

Technical Description

Network Interface Card for NTP- and udp/time protocol



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1 Network Interface Card

The **hopf** Network Radio Clock is a board which receives standard world time information from the **hopf** GPS or DCF77 system 7000/1 bus, and makes this information available to computers, controllers and other equipment needing correct time information. The time information is distributed over the network interface and the Network Radio Clock supports the most popular time distribution protocols, NTP, time/udp plus an easy-to-integrate proprietary protocol, which supports broadcasting.

2 Hardware Installation Requirements

2.1 Controller

The controller can be installed anywhere in the network and has to be connected through the appropriate interface and cables.

2.2 Controller Setup

Before connecting the controller the first time to the LAN, it has to be configured, preferably through its serial port and a terminal or terminal emulation software on a PC. Connecting the controller to the network with wrong settings might produce network faults, especially if a wrong Token Ring ring rate or duplicate IP address is set.

2.2.1 Steps to configure the controller

1. An ASCII terminal or PC with a terminal emulation is connected to the first serial port (**CN1**) of the Controller. The terminal must be configured to 9600 Baud, no parity, 8 bit, 1 or 2 stop bits.
2. To enter configuration mode, the controller must be reset (by pushing the reset switch, if installed, or by cycling the power). Immediately after power-up, the controller performs a self test and lights all three status LED's.
3. Within about one second, the red LED starts blinking and an asterisk (*) is sent out over the serial line. Three small "x" characters (HEX value 120h) must be sent at that time. The controller responds with Identification data (serial number, software version etc.) and asks for a <CR> (HEX 0Dh) to enter setup mode.

2.2.2 The following shows a typical setup session

```
*xxx
*** FunkUhr atomic reference clock ***
Serial Number 102-040  Software Version 02.97 (980609)

Press Enter to go into Setup Mode
```

After <CR> is entered, the actual settings are displayed and parameters can be changed.

```
*** basic parameters
Hardware: Ethernet TPI
IP addr 150.100.100.021, no gateway set

*** Funkuhr parameters
Antenna type: Hopf 6021
UDP datagram disabled

Change Setup (0 Basics, 1 FunkUhr, 8 exit, 9 save and exit) ? 0
0      <- start basic setup
Ethernet Interface AUI (N) N

IP Address : (150) .(100) .(100) .(021)
Set Gateway IP Adress (N) N

Netmask: Number of Bits for Host Part (0=default) (00)
Change telnet config password (N) N

*** basic parameters
Hardware: Ethernet TPI
IP addr 150.100.100.021, no gateway set

*** Funkuhr parameters
Antenna type: Hopf 6021
UDP datagram disabled

Change Setup (0 Basics, 1 FunkUhr, 8 exit, 9 save and exit) ? 1

Change Setup (0 Basics, 1 FunkUhr, 8 exit, 9 save and exit) ? 1
1      <- start funkuhr setup
Antenna Type (0=DCF77,1=Trimble,2=TRAK,3=Hopf 6021)
Enter UDP Port (hex 0000), 0 to disable
Send Block every n minutes (001)
Send UDP broadcast (N) N
Enter up to eight target addresses for UDP block, 0.0.0.0 to end
#1 : (000) .(000) .(000) .(000)

*** basic parameters
Hardware: Ethernet TPI
IP addr 150.100.100.021, no gateway set
```

```
*** Funkuhr parameters
Antenna type: Hopf 6021
  UDP datagram disabled

Change Setup (0 Basics, 1 FunkUhr, 8 exit, 9 save and exit) ? 0
save and exit
```

The controller can be configured over a Telnet connection to port 9999 (assuming the network parameters are set correctly and it is connected to the network).

2.3 Network Parameters

Within the basic parameters, the controllers IP address and network interface selection are most important. Make sure that a valid IP address for the network is entered and the right network interface is selected (model dependent) before connecting to the network. The default gateway IP address has to be set to the default router or gateway if targets outside of the logical network have to be adjusted or the controller must be reached by computers from outside the logical network. The netmask setting is important if the standard IP addressing scheme (Class A/B/C) is not used (active sub-netting). The netmask is entered for historical purposes as the # of host bits. Zero means standard Class A/B/C. Some examples:

Netmask	# host bits
255.255.255.192	6
255.255.255.128	7
255.255.255.000	8
255.255.254.000	9

The Telnet password prevents unauthorized access to the setup menu over the network (through the serial interface, the password is not required). It's maximum length is 4 characters. **Token Ring Version:** The Ring Speed has to be set by Jumper (installed: 16Mbit, open: 4Mbit) to avoid a configuration error by accident. An administered address can be entered in the dialog.

2.4 Network Clock Parameters

The network parameters control the operation of the Server. The UDP port selects the port number for the proprietary protocol. To be compatible with PC software and KABA Benzing Terminals, it should be set to 77FF (hexadecimal). The remaining parameters cover how often the data block should be sent (starting at every full hour), if it should be sent as broadcast, and, additionally, up to eight target addresses can be defined to which the data block should be sent. NTP and udp/time port numbers are fixed to the values defined in RFC-37 and RFC-123 respectively. If the authentication option is enabled, up to seven md5 or DES keys can be entered (key numbers 1..7). All key input must be done in hexadecimal, and md5 key length is limited to eight characters. When leaving the setup mode (by selecting function 9), the parameters are stored in nonvolatile memory and the controller goes through a reset.

3 Time distribution formats

After the Network Radio Clock receives valid time information, it distributes the standard time via different services to the systems connected to the LAN.

3.1 NTP

The controller operates in server mode. Symmetric operation modes are not supported. It understands NTP Version 1, 2, and Version 3 frames, and optionally supports authentication via DES and MD5 cryptographic checksums. If authentication is not used, the controller can typically be used for hundreds of clients without overloading it. Authentication requires typically 40 ms for checking and generating the cryptograms, which is covered and averaged out by the protocol. The Network Radio Clock supports full SNTP and all NTP functions required for reliable server operation. Functions not required for server operation are not implemented.

3.2 udp/time

This rather old protocol has a resolution of one second, and is used by older UNIX systems and a variety of PC and technical equipment solutions.

3.3 Proprietary protocol

This has been developed to ease the setting of KABA Benzing Terminals and controllers which are connected to the networks with BETA and BETOR network adapters. Also suitable for Windows 3.1, 3.11 PC's and other systems which do not support NTP. A simple "C" program sample source works on UNIX and VMS systems and can easily be ported to others. In central Europe, it can be used to facilitate automatic daylight savings switching, as the Network Radio Clock knows the CET rule (and DCF77 provides an indicator).

This "Protocol" simply sends out a UDP block in a programmable interval as broadcast or direct to targets. The port number can be set, but it is necessary to set it to 77FF(hex) for operation with KABA Benzing equipment and the provided software.

UDP Block contents:

UDP Data offset Contents

00..14 ASCII string, containing CET/CST

- 00..01 Year (00..99)
- 02..03 Month (01..12)
- 04..05 Day (01..31)
- 06..07 Hour (00..23)
- 08..09 Min. (00..59)
- 10..11 Sec. always 00
- 12 Day of week (1-Mo, 2-Tue ..)
- 13 DST active (0-no,1-yes)
- 14 String termination, '\0'

16..19 CET/CST time in UNIX format

- 32bit value, network byte order
- seconds since 1/1/1970

20..23 GMT time in UNIX format

- 32bit value, network byte order
- seconds since 1/1/1970

This data can be used to synchronize to about one second accuracy, as the block is sent out at the beginning of the first second of every minute. This interval can be changed. The controller can be configured with various methods, remote or locally. To configure locally, access to the first (or only) serial port and an ASCII terminal is necessary. To configure over the network, a Telnet connection to port 9999 must be established. The controller configuration is stored in nonvolatile memory. The configuration can be changed at any time.

3.4 Network connectors

Depending on the model, the Network Radio Clock features 10-Base 2, 10-Base T and/or AUI connectors. Selection of the active connection is done by software.

The transceiver interface can supply 12 V, up to 300 mA. If more power is needed (i.e. for a fiber-optic transceiver), an external transceiver power supply must be used.

4 Serial interface

The setup menu is available at the (first or only) serial port at the controller.

Pin-out of the RJ-45 connector for the 19" rack version:

Pin	RS 232	RS485
1	Shield	Shield
2	CTS (input)	TXD –
3	TXD (output)	RXD +
4	DTR (output)	RXD –
5	Signal GND	TXD +
6	RXD (input)	Signal GND
7		CD (input) –
8	RTS (output)	Signal GND

4.1 LED status and error codes

After the initial self test phase, where all status LEDs should be lit, the LEDs indicate the status of the Network Radio Clock.

Green LED on:

synchronized to the time signal, correct reception of time data.

Green LED flashing 50% duty cycle:

Some information received, but not yet synchronized reliable.

Red LED stable on or flashing 50%, green LED flashing:

1x: EPROM-checksum error

2x: RAM-error

3x Network controller error

4x: E²PROM checksum error or bad

5x: I P address already used on network

5 Maintenance and testing

To enter monitor mode, the same principle as setting the parameters is used (see Controller Setup). Instead of entering three "x", "x x 1" is keyed in. The controller will respond with a special prompt. Network functions are needed for some diagnostics commands and it may take up to 20 seconds until the network part of the controller is initialized and the prompt is displayed. This is especially true if a token ring is empty or a ring simulator is used. For a simple ring simulator, see the appendix. To start the monitor mode without network functions, enter xx2 (new function from Version 2.05 up).



Please note : A Token Ring controller needs a working network connection to enter monitor mode

5.1 Monitor commands

The following commands are available in the monitor mode. Many commands have an IP address as an optional parameter (x.x.x.x). If it is given, the command is applied to a remote controller with that IP address. If no IP address is given, the command is executed locally. All commands must be given in capital letters, only blanks are accepted as white space between parameters.

DL	Firmware download to the Controller
SF x.x.x.x	Send Firmware to Controller with IP x.x.x.x
VS (x.x.x.x)	Query software header record (16 Byte).
GC (x.x.x.x)	Get configuration as HEX records (120 Bytes)
SC (x.x.x.x)	Set configuration from HEX records (120 Bytes)
PI x.x.x.x	Check with ICMP packages (PING) if IP x.x.x.x is alive reachable.
QU	Quit - exit diagnostics mode

command result codes:

0	OK, no error
1	no answer from remote device
2	cannot reach remote device or does not answer
8	wrong parameter(s)
9	invalid Command

5.2 Firmware download serial

Downloading is done in Monitor mode. Once in Monitor mode, the "DL" command is given. The node now waits for the firmware image in "HEX" format, which must be sent complete through the serial interface. When the end record is received, the controller checks the integrity of the firmware image and then starts programming the new firmware in the Flash prom. After complete reprogramming, the controller resets.

WARNING!

A loss of power while reprogramming will result in a corrupt program image and a nonfunctional controller.

5.3 Firmware download from host

To download a new firmware from a computer to a CoBox, a working TFTP implementation is needed. For Win95 systems, a download program is available from **hopf** on request. The parameters to send the firmware are:

Target filename: 3Q

Transfer mode: binary

The file to be downloaded must be the "ROM" image, not the "HEX" version.

File size should be 32768 or 65536 bytes.

WARNING!

A loss of power while reprogramming will result in a corrupt program image and a nonfunctional controller.

6 Technical data

6.1 CPU, Memory, Controllers:

V.40 CPU, 10 MHz clock

Z85C30 SCC Serial Controller

National Semiconductor DP839xx Ethernet Controller or

IBM Tokenring OEM module (starting 1997: TMS340 chipset)

128kByte RAM, 128k-512kByte Flash PROM

256 Byte E²PROM for parameter storage

6.2 Serial interface

External 19" Rack OEM module

Connector SubD25 RJ-45 pin strap

Speed ..38400 ..38400 ..19200

RS-232/485 sw software jumper TTL level only

6.3 Network Interface:

10-Base T interface

6.4 Power Supply:

5 V, 600 mA max, +12 V, -12 V

6.5 Status Indication

Three colored LED's.

6.6 Token Ring Version

Network Interface

The Token Ring controller has a standard D-Shell 9 pin female connector to be connected to standard token ring drop cables. The ring interface speed is configured by a jumper to prevent accidental misconfiguration. After opening the case, a jumper must be removed for 4 Mbit operation (delivery standard is jumper installed, 16 Mbit).