

LCS

COMPASS SENSOR



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1 Introduction

This manual contains information about the operation, calibration and installation of the Electronic Compass Sensor 'LCS'.

In this manual we also refer to a display unit called ECI1 or ECI2. These units have been developed especially to show the measured heading the LCS provides. These display units also support the special calibration commands which the compass needs to calibrate after mounting.

2 Installation

2.1 Choosing a location

2.1.1 Magnetic interference

Each compass is calibrated in the factory so the more careful you choose the location for the ECS Compass sensor the better the result will be.

It is very important that the sensor is mounted away from any material that is likely to cause magnetic interference.

This compass is for inside mounting only.

- A safe distance from external magnetic interference: 3m/10ft from VHF, RDF, loudspeakers, depth sounders, engines, or power cables carrying heavy current.
- 3m/10ft from Radar and SSB equipment.
- Well protected from physical damage.
- Optimum positioning: As low as possible to minimise effect of pitching and rolling of boat.
- Do not mount the compass near magnets (card compass)

Should there be any doubt about the suitability of mounting the sensor due to magnetic interference, a hand compass may be used to determine any magnetic deviation at the proposed mounting place.

2.2 Mounting (inside)

The back side of the compass has two mounting holes to install the compass.

Use only non-magnetic fasteners to secure the compass.

The arrow on top of the LCS should point upwards and the printed side should point to the bow of the vessel.



3 Calibration of LCS1

Magnetic deviation, caused by the vessel itself, results in incorrect compass readings. This magnetic deviation can be corrected by means of the calibration procedure.

3.1 ECI1/2 owners

If you own an ECI1 or ECI2 display then you can do the following to start calibration:

To calibrate the LCS compass you need a calm day and a clear area. Start turning your boat in a large circle at a slow speed. Then select calibrate in the menu and press up and down buttons together for two seconds. Now the display shows the heading and 'In process'. The time to complete the circle (full 360°) should be at least 1 up to max. 4 minutes. When the calibration was successful the display shows Done and a short beep will be heard. Circles may be clockwise or counter clockwise. If the circle was not in between the time limits, the old calibration is restored and you can see on the display if the circle was too fast or too slow.

Example: -Start turning the boat in a large circle
 -goto menu Calibration -> Calibration
 -press up and down together for 2 seconds -> In process
 -now continue the circle and wait for the ECI1/2 to beep.

The ECI1/2 compass display now shows if the calibration was done or not.

3.2 NMEA calibration commands

The LCS units has a few commands to start and to check the calibration. The LCS uses a baudrate of 4800 baud, no parity, 1 stopbit.

The procedure is :

- Start turning the boat in a large circle The time to complete the circle (full 360°) should be at least 1 up to max. 2 minutes.
- Send the message "Start Calibration" to the LCS
The LCS sends one "BUSY" message back
The LCS send "HDG" messages while turning (Unfiltered heading)
- Now continue the circle and wait for the "Done", "Fast" or "Slow" message.

If the last received message is "Fast" or "Slow" the procedure must be repeated, no values have been saved and the old calibration values are restored.

3.2.1 Start calibration command

```
$IIELP,CAL,ECS,STRT*CC<13><10> // Start calibration command
```

Start calibrating, be sure that the vessel is already turning before sending this command.

3.2.2 Stop calibration command

```
$IIELP,CAL,ECS,STOP*CC<13><10> // Stop calibration command
```

If for some reason you want to stop calibrating, send this message.

3.3.3 Auto calibration ON command

```
$IIELP,CAL,ECS,AUTO*CC<13><10> // Auto calibration command
```

The compass now will calibrate itself every time two full circles have been made within 1 to max. 4 minutes per circle.

3.3.4 Auto calibration OFF command

\$IIELP,CAL,ECS,MANU*CC<13><10> // Stop auto calibration command
Autocalibration Off.

3.2.5 Done message

\$IIELP,CAL,ECS,DONE*CC<13><10> // message "Done"
The calibration circle was fine. New calibration values are now active.

3.2.6 Fast message

\$IIELP,CAL,ECS,FAST*CC<13><10> // message "Fast"
The calibration circle was too fast, this means less than 1 minute.

3.2.7 Slow message

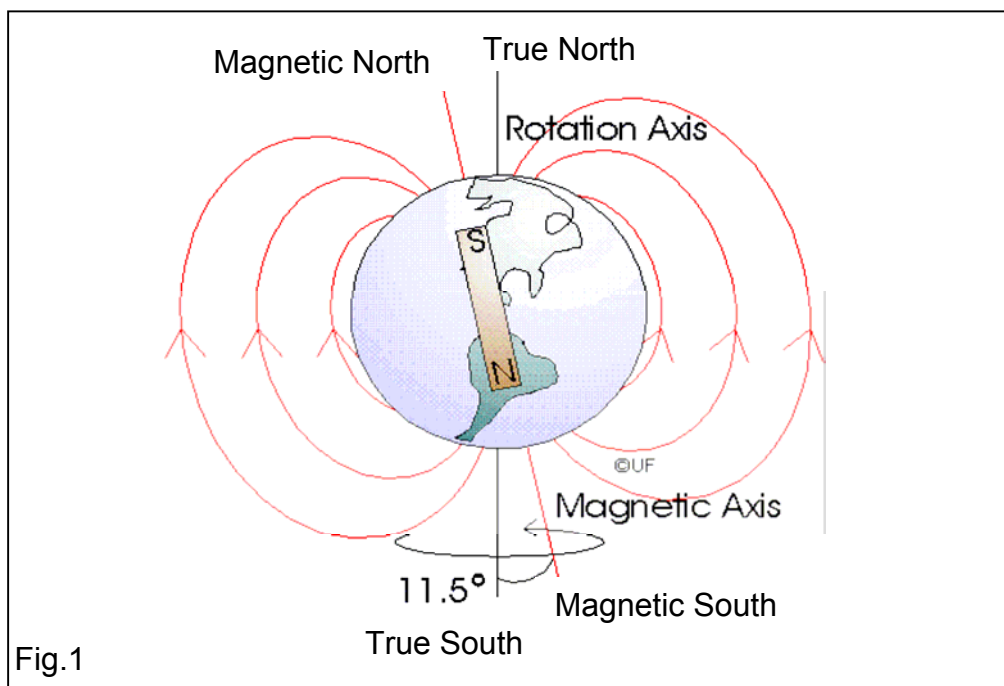
\$IIELP,CAL,ECS,SLOW*CC<13><10> // message "Slow"
The calibration circle was too slow, this means more than 4 minutes.

3.2.8 Calibration busy message

\$IIELP,CAL,ECS,BUSY*CC<13><10> // message "Busy"
Response on a "Start Calibration" command.

3.3 Variation command

The magnetic field of the earth is the physical quantity to be evaluated by a compass. Figure 1 gives an illustration of the field shape.



The magnetic field strength on the earth varies with location and covers the range from about 20 to 50 A/m. An understanding of the earth's field shape can be gained, if it is assumed to be generated by a bar magnet within the earth, as pointed out in Figure 1. The magnetic field lines point from the earth's south pole to its north pole. Fig. 1 indicates, that this is opposite to the physical convention for the poles of a bar magnet (the background is a historical one, in that a bar magnet's north pole has been defined as that pole, that points towards north in the earth's magnetic field). The field lines are perpendicular to the earth surface at the poles and parallel at the equator. Thus, the earth field points downwards in the northern hemisphere and upwards in the southern hemisphere. An important fact is, that the magnetic poles do

not coincide with the geographical poles, which are defined by the earth's axis of rotation. The angle between the magnetic and the rotation axis is about 11.5°. As a consequence, the magnetic field lines do not exactly point to geographic or "true" north.

The LCS compass has a non volatile memory where the current variation can be stored. This value will be send together with the current heading in the "HDG" message (see chapter 4.3).

```
$IIELP,CAL,ECS,VARI,X.X*CC<13><10 // Variation value command  
X.X = variation in degrees, -45.0 up to 45.0 max, CC is the checksum.
```

3.4 Align command

Align can be used to set the difference between the real magnetic north and the position of the compass. This can be used when it is impossible to mount the compass in the correct direction or to fine-tune the heading with a reference compass.

```
$IIELP,CAL,ECS,ALIG,X.X*CC<13><10 // Align value command  
X.X = Align in degrees, -99.0 up to 99.0, CC is the checksum (see 4.3).
```

3.5 Software version command

To find out which firmware version is installed use the following command:

```
$IIELP,CAL,ECS,SFWR*CC<13><10>
```

The reply will be:

```
$IIELP,CAL,ECS,SFWR,X.X,Y,Z*CC<13><10> //
```

X.X: Software version.

Y: 1=ECS1 or
2=ECS2 or
3=ECS3 or
4=LCS

Z: 1=NMEA0183 or
2=NMEA2000 or
3=Bluetooth

4 LCS Specifications

4.1 Hardware

| | |
|----------------------------|--------------------------|
| Resolution | : 0.1° |
| Repeatability | : 1° |
| Tilt compensated | : up to 35° |
| Output error | : 3° max. |
| Output change with tilt | : 3° max. |
| Interface | : NMEA 0183 |
| Baudrate | : 4800 |
| Parity | : N |
| Stopbits | : 1 |
| Power supply | : 50mA @ 12V, 30mA @ 24V |
| Operating temp. Range | : -10 to +55 °C |
| Dimensions | : 33 X 17 X 89/110mm |
| Cable length | : 10m |
| Reverse battery protection | |

4.2 Certifications

| | |
|--|---------------------------|
| Maritime Navigational and Radiocommunication Equipment & Systems : | according to IEC 60945 |
| EMC : Conducted/Radiated Emmission : | according to IEC 60945-9 |
| Conducted/Radiated Immunity : | according to IEC 60945-10 |
| Safety : Dangerous voltage, etc. : | according to IEC 60945-12 |

4.3 NMEA0183 messages

The LCS uses standard NMEA0183 messages but also some special calibration commands and messages. The messages are updated two times per second. The used serial interface is 4800 baud, no parity, 1 stopbit.

Receive standard message:

\$HCHDG,X.X,Y.Y,v,Z.Z,Q*CC<13><10>

X.X = compass heading.
Y.Y,v = not used
Z.Z = variation
Q = variation "E"ast or "W"est
CC = Checksum field
<13> = carriage return
<10> = line feed

Checksum = The checksum is the last field in a message and follows the checksum delimiter character "*". The checksum is the 8-bit exclusive OR (no start or stop bits) of all characters in the message, including ",", delimiters, between but not including the "\$" and the "*" delimiters.

The hexadecimal value of the most significant an least significant 4 bits of the result are converted to two ASCII characters (0-9 A-F) for transmission. The most significant character is transmitted first.

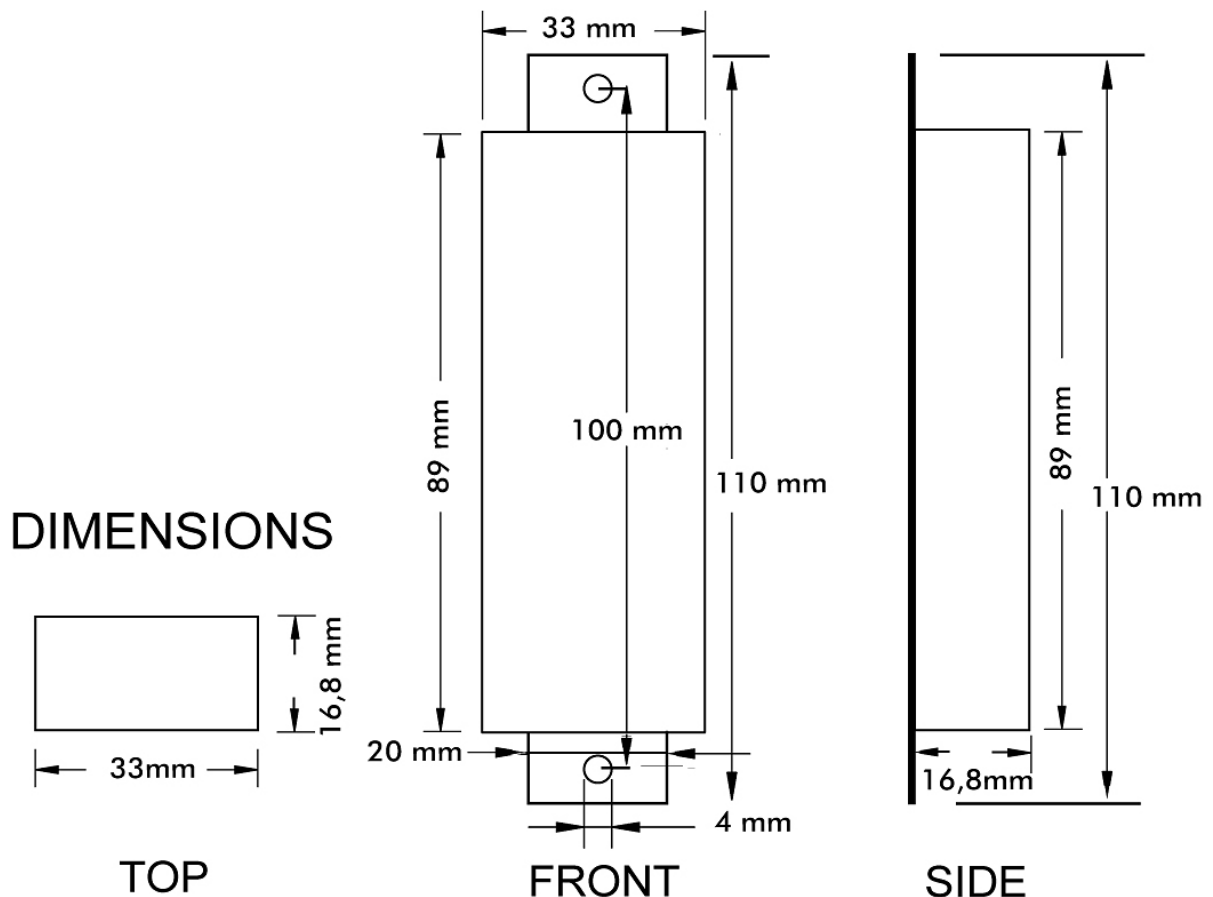
Special calibration commands:

| | |
|-------------------------------------|-------------------------------------|
| \$IIELP,CAL,ECS,STRT*CC<13><10> | // Start calibration command |
| \$IIELP,CAL,ECS,STOP*CC<13><10> | // Stop calibration command |
| \$IIELP,CAL,ECS,AUTO*CC<13><10> | // Auto calibration command |
| \$IIELP,CAL,ECS,MANU*CC<13><10> | // Disable auto calibration command |
| \$IIELP,CAL,ECS,VARI,X.X*CC<13><10> | // Variation value command |
| \$IIELP,CAL,ECS,ALIG,X.X*CC<13><10> | // Align value command |
| \$IIELP,CAL,ECS,SFWR*CC<13><10> | // Version command |

Response messages:

| | |
|---|---|
| \$IIELP,CAL,ECS,DONE*CC<13><10> | // message "Done" |
| \$IIELP,CAL,ECS,FAST*CC<13><10> | // message "Fast" |
| \$IIELP,CAL,ECS,SLOW*CC<13><10> | // message "Slow" |
| \$IIELP,CAL,ECS,BUSY*CC<13><10> | // message "Busy" |
| \$IIELP,CAL,ECS,STOP*CC<13><10> | // message "Stop" |
| \$IIELP,CAL,ECS,SFWR,X.X,Y,Z*CC<13><10> | // X.X: Software version. Y:1=ECS1; 2=ECS2; 3=ECS3; 4=LCS Z: 1=NMEA0183; 2=NMEA2000 3=Bluetooth |

5 Overall dimensions



6 Wiring diagrams

6.1 pin assignments

| Wire number | Color | description |
|-------------|--------------|--|
| 1 | Blank shield | Shield GND |
| 2 | White | Not used |
| 3 | Yellow | Not used |
| 4 | Black | GND |
| 5 | Red | +12/24V Power input |
| 6 | Brown | NMEA0183-IN- |
| 7 | Purple | NMEA0183-IN+ |
| 8 | Blue | NMEA0183-out (in combination with GND) |

6.2 Connecting the ECI1 or ECI2 display

