Technical Description

Base System

7001DCF77

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 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 has replaced the circuit board 7010 and belongs as a control board to the base equipment of the system 7001. DCF77-reception[1], key pad and display control as well as bus communication are its tasks.

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 7220 / 7221 master boards and multiplies it via 4 x RS232-, 4 x RS422- and 4 x TTY active or passive interface.

Board 7220 / 7221

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

Board 7245

This board contains a 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.

Board 7250

IRIG-A Decoder

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

[1] DCF77 = (D) German - (C) long wave signal - (F) Frankfurt - (77) 77,5 kHz

Board 7265

The board has 4 analogue dip switches with 4 inputs each. Those inputs supply the signals generated on the board itself as IRIG B 12x, IRIG B 00x and PPS pulse and an external input for the frequency boards 7530 and 7550.

The inputs are interconnected to the outputs via DIP switches. The output signals are provided at BNC female connectors.

Board 7270

This board is equipped with an Ethernet-interface 10BaseT which can operate as time-server in local networks. The various configurations can be set by means of the key-pad. NTP as well as the SINEC-H1 string can be used as time protocols.

Board 7317

This board contains 4 potential free antenna amplifiers.

Board 7406

This board contains all the units necessary for the output of two independent synchronous clock lines for pole changing pulse mode and DCF77 time code clocks.

Board 7500

This universal-clock-generator can be used for special cases which require a higher quartz accuracy. Time deviations maximum of 0,1 ppm can be reached.

2 Introduction

The ***hopf*** radio-quartz clock system 7000, well proved since 1985, has received a new base circuit board (7015), which allows the system to be synchronized by DCF77 and also - if extended by the board 7019, by GPS[2].

The time synchronization of the standard system is carried out by the stationary time-code transmitter DCF77, MSF and WWVB, which transmit the local or the UTC[3] time resp. in the long wave range (60-90 kHz). The reception limit lies at about 2000 to 3000 km around the transmitter. GPS allows a world wide use.

[2] GPS= Global positioning system
[3] UTC = Universal time coordinated

3 Set-up

3.1 Voltage Supply

As the system can be delivered with many different voltage supplies it is necessary to take the right voltage and polarity into account when connecting the voltage.

The following standard supplies are available:

- 230 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)

Other voltage supplies are available on request.

3.2 Align Antenna

All ***hopf*** antennas (except 4437 all-round reception) are antennas with directional pattern. These antennas must be aligned to Frankfurt a.M.[4] for the optimum reception.

If at the reception location the direction Frankfurt is only vaguely known the alignment can be carried out by means of the **"alignment of the antenna program"**.

- the antenna is turned roughly to the direction Frankfurt a.M. (see appendix)
- then the alignment of the antenna program is started via the **"Show-Function"**. (see 4.4.4)
- The display shows the information **"Bitte 20 sec. warten"** (please wait for 20sec.) This time is needed to find the amplifications of the receiver required for the installation location of the antenna.
- After 20 seconds the display shows a bar diagram consisting of **">"**-signs. This diagram covers both display lines and fills the second line to about 60% - 80%.

The bar diagram indicates the relative field strength at the antenna position.

When the antenna is slowly turned from this position (ca.5°/sec) the field strength decreases and the bar diagram becomes smaller.

- Now the field strength minimum is sought. The minimum is reached when the least **">"** signs are displayed.
- From this position the antenna is turned by exactly 90° and thus set to maximum.
- The alignment of the antenna program is left by the **"BR"** entry.
- When the alignment of the antenna program is completed the device should be re-started by a reset.

[4] transmission location Mainflingen east of Frankfurt a.M.

3.3 Set-Up of the Base System

The device is switched on by means of a mains switch after the correct operating voltage is connected.

3.3.1 Display

The 2x40 digit VFD display shows the following picture after switch on:

hopf-Elektronik DCF-SYSTEM
VERSION 07.00 04/JAN/2001

This picture stays on display for about 3 seconds.

In case of a first set-up or after a three day voltage dropout, the following picture is displayed:

L.T: [1]00:00:00 [2] – – / [3] – – / – – – / – – – [4] – – DCF_M
UTC: [5]00:00:00 [6] – – / [7] – – / – – – / – – – – [8]C [9]10 ppm

The individual positions have the following meaning:

[1] **L-T:** 00:00:00

Here the local time is displayed.

[2] Display of the day of the week abbreviated:

MO - DI - MI - DO - FR - SA - SO (MO - TU - WE - TH - FR - SA - SU)

[3] Display of the date:

day / month abbreviation / year

[4] Status display:

position 1 X-- **"D"** for summer time (daylight time)
"S" for standard or winter time resp.
position 2 -X- **"A"** announcement of changeover to a different time zone.
this announcement occurs 1 hour before the time zone changeover
position 3 --X **"A"** announcement of a leap second
this information occurs 1 hour before the insertion of leap second.

System description:

DCF_M e.g DCF77 master system
QUARZ e.g quartz clock system

[5-7] In this position, analogue to the local time, the UTC world time is displayed

8 Display of the internal status of the clock system:

"C" = the clock system is running in crystal operation (C = Crystal).

"r" = the clock system is running radio synchronously during DCF77 antenna reception.

During operation with serial synchronisation (slave-system) it indicates that the slave system receives its synchronisation from an unsynchronised master system.

"R" = the clock system is running on DCF77-reception with highest accuracy and output of the PPS pulse (R=radio).

During slave operation the **"R"** appears when the master-system is radio synchronous.

9 In this position the quartz accuracy with which the internal clock is running is stated. The display starts with **10 ppm**.

This means that the accuracy of the crystal is ± $10x10^{-6}$ = **10 ppm**. In case of DCF77 control the crystal is adjusted to **2 ppm** ($2x10^{-6}$) .

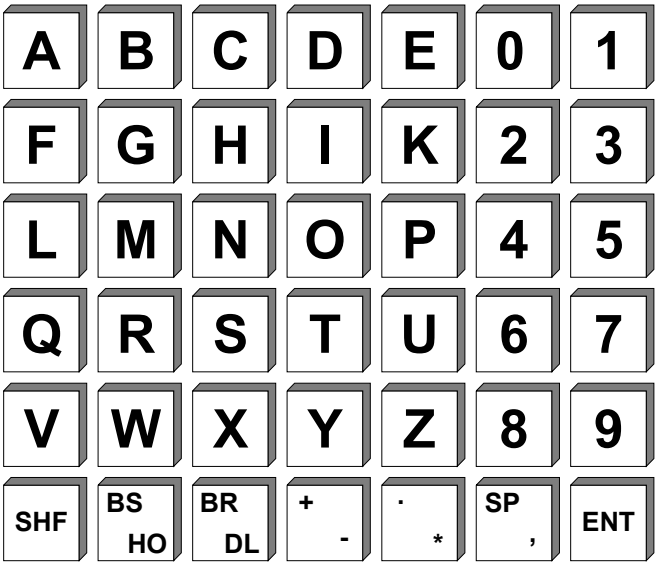
3.3.2 Standard Display

After a voltage breakdown, < 3 days, the display starts with the internally continued back-up clock information.

4 Key-Pad

The key-pad consists of 42 keys, where 5 keys have double functions. The second function is called up by pressing **SHF** (shift) and is valid for the next key entry.

4.1 Structure

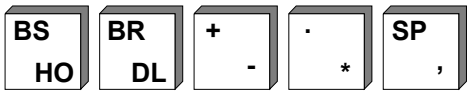


4.2 Key Functions

A ... Z entry of the alphabet in capital letters (without "J")

0 ... 9 entry of the digits

SHF shift functions for the keys:



BS BS= BACKSPACE, delete last entry

HO HO= home, delete whole line

BR BR=BREAK, stop all keypad controls

DL DL= delete, not used at present

+ entry of the signs for the numbers

-

. entry point and star

*****

SP entry of a free display place

, entry comma

Key-Pad Entry / System Control

The key-pad is activated by pressing the **"ENT"** key. The display jumps from the standard picture i.e. display of the time information, to the start picture of the key-pad or system control. At present this picture offers 7 entry or control modes. When entering the according digit, the key-pad entry jumps to the according mode.

Start picture

SET: 1 SHOW: 2 INI: 3 MON: 4 S.-CLK: 5 LAN:6
PROG.-R: R MASTER-R: M INPUT 1-6: R ,M

The modes have the following meaning:

SET:	Entry of set functions like time/date, position, time offset etc.
SHOW:	Choice of display-functions like time difference, position etc.
INI:	Initializing function (please note: handle with care)
MON:	Monitor function, this function is used within the company only
PROG.-R.:	Entering **"R"** for PROG.-R resets the program on the board 7015, i.e. a program restart.
MASTER-R:	Entering **"M"** causes a hardware master reset of the whole system. All the boards within the system are reset and started again.
S.-CLK:	Choice of special functions
LAN :	Controlling the LAN-boards in the system

4.3 SET-Functions

When entering the digit 1 the program jumps to the set functions. The program is designed as user guidance.

The different subfunctions are displayed and can be selected by

"Y" = yes or rejected by
"N" = no

When entering **"N"** the next subfunction is displayed. The following set functions can be selected at present.

4.3.1 Time/Date - Entry

display

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

entry picture

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

The local time can be set by means of this function. The entry is carried out in the second line between the > ... < and must be complete, including the entry of points and leading zeros.

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 = Monday ... 7 = Sunday		
DD	day	— " —	from 01 - 31
MM	month	— " —	from 01 - 12
YY 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 time zone is entered which is valid for the entered time information.

Entry **"D"** means summer time or daylight time zone

Entry **"S"** means winter or standard time zone

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

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

If the entry is plausible the time is taken over into the system, otherwise the information **"INPUT-ERROR"** is displayed for 3 seconds. In both cases the set function is left and the standard picture is displayed again.

4.3.2 Time Difference

display

TIME OFFSET Y/N

entry picture

TIME-OFFSET +/-HH.mm **EAST + WEST -**

> **<**

By means of this function the time difference between the local time and the world time (UTC time) is entered. The sign indicates in which direction the local time deviates from the world time.

Generally it is

+ = East

– = West of the 0 meridian

As most countries in the world choose their time difference in full hours the entry is done also in hour steps.

e.g. +05.00; -11.00

Some countries though move in 1/2 hour time zone steps. Here the minutes are added to the entry.

e.g. +5.30; -08.30

Please Note: AUTOMATICALLY SET TO + 1 H IN DCF77 MODE; SEE PT. 4.3.4 SYSTEM BYTE.

4.3.3 Time Zone Changeover

display

CHANGE-OVER DATE S -> D AND D -> S
S = STANDARD TIME D = DAYLIGT TIME Y / N

entry picture

S -> D / D -> S hh.MM _ _ _ hh.MM
>_ <

This entry can be used to enter times of the changeover from daylight saving time to standard time during the course of the year. The hour and the month of the due changeover are entered. The exact points of time are calculated automatically from the date for the current year. These entries are required only for the operation as a crystal clock. The changeover always takes place on the last Sunday of the entered month.

S ⇨ D the entered changeover time is valid for the changeover from **S**tandard time (wintertime) to **D**aylight Saving Time (summertime)

D ⇨ S the entered changeover time is valid for the changeover from **D**aylight Saving Time (summertime) to **S**tandard time (wintertime)

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

Please Note: NOT NECESSARY IN DCF77 MODE; SEE PT. 4.3.4 SYSTEM BYTE.

4.3.4 System Byte

The system byte can be used to select different functions in the system.

Selection picture

SET SYSTEMBYTE Y/N

When entering (**Y**)es the following picture is shown e.g.

SYSTEMBYTE OLD >00000001<
SYSTEMBYTE NEW >_ <

The top line shows the old, presently valid byte. The next byte can be entered in the line below by entering **"0"** or **"1"**. If this function was selected just to view the system byte, you can leave the function again by entering **"BR".**

Entries are made from bit 7 to bit 0 of the system byte and finished by **"ENT"** .

At present the bits are used as follows :

Bit 7 = free
Bit 6 = free
Bit 5 = free
Bit 4 = free
Bit 3 = free

Selection of the system

Bits 2 - 0 determine the function of the system.

Bit 2	Bit 1	Bit 0	
0	**0**	**0**	the system is operating as a crystal clock. It is not synchronised by another system. The times of the changeover and the entered difference time to UTC are activated. The display shows **CRYSTAL**
0	**0**	**1**	The system is synchronised with the DCF77 signal via the antenna input. The receiver is activated and the difference time to UTC is set to 1 hour. The changeover to daylight saving time is done from the DCF77 data string. The display shows **DCF_M**
0	**1**	**0**	The system is synchronised with the ***hopf*** data string DCF-slave via the serial interface RS422. The receiver is deactivated and the difference time to UTC is set to 1 hour. The changeover to daylight saving time is done from the serial DCF77-data string. The display shows **DCF_S**
0	**1**	**1**	The system is synchronised with the ***hopf*** data string master/slave via the serial interface RS422. The receiver is deactivated and the difference time to UTC is taken over from the serial data string. The changeovers to daylight saving time / standard time are also done from the serial data string. The display shows **GPS_S**
1	**0**	**0**	The system is synchronised with a DCF77 compatible antenna signal. The receiver is activated. The difference time to UTC can be entered manually. The changeover to daylight saving time is done from the compatible DCF77 data string. The display shows **GPS_A**

Any other combination of entries results in **ERROR** being shown in the display.

4.3.5 LAN-Board

If there is a LAN board with time server function installed in the system 7001 settings like with IP-address, gateway-address and modebyte can be entered via key-pad (please see description 7270).

4.3.6 Data Securing

All entered data of the points 4.3.1 - 4.3.3 are checked for plausibility and then stored in a non volotile EEPROM memory. To check these values **PROG.-R** or **M.-RESET** is carried out so that the stored values in the EEPROM are read back into the working memory.

4.4 Checking the Entered Values

To check the entered or by the DCF77-receiver updated values, the **SHOW** function is called up.

After jumping to the key-pad basic picture by **"ENT"** the digit **"2"** is entered. The first SHOW request picture appears.

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

4.4.1 Time Difference

This function allows to view the actual time difference between the local time and UTC time.

display

TIME-OFFSET Y/N

Pressing **"Y"** key shows the time difference e.g. as follows

TIME-OFFSET: +2:00
EAST + WEST -

If **"N"** or any other key, except for **"Y"**, is used the display jumps to the next request picture.

4.4.2 Time Zone Changeover S ⇨ D

This function shows the calculated point of changeover from **S**tandard time (wintertime) to **D**aylight saving time (summertime). Changeover is only active in the crystal clock mode. In case of antenna synchronisation or serial interface synchronisation the changeover occurs automatically at the point of time stated in the time data string.

display

STANDARD / DAYLIGHT CHANGE-OVER Y/N

Pressing **"Y"** displays the following:

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

The changeover point was (Sunday), 30.March 1992 at 2.00 h.

4.4.3 Time Zone Changeover D ⇨ S

(active in quartz clock systems only)

This function shows the point of changeover from **D**aylight time (summer time) to **S**tandard time (winter time).

display

DAYLIGHT / STANDARD CHANGE-OVER Y/N

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

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

The changeover happened on (Sunday), 27. September at 3.00 h.

4.4.4 Align the Antenna

This function shows the relative field strength

display

ANTENNA ALIGNMENT Y/N

Pressing **"Y"** calls up the following display:

BITTE 20 sec. WARTEN
PLEASE WAIT 20 sec.

The relative field strength is then shown in both lines e.g.

>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>
>>>>>>>>>>>>>>>

4.4.5 Error-Byte

This function shows the internal error byte.

Selection picture

SHOW ERROR-BYTE Y / N

After pressing the **"Y"** key the following is displayed:

ERROR -BYTE BIT 76543210
>00000000 <

If a **"1"** is shown in any position there is an error. The bits have the following meaning:

Bit 7 - 2 not used yet.

Bit 1 the calculated value of the difference time between local time and UTC is stored fail-safe in an EEPROM. The checking with a control byte has shown an error. The time is set to invalid in the display and in the data string.

Bit 0 the entry of the difference time by means of the key-pad is stored fail-safe in an EEPROM. The checking with a control byte has shown an error. The time is set to invalid in the display and in the data string.

4.5 Selection of Special Functions

Extension boards integrated in the system can be addressed via the menu item **S.-CLK**.
Key **"5"** changes into a selection dialogue.

The following functions can be called up.

- **SLAVE - CLOCK MANIPULATION Y/N**
  Master clock function, setting, starting and stopping of analogue slave clock works.
  Requires master clock board 7405/7406 in the system.
  Further information, if board at hand, in appendix.

- **IRIG-A TIMECODE MANIPULATION Y/N**
  Display and entry of control values for the IRIG-A timecode output.
  Requires board 7250 in the system.
  Further information, if board at hand, in appendix.

- **IRIG-B TIMECODE MANIPULATION Y/N**
  Display and entry of control values for the IRIG-B timecode output.
  Requires board 7230 in the system.
  Further information, if board at hand, in appendix.

- **TIME-SWITCH MANIPULATION Y/N**
  Function not implemented

4.6 Ini Functions

Through menu item **INI:3** different standards can be set. Key **"3"** is used to change into a selection dialogue.

4.6.1 Crystal Control Value

This function is used within our company only. It should not be used in operation. It is used to deteriorate the accuracy of the crystal control to test the control qualities of the adjustment programme.

4.6.2 Delay of the Change in Status "no radio"

The display as well as the serial data string show if the system is synchronised by DCF77 or running on the basis of the internal crystal. This information often causes error messages in the connected devices. To stop a short interruption of the reception from being interpreted as an error the change of status from reception to crystal basis can be delayed. The delay time can be set between 0-255 minutes.

During the delay time the status turns into radio reception. The display shows **"r"**. At the end of the delay time the status will be shown **"C"**.

Picture

ZEITVERZOEGERUNG KEIN DCF_EMPFANG Y/N

Pressing the **"Y"-**key changes the display into the entry mode. The following is displayed e.g.

ZEITVERZOEGERUNG VON 002 - 255 MIN.
>XXX< MIN.

xxx is replaced by the presently valid delay time for 3 seconds.

After that a new delay time can be entered in three digits, e.g. 060 for 1 hour of delay time.

When you leave the programme via the keys **"ENT"** and **"BR"** the last shown value is stored in a fail-safe memory.

4.7 Summary Key-Pad

- The key pad is activated by pressing **"ENT"**.
- Selection of functions by **"1"** to **"5"**.
- Switching to standard picture by **"BR / DL"** = BREAK
- Complete entry by **"ENT"**
- Selection of individual functions by **"Y"**
- Changing functions by **"N"** or any other key except **"BR / DL"** = BREAK
- Plausibility errors are indicated by **INPUT-ERROR**, requires new address and entry.

Please Note: IN CASE OF HIGHER DATA THROUGHPUT TO THE BUS (MANY EXTENSION BOARDS INSTALLED) IT MAY HAPPEN THAT THE KEYPAD ENTRY IS NOT ACCEPTED IMMEDIATELY.

In this case end the entry by **"BR / DL"** and restart the entry process.

4.7.1 Set Functions

T	Tens	**M**	Thousands
S	Unit	**C**	Hundreds

- 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	M	Y	1-2
YEAR	C	Y	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 as local time

4.7.2 Display Functions

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

4.8 Set-up

- connect DCF77-antenna
- direct antenna roughly to Frankfurt
- connect voltage
- switch on voltage
- entry local time (in case of quartz clock systems)
- entry time difference (in case of quartz clock systems)
- entry point of changeover **S => D** (in case of quartz clock systems)
- entry point of changeover **D => S** (in case of quartz clock systems)
- cause program reset
- view time difference
- view point of changeover **S => D**
- view point of changeover **D => S**
- call up alignment of antenna if necessary
- align antenna
- end alignment of antenna
- cause master reset

5 Interface Assignment of 7015 RS422

The interface is used only for the synchronisation in the slave mode.

9-pole SUB-D connector

Pin	Signal
1	GND
2	/TxD
3	TxD
4	/RxD
5	RxD
6	DCF77-pulse (low active)
7	/DCF77-pulse (high active)
8	PPS
9	GND

The assignment parameters are firmly oriented and cannot be changed.

- baud rate 9600
- no parity
- 8 data bits
- 1 stop bit
- no handshake

6 Technical Data Base System

operating voltage	standard:	230 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 complete system:		50 VA
display:		VFD display 2x40-digits
display type:		alphanumeric
height of digits:		5 mm
colour:		green
quartz accuracy:		± 10 ppm (after DCF77-control ± 2 ppm at 25° C)
back-up clock:		± 25 ppm at 25° C
maintenance free buffering:		3 days
key-pad:		42 keys

Technical Data DCF77-Receiver

potential separation:	500 V
receiver type:	AM / FM converter
sensitivity:	40 µV
synchronization time:	3 - 5 min.
temperature range:	0 - 50° C for the specified data 0 - 70° C with reduced free-running characteristics

special equipment:

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.