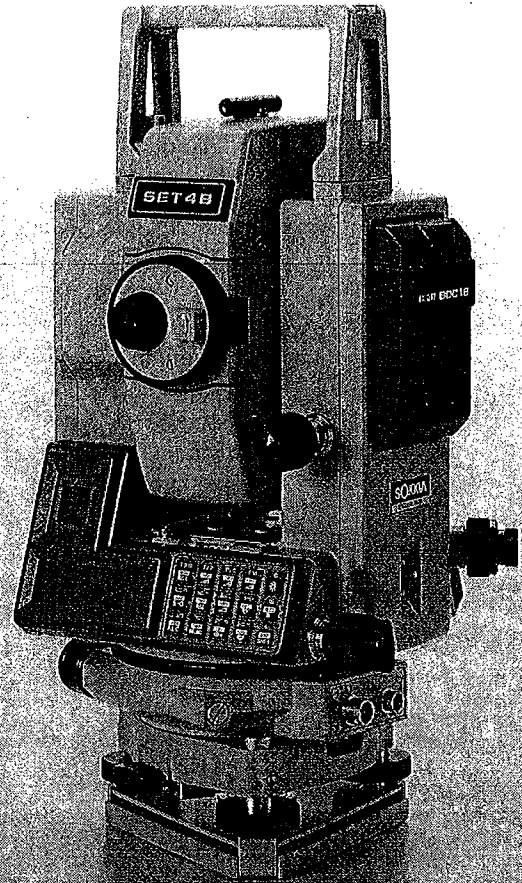


SURVEYING INSTRUMENTS

SOKKIA

SET4B

Electronic Total Station



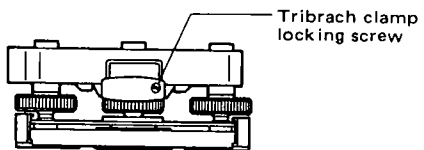
OPERATOR'S MANUAL

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Tribrach clamp
locking screw

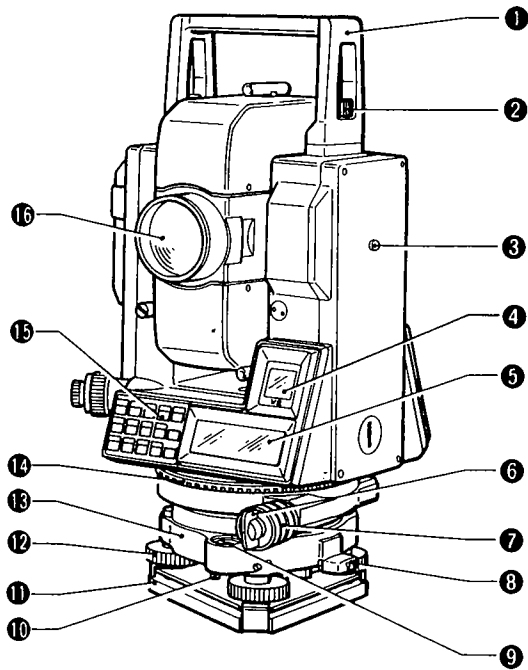
IMPORTANT

When the new SET4B is shipped, the tribrach clamp is fixed with a screw. Loosen it and leave it loose.

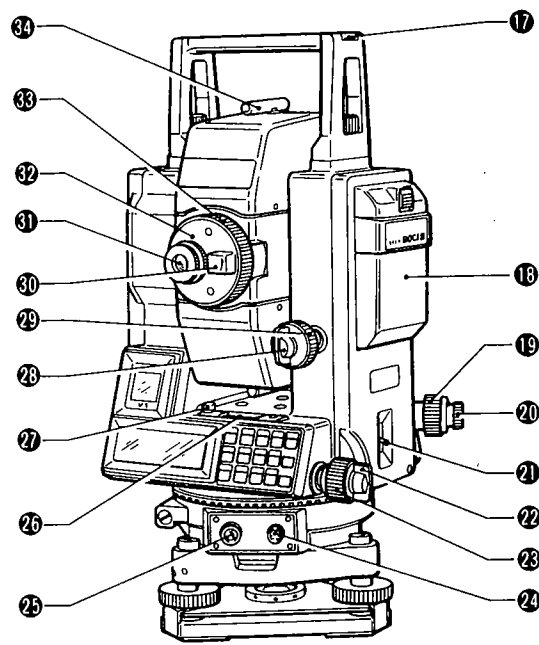
1. PRECAUTIONS

- 1) When the SET4B is not used for a long time, check it at least once every three months.
- 2) Handle the SET4B with care. Avoid heavy shocks or vibration.
- 3) If any trouble is found on the rotatable portion, screws or optical parts (e.g. lens), contact our agent.
- 4) When removing the SET4B from the carrying case, never pull it out by force. The empty carrying case should then be closed to exclude dust.
- 5) Never place the SET4B directly on the ground.
- 6) Never carry the SET4B on the tripod to another site.
- 7) Protect the SET4B with an umbrella against direct sunlight, rain and humidity.
- 8) When the operator leaves the SET4B, the vinyl cover should be placed on the instrument.
- 9) Do not aim the telescope at the sun.
- 10) Always switch the power off before removing the internal battery.
- 11) Always remove the battery from the SET4B when returning it to the case.
- 12) Do not wipe the display **⑤**, keyboard **⑬** or the carrying case with an organic solvent.
- 13) When the SET4B is placed in the carrying case, follow the layout plan.
- 14) Make sure that the SET4B and the protective lining of the carrying case are dry before closing the case. The case is hermetically sealed and if moisture is trapped inside, damage to the instrument could occur.

2. PARTS OF THE INSTRUMENT



- | | |
|--------------------------|--------------------------------------|
| ① Handle | ⑩ Circular level adjusting screws |
| ② Handle securing screw | ⑪ Base plate |
| ③ Instrument height mark | ⑫ Levelling foot screw |
| ④ Sub-display | ⑬ Tribrach |
| ⑤ Main display | ⑭ Horizontal circle positioning ring |
| ⑥ Lower clamp | ⑮ Keyboard |
| ⑦ Lower clamp cover | ⑯ Objective lens |
| ⑧ Tribrach clamp | |
| ⑨ Circular level | |



- | | |
|------------------------------------|---------------------------------------|
| ①⑦ Tubular compass slot | ②⑤ Plate level |
| ①⑧ Battery BDC18 | ②⑦ Plate level adjusting screw |
| ①⑨ Optical plummet focussing ring | ②⑧ Vertical clamp |
| ②⑩ Optical plummet eyepiece | ②⑨ Vertical fine motion screw |
| ②① Power switch | ③⑩ Telescope transitting knob |
| ②② Horizontal clamp | ③① Telescope eyepiece |
| ②③ Horizontal fine motion screw | ③② Telescope reticle adjustment cover |
| ②④ Data output connector | ③③ Telescope focussing ring |
| ②⑤ External power source connector | ③④ Peep sight |

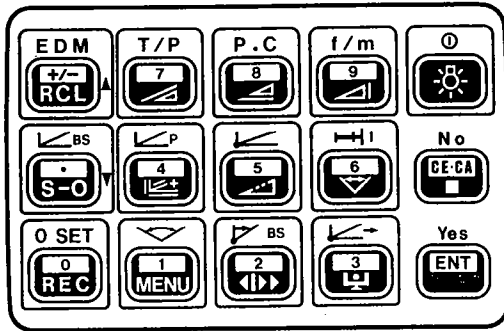
3. FEATURES







- Distance and angle measurements are electronically measured and displayed on a main display located on both faces of the instrument. These 3-line, 48-character alphanumeric dot-matrix displays can simultaneously show measured or stored angle and distance data or N- and E-coordinates and height, or display prompts and messages. The 3-line, 12-character sub-display on each face of the instrument shows the atmospheric correction, prism constant value and instrument mode.
- Advanced software functions include the calculation of 3-dimensional coordinates, automatic calculation and setting of the azimuth angle from input coordinates, traverse-style measurement, and setting out from input coordinates, in addition to the standard functions of remote elevation measurement, missing line measurement and setting out by distance and angle. The distance measurement can be set to single or repeat readings with a choice of fine, coarse or tracking-type measurement modes. The Instrument parameter settings are stored in an internal memory which can be changed by key operation, and remain stored in the memory even after power off. The atmospheric correction ppm values are calculated by the instrument after input of the temperature and pressure values. A micro-computer constantly checks the instrument operation; if an error is detected, an error message or code is displayed.
- Both the horizontal and vertical circles are provided with 0 index points. The horizontal index can be set to any direction and the value is stored in the short-term memory so that even after power is switched off (i.e. battery change), the previous index position can be recovered when the instrument is switched on and the circle is indexed again (in auto indexing mode).


























- The tilt angles of the vertical axis are measured by an internal 2-axis tilt sensor. These tilt angles can be displayed for use in accurately levelling the instrument, and can also be used to automatically compensate the vertical and horizontal angles.
- The SET4B RS-232C-compatible data output connector allows 2-way communication and output of data for recording with an external device.

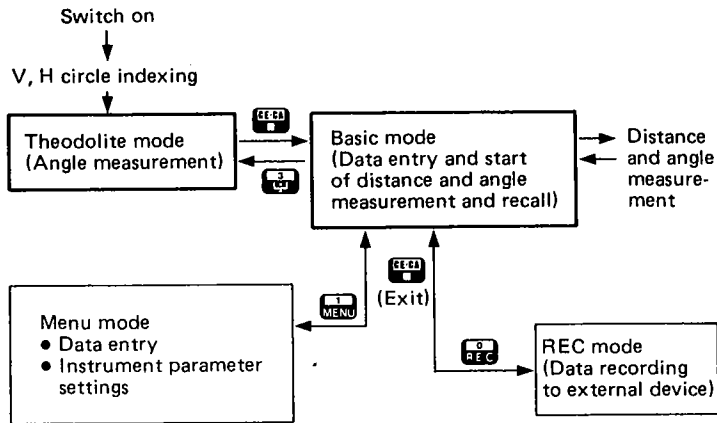
4. KEY FUNCTIONS



- 
 - Select the distance measuring mode ($\text{ENT SHFT} + \text{EDM RCL}$)
 - Change the sign of the data input value
 - Recall data from the memory
 - Move to previous option (▲)
- 
 - Enter the Atmospheric correction (Temperature/Pressure values ($\text{ENT SHFT} + \text{T/P}$)
 - Enter "7"
 - Measure slope distance
- 
 - Enter the prism constant value ($\text{ENT SHFT} + \text{P.C}$)
 - Enter "8"
 - Measure horizontal distance
- 
 - Change meters ↔ feet for 5 seconds ($\text{ENT SHFT} + \text{f/m}$)
 - Enter "9"
 - Measure height difference
- 
 - EDM power ON/OFF for locating prism ($\text{ENT SHFT} + \text{Power}$)
 - Display and reticle illumination ON
- 
 - Enter Backsight station coordinates ($\text{ENT SHFT} + \text{BS S-O}$)
 - Enter "." (Decimal point)
 - Setting out measurement (+ mode key)
 - Move to next option (▼)

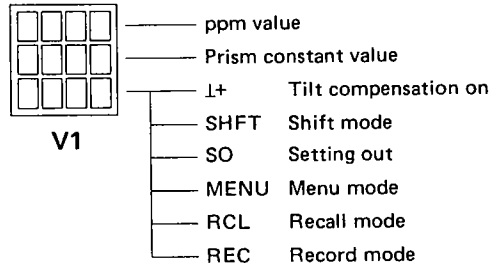
- 
 - Enter coordinates of point to be set out ( + )
 - Enter "4"
 - Measure 3-dimensional coordinates
- 
 - Enter Instrument station coordinates ( + )
 - Enter "5"
 - Measure remote elevation
- 
 - Enter distance setting out data ( + )
 - Enter "6"
 - Missing line measurement
- 
 - Clear entered data
 - Stop measurement and transfer to basic mode
 - Exit from mode
 - Enter "No"
- 
 - Set the horizontal angle to zero/In Missing line measurement, change the starting ( + ) point
 - Enter "0"
 - Output data to an external device
- 
 - Set horizontal circle to a required value ( + )
 - Enter "1"
 - Transfer to menu mode
- 
 - Set azimuth angle from Instrument and Backsight station coordinates ( + )
 - Enter "2"
 - Select horizontal angle right, left or repetition
- 
 - Set Instrument station coordinates and azimuth angle using data from previous station ( + )
 - Enter "3"
 - Transfer to theodolite mode
 - Display tilt angle (When instrument is in Theodolite mode and the "Tilt correction" parameter is ON)
- 
 - Enter data into memory
 - Select/release SHIFT mode (Upper key functions)
 - Enter "Yes"

MODE DIAGRAM



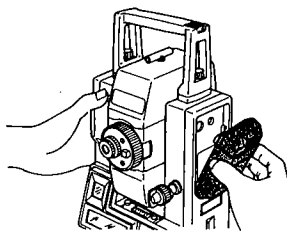
DISPLAY SYMBOLS

Upper Display:



The main lower display shows program prompts, stored, entered and measured data, and error messages.

5. BATTERY BDC18: MOUNTING AND CHECK



- 1) Ensure that the SET4B power switch ① is off.
- 2) Mount the BDC18 battery in the SET4B. Hold the left standard and push the battery until a click is heard. Confirm that the battery is securely mounted.
- 3) Level the SET4B instrument.
- 4) Instrument and battery check: Switch the SET4B power switch ① on.



- ♪ The audio tone sounds and the instrument performs self-diagnostic checks, "Self check ok" is displayed for two seconds when the instrument has successfully completed the checks.

The remaining battery power is then displayed for three seconds in the format "Battery level X" where X represents the battery level as follows:

Self check ok

Battery level 3

Code	0	less than 1 hr	
	1	less than 1.5 hrs	[Angle-only measurement at 25° C]
	2	less than 5 hrs	
	3	less than 9 hrs	

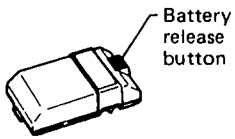
ppm
p.c
1+

V1

ZA 0 SET
HAR 0 SET

- ♪ The display of "ZA/HAR 0 SET" indicates that the instrument is ready for vertical and horizontal circle indexing. If "HAR 0°00'00" or "ZA Face 1" is displayed, the Horizontal/Vertical indexing is set to "Manual". See "Instrument parameter settings" on page 42—.

Battery is low



If "Battery is low" is displayed, the BDC18 battery should be recharged or replaced by a charged battery. To remove the battery, ensure that the SET4B power switch is off, then push down the battery release button.

Memory error

A display of "Memory error" after more than 1 week of power off means that previously-entered data such as station and backsight coordinates, instrument and target heights and setting out information has been cleared from the short term memory.

ppm
P.C
I+

V1

- When the I+ symbol is shown on the small display, the vertical and horizontal angles are automatically compensated for small tilt errors using the 2-axis tilt sensor. The tilt sensor has a range of $\pm 3'$.

Out of range

If "Out of range" is displayed, the SET4B tilt sensor is indicating that the instrument is off-level. The instrument should be re-levelled using the plate level bubble.

Instrument parameters: See page 42—.

The "Tilt correction (Dual axis)" parameter can be used to switch on (Yes) and off (No) the automatic angle compensation. For example, the compensation should be switched off if the displayed values are unsteady due to vibration or strong wind.

6. SETTING UP THE INSTRUMENT

6.1 CENTRING THE SET4B BY ADJUSTING TRIPOD LEG LENGTH

- 1) Make sure that:
 - a. The tripod head is approximately level.
 - b. The tripod shoes are firmly fixed in the ground.
- 2) Set the SET4B on the tripod head. Tighten the centring screw.
- 3) Focus on the surveying point:
 - a. Turn the optical plummet eyepiece ⑳ to focus on the reticle.
 - b. Turn the optical plummet focussing ring ⑲ to focus on the surveying point.
- 4) Turn the levelling foot screws ⑫ to centre the surveying point in the reticle.
- 5) Observe the off-centre direction of the bubble in the circular level ⑨. Shorten the leg nearest that direction, or extend the leg farthest from that direction.
Generally, two legs must be adjusted to centre the bubble.
- 6) When centring of the circular level is completed, turn the levelling screws to centre the plate level ㉔ bubble.
- 7) Look through the optical plummet again. If the surveying point is off-centre, loosen the centring screw to centre the surveying point on the reticle. Tighten the centring screw.
- 8) Repeat 6), 7) if the plate level bubble is off-centre.

6.2 FOCUSING

- 1) Looking through the telescope, turn the eyepiece fully clockwise, then anticlockwise until just before the reticle image becomes blurred. In this way, frequent refocussing can be dispensed with, since your eye is focussed at infinity.
- 2) Loosen the vertical ㉓ and horizontal clamp ㉒. Bring the target into the field of view with the peep sight ㉑. Tighten both clamps.
- 3) Turn the focussing ring ㉖ and focus on the target. Sight the target centre using the vertical ㉑ and horizontal fine motion screws ㉗. Focus on the target until there is no parallax between the target and the reticle.

Parallax:

Relative displacement of target image in respect to the reticle when observer's head is moved slightly before the eyepiece.

If sighting is carried out before parallax is eliminated, this will introduce errors in reading and will impair your observations.

7. INDEXING THE VERTICAL AND HORIZONTAL CIRCLES

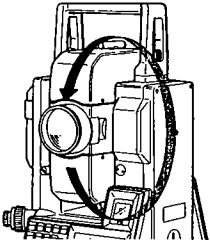
Switch the SET4B on, and ensure that the display shows the "ZA/HAR 0 SET" prompt.

(If H and/or V circle indexing parameters are "Manual", this procedure is different.)

ZA	0 SET
HAR	0 SET

---- Waiting for vertical circle indexing

---- Waiting for horizontal circle indexing

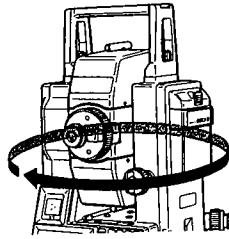



1) Vertical circle indexing:

Loosen the vertical clamp **28** and transit the telescope completely. (Indexing occurs when the objective lens crosses the horizontal plane in face left.)

ZA	81°38'45"
HAR	0 SET

♪ The audio tone sounds and the vertical angle (ZA) is displayed.



- 2) Horizontal circle indexing:
Loosen the horizontal clamp  and rotate the upper part of the instrument through 360°.

ZA	81°38'45"
HAR	314°50'35"

♪ The audio tone sounds and the horizontal angle right (HAR) is displayed.

Measurement can now take place

The instrument is now in Theodolite (Angle measurement) mode.

Note: Each time the instrument is switched on, the vertical and horizontal indices must be re-determined. However, note that if the instrument was only switched off for a short time (less than 1 week), the previous horizontal 0° position will be recovered when the horizontal circle is indexed again.

Instrument parameters: See page 42—.

The "V indexing" parameter can be used to change the vertical circle indexing method. Options are indexing by transitting the telescope as above or indexing by face left, face right sightings. See page 68.

The "H indexing" parameter can be used to change the horizontal circle indexing method. Options are indexing by rotating the upper part as above or indexing and zero setting at power on.

8. ANGLE MEASUREMENT

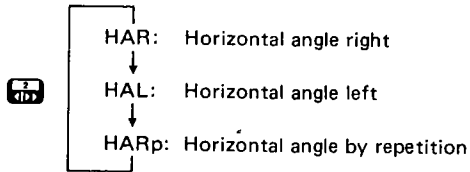
Go to distance measurement: **ENT** **0**

Return to angle measurement: **ENT** **3**

8.1 SELECTION OF HORIZONTAL ANGLE DISPLAY

The **ENT** **2** key can be used to select the required horizontal angle display.

The options are:



8.2 SETTING THE HORIZONTAL ANGLE TO ZERO

ENT **SHFT** + **0** **SET** **REC**

Press **ENT** **SHFT** + **0** **SET** **REC** to set the horizontal angle value to zero.

ZA	81°38'45"
HAR	0°00'00"

This zero position is memorized for up to a week after power off.

8.3 SET THE HORIZONTAL ANGLE TO A REQUIRED VALUE

e.g. Set 90°30'20" to reference target R.

ENT **SHFT** + **1** **MENU**

H angle
HAR

1) Press **ENT** **SHFT** + **1** **MENU**. The display prompts for the input of the horizontal angle value.

< Input value >

H angle	
HAR	90.3020

2) Input the value as 90.3020 and press **ENT** **SHFT** to enter the value.

The display returns to the angle measurement display and the horizontal angle is set to 90°30'20".

ENT **SHFT**

ZA	81°38'45"
HAR	90°30'20"

- The input angle value should be between 0°00'00" and 359°59'55".
- To correct a mis-entered value, press **CE/CA** to clear the wrong value then input the correct value.
- To exit from the angle entry function, press **CE/CA** two times.

Instrument parameters: See page 42—.

The "Vertical angle display mode" parameter can be used to change the displayed vertical angle. Options are 0° at zenith, 0° horizontal on face left, and 0° horizontal ±90°.

8.4 TILT ANGLE DISPLAY AND TILT COMPENSATION OF MEASURED ANGLES

The SET4B is provided with a 2-axis (X, Y) tilt sensor which is used to automatically correct the vertical and horizontal angles for errors due to the non-verticality of the vertical axis. The tilt angle X and Y values can be displayed.

Note that the "Tilt correction (Dual axis)" parameter must be set to ON (⊥ symbol shown in small display) to obtain tilt-corrected angles and the tilt angle display. See page 42—.

ZA	81°38'45"
HAR	314°50'35"

- 1) In the angle measurement mode, press **3 CLR**.

The X and Y tilt angles are displayed.

3 CLR

Tilt angle	
X	0°01'25"
Y	-0°00'45"

- X: Tilt angle in sighting axis direction.
 ----- Y: Tilt angle in horizontal axis direction.

To exit from the tilt angle display, press **3 CLR** again to return to theodolite mode, or press **CE/CA** to go to Basic mode.

- The range of the tilt sensor is ±3'. If the tilt angle is greater than this, "Out of range" is displayed.

Notes for horizontal angle tilt compensation


- The formula used for calculation of the compensation value applied to the horizontal angle uses the tilt and vertical angles as shown below:

$$\text{Compensated horizontal angle} = \text{Measured horizontal angle} + \frac{\text{Tilt angle } Y}{\tan(\text{Vertical angle})}$$


Therefore, when the SET4B is not perfectly levelled, changing the vertical angle by rotating the telescope will cause the displayed (compensated) horizontal angle value to change. (The displayed horizontal angle value will not change during telescope rotation when the instrument is correctly levelled.)

- When the measured vertical angles are within $\pm 1^\circ$ of the zenith or nadir, tilt compensation is not applied to the horizontal angle. In this situation, the displayed horizontal angle value flashes to show that the tilt compensation is not being applied.

8.5 DISPLAY AND RETICLE ILLUMINATION

For work in low-light conditions, the  key can be used to switch on the display and reticle illumination.

Instrument parameters: See page 42—.

The “Reticle illumination” and “Backlight control” parameters can be used to change the illumination function. “Reticle illumination” has the option of bright or dim illumination, and “Backlight control” allows the user to select a 30-second automatic cut-off function or to switch on/off by pressing .

9. PREPARATION FOR DISTANCE MEASUREMENT

9.1 ENTRY OF PRISM CONSTANT VALUE

The prism constant value can be entered for correction of the measured distances.

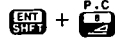
The stored prism constant value is shown in the small upper display of the SET4B and is stored in the permanent memory.



Press function keys
to select operation

- 1) Press **CEC1** to enter the Basic mode from the Angle measurement mode.

"Press function keys . . ." is displayed.



Prism constant
P.C. -40mm

- 2) Press **ENT SHFT** + **P-C** to enter the prism constant setting display.

----- The previous stored prism constant value is displayed.

- 3) To change the prism constant, input the required value (taking care with the sign) and press **ENT SHFT** to enter the value in the memory. The instrument returns to the "Press function keys . . ." display.

e.g. To input a prism constant correction value of -30 mm, enter:

Prism constant
P.C. -30mm



- The prism constant value can be input as a value from -99mm to +99mm in 1 mm steps.

- To correct a mis-entered value, press **CEC1** to clear the wrong value, then enter the correct value.

- To exit from the prism constant setting mode to the Basic mode, press **CEC1** two times.

6
-30 P.C value

V1

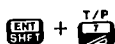
Press function keys
to select operation

9.2 ATMOSPHERIC CORRECTION

In the SET4B it is possible either to set 0ppm, or to input the temperature and pressure from which the ppm correction will be automatically calculated and applied.

The stored ppm value is displayed on the small upper SET4B display and is stored in the temporary memory for about 1 week after power off.

Press function keys
to select operation



- 1) From the SET4B Basic mode ("Press function keys...") displayed), press to enter the Atmospheric correction setting display.

Select

1. Set 0 ppm
2. Set value

----- Atmospheric correction not applied
(ppm value = 0).

----- Enter temperature and pressure values for
automatic ppm calculation and correction.



0ppm

- 2) Either:
Press to set 0ppm (no atmospheric correction). The SET4B returns to the basic mode after setting 0ppm.



- 3) Or:
a) Press to input the temperature and pressure values. The display prompts for the input of the Temperature (T) value. Use the keyboard to input the value and press to enter it. The display prompts for the input of the Pressure (P).

15 °C
P. 1013 mbar

< Input temp >

T. 15 °C
 P. 1013 mbar


< Input press >

- b) Input the pressure value and press to enter it. The ppm value is calculated and displayed on the SET4B small upper display and this value is applied to all measured distance values. The instrument returns to the Basic mode.

6 ppm
-30 P.C

V1

Press function keys
to select operation

- The entered values should be between -30°C and +60°C (-22°F and 140°F) for temperature, and between 500mb and 1400mb (375mmHg and 1050 mmHg) for pressure.
- To correct a mis-entered value, press  to clear the wrong value then input the correct value. The ppm value is memorized for about a week after power off.
- When temperature is known in °C and pressure is in mb, the following formula is used:

$$\text{ppm} = 278.96 - \frac{0.2904 \times P \text{ (mb)}}{1 + 0.003661 \times T \text{ (°C)}}$$

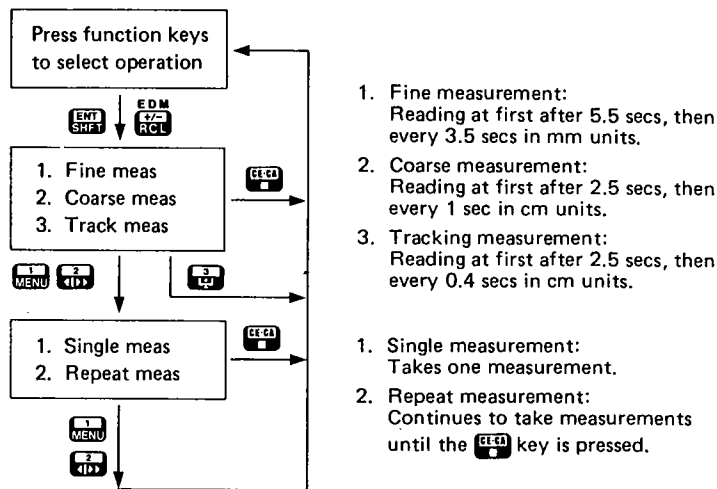
Instrument parameters: See page 42—.

The "Temp & Press units" parameter can be used to change the units for temperature and pressure entry. Options are °C, °F, mb, mmHg, inchHg.

9.3 SELECTION OF THE MEASUREMENT MODE

The distance measurement mode can be set to fine or coarse, single or repeat measurements or tracking measurements using the

ENT **SHFT** + **EDM** **RCL** keys.



1. Fine measurement:
Reading at first after 5.5 secs, then every 3.5 secs in mm units.
 2. Coarse measurement:
Reading at first after 2.5 secs, then every 1 sec in cm units.
 3. Tracking measurement:
Reading at first after 2.5 secs, then every 0.4 secs in cm units.
-
1. Single measurement:
Takes one measurement.
 2. Repeat measurement:
Continues to take measurements until the **CE/CA** key is pressed.

- 1) From Basic mode ("Press function keys . . ." displayed), press **ENT** **SHFT** + **EDM** **RCL** to enter the measurement mode setting menu. The cursor flashes at the currently-selected option.
- 2) Press **1 MENU**, **2 MENU** or **3 MENU** to select the Fine, Coarse or Tracking modes. If Tracking mode is selected, the mode is set and the instrument returns to the "Press function keys . . ." display.
- 3) For Fine or Coarse measurements, the display prompts for the selection of 1) Single or 2) Repeat measurements. Input **1 MENU** or **2 MENU**, then the instrument returns to the Basic mode.
 - To exit from the measurement mode setting displays, press **CE/CA**. The previously-stored values are retained in the instrument memory.
 - When tilt compensation is not being applied, all the above measurement times are 0.2 sec less.

9.4 EARTH-CURVATURE AND REFRACTION CORRECTION

The earth-curvature and refraction correction can be selected using the "C + R correction" Internal parameter. This correction is applied in the measurement of horizontal distance and height difference and the Atmospheric refraction constant K can be chosen as either 0.142 or 0.20.

When the correction is applied, the following formulas are used:

- Horizontal distance after correction:

$$H' = S \times \sin Z - \frac{1 - \frac{K}{2}}{R} \times S^2 \times \sin Z \times \cos Z$$

- Height difference after correction:

$$V' = S \times \cos Z + \frac{1 - K}{2R} \times S^2 \times \sin^2 Z$$

When the correction is not applied, the following formulas are used:

- Horizontal distance: $H = S \times \sin Z$
- Height difference: $V = S \times \cos Z$

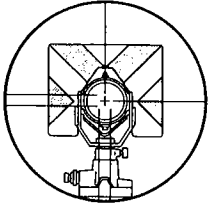
where:

- S: Slope distance value (after atmospheric correction)
- Z: Vertical angle (0° at zenith)
- K: Atmospheric refraction constant (A value of 0.142 or 0.20 can be selected using the Internal parameters. See page 42-.)
- R: Radius of the earth (6.372×10^6 m)

Instrument parameters: See page 42-.

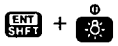
The "C + R correction" parameter can be used to switch on and off the curvature and refraction correction and to select the refraction constant value. Options are: 1. Off, 2. On: K=0.142, 3. On: K=0.20.

9.5 PRISM SIGHTING FOR ANGLE AND DISTANCE MEASUREMENT



- 1) Sight the centre of the reflecting prism with the SET4B telescope.

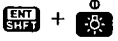
Press function keys
to select operation



Signal

- 2) To confirm the sighting, if required:
From the Basic mode ("Press function keys . . ." displayed), press + to switch the EDM power on for about 2 minutes to allow prism sighting. "Signal" is displayed.

When the SET4B is correctly sighting the prism, and the returned beam strength is adequate for measurement, a "*" symbol appears on the display and an optional audio tone is output.



Press function keys
to select operation

Signal *

- 3) Press + again to switch off the power to the EDM unit.

*Instrument parameters: See page 42—.

The "Return signal audio tone" parameter can be used to switch on and off the audio tone which is output when the EDM is correctly sighting the reflecting prism.

10. DISTANCE MEASUREMENT

Before distance measurement, ensure that:


- ① The SET4B is set up correctly over the surveying point.
- ② The remaining battery power is adequate.
- ③ The vertical and horizontal circles have been indexed.
- ④ The prism constant, curvature and refraction and atmospheric corrections have been correctly set. (See Section 9.)
- ⑤ The SET4B is correctly sighting the reflecting prism and the returned beam strength is adequate for measurement.

Press function keys to select operation




S dist

S	234.567m
ZA	81°12'35"
HAR	12°23'45"



- 1) From the Basic mode ("Press function keys..." displayed), press  to measure the slope distance.

"S dist" is displayed while the SET4B measures the distance.

After 5.5 seconds (fine measurement mode), the slope distance value and the vertical and horizontal angles are displayed.

- 2) In the repeat and tracking measurement modes, press  to stop the distance measurement. (In single measurement mode, this step is unnecessary.)

Horizontal distance and height difference:

To measure horizontal distance or height difference, follow the same procedure as described above, but in step 1), press  for horizontal distance or press  for height difference.




H dist


H	231.812m
ZA	81°12'35"
HAR	12°23'45"

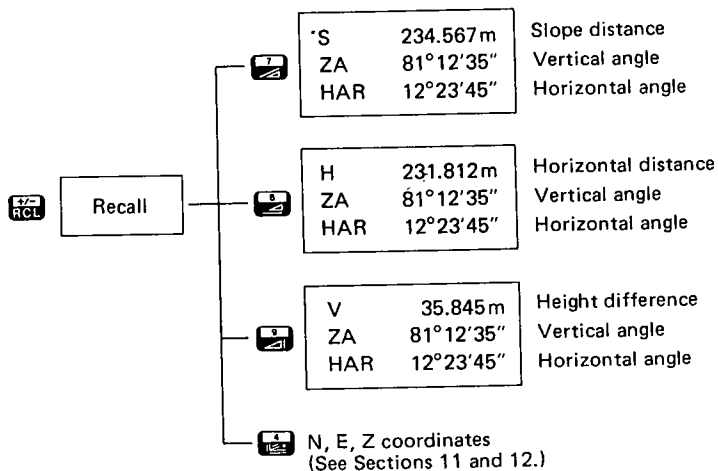


V dist


V	35.845m
ZA	81°12'35"
HAR	12°23'45"

Note: A display of "Signal off" or "Timeout" means that the returned beam strength has decreased during measurement. Ensure that the line of sight is free from obstruction, press  to clear the "Timeout" display and re-start the measurement.

3) After distance measurement has been performed and stopped, the Recall  key can be used to display the following data:



Each distance value displayed is the result calculated from the most recent measurement.

(To return to theodolite mode, press .)

11. PREPARATION FOR COORDINATE MEASUREMENT

The SET4B calculates the 3-dimensional coordinates of the prism position. To calculate the Z (Height) coordinate, first enter the instrument and target heights, then the Instrument station coordinates.

By entering the Backsight station coordinates, sighting the backsight station and pressing a key on the SET4B keyboard, the horizontal angle can be set to the azimuth value.

11.1 INPUT OF INSTRUMENT AND TARGET HEIGHTS

Press function keys to select operation



1. Set value
2. Config



1. AZ S-O ang
2. Instr Ht
3. Target Ht



Instrument
Ht 0.000m

< Input value >

1. AZ S-O ang
2. Instr Ht
3. Target Ht



1) From the SET4B Basic mode, press to enter the Menu mode. "MENU" is displayed in the small display.

2) Select the "1. Set value" option by pressing .


3) To input the Instrument height value, press to select the "2. Instr Ht" option.


4) Input the instrument height value and press to enter it in the memory. e.g. To input a height of 1.567m, input



The display returns to the Set value menu.

5) To input the Target height value, press to select the "3. Target Ht" option.

Target
 0.000m

< Input value > 

1. AZ S-O ang
 2. Instr Ht
 3. Target Ht




1. Set value
 2. Config





Press function keys
 to select operation

6) In the same way as described in part 4), input the target height value and enter it in the memory.

The display returns to the Set value menu.



7) Press  (exit) to return to the main menu display.


8) Press  again to exit from the Menu mode to the Basic mode ("Press function keys . . ." displayed).



- Entered data should be between -9999.999 and +9999.999.
- The instrument and target height values remain in the memory for about a week after the instrument power is switched off.
- During data entry, press  to clear a displayed value.


11.2 INPUT OF INSTRUMENT STATION COORDINATES


Press function keys
 to select operation



 + 

ST  0.000
 E 0.000
 Z 0.000

1) From the SET4B Basic mode, press  +  to enter the instrument station coordinate setting display. Previously-entered coordinate values are displayed, and the cursor flashes beside the N-coordinate.


< Input N-coord > 

2) Input the N-coordinate value and press  to enter this value in the memory. The cursor moves to the E-coordinate.

< Input E-coord > 
< Input Z-coord > 



Press function keys
to select operation


3) In the same way, input and enter the E and Z-coordinate values in the memory. The display returns to the Basic mode.


- The instrument station coordinates are stored in the memory for about a week after the SET4B is switched off.
- The entered data should be between -9999.999 and +9999.999.
- During data entry, press  to clear a displayed value.


11.3 INPUT OF BACKSIGHT STATION COORDINATES


Press function keys
to select operation

 + 



BS		0.000
	E	0.000
	Z	0.000


< Input N-coord > 

< Input E-coord > 


< Input Z-coord > 

Press function keys
to select operation

1) In the SET4B Basic mode, press  +  to enter the Backsight station coordinate setting display. Previously-entered backsight station coordinate values are displayed and the cursor flashes on the N-coordinate position.

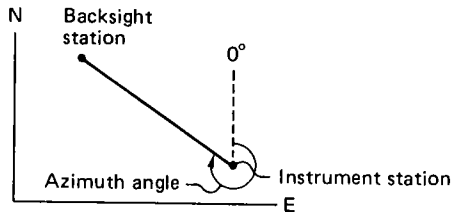
2) Input the N-coordinate value and press  to enter the value in the memory. The cursor moves to the E-coordinate position.

3) In the same way, input and enter the E- and Z-coordinate values. The display returns to the Basic mode.

- The entered values remain stored in the memory of the SET4B for about a week after the instrument is switched off.
- Entered values should be between -9999.999 and +9999.999.
- During data entry, press  to clear a displayed value.

11.4 SETTING THE AZIMUTH ANGLE FROM THE INSTRUMENT AND BACKSIGHT STATION COORDINATES

After input of the Instrument and Backsight station coordinates, the SET4B can calculate the azimuth angle and can set this value to the horizontal angle.



Press function keys to select operation

ENT + $\frac{2}{\text{HAR}}$

Calculating

ZA 81°38'45"
HAR 304°20'10"

CESET

Press function keys to select operation

1) With the SET4B set up over the Instrument station and in the Basic mode, sight the Backsight station.

2) Press $\frac{2}{\text{HAR}}$ + $\frac{2}{\text{HAR}}$ to calculate and set the azimuth angle to the horizontal angle. "Calculating" is displayed during calculation.

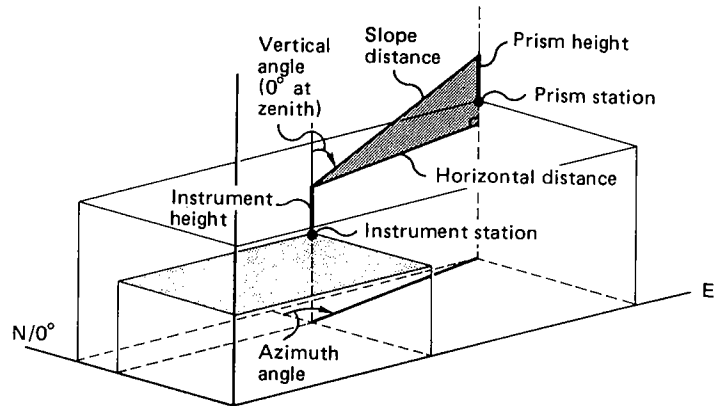
The SET4B returns to the Angle measurement mode and displays the vertical and horizontal (azimuth) angle.

3) Press $\frac{2}{\text{HAR}}$ to return to the Basic mode ("Press function keys . . ." displayed).

Note: If the azimuth angle is already known, it can be input directly using the "Set the horizontal angle to a required value" procedure described on page 14.

12. COORDINATE MEASUREMENT

12.1 3-DIMENSIONAL COORDINATE MEASUREMENT



The following formulas are used for calculation of the 3-dimensional coordinates:

$$\text{N-coordinate} = N_0 + S \times \sin \theta_Z \times \cos \theta_H$$

$$\text{E-coordinate} = E_0 + S \times \sin \theta_Z \times \sin \theta_H$$

$$\text{Z-coordinate} = Z_0 + Mh + S \times \cos \theta_Z - Ph$$

where:

N_0, E_0, Z_0 : Instrument station coordinates

S : Slope distance

θ_Z : Vertical angle (0° at zenith)

θ_H : Azimuth angle

Mh : Instrument height

Ph : Prism height

- When measuring 3-dimensional coordinates, it is first necessary to enter the Instrument and prism heights, Instrument and Backsight station coordinates and calculate or input the azimuth angle (see previous pages).

Press function keys
to select operation

1) Sight the centre of the reflecting prism.

2) From the SET4B Basic mode, press



