

**SOKKIA**

**DT500**  
**DT500S**  
**DT500A**  
**DT500AS**  
**DT600**  
**DT600S**

Electronic Digital Theodolite



**OPERATOR'S MANUAL**



: This is the mark of the Japan Surveying Instruments Manufacturers Association.

**SOKKIA**

**DT500**  
**DT500S**  
**DT500A**  
**DT500AS**  
**DT600**  
**DT600S**

Electronic Digital Theodolite

**OPERATOR'S MANUAL**

- Thank you for selecting the DT500/DT500S/DT500A/DT500AS/DT600/DT600S.
- Before using the instrument, please read this operator's manual carefully.
- Verify that all equipment is included.  
 "14.1 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.
- Some of the diagrams shown in this manual may be simplified for easier understanding.

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# 1. PRECAUTIONS FOR SAFE OPERATION

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

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

## Definition of Indication

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### **WARNING**

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

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### **CAUTION**

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



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



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



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

## 1. PRECAUTIONS FOR SAFE OPERATION

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### General

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#### **WARNING**

-  Do not use the unit in areas exposed to high amounts of dust or ash, in areas where there is inadequate ventilation, or near combustible materials. An explosion could occur.
-  Do not perform disassembly or rebuilding. Fire, electric shock or burns could result.
-  Never look at the sun through the telescope. Loss of eyesight could result.
-  Do not look at reflected sunlight from a prism or other reflecting object through the telescope. Loss of eyesight could result.
-  Direct viewing of the sun during sun observation will cause loss of eyesight.

#### **CAUTION**

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

### Power Supply

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#### **WARNING**



Do not heat or throw batteries into fire. An explosion could occur, resulting in injury.



To prevent shorting of the battery in storage, apply insulating tape or equivalent to the terminals. Otherwise shorting could occur, resulting in fire or burns.



Do not use batteries if wet. Resultant shorting could lead to fire or burns.

#### **CAUTION**



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

### Tripod

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#### **WARNING**



When mounting the instrument to the tripod, tighten the centering screw securely. Failure to tighten the screw properly could result in the instrument falling off the tripod, causing injury.



Tighten securely the leg fixing screws of the tripod on which the instrument is mounted. Failure to tighten the screws could result in the tripod collapsing, causing injury.



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



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



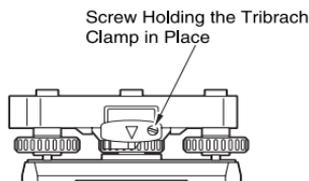
Tighten the leg fixing screws securely before carrying the tripod. Failure to tighten the screws could lead to the tripod legs extending, causing injury.

## 2. PRECAUTIONS

### **Tribrach Clamp (DT500)**

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- When the instrument is shipped, the tribrach clamp is held firmly in place with a locking screw to prevent the instrument from shifting on the levelling base. Before using the instrument the first time, loosen this screw with a screwdriver. And before transporting it, tighten the locking screw to fasten the tribrach clamp in place so that it will not shift on the levelling base.



### **Precautions concerning water and dust resistance**

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DT conforms to IP66 specifications for waterproofing and dust resistance when the battery cover is closed and connector caps are attached correctly.

- Be sure to close the battery cover and correctly attach the connector caps to protect the DT from moisture and dust particles.
- Make sure that moisture or dust particles do not come in contact with the inside of the battery cover, terminal or connectors. Contact with these parts may cause damage to the instrument.
- 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.

### **Other precautions**

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- If the DT is moved from a warm place to an extremely cold place, internal parts may contract and make the keys difficult to operate. This is caused by cold air trapped inside the hermetically sealed casing. If the keys do not depress, open the battery cover to resume normal functionality. To prevent the keys from becoming stiff, remove the connector caps before moving the DT to a cold place.
- Never place the DT directly on the ground. Sand or dust may cause damage to the screw holes or the centering screw on the base plate.

- Protect the DT from heavy shocks or vibration.
- Never carry the DT on the tripod to another site.
- Turn the power off before removing the battery.
- When placing the DT in its case, first remove its battery and place it in the case in accordance with the layout plan.



“14.3 Layout Plan”

### **Maintenance**

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- Always clean the instrument before returning it to the case. The lens requires special care. First, dust it off with the lens brush to remove tiny particles. Then, after providing a little condensation by breathing on the lens, wipe it with a soft clean cloth or lens tissue.
- If the display is dirty, carefully wipe it with a soft, dry cloth. To clean other parts of the instrument or the carrying case, lightly moisten a soft cloth in a mild detergent solution. Wring out excess water until the cloth is slightly damp, then carefully wipe the surface of the unit. Do not use any organic solvents or alkaline cleaning solutions.
- Store the DT in a dry room where the temperature remains fairly constant.
- Check the tripod for loose fit and loose screws.
- If any trouble is found on the rotatable portion, screws or optical parts (e.g. lens), contact your SOKKIA agent.
- When the instrument is not used for a long time, check it at least once every 3 months.



“13. CHECKS AND ADJUSTMENTS”

- When removing the DT from the carrying case, never pull it out by force. The empty carrying case should be closed to protect it from moisture.
- Check the DT for proper adjustment periodically to maintain the instrument accuracy.

## 3. HOW TO READ THIS MANUAL

The following conventions are used in this manual.

- This manual is for DT500/DT500S/DT500A/DT500AS/DT600/DT600S.
- Functions differ depending on the theodolite model used.
- Screens and illustrations appearing in this manual are of DT500.

### Symbols

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The following conventions are used in this manual.

**Caution**

: Indicates precautions and important items which should be read before operations.



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

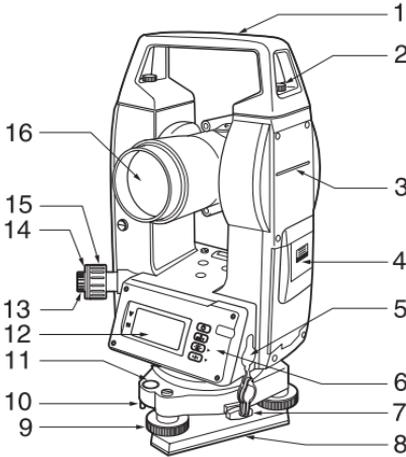


: Indicates supplementary explanation.

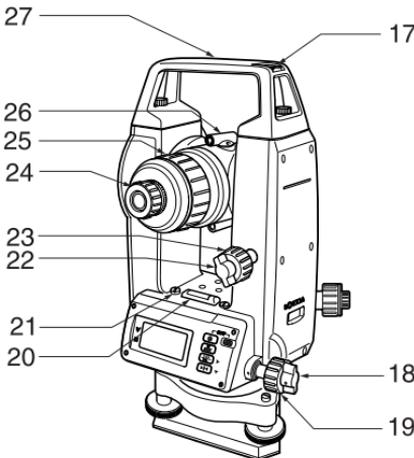


: Indicates an explanation for a particular term or operation.

## 4. PARTS OF THE INSTRUMENT



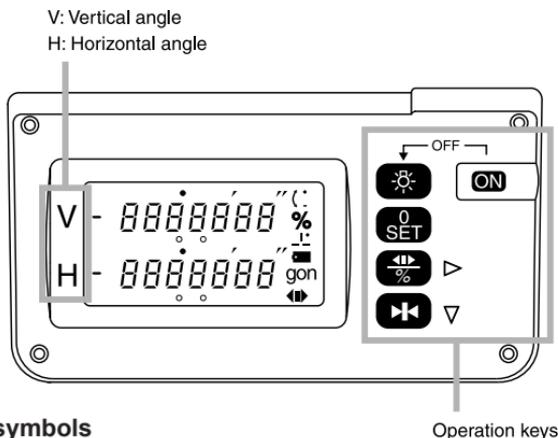
- 1 Handle
- 2 Handle securing screw
- 3 Instrument height mark
- 4 Battery cover
- 5 Data output connector  
(Not included on DT600/DT600S)
- 6 Operation panel
- 7 Tribrach clamp  
(Not included on DT600.  
DT500S/500AS/600S:Shifting  
clamp)
- 8 Base plate
- 9 Levelling foot screw
- 10 Circular level adjusting screws
- 11 Circular level
- 12 Display
- 13 Optical plummet eyepiece
- 14 Optical plummet reticle cover
- 15 Optical plummet focussing ring
- 16 Objective lens



- 17 Tubular compass slot
- 18 Horizontal clamp
- 19 Horizontal fine motion screw
- 20 Plate level
- 21 Plate level adjusting screw
- 22 Vertical clamp
- 23 Vertical fine motion screw
- 24 Telescope eyepiece
- 25 Telescope focussing ring
- 26 Peep sight
- 27 Instrument center mark

## 4. PARTS OF THE INSTRUMENT

### Operation panel — Display Functions —



#### ● Display symbols

( : : Vertical angle  $\pm 90^\circ$

% : % vertical angle

⌋ : Tilt angle compensation

☞ "11. CHANGING INSTRUMENT OPTIONS"

■ : Battery mark (displayed when batteries need to be replaced)

gon : gon angle units

☞ : {  
 ▶ Horizontal angle right  
 ◀ Horizontal angle left  
 ▮ Horizontal angle hold

#### ● Key Operation

ON : Power on

ON + ☞ : Power off

☞ : Select horizontal angle display mode / vertical angle display mode  
 ☞ "9.3 Changing Horizontal Angle Display Mode" and  
 "9.4 Changing Vertical Angle Display Mode"

☞ : Lighting up the display

0 SET : Set horizontal angle to 0

☞ "9.1 Measure the horizontal angle between 2 points (H angle 0)"

☞ : Hold / release horizontal angle

☞ "9.2 Changing Horizontal Angle Direction PROCEDURE Horizontal angle hold"

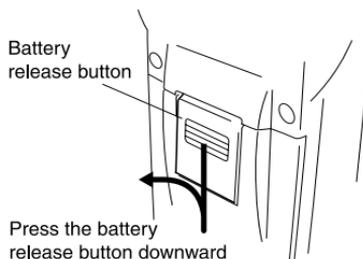
## 5. INSTALLING / REMOVING THE BATTERY

Mount the charged battery.

- Caution** :
- When removing the battery, turn the power off.
  - When installing / removing the battery, make sure that moisture or dust particles do not come in contact with the inside of the instrument.

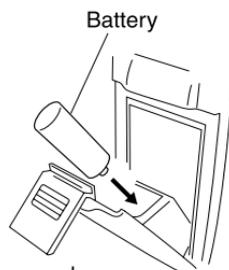
### ► PROCEDURE

#### 1. Open the battery cover



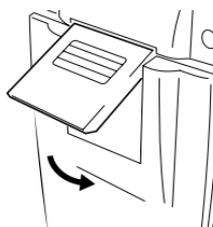
#### 2. Insert 2 batteries (R14/C)

The direction of the batteries is indicated in the battery cover.



Insert and press down checking the direction of the battery.

#### 3. Close the battery cover



Insert the lip on the top of the battery release button into the groove on the SET and press until a click is heard.

## 5. INSTALLING / REMOVING THE BATTERY

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Remaining battery power : When the instrument is turned on, remaining battery power is displayed for a few seconds.

3 : 90 to 100 %

2 : 50 to 90 %

1 : 10 to 50 %

0 : 0 to 10 % Battery mark is displayed. Replace all batteries. If you continue to use the instrument, the battery mark flashes and a beep sounds. In this status, measurement cannot be performed correctly.

## 6. SETTING UP THE INSTRUMENT

### Caution

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

### 6.1 Centering

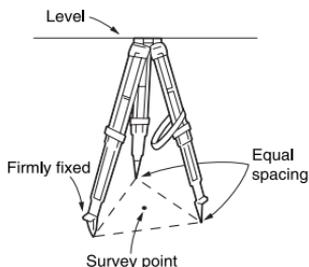
#### ► PROCEDURE

##### 1. Set up the tripod

Make sure the legs are spaced at equal intervals and the head is approximately level.

Set the tripod so that the head is positioned over the surveying point.

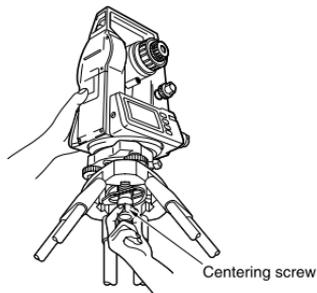
Make sure the tripod shoes are firmly fixed in the ground.



##### 2. Install the instrument

Place the instrument on the tripod head.

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

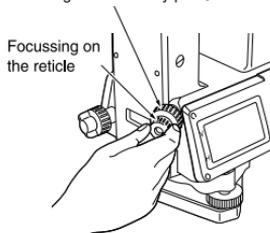


##### 3. Focus on the surveying point

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

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

Focussing on the surveying point



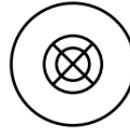
## 6. SETTING UP THE INSTRUMENT

### 6.2 Levelling

#### PROCEDURE

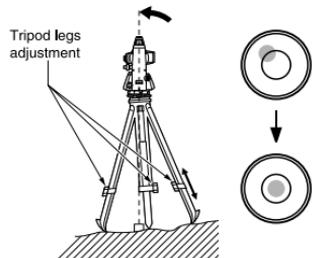
**1. Center the surveying point in the reticle**

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



**2. Center the bubble in the circular level**

Center the bubble in the circular level by either shortening the tripod leg closest to the offcenter direction of the bubble or by lengthening the tripod leg farthest from the offcenter direction of the bubble. Adjust one more tripod leg to center the bubble.

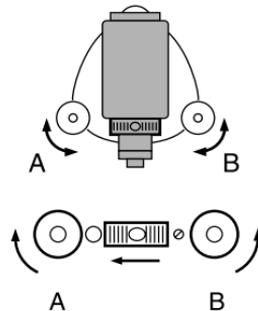


**3. Center the bubble in the plate level**

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.

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

The bubble moves towards a clockwise rotated levelling foot screw.

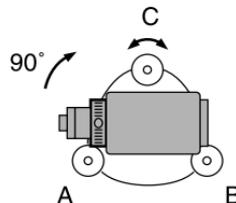


**4. Turn 90° and center the bubble**

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.

Center the air bubble using levelling foot screw C.



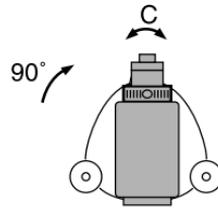
### 5. Turn another 90° and check bubble position

Turn the upper part of the instrument a further 90° and check to see if the bubble is still in the center of the plate level. If the bubble is off-center, perform the following:

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

Or adjust the plate level.

 "13.1 Plate Level"



### 6. Check to see if bubble is in same position in any direction

Turn the instrument and check to see if the air bubble is in the same position in all directions.

If it is not, repeat the levelling procedure.

### 7. Center the DT over the Surveying point

(DT500 / 500A / 600):

Loosen the centering screw slightly.

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

Retighten the centering screw securely.

## 6. SETTING UP THE INSTRUMENT

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(DT500S/500AS/600S):

Turn the tribrach shifting clamp counterclockwise.

Shifting tribrach can be adjusted up to  $\pm 8$ mm.

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

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

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

If not, repeat the procedure starting from step 3.

## 7. FOCUSING AND TARGET SIGHTING

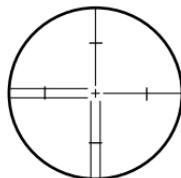
### ► PROCEDURE

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#### 1. Focus on the reticle

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

Using these procedures, frequent reticle refocussing is not necessary, since your eye is focussed at infinity.



#### 2. Sight the target

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

#### 3. Focus on the target

Turn the telescope focussing ring to focus on the target.

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.

#### 4. Readjust the focus until there is no parallax

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

## 7. FOCUSING AND TARGET SIGHTING

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### **Eliminating 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 refocussing the reticle.

## 8. POWER ON

### ► PROCEDURE

#### 1. Power on

Press **ON**.

When the power is switched on, a self-check is run to make sure the instrument is operating normally. Remaining battery power is displayed for a few seconds.

 "5.INSTALLING / REMOVING THE BATTERY"

After that the instrument is ready for vertical and horizontal circle indexing.

V	0
H	0

- When Item NO.3 (Horizontal angle indexing) is set to "Manual", the display appears as at right.

V	0
H	00000"

- When Item NO.2 (Vertical angle indexing) is set to "Manual", the display appears as at right.

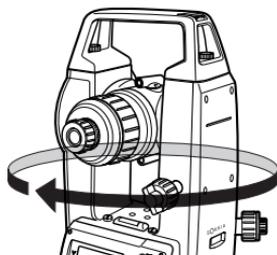
V	1
H	0

 Manually indexing the vertical circle by face left, face right measurements: "15.1 Manually Indexing the Vertical Circle by Face Left, Face Right Measurement"

## 8. POWER ON

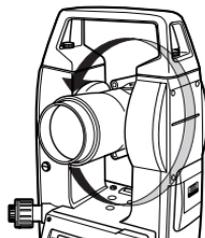
### 2. Horizontal and Vertical circle indexing

Loosen the horizontal clamp and rotate the upper part of the instrument until the DT beeps for horizontal indexing.

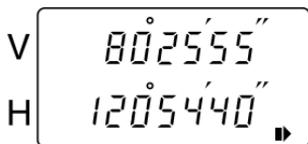


Loosen the vertical clamp and transit the telescope.

Indexing occurs when the objective lens crosses the horizontal plane in face left.



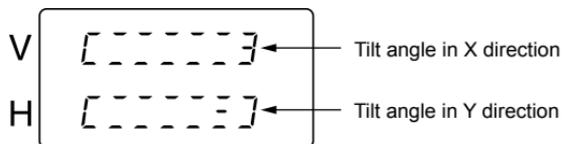
When horizontal indexing and vertical indexing have been completed, the display is ready for measurement.



#### Note

- Out of range message

When the screen below is displayed on DT500/500S, the tilt sensor is indicating that the instrument is out of level. Level the instrument once again. When leveling is done on the screen, make sure to use Face 1. Center both "—" in the bar.



- Set Item No.4 (Tilt correction) to "Off" or "On (V)" if the display is unsteady due to vibration or strong wind.



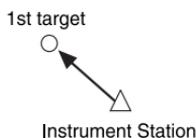
"11. CHANGING INSTRUMENT OPTIONS"

## 9. MEASUREMENT

### 9.1 Measure the horizontal angle between 2 points (H angle 0)

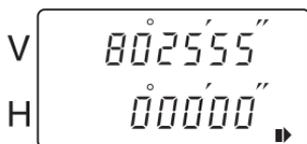
#### ► PROCEDURE

1. Sight the first target as at right.

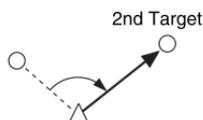


2. Set the horizontal angle of the first target to 0°.

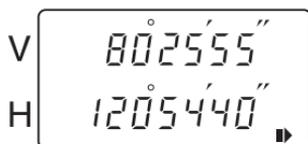
Press **0 SET** twice. The horizontal angle at the first target becomes 0°.



3. Sight the second target.



The displayed horizontal angle is the included angle between two points.



### 9.2 Set Horizontal Circle to a Required Value (Horizontal angle hold)

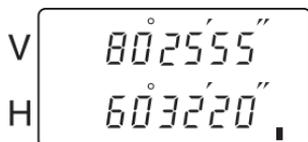
Horizontal angle hold function can be used to set the horizontal angle of the sighting direction to a required angle.

#### ► PROCEDURE Horizontal angle hold

1. Turn the upper part of the instrument and display the horizontal angle you want to set

2. Hold the displayed angle

Press **◀▶** twice. The horizontal angle is in hold status.



## 9. MEASUREMENT

---

3. **Set the horizontal angle that is in hold status to the direction you require**

Sight the direction that you want to set the horizontal angle to in step 2, and press  again.

The horizontal angle hold-status is released.

### 9.3 Changing Horizontal Angle Display Mode

#### PROCEDURE Selecting horizontal angle display mode (Right / left)

1. **Set Item No.7 ( function)**

Set Item No.7 ( function) to "Horizontal angle (Right/left)" in advance.

 "11. CHANGING INSTRUMENT OPTIONS"

2. **Change the horizontal angle direction on measuring screen**

Every time  is pressed, horizontal angle right / left is switched.

### 9.4 Changing Vertical Angle Display Mode

#### PROCEDURE Selecting vertical angle display mode (Angle / slope in %)

1. **Set Item No.7 ( function)**

Set Item No.7 ( function) to "Angle / slope in %" in advance.

 "11. CHANGING INSTRUMENT OPTIONS"

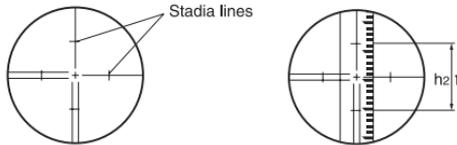
2. **Change the vertical angle direction on measuring screen**

Every time  is pressed, vertical angle / slope in % is switched.

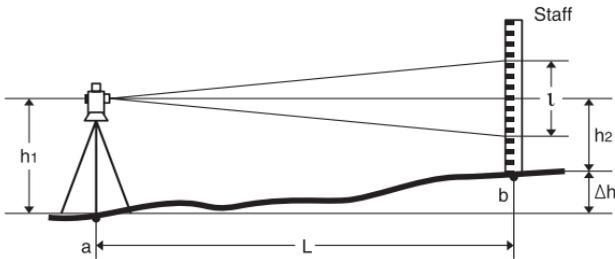
**9.5 Stadia Survey**

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:

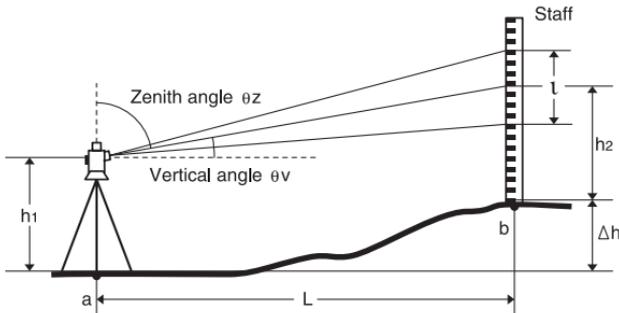
Stadia line separation = 1/100 of the focal distance.



- When the telescope is horizontal  
 Horizontal distance between a and b:  $L=100 \times l$   
 Height difference between a and b :  $\Delta h=h_1 - h_2$



- When the telescope is slanted  
 Horizontal distance between a and b:  $L=100 \times l \times \sin^2 \theta_z$ , or  
 $L=100 \times l \times \cos^2 \theta_v$   
 Height difference between a and b :  $\Delta h=50 \times l \times \sin 2 \theta_z + h_1 - h_2$ , or  
 $\Delta h=50 \times l \times \sin 2 \theta_v + h_1 - h_2$



# 10. DATA OUTPUT

After connecting the data output connector on the DT with a computer, the measurement results can be output.

- This function is not included on DT600/DT600S

## 10.1 Connecting a Computer

Choose the right interface cable for the computer you are connecting.

 "14.2 Optional Accessories"

- Data communication  
External data collection from the DT uses RS-232C baseband signals.

Synchronization : Asynchronous

Baud rate : 1200 bps

Start bit : 1 bit

Data length : 8 bits

Parity : None

Stop bit : 1 bit

- Data output connector pin assignments

Pin No.	Signal name
1	ST (GND)
2	NC
3	SD (TXD)
4	RD (RXD)
5	NC
6	NC

**10.2 Communication Functions Command and Output**

- Formats for standard commands

Every time the command below is sent to the DT, a measurement result is output.

00H

- Format of output data

Measurement results are output in the following formats to a computer. "–" means space (20H).

0855580 – 1206540 – CR LF

a            b

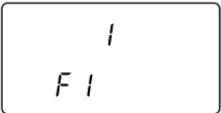
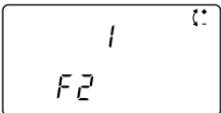
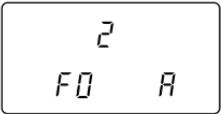
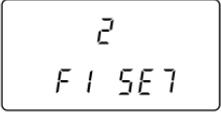
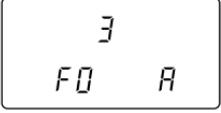
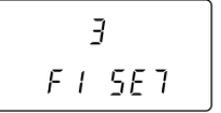
a) Horizontal angle

b) Vertical angle

# 11. CHANGING INSTRUMENT OPTIONS

The following items can be changed to meet your measurement requirements.

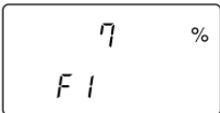
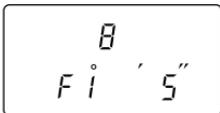
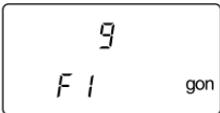
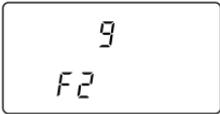
- "\*" : Factory setting

Item NO.	Parameter	Options	Display
1	Vertical angle display mode   "Vertical angle display mode"	Zenith0°*	
		Horizontal 0°	
		Horizontal ±90°	
2	Vertical angle indexing	Auto*	
		Manual	
3	Horizontal angle indexing	Auto*	
		Manual	

## 11. CHANGING INSTRUMENT OPTIONS

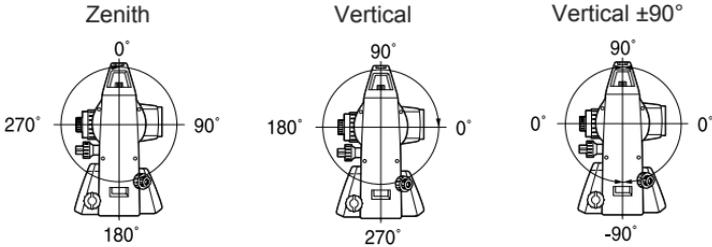
Item NO.	Parameter	Options	Display
4	Tilt correction (only DT500/500S)	On (H, V) *	4 F0 On
		On (V)	4 F1 On
		Off	4 F2 OFF
5	Auto power cut-off	On (instrument powers off if not used for 30 min.)*	5 APC F0 On
		Off	5 APC F1 OFF
6	Reticle illumination (only DT500/500S/ 500A/500AS)	Bright*	6 F0 H
		Dim	6 F1 L

## 11. CHANGING INSTRUMENT OPTIONS

Item NO.	Parameter	Options	Display
7	 function	Horizontal angle (Right/left)*	
		Angle / slope in %	
8	Minimum display	DT500: 1" ( 0 . 2 m g / 0.005mil)* DT600: 5"(1mg/0.02mil)	
		DT500: 5"(1mg/0.02mil) DT600: 1 0 " ( 2 m g / 0.05mil)*	
9	Unit	Degree*	
		gon	
		mil	
10	Instrument constant  "13.3 Tilt Sensor"		



## Vertical angle display method

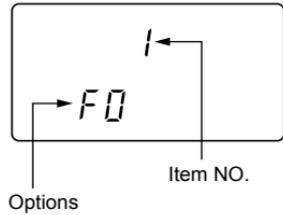


### ► PROCEDURE Changing the settings

**Caution** : Repeat step 1 to 4 for every item setting.

#### 1. Display the Item screen

Press and at the same time to display the Item screen.



#### 2. Select the item you want to change

Press until the item you want to change is displayed. Details of the items are explained in the table above.

#### 3. Select the option

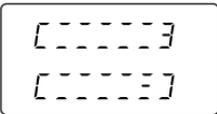
Press until the option you want to select is displayed. Details of the items are explained in the table above.

#### 4. Set the option

Press and at the same time to set the selected option. The measuring screen is restored.

## 12. ERROR MESSAGES

If there is a fault in the DT, the following messages are displayed.

Display messages	Meaning
E100	Horizontal circle is turned too fast to measure the value. Index the horizontal circle again.
E101	Vertical circle is turned too fast to measure the value. Index the vertical circle again.
 (only DT500/DT500S)	The tilt of the instrument exceeds the tilt angle compensation range during measurement. Level the instrument again.

### Note

- Error messages starting with "E" indicate trouble with the instrument. Contact your Sokkia agent.

If an error occurs when measurement results are being output, the following codes are displayed on the computer. (Only DT500/DT500S)

Coded messages	Meaning
E114	Out of tilt compensation range (– direction of Y-axis). Level the instrument again.
E115	Out of tilt compensation range (– direction of X-axis). Level the instrument again.
E116	Out of tilt compensation range (+ direction of Y-axis). Level the instrument again.
E117	Out of tilt compensation range (+ direction of X-axis). Level the instrument again.

## 13. CHECKS AND ADJUSTMENTS

A DT is a precision instrument that requires fine adjustments. It must be inspected and adjusted before use so that it always performs accurate measurements.

- Always perform checking and adjustment in the proper sequence beginning from "13.1 Plate Level" to "13.5 Optical plummet."
- In addition, the instrument should be inspected with special care after it has been stored a long time, transported, or when it may have been damaged by a strong shock.

### 13.1 Plate Level

The bubble tube is made of glass, so it is sensitive to temperature changes or to shock. Check and adjust it as outlined below.

#### ► PROCEDURE Checking and adjusting

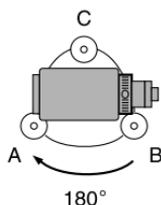
1. **Level the instrument and check the position of the bubble of the plate level.**

 "6.2 Levelling," steps 3 to 5.

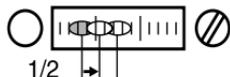
2. **Turn the upper part through 180° and check the bubble position.**

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

If the bubble is off-center, adjust as follows.

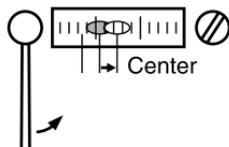


3. **Correct half of the bubble displacement using levelling foot screw C.**



4. **Correct the remaining half of the displacement by using the adjustment pin to rotate the plate level adjustment screw.**

When the plate level adjustment screw is tightened in the counterclockwise direction, the bubble moves in the right direction.



## 13. CHECKS AND ADJUSTMENTS

---

5. **Rotate the top of the instrument and continue adjustments until the bubble remains centered for any position of the upper part.**

If the bubble does not move to the center even when the adjustment has been repeated, have your Sokkia agent adjust it.

### 13.2 Circular Level

#### ► PROCEDURE Checking and adjusting

---

1. **Perform the plate level inspection and adjustment.**

 "13.1 Plate Level"

2. **Check the position of the bubble of the circular level.**

 "6.2 Levelling," steps 1 to 2.

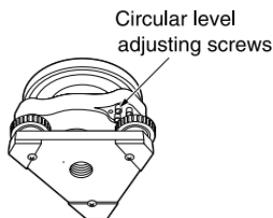
If the bubble is not off-center, no adjustment is necessary.

If the bubble is off-center, perform the following adjustment.

3. **First confirm the off-center direction.**

Use the adjusting pin to loosen the circular level adjustment screw on the side opposite to the direction the bubble is displaced to move the bubble to the center.

4. **Adjust the adjusting screws until the tightening tension of the three screws is the same to align the bubble in the middle of the circle.**



**Caution**

:Be careful that the tightening tension is identical for all the adjusting screws.

Also, do not over-tighten the adjusting screws as this may damage the circular level.

### 13.3 Tilt Sensor

If the tilt angle shown on the display shifts from tilt angle 0 (zero point), the instrument is not correctly levelled. This will adversely affect angle measurement.

Perform the following procedure to cancel the tilt zero point error.

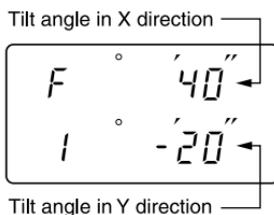
- Only DT500/DT500S include a tilt sensor function. Set Item NO.4 (Tilt corection) to "On (H, V)" or "On (V)" beforehand.



"11. CHANGING INSTRUMENT OPTIONS"

#### ► PROCEDURE Check

1. **Carefully level the instrument. If necessary, repeat the procedures to check and adjust the bubble levels.**
2. **In the Item display, select Item No.10 (Instrument constant)**  
Press  and  at the same time, to display the Item screen, and select Item No.10 (Instrument constant). Current correction constant is displayed.
3. **Accurately sight a clear target in face left.**
4. **Wait a few seconds for the display to stabilize, then read the automatically compensated angles X1 and Y1.**



### 13. CHECKS AND ADJUSTMENTS

---

- 5. Rotate the top of the instrument through 180° and sight the same object in face right**

Loosen the horizontal clamp and turn the instrument 180°, sight the object, then retighten the clamp.

- 6. Wait a few seconds for the display to stabilize, then read the automatically compensated angles X2 and Y2.**

- 7. In this state, calculate the following offset values (tilt zero point error).**

$$X \text{ offset} = (X1 + X2)/2$$

$$Y \text{ offset} = (Y1 + Y2)/2$$

If one of the offset values (X offset, Y offset) exceeds  $\pm 20''$ , adjust the value using the following procedure.

When the offset value falls within the range  $\pm 20''$ , adjustment is not necessary. Press  and  at the same time to return to the measuring screen.

### ► PROCEDURE Adjustment

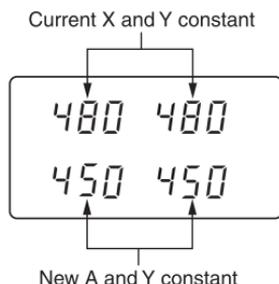
#### 8. Store values X2 and Y2

Press **0 SET** to store the values.

#### 9. Rotate the top of the instrument through 180° and sight the same object accurately

#### 10. Wait a few seconds for the display to stabilize, then store values X1 and Y1.

Press **0 SET** to store the values. The new correction constant is displayed.



#### 11. Confirm that the values are in the adjustment range

If both correction angles are within the range  $444 \pm 33$ , press **0 SET** to renew the correction angle. Go to step 12.

If the value exceeds the adjustment range, stop the adjustment and contact your Sokkia agent to perform the adjustment.

### ► PROCEDURE Recheck

#### 12. In the Item display, select Item No.10 (Instrument constant) again

#### 13. Wait a few seconds for the display to stabilize, then read the automatically compensated angles X3 and Y3

### 13. CHECKS AND ADJUSTMENTS

---

14. Rotate the top of the instrument through 180° and sight the same object in face right
15. Wait a few seconds for the display to stabilize, then read the automatically compensated angles X4 and Y4.
16. In this state, calculate the following offset values (tilt zero point error).

$$X \text{ offset} = (X3 + X4)/2$$

$$Y \text{ offset} = (Y3 + Y4)/2$$

When the offset value falls within the range  $\pm 20''$ , adjustment is completed. Press  and  at the same time to return to the measuring screen.

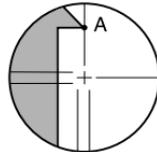
If one of the offset values (X offset, Y offset) exceeds  $\pm 20''$ , repeat the check and adjustment procedure from the beginning.

If the difference continues to exceed  $\pm 20''$  after repeating the check 2 or 3 times, have your Sokkia agent perform the adjustment.

## 13.4 Reticle

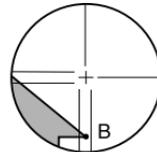
### ► PROCEDURE Check 1: Perpendicularity of the reticle to the horizontal axis

1. Carefully level the instrument.
2. Align a clearly visible target (the edge of a roof for example) on point A of the reticle line.



3. Use the telescope fine motion screw to align the target to point B on a vertical line.

If the target moves parallel to the vertical line, adjustment is unnecessary. If its movement deviates from the vertical line, have your Sokkia agent adjust it.



### ► PROCEDURE Check 2: Vertical and horizontal reticle line positions

1. Install a target at a point about 100m in the horizontal direction from the DT.
2. Level the instrument carefully, turn on the instrument's power and index the vertical and horizontal circles.
3. While the Meas mode screen is displayed and the telescope is in face left, sight the center of the target and read out the horizontal angle A1 and the vertical angle B1.



Example: Horizontal angle  $A1 = 18^{\circ} 34' 00''$   
 Vertical angle  $B1 = 90^{\circ} 30' 20''$

## 13. CHECKS AND ADJUSTMENTS

---

4. **While the telescope is in face right, sight the center of the target and read out the horizontal angle A2 and the vertical angle B2.**

Example: Horizontal angle  $A2=198^{\circ} 34' 20''$

Vertical angle  $B2=269^{\circ} 30' 00''$

5. **Do the calculations:**

### **A2-A1 and B2+B1**

If  $A2-A1$  is within  $180^{\circ}\pm 40''$  and

$B2+B1$  is within  $360^{\circ}\pm 40''$ , adjustment is unnecessary.

Example:  $A2-A1$  (Horizontal angle)

$$=198^{\circ} 34' 20'' - 18^{\circ} 34' 00''$$

$$=180^{\circ} 00' 20''$$

$B2+B1$  (Vertical angle)

$$=269^{\circ} 30' 00'' + 90^{\circ} 30' 20''$$

$$=360^{\circ} 00' 20''$$

If the difference is large even after repeating the check 2 or 3 times, have your Sokkia agent perform the adjustment.

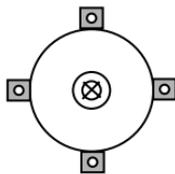
## 13.5 Optical plummet

### ► PROCEDURE Checking

1. **Carefully level the DT and center a surveying point precisely in the reticle of the optical plummet.**
2. **Turn the upper part through  $180^{\circ}$  and check the position of the surveying point in the reticle.**

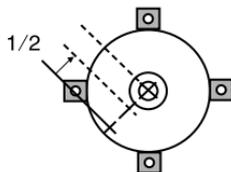
If the surveying point is still centered, no adjustment is necessary.

If the surveying point is no longer centered in the optical plummet, perform the following adjustment.



### ► PROCEDURE Adjustment

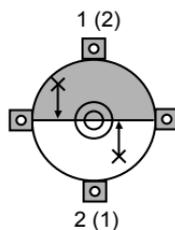
3. Correct half the deviation with the levelling foot screw.



4. Remove the optical plummet reticle cover.

5. Use the 4 adjusting screws of the optical plummet to adjust the remaining half of the deviation as shown below.

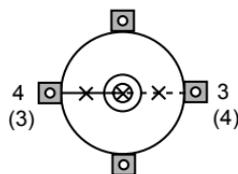
When the surveying point is on the upper or lower part of the illustration: Loosen the upper (lower) adjusting screw slightly, and tighten the upper (lower) adjusting screw the same amount to move the surveying point to a point directly under the center of the optical plummet.



(It will move to the line in the figure on the right.)

If the surveying point is on the solid line (dotted line):

Loosen the right (left) adjusting screw slightly and, tighten the left (right) adjusting screw by the same amount to move the surveying point to a point in the center of the optical plummet.



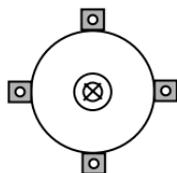
**Caution** : Be extremely careful to adjust all the adjustment screws by the same amount so that none will be over-tightened.

### 13. CHECKS AND ADJUSTMENTS

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6. Check to make sure that the surveying point remains centered on the reticle even if the upper part of the instrument is rotated.

If necessary, perform the adjustment again.

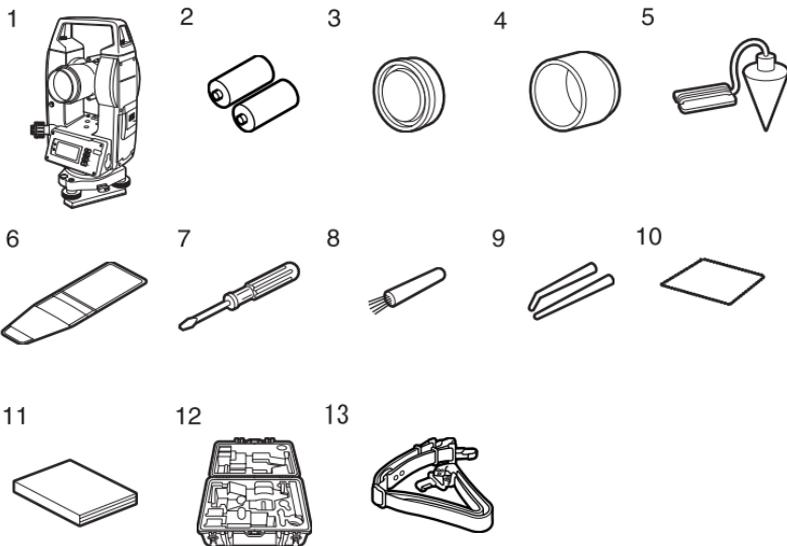


7. Replace the optical plummet reticle cover.

# 14. STANDARD EQUIPMENT AND OPTIONAL ACCESSORIES

## 14.1 Standard Equipment

Please verify that all equipment is included.

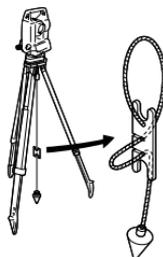


1	DT main unit .....	1	8	Lens brush .....	1
2	R14/C manganese battery ....	2	9	Adjusting pin .....	2
3	Lens cap .....	1	10	Cleaning cloth .....	1
4	Lens hood .....	1	11	Operator's manual .....	1
5	Plumb bob .....	1	12	Carrying case (SC181) .....	1
6	Tool pouch .....	1	13	Carrying straps .....	1
7	Screwdriver .....	1			

## 14. STANDARD EQUIPMENT AND OPTIONAL ACCESSORIES

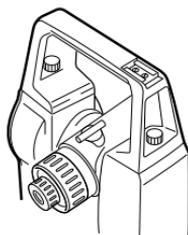
### ● Plumb bob

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



### ● Handle

The carrying handle can be removed from the instrument. To remove it, loosen the handle securing screw.

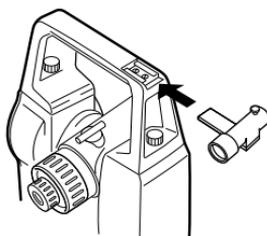


## 14.2 Optional Accessories

The following are optional accessories which are sold separately from the DT.

### ● Tubular compass (CP7)

Slide the tubular compass into the tubular compass slot, loosen the clamp screw, then rotate the top part of the instrument until the compass needle bisects the index lines. The telescope's face left sighting direction in this position will indicate magnetic north. After use, tighten the clamp and remove the compass from the slot.



#### Caution

: The tubular compass is susceptible to the influence of nearby magnets or metal. Such influence could cause it to fail to accurately indicate magnetic north. Do not use magnetic north as indicated by this compass for base line surveying.

- **Telescope eyepiece lens (EL6)**

Telescope eyepiece lens for DT600

Magnification: 30X

- **Diagonal eyepiece (DE25)**

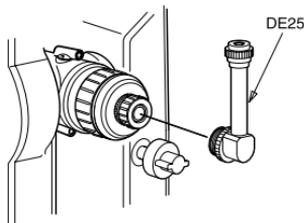
The diagonal eyepiece is convenient for observations near the nadir and in narrow spaces.

Magnification: 30X

After removing the handle from the DT, loosen the attachment screw to remove the telescope eyepiece. Then screw the diagonal lens into place.

 For handle removal method:

"14.1 Standard Equipment"



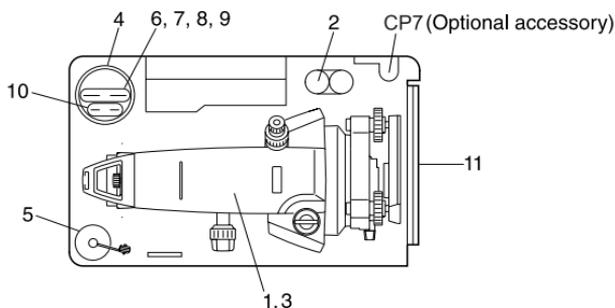
- **Interface cable**

Connects between the DT and a computer for data output.

Computer	Cable	Notes
IBM PC/AT or compatible	DOC26	Length: 2m Pin Numbers and signal levels: RS-232C compatible D-sub connector: DOC26: 25 pins (female) DOC27: 9 pins (female)
	DOC27	
Other personal computers	DOC1	No connector for attachment to a computer.

### 14.3 Layout Plan

The following numbers indicate the equipment listed in "14.1 Standard Equipment".



# 15. APPENDICES

## 15.1 Manually Indexing the Vertical Circle by Face Left, Face Right Measurement

The 0 index of the vertical circle of your DT is almost 100% accurate, but when it is necessary to perform particularly high precision angle measurements, you can eliminate any inaccuracy of the 0 index as follows.

**Caution** : If the power is cut off, the vertical circle indexing is ineffective.  
Repeat circle indexing every time the power is turned on.

### ► PROCEDURE

#### 1. Set Item No.2(Vertical angle indexing)

Set Item No.2 (Vertical angle indexing) to "Manual".

#### 2. Go to the measuring screen

"1" is displayed in "V".

V	1
H	0

#### 3. Carefully level the instrument

#### 4. Accurately sight a clear target with a distance of about 30m in the horizontal direction with the telescope in face left

Sight the target and press **0 SET** twice.  
"2" is displayed in "V".

V	2
H	0

#### 5. Rotate the top of the instrument through 180° and sight the same object in face right

Sight the object and press **0 SET** twice.  
In "V", vertical angle is displayed.

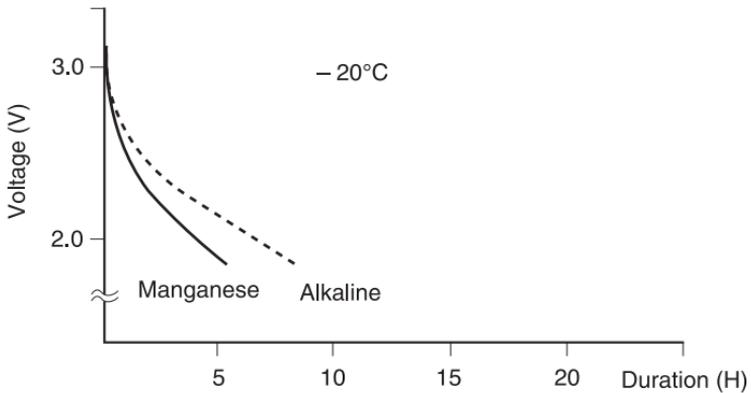
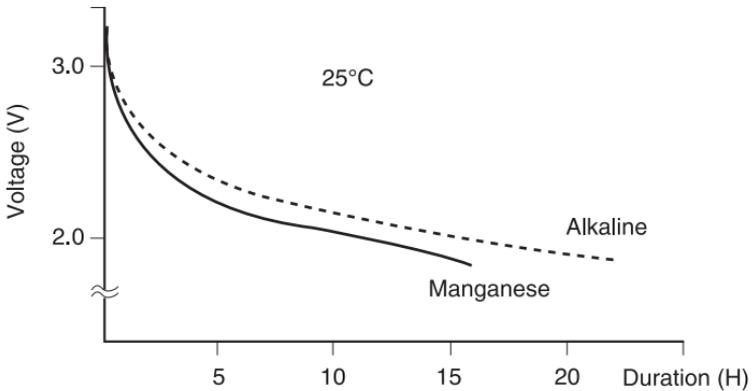
This concludes the vertical circle indexing procedure.

## 15.2 Battery Selection

Choose batteries according to the temperature where you use the DT.

- Manganese batteries work well in normal temperatures, but alkaline batteries normally last longer than the other types.
- The life expectancy of a battery is adversely affected by low temperatures.

Characteristic of electric discharge of alkaline and manganese battery.



## 16. SPECIFICATIONS

Except where stated, the following specifications apply to all DTs. "DT500" means DT500/DT500S/DT500A/DT500AS and "DT600" means DT600/DT600S here.

### Telescope

Length:	DT500: 165mm DT600: 160mm
Aperture:	DT500: 45mm DT600: 35mm
Magnification:	DT500: 30X DT600: 26X
Image:	Erect
Resolving power:	DT500: 3" DT600: 3.5"
Field of view:	1°30'
Minimum focus:	0.9m
Reticle illumination:	Bright or dim (Selectable with parameter)(only DT500)
Stadia ratio:	1:100
Additive constant:	0

### Angle measurement

Horizontal and Vertical circles type:	Increment with 0 index
Minimum display:	DT500: 1" (0.2mg/0.005mil)/5" (1mg/0.02mil) DT600: 10" (2mg/0.05mil)/5" (1mg/0.02mil) (Selectable with parameter)
Accuracy:	DT500: 5" ISO/DIS 12857-2 (1995) DT600: 7" ISO/DIS 12857-2 (1995)
Measuring time:	Less than 0.5 sec
Automatic compensator:	On (H & H/V) / Off (Selectable with parameter) (only DT500/DT500S)
Type:	Liquid 2-axis tilt sensor
Minimum display:	Agrees with minimum displayed measurement angle
Range:	±3'
Measuring mode:	
Horizontal angle:	Right/Left (Selectable with parameter)
Vertical angle:	Zenith, Vertical, Vertical±90°(Selectable with parameter)

**Power Supply**

Power source:	Battery type: R14 / C × 2
Working duration :	DT500/DT500S: about 13 hours DT500A/DT500AS/DT600/DT600S: about 23 hours (with R14/C manganese batteries at 25°C)

**General**

Display:	LCD (2 rows: 8-digits each) display with illumination 120dots × 64dots DT500/DT500S: 1 LCD graphic display on each face DT500A/DT500AS/DT600/DT600S: 1 LCD graphic display
Auto power-off:	On (instrument powers off if not used for 30 min.)/ Off (selectable with parameter)
Data output:	asynchronous serial, RS232C
Sensitivity of levels:	Plate level: DT500: 40"/2mm DT600: 60"/2mm Circular level: 10"/2mm
Optical plummet Image:	Erect Magnification: 3× Minimum focus: 0.3m (from base plate)
Operating temperature:	-20 to 50°C
Storage temperature:	-30 to 70°C
Water and dust resistance:	IP66
Instrument height:	236mm
Size:	165(W) × 165(D) × 341(H)mm (with handle)
Weight:	DT500/DT500AS/600S: 4.7kg DT500A: 4.6kg DT500S: 4.8kg DT600: 4.2kg

# 17. REGULATIONS

## Radio Frequency Interference

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**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

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: Electronic Digital Theodolite (Surveying Instrument)

Model Name : DT500, DT500S, DT500A, DT500AS, DT600, DT600S

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  
+ A1(1995) + A2(1997)  
EMS : EN50082-2 1995  
EN61000-4-2 1995  
ENV50140 1993  
ENV50204 1995

Date: 08 June 1999

Firm: SOKKIA B.V.

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

Representative's Signature:



Name of Representative : Hajimu Maeda

Representative's position : European President



## **SOKKIA Customer Service**

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