# SeaTalk Technical Reference **Revision 3.22**

## General Information

SeaTalk is a simple interface for networking Raymarine/Autohelm marine equipment so that all devices of a ship can exchange and share their data. SeaTalk is a proprietary solution of Autohelm and **not** compatible with NMEA or CAN. Unfortunately Raymarine keeps the technical details of SeaTalk secret. To assist users who want to develop hard- or software to connect their devices to the SeaTalk bus these pages uncover some of the mysteries. Part 3 adds hints how to interface SeaTalk with a PC. The information is unsupported by Raymarine and was found by watching the bits travelling on the bus. Therefore the description is incomplete inaccurate and may even be wrong. Corrections and contributions are welcome.

## Content

The technical description of the SeaTalk protocol is divided into three parts:

1. Part 1: How SeaTalk works
    a. Hardware-Interface describes the function of the three SeaTalk wires
    b. Serial Data Transmission describes the parameters of the asynchron serial port
    c. Composition of Messages describes the structure of datagrams
    d. Collision Management describes the arbitration between simultaneous talkers
    e. Data Coding describes common rules for coding numerical values
2. Part 2: Recognized Datagrams describes the SeaTalk messages and their meaning
3. Part 3: Processing SeaTalk Data with a PC
    a. Circuit example for an unidirectional SeaTalk => PC interface
    b. Circuit example for a bidrectonal SeaTalk <=> PC interface
    c. Simple SeaTalk monitoring utility for download
    d. SeaTrack: VisualBasic software for trip documentation
    e. SeaSigma: A small SeaTalk command generator for download

## Revision History:

Rev 3.22: [May 2014] Command 53 corrected thx John Rind and Mindert Sprang
Rev 3.21: [March 2011] Time coding in command 54 clarified thx Tim Thornton
Rev 3.20: [January 2011] Some observations with Raystar 120 GPS included thx Tim Thornton
Rev 3.19: [August 2010] Command A2 revised thx Frank Wallenwein
Rev 3.18: [March 2009] Several commands edited and new commands 05 and 68 added thx Frank Wallenwein
Rev 3.17: [February 2009] Command A4 added thx Tord Lindner
Rev 3.16: [October 2008] Commands 65, 66, A8 and AB added thx Ray Holland

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Return to Top of Page  Part 1  Part 2  Part 3

# SeaTalk Technical Reference Part 1: How SeaTalk works

## Hardware-Interface

SeaTalk uses three wires, connected in parallel to all devices on the bus:

1. +12V Supply, red
2. GND Supply, grey
3. Data Serial Data, yellow: +12V=Idle/Mark=1, 0V=Space/Data=0, 4800 Baud, pullup circuit in each device, talker pulls down to 0V (wired OR). For connection to a RS232 receiver voltage levels must be inverted.

## Serial Data Transmission

11 bits are transmitted for each character:

- 1 Start bit (0V)
- 8 Data Bits (least significant bit transmitted first)
- 1 Command bit, set on the first character of each datagram. Reflected in the parity bit of most UARTs. Not compatible with NMEA0183 but well suited for the multiprocessor communications mode of 8051-family microcontrollers (bit SM2 in SCON set).
- 1 Stop bit (+12V)

## Composition of Messages

Each datagram contains between 3 and 18 characters:

1. Type of command (the only byte with the command-bit set)
2. Attribute Character, specifying the total length of the datagram in the least significant nibble:

   Most significant 4 bits: 0 or part of a data value
   Least significant 4 bits: Number of additional data bytes = n =>
   Total length of datagram = 3 + n characters

3. First, mandatory data byte
4. - 18. optional, additional data bytes

No datagrams or devices carry addresses. This eliminates the need for an initialization or arbitration phase on the bus. Events (such as a keystroke) are published as soon as they occur. Measured data is repeatedly transferred, typically about once per second. So the current values are always available to all devices on the bus and there is no need (and with the exception of command A4 no way) to request a particular information.

## Collision Management

There is no master on the bus. Every device has equal rights and is allowed to talk as soon as it recognizes the bus to be idle (+12V for at least 10/4800 seconds). Low priority messages use a longer or randomly selected idle-bus-waiting-time. This allows messages from other devices with a higher priority to be transmitted first. The different waiting times of all devices make data collisions (two or more devices start talking at exactly the same moment) very rare. Since each device also listens to its own transmission it will recognize when its message is garbled by a second talker. In this case it abandons the remaining characters of the datagram. It waits for the bus to become free again and then retransmits the whole message. For listeners this means that messages which are shorter than expected are invalid and have to be cancelled totally.

## Data Coding

Some characters are repeated with all bits inverted for noise or transmission error detection. Example: 0xA2 is followed by 0x5D. The sum of both bytes must always be 0xFF. The listing below shows repeated bytes in small letters (example: ZZ zz).

Numerical values are transmitted binary coded and with least significant data first. Example: 0x13 0x57 means 0x5713 = 22291

Some values are put together by certain bits of a byte or nibble. The meaningful bits can be isolated by a bitwise AND operation (&). Example: (U & 0x3) filters the least significant two bits of U.

The "distance to destination" value (ZZZ in command 0x85) uses a scaling factor of 1/10 or 1/100 nm depending on the shift indicator bit (LSBit of Y).

Return to Top of Page Part 1 Part 2 Part 3

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# SeaTalk Technical Reference Part 2:

## Recognized Datagrams (in hexadecimal notation):

```
Com Att Dat Dat...

 00  02  YZ  XX XX  Depth below transducer: XXXX/10 feet
                     Flags in Y: Y&8 = 8: Anchor Alarm is active
                                 Y&4 = 4: Metric display units or
                                          Fathom display units if followed
by command 65
                                 Y&2 = 2: Used, unknown meaning
                     Flags in Z: Z&4 = 4: Transducer defective
                                 Z&2 = 2: Deep Alarm is active
                                 Z&1 = 1: Shallow Depth Alarm is active
                   Corresponding NMEA sentences: DPT, DBT

 01  05  XX XX XX XX XX XX  Equipment ID, sent at power on, reported
examples:
 01  05  00 00 00 60 01 00  Course Computer 400G
 01  05  04 BA 20 28 01 00  ST60 Tridata
 01  05  70 99 10 28 01 00  ST60 Log
 01  05  F3 18 00 26 0F 06  ST80 Masterview
 01  05  FA 03 00 30 07 03  ST80 Maxi Display
 01  05  FF FF FF D0 00 00  Smart Controller Remote Control Handset

 05  03  0X  YY ZZ  PP   Engine RPM and PITCH:
                            X = 0: RPM & PITCH
                            X = 1: RPM & PITCH  starboard
                            X = 2: PRM & PITCH  port
                            YY*256+ZZ = RPM Value (signed value, example:
YYZZ=0x0110=272 RPM, YYZZ=0xfef0= -272 RPM)
                            PP = % Pitch (signed value -128%...+127%, example
0x03=3%, 0xFD= -3%)

 10  01  XX  YY  Apparent Wind Angle: XXYY/2 degrees right of bow
                Used for autopilots Vane Mode (WindTrim)
                Corresponding NMEA sentence: MWV

 11  01  XX  0Y  Apparent Wind Speed: (XX & 0x7F) + Y/10 Knots
                Units flag: XX&0x80=0    => Display value in Knots
                            XX&0x80=0x80 => Display value in Meter/Second
                Corresponding NMEA sentence: MWV

 20  01  XX  XX  Speed through water: XXXX/10 Knots
                Corresponding NMEA sentence: VHW
```

```
 21  02  XX  XX  0X  Trip Mileage: XXXXX/100 nautical miles

 22  02  XX  XX  00  Total Mileage: XXXX/10 nautical miles

 23  Z1  XX  YY  Water temperature (ST50): XX deg Celsius, YY deg Fahrenheit
                 Flag Z&4: Sensor defective or not connected (Z=4)
                 Corresponding NMEA sentence: MTW

 24  02  00  00  XX  Display units for Mileage & Speed
                     XX: 00=nm/knots, 06=sm/mph, 86=km/kmh

 25  Z4  XX  YY  UU  VV AW  Total & Trip Log
                     total= (XX+YY*256+Z* 4096)/ 10 [max=104857.5] nautical
miles
                     trip = (UU+VV*256+W*65536)/100 [max=10485.75] nautical
miles

 26  04  XX  XX  YY  YY DE  Speed through water:
                     XXXX/100 Knots, sensor 1, current speed, valid if D&4=4
                     YYYY/100 Knots, average speed (trip/time) if D&8=0
                              or data from sensor 2 if D&8=8
                     E&1=1: Average speed calulation stopped
                     E&2=2: Display value in MPH
                     Corresponding NMEA sentence: VHW

 27  01  XX  XX  Water temperature: (XXXX-100)/10 deg Celsius
                 Corresponding NMEA sentence: MTW

 30  00  0X      Set lamp Intensity; X=0: L0, X=4: L1, X=8: L2, X=C: L3
                     (only sent once when setting the lamp intensity)

 36  00  01      Cancel MOB (Man Over Board) condition

 38  X1  YY  yy  Codelock data

 50  Z2  XX  YY  YY  LAT position: XX degrees, (YYYY & 0x7FFF)/100 minutes
                     MSB of Y = YYYY & 0x8000 = South if set, North if
cleared
                     Z= 0xA or 0x0 (reported for Raystar 120 GPS), meaning
unknown
                     Stable filtered position, for raw data use command 58
                     Corresponding NMEA sentences: RMC, GAA, GLL

 51  Z2  XX  YY  YY  LON position: XX degrees, (YYYY & 0x7FFF)/100 minutes
                      MSB of Y = YYYY & 0x8000 = East if set, West if cleared
                      Z= 0xA or 0x0 (reported for Raystar 120 GPS), meaning
unknown
                     Stable filtered position, for raw data use command 58
                     Corresponding NMEA sentences: RMC, GAA, GLL

 52  01  XX  XX  Speed over Ground: XXXX/10 Knots
                 Corresponding NMEA sentences: RMC, VTG
```

```
 53  U0  VW      Magnetic Course in degrees:
                 The two lower  bits of  U * 90 +
                    the six lower  bits of VW *  2 +
                    the two higher bits of  U /  2 =
                    (U & 0x3) * 90 + (VW & 0x3F) * 2 + (U & 0xC) / 8
                 The Magnetic Course may be offset by the Compass Variation
(see datagram 99) to get the Course Over Ground (COG).
                 Corresponding NMEA sentences: RMC, VTG

 54  T1  RS  HH  GMT-time: HH hours,
                          6 MSBits of RST = minutes = (RS & 0xFC) / 4
                          6 LSBits of RST = seconds =  ST & 0x3F
                 Corresponding NMEA sentences: RMC, GAA, BWR, BWC

 55  X1  YY  yy  TRACK keystroke on GPS unit
                 keycodes identical with autopilot (command 86)

 56  M1  DD  YY  Date: YY year, M month, DD day in month
                 Corresponding NMEA sentence: RMC

 57  S0  DD      Sat Info: S number of sats, DD horiz. dillution of position,
if S=1 -> DD=0x94
                 Corresponding NMEA sentences: GGA, GSA

 58  Z5  LA XX YY LO QQ RR   LAT/LON
                 LA Degrees LAT, LO Degrees LON
                 minutes LAT = (XX*256+YY) / 1000
                 minutes LON = (QQ*256+RR) / 1000
                 Z&1: South (Z&1 = 0: North)
                 Z&2: East  (Z&2 = 0: West)
                 Raw unfiltered position, for filtered data use commands
50&51
                 Corresponding NMEA sentences: RMC, GAA, GLL

 59  22  SS MM XH  Set Count Down Timer
                   MM=Minutes ( 00..3B ) ( 00 .. 63 Min ), MSB:0 Count up
start flag
                   SS=Seconds ( 00..3B ) ( 00 .. 59 Sec )
                   H=Houres  ( 0..9 )   ( 00 .. 09 Houres )
                   X= Counter Mode: 0 Count up and start if MSB of MM set
                                    4 Count down
                                    8 Count down and start
                   ( Example 59 22 3B 3B 49 -> Set Countdown Timer to 9.59:59
)
 59  22  0A 00 80  Sent by ST60 in countdown mode when counted down to 10
Seconds.

 61  03  03 00 00 00  Issued by E-80 multifunction display at initialization

 65  00  02      Select Fathom (feet/3.33) display units for depth display
(see command 00)

 66  00  XY      Wind alarm as indicated by flags in XY:
                   X&8 = 8: Apparent Wind angle low
                   X&4 = 4: Apparent Wind angle high
```

```
                  X&2 = 2: Apparent Wind speed low
                  X&1 = 1: Apparent Wind speed high
                  Y&8 = 8: True Wind angle low
                  Y&4 = 4: True Wind angle high
                  Y&2 = 2: True Wind speed low
                  Y&1 = 1: True Wind speed high (causes Wind-High-Alarm on
ST40 Wind Instrument)
                  XY  =00: End of wind alarm (only sent once)

 68  X1 01 00   Alarm acknowledgment keystroke (from ST80 Masterview)
 68  X1 03 00   Alarm acknowledgment keystroke (from ST80 Masterview)
 68  41 15 00   Alarm acknowledgment keystroke (from ST40 Wind Instrument)
                  X: 1=Shallow Shallow Water Alarm, 2=Deep Water Alarm,
3=Anchor Alarm
                     4=True Wind High Alarm, 5=True Wind Low Alarm, 6=True
Wind Angle high
                     7=True Wind Angle low, 8=Apparent Wind high Alarm,
9=Apparent Wind low Alarm
                     A=Apparent Wind Angle high, B=Apparent Wind Angle low

 6C  05  XX XX XX XX XX XX Second equipment-ID datagram (follows 01...),
reported examples:
 6C  05  04 BA 20 28 2D 2D ST60 Tridata
 6C  05  05 70 99 10 28 2D ST60 Log
 6C  05  F3 18 00 26 2D 2D ST80 Masterview

 6E  07  00  00 00 00 00 00 00 00 MOB (Man Over Board), (ST80), preceded
                by a Waypoint 999 command: 82 A5 40 BF 92 6D 24 DB

 70  10  XY      Keystroke on Raymarine A25006 ST60 Maxiview Remote Control
                  X=0 => Single keypress; X=2 => Two keys pressed;
                  X=4 => Single key: Press,hold&release; X=6 => Two keys:
Press,hold&release
                  Y=0 => Key 1 "Depth"; Y=1 => Key 2 "Speed" or Keys 1+2;
                  Y=2 => Key 3 "HDG" or Keys 2+4; Y=3 => Key 4 "Wind" or
Keys 1+3;
                  Y=4 => Keys 3+4 "Nav"

 80  00  0X      Set Lamp Intensity: X=0 off, X=4: 1, X=8: 2, X=C: 3

 81  01  00  00  Sent by course computer during setup when going past USER
CAL.
 81  00  00      Sent by course computer immediately after above.

 82  05  XX  xx YY yy ZZ zz   Target waypoint name
                XX+xx = YY+yy = ZZ+zz = FF (allows error detection)
                Takes the last 4 chars of name, assumes upper case only
                Char= ASCII-Char - 0x30
                XX&0x3F: char1
                (YY&0xF)*4+(XX&0xC0)/64: char2
                (ZZ&0x3)*16+(YY&0xF0)/16: char3
                (ZZ&0xFC)/4: char4
                Corresponding NMEA sentences: RMB, APB, BWR, BWC
```

```
 83  07  XX  00  00  00  00  00  80  00  00  Sent by course computer.
                XX = 0 after clearing a failure condition, also sent once
after power-up.
                XX = 1 failure, auto release error. Repeated once per
second.
                XX = 8 failure, drive stopped.

 84  U6  VW  XY 0Z 0M RR SS TT  Compass heading  Autopilot course and
                 Rudder position (see also command 9C)
                 Compass heading in degrees:
                   The two lower  bits of  U * 90 +
                   the six lower  bits of VW *  2 +
                   number of bits set in the two higher bits of U =
                   (U & 0x3)* 90 + (VW & 0x3F)* 2 + (U & 0xC ? (U & 0xC ==
0xC ? 2 : 1): 0)
                 Turning direction:
                   Most significant bit of U = 1: Increasing heading, Ship
turns right
                   Most significant bit of U = 0: Decreasing heading, Ship
turns left
                 Autopilot course in degrees:
                   The two higher bits of  V * 90 + XY / 2
                 Z & 0x2 = 0 : Autopilot in Standby-Mode
                 Z & 0x2 = 2 : Autopilot in Auto-Mode
                 Z & 0x4 = 4 : Autopilot in Vane Mode (WindTrim), requires
regular "10" datagrams
                 Z & 0x8 = 8 : Autopilot in Track Mode
                 M: Alarms + audible beeps
                   M & 0x04 = 4 : Off course
                   M & 0x08 = 8 : Wind Shift
                 Rudder position: RR degrees (positive values steer right,
                   negative values steer left. Example: 0xFE = 2° left)
                 SS & 0x01 : when set, turns off heading display on 600R
control.
                 SS & 0x02 : always on with 400G
                 SS & 0x08 : displays “NO DATA” on 600R
                 SS & 0x10 : displays “LARGE XTE” on 600R
                 SS & 0x80 : Displays “Auto Rel” on 600R
                 TT : Always 0x08 on 400G computer, always 0x05 on 150(G)
computer

 85  X6  XX  VU ZW ZZ YF 00 yf   Navigation to waypoint information
                 Cross Track Error: XXX/100 nautical miles
                  Example: X-track error 2.61nm => 261 dec => 0x105 =>
X6XX=5_10
                 Bearing to destination: (U & 0x3) * 90° + WV / 2°
                  Example: GPS course 230°=180+50=2*90 + 0x64/2 => VUZW=42_6
                  U&8: U&8 = 8 -> Bearing is true, U&8 = 0 -> Bearing is
magnetic
                 Distance to destination: Distance 0-9.99nm: ZZZ/100nm, Y &
1 = 1
                                          Distance >=10.0nm: ZZZ/10 nm, Y &
1 = 0
                 Direction to steer: if Y & 4 = 4 Steer right to correct
error
                                     if Y & 4 = 0 Steer left  to correct
```

```
error
                  Example: Distance = 5.13nm, steer left: 5.13*100 = 513 =
0x201 => ZW ZZ YF=1_ 20 1_
                           Distance = 51.3nm, steer left: 51.3*10  = 513 =
0x201 => ZW ZZ YF=1_ 20 0_
                  Track control mode:
                     F= 0x1: Display x-track error and Autopilot course
                     F= 0x3: Enter Track Control Mode, i.e. lock on to GPS.
                             Display x-track error, autopilot course and
bearing
                             to destination
                     F= 0x5: Display x-track error, distance to waypoint,
                             autopilot course and bearing to destination
           normal--> F= 0x7: Enter Track Control Mode, i.e. lock on to GPS.
                             Display x-track error, distance to waypoint,
                             autopilot course and bearing to destination
                     F= 0xF: As 0x7 but with x-track error alarm
                     F= 2, 4, 6, 8 ... causes data errors
                   In case of a waypoint change, sentence 85, indicating the
new bearing and distance,
                   should be transmitted prior to sentence 82 (which
indicates the waypoint change).
                   Corresponding NMEA sentences: RMB, APB, BWR, BWC, XTE

86  X1  YY  yy  Keystroke
                 X=1: Sent by Z101 remote control to increment/decrement
                      course of autopilot
     11  05  FA     -1
     11  06  F9    -10
     11  07  F8     +1
     11  08  F7    +10
     11  20  DF     +1 &  -1
     11  21  DE     -1 & -10
     11  22  DD     +1 & +10
     11  28  D7    +10 & -10
     11  45  BA     -1        pressed longer than 1 second
     11  46  B9    -10        pressed longer than 1 second
     11  47  B8     +1        pressed longer than 1 second
     11  48  B7    +10        pressed longer than 1 second
     11  60  DF     +1 &  -1  pressed longer than 1 second
     11  61  9E     -1 & -10  pressed longer than 1 second
     11  62  9D     +1 & +10  pressed longer than 1 second
     11  64  9B    +10 & -10  pressed longer than 1 second (why not 11 68 97
?)

                 Sent by autopilot (X=0: ST 1000+,  X=2: ST4000+ or ST600R)
     X1  01  FE    Auto
     X1  02  FD    Standby
     X1  03  FC    Track
     X1  04  FB    disp (in display mode or page in auto chapter = advance)
     X1  05  FA     -1 (in auto mode)
     X1  06  F9    -10 (in auto mode)
     X1  07  F8     +1 (in auto mode)
     X1  08  F7    +10 (in auto mode)
     X1  09  F6     -1 (in resp or rudder gain mode)
     X1  0A  F5     +1 (in resp or rudder gain mode)
```

```
     X1  21  DE     -1 & -10 (port tack, doesn´t work on ST600R?)
     X1  22  DD     +1 & +10 (stb tack)
     X1  23  DC    Standby & Auto (wind mode)
     X1  28  D7    +10 & -10 (in auto mode)
     X1  2E  D1     +1 & -1 (Response Display)
     X1  41  BE    Auto pressed longer
     X1  42  BD    Standby pressed longer
     X1  43  BC    Track pressed longer
     X1  44  BB    Disp pressed longer
     X1  45  BA     -1 pressed longer (in auto mode)
     X1  46  B9    -10 pressed longer (in auto mode)
     X1  47  B8     +1 pressed longer (in auto mode)
     X1  48  B7    +10 pressed longer (in auto mode)
     X1  63  9C    Standby & Auto pressed longer (previous wind angle)
     X1  68  97    +10 & -10 pressed longer (in auto mode)
     X1  6E  91     +1 & -1 pressed longer (Rudder Gain Display)
     X1  80  7F     -1 pressed (repeated 1x per second)
     X1  81  7E     +1 pressed (repeated 1x per second)
     X1  82  7D    -10 pressed (repeated 1x per second)
     X1  83  7C    +10 pressed (repeated 1x per second)
     X1  84  7B     +1, -1, +10 or -10 released

 87  00  0X        Set Response level
                  X=1  Response level 1: Automatic Deadband
                  X=2  Response level 2: Minimum Deadband

 88  03  WW  XX  YY  ZZ  Autopilot Parameter: Sent by AP every
                         second while in parameter setting mode.
                         (User or Dealer Calibration Mode)
                         WW Parameter Number
                         XX Current Setting
                         YY Max Parameter Value
                         ZZ Min Parameter Value
                         Known Paramters: Parameter (min-max)
[default]             Number
                         rudder gain  (1-9)
[2]                                      1
                         counter rudder (1-9)
[2]                                   2
                         rudder limit  (10-40)
[30]                                 3
                         turn rate limit  (1-30)
[off]                                4
                         speed  (4-60)
[8]                                          5
                         off course limit  (15-40)
[20]                               6
                         auto trim  (0-4)
[1]                                        7
                         power steer [Joy Stick] ON/OFF (not on new
400G)             9
                         drive type  (3,4,5)
[3]                                   A
                         rudder damping  (1-9)
[2]                                B
                         variation: (full degrees)(-30 to +30)
```

```
[0]                    C
                         auto adapt: 0=Off,1=North,2=South
[1]                        D
                         auto adapt latitude (0-80)
[0]                               E
                         auto release (only for stern drive)
ON/OFF                   F
                         rudder alignment (-7 to +7)
[0]                             10
                         Wind Trim (Wind Response) (1-9) [5] (only for
sail)         11
                         Response  (1-9)
[5]                                  12
                         Boat type:1=displ,2=semi-
displ,3=plan,4=stern,5=work,6=sail 13
                         Cal Lock:  0=OFF, 1=ON
[0]                               15
                         Auto Tack Angle (40-125) [100] (only for
sail)              1d
```

```
 89  U2  VW  XY  2Z  Compass heading sent by ST40 compass instrument
                     (it is read as a compass heading by the ST1000(+) or
ST2000(+) autopilot)
                       Compass heading in degrees:
                         The two lower bits of  U  *  90   +
                         the six lower bits of VW  *   2   +
                         the two higher bits of U  /   2   =
                         (U & 0x3) * 90 + (VW & 0x3F) * 2 + (U & 0xC) / 2
                      Locked stear reference (only send by the ST40 compass):
                         The two higher bits of V * 90 + XY / 2
                       Z & 0x2 = 0 : St40 in Standby mode
                       Z & 0x2 = 2 : St40 in Locked stear mode
                     Corresponding NMEA sentences: HDM, HDG, HDT, VHW

 90  00  XX        Device Indentification
                   XX=02  sent by ST600R ~every 2 secs
                   XX=05  sent by type 150, 150G and 400G course computer
                   XX=A3  sent by NMEA <-> SeaTalk bridge ~every 10 secs

 91  00  0X        Set Rudder gain to X

 92  02  XX  YY  00 Set Autopilot Parameter: Sent by the remote head
                    (e.g. ST600R) to set a particular parameter.
                    XX Parameter Number (see 88)
                    YY Value to set to.

 93  00  00         Enter AP-Setup: Sent by course computer before
                    finally entering the dealer setup. It is repeated
                    once per second, and times out after ten seconds.
                    While this is being sent, command 86 X1 68 97 is
                    needed for final entry into Setup. (600R generates
                    this when -1 & +1 are pressed simultaneously in this
                    mode).
```

```
 95  U6  VW  XY 0Z 00 RR 00 0T  Replaces command 84 while autopilot is in
value setting mode
                   e.g. lamp intensity or response level

 99  00  XX        Compass variation sent by ST40 compass instrument
                     or ST1000, ST2000, ST4000+, E-80 every 10 seconds
                     but only if the variation is set on the instrument
                     Positive XX values: Variation West, Negative XX values:
Variation East
                     Examples (XX => variation): 00 => 0, 01 => -1 west, 02
=> -2 west ...
                                                 FF => +1 east, FE => +2 east
...
                   Corresponding NMEA sentences: RMC, HDG

 9A  09  L11  L12  L13  L14  L21  L22  L23  00  00  00  Version String:
                   L11 means line 1 char 1. There are two lines, line 1
                   Can have 4 characters and line two can have 3
                   Characters. Char: "A"= 0x00, "B"= 0x01,……..
                   Char: "0"= 0x25, "1"= 0x26, …….
                   Some special characters are mapped to the range
                   Between alphas and numeric chars. It seems modulo
                   masked at 0x36, and wraps around from there.

 9C  U1  VW  RR    Compass heading and Rudder position (see also command 84)
                     Compass heading in degrees:
                       The two lower  bits of  U * 90 +
                       the six lower  bits of VW *  2 +
                       number of bits set in the two higher bits of U =
                       (U & 0x3)* 90 + (VW & 0x3F)* 2 + (U & 0xC ? (U & 0xC
== 0xC ? 2 : 1): 0)
                     Turning direction:
                       Most significant bit of U = 1: Increasing heading,
Ship turns right
                       Most significant bit of U = 0: Decreasing heading,
Ship turns left
                     Rudder position: RR degrees (positive values steer
right,
                       negative values steer left. Example: 0xFE = 2° left)
                     The rudder angle bar on the ST600R uses this record

 9E  FC  49  49 03 XX AA BB YY OO PP GG HH II JJ   Waypoint definition
                   XX: Degrees LAT, YY: Degrees LON
                   min&sec LAT= AA+(BB&0x1F)*256, BB&0x80 = 0: North, BB&0x80
= 0x80: South
                   min&sec LON= OO+(PP&ßx1F)*256, PP&0x80 = 0: West,  PP&0x80
= 0x80: East
                   GG HH II JJ: Last four characters of waypoint name

 A1  XD  49  49 GG HH II JJ C1 C2 C3 C4 C5 C6 C7 C8  Destination Waypoint
Info
                   GG HH II JJ: Last four characters of waypoint name
                   C1...C8: Up to 8 characters of WP name, unused are 0
                   Longer names (> 8 chars) create an additional record:
                   X=0: single record (short name)
                   X=1: 1st record, more follows
```

```
                  X=3: last record
                  Corresponding NMEA sentences: RMB, APB, BWR, BWC

 A2  X4  00  WW XX YY ZZ Arrival Info
                  X&0x2=Arrival perpendicular passed, X&0x4=Arrival circle
entered
                  WW,XX,YY,ZZ = Ascii char's of waypoint id.   (0..9,A..Z)
                                Takes the last 4 chars of name, assumes
upper case only
                  Corresponding NMEA sentences: APB, AAM

 A4  02  00  00 00 Broadcast query to identify all devices on the bus, issued
e.g. by C70 plotter
 A4  06  00  00 00 00 00 Termination of request for device identification,
sent e.g. by C70 plotter
 A4  12  II  VV WW Device answers identification request
                     II: Unit ID (01=Depth, 02=Speed, 03=Multi, 04=Tridata,
05=Tridata repeater,
                                  06=Wind, 07=WMG, 08=Navdata GPS,
09=Maxview, 0A=Steering compas,
                                  0B=Wind Trim, 0C=Speed trim, 0D=Seatalk
GPS, 0E=Seatalk radar ST50,
                                  0F=Rudder angle indicator, 10=ST30 wind,
11=ST30 bidata, 12=ST30 speed,
                                  13=ST30 depth, 14=LCD navcenter, 15=Apelco
LCD chartplotter,
                                  16=Analog speedtrim, 17=Analog depth,
18=ST30 compas,
                                  19=ST50 NMEA bridge, A8=ST80 Masterview)
                     VV: Main Software Version
                     WW: Minor Software Version

 A5               GPS and DGPS Info
 A5  57  QQ  HH ?? AA GG ZZ YY DD   GPS and DGPS Fix Info
                  Signal Quality= QQ&0xF, QQ&0x10: Signal Quality available
flag
                  HDOP= HH&0x7C, HH&0x80: HDOP available flag
                  Antenna Height= AA
                  Number of Sats= (QQ&0xE0)/16+(HH&0x1), HH&0x2: NumSats
available flag
                  GeoSeperation= GG*16 (-2048....+2047 meters)
                  Differential age=(ZZ&0xE0)/2+(YY&0xF), YY&0x10: Diff. age
available flag
                  Differential Station ID=(YY&0xC0)*4+DD, YY&0x20:
Diff.St.ID available flag
                  Corresponding NMEA sentences: GGA, RMC, GSV, GLL, GGA
 A5  61  04  E2    , A5 8D ..., A5 98 ..., A5 B5 ..., A5 0C...  Unknown
meaning
 A5  74  ID  ID ID ID ID   GPS Info: ID numbers of satellites
 A5  XD  NN  AA EE SS MM BB FF GG OO CC DD XX YY ZZ   GPS Info: Sat Position
and Signal
                  Data of up to three sattelites [1,2,3] per datagram
                  Satellite number: [1] NN&0xFE, [2] (MM&0x70)/2+(BB&0x7),
[3] CC&0x3F
                  Satellite azimuth:[1] AA*2+(EE&0x1), [2]
(BB&0xF8)*2+(FF&0xF), [3] (CC&0xC0)*2+DD&0x7F
```

Satellite elevation:[1] (EE&0xFE)/2, [2] (FF&0xF0)/2+GG&0x7, [3] XX&0x7F
Satellite signal: [1] (SS&0xFE)/2, [2] (GG&0x80)/2+OO&0x3F, [3] (YY&0xFC)/2+ZZ&0x1

It seems that there will be 4 sat info datagrams generated, the first with X=0 carries the position and signal data of the 1st 3 satellites. The second also with X=0, but NN&0x1 set and a length of 0x0C carries the data of the next 2 satellites and then the ID numbers of the 1st 4 sats. A datagram like the 1st one, but with X=2 carries data of 3 more sats [6,7,8]. It was not possible to get more than 8 sats mapped to SeaTalk. Finally a datagram with X=7 carries the next 5 ID numbers.

Corresponding NMEA sentences: GSV, GSA

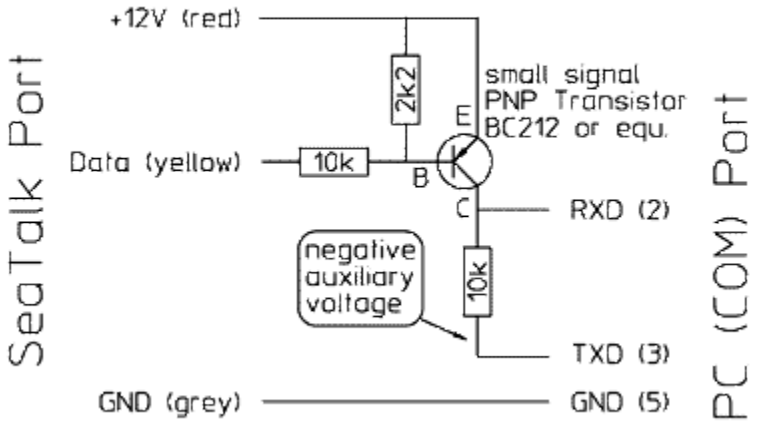
```
 A7  09  86 000000000000000079 Unknown meaning, sent by Raystar 120 GPS

 A8  53  80 00 00 D3  Alarm ON  for Guard #1 or #2
 A8  43  80 00 00 C3  Alarm OFF for Guard #1 or #2
 AB  53  80 00 00 D3  Alarm ON  for Guard #1 or #2
 AB  43  80 00 00 C3  Alarm OFF for Guard #1 or #2
```

Return to Top of Page Part 1 Part 2 Part 3

# SeaTalk Technical Reference Part 3: Processing SeaTalk Data with a PC

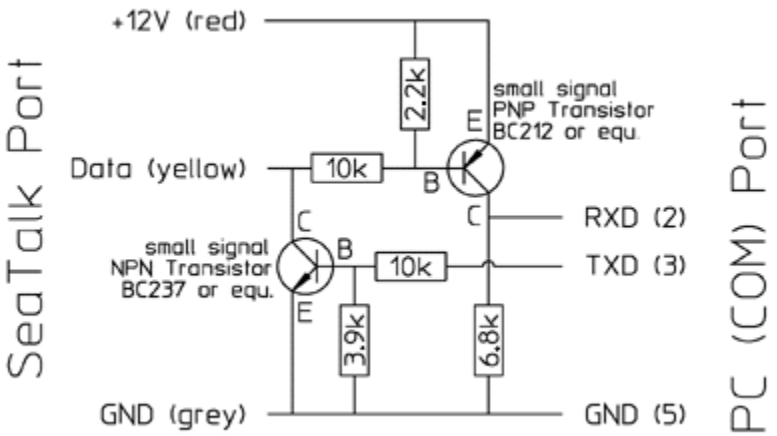
## Unidirectional SeaTalk => RS232 Interface

This simple unidirectional interface circuit inverts the SeaTalk signal to make it readable by the PC serial port:



## Bidirectional SeaTalk <=> RS232 Interface

For bidirectional communication the circuit has to be extended by a second transistor:




A PC-board may be obtained from Frank Wallenwein.

## SeaTalk Monitor

The following piece of C-code gives an example of how to collect and process SeaTalk data. It monitors the SeaTalk bus and echoes the SeaTalk datagrams in hexadecimal notation to the screen.

```
#include <stdio.h>

/* Set Address of Serial Port: COM1=0x3F8, COM2=0x2F8 */
#define PORT 0x3F8

unsigned int collision_ctr,overrun_ctr;
char buffer[256],in_ptr,out_ptr,limit_ptr;
char line_status_reg,receiver_buf,byte_ctr;
char hex[]="0123456789ABCDEF";

main() {
  puts("SeaTalk Monitor Rev. 1.01    (c)2000 by Thomas Knauf\r\n");

 /* Serial Port Initialization */
 _outb(   0, PORT+1); /*IER Disable Interrupts */
 _outb(   1, PORT+2); /*FCR Enable Fifo */
 _outb(0x80, PORT+3); /*LCR Enable access to Divisor Latch */
 _outb(  24, PORT  ); /*DLL Set Baud Rate to 4800 LSB*/
 _outb(   0, PORT+1); /*DLM Baud Rate Divisor MSB */
 _outb(0x3B, PORT+3); /*LCR Stick Parity to 0, Enable Parity, 1 Stop bit, 8
bits/char */
 _outb(0x0F, PORT+4); /*MCR Disable LOOP Mode */
 _outb(   0, PORT+5); /*LSR Clear Error flags */

 while(1) { /* Continous data processing loop */
   if((line_status_reg= _inb(PORT+5)) & 1) { /* LSR New SeaTalk Data received
? */
     receiver_buf=_inb(PORT);  /* RBR Read SeaTalk Data Byte */
     if(line_status_reg & 2) overrun_ctr++; /* PC too slow, should not happen
*/
     if(line_status_reg & 4) { /* Parity bit set => Command Byte */
       if(byte_ctr) {         /* More characters expected => Collision */
         in_ptr=limit_ptr;    /* Discard last datagram, restart from
beginning */
         collision_ctr++;     /* Count collision events */
       }
       buffer[in_ptr++]='\r';  /* Put new command on new line */
       buffer[in_ptr++]='\n';
       byte_ctr=255;           /* Undefined datagram length, wait for next
character */
     } else
       if(byte_ctr==254)       /* Attribute byte ? */
         byte_ctr=(receiver_buf & 0xF) + 2; /* Read expected datagram length
*/
     if(byte_ctr) {            /* Process valid data bytes, should always be
true */
       buffer[in_ptr++]=hex[receiver_buf >>  4]; /* Convert Data to hex */
```

```
       buffer[in_ptr++]=hex[receiver_buf & 0xF];
       buffer[in_ptr++]=' ';                    /* Seperate by space */
       if(! --byte_ctr) limit_ptr=in_ptr;       /* Complete datagram ready
for output */
     }
   } else
     if(out_ptr != limit_ptr)          /* Characters waiting for Output ? */
       putc(buffer[out_ptr++],stdout); /* Copy single character from buffer
to screen */
     else if(scr_csts()) break;        /* Query keyboard, terminate if any
key hit */
 }
 printf("\r\nSeatalk Collisions : %5u",collision_ctr);
 printf("\r\nUART Overrun Errors: %5u",overrun_ctr);
}
```

Compiled EXE-Files can be downloaded here as SEAMON1.EXE (using COM1:) or SEAMON2.EXE (using COM2:). They run in any MS-DOS environment. Redirecting the output logs data to a file (example: SEAMON1 > LOGFILE). Pressing any key terminates the program.

## SeaTrack: Route documentation software

The SeaTrack software developed by Philip Beekman for reading editing combining displaying and saving trip routes is able to handle SeaTalk data directly. The author also describes how he solved the problem to handle the parity/command-bit interpetation within VisualBasic.

## SeaSigma: A simple SeaTalk command generator

The file SeaSigma.zip contains a MS-Windows program which allows to generate SeaTalk commands and to send them via COM1: or COM2: to the SeaTalk bus. Since SeaSigma is a contribution of Ales Janhar I cannot give support or take any responsibility for this software.

Return to Top of Page Part 1 Part 2 Part 3