Obtaining true heading output from the *Airmar H2183 / Si-Tex HDK-11* heading sensor

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Abstract

This document provides details on the *Airmar H2183* heading sensor[1] and the required setup to make use of the sensor as a source of true heading data.

While the heading sensor *is* capable of emitting the HDT sentence, it does require a source of magnetic variation data. This information is normally provided by a GPS receiver, which includes this information as part of the RMC and VTG sentences.

Unfortunately, the *Airmar H2183* unit comes pre-configured to *not* output the HDT sentence even if magnetic variation data is available. Configuring the heading sensor to emit the HDT sentence seems to require a further US$ 200 investment in a USB-to-NMEA bridge as well as an additional hookup cable.

Add 70 MB of downloadable *Airmar* software, which will expand to some 110 MB once the software has been installed — that's *some* overhead for sending just a few bytes of data to the heading sensor, in order to apply the required configuration settings. It should be noted that the suggested approach is OS/platform independent.

US$ 550 worth of heading sensor.

[1] Also known as the *Si-Tex HDK-11*, the *Garmin Marine heading sensor*, etc.

Disclaimer

The sole purpose of this document is to provide owners of the *Airmar H2183* heading sensor – including OEM/branded versions of the same product – with information on how to make the most out of their units.

While the *Airmar H2183* unit may come with all relevant documentation included, the setup/configuration details are indeed sadly lacking when the unit is shipped under a different brand name (e.g. *Si-Tex HDK-11*). Also, the official *Airmar* FAQ contains somewhat vague answers when it comes to the true capabilities of the *H2183* heading sensor.

The author does not represent any manufacturer of software products or hardware units mentioned in this document. Likewise, the author does not have any commercial interests in any of the companies or products mentioned in this document. The author happens to own and use a *Si-Tex HDK-11*, though.

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The author assumes no responsibility for your use of information contained in this document.

Contents

1 Introduction

1.1 The *Airmar H2183* heading sensor

The *Airmar H2183* heading sensor contains a 3-axis magnetoinductive electronic compass. A 3-axis accelerometer provides pitch and roll information, which is used by the compass to provide a Z-field correction. A 2-axis rate gyro further corrects the pitch and roll readings for vessel accelerations in 3 dimensions.

The unit is capable of producing the following *NMEA 0183* sentences (and a number of *NMEA2000* PGNs) :

- `$HCHDG` (HDG)
- `$HCHDT` (HDT)
- `$TIROT` (ROT)
- `$XYXDR` (XDR)

According to the *Airmar* FAQ [4], true heading data is *not* available from the *Airmar H2183* unit. The same FAQ also states that the *H2183* unit *will not output the HDT sentence by default*.

A prerequisite for true heading output is *input* of valid magnetic variation data. This information can be provided by means of the RMC or the VTG sentences, originating from a GPS receiver.

The unit also has to be configured to output true heading data once magnetic variation data is made available as true heading output is disabled by default.

It definitely pays off to read beyond the *"the short answer is no"* statement found in the FAQ, as the unit is definitely capable of providing true heading data when the above conditions are met.

2 Setup using original *Airmar* equipment and software

The easy (and expensive) way to connect the *Airmar H2183* heading sensor to a PC is by means of *Airmar* parts *WS-USB* and *WS-C01* — representing the manufacturer´s NMEA-to-USB converter and the cable required to connect the heading sensor to the converter unit.

Figure 1: The Airmar WS-USB NMEA-to-USB converter. Photo from the Airmar product catalog.

Figure 2: The Airmar WS-C01 sensor cable. Photo from the Airmar product catalog.

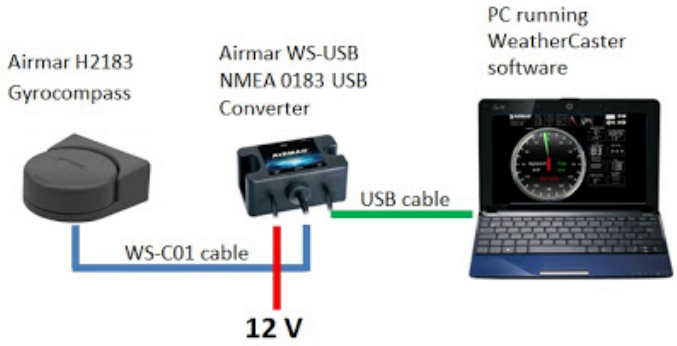

Figure 3: The Airmar H2183, WS-C01 and WS-USB units connected to a Windows-based PC running the WeatherCaster software. Illustration from the Airmar product catalog.

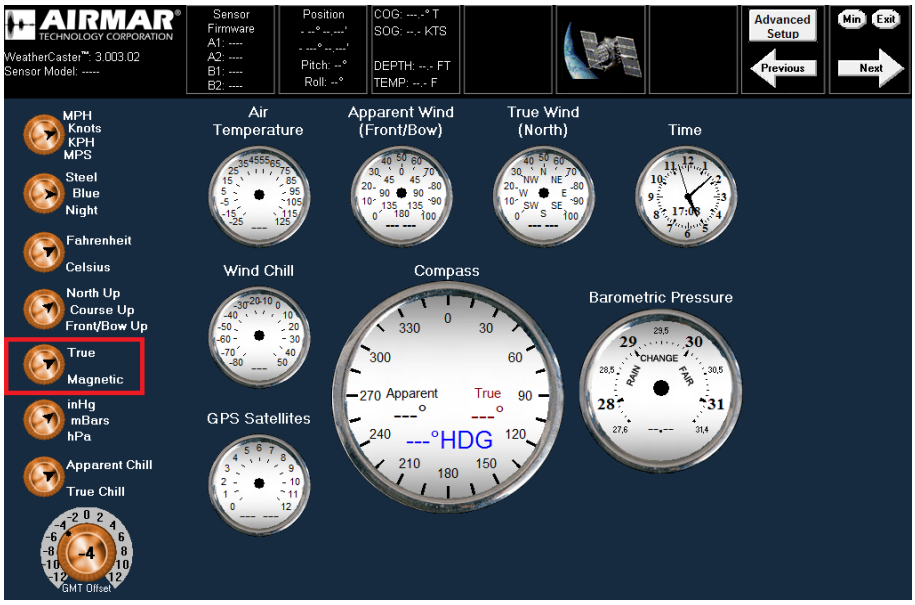

Figure 4: The WeatherCaster software with its somewhat exotic user interface. Just switch on true heading output by clicking on the indicated knob.

The *WeatherCaster* software can be downloaded free of charge from the *Airmar* web site [3]. Download size is approximately 70 MB which expands to some 110 MB once the software has been installed.

While 110 MB of not-the-greatest-looking software seems like an overkill for something as simple as sending a few bytes of data to the heading sensor, the *WeatherCaster* software also includes an option to upgrade the firmware of the sensor unit.

The greatest drawback of the above setup is the cost of the extra *Airmar* units. Adding S&H, the price tag of this setup will easily exceed US$ 200.

3 Setup using a less expensive approach

Luckily, the *Airmar H2183* can be configured by means of a serial line and a serial terminal program. A number of *Airmar* products can be wired for RS-232 operation [5]. This also applies to the *Airmar H2183* heading sensor.

The suggested procedure is platform/OS-independent.

3.1 Required parts

- USB-to-serial (RS-232) adapter. Most personal computers no longer come with on-board serial ports. Adapters are available in the US$ 10-20 price range.
- Interface cable. Some versions of the *Arimar H2183* unit, including the *Si-Tex HDK-11* version, come with a *NMEA 0183* interface and power cable. The optional *Airmar WS-C01* cable can also be used, or you can make your own interface cable as described in section 3.2 (requires a DE-9F connector, Farnell/Newark part # 2433291).
- A serial communication terminal program such as *HyperTerminal* (*Windows* version up to and including *Windows XP* came with *HyperTerminal* included), *Tera Term* [10] or *Realterm* [1].
- A 12V DC power source.

3.2 The serial interface cable

The original *NMEA 0183* cable included with the *Airmar H2183* unit comes with a 10-pin *Airmar* connector readily assembled at the sensor end. Simply follow the wiring table below when connecting the "free" cable end to the DE-9F connector. The DE-9F connector can then be hooked up to the USB-to-serial converter. Refer to section 5.2 for descriptions of the DE-9F/DE-9M pin layouts.

Figure 5: The original Airmar connector. No, it´s not a Conxall CX-119. If anyone knows where to obtain a compatible connector, please inform the author.

***Airmar* pin #**	**Wire color**	**DE-9F pin #**	**RS-232 signal**
1	Red	*Do not connect*	+9 to 24V DC (V+)
2	Black	*Do not connect*	Ground (V-)
9	Blue	5	Signal ground
8	Orange	5	Signal ground
3	White	2	RX data
7	Yellow	3	TX data

Table 1: Wiring diagram for the original Airmar NMEA 0183 sensor cable and a DE-9F connector for RS232 interfacing.

Please note that initial tests indicate that the *WeatherCaster* software will not work with the proposed interface cable. A RTS/CTS handshake may possibly be required.

3.3 Required software/communication parameters

Any serial terminal program will probably do. For this project, *TeraTerm* [10] was used.

The following communication parameters apply:

Baud rate: 4,800 bps (if not previously set to 38,400)

Data bits: 8

Parity: None

Stop bit(s): 1

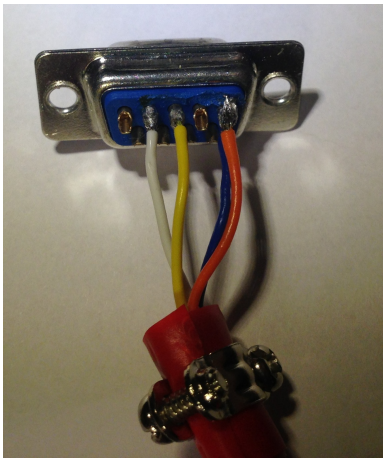

Figure 6: The original Airmar cable soldered onto a DE-9F connector.

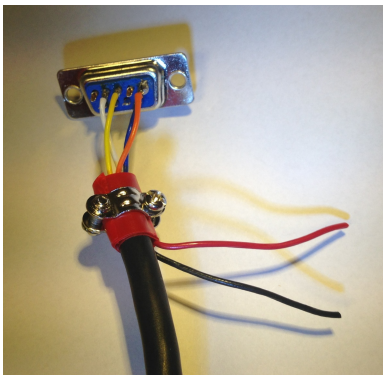

Figure 7: The red and black wires will be used to provide 12V DC to the heading sensor. Table 1 refers.

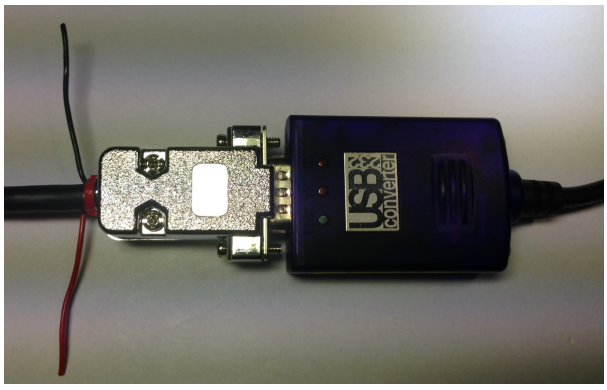

Figure 8: The DE-9F connector hooked up to a serial-to-USB converter. The red and black wires will be used to provide 12V DC to the heading sensor. Table 1 refers.

3.4 The crazy mouse problem

The "crazy mouse" problem remains a common nuisance when connecting a *NMEA 0183* unit to a *Windows*-based PC. The problem is still present in *Windows* 8.1.

Unfortunately, the serial data returned by GPS, AIS and other *NMEA 0183* units is formatted in a way which somewhat resembles the output from old-school serial mice. The result is that the mouse cursor will be jumping crazily all over the screen, performing left- and right-clicks all by itself.

The problem is dealt with in various articles and several remedies exist, including the *COMDisable* tool [6] and *Microsoft* knowledgebase article #283063 [7]. Unfortunately, the *COMDisable* tool does not seem to work with the *Windows 7* and *Windows 8* operating systems. Another software-based solution is offered by *Stentec* [9].

Figure 9: The ever-present "crazy mouse" problem, a common Windows nuisance.

Using the *Registry Editor*, the problem can be eliminated without installing any additional software.

1. Start *Registry Editor* — `regedit.exe`. To do this, click *Start*, click *Run*, then type `regedit` in the *Open* box, then press `[ENTER]`.

2. Navigate to `LOCAL_MACHINE\System\CurrentControlSet\Enum\USB\DeviceID\InstanceID\Device Parameters`

   Replace `DeviceID` and `InstanceID` with relevant values (these values will change from system to system). As an example, these values could be `VID_046D` and `PID_C52B`. NOTE: This change may have to be applied to more than one `InstanceID`.

3. On the *Edit* menu, click *Add Value*, and then add the following registry entry:

   Value Name: `SkipEnumerations`
   Data Type: `REG_DWORD`
   Radix: `Hexadecimal`
   Value: `FFFFFFFE`

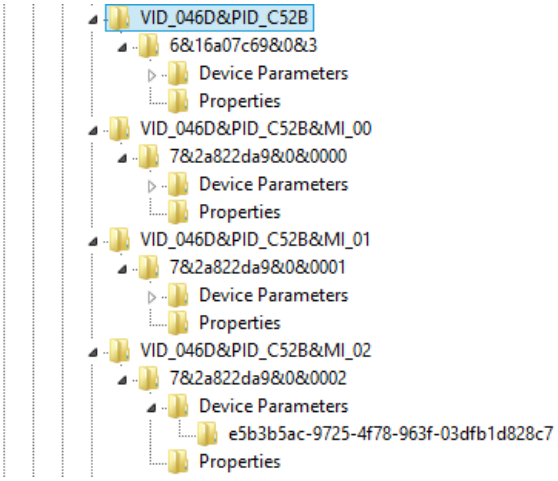

Figure 10: Using the Registry Editor, there are multiple InstanceIDs which should be updated.

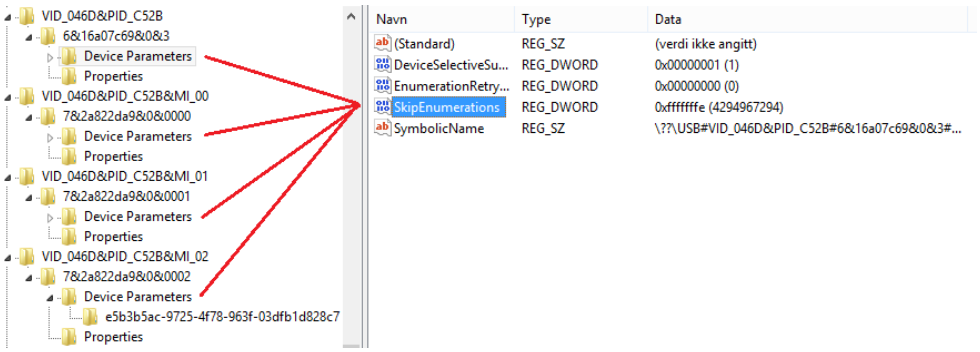

Figure 11: The SkipEnumerations key and the associated value of FFFFFFFE.

4. Quit the *Registry Editor*, reboot and wait for *Windows* to complete the startup sequence. Then connect the heading sensor. The problem should be gone.

5. Note that the ”crazy mouse” problem may occur again if a different USB device is connected to the same USB port.

The *FixSerialBallpoint* utility [8] provides yet another solution to this problem.

NOTE: Using a serial-to-USB converter, it is generally recommended to connect the converter *before* switching on the unit emitting *NMEA 0183* sentences. *Windows* will then get a chance to load the relevant drivers and recognize the serial-to-USB converter before the flow of data starts. This approach seems to minimize the ”crazy mouse” problem.

4 Communicating with the *Airmar H2183* heading sensor

A proprietary command set is used for configuring the *Airmar* sensors. The relevant command set is detailed in [2], which unfortunately does not accompany all OEM/branded variants of the *Airmar H2183* heading sensor.

Command sentences can be entered with or without the trailing *NMEA* checksum, but the *NMEA* checksum is *not* required. A simple checksum calculator is provided in [11]. All lines are terminated by the `<CR><LF>` character sequence.

4.1 Power-up output

Typical power-up output from the *Airmar H2183* heading sensor is shown below.

```
AIRMAR (R) Serial Flash Bootloader
Copyright (C) 2005-2009 AIRMAR Technology Corp.
All rights reserved.

$PAMTT,Heading Device model H2183
$PAMTT,Copyright (C) 2005-2012 AIRMAR Technology, Inc.
$PAMTT,POST,0,0,0,0,,0,0,0,0,GCR200*0C
$PAMTT,QV,,2,0,,1.205,1.250,,1.15*6E
$PAMTT,QPS,44-727-2-01,2811322*37
```

Refer to the `$PAMTC,POST`, `$PAMTC,QV` and `$PAMTC,QPS` commands for further details. These commands are fully described in [2].

4.2 Default sensor output

An example of default sensor output from the *Airmar H2183* heading sensor is shown below.

```
$YXXDR,A,0.3,D,PTCH,A,2.2,D,ROLL*5E
$HCHDG,205.7,0.0,E,,*29
$TIROT,-24.1,A*21
$HCHDG,205.8,0.0,E,,*26
$HCHDG,205.6,0.0,E,,*28
$YXXDR,A,0.3,D,PTCH,A,2.5,D,ROLL*59
$HCHDG,205.7,0.0,E,,*29
$TIROT,-65.2,A*27
$YXXDR,A,0.5,D,PTCH,A,2.6,D,ROLL*5C
$HCHDG,205.6,0.0,E,,*28
```

The output sentences are fully described in [2]. As shown, there is no trace of the true heading sentence `$HCHDT`.

4.3 Suggested setup procedure

First of all, make sure that your desired data output will not exceed the data-carrying capabilities of the 4800 baud output channel. The length of the various output sentences supported by the *Airmar H2183* heading sensor is detailed in [2] along with an example of how to ensure that the output channel is not overloaded with data. The suggested setup procedure consists of three steps:

- Apply the desired change(s).
- Manually verify the sensor output data.
- Save the modified sensor setup.

It should be noted that a separate command is required to save the changes made to the sensor settings. If not provided, the sensor will revert to its default settings after a restart.

The following commands will enable true heading output for the *Airmar H2183* heading sensor:

```
$PAMTC,EN,HDT,1,5*1C
```

...which enables true heading output at a rate of once per 0.5 second. True heading data for use with class A AIS units should be supplied once per 0.2 to 1 second.

```
$PAMTC,EN,S*13
```

...is required to save the current sensor configuration. If not supplied, the applied changes will be lost after a power-down/sensor reset.

NOTE: The true heading sentence will *not* contain any information until the heading sensor has been supplied with magnetic variation data by means of the RMC or VTG sentence. If magnetic variation data is not available, true heading output will take the form of an empty `$HCHDT,,*53` sentence.

4.4 A quick test drive

A sample RMC sentence can be supplied to the heading sensor in order to provide magnetic variation data for test purposes. The RMC sentence shown below indicates an easterly magnetic variation of 000.1 degrees:

```
$GPRMC,115000,A,5930.00,N,00011.20,E,0.0,180.0,201014,000.1,E*70
```

The heading sensor should immediately start providing the true heading sentence at the requested interval. Compare the HDG and HDT sentences to verify that the resulting HDT sentences contain meaningful information:

```
$HCHDG,207.8,0.0,E,,*24
$HCHDT,207.9,T*25
```

Do not worry about supplying erroneous magnetic variation data for test purposes — values will be overwritten once the heading sensor receives a new RMC or VTG sentence.

4.5 Sensor output including HDT data

Upon reset, the *Airmar H2183* heading sensor will output the usual boot information. It will then move on to output the sensor values, but the HDT sentence will remain empty until a RMC or VTG sentence has been received:

```
AIRMAR (R) Serial Flash Bootloader
Copyright (C) 2005-2009 AIRMAR Technology Corp.
All rights reserved.

$PAMTT,Heading Device model H2183
$PAMTT,Copyright (C) 2005-2012 AIRMAR Technology, Inc.
$PAMTT,POST,0,0,0,0,,0,0,0,0,GCR200*0C
$PAMTT,QV,,2,0,,1.205,1.250,,1.15*6E
$PAMTT,QPS,44-727-2-01,2811322*37
$HCHDG,,,,,*6C
$YXXDR*4F
$HCHDG,206.2,0.0,E,,*2F
$HCHDT,,*53
$TIROT,41.6,A*08
```

Once magnetic variation data becomes available by means of the RMC or VTG sentence, the output data stream will include valid HDT data as shown below:

```
$TIROT,47.5,A*0D
$HCHDG,205.3,0.0,E,,*2D
$YXXDR,A,0.4,D,PTCH,A,2.2,D,ROLL*59
$HCHDT,205.9,T*27
$HCHDG,205.8,0.0,E,,*26
$HCHDG,206.0,0.0,E,,*2D
$HCHDG,206.2,0.0,E,,*2F
$HCHDG,206.3,0.0,E,,*2E
$YXXDR,A,0.6,D,PTCH,A,2.3,D,ROLL*5A
$HCHDG,206.5,0.0,E,,*28
$TIROT,41.6,A*08
$HCHDG,206.3,0.0,E,,*2E
$HCHDT,206.4,T*29
```

The heading sensor will output valid HDT data as long as magnetic variation data is available. For this purpose, the heading sensor *will* need a supply of ”fresh” RMC or VTG sentences from a GPS receiver.

4.6 Compass calibration procedure

It is worth noting that [2] contains a description of the full command set to be used for compass calibration. The outlined procedure provides more feedback to the user than the ”keep turning during power-up” procedure which would otherwise be used.

4.7 Factory reset procedure

The heading sensor can easily be reset to its default factory state.

The `$PAMTC,EN,LD` command loads the factory default settings from the heading sensor´s ROM memory into RAM memory. Note that the `$PAMTC,ERST` command differs from the `$PAMTC,EN,LD` command in that `$PAMTC,ERST` will initialize all of user EEPROM memory to its factory default settings. This includes settings unrelated to the selection of transmitted sentences.

4.8 Wiring diagram – HDG/HDT/ROT/XDR output, RMC/VTG input

This wiring table describes the required wiring when using the *Airmar H2183* heading sensor with an autopilot and/or an AIS unit. The required GPS wiring is also shown.

***Airmar* pin #**	**Wire color**	**External device**	***NMEA 0183* signal**
1	Red	Power source	+9 to 24V DC (V+)
2	Black	Power source	Ground (V-)
9	Blue	Autopilot, AIS	NMEA out -
8	Orange	GPS	NMEA in -
3	White	Autopilot, AIS	NMEA out +
7	Yellow	GPS	NMEA in +

Table 2: NMEA 0183 wiring diagram for the Airmar H2183 heading sensor.

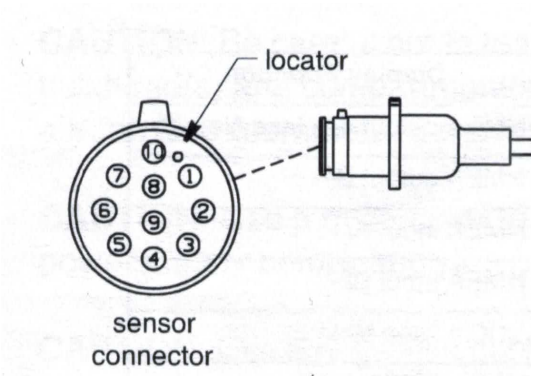

Figure 12: The original Airmar connector pin numbering.

5 Summary, etc.

5.1 Summary

As shown the *Airmar H2183* heading sensor is capable of providing true heading output when certain conditions are met. It is, however, necessary to configure the sensor to output the true heading *NMEA* sentence, which is disabled by default.

The configuration procedure can be carried out either using original *Airmar* equipment and software or by using a straightforward RS-232 serial line at little or no additional cost.

5.2 DE-9M and DE-9F pin layouts

The pin layouts of the DE-9M/DE-9F connectors cannot be repeated often enough.

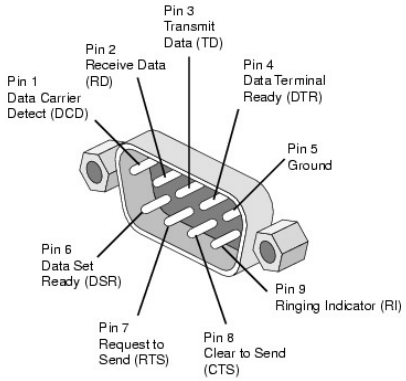

Figure 13: DE-9M connector pin numbering.

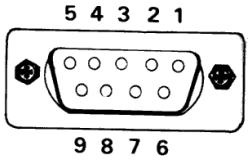

Figure 14: DE-9F connector pin numbering (looking into the connector).

5.3 Contact information

Contact information, web address, et cetera:

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Glassv. 71
NO-1515 Moss
Norway

Email → `tmj@bitwrap.no` (no technical questions, please).

Web → `http://www.annoyingdesigns.com/airmar`

Remember → Always have the appropriate amount of fun.

List of terms and abbreviations

CTS Clear To Send.

EEPROM Electrically Erasable Programmable Read-Only Memory.

FAQ Frequently Asked Questions.

GNSS Global Navigation Satellite System.

GPS Global Positioning System, formerly known as *NAVSTAR*.

HDG *NMEA 0183* sentence: Heading data.

HDT *NMEA 0183* sentence: True Heading Data.

NMEA National Marine Electronics Association: `http://www.nmea.org`.

NMEA 0183 A combined electrical and data specification for communication between marine electronic units.

NMEA 2000 Often abbreviated to NMEA2k or N2K. Standardised as IEC 61162-3. A plug-and-play communications standard used for connecting marine sensors and display units within ships and boats.

OS Operating System.

PC Personal Computer.

PGN Parameter Group Numbers — as defined by *NMEA 2000*.

RAM Random-Access memory.

RMC *NMEA 0183* sentence: Recommended Minimum Specific GNSS Data, including time, date, position, magnetic variation, course and speed data.

ROM Read-only memory.

ROT *NMEA 0183* sentence: Rate of Turn data.

RTS Ready To Send.

USB Universal Serial Bus.

VTG *NMEA 0183* sentence: Course Over Ground and Ground Speed, including track (magnetic and true).

XDR *NMEA 0183* sentence: Transducer Measurement (*Airmar H2183* measurements include pitch and roll).

References

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Revision history

The revision history of this document is recorded below.

Date	Change(s) applied
2015.11.12	Minor editorial changes.
2015.03.08	Minor changes to sections 3.2 and 5.2.
2014.10.29	Initial public release.