

*CLIPPER*  
**MARINE  
STEERING  
COMPASS**

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## **INTRODUCTION**

The Clipper Compass is supplied complete with display unit, fluxgate sensor unit, and mounting kit. It is designed to operate from the vessel's 12V battery supply.

## **PRE-TEST OF INSTRUMENT**

Before mounting the units, check that the instrument is complete and undamaged. Plug the fluxgate sensor unit into the display unit and apply 12 volts. Confirm that a reading is shown on the display.

## **INSTALLATION OF SENSOR**

The sensor measures the direction of the Earth's weak magnetic field, and **so** is sensitive to other magnetic fields which can affect the unit's accuracy. It should therefore be positioned carefully. Select a position as far as possible away from large ferrous objects such as engines, and items such as DC motors or loudspeakers which have powerful permanent magnets in them. Check also for small ferrous objects close to the mounting location such as screws, nails, hinges etc. These can become magnetised and cause errors. When a likely location has been found, a check for reasonable accuracy can be made with a hand bearing compass to confirm its suitability.

The magnetic sensor itself is fully gimballed within the housing. To accommodate the maximum pitch and roll motions, mount the sensor as near to horizontal as possible. For best performance in rough weather conditions, it **is** also advisable to mount the sensor in a position (usually amidships) that minimises lateral accelerations due to pitch and roll. Avoid mounting the sensor high above the water line because doing so also increases pitch and roll acceleration.

Before mounting the sensor, remove the gimbal locking pin from the bottom of the unit. Retain and store this pin safely as it must be replaced to protect the delicate sensor mechanism if the sensor is moved from the vessel (see **SENSOR REMOVAL** on Page 3).

The sensor is supplied with the mounting plate on the bottom of the unit for mounting onto a horizontal surface. This mounting plate can be unscrewed and fixed on top of the sensor if mounting below a horizontal surface is required. Position the sensor and using non-magnetic screws fasten through the slots in the mounting plate. The rotational position of the sensor can be chosen to allow the most convenient cable position. There is no need to allow for in-situ alignment of the sensor head, because compass alignment is done entirely electronically.

## **SENSOR REMOVAL**

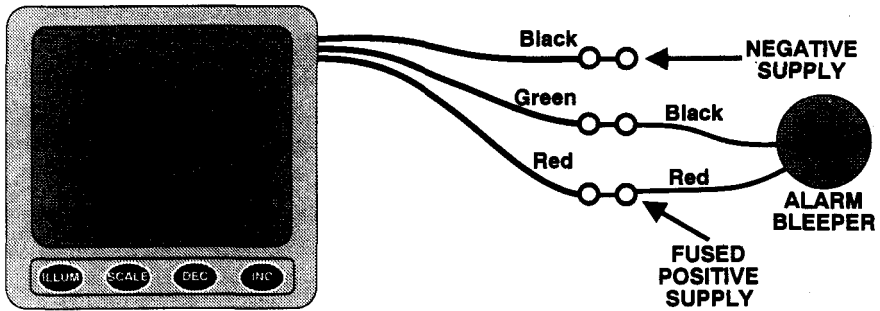
If it is necessary to remove the sensor from its normal mounting position at any time, it is important to replace the gimbal retaining pin so that the delicate internal gimbal mechanism is not accidentally damaged. If the pin is lost, and a substitute has to be used, ensure that it has a head which prevents it getting lost inside the sensor housing. The pin should have a diameter between 2mm and 3mm, and not penetrate more than 18mm ( $\frac{3}{4}$  inch) into the unit, or expensive damage may result.

To replace the pin, hold the sensor unit completely level and gently push the pin back up into its locating hole to its full depth. Tape it in place to prevent it falling out.

## **INSTALLING THE DISPLAY**

Select a convenient position for the display on a panel or bulk-head. The site must be flat and the cavity behind the panel must remain dry at all times. (The cable entry is deliberately not sealed to ensure adequate ventilation. This prevents misting of the display).

Cut a hole in the panel 67mm high and 87mm wide. Bring the wiring through the hole in the panel and connect the black wire to negative and red to positive. (See Figure 1). It is wise to use a fused supply to provide protection should a fault occur. The current consumption is very small, so any supply with a  $\frac{1}{4}$ -Amp fuse is more than adequate.



**Figure 1 - Wiring Installation**

Unscrew and remove the two wing nuts from the rear of the instrument and remove the stainless steel clamping bracket. Fit the "O" ring seal into the groove in the panel mounting face of the instrument. Ensure that it is correctly lying in its groove before fitting the instrument to the panel, which provides the watertight seal for the display,

Fit the instrument into the panel, fit the stainless clamp over the studs, fit and tighten the two wing nuts finger tight only.

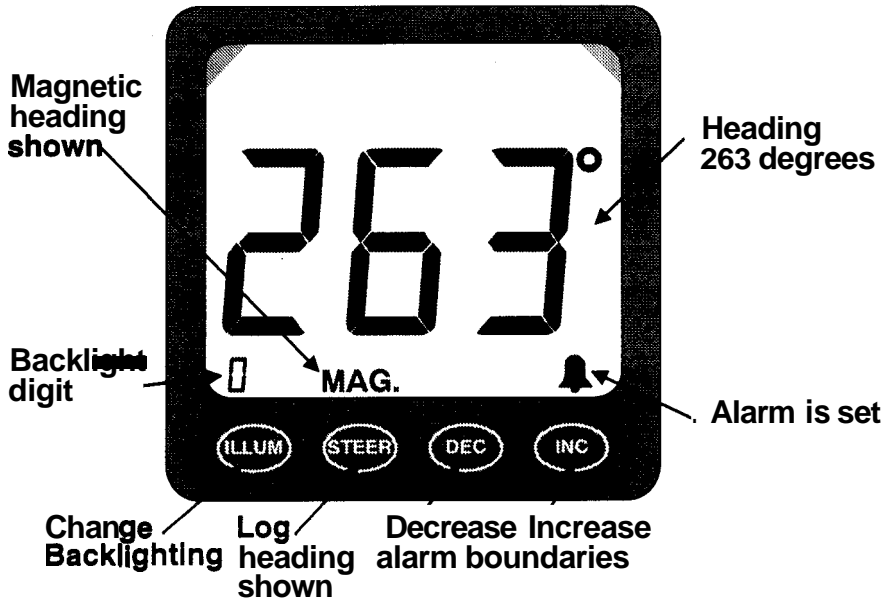
It is important that the O-ring rubber seal makes good contact with the panel to prevent water getting behind the unit and entering the cavity behind the panel.

It is good practice to run the cables vertically downwards from the unit, even if they later have to rise to connect to the vessel's supplies. Doing so prevents any water that might get onto the cables from running back along the cables and into the unit. Plug the cable from the sensor into the back of the display unit. For the marine environment it is advisable to smear a small amount of light grease (ideally a silicon grease, but a petroleum jelly such as Vaseline will do) to protect the connection.

## **NORMAL OPERATION**

When power is applied to the Clipper Compass, it executes a comprehensive internal test routine. It then displays the heading.

When first powered up, the displayed heading will not be correct until the Compass alignment is done. A typical display is shown on Figure 2.



*Figure 2 - Normal operation display.*

### **CHANGING THE BACKLIGHT SETTING**

Backlighting is provided to allow the unit to be seen at night. The backlit area is restricted in the top corners of the display to concentrate the lighting in the areas of interest (see Figure 2). The brightness of the backlighting is adjusted by pressing the ILLUM button at any time during normal operation. Each press of the button increases the brightness by one in the range 0 to 7, shown by the backlight indicator in the bottom left of the display (see Figure 2).

A setting of zero switches the backlighting off, and a setting of 7 is maximum. In common with all the other settings in the unit, the backlight setting is stored even when the unit is off, so that it returns to the chosen setting whenever the unit is powered up again.

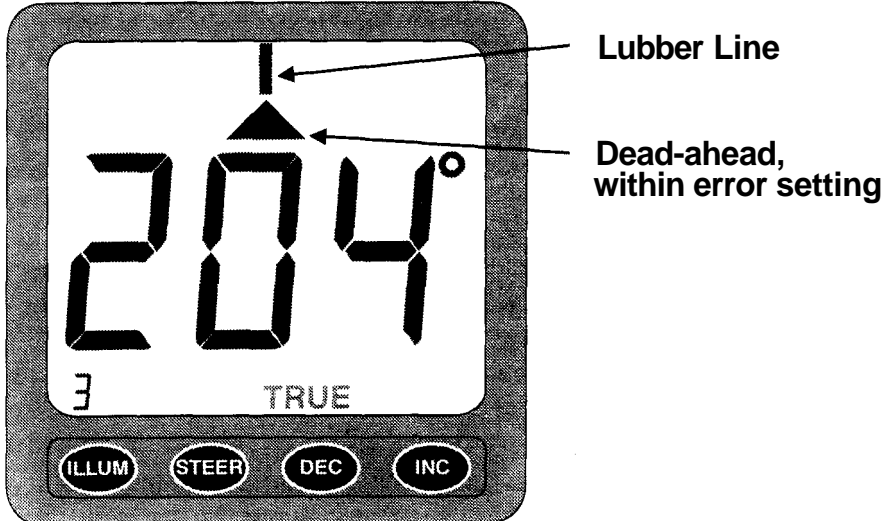
## CHANGING THE DAMPING

When the vessel is affected by rapid variations of heading in rough seas, a more heavily damped display can be selected instead of the normal lightly damped display. Press STEER and DEC together to switch between heavily and lightly damped modes. The backlight digit shows "L" (for Light damping) or "H" (for Heavy damping) for two seconds after the keys are released to indicate which mode has been selected. Successive presses of the two keys switches between the two damping settings.

## ASSISTED STEERING

Assisted steering means using the Clipper Compass to show errors from a chosen heading, and the direction to steer to bring the vessel back to the chosen heading, which is marked by the lubber line at all times.

When the vessel's heading is within the pre-set error limits, the dead-ahead indicator is lit to show that all is well (see Figure 3), and no steering adjustment is required.

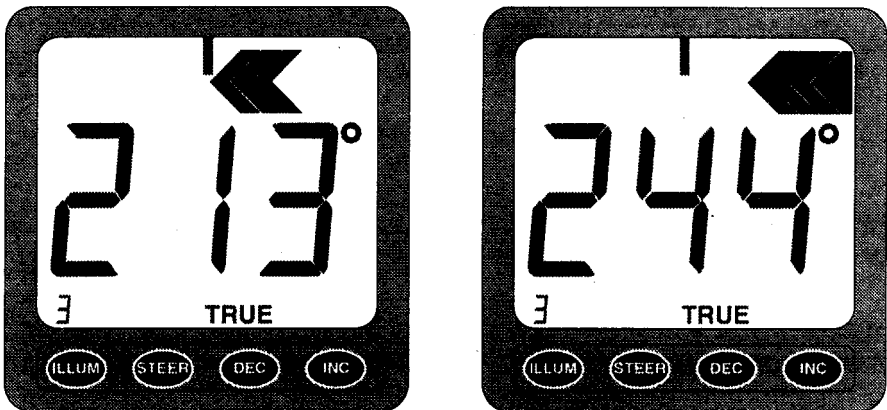


**Figure 3 - Dead-ahead indication.**

Steering chevrons light whenever the heading error is greater than a pre-set value (see Figures 4a and 4b). The factory default setting for the error value is 3° per chevron, but the setting can be adjusted when in Engineering mode (see page 10).

As the error builds up, more steering chevrons are lit to indicate the increasing strength of steering needed to correct the heading error. Three are shown on Figure 4a. If the error exceeds seven chevrons-worth, the central chevrons clear in sequence to indicate how far “Off the Scale” the steering correction is needed. Ten error chevrons-worth are shown on Figure 4b.

If the error increases beyond 180°, the error display reverses to show that the shortest route back to the desired heading is now using the opposite tiller.

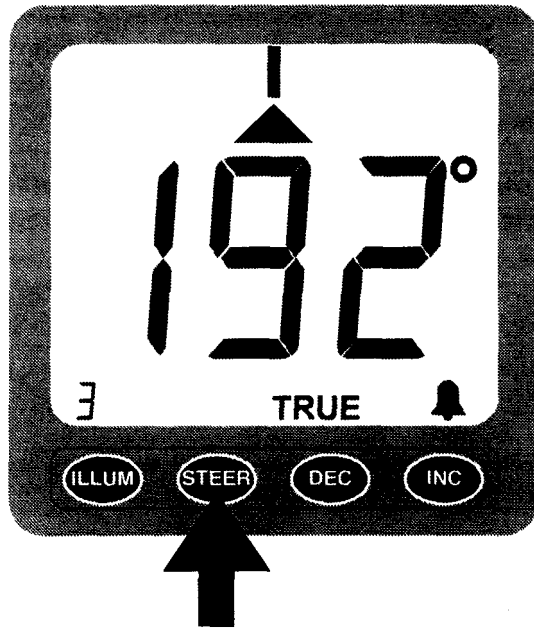


**Figure 4a & b - Three and ten-chevron Steering indications**

### **SETTING THE DESIRED HEADING**

Bring the Vessel to the desired heading, and press STEER to log that heading. The display changes as shown on Figure 5. The logged heading is the heading shown when the STEER button is FIRST pressed.

The dead-ahead symbol indicates that the vessel's heading is within the error setting. The size of the error setting can be changed only in Engineering (see page 10).



**FIGURE 5\*** *Vessel heading aligned with setting*

### **SWITCHING ASSISTED STEERING ON AND OFF**

At any time while Assisted Steering is operating, pressing STEER switches it off. Pressing STEER again switches it back on again, but with the reference heading updated to the heading which is displayed when STEER is pressed. This facility is useful for resetting the desired heading when sailing on different legs of a route.

### **HEADING ALARM**

When Assisted Steering is in operation, an alarm can be set to sound whenever the heading exceeds a pre-set amount from a chosen heading. The chosen heading is the heading logged when assisted steering was selected by pressing STEER. Alarm operation is inhibited when Assisted Steering is off. The alarm, when set, sounds whenever the heading is at or outside the alarm setting to port or starboard.

The alarm setting is altered at any time. during Assisted Steering operation by pressing INC to increase its value, or DEC to decrease it. The step size for the alarm setting is the same as the steering error chevron sensitivity. So, for example, if the default sensitivity of 3" is in place, the alarm settings will change from 3" to 6°, to 9°, etc., for each press of the INC key. It is not necessary to wait for the normal display to return before pressing a key again. The alarm boundaries are shown by the steering chevrons, as shown on Figure 6, for two seconds when the key is released, whereupon the display returns to the normal steering display.



**FIGURE 6 - Alarm Boundaries set at +/- 9°**

The minimum alarm setting is 1 chevron at whatever steering sensitivity is set, and the maximum is 120° whatever the sensitivity setting. If the alarm setting is increased beyond seven chevrons, they change in the same way as the assisted steering indication up to a maximum of thirteen chevrons-worth.

### **SETTING OR STOPPING THE ALARM**

Press INC and DEC together to switch the alarm on or off. When the alarm is on, the bell symbol shows, as shown on Figure 5. The alarm is *off* when the bell symbol is off.

Whenever the alarm is on, and the heading is outside the boundaries set at the desired heading, the alarm sounds, and the bell symbol flashes. It can be stopped only by correcting the heading error, or by pressing INC and DEC together (to switch it off), or by disengaging Assisted Steering by pressing STEER.

## **ENGINEERING MODE**

Engineering settings means those adjustments which seldom need changing, but which affect how the unit operates. The settings (as are all those which can be selected in normal operation too) are stored even when the power is disconnected. There are four operating characteristics which can be set in Engineering: Magnetic or True heading display; Magnetic Deviation; steering error chevron sensitivity; and Compass settings.

Engineering mode is entered by holding down the ILLUM button while turning on the power. The Engineering mode displays “En” (for Engineering) for two seconds when the button is released. When the two seconds is up, the Magnetic deviation is shown in degrees. The present set-up is shown as “MAG.” (for magnetic readings) or “TRUE” (for true readings). Note that the magnetic deviation affects only true readings, and need not be corrected as described below if magnetic bearing readings are required.

Magnetic Deviation can be adjusted immediately when the “En” display clears, as described below.

Any of the following settings can be done when in Engineering. If more than one different setting is to be done, it is necessary only to return via the “En” display between different adjustments or settings, as described below.

## **ADJUSTING MAGNETIC DEVIATION**

The Earth’s magnetic deviation varies from year to year, and from place to place. The appropriate deviation value can be found by reference to Almanacs, maps, or charts. The deviation is quoted as the deviation from true North. If Grid North of map or chart to be used is not correctly aligned with true North, allowance for the Grid

offset (which is usually small) can be combined with the Magnetic deviation if desired. If the Magnetic deviation is quoted as West of true North, enter the deviation as a negative number. If it is quoted as East of true North, enter a positive deviation value.

If not already in Engineering ("En" displayed), hold down the ILLUM button while turning on the power to put the unit into the Engineering mode. The display shows "En" (for Engineering) for two seconds. The display then changes as shown in Figure 7 to show the stored magnetic deviation and whether the unit is operating in Magnetic or true modes (Figure 7 shows Magnetic operation, and a Westward deviation of 6.5°)



**FIGURE 7- Magnetic Deviation Display**

Positive numbers represent Eastward deviations, and negative numbers (as shown on Figure 7) represent Westward deviations. Each press of INC or DEC alters the stored deviation in steps of 0.5°. The half-degree value is always repeated in the backlight digit (as shown on Figure 7). If the total deviation is greater than  $\pm 9.5^\circ$ , the half degree increments are shown only in the backlight digit. The maximum deviation which can be set is  $\pm 64^\circ$ .

Press INC or DEC to change the stored deviation value to the correct value (found from charts, etc.) for the vessel's location and year of use. Note that changing the magnetic deviation has no effect on the accuracy of the compass's compensation (see page 14). If it is desired to end Engineering adjustments, press ILLUM to return to normal heading indication, using the revised magnetic deviation value.

## **MAGNETIC OR TRUE READOUT**

If not already in Engineering ("En" displayed), hold down the ILLUM button while turning on the power to put the unit into the Engineering mode.

Press STEER and INC together to switch between Magnetic and True display of the compass readings. When True is selected "TRUE" is displayed, and the deviation shown is used to correct the readings made by the fluxgate sensor. When Magnetic is selected, "MAG." is displayed as shown on Figure 7. In Magnetic indication mode, the fluxgate sensor readings are used as they are, and the deviation value is ignored.

If it is desired to end Engineering adjustments, press ILLUM to return to normal heading indication.

## **SETTING THE STEERING SENSITIVITY**

During assisted steering in normal operation, the steering chevrons show the size of the heading error, and the direction to steer to remove the heading error. The sensitivity, which is the size of the steps between each chevron, is set in Engineering. The sensitivity step size represents the error required to light each successive chevron during assisted steering. The higher the sensitivity step size, the larger the error required to light all the chevrons, which fill up as the error increases.

If not already in Engineering ("En" displayed), hold down the ILLUM button while turning on the power to put the unit into the Engineering mode. The display shows "En" (for Engineering) when in Engineering mode.

To set the sensitivity, press STEER and DEC together. "MAG." and "TRUE" both disappear, and the first port and starboard error chevrons light to show that sensitivity is being set (see Figure 8).



**FIGURE 8 - Sensitivity Setting Display**

The step size is shown in degrees. The factory default is 3°. Press INC to increase the setting in 1° steps, and DEC to decrease the setting in 1° steps. The minimum setting is 1°, and the maximum is 10°. If 1° is set, the maximum indication of heading error which can be displayed is when 13° (and beyond) is reached to Port or Starboard. Likewise, when 10° is chosen, the maximum indication of heading error which can be displayed is when 130° (and beyond) is reached to Port or Starboard. The maximum displayable error is always 13 times the step size shown.

Press STEER to return to Engineering ("En" displayed for two seconds) again. If it is desired to end Engineering adjustments, press ILLUM to return to normal heading indication.

## **COMPASS ERROR CORRECTIONS**

In common with all magnetic compasses, the presence of magnetic objects in the vessel distorts the earth's magnetic field nearby, and can affect the accuracy of the detection of magnetic North, and the accuracy of readings at other points of the compass.

These errors can be compensated automatically in the Clipper compass if the vessel can be pointed accurately in particular directions by reference to known geographical features.

The first requirement is to align the North setting of the whole compass to North, known as setting the Compass ring. It **MUST** always be done on first installation to ensure that North is correctly shown. If the compass is then found to measure all points of the compass with sufficient accuracy, the sources of external magnetic field distortion are at an acceptably low level, and no further adjustments will be required.

If, after setting North on the compass ring correctly, it is found that there are significant errors at other points of the compass, these errors can be compensated. This compensation is done by logging the actual readings when the vessel is correctly aligned at the principal directions 45° (North-East), 90° (East), 135° (South-East), and so on. The logging is done automatically, with the compensations calculated and stored in the unit's memory. Corrections at intermediate angles in normal operation of the compass are in proportion to the compensation values logged at the seven principal directions. All settings are stored even when the unit is switched off. However, compensation at these other points of the compass is seldom necessary if a good position for the sensor head has been chosen which has no field distortion by magnetic objects.

## **SETTING THE COMPASS RING**

It is important to decide before setting the compass ring how the alignment of the vessel is to be achieved. If a hand bearing reference compass is to be used, set the unit to display Magnetic. If maps or chart references are to be used, set the unit to display True, and ensure that the magnetic deviation is correctly set (see page 10).

It is important that the correct magnetic deviation is set before doing the compass setting, because the magnetic deviation is always allowed for before the true heading is displayed.

Note that it is not necessary to reset the compass ring if the magnetic deviation is changed during a voyage or from year to year - the original setting of the Compass ring remains correct.

Accurately point the vessel to True (or Magnetic) North. Either MAG. or TRUE is displayed to remind the user which physical alignment of the vessel is to be used.

Put the unit into Engineering mode, and then press the three keys STEER, INC and DEC together. It is not important to release them at exactly the same moment, but all must have been pressed at the same time to calibrate the compass ring. This three-key requirement is to ensure that the compass ring cannot easily be recalibrated by accident, because all the other compensation settings are also cleared when North is set. The word "clr" is displayed for two seconds, showing that the indication accords with the vessel's North heading, and to show that all the compass error compensation settings have been cleared.

## **SETTING THE COMPASS COMPENSATION VALUES**

North alignment as described above must be done before compensating for errors at other points of the compass. If the compass errors after setting the compass ring's North alignment are found to be significant, the errors can be compensated as follows:

- 1 Put the unit into Engineering mode by pressing ILLUM when the unit is switched on.
- 2 Press INC and DEC together to get into compass compensation mode. The first display is 45°, representing North-East.
- 3 Bring the vessel to the displayed heading using a reference compass or charts.

- 4 Allow at least ten seconds to pass after aligning the vessel to allow the damping to settle at the correct value, and then press STEER to log the compass error automatically. The display shows "At" for two seconds to acknowledge the key press, and to show that the error at that bearing has been logged and permanently stored.
- 5 Press INC to advance the display by 45°, and then continue the sequence at instruction 3 until 315° has been logged.
- 6 When all the errors have been logged, Press INC and DEC together to return to Engineering.
- 7 Press ILLUM to return the unit to normal operation.
- 8 As a final test, the vessel can be swung to confirm that the compass is operating satisfactorily with all errors correctly compensated.

Note that it is not necessary to do all the settings as described above at the same session, and the fixed headings (45°, 90°, 135°, etc.) can, if desired, be checked at different times to improve the compass's accuracy. Likewise, if the error at a particular angle is known to be negligible, there is no need to align the vessel and log the compensation at that position.

### **REMOTE REPEATER FACILITY**

An intelligent repeating display unit is available for use with the Clipper Compass, offering most of the main unit's facilities with independent controls. The repeater cable is plugged into the rear of the master instrument. The repeater socket is exposed by pulling off the round cover on the rear of the instrument. If no repeater is to be connected, leave the cover in place.