Consort

Hertenstraat 56/9
B-2300 Turnhout
Belgium

+32 (0)14 411279
+32 (0)14 429179
support@consort.be

C30xx Digital communication

Table of contents

Rev. August 19, 2016

Consort

Hertenstraat 56/9
B-2300 Turnhout
Belgium

+32 (0)14 411279
+32 (0)14 429179
support@consort.be

1 Introduction

The range of electrochemical instrumentation C30xx 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 ending on a '0' are equipped with an USB and a RS232 port, the device ending on '1' are equipped with an Ethernet and a RS232 port.

The Ethernet systems require some set up which is explained in the *Ethernet Configuration document* which can be downloaded from our website http://www.consort.be, section *Downloads>Software.*

The USB driver can be downloaded from our website http://www.consort.be, section *Downloads>Software.*

After installing the Ethernet or USB driver, the instrument will appear, when connected, as a serial COMx port. Set the communication software to use this port. The default serial communication settings are 19200 baud, 8 data bits, 1 stop bit, No parity.

The device allows a baud rate up to 115200 bps. Most computers can operate at this high speed which might be interesting especially for transferring a large data table to the computer.

3 Command protocol to send

Commands are sent according to the next protocol:

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

With:

'>'	Start of command protocol.
Command	Single byte. A specific character invoking a special action or requesting information from the device.
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. These 2 bytes are not required for the receipt of the command and may be omitted.

- 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.

Hertenstraat 56/9
B-2300 Turnhout
Belgium
+32 (0)14 411279
+32 (0)14 429179
support@consort.be

4 Command protocol to receive

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

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

With:

'<'	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.
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.

Consort
Hertenstraat 56/9
B-2300 Turnhout
Belgium
+32 (0)14 411279
+32 (0)14 429179
support@consort.be

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
'X'	1	yes	Read text row from display	Display text
'(', ')'			Start and stop dumping of display text	Start/Stop Display dump
'I'	1	yes	Request specific device information	Device Information
'U'	2	yes	Read specific user table	Read User table
'u'	65		Store user table	Store User table
'R'	4		Resets/Restarts the device	Reset
'N'		Yes	Read Number information	Read Number
'n'	4		Set number value	Send Number

Consort
Hertenstraat 56/9
B-2300 Turnhout
Belgium
+32 (0)14 411279
+32 (0)14 429179
support@consort.be

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 binary codes, hexadecimally written. The ASCII coded examples don't always show the additional code for the checksum, carriage return and linefeed.

6.2 Print Measurements

Send the command '?' to request the last measurements.
e.g.

```
>?
<?{
31/05/2010 15:00:18 7.215 pH    18.2 °C
                    0.73  ng/l 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.

```
>-
<-i /* the keyboard is now disabled */
>+
<+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	STORE
4	CAL
5	HOLD
6	MODE

e.g.

```
3E 42 00 80 0D 0A      /* '>B'+CHR(0)+CS+CR+LF :  Simulate up arrow */
3C 42 7E 0D 0A         /* Device answer, command is accepted */
                       /* the keyboard is now disabled !! */
```

Hertenstraat 56/9
B-2300 Turnhout
Belgium
+32 (0)14 411279
+32 (0)14 429179
support@consort.be

6.5 Settings

6.5.1.1 Request device Settings

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

e.g.
```
3E 53 91 0D 0A
3C 53 28 02 03 E8 05 FF 00 01 03 00 00 02 02 00 40 00 00 00 00 01 02 03 04 05 00 3C 2E E0 00 00 00 00
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
00 00 00 00 00 00 04 00 00 4D 0D 0A
34 35 36 37 38 39 40 41 42 43 44 45 : byte number offsets)
```

Data record structure

Byte 0, 1:
'<S' = start of answer from device

Byte 2:
number of bytes to follow, excluding checksum + termination code CR+LF,
here *40* bytes.

Byte 3:
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 4, 5:
Temperature reference for conductivity measurements.
= *1000* for **25°C**
= *896* for **20°C**

Byte 6:
Display Contrast setting

Byte 7:
Standby setting. When 0, the device will stop operation after pressing the standby button or after a power failure, otherwise, the device will restart each time.

Byte 8:
Language setting. 0 = English, 1 = Dutch, 2 = French, 3 = German

Byte 9, 10, 11, 12, 13, 14:
Measurement settings of all the channels.
Here in the example are 6 bytes given for 6-channel model C3040, there are ***only 2 bytes*** *for the models C3010, C3020, C3030.*

Byte 15: (***11*** *for the models C3010, C3020, C3030*)
Display resolution settings.

Byte 16, 17, 18, 19: (***12, 13, 14, 15*** *for the models C3010, C3020, C3030*)
32 bits Password settings. The highest bit (*32nd*) indicates the password is enabled.

Hertenstraat 56/9
B-2300 Turnhout
Belgium
+32 (0)14 411279
+32 (0)14 429179
support@consort.be

Byte 20, 21, 22, 23, 24, 25: (***16, 17*** *for the models C3010, C3020, C3030*)
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 *20* indicates °C1 is used for CH1, byte *21* indicates °C2 is used for CH2, … byte *25* indicates °C6 is used for CH6. Also here are ***only 2 bytes*** *for the models C3010, C3020, C3030.*

Byte 26, 27: (***18, 19*** *for the models C3010, C3020, C3030*)
Data log settings:
Highest bit (16^{th}) = the data logger is enabled when 1.
Second highest bit (15^{th}) = memory rotation or continuous data registration.
Remaining lower *14* bits: Time interval in seconds

Byte 28, 29: (***20, 21*** *for the models C3010, C3020, C3030*)
Data log settings: irrelevant information

Byte 30, 31: (***22, 23*** *for the models C3010, C3020, C3030*)
Data log settings: Number of logged data points

Byte 32, 33, 34, 35, 36: (***24, 25, 26, 27, 28*** *for the models C3010, C3020, C3030*)
Data log settings: irrelevant information

Byte 37, 38, 39, 40, 41, 42: (***29, 30, 31, 32, 33, 34*** *for the models C3010, C3020, C3030*)
Digital output settings of which byte 41 and 42 (***33*** and ***34***) returns the time interval in seconds.

Byte 43: (***35*** *for the models C3010, C3020, C3030*)
lowest byte of Checksum of preceding data bytes

Byte 44, 45: (***36, 37*** *for the models C3010, C3020, C3030*)
CR + LF, End of data block

Starting from version 3.5 has the conductivity measurement signal frequencies been included in the settings. There are 5 frequencies (1 per channel) of 2 bytes each and are given as 10 bytes before the checksum, after the digital output timer interval.

6.5.1.2 Set measurement settings

Starting from firmware version 4.2, it is possible to change the measurement settings on the fly. This makes it possible to disable a specific channel and to enable it again without changing the initial configuration of the device. As soon as the measurement has been exited or the device is restarted, the original configuration is used again. It is not possible to use an enabled channel while this was first disabled or a non compatible measurement was set in the initial configuration. Therefore use it e.g.

- to read the mV values while in pH in dissolved Oxygen measurement mode,
- to switch between conductivity and resistivity measurement mode,
- to disable a specific channel,
- …

The command 's' followed by the measurement mode bytes for ALL device channels. Always use the command with as many bytes for all device channels to prevent that problems occur.

Hertenstraat 56/9
B-2300 Turnhout
Belgium
+32 (0)14 411279
+32 (0)14 429179
support@consort.be

The measurement mode bytes are specific for each device model. The configured bytes can be requested using the previous command ('S') and found starting from byte 9 in the example.

e.g. A C3010 device is configured to measure pH (0x01) on CH1 and EC (0x03, Electrical Conductivity) on CH2.

This example sets CH1 to mV readings (0x02) and disables CH2 (0x00) :

```
3E 73 02 00 B2 0D 0A
3C 73 AF 0D 0A
```

The following example sets CH1 to pH readings (0x01) and set CH2 back to EC(0x03) :

```
3E 73 01 03 B5 0D 0A
3C 73 AF 0D 0A
```

e.g. A C3040 device (6 channels) is configured to measure pH (0x01) on CH1 and EC (0x03, Electrical Conductivity) on CH2, CH3 to CH4 are configured also for pH.

This example sets CH1, CH3, CH4, CH5 and CH6 to mV readings (0x02) and disables CH2 (0x00) :

```
3E 73 02 00 02 02 02 02 BB 0D 0A
3C 73 AF 0D 0A
```

The following example sets CH1 to pH readings (0x01), CH2 back to EC(0x03) and the remaining channels to mV:

```
3E 73 01 03 02 02 02 02 BD 0D 0A
3C 73 AF 0D 0A
```

6.6 Request measurement

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.

Before device version 1.7:

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

```
3E 4D 00 8B 0D 0A /* send the request */
3C 4D 13 00 80 01 01 28 00 3E 7E 2A 00 00 94 E3 00 03 D0 90 03 E4 ED 0D 0A /* returned data */
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 : byte number offsets)
```

Data record structure

Byte 0 + 1 = '<M':
start of answer from device

Byte 2:
number of bytes follow, excluding checksum + termination code CR+LF,
here 19 bytes.

Hertenstraat 56/9
B-2300 Turnhout
Belgium
+32 (0)14 411279
+32 (0)14 429179
support@consort.be

Byte 3+4: 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

Byte 5: Type of measurement. This will depend on the device model.

Byte 6, 7, 8, 9, 10: Internal information, not of use
Byte 11: Output format of measurement.

See the table Measurement formats to find here the value 2A (= 42 decimal) corresponds with the format of '0,001 pH'.

Byte 12, 13, 14, 15:

32 bits with measurement data where the value 10000 corresponds to the unit 1. In this example, the hex value `00 00 94 E3` corresponds with 38115. Using the format from byte 11, this example returns thus the value of '3,811 pH'.

Byte 16, 17, 18, 19:

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 20, 21: ***Not for the models C3010, C3050 and C3060(without Dissolved Oxygen Measurements)***
16 Bits with air pressure measurement.
The value `03 E4` corresponds to an air pressure of 996 hPa.

Byte 22: lowest byte of Checksum of preceding data bytes

Byte 23, 24: CR + LF, End of data block

Starting from device version 1.7:

The returned data is reduced to only the useful information bytes. It also possible now to request the measurements of all channels at once by using 255 as channel number

e.g. Request the measurement from channel 2 (=> Send 'M'+1, see command table)

```
3E 4D 01 8C 0D 0A/* send the request */
3C 4D 0E 20 00 09 1E 00 01 F4 C8 00 02 D1 E4 03 DE 33 0D 0A /* returned data
0  1  2  3  4  5  6  7  8  9  10 11 12 13 14 15 16 17 18 19 : byte number offsets) */
```

Data record structure

Byte 0 + 1 = '<M':
start of answer from device

Byte 2:
number of bytes follow, excluding checksum + termination code CR+LF,

Hertenstraat 56/9
B-2300 Turnhout
Belgium
+32 (0)14 411279
+32 (0)14 429179
support@consort.be

here 14 bytes.

Byte 3+4: 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

Byte 5: Type of measurement. This will depend on the device model.

Byte 6: Output format of measurement.

See the table Measurement formats to find here the value 1E corresponds with the format of '0,1 µg/l' (Ion measurement).

Byte 7, 8, 9, 10:

32 bits with measurement data where the value 10000 corresponds to the unit 1. In this example, the hex value 00 01 F4 C8 corresponds with 128200. Using the format from byte 1E, this example returns thus the value of '12,8 µg/l'.

Byte 11, 12, 13, 14:

32 bits with temperature measurement where the value 10000 corresponds to the unit 1.
Here is the temperature 00 02 D1 E4 corresponding to 184804 or 18,5°C.

Byte 15, 16: ***Not for the models C3010, C3050 and C3060(without Dissolved Oxygen Measurements)***
16 Bits with air pressure measurement.
The value 03 DE corresponds to an air pressure of 990 hPa.

Byte 17: lowest byte of Checksum of preceding data bytes

Byte 18, 19: CR + LF, End of data block

e.g. Request the measurements from all available channels

```
3E 4D FF 8A 0D 0A
3C 4D 1C 00 80 02 00 00 25 E3 38 00 03 D0 90 03 E1 20 80 09 1E 00 01 F5 F4 00 02 D0 AC 03 E1 C1 0D 0A
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 /* offsets */
```

These returned data bytes contain the measurements from the 2 channels from the C3030 device. The measurements are returned in the order of the channels.

Bytes 0, 1 en 2: Start of answer and the number of returned bytes (here = 1C or 28 decimal)
Bytes 3 → 16: 14 bytes of data from first channel. The analysis is similar to bytes 3 → 16 from the previous example.
Bytes 17 → 30: 14 bytes of data from the second channel. The analysis is similar to bytes 3 → 16 from the previous example.
Bytes 31: lowest byte of Checksum of preceding data bytes

Hertenstraat 56/9
B-2300 Turnhout
Belgium
+32 (0)14 411279
+32 (0)14 429179
support@consort.be

Bytes 31: CR + LF, End of data block

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 like the GLP report.

Use the command 'F' + (channel number) to set a specific channel measurement on the display. The display with measurement information of all channels has the number 0, the channels start from 1, the temperature displays start from 1+number of channels.

e.g. To set the display of CH2

```
3E 46 02 86 0D 0A
3C 46 82 0D 0A
```

To set the display of °C3 for the C3040 model (6 channels)

```
3E 46 09 8D 0D 0A
3C 46 82 0D 0A
```

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.

```
>G
****              GLP               ****
Device             : C3040
Version            : 1.2
Serial nr.         : 9999999
Channel            : 2
Input              : S/cm
Reference temp.    : 25°C
Cap.Comp.          : NO

CALIBRATION
Date               : 00/00/2000
Time               : 00:00:00

Reference temp.    : 25°C

Standard 1         : 0.01M KCl
  Value            : 0.000µS/cm
  CC               : 0.000cm1
  °C               : 0.0
  Time             : 00:00
Standard 2         : 0.01M KCl
  Value            : 0.000µS/cm
  CC               : 1.000cm1
  °C               : 25.0
  Time             : 00:00
Standard 3         : 0.01M KCl
  Value            : 0.000µS/cm
  CC               : 1.000cm1
  °C               : 25.0
  Time             : 00:00

STATISTICS
CC1                : 1.000cm1
CC2                : 1.000cm1
CC3                : 1.000cm1
```

Hertenstraat 56/9
B-2300 Turnhout
Belgium
+32 (0)14 411279
+32 (0)14 429179
support@consort.be

6.9 Set Parameters Data log

The command 'D' allows to adjust the data log parameters while measuring. Four additional bytes (32 bits) are required:

- Highest bit: enable data log function
- 2nd highest bit: log continuously when 1. The oldest data can be overwritten.
- The next 14 bits is the Interval of time in seconds, max 14400 = 4 hours.
- The next bit is irrelevant
- The lowest 15 bits is the maximum number of data points to log. The device is technically limited to 12000 points.

e.g. Enable the data log function, have the values logged at an interval of 15 seconds and let it end when 10000 values have been logged.

```
3E 44 80 0F 27 10 48 0D 0A
3C 44 80 0D 0A
```

Enable the data log function, have the values logged at an interval of 1 minute and keep only the last 60 values in memory.

```
3E 44 C0 3C 00 3C BA 0D 0A
3C 44 80 0D 0A
```

Mind that these settings remain valid only as long as the measurement mode has not been canceled due to entering the settings or a calibration. The number of data points to log will then be reset to its maximum. Therefore it is advised to resend the settings when returning in measurement mode.
It is not really advised to log data continuously when less then 12000 points need to be logged. This leads to mixed time points in the data table.

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.

```
<L^
LOG.00001      26/08/2010      08:10:39      CH1      15.57  pH      21.9   °C
LOG.00002      26/08/2010      08:10:39      CH2    1060.   µS/cm    22.3   °C
LOG.00003      26/08/2010      08:10:39      CH3    -501.5  mV       25.0   °C
LOG.00004      26/08/2010      08:10:39      CH4    -501.5  mV       25.0   °C
LOG.00005      26/08/2010      08:10:39      CH5    -501.5  mV       25.0   °C
LOG.00006      26/08/2010      08:10:39      CH6    -501.5  mV       25.0   °C
LOG.00007      26/08/2010      08:10:49      CH1      15.57  pH      21.9   °C
LOG.00008      26/08/2010      08:10:49      CH2    1060.   µS/cm    22.3   °C
LOG.00009      26/08/2010      08:10:49      CH3    -501.5  mV       25.0   °C
LOG.00010      26/08/2010      08:10:49      CH4    -501.5  mV       25.0   °C
LOG.00011      26/08/2010      08:10:49      CH5    -501.5  mV       25.0   °C
LOG.00012      26/08/2010      08:10:49      CH6    -501.4  mV       25.0   °C
```

Hertenstraat 56/9
B-2300 Turnhout
Belgium
+32 (0)14 411279
+32 (0)14 429179
support@consort.be

6.11 Request Data table as binary data

The command 'I' 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 100 data records, starting from 0

```
3E 6C 0 0 0 0 0 0 0 64 E 0D 0A              ' The request
3C 6C 0 0 0 64 C D A          ' the 4 byte number of records/lines (here 100) which will be returned
3C 6C A 3C CF 1 D A 82 A7 D2 2B 0 FB D A    ' first record at address 0,
3C 6C A 4 24 11 11 A 82 A7 D2 7 0 8 D A     ' address 1, record 2
3C 6C A EC 69 21 2C A 82 A7 D2 0 0 59 D A   ' address 2, record 3
3C 6C A EC 69 31 2C A 82 A7 D2 0 0 69 D A   ' address 3, record 4
3C 6C A EC 69 41 2C A 82 A7 D2 0 0 79 D A   ' address 4, record 5
3C 6C A EC 69 51 2C A 82 A7 D2 0 0 89 D A   ' and so on …
… … …
3C 6C A EC 69 21 2C A 83 53 D2 0 0 6 D A    ' address 98, record 99
3C 6C A EC 6A 31 2C A 83 53 D2 0 0 17 D A   ' address 99, record 100
```

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: `3C CF 01 0D 0A 82 A7 D2 2B 00`
or binary written:

- First 2 bytes = The measured value.
  - `3C CF` or *15567*: 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: `1 0D` or *269*, this value has an offset of the minimal temperature (*-5,0*°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 *(269-50)*1000 = 219000* or *21,9*°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).

Hertenstraat 56/9
B-2300 Turnhout
Belgium
+32 (0)14 411279
+32 (0)14 429179
support@consort.be

- 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: `1000 0010 1010 0111 1101 0010 0010 1011`
  - b31 → b28: 4 bits with the Month (0..12), in example `1000` = *8*, the month August
  - b27 → b22: 6 bits with the Minutes (0..59), in example `0010 10` = *10*
  - b21 → b16: 6 bits with the Seconds (0..59), in example `10 0111` = *39*
  - b15 → b11: 5 bits with the date (day of the month, 0..31), in example `1101 0` = *26*
  - b10 → b6: 5 bits with the hour (0..23), in example `010 00` = *8*
  - 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 which has the following values:
  - *0* The data is recorded due to the timer
  - *1* The data is recorded due to pressing the STORE button
  - 2 The data is recorded due to pressing the HOLD button

The recorded data from the example is *15.57 pH*, *21.9°C* on the *26th of August, 2010* at *08:10:39*. The value is recorded due to the timer.

6.12 Read Date/time

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

```
3E 59 0D 0A
3C 59 6 A B F 11 C 1D F9 D A
```

Returned information:

- `3C 59 6` First 3 bytes = start of answer + number of data bytes to follow.
- `A B F` Next 3 bytes form the date in the order Year (10), month (11) and date (15).
- `11 C 1D` Next 3 bytes form the time in the order hour (17), minutes (12) and seconds (29).
- `F9 D A` Last 3 bytes with checksum and closing codes.

The current date and time here is: 15 November (20)10, 17:12:29.

6.13 Set Date/time

e.g. Send the 'y' command +data to set the date and time to 15 Nov 10, 17:30:00

```
3E 79 A B F 11 1E 0 A 0D 0A   ' '>y' + year + month + date + hour + minutes + seconds + CS + cr + lf
3C 79 B5 D A
```

6.14 Read Display text

One line of the text on the display can be read using the command 'X' + line number (starting from 0).

Important:
- Only the regular text format will be returned, Bold characters and large font characters are not returned!
- The number of returned characters depend on the current action of the device. Some display outputs give also help information on the right side, which is not returned with this command.

e.g. Read line 0 during the display of the measurement of CH1:

```
3E 58 00 96 0D 0A      /* 'X' + 0 + … */
3C 58 28 31 20 70 48 20 20 20 20 20 20 20 20 20 20 20 20 32 35 2E 30 F8 43 20 0D 20 20 20 20 20 20
20 20 20 20 20 20 20 20 20 20 20 72 0D 0A
```

Hertenstraat 56/9
B-2300 Turnhout
Belgium
+32 (0)14 411279
+32 (0)14 429179
support@consort.be

```
40 bytes are returned for the line as ASCII formatted characters =
'1 pH            25.0øC                '
```

Read line 2 during the display of the pH calibration menu:

```
3E 58 02 98 0D 0A
3C 58 15 20 20 42 75 66 66 65 72 32 3A 20 20 20 34 2E 30 30 20 70 48 20 C9 0D 0A
Only 21 bytes are returned for the line as ASCII formatted characters =
'  Buffer2:   4.00 pH '
```

6.15 Start/Stop Display dump

When sending the command '(' the device starts to send all data written to the display, also to the serial port. The dumping will be stopped when sending the closing bracket command ')'.
Each string sent to the display will be terminated with a CR+LF combination on the serial port.

e.g. Start the dump during the pH measurement:

```
>(f_                                                    ' start the dump
<(d_
18/04/2012_08:47:05_1_  -10.5_mV_2_  72.3_°C_ 0.61_ng/l_   ' the characters '_'
18/04/2012_08:47:06_1_  -10.5_mV_2_  72.3_°C_ 0.61_ng/l_   ' are CR+LF combinations
18/04/2012_08:47:06_1_  -10.5_mV_2_  72.3_°C_ 0.61_ng/l_
18/04/2012_08:47:07_1_  -10.5_mV_2_  72.3_°C_ 0.61_ng/l_
18/04/2012_08:47:07_1_  -10.5_mV_2_  72.3_°C_ 0.61_ng/l_
18/04/2012_08:47:08_1_  -10.5_mV_2_  72.3_°C_ 0.61_ng/l_
18/04/2012_08:47:08_1_  -10.5_mV_2_  72.3_°C_ 0.61_ng/l_
18/04/2012_08:47:09_1_  -10.5_mV_2_  72.3_°C_ 0.61_ng/l_
18/04/2012_08:47:09_1_  -10.5_mV_2_  72.3_°C_ 0.61_ng/l_
18/04/2012_08:47:10_1_  -10.5_mV_2_  72.3_°C_ 0.61_ng/l_
18/04/2012_08:47:10_1_  -10.5_mV_2_  72.3_°C_ 0.61_ng/l_
>)g_                                                    ' stop the dump
<)e_
```

Mind that special characters such as battery symbols are given in the internal font code which is similar to the ASCII table, besides these special characters. Mind that characters with an ASCII code less then a space (0x20) are given as underscore '_'.

6.16 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 */
```

Hertenstraat 56/9
B-2300 Turnhout
Belgium
+32 (0)14 411279
+32 (0)14 429179
support@consort.be

6.17 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 */
```

6.18 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 (199).
3. Send the Device Information command code with the second unlock code 0x63 (99).
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!)

Hertenstraat 56/9
B-2300 Turnhout
Belgium
+32 (0)14 411279
+32 (0)14 429179
support@consort.be

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.

6.19 Restart the device

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

e.g.

```
3E 52 45 53 45 54 C1 0D 0A /* 'RESET' + Checksum + CR + LF */

The device restarts without any answer !
```

6.20 Read number information

Send the command 'N' to read the current number information of a value that is shown to be entered on the screen.

e.g. When entering a pH value in a user table

```
3E 4E 8C 0D 0A /* Send 'N'
3C 4E 34       /* start of reply
FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
               /* 32 bytes that can be ignored
00 00 00 00    /* Allowed lowest limit of value, here is it 0
00 02 22 E0    /* Allowed highest limit of value, here is it 14.0000 (see measurement formats)
00 00 00 64    /* unit value of increment, here is it 0.0100 (see measurement formats)
00 00 4E 20    /* the value of the number, here 20000 which corresponds to 2.0000 (see
                  measurement formats)
00 01 01 60    /* 4 bytes that can be ignored
D6 0D 0A       /* CS + CR + LF
```

6.21 Send number value

Send the command 'n' with a value consisting of 4 bytes.

e.g. Send a pH value = 7.00 in a user table

```
3E 6E 00 01 11 70 2E 0D 0A          /* send 'n' + 70000 (0x00011170) as value
3C 6E AA 0D 0A                      /* answer as confirmation
```

On the screen might the value not be given immediately yet but it will be as soon as confirmed with the key OK. The command 'N' (6.20) will show the correct value that has been entered.

Hertenstraat 56/9
B-2300 Turnhout
Belgium
+32 (0)14 411279
+32 (0)14 429179
support@consort.be

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 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 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
28	1	ng/l	10000	Ion

Hertenstraat 56/9
B-2300 Turnhout
Belgium
+32 (0)14 411279
+32 (0)14 429179
support@consort.be

Code	*Format*	*Unit*	*Data value Multiplicator*	*Measurement*
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