for SyncOFF timer
(nearest possible value below 83 minutes)



DIP-switch SW1 - Switch 8 ⇨ no function in CET operating mode

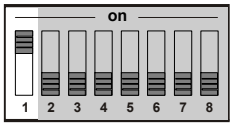
4.3 Operation in a Different Time Zone (Worldwide)

If the system is configured for worldwide application, the time offset for the respective time zone must be parameterised with the ***hopf*** Master/Slave-String for the correct synchronisation of a connected system. Settings for the changeover points of time are not required, as ST/WT changeover is controlled by means of the information contained in the synchronisation signal.

Time offset: Standard time (wintertime)⇨ set time offset
Summertime ⇨ set time offset +1h

Changeover point of time + current time status (summer or wintertime) are taken from the synchronisation signal

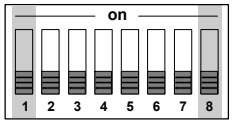
4.3.1 Configuration for Other Time Zones (Worldwide)



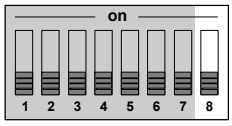
DIP-Switch SW1 - Switch 1 = ON

4.3.2 Setting the Time Offset for the *hopf* Master/Slave-String (Worldwide only)

The time offset can be set between ±13h at step intervals of 15 minutes. The time values selected via the DIP-switch are added to the time offset. The operational sign of the time offset is selected via DIP-switch 8 (see ***Chapter 4.1 Summary of the Functions of the SW1***).



DIP-Switch SW1 - Switches 2-7 = Time Offset



DIP-Switch SW1 - Switch 8 = Time Offset Operational Sign

hopf Elektronik GmbH
Nottebohmstr. 41 • D-58511 Lüdenscheid • Tel.: +49 (0)2351 9386-86 • Fax: +49 (0)2351 9386-93 • Internet: http://www.hopf.com • E-Mail: info@hopf.com

5 Antenna Alignment

The optimum alignment of the antenna can be calculated with this function.

hopf DCF77 antennas generally have directional characteristic (the arrow on the underside of the antenna housing must be aligned to the transmitter in Frankfurt am Main in order to guarantee optimum reception).

The System is not synchronized when the **'ALIGN ANTENNA'** function is active.

This function can also be used to test a DCF77 signal which is connected to the reception board via a DCF77 antenna switch or DCF77 antenna simulation.

It is possible to quit this function at any time by a reset. This mode is automatically ended after approx. 10 minutes.

The **'ALIGN ANTENNA'** principle is based on the fact that the minimum field strength of the signal can be calculated more easily than the maximum. This means that, for the alignment procedure, alignment is first calculated with the lowest field strength in order then to rotate the antenna by 90° (the direction of rotation is not important in this instance).

5.1 Alignment Procedure

Rotate the antenna with the marking in the supposed / known direction of Frankfurt am Main. Then start the antenna alignment program.

After pressing the T key the signal amplifier of the DCF77 receiver is re-aligned. After approximately 20 seconds the DCF77 receiver has calculated and stored the signal amplification required for the installation location.

The current field strength is shown by the time of illumination of the LEDs. The longer illumination of the LEDs per second is the higher is the field strength.

The received field strength changes if the antenna is rotated slowly. Since the amplification is fixed there is no readjustment of the amplifier. If the antenna is now rotated away from the direction of Frankfurt am Main then the field strength is reduced - and consequently also the illumination per second.

The minimum field strength has been determined when the antenna has been rotated in such a way that the LEDs only flashes per second or completely go out.

From this position the antenna is now rotated by 90° (in any direction). The alignment of the antenna is now complete.

When the LEDs are not shining or flashing unsteadily, e.g. short and minimum flashing followed by a longer shining (0.5 seconds), the DCF77 signal at the position of the antenna is considerably interfered. A clean reception is not guaranteed then.

In case the alignment takes longer than 10 minutes, the function must be started after that time period again.

hopf Elektronik GmbH
Nottebohmstr. 41 • D-58511 Lüdenscheid • Tel.: +49 (0)2351 9386-86 • Fax: +49 (0)2351 9386-93 • Internet: http://www.hopf.com • E-Mail: info@hopf.com

5.2 Signal Quality

The availability of field strength alone is not conclusive evidence that DCF77 reception is actually possible.

If there is no synchronisation after several hours even though the antenna has been aligned correctly, there are probably interferences of the DCF77 signal caused by conditions of surroundings at the current location of the antenna (see ***chapter 8.2.2 No DCF77 Reception / No Synchronisation***).

6 Resetting the Reception Board

A reset can be triggered on the Reception Board in two different ways. Following a reset, the Reception Board is in a defined condition and in INVALID status. Any active SyncOFF timer is also reset during the reset.
The configuration of the Reception Board remains unaffected by a reset.

Reset can be triggered in the following ways:

- **Pushbutton on the Front Panel**

  The pushbutton must be pressed for longer than 3 seconds in order to trigger a reset on the Reception Board

- **Input on the VG-Ledge**

  There is a reset input on the VG-ledge in TTL-level. This reset is triggered through the system control board when the board is installed in a ***hopf*** system with a system-BUS. This guarantees that the Reception Board will also be reset to a defined condition when the system is reset.

hopf Elektronik GmbH
Nottebohmstr. 41 • D-58511 Lüdenscheid • Tel.: +49 (0)2351 9386-86 • Fax: +49 (0)2351 9386-93 • Internet: http://www.hopf.com • E-Mail: info@hopf.com

7 Signal Output

The Reception Board transmits the received time information in two different time protocols.

7.1 DCF77 Pulse (1Hz)

The DCF77 pulse (1Hz) always transmits the local time to the Reception Board. These signals do not contain information about the synchronisation status of the transmitting (master) device. Thus, connected slave systems are always radio-synchronous with this signal; even if the transmitting device is running on its internal quartz base. For this reason the DCF77 pulse (1Hz) is only transmitted in RADIO status.

Further information about the DCF77 pulse (1Hz) can be found in ***Chapter 12.1 DCF77 (German Long-Wave Transmitter Frankfurt 77.5kHz)***.

7.1.1 DCF77 Pulse Output (1Hz)

The output of the DCF77 pulse (1Hz) takes place in TTL-level via the VG-ledge of the Reception Board. The signal is output as LOW-Active.

7.1.2 Output in INVALID / QUARTZ Status

In INVALID and QUARTZ status, a signal with a 2Hz pulse is transmitted instead of time information. No synchronisation of the connected system is possible when the signal is modulated in this way.

7.1.3 Output in RADIO Status

Output of the DCF77 pulse (1Hz) begins one minute after reaching RADIO status.

7.2 *hopf* Master/Slave-String

The ***hopf*** Master/Slave-String can be used to synchronize slave systems with the time data of the master system up to an accuracy of ± 0.5msec.

The ***hopf*** Master/Slave-String transmits:

- the full time information (hour, minute, second)
- the date (day, month, year [2 digits])
- the difference time local to UTC (hour, minute)
- the day of the week
- and status information (announcement of ST/WT changeover, announcement of a leap second and the status of reception of the Master/Slave-String source)

The following settings are required for the synchronisation of the ***hopf*** slave-systems:

- output every minute
- output second advance
- ETX on the second change; selectable: data string at the beginning or at the end of the 59. second.
- local time
- 9600 baud, 8 bit, 1 stop bit, no parity

This setting guarantees the best control of the time basis in the slave systems.

hopf Elektronik GmbH
Nottebohmstr. 41 • D-58511 Lüdenscheid • Tel.: +49 (0)2351 9386-86 • Fax: +49 (0)2351 9386-93 • Internet: http://www.hopf.com • E-Mail: info@hopf.com

7.2.1 Output *hopf* Master/Slave String

The ***hopf*** Master/Slave String is in TTL level given out on the VG ledge of the receiver board. The signal is LOW active.

7.2.2 Output by Status INVALID / QUARTZ

A string with zeros will be send:

Character No.	Meaning	Hex-Value
1	STX (start of text)	$02
2	0 (Null)	$30
3	0 (Null)	$30
4	0 (Null)	$30
5	0 (Null)	$30
6	0 (Null)	$30
7	0 (Null)	$30
8	0 (Null)	$30
9	0 (Null)	$30
10	0 (Null)	$30
11	0 (Null)	$30
12	0 (Null)	$30
13	0 (Null)	$30
14	0 (Null)	$30
15	0 (Null)	$30
16	0 (Null)	$30
17	0 (Null)	$30
18	0 (Null)	$30
19	0 (Null)	$30
20	LF (line feed)	$0A
21	CR (carriage return)	$0D
22	ETX (end of text)	$03

hopf Elektronik GmbH
Nottebohmstr. 41 • D-58511 Lüdenscheid • Tel.: +49 (0)2351 9386-86 • Fax: +49 (0)2351 9386-93 • Internet: http://www.hopf.com • E-Mail: info@hopf.com

7.2.2.1 Output by Status RADIO

Character No.	Meaning	Hex-Value
1	STX (start of text)	$02
2	status	$30-39, $41-46
3	day of the week	$31-37
4	tens hour	$30-32
5	unit hour	$30-39
6	tens minute	$30-35
7	unit minute	$30-39
8	tens second	$30-36
9	unit second	$30-39
10	tens day	$30-33
11	unit day	$30-39
12	tens month	$30-31
13	unit month	$30-39
14	tens year	$30-39
15	unit year	$30-39
16	difference time tens hour / operational sign	$30-31, $38-39
17	difference time unit hour	$30-39
18	difference time tens minutes	$30-35
19	difference time unit minutes	$30-39
20	LF (line feed)	$0A
21	CR (carriage Return)	$0D
22	ETX (end of text)	$03

The difference time is transmitted in hours and minutes following the year. The transmission is done in BCD. The difference time may be up to max. ± 13.00h.

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

logic **1** = local time before UTC
logic **0** = local time after UTC

Example:

Data String	Tens Difference Time Nibble	Difference Time
(STX)8312345603019**0**300(LF)(CR)(ETX)	**0000**	- 03:00h
(STX)8312345603019**1**100(LF)(CR)(ETX)	**0001**	- 11:00h
(STX)8312345603019**8**230(LF)(CR)(ETX)	**1000**	+ 02:30h
(STX)8312345603019**9**100(LF)(CR)(ETX)	**1001**	+ 11:00h

hopf Elektronik GmbH
Nottebohmstr. 41 • D-58511 Lüdenscheid • Tel.: +49 (0)2351 9386-86 • Fax: +49 (0)2351 9386-93 • Internet: http://www.hopf.com • E-Mail: info@hopf.com

7.2.2.2 Status

	b3	b2	b1	b0		Meaning
Status:	x	x	x	0		no announcement hour
	x	x	x	1		announcement (ST-WT-ST)
	x	x	0	x		standard time (WT)
	x	x	1	x		daylight saving time(ST)
	x	0	x	x		no announcement leap second
	x	1	x	x		announcement leap second
	0	x	x	x		crystal operation
	1	x	x	x		radio operation
Day of the Week:	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

Status	Operating Mode	Time	Changeover ST-WT-ST	Leap Second
0 = 0000	quartz	winter	no announcement	no announcement
1 = 0001	quartz	winter	announcement	no announcement
2 = 0010	quartz	summer	no announcement	no announcement
3 = 0011	quartz	summer	announcement	no announcement
4 = 0100	quartz	winter	no announcement	announcement
5 = 0101	quartz	winter	announcement	announcement
6 = 0110	quartz	summer	no announcement	announcement
7 = 0111	quartz	summer	announcement	announcement
8 = 1000	radio	winter	no announcement	no announcement
9 = 1001	radio	winter	announcement	no announcement
A = 1010	radio	summer	no announcement	no announcement
B = 1011	radio	summer	announcement	no announcement
C = 1100	radio	winter	no announcement	announcement
D = 1101	radio	winter	announcement	announcement
E = 1110	radio	summer	no announcement	announcement
F = 1111	radio	summer	announcement	announcement

7.2.2.3 Example

(STX)841234561807028230(LF)(CR)(ETX)

- It is Thursday 18.07.2002 - 12:34:56 o'clock
- radio operation
- standard time
- no announcement
- The difference time to UTC is +2.30 h

hopf Elektronik GmbH
Nottebohmstr. 41 • D-58511 Lüdenscheid • Tel.: +49 (0)2351 9386-86 • Fax: +49 (0)2351 9386-93 • Internet: http://www.hopf.com • E-Mail: info@hopf.com

8 System Indicators / Fault Analysis / Troubleshooting

Various indicators are available on the Reception Board for presentation of the system status and problem analysis.

8.1 Status and Fault Indicators

The system status and any faults occurring can be identified by means of the following elements:

8.1.1 Status LED's

The Board has status LED's on the front panel by means of which the current status of the Reception Board can be determined (see ***Chapter 3.1 Status LEDs***).

8.1.2 DCF77 Pulse (1Hz)

The DCF77 pulse (1Hz) is transmitted in RADIO synchronisation status only. A signal with a 2Hz pulse is transmitted in INVALID and QUARTZ status.

8.1.3 Serial Output

The serial datastring of the Reception Board is **always** transmitted provided that the Reception Board is connected to the power supply.

However, the construction of the string is different depending on the synchronisation status (see ***Chapter 7.2 hopf Master/Slave-String***).

Recording of the serial datastring (e.g. via "Hyperterminal") facilitates long-term analysis of reception status.

8.2 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.

8.2.1 Complete Failure

Description

- The LED's on the front panel are off
- No signal on DCF77 pulse (1Hz) output
- No signal output to the serial output

Cause / Solution

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

hopf Elektronik GmbH
Nottebohmstr. 41 • D-58511 Lüdenscheid • Tel.: +49 (0)2351 9386-86 • Fax: +49 (0)2351 9386-93 • Internet: http://www.hopf.com • E-Mail: info@hopf.com

8.2.2 No DCF77 Reception / No Synchronisation

The reception of time information via DCF77 is comparable to a bitwise serial data transfer. One bit is transmitted every second. The time can be evaluated after one minute has lapsed. For security purposes, ***hopf*** radio-controlled clocks require several successive, fault-free time telegrams in order to apply the time.

The antenna should be mounted as far away as possible from the following sources of interference:

- Television and computer monitors
- Lift shafts
- Nearby transmitters
- Electric motors
- Fluorescent lamps
- Phase-controlled electrical devices
- Inductive load switchgear
- Motor vehicle ignition equipment

Description

- The LED's on the front panel signal INVALID or QUARTZ status
- A 2Hz signal is transmitted instead of the DCF77 pulse (1Hz)
- The serial strings contain only noughts

Cause / Solution

- **DCF77 Antenna**
  - Reception via the DCF77 antenna is faulty
  - The antenna equipment is defective
- **DCF77 Antenna Simulation (77.5kHz)**
  - The system is not provided with the required signal
  - Transmission of the DCF77 antenna simulation (77.5kHz) is faulty
  - The transmitter for the DCF77 antenna simulation (77.5kHz) has failed

8.2.3 The connected Slave System is not synchronous

Description

- The Reception Board is in RADIO status
- The slave system still does not become synchronous after 10-15 minutes

Cause / Solution

- The connection between the Reception Board and the slave system has not been made correctly or is faulty
- The slave system is not set to the correct synchronisation source

hopf Elektronik GmbH
Nottebohmstr. 41 • D-58511 Lüdenscheid • Tel.: +49 (0)2351 9386-86 • Fax: +49 (0)2351 9386-93 • Internet: http://www.hopf.com • E-Mail: info@hopf.com

8.2.4 The connected Slave System synchronises with an incorrect time

Description

- The Reception Board is in RADIO status
- The slave system displays an incorrect local time and/or UTC time

Cause / Solution

- An incorrect time base was set up when connecting to the Reception Board using DCF77 antenna simulation (77.5kHz)
- The Reception Board was configured incorrectly
- The slave system is configured incorrectly

8.2.4.1 Incorrect Local and UTC Time in the Slave System

Description

- Transmitted **Local Time and UTC Time** are at variance with the respective current time

Cause / Solution

- The Reception Board is synchronised with DCF77 antenna simulation (77.5kHz) which was **not** set correctly (incorrect time base, incorrect operating mode)

8.2.4.2 Only UTC Time is incorrect in the Slave System

It is assumed that the local time is correct in this case.

Description

- Only the **UTC Time** of the slave system is at variance with the current time

Cause / Solution

- The slave system is synchronised with the ***hopf*** Master/Slave-String and the time offset for the ***hopf*** Master/Slave-String on the Reception Board is set incorrectly
- The slave system is synchronised with the DCF77 pulse (1Hz) and the application territory is not within the CET time zone.
  If the "Synchronisation with DCF77 Pulse (1Hz) WORLDWIDE" mode is missing in the slave system or is incorrectly configured, the UTC time is calculated on an incorrect basis.

8.2.4.3 No Summertime/Wintertime Changeover in the Slave System

Description

- The slave system time is at variance with the actual time following a summertime/wintertime changeover.

Cause / Solution

- The Reception Board is **not** permanently in RADIO status
- The Reception Board is synchronised with DCF77 antenna simulation (77.5kHz) which was **not** set correctly

hopf Elektronik GmbH
Nottebohmstr. 41 • D-58511 Lüdenscheid • Tel.: +49 (0)2351 9386-86 • Fax: +49 (0)2351 9386-93 • Internet: http://www.hopf.com • E-Mail: info@hopf.com

8.2.5 No DCF77 Pulse (1Hz) Output

Description

- Board in operation
- The Reception Board does not transmit a DCF77 pulse (1Hz)

Cause / Solution

- The Reception Board is **not** in RADIO status
  (No reception or SyncOFF timer expired)
- If no 2Hz pulse is transmitted either, the output on the Board is defective or the connection is not made correctly

8.2.6 No Output of the Serial *hopf* Master/Slave-String

Description

- Board in operation
- The Reception Board does not transmit a *hopf* Master/Slave-String

Cause / Solution

- The Reception Board is **not** in RADIO status
  (No reception or SyncOFF timer expired)
- If, in addition, a blank string is not transmitted every minute, the output on the Board is defective or the connection is not made correctly

8.3 Support from the *hopf* Company

Should the System demonstrate error descriptions other than those listed in ***Chapter 8.2 Fault Scenarios***, please contact Support at ***hopf*** Elektronik GmbH with an exact description of the fault and the following information:

- Serial number of the System
- Occurrence of the error during commissioning or operation
- Exact error description
- In the case of DCF77 reception/synchronization problems ⇨ description of the antenna equipment used:
  - Components used (antenna, indirect lightning protector, etc.)
  - Cable type used
  - Total length of the antenna equipment
  - Sequence of components and cable lengths between the components
  - Antenna installation position (e.g. signal shading by building)

  and
  - Settings of DIP switch SW1

Please write to the following E-mail address: **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.

hopf Elektronik GmbH
Nottebohmstr. 41 • D-58511 Lüdenscheid • Tel.: +49 (0)2351 9386-86 • Fax: +49 (0)2351 9386-93 • Internet: http://www.hopf.com • E-Mail: info@hopf.com

9 Maintenance / Care

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

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

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

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

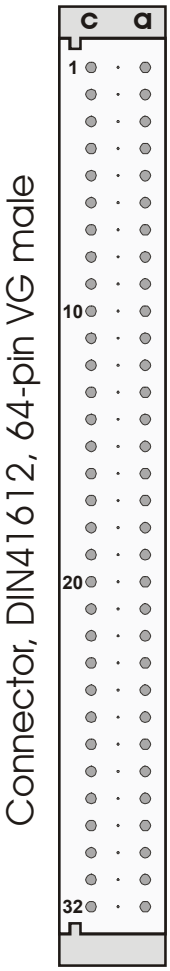
Do not use a wet cloth to clean the board.
There is the danger of an electric shock.

To clean the receiver board use a cloth that is:

- Antistatic
- Soft
- Non-fabric
- Damp

hopf Elektronik GmbH
Nottebohmstr. 41 • D-58511 Lüdenscheid • Tel.: +49 (0)2351 9386-86 • Fax: +49 (0)2351 9386-93 • Internet: http://www.hopf.com • E-Mail: info@hopf.com

10 Assignment of the VG ledge 64-pole



Connector, DIN41612, 64-pin VG male

Connector, DIN 41612, 64-pin VG male			
Pin	**c**	**a**	**Pin**
1	n.c.	n.c.	1
2	n.c.	n.c.	2
3	**TxD**	n.c.	3
4	n.c.	n.c.	4
5	n.c.	n.c.	5
6	n.c.	n.c.	6
7	n.c.	**GND**	7
8	n.c.	n.c.	8
9	n.c.	**GND**	9
10	n.c.	n.c.	10
11	**GND**	n.c.	11
12	n.c.	n.c.	12
13	n.c.	n.c.	13
14	n.c.	**GND**	14
15	n.c.	n.c.	15
16	n.c.	n.c.	16
17	n.c.	n.c.	17
18	n.c.	n.c.	18
19	n.c.	n.c.	19
20	n.c.	n.c.	20
21	**RESET**	n.c.	21
22	n.c.	**DCF77 pulse (1Hz)**	22
23	n.c.	n.c.	23
24	n.c.	n.c.	24
25	n.c.	n.c.	25
26	n.c.	n.c.	26
27	n.c.	n.c.	27
28	n.c.	n.c.	28
29	n.c.	n.c.	29
30	n.c.	n.c.	30
31	**GND**	**GND**	31
32	**+5V**	**+5V**	32

n.c. = not connected
Row **b** = not connected

Signal	**Pegel**	
Reset	TTL	Low active
DCF77 Takt (1Hz)	TTL	Low active
TxD / ***hopf*** M/S String	TTL	Low active

hopf Elektronik GmbH
Nottebohmstr. 41 • D-58511 Lüdenscheid • Tel.: +49 (0)2351 9386-86 • Fax: +49 (0)2351 9386-93 • Internet: http://www.hopf.com • E-Mail: info@hopf.com

11 Technical Data DCF77 Reception Board

General Data	
Operation/Configuration:	Via pushbuttons on the front panel and DIP-switches on the Board
Dimensions:	Euro-Board 160mm*100mm with 3U/4HP front panel
MTBF:	> 600,000 hours
Weight:	approx. 0.15 kg

DC Power Supply 5V	
Nominal Input Voltage:	5V DC
Input Voltage Range:	4.75-5.25V DC
Power Consumption (at nominal values):	Typically 70mA / max. 75mA

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

CE Conformity to EMC Directive 89/336/EC and Low Voltage Directive 73/23/EC	
Safety / Low Voltage Directive:	DIN EN 60950-1:2001 + A11 + corrigendum
EN 61000-6-4:	
EMC (Electromagnetic Compatibility) / Interference Immunity:	EN 610000-4-2 /-3/-4/-5/-6/-11
EN 61000-6-2:	EN 61000-3-2 /-3
Radio Noise Voltage EN 55022:	EN 55022 Class B
Radio Interference Radiation EN 55022:	EN 55022 Class B

Accuracy – for DCF77 Reception via Antenna	
Internal PPS Pulse on DCF77 Reception:	< ± 2 msec compared with the DCF77 signal at the location of the antenna
VCO Regulation of the internal Quartz Base:	< ± 2ppm, after min. 1 hour of DCF77 reception
Freewheel Accuracy:	< ± 2ppm after min. 1 hour of DCF77 reception / T = +20°C • Drift for T = +20°C (constant): - after 1h: 7.2msec. - after 24h: 172.8msec.

Signal Outputs	
Serial Interfaces (TxD only):	Via VG-ledge in TTL-level (LOW Active)
DCF77 Pulse (1Hz):	Via VG-ledge in TTL-level (LOW Active)
Signal Inputs	
Reset:	Via VG-ledge in TTL-level (LOW Active)

Special Production:

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

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

hopf Elektronik GmbH
Nottebohmstr. 41 • D-58511 Lüdenscheid • Tel.: +49 (0)2351 9386-86 • Fax: +49 (0)2351 9386-93 • Internet: http://www.hopf.com • E-Mail: info@hopf.com

12 Appendix

12.1 DCF77 (German Long-Wave Transmitter Frankfurt 77.5kHz)

DCF77[1] is a time signal that is radiated via a terrestrial long-wave transmitter in Frankfurt, Germany, with a carrier frequency of 77.5kHz.

The transmission of the data is amplitude modulated whereas the transmission of the time information is bit serial.

12.1.1 DCF77 General

The DCF77 signal transmits central European time (CET) or central European summer time (CEST). This time is calculated from UTC plus one hour (CET) or two hours (CEST).

The DCF77 signal contains complete time information: minute, hour, day-of-week and date. The following information is transmitted:

- Local time
- Current time zone (ST or WT)
- Announcement bit for ST/WT changeover
- Announcement bit for the leap second

If UTC is to be calculated from the local time transmitted by DCF77 then the receiver must know the time offset (local time to UTC). In the CET zone this is +1 hour in an easterly direction. A ***hopf*** system calculates the correct UTC time from the local time, via the internally set time offset and the ST/WT changeover points.

12.1.1.1 DCF77 Signal Structure

The complete time information is transmitted in every minute. A part of time information is transmitted every second of every minute, with the exception of the 59th second. The missing signal in this second gives notice of an impending minute change in the next second.

The amplitude of the 77.5kHz carrier frequency is reduced from 100% to 25% at the beginning of every second for a duration of 100 or 200ms (amplitude modulation). The beginning of each reduction marks the precise second change.

The duration of reductions of 100 and 200ms (binary 0 and 1) is converted into a BCD code and in this way decodes the transmitted time telegram.

The data string is sub-divided into different groups. Three of them followed by a parity check:

- P1 = parity of minutes
- P2 = parity of hours
- P3 = parity of current day-of-year, day-of-week, month and year

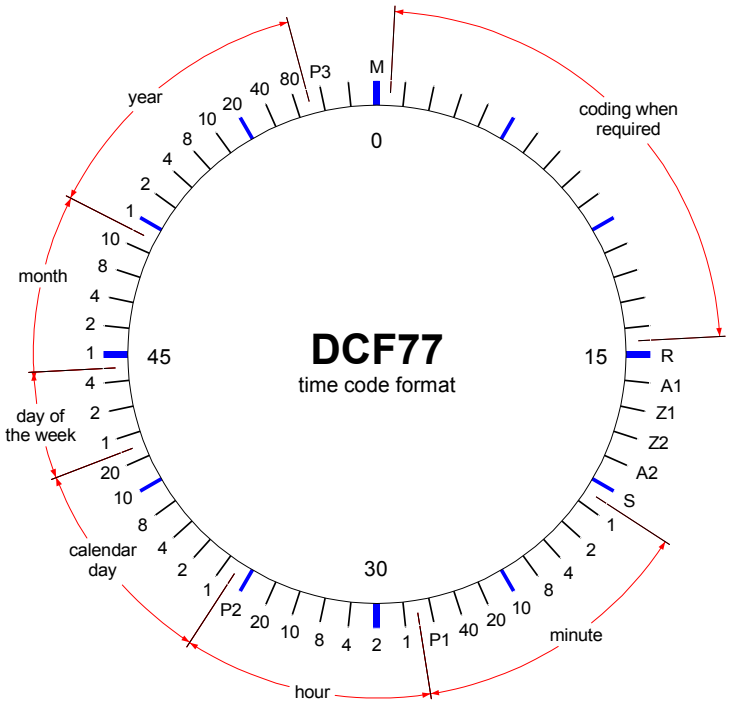
The binary 1s' of a group are calculated and supplemented with the parity bit to form an even number.

[1] DCF77: **D** = Deutscher (German), **C** = Long-wave transmitter, **F** = Frankfurt, **77** = frequency

hopf Elektronik GmbH
Nottebohmstr. 41 • D-58511 Lüdenscheid • Tel.: +49 (0)2351 9386-86 • Fax: +49 (0)2351 9386-93 • Internet: http://www.hopf.com • E-Mail: info@hopf.com

When valid time information is transferred from CEST, the 17th second mark has a duration of 200ms. One hour before changeover from CEST to CET, or vice-versa, the 16th second mark has a duration of 200ms.

The coding is shown in the following illustration:



M	Minute mark (100msec.)
R	The second mark no. 15 has a duration of 200msec. when radiation takes place via the standby antenna.
A1	Announcement of an imminent change from CET to CEST or vice-versa.
Z1, Z2	Time zone bits
A2	Announcement of a leap second
S	Start bit of the coded time information
P1, P2, P3	Test bits

hopf Elektronik GmbH
Nottebohmstr. 41 • D-58511 Lüdenscheid • Tel.: +49 (0)2351 9386-86 • Fax: +49 (0)2351 9386-93 • Internet: http://www.hopf.com • E-Mail: info@hopf.com

12.1.1.2 Advantages and Disadvantages DCF77

+ DCF77 receivers are generally less expensive than GPS receivers
+ Reception of the legal time in Germany
+ The antenna can be installed inside a building under favorable conditions (no lightning protection or expensive laying of antenna cable is necessary)
- Sensitive to interference signals (atmospheric interference or radiation from electric motors, monitors or other switched, inductive loads)
- Installation limited to within approx. 1500km of Frankfurt, Germany
- Transmitter may be switched off when there is bad weather at the transmission location
- Lower short-term accuracy when compared with GPS

12.1.2 DCF77 Generation by *hopf* Clocks

hopf clocks can simulate the DCF77 signal for other clocks in order to operate DCF77 clocks in locations where the DCF77 signal is not available.

This can realized as DCF77 antenna simulation (77.5kHz) and also as DCF77 pulse (1Hz).

12.1.2.1 DCF77 Signal Simulation (77.5kHz)

An analogue, amplitude-modulated carrier signal is generated by the clock system. A connected, standard DCF77 radio-controlled clock is unable to differentiate this signal from an "original" DCF77 signal received via an antenna. It is also possible to use time bases other than only CET/CEST to simulate the signal.

The term **DCF77 Antenna Simulation** or, in short, **DCF77 Sim** is commonly used in ***hopf*** literature to describe this term.

12.1.2.2 DCF77 Pulse (1Hz)

The DCF77 pulse uses the same coding procedure as that used by the DCF77 signal radiated by the transmitter. The difference lies in the fact that an amplitude-modulated carrier signal is not used for transmission. The 100 and 200msec. long reductions are represented by logical signal levels.

In this digital form the signal can then also be transmitted via a fiber optic cable, for example.

hopf Elektronik GmbH
Nottebohmstr. 41 • D-58511 Lüdenscheid • Tel.: +49 (0)2351 9386-86 • Fax: +49 (0)2351 9386-93 • Internet: http://www.hopf.com • E-Mail: info@hopf.com