R36xx Digital communication

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1. Introduction

The new range of electrochemical instrumentation R36xx from **Consort** has been completely redesigned and is significantly improved compared to his predecessors. The digital communication allows more direct commands to be able to read faster and more accurate.

2. Digital ports

The devices are equipped with a RS485 port.

3. Command protocol to send

Commands are sent according to the next protocol:

'#xxx' + '>' + Command + Data + Checksum + CR + LF

With:

'#'	Start of Identification number
xxx	The 3 digit identification number which is preset in the instrument, e.g. 001
'>'	Start of command
Command	Single byte. A specific character invoking a special action or requesting information from the device (see *command table*).
Data	Additional binary information to complete the command. This is not always required. See the *command table* when data is required.
Checksum	Single byte, the lowest binary byte of the sum of the previous bytes which have already been sent starting from '>'.
CR+LF	Carriage return + Linefeed, or ASC(13)+ASC(10). To indicate the termination of the command.

- the single quote signs are only to indicate it is a character, the signs are not to be sent to the device.
- the + signs are to not to be sent either unless when placed between quotes.
- the function ASC() indicates the character with the ASCII value given between the brackets, ought to be used.
- Simple commands that do not require additional data don't need to be completed with the checksum.

4. Command protocol to receive

Responses to the command are sent by the device follow the next protocol:

'#xxx' + '<' + Command (+ Size + Data) + Checksum + CR + LF

With:

'#'	Start of Identification number from the responding device
xxx	The 3 digit identification number which is preset in the instrument, e.g. 001
'<'	Start of response. Note the opposite direction of the character, compared to the protocol to send.
Command	Single byte. The command for which is being responded (see _command table_).
Size	Binary single byte value. The amount of data bytes to follow. The size is only returned when data is following. See the _command table_ when size and data will follow.
Data	The requested information. This information can be ascii coded or binary. See the _command table_ when and which data will follow.
Checksum	Single byte. The lowest byte of the binary sum of the previous bytes which have already been sent starting from '<'.
CR+LF	Carriage return + Linefeed, or ASC(13)+ASC(10), to indicate the termination of the response.
()	Size and data are not always returned! See the _command table_ when and which data will follow.

5. Command table

Command	Additional data bytes	Returned data bytes	Purpose	See
'?'			Request to print last measurements in ASCII format	*Print measurements*
'-'			Disable user keyboard	*Keyboard*
'+'			Enable user keyboard	*Keyboard*
'B'	1		Simulation of key	*Key simulation*
'S'		yes	Request the settings from the device	*Settings*
'M'	1	yes	Request measurements from a channel	*Request Measurement*
'F'	1		Change display Output	*Display output*
'G'		yes	Return the GLP report from the current focused channel	*GLP report*
'D'	4		Modify the data logger settings	*Parameters Data log*
'L'		yes	Requests complete Data table in ASCII format	*Data table text*
'l'	8	yes	Requests Data information in binary format	*Data table binary*
'Y'		yes	Read date and time from device	*Read Date/time*
'y'	6		Set date and time from device	*Set Date/time*
'P'		yes	Request menu parameters	*Read Menu parameters*
'p'	1		Set menu parameter position	*Set Menu parameters*
'N'		yes	Request number menu parameters	*Read Number parameters*
'n'	4		Set number	*Set Number parameters*
'R'	4		Resets/Restarts the device	*Reset*

6. Command specifications + examples

6.1 Conventions

- The examples are written in a coloured fixed pitch font (Courier).
- The blue coloured text in the example highlights the text sent by the computer (see Command protocol to send).
- The magenta coloured text highlights the answer received from the device (see Command protocol to receive).
- Green text highlights additional comments or clarifications which are not sent or received.
- The examples are either given in ASCII text or as hexadecimal codes. The ASCII coded examples don't always show the additional code for the checksum, carriage return and linefeed. These are however required.

6.2 Print Measurements

Send the command '?' to request the last measurements printed in ASCII format.
e.g.

```
#999 >?
#999   <?{
#999   31/05/2010 15:00:18 7.215 pH          18.2 ˚C
#999                        38.2 mS/cm        18.2 ˚C
```

6.3 Keyboard

With the commands '-' and '+', it is possible to disable and enable the keyboard so the user cannot interact while the software communicates. This way the software can control the device completely. The keyboard is automatically re-enabled when the device restarts.
e.g.

```
#999 >-
#999   <-i /* the keyboard is now disabled */
#999 >+
#999   <+g /* the keyboard is now enabled */
```

6.4 Key Simulation

With the commands 'B' and an additional code (see table below), it is possible to simulate the keyboard. As soon as a 'B' command has been received, the keyboard will be automatically disabled and should be enabled again with the '+' command when required.

Table Key codes:

Code (binary!)	Key
0	UP (arrow)
1	OK
2	DOWN (arrow)
3	SET
4	HELP
5	STOP
6	CAL

e.g.

```
23 39 39 39 20 3E 42 5 85 0D 0A      /* '>B'+CHR(5)+CS+CR+LF :  Simulate STOP on device #999 */
23 39 39 39 9 3C 42 7E D A           /* Device answer, command is accepted */
                                     /* the keyboard is now disabled !! */
```

6.5 Request Settings

The command 'S' returns the binary settings of the device.

```
e.g.   23 39 39 39 20 3E 53 91 0D 0A /* request settings with 'S' from  device #999 */
       23 39 39 39 9 3C 53 72        /* start of answer of device #999, 114 data bytes to follow */
/*     → data bytes 0 → 33 */
        0 3 E8 5 0 1 1 3 1 C0  0  0  0  0  1 C0 3C 2E E0  B 20  B 20  3 D2  2  0 F8 30 3E 80 20 FE D4
/*      0 1  2 3 4 5 6 7 8  9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 */
/*     → data bytes 33 → 64 */
        5 14  3 E7  0  5  0  0  0  1 7F FF FF FF  5  0  4 80  0  0  0  0  0  4  0  0  0  0  A  0  0  0
/*     34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 */
/*     → data bytes 65 → 94 */
        0  0  0  0  0  0  1  2  3  0  0  7 CE  5  1  4  0  0  0 23  5  1  4  0  0  0  A  5  0  0
/*     65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 */
/*     → data bytes 95 → 113 */
        0  1  5  0  0  0  1  4  0  0  4  0  0  0  0  0  1  0  0
/*     95 96 97 98 99 00 01 02 03 04 05 06 07 08 09 10 11 12 13 */

       14 D A /* Checksum + Carriage Return + LineFeed */
```

Settings data structure

Byte 0: Display focus number. The device has several display outputs which are selected manually using the arrow keys. These are indicated with a focus number starting from 0. This number can be checked this way. The focus can be changed using a specific command.

Byte 1, 2: Temperature reference for conductivity measurements.
= *1000* for **25°C**
= *896* for **20°C**

Byte 3: Display Contrast setting

Byte 4: irrelevant information, to be ignored.

Byte 5: Language setting. 0 = English, 1 = Dutch, 2 = French, 3 = German

Byte 6, 7: Measurement settings of the channels, one byte for each channel.
1=pH, 2=mV, 3=EC, 4=O_2, 5=%O_2, 6=°C, 0= OFF

Byte 8: Display resolution settings.

Byte 9, 10, 11, 12: 32 bits Password settings. The highest bit indicates the password is enabled.

Byte 13, 14: Settings of the ATC channels.
The byte sequence and the number contents indicates for which channel the °C measurement will be used as temperature compensation. In this example byte 13 (0) indicates °C1 is used for CH1, byte *14 (*1*)*indicates °C2 is used for CH2.

Byte 15, 16:   Data log settings
Highest bit (*16th*) = the data logger is enabled when 1.
Second highest bit (*15th*) = memory rotation or continuous data registration.
Remaining lower *14* bits: Time interval in seconds (here 60 s).

Byte 17, 18: Data log settings: irrelevant information

Byte 19, 20: Data log settings: Number of logged data points

Byte 21, 22, 23, 24, 25: Data log settings: irrelevant information

Byte 26 : Analogue output settings (OUT1)
highest nibble = channel to follow
lowest nibble = Measurement range for EC measurement

Byte 27, 28 : Analogue output settings (OUT1)
Setting Value @ 4 mA

Byte 29, 30 : Analogue output settings (OUT1)
Setting Value @ 20 mA

Byte 31 : Analogue output settings (OUT2)
highest nibble = channel to follow
lowest nibble = Measurement range for EC measurement

Byte 32, 33 : Analogue output settings (OUT2)
Setting Value @ 4 mA

Byte 34, 35 : Analogue output settings (OUT2)
Setting Value @ 20 mA

Byte 36, 37, 38, 39, 40, 41: Digital output settings of which byte 30 and 31 returns the time interval in seconds.

Byte 42→71 (72→101): 30 bytes with control settings of channel 1
(between round brackets, byte offsets for channel 2)

Byte 42 (72): Control type
0 = no control, 1 = ON/OFF control, 2 = Proportional control.

Byte 43 (73): Measurement type
1=pH, 2=mV, 3=EC, 4=O_2, 5=%O_2, 6=°C

Byte 44 →47 (74→77): Value High control limit (32 bit, 10000 = unit value)
Byte 48 (78): Conductivity range of High control limit
Byte 49 (79): = 1, When the control of the High value is enabled
Byte 50 (80): = 0-3, The number of the associated relay subtracted with 1

Byte 51 →54 (81→84): Value Low control limit (32 bit, 10000 = unit value)
Byte 55 (85): Conductivity range of Low control limit
Byte 56 (86): = 1, When the control of the Low value is enabled
Byte 57 (87): = 0-3, The number of the associated relay subtracted with 1

Byte 58→61 (88→91): Hysteresis value (32 bit, 10000 = unit value)
Byte 62 (92): Conductivity range of Hysteresis

Byte 63→66 (93→96): Proportional control area value (32 bit, 10000 = unit value)
Byte 67 (97): Conductivity range of Proportional control area

Byte 68→69 (98→99): Timer value (in seconds) to wait after exceeding the limit
Byte 70→71 (100→101): Pulse time value (in seconds) proportional control

Byte 102: The number of the <u>Alarm</u> relay subtracted with 1
Byte 103→104: Alarm timer value, disabled when 0

Byte 105: The number of the <u>Maintenance </u>relay subtracted with 1
Byte 106→107: Time interval (in 0.1 hours) between Maintenance programs
Byte 108→109: Wait time interval (in seconds) before closing the maintenance relay
Byte 110→111: Duration time interval (in seconds) to close the maintenance relay
Byte 112→113: Wait time interval (in seconds) after opening the maintenance relay, before
restarting the control.

6.6 Request measurement (binary data)

The command to print the measurements (using '>?') returns ASCII coded measurement values of all active channels. This requires more time for the sending and can only be used during the regular measurement mode. To request the measurements during calibrations or to reduce communication time, use the command 'M' + (the channel number – 1) for which the data is requested. The device will return all measurement and status information for that channel as binary data.

e.g.   Request the measurement from channel 1 (=> Send 'M'+0, see command table)

```
23 39 39 39 20 3E 4D 0 8B 0D 0A        /* send the request to device #999 */
23 39 39 39 9 3C 4D 13                  /* Start of answer from device #999, 19 data bytes to follow */
10 80 01 01 2C 00 58 B5 2B 00 01 14 E3 00 03 D0 90 03 DA  /* returned data */
0  1  2  3  4  5  6  7  8  9  10 11 12 13 14 15 16 17 18  : byte number offsets)
CA D A /* Checksum + Carriage Return + LineFeed */
```

Data record structure

Byte 0→1: 16 bit information with measurement status of which:
bit 14: temperature out of range, when 1
bit 13: temperature probe connected, when 1
bit 11: measurement out of range, when 1
bit 7: measurement is found to be stable, when 1
The other bits are to be ignored.

Byte 2: Type of measurement.
1=pH, 2=mV, 3=EC, 4=O_2, 5=%O_2, 6=°C, 0= OFF

Byte 3→7: Internal information, to be ignored

Byte 8: Output format of measurement.
See the table Measurement formats to find here the value 2A (= 42 decimal) corresponds with the format of '0,01 pH'.

Byte 9→12:
32 bits with measurement data where the value 10000 corresponds to the unit 1. In this example, the hex value `00 01 14 E3` corresponds with 70883. Using the format from byte 8, this example returns the value of '7,09 pH'.

Byte 13, 14, 15, 16:
32 bits with temperature measurement where the value 10000 corresponds to the unit 1. Here is the temperature `00 03 D0 90` corresponding to 250000 or 25,0°C.
Byte 17, 18:
16 Bits with air pressure measurement.
The value `03 DA` corresponds to an air pressure of 986 hPa.

6.7 Set Display Output

The device has several display outputs which are normally selected by the user manually with the arrow keys. It is required to set the correct channel on the display to start the calibration or to request some info.

This can be achieved using the command 'F' together with the display number. The display with measurement information of all channels has the number 0, the channel display numbering starts from 1, the temperature display numbering starts from 1+number of channels.

e.g.   To set the general display (all channels)
```
23 39 39 39 20 3E 46 0 84 0D 0A      /* send 'F' + 0x00 to device #999 */
23 39 39 39 9 3C 46 82 D A
```

To set the display of channel 2
```
23 39 39 39 20 3E 46 2 86 0D 0A      /* send 'F' + 0x02 to device #999 */
23 39 39 39 9 3C 46 82 D A 0
```

To set the display of °C1
```
23 39 39 39 20 3E 46 3 87 0D 0A      /* send 'F' + 0x03 to device #999 */
23 39 39 39 9 3C 46 82 D A 0
```

6.8 Request GLP report

Request the GLP report from the current displayed channel. This is the same as selecting manually GLP>SEND REPORT from the calibration menu.

e.g.
```
#999 >F__              /* set the display focus on channel 2 */
#999   <Fé
#999 >G               /* request the GLP report */
#999   ****     GLP     ****
#999   Device    : R362
#999   Version   : 1.8
#999   Serial nr : 98023
#999   Channel   : 2
#999   Input     : S/cm
#999   Ref.temp. : 25°C
#999   Cap.Comp. : NO
#999
#999   CALIBRATION
#999   Date      : 24/11/2010
#999   Time      : 11:52:36
#999
#999   Ref.temp.  : 25°C
#999
#999   Standard1 : 0.01M KCl
#999     Value   : 1413. µS/cm
#999     CC      : 1.473cm1
#999     °C      : 25.0
#999    min:sec  : 00:16
#999   Standard2 : STD1
#999     Value   : 10.00 mS/cm
#999     CC      : 1.059cm1
#999     °C      : 25.0
#999    min:sec  : 00:16
#999
#999   STATISTICS
#999   CC1        : 0.150cm1
#999   CC2        : 1.000cm1
```

6.9 Set Parameters Data log

6.10   Request Data table as text

The command 'L' is the same as manually selecting DATA>PROCESS>SEND from the SETTINGS menu.
It is required to use this command during a measurement display screen. This can be achieved by sending a Set Display Output command first.

e.g.   #999 >L

```
#999    <L
#999    LOG.00001 24/11/2010  14:06:14  CH1   7.26  pH      25.0 °C    <   REL.1---
#999    LOG.00002 24/11/2010  14:06:14  CH2  10.01  mS/cm   25.0 °C    -   REL.1---
#999    LOG.00003 24/11/2010  14:07:14  CH1   7.26  pH      25.0 °C    <   REL.1---
#999    LOG.00004 24/11/2010  14:07:14  CH2  10.01  mS/cm   25.0 °C    -   REL.1---
#999    LOG.00005 24/11/2010  14:08:14  CH1   7.26  pH      25.0 °C    <   REL.1---
#999    LOG.00006 24/11/2010  14:08:14  CH2  10.01  mS/cm   25.0 °C    -   REL.1---
```

The last 2 columns indicate the control condition and the activated relays (here relay 1 is active):
'<' = Low, '>' = High, 'A' = Alarm, 'M' = Maintenance, 'S' = Stop, '-' = normal condition.

6.11   Request binary data table

The command 'l' allows to read the data table as binary information. This is a lot faster but requires the receiver program to decode the information.

Additional required information are:
 – a 4 byte long number, the start record number,
 – a 4 byte long number, the number of records to send.

The device will first return the number of records which will be actually returned. This number can be different from the requested number depending on the amount of available records starting from the given start record number.

e.g.   Read the first 10 data records, starting from 0:

```
23 39 39 39 20 3E 6C 0 0 0 0 0 0 0 A B4 0D 0A       /* the request */
23 39 39 39 9 3C 6C 0 0 0 A B2 D A                  /* the number of records which will be sent */
23 39 39 39 9 3C 6C A 1C 5F 2 26 A B1 8E C3 AB 0 C D A    /* 1st record at address 0     */
23 39 39 39 9 3C 6C A 3 E9 12 26 A B1 8E C3 88 0 6A D A   /* 2nd record at address 1     */
23 39 39 39 9 3C 6C A 1C 5F 2 26 8A B1 E4 C3 AB 0 E2 D A  /* 3rd record ...              */
23 39 39 39 9 3C 6C A 3 E9 12 26 8A B1 E4 C3 88 0 40 D A  /* 4th record ...              */
23 39 39 39 9 3C 6C A 1C 5F 2 26 A B2 E C3 AB 0 8D D A    /* 5th record ...              */
23 39 39 39 9 3C 6C A 3 E9 12 26 A B2 E C3 88 0 EB D A    /* 6th record ...              */
23 39 39 39 9 3C 6C A 1C 5F 2 26 A B2 4E C3 AB 0 CD D A   /* 7th record ...              */
23 39 39 39 9 3C 6C A 3 E9 12 26 A B2 4E C3 88 0 2B D A   /* 8th record ...              */
23 39 39 39 9 3C 6C A 1C 5F 2 26 A B2 8E C3 AB 0 D D A    /* 9th record ...              */
23 39 39 39 9 3C 6C A 3 E9 12 26 A B2 8E C3 88 0 6B D A   /* 10th record at address 9    */
```

Data record structure

The returned information from a data record contains 10 bytes with the following information.
Here's a description with the data from the first record as example: `1C 5F 2 26 A B1 8E C3 AB 0`

 • First 2 bytes = The measured value.
   ➢ `1C 5F` or *7263*: This value needs to be multiplied with the 'Data value multiplicator', which can be found in the measurement format table, to obtain a 32 bit measurement value based on 10000 as unit value. The required measurement format can be retrieved from the lower 6 bits from the 9th data byte.

 • Next 2 bytes contain the channel number minus 1 and the measured temperature:

➢ highest 4 bits (*b15* → *b12*) = channel number minus 1
The example is `0`, this is the lowest channel number CH1.
➢ lowest 12 bits (*b11* → *b0*) = temperature.
In the example: `2 26` or *550*, this value has an offset of the minimal temperature (-30,*0*°C) and needs to be multiplied with the 'Data value multiplicator' for °C, which can be found in the [measurement format table](#), to obtain a 32 bit measurement value based on *10000* as unit value. The resulting °C value is *(550-300)*1000* = 250*000* or 25,*0*°C.

- The 5th Byte contains the 'out of range flag' and the lowest 2 digits of the year.
  ➢ The highest bit is 1 when the value or the temperature is out of range
  In the example: `0`, No out of range measurements.
  ➢ The lowest seven bits is a number for 0 to 99, indicating the last 2 digits of the year
  In the example: `0A`, year 10 (lowest 2 digits from 2010).

- The 6th , 7th , 8th and 9th byte (32 bits, starting from *b31* down to *b0*) contain the date/time information and the measurement format range.
  In the example, this information is binary: `1011 0001 1000 1110 1100 0011 1010 1011`
  ➢ b31 → b28: 4 bits with the Month (0..12), in example `1011` = *11*, the month November
  ➢ b27 → b22: 6 bits with the Minutes (0..59), in example `0001 10` = *6*
  ➢ b21 → b16: 6 bits with the Seconds (0..59), in example `00 1110` = *14*
  ➢ b15 → b11: 5 bits with the date (day of the month, 0..31), in example `1100 0` = *24*
  ➢ b10 → b6: 5 bits with the hour (0..23), in example `011 10` = *14*
  ➢ b5 → b0: 6 bits with the [measurement format table](#) index, in example `10 1011` = *43* or the range *0.01 pH*.

- The 10th byte returns additional information about the control:
  ➢ *upper 4 bits (b4 to b7):* 4 relays, a bit is 1 when the corresponding relay is closed/activated:
    bit b4 (lowest bit upper nibble) for relay 1,
    bit b5 for relay 2,
    bit b6 for relay 3,
    bit b7 (highest bit) for relay 4.
  ➢ *lower 4 bits:* Control activity, when this 4 bit value =
    - *0* → Normal (no limits exceeded),
    - *1* → Low limit exceeded,
    - *2* → High limit exceeded,
    - *3* → Alarm condition (Alarm timer exceeded),
    - *4* → Maintenance program ON,
    - *5* → STOP condition (Controlled stopped).

The recorded data from the example is 7.*26 pH, 25.0*°C on the *24th of November, 2010* at *14:06:14.* There was limit exceeded and no control active.

6.12   Read Date/time

e.g.   Send the 'Y' command to return the date and time

```
23 39 39 39 20 3E 59 97 0D 0A
23 39 39 39 9 3C 59 6 A B 1D E 1C D 4 D A
```

Returned data information:
- `A B 1D` First 3 bytes form the date in the order Year (10), month (11) and date (29).
- `E 1C D` Next 3 bytes form the time in the order hour (14), minutes (28) and seconds (13).

The current date and time here is: 29 November (20)10, 14:28:13.

6.13   Set Date/time

e.g.   Send the 'y' command +data to set the date and time to 29 Nov 10, 17:12:00

```
23 39 39 39 20 3E 79  /* protocol start '>y' */
A B 1D 11 C 0 6 0D 0A /* year + month + date + hour + minutes + seconds + CS + cr + lf */

23 39 39 39 20 3C 79 B5 D A   /* device confirmation */
```

6.14   Read Menu parameters

When the device shows a menu, the following parameters can be read using the command 'P':
```
e.g.   23 39 39 39 20 3E 50 8E 0D 0A              /* Send request to device #999
       23 39 39 39 9 3C 50 D                      /* Start of answer from device #999
       02 03 00 0A 27 75 00 00 00 00 0A 00 00     /* data bytes
/*     0  1  2  3  4  5  6  7  8  9  10 11 12       data byte number offsets */
       4E 0D 0A                                   /* Checksum + Carriage Return + LineFeed */
```

Data bytes, menu parameter structure:
- byte 0:   the current position of the menu selection bar on the screen.
- byte 1:   irrelevant information, to be ignored.
- byte 2:   max. position. To be ignored when 0.
- byte 3:   column left (note: in pixels, most left row = 0)
- byte 4:   upper nibble, start row   = 2 (note: top row = 0)
             lower nibble, bottom row   = 7
- byte 5:   column right.
- byte 6→12:   irrelevant information, to be ignored.

6.15   Set Menu parameters

The position of the menu selection bar can be changed using the command 'p'.
```
e.g.   23 39 39 39 20 3E 70 05 B3 0D 0A      /* Send request at device #999 */
       23 39 39 39 9 3C 70 AC D A            /* Device answer/confirmation  */
```

Set the menu bar position to 5, i.e. the sixth element of menu. Note that the display itself is not refreshed but the selection is set to 5. This can be tested with reading the menu parameters (6.15).

IMPORTANT: There is no checking on the values that will be tried to put in. The result on an invalid value, when continuing using the OK button, will then be unpredictable.

6.16   Read Number parameters

When the device expects a value to be put in, the following parameters can be read using the command 'N':

```
e.g.    23 39 39 39 20 3E 4E 8C 0D 0A         /* request number parameters of device with id.no 999 */
        23 39 39 39 9 3C 4E 26                /* Start of answer from #999 and number of data bytes(0x26) */
        0 0 0 0 0 0 0 0 0 0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  9  0  0  0  1  0
/*      0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 */
        0  0  6
/*      35 36 37 (byte offsets) */
        C0 D A /* Checksum + CarriageReturn + LineFeed */
```

Number parameter structure (38 bytes):

- byte 0→21:   Irrelevant information, to be ignored
- byte 22→25: minimum number value (to understand the value format: see Measurement format)
- byte 26→29: maximum number value (to understand the value format: see Measurement format)
- byte 30→33: increment value, the amount to increase/decrease the number when pressing the ↑/↓ arrow.
- byte 34→37: The number value(to understand the value format: see Measurement format).

6.17   Set Number parameters

When the device expects a value, it can be entered using the command 'n':
e.g.   Enter the value 70000 to the device with id.no 999:

```
        23 39 39 39 20 3E 6E 0 1 11 70 2E 0D 0A      /* send the command and value */
        23 39 39 39 9 3C 6E AA D A                   /* confirmation from device */
```

IMPORTANT: There is no checking on the values that will be tried to put in. The result on an invalid value, when continuing using the OK button, will then be unpredictable.

6.18   Device Information

Using the command 'I' with extra byte, it is possible to request some device specific information.

Byte	Returned information
0	Device model
1	Version
2	Serial number
199,99	Special codes. See Store User Table

e.g.   Request model:

```
        3E 49 00 87 0D 0A
        3C 49 05 43 33 30 33 30 93 0D 0A      /* '<I'+nr of data bytes+'C3030'+Checksum+CR+LF */
```

Request version:

```
        3E 49 01 88 0D 0A
        3C 49 04 20 31 2E 37 3F 0D 0A         /* '<I'+nr of data bytes+' 1.7'+Checksum+CR+LF */
```

6.19   Read User table

There are 5 pH user tables and 3 Conductivity user tables available in these devices. It is possible to read these user tables using the command 'U' added with the *table number – 1* and the *table type (0x00 = pH, 0x01 = EC)*. More explanation is given in the following examples.

e.g.   Read pH user table nr. 2

```
3E 55 01 00 94 0D 0A  /* '>U'+0x01+0x00+Checksum+CR+LF = Read pH table 2 (BUF2)*/
3C 55 41              /* start of answer '<U' + 65 data bytes to follow           */
42 55 46 32 00 00     /* 6 bytes: 5 characters with name('BUF2') + 0x00 as end of string     */
00 00 C3 50 00 09 27 C0 /* 10 bytes: 4 bytes as minimum and 4 bytes as maximum temperature,
                         (here 50000 (00 00 C3 50) and 600000 (00 09 27 00), or 5,0 and 60°C   */
0B                   /* 1 byte as size of table -1: 0B=11 => 12 values of 4 bytes each,     */
02                   /* 1 byte with irrelevant information, NOT USED                */
00 00 71 A8 00 00 00 00 00 00 00 00 00 00 00 00 /* 12 table values (4 bytes each)starting from 5
<----0----> <----1----> <----2----> <----3----> /  to 60°C. The value at 25°C (group 4)is       */
00 00 71 A8 00 00 00 00 00 00 71 A8 00 00 00 00 /* obligatory. Values equal to 0 are not used !
<----4----> <----5----> <----6----> <----7----> /  The representation of the values is in      */
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 /* combination with the measurement format byte
<----8----> <----9----> <----10---> <----11---> /  (=last table byte = 2B)                   */
2B                   /* Format of the table values = '0,01 pH' (see Measurement formats)      */
67 0D 0A             /* checksum + CR +LF */
```

e.g.   Read Conductivity (EC) user table nr. 1

```
3E 55 00 01 94 0D 0A  /* '>U'+0x00+0x01+Checksum+CR+LF = Read EC table 1 (STD1)         */
3C 55 41              /* start of answer '<I' + 65 data bytes to follow              */
53 54 44 31 00 00     /* 6 bytes: 5 characters with name ('STD1') + 0x00 as end of string     */
00 00 C3 50 00 05 57 30 /* 8 bytes: 4 bytes as minimum and 4 bytes as maximum temperature,
                         (here 50000 (00 00 C3 50) and 350000 (00 05 57 30), or 5,0 and 35°C
                         (see Measurement formats)                                  */
06                   /* 1 byte as size of table-1: 06 => 7 values of 4 bytes each       */
02                   /* 1 byte with irrelevant information, NOT USED                */
00 00 00 00 00 9B A3 C0 00 AF 04 B0 00 C3 01 E0 /* 12 table values (4 bytes each)starting from 5
<----0----> <----1----> <----2----> <----3----> /  to 35°C. The value at 25°C is obligatory. The */
00 D7 9B 50 00 EC D1 00 00 00 00 00 00 00 00 00 /* last 5 table values (marked X) are not used
<----4----> <----5----> <----6----> <----X----> /  but are required.                           */
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 /*
<----X----> <----X----> <----X----> <----X----> /                                             */
07                   /* Format of the table values = '1 µS/cm' (see Measurement formats)     */
20 0D 0A             /* checksum + CR +LF */
```

6.20   Store User table

It is also possible to store your user tables with the 'u' command. It is however required to follow the next procedure:

1. Set the device in the SETTINGS menu mode using the 'B' command.
2. Send the Device Information command code with the first unlock code 0xC7.
3. Send the Device Information command code with the second unlock code 0x63.
4. Send the table number, table type and the table information in the same format as one can read them with the 'U' command (mind the capital size or lower case of the command codes!). This table format requires : (see examples in Read User Table)

   - 6 bytes for the table name,
   - 10 bytes with table information,
   - 48 bytes with table values, also required for EC for which the last 20 bytes are irrelevant !
   - 1 byte with the measurement format of the table values (Important for EC!)

e.g.   Store the table 0,01 M KCl as EC table nr 3

```
3E 46 00 84 0D 0A       /* Step1: '>F'+ 0x00 = command to get into the SETTINGS menu */
3C 46 82 0D 0A          /* device confirmation */
3E 49 C7 4E 0D 0A       /* Step2: '>I'+ 0xC7 (199) = First step of unlock code */
3C 49 85 0D 0A          /* device confirmation */
3E 49 63 EA 0D 0A       /* Step3: '>I'+ 0x63 (99)  = Second step of unlock code */
3C 49 85 0D 0A          /* device confirmation */
3E 75 02 01             /* Step4: '>u'+ 0x02 (= table number 3)+ 0x01 (=EC table) */
53 54 44 31 00 00 00 00 C3 50 00 05 57 30 06 02 /* table name + min/max°C+ ... */
00 88 B8 00 00 9B A3 C0 00 AF 04 B0 00 C3 01 E0 /* first 4 values  */
00 D7 9B 50 00 EC D1 00 00 00 00 00 00 00 00 00 /* next 4 values   */
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 /* last 4 values   */
07                                               /* Measurement format */
44 0D 0A                /* checksum + CR + LF  */
3C 75 B1 0D 0A          /* device confirmation */
```

Mind that all these table elements (name, min/max, values, format, irrelevant values/bytes, ...) are required but only the 12 values and the measurement format for conductivity tables will be stored. The measurement format cannot be changed for pH tables. The names, min/max temperature, number of table values... cannot be changed.

There is no control on the 12 table values or the measurement format when writing the table. The incorrectness of these are solely the responsibility of the user.

6.21 Restart the device

Send the Command '>R' followed by 'ESET'+Checksum to restart the device. There will be no confirmation given!

e.g.
```
23 39 39 39 20 3E 52 45 53 45 54 C1 0D 0A   /* '#999 >RESET' + Checksum + CR + LF */

The device restarts without any answer !
```

7. Measurement formats

The measurements returned as 32 bit numbers are based on the integer 10000 as unit value. The returned format number indicates which value is represented according to the following table. The values should rounded against the given format.

e.g. 1. The measured 32 bit value is *86932*, the given format number is *43* which is 0,01 pH according to the table. This value/format combination represents the measurement of *8,69 pH*.

2. The measured 32 bit value is *1006325*, the given format number is *9* which is 0,1 mS/cm according to the table. This value/format combination represents the measurement of *100,6 mS/cm*.

Code	Format	Unit	Data value Multiplicator	Measurement
0	0.1	mV	1000	Redox Potential
1	1	mV	1000	Redox Potential
2	0.1	%O_2	100	Dissolved Oxygen, saturation in water
3	1	%O_2	100	Dissolved Oxygen, saturation in water
4	0.001	μS/cm	10	Conductivity
5	0.01	μS/cm	100	Conductivity
6	0.1	μS/cm	1000	Conductivity
7	1	μS/cm	10000	Conductivity
8	0.01	mS/cm	100	Conductivity
9	0.1	mS/cm	1000	Conductivity
10	1	mS/cm	10000	Conductivity
11	0.001	mg/l	10	TDS (Total Dissolved Solids)
12	0.01	mg/l	100	TDS (Total Dissolved Solids)
13	0.1	mg/l	1000	TDS (Total Dissolved Solids)
14	1	mg/l	10000	TDS (Total Dissolved Solids)
15	0.01	g/l	100	TDS (Total Dissolved Solids)
16	0.1	g/l	1000	TDS (Total Dissolved Solids)
17	1	g/l	10000	TDS (Total Dissolved Solids)
18	0.1	MΩ.cm	1000	Resistivity
19	0.01	MΩ.cm	100	Resistivity
20	1	KΩ.cm	10000	Resistivity
21	0.1	KΩ.cm	1000	Resistivity
22	0.01	KΩ.cm	100	Resistivity
23	1	Ω.cm	10000	Resistivity
24	0.1	Ω.cm	1000	Resistivity
25	0.1	SAL	100	Salinity
26	0.01	ng/l	100	Ion
27	0.1	ng/l	1000	Ion

Code	Format	Unit	Data value Multiplicator	Measurement
28	1	ng/l	10000	Ion
29	0.01	µg/l	100	Ion
30	0.1	µg/l	1000	Ion
31	1	µg/l	10000	Ion
32	0.01	mg/l	100	Ion
33	0.1	mg/l	1000	Ion
34	1	mg/l	10000	Ion
35	0.01	g/l	100	Ion
36	0.1	g/l	1000	Ion
37	1	g/l	10000	Ion
38	0.1	°C	1000	Temperature in degrees Celsius
41	1	hPa	n.a.	Air Pressure
42	0.001	pH	10	pH
43	0.01	pH	10	pH
44	0.1	pH	10	pH
45	0.01	ppm O_2	100	Dissolved Oxygen in ppm (=mg/l)
46	0.1	ppm O_2	100	Dissolved Oxygen in ppm (=mg/l)
50	0.1	%	100	General unit in percentage
51	1	%	100	General unit in percentage
53	0.1	mVH	1000	Redox Potential, Normal Hydrogen Electrode reference
54	1	mVH	1000	Redox Potential, Normal Hydrogen Electrode reference
55	0.01	rH_2	100	rH_2, Hydrogen Potential
56	0.1	rH_2	100	rH_2, Hydrogen Potential
57	0.001	µW	10	Power in microWatts, quantification of Vincent
58	0.01	µW	100	Power in microWatts, quantification of Vincent
59	0.1	µW	1000	Power in microWatts, quantification of Vincent
60	1	µW	10000	Power in microWatts, quantification of Vincent
61	1	µW	10000	Power in microWatts, quantification of Vincent
62	1	µW	10000	Power in microWatts, quantification of Vincent
63	1	µW	10000	Power in microWatts, quantification of Vincent