

## FOREWORD

Thank you for purchasing KOLIDA Digital Level KL-03. Please read this manual carefully before the operation.

Serial Number:

Please record the Model Name and Serial Number on the equipment. If you have any question, you can send the SN to our dealer when necessary to receive our prompt service.

The meaning of following symbols:

※DANGER:

It means the dangerous situation, which might cause the human injury or even death.

※WARNING:

It indicates the risk of potential or accidental operation, which might cause the human injury or even death.

※CAUTION:

It might cause a slight damage or obvious lost of equipment, economic or environment.

Please use the equipment in a correct and efficient way.

## PRECAUTIONS

Please check the equipment before operation, in order to ensure the normal usage.

- Avoid the surface or connector damage on code staff

The surface and connector are easily to be damaged by accident during the storage or shipment. Otherwise it will influence the accuracy of leveling.

- Tripod

Wooden tripod is the better choice for leveling, instead of metal tripod. Metal tripod is not stable enough in the tough situation to keep the high accuracy. Please tighten the twist or clamp lock on each leg.

- Tribraich

Please check the adjusting screws on tribraich regularly to ensure the correct installation. And don't forget to tighten the center screw.

- Package and shock preventing

Please reduce the shock or vibration during shipment. The strong vibration might cause the function damage. Please take off the battery when packaging.

- Move the equipment carefully.

Please hold the handle when moving the equipment from tripod.

- Avoid direct exposure under sun or rain, and any affect by damp

Keep the equipment under a high temperature (+50℃) situation will make a bad effect on the function.

Don't aim the equipment to the sun, otherwise the inside components will be damaged.

- Avoid temperature sudden change

The sudden change for temperature will decrease the measure range. Please let the equipment adapt the environment gradually before operation.

- Battery checking

Please check the battery voltage before operation.

- Code staff

Please wearing gloves when using a code staff.

## SAFETY GUIDE

Please check the equipment before operation, in order to ensure the correct usage.

- Do not put the equipment beside the burning gas/liquid or the other explosive substance. Do not using the equipment at coal mine or dusty place, in order to avoid the combustion or explosion.
- Do not repair or install the equipment without authorization, to avoid the unnecessary damage from fire, electric shock or object injures.
- Do not aim at the sun directly or even any reflected sunshine by objective lens.
- Please be careful when doing the leveling with staff besides the high-voltage lines or transformer, in order to avoid electric shock.
- Do not use staff under thunder weather, in order to avoid the damage or death by thunder-strike
- Do not use the unofficial charger or battery.
- Do not use broken cables, plugs or sockets for power supply.
- Do not put the battery in the fire or any high-temperature environment, otherwise it will cause the combustion and explosion.
- Do not short-circuit the battery when storage, otherwise it will cause the fire.
- Do not assemble or disassemble the equipment or power supply in a wet hand, otherwise it will cause the electric shock.
- Do not cover the charger when charging the battery, otherwise it will cause the fire.
- Do not touch the leaking liquid from battery, to avoid the chemical hurts. Please change a new battery in the same time.

Please notice the below item in order to avoid the damage

- Overturn the case might broken the equipment inside.
- Please do not sit down or stand on the case to avoid fallen.
- Please do not use the case with broken accessories, in order to avoid unnecessary damage to equipment or any other people.
- Please be careful when setting or moving a tripod.

- Please set the tribrach correctly. If the tribrach falling down, the equipment might get a serious damage by accident.
- Please tighten the center screw on tripod when setting the equipment.
- When moving the tripod, please lock the twist or clamp on the leg to keep it stable.

When doing the field surveying, please ensure that:

- About station movement: Move the equipment after package or fix it vertically on the tripod before the movement.
- Short-term shipment: Please do not deliver the equipment by car separately. The shaking and vibration will damage the equipment. Please deliver it into its case.
- Long-term shipment: Please using a outer carton and original case during the long-term shipment by train, air or sea. The other carton can escape the shocking from outside in a certain way.
- Storage: Please keep the temperature between  $-30^{\circ}\text{C} \sim +70^{\circ}\text{C}$ .
- Damp: When the equipment is damped in the case, please take out the equipment, wipe and clean it immediately. Put back the equipment after complete drying. Don't forget to close the case tightly.
- Cleaning: Do not using a strongly stimulated liquid to clean the equipment. You can have a soft and clean cloth dampened with soap-suds to clean the cover, keyboard and display unit.

## User

- The Digital Level KL-03 only for professional.

The user should have the background for surveying or related knowledge. Please also read the safety guide carefully before the usage, checking and adjustment.

- Please wear the protection when operating, for example the safety shoes or hat.
- Do not put the equipment on ground directly.

## EXECEPTION CLAUSE

- The user should follow the guide which described in this users manual, and check the equipment regularly when necessary.
- The manufacture and dealer do not have any responsibility for any direct or indirect consequences and losses of profit under improper and destructive operation.
- The manufacture and dealer do not have any responsibility for any direct or indirect consequences or losses which caused by natural disasters, such as earthquakes, storms, floods, and fires, accidents or any other third-party liabilities.
- The manufacture and dealer do not have any responsibility for the defect products caused by the change or lost of data, and the other interference factors.
- The manufacture and dealer do not have any responsibility for the consequences and losses of profit which caused by the improper operation.
- The manufacture and dealer do not have any responsibility for the consequences and losses of profit which caused by improper shipment or the illegal connection with other equipment.

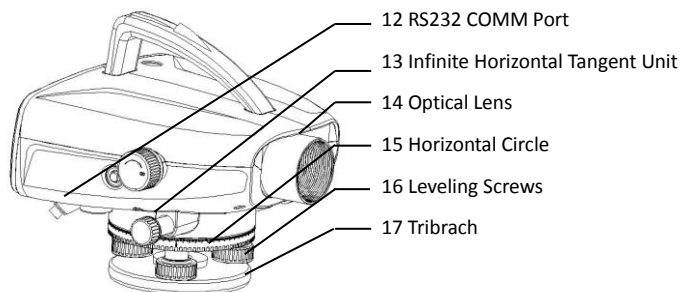
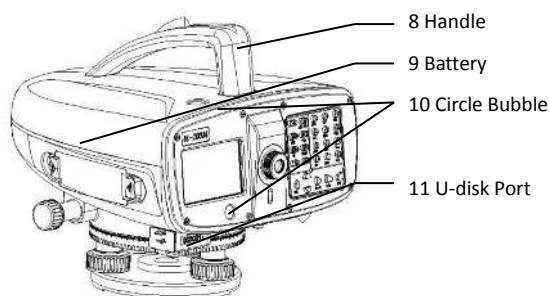
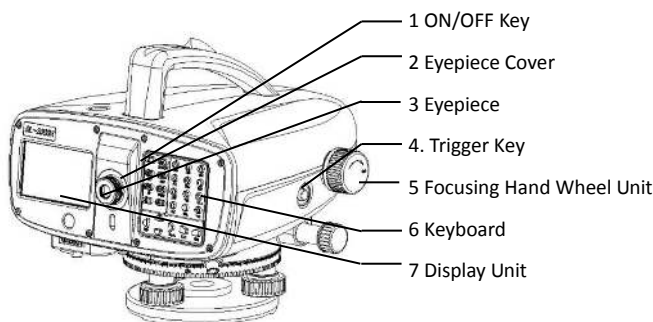
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# 1. BRIEF INTRODUCTION

## 1. 1 Appearance





## 1.2 Features

Colorful Touch Screen

Numerical and Alphabetic Keyboard

Dual-side Horizontal Tangent

Rechargeable Battery

Magnetic Damping Compensator

Humanized On-board Software

Large Internal Storage for Data

Backup by U-disk or Bluetooth Transmission

Comm/Bluetooth Connection and Interface

Electric Bubble

## 1.3 Measuring Principle

The staff code was saved in KL-03 as a reference signal. When measuring, the image sensor will catch the staff image in the sight of view as the signal, then compare it with reference signal inside. Then it will get the height of sight line and the horizontal distance. Please up-right the staff vertically. If you lighten the staff, KL-03 can work at night.

## 1.4 Instrument Setup

Mount the KL-03 on a tripod, leveling and center it precisely will ensure the best performance for measurement.

### 1) Set up a tripod

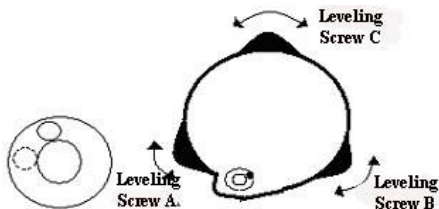
- A. Extend the tripod legs to a suitable height, tighten the screws.
- B. Keep the center and the occupied point approximately on the same plumb line
- C. Step on the tripod to ensure the stability on the ground.

### 2) Attaching KL-03 on the tripod

Place the instrument carefully on the tripod head and slide the instrument by loosening the tripod screw.

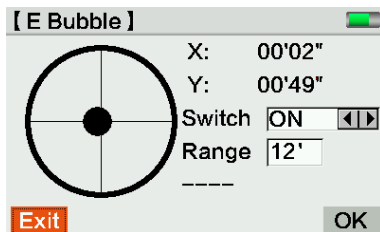
### 3) Roughly leveling the instrument by adjust the circular vial

A. Turn the leveling screw A and B to move the bubble in the circular vial, in which case the bubble is located on a line perpendicular to a line running through the centers of the two leveling screw being adjusted .



B. Turn the leveling screw C to move the bubble to the center of the circular vial.

C. You can also adjust the bubble by electric.



#### 4) Focusing the lens

- Aim at a bright background, for example a piece of white paper
- Rotate the eyepiece to clear the cross-line
- Aim at the code staff by collimator at first
- Rotate the telescope focusing screw to clear the image. The code staff and cross-line will not move according the eyes' movement.

## 1.5 Others

1) Please check the i Angle of KL-03, the circular bubble on equipment and staff before:

- ① doing the field measurement

② a long-term shipment

③ a long-term storage

2) Keep the lens cleaning. The dust or dirty spot will influence the accuracy.

3) Make the equipment adapt to the environment before measurement. Each 1 °C temperature difference might cost 2mins to adapt.

4) Under special conditions:

Vibration: Step at the legs of tripod will decrease the vibration of equipment

Back-lighting: If the back-light of sunshine influenced the measurement, please assemble the optical cover tube.

Darkness: Please use a flashlight to lighten the code on staff

Measurement at bottom code: KL-03 is available to aim at the position lower than 0 in a little. The value will be minus.

Measurement at the top code: KL-03 is available to aim at the bottom, but it will influence the accuracy for level.

5) The requirement for code's length in sight of view:

For precise measurement, the center of sight should without any cover. The code's length is related to the distance between equipment and staff. Here is the form for the requirements:

Distance	Code's Length	Cover Rate in Sight
0m – 10m	100%	0%
10m – 50m	80%	20%
50m – 90m	70%	30%
90m –110m	60%	40%

6) Shadow: the shadow on staff will not influence the result in common.

7) Focusing: A tinny dis-focused target will not influenced the measure time and accuracy.

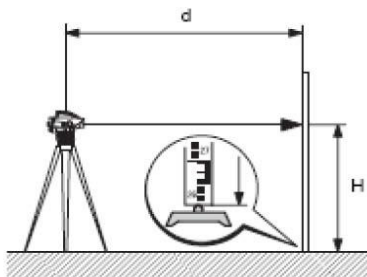
8) Measurement via glass: Please avoid the measurement via glass or window.

9) Fine mode for line measurement: Please activate fine mode when doing the line measurement. It will increase the accuracy than the other measure mode.

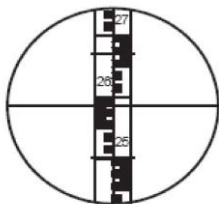
## 1.6 Optical Level

Using height and distance measurement as example

### 1.6.1 Height Measurement



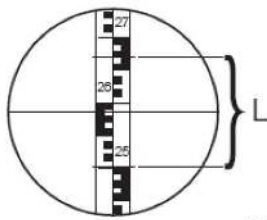
- 1) Set KL-03 on a tripod, leveling the equipment, focusing lens.
- 2) Hold the code staff vertically.
- 3) Aim at the target roughly at first
- 4) Focus to the target by adjusting focusing screw
- 5) Aim at the target precisely by adjusting horizontal tangent
- 6) Check the bubble
- 7) Record the center height  $H$  of cross-hair on the staff



Eg.  $H=2.586\text{m}$

- When using the digital level, press trigger key after repeat the step 1-6, KL-03 will record the code and distance automatically.

### 1.6.2 Distance Measurement



After the same steps 1 -6 of Chapter 2.2.1 Height Measurement.

Upper cross-hair: 2.670 m, bottom cross-hair: 2.502 m

Interval L: 0.168 m, based on the formula distance= 100 x L

Distance d: 16.8 m

### 1.6.3 Angle Measurement

The bottom horizontal disk can be the reference of angle measurement in  $360^\circ / 400$  gon, each 1 scale means 1 degree.

## 2. OPERATIONS

### 2.1 Operation Keys



Power on: Press [ON/OFF] key shortly

Power off: Hold [ON/OFF] key in 1s

Trigger Key: Press trigger key to start measurement

⚠ If you press the keyboard too hard, it might cause the vibration of equipment. The vibration might influence the compensation and the accuracy for measurement. Users can improve the stability of measurement by averaging in multiple measurement.

#### Function Key

[↑ ↓ ←→] Navigation key, select correct item by control the cursor

[INT] Switch to point-to-point measurement

[MODE] Set measure mode

[USER] Arbitrarily function key defined by FNC menu

[PROG] Program

[DATA] Data management

[CE] Delete characters

[SHIFT] Switch to the second function key (SET OUT, INV, FNC, MENU, LIGHTING, PgUp, PgDn) and switch between numbers and alphabet.

[ESC] Exit, cancel or stop the measurement

**[ENT]** Enter to next step

### Combination Key

**[SET OUT]** Start Stake Out function. Press [SHIFT][INT] to enter.

**[INV]** Inverse the code staff (0 scale on top) then it will display a “T” on the screen after activate. Press [INV] again to back for normal mode, the value will be minus. Press [SHIFT][MODE] to enter.

**[FNC]** Activate the other functions on KL-03. Press [SHIFT][USER] to enter.

**[MENU]** Menu setting. Press [SHIFT][PROG] to enter.

 is for illumination. Press [SHIFT][DATA] to activate.

**[PgUp]** Page Up. Press [SHIFT][ ↑ ] to enter.

**[PgDn]** Page Down. Press [SHIFT][ ↓ ] to enter.

### Symbols (on the screen)

**[1 / 3]** means the first of total 3 pages. Press “PgUp” or “PgDn” to check the other pages.

**[←→]** Use the navigation key to select.

**[OK]** OK and exit this interface.

[ ↑ ↓ ] Skip to next column.

 Battery capacity.

E: Correction of earth curvature has been activated.

T: Inverse the staff and start the measurement. This mode is only for inverse code staff.

N: Numeric keyboard has been activated.

α : Alphabetic keyboard has been activated.

## 2.2 Main Menu



Option 1: Click corresponding area to start

Option 2: Move the cursor by [ ↑ ↓ ] key and press [ENT] to start

Option 3: Press the number 1-6 to start

ESP Note: In KL-03, you can enter any interface by one of those start-up methods. The following manual will only select one to explain.

Main menu shown as below:

Menu	1 <sup>st</sup> Sub-Menu	2 <sup>nd</sup> Sub-Menu	Description
1. Meas	Height		Height Measurement
	Stake Out		Stake Out
	Line Meas	Level 1 Measurement	Level 1 Measurement
		Level 2 Measurement	Level 2 Measurement
		Level 3 Measurement	Level 3 Measurement
		Level 4 Measurement	Level 4 Measurement
		User-defined	User-defined measurement
		Line Meas	
	COM/ Bluetooth	COM Port	RS232 COMM Port
		Bluetooth	Bluetooth connection
2 Data	Edit Data	Meas Point	Check the info of measured point
		Known Point	View/Add/Delete known point



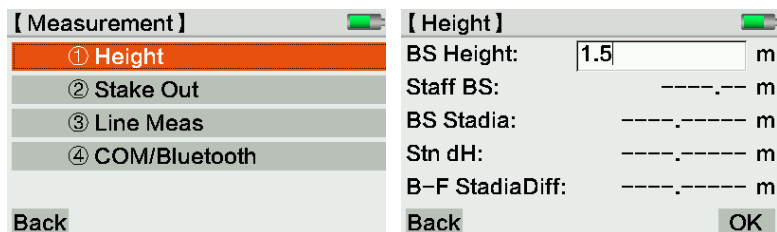
		Job	View/Add/Delete job
		Code	View/Add/Delete code
		Line	View/Add/Delete line
		Line Tolerance	View/Add/Delete line tolerance
	Memory Management	Memory Info	Check the line/known pt/job...etc which store in internal memory
		Memory Format	Formatting memory
	Export Data	Export Job	Export the job data to u-disk or Bluetooth device
		Expt Line	
3 Adjust	Check		Check the digital level
	Dual-axis Adjust		Adjust the dual-axis
4 Calc	Line Adjustment		Line adjustment
5 Set	Quick Set		Atmosphere correction, earth curvature, user key, decimals set.
	Complete Set	Meas Setting	Unit, format, earth curvature, staff invert, constant set, etc.
		System	Sound, back light and others set.
		Instruction Info	Information about jobs, battery, memory, date, SN, etc.
		Factory Mode	Recovery to initial mode.
	E bubble		Electric bubble
6. Help	User Manual	Key Note	Introduction about basic, function and combination keys.
		Adjust Explanation	Adjust Explanation

### 3. MEASUREMENT

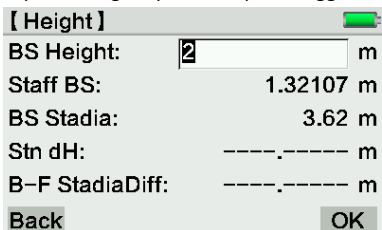


#### 3.1 Height

Press [Meas], [Height] to enter the height measurement interface.



Input BS height by manual, press Trigger Key to measure. Press [OK] to check the result.



## 3.2 Stake Out

Press [Meas], [Stake Out] to enter the height measurement interface.

【 Measurement 】	
① Height	
② Stake Out	
③ Line Meas	
④ COM/Bluetooth	
Back	

Input or search the existed back-sight point and height.

Press Trigger Key to measure this point.

【 Stake Out 】		N	
BS.Ponit NO:	A1	Find	
Height:	1.5	m	
Sight Height:	-----	m	
Staff Record:	-----	m	
Stadia:	-----	m	
Back		OK	

【 Stake Out 】		N	
BS.Ponit NO:	123	Find	
Height:	5.00000	m	
Sight Height:	6.32097	m	
Staff Record:	1.32097	m	
Stadia:	3.60	m	
Back		OK	

You can choose Elevation, Difference Height or Stadia stake out after press [OK]

If the height is existed in the current job, it will display on the blank of S.O Pt Height automatically.

【 Stake Out 】		
① Elevation		
② Difference Ht		
③ Stadia		
Back		

【 Input S.O Pt 】		N	
S.O Pt N:	125		
Note:	-----		
S.O Pt Height:	1.35	m	
Back		OK	

Then finish the stake out.

### 3.3 Line Meas

Press [Meas], [Line Meas] to enter the line measurement interface.

You can enter the sub-menu in following methods:

- 1) Click the corresponding area to activate
- 2) Use[ ↑ ↓ ] to move the cursor and press [ENT] to confirm
- 3) Press numeric keyboard, for example [1] for quick start

<b>【 Measurement 】</b>	
①	Height
②	Stake Out
③	<b>Line Meas</b>
④	COM/Bluetooth
Back	

The line tolerance has been settled in Level 1-4 Measurement. Use 1. Level 1 Measurement as an example:


<b>【 Measurement 】</b>	
①	<b>Level 1 Measurement</b>
②	Level 2 Measurement
③	Level 3 Measurement
④	Level 4 Measurement
⑤	User-defined Line Meas
Back	


<b>【 Level 1 Meas 】</b>	
① Job	DEFAULT
② Line	LINE005
③ Start	
Back	


Select Job/Line/Start menu to input the configuration according to the request.


<b>【 New Job 】</b>	
Job:	170509
Operator:	JK
Note 1:	
Note 2:	
2017.05.09	16:06:02
Back	Save


<b>【 New Line 】</b>	
Name:	LINE003
Start Pt:	A1
H0:	0.00000
	Find
	m
Back	OK


**【 Tolerance 】** 1/2 

Fine Mode: **ON** 


Total StadiaDiff: **ON** 

Stadia Limited: **ON** 


Staff Limited: **ON** 


dH Tolerance: **ON** 

**Back** **Tolerance** **OK**

**【 Tolerance 】** 2/2 

B-B/F-F: **ON** 

B-F Diff.: **ON** 

Turn Diff: **ON** 

**Back** **Tolerance** **OK**

The below form has listed the measure method and tolerance for Level 1/2/3/4 Measurement.

Line Measurement	Method	Line Tolerance (unit: m)
Level 1	aBFFB	Total Stadia Diff: 3 Max. Stadia:30; Min. Stadia: 4 Max. Sight Ht:2.8; Min. Sight Ht: 0.65 dH Tolerance: 0.0004 B-B/F-F: off B-F Diff: 1 Turn Diff: off
Level 2	aBFFB	Total Stadia Diff: 6 Max. Stadia:50; Min. Stadia: 3 Max. Sight Ht:2.8; Min. Sight Ht: 0.55 dH Tolerance: 0.0006 B-B/F-F: off B-F Diff: 1.5 Turn Diff: off
Level 3	BFFB	Total Stadia Diff: 5 Max. Stadia:75; Min. Stadia: 3 Max. Sight Ht: off; Min. Sight Ht: off dH Tolerance: 0.0003 B-B/F-F: off B-F Diff: 2.0 Turn Diff: off

Level 4	BBFF	Total Stadia Diff: 10 Max. Stadia:100;      Min. Stadia: 3 Max. Sight Ht: off;      Min. Sight Ht: off dH Tolerance: 0.005 B-B/F-F: off      B-F Diff: 3.0 Turn Diff: off
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### User-defined Line Measurement

This user-defined line measurement is saved by station. It will save the data after pressing [OK]. Once the user confirm the data for the current station, it cannot back to the last station to measure. If there is any mistake about the data, user can choose [BACK] to the first point and re-measure it.

#### (1) Start measure

Press [4 Start]. After setting the tolerance, the user can start measurement.

【 Line Meas 】		【 Line 】 N E FFB FBBF 1/2	
① Job	20170413	BS.Ponit NO:	A1
② Line		Staff BS:	----- m
③ Tolerance		BS Stadia:	----- m
④ Start		FS Height:	----- m
		FS Height:	----- m
Back		Back	View RETN OK

#### (2) Set a new job

Move the cursor to Job, press [ENT] to the setting page. Then input the information. If the user forget to create a new job, the equipment will use "DEFAULT" as the name.

【 New Job 】 N	
Job:	
Operator:	
Note 1:	
Note 2:	
2017.05.04	09:37:38
Back	Save

(3) Set the line

**[ New Line ]** N 1/2

Name:

MeasType:

Start Pt:  **Find**

H0:  m

Rotate:

**Back** **OK**

Choose 2.Line to create a new line.

**Name:** Input the line name.

**Meas. Type:** BF / aBF / BFFB / aBFFB/BBFF

**Start Pt:** Start point

**H0:** Height for start point.

Measure Type	Odd Station	Even Station
BF	BF	BF
aBF (Alternate BF)	BF	FB
BFFB	BFFB	BFFB
aBFFB (Alternate BFFB)	BFFB	FBBF
BBFF	BBFF	BBFF

**[ Find Pt ]** N **Back** **OK**

Job: 0508-01

Pt Type:

Search:  **Find**

Pt N:

Height:  m

After input the name of start point, it will check whether this point existed. If yes, it can be selected from the data list.

**Pt Type:** Known point, or measured point.

**Search:** Input "A" as a common character to find all the existed points.

(4) Set the tolerance

Click [3.Tolerance] to activate the tolerance, the equipment will notice the user when over-range, and the user can re-measure the same point immediately.

<p><b>[ Tolerance ]</b> 1/2 </p> <p>Fine Mode: <input type="text" value="ON"/> </p> <p>Total StadiaDiff: <input type="text" value="ON"/> </p> <p>Stadia Limited: <input type="text" value="ON"/> </p> <p>Staff Limited: <input type="text" value="ON"/> </p> <p>dH Tolerance: <input type="text" value="ON"/> </p> <p><b>Back</b> <b>Tolence</b> <b>OK</b></p>	<p><b>[ Tolerance ]</b> 2/2 </p> <p>B-B/F-F: <input type="text" value="ON"/> </p> <p>B-F Diff.: <input type="text" value="ON"/> </p> <p>Turn Diff: <input type="text" value="ON"/> </p> <p><b>Back</b> <b>Tolence</b> <b>OK</b></p>
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**Fine Mode:** On one hand, the equipment will monitor the distance between ends of staff and the record. The code at the edge might decrease the accuracy of leveling. The equipment will warning the user when the distance to the ends is less than 50cm. When activate Fine Mode, the equipment will set the invar staff in 3m. The users can also defined it by themselves. On the other hand, the equipment will monitor the distance between station and staff. The distance is depend on the configurations.

**Stadia Diff:** The difference between back-sight distance and fore-sight distance.

**Turn Diff:** Turning measurement in one way

**B-B/F-F:** The largest difference between twice measurement

(5) Input Tolerance

Click [Tolence] on the bottom menu. Input the information.

【 InputDiff 】		1/2	
Total StadiaDiff:	3.00	m	
Max Stadia:	50.00	m	
Min Stadia:	5.00	m	
Max Sight Ht:	2.50000	m	
Min Sight Ht:	0.50000	m	
Back	Call	Defa	OK

【 InputDiff 】		2/2	
dH Tolerance:	0.00030	m	
B-B/F-F:	0.00020	m	
B-F Diff.:	1.00	m	
Turn Diff:	0.00150	m	
Back	Call	Defa	OK

【 Line Tolerance 】		1/2	
Tolence Name:	<input type="text"/>		
Total StadiaDiff:		m	
Max Stadia:		m	
Min Stadia:		m	
Max Sight Ht:		m	
Back	Add	OK	

**Back:** Return to last page

**Call:** Call the Line Tolerance page.

**Defa:** Use the default value.

**Add:** Add a new tolerance value.

**OK:** Confirm the value

【 Line Tolerance 】		N	
Tolence Name:	<input type="text"/>		
Total StadiaDiff:	3.00	m	
Max Stadia:	50.00	m	
Min Stadia:	5.00	m	
Max Sight Ht:	2.50000	m	
Back	1/2	OK	

【 Line Tolerance 】		N	
Min Sight Ht:	0.50000	m	
dH Tolerance:	0.00030	m	
B-B/F-F:	0.00020	m	
B-F Diff.:	1.00	m	
Turn Diff:	0.00150	m	
Back	2/2	OK	



## (6) Start

After input all the configuration, press [Trigger Key] to start measurement.

【 Line 】	N	EF	BF	1/2	
BS.Ponit NO:	A1				
Staff BS:	-----			m	
BS Stadia:	-----			m	
FS Height:	-----			m	
FS Height:	-----			m	
Back	View			OK	

**BS Point NO:** Back-sight point (start point) number. If the line is continuously, it will show the name of last station.

It will display the height, and distance on screen. Repeat measurement is available. Press [OK] to confirm and measure the fore-sight point.

【 View Last FS 】				
FS Pt N:	A1			
Note:	-----			
Height:	100.00000		m	
Difference Ht:	0.00000		m	
Staff Record:	0.00000		m	
Back				

**View:** display the last result for FS or BS point.

**Back:** Return to last page.

As long as the new line measurement does not start, the equipment will continue the measurement in current line.

### Measure the Detail/Stake-out Point

The calculation of detail point and stake-out point should according to the last back-sight point. In BF method, the detail points and stake-out points can switch under any BS or FS situation. However, in other methods, the detail points and stake-out points should be measured after finishing all the BS points.

Press [INT] to open the detail points list. Press [SETOUT] for stake-out interface.

After changing a new station, please measure the back-sight staff before the detail points and stake-out points. Otherwise, measurement for the detail points will fail. After all the measurement in the current station, please press [OK] to confirm then save the data, press [BACK] to cancel then re-measure this station.

The detail measurement will show the height difference between the BS to current station, and the height difference between the last detail points to current station.

The point name will increasing in automatic after measurement in each time.

## 3.4 COM/Bluetooth

Press [1. Meas], [4 COM/Bluetooth] to enter the Com/Bluetooth measurement page.

【 Measurement 】	【 Protocol Set 】
① Height	End Mark <b>CRLF</b> ◀▶
② Stake Out	
③ Line Meas	
④ <b>COM/Bluetooth</b>	
Back	Back <span style="float: right;">Next</span>

If you need to know more about the protocol it supported, please contact our dealer for further help.

Press [Next] to choose Comm Port or Bluetooth measurement.

### 3.4.1 Comm Port

Choose [1.COM Port]. Setting the configurations, then press [Next] to next page.

Comm port is only for remote control measurement, not for data transmission.

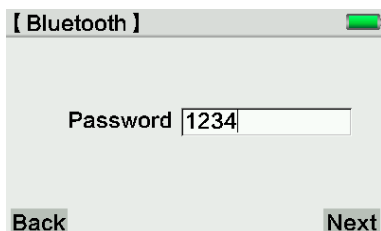
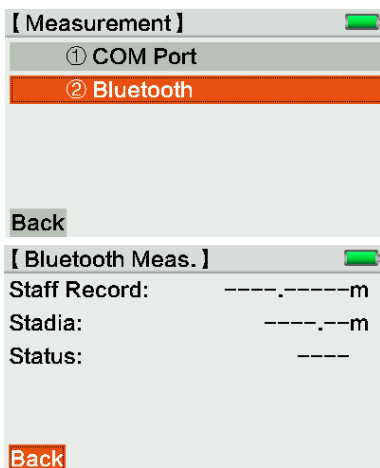
【 Measurement 】	【 COM Port 】
① <b>COM Port</b>	Baud <b>1200</b> ◀▶
② Bluetooth	Data Bit 8 ◀▶
	Parity None ◀▶
	Stop Bit 1 ◀▶
Back	Back <span style="float: right;">Next</span>

【 Comm Meas. 】
Staff Record: ----.----m
Stadia: ----.---m
Status: ----
<b>Back</b>

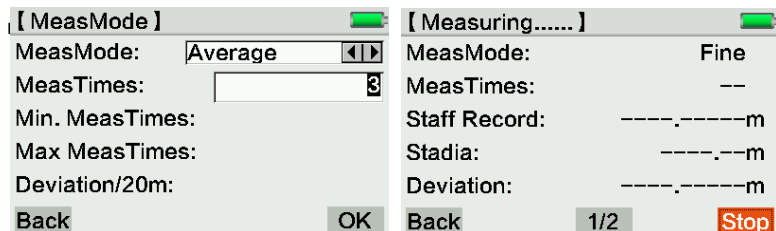
### 3.4.2 Bluetooth

Choose [2.Bluetooth]. Set the password for Bluetooth connection. The data can be transferred from KL-03 to PC by Bluetooth or U-disk.



### 3.5 Measure Mode

Under measurement interface, press [MODE] key to set the measure mode.



Measure mode:

- Fine: Fine measurement. (n=1)
- Fine Repeat: Repeat the fine measurement in n times,  $n \leq 99$ , until pressing [stop].  
The fine repeat mode will increase the quality of data, especially under the unstable environment.
- Average: Average value for measurement in several times, for example  $n=3$  (2...99)
- Limit Avg.: The equipment will check whether average measured value (sDevM) is less than standard value. If the average value less or equals to standard deviation value, the equipment will stop measurement. Otherwise, the measurement will still

go on until the settled measure times. The equipment will check the standard deviation in each steps.

Min. Meas Times: 2-99

Max. Meas Times: 2-99

Deviation/20m: the average standard deviation in 20m

Eg. Measure Range= 60m, Standard Deviation/20m = 0.007m

Standard = Deviation x 60m = 0.0021m

In 60m, the max. Standard deviation value is 0.0021m

- Median: Middle value for measurement in several times, for example n=3 (2...99)

If n is odd, for example the value is 2,5,6, the median is 5

If n is even, for example the value is 2,5,6,7, the median is 5.5

## 3.6 Function

Press [SHIFT] + [FNC] under any measure interface to enter the function setting page.

If a function is unavailable when calling-out, it means this function is not suitable for current application.

### 3.6.1 Test

The Test function afford a solution for users who want to measure in several times without saving data. It can also test the equipment or improve the distance measurement. The Test function is independent to current job.

【 Func. 】	Back	【 Test 】
① Test		Staff Record:      ----.----- m
② View		Stadia:                ---.--- m
③ Code		
④ Pt N		
⑤ Input		
⑥ E Bubble		Back

### 3.6.2 View

In View page, it can show the last measured result in current job.

【 Func. 】	Back	【 View 】	Back
① Test		MeasMode: -----	
② View		Staff Record: ----- m	
③ Code		Count: -----	
④ Pt N		Standard Devi: ----- m	
⑤ Input		Avg Devi: ----- m	
⑥ E Bubble		Dispersion: ----- m	

### 3.6.3 Code

In Code page, the user can input code in below method:

- 1) choose the code from code list when the codes are existed in memory previously.
- 2) Search or input the codes, press [Add] to add a new code, then press [Save] to confirm

【 Func. 】	Back	【 Code 】	N
① Test		Search: *	
② View		Code: <span style="background-color: blue; color: white;">                    </span>	
③ Code		Description:	
④ Pt N		Info 1:	
⑤ Input		Back	Save Add
⑥ E Bubble			

### 3.6.4 Pt N

Input the name of start point and interval for automatic increasing point number.

【 Func. 】	Back	【 Pt N 】	N
① Test		Running Pt N	
② View		Start Pt:	1
③ Code		Increa:	0001
④ Pt N		Back	OK
⑤ Input			
⑥ E Bubble			

#### Point Name Management

The start point will settle as A1. The FS point which input by manual can be seen as a separate point name, and only available for current measurement. The next FS point will increasing automatically. The point number will start from 1001 in default. The

number input by manual will increasing from the start point.

### 3.6.5 Input

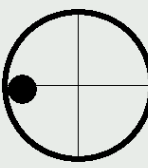
When the target distance is less than 1.8m, the equipment will not available for digital leveling. Please use optical level mode to finish the job by inputting data by manual.

Please notice that:

- 1) Consider the correction of earth curvature
- 2) Whether the value of inverse measurement is negative
- 3) Whether the decimal digits compatible with the equipment setting.
- 4) The distance has been inputted by manual

【 Func. 】	Back	【 Input 】
① Test		Staff Record: 0.00000 m
② View		Stadia: 0.00 m
③ Code		
④ Pt N		
⑤ Input		
⑥ E Bubble		
	Back	OK

### 3.6.6 E Bubble

【 Func. 】	Back	【 E Bubble 】
① Test		
② View		
③ Code		
④ Pt N		
⑤ Input		
⑥ E Bubble		
	Exit	OK

X: 02'49"  
Y: Over  
Switch OFF  
Range 12'

## 4. DATA

The Data Page can input, edit and copy the data in other format. All the measured data can seamless export to PC by U-disk or Bluetooth device. Press [2] or click the icon directly to enter.



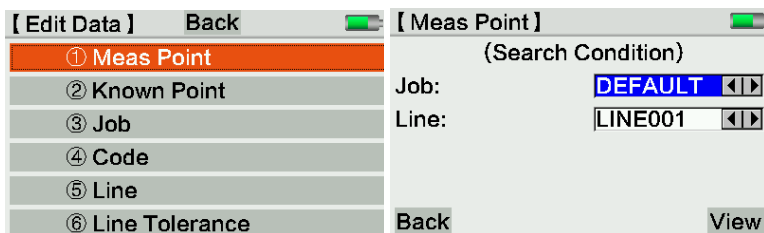
### 4.1 Edit Data

Edit, create, view or delete the data of measure point, known point, job, code, line, line tolerance. Press [1] or click it on screen to enter edit mode.



#### 4.1.1 Meas. Point

Press [1] or click Meas.Point to enter. Input the line and job name, press [View] to check the information.



Press [Next] or navigation key to check the next page. Press [Last] to check the last point.

【 View 】 1/2		【 View 】 1/2	
DateType:	Line	DateType:	Start Pt
Line:	LINE001	Pt N:	A1
MeasType:	BFFB	E:	0.000
Rotate:	OFF	N:	0.000
Staff 1:		H:	0.00000
Back	Last	Next	

#### 4.1.2 Known Point

The data of known point should including the coordinate (X, Y, H) or only Height.

【 Edit Data 】 Back		【 KnownPt 】 Back Del. Add N	
① Meas Point		Job:	DEFAULT
② Known Point		Search:	* Find
③ Job		Pt N:	
④ Code		E:	0.000 m
⑤ Line		N:	0.000 m
⑥ Line Tolerance		H:	0.00000 m

【 New KnownPt 】 N	
Job:	DEFAULT
Pt N:	
E:	0.000 m
N:	0.000 m
H:	0.00000 m
Back	Save

Choose the job and point name. ("\*" means "all") to search.

E/N/H: means the coordinate for known point. For Height point, only need to input Ht.

Del: Delete a single point

Add: Add a new point

#### 4.1.3 Job

【 Edit Data 】 Back		【 View Job 】	
① Meas Point		Job:	DEFAULT
② Known Point		Operator:	SYSTEM
③ Job		Note 1:	-----
④ Code		Note 2:	-----
⑤ Line		2165.25.45	37:85:05
⑥ Line Tolerance		Back	Add Del.



User can delete or add a new job in this function.

【 New Job 】		a		【 Note 】	
Job:	123	Data delete,Sure?			
Operator:	JK				
Note 1:					
Note 2:					
2017.05.11	13:36:44				
Back		Save		Back	
				OK	

#### 4.1.4 Code

The user can check the code list, with maximum 8 property in 2 pages. The code list will store at a fixed file. All the job on this equipment can view, edit or delete this code list.

【 Edit Data 】		Back		【 Code 】		N	
① Meas Point				Search:		*	Find
② Known Point				Code:			◀▶
③ Job				Description:			
④ Code				Q Code:			
⑤ Line				Info 1:			
⑥ Line Tolerance				Back		Del.	Add

【 Input Code 】		N	
Code:		Del: Delete the existed code Add: Add a new code into list. It will show the left interface for manual input.	
Description:			
Q Code:	00		
Info 1:			
Back		Save	

#### 4.1.5 Line

The user can add or delete Line files in this interface.

【 Edit Data 】		Back		【 Line 】	
① Meas Point				Job: DEFAULT ◀▶	
② Known Point				Line: LINE001 ◀▶	
③ Job					
④ Code					
⑤ Line					
⑥ Line Tolerance					
				Back	
				Add	
				Del.	

【 New Line 】		N	1/2	
Name:	LINE009			
MeasType:	BF			
Start Pt:	A1			
H0:	0.00000	m		
Rotate:	OFF			
Back		OK		

【 New Line 】		N	2/2	
Staff 1:	1			
Staff 2:	2			
Back		OK		

#### 4.1.6 Line Tolerance

The user can view, edit and add the tolerance standard in this interface. The tolerance standard will store at a fixed file. All the job on this equipment can view, edit or delete it, with maximum 10 property in 2 pages.

【 Edit Data 】	Back	
① Meas Point		
② Known Point		
③ Job		
④ Code		
⑤ Line		
⑥ Line Tolerance		

【 Line Tolerance 】		1/2	
Tolence Name:			
Total StadiaDiff:	m		
Max Stadia:	m		
Min Stadia:	m		
Max Sight Ht:	m		
Back	Add	Del.	

【 Line Tolerance 】		N	
Tolence Name:			
Total StadiaDiff:	3.00	m	
Max Stadia:	50.00	m	
Min Stadia:	5.00	m	
Max Sight Ht:	2.50000	m	
Back	1/2	OK	

【 Line Tolerance 】		N	
Min Sight Ht:	0.50000	m	
dH Tolerance:	0.00030	m	
B-B/F-F:	0.00020	m	
B-F Diff.:	1.00	m	
Turn Diff:	0.00150	m	
Back	2/2	OK	

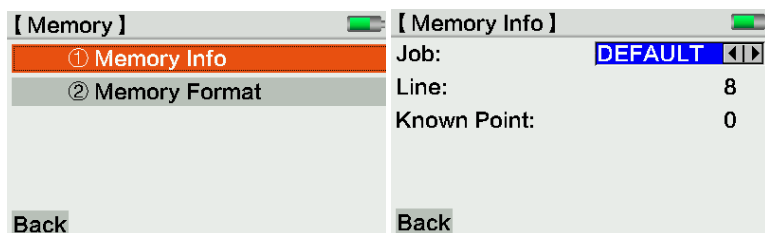
## 4.2 Memory Management

Check the information, storage situation and memory formatting.



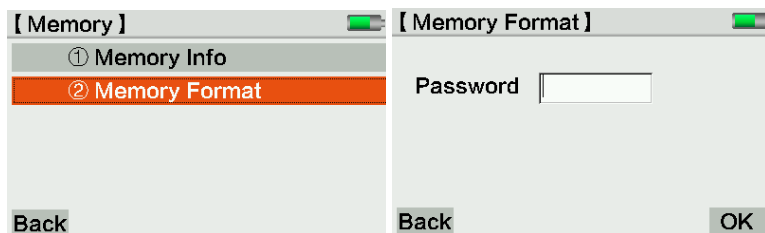
### 4.2.1 Memory Info

The user can check the job name, existed quantity of lines and known points.



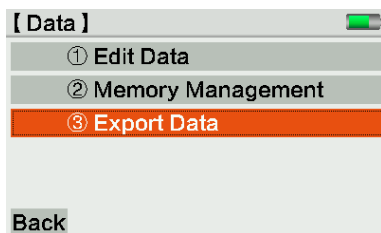
### 4.2.2 Memory Format

The formatting password is 519

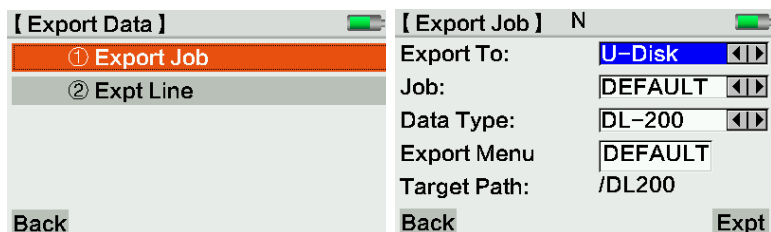


## 4.3 Export Data

The equipment can export the data by U-disk or Bluetooth device.



### 4.3.1 Export Job

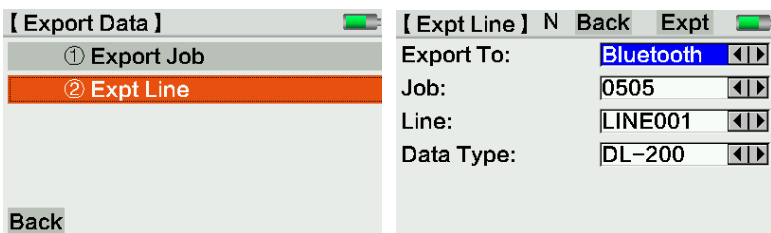


If export to U-disk, the user should select the job, data type and export menu. Click [Expt] to confirm and export data. It will create a folder named “DEFAULT” (or the other job name) under menu “DL200” in U-disk. The data will be included in this folder.

If export to Bluetooth device, the user should search the device at first. Then input the folder's name and finish the steps.

Please notice that COMM port is only for remote control, not for data export.

### 4.3.2 Export Line



Using export to Bluetooth device as an example, after select the job, line name and data type, click [Find] to search a new Bluetooth device for transfer. Then press [Next] to confirm.

【 Bluetooth Search 】	【 Data Export 】
<div>S825751172A-PC A-PC A82567117186653</div>	<div>FileName: <input type="text" value="1"/></div>
<div>BackFindNext</div>	<div>BackExpt</div>

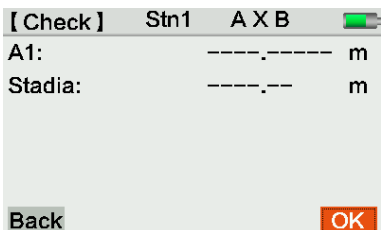
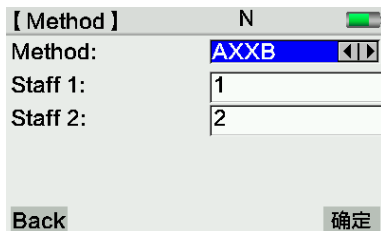
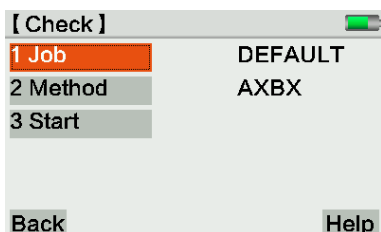
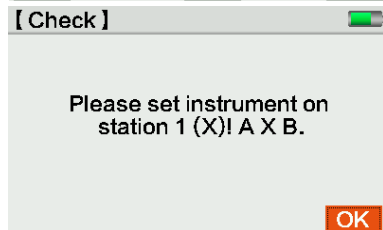
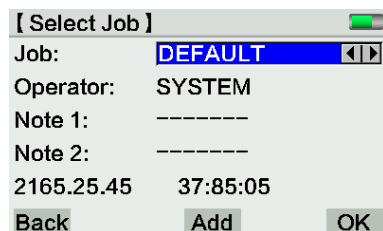
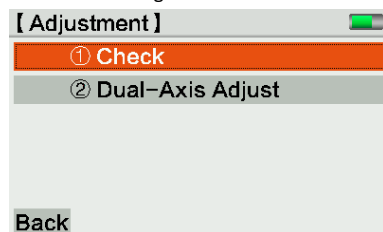
Input the folder's name by manual, press [Expt] to export data into device.

## 5. ADJUST



### 5.1 Check

KL-03 has two kinds of adjust method. The first is "A X B X" and the second is "A X X B". A/B means the code staff, X means the position for equipment. Press [1] or click it directly to enter the checking mode.



### Steps:

1)Job: click Job column or press [1] to confirm the job name.

2)Method: choose the checking method “AXBX” or “AXXB”. The users can name the staff in this page.

Each method including 2 ways:

AXBX: Center measurement and Kukkamäki method.

AXXB: Förstner and Nbauer method.

The tilt error of sight will display by radian. The approximation from radian to second is:  $1'' = 0.1\text{mm}/20\text{m}$ ,  $2'' = 0.001\text{ft}/100\text{ft}$

The record for code staff (A1, B1, B2, A2) should follow as below order:

Station 1: A1, B1

Station 2: B2, A2

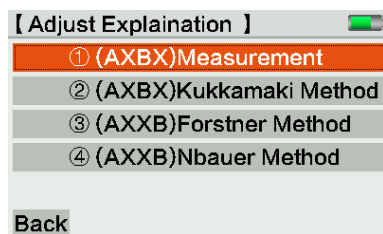
The user should measure the closer staff (except center measurement method) at first. The checking mode defined the distance range in default. Once the distance is mismatch, the equipment will show the corrective value for the position.

After 4 times record, the equipment will compare the measured tilt error with existed value and display the result on screen. Then the equipment will choose the new tilt error as the corrective value. In the same time, it will show the corrective value for cross-line in optical measurement.

### Data Storage

The checking result will store under the selected job. This line will pre-named as “CHEKADJ”.

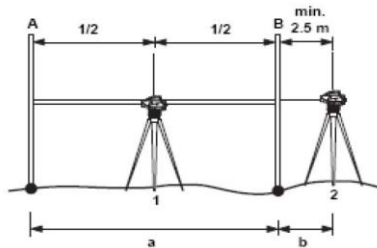
3)Start: start the checking procedure based on the notice shown on screen. The user can also click [Help] to see the diagram for help.



### 5.1.1 AXBX Method

#### 1) Center Measurement.

Set the equipment between the two code staffs of 30m. Then move the equipment closer to Staff B. As picture shown:



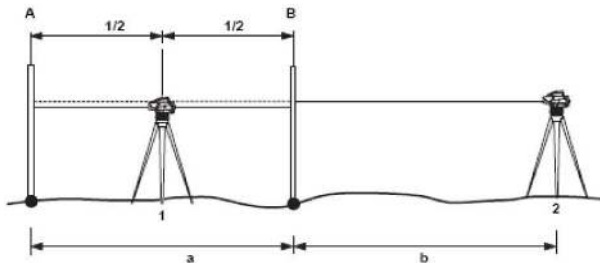
The distance should meet the following conditions:

A. Station 1, the equipment should set in the center, the deviation should within  $\pm 1\text{m}$ , without focusing.

B. Station 2,  $b \leq 2.5\text{m}$

#### 2) Kukkamäki Method

Set the equipment between the 2 staffs in a m away, a is about 20m. Then set the equipment outside the staff B, the distance is b. The conditions for distance are same to center measurement method.



### 5.1.2 AXXB Method

In AXXB method, the distance scale between each staff and station should be 1:2

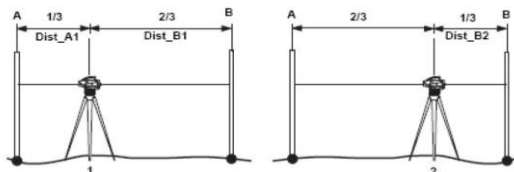
#### 1) Förstner Method



Set the equipment at  $1/3$  between two staffs. The distance between two staffs should be 40m-60m. It also need to meet the following conditions:

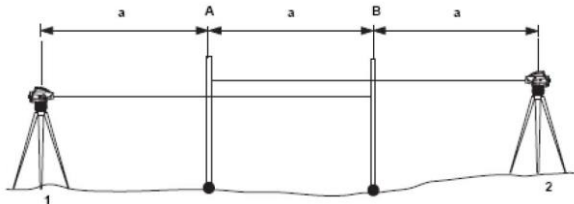
A. Station 1:  $0.2 \times D < \text{Dist\_A1} < 0.4 \times D$

B. Station 2:  $0.2 \times D < \text{Dist\_B2} < 0.4 \times D$



## 2) Näbauer Method

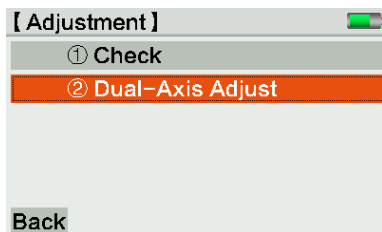
Set the equipment outside the staff,  $a$  is about 15m-20m. The conditions for distance should same as Förschner method.



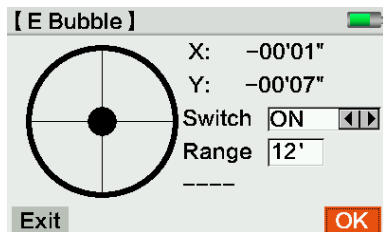
It will display the  $i$  angle, the corrective stadia as the checking result on the screen.

## 5.2 Dual-axis Adjust

After leveling the equipment precisely, the tilt value should near to zero. Otherwise it will cause the error.



1) Adjust and leveling the equipment.



2) Open the E bubble

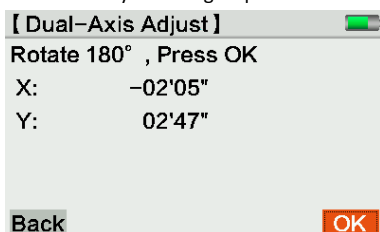
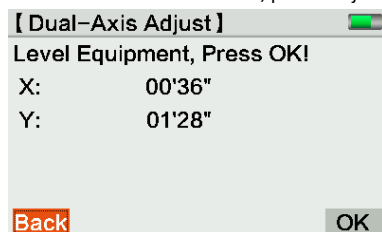
3) Read the compensate value X1 and Y1

4) Rotate the equipment in  $180^\circ$ , read the value X2 and Y2.

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

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

If the deviation is over  $\pm 15''$ , please adjust the dual-axis by following steps:



1) Adjust and leveling the equipment

2) Open the dual-axis adjust page.

3) Press [OK] and rotate  $180^\circ$  for second adjust.

4) Confirm that the corrective value is within the range. If yes, press [OK] to update the value. If not, please exit this page and do the step 1-4 again. If the user can not solve the over-range problem, please contact the dealer for further help.

## 5.3 Reticle Cross-hair

If the tilt error is over 3mm/each 30m, the user need to adjust the equipment.

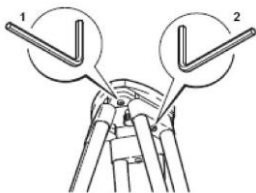
1. Adjust the screws by allen key slowly to correct the value
2. Check the tilt error: compare the digital value with optical value, the difference is the error value.

## 5.4 Circular Bubble

1. Leveling the equipment
2. Rotate it in  $180^{\circ}$
3. Check whether the bubble has deviate to the center
4. If not, please use an allen key to correct half of it. Repeat step 1-4 until it centered.

## 5.5 Tripod

1. Tighten each spare parts (1)of tripod by allen key
2. Adjust the screw under tripod head, to ensure the tripod still stand well when legs leave the ground



Please adjust the equipment regularly. Especially when it has a long-term delivery or storage, please adjust the specification on field.

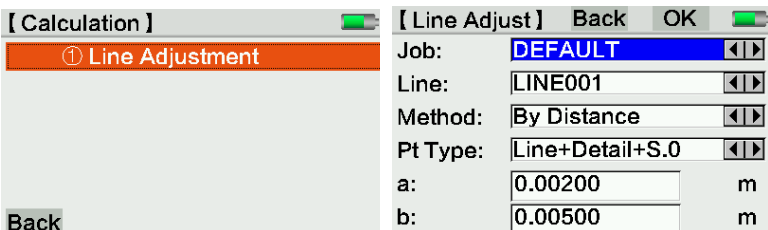
## 6. CALC



### 6.1 Line Adjustment

In Line Adjustment program, the user can do the adjustment for single line. It can define any two points as occupied point with known height. This program will calculate the closure error and adjust it.

Press [4.CALC] under main menu to enter the line adjustment page.



Choose a line in a existed job at first. eg. LINE001 in the picture. The equipment can calculate the tolerance value of closure error in two methods:

Based on distance: Tolerance value =  $a + b\sqrt{L}$ , L is the total length of this line.

Based on station: Tolerance value =  $a\sqrt{n}$ , n is the total quantity of station.

a and b: the basic configuration to calculate the value

Pt Type: Point type. It can choose three different kinds of point with their combination. Line points, detail points (median points) and stake-out points. All these points can be adjust.

Press [OK] to confirm.

【 Known Pt Ht 】		
Pt 1:	A1	◀▶
Pt 1 Ht:	1.00000	m
Pt 2:	4	◀▶
Pt 2 Ht:	1.12314	m
Back		OK

Pt 1: is the first point in this line, the user can choose an arbitrary point.

Pt 2: is the end point in this line, it should be an arbitrary point which can makes this line into correct order. The order of Pt 1 to Pt 2 should be accordance with the line.

Pt 1 Ht/ Pt 2 Ht is the height for these two points. The height should be input by manual.

Press [OK] to calculate the closure error and check the result. If it is over-range, the equipment will show it on screen

【 Result 】		
Job:	0505	
Line:	LINE001	
Closure Err:	0.00000	m
Error Tol.:	0.00337	m
/St Closure Err:	0.00000	m
Adj Method:	By Distance	

**St Closure Err:** the closure error in each station

**Adj Method:** the adjustment method, for example by distance or by station

**[Adj]:** Adjustment. Calculate and record each points in this line.

【 Result 】		
Pt N:	A1	◀▶
Adj Ht:	1.00000	m
Residual:	0.00000	m
Original Ht:	1.00000	m
Back		

Pt N: Press [←][→] to check all the adjusted point

Residual: the difference between the adjusted height and original height

All the adjust result will be saved after the measured data. It will add a new data block with the height for all new points, after adjustment in each time.

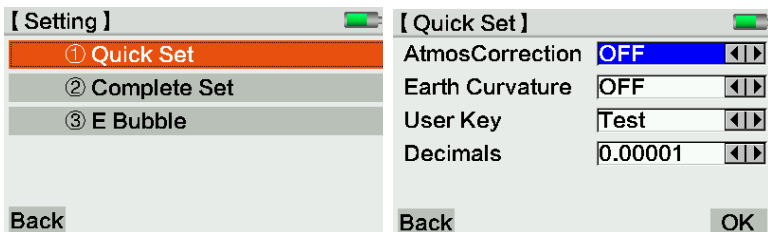
## 7. SET



### 7.1 Quick Set

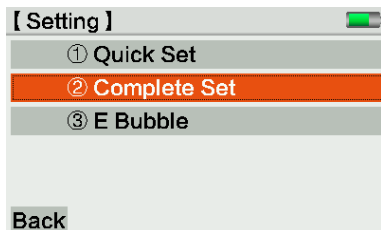
Press [1.Quick Set] by numeric key or click on screen to enter this setting page.

In Quick Set interface, the user can change the settings for Atmosphere correction, earth curvature, user key and decimals.

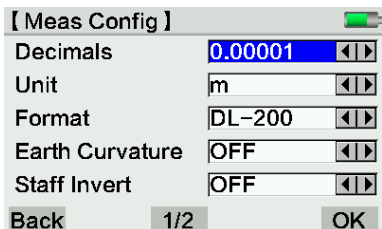
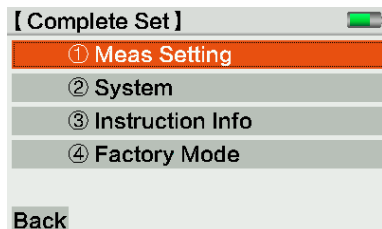


### 7.2 Complete Set

In Complete Set page, it divide into four parts.



### 7.2.1 Meas Setting



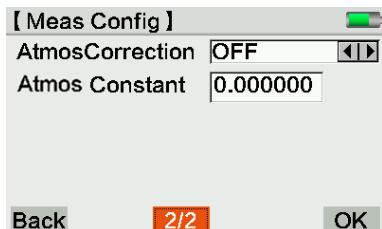
**Decimals:** the digits for display and input

**Unit:** m or ft

**Format:** DL200

**Earth Curvature:** On or Off

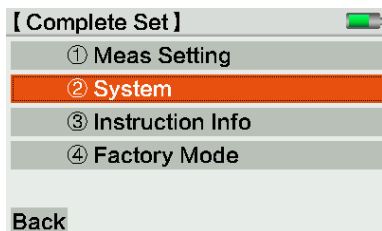
**Staff Invert:** On or Off



**Atmos Correction:** On or Off

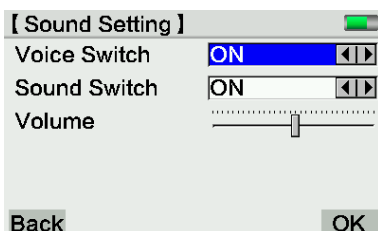
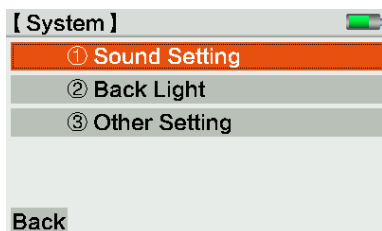
**Atmos Constant:** User can input the atmosphere constant by manual.

### 7.2.2 System



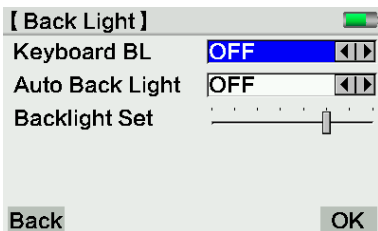
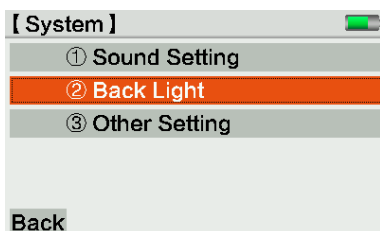
#### (1) Sound Setting

The sound setting including voice switch, sound switch and volume.

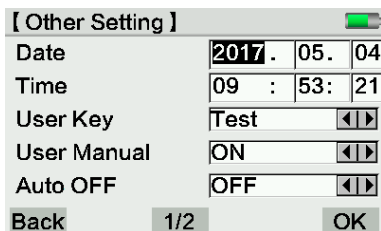
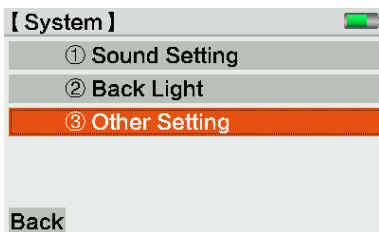


## (2) Back Light

The back-light setting including keyboard and bubble back-light, LCD auto back-light control.



## (3) Other Setting

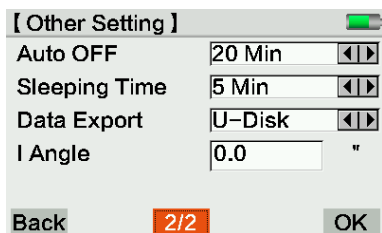


**Date:** Display and set the system date. The format is Year/Month/Day

**Time:** Display and set the system time in Hour/Minute/Second

**User Key:** User-defined for [User] key. It can be settled as View/Code/Pt N/Input/E bubble/Test key.





**User Manual:** On or Off

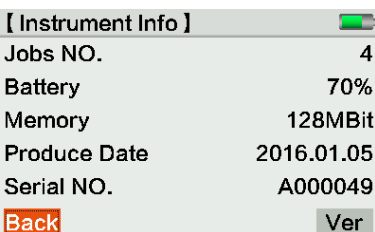
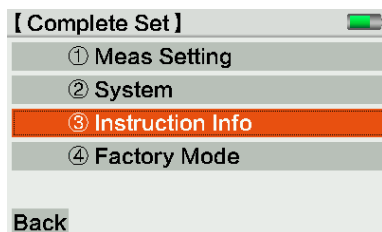
**Auto Off:** On or Off, if on, select the off time

**Sleeping Time:** Select the sleeping time without operation. Press any key to wake up.

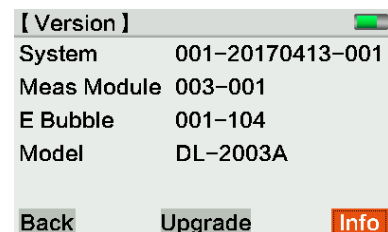
**Data Export:** by U-disk or Bluetooth

**I Angle:** display the current i angle. It can be modified by manual.

### 7.2.3 Instruction Info

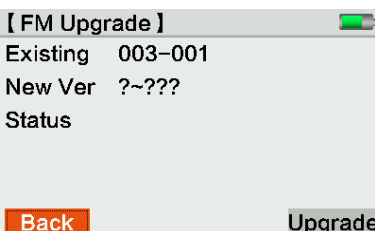
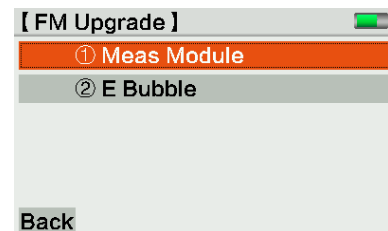


Click [Ver] to check the version of system, measure module, E bubble and model name.



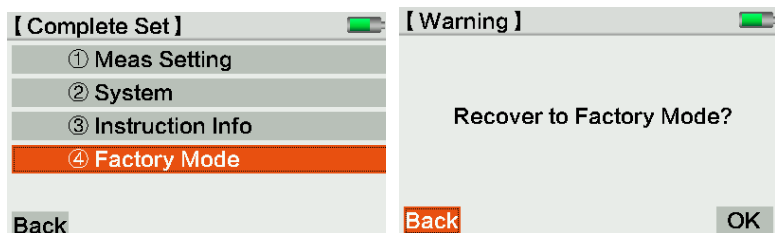
Press [Upgrade] to enter the upgrade page for firmware or E bubble.

Please put the update file under the root menu in the U-disk. Then press [Upgrade] again.

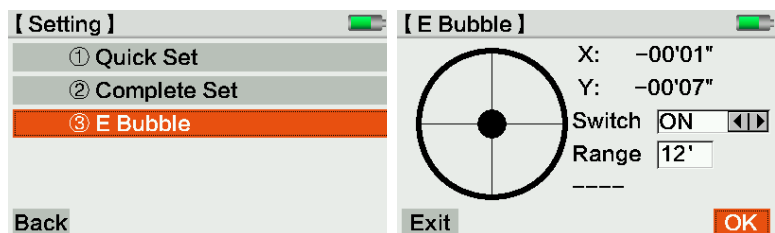


### 7.2.4 Factory Mode

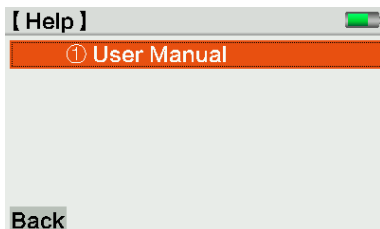
Please notice that all the data will be recover under factory mode.



### 7.3 E bubble



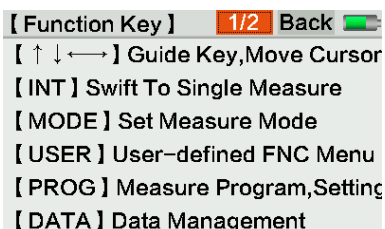
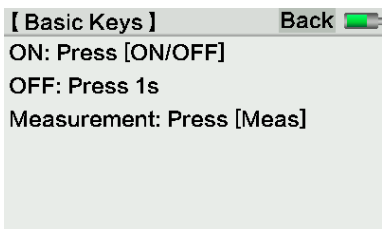
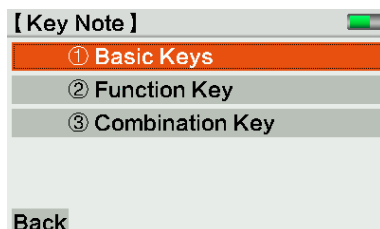
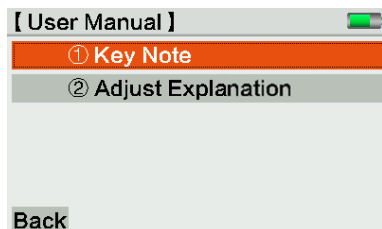
## 8. HELP



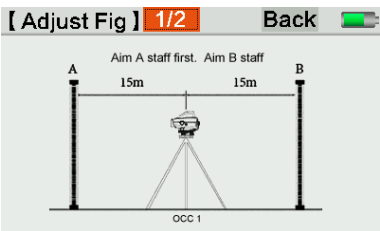
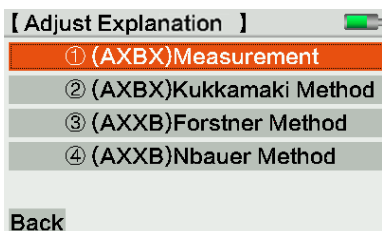
### 8.1 User manual

In Help page, the user can check the key note and adjust explanation in detail.

#### 8.1.1 Key Note



#### 8.1.2 Adjust Explanation



## 9. SPECIFICATIONS

Height Measurement (ISO17123-2)	With Invar Staff	0.3mm
	With Standard	1.0mm
	Optical Level	2.0mm
Distance Measurement	Standard Deviation	5mm/10m
	Accuracy	$D \leq 10m: 10mm; D > 10m: D * 0.001$
Distance Range	Digital	1.8m - 110m
	Optical	$\geq 0.6m$
Min. Display	Height	1mm/0.1 mm/0.01mm optional
	Distance	0.01m
Measure Time		3 seconds
Measure Mode	Fine, Fine Repeat, Average, Median	
Measure Method	(a)BF, BBFF, (a)BFFB	
Code	User-defined	
Data Storage	Internal Memory	128MBit, 150000 pt
	Point Name	Increasing or User-defined
	Data Transfer	Bluetooth, RS-232
	U-disk	FAT32 format
Telescope	Magnification	32×
	Diameter	40mm
	Field of View	1° 20"
	Multiple Constant	100
	Additive Constant	0
Circular Bubble		8' /2mm
Compensator	Type	Magnetic Damping
	Range	$\geq 10'$

	Accuracy	0.2"
Display	3.0inch TFT LCD	400*240, Colorful Touch Screen
Value Correction	Tilt Error	Automatic
	Earth Curvature	ON/OFF
Dimension	L×B×H	230mm×225mm×203mm
Weight	(Including battery)	3.1kg
Working Temperature		-20° C - +50° C
Storage Temperature		-40° C - +70° C
Protection		IP56
Battery	Lithium	3100mAh/7.2V
Working Time		Over 20hrs

## Correction Statement

Earth Curvature:  $E = X^2 / (2R)$

$X$  = measured distance,  $R = 6378000\text{m}$  (Diameter of earth)

Refractive index:  $K = rk * (X^2) / (2R)$

$rk$  = refractive constant,  $X$  = measured distance.

Angle =  $\arctan[(A1-B1+B2-A2) / (d1-d2+d3-d4)]$

$A1, B1, B2, A2$  = height of staff

$d1, d2, d3, d4$  = the distance which relative to the height of staff

Total Stadia difference =  $\sum \text{BS Stadia} - \sum \text{FS Stadia}$

Total Stadia =  $\sum \text{BS Stadia} + \sum \text{FS Stadia}$

Station Distance =  $\text{BS Stadia} + \text{FS Stadia}$

Station Height Difference =  $(\text{back staff record 1} + \text{back staff record 2} - \text{fore staff record 1} - \text{fore staff record 2}) / 2$

Total Height Difference =  $\sum \text{station height difference}$

Height Difference =  $(\text{back staff record 1} - \text{fore staff record 1}) - (\text{back staff record 2} - \text{fore staff record 2})$

Observation Difference in two times measurement:  $\text{back staff record 1} - \text{back staff record 2};$   
 $\text{fore staff record 1} - \text{fore staff record 2}.$