Technical Description

DCF Slave / Quartz Clock

7001 DCFS / QRTZ

hopf Elektronik

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1 Brief Description System - 7001

The ***hopf*** system 7001 is a multiprocessor system of modular design. Each master circuit board of this Euroboard system contains its own microprocessor; time critical tasks on the boards themselves are thus easy to execute. The modular concept allows an individual configuration of systems according to customers specifications. Furthermore, this concept ensures simplified servicing.

Board 7015

This board replaces the circuit board 7010 and being a control board belongs to the basic system. DCF77 [1] as well as GPS [2] receivers can be connected to this board.

Board 7017/ 7019

This board contains the GPS receiver for the world-wide operation of the ***hopf*** system 7001.

Board 7112/ 7121

By means of the optical-coupler or relay board up to 24 bit can be put out potential free. 8 potential free entries are available for the output control. The optical-coupler and relay boards are pin compatible.

- Board 7112 optical-coupler board
- Board 7121 relay board.

Board 7200/7201

The serial interface board 7200 / 7201 sends a time data string either via a RS232c (V.24), RS422 (V.11) or a passive TTY interface. The transmission format and the output mode can be selected by a DIP switch on the board.

Board 7210

This board receives the transmit data string TxD at TTL level from the 7200/7201 or 7221/ 7221 mains boards and multiplies it via 4x RS232-, 4x RS422- and 4x TTY hardware.

Board 7220/ 7221

This serial interface board contains a full duplex interface and 7 multiplied transmit data strings via RS232 and RS422 hardware.

Board 7230

IRIG-B Decoder

This board is used to transmit the DCF77 synchronised time information on TTL level and modulated with 1 kHz carrier. At the same time it is possible to display an externally modulated time information in IRIG-B format.

Board 7240/ 7245

This board contains a serial full-duplex interface and 4 multipliers for the transmission line TxD. The interface hardware is designed for the RS232- and RS422-level. All the interfaces are set potential free to each other and to the lower logic. There are also 4 potential free minute-pulses available.

[1] DCF77 = (D) german - (C) long wave signal - (F) Frankfurt a. M. - (77) 77,5 kHz
[2] GPS = global positioning system

Board 7250

IRIG-A Decoder

This board is used to transmit the DCF77 synchronised time information on TTL level, and modulated with 10 kHz carrier. At the same time it is possible to display an externally modulated time information in IRIG A-format.

Board 7317

This board contains 4 potential free , simulated DCF77-antenna circuits, thus enabling other radio controlled clocks to be synchronised the antenna input.

Board 7400/ 7405

This board contains all the units necessary for the output of two independent clock lines.

Board 7500

This universal clock generator board can be used for special operations requiring a higher crystal accuracy. Time deviation of max. 0.1 ppm can be reached.

Board 7515

The circuit board 7515 is structured so that it can function at the bus of the clock system 7001 or as a separate clock in the large display 4980. The board contains an independent microprocessor system for the following tasks:

- calculation of the mains frequency
- serial interface to large displays or to superior computers
- bus interface
- calculation of the NET time
- calculation of the difference time in ms
- calculation of the difference frequency mains / GPS in MHz
- AD-converter for the power display in MW

2 Introduction

The since 1985 well proved ***hopf*** radio- quartz clock system 7000 and 7001 respectively has been extended by a GPS receiver unit. This makes it possible to use this time basis world-wide with utmost precision.

In the standard system the time was synchronised by the local time code transmitters DCF77, which transmit the local time within the longwave range (77.5 kHz). The reception is limited to a distance of 2000 to 3000 km around transmitter. A world-wide use is possible with GPS.

In the present version the system is not synchronised via the DCF77 receiver on the board 7015, but via a serial data string from a different ***hopf*** master system

3 Set-Up

3.1 Voltage Supply

The system can be delivered with different voltages. It is therefore important to check that voltage and polarity are correct before connecting to power.

The following supplies are available:

- 240 V AC +10%, -15% (standard)
- 120 V AC +10%, -15% (option)
- 110 V DC (60 V - 120 V) (option)
- 60 V DC (38 V - 75 V) (option)
- 24 V DC (18 V - 36 V) (option)

Further supply voltages are available on request.

3.2 DCF-Slave System (DCFS)

The DCF-Slave System can be synchronised by a serial data string. A different hopf system or a strange one with the according data string can operate as the master system. The link may be a RS232 interface. But this requires a circuit board 7200 / 7201 in the system. If an RS422 interface is available the board 7200 / 7201 is not necessary. The data string is fed directly into the RS422 interface of the board 7015 (see 5).

3.3 Quartz-System (QRTZ)

The clock of the crystal system can be controlled either by the internal crystal of the board 7015 or the system, if a higher accuracy is required, can be extended by the board 7500 whose oven-stabilised crystal reaches an accuracy of 0.1ppm.

3.4 Set-Up Basic System

Connect the correct operating voltage and then switch the device on via the power switch.

display

The 2x40 digit VFD display shows the following picture after power-on.

***hopf*-Elektronik DCF-Empfänger**
Programmstand vom 20.JUL. 93 REV. 1.0

This picture stays on display for about 3 seconds. Afterwards , in case of a first installation or after at least 3 days without voltage supply, the following picture appears:

L-TIME: [1]00:00:00 [2]-- / [3]-- / --- / -- [4]--- DCFS
UTC: [5]00:00:00 [6]-- / [7]-- / --- / -- [8]C [9]10 -06

The positions have the following meaning:

[1] **L-TIME :** 00:00:00
These spaces show the local time.

[2] Display of the abbreviation for the day of the week
MO - DI - MI - DO - FR - SA - SO (MO - TU - WE - TH - FR - SA - SU)

[3] Display of the date:
day/ abbr. of month/ year

[4] status display:

Position 1 X--	**"D"**	for summertime (Daylight-Time).
	"S"	for standard or wintertime.
Position 2 -X-	**"A"**	announcement of changeover to a different time zone. this announcement occurs 1 hour before the changeover.
Position 3 --X	**"A"**	announcement of a leap second this information is given 1 hour before the leap second is inserted

DCFM = DCF-Mastersystem / DCFS = DCF-Slavesystem

[5-7] In this position the UTC time is displayed, together with the local time.

[8] shows the internal status of the clock system
"C" = the clock system runs in crystal operation
"R" = the clock system runs on DCF77 reception at highest accuracy (R=radio)

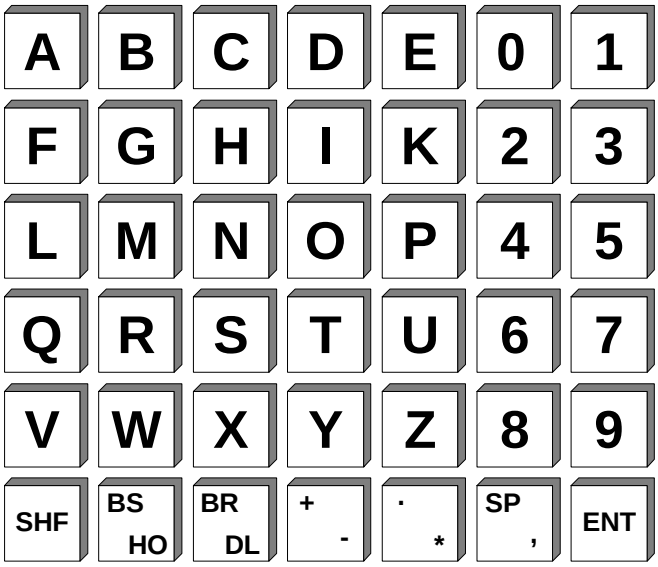
[9] here the crystal accuracy the clock is running at is shown, the display starting with **10 -06**. This means the accuracy of the crystal is $10x10^{-6}$ = 1ppm. DCF77-control adjusts the crystal to **02 -06** ($2x10^{-6}$) .

After a normal power cut <3 days, the display starts with back-up clock information updated internally.

4 Key-Pad

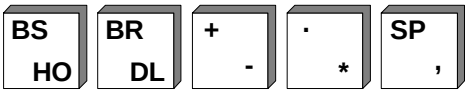
The key-pad consists of 42 keys, 5 keys fulfil double functions. The second function on the double-function-keys is selected via the key SHF (shift) and is valid only for the next key entry.

4.1 Design



4.2 Key Functions

A ... Z entry of the alphabet in capital letters (without J)
0 ... 9 entry of the digits
SHF shift function of the keys:



BS BS = BACKSPACE, deletes the last entry.
HO HO = home, deletes the whole line.

BR BR = BREAK, stops all key controls.
DL DL = delete, not used at the moment.

+ entry of the sign for the digits.
-

. entry full stop, asterisk
*

SP entry of a free display-space.
, entry of the comma

4.2.1 Key-Entry / System Control

The key pad is activated by pressing **"ENT"**.

The display jumps from the standard picture, display of the time information, to the start picture for key-pad or system control. At the moment 6 entry- or control modes are offered in this picture. Entering the according digit moves the key entry into the according mode.

start-up screen:

KEY: K SET: 1 SHOW: 2 INI: 3 MON: 4 S.-CLK: 5
PROG.-R: R MASTER-R: M INPUT 1-5: R ,M

The individual modes have the following meaning:

SET:	entry of set functions like time/date, position, time offset etc.
SHOW:	select display functions like time difference, position etc.
INI:	initialising-function, manufactures internal use only.
MON:	monitor function, manufactures internal use only.
PROG.-R:	by entering the **"R"** for PROG.-R the programme on the board is set back, i.e. programme restart.
MASTER-R:	Entering the **"M"** releases a hardware-master-reset of the whole system. All the boards contained in the system are set back and restarted.
S.-CLK:	select special functions

4.3 SET-Functions

When you enter the digit 1 the programme jumps into the field of set-functions. The programme is constructed as user menu. Every sub-function is displayed and selected by

"Y" = yes or turned down by

"N" = no.

When entering **"N"** the next sub-function is displayed, for the time being only the following set-functions can be selected.

4.3.1 Time / Date Entry

Select screen

INPUT TIME / DATE Y / N
HH.mm.ss..d.DD.MM.YY.Z Z = D or S

Entry Picture

LOC.-TIME HH.mm.ss..d.DD.MM.YY.Z
> **<**

By means of this entry function the local time can be set. The entry is done in the second line between the arrows >...< and must be complete. This necessarily includes the entry of points and leading naughts.

The individual positions have the following meaning:

HH	hour	range from 00 - 23
mm	minute	" from 00 - 59
ss	second	" from 00 - 59
d	day of the week	" from 1- 7
	1 represents Monday ... 7 represents Sunday	
DD	day	range from 01 - 31
MM	month	" from 01 - 12
YY	year	" from 00 - 99
Z	time zone D or S	

Many countries change their time zone during the course of the year. In this position the valid time zone for the entered time information is set.

Enter **D** represents the summer time or daylight time zone.

Enter **S** represents the winter time or standard time zone.

In countries without time zone changeover, **"S"** for standard time is to be entered.

All entries are taken over by the key **"ENT"**.

If the entry is plausible, this time is taken over into the system, otherwise the information **"INPUT-ERROR"** appears for 3 seconds. In both cases the set-functions is left, the standard picture appears on display.

4.3.2 Data Securing

All entry data of the pt. 4.3-4.3.1 are checked for plausibility and then stored in a fail-safe memory in an EEPROM. A **PROG.-R** or **M.-RESET** is carried out to check these values, thus achieving that the stored values in the EEPROM are read back into the working memory.

4.4 Checking the Entered Values

If you want to check the entered or updated values, by the DCF-master, call up the **SHOW** function.

After jumping to the basic picture for the key-pad by pressing **"ENT",** enter the digit **"2".**

The first **SHOW** request picture appears**.**

The SHOW function can be stopped by **"BR / DL" =** BREAK at any time**.**

4.4.1 Time Difference

This function shows the difference-time between local time and UTC.

select screen

TIME OFFSET Y/N

Pressing the **"Y"** key calls up the following picture, e.g.:

TIME-OFFSET: +02:00
EAST + WEST -

When any key but **"Y"** is entered the display moves to the next request picture.

4.4.2 Timezone Changeover S ⇨ D

(only active with crystal clocks)

This function shows the points of changeover from standard time (wintertime) to daylight time (summertime). It also shows if this changeover is still active or if it has passed.

request picture

STANDARD / DAYLIGHT CHANGE-OVER Y/N

Pressing the **"Y"** key calls up the time difference with the following display e.g.:

TIME S > D DONE
02:00:00 SU 30/MAR/92

The changeover occurred on Sunday, 30. March 92 at 2.00 h or

TIME S > D ACTIVE
02:00:00 SU 30/MAR/92

The changeover will be on Sunday, 30. March 92 at 2.00 h.

As this date has elapsed already the changeover is not carried out. A passed date is entered in countries which have no winter/summer changeover or do not want one.

4.4.3 Timezone Changeover D ⇨ S

(only active in crystal clock systems)

This function shows the point of changeover from daylight-time (summertime) to standard time (wintertime).

request picture

DAYLIGHT / STANDARD CHANGE-OVER Y/N

Pressing the **"Y"** key call up the following picture, e.g.:

TIME D > S AKTIVE
03:00:00 SU 27/SEP/92

The changeover occurs on Sunday 27. September at 3.00 h or

TIME D > S DONE
03:00:00 SU 27/SEP/92

The changeover has been carried out.

4.4.4 Alignment of the Antenna

This function shows the relative field strength.

request picture

ANTENNA ALIGNMENT Y/N

Pressing the **"Y"** key calls up the following picture:

BITTE 20sec. WARTEN
PLEASE WAIT 20sec.

Please note : The slave clock is synchronised by the master. Function is irrelevant.

4.5 *Choice of Special Functions*

Via the menu item **S.CLK** the extension boards integrated in the system can be addressed. Pressing **"5"** changes over to a selection dialogue.

The following special functions can be called up.

- **SLAVE - CLOCK MANIPULATION Y/N**
  Master clock function: setting, start- and stopping of analogous slave clocks.
  Requires master clock board 7400 in the system.
  Further information in the appendix ,if board exists.

- **IRIG- A TIME CODE MANIPULATION Y/N**
  Display and entry of control values for the IRIG - A- time code output.
  Requires board 7250 in the system.
  Further information in the appendix , if board exists.

- **IRIG - B TIME CODE MANIPULATION Y/N**
  Display and entry of control values for the IRIG - B- time code output.
  Requires board 7230 in the system.
  Further information in the, appendix if board exists.

- **TIME- SWITCH MANIPULATION Y/ N**
  Display, entry etc. of switching times.
  Requires boards 7131 and 7140 in the system.
  Further information in the appendix if board exists.

- **NET - TIME MANIPULATION Y/N**
  Synchronisation of network times.
  Requires board 7515 in the system.
  Further information in the appendix , if board exists.

4.6 Summary Key Pad

- The key pad is activated by pressing the key **"ENT"**.
- Selection of functions by **"1"** to **"5"**.
- Switching to standard picture by **"BR / DL"** = BREAK.
- Completion of entry by **"ENT"**.
- Selection of functions by **"Y"**.
- Continue function by **"N"** or any other key except **"BR / DL"** =BREAK
- Plausibility errors are indicated by **INPUT-ERROR**, new selection and entry is necessary.

Please note : In case of a higher data flow rate on the bus (many extension boards installed) it can happen that the key entry is not accepted immediately.

In this case stop the entry by pressing **"BR / CL"** and start the editing process again.

4.6.1 Set Functions

T = tens
S = unit

- Local Time

hour	T	H	0-2
hour	S	H	0-9
.			
minute	T	m	0-5
minute	S	m	0-9
.			
second	T	s	0-5
second	S	s	0-9
.			
.			
day of the week		d	1-7
.			
day	T	D	0-3
day	S	D	0-9
.			
month	T	M	0-1
month	S	M	0-9
.			
year	T	Y	0-9
year	S	Y	0-9
.			
time zone			D or S

- Time Offset

sign +-	+ or -
hour	0-1
hour	0-9
.	
minute	0 or 3
minute	0

- Time Zone Point of Changeover
  data string like local time

4.6.2 Display Functions

- time offset
- standard / daylight changeover
- daylight / standard changeover
- alignment of antenna

4.7 Set-Up

- connect the coupling of the serial interface
- connect voltage
- switch on voltage
- enter local time (for crystal clock systems)
- enter time difference (for crystal clock systems)
- enter point of changeover **S** ⇨ **D** (for crystal clock systems)
- enter point of changeover **D** ⇨ **S** (for crystal clock systems)
- release programme reset
- view difference time
- view position
- view point of changeover **S** ⇨ **D**
- view point of changeover **D** ⇨ **S**
- release master reset

5 Data String Format DCF77-Synchronisation

The synchronisation data string is inserted into the system via the board 7200 / 7201 with RS232 coupling or via the board 7015 with RS422 coupling.

A high baud rate is required to achieve a synchronisation of ± 0.5 msec. The synchronisation data string must have the following transmission parameter:

- baudrate : 9600 Baud
- parity-bit : no Parity
- stop-bit : 1 Bit
- word length : 8 Bit

These parameter are pre-programmed in the DCF-slave system.

The synchronisation data string has the following structure:

character no.:	meaning	value (value range)
STX	control ch. "start of text"	$02
STATUS		$30-39, 41-46
DAY OF WEEK		$31-37
HOUR	Tens digit	$30-32
HOUR	Unit digit	$30-39
MINUTE	Tens digit	$30-35
MINUTE	Unit digit	$30-39
SECOND	Tens digit	$30-35
SECOND	Unit digit	$30-39
DAY	Tens digit	$30-33
DAY	Unit digit	$30-39
MONTH	Tens digit	$30-31
MONTH	Unit digit	$30-39
YEAR	Tens digit	$30-39
YEAR	Unit digit	$30-39
LF	Line Feed	$0A
CR	Carriage Return	$0C
ETX	End of Text	$03

5.1 Status

4 bit are transmitted as ASCII-characters in the status.

The bit combination 0..9 as ASCII-numbers and A..F ass ASCII-letters A..F

The bits have the following meaning:

B3	B2	B1	B0	meaning
1	x	x	x	master-system in radio operation
0	x	x	x	master-system in crystal operation
x	1	x	x	announcement of leap second
x	0	x	x	no leap second
x	x	1	x	summertime
x	x	0	x	wintertime
x	x	x	1	announcement of timezone changeover
x	x	x	0	none

5.2 Synchronisation

The slave system is synchronised by means of the data string. The data string is transmitted every second with the data for the next second. These data are decoded in the slave system and held ready for take-over as valid time. The ETX is transmitted exactly on the second change. The data are taken over with the ETX and the internal millisecond counter is set to 1 (1 character at ≈ 1 msec. transmission time). After the initial synchronisation of the system synchronisations are carried out only once a minute.

6 Technical Data Basic System

operating voltage	standard:	240 V AC +10% -15%
	option:	120 V AC +10%, -15% 110 V DC (60 V - 120 V) 60 V DC (38 V - 75 V) 24 V DC (18 V - 36 V)
power consumption system fully equipped:		50 VA
display:		VFD display 2x40 digits
type of display:		alphanumerical
height of digit:		5 mm
colour:		green
synchronisation accuracy		± 0.5 msec.
crystal accuracy:		± 10 ppm ± 0.2 ppm at 25°
back-up clock accuracy:		± 25 ppm
maintenance free back-up clock buffering:		3 days
key pad:		42 keys

Special productions:

Hard- and software alterations according to customer specifications are available.

Please note : The ***hopf*** company withhold the right to hard and software alterations at any time.