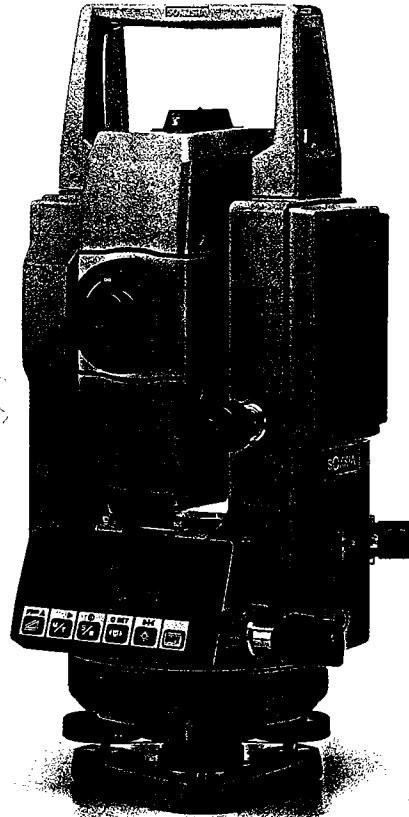


SOKKIA

SET6 SET6S

Electronic Total Station



OPERATOR'S MANUAL

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Congratulations on your purchase of the SET6!
Before using the instrument, please read this operator's manual.

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

- The specifications and general appearance of the instrument may be altered at any time and may differ from those appearing in catalogues and this operator's manual.

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QUICK GUIDE

- Ensure that the battery is charged before measurement.




1 Setting up the instrument

- Battery mounting  P. 7
- Centring/Levelling/Focussing  P. 8



2 Preparation for power on P. 12

- Prism constant correction/Distance mode/Distance units/Earth curvature and refraction/Vertical angle display/ Angle units




3 Power on/V circle indexing P. 13

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4 Angle measurement P. 19

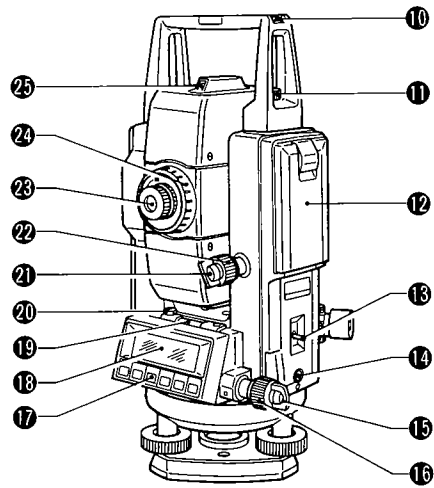
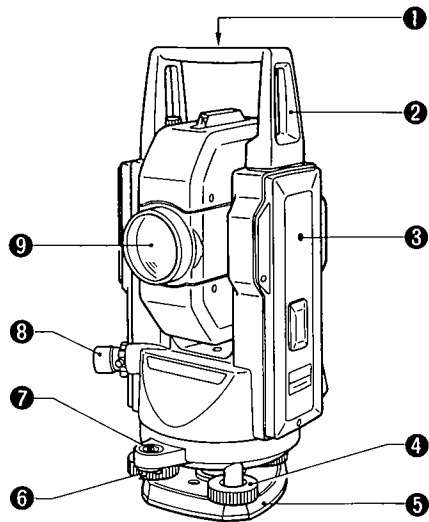
- Measure the angle between two points  P. 19
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5 Distance measurement P. 23

- Atmospheric correction  P. 23
- Return signal check  P. 25
- Distance and angle measurement  P. 27


Note: The instrument parameters are set to default settings at the factory. Before use, ensure that the parameters are set to your required options. See Section 2.

1. NAMES OF PARTS



Above figures are SET6.

1

- 
- | | |
|----------------------------------|--------------------------------|
| ① Instrument centre mark | ⑬ Power switch |
| ② Handle | ⑭ Data output connector |
| ③ Instrument height mark | ⑮ Horizontal clamp |
| ④ Levelling foot screw | ⑯ Horizontal fine motion screw |
| ⑤ Base plate | ⑰ Keyboard |
| ⑥ Circular level adjusting screw | ⑱ Display |
| ⑦ Circular level | ⑲ Plate level |
| ⑧ Optical plummet eyepiece | ⑳ Plate level adjusting screw |
| ⑨ Objective lens | ㉑ Vertical clamp |
| ⑩ Tubular compass slot | ㉒ Vertical fine motion screw |
| ⑪ Handle securing screw | ㉓ Telescope eyepiece |
| ⑫ Battery BDC25 | ㉔ Telescope focussing ring |
| | ㉕ Peep sight |

IMPORTANT:

The battery has not been charged at the factory. Please charge the battery fully before using.

FEATURES

〈Light in weight, highly accurate total station〉

- The total weight of the instrument is 4.8 kg including the handle and battery. For total station operations, all keys on the keyboard can be used for two or more functions.

〈Automatic tilt compensation of vertical angles〉

- The tilt angle of the vertical axis is measured by an internal sensor. The vertical angle value can be automatically compensated for this tilt angle and the compensated value displayed.

〈Instrument parameter settings stored in memory〉

- The SET6 has an internal memory which stores the instrument parameter settings. The parameter settings can be changed by key operation and the new settings are memorized even after power off.

〈Rechargeable battery〉

- The SET6 is powered by a rechargeable battery. For continuous angle measurement, a fully-charged battery supplies power for 17 hours, and for continuous angle and distance measurement, the battery will allow operation for 2 hours 50 minutes (at an ambient temperature of 25°C).

〈Data output function〉

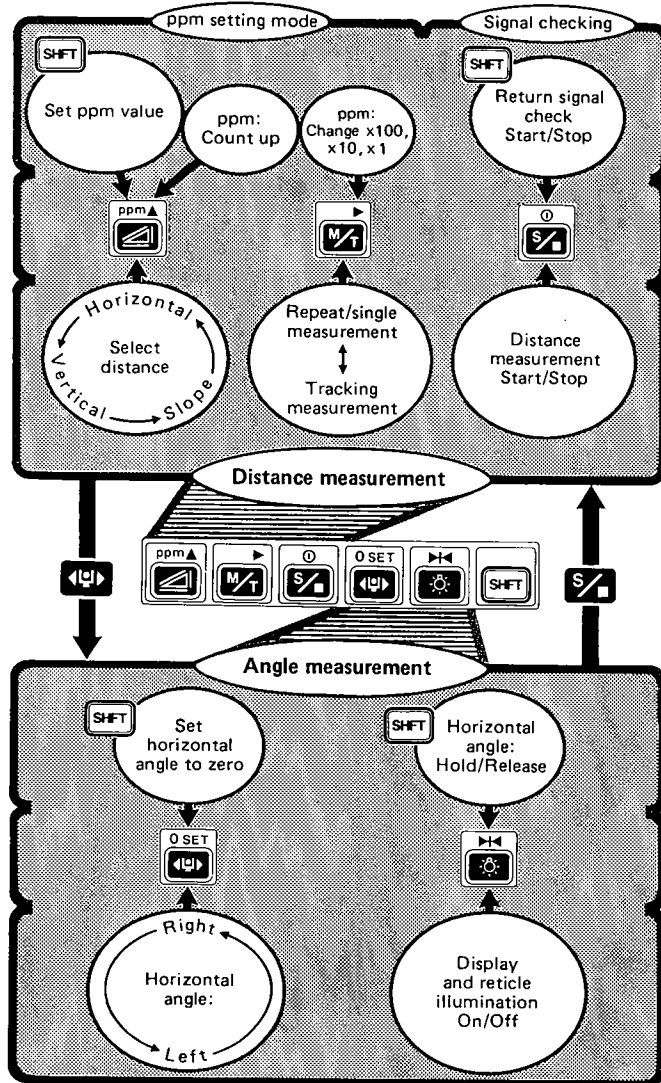
- An RS-232C data output connector is provided for use with a data collector or external computer. The SET6 can transmit slope distance and horizontal and vertical angle data to an external device.

2. PRECAUTIONS

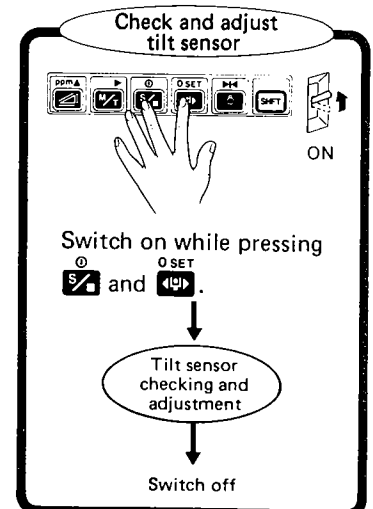
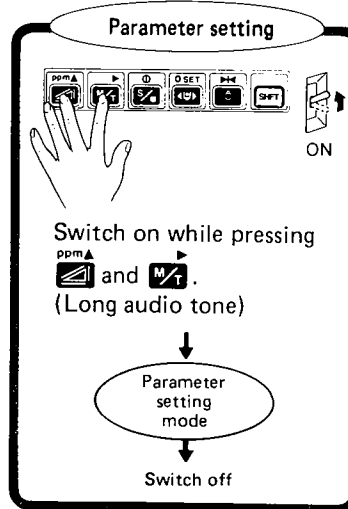
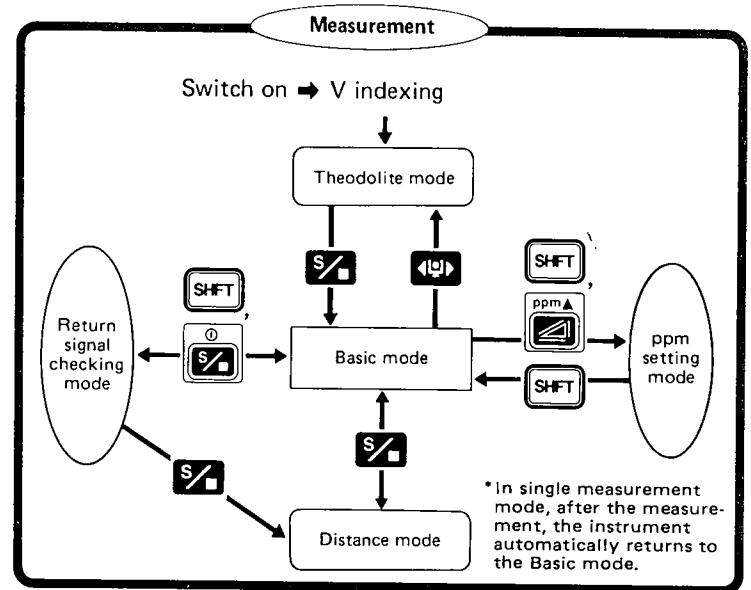
- 1) When the SET6 is not used for a long time, check it at least once every three months.
- 2) Handle the SET6 with care. Avoid heavy shocks or vibration.
- 3) When removing the SET6 from the carrying case, never pull it out by force. The empty carrying case should then be closed to exclude dust.
- 4) If any problems are found with the rotatable portion, screws or optical parts (e.g. lens), contact our agent.
- 5) Never place the SET6 directly on the ground.
- 6) Never carry SET6 on the tripod to another site.
- 7) Protect the SET6 with an umbrella against strong sunlight and rain.
- 8) When the operator leaves the SET6, the vinyl cover should be placed over the instrument.
- 9) Do not aim the telescope at the sun.
- 10) Always remove the battery from the SET6 before returning it to the case.
- 11) Always switch the power off before removing the internal battery.
- 12) Do not wipe the display ⑩, keyboard ⑪ or the carrying case with any organic solvent.
- 13) When the SET6 is placed in the case, follow the layout plan.
- 14) Make sure that the SET6 and the protective lining of the carrying case are dry before closing the case. (The case is hermetically sealed; if moisture is trapped inside, damage to the instrument could occur.)

3. KEY FUNCTIONS

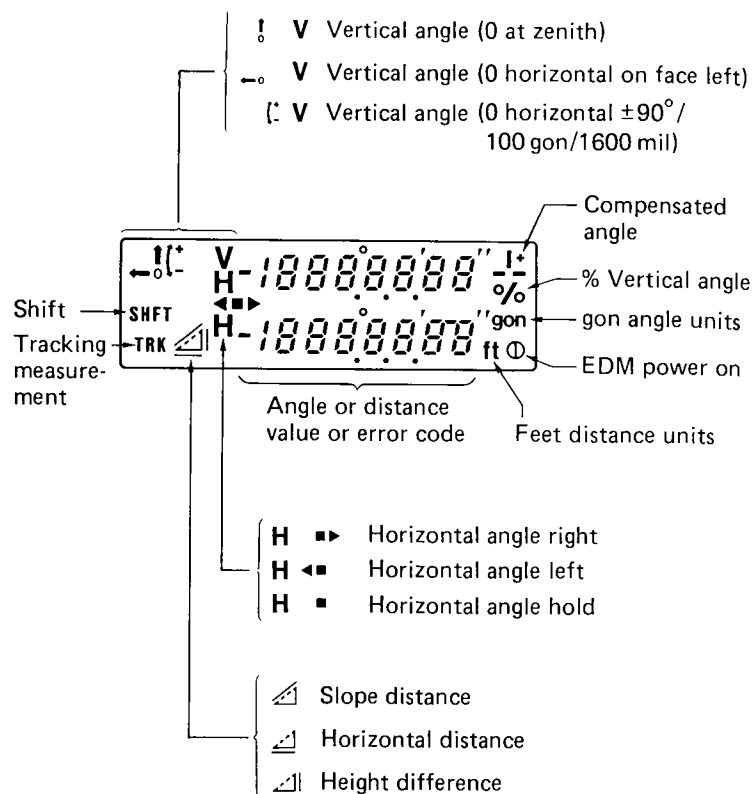
- The upper functions are accessed by pressing **SHIFT** and the required key.



4. MODE DIAGRAM



5. DISPLAY SYMBOLS



6. BATTERY BDC25: MOUNTING

- Charge the battery before measurement.

P. 48

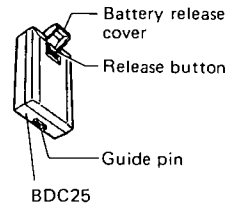
* Ensure that the power switch **18** is OFF.

〈Mounting the battery〉

1) Close the battery release button cover.

2) Match the battery guide with the hole in the instrument battery recess.

3) Press the top of the battery until a click is heard.

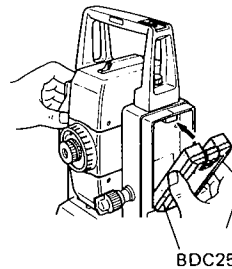


〈Removing the battery〉

1) Open the battery release cover.

2) Press the release button downward.

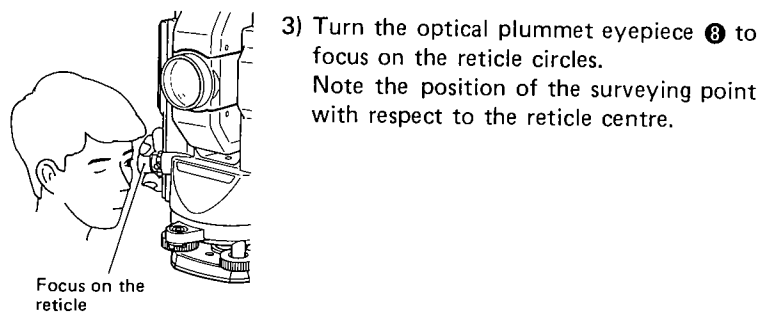
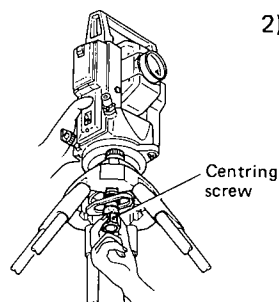
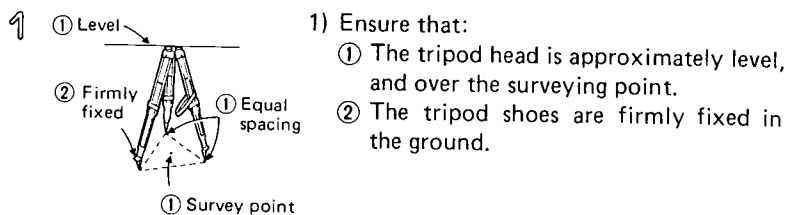
3) Remove the battery.



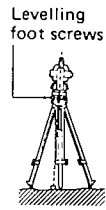
7. SETTING UP THE INSTRUMENT

- Mount the battery in the instrument before performing this operation.

7.1 Centring

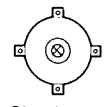


7.2 Levelling



Levelling foot screws

1) Optical plummet

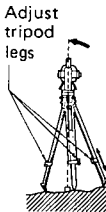


2) Circular level



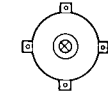
- 1) Adjust the levelling foot screws ④ to centre the surveying point in the optical plummet reticle.

- 2) Observe the off-centre direction of the circular level ⑦ bubble.

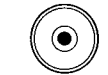


Adjust tripod legs

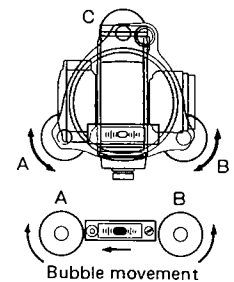
Optical plummet



Circular level



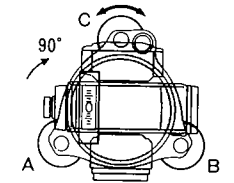
- 3) Shorten the tripod leg nearest the bubble direction or extend the leg farthest from this direction. Generally, two tripod legs must be adjusted to centre the bubble.



- 4) Using the horizontal clamp ⑮, turn the upper part of the instrument until the plate level ⑱ is parallel to a line between levelling screws A and B.

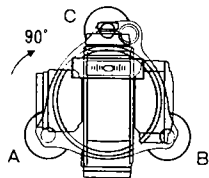
- 5) Centre the plate bubble using levelling screws A and B.

Note: The bubble moves towards a clockwise-rotated foot screw.



- 6) Turn the upper part through 90°. The plate level is now perpendicular to a line between levelling screws A and B. Centre the plate level bubble using levelling screw C.

1



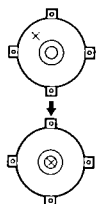
- 7) Turn the upper part a further 90° and check the bubble position.

If the bubble is off-centre, either perform the plate level adjustment described on page 31 or carefully adjust levelling screws A and B in equal and opposite directions to remove half of the bubble displacement. Again turn the upper part a further 90° and use levelling screw C to remove half of the displacement in this direction.

- The bubble should now remain in the same position for any position of the upper part. (If it does not, repeat the levelling procedure.)

The following steps are different for the SET6 and SET6S.

<SET6>



- 8) Look through the optical plummet eyepiece. Loosen the centring screw slightly, then carefully slide the instrument over the tripod head until the surveying point is exactly centred in the reticle.

Re-tighten the centring screw.

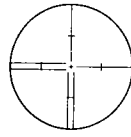
- 9) Repeat procedures 4)–8) until the instrument is correctly levelled and centred over the surveying point.

<SET6S>

- 8) Turn the tribrach shifting clamp anti-clockwise. Adjust the instrument position on the tribrach to centre the surveying point. Tighten the shifting clamp to fix the instrument in the centre position.

Note: The SET6S shifting tribrach can be adjusted up to ± 8 mm.

7.3 Focussing



- 1) Look through the telescope at a bright, featureless background.
- 2) Turn the eyepiece ⌚ clockwise, then anticlockwise until just before the reticle image goes out of focus. Using this procedure, frequent reticle re-focussing is not necessary, since **your** eye is focussed at infinity.

8. PREPARATION FOR POWER ON

The SET6 instrument parameters are set at the factory to the options tabulated below. Before using the instrument for the first time, check that these parameters are set to your required options.

- To change the parameter options, see "INSTRUMENT PARAMETERS" on page 41.

Parameter No.	Function	Options
1	Prism constant correction	<u>-30mm</u> (adjustable from 0 to -90mm in 10mm steps.)
2	Distance mode	<u>Repeat</u> /Single measurements P. 42
3	Distance units	<u>Metres</u> or feet
4	Earth curvature and refraction correction	<u>Not applied</u> or applied P. 56
6	Vertical angle	<u>Zenith 0</u> /Horizontal 0/ Horizontal $0 \pm 90^\circ$ (100 gon/1600 mil)/ % vertical angle
9	Angle resolution	<u>20"</u> (5 mgon/0.1 mil) or 10" (2 mgon/0.05 mil)
10	Angle units	<u>Degrees</u> or gon or mil

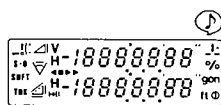
(Underlined values are the factory settings.)

- See page 41 for a complete list of the instrument parameters.

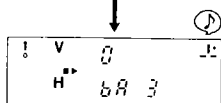
9. POWER ON AND INSTRUMENT CHECKS



- 1) Turn the SET6 power switch **ON**.
The audio tone sounds and all the display symbols are shown on the display while the instrument performs self-diagnostic checks.



- 2) On successful completion of the checks, the battery power is displayed as a numeric code for three seconds.



(Angle only)

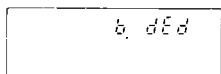
0	Less than 1 hr 20 min
1	1 hrs 20 min to 11 hrs 50 min
2	11 hrs 50 min to 20 hrs 50 min
3	20 hrs 50 min to 21 hrs 40 min

(At 25°C)

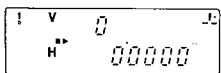
(Distance and angle)

Less than 30 min
30 min to 2 hrs 30 min
2 hrs 30 min to 2 hrs 50 min
2 hrs 50 min

or



If **b. dEd** is displayed, the battery voltage is too low for measurement. Turn the power switch off and re-charge the battery. (This display also occurs during measurement when the battery power is low.)



- 3) The "V 0" display indicates that the instrument is ready for vertical circle indexing.

E 114, **E 115**, **E 116** or **E 117** is displayed when the tilt angle exceeds 10'. Re-level the SET6 using the plate level bubble.

[Note: Power-saving cut-off]

- If the power switch is left on, the SET6 has the option to switch off automatically 30 minutes after the last key operation.

Instrument parameter No. 11 P. 41

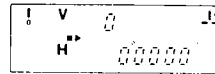
- Parameter 11 can be used to switch off and on the 30-minute power cut-off facility.

10. PREPARATION FOR MEASUREMENT

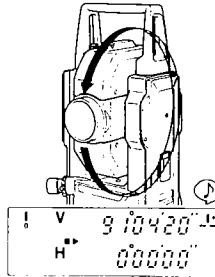
10.1 Indexing the vertical circle

(When V circle indexing parameter is set to "H".)

Turn the SET6 power switch **13** ON.



..... Waiting for vertical circle indexing



〈Vertical circle indexing〉

- 1) Loosen the vertical clamp **21**, and transit the telescope completely.
(Indexing occurs when the objective lens crosses the horizontal plane in face left.)
The audio tone sounds and the vertical angle (V) is displayed.

- Angle measurement can now begin.
(The instrument is now in the theodolite mode.)

Note: Each time the instrument is switched on, the vertical index must be re-determined.

Instrument parameter No. 7 **P. 41**


- Parameter 7 can be used to change the vertical circle indexing.
Options are indexing by transitting the telescope or indexing by face left, face right sightings. P. 54

[Note: Automatic vertical angle compensation]

Automatic vertical angle
compensation mark



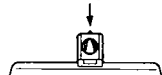
- When the compensation mark is shown on the display, the vertical angle is automatically compensated for small tilt errors.
- Read the compensated vertical angle after the displayed angle value becomes steady.

Instrument parameter No. 8  P. 41

- Parameter 8 can be used to switch off and on the automatic vertical angle compensation; for example, the automatic compensation should be switched off if the display is unsteady due to vibration or strong wind.

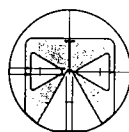
10.2 Target sighting

Line the target with the white arrow in the peep sight.

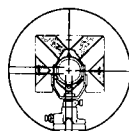


- 1) Loosen the vertical and horizontal clamps ②, ①⑤ and use the peep sight ②③ to bring the target into the field of view.
- 2) Re-tighten both clamps.
- 3) Turn the focussing ring ②④ to focus on the target.
- 4) Use the vertical and horizontal fine motion screws ②②, ①⑥ to sight the target precisely. The last adjustment of each fine motion screw should be in a clockwise direction.

Position of the target in relation to the reticle:



(Target centre)



(Prism centre)

- Angle only measurement:
Use the reflecting prism or the target.

- Distance and angle measurement:
Use the reflecting prism.

Note: Observe to the same point of the reticle when the telescope face is changed.

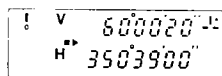
- 5) Check that there is no parallax between the target image and the reticle.



[Note: Parallax]

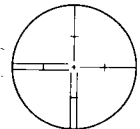
- This is the relative displacement of the target image with respect to the reticle when the observer's head is moved slightly before the eyepiece.


Parallax will introduce reading errors and must be removed before observations are taken. Parallax can be removed by re-focussing.

10.3 Display and reticle illumination




- Press  to illuminate the display and reticle of the SET6.
Press  again to switch the illumination off.



Instrument parameter No. 12  P. 41





- Parameter 12 can be used to switch on/off the 30-second illumination automatic cut-off facility.

Instrument parameter No. 13  P. 41

- Parameter 13 can be used to select the illumination brightness (2 steps).

11. ANGLE MEASUREMENT

Check! before angle measurement:

1. The SET6 is set up correctly over the surveying point.  P. 8
2. The remaining battery power is adequate.  P. 13
3. The vertical angle display mode and angle units are correct.  P. 12
4. The vertical circle has been indexed.  P. 15



11.1 Measure the horizontal angle between two points — Zero set —

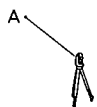
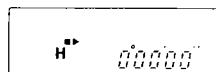


Note:

Horizontal angle 0 set





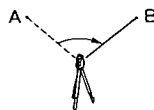
- Press ,  to set the horizontal angle to zero.





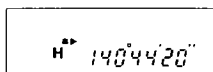
- 1) Sight the first target A.



- 2) Press ,  to set the horizontal angle display to zero.



- 3) Use the horizontal clamp  and fine motion screw  to sight target B.



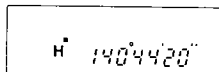
The displayed horizontal angle is the angle between points A and B.

11.2 Set the horizontal circle to a required value — Angle hold —

Notes: Horizontal angle hold



- Press **SHIFT**, to hold the displayed horizontal angle.

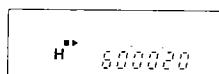


- The hold symbol is displayed.



- To release the horizontal angle hold, again press **SHIFT**, .

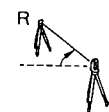
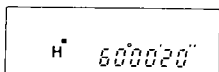
e.g. Set 60°00'20" to reference target R.



- 1) Use the horizontal clamp and fine motion screw to turn the theodolite until an angle of 60°00'20" is shown on the display.



- 2) Press **SHIFT**, to hold the horizontal display, as above.



- 3) Use the horizontal clamp and fine motion screw to turn the theodolite to sight on the reference target R.



- 4) Press **SHIFT**, to release the display hold.
Reference target R has now been set to 60°00'20".

11.3 Select the horizontal display — Angle right/left —

Notes Horizontal angle right/left

• Select the required horizontal angle display using the key.

(Display symbol : horizontal angle right)

(Display symbol : horizontal angle left)

- The horizontal left angle display selection is lost after the power is switched off.

12. DISTANCE MEASUREMENT

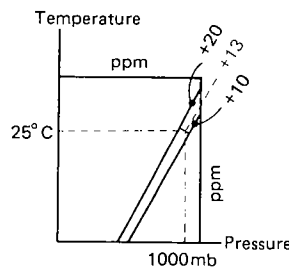
12.1 Atmospheric correction

- The atmospheric correction is necessary for accurate distance measurement, because the velocity of light in air is affected by the temperature and atmospheric pressure.

The SET6 is designed so that the correction factor is 0 for a temperature of +15°C (+59°F) and an atmospheric pressure of 1013 mb (29.9 inchHg).

Note: To obtain the average refractive index of the air throughout the measured light path, you should use the average atmospheric pressure and temperature. Take care when calculating the correction factor in mountainous terrain. P. 55

- Measure the temperature and pressure with a thermometer and a barometer and read the correction factor from the table on page 63.



e.g. Temperature: +25°C
Atmospheric pressure: 1000 mb
Read correction value from the table.
The correction value is +13 ppm.

The correction value can be calculated from:

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

where: P = Atmospheric pressure in mb
t = Temperature in Centigrade

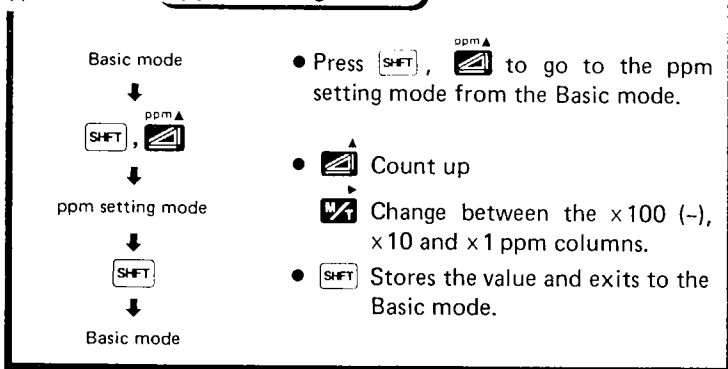
To convert inchHg to millibars, divide by 0.0295.

To convert temperature from Fahrenheit to Centigrade, use the formula:

$$^{\circ}\text{C} = \frac{5 \text{ (}^{\circ}\text{F} - 32\text{)}}{9}$$

- The atmospheric correction value can be input to the SET6 as a value between -499 ppm and +499 ppm in 1 ppm steps.
- The input atmospheric correction value is stored in the memory for about 15 hours after the power is switched off.
- If the atmospheric correction is not required, set the ppm value to zero.

Note: ppm setting mode



e.g. Set a ppm value of 13 ppm

From Basic mode:

Press [SHIFT], [ppm] to go to the ppm setting mode.

The x100 (-) ppm column flashes.

Set this column to 0 using [Count up].
(-0, 0, 1, 2, 3, 4, -4, -3, -2, -1)

Press [Change] to change to the x10 ppm column. (Value flashes)

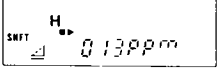
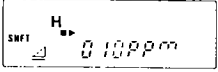
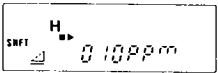
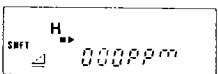
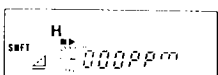
Set 1 to this column using [Count up].

Press [Change] to change to the x1 ppm column. (Value flashes)

Set 3 to this column using [Count up].

Press [SHIFT] to return to the Basic mode.

- The entered ppm value is stored in the memory for about 15 hours after the power is switched off.

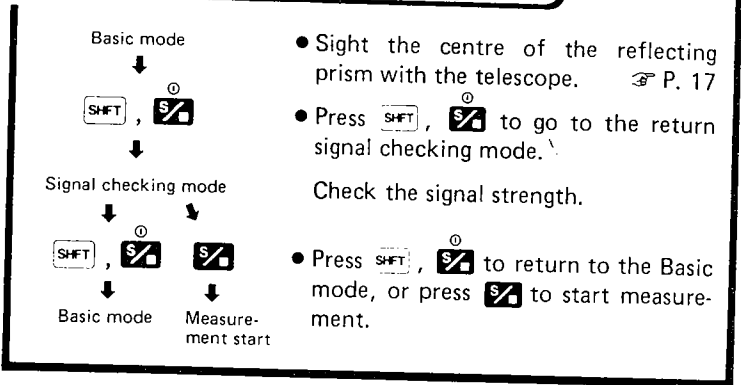


12.2 Prism sighting and return signal check

- Especially for long distances, it is useful to check that the return signal is adequate for measurement.

Note:

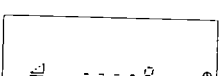
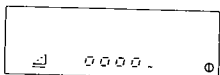
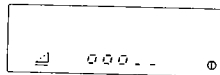
Return signal checking mode



- The return signal level is displayed according to its strength. An optional audio tone is output when the signal strength is adequate.



No return signal. Sight the prism centre again. *P. 17*



Adequate for measurement.
(Optional audio tone is output.)










Return signal is too strong. If this display persists, please contact our agent.

Return signal audio tone on/off P. 41

- Parameter 5 can be used to switch on/off the return signal audio tone.

12.3 Distance and angle measurement

Check! before distance and angle measurement:


1. The SET6 is set up correctly over the surveying point.  P. 8
2. The remaining battery power is adequate.  P. 13
3. The prism constant, the distance mode, the distance units and the curvature and refraction correction have been correctly set.  P. 12
4. The vertical angle format and angle units have been correctly set.  P. 12
5. The vertical circle has been indexed.  P. 15
6. The SET6 is in the Basic mode.
7. The atmospheric correction is correctly set.  P. 23
8. The centre of the reflecting prism is being sighted and the return signal is adequate for measurement.  P. 25

- For simultaneous measurement of distance and horizontal angle, the horizontal angle can be set to zero or a required value. For horizontal angle operations, see page 19—.

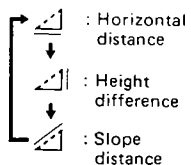


- 1) In Basic mode, select repeat/single* or tracking measurement. (Tracking measurement = Distance value displayed at first after 1.5 sec, then every 0.4 sec in cm units.)

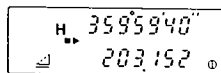
The TRK symbol is shown on the display in tracking mode.

* Repeat or single measurement can be selected by instrument parameter No. 2.  P. 42

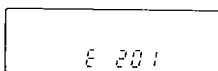




: Measurement start



: Measurement stop



2) Select the distance measuring mode by pressing .

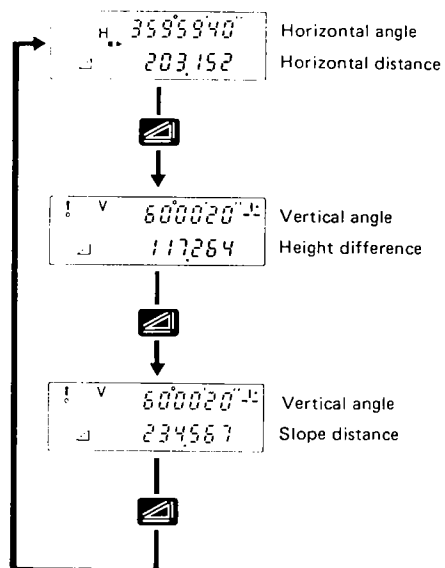
3) Press to start the measurement.
The display flashes to show that the measurement is being performed.



4) The selected distance and angle will be displayed after measurement.
In repeat or tracking measurement mode, press to stop the measurement.

- In single measurement mode, the stop key does not need to be pressed.

Note: If $E\ 201$ is displayed, the return signal is absent. In this situation, sight the prism correctly and re-measure. If any other error code is displayed, see page 30.



- After the measurement has been stopped, the horizontal distance, height difference and slope distance, and vertical and horizontal angle data are stored in the memory.



- The horizontal angle and horizontal distance, the vertical angle and height difference or the vertical angle and slope distance can be displayed by pressing .
- Press  to go to the Theodolite mode from the Basic mode.

13. ERROR CODES

- If there is any fault in the SET6 operation, the error codes shown below will be displayed.

Display	Meaning	Action
b. dEd	Battery voltage is too low.	Replace the battery with a charged one, or charge the battery.
E 100	* Error when measuring a horizontal angle.	Press  ,  to set the horizontal angle to zero.
E 101	* Error when measuring a vertical angle.	Index the vertical circle again.
E 114	Tilt angle of trunnion direction exceeds -10'.	Re-level the SET6.
E 115	Tilt angle of sighting direction exceeds -10'.	
E 116	Tilt angle of trunnion direction exceeds +10'.	
E 117	Tilt angle of sighting direction exceeds +10'.	
S ---	Incoming reflection was disturbed. Or measurement conditions are bad.	Re-sight the prism. Increase the number of prisms for long distances. Remeasure the distance after confirming the return signal.
S. OFF E 201	Incoming reflection was totally absent at start of measurement.	

* If the SET6 telescope or upper part is rotated faster than four revolutions per second, the error indication "E 100" or "E 101" is displayed.

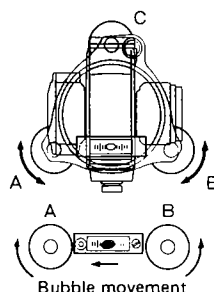
- When an error indication persists, or if an error indication "E xxx" is displayed with any number other than those displayed above, please contact our agent.

14. CHECKS AND ADJUSTMENTS

- It is important that the SET6 is periodically checked and adjusted. In addition, the instrument should be checked after transportation, long storage or when damage to the instrument is suspected to have occurred.

14.1 Plate level

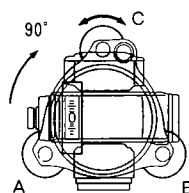
- The glass tube of the plate level is sensitive to temperature change or shock. Check and adjust as follows:



< Check >

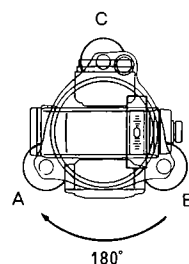
- 1) Turn the upper part of the instrument until the plate level is parallel to a line between levelling foot screws A and B. Centre the plate level bubble using levelling screws A and B.

Note: The bubble moves towards a clockwise-rotated footscrew.



- 2) Loosen the horizontal clamp ⑮ and turn the upper part 90°. i.e. The plate level is perpendicular to a line between levelling screws A and B.

Centre the plate level bubble using levelling screw C.



- 3) Turn the upper part through 180° and check the bubble position.

If the bubble is still centred, no adjustment is necessary.

If the bubble is not centred, adjust as follows:

4) Use levelling screws



→ 1/2

5) Use adjusting pin



→ Centre

< Adjustment >

4) Correct half of the bubble displacement using levelling screw C.

5) Correct the remaining half displacement with the adjusting pin.

Note: The bubble moves away from a clockwise rotation of the adjusting screw.

6) Repeat the procedures from 1) until the bubble remains centred for any position of the upper part.

If the bubble is not still centred in the plate level, please contact your SOKKIA agent.

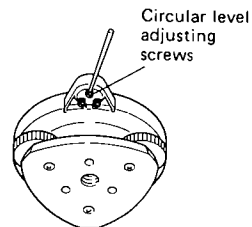
14.2 Circular level

〈Check〉

- 1) Perform the plate level adjustment as in 14.1, or carefully level the instrument using the plate level.
- 2) Check the position of the circular level bubble. If the bubble is off-centre, adjust as follows:

〈Adjustment〉

- 3) Note the off-centre direction of the bubble.
- 4) Loosen the adjusting screw farthest from this direction to centre the bubble.
- 5) Adjust all three adjusting screws until the tension of each screw tightening is the same, and the bubble is centred.



Warning: Over-tightening the adjusting screws may damage the circular level. Unequal tightening of the screws may mean that the bubble will go out of adjustment.

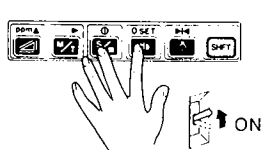
If the bubble is not still centred in the circular level, please contact your SOKKIA agent.

14.3 Tilt sensor

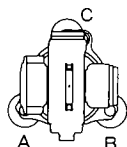
- If there is a tilt 0 point error, the tilt angle is not 0 when the instrument is properly levelled, and it causes an angle error. This tilt 0 point error can be checked and adjusted as follows.

<Check>

1) Carefully level the SET6.

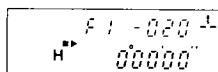


2) Press the and keys and switch the SET6 on at the same time.



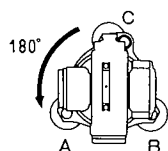
3) The tilt angle is displayed at the upper line, and the horizontal angle is displayed at the lower line.

Note the tilt angle value A, e.g. -20".



Tilt angle A

Horizontal angle

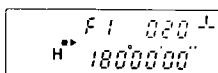


4) Loosen the horizontal clamp and turn the upper part through 180°±5' watching the display of horizontal angle.

Note the tilt angle value B at the 180° position, e.g. 20".

Calculate the offset value: $(A + B)/2$

e.g. $(-20 + 20)/2 = 0$



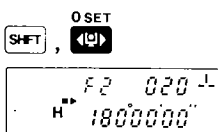
$$(A + B)/2 \leq \pm 20''$$

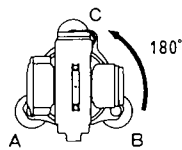
- If the offset value is $\pm 20''$ or less, no adjustment is necessary, and switch the power off to finish the check.

- If the offset value is greater than $\pm 20''$, the sensor index should be adjusted as follows:

<Adjustment>

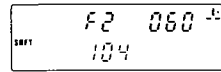
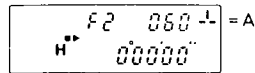
5) Press , to input the tilt angle B at the 180° position.





- 6) Loosen the horizontal clamp and turn the upper part back to the 0° horizontal angle position.

The tilt angle for this position is displayed.



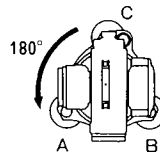
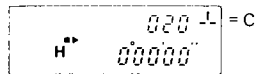
- 7) Press **SHIFT**, **O SET** to input this displayed tilt angle A.

The audio tone sounds and the tilt 0 point data is displayed.

(If the tilt 0 point data is greater than 100 ± 12 , please contact your SOKKIA agent.)

After three seconds, the adjusted new tilt angle value is displayed.

Note this tilt angle value C, e.g. 20".



- 8) Loosen the horizontal clamp and turn the upper part to the 180° horizontal angle position.

Note the tilt angle value D, e.g. -20".

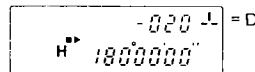
Calculate the new offset value: $(C + D)/2$

e.g. $\{20 + (-20)\} / 2 = 0$

Confirm that the offset value is $\pm 20''$ or less and switch the power off.

If the offset value is greater than $\pm 20''$, switch the power off and repeat the adjustment procedures from 1).

If the offset value is greater than $\pm 20''$ in spite of repeating the adjustment, please contact your SOKKIA agent.



$$(C + D)/2 \leq \pm 20''$$



Switch off

14.4 Reticle

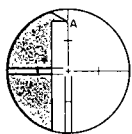
Note: Before this procedure, check the tilt sensor as in 14.3.

Perpendicularity of the reticle to the horizontal axis

< Check >

- 1) Carefully level the SET6.

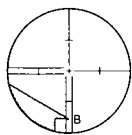
Select and sight a clear target on the upper part A of the reticle line.



- 2) Turn the telescope vertical fine motion screw until the target is on the lower part of the reticle B.

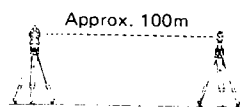
Check that the target is still positioned centrally within the reticle lines.

If the target is off-centre, please contact your SOKKIA agent.

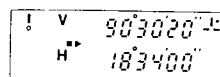


Vertical and horizontal reticle line positions

< Check >

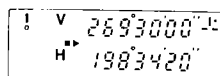


- 1) Set up a clear target 100 m (330 ft) from the SET6. Carefully level the SET6, switch on and index the vertical circle.



Face left

- 2) Sight the target on face left.
Read the horizontal and vertical angles.
e.g. H: 18°34'00" a_l
V: 90°30'20" b_l



Face right

- 3) Now sight the target on face right and read the horizontal and vertical angles.
e.g. H: 198°34'20" a_r
V: 269°30'00" b_r

- 4) Subtract the horizontal face left angle from the horizontal face right angle.
The difference should be $180^\circ \pm 40''$.
Add the vertical face left and face right angles. The sum should be $360^\circ \pm 40''$.

$$a_r - a_l = 180^\circ 00' 20''$$

$$b_r + b_l = 360^\circ 00' 20''$$

- 5) If either of the values are greater than $\pm 40''$, repeat the above procedures. If, after repeating the procedures, the values are still greater than $\pm 40''$, please contact your SOKKIA agent.

14.5 Optical plummet

<Check>

- 1) Carefully level the SET6 and exactly centre a surveying point in the reticle of the optical plummet.
- 2) Turn the upper part 180° and check the position of the surveying point in the reticle. If the surveying point is still centred, no adjustment is necessary. If the surveying point is not still centred in the optical plummet, please contact your SOKKIA agent.

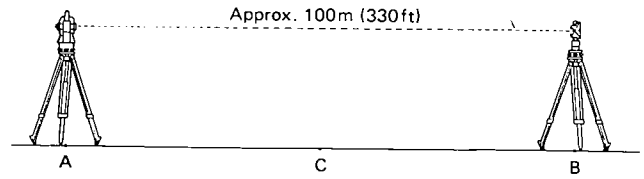


14.6 Additive distance constant

- The additive distance constant of the SET6 is adjusted to 0 before delivery. However, the additive constant can change with time and so should be determined periodically and then used to correct distances measured.

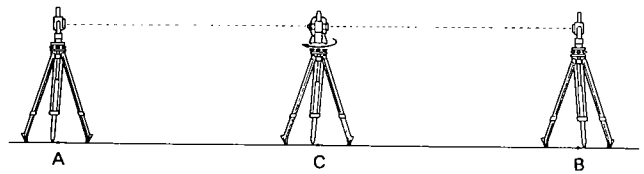
< Check >

- 1) Select points A and B on flat ground about 100 m (330 ft) apart, and C in the middle.



- 2) Set up the SET6 at A and measure the distance AB.

- 3) Move the SET6 to C, and measure the distances CA and CB.



- 4) Compute the additive distance error K using the formula:

$$K = \overline{AB} - (\overline{CA} + \overline{CB})$$

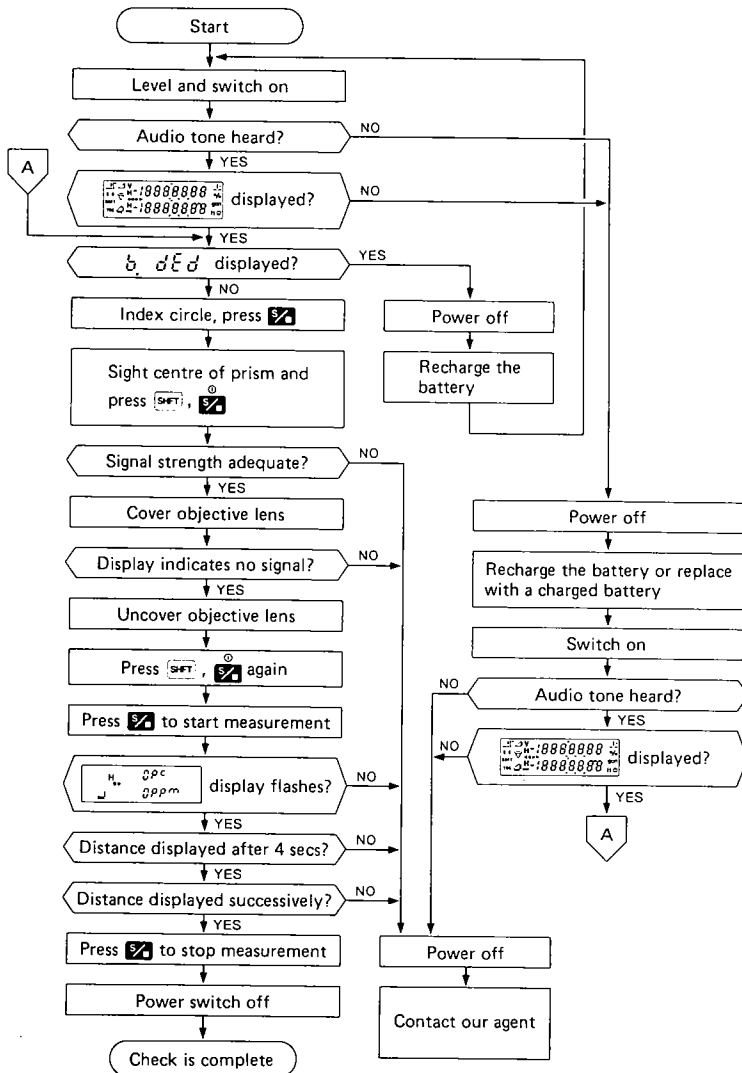
\overline{AB} , \overline{CA} , \overline{CB} : Average of ten measurements.

- 5) Obtain the K value three times. If all K are greater than ± 5 mm, please contact your SOKKIA agent.

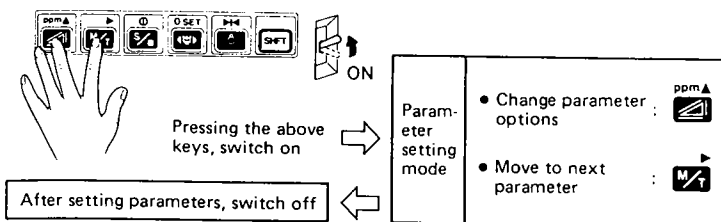
Note: Ensure that the prism height is the same as the height of the SET6 objective lens centre. If the ground is not level, use an automatic level to set the correct instrument heights of all points.


14.7 Distance measurement check flow chart

- Before this check, set the distance measuring mode to repeat measurement mode, then perform the procedures in the flow chart below.



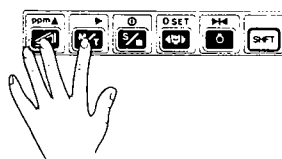
15. INSTRUMENT PARAMETERS



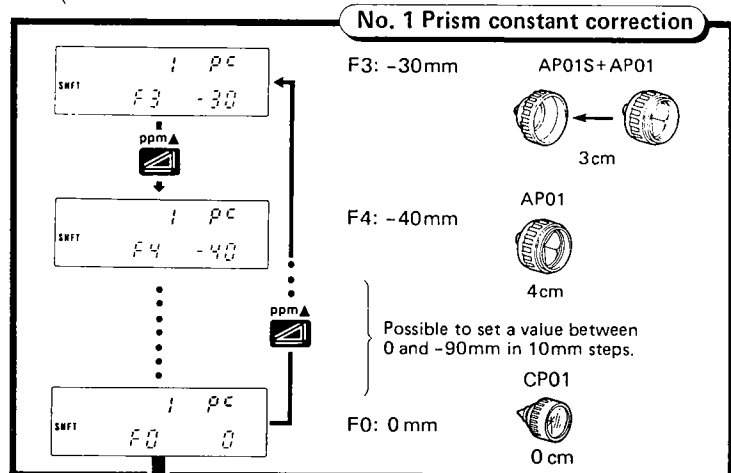
No.	Parameter		Options
1	Prism constant correction	F0 *F3 F9	0mm -30mm -90mm } in 10mm steps
2	Distance measurement mode	*F0 F1	Repeat measurements Single measurement
3	Distance units	*F0 F1	m (metres) ft (feet)
4	Earth curvature and refraction correction	*F0 F1	Not applied Applied
5	Audio for return signal	*F0 F1	On Off
6	Vertical angle display format	*F0 F1 F2 F3	Zenith 0 Horizontal 0 face left Horizontal 0±90°/100gon/1600mil % vertical angle
7	Vertical circle indexing	*F0 F1	Rotate telescope Observe face left, face right sightings
8	Auto vertical angle compensation	*F0 F1	Applied Not applied
9	Angle resolution	*F0 F1	20" (5 mgon/0.1 mil) 10" (2 mgon/0.05 mil)
10	Angle units	*F0 F1 F2	360° 400gon 6400mil
11	Auto power cut-off	*F0 F1	Auto power cut-off after 30 minutes Switch on/off with the SET5 switch
12	Auto illumination cut-off	*F0 F1	Illumination on/off using  Illumination auto off after 30 seconds
13	Reticle illumination brightness	F0 *F1	High (Bright) Low (Dim)

* Parameter settings when the instrument left the factory.

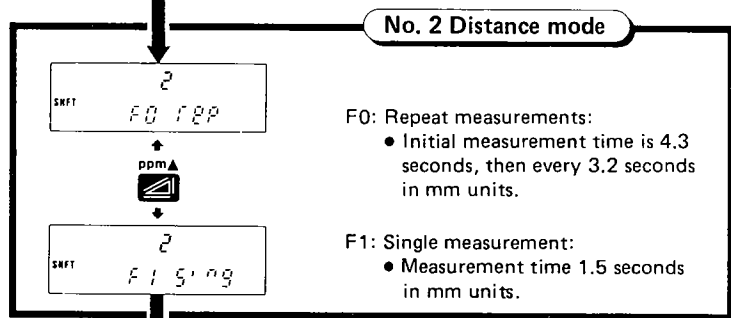
- The parameter options selected are stored in the permanent memory even after power off.
- Parameter setting method:

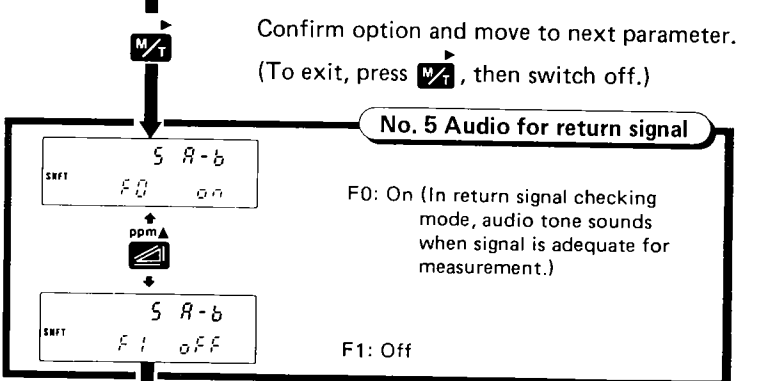
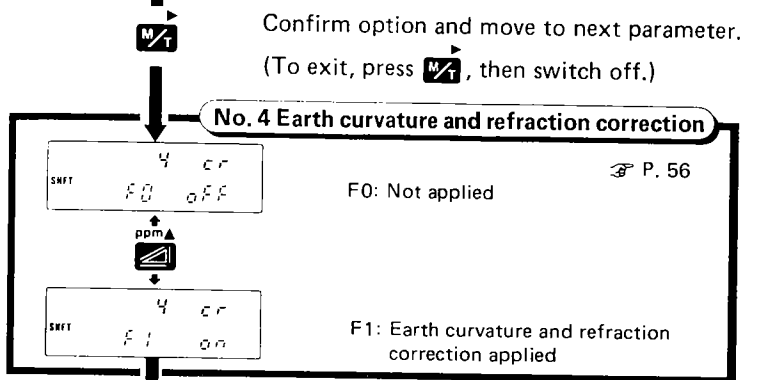
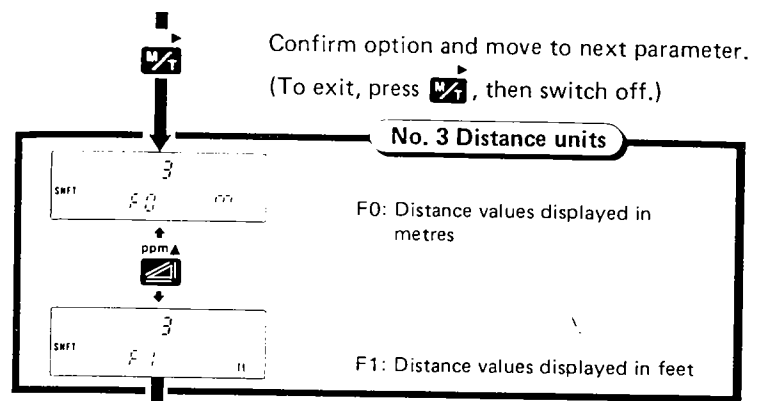


ON • While pressing and , switch the power on.



Confirm option and move to next parameter.
(To exit, press , then switch off.)





To next page

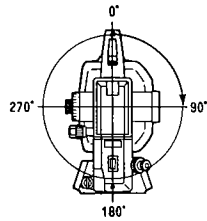
Confirm option and move to next parameter.

(To exit, press , then switch off.)

No. 6 Vertical angle mode

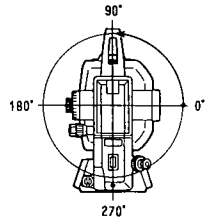
1 V 6
SWF1 F0

F0: Vertical angle (0 at Zenith)



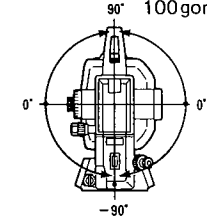
1 V 6
SWF1 F1

F1: Vertical angle (0 Horizontal face left)



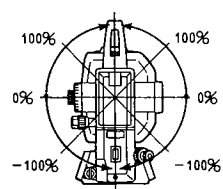
1 V 6
SWF1 F2

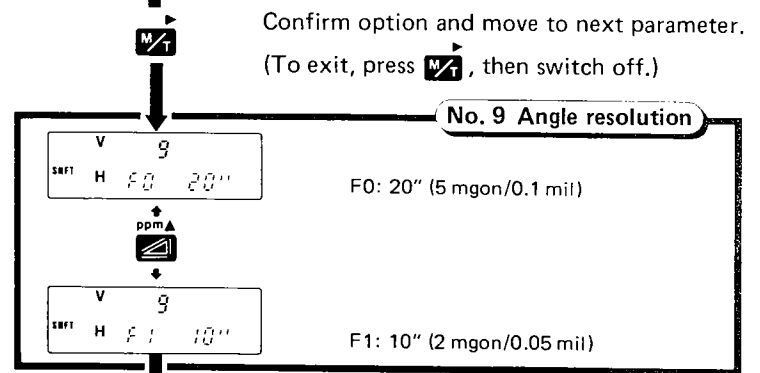
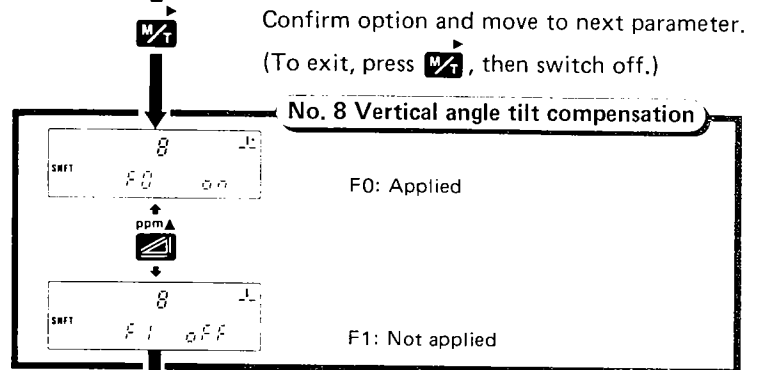
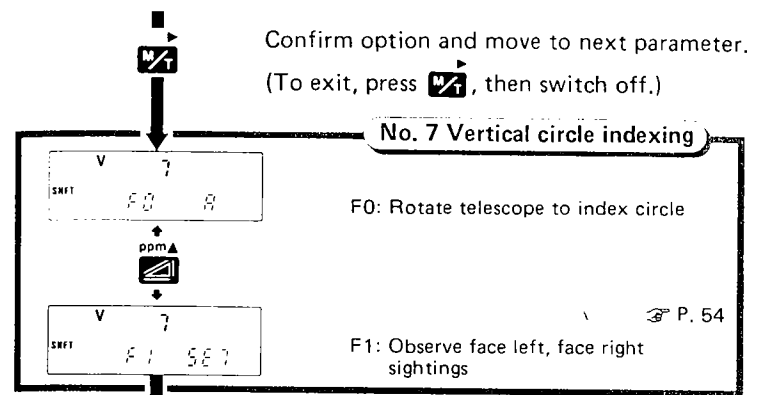
F2: Vertical angle (0 Horizontal $\pm 90^\circ$ / 100 gon/1600 mil)



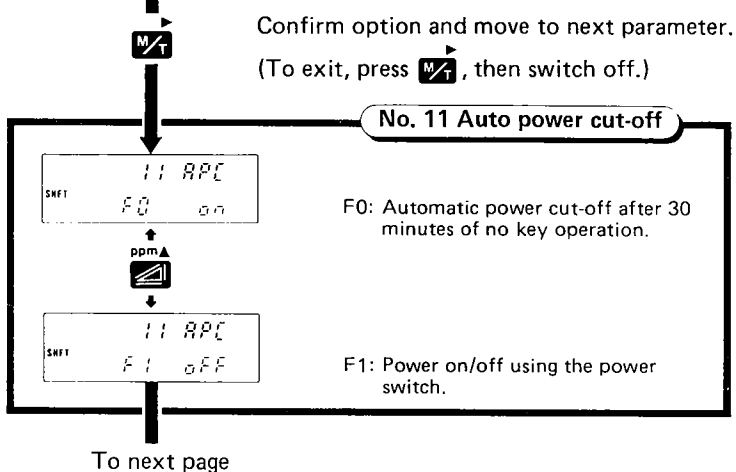
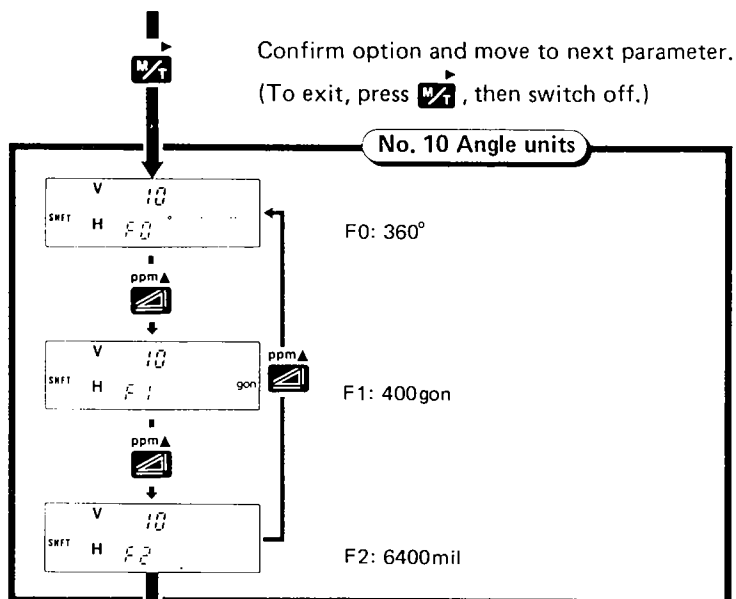
1 V 6
SWF1 F3

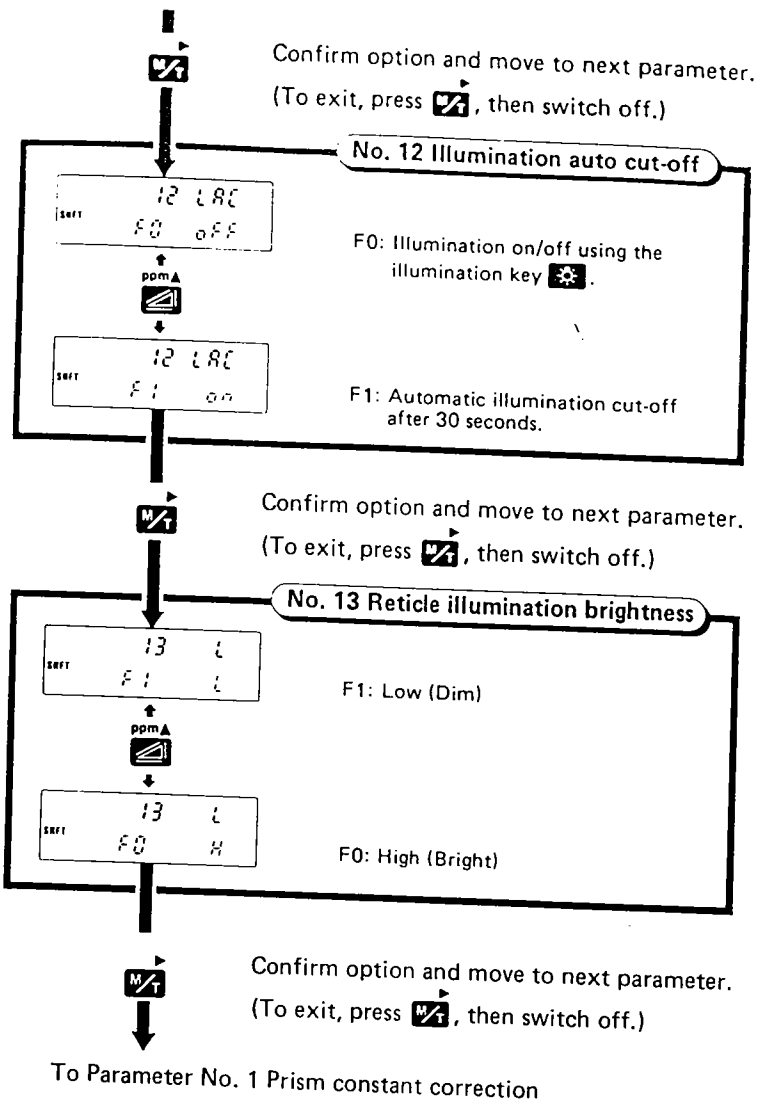
F3: % vertical angle (up to 1000%)





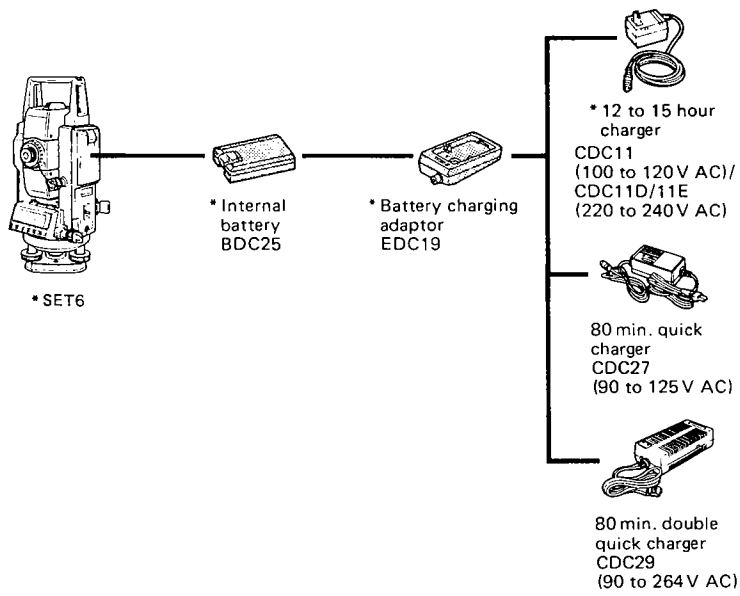
To next page





16. POWER SYSTEM

- The SET6 can be operated with the following combinations.



* Standard equipment. Items not marked with * are optional accessories.

Use the SET6 only with the combinations shown here.

1) Precautions for battery use and storage.

- Charge the battery at least once a month to maintain its quality if it is not used for a long time. If the battery has not been charged for more than a month, charge it fully without regard to the remaining battery power before using.
- Battery operating life is shortened at extreme temperatures.
- Store the battery in a place where the temperature is between 0°C and 40°C.

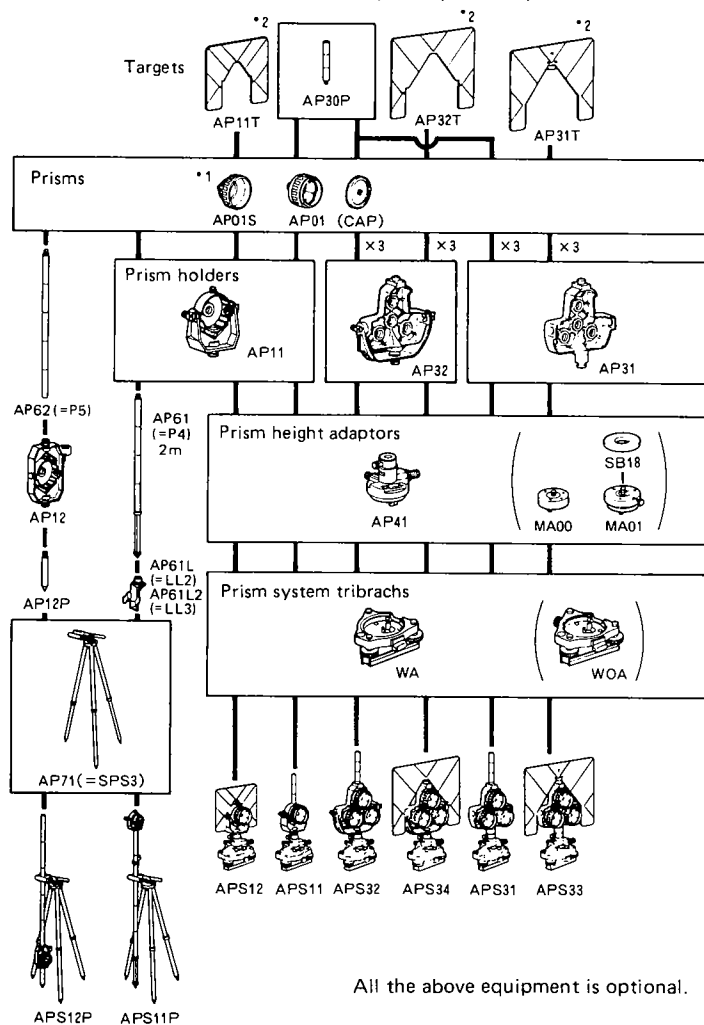
2) Precautions for battery charging using the standard charger.

To charge the battery, use only the recommended charger.

- Charge the battery at a temperature between 10°C and 40°C.
- Do not charge the battery for longer than the specified time.
- When charging the battery, first mount it in the adaptor and connect to the battery charger, then connect the charger to the power supply. Check that the charging light is on. If not, switch the power supply off and on and check that the light comes on.
- The battery charger normally becomes warm while charging.

17. REFLECTING PRISMS AND ACCESSORIES

- All SOKKIA reflecting prisms and accessories have standardized screws (5/8" x 11 thread) for easy compatibility.



*1: To change the stored prism constant value, see page 42.

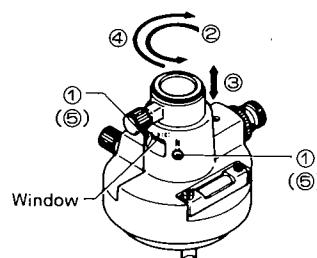
*2: Fluorescent target paint finishing allows clearer sighting in adverse observing conditions.

1) Precautions for use of reflecting prisms.

- Carefully face the reflecting prism towards the instrument; sight the prism target centre accurately.
- To use the triple prism assembly AP31 or AP32 as a single prism (e.g. for short distances), mount the single prism AP01 in the centre hole of the prism holder.

2) Precautions for use of the instrument height adaptor AP41.

- Check the optical plummet of the AP41 as described in Section 14.5.
- The height of the AP41 can be adjusted as follows:

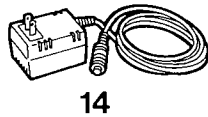
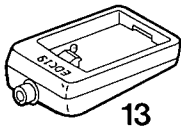
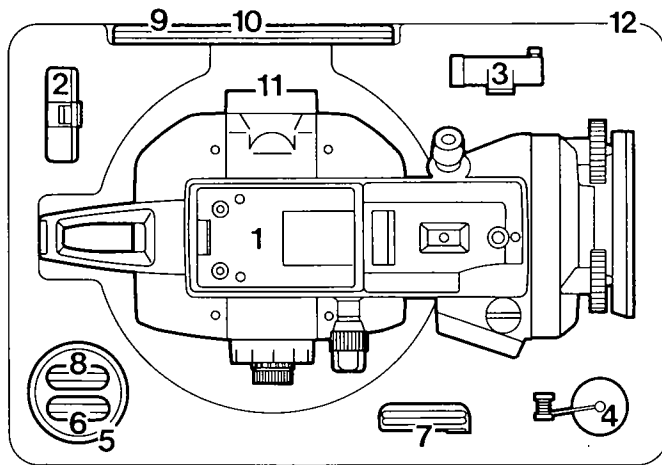


- ① Loosen the two fixing screws.
- ② Turn the centre part counter-clockwise to unlock it.
- ③ Move it up or down until the height appears in the window.
- ④ Turn the centre part clockwise to lock it.
- ⑤ Tighten the fixing screws.

3) Precautions for use of tribrach.

- Use the plate level on the AP41 to adjust the tribrach circular level as described in Section 14.2.

18. STANDARD EQUIPMENT



- | | |
|-----------------------------------|--|
| 1. SET6/SET6S main unit . . . 1 | 9. Operator's manual 1 |
| 2. Internal battery BDC25 . . . 1 | 10. Atmospheric correction chart 1 |
| 3. Tubular compass CP7 . . . 1 | 11. Lens cap 1 |
| 4. Plumb bob 1 | 12. Carrying case 1 |
| 5. Lens hood 1 | SET6 use: SC91 |
| 6. Vinyl cover 1 | SET6S use: SC95 |
| 7. Tool pouch 1 | 13. Battery charging adaptor EDC19 1 |
| Screwdriver 1 | 14. Battery charger CDC11/11D/11E 1 |
| Lens brush 1 | |
| Adjusting pins 2 | |
| 8. Cleaning cloth 1 | |

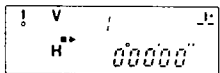
19. MAINTENANCE

- 1) Wipe off moisture completely if the instrument gets wet during survey work.
- 2) Always clean the instrument before returning it to the case.
The lens requires special care. Dust it off with the lens brush first, to remove minute particles. Then, after providing a little condensation by breathing on the lens, wipe it with a soft, clean cloth or lens tissue.
- 3) Store the SET6 in a dry room where the temperature remains fairly constant.
- 4) If the battery is discharged excessively, its life may be shortened. Store it in a charged state.
- 5) Check the tripod for loose fit and loose screws.
- 6) If any trouble is found on the rotatable portion, screws or optical parts (e.g. lens), contact our agent.
- 7) To maintain the accuracy of the SET6, check it for proper adjustment periodically.

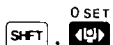
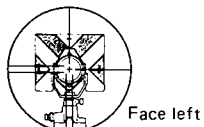
APPENDIX 1: MANUALLY INDEXING THE VERTICAL CIRCLE

- Like all theodolites, the SET6 will have a vertical index error. The vertical index can be determined, and the index error removed, by the following procedure.

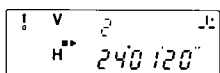
- 1) Set parameter 7 to "Indexing vertical circle by face left, face right readings".
P. 41



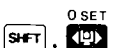
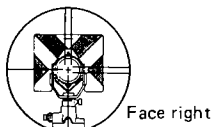
- 2) Carefully level the SET6 and switch the instrument on.
The prompt 1 is displayed.



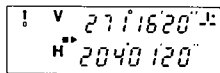
Press **SHIFT**, **O SET**.



The prompt 2 is displayed.



Press **SHIFT**, **O SET** again.



- When the vertical circle has been indexed, the vertical angle is displayed.

The horizontal circle should now be indexed.

Note: The vertical and horizontal circles must be re-indexed each time the SET6 is switched on.

APPENDIX 2: ACCURACY OF MEASUREMENT OF ATMOSPHERIC CONDITIONS

1) Atmospheric conditions

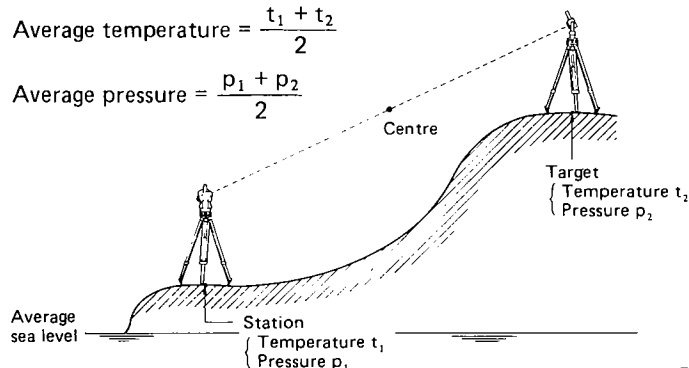
- The SET6 uses a beam of infra-red light to measure the distance. The velocity of this light in the atmosphere varies according to the temperature and pressure.
For a variation in temperature of 1°C, the distance is changed by 1 ppm.
For a variation in pressure of 3.6 mb, the distance is changed by 1 ppm.
(A 1 ppm change is 1 mm for every 1 km of distance measured.)
Consequently, temperature and atmospheric pressure must be carefully measured to correct the measured distances. (Temperature should be measured to the nearest 1°C and pressure to within 3.8 mb.)
- The ppm correction does not need to be applied when the calculated ppm value is within ±5 ppm and the distances are less than 200 m.

2) To obtain the average velocity along the measured light path, the average temperature and pressure is required.

- In flat terrain, measure the temperature at the midpoint of the line.
- In mountainous terrain, if the temperature and pressure at the midpoint can not be measured, take the temperature and pressure at the instrument and target and calculate the average values.

$$\text{Average temperature} = \frac{t_1 + t_2}{2}$$

$$\text{Average pressure} = \frac{p_1 + p_2}{2}$$



APPENDIX 3: EARTH CURVATURE AND REFRACTION CORRECTION

- The curvature and refraction correction can be selected using parameter No. 4. This correction is applied in the measurement of horizontal distance and height difference and uses an atmospheric refraction constant of 0.142.

(When the correction is not applied)

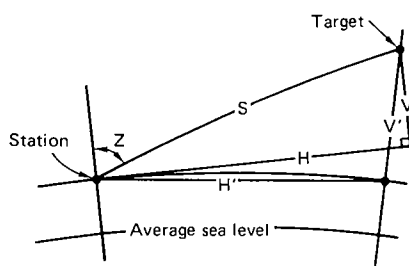
$$\text{Horizontal distance: } H = S \sin Z$$

$$\text{Height difference: } V = S \cos Z$$

(When the correction is applied)

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

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



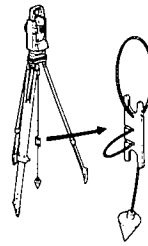
S: Slope distance after atmospheric correction
Z: Vertical angle (0 at zenith)
K: Atmospheric refraction constant (0.142)
R: Radius of the earth (6.372×10^6 m)

e.g. Amount of correction for a zenith angle of 70°

Distance S (m)	100	300	500
$H' - H$ (m)	-0.0005	-0.004	-0.012
$V' - V$ (m)	0.0006	0.005	0.015

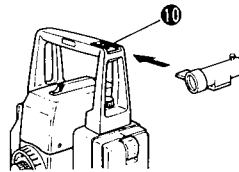
Note: The horizontal distance is a distance measured at the height of the surveying point above sea level. If required, reduce this distance to the average sea level and apply the local projection correction.

APPENDIX 4: STANDARD ACCESSORIES



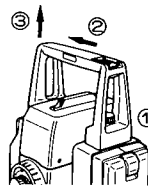
1) Plumb bob

If the weather is calm, or for initial tripod centring, the plumb bob can be used for centring. To use, unwind the plumb bob cord and attach it to the hook inside the centring screw. Use the cord grip piece to adjust the cord length.



2) Tubular compass CP7 (accuracy $\pm 1^\circ$)

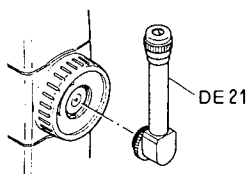
To mount the CP7, slide it into the tubular compass slot ⑩. To use, loosen the clamping screw to free the compass needle. Turn the instrument in the face left position until the compass needle bisects the index lines. The telescope is now aligned with magnetic north. After use, tighten the clamp.



3) Handle

The carrying handle ② can be removed from the instrument by unscrewing the handle securing screw and sliding the handle to the side. When replacing the handle, ensure that the securing screw is fully tightened.

APPENDIX 5: OPTIONAL ACCESSORIES

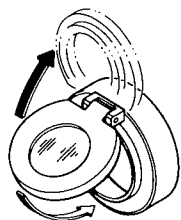


1) Diagonal eyepiece DE21

The diagonal eyepiece is convenient for near-vertical observations and in places where space around the instrument is limited. Remove the telescope eyepiece by unscrewing the mounting ring, and screw in the diagonal eyepiece.



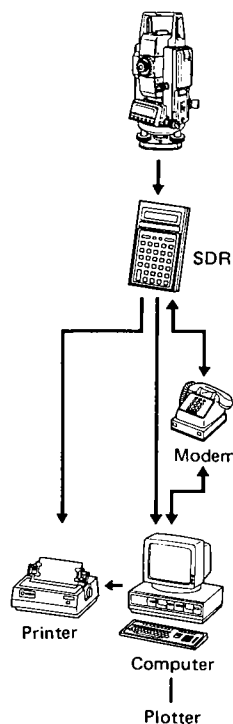
OF1



OF1A

2) Solar filter OF1/OF1A

For observations to the sun, and where glare is present. The OF1 and OF1A (flip-up type) filters are mounted on the objective lens.



3) Electronic field books SDR

The SDR series can collect and store all angle and distance values output from the SET6 data output connector ⑭. The stored data can be verified and printed in the field, then transmitted by cable or modem to an IBM-compatible office data processing system for final computation, printing and plotting.

SDR features:

- Simple operation with clear menu and program display prompts.
- Wide choice of recording parameters.
- Recorded data can not be cleared from the memory until it has been transmitted or printed.
- Additional programs or data can be input to the SDR from an external computer.

SDR specifications:

Power source: "AA" size batteries
 Memory type: CMOS
 Keyboard: 33 keys
 Display: LCD
 Baud rate: 300/600/1200/2400/
 4800/9600 bps
 Operating temperature: 0 to 50°C (32 to 122°F)
 Weight: 450g (1 lb)

SPECIFICATIONS

Telescope

Length: 166 mm
Aperture: 45 mm
Magnification: 26×
Resolving power: 3.5"
Image: Erect
Field of view: 1°30' (26 m/1,000 m)
Minimum focus: 1.3 m (4.3 ft)
Reticle illumination: Brightness selectable in 2 levels

Angle measurement

Horizontal circle

Type: Incremental
Minimum display: 20" (0.005 gon/0.1 mil)/10" (0.002 gon/0.05 mil) (Selectable with parameter)

Vertical circle

Type: Incremental with zero index
Minimum display: 20" (0.005 gon/0.1 mil)/10" (0.002 gon/0.05 mil) (Selectable with parameter)

Angle range: 0°00'00" to 359°59'50"
0.000 gon to 399.998 gon
0.00 mil to 6,399.95 mil
±999.909 %

Accuracy: Standard deviation of mean of measurement taken in positions I and II (DIN 18723)
7" (2.2 mgon/0.03 mil)

Automatic compensator: Selectable on/off

Type: Liquid

Range of compensation: ±10'

Measuring mode

Horizontal angle: Right/left/hold

Vertical angle: 0 at zenith
0 horizontal on face left
0 horizontal ±90°/100 gon/1,600 mil
% vertical angle

Measuring time: Less than 0.5 sec

Distance measurement

Maximum range: (When using SOKKIA reflecting prisms)

Average conditions: (Slight haze, visibility about 20 km,
sunny periods, weak scintillation)

Compact prism (CP series)

300 m (900 ft)

1-prism (AP series) 500 m (1,600 ft)

Accuracy:

(Standard deviation)

5 mm + 5 ppm · D (Repeat measurement)

Distance display range:

1,999.999 m/6,561.66 ft

Display of feet units:

Selectable

Minimum display:

Repeat 1 mm (0.01 ft)

Single 1 mm (0.01 ft)

Tracking 10 mm (0.1 ft)

Measuring modes:

Repeat/Single/Tracking

Measuring times:

Distance mode	Measurement mode		
	Repeat	Single	Tracking
Slope distance	4.3s, then every 3.2s	1.5s	1.5s, then every 0.4s
Horizontal distance			
Height difference			

Atmospheric correction:

-499 to +499 ppm (in 1 ppm steps)

Prism constant correction:

0 to -90 mm (in 10 mm steps)

Earth curvature and

refraction correction:

Selectable on/off

Audio target acquisition:

Selectable on/off

Signal source:

Infra red LED

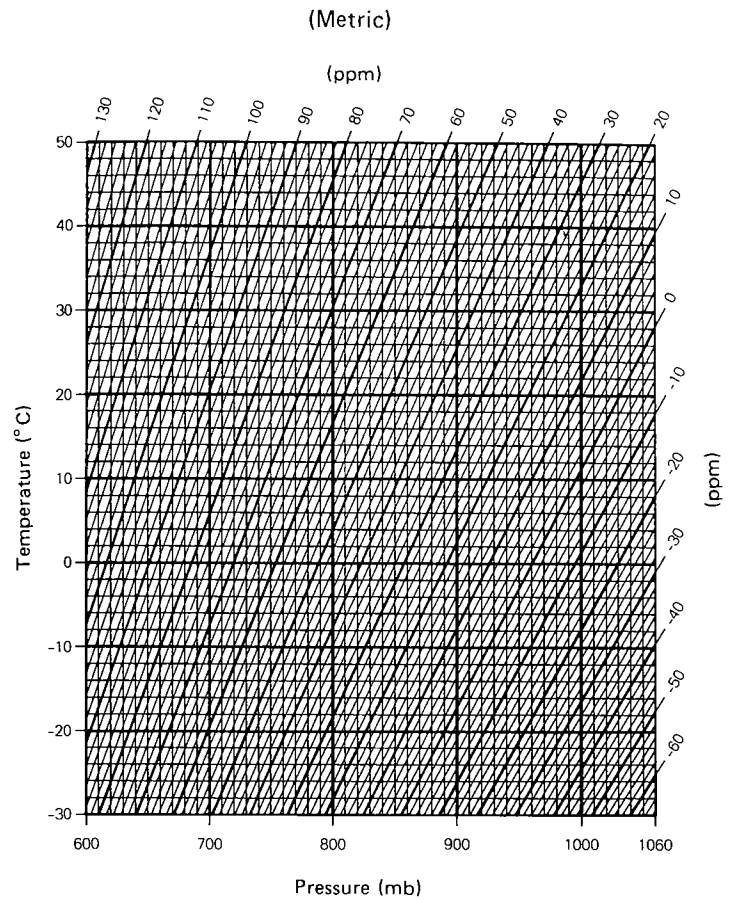
Light intensity control:

Automatic

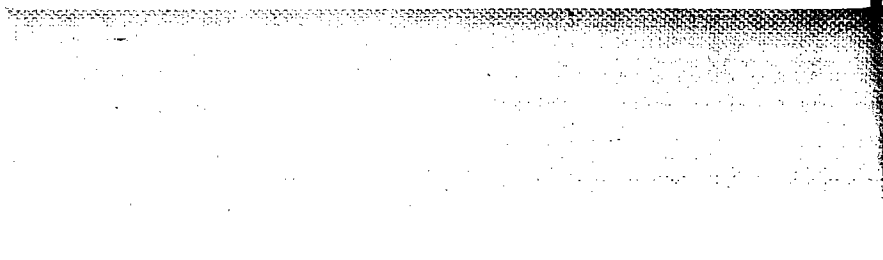
General

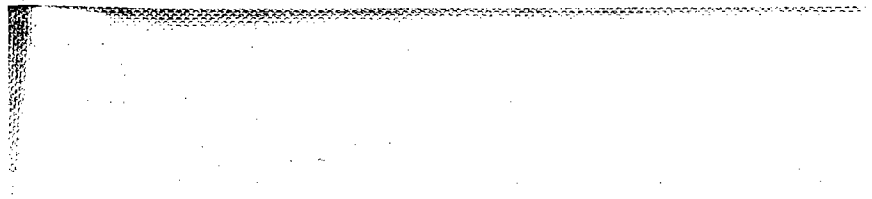
Display:	LCD 2-line, 8-digit display on one face
Sensitivity of levels	
Plate level:	60"/2 mm
Circular level:	10'/2 mm
Optical plummet	
Image:	Erect
Magnification:	2 x
Focus:	Fixed at 1.3 m (4.3 ft)
Data output:	Asynchronous serial, RS-232C compatible
Self-diagnosis:	Provided
Power-saving cut-off:	30 minutes after last key operation (Selectable on/off)
Operating temperature:	-20°C to +50°C (-4°F to +122°F)
Power source:	Ni-Cd rechargeable battery BDC25 (6V)
Working duration:	21 hrs 40 min at 25°C/77°F (Angle measurement) 2 hrs 50 min at 25°C/77°F (Distance and angle measurement)
Charging time:	12 to 15 hrs (using standard charger CDC11/11D/11E)
Instrument height:	210 mm
Size (with handle and battery):	150 (W) x 165 (D) x 343 (H) mm (5.9 (W) x 6.5 (D) x 13.5 (H) inches)
Weight (with handle and battery):	4.8 kg (10.6 lbs)

ATMOSPHERIC CORRECTION CHART



- This chart shows the correction every 2 ppm, while the atmospheric correction can be input to the SET6 for every ppm.
To convert a pressure in mmHg to one in mb, divide by 0.75.
e.g. $719 \text{ mmHg} = (719 \div 0.75) = 959 \text{ mb}$

[illegible]

[illegible]

[illegible]

3