2.2 Key Features

The LaserAce® 300 incorporates the following features:

- Eye safe semiconductor 'pulse' laser.
- Polycarbonate construction (600g)
- Range up to 300m reflectorless, up to 5,000m with retroreflectors.
- Accuracy 10cm, resolution 1cm.
- Simple red-dot aiming sight.
- Built-in inclinometer for height measurement of objects and for horizontal path length calculation.
- Optional 'plug in' digital fluxgate compass or horizontal angle encoder.
- Display of the measured data on the backlit LCD panel.
- Built-in buzzer.
- Long operation time from built-in standard "AA" size batteries.
- RS232 data interface.

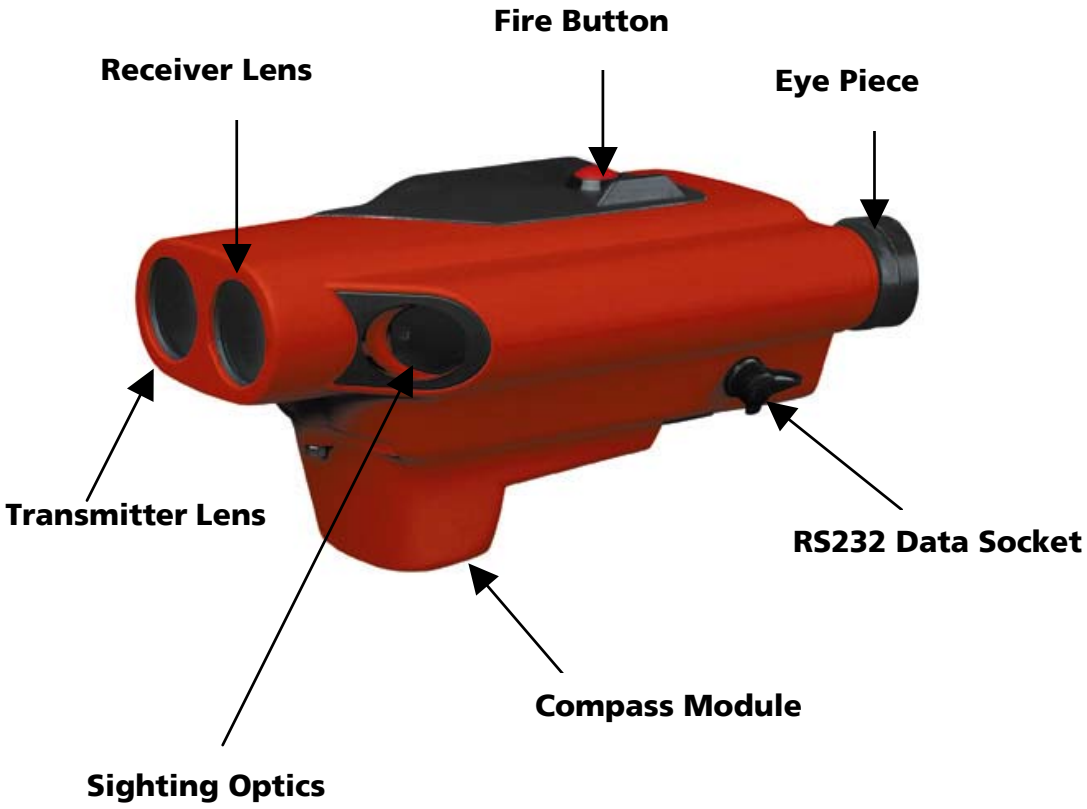


Figure 1 – LaserAce® 300 Features with optional Compass

4 Handling and Storage

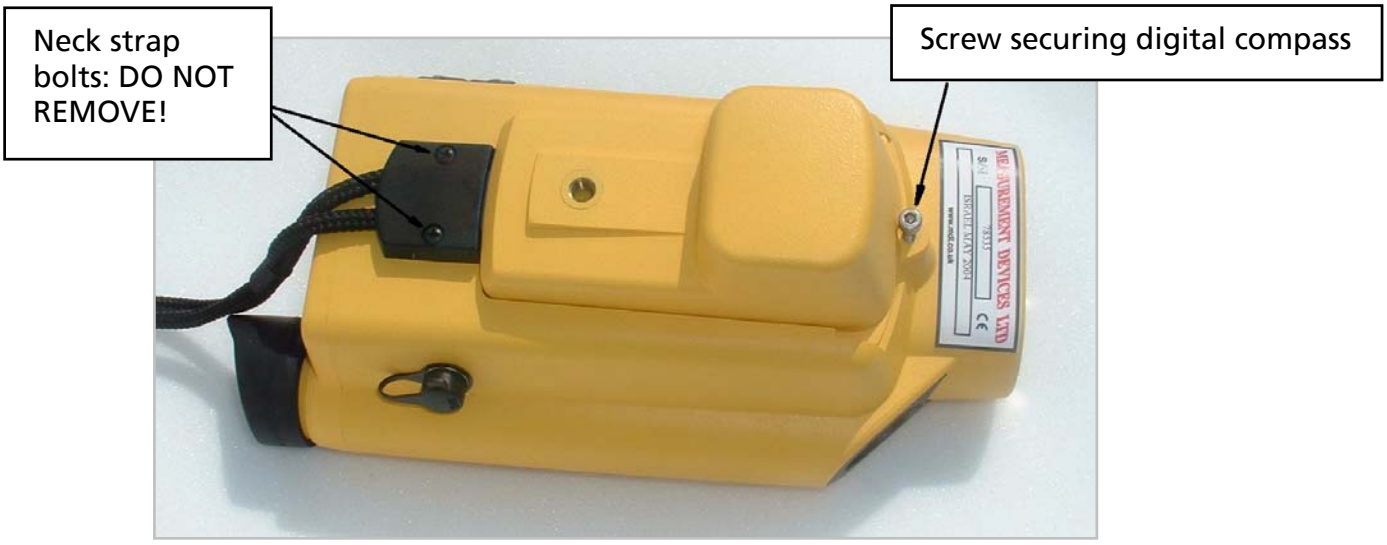
4.1 Handling

Avoid mechanical shock. Operate within the environmental temperature limits of –10°C to 45°C (storage –25°C to 70°C).

Avoid directing the LaserAce® towards the Sun or other high power, infrared light source. A reflective prism can be used to extend the range of the unit to around 5km. However, it is not recommended to use the reflector at distances of less than 50m.

Do not use paint solvents to clean the instrument. Use mild detergent applied using a cloth.

No attempt should be made by the user to tamper with or repair the LaserAce® 300. No screws on the LaserAce®, other than that securing the Digital compass / Blanking plate, should be removed or adjusted by the user. This includes the bolts either side of the neck strap. If the neck strap is not required, it should be cut off.



4.2.1 Storage

If the instrument remains unused for several weeks, at least one of the batteries should be removed.

If the instrument remains unused for an even longer period of time, it is advisable to remove both the batteries in order to prevent damage to the battery compartment, which could occur as a result of leaking batteries.

5 Preparation for use

5.1 Power Supply

The instrument can only be operated from the internal power supply. The batteries that operate the instrument are 2 x AA alkaline battery cells *(do not use cheaper zinc carbon batteries as they do not give enough amperage to fire the laser)*.

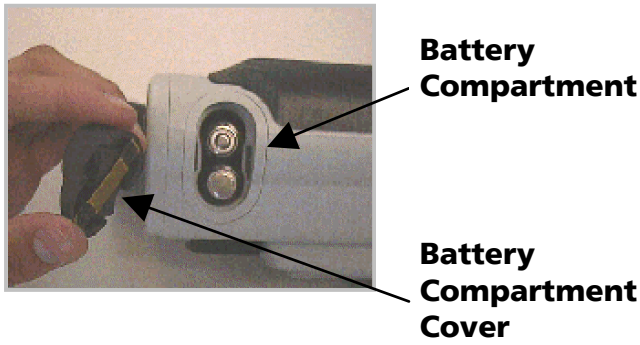


Figure 3 – The Battery Compartment

Insert the batteries as follows:

- Insert a small coin into the groove on the battery cover and give a quarter turn anti-clockwise to release the battery compartment cover. Remove the cover of the battery compartment.

- When inserting the batteries, care should be taken to ensure that the polarity of the batteries is observed. This is clearly marked on the inside of the battery compartment. The battery nearest the **TOP** of the compartment should have the positive terminal (**+**) visible and the battery nearest the **BOTTOM** of the compartment should have the negative terminal (**–**) visible.

- The battery compartment has a reverse battery protection device that means incorrect insertion of the batteries cannot result in faulty operation of/or damage to the instrument.

- Replace the battery compartment cover.

5.2 Data Cable

The LaserAce® 300 is normally supplied with 1/2m data cable. The cable pushes into the RS232 Data Socket on the LaserAce® 300 and is placed into an RS232 (serial) socket on your data logger.

6.2 Switching On/Off

To switch the instrument on, press the **FIRE** button once.

To switch the instrument off, press and hold the ● and ■ keys at the same time. The display will show **OFF** and a digit will count down from 5 to 0. If the keys are released before 0 is reached then the unit resets to mode 1.

If 'auto switch-off' activated, the instrument will switch off one minute after the last key press occurred.

6.3 Buzzer

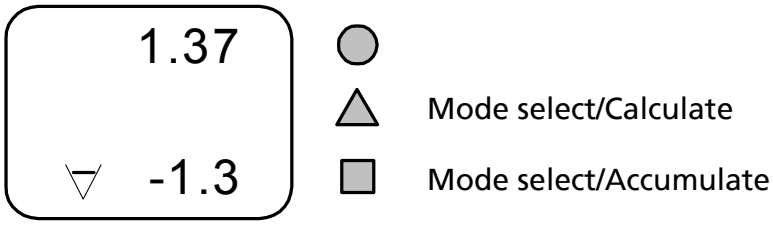
The buzzer in the instrument has been programmed to automatically sound when:

- The FIRE Button is used.
- During the compass calibration routine.
- To confirm when a range/distance has been acquired.

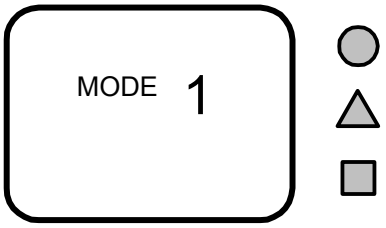
6.4 Basic Instrument Functions

To switch on the LaserAce®, firstly, press the red **FIRE** button situated on the top of the instrument. A built in **BUZZER** will sound automatically and the LCD will very briefly display an LCD check screen then:

- software version number on the top line
- if an angle encoder or compass if fitted, horizontal angular offset *(refer to section 7.2)* on the bottom line.



After approximately 5 seconds, it will then display the **mode-select** view, showing **MODE 1**, the default mode below.



The red sighting dot is also switched on at this time and is visible when you look through the sighting lens.

The three keys on the front panel are for changing modes, performing calculations from the measurements and checking the compass calibration.

6.5 Principle of Operation

When the unit is operational and the **FIRE** button is pressed, invisible pulses are sent out from the LaserAce® transmitter lens and reflected pulses from the target are received via the instrument receiver lens.

A target can be identified by aiming/aligning the red dot directly with the target. The red dot can be viewed through the instrument eyepiece.

If a valid range is observed a built in **BUZZER** will automatically sound twice (long then short) and the **LCD** panel will be updated with the range, vertical angle (and bearing if a compass or encoder module is being used).

NOTE:
Do NOT move the red dot aiming point off the target until the second BEEP is heard.

The maximum range observable varies due to:

a) Size of the target (with respect to the laser beam footprint).

b) Environmental conditions e.g. Overcast/dark - longer ranges, bright sunlight - shorter ranges.

c) Rain or snow - shorter ranges.

NOTE:
Avoid shooting targets towards the direction of the sun. Damage may occur to the receiver optics if pointed directly at the sun.

The custom designed LCD is fitted with a sensor which allows the instrument to automatically illuminate in poor lighting conditions.

A few helpful tips to enable optimum ranges to be obtained are:

- Good reflective targets include:
  Light coloured rocks, traffic signs and vehicle reflectors, reflective foils, light coloured masonry and light coloured stone.

- Try to observe targets that are in the shade or away from prevailing sunlight.

- Ideal target size is the same, or larger than, the LaserAce® beam footprint.

Distance	Diameter of the Measuring Beam (footprint)
100m	40cm
200m	80cm
300m	120cm
400m	160cm

Table 1 – Laser Footprints at Various Ranges

6.6 Hand-held Operation

The instrument should be held like a camcorder and aimed at the target. The sighting lens should preferably be looked through using the right eye and the left eye kept open to make the selection of the target easier to identify.

The three keys on the right hand side of the LCD should preferably be operated using the index finger.

6.7 Operation

6.7.1 Error Messages

The following error messages may be displayed during operation:

Error message code	Explanation
E 11	Laser not responding
E 21	Tilt sensor not responding
E 22	Temperature too high
E 23	Temperature too low
E 31	Compass not responding

6.7.2 Operating Modes

There are 6 possible operating modes. Press the ■ key to decrement through the selections and the ▲ key to increment. The display will show **MODE** and a single flashing digit.

With the display showing the chosen mode, the **FIRE** button must be pressed to select the measurement task.

To quit any task, the instrument mode is reset by pressing the ● and ■ keys together.

Key	Mode	Description
↑ ■ ▲ ↓	1	Direct Measurement
↑ ■ ▲ ↓	2	Missing Distance
↑ ■ ▲ ↓	3	Missing Height
↑ ■ ▲ ↓	4	Area Calculation
↑ ■ ▲ ↓	5	Tree Height Calculation
↑ ■ ▲ ↓	6	Tree Width Calculation

Table 2 – Operating Modes

MODE 1 is for measurement of range and inclination only and for reduction of the range to horizontal distance and height difference above or below the laser.

MODE 2 is for the calculation of missing distances.

MODE 3 is for the calculation of missing heights.

MODE 4 is for the calculation of triangular areas.

MODE 5 is for the calculation of tree height.

MODE 6 is for the calculation of tree width.

6.7.3 Accumulators

Once the unit has performed a measurement task, the effect of the ▲ key is to add the calculated results to two accumulators.

- The X accumulator holds the sum of the slope distances (or areas).
- The Z accumulator holds the sum of the horizontal distances (or areas). This feature is useful for calculating perimeters and, in the case of the area measurement function, the areas of open spaces.

6.7.4 Setup

To select set up, press the key while in mode 1. Press the **FIRE** button to enter **SETUP**. Press the **FIRE** button to move to the next step.

Step*		Display	Activity
1		Tilt	Calibrate tilt sensor in the flux-gate compass. Press the ■ key to toggle YES/NO, then press **FIRE.** **NOTE:** This calibration should be done every time the LaserAce® is switched on.
2		Cal	Calibrate flux-gate compass for magnetic correction. Press the ■ key to toggle YES/NO, then press **FIRE**
3	1	unit	Select metres or feet by pressing the ν key
4	2	Ang	Select degrees(deg) or gons(gon) by pressing the ■ key
5	3	Auto	Select Auto-power on (YES) or off(no) by pressing the ■ key
6	4	IF	Select required Interface protocol by pressing the ■ key
7	5	Baud	Select required baud rate (9600 or 4800) for connected devices by pressing the ■ key
8		dEV	Magnetic/ horizontal deviation (dEV). Enter required deviation value using the ▲ to increment and the ■ key to decrement. Press the ● key to cause increments to toggle between 0.1°/1.0° steps (slow/quick increment)
9		ACAL	Auxiliary Calibration. Press the ■ key to toggle YES/NO. If Yes follow the instructions in the next section.

Press the ● and ■ keys together to exit.
*Step number displayed depends on whether a compass or horizontal encoder is detected.

7. Press, and release, the FIRE key to take a reading at the 0° position. The bottom line of the display will show centre bars whilst the laser averages a number of readings. Do not touch the laser whilst this is in progress.
8. Once complete the laser will emit more beeps and the display will show 'Point 30'. Again, the lower display will show a live current azimuth reading.
9. Place your hand on the handle of the Calibration Aid (Fig 3.), in order to prevent the lower part from rotating, and rotate the top disk with the laser clockwise so that the 30° position is visible through the large aperture (Fig 4.). The top disk can be moved by gripping the edge of the disk as the top disk is larger than the lower part.

Fig 4.

10. Once the 30° position is aligned with the lines on the top part press and release the FIRE key.
11. As in step 7. The LaserAce® 300 will average readings from this new position and show the next point to acquire.
12. Repeat for 'Points 9 to11'. Once the laser has recorded Point 11 the process is complete and the laser will beep completion and display the message SAVE no/Yes appears.
13. Assuming no error messages have been displayed the laser and compass combination is now calibrated. Select SAVE YES by toggling the ■ key and press the FIRE button. The LaserAce® 300 is now ready for use.

6.7.6 Mode 1

When the instrument is switched on, following a few seconds of configuration it is automatically set to **MODE 1** where direct measurements are made to the target, and the height difference and horizontal distance to the target are calculated from the range and inclination values. Press the **FIRE** button to enter **MODE 1**. The display will show zero values on the display awaiting a measurement.

To take a measurement, align the red dot with the required target, press and immediately release the red **FIRE** button on the top of the instrument. The **BUZZER** will sound on pressing and releasing the **FIRE** button. Once the distance has been calculated a short **BEEP** sound is heard and the results displayed on the LCD.

NOTE:
Do NOT move the red dot aiming point off the target until the second short Beep is heard.

Figure 4 shows the sequence of key presses and displays in Mode 1.

The first press of the red **FIRE** button will display the actual distance from the laser to the target ***(Slope Distance)*** inclination ***(Vertical Angle)*** in degrees +/– from the horizontal and the horizontal angle or compass bearing if fitted.

Note:
If the horizontal angle value is not displayed then the laser is not being operated with a horizontal angle device (compass or encoder) OR **the compass/encoder does not have sufficient power to operate or is not properly connected.**

Press the ▲ button to display the vertical height difference between the laser and the target together with the horizontal distance to the target. If the horizontal distance is greater than that which can be displayed on the lower line of the display it will be displayed on the top line instead. Press the ▲ button again to return to the original display.

To take a new measurement, sight the target and press the **FIRE** button.

Note:
If the range display shows a flashing 9999.99**. This indicates that the LaserAce® has not been able to obtain a distance to the selected target.**

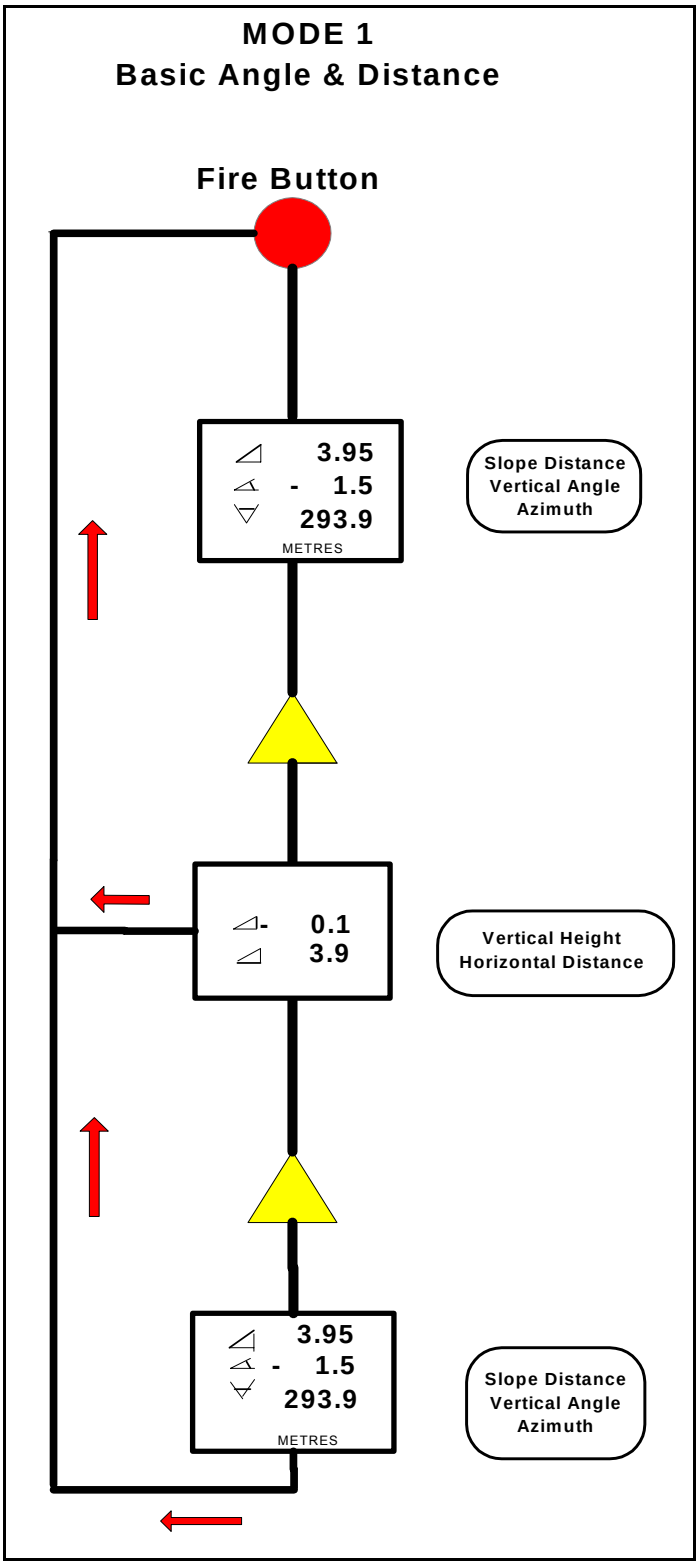


Figure 4 – Instrument Mode 1

6.7.7 Mode 2

This **MODE** is used for remote calculation of height and distances between two or more successive points. This is useful for finding the heights of trees and buildings, the width of a river or distance between electricity pylons. The LaserAce® will also calculate the gradient between measured points.

After selecting this mode, the LCD displays **SHOOT A.** The first measurement should be taken at this time by pressing the **FIRE** button. The display will show the range, inclination and azimuth to the first point.

The LCD will then display **SHOOT B** and the second measurement should be taken by pressing the **FIRE** button. The LCD will now display the slope distance, height difference and horizontal distance between the two points.

Press the ▲ button and the centre line of the display will change to show the gradient in % between the two points. Press the same ▲ button and the display will return to the original values.

Figure 5 shows the sequence of key presses and displays in Mode 2.

To calculate a perimeter:
Use the ■ button to add the slope and horizontal distances to the X and Z accumulators respectively.

NOTE:
It is best to measure each distance in the reverse direction as a check before adding.

If the accumulated values exceed the capability of the display then the middle line will show a percentage e.g. if the value is 1275.00 then the display will show 127.50 10%.

The display continues to show **SHOOT A.** Pressing the **FIRE** button again will repeat the **MODE 2** measurement task.

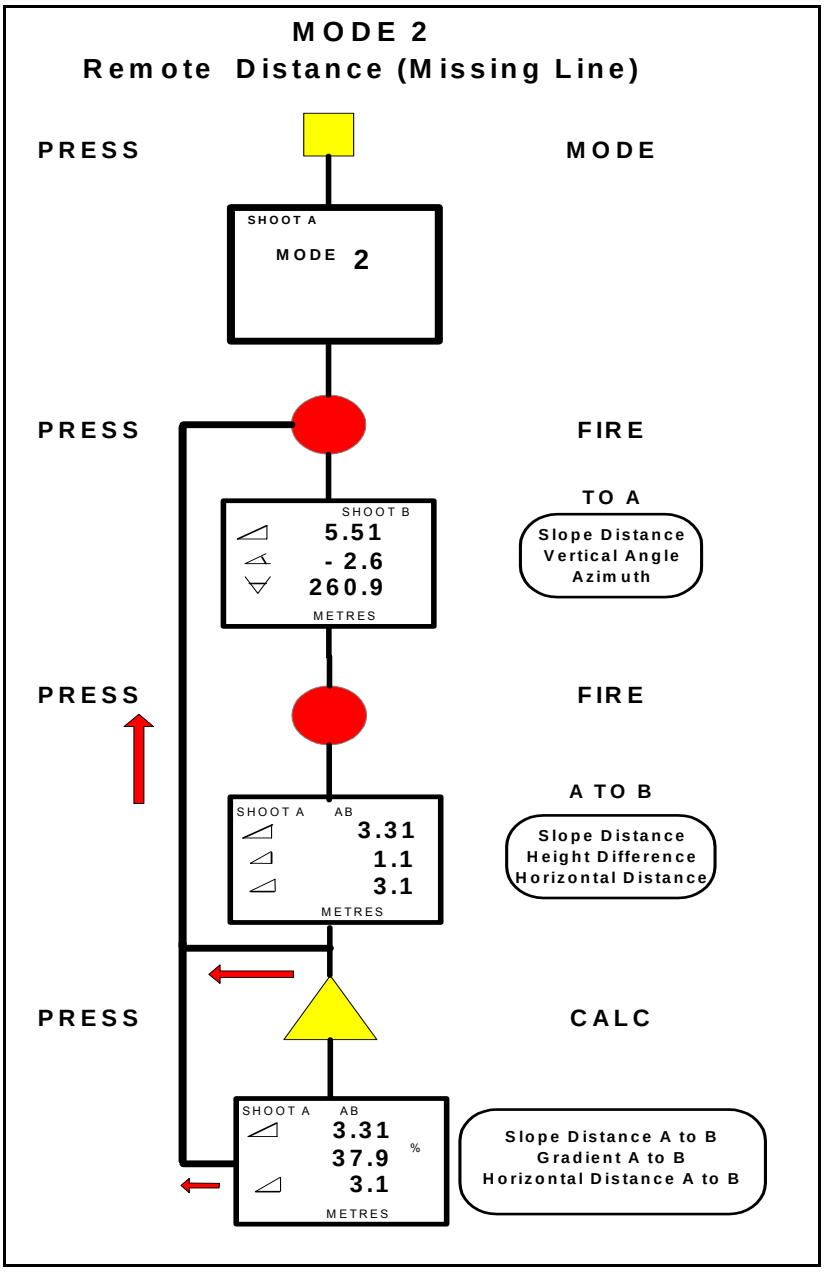


Figure 5 – Instrument Mode 2

6.7.8 Mode 3

As Mode 2 but returns 'Vertical' missing distances only.

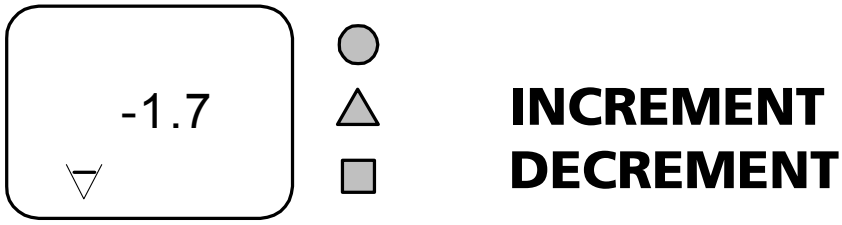
6.8 Horizontal Angle Offset

This offset is applied to horizontal angles, whether they come from a compass or a horizontal encoder.

It is an additive correction i.e. a positive value will increase the size of the raw reading. If a compass is being used then it allows the bearings to be referenced to **grid North** instead of magnetic North.

If an encoder is being used then, by using the horizontal encoder reset (refer to section 7.2), bearings can be referenced to Grid or True North using an object with a known bearing, **a Reference Object – RO**.

The offset editing task is accomplished when in **SETUP**. The middle line of the display shows the offset and the buttons perform the function shown in the diagram below.



Pressing the ● button causes the increments to toggle between 0.1°/1.0° steps (slow/quick increment).

After pressing **FIRE** you accept the value which is stored and then applied to all horizontal angle measurements. The store value is always displayed (underneath the software version) when the instrument is powered up as a check.

7 Optional Equipment

The standard unit has a built-in inclinometer to enable simple heights to be calculated and slope distances to be reduced to the horizontal. Two optional items are available which gives the instrument a 3D measurement capability.

- A **digital 3 axis fluxgate compass.**
- A **horizontal angle encoder** to enable accurate horizontal angles to be measured.

A specially designed **Monopod** which enables rapid movement between sites is also available.

7.1 Digital 3 Axis Fluxgate Compass

The compass has been specially designed to operate with the LaserAce® and draws power from the 2 AA cells fitted in the body of the laser. The compass is a digital 3 axis device and can therefore compensate for any pitch and roll of the instrument.

To fit the compass, first switch off the instrument and, if fitted, remove the blanking plate attached to the base of the LaserAce® using the allen key provided.

Slide the compass onto the laser until the connector on the compass fits into the connector on the base of the laser. This should be a tight fit and once located the compass should be secured to the laser by the screw on the base of the compass.

Power on the laser as described in section 6.2. If the angular offset does not appear on the initial screen then the compass has not been detected. Power down the laser and check that the compass is firmly inserted into the laser and also that the batteries are new. Power up the laser and, assuming the horizontal deviation is displayed, take a measurement by pressing the **FIRE** button. The bottom line of the LCD display will now display the magnetic compass bearing to the target point. If the display is flashing then this indicates that the compass needs calibrating. Refer to section 7.1.2.

If the bottom line of the LCD display is blank this indicates that there may be a fault. Switch off the laser as described in section 6.2 and check that the compass is firmly attached to the laser and switch on again.

If the unit still fails to display a horizontal angle there may not be enough power in the batteries to operate the compass. Switch off the instrument and replace the batteries, with two new AA cells as described is section 5.1.

If the instrument fails to display a bearing after switching it on again, this may indicate a fault. Repeat the above procedures and if the fault continues contact your local dealer for further advice.

7.1.1 Compass Accuracy

The resolution of the compass is **0.1 degrees** but the accuracy is **1 degree**. It is therefore advisable that caution is exercised when using the compass over long ranges for use with any co-ordinate based system.

The compass bearing is relative to the direction of magnetic North and correction is made for the local magnetic to grid North deviation values, which vary with different map projections, using the horizontal angle offset. Please refer to section 7.2.3.

The effects of deviation are also exaggerated. Therefore, the higher the latitude at which the instrument is operated, the more caution should be exercised.

The table below shows the distance subtended by an angle **of 1 degree** at various ranges.

Range	Distance subtended by 1 degree
50 metres	0.87 metres
100 metres	1.74 metres
200 metres	3.49 metres
300 metres	5.23 metres

Table 3 – Distances Subtended by 1 Degree

7.1.2 Compass Calibration

This procedure enables calculation of the errors induced in the compass due to local magnetic anomalies e.g. the batteries in the case.

The procedure only compensates for anomalies due to elements that move with the compass unit i.e. are mounted on the same platform. It cannot compensate for influences from items that are stationary e.g. nearby metal objects or cars.

To use within a car it is necessary to mount an already calibrated compass and use a bearing digitiser for the angular offsets of the LaserAce® from the car.

To improve the accuracy of the laser the unit also allows the tilt-sensing element, contained with in it, to be re-calibrated by the user. For correct and accurate operation of the unit this should be done prior to calibrating the unit for angular or near magnetic effects.

To begin the calibration, move to a position remote from any magnetic influence i.e. away from any iron structures or transformers.

N.B.
At any stage during the calibration the procedure can be aborted by pressing the FIRE button.

To begin the calibration routine:

- Press the **FIRE** button to switch the unit on.

- Press the ■ button. **SETUP** should be displayed then press the **FIRE** button. The first option under **SETUP** (assuming a compass has been detected by the Laser ACE300) is 'TILT'. This allows the 'tilt calibration' of the compass to be carried out. It is recommended that this function is executed at switch on and prior to magnetic compensation. Press the ■ key to toggle YES/NO, select YES then press **FIRE**.

- The display now changes to a guidance frame. In the case of 'tilt calibration' this merely instructs the user to hold the laser (with compass) level. It is made easier by resting the laser level on a surface. After a short period the unit should return to the **SETUP** menu. **NOTE:** This calibration should be done every time the LaserAce® is switched on.

- On exit from 'tilt calibration', or stepping through the **SETUP** menu, 'CAL' will be displayed. This is where the magnetic corrections are compensated for. Press the ■ key to toggle YES/NO, select YES then press **FIRE**.

- The display now changes to a guidance frame that will guide the user through the sequence of positions at which measurements will be taken.

- When the compass is ready for calibration, the first sequence number **(00)** will appear at the top left of the display and the guidance frame will bring the unit to a North facing horizontal position.

- The sequence has 12 positions that guide the operator in a clockwise direction. The routine below will end by the operator facing West.

Note:

At each of the points of the compass calibration routine in the above table, the unit will guide the operator to maintain azimuth alignment within a 15 degree corridor. If during tilt or roll guidance the unit goes out of this corridor, it will issue pan left or right instructions until again within the corridor.

The table below describes this sequence of positions:

Sequence	Azimuth	Vertical Angle (degrees)	Roll (degrees)	LaserAce® 300 Responses
00	North	0	0	Beeps and flashes lower bar
01	North	-80	0	Beeps and flashes upper bar
02	North	30	0	Beeps and flashes lower bar
03	North	0	0	Flashes right bar
04	East	0	0	Beeps and flashes roll left
05	East	0	80	Beeps and flashes roll right
06	East	0	0	Flashes right bar
07	South	0	0	Beeps and flashes upper bar
08	South	+80	0	Beeps and flashes lower bar
09	South	0	0	Flashes right bar
10	West	0	0	Beeps and flashes roll right

11	West	0	80	Beeps and LCD displays continuous heading

Table 4 – Compass Calibration

Move the instrument slowly and steadily throughout the entire calibration routine. The whole routine should only take a few minutes. The above procedure may seem cumbersome at first but with some practice the routine becomes very simple and easy to carry out.

It is recommended that both calibration routines be carried out at regular intervals to ensure maximum accuracy from the compass.

A continuous display of the compass bearing or horizontal angle follows the calibration. This is useful to obtain the local magnetic deviation by observing the compass bearing along a line of known grid azimuth and a note made of the difference.

To quit the continuous heading display that follows the calibration routine, press any key for a period. The unit then returns to the setup menu.