

# AUTONNIC

## **A408X** MANUAL DIGITAL COMPASS MODULES

Document	A408x manual 03.docx
Date	October 2012
Hardware version	2
Software release	M001 0.3

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## **1. Introduction and description of fluxgate compass.**

### **1.1 Description of compass.**

The Autonnic NMEA compass unit is a complete digital module for a compass indicating system, satellite or solar positioning, RADAR 'North-up' or autopilot.

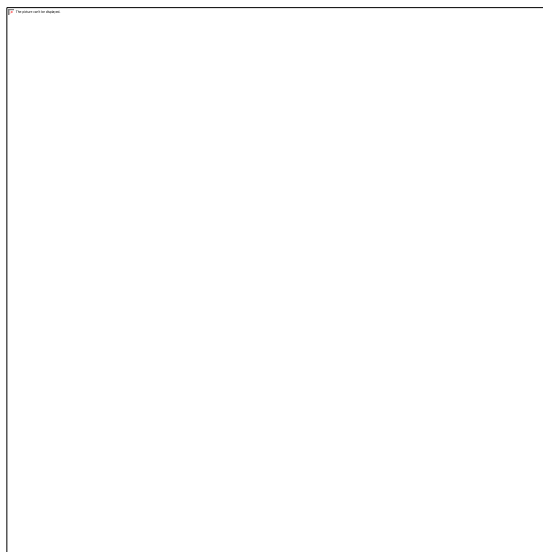
It is supplied in different forms: the A4080 has a fixed-core fluxgate, the A4081 a 35° floating-core and the A4082 has a 45° floating core fluxgate. It delivers heading serial data in industry-standard form and has an option for analogue outputs.

The A408x contains a fluxgate surrounded by high-precision interface circuits. These are contained in an analogue board which is obtainable separately as the A407x equivalent. This board obtains analogue values from two orthogonal sensors of the Earth's magnetic field. The processor on the lower board calculates the heading vector from these values, uses a calibration table to correct for local field disturbance errors, offsets the result and then presents the data in the manner which has been requested. Such requests alter the frequency of the data, the degree of filtering and the angle offset value. Calibration sequences can also be commanded.

### **1.2 Connections**

Connection to J2 (see Fig 1) are as follows:

<b>Pin</b>	<b>Type</b>	<b>Symbol</b>	<b>Description</b>
1	P	Vs	+ Supply
2	P	5v	Do not use
3	I	ZERO	Set zero
4	I	CAL	Start auto-calibration
5	O	TX	Data Output
6	O	CALSTAT	Calibration Status
7	I	RX	Data Input
8	P	GND	Ground



**Fig 1 Underside view**

### **1.3 Power supply.**

The compass is compatible with any DC power supply of between 7 and 15 Vdc. Typical supply current during operation is an average of around 25mA but contains 60mA peaks. During auto-calibration this peak current is maintained. 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. It is not possible to cover all possible scenarios here, and it remains up to the user to determine the suitability of a possible location for the compass.

It is possible, but not recommended, to operate a member of the A408x series from 5v. If you need to do this please consult the factory.

#### **1.3.1 Power up**

When the unit is powered up full accuracy will not be achieved during the first 2s of operation.

Auto calibration and/or set heading operations should not be performed during this time.

#### **1.3.2 Power consumption**

Normal operation average = 25mA peak 60mA

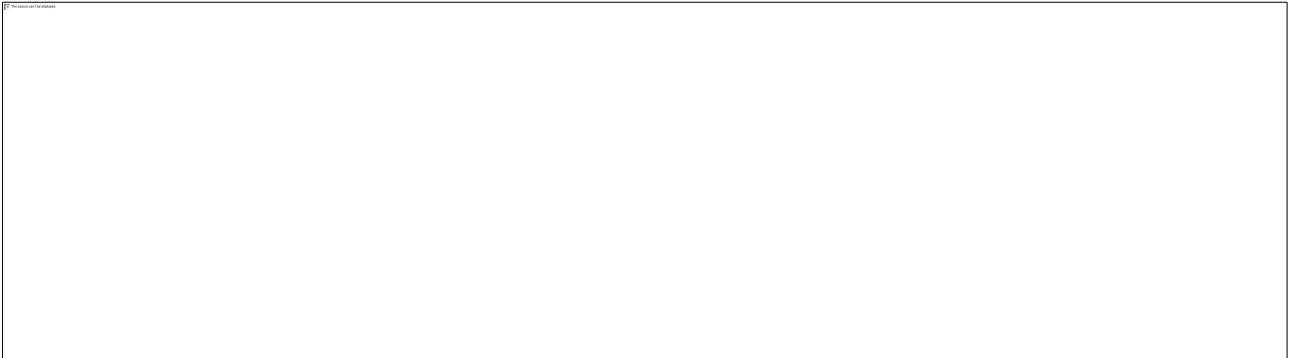
During Auto calibration average = 55mA peak = 60mA

Allow +/- 10% on the above values

Voltage input +7v min, +15v max

## 2 Connecting the compass to your application.

### 2.1 Compass to a PC serial port.



**Fig 2**

The recommended connection is shown in Fig 2. The A3036 supplies power to the A408x and performs the appropriate level-change between the TTL levels of the A408x and the RS-232 levels of the standard computer interface. The A4036 may in turn be connected to a computer via a USB adaptor.

## 3 Output formats available

### 3.1 Serial Digital

The serial output format is: 4800 Baud, 8 data bits, 1 stop bit, no parity and is closely modelled on the the Marine NMEA-1083 specification for format and timing. The output data voltage levels are not NMEA compatible as they are directly from a microprocessor operating at 5v.

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 A4020 the sentence may have one of two forms

Either  $\$HCHDG, hhh.h, , , , ssss<CR><LF>$  or  $\$HCHDG, hhh.h, , , , cc<CR><LF>$

where **hhh.h** represents the magnetic heading with one decimal place of precision, i.e: 000.0 to 359.9 degrees.

And where **ssss** is either a 4 digit checksum or a 4 digit serial number.

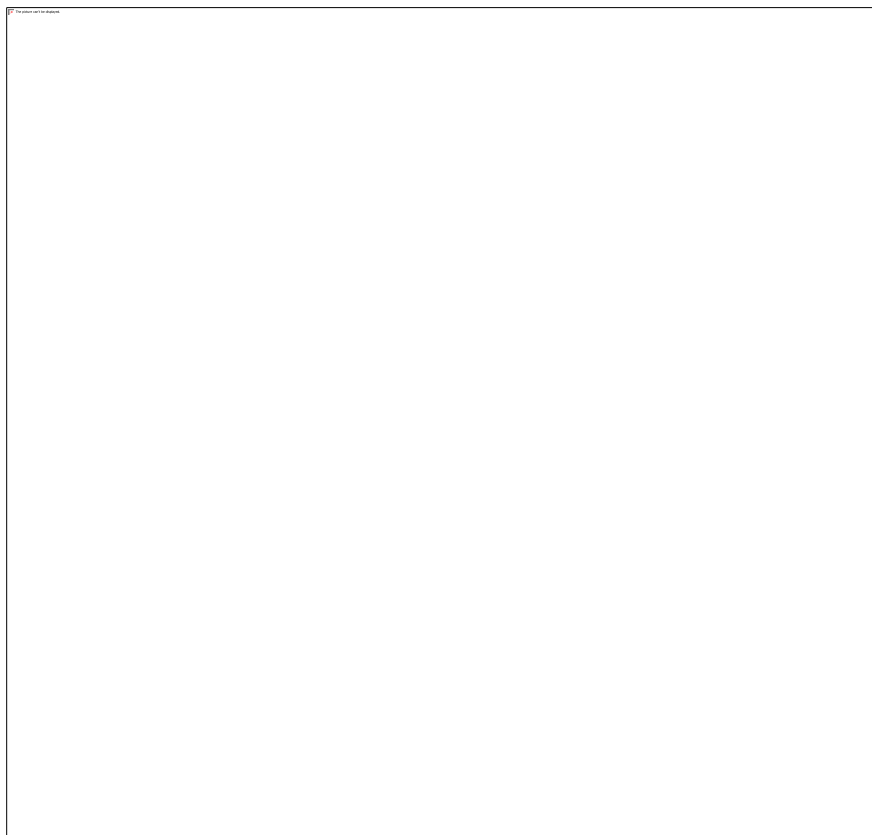
The value returned as **cc** is a two digit checksum. The choice depends on the configuration command described at the end of section 5. The default is 4 digit checksum.

### 3.2 Analogue

The A4081 and A4082 use a separate analogue board as part of their build. The interface between these boards can be accessed if needed by inserting connectors and using the signals; provided they are connected to a high-impedance the loading will not affect the rest of the circuit on the second, digital, board.

The analogue board itself is available from Autonnic as the A4071 or A4072 and also with a fixed fluxgate when it is called the A4070. The outputs are two analogue values from each of the two orthogonal magnetometers and are centred around a 2.5v (nominal) reference. This reference is also available and its value represents zero flux so that the signals move both above and below this level. The calibration is approximately such that 50microTesla of flux corresponds to 2v of signal i.e either 4.5v if positive flux or 0.5v if negative flux where the sign is the direction of the flux with respect to the sense windings on the fluxgate capsule in the plane of the core.

The diagram of Fig 3, below, shows these connections and the orientation of the sense windings.



**Fig 3**

## **4 Calibration**

### **4.1 Why the compass needs calibrating.**

When any compass is installed the magnetic characteristics of the whole installation affect the way the Earth's field reaches the detector inside the device. Each individual installation will be different and so the A408x is equipped with an auto-calibration routine which corrects for these installation distortions.

### **4.2 Starting calibration.**

The calibration process can be started in either of two ways:

- A NMEA-0183 command (section 5) can be sent to initiate the process.

OR

- The /AC pin can be asserted low. This can be done with a resistance to GND of not more than 10K

The process consists of rotating the whole installation in the Earth's field so that both permanent magnets and induced magnets are corrected. The method used is the single turn at a constant rate. The whole arrangement is turned at constant angular velocity and the method relies on applying a correction when the heading measured is uneven with time.

The output /CE is asserted low during this process and is provided so that the status can be monitored. /CE can be used to operate an LED drawing a current of not more than 10mA from a +5v (maximum) supply.

### **4.3 Terminating a bad calibration.**

If the process is faulty in any way the process is terminated and the original factory default (linear) table is restored.

The status is available either:

- by observing the /CE pin (If this process does not succeed the pin will toggle at approximately 1s low and 1s high).

OR

- by sending a NMEA request (see section 5). The reply will supply information about the cause of a terminated calibration.

## 5 OUTPUT FORMATS AND COMMANDS

### 5.1 Configuration of output sentence type and structure

`$PATC,IIHDG,CFG,ab<CR><LF>` The device replies with the standard acknowledge sentence:  
`$PATC,HCHDG,ACK<CR><LF>`

where a = sentence type from 0 to 3

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>`  
a=4 : `$HEHDT,hhh.h<CR><LF>`

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

and where b=sentence end structure from 0 to 2

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 two digit checksum, cc.  
e.g. `$HCHDG,hhh.h,,,,*cc<CR><LF>`

b=2 : send unit's 4 digit serial number, ssss, instead of the checksum.  
e.g. `$HCHDG,hhh.h,,,,*ssss<CR><LF>`

### 5.2 Set direction heading point

`$PATC,IIHDG,AHD,a.a<CR><LF>`

### 5.3 Set direction damping value

`$PATC,IIHDG,DHD,xx.x<CR><LF>`

### 5.4 Set NMEA output update period

`$PATC,IIHDG,TXP,xxx.x<CR><LF>`



## **5.6 Start direction calibration process**

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

## **5.7 Abort direction calibration process**

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

## **5.8 Restore calibration data to factory value**

\$PATC,IIHDG,0CV<CR><LF>

## **5.9 Copy calibration data as factory values**

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

## **5.10 Read out calibration data**

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

## **5.11 Read last calibration status**

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

## **5.12 Readout unit's serial number (ID)**

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

## **5.13 Set the start-up delay**

\$PATC,IIHDG,DLY,x.x<CR><LF>

This sets the period after power up during which the heading field in the NMEA sentence will be omitted.

Where x.x is the period value in seconds, 0 to 9.9 (entering larger periods will result in truncated values) [i.e. if enter 12.4, 2.4 will be accepted as the period value].

Note : same applied after calibration process.

Default: period = 0 second.



## 5.14 Set device mounting preference

Reply with the standard acknowledge sentence

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

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)

## 5.15 Get unit's application software release number

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

A special reply sentence follows:

**\$SRM001.a.b<CR><LF>** where a= major number & b=minor number

e.g. \$SRM001.2.3 means application software type M001 and release number is 2.3.

## 5.16 Request device to go into boot-loader mode

**\$UPLOAD<CR><LF>**

The device replies with **#M<CR><LF>** if successful.

*End*

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