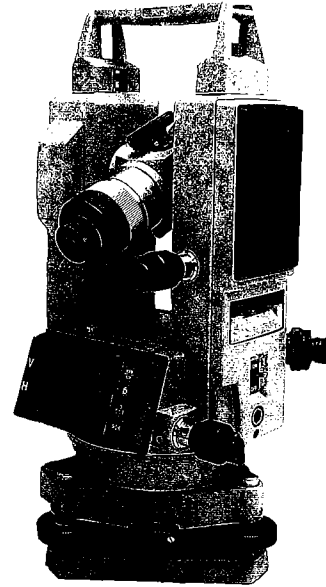


**SOKKIA**

**DT5/DT5S  
DT5A/DT5AS**

Electronic Digital Theodolite



**OPERATOR'S MANUAL**



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## 1. ALWAYS FOLLOW PRECAUTIONS FOR SAFE OPERATION

For the safe use of the product and prevention of injury to operators and other persons as well as prevention of property damage, items which should be observed are indicated in both the operator's manual and on the product itself.

### Definition of Indication

 <b>Warning</b>	Ignoring this indication and making an operation error could possibly result in death or serious injury to the operator
 <b>Caution</b>	Ignoring this indication and making an operation error could possibly result in personal injury or property damage

### Safety guidelines for using DT5/DT5S/DT5A/DT5AS

#### **Warning**

- Never look at the sun through the telescope. Loss of eyesight could result.
- Personnel other than qualified service engineers should not perform disassembly, rebuilding or repair. Fire, electric shock or burns could result.
- Do not use the unit in areas exposed to high amounts of dust or ash, in areas where there is inadequate ventilation, or near combustible materials. An explosion could occur.

#### **Caution**

- Do not use the carrying case as a footstool. The case is slippery and unstable so a person could slip and fall off it.
- Secure the handle to the 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 securely. Failure to properly secure the handle could result in the unit falling off while being carried, causing injury.
- When mounting the instrument to the tripod, tighten the centring screw securely. Failure to tighten the screw properly could result in the instrument falling off the tripod causing injury.
- Tighten securely the leg fixing screws of the tripod on which the instrument is mounted. Failure to tighten the screw properly could result in the instrument falling off the tripod 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.
- Check that hands and feet are not in the vicinity of the tripod legs when erecting the tripod. A hand or foot stab wound could occur.
- Do not place the instrument in a case with a damaged catch, belt or handle. The case or instrument could be dropped and cause injury.
- Do not wield or throw the plumb bob. A person could be injured if struck.

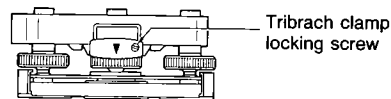
### Safety guideline for using battery

#### **Warning**

- Do not use the battery if wet. Resultant shorting could lead to fire or burns.

## 2. PRECAUTIONS

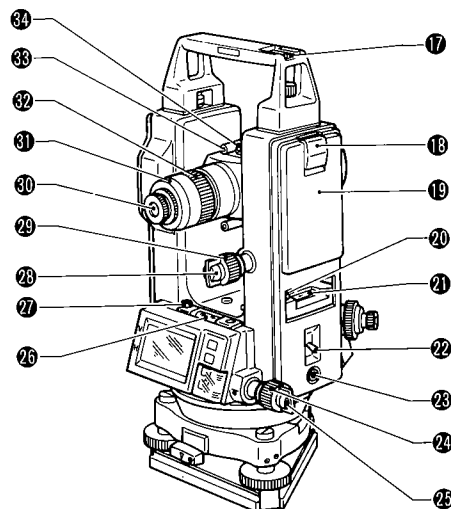
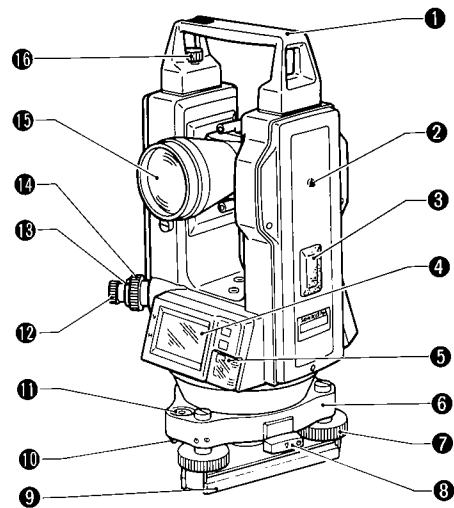
- a) When the DT5 is not used for a long time, check it at least once every three months.
- b) Handle the DT5 with care. Avoid heavy shocks or vibration.
- c) If any problems are found with the rotatable portion, screws or optical parts ( e.g. lens), contact your SOKKIA agent.
- d) After removing the DT5 from the carrying case, close the case to exclude dust.
- e) Never place the DT5 directly on the ground. (Attached dirt may damage the base plate and centering screw.)
- f) Never carry the DT5 on the tripod to another site.
- g) Protect the DT5 with an umbrella against strong sunlight and rain.
- h) When the operator leaves the DT5, the vinyl cover should be placed over the instrument.
- i) Always switch the power off before removing the battery.
- j) Always remove the battery from the DT5 before returning it to the case.
- k) When the DT5 is placed in the carrying case, follow the layout plan.
- l) Make sure that the DT5 and the protective lining of the carrying case are dry before closing the case. (The case is hermetically sealed; if moisture is trapped inside, damage to the instrument could occur.)



### IMPORTANT

When the DT5 leaves our factory, the tribrach clamp ⑧ is locked with a screw. Loosen it and leave it loose.

### 3. PARTS OF THE INSTRUMENT



\*Above figures are DT5.

- |  |                                      |
|--|--------------------------------------|
| ① Handle                                   | ⑰ Tubular compass slot               |
| ② Instrument height mark                   | ⑱ Battery release cover              |
| ③ Internal switch cover                    | ⑲ Battery BDC21                      |
| ④ Display                                  | ⑳ Plate level adjusting screw        |
| ⑤ Keyboard                                 | ㉑ Plate level                        |
| ⑥ Tribrach                                 | ㉒ Power switch                       |
| ⑦ Levelling foot screw                     | ㉓ Data output connector              |
| ⑧ Tribrach clamp                           | ㉔ Horizontal fine motion screw       |
| ⑨ Base plate                               | ㉕ Horizontal clamp                   |
| ⑩ Circular level adjusting screws          | ㉖ Plate level                        |
| ⑪ Circular level                           | ㉗ Plate level adjusting screw        |
| ⑫ Optical plummet eyepiece                 | ㉘ Vertical clamp                     |
| ⑬ Optical plummet reticle adjustment cover | ㉙ Vertical fine motion screw         |
| ⑭ Optical plummet focussing ring           | ⑳ Telescope eyepiece                 |
| ⑮ Objective lens                           | ㉑ Telescope reticle adjustment cover |
| ⑯ Handle securing screw                    | ㉒ Telescope focussing ring           |
|  | ㉓ Peep sight                         |
|  | ㉔ Field of view illumination lever   |

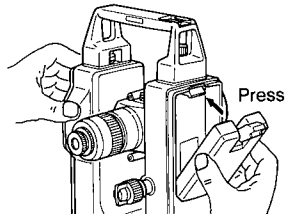
#### **4. FEATURES**

- The DT5 is a highly-accurate electronic digital theodolite. Horizontal and vertical angles are simultaneously displayed on an easy-to-read LCD display.
- A self-diagnostic function is provided; a microcomputer constantly checks the angle-measuring function. If the instrument is not functioning correctly, an error code is displayed.
- Any standard "AA" size batteries, rechargeable Ni-Cd or alkaline type (i.e. LR6 or R6P) batteries can be used.
- The built-in reticle and display lighting is useful for surveying at night or in underground work.
- A power saving cut-off function can be selected, which switches the instrument power off 30 minutes after the last key operation to save battery power.
- An RS-232C data-output connector is provided, to allow the horizontal and vertical angle data to be output to a data collector or external computer.
- The DT5 is provided with a removable tribrach base, while the DT5S has a shifting-style tribrach for quick centring.

## 5. QUICK GUIDE TO DT5 OPERATION

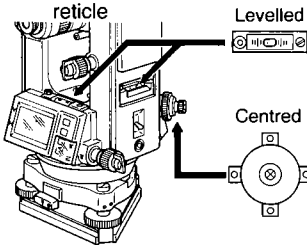
Please ensure that you are fully familiar with the instrument and manual before using this quick guide.

1. a) Mount the battery in the DT5  
b) Mount the DT5 on the tripod



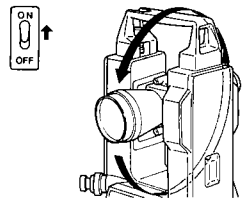
Battery operations; page 6

2. a) Level and centre the DT5 over the surveying point  
b) Focus the telescope reticle



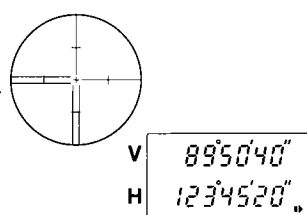
Levelling, centring and focussing; pages 8-11

3. a) Switch on  
b) Index the vertical circle (Rotate the telescope through 360°)



Power on; page 6  
Vertical circle indexing; page 12

4. a) Sight and focus on the target  
b) Read the displayed H and V angles



Sighting procedure; page 11  
Angle reading; page 13

Key operations:

- To set horizontal angle to zero, press **0 SET**.
- To hold the displayed horizontal angle value, press **Hold**.
- \*To select horizontal angle right or left, press **Angle**.  
\*To change vertical angle to % vertical angle mode, press **Angle %**.
- To illuminate display and reticle of telescope, press **Light**.

\* Key function depends on the internal switch setting.

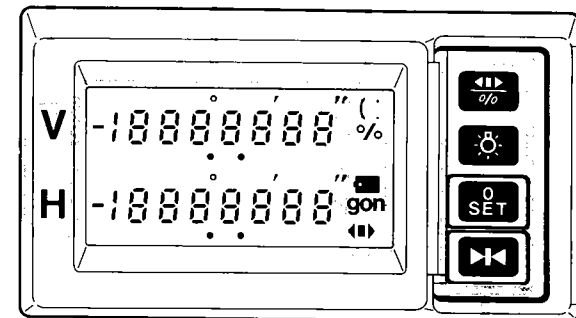
## 6. DISPLAY SYMBOLS/KEY FUNCTIONS

### Display symbols

V = Vertical angle  
H = Horizontal angle

**(±)** : Vertical angle (0° horizontal ±90°)  
**%** : % vertical angle  
**Battery low warning**  
**gon** : gon angle units  
**Horizontal angle right**  
**Horizontal angle left**  
**Horizontal angle hold**

Angle value or error code



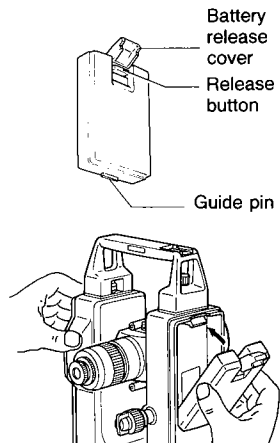
### Key functions

- Angle** : \* Select horizontal angle direction to right or left  
\* Select/release % vertical angle mode
- Light** : Illuminate display and reticle of telescope
- 0 SET** : Set horizontal angle to zero
- Hold** : Hold/release horizontal angle

**Note:** The **0 SET** and **Hold** keys can be protected from accidental resetting with the sliding keyboard cover.

\* The function of **Angle %** is determined by the internal switch 1 setting. (See page 26.)

## 7. BATTERY BDC21: MOUNTING AND CHECK

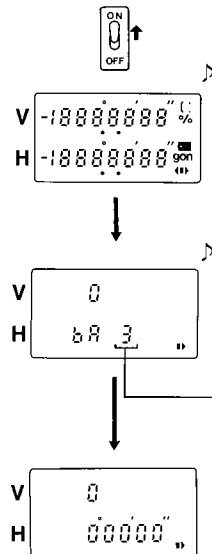


- 1) Ensure that the power switch ② is OFF.
- 2) Mounting the battery:
  - a) Insert the bottom of the battery into the battery recess.
  - b) Press the top of the battery until a click is heard.
  - c) Close the battery release button cover ⑬.
- 3) Removing the battery:
  - a) Open the battery release cover ⑬.
  - b) Press the release button downwards.
  - c) Remove the battery.

- 4) Instrument and battery check:
 

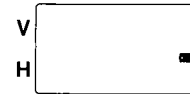
Turn the DT5 power switch ② on. The audio tone sounds and all the display symbols are shown on the display while the instrument performs self-diagnostic checks.


When the instrument has successfully completed the checks, the remaining battery power is displayed as a numeric code for three seconds:



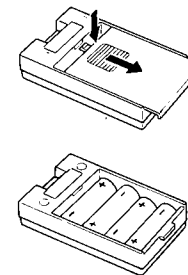
Code 0	.....	Less than 1.5 hrs	(e.g. R6P batteries at 25°C)
1	.....	1.5-10 hrs	
2	.....	10-15 hrs	
3	.....	More than 15 hrs	

The display of 0 in the V display indicates that the instrument is ready for vertical circle indexing.



When the  symbol is displayed, the batteries should be replaced.

Turn the power switch off and replace the dry cell batteries in the battery case as follows:



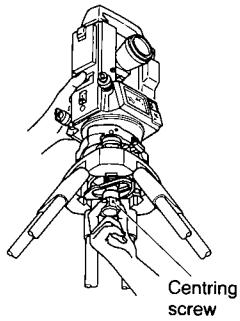
- 5) Changing the dry cell batteries:
 

Remove the battery from the DT5. Push down and slide open the battery case cover. Install the four new "AA" size batteries in the directions indicated inside the case.

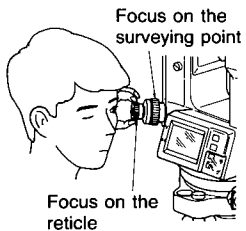


## 8. SETTING UP THE INSTRUMENT

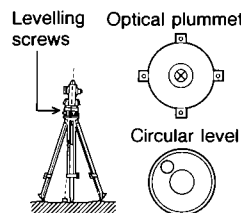
### 8.1 Centring and levelling



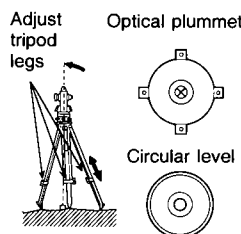
- 1) Set up the tripod so that:
  - a) The tripod head is approximately level, at a convenient height for the operator, and over the surveying point.
  - b) The tripod shoes are firmly fixed in the ground.
- 2) Place the DT5 on the tripod head. Support it with one hand and insert and tighten the centring screw with the other. This screw should be tight whenever the theodolite is on the tripod.



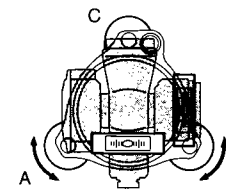
- 3) Focus on the surveying point:
  - a) Turn the optical plummet eyepiece 12 to focus on the reticle.
  - b) Turn the optical plummet focussing ring 14 to focus on the surveying point.



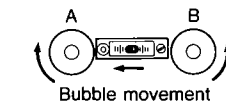
- 4) Adjust the levelling foot screws 7 to centre the surveying point in the optical plummet reticle circles. Observe the off-centre direction of the circular level 11 bubble.



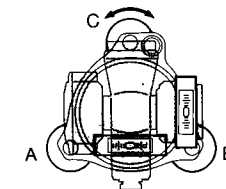
- 5) Shorten the tripod leg nearest the bubble direction or extend the leg farthest from this direction. Generally, two tripod legs must be adjusted to centre the circular level bubble.



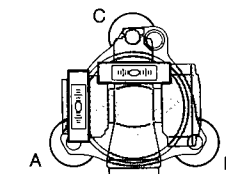
- 6) Using the horizontal clamp 25, turn the upper part of the instrument until one plate level 24 or 26 is parallel to a line between levelling screws A and B. Centre this plate level bubble using levelling screws A and B.



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



- 7) Centre the other plate level bubble using levelling screw C.



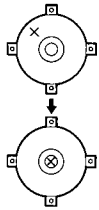
- 8) Turn the upper part 180° and check the position of the plate level bubbles.

If the bubbles are off-centre, either perform the plate level adjustment described on page 19 or carefully adjust levelling screws A and B in equal and opposite directions to remove half of the bubble displacement of the plate level which is parallel to a line between levelling screws A and B. Use levelling screw C to remove half of the bubble displacement of the other plate level bubble.

The bubbles should now remain in the same position for any position of the upper part of the instrument.

(If they do not, repeat the levelling procedure.)

The following steps are different for the DT5 and DT5S:



**DT5:**

- 9) Check the position of the surveying point in the optical plummet eyepiece. If necessary, loosen the centring screw slightly and carefully slide the instrument over the tripod head until the surveying point is exactly centred in the reticle.  
Re-tighten the centring screw.

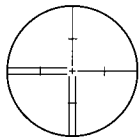
- 10) Repeat procedures 6) ~ 9) until the instrument is correctly levelled and centred over the surveying point.

**DT5S:**

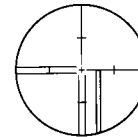
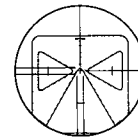
- 9) Turn the tribrach shifting clamp counterclockwise.  
Adjust the instrument position on the tribrach to centre the surveying point in the reticle. Tighten the shifting clamp to fix the instrument in the centred position.

**Note:** The DT5S shifting tribrach can be adjusted up to  $\pm 10\text{mm}$  without moving the base plate.

**8.2 Focussing and target sighting**



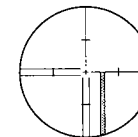
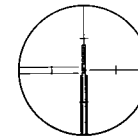
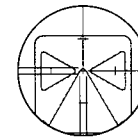
- 1) Look through the telescope at a bright, featureless background and turn the eyepiece clockwise, then counter-clockwise until just before the reticle (cross lines) image goes out of focus. Using this procedure, frequent reticle re-focussing is not necessary, since your eye is focussed at infinity.



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

**IMPORTANT:**

4) While looking at the target, move your head slightly up and down and to the right and left. If the reticle line appears to move with respect to the target, parallax is present, which will introduce reading errors. To eliminate this parallax effect, re-focus with the focussing ring. (If parallax is still present, check the reticle focussing in 1).

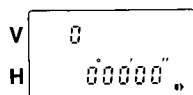


- 5) Position of the target in relation to the reticle lines;
  - a) When observing horizontal and vertical angles at the same time.
  - b) When observing horizontal angle only.
  - c) When observing vertical angle only.

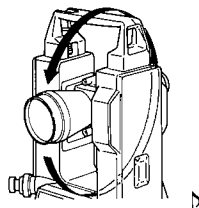
**Note:** Observe to the same point of the reticle when the telescope face is changed.


## 9. INDEXING THE VERTICAL CIRCLE

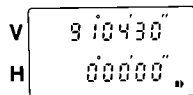
Turn the DT5 power switch  ON.



... waiting for vertical circle indexing  
(If **V!** is displayed, the instrument parameters have been set to manual circle indexing. See note below.)



- 1) Vertical circle indexing  
Loosen the vertical clamp , and rotate the telescope through 360°. (Indexing occurs when the objective lens crosses the horizontal plane in face left.)



The audio tone sounds and the vertical angle is displayed.

**Angle measurement can now begin.**

**Note 1:** Each time the instrument is switched on, the vertical index must be redetermined.

**Note 2:** The default parameter switch settings mean that the DT5 power is automatically cut off 30 minutes after the last key operation. (See note below)

Instrument parameters: See page 26.

Internal switch 4 can be used to change the vertical circle indexing. Options are indexing by transiting the telescope (as above) or manual indexing by face left, face right sightings (see page 27).

Internal switch 5 can be used to switch OFF/ON the Auto Power-off function which switches the DT5 power off 30 minutes after the last key operation.

## 10. ANGLE MEASUREMENT

Instrument internal parameter switches: See page 26.

Internal switches 2 and 3 can be used to select the displayed vertical angle mode. Options are:

Zenith 0°

SW2: OFF

SW3: OFF

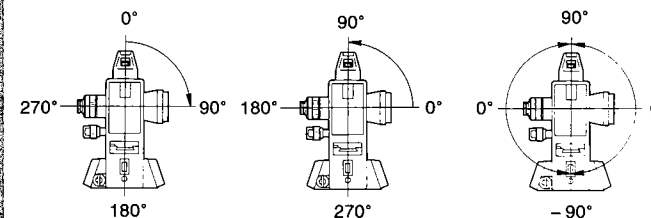
Horizontal 0° F.L.

SW2: ON

SW3: OFF

Horizontal 0° ± 90°

SW3: ON

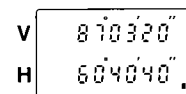


Drawings show DT5 in the face left position.

The internal rotary switch can be used to select the V and H angle units.

Options are: Degrees, gon, Mil.

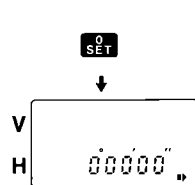
### 10.1 Reading the horizontal and vertical angles



... Vertical angle 87°03'20"

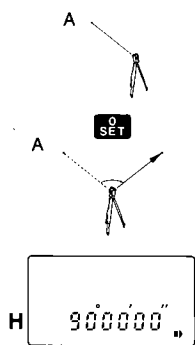
... Horizontal angle 60°40'40"

### 10.2 Set horizontal angle to zero



Slide up the keyboard cover and press **0 SET** to set the horizontal angle to zero.

### 10.3 Lay out a required horizontal angle, e.g. 90°00'00"



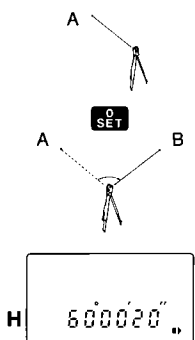
Sight the reference target A.

Press **0 SET** to set the horizontal angle display to zero, as above.

Loosen the horizontal clamp and turn the upper part until the required horizontal angle (90°00'00") is displayed.

The telescope is now sighted in the required direction.

### 10.4 Measure the horizontal angle between two targets



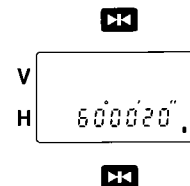
Sight the first target A.

Press **0 SET** to set the horizontal angle display to zero, as in 9.2 above.

Use the horizontal and vertical clamps and fine motion screws to sight target B.

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

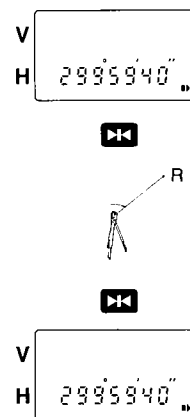
### 10.5 Hold the horizontal angle value



Slide up the keyboard cover and press **⏪** to hold the displayed horizontal angle value. (The hold symbol **⏪** is displayed.)

To release the horizontal angle hold, press **⏩** again.

### 10.6 Set the horizontal circle to a required value



e.g. Set 299°59'40" to reference target R.

Use the horizontal clamp and fine motion screw to turn the upper part until an angle of 299°59'40" is shown on the display.

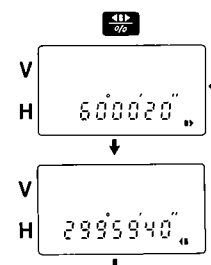
Press **⏪** to hold the horizontal angle display, as described above.

Use the horizontal and vertical clamps and fine motion screws to turn the theodolite to sight on reference target R.

Press **⏩** to release the display hold.

Reference target R has now been set to 299°59'40".

### 10.7 Select the horizontal angle right or left.




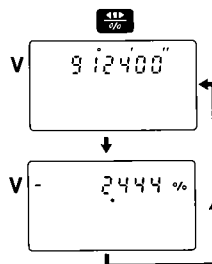
When the internal parameter switch 1 (See page 26) is set to OFF, the **%/°** key can be used to select the required horizontal angle display:

(display symbol **▶** : horizontal angle right)  
(display symbol **◀** : horizontal angle left)


**Note:** When internal parameter switch 1 is OFF (L/R), the % vertical angle can not be displayed.

### 10.8 % vertical angle mode

When the internal parameter switch 1 (See page 26) is set to ON, the  key can be used to enter/exit from the % vertical angle display.

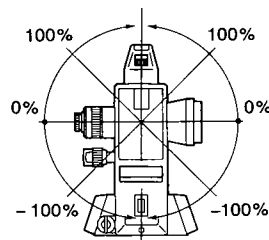


Vertical angle display.

Press  to change to the % vertical angle display.

The % symbol is displayed.

**Note:** When internal parameter switch 1 is ON (%), horizontal angle left can not be displayed.

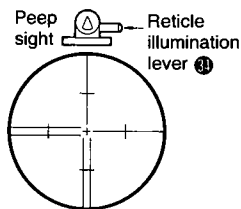



Maximum displayed value =  $\pm 999.909\%$

% vertical angle =  $100 \times \tan \theta$   
where  $\theta = 0^\circ \pm 90^\circ$


Press  again to return to the vertical angle display.

### 10.9 Display and reticle illumination



Press  to illuminate the display and reticle of the DT5.

Press  again to switch the illumination off.


To adjust the brightness of the reticle illumination, turn the illumination lever  on the theodolite telescope.

### 11. ERROR CODES

If there is any fault in the theodolite function, the error codes shown in the following table will be displayed.

Display	Meaning	Action
$\epsilon$ 100	* Error when measuring a horizontal angle	Reset the horizontal angle to zero.
$\epsilon$ 101	* Error when measuring a vertical angle	Index the vertical circle again.

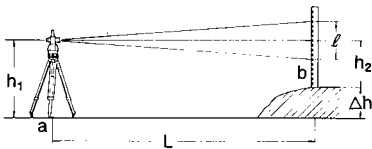
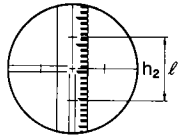
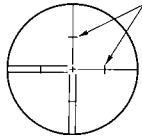
\* If the upper part or the telescope of the DT5 is rotated faster than four revolutions per second, the error indication  $\epsilon$  100 or  $\epsilon$  101 is displayed.

If  is displayed, replace the batteries as described on page 7.

If the error indication  $\epsilon$  appears with any number other than the ones above, please contact your SOKKIA agent.

## 12. OPTICAL DISTANCE MEASUREMENT: STADIA SURVEY

**Stadia lines** 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 centre 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:

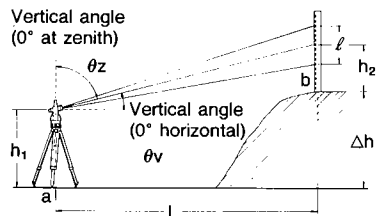
Read the distance ( $l$ ) on the staff between the two stadia lines, the vertical angle, and the centre line value,  $h_2$ .

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

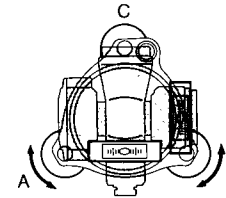


## 13. CHECKS AND ADJUSTMENTS

It is important that the DT5 is periodically checked and adjusted. In addition, the instrument should be checked after transportation, long storage or when damage to the instrument is suspected to have occurred.

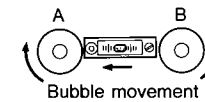
### 13.1 Plate levels

The glass tubes of the plate levels are sensitive to temperature change or shock. Adjust as follows:

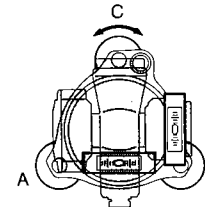


- Turn the upper part of the instrument until one plate level is parallel to a line between levelling foot screws A and B.

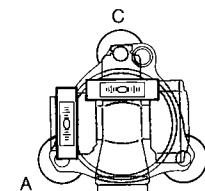
Centre this plate level bubble using levelling screws A and B.



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



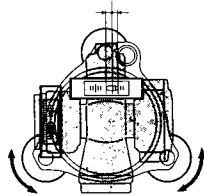
- Centre the other plate level bubble using levelling screw C.



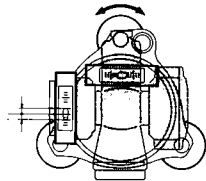
- Turn the upper part through 180° and check the positions of the plate level bubbles. If the bubbles are still centred, no adjustment is necessary.

If the bubbles are not still centred, adjust as follows:

① Use levelling screws

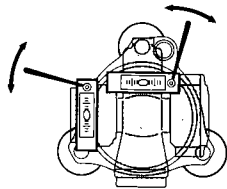


- ① Correct half of the bubble displacement of the plate level which is parallel to a line between levelling screws A and B by turning levelling screws A and B in equal and opposite directions.



Correct half of the bubble displacement of the other plate level bubble with levelling screw C.

② Use adjusting pin

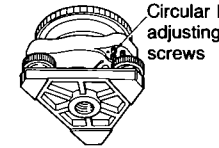


- ② Centre both plate level bubbles by turning the plate level adjusting screws ④ and ⑤ with the adjusting pin.
- ③ Repeat the procedures from a) until the bubbles remain centred for any position of the upper part.

### 13.2 Circular level

- a) Perform the plate level adjustment as in 12.1, or carefully level the plate level.
- b) Check the position of the circular level bubble.

If the bubble is off-centre, adjust as follows:



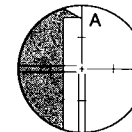
- ① Note the off-centre direction of the bubble.
- ② Loosen the adjusting screw farthest from this direction to centre the bubble.
- ③ Adjust all three adjusting screws until the tension of each screw tightening is the same, and the bubble is centred.

**WARNING:** Over-tightening the adjusting screws may damage the circular level.

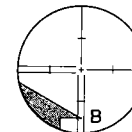
Unequal tightening of the screws may mean that the bubble will go out of adjustment.

### 13.3 Reticle

#### 13.3.1 Perpendicularity of the reticle to the horizontal axis

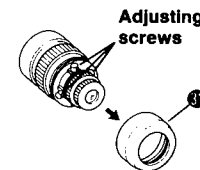


- a) Carefully level the DT5. Select and sight a clear target on the upper part A of the reticle line.



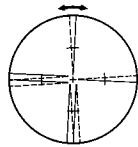
- b) Turn the telescope vertical fine motion screw until the target is on the lower part of the reticle B. Check that the target is still positioned centrally within the vertical lines.

If the target is off-centre, the following adjustment should be performed:



- ① Unscrew and remove the telescope reticle adjustment cover ①.

Adjusting screw mount



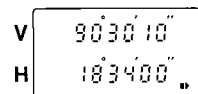
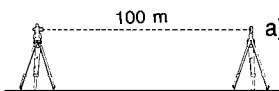
- ② Very slightly loosen one vertical and one horizontal adjusting screw by a certain amount.
- ③ Place a small piece of plastic or wood against one side of the top adjusting screw mount as a buffer.
- ④ Look through the eyepiece and gently tap the piece of plastic or wood to rotate the reticle slightly.
- ⑤ Re-tighten the two adjusting screws (loosened in ②) by the same amount.

**WARNING:** Over-tightening the adjusting screws may damage the reticle.

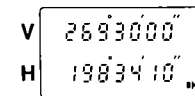
Unequal tightening of the adjusting screws may mean that the reticle will go out of adjustment.

- ⑥ Check the reticle perpendicularity again using procedures a) and b) above and repeat the adjustment if necessary. Replace the reticle adjustment cover.
- ⑦ After this adjustment, the vertical and horizontal reticle line positions should be checked as follows:

### 13.3.2 Vertical and horizontal reticle line positions



- a) Set up a clear target about 100 metres (300 feet) from the DT5. Carefully level the DT5, switch on and index the vertical circle.
- b) Sight the target on face left and read the horizontal and vertical angles.



$$\text{e.g. } H = 198^{\circ}34'10'' - 18^{\circ}34'00'' = 180^{\circ}00'10''$$

$$\text{e.g. } V = 90^{\circ}30'10'' + 269^{\circ}30'00'' = 360^{\circ}00'10''$$

- c) Now sight the target on face right and read the horizontal and vertical angles.
- d) Subtract the horizontal face left angle from the horizontal face right angle. The difference should be within  $180^{\circ} \pm 40''$ .
- e) Add the vertical face left angle and the vertical face right angle. The sum should be within  $360^{\circ} \pm 40''$ . If either of the values are  $40''$  or greater, repeat the above procedures.

If the difference is consistently  $40''$  or greater, the theodolite reticle should be adjusted using the following procedures:

Example when:  
Horizontal F.L./F.R. =  $18^{\circ}34'00''/198^{\circ}34'40''$   
i.e. error =  $+40''$

Vertical F.L./F.R. =  $90^{\circ}30'10''/269^{\circ}30'30''$   
i.e. error =  $+40''$

$$\text{Mean } H = \frac{18^{\circ}34'00'' + 196^{\circ}34'40''}{2} + 90^{\circ}$$

$$= 198^{\circ}34'20''$$

$$\text{Mean } V = \frac{269^{\circ}30'30'' - 90^{\circ}30'10''}{2} + 180^{\circ}$$

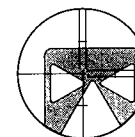
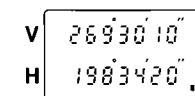
$$= 269^{\circ}30'10''$$

**Note:** Ensure that the vertical and horizontal clamps are fully tightened.

- ① Calculate the mean face right horizontal and vertical angles, i.e.

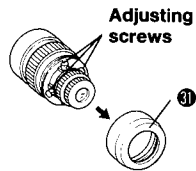
$$\text{horizontal} = \frac{(F.L. + F.R.)}{2} + 90^{\circ}$$

$$\text{vertical} = \frac{(F.R. - F.L.)}{2} + 180^{\circ}$$



- ② 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.
- ③ Look through the telescope. The reticle is now slightly shifted from the target.





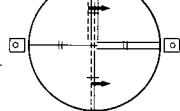
④ Unscrew and remove the telescope reticle adjustment cover ④

⑤ To move the vertical reticle line towards the target centre, use the adjusting pin to adjust the left and right adjusting screws as follows:

**Vertical reticle line**

Example: **To move the reticle to the right (left)**

- ① Slightly loosen.
- ② Tighten by the same amount



(2 Tighten.) (1 Loosen.)

To move the reticle to the right (left), first very slightly loosen the left (right) adjusting screw, then tighten the right (left) adjusting screw by this same amount.

Check the reticle position and repeat the procedure until the reticle comes close to the target centre.

⑥ To move the horizontal reticle line towards the target centre, adjust the top and bottom adjusting screws as follows:

**Horizontal reticle line**

Example: **To move the reticle down (up)**

- ① Slightly loosen.
- (2 Tighten.)



- ② Tighten by the same amount
- (1 Loosen.)

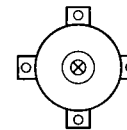
To move the reticle down (up), first very slightly loosen the top (bottom) adjusting screw, then tighten the bottom (top) adjusting screw by this same amount. Check the reticle position and repeat the procedure until the reticle comes close to the target centre.

⑦ Replace the reticle adjustment cover.

**WARNING:**

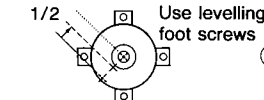
Over-tightening the adjusting screws may damage the reticle. Unequal tightening of the adjusting screws may mean that the reticle will go out of adjustment.

**13.4 Optical plummet**

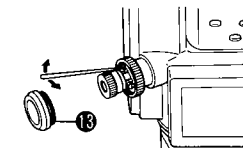


- a) Carefully level the DT5 and exactly centre a surveying point in the reticle of the optical plummet.
- b) Turn the upper part 180° and check the position of the surveying point in the reticle.

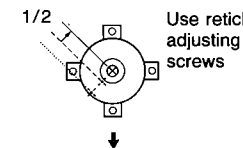
If the surveying point is not still centred in the optical plummet, adjust as follows:



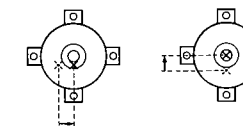
- ① Remove half of the displacement using the levelling foot screws.



- ② Unscrew the optical plummet reticle cover ⑤.



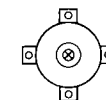
- ③ Now adjust the four optical plummet reticle adjusting screws with the adjusting pin to centre the reticle exactly on the surveying point.



For procedure, refer to "vertical and horizontal reticle adjustment" parts ⑤ and ⑥ on the previous page.

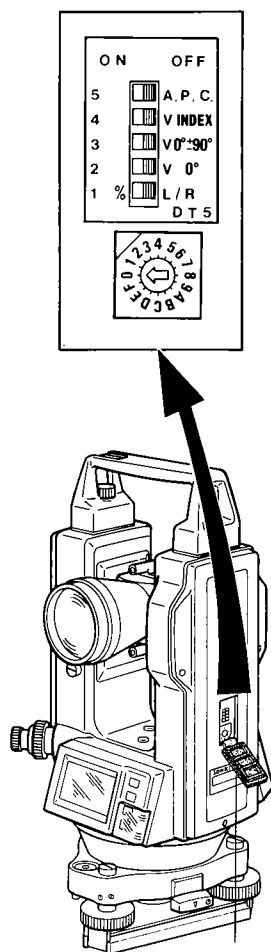
**WARNING:** Over-tightening the adjusting screws may damage the reticle.

Unequal tightening of the adjusting screws may mean that the reticle will go out of adjustment.



- ④ Check the adjustment by rotating the upper part. The surveying point should remain centred in the reticle. If necessary, repeat the adjustment.

## 14. INSTRUMENT INTERNAL PARAMETER SWITCHES



Internal switch cover ③

**Note:** Before changing these switch settings, turn the DT5 power off.

SLIDE SWITCH	FUNCTION
1 * OFF ON	Display horizontal right/left angle using $\frac{H}{V}$ key Display vertical/% vertical angle using $\frac{V}{\%}$ key
2 * OFF ON	Vertical angle (0° at zenith) Vertical angle (0° horizontal on face left)
3 * OFF ON	Switch has no function Vertical angle (0° horizontal $\pm 90^\circ$ ) (over-rides switch 2 setting)
4 * OFF ON	Vertical circle indexing by rotating the telescope Vertical circle indexing by face left, face right observations
5 * OFF ON	Auto power cut-off after 30 minutes No auto power cut-off

Rotary switch	V and H angle units
*0	Degrees 0° ~ 359°59'55"
1	gon 0 gon ~ 399.999 gon
2	Mil 0 Mil ~ 6399.98 Mil
3 ~ F	Do not set during use. (These positions are for service)

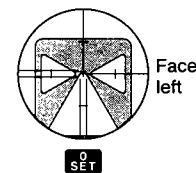
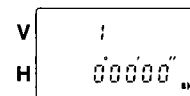
\* Switch position when instrument left the factory.

## APPENDICES

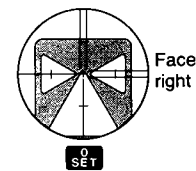
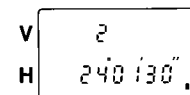
### Appendix A. Indexing vertical circle by face left, face right readings.

Like all theodolites, the DT5 will have a vertical index error. The vertical index can be determined, and the index error removed, by the following procedure:

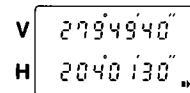
- 1) Ensure that the DT5 power switch is off.
- 2) Change the internal switch 4 to ON (see previous page); i.e. Vertical circle indexing by face left, face right readings. Carefully level the DT5 and switch the instrument on. The prompt  $\frac{V}{H}$  is displayed in the V display.



- 3) In the face left position, accurately sight a clear target at a horizontal distance of about 30 metres (100 feet). Press  $\frac{0}{SET}$ .



- 4) On face right, accurately sight the same target. Press  $\frac{0}{SET}$  again.



Press  $\frac{0}{SET}$  again.

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

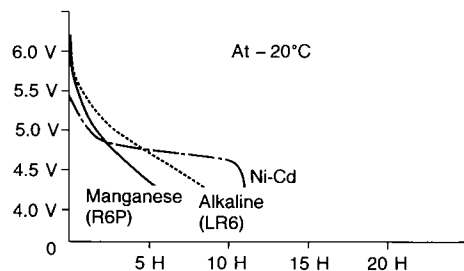
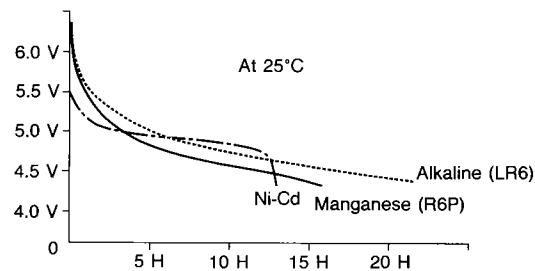
**Note:** The vertical circle must be re-indexed each time the DT5 is switched on.

Ensure that the instrument is switched off when moving it to a new location.

## Appendix B. Battery selection

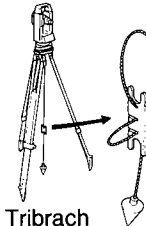
### Battery selection

Any good-quality "AA" size batteries may be used in the DT5, although alkaline batteries normally last longer than the other types. However, battery characteristics change with the working temperature. From the graphs it can be seen that for sub-zero temperatures re-chargeable Ni-Cd batteries will last the longest. Choose the battery type best suited to the working temperatures.



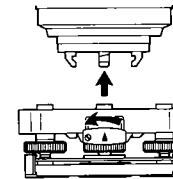
## Appendix C. Standard accessories

### 1) Plumb bob



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

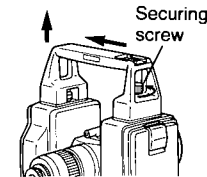
### 2) Tribach



The DT5 instrument can be removed from the tribrach by rotating the tribrach clamp anticlockwise and carefully lifting the instrument up.

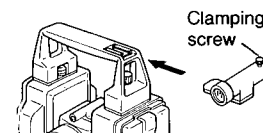
(The DT5S has a shifting tribrach for quick centring, and the instrument can not be removed.)

### 3) Handle



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

### 4) Tubular compass CP7

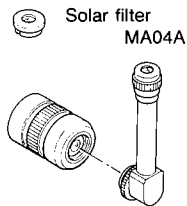


To mount the CP7, slide it into the tubular compass slot on the carrying handle. To use, loosen the clamping screw to free the compass needle. Turn the instrument in the face left position until the compass needle bisects the index lines. The telescope will be nearly aligned with magnetic north. After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

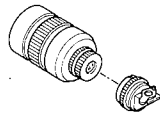
## Appendix D. Optional accessories

### 1) Diagonal eyepiece DE17A



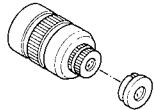
The diagonal eyepiece is convenient for near-vertical observations and in places where space around the instrument is limited. Remove the telescope eyepiece by unscrewing the mounting ring, and screw in the diagonal eyepiece.

### 2) Eyepiece prism EP3



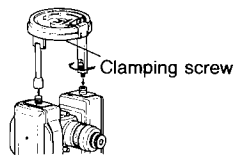
The eyepiece prism is convenient for steep observations up to 60° from the horizontal, and has an attached solar filter.

### 3) Solar filter EF2



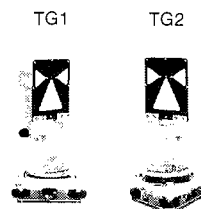
For observations to the sun, and where glare is present.

### 4) Circular compass CP8



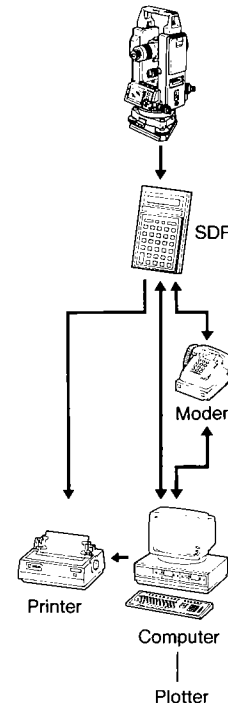
Mount the compass on the standards after removing the carrying handle. Before use, loosen the clamping screw on the underside of the compass. After use, re-clamp the screw.

### 5) Target sets TG1 and TG2



The TG1 and TG2 targets can be mounted on the standard tribrach. An illumination device (standard accessory) can be attached to the back of the target plate for surveying in low light conditions. The target heights are 233 mm.

### 6) Electronic field books SDR series



The SDR series can collect and store all angle values output from the DT5 data output connector ②. (Distance values can be input manually if required).

The stored data can be verified and printed in the field, then transmitted by cable or modem to an IBM-compatible office data processing system for final computation, printing and plotting.

SDR features:

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

### 7) Interface IF1A for the HP41CV

Using this interface, the DT5 can transmit the measured angle data to a HP41CV computer.

## SPECIFICATIONS

### Telescope

Length:	165mm
Aperture:	45mm
Magnification:	30X
Image:	Erect
Resolving power:	3"
Field of view:	1° 30' (26m/1000m)
Minimum focus:	0.9m (3ft)
Stadia ratio:	100
Additive constant:	0
Reticle illumination:	Provided

### Angle measurement

Horizontal and Vertical Circles type:	Incremental with 0 index (0 index for vertical circle only)
Angle units:	Degree/gon/mil (Selectable with internal switch)
Minimum display:	5" (0.001gon/0.02mil)
Accuracy:	Standard deviation of mean of measurement taken in positions I and II (DIN 18723) 5" (0.0015gon/0.02mil)
Measuring time:	Less than 0.5 sec
Display range:	
Horizontal angle:	0° 00' 00" to 359° 59' 55" (0.000 to 399.999gon/0.00 to 6399.98mil)
Vertical angle:	0° 00' 00" to 359° 59' 55" (0.000 to 399.999gon/0.00 to 6399.98mil)/ -90° 00' 00" to 90° 00' 00" (0.000 to 100.000gon/0.00 to 1600.00mil) (-999.909 to 999.909%)

Measuring mode:

Horizontal angle:	Right/Left/Hold (Selectable with key board)
Vertical angle:	Zenith 0° (0gon/0mil)/Horizontal 0° (0gon/0mil)/Horizontal 0 ± 90° (0 ± 100gon/0 ± 1600mil) (Selectable with internal switch) Slope in % (Selectable with key board)

### Power supply

Power source:	Detachable battery BDC21 (6VDC) (Alkaline batteries LR6, R6P × 4)
Working duration:	About 15 hours (at 25°C/77°F, when using LR6)

### General

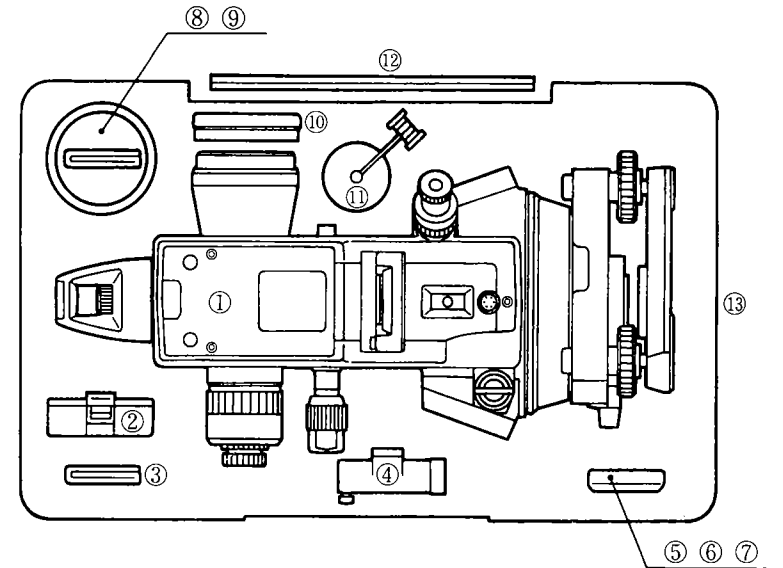
Display:	DT5/DT5S: LCD double 8-digit on each face DT5A/DT5AS: LCD double 8-digit on one face With illumination
Sensitivity of levels:	Plate levels: 40"/2mm Circular level: 10"/2mm
Optical plummet:	Image: Erect Magnification: 3X Minimum focus: 1.0m (3ft)
Self-diagnostic function:	Provided
Power saving cut off:	30 minutes after last key operation (ON/OFF with internal switch)
Audio device:	Provided
Data output:	Asynchronous serial, RS-232C compatible
Operating temperature:	-20 to 50°C (-4 to 122°F)
Instrument height:	230mm (0.7ft) (187mm from tribrach dish)
Size:	150 (W) × 165 (D) × 335 (H) mm (5.9 × 6.5 × 13.2 inch) (including handle and battery)

Weight: DT5/DT5A:4.6kg (10.1 lbs)  
 DT5S/DT5AS:4.7kg (10.3 lbs)  
 (including handle and battery)

Tribrach: DT5/DT5A:Detachable type  
 DT5S/DT5AS:Shifting type

## STANDARD EQUIPMENT

Layout Plan



- |   |                                   |
|---|-----------------------------------|
| ① DT5/DT5S/DT5A/DT5AS main unit .1                | ⑧ Cleaning cloth . . . . .1       |
| ② Battery (BDC21) . . . . .1<br>(including R6P×4) | ⑨ Lens hood. . . . .1             |
| ③ Vinyl cover. . . . .1                           | ⑩ Lens cap. . . . .1              |
| ④ Tubular compass (CP7) . . . . .1                | ⑪ Plumb bob. . . . .1             |
| ⑤ Adjusting pins . . . . .2                       | ⑫ Operator's manual . . . . .1    |
| ⑥ Screwdriver . . . . .1                          | ⑬ Carrying case (SE30) . . . . .1 |
| ⑦ Brush . . . . .1                                | Shoulder strap . . . . .1         |

## MAINTENANCE

- a) Wipe off any moisture if the instrument gets wet during operation.
- b) Always clean the instrument before returning it to its 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. When cleaning the display, keyboard and carrying case, never use any organic solvent (eg. thinners).
- c) Store the instrument in a dry room where the temperature remains fairly constant.
- d) Check the tripod for loose fitting and loose screws.

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

## REGULATIONS

### Radio Frequency Interference

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

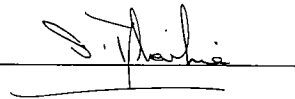
**NOTE:** This equipment has been tested and found to comply with the limits for a Class A digital device pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment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

### **Notice for Canada**

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

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

## CE Conformity Declaration

<b>CE Conformity Declaration</b> 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: Digital Theodolite (Surveying Instrument)	
Model Name :	DT5, DT5S, DT5A, DT5AS
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 1995 ENV50204 1995 EN61000-4-2 1995
Date:	96-Dec-9
Firm:	SOKKIA B.V.
Address:	Industrieterrein De Vaart, Damsluisweg 1, NL-1332 EA Almere
Representative's Signature:	
Name of Representative :	Stephen Blaikie
Representative's position :	European vice President

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