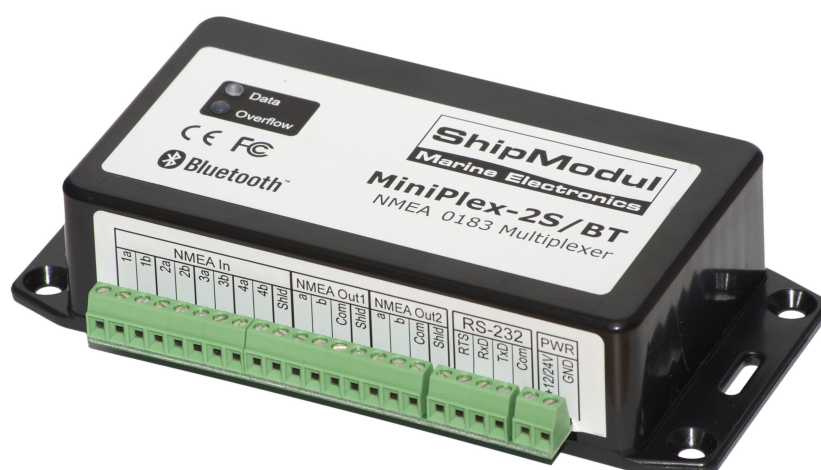


ShipModul

Marine Electronics

MiniPlex-2S/BT NMEA 0183 multiplexer Manual



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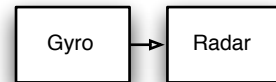
Introduction

The MiniPlex-2S/BT is an NMEA multiplexer that enables the connection of multiple NMEA 0183 instruments to each other and a computer. It is developed to solve a fundamental problem with the NMEA 0183 standard.

The NMEA 0183 standard defines a communication protocol that enables navigation instruments to exchange data with each other. A compass can send a bearing to a radar to enable a north-up display, a GPS can send cross-track information to an autopilot in order to steer a programmed course. The same GPS can also send information to the radar at the same time since the NMEA 0183 standard specifies that one device must be able to send data to up to four other devices. NMEA data is made up of short text messages with a strict format called sentences and are human-readable.

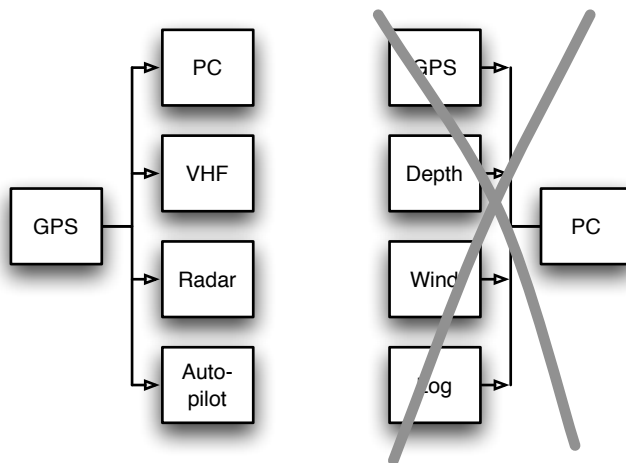
Talkers and Listeners

Communication using the NMEA 0183 protocol involves at least one device that sends NMEA sentences and another device that receives NMEA sentences. By convention, a sending device is called a talker while a receiving device is called a listener. The picture on the right shows such a minimal system: a gyrocompass sending heading sentences to a radar.



The NMEA 0183 standard specifies that a talker should have enough driving capability to talk to four listeners. This is as easy to achieve as telling a story to an audience of up to four people. The only requirement is to talk loud enough.

The picture left below shows such a situation.



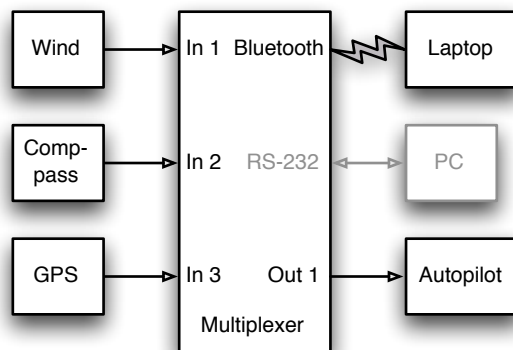
It gets complicated when several talkers must send data to one listener as shown in the picture on the right. Unless that listener has multiple inputs, this is not possible without help. Simply connecting talkers to one listener as shown is like four persons simultaneously telling you a different story. You can make neither head nor tail of it. In electronics terms: the outputs of the talkers will effectively short-circuit each other and the sentences they transmit will be corrupted. This is where a multiplexer offers the solution.

The Multiplexer

A multiplexer, sometimes called 'combiner', has multiple inputs, each acting as a single listener connected to a talker. It can also have several outputs that are able to talk to multiple listeners. A clever piece of software inside the multiplexer reads the NMEA sentences that are received on the listener ports simultaneously and stores them into queues. Another part of the software retrieves the sentences from the queues, one at a time, and sends them to the outputs of the multiplexer. This way, four incoming streams of sentences are combined into one single stream.

The picture below shows a typical setup with a multiplexer combining data from a wind instrument, a compass and a GPS. This data is forwarded to a laptop and an autopilot using two different types of outputs: an NMEA talker port called 'Out1' and a Bluetooth interface. The multiplexer forwards the received NMEA sentences to the laptop and the autopilot at the same time.

The Bluetooth connection to the laptop is actually bi-directional: the laptop acts as a listener and a talker at the same time. It receives NMEA sentences from the instruments to be processed by navigation software on the laptop. This software can generate NMEA sentences to control an autopilot. These sentences are sent to the multiplexer and forwarded to the autopilot. They can be combined with the sentences received from the other navigation instruments.



The picture also shows a computer in light grey that is connected to a RS-232 port on the multiplexer. The MiniPlex-2S/BT also has an RS-232 port with the same function as the Bluetooth interface. This allows you to connect a second (fixed) computer while having the freedom of moving around with your laptop, PDA or Smartphone having access to the same navigation data as the fixed computer.

The MiniPlex-2S/BT

The MiniPlex-2S/BT is a multiplexer with four NMEA inputs (listener-ports), two NMEA outputs (talker-ports) a Bluetooth interface for a wireless connection with a computer and a serial port (RS-232). The multiplexer combines NMEA data that is received on the listener ports **In1** to **In4** and sends this data to talker ports **Out1** and **Out2**, the serial port and the Bluetooth interface. The serial port and the Bluetooth interface are also used to send data to the multiplexer to be forwarded to **Out1**, as well as to send commands to configure the multiplexer.

Every NMEA input of the MiniPlex is galvanically isolated, sometimes called opto-isolation because of the use of opto-couplers for isolation. An opto-coupler is a small device that transports information by means of light instead of electricity.

A galvanically isolated input prevents unwanted currents to flow between instruments and the multiplexer. These currents can damage equipment or interfere with radio signals and should therefore be avoided. Galvanically isolated inputs are required by the NMEA standard.

The serial port of the MiniPlex is also galvanically isolated, which isolates the computer from the navigation network and protects it against potential damage caused by ground loops or voltage spikes.

Both NMEA outputs can drive up to four listeners each. Flexible routing options allow you to specify which NMEA sentences are sent to these outputs.

Besides the basic functionality of combining NMEA data from multiple sources, the MiniPlex offers a range of features to manage NMEA data like Sentence Filtering and Routing, Input Priority with automatic switchover, testing of data integrity, Talker ID modification and SeaTalk® to NMEA translation.

The MiniPlex can seamlessly be integrated into an existing Raymarine SeaTalk network when SeaTalk mode is enabled. This mode changes one NMEA listener port into a SeaTalk input. When connected to a Raymarine SeaTalk network, the multiplexer will translate SeaTalk data into NMEA sentences and combine these with NMEA sentences that are received on the other listener ports. Only one SeaTalk input is needed since the SeaTalk bus is a single-cable system that connects all instruments together through one single cable. SeaTalk to NMEA translation in the MiniPlex works only one-way. No NMEA sentences are converted into SeaTalk, the multiplexer just listens on the SeaTalk bus.

Connections

NMEA Signals

Although the NMEA 0183 standard very clearly specifies the signal names, voltage levels and connection methods, the reality is far from this ideal world.

The most important property of an NMEA port is that the connections or wires are labelled 'A' and 'B' and that it uses a differential signalling scheme. This means that data is transmitted on both wires, but in 'opposite direction'. Both wires are driven between 5V and 0V and opposite of each other. This means when A is 5V, then B is 0V and vice versa. The advantage of this signalling scheme is that it is very insensitive to electrical interference. NMEA 'A' and 'B' are often labelled as NMEA '+' and '-' respectively. When connecting devices, simply connect NMEA 'A' to NMEA 'A' or NMEA '+' and NMEA 'B' to NMEA 'B' or NMEA '-'.

Things get complicated when manufacturers don't follow the NMEA 0183 standard, which is very often the case. Many devices have an NMEA port, which is really an RS-232 port. The only resemblance with the NMEA standard is the format of the data transmitted. Electrically, they are an entirely different world. The used signal names differ wildly and often lead to confusion. When a device has a listener port with connections 'Data In' and 'Data Return' it is not clear whether this input is galvanically isolated or 'Data Return' is simply another name for 'Signal ground'

As opposed to the NMEA standard, many devices use a single-ended signalling scheme where data is transmitted on one signal wire while a power/signal ground presents the return path for data. Single ended devices often have connections named as TX and Gnd (transmit and ground) on the talker port and RX and Gnd (receive and ground) on the listener port. Also used are Data Out, Data In and Signal Ground. Mix these with 'standard' NMEA connections and confusion is imminent!

In general it is safe to connect a single ended talker port to a differential listener port. Connecting a differential talker port to a single ended listener port however is less obvious. When NMEA 'B' of a talker port is connected to the signal ground of a listener port, the 'B' signal is effectively short-circuited to ground. A properly designed talker port can handle this abuse but it will result in fairly high currents in long cables, which in turn leads to severe interference on SSB radios and possibly on VHF radios too. In the worst case, the talker port will be destroyed.

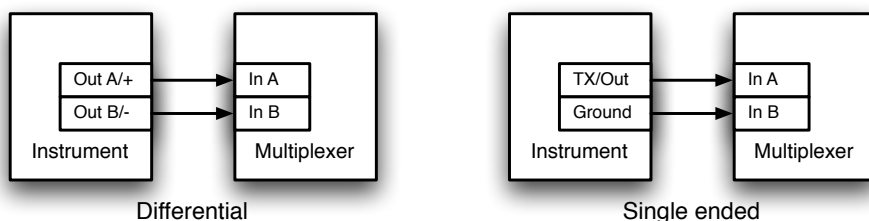
To overcome this problem, the MiniPlex multiplexers provide a Com terminal on each talker port in addition to the 'A' and 'B' terminals. This 'Com' terminal is similar to a signal ground. To connect a talker port of the MiniPlex to a differential NMEA listener port, use the 'A' and 'B' terminals. Use the 'A' and 'Com' terminals to connect to a single-ended or RS-232 listener port.

NMEA Listener Ports/Inputs

The multiplexer has four listener ports, **In 1** to **In 4**. Each listener port should be connected to one instrument only. These inputs are completely floating and galvanically isolated from the multiplexer, as specified in the NMEA 0183 standard.

Connect the **A** and **B** terminals of the listener port on the multiplexer to the **A** and **B** terminals of the talker port on the instrument. These terminals may also be labelled as **Data+** and **Data-**, **TX+** and **TX-**, **Out+** and **Out-** or **ve+** and **ve-**.

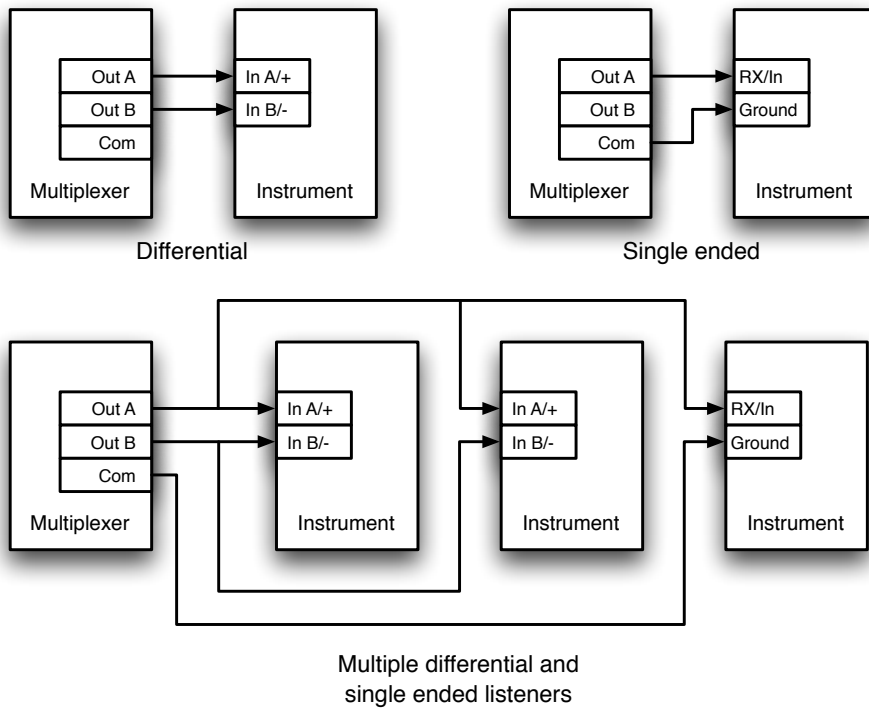
Some instruments have single ended talker ports, with only one data terminal. Connect this terminal to the **A** terminal on the multiplexer, and connect the ground of the instrument to the **B** terminal on the multiplexer. The instrument's data ground is often combined with its power supply ground.



NMEA Talker Ports/Outputs

Both talker ports can be connected to up to four instruments. Connect the **A** and **B** terminals of the talker port on the multiplexer to the **A** and **B** terminals of the listener port(s) on the instrument(s). These terminals may also be labelled as **Data+** and **Data-**, **RX+** and **RX-**, **Out+** and **Out-** or **ve+** and **ve-**.

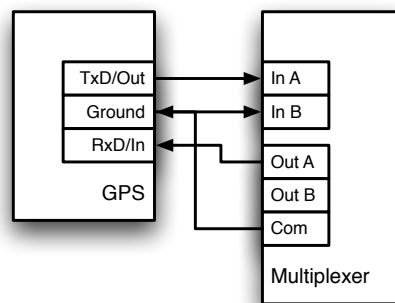
Some instruments have single ended listener ports, with only one data terminal. Connect this terminal to the **A** terminal on the multiplexer, and leave the **B** terminal on the multiplexer unconnected. Connect the ground of the instrument to the **Com** terminal on the multiplexer. The instrument's data ground is often combined with its power supply ground.



The shield terminals on the multiplexer (**Shld**) can be connected to the screen/shield of the cable if available. This should always be done on one end of the cable only, preferably on the end that is connected to a talker port.

Combining Ports

It is sometimes necessary to combine a listener and talker port of the multiplexer to connect to an instrument. One of the most commonly used combinations is the connection of a GPS to the multiplexer. While some GPS receivers have properly designed NMEA ports, many only have an RS-232 port which is single ended with three terminals: TxD (data out), RxD (data in) and Ground. The picture below shows how to connect such a GPS to the multiplexer.



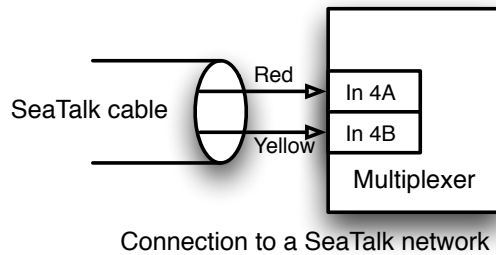
Connecting a GPS with a serial port to the multiplexer

SeaTalk

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.

To be able to use these instruments with commonly available navigation programs or to feed their data into other non-Raymarine instruments, the SeaTalk data needs to be translated into NMEA. Even Raymarine's own navigation software, Raytech Navigator, needs this translation.

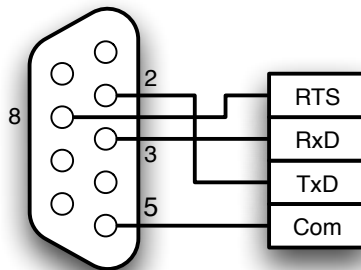
The MiniPlex can be directly connected to a SeaTalk network. It will translate all SeaTalk data required for navigation into NMEA sentences. Input **In 4** can be set to SeaTalk mode (**SeaTalk -> NMEA**) and should be connected as shown below:



Note that the **red** and **yellow** wires are used! The screen of the SeaTalk cable is not connected to the multiplexer.

RS-232 Serial Port

The RS-232 serial port can be used to connect the multiplexer to a computer as shown in the diagram below. The serial port is bi-directional: the multiplexer sends NMEA data to the computer and the computer can also send NMEA data back to the multiplexer. This data can be routed to **NMEA Out 1** and **NMEA Out2**.



The serial port is galvanically isolated from the multiplexer to prevent ground loops and excessive currents that could otherwise destroy the multiplexer or the serial port of the connected computer.

The default speed of the serial port is 38400 Baud. It can however be set to any speed in the range from 4800 to 115200 Baud using the MPX-Config utility.

The serial port and the Bluetooth interface support flow control, the serial port through its RTS connection, the Bluetooth interface virtualizes this signal. Flow control is needed when waypoints and routes are sent from the computer to a GPS through the multiplexer. While normal NMEA sentences are sent at regular intervals, waypoints and routes are sent 'in one go' without any pause between these NMEA sentences. This fills up the queue in the multiplexer almost immediately after which the multiplexer discards the remaining waypoints and routes. The GPS now only receives a few waypoints and partial routes.

Flow control prevents this from happening. When the queue in the multiplexer is almost filled, the multiplexer signals the computer to stop sending data. When the queue is sufficiently emptied, the multiplexer signals the computer to continue. This requires a special setting in your navigation software, which is mostly called 'Flow Control'. This setting can mostly be found in the port settings of your software. Set the Flow Control to Hardware or CTS/RTS. Do not use Xon/Xoff flow controls since this uses special characters instead of a (virtual) signal. These characters are not part of the NMEA standard and therefore ignored by the multiplexer.

Bluetooth

The MiniPlex-2S/BT communicates with a computer, a PDA, a Smartphone or any Bluetooth device that supports the Serial Port Profile (SPP) through its Bluetooth interface, allowing a computer to receive all incoming NMEA data wirelessly. The computer can also send data back to the multiplexer. This data can be routed to **NMEA Out 1** and **NMEA Out2**.

The Bluetooth interface uses the 'Serial Port Profile', which means that this connection is presented on a computer or other device as a standard (virtual) COM port. Such a COM port can be opened by any application. To setup a connection, the MiniPlex-2S/BT must be paired to your computer. Pairing is a process that connects two Bluetooth devices together by their unique address.

Pairing is initiated by issuing the appropriate commands on the respective devices. Mostly this will be something like 'Find Bluetooth Devices'. This operation will show a list of Bluetooth devices in the near surroundings that have responded to the inquiry scan. The multiplexer will be listed as 'MiniPlex-2S/BT'. Select this entry and enter the required passkey when asked. The passkey of the multiplexer is '0000' (four zeros). Follow the directions on the screen to finish the pairing process and assigning it to a COM port. This COM port will now be permanently assigned to the MiniPlex-2S/BT. Sometimes, two COM ports are assigned to the multiplexer, one for outgoing connections and one for incoming connections. The port for outgoing connections must be used.

Power Supply

The multiplexer must be powered from an externally supplied DC voltage from 8 to 35V. The power supply connection is protected against reversed polarity.

Indicators

The multiplexer has two LEDs. The green LED indicates the reception of valid NMEA data on the listener ports or from the network. It only blinks on valid NMEA sentences that start with a '\$' or '!' and end with a CR and LF character, thus indicating a proper connection and polarity of the connected instrument. In case of a reverse polarity of a connected talker, the green LED will not blink. The green LED also blinks every two seconds to indicate that power is present and it is operational. This blink is slightly dimmer than a blink on data reception.

The red LED indicates a queue overflow, in case more data is received than can be transmitted. See section 'Data Throughput' for options to resolve this situation.

During a firmware update, the red LED will be lit continuously when the update is in progress while the green LED blinks on the reception of firmware data from the computer. This will give a visual indication of the update process.

Data Throughput

Depending on the configuration of the multiplexer, NMEA sentences are sent to one or more talker ports with different communication speeds. A situation could arise where more data is received than can be transmitted because of the different speed settings of the listener and talker ports. Such a situation leads to an overflow of the queues within the multiplexer. When an NMEA sentence is being received while a queue is full, this sentence is discarded. Only complete NMEA sentences are stored and forwarded. This event is indicated by the red LED, which will blink briefly when a sentence is discarded.

In its default factory setting, as shown on the right, the data flow through the MiniPlex is very straightforward. First of all, the data that is received on the NMEA inputs is always sent to the computer.

In addition to this, the same data is also routed to **Out2**, as indicated by the checkboxes in the section **NMEA Input Settings**.

The section **NMEA Output Settings** shows that data from the computer is routed to **Out1** only.

This basic configuration allows you to combine data from navigation instruments and send it to a computer using the serial port or Bluetooth interface and to a chartplotter connected to **Out2** while the computer can control an autopilot connected to **Out1**.

The default speed setting of the inputs, outputs and the serial port ensures that there will be no queue overflows.

The screenshot shows two configuration panels. The top panel, 'NMEA Input Settings', is a table with columns: Speed, Talker ID, Real Time, To Output 1, To Output 2, and OF. It lists four inputs (In 1 to In 4), each with a speed of 4800, a Talker ID of '--', Real Time disabled, and data routed to both Output 1 and Output 2. The bottom panel, 'NMEA Output Settings', has columns for Speed and Computer Data. It shows Output 1 with a speed of 4800 and Computer Data set to 'Yes', and Output 2 with a speed of 38400 and Computer Data set to 'No'.

NMEA Input Settings						
	Speed	Talker ID	Real Time	To Output 1	To Output 2	OF
In 1:	4800	--	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
In 2:	4800	--	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
In 3:	4800	--	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
In 4:	4800	--	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>

NMEA Output Settings		
	Speed	Computer Data
Out 1:	4800	Yes
Out 2:	38400	No

Please note that the default communication speed of **Out2** is 38400 baud. Most chartplotters support this high speed for reception of AIS data. However, if you want to connect a repeater display or a VHF radio, the speed of **Out2** must be lowered to 4800 baud. If this leads to excessive overflows, it is necessary to reduce the amount of data sent to this output. This can be achieved by changing the default routing settings, either by disabling certain inputs for **Out2** or by using the Sentence Filtering & Routing facility of the MiniPlex.

Now back to data throughput. The standard speed of an NMEA port is 4800 Baud or bits/second, representing 480 characters per second. It is quite obvious that when four inputs receive data at 480 char/s and all of this data must be sent out again on an output with the same bandwidth of 480 char/s, a huge problem will arise. In the default configuration, this problem is quite easy to overcome: simply set the speed of the serial port and **Out2** to 19200 Baud (1920 char/s) or higher. When **Out2** is not used, set it to the highest speed or disable routing of any of the inputs to **Out2**. When **Out2** is connected to a chartplotter, try to choose the highest speed the plotter will accept.

If data from more than one input needs to be routed to an output operating at 4800 Baud, problems with data throughput can arise when too much data is sent to this output.

NMEA data tends to be sent in bursts. Some devices like depth sounders or wind instruments only send one sentence per second while a GPS may send bursts of up to 13 sentences every two seconds. While the average throughput over time may be low, an input might fill its queue quite rapidly when a burst of sentences is received. The queues in the MiniPlex are quite large and may contain up to 30 sentences of GPS data.

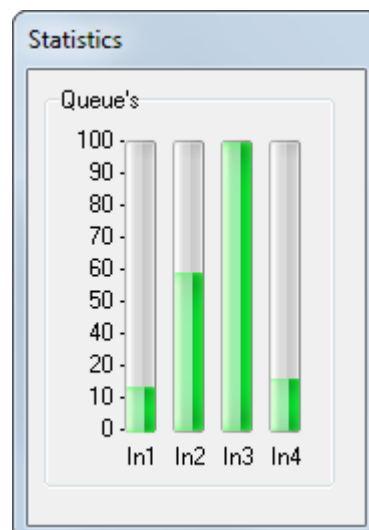
A couple of occasional blinks of the red LED over a period of a few seconds means that large bursts of sentences are received and a queue is hitting its limit. Some sentences are discarded but most of them will be passed without problems. Such a situation is totally acceptable and would mean that for instance one depth, wind or position update is missed every few seconds.

A quite different situation may arise with some fluxgates or gyrocompasses. These devices may send their heading sentences with a speed up to 40 sentences per second! Instead of queuing a burst of sentences every one or two seconds, the multiplexer must queue a constant stream of sentences, possibly utilizing the maximum bandwidth of the multiplexer. Such a situation can lead to a queue that is constantly filled up to its maximum size. This in turn results in heading data that can be up to 20 seconds old when it is forwarded, which is totally unusable for any autopilot to steer on. Enabling the Real Time option for this input can solve this specific problem. This option bypasses the queue entirely. Only one sentence will be stored now and sent out when the time slot for this input arrives. Outside its time slot, incoming sentences will be discarded. A lot of heading

sentences will be lost now but the ones that are passed, are passed almost immediately. Hence the name 'Real Time'.

When the red LED is blinking severely or stays on almost continuously, it is advisable to investigate which instrument or input leads to this overflow. The MPX-Config utility will show on which input the overflow occurs by a blinking indicator in the **NMEA Input Settings** section. Opening the Statistics window from the **Tools** menu will give an insight about the amount of data in a queue and whether it is filled constantly or occasionally.

Some general rules are applicable for reducing overflow situations. A simple rule of thumb is that an overflow can never occur if the speed of an output is equal or higher than the combined speeds of all inputs that are routed to that output. For example: if the multiplexer is in its default configuration and all four inputs are set to 4800 Baud, the minimum output speed equals $4 \times 4800 = 19200$ Baud. This rule is only a hard rule when the input bandwidth is fully utilized i.e. an instrument is sending data continuously. This is hardly ever the case. As mentioned earlier, NMEA data is often sent in bursts, resulting in a much lower overall bandwidth. It could be perfectly feasible to have a system with four instruments connected to the multiplexer, while running all in- and outputs on 4800 Baud without a single overflow.



There are several ways to resolve overflow situations:

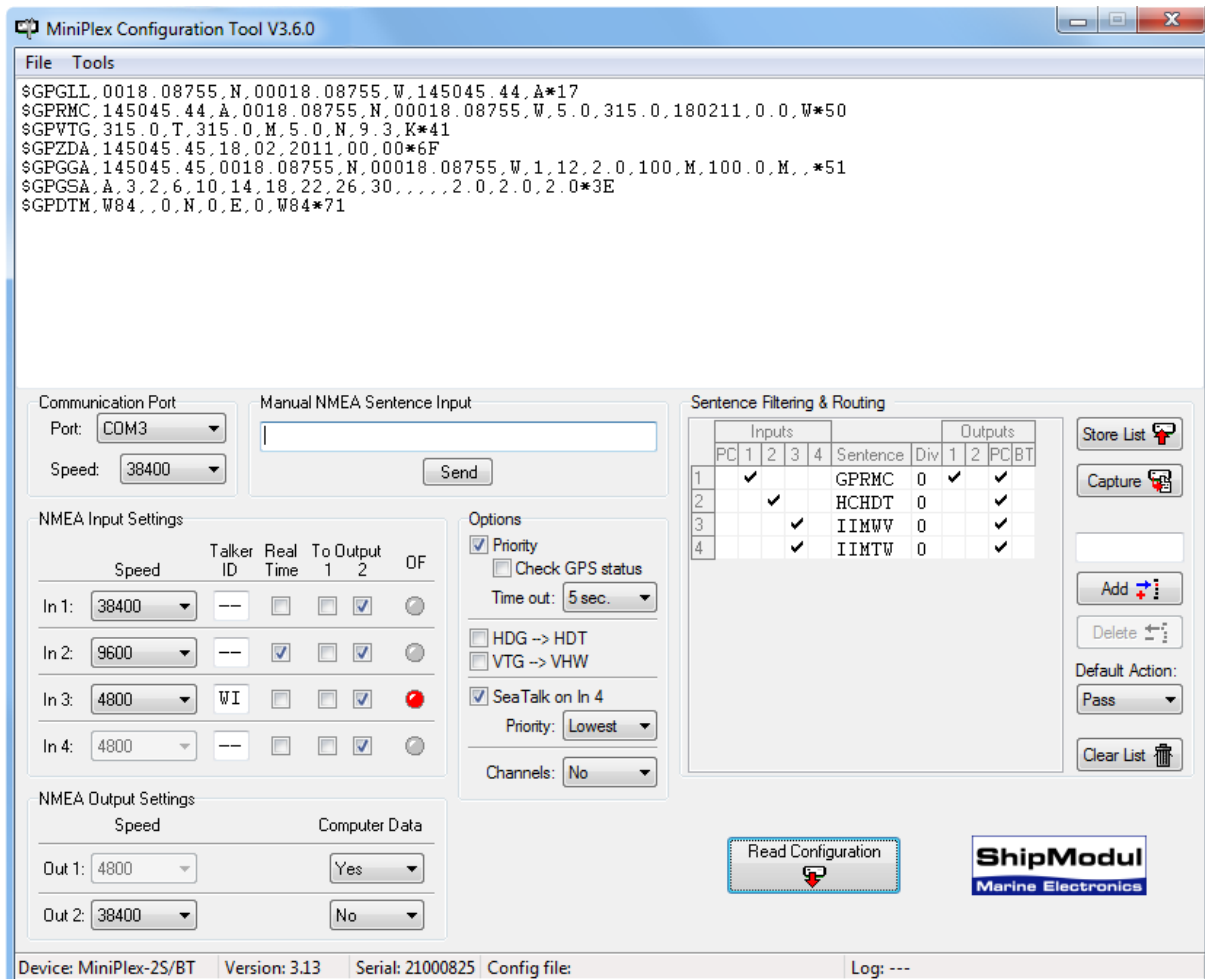
1. Configure the instruments on the listener ports to send less data or with greater intervals. GPS receivers can sometimes be configured for this.
2. Use the sentence filter of the multiplexer to block unwanted sentences. Unwanted sentences are discarded immediately and do not occupy queue space or bandwidth.
3. For sentences that should not be blocked, setting a divisor in the sentence filter may lower their rate. A gyro may be 'throttled down' to 10 sentences per second or even less. From the GPS output, the rate of the sentences containing satellite information could be lowered to once every 10 seconds instead of being output every time a position is output by the GPS.
4. Use the routing options to select which input is routed to an output or use the routing options in the sentence filter to selectively route NMEA sentences to an output.
5. Increase the speed of the NMEA output that causes the bottleneck. This will only work when the connected equipment also supports higher communication speeds.

Configuration

The multiplexer can be configured with a configuration program called MPX-Config. This program can be found on the accompanying CD. There is no installation procedure for this program, just start it from the CD or copy it to a suitable folder on the hard disk of your computer and start it from there.

The multiplexer itself is configured with proprietary NMEA sentences. MPX-Config sends these sentences to the multiplexer when you change a control on the screen.

All configuration settings are stored in the multiplexer's non-volatile memory. These settings are retained without power supply.



Screenshot of MPX-Config

The screen is divided into four sections from top to bottom: the menu, the data area, the control area and the status bar. The menu basically controls the MPX-Config program. The data area shows the NMEA sentences that are received from the multiplexer. These sentences include the NMEA data received by the multiplexer on its inputs as well as status messages generated by the multiplexer. The latter can be recognised fairly easy: they all start with '\$PSMD'. The control area contains controls that determine the operation and configuration of the multiplexer. The status bar shows the name or type of multiplexer that is connected, its internal software (firmware) version number and its serial number. This information is useful when you need technical support. Also shown are the optionally loaded or saved configuration file and a line counter when you have started a log file.

Menu

The menu contains two sub-menus: **File** and **Tools**. The **File** menu contains the following options to choose from:

Start Log...	Start writing NMEA data to a log file. A log file is a plain text file and can later be opened by any text editor to examine the data. A log file can be a useful tool for diagnostic purposes and is often requested by us for support. If you enter a new filename in the file dialog window, a new log file is created. If you choose an existing file, this file will be overwritten with new data. The Log counter on the status bar will show the number of NMEA sentences that are currently written to the log file.
Timed Log...	Start writing to a log file with the addition of a time stamp at the beginning of each NMEA sentence.
Stop Log	Stop writing NMEA data to the current log file and close that file.
Load Configuration...	Load a previously saved configuration file into the multiplexer. The current configuration will be overwritten. A configuration file stores all settings made with MPX-Config. See the Technical Reference section for a description of this file format.
Save Configuration	Save the current configuration to a file. If a file was previously opened, that file will be overwritten. If no file has been opened before, you will be prompted for a file name. The name of the currently loaded configuration file is shown on the status bar.
Save Configuration As...	Save the current configuration to a new file.
Update Firmware...	Load new firmware into the multiplexer. From time to time, new features are developed for the multiplexer or bugs are fixed. New firmware image files will then be made available through our website. These image files can be downloaded to your computer and loaded into the multiplexer with this option. This option will only be visible when your multiplexer supports firmware updates. This is the case from firmware version 3.00 and up. Multiplexers containing lower firmware versions need to be returned to our factory for an update.
Exit	This option exits MPX-Config.

The **Tools** menu contains the following options to choose from:

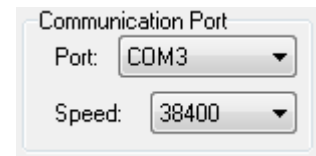
Clear Screen	Clear the data area on the screen. New sentences will be displayed from the top.
No Scroll	Normally, incoming NMEA sentences are displayed from the top down and when the bottom of the data area has been reached, all sentences are scrolled up one line before the new one is shown. When No Scroll is activated, a list of incoming NMEA sentences will be displayed that will be refreshed constantly when new similar sentences are received. A scroll bar will appear when the list grows beyond the length of the data area. This feature allows you to closely examine the types of sentences that are received from the connected instruments. Any proprietary NMEA sentences that are generated by the multiplexer are also listed. They can be recognised by the firsts four characters, which are '\$PSMD'.
Show Statistics	This option opens a new window that will be displayed on top of the MPX-Config window. This window shows bars that indicate how much NMEA data is stored in the input queues. This is a useful option for diagnosing data congestion and overflow situations as mentioned in paragraph 'Data Throughput'. A queue that is filled constantly can lead to unacceptable delays in data transfer.
About	Show a window with version information.

Controls

The control area of the MPX-Config screen contains all the controls to configure the multiplexer. When MPX-Config is started, it will retrieve the current settings from the multiplexer and set the controls accordingly. If this query is unsuccessful, some controls will not be filled with values. This could happen when the multiplexer was not powered up when MPX-Config was started.

Communication Port

Before being able to configure the multiplexer, select the communication port to which the multiplexer is connected. When connected to the COM port of the Bluetooth interface, the speed setting only changes the speed of the serial port of the multiplexer.



When connected to the serial port, you must choose the right speed to be able to communicate with the multiplexer. When selecting the baudrate, select either 38400 (factory default) or **Automatic** to let MPX-Config detect the communication speed of the multiplexer automatically. This may take a few seconds, especially when instruments are sending data to the multiplexer. When a 'Multiplexer does not respond' - message appears, disconnect or shut down the connected instruments. Another way is to choose every possible setting from 4800 to 38400 Baud and click on the **Read Configuration** button, until NMEA sentences appear in the data area.

When the right baudrate has been found, the multiplexer will follow any change you make: when you select a different speed, the multiplexer will also be set to this value in order to stay 'synchronized' with MPX-Config. If you exit MPX-Config, the speed setting will be saved on your computer.

Read Configuration

Clicking this button will request the current configuration settings from the multiplexer. MPX-Config will do this automatically when started but the very first time, when no port and communication speed have been selected, you need to do this manually after selecting the port and communication speed.



When the wrong port or communication speed is selected, MPX-Config will show a 'Multiplexer does not respond' - message and all controls will be disabled (greyed).

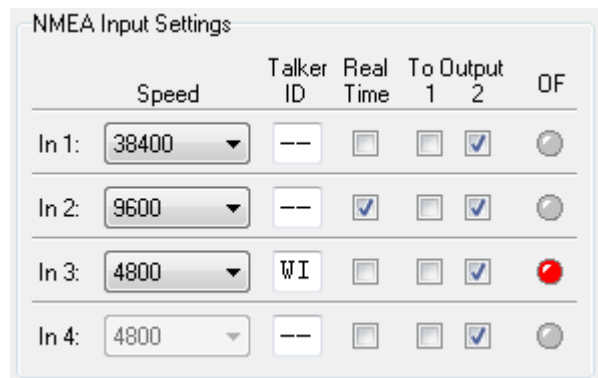
The status line on the bottom of the MPX-Config window will show the name of the multiplexer, the internal software (firmware) version and the serial number.

NMEA Input settings

This section allows you to set various options for each of the inputs of the multiplexer. The settings of each input are grouped together in horizontal direction.

Speed

This sets the speed of each NMEA input in a range from 4800 to 57600 Baud. 4800 Baud is the standard speed for navigation equipment. Some fluxgate or gyrocompasses operate at 9600 Baud to accommodate the higher throughput of 20 headings per second or more. AIS equipment operates at 38400 Baud.



	Speed	Talker ID	Real Time	To Output 1	To Output 2	OF
In 1:	38400	--	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
In 2:	9600	--	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
In 3:	4800	WI	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
In 4:	4800	--	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>

If you change the speed of **In4**, the speed of **Out1** will be changed too. **In 4** and **Out 1** share the same communication port inside the multiplexer and therefore always have the same speed. **Out 1** is generally used to control an autopilot and should be left at 4800 Baud for this purpose. The settings for **In4** and **Out1** are disabled and fixed to 4800 Baud when SeaTalk translation is enabled.

Care should be taken when selecting other speeds than 4800 Baud with respect to possible queue overflows. See paragraph 'Data Throughput' for more information.

Talker ID

The multiplexer allows you to change the Talker ID of incoming sentences. The Talker ID consists of the first two characters of an NMEA sentence and determines which instrument (talker) the sentence is originating from. Enter the desired Talker ID in the edit box of the desired input and press the Enter to send the setting to the multiplexer. A Talker ID may consist only of upper case characters and numbers. See the Technical Reference section for an overview of the most commonly used Talker ID's.

When the Talker ID is changed, the background turns yellow to indicate that the modified Talker ID has not yet been sent to the multiplexer. Pressing Enter will send all Talker ID's to the multiplexer and the background colour will return to white again. It is possible to change all Talker ID's first and press Enter after changing the last one. Starting at the Talker ID field of input 1, pressing the Tab key will jump to the Talker ID of the next input.

Clicking the **Read Configuration** button will read the Talker ID settings from the multiplexer. Any modified Talker ID's that have not been sent to the multiplexer (yellow background) will revert to their original values. To clear a Talker ID, simply clear the edit box(es) by selecting them with the cursor and press the Del or Backspace key on your keyboard and finally press Enter. An empty Talker ID setting will show two dashes.

With the setting as shown in the picture, any NMEA sentence received on input 3 will get Talker ID 'WI'. A combined wind instrument may output a Talker ID of 'II' - meaning 'Integrated Instrument'. Some navigation programs may not accept this and require 'WI' as Talker ID for weather instruments. With the setting as shown, an IIMWV sentence from a wind instrument will be changed into WIMWV. NMEA sentences received on inputs 1, 2 and 4 remain unchanged.

Setting a Talker ID can also be useful when similar instruments are connected to the multiplexer while the navigation software must be able to distinguish between the data from these instruments. A catamaran for instance could have a depth sounder in each hull, sending similar sentences to the navigation software. Setting the Talker ID for two inputs to 'H1' and 'H2' respectively allows the software to recognise both depth readings separately.

Real-Time

The Real-Time option bypasses the queue for a specific channel. During normal operation, all incoming NMEA sentences are stored in a queue - one for each channel - that can hold several seconds of NMEA data. In situations with heavy NMEA traffic, these queues can be filled up quite rapidly until an overflow occurs. If this is the case, the red LED on the multiplexer will blink as well as one or more of the **OF** indicators at the right of each input section. The Statistics window (menu **Tools** → **Show Statistics**) will show a constant high for such a queue.

An occasional overflow does not pose an immediate problem; it only means that every now and then an incoming NMEA sentence is discarded because there is no room left in the queue.

However, when a fluxgate or gyrocompass is connected, which sends its heading 10 or 20 times per second, the corresponding input queue in the multiplexer is filled up constantly. Together with NMEA data from other instruments, the total amount of data passing through the multiplexer gets so high that this queue will be in a constant overflow situation, resulting in an unacceptable delay of information of up to 20 seconds. This makes it impossible for an autopilot to steer on a compass heading.

The overflow indicators (**OF**) at the end of each input section show which input is causing the overflow. The indicator corresponding to the compass channel will be lit almost continuously. By enabling the Real-Time option for the input that is connected to the gyro or fluxgate compass, the queue of that input is bypassed and the NMEA data from the compass is passed through the multiplexer without delay. Some NMEA sentences will be discarded when the multiplexer is servicing another input but this is far less of a problem than having a 20 second delay in the heading information.

See the section 'Data Throughput' for other ways to prevent overflow situations with different instruments.

To Output 1 & 2

These options allow you to set the default route from the inputs to the outputs. The default route as shown in the picture routes all inputs to **Out2** and none to **Out1**. The default route also routes the inputs to the computer.

The default route is applied to an input when no specific route for that input exists in the sentence filter. A match in the sentence filter always takes precedence over the default route.

NMEA Output Settings

This section controls the NMEA outputs **Out1** and **Out2**. When you change the speed of **Out1**, the speed of **In4** will also change. **Out 1** is best used to control an autopilot and should be left at 4800 Baud for this purpose. The settings for **Out1** and **In4** are disabled and fixed to 4800 Baud when SeaTalk translation is enabled.

NMEA Output Settings	
Speed	Computer Data
Out 1: 4800	Yes
Out 2: 38400	No

Computer Data

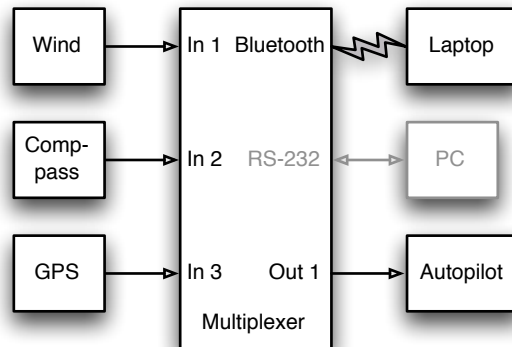
This controls the default route from the computer (both serial and Bluetooth) to both NMEA outputs. Possible options are **No**, **Yes** or **Override**.

No No data from the computer is routed to the NMEA output.

Yes Data from the computer is routed to the NMEA output and mixed with data from the inputs.

Override Data from the computer is routed exclusively to the output and takes precedence over the data from the inputs. When the computer sends data to the multiplexer, no input data is routed to the output. When the computer stops sending data however, data from the inputs will be routed to the outputs after a time out of 10 seconds.

The **Override** option is very useful when sailing alternately with our without a laptop. Consider a typical set-up as shown below:



When the laptop is connected, it will receive all information from the instruments and the navigation software calculates the course to steer and drives the autopilot accordingly. Because the laptop is sending NMEA data, the multiplexer routes this data exclusively to **Out 1**. The autopilot will therefore receive information from the laptop only.

When the laptop is not connected or the navigation software is not sending any data, the multiplexer automatically routes the inputs to **Out1**, sending the data from the instruments to the autopilot. This way, the autopilot will receive course information directly from the GPS.

Options

Various options can be enabled and set on the multiplexer that control how NMEA data is treated.

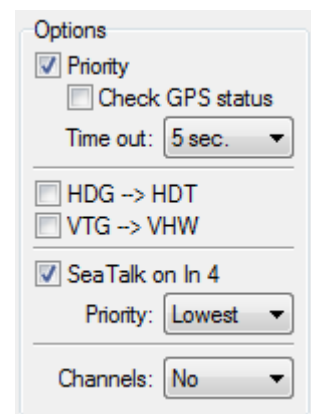
Priority

This option deletes duplicate NMEA sentences received on multiple inputs. When enabled, the multiplexer assigns a priority to incoming NMEA data based on the input on which it is received. The serial port and the Bluetooth interface have the highest priority, followed by **NMEA In 1, In 2, In 3** and **In 4** in descending order. If for instance two GPS receivers are connected to input 1 and 2 and both GPS receivers output GPRMC sentences, only those from the GPS on input 1 are passed. This feature can be useful to set up a second GPS as a backup for the main GPS.

The multiplexer only uses the Sentence Formatter (the 'RMC' part) for comparison - the Talker ID (the 'GP' part) is ignored.

Another useful application of Priority is when a GPS and an AIS transponder are connected to the multiplexer. An AIS transponder also outputs sentences from its internal GPS. A navigation program now receives GPS data from two sources that might differ in position due to GPS inaccuracy. This will lead to navigation errors. When the AIS transponder is connected to input 1 and the GPS to input 2, all the NMEA sentences from the AIS transponder is passed while duplicate NMEA sentences (e.g. GPRMC) from the GPS are blocked. When the AIS transponder fails, GPRMC sentences from the GPS will be passed again after an adjustable timeout.

Please note that the priority system does not block an entire input, it only blocks duplicate sentences. Sentences received from the GPS that are not received on the AIS input are passed.



The following example shows what is passed and what not. The left column in the table shows sentences from the AIS transponder on input 1 and the right column sentences from the GPS on input 2. The sentence that is greyed in the table is blocked by the priority system. The table shows that only the RMC sentence from the GPS is blocked.

AIS (In 1)	GPS (In 2)
GPRMC	GPRMC
AIVDM	GPGGA

The priority feature can store up to 50 different sentence types to determine their priority. A time out mechanism ensures that sentences received on lower priority inputs are passed again after an adjustable time out when their duplicates on higher priority inputs are no longer received.

Check GPS status

Normally, the priority system detects the *absence* of NMEA sentences. With **Check GPS status** enabled, it detects *invalid* sentences, specifically from a GPS.

When a second GPS is connected as a backup to the first GPS, the first GPS must completely fail (stop sending data) before sentences from the second GPS are passed. In a situation where the first GPS no longer receives any signal from satellites (broken antenna, cable etc.), it will still output NMEA sentences and the priority system will not fall back to the second GPS. When **Check GPS status** is enabled, the multiplexer checks the Status field of GPS sentences. When the Status field indicates 'Invalid data', the multiplexer will block these sentences, allowing the priority system to time out and pass sentences from the second GPS. Sentences of which the Status flag is checked are APB, GGA, GLL, RMA, RMB, RMC, VTG and XTE.

Time Out

This setting allows you to set the time it takes before sentences from a lower priority input are passed.

HDG -> HDT

If this option is enabled, the multiplexer will generate an HDT sentence (true heading) when an HDG or HDM sentence (magnetic heading) is received. If the HDG sentence contains a magnetic variation, it is used to calculate the true heading from the magnetic heading. Otherwise the magnetic heading value is just copied. The original HDG or HDM sentence is also forwarded but if desired, it can be blocked using the sentence filter.

This option can be useful when a device needs a true heading while only a fluxgate compass is available on board. Many satellite telephones for instance need a true heading to be able to direct their antenna to the right communications satellite.

VTG -> VHW

If this option is enabled, the multiplexer will generate a VHW sentence (water speed and heading) when a VTG sentence (course over ground and ground speed) is received. The VTG sentence is generated by a GPS and the VHW sentence by a log. Often the paddlewheel of a log gets stuck when fouled and this option offers a solution to substitute the log data with GPS data.

SeaTalk on In 4

To receive SeaTalk[®] data from Raymarine[®] instruments and convert it into NMEA sentences, this option must be enabled. SeaTalk is a proprietary protocol developed by Raymarine and it is used for data exchange between Raymarine navigation instruments like the ST40, ST50 and ST60 series. To be able to use these instruments with commonly available navigation programs or to feed their data into non-Raymarine instruments, the SeaTalk data needs to be translated into NMEA sentences. See the Technical Reference section for an overview of translated SeaTalk data.

Selecting this option will automatically set **In4** and **Out1** to 4800 Baud and disable these controls.

SeaTalk Priority

This sets the priority of the SeaTalk data. It can be either Highest (SeaTalk - In1 - In2 - In3) or Lowest (In1 - In2 - In3 - SeaTalk).

Channels

This option inserts channel number information in the NMEA stream that is output by the multiplexer. When **NMEA** is selected, each NMEA sentence that is sent to the computer is preceded by a proprietary NMEA sentence '\$PSMDCN' to indicate on which NMEA input the following sentence was received. The following example shows that the IIGGA sentence was received on input 1, the GPGGA sentence on input 2, the IIGLL sentence on input 1 and the HEHDT sentence on input 3.


```

$PSMDCN,1*1A
$GPGGA,143357.999,5301.0061,N,00635.5479,E,1,06,1.9,90.0,M,,,,,0000*2E
$PSMDCN,2*19
$GPGGA,143357.999,5301.0061,N,00635.5479,E,1,06,1.9,90.0,M,,,,,0000*39
$PSMDCN,1*1A
$IIGLL,5301.0061,N,00635.5479,E,143357.999,A*22
$PSMDCN,3*18
$HEHDT,67.0,T*1E

```

When **TAG BIK** is selected, the multiplexer adds an NMEA 0183 V4.0 TAG block to each sentence that is sent to the computer. This TAG block contains a source identification parameter indicating on which input that sentence was received.

The following example shows the same data as above, but with TAG blocks added.

```

\s:mch1*1E\ $GPGGA,143357.999,5301.0061,N,00635.5479,E,1,06,1.9,90.0,M,,,,,0000*2E
\s:mch2*1D\ $GPGGA,143357.999,5301.0061,N,00635.5479,E,1,06,1.9,90.0,M,,,,,0000*39
\s:mch1*1E\ $IIGLL,5301.0061,N,00635.5479,E,143357.999,A*22
\s:mch3*1B\ $HEHDT,67.0,T*1E

```

Channel numbers allow distinguishing between similar data from different instruments, like two depth sounders on the same boat.

See the Technical Reference section for a description of the TAG block.

Sentence Filtering & Routing

The Sentence Filtering & Routing feature is the most powerful feature of the MiniPlex. It allows you to filter and route NMEA sentences based on the Address Field of an NMEA sentence (the 'GPRMC' part) and optionally reduce the rate of the sentence. Sentences can be passed or blocked, specified by input (filtering) and they can be forwarded to specific outputs (routing). Up to 50 rules can be entered, either manually or by capturing the NMEA sentences received by the multiplexer on its inputs.

Each filter/routing rule consists of the Address Field of an NMEA sentence, checkboxes to specify the source inputs and destination outputs and a divisor factor to reduce the sentence rate. Wildcards are allowed in the Address Field by using the '*' character. A wildcard will match any character. The computer interface, shown in the list as 'PC', is present in both the input and output section because it can send and receive data. The 'BT' column is only valid for multiplexers that have a Bluetooth interface.

When the multiplexer receives an NMEA sentence, the list of filter/routing rules is traversed from top to bottom until a match is found. The order of filter rules in the multiplexer is exactly the same as shown in MPX-Config. When a match is found, the input on which the sentence was received is checked against the input settings in this rule to determine whether the sentence may be passed or not. If a match is found, the sentence is routed to the outputs that are checked.

If no match is found, the **Default Action** determines what happens next: when **Pass** is selected, the received sentence is passed and the default routes are applied. When it is set to **Block**, the sentence is discarded. The default routes are set in the **NMEA Input Settings** and the **NMEA Output Settings**. It will be obvious that no sentences will pass the filter when the list is empty and the **Default Action** is set to **Block**.

It is important to know that when a **Talker ID** is set for an input in the **NMEA Input Settings**, it is applied to incoming NMEA sentences before the sentence filter processes them.

Example 1

The first step is to fill the list with NMEA sentences to be filtered. This can be done automatically by clicking on the **Capture** button. All controls will be disabled during capture and the **Capture** button changes to **Stop**.

Leave the capture mode running for approximately 10 seconds. By that time, all connected instruments will have sent NMEA sentences. Click on **Stop** to end the capture mode.

After the capture process the list may look like the example on the right. The list shows four received sentences: 'GPRMC' on input 1, 'HCHDT' on input 2 and 'IIMWV' and 'IIMTW' on input 3.

The screenshot shows the 'Sentence Filtering & Routing' window. It contains a table with columns for Inputs (PC, 1, 2, 3, 4), Sentence, Div, and Outputs (1, 2, PC, BT). The table lists four rules:

	Inputs					Sentence	Div	Outputs			
	PC	1	2	3	4			1	2	PC	BT
1	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>				GPRMC	0	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
2	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>			HCHDT	0	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
3	<input checked="" type="checkbox"/>			<input checked="" type="checkbox"/>		IIMWV	0	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
4	<input checked="" type="checkbox"/>			<input checked="" type="checkbox"/>		IIMTW	0	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>

Below the table are buttons for 'Store List', 'Capture', 'Add', 'Delete', 'Default Action' (set to 'Pass'), and 'Clear List'.

Please note that all outputs are checked by default when the list is filled with the **Capture** function. This might lead to overflows since all sentences will be routed to **NMEA Out1**, which is mostly used to drive an autopilot at 4800 Baud. So the next important step is to select the desired routes carefully before storing the list into the multiplexer.

Simply capturing the list and storing it unmodified is useless and can lead to unforeseen problems.

Suppose you're not interested in the water temperature ('IIMTW') you can block it by unchecking the checkbox for input 3 on that line.

Clicking on the **Store List** button sends the filter list to the multiplexer. Now the filter is operational. All editing operations of the filter list are performed on the list in MPX-Config on your computer. When editing is complete, the filter list must be sent to the multiplexer by clicking on the **Store List** button. Clicking on the **Read Configuration** button re-reads the filter list into MPX-Config.

Example 2

In the following example, some changes are made to the captured filter list of Example 1. The captured sentences are now routed to the computer only, except the GPS position which is also routed to **NMEA Out1**. A few rules with wildcards are added, a divisor factor is entered and the default action is changed to blocking everything that is not listed.

The second rule in the list now shows a 5 in the **Div** column. This is a divisor factor that lowers the rate of an incoming NMEA sentence. In this example the 'HDT' sentence rate lowers by a factor of 5. Only every fifth sentence is passed by the multiplexer. If these sentences came in at a rate of 20 sentences per second, they will leave the multiplexer at a rate of only 4 sentences per second. Any number from 2 to 99 can be entered.

Rule 4 shows no checkbox on any of the inputs, creating a full block of the 'MTW' sentence for all inputs.

Rules 5 to 7 show a 'GLL', 'GGA' and 'GSV' entry preceded with wildcards '--'. This means that the first two characters are not used in the comparison with received data. In this case, the filter processes anything that has a Sentence Formatter of GLL, GGA or GSV, regardless of the Talker ID.

When a list is captured, you can double-click on a sentence formatter with the cursor and edit the characters of that entry. Thus a captured rule with 'GPRMC' can be changed into '--RMC'. A useful purpose for wildcards is to block proprietary sentences from a device by entering 'P----' in the list. This will block any sentence starting with a 'P'.

Editing the list

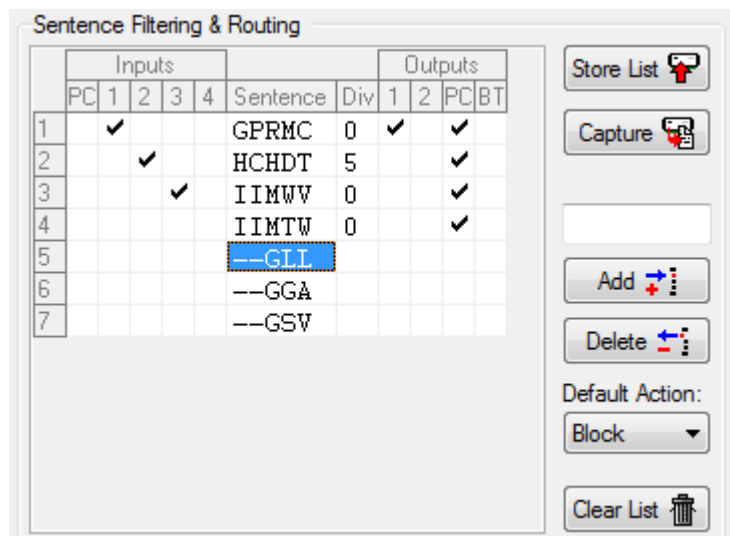
The list of rules is edited in MPX-Config and can be stored to or retrieved from the multiplexer. The checkboxes from the Inputs section determine on which input a sentence may be received. Note that the PC is also listed - this allows you to block sentences sent from the computer to the multiplexer if your navigation software lacks that possibility.

The checkboxes from the Outputs section determine to which output a sentence is routed. The BT output is the Bluetooth interfaces, present on some MiniPlex models. These settings override the default route.

Clicking on a checkbox changes its state from checked to unchecked and vice versa. This determines whether a sentence is passed (checked) or blocked (unchecked).

The following buttons are available:

- Store List** Stores the list from MPX-Config into the multiplexer. This overwrites the list in the multiplexer.
- Capture** Enables capture mode. The list will be filled automatically with NMEA sentences that are received by the multiplexer.
- Add** Add a new rule. Type the desired sentence address into the edit box above the **Add** button and click on **Add** or press the enter key. This will enter a new rule with all channels blocked. The input is case-insensitive; every entered sentence address will be converted into uppercase. The input must contain 5 characters, including wildcards. Numbers are also allowed.
- Delete** Delete a rule from the list in MPX-Config. Select the entry to be deleted by clicking on the address in the **Sentence** column ('--GLL' in the example) and click on the **Delete** button.
- Default Action** This determines what happens when an incoming sentence is not in the filter/routing list. It can be set to pass or block such a sentence.
- Clear List** This button clears the list in MPX-Config (not in the multiplexer!). To clear the list in the multiplexer, click on the **Store** button after clearing the list in MPX-Config.



A sentence address or divisor can be edited by selecting it with the cursor. Entering Edit mode can be done in different ways:

- Press function key 'F2'. This enters Edit mode with the cursor at the end of the text. Move the cursor around with the mouse or arrow keys.
- Press Enter or click with the cursor: This enters Edit mode with the text selected and the cursor at the end. Any character or number that is typed now will erase the existing text entirely unless the cursor is moved around with the mouse or arrow keys. This will unselect the text.
- Double-click on the entry. This enters Edit mode the same way as pressing Enter or clicking it for the second time.

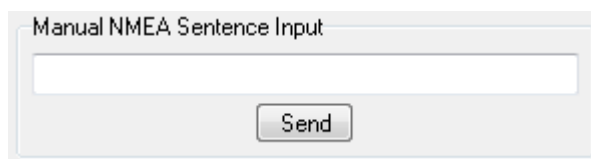
When changes are made, press Enter to confirm them or press Escape to discard any changes and exit Edit mode.

The Technical Reference section lists all commonly used Sentence Formatters. This list can be a useful aid while setting up the sentence filter.

Manual NMEA input

MPX-Config allows manual entry of NMEA sentences for testing, configuration etc.

Type the desired NMEA sentence in the edit box as shown on the right and click on the **Send** button or press the enter key.



Preceding the NMEA sentence with a '\$' is optional. MPX-Config will add a '\$' if necessary. The input is case sensitive, so whatever you type will be sent literally to the multiplexer. Since all NMEA commands are uppercase, you have to enter them as uppercase.

Any sentence starting with '\$PSMD' will be recognized by the multiplexer as a configuration command and will be processed as such. Any other sentence will be sent to the NMEA outputs.

Resetting the multiplexer

The multiplexer can be reset to its default factory configuration by entering 'PSMDRESET,1' in the **Manual NMEA Sentence Input** and clicking on the **Send** button.

Firmware Update

From time to time, we will develop new features for the multiplexer or fix bugs in the existing firmware. New firmware image files will then be made available through our website. These image files can be downloaded to your computer and loaded into the multiplexer with the option **Update Firmware** from the **File** menu.

In order to perform an update, download a firmware image file from our website www.shipmodul.com and store it on your computer. Connect your computer to the serial port of the MiniPlex.

You can only update the MiniPlex-2S/BT using the serial port!

The update process resets the multiplexer, which results in a lost Bluetooth connection. Therefore updating over the Bluetooth interface is not supported.

Select a communication speed of 38400 Baud and choose **Update Firmware** from the **File** menu.

A file dialog opens which allows you to select the previously downloaded image file ending at a '.mpx' extension. When you have selected the file and clicked on **OK**, the update process is started. The image file's integrity and version is checked first before initiating the download procedure in the multiplexer.

When the download is started, the red LED on the multiplexer will be lit continuously while the green LED blinks on reception of data from the computer. MPX-Config will show a progress indicator on the status bar during the update process. When the update is complete and successful, a message will show 'The firmware update was successful'.

Any errors that occur during the process will be shown. It is important to make a note of the error message when asking for support. See the Technical Reference section for an explanation of the error messages.

After an update you need to reset the multiplexer with the 'PSMDRESET,1' command.

Mounting

The multiplexer is not waterproof. It should be mounted at a dry place, like behind the instrument panel, on a flat surface.

Technical Reference

NMEA Glossary

This glossary lists the most common Talker ID's and Sentence Formatters in alphabetical order.

Talker ID's

AG	Autopilot (general)
AP	Autopilot (magnetic)
AI	Automatic Identification System
CD	Communications: Digital Selective Calling (DSC)
CR	Data receiver
CS	Satellite
CT	Radio telephone (MF/HF)
CV	Radio telephone (VHF)
CX	Scanning receiver
DE	Decca navigator
DF	Direction finder
EC	Electronic chart systems (ECS)
EI	Electronic chart display and information system (ECDIS)
EP	Emergency position indicating radio beacon (EPIRB)
ER	Engine room monitoring systems
GP	Global Positioning System (GPS)
GL	GLONASS receiver
GN	Global navigation satellite system (GNSS)
HC	Heading sensors: compass, magnetic
HE	gyro, north seeking
HN	gyro, non-north seeking
II	Integrated instrumentation
IN	Integrated navigation
LC	Loran, Loran-C
P	Proprietary sentence
RA	Radar and/or radar plotting
SD	Sounder, depth
SN	Electronic positioning system, other/general
SS	Sounder, scanning
TI	Turn rate indicator
VD	Velocity sensors: doppler, other/general
VM	speed log, water, magnetic
VW	speed log, water, mechanical
VR	Voyage data recorder
YX	Transducer
ZA	Timekeepers: atomic clock
ZC	chronometer
ZQ	quartz
ZV	radio updated
WI	Weather instruments

Sentence formatters

AAM	Waypoint arrival alarm
ACK	Acknowledgement alarm
ALM	GPS almanac data
ALR	Set alarm state
APB	Heading/track controller (Autopilot) sentence B
BEC	Bearing and distance to waypoint, dead reckoning
BOD	Bearing, origin to destination
BWC	Bearing and distance to waypoint
BWR	Bearing and distance to waypoint, rhumb line
BWW	Bearing, waypoint to waypoint
DBT	Depth below transducer
DCN	DECCA position
DPT	Depth
DSC	Digital selective calling information
DSE	Expanded digital selective calling
DSI	DSC transponder initialise
DSR	DSC transponder response
DTM	Datum reference

FSI	Frequency set information
GBS	GNSS Satellite fault detection
GGA	Global positioning system fix data
GLC	Geographic position, LORAN-C
GLL	Geographic position, latitude/longitude
GNS	GNSS fix data
GRS	GNSS range residuals
GSA	GNSS DOP and active satellites
GST	GNSS pseudorange error statistics
GSV	GNSS satellites in view
HDG	Heading, deviation and variation
HDT	Heading, true
HMR	Heading monitor – receive
HMS	Heading monitor – set
HSC	Heading steering command
HTC	Heading/track control command
HTD	Heading/track control data
LCD	LORAN-C signal data
MLA	Glionass almanac data
MSK	MSK receiver interface
MSS	MSK receiver signal status
MTW	Water temperature
MWD	Wind direction and speed
MWV	Wind speed and angle
OSD	Own ship data
RMA	Recommended minimum specific LORAN-C data
RMB	Recommended minimum navigation information
RMC	Recommended minimum specific GNSS data
ROT	Rate of turn
RPM	Revolutions
RSA	Rudder sensor angle
RSD	Radar system data
RTE	Routes
SFI	Scanning frequency information
STN	Multiple data ID
TLB	Target label
TLL	Target latitude and longitude
TTM	Tracked target message
TXT	Text transmission
VBW	Dual ground/water speed
VDR	Set and drift
VHW	Water speed and heading
VLW	Distance travelled through the water
VPW	Speed, measured parallel to wind
VTG	Course over ground and ground speed
WCV	Waypoint closure velocity
WNC	Distance, waypoint to waypoint
WPL	Waypoint location
XDR	Transducer measurements
XTE	Cross-track error, measured
XTR	Cross-track error, dead reckoning
ZDA	Time and date
ZDL	Time and distance to variable point
ZFO	UTC and time from origin waypoint
ZTG	UTC and time to destination waypoint

Translated SeaTalk datagrams

When the SeaTalk translation is enabled, the following datagrams are translated into NMEA sentences:

SeaTalk	NMEA	Description
00	DBT	Depth below transducer
10	MWV	Wind angle, (10 and 11 combined)
11	MWV	Wind speed, (10 and 11 combined)
20	VHW	Speed through water, includes heading when present
21	VLW	Trip mileage (21 and 22 combined)
22	VLW	Total mileage (21 and 22 combined)
23	MTW	Water temperature
25	VLW	Total and Trip mileage
26	VHW	Speed through water, includes heading when present
27	MTW	Water temperature
50	---	GPS latitude, value stored
51	---	GPS longitude, value stored
52	---	GPS speed over ground, value stored
53	RMC	Course over ground. RMC sentence is generated from stored values from other GPS related datagrams.
54	---	GPS time, value stored
56	---	GPS date, value stored
58	---	GPS lat/long, values stored
89	HDG	Magnetic heading, including variation (99)
99	---	Magnetic variation, value stored

The table shows that not all datagrams result in an NMEA sentence. Some datagrams are only used to retrieve data, which is combined with data from other datagrams to be able to create one NMEA sentence.

When the SeaTalk translation is enabled with option 2 (the 's' parameter in the CF sentence is 2), unlisted datagrams are translated into a proprietary NMEA sentence with the following format:

```
$PSMDST,aa,bb,cc,dd...*hh<CR><LF>
```

aa,bb,cc,dd... represent the hexadecimal value of the bytes from the received SeaTalk datagram.

Firmware Update Error messages

During a firmware update, the following warnings or error messages may be displayed:

Before updating firmware, the speed of the Communication Port must be set to 38400 Baud

Updating firmware is done at a speed of 38400 Baud. If you would start the update while operating at a different baudrate, MPX-Config would not be able to continue communicating with the multiplexer after initiating the update process.

The firmware update failed

This message appears when the overall update process failed without any other error message. It is shown when the updated multiplexer firmware does not report a version message after start-up.

Not a valid firmware file

The file you are trying to open is not a valid firmware file. A firmware file not only ends with an '.mpx' extension, it also contains a distinct signature that must be present. This prevents you from accidentally loading the wrong file into the multiplexer.

Unsupported firmware file version

The firmware file version is not supported by MPX-Config. Currently, there is only one firmware file version but it is not unlikely that in the future new versions are developed which require an update of MPX-Config.

Firmware file is corrupt

The firmware file is damaged, possibly due to an error during download from our website.

The version of the firmware file is lower than the version of the multiplexer. Do you really want to proceed?

You are trying to update the firmware in the multiplexer with an older version. This is just a warning and very well possible to do.

Bootloader initialisation failed

When MPX-Config starts the update process, a small program called the Bootloader must be started in the multiplexer. This message tells you that the bootloader could not be started. This can happen when you try to update the multiplexer while navigation instruments are connected and sending lots of NMEA data to the multiplexer. This can interfere with starting the update process. Disconnect or power down the instruments to prevent this problem.

Firmware file does not match with the multiplexer type

Most firmware files will be compatible with all types of multiplexers. It is however possible that special firmware is made available that only runs on a specific type of multiplexer. If this message appears, you apparently are trying to update using a firmware file that is not suitable for your type of multiplexer.

Bootloader: Erase command timeout

An error occurred when the bootloader tried to erase the old firmware.

Bootloader: Encryption command timeout

The bootloader did not respond to the Encryption command sent by MPX-Config.

Bootloader: Programming timeout

There was an error during programming a section of the firmware image.

Bootloader: CRC command timeout

The bootloader failed to calculate the checksum of the newly loaded firmware image.

Bootloader: CRC error

The calculated checksum of the newly loaded firmware image does not match the checksum of the image file. Apparently there was a communication error between MPX-Config and the multiplexer. You can try to update again.

Invalid response from bootloader

The bootloader returned an unknown response to a command from MPX-Config.

MPX-Config Registry keys

The communication port settings of MPX-Config are stored in the Windows registry, using the following keys:

```
HKEY_CURRENT_USER\Software\CustomWare\MPXConfig\BaudRate
HKEY_CURRENT_USER\Software\CustomWare\MPXConfig\Port
HKEY_CURRENT_USER\Software\CustomWare\MPXConfig\IP
HKEY_CURRENT_USER\Software\CustomWare\MPXConfig\Mode
HKEY_CURRENT_USER\Software\CustomWare\MPXConfig\FilterUDP
```

MPX-Config INI file format

The configuration file format of MPX-Config resembles the standard Windows INI file format and is readable text. Below is an example of the configuration file. This example corresponds with the settings shown on the MPX-Config screenshot on page 10.

```
[Configuration]
Baud In1=3
Baud In2=1
Baud In3=0
Baud In4/Out1=0
Baud Out2=3
SeaTalk=1
Priority=1
Priority Timeout=3
Channel Numbers=0
RealTime Ch.1=0
RealTime Ch.2=1
RealTime Ch.3=0
RealTime Ch.4=0
HDG Translation=0
VTG Translation=0
Talker ID1=
Talker ID2=
Talker ID3=WI
Talker ID4=
Route 11=0
Route 21=0
Route 31=0
Route 41=0
Route 12=1
Route 22=1
Route 32=1
Route 42=1
Mode Out1=1
Mode Out2=0
Filter Mode=0
[Filter]
GPRMC=01000,,1010
HCHDT=00100,,0010
IIMWV=00010,,0010
IIMTW=00010,,0010
```

Proprietary NMEA commands

The MiniPlex multiplexers are configured with proprietary NMEA sentences. They also generate certain proprietary NMEA sentences in some modes of operation or as a response to NMEA commands.

All commands have the following format:

\$PSMDxx

\$P: Start of a proprietary command. Dictated by the NMEA standard.

SMD: ShipModul manufacturer's mnemonic.

xx: Two- or three-character command code.

For ease of manual configuration, the commands issued to the multiplexer do not require a checksum. Sentences output by the multiplexer always contain a checksum, denoted with *hh in the descriptions below.

Proprietary sentence definitions

CF – Configuration

This sentence sets the configuration of the multiplexer. The same sentence is sent by the multiplexer in response to a CFQ sentence.

Command: \$PSMDCF,b,s,p,n,rrrr,h,v,t,f[*hh]<CR><LF>

b: baudrate selector: ¹⁾ 0 = 4800 Baud

1 = 9600 Baud

2 = 19200 Baud

3 = 38400 Baud

4 = 57600 Baud

5 = 115200 Baud

9 = toggle checksum mode ²⁾

s: SeaTalk translation: 0 = off

1 = on

2 = dump all unknown SeaTalk datagrams (PSMDST,xx,xx,...)

3 = dump all SeaTalk datagrams

4 = toggle generated wind sentence between VWR and MWV

p: Channel priority: 0 = off

1 = on, standard priority order.

3 = on, SeaTalk has highest priority.

5 = on, standard priority order, GPS status checked

7 = on, SeaTalk has highest priority, GPS status checked

n: Channel numbers: 0 = off

1 = send as NMEA sentence

2 = send a TAG block

rrrr: Real-time mode: 1 = on, 0 = off. Four digits, one digit per channel, numbered from 1 to 4

h: Heading translation: 1 = on, 0 = off

v: Velocity translation: 1 = on, 0 = off

t: Priority Timeout 0 = 1 sec.

1 = 2 sec.

2 = 3 sec.

3 = 5 sec.

4 = 10 sec.

5 = 30 sec.

f: Filter mode: 0 = Pass sentences that are not present in the filter list

1 = Block sentences that are not present in the filter list

hh: optional checksum

When sending this command to the multiplexer, it is not necessary to specify every field when only one configuration parameter has to be changed. Fields preceding the one to be changed can be left blank. Fields after the one to be changed may be omitted. When for example only the channel

priority must be changed, the command "\$PSMDCF,,,1" may be sent. The fields 'b' and 's' are left blank while the fields for 'n', 'rrrr', 'h', 't' and 'f' are omitted.

The 's' field will always return a 0 or 1 in response to a CFQ command.

- 1) The speed setting is ignored on multiplexers without RS-232 serial port.
- 2) Normally the multiplexer blocks sentences that have a checksum error. Toggling the checksum mode lets the multiplexer pass sentences with a checksum error unprocessed. The response of the CFQ command shows in which mode the multiplexer is configured: when a checksum is added to the CF response, the multiplexer is in normal mode and blocks erroneous sentences. When the CF response shows no checksum, the multiplexer passes erroneous sentences. Note that this is a toggle, it does not change the baudrate and a CF response will always show the normal baudrate setting (No. 0..3).

CFQ – Request current configuration

This sentence requests the current configuration settings from the multiplexer.

\$PSMDCFQ<CR><LF>

The multiplexer responds with a CF sentence. When the response contains a checksum, the multiplexer is in normal mode and blocks erroneous sentences. When the CF response shows no checksum, the multiplexer passes erroneous sentences.

CN - Channel Number indicator

This sentence precedes an NMEA sentence to indicate through which input channel the sentence was received.

\$PSMDCN,x<CR><LF>

x: channel number 1,2,3 or 4.

Example: \$PSMDCN,1<CR><LF>

DR – Default Route

This command specifies the default route from the NMEA inputs to the NMEA outputs and from the computer interfaces to the NMEA outputs. Any route set by the FL command overrides the standard route.

\$PSMDDR,xxxx,a,yyyy,b[*hh]<CR><LF>

xxxx: Input field for NMEA Out1. Each 'x' represents an input, numbered from 1 to 4 from left to right. A '1' means that data is routed from that input to output 1, a '0' means that no data is routed to output 1.

- a: Computer data to NMEA Out1.
- 0: Computer data is not routed
 - 1: Computer data is routed
 - 2: Computer data is routed and overrides data from the inputs. A time out mechanism will route data from the inputs when no data from the computer is received.

yyyy: Input field for NMEA Out2. Each 'y' represents an input, numbered from 1 to 4 from left to right. A '1' means that data is routed from that input to output 2, a '0' means that no data is routed to output 2.

- a: Computer data to NMEA Out2.
- 0: Computer data is not routed
 - 1: Computer data is routed
 - 2: Computer data is routed and overrides data from the inputs. A time out mechanism will route data from the inputs when no data from the computer is received.

DRQ – Request Default Route

Requests the default route settings. The multiplexer responds with a DR sentence.

FL – Filter

This sentence specifies a filter rule that is applied on every incoming NMEA sentence. Sentences for which a rule is specified, will only be transferred if the input on which they are received matches the input specified in the filter rule.

Filter rules are specified by the formatter part of the NMEA address field, for instance the 'GPRMC' part of a GPS '\$GPRMC' sentence. For each filter rule, the inputs to be passed can be specified.

Sentences for which no rule exists are passed unrestricted.

\$PSMDFL,cccc,xxxx[,dd][yyyy][*hh]<CR><LF>

cccc: Address field of the filter rule (e.g. 'GPRMC', 'IIMWV', etc). This field may contain wildcard characters ('-'). For instance, 'GP---' will apply to all sentences starting with 'GP'. Similarly, '--MWV' will apply to all sentences ending on 'MWV' regardless of the Talker ID. One filter rule with all wildcards and all inputs blocked is allowed to let the multiplexer block all sentences for which no rule exists. When an all-wildcard rule is entered, the multiplexer will not accept subsequent filter rules.

Example: \$PSMDFL,-----,00000<CR><LF>

xxxx: Input field. Each 'x' represents an input to assign to this rule, numbered from 0 to 4 from left to right, where input 0 is the computer interface, including Bluetooth, and 1 to 4 represent NMEA inputs 1 to 4. A '1' means that the sentence must be forwarded a '0' means that the sentence must be blocked.

dd: Optional divisor factor (0..99). The rate or frequency of a sentence is divided by this number to reduce the number of sentences over time. If for instance a divisor of 6 is specified, only every 6th occurrence of this sentence is passed.

yyyy: Optional routing field. Each 'y' represents an output the NMEA sentence must be routed to. A '1' routes the sentence to an output, a '0' does not. Each digit represents one output. From left to right, the outputs are NMEA Out1, NMEA Out2, Host port (Serial/USB), Bluetooth.

hh: Optional checksum

A FL sentence without any parameters will erase all rules. A FL sentence with only a 'cccc' field will erase that entry.

Example: \$PSMDFL,HEHDT,00011,5,1010<CR><LF>

This sentence specifies a rule for all sentences that have the 'HEHDT' address field. When this rule is applied, only 'HEHDT' sentences on inputs 3 and 4 are passed, the rate is lowered by a factor of 5 and the sentence is routed to NMEA Out1 and the Host port only

FLQ – Request Filter List

This sentence requests the filter list from the multiplexer. The multiplexer responds by sending FL sentences, one for each list entry. An empty FL sentence denotes the end of the list.

Example:

```
$PSMDFL,GPRMC,10011,0,1111*hh<CR><LF>
$PSMDFL,GPGGA,10001,0,1111*hh<CR><LF>
$PSMDFL,--VWT,01000,5,0001*hh<CR><LF>
$PSMDFL,GPGSV,00001,0,0010*hh<CR><LF>
$PSMDFL,*hh<CR><LF>
```

The sentences may not be dumped as one contiguous block. In case of heavy NMEA traffic, they may be interspersed with other NMEA sentences.

ID – Talker ID

Enables a Talker ID to be set for a specific channel. If the Talker ID is set for a specific channel, the original Talker ID in the sentences received on that channel is replaced by the specified one, before sending the sentence to the computer.

\$PSMDID,aa,bb,cc,dd[*hh]<CR><LF>

aa: Talker ID for channel 1
bb: Talker ID for channel 2
cc: Talker ID for channel 3
dd: Talker ID for channel 4
hh: optional checksum

An empty field clears the ID and disables the translation for that specific channel. Sending PSMDID without any fields clears all translations.

IDQ – Request Talker ID's

Requests the Talker ID Translation settings. The multiplexer responds with an ID sentence.

LDR – Loader message

This message is output by the bootloader. It contains the loader version and multiplexer ID. The loader will wait for a special key during 0.2s after sending this message. When no key is received, the application code is started. If no application code is found, the loader will continue sending this message.

OV – Overflow

In case of a queue overflow (blinking red LED on the multiplexer), an overflow sentence is output, to indicate on which input queue the overflow occurred:

```
$PSMDOV,x<CR><LF>
```

x: Binary field. The first four bits indicate on which input queue the overflow occurred.

RESET – Reset the multiplexer

This command resets the multiplexer and starts the bootloader. When a '1' is given as parameter, the multiplexer is reset to its factory settings as well.

SP – Speed

This sentence sets the baudrate of the NMEA inputs and outputs.

```
$PSMDSP,a,b,c,d,e[*hh]<CR><LF>
```

The following fields are defined for setting the various ports:

- a: NMEA In 1
- b: NMEA In 2
- c: NMEA In 3
- d: NMEA In 4/Out 1
- e: NMEA Out 2

These fields accept the following values:

- 0 = 4800 Baud
- 1 = 9600 Baud
- 2 = 19200 Baud
- 3 = 38400 Baud
- 4 = 57600 Baud (field <e> only)

Field <d> is ignored when SeaTalk translation is enabled with the \$PSMDCF command.

SPQ – Request Speed

Request the baudrate settings of the NMEA inputs and outputs.

```
$PSMDSPQ<CR><LF>
```

The multiplexer responds with a \$PSDMSP sentence.

TAG Block

When the Channel number option is set to '2' (field 'n' of the CF sentence), the multiplexer adds a TAG block to every NMEA sentence that is sent to the computer. This TAG block has one source parameter, indicating the input that sentence was received on. It has the following format:

```
\s:mchx*hh\
```

where 'x' is a digit from 1 to 4, representing the input number. A heading sentence received on input 1 will be sent to the computer as

```
\s:mch1*1E\ $HEHDT,23.5*37<CR><LF>
```

VER – Get Version

Retrieves version information from the multiplexer. The multiplexer responds with the following version sentence:

```
$PSMDVER,3.13.0,MiniPlex-2S/BT,10025943,8044*hh<CR><LF>
```

3.13.0: firmware version number
MiniPlex-2S/BT: product descriptor
10025943: serial number

8044: Multiplexer capabilities. This is a 4 digit, 16-bit field represented as a hexadecimal number. Each bit identifies a capability of the multiplexer. The following bits are defined:

- 1-0: Interface type, 0 = serial, 1 = USB, 2 = Ethernet
- 2: Bluetooth module installed
- 6: Firmware update supported
- 15: 3rd generation multiplexer

hh: checksum

BT – Bluetooth command

This command sends commands to the Bluetooth module or controls the configuration regarding the Bluetooth module. The following sub-commands are defined:

- Atxxxx: Send an AT command to the Bluetooth module.
- D: Delete the trusted (paired) devices list in the Bluetooth module.
- &: Initialize the Bluetooth module. This command is used to send a sequence of AT commands to the module in order to configure it for use in the MiniPlex. It is issued only once during production.
- 9: Set the communication port of the MiniPlex that is connected to the Bluetooth module to 9600 Baud. This is the default speed of the module and this option is used to be able to talk to the module when initialization fails and commands must be issued by hand.

Technical Specifications

Supply voltage:	8 – 35 V _{DC} , protected against reversed polarity.
Current consumption:	100 mA (150 mA max. with fully loaded talker ports and active Bluetooth connection).
Computer interface:	RS-232, galvanically isolated, Bluetooth using Serial Port Profile.
Inputs:	4 x NMEA 0183/RS-422, galvanically isolated. Input 4 can be set to SeaTalk mode.
Input resistance:	>800 Ohm.
Outputs:	2 x NMEA 0183/RS-422.
Queues:	6 queues of 1024 characters (4 x NMEA, 1 x RS-232, 1 x Bluetooth).
Filter list size:	50 sentence types
Priority list size:	50 sentence types
Speed NMEA In 1-3:	4800 - 57600 Baud.
Speed NMEA In 4/Out 1:	4800 - 57600 Baud.
Speed NMEA Out 2:	4800 - 115200 Baud.
Speed serial port:	4800 - 115200 Baud.
Indicators:	Overflow and Data.
Bluetooth range:	100 meters / 300 feet.
Bluetooth Device Name:	"MiniPlex-2S/BT"
Bluetooth Pass Key (PIN):	"0000"
Bluetooth transceiver:	Type: Ezurio TRBLU23-00200, Class 1 device. FCC ID: PI401B
Dimensions:	138 x 72 x 33 mm.
Housing:	Flame retardant ABS.

Declaration of Conformity

We,

CustomWare
Borgstee 27b
9403 TS Assen
The Netherlands
Tel.: +31 592 375700
Fax: +31 592 375550

Declare under our sole responsibility that the product

ShipModul MiniPlex-2S/BT

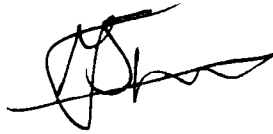
to which this declaration relates is in conformity with the following specifications:

EN/IEC60945:2002 and EN/IEC61162-1:2000
EN300328 and EN301489
FCC Title 47 CFR, Part 15, FCC ID: PI401B

The product herewith complies with the requirements of the EMC Directive 89/336/EEC and carries the CE-marking accordingly.

Assen, 1-1-2011

M. Sprang



This device complies with Part 15 of the FCC Rules. Operation is subject to the following conditions:
(1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

CE 0700 FC

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