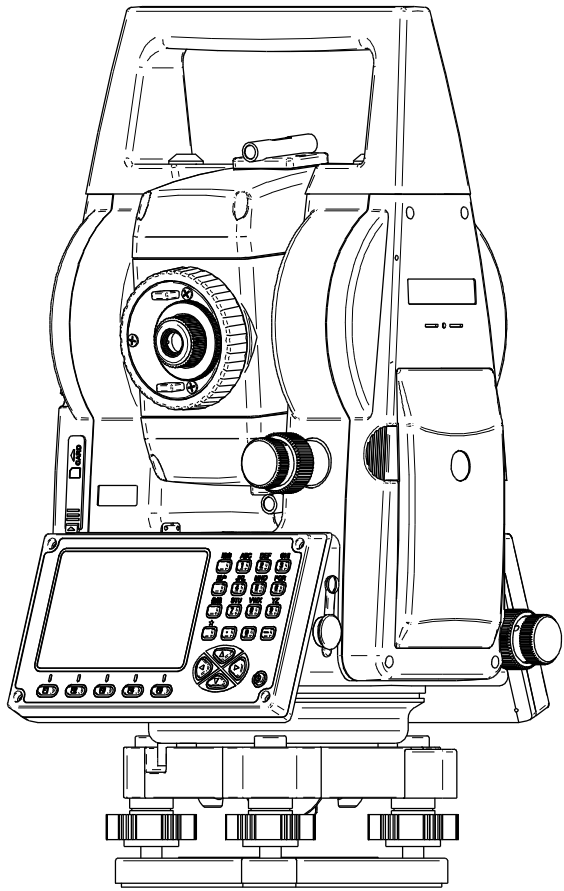
# MTS1200 SERIES TOTAL TATION



## Instruction Manual

# Preface

Thank you for selecting the MTS1200 Electronic Total Station. For the best performance of the instrument, please read this manual carefully and keep it for future reference. Some of the diagrams shown in this manual may be simplified for easier reading.

No further notice will be given for any changes of technical specifications or appearance to the instrument for the improvement of performance and preciseness.

# PRECAUTIONS FOR SAFE OPERATION

## General

- 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.
- Use solar filter for sun observation.
- 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 wield or throw the plumb bob. A person could be injured if struck.
- Secure handle to main unit with locking screws. Failure to properly secure the handle could result in the unit falling off while being carried, causing injury.
- Tighten the adjustment tribrach clamp securely. Failure to properly secure the clamp could result in the tribrach falling off while being carried, causing injury.

## Power supply

- Do not use voltage other than the specified power supply voltage. Fire or electrical shock could result.
- Do not use damaged power cords, plugs or loose outlets. Fire or electric shock could result.
- Do not use power cords other than those designated. Fire could result.
- Do not place articles such as clothing on the battery charger while charging batteries. Sparks could be induced, leading to fire.

- Use only the specified battery charger to recharge batteries.
- 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 or the battery charger if wet. Resultant shorting could lead to fire or burns.
- Do not connect or disconnect power supply plugs with wet hands. Electric shock could result.
- Do not touch liquid leaking from batteries. Harmful chemicals could cause burns or blisters.
- Recharge the battery once a month at least when not in used for a long time. And storied separately.

**Tripod**

- 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.
- 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.

**Laser safety information**

- In the series products is equipped with laser source, and you shall not directly watch light in the point aligner so as to avoid being hurt in the eyes.
- Do not frequently start and shut down the laser point aligner, which may cause damage to it.

# PRECAUTIONS

**Precautions concerning water and dust resistance**

- Do not put the instrument in the water. The instrument conforms to IPX4, so the normal rain can not damage to the instrument.
- Be sure to close the battery cover and correctly attach the connector caps to protect the SET from moisture and dust particles.
- Make sure that the inside of the carrying case and the instrument is dry before closing the case. If moisture is trapped inside the case, it may cause the instrument to rust.
- Never place the instrument directly on the ground. Sand or dust may cause damage to the screw holes or the centering screw on the base plate.

**Using**

- Mount the instrument on the wooden tripod, because the metal tripod will shake, and it will decrease the observing precision.
- The tribrach will affect the precision of the instrument, so you should check the screw on it. It must be tighten in order to protect the instrument.
- Before your measurement, check all the settings and the parameter of the instrument carefully.

- Never carry the instrument on the tripod to another site.
- Turn the power off before removing the battery.

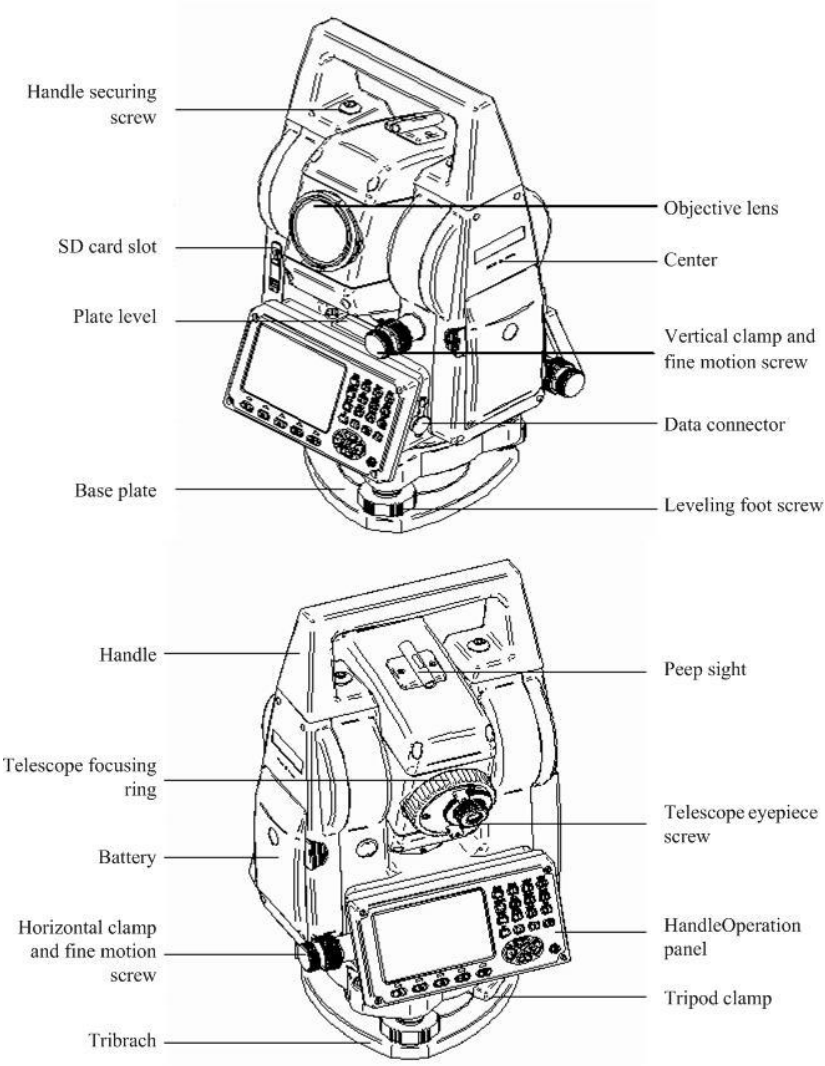
**Other precautions**

- If the instrument 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 instrument to a cold place.
- Protect the instrument from heavy shocks or vibration.

# CONTENTS

# 1.Before using the instrument

## 1.1 Parts of the instrument



## 1.2 Unpacking and packing

Take out the instrument from the case

① Lays down the instrument case with lid up.

② Unlock the case open it.

③ Takes out the instrument from the case with care.

Put instrument back to the case

① Cover lens of the telescope with the lid.

② Make the instrument horizontal with vertical brake handwheel and circular bubble face up. And objective lens faces down. Put the instrument back to the case.

③ Close the case and lock it.

## 1.3 Using the battery

### 1.3.1 Cautions

- When the instrument is working on , don't remove the battery.
- Before removing the battery, turn off the power to the instrument.
- When installing/removing the battery, make sure that moisture or dust particles do not come in contact with the inside of the instrument.
- Periodically wipe clean the pole with the cleaning cloth to keep them free of dirt.
- Please charge the battery at this temperature range 0℃~45℃.
- Before storing the battery, you should charge it full, and you should charge it every three months at least. If not doing so, the battery will discharge by itself, and the voltage will be very low. Life of the battery will be affected.
- The temperature and the humidity will affect the battery discharge speed. So we advice you store the battery in a dry room and the

temperature range should be 0℃~20℃.

### 1.3.2 Charging procedure

① Connect the battery case with the charger.

② Plug the charger into the wall outlet. Mount the battery in the charger. Make sure the battery contact the charger well. When charging starts, the red lamp starts blinking.

③ The lamp light turns to green when charging is finished.

④ When charging finished, unplug the charger and then remove the battery.

### 1.3.3 Charger operation manual

- Never use this charger with other batteries.
- This charger is a speedy set. it will finished the speed-charging in four hours.
- After speed-charging, the capability of the battery will attain 75%~80%. If you want to charge it full, you need 2~4 hours small current charging.
- When the charger is empty or in the small current charging, the green light will bright. In the speediness status the red light will bright, when it finished, it will turn into the small current status.
- The battery will not be damaged in the small current status, but you had better charge the battery not over twenty-four hours.
- If there is much electricity remains in the batteries, the charger may not come in the speediness status. It will charge it in the small current status. If you want to charge it speediness, you must put the batteries in the charger and then connect the charger with the power supply.

### 1.3.4 Battery Installation

First of all, align the battery bottom jar with the bump at battery case to push the battery into the battery case, then block the battery case in the battery jar inside baffle.

### 1.3.5 Battery Removal

Use the thumb and index finger to press the battery case clip to opposite direction to the extreme position, and take out the battery case from the baffle battery jar at the same time. Then one hand is taking the battery case and the thumb of the other hand takes out the battery in an inclined manner when pressing it.

### 1.3.6 Battery power display

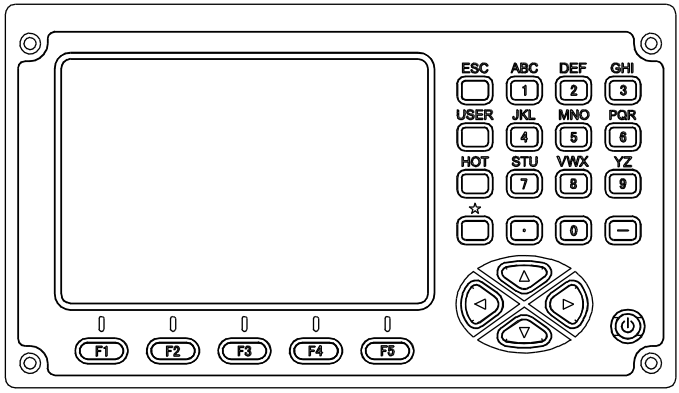
There is a mark on the screen that can be used to check the status of the battery power.

90-100% 50-90% 10-50% 0-10%

If there is no power, the instrument will give an alarm every ten seconds, and it will display “Battery is low”. You should finish the measurement quickly, saving data and changing another battery. Or not the power will be shut off after one minute

# 2. Basic Operation

## 2.1 Screen and keyboard




## 2.2 Operation key

| Keys | Description |
|---|---|
| ⏻ | Press the key to turn on the power . Press and hold it for more than 2 seconds to turn off the power. |
| ESC | Cancel the input or return the previous screen. |
| USER | During measurement, press the key to enter user-defined function. |
| HOT | During measurement, press the key to enter commonly-used measurement function |
| ◀ | Move cursor leftward or select other options |
| ▶ | Move cursor rightward or select other options |
| ▲ | Move cursor upward |
| ▼ | Move cursor downward |

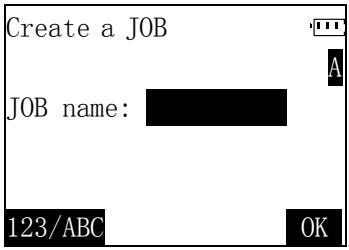
| | |
|---|---|
| Numeric/Alpha key | Input numerals or alphabets |
| F1~F5 | Functions are according to the displayed message |

## 2.3 Method of inputting numerals and alphabets

For example: create a new JOB , input the JOB name as “JOB01”

① Press the key <123/ABC> to switch alphabets input state, and A displays on the right side of the screen at the moment;

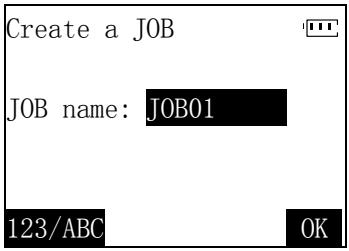
② Press the key [JKL] once, and “J” displays;




③ Press the key [MNO] for three times, and “JO” displays;

④ Press the key [ABC] twice, and “JOB” displays;

⑤ Press the key <123/ABC> to switch numerals input state, and A disappears on the right side of the screen at the moment;

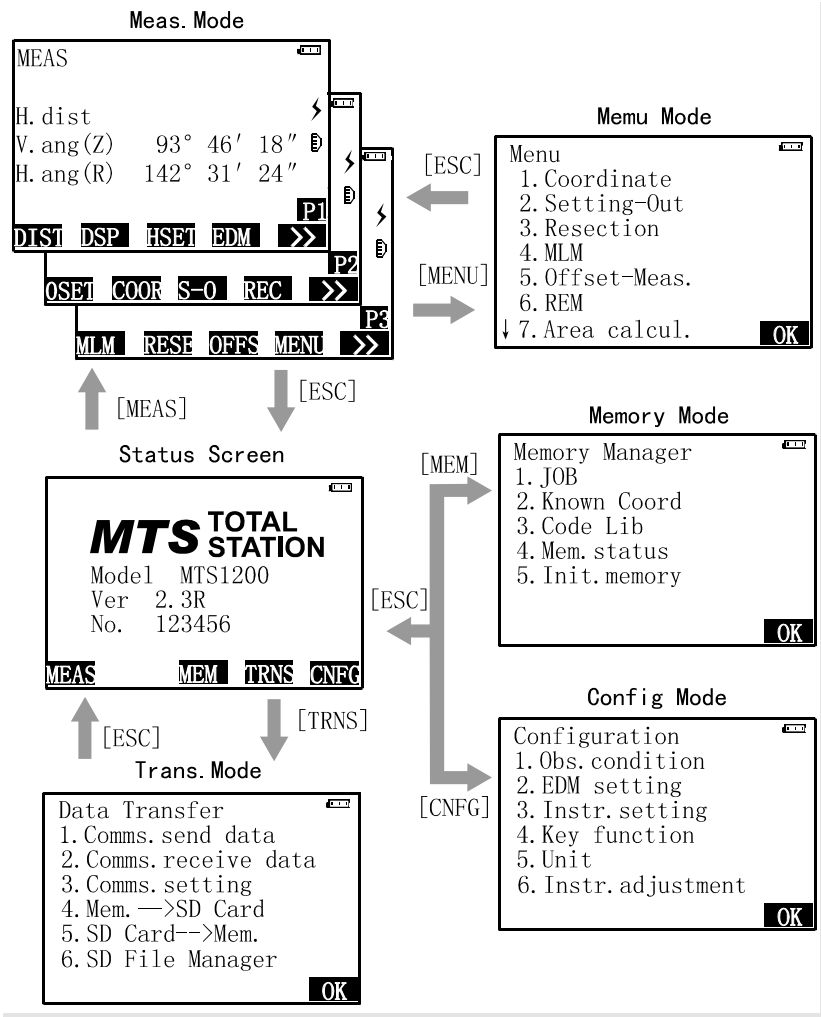



⑥ Press the numeric key [0], and “JOB0” displays;

⑦ Press the numeric key [1], and “JOB01” displays.

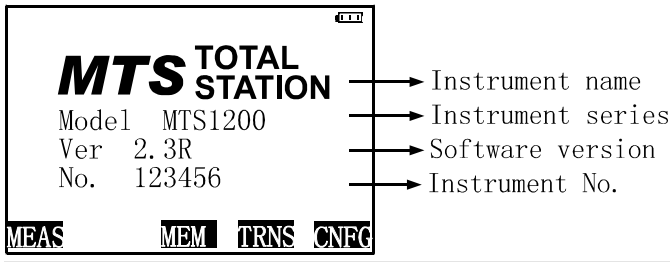
- Press the key【◄】 to delete the character before the cursor;
- In case the cursor is located at the first character of an edit box, press the key 【◄】 to delete all the characters in the edit box;
- Press the key【►】 to move the cursor to the character that needs to be modified and input again.

## 2.4 Mode diagram



## 2.5 Display information

Status screen



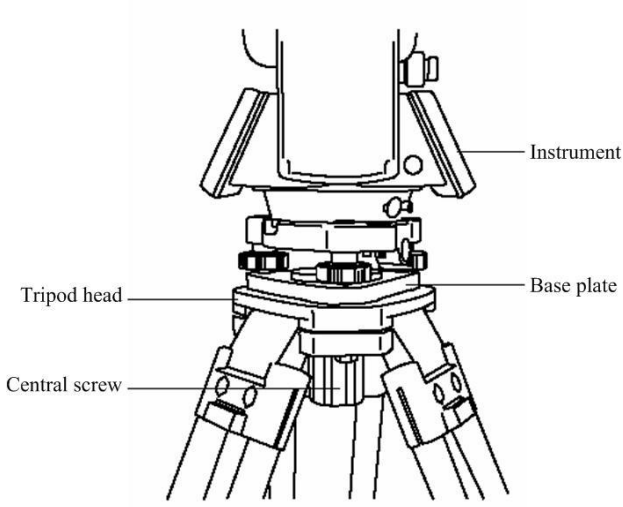

A number of symbols are used in measurement mode. The meanings of these symbols are as follows:

- The cooperative target is prism
- The cooperative target is reflective sheet
- No cooperative target
- Laser-pointer beam is turned on
- Tilt compensation is turned on
- USER key and HOT key are effective

# 3. Preparation for measurement

## 3.1 Setting up the instruction and tripod

① 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



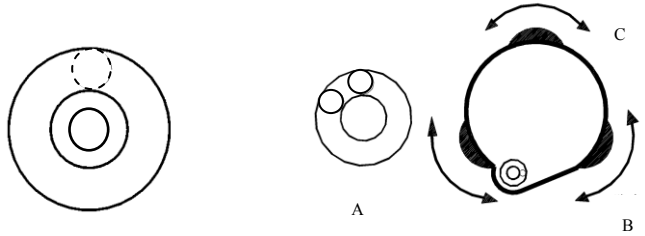

② Instruments will be carefully placed on tripod, loosens the central connection screw little, moves the instrument lightly, until the hammer ball alignment station point symbol center, then fasten the screws tight.

## 3.2 Leveling and centering the instrument

**Leveling the instrument with the circular level**

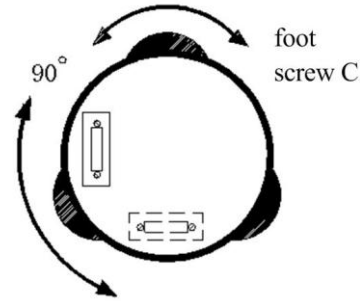
①Rotate the foot screw s A、B, make the bubble to the vertical line of the foot screw center line.

②Rotate the foot screw C, make the bubble in the center.




**Leveling the instrument with the plate level**

①Loosen the horizontal clamp to turn the upper part of the instrument until the plate level is parallel to a line between leveling foot screws A and B. Center the air bubble using leveling foot screws A and B. the bubble moves towards a clockwise rotated leveling foot screw.



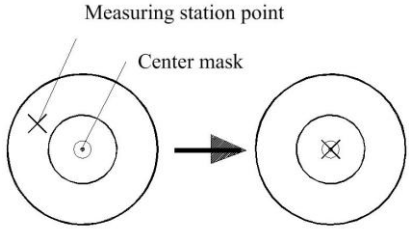

②Turn the upper part of the instrument though 90° (100g). The plate level is now perpendicular to a line between leveling foot screws A and B. center the air bubble using leveling foot screw C.

## Centering the instrument with laser plummet

After the instrument is turned on, press【★】to enter the star key mode, and then press the key 【PLMT】to make the laser plummet launch laser. Loosen the central handle on the tripod, slightly move it to make the laser point launched from the laser plummet align with the instrument station point. Press the key 【PLMT】 to turn off the laser plummet.

## Centering the instrument with optical plummet(optional)

Adjust the eyepiece of the optical plummet telescope to the user's eyesight. Move the instrument by loosening adjusting screw. Coincide with image of the point on the ground with the center mark of the optical plummet telescope. Carefully move the instrument in order to make it steady.




- **Caution: don't rotate the instrument on the tripod, in order to decrease the excursion of the bubble.**

## Leveling the instrument accurately

Follow the step mentioned above, until you rotate the instrument and the bubble always in center. Tighten the centering screw.

## 3.3 Focussing and target sighting

① **Focus on the reticle:** look through the telescope eyepiece at a bright and featureless background. Turn the eyepiece screw clockwise, then counterclockwise little by little until just before the reticle image becomes focused. Using these procedures, frequent reticle refocusing is not necessary since your eye is focused at infinity.

② **Sight the target**: loosen the vertical and horizontal clamps, and 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 focusing 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 focusing ring until there is no parallax between the target image and the reticle.

**CAUTION：**

- **When sighting the target, strong light shining directly into the objective lens may cause the instrument to malfunction. Protect the objective lens from direct light by attaching the lens hood.**
- **Observe to the same point of the reticle when the telescope face is changed.**

## 3.4 Power ON/OFF

① Confirm that the instrument leveled and centered precisely.

② Press the power key, the instrument will make a sound of beep, instrument is powered on, the screen first display the instrument model information, the edition number and software version number, and a self-check is run. If the instrument is normal, the measurement mode screen appears after a few seconds.

③ Power off: press the power key and hold on 2 seconds to turn off the instrument's power

**Attention:**

- When the battery capacity is insufficient to support the instrument normal working, presses the power key, the screen will display "battery is low", and the instrument will turn power off automatically..
- After power on, you should pay attention to the mark indicates the battery power remaining on screen. Confirm that the battery power is enough for work, otherwise you should replace the battery or charge the battery.
- If "over range" is displayed, the instrument tilt sensor is indicating that the instrument is out of level, need to be leveled once again.
- Due to vibration or strong wind, the angle display is unsteady. You should turn off the tilt angle compensation before measurement. please see below for details.

## 3.5 Function in the star key (★) mode

In any mode, press【★】to enter the star key shortcut function interface. Following operation can be performed in this mode:

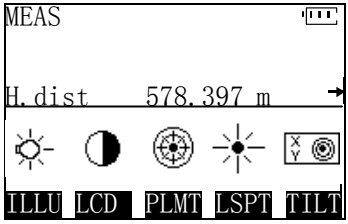
[F1] ——Turn on /off the display illumination

[F2] ——Adjust the contrast of the display

[F3] ——Turn on / off the laser plummet.

[F4] ——Turn on / off the laser-pointer

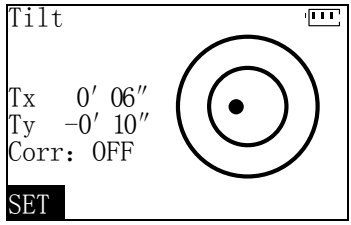
[F5] ——Display the inclination of the instrument graphically and turn on/off compensation



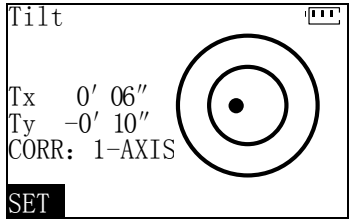

## 3.6 Tilt angle display and compensation

MTS1200 is equipped with dual-axis tilt sensor, which is able to detect, compensate and correct the vertical angle and horizontal angle observation errors caused by the tilt of standing axis of the instrument. The following explains how to check the tilt value of the instrument and turn/off the tilt compensation function.

① Press【★】 to enter the star key mode, then press【TILT】. The screen will display the tilt angle of the standing axis in the direction X (the direction of collimation axis) and the direction Y (the direction of horizontal axis).




② Press【 SET 】 to change tilt correction setting.




1-AXIS: Compensate the tilt of the standing axis of the instrument in the direction X

2-AXIS: Compensate the tilt of the standing axis of the instrument in the direction X and Y

③ Press 【ESC】 to exit after setting.

- To set automatic tilt compensation after power on, please see "12.Setting parameters of instrument"

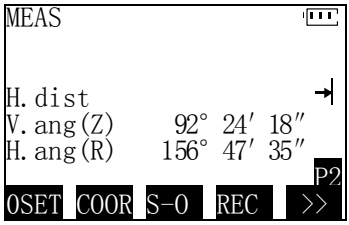
# 4. Angle measurement

- Before the survey, please inspect once more and make sure the instrument is leveled and centered precisely.

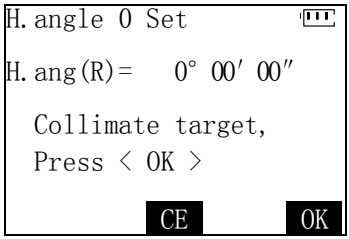
## 4.1 Measuring the horizontal angle between two points

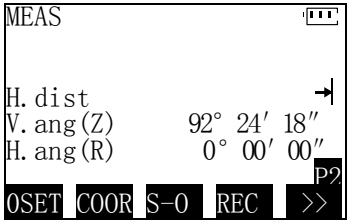
Use the "0 SET" function to measure the included angle between two points.

① Press 【>>】to the second page of Meas mode. Collimate the first target，Press 【0SET】.

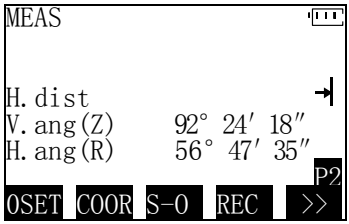



② Press 【OK】, the target direction's horizontal angle is set as 0°00 ' 00 ".



③ Collimate the second target, the horizontal angle displayed is the included angle between the two target points. (56°47′35″)。

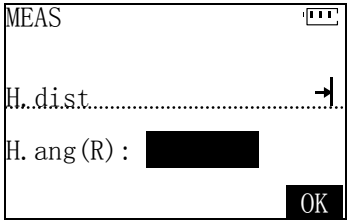



## 4.2 Horizontal angle setting

The horizontal angle can be set to any angle that required for.

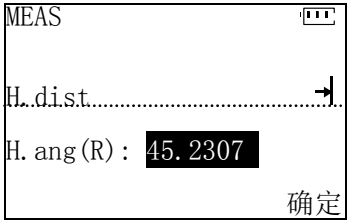
**Set angle by key input**

① Sight the target and press 【HSET】 in the first page of the measurement mode.

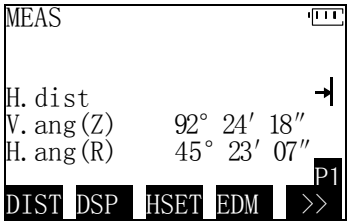



② Enter the horizontal angle value you wish to set.

Example: 45° 23′ 07″ 。




③ Press 【OK】, The target direction is set to the required angle.

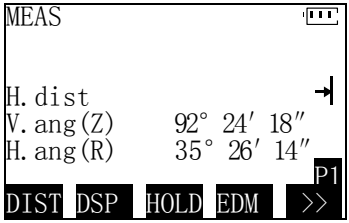



- **Angle inputting rule**: degree value and minute value are separated by ".",and minute value and second value do not need to separate, like 45°23 ' 07 ", should input 45.2307.

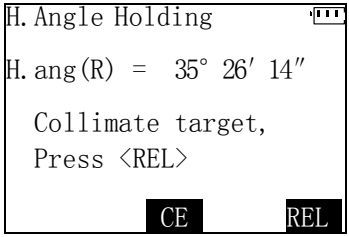
**Set angle by holding the angle**

Before performing the operation, the key 【HOLD】 should be allocated to the measurement mode. See "12.4 Allocating key function".

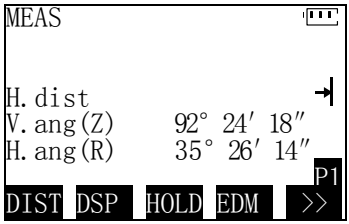
① Turn the instrument by the horizontal clamp and horizontal fine motion screw until the horizontal angle is displayed as the required value.




② Press【HOLD】, the angle is locked.




③ Collimate the target, and then press 【REL】 to set the target angle to the required value.

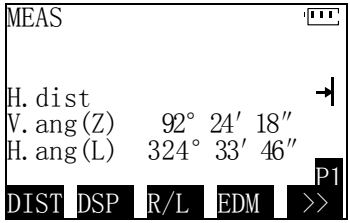


## 4.3 Changing the direction of horizontal angle（R/L）

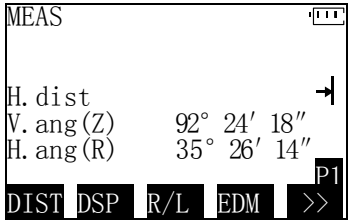
Horizontal angle can be displayed in right angle mode (increasing clockwise, marked as:H.ang(R)) or left angle mode (increasing counterclockwise, marked as : H.ang (L)), and can be switched in the measurement mode.

Before performing the operation, the key [R/L] should be allocated to the measurement mode. See "12.4 Allocating key function".

In the Meas mode, press 【R/L】, the horizontal angle display mode will be changed from right angle mode to left angle mode.




Press 【R/L】again，change back to right angle mode.



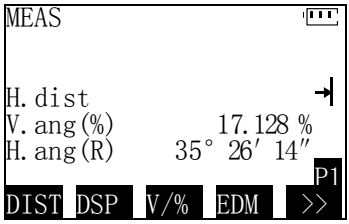

- The relation of left angle and right angle：H.ang(L)=360°-H.ang(R)

## 4.4 % percent grade

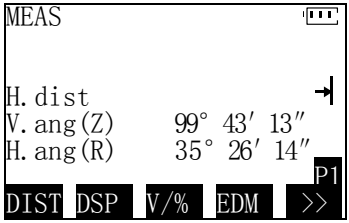
MTS1200 can display vertical angle by percent grade(%). The range of percent grade can be displayed： ±300％.

Before performing the operation, the key【V/%】should be allocated to the measurement mode. See "12.4 Allocating key function".

In the Meas mode,press【V/%】, the percent grade of the vertical angle will be displayed.

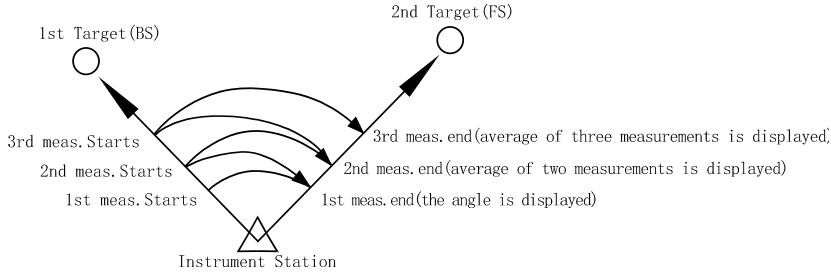



Press 【V/%】 once again，the display mode switches back to normal mode.

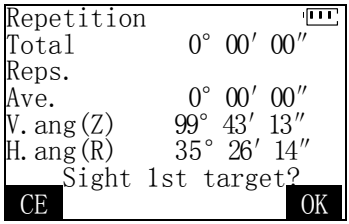


## 4.5 Horizontal angle repetition

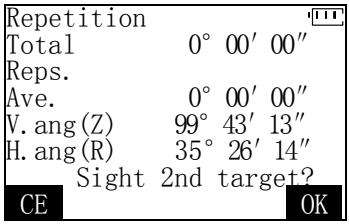
Measurement results of horizontal angles with higher accuracy can be obtained by performing repetition measurement.



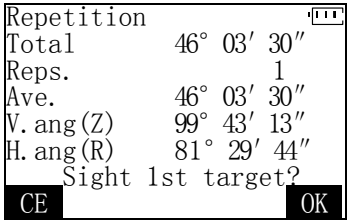

① In the third page of the Meas mode, press 【MENU】,then select "Repetition"




② Sight the first target（backsight） and press 【OK】.

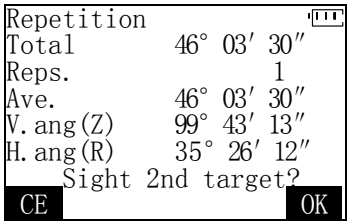



③ Sight the second target （forward sight), press【OK】. The included angle between two target points is displayed.

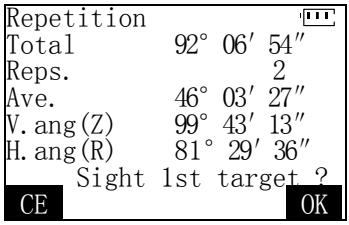



●Press【CE】to cancel the last measurement and redo it.

④ Sight the first target point again, and press【OK】。




⑤ Sight the target point 2 again, press【OK】, The added value of the horizontal angle and the average value of the horizontal angle are displayed. The times of measurement is displayed too. Repeat the step ②、 ③, and continue the measurement. When the measurement is completed, press【ESC】。




- The maximum number of angle measurements that can be made is 10.
- It is possible to perform repetition measurement by pressing【REP】when allocated to the Meas mode, please refer to “12.4 Allocating key function”

## 4.6 Outputting angle measurement data

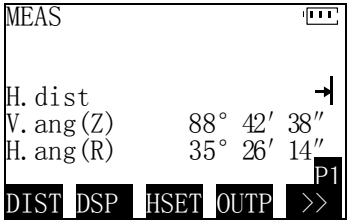
MTS1200 can output the angle measurement data to a peripheral equipment such as a computer .Before carrying out this function, you should allocate the key 【OUTP】to the measurement mode(See "12.4 Allocating key function"), and connect MTS1200 and the peripheral equipment using the serial communication cable, and set communication parameters correctly. See also "12. Setting parameters of instrument".

● **Default communications Settings** :

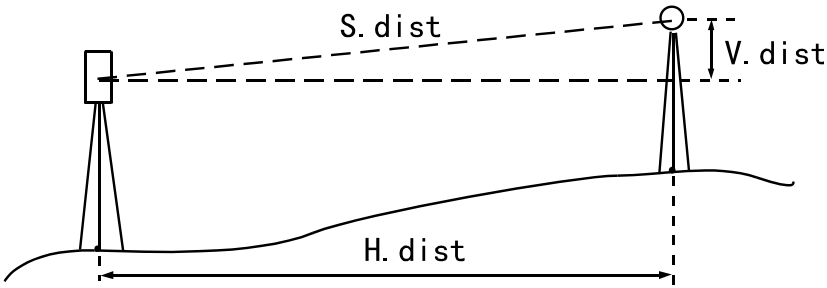
Data bits:8、Stop bits:1、parity:no、Baud rate：9600

① Sight the target point.

② Press 【OUTP】in the Meas. mode, the horizontal angle and the vertical angle data displayed on the screen are output to the peripheral equipment.



# 5. Distance measurement




## 5.1 EDM Settings

Complete the following EDM settings before the distance measurement：

- Types of cooperative target and prism constant correction value
- Distance measurement mode
- Atmospheric correction factor

**Target types and prism constant setting**

There are three types of cooperative targets for option: no cooperative target, reflector sheet and prism. Before performing distance measurement, the actual distance measuring cooperative target must be set in a correct manner. MTS1200 will automatically adjusts the intensity of the laser beam and switches the distance measurement display range to match the type of target used. if the target does not correspond to the target settings, the range and accuracy of distance measurement may be affected.

In case “Prism” is selected as cooperative target for distance measurement, the constant correction value of the prism must be set correctly. It should be noted that: different prisms and various installation methods of prisms have different prism constant correction

values. The constant for the prism equipped for the instrument is set as -30 by default.

- In case the cooperative target type is set as “Sheet” or “None”, the prism constant correction value is automatically set as 0.

**Selection of distance measurement modes**

In case the target type is set as prism or reflector sheet, MTS1200 will provides 5 kinds of distance measurement modes: Fine single measurement(Fine S), Rapid Repeat measurement(Rapid R), Tracking measurement(Tracking), Fine Repeat measurement(Fine R) and Fine Average measurement(Fine AVE).

Rapid Repeat measurement (approx. 0.8 seconds/time) and Tracking measurement (approx. 0.3 seconds/time) is suitable for survey of the movement target .In order to obtain the higher measurement precision, the Fine measuring mode should be selected (Fine Single mode has been set by default in factory). When Fine Ave mode is set, the instrument measures the distance as the setting times and the average distance will be displayed. The number of measuring times can be defined by the user.

- In case the target type is set as “None”, the corresponding distance measurement modes are: Single measurement(Single), Repeat measurement(Repeat), Tracking measurement(Tracking) and Average measurement(Average).

**Atmospheric correction factor**

To perform higher accuracy measurements, it is necessary to find the atmospheric correction factor from even more accurate temperature and pressure measurements and perform an atmospheric correction.

MTS1200 measures the distance with a beam of light, but the velocity of this light varies according to the index of refraction of light in the atmosphere. This index of refraction of light varies according to the temperature and pressure. In the normal conditions, with constant pressure, a temperature change of 1℃, or with constant temperature, a pressure change of 3.6hPa，an index change of 1ppm . This means the distance measurements will be changed 1mm for one kilometer. So in order to precisely determine the atmospheric correction factor, the average air pressure and temperature along the measurement beam route must be taken. Take care when calculating the correction factor in mountainous terrain as the difference in height will result in differences in atmospheric conditions between two points.

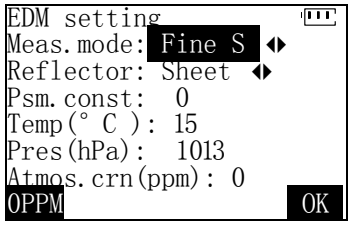
- The instrument is designed so that the correction factor is 0 ppm at an air pressure of 1013 hPa and a temperature of 15℃.
- The atmospheric correction factor (ppm) can be calculated using the following formula and stored in the instrument's memory.

$$ppm = 278.96 - \frac{0.2904 \times pressure\ (hPa)}{1+0.003661 \times temperature\ (^{\circ}C)}$$

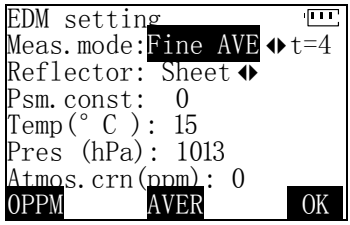
- If the weather correction is not required, set the ppm value to 0.
- The ppm data can also be entered directly.

For example, setting following distance measurement parameters: the distance measurement cooperative target is Prism, the distance measurement mode is Fine average measurement (6 times on average), the prism constant is -30 and the temperature is 25℃.

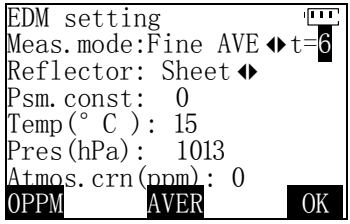
① Press 【EDM】 in the first page of Meas mode to enter the interface of distance measurement parameter setting.



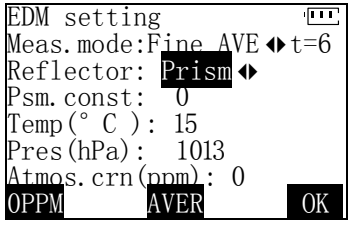

② Press 【◄】,【►】 to change the distance measurement mode into fine average measurement(Fine AVE).




③ Press 【AVER】, then input the average times for distance measurement as 6 times.




④ Press 【▼】 to move the cursor to the row of cooperative target, and press 【◄】 and【►】 to change the cooperative target into prism.



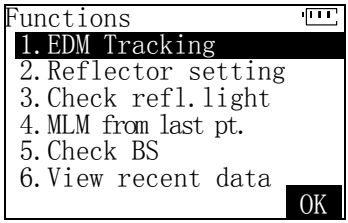
⑤ Press【▼】 to move the cursor to the row of prism constant, and input the prism constant: -30.


⑥ Press【▼】 to move the cursor to the row of temperature to input the temperature as 25°C, press【OK】, and the instrument will automatically calculate the atmosphere correction value (10 ppm) to finish the distance measurement parameter setting.


- If the atmosphere correction is not required, press [0PPM] to set the atmosphere correction value as 0ppm. In addition, the temperature is set as 15°C and the atmospheric pressure is set as 1013Pa automatically.
- When ppm value entered directly,the temperature and pressure values will be cleared.

## 5.2 Operation of hot key and user key

MTS1200 panel is equipped with a 【HOT】key which integrates some commonly-used measurement function for users to utilize these functions rapidly. One of these functions can also be individually allocated to 【USER】 key. During measurement ,user can enter the function quickly by merely pressing the 【USER】 key once. Utilizing 【HOT】 and 【USER】 key in a proper way can effectively improve working efficiency.




The 【HOT】key is equipped with following functions:

**EDM Tracking**: tracking measurement can be started immediately

**Reflector setting**: cooperative target type can be switched rapidly

**Check refl.light**: the intensity of signal reflected via cooperative targets can be inspected

**MLM from last.pt.**: the slope distance, horizontal distance and hight difference between the current measured target point and the last one can be calculated and displayed.

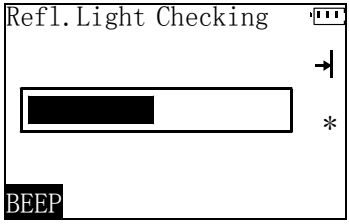
**Check BS**: backsight azimuth angle can be inspected and reset (refer to sections related to coordinate measurement)

**View recent data**: up to 10 groups of the recent measurement results stored in the internal memory of the instrument can be looked up

## 5.3 Returned light checking

The returned light checking function is used to check if sufficient reflected light is returned by the reflective prism sighted by the telescope. When the target is in a long distance, difficult to sight, this function is helpful in seeking and sight the target.

① In measurement mode, press 【HOT】key and select "Check refl.light", or directly press 【USER】key (Returned light checking is set as the default function upon delivery)




② When returned light is received, the buzzer will sound and the strength of light is displayed. If "*" is displayed, it indicates that enough light for the measurement is returned.

- Pressing【BEEP】can turn off the buzzer.

**Note:**

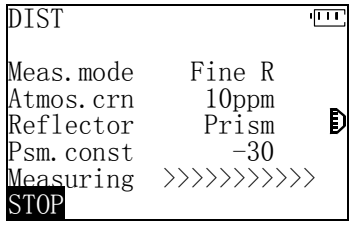
- In short distance measurement, even though the center of the reflective prism and the reticle are slightly misaligned, "*" will be also displayed, but in fact, accurate measurement is impossible. Therefore make sure that the target is sighted correctly.

## 5.4 Distance and angle measurement

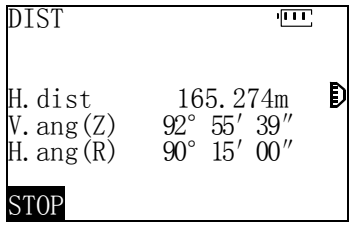
MTS1200 can measure both distance and angle data at the same time. Please get confirmation again before measuring:

- The instrument leveled and centered well.
- Battery full charged.
- Target type has been set up correctly
- The atmosphere correction and the prism constant are set correctly
- Prism center is already collimated and returned signal strength is suitable

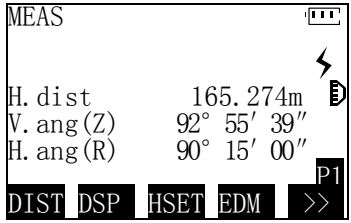
① In the first page of the Meas mode, press【DIST】. The screen displays the EDM settings, and start measuring the distance to the target.




After measurement completed, a short beep sounds, and the measured distance data, vertical angle, and horizontal angle are displayed.




② Press 【STOP】 to quit distance measurement and return to the Meas. mode. If the single measurement mode is selected, measurement automatically stops after a single measurement. During fine average measurement, the average value of the distance is displayed. and on the right side of the screen the number of the measuring times is displayed. When the measuring times reach pre-determined number, the measurement will stop automatically.




- During the measurement with prism, if the target is in a far distance (approximately over 2,000m) which is difficult to measure, the long distance measurement mode can be set. Please refer to "12. Setting parameters of instrument" for details.

## 5.5 Distance measurements display switch

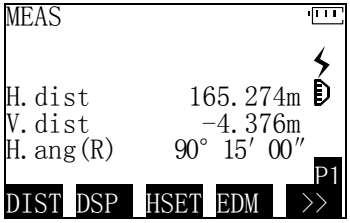
In the Meas.mode, the displayed items can be in the following three combinations.

(1) Horizontal distance, vertical angle, horizontal angle

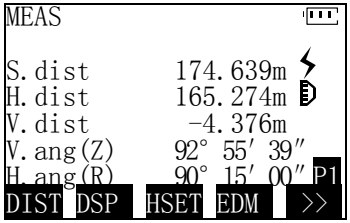
(2) Horizontal distance, height difference, horizontal angle

(3) Slope distance, horizontal distance, height difference, vertical angle, horizontal angle

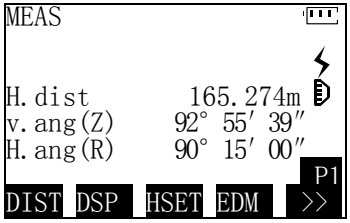
① In the first page of the Meas. mode, press【DSP】, display the horizontal distance, height difference, horizontal angle.。




② Press【DISP】again，display the slope distance, horizontal distance, height difference,vertical angle, horizontal angle.




③ Press【DISP】once again，return to the original display.




- When the instrument was shipped from the factory, the default display is the horizontal distance ,vertical angle, horizontal angle .if

the other combinations are required, please see “12. Setting parameters of instrument”

## 5.6 Output distance and angle measurement data

Distance and angle measurement data can be output to a peripheral equipment such as a computer. Before carrying out this function, you should allocate the key 【OUTP】to the measurement mode(See “12.4 Allocating key function”), and connect MTS1200 and the peripheral equipment using the serial communication cable, and set communication parameters correctly. See also “12. Setting parameters of instrument”.

① Collimate the target point and measure the distance to the point.

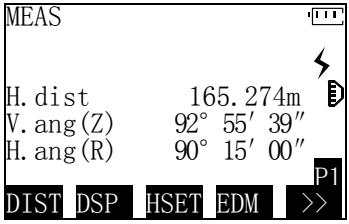
② After the measurement is finished, press 【OUTP】 to output the measurement data to peripheral equipment.

- Note: The function merely outputs data of slope distance, vertical angles and horizontal angles even other display mode is set for distance measurement.

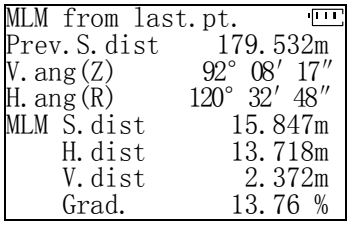
## 5.7 View the distance between the current point and the last measured point

The slope distance, horizontal distance, hight difference and gradient between the current measurement point and the last one can be calculated and displayed by using the “MLM from last pt.”function in 【HOT】key.

① Collimate the current target point and measure the distance of the target point.



② Press 【HOT】 after the measurement is finished, select"MLM from last pt." in the menu <Functions>, and the instrument will display the measurement data of the last point as well as the slope distance, horizontal distance, height difference and gradient between the current measured point and the last one.

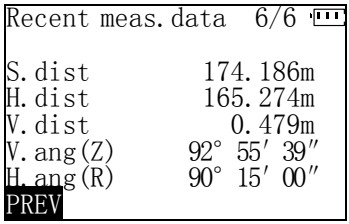



③ Press 【ESC】 to return to the previous function operation interface.

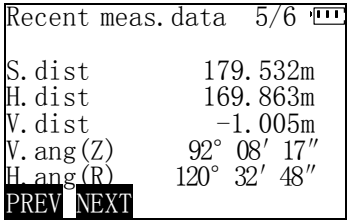
## 5.8 View recent measurement data

The measurement data of the last 10 measured points are stored in the internal memory of the instrument until the power is turned off. Looking up these distances, vertical angles, horizontal angles and coordinate values can be realized by pressing 【HOT】key.

① Press 【HOT】, select "View recent data" in the menu of <Functions>.



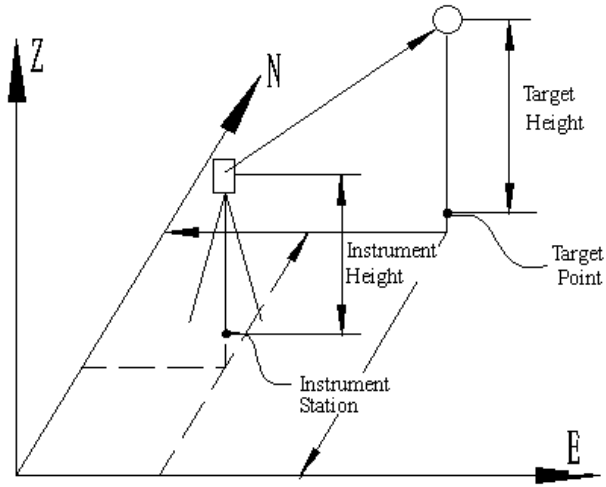

② Press【PREV】 to browse previous measurement data.




③ Press 【ESC】 to return to the previous function operation interface.

# 6. Coordinate measurement

By measuring the angle and the distance of target point, MTS1200 can get the three-dimensional coordinates of the target points (N, E, Z).

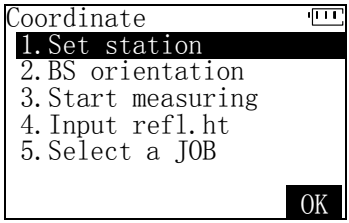



## 6.1 Station construction

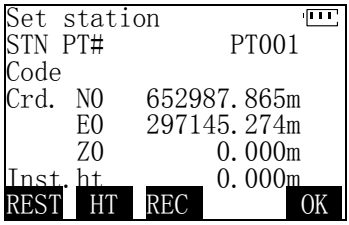
Before coordinate measurement, the coordinate system should be established at first ,by inputting the coordinates of instrument station and the direction angle of backsight point (this process call it "station construction"), if the Z coordinate of the target point need to be measured, the instrument height and the prism height should be inputted also.

### 6.1.1 Set station

① In the second page of the Meas. mode, press【COOR】.



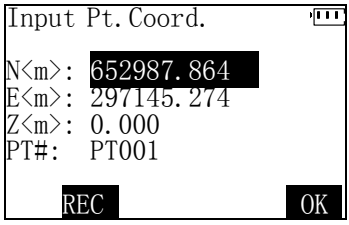

② Select "Set station" in the menu <Coordinate>.The Data of the current instrument station point and instrument height are displayed.




- Press【REC】 to store the instrument station data
- Press【HT】 to modify the instrument height

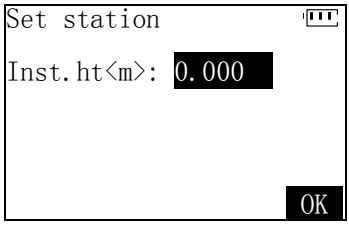
③ Press【REST】 to reset the instrument station point.


④ Press【NEZ】 to select inputting the coordinates of instrument station point directly.




- Press 【REC】 to store the input coordinate data in the instrument memory (or SD card).

⑤ Press numeric keys to input coordinate N of the point. Press 【▼】 to move the cursor to the next row and successively input coordinates E and Z of the point and finally press【OK】.




- Coordinate Z can be ignored in case only the plane coordinates of the target point are measured.

⑥ Input the instrument height, and press【OK】to finish the setting.

- Instrument height can be ignored in case only the plane coordinates of the target point are measured.
- The data of instrument station point are still stored even the instrument is switch off until next instrument station is set.

## Reading in the Coordinate Data of Previously Stored Points

The coordinate data of previously stored known points and measurement points can be read in and used as the coordinates for instrument station points, backsight points, setting-out points and so on. About memory data management, please refer to "9. Memory manager" .

Input the point number and the property of the point whose coordinate data are to be read, press 【OK】 and the system will search for the point in selected coordinate files ("Known Coord database" file by default). If the point is found, the coordinate data of the point

will be read in. Otherwise the screen will prompt whether the coordinates of the point need to be input or not.

- Point property includes:

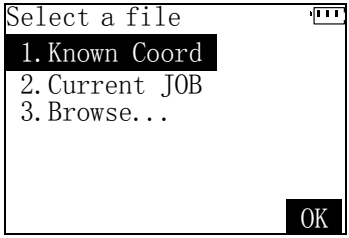
  **KNOWN**: Known coordinate points input via keyboard or communication

  **MEAS**: Points achieved by measuring coordinate data

- Selection of other coordinate files from instrument memory or SD card can be performed by pressing 【FILE】 .
- Listing coordinate points stored in coordinate files by pressing 【LIST】 to select desired coordinate points.
- Press【NEZ】to directly input coordinate data of the point.

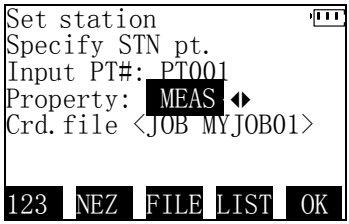
For example: utilize a measured coordinate point stored in the current JOB to set station.

① Press【FILE】when setting instrument station.

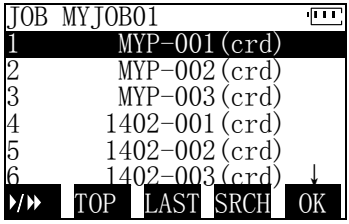



② Select "Current JOB" in the menu <Select a file>.

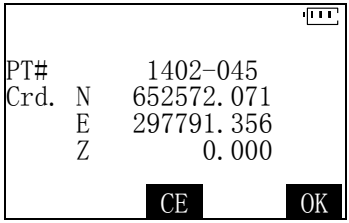
③ Press【▼】 to move the cursor to point property row and press 【◀】 and 【▶】 to change the point property to "MEAS".




④ Press【LIST】 to list the records of measurement points stored in the current JOB.




⑤ Press【▲】【▼】 to move the cursor to the desired point and press【OK】 , the screen will display the coordinate data of the point. Press 【OK】 after confirming that it is correct, and the coordinate data of the point will be read and used as the coordinates for instrument station point.



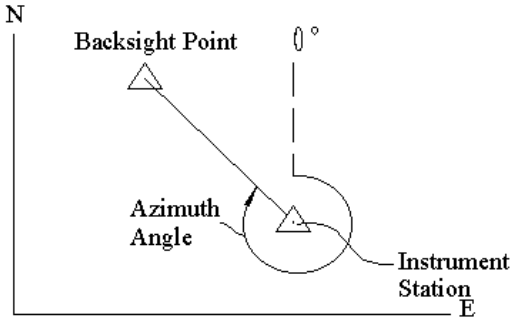

**Method of operating list:**

- Press【▲】【▼】to move the cursor up and down ;
- Press【▶/▶▶】to switch the mode in which pressing the keys 【▲】 and 【▼】 to move the cursor by rows or by pages ( will be displayed on the right side of the list);
- Press【TOP】to move the cursor to the list's beginning

- Press【LAST】to move the cursor to the list's end.
- Press【SRCH】to input the point number for searching ；
- Press【OK】to select the record where the cursor locates

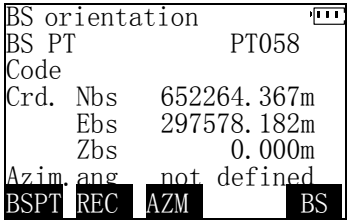
### 6.1.2 Backsight orientation

There's two method of orientation: setting azimuth angle of the backsight poin by inputting the angle value directly or by calculating from input coordinates of the backsight point



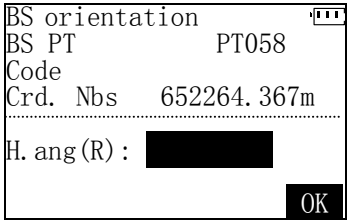

Select "BS orientation" in the <Coordinate> menu.

If backsight orientation has been performed previously, the data of the backsight point and the azimuthal angle will be displayed; otherwise the screen will display "not defined".



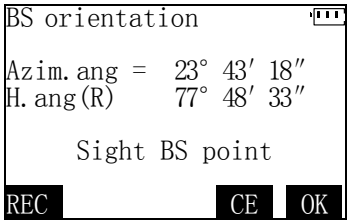
## Inputting the azimuth angle

① Press【AZM】.Input the azimuth angle and press 【OK】.



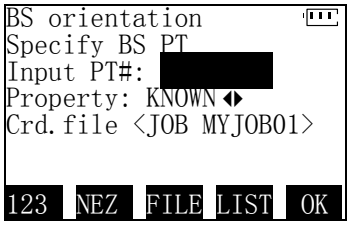

② Sight the backsight point, press 【OK】,The horizontal angle of the instrument can be set as the required azimuth.

- Pressing 【REC】can store the azimuth angle data.

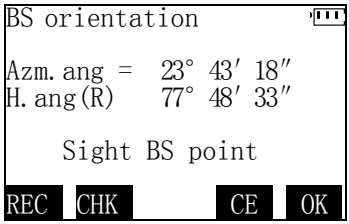



## Inputting the coordinate of backsight point

① Press【BSPT】in the screen of BS orientation.



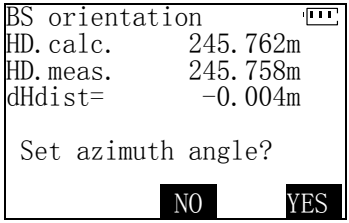

② Input the point number of the backsight point and press 【OK】 to search for and call the coordinate data previously stored or press 【NEZ】 to directly input the coordinates of the backsight point. Please refer to the last section "Set station" for detailed steps.



③ Sight the backsight point accurately，press【CHK】 to measure the backsight point.

- If no need for checking, press【OK】 directly。

④ When measurement finished，the measured distance ,the calculated distance by known coordinates of the station point and backsight point , and the difference between the two values are displayed. If the error does not exceed the range permitted,press【YES】to set the azimuth angle and finish the backsight orientation，otherwise，press【NO】to return the last step and，re-sight.

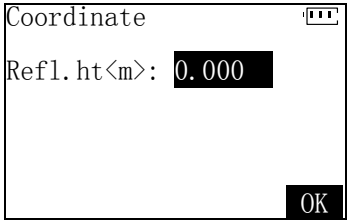



- In case the displayed distance difference is relatively large, it means that there is a mistake in setting instrument station and backsight orientation operation. **However, even the displayed distance difference is quite small, it does not mean that the above operation is completely accurate, and users should still carefully inspect all the steps for setting up a station to make sure that there is no mistake.**

### 6.1.3 Inputting the height of target

If you wish to measure the Z coordinate of the target point， the height of the target(prism or sheet) must be measured and entered.

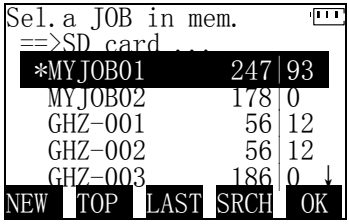
In the ＜Coordinate＞menu，select **"**Input refl.ht**"**. Input height of the target(prism or sheet) used, then press【OK】.



## 6.2 Select a JOB

Coordinate measurement data can be recorded and stored in the memory of the instrument or SD card. In case such operation is needed, first of all, a JOB should be selected for storing data.

① Select "Select a JOB" in the menu <Coordinate > to enter the JOB list in the memory of the instrument.




**Operation method of list:**

- Press【▲】 and 【▼】 keys to move the cursor up and down;
- Press【NEW】 to create a new JOB;
- Press【TOP】 to move the cursor to the beginning of the list;
- Press【LAST】 to move the cursor to the end of the list;
- Press【SRCH】 to input the JOB name to find the JOB;

② Move the cursor up and down to the desired JOB and press【OK】 to select the JOB. Unless other JOB is selected, the selected JOB is the current JOB in which the system will store all measurement data.

- In case the current JOB has been selected before entering coordinate measurement and changes are not required, then the step can be ignored.
- Please refer to “9. Memory manager” for more information about JOB management.

## 6.3 3-D coordinate measurement

The coordinate values of the target can be found by measuring the target based on the settings of the instrument station and backsight azimuth angle.

The coordinate values of the target are calculated using the following formula.

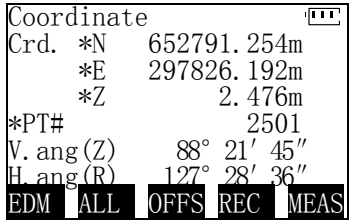
$$N1=N0+S\times\sin Z\times\cos Az$$
$$E1=E0+S\times\sin Z\times\sin Az$$
$$Z1=Z0+S\times\cos Z+ih-fh$$

N0：Station N coordinate S：Slope distance ih：Instrument height
E0：Station E coordinate Z：Zenith angle fh：Target height
Z0：Station Z coordinate Az：azimuth angle

Please get confirm again before measurement:

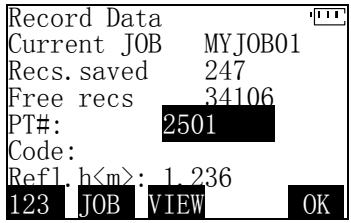
- Confirmed that the instrument leveled and centering well.
- Battery full charged.
- Target type has been correctly set
- The atmosphere correction and the prism constant has been set correctly.
- Setting up station. completed.
- Already sight the center of prism well, the strength of the returns signal being suitable for measuring.

① In the menu <Coordinate>, select "Start measuring" to start coordinate measurement. When the measurement completed,the three-dimensional coordinate values of the measured target points are displayed.



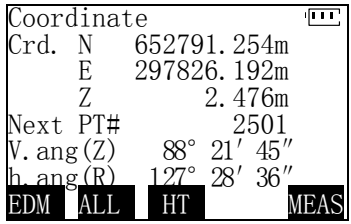

- Press【EDM】 to change distance measurement parameter setting. Please refer to "5. Distance Measurement".
- If the target point situated in which a prism cannot be installed directly or cannot be sighted, press [OFFS] to calculate the data of the target point by carrying out Offset-Measurement program. Please see "9.2 Offset-Measurement" for details.

② Press【REC】, the screen will display the name of the current JOB, the total sum of measurement data stored in the JOB and available records in the memory of the instrument.




- Press【JOB】 to reselect another JOB for storing measurement data.
- Press【VIEW】 to view the measurement data storeded in the current JOB.
- When editing code, press【READ】 to recall the code which was stored in the memory in advance.

③ Input the point number, code, instrument height and press【OK】 to record the measured coordinate data into the current JOB. Return to the coordinate measurement screen. Then sight the next target point , measure and record the coordinates of the target point according to the same procedure as above-mentioned .

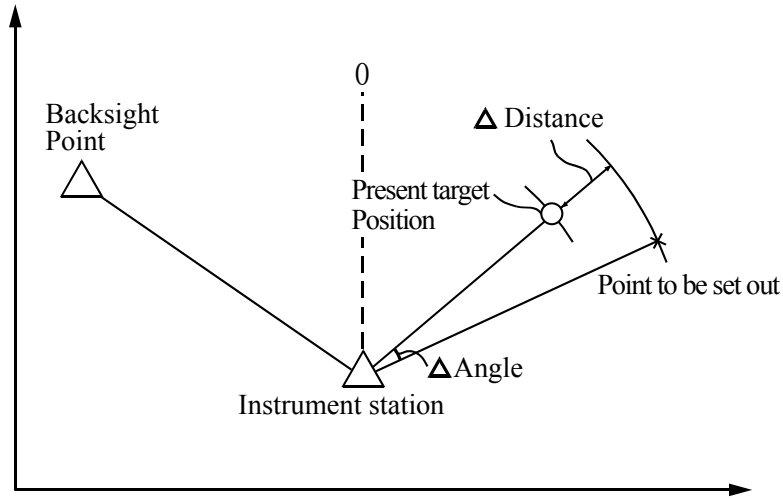



- If the cooperative target (prism or reflective sheet) height or the instrument height has been changed, press 【HT】to input again.
- If no change is necessary for next point number displayed on the screen, then press 【ALL】 key to measure the target point and automatic store the measurement results.

# 7. Coordinates Setting-out measurement

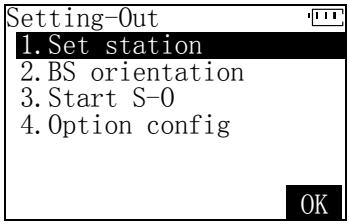
Coordinates setting-out measurement is used to set out the point whose coordinates are known. After inputting the coordinates for the point to be set out, the instrument calculates the setting-out horizontal angle, horizontal distance, and store them in the memory. By measuring the horizontal angle, distance or coordinate of the sighted point.The difference between the previously input data to the instrument (the setting-out data) and the measured value can be displayed and used to guide setting-out.

Display data=measured data-setting-out data




- To find the Z coordinate, you had better attach the target to a pole etc. with the same target height.

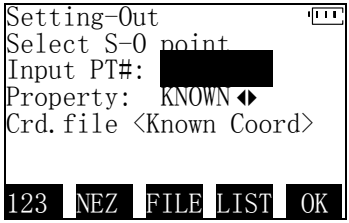
① Press【S-O】 on the second page of the Meas. mode. Enter the menu <Setting-Out >.




② Select “Set station ” in the <Setting-Out > menu, and input the coordinates of the instrument station and instrument height to finish the instrument station setting. Select “BS orientation” in the <Setting-Out > menu and set the azimuth angle of the backsight point. Please refer to “6. Coordinate Measurement” for detail steps.

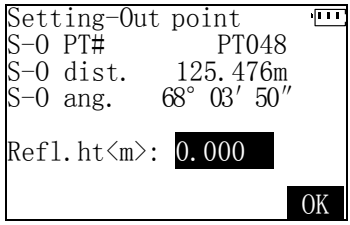
- If setting up station has been made in coordinate measurement, the step can be omitted.

③ Select “Start setting-out” in the<Setting-Out > menu. Input the number and select the property of the desired setting-out point and press 【OK】 . The coordinate data of the point will be read in. Please refer to “6. Coordinate Measurement: Reading in the Coordinate Data of Previously Stored Points”.



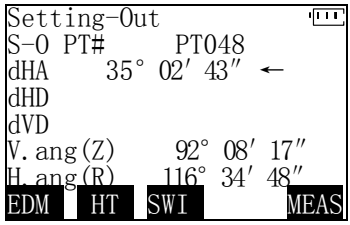

- Press【NEZ】 to directly input the coordinates of the desired setting-out point.

④ The instrument will display the setting-out distance and angle for the desired setting-out point, and it is required to input the cooperative target (prism or reflective sheet) height, measure and input the height from ground to the cooperative target and press 【OK】.




- In case only setting-out plane coordinates is needed, the prism (target) height can be ignored.

⑤ The horizontal angle difference between the sighted target and the point to be set out(dHA) is displayed. In addition, an arrow is used to indicate which direction the target should be moved.

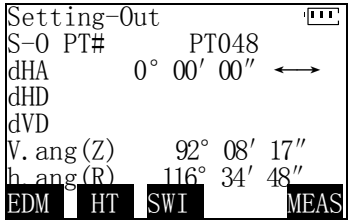



←: looking from the instrument station, move the prism leftward

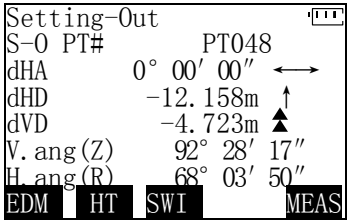
→: Looking from the instrument station, move the prism rightward

Rotate the top of the instrument until the angle difference is 0 and place the target on the sighted direction.

- In case the angle difference is within the range of ±30", the screen will display "← →".



⑥ Sight the target, press【MEAS】to start distance measurement.The horizontal distance difference between the actual measured point and the setting-out point (dHD)is displayed. In addition, an arrow is used to indicate which direction the target should be moved.

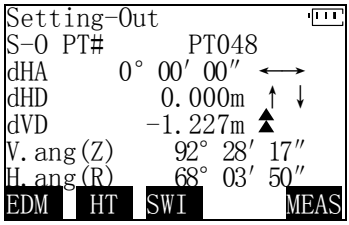



↑: Move the prism toward the direction away from the instrument station

↓: Move the prism toward the direction of the instrument station

- Press【EDM】 to change distance measurement parameter setting. Please refer to "5. Distance Measurement".
- In case repeat measurement or tracking measurement is selected for setting-out, without pressing any key ,the measurement results can be displayed in real time by sight the moving prism.
- Press 【SWI】 to check the coordinates of the current measured point and the difference between the current measured coordinates and setting-out coordinates. In case the screen is switched to display the coordinates of the measured point, it can be recorded and stored.

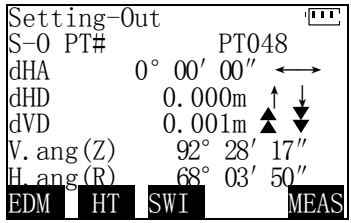
⑦ Command to move the prism forward and backward along sighted direction and measure the target distance until the distance difference is 0.




- Two arrows will be displayed on the screen in case the distance

difference is within the range of ±1cm.

⑧ Observe the height difference between the target point and desired setting-out point displayed on the third row and the arrow indicator.



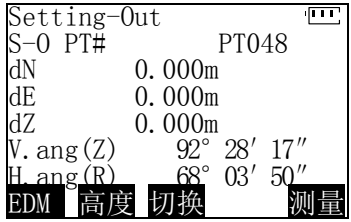

▲▲: Move the prism upward (the target point elevation is lower than setting-out elevation, which filling is needed)

▼▼: Move the prism downward (the target point elevation is higher than setting-out elevation, which excavation is needed)

Move the prism upward or downward until the displayed height difference become 0m (two arrows will be displayed on the screen when the value is close to 0m)

In case the angle difference, distance difference and height difference are all 0, the setting-out point is just located at the bottom of the pole that the prism(or reflective sheet) attached to.

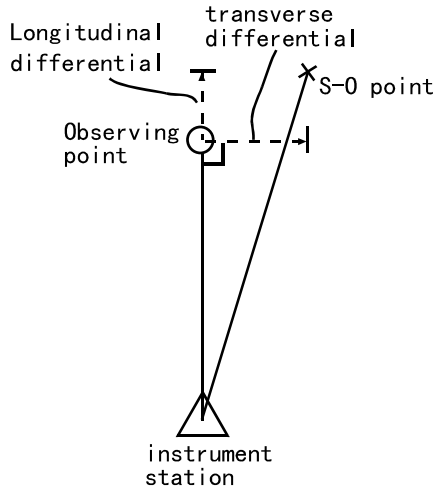
⑨ Press【SWI】 to display the coordinates difference between the measured target point and the setting-out point .



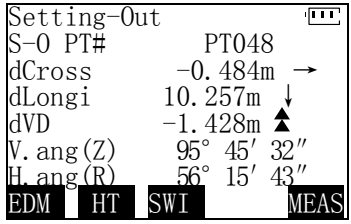

Press[ESC] to finish the setting-out the point and continue the setting-out for next point.

## Guiding Setting-out with Orthogonal Method

For guiding setting-out,MTS1200 uses polar coordinate method by default, namely displaying the angle difference and distance difference of the measured target point and setting-out point relative to the instrument station and reminding the prism holder to move it so as to determine the setting-out point. In addition, orthogonal method can also be used by MTS1200 for guiding setting-out. The introduction is as follows.




As shown above, in case orthogonal method is employed for guiding setting-out, the observation screen will display: the difference value of the measured point and setting-out point in the longitudinal and horizontal direction of a shaft of instrument station point and current measured point.

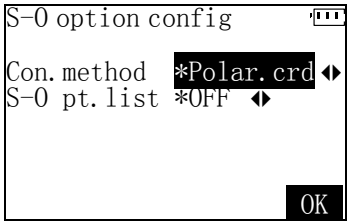



During setting-out, the observer should command the prism holder to

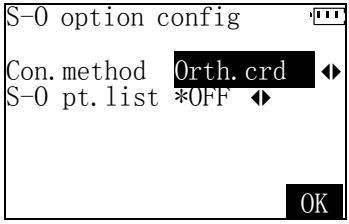
move the prism along the direction indicated by the instrument screen until the transverse difference, longitudinal difference and height difference are all 0 to finish the setting-out for the point.

Prior setting should be performed before measurement in case orthogonal method is needed for guiding setting-out.

① Select "Option config" in the menu <Setting-Out >.




② Press【◀】 and【▶】 to change the setting-out guiding method as "Orth.crd" and press【OK】 to return to the menu <Setting-Out >.




**Point Listing Setting-out**

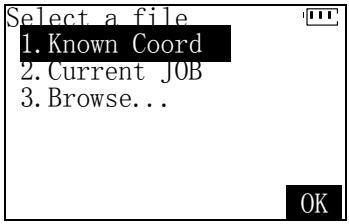
Point listing setting-out function can be activated by setting "S-O pt.list" as "ON" in the setting-out option setting.

The function refers to adding a batch of desired setting-out points related to current instrument station into a list for management. The distance range with the instrument station can be specified for the points that will be added into the list; marks can be made for the points which has been

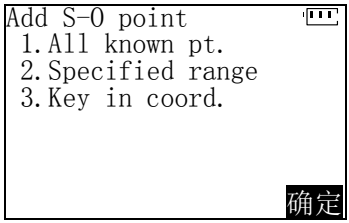
finished setting-out in the list; sorting can also be made for these setting-out points as per the principle “prism-holding moving distance is the minimum between adjacent setting-out points” to guide setting-out and improve working efficiency.

- Only known coordinate points stored in the memory are supported by point listing setting-out function, while measurement points and SD card files are not supported.
- The maximum volume of the list: 300 points

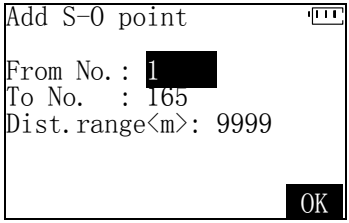
① Select “Start S-O” in the menu <Setting-Out >.



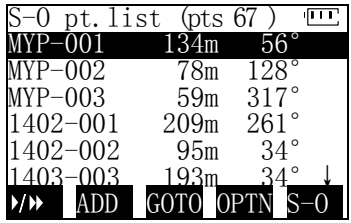

② Select one coordinate file in which desired setting-out points are stored.




③ Select “Specified range” in the menu <Add S-O point>.



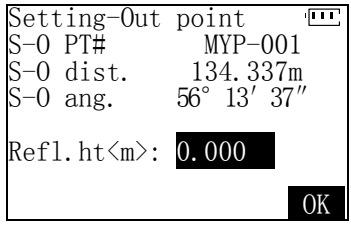
④ Input the serial number range of the setting-out points in the file as well as the limited value of distance from the setting-out points to the current instrument station and press 【OK】 . All known coordinate points in line with conditions will be listed on the screen. Listed contents include: point number, setting-out distance and setting-out angle.




**Operation method of list:**

- Press[▲] and [▼] keys to move the cursor up and down;
- Press【▶/▶▶】to switch the mode in which pressing the keys 【▲】 and 【▼】 to move the cursor by rows or by pages ( will be displayed on the right side of the list);
- Press【ADD】 to add setting-out points;
- Press【GOTO】to move the cursor to the first row or the last row or input point number to search for the known point in the list;
- Press【OPTN】 to manage the list;
- Press【S-O】 to perform coordinate setting-out.for the the known point where the cursor locates

⑤ Move the cursor to select desired setting-out point, press 【S-O】 to perform setting-out for the known point. Please refer to the above-mentioned for detailed steps of coordinate setting-out.

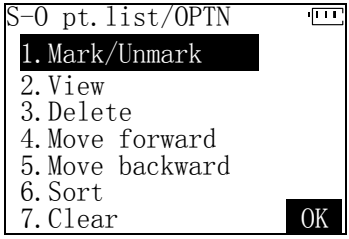


**Management of setting-out point list**

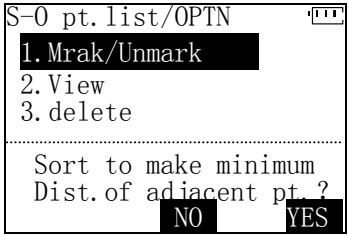
Operation such as marking, deleting, moving front and back, sorting and checking coordinate data can be performed for setting-out points in the list.

For example: sorting can be made for setting-out points as per the principle “prism-holding moving distance is the minimum between adjacent setting-out points”.

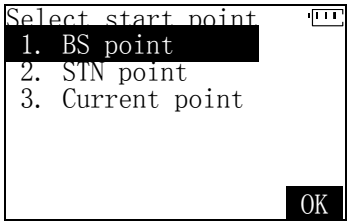
① Press 【OPTN】 in the setting-out point list to enter the menu <S-O pt.list/OPTN>.



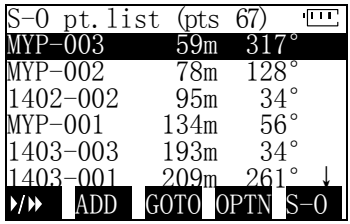

② Select “6.Sort”.




③ Press 【YES】 . The system requires selecting the start point for sorting, backsight point, instrument station point or current point.



④ After the starting point is selected, press 【OK】.The system will perform sorting for points in the list. Setting-out points will be listed as per the new order after the sorting is finished.




- Illustration of sorting principle example:

  In case there are 50 setting-out points in the list and the backsight point acts as the starting point for sorting, the system will find the point which has the shortest plane distance with the backsight point among the 50 points. In case the point is Point No.10, the point which has the shortest plane distance with Point No.10 will be found among the rest 49 points and son on to finish the sorting of all setting-out points.

- Note: the sorting basis is the straight-line distance of adjacent points calculated based on the horizontal coordinates of points and landform or terrain conditions of all setting-out points are not taken into consideration. The sorting results are only for reference during setting-out.

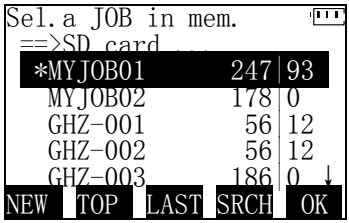
# 8.Data Recording

Press 【REC】 on the second page of the Meas mode to store distance and angle measurement data in the internal memory of the instrument or external SD card. Recorded data include slope distance, vertical angle, horizontal angle, point number, character code and the target height.

## 8.1 Select a JOB for recording data

Before starting measurement and recording data, a JOB should be selected.

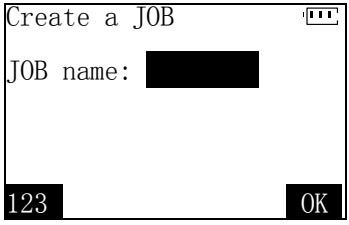
① Press 【REC】 on the second page of the Meas mode to enter JOB list in the internal memory of the instrument.



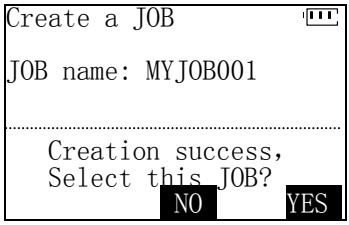

**Operation method of listing:**

- Press【▲】 and 【▼】 keys to move the cursor up and down;
- Press【NEW】 to create a new JOB;
- Press【TOP】 to move the cursor to the beginning of the list;
- Press【LAST】 to move the cursor to the end of the list;
- Press【SRCH】 to input the JOB name to search for the JOB;

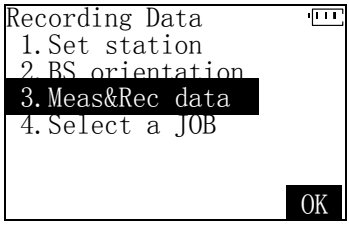
② Select a JOB or create a new JOB. Take creating a new JOB as an example: press【NEW】in the JOB list.



③ Input JOB name and press 【OK】 to create a new JOB.



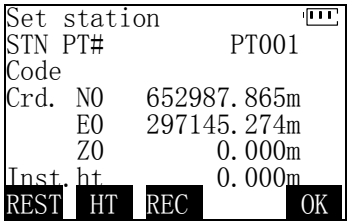

④ Press 【Yes】 to confirm selecting the JOB as current JOB and enter the menu <Recording Data>.



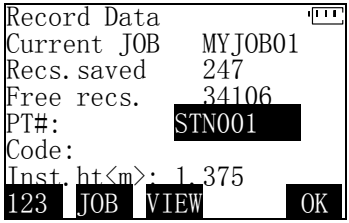

## 8.2 Set instrument station and record the station data

① Seclect "Station data" in the menu <Recording Data> .The screen will display the data of the current instrument station.

Press【REST】 to reset the instrument station. Please refer to "6.1.1 Set station".




② After the instrument station setting is finished, press 【REC】 and the screen will display the current JOB, the total sum of measurement data stored in the JOB and available records in the internal memory of the instrument.

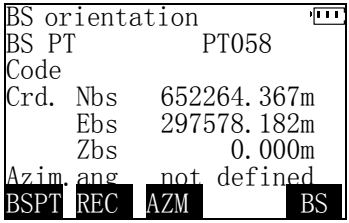


- Press【JOB】 to reselect JOB for storing the data.
- Press【VIEW】to look up the measurement data recorded in the current JOB.
- In case the edit box is located in the character code row, press 【READ】 to call the character code which was stored in the internal memory in advance.

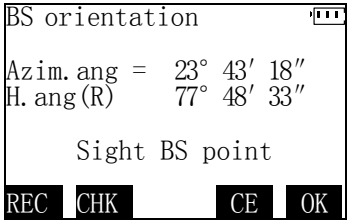
③ Input the point number, character code, instrument height and press 【OK】to record the data of the instrument station into the current JOB.

## 8.3 Orientate station by backsight and record the BS data

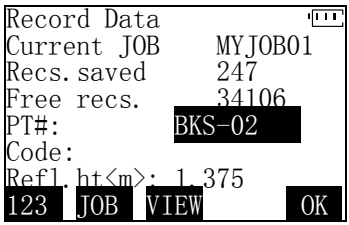
① Select "2. BS orientation" in the menu <Recording Data>



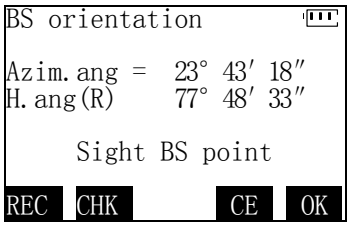

② After pressing【OK】 to input backsight point coordinates or pressing 【AZM】to input backsight azimuth angle, the instrument will prompt the user to sight the backsight point. Please refer to "6.1.2 Backsight orientation" for detailed steps.



③ Sight the backsight point well, press【REC】.



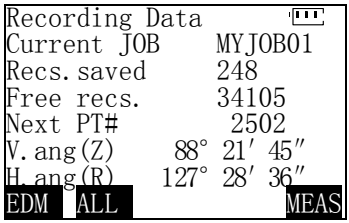

④ Input point number, character code, and target height，press【OK】 to store the BS data into memory.




⑤ Press 【OK】to finish backsight orientation and exit .

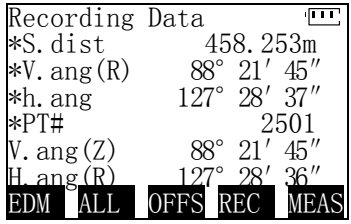
## 8.4 Measure target and record measurement data

① Select “Meas&Rec data” in the menu <Recording Data>. The screen will display the current JOB, the total sum of measurement data stored in the JOB and available records in the internal memory of the instrument.



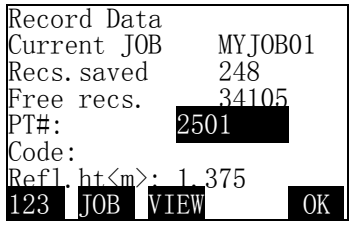

- Press【EDM】 to modify distance measurement parameter setting. Please refer to “5. Distance Measurement”.

② Sight the target and press 【MEAS】 to start measuring. After the measurement is completed, the measurement results of the target point are displayed.




- If the target point situated in which a prism cannot be installed or cannot be sighted directly , after measurement completed, press【OFFS】to enter the Offset-Measurement function to calculate data of the target point. Please see "11.2 Offset-Measurement".

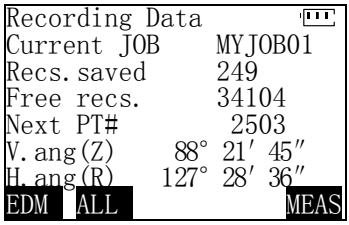
③ Press【REC】 to record measured data marked with"*".




④ Input point number, character code, prism height step by step, press【OK】to store the measurement data into the current JOB.

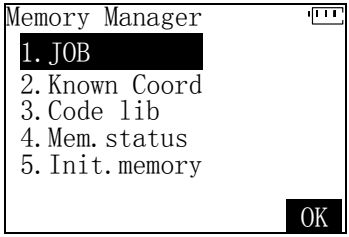
- Press【JOB】 to reselect another JOB for storing measurement data.
- Press【VIEW】 to view the measurement data storeded in the current JOB
- In case the edit box is located in the character code row, press 【READ】 to call the character code which was stored in the internal memory in advance.

⑤ Keep on measuring next point..



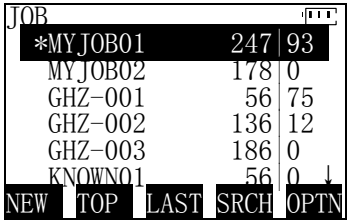

- Press【ALL】 to perform measurement and automatically record the results. In this case, the point number is the last point number add one(as displayed on the screen), the code and prism height remain the same. When the measurement results recording finished, the results will be displayed for two seconds, then the screen of last step is restored

# 9.Memory Manager




Press 【MEM】 in status screen to enter memory mode. In this mode, operations of JOB and relevant data in internal memory can be performed. These operations include looking up the contents of JOBs, renaming JOBs, deleting JOBs and records, inputting known coordinate data, looking up or deleting the coordinate data of known points and inputting character code to internal memory in advance for future calling,etc.

## 9.1 JOB manager




Select “JOB” in the menu <Memory Manager>, the list of JOBs stored in the memory is displayed on the screen, including JOB name, the number of measurement data and known coordinate data has been stored in the JOB.

- The JOB marked with“*” is the current JOB selected to store measurement data.

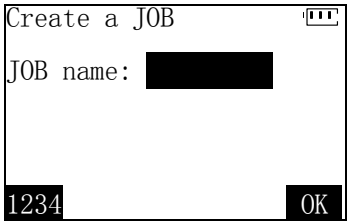
Method of operate JOB list：

- Press【▲】【▼】key to move cursor up and down;
- Press【NEW】to create a new JIB in the internal memory.
- Press【TOP】 to move cursor to the beginning of the list.
- Press【LAST】to move cursor to the end of the list.
- Press【SRCH】to input JOB name to find the JOB.

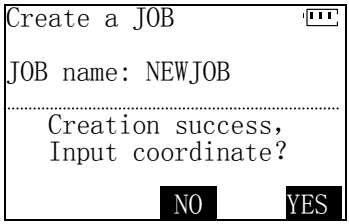
- Press【OPTN】 to enter the menu of JOB manager option.

### 9.1.1 Create a new JOB

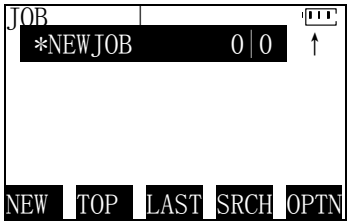
① Press【NEW】 in the list of JOB.




② Press【OK】 after the JOB name is input.



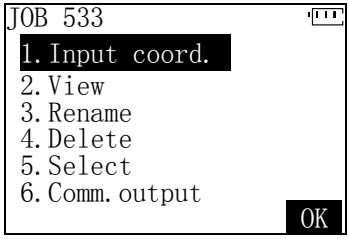

③ After the new JOB is successfully created, the instrument will remind the user whether to input known coordinates to the new JOB immediately. If the operation is not needed, press 【NO】 to return to the list of JOB.



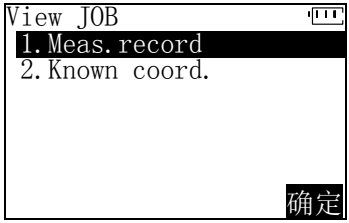

### 9.1.2 View and delete records in JOB

Data of measurement points and coordinate data of known points are separately stored in the internal memory JOB, and they can be viewed separately; in addition, the data that are not needed can also be deleted.

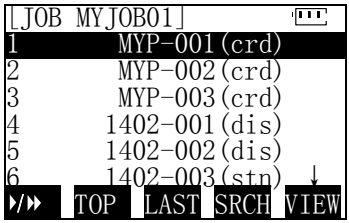
① In the list of JOB, press【▲】 and 【▼】 keys to move the cursor to the desired JOB and press 【OPTN】 to enter the option menu of the JOB.




② Select “View” in the menu.



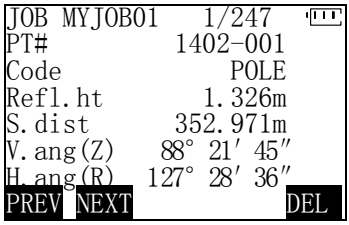

③ Select “Meas.record”. The screen will list the record of measurement points stored in the JOB. The type of the record is indicated in brackets.




Method of operate file list：

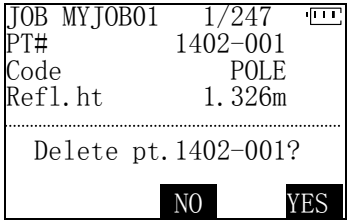
- Press【▲】【▼】to move the cursor up and down ;
- Press【▶/▶▶】to switch the mode in which pressing the keys 【▲】 and 【▼】 to move the cursor by rows or by pages ( will be displayed on the right side of the list);
- Press【TOP】to move the cursor to the list's beginning
- Press【LAST】to move the cursor to the list’s end.
- Press【SRCH】to input the point number for searching ；
- Press【VIEW】to see details of the record where the cursor locates

④ Move cursor to the desired point, press【VIEW】 to display details of the point.




- Press【PREV】 to display previous point record.
- Press【NEXT】 to display next point record.

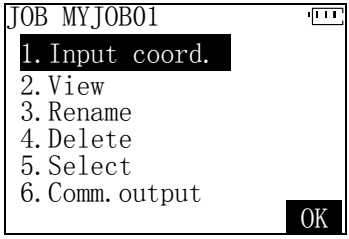
⑤ Press 【DEL】. Deletion confirmation is displayed.



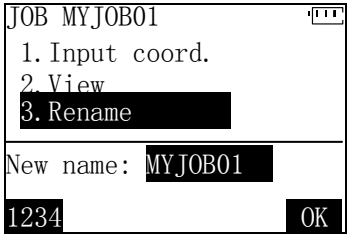

- Press【YES】 to delete the point and return back to list of points.
- Press【NO】to cancel the deletion and return back to the screen of viewing details of the point.

### 9.1.3 Rename a JOB

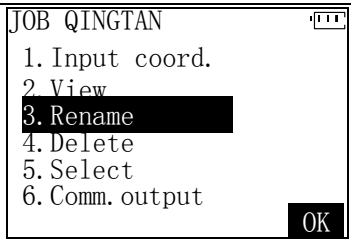
① Press【▲】【▼】 to move cursor to the desired JOB and press【OPTN】 to enter JOB option menu.




② Select “Rename”.

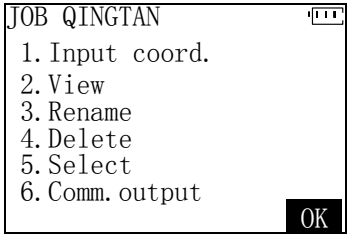


③ Input new name of the JOB then press【OK】.



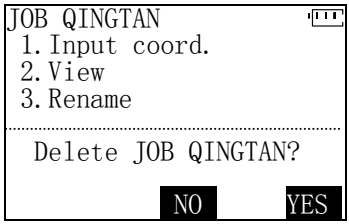

### 9.1.3 Delete a JOB

① Press【▲】【▼】 to move cursor to the JOB that you want to delete in JOB list, press【OPTN】 to enter JOB option menu.




② Select "delete".Deletion confirmation is displayed.

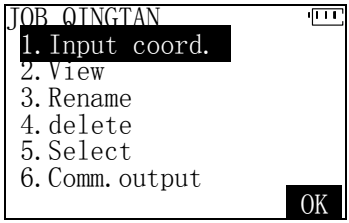
- Press【YES】 to delete the JOB and return to JOB list.
- Press【NO】 to cancel the deletion and return to JOB list.




### 9.1.4 Select a JOB

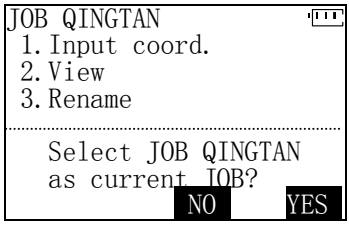
In memory JOB management, the current JOB used for recording measurement data can be selected in advance.

① Press【▲】【▼】 to move cursor to the desired JOB and press【OPTN】 to enter JOB option menu.




② Select“Select”.

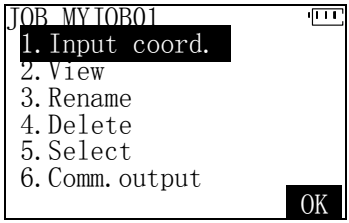
③ Press【YES】to select this JOB, then return to list of JOB.



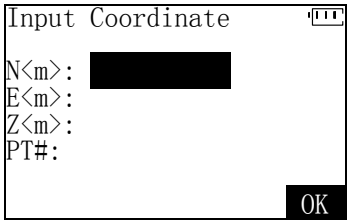

### 9.1.5 Input known coordinates into JOB

Not only measurement data can be stored in JOB, but also known coordinate data can also be directly input into JOB for calling by measurement tasks.

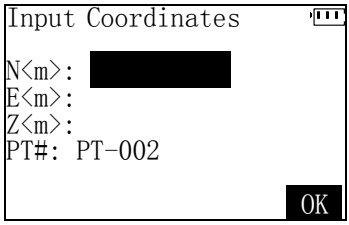
① Press【▲】【▼】 to move cursor to the JOB in which you want to input data , press【OPTN】 to enter JOB option menu.



② Select “Input coord.”.




③ Successively input the numerical values of coordinates N, E, Z and point number. After inputting one item, press 【▼】 key to enter the next item. After inputting all the items, press 【OK】 to store the coordinates of known points into the JOB. After the screen displaying “Data recorded” for a short period, the point number will automatically add 1 to continue inputting the next known point.



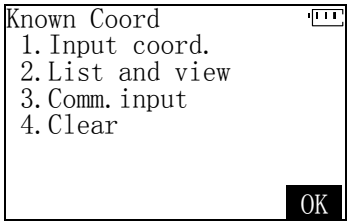

④ After inputting the coordinates of all known points, press 【ESC】 to return to the option menu of the JOB.

## 9.2 Management of the Known Coord database

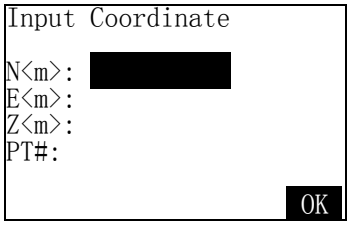
The Known Coord database can be used for storing the coordinate data of some frequently used control points or instrument station points for calling by users in different measurement tasks. The difference between it and common JOB is: it can be merely used for storing known coordinate data instead of storing measurement data. Coordinate data in the known coordinate database can be manually input via the keyboard of the instrument or input through communication with a computer.

### 9.2.1 Input the coordinate data of known point

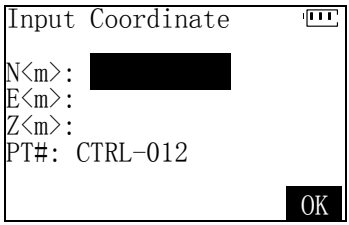
① Select “Known Coord” in the menu <Memory Manager> to enter the menu < Known Coord >.




② Select “Input coord.”.




③ Input the coordinates and the point number of known point. After input each item. Press【 ▼ 】 to input the next item.When each data item is finished，press【OK】 to store the data in the memory. Screen briefly displays "Data recorded." ,the the point number adds one automatically , keep on



inputting the coordinates of the next point .

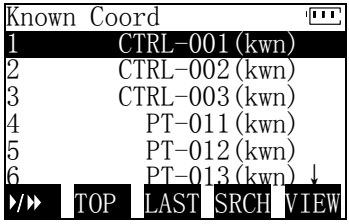
④ Repeat the steps above to input coordinate data of all known points. Press【ESC】to finish input and return to the <Known Coord> menu.

### 9.2.2 Review and delete known point coordinate data

All the known coordinate data stored in the Known Coord database can be reviewed and the data no more needed can be deleted.

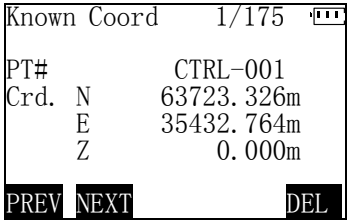
① Seclet"List and view"in the menu <Known Coord> , The known coordinate data list is displayed.

- List operation see "9.1.2 View and delete records in JOB".




② Move cursor to the record to be viewed，Press【VIEW】 to display the contents of the record。

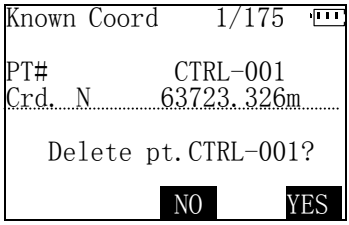
- Press【PREV】 to display previous point record.




- Press【NEXT】 to display next point record

③ Press 【DEL】.Deletion confirmation is displayed.

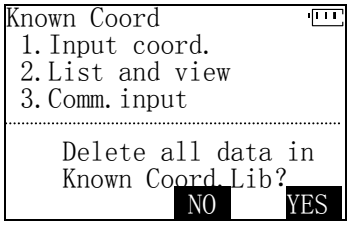
- Press 【NO】to abort the operation and return to the previous screen.
- Press【YES】to confirm deletion of the known point and return to the known point list screen.



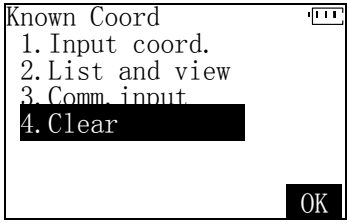

### 9.2.3 Delete all the known coordinate data

This operation will delete all the known points record in the Known Coord database.

① Select “Clear” in the <Known Coord>menu，deletion confirmation is viewed.

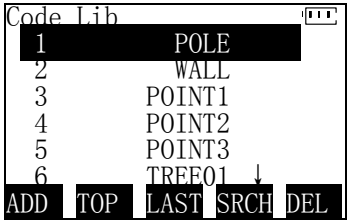



② Press 【YES】 to delete all the known coordinate data and returns the < Known Coord > menu.



## 9.3 Management of the character code library

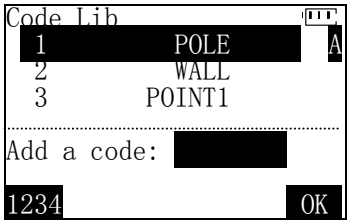
Character code library is used to store character code which often be used.When recording measurement data or station data, the pre-stored character code in the library can be called.



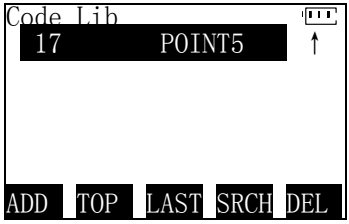

Select “Code Lib” in the menu <Memory Manager> to enter the character code library of the internal memory to perform operations such as inputting, deleting and viewing codes in the characte code library.

### 9.3.1 Add character codes

① Press【ADD】 in the list of the characte code library.

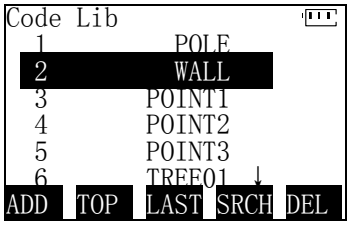



② Input character code then press【OK】, the character is added to the character code library.

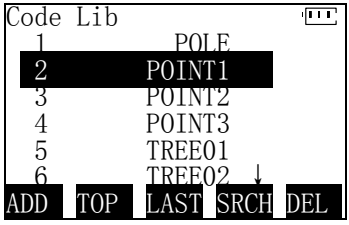


### 9.3.2 Delete character codes

① Press [▲] and[▼] keys in the list of the character code library to move the cursor to the code that needs to be deleted and press 【DEL】.



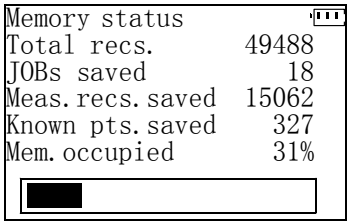

② Delete the character code in the list of the character code library.



## 9.4 Display status of memory

Select “Memory status”, current status of the internal memory will display on the screen.

- The progress bar shows the status of of the memory is occupied.

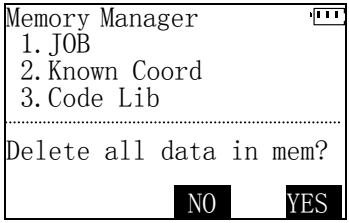



## 9.5 Initialize memory

Operation of initializing memory will delete all data in memory include all JOBs, Known Coord database and character code library, and set the memory as factory default. Please take care to use this function to avoid loss of useful data.

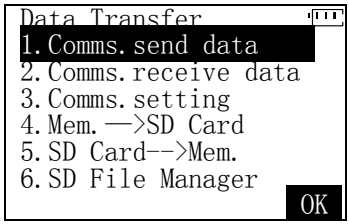
① Select “Init. memory” in<Memory Manager> menu，deletion confirmation is displayed..

② Press【YES】 to delete all data in memory and initialize memory.



# 10. Data Transfer

Press【TRNS】in status screen to enter data transfer mode. In this mode, measurement data stored in the internal memory or SD card can be transferred to a computer via data communication, and coordinate data can be transferred to the internal memory or SD card from a computer. In addition, data can be exchanged between the internal memory of the instrument and SD card.

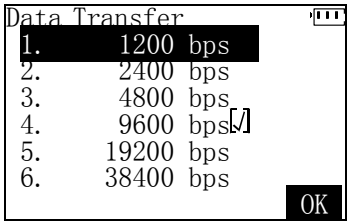



## 10.1 Settings of communication

- MTS1200 serial communication protocol: 8 databits , 1 stopbits ,none parity, baud rate 1200、2400、4800、9600、19200 bps optional (default 9600 bps).
- Before starting communication with PC, please insure the parameters of communication of each other are set correctly and the same, otherwise the communication will be failed.

Following steps below, the communication baud rate can be changed.

① Select “Comms. setting” in the <Data Transfer> menu.




② Press [▼] key to move the cursor to the desired baud rate and press [Ok] to finish the setting and return.

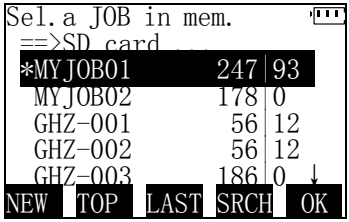
- The baud rate can be set in parameter setting mode also, please see

"12.Setting parameters of instrument"

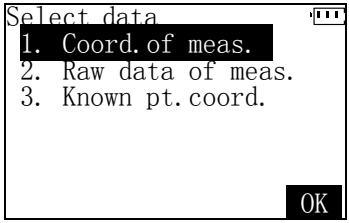
## 10.2 Send JOB data

① Use communication cable to connect PC and MTS1200, run the total station communication program on PC, click 【COMMUNICATION】, 【RECEIVE】, set the parameter of communication correctly, then click【OK】.

② Select "Comms. send data" in the <Data Transfer> menu.



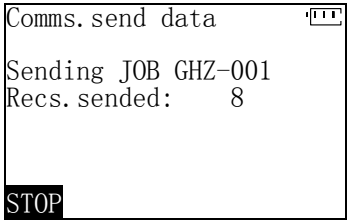

③ Press【▲】【▼】to move cursor to the JOB that you want to send, press 【OK】to select the JOB. It needs selecting data type and format for output.



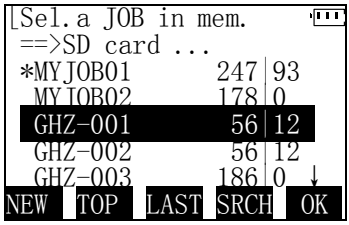

- Coord. of meas.: Convert measurement point coordinate data, station data stored in JOB to simple format (point number, character code, N, E, Z) for output.
- Raw data of meas.: All raw measurement data stored in memory.
- Known pt. coord: Coordinates of known point(simple format).

④ Press 【▲】 【▼】 key to select the data type and output format.Press【OK】, instrument begin sending the JOB data to PC.

- Press【STOP】 to stop sending.



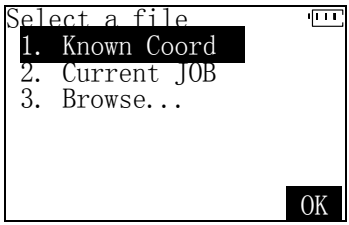

⑤ After sending finished, the screen of the JOB list is restored. You can select and send next JOB.



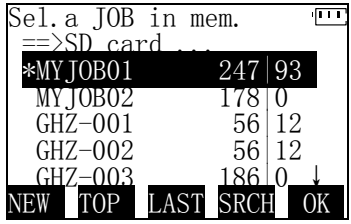

## 10.3 Receive known point coordinate data

① Connect PC and MTS1200 by cable, run total station communication program on PC, edit coordinate data, then click 【COMMUNICATION】,【SEND】, set parameter of communication, then click【OK】.

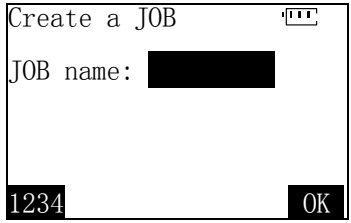
② Select “Comms.receive data” in the <Data Transfer> menu to enter < Select a file > menu.



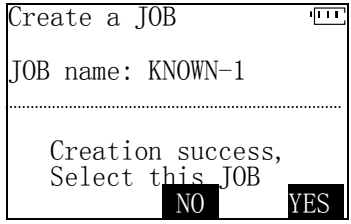
③ e.g. Select creating a new JOB used to receive known coordinate data. Select "Browse…" in the < Select a file > menu." to enter the JOB list in memory.



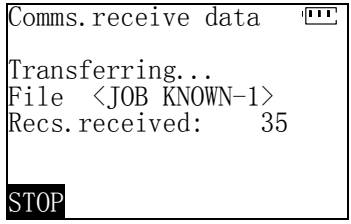

④ Press【NEW】.




⑤ Input JOB name, then press【OK】, new JOB will be created. Instrument prompts whether to select this JOB as the receiving file.



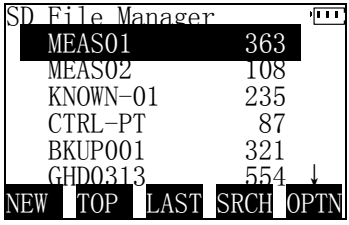

⑥ Press【OK】, to start receiving data from PC. The number after "Recs. received" means amount of data received




- Press【STOP】 to stop the transferring

## 10.4 SD card file management

Select “SD file manager” in the menu <Data Transfer>, the screen will display the list of Total Station Record files (TSR) in the SD card. The listed contents include file names, numbers of TSR stored in the file.

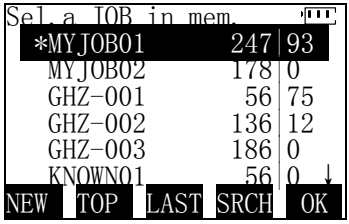



SD card file management includes creating new files, looking up file contents, renaming files, deleting files and records, inputting known coordinate data and so on. The specific operating steps are mostly the same as those for internal memory JOB management, please refer to “9.3 JOB manager” for details about it that will not be repeated here.

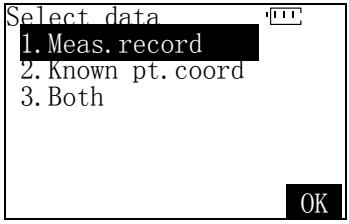
## 10.5 Data transfer: internal memory → SD card

Measurement point records and known coordinate data stored in the JOB of internal memory can be exported to Total Station Record files (TSR) of SD card.

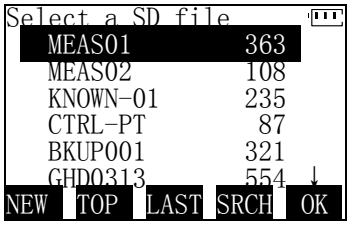
① Select “Mem.-->SD card” in the menu <Data Transfer> to enter the list of JOBs in internal memory.



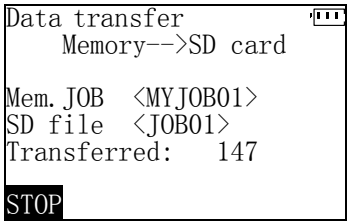

② Press【▲】and【▼】keys to move the cursor to the JOB which its data need to be exported and press【Ok】 to select the JOB. The instrument requires selecting data type.



③ Press 【▲】 and 【▼】 keys to select data type and press [Ok] to enter the list of files in the SD card.




④ Press【▲】 and 【▼】 keys to move the cursor to the file that is used to receive data and press【OK】 to select it. Data transferring is started.



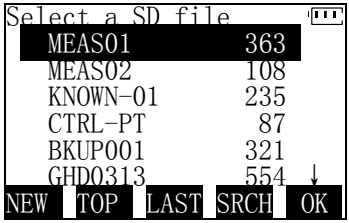

- Press 【STOP】 to stop the transferring.

⑤ Return to the list of JOBs in internal memory after the transferring is finished.

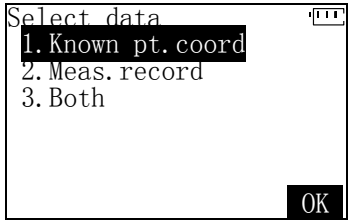
## 10.6 Data transfer: SD card → internal memory

Data stored in the Total Station Record files of SD card can also be exported to a JOB of the internal memory of instrument.

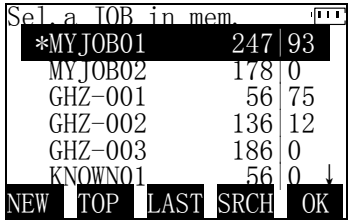
① Select “SD card->Mem.” in the menu <Data Transfer> to enter the list of Total Station Record files (TSR) in SD card.



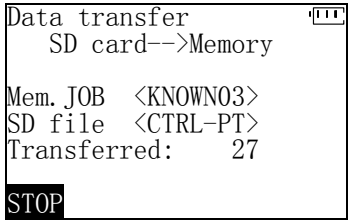
② Press【▲】 and 【▼ 】 keys to move cursor to the file which its data need to be exported and press【Ok】 to select the file. The instrument requires selecting data type.




③ Press 【▲】 and 【▼】keys to select data type and press [Ok] to enter the list of JOBs in internal memory.




④ Press【▲】 and 【▼】 keys to move cursor to the JOB that is used to receive data and press【OK】 to select it. Data transferring is started.




- Press【STOP】 to stop the transferring.

⑤ Return to the list of files in SD card after the transferring is finished.

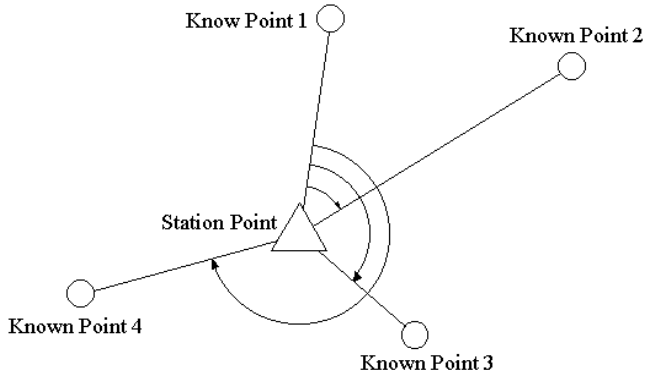
# 11. Application Program

Besides commonly-used basic measurement functions (angle measurement, distance measurement), MTS1200 is also equipped with application programs such as coordinate measurement, setting-out measurement, resection, offset measurement, missing line measurement(MLM), remote elevation measurement(REM), area caclculation, straight line setting-out, arc setting-out, road setting-out and so on to adapt to various measurement tasks. Coordinate measurement and setting-out measurement have been described in previous chapters and sections. The following will introduce the functions and operating steps for other application programs.

## 11.1 Resection measurement

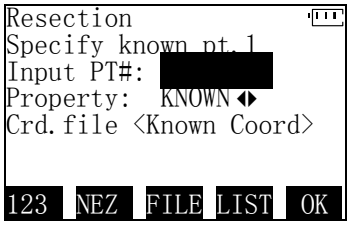
When the coordinate of station point is unknown，MTS1200 can calculate the instrument station coordinate by measuring 2 to 10 known points.

When the measured point more than 2 points, the N,E coordinates of the instrument station are found using the method of least squares. Therefore the more known points are measured, the higher the calculation precision can be got.

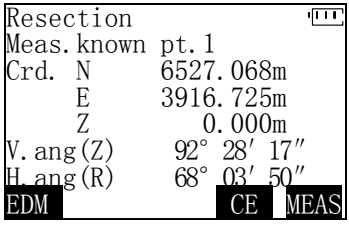


### 11.1.1 Calculating station coordinate by measuring 2 known point

① Press【RESE】 in the third page of the Meas.mode to enter resection measurement program.

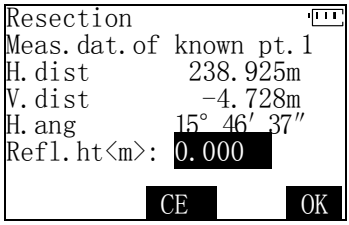



② Input the point number and select property of the known point 1 and press 【OK】, the coordinate data of the point will be read in. Please refer to "6. Coordinate Measurement: Reading in the Coordinate Data of Previously Stored Points".

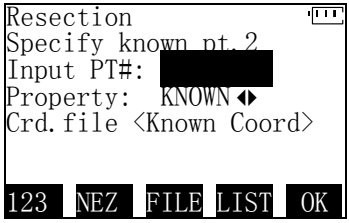



- Press[NEZ] to directly input the coordinates of the known point 1.

③ Accurate aim at the known point 1 and press【MEAS】, the instrument will start measuring the distance value and angle value of the known point 1. Measurement results will be displayed after the measurement is finished.



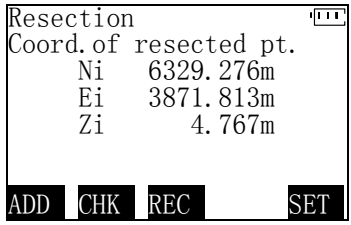

④ In case the data are wrong, press 【CE】to re-observe the known point 1, otherwise press 【OK】 after inputting the cooperative target (prism) height.



- If only plane coordinate resection measurement is performed, the target height can be ignored.

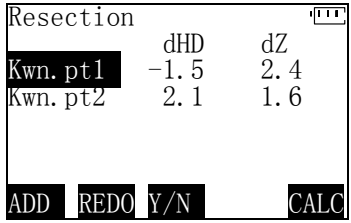
⑤ Repeat above steps to finish the inputting and observation for the known point 2.

⑥ The screen will display the resection point coordinate calculation results after two known points are input and measured.




- Press 【 REC 】 to store the calculation results as instrument station coordinate record.
- Press【SET】to accept the resection results as the instrument station coordinate and set the station.

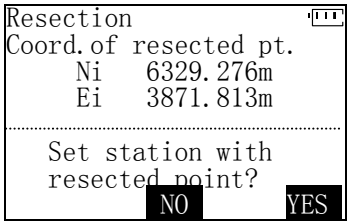
⑦ Press 【 CHK 】,the screen will display the difference of the calculated distance and actual measured distance between the known point and resection point (dHD) and the difference of calculated elevation and actual measured elevation of the known point (dZ), unit:mm. The difference values reflect the accuracy of resection measurement results.



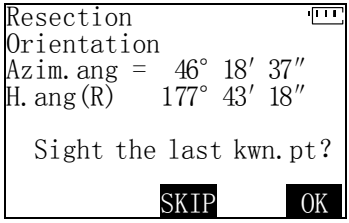

- If the difference value exceed ±100mm, "?????" will be displayed.
- Press【▲】【▼】to move the cursor and select the known point.
- Press 【ADD】to add a known point for resection.
- Press 【REDO】to reenter or re-observe the known point selected.
- Press 【CALC】to start calculations
- Press 【Y/N】 abandon known points indicated by the cursor, this

known point will not participate in calculation,press again to restore selected.

⑧ If the resection point coordinate is used for setting an instrument station, press 【SET】 when the intersection point coordinate is displayed, and the program will remind the user to confirm it.

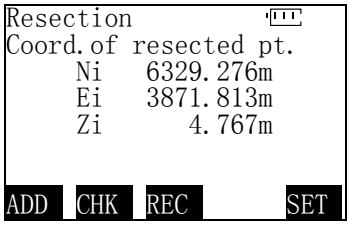



⑨ Press【YES】 to set the instrument station coordinate. The program will remind the user whether to use the last known point as the backsight point to set the azimuth angle and orientate the instrument station.



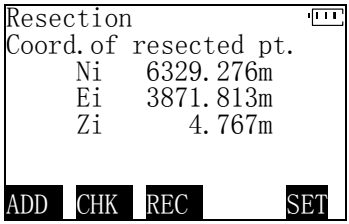

- Press【SKIP】 to omit the step and return.

⑩ Sight the last known point，press 【OK】to set the azimuth angle and return.

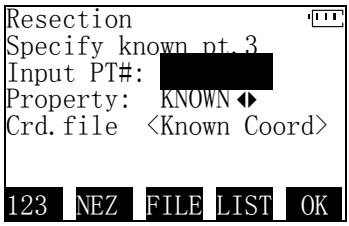


### 11.1.2 Calculating station coordinate by measuring multiple known point

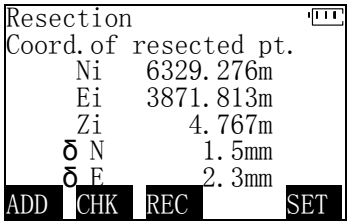
① According to"11.1.1 Calculating the station coordinate by measuring 2 known point"，input and measure two known point, and then screen shows the results of the resection point coordinate calculation results.




② Press【ADD】to input and measure the other points in the same way as described above.




③ Finish the inputting and measurement for all known points as per the description of steps ②-⑤ in "11.1.1 Calculating the station coordinate by measuring 2 known point". The screen will display the results obtained with least square method adjustment and standard deviation.




## Caution:

In some cases it is impossible to calculate the coordinates of an unknown point if the unknown point and three or more known points are arranged on the edge of a single circle. If it occured, Try to take one of the following：

a) Move the instrument station as close as possible to the center

of the triangle.

b) Observe one more known point that is not on the circle.

In some cases it is impossible to calculate the coordinates of the instrument station if the included angle between the known points is too small. It is difficult to imagine that the longer the distance between the instrument station and the known points, the narrower the included angle between the known points. Be careful because the points can easily be aligned on the edge of a single circle.

## 11.2 Offset measurement

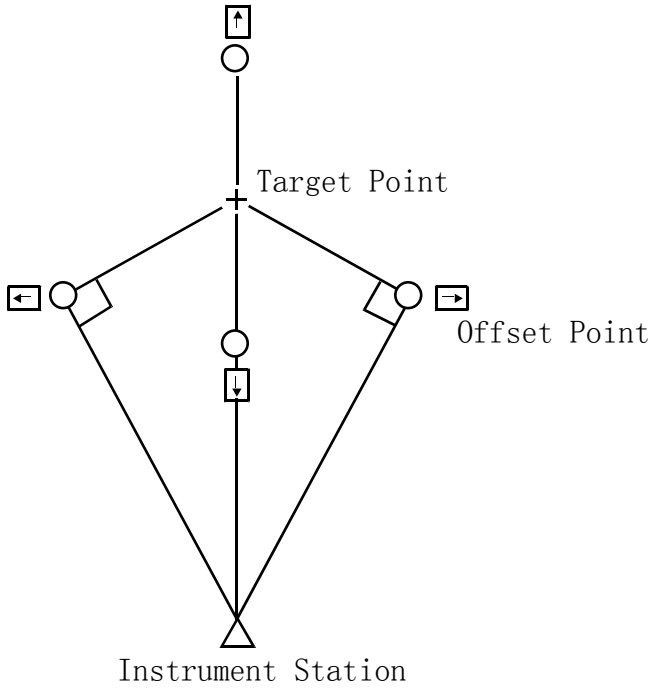
Offset measurements are performed in order to find a point where a target cannot be installed directly or to find the distance and angle to a point which cannot be sighted.

It is possible to find the distance and angle to a point you wish to measure by installing the target at a location a little distance from the target point and measuring the distance and angle from the surveying point to the offset point.

There are two measuring methods: distance offset and angle offset.

### 11.2.1 Distance offset measurement

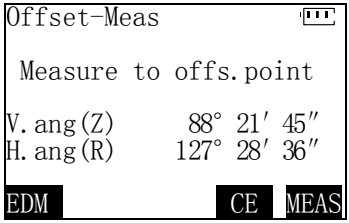
This function is to measure target target point by entering the horizontal distance from the target point to the offset point.(offset)



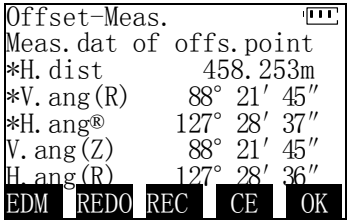

- When the offset point is positioned to the left or right of the target

point, make sure the angle formed by lines connecting the offset point to the target point and to the instrument station is almost 90°. When the offset point is positioned in front of or behind of the target point, install the offset point on a line linking the instrument station with the target point.

① Press 【OFFS】 on the third page of the Meas. mode to enter offset measurement program, and the program will remind the user to measure offset point first.

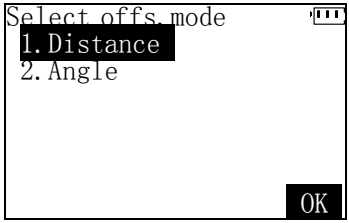



② Sight the offset point, press 【MEAS】. The instrument starts to measure the offset point and display the result.

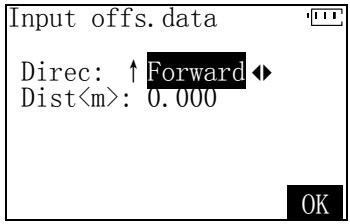



- Press【REDO】to re-measure offset point.
- Press【REC】to record and store the measurement data of offset point.

③ Press【 OK 】.Procedure request selecting offset mode.

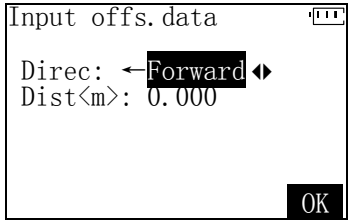


④ Select “Distance”. Program request inputting the direction of offset point and horizontal distance from the target point to the offset point.



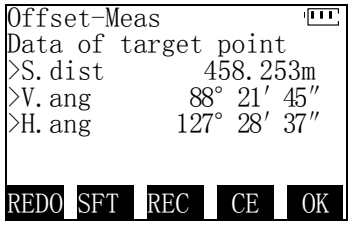

- ↑ Forward：Closer than the target point.
- ↓ Rear：Beyond the target point.
- ← Left：On the left of the target point.
- → Right：On the right of the target point.

⑤ Press 【◀】and 【▶】to switch offset direction.




⑥ Input the horizontal distance between the offset point and target point.

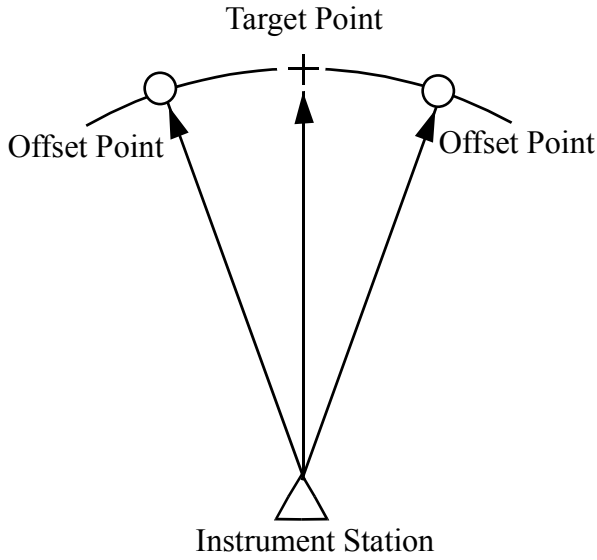
Press 【OK】.The distance and angle of the target point are calculated.

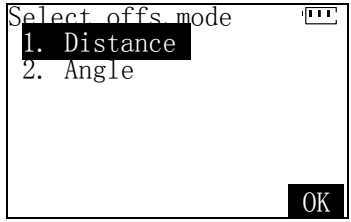



- Press【REC】 to record the result.
- Press【SFT】to switch the screen display from distance values to coordinates values.
- Press【CE】to return to step ④ ,re-input the distance and angle of the offset point.
- Press【OK】to finish the offset measurement.

### 11.2.2 Angle offset measurement

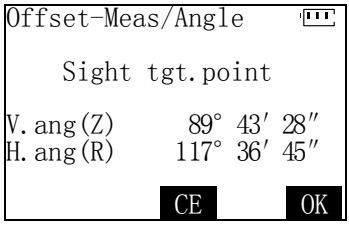
Sighting the direction of the target point and find it from the included angle. Install offset points for the target point on the right and left sides of and as close as possible to the target point and measure the distance to the offset points and the horizontal angle of the target point.



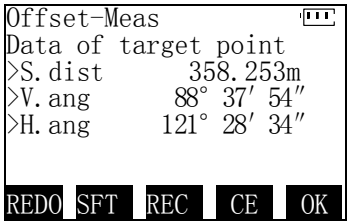




① Set the offset points close to the target point, making sure the distance from the instrument station to the target point and the height of the offset points and the target point are the same, then place the prism on the offset point. Accordance with the "11.2.1 distance offset measurement" Step ① - ② to complete measurement of the offset point.

② Select “Angle” . Program prompts to sight the target point.

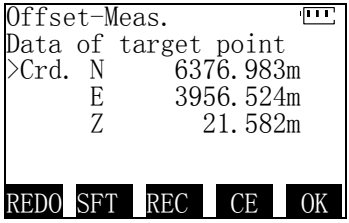



③ Sight the target point, press 【OK】,the slope distance, vertical angle, horizontal angle of the target point are calculated and displayed




- Press【REC】to record the results.
- Press【SFT】to switch the screen display from distance values to coordinates values.
- Press【CE】to return to sight the target point again.
- Press【OK】to finish the offset measurement.

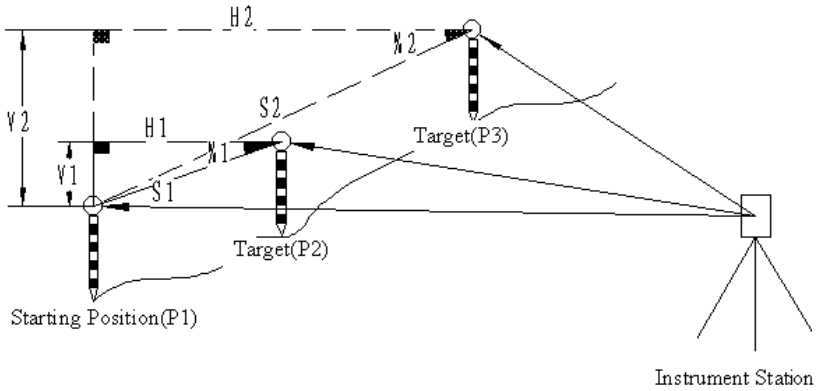
④ Press【SFT】, the coordinates of the target point are displayed(assuming that the instrument station has been setup).



## 11.3 Missing line measurement

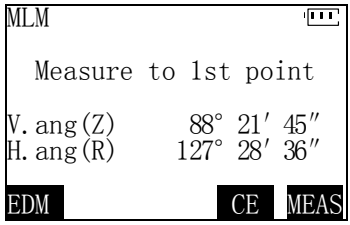
Missing line measurement is used to measure the slope distance, horizontal distance, height difference, slope and direction angle from multiple target points to the starting point without moving the instrument.

- It is possible to change the last measured point to the next starting position.
- When measuring the height difference of two or more points, you should put a prism on the rod, and make all the targets at the same height.

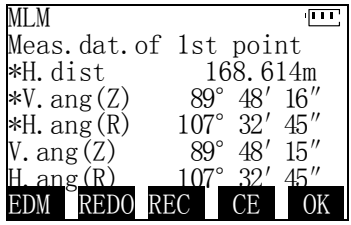



### 11.3.1 Measuring the distance between 2 or more points

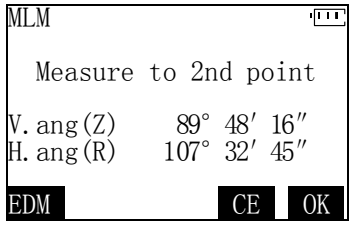
① Press 【MLM】on the third page of the Meas. mode to enter the missing line measurement program, and the program will remind the user to measure the starting point of the missing line.



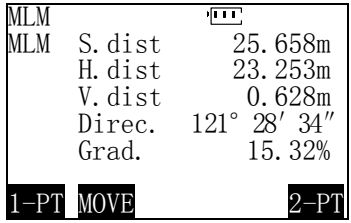
② Sight the target，press【MEAS】. The instrument starts to measure the missing line starting point and display the result.




③ Press【OK】to confirm the measure result. The program prompts to measure the end point of the missing line.

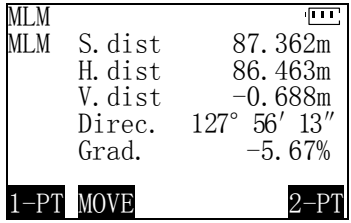



④ After the measurement of missing line end point is finished, the program will calculate the slope distance, horizontal distance, height difference, direction angle and gradient from the starting point to the end point of missing line.



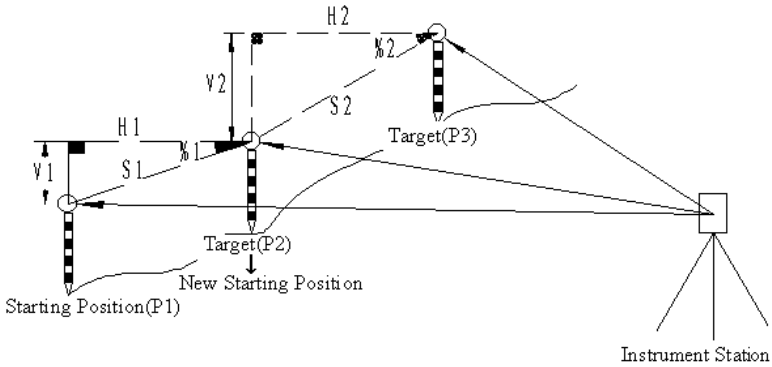

- Sight the start point, press【1-PT】to re-observe the starting point.

⑤ Sight another target point and press【2-PT】 to measure it. The program will calculate, update and display the data of missing line measurement.

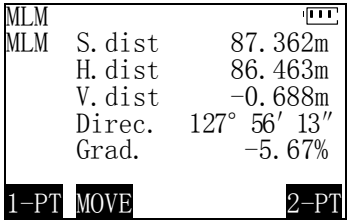


### 11.3.2 Changing the starting point

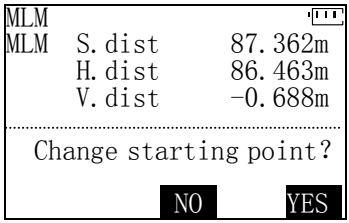
It is possible to change the last measured point to the next starting position.




① Observe the starting position and target following steps in "11.3.1 Measuring the distance between 2 or more points".



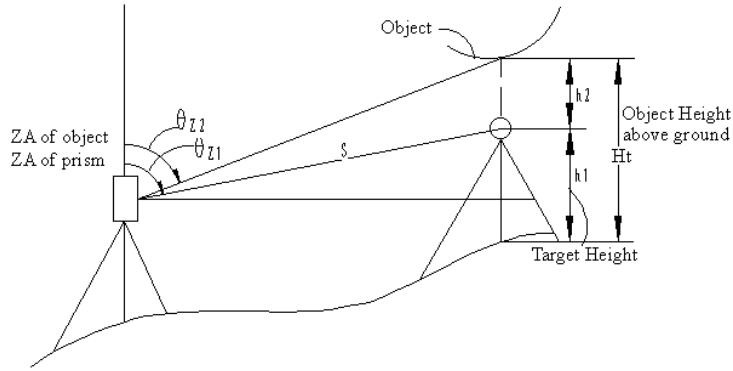

② After measuring the targets, press 【 MOVE 】 .Program prompts confirmation.




③ Press【YES】to change the last measured point to the next starting position. Perform missing line measurement following steps in "11.3.1 Measuring the Distance between 2 or more points".

## 11.4 Remote elevation measurement

Remote elevation measurement(REM) is used to measure the height to a point where a prism cannot be directly installed such as power lines , bridge and overhead cables, etc.



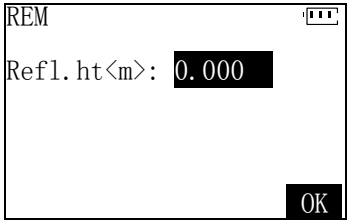

- The height of the target is calculated using the following formula
  $h2=S\sin\theta_{z1}\times\cot\theta_{z2}-S\cos\theta_{z1}$
  $Ht=h1+h2$

MTS1200 has two REM measurement mode:： use the prism height and not use. When used the prism height, REM will select the center of the prism as the reference point. When no prism height is used, REM will select the ground point of the prism as the reference point.

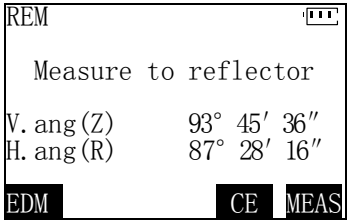
### 11.4.1 With prism height input

① Place the prism directly under or directly over the object. In the third page of the Meas mode, press 【MENU】,then select "REM".

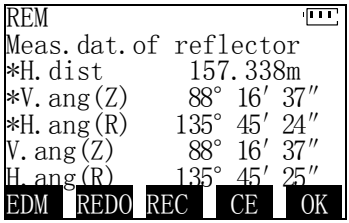
② Select “With refl.ht input”.



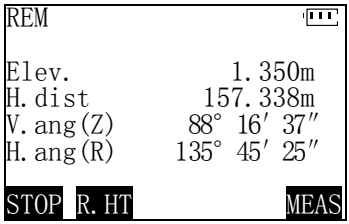

③ Measure the prism height with a tape measure etc and input the prism height, press【OK】. The program prompts “Measure to reflector”.




④ Sight the center of the prism，press【MEAS】to start measurement. When the measurement is complete, the results are displayed.



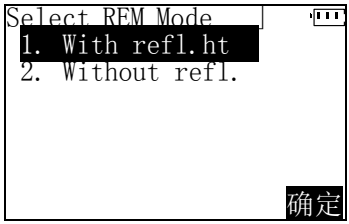

⑤ Press【OK】to come in the REM function screen. Sight the object, the height from the ground to the object is displayed. While rotating the telescope, the height is calculated and displayed in real time.



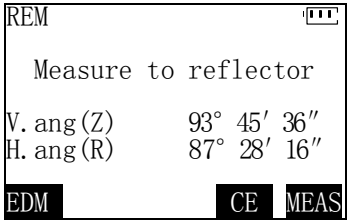

- Press【MEAS】to re-observe the prism.
- Press【R.HT】to re-enter the prism height.
- Press【STOP】to stop REM measurement

### 11.4.2 Without prism height input

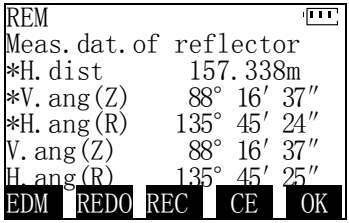
① Place the prism directly under or directly over the object. In the third page of Meas mode, press 【MENU】,then select "REM".



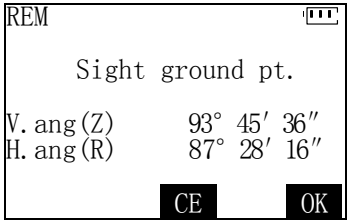

② Select “Without refl.ht input”.



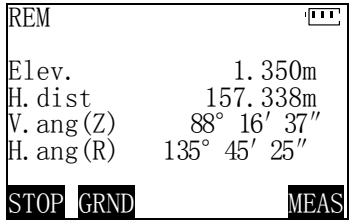

③ Sight the center of the prism, press【MEAS】 to start measurement. When the measurement is complete, the results are displayed.




④ Press 【 OK 】 to confirm the measurement results. The program prompts sighting the prism ground point.



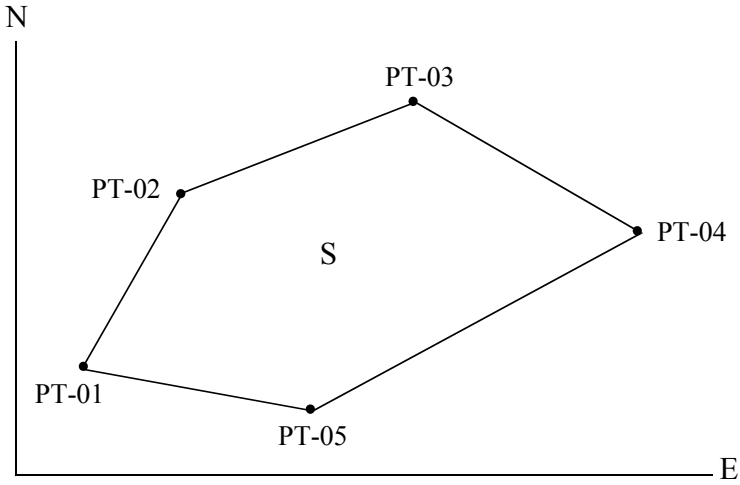
⑤ Sight the ground point of the prism, press 【OK】to come in the REM function screen. Sight the object, the height from the ground to the object is displayed. While rotating the telescope, the height is calculated and displayed in real time.




- Press【GRND】sight point on the ground again.

## 11.5 Area calculation

This function can calculate the area of polygon land enclosed with three or more points. The coordinates of the point can be specified by measuring the points, reading in from memory , and entering directly.

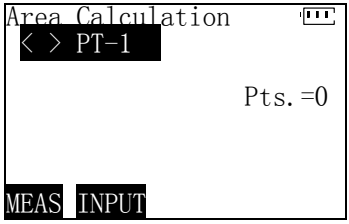



- Boundary points forming any polygon must be provided with clockwise or counterclockwise sequence, otherwise the calculation results will be not correct. As shown above, measurement and inputting of all points should be made with the sequence of 1→2→3→4→5 or 5→4→3→2→1.
- In case only measurement of all boundary points is needed for calculating area, setting instrument station and backsight orientation can be ignored. However, in case both measurement points and known point coordinates are used for calculating area, the instrument station must be correctly setup to ensure that all points involved in calculation are within the same coordinate system.
- The number of specified coordinate points: 3 to 30.

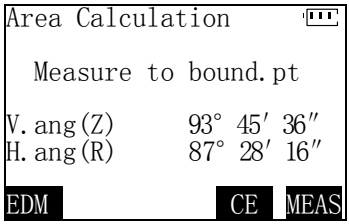
**Slope area**: The first three points specified (measured/read-in) are used to create the surface of the slope area. Subsequent points are projected vertically onto this surface and the area calculated.

### 11.5.1 Calculate area from measuring boundary point

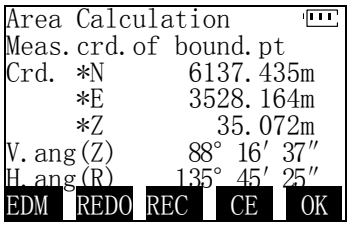
① In the third page of the Meas mode, press【MENU】,then select "Area calcul.".



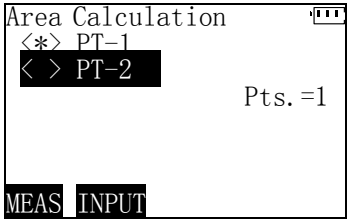

② Press【MEAS】 .The program remind to sight at boundary points for measurement.



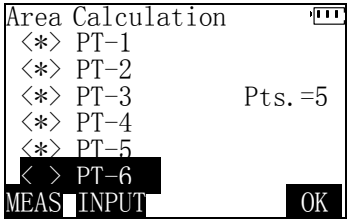

③ Sight the first boundary point and press【MEAS】to start measurement. When measurement finished, the measured values are displayed .




④ Press【OK】.

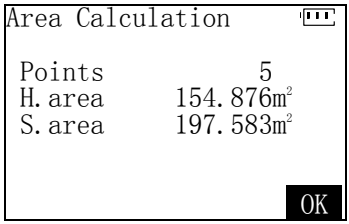


⑤ Same as above mentioned, according to the clockwise or counterclockwise order, measure each boundary point in turn. When measured points are not less than 3 points, area can be calculated.




- Press【▲】/【▼】to move the cursor to the boundary point, pressing 【MEAS】 can re-observe the boundary point.

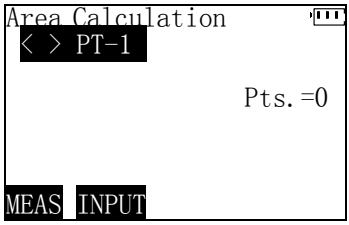
⑥ Press 【CALC】to calculate and display the area calculation results of the polygon area composed of the boundary points.



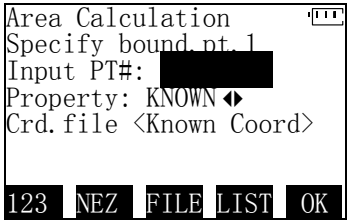

- press 【ESC】to return to the boundary point list.
- Press 【OK】 to finish the area calculation function.

### 11.5.2 Calculate area from inputting boundary point

① In the third page of the Meas mode, press【 MENU 】,then select "Area calcul.".

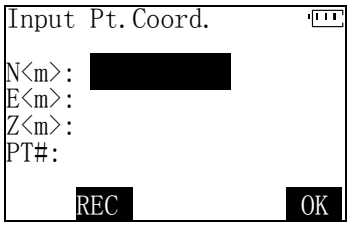


② Press【INPUT】. Input the point number and select property of the boundary point 1 and press 【OK】, the coordinate data of the point will be read in. Please refer to "6. Coordinate Measurement: Reading in the Coordinate Data of Previously Stored Points".

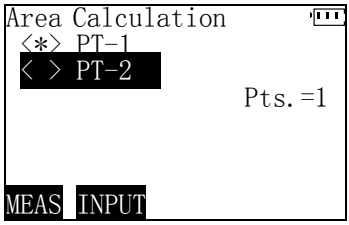



- Press 【NEZ】 to directly input the coordinates of the boundary point 1.

③ Press【NEZ】. Successively input the coordinates N, E and Z. After inputting one item, press 【▼】 key to enter the next item. After inputting all the items, press 【Ok】.

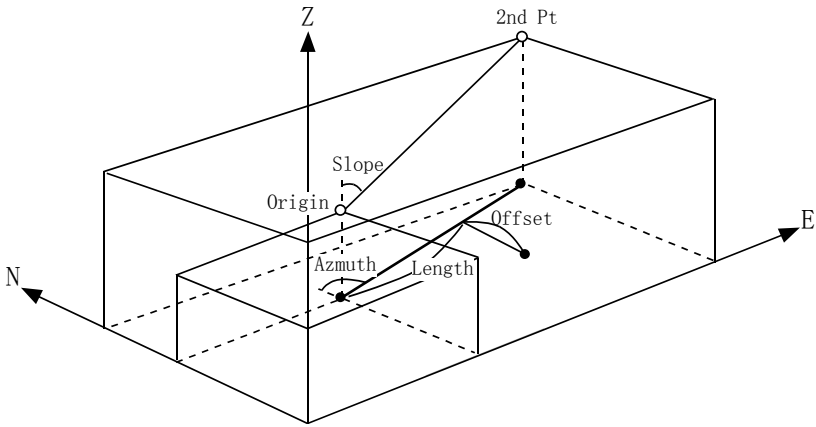



④ Same as above mentioned, according to the clockwise or counterclockwise order, input each boundary point in turn. When the points are no less than 3 points, area can be calculated.The following steps is the same as "11.5.1 Calculate area from measuring boundary point."



## 11.6 Setting-out line

Setting-out line is used for setting out a required point at a designated distance from the baseline and for measuring the distance from the baseline to a measured point.



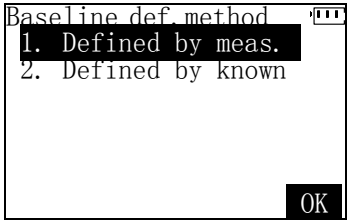

### 11.6.1 Defining baseline

To perform setting-out line measurement, the baseline should be defined at first. The program supports two kinds of ways for defining a baseline:

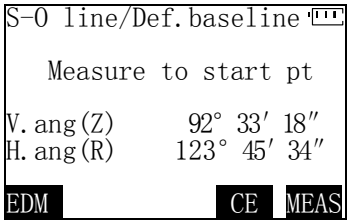
- **Defined by measurement**: Defining a baseline by measuring the the starting point and the second point of the baseline
- **Defined by known point:** Defining a baseline by inputting the known coordinates of the starting point and the second point of the baseline. It should be noted that if this method is employed ,the instrument station and backsight orientation must be set correctly in subsequent operation to make sure that the measured points and the baseline are within the same coordinate system.

Following operating steps are provided by using method "Defined by measurement" as an example.

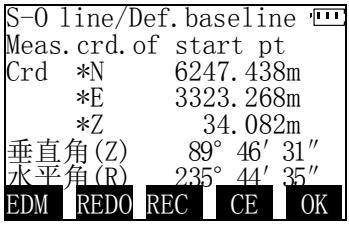
① In the third page of the Meas mode, press【MENU】,then select "S-O line".



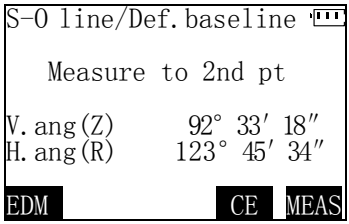

② Select“Defined by meas.”.



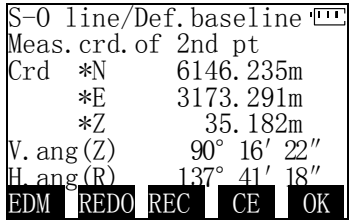

③ Sight the starting point of the baseline and press 【MEAS】 to start measurement. After the measurement is finished, the measurement results of the baseline starting point coordinates will be displayed.



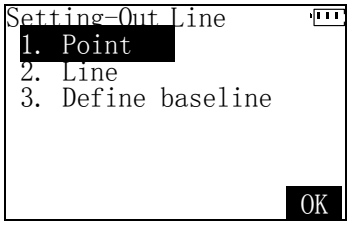

④ Press【OK】 and the program will remind the user to sight the second point of the baseline for measurement.



⑤ Sight the second point of the baseline and press 【MEAS】 to measure the second point. After the measurement is finished, the coordinate measurement results will be displayed.

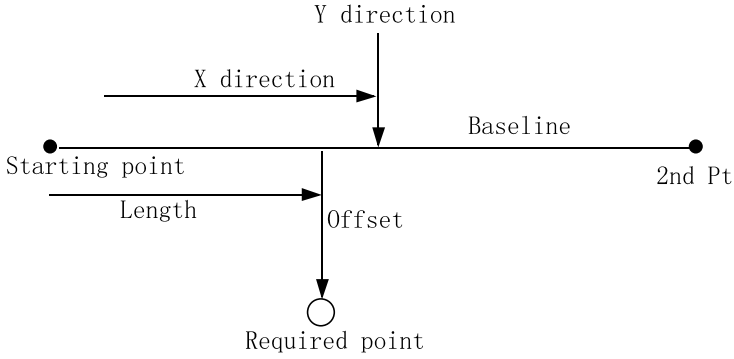



⑥ Press 【 OK 】 to finish the the definition of the baseline and come in menu <Setting-out line >.

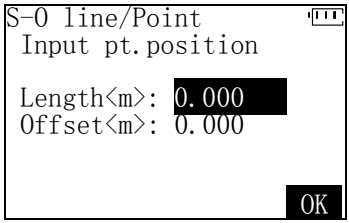



### 11.6.2 Setting-out line/Point

This function can be used to calculate the required point coordinate by inputting the length and the offset based on the baseline, then this point can be set out by setting-out coordination measurement.



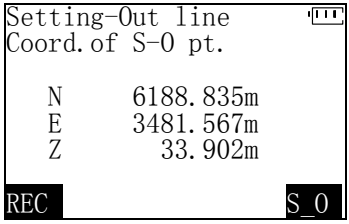
① After the baseline defined,select "setting-out point" in the menu< Setting-Out line >. Program requires inputting setting-out point position.




- Length: Distance along the baseline from the starting point to the position at which a line extending from the required point intersects the baseline at right angles(X direction).
- Offset: Distance along the baseline from the starting point to the position at which a line extending from the required point intersects the baseline at right angles (Y direction).

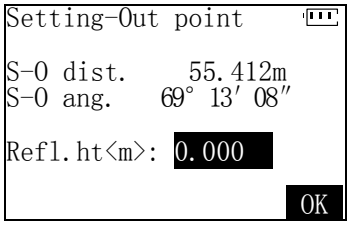
② Input setting-out point position, presss【OK】. The coordinate value of the required point is calculated and displayed.

- Press 【REC】to store the coordinate value.



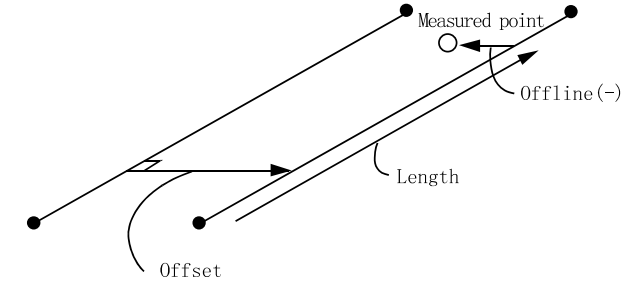

③ Press 【S-O】to start setting-out measurement of the required point.

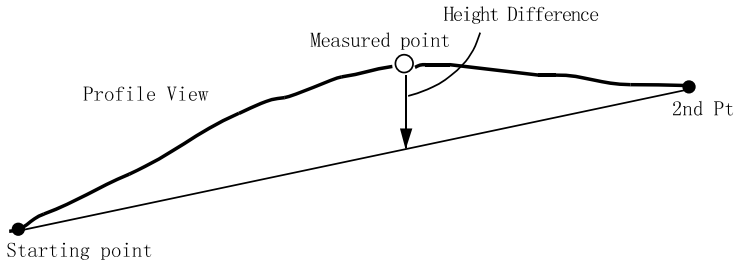
The following steps refer to "7. Coordinates setting-out measurement "



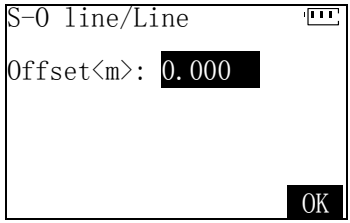
### 11.6.2 Setting-out line/Line

This function is used to find the deviation of the measured target point relative to a known line.



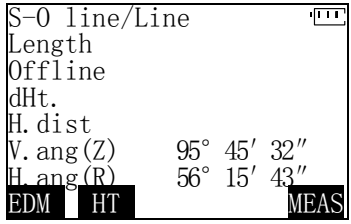




① After the definition of baseline is finished, select “Line” in the menu <Setting-Out line>. The program allows inputting the horizontal translation distance value (offset distance) of desired setting-out straight line relative to the baseline.



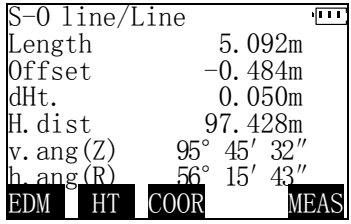

Right side indicates positive value and left side indicates negative value.

② Input the offset value, presss【OK】 to enter the point-to-line setting-out observation.




- Press【EDM】 to modify distance measurement parameter setting. Please refer to "5. Distance Measurement".
- Press【HT】 to input instrument height and the height of cooperative reflection target (prism).

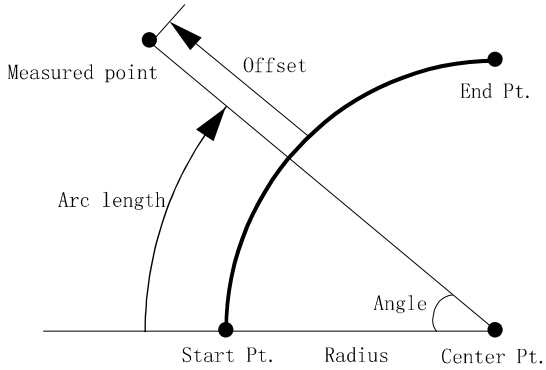
③ Sight the target and press 【MEAS】to start measurement. After the measurement finished, the difference between the measured point and the baseline is displayed.




- Length: Distance along the baseline from the starting point to the measured point.
- Offline: A positive value indicates the point is on the right of the baseline and a negative value indicates it is on the left
- dHt: Height difference between the measured point and the baseline
- Press 【COOR】to display the coordinate of the measured point,and allows the user to store the coordinate.
- When repeat measurement mode or tracking measurement mode is selected, without any key press, the difference between the measured point and the baseline will be displayed continuously while sighting the target. Pressing 【STOP】 can stop the measurement.

## 11.7 Setting-out arc

Setting-out arc program allows the user to define a reference arc section , and set out this arc as well as points(offsets) along it.




### 11.7.1 Defining an arc

To perform setting-out arc measurement, the reference arc should be defined at first. Users can use two kinds of combinations of arc parameters to define arc:

(1) Circle center point, start point

(2) Start point, end point, radius

**Note**: Clockwise from start point to end point must be guaranteed for defining curve.

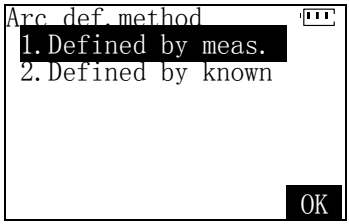
The program supports two kinds of ways for defining arc parameters:

- **Defined by measurement**: Defining an arc by measuring the arc parameters
- **Defined by known point:** Defining an arc by inputting the known arc parameters. It should be noted that if this method is employed ,the instrument station and backsight orientation must be set correctly in subsequent operation to make sure that the

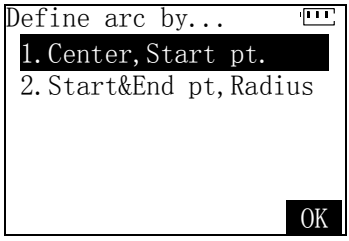
measured points and the reference arc are within the same coordinate system.

Following operating steps are known by inputting the known coordinates for start point and end points and radius of an arc to define a reference arc as an example.

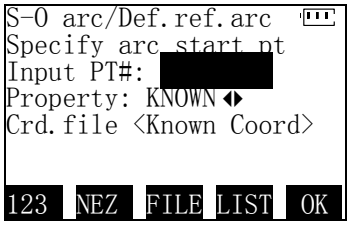
① In the third page of Meas mode, press【MENU】,then select "S-O arc"



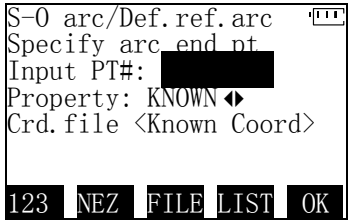

② Select “2.Known point alignment”.




③ Select “Start&End pt,Radius”.

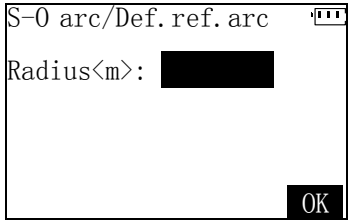


④ Input the point number and point property of the start point of the arc and press 【OK】 , the coordinate data of the point will be read in. Please refer to "6. Coordinate Measurement: Reading in the Coordinate Data of Previously Stored Points".

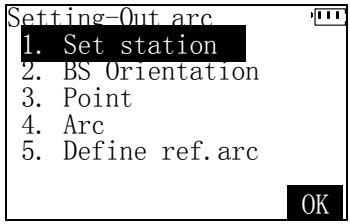



- Press【NEZ】 to directly input the coordinates of the starti point of the arc.

⑤ Input the coordinates of the end point of the arc with the same method.




⑥ Input the arc radius, and press 【OK】to finish the definition of the reference arc and enter menu <Setting-Out arc>.



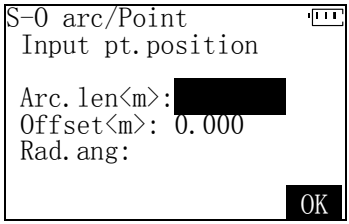

### 11.7.2 Setting-Out arc/Point

This function can be used to calculate the coordinate of required point along the arc by inputting the arc length (or central angle)and offset based on the arc, then this point can be set out by setting-out coordination measurement.

- In case the reference arc is defined by inputting the known coordinates of the arc parameters, the instrument station and back

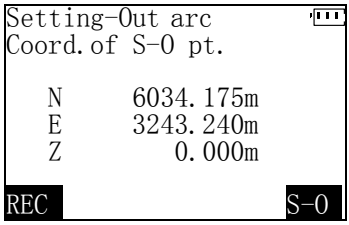
sight orientation must be correctly set before performing the function.

① Select "Point" in the menu < Setting-out arc>. Program requires inputting setting-out point position.



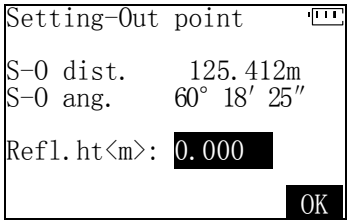

- Arc len: the arc length of perpendicular foot of setting-out point on the arc from the start point. If the start point rotates to the setting-out point along the arc clockwise, its value is positive, otherwise it is negative.
- Offset: the distance from the setting-out point to its perpendicular foot on the arc. It is positive in case the setting-out is on the right of the arc, otherwise it is negative.

② Press【Ok】 after inputting the arc length from setting-out point to start point (or central angle from start point) and offset (0 by default), and the program will calculate the coordinates of the setting-out point.




- Press【REC】 to record and store the coordinate data.

③ Press 【S-O】to start setting-out measurement of the required point.
The following steps refer to "7. Coordinates Setting-out Measurement"

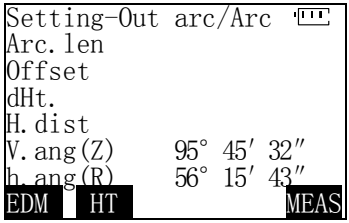


### 11.7.2 Setting-Out arc/Arc

This function is used to find the deviation value of measured target value relative to the defined reference arc.

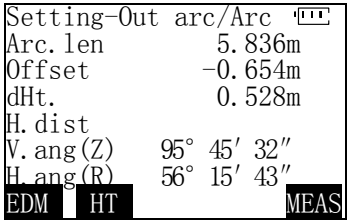
- In case the reference arc is defined by inputting the known coordinates of the arc parameters, the instrument station and back sight orientation must be correctly set before performing the function.

① Select "Arc" in the menu < Setting-out arc >.




- Press【EDM】 to modify distance measurement parameter setting. Please refer to "5. Distance Measurement".
- Press【HT】to input instrument height and the height of cooperative reflection target (prism).

② Sight the target and press 【MEAS】to start measurement. After the measurement finished, the difference between the measured point and the reference arc is displayed.




- dHt: Height difference between the measured point and the start point of the arc
- Press 【COOR】to display the coordinate of the measured point,and allows the user to store the coordinate.

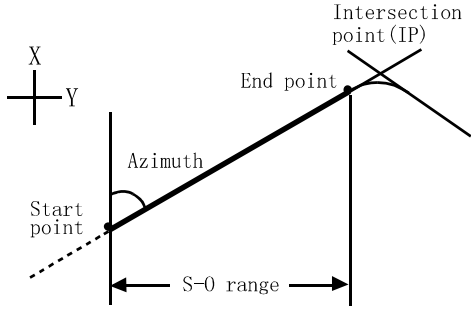
- When repeat measurement mode or tracking measurement mode is selected, without any key press, the difference between the measured point and the reference arc will be displayed continuously while sighting the target. Pressing 【STOP】can stop the measurement.

## 11.8 Setting-out road

Setting-out road program provided by the instrument can setting-out the border stake and center stake of the road of straight line type, circular curve type ,spiral curve type or the road defined by three intersection points.After defining the road necessarily, input the number and the offset of the setting-out stake. And then the setting-out coordinates will be calculated automatically and leads setting-out. Observing any stake, the stake number and offset of the target can be shown at the same time. So it is convenient to test the stake setting-out result by this function.

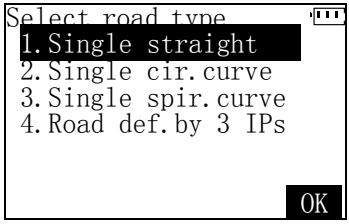
### 11.8.1 Selecting road line type and defining road

**Definition of single straight line type road**

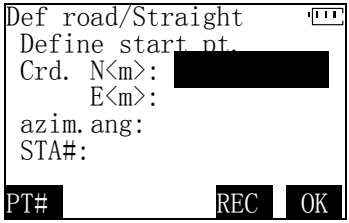



Road definition parameters: stake number of the start point, coordinates of the start point and azimuth angle

① In the third page of the Meas mode, press【MENU】,then select "S-O road"

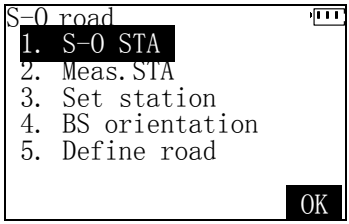


② Select “Single straight”.

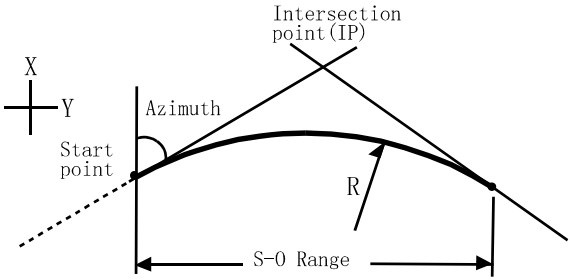



- Press 【PT#】 to find and call the point coordinates from the memory of the instrument by inputting the point number and point property. Please see“6. Coordinate Measurement: Reading in the Coordinate Data of Previously Stored Points”.
- Press【REC】 to record and store the input coordinate data.

③ Input the start point stake number, start point coordinate and azimuth angle of the road. Press 【OK】 to finish the road definition and enter the menu of road setting-out.



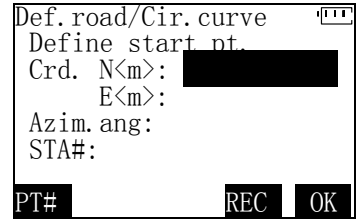

**Definition of single circular curve type road**




Road definition parameters: start point stake number, start point

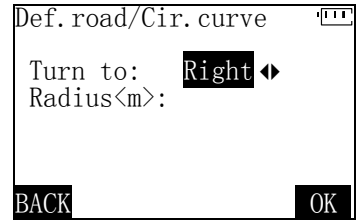
coordinates, start point (tangent line) azimuth angle, road turning direction(right/left from the start point) and circular curve radius.

① Select “Single cir.curve” in the menu <Select road type>.



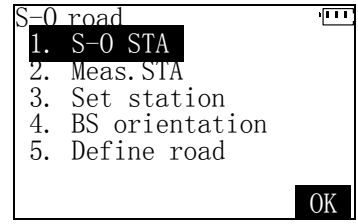

- Press 【PT#】 to find and call the point coordinates from the memory of the instrument by inputting the point number and point property. Please see“6. Coordinate Measurement: Reading in the Coordinate Data of Previously Stored Points”.
- Press【REC】 to record and store the input coordinate data.

② Input the start point stake number, starting point coordinates and starting point (tangent line) azimuth angle of the road and press 【OK】 .

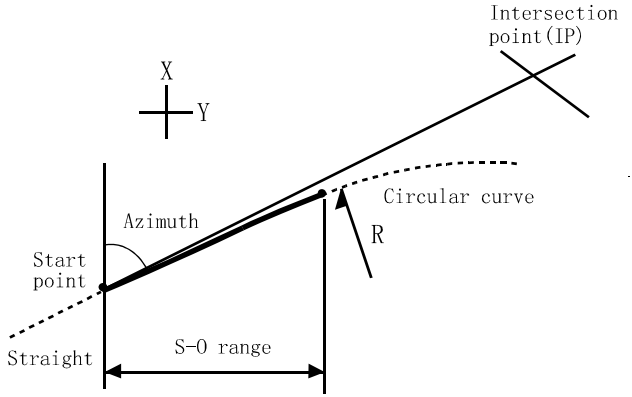



- Press【BACK】 to return to the last step.

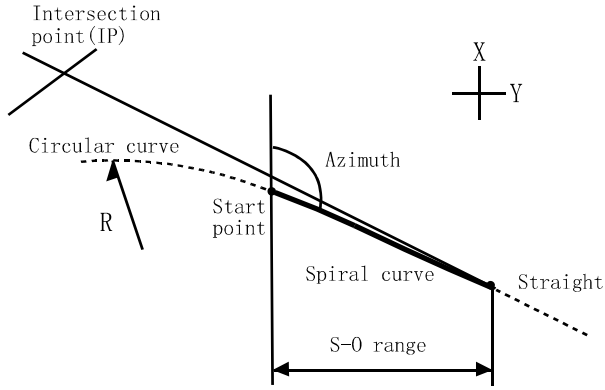
③ Press【◀】 and 【▶】 to switch the road turning direction to rightward or leftward and input the circular curve radius. Press【OK】 to finish the road definition and enter the setting-out road menu.



**Definition of single spiral curve type road**




Type: Spiral in

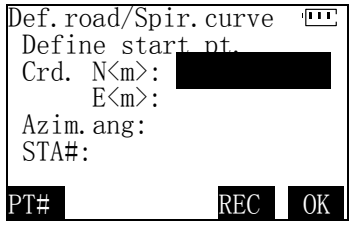



Type: Spiral out

Road definition parameters: type (spiral in/spiral out) ,start point stake number, start point coordinates, start point (tangent line) azimuth angle, road turning direction(right/left from the start point), minimum radius and curve length.

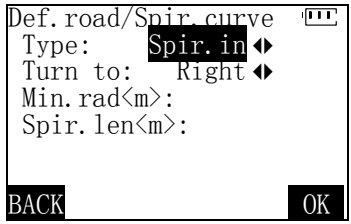
- **Spiral in**: the radius of spiral curve is gradually reduced from infinitely great.
- **Spiral out**: the radius of spiral curve is gradually increased to infinitely great from a specified value.

① Select "Single spir.curve" in the menu <Select road type>.



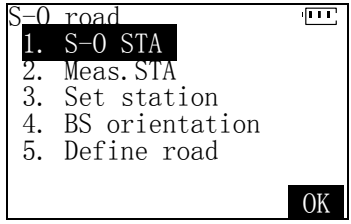

- Press 【PT#】 to find and call the point coordinates from the memory of the instrument by inputting the point number and point property. Please see"6. Coordinate Measurement: Reading in the Coordinate Data of Previously Stored Points".
- Press【REC】 to record and store the input coordinate data.

② Input the start point stake number, start point coordinates and start point (tangent line) azimuth angle of the road and press 【OK】 .

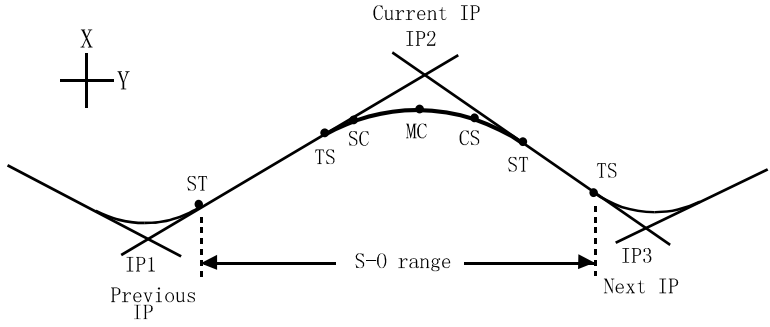



- Press【BACK】 to return to the last step.

③ Press【◀】 and 【▶】 to switch the spiral type (spiral in or spiral out) and the road turning direction to rightward or leftward and input the minimum radius and curve length. Press 【OK】 to finish the road definition and enter the setting-out road menu.

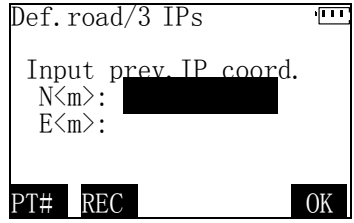


## Road line defined by three-intersection-point



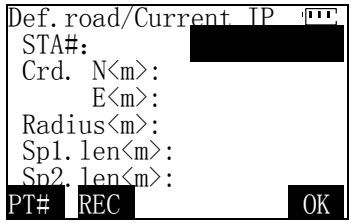

Road definition parameters: coordinates of the previous intersection point and the next intersection point, the stake number and coordinates of the current intersection point, the circular curve radius and spiral-in and sprial-out curve lengths (they can be unequal).

① Select “Road def.by 3 IPs” in the menu <Select road type>.



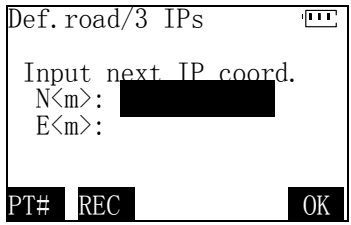

- Press 【PT#】 to find and call the point coordinates from the memory of the instrument by inputting the point number and point property. Please see“6. Coordinate Measurement: Reading in the Coordinate Data of Previously Stored Points”.
- Press【REC】 to record and store the input coordinate data.

② Input the coordinates of the previous intersection point (IP1)and press 【OK】 .

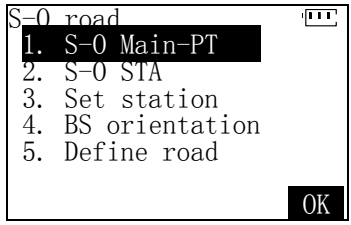



③ Successively input the stake number, circular curve radius and spiral curve length for the current intersection point (IP2)and press 【OK】 .

- In case a spiral curve is not set, input 0 for the length of spiral curve.




④ Continue inputting the coordinates of the next intersection point(IP3), press 【OK】 to finish the road definition and enter the road setting-out menu.

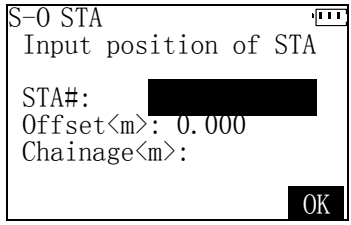



### 11.8.2 Setting-Out center and side stake

① Select “Set station” and “BS orientation” in the menu < S-O road > and finish setting up the station as per “6.1 Station construction”.

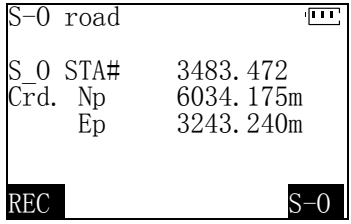
- This step can be ignored in case a station has been established before.

② Select “S-O STA” in the menu < S-O road >. Input the stake number of the desired stake (or directly input the chainage from the start point) and centerline offset distance.




- Left-side stake: input a negative value for offset distance.
- Right-side stake: input a positive value for offset distance.
- Center-stake: Input 0 for offset distance
- For three-intersection-point type road, the straight -transition point (ST) is used as the start point of the road.

③ After the inputting is finished, Press【Ok】.The stake number and coordinate values of the desired setting-out stake are calculated and displayed.




- Press【REC】 to record and store the coordinate data.

④ Press【S-O】 to perform coordinate setting-out measurement for the point. The following steps refer to "7. Coordinates Setting-out Measurement".

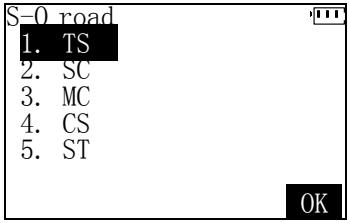
### 11.8.3 Setting-Out main point of curve

This function is only available for the road line defined by three-intersection-point .After the three-intersection-point road definition is finished, the program is able to calculate the curve main points of the road: TS, SC, MC, CS, ST, the stake numbers and coordinates of these points. In addition, the setting-out will be guided.

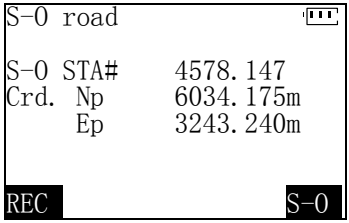
① Select "Set station" and "BS orientation" in the menu < S-O road > and finish setting up the station as per "6.1 Station construction".

- The step can be ignored in case a station has been established.

② Select "S-O Main-PT" in the menu < S-O road >.




③ Select the desired main point in the menu <Select Main-PT>. The stake number and coordinate values of the desired main-pt stake are calculated and displayed.




- Press【REC】 to record and store the coordinate data.

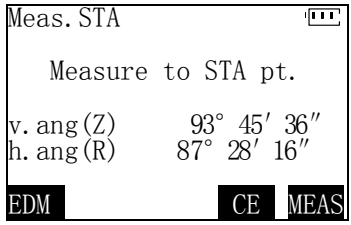
④ Press【S-O】 to perform setting-out measurement for the point.Please refer to "7. Coordinates Setting-out Measurement" for following steps.

### 11.8.4 Stake location measurement

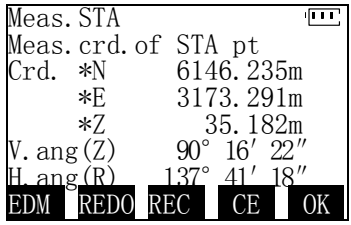
① Select “Set station” and “BS orientation” in the menu < S-O road > and finish setting up the station as per “6.1 Station construction”.

- The step can be ignored in case a station has been established.

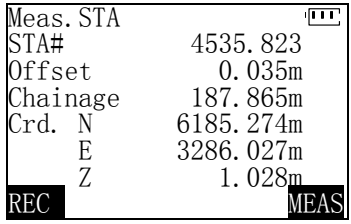
② Select “Meas.STA” in the menu <S-O road >.




③ Accurately sight the target on the stake point and press 【MEAS】 . The instrument starts measuring the target. After the measurement is finished,the coordinate measurement values of the measured target are displayed



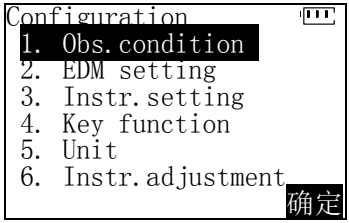

④ Press【OK】. The stake number of the measured stake point and the offset distance to the centerline are calculated and displayed




- Press【REC】 to record and store the measured coordinate data.
- Press【MEAS】 to continue the stake location measurement for the target or other targets.

# 12. Setting parameters of instrument

Press 【CNFG】 in the status screen to enter the config mode. In this mode, instrument parameters related to instrument functions can be set. Once these parameters are set, they will be stored until they are changed again.




## 12.1 Observation condition

The items and their options list in the following table can be set in Observation Condition setting. The option marked with "*" is factory setting.

| parameters | Options | Explanation |
|---|---|---|
| Tilt corr | *OFF<br>1-AXIS<br>2-AXIS | Select whether tilt angle compensation function is enabled.<br>OFF: No compensation;<br>1-AXIS:Vertical Angle compensati--on<br>2-Axis: Vertical Angle and horizontal Angle compensation |
| Dist.obs | *HD<br>HD-VD<br>SD-HD-VD | Select priority distance display mode in the Meas mode. |
| V.ang.obs | *Zenith<br>V±90°<br>Verti | Select vertical angle display method from zenith 0 (0~360°), horizontal direction 0 (0±90°)or horizontal direction 0(0~360°) |

| | | |
|---|---|---|
| Coord.obs | *N-E-Z<br>E-N-Z<br>X-Y-Z | Select the display format of coordinate |
| Ang.reso. | *1″<br>5″<br>10″ | Select the minimum display angle reading . |
| Curv&Refr corr. | *off<br>0.14<br>0.20 | Set whether earth curvature and refraction correction is enabled and select refraction coefficient. See the following. |
| Coll. crn | *OFF<br>ON | Select whether collimation correction is enabled. (2C error). |
| Scale corr. | *OFF<br>ON | Select whether scale correction is enabled when calculating coordinates from distance or calculating distance from coordinates. See the following. |
| Long-dist meas. | *OFF<br>ON | Select whether extra long distance measurement mode is enabled during measurement with prism. |

**Correction for refraction and earth curvature**

- MTS1200 can correct the measurement error of horizontal distance and height difference caused by atmosphere refraction and earth curvature.
- When slope distance and vertical angle measured, MTS1200 carries out correction of horizontal distance and height difference using the formula below:

Horizontal distance : Hd=Sd×[cosα + sinα ×Sd * cosα (K-2) / 2Re];
Height difference: Vd= Sd×[sinα + cosα ×Sd * cosα (1-K) / 2Re];

K: refraction modulus（0.14 or 0.20）;
Re: earth curvature radius（6372 km）;
α :vertical angle from horizontal plane;
Sd: slope distance;

**Scale correction**

MTS1200 can carry out the distance correction of Average Elevation and Projection by setting a scale factor. If there's a need for this correction, the scale factor should be calculated and entered in instrument's memory by user. Please refer to some professional book about surveying for more details.

The correction will be performed using the following formula:

(1)The distance on the projection plane:

HDg = HD×scale factor

HDg：The distance on the projection plane.

HD： The distance on the ground.

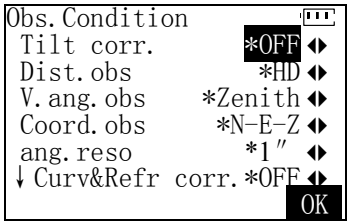
(2)The distance on the ground:

HD = HDg/ scale factor

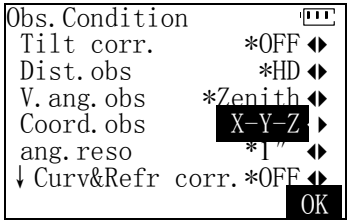
- Note: When the scale factor is set, it will affect all functions relate to coordinate measuring .
- Scale factor input range: 0.98-1.02 .Default value is 1.000000(This means no correction is carried out.)

**Parameter setting procedure**

① Select "Obs.condition" in the menu <Configuration>.




② Press 【▲】/【▼】to move the cursor up and down to select item. Press 【◀】/【▶】 to change the option of the item.



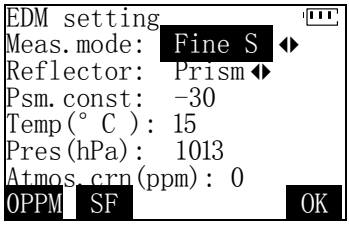

③ Press 【OK】 to accept the option change and return to the menu <Configuration>.

## 12.2 EDM setting

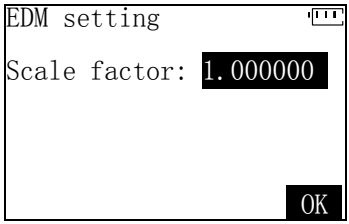
Pre-setting can be performed for distance measurement parameters in the config mode. Please refer to "5. Distance Measurement" for the meanings of distance measurement parameters and detailed setting steps. Details about these will not be known here.

The following will introduce how to input scale factor when setting the "Scale corr" option as "ON" in the observation condition setting:

① Select “EDM setting” in the menu <Configuration>.




② Press【SF】.After inputting the scale factor . press【OK】.




## 12.3 Instrument function setting

The items and their options list in the following table can be set in instrument function setting. The option marked with “*” is factory setting.

| Parameters | Options | Explanation |
|---|---|---|
| Auto off power | *No<br>20′ | Select whether to turn power supply off automatically if no key press in twenty minutes. |
| Auto on/off illu. | *No<br>15″<br>30″<br>1′ | Select whether to enable automatic liquid crystal back lighting and the time of switching off lighting automatically |

| | | |
|---|---|---|
| Auto off plmt. | *No<br>3′ | Select whether to switch off the laser plummet automatically after it is turned on for 3 minutes. |
| Key beep | *On<br>Off | Select whether beep sounds when a key is pressed. |
| Com.baud rate | 1200bps<br>4800bps<br>*9600bps<br>19200bps<br>38400bps | Select the baudrate of communication with external equipment. |

- Please refer to the above-mentioned “Parameter setting procedure” for detail steps of setting relevant parameters in “Instrument function setting”.

## 12.4 Allocating key function

It is possible to allocate the softkeys(F-key) in Meas. mode to suit the measurement conditions. The current softkey allocations are retained until they are revised again, even when the power is cut off. It is possible to register three sets of key function allocations: Def.1, Def.2 and Def.3, and these allocations can be recalled at anytime.

In addition, one certain function of some frequently used measurement functions integrated in the <HOT> key on the instrument panel can also be individually defined to the <USER> key for users to call these functions in measurement tasks.

It is possible to improve the efficiency of measurement operation in high degree because unique softkey allocation can be preset to suit various

applications and the ways that different operators handle the instrument.

### 12.4 .1 Defining softkeys

The following are the softkey allocations in Meas. mode when the instrument was shipped:

Page 1 【DIST】 【DSP】 【HSET】 【EDM】
Page 2 【0SET】 【COOR】 【S-O】 【REC】
Page 3 【MLM】 【RESE】 【OFFS】 【MENU】

The following functions can be allocated to the softkeys.

【DIST】: Distance measurement
【DSP】: Switch distance display mode
【HSET】: Set required horizontal angle
【EDM】: Setting EDM
【0SET】: Set horizontal angle to 0
【CRD】: Coordinates measurement
【S-O】: Coordinate setting-out measurement
【REC】: To recording data function
【MLM】: Missing line measurement
【RESE】: Resection measurement
【OFFS】: Offset measurement
【MENU】: To menu mode（coordinates measurement, setting-out measurement, resection measurement, missing line measurement, REM measurement, area calculation, offset measurement, repetition measurement, setting-out line, setting-out arc, setting-out road）
【HT】: Set the instrument station height and target height
【HOLD】: Hold horizontal angle /release horizontal angle
【R/L】: Select horizontal angle right / left
【REPT】: Angle repetition measurement

【V/%】: Switch vertical angle/slope in %

【COMM】: Output measurement results to an external equipment

【REM】: REM measurement

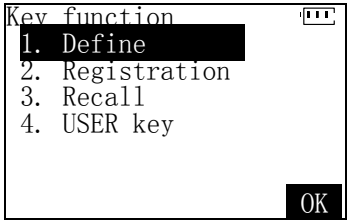
【LINE】: Setting-out line measurement

【ARC】: Enter the application program: arc setting-out

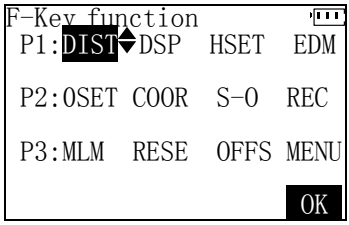
【ROAD】: Enter the application program: road setting-out

Users can freely define above functions to 12 soft keys, and these defined functions will be stored until they are re-defined.

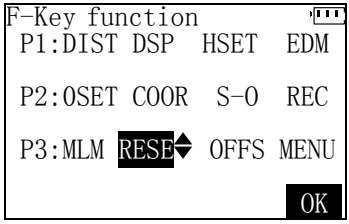
① Select" Key function "In the menu .



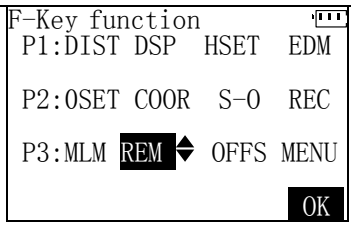

② Select "1.Define".Currently allocated softkeys in Meas. mode are displayed. The cursor of the selected softkey flashes.




③ Press 【◀】/【▶】to move the cursor to the softkey whose function you want to change.



④ Press 【▲】/【▼】 to change the function of this soft key.

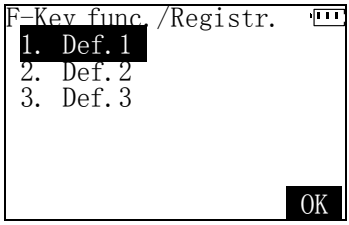



⑤ Press【OK】 to complete the definition of F key functions in the Meas. mode.

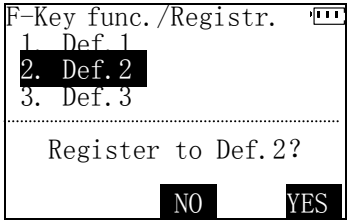
### 12.4 .2 Registering a softkeys allocation

After the softkey allocation defined, it can be registered in user definition 1 to 3 ,and the factory definition and user definition can be recalled later whenever you want..

① In the menu <Key function>, select "Registration".




② Press【▲】/【▼】to move the cursor to one of the"def.1-def.3", Press "OK" to save the registration

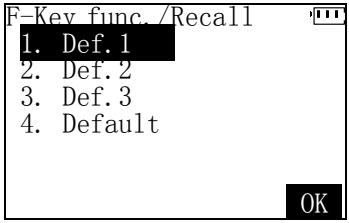



③ Press 【YES】.The softkey array is registered and the key function menu screen restored.

### 12.4 .3 Recalling a softkeys allocation

The softkey array registered in the memory and the factory setting can be recalled when necessary. At the same time, the current softkey allocations are cleared.

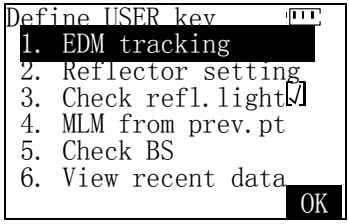
① Select “Recall” in the menu <Key function> menu.




② Select the softkey array(Def.1 ,Def.2,Def.3,Default-) you want to recall and press 【OK】to recal the key function.

### 12.4 .4 Defining <USER> key function

① Select “User key” in the menu < Key function >.




② Press【▲】 and 【▼】 to move the cursor to the function item that is to be defined and press【Ok】to finish defining the function of <USER> key.

- <USER> key is allocated function as “Check refl.light” by default when the instrument was shipped.

## 12.5 Unit setting

The option marked with "*" is factory setting.

| Parameter | Option | Description |
|---|---|---|
| Distance | *m<br>Intl.ft<br>US.ft | Select unit for distance: m (meter), Intl.ft(international feet ) or US.ft (US feet) |
| Angle | *deg<br>gon<br>mil | Select unit for angle: deg (360°), gon(400G) ,or mil(6400M) |
| Temperature | *℃<br>˚F | Select the temperature unit for atmospheric correction, Centigrade or Fahrenheit |
| Pressure | *hPa<br>mmHg<br>inHg | Select the atmospheric pressure unit for atmospheric correction, millibar, millimeter of mercury or inch of mercury |

- Please refer to the above-mentioned "Parameter setting procedure" for detail steps of setting relevant parameters in "Setting of unit".

# 13. Checks and adjustments

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

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.

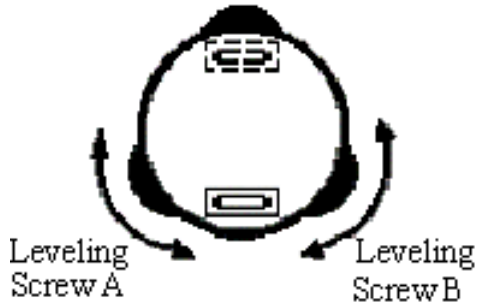
## 13.1 Plate level and circular level

### 13 .1.1 Plate level

- **Check**

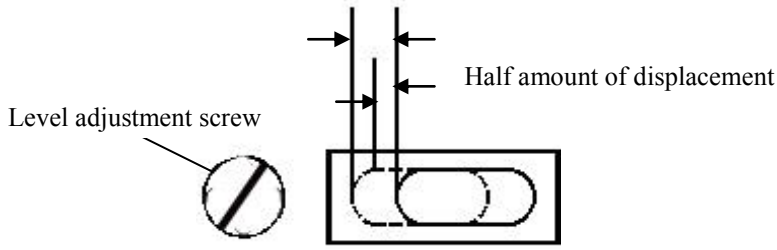
① Place the plate level parallel to a line running through the centers of two leveling screws (eg. A, B). Use these two screws to place the bubble in the center of the plate level vial.

② Rotate the instrument 180°or 200g around the vertical axis and check bubble movement of the plate level. If the bubble has been displaced, then proceed with the following adjustment.



- **Adjustment**

① Adjust the level adjustment capstan screw, with the accessory adjusting pin and return the bubble towards the center of the plate level vial. However, correct only one-half of the displacement by this method.




② Correct the remaining 1/2 amount of the bubble displacement with the leveling screws.

③ Rotate the instrument 180°or 200g around the vertical axis once more and check bubble movement. if the bubble is still displaced, then repeat the adjustment.

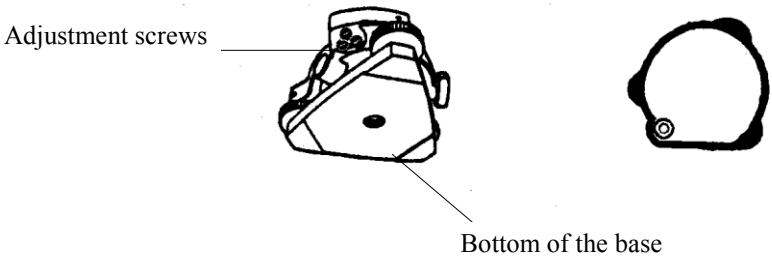
### 13.1.1 Circular level

- **Check**

Carefully level the instrument with the plate level. If the bubble of the circular level is centered properly at this time, adjustment is not required. Otherwise, proceed with the following adjustment.

- **Adjustment**

Shift the bubble to the center of the level by adjusting three capstan adjustment screws on the bottom surface of the circular level, with the accessory adjusting pin. (See diagram)




## 13.2 Reticle

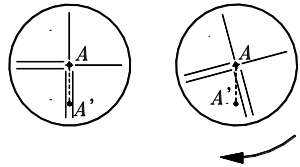
- **Check**

① Set the instrument on the tripod and carefully level it.

② Sight the cross-hair on a well-defined point A on the wall at a distance of at least 50 meters. (160ft)

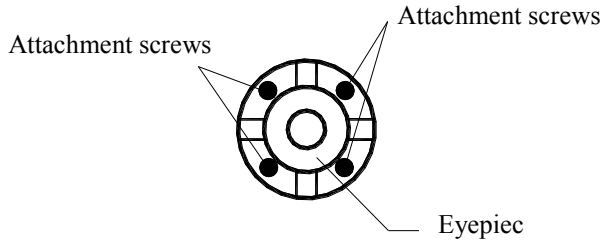
③ Next swing the telescope and check whether the point travels along the length of the vertical cross-hair.

④ If the point appears to move continuously on the vertical hair, the vertical cross-hair lies in a plane perpendicular to the horizontal axis.(Adjustment is not required.)




- **Adjustment**

① Unscrew the cross-hair adjustment section cover by revolving it in the counterclockwise direction, and take it off. This will expose four eyepiece section attachment screws.




② Loosen all four attachment screws slightly with the accessory screw-driver. (While taking note of the number of the revolutions) make vertical cross-hair coincide with A by turning eyepiece and tighten the four attachment screws.

③ Check if there is displacement in horizontal direction while point A traveling along vertical reticle. If not, check is concluded.

【**NOTE**】: After you finish it, you should perform adjustment as follows:

"13.3Telescope axis"，"13.6 Tilt zero point error check and adjustment"
"13.5Vertical circle index error and collimation error"

## 13.3 Telescope axis

- **Check**

① Set the instrument up with clear sights of about 50 to 60 meters of both sides of the instrument.

② Sight point A at approximately 50 meter distance.

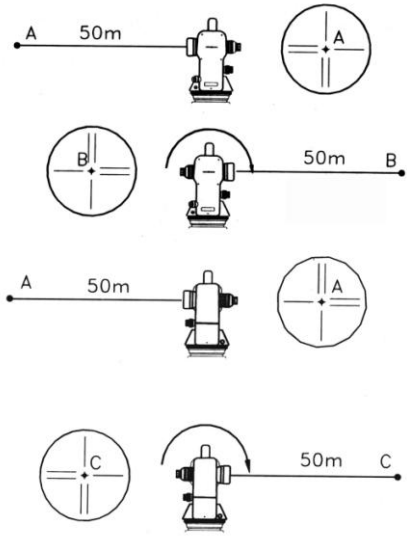
③ Loosen the vertical tangent screw only and plunge the telescope 180°around the horizontal axis so that the telescope is pointed in the opposite direction.

④ Sight point B, at equal distance as point A.

⑤ Loose the horizontal motion clamp and tangent screw and revolve the instrument 180°or 200g. Fix a sight on point A once more and tighten the motion clamp and screw.

⑥ Loose the vertical motion clamp and tangent screw and plunge the instrument 180°or 200g and fix a sight on point C, which should coincide with the previous point B.

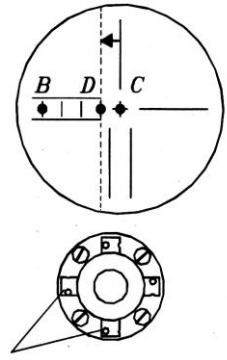
⑦ If point B and C do not coincide, adjust in the following order:




- **Adjustment**

① Unscrew the cross-hair adjustment section cover.

② Find point D at a point between points C. B, which should be equal to 1/4 the distance between points B and C, and measured from point C. This is because the apparent error of BC is four times of the real error since the telescope has been reversed twice during checking operation.




reticle adjustment screw

③ Shift the vertical cross-hair line and coincide it with point D, by revolving the left and right capstan adjustment screws. Upon completing the adjustment, repeat the checking operation once more. If point B and C coincide, further adjustment is not required. Otherwise, repeat the adjustment.

## 13.4 Optical plummet

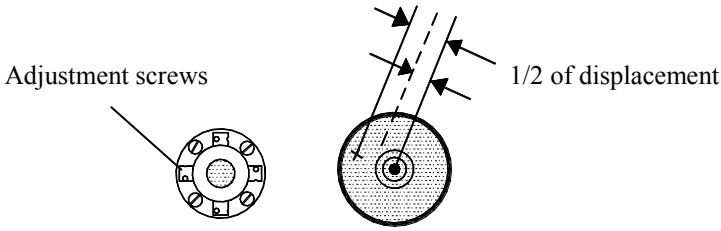
- **Check**

① Coincide the center point with the center mark of optical plummet telescope by adjusting optical plummet.

② Revolve the instrument 180°or 200g around the vertical axis and check the center mark. If the point is properly centered in the center mark, adjustment is not required. Otherwise, adjust in the following manner.

- **Adjustment**

① Unscrew the adjustment section cover of the optical plummet telescope eyepiece, by revolving it in the counterclockwise direction and take it off. This will expose four capstan adjustment screws which should be adjusted with the accessory adjusting pin to shift the center mark to the point. However, correct only 1/2 of the displacement in this manner.




② Next use the leveling screws and coincide the point and center mark.

③ Revolve the instrument 180°or 200g around the vertical axis, and check the center mark. If it is coincided to the point, then further adjustment is not required. Otherwise, repeat the adjustment.

## Appendix: Verification and correction of laser plummet

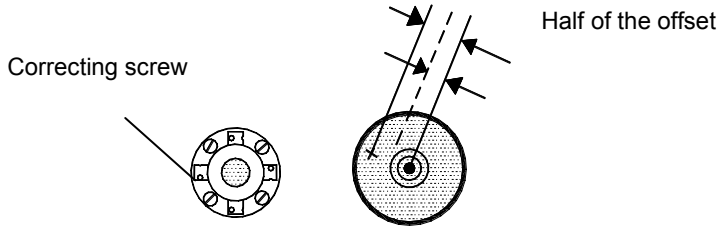
- **Check**

① Aiming the center mark of the laser plummet at one clear ground point (refer to "3.2 Leveling and centering the instrument")

② Rotate the instrument 180 degrees or 200g around the vertical shaft, observe the laser point, if the ground point is still at the laser point,, it need no correction, otherwise, you should correct it according to the following steps.

- **Adjustment**

① Open the mask of the eye piece of the telescope of the laser plummet, you can see 4 correction screws, use correcting needle to turn them to make the center mark of the laser plummet move to the ground point, the offset is half of the offset value.



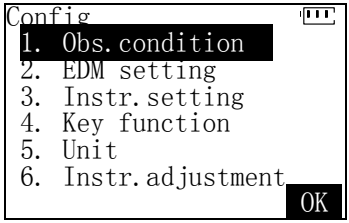

② Use foot screws to make the ground point falls on the center mark of the laser plummet.

③ Rotate the instrument another 180 degrees or 200g around the vertical shaft, check if the laser point falls on the ground point, if so, it needs no correction, otherwise, you should repeat the previous correction step.

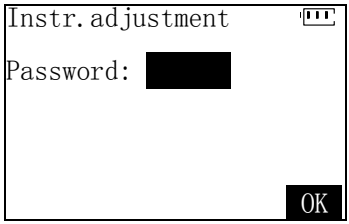
## 13.5 Vertical circle index error and collimation error correction

With this option, making both face angular observations, the 0 index error of the vertical circle of the instrument can be measured and corrected. Meanwile,the collimation error can be measured too. If users select correcting collimation error in the config mode, the collimation error can be compensated in single face observations.

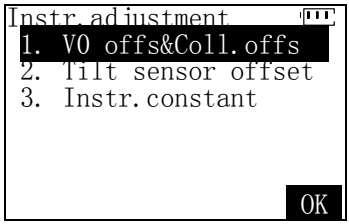
① In the status screen press 【CNFG】 to enter the menu < Configuration> .



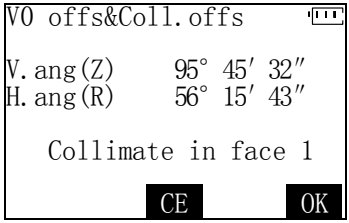

② Select "Instr. adjustment" .The instrument prompts to enter password.




③ Input"1234", press 【OK】 to enter the menu < Instr. adjustment >.

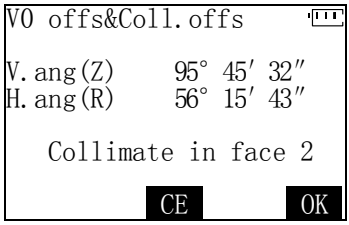


④ Select "V0 offs&Coll.offs".

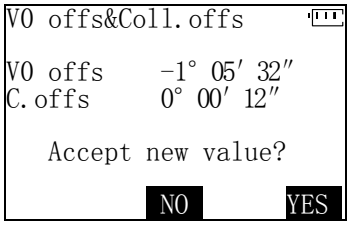



⑤ Accurately collimate a target with a distance of 30m or further in normal telecope setting(Face 1), then press 【OK】.

- Press 【CE】 to cancel the last operation and redo it.




⑥ Loosen the horizontal clamp, rotate the top of the instrument through 180°, collimate the same target accurately in reverse telecope setting (Face 2),press 【OK】.If there's no error in operation, the offset value of vertical circle index and collimation are displayed.




⑦ Press 【YES】 to accept the values for correction and return to the menu< Instr.adjustment>.

## 13.6 Tilt sensor zero point error check and adjustment

If tilt angle correction enabled, the tilt sensor zero point error will adversely affect angle measurement. So it is necessary to check and adjust the tilt sensor zero point error periodically.

- **Check**

① Accurately level the instrument. turn the power on, press【★】 to enter the shortcut functions of star key. Press【TILT】 to observe the tilt angle for the instrument.

② Sight a target in normal telecope setting(Face 1) and read the values of tilt angle Tx1 and Ty1 after the display is stable.

③ Loosen the collimation of the instrument and rotate it for 180°, reversely sight the same target(Face 2). Read the values of tilt angle Tx2 and Ty2 after the display is stable.

④ Calculate the zero deviation value of the tilt sensor:

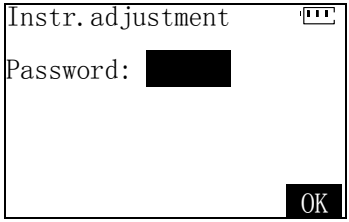
Zero point error in direction X = (Tx1+ Tx2)/2

Zero point error in direction Y = (Ty1+ Ty2)/2

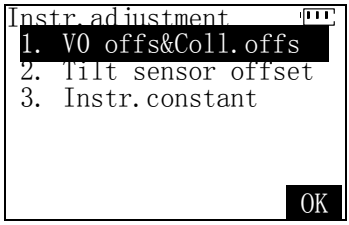
Correction is not needed in case the obtained value is within ±20″, otherwise correction must be performed as per the following method.

- **Adjustment**

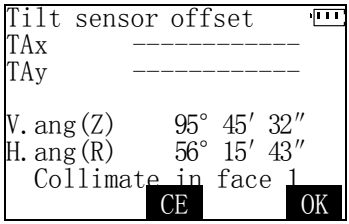
① Select “Instr. adjustment” In the menu < Configuration>， The system prompts to enter password.



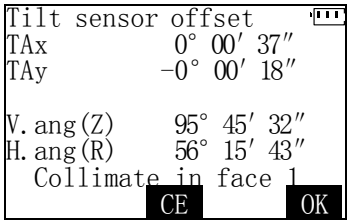
② Input“1234”, then press 【OK】 to enter the menu < Instr. adjustment >.




③ Select “Tilt sensor offset”.

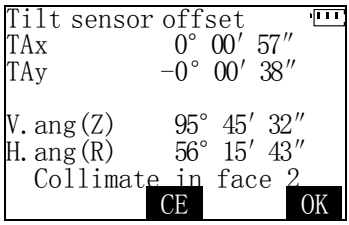



④ Leveling the instrument, the tilt angle value in the X-direction and the Y-direction of the instrument are displayed.

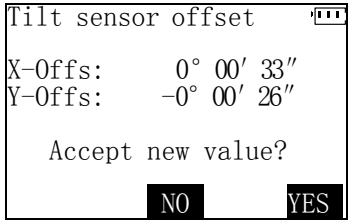



⑤ Accurately colimate a target with a distance of 30m or further in normal telecope setting(Face 1), then press 【OK】.

- Press 【CE】 to cancel the last operation and redo it.



⑥ Loosen the horizontal clamp, rotate the top of the instrument through 180°, collimate the same target accurately in Face 2, then press 【OK】. If there's no error in operation, the new offset value of tilt sensor zero point is displayed.



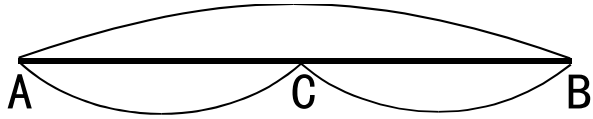

⑦ Press 【OK】 to accept the new value for correction and return to the menu <Instr. adjustment>.

## 13.7 Check and adjust the constant of instrument

The additive distance constant of the instrument is adjusted accurately before delivery, and seldom deviates. The additive distance constant can be checked using a baseline with a known distance precision. If there is no baseline, perform these checks as follows.

- **Check**

① Find an area of flat ground where two points 100m apart can be selected. Set up the instrument at point A and the reflective prism at point B, establish a point C half way between points A and B.




② Precisely measure the horizontal distance between point A and point B 10 times and calculate the average value.

③ Place the instrument at point C directly between points A and B and

set up the reflective prism at point A.

④ Precisely measure the horizontal distances CA and CB 10 times each and calculate the average value for each distance.

⑤ Calculate the additive distance constant as follows：K=AB－(CA＋CB)

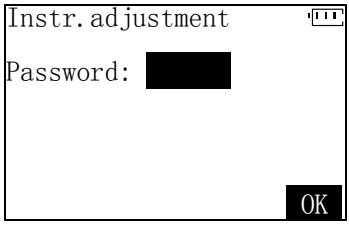
K should near equal to 0, if |K| >5mm, it should send to standard base line to check carefully, then to correct it.

**Caution:** Error in setting up the instrument and reflective prism or in sighting the target will influence the additive distance constant. Be extremely careful to prevent such errors when performing these procedures. Set up so that the instrument height and the target height are identical. If a flat place is not available, use an automatic level to make sure the heights are identical.

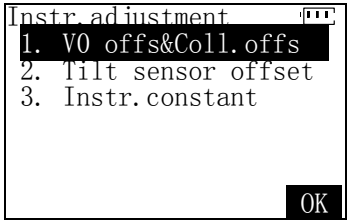
- **Adjustment**

If K changed not near equal to 0, customer should adjust it by step below:

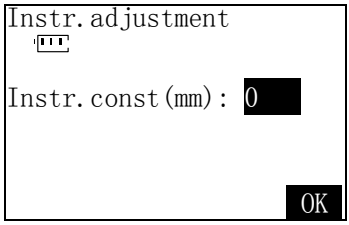
① Select “Instr. adjustment” in the menu < Configuration>，The system prompts to enter password.



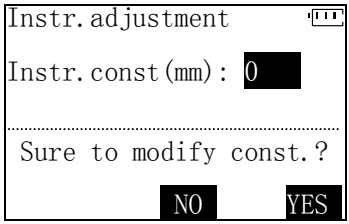

② Input“1234”, press【OK】to enter the menu < Instr. adjustment >.



③ Select “Instr. constant”.




④ Input the new value,press【OK】.




⑤ Press【YES】to confirm the new value and return the menu <Instr.adjustment>.

# 14. Maintenance

- If the instrument is moistened by the rain, please make it dry immediately.
- Always clean the instrument before returning it to the carrying case. Then lens requires special care. First, dust it off with the lens brush to remove tiny particles, then wipe it with the lens paper or clean soft cloth.
- If the display is dirty, carefully wipe it with a soft, dry cloth. To clean other parts of the instrument or the carrying case, carefully wipe the surface of the unit with a slightly damp cloth moistened in a mild detergent solution. Do not use any organic solvents cleaning the display, key panel and the carrying box.
- Store the instrument in a dry room where the temperature remains fairly constant.
- Often check the tripod for loose fit and loose screws when it is used for a long time.
- If any trouble is found on the rotatable portion, screws or optical parts, please contact our company.
- If the instrument will be not used for a long time, disjoin the instrument and the battery and charge the battery at least once every month.
- When the instrument is not used for a long time, check it at least once every 3 months, following the steps in“13.checks and adjustments”.
- When removing the instrument from the carrying case, never pull it out by force. The empty carrying case should be closed to protect it from moisture.
- Check the instrument for proper adjustment periodically to maintain the instrument accuracy.

# 15. Error message

| Message | Meaning | What to do |
|---|---|---|
| Over range | The instrument is tilted beyond the vertical compensation range. (±3') | Re-level the instrument or turn off the tilt compensation in the bad conditions. if the message displays again, repair is required. |
| Signal off | The reflector is not aimed, the target reflectivity is low or the target is blocked. | Aim at the target again. In case no reflector measurement, please use reflective sheet or prism. |
| Wrong face | During setting of the vertical circle index error or during setting of the tilt compensator zero point error, when sighting target in Face 1 and Face 2,the difference of horizontal angle is not 180° (±30'). | Redo it and confirm sight the same target accurately in Face 1 and Face 2. |

| Message | Meaning | What to do |
|---|---|---|
| E01 | During setting of the 0 index of the vertical circle, the value measured is out of range. | Redo it and confirm the operation procedure is correct. If the message displays again, repair is required. |
| E02 | During measuring of the tilt zero point error, the measured value is out of range. | Redo it and confirm the operation procedure is correct. If the message displays again, repair is required. |
| E03 | During measuring of the collimation error, the measured value measured is out of range. | Redo it and confirm the operation procedure is correct. If the message displays again, repair is required. |
| E04 | There's abnormality in internal memory system. | Turn off the power and turn it on again, if the message displays again, repair is required. |

| Message | Meaning | What to do |
|---|---|---|
| E06 | Displayed when any abnormality occurs in angle measuring system. | Turn off the power and turn it on again, if the message displays again, repair is required. |
| E11 | Displayed when any abnormality occurs in distance measurement communication. | Turn off the power and turn it on again, if the message displays again, repair is required. |
| E20 | There's abnormality in reading and writing SD card . | Turn off the power and turn it on again, if the message displays again, repair is required. |

# 16. Specifications

**Telescope**

| | |
|---|---|
| Aperture: | 45mm |
| Magnification： | 30× |
| Image | Erect |
| Field of view | 1° 30′ |
| Minimum focus: | 1.5m |

**Distance Measurement**

Measuring range（in good atmospheric conditions）

Without prism （Standard whiteboard：White face，Standard A4 paper

MTS1202R 230m
MTS1202R+ 600m

Reflection film:（White 3M LDP series dimond-class reflection film, and the dimension is standard 6cm×6cm )

MTS1202R 500m
MTS1202R+ 1000m

Single prism:(in good weather condition)

MTS1202R ----5.0km
MTS1202R+---7.5 km
MTS1202 -----5.0km
MTS1205 -----5.0km

Accuracy :

| | |
|---|---|
| Prism mode | ±(2mm+2ppm·D) |
| Without prism mode | ±(5mm+3ppm·D) |

Minimum display: 1 mm

Measuring time

Fine measurement (repeat) about1.8sec (first time2.5sec)

Rapid measurement (repeat): about 0.8sec (first time 2.5sec.)

Tracking measurement: about 0.3 sec (first time 1.5sec.)

Atmospheric correction: -499ppm~+499ppm（step1ppm）

Target constant correction: -99mm~+99mm (step 1ppm)

**Angle measurement**

Minimum display: 10″ /5″ /1″

Standard deviation:

MTS1202R ---2″

MTS1202R+---2″

MTS1202------2″

MTS1205------5″

Measuring time: 0.1sec

Range of compensation : ±3′

Level parameter ：

Circular level： 8'/2mm

Plate level : 30″/2mm

**Plummet**

Red laser 1.5mm(Ins.H:1.5m)

**Data management and transfer**

Memory points 50000

SD card（optional） 2G---16G

transmission

RS-232C
USB (optional)
bluetooth（optional）

**Battery**

Voltage: DC 7.2—7.4V

Capacity

Rechargeable batteries BDC25H 2.5AH

Working duration（20℃）:

Distance and angle measurement: 6 hours

Angle measurement 20 hours

Rechargeable batteries BDC40L(optional) 4.0AH

Working duration（20℃）:

Distance and angle measurement: 10 hours

Angle measurement 32 hours

Rechargeable batteries BDC40L(optional) 3.0AH

Working duration（20℃）:

Distance and angle measurement: 8 hours

Angle measurement 25 hours

**Temperature range**

Storage : -40℃～+60℃

Operating : -20℃～+55℃

**Dimension** 190X210X350mm

**Weight** 6.5kg