



**AUTONAUTIC**  
the compass **specialist**

**C20-00132 NMEA0183  
COMPASS PICK-UP USER MANUAL**



**October 2022  
C20-00132 manual 13  
Hardware version 3  
PCB 7319-6  
PCB 7322-3  
Software version V040**

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## 1. Description

The Autonatic C20-00132 is a complete sensing and processing sub-system for a compass indicating system which gets its heading information from a main or 'master' compass. It derives its output from the position of the powerful permanent magnet inside the main compass.

The C20-00132 contains a dual-axis fluxgate magnetometer surrounded by high-precision interface circuits which, together with the special clockwise/anticlockwise and a sequence to null offsets allow a microprocessor to acquire a binary value from the two orthogonal sensors of the direction of the field created by the main compass. The processor calculates the vector from these values and then presents the data in a manner which has been requested. Such requests alter the frequency of the data, the degree of filtering and the offset value. Calibration sequences can also be commanded.

The embedded software can be uploaded by command so that special or updated versions releases can be put into the C20-00132 to replace the previous software. These data files may be sent from Autonatic by email or downloaded from our website.

## 2 Installation

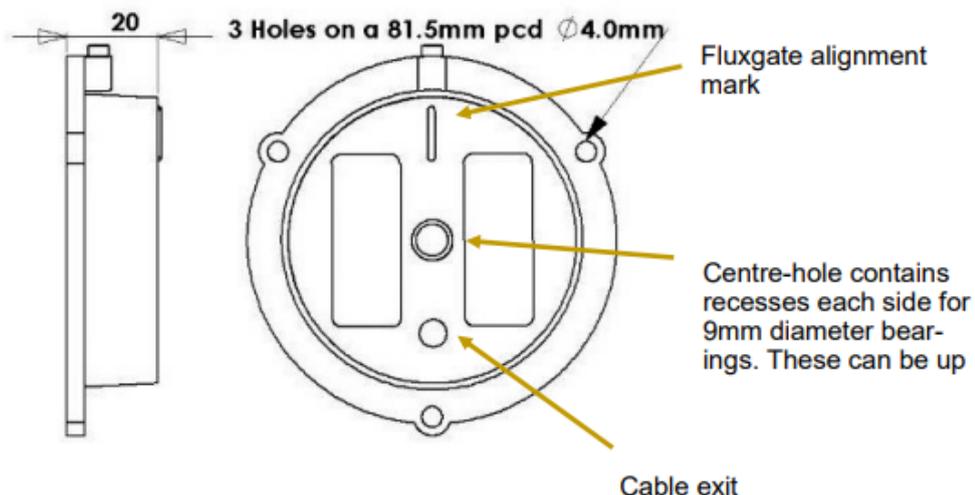
### 2.1 Mounting

The C20-00132 is fixed to the base of the ship's compass using the fixing holes shown in the data sheet. The cable hangs down directly from the labelled side of the housing with a Snap-In IP67 Male cable connector.

The C20-00132 is supplied with compass sensor adhesive mount and 3 screws and washer to fix the pick-up coil to the sensor base and 3 m multicore data cable tail with Snap-In IP67 female cable connector,

To prevent errors when mounted, the sensor must be parallel and concentric with the compass card.

### DIMENSIONS



It does not matter which way it faces as the azimuth can be set to North at any time. But some installers prefer to align the internal sensor to magnetic North and to facilitate this the C20-00132 is provided with an alignment mark and a rotatable housing assembly.

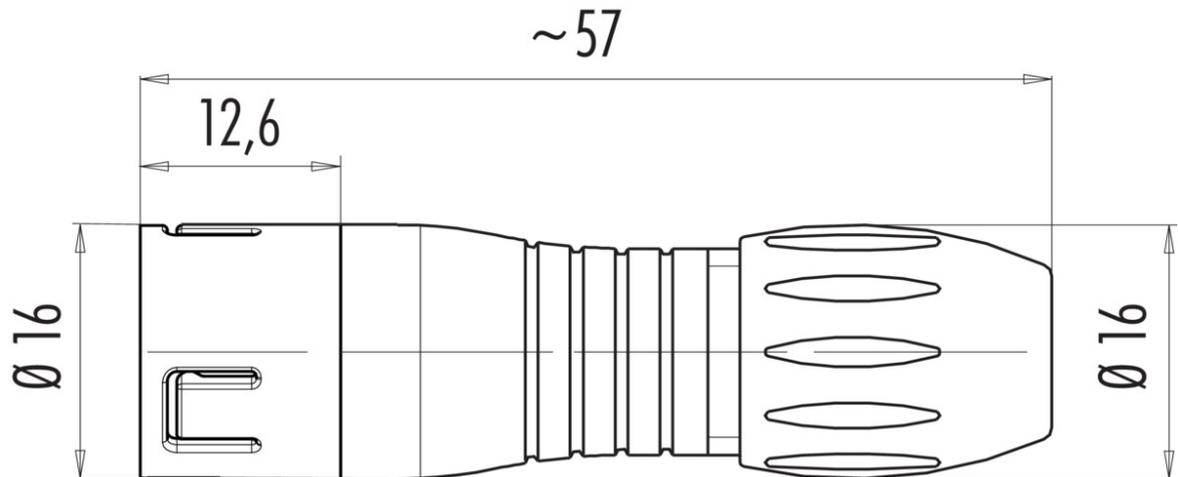
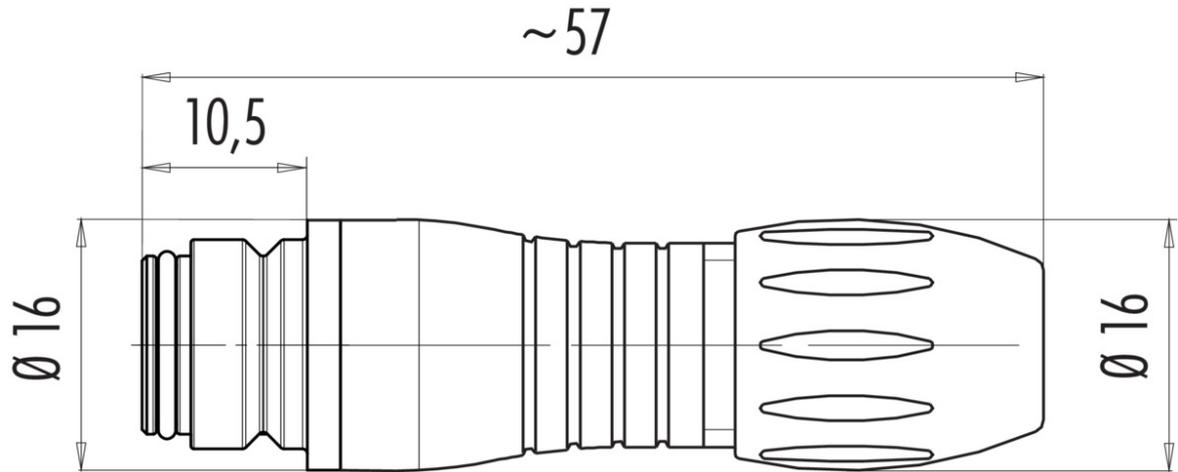
**NOTE 1** The heading data is suppressed when the field is low – see the RXY command in section 4.2.14

**NOTE 2** The heading data is also suppressed when the field is high. See 4.2.14

## **2.2 Power supply**

The compass is compatible with any DC power supply of between 8 and 30 V but note that for nominal 24V operation a 1W resistor of 330ohms should be inserted in the supply wire. This applies to any power supply of greater than 18V. Note that the maximum voltage must not be greater than 30V.

Typical supply current during operation is approx. 25mA. The compass is protected against reversed polarity.



Care should be taken to make sure the compass is not situated too close to the power supply, as it's accuracy may be affected by either the iron in the mains transformer, or by magnetic field 'noise' from a switching power supply. But this is unlikely as the C20-00132 will be mounted on a fixed compass which should have been sited correctly.

Note that the output from the C20-00132 takes several seconds to stabilize after power is applied; the time taken depends on the damping settings. There is a command - see section 5 - which can be used to suppress the output after power-up.

### 2.3 Connection

*Check the datasheet that this table is valid for your version.*

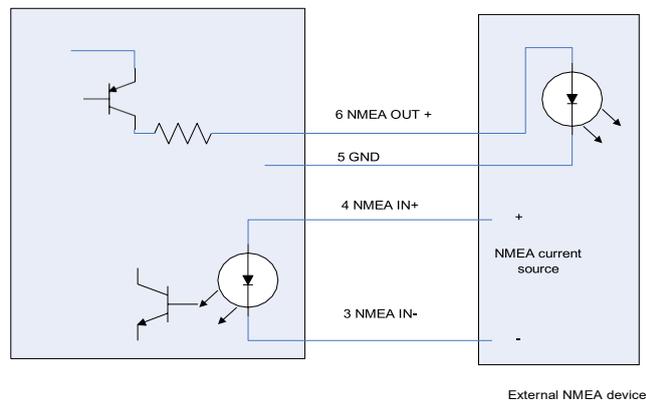
Wire	Colour	Type	Function
1	Red	Power	+8 to +30V note 1
2	Blue	Signal	NMEA OUT+
3	Green	Signal	NMEA IN+

4	Yellow	Signal	NMEA IN-
5	Screen	Power and Signal	GROUND 0V

**Note 1** For nominal 24V operation a 1W resistor of 330ohms should be inserted in the supply wire.

### 2.3.1 Compass to a NMEA-0183 instrument

The hardware on which the NMEA-0183 standard is based on is a balanced serial protocol called RS422. This means that two wires are need for send and two for receive.



**Fig 1**

Note that the GND wire is used for the current return path. This might be shared with the NMEA- wire in some installations.

### 2.3.2 Compass to a PC serial port

In many cases the wires can be joined directly as shown in Fig 2. Alternatively use the Autonatic A3036 serial interface unit.

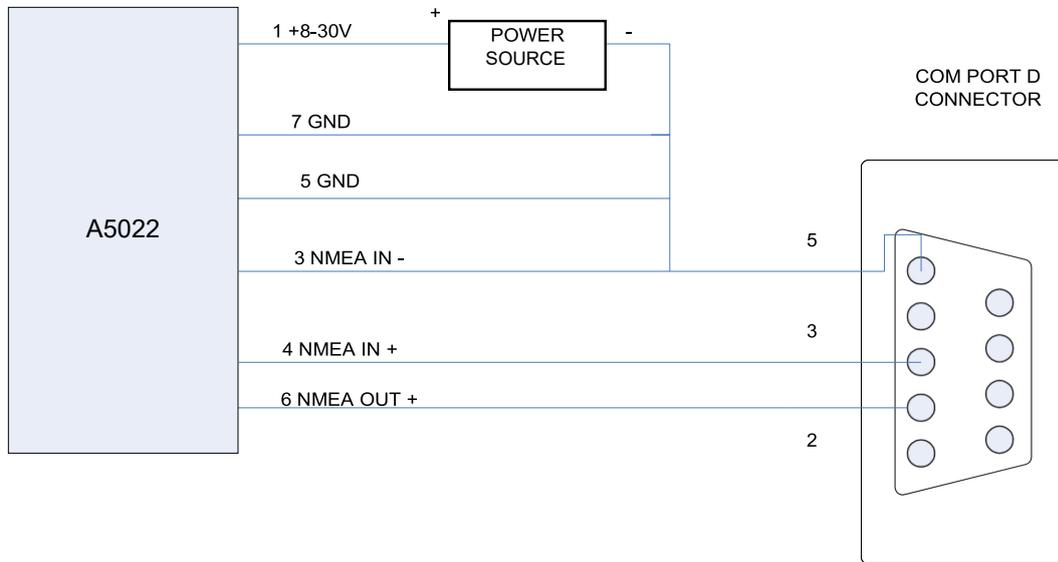


Fig 2

## 3 Calibration

### 3.1 Basic Calibration Operation

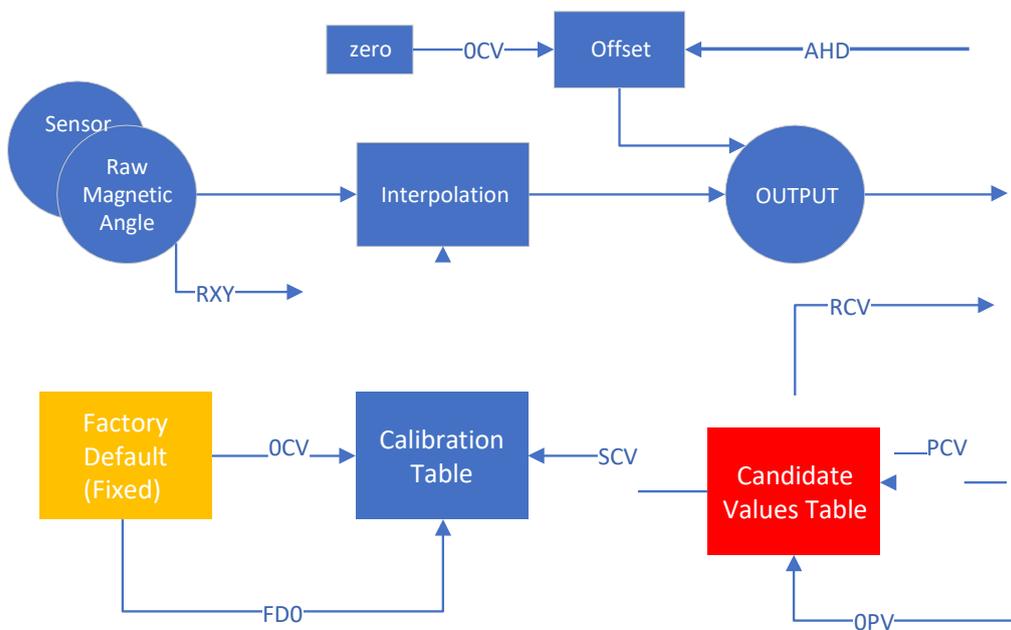


Fig 3

This diagram is intended to illustrate the operation of commands involved in the calibration process.

**The Calibration Sequence is:**

- Send 0CV
- Turn the compass so it points to 0 i.e. it is pointing magnetic North
- Rotate the C20-00132 until the output angle is zero
- Send a sequence of PCV commands while the compass is rotated
  - one every 10deg
- Send SCV to update the table used for correction

3.2 Use of PC Calibration Software Tools

This describes the operation of the two Autonatic C20-00132 Calibration software tools  
*Factory Utility 1.13* and  
*P6033 Calibration Tool V1.02*

**[Note that the Calibration Tool is only for use with C20-00132 firmware v040 and later]**

This normally is delivered packed as a zip file: *C20-00132 Cal tool kit.zip*

This must first be unpacked so it can be used. Once that is done the files can be installed.

Open the Factory Utility 1.13 directory and use the file called *setup.exe*  
This is likely to cause your PC to advise against it – but ignore the warnings and complete the installation

Similarly, open the P6033 Calibration Tool V1.02 directory and use the file also called *setup.exe* to install it.  
This is also likely to cause your PC to advise against it – but, again, ignore the warnings and complete the installation.

**Hardware notes:**

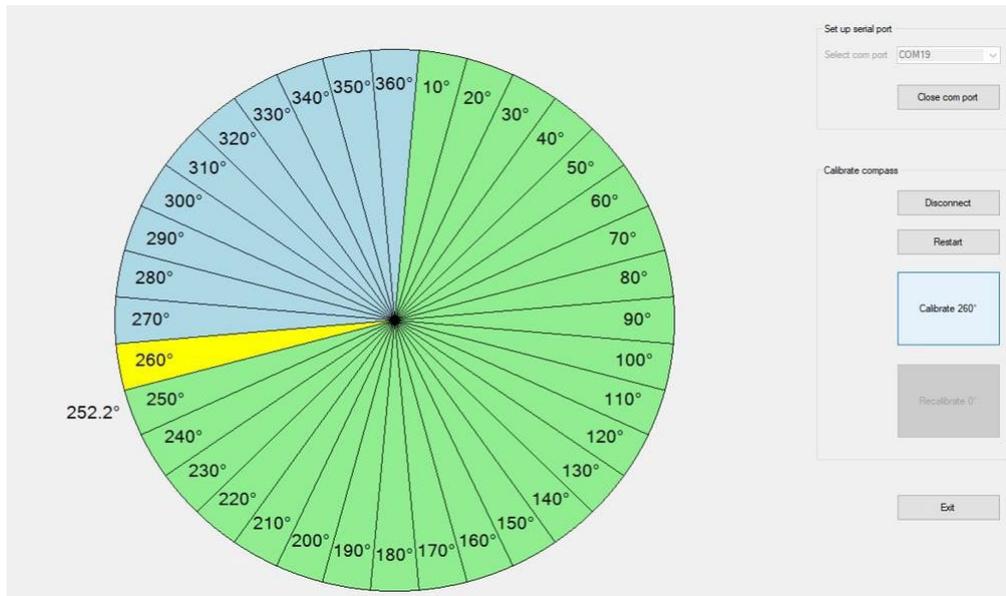
- 1 The C20-00132 is to be attached to a magnetic compass which itself can be rotated while the C20-00132 does not move relative to the compass so that, at all times, the C20-00132 data represents the angle of the magnet of the Compass.
- 2 The PC will have a port assigned to the USB-RS232 cable attached to the C20-00132 and the number of this port must be found from the Device Manager Windows utility. Eg COM 6

Once this is operating the software can be used as follows:

**Note** that the [bracket] means the button on the screen of that name.

- 1                    Connect the C20-00132 to the Autonatic Factory Utility V1.12 with the correct port selected (see note above) and use the [CONFIG] button to put a command string into the send panel on the screen which looks like this:  
PATC,IIHDG,CFG,020  
                    Make sure that the field is 020 as above – edit it so that it does. Then press [SEND] so that the message now uses the **HDM** format which you can see in the scrolling window.
- 2                    The press [SCI] and adjust the field at the end of the command so it shows the calibration angle interval you wish to use - usually 10 and then press [SEND]
- 3                    Close the port (but leave the program running) and open the Calibration Tool V1.02. Open the correct comm port to connect. Then adjust the Compass so the needle is at 0.0 and adjust the C20-00132 by rotating it so it too reads 0.0.        Then press [START]
- 4                    Click [Calibrate 0] and this button changes to 'Calibrate 10'. Turn the Compass so that it points to 10deg and press [Calibrate 10] which then changes to 'Calibrate 20' and so on. The output of the C20-00132 appears on the screen but will not exactly match the heading – that is purpose of calibration.

- 5 The sectors on the screen change colour as each point is set.



- 6 When the button says 'Calibrate 360' DO NOT press it but close the com port with [Close com port].
- 7 On the Autonatic Factory Utility V1.12 screen reconnect the port. Then press [SCV] to transfer the points to the internal calibration tables within the C20-00132. Which is now calibrated.
- 8 Note that if you don't like a point you can go back to it and reset it using the [PCV] button but any change must be transferred with [SCV]
- 9 If you do not want to continue with the HDM format use the [CFG] button to load the configuration string into the text window and edit it to give you the format you want according to the details in section 4.2.4

Use the buttons on the PC screen to use either the calibrated table [SCV] or the uncalibrated values [OCV].

## 4 NMEA-0183 Serial data

### 4.1 General Format

The serial output format is: 4800 Baud, 8 data bits, 1 stop bit, no parity but note that it is not NMEA-0183 at the physical level – solely in the meaning of the data.

The compass sends information using the standard NMEA-0183 sentence 'HDG': Magnetic Heading, Deviation, and Variation. But note that the information of Deviation and Variation is not sent and so blank fields are defined by consecutive commas. In the C20-00132 the sentence may have one of several forms typically of the general form:

```
$HCHDG, hhh. h, , , , *ssss<CR><LF>
```

Note that the first character is typically \$ but the C20-00132 will respond correctly even if it is missing.

### 4.2 List of Command in V040 of the software

4.2.1	OCV	Factory default calibration values; zero heading offset;
4.2.2	OPV	Set the calibration candidate table to factory default values
4.2.3	AHD	Set heading offset Configure NMEA sentence output
4.2.4	CFG	format
4.2.5	DHD	Set heading damping value
4.2.6	DLY	Set power up delay
4.2.7	FDO	Factory default: fluxgate heading output rate; fluxgate damping factor; last calibration error code
4.2.8	INV	Set normal / inverted compass mount
4.2.9	PCV	Read current heading, calculate and program calibration value
4.2.10	RCV	Read calibration values



#### 4.2.4 CFG

**\$PATC,IIHDG,CFG,ab<CR><LF>**

**Configures the output sentence structure and type.**

[Replies with the standard acknowledge sentence  
*\$PATC,HCHDG,ACK<CR><LF>*]

Where 'a' specifies the heading of the output sentence as follows:

a=0 : ***\$HCHDG,hhh.h,,,,<CR><LF>***  
a=1 : ***\$HCHDT,hhh.h,T<CR><LF>***  
a=2 : ***\$HCHDM,hhh.h,M<CR><LF>***  
a=3 : ***\$HCHCC,hhh.h<CR><LF>*** - default  
a=4 : ***\$HEHDT,hhh.h<CR><LF>***  
a=5: no heading data sent

**hhh.h** is the compass heading in degrees  
(this compass heading field will be omitted when auto-calibration is in process)

and 'b' is sentence end structure as follows:

b=0 : direction sentence will NOT include checksum nor unit ID serial number.

e.g. ***\$HCHDG,hhh.h,,,,<CR><LF>***

b=1 : direction sentence will include a checksum.

e.g. ***\$HCHDG,hhh.h,,,,\*cc<CR><LF>*** (cc is the checksum)

b=2 : include the serial number.

e.g. ***\$HCHDG,hhh.h,,,,\*ssss<CR><LF>*** (ssss is the unit's serial number)

#### 4.2.5 DHD

**\$PATC,IIHDG,DHD,ddd.d<CR><LF>**

**Set the internal filtering:** ('damping')

Valid range for d is 2 to 30 with the default set at 15.

#### 4.2.6 **DLY**

**\$PATC,IIHDG,DLYn.n<CR><LF>**

##### **Startup Delay**

Sets a delay from Power-up to the transmission of the first output sentence where n.n is in seconds with a maximum of 6.5

#### 4.2.7 **FDO**

**\$PATC,IIHDG,FDO<CR><LF>**

This is very similar to 0CV except that the calibration tables are unchanged.

#### 4.2.8 **INV**

**\$PATC,IIHDG,INV,a<CR><LF>**

##### **Set device mounting preference**

where :

a=0 device mount normally (i.e. top of fluxgate pointed upward)

a=1 device mount inertly (i.e. top of fluxgate pointed downward)

The C20-00132 replies with the standard acknowledge sentence

#### 4.2.9 **PCV**

**\$PATC,IIHDG,PCV,aa0<CR><LF>**

This command should be used only after sending the 0CV command.

The PCV command has the following format:

where angle is in degrees  $0 \leq aa0 \leq 360$  and must be a multiple of  $10^\circ$ .

To perform full calibration:

\$PATC,IIHDG,PCV,0

\$PATC,IIHDG,PCV,10

\$PATC,IIHDG,PCV,20

...

...

\$PATC,IIHDG,PCV,340

\$PATC,IIHDG,PCV,350

NOTE: \$PATC,IIHDG,PCV,360 is not supported.



#### 4.2.12 RHO

**\$PATC,IIHDG,RHO<CR><LF>**

**\$PATC,IIHDG,RHO,nnn.n<CR><LF>**

Where nnn.n is the heading offset **Note** that leading zeros are suppressed eg 0.0

#### 4.2.13 RID

**\$PATC,IIHDG,RID<CR><LF>**

##### **Request the serial number:**

A special proprietary reply sentence follows:

**\$PATC,IIHDG,RID,ssss<CR><LF>** where ssss is the serial number in ASCII decimal.

#### 4.2.14 RXY

**\$PATC,IIHDG,RXY<CR><LF>**

Returns the magnetic sensor values of X, Y, the reference voltage and the field vector and Temperature in decimal with the range 0 to 4095.

**\$RXY,xxxx,yyyy,vvvv,tttt,\*cc<CR><LF>**

A value of zero field is represented by 0. The internal analogue zero is not sent as it has already been corrected for.

The main purpose is to check that the magnetic field is not so high that it overloads the sensor (by the strong field of the compass magnet to which it is attached) nor is so low that the output will be noisy.

See also 4.2.21 for the MFE field strength warning message details.

#### 4.2.15 SCV

**\$PATC,IIHDG,SCV<CR><LF>**

Copy calibration data into the Calibration Table to be used for all subsequent outputs. This is why it must be cleared before calibration so that the data used for calibration is 'raw' magnetic data.

#### 4.2.16

#### SR

**\$SR <CR><LF>**

##### **Read device firmware release**

A typical response from a unit is as follows:

**\$SR,A5024,016,02<CR><LF>**

showing the release is 016.

#### 4.2.17

#### TMP

**\$PATC,IIHDG,TMP,rr**

##### **Set rate at which temperature data is sent.**

where rr is the rate from 0 (default) to 30.

\$PATC,IIHDG,TMP,0 disables the temperature display feature

\$PATC,IIHDG,TMP,1 sets the temperature display rate to the fastest rate of once a minute

\$PATC,IIHDG,TMP,10 sets the temperature display rate to a value in between, in this case, once every 10 minutes.

\$PATC,IIHDG,TMP,30 sets the temperature display rate to the slowest of once every 30 minutes

When the set temperature display rate command is issued the temperature is displayed within 1 second and then repeats at the new rate set.

The rate setting is stored in non-volatile memory.

The output of temperature has the following format:

**\$TEMP,tt**

OR

**\$TEMP,tt\*cc** if checksum is enabled in HCHDM heading output display where cs is checksum

Where tt is temperature and has the following range and format:

-20 to 70

Leading zeros suppressed. Negative temperatures displayed with '-'.  
E.g.: -10, -9 etc..

Zero and positive temperatures displayed purely with digits. E.g. 0, 9, 19 etc..

#### 4.2.18 TXP

**\$PATC,IIHDG,TXP,uuuu<CR><LF>**

##### **Set the Output update period:**

Valid range is u=100 (default) to 2500 milliseconds. This is limited by the maximum data rate of NMEA-0183 output at 4800 baud.

#### 4.2.19 TXY

**\$PATC,IIHDG,TXY<CR><LF>**

##### **Toggle RXY**

This command sets a flag to enable the transmission of the data of the RXY command continuously interleaved with the heading. By sending the command again the flag is cleared; it is also cleared on power-up.

#### 4.2.20 UPLOAD

This command is used by Autonautic's updater software which runs under Microsoft Windows. It is used to send **.aeh** files to install a new version of firmware.

#### 4.2.21 Out-of-range output

Interleaved with the normal data there is a special message sent every 500ms if the field strength is deemed to be out of range.

Typical examples are:

Low:

**\$PATC,HCHDG,MFE,119,LOW\*65** interleaved with \$HCHCC,\*6F

High:

**\$PATC,HCHDG,MFE,1652,HIGH\*06** interleaved with \$HCHCC,\*6F

Where the value following the MFE is a representation of the field strength.

## 5 References

C20-00132 data sheet  
NMEA-0183 specification