NMEA-Multiplexer
with SeaTalk® and USB Port

Installation- and operators manual

Hardware Version : V 1.0
With galvanic isolation
Software Version : V 1.8

April 2014

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Credits / Warning / Disclaimer

This NMEA multiplexer has been developed as a research project on data communication, computer communication and data conversion on computers used on board boats.

Hard- and Software are still under development and have NOT been fully tested.
Malfunctions of the NMEA multiplexer and of any connected device might be possible at any time.

Do not rely on data from this device for navigation.
Liability cannot be accepted for any damages, personal injuries or malfunctions caused by this device.

SeaTalk® is a proprietary protocol developed by Raymarine®. This protocol is used for communication between Raymarine navigation instruments like the ST40, ST50 and ST60 series as well as the older Autohelm devices.

There are no SeaTalk® technical specifications available from the manufacturer. I have used the technical Reference of the SeaTalk® protocol, compiled by Thomas Knauf GmbH.
See http://www.thomas-knauf.de/seatalk.htm
Thank you to Thomas Knauf for his work.

DO NOT USE AS PRIMARY SOURCE FOR NAVIGATION

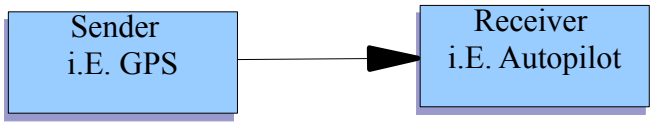
An operating GSM mobile phone should not be placed within 2m of an unshielded NMEA Multiplexer because of interference from the phone's radio transmissions. If a phone is brought closer than this 2m distance, the device may stop operating or data may become corrupted.
(Thank's John Blaiklock for testing on his boat.)

Overview

The gadgetPool NMEA & SeaTalk® Multiplexer is a NMEA multiplexer with additional SeaTalk®- and USB interface. This NMEA multiplexer allows you to connect several NMEA devices, one SeaTalk® network and a board computer.

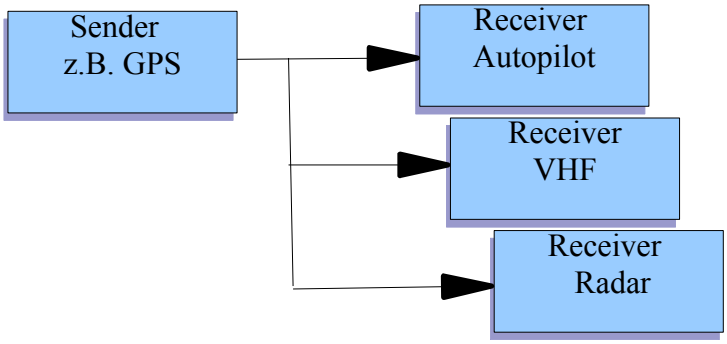
NMEA devices can send data (sender) or they can receive data from other devices (receiver).

Example:

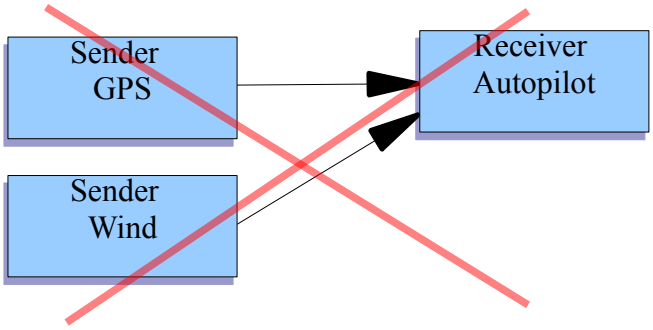


According to NMEA standards, a sender can send it's data to up to 4 receivers.

Example:



For a receiver it is **not** possible to receive data from more than one sender at a time. A NMEA receiver can receive data only from one source. So, as an example, the NMEA input port of an autopilot can not receive data from a GPS and from a NMEA wind instrument at the same time.



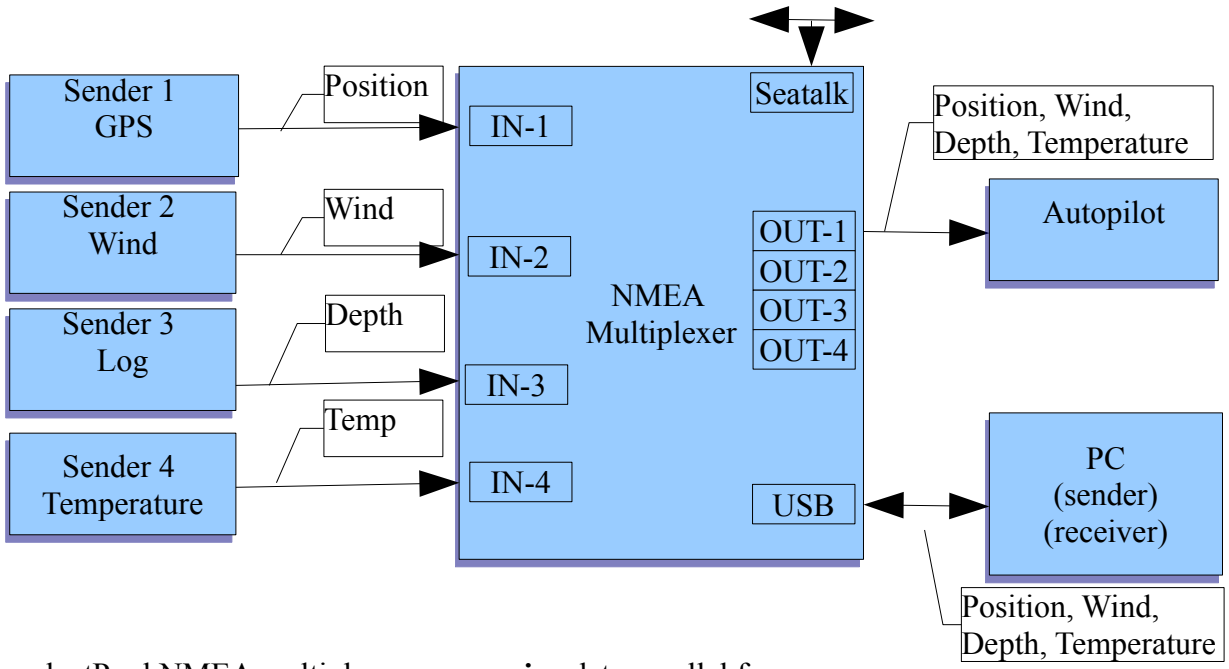
Apart from hardware problems, this senders would just send their data without waiting for each other. So the receiver would “hear” a mix-up of different messages.

To be able to feed a NMEA receiver with data from more than one NMEA sender, a NMEA multiplexer has to be used.

This NMEA multiplexer receives data from several devices parallel on separate input ports. It stores and sorts this data and sends them out to a NMEA receiver in an orderly fashion.

4 senders send their data parallel without any order

The Multiplexer receives and sorts these data and sends them out one after the other.



This gadgetPool NMEA multiplexer can **receive** data parallel from :

- **Up to 4** NMEA devices (e.g. GPS, Log, Wind, AIS, Depth …. etc.)
- **1** USB device (e.g. board PC)
- **1** SeaTalk® Network.

It stores, sorts, orders, filters this data and **sends** them to :

- 1 USB device (e.g. Board PC)
- Up to 4 NMEA devices

With the USB port, a navigation software on the board computer can receive data from up to 4 NMEA devices and from SeaTalk® devices.

Incoming NMEA- and SeaTalk® messages will be received parallel. Incoming messages are buffered until the message is received completely. Only once a message has been received completely, it will be sent out to the USB port and to the NMEA-OUT ports again as a complete messages.

With this function, a mix-up of messages from different sources can be avoided.

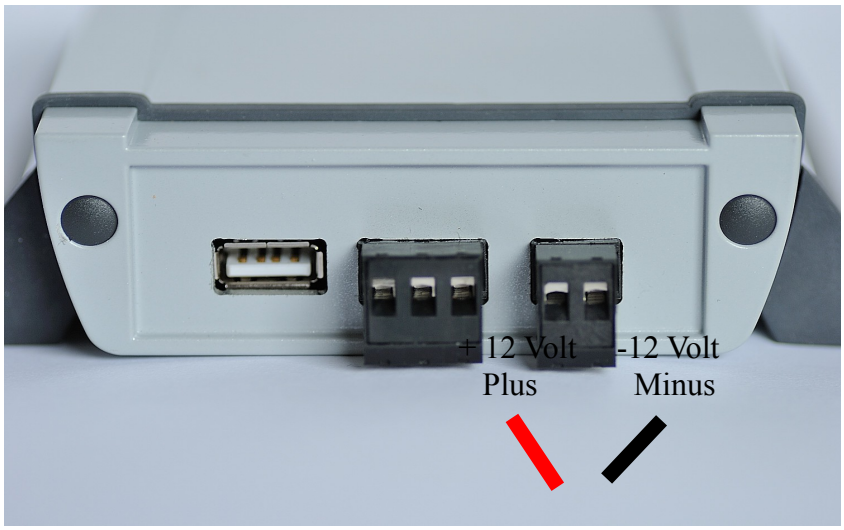
Where to place the device....

The multiplexer must be mounted on a dry and cool place below deck. It should be fixed securely. Also the cables should be fixed securely. Shifting in rough sea or vibrations could loose cable connections and could cause malfunctions or short circuits.

Power supply

This NMEA multiplexer can work on 12 Volt or on 24 Volt.

Connection to the boat supply must be fused. Never connect the device to a battery or generator without a fuse. In case of a defect or a short circuit this device or it's cables could catch fire. The NMEA multiplexer draws approx.100 mA – so a 500mA fuse should be sufficient.



All NMEA-input ports, and also the SeaTalk® port, are electrically isolated. (galvanic isolation) Therefore the power supply terminals must be connected to 12 Volt (24 Volt). The Multiplexer can not operate alone on SeaTalk® or USB supply.

If galvanic isolation is not needed, it is possible to take the operating power from the SeaTalk® bus. In order to use the SeaTalk® as power supply for the multiplexer, you need to use two jumper cables. One goes from SeaTalk® + to +12 Volt (Plus), the other goes from SeaTalk® – to -12 Volt (Minus).

!!! If SeaTalk® power is used to operate the device, there will be no galvanic isolation between PC, NMEA-In Ports or the SeaTalk® port. !!!

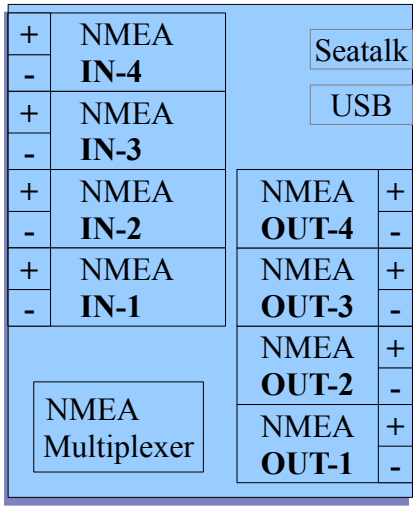
It is not possible to power the multiplexer from the USB port.

Overview NMEA In- und Out-Ports

The NMEA multiplexer has

4 * NMEA-In Ports.

4 * NMEA-Out Ports.

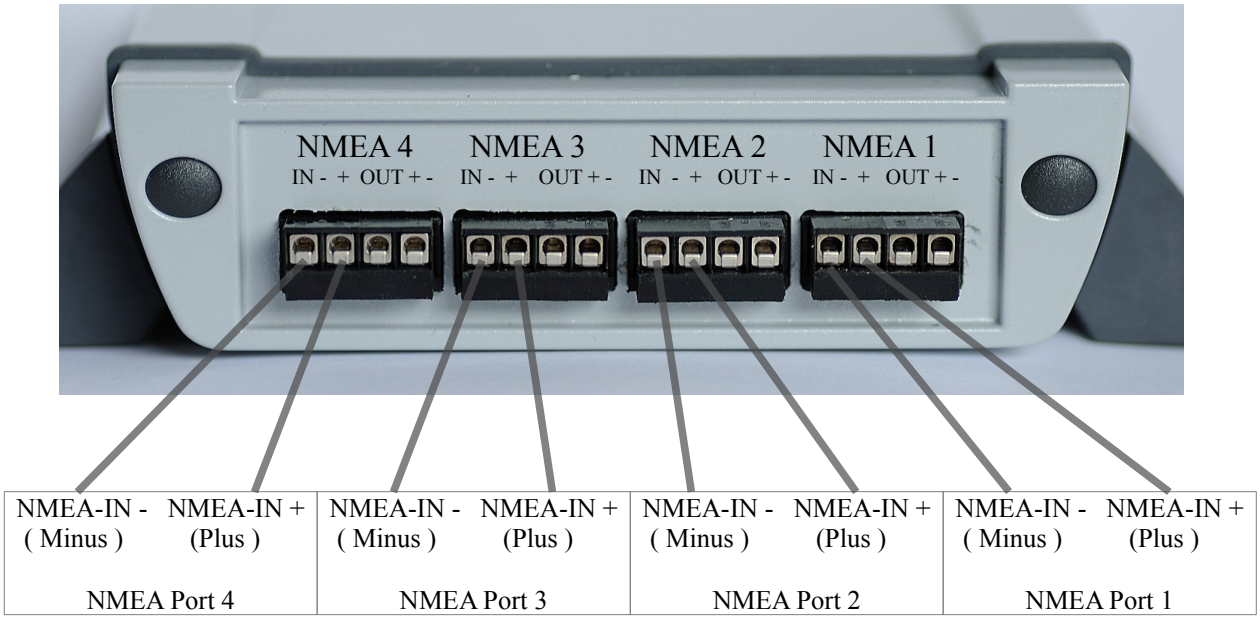


NMEA-IN Ports (IN 1..4)

The Multiplexer has 4 galvanic isolated **NMEA-IN ports.**

NMEA-IN Terminals

The 4 MNEA-IN terminals.



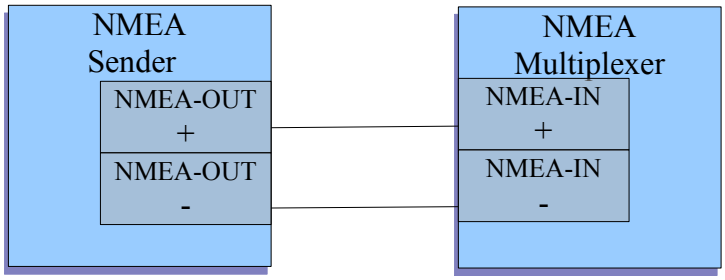
Some devices sending NMEA data, do not have a “real NMEA” port. They have a RS232 port, which is a very common serial interface used with computers. Especially hand held GPS often have this RS232 interface.

The Multiplexer IN-Ports can receive data from “real” NMEA devices, but they can also be used to connect RS232 devices.

Example for connection of NMEA or RS232 devices.

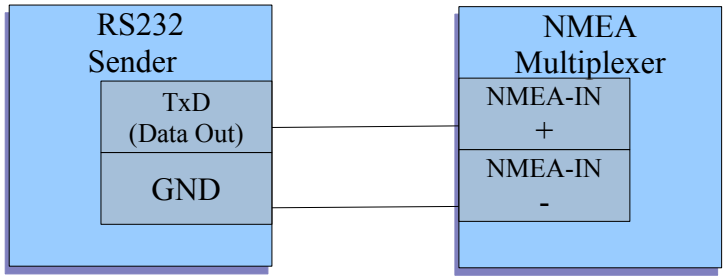
Connecting a NMEA sender to the multiplexer.

Example: NMEA Wind instrument sends data to the Multiplexer.



Connecting a RS232 sender to the multiplexer

Example: Garmin hand GPS sends data to the multiplexer.



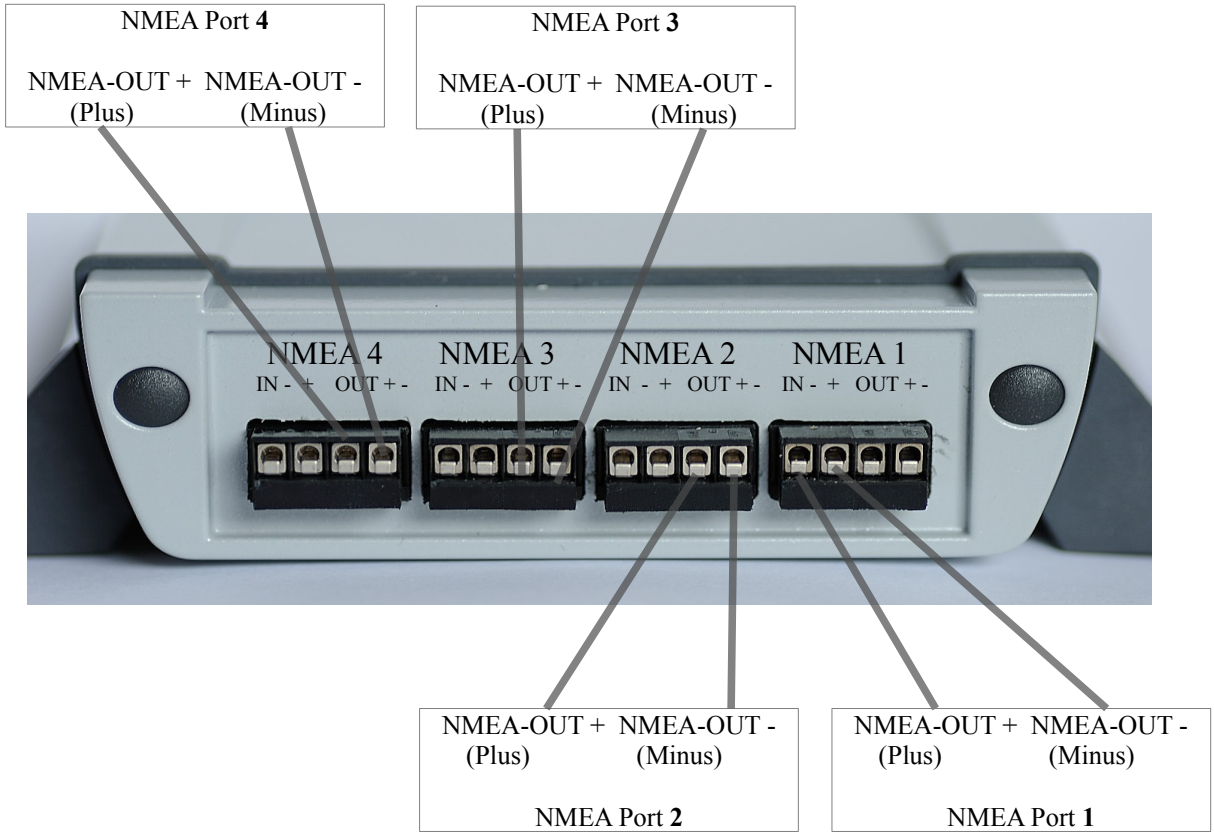
NMEA-OUT ports (Out1..4)

The NMEA multiplexer has **4** seperate **NMEA-OUT ports**.

With this four out ports, four different nautical devices can get exactly the type of data they need. (E.g. Autopilot and GMDSS radio).

Different Out-Ports can have different filter settings, so that the NMEA devices attached only have to deal with data they can work with.

NMEA-OUT terminals

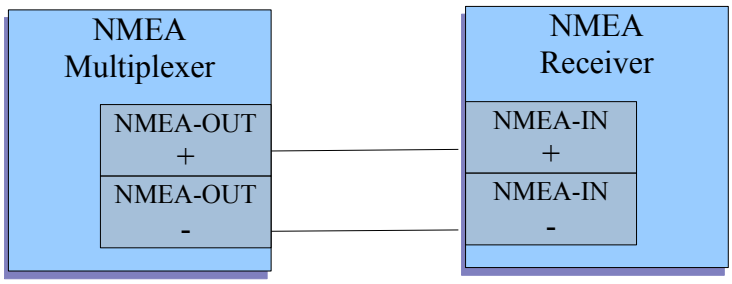


The multiplexer NMEA-OUT ports can be connected to NMEA receivers or to RS232 receivers. Even though NMEA ports have different electrical characteristics than RS232 ports, most RS232 receivers can operate on signals from a NMEA port.

Example for connection of NMEA or RS232 receivers.

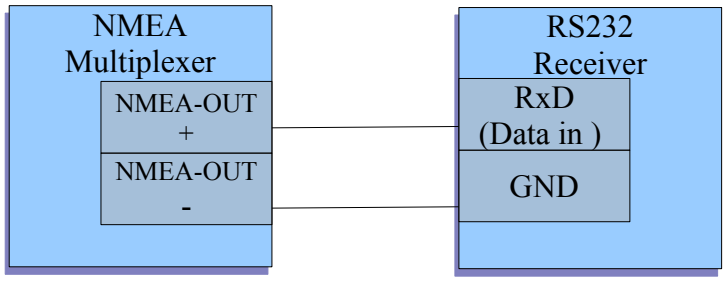
Connecting the multiplexers to a NMEA receiver.

Example: Multiplexer sends Data to a GMDSS radio that has NMEA ports.



Connecting the Multiplexer to a RS232 receiver.

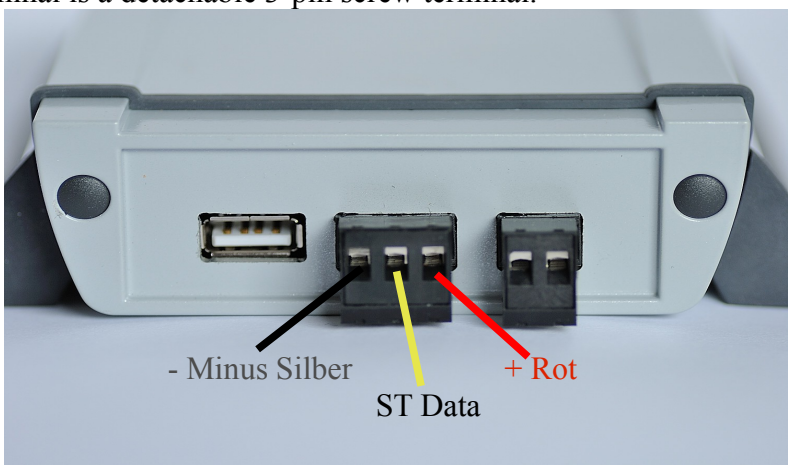
Example: Multiplexer sends Data to a Garmin hand GPS which has RS232 ports.



SeaTalk® Bus

The multiplexer has a galvanic isolated **SeaTalk® Bus port**.

SeaTalk® is a proprietary protocol developed by Raymarine®. This protocol is used for communication between Raymarine navigation instruments like the ST40, ST50 and ST60 series as well as the older Autohelm devices.
The SeaTalk® Terminal is a detachable 3-pin screw terminal.



Description	Color	Function
+	RED	+ 12 Volt SeaTalk® Bus
ST	YELLOW	SeaTalk® Data
-	SILVER	- SeaTalk® Bus

Please make sure, that the cables are connected as shown in the picture. A wrong connection might damage the device or other devices on the SeaTalk® bus and it will interrupt data communication between any device on the SeaTalk® network.

SeaTalk® to NMEA translation

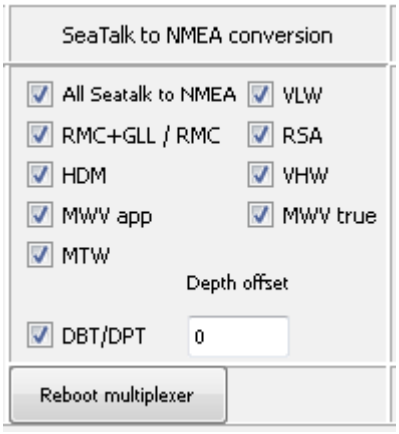
The multiplexer will translate data from SeaTalk® devices into NMEA sentences and sends this generated NMEA sentences to it's NMEA-OUT ports. With this generated NMEA sentences, the information from SeaTalk® devices are now available and can be used by other NMEA devices and – via USB Port – they are available on a board computer.
Currently this NMEA sentences will be created from SeaTalk® data :

$IIDBT	Depth below transducer Optional a $IIDPT sentence is also available.
$IIVHW	Speed through water
$IIMTW	Water temperature
$IIVLW	Total milage, trip milage
$IIMWV	Wind speed and wind direction (apparent / true)
$IIHDM	Compass course
$IIRMC	Speed over ground, course over ground, Lat, Long , Time, Date Optional an additional $IIGLL sentence can be produced.
$IIRSA	Rudder

Each of this NMEA sentences can be switch on or off.

You can switch on/off each sentence with the configuration software.

- Ticked – Sentence will be created on data available from SeaTalk®
- Empty – Sentence will NOT be created, even if data is available on the SeaTalk® network.



Any change in the configuration settings is saved immediately – but the changes will only become active after the multiplexer is switched off and on again. Instead of switching it off/on you can also reboot it with the button “Multiplexer reboot”

RMC+GLL / RMC :
If RMC+GLL is switched on, the multiplexer will create and send a RMC sentence and a GLL sentence when it receives position data from seatalk.
If RMC+GLL is switched off, the multiplexer will create and send only a RMC sentence when it receives position data from seatalk.

MWV true:
SeaTalk sends only apparent wind information. When “MWV true” is switched on, the multiplexer will calculate true wind direction and true wind speed from apparent wind data and from speed through water data.

Depth offset:
If depth offset is “0”, the multiplexer will create and send a DBT Nmea sentence.
If depth offset is not “0”, the multiplexer will create and send a DPT Nmea sentence
Depth offset can go from -32000 mm to 32000 mm. (mm = 1000th of a meter)
Positive value = distance from transducer to water line.
Negative values = distance from transducer to keel.

NMEA to SeaTalk® translation

The multiplexer will translate data from NMEA devices into SeaTalk® sentences and sends this generated SeaTalk® sentences to the SeaTalk® bus. With this generated SeaTalk® sentences, the information from NMEA devices are now available and can be used by SeaTalk® devices.
Currently this SeaTalk® sentences will be created from NMEA data :

Depth below transducer	– From NNMEA DBT / DPT sentence
Apparent Wind Angle	– From NNMEA MWV / VWR sentence
Apparent Wind Speed	– From NNMEA MWV / VWR sentence
Trip Milage	– From NMEA VLW sentence
Total Milage	– From NMEA VLW sentence
Water temperature	– From NMEA MTW sentence
GPS Position	– From NMEA RMC / GLL sentence
Speed over ground	– From NMEA RMC / VTG sentence
Speed through water	– From NMEA VHW sentence
Course over ground	– From NMEA RMC / VTG sentence
Navigation to Waypoint	– From NMEA RMB / APB / BWC sentence
Waypoint name	– From NMEA RMB / APB / BWC sentence
Waypoint Arrival Info	– From NMEA RMB / APB sentence
Compass heading	– From NMEA HDG / HDM sentence
Time / Date	– From NMEA RMC / ZDA sentence

Special Functions

SOG->STW :

If SOG->STW is switched on, the multiplexer will send speed-over-ground data (i.e. received from a GPS) as speed-over-ground **and** as speed-through-water data to the SeaTalk® bus.
With this special function, SeaTalk® devices will “see” speed-through-water even if only speed-over-ground information is available.

If COG->CMAG is switched on, the multiplexer will send true heading data (i.e. received from a GPS) as true heading **and** as compass course data to the SeaTalk® bus.
With this special function, SeaTalk® devices will “see” compass data even if only true heading information is available.

Same type of data from the SeaTalk® network and from NMEA devices.

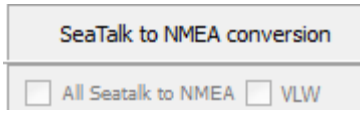
Information available from like instruments on both Busses (SeaTalk® & NMEA) are not converted.

Example:
We have a depth sounder on the SeaTalk® network and another depth sounder on the NMEA bus.

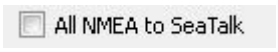
So, on both sides depth information is available.

In this case no depth information in transferred from one bus to the other.
(If depth information is not updated within 30 sec. on one bus, sending to the other bus is activated again.)

This function can be switched off, if you would like to send new data to the NMEA port, regardless if this type of data is already available on the NMEA bus.



Send SeaTalk® to NMEA bus even if already available on NMEA bus.



Send NMEA data to SeaTalk® even if already available on SeaTalk® bus.

USB PC Port

The NMEA multiplexer has one USB port. It can be used to connect it to a computer or notebook.

After connection the multiplexer, a new serial port will be available on your computer (See below – Com Port assignment)

With this serial port, the computer can act as a NMEA sender and as a NMEA receiver. It can receive data from the devices attached to the multiplexer, and it can send data to this devices.

In every navigation software, an option can be found to select the serial port to be used.

USB Driver installation

Depending on the operating system of the computer, it might be necessary to install a driver software. The multiplexer is using a standard FTDI USB Serial Converter Chip.

Drivers for this chip can be found on the CD and on the FTDI webpages. (http://www.ftdichip.com/FTDrivers.htm)

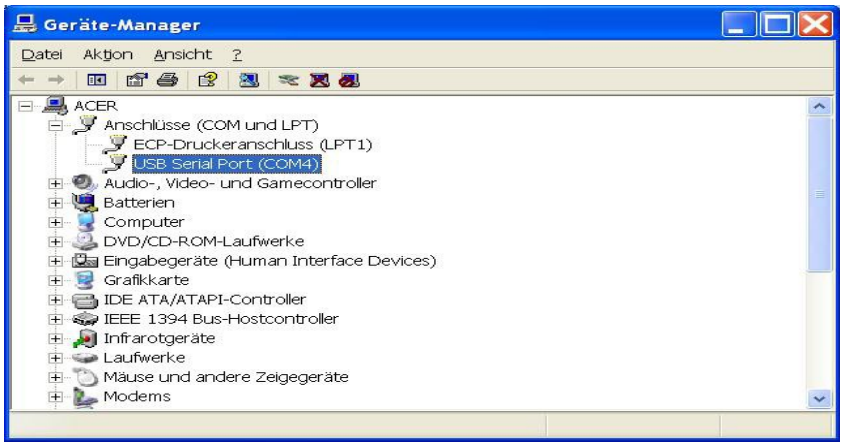
A reasonable modern LINUX system does not need a special driver installation. The FTDI chip will be recognized and the system will provide a new serial port. Usually this is /dev/ttyUSB**0**. If there is already another USB-Serial converter attached to your system, the new multiplexer port will be /dev/ttyUSB**1** or /dev/ttyUSB**2** etc. .

On a MS-Windows system, it might be necessary to install the driver software. If there is already some other devices using FTDI chips, this driver will be available already. Otherwise the driver needs to be installed. You'll find the driver software on the CD in the subdirectory /DRIVERS.

Com Port assignment

MS-Windows assign a COM port automatically. In order to find out which port has been assigned, please check the MS-Windows device manager. In the device manager you'll find “Ports – COM & LPT “.

In this example, windows has put the NMEA multiplexer on COM4



Filters

Every NMEA device sends a lot of different data.

The more NMEA devices are in our network, the more data has to be transferred. Sometimes two different NMEA devices send the same information. Since the capacity of a NMEA network is limited, it can happen, that the NMEA interface will be overloaded with data. The board computer and all attached devices have to deal with a large amount of – partly unnecessary or redundant – data.

The NMEA multiplexer offers adjustable data filters. With this filters the user can adjust which data will be sent to which NMEA port. This helps to remove unnecessary or redundant information.

With the 2 separate NMEA-OUT ports, different NMEA receivers can be supplied with exactly that kind of data they need. Unnecessary information can be removed or limited.

Example : A wind instrument can show not only apparent wind but also true wind direction and speed, if it knows how fast the boat goes. So if it is feed with speed information, it can give us more detailed information.

But - this wind instrument does not need to know things like waypoint names, water temperature or maybe engine oil pressure. This unnecessary information might slow down the data flow of important information, it can lead to slower operation of the instrument or might even cause loss of data. With the filters, the stream of data can be adjusted, so that our wind instrument only receives what it needs, and all the other data can be filtered out.

Or maybe – you have a modern high speed 10 Hertz GPS device and a depth sounder in your network. This fast GPS will certainly help the autopilot to steer better – but a GMDSS VHF does not need an position update 10 times per second.

With the filters you can adjust the data, so that the autopilot gets the fast 10 Hertz update but no depth information, and the other devices only get every 10th position information and the depth information.

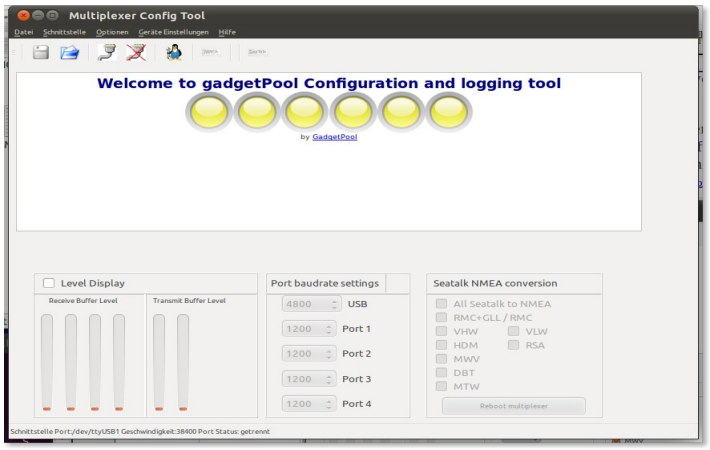
PC Software

In normal operation the NMEA multiplexer does not need a connection to a computer. It will work “stand alone” and the computer can do other jobs – or it just can be switch off.

The connection to the computer is used to make settings or adjustments to the multiplexer or to monitor or record data. Of course, the computer also can be used in connection with the multiplexer to run some navigation software, which receives it's data from the multiplexer.

Installation

For configuration settings of the multiplexer, you'll find a configuration software on the CD



Pic 1: Start screen

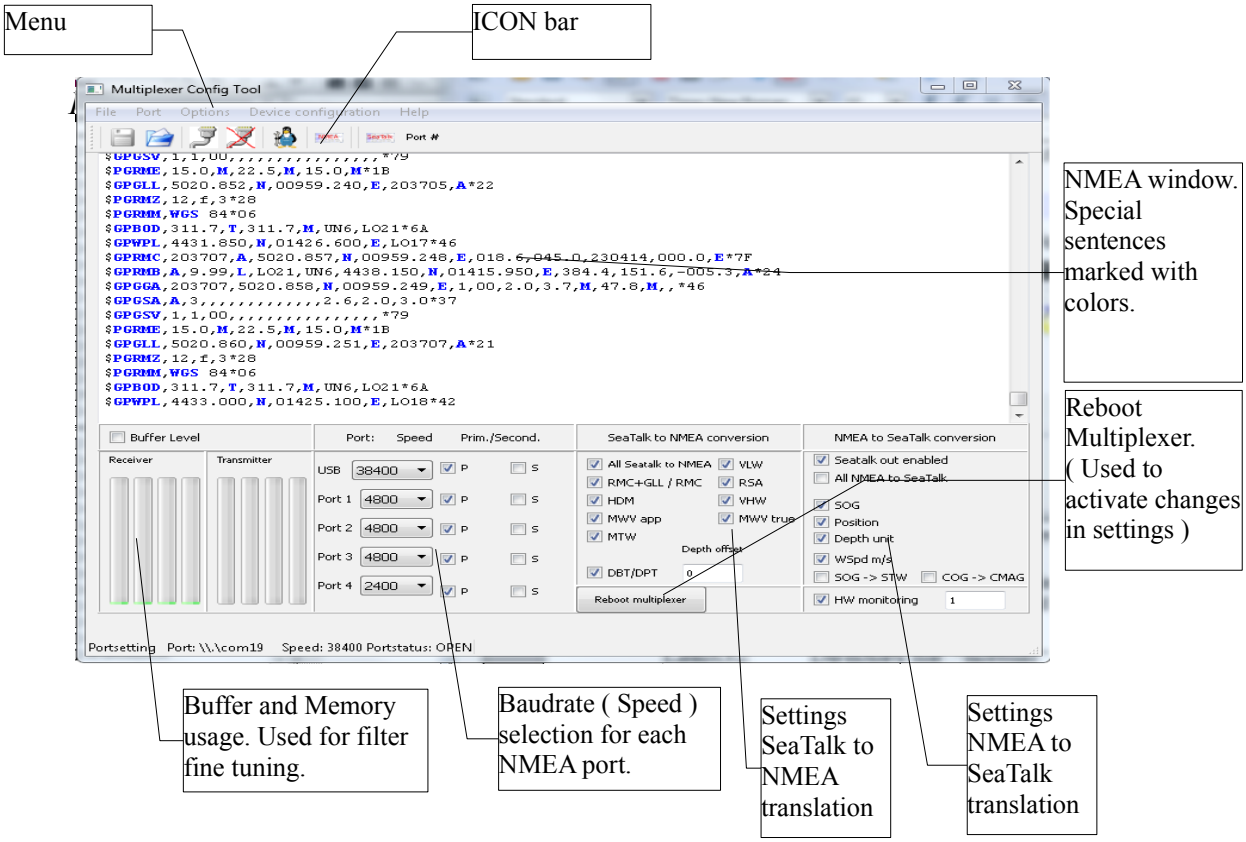
The configuration software needs no installation procedure. It simply should be copied from the CD to the computer. On the CD you'll find subdirectories for different operating systems, which contain all the files needed.

Linux32	Directory for “normal” Linux PC's like Ubuntu etc.
Linux64	Directory for Linux PC's with a 64 Bit Processor like e.g. Ubuntu.
Windows32	Directory for “normal” MS-Windows PC's with Windows XP,Windows 7
Windows64	Directory for MS-Windows 7 PC's with 64 Bit Processor

Just create a subdirectory on the hard disk of you computer, where you would like the configuration software to be stored. Copy all files form the appropriate CD - Subdirectory into this newly created hard disk directory. Here you can start the configuration software by double clicking on the program file stConfig (or. stConfig.exe under MS-Windows).

Connect the NMEA multiplexer to the USB port of your computer and start the configuration software.

Configuration software - Main Screen



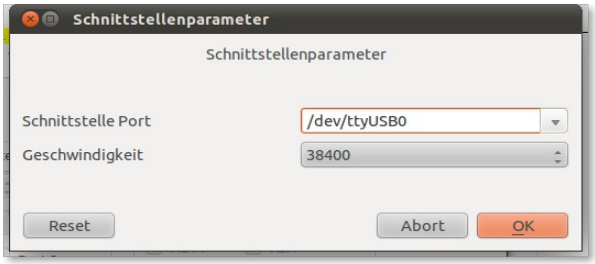
Computer ↔ Multiplexer communication settings

Before the configuration software can talk to the NMEA multiplexer, the software has to know where it can find the multiplexer. So we have to select the communication port, the operating system has chosen for the multiplexer.

Under Linux it will be /dev/ttyUSB0 or /dev/ttyUSB1.
Under MS-Windows it will be COM1: or COM2: or COM3 [1].

In the “Menu”, open

Port → Parameters



Pic 3: COM Port Parameters

Here you choose the com port assigned by the operating system. If the port is not in the list, please just type it in. After that you should choose the communication speed (baud rate) and press OK.

The NMEA multiplexer default speed is set to 38400 baud. So if you have not changed it previously – select 38400 here.

The selected settings can be saved for later use.
If you don't want to select the port and baud rate at each program start, just save them and they will be loaded automatically on program start.

In the “Menu”, choose
Port → save settings.
The next time the configuration software is started, this settings will loaded automatically.

Connecting / disconnecting

After choosing the port and baud rate, the configuration software can connect to the multiplexer.

In the “Menu”, open
Port → *connect*, or just click at the icon

The program will now read the current configuration settings from the multiplexer. It will show the currents baud rate settings for each NMEA port, the SeaTalk®->NMEA settings etc.
As soon as the multiplexer receives any NMEA or SeaTalk® Data, they will be displayed in the NMEA windows.

1 If you don't know which port has been assigned. please check the Windows system manager

Disconnecting

In the “Menu”, choose
Port → *disconnect*, or just click on the icon

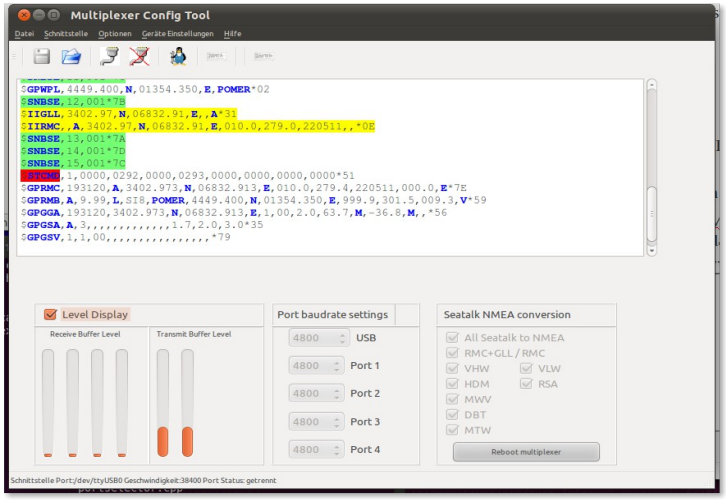
The ICON-bar

With the icon-bar, you can start functions or actions with just one click.

Icon	Funktion
	In the “Menue”, choose . Previously selected port and baudrate will be used. Multiplexer settings will be read and displayed.
	Disconnect computer from the multiplexer.
	Filter settings. This opens a new windows for filter settings.
	NMEA Data logging. All incoming NMEA or SeaTalk® data will be saved in a file „nmealog.txt“. New data will be appended to this file. The log file might become very large if this function is enabled for a long time.
	SeaTalk® Data Protocoll. All incomming SeaTalk® data will be shown as a special „$STALK“ sentence. This function should be used for configuration, network checking or tests mainly. It causes additional load on the NMEA port.

You will also find all this functions in the main menu.

NMEA logging window



Pic 4: NMEA window

In this NMEA window, all incoming NMEA data are shown. Different types of data are shown in different colors.

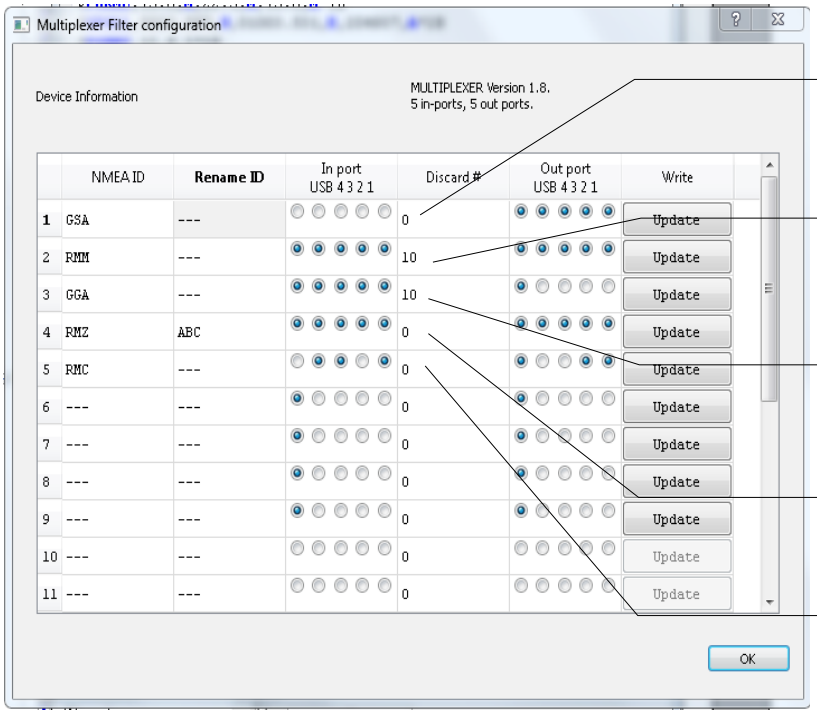
Yellow	NMEA sentences, produced by the multiplexer itself on incoming SeaTalk® data.
Red	Configuration and control data. These are special sentences, the configuration software sends to change multiplexer settings.
Green	Configuration and control data for SeaTalk® to NMEA translation. These are special sentences, the configuration software sends to change multiplexer settings.
White	Incoming NMEA data from attached NMEA devices.

Filter settings

Filter settings is activated by clicking the icon

The program will read and display current filter settings.

Some examples for filter settings



„GSA“ sentence is NOT accepted from any In-Port. Any GSA sentence will just be dropped
(All In-Port's OFF)

When receiving „RMM“ sentence from port 1,2,3 or 4 : send only every 11 th sentence to Out-Port 1 and 2
(Discard# 10)

Every 10 th „GGA“ sentence will be forwarded to the USB Port.
It will not be sent to NMEA out ports
(Discard = 10, All Out-Port's off)

Every „RMZ“ sentence will be rewritten to a „ABC“ sentence

Accept „RMC“ only from NMEA In-Port 1,3,4. Not from USB port.
It will be forwarded to USB and NMEA-OUT Port 1 and Port 2

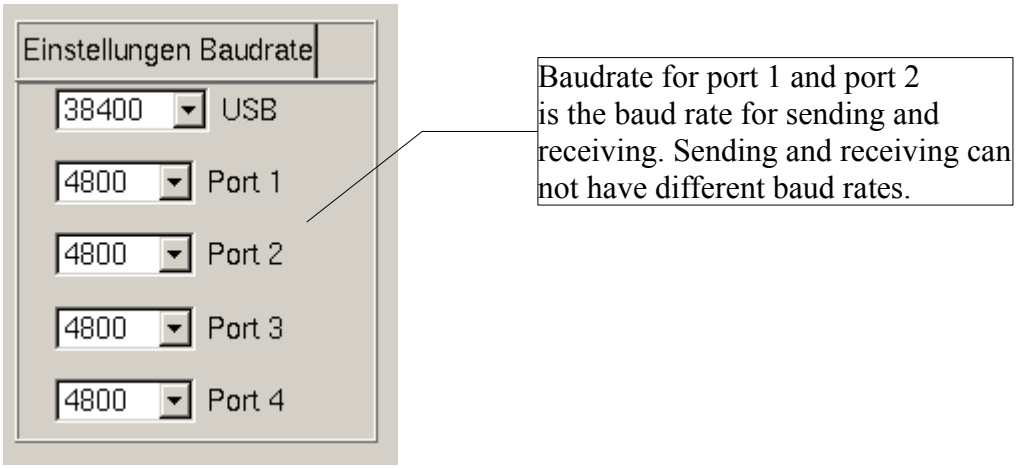
Column	Function
NMEA-ID	Defines for which NMEA sentence ID the rest of the setting in this line are done. I.e. „RMC“ → This filter is valid for sentences „$GPRMC“, „$IIRMC“ ...
Rename-ID	The new ID, that the sentence will get. Example line 4 : A sentence „$GPRMZ“ will be sent out as „$GPABC“
IN port	Defines from which IN-Port this sentence will be accepted. This can filter out unwanted sentences. Example line 1 : Any GSA sentence will be dropped. All In-Ports are deactivated Example line 5 : A RMC sentence will only be processed, when it comes in from port 1,3 or 4. RMC sentences from port 2 or from USB port are ignored and will be dropped.
Discard #	Some devices send data too often. (Up to 10 times a second) . With this function, the data update rate can be reduced. Example line 2 : Only every 11th „RMM“ sentence will be forwarded to the out-ports Example: 1 → One sentence is dropped, every second sentence will be forwarded. 2 → Two sentences are dropped, every third sentence will be forwarded.
Out port	Defines to which out-port the sentence will be forwarded. (Data will additionally always be sent to the USB port) Example line 3: GGA sentences will sent to USB port only. They will not be sent to NMEA out 1 or NMEA out 2.
Update	This button is active whenever a filter line was changed. By pressing this button, this changes will be updated on the multiplexer

All sentences, to which no filter condition applies, will be sent to NMEA out 1..4 and to the USB port. If filter settings is empty, every incoming NMEA sentence will be forwarded to all out ports.

NMEA Port baud rates

The baud rates (communication speed) for all 4 NMEA in ports and the 2 NMEA out ports can be configured. This allows you to adjust the NMEA ports to different NMEA devices attached.

NMEA devices usually send and receive with 4800 Baud.
AIS devices or fast GPS usually send and receive with 38400 Baud.



For every NMEA port and for the USB-PC port, the baud rate can be selected between 1200 and 38400 Baud.

All Ports are NMEA receivers and NMEA senders at the same time. The selected baud rate for any port is the sending and the receiving speed.

Baud rate changes are stored on the multiplexer immediately. They will be effective after the next start of the multiplexer. This is the next time the multiplexer is switch on.

Instead of switching it off/on you can also reboot it with the button “Multiplexer reboot”

Warning :

Whenever the baud rate of the USB port is changed, it is necessary to also set the baud rate of the computer (configuration software) to the same value.

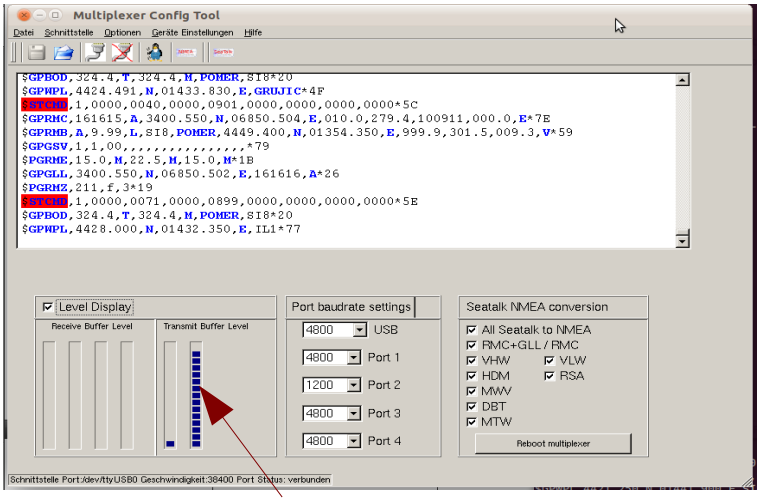
Buffer memory

If one device sends data faster as they can be received by the other devices, data will be lost.

The multiplexer offers a function to check the settings and to see if data are received faster as they can be sent out again.

NMEA Data received by the multiplexer are temporarily stored in it's internal memory. After that, they are processed and sent out to the different out ports.

The “fill level” of this internal memory can be monitored. This function should only be switched on to check the filters and baud rates, as it causes additional load on the USB port.



In the example above, you can see that buffer memory for out-port 2 is nearly used up.
Here we received data from port 1 with 4800 baud.
This data will be sent to a device attached to out-port 2 - which is configured to 1200 baud only.

That means, that data can be sent out only with half the speed as they are received.

New data come in faster as they can be sent out again. This causes the buffer memory to fill up slowly, and after some time, this would result in a loss of data.

What can be done ?
- For all ports that sent out data (USB, Port 1..4), the baud rate should be equal or faster than the fastest receive port baud rate.

- If this is not possible, is is necessary to configure filters, so that only really necessary data are forwarded to the slow out port.

Software update

The software of the multiplexers is constantly extended and improved.
You can find new software versions on our website.
(http://www.gadgetpool.de)

Every update consists of two files. One file containing the actual software, and one file containing configuration preset data.

The file with the ending .hex contains the new multiplexer software.
This file must be loaded with every software update.

The file with the ending .eep contains configuration preset data.
This can be loaded optionally, to restore the device's settings and configurations to factory default values.

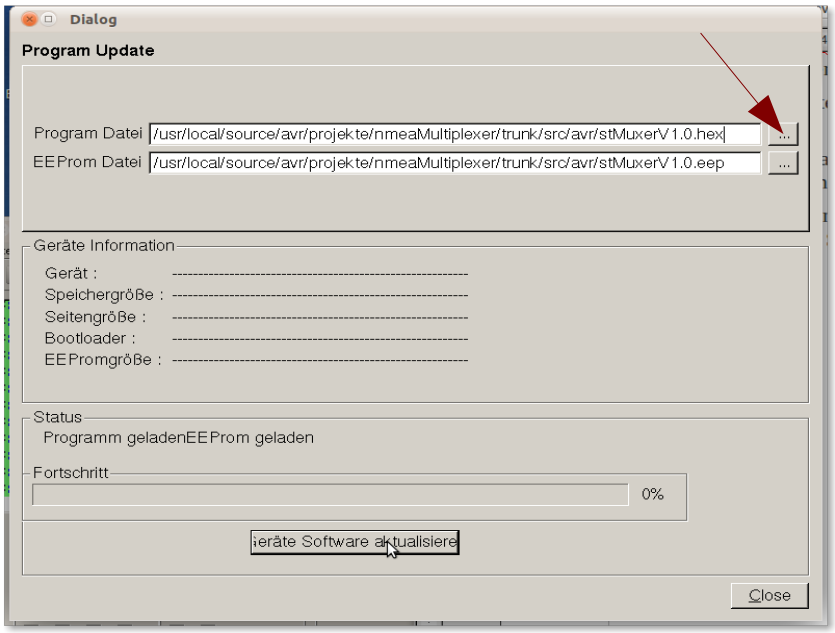
If the .eep file is not used during a software update, all the old configurations and settings remain as they are.

Please read any manuals, texts or descriptions that might come with a new software version.

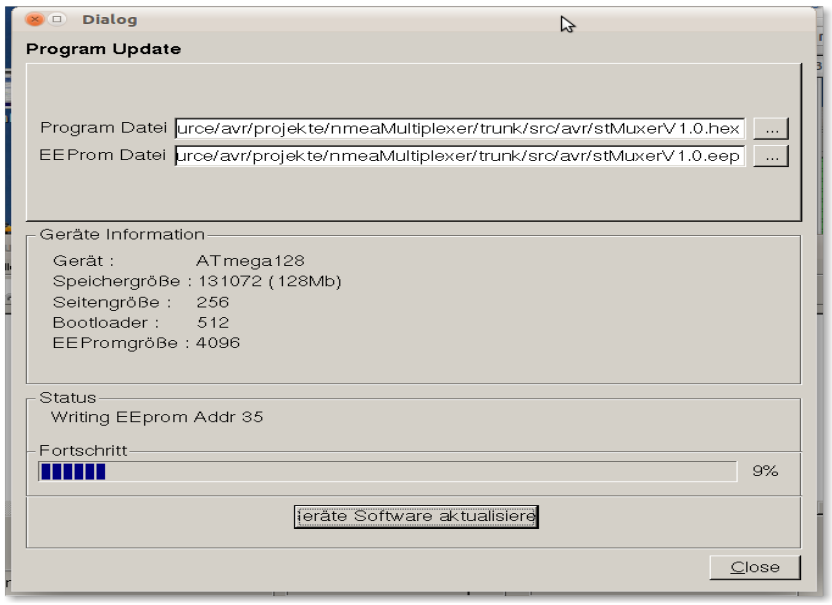
If you'd like to update your multiplexer to a new software version, please get the latest software release from the gadgetPool website. Save the two files (xxx.eep xxx.hex) on your computer harddisk.

You find the software update function in the configuration program.
Menue → Device configuration → *Softwareupdate*.

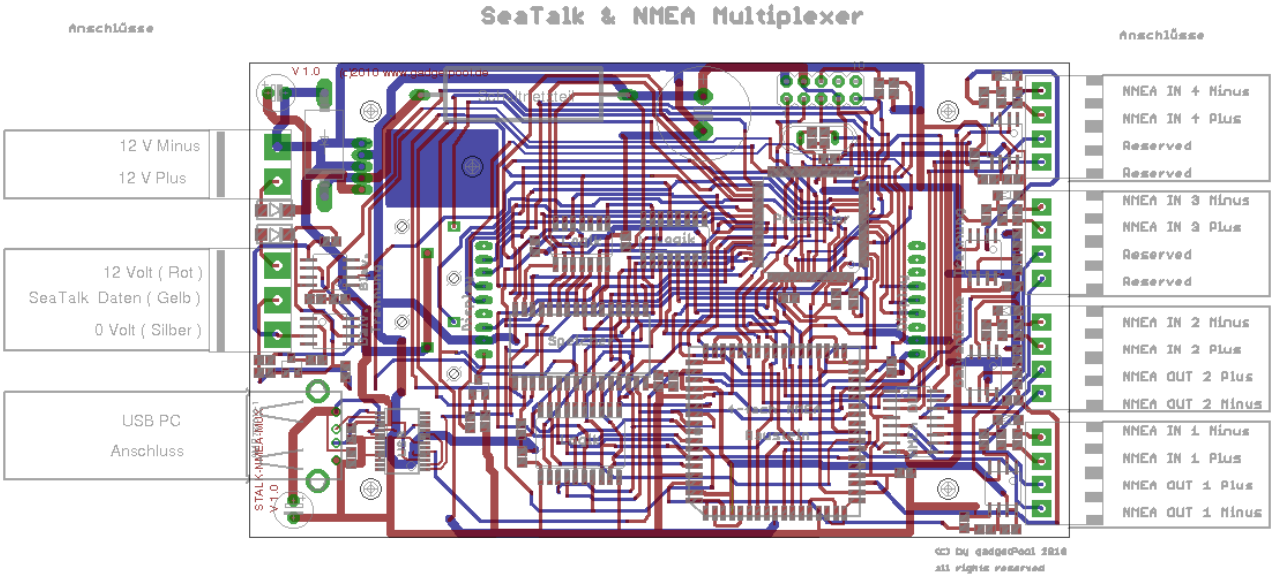
Select the two previously saved files with the ... Button and press “Update Software”.



During update process, the multiplexer MUST NOT BE SWITCHED OFF.



Terminals



Terminals	**Terminals**
12 Volt (24 Volt) Power supply from boat.	NMEA IN 4 NMEA OUT 4
SeaTalk Bus	NMEA IN 3 NMEA OUT 3
PC USB port	NMEA IN 2 NMEA OUT 2
	NMEA IN 1 NMEA OUT 1

Technical data

Power supply :	10-30 Volt DC.
Current consumption :	typical 60 mA (max 100 mA)
In-Ports :	4 * NMEA-0183 (RS-422) (galvanic isolated)
Out-Ports :	4 * NMEA-0183 (RS-422) (not isolated)
Bus-Interface :	1 * SeaTalk input (galvanic isolated)
PC-Interface :	1 * USB virtual serial port. (not isolated) NMEA in and NMEA out.

Dimensions

Length	15,5 cm (with terminals)
Width	13,0 cm
Height	4,0 cm