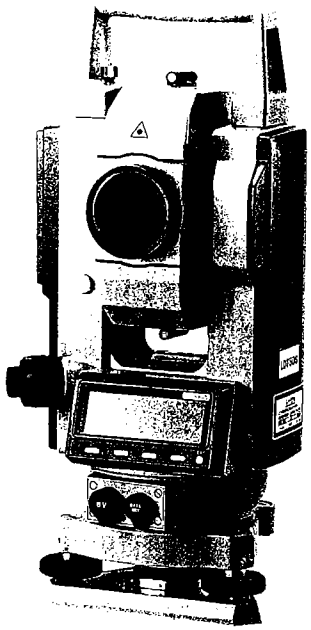
SURVEYING INSTRUMENTS

SOKKIA

LDT50
LDT50S



Class 3a Laser Product
Class Ⅲa Laser Product

OPERATOR'S MANUAL

LDT50
LDT50S

Laser Digital Theodolite

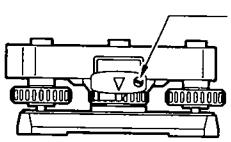
Class 3a Laser Product
Class IIIa Laser Product

OPERATOR'S MANUAL

- Thank you for selecting the LDT50/LDT50S Laser Digital Theodolite.
- Before using the instrument, please read this operator's manual carefully.
- Verify that all equipment is included by referring to "STANDARD EQUIPMENT."
- 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.

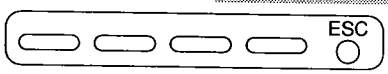
- **For rechargeable battery**
  The battery has not been charged at the factory. Please charge the battery fully before using by referring to **"16. POWER SUPPLIES."**

- **For Tribrach**
  When the LDT50/50S is shipped, the tribrach clamp is fixed with a screw. Loosen it and leave it loose. If the LDT is again shipped, fix the tribrach clamp with this screw to secure the tribrach to the instrument.



Power on and off

▶PROCEDURE **Power on**



- Press any one of the 5 keys.

▶PROCEDURE **Power off**

<ESC>

- Press and hold the **<ESC>** key in any mode to display the screen on the left. To switch the power off, while holding **<ESC>**, press **<off>**.

Hold **<ESC>** and press **<off>**

- To cancel power off and return to Basic mode, take your finger off the **<ESC>** key.

Release finger from **<ESC>** key: Power off cancelled.

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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 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.

Definition of Symbols

△	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.

General

⚠WARNING

- 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.
- Do not perform disassembly or rebuilding. Fire, electric shock or burns could result.
- Do not use the main 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.

⚠CAUTION

- 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 tribrach clamp securely. Failure to properly secure the clamp could result in the tribrach falling off while being carried, causing injury.
- Do not wield or throw the plumb bob. A person could be injured if struck.
- 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 use the carrying case as a footstool. The case is slippery and unstable, so a person could slip and fall off of it.

Power Supply

⚠WARNING

- Do not use voltage other than the specified power supply voltage. Fire or electrical shock could result.
- Use only the specified battery charger to recharge the batteries. Other chargers may be of different voltage rating or polarity, causing sparking which could lead to fire or burns.
- Do not place articles such as clothing on the battery power charger while charging batteries. Sparks could be induced, leading to fire.
- Do not use damaged power cords, plugs or loose outlets. Fire or electric shock could result.
- Do not use batteries or the battery charger if wet. Resultant shorting could lead to fire or burns.
- Do not use power cords other than those designated. Fire or electric shock could result.
- To prevent shorting of the battery in storage, apply insulating tape or the equivalent to the battery terminals. Otherwise shorting could occur, resulting in fire or burns.
- Do not heat or throw batteries into fire. An explosion could occur, resulting in injury.

⚠CAUTION

- Do not connect or disconnect power supply plugs with wet hands. Electric shock could result.
- 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.

Securely tighten 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.

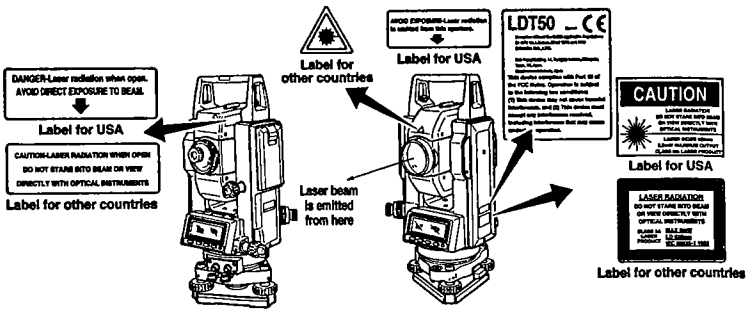
Do not carry the tripod with the tripod shoes pointed at other persons.
A person could be injured if struck by the tripod shoes.

Keep hands and feet away from the tripod shoes when fixing the tripod in the ground.
A hand or foot stab wound could occur.

Tighten the leg fixing screws securely before carrying the tripod.
Failure to tighten the screws could lead to the tripod legs extending, causing injury.

LASER SAFETY INFORMATION

The LDT is classified as a class 3A Laser Product according to IEC Standard Publication 825-1, and as a class IIIa Laser Product according to the United States Government Code of Federal Regulation CFR21. Follow the safety instructions on the labels attached to the instrument as well as in this manual to ensure safe use of the laser product.



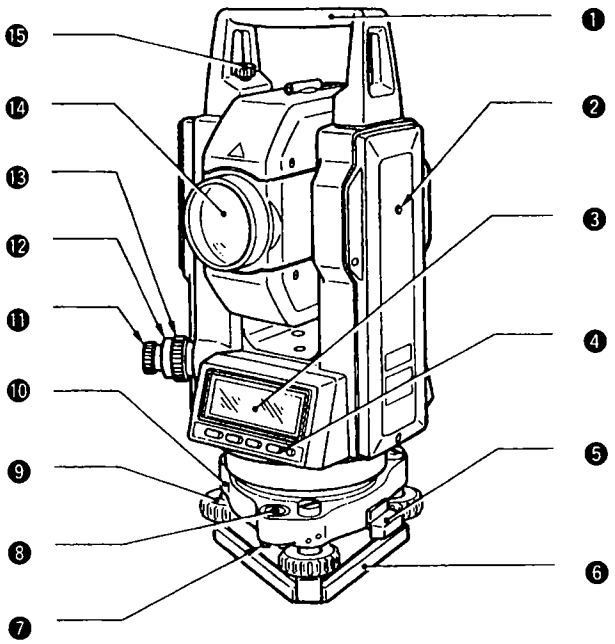
CAUTION

- Use of controls or adjustments or performance of procedures other than those specified herein may result in hazardous radiation exposure.
- The laser beam should be terminated at the end of its useful beam path and should in all cases be terminated if the hazardous beam path (to NOHD) extends beyond the controlled area.
- The laser beam path should be located well above or below eye level wherever practicable.
- Areas in which the laser is used should be posted with a standard laser warning sign.
- Precautions should be taken to ensure that persons do not look directly into the beam (prolonged intrabeam viewing is hazardous). Direct viewing of the beam through optical instruments (theodolite, etc.) may be hazardous and should not be permitted unless specifically approved by a laser safety officer.

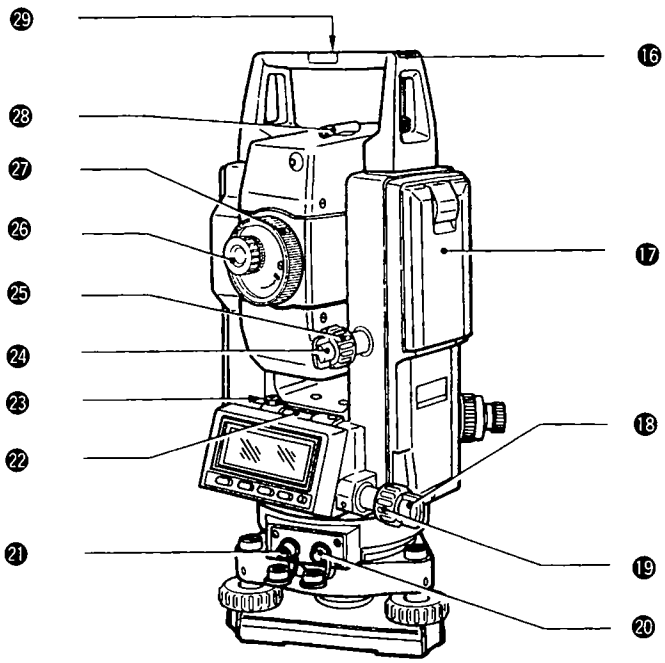
1. PRECAUTIONS

- Never place the LDT directly on the ground.
  Avoid damaging the tripod head and centering screw with sand or dust.
- Do not aim the telescope at the sun.
  Avoid damaging the LED by using a solar filter when the telescope is pointed at the sun.
- Protect the LDT with an umbrella against direct sunlight, rain and humidity.
- Handle the LDT with care. Avoid heavy shocks or vibration.
- When the operator leaves the LDT, the vinyl cover should be placed on the instrument.
- Always switch the power off before removing the standard battery.
- Remove the standard battery from the LDT before putting it in the carrying case.
  When the LDT is placed in the carrying case, follow the layout plan.

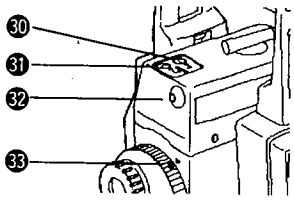
2. PARTS OF THE INSTRUMENT



❶ Handle
❷ Instrument height mark
❸ Display
❹ Keyboard
❺ Tribrach clamp
❻ Base plate
❼ Circular level adjusting screws
❽ Circular level
❾ Levelling foot screw
❿ Tribrach
⓫ Optical plummet eyepiece
⓬ Optical plummet reticle adjusting cover
⓭ Optical plummet focussing ring
⓮ Objective lens
⓯ Handle securing screw



16 Tubular compass slot
17 Battery
18 Horizontal clamp
19 Horizontal fine motion screw
20 Data output connector / Connector cap
21 External power source connector / Connector cap
22 Plate level
23 Plate level adjusting screw
24 Vertical clamp
25 Vertical fine motion screw
26 Telescope eyepiece
27 Telescope focusing ring
28 Peep sight
29 Instrument center mark
30 Laser beam horizontal adjusting screw
31 Laser beam vertical adjusting screw
32 Laser indicator lamp
33 Focusing mark



3. DISPLAY SYMBOLS

ZA : Zenith angle (Z=0)
VA : Vertical angle (H=0) /
Vertical angle (H=0±90°)
: Slope in % or ‰
HAR : Horizontal angle right
HAL : Horizontal angle left
HAh : Horizontal angle hold
HARp : Horizontal angle repetition
X : Tilt angle in sighting direction
Y : Tilt angle in horizontal axis direction
: Tilt angle compensation on

<Remaining battery power>
(BDC25A, Temperature=25˚C)

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

4. KEY FUNCTIONS

- The key functions are listed below. To use the functions marked with " * ", allocate them to the softkeys by referring to **"15. CHANGING LOCATION OF FUNCTIONS FOR KEYS."**

General

<ESC>: Go to Basic mode
While holding **<ESC>**, press **<CONF>**: Configuration/Tilt correction/Key select
While holding **<ESC>**, press **<ILLUM>**
: Display and reticle illumination ON/OFF
While holding **<ESC>**, press **<off>**: Switch the power off

<→PX>	: Go to next page
<--->*	: No function
<ILLUM>	: Display and reticle illumination ON/OFF
<Enter>	: Memorize the selected data
<Exit>	: Exit from each mode
<CE>	: Return to previous display
<EDIT>	: Edit the data
<Input>	: Change the displayed data
<off>	: Switch the power off
<↑>	: Move to previous option / Count up (*1)
<↓>	: Move to next option / Count down (*1)
<→>	: Move to right option / Go to the next column (*1)
<1>	: Select the number 1
<2>	: Select the number 2
<3>	: Select the number 3

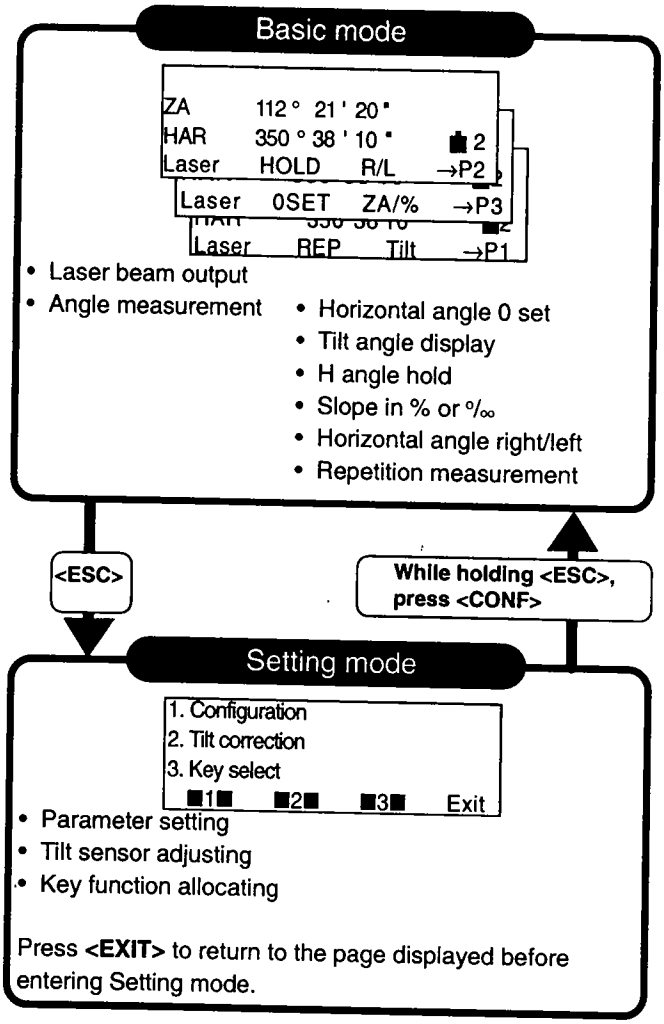
(*1) : When **<↑>**, **<↓>** or **<→>** is held down, scrolling of the selected function is performed.

For Angle measurement

<Laser> **:Laser beam ON/OFF**
<0SET> : Set Horizontal angle to 0 /Index V circle
<HOLD> : Hold H angle / Release H angle
<Tilt> : Display the tilt angle
<REP> : Transfer to Repetition mode
<BS> : Finish No.1 point sighting
<FS> : Finish No.2 point sighting
<CE> :Return to previous display/setting
<ZA/%> : Zenith angle / Slope in % (percent) (*2)
<VA/%> : Vertical angle / Slope in % (percent) (*2)
<ZA/°/∞> : Zenith angle / Slope in °/∞ (per mill) (*2)
<VA/°/∞> : Vertical angle / Slope in °/∞ (per mill) (*2)
<R/L>* : Select Horizontal angle right / left

(*2) : "ZA/%" or "ZA/°/∞" is displayed when parameter "V angle format" is set to "Zenith 0".
"VA/%" or "VA/°/∞" is displayed when parameter "V angle format" is set to "Horizontal 0" or "Horizontal ±90°".

5. MODE DIAGRAM



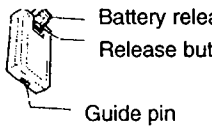
6. MOUNTING THE BATTERY

- Charge the battery fully before measurement.

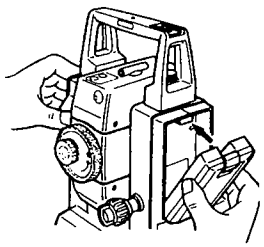
▶**NOTE** Switch off the power before replacing the battery.

▶**PROCEDURE**

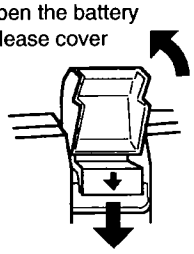
Mounting the battery



1. Close the battery release 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.

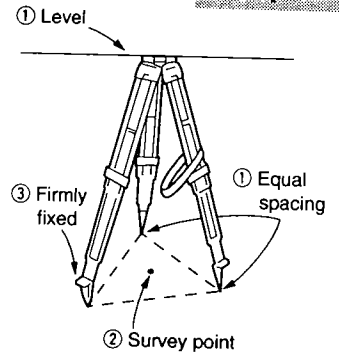
7. SETTING UP THE INSTRUMENT

- Mount the battery in the instrument before performing this operation because the instrument will tilt slightly if the battery is mounted after levelling.

7.1 Centering

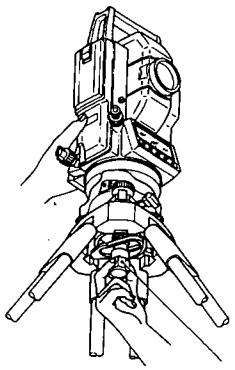
▶PROCEDURE

Set up the tripod



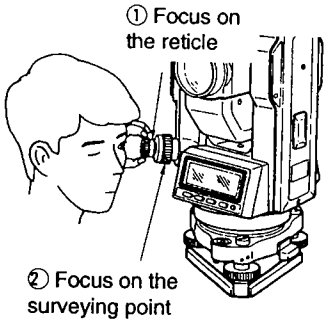
1. Make sure the legs are spaced at equal intervals and the head is approximately level.
2. Set the tripod so that the head is positioned over the surveying point.
3. Make sure the tripod shoes are firmly fixed in the ground.

Install the instrument



4. Place the instrument on the tripod head.
5. Supporting it with one hand, tighten the centering screw on the bottom of the unit to make sure it is secured to the tripod.

Focus on the surveying point



6. Looking through the optical plummet eyepiece, turn the optical plummet eyepiece to focus on the reticle.

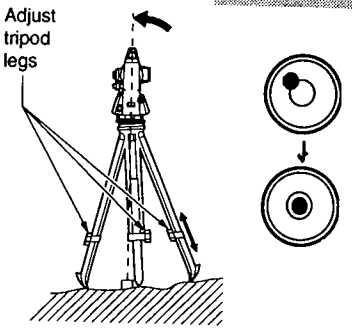
7. Turn the optical plummet focusing ring to focus on the surveying point.

7.2 Levelling

▶PROCEDURE **Center the surveying point in the reticle**

1. Adjust the levelling foot screws to center the surveying point in the optical plummet reticle.

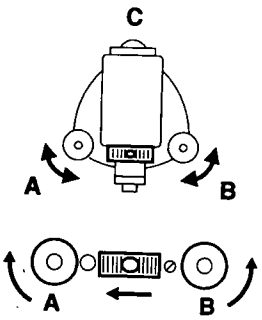
Center the bubble in the circular level



2. Observe the off-center direction of the bubble in the circular level, and shorten the nearest tripod leg, or extend the leg farthest from the direction to center the bubble.

3. One more tripod leg must be adjusted to center the bubble.

Center the bubble in the plate level



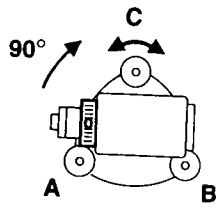
Bubble movement

4. Loosen the horizontal clamp to turn the upper part of the instrument until the plate level is parallel to a line between levelling foot screws A and B.

5. Center the air bubble, using levelling foot screws A and B.

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

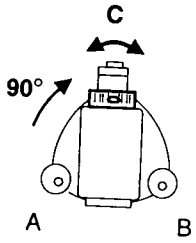
Turn 90° and center the bubble



6. Turn the upper part of the instrument though 90°. The plate level is now perpendicular to a line between levelling foot screws A and B.

7. Center the air bubble using levelling foot screw C.

Turn another 90° and check bubble position



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

   If the bubble is off-center, perform the following:

   ① Adjust levelling foot screws A and B in equal and opposite directions to remove half of the bubble displacement.

   ② 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 "**13.1 Plate level**".

Check to see if bubble is in same position in any direction

9. Turn the instrument and check to see if the air bubble is in the same position for any position of the upper part. If it is not, repeat the levelling procedure.

Center the LDT50 over the Surveying point

10. Loosen the centering screw slightly.

11. Looking through the optical plummet eyepiece, slide the instrument over the tripod head until the surveying point is exactly centered in the reticle.

12. Retighten the centering screw securely.

13. Check again to make sure the bubble in the plate level is centered.

Center the LDT50S over the Surveying point

10. Turn the tribrach shifting clamp counterclockwise.
    Shifting tribrach can be adjusted up to ±8mm.

11. Looking through the optical plummet eyepiece, adjust the instrument position on the tribrach to center the surveying point.

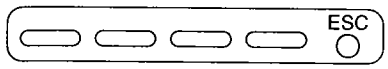
12. Tighten the shifting clamp to fix the instrument in the center position.

8. POWER ON AND PREPARATION FOR MEASUREMENT

- The following preparations are required for measurement.

8.1 Power on and off

▶PROCEDURE **Power on and off**



Press any one of the 5 keys

When the power is switched on, a self-check is run to make sure the instrument is operating normally. After that, the display indicates that the instrument is ready for vertical and horizontal circle indexing.

```
ZA    0      SET
HAR   0      SET        ▟2
Laser  0SET  ZA/%   →P2
```

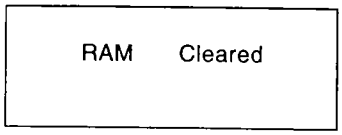
```
   Tilt   out   of   range
X- >      ⊥     +
Y-        ⊥     <+        ▟2
                EXIT
```

X: Tilt angle in the sighting derection
Y: Tilt angle in the horizontal axis derection

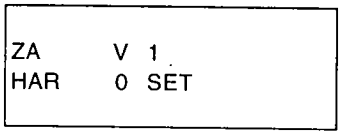
- If this error message is displayed, the instrument tilt sensor is indicating that the instrument is off-level. Relevel the instrument once again until ▮▮ is displayed. To switch the power off, while holding **<ESC>**, press **<off>**.

▶NOTE Automatic tilt angle correction (refer to "14. CHANGING INSTRUMENT PARAMETERS")
The parameter setting when the instrument left the factory was Automatic tilt angle correction OFF. Depending on your measurement needs, you can change the setting between Horizontal and vertical angle correction and Vertical angle correction only.

▶NOTE Tilt alarm (beep tone) (refer to "14. CHANGING INSTRUMENT PARAMETERS")
The parameter setting when the instrument left the factory was Tilt alarm Off. Depending on your measurement needs, you can change the parameter setting to Tilt alarm ON.

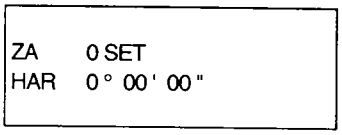


- When all data has been cleared from the memory, the display appears as at left. After that the instrument is ready for vertical and horizontal circle indexing.



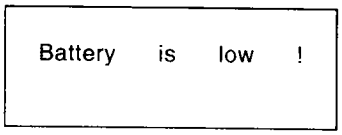
- When "V1" is displayed for the vertical angle, please refer to "Appendix1: Manually indexing the vertical circle".

▶NOTE Instrument parameter "V indexing" (refer to chapter 14)
Parameter "V indexing" can change the vertical indexing method. Options are indexed by transitting the telescope or indexing by face left, face right sightings.



- When the parameter "H indexing" is set to "Manual," "0" is displayed for the horizontal angle.

▶NOTE Instrument parameter "H indexing" (refer to chapter 14)
Parameter "H indexing" 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.



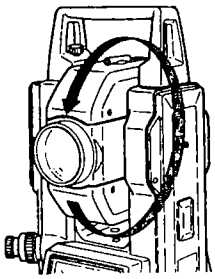
- If the battery is at the "low" level, the message "Battery is low !" will be displayed. Switch the power off and charge the battery.

▶NOTE Power-saving cut off (refer to chapter 14)
Depending on your measurement needs, you can change the parameter setting so that LDT automatically switches off 30 minutes after the last operation.

8.2 Indexing the vertical and horizontal circles

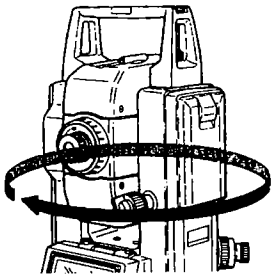
▶PROCEDURE

Vertical circle indexing



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

Horizontal circle indexing



2. Loosen the horizontal clamp and rotate the upper part of the instrument completely.
   An audio tone sounds, and the horizontal angle (HAR) is displayed.

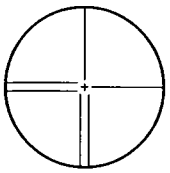
- Vertical indexing and horizontal indexing have been completed.

▶NOTE Each time the instrument is switched on, the vertical and horizontal indexes must be redetermined.
If the parameter "Resume function" is set to "on," the screen previous to power off is displayed. To change the parameter to "off", refer to chapter 14.

8.3 Focusing and target sighting

▶PROCEDURE

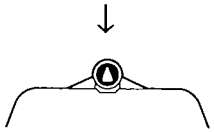
Focus on the reticle



1. Look through the telescope eyepiece at a bright and featureless background.
2. Turn the eyepiece clockwise, then counterclockwise little by little until just before the reticle image becomes focused.

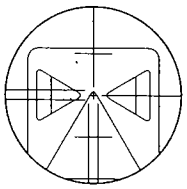
- Using these procedures, frequent reticle refocusing is not necessary, since your eye is focused at infinity.

Sight the target



3. Loosen the vertical and horizontal clamps, and use the peep sight to bring the target into the field of view. Tighten both clamps.

Focus on the target



<Target center>

4. Turn the telescope focusing ring to focus on the target.
5. Turn the vertical and horizontal fine motion screws to align the target with the reticle.

The last adjustment of each fine motion screw should be in the clockwise direction.

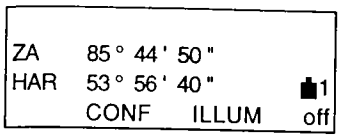
Readjust the focus until there is no parallax

6. Readjust the focus with the focusing ring until there is no parallax between the target image and the reticle.

▶**NOTE** Observe to the same point of the reticle when the telescope face is changed.

8.4 Display and reticle illumination

▶PROCEDURE **Display and reticle illumination on/off**



Holding **<ESC>**, press **<ILLUM>**

- While holding **<ESC>**, press **<ILLUM>** to turn the display and reticle illumination on and off.

▶**NOTE** Instrument parameter "Auto power off" (refer to chapter 14) Parameter "Auto power off" can be used to switch ON/OFF the 30-second illumination automatic cut-off facility.

▶**NOTE** Instrument parameter "Backlight timeout" (refer to chapter 14) Parameter "Backlight timeout" can be used to change the brightness of the reticle illumination.

▶**NOTE** To display ILLUM function
The key function allocation allows **<ILLUM>** to be displayed in any page of any mode. See **"15. CHANGING LOCATION OF FUNCTIONS FOR KEYS"**.

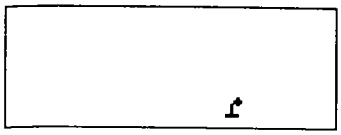
8.5 Setting the Instrument options

- Confirm that these parameters are set according to your measurement needs.
- To confirm or change the parameter options, please refer to **"14. CHANGING INSTRUMENT PARAMETERS"**.

Parameter	Options
Angle unit	1. degree* 2. gon 3. mil
Vertical angle format	1. Zenith angle (Zenith 0)* 2. Vertical angle (Horizontal 0) 3. Vertical angle (Horizontal ±90°)
Tilt correction	1. Horizontal and Vertical angle Yes* 2. Vertical angle Yes 3. No correction
Angle resolution	1. 1" / 0.2mgon / 0.005mil* 2. 5" / 1mgon / 0.02mil

*: Factory setting

▶EXPLANATION Automatic tilt angle compensation



- When the compensation symbol is shown on the display, the vertical and horizontal angles are automatically compensated for small tilt errors using the 2-axis tilt sensor.
- Read the compensated angles after the displayed angle values become steady.
- 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).
  Therefore, when the LDT is not perfectly 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 measured vertical angles are within ±1° of the zenith or nadir, tilt compensation is not applied to the horizontal angle. In this situation, the displayed horizontal angle value flashes to show that the tilt compensation is not being applied.

▶EXPLANATION Horizontal angle back-up

- The parameter "H circle indexing" default setting allows for the memorization of the previous horizontal 0 position at power-off for about 1 week. The horizontal left or right angle display selection is also memorized. When next switching on the LDT 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.

▶EXPLANATION Resume function

- "Resume function" means to return to or begin again after interruption. It means that the previous mode is recovered after switching on the LDT and indexing the vertical and horizontal circles.
- The resume function does not work after more than 1 week (memory back-up period). In that case or when the resume function "no" is selected, the LDT returns to Basic mode after switching on and indexing the vertical and horizontal circles.

▶EXPLANATION 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 refocusing the reticle.

▶EXPLANATION Levelling using the tilt angle display

- For levelling, the tilt angle X and Y values can be displayed for use as a 2-axis (X,Y) tilt sensor. The measurement range is ±3'.

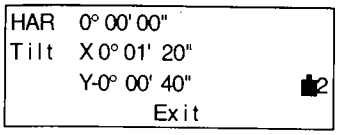
▶PROCEDURE

Set the telescope parallel to a line between levelling foot screws A and B

1. Turn the upper part of the instrument until the telescope is parallel to a line between levelling foot screws A and B and tighten the horizontal clamp.

Display the tilt angle

<Tilt>



2. In 1st page of Basic mode, press **<Tilt>**.

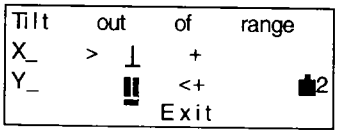
   The X and Y tilt angles are displayed.

Set both tilt angles to 0

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

4. To exit from the tilt angle display, press **<Exit>** to return to the previous mode or press **<ESC>** to go to Basic mode.

▶**NOTE** "Tilt out of range" indicates that the tilt angle exceeds the ±3' measurement range.



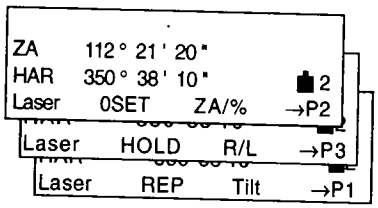
- This section explains how to output the laser beam and adjust the beam angle.

▶PROCEDURE

1) Focus on the target.

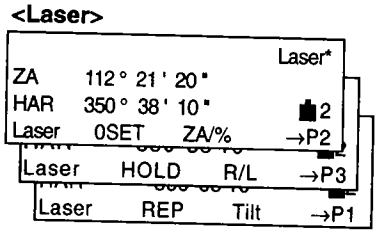
2) In Basic mode, display page 1, 2, or 3.

<Laser>



3) Press **<Laser>**
:Laser beam output.

<Laser>

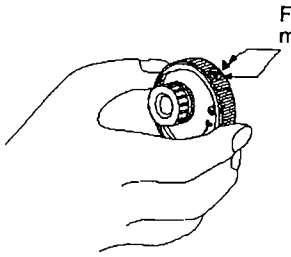


4) Press **<Laser>** again
:Laser beam off.

- During output of the laser beam, "Laser*" or "*" is displayed and the laser indicator lamp flashes.
- After focusing is finished, the minimum beam spot diameter is output.

▶NOTE Laser output power (refer to 14. CHANGING INSTRUMENT PARAMETERS)
Depending on your measurement needs, the output power of the laser can be set to either 1.0mW or 2.5mW.

Horizontal beam output

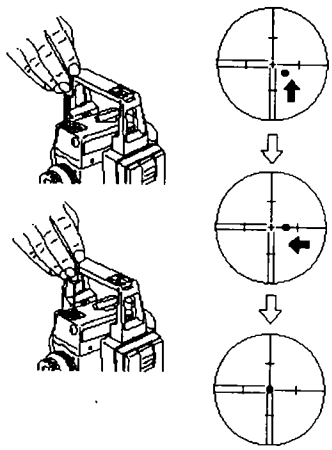


1) Focus on the target and output the laser beam.

2) Turn the telescope focusing ring fully clockwise and then gradually anticlockwise until the focusing marks on the body of the unit and focusing ring are aligned.

- There is very little variation in the diameter of the laser beam spot from the LDT to a target 200m away.

Laser beam angle adjustment



- When the laser beam spot does not coincide with the reticle center, adjust as follows by turning the laser beam adjusting screws.
- Vertical position adjustment: By turning the vertical adjusting screw clockwise (anticlockwise), the beam spot moves up (down).
- Horizontal position adjustment: By turning the horizontal adjusting screw clockwise (anticlockwise), the beam spot moves left (right).

10. ANGLE MEASUREMENT

- The following functions are available for angle measurement.

10.1 Measure the horizontal angle between 2 points (Horizontal angle 0)
10.2 Set Horizontal circle to a required value (Horizontal angle hold)
10.3 Horizontal angle display selection (Right / left)
10.4 Horizontal angle repetition
10.5 Slope in %
10.6 Slope in ‰

▶**NOTE** Check before Angle measurement:

1. The LDT is set up correctly over the surveying point.
2. The remaining battery power is adequate.
3. The V and H circles have been indexed.
4. The instrument parameters have been set.

10.1 Measure the horizontal angle between 2 points (H angle 0)

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

▶PROCEDURE **Horizontal angle 0 set**

1st page of Basic mode

```
ZA    112° 21' 20"
HAR   350° 38' 10"    2
Laser 0SET ZA/%   →P2
```

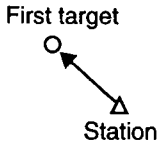
In 1st page of Basic mode

<0SET>

```
ZA    112° 21' 20"
HAR    0° 00' 00"    2
```

Press **<0SET>** to set the horizontal angle to zero.

▶EXAMPLE **Measure the horizontal angle between 2 points**



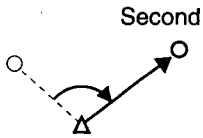
1. Using horizontal clamp and fine motion screw, sight the first target as at left.

<0SET> <OSET>

```
ZA    112° 21' 20"   - 30
HAR    0° 00' 00"    2
```

2. In Basic mode, press **<0SET>** twice.

   The horizontal angle display has been set to "0°" as at left.



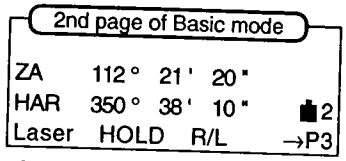
3. Sight the second target.

   The displayed horizontal angle is the angle between the 2 points.

10.2 Set Horizontal circle to a required value

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

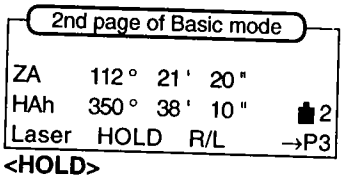
▶PROCEDURE **Horizontal angle hold / release**



In 2nd page of Basic mode

<HOLD> <HOLD>

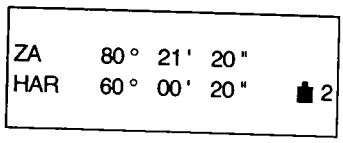
1. Press **<HOLD>** twice to set the required horizontal angle value.



<HOLD>

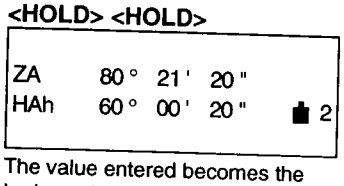
2. Press **<HOLD>** again to cancel the entered horizontal angle.

▶EXAMPLE **Set Horizontal circle to a required value.**



1. In Basic mode, use the horizontal clamp and fine motion screw to turn the theodolite until a required value is shown on the display.

<HOLD> <HOLD>



The value entered becomes the horizontal angle
Sight the reference target, **<HOLD>**

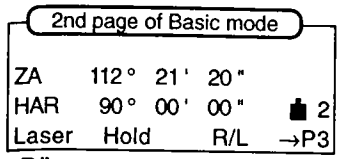
2. Press **<HOLD>** twice to set the horizontal angle.

   The display on the left shows the horizontal angle for the target set to a required value.

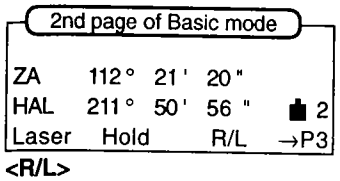
3. Sight the reference target and press **<HOLD>** again to release the setting.

10.3 Horizontal angle display selection (Right / left)

▶PROCEDURE **Horizontal angle right / left**



<R/L>



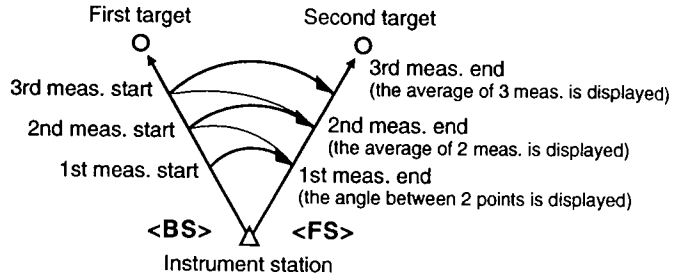
<R/L>

In 2nd page of Basic mode

- Press **<R/L>** to select horizontal angle left.
- Press **<R/L>** to select horizontal angle right.

10.4 Horizontal angle repetition

- For higher accuracy horizontal angle measurement, the average of the horizontal angle can be measured by repetition. The LDT can calculate and display the average of the horizontal angle.



▶PROCEDURE **Horizontal angle repetition**

3rd page of Basic mode

```
ZA    112° 21' 20"
HAR   350° 38' 10"      2
Laser   REP    Tilt   →P1
```

<REP>

H angle repetition mode

```
HARp  0° 00' 00"
HARp  base point
                        2
 CE      BS      FS    Exit
```

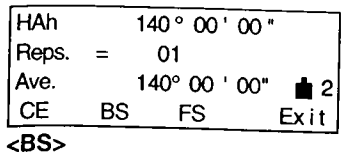
<BS>

```
HARp  0° 00' 00"
Reps.  =    00
Ave.                    2
CE      BS      FS    Exit
```

<FS>

In 3rd page of Basic mode

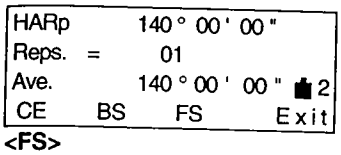
1. Sight the first target.
2. Press **<REP>** to select horizontal angle repetition mode.
3. Press **<BS>** to start 1st measurement.
4. Sight the second target.
5. Press **<FS>** to display the angle between two points. (The angle of the 2nd target is held.)



<BS>

6. Sight the first target again.

7. Press **<BS>** to release horizontal angle hold and begin second measurement.



<FS>

8. Sight the second target again.

9. Press **<FS>** to display the average of the 2 measurements at the 3rd line.
(The angle of the 2nd target is held.)

- To continue the measurement, repeat steps 6 to 9.

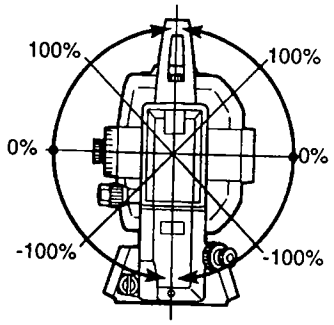
10. Press **<EXIT>** to end horizontal angle repetition mode.

- In Repetition mode, the displayed horizontal angle is not corrected by the tilt sensor.
- When the data output is requested by an external device in H angle repetition mode, H angle from 0°, which is determined before selecting H angle repetition mode, is output. The average of measurements is not output.

- Number of measurements: Up to 10 times.
- Repetition display range: ±3599° 59' 59"
- To previous measurement: **<CE>**
- Exit from the mode: **<Exit>**

10.5 Slope in %

- The LDT can display the slope in %.



▶PROCEDURE **Slope in %**

1st page of Basic mode				
ZA	90°	13'	50"	
HAR	0°	00'	00"	2
Laser	0SET		ZA/%	→P2

<ZA/%>

In 1st page of Basic mode

- Press **<ZA/%>** to display Slope in %.

1st page of Basic mode				
VA	-0.402 %			
HAR	0°	00'	00"	2
Laser	0SET		ZA/%	→P2

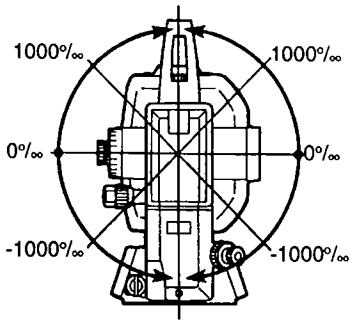
<ZA/%>

- Press **<ZA/%>** again to display Vertical angle.

- Display range: Less than ±1000%
- **<ZA/%>** is displayed when parameter "V angle format" is set to "Zenith 0°". **<VA/%>** is displayed when parameter "V angle format" is set to "Horizontal 0°" or "Horizontal ±90°".

10.6 Slope in °/∞

- The LDT can display the slope in °/∞.



▶PROCEDURE **Slope in °/∞**

▶NOTE Display slope (refer to "14. CHANGING INSTRUMENT PARAMETERS)
Depending on your measurement needs, you can change the parameter setting from Slope in % to Slope in °/∞.

1st page of Basic mode

ZA	90° 13' 50"	
HAR	0° 00' 00"	2
Laser	0SET	ZA/°/∞ →P2

In 1st page of Basic mode

- Press **<ZA/°/∞>** to display Slope in °/∞.

<ZA/°/∞>

1st page of Basic mode

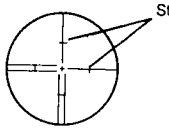
VA	-0.402 °/∞	
HAR	0° 00' 00"	2
Laser	0SET	ZA/°/∞ →P2

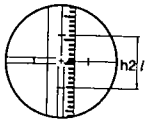
- Press **<ZA/°/∞>** again to display Vertical angle.

<ZA/°/∞>

- Display range: Less than ±10000°/∞
- "Out of range" appears when display range is exceeded.
- **<ZA/°/∞>** is displayed when parameter "V angle format" is set to "Zenith 0°". **<VA/°/∞>** is displayed when parameter "V angle format" is set to "Horizontal 0°" or "Horizontal ±90°".

11. OPTICAL DISTANCE MEASUREMENT: STADIA SURVEY





The telescope reticle is provided with stadia lines (two vertical and two horizontal) which can be used to measure the target distance and height difference as follows.

Stadia line separation = 1/100 of the focal distance.

When the telescope is horizontal:

Read the distance (l) on the staff between the two stadia lines, and the center line value, h_2.

Horizontal target distance $L = 100 \times l$

Target height difference $\Delta h = h_1 - h_2$

When the telescope is slanted:

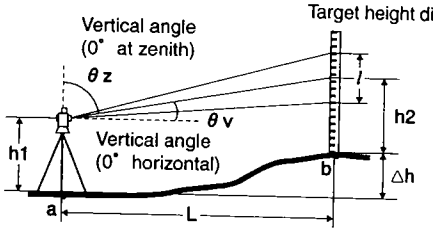
Read the distance (l) on the staff between the two stadia lines, the vertical angle, and the center line value, h_2.

Horizontal target distance $L = 100 \times l \times \sin^2\theta z$

or $100 \times l \times \cos^2\theta v$

Target height difference $\Delta h = 50 \times l \times \sin 2\theta z + h_1 - h_2$

or $50 \times l \times \sin 2\theta v + h_1 - h_2$



12. ERROR MESSAGES

- When an error message is displayed, take the action described in the table below.
- If the same error message is repeated or if other messages are shown, please contact your SOKKIA agent.

Message	Meaning	Action
RAM cleared	After About 1 week, data stored in the short term memory has been cleared.	
Tilt out of range	Tilt sensor range error when measuring. The tilt angle exceeds ±3'.	Level the LDT again.
Tilt out of range X- > ⊥ + Y- ⊥ <+	Tilt sensor range error. The tilt angle exceeds ±3'.	Level the LDT again.
Battery is low!	Battery voltage is too low.	Charge the battery or replace it with a charged one.
E 100	Error when measuring a horizontal angle.*	Index the horizontal circle again.
E 101	Error when measuring a vertical angle.*	Transit the telescope again.

* If the LDT telescope or upper part is rotated faster than 4 revolutions per second, the error indication "E 100" or "E 101" is displayed.

13. CHECKS AND ADJUSTMENTS

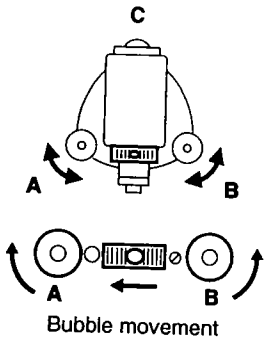
- Periodically, checks and adjustments should be performed before and during measurement. In addition, the instrument should be checked after long storage, transportation or when damage to the instrument is suspected to have occurred due to a strong shock.

▶NOTE The checks should be performed in the following order.

13.1 Plate level

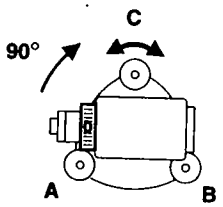
- The glass tube of the plate level is sensitive to temperature changes or shock.

▶PROCEDURE **Check**



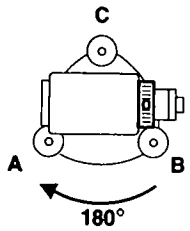
Bubble movement

1. 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 plate level bubble using levelling foot screws A and B.
   The bubble moves towards a clockwise rotated levelling foot screw.



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

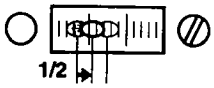
3. Center the plate level bubble using levelling screw C.



4. 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:

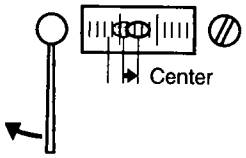
▶PROCEDURE **Adjustment**

Use levelling screws



5. Correct half of the bubble displacement using levelling foot screw C.

Use adjusting pin



6. Correct the remaining half of the displacement by adjusting the screw with the adjusting pin.
   The bubble moves towards a clockwise rotation of the adjusting screw.

7. Repeat the procedures from 1 to 6 until the bubble remains centered for any position of the upper part.

   If the bubble cannot be centered, please contact your SOKKIA agent.

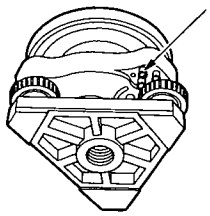
13.2 Circular level

▶PROCEDURE **Check**

1. Perform the plate level adjustment or level the instrument carefully using the plate level.

2. Check the position of the circular level bubble.
   If the bubble is still centered, no adjustment is necessary.
   If the bubble is off-center, adjust as follows:

Adjustment



3. Verify the off-center direction of the bubble.

4. Loosen the adjusting screw farthest from that direction to center the bubble.

5. Adjust all 3 adjusting screws until the tightening tension of each screw is the same, and the bubble is centered.

▶NOTE 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.

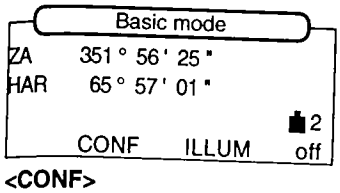
If the bubble cannot be centered, please contact your SOKKIA agent.

13.3 Tilt sensor

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

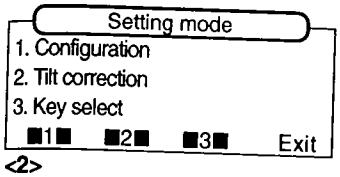
▶PROCEDURE **Check**

1. Carefully level the LDT.



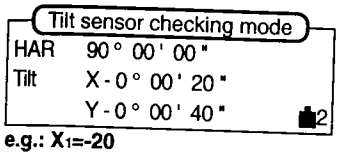
<CONF>

2. In Basic mode, hold **<ESC>** and press **<CONF>** for Setting mode.



<2>

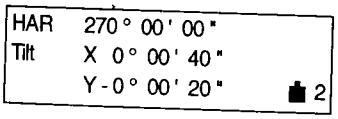
3. Press **<2>** for Tilt sensor checking mode.



e.g.: X_1=-20
Y_1=-40

4. Wait for a few seconds until the tilt angle readings are steady, and note the tilt angle values, X_1 and Y_1.

1st line: Horizontal angle
2nd line: Tilt angle of X direction
3rd line: Tilt angle of Y direction



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

e.g.: X_2 = 40
Y_2 = -20

e.g.:
X direction = (-20+40) /2=10
Y direction = {-40+(-20)} /2=-30

6. When the tilt angle readings are steady, note the tilt angle values, X_2 and Y_2.

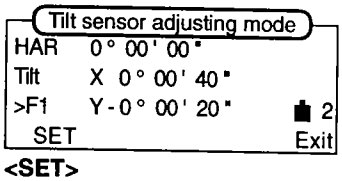
7. Calculate the offset values.
$(X_1 + X_2) / 2$
$(Y_1 + Y_2) / 2$

If the offset value (X and Y) are ±10" or less, no adjustment is necessary.
Press **<Exit>** to finish the check.

If one of the offset values is greater than ±10", the sensor index should be adjusted as follows without pressing **<Exit>.**

▶PROCEDURE Adjustment

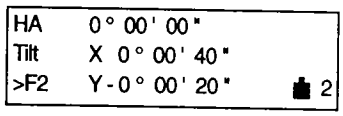
<0SET>



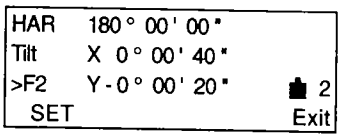
8. Press **<0SET>** for Tilt sensor adjusting mode.

The horizontal angle becomes 0°.

<SET>

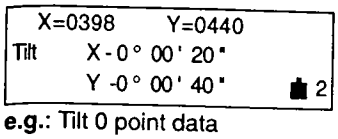


9. Press **<SET>** to memorize tilt angle X2 and Y2.



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

<SET>



e.g.: Tilt 0 point data
X =398
Y =440

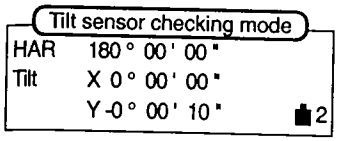
11. When the tilt angle readings are steady, press **<SET>** to memorize X2 and Y2.

The tilt 0 point data is displayed at the 1st line.

If the tilt 0 point data is greater than 400±120, press **<Exit>** to stop the adjustment (Please contact your SOKKIA agent).

If it is 400±120 or less, continue the adjustment without pressing **<Exit>.**

<Enter>

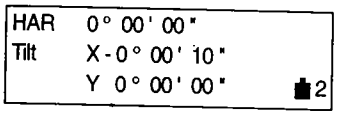


12. Press **<Enter>** to store the new Tilt 0 point data.
(Tilt sensor checking mode)

The adjusted new tilt angle values, X and Y are displayed.

e.g.: $X_3 = 0$
$Y_3 = -10$

13. When the tilt angle readings are steady, note the tilt angle values, X3 and Y3.



e.g.: $X_4 = -10$
$Y_4 = 0$

14. Loosen the horizontal clamp and turn the upper part through 180°.

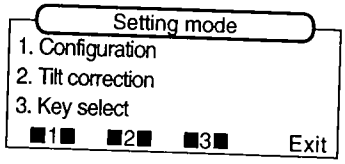
15. When the tilt angle readings are steady, note the Tilt angle values, X4 and Y4.

e.g.:
X direction = {0+(-10)} /2 = -5
Y direction = (-10+0) /2 = -5

16. Calculate the offset values.
$(X_3 + X_4) / 2$
$(Y_3 + Y_4) / 2$
If the offset values (X and Y) are ±10" or less, the adjustment has been finished.

<Exit>

17. Press **<Exit>** to finish the check.
(Setting mode)



If one of the offset values are greater than ±10", repeat the adjustment procedures.

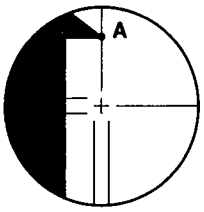
- Exit from the mode: **<Exit>**
- If the offset values are greater than ±10", in spite of repeating the adjustment, please contact your SOKKIA agent.

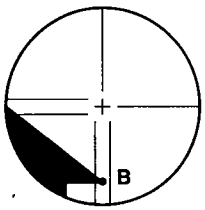
13.4 Reticle

- This adjustment is very delicate. If you have any difficulties, please contact your SOKKIA agent.

▶IMPORTANT Make sure that no dirt, dust or water becomes attached to the inside of the telescope reticle cover when it is removed to adjust the reticle. After adjustment, securely reattach the reticle cover. Any water or dust on the inside of the reticle cover will reduce the instruments capacity for water resisting.

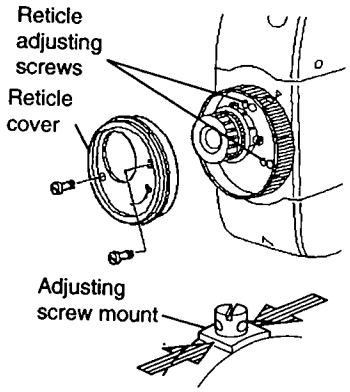
▶PROCEDURE **Check 1 <Perpendicularity of the reticle to the horizontal axis>**





1. Carefully level the LDT.
2. Select and sight a clear target on the upper part A of the reticle line.
3. 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-center, adjust as follows:

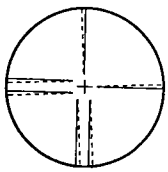
Adjustment 1



4. Remove the telescope reticle cover.

5. Slightly loosen one vertical and one horizontal adjustment screw by an equal amount using the adjusting pin.

6. Place a small piece of plastic or wood against one side of the top adjusting screw mount as a buffer.



7. Look through the eyepiece and gently tap the piece of plastic or wood to rotate the reticle slightly.

8. Retighten the two adjusting screws loosened in step 5 by the same amount.

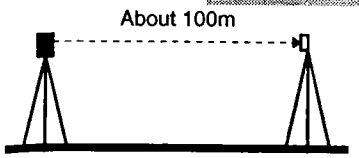
▶**NOTE** Over-tightening the adjusting screws may damage the reticle. Unequal tightening of the adjusting screws may mean that the reticle will go out of adjustment.

9. Check the reticle perpendicularity again using procedures 1 and 2 above and repeat the adjustment if necessary.

10. Replace the reticle cover.

▶**NOTE** After this adjustment, perform the check and adjustment of the reticle position as follows.

Check 2 (Vertical and horizontal reticle line positions)



1. Set up a clear target 100m (328ft) from the LDT.

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

ZA	90° 30' 20"	
HAR	18° 34' 00"	2

3. Sight the target on face left. Read the horizontal angle A_1 and vertical angle B_1.

e.g.: H angle A_1 = 18° 34' 00"
V angle B_1 = 90° 30' 20"

Telescope face right

ZA	269° 30' 00"	
HAR	198° 34' 20"	2

4. Now sight the target on face right and read the horizontal angle A_2 and vertical angle B_2.

e.g.: H angle A_2 = 198° 34' 20"
V angle B_2 = 269° 30' 00"

e.g.:
H angle A_2 - A_1
= 198° 34' 20" - 18° 34' 00"
= 180° 00' 20"
V angle B_2 + B_1
= 269° 30' 00" + 90° 30' 20"
= 360° 00' 20"

5. Calculate $A_2 - A_1$ and $B_2 + B_1$.
$A_2 - A_1$ should be within 180° ±20"
$B_2 + B_1$ should be within 360° ±20".
If a difference of more than ±20" still remains after repeating these procedures several times, adjust as follows.

▶**IMPORTANT** Do not move the reticle more than 20".

e.g.: H angle A_1 = 18° 34' 00"
V angle B_1 = 90° 30' 10"
H angle A_2 = 198° 34' 20"
V angle B_2 = 269° 30' 10"

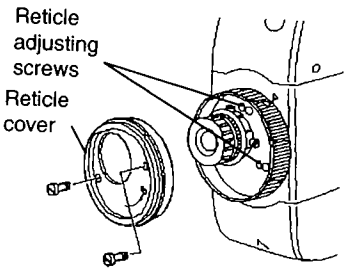
ZA	269 ° 30 ' 00 "	
HAR	198 ° 34 ' 10 "	2

6. Calculate the horizontal angle A and vertical angle B.
   $A = (A_2 + A_1) / 2 + 90°$
   $B = (B_2 - B_1) / 2 + 180°$

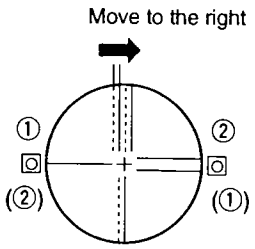
7. While still sighting the target on face right, use the horizontal and vertical fine motion screws to adjust the displayed horizontal and vertical angles to the above values.

8. Look through the telescope. The reticle is now slightly shifted from the target.

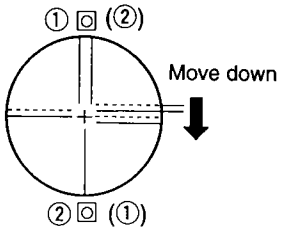
9. Remove the telescope reticle cover.



10. To move the vertical reticle line towards the target center, loosen the right and left adjusting screws using the adjusting pin.
    To move the reticle to the right (left):



① very slightly loosen the left (right) adjusting screw,
② tighten the right (left) adjusting screw by the same amount.



To move the horizontal reticle line towards the target center, loosen the top and bottom adjusting screws using the adjusting pin.
To move the reticle down (up):
① slightly loosen the top (bottom) adjusting screw,
② tighten the bottom (top) adjusting screw by the same amount.
[( ) for opposite direction]

▶**NOTE** Over-tightening the adjusting screws may damage the reticle. Unequal tightening of the adjusting screws may mean that the reticle will go out of adjustment.

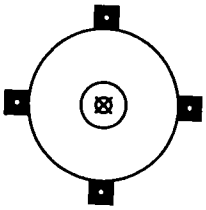
11. Finally tighten the top and bottom adjusting screws as before.
Check the reticle position and repeat the procedure until the reticle comes close to the target center.

12. Replace the reticle cover.

13.5 Optical plummet

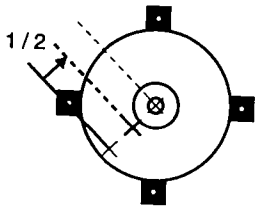
▶IMPORTANT Make sure that no dirt, dust or water becomes attached to the inside of the optical plummet cover when it is removed to adjust the optical plummet. After adjustment, securely reattach the optical plummet cover.

▶PROCEDURE **Check**

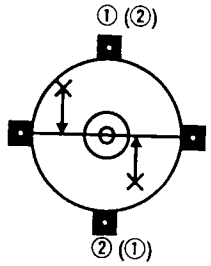


1. Carefully level the LDT and exactly center a surveying point in the reticle of the optical plummet.
2. Turn the upper part 180° and check the position of the surveying point in the reticle. If the surveying point is still centered, no adjustment is necessary. If the surveying point is not still centered in the optical plummet, adjust as follows:

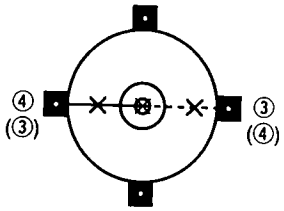
▶PROCEDURE **Adjustment**



3. Correct half the deviation with the levelling foot screw.
4. Unscrew the optical plummet reticle cover to adjust the remaining half of the displacement with the 4 adjusting screws.

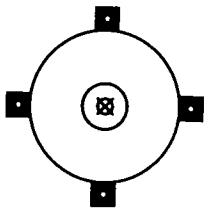


5. When the surveying point is on the part shown in ⌓ (⌒) area:
   ① Loosen the upper (lower) screw slightly,
   ② tighten the lower (upper) screw by the same amount.



6. Next, if the surveying point is seen to be on the part shown in solid line (dotted line):
   ③ Loosen the right (left) screw slightly,
   ④ tighten the left (right) screw by the same amount.

▶**NOTE** Over-tightening the adjusting screws may mean that the reticle will go out of adjustment.



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.

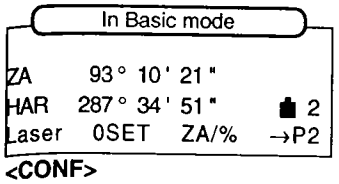
14. CHANGING INSTRUMENT PARAMETERS

- 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.

Parameter	Options	
Angle unit	1* 2 3	degree gon mil
V angle format	1* 2 3	Zenith angle (Zenith 0°) Vertical angle (Horizontal 0°) Vertical angle (Horizontal ±90°)
V circle indexing	1* 2	Transit telescope Observe face left, face right sightings
H circle indexing	1* 2	Rotate upper part 0° at power on
Tilt correction	1* 2 3	No correction Horizontal and Vertical angle Yes Vertical angle Yes
Reticle illumination	1* 2	Bright Dim
Backlight control (Auto illumination cut-off)	1* 2	Illumination on/off using key Illumination auto off after 30 seconds
Auto power cut-off	1* 2	Continuours 30 minutes Timeout
Baud rate	1* 2	1200 baud 9600 baud
Resume function	1* 2	On Off
Angle resolution	1* 2	1" (0.2mgon / 0.005mil) 5" (1mgon / 0.02mil)
Laser power	1* 2	1.0mW 2.5mW
Tilt alarm	1* 2	Off On
Slope display	1* 2	% (percent) ‰ (per mill)

*: Factory setting

▶PROCEDURE From Basic mode to Setting mode



In Basic mode

1. Hold **<ESC>** and press **<CONF>** for Setting mode.

2. Press **<1>** for Parameter setting mode.

   The first parameter is displayed.

3. Select the required options by the following key operations.

- To next parameter: < ↓ >
- To previous parameter: < ↑ >
- Change options: **<Edit>**
- To Setting mode: **<Exit>**
- To Basic mode: **<ESC>**

▶PROCEDURE Edit the parameter

1. Select the parameter to be edited with < ↓ > or < ↑ > and press **<Edit>**.

2. Edit the parameter.

Angle unit

```
1. degree
2. gon
3. mil
 ■1■   ■2■   ■3■   Exit
```

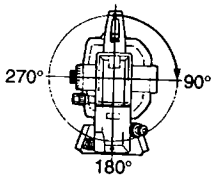
<1>: degree
<2>: gon
<3>: mil
<Exit>: Retain the previously selected option.

V angle format

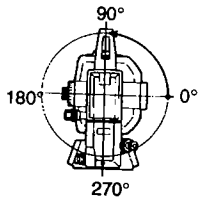
```
1. Zenith
2. H. = 0...360
3. H. = +/- 90
 ■1■   ■2■   ■3■   Exit
```

<1>: Zenith 0°
<2>: Horizontal 0°
<3>: Horizontal +/- 90°
<Exit>: Retain the previously selected option.

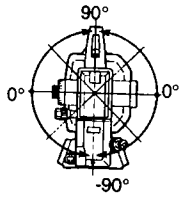
• Zenith 0°



• Horizontal 0°



• Horizontal ±90°



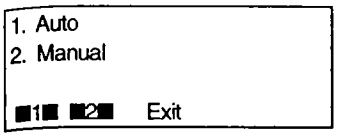
V circle indexing

```
1. Auto
2. Manual

 ■1■   ■2■   Exit
```

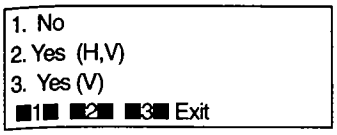
<1>: Transit telescope
<2>: F.L./F.R.Sighting
<Exit>: Retain the previously selected option.

H circle indexing



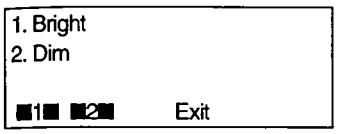
<1>: Rotate upper part
<2>: 0° at power on
<Exit>: Retain the previously selected option.

Tilt correction



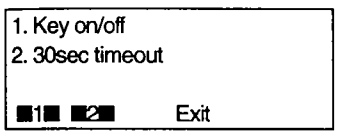
<1>: No
<2>: H & V angle Yes
<3>: V angle Yes
<Exit>: Retain the previously selected option.

Reticle illumination



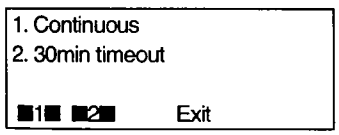
<1>: Bright
<2>: Dim
<Exit>: Retain the previously selected option.

Auto illumination cut-off



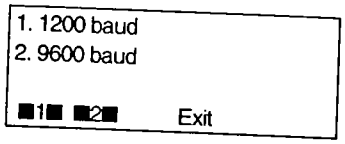
<1>: On/Off using key
<2>: Auto off after 30 seconds
<Exit>: Retain the previously selected option.

Auto power cut-off



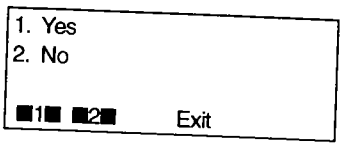
<1>: On/Off using key
<2>: Auto power off after 30 minutes
<Exit>: Retain the previously selected option.

Baud rate



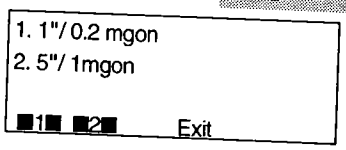
<1>: 1200 baud
<2>: 9600 baud
<Exit>: Retain the previously selected option.

Resume function



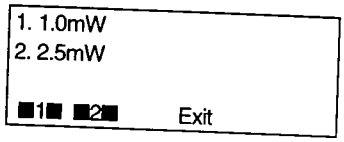
<1>: Resume function ON
<2>: Resume function OFF
<Exit>: Retain the previously selected option.

Angle resolution



<1>: 1" / 0.2mgon
<2>: 5" / 1mgon
<Exit>: Retain the previously selected option.

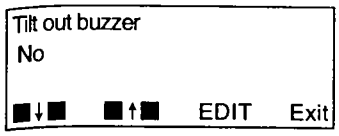
Laser power

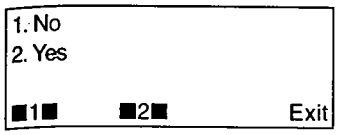


<1>: 1.0mW
<2>: 2.5mW
<Exit>: Retain the previously selected option.

Tilt alarm (beep tone)

<EDIT>

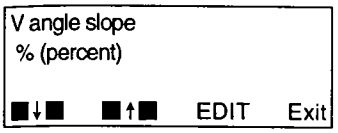


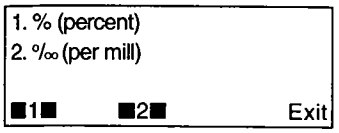


<1>: Beep tone does not sound when outside tilt range.
<2>: Beep tone sounds when outside tilt range.
<Exit>: Retain the previously selected option.

Slope resolution

<EDIT>

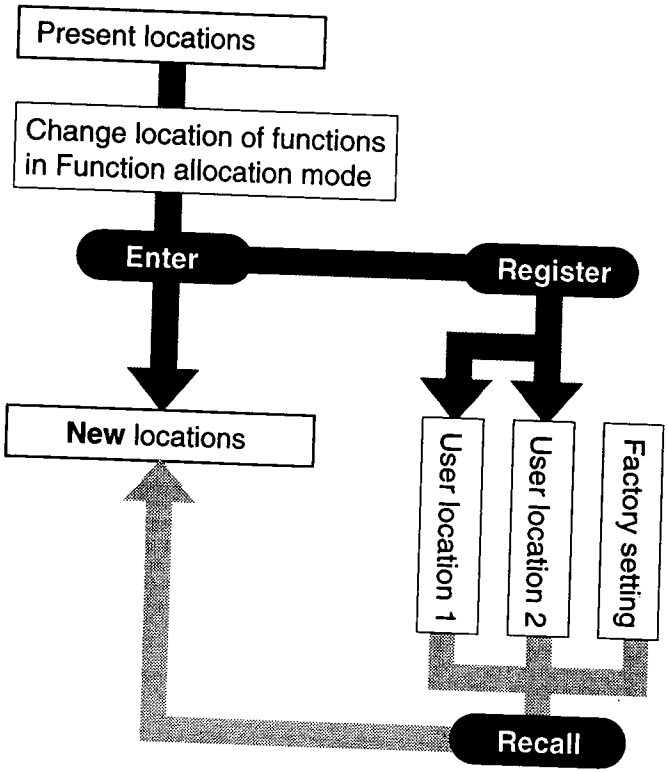




<1>: Slope in % (percent)
<2>: Slope in ‰ (per mill)
<Exit>: Retain the previously selected option.

15. CHANGING LOCATION OF FUNCTIONS FOR KEYS

- The LDT allows you to change locations of the functions for each key (except **<ESC>**). You can arrange the keyboard according to your requirements in order to save key strokes and to avoid mistakes. You will get the most efficiency by customizing function locations for your own applications.



- Difference between "Enter" and "Register" ▶**EXPLANATION** Difference between "Enter" and "Key registration" in key function allocating

15.1 Key function allocating

- Any functions mentioned below can be allocated in any page of any mode. After storing the locations, the locations are stored permanently until they are changed again. 2 locations can be registered at the internal memory. The registered location can be renewed.

▶NOTE The previously-stored locations of functions are cleared after changing or registering the new locations.

▶NOTE The functions marked with * are not allocated in the default setting.

General

<Laser> : Laser beam ON/OFF
<CONF> : Transfer to Setting mode
<→PX> : Go to next page
<--->* : No function
<ILLUM> : Display and reticle illumination ON/OFF
<off> : Switch the power off

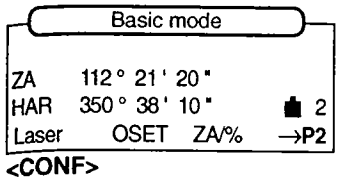
For Angle measurement

<0SET> : Set Horizontal angle to 0 /Index V circle
<HOLD> : Hold H angle / Release H angle
<Tilt> : Display the tilt angle
<REP> : Transfer to Repetition mode
<ZA/%> : Zenith angle / Slope in % (*1)
<VA/%> : Vertical angle / Slope in % (*1)
<R/L> : Select Horizontal angle right / left

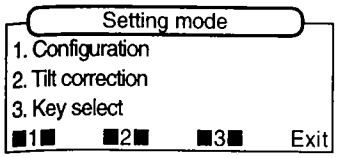
(*1) : "ZA/%" is displayed when parameter "V angle format" is set to "Zenith 0".
"VA/%" is displayed when parameter "V angle format" is set to "Horizontal 0" or "Horizontal ±90°".
"ZA/‰" is displayed when parameter "V angle format" is set

to "Zenith 0".
"VA/‰" is displayed when parameter "V angle format" is set to "Horizontal 0" or "Horizontal ±90°".

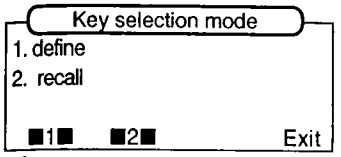
▶PROCEDURE Key function allocating



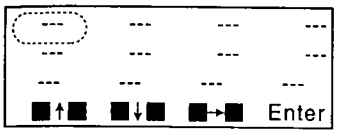
<CONF>



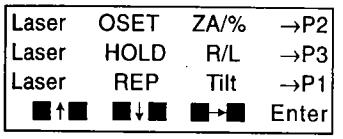
<3>



<1>



<↓> or <↑>, <→>
<Enter>



In Basic mode

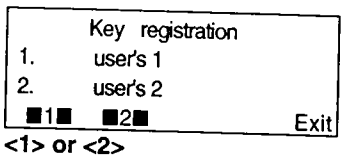
1. Hold **<ESC>** and press **<CONF>** for Setting mode.
2. Press **<3>** for Key selection mode.
3. Press **<1>** for Function allocating mode.

First line = First page
Second line = Second page
Third line = Third page

- Go to next function: **<↓>**
- Go to previous function: **<↑>**
- Go to next position: **<→>**

4. Display the required function. Repeat for the required numbers of functions.

5. Press **<Enter>** to enter the new location into memory.



<1> or <2>

6. Register the new location to "user's 1" or "user's 2". (The previously-registered location is cleared.) Or exit from this mode without registering. (Function allocating mode)

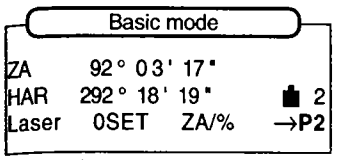
- Register to user's 1: **<1>**
- Register to user's 2: **<2>**
- Not register: **<Exit>**

- If there are more than 5 functions to be allocated, allocate the page-turn function in any location of each line.
- If there is no function to be allocated, allocate "- - -" for key.
- To Setting mode: **<Exit>**
- Exit from the mode: **<ESC>** (To Basic mode)
- Location storage period: Until next changing (Power-off possible)
- Up to 9 functions in 3 pages can be allocated

15.2 Registered location recalling

- The factory setting location or the registered locations stored in the memory can be recalled.

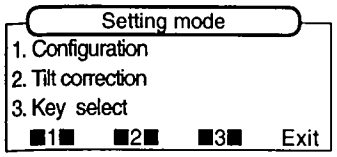
▶PROCEDURE **Key function recalling**



In Basic mode

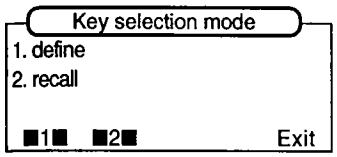
1. Hold **<ESC>** and press **<CONF>** for Setting mode.

<CONF>



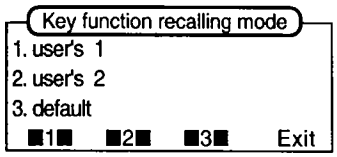
2. Press **<3>** for Key selection mode.

<3>



3. Press **<2>** for Key function recalling mode.

<2>



4. Select the required location. (Key function mode)

- Recall "user's 1": **<1>**
- Recall "user's 2": **<2>**
- Recall Factory setting: **<3>**

- The previously-stored locations of functions are **cleared** after recalling the registered locations.
- To Setting mode: **<Exit>**
- To Basic mode: **<ESC>**

▶EXPLANATION Difference between "Enter" and "Key registration" in key function allocating

- There are 2 methods for changing the locations of functions for keys. By knowing how to use **"Enter"** or **"Key registration"** properly, it will be easier to operate the LDT.

  ① **<Enter>** the new location or **register** the new location:
  After **enter**ing the new location, the functions are displayed in the entered location until next changing.

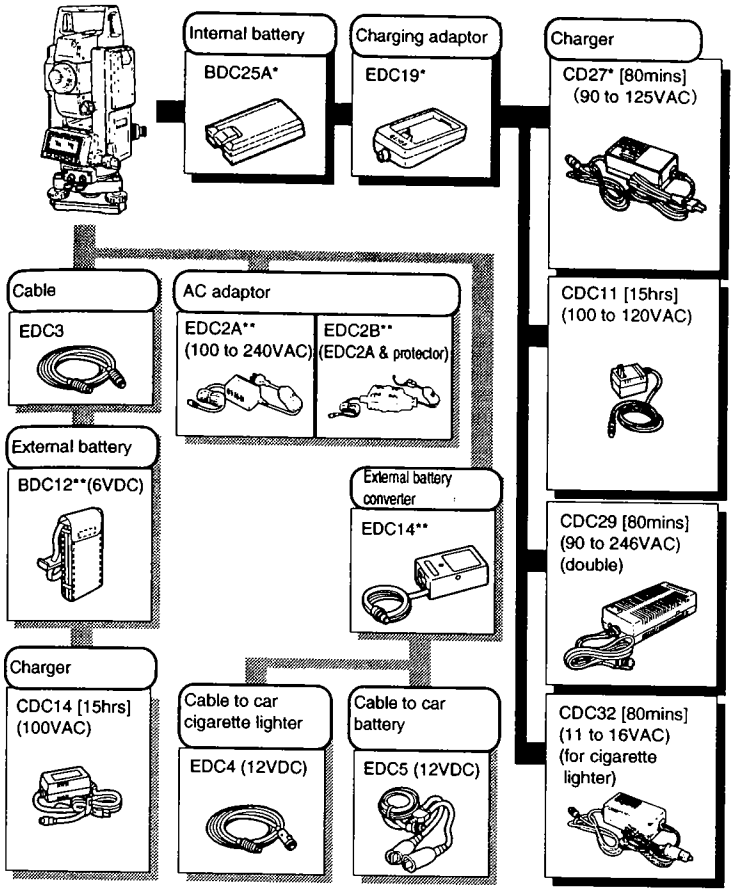
  ② Recall the **register**ed locations:
  After **register**ing a location, the **register**ed location can be recalled at any time.

  For example, if someone **enter**s another location, you can recall the location you **register**ed.

16. POWER SUPPLIES

- The LDT can be operated with the following combinations.

▶**NOTE** Use the LDT only with the combinations shown here.



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

▶**NOTE** When using any external power supply (**), it is recommended that the BDC25A battery be left in place to balance the weight on the the axes.

Battery BDC25A

- Battery operating life is shortened at extreme temperatures due to the battery's Ni-Cd compositon.
- If the battery is discharged excessively, its life may be shortened. Store it in a charged state.
- The battery can be recharged about 300 times under ordinary use (Temperature = 20°C, Humidity = 65%).
- The storage temperature is between 0 and 40°C.
- Specifications:
  Output voltage: 6VDC
  Capacity: 1200mAh
  Water resistance: IPX7 (BDC25A)
  Size: 58 x 23 x 92mm
  Weight: about 0.2kg

Battery charger CDC27 or CDC31A

- The battery charger becomes warm while charging. This is normal.
- How to charge: Connect the charger to the power supply, connect the adaptor to the battery charger and mount the battery in the adaptor. The charging light flashes during charging and lights steadily when charging is finished.
- The charging temperature is between 10 and 40°C.
- Charge the battery until the light remains on.
- Specifications:
  Input: CDC27: 90 to 125V AC, 50/60Hz, 20VA
  CDC31A: 180 to 264V AC, 50/60Hz, 20VA
  Output: 7.5V DC, 1.2A
  Charging time at 25°C: about 80 minutes (BDC25A)
  Size: 66 x 124 x 45mm
  Weight: CDC27: about 0.35kg
  CDC31A: about 0.38kg

▶PRECAUTION For the use of external power supplies

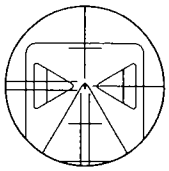
- Ensure that the car cigarette lighter has 12V DC output and that the negative terminal is grounded. Leave the engine running during use.
- Before using EDC2/2A, set the voltage selector to the correct voltage.
- EDC14 has a breaker switch. If you short circuit the battery or the polarity is not correct, the breaker will switch off the power. When the breaker switches off the power, remove the rubber cover and set the breaker switch so that a red mark appears.

Appendix 1: Manually indexing the vertical circle by face left, face right measurements

- Like all theodolites, the LDT will have a small vertical index error. For angle measurement of the highest accuracy, the vertical index error can be removed as follows:
- Set Parameter "V circle indexing" to "Manual". See chapter 14.

▶PROCEDURE **Manually indexing the vertical circle**

```
ZA     V 1
HAR    60° 00' 00"      2
Laser  0SET  ZA/%  →P2
```



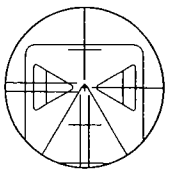
1. Level the LDT.

   "V1" is displayed.

2. In face left (V1), accurately sight a clear target at a horizontal distance of about 30m.

<0SET><0SET>

```
ZA     V 1
HAR    60° 00' 00"      2
Laser  0SET  ZA/%  →P2
```



3. Press **<0SET> twice.**

   "V2" is displayed.

4. Loosen the horizontal clamp and rotate the upper part of the LDT through 180°. In face right (V2), accurately sight the same target.

5. Press **<0SET>.**
   The vertical circle has been indexed.

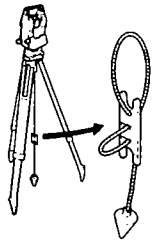
<0SET><0SET>

```
ZA     89° 10' 40"
HAR    240° 00' 00"     2
Laser  0SET  ZA/%  →P2
```

- If the power is switched off, the vertical circle should be indexed again.

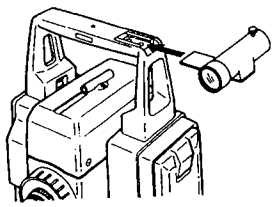
Appendix 2: Standard accessories

- **Plumb bob**



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

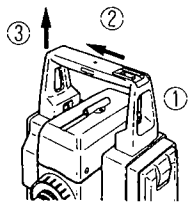
- **Tubular compass CP7**



- 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 left position until the compass needle bisects the index lines. The telescope is now aligned with magnetic north. After use, tighten the clamp and remove the compass from the slot. Replace it in the specified position in the carrying case.

▶**NOTE** 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.

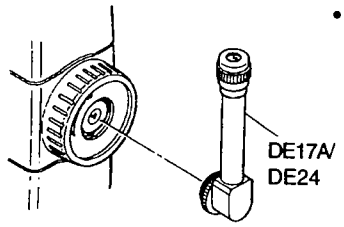
- **Handle**



- The carrying handle can be removed from the instrument as follows:
  ① Unscrew the handle securing screw
  ② Slide the handle to the side
  ③ Remove the handle

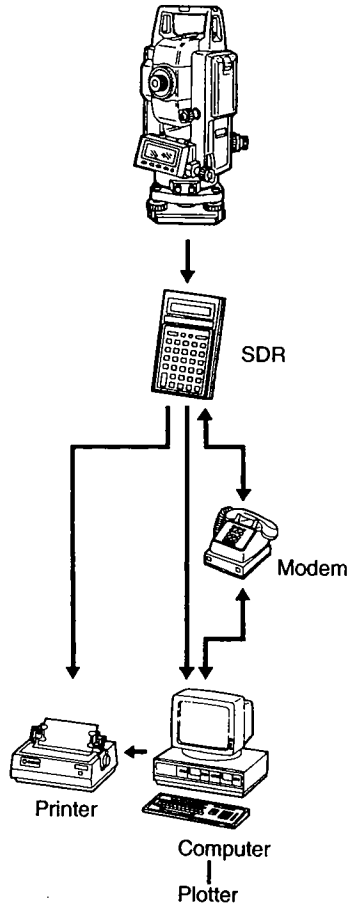
Appendix 3: Optional accessories

- **Diagonal eyepiece DE17A/DE24.**



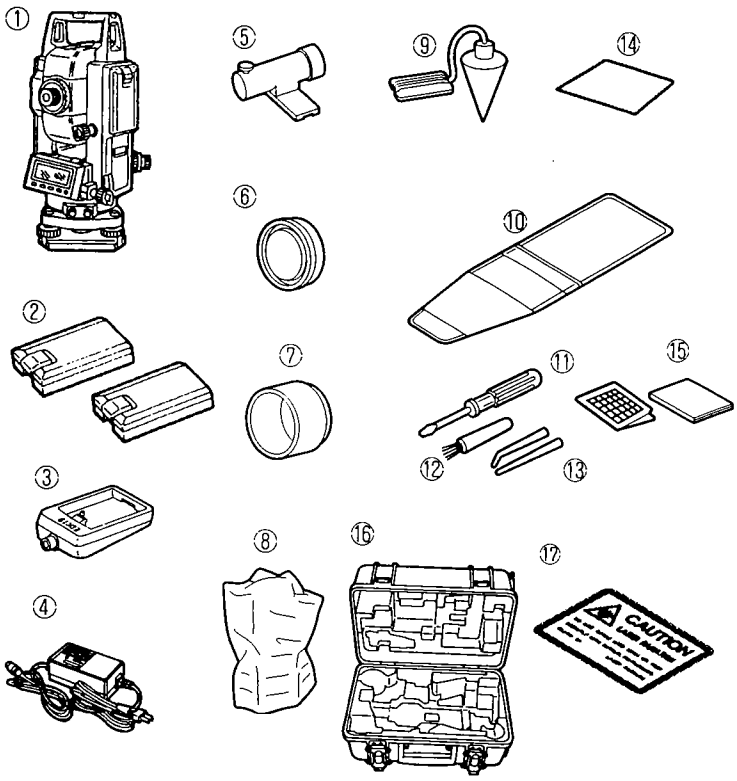
- The diagonal eyepiece is convenient for near-vertical observations and in places where space around the instrument is limited. Remove the handle and the telescope eyepiece by unscrewing the mounting ring, and screw in the diagonal eyepiece.

- **Electronic field book SDR series**



- The SDR series collects and stores vertical and horizontal angle data from the LDT. Calculations can be performed on the data so that the measurements can be verified in the field. The stored data can be transmitted to a data processing system.

STANDARD EQUIPMENT



① LDT50/50S 1
② Internal battery, BDC25A 1
③ Battery charging adaptor, EDC19 1
④ Battery charger, CDC27/CDC31A 1
⑤ Tubular compass, CP7 1
⑥ Lens cap 1
⑦ Lens hood 1
⑧ Vinyl cover 1
⑨ Plumb bob 1
⑩ Tool pouch 1
⑪ Screwdriver 1
⑫ Lens brush 1
⑬ Adjusting pin 1
⑭ Cleaning cloth 1
⑮ Operator's manual 1
⑯ Carring case (SC178) 1
⑰ Laser warning sign (LWS1E)... 1

MAINTENANCE

1. Make sure that the inside of the carrying case and the instrument are dry before closing the case. If moisture is trapped inside the case, it may cause the instrument to rust.

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. Do not wipe the displays and keyboard or carrying case with an organic solvent.

4. Store the LDT in a dry room where the temperature remains fairly constant.

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 your SOKKIA agent.

7. When the instrument is not used for a long time, check it at least once every 3 months.

8. When removing the LDT from the carrying case, never pull it out by force. The empty carrying case should then be closed to protect it from moisture.

9. Check the LDT for proper adjustment periodically to maintain the instrument accuracy.

SPECIFICATIONS

Laser

Light source:	Laser diode
Wavelength:	635nm
Output power:	1mW/2.5mW (Selectable with parameter)
Laser class:	Class 3A (IEC 60825-1) Class IIIa (FDA CFR21)
Laser focusing:	Simultaneous with telescope focusing. Parallel beam is generated when the focusing ring is adjusted to the mark.
Measuring range:	Parallel beam range up to 200m 200m and above at 1mWh 400m and above at 2.5mWh
Beam spot diameter:	5m: Ø0.5mm 20m: Ø2.1mm 50m: Ø5.2mm 100m: Ø10.3mm 150m: Ø15.5mm 200m: Ø20.7mm 300m: Ø31.0mm 400m: Ø41.3mm
Beam angle adjustment function:	Built-in
Laser on/off switch:	Select with softkey

Telescope

Length:	160mm
Aperture:	Ø42mm
Magnification:	30 x
Image:	Erect
Resolving power:	3"
Field of view:	1°30' (26m / 1000m)
Minimum focus:	1.3m
Stadio ratio:	1 : 100
Additive constant	0
Reticle illumination:	Bright or dim settings (Selectable with parameter)

Angle measurement

Horizontal and vertical circles type:	Incremental with 0 index
Angle units:	Degree / gon / mil (Selectable with parameter)
Display range:	
Horizontal angle:	-3599° 59' 59" to 3599° 59' 59"
Vertical angle:	0°0'0" to 359° 59' 59"
Minimum display:	1" (0.2mgon / 0.005mil) /5" (1mgon / 0.02mil) (Selectable with parameter)
Accuracy:	Standard deviation of mean of measurement taken in positions I and II (DIN 18723) 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:	Same as the angle display
Range of compensation:	±3'
Measuring mode:	
Horizontal angle:	Right / Left / Repetition / Hold (Selectable with keyboard)
Vertical angle:	Zenith 0 / Horizontal 0/Horizontal ±90° (Selectable with parameter) Slope in %/Slope in ‰ (Selectable with keyboard)

Power supply

Power source:	Ni-Cd rechargeable battery, BDC25A (6VDC)
Working duration at 25°C:	Laser emission & Angle measurement: BDC25A: About 5 hours Optional battery BDC12: About 25 hours Angle measurement only: BDC25A: About 9 hours BDC12: About 45 hours
Water resistance:	BDC25A: conforms to IPX7
Charging time:	CDC27 / 31A : About 80 minutes

General

Water resistance:	Conforms to IPX4
Display:	2 LCD dot matrix displays on each face 20 characters x 4 lines
Keyboard:	5 keys on both faces, free assignment of functions
Sensitivity of levels:	Plate level: 40" / 2mm Circular level: 10' / 2mm
Optical plummet:	Image: Erect Magnification: 3x Minimum focus: 20cm (7.9in.) from the tribrach bottom
Self-diagnostic function:	Provided
Data output:	Asynchronous serial, RS-232C compatible
Operating temperature:	-20 to 50°C
Instrument height:	236mm (9.3inch) from tribrach bottom
Size:	W150 x D160 x H353 mm (W5.9 x D6.3 x H13.9 in.) (with handle and battery)
Weight:	LDT50: about 5.7kg LDT50S: about 5.8kg (with handle and battery)

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 Réglement sur le matériel brouilleur du Canada.

CE Conformity Declaration

CE Declaration of Conformity
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: Laser Digital Theodolite (Surveying Instrument)

Model Name : LDT50

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

Applied
Harmonized Standard: EMI EN50081-1 1992
EN55022 1994-8 ClassB
EMS : EN50082-2 1995
ENV50140 1994
ENV50141 1994
EN61000-4-2 1995
EN61000-4-2 1995

Date: 07 Sept 1998
Firm: SOKKIA B.V.

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

Representative's Signature: Takeshi Fukawa

Name of Representative : Takeshi Fukawa
Representative's position : European vice President

MEMO

MEMO