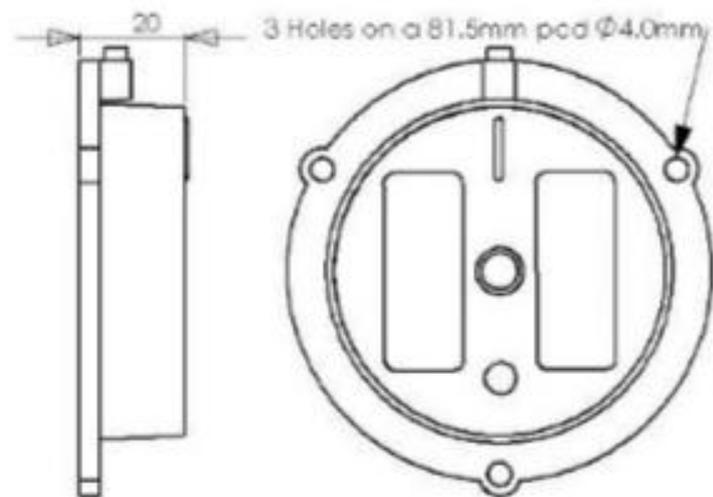


AUTONNIC

A4032 COMPASS PICK-UP USER MANUAL



January 2022
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Hardware version 3
PCB 7319-6
PCB 7322-3
Software version V040

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1. Description

The Autonnic A4032 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 A4032 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 A4032 to replace the previous software. These data files may be sent from Autonnic by email or downloaded from our website.

2 Installation

2.1 Mounting

The A4032 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.

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 A4032 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 Vdc. 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 A4032 will be mounted on a fixed compass which should have been sited correctly.

Note that the output from the A4032 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
2	Blue	Signal	NMEA OUT+
3	Green	Signal	NMEA IN+
4	Yellow	Signal	NMEA IN-
5	Screen	Power and Signal	GROUND 0V

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.

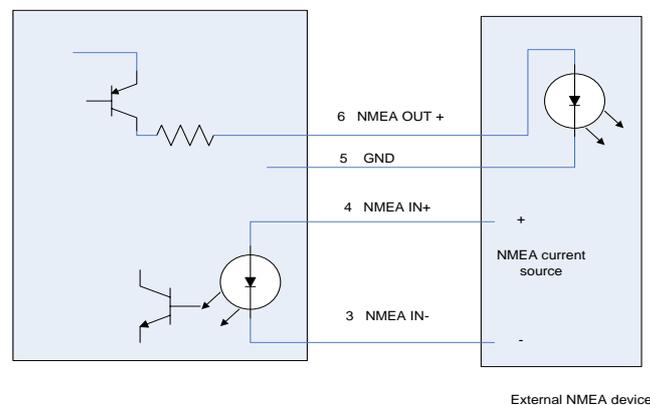


Fig 1

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 Autonnic A3036 serial interface unit.

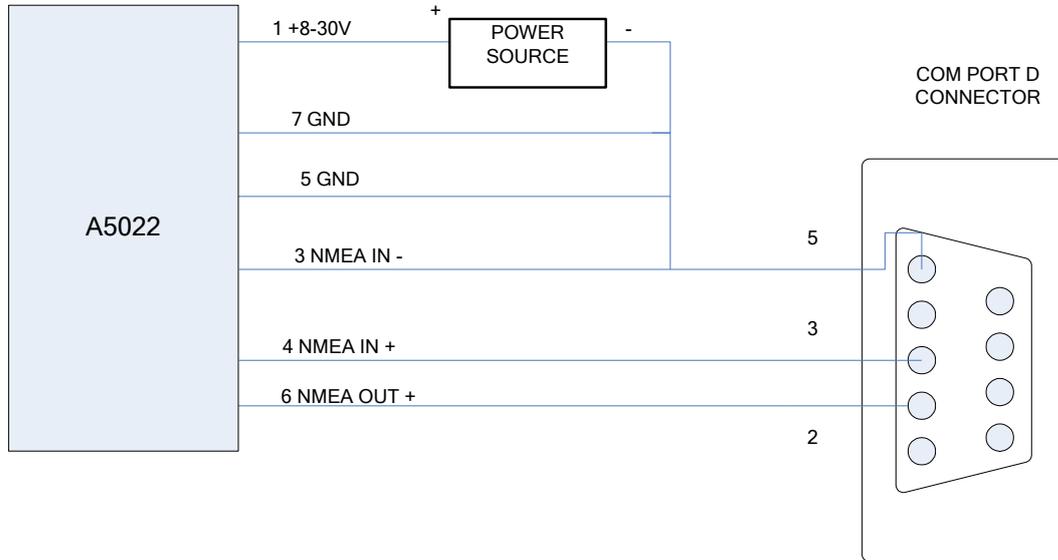


Fig 2

3 Calibration

3.1 Basic Calibration Operation

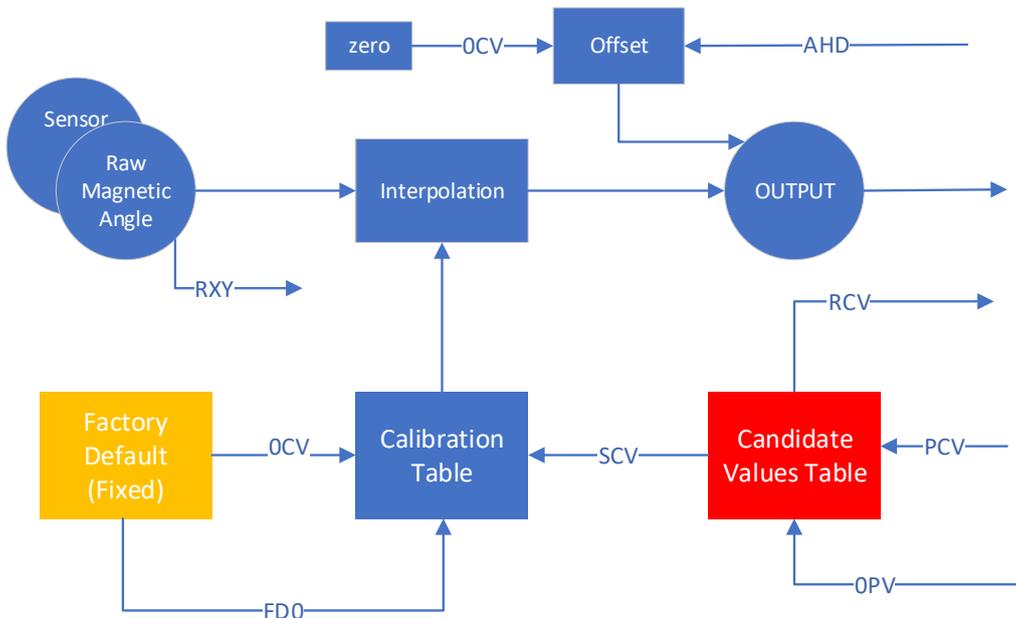


Fig 3

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

Rotate the A4032 until the output angle is zero

Send a sequence of PCV commands while the compass is rotated – one every 10deg

Send SCV

3.2 Use of PC Calibration Software

This describes the operation of the Autonnix A4032 Calibration Tool V1.05.

The tool has been designed so that the button most likely to be pressed has the focus. After setting up the serial port it should be a simple matter of pressing the ENTER or RETURN key on the keyboard.

Connect your Windows computer to a A4032 compass, and then proceed as follows:

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

- 1 The A4032 is attached to a magnetic compass which itself can be rotated while the A4032 does not move relative to the compass so that at all times the A4032 data represents the angle of the magnet of the Compass.

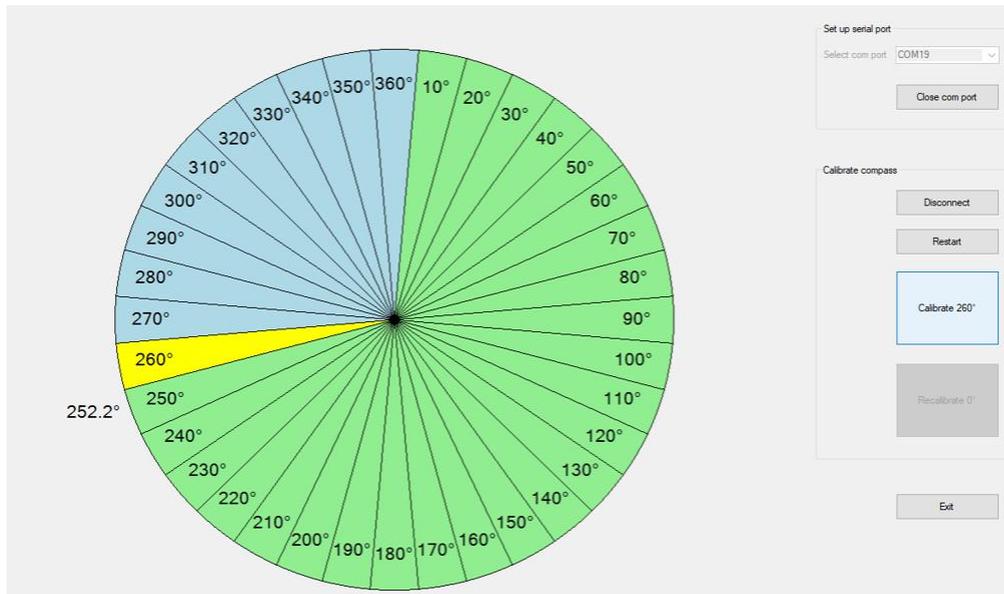
- 2 Connect the A4032 to the Autonnix Factory Utility V1.12 with the correct port selected and press [CONFIG] 2 [SEND] so that the message now uses the HDM format.

- 3 [SCI] 10 [SEND] to set the calibration angle interval.

- 4 Close the port (but leave the window 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 A4032 by rotating it so it too reads 0.0. [START]

- 5 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.

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



- 7 At 360 deg close the port
- 8 On the Autonnic Factory Utility V1.12 screen reconnect the port. Then press [SCV] to transfer the points to the internal calibration tables within the A4032. Which is now calibrated.
- 9 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]

Use the buttons on the PC screen to use either the calibrated table or the uncalibrated values.

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 A4032 the sentence may have one of several forms typically of the general form:

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

4.2 List of Command

V040	
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
4.2.4	CFG Configure NMEA sentence output 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
4.2.11	RHD Read heading damping value
4.2.12	RHO Read heading offset
4.2.13	RID Read device serial number
4.2.14	RXY One shot read of raw ADC values: X, Y, REF, Vector, Temperature
4.2.15	SCV Copy calibration bank 2 to bank 1
4.2.16	SR Read software version
4.2.17	TMP Set temperature output period
4.2.18	TXP Set NMEA output period
4.2.19	TXY Toggle RXY
4.2.20	UPLOAD Enter bootloader

4.2.1 OCV

\$PATC,IIHDG,OCV<CR><LF>

Sets the following:

Output rate u= 100 milliseconds (10 updates/second),
output damping d= 50 percent
heading offset f= 0 degrees.
Calibration Table to Factory Settings (i.e. not calibrated)

4.2.2 OPV

\$PATC,IIHDG,OPV<CR><LF>

Sets the Candidate Calibration Table values to Default (see Fig 3)

4.2.3 AHD

\$PATC,IIHDG,AHD,fff.f<CR><LF>

Set heading:

Forces the heading to a certain value by supplying an offset which is stored and used thereafter.

Where f is in degrees with a valid range of 000.0 to 359.9

When f = 000.0 the result is the same as pressing switch 2 – see 1.3.

Do not use this when calibrating.

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 A4032 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 OCV 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° .

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.

If the calibration is successful and within allowed limits ACK is sent back otherwise a NACK is sent back:

\$PATC,IIHDG,PCV,340

\$PATC,HCHDG,ACK successful

or

\$PATC,IIHDG,PCV,322

\$PATC,HCHDG,NACK not successful because angle not multiple of 10° .

or

\$PATC,IIHDG,PCV,320

\$PATC,HCHDG,NACK not successful because at 320° the P6033 thought it was at $< 290^\circ$ or $> 350^\circ$. It must be within $\pm 30^\circ$

There is no checking by the P6033 to make sure all 37 points have been manually calibrated. This should be done at a higher level by the PC utility sending the PCV commands. The points can be calibrated in any order and recalibration of any point can be done at any time provided the pickup thinks it is within $\pm 10^\circ$ of the point.

By implication an error of greater than $\pm 10^\circ$ cannot be corrected.

4.2.10 RCV

\$PATC,IIHDG,RCV<CR><LF>

This command is to read the calibration table values and the response is in the form of the example shown below:

```
$TCF,0,0000,071C,0E38,1554,  
$TCF,1,1C70,238C,2AA8,31C4,  
$TCF,2,38E0,3FFC,4718,4E34,  
$TCF,3,5550,5C6C,6388,6AA4,  
$TCF,4,71C0,78DC,7FF8,8714,  
$TCF,5,8E30,954C,9C68,A384,  
$TCF,6,AAA0,B1BC,B8D8,BFF4,  
$TCF,7,C710,CE2C,D548,DC64,  
$TCF,8,E380,EA9C,F1B8,F8D4,
```

4.2.11 RHD

\$PATC,IIHDG,RHD,nn<CR><LF>

Request internal filter response

Where nn is the damping value within the range 0 to 30

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 Autonnic'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

A4032 data sheet
NMEA-0183 specification
Autonnic A4032 Calibration Tool V1.05

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