# ShipModul
## Marine Electronics

# MiniPlex-3 series NMEA 0183/2000 multiplexer Manual

**MiniPlex-3USB(-N2K)**

**MiniPlex-3E(-N2K)**

**MiniPlex-3Wi(-N2K)**

# Introduction

The MiniPlex-3 series NMEA multiplexers enable the connection of multiple NMEA 0183/2000 devices and a host device like a PC, a laptop or a tablet. All models share the same number of NMEA ports and features. They differ in the type of host interface, the interface that talks to the computer. Some models also have an NMEA 2000 interface.

This manual covers all models of the MiniPlex-3 series. There is a chapter for each type of host port. The remaining part of the manual covers NMEA 0183 connections and configuration, which are the same for all models.

We will also explain NMEA 0183 and how things connect (or not).

For all –N2K model there's a chapter about NMEA 2000.

# NMEA 0183

The NMEA 0183 Standard, a communication standard defined by the NMEA organization (www.nmea.org), defines a communication protocol called NMEA 0183 which enables navigation instruments and devices to exchange data with each other.

This way, a compass can send a heading to a radar to enable a north-up display, a GPS can send cross-track and waypoint information to an autopilot to steer a programmed course.

## NMEA Sentences

NMEA 0183 data consists of readable text sentences. If you would connect the output of a navigation instrument to the serial port of a computer and start a program that displays the incoming data, you would see something like this:

```
$GPGGA,143357.999,5301.0061,N,00635.5479,E,1,06,1.9,90.0,M,,,,0000*2E
$GPGGA,143357.999,5301.0061,N,00635.5479,E,1,06,1.9,90.0,M,,,,0000*39
$GPGLL,5301.0061,N,00635.5479,E,143357.999,A*22
$HEHDT,67.0,T*1E
```

This is plain text in a specific format defined by the NMEA 0183 standard. Every device that receives this information would know that the sentence starting with GPGLL originates from a GPS (hence the GP at the beginning of the sentence) and that it contains the geographic longitude and latitude (GLL).

The term "NMEA sentence" is used for NMEA data because it is made up of single lines of text. Throughout this manual, "NMEA sentences" and "NMEA data" will be used randomly.

## Talkers and Listeners

The NMEA 0183 standard defines talkers and listeners. A device that sends information is a talker and a device that receives information is a listener. When connected to each other, the talker sends information to the listener.

Communication using the NMEA 0183 protocol involves at least one talker sending data to one listener. Figure 1 on the right shows such a minimal system: a gyrocompass sends heading data to a radar.
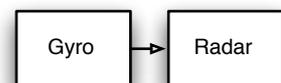
Figure 1

It is important to know that a talker or listener port is named after its function, not after what it is connected to. So, a talker port sends out information but it connects to a listener. This might be confusing at times so further in this manual we will use the terms input and output instead of listener and talker port respectively.

The NMEA 0183 standard specifies that a talker should have enough driving capacity to talk to four listeners. This is as easy to achieve as telling a story to an audience of four people - the only requirement is to talk loud enough.
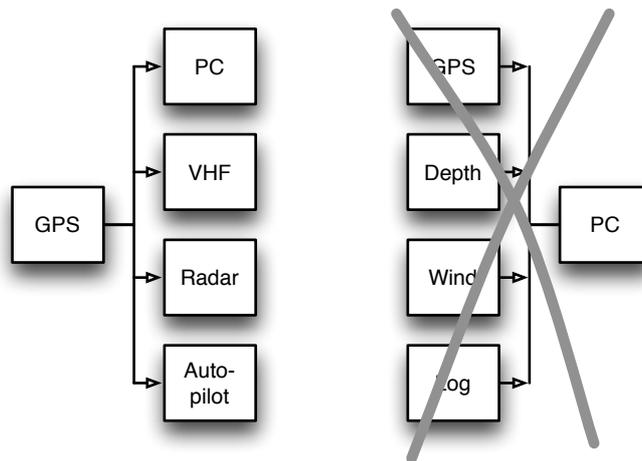
Figure 2

The left part of Figure 2 shows such a situation: one GPS sends data to four devices.

It gets complicated when several talkers must send data to one listener (the PC) as shown in the right part of Figure 2. Unless that listener has multiple inputs, this is not possible without help.

Simply connecting multiple talkers to one listener as shown is like four people simultaneously telling you a different story. You can make neither head nor tail of it. In electronics terms: the outputs of the talkers will 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 listener ports, each acting as a listener connected to a single talker. It also has at least one talker port that transmits the combined data from the inputs to a listener. So, what seemed impossible in Figure 2 is possible when a multiplexer is added as shown in Figure 3. The multiplexer listens to the instruments by receiving NMEA sentences simultaneously and forwarding them sequentially to the PC.



Since a PC can do so much more than just displaying the combined data, it soon became apparent that a multiplexer needs more than just a few inputs and one output. The single talker port that connects to the PC became a bi-directional host port, being input and output at the same time. A few extra talker ports made it possible to send data to other devices and to drive an autopilot.
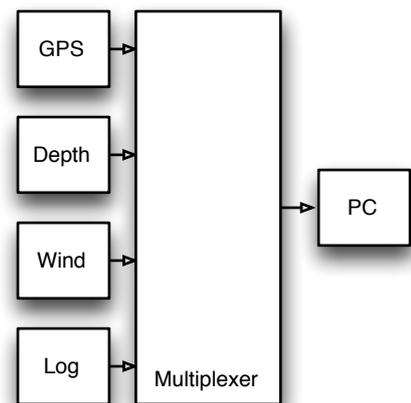
Figure 3

## The Host

NMEA 0183 devices already existed before it was common practice to use a computer for navigation. Of course, there were ECDIS systems (Electronic Charting and DISplay), but these were used only on commercial ships. Nowadays it is very common to use a computer, a laptop or a tablet as a charting device while the navigation software sends information to an autopilot to automatically follow a programmed route. This computer, laptop or tablet becomes a navigation host and what used to be a talker port on the multiplexer is now called a host port. The multiplexer becomes the central interface that listens and talks to all navigation instruments and devices.

Throughout this manual, the common term Host is used for a PC, laptop, smartphone, tablet or any device that is connected to the multiplexer to send and receive NMEA data for processing and display.

The host interface or host port is the interface that connects to these devices and this can be a USB, Ethernet or WiFi interface.

# The MiniPlex-3 Multiplexer

The MiniPlex-3 multiplexer is an advanced NMEA 0183 multiplexer with four NMEA inputs or listener ports, two NMEA outputs or talker ports and one or two host interfaces.

It combines NMEA sentences that are received on the NMEA inputs and it can send these sentences to the NMEA outputs and to the host interface(s). These host interfaces can also be used to send NMEA sentences back to the multiplexer to be forwarded to its NMEA outputs and to send commands to configure the multiplexer.

Figure 4 shows a typical setup where the MiniPlex-3 is used to combine data from four instruments, send it to a PC and, depending on the configuration of the MiniPlex, send the same data to an autopilot and a repeater display. The PC is also capable of controlling the autopilot to steer a programmed route and to display information such as distance to next waypoint on the repeater display.
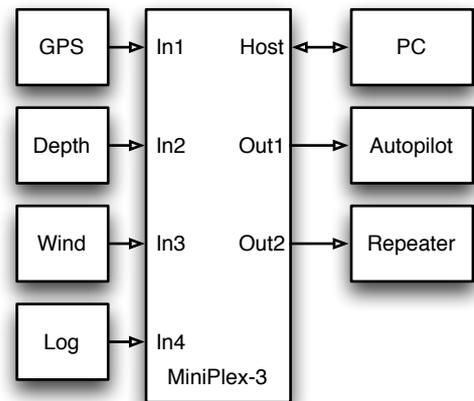


Figure 4

## Galvanic Isolation

Every NMEA input and output of the MiniPlex-3 is galvanically isolated, sometimes called opto-isolation because opto-couplers are used to achieve this isolation. An opto-coupler is an electronic component that transports information by means of light instead of electricity, thus creating a barrier for electrical currents and voltages.

Galvanically isolated inputs and outputs prevent unwanted flow of electrical currents between instruments and the multiplexer. These currents could damage the instruments or interfere with radio signals and should therefore be avoided. Galvanically isolated inputs are required by the NMEA 0183 standard. As an extra measure of protection, the MiniPlex-3 also has galvanically isolated outputs.

The host port of the MiniPlex is also galvanically isolated to protect 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. The outputs are also galvanically isolated. The NMEA 0183 standard does not require this but we added isolation because it makes the outputs more universal when it comes to connecting them to different kinds of inputs (NMEA 0183/RS-422 or RS-232).

## NMEA 2000

Some models in the MiniPlex-3 range (the ones ending on '-N2K') are equipped with an NMEA 2000 interface to connect to an NMEA 2000 backbone with other navigation instruments. The MiniPlex-3 will translate NMEA 2000 PGN's (messages) into NMEA 0183 sentences and vice versa. This feature enables a seamless integration between NMEA 0183 and NMEA 2000 navigation devices. It also allows navigation software, which usually only supports NMEA 0183, to receive data from NMEA 2000 devices and to control NMEA 2000 autopilots. Figure 5 shows a typical setup, which makes the data from the GPS/plotter available to the PC and a repeater. Similarly, the data from the Depth, Wind and Log instruments and the PC will be sent onto the NMEA 2000 backbone for use by the GPS/plotter and the autopilot.
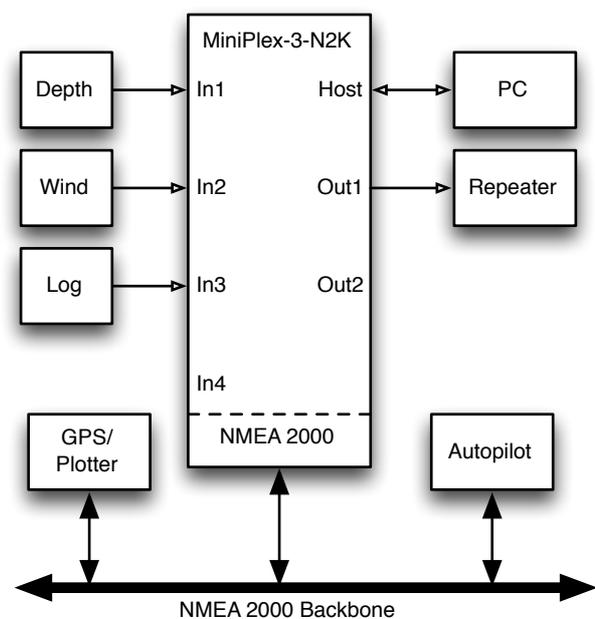


Figure 5

## Feature Set

Besides the basic functionality of combining NMEA sentences from multiple sources, the MiniPlex-3 offers a range of features like sentence filtering and routing, input priority with automatic switchover, testing of data integrity, NMEA 0183 conversions, Talker ID modification and SeaTalk® to NMEA translation.

The MiniPlex-3 can be integrated seamlessly into an existing Raymarine SeaTalk[1] network when SeaTalk mode is enabled. This mode changes NMEA In1 into a bi-directional SeaTalk[1] port. When connected to a

Raymarine SeaTalk network, the multiplexer will share all data between all 3 buses: SeaTalk[1], NMEA 0183 and NMEA 2000: Received SeaTalk[1] data will be converted and transmitted as NMEA 0183 and NMEA 2000 while at the same time, NMEA 0183 and NMEA 2000 will be converted into SeaTalk[1] data.

All MiniPlex-3 models have the same features and number of NMEA inputs and outputs. The only difference between each model is the type of host port. The following chapters describe the details of each host port.

# Host Port

The host port is the port that connects to a PC, laptop, smartphone, PDA, tablet or any device that is connected to the multiplexer to receive the combined NMEA data for processing and display. Throughout this manual, the Host port will be used to describe any of the interfaces USB, Ethernet or WiFi. The type of the available host(s) port differs for each type of multiplexer.

The host port is always bi-directional: it delivers the combined NMEA 0183/2000/SeaTalk data from the multiplexer to the host in the form of NMEA 0183 sentences. At the same time, it can receive NMEA 0183 sentences from the host, which are sent to the NMEA outputs and converted into NMEA 2000 and SeaTalk. The host port is also used to configure the multiplexer and to update its firmware.

The following chapters describe each type of host port. The applicable type of multiplexer is listed underneath the caption.

# USB Port

**(MiniPlex-3USB, MiniPlex-3USB-N2K)**

The USB port is galvanically isolated from the multiplexer to prevent ground loops when connected to a computer. Ground loops can result in excessive currents in ground connections, which could destroy the multiplexer or the serial port of the connected computer.

Because of this galvanic isolation, a MiniPlex-3 with a USB port will not be powered from the USB bus unlike older MiniPlex models. The MiniPlex-3 always requires a separate power supply to operate. The USB port circuitry however does receive its power from the USB bus. A computer will therefore always show a virtual COM port when the multiplexer is connected, with or without power supply.

The USB port supports flow control. With a waypoint activated, a navigation application can send many sentences at a time to the multiplexer to control an autopilot. The same happens, when uploading waypoints and routes through the multiplexer to a GPS.

Since the communication speed of the USB interface is 10 to 100 times higher than an NMEA 0183 output, this will cause the host buffer in the multiplexer to fill very rapidly. Eventually, sentences will be lost.

To prevent this loss of sentences, the navigation application must support hardware flow control (CTS/RTS). This allows the multiplexer to suspend the flow of data when the host buffer in the multiplexer is almost full. Unfortunately, not all applications support this. The multiplexer therefore has a larger host buffer to prevent overflow in such cases.

Flow control settings can be found in the communication port settings of your software, and is often called "flow control" or "handshake". Set the flow control to "Hardware" or "CTS/RTS". Do not use "Xon/Xoff" flow control. The latter uses special characters instead of a hardware signal. These characters are not part of the NMEA standard and therefore not supported by the multiplexer.

## Driver Installation

To use a MiniPlex-3 with a USB port, a driver must be installed. This driver creates a virtual COM port, which can be opened by navigation software.

The CD contains drivers for Microsoft Windows (Windows 2000, XP, Vista, 7, 8 and 10) and Apple's Mac OS X.

### Windows 7 and up

When the MiniPlex is connected to the computer for the first time, Windows will automatically download the most recent drivers from the Windows Update Service if an Internet connection is available. Without Internet connection, these drivers must be installed manually.

To install the drivers for the MiniPlex manually, open the Control Panel, choose "System and Security" and then "Device Manager".

The Device Manager will show a "ShipModul MiniPlex-3USB" listed under "Other Devices" as shown in Figure 6.
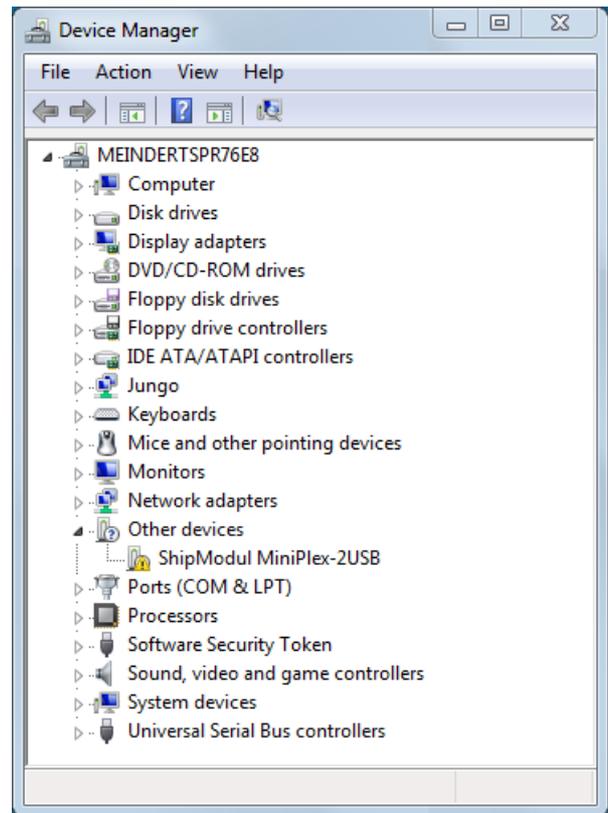


Figure 6

Right-click on the MiniPlex entry and choose "Update Driver Software..." from the menu that appears. This will open the window as shown in Figure 7.

Choose "Browse my computer for driver software".
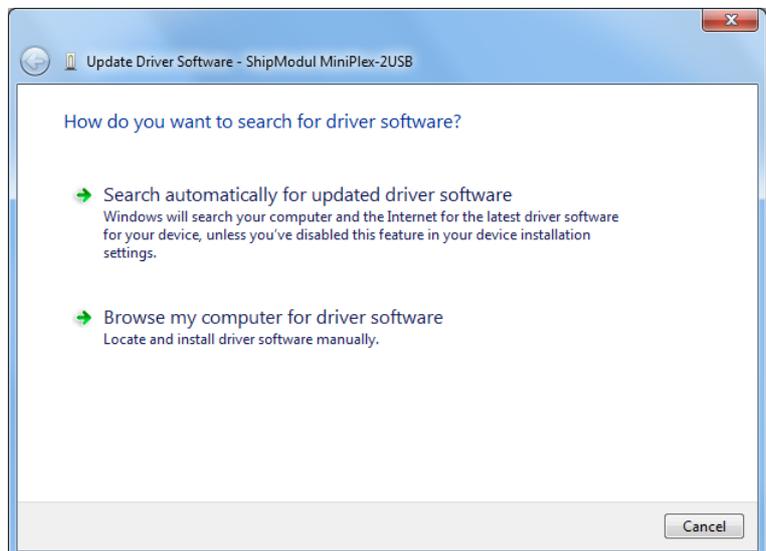


Figure 7

A new window opens (Figure 8) where you must choose the location of the driver. The driver is located in the subfolder "\USB Driver\Windows" on the MiniPlex Driver & Utility CD.

If you click on "Next", Windows will install the driver.
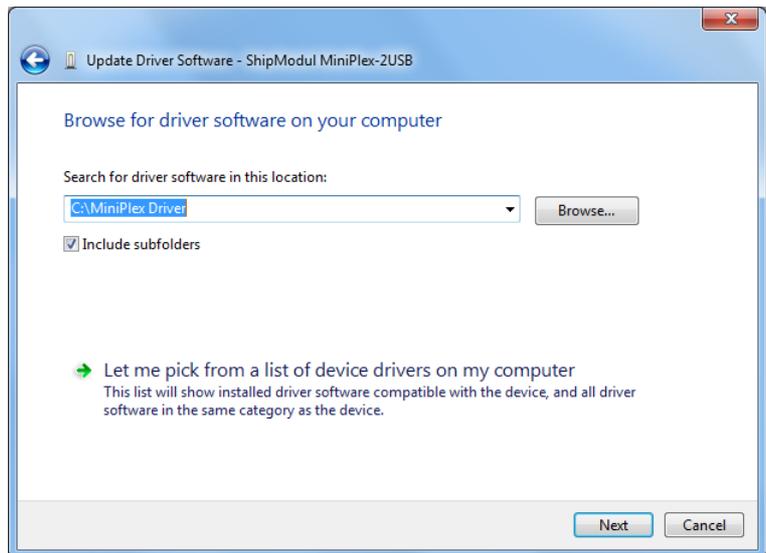
Figure 8

When Windows has successfully installed the driver, the window as shown in Figure 9 appears.

You can close this window.
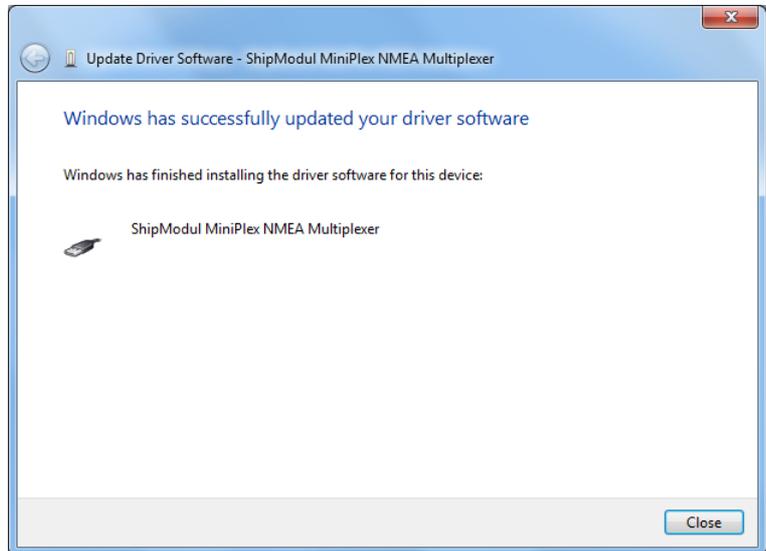
Figure 9

The Device Manager will now list a "USB Serial Port" under "Other Devices" (Figure 10). For this port to work, a second driver needs to be installed.

Right-click on the USB Serial Port entry and choose "Update Driver Software..." from the menu that appears. This will open the window as shown in Figure 11.
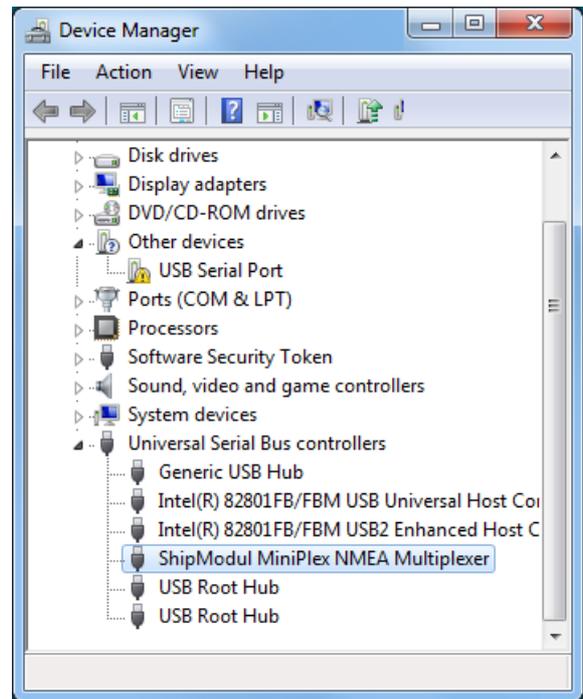


Figure 10

Choose "Browse my computer for driver software".
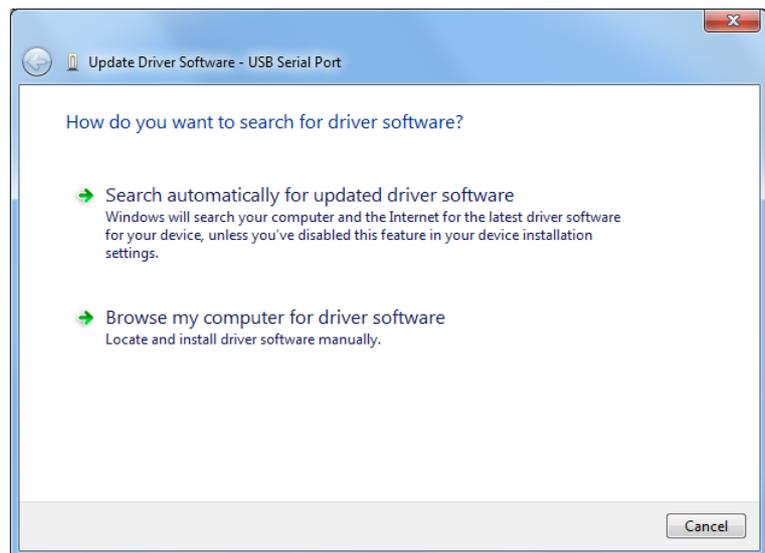


Figure 11

A new window opens (Figure 12) where you must choose the location of the driver again. This time, the location is already set and you can click on "Next".
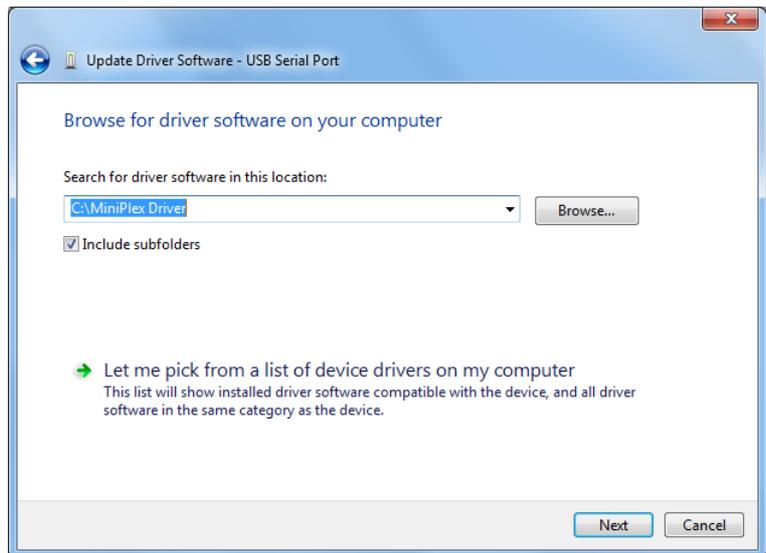
Figure 12

When Windows has successfully installed the driver, the window as shown in Figure 13 appears.

You can close this window.

Figure 13

The Device Manager will now list a "ShipModul MiniPlex NMEA Multiplexer" under "Universal Serial Bus controllers" and a "MiniPlex-3 Serial Port (COMx)" under "Ports (COM & LPT)".

Figure 14

12
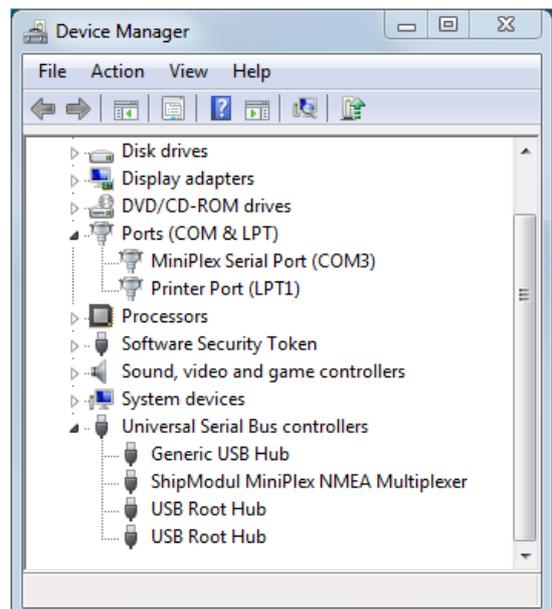
## Windows XP

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. If you have an Internet connection, you can let Windows search the Internet for updated drivers. Otherwise, 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 de folder "\USB Driver\Windows"

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 wrong conclusion that the installation is complete after the first driver is installed. 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.

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-3 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 assigned 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 if 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. Once created, 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

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. When the installation is complete, plug in the USB cable of the MiniPlex. The MiniPlex will show up in the ports list of your navigation software as MiniPlex-xxxxxxxx where the xx's represent the serial number of the MiniPlex.

# Network Basics

A network interface connects the multiplexer directly to a network with possibly more than one device. In general, there can be more than one multiplexer connected to a network and/or more than one device that needs to communicate with a multiplexer.

To understand how a networked multiplexer works and how to connect to it, it is necessary to know a little bit about IP addresses, port numbers and protocols.

## IP Address

Every device on a network has a unique number to be able to identify that device. This allows us to send a message to one single device on a network. These numbers are called MAC addresses. Every device in the world that is connected to a network has such a MAC address. The MAC address of a device is sometimes printed on a label and looks like this:

00-20-4A-E4-28-58

These addresses are a bit cryptic and not easy to work with. Therefore, a mechanism is used to assign an easier to read number to a device, called an IP address. An IP address consists of four numbers grouped together, separated by dots. Each number can range from 0 to 255. An IP address looks like this:

192.168.1.45

Assigning an IP address to a device could be compared to sticking a coloured label to your house. Now the postman only needs to remember the colour of your label instead of your complete address. Of course, someone needs to manage a list that matches the colour to your address to prevent two houses of receiving the same coloured label. Networks and network devices have mechanisms built in that take care of this so we don't have to worry about it (it's called ARP or Address Resolution Protocol).

## Netmask

Another tricky bit of networking is a netmask. A netmask basically determines which part of an IP address is the network address and which part is the device address. In its most basic form, a netmask consists of four numbers, like an IP address, that are either 255 or 0. And the 255's always come first. A device always has an IP address AND a netmask, for instance:

192.168.1.45 and 255.255.255.0

This combination of IP address and netmask tells us that the first three numbers of the IP address are the network address (192.168.1) and the fourth (45) is the device's address. It also means that this combination limits the number of devices on this network to 254 (0 and 255 are reserved).

A network address allows us to send a single message to all devices on the network, instead of sending it to one single device. This is called a *broadcast* (see below). In this example, the broadcast address is 192.168.1.255. The last number here is 255, which means that it targets all devices on the network.

If we have an IP/netmask combination of 192.168.1.45/255.255.0.0, it means the network address is 192.168 and the device's address 1.45, that there are 65534 possible devices (0.0 and 255.254 are reserved) and that the broadcast address is 192.168.255.255.

If you're completely lost at this point, don't worry. Just remember two things:

- All devices on a single network must have the same netmask
- All devices on a single network must have the same network address

So, when the netmask for example is 255.255.255.0, the first three numbers of the IP addresses must be the same.

## Port Number

A port number can be seen as a sub address within one single device. When a message is sent over the network, it always contains the IP address of the sender, the IP address of the receiver and a port number. This port number is just a logical number that determines the type of data in the message.

Web servers for instance, always listen to messages that have port number 80. If you start your web browser and enter the name of a web site, the request to show the contents of a page is sent to a web server using port number 80. Similarly, your mail program always uses port number 110 to retrieve mail from a mail server and port number 25 to send mail to a mail server.

The use of different port numbers allows us to use the same physical device on a network for different services.

Port numbers are not chosen arbitrarily, they are standardized and controlled by an organization called IANA.

Our multiplexers all use port number 10110, which is a registered port for NMEA data.

## Protocols

Two transport protocols are available for sending data over the network: UDP and TCP. UDP can be used in two different modes: Broadcast and Directed.

### UDP Broadcast

NMEA sentences are broadcast on the network using UDP messages. Every device on the network will receive these messages. At the same time, any device on the network can send data to the multiplexer, either to its IP address (directed) or as a broadcast. UDP Broadcast has the following properties:

- Every device on the network will receive NMEA data from the multiplexer.
- Every device on the network can send NMEA data to the multiplexer.
- Other MiniPlex-3E/2Wi's on the same network will also receive each other's data. It is therefore possible to send NMEA data over the network from NMEA device to another. Care should be taken to prevent buffer overflows by selectively routing the desired NMEA data to an NMEA output at the receiving end and blocking unwanted NMEA data.
- Routers do not pass UDP Broadcasts from one network to another so this mode can only be used on one network.
- Delivery of NMEA data is not guaranteed, messages can be lost.
- Wi-Fi routers often assign a low priority to UDP broadcasts, resulting in dropped messages. Typically, up to 5% of the messages gets lost.

### UDP Directed

With directed UDP data is sent to a specific IP address. The advantage is that it travels across routers and networks and can therefore also be used to send NMEA data over the Internet. Any device on the network can send data to the multiplexer either to its IP address (directed) or as a broadcast. Directed UDP has the following properties:

- Travels across routers/networks and the Internet.
- Higher change of delivery than UDP broadcast.
- Every computer on the network can send NMEA data to the multiplexer.
- Only one computer can receive NMEA data from the multiplexer.
- Delivery of NMEA data is not guaranteed, messages can be lost.

### TCP

When using TCP, a device sets up an exclusive connection with the MiniPlex. The TCP protocol is reliable, which means that when data gets lost on the way from one device to another, it is automatically retransmitted. Both the MiniPlex-3E and the MiniPlex-3Wi are limited to one TCP connection at a time.

TCP has the following properties:

- Travels across routers/networks and the Internet.
- Only one computer or similar device may communicate with the multiplexer.
- Reliable connection. Lost messages are automatically retransmitted.

Although TCP might seem the best option from the above, it is favourable to use UDP. Compared with TCP, UDP will minimize network bandwidth. To send periodically updated sensor data, it is usually more appropriate to NOT use a guaranteed-delivery protocol like TCP. In navigation applications, the best thing to do in the rare event that a message doesn't get through is to simply wait for the next message. The TCP protocol forces retries which increase network traffic unnecessarily.

UDP resembles NMEA the most because NMEA is also a message based broadcast protocol without any acknowledgements or retries.

# Assigning IP addresses

When devices are connected to a network, they all must have a unique IP address and a matching netmask. One way of achieving this is to set the IP address and netmask of each device manually. The other way is to let a DHCP server take care of this.

DHCP is an acronym for Dynamic Host Configuration Protocol and it is a mechanism to automatically assign IP addresses to devices (hosts) on a network. A DHCP server on a network will respond to requests from DHCP clients to obtain an IP address.

In a typical network environment, a router acts as a DHCP server while other devices such as computers, laptops, tablets and smartphones are DHCP clients, receiving IP addresses from the DHCP server. This ensures that you can connect these devices to the network without worrying about IP addresses, netmasks and gateways - all of this is taken care of by the DHCP server.

The MiniPlex-3Wi acts as a WiFi access point with a DHCP server built-in. When a device joins its WiFi network, it will automatically receive an IP/netmask from the MiniPlex-3Wi. The only thing you need to do is to enter the fixed IP address of the MiniPlex-3Wi (10.0.0.1) in your navigation software.

The MiniPlex-3E is completely different in this respect. It has a DHCP client and thus relies on a DHCP server already present on the network to obtain an IP/netmask automatically. If no DHCP server is present, you must manually assign an IP/netmask. This is the case for instance, if your "network" is just the MiniPlex-3E and a computer. Obviously, you will need to assign a manual IP address and netmask to your computer too in this case.

**Auto-IP**
When DHCP request remains unanswered, a device assigns itself an IP address in the range of 169.254.0.0 to 169.254.255.254 with netmask 255.255.0.0. This is called an Auto-IP address. Although two devices with an Auto-IP address on the same network can perfectly communicate with each other, this is not a desired situation because these addresses are assigned totally at random. So, every time a device powers up, the address changes within the Auto-IP range and you'll never be sure of its IP address. Also, the time it takes for a device to auto-assign varies wildly from a few seconds to over a minute.

# Ethernet Interface

**(MiniPlex-3E, MiniPlex-3E-N2K)**

If you are going to use a MiniPlex-3E, it is important to know whether your network has a DHCP server or not. If you have a router or a WiFi Access Point, it is most likely that they have a DHCP server enabled. In this case, you don't need to manually assign a fixed IP address to the MiniPlex-3E if the following conditions are met:

- The DHCP server always assigns the same IP address to the same MAC address
- The DHCP pool of free addresses will never be exhausted

This ensures that the MiniPlex-3E will always get the same IP address. The best practice however is to assign a fixed IP and netmask to the MiniPlex-3E.

To find the MiniPlex-3E on the network, first select UDP or TCP with the Port selector in the "MiniPlex Connection" box. After this, the Tools menu will show a "MiniPlex-3E" sub-menu. From this sub-menu, select "Search…"

This will bring up a window showing the MiniPlex-3E's found on the network (Figure 15). In this case, there's only one and its IP address appears to be 192.168.1.250. The cryptic number in brackets is the MAC address of the multiplexer, which is also printed on the serial number label. If you select this entry and click OK (or double-click on the entry), the window closes and the IP address is transferred to the Host field in the "MiniPlex Connection" box. At this point you can click on the Connect button to open a connection with the multiplexer and the MPX-Config3 window should show some NMEA sentences in the NMEA viewer.



Figure 15

If the listed address is an Auto-IP address in the 169.254.x.x range, select the listed entry and click on the "Change IP Address" button to assign a sensible IP address to the MiniPlex. When done, the window will show the MiniPlex with the newly assigned address and it can be selected for normal use. You can use the "Factory Reset" button to restore the network settings to its factory defaults if necessary (DHCP and UDP broadcast).

If you're happy with the DHCP assigned IP address and the default UDP mode, there is no further network configuration required and you can proceed with the normal multiplexer configuration as outlined in chapter "MPX-Config3" on page 36.

To change any of the network settings, make sure the IP address of the multiplexer is in the Host field in the "MiniPlex Connection" box and select menu Tools -> MiniPlex-3E -> Network Setup… This will open the "MiniPlex Network Settings" as shown in Figure 16.

These are the factory default settings. The IP address shown here is 0.0.0.0, which means the multiplexer is set to DHCP. This address is different from what you have entered in the Host address field on the main window because that is the address that the MiniPlex received from the DHCP server.



You can now enter the desired IP address and a netmask that matches your network. The Gateway IP can be left to 0.0.0.0 if you are not going to set the multiplexer to UDP Directed.
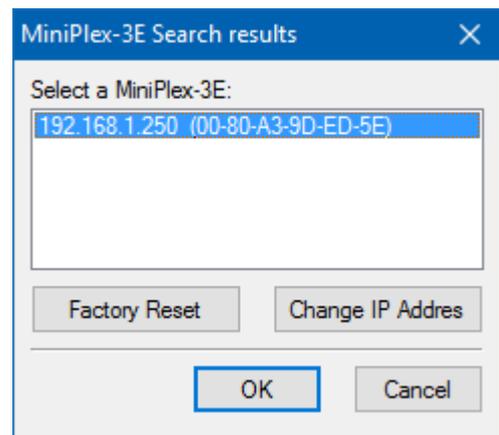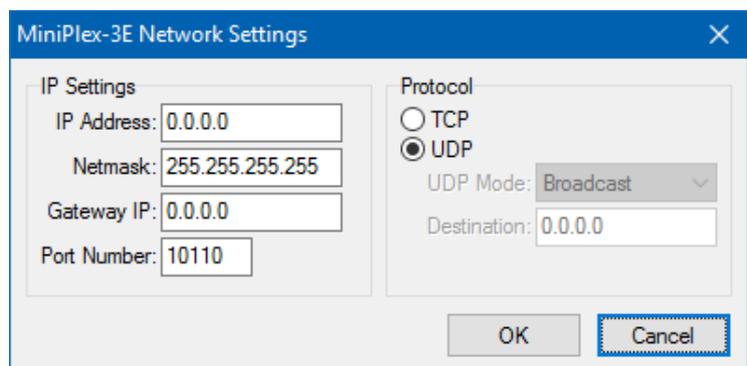
Figure 16

The example in Figure 17 shows an example of fixed IP settings.

If you set the multiplexer to UDP Directed, you must enter a destination IP address in the Destination field. If this IP address is not on the same network as the multiplexer, you must also enter the address of your network gateway in the Gateway IP field.

Please note that when UDP Directed is enabled, you will not receive any NMEA data from the multiplexer anymore when the IP address of your computer is different from the Destination IP. The network settings however can always be changed regardless of this setting.
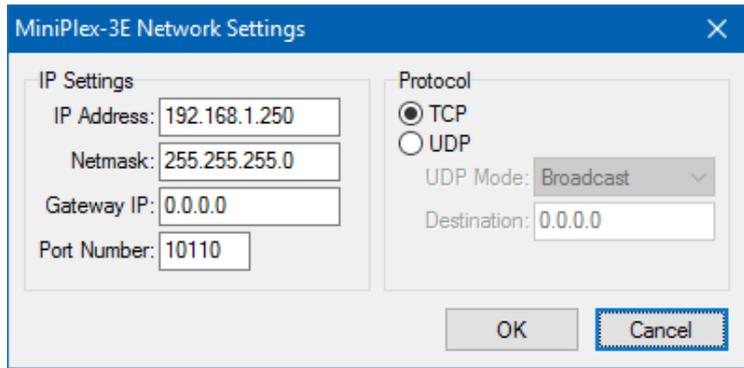
Figure 17

The default port number is 10110. This is the standard port number for NMEA 0183 over UDP and TCP. MPX-Config3 uses this port number by default. Some apps however, work with a different and fixed port number. A well-known example is the Navionics app, which uses port number 2000.

If you click on the OK button to activate the settings, a progress bar will appear and the network interface will be restarted. This takes approx. 7 seconds. The new IP address and protocol will appear automatically in the Host and Port controls on the main window of MPX-Config3 when the process is completed.

If you need to change the network settings back to DHCP, set the IP Address field to 0.0.0.0 and click OK.

In some cases, the settings of the multiplexer cannot be verified after change, for instance because the IP address is changed from a fixed address to DHCP (0.0.0.0) or when an IP address is entered which is not on your network. In this case, a warning will appear.

## Search

The search function (menu Tools -> MiniPlex-3E -> Search…) will almost always find any MiniPlex-3E on the network, even if it has been configured with the wrong IP/Netmask combination for the network it is connected to. In rare cases MiniPlex-3E cannot be found. See the paragraph "Network Recovery" below how to resolve that situation.

The search result window (Figure 18) has two buttons that allow you to restore the network settings to the factory default values and to change the current IP address in case it is outside your network. In that case, the normal network setup cannot be used.

If no MiniPlex-3E shows up, you probably have a firewall active that blocks the specific type of network access MPX-Config3 uses to find the MiniPlex-3E. To prevent this, add MPX-Config3 to the allowed applications in the firewall settings.
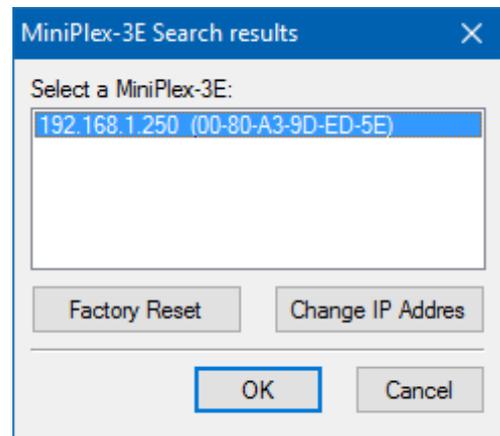
Figure 18

## Network Recovery

In rare cases a MiniPlex-3E might not show up in the search results window due to a possible misconfiguration in the Network Settings. This might happen when duplicate IP addresses exist on the network or the multiplexer has an illegal IP address. To recover from such a situation, a new IP address can be assigned with menu option "Tools -> MiniPlex-3E -> Assign IP".

In the "Assign IP Address" dialog (Figure 19), enter the MAC address of the multiplexer. This MAC address can be found on the label on the topside of the multiplexer, below the serial number. Enter the MAC address with the fields separated by dashes as shown. Then enter a valid IP address and click on OK. A progress bar will appear during the update process, which will take approximately 10 seconds. After that, the multiplexer can be reached again through the normal "Network Settings" dialog.
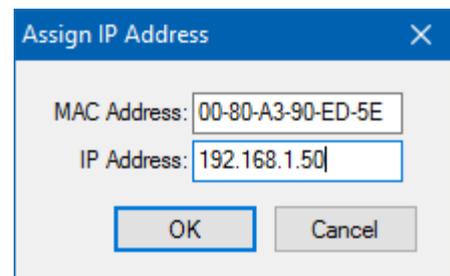
Figure 19

# WiFi Interface

**(MiniPlex-3Wi, MiniPlex-3Wi-N2K)**

Through its WiFi interface, the MiniPlex-3Wi(-N2K) can communicate with wireless devices like an iPad, iPhone, a PC or a Mac.

## WiFi Access Point

The MiniPlex-3Wi provides a wireless access point through its 802.11b/g/n interface with the following parameters:

| | |
|---|---|
| **SSID (name):** | **MiniPlex-xxxxxxxx** |
| **Password:** | **MiniPlex** |
| **Security:** | **WPA2** |
| **IP address:** | **10.0.0.1** |
| **Port:** | **10110** |
| **Protocol:** | **TCP/IP** |
| **DHCP:** | **yes** |

The xxxxxxxx's are the serial number of the multiplexer as printed on the serial number sticker. This uniquely identifies a MiniPlex-3Wi from other access points.

On an iPad for instance, the MiniPlex-3Wi will appear as shown in Figure 20.
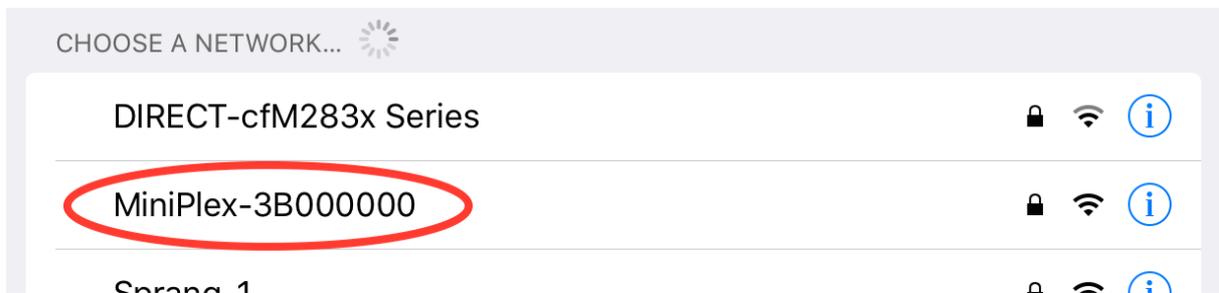


Figure 20

Simply tap on the MiniPlex entry to connect and enter the password "MiniPlex" when prompted. No further configuration is required.

The built-in DHCP server of the MiniPlex-3Wi automatically assigns IP addresses to devices that connect wirelessly to its access point. It is not necessary to add or change any settings in the network configuration of your wireless device.

The NMEA data from the multiplexer is available on the WiFi network via TCP on port 10110. Currently only one connection is possible.

In your navigation application, you need to enter the IP address of the MiniPlex-3Wi, which is 10.0.0.1. The port number to use is 10110. Figure 21 shows the settings in iNavX®.
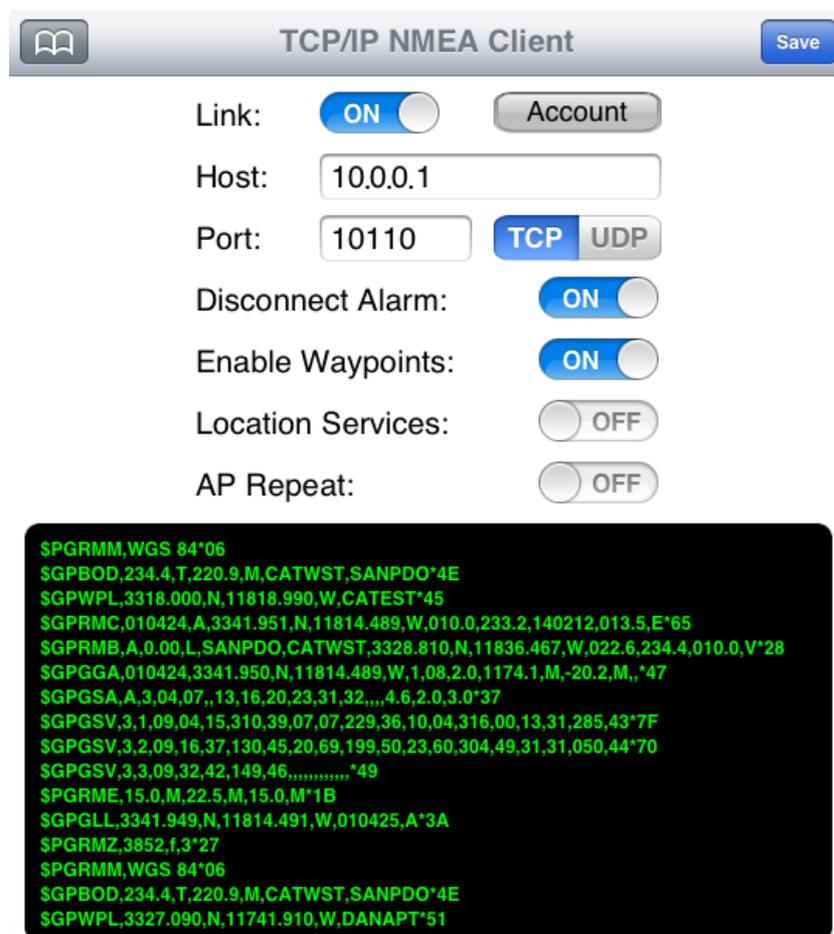
Figure 21

The WiFi interface and the USB port operate simultaneously and with the same priority. This allows an on-board fixed computer to be connected simultaneously with a wireless device.

The WiFi interface cannot be used to update the firmware of the MiniPlex-3Wi or to configure the WiFi interface using $PSMDWI commands (see the Technical Reference, Proprietary NMEA Commands). Only the USB interface can be used for this.

## App Behaviour

When switching between apps, it is not always clear from their documentation if an app closes the TCP connection. As mentioned earlier, the multiplexer supports one single TCP connection at a time. Switching from one app to another is usually done by pressing/touching the home button on your device and selecting the new app. The app that was running before however, is not closed! It is merely switched to the background. Depending on what the developer of the app has envisioned, the app can go to sleep or it can keep running.

In either case, it can also keep the TCP connection open for a background task like logging your position. It is then impossible for the new app that is just started to open a TCP connection. iNavX behaves "nice": it closes the TCP connection and only reopens it when you activate the app again. But other apps might not close the TCP connection, preventing other apps from opening it.

If that is the case, the only way of making the app close the TCP connection is to really terminate the app. On an iPad or iPhone, this is done by double-clicking the home button and swipe the app to the top edge of the screen. Only this will close and terminate the app.

## Connect to another WiFi Access Point/Router

It is possible to configure the WiFi interface of the MiniPlex-3Wi to connect to an existing WiFi access point/router on your boat. This lets you access the NMEA 0183 data provided by the multiplexer from anywhere on your main inboard network, and you then don't need to switch the WiFi connection of your remote device between the WiFi Access Points.

The MiniPlex-3Wi provides a web interface to configure the WiFi access point and many other parameters related to the TCP server and network.

We recommend you not to change any other setting in the web interface than what is described here, as some settings are critical for the NMEA data communication. In any case, you can always get the factory WiFi configuration back by issuing "PSMDWI,A" command in MPX-Config3 via the USB port (Send NMEA); this re-initialization takes approx. 40 seconds.

### Here is how to connect the MiniPlex–3Wi to an Access Point:
1. Connect your computer or tablet to the MiniPlex WiFi Access Point (AP).
2. Open a web browser and type 10.0.0.1 in the URL address bar.
3. An authentication is required (Figure 22), use username: "**admin**" and password: "**MiniPlex**"
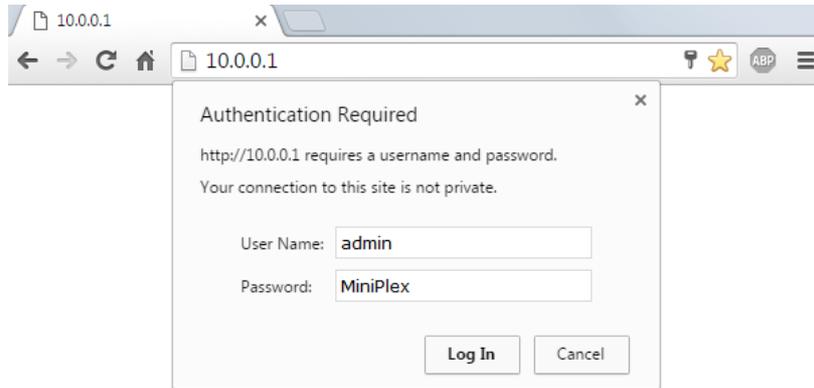


Figure 22

4. You will get the following web server page (Figure 23):



Figure 23

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5. Click on QuickConnect to get on the WLAN Link Scan page (Figure 24), which shows all the Access Points around the MiniPlex-3Wi that are available to connect to.



Figure 24

6. Click on the Access Point Name you want to connect to.

7. This will show the WLAN profile connection setting of the selected AP (Figure 25).
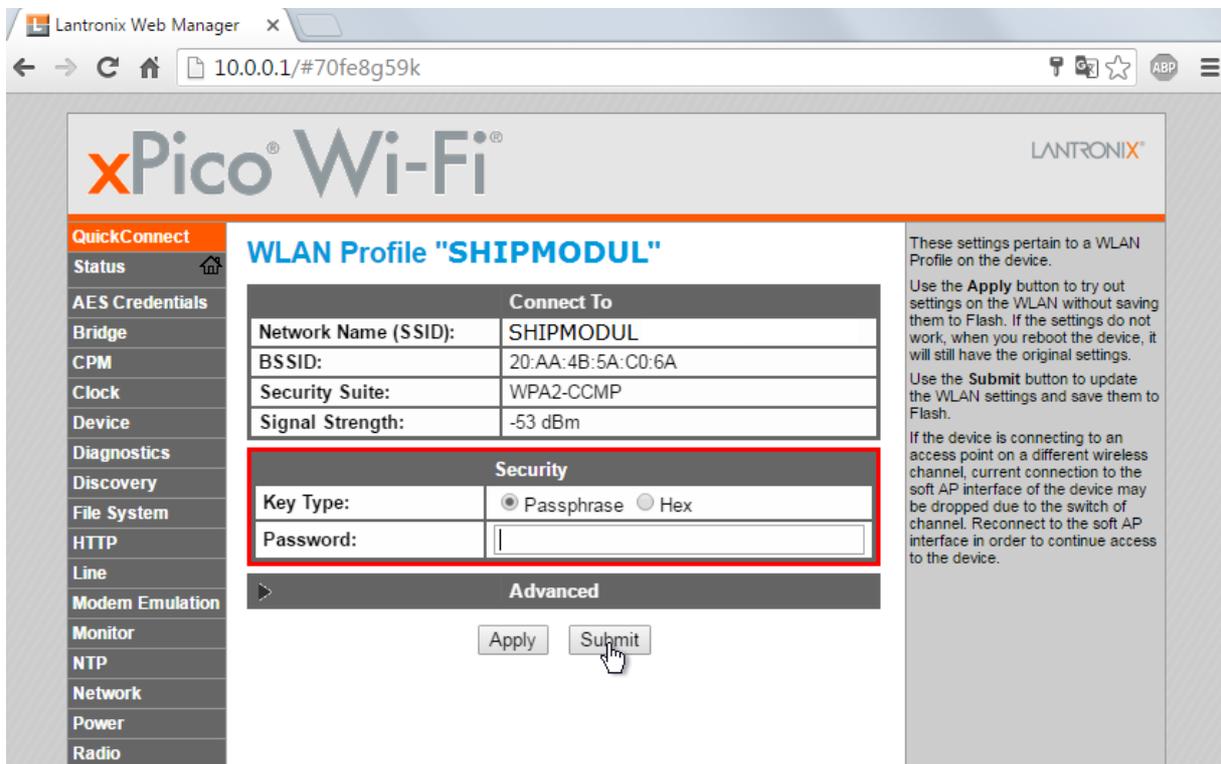


Figure 25

8. Enter the password of your routers Access Point if required and click on Submit

9. You get notifications that all changes are made and saved (Figure 26).


Figure 26

10. You can go back to the status page by clicking on the tab Status on the left (Figure 26)


Figure 27

11. Check that the WLAN interface is connected (black outline in Figure 27)

12. You can see the new IP address of the MiniPlex-3Wi in the red outline in Figure 27. This is the address you need to enter in your navigation app to connect to the MiniPlex-3Wi.
Due to a limitation of the current WiFi firmware, you can only connect to this IP address using TCP. The UDP server cannot be active on the access point and the client interface of the MiniPlex at the same time. If you need UDP to work while the MiniPlex-3Wi is connected to your access point, we need to change another setting. To do this, write down the IP address including the number after the slash ('/'). Then Click on "Tunnel" in the left menu bat to get to the Tunnel Status and Settings page (Figure 28).
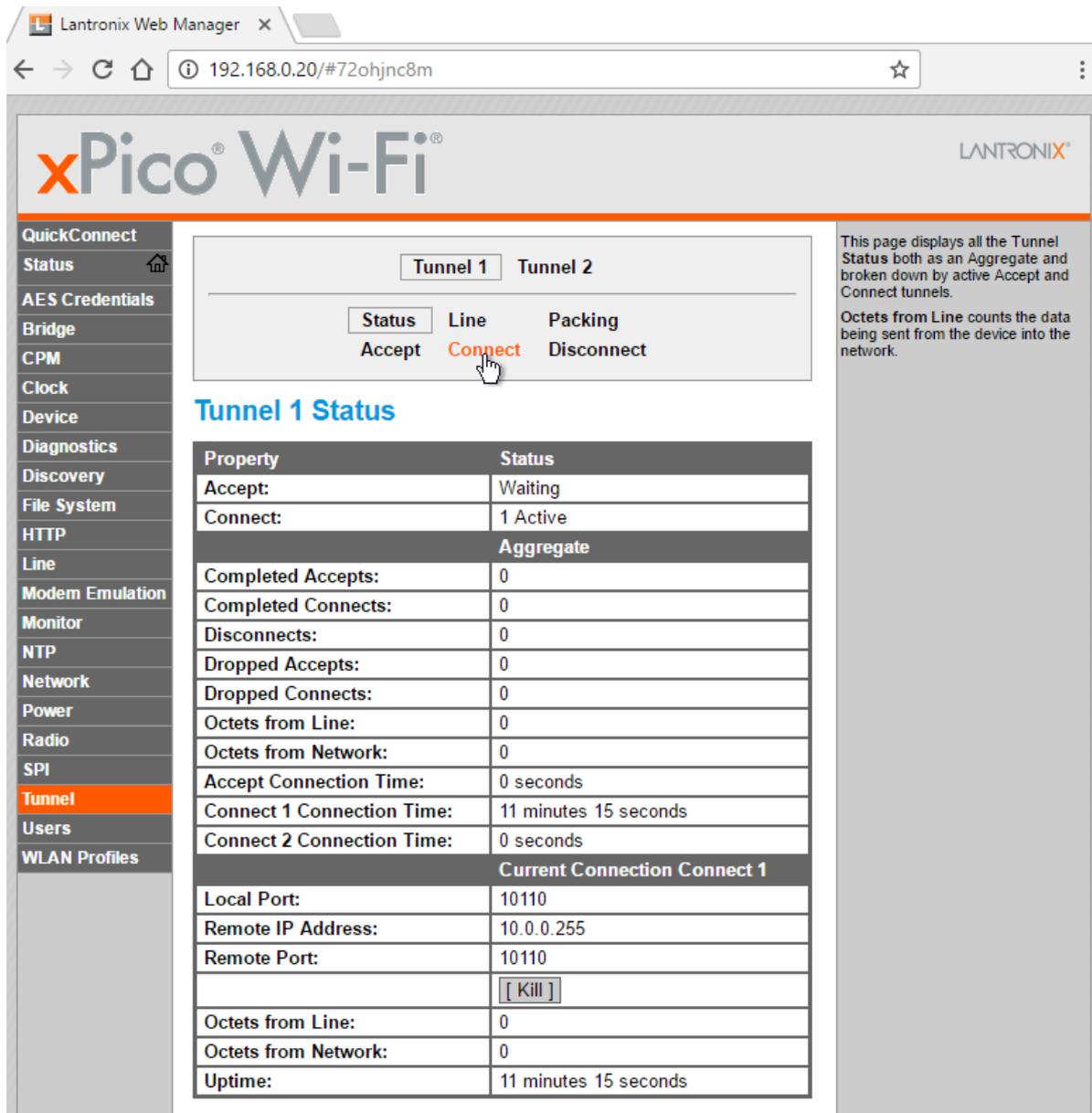


Figure 28

13. Click on "Connect" at the top of the page.
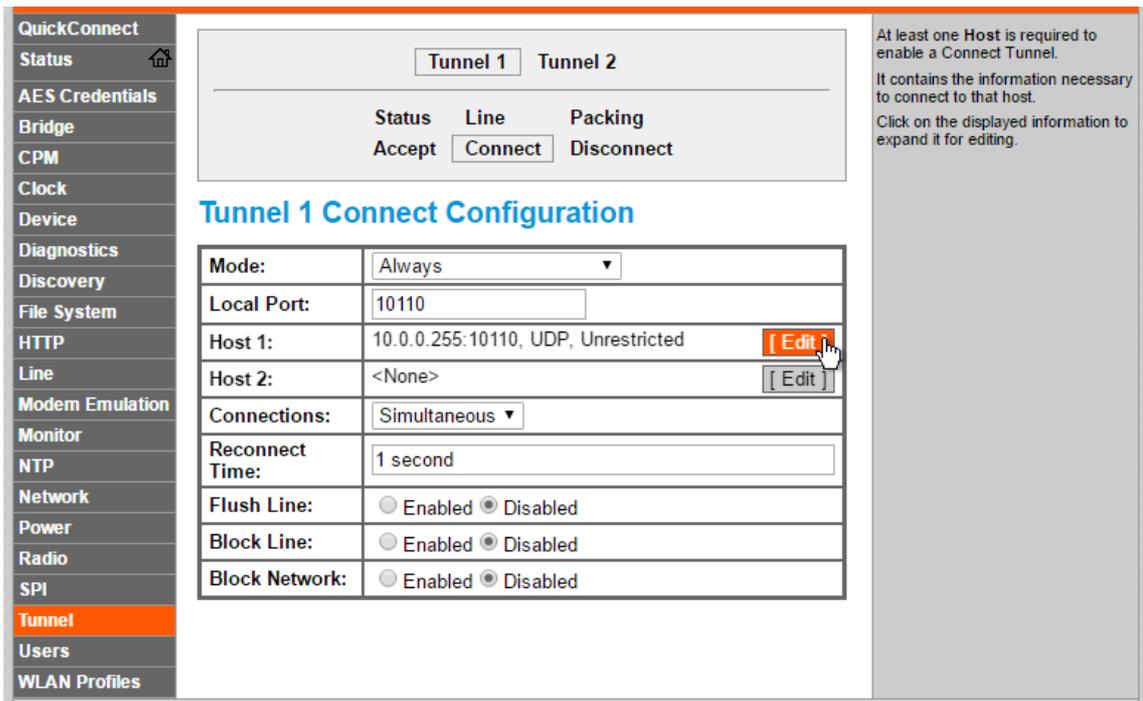
Figure 29

14. On the page that appears (Figure 29), click on "Edit" on the "Host 1" line as shown. Now you can change IP address into the so called "broadcast address" of your own WiFi access point. And this is the tricky bit. If the IP address you wrote down in step 12 starts with 192., and ends on "/24", you need to enter that address here and replace the last number group of the IP address with 255. So if the IP address in step 12 was 192.168.15.**106**/24, you need to enter 192.168.15.**255** here. In general, the number of "255" groups in the broadcast address depends on the value of the first number group and the number after the slash in the IP address of step 12. The following table shows the most commonly used address groups and what to replace them with:

aaa.bbb.ccc.ddd/24:    aaa.bbb.ccc.255
aaa.bbb.ccc.ddd/16:    aaa.bbb.255.255
aaa.bbb.ccc.ddd/8:     aaa.255.255.255
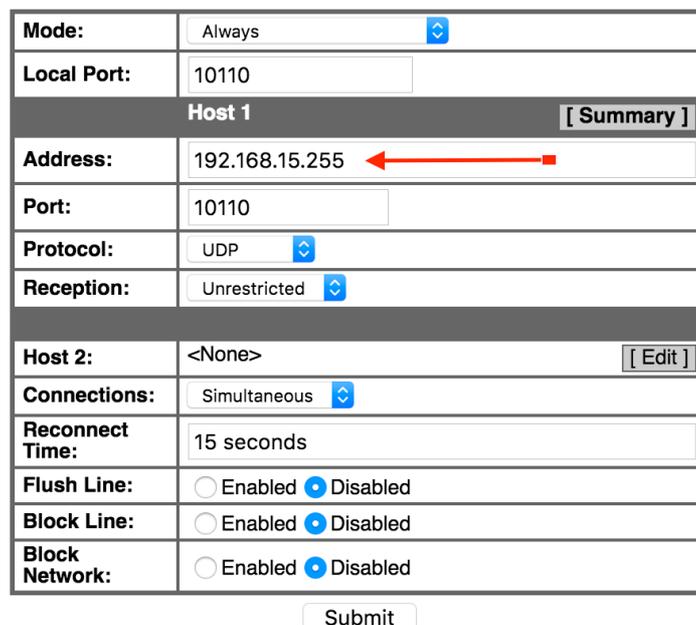


Figure 30

15. Enter the broadcast address as shown in Figure 30 and Click on "Submit". A notification is shown in green text if the setting is stored successfully.

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Your MiniPlex-3Wi is now all set and you can access the MiniPlex-3Wi using both UDP and TCP via your access point.

You can still join the MiniPlex-3Wi's access point and use TCP at the same time.

# NMEA 0183 Ports

The NMEA 0183 ports are the inputs/listener ports and outputs/talker ports on the MiniPlex-3, which connect to NMEA 0183 ports on navigation instruments, chart plotters etc. There are many interpretations and variations of NMEA 0183 ports so we'll explain a few things first.

## NMEA 0183 Signals

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

The most important property of an NMEA 0183 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: when wire A is at 5V, wire B is at 0V and when wire A is at 0V, wire B is at 5V. 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 -.

Some devices even have NMEA + and NMEA – the other way around. It is perfectly safe to swap the wires if no signal is received when connected to an NMEA 0183 port of the MiniPlex-3.

Things get complicated when manufacturers don't follow the NMEA 0183 standard, which is very often the case. Many devices have an NMEA 0183 interface, which is electrically speaking an RS-232 interface. The only resemblance with the NMEA 0183 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 NMEA input with connections "Data In" and "Data Return" it is often not clear whether this input is galvanically isolated or if "Data Return" is simply another name for "Signal ground".

Instead of being fully compatible with the NMEA 0183 standard, many devices use a single-ended signalling scheme where data is transmitted on one a single wire while the power ground provides the return path. Single ended devices often have connection names like TX and Gnd (transmit and ground) on the NMEA output and RX and Gnd (receive and ground) on the NMEA input. Also used are Data Out, Data In and Signal Ground. Mix these with standard NMEA connections and confusion is imminent!

The MiniPlex-3 Series multiplexers takes away the confusion by offering galvanically isolated NMEA inputs and outputs. Because of this isolation, a ground reference no longer exists: both the A and B signals of an NMEA port are completely "floating". This means that you don't have to think about the nature of an input or output of the device you want to connect to multiplexer. Any NMEA output of a device can be connected to an NMEA input of the multiplexer while an NMEA output of the multiplexer can be connected to any type of input of your device or instrument.

## NMEA 0183 Inputs

The MiniPlex-3 has four NMEA inputs called In1 to In4. Each input should be connected to one output only. These inputs are galvanically isolated from the multiplexer, as specified by the NMEA 0183 standard.

The default communication speed of the NMEA 0183 inputs is 4800 Baud (NMEA standard) and it can be set to any value from 4800 to 57600 Baud using MPX-Config3. Set the speed of an input to 38400 Baud if it will be connected to an AIS receiver or transponder.

Connect the A and B terminals of the NMEA input on the multiplexer to the A and B terminals of the NMEA 0183 output on the navigation device as shown in Figure 31 on the left. These terminals may also be labelled as Data+/Data-, TX+/TX-, Out+/Out– or ve+/ve-.

Some navigation devices have single ended outputs with only one data terminal. Connect this terminal to the A terminal of the multiplexer input, and connect the ground of the navigation device to the B terminal of the multiplexer input as shown on the right in Figure 31. The navigation device's data ground is often combined with its power supply ground. In that case, connect the power ground of the navigation device to the B terminal of the multiplexer input.

Differential                                Single ended
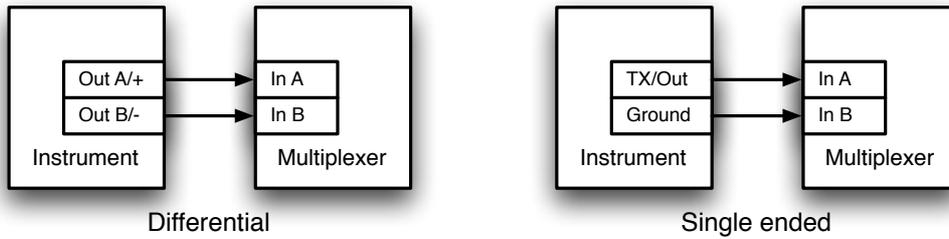
Figure 31

## NMEA 0183 Outputs

The MiniPlex has two NMEA 0183 outputs called Out1 and Out2. Each output can drive up to four NMEA 0183 inputs.

The default communication speed of NMEA Out1 is set to 4800 Baud while NMEA Out2 is set to 38400 Baud. This speed can be set to any value from 4800 to 115200 Baud using MPX-Config3.

Connect the A and B terminals of the NMEA output on the multiplexer to the A and B terminals of the input(s) on the instrument(s). These terminals may also be labelled as Data+/Data-, RX+/RX-, In+/In– or ve+/ve-.

Some instruments may have single ended inputs, with only one data terminal. Connect this terminal to the A terminal of the multiplexer output, and connect the B terminal of the multiplexer output to the ground terminal of the instrument. Figure 32 shows several examples of differential and single ended connections and combinations of both.



Differential                                Single ended

Multiple differential and
single ended listeners
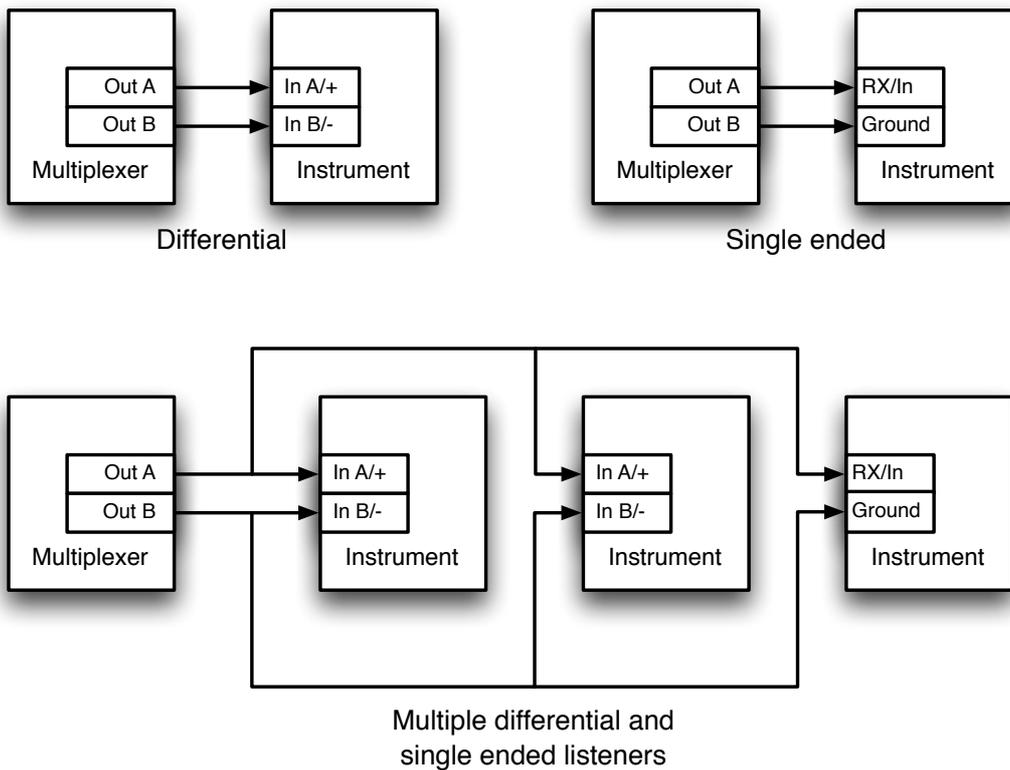
Figure 32

# Combining Ports

It is sometimes necessary to combine an input and an output of the multiplexer to connect to an instrument. One of the most common cases is the connection between a GPS and 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. Figure 33 shows how to connect such a GPS to the multiplexer.
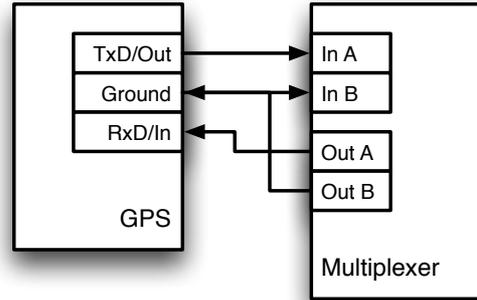


Figure 33: Connecting a GPS with a serial port to the multiplexer.

# SeaTalk[1]

NMEA In1 can be switched to SeaTalk[1]®, which is a proprietary protocol developed by Raymarine®. This protocol is used for communication between Raymarine navigation instruments like the ST40, ST50 and ST60 series.

While In1 is just an input for NMEA 0183, when switched to SeaTalk[1] mode, it becomes a bi-directional port capable of receiving and sending SeaTalk[1] data.

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.



Figure 34

The MiniPlex-3 can be directly connected to a SeaTalk[1] network. It will translate all SeaTalk[1] data required for navigation into NMEA sentences. Input In1 can be set to SeaTalk mode and should be connected as shown in Figure 34.
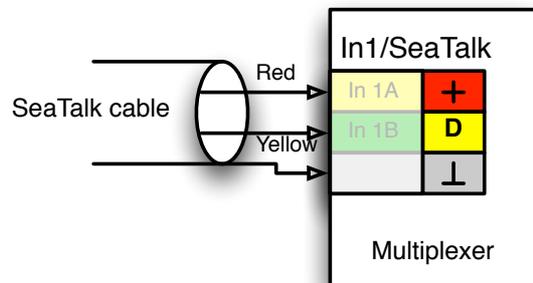
Figure 35 shows how to power the MiniPlex-3 from the SeaTalk[1] network. The SeaTalk[1] cable is connected to In1/SeaTalk[1] and at the same time the red wire and shield are connected to the power terminals of the multiplexer. Although this will work just fine, it is recommended to give the MiniPlex-3 its own power supply just for safety.

The multiplexer will both receive and send SeaTalk data. Received SeaTalk[1] data always is converted into NMEA 0183 and NMEA 2000. Similarly, received NMEA 0183 and NMEA 2000 data can be converted and transmitted on the SeaTalk[1] bus.

To prevent overloading the SeaTalk[1] bus, no NMEA 0183 or NMEA 2000 data is converted to SeaTalk[1] by default. Any conversion to SeaTalk[1] must be specified with an entry in the routing table.
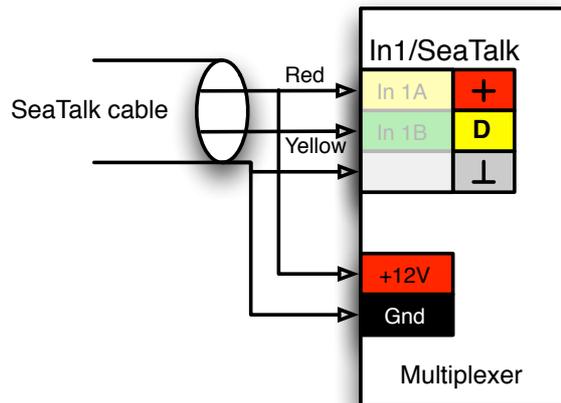


Figure 35: Power and data from the SeaTalk[1] network.

# NMEA 2000 Port

MiniPlex-3 multiplexers with an NMEA 2000 port (the "-N2K" models) can be connected to an NMEA 2000 network or "backbone". The MiniPlex-3 can also be connected to a SeaTalk[NG] network using a Raymarine SeaTalk[NG] to DeviceNet cable (no. A06075). SeaTalk[NG] is compatible with NMEA 2000.

NMEA 2000 messages, called PGN's, are translated into NMEA 0183 sentences. No NMEA 2000 data is transmitted on the Host ports and WiFi interface simply because there is no standard defined for this.

## Virtual Devices

Every device on the NMEA 2000 network is known by a unique number and a network address called a Source Address. It can be interrogated by other devices for product information containing manufacturer information, device name, serial number, etc. This is how a for instance a plotter can show a list of all devices on the NMEA 2000 network.

One physical device can make itself known to other devices on the NMEA 2000 network using more than one unique number and network address. This way, a single physical device shows up on the network as multiple "virtual" devices.

The MiniPlex-3 also shows up as multiple virtual devices: one "Main" device, and one for each NMEA 0183/SeaTalk input and the conversion results. Thus, if a MiniPlex-3USB-N2K is connected to the NMEA 2000, the MiniPlex will appear in the Device List on a plotter as shown below:

| Model ID | Serial No. |
| --- | --- |
| MiniPlex-3USB-N2K - Cnv | 39001234 |
| MiniPlex-3USB-N2K - In1 | 39001234 |
| MiniPlex-3USB-N2K - In2 | 39001234 |
| MiniPlex-3USB-N2K - In3 | 39001234 |
| MiniPlex-3USB-N2K - In4 | 39001234 |
| MiniPlex-3USB-N2K - Main | 39001234 |

Each input is listed as a device and can be selected as a data source. It is thus possible to select the desired GPS data source on a plotter if you have a GPS connected to one NMEA 0183 input of the MiniPlex and an AIS transponder to another input. Both deliver a GPS position but in general, you only want one of them to appear on a plotter or display.

Similarly, on larger yachts a selection can be made which depth sensor (fore or aft) to show on a particular NMEA 2000 display.

The virtual device ending on "Cnv" outputs the NMEA 0183 conversion results and the one ending on "Main" is the Host port (USB, Ethernet, WiFi). The latter is also the only device outputting system-related data like System Time (PGN 126992), Heartbeat (PGN 126993) or the MiniPlex-3's LEN value.

The default device type of each NMEA 0183 input is an "NMEA 0183 Gateway". The "Main" device is a "PC Gateway".  The Device Type can be changed to match the connected NMEA 0183 device.

In the example above, having a GPS and an AIS transponder connected to the NMEA 0183 inputs of the MiniPlex, a plotter can be instructed to use either source for GPS position. In general, plotters will automatically choose the best data source of GPS position based on the device type of a data source. In this case, the ability of setting the device type of a MiniPlex NMEA 0183 comes in handy: by setting the input which is connected to the GPS to device type "Ownship Position (GNSS)", the plotter can decide to prefer the position from the GPS over the one of the AIS.

Also, VHF radios with an NMEA 2000 interface and GMDSS are known to require the GPS position to originate from a GPS device. In this case, it is also necessary to change the Device Type of the input which receives GPS data to "Ownship Position (GNSS)".

## Connecting to the NMEA 2000 network

The MiniPlex-3 is equipped with a standard Micro-C style male connector. Connect the multiplexer with a spur cable and a T-piece to the NMEA 2000 backbone.

NMEA 2000 networks must always consist of a powered backbone with terminators, to which the multiplexer and other devices must be connected. It is not possible to simply connect two NMEA 2000 devices directly together. An NMEA 2000 backbone needs to be powered and terminated on both ends.

# Protocol Conversions

The MiniPlex-3 converts navigation data between all three supported protocols – NMEA 0183, NMEA 2000 and SeaTalk[1] – and in all directions. This feature offers an almost seamless integration of NMEA 2000, NMEA 0183 and SeaTalk[1] networks and devices. NMEA 0183 and SeaTalk[1] data from legacy devices will be available on new NMEA 2000 capable instruments, chart plotters and autopilots. Similarly, every navigation software outputting NMEA 0183 sentences will be able to drive an autopilot on the NMEA 2000 or SeaTalk[1] network. Even so, data from newer NMEA 2000 sensors and instruments can be made available to legacy devices using NMEA 0183 or SeaTalk[1].

There are subtle differences in the way each of these conversions work. Knowing these differences can be of great help when adding entries to the routing table.

The diagram below (Figure 36) shows how the data flows from one protocol to another. Since each protocol groups parameters differently, there is no one-on-one relationship between NMEA 0183 sentences, NMEA 2000 PGN's and SeaTalk[1] datagrams. So, every single parameter like a position, COG, SOG etc. is taken from the received sentences, PGN's and datagrams and stored in a database first.

From this database, the parameters are retrieved to build new sentences, PGN's and datagrams. Their route is determined and they are transmitted again.
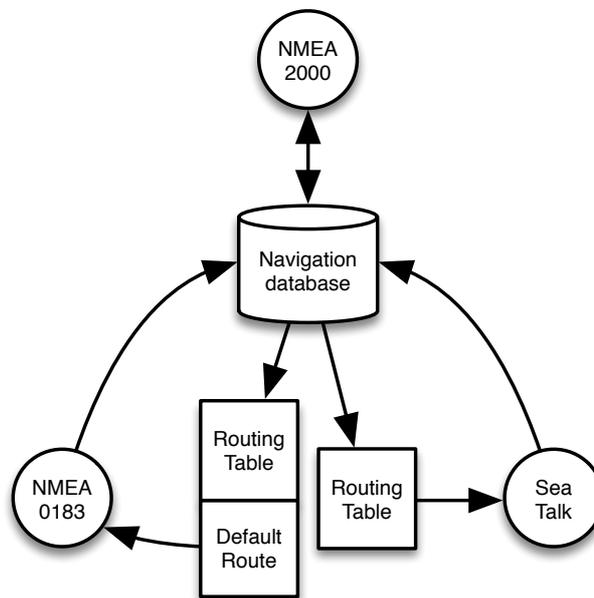


Figure 36

## NMEA 0183 and SeaTalk to NMEA 2000

These conversions are very straightforward: Every received NMEA 0183 sentence or SeaTalk[1] datagram results in corresponding NMEA 2000 PGN's. No routing is applied.

Similar data from two or more NMEA 0183 or SeaTalk[1] inputs appears on the NMEA 2000 network as originating from different devices.

## NMEA 2000 to NMEA 0183

This conversion is controlled by the routing system of the MiniPlex-3. When no entries exist in the routing table, the default route is applied and all NMEA 2000 data is converted into NMEA 0183 sentences.

Similar devices on the NMEA 2000 network like two sources of GPS data result in two sets of GPS sentences. These can be identified by a $MXSTN sentence or a TAG Block which contain the Source Address of the NMEA 2000 device which has sent this data.

If a receiving device or application has no means of selecting the right NMEA 0183 sentence by decoding $MXSTN sentences or TAG Blocks, it is necessary to add these sentences to the routing list including the Source Address of the device. This way, similar data from multiple NMEA 2000 devices can be filtered or routed to different NMEA 0183 outputs on the MiniPlex-3. Setting this up is explained in detail in chapter "Routing" on page 46.

## NMEA 2000 and NMEA 0183 to SeaTalk[1]

These conversions are fully controlled by the routing system of the MiniPlex-3. There is no default route to SeaTalk1. No data is converted and sent to SeaTalk1 unless one or more entries in the routing table have a checkbox in the ST column on the Outputs side.

## SeaTalk[1] to NMEA 0183

This conversion is controlled by the routing system of the MiniPlex-3. When no entries exist in the routing table, the default route is applied and all SeaTalk[1] data is converted into NMEA 0183 sentences.

# Routing

On a SeaTalk[1] network, data is exchanged using messages called datagrams, which are identified by a number. Similarly, on a NMEA 2000 network, data is exchanged using messages called PGN's. The PGN is the number (Parameter Group Number) of the message.

These numbers identify the message and which data (parameters) it contains.

The number of datagrams and PGN's is quite large and those numbers are not easy to remember. Therefore, the MiniPlex-3 uses NMEA 0183 identifiers in the routing table with well-known sentence formatters like "HDG" and "RMC" for example. The Technical Reference has a list of commonly used sentence formatters and talker ID's.

# 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 LEDs on the MiniPlex provide information about the status and operation of the multiplexer. When the multiplexer is power up, all LEDs flash once.

Green (NMEA 2000): This LED flashes when an NMEA 2000 PGN is received.

Green (NMEA 0183): This LED flashes upon reception of a valid NMEA sentence. During a firmware update, this LED flashes upon reception of a firmware block.

Red (Overflow): This LED flashes on a buffer overflow, indicating that a currently received NMEA sentence will be lost.
During start-up, this LED is on for a short moment while the multiplexer checks if firmware is loaded or if a firmware update is initiated by MPX-Config3. If firmware is found, the LED goes off. When the LED stays lit, no firmware was found.
During a firmware update, this LED is on. When the update is completed, the LED goes off. If the LED stays on after a firmware update error, it indicates that no valid firmware is present.

# Data Throughput

A multiplexer is not the Holy Grail for connecting NMEA 0183 devices. It is obvious that if a device combines NMEA 0183 sentences from four sources, the total number of sentences that must be forwarded is the sum of the amount of each source. Still, the NMEA 0183 standard specifically limits the communication speed to 4800 Baud or bits per second, which equals 480 characters per second.

So, when using an NMEA 0183 multiplexer, it is easy to create a situation in which more data is received than can be transmitted because of the speed limitations of the NMEA 0183 outputs. Such a situation will inevitably lead to an overflow of buffers inside the MiniPlex.

The MiniPlex has two buffers, one for each NMEA 0183 output, which can hold 500 bytes of data. This is slightly more than 1 second of data at 4800 Baud.

When a received sentence must be routed to Out1 or Out2, it is stored in the corresponding output buffer. Because of the limited size of this buffer, it is obvious that it will overflow if the buffer is filled faster than emptied. While it might seem a good solution to have larger buffers to prevent overflows, it is not. A larger buffer will eventually fill up too, it just takes longer. Since NMEA 0183 is based on a sentence frequency of 1Hz (except for heading), it makes sense to limit the size of the buffers to store one second worth of data. This also limits the delay to one second max. If more data needs to be sent than a buffer can hold, it is simply discarded.

Note that sentences are never discarded when sent to a host port. The speed of a host port is 100 times higher than an NMEA 0183 port at 4800 Baud so it will never pose any throughput limitation. If a sentence is sent to a host port and an NMEA 0183 output and the buffer of that output is full, that sentence will still be sent to the host port.

An overflow event is signalled by the red LED on the MiniPlex and by the led symbols on the MPX-config3 window in section "Overflow".

Figure 37 shows a typical example of an overflow situation: AIS data is being received on In2 at 38400 Baud and sent to Out1, which operates at 4800 Baud. The overflow indicator on the right side of the window indicates an overflow on NMEA output 1.



Figure 37

34
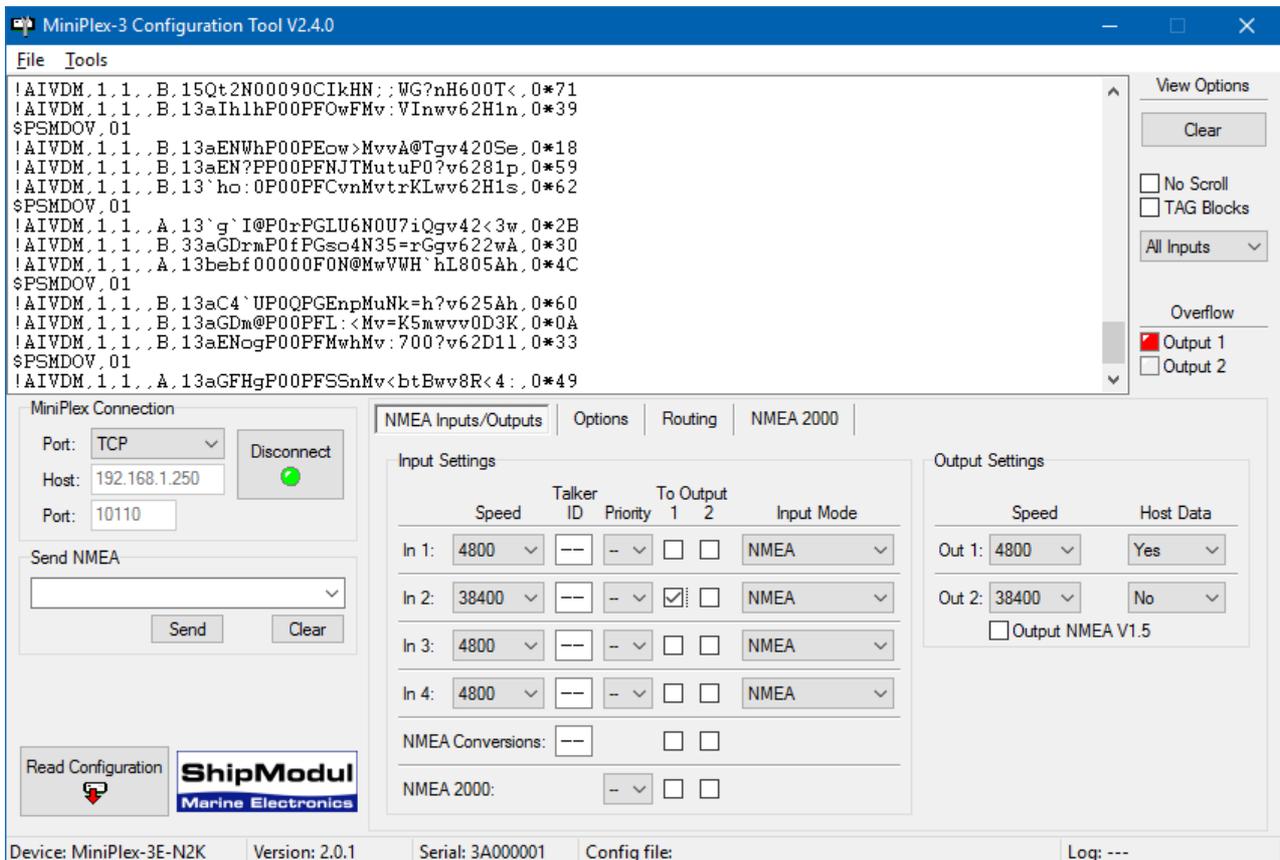
All this may raise the question if it is possible at all to combine data from four inputs at 4800 Baud and still transmit this on an output at 4800 Baud.

It depends…

The standard speed of an NMEA 0183 port is 4800 Baud or bits/second, representing 480 characters per second (10 bits are needed for one character). It might seem obvious that combining four NMEA 0183 streams at 4800 baud would require the output to be operating at 4 x 4800 = 19200 Baud to prevent any data loss.

In general, devices do not send a continuous stream of NMEA sentences. A wind instrument for instance, typically sends one $WIMWV sentence per second and the length of this sentence will be 30 characters at most. Thus, the occupied bandwidth of this device is 30 char/s, leaving room (430 char/s) for sentences from other devices.

On the other hand, a GPS might send $GPRMB, $GPRMC, $GPGLL, $GPGGA, $GPVTG, $GPZDA, $GPGSA and $GPGSV (3x), totalling 10 sentences and exceeding the bandwidth of 480 char/s when sent every second. Such a GPS would typically send these sentences once every two seconds.

So, it totally depends on the kind of data received if combining all data will be successful at 4800 Baud.

There are several ways to resolve overflow and loss of data:

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 routing table of the MiniPlex to block unwanted sentences. Unwanted sentences are discarded immediately and do not occupy buffer space or bandwidth.

3. For sentences that should not be blocked, setting a divisor in the routing table may reduce their frequency. A gyro may be throttled down to 10 sentences per second or even less.

4. Use the routing options to select which input is routed to an output or use the routing options in the routing table to selectively route NMEA 0183 sentences to an output.

5. Increase the speed of the NMEA 0183 output that suffers from overflows. This will only work when the connected equipment also supports higher communication speeds. Connected ports must always match their communication speed (Baud rate).

In any case: a red LED blink means loss of data. If that occurs once every few seconds, it might not be a problem at all. But a blink every second or even faster means that one or more sentences will be lost all the time.

# MPX-Config3

The MiniPlex-3 multiplexer is configured with a tool called MPX-Config3. This tool can be found on the accompanying CD. There is no installer for this tool, 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 0183 sentences. MPX-Config3 sends these sentences to the multiplexer immediately when you change a setting. Settings do not have to be stored explicitly except for the routing table.

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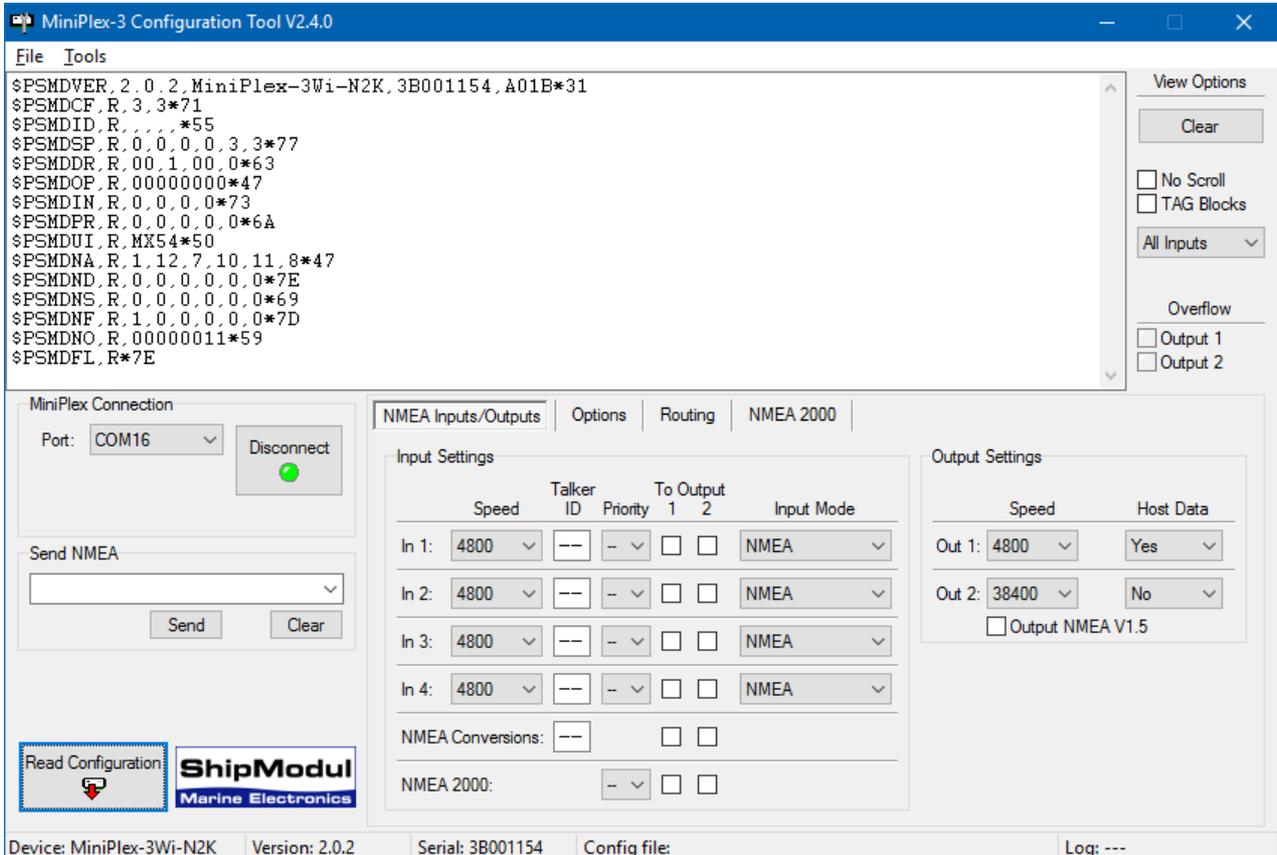


Figure 38: MPX-Config3 main window

The window of MPX-Config3 is divided into four sections from top to bottom: the menu, the NMEA viewer, the controls and the status bar. The menu basically controls the MPX-Config3 program. The NMEA viewer shows the NMEA 0183 sentences 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 (sentences starting with $PSMD). The controls determine the operation and configuration of the multiplexer. The status bar shows the name or type of the connected multiplexer, 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. Some options of these menus are disabled or not visible, depending on the type of connected multiplexer or on the status of the connection.

The **File** menu offers the following choices:

| | |
|---|---|
| Log NMEA… | 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. The Log counter on the status bar will show the number of NMEA sentences that are currently written to the log file. |
| Log Diagnostic Info… | 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-Config3. |
| Save Configuration | Save the current configuration to a previously file. |
| Save Configuration As… | Save the current configuration to a new file. |
| Update MiniPlex Firmware… | Load new a firmware file into the multiplexer. |
| Exit | This exits MPX-Config3. |

The **Tools** menu offers the following choices:

| | |
|---|---|
| Show Statistics | Opens a window showing bars that indicate how much data is stored in the database and the NMEA 2000 queues and the processing time for conversions. |
| MiniPlex-3E | Opens a sub-menu for the MiniPlex-3E. |
| Reset Factory Settings… | Reset the multiplexer to its default factory configuration. |
| Automatic Update | Update the firmware in the MiniPlex with the firmware embedded in MPX-Config3. This is the minimum required firmware version that is compatible with this version of MPX-Config3. |
| About | Show a window with version information. |

The **MiniPlex-3E** sub-menu offers the following choices:

| | |
|---|---|
| Network Setup… | Open a window to setup the network parameters of a MiniPlex-3E. |
| Search… | Search the network for MiniPlex-3E's. A window is shown with the search results. |
| Assign IP… | Assign an IP address to a MiniPlex-3E using its MAC address. |

***Please note that this sub-menu is meant for the MiniPlex-3E(-N2K) only. It does not change any network settings of the MiniPlex-3Wi(-N2K)!***

# Controls

## MiniPlex Connection

Before being able to configure the multiplexer, a connection must be set up. Use the Port selector either to select the COM port of the multiplexer or to select TCP or UDP when using a network connection.

### COM Port

When using a multiplexer with a USB port, select the COM port that was assigned after installing the driver. Click on the Connect button to initiate the connection. MPX-Config3 will immediately read the current configuration from the multiplexer.
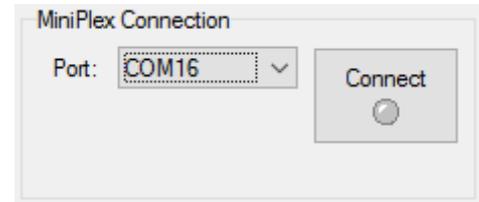
Figure 39

### Network

When a network connection is used to connect to a MiniPlex-3E or a MiniPlex-3Wi, select TCP or UDP as shown in Figure 40. A Host and Port field will appear.

When connecting to a MiniPlex-3E, select TCP or UDP to match the protocol as set in "Ethernet Interface" on page 17.

The MiniPlex-3Wi always accepts both TCP and UDP.

Enter the IP address of the MiniPlex-3E as specified in the "Network Setup" or use menu Tools -> MiniPlex-3E -> Search… to find the MiniPlex-3E on your network.

When connecting to the access point of a MiniPlex-3Wi, the IP address is always 10.0.0.1.
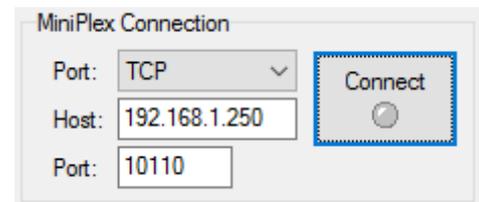
Figure 40

The Port field can be left blank or enter 10110, which is the standard NMEA 0183 port value. When left blank, port 10110 is automatically assumed.

Click on the Connect button to initiate the connection. MPX-Config3 will immediately read the current configuration from the multiplexer.

### UDP All

The Port selector also offers a UDP All option, which can be useful when more MiniPlex-3E's are connected to the same network, which are all set to UDP. These multiplexers will all send (broadcast) NMEA 0183 data on the network and any application listening to port 10110 will receive this data from all multiplexers. MPX-Config3 will only listen to data from the IP address entered in the Host field when set to UDP. When UDP All is selected however, MPX-Config3 will display NMEA data from ALL multiplexers on the network sending UDP data. When connecting in UDP All mode, MPX-Config3 will therefore not read the configuration because all multiplexers would respond and return their configuration. Only the version sentence PSMDVER is requested and displayed in the NMEA viewer.

The effect of changing a setting in this mode depends on the IP address entered in the Host field. If it contains an IP address of a multiplexer, the configuration setting is sent to that multiplexer only. If the Host field contains a broadcast address however, the configuration setting will be sent to ALL multiplexers. A broadcast address is an address with 255 in the device part of the IP address. In case of the address used above, 192.168.1.250, the broadcast address for that network would be 192.168.1.255.

In short: do not use this option when a single MiniPlex-3E is used.

### Reading the configuration

When the Connect button is clicked, MPX-Config3 opens a connection to the multiplexer and automatically retrieves its current configuration. The tabbed configuration pages will be enabled upon success and the LED on the Connect button will become green. Depending on the type of connected multiplexer, the NMEA 2000 page may or may not be visible, as well as any other NMEA 2000 related settings.

If a "Multiplexer does not respond" message appears, you may have selected the wrong COM port.  An "Unable to connect" or "Socket error" message indicates a wrong IP address or protocol (TCP or UDP).

If you exit MPX-Config3, the connection settings will be saved and reloaded when MPX-Config3 is started again. When you select a different port while being connected, MPX-Config3 disconnects from the multiplexer.

You can also force MPX-Config3 to retrieve the configuration from the multiplexer with the "Read Configuration" button (Figure 41).

## Send NMEA

MPX-Config3 allows manual entry of arbitrary NMEA sentences for testing, configuration etc.

Type the desired NMEA sentence in the edit box and click on the Send button or press the enter key. MPX-Config3 will keep a history of entered sentences/commands. These can be selected by clicking on the small arrow on the right side of the input field. A selected sentence can be sent again by clicking on the Send button or pressing the Enter key. It can also be edited prior to sending. The Clear button clears the history.

Preceding the NMEA sentence with a $ is optional, MPX-Config3 will add it if omitted. The input is case sensitive, so whatever you type will be sent to the multiplexer verbatim. Since all standard NMEA sentences are uppercase, you must 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 any NMEA output which has its Host Data set to Yes or Override.

This feature can also be used to test if an NMEA input or output is functional: Connect an NMEA output to an input, set Host Data for that output to Yes and type an arbitrary text of at least 6 characters in the "Send NMEA" field. This text should appear in the NMEA viewer when you click on the Send button or press the enter key.
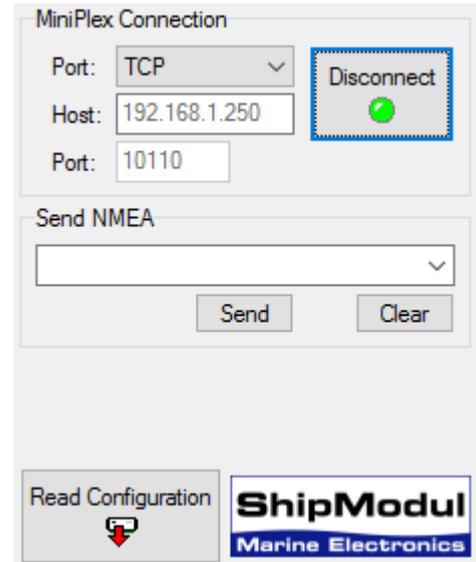
Figure 41

## View Options

The NMEA Viewer area (Figure 42) offers a few controls that make observing NMEA data easier.

The NMEA viewer itself stored up to 100 sentences which can be scrolled back (Disconnect first). These sentences can also be copied and pasted into another application (Windows only).

### Clear

This button clears the NMEA Viewer window.

### No Scroll

When this option is enabled, a list of received NMEA sentences will be displayed which will refresh constantly when new similar sentences are received. This feature allows you to closely examine the types of sentences received from the connected instruments. Any proprietary NMEA sentences that are generated by the multiplexer are also listed. These sentences start with $PSMD.

Figure 42

### Tag Blocks

This option will show any TAG blocks that precede a sentence. TAG blocks can be seen when they are enabled (see "Channel Information"), when the input selector is set to a specific input or when the Capture function on the Routing page is activated. Of course, when a device connected to the inputs of the multiplexer sends TAG blocks, they will also be visible.

### Input selector

The input selector allows you to selectively see sentences from one specific NMEA input of the multiplexer, the NMEA 2000 interface or from the conversion results. Setting this selector to any setting besides "All Inputs" will enable TAG blocks automatically. These are used to identify the input a sentence is received on. When set to "All Inputs", the original TAG block setting is restored.

### Overflow

The overflow indicators show which output buffer suffers from an overflow. See the section "Data Throughput" on page 34 for ways to prevent overflow situations with different instruments.
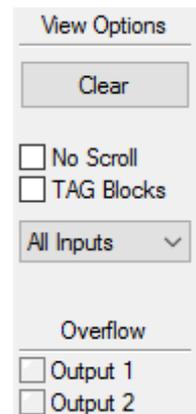
## NMEA Inputs/Outputs

This page contains all settings dealing with inputs and outputs of the multiplexer and the default routing settings.



Figure 43

### Speed

This sets the speed of each NMEA 0183 input or output. 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 receivers and transponders operate at 38400 Baud.

If you change the speed of In4, the speed of Out1 will be changed too. In4 and Out1 share the same communication port inside the multiplexer and therefore always have the same speed. Out1 is generally used to control an autopilot and should be left at 4800 Baud for this purpose.

If the Input Mode of In1 is set to SeaTalk[1], the speed setting for In1 is disabled and fixed to 4800 Baud, which is the standard speed on the SeaTalk[1] bus.

Care should be taken when inputs are set to higher speeds than the outputs they are routed to. This can possibly lead to buffer overflows. See the paragraph "Data Throughput" on page 34 for more information.

### Talker ID

The multiplexer can change the Talker ID of sentences it receives. The first two characters of an NMEA sentence represent the Talker ID, indicating which instrument (talker) has sent this sentence. Normally you don't need to change this and these fields can be left blank ("--").

Changing the Talker ID of a sentence might be necessary for instance when using a GPS compass. Such a compass often outputs a true heading sentence starting with $GPHDT. Many instruments or navigation programs however require a true heading starting with $HE, which is the standard Talker ID for true heading devices. By entering HE in the Talker ID field of the input connected to the GPS compass, the received $GPHDT sentence will be changed into $HEHDT.

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 those inputs to H1 and H2 respectively allows the software to recognise both depth readings separately.

Enter the 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 of the edit field turns yellow to indicate that de 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.

There is no Talker ID setting for NMEA 2000 sources. It would be quite useless to set a Talker ID for an entire range of instrument data.

### Priority

Each input on the MiniPlex can be assigned a priority from 1 to 5 where 1 sets the highest priority and 5 the lowest. By default, no priority is set ("--"). There is no priority setting for the conversion results – these have the same priority as the input receiving the source of the conversion.

Assigning a priority to at least two inputs will cause the multiplexer to block duplicate NMEA 0183 sentences received on inputs with the lowest priority. If a duplicate sentence on the higher priority input is no longer received, the same sentence on the next lower priority input will be received after a time out. This time out can be set from 1 to 30 seconds on the Options page.

Only the Sentence Formatter (e.g. the RMC part) is used for comparison - the Talker ID (the GP part) is ignored.

If for instance two GPS receivers are connected to In1 and In2 with a priority settings of 1 and 2 respectively and both GPS receivers send GPRMC sentences, only those from the GPS on In1 are passed. This feature can be useful to set up a second GPS as a backup for the main GPS.

Another useful Priority application is when both a GPS and an AIS transponder are connected to the multiplexer. By assigning a lower priority to the transponder input, the duplicate GPS sentences from the AIS transponder will be removed.

Note that the priority system does not block an entire input; it only blocks duplicate sentences. Sentences received from the AIS like AIVDM – which are not received from the GPS input – are passed.

The following example shows what is passed and what not: the left column in Table 1 shows sentences from the GPS on In1 and the right column sentences from the AIS transponder on In2. The priority feature blocks the greyed sentence in the table.

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

| GPS (In1) | AIS (In2) |
|-----------|-----------|
| GPRMC | GPRMC |
| GPGGA | AIVDM |

Table 1

### To Output 1 & 2

These options set a default route from the NMEA 0183 inputs, the NMEA 2000 port and the conversion results to the NMEA 0183 outputs.

The NMEA 0183 inputs and NMEA 2000 port are always routed to the host port. Similarly, the Host port is always routed to the NMEA 2000 port. Only entries in the routing table can override this.

The default route is applied to an input when no specific route for an NMEA 0183 sentence exists in the routing table. A match in this table always takes precedence over the default route.

### Input Mode

The NMEA 0183 inputs of the multiplexer can be set to different modes besides standard NMEA, to be able to accept "not quite standard" NMEA, plain text or SeaTalk. The following modes are supported:

NMEA: Normal NMEA processing. This is the default processing mode which checks sentences for correct formatting. They must start with a '$' or '!' character and end with a Carriage Return (CR) and a Line Feed (LF) character in that order. If a sentence contains a checksum field, the checksum of the sentence is calculated and compared with the checksum field. If all of the conditions above are met, the sentence is passed. Otherwise it is rejected. This processing meets the IEC/EN60945 standard.

NMEA (ERR): Pass NMEA sentences with a checksum error unmodified, bypassing all further NMEA processing and routing. Only the default route is applied.

NMEA (CR/LF): Relaxed NMEA format checking. This will pass an incorrectly terminated sentence. A sentence is considered terminated if it ends on a CR, a LF or a combination of both in arbitrary order.

Text to NMEA: Accept a plain text string and forward it in a standard NMEA $--TXT sentence. Any character with an ASCII value > 32 (a space) is detected as the start of a string. The string must end on a CR or LF and may not be longer than 61 characters. A longer string

is discarded. Only valid NMEA characters are passed. Invalid characters are stripped from the input data.

The Total number and Sentence number fields are always set to '01'. The Text Identifier field of the $MXTXT sentence contains the input number on which the text was received. When for instance 'Hello World' is received on input 3, the resulting sentence will be: $MXTXT,01,01,03,Hello World*6E.

Text to PTXT:     Accept a plain text string and forward it in a $PTXT sentence. Any character with an ASCII value > 32 (a space) is detected as the start of a string. The string must end on a CR or LF and may not be longer than 61 characters. A longer string is discarded. All characters with an ASCII value from 32 to 127 are passed.

Plain Text:       Accept a plain text string and forward it as a plain text string. Any character with an ASCII value > 32 (a space) is detected as the start of a string. The string must end on a CR or LF and may not be longer than 61 characters. A longer string is discarded. All characters with an ASCII value from 32 to 127 are passed. The multiplexer will always end a forwarded string with a CR/LF pair.

SeaTalk:          This option enables translation of SeaTalk[1] data received on In1 into NMEA 0183 sentences and NMEA 2000 PGNs (only on NMEA 2000 enabled multiplexers). See the Technical Reference section for an overview of translated SeaTalk data. Selecting this option will automatically set the communication speed of In1 to 4800 Baud and disable the speed setting.

### NMEA Conversions

The results of NMEA conversions (see Options page, Figure 45) are available as if these NMEA 0183 sentences were received on a separate – virtual – input. They can be routed accordingly using the default route settings and the routing table.

### NMEA 2000

NMEA 2000 PGN's are converted into NMEA 0183 sentences which are processed in the same way as NMEA 0183 sentences received on In1 to In4. They can be routed accordingly using the default route settings and the routing table.

### Host Data

This controls if and how the data from the host interfaces USB, Ethernet or WiFi is sent to both NMEA outputs:

No:         No data from the host is sent to the NMEA output.

Yes:        Data from the host is sent to the NMEA output and mixed with data from the inputs.

Override:   Data from the host is sent exclusively to the output and takes precedence over the data from the inputs. When the host sends data to the multiplexer, no other data is sent to that output. When the host stops sending data however, data from the inputs will be sent to the outputs again after a time out of 10 seconds.

The Override option is very useful when sailing alternately with and without a laptop. Consider a typical set-up as shown in Figure 44:
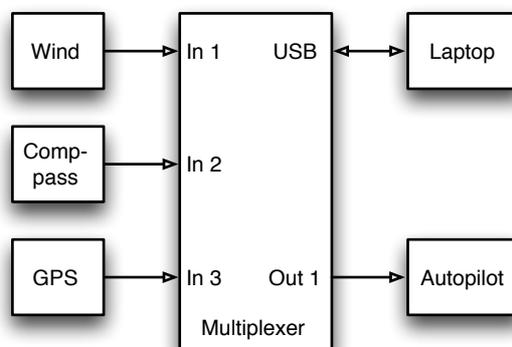


Figure 44

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 Out1. 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.

## Output NMEA V1.5

NMEA output 2 has an option to convert specific NMEA 0183 sentences to V1.5 format. Some older navigation devices can only process NMEA 0183 V1.5 sentences. The major difference between NMEA 0183 V1.5 and later versions is an added status field at the end of specific sentences. Older devices may have trouble reading these newer sentences. If this option is enabled, the multiplexer removes this status field from the end of NMEA sentences ABP, BWC, BWR, GLL, RMB, RMC, VTG and XTE.

*Note: this option only works on NMEA Out2!*

## Options

On the Options page, several operational options and NMEA 0183 conversions and sentences can be enabled.
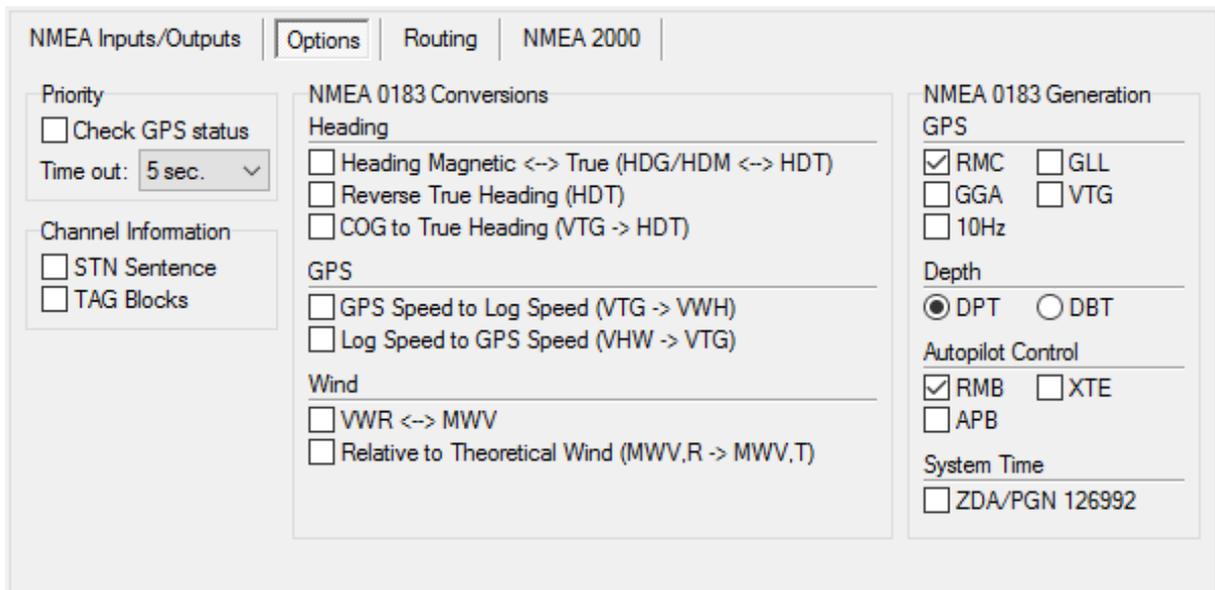


Figure 45

## Priority

Two settings influence the behaviour of the priorities set on the NMEA Input & Output page:

### Check GPS status

When the "Check GPS status" option is enabled, the status and mode flags of GPS sentences are checked. If these flags indicate an "invalid" status (e.g. No fix or Simulator mode), the sentence is blocked. This causes the priority features to choose the next available, lower priority source of these sentences.

When a secondary GPS is connected as a backup to the primary GPS, the primary GPS must completely fail (stop sending data) before sentences from the secondary GPS are passed. A situation may arise however, in which the primary GPS no longer receives a satellite signal (broken antenna, cable, etc.). It will still send NMEA 0183 position sentences to the multiplexer with the status flag set to "invalid fix", so the priority feature will not fall back to the secondary GPS.

When "Check GPS status" is enabled however, the multiplexer will check the status field of the GPS sentences, detect the invalid position fix and fall back to the secondary GPS. Sentences of which the Status flag is checked are APB, GGA, GLL, RMA, RMB, RMC, VTG and XTE.

### Time Out

This sets the time it takes before sentences from a lower priority input are passed.

## Channel Information

These options insert channel number information in the NMEA stream sent to the host interfaces. Channel numbers allow distinguishing between similar data from different instruments, like two depth sounders on the same boat.

**STN Sentence**

When enabled, each received NMEA sentence is preceded by am $MXSTN sentence to indicate on which NMEA input the following sentence was received. The example in Figure 46 shows that an IIGGA sentence was received on In1, a GPGGA sentence on In2, an IIGLL sentence on In1 and an HEHDT sentence on In3.

```
$MXSTN,01*71
$IIGGA,143357.999,5301.0061,N,00635.5479,E,1,06,1.9,90.0,M,,,,0000*2E
$MXSTN,02*72
$GPGGA,143357.999,5301.0061,N,00635.5479,E,1,06,1.9,90.0,M,,,,0000*39
$MXSTN,01*71
$IIGLL,5301.0061,N,00635.5479,E,143357.999,A*22
$MXSTN,03*73
$HEHDT,67.0,T*1E
```

Figure 46

The $MXSTN sentence is defined by the NMEA standard and a description can be found in the Technical Reference at the back of this manual.

**TAG Blocks**

This option adds an NMEA 0183 V4.0 TAG block to each sentence. This TAG block contains a source identification parameter indicating on which input that sentence was received. Figure 47 shows the same data as above, but with TAG blocks added.

```
\s:MX02-1*42\$IIGGA,143357.999,5301.0061,N,00635.5479,E,1,06,1.9,90.0,M,,,,0000*2E
\s:MX02-2*41\$GPGGA,143357.999,5301.0061,N,00635.5479,E,1,06,1.9,90.0,M,,,,0000*39
\s:MX02-1*42\$IIGLL,5301.0061,N,00635.5479,E,143357.999,A*22
\s:MX02=020*51\$HEHDT,67.0,T*1E
```

Figure 47

Note that the first three lines indicate an NMEA 0183 input by the last digit after a dash whereas the last line indicates an NMEA 2000 source address after the equal sign.

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

# NMEA 0183 Conversions

The MiniPlex can convert certain NMEA 0183 sentences into new NMEA 0183 sentences. The originating sentence used for the conversion is forwarded as usual and the conversion result is available on a virtual input called "NMEA Conversions" on the "NMEA Inputs/Outputs" page and on input C on the Routing page. Both the original sentence and the conversion result can be routed anywhere using the default route or the routing table.

Note that if the original sentence should be blocked, the entry in the routing table must have a checkbox on the input side of the table but no checkbox on the output side. The checkbox on the input side ensures the sentence is passed to the conversion function.

### Heading Magnetic <-> True (HDG/HDM <-> HDT)

This option converts magnetic and true heading in both directions. If the multiplexer receives an HDG or HDM sentence, it will transmit an HDT sentence (true heading). If the multiplexer receives an HDT sentence, it will transmit an HDM sentence.

Any magnetic variation or deviation present in the HDG sentence is used to calculate the true heading from the magnetic heading. Otherwise the magnetic heading value is just copied. If the HDG sentence contains no variation, the MiniPlex will use any variation received from an NMEA 0183, NMEA 2000 or SeaTalk source. The variation in the HDG sentence always takes precedence over any other variation.

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.

### Reverse True Heading (HDT)

This option reverses the true heading in a received HDT sentence. When an HDT sentence is received, the multiplexer transmits a new HDT sentence with 180° added to the original heading. This can be used to provide two opposing navigation stations on ferries with a heading from the same source. Each HDT sentence can be routed to different outputs if needed.

### COG to True Heading (VTG -> HDT)

This option transmits an HDT sentence when a VTG sentence is received.

### GPS Speed to Log Speed (VTG -> VHW)

This option transmits a VHW sentence (water speed and heading) when a VTG sentence (course over ground and ground speed) is received. This option can be useful to simulate a log with a stuck paddlewheel.

### Log Speed to GPS Speed (VHW -> VTG)

This option transmits a VTG sentence (course over ground and ground speed) when a VHW sentence (water speed and heading) is received. This can be useful if a device needs a VTG sentence while only a Log is available.

### VWR <-> MWV

This option generates an MWV sentence from a VWR sentence and vice versa. Sometimes software expects one sentence while the wind instrument generates the other. By enabling this option, 'old' and 'new' can be connected without problems.

### Relative to Theoretical Wind (MWV,R -> MWV,T)

This option calculates the Theoretical Wind (often called True Wind) from the Apparent Wind. When the multiplexer receives an MWV sentence with Apparent/Relative Wind, it will calculate the Theoretical wind using the SOG from a GPS source and transmit a new MWV sentence.

If only VWR sentences are received, the **VWR <-> MWV** option can be enabled to convert to an MWV sentence first.


## NMEA 0183 Generation

This section controls which NMEA 0183 sentences are generated from NMEA 2000 and SeaTalk[1] for GPS data, autopilot control, depth and system Time. The factory default settings (RMC & RMB only) are sufficient for most applications.

When connected devices require other sentences, they can be enabled here. For instance, a VHF radio might require a GGA sentence for GMDSS instead of an RMC. Some autopilots are also known to require APB and XTE in addition to the RMB sentence to operate properly.

### 10Hz

This option sets the frequency of the RMC, GGA, GLL and VTG sentence to 10Hz. This will result in 10 position updates per second, taking advantage of the NMEA 2000 PGN 129025, "Position, Rapid Update", which is also transmitted at 10Hz. The COG and SOG values in the RMC and VTG sentences will be updated at 4Hz, being the frequency of PGN 129026, "COG & SOG, Rapid Update".

Be careful when routing these sentences to NMEA outputs that operate on a slow speed: A single RMC sentence at 10Hz will already overflow an output at 4800 Baud!

### System Time – ZDA/PGN 126992

This option will enable the output of an NMEA 0183 ZDA sentence and/or PGN 126992 containing a System Time. The MiniPlex-3 features an internal real-time clock which can be set from a time source or be free running. This clock will be set when a system time is received from either NMEA 2000, NMEA 0183 or SeaTalk. The system time will never be retransmitted on the same bus or protocol it was received from. For example: if the System Time was received from an NMEA 0183 ZDA sentence, the MiniPlex will only transmit the System Time on NMEA 2000 and SeaTalk.

The priority of the System time is in descending order: NMEA 2000, NMEA 0183, SeaTalk.

Both the Source field (2) in PGN 129992 as the Talker ID of the ZDA sentence transmitted by the MiniPlex-3 will indicate the source of the System Time.

When the System Time is no longer received, the MiniPlex-3 will continue transmitting the System Time from the internal clock, indicating this as a "Local Crystal Clock" in PGN126992 field 2 and as a Talker ID "ZQ" in the ZDA sentence. Note that the real-time clock of the MiniPlex-3 is not very accurate, it can wander off several seconds within an hour.

The ZDA sentence is generated internally, originating from the "NMEA Conversions". This means that this sentence is transmitted by default on the host interfaces only. When it needs to be transmitted from one of the NMEA outputs, the default route from "NMEA Conversions" to Out1 and/or Out2 must be enabled or the a "—ZDA" entry must be made in the routing table with the corresponding input ('C') and the desired outputs enabled.

## Routing

The routing feature is the most powerful feature of the MiniPlex. It enables filtering and routing of NMEA 0183 sentences based on its Address Field (the "GPRMC" part) and optionally reduce their rate or frequency when sent to one of the NMEA outputs. The divisor is not applied to the host and WiFi outputs.

Sentences can be passed or blocked, specified by input and they can be forwarded to specific outputs. Up to 50 entries can be created, either manually or by capturing the NMEA 0183 sentences received by the multiplexer.

NMEA 2000 and SeaTalk[1] data is also routed here though not based on their PGN or datagram number but on the equivalent NMEA 0183 sentence it would be converted to.
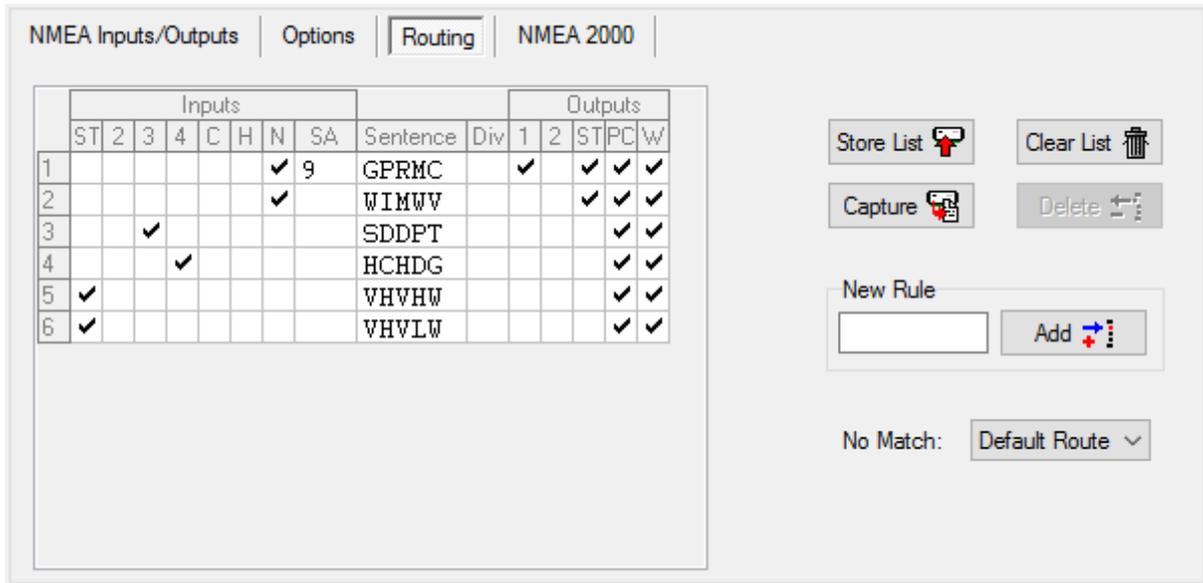


Figure 48

Each entry in the routing table 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. The buttons on the right allow you to modify the list and to store it into the multiplexer.

### List Columns

The routing table contains the following columns:

Inputs:
| | |
|---|---|
| 1-4: | NMEA 0183 inputs 1 to 4. If In1 is set to SeaTalk, the '1' changes into 'ST' |
| C: | NMEA 0183 Conversion results |
| H: | Input from the Host port |
| N: | Input from the NMEA 2000 port[1] |
| SA: | Source Address of the NMEA 2000 data |

| | |
|---|---|
| Sentence: | The Address Field of an NMEA 0183 sentence. This fully specifies the type of NMEA sentence to be filtered or routed. A '-' (dash) matches any character. If for instance --GLL is entered, any sentence that ends on GLL will match, regardless of the first two characters (the Talker ID). A "P----" will match on every proprietary sentence starting with $P. The Sentence field must contain 5 characters. |
| Div: | Divisor field. A number from 1 to 99 will divide the sentence rate by the number entered. If this field contains a divisor of 5 for instance, only every fifth occurrence of this sentence will be passed. |

Outputs:
| | |
|---|---|
| 1,2: | NMEA outputs 1 and 2 |
| ST: | Output to SeaTalk port[2] |
| PC: | Output to Host port (USB or Ethernet) |
| W: | Output to WiFi interface[1] |

Note 1: This column is only enabled if MPX-Config3 is connected to a MiniPlex-3 with this interface.

Note 2: This column is only enabled if In1 is set to SeaTalk mode.

No output column for NMEA 2000 exists because all received NMEA 0183 and SeaTalk data is always routed to the NMEA 2000 network.

**Editing the list**

It is important to keep in mind that all modifications and additions are made to the list loaded in MPX-Config3, not in the multiplexer. The current list is automatically loaded from the multiplexer when you connect to the multiplexer or when you click on the "Read Configuration" button. After editing, the list must be stored in the multiplexer using the "Store List" button to be effective.

Inputs/Outputs: Clicking on a checkbox in an input or output column enables a sentence on that input or output.

SA: The SA field is filled by double-clicking on the field and selecting the desired NMEA 2000 from the window that appears. The SA field can be cleared again by selecting it and pressing the Delete key on your keyboard.

Sentence/Div: The Sentence and Divisor fields can be edited by selecting it with the cursor. Edit mode is entered in several ways:

- Press function key F2 on your keyboard. 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 following buttons are available to edit the list:

Store List: Stores the list from MPX-Config3 into the multiplexer. This overwrites the list in the multiplexer.

Capture: Enables capture mode. The list will be filled automatically with NMEA 0183 sentences currently received by the multiplexer.

Add: Add a new entry. Type the desired sentence address into the edit box next to the Add button and click on Add or press the enter key. This will create a new entry with all inputs and outputs disabled. The input is case-insensitive; every entered sentence address will be converted into uppercase. The input must contain 5 characters, including dashes. Numbers are also allowed.

Delete: Delete an entry from the list in MPX-Config3. Select the entry to be deleted by clicking on the address in the Sentence column and click on the Delete button.

Default Action: This setting determines what happens if a received sentence is not found in the routing table. It can be set to either apply the default route or to block it.

Clear List: This button clears the list in MPX-Config3 (not in the multiplexer!). To clear the list in the multiplexer, click on the Store List button after clearing the list in MPX-Config3.

**Filling the list**

The routing entries can be entered in two ways: manually and automatically. You can add individual sentences to the table and set the desired routing information.

You can also fill the table automatically with 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.

The Technical Reference section lists commonly used Talker IDs and Sentence Formatters. This list can be a useful aid while setting up the routing table.

It is very important to realize that using capture to fill the table overrides the default routes since every sentence is in the filter list.

***It is absolutely necessary to review and modify the routing settings for each sentence after a Capture! It is often best not to use the routing table at all if you don't need sentence-specific routing.***

***Use the routing table with care! Simply capturing the list and storing it unmodified is useless and can lead to unforeseen problems!***

## NMEA 2000

A checkbox in the 'N' column and an empty "SA" field will pass that sentence from every device on the NMEA 2000 network. Using only the checkbox is sufficient in case of a single source of each sentence.

In case of multiple sources of the same data or sentence, the SA field needs to be used to distinguish between these sources. This would be the case with a GPS and an AIS transponder on the NMEA 2000 network: both devices transmit GPS data, which would be visible in the multiplexer as a GPRMC sentence. By adding two GPRMC entries in the routing table, each with the Source Address of the device transmitting this data, it is possible to route or block each of the GPRMC differently.

To add a Source Address, double-click on the SA field of the desired entry. A window appears which shows all devices on the NMEA 2000 network:



| Device | Serial Number | SA | DI |
|---|---|---|---|
| NMEA 2000 PC Interface (NGT-1) | 147824 | 9 | 0 |
| HDS Gen2 5m Pilot Controller | 3257260698 | 13 | 0 |
| HDS Gen2 5m iGPS | 3257260698 | 14 | 0 |
| HDS Gen2 5m Navigator | 3257260698 | 15 | 0 |
| HDS Gen2 5m MFD | 3257260698 | 16 | 0 |
| E22167 | 0560248 | 17 | 29 |
| NMEA 2000<->0183 Gateway (NGW-1) | 133177 | 20 | 0 |
| Graphene AIS Class B Transceiver | 1474 | 43 | 0 |
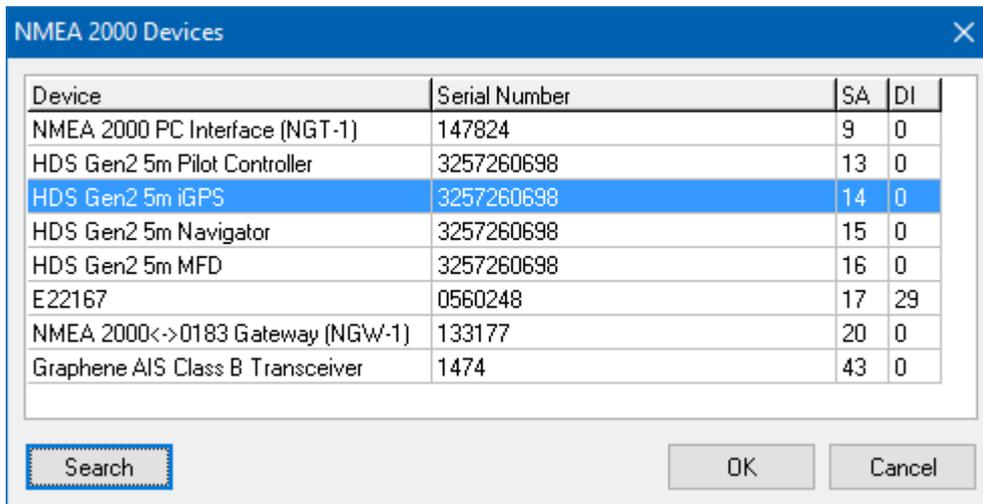
Figure 49

This window shows all devices on the NMEA 2000 network and their Source Address (SA) and Device Instance (DI). If the window shows empty Device or Serial Number fields, click on Search to refresh the list.

Select the desired device and click on OK. A double click on the desired entry has the same effect. After setting the SA's for both GPRMC sentence, the routing list might look like Figure 50. Entry 1 passes GPRMC sentences from the "HDS Gen5m iGPS" in Figure 49 to the host port "PC". Entry 2 blocks GPRMC sentences from the "Graphene AIS Class B Transceiver" because none of the outputs are enabled and entry 3 passes the AIS sentences to the host port.



Figure 50

**Important:** Source Addresses are dynamically "claimed" by devices on power up. When two devices claim the same SA, they will compare their unique numbers in the Address Claim PGN and the one with the lowest numerical value wins the claimed SA. The other device will have to claim a new address. Once all devices have claimed a unique SA, they will remain the same and it is safe to use the SA of a device in the routing table.

When a new device is connected to the NMEA 2000 network for the first time, it will also claim an SA. If the SA claimed is already in use by another device, it is possible that the existing device "loses" the Address Claim and must claim a new address. Long story short: when new devices are connected to the NMEA 2000 network, the Source Addresses of existing devices may change. It is then necessary to edit the routing table and re-assign the devices to each entry.

## Operation

When the multiplexer receives an NMEA 0183 sentence, it searches the routing table for a match. It doesn't matter if this sentence is received on one of the NMEA 0183 inputs, a conversion result or converted NMEA 2000 or SeaTalk[1] data.

The routing entries are processed in the order as they appear in the list in MPX-Config3. When a match is found, the input or Source Address from which the sentence was received is checked against the input settings (input checkboxes and SA) of this entry to determine whether the sentence may be passed or not. If the input matches, the sentence is passed for further processing or conversion and eventually it is routed to any enabled output (output checkboxes). For each received sentence, the entire routing table is scanned and a sentence may occur multiple times in the routing table.

If no match is found, the "No Match" setting determines what happens next: when set to "Default Route", the default routes the are applied. When it is set to "Block", the sentence is always blocked.

The default routes are set in the "Input Settings" section on the "NMEA Inputs/Outputs" page. Note that the multiplexer will not pass any sentence if the routing table is empty and the "No Match" setting is set to Block.

Received NMEA 0183 sentences are following a specific processing route, as shown in Figure 51 below:
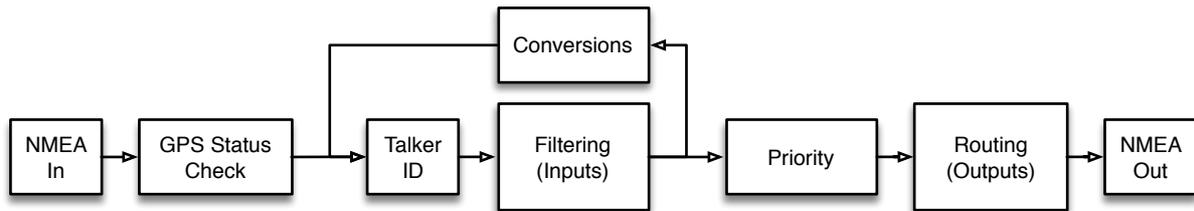


Figure 51

A few important things can be seen from this figure:

- If a Talker ID is set for an input, it is applied to received NMEA sentences *before* filtering is applied. A routing entry must therefore contain the correct Talker ID.

- Conversions are applied *after* filtering. As a result, sentences that are blocked on an input will not be converted. So if you need to convert a sentence and only want to use the conversion result only, the originating sentence must be enabled on the receiving input and blocked on all outputs. The conversion result needs to be enabled on the 'C' input and routed to the desired output.

### Example
Figure 52 shows a small routing table:



Figure 52

These entries have the following effect:

1. GPRMC sentences are passed from SeaTalk and routed to output 1, the PC and WiFi.

2. HEHDT sentences are passed from input 2 and routed to SeaTalk[1], the PC and WiFi. Only every 5th sentence is passed to Out2.

3. WIMWV sentences are passed from any NMEA 2000 source and routed to the PC and WiFi.

4. WIMTW sentences are passed from any NMEA 2000 source and routed to the PC and WiFi.

5. VWVHW sentences are passed from SeaTalk[1] and routed to the PC and WiFi.

6. AIVDM sentences are passed from any NMEA 2000 source and routed to Out2 and the WiFi.

7. WIVWR sentences are passed from a conversion and routed to output 1.

8. GPRMC sentences received from NMEA 2000 Source Address 43 are blocked.

The default route is applied to sentences that are not in the routing table.

## NMEA 2000

In general, it is not necessary to change any of the settings on this page. If all devices on the NMEA 2000 bus receive the converted NMEA 0183 from the multiplexer, everything is just fine.

The MiniPlex announces itself on an NMEA 2000 as six "virtual" devices: one "Main" device, and one device for each NMEA 0183/SeaTalk input and the conversion results. Each device has its own Device Type, Source Address and Device Instance.

The Source Address is "claimed" automatically on power up and cannot be changed manually. No two devices exist on an NMEA 2000 network with the same SA. This ensures that similar data from multiple devices can always be identified. Device Type and Device Instance however, can be configured.



Figure 53

### Device Type

Each device on an NMEA 2000 network has a Device Class and Device Function code. These codes enable other devices to make an automatic "best choice" for their source(s) of data. In MPX-config3, a Device Type can be selected for the "Main" device and each of the NMEA 0183/SeaTalk[1] inputs. Selecting a Device Type set the right Device Class and Device Function code for each MiniPlex-3 device on the NMEA 2000 network. In general, it is not necessary to change any of the settings on this page; the default Device Types work just fine in most situations.

In some situations however, it might be convenient or even necessary to set a Device Type that matches with the device connected to an NMEA 0183 input. Two examples are given:

1)  An AIS transponder and a GPS are connected to NMEA 0183 inputs of the multiplexer and a plotter is connected to the NMEA 2000 network. This plotter will see two similar sources of GPS data, both originating from an "NMEA 0183 Gateway". The plotter will randomly decide which source to use.
    By setting the AIS input to "AIS" and the GPS input to "Ownship Position (GNSS)", that same plotter can make an "educated" decision to use the GPS as the main source of position data and fall back to the AIS in case the GPS fails.

2)  A GPS is connected to an NMEA 0183 input of the multiplexer and a GMDSS capable VHF radio is connected to the NMEA 2000 network. Some of these radios do not accept position data from any other source than a GPS for safety reasons. In this case, it is necessary to set the Device Type of the NMEA 0183 input of the multiplexer to "Ownship Position (GNSS)".

Some Device Types appear in the list twice while one of them is marked with "(< V2)". This has to do with different versions of the NMEA 2000 standard. In the transition of V1.300 to V2.000 of the NMEA 2000 standard, some Device Class and Device function codes were changed. So, if an NMEA 2000 plotter does not recognize an "EPIRP" connected to an NMEA 0183 input as such, try using "EPIRB (<2)" instead.

### SA (Source Address)

This column shows the Source Addresses claimed by the virtual multiplexer devices/inputs. Other devices on the NMEA 2000 can use these addresses to specifically address a multiplexer devices. This is for informational purposes only.

## DI (Device Instance)

Every device on an NMEA 2000 network has a Device Instance, a number identifying multiple sources of the same data. By default, the DI of each device is 0. But in case of similar devices it is convenient to number them, to be able to identify each device regardless of its Source Address.

The DI of each NMEA 0183 input can be changed to enable identifying two similar devices on the NMEA 2000 bus. If two depth sensors are connected to NMEA 0183 inputs of the multiplexer, assigning different DI's to each input allows other devices to identify both depth sensors. The NMEA 2000 numbering convention is from port to starboard, then from bow to stern.

The default DI value is 0 and it is not necessary to change this if no NMEA 0183 input receives the same data.

## Show unknown PGN's

Normally, unknown PGN's are simply ignored by the multiplexer. When this option is enabled, these unknown PGN's are converted into an $MXPGN sentence. This is an NMEA 0183 sentence containing the PGN number, an attribute field and the binary data of the PGN, all represented as hexadecimal ASCII field. Such a sentence looks like this:

    $MXPGN,01F112,2807,FC7FFF7FFF168012*11

This option can be useful when navigation software needs to read PGN's for which no NMEA 0183 sentence exists. Such PGN's could contain a battery or alternator status, engine data or an electrical switch position. Converting these PGN's to an $MXPGN sentence allows developers to easily read NMEA 2000 data with existing NMEA 0183 sentence parsers.

## Show all PGN's

When this option is enabled, the conversions from NMEA 2000 to NMEA 0183 sentences is completely disabled and every received NMEA 2000 PGN is converted into an $MXPGN sentence. This allows software on a PC to read and decode all NMEA 2000 PGN's.

It is also possible to send an $MXPGN sentence to the multiplexer. The multiplexer will then convert this to an NMEA 2000 PGN and send it onto the NMEA 2000 network.

The Technical Reference in the back of this manual contains a detailed description of the $MXPGN sentence and how to use it.

One $MXPGN sentence is always transmitted by the multiplexer: $MXPGN,00EE00,…. This sentence contains the NMEA 2000 Address Claim message, which is transmitted by every device on the NMEA 2000 network for network address management. MPX-Config3 uses this message to build a list of all devices present on the NMEA 2000 network (Figure 54).

## Device List

This button opens a window showing all devices present on the NMEA 2000 network.
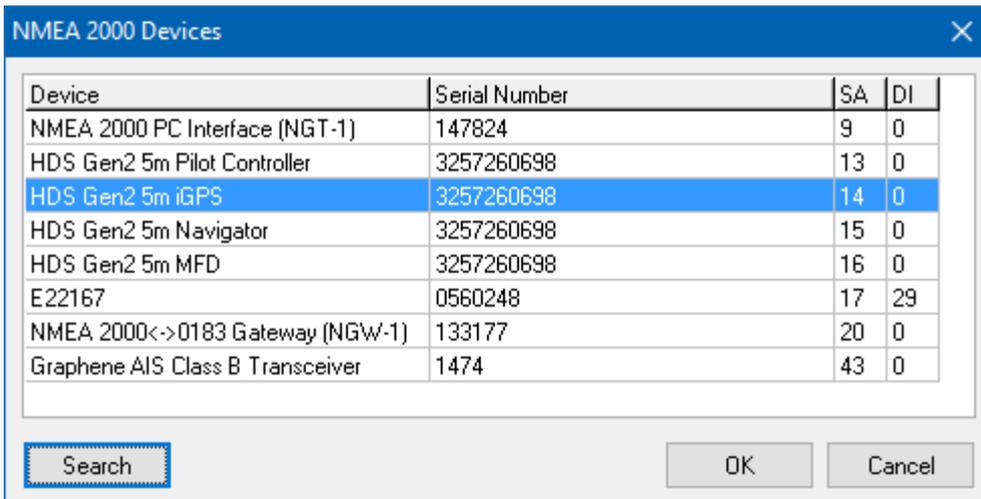


| Device | Serial Number | SA | DI |
|---|---|---|---|
| NMEA 2000 PC Interface (NGT-1) | 147824 | 9 | 0 |
| HDS Gen2 5m Pilot Controller | 3257260698 | 13 | 0 |
| HDS Gen2 5m iGPS | 3257260698 | 14 | 0 |
| HDS Gen2 5m Navigator | 3257260698 | 15 | 0 |
| HDS Gen2 5m MFD | 3257260698 | 16 | 0 |
| E22167 | 0560248 | 17 | 29 |
| NMEA 2000<->0183 Gateway (NGW-1) | 133177 | 20 | 0 |
| Graphene AIS Class B Transceiver | 1474 | 43 | 0 |

Figure 54

# Firmware Update

Firmware updates with new features or bug fixes will be available through our web site. These firmware files can be downloaded to your computer and loaded into the multiplexer using option "Update MiniPlex Firmware…" from the File menu.

MPX-Config3 also contains MiniPlex firmware, which is embedded in the application. This firmware version is the minimum required version that is compatible with this version of MPX-Config3.

When MPX-Config3 connects to the MiniPlex, it will interrogate the currently loaded firmware version and check that against the minimum version required. If the version in the MiniPlex is lower, an update is automatically started. This update can also be forced using menu Tools -> Automatic Update.

## Procedure

Make sure the multiplexer is connected to your computer via USB or Ethernet, start MPX-Config3 and connect to the multiplexer.

In case of a MiniPlex-3E, make sure the protocol is set to TCP first. It is not possible to update the firmware using the UDP protocol.

In case of a MiniPlex-3Wi, connect via the USB interface. It is not possible to update the MiniPlex firmware via WiFi.

Download the firmware update from our web site and unpack the .zip file. Remember in which folder you stored the .mpx file.

Choose "Update MiniPlex Firmware…" from the File menu.

Using the file dialog, locate and select the firmware image file. When you have selected the firmware 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 starts, the red LED on the multiplexer will be lit continuously while the green LED blinks on reception of data from the computer. MPX-Config3 will show a progress indicator 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 "Firmware Update Error messages" for an explanation of the error messages.

Whenever the update process aborts, the multiplexer will start outputting "$PSMDLDR…" sentences. This indicates that no firmware is loaded and the multiplexer waits for a new firmware update. Just try updating again until the process is successfully finished.

Sometimes the communication during the firmware update times out and the update is aborted with an error message. This time out can be caused by delays in the communication drivers that are part of Windows. These time outs happen frequently when software is running which communicates with other serial devices.

When such a time out occurs, the MiniPlex has no firmware loaded and the internal loader keeps sending $PSMDLDR… sentences, indicating that it waits for a firmware upload. Just try updating again until the process is successful. Sometimes it helps to try the update on a different computer.

# Mounting

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

Make sure there is enough space around the multiplexer to connect the NMEA 0183 wiring at the bottom, the NMEA 2000 connector on the left side and USB/Network connector on the right side of the housing.

# Technical Reference

## NMEA 0183 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 |
| MX | Multiplexer |
| 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 pseudo range 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 | Glonass 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 |
| PGN | NMEA 2000 PGN 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 |

# Supported NMEA 2000 PGN's

| PGN Decimal | PGN Hex | Description | TX | RX |
|---|---|---|:-:|:-:|
| 059392 | E800 | ISO Acknowledge | • | • |
| 059904 | EA00 | ISO Request | • | • |
| 060160 | EB00 | ISO Transport Protocol, Data Transfer | | • |
| 060416 | EC00 | ISO Transport Protocol, Connection Management | | |
| 060928 | EE00 | ISO Address Claim | • | • |
| 065240 | FED8 | ISO Commanded Address | | • |
| 126208 | 1ED00 | Request/Command/Acknowledge group function | • | • |
| 126464 | 1EE00 | Receive/Transmit PGN's group function | • | |
| 126992 | 1F010 | System Time | • | • |
| 126993 | 1F011 | Heartbeat | • | |
| 126996 | 1F014 | Product Information | • | • |
| 126998 | 1F016 | Configuration Information | • | |
| 127237 | 1F105 | Heading/Track Control | • | • |
| 127245 | 1F10D | Rudder | • | • |
| 127250 | 1F112 | Vessel Heading | • | • |
| 127251 | 1F113 | Rate of Turn | • | • |
| 127252 | 1F114 | Heave | | • |
| 127257 | 1F119 | Attitude | | • |
| 127258 | 1F11A | Magnetic variation | • | • |
| 128259 | 1F503 | Speed, Water referenced | • | • |
| 128267 | 1F50B | Water Depth | • | • |
| 128275 | 1F513 | Distance Log | • | • |
| 129025 | 1F801 | Position, Rapid Update | • | • |
| 129026 | 1F802 | COG & SOG, Rapid Update | • | • |
| 129029 | 1F805 | GNSS Position Data | • | • |
| 129033 | 1F809 | Local Time Offset | | • |
| 129038 | 1F80E | AIS Class A Position Report | • | • |
| 129039 | 1F80F | AIS Class B Position Report | • | • |
| 129040 | 1F810 | AIS Class B Extended Position Report | • | |
| 129283 | 1F903 | Cross Track Error | • | • |
| 129284 | 1F904 | Navigation Data | • | • |
| 129285 | 1F905 | Navigation - Route/Waypoint information | • | • |
| 129794 | 1FB02 | AIS Class A Static and Voyage Related Data | • | • |
| 129802 | 1FB0A | AIS Safety Related Broadcast Message | • | • |
| 129809 | 1FB11 | AIS Class B "CS" Static Data Report, Part A | • | • |
| 129810 | 1FB12 | AIS Class B "CS" Static Data Report, Part B | • | • |
| 130074 | 1FC1A | WP List - WP Name & Position | • | |
| 130306 | 1FD02 | Wind Data | • | • |
| 130310 | 1FD06 | Environment | • | • |
| 130311 | 1FD07 | Environment | • | • |
| 130312 | 1FD08 | Temperature | • | • |
| 130313 | 1FD09 | Humidity | • | • |
| 130314 | 1FD0A | Actual Pressure | • | • |
| 130316 | 1FD0C | Temperature, extended range | • | • |

# Translated SeaTalk datagrams

When the SeaTalk translation is enabled, the following datagrams are received and transmitted:

| SeaTalk | Description | TX | RX |
|---|---|---|---|
| 00 | Depth below transducer | • | • |
| 10 | Wind angle | • | • |
| 11 | Wind speed | • | • |
| 20 | Speed through water | • | • |
| 21 | Trip mileage | • | • |
| 22 | Total mileage | • | • |
| 23 | Water temperature | • | • |
| 25 | Total and Trip mileage | • | • |
| 26 | Speed through water | • | • |
| 27 | Water temperature | • | • |
| 50 | GPS latitude | • | • |
| 51 | GPS longitude | • | • |
| 52 | GPS speed over ground | • | • |
| 53 | GPS course over ground | • | • |
| 54 | GPS time | • | • |
| 56 | GPS date | • | • |
| 57 | GPS Satellites | | • |
| 58 | GPS latitude and longitude | • | • |
| 82 | Waypoint name | | • |
| 84 | Autopilot heading and rudder position | | • |
| 85 | Navigation to waypoint data | • | • |
| 89 | Compass heading | • | • |
| 99 | Magnetic variation | • | • |
| 9C | Compass heading and rudder position | | • |
| A1 | Long waypoint name | • | • |
| A2 | Arrival status | • | • |
| A5 | GPS info and status | • | • |

When the option 2 is enabled using the $PSMDOP sentence, 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:

**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-Config3. Currently, there is only one firmware file version but it is not unlikely that in the future new version are developed which require an update of MPX-Config3.

**Firmware file is corrupt**

The firmware file is damaged, possible 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-Config3 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 which 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-Config3.

**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 loader firmware image does not match the checksum if the image file. Apparently, there was a communication error between MPX-Config3 and the multiplexer. You can try to update again.

**Invalid response from bootloader**

The bootloader returned an unknown response to a command from MPX-Config3.

# Standard NMEA 0183 Sentences

The following standard NMEA 0183 sentences are used by the MiniPlex-3.

## $MXSTN – Multiple Data ID

When STN sentences are enabled ($PSMDOP, option 11), the multiplexer transmits a $MXSTN sentence before every NMEA sentence that is sent from the host interface.

Format:  $MXSTN,xx*hh<CR><LF>
xx:  Input number, 00 to 06.

The Input Number indicates on which the following NMEA sentence was received:

00: Internally generated responses ($PSMD sentences)
01: NMEA 0183 Input 1 or SeaTalk
02: NMEA 0183 Input 2
03: NMEA 0183 Input 3
04: NMEA 0183 Input 4
05: NMEA 2000
06: Conversion results

## $MXPGN – NMEA 2000 PGN Data

This sentence transports NMEA 2000 Single Frame messages over NMEA 0183. The MiniPlex will output this sentence with Talker ID "MX". When sent to the MiniPlex, the Talker ID is ignored unless a routing entry exists for this sentence.

Format:  $--PGN,pppppp,aaaa,c--c*hh<CR><LF>

pppppp:  PGN of the NMEA 2000 message, 3-byte hexadecimal number. If the PGN is non-global, the lowest byte contains the destination address.

aaaa:  Attribute Word, 2-byte hexadecimal number. This word contains the priority, the DLC code and then source/destination address of the message, formatted as shown below:

| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| S | Priority | | | DLC | | | | Address | | | | | | | |
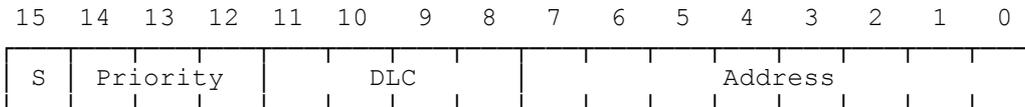
S:  Send bit. When an NMEA 2000 message is received, this bit is 0.
To use the $MXPGN sentence to send an NMEA 2000 message, this bit must be set to 1.

Priority:  Message priority. A value between 0 and 7, a lower value means higher priority.

DLC:  Data Length Code field, contains the size of the message in bytes (1..8) or a Class 2 Transmission ID (9..15).

Address:  Depending on the Send bit, this field contains the Source Address (S=0) or the Destination Address (S=1) of the message.

c--c:  Data field of the NMEA 2000 message, organized as one large number in hexadecimal notation from MSB to LSB. This is in accordance with "NMEA 2000 Appendix D", chapter D.1, "Data Placement within the CAN Frame".

The size of this field depends on the DLC value and can be 1 to 8 bytes (2 to 16 hexadecimal characters).

### NMEA 2000 Reception

When the multiplexer converts an NMEA 2000 message into an $MXPGN sentence, the S bit in the Attribute field will be 0 and the Address field contains the source address of the message. The destination address of the message is either global or contained in the lower byte of the PGN, in accordance with the NMEA 2000/ISO specification.

### NMEA 2000 Transmission

A $--PGN sentence sent to the multiplexer will be converted to an NMEA 2000 message if the S bit in the Attribute field is 1.

The Address field is the Destination Address of the NMEA 2000 message. The Source Address of the message will be the address the multiplexer has acquired during the Address Claim Procedure. If a global PGN is used, the contents of the Address field will be ignored. A non-global PGN can be sent globally by setting the Address field to 0xFF.

The Destination Address of a non-global PGN can also be specified by loading it into the lower byte of the PGN. The Address field of the Attribute word must be set to 0x00 for this.

The DLC field must be set to the size of the Data field (1 to 8 bytes) and the actual size of the Data field must match with the DLC. If the DLC field us used as a Class 2 Transmission ID (9..15), the size of the Data field must be 8 bytes/16 characters. If any of these conditions is not met, the message will not be transmitted.

For quick transmission of an NMEA 2000 message, the Attribute field of the $--PGN sentence may be omitted. In this case, the following values for the Attribute will be assumed:

S:        1
Priority: 7
DLC:      Set automatically from the size of the Data field (c—c) field.
Address:  0. The Destination Address of the message will be contained in the PGN field (pppppp).

## Examples

A received PGN 127250 (hex: 1F112, Vessel Heading) will be converted into the following $MXPGN sentence:

```
$MXPGN,01F112,2807,FC7FFF7FFF168012*11
```

The Attribute word shows a received frame (S=0), with priority 2, it is 8 bytes and the Source Address is 0x07.

To transmit PGN127250, the following $--PGN sentence must be sent to the multiplexer:

```
$MXPGN,01F112,A800,FC7FFF7FFF168012*65
```

In this example, the Address field of the Attribute field is ignored and set to 0x00 because PGN 127250 is a Global PGN.

An ISO Request (PGN 059904) can be transmitted in the following ways:

```
$MXPGN,00EA00,F309,01F016*68
$MXPGN,00EA09,,01F016*1D
```

In both cases, this message is sent to Destination Address 0x09. In the first sentence, the Destination Address is specified in the Attribute word, the second sentence has it embedded in the PGN field.

# Proprietary NMEA 0183 Sentences

The MiniPlex multiplexers are configured with proprietary NMEA sentences that can be sent to the multiplexer through the host interface. These will be called commands.

The multiplexer can also output proprietary NMEA sentences on a host interface to output status information or a response to a received proprietary NMEA sentence.

The multiplexer also outputs some standard NMEA sentences. These sentences all start with 'MX', which is the talker ID for a multiplexer as defined by the NMEA standard.

The host interface is the port that connects to a computer, laptop, smartphone or tablet by means of RS-232, USB, Bluetooth, WiFi or Ethernet. A MiniPlex can have more than one host interface. When the multiplexer outputs something on a host interface, it is sent to all host interfaces simultaneously. All host interfaces operate equally and have equal priority.

All MiniPlex proprietary sentences have the following format:

$PSMDxxx,a,b,…*hh<CR><LF>

| | |
|---|---|
| $P: | Start of a proprietary sentence as dictated by the NMEA standard |
| SMD: | ShipModul manufacturer mnemonic |
| xxx: | One, two- or three-character sentence formatter |
| a,b,…: | Optional fields |
| *hh: | Optional checksum field |
| <CR><LF>: | Carriage Return and Line Feed characters that terminate the sentence |

Unless specified otherwise, fields are optional and may be skipped when no change is required. For instance, a $PSMDCF,C,,,,1 sentence only enables Channel Numbers. The preceding fields are skipped (,,,,) and the trailing fields are omitted.

For ease of manual configuration, these sentences do not require a checksum. If the sentence has a checksum however, it is checked and the sentence is rejected on a checksum failure. Sentences output by the multiplexer always contain a checksum. Checksums are denoted with *hh in the descriptions below.

Sentences that are used to both set and retrieve a configuration setting have a Sentence Status field. This field is the first field of the sentence and can be one of the following:

   C: the sentence was a configuration command
   R: the sentence was a response to a command

A configuration command is sent to the multiplexer to change a setting. A response is sent by the multiplexer to report a setting.

Unless specified otherwise, all command sentences return a response with their settings when sent without parameters.

A command sentence with its Sentence Status field set to 'R' is ignored by the multiplexer.

## Example

The $PSMDID sentence controls the Talker ID settings of the multiplexer. When $PSMDID is sent to the multiplexer, it will report with the current Talker ID settings with:

   $PSMDID,R,aa,bb,cc,dd,ee*hh

To set the change the Talker ID settings, send the following sentence:

   $PSMDID,C,aa,bb,cc,dd,ee

## $PSMDCF – Set Configuration

This sentence sets various configuration settings of the multiplexer.

Format: $PSMDCF,a,b,t*hh<CR><LF>

a: Sentence Status flag:
   R = sentence is a response with current settings
   C = sentence is a command to change settings

b: Baud rate selector for the RS-232 interface (ignored when no RS-232 port present):
   0 = 4800 Baud
   1 = 9600 Baud
   2 = 19200 Baud
   3 = 38400 Baud
   4 = 57600 Baud
   5 = 115200 Baud

t: Priority Timeout (in seconds):
   0 = 1
   1 = 2
   2 = 3
   3 = 5
   4 = 10
   5 = 30

## $PSMDDR – Set Default Route

This sentence specifies the default route from the NMEA inputs to the NMEA outputs and from the host interface to the NMEA outputs. Any route set by the FL sentence overrides the standard route.

Format: $PSMDDR,a,xx,b,yy,c*hh<CR><LF>

a: Sentence Status flag:
   R = sentence is a response with current settings
   C = sentence is a command to change settings

xx: Input field for NMEA Out1. This is a hexadecimal number where each bit represents an NMEA input. The following bits are defined:

   0: NMEA In1
   1: NMEA In2
   2: NMEA In3
   3: NMEA In4
   4: NMEA Conversions
   7: NMEA 2000

   When a bit is 1, the input is routed to output 1, otherwise the input is not routed.

b: Host data to NMEA Out1:
   0: Host data is not routed
   1: Host data is routed
   2: Host data is routed and overrides data from the inputs. A time out mechanism will route data from the inputs when no data from the host is received.

yy: Input field for NMEA Out2. This is a hexadecimal number where each bit represents an NMEA input. The following bits are defined:

   0: NMEA In1
   1: NMEA In2
   2: NMEA In3
   3: NMEA In4
   4: NMEA Conversions
   7: NMEA 2000

   When a bit is 1, the input is routed to output 2, otherwise the input is not routed.

c: Host data to NMEA Out2:
   0: Host data is not routed
   1: Host data is routed
   2: Host data is routed and overrides data from the inputs. A time out mechanism will route data from the inputs when no data from the host is received.

## $PSMDFL – Set Filter/Routing entries

This sentence load a routing entry into the routing table which is applied to every NMEA 0183 sentence received or generated from SeaTalk or NMEA 2000 data.

Routing entries are specified using the address field of an NMEA sentence. For each entry, the inputs on which the sentence may be received must be specified. Optionally, a divisor and an output routing field can be added.

Sentences for which no entries exists are passed or blocked, depending on the routing mode set by option/bit 0 of the PSMDOP sentence.

Format:   $PSMDFL,a,ccccc,xx,dd,yy,ss*hh<CR><LF>

a:        Sentence Status flag:
          R = sentence is a status report of current settings
          C = sentence is a command to change settings

ccccc:    Address field of the routing entry (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.
          Multiple entries with the same address field may be loaded to route similar sentences form different inputs to different outputs.

xx:       Input field. This is a hexadecimal number where each bit represents an NMEA input. The following bits are defined:

          0: NMEA In1
          1: NMEA In2
          2: NMEA In3
          3: NMEA In4
          4: NMEA Conversions
          5: Host input
          6: WiFi input (not implemented yet)
          7: NMEA 2000

          When a bit is 1, the sentence is forwarded, otherwise the sentence is blocked from that input.

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 $6^{th}$ occurrence of this sentence is passed.

yy:       Optional routing field. This is a hexadecimal number where each bit represents an output. The following bits are defined:

          0: NMEA Out1
          1: NMEA Out2
          2: SeaTalk bus
          3: NMEA 2000
          4: Wireless output
          5: Host output

          When a bit is 1, the sentence is routed to that output.
          When this field is omitted, a default of 'C0' is assumed, routing the specified sentence to all the Host and Wireless output only.

ss:       Optional Source Address or Device Instance of data if the input field has the NMEA 2000-bit set.

hh:       Optional checksum

An FL sentence with the word DELETE in the 'ccccc' field erases all rules. The table accepts duplicate entries with the same 'ccccc' field to allow separate routes from inputs to outputs.

Example: $PSMDFL,C,HEHDT,18,5,05<CR><LF>

This sentence specifies an routing entry for all sentences that have 'HEHDT' in the address field. It only passes HEHDT sentences from inputs 3 and 4, the rate is lowered by a factor of 5 and the sentence is routed to NMEA Out1 and the host only.

When the routing table is requested, the multiplexer responds by sending FL sentences, one for each entry. An empty FL sentence marks the end of the list.

Example response:

$PSMDFL,R,GPRMC,19,0,0F*4A<CR><LF>
$PSMDFL,R,GPGGA,18,0,0F*56<CR><LF>

$PSMDFL,R,--VWT,02,5,01,132*50<CR><LF>
$PSMDFL,R,GPGSV,10,0,04*55<CR><LF>
$PSMDFL,R*2C<CR><LF>

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

## $PSMDID – Set Talker ID
This sentence sets a Talker ID translation for a specific input. If a Talker ID is specified, the original Talker ID of the sentences received on that input is replaced by the specified one, before sending the sentence to the host.

Format: $PSMDID,a,aa,bb,cc,dd,ee*hh<CR><LF>

a:      Sentence Status flag:
        R = sentence is a response with current settings
        C = sentence is a command to change settings

aa:     Talker ID for In1
bb:     Talker ID for In2
cc:     Talker ID for In3
dd:     Talker ID for In4
ee:     Talker ID for conversion results
hh:     optional checksum

An empty field clears the ID and disables the translation for that specific channel.

## $PSMDIN – Input options
Set the operating mode of the NMEA inputs.

Format:   $PSMDIN,a,x,x,x,x

a:   Sentence Status flag:
      R = sentence is a response with current settings
      C = sentence is a command to change settings

x:   Operating mode field for input 1 to 4:

   0:   Normal NMEA processing.

   1:   Pass NMEA sentences containing an erroneous checksum unmodified, bypassing all further NMEA processing.

   2:   Relaxed NMEA format checking. Normally the multiplexer only passes sentences when they are correctly formatted: starting with a '$' or a '!' and ending on a CR/LF pair.
       When this mode is selected, an NMEA sentence will be passed if it starts with a '$' or a '!' and ends on a CR or a LF or a combination of both in arbitrary order.
       A sentence with a checksum error is blocked.

   3:   Accept plain text strings as input and forward them in $MXTXT sentences. Any character with an ASCII value > 32 (a space) regarded as the start of a string. The string must end on a CR or LF and may not be longer than 61 characters. A longer string is discarded. Only valid NMEA characters are passed. Invalid characters are stripped from the input data.
       The Total number and Sentence number fields are always set to '01'. The Text Identifier field of the $MXTXT sentence contains the input number on which the text was received. When for instance 'Hello World' is received on input 3, the resulting sentence will be:
       $MXTXT,01,01,03,Hello World*6E

   4:   Accept plain text strings as input and forward them in $PTXT sentences. Any character with an ASCII value > 32 (a space) regarded as the start of a string. The string must end on a CR or LF and may not be longer than 61 characters. A longer string is discarded. The multiplexer will always end a forwarded string with a CR/LF pair.
       All characters with an ASCII value from 32 to 127 are passed.

   5:   Accept plain text strings as input and forward them as plain text. Any character with an ASCII value > 32 (a space) regarded as the start of a string. The string must end on a CR or LF and may not be longer than 61 characters. A longer string is discarded. The multiplexer will always end a forwarded string with a CR/LF pair.
       All characters between from ASCII 32 to 127 are passed.

   6:   SeaTalk to NMEA conversion on input 1 only. When this mode is selected, the $PSMDOP response will show option 1 enabled. Any other mode (0..4) will clear both SeaTalk options in the $PSMDOP response.

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

Format:   $PSMDLDR,xx,v.v,zzz,rr

xx:   Hardware ID of the multiplexer (a hexadecimal number)
v.v:   Bootloader version number
zzz:   Hardware name of the multiplexer
rr:   Reset source

The following hardware ID's and names are defined:

01:   MPX-S   (board with RS-232 interface)
02:   MPX-U   (board with USB interface)
03:   MPX-E   (board with Ethernet interface)
04:   MPX-W   (board with USB and WiFi interface)

When bit 7 of the hardware ID is set, e.g. 81, the board has a Bluetooth module installed.

The Reset source indicates what caused the multiplexer to restart or reset. It is a bit-field with the following bits defined:

0: Power-on reset (01)
1: External reset via Reset pin (02)
2: Brownout reset     (04)
3: Watchdog reset (08)
4: Program and Debug interface reset (10)
5: Software reset (20)

The value in brackets indicate the value of the reset source field when the corresponding bit is set. A few values are of interest when troubleshooting a multiplexer which constantly outputs $PSMDLDR sentences:

Power-on reset (01):    A bad power connection (loose contact) causes the multiplexer to restart.

Brownout reset (04):    This reset occurs when the supply voltage is too low. When the multiplexer is powered from a pulsing DC source (using a battery charger at home), it will almost continuously output a $PSMDLDR sentence ending with 04. This is because a battery charger does not output a smooth DC voltage but a pulsating (100or 120Hz) DC voltage which causes the multiplexer to reset continuously.

Watchdog reset (08):    This reset indicates a watchdog time out. The watchdog timer is a safety measure made of a timer which must be reset periodically by the running firmware. When this no longer happens because the firmware is "stuck"  somewhere or not loaded, the watchdog timer will time out and in turn reset the multiplexer. A continuous stream of $PSMDLDR sentences with this reset value occurs when a firmware update failed.

Software reset (20):    This value can be seen when issuing a PSMDRESET command, which effectively results in a software reset.

Example: $PSMDLDR,82,1.2,MPX-U,01

This multiplexer has a MPX-U board with a USB interface and a Bluetooth module installed and the bootloader is version 1.2. The reset source was a power-on event.

## $PSMDNA – Set NMEA 2000 Source Address
This sentence sets the NMEA 2000 Source Address of each virtual NMEA 2000 device of the multiplexer.

Format:  $PSMDNA,a,b,c,d,e,f,g*hh<CR><LF>

a:     Sentence Status flag:
        R = sentence is a response with current settings
        C = sentence is a command to change settings

b:     Main Source Address (System and Host interfaces USB, Ethernet, WiFi)
c:     Source Address of NMEA 0183 In1/SeaTalk
d:     Source Address of NMEA 0183 In2
e:     Source Address of NMEA 0183 In3
f:     Source Address of NMEA 0183 In4
g:     Source Address of NMEA 0183 conversions

Note that when this command is executed, these addresses will be requested using the NMEA 2000 Address Claim Procedure. If other devices on the NMEA 2000 network have already claimed one of these addresses, the Address Claim Procedure determines who "wins" the specified address. So the addresses claimed by the MiniPlex may eventually be different.

## $PSMDND – Set NMEA 2000 Device Instance
This sentence sets the NMEA 2000 Device Instance of each virtual NMEA 2000 device of the multiplexer.

Format:  $PSMDND,a,b,c,d,e,f,g*hh<CR><LF>

a:     Sentence Status flag:
        R = sentence is a response with current settings
        C = sentence is a command to change settings

b:     Main Device Instance (System and Host interfaces USB, Ethernet, WiFi)
c:     Device Instance of NMEA 0183 In1
d:     Device Instance of NMEA 0183 In2
e:     Device Instance of NMEA 0183 In3
f:     Device Instance of NMEA 0183 In4
g:     Device Instance of NMEA 0183 conversions

# $PSMDNF – Set NMEA 2000 Class and Function Code

This sentence sets the NMEA 2000 Device Class and Device Function of each virtual NMEA 2000 device of the multiplexer.

Format: $PSMDNF,a,b,c,d,e,f,g*hh<CR><LF>

a: Sentence Status flag:
   R = sentence is a response with current settings
   C = sentence is a command to change settings

b: Main Class and Function (System and Host interfaces USB, Ethernet, WiFi)
c: Class and Function of NMEA 0183 In1
d: Class and Function of NMEA 0183 In2
e: Class and Function of NMEA 0183 In3
f: Class and Function of NMEA 0183 In4
g: Class and Function of NMEA 0183 conversions

The Device Class and Device Function is set by a single number. Each number defines a combination of Device Class and Device Function as shown in the table below:

| Num | Class | Function | Name |
|---|---|---|---|
| 0 | 25 | 135 | NMEA 0183 Gateway |
| 1 | 25 | 130 | PC Gateway |
| 2 | 60 | 195 | AIS |
| 3 | 70 | 140 | AIS (< V2) |
| 4 | 40 | 150 | Autopilot |
| 5 | 60 | 130 | Depth |
| 6 | 60 | 135 | Depth & Speed |
| 7 | 120 | 130 | Display/User Interface/Plotter |
| 8 | 70 | 150 | DSC (< V2) |
| 9 | 60 | 205 | ECDIS (< V2) |
| 10 | 60 | 210 | ECS (< V2) |
| 11 | 20 | 130 | EPIRB |
| 12 | 70 | 130 | EPIRB (< V2) |
| 13 | 80 | 160 | General Purpose Display (< V2) |
| 14 | 40 | 160 | Heading (< V2) |
| 15 | 60 | 140 | Ownship Attitude |
| 16 | 80 | 150 | Integrated Instruments (< V2) |
| 17 | 60 | 170 | Integrated Navigation (< V2) |
| 18 | 60 | 175 | Integrated Navigation System |
| 19 | 20 | 135 | Man Overboard |
| 20 | 70 | 180 | MF/HF Radio (< V2) |
| 21 | 60 | 145 | Ownship Position (GNSS) |
| 22 | 60 | 150 | Ownship Position (Loran C) |
| 23 | 60 | 200 | Radar |
| 24 | 40 | 155 | Rudder |
| 25 | 70 | 170 | Satellite Communications |
| 26 | 60 | 155 | Speed |
| 27 | 60 | 160 | Turn Rate (< V2) |
| 28 | 70 | 190 | VHF Radio with DSC |
| 29 | 20 | 140 | Voyage Data Recorder |
| 30 | 80 | 140 | Voyage Data Recorder (< V2) |
| 31 | 85 | 160 | Water Temperature |
| 32 | 80 | 180 | Weather Instrument (< V2) |
| 33 | 85 | 130 | Wind/Pressure/Humidity |

## $PSMDNO – Set NMEA 2000 Options

This sentence enables or disables NMEA 2000 options.

Format:  $PSMDNO,a,o,e*hh<CR><LF>
or:      $PSMDNO,a,xxxxxxxx*hh<CR><LF>

a:  Sentence Status flag:
    R = sentence is a response with current settings
    C = sentence is a command to change settings

o:  option number

e:  0 = off/disable
    1 = on/enable

xxxxxxxx:  all options at once as a 32-bit hexadecimal number. Each bit represents an option where bit 0 is option 0, bit 1 is option 1 etc.

Example:  $PSMDOP,C,6,1<CR><LF>          (enables option 6)
          $PSMDOP,C,00000021<CR><LF>  (enables options 5 and 0)

The following options are defined:

0:  Enable RMC sentence from a GPS source (enabled by default)

1:  Enable GGA sentence from a GPS source

2:  Enable GLL sentence from a GPS source

3:  Enable VTG sentence from a GPS source

4:  Enable RMB sentence from a navigation source (enabled by default)

5:  Enable APB sentence from a navigation source

6:  Enable XTE sentence from a navigation source

7:  Output system time using a $MXZDA sentence and PGN 126992

8:  Output a DBT sentence instead of a DPT sentence

29: Use the Device Instance for routing of NMEA 2000 data instead of its Source Address.

30: Output unknown NMEA 2000 PGN's as an $MXPGN sentence.

31: Output all NMEA 2000 PGN's as an $MXPGN sentence.

## $PSMDNS – Set NMEA 2000 System Instance

This sentence sets the NMEA 2000 System Instance of each virtual NMEA 2000 device of the multiplexer.

Format:  $PSMDND,a,b,c,d,e,f,g*hh<CR><LF>

a:  Sentence Status flag:
    R = sentence is a response with current settings
    C = sentence is a command to change settings

b:  Main System Instance (System and Host interfaces USB, Ethernet, WiFi)
c:  System Instance of NMEA 0183 In1
d:  System Instance of NMEA 0183 In2
e:  System Instance of NMEA 0183 In3
f:  System Instance of NMEA 0183 In4
g:  System Instance of NMEA 0183 conversions

## $PSMDOP – Set Options

This sentence enables or disables options which control the operation of the multiplexer.

Format:  $PSMDOP,a,o,e*hh<CR><LF>
or:      $PSMDOP,a,xxxxxxxx*hh<CR><LF>

a:  Sentence Status flag:
    R = sentence is a response with current settings
    C = sentence is a command to change settings

o:  option number

e:  0 = off/disable
    1 = on/enable

xxxxxxxx:  all options at once as a 32-bit hexadecimal number. Each bit represents an option where bit 0 is option 0, bit 1 is option 1 etc.

Example:   $PSMDOP,C,6,1<CR><LF>        (enables option 6)
           $PSMDOP,C,00000021<CR><LF>  (enables options 5 and 0)

The following options are defined:

0:  Routing Block. Block sentences that are not in the routing table. The default operation is to apply the default route to sentences that are not in the routing table.

1:  Enable SeaTalk mode. This will also be reflected in the $PSMDIN response: input 1 will report SeaTalk mode.

2:  Convert SeaTalk datagrams into $PSMDST,xx,xx,… sentences. Datagrams are only converted if they are not translated into NMEA. When option 1 is enabled, only unknown datagrams are converted, otherwise all datagrams are converted. . This will also be reflected in the $PSMDIN response: input 5 will report SeaTalk mode.

3:  Test GPS status field. When enabled, the status field of a GPS related sentence is checked. When the data is invalid, the sentence is discarded to allow the Priority mechanism to pass GPS data from a lower priority input.

4:  Enable COG to HDT conversion A $HEHDT sentence is generated when a VTG sentence is received.

5:  Heading translation. When a magnetic heading sentence (HDM or HDG) is received, the multiplexer generates a true heading sentence (HDT). The heading is corrected for magnetic variation if this field is available in the HDG or HDM sentence or if another source of magnetic variation is available. When a True heading (HDT) is received, the multiplexer generates an HDM sentence.

6:  Reverse heading. When enabled, a new HDT sentence is generated from an incoming HDT sentence with the heading reversed by 180 degrees. Use the routing table to route the original and new HDT sentences to different outputs.

7:  Velocity translation. Generate a log sentence (VHW) from a GPS speed sentence (VTG). This is the opposite translation of option 8.

8:  Velocity translation. Generate a VTG sentence when a VHW sentence is received. This is the opposite translation of option 7.

9:  Wind translation. When a VWR sentence is received, an MWV,R is generated. Reception of an MWV sentence results in either a VWR or a VWT sentence, depending on the R or T flag in de MWV sentence.

10: Generate theoretical wind speed from apparent wind speed. This option generates an MWV,T sentence. The necessary SOG is extracted from received RMC or VTG sentences.
    This option can be used in conjunction with option 9, to first convert VWR to MWV,R and then to MWV,T

11: Output channel information with STN sentences. When enabled, the multiplexer transmits an STN sentence before each individual sentence to indicate on which input this sentence was received.

12: Output channel information with TAG Blocks. . When enabled, the multiplexer transmits a TAG Block before each individual sentence to indicate on which input this sentence was received.

13: Enable conversion from NMEA 0183 V3.0 to V1.5 sentences for NMEA Out2. The following sentences are converted: APB, BWC, BWR, GLL, RMB, RMC, VTG, XTE and ZDL.

14: Enable Modbus conversion. Not documented yet.

15: Set Out2 to 2 stop bits. Not implemented/documented yet.

When a PSMDOP sentence without any parameters is sent, the multiplexer returns an OP sentence with a 32-bit hexadecimal number. Each bit represents an option where bit 0 is option 0, bit 1 Is option 1 etc.

Format:    $PSMDOP*hh<CR><LF>

Response:  $PSMDOP,R,xxxxxxxx*hh<CR><LF>


## $PSMDOV – Overflow

This sentence is output when too many NMEA sentences are sent to an output (Out1 and Out2) and its buffer is full. In MPX-Config3, this will be indicated by two blinking red indicators, one for each output. The red LED on the multiplexer will blink too.

Format:  $PSMDOV,xx*hh<CR><LF>

xx:      Hexadecimal field. This is a hexadecimal number where each bit represents an NMEA output. The following bits are defined:

        0: NMEA Out1
        1: NMEA Out 2

## $PSMDPR – Priority

Set the priority of the NMEA inputs.

Format:  $PSMDPR,a,x,x,x,x,x

a:    Sentence Status flag:
      R = sentence is a response with current settings
      C = sentence is a command to change settings

x:    Priority field for input 1 to 4 and NMEA 2000

When similar sentences are received on multiple inputs, priority of an input is used to determine if a sentence should be passed or blocked. Priority values range from 1 to 5 in descending order (1: highest). A 0 disables any priority checks on that input.

## $PSMDRESET – Reset the multiplexer

This sentence resets the multiplexer and starts the bootloader. When a '1' is given as parameter, the factory settings of the multiplexer are restored.

Format:  $PSMDRESET,x*hh<CR><LF>

x:    Optional parameter to indicate an action while resetting
      1: restore the multiplexer to its factory settings

After a reset, the multiplexer outputs a LDR sentence and a VER sentence on the host interface.

## $PSMDSP – Set Speed

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

Format:  $PSMDSP,a,b,c,d,e,f,g[*hh]<CR><LF>

The following fields are defined for setting the various inputs and outputs:

a:  Sentence Status flag:
    R = sentence is a response with current settings
    C = sentence is a command to change settings

b:  NMEA In1
c:  NMEA In2
d:  NMEA In3
e:  NMEA In4/Out1
f:  NMEA Out2
g:  RS-232 host port (ignored on multiplexers without RS-232 host port)

Valid field values are:

0 = 4800 Baud
1 = 9600 Baud
2 = 19200 Baud
3 = 38400 Baud
4 = 57600 Baud
5 = 115200 Baud (field e and f only)

Field 'b' is ignored when In1 is set to SeaTalk.

## TAG Block

When TAG Blocks are enabled ($PSMDOP, option 12), the multiplexer adds a TAG block to every NMEA sentence that is sent from the host interface. This TAG block has one source parameter, containing the UI of the multiplexer and the input or Source Address the sentence was received on. It has the following format:

\s:UI-x*hh\

or

\s:UI=nnn*hh\

where UI is the Unique Identifier of the multiplexer,'x' is a digit representing the input number and nnn the NMEA 2000 Source Address

x can have the following values:

0: Internally generated responses ($PSMD sentences)
1: NMEA 0183 In1/SeaTalk
2: NMEA 0183 In2
3: NMEA 0183 In3
4: NMEA 0183 In4
5: Conversion results

If no UI is specified with the PSMDUI sentence, "MXnn"  is sent, where "nn" are the last two digits of the serial number of the multiplexer.

A heading sentence received on input 1 will be sent to the host as

\s:MX01-1*1E\$HEHDT,23.5*37<CR><LF>

## $PSMDUI – Set Unique Identifier
Sets the Unique Identifier (UI) of the multiplexer. This UI is sent as source parameter in TAG blocks sent by the multiplexer.

Format:  $PSMDUI,a,c--c*hh<CR><LF>

a:    Sentence Status flag:
        R = sentence is a response with current settings
        C = sentence is a command to change settings

c--c: Unique Identifier, 11-character maximum. If this field exceeds the maximum character count,  is not present or empty, the UI is reset to "MXnn" where "nn" are the last two digits of the serial number of the multiplexer.

## $PSMDVER – Get Version
This sentence retrieves version information from the multiplexer.

Format:          $PSMDVER

The multiplexer responds with the following version sentence:

$PSMDVER,2.0.0,MiniPlex-3USB-N2K,39000943,A013*hh<CR><LF>

2.0.0:              firmware version number
MiniPlex-3USB-N2K:  multiplexer name
39000943:           serial number

A013:               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:
                    2-0:    Host interface type, 0 = serial, 1 = USB, 2 = Ethernet, 3 = USB + WiFi
                    3:      SeaTalk[1] transmission supported
                    4:      NMEA 2000 supported
                    15-13:  Multiplexer generation: 5 = 4th generation

hh:                 checksum

## $PSMDWI – WiFi control
This sentence controls the WiFi module on the multiplexer. This sentence always results in a response sentence from the multiplexer. This response reflects the response of the wireless module or the result of the operation.

Format:    $PSMDWI,x,a,b..*hh<CR><LF

x:          Sub-command. See below
a,b..:      Optional parameters required by a subcommand

Response:  $PSMDWI,message

The following sub-commands are defined:

A:    Initialize the WiFi module with the default access point settings:

```
SSID:            MiniPlex-xxxxxxxx
Channel:         1
IP address:      10.0.0.1
Network mask:    255.255.255.0
TCP/UDP port:    10110
```

xxxxxxxx is the serial number of the multiplexer.

B:      Boot WiFi module in Command Line mode (for diagnostics only).

C:      Enter Command Mode of the WiFi module (for diagnostics only).
        A ctrl-Q exits Command Mode.
        When command mode is enabled, all NMEA data is blocked.

D:      Disable the WiFi interface. The yellow LED will go off to indicate this.
        When WiFi is disabled, the WiFi module is switched off completely. All WiFi related commands will
        fail, only $PSMDWI,E will be accepted to switch the WiFi module on again.

E:      Enable the WiFi interface.

M:      Return the MAC address of the wireless module.

V:      Return the version number of the WiFi firmware. A $PSMDWI,VERx.xx sentence is returned.

W:      Set the WLAN parameters of the WiFi connection:

        $PSMDWI,W,mode,ssid,phrase*hh<CR><LF>

        mode:    A = Access Point, 1..13 = Channel number
        ssid:    SSID of the WiFi connection
        phrase:  Optional pass phrase

# Technical Specifications

## MiniPlex-3USB

| | |
|---|---|
| Supply voltage: | 8 – 35 $V_{DC}$, protected against reversed polarity. |
| Current consumption: | 50 mA (100 mA max. with fully loaded talker ports) |
| Host interface: | USB, galvanically isolated |
| Inputs: | 4 x NMEA 0183/RS-422, galvanically isolated. Input 1 can be set to SeaTalk[1] mode |
| Input resistance: | >1.4 kOhm |
| Input current: | 0.5mA @ 2V<br>3.0mA @ 5V<br>7.1mA @ 10V |
| Outputs: | 2 x NMEA 0183/RS-422, galvanically isolated. |
| Max output current: | 20mA @ >2V |
| 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 |
| Indicators: | Overflow and Data |
| Dimensions: | 138 x 72 x 33 mm |
| Housing: | Flame retardant ABS. |

## MiniPlex-3USB-N2K

| | |
|---|---|
| NMEA 2000 Port: | LEN: 1<br>Speed: 250kbps |
| NMEA 2000 Manufacturer Code: | 595 |
| NMEA 2000 Product Code: | 12738 |
| Connector: | M12 male Micro-C |

## MiniPlex-3E

| | |
|---|---|
| Supply voltage: | 8 – 35 $V_{DC}$, protected against reversed polarity. |
| Current consumption: | 100 mA (150 mA max. with fully loaded talker ports) |
| Host interface: | 10BASE-T/100BASE-TX Ethernet |
| Supported protocols: | TCP/IP and UDP, port 10110 for NMEA communication<br>TCP/IP, port 10110 for firmware updates<br>TCP/IP and UDP, port 30718 for network configuration<br>ARP, ICMP and DCHP for network management |
| Inputs: | 4 x NMEA 0183/RS-422, galvanically isolated. Input 1 can be set to SeaTalk[1] mode |
| Input resistance: | >1.4 kOhm |
| Input current: | 0.5mA @ 2V<br>3.0mA @ 5V<br>7.1mA @ 10V |
| Outputs: | 2 x NMEA 0183/RS-422, galvanically isolated. |
| Max output current: | 20mA @ >2V |
| 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 |
| Indicators: | Overflow and Data |
| Dimensions: | 138 x 72 x 33 mm |
| Housing: | Flame retardant ABS. |

## MiniPlex-3E-N2K

| | |
|---|---|
| NMEA 2000 Port: | LEN: 1<br>Speed: 250kbps |
| NMEA 2000 Manufacturer Code: | 595 |
| NMEA 2000 Product Code: | 26884 |
| Connector: | M12 male Micro-C |

## MiniPlex-3Wi

| | |
|---|---|
| Supply voltage: | 8 – 35 V$_{DC}$, protected against reversed polarity. |
| Current consumption: | 70 mA (120 mA max. with fully loaded talker ports) |
| Host interface: | USB, galvanically isolated<br>WiFi, 802.11 b/g/n at 2.4GHz |
| Supported protocols: | TCP/IP, port 10110 for NMEA communication<br>ARP, ICMP and DCHP for network management |
| Inputs: | 4 x NMEA 0183/RS-422, galvanically isolated. Input 1 can be set to SeaTalk[1] mode |
| Input resistance: | >1.4 kOhm |
| Input current: | 0.5mA @ 2V<br>3.0mA @ 5V<br>7.1mA @ 10V |
| Outputs: | 2 x NMEA 0183/RS-422, galvanically isolated. |
| Max output current: | 20mA @ >2V |
| 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 |
| Indicators: | Overflow and Data |
| Dimensions: | 138 x 72 x 33 mm |
| Housing: | Flame retardant ABS. |

## MiniPlex-3Wi-N2K

| | |
|---|---|
| NMEA 2000 Port: | LEN: 1<br>Speed: 250kbps |
| NMEA 2000 Manufacturer Code: | 595 |
| NMEA 2000 Product Code: | 24180 |
| Connector: | M12 male Micro-C |

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