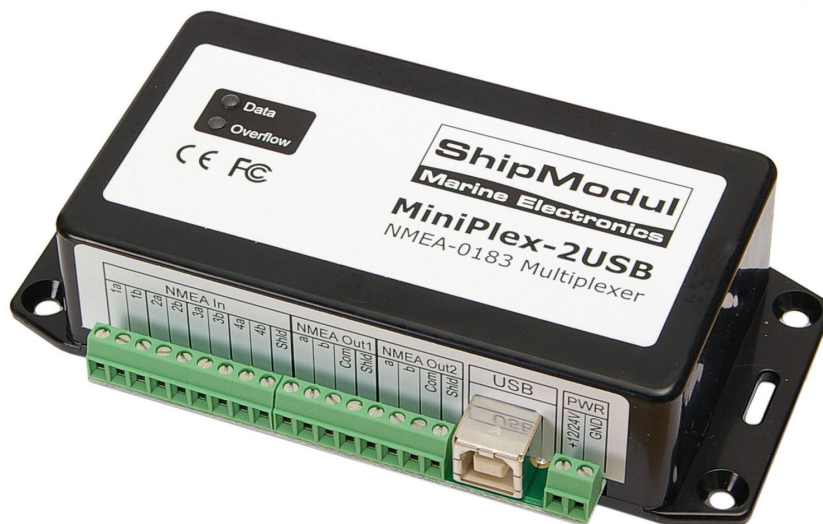


ShipModul

Marine Electronics

MiniPlex-2USB/BT NMEA 0183 multiplexer Manual



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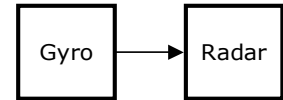
Introduction

The MiniPlex-2USB/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.

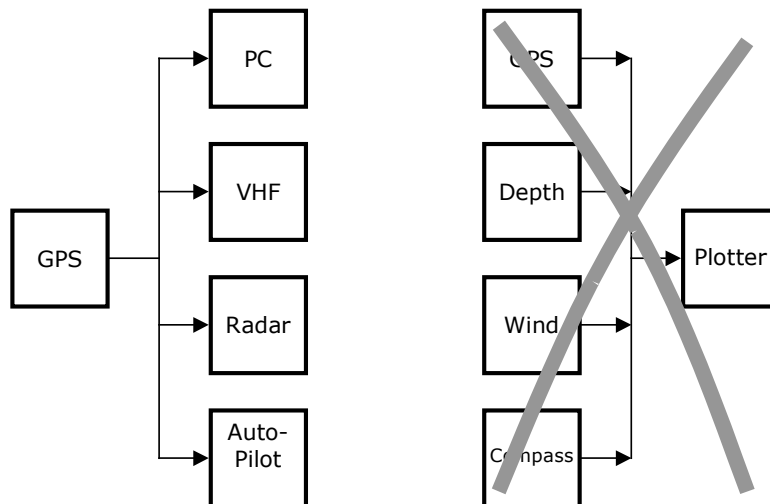
Talkers and Listeners

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.



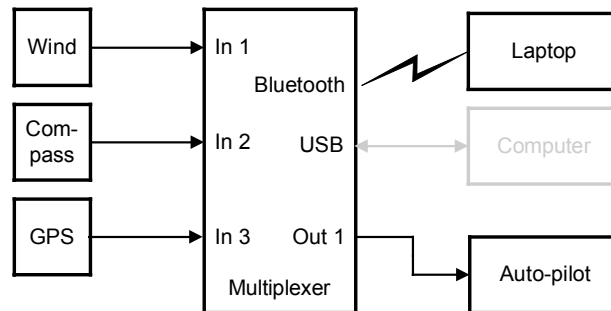
It gets complicated when several talkers must send data to one listener as shown in the picture on the right. Unless that listener has multiple inputs, this is not possible without help. Simply connecting talkers to one listener as shown is like four persons simultaneously telling you a different story. You can't make head or 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 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 and forwarding this data to a laptop and an autopilot. In this example, the multiplexer has two types of outputs: an NMEA talker port called 'Out1' and a Bluetooth interface to wirelessly connect to a computer. The multiplexer sends the received NMEA sentences to both the laptop and the autopilot at the same time.

The Bluetooth connection with 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 that is running on the laptop. This software can also generate NMEA sentences to control an autopilot. These sentences are sent to the multiplexer, which in turn sends them to the autopilot. These sentences can be combined with the ones received from the other navigation instruments.



The picture also shows a computer in light grey that is connected to a USB port on the multiplexer. The MiniPlex-2USB/BT also has a USB port that has the same functionality 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-2USB/BT

The MiniPlex-2USB/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 USB port. 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 USB port and the Bluetooth interface. The USB 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 USB 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. They are slightly different from each other: **Out1** is meant to be connected to an autopilot and repeater displays while **Out2** is more suitable to deliver data to a chartplotter. This will be explained later.

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, 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 is 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.

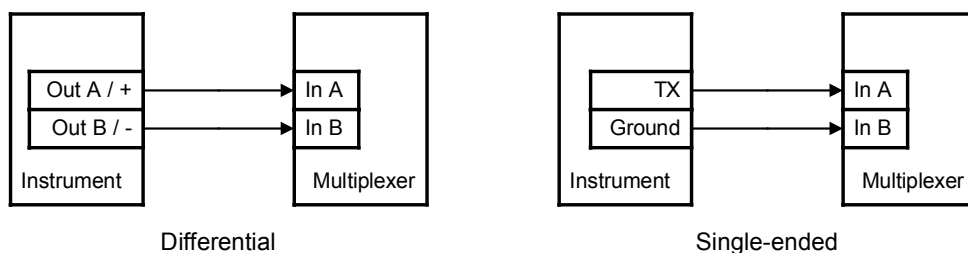
To overcome this problem, the MiniPlex multiplexers provide a Com terminal on each talker port in addition to the 'A' and 'B' terminals. This 'Com' terminal is similar to a signal ground. To connect a talker port of the MiniPlex to a differential NMEA listener port, use the 'A' and 'B' terminals. Use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

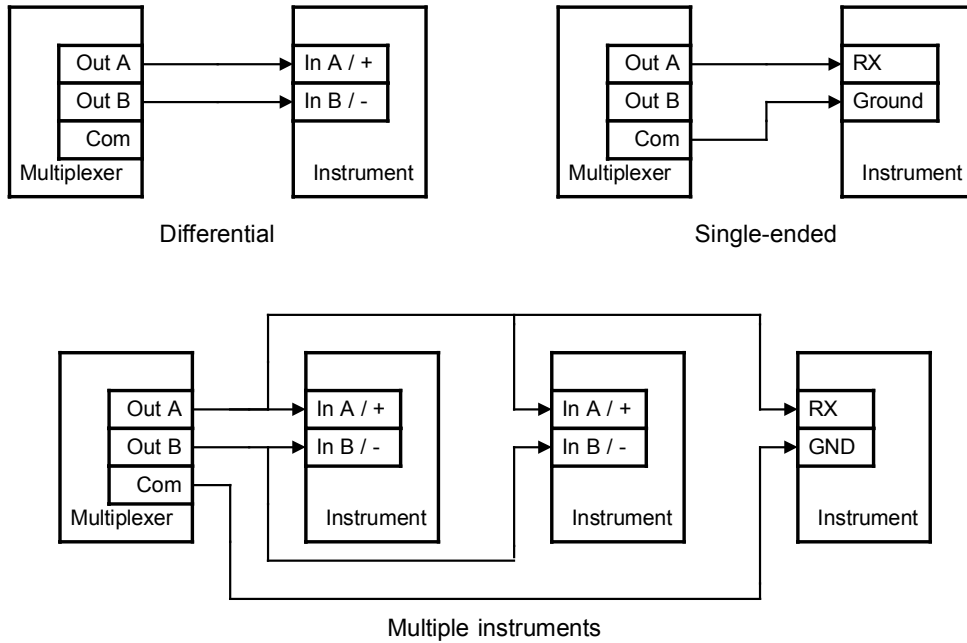
Some instruments have single ended talker ports, with only one data terminal. Connect this terminal to the **A** terminal on the multiplexer, and connect the ground of the instrument to the **B** terminal on the multiplexer. The instrument's data ground is often combined with its power supply ground.



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-**.

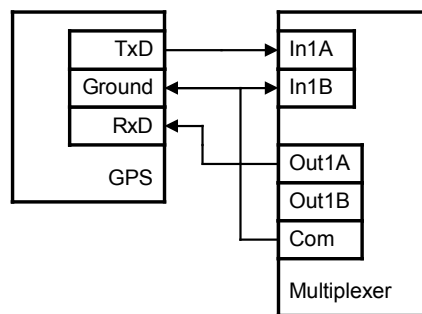
Some instruments have single ended listener ports, with only one data terminal. Connect this terminal to the **A** terminal on the multiplexer, and leave the **B** terminal on the multiplexer unconnected. Connect the ground of the instrument to the **Com** terminal on the multiplexer. The instrument's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



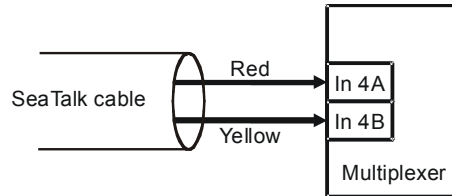
Connecting a GPS with an RS-232 port

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:



Connecting a SeaTalk network

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

Bluetooth

The MiniPlex-2USB/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 to control an autopilot connected to **NMEA Out 1**.

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-2USB/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-2USB/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-2USB/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.

USB port

The USB port connects the multiplexer to a computer or a USB hub with the supplied cable. The supplied driver provides a virtual COM port to allow navigation software to communicate with the multiplexer. The USB 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 is available on **NMEA Out 1**.

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

The USB connection and the Bluetooth interface support flow control, which 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.

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.

Driver Installation

To use the MiniPlex-2USB/BT with your computer, a USB device driver needs to be installed. This driver creates a virtual COM port, which can be opened with any navigation software just like any other COM port. Drivers are supplied for Microsoft Windows (Windows 2000, Windows XP, Windows Vista, Windows 7) and Apple's Mac OS X.

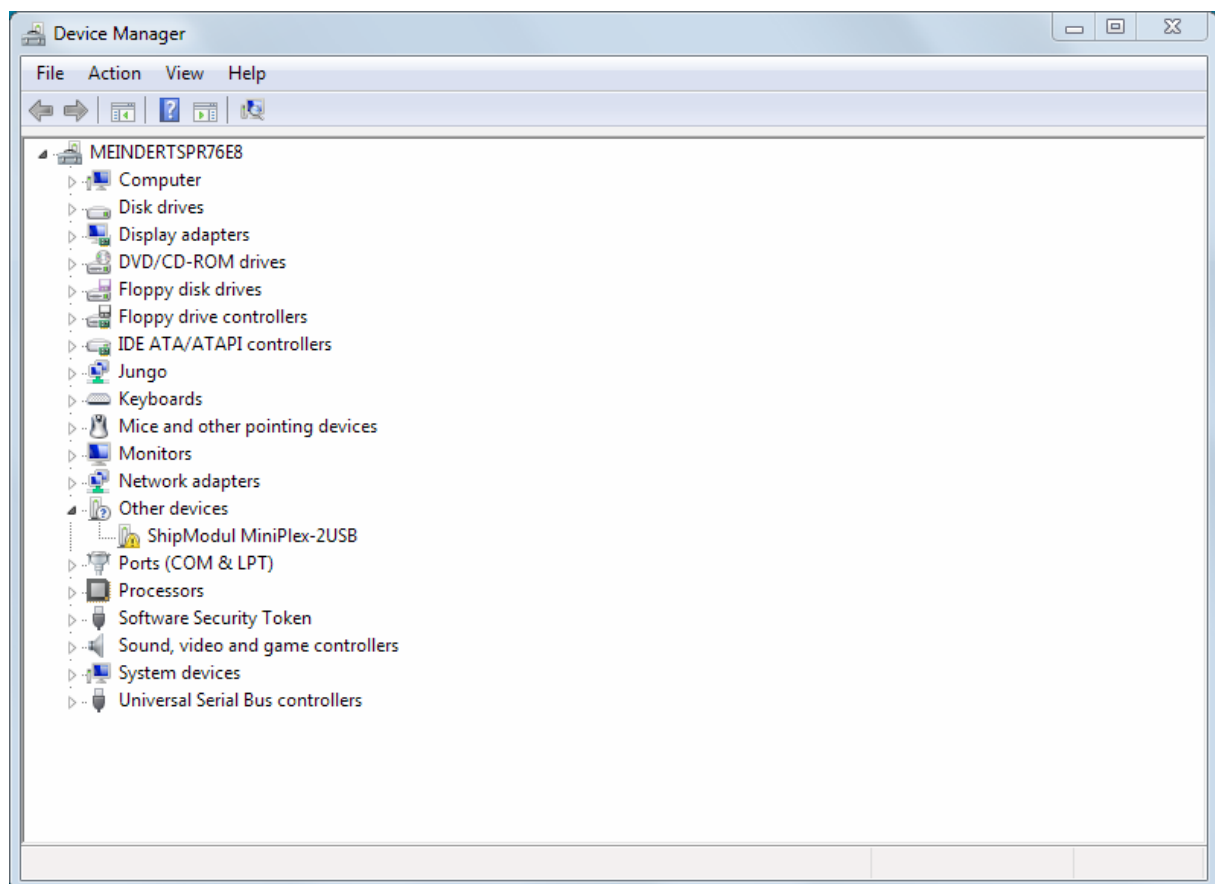
Windows 7 Installation

Due to enhanced security measures in Windows 7, drivers are required to be digitally signed. When a device is connected that has no digitally signed drivers, Windows 7 silently aborts the installation. It is however possible to install the drivers anyway. Follow the procedure as described below to manually install the MiniPlex drivers.

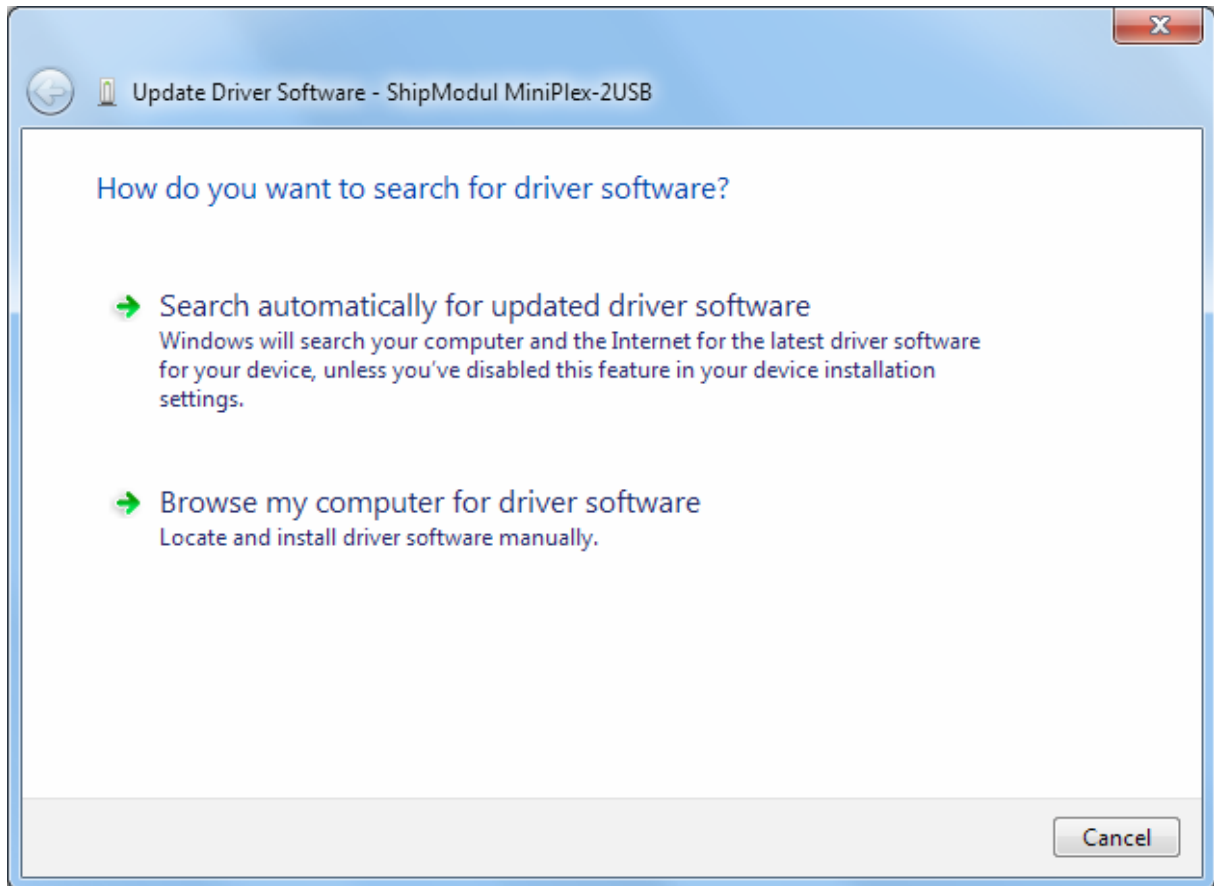
Connect the MiniPlex-2USB/BT to the computer and ignore the warning 'Device Driver software was not successfully installed'.

Open Control Panel -> System and Security -> Device Manager.

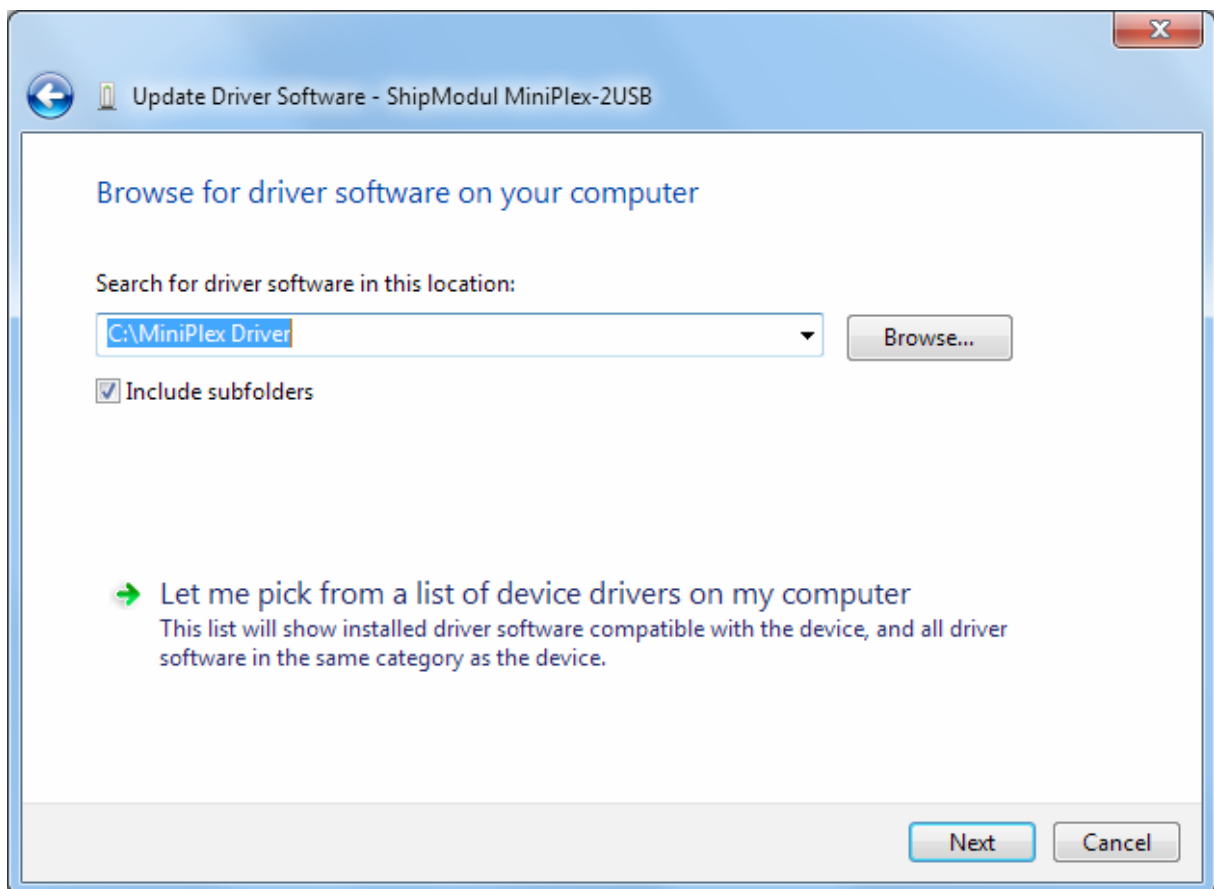
In the Device Manager, there will be a 'ShipModul MiniPlex-2USB/BT' listed under 'Other Devices' as shown in the picture.



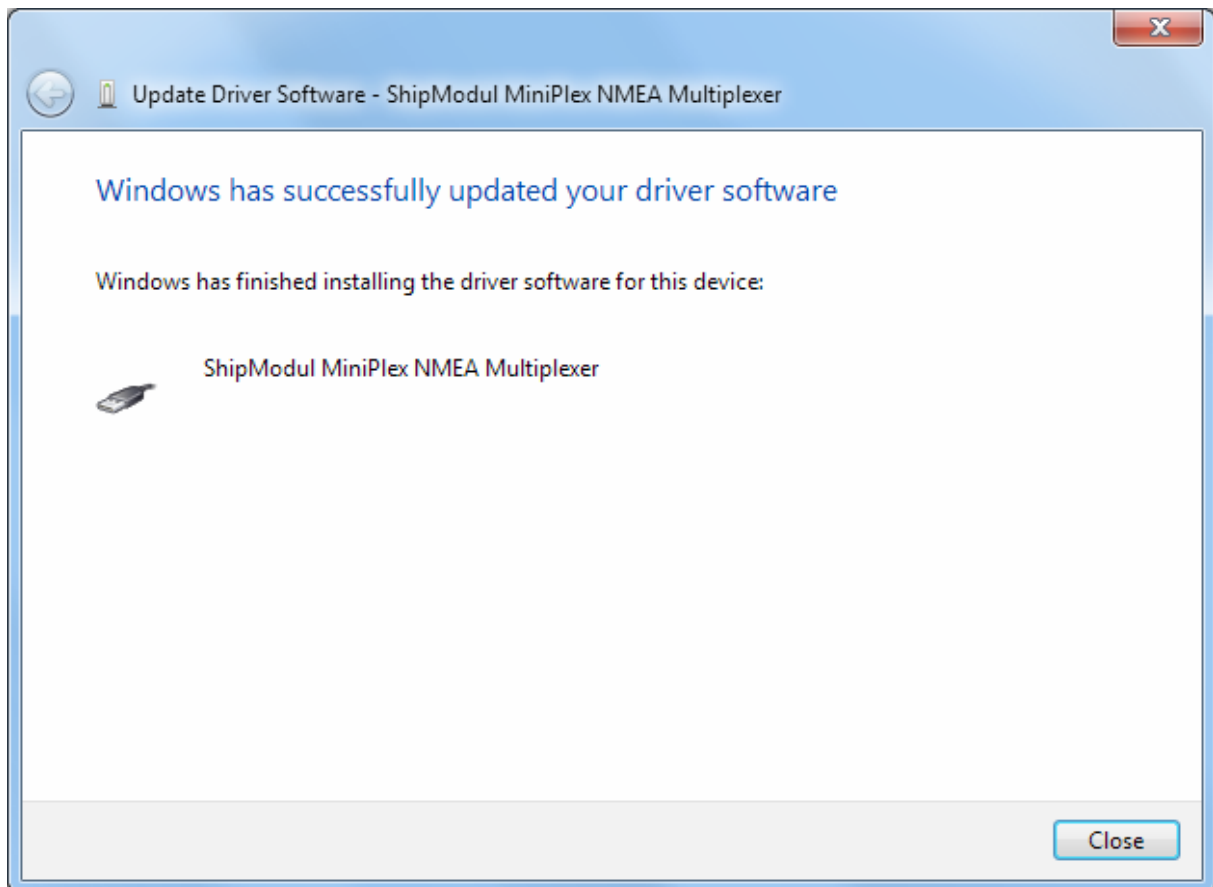
Right-click on the MiniPlex entry and choose 'Update Driver Software...' from the menu that appears. This will open the following window:



Choose 'Browse my computer for driver software'. In the following window, choose the location of the driver and press 'Next'.

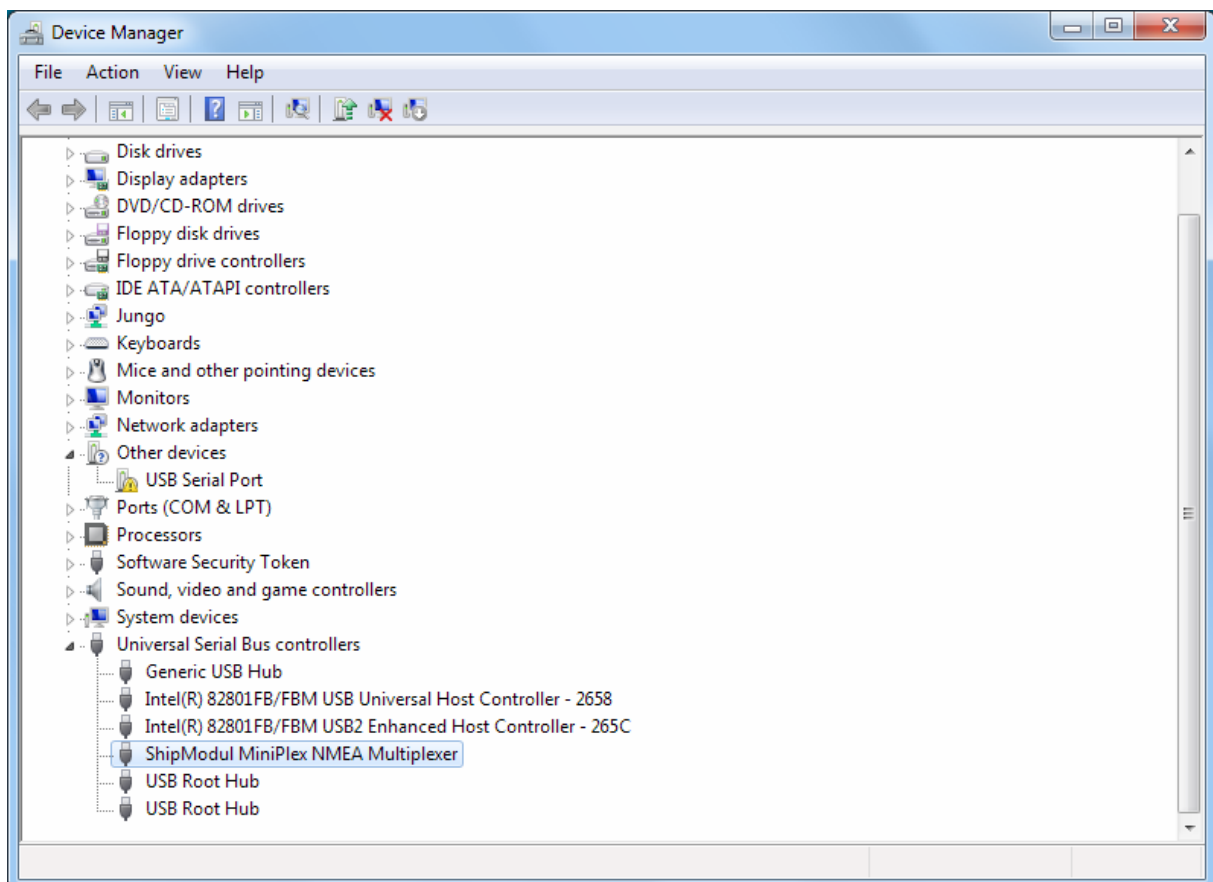


When Windows has successfully installed the driver, the following window appears:

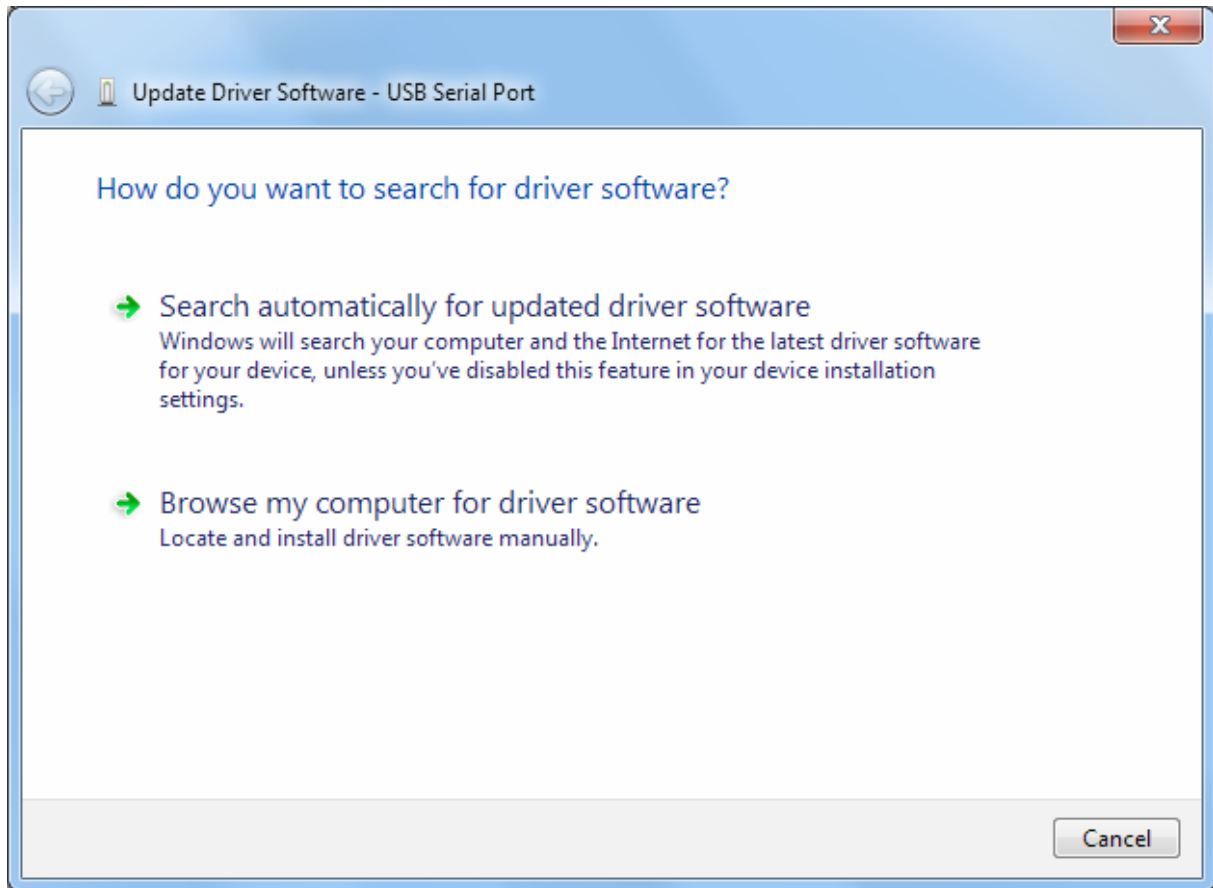


You can close this window.

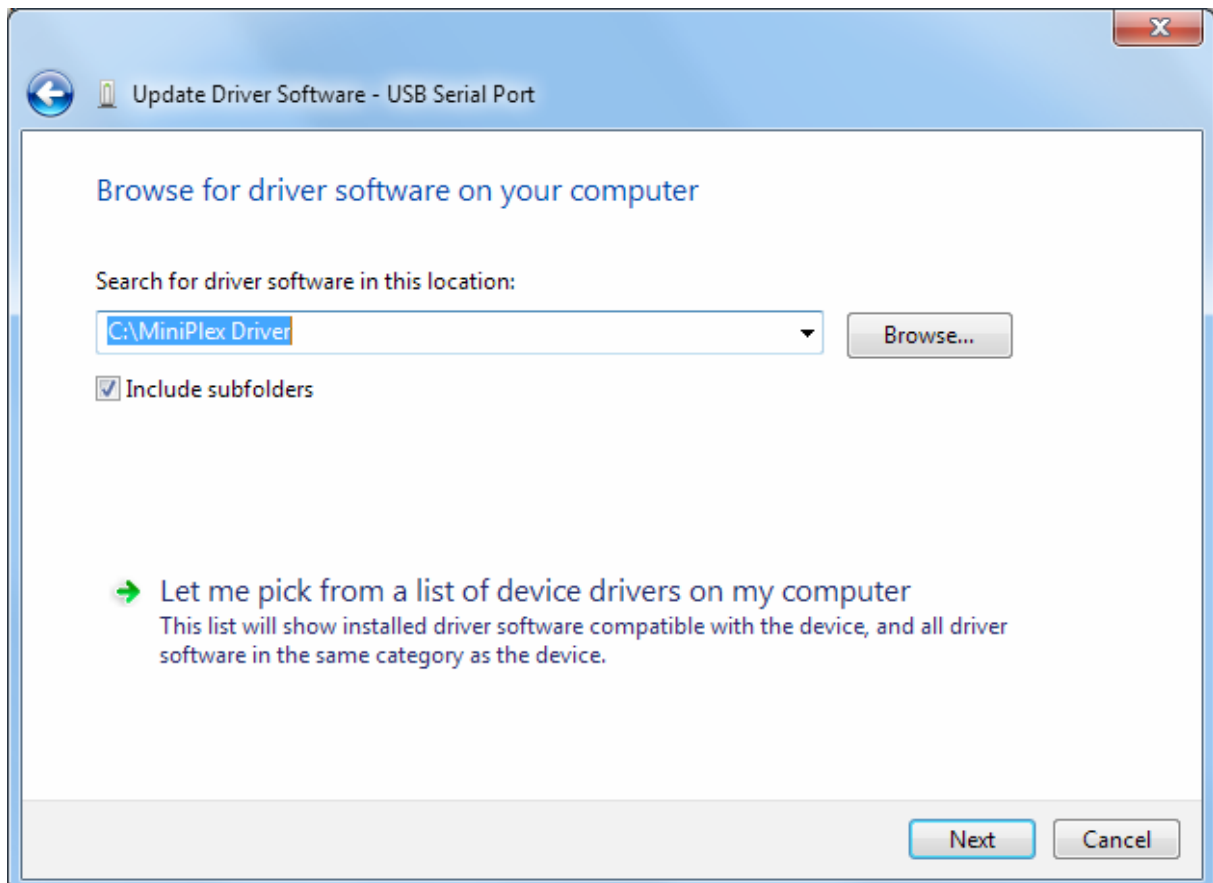
The Device Manager will now list an USB Serial Port under Other Devices:



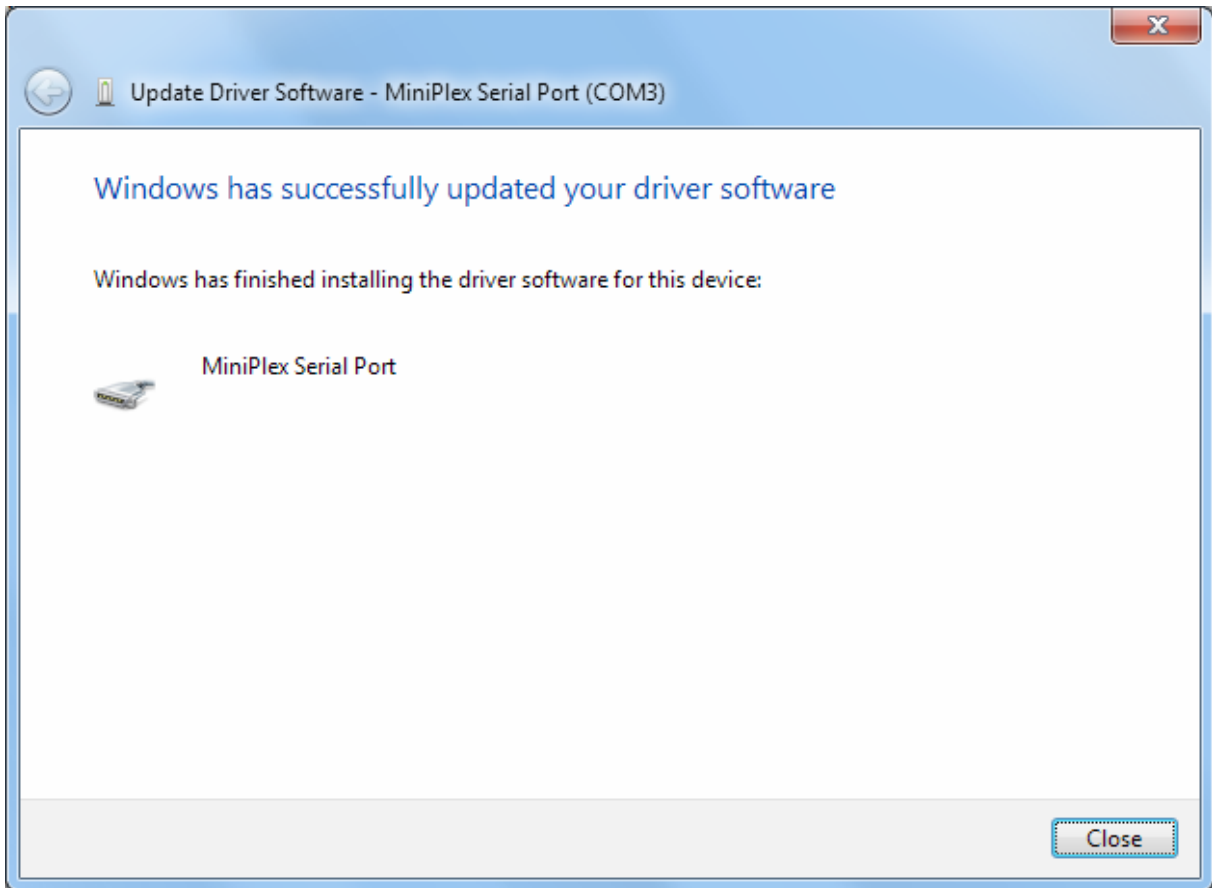
Right-click on the USB Serial Port entry and choose 'Update Driver Software...' from the menu that appears. This will open the following Window:



Choose 'Browse my computer for driver software'. In the following window, choose the location of the driver and press 'Next'.

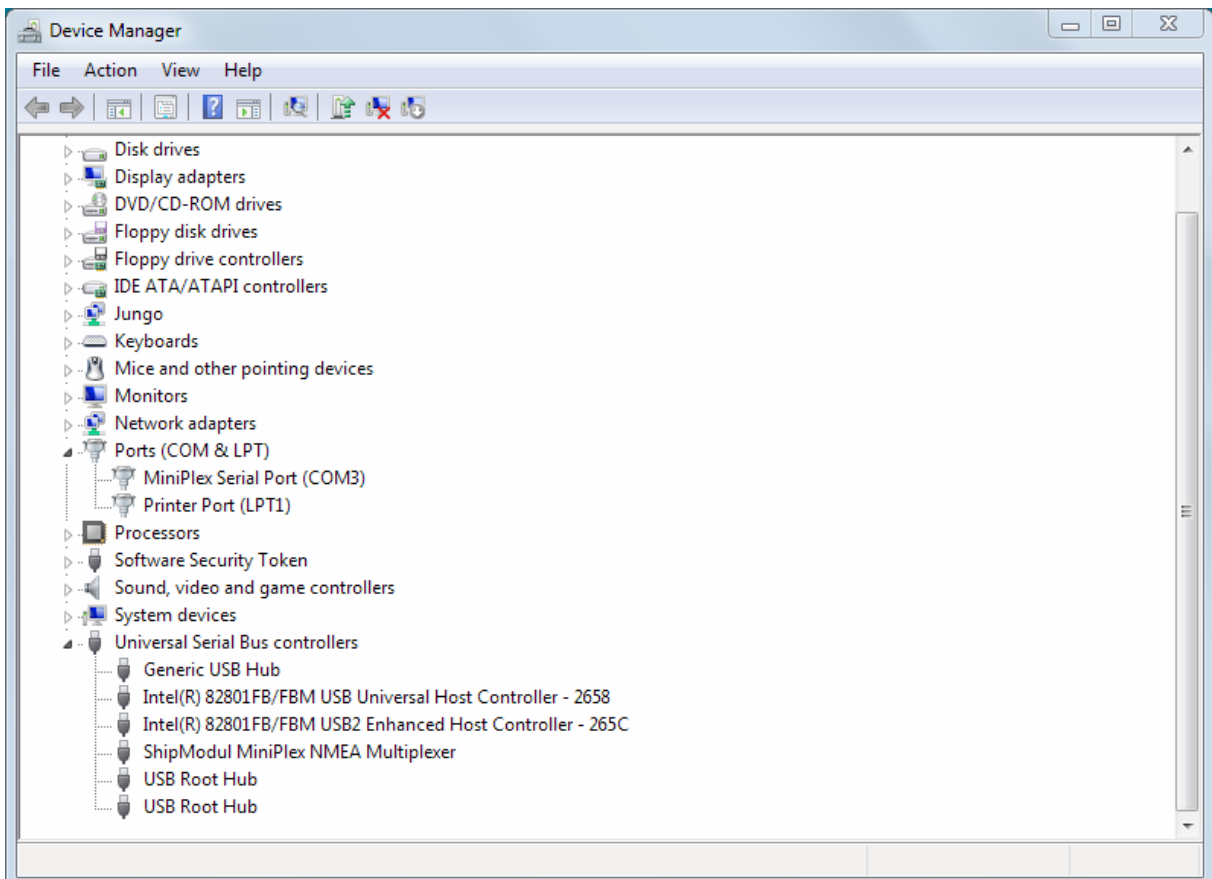


When Windows has successfully installed the driver, the following window appears:



You can close this window.

The Device Manager will now list a ShipModul MiniPlex NMEA Multiplexer under Universal Serial Bus controllers and a MiniPlex Serial Port (COMx) under Ports (COM & LPT).



Windows 2000/Vista/XP Installation

When the multiplexer is connected to a USB port for the first time, Windows will detect new hardware and prompts you for a driver. Insert the supplied CD into the drive and follow the instructions on your screen. Don't let Windows search the Internet for updated drivers. When asked to automatically search for drivers, answer no and choose the option to tell Windows where to find the driver. The driver can be found on the supplied CD, in the folder 'USB Driver'. This folder contains subfolders with drivers for various operating systems.

Windows will warn you that the drivers are not digitally signed and can pose a threat to the stability of Windows. Just ignore that warning and continue with the installation.

The installation on Windows is a two-step process. First, the driver for the multiplexer will be installed. Next, Windows will detect a USB Serial device and will install a second driver. On Windows XP systems, there can be a delay of up to 10 seconds between the installation of both drivers, which sometimes leads to the conclusion that the installation is complete after the first driver is installed which is not the case. On Windows Vista and Windows 2000 systems, there is only very little delay.

When the installation is complete, a new virtual COM port will be created. This COM port is shown in **MPX-Config** as **COMx (vcp)** where 'x' is a number. Select this port in your navigation software. The 'vcp' extension as shown in **MPX-Config** will not be visible in your navigation software.

If necessary, the number of this COM port can be changed in the Windows Device Manager. Click on the '+' sign next to the entry marked as 'Ports (COM & LPT)'. This will expand the entry to list all available COM ports on your computer. The port for the multiplexer is listed as 'MiniPlex Serial Port (COMx)' where 'COMx' is the name of the newly created serial port.

To change this port number, double click on the **MiniPlex Serial Port (COMx)** entry to open the property page for this port. Next, select the **Port Settings** tab and click on the **Advanced...** button. In the appearing window the used port number can be changed. Do not change any other setting in this window.

It is possible to select a port number that is already present on the computer, like COM1. The original COM1 port will then be disabled as long as the multiplexer is connected to the computer. This feature allows the port number to be set in a low range from COM1 to COM4, to accommodate software that only allows COM1 to COM4 to be selected.

More than one multiplexer can be connected at the same time. Every new unit will create a new virtual COM port. The number of the COM port will always be assigned to the same multiplexer regardless of the USB port being used.

Windows allows a maximum of 256 COM ports. However not all software may be able to select COM ports numbered above COM9.

When installing updated drivers, uninstall the original drivers first with the **Add/Remove Programs** icon in the Control Panel or use the **Update Driver** button on the **Driver** page of the **MiniPlex Serial Port** property-page.

Mac OS X Installation

The OS X driver is available as a disk image file (.dmg) and can be found on the supplied CD in the 'USB Driver' folder. Run the installer by double clicking on the icon. Follow the instructions on the screen and reboot the computer when asked.

When the computer has rebooted, plug in the multiplexer. Then open **System Preferences** and select **Network**. You should now get the message 'New Port Detected'. Click **OK** and select **Network Port Configurations** from the 'Show' list. The new port will be listed as **MiniPlex-xxxxxxx** where 'xxxxxxx' represents the serial number of the multiplexer. Enable the port by checking the **On** box and clicking **Apply Now**. You can now exit **Network** and use the multiplexer in your navigation software.

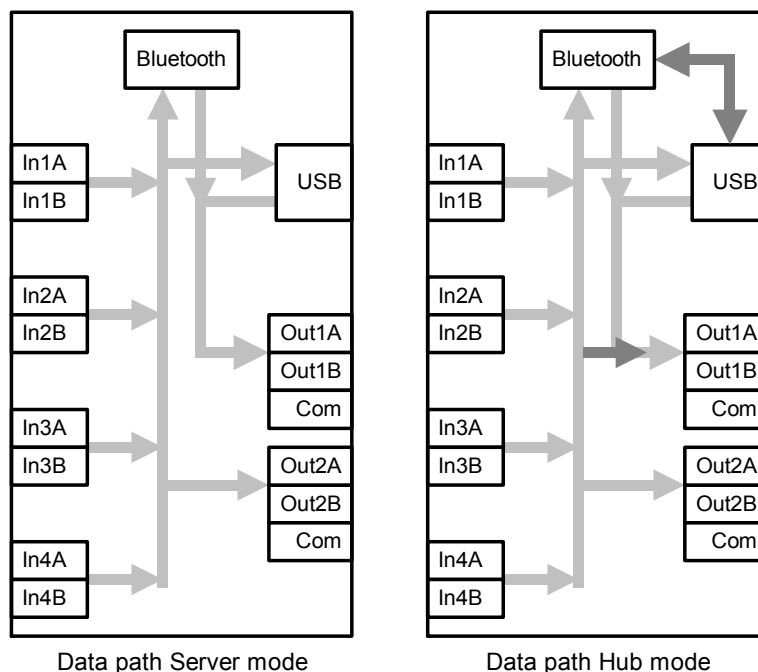
Data Throughput

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 speed settings of the listener and talker ports. Such a situation leads to an overflow of queues in 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.

The MiniPlex can be operated in two different modes called **Server** and **Hub** mode. These modes determine the flow of NMEA data to **Out1** and have a major impact on the data throughput. It is therefore very important to understand the difference between these modes.

In **Server** mode, data received on the listener ports **In1** to **In4** is sent to the USB port and the Bluetooth interface while data received on the USB port and the Bluetooth interface is sent to talker port **Out1**.

In **Hub** mode, data received on the listener ports **In1** to **In4** is sent the USB port and the Bluetooth interface *and* to talker port **Out1**, combined with the data that is received on the USB port and the Bluetooth interface. Data is also exchanged between USB port and the Bluetooth interface.



The pictures above show the flow of NMEA data in both modes. As you can see in **Server** mode, only a path exists from the USB port and the Bluetooth interface to **Out1**. In **Hub** mode, an extra path exists between the inputs and **Out1**, indicated by the darker arrow in the middle. **Out1** now outputs data that is received on the USB port and the Bluetooth interface *and* on the NMEA inputs. **Hub** mode also provides a path between the USB port and the Bluetooth interface as indicated by the dark arrow on the top-right.

The path from the inputs to the USB port, the Bluetooth interface and **Out2** is unaffected by the operating mode. These ports always output data received on the inputs. Port **Out2** can be used to send data to a chartplotter.

This leads to the different purposes of **Out1** and **Out2**: **Out1** is mainly used to control an autopilot. The autopilot needs steering information such as waypoint data, cross track error and heading. This information can either come from a GPS connected to an input of the multiplexer (**Hub** mode) or from a navigation program running on a computer connected to the USB port or the Bluetooth interface (**Server** mode). When a computer controls the autopilot, there is no need to send data from the inputs to the autopilot, possibly causing overflows because of the low speed of **Out1** (4800 Baud).

Out2 on the other hand, is mainly used to send data to a chartplotter. Especially when an AIS receiver or transponder is connected to the multiplexer, this output needs to be set to 38400 Baud. Most chartplotters also support this high speed.

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. When the MiniPlex is set to **Server** mode, this problem is quite easy to overcome: simply set the speed of **Out2** to 19200 Baud (1920 char/s) or higher. When **Out2** is not used, set it to the highest speed. When it is connected to a chartplotter, try to choose the highest speed the plotter will accept. In **Hub** mode however, the same data is also sent to **Out1**, which usually operates at 4800 Baud to control an autopilot. There is our bottleneck again!

However...

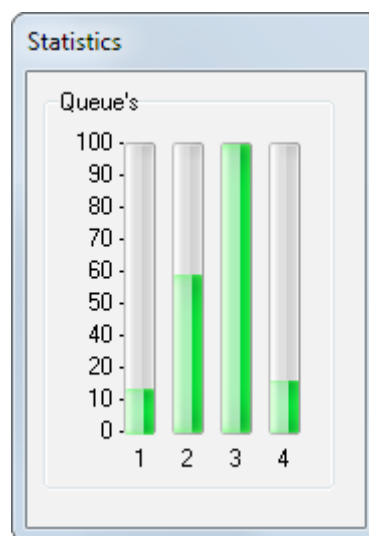
NMEA data tends to be sent in bursts. Some devices like depth sounders or wind instruments only send one sentence per second while a GPS may send bursts of up to 13 sentences every two seconds. While the average throughput over time may be low, an input might fill its queue quite rapidly when a burst 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. For example: if the multiplexer is in **Server** mode 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:

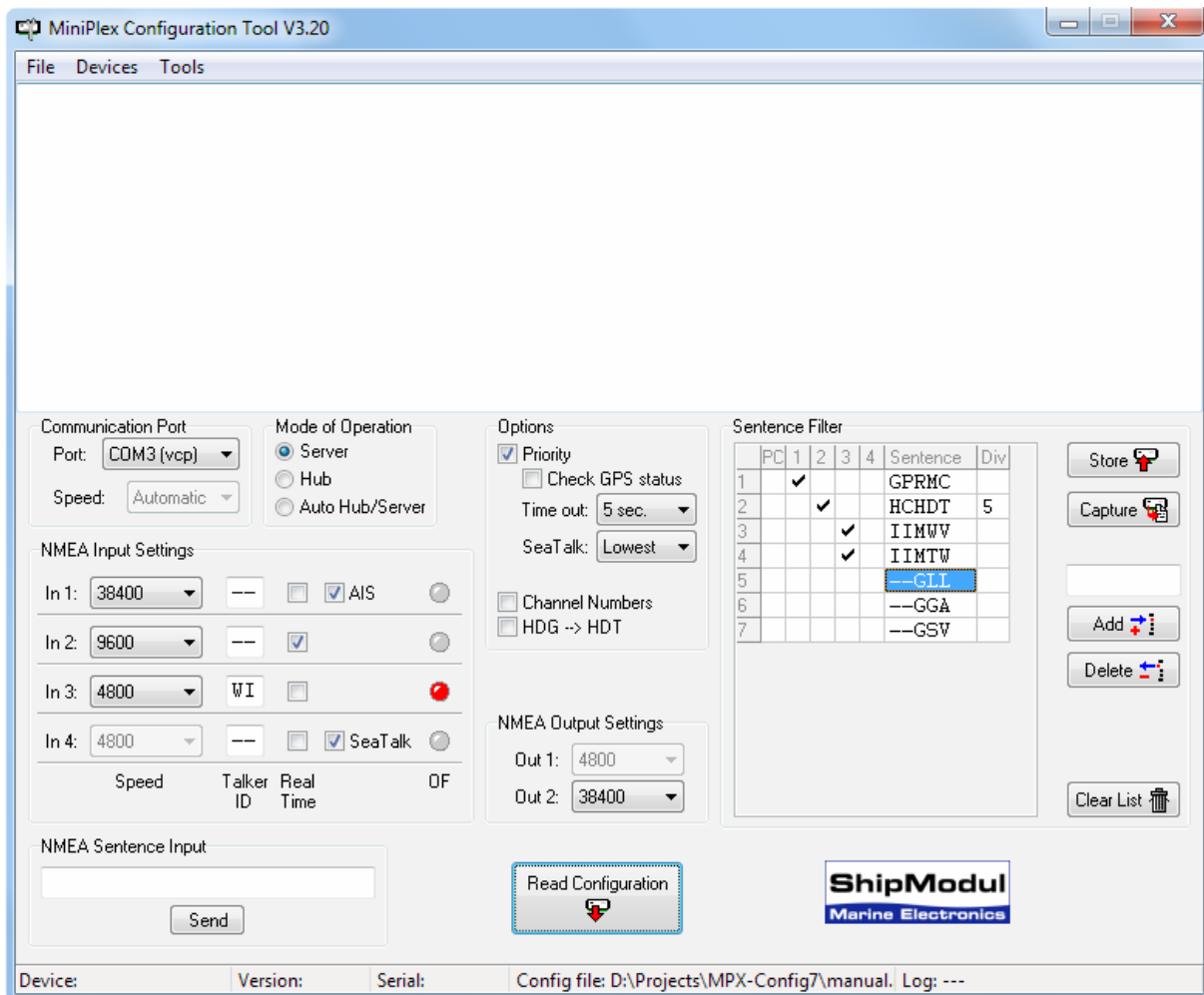
1. Configure the instruments on the listener ports to send less data or with greater intervals. GPS receivers can sometimes be configured for this.
2. Use the **Sentence Filter** of the multiplexer to block unwanted sentences. Unwanted sentences are discarded immediately and do not occupy queue space or bandwidth.
3. For sentences that should not be blocked, setting a divisor in the Sentence Filter may lower the 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. Set the operation mode of the multiplexer to **Server** mode (factory default). This mode only sends incoming data to the computer and to **NMEA Out 2**, which is factory set to high speed (38400 Baud). In **Hub** mode, the high-speed ports must wait for every character to be transmitted over any low speed ports.
5. Increase the speed of port **Out 2** on the multiplexer, especially when this port is not used. The maximum speed is 115200 Baud. From 19200 Baud and up (4 x 4800!) an overflow will never occur, except when the multiplexer is set to **Hub** Mode.

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:

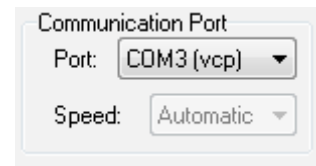
- Clear Screen** Clear the data area on the screen. New sentences will be displayed from the top.
- No Scroll** Normally, incoming NMEA sentences are displayed from the top down and when the bottom of the data area has been reached, all sentences are scrolled up one line before the new one is shown. 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 first 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

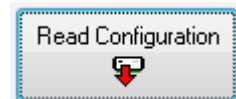
Before being able to configure the multiplexer, select the communication port to which the multiplexer is connected. This can either be the COM port of the Bluetooth interface or the virtual COM port of the USB driver. The USB COM port is marked with '(vcp)'. Since the speed setting has no relevance to the speed of the virtual serial port, the setting will show **Automatic** and will be disabled once the current configuration has been retrieved from the multiplexer.



If you exit MPX-Config, the port 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 has been selected, you need to do this manually after selecting the communication port.



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

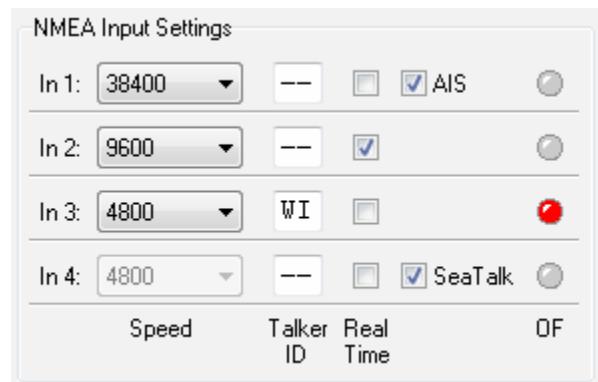
The status line on the bottom of the MPX-Config window will show the name of the multiplexer, the internal software (firmware) version and the serial number.

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 a horizontal section.

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.



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 -> NMEA** 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.

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 yet (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 end 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

AIS (Input 1 only)

This option enables AIS mode for input 1, in order to connect an AIS receiver or transponder to the multiplexer. It sets the speed of **In 1** to 38400 Baud and it prevents data received on **In 1** to be sent to **Out 1** when the multiplexer is in **Hub** or **Auto** mode.

It is very well possible to connect an AIS receiver or transponder to any input and set that input to 38400 Baud, but this requires the multiplexer to be set to Server mode to prevent the AIS data from being sent to **Out 1**, the port that is generally used to control an autopilot at 4800 Baud.

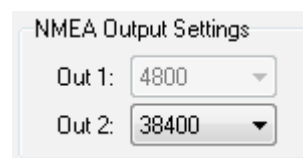
SeaTalk -> NMEA (Input 4 only)

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 which SeaTalk data is translated.

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

NMEA Output setting

This section allows you to set the speed of both NMEA outputs **Out1** and **Out2**. When you change the speed of **Out1**, the speed of **In4** will also change. **Out 1** is generally 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 -> NMEA** translation is enabled.



The image shows a software interface titled "NMEA Output Settings". It contains two dropdown menus. The first dropdown is labeled "Out 1:" and is set to "4800". The second dropdown is labeled "Out 2:" and is set to "38400".

Options

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

The screenshot shows a software interface with the following options:

- Priority
- Check GPS status
- Time out: 5 sec. (dropdown)
- SeaTalk: Lowest (dropdown)
- Channel Numbers
- HDG -> HDT

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 USB port input has 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 and XTE.

Time Out

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

SeaTalk

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

Channel Numbers

This option inserts input number sentences in the NMEA stream that is output by the multiplexer. Each NMEA sentence that is output on the USB port is preceded by the 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

```

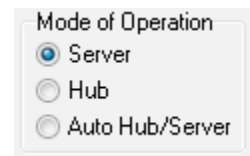
Channel numbers allow distinguishing between similar data from different instruments, like two depth sounders on the same boat.

HDG -> HDT

This option converts an HDG or HDM sentence (magnetic heading) into an HDT sentence (true heading). 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. This option can be used when a device like a Voyage Data Recorder needs a true heading from a gyrocompass while only a fluxgate compass is available.

Mode of Operation

The multiplexer can operate in three different modes: **Server**, **Hub** and **Auto Hub/Server**. Basically, these modes determine which NMEA data is available on **NMEA Out 1**.

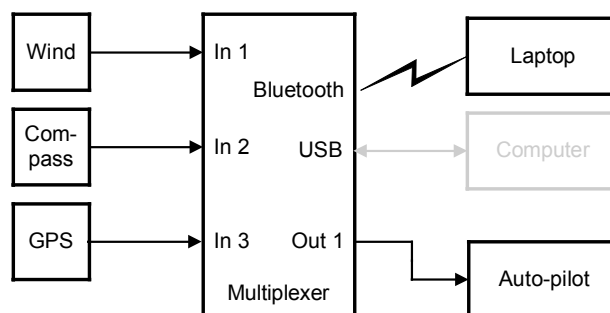


Server mode: In this mode, the combination of computer and multiplexer acts as an NMEA server. Incoming NMEA data from **NMEA In 1** to **In 4** is sent to the computer and **NMEA Out 2**. **NMEA Out 1** only outputs data received from the computer.

Hub mode: In **Hub** mode, the multiplexer acts as a hub where all NMEA data comes together and is sent out again. All incoming NMEA data from **NMEA In 1** to **In 4** and from the computer is available on **NMEA Out 1**. Incoming NMEA data from **NMEA In 1** to **In 4** only is available on **NMEA Out 1**. Data is also exchanged between the USB port and the Bluetooth interface. *This mode has one limitation: since the NMEA data is sent to multiple outputs on the multiplexer, the total throughput is limited by the speed of the slowest output. This may cause queue overflows!*

Auto mode: When **Auto Hub/Server** mode is selected, the multiplexer automatically switches between **Hub** and **Server** mode, depending on the presence of data on the computer interface. When the multiplexer receives NMEA data from the computer, it switches to **Server** mode. When no data is received from the computer for more than 10 seconds, the multiplexer will switch to **Hub** mode.

Auto mode 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 running navigation software is able to calculate the course to steer and drive the autopilot accordingly. Because the laptop is sending NMEA data, the multiplexer operates in **Server** mode and the autopilot on **NMEA Out 1** 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 switches to **Hub** mode and sends all data from the instruments directly to the autopilot. This way, the autopilot will receive course information directly from the GPS.

NMEA Out 2 is not affected by the mode setting. On this output, only NMEA data from the NMEA inputs is available.

Sentence Filter

The sentence filter is a powerful feature that allows you to specify exactly which NMEA sentence may be received on any channel, including the USB port. Up to 50 rules can be entered, either manually or by capturing the NMEA sentences received by the multiplexer on its inputs.

Each filter rule consists of the address field of an NMEA sentence (2 characters for the Talker ID and 3 characters for the Sentence Formatter like 'GPRMC') and a checkbox for each channel (Inputs 1 to 4 and the PC). Wildcards are allowed in the sentence formatter by using the '-' character. A wildcard will match any character. The checkboxes can be checked and unchecked by clicking on them. This determines whether that specific sentence will be passed or blocked by the multiplexer.

Whenever the multiplexer receives an NMEA sentence, the list of filter rules is traversed 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.

When no match is found, the received sentence is passed. This means that all sentences for which no rule exist, are passed through the multiplexer.

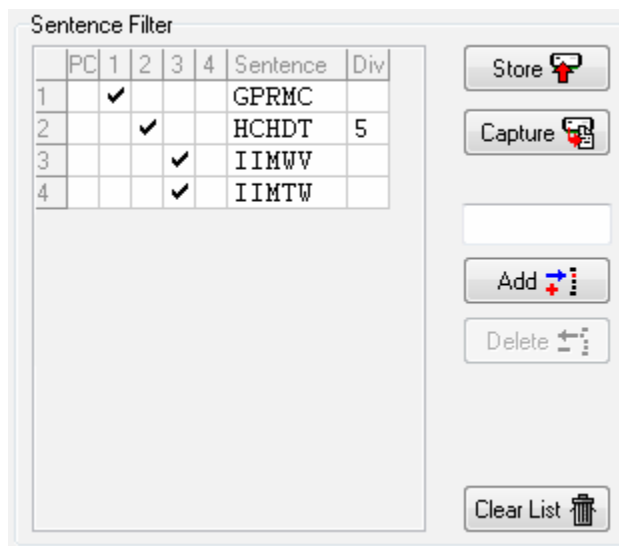
It is important to know that any **Talker ID** settings are applied to the NMEA sentences before applying the **Sentence Filter**.

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: 'RMC' on input 1, 'HDT' on input 2 and 'MWV' and 'MTW' on input 3.



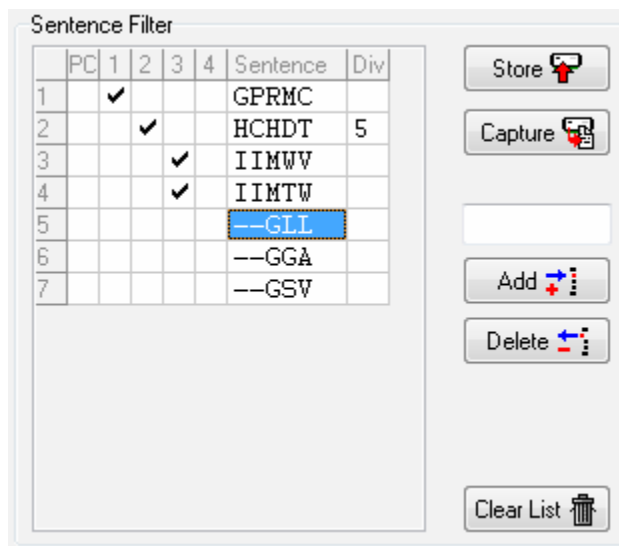
If you're not interested in the water temperature ('MTW'), uncheck the checkbox on that line. Clicking on the **Store** button sends the rule list to the multiplexer. Now the filter is operational. Please note that editing of the rule list is performed on the list in MPX-Config on your computer. After editing is complete, the rule list must be sent to the multiplexer by clicking on the **Store** button. Clicking on the **Read Configuration** button re-reads the rule list into MPX-Config.

Example 2

In the following example, some edits are made to the captured rule list of Example 1. A few rules with wildcards are added, a divisor factor is entered and the default operation of passing everything that is not in the list is changed to blocking everything that is not in the list.

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 is divided by 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, meaning 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 or RMC, regardless of the Talker ID.

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

As mentioned earlier, all sentences are passed for which no rule exists. It can be desired however to reverse this operation: block all sentences for which no rule exists. This can be achieved by adding an 'all wildcard' entry consisting of 5 dashes ('-----') to the end of the list with all inputs blocked. This entry acts as a 'catch-all' rule. When no match is found in the list, this last rule will always match any sentence and causes it to be blocked. This entry *must* be the last entry in the list. The multiplexer will not accept any rules after it has received an all wildcard rule.

Managing the list

The rule list is managed in MPX-Config and can be stored to or retrieved from the multiplexer. 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 management functions are available:

- Store** Stores the rule list from MPX-Config into the multiplexer. Any existing filter rules in the multiplexer are overwritten with the rules in the list.
- Capture** Enables capture mode. The rule list will be filled automatically with the NMEA sentences that are received by the multiplexer.
- Add** Add a filter 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 filter 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.
- Clear List** This button clears the rule list in MPX-Config (not 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 first selecting it with the cursor. Entering Edit mode can be done in different ways:

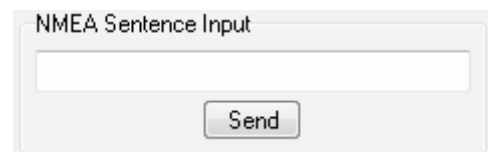
- Press function key 'F2'. This enters Edit mode with the cursor at the end of the text. Move the cursor around with the mouse or arrow keys.
- Press Enter or click with the cursor: This enters Edit mode with the text selected and the cursor at the end. Any character or number that is typed now will erase the existing text entirely unless the cursor is moved around with the mouse or arrow keys. This will unselect the text.

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

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.

The image shows a software dialog box titled "NMEA Sentence Input". It contains a single-line text input field that is currently empty. Below the input field is a button labeled "Send". The dialog box has a light gray border and a subtle drop shadow.

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 **NMEA Out1**.

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 USB port of the MiniPlex.

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

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

Choose **Update Firmware** from the **File** menu.

A file dialog opens which allows you to select the previously downloaded image file ending at an `.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.

Indicators

The multiplexer has two LED's. The green LED indicates the reception of valid NMEA data on the listener ports or the USB port. The LED 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 red LED indicates a queue overflow, in case more data is coming in than can be transmitted. See section 'Data Throughput' for options to resolve this situation.

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

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

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 a '.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\SerialPort
```

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 6.

```
[Configuration]  
Baud In1=1  
Baud In2=0  
Baud In3=0  
Baud In4/Out1=0  
Baud Out2=3  
Mode=0  
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  
AIS Mode=1  
Talker ID1=  
Talker ID2=  
Talker ID3=WI  
Talker ID4=  
[Filter]  
GPRMC=01000,  
HCHDT=00100,5  
IIMWV=00010,  
IIMTW=00010,  
--GLL=00000,  
--GGA=00000,  
--GSV=00000,
```

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

VER – Get Version

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

\$PSMDVER,3.00,MiniPlex-2USB/BT,10025943,8045*hh<CR><LF>

3.00: firmware version number

MiniPlex-2USB/BT: product descriptor

10025943: serial number

8045: 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

CN - Channel Number indicator

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

\$PSMDCN,x*hh<CR><LF>

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

hh: checksum

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

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,m,s,p,n,rrrr,h,a,t[*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⁾
- m: mode selector: 0 = Server mode
1 = Hub mode
2 = Auto mode
- 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: 1 = on, 0 = off
- 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
- a: AIS mode: 1 = on, 0 = off ³⁾
- t: Priority Timeout 0 = 1 sec.
1 = 2 sec.
2 = 3 sec.
3 = 5 sec.
4 = 10 sec.
5 = 30 sec.

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', 'm' and 's' are left blank while the fields for 'n', 'rrrr', 'h', 'a' and 't' 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).
- 3) In AIS mode, Input 1 is not routed to Out1 when in Hub mode.

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.

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.

FL – Filter

This sentence specifies a filter rule, which 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][*hh]<CR><LF>
```

cccc: Sentence formatter 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: Inputs to pass. Each 'x' represents an input to assign to this rule, numbered from 0 to 4, where input 0 is the computer interface and 1 to 4 represent NMEA inputs 1 to 4. A '1' means to pass, a '0' means to block. When all x'es are '1', the filter rule is removed.

dd: Optional divisor factor (0..99). This number divides the frequency of a sentence over time. If for instance a divisor of 6 is specified for a sentence, only every 6th sentence is passed. This can be used to reduce the output of a high-speed heading sensor.

hh: Optional checksum

A FL sentence without any parameters will erase all rules.

```
Example: $PSMDFL,GPRMC,10011<CR><LF>
```

This sentence specifies a rule for all sentences that have the 'GPRMC' sentence formatter. When this rule is applied, only 'GPRMC' sentences on inputs 0 (the computer), 3 and 4 are passed.

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*hh<CR><LF>  
$PSMDFL,GPGGA,10001,0*hh<CR><LF>  
$PSMDFL,--VWT,01000,5*hh<CR><LF>  
$PSMDFL,GPGSV,00001*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.

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.

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.

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
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
27	MTW	Water temperature
50	---	Latitude, value stored
51	---	Longitude, value stored
52	---	Speed over ground, value stored
53	RMC	Course over ground. RMC sentence is generated from stored values from 5x datagrams.
54	---	GMT time, value stored
56	---	Date, value stored
58	---	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 form 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.

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:	USB, 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 USB, 1 x Bluetooth).
Filter list size:	50 sentence types
Priority list size:	50 sentence types
NMEA Out 1:	Combined data from NMEA inputs, Bluetooth and USB port (Hub mode) or from Bluetooth and USB port only (Server mode)
NMEA Out 2:	Combined data from NMEA inputs.
Speed NMEA In 1-3:	4800 - 57600 Baud.
Speed NMEA In 4/Out 1:	4800 - 57600 Baud.
Speed NMEA Out 2:	4800 - 115200 Baud.
Indicators:	Overflow and Data.
Bluetooth range:	100 meters / 300 feet.
Bluetooth Device Name:	"MiniPlex-2USB/BT"
Bluetooth Pass Key (PIN):	"0000"
Bluetooth transceiver:	Type: TDK TRBLU20-00100, Class 1 device. FCC ID: PI4-TDK-BTISM. Canada: 1931-TDK-BTISM.
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-2USB/BT

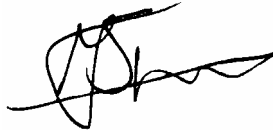
to which this declaration relates is in conformity with the following specifications:

EN/IEC61000-6-1:1997 and EN/IEC61000-6-3:1996
EN/IEC61162-1:2000
EN300328 and EN301489
FCC Title 47 CFR, Part 15, FCC ID: PI4-TDK-BTISM

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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