Technical Description

Serial Interface of the Board

6038

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1 The Serial Interface of the Clock Board 6038

The satellite radio controlled clock is equipped with one serial interface. The data are exchanged via the RS232c (V.24) signal level. The interface can be used for the transmission of data strings to other computers. At present the ***hopf*** 6021 data string is supported as the standard time data string. It is possible to supply data strings designed according to customer needs and requirements. The RS232c interface can be set either with the MSDOS programme **"SERVICE.EXE"** or with the programme**"GPS_6038.EXE"**.

Please note : The interface cannot be used as PC-interface (COM1-COMx).

1.1 Structure of the Configuration Bytes

The interface can be parametered by means of the enclosed "SERVICE.EXE".The various settings are transmitted to the clock in three configuration bytes; the individual bit positions are to be read as switches.

All the values are to be read as hexadecimal values. When the switch position for one bit position is put to "on" the according bit must be set to Bit = 1.

In general calculating the value that is to be transmitted looks as follows:

bit position	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	
valence	**80**	**40**	**20**	**10**	**8**	**4**	**2**	**1**	
	1								80
		0							0
			1						20
				0					0
					0				0
						1			4
							1		2
								0	0
calculated total value for the transmission:									**A6**

The first byte serves to select the stop-, data- and parity bit and the baud rate. This byte is called the parameter byte in the service programme and it is transmitted to the clock.

In your own programme the following transmission technique must be observed to supply the clock with a new setting (base = base address of the clock board).

no.	process	value(HEX)	port address (HEX)
1.	control code parameter - byte	30	base + 37
2.	write the new value	0..FF	base + 30

In the programme **"SERVICE.EXE"** only the hexadecimal value stated under no.2 must be entered for the new setting.

The second byte selects the data string, sets the type of synchronization, determines the time zone and a number of other settings.

In the service programme this byte is called the data string 1- byte and it is transmitted to the clock. In your own programme the following transmission sequence must be followed to supply the clock with a new setting for the data string structure etc.

no.	process	value(HEX)	port address(HEX)
1.	control code data string 1- byte	31	base + 37
2.	write the new value	0..FF	base + 30

In the programme **"SERVICE.EXE"** only the hexadecimal value stated under no.2 must be entered for the new setting.

The third byte determines the sequence of the control characters CR and LF and sets the time base for the output.

In the service programme this byte is called data string 2 - byte and it is transmitted to the clock. In your own programme the following transmission sequence must be followed to supply the clock with a new setting for the data string structure etc.

no.	Process	value(HEX)	port address(HEX)
1.	control code data string 2 - byte	32	base + 37
2.	write the new value	0..FF	base + 30

In the programme "SERVICE.EXE" only the hexadecimal value stated under no.2 must be entered for the new setting.

1.2 Settings with the Parameter Byte

1.2.1 Bit Position 1 not used at present

bit position 1	meaning
off	free
on	free

1.2.2 Setting the Word Length

bitposition 2	meaning
off	8 data bit
on	7 data bit

1.2.3 Setting the Parity Bit

bit position	3	4	meaning
	on	on	odd parity
	on	off	even parity
	off	off	no parity

1.2.4 Setting the Stop Bit

bit position 5	meaning
off	1 stop bit
on	2 stop bit

1.2.5 Setting the Baudrate

bit 8	bit 7	bit 6	baudrate/Bd
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

1.3 Settings with the Data String Byte 1

1.3.1 Second Advance of the Serial Output

bit position 8	second advance
off	with second advance
on	without second advance

1.3.2 Control Character ETX as On-Time-Marker

When this setting has been selected and also the transmission with control characters (STX/ETX) then the last character ETX is transmitted exactly on the next second change.

bit position 7	ETX on the second change only if selected with control characters
off	with ETX on the second change
on	without ETX on the second change

1.3.3 Selection of Data String

bit position 6 and 5		structure of data string
on	on	data string 6021
off	on	not used at present
on	off	not used at present
off	off	not used at present

1.3.4 Data String Structure Time or Time/Date

bit position 4	time or time/date
off	output time only
on	output time/date

1.3.5 Send with Control Characters STX/ETX

bit position 3	transmit with control characters
off	with control characters
on	without control characters

1.3.6 Synchronization Point of Time

bit position 2 and 1		transmission point of time
off	off	transmission every second
off	on	transmission on the minute change
on	off	transmission on the hour change
on	on	transmission on request only

1.4 Settings with the Data String Byte 2

1.4.1 Local or UTC Time

bit position 8	UTC/local time
on	local time
off	UTC - time

1.4.2 Exchange Control Characters CR and LF

bit position 7	CR...LF exchanged
on	CR...LF
off	LF...CR

The other bit positions of the data string byte 2 are meant for later use and not in use at present.

2 Data Format of the Serial Transmission

The data are transmitted in ASCII as BCD values and can be displayed with any terminal programme (example: TERMINAL.EXE under Windows). The following control characters from the set of ASCII- characters are also used in the data string structure.

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

Please note : Status value are to be decoded seperately (see data string structure).

3 Serial Requests with ASCII - Characters

The data string output can be released by the user by means of an ASCII character. The following characters release the output:

ASCII "U" -- for time (local - time)
ASCII "D" -- for time/date (local - time)
ASCII "G" -- for time/date (UTC-time)

Within 1 msec. the system answers with the according data string.

Often this is too fast for the requesting computer, therefore it is possible to delay the answer in 10 msec. steps in case of a request via software. To delay the transmission of the data string the requesting computer transmits the small letters "u, d, g" together with a two-digit multiplication factor to the clock.

The clock reads the multiplication factor as hexadecimal value.

Example :

The computer sends: **ASCII u05** (Hex 75, 30, 35)
After 50 milliseconds the clock answers with the data string time only (local time).

The computer sends **ASCII gFF** (Hex 67, 46, 46)
After 2550 milliseconds the computer sends the data string time/ date (UTC-time)

4 General Information on the Serial Data Output of the 6038

The control characters STX and ETX can only be transmitted if the output is set to "with control characters" in mode byte 0 switch 2. Otherwise there are no control characters.

In case of the setting ETX on the second change there will be a transmission gap of up to 970 msec. depending on the baudrate. Please take this into consideration when programming a time-out on the reception side.

In all the data strings it is possible to exchange the output of the control characters CR and LF by means of the mode byte 1 switch 6.Switch 6=on CR-LF, switch 6 = off LF-CR.

The transmitted data string is compatible with the data strings of the following ***hopf*** radio controlled clock boards.

- board 6020/6021 standard with control characters
- board 6025/6027 standard with control characters (string 6021 only)
- board 7200/7201 standard with control characters
- board 7220/7221 standard with control characters
- board 7240/7245 standard with control characters
- board 6840 standard with control characters

5 Structure of the Data String 6038/6021 Time and Date Standard

character no.	**meaning**	
1	STX (Start of Text)	
2	Status (internal status of the clock)	; see 5.2
3	day of the week (1= Monday ... 7=Sunday)	; see 5.2
	In case of 'UTC-time' bit 3 in the day of the week is set to 1	
4	tens - hours	
5	unit - hours	
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	tens - year	
15	unit - year	
16	LF (Line Feed)	
17	CR (Carriage Return)	
18	ETX (End of Text)	

5.1 Structure of the Data String 6038/6021 Time Only Standard

character no.	meaning
1	STX (Start of Text)
2	tens - hours
3	unit - hours
4	tens - minutes
5	unit - minutes
6	tens - seconds
7	unit - seconds
8	LF (Line Feed)
9	CR (Carriage Return)
10	ETX (End of Text)

5.2 Status and Day of the Week Nibble in the Data String 6038/6021 Standard

The second and the third ASCII character in the data string 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-DST-ST)
	x	x	0	x	standard time (ST)
	x	x	1	x	daylight saving time (DST)
	0	0	x	x	time/date invalid
	0	1	x	x	crystal operation
	1	0	x	x	radio operaton
	1	1	x	x	radio operation (high accuracy)
day of week nibble	0	x	x	x	ST/DST
	1	x	x	x	UTC
	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

5.3 Example of a Transmitted Data String 6038/6021 (Standard)

(STX)E3123456170496(LF)(CR)(ETX)

Radio operation (high accuracy)
summertime
no announcement
It is Wednesday 17.04.96 - 12:34:56 h
( ) - ASCII-control characters e.g. (STX)

6 Setting the Clock by Serial Interface

Time and date can also be set via the serial interface. This requires the following data string.

character no.	meaning	value (value range)
1	"S" (for setting time)	$53
2	tens - hour	$30...32
3	unit - hour	$30...39
4	tens - minute	$30...35
5	unit - minute	$30...39
6	tens - second	$30...35
7	unit - second	$30...39
8	tens - day	$30...33
9	unit - day	$30...39
10	tens - month	$30...32
11	unit - month	$30...39
12	tens - year	$30...39
13	unit - year	$30...39
14	day of the week	$31...37
15	CR (Carriage Return)	$0D

Alternatively at position 15 and 16 a status information can be transmitted which sets the clock status internally to standard- or daylight saving time. In this case the 17. character must be carriage return.

15	Status High Nibble	$34or 35
16	Status Low Nibble	$30 or 38
17	CR (Carriage Return)	$0D

meaning of the status byte

Hex 48 = daylight saving time
Hex 50 = standard time

Example of a transmission :

>S1234561704963CR< for Wednesday 07.08.94, 12:34:56
>S123456170496348CR< for Wednesday 07.08.94, 12:34:56 daylight saving time

7 Remote - Function of the Serial Interfaces

Remote-functions are necessary to install the clock from a remote computer. A number of different data strings are transmitted to set the time, date, points of changeover (summer-/wintertime), position data, difference time local-UTC and decoding of the GPS-reception quality. It is also possible to parameter the serial interface. The programme GPS_6038 (enclosed in the delivery of the clock board with Windows NT driver software) uses the below desribed mechanisms.

Activating a remote function interrupts the standard data traffic for ca. 15 seconds on the interface.

The control characters STX and ETX cannot be excluded from the transmitted remote string, they are always part of the remote data strings.

A communication between clock and computer is always started by the computer. The structure of the data string is as follows:

STX (command) [status] [data] CR LF ETX

The centre of the transmission is the STX (hex 02) and also the CR (Hex 0D), LF (Hex 0A) and ETX (Hex 03) at the end of the data string.

The instruction field contains ASCII-characters, which indicate the type of function. The following commands are possible:

TIM:	for time and date
DIF:	for difference time local - UTC
POS:	for position data
SAT:	for reception quality
RES:	for reset of the clock system
PAR:	for parameter byte of the interface
MOD:	for data string byte 0 of the interface
MO1:	for data string byte 1 of the interface

The fields ***status*** and ***data*** are optional and depend on the command or on the requested function.

The **TIM** command is always transmitted with a status. The status indicates whether the data string contains a time or a point of changeover. The other commands are transmitted without status.

7.1.1 The Status Byte and Data String Structure in the TIM Command

The status byte consists of two ASCII nibbles. The value range of each nibble can be from Hex 30 to 39 and Hex 41- 46 (00-FF). A conversion into binary values follows the reception of the two characters. Example: the two ASCII characters "4" and "2" (Hex 34 and 32) have been received, the ASCII correction results in the following byte:

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	1	0	0	0	0	1	0

Depending on whether the clock receives or sends a TIM command the status byte has the following meaning:

Bits in the sent status byte (by the clock system):

Bit 7 = 1,	Bit 6 = 1	clock is radio synchronous with crystal control
Bit 7 = 1,	Bit 6 = 0	clock is radio synchronous without crystal control
Bit 7 = 0,	Bit 6 = 1	clock is in crystal operation (time valid)
Bit 7 = 0,	Bit 6 = 0	clock has no valid time
Bit 5 = 1		announcement of a leap second on the next hour change
Bit 4 = 1		standard time
Bit 3 = 1		daylight saving time (only when operating with changeover)
Bit 4 = 0,	Bit 3 = 0	UTC (Universal Time Coordinated)
Bit 2 = 1		changeover (ST/DST-DST/ST) on the next hour change
Bit 0 = 1		in case of changeover only : changeover has been carried out
Bit 0 = 0		changeover time still active

Meaning of the bits in the received status byte:

Bit 7	no meaning
Bit 6 = 1	must always be set
Bit 5 = 1	clock is to insert a leap second on the next hour change (please note: for diagnostic purposes only)
Bit 4 = 1	standard time
Bit 3 = 1	daylight saving time
Bit 2 = 1	changeover ST/DST - DST/ST on the next hour change (please note: for diagnostic purposes only)
Bit 1 = 1	point of changeover ST/DST information
Bit 1 = 0	time and date information
Bit 0	no meaning

The data field in the TIM data string contains the actual settings of the clock during transmission operation. During reception operation the new times are entered here. If the data field is missing during reception then the received status is decoded according to requested clock data and the clock releases a transmission with the according data on the next possible point of time.

The data are transmitted and received as ASCII values in BCD. Received data are checked for plausibility by the clock. The clock reads invalid data like e.g. day = 32 in the data string as not valid and rejects the whole data string. The day of the week must always be included 1 = Monday, 7 = Sunday. In case of changeover times the day of the week must always be set to 7.

Structure of the data field in the string

consec. character no.:	meaning	value (value range)
1	comma	$2C
2	tens - hour	$30-32
3	unit - hour	$30-39
4	comma	$2C
5	tens - minute	$30-35
6	unit - minute	$30-39
7	comma	$2C
8	tens - second	$30-35
9	unit - second	$30-39
10	comma	$2C
11	tens - day	$30-33
12	unit - day	$30-39
13	comma	$2C
14	tens - month	$30-31
15	unit - month	$30-39
16	comma	$2C
17	tens- year	$30-39
18	unit - year	$30-39
19	comma	$2C
20	day of the week	$31-37

7.1.2 Setting the Time

statusbyte (Hex)	meaning
48	setting standard time (local time)
50	setting daylight saving time (local time)

Example of data string :setting standard time 12:34:56 h, Sunday 07.08.99

STX TIM: 48,12,34,56,07,08,99,7 CR LF ETX

After taking over the data the clock answers with the new time data string :

STX TIM: 48,12,34,56,07,08,99,7 CR LF ETX

7.1.3 Requesting the Time

statusbyte (Hex)	meaning
40	UTC (universal time coordinated) request
48	Local Time request

Example data string requesting UTC :

STX TIM: 40 CR LF ETX

On the next possible point of time the clock answers with the actual world time.

example answer : STX TIM: 40,10,34,56,07,08,99,7 CR LF ETX
It is 10:34:56 h, Sunday 07.08.99 UTC.

7.1.4 Setting the Points of Changeover

statusbyte (Hex)	meaning
4A	setting the point of standard time changeover
52	setting the point of daylight saving time changeover

Example data string setting points of standard time changeover 02:00:00h Sunday 23.09.96

STX TIM: 4A,02,00,00,23,09,96,7 CR LF ETX

After the reception the clock answers with the new points of standard time changeover:

STX TIM: 4B,02,00,00,23,09,96,7 CR LF ETX

Bit 0 = 1 in the status byte indicates that the new points of changeover have been activated.

7.1.5 Requesting Points of Changeover

statusbyte (Hex)	meaning
52	request point of standard time changeover
4A	request point of daylight saving time changeover

Example data string request point of standard time changeover

STX TIM: 52 CR LF ETX

On the next possible point of time the clock answers with the actual point of standard time changeover

Example answer : STX TIM: 53,02,00,00,23,09,96,7 CR LF ETX

The changeover to standard time is still active (Bit 0 in the statusbyte = 1) and will be carried out at 02:00:00 on Sunday 23.09.96 local time.

7.1.6 Time Difference Local UTC

The DIF-command can be used to set or request the difference between local time and UTC. The data field for this command is structured as follows:

meaning	value range (Hex)
direction	+/- 2B, 2D
tens -hour	30-32
unit - hour	30-39
comma	2C
tens - minute	30,33
unit - minute	30

The difference time must not exceed +/- 12 hours. The minutes may be 0 - 59.

Example data string setting the difference local time - UTC to 1 hour.

STX DIF: -01,00 CR LF ETX

The actual difference is requested by the following data string:

STX DIF: CR LF ETX

After the reception the clock answers with the new difference time:

STX DIF: -01,00 CR LF ETX

The actual difference is requested with the following data string:

STX DIF: CR LF ETX

After the reception the clock answers with the new difference time:

STX DIF: +02,00 CR LF ETX

7.1.7 Position Data

The position data for the respective operating location of the clock are set or requested with the following data string:

The data field is structured as follows:

character no.:	meaning	ASCII	value (value range)
1	longitude west/east	W, E	$57, 45
2	colon	:	$3A
3	degree hundreds	0,1	$30, 31
4	degree tens	0-8	$30-37
5	degree unit	0-9	$30-39
6	comma	,	$2C
7	tens - minute	0-5	$30-35
8	unit - minute	0-9	$30-39
9	comma	,	$2C
10	hundredth - minute	0-9	$30-39
11	thousandth - minute	0-9	$30-39
12	comma	,	$2C
13	latitude north/south	N, S	$4E,53
14	colon	:	$3A
15	degree tens	0-8	$30-38
16	degree unit	0-9	$30-39
17	comma	,	$2C
18	tens - minute	0-5	$30-35
19	unit - minute	0-9	$30-39
20	comma	,	$2C
21	hundredth - minute	0-9	$30-39
22	thousandth - minute	0-9	$30-39

Example data string setting the position data :

STX POS: E:007,33,34,N:53,12,21 CR LF ETX

7.1.8 Data about the GPS- Reception Quality

These data can only be requested. The request string reads as follows:

STX SAT: CR LF ETX

The clock answers with the number of located satellites and a relative value for the signal/noise ratio. This value may range between 0 to 255, values bigger than 50 representing good reception.

The data field is structured as follows:

character no.:	meaning	ASCII	value (value range)
1	ident. satellite track	T	53
2	colon	:	3A
3	number located sat.	0-9	30-39
4	comma	,	2C
5	ident. satellite	S	53
6	colon	:	3A
7	tens - sat. no.	0-9	30-39
8	unit - sat. no.	0-9	30-39
9	slash	/	2F
10	hundredth S/N ratio	0-9	30-32
11	tens - S/N ratio	0-9	30-39
12	unit - S/N ratio	0-9	30-39
13	comma	,	2C

Position 5 to 13 are repeated for 6 satellites in total.

Example of a transmitted answer with satellite data:

STX SAT: 08,S:07/143,S:12/145,S:23/034,S:14/145,S:03/123,S:19/047 CR LF ETX

7.1.9 Release Reset of the Clock System

A reset (master reset) is released by means of the following data string:

STX RES: CR LF ETX

First the clock answers with the following data string,

STX RES: CR LF ETX

to indicate that the reset command is carried out.

7.1.10 Parameter Byte of the Serial Interface

Setting the baud rate etc. see also pt.1.2 of this description.
The serial interface is parametered with the following string.

character no.:	meaning	ASCII	value (value range)
1	baudrate - tenthousand	0-1	30-31
2	baudrate - thousand	0-9	30-39
3	baudrate - hundred	0- 9	30-39
4	baudrate - tens	0	30
5	baudrate - unit	0	30
6	comma	,	2c
7	parity bit	N,E,O	4e,45,4f
8	comma	,	2c
9	data bit	7,8	37,38
10	comma	,	2c
11	stop bit	1,2	30,31
12	comma	,	2c
13	this position always	N	4e

Possible values for the baud rate incl. leading 0 are:

19200
09600
04800
02400
01200
00600
00300
00150

Example data string setting the parameter data:

STX PAR:09600,N,8,1,N CR LF ETX

This string sets the serial interface to the following setting:
9600 baud, no parity, 8 data bits, 1 stop bit

7.1.11 data string byte 0 of the Serial Interface

Data string byte 0 can be used to set operating status, every bit representing a switch, which can be either on=1 or off=0. The meaning of every bit position is explained under pt. 1.3 of this description.

character no.:	meaning	ASCII	value (value range)
1	bit 7	0-1	30-31
2	comma	,	2c
3	bit 6	0-1	30-31
4	comma	,	2c
5	bit 5	0-1	30-31
6	comma	,	2c
7	bit 4	0-1	30-31
8	comma	,	2c
9	bit 3	0-1	30-31
10	comma	,	2c
11	bit 2	0-1	30-31
12	comma	,	2c
13	bit 1	0-1	30-31
14	bit 0	0-1	30-31

Example data string setting the parameter data:

STX MOD:1,1,1,1,1,0,0,0,CR LF ETX

This string sets the following transmission modes:

- transmission every second
- transmission with control characters
- transmission without ETX as on-time marker
- transmission data string 6021
- transmission without second advance
- output time/date

7.1.12 data string byte of the Serial Interfaces

data string byte 1 serves to set operating status, every bit representing a switch, which is either on=1 or off=0. The meaning of every bit position is explained under pt.1.4 of this description.

consec. character no.	meaning	ASCII	value (value range)
1	bit 7	0-1	30-31
2	comma	,	2c
3	bit 6	0-1	30-31
4	comma	,	2c
5	bit 5	0-1	30-31
6	comma	,	2c
7	bit 4	0-1	30-31
8	comma	,	2c
9	bit 3	0-1	30-31
10	comma	,	2c
11	bit 2	0-1	30-31
12	comma	,	2c
13	bit 1	0-1	30-31
14	bit 0	0-1	30-31

Example of data string set data string byte 1:

STX MO1:1,1,0,0,0,0,0,0,CR LF ETX

This string sets the following transmission modes:

- send local time
- send control characters CR and LF.

7.1.13 Altering the Port Address of the Clock Board

The port address of the clock board can be set via the serial interface requiring the following data string:

meaning	value range (ASCII)
address thousand	0-F
address hundred	0-F
address tens	0-F
address unit	0

Please note : the new address must be plausible, see also manual for programmers chapter: ‘altering the port address’.

Example data string: setting a new port address to 0x280

STX ADR:0280 CR LF ETX

7.2 Remote Software for a Personal Computer

A software under MS Windows from 3.x is available for the remote control of the clock system.

This programme enables the user to carry out all the above described functions from a PC or laptop. To do so the computer must be connected with the clock system via a free serial interface.

The software includes the following functions:

- entry of clock data (time, date)
- entry of position data
- plausibility check of the entered data
- structure and transmission of the above data strings to the clock system
- supervision of the operation by decoding and displaying the answer strings
- altering the port address

8 Pin Allocation of the Serial Interface

8.1 Interface Signals to the 9-pole SUB-D Connector

pin no.:	name of signal
1	
2	
3	
4	
5	GND Ground
6	
7	RxD Receive Data
8	TxD Transmit Data
9	

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