Thermo
ELECTRON CORPORATION

Technical Description DT-020-021015 E

TECHNICAL REFERENCE DATA OF THE FHT 6020

Description of remote control commands for the FHT 6020

Version check

Rev.	Rev. version	Responsible Dept.	Name	Rev. Page	Cat. *)	Explanation
	25.10.02	SM-GE	Schl			

*) Category K: editorial correction
V: explanatory improvement
S: substantial change

An explanation is required at least for category S.

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FIGURES:

1. Introduction

The technical description DT-020-010518-E is an additional documentation for the FHT 6020 manual DB-045-100514 E. It describes the remote control commands of the serial pc interface.

By means of the commands listed here, the measured values can be read from the FHT 6020 and the device configuration can be set.

It is recommended to use the WINDOWS configuration program FHT6020.exe for the first configuration. This program is delivered with each FHT6020. So the configuration can be made very comfortable.

2. Remote control

2.1 Design of the serial interface

There are two alternative versions of the serial interface of the probe:

2.1.1 PC-interface RS-232

Hint: Only one FHT 6020 can be connected to one serial RS232 port of the PC.
In order to connect the FHT 6020 to a PC via a RS-232 interface you may either use:

- a commonly used 9-pin 1:1 cable with D-Sub connectors
- or the 9-pin D-sub connection cable, SM 1685 35225, available from Thermo Eberline ESM

In case that power for the FHT 6020 shall be supplied by the PC, the connection set 42542 / 60 comprising

- Probe supply for RS-232, 42542 / 6001,
- Connection cable, 5m long, 9-pin D-Sub, SM 1685 35225,
- and plug power supply 42510 / 4210-10 (230 VAC / 15 VDC, 540 mA)

may be employed.
The probe supply 42542 / 6001 for its part features already a connection cable, 0.3m long, 25-pin to 9-pin D-Sub, SM 1685 35149.

ATTENTION: When designing the power supply for the FHT 6020, the hints in chapter 4.3.5 of the FHT 6020 operation manual DB-045-010514 –E must be followed.

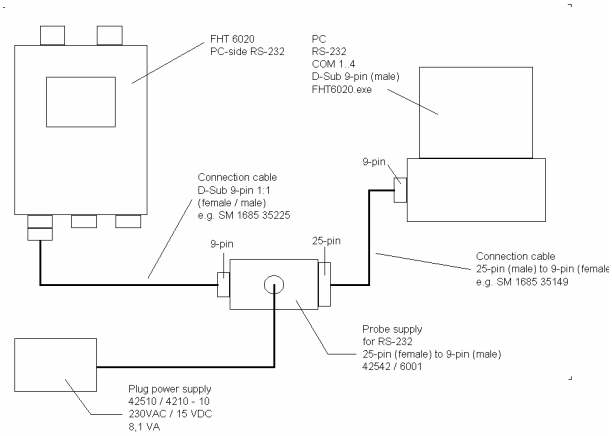

Figure 2-1: Connection to a PC via RS-232 interface

2.1.2 PC-interface RS-485

Hint: Via the RS-485 interface, more than one (up to 99) FHT 6020 can be connected to one serial RS232 port of the PC using the interface converter RS-232 / 485.

To connect the FHT 6020 to a PC via RS-485 the following items are required:

- the interface converter 42509 / 2028 (RS-232 / RS-485),
- the plug power supply 42510 / 4210-10 (230 VAC / 15 VDC, 540 mA),
- a connection cable, 9-pin, D-Sub, 1:1 to connect the PC to the RS-232 side of the interface converter (e. g. SM 1685 35225)
- as well as a second connection cable, 9-pin, D-Sub, 1:1 to connect the RS-485 side of the interface converter to the FHT 6020.

ATTENTION: When designing the power supply for the FHT 6020 the hints in chapter 4.3.5 of the FHT 6020 operation manual DB-045-010514 –E must be followed.

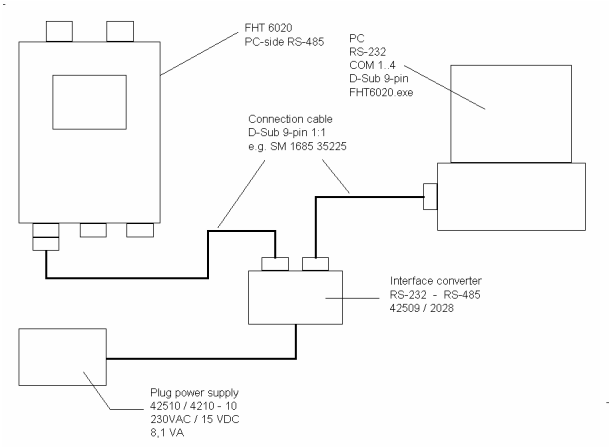

Figure 2-2: Connection to a PC via RS-485 interface

2.2 Interface parameters

Baud rate: 9600, 19200 or 38400 baud, settable by serial interface
Coding: 7 bit ASCII characters, even parity, 2 stop bits

The data transfer is handled in master-slave operation:
A command or a data request is sent from the computer to the FHT 6020. The FHT 6020 executes the command or responds to the request.

2.3 Data transmission format

A data record transmitted to or from the probe has the following format:

<BEL>nnAA[number]bc<ETX>

<BEL>	Start character for the transmission (ASCII code = 7)
<ETX>	End character for the transmission (ASCII code = 3)
nn	Address 01 to 99
AA	Remote control command (see list below)
bc	Block check: Modulo 256 sum of <BEL> to last character before bc (inclusive) coded as hexadecimal ASCII number (two characters, e.g. "8F")

Optional parameter:

[number]	One or several numerical values, depending on the type of message (for number format see list of remote control commands).

Example:
Request for the channel 1 measured value "RM1" (FHT 6020 address = 1)
<BEL>01RMEF<ETX>

2nd3.1 Response of the FHT 6020 to a command

Depending on the validity of a command to the FHT 6020, the FHT 6020 responds in the following ways:

- No response
  If a FHT 6020 that is connected up properly does not respond to a request, the address may be wrong, or an invalid command has been used.
- <NAK>
  If the FHt 6020 detects a parity or checksum error in the command received, it returns the character <NAK>.
- <ACK>
  If the FHT 6020 receives a command which initiates an action, but no data output in the FHT 6020, the probe returns the character <ACK>.
- <BEL>nnAADATAbc<ETX>
  If the FHT 6020 detects a valid request for data, it returns the desired data. With the response, the same format is used as with the request. The content of the data field DATA is stated in the list of remote control commands.
  (nn, AA and bc as in the request)

Control characters used:

ASCII characters	Decimal	Hexadecimal	Meaning
<BEL>	7	7	Start of the transmission
<ETX>	3	3	End of the transmission
<NAK>	21	15	Negative acknowledgement
<ACK>	6	6	Positive acknowledgement

2.3.2 Number format

Output format

The format in which numerical values are output depends on the type of data. The formats that can be used are listed below:

- Integer number, Format A
  Positive integer number between 0 and 16777215, leading blanks are allowed
  Example: 1234 --> 1234
  In the following table the Format A is represented as nnn.
- Floating-point number, Format E
  Number in exponential format: ±xxxxE±ee
  In the following table the Format E is represented as xxx.
- Hexadecimal number, Format H
  Positive integer number in hexadecimal format. Example: 3A
  In the following table the Format H is represented as hhh.

The response time between the reception of <ETX> from the master and the transmission of the first character is 900 ms (maximum) for commands directly sent to the FHT 6020. The list of these commands can be found in the table below.
All the other requests have a maximum response time of 500 ms.

Commands using Transparent mode (=Request to a probe connected at the probes interface of the FHT 6020 have a response time up to 1300 ms. The list of the valid commands can be found in the operation manual of the connected probe.

Input format

In order to facilitate reading variables into the probe, all input parameters must be entered in the prescribed format. When floating-point numbers are input, the following conditions must be fulfilled:

- A maximum of 7 digits are possible before the decimal (1 place obligatory)
- The decimal separator must be entered as point
- A maximum of 7 digits are possible after the decimal
- The exponent must be entered ("e" or "E" possible), e.g. 12.3456e+5 or 1.2345E-3

2.4 List of remote control commands

2.4.1 Reading current measured values

Command	Response of the FHT 6020	Designation	Number format
RM	xxx hhhh hhhh	Read measured value of channel n, value status and system status	C,H
MRn	xxx hhhh xxx	Read values of 40G port n: Mean value, status, measured time (n=1, 2)	C,H,C
##	hhhh	Read system status	H

2nd4.2 Reading and managing the FHT 6020 History

Command	Response of the FHT 6020	Designation	Number format
HIn	Data Set from history or <ACK> if history has been run through	n=0: sets read history pointer to current value. n=1: outputs subsequent data set; the pointer will be re-set, as soon as history has completely been run through	A
YW n	<ACK>	Set history store interval (n=60..3600 seconds)	A
YR	n	Read history store interval	H
HWn	<ACK>	Set history partition, code Bit 0-3 for 40G ports 1, 2, analogue inputs 1, 2 ($0 \le n \le 15$)	A
HR	h	Read history partition (Bit 0...3 see command HW)	H
HM	Data set or <ACK>	Read current data set from history <ACK> if set is not available	
HN nnnn	Data set or <ACK>	Read data set no. nnn <ACK> if set is not available	
CH	<ACK>	Clear history	

2.4.3 Channel configuration of FHT 6020

Command	Response of the FHT 6020	Designation	Number format
cWnn mm oo pp qq r	<ACK>	Set configuration of channel nn (1-16) mm: Type, oo: Port, pp: Decode, qq: Address	A...A
cRnn	nn mm oo pp qq r	Read configuration of channel nn (1-16) mm: Type, oo: Port, pp: Decode, qq: Address	A...A
dWnn mm xxx o	<ACK>	Select unit of channel nn mm: Number of unit from table with units 1-20 xxx: Display factor o: 0 = no Pre-Unit. 1 = automatic Pre-Unit n, µ, m, k, M	A,A,C,A
dRnn	mm xxx o	Read selected unit number of channel nn (see parameters at command dW)	
aWnn mm	<ACK>	Set display position 0-16 of value from channel nn Position m: 0 = value not displayed 1-16 = Line number in FHT 6020 display	A
aRnn	mm	Read display position of channel value (see parameters at command aW)	A
eWnn m	<ACK>	Activate (m=1) or deactivate (m=0) channel nn	A
eRnn	m	Read state of channel „active/not active“ n = channel number 1-20 m: 1 = channel active, 0 = channel not active	
bWnn ss	<ACK>	Set remote command of channel nn (1..16): ss = Command for Intelligent probe (max. 6 chars)	s
bRnn	ssssss or <ACK> (if no command set)	Read remote command of channel nn (1..16)	s
lWnn xxx xxx xxx	<ACK>	Set alarm limits of channel nn: (1-16) Alarm1, Alarm2, Failure rate	A, C
lRnn	xxx xxx xxx	Read alarm limits of channel nn: (1-16)	A, C

2.4.4 General configuration

Command	Response of the FHT 6020	Designation	Number format
AD	<ACK>	Set address 01..99	A
BDn	no answer	Set baud rate of PC-interface n = 0: 9600, 1: 19200, 2: 38400	A
bDn	<ACK>	Set baud rate of probe interface n = 0: 9600, 1: 19200	A
bS	nn	Read baud rate of probe interface	A
eE		Store device configuration to non-volatile memory. This action must be done at the end of every parameter change made	
VR	V 1.33	Read version of firmware	s
DP	0:FHT6020	Read type of device	s
jWn ssssss	<ACK>	Set freely programmable units 11-20 (max. 6 chars); n=11-20	A, s
jRnn	ssssss	Read freely programmable units 11-20 (max. 6 chars) n=11-20	A, s
yW nn	<ACK>	Set polling interval for connected measurement devices (nn=1..60)	A
yR	nn	Read polling interval (nn=1..60)	H
ZW jjmmtthhmmss	<ACK>	Set date and time	A
ZR	jjmmtthhmmss	Read date and time	S
sW ssss	<ACK>	Set device identification name (max. 10 chars)	S
sR	ssss	Read device identification name	S
NR	nnnnn	Read serial number	A
LWn	<ACK>	Set permanent display illumination n= 0 => OFF	A
LR	n	Read permanent display illumination n= 0 => OFF	A
uWn	<ACK>	Set language n = 0 => English n = 1 => German	A
uR	n	Read language n = 0 => English n = 1 => German	A
xW0 n mm	<ACK>	n=0: Deactivate single channel mode to normal mode n=1: Activate single channel mode for channel mm	A
xR0	n mm	Read single channel mode n: 0 = Normal mode (not single channel); 1 = Single channel mode for channel mm	H
!!		Hardware-Reset	
xW1 nn mm		Set number of tries when polling intelligent probes in case of transfer error: nn=1..10: maximum number of polling tries (nn>1: Polling is repeated (n-1) times in case of transfer error; nn=1: no repetition, nn=2: 1 time repetition mm=1..60: time of no polling an intelligent probe after transfer error in seconds	A
xR1	nn mm	Read number of polling tries (see also command xW1)	A

2nd4.5 Configuration for decoding status bits of connected probes

Command	Response of the FHT 6020	Designation	Number format
WSn m p	<ACK>	Set the probe-type specific mask for decoding measured status bits. Error-mask m and Alarm-mask p (16Bit) of probe types n=1-13. (m: Bit = 1: Status bit in probe status generates an error signalisation in FHT 6020; p: Bit = 1: Status bit in probe status generates an alarm 2 signalisation in FHT 6020)	A
RSn	m p	Read the probe-type specific mask for decoding measured status (see also command WS)	H

2nd4.6 Configuration of digital inputs and outputs, Led‘s and beeper

Command	Response of the FHT 6020	Designation	Number format
AWn m o p q r t	<ACK>	Set alarm configuration for digital outputs and beeper n=1-5: Output1-5, n=6: beeper m...q: fields for Alarm1, Alarm2, Failure, Error 16 bit-number r: system error (1: activated, 0: deactivated); t: 1=AND; 0=OR	A
ARn	m o p q r t	Read alarm configuration for digital outputs and beeper (parameter n, m, o, p, r, t see command AW)	H
hW nnn	<ACK>	Set digital outputs, 5 bit LSB coded for DOUT1, MSB coded for DOUT5, 0 ≤ nn ≤ 31	A
hR	hh	Read configuration for digital inputs (see also command hW)	H
kW nn	<ACK>	Set digital output, 5 Bit LSB coded for DOUT1, MSB coded for DOUT5, (0 ≤ nn ≤ 31)	
kR	00hh	Read setting of digital outputs	H
mW nn	<ACK>	Set logic of digital outputs, 5 bit LSB coded for DOUT1, MSB coded for DOUT5, 0 ≤ nn ≤ 31	A
mR	00hh	Read logic of digital outputs	H
SW nnn m	<ACK>	Set latching of outputs nnnn: Bit0-3, Bit8 -> digital outputs 2,3,4,5,1; Bit4,5,7: red LED, 2x yellow(alarm1 u. error); Bit9: beeper; m: quit alarm externally via digital input 4; activated(=1) or deactivated(=0).	A
SR	hhhh m	Read latching of outputs	
QA	<ACK>	Quit alarm (only valid, if no alarm actually exists)	

2nd4.7 Configuration of analog inputs and outputs

Command	Response of the FHT 6020	Designation	Number

			format
oWn mm	<ACK>	Set setting for analog output n (1,2) setzen: mm = bitwise coded value Bit0..15 corresponds to channel 1-16 Bit(x) = 1, value of channel(x+1) activive. The sum of all activated values is output as analog output.	A
oRn	hhhh	Read setting of analog output n (1,2)	H
pWn m xxx xxx	<ACK>	Set hardware configuration of analog output n (1..2). m: 0= 0-20mA(linear), 1= 4-20mA(linear), 2=0-20mA(logarithmic), 3= 4-20mA(log.) xxx: Upper and lower limit of measurement range (if linear) or upper and lower decade (if logarithmic – 10...+10)	A, C
pRn	m xxx xxx oo pp hh	m: 0= 0-20mA(linear), 1= 4-20mA(linear), 2=0-20mA(log.), 3= 4-20mA(log.) Upper and lower limit of measurement range (if linear) or upper and lower decade (if logarithmic – 10...+10), oo: Width of measurement range in bits of DAC pp: Offset hh: Error	A, C, C, A, A, H
WA nn mm		Set sample frequence for 2 analog inputs nn, mm : Sample rate / sec (nn, mm= 1, 2, 4, 8, 16) nn = analog input1, mm = analog input 2	A
RA	nn mm	Read sample frequence for 2 analog inputs nn, mm = 1, 2, 4, 8, 19	H

2.4.8 Managing alarm store

Command	Response of the FHT 6020	Designation	Number format
xW2 n mm	<ACK>	Set configuration for alarm store n=0: Alarm store off n=1 Alarm store on, no auto-print n=2 Alarm store on, auto print mm: Printer setting: header line is printed after each mm lines (mm=0: no header line)	A
xR2	n mmm	Read configuration for alarm store (parameters see command xW2)	H
Lo n	Data set of alarm store	n=0: Reset of alarm store read-pointer n=1: Output of subsequent data set	A

2nd4.9 Calibration parameters of FH40G external probes

Command	Response of the FHT 6020	Designation	Number format
KPn	xx xx xx xx xx yymmdd	Read calibration parameters of connected external probe (n=1..4) Type, calibration factor, dead time, ratio of high dose range to low dose range, high dose switching threshold, date (n=1 Probe at left connector, n=2: Probe at right connector n=3,4 : calibration parameters for high dose detector FHZ 612 left/right.	A, C

3. Transparent mode

Probes connected to the FHT 6020 which are completely configured for the FHT 6020 data transfer can directly be read from the PC through the FHT 6020 by serial commands.
Commands sent by the PC to the address of a probe connected to the FHT 6020 are forwarded to the addressed probe by the FHT 6020. After receipt the probe‘s answer is sent back to the PC.

Please see also chapter 7 „Rules for the network operation” of the FHT 6020 operation manual DB-045-010514-E .

Table 1: Admissible address range depending on the probe type

Probe type	**Admissible address**	**Used protocol**
FHT 191 N	1 ≤ Probe address ≤ 99	BEL/ETX
FHZ 621 G-L4, G-L4-10	1 ≤ Probe address ≤ 99	BEL/ETX
FHT 641 D4	1 ≤ Probe address ≤ 31	STX/ETX
FHT 671 S4 S4 HT	1 ≤ Probe address ≤ 31	STX/ETX
FHT 671 Y4, Y4 HT	1 ≤ Probe address ≤ 99	BEL/ETX
FHT 751	1 ≤ Probe address ≤ 99	BEL/ETX

4. Status

A measured value status and a system status are output together with each output of measured value. These status words contain bitwise coded information on the FHT 6020 and the measured values. Status is output in hexadecimal format.

4.1 Measured value status

The measured value status is generated by the connected measurement device. Intelligent probes (e.g. FHZ 621 G-L) provide a status word to the FHT 6020 with each measured value. This status word is copied by the FHT 6020 and will be sent to the PC together with the measured value.

The assignment of the status bits of the intelligent probes is described in the technical instructions manual of the probes (e.g. FHZ 621 G-L, FHT 671 S, FHT 671 Y, FHT 641D).
Additionally **status bit 14** (value = 4000hex) will be set, if serial data transfer between FHT 6020 and the probe is faulty.

The following table is valid for all FH40G external probes which can be connected to the FHT 6020

Bits in measured status of FH40 G external probes:

Bit number	**value (hex)**	**meaning**
Bit0 ... Bit 7		unused
Bit8	100	= 1, if EEPROM error
Bit9	200	=1, if value < failure rate
Bit10	400	=1, if value < measurement range
Bit11	1000	=1, if value > measurement range
Bit12	1000	not assigned
Bit13	2000	not assigned
Bit14	4000	=1, if RAM error
Bit15	8000	=1, if NBR alarm “artificial radiation” detected

4.2 System status

The System status word is generated in the FHT 6020 itself. These status bits provide information on the status of FHT 6020 and if alarms have occured.

The following table describes the bits of system status word. Also combinations of bits can be set (e. g. “3000” = alarm 1 and alarm 2 occured):

Bit number	Value (hex)	Meaning
Bit0	1	= 1, if RESET occured (Bit is reset to 0 by next command „RM“)
Bit1	2	= 1, if PROM error
Bit2	4	= 1, if RAM error
Bit3	8	= 1, if configuration error
Bit4	10	= 1, if history was cleared
Bit5	20	= 1, if battery voltage low
Bit6 ... Bit11		not assigned
Bit12	1000	= 1, if Alarm 2 occured
Bit13	2000	=1, if Alarm 1 occured
Bit14	4000	
Bit15	8000	=1, if error occured

5. Measured value storage (History)

5.1 Values stored in history

The measured values of the folowing device types can be stored to FHT 6020 history:

- FH40G External probe (Connector 1)
- FH40G External probe (Connector 2)
- Analog input 1
- Analog input 2

Dependent on the selection of device stored to history, the history can contain up to 5120 data records.

5.2 Output format

All data sets of the history can sequentially be read by means of remote control commands. The output is made in the following format:

<###### > <Value FH40G1> <Status FH40G1> <#Unit FH40G1> <Type FH40G1> <Value FH40G2> <Status FH40G2> <#Unit FH40G2> <Type FH40G2> <Value Analog1> <Status Analog1> <Value Analog2> < Status Analog2> <YYMMDDHHMMSS> <Systemstatus FHT 6020>

Meaning:

<###### >	Number of data set
<Value FH40G1>	Mesured value of FH40G external probe at connector 1
<Status FH40G1>	Measured status of FH40G external probe at connector 1
<#Unit FH40G1>	Measured unit of FH40G external probe at connector 1 „I“ = cps, „S“ = µSv/h, „?“=unknown unit
<Type FH40G1>	Type number of FH40G external probe at connector 1
<Value FH40G2>	Mesured value of FH40G external probe at connector 2
<Status FH40G2>	Measured status of FH40G external probe at connector 2
<#Unit FH40G2>	Measured unit of FH40G external probe at connector 2 „I“ = cps, „S“ = µSv/h, „?“=unknown unit
<Type FH40G2>	Type number of FH40G external probe at connector 2
<Value Analog1>	Measured value of analog input 1
<Status Analog1>	Measured status of analog input 1
<Value Analog2>	Measured value of analog input 2
<Status Analog2>	Measured status of analog input 2
<YYMMDDHHMMSS>	Date and time of data set
<Systemstatus 6020>	System status FHT 6020 at time of storing

Example of an output:
000372 0.18E+0 0 S 4 0 4200 ? 0 0 0 0 0 0208211503 3000
000371 0.975E-1 0 S 4 0 4200 ? 0 0 0 0 0 0208211502 3000
000370 0.135E+0 0 S 4 0 4200 ? 0 0 0 0 0 0208211501 3000
000369 0.6E-1 0 S 4 0 4200 ? 0 0 0 0 0 0208211500 3000
000368 0.12E+0 0 S 4 0 4200 ? 0 0 0 0 0 0208211459 3000
000367 0.9E-1 0 S 4 0 4200 ? 0 0 0 0 0 0208211458 3000

5.3 Procedure of polling history

The reading of the history must always be started with the command „HI0". This command sets the read pointer in the FHT 6020 to the most recent data set. Following commands output the older data sets.

The output of data sets is started by the command „HI1".

Starting with the latest data set the FHT 6020 outputs the subsequent older data set with each consecutively sent command „HI1". The output format is hexadecimal:

If end of history is reached and there are no more available, then the character <ACK> will be output instead of a data set.
Of course, history polling by command „HI1" can be stopped by the PC before the end of history has been reached.

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