

SOKKIA

Series220

SET2220

SET3220

SET4220

Electronic Total Station



Class 1 LED Product
Class I LED Product

OPERATOR'S MANUAL



Ni-MH

[English]	CONTAIN Ni-MH BATTERY. CADMIUM-FREE. MUST BE RECYCLED OR DISPOSED OF PROPERLY.
[Deutsch]	MIT NiMH AKKU. ENTHALT KEIN KADMIMUM. EFORDERT RECYCLING ODER FACHGERECHTE ENTSORGUNG.
[Français]	CONTIENT UNE BATTERIE AU Ni-MH. SANS CADMIUM. DOIT ÊTRE RECYCLÉE OU DONNÉE A UN ORGANISME DE RETRAITEMENT.
[Italiano]	CONTIENE NiMH BATTERIA. NON CONTIENE CADMIO. DEVE QUINDI ESSERE RICICLATA O ELIMINATA IN MODO APPROPRIATO.
[Nederlands]	BEVAT EEN NiMH BATTERIJ. BEVAT GEEN CADMIUM. DIENT GERECYCLEERD OF OP EEN CORRECTE MANIER VERNIEGTIGD TE WORDEN.
[Español]	CONTIENE UNA NiMH BATERÍA. NO CONTENE CADMIO. DEBE RECICLARSE O ELIMINARSE ADECUADAMENTE.
[Portugulês]	CONTEM BATERIA DE NiMH. SEM CÁDMIO. DEVERÁ SER RECICLADA OU DE CARTADA CONVENIENTEMENTE.
[Svensk]	INNEHÅLLER NiMH BATTERI. KÄDMIUMFRITT. BÖR ÅTERVINNAS ELLER FÖRSTÖRAS PÅ ETT SAKERT SÄTT.
[Suomi]	SISÄLTÄÄ NiMH AKUN. HÄVITETTÄESSÄ KÄSITELTÄVÄ ONGELMAJÄTTEENÄ.
[Norsk]	NiMH BATTERIER. INNEHOLDER IKKE KADMIMUM. MÅ RESIRKULERES ELLER KASTES PÅ EN FORSVARLIG MÅTE.
[Dansk]	INDEHOLDER NiMH BATTERI. KADMIMUMFRIT. SKAL GENVINDES ELLER KASSERES PÅ FORSVARLIG MÅDE.
[Ελληνικά]	ΠΕΡΙΕΧΕΙ ΜΠΑΤΑΡΙΑ ΝΙΚΕΛΙΟΥ-ΜΕΤΑΛΛΟΥ ΥΔΡΙΔΙΟΥ. ΔΕΝ ΠΕΡΙΕΧΕΙ ΚΑΔΜΙΟ. ΠΡΕΠΕΙ ΝΑ ΑΝΑΚΥΚΛΩΝΕΤΑΙ Η ΝΑ ΚΑΤΑΣΤΡΕΦΕΤΑΙ ΜΕ ΤΟΝ ΚΑΤΑΛΛΗΛΟ ΤΡΟΠΟ.

For U.S.A. ATTENTION:

The product that you have purchased contains a rechargeable battery. The battery is recyclable. At the end of its useful life, under various state and local laws, it may be illegal to dispose of this battery into the municipal waste stream. Check with your local solid waste officials for details in your area for recycling options or proper disposal. Use the standard battery charger.

Die Schweiz: Nach Gebrauch der Verkaufsstelle zurückgeben.

La Suisse: Après usage à rapporter au point de vente.

Swizzera: Ritornare la pila usate al negozio.

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OPERATOR'S MANUAL

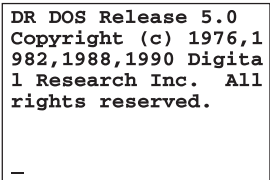
- Thank you for selecting the SET2220/SET3220/SET4220.
- Before using the instrument, please read this operator's manual carefully.
- Verify that all equipment is included."  "20. STANDARD EQUIPMENT"
- Data saved in the SET can be sent to a connected host computer. Commands operations from a host computer can also be performed. For details, refer to "Interfacing with the SOKKIA SDR Electronic Field Book" and "Command Explanations" manuals and ask your Sokkia agent.
- The specifications and general appearance of the instrument may be altered at any time and may differ from those appearing in brochures and this manual.
- Some of the diagrams shown in this manual may be simplified for easier understanding.

- **Warm boot**

If you are experiencing problems with the SET and suspect a fault in the program, you should try a warm boot. A warm boot will not erase surveying data in the SET. But parameter No.'s 1, 2, 4 and 7 are changed to the factory settings automatically, while others remain unchanged after warm boot is performed. Whenever possible transmit the data to a personal computer before rebooting.

To perform a warm boot, make sure the power is turned off, and while holding **<ALPHA>**, press **<ON>**. After that the instrument is ready for vertical and horizontal circle indexing. It takes some time to perform a warm boot.

The display of warm boot appears like below.



```
DR DOS Release 5.0
Copyright (c) 1976,1
982,1988,1990 Digita
l Research Inc. All
rights reserved.
_
```

- **Cold boot**

All data in the SET's internal memory will be lost after cold boot. If the data in the memory is necessary, **BE SURE TO TRANSFER IT TO A PERSONAL COMPUTER BEFORE PERFORMING A COLD BOOT.**

To perform a cold boot, while holding **<F4>**, **<ALPHA>**, **<I>** and **<L>**, press **<ON>**.

After cold boot is performed, all the parameters are changed to the factory settings automatically.

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1. ALWAYS FOLLOW PRECAUTIONS FOR SAFE OPERATION

For the safe use of the product and prevention of injury to operators and other persons as well as prevention of property damage, items which should be observed are indicated by an exclamation point within a triangle used with WARNING and CAUTION statements in this operator's manual.

The definitions of the indications are listed below. Be sure you understand them before reading the manual's main text.

Definition of Indication



WARNING

Ignoring this indication and making an operation error could possibly result in death or serious injury to the operator



CAUTION

Ignoring this indication and making an operation error could possibly result in personal injury or property damage



This symbol indicates items for which caution (hazard warnings inclusive) is urged. Specific details are printed in or near the symbol.



This symbol indicates items which are prohibited. Specific details are printed in or near the symbol.



This symbol indicates items which must always be performed. Specific details are printed in or near the symbol.

For General



Warning



Do not use the unit in areas exposed to high amounts of dust or ash, in areas where there is inadequate ventilation, or near combustible materials. An explosion could occur.



Do not perform disassembly or rebuilding. Fire, electric shock or burns could result.



Never look at the sun through the telescope. Loss of eyesight could result.



Do not look at reflected sunlight from a prism or other reflecting object through the telescope. Loss of eyesight could result.








Direct viewing of the sun during sun observation will cause loss of eyesight. Use solar filter (option) for sun observation.

☞ "21. OPTIONAL ACCESSORIES"










1. ALWAYS FOLLOW PRECAUTIONS FOR SAFE OPERATION

Caution



-  Do not use the carrying case as a footstool. The case is slippery and unstable so a person could slip and fall off it.
-  Do not place the instrument in a case with a damaged catch, belt or handle. The case or instrument could be dropped and cause injury.
-  Do not wield or throw the plumb bob. A person could be injured if struck.
-  Secure handle to main unit with locking screws. Failure to properly secure the handle could result in the unit falling off while being carried, causing injury.
-  Tighten the adjustment tribrach clamp securely. Failure to properly secure the clamp could result in the tribrach falling off while being carried, causing injury.

Power Supply


Warning

-  Do not disassemble, rebuild, mutilate, incinerate, heat or short circuit the battery and charger. Fire, electric shock, burns or an explosion could result.
-  Do not use voltage other than the specified power supply voltage. Fire or electric shock could result.
-  Do not use damaged power cords, plugs or loose outlets. Fire or electric shock could result.
-  Do not use power cords other than those designated. Fire could result.
-  Do not place articles such as clothing on the battery charger while charging batteries. Sparks could be induced, leading to fire.
-  Use only the specified battery charger to recharge batteries. Other chargers may be of different voltage rating or polarity, causing sparking which could lead to fire or burns.
-  Do not heat or throw batteries into fire. An explosion could occur, resulting in injury.
-  To prevent shorting of the battery in storage, apply insulating tape or equivalent to the terminals. Otherwise shorting could occur resulting in fire or burns.
-  Do not use the battery, charger or AC (power) cable for any other equipment or purpose. Fire or burns caused by ignition could result.

1. ALWAYS FOLLOW PRECAUTIONS FOR SAFE OPERATION






-  Do not short circuit the battery. Fire or burns caused by heat or ignition could result.
-  Do not connect or disconnect power supply plugs with wet hands. Electric shock could result.

Caution

-  Do not touch liquid leaking from batteries. Harmful chemicals could cause burns or blisters.

Tripod

Caution

-  When mounting the instrument to the tripod, tighten the centering screw securely. Failure to tighten the screw properly could result in the instrument falling off the tripod, causing injury.
-  Tighten securely the leg fixing screws of the tripod on which the instrument is mounted. Failure to tighten the screws could result in the tripod collapsing, causing injury.
-  Do not carry the tripod with the tripod shoes pointed at other persons. A person could be injured if struck by the tripod shoes.
-  Keep hands and feet away from the tripod shoes when fixing the tripod in the ground. A hand or foot stab wound could result.
-  Tighten the leg fixing screws securely before carrying the tripod. Failure to tighten the screws could lead to the tripod legs extending, causing injury.

2. HOW TO READ THIS MANUAL

- The SET comes equipped with 2 manuals for operation information.
BASIC OPERATOR'S MANUAL
SDR SOFTWARE REFERENCE MANUAL
- In this manual the functions in MEAS mode are explained.
For information on REC mode, please refer to the **"SDR SOFTWARE REFERENCE MANUAL."**
- Typefaces are used in this manual as follows:

Main Menu Indicates field identifiers, menu options, unit names, variables and functions.

<Key> Indicates a keyboard key or a softkey that causes an immediate action.
Examples:<1>, <ESC>, <Y>, <▼>, <←>
 <0SET>, <REC>.



: Indicates supplementary explanation.



: Indicates the chapter title to refer to for additional information.

Caution

: Indicates precaution information.

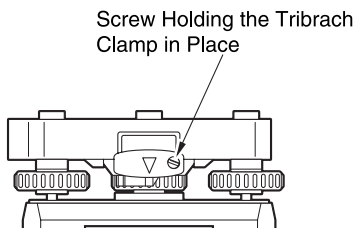


: Indicates an explanation for a particular term or operation.

3. PRECAUTIONS

Tribrach Clamp

- When the instrument is shipped, the tribrach clamp is held firmly in place with a locking screw to prevent the instrument from shifting on the levelling base. Before using the instrument the first time, loosen this screw with a screw-driver. If the instrument is shipped again, retighten the locking screw.



Battery Charging

The battery has not been charged at the factory. Please fully charge the battery before using it. Refer to the manuals for the battery and the battery charger.

For lithium battery

A lithium battery is used to power the SET memory. This ensures "continuous memory" so that all data is safe. The lithium battery contains enough power to back up the memory for about 5 years. If the lithium battery becomes low, an error message "Backup lithium dead" will be displayed in REC mode. If the lithium battery is completely discharged, all data will be cleared. Therefore, be sure to check periodically whether this message is displayed. If this message appears, please download the data to a personal computer or a memory card as soon as possible.

To replace the lithium battery, please contact your Sokkia agent. When the battery is replaced, all data is cleared.

Other precautions

- Never place the SET directly on the ground. Sand or dust may cause damage to the screw holes or the centering screw on the base plate.
- Do not aim the telescope at the sun. Avoid damaging your eyes and the LED of the EDM by using a solar filter when the telescope is pointed at the sun.
- Protect the SET from direct sunlight, rain or mist with an umbrella
- Never carry the SET on a tripod to another site.
- Handle the SET with care. Avoid heavy shocks or vibration.
- When the operator leaves the SET, the vinyl cover should be placed on the instrument.
- Always switch the power off before removing the battery.
- Remove the battery from the SET before putting it in the case.

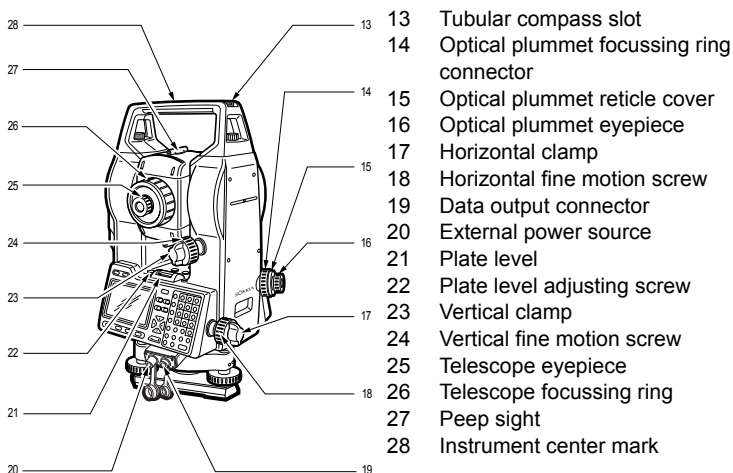
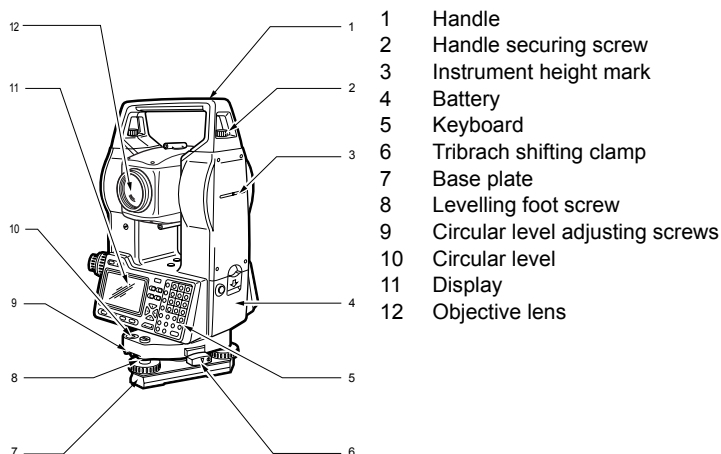
3. PRECAUTIONS

- When the SET is placed in the carrying case, follow the layout plan.
- Make sure that the SET 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, the instrument could rust.

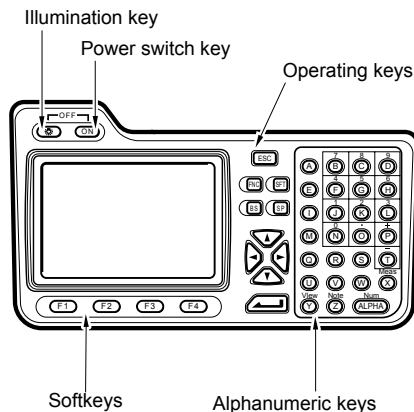
Maintenance

- Wipe off moisture completely if the instrument gets wet during survey work.
- Always clean the instrument before returning it to the case. The lens requires special care. First dust it off with the lens brush, to remove tiny particles. Then, after providing a little condensation by breathing on the lens, wipe it with a soft clean cloth or lens tissue.
- If the display is dirty, carefully wipe it with a soft, dry cloth. To clean other parts of the instrument or the carrying case, lightly moisten a soft cloth in a mild detergent solution. Wring out excess water until the cloth is slightly damp, then carefully wipe the surface of the unit. Do not use any organic solvents or alkaline cleaning solutions.
- Store the SET in a dry room where the temperature remains constant.
- Regularly check the tripod for loose feet or damaged thumbscrews when it is used for a long time.
- If any trouble is found with the rotating part, screws or optical parts (e.g. lens), contact your Sokkia agent.
- When the instrument is not used for a long time, check it at least once every 3 months in accordance with "14. CHECKS AND ADJUSTMENTS."
- When removing the SET from the carrying case, never pull it out by force. The empty carrying case should then be closed to protect it from moisture.
- Have the SET checked once or twice a year at your Sokkia agent to maintain its high precision.

4. PARTS OF THE INSTRUMENT



5. KEY FUNCTIONS



Power switch key


To switch the power on, press **<ON>**.

To switch the power off, while holding **<ON>**, press **<☀>**.

Illumination key

To switch the display and reticle illumination on / off, press **<☀>**.

Note

Instrument parameter No. 7.  "15. CHANGING INSTRUMENT PARAMETERS"

Parameter No. 7 can be used to change the brightness of the reticle illumination.

Softkeys

The bottom line of the SET display lists 4 softkeys. A softkey is a software key; the definition of the key is shown in the bottom line of the display.

Use keys **<F1>** through **<F4>** at the bottom left of the keyboard to select the corresponding softkey on the display.

Press **<FNC>** to view softkeys displayed on the next screen pages.

Operating keys

<ESC>	Transfer from REC mode to MEAS mode Transfer to previous display (Exit from the mode) Set the data to 0 Display the instrument data in MEAS mode
<FNC>	Display other functions
<SFT>	Switch between upper and lower case
<BS>	Delete a character
<SP>	Input a space
<▲> <▼>	Up and down cursor keys
<◀> <▶>	Select other options
<↔>	Generally accepts and stores data
<ALPHA>/<Num>	Switch between alphabetic and numeric input
<Meas>	Transfer from REC mode to MEAS mode
<View>	Display data in the current job
<Note>	Enter a note

6. DISPLAY SYMBOLS

- The following symbols appear in MEAS mode.

P.C.mm:	Prism constant
ppm:	Atmospheric correction
H.obs:	Horizontal angle right
HAL:	Horizontal angle left
V.obs:	Zenith angle
VA:	Vertical angle (Horizontal = 0)
S.Distance:	Slope distance
H.Distance:	Horizontal distance
V.Distance:	Height difference
N:	Numerical input
A:	Alphabet input
⌞:	Tilt angle compensation on

Remaining battery power

(BDC35A, Temperature=25°C, EDM on)

■ 3:	90 to 100%
■ 2:	50 to 90%
■ 1:	10 to 50%
■ 0:	0 to 10%

7. MENU STRUCTURE

MEAS mode

(Page 1)

<REC> Transfer to REC mode
<M.DISP> Distance mode selection
<CNFG> Parameter setting
<READ> Distance measurement

(Page 3)

<PPM> Atmospheric Correction
<REM> REM Measurement
<MLM> Missing line Measurement
<S-O> Setting-out Measurement

(Page 2)

<OSET> Horizontal angle 0 set
<H.ANG> Set horizontal circle to a required value
<AIM> Return signal checking
<TILT> Tilt angle display

<REC>

<ESC>

REC mode

<FUNC>

Job
Instrument
Job Settings
Configure Reading
Tolerances
Units
Date and Time
Job Deletion
Feature Code List
Hardware
Communications
Language

<SURV>

Topography
Traverse Adjustment
Resection
Set Collection
Set Review
Building Face Survey
Collimation
Tilt offset
Remote Elevation
Keyboard Input

<COGO>

Set Out Coords
Set Out Line
Set Out Arc
Resection
Inverse
Areas
Intersections
Point Projection
Taping From Base-line
Transformation
Keyboard Input

<ROAD>

Select road
Set out Road
Set out road surface
Road topo
Cross-Section Survey
Define road
Review road
Define template
Review template

7. MENU STRUCTURE

MEAS mode

P.C. mm	-30	0
ppm	0	0
	2	0
	2	0
H.obs	270°00'00"	2
V.obs	90°01'20"	2
S.Dist	<Null>	2
1	REC M.DISP CNFG READ	>
2	OSET H.ANG AIM TILT	>
3	PPM REM MLM S-O	>

Status screen

SOKKIA	
SET2220	VXX-XX
1 MB	No.012011
Expert	

<ESC>



<any key>

<REC>

<ESC>

<Meas>

REC mode

Feb-13-01	14:24:27
Job	
Stn	
BS pt	
Free recs	1000
FUNC SURV COGO ROAD	

View screen

Job	SOKKIA
Scale	1.00000000
Note	Feb-13-01 14:24
Instrument	SET2220
Stn	P1
Atmos	TP
RED	BS
SRCH SHFT PREV NEXT	

<View>



<ESC>



Note screen

Note
ABC
TIME
FCON A

<Note>



<ESC>



8. MOUNTING THE BATTERY

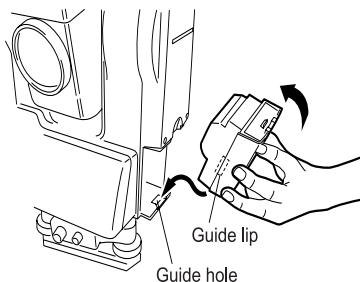
- Fully charge the battery before measurement.



Switch off the power before removing the battery.

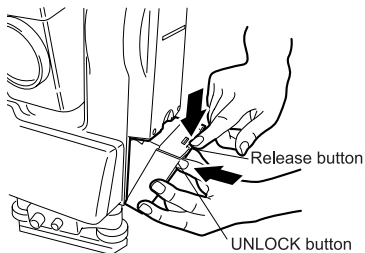
►PROCEDURE Mounting the battery

1. Insert the battery by aligning the battery guide with the guide hole in the instrument.
2. Press the top of the battery until you hear a click.



►PROCEDURE Removing the battery

1. While pressing UNLOCK button, press the release button downward.
2. Remove the battery by pulling it toward you.



9. SETTING UP THE INSTRUMENT

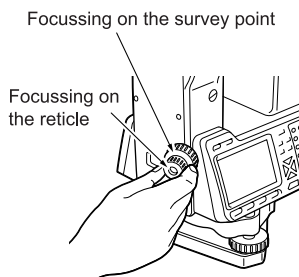
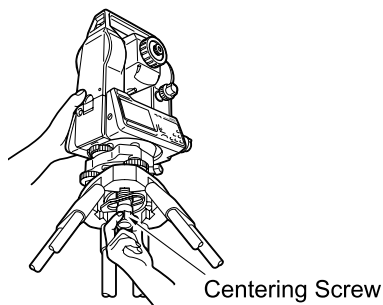
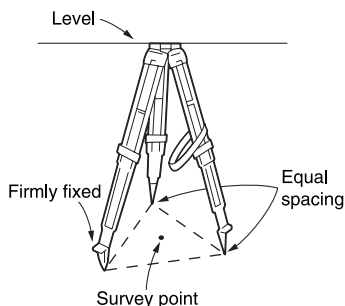
Caution

- Mount the battery in the instrument before performing this operation. If the battery is mounted after the instrument is set up, the instrument will tilt.


9.1 Centering

► PROCEDURE

1. Make sure the legs are spaced at equal intervals and the head is approximately level.
2. Set the tripod so the center of the head is positioned directly over the surveying point.
3. Make sure the tripod shoes are firmly fixed in the ground.
4. Place the instrument on the tripod head.
5. Supporting the instrument with one hand, tighten the centering screw to fix it to the female screw on the base plate of the instrument.
6. Looking through the optical plummet eyepiece, turn the optical plummet eyepiece to focus on the reticle.
7. Turn the optical plummet focussing ring to focus on the surveying point.

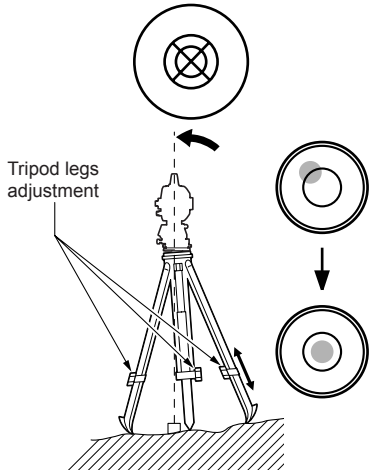


9.2 Levelling

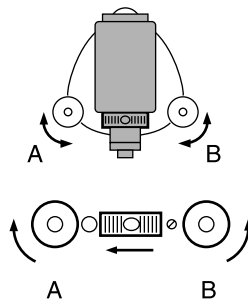
- If you require higher precision levelling after completing the following procedure, please refer to "  Levelling using the tilt angle display" .

► PROCEDURE

- Adjust the levelling foot screws to center the surveying point in the optical plummet reticle.
- Center the bubble in the circular level, by either shortening the tripod leg closest to the off center direction of the bubble or by lengthening the tripod leg farthest from the off center direction of the bubble.



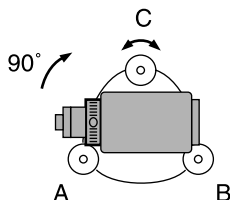
- Turn the upper part of the instrument until the plate level is parallel to a line between levelling foot screws A and B. Center the bubble using levelling foot screws A and B.



- The bubble moves towards a clockwise rotated levelling foot screw.

9. SETTING UP THE INSTRUMENT

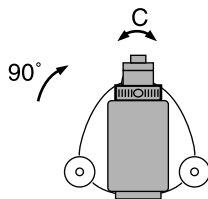
4. Turn the upper part of the instrument through 90° . The plate level is now perpendicular to a line between levelling foot screws A and B. Center the bubble using levelling foot screw C.



5. Turn the upper part of the instrument a further 90° and check to see if the bubble is still in the center of the plate level.

- a. Turn levelling foot screws A and B equally in opposite directions to remove half of the bubble displacement.
- b. Turn the upper part a further 90° , and use levelling foot screw C to remove half of the displacement in this direction.

Or try the adjustment described in "14.1 Plate level".



6. Turn the instrument and check to see if the bubble is in the same position in all directions. If it is not, repeat the levelling procedure.
7. Loosen the centering screw slightly. Looking through the optical plummet eyepiece, slide the instrument over the tripod head until the surveying point is exactly centered in the reticle. Retighten the centering screw securely.
8. Confirm that the bubble in the plate level is centered. If not, repeat the procedures starting from step 4.

10. POWER ON AND PREPARATION FOR MEASUREMENT

- The following preparations are required for measurement.

10.1 Power on / off

►PROCEDURE Power on


- Press **<ON>**.

When the power is switched on, a self-check is performed. If the instrument is operating normally, the display indicates that the instrument is ready for vertical and horizontal circle indexing.

H 0 set

V 0 set

- When parameter No. 11 "V indexing" is set to "Manual," the display appears as at right.

 "18. MANUALLY INDEXING THE VERTICAL CIRCLE."

H 0 set

V Face 1


Press ENT when done

- When parameter No. 10 "H indexing" is set to "Manual," "H 0 set" does not appear.

V 0 set

10. POWER ON AND PREPARATION FOR MEASUREMENT

- After power-off without indexing circles, the right display appears and a warm boot occurs.


 Page ii, "Warm boot".

```
DR DOS Release 5.0
Copyright (c) 1976,1
982,1988,1990 Digita
l Research Inc. All
rights reserved.
```

```
P.C. mm      -30
ppm           0
              █2

H.obs         0 set
V.obs         0 set
S.Dist        <Null>
```

- Furthermore, when parameter No. 11 "V indexing" is set to "Manual," the display appears as at right, instead of as in the above display.

 "18. MANUALLY INDEXING THE VERTICAL CIRCLE".

```
P.C. mm      -30
ppm           0
              █2

H.obs         0 set
V.obs         Face 1
S.Dist        <Null>
```

READ

Note


- Instrument parameter No. 10
Parameter No. 10 can be used to change the horizontal circle indexing method. Options are indexed by rotating the upper part or indexing and zero setting at power-on.
- Instrument parameter No. 11
Parameter No. 11 can be used to change the vertical indexing method. Options are indexed by transiting the telescope or indexing by face 1 (face left) and face 2 (face right) sightings.


 "15. CHANGING INSTRUMENT PARAMETERS"

► PROCEDURE Power off







- While pressing **<ON>**, press .

Caution

- If the remaining battery power is low, the symbol  is displayed every 3 seconds. Stop all work as quickly as possible, switch off the power and charge the battery.
- Before removing the battery, turn off the power to the instrument. Otherwise a warm boot occurs.

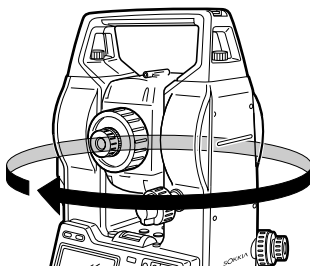
 Page ii, "Warm boot".

10.2 Indexing Horizontal and Vertical circles

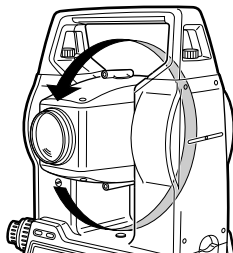
-  Resume function: "10.4 Setting the Instrument options"  Resume function"
-  Tilt angle compensation: "10.4 Setting the Instrument options"  Automatic tilt angle compensation"
-  Releveling: "10.4 Setting the Instrument options"  Levelling using the tilt angle display

►PROCEDURE Horizontal circle indexing



- Loosen the horizontal clamp and rotate the upper part of the instrument until the SET beeps. The horizontal circle is indexed.



- Loosen the vertical clamp and transit the telescope. When the objective lens crosses the horizontal plane in face 1, the SET beeps and the vertical circle is indexed.



When the horizontal circle and vertical circle have been indexed, the display appears as at right.

P.C.	mm	-30
ppm		0
		 2
		 1
H.obs		270°00'00"
V.obs		90°01'20"
S.Dist		<Null>
1	REC	M.DISF CNFG READ

10. POWER ON AND PREPARATION FOR MEASUREMENT

- If this error message is displayed, the instrument tilt sensor has exceeded the tilt angle compensation range.
Level the instrument once again and display the horizontal and vertical angles.

P.C. mm	-30
ppm	0
	2
	1
H.obs	<Null>
V.obs	Out of range
S.Dist	<Null>
1	REC M.DISP CNFG READ N

Note

- Each time the instrument is switched on, the horizontal and vertical indexes must be redetermined.
- When the resume function is available, the screen previous to power off is displayed.
- Instrument parameter No. 8.

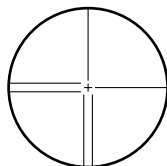
Parameter No.8 can be used to switch off and on automatic tilt angle compensation; for example, it should be switched off if the display is unsteady due to vibration or strong wind.

☞ "15. CHANGING INSTRUMENT PARAMETERS"

10.3 Focussing and target sighting



►PROCEDURE Focussing on the telescope's reticle image

1. Direct the telescope eyepiece at a bright and featureless background.



2. Looking through the telescope eyepiece, turn the eyepiece clockwise, then gradually counterclockwise until just before the reticle image becomes focussed.
- Using these procedures, frequent reticle refocussing is not necessary, since your eye is focussed at infinity.

3. Loosen the vertical and horizontal clamps, then use the peep sight to bring the target into the field of view. Tighten both clamps.
4. Turn the telescope focussing ring to focus on the target.
5. Turn the vertical and horizontal fine motion screws to accurately align the reticle image and the center of the target.
- Perform the levelling with both fine motion screws so that in both cases the last turn is to the right.
6. Readjust the focus with the focussing ring until there is no parallax between the target and the reticle image.

 Eliminating parallax:"10.4 Setting the Instrument options  Eliminating parallax"

10.4 Setting the Instrument options

- Confirm that these parameters are set in accordance with measurement conditions. Especially be sure to set parameter No.'s 3, 4 and 6 to your requirements.
- To confirm or change the parameter options, please refer to "15. CHANGING INSTRUMENT PARAMETERS."

Caution

- About one week after the last operation or after warm boot is performed, parameter No.'s 1, 2, 4 and 7 are changed to the factory settings automatically, while others remain unchanged.
- After cold boot is performed, all the parameters are changed to the factory setting automatically

No.	Parameter	Options
1	H. obs	Right *
		Left
2	V. obs	Zenith*
		Horiz
3	Meas mode	Fine *
		Rapid
		Track **
4	Meas repeat	Yes
		No*
5	Reflector type	Prism *
		Sheet
6	P.C. mm	-30mm * (-99 to 99mm)
7	Reticle	Bright *
		Dim
8	Tilt crn	Yes *
		No
		X only

10. POWER ON AND PREPARATION FOR MEASUREMENT

9	Collimation crn	Yes *
		No
10	H indexing	Auto *
		Manual
11	V indexing	Auto *
		Manual

* : Factory setting

** : If you set parameter No. 3 to "Tracking," the distance is measured independently of parameter No. 4 setting.

Caution

- If No. 2 and 6 parameter options and ppm setting are different from ones in REC mode, the display asks whether you want to discard the setting in MEAS mode or not when changing the mode from MEAS mode to REC mode.

Press **<Yes>** to discard the setting in MEAS mode. Or press **<No>** to keep the setting in MEAS mode. A new Instrument record or Station setup record will be required in REC mode. "ppm" is the exception. Even if **<No>** is selected, ppm setting in MEAS mode is discarded.

Discard changes V.obs P.C. mm ppm Confirm? YES NO
--

- There are other parameters in REC mode which control measurement options. To confirm or change the parameter options, please refer to the **"SDR SOFTWARE REFERENCE MANUAL"** for details.

10. POWER ON AND PREPARATION FOR MEASUREMENT



Horizontal angle back-up

- Parameter No. 10 default setting allows for the memorization of the previous horizontal 0 position at power-off for about 1 week. When next switching on the SET and indexing the horizontal circle again, the horizontal angle is recovered at the previously-memorized 0 position. This feature is useful when the battery voltage becomes low during measurement or after automatic power-off has occurred.



Resume function

- "Resume function" means to return to or begin again after interruption. It means that the previous screen is recovered after switching on and indexing the horizontal and vertical circles.
- The resume function does not work after more than 1 week (memory back-up period). In that case, the SET returns to MEAS mode after switching on and indexing the horizontal and vertical circle.



Automatic tilt angle compensation

P.C. mm	-30
ppm	0
	▲2
	↑
H.obs	0°01'20"
V.obs	90°00'00"
S.Dist	<Null>
1	REC H.DISP CNFG READ

- When the (compensation symbol) is shown on the display, the horizontal and vertical angles are automatically compensated for small tilt errors using the 2-axis tilt sensor.
- Read the automatically compensated angles after the display has stabilized.
- The formula used for calculation of the compensation value applied to the horizontal angle uses the tilt and vertical angles as follows:

Compensated horizontal angle

= Measured horizontal angle +

Tilt in Angle Y/tan (vertical angle)

The horizontal angle error (vertical axis error) fluctuates according to the vertical axis, so when the instrument is not completely levelled, changing the vertical angle by rotating the telescope will cause the displayed horizontal angle value to change. (The displayed horizontal angle value will not change during telescope rotation when the instrument is correctly levelled.)

- When the telescope is directed close to the zenith or nadir angle, tilt compensation is not applied to the horizontal angle.



Eliminating parallax

- Parallax 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 refocussing the reticle.



Power-saving automatic cut-off

- The SET switches off automatically 10 minutes after the last operation.
- This preset period can be changed in "Function" menu, "Date and Time," of REC mode. Please refer to the **"SDR SOFTWARE REFERENCE MANUAL."**



Collimation correction

- The displayed angles are corrected automatically by the stored collimation corrections.
- Parameter No. 9 can be used to turn "Collimation" off.

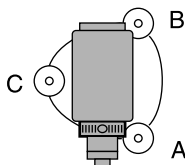


Levelling using the tilt angle display

- It is possible to display the state of tilt of the instrument graphically or numerically and level the instrument. The measurement range is $\pm 3'$.

►PROCEDURE

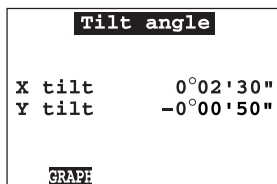
- Turn the instrument until the telescope is parallel to a line between levelling foot screws A and B, then tighten the horizontal clamp.
- Press **<FNC>** to go to next page.



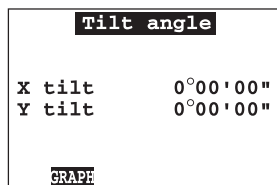
P.C. mm	-30
ppm	0
	2
	1'
H.obs	100°43'00"
V.obs	89°10'20"
S.Dist	<Null>
2	0SET H.ANG AIM TILT

10. POWER ON AND PREPARATION FOR MEASUREMENT

3. Press **<TILT>** to display the tilt angle.



4. Set both tilt angles to 0° by turning the levelling screws.
A and B for the X direction and C for the Y direction.



5. To exit from the tilt angle display, press **<ESC>**.

- To display the tilt angle graphically, press **<GRAPH>**.

"●" represents the bubble in the circular level.

The range of the inside circle is $\pm 3'$ and the range of the outside circle is $\pm 4'$.

Press **<DIGIT>** to return to the numeric display.



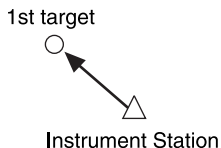
11. ANGLE MEASUREMENT

11.1 Measuring the horizontal angle between 2 points <H angle 0>

- To measure the included angle between 2 points, the horizontal circle can be set to 0° at any direction.

►PROCEDURE Measuring the horizontal angle between 2 points

- Using horizontal clamp and fine motion screw, sight the first target.

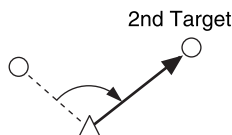


- In the second page of MEAS mode, press <0SET>. The horizontal angle display has been set to "0°" as at right.

P.C. mm	-30
ppm	0
	2
	↑
H.obs	0°00'00"
V.obs	112°21'20"
S.Dist	<Null>
2	0SET H.ANG AIM TILT

- Sight the second target. The displayed horizontal angle (H.obs) is the included angle between the 2 points.

The displayed horizontal angle (H.obs) is the included angle between the 2 points.



P.C. mm	-30
ppm	0
	2
	↑
H.obs	140°32'40"
V.obs	92°30'10"
S.Dist	<Null>
1	REC M.DISP CNFG READ

11.2 Setting Horizontal circle to a required value

- You can also set the horizontal circle of the target direction to any required value.

►PROCEDURE Setting Horizontal circle to a required value

In the second page of MEAS mode

- Press **<H.ANG>** to go to H angle input mode.
- Input the required horizontal angle value by using the numeric keys.

P.C. mm	-30
ppm	0
	2
	↑
H.obs	90.2030
V.obs	112°21'20"
S.Dist	<Null>
2	0SET H.ANG AIM TILT N

This prompt means that the keyboard is in numeric mode.

- Press **<←→>**.
The value entered becomes the horizontal angle (H.obs).

Note

- Input range
SET2220 :0° to 359° 59' 59.5"
SET3220/4220 :0° to 359° 59' 59"
- Least input
SET2220: 0.5"
SET3220/4220: 1"
- Correct value: **<BS>** (To clear the value: **<ESC>**)
- Exit from the input: **<ESC>**
- e.g. To set the horizontal circle to 90° 30' 20", input value of "90.3020".

12. DISTANCE MEASUREMENT

- The distance is measured according to parameter No.'s 3 and 4.

 "15. CHANGING INSTRUMENT PARAMETERS"

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.



Atmospheric correction factor and Humidity

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.

 "19. ATMOSPHERIC CORRECTION FOR HIGH PRECISION DISTANCE MEASUREMENT"

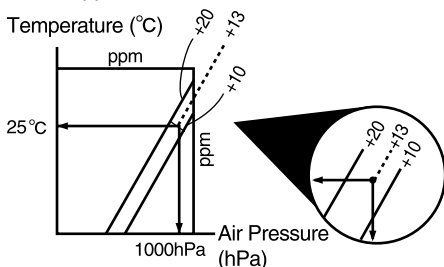
- The SET is designed so that the correction factor is 0ppm at a temperature of 15°C (59°F), an atmospheric pressure of 1013hPa (29.9inchHg) and humidity of 0%.
- By inputting the temperature and air pressure values, the correction value is calculated and set into the memory. The formula used is as follows:

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

- If the atmospheric correction is not required, set the ppm value to 0.
- To input ppm value, read the correction factor from the "**ATMOSPHERIC CORRECTION CHART.**"

12. DISTANCE MEASUREMENT

- Temperature = 25°C and
Pressure = 1000hPa
Correction value = +13ppm



- For precise distance measurement, relative humidity should be taken into account together with atmospheric pressure and ambient temperature.
☞ "19. ATMOSPHERIC CORRECTION FOR HIGH PRECISION DISTANCE MEASUREMENT" and the "SDR SOFTWARE REFERENCE MANUAL" for setting.

►PROCEDURE ppm setting 1 (Pressure & temperature)

In the third page of MEAS mode

- Press <PPM> to go to ppm setting mode.
- Input a pressure value by using the numeric keys.
- Press <←> or <▼>.
- Input a temperature value.
- Press <←>.

ppm setup	
	Press/Temp
Pressure	1013.0
Temperature	15.00

P.C. mm	-30
ppm	0
	2
	↑
H.obs	30°19'20"
V.obs	90°50'00"
S.Dist	<Null>
1	REC M.DISP CNFG READ

The atmospheric correction value is set, and is displayed on the second line of the display.

Note

- Pressure input range: 500 to 1400 hPa
- Temperature input range: -30 to 60°C
- Data storage period: About a week (Power-off possible)
- Exit from ppm mode: **<ESC>** (MEAS mode)

►PROCEDURE ppm setting 2 (Pressure, temperature & humidity)

In the third page of MEAS mode

1. Press **<PPM>** to go to ppm setting mode.
2. Press **<▶▶>** to set up "Press/Temp/Humid".
3. Input a pressure value by using the numeric keys.
4. Press **<▼>**.
5. Input a temperature value.
6. Press **<▼>**.
7. Input a humidity value.
8. Press **<◀▶>**.

ppm setup	
Press/Temp/Humid	
Pressure	1013.0
Temperature	15.00
Humidity	0

P.C. mm	S.Dis80
ppm	0
	2
	1"
H.obs	30°19'20"
V.obs	90°50'00"
S.Dist	<Null>
1	REC M.DISP CNFG READ

The atmospheric correction value (ppm) is set, and is displayed on the second line of the display.

Note

- Pressure input range: 500 to 1400 hPa
- Temperature input range: -30 to 60°C
- Humidity input range: 0 to 100%
- Data storage period: About a week (Power-off possible)
- Exit from ppm mode: **<ESC>** (MEAS mode)

►PROCEDURE ppm setting 3 (Correction value)

In the third page of MEAS mode

12. DISTANCE MEASUREMENT

1. Press **<PPM>** to go to ppm setting mode.
2. Press **<➡>** to set up "ppm input".
3. Input a correction value by using the numeric keys.
4. Press **<↔>**.

```
ppm setup
ppm      ppm input  0
```

```
P.C. mm      -30
ppm           0
             2
             1
H.obs        30°19'20"
V.obs        90°50'00"
S.Dist       <Null>
1 REC M.DISP CNFG READ
```

The atmospheric correction value is set, and is displayed on the second line of the display.

Note

- ppm value input range: -499 to 499ppm
- Data storage period: About a week (Power-off possible)
- Exit from ppm mode: **<ESC>** (MEAS mode)
- To change the units of the pressure, set the unit "**Pressure**" to "**Inch Hg**" or "**mmHg**" in "**Functions**" menu referring to the "**SDR SOFTWARE REFERENCE MANUAL**". To change the units of the temperature, set the unit "**Temp**" to "**Fahrenheit**" in "**Functions**" menu referring to the "**SDR SOFTWARE REFERENCE MANUAL**".
- Pressure input range: 14.8 to 41.3inchHg
Pressure input range: 375 to 1050mmHg
- Least input: 0.1inchHg
Least input: 1mmHg
- Temperature input range: -22 to 140°F Least input: 1°F

12.2 Returned signal checking

- Checking that the returned signal is adequate for measurement is particularly useful when performing long distance measurements.

►PROCEDURE Returned signal checking

In the second page of MEAS mode

1. Sight the center of the target with the telescope.
2. Press **<AIM>** to go to Return signal checking mode.
 "*" is displayed when the signal strength is adequate.
- To output an audio tone when the signal strength is adequate, press **<BEEP>**.
 To stop an audio tone, press **<OFF>**.
3. Press **<OK>** to finish the checking mode.

```

P.C. mm      -30
ppm          0
             ▲2
             ↑*
H.obs        350°38'10"
V.obs        112°21'20"
S.Dist       <Null>
2  OSET H.ANG AIM TILT

```

```

      Aiming

Signal  ■■■■■□□□*

      READ BEEP      OK

```

Or press **<READ>** to start the distance measurement.

Note

- When "*" is not displayed, sight the target center again.
- When "■■■■■□□□■" is displayed and if this display persists, please contact your local SOKKIA agent.
- When the light intensity is sufficient even though the center of the reflective prism and the reticle are slightly misaligned (short distance etc.), "*" will be displayed in some cases, but in fact, accurate measurement is impossible. Therefore make sure that the target center is sighted correctly.

12.3 Distance and angle measurement

►PROCEDURE Distance measurement (Slope distance)

In the first page of MEAS mode

1. Press **<READ>** to start the distance measurement.

```

P.C. mm      -30
ppm          0
             ▲2
             ↑*
H.obs        0°01'20"
V.obs        90°02'30"
S.Dist       <Null>
1  REC H.DISP CNFG READ

```

12. DISTANCE MEASUREMENT

The measured horizontal angle (H.obs), vertical angle (V.obs) and distance (S.dist) are displayed.

2. Press **<STOP>** or **<ESC>** to stop the measurement.

P.C. mm	-30
ppm	0
	1.2
	1"
H.obs	0°01'20"
V.obs	90°02'30"
S.Dist	<Null>
1	REC M.DISP CNFG READ



- If single measurement has been selected, the measurement stops automatically.
- To change distance mode, press **<M.DISP>**. Every time **<M.DISP>** is pressed, distance mode is changed (slope distance, horizontal distance, Height difference, and coordinates).



Coordinate measurement

- When coordinates are selected as distance mode, SET calculates the 3-dimensional coordinates of the target based on station point coordinates (default is 0) and the azimuth angle. (SET regards the horizontal angle which is set to 0 as the azimuth angle.) Instrument station coordinates can be set by pressing **<OPTNS>** in setting mode.



- The following are other functions that can be used in MEAS mode.

<REM>: REM (Remote elevation measurement).

Input the target height first, and measure the distance from the instrument to the target and the instrument to the object. The height from the surveying point to the object can be found.

<MLM>: Missing line measurement.

Measure the starting point first, and measure multiple targets to get the distance and angle from the starting point. It is possible to change the last measured point to the next starting position.

<S-O>: Setting-out measurement.

The point to be found is calculated using the horizontal angle from the reference direction and the distance from the instrument station. A required point can be found by inputting distance and angle values.

13. ERROR MESSAGES

- The following is a list of error messages displayed by the SET and the meaning of each message.
- If the same error message is repeated or if any message not shown below appears, please contact your Sokkia agent.

Bad condition

Distance measurement conditions are poor. Sight the target or reflecting prism again, and confirm the returned signal using the signal checking mode.

P.C. too large

The prism constant is out of the range -99 to 99mm.

Re 0 set

An error occurred when measuring a horizontal or vertical angle. Index the horizontal and vertical circle again. (If the SET telescope or upper part is rotated faster than 4 revolutions per second, this error indication is displayed.)

Signal off

The reflected light is not observed when distance measurement begins. Or, during measurement, the reflected light has weakened or is blocked. Either sight the target again, or when using a reflective prism, increase the number of reflective prisms.

Tilt out of range

A tilt sensor range error occurred or tilt angle exceeds $\pm 3^\circ$. Level the SET again.

Timeout

In one case, a timeout occurred during communications. Check your cable connections and switches. If timeout occurred after successful initiation of communications, make sure the connected device is handling flow control correctly. Using a lower baud rate may solve the problem.

In another case, this occurred during measuring distance. No measured distance is received. Either sight the target again, or when using a reflective prism, increase the number of reflective prisms.

14. CHECKS AND ADJUSTMENTS

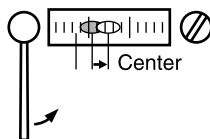
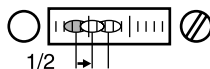
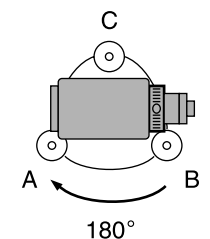
- Periodically, checks and adjustments should be performed before and during measurement. In addition, the instrument should be checked after long storage, transportation or when it may have been damaged by a strong shock.
- Always perform checking and adjustment in the proper sequence beginning from "14.1 Plate level" to "14.6 Additive distance constant."

14.1 Plate level

- The glass tube of the plate level is sensitive to temperature changes or shock.

► PROCEDURE Check and adjustment


- Level the instrument and check the position of the bubble of the plate level.
☞ "9.2 Levelling", steps 4 to 7
- Turn the upper part through 180° and check the bubble position. If the bubble is still centered, no adjustment is necessary. If the bubble is off-center, adjust as follows:
- Correct half of the bubble displacement using levelling foot screw C.
The bubble moves in the clockwise direction: the adjustment screw rotation direction.
- Correct the remaining half of the displacement by using the adjusting pin to rotate the plate level adjusting screw. When the plate level adjustment screw is turned in the counterclockwise direction, the bubble moves to the right.

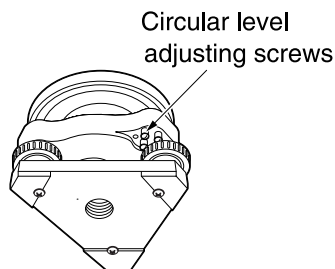


- Repeat the procedures from steps 1 to 4 until the bubble remains centered for any position of the upper part.
If the bubble cannot be centered, please contact your Sokkia agent.

14.2 Circular level

►PROCEDURE Check and adjustment

- Perform the plate level inspection and adjustment or carefully use the plate level to level the instrument.
 "9.2 Levelling", steps 1 to 3.
- Check the position of the bubble of the circular level.
If the bubble is off-center, adjust as follows:
- Verify the off-center direction of the bubble.
- Loosen the adjusting screw farthest from that direction to center the bubble.
- Adjust all 3 adjusting screws until the tightening tension of each screw is the same, and the bubble is centered.
If the bubble cannot be centered, please contact your Sokkia agent.



14. CHECKS AND ADJUSTMENTS

Caution

Do not over-tighten the adjusting screws as this may damage the circular level. Unequal tightening of the screws may mean that the bubble will go out of adjustment.

14.3 Tilt sensor

- If there is a tilt 0 point error, the tilt angle is not 0 when the instrument is levelled, and angle errors will occur. This tilt 0 point error can be checked and adjusted as follows.

► PROCEDURE Check

In the second page of MEAS mode

- Carefully level the SET.

```
P.C. mm      -30
ppm          0
             ▬2
             ↑
H.obs        120°30'20"
V.obs        90°00'00"
S.Dist       <Null>
2  OSET H.ANG AIM TILT
```

- Press <OSET> to set the horizontal angle to zero.

```
P.C. mm      -30
ppm          0
             ▬2
             ↑
H.obs        0°00'00"
V.obs        90°00'00"
S.Dist       <Null>
1  REC M.DISP CNFG READ
```

- Press <REC> to go to REC mode.
- Press <SURV> to go to next page.

```
Feb-13-01    14:24:17

Job
Stn
BS pt
             ▬2
Free recs    876
1  FUNC SURV COGO ROAD
```


5. Select "Tilt offset" by using \blacktriangleleft or \blacktriangleright and press \blacktriangleleft .

The tilt offset value and the tilt angle are displayed.


2nd line: Tilt 0 point data of X direction

3rd line: Tilt 0 point data of Y direction

5th line: Horizontal angle

6th line: Tilt angle of X direction

7th line: Tilt angle of Y direction

Tilt offset		
Remote elevation keyboard input		
FUNC	COGO	ROAD

6. Wait for a few seconds until the tilt angle readings are steady, and note the tilt angle values X1 and Y1.

Tilt offset	
X tilt. offset	1600
Y tilt. offset	1560
Face 1	
H.obs	0°00'00"
X tilt	-0°00'20"
Y tilt	-0°00'40"
READ	

7. Loosen the horizontal clamp and turn the theodolite through 180° by referring to the horizontal angle in the display. Tighten the horizontal clamp.

Tilt offset	
X tilt. offset	1600
Y tilt. offset	1560
Face 1	
H.obs	180°00'00"
X tilt	0°00'40"
Y tilt	-0°00'20"
READ	

8. When the tilt angle readings are steady, note the tilt angle values, X2 and Y2.
9. Calculate the offset values.
- $$(X1 + X2) / 2$$
- $$(Y1 + Y2) / 2$$
- If the offset values (X and Y) are $\pm 10''$ or less, no adjustment is necessary.

14. CHECKS AND ADJUSTMENTS

10. Press **<ESC>** to finish the check and return to "**Survey**" menu, and press **<ESC>** twice more to return to MEAS mode.

If one of the offset values is greater than $\pm 10''$, the sensor index should be adjusted as follows without pressing **<ESC>**.

► PROCEDURE Adjustment

11. Press **<READ>** to memorize tilt angle X2 and Y2.

Face 2" is displayed.

```
Tilt offset
X tilt. offset 1600
Y tilt. offset 1560
Face 2
H.obs          180°00'00"
X tilt          0°00'40"
Y tilt          -0°00'20"
READ
```

12. Loosen the horizontal clamp and turn the upper part through 180° by referring to the horizontal angle in the display.

```
Tilt offset
X tilt. offset 1600
Y tilt. offset 1560
Face 2
H.obs          0°00'00"
X tilt          -0°00'20"
Y tilt          -0°00'40"
READ
```

13. When the tilt angle readings are steady, press **<READ>** to memorize X1 and Y1.

New tilt 0 point data is displayed at the 6th and 7th line.

If either of the data is greater than 1600 ± 120 , press **<ESC>** to stop the adjustment.

The display asks whether the data is to be discarded.

Press **<YES>** to discard the data and return to "**Survey**" menu.

Please contact your Sokkia agent. If it is 1600 ± 120 or less, continue the adjustment without pressing **<ESC>**.

```
Tilt offset
X tilt. offset 1600
Y tilt. offset 1560
New tilt offset
X tilt. offset 1610
Y tilt. offset 1590
```

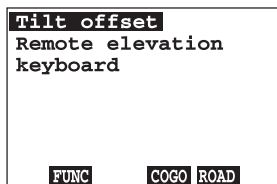
Discard data

Confirm?

YES

NO

14. Press **<←>** to store the new tilt 0 point data into the internal memory.
The display returns to "Survey" menu.

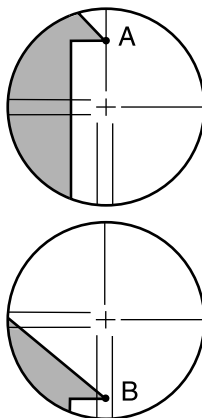


15. Press **<ESC>** twice to return to MEAS mode.

14.4 Reticle

► PROCEDURE Check 1 <Perpendicularity of the reticle to the horizontal axis>

- Carefully level the SET.
- Align a clearly visible target (the edge of A roof for example) on point A of the reticle line.
- Turn the telescope vertical fine motion screw to align the target to point B on the lower part of the reticle.
Check that the target is still centered within the reticle lines.
If the target is off-center, have your Sokkia agent adjust it.



► PROCEDURE Check 2 <Vertical and horizontal reticle line positions>

- Set up a clear target 100m (328ft) in the horizontal direction from the SET.



14. CHECKS AND ADJUSTMENTS

2. Carefully level the SET, switch the power on and index the horizontal and vertical circles.

P.C.mm	-30
ppm	0
	2
	↑
H.obs	18°34'00"
V.obs	90°30'20"
S.Dist	<Null>
1	REC M.DISP CNFG READ

3. Sight the target on face1.
Read the horizontal angle A1 and vertical angle B1.

e.g.

H angle A1 = 18° 34' 00"

V angle B1 = 90° 30' 20"

P.C.mm	-30
ppm	0
	2
	↑
H.obs	198°34'20"
V.obs	269°30'00"
S.Dist	<Null>
1	REC M.DISP CNFG READ

4. Now sight the target on face 2 and read the horizontal angle A2 and vertical angle B2.

e.g.

H angle A2 = 198° 34' 20"

V angle B2 = 269° 30' 00"

5. Calculate A2 - A1 and B2 + B1.

A2 - A1 (H angle)

= 198° 34' 20" - 18° 34' 00"

= 180° 00' 20"

B2 + B1 (V angle)

= 269° 30' 00" + 90° 30' 20"

= 360° 00' 20"

A2 - A1 should be within

180° ± 20".

B2 + B1 should be within

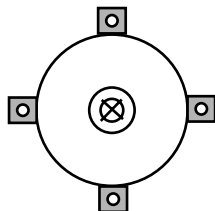
360° ± 20".

If a difference of more than ± 20" still remains after repeating these procedures several times, please contact your Sokkia agent.

14.5 Optical plummet

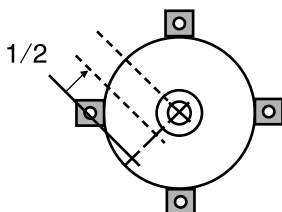
► PROCEDURE Check

1. Carefully level the SET and exactly center 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 centered, no adjustment is necessary.
If the surveying point is not still centered in the optical plummet, adjust as follows:



► PROCEDURE Adjustment

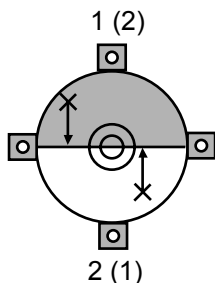
3. Correct half the deviation with the levelling foot screw.
4. Unscrew the optical plummet reticle cover and use the 4 adjusting screws of the optical plummet to adjust the remaining half of the deviation as show below.



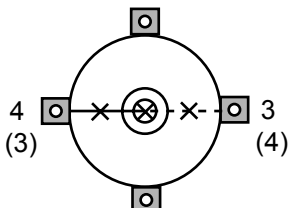
14. CHECKS AND ADJUSTMENTS

5. When the surveying point is on the lower (upper) part of the illustration :

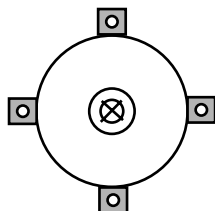
- 1 Loosen the upper (lower) screw slightly,
- 2 Tighten the lower (upper) screw by the same amount.



6. If the surveying point is on the solid line (dotted line):
- 3 Loosen the right (left) screw slightly and,
 - 4 Tighten the left (right) screw by the same amount.



7. Check the adjustment by rotating the upper part of the instrument. The surveying point should remain centered in the reticle. If necessary, repeat the adjustment.



8. Replace the optical plummet reticle cover.

Caution

Do not over-tighten the 4 adjusting screws as this may cause the reticle to go out of adjustment.

14.6 Additive distance constant

- The additive distance constant K of the SET is adjusted to 0 before delivery. Use a base line with a known distance precision to check that the additive distance constant K is close to 0 several times a year and whenever the values measured by the instrument begin to deviate by a consistent amount. Perform these checks as follows.

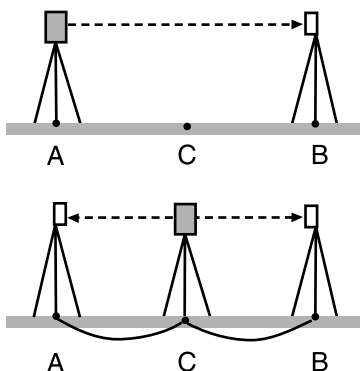
Caution

- Errors in setting up the instrument and reflective prism or in sighting the target will influence the additive distance constant, therefore perform these procedures as carefully as possible.
- Ensure that the target height is the same as the instrument height. If the ground is not flat, use an automatic level to set the correct instrument heights of all points.

► PROCEDURE Check

1. Select points A and B on flat ground about 100m apart, and establish point C in the middle.
2. Set up the SET at A and the target at B.
3. Measure (fine measurement) the distance between A and B 10 times.
4. Shift the SET to C and measure the distance between C and A and between C and B 10 times each.
5. Calculate the averages of AB, CA and CB.
6. Calculate the additive distance constant K using the following formula:

$$K = AB - (CA + CB)$$
7. Repeat steps 1 to 6 two or three times. If the additive distance constant K is within $\pm 2\text{mm}$ even once, adjustment is unnecessary. If it always exceeds this range, have your Sokkia agent perform an adjustment.



15. CHANGING INSTRUMENT PARAMETERS

- The instrument parameter settings can be changed by key operations to match the required measurement.
- The selected options are stored in the memory until they are changed.

Caution

- About one week after the last operation or after warm boot is performed, parameter No.'s 1, 2, 4 and 7 are changed to the factory settings automatically, while others remain unchanged.
- After cold boot is performed, all the parameters are changed to the factory setting automatically.

No.	Parameter	Options
1	H. obs: Horizontal angle display	Right *
		Left
2	V obs: Vertical angle display method	Zenith: Zenith 0° *
		Horiz: Horizontal 0°
3	Meas mode: Distance measurement mode	Fine *
		Rapid
		Track: Tracking **
4	Meas repeat: Distance repeat mode	Yes: Repeat
		No: Single *
5	Reflector type	Prism *
		Sheet
6	P.C. mm: Reflector constant	-30mm * (-99 to 99mm)
7	Reticle: Reticle illumination	Bright *
		Dim
8	Tilt crn: Tilt correction	Yes: H & V angle correction*
		No: No correction
		X only: Vertical angle correction
9	Collimation crn: Collimation correction	Yes *
		No

15. CHANGING INSTRUMENT PARAMETERS

10	H indexing	Auto: Rotate upper part *
		Manual: 0° at power on
11	V indexing	Auto: Transit telescope *
		Manual: Observe face1, face 2 measurements

* : Factory setting

** : If you set parameter No. 3 to "Tracking," the distance is measured independently of parameter No. 4 setting.

Caution

- If the parameter options in REC mode are different from ones in MEAS mode, the following parameter options in MEAS mode are changed automatically when changing the mode from REC mode to MEAS mode.
No. 2, V. obs, No. 3, Meas mode, No. 4, Meas repeat,
No. 5, Reflector type, No. 6, P.C. mm, No. 7, Reticle,
No. 8, Tilt crn and No. 9, Collimation crn.

►PROCEDURE Setting parameters

In the first page of MEAS mode

- Press **<CNFG>** to go to Parameter setting mode.

P.C. mm	-30
ppm	0
	2
	↑
H.obs	0°00'00"
V.obs	0°00'00"
S.Dist	<Null>
1	REC M.DISP CNFG READ

- Select the required parameter by using **<▼>** or **<▲>**.

- Change to the required option by using **<▶>** or **<◀>**.
When setting the prism constant correction value, use the numeric keys.

H.obs	Right
V.obs	Zenith
Meas mode	Fine
Meas repeat	No
Reflector type	Prism
P.C. mm	-30
Reticle	Bright
OPTNS	

15. CHANGING INSTRUMENT PARAMETERS

4. Press **<←→>** to set the parameters and options and return to MEAS mode.

Tilt crn	Yes
Collimation crn	Yes
H indexing	Auto
V indexing	Auto

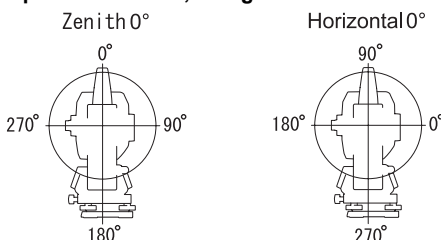
OPTNS



- Press **<OPTNS>** to set instrument station coordinates.



Instrument parameter No. 3, V angle format



Instrument parameter No. 6, Reflector constant correction value

Each reflecting target type has a different prism constant value. Here, you will set the constant correction value for the reflecting target being used.

The prism constant correction values for reflecting targets made by Sokkia are as follows:

AP01S+AP01 (Constant = 30mm) AP01 (Constant = 40mm) CP01 (Constant = 0mm)



Correction Value = -30



Correction Value = ∓ 40



Correction Value = 0

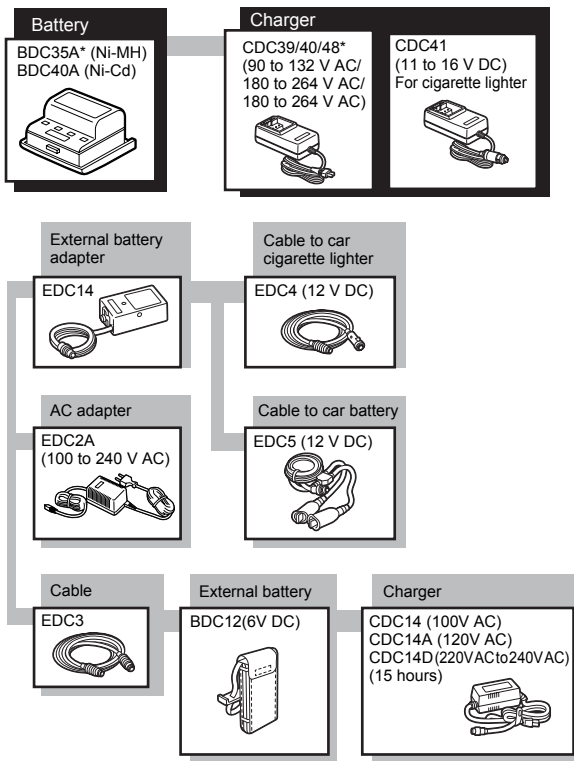
- Input range: -99 to 99mm
- Least input: 1mm

16. POWER SUPPLIES

- The SET can be operated with the following combinations of power equipment.

Caution

- Use the SET only with the combinations shown here.
- When using EDC14, EDC2A, and BDC12, mount the BDC35A in place to maintain the balance of the instrument.
- Ensure that the car cigarette lighter has 12VDC output and that the negative terminal is grounded.
- Leave the car engine running during use. Charging without running the engine will cause excessive discharge of the car battery.
- The EDC14 has a breaker switch. Normally the red mark appears on the breaker. If it cannot be seen, set the breaker so it is visible.
- When using a car battery, make sure that the polarity is correct.



*: Standard equipment. Others are optional accessories.

17. REFLECTING PRISMS AND ACCESSORIES

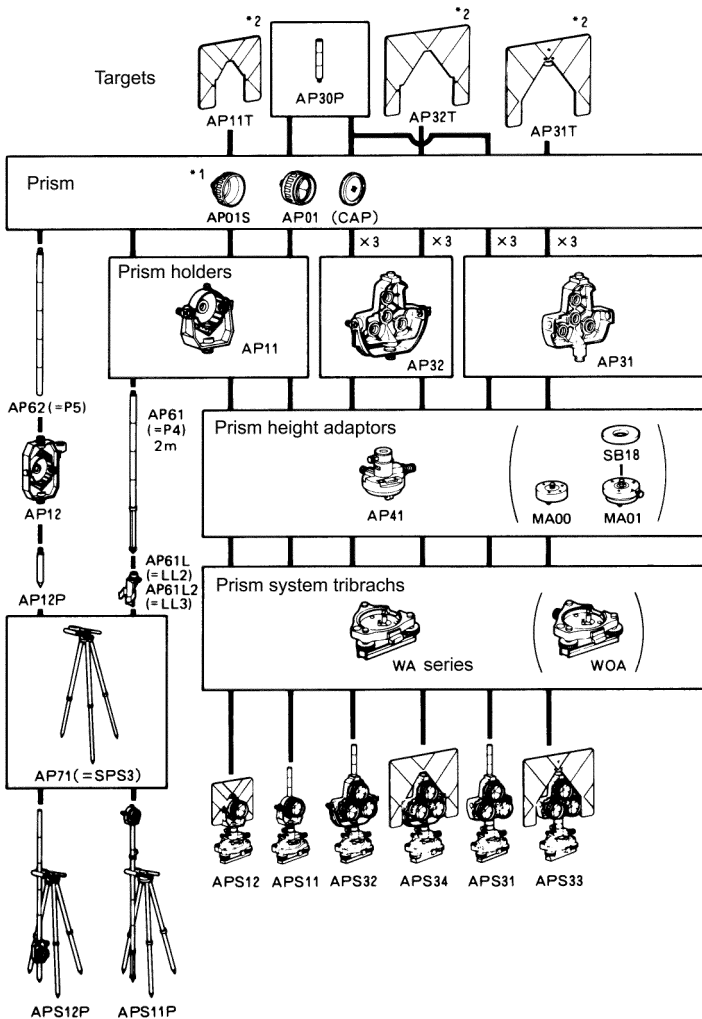
- All Sokkia prisms and accessories have standardized screws (5/8" x 11 thread) for ease of use.
- The following are all special accessories (sold separately).
- Because these targets (*2) are coated with fluorescent paint, they reflect when there is little light.

Caution

- When using a reflecting prism equipped with a target for distance and angle measurements, be sure to direct the reflective prism correctly and sight the center of the prism target accurately.
- Each reflective prism(*1) has its own prism constant value. When changing prisms, be sure to change the prism constant correction value.
- To use the triple prism assembly AP31 or AP32 as a single prism for short distance measurements, mount the single reflective prism AP01 in the center .

When using the reflecting prisms

- Carefully face the reflecting prism towards the instrument and sight the prism target center 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 center mounting hole of the prism holder.



17. REFLECTING PRISMS AND ACCESSORIES

● Instrument height adaptor (AP41)

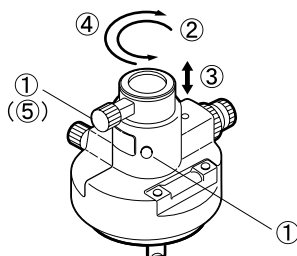
Caution

When using the instrument height adaptor AP41

- Check the plate level of the AP41 as described in "14.1 Plate level."
- Check that the optical plummet of the AP41 sights the same point as that of the SET by referring to "14.5 Optical plummet."
- Check that "236" (the height of the SET in mm) is displayed in the window of the instrument height adaptor AP41.

►PROCEDURE Adjusting the height of the AP41

1. Loosen the 2 fixing screws.
2. Turn the center part counterclockwise to unlock it.
3. Move it up or down until "236" appears in the window.
4. Turn the center part clockwise to lock it.
5. Tighten the fixing screws.



►PRECAUTION For the use of the tribrach

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

18. MANUALLY INDEXING THE VERTICAL CIRCLE

- Like all theodolites, the SET will have a small vertical index error. For high precision angle measurement, the vertical index error can be removed as follows:
- Set parameter No. 11 to "Manual" in advance.

►PROCEDURE Manually indexing the vertical circle

1. Level the SET.
"Face 1" is displayed.

P.C.mm	-30
ppm	0
	▀2
	↑
H.obs	0°00'00"
V.obs	Face 1
S.Dist	<Null>
READ	

2. In face 1, accurately sight a clear target at a horizontal distance of about 30m.

3. Press <READ>.
"Face 2" is displayed.

P.C.mm	-30
ppm	0
	▀2
	↑
H.obs	0°00'00"
V.obs	Face 2
S.Dist	<Null>
READ	

5. In face 2, accurately sight the same target.

6. Press <READ>.
The vertical circle has been indexed.

- If the power is switched off, the vertical circle should be indexed again. The procedures are as follows:

P.C.mm	-30
ppm	0
	▀2
	↑
H.obs	180°00'00"
V.obs	90°30'10"
S.Dist	<Null>
1 REC M.DISP CNFG READ	

18. MANUALLY INDEXING THE VERTICAL CIRCLE

►PROCEDURE Manually indexing at power on

1. Press **<ON>** to switch the power on.
"V Face 1" is displayed on the 4th line.

```
H  0 set
V  Face 1
Press ENT when done
```

2. Rotate the upper part of the instrument completely.

```
V  Face 1
Press ENT when done
```

3. In face 1, accurately sight a clear target at a horizontal distance of about 30m.

4. Press **<↔>**.
"V Face 2" is displayed on the 4th line.

```
V  Face 2
Press ENT when done
```

5. Loosen the horizontal clamp and rotate the upper part of the SET through 180°.

6. In face 2, accurately sight the same target.

7. Press **<↔>**.
The vertical circle has been indexed.

```
P.C.mn      -30
ppm          0
              ▲2
              ↑
H.obs        269°05'00"
V.obs        90°30'10"
S.Dist       <Null>
1  REC  M.DISP  CNFG  READ
```


19. ATMOSPHERIC CORRECTION FOR HIGH PRECISION DISTANCE MEASUREMENT

- Atmospheric correction

The SET uses a beam of infrared light to measure the distance. The velocity of this light in the atmosphere varies according to the temperature and pressure. The distance will be changed by 1ppm by:

- a variation in temperature of 1°C

- a variation in pressure of 3.6hPa

(A 1ppm change means a 1mm difference for every 1km of measured distance.)

To obtain high accuracy distance measurement, the temperature and pressure must be carefully measured by precise instruments.

The ppm correction should be applied when the calculated ppm value is over $\pm 5\text{ppm}$ or if the slope distance is more than 200m.

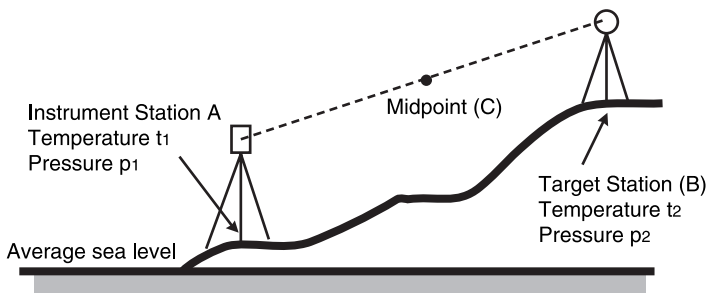
- Average temperature and pressure between 2 points in different atmospheric conditions

In flat terrain: Measure the temperature and pressure at the midpoint of the line as there is little variation in the values.

In mountainous terrain: Midpoint values should be used. If those values cannot be measured, measure temperature and pressure at the instrument and target stations, then calculate the average values.

$$\text{Average temperature} = (t_1 + t_2) / 2$$

$$\text{Average pressure} = (p_1 + p_2) / 2$$



19. ATMOSPHERIC CORRECTION FOR HIGH PRECISION DISTANCE MEASUREMENT

- Influence of relative humidity

The influence of humidity is very small. It is mainly of importance in very hot and humid conditions.

The correction value when the temperature, pressure and humidity values are input is calculated by using the following formula.

$$\text{ppm} = 278.96 - \frac{0.2904 \times P - 0.044735 \times e}{1 + 0.003661 \times T}$$

$$e = \frac{H \times e_w}{100}$$

$$e_w = a_0 T^4 + a_1 T^3 + a_2 T^2 + a_3 T + a_4$$

T: Temperature in °C

P: Pressure in hPa

e: Partial water vapour pressure in hPa

H: Humidity in %

e_w = Saturated water vapour pressure

$a_0 = 0.00000491539$

$a_1 = 0.00026202374$

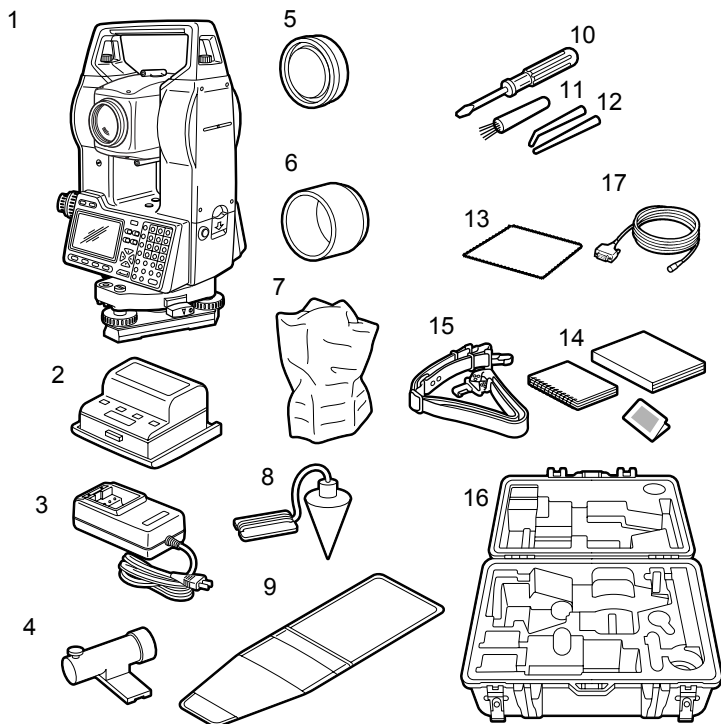
$a_2 = 0.01251534557$

$a_3 = 0.45183196592$

$a_4 = 6.32672468457$

20. STANDARD EQUIPMENT

Please verify that all equipment is included.

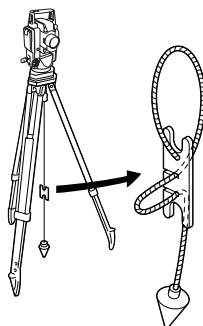


1	SET main unit.	1
2	Internal battery, BDC35A	2
3	Battery charger, CDC39/CDC40/CDC48	1
4	Tubular compass, CP7	1
5	Lens cap.	1
6	Lens hood.	1
7	Vinyl cover	1
8	Plumb bob	1
9	Tool pouch	1
10	Screwdriver	1
11	Lens brush.	1
12	Adjusting pin	2
13	Cleaning cloth	1
14	OPERATOR'S MANUAL	1
	SDR SOFTWARE REFERENCE	
	MANUAL	1
	ATMOSPHERIC CORRECTION	
	CHART	1
15	Carrying straps	1
16	Carrying case, SC141A	1
17	Interface cable, DOC27	1

20. STANDARD EQUIPMENT

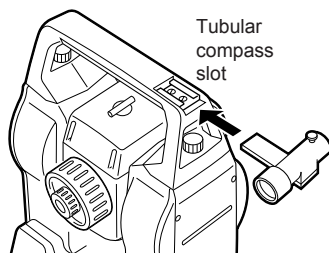
● Plumb bob

The plumb bob can be used to set up and center the instrument on days when there is little wind. To use the plumb bob, unwind its cord, pass it through the cord grip piece as shown in the figure to adjust its length, then suspend it from the hook attached to the centering screw.



● Tubular compass (CP7)

To mount the CP7, slide it into the tubular compass slot. To use, loosen the clamping screw to free the compass needle. Turn the instrument in the face 1 position until the compass needle bisects the index lines. The telescope will be nearly aligned with magnetic north. After use, tighten the clamp and remove the compass from the slot. Place it in the specified position in the carrying case.



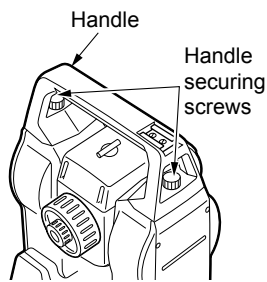
Caution

Magnetism and metal will influence the tubular compass, making it incapable of projecting true magnetic north. Do not use the magnetic north indicated by this compass for base line surveying.

- **Handle**

The carrying handle can be removed from the instrument.

To remove it, unscrew the handle securing screws.



21. OPTIONAL ACCESSORIES

- Data output cable DOC 46

The SET can be connected with a printer which uses the Centronics interface by attaching the data output cable DOC46. It is also possible to output the data directly from the SET to a parallel printer.

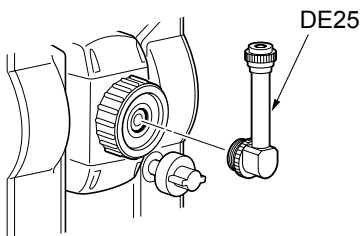


- Diagonal eyepiece DE25

The diagonal eyepiece is convenient for near-vertical observations and in narrow spaces.

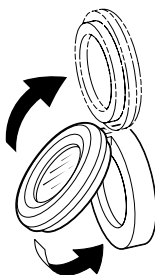
Magnification :30X

Remove the handle and the telescope eyepiece by unscrewing the mounting ring, and screw in the diagonal eyepiece.



- Solar filter OF3A

For observations made facing the sun, and where glare is present. The OF3A (flip-up) filter is mounted on the objective lens.



22. SPECIFICATIONS

Except where stated, specification apply to all SETs.

Telescope

Length	170mm
Aperture	45mm (EDM: 48mm)
Magnification	30x
Image	Erect
Resolving power	3"
Field of view	1° 30'
Minimum focus	1.0m
Reticle illumination	Bright or dim (selectable)

Angle measurement

Horizontal and Vertical	Incremental with 0 index circles type
Angle units	Degree / Gon / Mil / (Quad brng) (selectable)
Minimum display	
SET2220	1" (0.2mgon / 0.005mil) / 0.5" (0.1mgon / 0.002mil)
SET3220/4220	1" (0.2mgon / 0.005mil) / 5" (1mgon / 0.02mil) (selectable)
Accuracy	Standard deviation of mean of measurement taken in positions I and II (ISO/DIS 12857-2 (1997))
SET2220	2" (0.6mgon / 0.01mil)
SET3220	3" (1mgon / 0.015mil)
SET4220	5" (1.5mgon / 0.02mil)
Measuring time	Less than 0.5sec
Automatic compensator	Selectable ON (V & H / only V) / OFF
Type	Liquid, 2-axis tilt sensor
Minimum display	Agrees with minimum displayed measurement angle
Range of compensation	±3'
Measuring mode	
Horizontal angle	Right / Left (selectable)
Vertical angle	Zenith 0 / Horizontal 0 (selectable)

Distance measurement

Measuring range	(Slight haze, visibility about 20km, sunny periods, weak scintillation)
SET2220	Reflective sheet target RS90N-K: 2 to 120m OR1PA: 1 to 500m Compact prism CP01: 1 to 800m Standard prism AP01 x 1: 1 to 2400m Standard prism AP01 x 3: 1 to 3100m Standard prism AP01 x 9: 1 to 3700m

22. SPECIFICATIONS

SET3220	Reflective sheet target RS90N-K: 2 to 100m OR1PA: 1 to 500m Compact prism CP01:1 to 700m Standard prism AP01 x 1:1 to 2200m Standard prism AP01 x 3:1 to 2900m Standard prism AP01 x 9:1 to 3500m
SET4220	Reflective sheet target RS90N-K:2 to 80m OR1PA: 1 to 400m Compact prism CP01:1 to 600m Standard prism AP01 x 1:1 to 1600m Standard prism AP01 x 3:1 to 2100m Standard prism AP01 x 9:1 to 2500m
Minimum display	
SET2220	Fine measurement: 1 mm / 0.1mm (selectable) Rapid measurement: 1mm Tracking measurement: 10mm
SET3220 / 4220	Fine measurement: 1mm Rapid measurement: 1mm Tracking measurement: 10mm
Maximum slope distance	
SET2220	4200,0000m
SET3220 / 4220	4200,000m
Distance unit	meters / feet / US feet (selectable)
Accuracy	
(with reflective sheet target)	
Fine measurement:	$\pm (4 + 3\text{ppm} \times D) \text{ mm}$
Rapid measurement:	$\pm (5 + 5\text{ppm} \times D) \text{ mm}$ (with prism)
(with reflective prism)	
Fine measurement:	$\pm (2 + 2\text{ppm} \times D) \text{ mm}$
Rapid measurement:	$\pm (5 + 5\text{ppm} \times D) \text{ mm}$
Measurement mode	Fine measurement (single / repeat) / Rapid measurement (single / repeat) / Tracking measurement (selectable)
Measuring time	(When "C+R correction" is not being applied) (Slope distance) Fine measurement: 3.3s + every 1.6s Rapid measurement: 2.8s + every 0.8s Tracking: 2.3s + every 0.3s
Signal source	Infrared LED (Class1 IEC825-1:1993)

Atmospheric correction

Temperature input range	-30 to 60°C (in 0.01°C steps) / -22 to 140°F (in 0.01°F steps) (selectable)
Pressure input range	500 to 1399.8hPa (in 0.1hPa steps) / 375 to 1050mmHg (in 0.1mmHg steps) / 14.8 to 41.3inchHg (in 0.1inchHg steps) (selectable)
Humidity input range	0 to 100% (in 1% steps)
ppm input range	-499 to 499ppm (in 1ppm steps)
Prism constant correction	-99 to 99mm (in 1mm steps)
Earth curvature and refraction correction	No / Yes (K= 0.14 / K= 0.2) (selectable)

Power supply

Power source	Ni-MH rechargeable battery, BDC35A (6VDC)
Working duration at 25°C	
Distance & Angle measurement (Fine & single measurement, measurement interval = every 30 secs):	
BDC35A:	About 7.5 hours (About 800 points)
BDC40A:	About 3.4 hours (About 380 points)
BDC12:	About 14 hours (About 1600 points)
Angle measurement only:	
BDC35A:	About 9 hours
BDC40A:	About 5.4 hours
BDC12:	About 23 hours
Charging time	CDC39/40/48: About 70 minutes

General

CPU	V25+ (10MHz)
Operating system	DR-DOS® (MS DOS® compatible)
RAM	640Kbyte
SYSTEM ROM	128Kbyte
ROM DISK	1Mbyte
Internal memory	512Kbyte (About 4400 points)
Display	2 LCD graphic displays on each face 20 characters x 8 lines (120 dots x 64 dots)
Keyboard	43 keys (Soft function, Alphanumeric function, Operation, Power on, Illumination)
Automatic power cut off	Provided
Calendar / clock	Provided

22. SPECIFICATIONS

Data output	Asynchronous serial, RS-232C compatible Centronics compatible (with the optional cable DOC46)
Sensitivity of levels	
Plate level:	SET2220: 20" / 2mm SET3220 / 4220: 30" / 2mm
Circular level:	10' / 2mm
Optical plummet	
Image:	Erect
Magnification:	3x
Minimum focus:	0.5m
Horizontal and vertical fine motion screw	Fine / Coarse 2-speed motion
Operating temperature	-20 to 50°C
Water protection:	IPX4 (IEC 529/1989) (only when using BDC35A)
Instrument height	236mm (9.3inch) from tribrach bottom 193mm (7.6inch) from tribrach dish
Size	175 (W) x 170 (D) x 345 (H)mm (with handle and battery)
Weight	5.8kg (with handle and battery)

23. REGULATIONS

Radio Frequency Interference

WARNING: Changes or modifications to this unit not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

NOTE: This equipment has been tested and found to comply with the limits for a Class A digital device pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

Notice for Canada:

This Class A digital apparatus meets all requirements of Canadian Interference-Causing Equipment Regulations.

Cet appareil numérique de la Class A respecte toutes les exigences du Règlement sur le matériel brouilleur du Canada.

SOKKIA

CE Conformity Declaration
in accordance with EMC Directive 89/336/EEC of the European Community

We herewith declare that the undermentioned instrument, in view of its design and type of construction, fully complies with the relevant basic radio interference requirements of the EMC Directive.

Should the instrument be modified without agreement, this declaration becomes invalid.

Instrument Description: Total Station (Surveying Instruments)

Model Name : SET2220, SET2220S, SET3220, SET3220S,
 SET4220, SET4220S

Relevant EC Directive: EMC Directive (89/336/EEC)
 Version: 91/263/EEC, 92/31/EEC, 93/68/EEC

Applied

Harmonized Standard: EMI EN55022 Class B:1994 +A1:1995+A2:1997

 EMS EN61000-6-2:1999

Date: 27 September 2007

Firm: SOKKIA B.V.

Address: Industrieterrein De Vaart, Damsluisweg 1, NL-1332 EA Almere

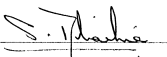
Representative's Signature: _____



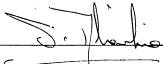
Name of Representative : Hajimu Maeda

Representative's position : European President

SOKKIA

CE Conformity Declaration in accordance with EMC Directive 89/336/EEC of the European Community	
We herewith declare that the undermentioned instrument, in view of its design and type of construction, fully complies with the relevant basic radio interference requirements of the EMC Directive. Should the instrument be modified without agreement, this declaration becomes invalid.	
Instrument Description: Power Supply (Battery Charger)	
Model Name :	CDC40
Relevant EC Directive:	EMC Directive (89/336/EEC) Version: 91/263/EEC, 92/31/EEC, 93/68/EEC
Applied	
Harmonized Standard:	EN50081-1 1992 , and EN50082-2 1995
Date: <u>Dec. 95</u> Firm: <u>SOKKIA B.V.</u> Address: <u>Industrieterrein De Vaart, Damsluisweg 1, NL-1332 EA Almere</u>	
Representative's Signature:	
Name of Representative :	Stephen Blaikie
Representative's position :	European vice President

SOKKIA

CE Declaration of Conformity in accordance with Low Voltage Directive 73/23/EEC of the European Community	
We herewith declare that the undermentioned instrument, in view of its design and type of construction, fully complies with the relevant electrical safety requirements of the Low Voltage Directive. Should the instrument be modified without agreement, this declaration becomes invalid.	
Instrument Description: Power Supply (AC Adapter)	
Model Name :	CDC40
Relevant EC Directive:	Low Voltage Directive (73/23/EEC) Version: 93/68/EEC
Applied Harmonized Standard:	EN60950: 1992 / A1: 1993 / A2: 1993 / A3: 1995
Date:	20/5/97
Firm:	SOKKIA B.V.
Address:	Industrieterrein De Vaart, Damsluisweg 1, NL-1332 EA Almere
Representative's Signature:	
Name of Representative :	Stephen Blaikie
Representative's position :	European vice President

SOKKIA

CE Conformity Declaration
in accordance with EMC Directive 89/336/EEC of the European Community

We herewith declare that the undermentioned instrument, in view of its design and type of construction, fully complies with the relevant basic radio interference requirements of the EMC Directive.

Should the instrument be modified without agreement, this declaration becomes invalid.

Instrument Description: Power Supply (Battery Charger)

Model Name : CDC41

Relevant EC Directive: EMC Directive (89/336/EEC)
Version: 91/263/EEC, 92/31/EEC, 93/68/EEC

Applied
Harmonized Standard: EN55011 1991 Group 1 class B, and EN50082-2 1995

Date: Feb. 96
Firm: SOKKIA B.V.
Address: Industrieterrein De Vaart, Damsluisweg 1, NL-1332 EA Almere

Representative's Signature: 

Name of Representative : Stephen Blaikie
Representative's position : European vice President

SOKKIA Customer Service

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