

White paper: The cheap way to make a chart plotter/cockpit display based upon a tablet computer

This paper describes the set-up of a WLAN for a yacht to transmit boat data (NMEA 0183) to a handheld or tablet computer by using a cheap RS232-to-WLAN adapter. This requires five definitive steps, which are described in more detail below. These steps are:

1. Understanding your current set-up
2. Decide which items are required for purchase
3. Connecting the WLAN adapter to power
4. Connecting the WLAN adapter to the boat's data
5. Programming the unit.

Total cost estimate for this installation excluding software is around \$ 50. Depending on chart software, you may need to add between \$ 0 - 50 for chart software plus up to \$ 20 for apps allowing to assess sailing performance.

This paper has been written by a lay-man in electronics. It is a proposal only. No liability is accepted for any malfunction or consequential loss or damage.

1. Your current installation should have the following requirements:

Minimum: GPS unit available on board delivering GPS NMEA phrases.

Improved: Data system available on board consisting of boat speed (through water), depth, GPS, compass and wind. This system must be equipped with an NMEA 0183-out connector, be this by screw-on type, proprietary connector or 9-pin D-SUB connector in male or female fashion.

The difference between the two arrangements is such that the minimum set-up will allow you to display your vessel's position in a chart plotter software¹ running on the tablet computer, which is perfectly ok for navigation. The improved set-up will allow you to display both navigation as well performance data on a hand-held or tablet computer and allow calculating additional boat performance.²

Note: Some of the OEMs producing boat electronics transmit data within their systems with an own so-called bus system (e.g. Raymarine with their Seatalk standards). These systems may need to be upgraded with a unit delivering NMEA 0183 data.

Furthermore, software running on IOS tablets (tested) and PCs like FUGAWI require data flow according NMEA V2.0 and above. **This may be the most important item to**

¹ Some examples for tablet computers are:

Navionics <http://www.navionics.com>

NV Publishers <http://www.nvcharts.com/shop/?redirect=no>

² See e.g.:

ZIFIGO's IRegatta <http://www.zifigo.com/?q=node/279>

resolve before you consider installation of a wifi as older sensors and nav units may not display their data over a wifi otherwise.

These software packages expect each NMEA phrase to be finished by a checksum at the end, otherwise they will not interpret the particular NMEA phrase (data set). Checksums may have been added in older equipment transmitting NMEA Version < 1.5 already, but not necessarily. You may estimate that even sensors produced up to the year 2005 may well work with V.1.5 standard only. Finding this out is possible by looking at the NMEA output of the nav equipment with a terminal program.

In case your equipment will not be able to display the data with a checksum you may upgrade your system with a dedicated Multiplexer. So far I am only aware of one unit which does this, it is Actisense's NDC-4³. However this unit does add a lot of other benefits like proper galvanic installation through opto-couplers and tailoring the content to what is required by the receiving unit as well as integrating AIS units. For details see their excellent explanation of NMEA methodology in their user manuals⁴.

Tools and equipment required: You may need a soldering iron and a multi-meter or a simple test bulb to make the NMEA and power connection.

2. To be purchased:

a) We use an RS232 Wireless Router from Hi-Link⁵ (WLAN or wifi unit) to be ordered from the manufacturer. It may be available from a source in the EU as well via Ebay.



Fig. 1: Hi-Link RS232 Wireless Router

³ <http://www.actisense.com/products/nmea-0183/ndc-4/ndc-4.html>

⁴ <http://www.actisense.com/products/nmea-0183/ndc-4/downloads-ndc4.html>

⁵ Hi-Link http://www.hlktech.net/product_detail.php?ProId=45



Fig. 2 (left) : LED (green) indicating data transfer with RJ45 socket for LAN cable

Fig. 3 (right): 5 V DC and RS232 D-sub 9-pin connector

The unit comes with an aerial (8", 20 cm), 230 V or equivalent power supply, network plus serial cable. Depending on type of NMEA source you got, the serial cable has to be adjusted to the source connector (see under 4).

b) Power supply for 5 Volts (see below).

c) Software for your tablet computer as indicated¹.

d) As your tablet will be very sensitive to water and your boat is a never ending moving one, you will be better off getting yourself a sturdy and protected case with min IP 67 standard. Look in the internet what suits your style and budget.

3. Making a Power Supply:

As the unit works with 5 volts you may need to find a 5 volt power source on board. This may be done by a 12 v to 5 v DC-DC converter available from electronic supply stores or Amazon⁶.

If you already have a USB hub installed on board, you may solder yourself a power cable by cutting off the existing mini- or micro-connector from an old USB cable and solder the remaining cable to a DC connector with 5.5 mm external diameter and 2.1 mm⁷ internal diameter. The colouring of the USB cable should be standardized (red = 5 Vpos, black = 5 Vneg)⁸ and pos is to be soldered to the internal pin, black to the outside.

4. Making the NMEA connection:

The unit has been shipped to you including a serial cable with male and female 9-D-SUB connector at each end (called as well RS232). There are three options to link the unit to

⁶ e.g. http://www.hlktech.net/product_detail.php?ProId=45

⁷ http://www.amazon.de/Netzgeraete-Stecker-1mm-mit-Knickschutz/dp/B000MSUN02/ref=sr_1_1?ie=UTF8&qid=1428833996&sr=8-1&keywords=DC-STECKER+2%2C1MM+%2F+5%2C5MM+%2F+9%2C5MM

⁸ http://de.wikipedia.org/wiki/Universal_Serial_Bus#Farbkodierung_und_Pinouts

your on-board data system:

a) If you have a data system on board featuring a male 9-D-SUB connector, you just plug the cable into this and the unit and the job is done.

b) if you have an NMEA connector with cables on your navigation system to be screwed on you may cut off the female connector from the current cable supplied with the unit. You need to find yourself the right line within the cable that leads to pin 2 on male the connector, which you mark 'pos' and the one leading to pin 5, which you mark 'neg'. You will find numbers printed both inside and outside any connector⁹. Now connect the cable marked 'pos' to the NMEA connector on your data system marked 'NMEA out pos' and the cable marked 'neg' with the NMEA connector on your data system marked 'NMEA out neg' or 'NMEA neg' or 'ground'. Unfortunately there are various names out there for the negative connector.

c) if you have a proprietary cable leading away from your data system you have work to do as under b) but you have to find the correctly colour coded line within this cable from your system's manual and connecting the cables to each other.

For help, you may already have a unit connected to the 'NMEA-out' connector on your vessels on-board data system, e.g. if you have your VHF radio connected to the GPS or data system. You may well connect more than one unit in parallel fashion to the NMEA-out connector.

5. Programming of your data system and the wifi unit.

a) Data system: You will have to set the NMEA output in your existing on-board data system. For this purpose you will have to check your data system's manual. If you already have a unit connected to the NMEA-out connector than there is nothing you need to adjust but just check, which speed is set (in most cases this will be set to 4,800, in some cases 9,600 baud).

b) We want to program the wifi unit with your individual data (this is shortened version from the supplier's manual¹⁰, if in doubt see there): The unit is programmed either by linking any PC to the unit's LAN connector via the network cable that is supplied with the unit or by wifi.

Power up the PC and the wifi unit and open your browser. In the address field please type the IP address of the unit <http://192.168.16.254>. If you are required to add an ID and PW use 'admin' in both fields. Once the browser opens up the wifi unit click on the item serial settings on the left.

You should see a page similar to this:

⁹ <http://de.wikipedia.org/wiki/RS-232>

¹⁰ <http://www.hlktech.net/download.php?CatId=2>

HERE LINK Remote Serial Port Server
Support the IEEE802.11b/g/n, IEEE802.3, IEEE802.3u,WPS/WDS, etc.

English 简体中文

HLK-WR02
Serial2Net Settings
Advance Settings
Serial2Net UART 2 Settings
Administration

HLK-WR02 Serial2Net Settings

NetMode: Default

WAN
IP Type: DHCP

WIFI
SSID: Noname
Encrypt Type: WPA2 AES
Password: Unknown.001
IP Address: 192.168.16.254
Subnet Mask: 255.255.255.0

	Current	Updated
Serial Configure:	4800,8,n,1	4800,8,n,1
Serial Framing Lenth:	64	64
Serial Framing Timeout:	10 milliseconds	10 milliseconds (< 256, 0 for no timeout)
Network Mode:	server	Server
Remote Server Domain/IP:	192.168.11.245	192.168.11.245
Locale/Remote Port Number:	8080	8080
Network Protocol:	tcp	TCP
Network Timeout:	0 seconds	0 seconds (< 256, 0 for no timeout)

Apply Cancel

Add the necessary data to fields as in the page indicated.

a) You want to give your network a dedicated name like your boat's name (instead of 'Noname')

b) You want to set a password. Note, choose a password with eight or more characters, otherwise some tablets may not work with the respective encryption.

c) You want to encrypt the data to WPA2.AES level (this is what an Apple Ipad will work with but this may be depending on your tablet make).

d) Set the serial speed to 4,800 baud (or any other speed you have set under 5a). Set the port to 8080 and the network protocol to TCP.

e) then click 'Apply' and the data will be stored in the unit.

It is best to make a print of the data on your screen for later reference.

6. Joining the systems:

Once you have connected and installed the wifi unit on board we are ready to go. You are just a few steps away from getting it working. Provided the wifi unit is on, start your tablet. As I am working with an Apple Ipad, I will describe the final steps for the ipad:

a) You need to download software to display your boat's data or navigation. This may be the software indicated before^{1,2}.

b) On the IPAD go to the set-up page and choose the WLAN ID (SSID) you have given to

your wifi unit. You will be required to enter your password. Your ipad should connect to the wifi unit on board your vessel.

b) Call up the app(s) you want to work with on your ipad and go to the respective set-up page in the app. You have to add the IP address the software should listen to, so here it is helpful to go back to the data set and printed before (IP=192.168.16.254), if you stuck to this one and the port 8080, plus setting it to TCP, if not done for default. Then close the settings.

Wait a few seconds and your tablet should show the data you wish to see for either navigation or performance purposes. This means you are done with this job.

7. Troubleshooting:

In case your system does not perform correctly check

a) Is your GPS or on-board data system set correctly for transmitting NMEA data. Check the settings as under 5b). This needs to be set only once.

b) Does the wifi unit receive data and transmit it: this can be traced using the app INMEALOGGER¹¹. This app is helpful also to understand exactly which data (NMEA phrase) is sent by your system. There is a lot of information available what these phrases mean¹². Some on-board data systems allow to suppress those NMEA phrases which provide redundant information and slow down transmission. Note, these redundant phrases are only there to allow for maximum compatibility.

8. Appendices:

a) Time is running fast, thus we learned that an already good unit has been upgraded even more. Vyachts Router has been upgraded even further and is now able to transmit NMEA 0813, 2000 as well as Saeatalk and Seataalk NG data over wifi, all at a reasonable cost¹³. We did not test this unit.

b) Here is an example of a data set transmitted and what it means:

¹¹ <http://inmealogger.soft112.com>

¹² <http://www.catb.org/gpsd/NMEA.html>

¹³ <http://vyacht.net/opencart/n2k-wifi>

<p>\$HCHDG,220.4,,,,*46 \$WIXDR,C,014.0,C,, \$IIDPT,1.72,-1.10 \$IIDBT,2.03,f,0.62,M,0.34,F \$IIMWV,314.0,R,007.10,N,A \$HCHDG,220.3,,,,*41 \$IIMTW,9.80,C \$GPRMC,092114,A,5440.26,N,00956.39,E,000.0, 046.6,110415,000.4,W*6A \$PMNXT,0006 \$GPRMB,A,,,,,,,,,V*71</p> <p>\$GPGLL,5440.26,N,00956.39,E*6A</p> <p>\$PLCJ,49,42,50,49,43, \$PLCJECBD3,8C5E,4400,00FF,FF, \$PGRMZ,21,f,3*28 \$PGRMM,WGS 84*06 \$GPXTE,A,A,,,N*3C \$IIVHW,,T,,M,0.00,N,,K \$GPBOD,,T,,M,,*47 \$GPBWC,092115,,,,,T,,M,,N,*18</p> <p>\$GPVTG,046.6,T,046.9,M,000.0,N,000.0,K*41 \$IIVLW,15240,N,0.00,N</p>	<p>Heading - Deviation & Variation Wind Transducer Measurement Depth of Water and Offset above Keel Depth below transducer Wind Speed and Angle Heading - Deviation & Variation Mean Temperature of Water Recommended Minimum Navigation Information (GPS) Trip Log Time Recommended Minimum Navigation Information GPS if waypoint is activated) Geographic Position - Latitude/Longitude LCJ-Capteur-specific: Wind Unit data LCJ-Capteur-specific: Wind Unit data Garmin-specific: Altitude information Garmin-specific: Map Datum Cross-Track Error, Measured Water speed and heading Bearing - Waypoint to Waypoint Bearing & Distance to Waypoint - Great Circle Track made good and Ground speed Log and Trip Log</p>
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