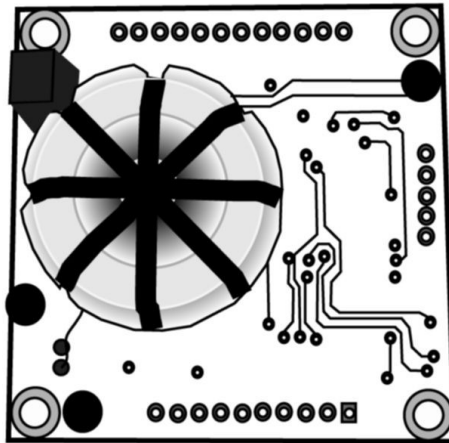


**A4020 OEM FLUXGATE COMPASS USER MANUAL**



OEM

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Software release 0.1.4  
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## **1. Introduction and description of fluxgate compass.**

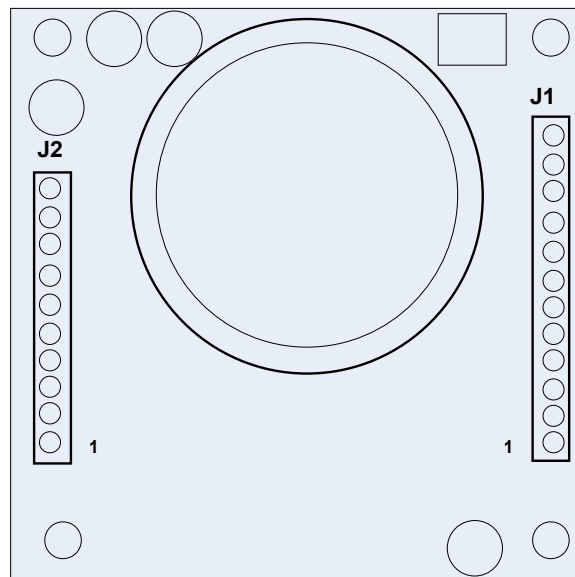
### **1.1 Description of compass.**

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

It is supplied in different forms: with a fixed, 35° floating or 45° floating core fluxgate and with the pins either up or down. It delivers heading serial data in two industry-standard forms and has an option for analogue outputs.

The A4020 contains a fluxgate surrounded by high-precision interface circuits which, together with the special clockwise/anticlockwise and offset nulling sequence allow a microprocessor to acquire a binary value from two orthogonal sensors of the Earth's magnetic field. The processor calculates the vector from these values, uses a calibration table to correct for local field disturbance errors, offsets the result 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.

### **1.2 Connections**



**Fig 1**

<b>J1 Header Block</b>			
Pin	In or Out		
1	P	GND	Supply and signal ground
2	I	/AC	not Start auto-calibration
3	I	/SZ	not Set zero heading
4	I	/BRC	not Change bit-rate
5	I	/SD	not Shut-down
6	O	/CE	Cal status output
7	I	ANI	Analogue Input
8	O	SO	Serial output
9	I	SI	Serial input
10	O	NMEAO	RS422 / NMEA-0183 O/P (+)
11	I	NMEAI-	RS422 / NMEA-0183 I/P (-)
12	I	NMEAI+	RS422 / NMEA-0183 I/P (+)

<b>J2 Header Block</b>			
Pin	In or Out		
1	O	ANO4*	Analogue Output 4
2	O	ANO1*	Analogue Output 1
3	O	ANO2*	Analogue Output 2
4	O	ANO3*	Analogue Output 3
5			n/c
6	O	SPICK	SPI/Furuno Clock
7	O	SPID	SPI/Furuno Data
8	I	/RTS	not Request SPI/Furuno
9	P	+7 to +15v	+ supply
10	P	GND	Supply and signal ground

\* absent on -N version

### 1.3 Pin functions

Note that most functions are active low (shown as /)

#### 1.3.1 J1

<b>/AC</b>	Start auto calibrate
<b>/SZ</b>	Set to zero (North)
<b>/BRC</b>	reserved for future: Change bit-rate
<b>/SD</b>	Shut-down. Reduces consumption
<b>/CE</b>	Calibration Status Output
<b>ANI</b>	reserved for future: Analogue Input
<b>SO</b>	Serial output direct from the micro-controller
<b>SI</b>	Serial input direct from the micro-controller
<b>NMEAO</b>	NMEA Output. Sourced through 150R to +5v

**NMEA1N+ and -** - Inputs to the photo-diode in the NMEA-0183 opto-isolator input.

### 1.3.2 J2

**ANO1-4** The four analogue outputs are absent on -N versions. These outputs are not directly from the magnetometer analogue circuits but are normalized by the on-board processor and created using a 10bit D-A

**SPICK** Furuno clock

**SPID** Furuno data

**/RTS** Furuno request to send

## 1.4 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 the A4020 from 5v. If you need to do this please consult the factory.

### 1.4.1 Power up

When the unit is powered up full accuracy will not be achieved during the first 5s of operation. There is a command to suppress output during this period (see section 5)

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

This constraint does not apply after exit from sleep/shutdown mode.

### 1.4.2 Power consumption

Shutdown mode <3mA

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 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.

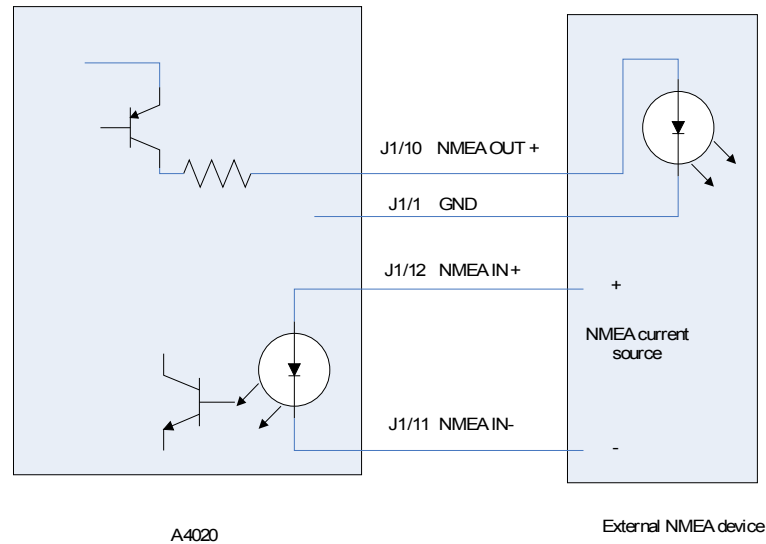


Fig 1

The NMEA current from the A4020 is sourced from the +5v regulation system. Note that the GND wire is used for the current return path. This might be shared with the NMEA- wire in some installations.

### 2.2 Compass to a PC serial port.

There is a choice: either use the NMEA connections or else connect directly to the micro-controller as shown in Fig 2

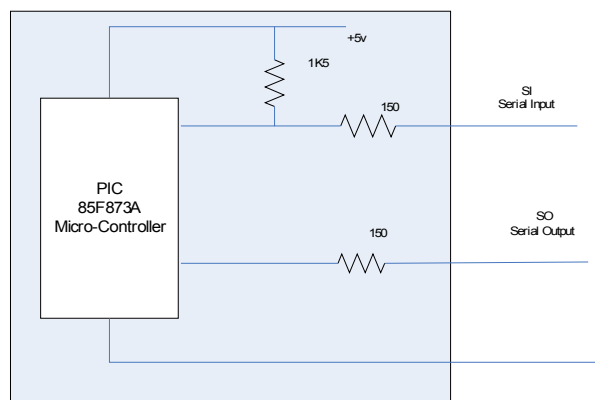


Fig 2

This sometimes needs a RS422 to RS232 converter but in most cases the wires can be joined directly as shown in Fig 3. The A4035 or A4036 Interface is recommended for ease of interfacing to both computers and NMEA devices.

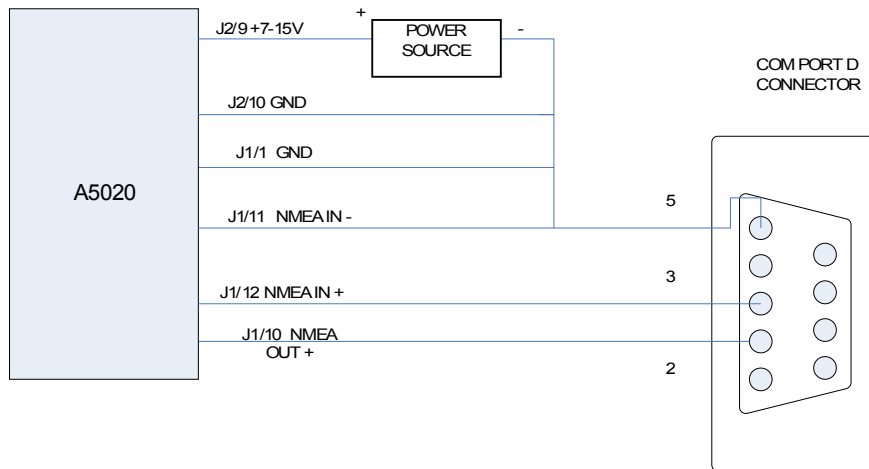


Fig 3

### 3 Output formats available

#### 3.1 NMEA-0183

The serial output format is: 4800 Baud, 8 data bits, 1 stop bit, no parity.

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 Furuno AD-10

The compass has a separate, dedicated output in Furuno AD-10 format. This is a proprietary 4 character serial format, which gives heading in degrees and tens of minutes. The string 0872 represents the heading 87° 20' so that the precision is to 1/6 of a degree. At the same time the A4020 would be also sending the NMEA data to a precision of 1/10 of a degree.

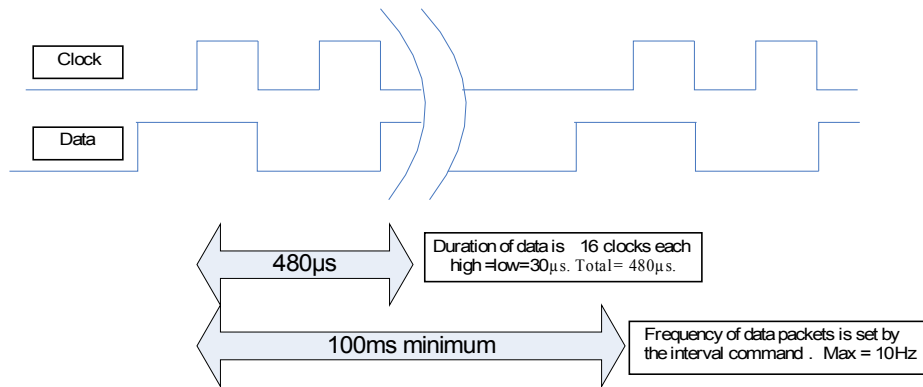


Fig 4

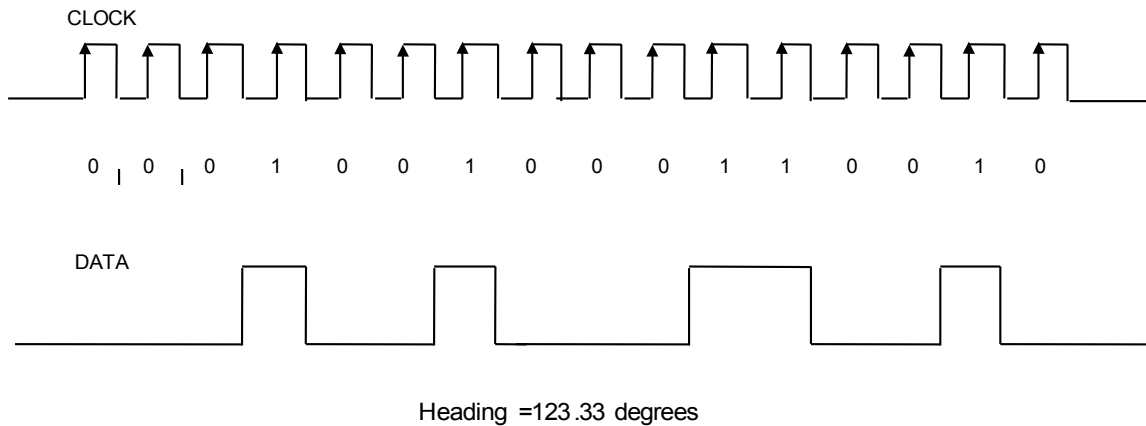
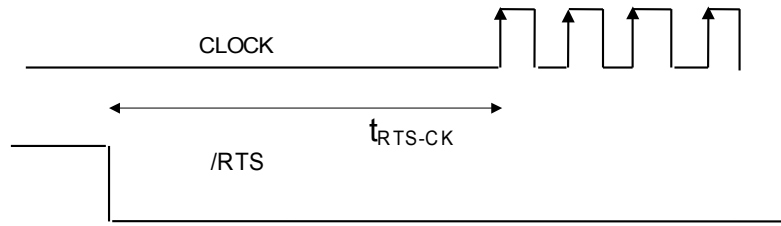


Fig 5

The SPI or Furuno output is a synchronously clocked serial stream. The clock rate is 17 KHz and the data is sampled by the receiver on the rising edge of the clock pulse. The serial data stream is made up of 4x4 bit messages. The first nibble (4 bits) is 100's of a degree, followed by 10's, 1's and 1/6<sup>th</sup> of a degrees. The diagram above shows the output signals for clock and data.

### 3.3 SPI

The data format is the same as for 3.2 but the 16bit packet is requested by /RTS. The response is by software so the delay to first clock,  $t_{RTS-CK}$ , can be any time from 25 $\mu$ s to 25ms. /RTS is ignored during autocalibration (see CE)



**Fig 6**

### 3.4 Analogue Format

The four outputs are arranged as SIN, COS, REF and LINEAR as follows –with the output value shown in volts :

$$ANO1 = 2\sin HDG + ANO3$$

$$ANO2 = 2\cos HDG + ANO3$$

$$ANO3 = 2.5 \text{ Use this as the common signal for ANO1 and ANO2}$$

$$ANO4 = 13.89\text{mV}/^\circ \text{ (0-4.998v = 0 - 359.9}^\circ\text{)}$$

## **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 A4020 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 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 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 NMEA-0183 inputs**

The compass can be configured by sending various proprietary sentences to its NMEA-0183 input. Once configured, the compass will remember those settings every time it is powered up.

In the list below the *normal case* denote input and the *italic case* denotes output.

**Start Auto-Calibration:** Refer to section 4.2. Same as asserting */AC*

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

**Abort Auto-Calibration:** Refer to section 4.3.

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

**Reset compass to factory default:**

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

Resets auto-calibration data to factory default value.

**Set Reference heading:**

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

**\$PATC, IIHDG, AHD, fff.f<CR><LF>** When *f* = 000.0 the result is the same as asserting the */SZ* input.

**Set Output update period:**

Valid range is 100 to 3000 milliseconds. This is limited by max. data rate of NMEA-0183 output at 4800 baud. For example, an output rate of 10/s is period of 100ms which can be entered either as 0100 or simply 100.

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

**Set the internal filtering** (expressed as 'damping')

**\$PATC, IIHDG, DHD, dd<CR><LF>**

Valid range for *d* is 00 to 99

**Response:**

When any of the above input sentences are received the A4020 will reply with an 'acknowledge' output sentence of the format:

**\$PATC, HCHDG, ACK<CR><LF>**

**Request Status:** Read out the last auto-calibration status.

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

The response is a proprietary sentence containing a code, k, for the status:

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

k=0 the last auto-calibration was successfully completed.

k=1 Resetting the calibration data to factory default was completed successfully.

k=2 The autocalibration has been aborted internally due to the rotation being too slow.

k=3 The autocalibration has been aborted internally due to the rotation being too fast.

k=4 The autocalibration has been aborted internally because of rotation inconsistency.

k=5 The autocalibration has been aborted by an external command.

**Report unit's serial number:**

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

A special proprietary reply sentence follows:

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

**Configure the output sentence structure.**

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

If x=0, heading sentence will NOT include checksum nor unit's serial number.

If x=1, heading sentence will include 2 digits checksum.

If x=2, heading sentence will include 4 digits serial number instead of checksum.

## **6 References**

- 1 A4020 data sheet
- 2 NMEA-0183 specification

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Autonnic Research Ltd Tollesbury Essex CM9 8SE UK  
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