Technical Description

Serial Interface Board

6021 (6022 / 6023)

hopf Elektronik

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1 Specifications

- fully automatic setting of the clock by reception of the time signal transmitter DCF77
- elimination of reception errors by micro-processor controlled checking of the received time data string
- extensive plausibility and parity checks
- imminent WT/ST or ST/WT changeovers are recorded in fail safe memory, so that reception interruptions during the announcement hour are permissible
- transmission failure bridging by integrated quartz clock which continues the time and date
- in case of power failure internally running back-up clock (buffered)
- completely maintenance free buffering of back-up clock due to modern components
- built-in watch-dog circuit (automatic restart in case of program error)
- data output via RS232c (V.24), RS422c (V.11), TTY (20mA passive)
- baud rate: 150 - 19200 baud, TTY (max. 2400 baud)
- different output strings selectable by DIP switch (e.g. UTC-time output)
- connection facilities for a LED display
- two potential free pulse entries (for special programs)
- three output relays (24V/20mA)
- display of internal clock status in the status byte of the data string
- indication of radio or quartz clock operation by LEDs
- version 6022 with optical fibre for the data string output

2 Functions

The radio clock board continually receives the time signal of the German time signal transmitter DCF77 via a selective, active ferrite antenna. Synchronising to the time derived from an atom frequency standard achieves a long-term accuracy of the clock which is close to the caesium frequency standard.

The running stability of the controlling frequency standard is guaranteed to deviate no more than 1x10 E-13 per week from the set point. That means that ***hopf*** radio clocks have a running deviation of only 1 second in 300.000 years.

As both the changeover point of winter to summer time (summer to winter time) and the leap seconds are transmitted by the transmitter, this time is recognised as legally binding by the Federal Republic of Germany (Bundesgesetzblatt 42/1978 page 1110).

The micro processor of the radio clock 6021/22 decodes the received time signal and synchronises an internal quartz clock and also a buffered back-up clock with this time. The time received from the transmitter can be output via three interfaces. Cyclic output (e.g. data output every minute) can be set by DIP switch. Baud rate, word length and the number of stop-bits can also be set by means of the DIP switch.

A built-in autoreset circuit guarantees that in case of a voltage drop or a mains transient or even a processor error, the radio clock is safely reset. In case of a power supply failure, the buffered back-up clock chip continues time and date (max.3 days). Therefore a quartz accurate time is available immediately after the restart, unless the maximum buffering time of three days has been exceeded. The buffering of the back-up clock is absolutely maintenance free due to modern components/chips.

3 Radio Clock Version 6021

3.1 Basic Euro Board

- display of the clock status by LEDs
- BNC-connectors to plug in antennas; 4 TE front panel

3.2 Euro Board with built-in LED Display for Time and Date

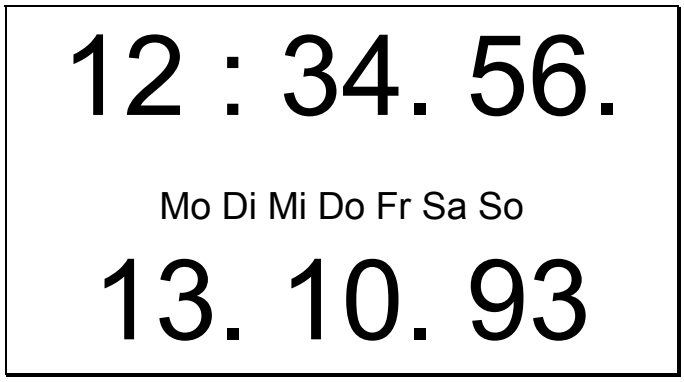
- 12 digits (time/date), height of digits 7mm, 1.5mm single LED for the day of the week; BNC connector for antenna connection; 16TE front panel with red filter screen

3.3 Stand-Alone-System in 1/2 x 19" Housing (system 6000)

- own supply unit 220V / 50Hz; built-in LED-display height of digits 13mm; LED-test key switch (different power supplies on request).

3.4 Display

The SYSTEM 6000 uses a two-line LED display of 13mm high digits to show the complete time information and the status values.



The status values are displayed by means of the colon and by the point to the bottom right of each digit. The following status information is given:

Colon: **simulated DCF77-pulse**
(field strength indicator during alignment of the antenna)

Point:	**min.**	**sec.**	**(second minute digit, second second digit)**
	off	off	time invalid
	off	on	quartz time
	on	off	DCF77-time
	on	on	DCF77-time with leap second control

Point:	**day**	**mon.**	**(second day digit, second month digit)**
	on	off	winter time
	off	on	summer time

Point:	**year**	**(second year digit)**
	off	no announcement bit
	on	announcement bit

The display of either UTC or CEST/CET is optional (see 8.1) During UTC (Universal Time Coordinated = World Time) there is no status display for summer, winter time and announcement of a changeover.

4 Set-Up

The built-in autoreset circuit initialises the micro-processor automatically. Therefore the radio clock is ready for operation immediately after the supply. Set-line voltage has been connected (+5V ⇨ pin: 32a/c and 0V ⇨ pin: 31a/c - resp. after switching on the mains voltage for system 6000).

A ***hopf*** DCF77 antenna must be connected to the BNC-connector in case of clocks with radio receiver (see.pt.5).

Immediately after switch-on the buffered back-up clock is read out. If the buffer voltage has dropped too low to read valid data from the chip, the clock displays 0 for all digits. The status-byte in the serial output shows "invalid time" and no LED in the frontpanel lights up.

5 Antenna Installation

Connect antenna coax-cable or any other clock compatible antenna signal, to the BNC-connector on the front panel or to the pins 1a (antenna core) and pin 2a (antenna GND) on the connector strip.

Please note : the following points are important

- The antenna must be installed at a right angle to the transmission direction of the transmitter. The arrow on the antenna housing should therefore point as precisely as possible to the location of the transmitter (Frankfurt a.M.).
- Monitors and televisions interfere with the reception! The antenna should be installed at a distance of at least 5m to any source of interference.
- Reinforced concrete and ferro-magnetic shielding (e.g. corrugated iron roofs) are almost "HF-proof". In these cases we advise outdoor installation. Weather-proof outdoor antennas are available on request.

5.1 Starting the Antenna-Alignment Program by Key Switch

The antenna should be aligned to direction Frankfurt with an angular deviation of +/-10°. The "antenna alignment program" helps to determine the exact antenna position. A key switch on the front panel starts the program. The key switch has two functions:

- start antenna alignment
- reset the clock circuit board

Pressing the key switch for about one second starts the "antenna alignment program". Pressing the key switch for longer than 3 seconds causes a reset on the board after the switch is released again.

As a user's guide, the three LEDs on the front panel extinguish when the key is pressed, and light up again one after the other. When the first LED lights up the key can be released again, the antenna alignment program is now active. On those boards which have an LED display, the day of the week LEDs MO, DI, MI are lit one after the other.

After about 20 seconds the sensitivity of the input amplifier, needed for the location and the present antenna position, is adjusted. All three LEDs now light up or stay lit for some time (approx 1 sec). The length of time indicates the relative field strength of the DCF77signal. If the antenna is now slowly turned out of the set range, the field strength grows weaker and weaker. This causes the LEDs to light up for increasingly shorter periods of time or to extinguish. This position is the reception minimum.

If the antenna is turned by 90° from this position the reception field strength maximum is reached. To leave the **"alignment program"** cause a restart (press the key switch for longer than 3 seconds until all the LEDs light up).

Please note : If the alignment takes longer than 3 minutes the program has to be restarted (see above).

5.2 Useable Types of Antennas

Only ***hopf*** antennas should be connected to ***hopf*** radio clocks. This guarantees a perfect adaptation to the receiver. At worst connecting a strange make of antenna can destroy the electronics. For the outdoor installation in areas with particularly rough weather conditions or in difficult reception locations special types of antennas are available.

5.3 Indirect Lightning Protection

To avoid a lightning stroke through the antenna to the computer, the system can be protected by an indirect lightning protection. This indirect lightning protection is looped into the antenna cable and does not influence the reception. We advise using the indirect lightning protection in case of an outdoor antenna installation.!!!!

5.4 DCF77 Reception Failure

The reception of the time signal via DCF77 is similar to a serial data transmission in bit mode. One bit is emitted every second. After one minute the time can be decoded. ***hopf*** radio clocks need - for safety reasons, two consecutive faultless time data strings to accept the time.

Please install the antenna as far away as possible from the below sources of interference:

- televisions and monitors
- lifts
- neighbouring transmitters
- fluorescent lamps
- phase-angle controlled electric gadgets
- switchgear of inductive consumers
- ignitions of motor vehicles

6 Synchronisation with the DCF77-Transmitter

After connecting the voltage supply it takes at least 3 minutes of faultless DCF77-reception to have a DCF77-synchronized time available. During this period the following checks are carried out:

- During the first minute the internal time base is synchronised to the DCF77-second and minute marker.
- During the second minute the first DCF77-time data string is read in. After parity and plausibility checks of the time data string this time information is loaded into a control clock and continued every second.
- After a further minute the newly read DCF77-data string is compared with the control clock after the according tests. If both times match the time information is taken over by the quartz clock.

6.1 Meaning of the LEDs on the Front Panel

LED F	LED Q	meaning
off	off	no valid time at hand
off	on	quartz time available
on	off	radio time basic accuracy
on	on	radio time basic accuracy; quartz control on; leap second control on

6.2 Quartz and Leap Second Control

If the reception is interfered with, the clock is continued by a quartz. The accuracy of the DCF77-pulse then depends on the accuracy of the quartz. To keep the drift of the time information as small as possible, the quartz is adjusted indirectly by the DCF77 frequency during good reception. The adjustment values are stored fail-safe. Also during good reception the DCF77-leap second is compared with the base clock leap second and, if necessary, adjusted after the minute change in small steps of at least 16 µsec. up to max. 496 µsec. This causes the emitted simulated DCF77-pulse to deviate only +/-2msec. from the actual leap second. This situation is indicated by both LEDs **"F"** (radio) and **"Q"** (quartz) being lit.

7 Hardware Configuration of Board 6021

7.1 Interface Selection

The radio clock is equipped with 3 serial interfaces:

- RS232c (V-24)
- RS422 (V-11)
- TTY (20 mA passive).

If cyclic data output is set the data string appears at all three serial outputs. Data via RxD lines can only be requested from one input. Necessary configuration by DIP-switch 3 switch 4 is:

DIP-Switch 3	Switch 4
off	serial input RS232 and RS422 active
on	serial input TTY active

7.2 Handshake Lines (RS232c only)

The RS232c interface of the board 6021 is equipped with the normed handshake lines. Depending on the needs the handshake lines can be used or not by using jumper 5:

J5 plugged: RTS ⇔ CTS handshake not active

J5 not plugged: RTS ⇔ CTS handshake active

Please note : During TTY or RS422 operation of the board the jumper must be plugged!

7.3 Pin Assignment of the RS232c Interface

25-pole SUB-D connector system 6000 pin no.:	meaning of signal	96-pole VG-strip board pin no.:
2	TxD (transmit data)	2a
3	RxD (receive data)	3a
4	RTS (ready to send)	4a
5	CTS (clear to send)	5a
7	0 V (GND)	7a

7.4 Pin Assignment of the TTY-Interface (passive)

9-pole SUB-D connector system 6000 pin no.:	meaning of signal	96-pole VG-strip board pin no.:
1	0V (GND)	16b
2	+ Output	17b
3	- Output	18b
4	+ Input	19b
5	- Input	20b

7.5 Pin Assignment of the RS422 Interface

9-pole SUB-D connector system 6000 pin no.:	meaning of signal	96-pole VG-strip board pin no.:
1	0V (GND)	9a
2	TxD	10a
3	/TxD	11a
4	RxD	12a
5	/RxD	13a

8 Selection of the Baud Rate by DIP-Switch 1

Dip-switch SW1 has the function to set the baud rate, word length, parity-mode and the stop-bits for the data traffic. The chosen configuration applies to all three interfaces.

8.1 UTC or CEST/CET Output

switch 1	meaning
on	UTC output via interface
off	CEST/CET via interface

The display can be set separately to UTC-time output by jumper 4 (see diagram in the appendix). To achieve this a jumper must be plugged in position 2.

8.2 CET

Even during the summertime (CEST) some situations require the output of the standard time (CET). Plugging in jumper 1 in jumper block 4 (see diagram in the appendix) causes CET to be displayed or put out in all functions (see chapter 9.2 "serial request").

8.3 Setting the Word Length

switch 2	meaning
on	8 bit
off	7 bit

8.4 Setting the Parity Mode of the Transmission

switch 3	switch 4	meaning
on	on	no parity
on	off	no parity
off	on	parity even
off	off	parity odd

8.5 Setting the Stop-Bits

switch 5	meaning
on	1 stop bit
off	2 stop bits

8.6 Setting the Baud Rate

switch 6	switch 7	switch 8	meaning
on	on	on	150 baud
on	on	off	300 baud
on	off	on	600 baud
on	off	off	1200 baud
off	on	on	2400 baud
off	on	off	4800 baud
off	off	on	9600 baud
off	off	off	19200 baud

9 The Emitted Data Strings

The received time can be output via the interfaces in a data string informing also about the internal clock status. The user is thus enabled to synchronise the connected computer systems with the official time of the Federal Republic of Germany. The output point, the string structure and control signals can be chosen by DIP-switch SW2 according to the needs.

Setting options by DIP switch board SW2 (see diagram in the appendix)

switch 1	**second forward run**
on	switched on
off	switched off

switch 2	**ETX on the second change** only if activated by control signal
on	with ETX on the second change
off	without ETX on the second change

switch 3	**switch 4**	**structure of data string** **Dip-switch SW3 pos. 3 = off**
off	off	data string 6021
on	off	data string 5500
off	on	data string 5050
on	on	data string MADAM-S

switch 3	**switch 4**	**structure of data string** **Dip-switch SW3 pos. 3 = on**
off	off	data string SINEC H1
on	off	data string 2000
off	on	Sysplex Timer
on	on	Master/Slave

switch 5	**time or time and date**
on	output time only
off	output time and date

switch 6	**control characters STX/ETX**
on	transmission with control characters
off	transmission without ctrl characters

switch 7	**switch 8**	**transmission point of time**
on	on	transmission every second
on	off	transmission on the minute change
off	on	transmission on the hour change
off	off	transmission on request only

9.1 Data Format of the Serial Transmission

The data are emitted in ASCII as BCD values using the following special characters:

$20 = Space
$0D = CR (carriage return)
$0A = LF (line feed)
$02 = STX (start of text)
$03 = ETX (end of text)

9.2 Serial Request

The data string can be emitted by the user using control characters which are:

ASCII **"U"** - for time
ASCII **"D"** - for time /date
ASCII **"G"** - for UTC-time/date or CET (see 8.2)

If the output of CET is wanted, it must be requested by **"G"** . Required hardware settings see chapter 8.2 "CET".

The system gives the according data string within 1 msec.

This is often too fast for the requesting computer. It is therefore possible to delay the answer in 10msec. steps in case of a software request. In case of the delayed emission of the data string the requesting computer transmits the small characters **"u, d, g"** plus a two digit multiplication factor to the clock.

The clock interprets the multiplication factor as hexadecimal values.

example:

The computer emits **ASCII u05** (hex 75,30,35)
After 50 milliseconds the clock emits the data string time only.

The computer emits **ASCII gFF** (hex 67, 46, 46)
After 2550 milliseconds the clock emits the data string UTC-time/date or CET (see 8.2).

if "MADAM-S" is selected the data string can be emitted with the request

:ZSYS:
or **:WILA:**

The system start the transmitting at the next second change.

10 The data string 6021

10.1 Data string 6021 time and date (standard)

The control characters STX and ETX are transmitted only if the output is set accordingly at the DIP switch board 2. When the setting is "ETX delayed", the last character (ETX) is transmitted exactly on the next second change.

character no.	meaning	
1	STX (start of text)	
2	status (internal clock status)	; see 10.3
3	day of the week (1=Monday ... 7=Sunday)	; see 10.3
	for UTC time bit 3 is set to 1 in the day of the week	
4	hour tens digit	
5	hour unit digit	
6	minute tens digit	
7	minute unit digit	
8	second tens digit	
9	second unit digit	
10	day tens digit	
11	day unit digit	
12	month tens digit	
13	month unit digit	
14	year tens digit	
15	year unit digit	
16	LF (line feed)	
17	CR (carriage return)	
18	ETX (end of text)	

10.2 Data string 6021 time only

The control characters STX and ETX cannot be transmitted unless the output has been set "with control characters" at DIP switch 2 (DIP switch 2 switch 6 = on). Otherwise these control characters are left out. The setting "ETX delayed" transmits the last character (ETX) exactly on the next second change.

character no.	meaning
1	STX (start of text)
2	hour tens digit
3	hour unit digit
4	minute tens digit
5	minute unit digit
6	second tens digit
7	second unit digit
8	LF (line feed)
9	CR (carriage return)
10	ETX (end of text)

10.3 Data string 6021 status and day of the week nibble

The second and the third ASCII-character contain the status and the day of the week. The status is decoded binarily. Structure of these characters:

	b3	b2	b1	b0	meaning
status nibble:	x	x	x	0	no announcement hour
	x	x	x	1	announcement(ST-WT-ST)
	x	x	0	x	wintertime (WT)
	x	x	1	x	summertime (ST)
	0	0	x	x	time /date invalid
	0	1	x	x	crystal operation
	1	0	x	x	radio operation
	1	1	x	x	radio operation (high accuracy)
day of the week nibble:	0	x	x	x	CEST / CET
	1	x	x	x	UTC-time or CET
	x	0	0	1	Monday
	x	0	1	0	Tuesday
	x	0	1	1	Wednesday
	x	1	0	0	Thursday
	x	1	0	1	Friday
	x	1	1	0	Saturday
	x	1	1	1	Sunday

10.4 Example of transmitted data string 6021

(STX)E3123456030196(LF)(CR)(ETX)

radio operation (high accuracy)
summer time no announcement
It is Wednesday 03.01.96 - 12:34:56 h.
( ) - ASCII-control characters e.g. (STX)

11 The data string 5500

11.1 Data string 5500 time and date

The control characters STX and ETX are transmitted only if the setting at the DIP switch board 2 is accordingly. If not those control characters are not transmitted. When the setting is "ETX delayed" the last character (ETX) is transmitted exactly on the second change.

character no.	meaning	
1	STX (start of text)	
2	status (internal clock status)	; see 11.3
3	space	
4	hour tens digit	
5	hour unit digit	
6	minute tens digit	
7	minute unit digit	
8	second tens digit	
9	second unit digit	
10	space	
11	day tens digit	
12	day unit digit	
13	month tens digit	
14	month unit digit	
15	year tens digit	
16	year unit digit	
17	space	
18	day of the week	; see 11.3
19	CR (carriage return)	
20	LF (line feed)	
21	ETX (end of text)	

11.2 Data string 5500 time only

The control characters STX and ETX are transmitted only if the setting at the DIP switch board 2 is accordingly. If not those control characters are not transmitted. When the setting is "ETX delayed" the last character (ETX) is transmitted exactly on the second change.

character no.	meaning
1	STX (start of text)
2	hour tens digit
3	hour unit digit
4	minute tens digit
5	minute unit digit
6	second tens digit
7	second unit digit
8	CR (carriage return)
9	LF (line feed)
10	ETX (end of text)

11.3 Data string 5500 status and day of the week nibble

	b3	b2	b1	b0	meaning
status nibble:	x	x	x	0	radio operation
	x	x	x	1	crystal operation
	x	x	0	x	no announcement WT-ST-WT
	x	x	1	x	announcement WT-ST-WT
	x	0	x	x	winter time
	x	1	x	x	summer time
	1	0	0	x	UTC
day of the week nibble:	x	0	0	1	Monday
	x	0	1	0	Tuesday
	x	0	1	1	Wednesday
	x	1	0	0	Thursday
	x	1	0	1	Friday
	x	1	1	0	Saturday
	x	1	1	1	Sunday

11.4 Example of a transmitted data string 5500

(STX)3 123456 030196 1(CR)(LF)(ETX)

crystal operation, no announcement, winter time
It is Wednesday 03.01.96 - 12:34:56 h

12 The data string 5050

12.1 Data string 5050 time and date

The control characters STX and ETX are transmitted only if the setting at the DIP switch board 2 is accordingly. If not those control characters are not transmitted. When the setting is "ETX delayed" the last character (ETX) is transmitted exactly on the second change.

character no.	meaning	
1	STX (start of text)	
2	hour tens digit	
3	hour unit digit	
4	space	
5	minute tens digit	
6	minute unit digit	
7	space	
8	second tens digit	
9	second unit digit	
10	space	
11	day tens digit	
12	day unit digit	
13	space	
14	month tens digit	
15	month unit digit	
16	space	
17	year tens digit	
18	year unit digit	
19	space	
20	status: internal clock status	; see 12.3
21	day of the week	; see 12.3
22	space	
23	CR (carriage return)	
24	LF (line feed)	
25	ETX (end of text)	

12.2 Data string 5050 time only

character no.	meaning
1	STX (start of text)
2	hour tens digit
3	hour unit digit
4	space
5	minute tens digit
6	minute unit digit
7	space
8	second tens digit
9	second unit digit
10	space
11	CR (carriage return)
12	LF (line feed)
13	ETX (end of text)

12.3 Data string 5050 status and day of the week nibble

	b3	b2	b1	b0	meaning
status nibble:	x	x	x	0	radio operation
	x	x	x	1	crystal operation
	x	x	1	x	announcement (WT - ST - WT)
	x	x	0	x	no announcement (WT - ST - WT)
	x	0	x	x	CET (UTC + 1h)
	x	1	x	x	CEST (UTC + 2h)
	1	0	0	x	UTC
day of the week nibble:	x	0	0	1	Monday
	x	0	1	0	Tuesday
	x	0	1	1	Wednesday
	x	1	0	0	Thursday
	x	1	0	1	Friday
	x	1	1	0	Saturday
	x	1	1	1	Sunday

12.4 Example of a transmitted data string 5050

(STX) 12 34 56 03 01 96 03 (CR)(LF)(ETX)

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

13 The data string MADAM-S

The structure depends on the request string. When the superior computer (PROMEA-MX) requests with the string:

:ZSYS:

the clock answers with the following data string:

character no.	meaning	value (value range)	
1	STX (start of text)	$02	
2	: colon	$3A	
3	Z ASCII Z	$5A	
4	S ASCII S	$53	
5	Y ASCII Y	$59	
6	S ASCII S	$53	
7	: colon	$3A	
8	status of the changeover	$00, 01, 7F	; see 13.2
9	time scale identification	$30-33	
10	day of the week	$31-37	
11	tens - year	$30-39	
12	unit year	$30-39	
13	tens month	$30-31	
14	unit month	$30-39	
15	tens day	$30-33	
16	unit day	$30-39	
17	tens hour	$30-32	
18	unit hour	$30-39	
19	tens minute	$30-35	
20	unit- minute	$30-39	
21	tens second	$30-35	
22	unit second	$30-39	
23	CR (carriage return)	$0D	
24	LF (line feed)	$0A	
25	ETX (end of text)	$03	

When the superior computer (PROMEA-MX) requests using the string

:WILA:

the clock answers with the following data string

character no.	meaning	value (value range)	
1	STX (start of text)	$02	
2	: colon	$3A	
3	W ASCII W	$57	
4	I ASCII I	$49	
5	L ASCII L	$4C	
6	A ASCII A	$41	
7	: colon	$3A	
8	status	$00, 01, 7F	; see 13.2
9	time scale ident.	$30-33	
10	day of the week	$31-37	
11	tens year	$30-39	
12	unit year	$30-39	
13	tens month	$30-31	
14	unit month	$30-39	
15	tens day	$30-33	
16	unit day	$30-39	
17	tens hour	$30-32	
18	unit hour	$30-39	
19	tens minute	$30-35	
20	unit minute	$30-39	
21	tens second	$30-35	
22	unit second	$30-39	
23	CR (carriage Return)	$0D	
24	LF (line feed)	$0A	
25	ETX (end of text)	$03	

13.1 Required setting in case of output MADAM-S

The synchronisation process in case of output MADAM-S requires the following setting on the board 6021:

- output on the minute change
- output with second advance
- output ETX on the second change

13.2 Data string MADAM-S status nibble

Announcement of a changeover (8. byte of the transmission)

This byte can have the following values

Nul (Hex 00)	no announcement
SOH (Hex 01)	announcement changeover summer-/wintertime winter-/summertime
DEL (Hex 7F)	no radio time available

time scale ident. (9. Byte of the transmission)

ASCII 0 (Hex 30)	wintertime
ASCII 1 (Hex 31)	summer time + announcement
ASCII 3 (Hex 33)	summer time

The day of the week nibble can have the values

ASCII 1 (Hex 31 ⇔ MO) to ASCII 7 (Hex 37 ⇔ SO)

In case of an invalid time the byte with ASCII 0 (Hex 30) is transmitted.

14 The data string SINEC H1

The control characters STX and ETX are transmitted only if the setting at the DIP switch board 2 is accordingly. If not those control characters are not transmitted. When the setting is "ETX delayed" the last character (ETX) is transmitted exactly on the second change.

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

14.1 Status in the data string SINEC H1

The characters 28 - 31 in the data string SINEC H1 tell the synchronisation status of the clock.

The characters mean the following:

no. 28	= "#"	no radio synchronisation after reset, time invalid
	space	radio synchronisation after reset clock min. in crystal operation
no. 29	= "*"	time from internal crystal in the clock
	space	time by radio reception
no. 30	= "S"	summer time
	space	winter time
no. 31	= "!"	announcement of a W/S or S/W changeover
	space	no announcement

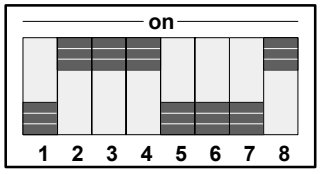
14.2 Example of a transmitted data string SINEC H1

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

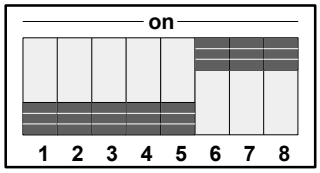
radio operation, no announcement, winter time
It is Wednesday 03.01.96 - 12:34:56 h

14.3 DIP-switch position for SINEC H1

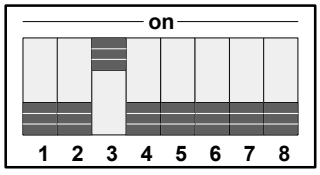
SW1



SW2



SW3



15 Data output for time-code-generator of the Leitch company

To activate the Leitch data string DIP switch 3 switch 3 = must be off.

The devices request data/time by means of the ASCII character "T" = Hex 54. After the request the date and time (incl. milliseconds) are stored temporarily and put out on the serial output line in a data string with 31 ASCII - characters.

character no.	meaning	value (value range)
1	tens hour	$30-32
2	unit hour	$30-39
3	" : " colon	$3A
4	tens minute	$30-35
5	unit minute	$30-39
6	" : " colon	$3A
7	tens second	$30-35
8	unit second	$30-39
9	" . " point	$2E
10	100th millisecond	$30-39
11	tens millisecond	$30-39
12	unit millisecond	$30-39
13	space	$20
14	tens day	$30-32
15	unit day	$30-39
16	" / " slash	$2F
17	tens month	$30-31
18	unit month	$30-39
19	" / " slash	$2F
20	tens year	$30-39
21	unit year	$30-39
22	space	$20
23	100th curr. day of year	$30-33
24	tens curr. day of year	$30-39
25	unit curr. day of year	$30-39
26	space	$20
27	day of the week	$31-37
28	space	$20
29	status	$30-33, 41-46
30	CR (carriage return)	$0D
31	LF (line feed)	$0A

A valid time is shown by Bit 4 = 1 and Bit 3 = 0 in the status byte.

Please note : Required DIP-switch settings: output on request only, string 6021, without ETX on the second change, DIP-switch 3 switch 3 = off.

Second advance and output UTC can be preselected by DIP switch.

16 Data String IBM 9037 Sysplex Timer

This protocol is used for the synchronization of an IBM 9037 Sysplex Timer. The 9037 expects the time at its input every second. The following settings are required: 9600 baud, 8 data bit, parity odd, 1 stop bit, sending on request without advance and without control characters. The clock starts sending the protocol automatically every second after a request by ASCII "C" of the IBM 9037 Sysplex Timer.

The setting UTC or local time is optional.

character-no.:	meaning	value (value range)
1	SOH (start of header)	$01
2	hundreds - current day of the year	$30-33
3	tens - current day of the year	$30-39
4	unit - current day of the year	$30-39
5	" : " colon	$3A
6	tens - hour	$30-32
7	unit - hour	$30-39
8	" : " colon	$3A
9	tens - minute	$30-35
10	unit - minute	$30-39
11	" : " colon	$3A
12	tens - second	$30-35
13	unit - second	$30-39
14	Quality Identifier	$20, 41, 42, 43, 58
15	CR (carriage return)	$0D
16	LF (line feed)	$0A

16.1 Status in the Data String Sysplex Timer

The 14th character informs about the synchronisation status of the clock. Possible values and their meaning are listed below.

"?"	=	Hex 3F	=	invalid time
" "	=	Hex 20	=	radio controlled time at hand
"A"	=	Hex 41	=	crystal operation for more than 20 minutes
"B"	=	Hex 42	=	crystal operation for more than 41 minutes
"C"	=	Hex 43	=	crystal operation for more than 416 minutes
"X"	=	Hex 58	=	crystal operation for more than 4160 minutes

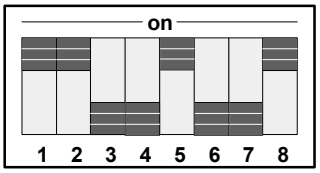
16.2 Example of a transmitted data string Sysplex Timer

(SOH)050:12:34:56 _ (CR) (LF) (_) = Space

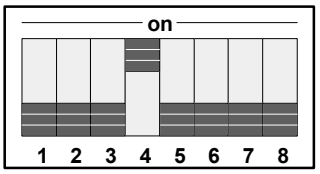
radio operation, 12:34:56 h, 50th day of the year

16.3 DIP-switch position for Sysplex Timer

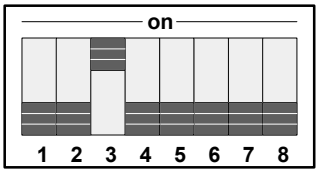
SW1



SW2



SW3



17 Data String 2000

A 4-digit output of the year has been added to the output string 6021 with time and date. The user can also start the output of the data string by means of control signals (see pt. 9.2). If the string 2000 has been set the complete data string is put out on the request "time only".

Use the DIP switches SW3 and SW2 to address strings (see pt. 9.0).

character no.	meaning	
1	STX (start of text)	
2	Status (internal status of the clock)	; see 17.1
3	day of the week (1=Monday ... 7=Sunday)	; see 17.1
	In case of UTC time bit 3 is set to 1 in the day of the week	
4	tens hour	
5	unit hour	
6	tens minutes	
7	unit minutes	
8	tens seconds	
9	unit seconds	
10	tens day	
11	unit day	
12	tens month	
13	unit month	
14	thousands year	
15	hundreds year	
16	tens year	
17	unit year	
18	LF (line feed)	
19	CR (carriage return)	
20	ETX (end of text)	

17.1 Data String 2000 Status- and Day of the Week Nibble

The second and the third ASCII character contain the status and the day of the week. The status is decoded binarily. The structure of these characters:

	b3	b2	b1	b0	meaning
status nibble:	x	x	x	0	no announcement hour
	x	x	x	1	announcement (ST-WT-ST)
	x	x	0	x	wintertime (WT)
	x	x	1	x	summertime (ST)
	0	0	x	x	time/date invalid
	0	1	x	x	crystal operation
	1	0	x	x	radio operation
	1	1	x	x	radio operation (high accuracy)
day of the week nibble:	0	x	x	x	CEST/CET
	1	x	x	x	UTC - time
	x	0	0	1	Monday
	x	0	1	0	Tuesday
	x	0	1	1	Wednesday
	x	1	0	0	Thursday
	x	1	0	1	Friday
	x	1	1	0	Saturday
	x	1	1	1	Sunday

17.2 Example of a Transmitted Data String 2000

(STX)E312345603011996(LF)(CR)(ETX)

radio operation (high accuracy)
summertime
no announcement
It is Wednesday 03.01.1996 - 12:34:56 h.
( ) - ASCII-control characters e.g. (STX)

18 Data String Master/Slave

This master /slave string can be used to synchronise slave systems with the time data of the master system up to an accuracy of ± 0.5 msec. It differs from the DCF-slave-string as much as the difference to the UTC time is included in the transmission.

The difference time on the board 6021 is fixly adjusted to +01:00 hour.

The local time is used as time base.

The difference time is transmitted in hours and minutes following the year. The transmission is done in BCD.

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

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

Example :

90.00 difference time + 10.00 h.
01.30 difference time – 01.30 h.

The whole data string shows the following structure:

character no.	meaning	value (value range)
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	tens diff.time a. sign hour	$30-31,$38-39
17	unit diff.time a. sign hour	$30-39
18	tens diff. time minutes	$30-35
19	unit diff. time minutes	$30-39
20	LF (line feed)	$0A
21	CR (carriage Return)	$0D
22	ETX (end of text)	$03

18.1 Status in the Data String Master-Slave

	b3	b2	b1	b0	meaning
status nibble:	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 nibble	0	0	0	1	Monday
	0	0	1	0	Tuesday
	0	0	1	1	Wednesday
	0	1	0	0	Thursday
	0	1	0	1	Friday
	0	1	1	0	Saturday
	0	1	1	1	Sunday

18.2 Example of a Transmitted Data String Master-Slave

(STX)831234560301968230(LF)(CR)(ETX)

Radio operation, no announcement, standard time
It is Wednesday 03.01.96 - 12:34:56 h
The difference to UTC is +2.30 hours

18.3 Settings

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

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

These settings allow the best control of the time basis of the slave systems better than ± 1 msec and a regulation of the quartz for the free running mode to ± 1 ppm referring to the accuracy of the master system.

19 Data String TimeServ for the Operating System Windows NT

The synchronization of a Computer running Windows NT version 3.51 and higher is done with the same string as described under pt. **"Sysplex Timer"**. The **mode byte 1** setting must match the following items:

- telegram Sysplex Timer
- transmission every second
- 9600 baud
- 8 data bit
- no Parity
- 1 stop bit
- without second advance
- transmission without control characters
- output UTC

To install TimeServ on the WinNT-computer you need the program files which can be found on the Microsoft Windows NT Recource Kit CD. The newest version of the program is although available free of charge on the Microsoft Internet site:

ftp://ftp.microsoft.com/bussys/winnt/winnt-public/reskit/nt40

A short description how to setup TimeServ for a ***hopf*** radio clock is available on the ***hopf*** internet site:

http://www.hopf.com

20 Data String for NTP (Network Time Protocol)

NTP or also xNTP is a batch of programmes to synchronise different computers and operating systems with network support. It is the standard for the Internet Protokoll TCP/IP (RFC-1305). Source code and documentation are available as freeware in the internet under the following address:

http://www.eecis.udel.edu/~ntp/index.html

Binary files for the IBM operating system AIX are available on the following internet page:

http://www.hopf.com

NTP supports the ***hopf*** standard protocol as described under pt.. **"Datentelegramm (data string) 6021"** The following settings in the clock are required:

transmission parameter:	9600 baud 8 data bit parity no 1 stop bit
transmission mode:	data string 6021 UTC as time basis with second advance with control characters (STX...ETX) with ETX on the second change (On Time Marker) output time and date transmission every second

21 Setting the Clock via Serial Interface

Time and date can also be set via serial interface. The following data string is needed.

character no.	meaning	value (value range)
1	"S" (setting the time)	hex 53
2	first hour digit	hex 30..32
3	second hour digit	hex 30..39
4	first minute digit	hex 30..35
5	second minute digit	hex 30..39
6	first second digit	hex 30..35
7	second second digit	hex 30..39
8	first day digit	hex 30..33
9	second day digit	hex 30..39
10	first month digit	hex 30..31
11	second month digit	hex 30..39
12	first year digit	hex 30..39
13	second year digit	hex 30..39
14	day of the week	hex 31..37
15	carriage return	hex 0D

Alternatively a status information can be transmitted in position 15 and 16, which internally sets the clock status to summer or winter time. In this case the 17. signal must be the carriage return.

15	status high nibble	hex 34 or 35
16	status low nibble	hex 30 or 38
17	carriage return	hex 0D

meaning of the status byte:

hex 48 = winter time
hex 50 = summer time

Example of a transmission:

>S1234560708942CR< for Tuesday 07.08.94, 12:34:56
>S123456070894250CR< for Tuesday 07.08.94, 12:34:56 summer time

22 Relay and Pulse Output

The board contains 3 switching exits which can be taken either as relay with changeover and normally closed contact, or in TTL-logic (active high) at the 96 pole VG-strip connector.

relay 1	**VG-strip**
normally close	Pin 2c
normally open	Pin 3c
common	Pin 4c
TTL - output active high	Pin 7b

relay 2	**VG-strip**
normally close	Pin 5c
normally open	Pin 6c
common	Pin 7c
TTL - output active high	Pin 8b

relay 3	**VG-strip**
normally close	Pin 8c
normally open	Pin 9c
common	Pin 10c
TTL - output active high	Pin 9b

22.1 Available Relay Programs

The following switching outputs can be activated by means of DIP-switch 3 switch 5-8.

5	6	7	8	standard setting ex works
off	off	off	off	relay 1 = 24-clock pulse (1 sec.) relay 2 = hour pulse (1 sec.) relay 3 = minute pulse (1 sec.)
on	off	off	off	relay 1 = output interfering signal relay 2 = hour pulse (1 sec.) relay 3 = minute pulse (1 sec.)
off	on	off	off	relay 1 = minute pulse (1 sec.) relay 2 = minute pulse (1 sec.) relay 3 = minute pulse (1 sec.)
on	on	off	off	relay 1 = day pulse at 3.00 o'clock (1 sec.) relay 2 = hour pulse (1 sec.) relay 3 = minute pulse (1 sec.)

In this setting the relay output takes place 10 ms before the internal second change.

off	off	on	off	relay 1 = 5 minute pulse (1 sec.) relay 2 = hour pulse (1 sec.) relay 3 = minute pulse (1 sec.)

Further settings:

on	off	on	off	relay 1 = day pulse at 03:59:59 (1 sec.) relay 2 = radio operation relay 3 = minute pulse (1 sec.)
off	on	on	off	relay 1 = day pulse (1 sec.) relay 2 = summertime/wintertime relay 3 = minute pulse (1 sec.)
on	on	on	off	relay 1 = minute pulse (20 msec.) relay 2 = minute pulse (20 msec.) relay 3 = minute pulse (20 msec.)
off	off	off	on	relay 1 = minute pulse (100 msec.) relay 2 = 5 minute pulses (100 msec.) relay 3 = day pulse (100 msec.)

Other outputs on request

23 Technical Data 6021

operating voltage	
internal	+ 5V DC ± 5%
external (optional)	+24V DC (18-36V) | 2,5A
	+48V DC (36-72V) | 1,3A
	120 / 240V AC | 0,8 / 0,45A | 47-63 Hz
power consumption:	ca.250mA (without display)
	ca.850mA (with display)
	power on current 1 second 1.3 A
interfaces:	TTY/ RS232c / RS422
data format:	ASCII
accuracy:	± 2 msec during DCF77-reception, plus propagation delay transmission-reception location
quartz clock deviation:	2ppm = 0.1728 sec/day after DCF77-control
back-up clock deviation:	25ppm
buffering period:	3 days
relay outputs:	3 (24V / 20mA)
potential free inputs:	2
display:	LED display 12 digits (13mm)
antenna:	active ferrite antenna (max. cable length 500m, weather-proof outdoor antennas available)
lightning protection:	indirect lightning protection for the antenna to protect the computer system from overvoltage is available
extras:	soft and hardware alterations according to customers specifications are possible

Please note : The ***hopf*** Company withhold the right to alterations in specifications of hard- and software without notice.

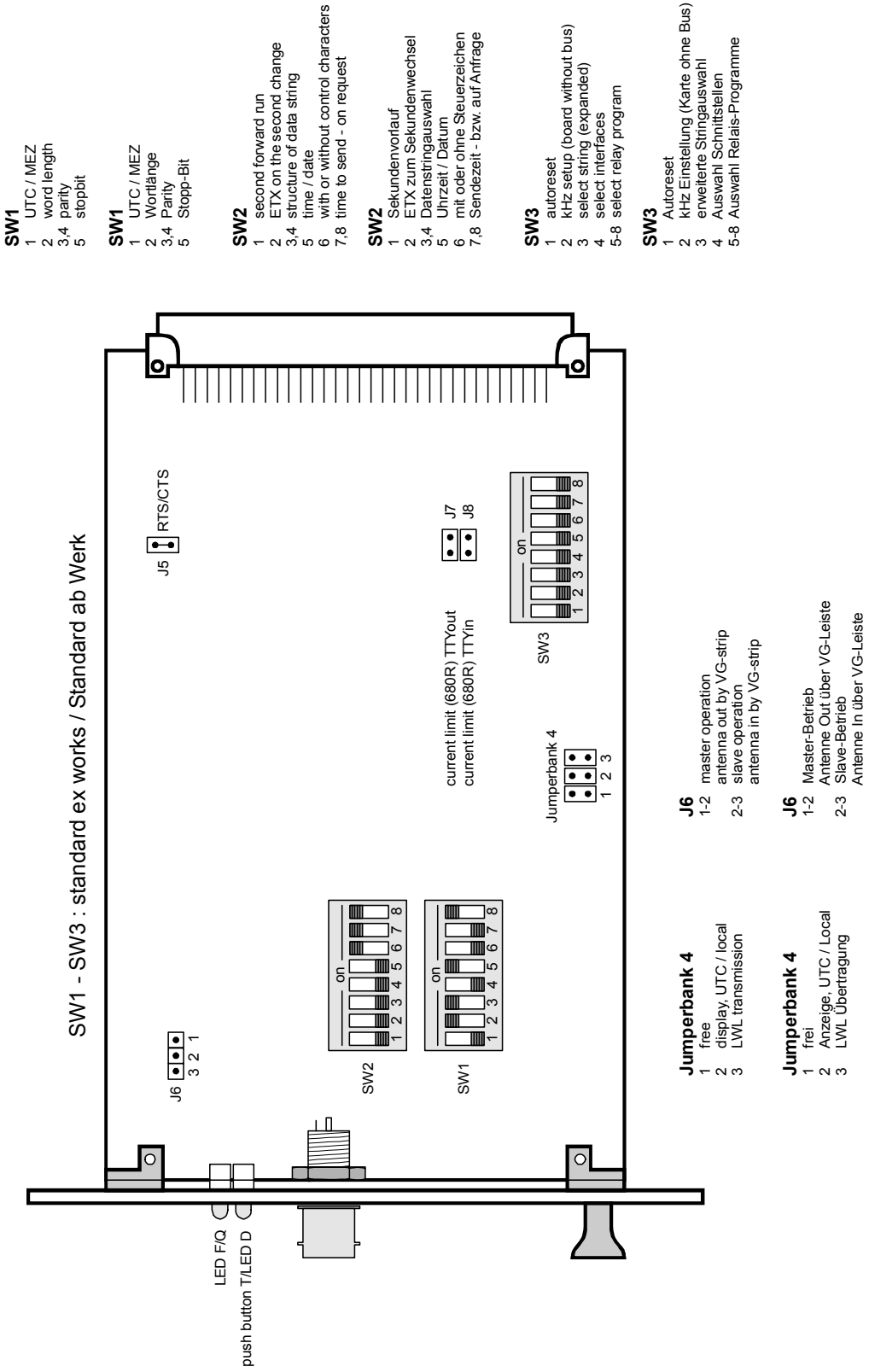
24 Pin Assignment of 96-pole VG-Strip

	a		b		c		
1	antenna-signal		GND		antenna-GND		1
2	TxD	V.24	+5V		R	REL1	2
3	RxD	V.24	n.c.		A	REL1	3
4	RTS	V.24	n.c.		M	REL1	4
5	CTS	V.24	n.c.		R	REL2	5
6	n.c.		n.c.		A	REL2	6
7	GND		K1		M	REL2	7
8	n.c.		K2		R	REL3	8
9	GND		K3		A	REL3	9
10	TxD	V.11	n.c.		M	REL3	10
11	/TxD	V.11	/DCF-T	display	GND		11
12	RxD	V.11	/VDR	display	+OK1 in		12
13	/RxD	V.11	/CLOCK	display	-OK1 in		13
14	GND		/DATA	display	+OK2 in		14
15	+5V		extendet C		-OK2 in		15
16	+5V		GND		GND		16
17	DCF-T	display	+TTY out		+DCF-pulse out		17
18	VDR	display	-TTY out		-DCF- pulse out		18
19	CLOCK	display	+TTY in		+DCF- pulse in		19
20	DATA	display	-TTY in		-DCF- pulse in		20
21	n.c.		n.c.		/RESET		21
22	n.c.		n.c.		n.c.		22
23	n.c.		n.c.		Bus-TxD		23
24	n.c.		n.c.		1kHz		24
25	n.c.		n.c.		n.c.		25
26	n.c.		n.c.		n.c.		26
27	n.c.		n.c.		n.c.		27
28	n.c.		n.c.		n.c.		28
29	n.c.		n.c.		n.c.		29
30	n.c.		n.c.		n.c.		30
31	GND		GND		GND		31
32	+5V		+5V		+5V		32

1	2	3	4	5	6	7	8	9
R	A	M	R	A	M	R	A	M
REL 1			**REL 2**			**REL 3**		

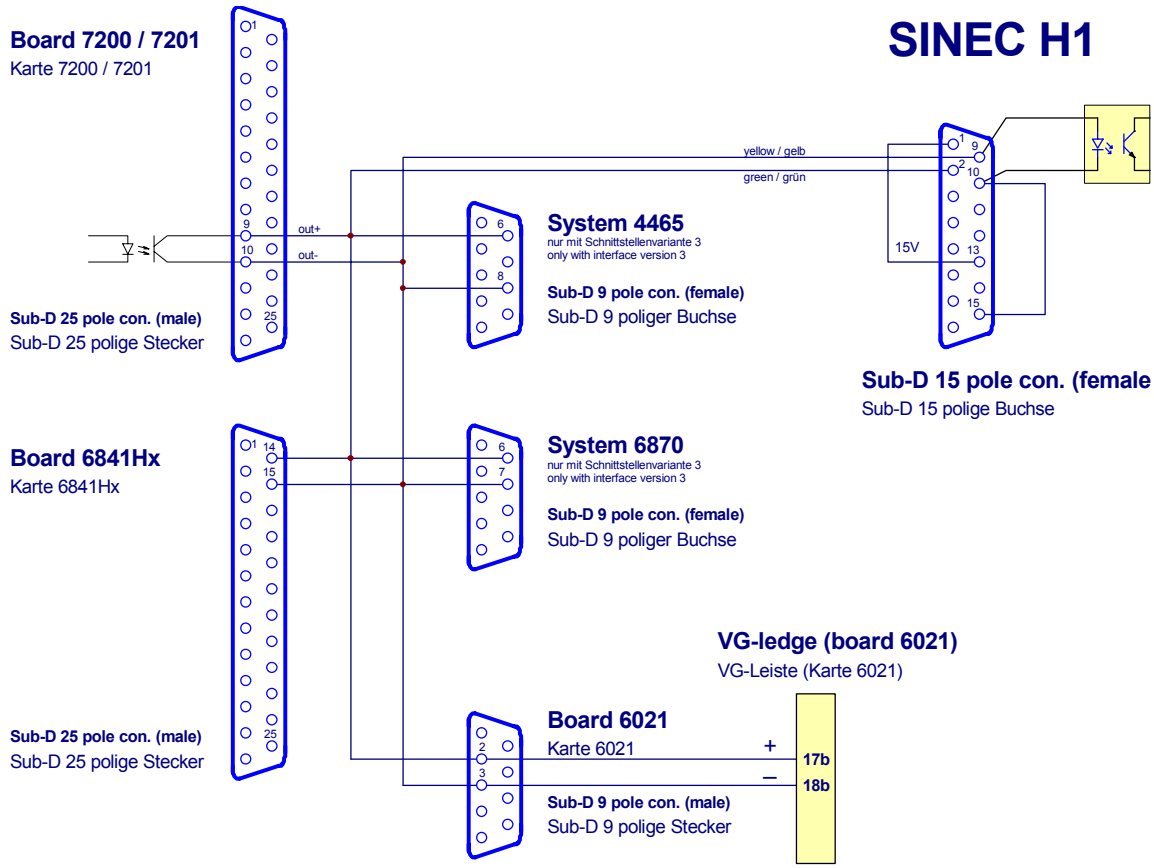
- R ⇨ normally close
- A ⇨ normally open
- M ⇨ common

Positioning 6021



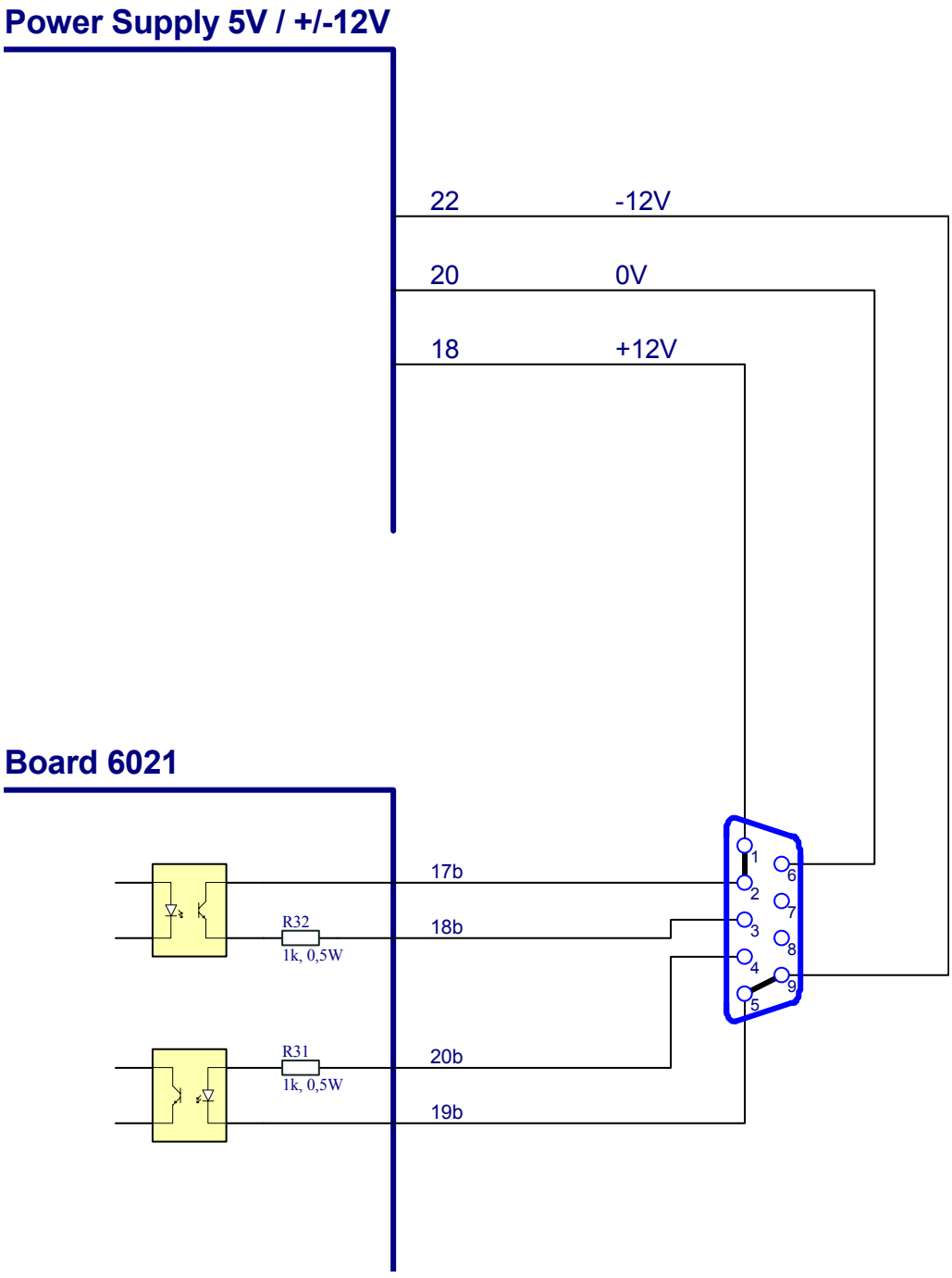
Drawing-No.: 97092306

Connection Diagram for SINEC H1



Drawing-No.: 97072401

TTY active for Board 6021



Drawing-No.: 97092308