STONEX

R1 PLUS

THE MOST AFFORDABLE HIGH PRECISION TOTAL STATIONS

Laser technology (class 3 laser with a wavelength between 650 and 690 nm) for distance measurement

Alphanumeric keyboard on both sides with high resolution LCD display and backlight and 6 lines of 20 characters

STONEX R1 PLUS
TOTAL STATION INSTRUCTION MANUAL

R1-5 PLUS 300

Dear Customer:

Congratulations! We, STONEX are proud to present you with these series instrument. Your total station is a rugged and reliable instrument whose performance and design are not surpassed.

To fully appreciate and protect your investment, we suggest that you take the necessary time to read and fully understand this manual. We have a dedicated service organization. If the need arises, please don't hesitate to contact us.

Thank you for your trust and confidence.

Contents

1. Precautions for Safety

1.1 Note

◆**Don't collimate the sun directly**

Avoid insolating the instrument, and don't collimate the sun directly for protecting eyes and instrument.

◆**Avoid the librations on the instrument**

When transporting, keep the instrument in the case and try your best to lighten librations.

◆**Carry the instrument**

When carrying, the instrument handle must be hold tight.

◆**Check the battery power**

Before using it, you should check the power whether it is enough.

◆**Battery maintenance**

If the instrument is not used for a long time, the battery should be taken out from the instrument and stored in separate place. Meantime, the battery should be charged every month.

◆**Take out the battery**

It is not suggested to take out the battery when the instrument is on, otherwise, the stored data may be lost, so it is better to replace the battery after power off the instrument.

◆**Set up the instrument on the tripod**

When using it please insure the connection between tripod and instrument is firm. It is better to work with wooden tripod for the measurement accuracy.

◆**Assemble the tribrach on the instrument**

The setting of tribrach would influence the accuracy. The tribrach should be check frequently, the screw which connects the tribrach and alidade must be locked tightly. And the central fixing screw should be tight.

◆**High temperature condition**

Don't put the instrument in high temperature condition for a long time, it is bad for the instrument performance.

◆**Temperature changing sharply**

The sharp temperature changing on the instrument or prism will shorten the distance measurement range, for example, after taking the instrument out from a warm car to a cold condition, wait for some time, it can be used when it adapts the surrounding condition.

◆**The noise from the instrument**

When the instrument working, it is normal if you hear the noise from instrument motor, it will not affect the instrument work.

◆**Stored data responsibility**

STONEX should not be held liable for the lost data because of wrong operation.

1.2 Definition of Indication

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

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

⚠ WARNING:	Ignoring this indication and making an operation error could possibly result in death or serious injury to the operator.
⚠ CAUTION:	Ignoring this indication and making an operation error could possibly result in personal injury or property damage.

⚠ WARNING

● Do not perform disassembly or rebuilding. Fire, electric shock or burns could result. Only STONEX authorized distributors can disassemble or rebuilt.

● Do not collimate the sun directly. The eye injury or blind could result.

● Do not cover the charger. Fire could be result.

● Do not use defection power cable, socket or plug. Fire, electronic shock could result.

● Do not use wet battery or charger. Fire, electronic shock could result.

● Do not close the instrument to burning gas or liquid, and do not use the instrument in coal mine. Blast could be result.

● Do not put the battery in the fire or high temperature condition. Explosion, damage could result.

● Do not use the battery which is not specified by STONEX. Fire, electric shock or burn could result.

● Do not use the power cable which is not specified by STONEX. Fire could result.

● Do not short circuit of the battery. Fire could result.

● When this product encounters disturbance of severe Electrostatic Discharge, perhaps it will have some degradation of performance like switching on/off automatically and so

on.

<div align="center">

⚠ CAUTION

</div>

● Do not touch the instrument with wet hand. Electric shock could result.
● Do not stand or seat on the carrying case, and do not turn over the carrying case arbitrarily, the instrument could be damaged.
● Be careful of the tripod tiptoe when setup or move it.
● Do not drop the instrument or the carrying case, and do not use defective belt, agraffe or hinge. Instrument damage could result.
● Do not touch liquid leaking from the instrument or battery. Harmful chemicals could cause burn or blisters.
● Please assemble the tribrach carefully, if the tribrach is not stable, series damage could result.
● Do not drop the instrument or tripod, series damage could result. Before use it, check the central screw is tight.

1.3 Safety Standards for Laser (R1 series)

R1 series adopt the class of Laser Product according to IEC Standard Publication 60825-1 Amd. 2:2001. According this standard, EDM device is classified as Class 3R Laser Product when reflectless measurement is selected, when the prism and reflective sheet is selected as target, the output is equivalent to the safer class 1. Follow the safety instructions on the labels to ensure safe use.

CAUTION: CLASS 3R LASER RADIATION WHEN OPEN

AVOID DIRECT EYE EXPOSURE.

CAUTION: CLASS 2 LASER RADIATION WHEN OPEN

DO NOT STARE INTO THE BEAM

Laser emit

CAUTION

Note for Safety

⚠ WARNING

- Never point the laser beam at other's eyes, it could cause serious injury.
- Never look directly into the laser beam source, it could cause permanent eye damage.
- Never stare at the laser beam, it could cause permanent eye damage.
- Never look at the laser beam through a telescope or other optical devices, it could cause permanent eye damage.

1.4 About User

1) This product is for professional use only!

The user is required to be a qualified surveyor or have a good knowledge of surveying, in order to understand the user manual and safety instructions, before operating, inspecting or adjusting.

2) Wear required protectors (safety shoes, helmet, etc.) when operating.

1.5 Exceptions from Responsibility

1) The user of this products is expected to follow all operating instructions and make periodic checks of the product's performance.

2) The manufacturer, assumes no responsibility for results of a faulty or intentional usage or misuse including any direct, indirect, consequential damage, and loss of profits.

3) The manufacturer, assumes no responsibility for consequential damage, and loss of profits by any disaster, (an earthquake, storms, floods etc.).

4) The manufacturer, assumes no responsibility for any damage, and loss of profits due to a change of data, loss of data, an interruption of business etc., caused by using the product or an unusable product.

5) The manufacturer, assumes no responsibility for any damage, and loss of profits caused by usage except for explained in the user manual.

6) The manufacturer, assumes no responsibility for damage caused by wrong transport, or action due to connecting with other products.

2.   Preparation before Measurement

2.1 About Battery
2.1.1 Battery Power Symbol

```
┌─────────────────────────────────┐
│ Meas    PC    0.0               │
│         ppm   0      ⊥⁺         │
│                                 │
│ SD                       ▯      │
│ VA                              │
│ HA                       P1     │
│ DIST SHV1 SHV2 0 S E T          │
└─────────────────────────────────┘
```

Measurement is possible

The battery is lower, it is better to replace or recharge it

Measurement is impossible, it is necessary to replace or recharge battery
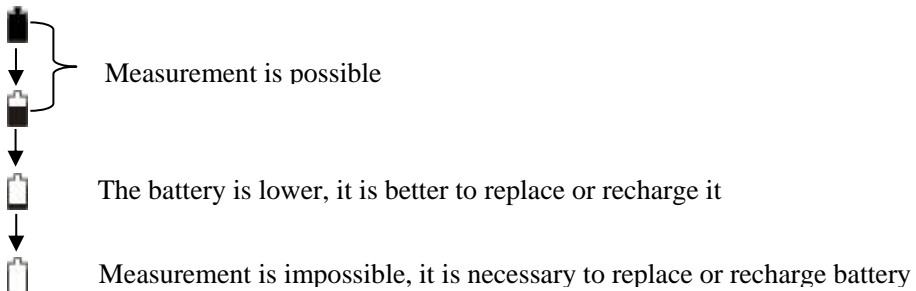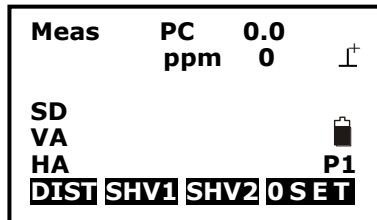
NOTE:

◆The working time of battery will be effected by many factors, such as ambient temperature, recharging time, recharging and discharging times. On the data safe side, we suggest the users recharge the battery full or prepare several full batteries before operation.

◆ The battery symbol only indicates power capability for current measurement mode. The power consumption in distance measurement mode is more than in angle mode, if the instrument enters into distance measurement mode from angle mode, the power maybe auto-off because of lower battery.

◆The symbol only indicates the supply power but not the instantaneous power change. And if the measurement mode changes, the symbol will not show the power's decrease or increase immediately.

◆It is suggested to check every battery power before field work.

2.1.2 Replace the Battery

1) Remove the battery

①Press the button downward as shown left
②Remove the battery by pulling it toward you

2) Mount the battery

①Insert the battery to the instrument
②Press the top of the battery until you hear a
    Click.

2.1.3 Recharge the Battery

As above figures show, connect the charger and the battery, then plug the charger into the outlet of 100V-240V AC power supply, recharging will begin.

NOTE:

◆For a new (or long time no use) battery, in order to fully extend its capacity, it is absolutely necessary to carry out 3 to 5 complete charging/discharging cycles, and the charging time must be 10 hours at least each time.

◆The indicator light on the charger will illuminate three separate colors for varies mode conditions:

Solid Red Light—indicates that the charger is working;

Solid Green Light— indicates that the charge has finished;

Flashing Red Light—indicates no battery on charging, poor connection or some problems exist.

◆It is recommended to continue charging for 1 or 2 hours after the light turn green.

◆Once the red light flashes constantly after the charger is plugged into the outlet of 100V-240V AC power supply, please remove the battery and reconnected it after 3 or 5 min.

2.2 Setting up the Instrument

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

I. Set up the tripod first: extend the extension legs to suitable lengths and tighten the screws on the midsections. 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.

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

2.3 Centering and Levelling-Up

1. Position tripod legs so that the plummet is aimed to the ground mark point. Turn the focusing ring of the optical plummet to focus.

2. Turn three footscrews of the tribrach till the center of reticle exactly coincides with the surveying point in any position.

3. Move the tripod legs to center the circular level. The instrument is now roughly leveled-up.

4. Center the bubble in the circular level

Screw A   Screw B

Plate level

Screw C

Loosen the horizontal motion clamp, and turn the instrument till the plate level is parallel to a line shaped with screws A and B. Adjust the screws A and B to make the bubble in the center of the level.
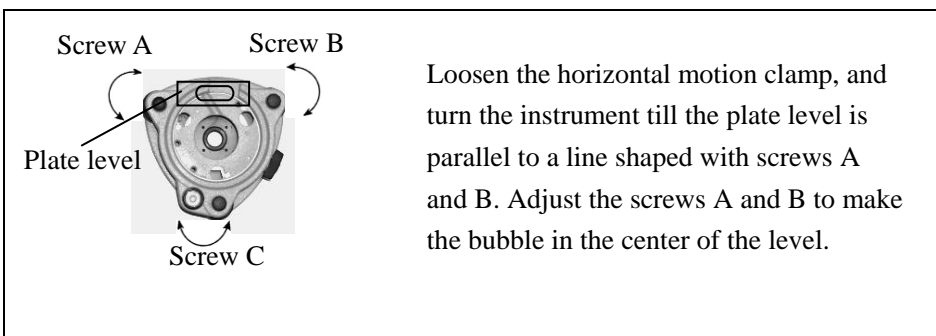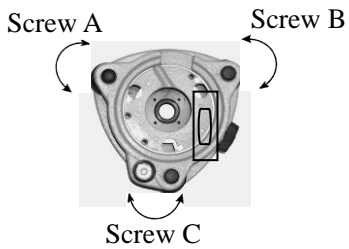
Turn the instrument approximately 90°. Adjust screw C, till the bubble in the center of the level.

Repeat above steps until the bubble remains in the center of the plate level while the instrument is rotated to any position.

5. Center the surveying point again

Loosen the centering screw slightly. Looking through the optical plummet eyepiece, slide the instrument over the tripod head until the surveying point is exactly centered in the reticle. Re-tighten the centering screw securely.

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

If not, repeat procedure 4.

2.4 Accurate Levelling-Up with Electronic Level on screen

It is convenient for R1 series to level-up with electronic level, especially when it is difficult to observe the circular level and plate level.

```
Tilt Value
  Tilt Mode
XONYON ⬍
Lightness

   0
◄ ☐☐☐☐☐ ►
```
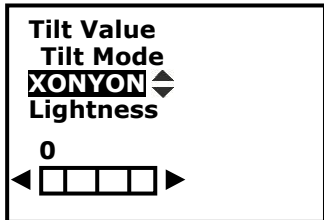
1. Power on the instrument and press key {BS} directly, and the electric level displays on screen.

```
  X      -0° 00'02''
Tilt Mode
XONYON ⬍
Lightness

   0
◄ ☐☐☐☐☐ ►
```
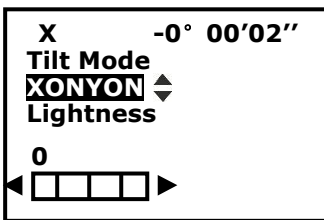
2. Level it by turning three foot screws, see above operation "3. Center the bubble in the plate level".

Note:

1. On this menu you can turn on/off the X/Y compensator by pressing ▲ or ▼ key.

2. If the instrument is equipped with laser plummet, after opening this menu, the laser plummet adjusting bar will display. With pressing ◄ or ► key the laser lightness can be adjusted.

3. Basic Functions

3.1 Nomenclature

Handle

Handle screw

Objective

Battery

Serial number

Onboard SD card

Keypad

USB port

Display

Horizontal motion clamp

Horizontal tangent screw

Tribrach

Footscrew

Optical sight

Eyepiece

Vertical motion clamp

Instrument height mark

Vertical tangent knob

Plate level

Model label

RS-232C port

Tribrach clamp

Circular level

S STONEX

3.2 Basic Key Operation

Keys	Description
F1~F4	Select the functions matching the softkeys
0~9	1.Input number when numeric input
	2.Input characters when alphabetic input
·	Input a decimal point
±	Input plus/minus sign
Power	Power on/off
★	Enter into setting mode directly
ESC	Escape to the previous menu or mode
SFT	1. Shift between number and alphabetic when inputting
	2.Shift targets model when measuring
BS	1. Delete the character at the left of the cursor when inputting
	2. Open electronic level menu
Space	1. Input a black space when inputting
	2. Input the target or instrument height
Func	Turn page
ENT	1. Select/Accept input data
	2. Accept the option when selecting

3.3 Display

The LCD could display 6 lines with 20 characters per line. In measurement mode, it displays some common information in above 5 lines and displays soft functions in the last line.

Status screen

```
                                    ──────────► Instrument model
  ┌──────────────────────────┐
  │ 02/12/2010  10：52：35     │
  │      R1 PLUS             │
  │ S/N      JK0002          │──────► Application software version
  │ Ver      13-03-08    🔋   │──────► Current power
  │ JOB      JOB1            │
  │ MEAS        MEM CNFG     │──────► The active JOB
  └──────────────────────────┘
                                   ►Enter into config mode directly
```

Basic measure mode

```
                                    ──────────► Target type
  ┌──────────────────────────┐
  │ Meas       PC    0.0     │
  │            ppm   0 ╨      │──────► Compensator on/off
  │                   ▷      │
  │ SD                      │
  │ VA                🔋     │
  │ HA                P1     │
  │ DIST SHV1 SHV2 0 S E T   │──────► Page
  └──────────────────────────┘
```

Measuring

```
  ┌──────────────────────────┐
  │ Dist                    │
  │                   ▷     │
  │ Fine        ppm 0       │
  │                         │
  │                         │
  │ -----※       STOP       │
  └──────────────────────────┘
                ───────► Measuring now
```

14
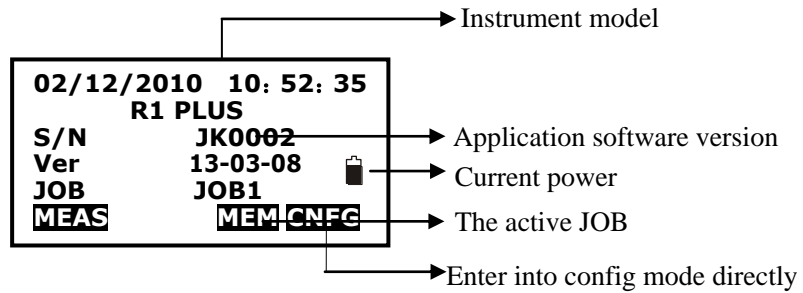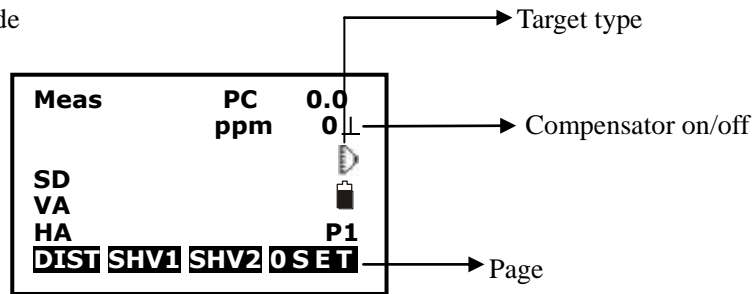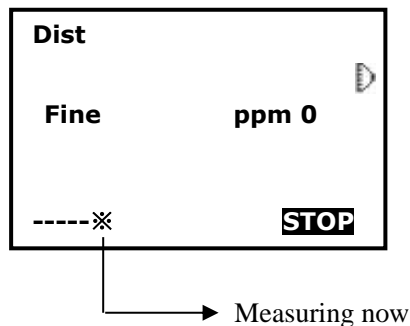
3.4 Mode Diagram

Meas mode

```
02/12/2010  10:52:35
        R1 PLUS
S/N        JK0002
Ver        13-03-08
JOB        JOB1
MEAS        MEM CNFG
```

[MEAS] →

{ESC} ←

```
Meas        PC      0.0
            ppm      0

SD
VA
HA                   P1
DIST SHV1 SHV2 0SET
CORD MENU HOLD HSET
EDM OCC OFST REC
```

[MEM] ↓   {ESC} ↑

```
Memory
1.JOB
2.Known data
3.Code
4.Storage Media
5.USB
```

{1}

```
JOB              P1
1.JOB select
2.JOB rename
3.JOB delete
4.Download
5.Com setting
```

[Func] ↓

```
JOB              P2
1.File copy
```

{2}

```
Known data    JOB 1
1.Key input
2.Com input
3.Delete
4.View
5.Clear
```

[Func] ↓

```
Known data    JOB 1
6.Com setting
```

[REC] →

```
REC      JOB1      P1
1.Occ.   data
2.Angle data
3.Collect Points
4.Note
5.View
```

[Func] ↓

```
REC      JOB1      P2
1.JOB select
```

[MENU] →

```
Menu              P1
1.Coordinate
2.Stake out
3.Area
4.Offset
5.MLM
```

[Func] ↓

```
Menu              P2
1.REM
2.Resection
3.Point Projection
4.Line stake out
5.Traverse
```

[Func] ↓

{3}

```
Code
1.Code Edit
2.Clear List
```

```
Menu                    P3
1.Inverse                ▲
2.Polarize
3.Repeat Measure         █
4.Arc staking out
5.Road Calculation
```

Cnfg mode

```
02/12/2010  10：52：35
        R1-2PLUS
S/N         JK0002
Ver         13-03-08  █
JOB         JOB1
MEAS           MEM CNFG
```

[CNFG]   {ESC}

```
Config              P1
1.Meas condition
2.Inst.config
3.Inst.adjust       █
4.Com setting
5.Unit
```
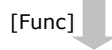
[Func]

```
Config              P2
1.Date&Time          ▲
2.Key Function
                     █
```

Setting mode (Press {★} directly)

```
Inst. Config        P1
1.Backlight     : YES
2.Laser         :NO
3.contrast      :9
4.Ret. Lev.     :0
EDM
```
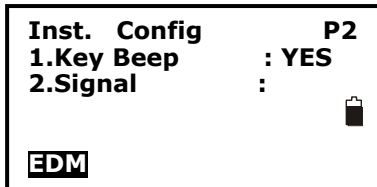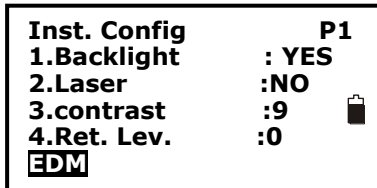
```
Inst.  Config       P2
1.Key Beep      : YES
2.Signal        :

EDM
```

3.5 Power On/Off

I. Power on

```
    Demo mode
  10 points limited

            REG SKIP
```
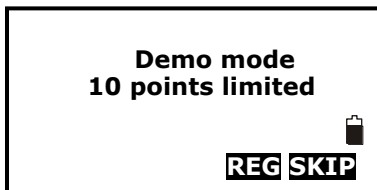
1.Confirm the instrument is leveling, press the red key {POWER},then press the key {skip}.

```
    STONEX
Initing……
```

```
02/12/2010  10:52:35
       R1 PLUS
S/N         JK0002
Ver         13-03-08
JOB         JOB1
MEAS        MEM CNFG
```
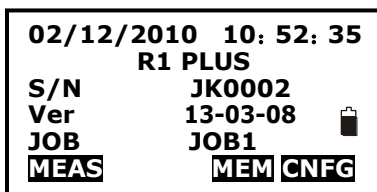
2.The instrument will power on and display the status screen.

II. Power off

```


POWER OFF?



        YES  NO
```
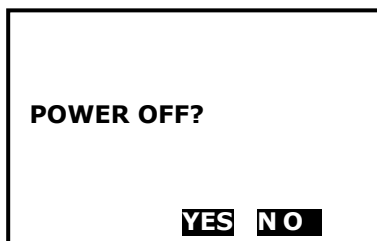
Press {POWER} key, the instrument will ask you to turn off the instrument or not, press F3(Yes), it will be turned off, press F4(No) back to previous screen.

3.6 Registration & Demo Mode

When you start R1 for the first time you will see the registration screen.

To activate R1 program you need to call Stonex local dealer, or email us the instrument serial number.

```
┌─────────────────────────────┐
│                             │
│      Demo mode              │
│  10 Data points limited  1  │
│                             │
│                          ▯  │
│             REG  SKIP       │
│                             │
└─────────────────────────────┘
```

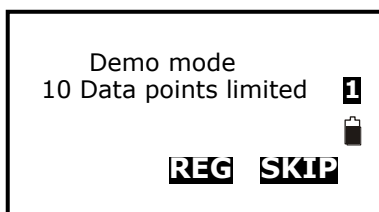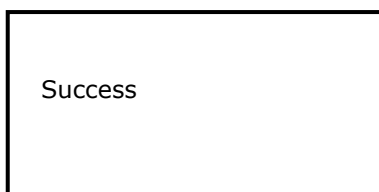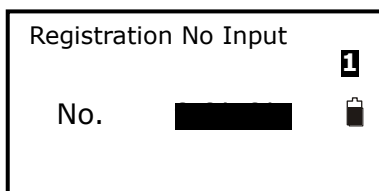We will then issue you a registration number that you can enter in the No. field. Press F3(REG) key to program resisting screen, when you enter the registration number you will see the words "Success" and the program will run in registered mode.

```
┌─────────────────────────────┐
│ Registration No Input       │
│                          1  │
│                             │
│   No.     ██████████     ▯  │
│                             │
│                             │
└─────────────────────────────┘
```

```
┌─────────────────────────────┐
│                             │
│                             │
│  Success                    │
│                             │
│                             │
│                             │
└─────────────────────────────┘
```

If you have no the registration number, you can press F4(SKIP) to run R1 in demo mode. In Demo mode the program is limited to taking only 10 points.

3.7 How to Input Number and Alphabet

```
001:CODEAB
002:[████████████]    1
003:
004:                  🔋
005:
↑↓.P TOP LAST DEL
```
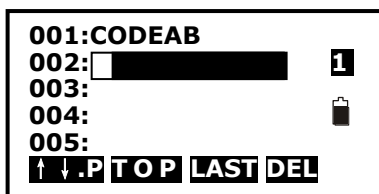
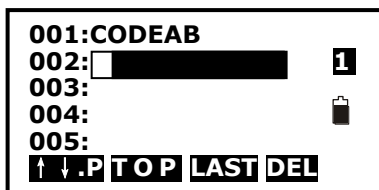1. Enter into input code status (See§21.1 Input a code), the cursor is blinking and ready to input. The note "A" at the top right corner shows the active input mode, you can press the key {shift} to switch between alphabet and number.

```
001:CODEAB
002:[████████████]    1
003:
004:                  🔋
005:
↑↓.P TOP LAST DEL
```

2. Input the code in turn and press the blue key {ENT} to save it. You can press key {BS} to delete your wrong input before the cursor. The max length of a code is 16 characters.

3.8 How to Configure

```
Inst. Config        P1
1.Backlight      : YES
2.Laser          :NO
3.contrast       :9
4.Ret. Lev.      :0
EDM
```

Press key {★} on panel directly to enter into in any status, and do some basic settings.

1. Backlight
Press numeric key {1}, then press left key { ▶} or right key { ◀} to turn on or not.

```
Inst. Config        P1
1.Backlight      : YES
2.Laser          :NO
3.contrast       :9
4.Ret. Lev.      :0
EDM
```

2. Laser
Press numeric key {2}, then press left key { ▶} or right key { ◀ } to turn no/off laser beam for pointing target.

```
Inst. Config        P1
1.Backlight      : YES
2.Laser          :NO
3.contrast       :9
4.Ret. Lev.      :0
EDM
```

3. contrast
Press numeric key {3}, then press left key { ▶} or right key { ◀ } to adjust LCD display contrast.

```
Inst. Config        P1
1.Backlight      : YES
2.Laser          :NO
3.contrast       :9
4.Ret. Lev.      :0
EDM
```

4. Ret. Lev.
Press numeric key {4}, then press left key { ▶ } or right key { ◀} to telescope illumination on reticle. If the value is zero, the illumination is turned off.

```
 EDM                P1
Mode        :Fine "s"
Reflector   :NoPrism
Pri.  const :0.0
```

5. EDM setting menu
Press function key {F1} to open the EDM setting menu.

```
 EDM                P2
Temp        : 20℃
Pressure    :760mmHg
ppm         :0
OPPM
```

Press Func key to turn to page 2.

Press Func key to turn to page 2 of Star Configure menu

```
Inst. Config      P2
1.key Beep    : YES
2.signal      :

EDM
```
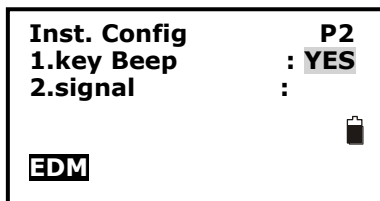
1. Key beep
Press numeric key {5}, then press left key { ▶ } or right key { ◀ } to turn on key beep or not, if you select NO, you will not hear the beep voice when press any key.

```
Inst. Config      P2
1.key Beep    : YES
2.signal      :

EDM
```
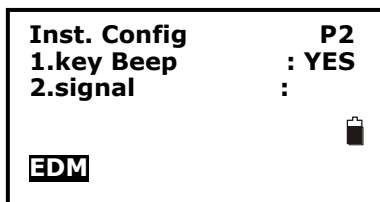
2. Signal
Aim at a target, then press numeric key {3} and the instrument will beep, the EDM returned signal value will display simultaneously.

3.9 How to Set Parameters

Press key {F4} on the keyboard to enter into config mode in any status, all the following items can be set.

3.9.1 Measure Condition Setting

```
Config              P1
1.Meas condition
2.Inst. config
3.Inst. adjust
4.Com setting
5.Unit
```

1. Press key {F4} to enter into config mode.

2. Select "**1.Meas condition**" to set measurement parameters. All items display on two pages.

```
Obs. condition      P1
1.Dist mode :Hdist
2.Tilt adjust :XOFFYOFF
3.C&R crn.  :.14
4.V.  obs    :Zenith
5.H.  obs    :HAR
```
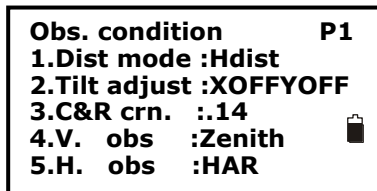
3. Change the settings if necessary. Press keys { ▲ }/ { ▼ } to select items and press keys { ◀ }/ { ▶ } to set options.

```
Obs. condition      P2
1.HA  Buzzer   :No
2.Coord        :N-E-Z
3.Ang.reso..   :1″
4.Code eff     :ALL
5.Vd mode      :VD
```

4. Press Func key to turn to page 2.

```
Obs. condition      P3
1.Min Unit     :1mm
```
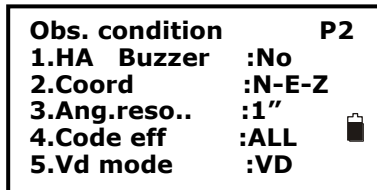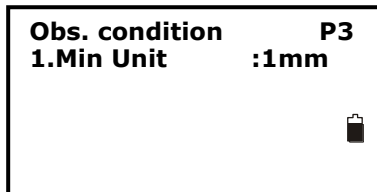
5.Press Func key to turn to page 3.

6. Press key {ESC} back to the previous mode.

Table 3-1 List of measurement condition setting

Item	Options
1.Dist Mode	SD * /HD/VD
2.Tilt Mode	XonYon * /XonYoff/XoffYoff
3.C&R crn	.14 * /.20/No
4.V. obs	Zenith * /VA/V90
5.H. obs	HAR * /HAL
1.HA Buzzer	No * /Yes
2.Coord	N-E-Z * /E-N-Z
3.Ang .reso	1″ * /5″ /10″ ; 0.0002g * /0.001g/0.002g; 0.005mil * /0.02mil/0.05mil
4.Code eff	The manual input code is available once or always
5.Vd mode	Display mode of vertical distance: to instrument center or to the ground
1.Min Unit	According to the minimum unit

NOTE:

◆Every first options with the symbol " * " are the factory setting.

3.9.2 Instrument Basic Setting

```
Config              P1
1.Meas condition
2.Inst. config
3.Inst. adjust
4.Com setting
5.Unit
```
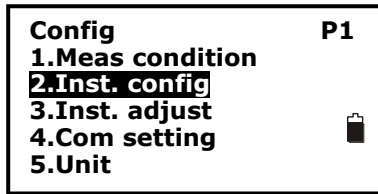
1. Press key {F4} to enter into config mode.

2. Select "**2.Inst. config**" to set instrument basic parameters. Three items display.
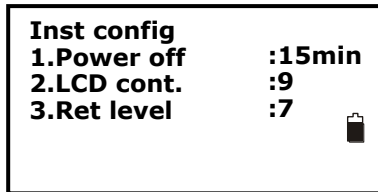
```
Inst config
1.Power off     :15min
2.LCD cont.     :9
3.Ret level     :7
```

3. Change the settings if necessary. Press keys { ▲ }/ { ▼ } to select items and press keys { ◀ }/ { ▶ } to set the options.

4. Press key {ESC} back to the previous mode.

Table 3-2   Option list of basic setting

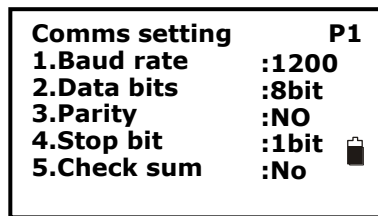| Item	Options
1. Power off	30min * /No/5min/10min/15min (The instrument would power off automatically to save battery if no operation in setting time)
2.LCD cont.	0~13 (9 *)
3.Ret level	0~9 (7 *)

NOTE:

◆The options with the symbol " * " are the factory setting.

3.9.3 Communication Port Setting

Please set communication parameters before connecting your computer.

```
Config              P1
1.Meas condition
2.Inst. config
3.Inst. adjust
4.Com setting
5.Unit
```
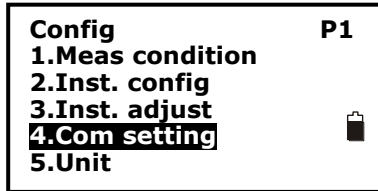
1. Press key {F4} to enter into config mode.

2. Select "**4.Com setting**" to set the parameters of communication port.

```
Comms setting      P1
1.Baud rate    :1200
2.Data bits    :8bit
3.Parity       :NO
4.Stop bit     :1bit
5.Check sum    :No
```

3. Change the settings if necessary. Press keys { ▲ }/ { ▼ } to select items and press keys { ◄ } / { ► } to set the options.

```
Comms setting      P2
1.Xon/Xoff     :No
```
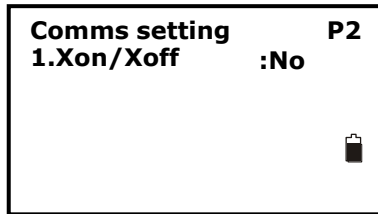
4. Press Func key to turn to page 2.

5. Press key {ESC} back to the previous mode.

Table 3-3   Option list of com setting

Item	Options
1.Baud rate	1200 * /2400/4800/9600/19200/38400
2.Data bits	8bit * / 7 bit
3.Parity	No * / Even/ Odd
4.Stop bit	1bit * / 2bit
5.Check sum	No * / Yes
1.Xon/Xoff	No * / Yes

Note:

◆Every first options with the symbol " * " are the factory setting.

3.9.4 Unit Setting

```
Config              P1
1.Meas condition
2.Inst. config
3.Inst. adjust
4.Com setting
5.Unit
```
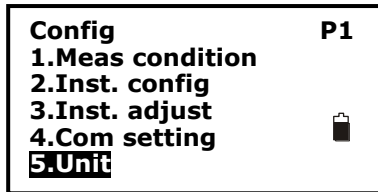
1. Press key {F4} to enter into config mode.

2. Select "**5.Unit**" to set unit.
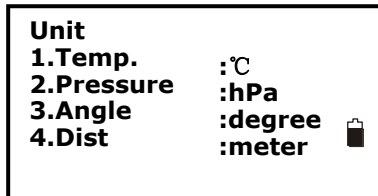
```
Unit
1.Temp.     :℃
2.Pressure  :hPa
3.Angle     :degree
4.Dist      :meter
```

3. Change the settings if necessary. Press keys { ▲}/ { ▼} to select items and press keys { ◀} / { ▶} to set the options.

4. Press key {ESC} back to the previous mode.

Table 3-4   Option list of unit setting

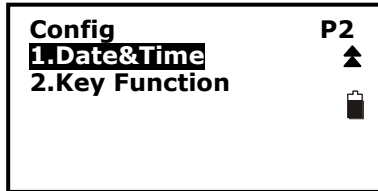| Item	Options
1.Temp.	℃ * / °F
2.Pressure	hPa * / mmHg / inchHg/mbar/psi
3.Angle	degree * / gon / mil
4.Dist	meter * / Us-feet/Int-ft

Note:

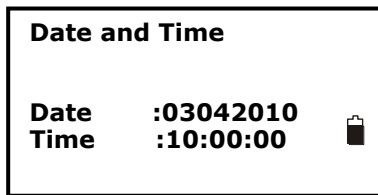◆Every first options with the symbol " * " are the factory setting.

3.9.5 Date & Time Setting

The date and time displays at the status mode.

```
Config              P2
1.Date&Time          ▲
2.Key Function
                     🔋
```

1. Press key {F4} to enter into config mode.

2. Select "**1.Date & Time**".

```
Date and Time


Date    :03042010    🔋
Time    :10:00:00
```
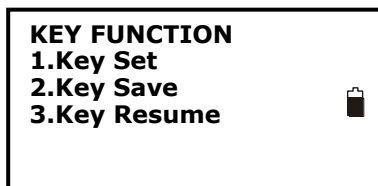
3. Input date and time. The date format: month/date/year.

4. Press key {ENT} to save settings and back to the previous mode.

3.9.6 Key Function Setting

1. Press key {F4} to enter into config mode.

```
Config              P2
1.Date&Time          ▲
2.Key Function
                     🔋
```

2. Select "**2.Key Function**".

3. Press key {1} to enter **Key Set** menu
4. Press key {2} to enter **Key Save** menu
5. Press key {3} to enter **Key Resume** menu

```
KEY FUNCTION
1.Key Set
2.Key Save            🔋
3.Key Resume
```

Key Set: the soft key's function at basic measurement mode can be changed

```
KEY SET

DIST  SHV1 SHV2 0SET
CORD MENU HOLD HSET
EDM  OCC  OFST  REC
```

1. Move the cursor to the key, change the key's function according to your need by pressing keys { }/ { } to select.

2. Press Key {F4} to confirm the key defined

Following items can be defined:

Items	Descriptions
DIST	Start distance measure
SHV1	Display switching between SD/HAVA, HD/HA/VA and VD/HA/VA
SHV2	Display switching between SD/HD/VD and SD/HA/VA
0SET	Set horizontal angle to 0
CORD	Enter coordinate measurement menu
MENU	Enter program menu
HOLD	Hold the horizontal angle
HSET	Set horizontal angle
EDM	Enter distance setting menu
OCC	Setting the station point
OFST	Enter offset measurement menu
REC	Enter points collection menu
RES	Enter resection program menu
REMS	Enter angle repeat measurement menu
MLM	Enter missing line measurement menu
S.O.	Enter stake out measurement menu
TILT	Display electronic level
REM	Enter remote elevation measurement menu
HARL	Horizontal angle display switching between HR and HL
ZA/%	Vertical angle display switching grade and zenith
OUT	Output the current measurement data via RS-232C port
AREA	Enter area measurement menu
ROAD	Enter road measurement menu
IHT	Enter instrument height setting menu
LSO.	Enter line stake out measurement menu
PROJ	Enter point projection measurement menu

KEY FUNCTION SAVE
**1.User Define 1**
2.User Define 2
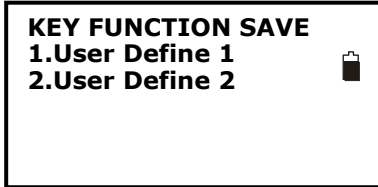
Key Save

1. Press key {1} to save the current key setting in **User Define 1**
2. Press key {2} to save the current key setting in **User Define 2**

KEY FUNCTION RESUME
1.User Define 1
2.User Define 2
3.Default Define
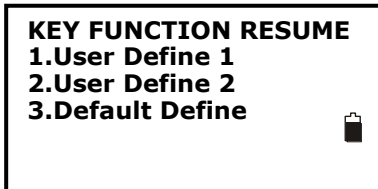
Key Resume

1. Press key {1} to resume the User Define 1 as the current Key setting
2. Press key {2} to resume the User Define 2 as the current Key setting
3. Press key {3} to resume the Default Define as the current Key setting
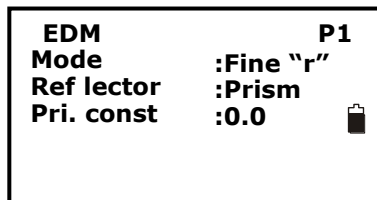
3.9.7 EDM Setting

Meas   PC   0.0
**   ppm   0**

SD
VA
HA   P3
EDM OCC OFST REC
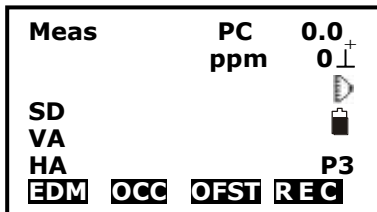
1. Press F1: [**MEAS**] in the status mode or select to enter into measure mode.

   Press key {Func} to turn to page P3.

2. Press F1: [**EDM**] to enter into EDM setting.

EDM   P1
Mode   :Fine "r"
Ref lector :Prism
Pri. const :0.0

3. Change the settings if necessary. Press keys { ▲}/ { ▼} to select the first three items and press keys { ◄} / { ►} to set the options.

4. Press Func key to turn to page 2.

EDM   P2
Temp.   :20℃
Pressure   :1013hPa
ppm   :0

0PPM
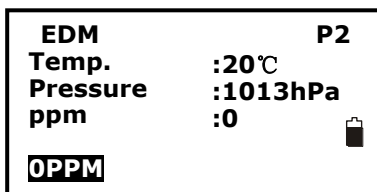
5. Press key {ESC} back to the previous mode.

Table 3-5　　EDM setting

Item	Options
1.Mode	Fine "r" * / FineAVG 3 / Fine "s" / Rapid "s" / Tracking
2.Ref lector	Prism * / Sheet/ No prism
3.Pri. const	-99~99
4.Temp.	-30～60℃(20℃ *)/-22～140℉
5.Pressure	500～1400hPa(1013hPa *); 375～1050mmHg(760mmHg *); 14.8～41.3 inchHg (29.9inchHg *) 500～1400mbar(1013mbar *); 7.2～20.3Psi(14.7Psi *)
6.ppm	-499～499(0 *), Press F1: [**0PPM**] to set temperature, pressure and ppm as factory setting.

Note:

◆Options with the symbol " * " are the factory setting.

◆ppm value could be calculated by inputted temperature and pressure, or input directly. If the option of "ppm correct" is set as "Yes", the temperature, pressure and ppm can not be inputted by hand.

◆This operation is also available in stake out mode.

◆You can press star{★}/F1[**EDM**] key to enter EDM setting menu directly.

4. Angle Measurement

4.1 Measure a Horizontal Angle of Two Points

```
Meas      PC     0.0
          ppm    0
VD
VA   85° 55′ 50″
HA    0° 00′ 00″    P1
DIST SHV1 SHV2 0SET
```

1. Sight the 1st target.

   Press F4: [**0SET**] twice to set the 1st target as

   0°at P1 in the measure mode.

   Press [**SHV1**] or [**SHV2**] to change display status firstly if in distance mode.

```
Meas      PC     0.0
          ppm    0
VD
VA   85° 55′ 50″
HA  156° 13′ 14″    P1
DIST SHV1 SHV2 0SET
```

2. Sight the 2nd target. The displayed value is the included angle between two points.

1st target   2nd target

4.2 Set the Horizontal Angle to a Required Value
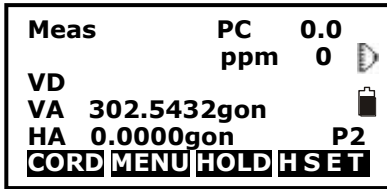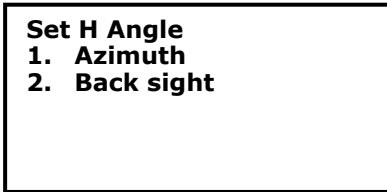
```
Meas          PC     0.0
              ppm      0    ▷
VD
VA   302.5432gon         ▮
HA   0.0000gon         P2
CORD MENU HOLD HSET
```
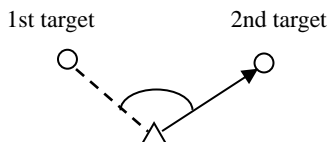
1. Take your instrument sight the 1ˢᵗ target.

    Press F4: [**HSET**] at P2 in the measure mode.

```
Set H Angle
1.  Azimuth
2.  Back sight
```

2. Select the first item 1.Azimuth, and input the required value in Azimuth filed, then press {ENT} to save the value. And it displays as the horizontal angle.

The range and format of the input value:

   gon: 0~399.9999

   degree: 0~359.5959

   mil: 0~6399.990

```
Azimuth -399.9998
Tgt.H            0.000m
PT#
Observe point!

                 OK
```
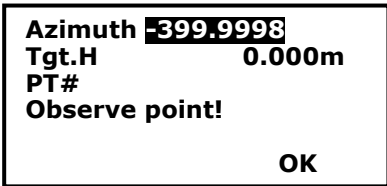
3. Sight the 2ⁿᵈ target. The horizontal angle from the 2ⁿᵈ target to the value set as the horizontal angle is displayed.

```
Meas          PC      0
              ppm      0    ▷
VD
VA   302.5432gon         ▮
HA   399.9998gon       P2
CORD MENU HOLD HSET
```
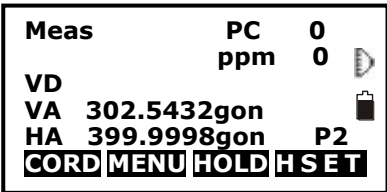
NOTE: Pressing [**HOLD**] performs the same function as above. The horizontal angle is in hold status when [**HOLD**] is flashing, press [**HOLD**] again to releasse the hold status.

5.   Distance Measurement

Please set the following items before distance measurement:
- Measurement condition (See §3.8.1 Measure Condition Setting)
- EDM (See §3.8.6 EDM setting)

【**Procedure of distance measurement**】

```
Meas          PC    0
              ppm   0
SD
HD
VD                  P1
DIST SHV1 SHV2 0SET
```

1. Aim at the target, press F3:[**SHV2**], the display mode of basic measurement will change to SD/HD/VD mode, and then press F1:[**DIST**] to start   measure distance.
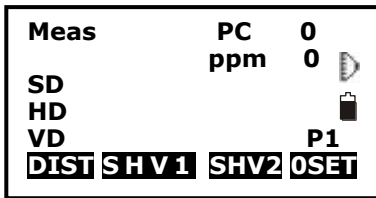
```
Dist

 Fine
              ppm 0

-----※        STOP
```

2. The symbol "＊" moves continually when measuring distance. Distance measuring mode, prism const and ppm value are also presented.

```
Meas          PC    0
              ppm   0
SD    10.329m
HD    7.009m
VD    7.586m         P1
DIST SHV1 SHV2 0SET
```
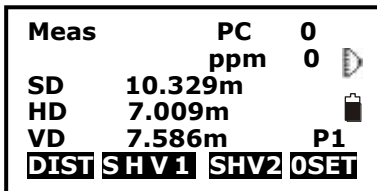
3. Press F4: [**STOP**] to finish measurement. The "SD","HD", and "VD" will display as shown left.

```
Meas          PC    0
              ppm   0
SD    10.329m
HD    7.009m
VD    7.586m         P1
DIST SHV1 SHV2 0SET
```
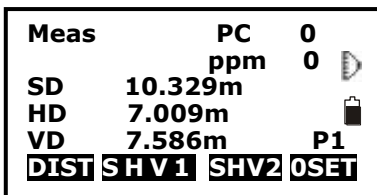
4. Press F3: [**SHV2**], SD/HD/VD and SD/VA/HA are displayed alternatively.

NOTE:

◆Make sure that the target setting in the instrument matches the type of target used.

◆If the objective lens is dirty, it will affect the accurate of measured results. Dust it off with your special brush and wipe it with your special cloth (in your carrying case) before putting away.

◆If an object with a high reflective factor (metal, white surface) exists between the instrument and the target when measuring, the accuracy of the measured results will be affected.

◆An angle is also able to be measured when distance measurement.

◆Measurement will automatically stop after a single measurement if the EDM mode is single (Fine "S" / Rapid "S").

◆If the distance measurement mode is average "Fine AVG", the measured distances are displayed as "-1","-2","-3"…"-9" in turn, and the average value will display behind "-A" once the selected time's measurement has been finished.
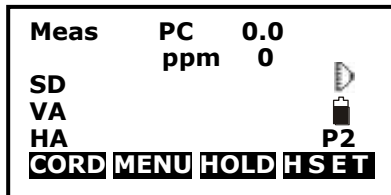
6. Coordinate Measurement

It is possible to find the 3D coordinates of a target by coordinate measurement. Please input the occupied coordinate, instrument height, target height, backsight coordinate (or azimuth angle) and azimuth before coordinate measurement.
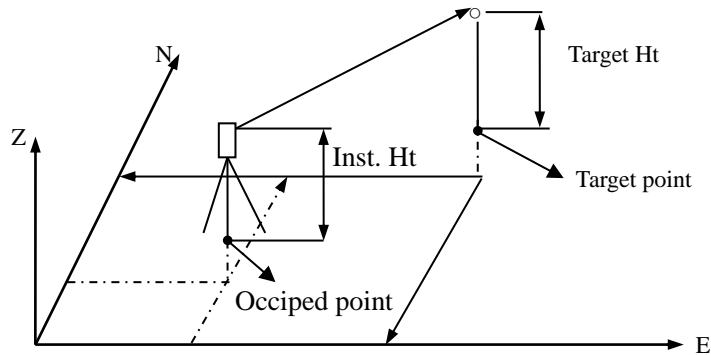
6.1 Input the Occupied Point Data

【**Procedure of inputting occupied point data**】

| ```
Meas    PC    0.0
        ppm   0
SD                      D
VA
HA                      P2
CORD MENU HOLD HSET
``` | 1. Measure the height of target and instrument with a tape, etc.<br><br>2. Press F1: [**CORD**] at P2 in the measurement mode. |
| ```
Coordinate
1. Occ. orientation
2. Measure
3. EDM
4. JOB select
``` | 3. Select "**1. Occ. orientation**". |
| ```
Coord
1. Occ. coordinate
2. Set H angle
``` | 4. Select "**1. Occ. coordinate**" to input the occupied coordinates, instrument height and target height in corresponding field. |

```
PT#
Inst.H            1.500m A
N0:               0.000
E0:               0.000
Z0:               0.000
READ RES REC    O K
```

5. Press F3: [**REC**] to record the data in active occupied data list, see "§18.1 Record Occupied Data". You could press F1: [**READ**] to read the existed data for occupied point from memory. You could also press F2: [**RES**] to enter Resection program to get the station point coordinate, see "§12. Resection".
Press F4: [**OK**] to confirm your setting.

How to read the existed data:

Known point data, coordinate data and instrument occupied data in the current JOB and coordinate search JOB can be read. Confirm that the JOB containing the coordinates you want to read is already selected in coordinate search JOB, see "§22.2 Select a JOB ".

```
PT#
Inst.H            1.500m A
N0:               0.000
E0:               0.000
Z0:               0.000
READ RES REC    O K
```

1. Press F1: [**READ**] when inputting the coordinate.

2. The list of existed coordinate displays as shown left:

```
Occ.     15
Coord    56
Coord    20
PT#      50
Coord    45
↑↓.P TOP LAST SRCH
```

Occ. : Occupied data saved in the current JOB or in the coordinate search JOB.

Coord: Measured coordinate data saved in the current JOB or in the coordinate search JOB

Pt# : Known point data saved in the current JOB or in the coordinate search JOB.

◆ [↑↓.**P**] : Press keys { ▲ }/ { ▼ } to move one by one.
◆ [↑↓.**P**]: Press keys { ▲ }/ {▼ } to turn the previous/next page.
   Press F1 to switch between [↑↓.**P**] status and [↑↓.**P**] status.
◆ [**TOP**]: Press it and the first point on the first page will display.
◆ [**LAST**]: Press it and the last point on the last page will display.
◆ [**SRCH**]: Press it to enter into "coordinate data search" mode. Input the required point number to search.

```
PT#      5
Inst.H:          1.500m 1
N0:              100.000
E0:              100.000
Z0:               10.000
READ RES REC    O K
```

3. Select the required data and press the key {ENT}. The corresponding data will display. You could re-edit the data and it won't affect the original coordinate data.

4. Press F4: [**OK**] to save the setting.

NOTE:

◆ The point number that was read is displayed until the current JOB is changed or a new point number is selected.

◆ If more than two points with the same point name exist in the current JOB, the instrument finds the first recorded data only.

6.2 Azimuth Setting

The azimuth of backsight could be inverse calculated by the coordinates of occupied and backsight.


```
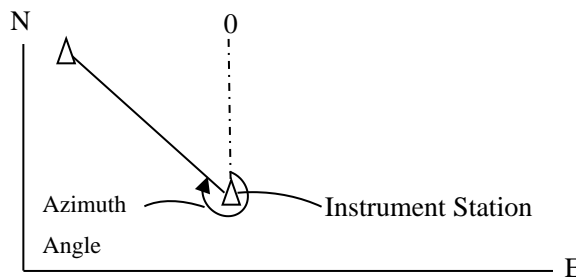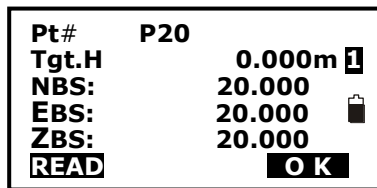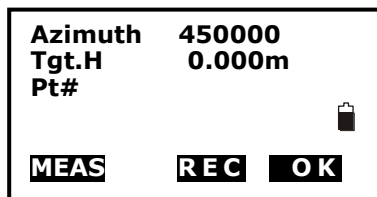Set H angle
1.Azimuth
2.Backsight          🔋
```

1. Select "**2. Set H angle**", see "§6.1 Input the occupied point data". Then select "**2. Backsight**".

```
Pt#      P20
Tgt.H          0.000m 🔢
NBS:           20.000
EBS:           20.000  🔋
ZBS:           20.000
READ              O K
```

2. Input the coordinate of backsight. You could also press F1: [**READ**] to select existed point data. If you input the same coordinates with the occupied point, a message "Same coordinates" will appear and disappear in 5sec，please re-input the data.

```
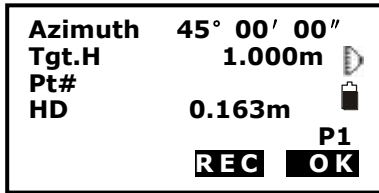Azimuth    450000
Tgt.H       0.000m
Pt#
                      🔋

MEAS    R E C   O K
```

3. Press F4: [**OK**] to accept the inputted occupied and backsight coordinates, the calculated azimuth angle will display.

4. Aim at the backsight point, and then press F1:[**MEAS**] to check the backsight, or press F3: [**REC**] to record and set the station, then back to the previous mode. You could also press F4: [**OK**] to set the station, but the data will not be recorded.

Note:

◆You can select "**1. Azimuth**" to input the azimuth angle directly.

```
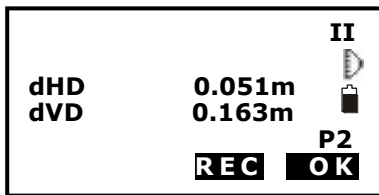Azimuth    45° 00′ 00″
Tgt.H        1.000m
Pt#
HD           0.163m
                      P1
        REC    OK
```

◆ After input the coordinate of backsight, you can press F1:[**MEAS**]   to check for backsight checking, HD between station and backsight, dHD and dVD between calculated backsight and measured backsight will be display.

```
                      II
dHD          0.051m
dVD          0.163m
                      P2
        REC    OK
```

Press F3: [**REC**] to record and set the station, then back to the previous mode. You could also press F4: [**OK**] to set the station, but the data will not be recorded.

6.3 3D Coordinate Measurement

The target coordinate could be measured after the setting of occupied point and backsight azimuth.

The formula used to calculate:

$N1=N0+S\times sinZ\times cosAz$

$E1=E0+S\times sinZ\times sinAz$

$Z1=Z0+S\times cosZ+IH-TH$

Where：

N0-E0-Z0: occupied point coordinates

S: SD　　　Z: Zenith angle　　　Az: Azimuth angle

IH: Instrument height　　　　TH: Target height

Azimuth angle

【**Procedure of 3D coordinates measurement**】

```
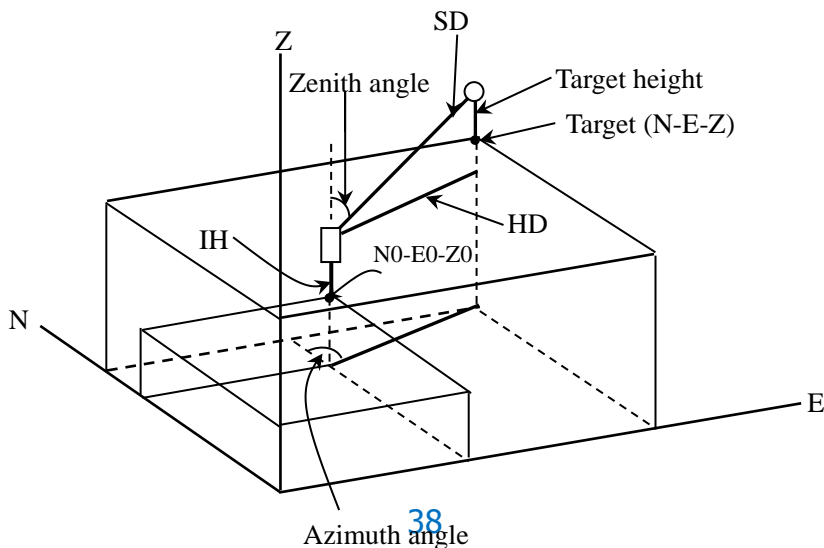Coordinate
1. Occ. Orientation
2. Measure
3. EDM
4. JOB select
```

```
N        1000.000
E        1000.000
Z          10.466
VA     132.3648gon
HA     150.3536gon
MEAS TAGT     REC
```

1. Aim at the target point.

2. Select "**2. Measure**" to start. The coordinate value of the target is displayed.

3. Press F2: [**TAGT**] to re-input the occupied data if necessary, see "§6.1 Input the occupied point data". You can press F4: [**REC**] to record the data.

4. Aim at the next target, press F2: [**TAGT**] to re-input the target height if necessary, and press F1: [**MEAS**] to continue. Follow this operation till all targets have been measured.

5. Press key {ESC} back to the coordinate mode.

7. Stake out Measurement

Stake out measurement is used to stake out the required point. The difference between the previously inputted data to the instrument (the stake out data) and the measured value can be displayed by measuring the horizontal angle, distance or coordinates of the sighted point.

The horizontal angle difference and distance difference are calculated and displayed using the following formulas:

Horizontal angle difference

dHA=Horizontal angle of stake out data - measured horizontal angle

Distance difference

Distance   Displayed item

SD: S-O SD=measured slope distance - slope distance of stake out data

HD: S-O HD=measured horizontal distance -horizontal distance of stake out data

VD: S-O VD=measured height difference - height difference of stake out data

NOTE:

◆ Stake out data can be input in various modes: SD, HD, VD, coordinates and REM measurement.

◆EDM settings could be set in this mode.

7. 1 Distance Stake out

The point to be found based on the horizontal angle from the reference direction and the distance from the instrument station.

【**Procedure of distance stake out measurement**】

```
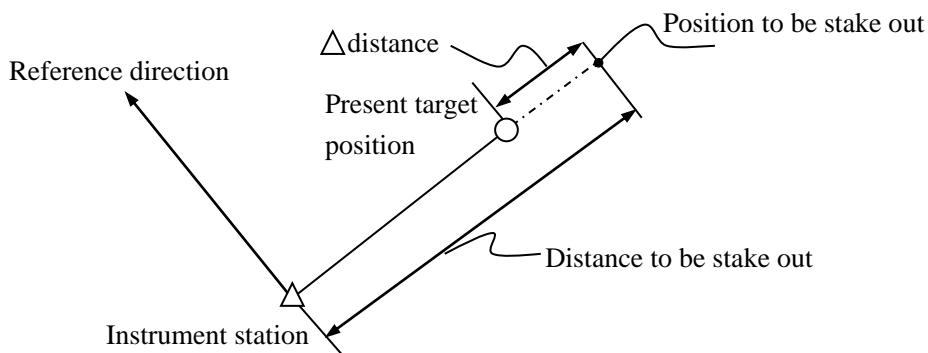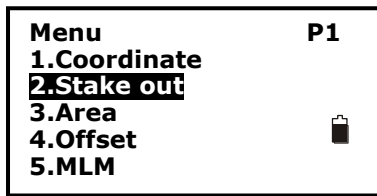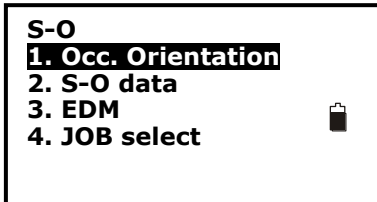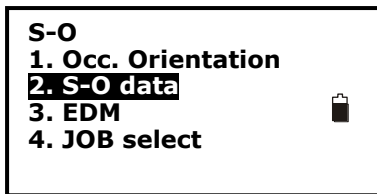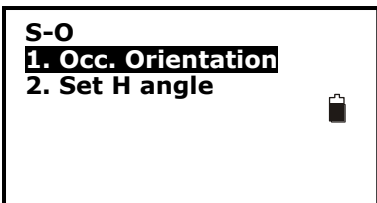Menu              P1
1.Coordinate
2.Stake out
3.Area
4.Offset
5.MLM
```

1. Press F2: [**MENU**] at P2 in the measure mode.
   Select "**2. Stake out**".

```
S-O
1. Occ. Orientation
2. S-O data
3. EDM
4. JOB select
```

2. Select "**1. Occ. Orientation**".
   Select "1. Occ. Orientation" ,Input the occupied orientation data, see "§6.1 Input the occupied point data ".
   Then set the azimuth angle of the backsight point, see "§6.2 Azimuth setting".

```
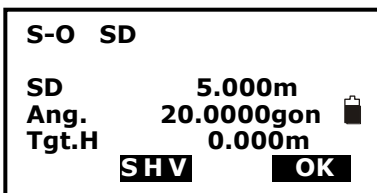S-O
1. Occ. Orientation
2. Set H angle
```

```
S-O
1. Occ. Orientation
2. S-O data
3. EDM
4. JOB select
```

3. Select "**2. S-O data**".

```
Stake out
1.Height
2.Angle & Dist
3.Coord
```

4. Select "**2. Angle & Dist**".

```
S-O  SD

SD          5.000m
Ang.    20.0000gon
Tgt.H       0.000m
     SHV        OK
```

Press F2: [**SHV**] to shift between S-O SD, S-O HD, S-O VD.
Input the following items:
SD/HD/VD: distance from the instrument station to the position to be stake out;

Ang.: included angle between the direction of the reference and the point to be stake out.
See "§ 4.2 Set the Horizontal Angle to a Required value".
Press F4: [**OK**] to set the input values.

```
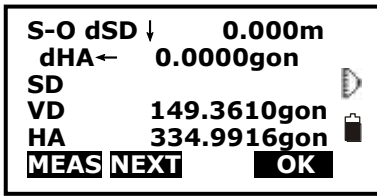S-O dSD↓      0.000m
 dHA←    0.0000gon
SD
VD      149.3610gon
HA      334.9916gon
MEAS NEXT        OK
```

6. Horizontally rotate the instrument until "dHA" is near 0 and set the target on the sight line.

Press F1: [**MEAS**] to start distance measurement.

7. The difference of measured and stake out value "**S-O dSD**" is displayed.
   Move the prism forward and backward until "S-O dSD" is 0m.

```
Stake out
1.Height
2.Angle & Dist
3.Coord
```

←: Move the prism left
→: Move the prism right
↓: Move the prism forward
↑: Move the prism backward
Press F4: [**OK**] back to stake out mode.

7.2 Coordinates Stake out Measurement

After setting coordinates for the point to be stake out, the instrument calculates the stake out HA and HD. By selecting the HA and then the HD stake out functions, the required coordinate location can be stake out.

To get the Z coordinate, attach the target to a pole etc., with the same target height.

【**Procedure of coordinate stake out measurement**】

```
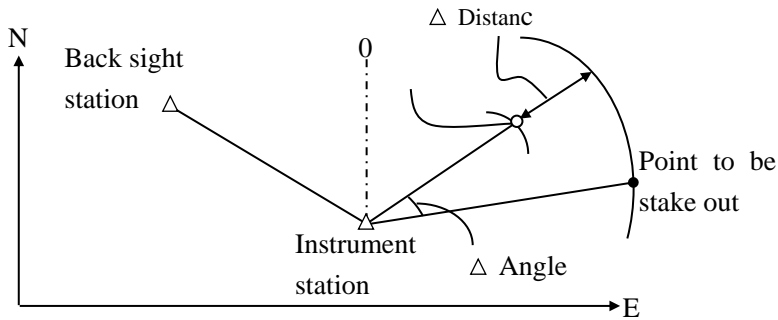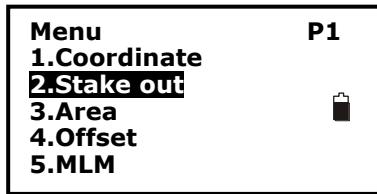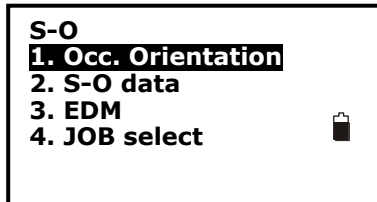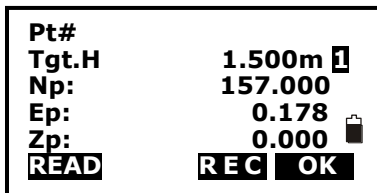Menu              P1
1.Coordinate
2.Stake out
3.Area
4.Offset
5.MLM
```

1. Press F2: [**MENU**] at P2 in the measure mode.
   Select "**2. Stake out**".

```
S-O
1. Occ. Orientation
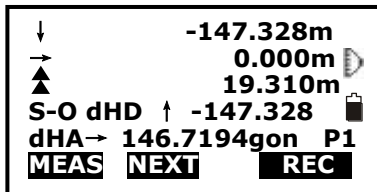2. S-O data
3. EDM
4. JOB select
```

2. Select "**1. Occ. Orientation**".
   Input the occupied orientation data, see "§6.1 Input the occupied point data ".
   Then set the azimuth angle of the backsight point, see "§6.2 Azimuth setting".

```
Stake out
1.Height
2.Angle & Dist
3.Coord
```

3. Press Esc, then Select "**2. S-O data**", then select "**3.Coord**".

```
Pt#
Tgt.H         1.500m
Np:         157.000
Ep:           0.178
Zp:           0.000
READ        REC   OK
```

4. Input the coordinates of the stake out point.
   Press F1: [**READ**] to read the existed coordinates as stake out coordinate.
   Press F4: [**OK**] to set the data.

```
↓           -147.328m
→             0.000m
↥            19.310m
S-O dHD  ↑ -147.328
dHA→ 146.7194gon   P1
MEAS  NEXT      REC
```

5. Press F1: [**MEAS**] begin coordinate stake out measurement. Move the prism to find the point to be stake out.
   ↥ : Move the prism upward
   ↧ : Move the prism downward

```
VA     296.1184gon
HA     249.0324gon
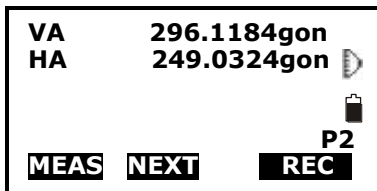
                   P2
MEAS  NEXT      REC
```

Press key {ESC} back to stake out mode.

7.3 REM Stake out Measurement

Perform this operation to find a point where a target cannot be directly installed, see "§11 REM".

【**Procedure of REM stake out measurement**】

```
S-O
1. Occ. Orientation
2. S-O data
3. EDM
4. JOB select
```

1. Set a target directly below or directly above the point to be found, then use a measuring tape etc. to measure the target height (height from the surveying point to the target).

   Press F2: [**MENU**] at P2 in the measure mode, then select "**2. Stake out**".

```
Stake out
1.Height
2.Angle & Dist
3.Coord
```

2. Select "**2. S-O data**", then select "**1. Height**".

```
Ht.          2.000m
Tgt.H        0.000m


                    OK
```

3. Input height from the surveying point to the position to be stake out. Then press F4: [**OK**] to set the data.

```
                        I
SD          10.251m
VA          79.6986gon
HA          249.0404gon
MEAS REM NEXT
```

4. Press F2: [**REM**] to begin REM stake out measurement. Move telescope to find the point to be stake out.

▼ : Move the telescope near the zenith

▲ : Move the telescope near the nadir

  Press key {ESC} back to stake out mode.

8. Area

Calculate an area shaped with several points. The coordinate data of the points could be either measured or input by hand.

Input: Output:

Coordinates: P1 (N1, E1)   Area：S
             P2 (N2, E2)
             P3 (N3, E3)
             …

NOTE:

◆ The number of points: 3 ~ 30.

◆ Make sure these points must be measured or listed clockwise or anticlockwise, or mistake will result.

8.1 Area Calculation by Measured Data
【Procedure of area calculation】

```
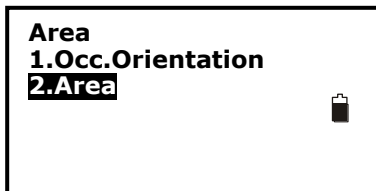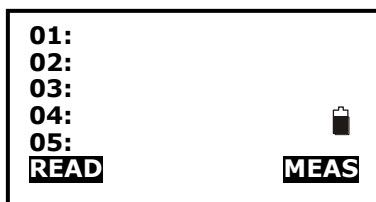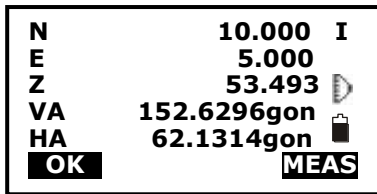Area
1.Occ.Orientation
2.Area
```

1. Select F2: [**MENU**]/ **3. Area /2.Area.**

```
01:
02:
03:
04:
05:
READ          MEAS
```

2. Aim at the first point, and then press F4: [**MEAS**].

```
N          10.000  I
E           5.000
Z          53.493
VA    152.6296gon
HA     62.1314gon
  OK            MEAS
```

3. Press F4: [**MEAS**] to re-measure distance or press F1: [**OK**], the measured data is set as"Pt-01".

```
01:Pt_01
02:Pt_02
03:Pt_03
04:Pt_04
05:
    CALC        MEAS
```

4. Repeat steps 2 and 3 till all points are measured one by one. Make sure measure them clockwise or anticlockwise. Press F2: [**CALC**] and the calculated area will display.

```
Area Calculation
Pt:      4
PArea          m2
               ha
                 OK
```

5. Press F4: [**OK**] back to menu mode.

8.2 Area Calculation by Reading Existed Coordinates

【**Procedure of area calculation**】

```
Menu            P1
1.Coordinate
2.Stake out
3.Area
4.Offset
5.MLM
```

1. Select F2: [**MENU**]/ **3. Area /2.Area.**

    .

```
01:
02:
03:
04:
05:
READ          MEAS
```

2. Press F1: [**READ**] to display existed coordinates data list.

```
Occ.
Pt#
Coord
Pt#
Pt#
↑ ↓.P TOP LAST SRCH
```

```
01:O1
02:Pt1
03:C1
04:Pt2
05:
READ CALC
```

```
Area Calculation
Pt:      4
Area          m2
              ha
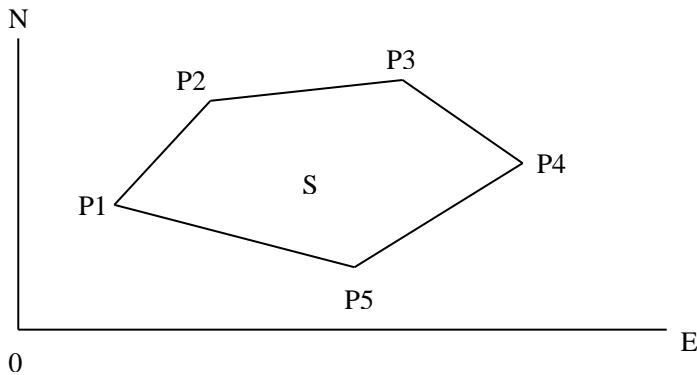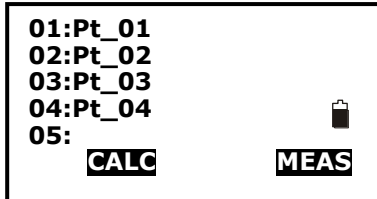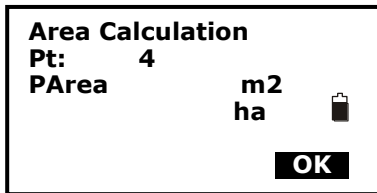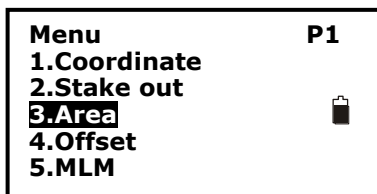
              OK
```

3. Pt#: Known point data saved in the active JOB or in the coordinate search JOB.

Occ./Coord: Coordinate data saved in the active JOB or in the coordinate search JOB.

4. Select the first point in the list and press key {ENT} to set.

The selected point is set as "Pt-01".

5. Repeat steps 2 and 4 till all points are selected.

Make sure read the points clockwise or anticlockwise.

6. Press F2: [**CALC**], and the calculated area will display. Press F4: [**OK**] to escape.

9. Offset Measurement

Offset measurement 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 (target point) by installing the target at a location (offset point) a little distance from the target point and measuring the distance and angle from the surveying point to the offset point.

The target point could be found in the following three ways.

9.1 Single-distance Offset Measurement

Finding a point by entering the horizontal distance from the target point to the offset point.

Instrument station

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 the target point, installs the offset point on a line linking the instrument station with the target point.

【**Procedure of single-distance offset measurement**】

```
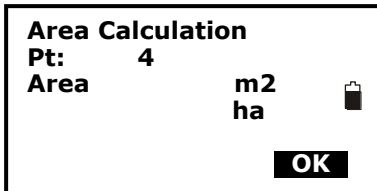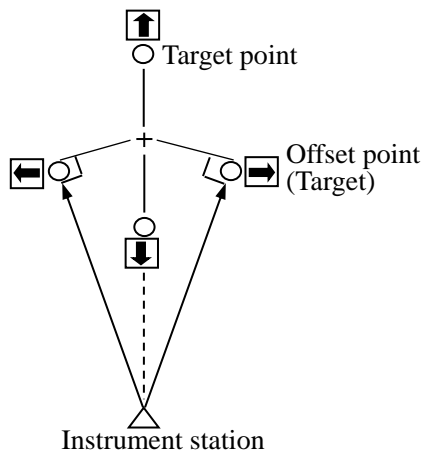Menu          P1
1.Coordinate
2.Stake out
3.Area              📱
4.Offset
5.MLM
```

1. Set the offset point close to the target point and measure the distance between them, then set up a

prism on the offset point.

2. Aim at the offset point and press F1: [**MEAS**] to measure the distance at P1 in measure mode.

3. Select [**MENU**]/**4. Offset**, or press F3: [**OFST**] at P3 of basic measurement menu.

```
Offset
1.Occ. Orientation
2.Offset/Dist
3.Offset/Angle
4.Offset/2Dist
```

4. Select "**1. Occ. orientation**" to input the instrument occupied data, see "§6.1 Input the occupied point data".

```
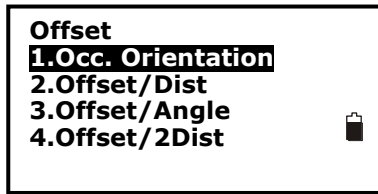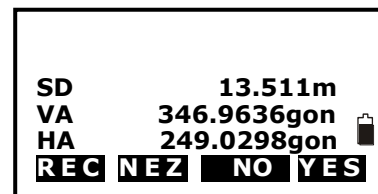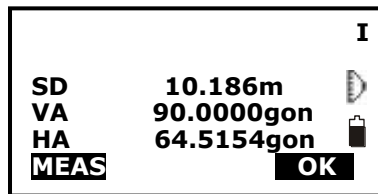Offset
1.Occ. Orientation
2.Offset/Dist
3.Offset/Angle
4.Offset/2Dist
```

5. Select "**2. Offset/Dist**".

```
                        I
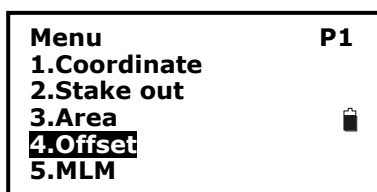
SD          10.186m
VA          90.0000gon
HA          64.5154gon
MEAS                OK
```

6. User could press F1: [**MEAS**] to re-measure the offset point or press F4: [**OK**] to the next step.

7. Input distance and direction of offset point:.

①Dist: horizontal distance from the target point to the offset point.

```
Dist        10.000m
Direc           ↓

                    OK
```

②Direc: direction of the offset point.

←: on the left of the target point

→: on the right of the target point

↓: in front of the target point

↑: at back of the target point

8. Press F4: [**OK**] to calculate and display the distance and angle of the target point.

```
SD          13.511m
VA          346.9636gon
HA          249.0298gon
REC NEZ    NO YES
```

9. Press F1: [**REC**] to save;

 Press F2: [**NEZ**] to display NEZ coordinate;

 Press F3: [**NO**] back to step 6;

 Press F4: [**YES**] back to offset mode.

9.2 Angle Offset Measurement

Sighting the direction of the target point to find it from the included angle. Set offset points for the target point on the right or 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.

Target point

Offset point
(Target)

Offset point
(Target)

Instrument station

【**Procedure of angle offset measurement**】

```
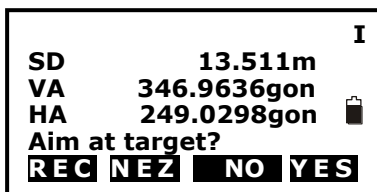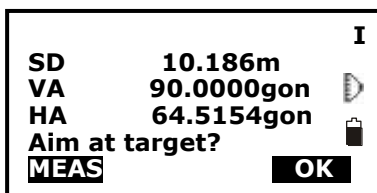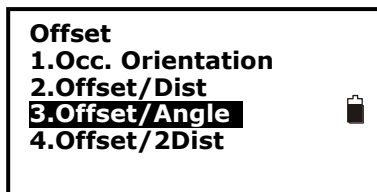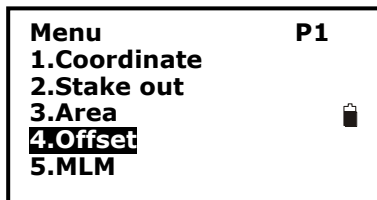Menu            P1
1.Coordinate
2.Stake out
3.Area
4.Offset
5.MLM
```

```
Offset
1.Occ. Orientation
2.Offset/Dist
3.Offset/Angle
4.Offset/2Dist
```

```
              I
SD      10.186m
VA    90.0000gon
HA    64.5154gon
Aim at target?
MEAS          OK
```

```
              I
SD      13.511m
VA   346.9636gon
HA   249.0298gon
Aim at target?
REC NEZ  NO YES
```

1. Set the offset points close to the target point (making sure the distance from the instrument station to the target point and distance to the offset point are same, the height of the offset points and the target point are the same), then use the offset points as the target.

2. Aim at the offset point and press F1: [**MEAS**] to measure the distance at P1 in measure mode.

3. Select [**MENU**] at P2 in measure mode, and then select "**4. Offset**", or press F3: [**OFST**] at P3 directly.

4. Select "**3. Offset/Angle**" after inputting instrument occupied data, see "§6.1 Input the occupied point data".

5. Accurately sight the direction of the target point and press F4: [**OK**], the distance and angle of the target point are displayed.

6. After finishing measurement:
   Press F1: [**REC**] to save;
   Press F2: [**NEZ**] to display NEZ coordinate;
   Press F3: [**NO**] back to step 6;

Press F4: [**YES**] back to offset mode.

9.3 Dual-Distance Offset Measurement

By measuring the distance between the target point and the two offset points. Set two offset points (1st target and 2nd target) on a straight line from the target point, measure the 1st and 2nd target, then input the distance between the 2nd target and the target point to find the target point.

Target point
Offset point
(Target)
Offset point
(Target)
Instrument station

【**Procedure of dual-distance offset measurement**】

```
Menu                P1
1.Coordinate
2.Stake out          🔋
3.Area
4.Offset
5.MLM
```

1. Set two offset points (1st target, 2nd target) on a straight line from the target point and use the offset points as target.
2. Select [**MENU**] at P2 in measure mode, and then select "**4. Offset**", or press F3: [**OFST**] at P3 directly.

```
Offset
1.Occ. Orientation
2.Offset/Dist        🔋
3.Offset/Angle
4.Offset/2Dist
```

3. Select "**4. Offset/2Dist**" after inputting the instrument occupied data, see "§6.1 Input the occupied point data".

```
Observe 1st offset   ▷
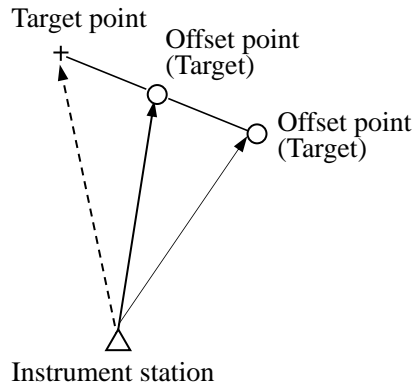
N       10.186       🔋
E       10.000
Z       10.000      P1
MEAS              OK
```

4. Aim at the 1st target and press F1: [**MEAS**] and measured data will display. Press F4: [**OK**] to accept this value.

```
Observe 2nd offset
                        ▷
N         10.186
E         10.000        ▯
Z         10.000        P1
MEAS               OK
```

5. Sight the 2nd target, press F1: [**MEAS**] and measured data will display, press F4: [**OK**] to accept this value.

```
Dist         ████████m
                        ▯
```

6. Input the distance from 2nd point to the target point and press key {ENT}, the angle and distance of the target point are displayed.

```
Offset/2Dist
SD          13.511m
VA       346.9636gon ▯
HA       249.0298gon ▮
REC  NEZ   NO  YES
```

7. Press F1: [**REC**] to save;
   Press F2: [**NEZ**] to display NEZ coordinate;
   Press F3: [**NO**] back to step 6;
   Press F4: [**YES**] back to offset mode.

10. MLM

MLM is used to directly measure slope distance, horizontal distance and the height difference from one base point to other points without moving the instrument.

NOTE:

◆ The last measured data could be set as the base point for the next starting operation.

◆ The height difference between one point and the base point could be displayed as grade mode.

10.1 Measuring Distance between Two or More Points

【**Procedure of measuring**】

```
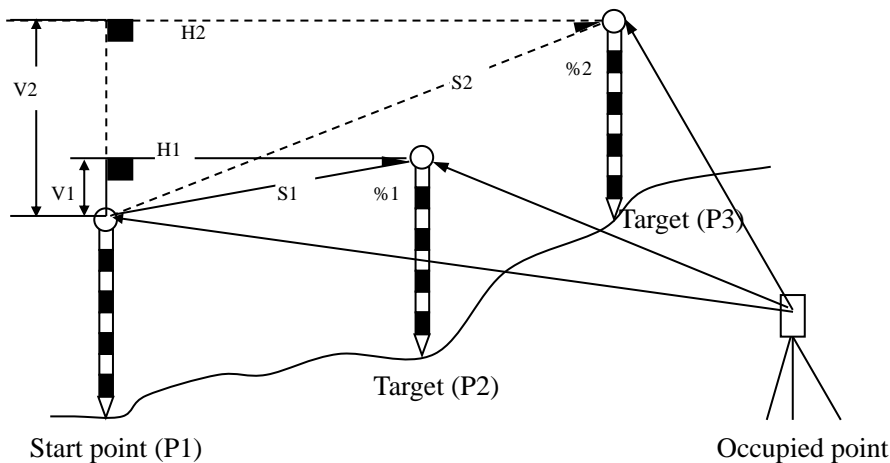Menu              P1
1.Coordinate
2.Stakeout
3.Area
4.Offset          ▯
5.MLM
```

1. Press F2: [**MENU**] at P2 in the measure mode.
   Select "**5. MLM**".

```
                   I
SD        33.421ft  ▷
HD     155.6594gon  ▯
VD     355.9246gon
MLM  MOVE      MEAS
```

2. Aim at the start point P1, then press F4: [**MEAS**] and the measured data will display.
3. Aim at the target point P2 and press F1: [**MLM**] to begin measure, SD, HD, VD will display.

```
                         I
S/%              %   ▷
SD
HD                   ▯
MLM  MOVE        MEAS
```

4. Aim at the next point P3 and press F1: [**MLM**] to begin measure. Repeat this operation to measure other target points.

5. Press F2: [**MOVE**], the last target measured becomes the new starting position to perform MLM of next target.

   Press F4: [**MEAS**] to re-measure the starting position.

 6. Press key {ESC} back to menu mode.

Note:

◆Once "S/%" is displayed, the distance between two points is displayed as the gradient

10.2 Change the Starting Point

The previous measured data could be set as the base point for the next operation.

Start point (P1)

Point (P2)

Point (P3)

【**Procedure of changing the starting point**】

```
  Move base point?
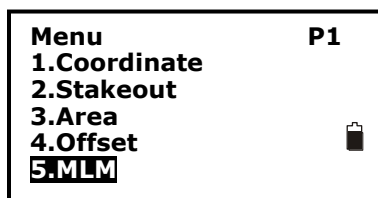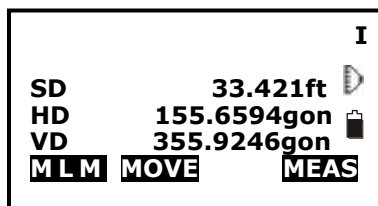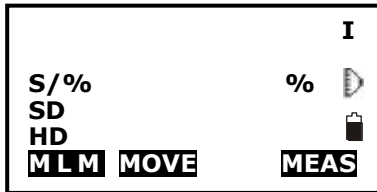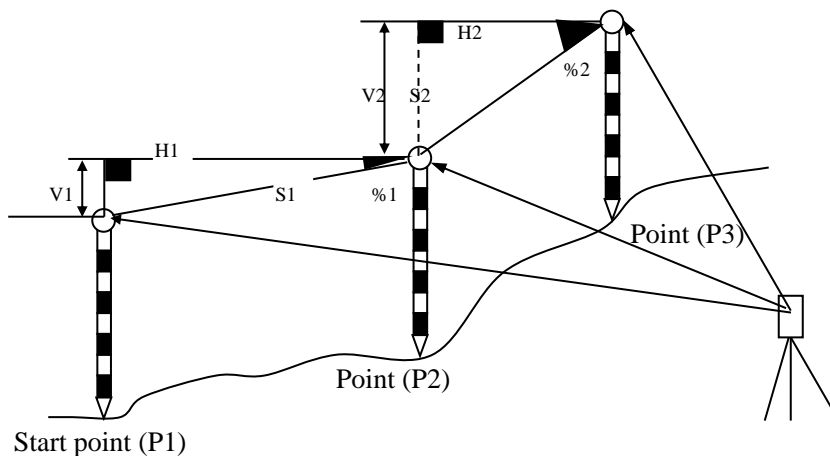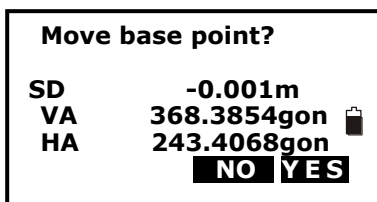
SD        -0.001m
 VA    368.3854gon  ▯
 HA    243.4068gon
            NO  YES
```

1. Measure the start point P1 and the first target P2 following above steps 1, 2 and 3.

2. After measuring the two points, press F2: [**MOVE**], and press F4: [**YES**] to set the last measured point as new starting point, or press F3: [**NO**] to give up.

11. REM

REM is a function used to measure the coordinate and height to a point where a target cannot be directly installed such as power lines, overhead cables or bridges, etc.

Here is the equation used to calculate the data presented in above figure:

$Ht = H1+S\cos\alpha1 \text{tg}\alpha2-S\sin\alpha1$

【**Procedure of REM**】

```
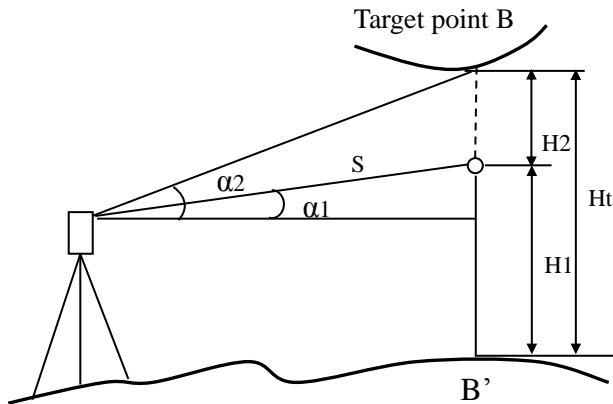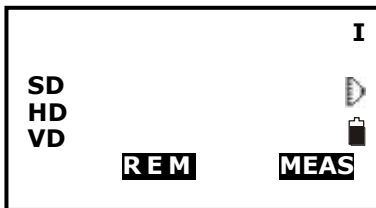Menu              P2
1.REM             ▲
2. Resection      ▯
3. Point Projection
4. Line stake out
5. Traverse
```

1. Set a target directly under or directly over the object and measure the target height with a tape measure etc.
2. Press F2: [**MENU**] on P2 of the basic measurement mode, then press Func key to turn to page 2, then select "**1.REM**" on P2 to enter into REM status.

```
                  I

SD                ▯
HD                ▯
VD
    REM      MEAS
```

3. Reference point measurement.
Aim at the prism accurately, and press F4: [**MEAS**] to measure distance. Press F4: [**STOP**] and the measured data are displayed. Press F4: [**MEAS**] to re-measure.

```
                  I
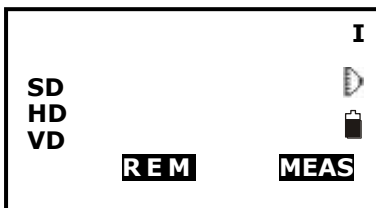
SD                ▯
HD                ▯
VD
    REM      MEAS
```

4. Aim at the target accurately and press F2: [**REM**]. The height from ground to the target is displayed in "**Ht**". Press F4: [**MEAS**] to repeat and press key {ESC} back to menu mode.

12.   Resection

Resection program is used to determine the coordinates of an instrument station (unknown) by measuring several known points. Coordinate data in memory could be read.

Input
Coordinates of known points: Xi, Yi, Zi
Measured HA: Hi
Measured VA: Vi
Measured distance: Di

Output
Coordinate of occupied data: Xo, Yo, Zo

Known point P1

Known point P2

Occupied point P0

Known point P4

Known point P3

NOTE:
◆ All N, E, Z value or only Z value of the occupied point is calculated by measuring known points.

◆Coordinate resection measurement overwrite the N, E, Z data of the instrument occupied point, while elevation resection measurement overwrite Z data only. Perform resection measurement, see "§ 12.1 Coordinate Resection" and "§ 12.2 Elevation Resection".

◆Inputted known coordinate data and calculated data could be recorded in the current JOB.

12.1 Coordinate Resection

Between 2 and 5 known points can be measured by distance measurement and angle measurement.

【**Procedure of coordinate resection**】

```
Menu                P2
1.REM
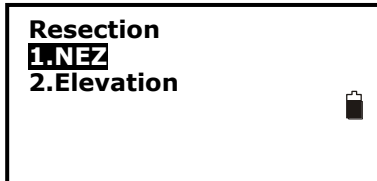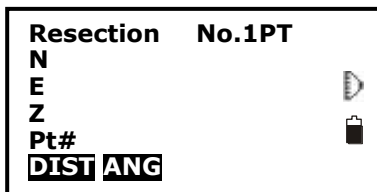2. Resection
3. Point Projection
4. Line stake out
5. Traverse
```

1. Select [**MENU**] at P2 of basic measurement mode, then press Func key to turn to page 2, and then select "**2. Resection**", or select [**RES**] at P3 directly.

```
Resection
1.NEZ
2.Elevation
```

2. Select "**1.NEZ**" and input known point data. After inputting the data of the first known point, press F3: [**NEXT**] to input the second point data.

```
Pt#
Tgt.H               m  1
Np:
Ep:
Zp:
READ  R E C  NEXT  MEAS
```

3. After all known points data have been set, press F4: [**MEAS**].
Press F1: [**READ**] to read existed coordinate data.

```
Resection    No.1PT
N
E
Z
Pt#
DIST  ANG
```

4. Sight the first known point and press F1: [**DIST**] to begin measurement. If known points number is more than two, F2: [**ANG**] will display, you can confirm the known point by angle measurement.

```
Resection  No.1Pt    I
SD        10.188m
VA     189.9284gon
HA      47.2432gon
Tgt.H             m
              NO  YES
```

5. Press F4: [**YES**] to use the measured data of the first known point.
Press F3: [**NO**] to re-measure this point.
You can also input target height here.

```
Resection   No.2Pt    I
SD        10.188m
VA      189.9284gon
HA       47.2432gon
Tgt.H             m
CALC        NO  YES
```

```
N
E
Z
dN
dE
NEXT DISP REC  OK
```

```
Resection
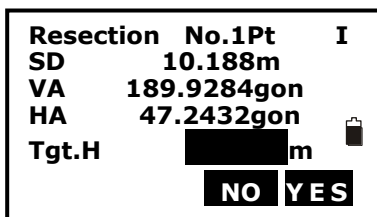
Set Azimuth
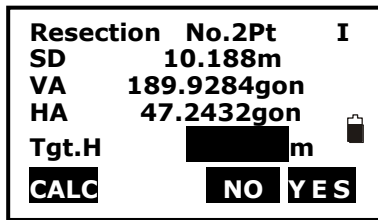

        NO  YES
```

6. Repeat procedures 4 and 5 of other points.

When the minimum quantity of measured data required for the calculation is present, [**CALC**] will be displayed.

Press F1: [**CALC**] to calculate. Instrument occupied coordinate and standard deviation are displayed.

Press F3: [**NO**] to re-measure the point.

7. Press F1: [**NEXT**] to add other known points.

Press F2:[**DISP**] to view the tolerance of measured known points

Press F3: [**REC**] to record the calculated result.

Press F4: [**OK**] to finish coordinate resection.

The instrument occupied coordinate setting is finished.

8. In this <Set Azimuth> screen, aim the first point then press F4: [**YES**] to set the first known point as backsight point and azimuth, press F3: [**NO**] to back to measure mode.

12.2 Elevation Resection

Only Z (elevation) of an instrument station is determined by this measurement. Between 1 and 5 known points can be measured by distance measurement only.

【**Procedure of elevation resection**】

```
Menu              P2
1.REM             ▲
2. Resection
3. Point Projection
4. Line stake out
5. Traverse
```

1. Press F2: [**MENU**] on P2 of the basic measurement mode, then press Func key to turn to page 2, and then select "**7. Resection**", or press F4: [**RES**] at P3 directly.

```
Resection
1.NEZ
2.Elevation
```

2. Select "**2. Elevation**" and input the known point.

```
    No. 1Pt#
                        1
Pt#
Tgt.H            m
Z
READ R E C NEXT MEAS
```

3. After setting the elevation for the first known point, press F3: [**NEXT**] to set the second point data.
4. After all known points data have been set, press F4: [**MEAS**].

   Press F1: [**READ**] to read existed coordinate data.

```
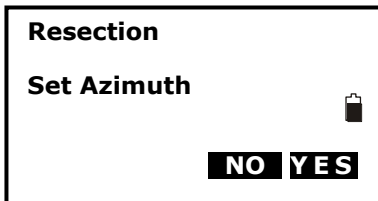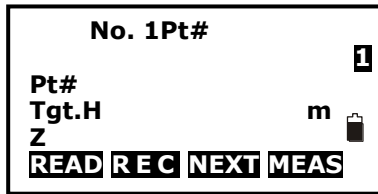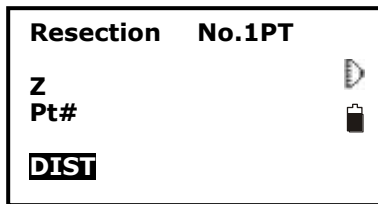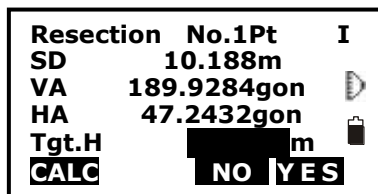Resection    No.1PT

Z
Pt#

DIST
```

5. Sight the first known point and press F1: [**DIST**] to begin measurement. The measured data are displayed.

6. Press F4: [**YES**] to use the measured data of the first known point data.

   Press F3: [**NO**] to re-measure the point. You can also input target height here.

   After finishing two measurements, [**CALC**] will be displayed.

```
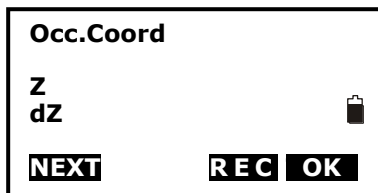Resection  No.1Pt    I
SD       10.188m
VA    189.9284gon
HA     47.2432gon
Tgt.H          m
CALC       NO  Y E S
```

6. Press F1: [**CALC**] to calculate. Instrument occupied elevation and standard deviation are displayed.

```
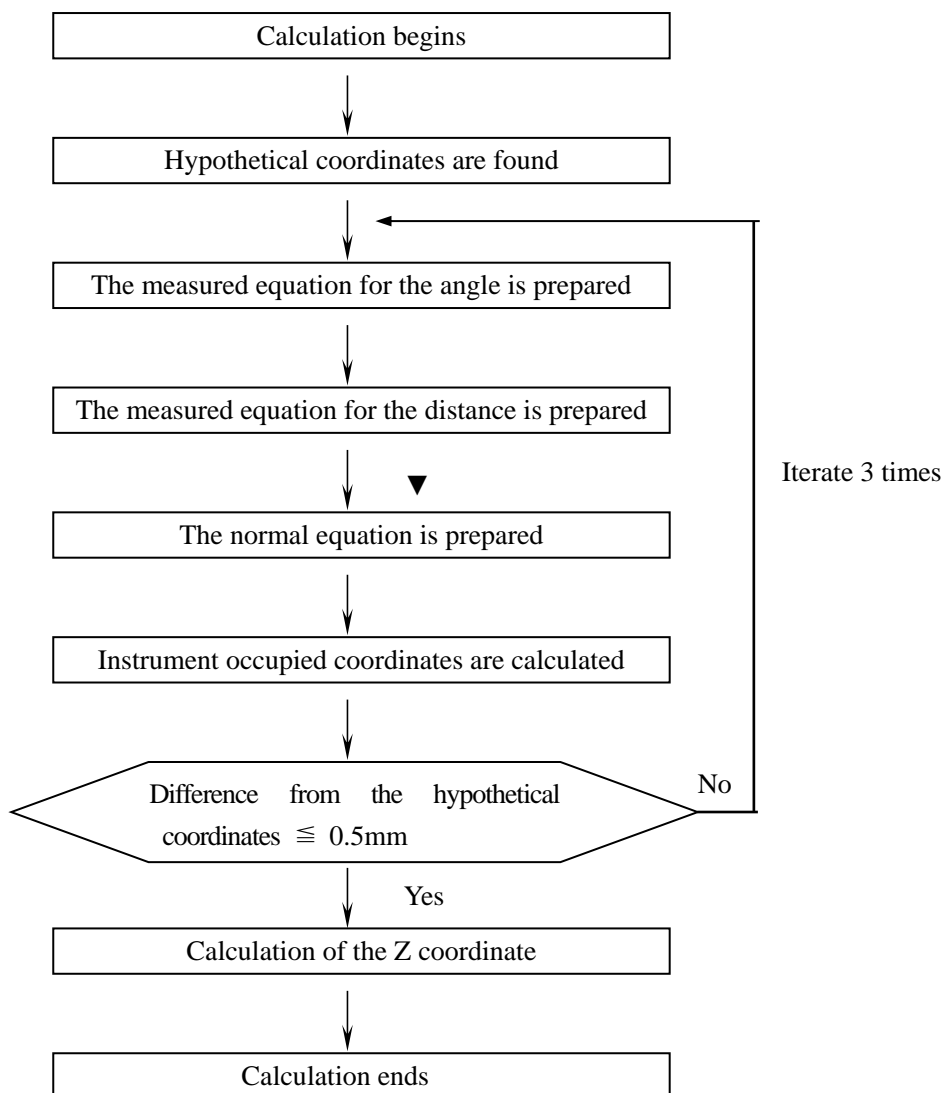Occ.Coord

Z
dZ

NEXT       R E C  OK
```

7. Press F1: [**NEXT**] to add other known points.

   Press F3: [**REC**] to record the calculated result.

   Press F4: [**OK**] to finish elevation resection. Only Z (elevation) of the instrument occupied coordinate is set. N and E values would not be overwritten.

12.3 Resection Calculation Process

The N, E coordinates are found by angle and distance measurement equations, and the instrument occupied coordinates are found using the least squares method. The Z coordinate is found by treating the average value as the instrument occupied coordinate.

```
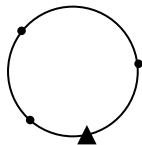                    ┌─────────────────────────────────┐
                    │        Calculation begins        │
                    └─────────────────────────────────┘
                                    │
                                    ▼
                    ┌─────────────────────────────────┐
                    │ Hypothetical coordinates are found│
                    └─────────────────────────────────┘
                                    │
                                    ▼
              ┌─────────────────────────────────────────┐
              │ The measured equation for the angle is prepared │
              └─────────────────────────────────────────┘
                                    │
                                    ▼
              ┌─────────────────────────────────────────┐
              │ The measured equation for the distance is prepared │
              └─────────────────────────────────────────┘
                                    │      ▼
              ┌─────────────────────────────────────────┐
              │      The normal equation is prepared      │
              └─────────────────────────────────────────┘
                                    │
                                    ▼
              ┌─────────────────────────────────────────┐
              │ Instrument occupied coordinates are calculated │
              └─────────────────────────────────────────┘
                                    │
                                    ▼
              ╱─────────────────────────────────╲   No
              │ Difference from the hypothetical  │───── Iterate 3 times
              │ coordinates ≦ 0.5mm               │
              ╲─────────────────────────────────╱
                                    │ Yes
                                    ▼
              ┌─────────────────────────────────────────┐
              │      Calculation of the Z coordinate      │
              └─────────────────────────────────────────┘
                                    │
                                    ▼
              ┌─────────────────────────────────────────┐
              │           Calculation ends               │
              └─────────────────────────────────────────┘
```

12.4 Precautions When Performing Resection

In some cases it is impossible to calculate the coordinates of occupied point if the unknown point and three or more known points are arranged on the edge of a single circle. It is also impossible to calculate if the included angle between the known points is too small. It is difficult to imagine that the longer the distance between the instrument occupied and known points, the narrower the included angle between the known points. Be careful for the points can easily be aligned on the edge of a single circle.

An arrangement such as shown below is desirable.

△ ▲：unknown point

○ ●：known point

It is sometimes impossible to perform a correct calculation such as shown below.

When they are on the edge of a   single circle, take one of the following methods:

(1) Move the instruction station as close
     as possible to the center of the triangle.

(2) Measure one more known point which
     is not on the circle.

(3) Perform a distance measurement on at
     least one of the three points.

13.　Point Projection

Point projection is used for projecting a point to an established baseline. The point to project can be either measured or input. Displays the distances from the first point and point to project to the position at which a line extending from point to project intersects the baseline at right angles.

Point to project

Length: Distance along the baseline from 1st point to 2nd point (X direction).
Offset: Distance from point to project to the position at which a line extending from point of project intersects the baseline at right angles (Y direction).

13.1 Define Baseline

【**Procedure of defining baseline**】

```
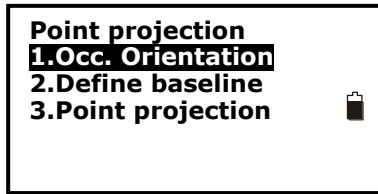Menu              P2
1.REM              ▲
2.Resection
3.Point projection ▯
4.Line stake out
5.Traverse
```

1. Press F2: [**MENU**] at P2 of basic measurement mode.

2. Turn to P2, select "**3. Point projection**".

```
Point projection
1.Occ. Orientation
2.Define baseline
3.Point projection
```

3. Input the instrument occupied data, see "§6.1 Input the occupied point data".

```
Point projection
1.Occ. Orientation
2.Define baseline
3.Point projection
```

4. Select "**2. Define baseline**".

```
Define 1st Pt.
Pt#:                    1
Np:
Ep:
Zp:
READ REC MEAS OK
```

5. Input the first point data, or press F1: [**READ**] to use existed coordinates data, or press F3:[**MEAS**] to measure the point.

```
Define 2st Pt.
Pt#:                    1
Np:
Ep:
Zp:
READ REC MEAS OK
```

6. Press F4: [**OK**] to input the second point data.

7. Press F4: [**OK**] to finish defining baseline. The grade of the baseline will display.

```
Azimuth       300gon
HD            10.412m
Grade         1:150
        1: * *    %    OK
```

8. Press F2: [**1:****] or F3: [**%**] to change the grade display mode.

NOTE:

◆ Defined baseline could be used in both stake out line measurement and point projection.

13.2 Point Projection

The baseline must be defined before performing point projection.

【**Procedure of point projection**】

```
Point projection
1.Occ. Orientation
2.Define baseline
3.Point projection      ▯
```

1. Select "**3. Point projection**" after finishing defining baseline.

2. Input the point coordinate.

   Press F2: [**MEAS**] to measure the point to project.

   When recording the data as a known point, press key {Func}, and press F2: [**REC**] on P2. Record method, see "§ 23.1 Input Known Point Coordinate by Keys".

```
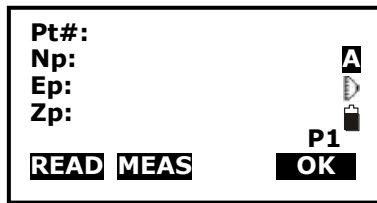Pt#:
Np:                     A
Ep:                     D
Zp:                     ▯
                     P1
READ  MEAS         OK
```

3. Press F4: [**OK**] to calculate Length, Offset and dVD will display.

   Length: Distance along the baseline from 1st point to 2nd point (X direction).

   Offset: Distance from point to project to the position at which a line extending from point of project intersects the baseline at right angles (Y direction)

```
Length
Offset
dVD                     ▯
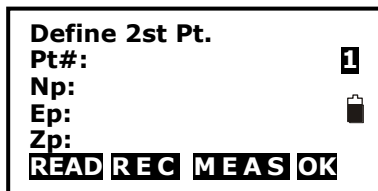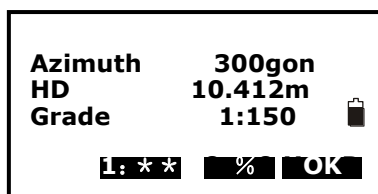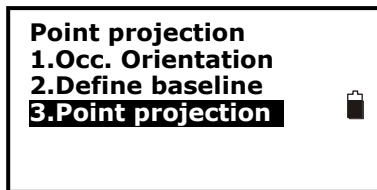
NEZ  REC         S-O
```

   dVD: Elevation between the baseline and the projected point.

Press F1: [**NEZ**] to display switching between coordinate and distance data.

Press F2: [**REC**] to record the coordinate as a known data.

Press F4: [**S-O**] to switch to stake out measurement of the projected point. See "6 Stake out measurement".

Press key {ESC} to continue point projection of a new point.

14. Stake out Line

Stake out line is used for stake out a required point at a designed distance from the base line and for finding the distance from the baseline to a measured point.

14. 1 Define Baseline

【Procedure of defining baseline】

To perform stake out line, please define a baseline first. The baseline can be defined by inputting coordinates of the two points.

```
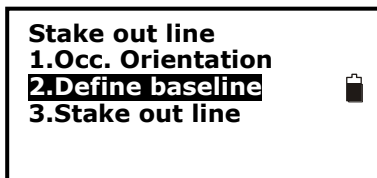Menu              P2
1.REM              ♠
2.Resection
3.Point projection  ▯
4.Line stake out
5.Traverse
```

1. Press F2: [**MENU**] on P2 of the basic measurement mode.

```
Stake out line
1.Occ. Orientation
2.Define baseline   ▯
3.Stake out line
```

2. Turn to P2, select "**4. Stake out line**".

3. Input the instrument occupied data, see "§6.1 Input the occupied point data".

4. Select "**2. Define baseline**", following operations see "§13.1 Define baseline" procedures 5, 6 and 7.

14. 2 Stake Out Line-Point

This measurement can be used to find the required point coordinates by inputting the length and offset based on baseline.

Length: Distance along the baseline from 1st point to the position at which a line extending from the required point intersects the baseline at right angles (X direction)
Offset: Distance from the required point to the position at which a line extending from the required point intersects the baseline at right angles (Y direction).

【**Procedure of stake out**】

Stake out line **1.Occ. Orientation** **2.Define baseline** **3.Stake out line**	1. Select "**3. Stake out line**" after defining a baseline.
Stake out line **1.Point** **2.Line**	2. Select "**1. Point**"
Stake out line **Length** **Offset** **OK**	3. Input values of length and offset, then press F4: [**OK**], the coordinate of the required point is calculated and displayed.

```
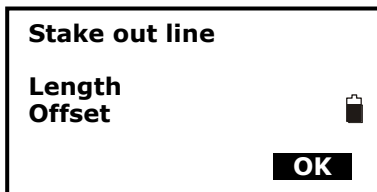Stake out line
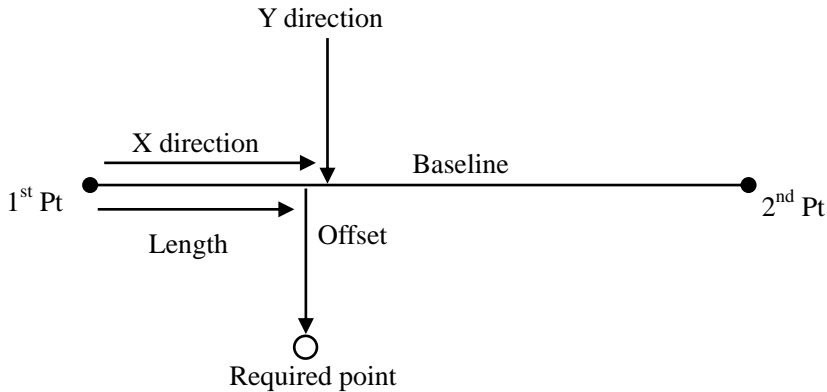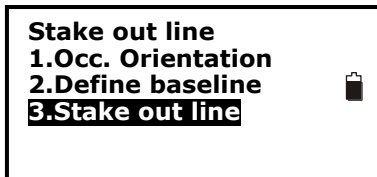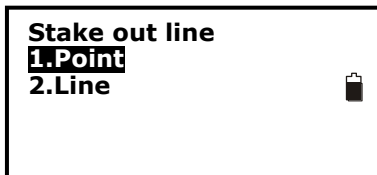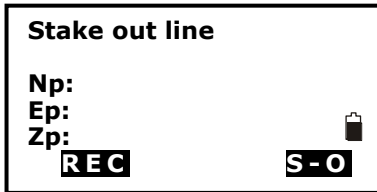
Np:
Ep:
Zp:
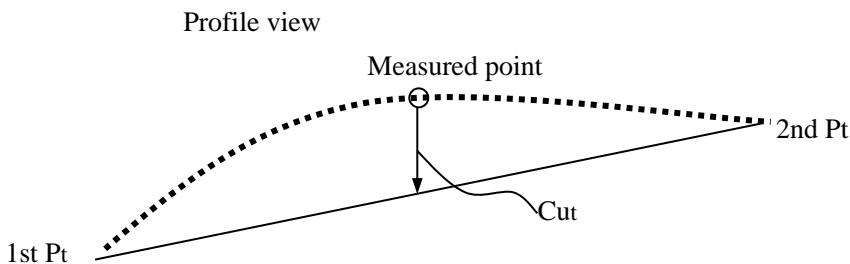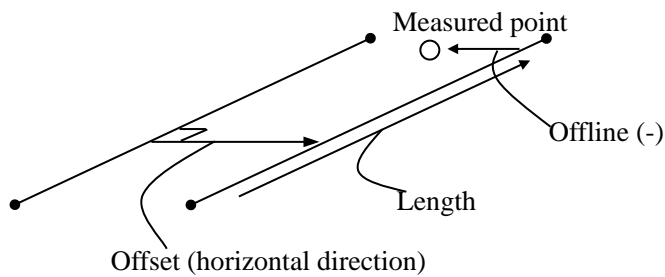    REC              S-O
```

4. Press F2: [**REC**] to record the value as a known point, see "§20.1 Input Known Point Coordinate by Keys".

Press F4: [**S-O**] to stake out the required point, see "§7. Stake out Measurement".

Press key {ESC} to continue.

14.3 Stake out Line/Line

Stake out line-line tells how far horizontally the measured point is from the baseline and how far vertically the measured point is from the connected line. Make sure to define a baseline before this operation.

Offline: A positive value indicates the point is on the right of the baseline and a negative value indicates it is on the left.

Cut: indicates that the point is below the baseline.

Fill: indicates that the point is above the baseline.

Length: distance along the baseline from 1st point to the measured point.

【Procedure of stake out line/line】

```
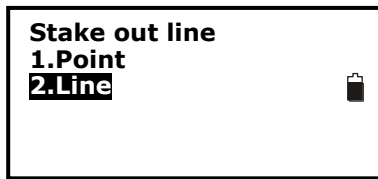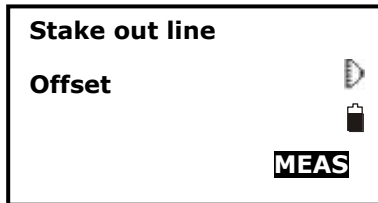Stake out line
1.Occ. Orientation
2.Define baseline
3.Stake out line
```

1. Select "**3. Stake out line**" after defining a baseline.

```
Stake out line
1.Point
2.Line
```

2. Select "**2.Line**".

```
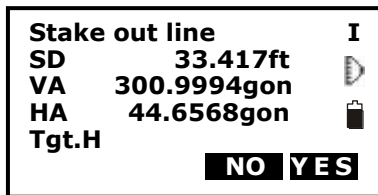Stake out line
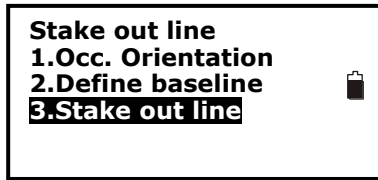
Offset

                MEAS
```

3. Input offset value: the horizontal move distance of baseline, right side indicates positive value and left side indicates negative value. Go to step 4 without inputting.

4. Aim at the target and press F4: [**MEAS**] to measure. The measured results are displayed.

```
Stake out line        I
SD        33.417ft
VA    300.9994gon
HA     44.6568gon
Tgt.H
              NO  YES
```

5. Press F3: [**NO**] to re-measure the target.

Press F4: [**YES**] to use the measured values. The difference between the measured data and the baseline displays:

Ofline: A positive value indicates the point is on the right of the baseline and a negative value indicates it is on the left.

```
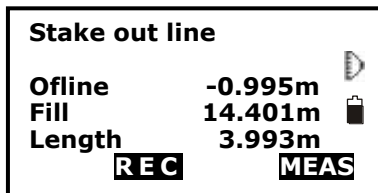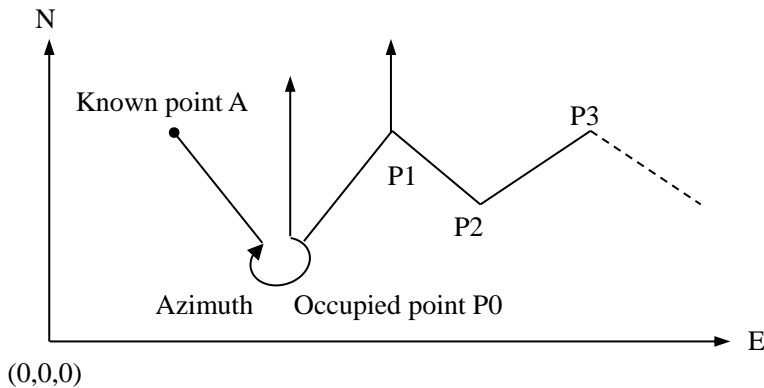Stake out line

Ofline     -0.995m
Fill       14.401m
Length      3.993m
       REC       MEAS
```

"Cut" indicates that the point is below the baseline.

"Fill" indicates that the point is above the baseline.

Length: Distance along the baseline from the first point to the measured point.

6. Aim at the next target and press F4: [**MEAS**] to continue the measurement.

15. Traverse Surveying

Measure the coordinate of foresight point and save it in the list, this point would be taken as the occupied point after transferring to point 2, and the previous occupied point will be taken as the backsight point, the azimuth angle will be calculated and set.

15.1 Save Coordinate

Here is the operation of how to measure the foresight point and save it in the list.

【**Procedure of saving coordinate**】

1. Press F2: [**MENU**] on P2 of the basic measurement mode.

2. Turn to P2, select "**3.Traverse**".

3. Press "**1.Save coord**".

```
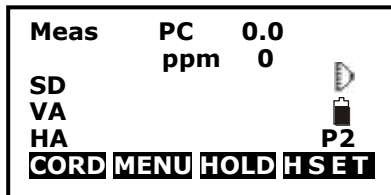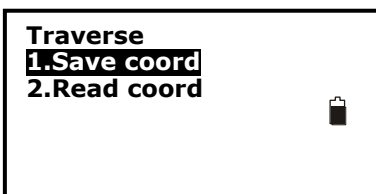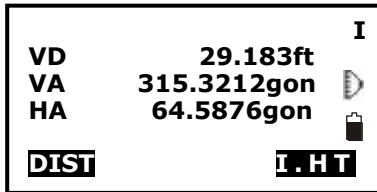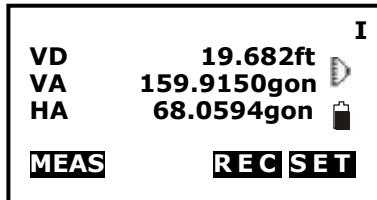                        I
VD          29.183ft
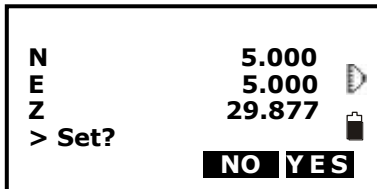VA      315.3212gon    ▷
HA       64.5876gon    🔋
DIST              I.HT
```

3. Aim at the target point and then press F1: [**DIST**]. You can press F4: [**I.HT**] to re-input instrument height or target height here.

```
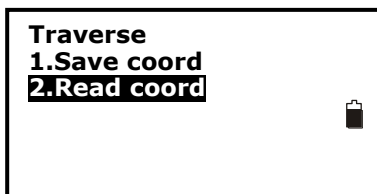                        I
VD          19.682ft   ▷
VA      159.9150gon
HA       68.0594gon    🔋
MEAS           REC SET
```

4. Press F4: [**SET**] to save the data, or press F3: [**REC**] to record it in the list.

```
N            5.000
E            5.000    ▷
Z           29.877
> Set?                🔋
               NO YES
```

5. Press F3: [**NO**] back to the previous mode and press F4: [**YES**] to set the data.

15.2 Read Coordinate

Set the measured foresight point in the saved coordinates list as the occupied point, and the previous occupied point becomes the back point.

```
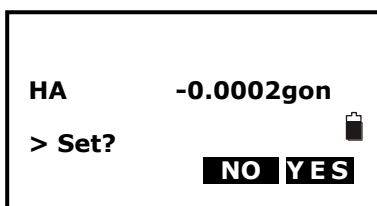Traverse
1.Save coord
2.Read coord
                      🔋
```

1. Move the instrument to the measured foresight point.

2. Select "**2. Read coord**".

```
HA         -0.0002gon
                      🔋
> Set?
               NO YES
```

3. First aim the previous occupied point, then press F4: [**YES**] to set the previous foresight point coordinate as the occupied point coordinate or press F3: [**NO**] to

give up.

16. Inverse

The distance and azimuth from a start point to an end point could be calculated according to input their coordinates.

Input: Output:

  Coordinate of start point: N0, E0, Z0   Distance: D

  Coordinate of end point : N1, E1, Z1   Azimuth: Az

```
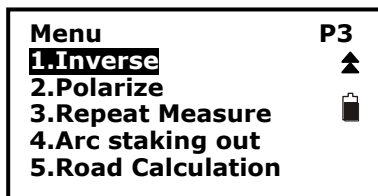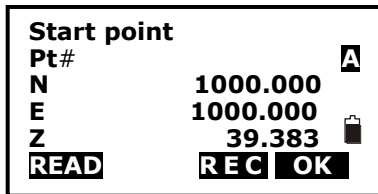Menu                    P3
1.Inverse               ▲
2.Polarize              █
3.Repeat Measure
4.Arc staking out
5.Road Calculation
```

【Procedure of Inversing】

1. Press F2: [**MENU**] on P2 of the basic measurement mode.

2. Turn to P3, select "**1.Inverse**".

```
Start point
Pt#                     A
N            1000.000
E            1000.000
Z              39.383   █
READ         R E C   OK
```

```
End point
Pt#                     A
N            1000.000
E            1000.000
Z              39.383   █
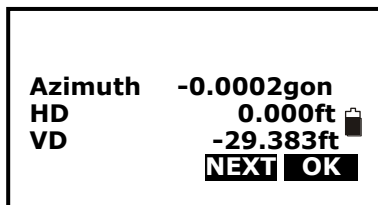READ         R E C   OK
```

3. Input coordinates of the start point, and press F3: [**REC**] to record the data in the list if necessary. You could press F1: [**READ**] to read the existed data. Press F4: [**OK**] to set.

4. Input coordinates of the end point. See the previous step.

```
Azimuth    -0.0002gon
HD            0.000ft   █
VD          -29.383ft
             NEXT   OK
```

5. The inversed value will display. Press F3: [**NEXT**] to continue, press F4: [**OK**] back to menu mode.

17. Polar Coordinates Calculation

The coordinates of the end point could be calculated according to input azimuth, distance and the NEZ coordinates of start point.

Input:

   Coordinate of start point: N0,E0,Z0

   Azimuth: Az

   Distance: Dist

   Output:

   Coordinate of end point:N1,E1,Z1

【**Procedure of Polarize**】

Menu **P3** **1.Inverse** **2.Polarize** **3.Repeat Measure** **4.Arc staking out** **5.Road Calculation**	1. Press F2: [**MENU**] on P2 of the basic measurement mode. 2. Turn to P3, select "**2.Polarize**".
P1 **Pt**# **A** **N** **1000.000** **E** **1000.000** **Z** **39.383** **READ** **OK**	3. Input the data in corresponding items. You could press F1: [**READ**] to read the existed coordinate data for start point. Press F4: [**OK**] to enter.
N **1000.000** **E** **1000.000** **Z** **0.000** **OK** **REC**	4. The calculated data displays. Press F3: [**REC**] to record it in the list, and press F1: [**OK**] back to menu mode.

18. Repetition Angle Measurement

Repetition angle measurement can be done by horizontal angle right measurement mode.

```
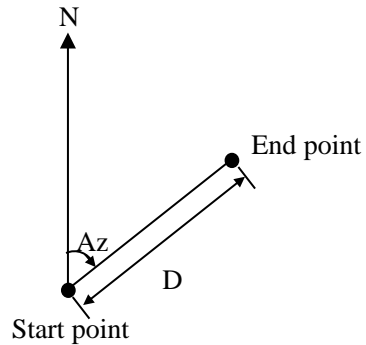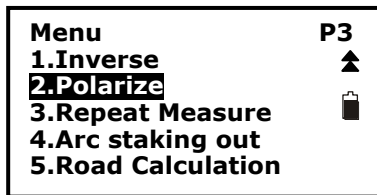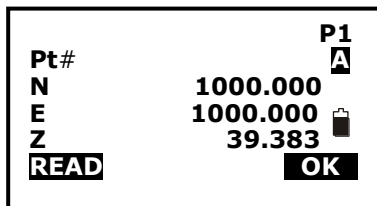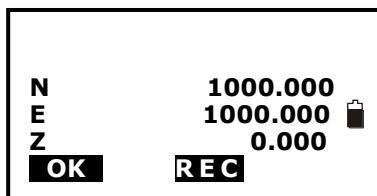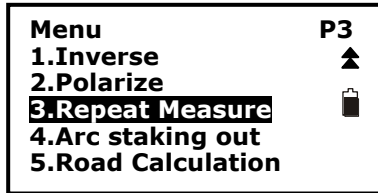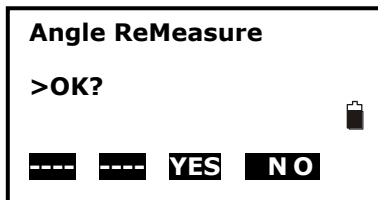Menu                    P3
1.Inverse               ▲
2.Polarize
3.Repeat Measure
4.Arc staking out
5.Road Calculation
```

1. Press F2: [**MENU**] on P2 of the basic measurement mode.

2. Turn to P3, select   **3.Repeat Measure**.

```
Angle ReMeasure

>OK?

---  ---  YES   N O
```

3. Press the F3: [Yes] key.

```
Angle Remeasure   [0]

Ht:    0° 00′ 00″
Hm:

0SET MEAS FREE HOLD
```

4. Collimate the target A and press the F1[0SET] key.
5. Press the F3:[Yes] key.

```
Angle Remeasure [1]
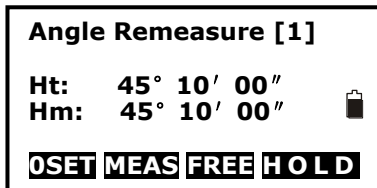
Ht:   45° 10′ 00″
Hm:   45° 10′ 00″

0SET MEAS FREE HOLD
```

6. Collimate the target B using the horizontal clamp and tangent screw.
Press the F4: [HOLD] key.

```
Angle Remeasure [1]

Ht:   45° 10′ 00″
Hm:   45° 10′ 00″
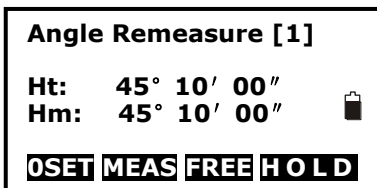
0SET MEAS FREE HOLD
```

7. Recollimate the target A using the horizontal clamp and tangent screw, and press the F3:[FREE] key.

```
Angle Remeasure [2]

Ht:   45° 10′ 00″
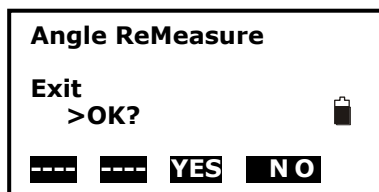Hm:   45° 10′ 00″
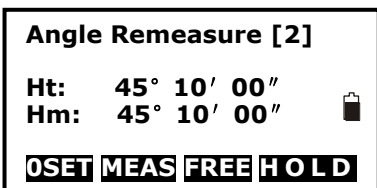
0SET MEAS FREE HOLD
```

8. Recollimate the target B using the horizontal clamp and tangent screw, press the F4:[HOLD] key.

9. Repeat 7 to 8 to measure the desired number of repetition.

```
Angle Remeasure [4]

Ht:    45° 10′ 00″
Hm:    45° 10′ 00″        🔋
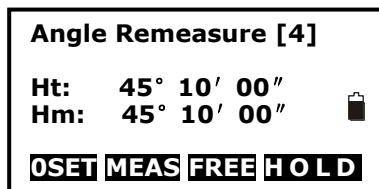
0SET MEAS FREE H O L D
```

10. Press F2: [Meas] or [ESC] key to return to the normal mode.

```
Angle ReMeasure

Exit
   >OK?                   🔋

--- --- YES  N O
```

11. Press the F3:[YES] key.

NOTE:

● Horizontal angle can be accumulated up to

(3600°00'00" – minimum reading) (horizontal angle right).

In case of 5 second reading, horizontal angle can be accumulated up to +3599°59'55".

● Error will be displayed when the results differ from first measurement by more than ±30".

19. Arc Staking Out Measurement

This application permits the user to define a Reference Arc by 2 points or 3 points and then stake out in relation to the arc.

19.1 Occ. Orientation

1. After power on, main interface will be presented, as shown in below figure.

```
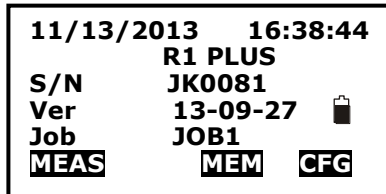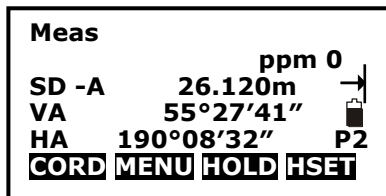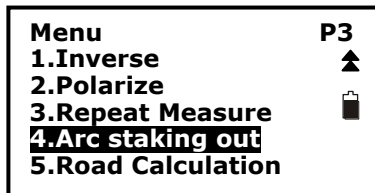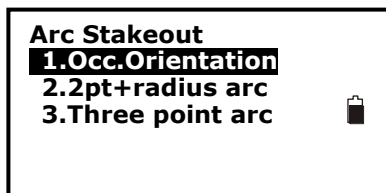11/13/2013    16:38:44
           R1 PLUS
S/N        JK0081
Ver        13-09-27    ▯
Job        JOB1
MEAS            MEM   CFG
```

2. Press F1: [**MEAS**] to enter into basic measurement mode.

```
Meas
                  ppm 0
SD -A      26.120m      →|
VA         55°27'41"    ▯
HA      190°08'32"      P2
CORD MENU HOLD HSET
```

3. Press F2: [**MENU**] to enter into programs menu, then press function key "**Func**" and switch to Page 3(P3).

```
Menu              P3
1.Inverse          ▲
2.Polarize
3.Repeat Measure   ▯
4.Arc staking out
5.Road Calculation
```

4. Next, select function key **"4.Arc Staking out"** to enter arc staking out menu.

```
Arc Stakeout
 1.Occ.Orientation
 2.2pt+radius arc
 3.Three point arc   ▯
```

5. Select **1.Occ.Orientation** to set the station.

```
Point projection
 1.Occ.Coordinate
 2.Set H angle
                    ▯
```

① Select **1.Occ.Coordinate** to confirm coordinate of occupied point.

```
Pt# 3
Inst.H            0.000m A
N0    :        30.434
E0    :         5.917    🔋
Z0    :       -10.492
READ   RES  REC   OK
```

[READ]: Reads the existed coordinate as occupied coordinate.

[RES]: Determines occupied coordinate by resection.

[REC]: Records current data.

[OK]: Completes inputting.

② Select **2.Set H angle** to carry out orientating by "Azimuth" and "Back sight".

```
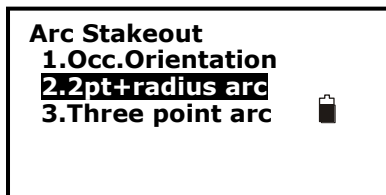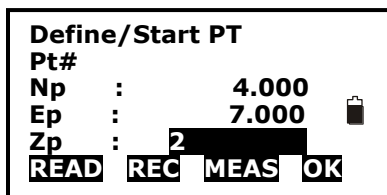Set H angle
 1.Azimuth
 2.Back sight
                        🔋
```

19.2 2pt+Radius Arc Staking Out

1.On arc staking out menu select **2. 2pt+radius arc** to start 2-point arc staking out measurement.

```
Arc Stakeout
  1.Occ.Orientation
  2.2pt+radius arc
  3.Three point arc    🔋
```

2. Input the coordinate of arc start point.

```
Define/Start PT
Pt#
Np    :        4.000
Ep    :        7.000    🔋
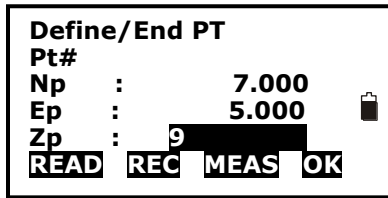Zp    :     2
READ  REC  MEAS  OK
```

[READ]: Reads the existed coordinate as start point.

[MEAS]: Determines start point by measuring**.**

[OK]: Sets the data.

3. Input the coordinate of arc end point.

```
Define/End PT
Pt#
Np    :        7.000
Ep    :        5.000
Zp    :    9
READ   REC   MEAS   OK
```

4. Input the radius of arc, press function key "**ENT**" to set the data.

```
Arc define/Rad Input
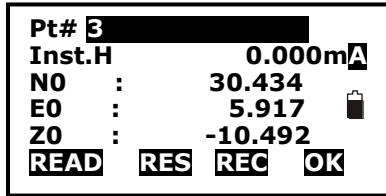
Rad          4.000m
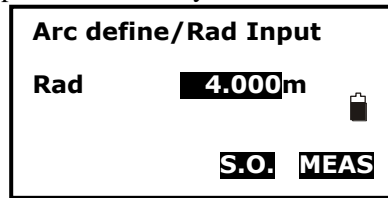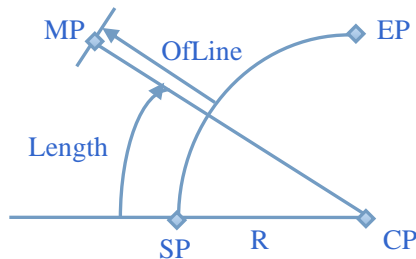
                S.O.   MEAS
```

5. Decide to Measure or Stake Out

[MEAS]: Activates Line & Offset measuring.

[S.O.]: Starts the program to stake out.

1) Measure

    SP: Start point of arc

    EP: End point of arc

    CP: Centre point of circle

    MP: Measured point

    R: Radius of circle

    Length: Distance from start of arc along with the curve

    OfLine: Vertical distance from arc

Press F4: **[MEAS]** to enter into below display.

```
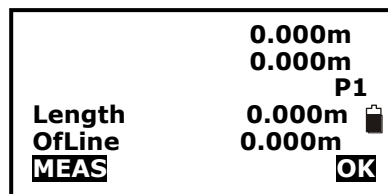                0.000m
                0.000m
                   P1
Length       0.000m
OfLine       0.000m
MEAS               OK
```

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Then press F1: **[MEAS]** to measure current rod (MP), "**Length**" and **OfLine** values relative to the arc will display, as figure shows.

```
↓                 18.672m
↥                  5.032m
                        P1
 Length       12.743m🔋
 OfLine       12.453m
 MEAS                 OK
```

Length: Distance from start point of arc along with the curve.

OfLine: Vertical distance from arc.

NOTE：When the arc radius is positive, if the MP has deviation, then it must be outside the arc. When the arc radius is negative, if the MP has deviation, then it must be inside the arc.

2) S.O. function

Press F3: **S.O.** to enter "Arc define/ Input" dialog, as figure shows:

```
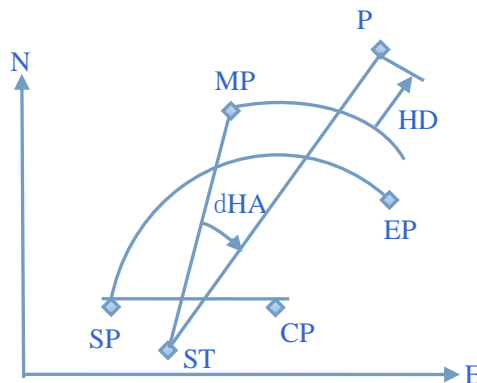 Arc define/Input

 Length        0.000m
 OfLine        0.000m   🔋

            E.A. E.S. Ok
```

[E.A.]: Equal arc stake out

[E.S.]: Equal string stake out

ST: Station
SP: Start point of arc
EP: End point of arc
CP: Centre point of circle
P: Point to stake out
MP: Measured point
dHA: Difference in horizontal angle
HD: Difference in distance measurement

① Normal arc stake out

dL: Distance from MP along with the curve.

HD: Difference in distance measurement between MP and P(stake out point).

Normal arc stake out is just operated on "Arc define/ Input" dialog. This allows to stake out a point by entering a length and an OfLine.

Length: Distance from start point of arc along with the curve.

OfLine: Vertical distance from arc.

Then press F4: **[OK]**, the stake out result will display as shown in below figure.

↓ : Represents HD in Figure 3.Indicates moving the rod (prism) in station direction.

⟶ : Represents dL in Figure 3.Indicates moving the rod (prism) in right direction. When this value goes to "0", the direction instrument faces is just the direction to stake out.

▼: This value indicates that the rod is higher than the arc. Indicates moving the prism downwards.

SO HD↓ : Stake out HD according to the arrow direction.

dHA: Difference in horizontal angle. When this value goes to "0", the direction instrument faces is just the direction to stake out.

[MEAS]: Measure a point.

NOTE: After rotating the instrument until dHA is "0", namely, the instrument points the stake out direction, press F1: **[MEAS]** to measure. When the values of the first two lines, namely HD and dL, are "0", the stake out point is found.

② Equal arc stake out

P: Point(s) to stake out
Arc: Arc length

On "Arc define/ Input" dialog, press F2:**[E.A.]**,then input arc length and offset distance, this program completes the staking out progress by dividing the arc between start point and end point into several parts.

```
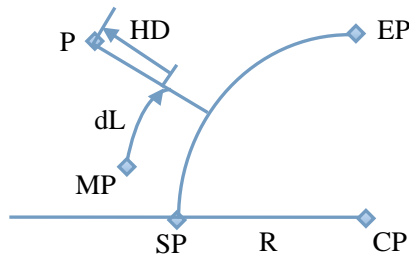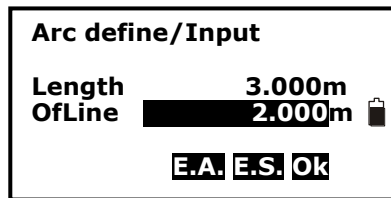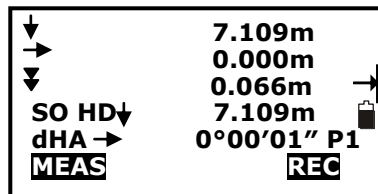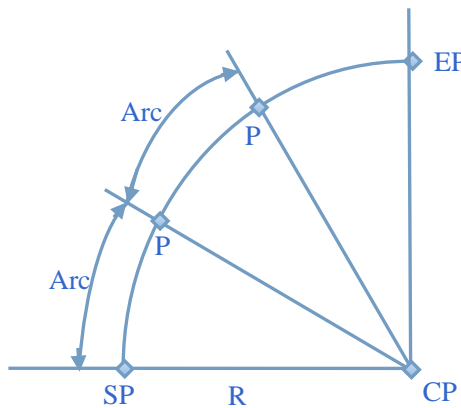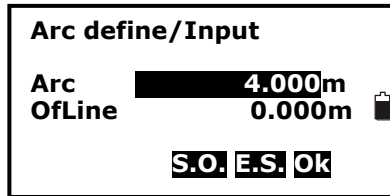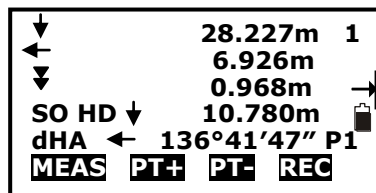Arc define/Input

Arc              4.000 m   📄
OfLine           0.000m    🔋

              S.O. E.S. Ok
```

Arc: Input the length of the arc-segment which you want to stake out.

OfLine: Input the offset value here.

After pressing F4: **[OK]**, the stake out result will display.

```
   ↓           28.227m  1
   ←            6.926m
   ↓            0.968m    →
 SO HD↓        10.780m    🔋
 dHA  ←    136°41'47" P1
 MEAS  PT+  PT-  REC
```

[PT +][PT -]: Toggles through the calculated stake out points. When up-right number is "0", it means start point. When up-right number is "1", it means the first equal arc point. And the rest may be deduced by analogy.

NOTE: The contents of stake out result can refer to normal arc stake out.

③Equal string stake out

String: Chord length

On "Arc define/ Input" dialog, press F3:**[E.S.]**,then input string length and offset distance,

the contents and softkey functions are the same as described in " Equal arc Stake Out " section.

```
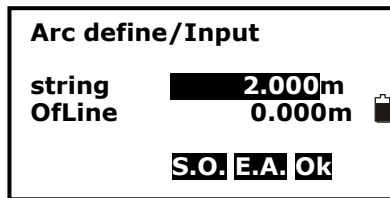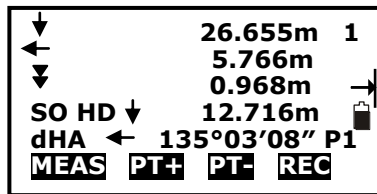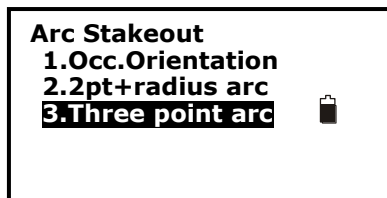Arc define/Input
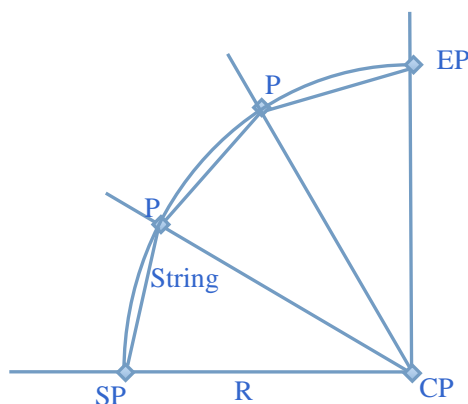
string          2.000m
OfLine          0.000m

            S.O. E.A. Ok
```

After pressing F4:**OK**,the stake out result will display.

```
↓              26.655m  1
←               5.766m
↡               0.968m      →
SO HD ↓        12.716m
dHA  ←    135°03'08" P1
MEAS  PT+  PT-  REC
```

19.3 Three Point Arc Staking Out

1.On arc staking out menu select **3. Three Point Arc** to start 3-point arc staking out measurement.

```
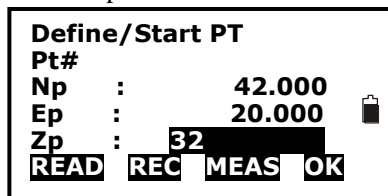Arc Stakeout
 1.Occ.Orientation
 2.2pt+radius arc
 3.Three point arc
```

2.Input the coordinate of arc start point.

```
Define/Start PT
Pt#
Np    :        42.000
Ep    :        20.000
Zp    :    32
READ  REC  MEAS  OK
```

[READ]:Reads the existed coordinate as start point.
[OK]:Sets the data.

3.Input the coordinate of arc end point.

```
Define/End PT
Pt#
Np    :        41.000
Ep    :         5.000
Zp    :    30
READ  REC  MEAS  OK
```

[READ]:Reads the existed coordinate as end point.

[OK]: Sets the data.

4. Input the coordinate of arc Mid point (random point on arc except start point and end point).

```
Arc define/Mid PT
Pt#                    A
Np    :        999.000
Ep    :          3.000
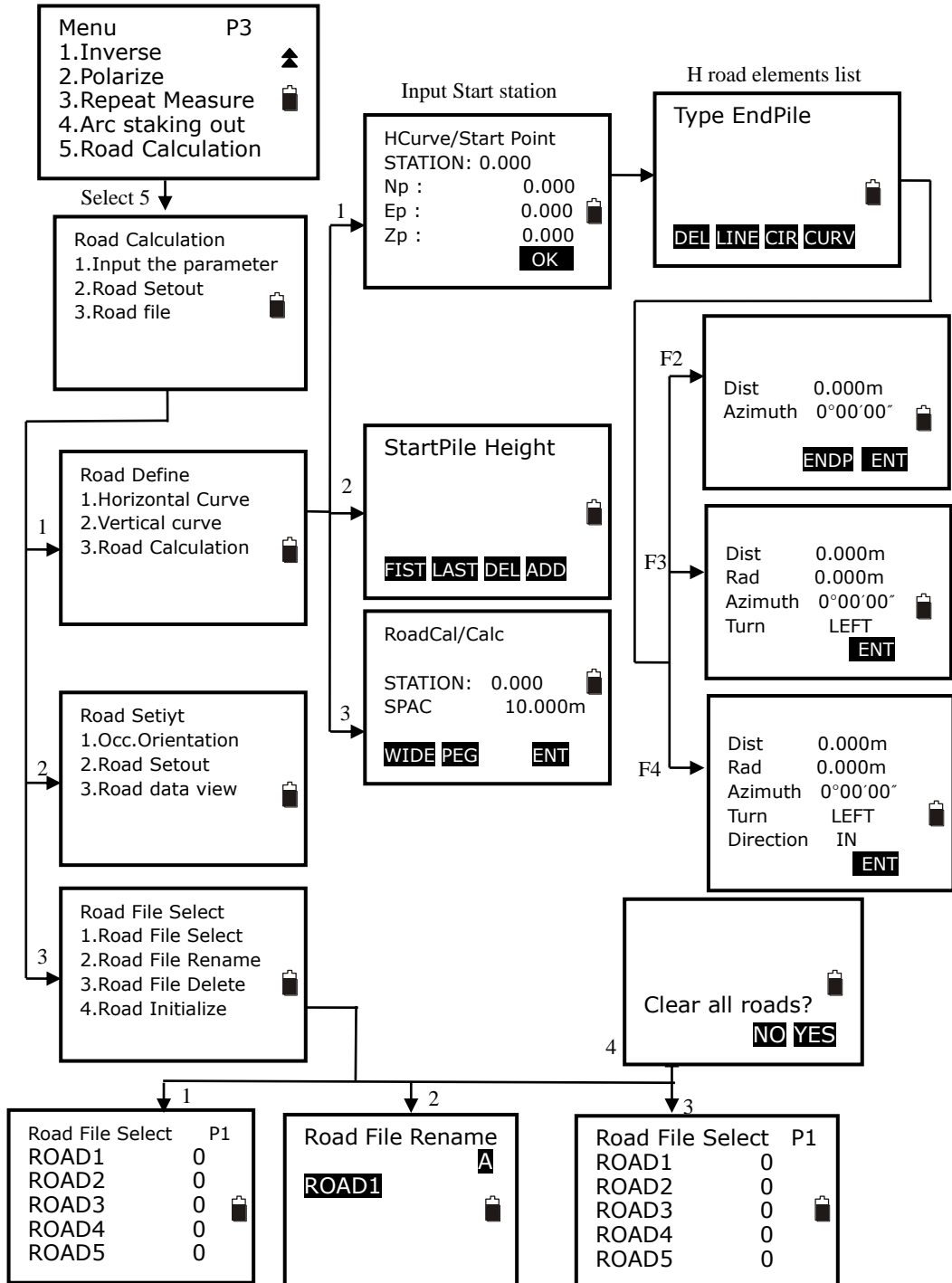Zp    :          1.000
READ   REC   MEAS   OK
```

[READ]:Reads the existed coordinate as stake out coordinate

[OK]: Sets the data.

5. After step 4, it'll enter into "arc define/Input" display. Specific operations are the same as described in "**Two Point Arc Staking Out**".

20. Road Staking Out Measurement

This program is especially designed for Road Layout measurement. It can be used for horizontal curve layout. Normally one road is constituted by several elements, such as line, circle curve or Spline.

```
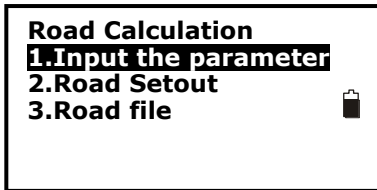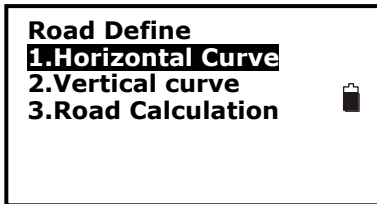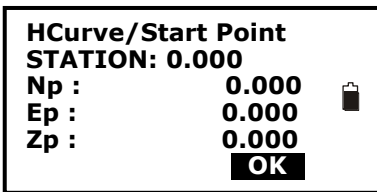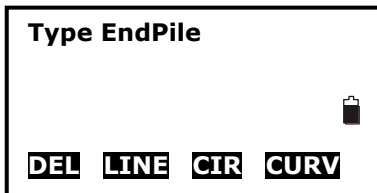Menu              P3
1.Inverse
2.Polarize
3.Repeat Measure
4.Arc staking out
5.Road Calculation
```

Select 5 ↓

```
Road Calculation
1.Input the parameter
2.Road Setout
3.Road file
```

Input Start station

```
HCurve/Start Point
STATION: 0.000
Np :          0.000
Ep :          0.000
Zp :          0.000
              OK
```

H road elements list

```
Type EndPile
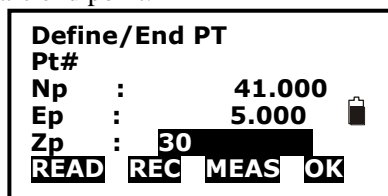


DEL LINE CIR CURV
```

```
Road Define
1.Horizontal Curve
2.Vertical curve
3.Road Calculation
```

```
StartPile Height




FIST LAST DEL ADD
```

```
RoadCal/Calc

STATION:  0.000
SPAC      10.000m

WIDE PEG      ENT
```

F2
```
Dist      0.000m
Azimuth  0°00′00″

         ENDP  ENT
```

F3
```
Dist      0.000m
Rad       0.000m
Azimuth  0°00′00″
Turn      LEFT
              ENT
```

F4
```
Dist      0.000m
Rad       0.000m
Azimuth  0°00′00″
Turn      LEFT
Direction  IN
              ENT
```

```
Road Setiyt
1.Occ.Orientation
2.Road Setout
3.Road data view
```

```
Road File Select
1.Road File Select
2.Road File Rename
3.Road File Delete
4.Road Initialize
```

```
Clear all roads?
              NO YES
```

1
```
Road File Select   P1
ROAD1          0
ROAD2          0
ROAD3          0
ROAD4          0
ROAD5          0
```

2
```
Road File Rename
                   A
ROAD1
```

3
```
Road File Select   P1
ROAD1          0
ROAD2          0
ROAD3          0
ROAD4          0
ROAD5          0
```

20.1 Input the Start Station

Road Calculation
1.Input the parameter
2.Road Setout
3.Road file

1. Press F2: [**MENU**] on P2 of the basic measurement mode, on the page 3 select **5.Road Calculation** enter road menu.

Road Define
1.Horizontal Curve
2.Vertical curve
3.Road Calculation

2. Select **1.Input the parameter** to enter road design menu. And then select **1.Horizontal Curve**, start point entering menu will display.

HCurve/Start Point
STATION: 0.000
Np :   0.000
Ep :   0.000
Zp :   0.000
           OK

3. Enter the start point station and coordinate, press F4:[OK] key. Road horizontal elements editing menu will display.

Type EndPile

DEL LINE CIR CURV

20.2 Input Road Horizontal Elements
Three types elements can be input, including line, curve and spiral.

20.2.1 Input Line Element

Dist   100m
Azimuth   0°00′00″
           ENDP ENT

1. Make sure the instrument is in horizontal elements editing menu, press F2 to display line element inputting menu.
Input the line length and azimuth in the **Dist** and **Azimuth** filed.
Press F4:[ENT] key to confirm.

NOTE:

```
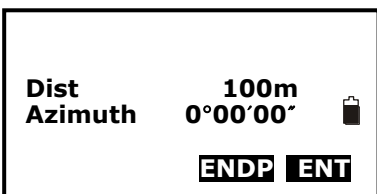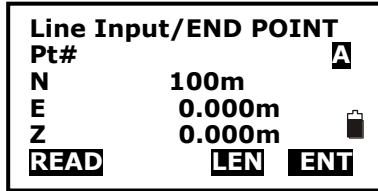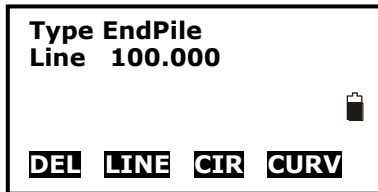Line Input/END POINT
Pt#                 A
N        100m
E         0.000m
Z         0.000m
READ          LEN  ENT
```

You can press F3:[ENDP] to enter the end point inputting menu.

Input the end point coordinate directly, or press F1:[READ] to recall from memory.

Press F3:[LINE] to back to the LENGTH menu

```
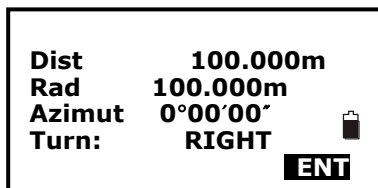Type EndPile
Line   100.000


DEL  LINE  CIR  CURV
```

Press F4:[ENT] to confirm, you will see the line element in the list menu.

Here EndPile means the end station of this element.

20.2.2 Input Circle Element

```
Dist        100.000m
Rad     100.000m
Azimut   0°00′00″
Turn:     RIGHT
                 ENT
```

1. Make sure the instrument is in horizontal elements editing menu, press F3 to display curve element inputting menu.

Input the curve parameters, including length [Dist], radius [Rad], azimuth [Azimuth] and turn [Turn].

```
Type EndPile
Line   100.000
Circle 200.000
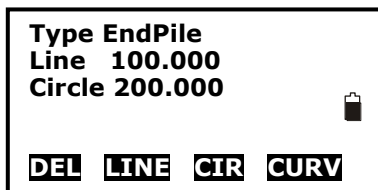

DEL  LINE  CIR  CURV
```

2. Press F4: [ENT] key to confirm, back to the horizontal elements menu.

Here EndPile means the end station of this element.

NOTE:

1. Normally the azimuth will calculate and display following previous element.

2. When you set the turn, move the cursor to [Turn] item, press ◄ or ► key to shift between Left and Right.

20.2.3 Input Spiral Element

```
Dist      100.000m
Rad       100.000m
Azimuth   57°17′44″
Turn        RIGHT
Direction    IN
                    ENT
```

1. Make sure the instrument is in horizontal elements editing menu, press F4 to display spiral element inputting menu.

Input the curve parameters, including length [Dist], radius [Rad], azimuth [Azimuth], turn [Turn] and direction [Direction].

```
Type    EndPile
Line    100.000
Circle  200.000
Spiral  300.000

DEL  LINE  CIR  CURV
```

2. Press F4: [ENT] key to confirm, back to the horizontal elements menu.

Here EndPile means the end station of this element.

NOTE:

1. Normally the azimuth will calculate and display following previous element.

2. When you set the turn or direction, move the cursor to [Turn] or [Direction]item, press ◄ or ► key to shift the options.

3. If you set the Direction is IN, here the inputted Rad is End radius of spiral, its start radius is default as ∞; if you set the direction is OUT, here the inputted is start radius of spiral, its end radius is default as ∞.

20.2.4 Road Horizontal Element Editing

In the horizontal element editing menu, the inputted element can be edited.

```
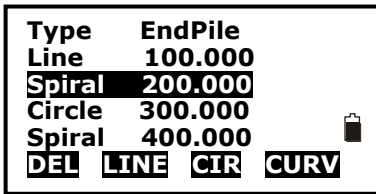Type    EndPile
Line    100.000
Circle  200.000
Spiral  300.000
Circle  400.000
DEL  LINE  CIR  CURV
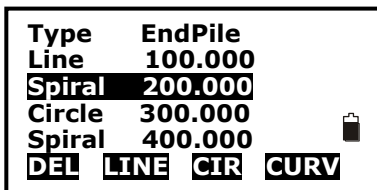```

● Delete horizontal element

1. Move ▲ or ▼ key, the cursor will move to different element.

```
Type    EndPile
Line    100.000
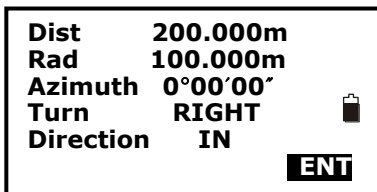Circle  200.000
Spiral  300.000
Circle  400.000
DEL  LINE  CIR  CURV
```

2. Press F1:[DEL] to delete the selected element, the two elements adjacent with deleted one will connect automatically.

```
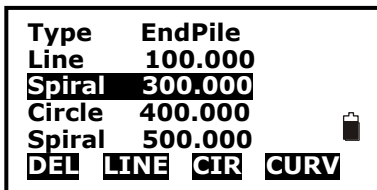Type    EndPile
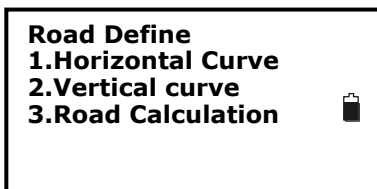Line      100.000
Spiral    200.000
Circle    300.000
Spiral    400.000
DEL  LINE  CIR  CURV
```

● Edit horizontal element

```
Type    EndPile
Line      100.000
Spiral    200.000
Circle    300.000
Spiral    400.000
DEL  LINE  CIR  CURV
```

1. Move ▲ or ▼ key, the cursor will move to different element.

```
Dist      200.000m
Rad       100.000m
Azimuth  0°00′00″
Turn       RIGHT
Direction    IN
                ENT
```

2. Press ENT key to edit the selected element.

```
Type    EndPile
Line      100.000
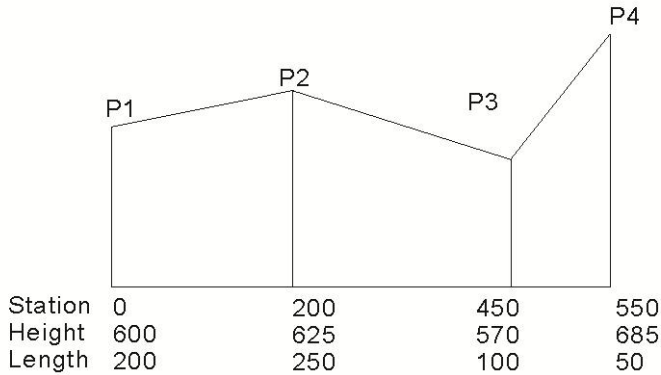Spiral    300.000
Circle    400.000
Spiral    500.000
DEL  LINE  CIR  CURV
```

3. Press F4:[ENT] key to confirm, other elements following the edited one will upgrade automatically.

```
Road Define
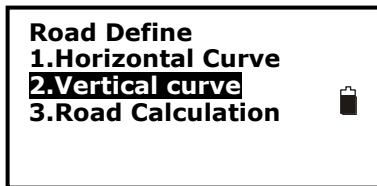1.Horizontal Curve
2.Vertical curve
3.Road Calculation
```

4. After all the horizontal elements are confirmed, press [ESC] key back to previous menu.

20.3 Input Road Vertical Elements

Road vertical elements is confirmed by some intersection points, you should input same parameters for the intersection points, including station, height, and length from this intersection point to next intersection point.

20.3.1 Input Vertical Road Element.

```
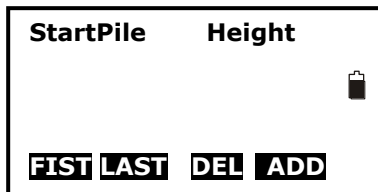Road Define
1.Horizontal Curve
2.Vertical curve
3.Road Calculation
```

1. Make sure the instrument is in Road Define menu, select **2.Vertical Curve** to vertical elements editing menu.

```
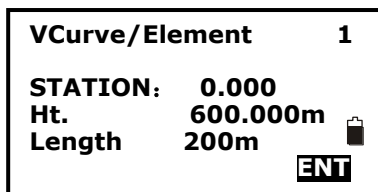StartPile      Height



FIST LAST  DEL  ADD
```

Here:
Press F1:[FIST] key, the cursor will move to the first element.
Press F2:[LAST] key, the cursor will move to the last element.
Press F3:[Del] key to delete the selected element.
Press F4:[ADD] key to add a new vertical element.

```
VCurve/Element       1

STATION：   0.000
Ht.         600.000m
Length      200m
                  ENT
```

2. Press F4 to display Vertical road element inputting menu. Input the parameter for vertical element.
Press F4:[ENT] key to confirm.

```
StartPile      Height
0.000          600.000

                         🔋

FIST LAST  DEL  ADD
```

3. You will see the just inputted element in the vertical element editing menu.

```
VCurve/Element
STATION     200.000
Ht.         625.000        🔋
Lengh       250

                    ENT
```

4. Press F4:[ADD] to input next one.

Here the STATION is displayed automatically, it comes from the previous element's length.

Press F4: key to confirm.

```
StartPile      Height
0.000          600.000
200.000        625.000
400.000        570.000        🔋
550.000        700.000
FIST LAST  DEL  ADD
```

5. Repeat step 4 to input all the vertical elements for the road.

20.3.2 Edit Vertical Road Element

In the horizontal element editing menu, the inputted element can be edited.

```
StartPile      Height
0.000          600.000
200.000        625.000
400.000        570.000
500.000        685.000        🔋
FIST LAST  DEL  ADD
```

● Delete vertical element

1. Move F1:[FIST], F2:[LAST], ▲ or ▼ key, the cursor will move to different element.

```
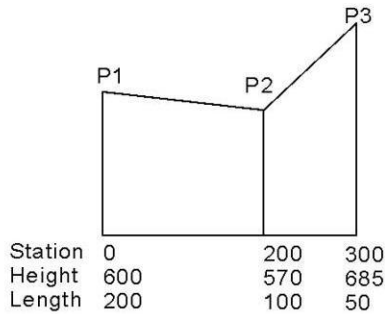StartPile      Height
0.000          600.000
200.000        570.000
300.000        685.000        🔋

FIST LAST  DEL  ADD
```

2. Press F3:[DEL] to delete the selected element, the two elements adjacent with deleted one will connect automatically.

For example, after delete the second element, the vertical road curve figure is shown

below:

● Edit horizontal element

1. Move ▲ or ▼ key, the cursor will move to different element.

2. Press ENT key to edit the selected element.

3. Press F4:[ENT] key to confirm, other elements following the edited one will upgrade automatically.

4. After all the horizontal elements are confirmed, press [ESC] key back to previous menu.

For example, after edit the second element, the vertical road curve figure is shown below:

20.4 Road Calculation
20.4.1 Input the road width element

```
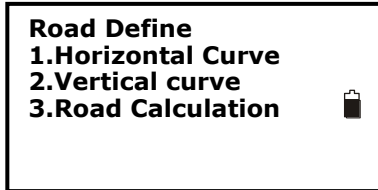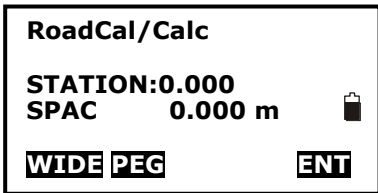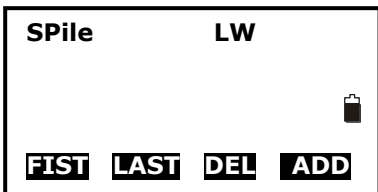Road Define
1.Horizontal Curve
2.Vertical curve
3.Road Calculation
```

1. Make sure the instrument is in Road Define menu, select **3.Road Calculation**

2. Press F1:[WIDE] to road width setting menu.

```
RoadCal/Calc
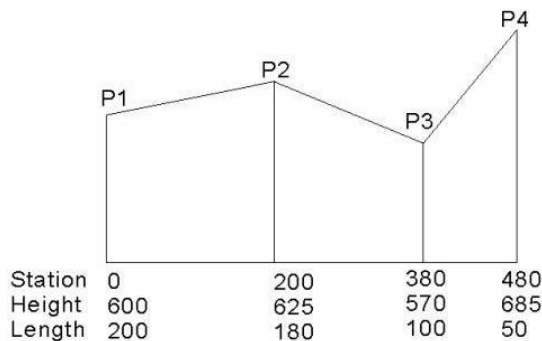
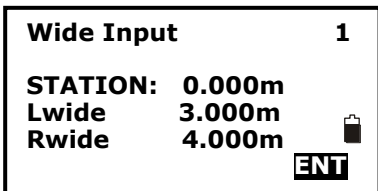STATION:0.000
SPAC     0.000 m
WIDE PEG          ENT
```

Press F1:[FIST] key, the cursor will move to the first element.
Press F2:[LAST] key, the cursor will move to the last element.
Press F3:[Del] key to delete the selected element.
Press F4:[ADD] key to add a new vertical element.

```
SPile        LW




FIST  LAST  DEL  ADD
```

3. Press F4:[ADD] to enter road wide inputting menu.

```
Wide Input           1

STATION:  0.000m
Lwide     3.000m
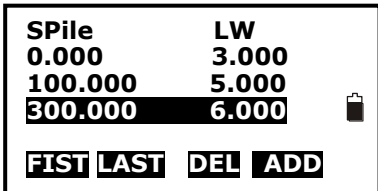Rwide     4.000m
                 ENT
```

4. Input the parameters of road width.
STATION: the road will take this width begin from this point to next road width element
Lwide: left width
Rwide: right width
Press F4:[ENT] key to confirm.

```
SPile        LW
0.000        3.000
100.000      5.000
300.000      6.000

FIST LAST  DEL  ADD
```

5.Repeat step 4 to input other road width.

```
RoadCal/Calc

STATION:0.000
SPAC     0.000 m

WIDE PEG      ENT
```

6. Press [ESC] back to road calculation menu.

20.4.2 Additional Station Setting

Some special stations can be calculated and stake out, the setting procedures are same with road width element inputting, but their result are different; for road width element, the inputted parameters are available from setting station to next element, but for additional station setting, the inputted parameters are available only for setting station.

```
Road Define
1.Horizontal Curve
2.Vertical curve
3.Road Calculation
```

1. Make sure the instrument is in Road Define menu, select **3.Road Calculation**

```
RoadCal/Calc

STATION:0.000
SPAC     0.000 m

WIDE PEG      ENT
```

2. Press F2:[PEG] to enter additional station setting menu.

Press F1:[FIST] key, the cursor will move to the first element.
Press F2:[LAST] key, the cursor will move to the last element.

```
SPile        LW



FIST LAST DEL ADD
```

Press F3:[Del] key to delete the selected element.
Press F4:[ADD] key to add a new vertical element.

3. Press F4:[ADD] to enter road wide inputting menu.

```
Wide Input
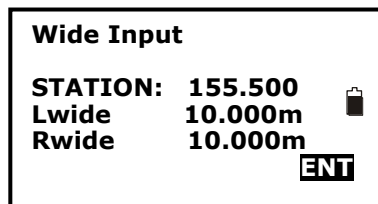
STATION:  155.500
Lwide    10.000m
Rwide    10.000m
                ENT
```

4. Input the parameters of road width.
STATION: the road will take this width begin from this point to next road width element
Lwide: left width
Rwide: right width
Press F4: [ENT] key to confirm.

```
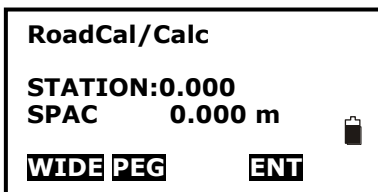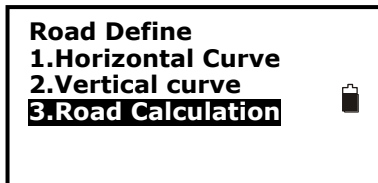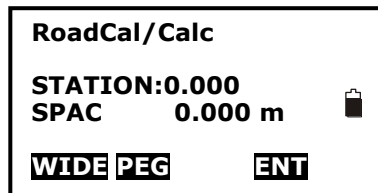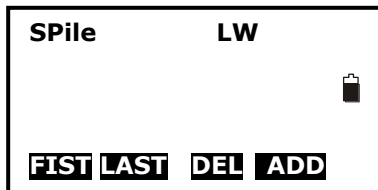SPile        LW
155.500      10.000



FIST LAST DEL ADD
```

5.Repeat step 4 to input other road width.

6. Press [ESC] back to road calculation menu.

20.4.3 Road Calculation

After design the road, input the interval to calculate the staking points.

```
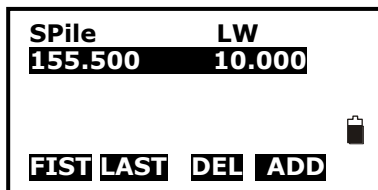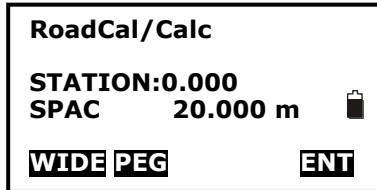RoadCal/Calc
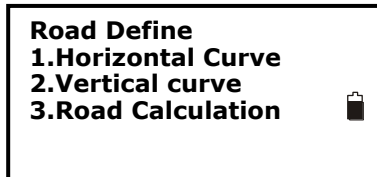
STATION:0.000
SPAC      20.000 m    🔋

WIDE PEG           ENT
```

1. Input the interval of staking points on the road.

```
Road Define
1.Horizontal Curve
2.Vertical curve
3.Road Calculation    🔋
```

2. Press F4: [ENT] to calculate, "calculating" will display until "Cal complete" appear, the program go back to previous menu automatically.

NOTE: If following display, it means there are some staked points exist in this file already. Press F3:[YES] key to cover these points, or press F4:[NO] back to previous screen.

```
OVERLAP

                      🔋

        YES  NO
```

20.5 Road Staking Out Data View

After design and calculate the road, all the staking points can be view.

```
Road Calculation
1.Input the parameter
2.Road Setout
3.Road file              🔋
```

1. Press F2: [**MENU**] on P2 of the basic measurement mode, on the page 3 select **5.Road Calculation** enter road menu.

```
Road Setout
1.Occ.Orientation
2.Road Setout
3.Road data view         🔋
```

2. Select **2.Road Setout** to road setout menu.

3. Select **3.Road data view** to view the staking station data, the station list will display.

Here:

STAKE: Center station serial number

RSTAKE: Right station serial number

LSTAKE: Left station serial number

```
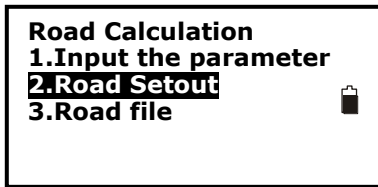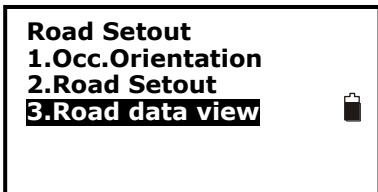STAKE    1
STAKE    2
STAKE    3
STAKE    4              🔋
STAKE    5
↑↓.P TOP LAST SRCH
```

Press F1: [↑↓.**P**] key to change the function of ▲ and ▼ keys, if it is light, press ▲ or▼ to move cursor between adjacent points. If it is backlight display, press▲ or ▼ key to move cursor to display adjacent pages.

Press F2: [**TOP**] key to move cursor to first station.

Press F3: [**LAST**] key to move cursor to last station

Press F4: **[SRCH]** key to enter the serial number(PT#) to look for the station.

```
Pt#      1
Code   0.000C        1
Np :          0.000
Ep :          0.000
Zp :        600.000     🔋
READ PREV NEXT ENT
```

```
Np :          0.000
Ep :          0.000
Zp :        600.000
Pt#      1
Code   0.000C          🔋
NEXT PREV
```

4. Press F4: [ENT] to display the coordinate of selected station.

PT#: Station serial number

Code: Station mileage, "C" means center station, "R" means right station, "L" means left station.

Press F1: [NEXT] key to display next station.

Press F2: [PREV] key to display previous station.

20.6 Road Stake Out

```
Road Calculation
1.Input the parameter
2.Road Setout
3.Road file
```

1. Press F2: [**MENU**] on P2 of the basic measurement mode, on the page 3 select **5.Road Calculation** enter road menu.

```
Road Setout
1.Occ.Orientation
2.Road Setout
3.Road data view
```

2. Select **2.Road Setout** to road setout menu.
At road setout menu select **2.Road file** to road setout menu, select **1.Occ.Orientation** to set the station and backsight.

```
Pt#      1
Code   0.000C        1
Np :            0.000
Ep :            0.000
Zp :          600.000
READ PREV  NEXT ENT
```

```
Pt#      1
Code   0.000C        1
Np :            0.000
Ep :            0.000
Zp :          600.000
READ PREV NEXT ENT
```

3. Select **2.RoadSetout** to stake out road, the first center station of road will display.
Here:
PT#: Station serial number
Code: Station mileage, "C" means center station, "R" means right station, "L" means left station.
Press F1: [READ] key to open the station list.
Press F2: [PREV] key to display previous station..
Press F2: [NEXT] key to display next station.

4. Press F4: [ENT] to enter coordinate staking out screen, see chapter "7.2 Coordinates Stake out Measurement" to do that.

20.7 Road File Management
20.7.1 Select a Road File

All the elements you inputted and the staking data you calculated are recorded in the current road file. You can select other file to define other road, normally one file includes one road.

NOTE:

◆ There are 10 road files in total, the factory default setting is "ROAD1".

◆ The default names are "ROAD1", "ROAD2"… "ROAD10", you can rename them if necessary.

```
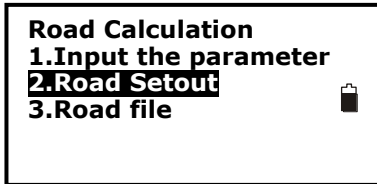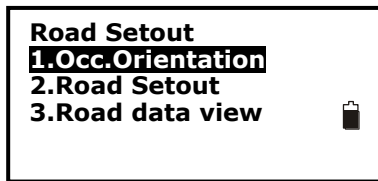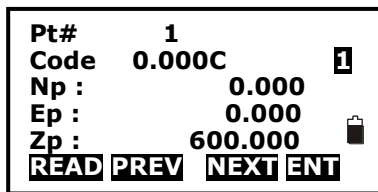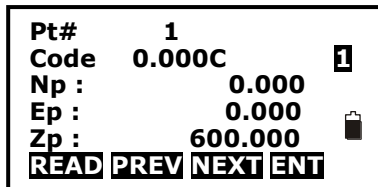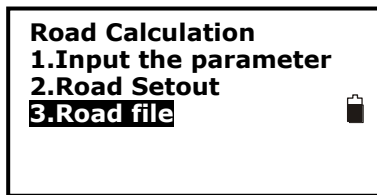Road Calculation
1.Input the parameter
2.Road Setout
3.Road file            🔋
```

Procedures:

1. Press F2: [**MENU**] on P2 of the basic measurement mode, on the page 3 select **5.Road Calculation** enter road menu.

```
Road file
1.Road File Select
2.Road File Rename
3.Road File Delete
4.Road Initialize     🔋
```

2. Select **3.Road file** to road file management menu.

```
Road File Select    P1
ROAD1        96
ROAD2        55
ROAD3         0        🔋
ROAD4         0        ⬇
ROAD5         0
```

3. Select **1.Road File Select** to display road file list, the cursor will stay on current Job file.

```
Road File Select    P1
ROAD1        96
ROAD2        55
ROAD3         0        🔋
ROAD4         0        ⬇
ROAD5         0
```

4. Press ▼ or ▲ arrow key to move cursor, after reach to the job you want to select, press [ENT] key to confirm. The program will back to road file management menu automatically.

20.7.2 Rename a Road File

Road Calculation
1.Input the parameter
2.Road Setout
3.Road file

Procedures:

1. Press F2: [**MENU**] on P2 of the basic measurement mode, on the page 3 select **5.Road Calculation** enter road menu.

Road file
1.Road File Select
2.Road File Rename
3.Road File Delete
4.Road Initialize

2. Select **3.Road file** to road file management menu.

Road File Rename   **1**

Road4

3. Select **2.Road File Rename,** current road file will display.

Road File Rename   **1**

STO MA

4. Input new name, press [ENT] key to confirm. The program will back to road file management menu automatically.

NOTE:

The max length of road file name is 8 characters, special symbols cannot be accepted, such as "#, ? /……"

20.7.3 Delete a Road File

```
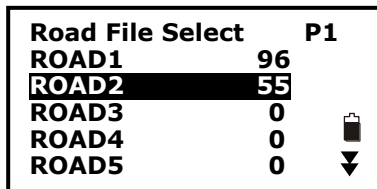Road Calculation
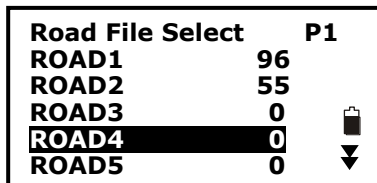1.Input the parameter
2.Road Setout
3.Road file
```

Procedures:
1. Press F2: [**MENU**] on P2 of the basic measurement mode, on the page 3 select **5.Road Calculation** enter road menu.

```
Road file
1.Road File Select
2.Road File Rename
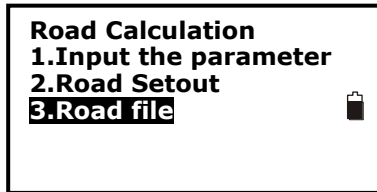3.Road File Delete
4.Road Initialize
```

2. Select **3.Road file** to road file management menu.

```
Road File Select    P1
ROAD1          96
ROAD2          55
ROAD3           0
STO MA        100
ROAD5           0
```

3. Select **3.Road File Delete,** road file list will display.

```
STO MA
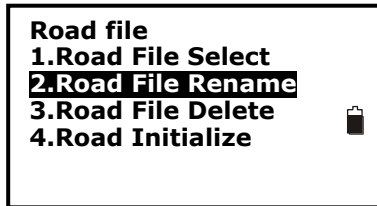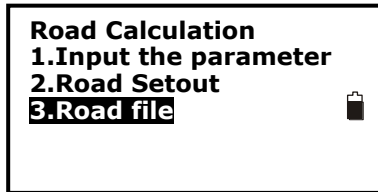
   Confirm to delete?
              NO   YES
```

4. Press ▼ or ▲ arrow key to move cursor, after reach to the job you want to delete, press [ENT] key, it will ask you to confirm to delete, press F3:[NO] back to file list, the file will not be deleted.

```
Road File Select     P1
ROAD1          96
ROAD2          55
ROAD3           0
ROAD4           0
ROAD5           0
```

5. Press F4:[YES] to delete this file, all the inputted and calculated data in this file will be cleared, and the file name change to initial status.

20.7.4 Delete all Road Files

```
Road Calculation
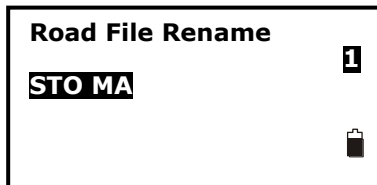1.Input the parameter
2.Road Setout
3.Road file
```

Procedures:

1. Press F2: [**MENU**] on P2 of the basic measurement mode, on the page 3 select **5.Road Calculation** enter road menu.

```
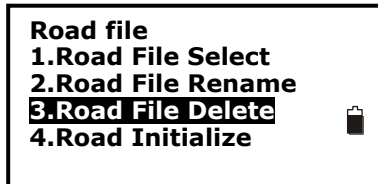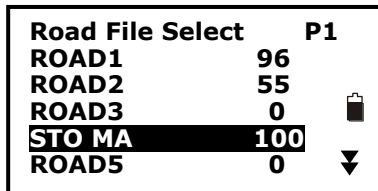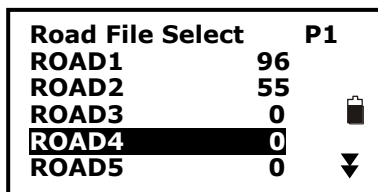Road file
1.Road File Select
2.Road File Rename
3.Road File Delete
4.Road Initialize
```

2. Select **3.Road file** to road file management menu.

```
Clear all roads?
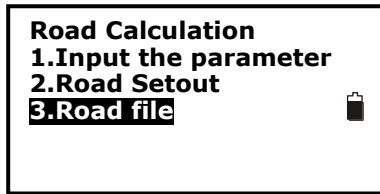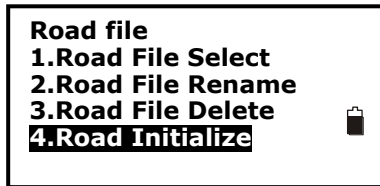
    NO    YES
```

3. Select **4.Road Initialize**. it will ask you to confirm to clear all roads, press F3:[NO] back to road file management menu, no file is deleted.

```
Initing
```

4. Press F4:[YES] to delete all road files, Initing will display, at last it will back to road file management menu automatically.

NOTE:

Pay more attention to this operation, after initialization, all the files back to initial status, the deleted elements and data can not be resumed.

```
Road File Select    P1
ROAD1           0
ROAD2           0
ROAD3           0
ROAD4           0
ROAD5           0
```

21.　Record

You can record measured data, occupied data and notes into the active JOB. The memory is 60000 points in total.

21.1 Record Occupied Data

You can input occupied data into the active JOB. The record items include: occupied coordinates, point number, instrument height, code, user, date, time, weather, wind, temperature, air pressure and ppm. If the current occupied data have not been recorded in the active JOB, the previous occupied data will be used as the active one.

【**Procedure of recording occupied data**】

```
Meas      PC    0.0
          ppm   0      D
SD
VA  302.5432gon        ▯
HA  0.0000gon      P3
EDM  OCC  OFST  R E C
```

1. Press F4: [**REC**] on P3 in basic measurement mode to enter into record mode. The active JOB will display.

```
REC    JOB1        P1
1.Occ.  data
2.Angle data
3.Collect Points   ▯
4.Note
5.View
```

2. Select "**1. Occ. data**" to set occupied station.

```
REC    JOB1        P2
1.JOB select
                   ▲
                   ▯
```

3. You can input the following items by hand: PT#, instrument heigt(Inst.H), code, N0-E0-Z0, , user, date, time, weather, wind, temperature, pressure, and ppm. Press key "▲"/ "▼" to select item or press [**FUNC**] to turn page.

```
Pt#    J2
Inst.H        0.000m  ▼
N0:           0.000
E0:           0.000
Z0:           0.000    ▯
READ  RES  REC  OK
```

Press F1:[**READ**] to read coordinate from memory. See "§6.1 Input the occupied point data".

Press F2:[**RES**] to enter resection program and get the station coordinate

Press F3:[**REC**] to record the station coordinate into memory.

```
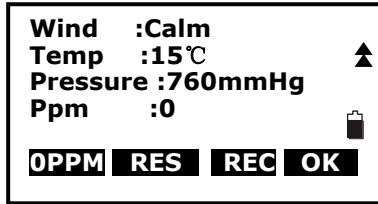Code  ROAD
User  MA              ▼
Date   :08/08/2006
 Time   :10:00:00     ▯
Weather :Fine
      RES  REC  OK
```

At the page 2 of station setting screen, press F1: [**0PPM**] to set ppm value as 0 directly.

4. Press F1: [**OK**] to set the station coordinate.

```
Wind    :Calm
Temp    :15℃
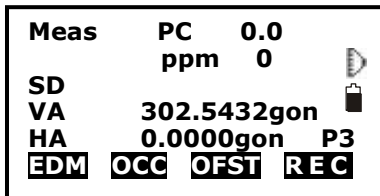Pressure :760mmHg
Ppm     :0
0PPM  RES   REC   OK
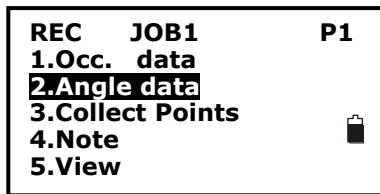```

5. Set the backsight information, and back to Rec menu.

NOTE

◆ The max length of Pt# is 14 characters.

◆ The instrument height range: -9999.999~9999.999.

◆ The max length of code and user is 16 characters.

◆ Date and time are not allowed to change here.

◆ Weather options: Fine, Cloudy, Flurry, Rain, Snow.

◆ Wind options: Calm, Gentle, Light, Strong, Gust.

◆ The temperature range: -30 ~ 60℃.

◆ The pressure range: 500 ~ 1400 hPa（mbar）/ 375 ~ 1050 mmHg /14.8～41.3 inch Hg/ 7.3~20.3 Psi.

◆ The ppm range: -499 ~ 499 ppm.

## 21.2 Collect Angle Data

```
Meas    PC    0.0
              ppm   0
SD
VA      302.5432gon
HA      0.0000gon   P3
EDM  OCC  OFST  REC
```

1. Enter into record mode. The active JOB will display.

```
REC   JOB1       P1
1.Occ.  data
2.Angle data
3.Collect Points
4.Note
5.View
```

2. Select "**2. Angle data**", then aim at the target, the angle will display in real time.

```
REC  Free 44000     II

VA      148.7080gon
HA      352.4228gon
Pt#     PP01       P1
AUTO 0SET       REC
```

```
REC  Free 44000
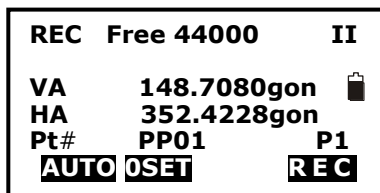
Tgt.H           1.45ft
Code    NO
                    P2
AUTO 0SET       REC
```

3. Press F4: [**REC**] to input the following items: point number, target height and code, press F1: [**OK**] to save data.

You could press F1: [**AUTO**] to perform this process directly if PT#, code and tgt.H are unnecessary to re-set.

Press F2:[**0SET**] to set horizontal angle as 0

4. Repeat step 3 to collimate and collect other points angle data..

21.3 Collect Points

【Procedure of recording coordinate and distance data】

```
Meas      PC    0.0
          ppm   0        ▷
SD
VA   302.5432gon         ▯
HA   0.0000gon      P3
EDM  OCC  OFST  R E C
```

1. Press F4: [**REC**] on P3 in basic measurement mode to enter into record mode. The active JOB will display.

```
REC    JOB1        P1
1.Occ.  data
2.Angle data
3.Collect Points
4.Note                   ▯
5.View
```

2. Select "**3. Collect Points**".

```
REC    Free 43997
N              5.000    ▷
E              5.000    ▯
Z              5.000    ▮
Pt#    D10          P1
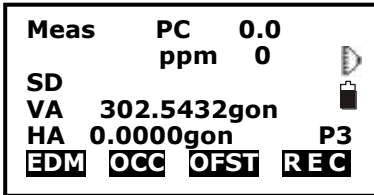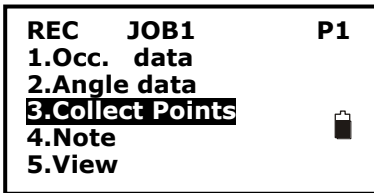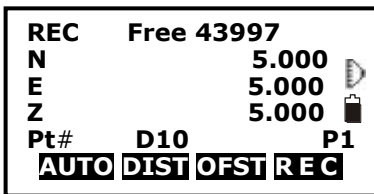AUTO DIST OFST R E C
```

3. Aim at the target and press F2: [**DIST**] to measure distance, and then [**REC**] will display at the last line, press F4: [**REC**] to input the following items: point number, target height and code, press F1: [**OK**] to save data.

```
REC    Free 43997    I
SD            5.000m  ▷
VA    302.5432gon     ▯
HA    0.0000gon
Pt#   D10          P1
AUTO DIST OFST R E C
```

You could press F1: [**AUTO**] to perform this process directly if PT#, code and tgt.H are unnecessary to re-set.

```
REC    Free 43997
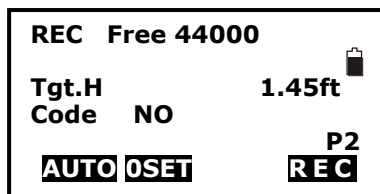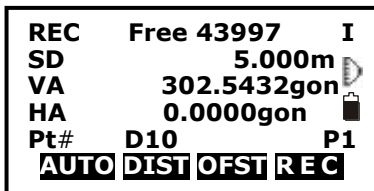
Code S
Tgt.H      45.000m    ▮
                   P2
AUTO DIST OFST R E C
```

4. Aim at other targets, repeat step 3 to collect other points.

NOTE:

◆After performing the process once, both distance measurement data and coordinate data are recorded into memory as the same Pt#.

◆Measured distance and coordinate data are recorded simultaneously.

◆Press [FUNC] key, the screen will switch between coordinate mode and distance mode.

21.4 Record Note

【**Procedure of recording note**】

```
Meas     PC    0.0
              ppm    0
SD
VA   302.5432gon
HA   0.0000gon      P3
EDM  OCC  OFST  R E C
```

1. Press F3: [**REC**] on P3 in measure mode to enter into record mode. The active JOB will display.

```
REC    JOB1      P1
1.Occ.  data
2.Angle data
3.Collect Points
4.Note
5.View
```

2. Select "**5. Note**".

```
REC/Note  Free  13996
ROAD100           A
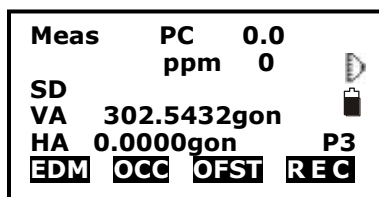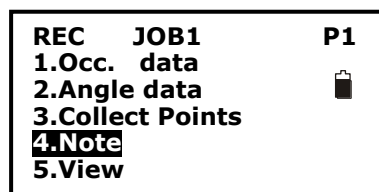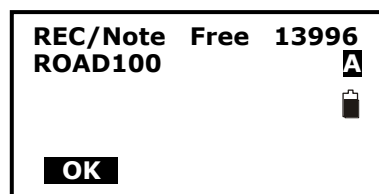
   OK
```

3. Input note and press F1: [**OK**] to save. The max length is 60 characters.

NOTE:

◆Max note length is 60 characters.

21.5 View Data

【**Procedure of view data** 】

```
Meas      PC    0.0
          ppm   0
SD
VA   302.5432gon
HA   0.0000gon      P3
EDM  OCC  OFST  R E C
```

1. Press F3: [**REC**] on P3 in measure mode to enter into record mode. The active JOB will display.

```
REC   JOB1        P1
1.Occ.  data
2.Angle data
3.Collect Points
4.Note
5.View
```

2. Press Func key to turn to page 2，Select "**1. View**".

3. All recorded data of the active JOB will display,

```
Stn        J2
Dist       J3
Coord      J3
Dist       J4
Coord      J4
↑↓.P TOP LAST SRCH
```

Press F1:[↑↓.**P**] key to change the function of ▲ and ▼ keys, if it is light, press ▲ or▼ to move cursor between adjacent points. If it is back light, press▲ or ▼ key to move cursor to display adjacent pages.
Press F2:[**TOP**] key to move cursor to first point..
Press F3:[**LAST**] key to move cursor to last point
Press F4:[**SRCH**] key to enter the serial number(PT#) to look for the point.

```
SD        3.133m
VA      84° 39′ 42″
HA     352° 28′ 59″
Pt#    J4
Tgt.H          1.45ft
NEXT PREV
```

4.Select one and press key {ENT} to view, press [ESC] back to list.

NOTE:
◆ If the point number is the same, only the newer recorded data could be viewed.
◆ The data inputted beforehand could be viewed here.

21.6 Select job

【**Procedure of job select** 】

```
Meas     PC    0.0
              ppm   0
SD
VA    302.5432gon
HA   0.0000gon        P3
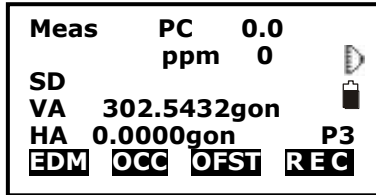EDM   OCC   OFST   R E C
```

1. Press F3: [**REC**] on P3 in measure mode to enter into record mode. The active JOB will display.

```
REC    JOB1         P2
1. JOB select
```

2. Press Func key to turn to page 2，Select 2.JOB select to set job, see "22.1 Select a JOB" to operate.

```
JOB selection
: JOB2
S.F. =1.000000
Coord search JOB
:JOB3
LIST              S.F.
```

22.   JOB Management

22.1 Storage Media Select

For R1 series, SD card slot is an standard equipment, user can record the measured data in internal memory or SD card directly. Before your work, it is necessary select appropriate storage media. For both memory, the file management procedures are same.

【**Procedure of storage select**】

```
Memory
1.JOB
2.Known data
3.Code
4.Storage Media
5.USB
```

1. Select [**MEM**] in the status mode to enter into memory management.

2. Select "**4. Storage Media Select**" to enter storage media setting screen.

```
Storage Media Slect
[F1:Internal MSD]
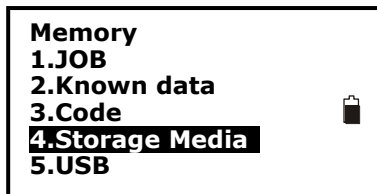F2:External SD
```

3. Press F1:Internal MSD to set the internal card as current storage media.
Or press F2:External SD to set the external SD card as current storage media.

```
Meas    PC    0.0
             ppm   0
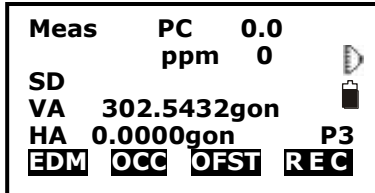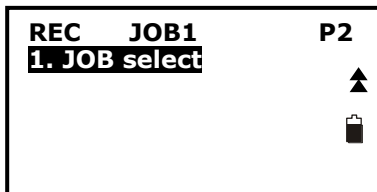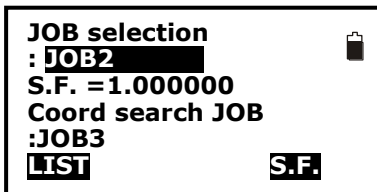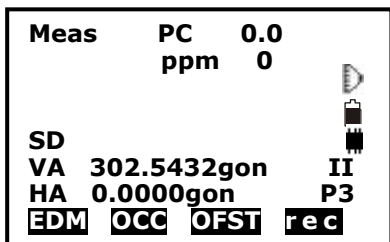
SD
VA  302.5432gon      II
HA  0.0000gon        P3
EDM  OCC  OFST  rec
```

If the internal card is current storage media, ⊞ will display on screen right.

```
Meas    PC    0.0
             ppm   0
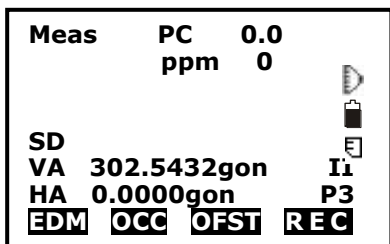
SD
VA  302.5432gon      Iı
HA  0.0000gon        P3
EDM  OCC  OFST  REC
```

If the external SD card is current storage media, ⊟ will display on screen right.

NOTE

1. If the SD card is first using on the total station, when select it as storage media, "Initialing" will take about 30s.

2. If there is no SD card in the card slot, if you select F2:External SD, <NO SD CARD>

will display.

3.At power on mode, if you insert or pull out the SD card, <SD INSERT> or <SD is pulled out> will display, but these operations are not recommended.

4. All the menu for internal memory or external SD card are same.

22.2 Select a JOB

The active JOB or coordinate search JOB could be selected. The data (known data, measured data, occupied data, coordinates, note, etc) are recorded in the active JOB, and user is able to search and read coordinate in the coordinate search JOB when coordinate measuring, resection or stake out.

NOTE:

◆ There are 20 JOBs in total, the factory default setting is "JOB1".

◆ The default names are "JOB1","JOB2"…"JOB20", you can rename them if necessary.

◆ Scale factor could be set for every JOB, but only the one of the active JOB could be modified.

Here is the equation used to calculate the data: HD2=HD1×**S.F.**

Where,   HD2: corrected horizontal distance

HD1: measured horizontal distance

S.**F.** : scale factor

【Procedure of JOB selection and scale factor setting 】

```
Memory
1.JOB
2.Known data
3.Code
4.Storage Media Select 🔋
5.USB
```

1. Press F3: [**MEM**] in the status mode to enter into memory management.

2. Select "**1. JOB**" to enter JOB management.

```
JOB              P1
1.JOB select
2.JOB rename
3.JOB delete      🔋
4.Download
5.Com setting
```

3. Select "**1. JOB select**" to set an active JOB and a coordinate search JOB.

```
JOB selection
: JOB2
S.F. =1.000000
Coord search JOB  🔋
:JOB3
LIST         S.F.
```

4. Press F1: [**LIST**] to display all JOBs on three pages.
   Press F4: [**S.F.**] to modify the scale factor.

```
JOB selection      P1
JOBA          15
JOB1          56
JOB-MY        20
MYJOB         50
JOB-B         45
```

5. Select an active JOB. The numbers to the right represent the number of data items in each JOB. Press key {ENT} to save the setting.

```
JOB-MY
S.F.=0.999998
```

6. Input the scale factor if necessary. The range: 0.5000000 ~ 2.000000, and the factory setting is 1.000000.

```
JOB selection
:JOB-MY
S.F.=0.999998
Coord search JOB
:CORD1
LIST              S.F.
```

7. Select a coord search JOB following above steps 4 and 5.

22.3 Rename a JOB

```
Memory
1.JOB
2.Known data
3.Code
4.Storage Media Select
5.USB
```

1. Press F3: [**MEM**] in the status mode to enter into memory management.

2. Select "**1. JOB**" to enter JOB management.

```
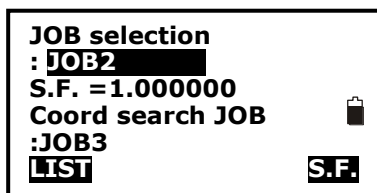JOB                P1
1.JOB select
2.JOB rename
3.JOB delete
4.Download
5.Com setting
```

3. Select "**2. JOB rename**" to rename the active JOB.

```
JOB rename          A
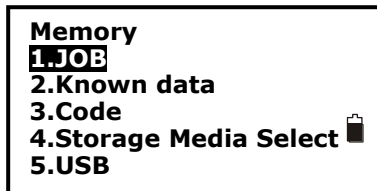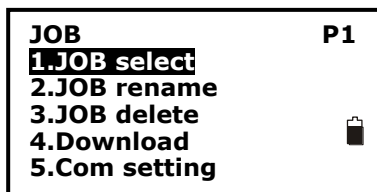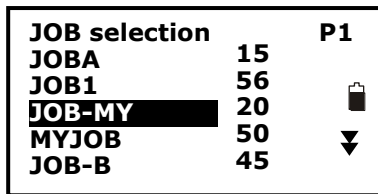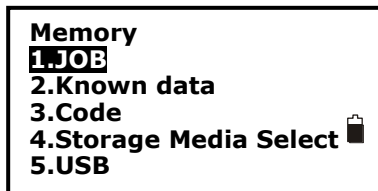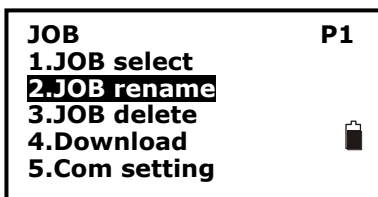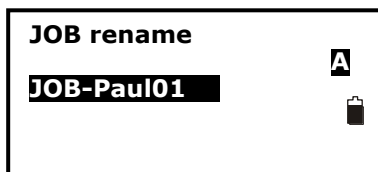
JOB-Paul01
```

4. Input a new name and press key {ENT} to save the setting. The maximum length of a JOB name is 12 characters.

22.4 Delete a JOB

It is possible to delete an existed JOB. Once the JOB has been deleted with the recorded data cleared, the JOB name returns to the default one.

【**Procedure of JOB deletion**】

```
Memory
1.JOB
2.Known data
3.Code
4.Storage Media Select
5.USB
```

1. Press F3: [**MEM**] in the status mode to enter into memory management.

2. Select "**1. JOB**" to enter JOB management.

```
JOB            P1
1.JOB select
2.JOB rename
3.JOB delete
4.Download
5.Com setting
```

3. Select "**3. JOB delete**" .

```
JOB deletion       P1
JOBA          15
JOB1          56
JOB-Paul01    20
MYJOB         50
JOB-B         45
```

4. 20 JOBs display on three pages. The numbers to the right represent the points quantity recorded in each JOB. Select the useless JOB that you wanna deleteand press key {ENT}.

```
JOBA
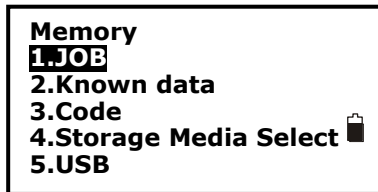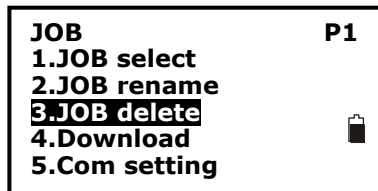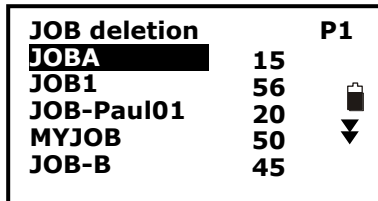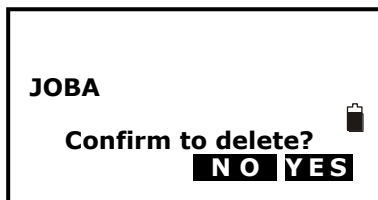
  Confirm to delete?
     N O  Y E S
```

5. Press F3: [**NO**] to give up or press F4: [**YES**] to delete the JOB.

22.5 Output JOB Data

Measured data, occupied data, known point data, note and coordinates data existed in all JOBs could be outputted to PC via serial port.

NOTE:

◆The software STONEX exchange is available in your CD-ROM

◆Be sure the communication port setting of instrument and PC is the same, see "§3.8.3 Communication Port Setting", you can select **MEM/1.JOB/5.Com setting** to set the communication parameters also.

【**Procedure of download**】

```
Memory
1.JOB
2.Known data
3.Code
4.Storage Media Select ▯
5.USB
```

1. Select [**MEM**] in the status mode to enter into memory management.

2. Select "**1. JOB**" to enter JOB management.

```
JOB              P1
1.JOB select
2.JOB rename
3.JOB delete        ▮
4.Download
5.Com setting
```

3. Connect your instrument and computer via communication cable (standard component).

4. Select "**4. Download**" to enter into com output mode and all JOBs display.

```
Com output       P1
JOBA
JOB1
JOB-Paul01          ▯
MYJOB              ▼
JOB-B
```

5. Select the JOB to be output.

```
Com output
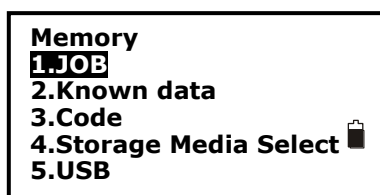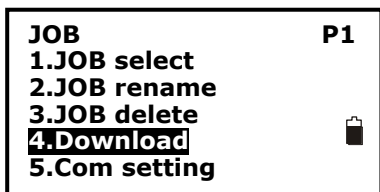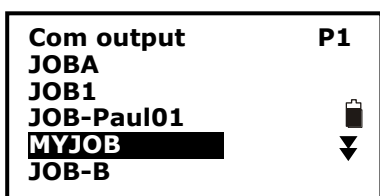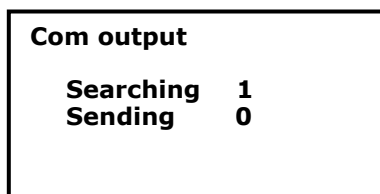
   Searching   1
   Sending     0
```

6. Press key {ENT} to start to send out via RS-232C port, it will back to JOB list mode after finishing.

More details see the Help file of STONEX Exchange, see chapter "2.1 Data transfer via RS-232C port".

22.6 File Copy

It is possible to copy the job from current internal memory to SD card, or copy known data from SD card to internal memory.

【**Procedure of JOB copy**】

```
Memory
1.JOB
2.Known data
3.Code
4.Storage Media Select
5.USB
```

1. Select **MEM/1.JOB/6.File Copy**.

```
JOB                    P2
1.File Copy             ▲
```

2. Press Func key to turn to page 2，Select "**1. File Copy**", the job list for current memory will display.

```
JOB Copy               P1
JOBA
JOBCDD
JOB-Paul01
MYJOB                   ▼
JOB-B
```

3. 20 JOBs display on three pages, select one job you want to copy. And press [ENT] key to confirm.

```
JOBCDD
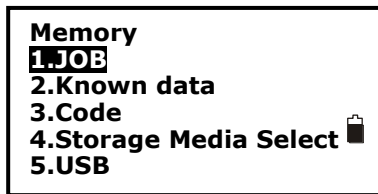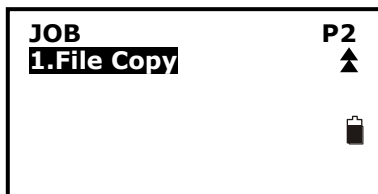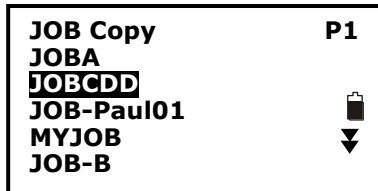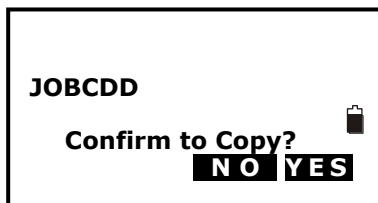
  Confirm to Copy?
         NO  YES
```

4. Press F3: [**NO**] to give up or press F4: [**YES**] to copy.

5. For more information, please read the Help file of STONEX Exhange on chapter "2.3 Data transfer via SD card".

22.7 Connect PC via USB port

R1 is equipped with USB port, you can connect it with PC for data transferring.

【**Procedure of USB port connecting**】

```
Memory
1.JOB
2.Known data
3.Code
4.Storage Media Select
5.USB
```

1. Select [**MEM**] in the status mode to enter into memory management.

```
U FUNCTION
Plug the USB
Exit Press ESC
```

2. Select "**5.USB**" to enter USB port connecting screen.

```
U FUNCTION
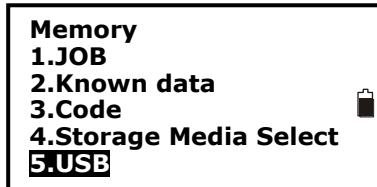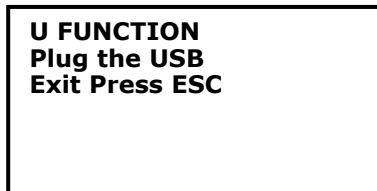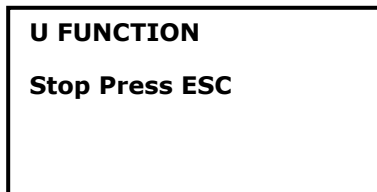
Stop Press ESC
```

3. Connect instrument and PC via USB cable,R1 will display "U FUNCTION　Stop Press ESC".
It means the R1 is connected with PC already.
Press [ESC] to disconnect them, and the instrument bact to previous menu.

```
Memory
1.JOB
2.Known data
3.Code
4.Storage Media Select
5.USB
```

For more information to see the Help file of STONEX Exchane on chapter "2.2 Data transfer via USB slave port".

23. Known Data Management

There are 6 items in known data management.

23.1 Input Known Point Coordinate by Keys

You could input or delete coordinates of known point in the active JOB by key entry or entry from PC. The existed data you have input beforehand could be used as occupied point, backsight point, coordinates of known point or stakeout point. The memory is 60000 points in total.

【**Procedure of Inputting known points coordinate**】

```
Memory
1.JOB
2.Known data
3.Code
4.Storage Media Select
5.USB
```

1. Press F3: [**MEM**] in the status mode to enter into memory management.

```
JOB selection      P1
 DAFENG       10
 JOBFF      3000
 WOMENSHI   1256
 FATELU      100
 JOB6          0
```

2. Select "**2.Known data**", job list will display. Select one Job you want to operate, press [ENT] key to confirm, known data menu will display, you can see the active JOB on the second line..

```
JOB    JOB6
1.Key input
2.Com input
3.Delete
4.View
5.Clear
```

3. Select **1.Key Input.**

4. Input point number and coordinates. The active job and free memory is displayed at the top right corner. Press F4: [**OK**] to save settings and continue to input other points. Press key {ESC} back to the known data mode.

```
Free  45912
Pt#        S1          A
N         10.500
E         11.544
Z        100.000
                    OK
```

```
Free   45911
Pt#       S1          A
N          10.500
E          11.544
       Overwrite?
ADD           NO  YES
```

5. Once the Pt# is the same as an existed one, it will display as shown left:

    Press F3: [**NO**] to re-input;

    Press F4: [**YES**] to overwrite;

    Press F1: [**ADD**] to save, and the original one will not be deleted.

23.2 Input Known Point Coordinate via RS-232C

【**Procedure of Inputting known points coordinate**】

```
Memory
1.JOB
2.Known data
3.Code
4.Storage Media Select
5.USB
```

1. Connect instrument and PC via RS-232C communication cable. Press F3: [**MEM**] in the status mode to enter into memory management.

```
JOB selection        P1
 DAFENG      10
 JOBFF       3000
 WOMENSHI    1256
 FATELU      100
 JOB6        0
```

2. Select "**2.Known data**" , job list will display. Select one Job you want to operate, press [ENT] key to confirm, known data menu will display, you can see the active JOB on the second line..

```
JOB    JOB6
1.Key input
2.Com input
3.Delete
4.View
5.Clear
```

3. Select "**2.Com input**".

```
Com input
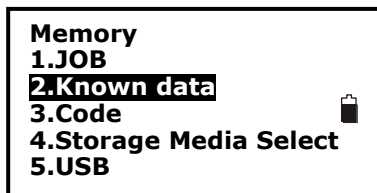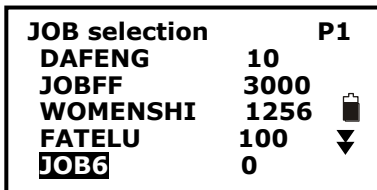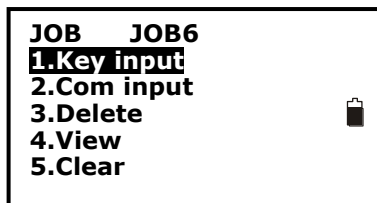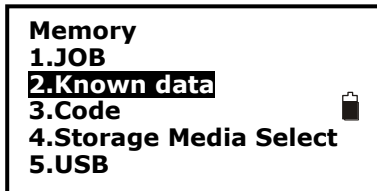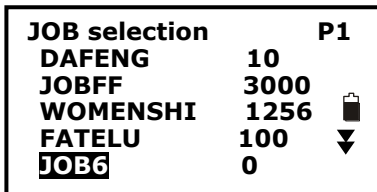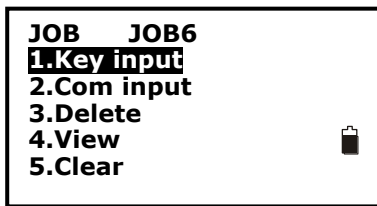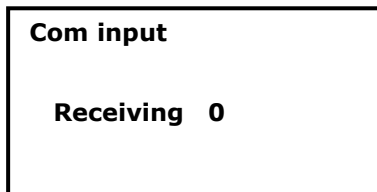
  Receiving   0
```

4. Run STONEX Exchange software PC, see the help file of STONEX Exchagne to upload known data to current JOB, the chapter is "2.1.2 Upload Known data from PC to R1 internal memory".

When data transferring, the number following Receiving will upgrade continually, at last it will back to known data mode after finishing.

23.3 Delete known point coordinate

【**Procedure of known points deletion**】

```
Memory
1.JOB
2.Known data
3.Code
4.Storage Media Select
5.USB
```

1. Press F3: [**MEM**] in the status mode to enter into memory management.

```
JOB selection        P1
 DAFENG        10
 JOBFF        3000
 WOMENSHI     1256
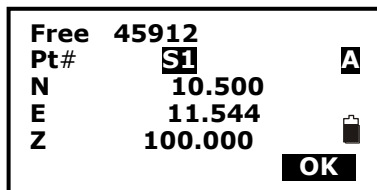 FATELU        100
 JOB6           0
```

2. Select "**2.Known data**" , job list will display. Select one Job you want to operate, press [ENT] key to confirm, known data menu will display, you can see the active JOB on the second line..

```
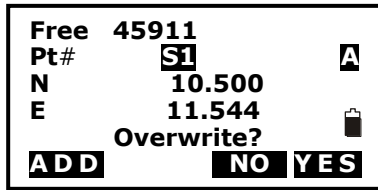JOB    JOB6
1.Key input
2.Com input
3.Delete
4.View
5.Clear
```

3. Select "**3.Delete**" and all known points in current JOB will display.

```
Pt#    1
Pt#    2
Pt#    3
Pt#    S1
Pt#    S1
↑ ↓ .P TOP LAST SRCH
```

4. Select a point you want to delete, the point coordinate will display.

```
N
E
Z
Pt#    S1
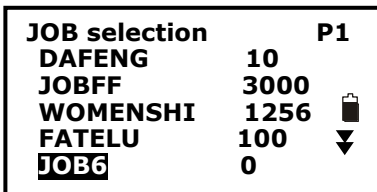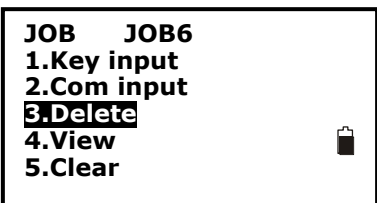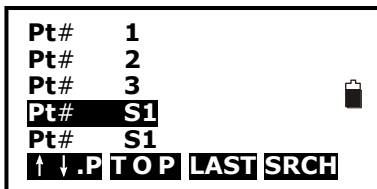
NEXT PREV       DEL
```

5. Press F1: [**NEXT**] to display the next point data;
   Press F2: [**PREV**] to display the previous point data;
   Press F4: [**DEL**] to delete it and continue to delete other points;
   Press key {ESC} back to known data management mode.

23.4 View known points data

【Procedure of known points view】

```
Memory
1.JOB
2.Known data
3.Code
4.Storage Media Select
5.USB
```

1. Press F3: [**MEM**] in the status mode to enter into memory management.

```
JOB selection        P1
 DAFENG       10
 JOBFF       3000
 WOMENSHI    1256
 FATELU      100
 JOB6        0
```

2. Select "**2.Known data**", job list will display. Select one Job you want to operate, press [ENT] key to confirm, known data menu will display, you can see the active JOB on the second line..

```
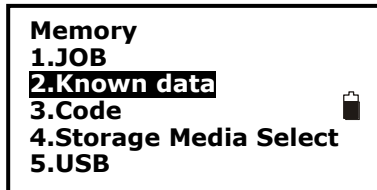JOB    JOB6
1.Key input
2.Com input
3.Delete
4.View
5.Clear
```

3. Select "**4.View**" and all known points of the current JOB will display.

```
Pt#    1
Pt#    2
Pt#    3
Pt#    S1
Pt#    S1
↑↓.P TOP LAST SRCH
```

4. Select a required point.
Here:
Press F1:[↑↓.**P**] key to change the function of ▲ and ▼ keys, if it is light, press ▲ or▼ to move cursor between adjacent points. If it is back light, press▲ or ▼ key to move cursor to display adjacent pages.

```
N
E
Z
Pt#    S1
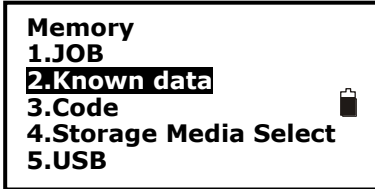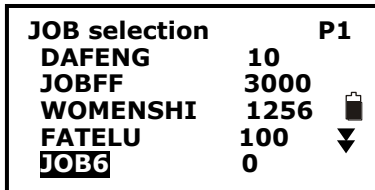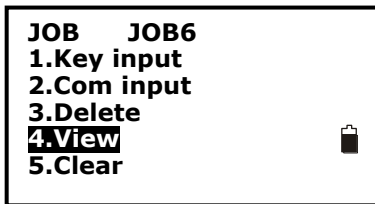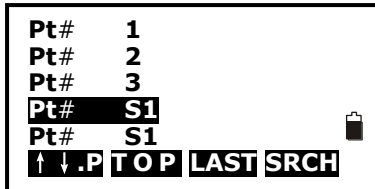
NEXT PREV        DEL
```

Press move	**0.000** **0.000** **10.919**	F2:[**TOP**] key to cursor to first point..
Press		F3:[**LAST**] key to

move cursor to last point
Press F4:[**SRCH**] key to enter the serial number(PT#) to look for the point.

5. The coordinate and point number will display.
Press F1: [**NEXT**] to display the next point data;
Press F2: [**PREV**] to display the previous point data.

23.5 Clear all known points' data

【**Procedure of clearing all known points**】

```
Memory
1.JOB
2.Known data
3.Code
4.Storage Media Select
5.USB
```

1. Press F3: [**MEM**] in the status mode to enter into memory management.

```
JOB selection        P1
 DAFENG      10
 JOBFF       3000
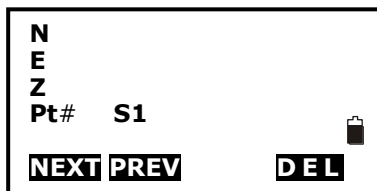 WOMENSHI    1256
 FATELU      100
 JOB6        0
```

2. Select "**2.Known data**" , job list will display. Select one Job you want to operate, press [ENT] key to confirm, known data menu will display, you can see the active JOB on the second line..

```
JOB    JOB6
1.Key input
2.Com input
3.Delete
4.View
5.Clear
```

3. Select "**5.Clear**".

```
 Clear
Confirm to delete?
             NO  YES
```

4. Press F3: [**NO**] back to known data management.
   Press F4: [**YES**] to delete all known points data of the active JOB completely.

24. Code Management

You could edit codes in this mode. All existed codes in memory could be read for all jobs, and the selected code could be recorded together with occupied data or measured data.

24.1 Edit Code list

【**Procedure of inputting a code**】

```
Memory
1.JOB
2.Known data
3.Code
4.Storage Media Select
5.USB
```

1. Select [**MEM**] in the status mode to enter into memory management.

2. Select "**3.Code**" to enter into code management.

```
Code
1.Code Edit
4.Clear list
```

3. Select "**1.Code Edit**", the code will display.

```
001:CODE
002:CODEA              A
003:CODEB
004:CODEBCD
005:CODEBDEG
↑↓.P  TOP LAST DEL
```

4. Press ▲ or ▼ key to move the cursor, and input or correct code.

Here:

Press F1:[↑↓.**P**] key to change the function of ▲ and ▼ keys, if it is light, press ▲ or▼ to move cursor between adjacent codes. If it is back light, press▲ or ▼ key to move cursor to display adjacent pages.

Press F2:[**TOP**] key to move cursor to first code

Press F3:[**LAST**] key to move cursor to last code

Press F4:[**DEL**] key to selected code.

NOTE:

◆ The codes recorded in memory could be read for all JOBs.

◆ 50 codes can be inputted.

24.2 Clear all Codes

【**Procedure of clearing all codes**】

```
Memory
1.JOB
2.Known data
3.Code
4.Storage Media Select
5.USB
```

1. Press F3: [**MEM**] in the status mode to enter into memory management.

2. Select "**3.Code**" to enter into code management.

```
Code
1.Code Edit
4.Clear list
```

3. Select "**2.Clear list**".

```
 Clear all codes,
Confirm to delete?
                  NO  YES
```

4. Press F3: [**NO**] back to previous mode;
   Press F4: [**YES**] to delete all codes recorded in memory of all JOBs completely.

```
001:
002:              A
003:
004:
005:
↑↓.P  TOP LAST  DEL
```

5.If you select "**1.Code Edit**", you will find no code inside.

25. Warning and Error Messages

"Low Signal !"
Please accurately re-sight the target.

"Same coordinates"
The coordinates of the backsights are the same, please re-define or re-input.

"Out of value"
The difference value of coordinates is over range

"Out of range"
The stake out height is over range.

"Need 1st obs"
During missing line measurement, the observation of the starting position was not completed normally. Sight the starting position accurately and press [**OBS**] to perform the measurement again.

"Change 1st obs?"
During missing line measurement, the observation of the target was not completed normally. Sight the target accurately and press [**MLM**] to perform the measurement again.

"Need prism obs"
During REM measuring, the observation of the target was not completed normally. Sight the offset point accurately and press [**MEAS**] to perform the measurement again.

"No Free Space!"
There is no more space to enter data. Record the data again after deleting unnecessary data from the JOB or coordinate data from memory.

"No data"
When searching for coordinate data or searching for code data, the search stopped either because the item in question does not exist or the data volume is large.

26. Check and Adjustment

26.1 The Instrument Constant

Ⅰ．Check

It is suggested to observe and compare the instrument with a testing baseline which is set on stable ground with a particular accuracy, though error is not generally included in the instrument constant. If the testing line is unavailable, you can select a flat place and set up the instrument and a target in the same height.

1. Select a point B on the approximately horizontal line AC with about 100 meters long. Measure the distances of lines AB , AC and BC .

2. The instrument constant can be calculated;

instrument constant =AB+BC-AC

3. Repeat steps 1 and 2 ten times, and get the average value for instrument const, if the average value is within ±3mm, adjustment is unnecessary.
4. If the difference is over ±3mm after the preceding operations, it is necessary to reset the instrument constant .

Ⅱ．Adjustment

If the instrument const is necessary to reset, please contact STONEX service representative to perform that.

26.2 Tubular Level

Ⅰ．Check

1. Mount the instrument on a stable device (as tripod, adjusting device), and fix it.

2. Level the instrument until the plate level is parallel to a line linking leveling foot screws A and B, then adjust the two screws to center the bubble.

3. Turn the instrument 180°/200gon, observe the moving direction of the bubble, if it is still centered, no adjustment is necessary, if not, you have to adjust it.

Ⅱ．Adjustment

1. Mount the instrument on a stable device and fix it.

2. Level it roughly.

3. Turn the instrument and make the tubular level be parallel to a line linking two leveling foot screws, then adjust the two screws to center the bubble.

4. Turn the instrument 180°/200gon, adjust the Adj-screw with adjustment pin slightly to correct half of the bubble's displacement when it doesn't move,

5. Repeat operations 3, 4 until the bubble remains centered in any position.

26.3 Circular Level

Ⅰ．Check

1. Mount the instrument on a stable device and fix it.

2. Level it accurately by the plate level.

3. Observe the bubble of the circular level, if it is centered, no adjustment is necessary, if not, you have to adjust it.

Circular Level

Ⅱ．Adjustment

1. Mount the instrument on a stable device and fix it.

2. Level it accurately by the plate level.

3. Adjust the three adj-screws to center the bubble by a wrench.

NOTE: Be careful when adjusting the three screws,

Adjusting pin

and the tightening tension is identical for them.

26.4 The Optical Sight

Ⅰ． Check

1. Mount the instrument on a tripod and fix it.

2. Set a cross mark target which apart from the instrument about 50m.

3. Take the telescope sight the cross mark.

4. Observe the optical sight collimator whether collimating the cross mark, if collimate the mark, adjustment is not necessary; if not, adjust it.

Ⅱ． Adjustment

1. Mount the instrument at the tripod and fix it.

2. Set a cross mark target which apart from the instrument about 50m.

3. Take the telescope sight the cross mark.

4. Loosen two fixing screws, adjust the collimator, then fix the two screws again.

26.5 Optical Plummet   (optional)

Ⅰ. Check

1. Mount the instrument at the tripod and fix it.

2. Set a cross mark under the instrument

3. Coincide the center mark of the optical plummet with the cross mark by adjusting three leveling foot screws.

4. Turn the instrument 180°/200gon, check the center mark and cross mark, if they are coincide, no adjustment is necessary, if not, adjust it.

Ⅱ． Adjustment

1. Set the instrument on stable device and fix it.

2. Set a cross mark under the instrument.

3. Use the three leveling screws and coincide the center mark of plummet and cross mark on the ground.

4. Rotate the instrument 180°/200gon around and take off the cover of the optical plummet eyepiece, adjust the four adjusting screws with the adjusting pin to shift the center mark to the cross mark, correct only one-half of the displacement in this manner.

(5) Repeat the operation in (3) and (4) until coincide the center mark of the plummet and cross mark on the ground.

NOTE: When adjust the screws of plummet reticle, firstly loosen the screw on the moving direction of reticle, secondly tighten another screw by the same mount, clockwise turning is for tightening, and anticlockwise turning is for loosening, the turning mount for tightening or loosening should be same.

26.6 Laser Plummet

Ⅰ. Check

(1) Set the instrument on stable device and fix it;

(2) Set a cross mark on the ground under the instrument;

(3) Turn the three leveling screws until the instrument keeps leveling and the laser spot coincides with the cross mark on the ground;

(4) Rotate the instrument 180°(200gon) around and check the laser spot and cross mark，
if they are coincide, adjustment is not required. Otherwise, adjust it.

Ⅱ. Adjustment

(1) Set the instrument on stable device and fix it;

(2) Set a cross mark on the ground under the instrument;

(3) Turn the three leveling screws until the instrument keeps leveling and the laser spot coincides with the cross mark on the ground;

(4) Rotate the instrument 180°(200gon) around and take off the protecting cover of the laser plummet, adjust the four adjusting screws with the screwdriver to move the laser spot to the cross mark, correct only one-half of the displacement in this manner.

(5) Repeat operation 3, 4 until the instrument keeps leveling and the laser spot coincides with the cross mark when rotating alidade of instrument to any direction.

26.7 Vertical Cross-hair on Telescope

Ⅰ. Check

(1) Set the instrument up the tripod and carefully level it.

(2) Set a point A front the instrument 50m apart;

(3) Collimate the point A and adjust the vertical tangent screw; If the point appears to move continuously on the hair, adjustment is not required. Otherwise, adjust it.

Ⅱ．Adjustment

(1) Set the instrument, and set the point A front the instrument 50m apart.

(2) Take off cover of telescope eyepiece, there are 4 screws for the reticle part.

(3) Loosen all four fixing screws slightly with the cross screw-driver.

(4) Revolve the eyepiece section so that the vertical cross-hair coincides to point A, finally, re-tighten the four screws.

(5) Repeat the checking and adjusting until there is no deviation.

NOTE: After the adjustment of cross-hair, please check the collimation error and vertical index error, see "§27.11 EDM Optical Axis and the Telescope Sighting Axis Error".

26.8 Horizontal Collimation Error C

If the telescope's sight line isn't perpendicular to the horizontal axis, the collimation error will appear. The assembling, transportation and operation will cause this error.

Ⅰ．Check

(1) Set-up the instrument on tripod or adjustment platform and leveling accurately.

(2) Aim at the cross-hairs of collimator or the obvious target at a distance. Gets the face left angle reading H1 and the face right angle reading Hr.

(3) Calculating the horizontal collimation error C according to C=（Hl- Hr±180°）/2, if C<8″, no adjustment will be necessary. If C>8″, proceed with the following adjustment.

Ⅱ．Adjustment

(1) Power on the instrument after leveling-up, and rotate telescope to initial.

(2) Aim at the cross-hairs of collimator or the obvious target at a distance. Gets

the face left angle reading H1 and the face right angle reading Hr.

(3) Rotate the instrument in face right position, turning horizontal tangent screw until Hr′=Hr+C.

(4) Loosen the shield of telescope's reticle. Adjusting two screws at left and at right until the vertical hairs of telescope's reticle coincides with the cross-hairs of collimator or target.

(5) Repeat the check and adjustment procedure until the error is accepted.

NOTE:

1. When adjusting the screws of reticle, firstly loosen the screw on the moving direction of reticle, secondly tighten another screw by the same mount, clockwise turning is for tightening, and anticlockwise turning is for loosening, the turning mount for tightening or loosening should be same.

2. After the reticle adjustment, it is necessary to adjust the vertical index error by program, see "§23.10 Vertical Index Error".

26.9 Tilt Sensor

If the tilt angle shown on the display shifts from tilt angle 0°(zero point), the instrument is not correctly leveled. This will adversely affect angle measurement. Perform the following procedures to cancel the tilt zero point error.

Ⅰ. Check

Set-up the instrument on tripod or adjustment platform, and level it accurately.

Config   P1
1.Meas condition
2.Inst. config
3.Inst. adjust
4.Com setting
5.Unit

1. Press F4: [**0SET**] twice to set HA to 0°on P1 in measure mode.

   Press ESC then press F4: [**CNFG**] to enter into config mode.

Inst. adjust
1.Tilt correct
2.Collimation corre

2. Select "**3.Inst adjust**" to set instrument basic parameters, two items display.

3. Select "**1. Tilt correct**".

```
X        -0.0020gon
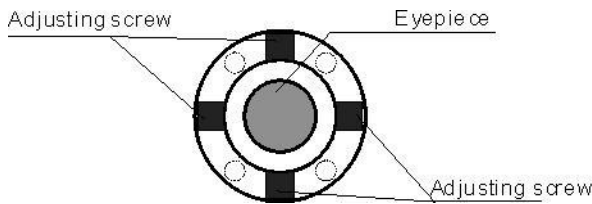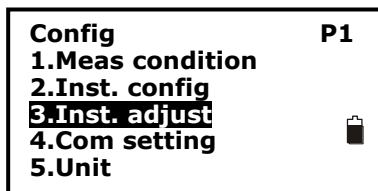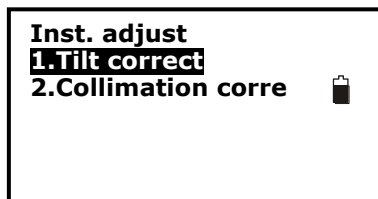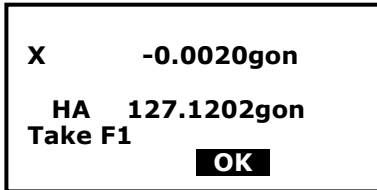
 HA   127.1202gon
Take F1
            OK
```

4. Wait a few seconds for this display to stabilize, then read the automatically compensated angles X1 and Y1.

```
X        -0.0008gon
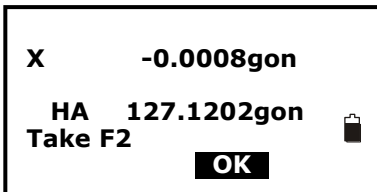
 HA   127.1202gon
Take F2
            OK
```

5. Rotate the instrument 180°/200gon. Loosen the horizontal clamp and turn the instrument 180°/200gon while referring to the displayed horizontal angle, then re-tighten the clamp. Wait a few seconds for the display to stabilize, then read the automatically compensated angles X2 and Y2.

Calculate the following offset values (tilt zero point error):

Xoffset= (X1+X2)/2

Yoffset= (Y1+Y2)/2

When the offset value falls within the range ±20″, adjustment is not necessary. If one of the offset values (Xoffset, Yoffset) exceeds ±20″, adjust the value as follows.

II. Adjustment

```
             I
X        -0.0008gon
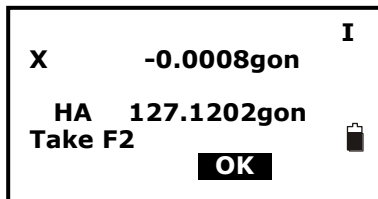
 HA   127.1202gon
Take F2
            OK
```

6. Press F3: [**OK**] to set the horizontal angle to 0°, "Take F2" is displayed.

7. Rotate the top of instrument 180°/200gon. Wait a few seconds for the display to stabilize, then press F3: [**OK**].

```
X Old       0.0020gon

X New       0.0006gon
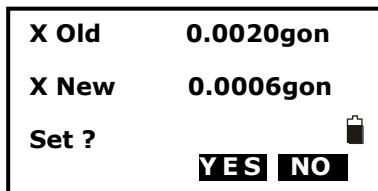
Set ?
         YES NO
```

8. If both correction constant are in the range, press F3: [**YES**] to renew the correction angle, or press F4: [**NO**] to give up this adjustment,

26.10 Vertical Index Error

The deviation between vertical circle zero position and horizontal direction is vertical

index (i), it is necessary to concern this error when measure vertical angle. The instrument program applied a formula to correct this error.

Warning: Before starting this operation, be sure to read this manual carefully, otherwise it may cause data faulty.

Because of the close relationship between vertical index and compensator zero position, it is necessary to check and adjust compensator zero position before adjusting vertical circle, the value should be stable when reading.

Ⅰ. Check:

Please adjust the reticle of telescope and correct the collimation error before this operation.

(1) Mount the instrument at the tripod or a stable device and level it accurately, then turn on the instrument.

(2) Aim at the cross-hairs of collimator or the obvious target at a distance, VA should be about ±10°. Read the face left angle Vl and face right angle Vr.

(3) Calculate the index error according to the formula below:

$$i = (Vl+Vr-360°)/2$$

(4)If I<10″ , no adjustment is necessary , or you have to adjust it .

Ⅱ. Adjustment by program:

Set-up the instrument on tripod or adjustment platform, and level it accurately.

Config   P1
1.Meas condition
2.Inst. config
3.Inst. adjust
4.Com setting
5.Unit

1. press F4: [**CNFG**] to enter into config mode.

2. Select "**3.Inst adjust**" to set instrument basic parameters. Two items display.

Inst. adjust
1.Tilt correct
2.Collimation corre

3. Select "**2.Index error correct**".

I
VA   95.8860gon
HA   115.4506gon
Take F1
OK

4. Sight a reference point in face I and press F3: [**OK**].

II
VA   295.8860gon
HA   115.4506gon
Take F2
OK

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5. Sight the reference point in face II. Rotate the instrument 180°/200gon and sight the same point, then press F3: [**OK**].

```
Index Error
Old        0.0048gon
New        0.0012gon
Set ?
           YES  NO
```

6. Press F3: [**YES**] to set the correction, and press F4: [**NO**] to give up.

26.11 EDM Optical Axis and the Telescope Sighting Axis Error

It is necessary to check this error after the adjustment of telescope reticle error.

Ⅰ. Check (For R1 series)

(1)Install the instrument at the tripod or a stable device and level it accurately, then turn on the instrument's power on.

(2) Set a prism about 2m far away from the instrument.

(3) Aim at the prism center with telescope reticle

(4) Enter EDM signal testing screen, see "§4.7 Setting Mode".

(5) Observe through eyepiece, turn the focusing knob until the read mark is clear, if the deviation between mark and cross-hair is not over 1/5 of red mark diameter, adjustment is unnecessary.

Ⅱ. Check (For R1 series)

(1) Install the instrument at the tripod or a stable device and level it accurately, then power on the instrument.

(2) Set a reflective sheet about 5m-20m far away from the instrument.

(3) Aim at the sheet cross-mark with telescope reticle.

(4) Enter EDM signal testing screen, see "§4.7 Setting Mode".

(5) Observe the laser spot, if the laser spot coincides with the cross-mark of reflective sheet, adjustment is unnecessary.

NOTE:

1. Laser radiation—Avoid direct eye exposure.

2. If the instrument needs adjustment, please contact your local dealer.

27. Technical Data

R1 series

Telescope

Length	156mm
Image	Erect
Objective aperture	Φ45mm
Magnification	30×
Field of view	1°30′
Mini focus distance	1.0m
Reticle illumination	10 brightness levels

Angle measurement

Reading system	Absolute encoder for R1 series
Circle diameter	79mm
Angle unit	degree/gon, selectable
Minimum display	1″/5″/10″, selectable
	0.2mgon/1mgon/2mgon, selectable
Detecting mode	Both circles adopt diametrical detection
Accuracy	2″/5″

Distance measurement

Laser wave length	650-690nm
Laser class	
Reflectorless	Class 3R (IEC 60825-1)
Reflective sheet	Class 3R (IEC 60825-1)
Prism	Class 1(IEC 60825-1)

Measurement range (Overcast, no haze, visibility about 30 km; no heat shimmer)

Reflectorless [1]	
R300	1 to 300m
R500	1 to 500m
Single prism	1 to 3000m/Class 1
	1000~7000m/Class 3R
Reflective sheet/RP60	1 to 800m

Accuracy

Prism mode	2mm+2ppm(optional)
Reflective sheet/RP60	3mm+2ppm
Reflectorless mode	
R300	3mm+2ppm(1-150m)/5mm+3ppm(≧150m)

R500	3mm+2ppm(1-200m)/5mm+3ppm($\geqq$200m)

Measurement time(Initial:2.5s)

Prism	typical 1.0-1.5s,
Reflective sheet(RP60)	typical 1.5s
Reflectorless	typical 1.5-5s, max. 20s
Display resolution(m/inch selectable)	0.2mm/1mm
Temperature unit	℃/℉, selectable
Pressure unit	hPa/mmHg/inchHg, selectable
Temperature input range	-40℃ to +60℃ (1℃ steps)
Pressure input range	500hPa to 1500hPa(1hPa setps)
Prism constant condition	-99.9mm to +99.9mm
Refraction and earth curvature correction	OFF/0.14/0.2, selectable
Reflecting prism constant correction	-99.9mm to +99.9mm

Level vial sensitivity

Plate level	30″ / 2mm
Circular level	8′ / 2mm

Compensation	Dual-axis（FOR R1 PLUS ONLY）
System	Liquid type
Range	±3′
Setting accuracy	1″
Compensation	Single-axis（FOR R1-5 300）
System	Liquid type
Range	±3′
Setting accuracy	1″

Laser plummet*[2]

Accuracy	±1mm/1.5m
Laser class	Class 2/IEC60825-1
Laser wave length	635nm

Display

LCD	6lines×20 characters(96 x160 dots)

Memory

Internal memory	128M
External SD card	standard

Data communication

I/O	RS-232C/USB/SD card

Power

Battery	3400mAh Li-ion Rechargeable battery
Voltage	7.4 V DC
Continuous operation time	Approx. 26 hours(At +20℃, single distance measurement every 30s)
Chargers	FDJ6-Li(100V to 240V)
Charging time	Approx. 4 hours

Others

CPU	32-bit
EDM technology	Digital signal processing
Working temperature	-20°～+50℃
Dimension	175×178×340mm(W×D×H)
Weight	5.1kg
Water and dust protection	IP66(IEC60529)

*[1] **Technical Data for R1 Power series EDM Reflectorless Measurement Range**

Option	Kodak Gray Card	Range D m	Range E m	Range F m
R300	White side, 90% reflective	200	250	300
	Gray side, 18% reflective	100	120	150
R500	White side, 90% reflective	300	400	500
	Gray side, 18% reflective	150	200	250

Atmospheric Conditions

D: Object in strong sunlight, severe heat shimmer
E: Object in shade, sky overcast
F: Underground, night and twilight

*[2] Laser plummet mounted on the bottom of the vertical axis
*[3] Bluetooth

28. Accessories

- Carrying case   1 pcs

- Battery   2 pcs

- Charger   1 pcs

- Adjusting pins   2 pcs

- Screwdriver   1 pcs

- Wrench   1 pcs

- Silica gel   1 pcs

- Certification   1 pcs

- Packing list   1 pcs

- Instruction manual   1 pcs

- CD-ROM   1 pcs

- Communication cable   1 pcs

- Reflective sheet/RP30   4 pcs (only for R1 series)
- Reflective sheet/RP60   1 pcs (only for R1 series)
- Laser caution sign board   1 pcs (only for R1 series)

Appendix I: Atmospheric correction formula and chart

(Just for reference)

Factory setting: temperature: 20℃, pressure:1013hPa, 0ppm

The correction:

Kpt＝274.417-0.2905*p/(1＋0.0036*t)………………..

Kpt＝278.960-0.2902*p/(1＋0.0036*t)………………...

Where:　　p--Pressure value (hPa)

　　　　　t--Temperature value (℃)

　　　　　Kpt--Atmospheric correction (ppm)

Example:

t=20℃, p=1013hpa, L0=1000m.

Then:　　　Kpt=0ppm

　　　　　　Kpt=4ppm

L=L0(1+Kpt)=1000×(1+0×10-6)=1000.000m

L=L0(1+Kpt)=1000×(1+4×10-6)=1000.004m

The atmospheric value is obtained easily with the atmospheric correction chart.

Find the measured temperature in horizontal axis, and pressure in vertical axis on the chart.

Read the value from the diagonal line, which is the required atmospheric correction value.

For R1 series

For R1 series

Appendix Ⅱ：Correction for refraction and earth curvature

Considering the correction of refraction and earth curvature for distance measurement, the formula for slope distance, horizontal distance and vertical distance applied in the instrument are as followings:

$$SD = D_0 \times (1 + ppm \times 10^{-6}) + mm$$

SD——Displayed slope distance（m）
D_0——Real measured distance（m）
ppm——Scale coefficient（mm/km）
mm——Target constant（mm）

$$HD = Y - A \times X \times Y$$
$$VD = X + B \times Y^2$$

HD——Horizontal distance（mm）
VD——Vertical distance（mm）
$Y = SD.|Sin\, \xi|$
$X = SD.Cos\, \xi$
ξ——Zenith angle

$$A = \frac{1 - K/2}{R}$$

$$B = \frac{1 - K/2}{2R}$$

$K = 0.142$ or 0.20
$R = 6.37 \times 10^6$（m）

The conversion formula for horizontal and vertical distance is as follows when

correction for refraction and earth curvature is not applied:

HD=SD COS§   VD=SD | SIN§|

NOTE:

◆The factory setting for the refraction coefficient K is 0.142.

 Refer to the "§3.8.1 Measure Condition Setting" to change the value.

NOTE:

These designs, figures and specifications are subject to change without notice. We shall not be held liable for damages resulting from errors in this instruction manual.

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Appendix III :STANDARD LIMITED WARRANTY

General Warranty for Instruments.

The terms and conditions of this Limited Warranty constitute the complete and exclusive warranty agreement between The Customer or Dealer and STONEX® for the Product and it supersedes any prior agreement or representation made in any STONEX® sales document or advice that may be provided to Customer by any STONEX® representative in connection with Customer's purchase of the Product. No change to the conditions of this Limited Warranty is valid unless it is made in written form and signed by an authorized STONEX® supervisor.
STONEX ® Europe warrants that its Products:
1． are free from defects in materials or workmanship for generally 1/2 year except for accessories or specific parts for which different limited warranty period shall apply .
2． have been tested/calibrated in proper working status prior to shipment.
The warranty period starts from date of first sale of the instruments. At its sole discretion, under the warranty period, STONEX® Europe will repair the product or send parts for replacement at its expense. STONEX® Europe agree to repair or replace the defected instrument within thirty (30) days, only if STONEX® Europe recognizes that the defects of the instrument are not caused by human factors or no obvious damage to its surface is visible. STONEX® Europe warrants any new replaced parts or products are warranted to be free from defects in materials and workmanship for thirty (30) days or for the remainder of the Limited Warranty Period of the Product in which they are installed, whichever is longer. Faulty Parts or Products replaced under this Limited Warranty shall become property of STONEX® Europe.
All products that have to be repaired have to be returned to our technical

representative office location via any delivery company the customer prefers.

NOTE: STONEX® Europe is not accountable for the unlikely event that the Products gets lost in transit.

Any damage inflicted by the customer or by third party after the products has been delivered to the customer is excluded from the limited warranty as well any damage arising from an improper use, from any action or use not provided for in the enclosed user guides and/or manuals.

Shipping policy.

The Customer or the dealer is required to pay for the charges for shipping of fault

parts or instruments to STONEX® Europe representative office and STONEX®

Europe (will provide) the shipping for return. Dealers needs to follow STONEX® Europe repair/service procedure (see appendix 4) to achieve a better and prompt service result.

Return policy Dead On Arrival instruments.

All returned products have to be shipped to STONEX® Europe representative office.

The original Purchaser has a period of seven (7) days, starting from date (data) of purchasing to signal the existence of a defect in the instrument for a full refund (less shipping and handling), provided the merchandise is in new, resalable condition and returned in the original, undamaged packaging. Customer has to pay for both the return and the original freight fees, regardless of the original freight paid by the Company. All warranty books, instruction manuals, parts and accessories must be included as well as the original box in which the item was shipped. We recommend to place the original carton inside another box, to avoid any additional damage to the carton itself. In some cases, returns of special items will require a   re-stock fee . Acceptance of returned merchandise is final only after inspection by STONEX® Europe.

Above terms and (policy shall apply as for hardware.) Dealers needs to follow STONEX® Europe repair/service procedure (see appendix 4) to achieve a better and prompt service result.

Firmware/Software warranty.

Stonex Europe doesn't warrant that operation of Firmware/Software on any instruments will be uninterrupted or error-free, or that functions contained in Firmware/Software will operate to meet your requirements.

Stonex will forward the Software/Firmware Fix to the dealer or customer. Firmware/software Fix means an error correction or other update created to fix a previous firmware version that substantially doesn't conform to the instruments specification.

Over Warranty repair(s) policy.

Customer shall pay the standard repair fees for any service (whether part replacement or repairs) and performed by STONEX® Europe under request and explicit authorization of the customer itself. In this case the customer is charged for return shipment's fees as well.

Disclaimer and Limitation of Remedy.

ALL OTHER EXPRESS AND IMPLIED WARRANTIES FOR THIS PRODUCT, INCLUDING THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE AND/OR NONINFRINGEMENT OF ANY THIRD PARTY'S RIGHTS, ARE HEREBY DISCLAIMED. STONEX® EXPRESSLY DISCLAIMS ALL WARRANTIES NOT STATED IN THIS LIMITED WARRANTY. ANY IMPLIED WARRANTIES THAT MAY BE IMPOSED BY LAW ARE LIMITED IN DURATION TO THE TERM OF THIS LIMITED WARRANTY. SOME JURISDICTIONS DO NOT ALLOW THE EXCLUSION OF IMPLIED WARRANTIES OR LIMITATIONS ON HOW LONG AN IMPLIED WARRANTY LASTS, SO THE ABOVE EXCLUSIONS OR LIMITATIONS MAY NOT APPLY TO CUSTOMER. CUSTOMER MUST READ AND FOLLOW ALL SET-UP AND USAGE INSTRUCTIONS IN THE APPLICABLE USER GUIDES AND/OR MANUALS ENCLOSED. IF CUSTOMER FAILS TO DO SO, THIS PRODUCT MAY NOT FUNCTION PROPERLY AND MAY BE DAMAGED. CUSTOMER MAY LOSE DATA OR SUSTAIN PERSONAL INJURIES. STONEX®, ITS AFFILIATES AND SUPPLIERS DO NOT WARRANT THAT OPERATION OF THIS PRODUCT WILL BE UNINTERRUPTED OR ERROR FREE; AS DO ALL ELECTRONICS AT TIMES. IF THIS PRODUCT FAILS TO WORK AS WARRANTED ABOVE,

CUSTOMER'S SOLE AND EXCLUSIVE REMEDY SHALL BE REPAIR OR REPLACEMENT. IN NO EVENT WILL STONEX®, ITS AFFILIATES OR SUPPLIERS BE LIABLE TO CUSTOMER OR ANY THIRD PARTY FOR ANY DAMAGE IN EXCESS OF THE PURCHASE PRICE OF THE PRODUCT. THIS LIMITATION APPLIES TO DAMAGES OF ANY KIND WHATSOEVER INCLUDING (1) DAMAGE TO, OR LOSS OR CORRUPTION OF, CUSTOMER'S RECORDS, PROGRAMS, DATA OR REMOVABLE STORAGE MEDIA, OR (2) ANY DIRECT OR INDIRECT DAMAGES, LOST PROFITS, LOST SAVINGS OR OTHER SPECIAL, INCIDENTAL, EXEMPLARY OR CONSEQUENTIAL DAMAGES, WHETHER FOR BREACH OF WARRANTY, CONTRACT, TORT OR OTHERWISE, OR WHETHER ARISING OUT OF THE USE OF OR INABILITY TO USE THE PRODUCT AND/OR THE ENCLOSED USER GUIDES AND/OR MANUALS, EVEN IF STONEX®, OR AN AUTHORIZED STONEX® REPRESENTATIVE, AUTHORIZED SERVICE PROVIDER OR RESELLER HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES OR OF ANY CLAIM BY ANY OTHER PARTY. SOME JURISDICTIONS DO NOT ALLOW THE EXCLUSION OR LIMITATION OF INCIDENTAL OR CONSEQUENTIAL DAMAGES FOR SOME PRODUCTS, SO THE EXCLUSIONS OR LIMITATIONS MAY NOT APPLY TO CUSTOMER. THIS LIMITED WARRANTY GIVES CUSTOMER SPECIFIC LEGAL RIGHTS, AND CUSTOMER MAY ALSO HAVE OTHER RIGHTS WHICH VARY FROM COUNTRY/STATE/JURISDICTION TO COUNTRY/STATE/.

Two (2) years on STONEX® Product:

Total Station R1/R1 Plus (all variants) excluding battery and power supply accessories (6 months) .

Repair/Service procedure for dealers.
(1) S/N of the instrument and a detailed description of the defect (sometimes pictures or video) will be required to indicate the cause and problem.
(2) If dealer wants to repair an instrument under warranty period on their site:

1) If dealers　(don't) have the part in stock they have to send an official order to STONEX® Europe and pay for it and then so STONEX® Europe will send the new part to them so they can repair the instrument.

2) When the repair is over dealer has to fill the "Spare Part Refund" module and send it to the dedicated mail address.

3) wait for STONEX® Europe's authorization SPR no;

4) when dealer receives the SPR authorization number they can send back to STONEX® Europe appointed office the broken part with attached the SPR module;

5) when STONEX® Europe receive the broken part STONEX® Europe shall verify it and if　everything is ok the cost of the part shall be refund (refund will be done only after　check of the failure part and final approval of STONEX® Europe).

(3) If the instrument needs to be sent back to STONEX® Europe for repair/replacement, dealers/customers has to send to STONEX® Europe a "Returned Merchandise Authorization (RMA)" before they send back the fault instrument. STONEX® Europe shall, at its sole discretion, decide on the place of performance for work under warranty.

Appendix IV : Environmental recycling

The cardboard box, the plastic in the package and the various parts of this product have to be recycled and disposed of in accordance with the current legislation of your Country.

FOR COUNTRIES IN THE EUROPEAN UNION (EU)

The disposal of electric and electronic device as solid urban waste is strictly prohibited: they must be collected separately.

Contact Local Authorities to obtain practical information about correct handling of the waste, location and times of waste collection centres. When you buy a new device of ours, you can give back to our dealer a used similar device.

The dumping of these devices at unequipped or unauthorized places may have hazardous effects on health and environment.

The crossed dustbin symbol means that the device must be taken to authorized collection centers and must be handled separately from solid urban waste.

FOR COUNTRIES OUTSIDE EUROPEAN UNION (EU)

The treatment, recycling, collection and disposal of electric and electronic devices may vary in accordance with the laws in force in the Country in question.