



NMEA 2000 to USB-WiFi Isolated Converter Manual

1 Description

This converter allows an NMEA2000 device to connect to a USB port (NMEA0183) and/or Wi-Fi, while providing galvanic isolation between the NMEA2000 bus and the USB port.

It uses an ESP32 processor running open-source software developed by Andreas (Wellenvogel) as part of the Open-boat project.

The converter is fast and features overvoltage and overcurrent protection.

Isolation between the NMEA2000 bus and the USB port prevents ground loops and effectively protects the Pypilot computer—or any device connected to the USB port—from potential electrical surges on the NMEA2000 cable (such as indirect lightning effects).

Powered via the 5V USB connector, the converter has very low power consumption.

Two LEDs indicate data activity (yellow: receive, green: transmit).

Housing dimensions: 56 x 24 x 20 mm

The converter is built using M5Stack modules, including an ESP32 and a galvanically isolated CAN adapter..



2 Raccordements

- 25 cm USB cable with a male USB-C or USB-A connector for the converter's 5V power supply and NMEA0183 (USB) data exchange.
- Screw terminal block for connecting the NMEA2000 bus H and L wires (corresponding to pins 4 and 5 of NMEA2000 connectors). A third terminal, G, allows for the optional connection of the cable shield (corresponding to pin 1 of NMEA2000 connectors).

The converter can be connected to the NMEA2000 bus using only the H and L wires. Connecting the G terminal to the shield wire (terminal 1) provides better protection against overvoltage.

3 Converter configuration

When the converter is powered via its USB port, a Wi-Fi access point is created. Connect to the ESP32NMEA2K Wi-Fi network using the password `esp32nmea2k`. Then, access the address `ESP32NMEA2k.local` or the IP address `192.168.15.1` in a web browser. You will see a simplified user interface for monitoring status and adjusting settings.

ESP32NMEA2K

connected



Status	Config	XDR	Data	Update	Help
--------	--------	-----	------	--------	------

VERSION 20251126 ?

Access Point IP 192.168.15.1

wifi client connected false []

wifi client IP 0.0.0.0

clients 0

TCP client connected false

TCP client error disabled

Free heap 74652

NMEA2000 State [32] RUNNING

✓ NMEA2000 in 0

✓ NMEA2000 out 0

✓ USB out 0

✓ USB in 0

✓ TCPServer out 0

✓ TCPServer in 0

Reset

To connect it to another Wi-Fi network, simply enter the access details in the "Wi-Fi Client" tab and enable the client. You can configure all inputs and outputs (NMEA2000, USB, TCP, RS485), including NMEA0183 filtering. An administrator password is required to save your changes. The default password is `esp32admin`. You can change or disable it in the "Configuration/System" tab. Be sure not to lose it. To recover it, you must reset the device to factory settings (press and hold the LED button until it flashes blue, then red, and finally green). To assist with recovering lost passwords, the Wi-Fi access point password and the administrator password are sent to the USB port when the device starts up; you can view them using terminal software.

Since the autopilot is almost always powered on while sailing, it makes sense to use Pypilot as a marine Wi-Fi server. With a single Wi-Fi network, you can control Pypilot from other devices (Raspberry Pi, tablet, or Wi-Fi remote) and stream all marine data to those devices.

4 [Data exchange configuration](#)

Here is the default configuration for the converter:

ESP32NMEA2K

connected



Status Config XDR Data Update Help

USB mode

USB baud rate

NMEA to USB

NMEA from USB

USB to NMEA2000

USB read Filter

USB write Filter

^ TCP server

TCP port

max. TCP clients

NMEA0183 out

NMEA0183 in

to NMEA2000

NMEA read Filter

NMEA write Filter

Seasmart out

^ TCP client

enable

^ UDP writer

enable

^ UDP reader

It can be seen that data exchange via TCP server is enabled by default and that the USB port is configured for NMEA0183 communication at 115,200 baud—the speed required for AIS data exchange as well as for certain GPS units.

5 Wi-Fi Safety Guidelines

Connect the device only to trusted Wi-Fi networks. Protection against network eavesdropping and denial-of-service attacks is very limited. Never connect the device directly to the Internet without using a firewall, such as a Wi-Fi or LTE router. Exercise particular caution when connecting to networks with open ports. You will be prompted for the administrator password whenever a change is made, and it will always be transmitted in encrypted form. However, if you change the Wi-Fi access point password or the Wi-Fi client password, it will be transmitted in plain text. If you enable the "Remember me" option for the administrator password, it will be stored in plain text in your browser. Use the "Forgot Password" function to delete it.

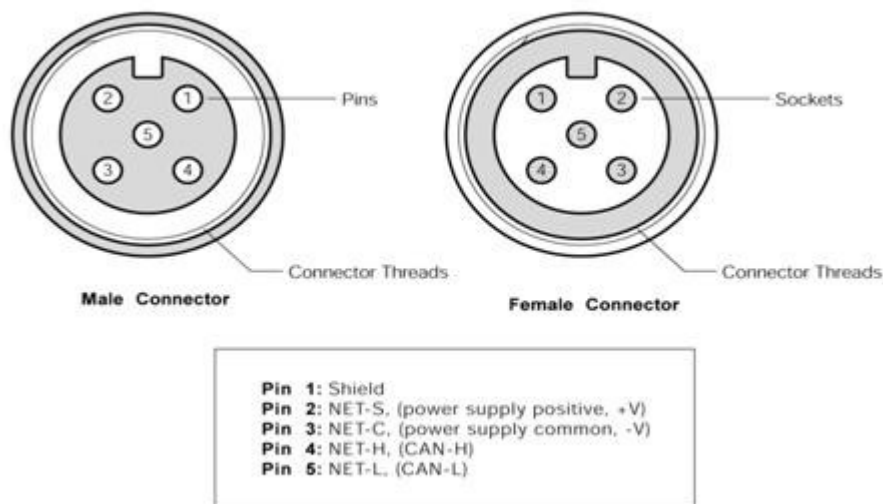
6 NMEA2000 bus

6.1 Connector system

The NMEA 2000 bus uses standardized, waterproof, and shielded 5-pin M12 connectors with A-coding (indexing notch between pins 1 and 2). Note that other coding types exist where the indexing notch is positioned differently.

Depending on the model, they may be made entirely of plastic or partially of metal. In addition to the CAN-H and CAN-L data lines, there are two power supply lines—ground (V-) and +12 V (V+)—as well as a connection for the shield. Sensor connections generally consist of male plugs with external threads, while the mating connectors are always equipped with a coupling nut featuring internal threads..

Fig. Top view of the contact face



SeaTalk NG, Simnet, and Philippi P-Bus are bus systems similar to NMEA 2000, based on the CAN bus as the physical layer. However, they differ from NMEA 2000 in certain respects and are not fully compatible. Furthermore, each manufacturer uses its own connectors, which are incompatible with NMEA 2000. Nevertheless, data exchange between these networks is possible using the appropriate adapter cables. As a general rule, it is best to avoid mixing different bus technologies.

6.2 Bus Power Supply

This NMEA2000-USB converter is not powered by the NMEA2000 bus.

However, low-power NMEA2000 devices, such as sensors, can be powered by the NMEA2000 bus. No additional power cable is required. The 12 V supply voltage is injected into the NMEA2000 bus via a power cable or a compatible chartplotter. It is essential not to exceed a total power consumption of 35 W on the NMEA2000 bus. NMEA2000 devices are marked with load values indicating their current consumption. The load is expressed in multiples of 50 mA. A device with a load of 3 will therefore require 150 mA at 12 V and consume 1.8 W. Ideally, the 12 V power supply should be injected at the midpoint of the bus to minimize resistive power losses..

6.3 Cable

Only high-quality, shielded, and watertight industrial cables should be used as bus cables, such as the Lapp UNITRONIC 2 x 2 x 0.34 mm² bus cable.

Two pairs of conductors are twisted and surrounded by a braided shield. One twisted pair is used for CAN-H and CAN-L, and the other for ground (GND) and 12 V power. The braided shield is connected to ground (GND) at one end. This configuration ensures optimal performance as well as a safe and durable installation. Cables with a cross-section smaller than 0.34 mm² must not be used if power is supplied via the bus. The total length of the bus cable must not exceed 40 m.

6.4 Termination resistors

The NMEA 2000 bus physical layer is based on the CAN bus, utilizing differential signal transmission. Two signals of opposite polarity are transmitted, and a single signal is generated at the receiver by subtracting one from the other. Disturbances affecting both signal lines equally are eliminated through this subtraction process. This ensures robust signal transmission that is immune to interference.

A CAN bus employs 120-ohm termination resistors between the CAN-H and CAN-L lines at each end of the system. These two resistors match the 120-ohm line impedance and prevent signal reflections at the line ends during high-speed data transmission (1 Mbit/s). The CAN bus consists of a main line with drop lines (stubs) shorter than 1.5 m. A star topology for the bus system is not permitted. The two termination resistors must be installed only at the ends of the bus, not in the middle.

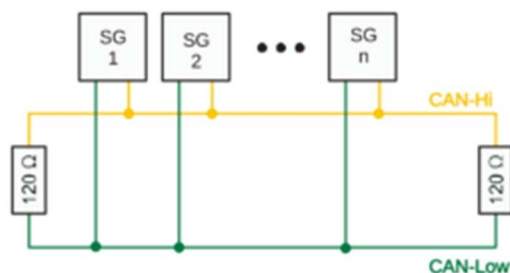


Fig. CAN bus structure (without power supply)

Some devices feature built-in termination resistors that can be enabled or disabled using dedicated switches. Before installing new devices, check for the presence of built-in termination resistors and their configuration. An improperly terminated bus can lead to transmission problems that are difficult to diagnose.

CAUTION: Failure to use termination resistors, or the use of incorrect resistors, on the CAN bus can lead to malfunctions. Data packets may be lost, and the CAN bus may lock up completely or fail to start altogether. This issue typically occurs with unshielded, non-twisted cables, or when the CAN-H and CAN-L data lines are touched by hand or come into contact with ground (GND) or +12 V (high-resistance connection). The CAN bus can only be restarted after completely disconnecting the power and rebooting all systems. These issues do not occur if the CAN bus is correctly terminated and appropriate cables and connectors are used.