Operation Manual

N6 Series

Electronic Total Station

SOUTH SURVEYING &MAPPING INSTRUMENT CO., LTD

INTRODUCTION

Congratulations on purchasing total station N6 series!
This manual is applicable for total station N6 series.
N6 series is equipped with visible laser emitter and reflectorless EDM.
Sections with"☞" will be just application for N6 series. Read this manual carefully before use.

Declaration: South reserves the right of not notifying users in advance about any technical modification.

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FEATURES:

1. Excellent Functionality

SOUTH total station N6 is embedded with various outstanding surveying programs, coupled with functions of data storing and parameter setting, which can be widely applied in various kinds of professional and construction survey.

2. Absolute Encoding Disk

With absolute encoding disk, you can start your work directly as the instrument is powered on. Azimuth angle will be saved even if the power is off incidentally in the job.

3. SD card Function

SD card provides huge memory, fast speed of data transferring, incredibly flexibility and reliable safety. Saving various data of job into the SD card, you can easily read it just by inserting it into the SD port of your laptop.

Every 1 MB in the SD card can store up to 8500 units of surveying data and coordinate data which is transferred from surveying data, or up to 22000 units of coordinate data.

4. Convenient Management on Internal Memory

Huge capacity of internal memory enables you to easily complement file system management, including adding, deleting, modifying and transferring data.

5. Reflectorless Distance Measurement

Total station N6 series is functioned by reflectorless distance measurement, which is applicable for long distance measurement with high accuracy on various kinds of materials or colors such as wall, wire pole, wire, cliff, hill, earth, timber pile, etc. For those targets which are not easy or even impossible to reach, reflectorless distance measurement can complete the measurement task easily.

6. Special Surveying Programs

Besides of ordinary surveying programs, such series of total station also has special

surveying programs, such as remote height measurement, offset measurement, remote distance measurement, stake out, resection, area calculation, road design and stake out, etc., which are sufficient to meet the needs of professional measurement and surveying measurement.

CAUTIONS

1. Do not collimate the objective lens direct to sunlight without a filter.

2. Do not store the instrument in high and low temperature to avoid the sudden or great change of temperature.

3. When the instrument is not in use, place it in the case and avoid shock, dust and humidity.

4. If there is great difference between the temperature in work site and that in store place, you should leave the instrument in the case till it adapts to the temperature of environment.

5. If the instrument has not been used for a long time, you should remove the battery for separate storage. The battery should be charged once a month.

6. When transporting the instrument should be placed in its carrying case, it is recommended that cushioned material should be used around the case for support.

7. For less vibration and better accuracy, the instrument should be set up on a wooden tripod rather than an aluminum tripod.

8. Clean exposed optical parts with degreased cotton or less tissue only!

9. Clean the instrument surface with a woolen cloth after use. If it gets wet, dry it immediately.

10. Before opening, inspect the power, functions and indications of the instrument as well as its initial setting and correction parameters.

11. Unless the user is a maintenance specialist, do not attempt to disassemble the instrument by yourself even if you find the instrument abnormal.

12. Reflectorless total station N6 series emits visible laser. Do not shoot at eyes.

BATTERY NOTIFICATION

1 .Battery should be recharged only with the charger NC-20 going with the instrument

2 .Battery Recharging Cautions：

The charger has built-in circuitry for protection from overcharging. However, do not leave the charger plugged into the power outlet after recharging is completed.

Be sure to recharge the battery at a temperature of 0° ～±45° C, recharging may be abnormal beyond the specified temperature range .

Prohibit the use of any charger or battery that has been damaged.

3.Battery Storage Cautions：

Rechargeable battery can be repeatedly recharged 300 to 500 times. Complete discharge of the battery may shorten its service life.

In order to get the maximum service life, be sure to recharge it at least once a month.

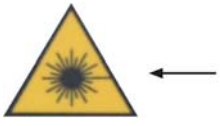
Do not store the battery at high temperature, abnormal heat or damp places, not to short-circuit the battery, otherwise it will damage the battery.

Please properly handle the batteries according to local rules. Batteries recovery is recommended. Do not throw battery into the fire.

SAFETY GUIDE

Warning:

The total station is equipped with an EDM of a laser grade of 3R/IIIa. It is verified by the following labels.



On the vertical tangent screw sticks an indication label "CLASS III LASER PRODUCT". A similar label is stick on the opposite side.

This product is classified as Class 3R laser product, which accords to the following standards.

IEC60825-1:2001 "SAFETY OF LASER PRODUCTS".

Class 3R/III a laser product: It is harmful to observe laser beam continuously. User should avoid sighting the laser at the eyes. It can reach 5 times the emitting limit of Class2/II with a wavelength of 400mm-700mm.

Warning:

Continuously looking straight at the laser beam is harmful.

Prevention:

Do not stare at the laser beam, or point the laser beam to others' eyes. Reflected laser beam is a valid measurement to the instrument.

Warning:

When the laser beam emits on prism, mirror, metal surface, window, etc., it is dangerous to look straight at the reflex.

Prevention:

Do not stare at the object which reflects the laser beam. When the laser is switched on (under EDM mode), do not look at it on the optical path or near the prism. It is only allowed to observe the prism with the telescope of total station.

Warning:

Improper operation on laser instrument of Class 3R will bring dangers.

Prevention:

To avoid to be harmed, each user is required to take safety precautions, and take everything under

control within the distance that would incur dangers (according to IEC60825-1:2001).

The following shows the explanation related to the key sections of the Standard.

Laser instrument of Class 3R is applicable outdoors and in construction field (measurement, defining lines, leveling).

a) Only those persons who are trained with related course and authenticated are allowed to install, adjust, and operate this kind of laser instrument.

b) Stand related warning symbols in the scale of use.

c) Prevent any person to look straight at or use optical instrument to observe the laser beam.

d) To prevent the harm caused by laser, block the laser beam at the end of the working route. When the laser beam exceeds the limit area (harmful distance*) and when there are motivating persons, stopping the laser beam is a must.

e) The optical path of the laser should be set higher or lower than the line of sight.

f) When the laser instrument is not in use, take care of it properly. The person who is not authenticated is not allowed to use.

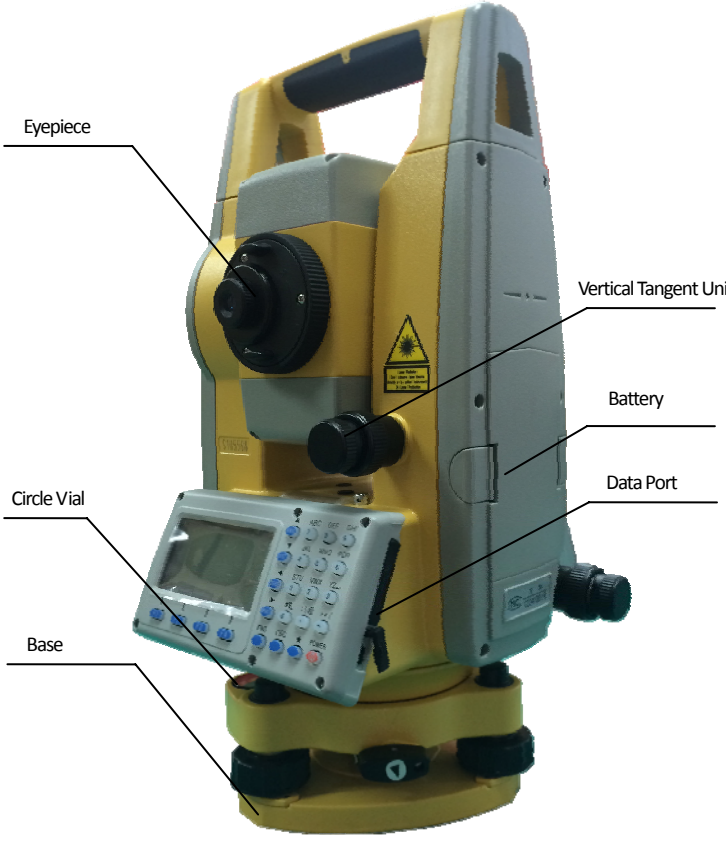
g) Prevent the laser beam from irradiating plane mirror, metal surface, window, etc.; especially beware of the surface of plane mirror and concave mirror.

* Harmful distance means the maximum distance between the start point and the point which the laser is weakened to a degree that doesn't harm people.

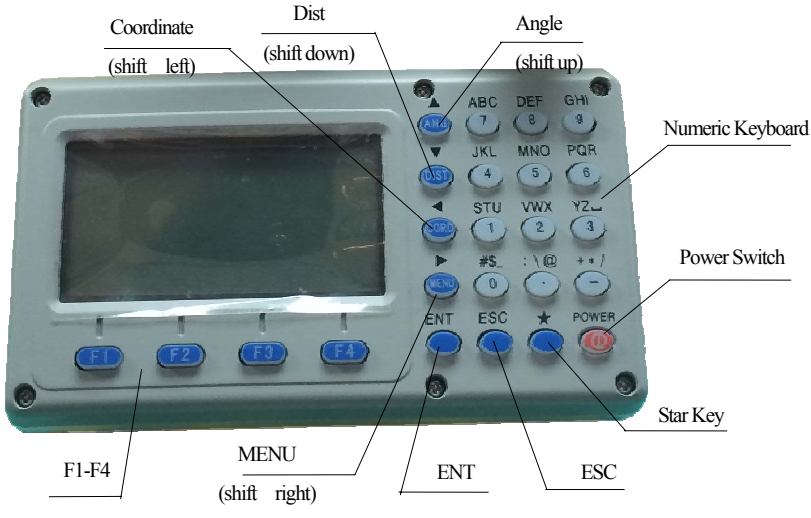
The internal EDM instrument equipped with a Class 3R/III a Laser has a harmful distance of 1000m (3300ft). Beyond this distance, the laser intensity is weakened to Class I (Looking straight at the laser beam causes no harm to the eyes.)

1. NOMENCLATURE AND FUNCTIONS

1.1 NOMENCLATURE


Eyepiece
Vertical Tangent Unit
Battery
Data Port
Circle Vial
Base

1.2 FUNCTIONS OF KEYS AND INFORMATION DISPLAYED



KEYS:

Key	Name	Function
ANG	Angle measuring	Enter to angle measurement mode (▲: UP. move the cursor upward or select upper items)
DIST	Distance measuring	Enter to distance measurement mode (▼:Down. move the cursor downward or select lower items)
CORD	Coordinate Measuring	Enter to coordinate measurement mode (◀ :Left. move the cursor leftward)
MENU	Menu	Enter to menu mode (▶:Right. move the cursor rightward)
ENT	Enter	Confirm the data entered or save the data in the item and go down to next item
ESC	Escape	Cancel last operation, return to last display, or last mode.
POWER	Power	Shift the power ON/OFF

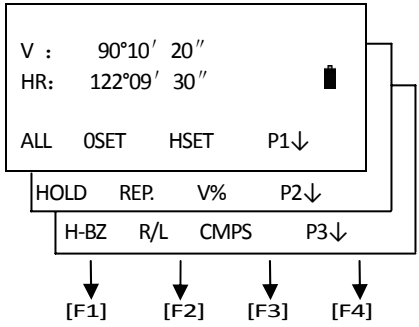
F1～F4	Soft Keys	Functions corresponding to information displayed.
0～9	Number Keys	Input numbers or characters or select items of the menu.
·～ -	Symbol Keys	Input symbols, decimal point, ± signs.
★	Star Key	Applicable for some certain common functions.

Symbols Displayed:

Symbol Displayed	Meaning
V%	vertical angle (slope)
HR	horizontal angle(right)
HL	horizontal angle(left)
HD	horizontal distance
VD	vertical distance
SD	slop distance
N	coordinate N
E	coordinate E
Z	coordinate Z
*	EDM (electronic distance meter) is under operation.
m	meter as the unit
ft	foot as the unit
fi	foot and inch as the unit

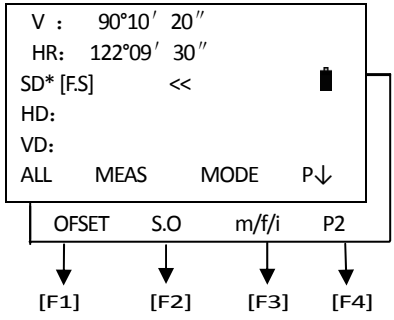
1.3 FUNCTIONAL KEYS

ANGLE MEASUREMENT MODE (3 interface menus)



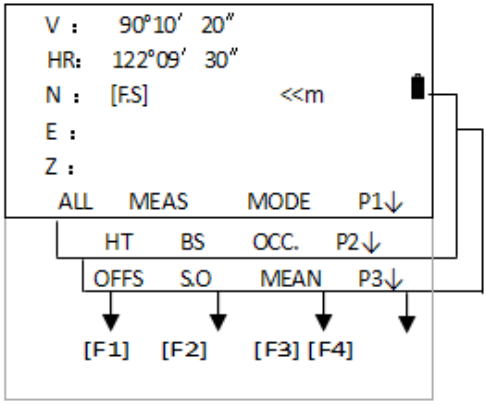
Page	Soft Key	Display	Function
Page 1 (P1)	F1	ALL	Start angle measurement, and save the results in respective job. (Measurement files and coordinates files are selected in DATA COLLECT menu.)
	F2	0SET	Set horizontal angle to 0 degree.
	F3	HSET	Input a horizontal angle by keyboard.
	F4	P1↓	Display the soft key functions in Page 2.
Page 2 (P2)	F1	HOLD	Lock the reading of horizontal angle.
	F2	REP.	Repeat measuring on horizontal angle.
	F3	V%	Shift between vertical angle/slope percentage.
	F4	P2↓	Display the soft key functions on Page 3.
Page 3 (P3)	F1	H-BZ	Set ON/OFF for the beep when the horizontal angle reaches 0°, 90°, 180°, 270°.
	F2	R/L	Shift between right/left angle of horizontal angle.
	F3	CMPS	Shift the display format of vertical angle (vertical angle/azimuth angle).
	F4	P3↓	Display the soft key functions on Page 1.

DISTANCE MEASUREMENT MODE (2 interface menus)



Page	Soft Key	Display	Function
Page 1 (P1)	F1	ALL	Start distance measurement, and save the results in respective job. (Measurement files and coordinates files are selected in DATA COLLECT menu.)
	F2	MEAS	Start distance measurement.
	F3	MODE	Shift the distance measurement modes (F.S/F.N/F.R/T.R).
	F4	P1↓	Display the soft key functions in Page 2.
Page 2 (P2)	F1	OFSET	Offset measurement mode.
	F2	S.O	Distance stake out mode.
	F3	m/f/i	Set distance unit (meter/feet/feet. inch).
	F4	P2↓	Display the soft key functions in Page 1.

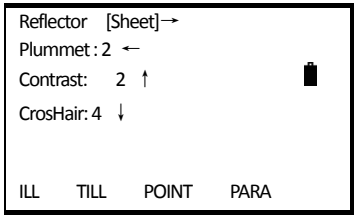
COORDINATES MEASUREMENT MODE (3 interface menus)



Page	Soft Key	Display	Function
Page 1 (P1)	F1	ALL	Start coordinates measurement, and save the results in respective job. (Measurement files and coordinates files are selected in DATA COLLECT menu.)
	F2	MEAS	Start coordinates measurement.
	F3	MODE	Shift the distance measurement modes (F.S/F.N/F.R/T.R).
	F4	P1↓	Display the soft key functions in Page 2.
Page 2 (P2)	F1	HT	Set the instrument height and target height.
	F2	BS	Set the coordinates of the backsight point.
	F3	OCC.	Set the coordinates of the occupied point.
	F4	P2↓	Display the soft key functions in Page 3.
Page 3 (P3)	F1	OFFS	Offset measurement mode.
	F2	S.O	Coordinates stake out mode.
	F3	MEAN	Set the measuring times of fine measurement.
	F4	P3↓	Display the soft key functions in Page 1.

1.4 STAR (★) KEY MODE

Press ★, the screen will show:



Through Star key(★), you can set the below items:

1. Reflector: press ► to change the mode among Prism/ Non-prism/ Sheet

   Plummet: press ◄ to change the laser plummet level from 0 to 4. 0 means closed.

   Contrast: Press ▲, you can adjust the contrast of the LCD

   CrosHair: Press ▼, change the cross hair level from 0-4

2. Illumination:

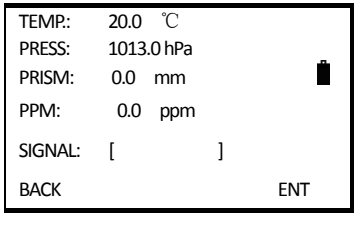
   Press [F1]: Turn on the background light.

   Press [F1] again: Turn off the background light.

3. Tilt Compensation: press [F2] to enter to settings of tilt compensation. Press [F1] or [F3] to switch ON/OFF in X or Y sensor.

5. Pointer: Press [F3] to activate the visible laser beam. Double press will close the pointer.

6. Parameter: Press [F4] to select "PARA", you can set the prism constant, PPM value, temperature and atmospheric pressure, and check the reflecting signal.



2. INITIAL SETTINGS

2.1 POWER ON/OFF

Operation	Operation Procedure	Display
Press [POWER] Key	Turn on the power, the screen will show:	Model :N6 Number: S00001 Ver. :2016.04.26
	Insert a SD card, the instrument will start to detect the SD card.	SD Card Connected!
	After inspection, you can enter to measurement mode automatically.	V : 90°10′ 20″ HR: 122°09′ 30″ SD: HD: VD: ALL 0SET HSET P1↓
	Hold [POWER] for 3 seconds to switch off the power.	POWER OFF.....

2.2 SETTING OF TILT CORRECTION ON VERTICAL AND HORIZONTAL ANGLES

When activating the tilt sensor, it will show the correction value of vertical and horizontal angles because the instrument is not perfectly leveled. To ensure the measurement accuracy, the tilt sensor should be activated (single/dual axis), which will facilitate you to level the instrument better. When "Tilt Over" shows, it needs to be leveled manually.

● Total station N6 Series is able to automatically correct the horizontal and vertical angle readings deviations which are caused by tilt of instrument's vertical axis on X and Y direction.

● Total station N6 Series provide 3 tilt correction modes: disable tilt sensor, X-ON (single axis) and XYON (dual axis).

Dual axis compensation: Correct the errors of horizontal angle caused by the index error of vertical angle and tilt of vertical axis. When it exceeds the limit, the system will indicate "Tilt Over". User should level the instrument manually.

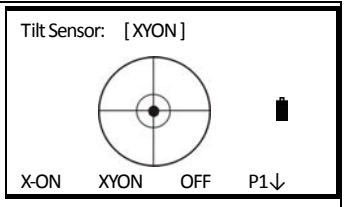
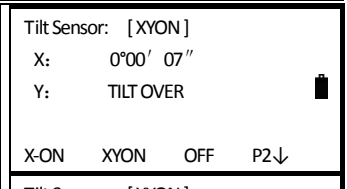
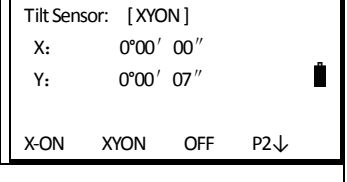
Single axis compensation: Correct the index error of vertical angle. When it exceeds the correction limit of vertical angle, the system will show notice.

Disable tilt sensor: Close the tilt compensator.

● If the instrument operates under a unstable status or windy days, the vertical angle displays unstably. In such circumstances, the tilt sensor should be disabled, so that it will avoid the instrument from displaying error messages as well as abortion of measurement caused by the tilt sensor exceeding the correction limit.

E.g.: Setting Tilt Correction

Operation Procedure	Operation	Display
① Enter to Star (★) key	[★]	Reflector [Sheet]→ Plummet : 2 ← Contrast: 2 ↑ CrosHair: 4 ↓ ILL TILL POINT PARA
② Press [F2] to enter to tilt correction settings.	[F2]	Tilt Sensor: [XYON]  X-ON XYON OFF P1↓

③ When the tilt of instrument exceeds the correction range, it needs leveling manually. Follow the steps described in "3.2 Instrument Setup" to center the black dot, as shown on the right. ※1) Single Axis: only corrects the vertical angle. Dua Axis: coorects vertical and horizontal angles.		
④ Press [F4] (P1↓) to display the tilt value on X (horizontal) and Y (vertical) direction. When displaying "TILT OVER", it needs leveling manually. Rotate the screws on the tribrach to level the instrument until "TILT OVER" disappears. Press [ESC], return to Star key mode. Press [F3] to disable the correction.	[F4] [ESC]	 
※1) If the tilt sensor is disabled, press [F1] (X-ON) or [F2] (XYON) to activate the correction function.		

2.3 SETTNG DISTANCE MEASUREMENT MODE

Total station NTS360R Series can adopt visible laser distance measurement and invisible IR distance measurement. Prism, non-prism and reflecting sheet are selectable as reflector. User can set a mode according to the job requirement.

Please refer to "13. TECHNICAL PARAMETER" about the parameters of various kinds of reflectors.

Operation Procedure	Operation	Display
① Enter to Star (★) key mode.	[★]	Reflector [Sheet]→ Plummet : 2 ← Contrast: 2 ↑ CrosHair: 4 ↓ ILL TILL POINT PARA
② press ► to change the mode among Prism/ Non-prism/ Sheet	[MENU]	Reflector [PRISM]→ Plummet : 2 ← Contrast: 2 ↑ CrosHair: 4 ↓ ILL TILL POINT PARA

2.4 SETTING CONSTANT OF REFLECTING PRISM

When using prism as reflector, it is required to set the prism constant before measurement. As the prism constant is set, such constant will be maintained even after power off.

Step	Operation	Operation Procedure	Display
1	[★] [F4]	Enter to Star (★) key mode. And press [F4] (PARA).	TEMP. : 20.0 ℃ PRESS. : 1013.0 hpa PRISM : 0.0 mm PPM : 0.0 ppm SIGNAL : [ ] BACK ENT
2	[▼]	Press [▼] to move down to prism constant item.	TEMP. : 20.0 ℃ PRESS. : 1013.0 hpa PRISM : 0.0 mm PPM : 0.0 ppm SIGNAL : [ ] BACK ENT
3	Input data [F4]	Input prism constant correction vale and press [F4] (ENT). Press [ESC] to return to Star key mode. ※1)	TEMP. : 20.0 ℃ PRESS. : 1013.0 hpa PRISM : 15.0mm PPM : 0.0 ppm SIGNAL : [ ] BACK ENT

※1) Refer to "3.7 METHOD OF INPUTTING ALPHARNUMERIC CHARACTERS" to learn ho w to input numbers or characters.

Inputting range: -99.9mm to +99.9mm Step length: 0.1mm.

2.5 REFLECTING SIGNAL

Reflecting signal function displays the intensity of EDM's reflecting signal. It helps user to collimate the target in tough conditions.

Once receiving the reflecting light from the prism, the instrument will buzz. In circumstance that target is not easy to be found, this function will help you easily collimate the target.

Step	Operation	Operation Procedure	Display
1	[★]	Enter to Star key mode.	Reflector [Sheet]→ Plummet : 2 ← Contrast: 2 ↑ CrosHair: 4 ↓ ILL TILL POINT PARA
2	[F4]	Press [F4] (PARA) to display the intensity (signal) of the reflecting light. It will show the intensity by a colume. ※1), ※2)	TEMP. : 20.0 ℃ PRESS. : 1013.0 hpa PRISM : 0.0 mm PPM : 0.0 ppm SIGNAL : [ ] BACK ENT

※1) When receiving the reflecting light, the instrument will buzz. To disable the buzzer, refer to "10. PARAMETER SETTING".

※2) Press [ESC] to return to Star key mode.

2.6 SETTING ATMOSPHERIC CORRCTION

When during distance measurement, the result may be affected by atmostpheric condition.

To overcome the affection of the atmospheric condition, it is necessary to use make correction through atomospheric correction constant during distance measurement.

Temperature: the temperature of the surrounding air.

Pressure: the atmospheric pressure surrounding the inistrument.

PPM: the atmospheric correction calculated and estimated.

●Standard atmospheric condition of total station NTS series (i.e. the atmospheric condition when the atmospheric correction value is 0):

Pressure： 1013hPa

Temperature： 20℃

● Calculation of atmospheric correction:

$$\Delta S = 278.44 - 0.294922\,P / (1 + 0.003661T)(ppm)$$

In the formula:

ΔS: correction coefficient (unit: ppm)

P: pressure (unit: hPa)

When the unit of atmospheric pressure is mmHg, follow this formula:

1hPa = 0.75mmHg

T: temperature (unit: ℃)

2.6.1 Setting the Atmospheric Correction Value Directly

Measure the temperature and press, then calculate the atmospheric correction value (PPM) through the atmospheric correction grap or the formula.

Step	Operation	Operation Procedure	Display
1	[★] [F4]	Enter to Star key mode, press [F4] (PARA).	TEMP. : 20.0 ℃ PRESS. : 1013.0 hpa PRISM : 0.0 mm PPM : 0.0 ppm SIGNAL : [ ] BACK ENT
2	[▼]	Press [▼] to move down to PPM item.	TEMP. : 20.0 ℃ PRESS. : 1013.0 hpa PRISM : 0.0 mm PPM : 0.0 ppm SIGNAL : [ ] BACK ENT
3	Input the value [F4]	Input the atmospheric correction value, and press [F4] (ENT) to return to Star key mode. ※1)	TEMP. : 20.0 ℃ PRESS. : 1013.0 hpa PRISM : 0.0 mm PPM : 4.0 ppm SIGNAL : [ ] BACK ENT

※1) Refer to "3.7 METHOD OF INPUTTING ALPHARNUMERIC CHARACTERS" to learn ho w to input numbers or characters.

Inputting range: -99.9mm to +99.9mm Step length: 0.1mm.

2.6.2 calculating the Atmospheric Correction based on Temperature and Pressure

Measure the temperature and pressure of the surrounding air previously. E.g. temperature: +25℃, pressure: 1017.5

Step	Operation	Procedure	Display
1	[★]	Enter to Star key mode.	TEMP. : 20.0 ℃ PRESS. : 1013.0 hpa PRISM : 0.0 mm PPM : 0.0 ppm SIGNAL : [ ] BACK ENT
2	[F4]	Press [F4] (PARA) to ener to parameter settings. Input the temperature and pressure values, the system will calculate the PPM value automatically according to the values you input. ※1)	TEMP. : 20.0 ℃ PRESS. : 1017.5 hpa PRISM : 0.0 mm PPM : 3.5 ppm SIGNAL : [ ] BACK ENT
3	[F4]	Press [F4] (ENT) to return to Star key mode.	TEMP. : 20.0 ℃ PRESS. : 1017.5 hpa PRISM : 0.0 mm PPM : 3.5 ppm SIGNAL : [ ] BACK ENT
NOTICE	※1) Refer to "3.7 METHOD OF INPUTTING ALPHARNUMERIC CHARACTERS" to learn ho w to input numbers or characters. Inputting range of temperature: -30°～+60℃ (step length: 0.1℃) or -22～+140℉ (step length: 0.1℉) Inputting range of pressure: 560～1066hPa (step length: 0.1hPa) or 420～800mmHg (step length: 0.1 mmHg) or 16.5～31.5inHg (step length: 0.1 inHg) If the PPM calculated according to temperature and press input is beyond ±999.9ppm, the system will return to Step 2 automatically and you should input the value again.		

2.7 CORRECTION ON ATMOSPHERIC REFRACTION ERROR AND EARTH CURVATURE

During horizontal distance measurement and height difference measurement, the instrumentcna correct the atomospheric refraction error and earth curvature automatically.

Formular of correction on atomospheric refraction error and earth curvature:

Hrozizontal distance after correction:

$D=S * [\cos\alpha + \sin\alpha * S * \cos\alpha (K-2) / 2Re]$

Vertical differecen after correction:

$H= S * [\sin\alpha + \cos\alpha * S * \cos\alpha (1-K) / 2Re]$

If you do not correct the atomospheric refraction error and earth curvature, the fomular for HD and VD:

$D=S\cdot\cos\alpha$ $H=S\cdot\sin\alpha$

In the formula

K=0.14 .....coefficient of atmospheric refracition

Re=6370 km ..... radius of earth curvature

α(or β) .....vertical angle measured from horizontal plane (vertical angle)

S .....Slide distance

Notice: the default value of the atmospheric refraction is set to K=0.14. K can be set to 0.14 or 0.2. It can also be closed. To modify the K value, refer to "10. PARAMETER SETTINGS [3]: OTHER SET.

2.8 SETTING MINIMUM READING OF SETTING ANGLE/DISTANCE

Setting of minimum reading, the units of angle/distance measurement are selectable.

Model	Angle Unit	Distance Unit
N6	1"/5"/10"/0.1"	1mm /0.1mm

[E.g.] Minimum Reading: 0.1"

Procedure	Operation	Display
① Press [MENU] to enter to 1/2 of main menu, and press [5] (PARAMETERS).	[MENU] [5]	MENU 1/2 1 · DATA COLLECT 2 · LAYOUT 3 · MEMORY MGR. 4 · PROGRAMS 5 · PARAMETERS P↓
② Press [3] (OTHER SET).	[3]	PARAMETERS 1 · UNIT SET 2 · MODE SET 3 · OTHER SET
③ Press [1] (Min Angle Read).	[1]	OTHER SET 1/2 1 · Min Angle Read 2 · Min Dist Read 3 · Face in L or R 4 · Auto Power Off 5 · H-Angle Buzzer P↓
④ Press [1]～[4] to set the minimum angle reading. e.g.: Press [4] (0.1 second) and press [F4] (OK).	[4] [F4]	Min Angle Read 1 · 1 second 2 · 5 second 3 · 10 second [4 · 0.1 second] OK
⑤ Return to menu of OTHER SET.		OTHER SET 1/2 1 · Min Angle Read 2 · Min Dist Read 3 · Face in L or R 4 · Auto Power Off 5 · H-Angle Buzzer P↓

2.9 SETTING AUTO POWER OFF

When no key is pressed or no suvey is implemented in 30 minutes, the instrument will be switched off automatically.

Procedure	Operation	Display
① Press [MENU] to enter to 1/2 of the main menu, and press [5] (PARAMETERS).	[MENU] [5]	MENU 1/2 1 . DATA COLLECT 2 . LAYOUT 3 . MEMORY MGR. 4 . PROGRAMS 5 . PARAMETERS P↓
② Press [3] (OTHGER SET).	[3]	PARAMETERS 1 . UNIT SET 2 . MODE SET 3 . OTHER SET
③ Press [4] (Auto Power Off).	[4]	OTHER SET 1/2 1 . Min Angle Read 2 . Min Dist Read 3 . Face in L or R 4 . Auto Power Off 5 . H-Angle Buzzer P↓
④ Press [1] (OFF) or [2] (ON), and press [F4] (OK).	[1]/[2] [F4]	Auto Power Off [1 . OFF] 2 . ON OK
⑤ Return to menu of OTHER SET.		OTHER SET 1/2 1 . Min Angle Read 2 . Min Dist Read 3 . Face in L or R 4 . Auto Power Off 5 . H-Angle Buzzer P↓

2.10 SETTING INSTRUMENT CONSTANT

Follow the method described in 12.9 "ADDICTIVE CONSTANT OF THE INSTRUMENT" to calculate the addictive constant of the instrument. Setting of instrument constant is stated below.

Procedure	Operation	Diplay
① Press [MENU] to enter to the main menu, and press [F4] (P↓) to turnt o 2/2, then press [2].	[MENU] [F4] [2]	MENU 2/2 1. ADJUSTMENT 2. INST.CONSTANT 3. Select code file 4. Hardware 5. Grid Factor P↓
② It displays the instrument constants and multiplication constant. Input the instrument constant and press [F4] (ENT).※1),※2)	Input the constant [F4]	INST. CONSTANT CONSTANT: 1.5 mm MUL. Cons: 0 ppm BACK ENT
③ Return to 2/2 of the menu.2/2.		MENU 2/2 1. ADJUSTMENT 2. INST. CONSTANT 3. Select code file 4. Hardware 5. Grid Factor P↓

※1) Refer to "3.7 METHOD OF INPUTTING ALPHARNUMERIC CHARACTERS" to learn ho w to input numbers or characters.

※2) Press [ESC] to cancel the settings.

※Notice:

The instrument constant is strictly preset before release. Users are not recommended to modify such settings in normal use, unless user has implemented a precise measure (e.g. measurement made by professional inspection organization in a standard baseline field) and needs to modify the default settings.

2.11 SELECT A CODE FILE

Procedure	Operation	Display
① Press [MENU] to enter to the main menu, press [F4] (P↓) to turn to 2/2 and press [3].	[MENU] [F4] [3]	MENU 2/2 1. ADJUSTMENT 2. INST. CONSTANT 3. Select code file 4. Hardware. 5.Grid Factor P↓
② When it displays the interface of selecting a code file, enter the file name of the code you want to call up. ※1)		Select code file FILE：SOUTH BACK LIST ALPH ENT
③ Press [▲] or [▼] to move up or down to select a code file. Press [▶] or [◀] to turn the page.	[▲] or [▼]	C000.SCO [CODE] C001.SCO [CODE] C002.SCO [CODE] C003.SCO [CODE] ATTRIB SRCH EXIT P1↓
④ You can also press [F2] (LIST) to display the list in the memory. Press [F4] (OK) or [ENT] to enter to it, and display the code list.※2)	[F2] [F4]	C000.SCO [CODE] C001.SCO [CODE] C002.SCO [CODE] C003.SCO [CODE] ATTRIB SRCH EXIT P1↓
⑤Press [ENT] (ENT). Succeed to call up a file. Return to the main menu.2/2	[ENT]	MENU 2/2 1. ADJUSTMENT 2. INST. CONSTANT 3. Select code file 4. Hardware 5. Grid Factor P↓

2.12 HARDWARE

Procedure	Operation	Display
① Press [MENU] to enter to the main menu, press [F4] (P↓) to turn to 2/2 and press [4].	[MENU] [F4] [4]	MENU 2/2 1. ADJUSTMENT 2. INST. CONSTANT 3. Select code file 4. Hardware. 5.Grid Factor P↓
② Each version of MB, EDM, Vertical CCD sensor, Horizontal CCD sensor and Tilt sensor will shown on this page		Hardware MB: 00/20160426 EDM: 05/20160425 CCDV: 19/20160315 CCDH: 19/20160315 TILT: 01/20131015

3. PREPARATION FOR MEASUREMENT

3.1 UNPACKING AND STORE OF INSTRUMENT

· Unpacking of instrument

Place the case lightly with the cover upward, and unlock the case, take out the instrument.

· Storage of instrument

Cover the telescope cap, place the instrument into the case with the vertical clamp screw and circular vial upwards (Objective lens towards tribrach), and slightly tighten the vertical clamp screw and lock the case.

3.2 INSTRUMENT SETUP

Mount the instrument to the tripod. Level and center the instrument precisely to ensure the best performance.

Operation Reference:

1. Leveling and Centering the Instrument by plumb bob

1) Setting up the tripod

① First of all, extend the extension legs to suitable length, make the tripod head parallel to the ground and tighten the screws.

② Make the centre of the tripod and the occupied point approximately on the same plumb line.

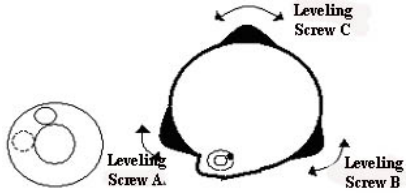
③ Step on the tripod to make sure whether it is well stationed on the ground.

2) Attaching the instrument on the tripod

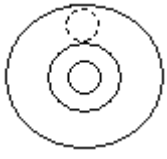
Place the instrument carefully on the tripod head and slide the instrument by loosening the tripod screw. If the plumb bob is positioned right over the center of the point, slightly tighten the tripod.

3) Roughly leveling the instrument by using the circular vial

① Turn the leveling screw A and B to move the bubble in the circular vial, in which case the bubble is located on a line perpendicular to a line running through the centers of the two leveling screw being adjusted .

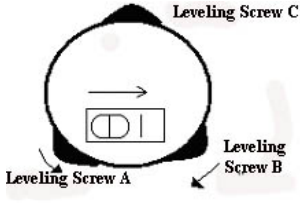


② Turn the leveling screw C to move the bubble to the center of the circular vial.

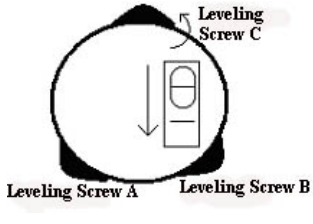


4) Precisely leveling by using the plate vial

① Rotate the instrument horizontally by loosening the Horizontal Clamp Screw and place the plate vial parallel to the line connecting leveling screw A and B, and then bring the bubble to the center of the plate vial by turning the leveling screws A and B.



② Rotate the instrument 90º(100g) around its vertical axis and turn the remaining leveling screw or leveling C to center the bubble once more.



③Repeat the steps ①② for each 90º(100g) rotation of the instrument and check whether the bubble is correctly centered in all directions.

2. Centering by using the optical plummet

1) Set tripod

Lift tripod to suitable height, ensure equal length of three legs, spread and make tripod head parallel to the ground, and place it right above the measurement station point. Prop up tripod on the ground and fix one leg.

2) Install instrument and collimate the point

Set instrument carefully on tripod, tighten the central connecting screw and adjust optical plummet to make the reticle distinctly. Hold the other two unfixed legs with both hands and adjust position of these two legs through observation of optical plummet. As it approximately aims at the station point, make all three legs fixed on the ground. Adjust three leg screws of the instrument to make optical plummet collimate precisely to the station point.

3) Use circular vial to roughly level the instrument.

Adjust length of three legs of tripod; make the circular vial bubble of the instrument in the middle.

4) Use plate vial to level the instrument accurately.

① Rotate the instrument horizontally by loosening the Horizontal Clamp Screw and place the plate vial parallel to the line connecting leveling screw A and B, and then bring the bubble to the center of the plate vial by turning the leveling screws A and B.

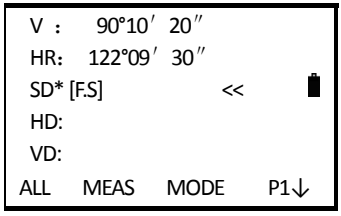
② Rotate the instrument 90℃, make it perpendicular to the connecting line of level screws A and B. Turn level screw C to make the bubble of the plate vial in the middle.

5) Precisely centering and leveling

Through observation of optical plummet, slightly loosen the central connecting screw and move the instrument evenly (Don't rotate the instrument), making the instrument precisely collimating to the station point. Then tighten the central connecting screw and level the instrument precisely again.

Repeat this operation till the instrument collimate precisely to the measurement station point.

3.3 LOADING, UNLOADING, CHARGING THE BATTERY AND ITSINFORMATION



----------Battery is sufficient, good for operation.

----------When displaying this status, the battery can be used for an hour; if you are not sure the time it has used, please prepare a substitutional battery or charge the battery.

----------The battery is low. Please abort the job and change or charge the battery.

Twinkles and disappear ---- It will just take several minutes when the symbol twenkles and finally disappears. The battery is in empty voltage , please change a new one

Notice:

① The battery operating time will vary depending on the environmental conditions such as ambient temperature, charging time, the number of times of charging and discharging etc. It is recommended for safety to charge the battery beforehand or to prepare spare full charged batteries.

② The battery power remaining display shows the power level

regarding the current measurement mode. The distance measurement mode consumes more power than angle measurement mode, so the power enough for the latter is not sure applicable for the previous one. Pay particular attention to this when switching angle measurement mode to distance measurement mode, because insufficient battery power might lead to interrupted operation.

Cautions for Unloading the Battery:

▲ when unloading the battery, please switch off the instrument in case the instrument may be damaged.

Charging the Battery

Charge the battery with the appropriative charger (NC-20A).

Before charging, link the charger with the electrical outlet first. Unload the battery from the instrument and connect the charger plug with the charging outlet of the battery. When the indicator light of the charger is orange, it means the battery is being charged. When the light is green, it means the battery is fully charged, please pull out the plug.

Cautions for Charging

▲The charger has built-in circuitry for protection from overcharging. However, do not leave the charger plugged into the power outlet after recharging is completed.

▲Be sure to recharge the battery at a temperature of 0°～±45℃,

recharging may be abnormal beyond the specified temperature range .

▲When the indicator lamp does not light after connecting the battery and charger, either the battery or the charger may be damaged. Please connect professionals for repairing.

Cautions for Storage:

▲Rechargeable battery can be repeatedly recharged 300 to 500 times. Complete discharge of the battery may shorten its service life.

▲In order to get the maximum battery life and make sure to recharge it at least once a month.

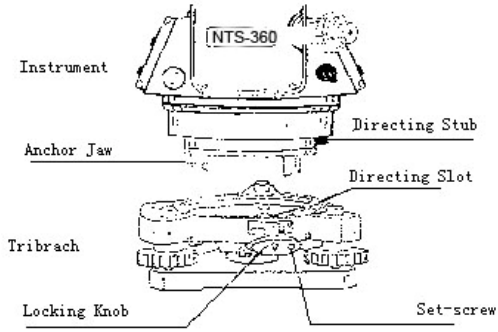
3.4 REFLECTING PRISM

When measuring distance, a reflector prism needs to be placed at the target place. Reflector systems come with single prism and triple prisms, which can be mounted with tribrach onto a tripod or mounted onto a prism pole. Reflector systems can be self-configured by users according to job.

3.5 MOUNTING AND DISMOUNTING INSTRUMENT FROM TRIBRACH

Dismounting

If necessary, the instrument (including reflector prisms with the same tribrach) can be dismounted from tribrach. Loosen the tribrach locking screw in the locking knob with a screwdriver. Turn the locking knob about 180° counter-clockwise to disengage anchor jaws, and take off the instrument from tribrach.



Mounting

Insert three anchor jaws into holes in tribrach and line up the directing stub with the directing slot. Turn the locking knob about 180°clockwise and tighten the locking screw with a screwdriver.

3.6 EYEPIECE ADJUSTMENT AND COLLIMATING OBJECT

Method of Collimating Object（for reference）

① Sight the Telescope to bright place and rotate the eyepiece tube to make the reticle clear.

② Collimate the target point with top of the triangle mark in the coarse collimator. (Keep a certain distance between eye and the coarse collimator).

③ Make the target image clear with the telescope focusing screw.

☆ if there is parallax when your eye moves up, down or left, right, it means the diopter of eyepiece lens or focus is not well adjusted and accuracy will be influenced, so you should adjust the eyepiece tube carefully to eliminate the parallax.

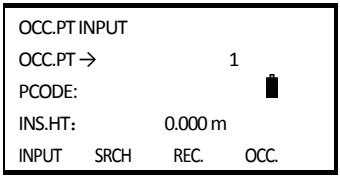
3.7 METHOD OF INPUTTING ALPHARNUMERIC CHARACTERS

Total station N6 Series is equipped with alphanumeric keyboards. User can input number and characters during operation.

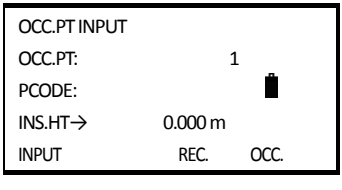
**** Inputting Numbers***

[Example 1] Input the instrument height in Data Collect mode.

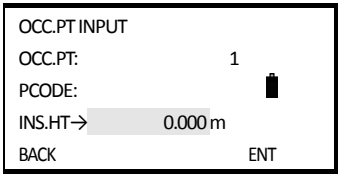
1. The arrowhead points to the item which needs to be input. Press [▲] [▼] to move up or down the arrowhead.



2. Press [▼] to move the "→" to the item of "INS.HT".



3. Press [F1] (INPUT) to activate the inputting function. The item of instrument height will appear a cursor.



4. Press [1] to input a "1".

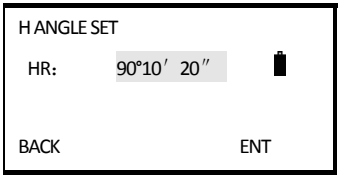
   Press [.] to input a ".".

   Press [5] to input a "5 ". After inputting, press [F4] to confirm.

   Then the instrument height is defined to 1.5 m.

Inputting Angle

[Example 2] Input the angle 90°10′20″.



Press [9] to input a "9"; press [0] to input a "0".

Press [.] to input the unit "°".

Press [1] to input a "1"; press [0] to input a"0".

Press [.] to input the unit"′".

Press [2] to input a "2"; press [0] to input a "0".

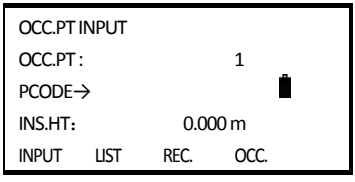
Press [F4] to confirm.

Then the horizontal angle is defined as 90°10′ 20″.

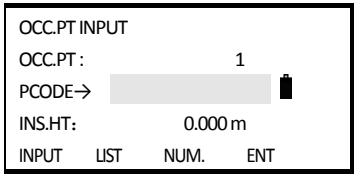
Input Characters

[Example 3] Input the code of occupied point "SOUTH1" in Data Collect mode.

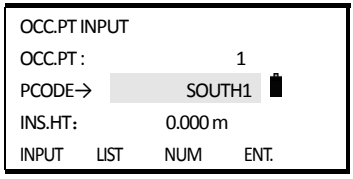
1、 The arrow points to the item which needs to be input. Press [▲] [▼] to move up or down the arrow



2、 Press [F1] (INPUT) to activate the cursor.



3、 Press [F3] to change the inputting mode to number. Press [F3] again to shift the mode between number and alphabet.



Notice:

When "ALPH" shows, it means you can type numbers, while "NUM" shows, it means you can type characters.

Press [F1] (BACK) to cancel the characters or numbers you entered.

4. ANGLE MEASUREMENT

4.1 MEASURING HORIZONTAL AND VERTICAL ANGLE

Make sure it is in angle measurement mode.

Procedure	Operation	Display
① Collimate the first target A.	Collimate A	V : 82°09′ 30″ HR : 90°09′ 30″ ALL OSET HSET P1↓
② Press [F2] (OSET) and [F4] (YES) to define the horizontal angle of target A to 0°00′ 00".	[F2] [F4]	H ANGLE O SET? [NO] [YES] V : 82°09′ 30″ HR: 0°00′ 00″ ALL OSET HSET P1↓
③ Collimate the second target B, it displays the V/H of target B.	Collimate B	V : 92°09′ 30″ HR: 67°09′ 30″ ALL OSET HSET P1↓

Method to shoo the target (for reference)

① Sight the telescope to the bright sky. Turn the eyepiece sleeve until you can see the cross hair clearly.

② Collimate the target by observing through the tip of the triangle on the collimator. Keep some distance between your eyes and the collimator.

③ Rotate the telescope focusing nob until the object can be seen clearly.

※ If there are deviations when moving your eye up, down, left or right, it proves that the focus or the center of the eyepiece is not adjusted well, which will affect the observation accuracy. You should focus and adjust the eyepiece sleeve carefully to eliminate such errors.

4.2 SHIFT THE HORIZONTAL ANGLE (RIGHT/LEFT)

Make sure it is under angle measurement mode.

Procedure	Operation	Display
① Press [F4] (↓) twice to turn to P3.	[F4] x 2	V : 122°09′ 30″ HR: 52°44′ 10.1″ ALL OSET HSET P1↓ HOLD REP. V% P2↓ H-BZ R/L CMPS P3↓
② Press [F2] (R/L) to shift the mode from horizontal right angle (HR) to horizontal left angle (HL)	[F2]	V : 122°09′ 30″ HL: 307°15′ 51.9″ H-BZ R/L CMPS P3↓
③ Press [F2] again to return to the mode of horizontal right angle (HR). ※1)		
※1) Every pressing on [F2] (R/L) is to shift between HR/HL.		

4.3 SETTING HORIZONTAL ANGLE

4.3.1 Setting by [HOLD]

Make sure it is under angle measurement mode.

Procedure	Operation	Display
① Rotate the lens to the horizontal angle which is to be defined by horizontal tangent screw.	Display the angle	V : 122°09′ 30″ HR: 90°09′ 30″ ALL OSET HSET P1↓
② Press [F4] to turn to P2.	[F4]	V : 122°09′ 30″ HR: 90°09′ 30″ HOLD REP. V% P2↓
③ Press [F1] (HOLD).	[F1]	H ANGLE HOLD HR: 90°09′ 30″ >SET ? [NO] [YES]
④ Collimate the target point.	Collimate the target.	
⑤ Press [F4] (YES) to hold the horizontal angle. Return to angle measurement mode as shown on the right. ※1)	[F4]	V : 122°09′ 30″ HR: 90°09′ 30″ HOLD REP. V% P2↓

※1) To return to last mode, press [F3] (NO).

4.3.2 Setting by Inputting through the Keyboard

Make sure it is under angle measurement mode.

Procedure	Operation	Display
⑥ Collimate the target point and press [F3] (HSET).	Collimate [F3]	V : 122°09′ 30″ HR: 90°09′ 30″ ALL OSET HSET P1↓
② Input the desired horizontal angle by the keyboard and press [F4] (ENT). ※1), e.g. 150°10′ 20″.	[F4]	H ANGLE SET HR: 150°10′ 20″ BACK ENT
③ H angle is defined.		V : 122°09′ 30″ HR: 150°10′ 20″ ALL OSET HZET P1↓

※1) Refer to "3.7 METHOD OF INPUTTING ALPHARNUMERIC CHARACTERS" to learn ho w to input numbers or characters. Input the angle units "°", "′" and "″" by press [.].

4.4 SHIFT BETWEEN V ANGLE AND V%

Make sure it is under angle measurement mode.

Procedure	Operation	Display
① Press [F4] (↓) to turn to P2.	[F4]	V : 90°10′ 20″ HR: 120°09′ 30″ ALL OSET HSET P1↓ OSET REP. V% P2↓
② Press [F3] (V%). ※1)	[F3]	V : 10.30% HR: 120°09′ 30″ HOLD REP. V% P2↓

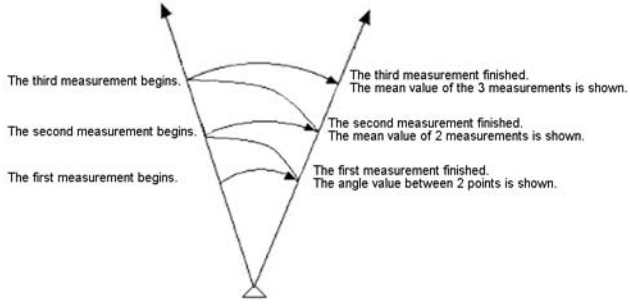
※1) Press [F3] (V%) to shift the mode displaying.

When the height exceeds 45° (100%), it will show"<Over>" (beyond the survey range).

4.5 REPETITIOUS ANGLE MEASUREMENT

Under horizontal angle (HR) measurement mode, user can implement repetitious angle measurement.

Make sure it is under horizontal angle (HR) measurement mode.



Procedure	Operation	Display
① Press [F4] (↓) to turn to P2.	[F4]	V: 90°10′ 20″ HR: 120°09′ 30″ ALL 0SET HSET P1↓ HOLD REP. V% P2↓
② Press [F2] (REP.).	[F2]	Rep-Angle Count [0] Ht: 90°10′ 20″ Hm: HR : 90°09′ 30″ 0SET EXIT HOLD
③ Collimate target A and press [F1] (0SET).	Collimate A [F1]	Repetition Angle 0SET? [NO] [YES]
④ Press [F4] (YES).	[F4]	Rep-Angle Count [0] Ht : 0°00′ 00″ Hm: HR : 0°00′ 00″ 0SET EXIT HOLD
⑤ Collimate target B by rotating the horizontal clamp and tangent screws, and press [F4] (HOLD).	Collimate B [F4]	Rep-Angle Count [1] Ht: 120°20′ 00″ Hm: 120°20′ 00″ HR : 120°20′ 00″ OSET EXIT REL
⑥ Collimate A again by adjusting horizontal clamp and tangent screws and press F3 (REL).	Collimate A [F3]	Rep-Angle Count [1] Ht: 120°20′ 00″ Hm: 120°20′ 00″ HR : 120°09′ 30″ 0SET EXIT HOLD

⑦	Collimate B again and press [F4] (HOLD).	Collimate B [F4]	Rep-Angle Count [2] Ht: 240°40′ 00″ Hm: 120°20′ 00″ HR : 120°18′ 00″ OSET EXIT REL
⑧	Repeat procedure ⑥~⑦ until desired times of measurement are finished. E.g. repeat 6 times. ※1) 2)		Rep-Angle Count [6] Ht: 722°00′ 00″ Hm: 120°20′ 00″ HR : 120°20′ 00″ 0SET EXIT REL HOLD
⑨	To quit the repetitious angle measurement, press [F2] (EXIT) and press [F4] (YES) to return to normal angle measurement mode.	[F2] [F4]	Repetition Angle Exit ? [NO] [YES] V : 90°10′ 20″ HR: 120°09′ 30″ HOLD REP. V% P2↓

※1) Horizontal angle can be totaled from 3600°00′ 00″ to minimum reading. Under horizontal right angle:

e.g.: when minimum reading is 5", horizontal angle can be totaled to ±3599°59′ 55″.

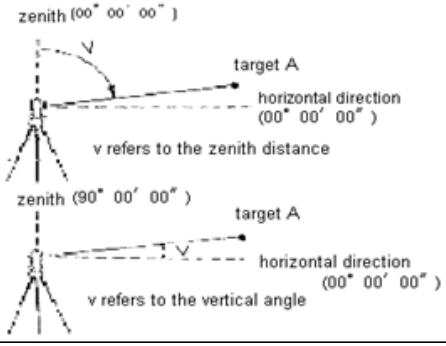
※2) When the difference between the measured angle result and the first result exceed ±30″, then an error message will show.

4.6 HORIZONTAL ANGLE 90° BUZZER

When the horizontal angle reaches the range of 00° (90°, 180° or 270°)±4°30′, the buzzer will be activated. This setting will not be maintained after power-off.

Procedure	Operation	Display
① Press [F4] (↓) twice to enter to P3.	[F4] x 2	V : 90°10′ 20″ HR: 170°30′ 20″ ALL 0SET HSET P1↓ HOLD REP. V% P2↓ H-BZ R/L CMPS P3↓
② Press [F1] (H-BZ), it will display the latest status.	[F1]	H-Angle Buzzer [1. OFF] 2. ON OK
③ Press [1] (OFF) or [2] (ON) to switch the buzzer ON/OFF.	[1] or [2]	H-Angle Buzzer [1. OFF] 2. ON OK
③ Press [F4] (OK). It returns to angle measurement mode.	[F4]	V : 90°10′ 20″ HR: 170°30′ 20″ H-BZ R/L CMPS P3↓

4.7 SHIFT BETWEEN AZIMUTH AND VERTICAL ANGLE



Procedure	Operation	Display
① Press [F4] (↓) twice to turn to P3.	[F4] x 2	V : 20°30′ 24.8″ HR: 170°30′ 20″ ALL 0SET HSET P1↓ H-BZ R/L CMPS P3↓
② Press [F3] (CMPS). ※1)	[F3]	V : 290°30′ 24.8″ HR: 170°30′ 20″ H-BZ R/L CMPS P3↓
※1) Every pressing [F3] (CMPS) can shift these 2 modes.		

5. DISTANCE MEASUREMENT

User should avoid measuring distance to targets with high reflectivity (e.g. traffic light) neither in IR distance measurement mode nor in laser reflectorless distance mode, otherwise the measured distance is incorrect or inaccurate.

When pressing Meas, the total station will measure the distance between the instrument to the target.

During distance measurement, if there're passers-by, cars, animals or shaking branches block the light path, some light beams may be refected back to the instrument, which will lead a fake result of measurement.

☞ Under the mode of reflectorless and reflecting sheet, user should avoid the light path being blocked by other objects.

☞ **Reflectorless Distance Measurement**

● Make sure the laser beam is not reflected by any reflecting objects nearby.

● When starting distance measurement, EDM will measure the distance to the target on the light path. If there're passing objects (like cars, rain, snow or frog), EDM will measure the distance to the nearest object.

● When measuring a longer distance, the laser beam may deviate from the collimation line, which will affect the accuracy. This is because the emitting point of laser beam may not coincide the point which is collimated by the crosshair. Thus, users are recommended to adjust the instrument precisely to ensure the laser beam is consistent with the collimation line. (Refer to "12.11 REFLECTORLESS DISTANCE MEASUREMENT")

● Do not measurement the same target with 2 instruments.

To implement precise distance measurement to the prism, user should adopt standard mode (Prism mode).

☞ **Laser Distance Measurement with Reflecting Sheet**

Reflecting sheet can be also used in laser distance measurement. To ensure a high accuracay, please make sure the laser beam is perpendicular to the reflecting sheet, coupled with price adjustment. (Refer to "12.11 REFLECTORLESS DISANCE MEASUREMENT")

Ensure the Right Addictive Constant of Different Prisms

Before distance measurement, atmospheric correction and prism constant are needed to be set. Please refer to "2. INITIAL SETTINGS" know more about how to set atmospheric correction and prism constant.

5.1 DISTANCE MEASUREMENT

Procedure	Operation	Display
① Press [DIST] to enter to interface of distance measurement. Start distance survey. ※1)	[DIST]	V: 90°10′ 20″ HR: 170°09′ 30″ SD* [F.S] << HD: VD: ALL MEAS MODE P1↓
② It displays the distances measured.※2)，※3)		V: 90°10′ 20″ HR: 170°09′ 30″ SD* 241.551m HD: 235.343m VD: 36.551m ALL MEAS MODE P1↓
③ Press [F1] (ALL) to start measurement, and record the data. After measurement, press [F4] (YES) to return to distance measurement mode. After the measurement of one point is finished, the name of next point will be automatically +1. Repeat the procedure above to start new measurement. ※4)	[F1] [F4]	V: 90°10′ 20″ HR: 170°09′ 30″ SD* 241.551m HD: 235.343m VD: 36.551m > REC.? [NO] [YES] POINT: 1 PCODE: SOUTH V : 90°10′ 20″ HR: 170°09′ 30″ SD: 241.551m < Complete >

※1) When under electronic distance measurement (EDM), the symbol "*" will show on the screen.

※2) Units of distance: “m” (meter), “ft” (feet), “fi”(feet·inch).

※3) If the measurement result is affected by atmospheric agitation, the instrument will repeat the survey operation automatically.

※4) Refer to “7. 6 SETTING DATA COLLECTION”.

5.2 SETTING MEASUREMENT MODE

Total station NTS360R series provide measurement modes as following: Fine.S/F.N/F.R/T.R.

Uner F.N mode, when defining the times, the instrument will measure according to the times defined, and calculate the average value.

Procedure	Operation	Display
① Press [DIST] to enter to distance measurement interface. Start distance measurement.	[DIST]	V: 90°10′ 20″ HR: 170°09′ 30″ SD* [F.S] << HD: VD: ALL MEAS MODE P1↓
② Press [F3] (MODE) to shift measurement modes among F.S/F.N/F.R/T.R.	[F3]	V: 90°10′ 20″ HR: 170°09′ 30″ SD* [F.3] << HD: VD: ALL MEAS MODE P1↓ V: 90°10′ 20″ HR: 170°09′ 30″ SD* 241.551m HD: 235.343m VD: 36.551m ALL MEAS MODE P1↓

5.3 SELECT DISTANCE UNIT BY SOFT KEYS (m/ft/ft-in)

You are able to change the distance unit by soft keys.

This setting will not be maintained after power-off. Refer to "10. PARAMETER SETTINGS" to implement the initial settings (this setting will be maintained even after power-off). Make sure it is under distance measurement mode.

Procedure	Operation	Display
① Press [F4] (P1↓) to turn to P2.	[F4]	V : 99°55′ 36″ HR: 141°29′ 34″ SD* 2.344m HD: 2.309m VD: -0.404m ALL MEAS MODE P1↓ OFSET S.O m/f/i P2↓
② Press [F3] (m/f/i) to change the unit. Every pressing [F3] (m/f/i) can change the unit mode.	[F3]	V : 99°55′ 36″ HR: 141°29′ 34″ SD* 7.691ft HF: 7.576ft VD: -1.326ft OFSET S.O m/f/i P2↓

5.4 STAKE-OUT

This function can display the difference between the distance measured and the distance of stake-out.

distance measured – distance of stake-out= difference displayed

During stake-out, user can choose any mode (HD, VD and SD) to stake out.

Procedure	Operation	Display
① Press [F4] under distance measurement mode to enter to P2.	[F4]	V ： 90°10′ 20″ HR： 170°09′ 30″ SD* [F.S] << HD： VD： ALL MEASN MODE P1↓ OSET S.O m/f/i P2↓
② Press [F2] (S.O) to display the data of previous settings.	[F2]	STAKE OUT HD： 0.000 m HD VD SD
③ Press [F1]-[F3] to select the stake out mode. F1:HD, F2：VD, F3：SD e.g.: press [F1] (HD) to adopt horizontal distance stake out.	[F1]	STAKE OUT HD： 0.000 m BACK ENT

④ Input distance to stake out (e.g. 3.500 m). After inputting, press [F4] (ENT). ※1)	Input3.500 [F4]	STAKE OUT HD: 3.500m BACK ENT
⑤ Collimate the target (prism) and start to measure. It displays the difference between the distance measured and the distance to stake out.	Collimate prism	V : 99°46′ 02″ HR: 160°52′ 06″ SD: 2.164 m dHD: -1.367 m VD: -0.367 m OFSET S.O m/f/i P2↓
⑥ Move the prism until the difference close to 10.		V : 99°46′ 02″ HR: 160°52′ 06″ SD: 2.164 m dHD: 0.000 m VD: -0.367 m OFSET S.O m/f/i P2↓
※1) Refer to "3.7 METHOD OF INPUTTING ALPHARNUMERIC CHARACTERS".		

5.5 OFFSET MEASUREMENT

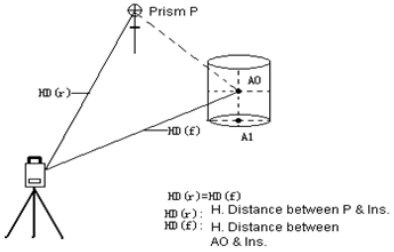
1. Angle Offset Measurement
2. Distance Offset Measurement
3. Plane Offset Measurement
4. Column Offset Measurement

5.5.1 Angle Offset

If it is difficult to set up a prism directly, for example the center of a tree, this mode is helpful. It only needs to set the prism on the point which has the same horizontal distance to the instrument as that of the prism to the instrument. Then define the instrument height/target height to start offset measurement, you can get the coordinates of the center of the object.

When measuring the coordinates of A1 which is the projection of A0, set the instrument height/target height.

Only measurement the coordinates of AO: only define the instrument height (set the target height as 0).



Before offset measurement, define the instrument height/target height first.

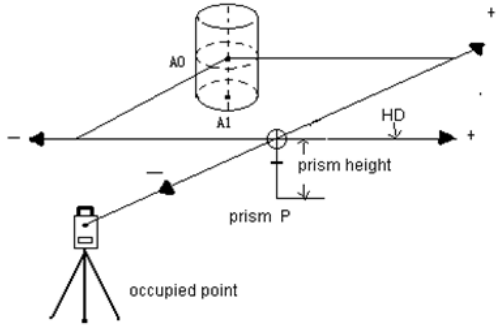
Refer to "6.2 SETTING COORDINATES OF OCCUPIED POINT".

Procedure	Operation	Display
① Press [F4] (P1↓) under distance measurement mode to enter to P2.	[F4]	V : 99°46′ 01″ HR: 161°00′ 52″ SD* 2.207 m HD: -1.326 m VD: -0.374 m ALL MEAS MODE P1↓ OFSET S.O m/f/i P2↓
② Press [F1] (OFSET).	[F1]	Offset 1. ANG. OFFSET 2. DIST. OFFSET 3. PLANE OFFSET 4. COLUMN OFFSET
③ Press [1] (ANG. OFFSET) to enter to angle offset measurement mode.	[1]	ANG. OFFSET HR: 170°01′ 15″ SD: HD: VD: MEAS
④ Collimate prism (P) and press [F1] (MEAS). It measures the distance between the instrument and the prism. ※1)	Collimate P [F1]	ANG. OFFSET HR: 170°01′ 58″ SD* [T.R] - HD: VD: Measuring…… ANG. OFFSET HR: 170°01′ 55″ SD* 2.207 m HD: 2.175 m VD: -0.374 m NEXT

⑤ Collimate A0 by rotate horizontal clamp and tangent screws. It displays the SD, HD, and VD from the instrument to A0.	Collimate A0	ANG. OFFSET HR: 160°01′ 55″ SD* 2.557 m HD: 2.175 m VD: 1.278 m NEXT
⑥Display the coordinates of AO or A1, press [CORD]. ※2	[CORD]	ANG. OFFSET HR: 157°04′ 300″ N : 34.004 m E : 47.968 m Z : 24.146 m NEXT
※1) Press [F1] (NEXT) to return to Procedure 4. ※2) Press [ESC] to return to distance measurement mode		

5.5.2 Distance Offset

If the radius of the tree or lake is known, now to measure the distance and coordinates of the center, you need to input the oHD (offset distance) as the following graph and measure P1 under the mode of distance offset. the distance and coordinates of P0 will be displayed in the screen.



Refer to "6.2 SETTING COORDINATES OF OCCUPIED POINT".

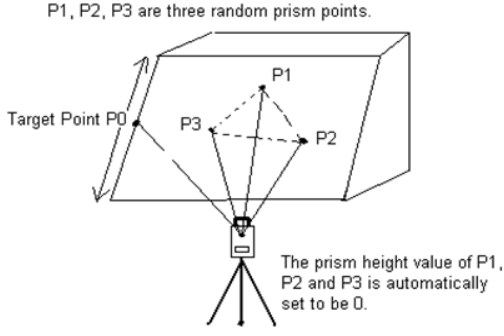
Procedure	Operation	Display
① Press [F4] under distance measurement mode to enter to P2.	[F4]	V : 99°46′01″ HR: 157°01′10″ SD* 2.207 m HD: -1.326 m VD: -0.374 m ALL MEAS MODE P1↓ OFSET S.O m/f/i P2↓
② Press [F1] (OFSET).	[F1]	Offset 1. ANG. OFFSET 2. DIST. OFFSET 3. PLANE OFFSET 4. COLUMN OFFSET
③ Press [2] (DIST. OFFSET) to enter to offset measurement.	[2]	DIST. OFFSET INPUT L or R oHD : 0.000 m INPUT FORWARD oHD : 0.000 m BACK ENT
④Input offset distance of left or right, and forward. Then press [F4] (ENT).	Input L/R, forward offset distance. [F4]	DIST. OFFSET INPUT L or R oHD : 1.600 m INPUT FORWARD oHD : 2.000 m BACK ENT

⑤Collimate P1 and press [F1] (MEAS) to start measurement. When distance measurement is finished, it displays the measured result that is corrected by offset distance.	Collimate P1 [F1]	DIST. OFFSET HR: 157°15′ 12″ SD* HD: VD: MEAS DIST. OFFSET HR: 173°17′ 25″ SD: 4.698 m HD: 4.691 m VD: 0.249 m NEXT
⑥ Press [CORD] to display the coordinates of PO. ※1), ※2)	[CORD]	DIST. OFFSET HR: 173°17′ 25″ N : 31.314 m E : 47.508 m Z : 23.626 m NEXT

5.5.3 Plane Offset

This function can measure the point that cannot be measured directly, e.g. measure the distance or coordinates of a plane edge.

First, measure any 3 points of the plane (P1, P2, P3) in this mode. Then Collimate P0. It will calculate and display the distance and coordinates of the intersection of collimation line and this plane.



Refer to "6.2 SETTING COORDINATES OF OCCUPIED POINT".

Procedure	Operation	Display
① Press [F4] (P1↓) under distance measurement mode to enter to P2.	[F4]	V : 94°16′ 23″ HR: 143°46′ 52″ SD* 2.438 m HD: 2.429 m VD: -0.214 m ALL MEAS MODE P1↓ OFSET S.O m/f/i P2↓
② Press [F1] (OFSET)	[F1]	Offset 1. ANG. OFFSET 2. DIST. OFFSET 3. PLANE OFFSET 4. COLUMN OFFSET
③ Press [3] (PLANE OFFSET).	[3]	PLANE OFFSET No. 01 HR: 153°49′ 46″ SD: HD: MEAS

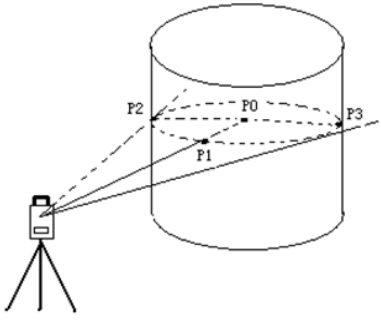
④ Collimate the prism (P1) and press [F1] (MEAS). After measurement it will forward to the measurement of the second point.	Collimate P1 [F1]	PLANE OFFSET No. 01 HR: 151°49′ 46″ SD: [T.R] - HD: Measuring.....
⑤ Measure the second and third point with the same method	Collimate P2 [F1] Collimate P3 [F1]	PLANE OFFSET No.02 HR: 155°24′ 05″ SD: [T.R] - HD: Measuring..... PLANE OFFSET No.03 HR: 148°28′ 58″ SD: [T.R] - HD: Measuring.....
⑥ It will calculate and display the distance and coordinates of the intersection of collimation line and this plane.		PLANE OFFSET HR: 148°28′ 58″ SD: 2.479 m HD: 2.472 m VD: 0.685 m NEXT
⑦ Collimate the edge of the plane (P0).	Collimate P0	PLANE OFFSET HR: 157°57′ 29″ SD: 3.068 m HD: 3.059 m VD: 0.703 m NEXT

⑧ Press [CORD] to display the coordinates of P0. ※1), ※2)	[CORD]	PLANE OFFSET HR: 157°57′ 29″ N : 33.644 m E : 47.968 m Z : 26.299 m NEXT
※1) Press [F1] (NEXT) to return to Procedure 4. ※2) Press [ESC] to return to distance measurement mode.		

5.5.4 Column Offset

First, measure the distance to the point (P1) of the column surface directly. Then by measuring the azimuth angles of P2 and P3 on the column, you can calculate the distance, azimuth and coordinates of the column center.

Azimuth of the column center is the average value of point of column surface (P2) and azimuth (P3).



Refer to "6.2 SETTING COORDINATES OF OCCUPIED POINT".

Procedure	Operation	Display

① Press [F4] (P1↓) under distance measurement mode to enter to P2.	[F4]	V ： 94°16′ 23″ HR： 143°46′ 52″ SD* 2.438 m HD： 2.429 m VD： -0.214 m ALL MEAS MODE P1↓ OFSET S.O m/f/i P2↓
② Press [F1] (OFSET).	[F1]	Offset 1. ANG. OFFSET 2. DIST. OFFSET 3. PLANE OFFSET 4. COLUMN OFFSET
③ Press [4] (COLUMN OFFSET).	[4]	COLUMN OFFSET Center HR： 147°13′ 57″ SD： HD： MEAS
④ Collimate the center of the column (P1) and press [F1] (MEAS) to start measuring. After measurement, the system will remind you to implement angle measurement of the left point (P2).	Shoot P1 [F4]	COLUMN OFFSET Center HR： 147°13′ 57″ SD： [T.R] -< HD： >Measuring....

⑤ Collimate the left point of the column surface (P2) and [F4] (SET) to finish measurement. Then it will display the message to measure the angle of the right point (P3). * When displaying "<Range Error>, it reminds you to Collimate the right target.	Collimate P3 [F4]	COLUMN OFFSET LEFT HR: 155°20′ 03″ SD: 2.455 m HD: 2.445 m SET
③ Collimate the right of the column surface (P3) and press [F4] (SET). Then the distance between the instrument and the column center (P0) will be calculated.	Collimate P3 [F4]	COLUMN OFFSET RIGHT HR: 122°08′ 05″ SD: 2.455 m HD: 2.445 m SET COLUMN OFFSET HR: 113°43′ 06″ SD: 0.219 m HD: 2.863 m VD: —0.219 m NEXT
④ To display the coordinates of P0, press [CORD]. ※1), ※2)	[CORD]	COLUMN OFFSET HR: 113°43′ 06″ N : 2.782 m E : 0.679 m Z : 1.781 m NEXT

6. COORDINATES MEASUREMENT

6.1 PROCEDURE OF COORDINATES MEASUREMENT

When measuring the coordinates after inputting the instrument height and target height, you can measure the unknown coordinates directly.

○ To define the coordinates of occupied point, refer to "6.2 SETTING COORDINATES OF OCCUPIED POINT".

○ To define the instrument height and target height, refer to "6.3 SETTING INSTRUMENT HEIGHT" and "6.4 SETTING TARGET HEIGHT".

○ To measure the coordinates, you should define the backsight point and measure the azimuth of backsight point first.

The coordinates of unknown point can be calculated by the formula below:

Coordinates of occupied point: (N0, E0, Z0)

The central coordinates of the target corresponding to the center of the instrument.:(n, e, z)

instrument height: INS. HT coordinates of unknown point:(N1, E1, Z1)

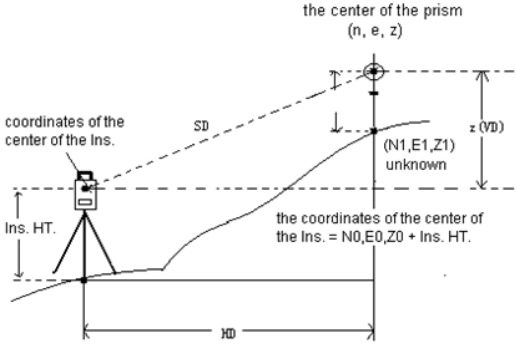
target height: R. HT VD：Z(VD)

N1=N0+n

E1=E0+e

Z1=Z0+INS. HT+Z-R. HT

Coordinates of instrument center ((N0, E0, Z0+INS. HT)



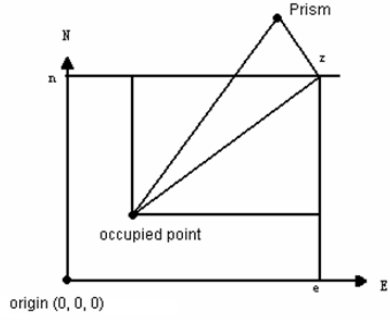
Caution during coordinates measurement: to define the coordinates of occupied point, instrument height, target height and backsight azimuth first.

Procedure	Operation	Display
① Define the azimuth of known point A. ※1)	Define azimuth	V : 276°06′ 30″ HR: 90°00′ 30″ ALL OSET HSET P1↓
② Collimate target B and press [CORD].	Collimate the prism [CORD]	V : 276°06′ 30″ HR: 90°09′ 30″ N *[F.S] -< m E : m Z : m ALL MEAS MODE P1↓
③ Start measurement and press [F1] (ALL) to restart measurement.	[F1]	V : 276°06′ 30″ HR: 90°09′ 30″ N : 36.001 m E : 49.180 m Z : 23.834 m ALL MEAS MODE P1↓

④ Press [F4] (YES) to save this point, then return to coordinates measurement. After measurement of one point, the system will add 1 to the point name automatically. Repeat the procedures to restart a new measurement.	[F4]	V : 276°06′ 30″ HR: 90°09′ 30″ N : 36.001 m E : 49.180 m Z : 23.834 m > REC. ? [NO] [YES] POINT: 1 PCODE: SOUTH N : 36.001 m E : 49.180 m Z : 23.834 m < Complete >
※1) Refer to "4.3 SETTING HORIZONTAL ANGEL".		

6.2 SETTING COORDINATES OF OCCUPIED POINT

By setting the coordinates of the instrument (occupied point) with respect to the origin of coordinates, the instrument can transform and display the coordinates of unknown point (target point) under this coordinates system.



Procedure	Operation	Display
① Under coordinate measurement mode, press [F4] (P1↓) to turn to P2.	[F4]	V : 95°06′ 30″ HR: 86°01′ 59″ N : 0.168 m E : 2.430 m Z : 1.782 m ALL MEAS MODE P1↓ HT BS OCC. P2↓
② Press [F3] (OCC.).	[F3]	OCC.PT INPUT N0 _ 0.000 m E0: 0.000 m Z0: 0.000 m BACK ENT
③ Input coordinate N	Input N	OCC.PT INPUT N0: 36.976 m E0: _ 0.000 m Z0: 0.000 m BACK ENT
④ Input the coordinate E and Z with the same method. Then press F4 to confirm	Input E/Z [F4]	V : 95°06′ 30″ HR: 86°01′ 59″ N : 36.976 m E : 30.008 m Z : 47.112 m HT BS OCC. P2↓

※1) Refer to "3.7 METHOD OF INPUTTING ALPHARNUMERIC CHARACTERS".

Inputting Range：-99999999.9999 ≤N, E, Z ≤ +99999999.9999 m

-99999999.9999 ≤ N, E, Z ≤ +99999999.9999 ft

-99999999.11.7 ≤ N, E, Z ≤ +99999999.11.7 ft+inch

6.3 SETTING INSTRUMENT HEIGHT

Instrument height will be saved even the power is switched off.

Procedure	Operation	Display
① Under coordinates measurement mode, press [F4] (P1↓) to turn to P2.	[F4]	V : 95°06′ 30″ HR: 86°01′ 59″ N : 0.168 m E : 2.430 m Z : 1.782 m ALL MEAS MODE P1↓ HT BS OCC. P2↓
② Press [F1] (HT) to display the instrument height and the target height.	[F1]	HEIGHT INPUT INS.HT: _ 0.000 m R.HT : 0.000 m BACK ENT
③ Input the instrument height and press [F4] (ENT). ※1)	Input INS.HT [F4]	HEIGHT INPUT INS.HT: 2.000 m R.HT : 0.000 m BACK ENT

※1) Refer to "3.7 METHOD OF INPUTTING ALPHARNUMERIC CHARACTERS".

Inputting Range: -9999.9999≤ INS. HT ≤+9999.9999 m

-9999.9999≤ INS.HT ≤+9999.9999 ft

-9999.11.7≤ INS.HT ≤+9999.11.7 ft+inch

6.4 SETTING TARGET HEIGHT

This function is used to acquire coordinates of Z. Target height will be saved even the power is switched off.

Procedure	Operation	Display
① Under coordinate measurement mode, press [F4] (P1↓) to turn to P2.	[F4]	V : 95°06′ 30″ HR: 86°01′ 59″ N : 0.168 m E : 2.430 m Z : 1.782 m ALL MEAS MODE P1↓ HT BS OCC. P2↓
② Press [F1] (HT) to display the instrument height and target height. Move to "R.HT".	[F1]	HEIGHT INPUT INS.HT: 2.000 m R.HT : 0.000 m BACK ENT
③ Input target height, and press [F4] (ENT). ※1)	Input R.HT [F4]	HEIGHT INPUT INS.HT: 2.000 m R.HT : 1.500 m BACK ENT

※1) Refer to "3.7 METHOD OF INPUTTING ALPHARNUMERIC CHARACTERS".

Inputting range: -9999.9999≤ R.HT ≤+9999.9999 m

-9999.9999≤ R.HT ≤+9999.9999 ft

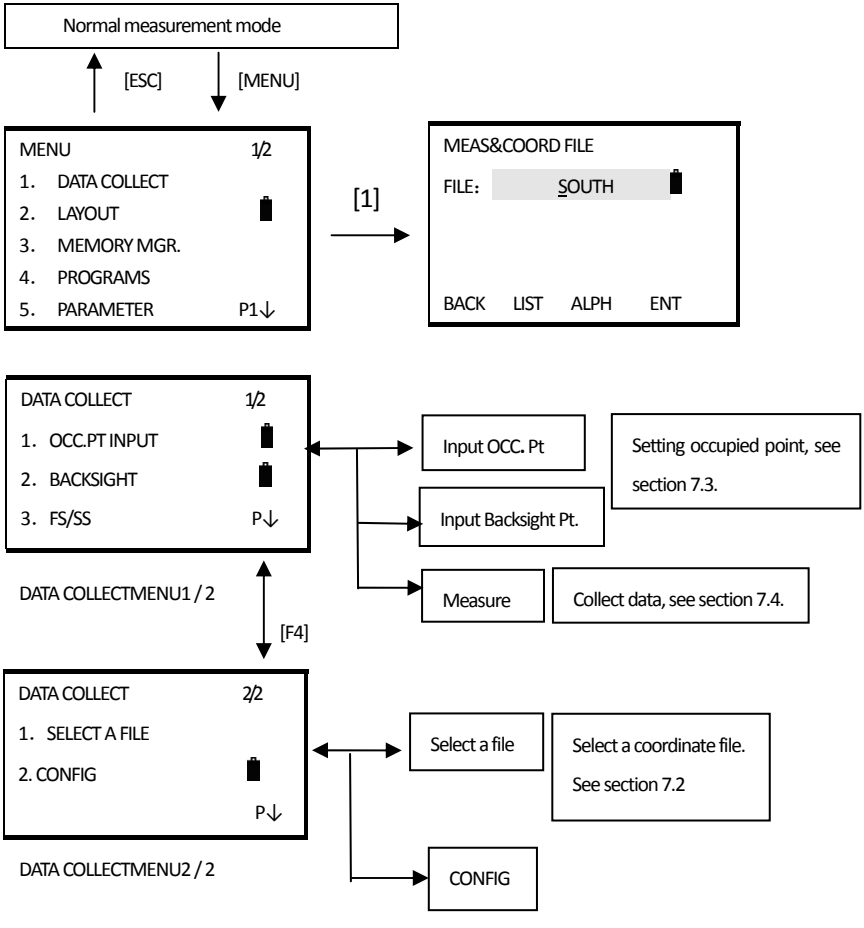
-9999.11.7≤ R.HT ≤+9999.11.7 ft+inch

7. DATA COLLECTION

Operation of Data Collect menu:

By pressing the MENU, the instrument will be in MENU 1/2 mode.

Press 1 (DATA COLLECT)



N6 is able to store the measured data into the internal memory

The internal memory is divided as the measured data files and the coordinate data files.

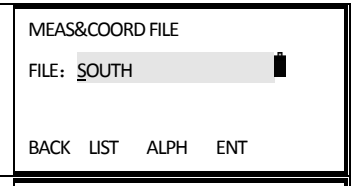
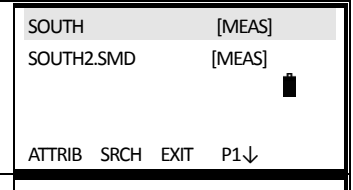
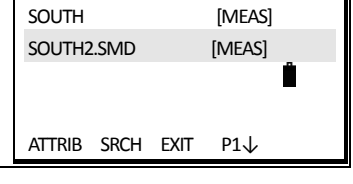
7.1 OPERATION PROCEDURE

1. Select a Data Collection File.

2. Select "REC. coordinate file", and save the coordinate data converted from original data.

3. Select Coordinate Data File so that you can use Occupied Point coordinate data and Backsight coordinate data. (If coordinate data of known point is not necessary for use, pass this step)

4. Set Occupied Point including Instrument Height, Point Number and Coordinate.

②Press [F2] (LIST).	[F2]	
③The screen shows Disk list. Choose the Disk which the work file is in. Press [F4] (OK) or ENT. ※1)	[F4]	
④Display the file list.※2)		
⑤Press [▲] or [▼] to scroll the file list, and then select a file.※3)	[▲] or [▼]	

5. Set Backsight Point, Direction and Azimuth.

6. Start collecting and saving data.

7.2 PREPARATION

7.2.1 Selecting a File for Data Collection

A file used by data collection mode must be selected at first. Then the screen of selection a file is displayed.

A selection from data collection menu is possible in the data collecting menu of this mode.

Operation procedure	Operation	Display
①Press [MENU] to enter into MENU1/2, and then press [1] (DATA COLLECT).	[MENU] [1]	MENU 1/2 1. DATA COLLECT 2. LAYOUT 3. MEMORY MGR. 4. PROGRAMS 5. PARAMETERS P1↓
② [ENT], success to call out file, and then the screen returns to DATA COLLECT MENU 1/2.	[ENT]	DATA COLLECT 1/2 1. OCC. PT INPUT 2. BACKSIGHT 3. FS/SS P↓

※1) For Instruction of Disk , please refer to "11.1.1 Check the Memory and Format the Disk

※2) If to create a new file, input the file name on the screen of MEAS & COORD FILE directly.

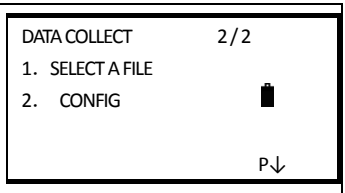
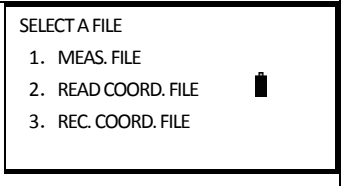
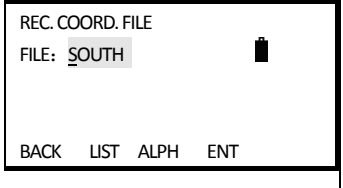
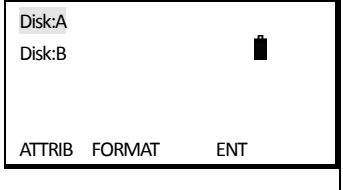
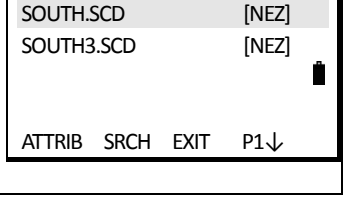
※3) Press [F2](SRCH), you can search a file by entering file name directly.

To select a file, you can also do the same in DATA COLLECT MENU, press ENT, enter 2/2→"1. SELECT A FILE"

7.2.2 Selecting a Coordinate File (for storage)

The coordinate data that converted by collected original data can be memorized in the file designated by customer.

Operation procedure	Operation	Display

①In DATA COLLECT MENU 2/2, press [1] (SELECT A FILE).	[1]	
② Press [3] (REC. COORD. FILE).※1)	[3]	
③Select a coordinate file as the method in "7.2.1 Selecting a File for Data Collection".		
④Press [F2] (LIST), screen shows Disk list. Choose the Disk which the work file is in. Press [F4] (OK) or ENT.※2)	[F2] [F4]	
⑤ Display the file list.		

7.2.3 Selecting a Coordinate File (for use)

When coordinate data in a coordinate data file is used for occupied point or backsight point, select a coordinate file from the data collect menu 2/2 beforehand.

Operation procedure	Operation	Display
①In DATA COLLECT MENU 2/2, press [1] (SELECT A FILE).	[1]	DATA COLLECT 2/2 1. SELECT A FILE 2. CONFIG P↓
② Press [2] (READ COORD. FILE).	[2]	SELECT A FILE 1. MEAS. FILE 2. READ COORD. FILE 3. REC.COORD.FILE
③Select a coordinate file as the method in "7.2.1 Selecting a File for Data Collection".		READ COORD.FILE FILE: SOUTH BACK LIST ALPH ENT

7.3 OCCUPIED POINT AND BACKSIGHT POINT

The occupied point and direction angle in the data collect mode are linked with the occupied point and it is possible to set or change the occupied point and direction angle from the data collect mode.

Occupied point can be set by two setting methods as follow:

1) Setting from the coordinate data stored in the internal memory

2) Direct key input

The following three setting methods for backsight point can be selected:

1) Setting from the coordinate data stored in internal memory

2) Directly input the coordinate of backsight point

3) Directly input the set angle

※ the setting of azimuth is decided by measurement.

Note: How to save coordinate data into internal memory, please refer to 11.4.3 "LOAD DATA"

7.3.1 Example for setting the occupied point

In case of setting occupied point from the coordinate data stored in the internal memory.

Operation procedure	Operation	Display
①In DATA COLLECT Menu 1/2, press [1](OCC. PT INPUT), then pre-existing data are displayed.	[1]	DATA COLLECT 1/2 1. OCC. PT INPUT 2. BACKSIGHT 3. FS/SS P↓
②Press [F4] (OCC.).	[F4]	OCC. PT INPUT OCC. PT→ PCODE: INS. HT: 2.000 m INPUT SRCH REC. OCC.
③Press [F1] (INPUT).	[F1]	DATA COLLECT OCC. PT INPUT POINT: INPUT LIST NEZ OK
④Input the point and [F4].※1)	Input point name [F4]	DATA COLLECT OCC. PT INPUT POINT: PT-01 BACK LIST NUM ENT
⑤The system searches in current files. If the Point is found, the coordinate data will be displayed on the screen. Press F4(YES) to confirm.※2)	F4	OCC. PT INPUT N0: 100.000 m E0: 100.000 m Z0: 10.000 m > OK? [NO] [YES]

⑥The display returns to OCC. PT screen. Press [▼] to move to PCODE column	[▼]	OCC. PT INPUT OCC. PT→1 PCODE：SOUTH INS. HT： 0.000 m INPUT SRCH REC. OCC.
⑦Press [F1](INPUT) to input pcode, and then press [F4](ENT).※3)，※4)	[F1] Input pcode [F4]	OCC. PT INPUT OCC. PT : 1 PCODE→_ INS. HT： 0.000 m BACK LIST ALPH ENT
⑧Move → to INS. HT column input the INS. HT and then press [F4] (ENT).	Input INS. Ht + [F4]	OCC. PT INPUT OCC. PT： 1 PCODE： SOUTH INS. HT→ 2.000 m BACK ENT
⑨Press [F3] (REC.) to display the coordinate of the OCC. PT.※5)	[F3]	OCC. PT INPUT OCC. PT： 1 PCODE： SOUTH INS. HT→ 2.000 m INPUT REC. OCC. OCC. PT INPUT N0： 100.000 m E0： 100.000 m Z0： 10.000 m > OK? [NO] [YES]
⑩Press [F4] (YES) to finish setting of occupied point. The display returns to DATA COLLECT menu 1/2. ※6)	[F4]	DATA COLLECT 1/2 1. OCC. PT INPUT 2. BACKSIGHT 3. FS/SS P↓

*1) See section “3.7 METHOD OF INPUTTING ALPHARNUMERIC CHARACTERS”.

*2) If the appointed Point can’t be found in internal memory, the system will prompt “PT# DOES NOT EXIST”.

*3) PCODE: To show the list of PCODE, press F1（SRCH）in step⑥

*4) BACK: Delete the input data.

*5) If not to change the instrument height, press F4 (ENT).

*6) The data recorded in data collect are Point, CODE and INS. HT.

7.3.2 Example for setting the azimuth

●The direction angle must be decided by measurement.

The following is to memorize the data of the backsight after setting the backsight point from point number

Operation procedure	Operation	Display
①In DATA COLLECT menu 1/2, press [2] (BACKSIGHT).	[2]	DATA COLLECT 1/2 1. OCC. PT INPUT 2. BACKSIGHT 3. FS/SS P↓
②The previous data is shown, press [F4] (BS).	[F4]	BACKSIGHT BKS PT→1 PCODE : R. HT: 0.000 m INPUT SRCH MEAS BS
③Press [F1](INPUT).※1)	[F1]	DATA COLLECT BACKSIGHT POINT : 2 INPUT LIST NE/AZ ENT

④Input point name, and press [F4] (ENT). ※2)	Input point [F4]	DATA COLLECT BACKSIGHT POINT ： 2 BACK LIST ALPH ENT
⑤The system searches the coordinate in current project. If the Point is found, the coordinate data will be displayed on the screen. Press [F4] to confirm the coordinate of backsight point. ※3)	[F4]	BACKSIGHT NBS: 20.000 m EBS: 20.000 m ZBS: 10.000 m ＞OK? [NO] [YES]
⑥The display returns to BACKSIGHT screen. Enter PCODE, R.HT in the same way.※4)		BACKSIGHT BKS PT：1 PCODE：SOUTH R. HT→ 1.500 m INPUT SRCH MEAS BS
⑦Press [F3] (MEAS).	[F3]	BACKSIGHT BKS PT：1 PCODE：SOUTH R. HT→ 1.500 m ANG. *SD NEZ

※1) Pressing each time the F3, the input method changes as Coordinate value, angle, Coordinate point name alternatively.

※2) Refer to Chapter 3.7 METHOD OF INPUTTING ALPHARNUMERIC CHARACTERS Press [F2](LIST) in step ④ to call out data in Pcode library.

※3) If point is not found in internal memory, "PT# DOES NOT EXIST" is displayed.

※4) Pcode: When entering numeric code, if there is code corresponding to this number in the Pcode library, the system will list the code. If not, the numeric code will be displayed on Pcode column.

※5) The sequence of data collect can be set as [EDIT→MEAS] or [MEAS→EDIT]. See "7.6 Setting Config of Data Collection".

7.4 MEASURING AND SAVING THE DATA

Operation procedure	Operation	Display
①Press [3] in Data Collect menu 1/2 to measure the unknown point.	[3]	DATA COLLECT 1/2 1. OCC. PT INPUT 2. BACKSIGHT 3. FS/SS P↓
②Press [F1] (INPUT).	[F1]	FS/SS POINT→ PCODE: R. HT: 0.000 m INPUT SRCH MEAS ALL
③After inputting the point, press [F4]ENT.※1)	Input point [F4]	FS/SS POINT→ 3 PCODE: 0 R. HT: 0.000 m BACK SRCH ALPH ENT
④Enter PCODE, R.HT in the same way.※2)	Input PCODE [F4] Input R HT [F4]	FS/SS POINT: 3 PCODE: SOUTH R. HT→ 1.000 m BACK ENT
⑤Press [F3] (MEAS).	[F3]	FS/SS POINT: 3 PCODE: SOUTH R. HT→ 1.000 m INPUT MEAS ALL

⑥Collimate the target point, press one of [F1]--[F3].※3) e.g.: [F2] (SD).	Collimate [F2]	FS/SS POINT: 3 PCODE: SOUTH R. HT→ 1.000 m ANG. *SD NEZ OFFS
⑦System starts to measure.		V : 90°00′ 00″ HR: 225°00′ 00″ SD* [F.3] <<< m HD: VD: Measuring...
⑧After measuring, press [F4] (Yes) to save the data.	[F4]	V : 90°00′ 00″ HR: 225°00′ 00″ SD: 17.247 m HD: 17.176 m VD: -1.563 m >OK? [NO] [YES] 〈Complete〉
⑨System makes the PT# to add one (+1) automatically, and starts to measure the next PT#. Then input PT# of the target, and collimate this point. Press [F4], and measure as last point; Also press [F3] (MEAS.) to select measurement mode.	[F4]	FS/SS POINT: 4 PCODE: SOUTH R. HT→ 1.000 m INPUT MEAS ALL

⑩Data is saved after measuring. Press [ESC] to quit the data collection mode.		V ： 90°00′ 00″ HR： 225°00′ 00″ SD： 98.312 m HD： 98.312 m VD： 9.983 m >OK? [NO] [YES] < Complete> FS/SS POINT：5 PCODE：SOUTH R. HT→ 1.000 m INPUT MEAS ALL

※1) Refer to Section 3.7 METHOD OF INPUTTING ALPHARNUMERIC CHARACTERS

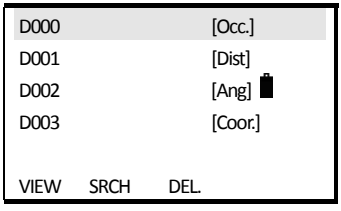
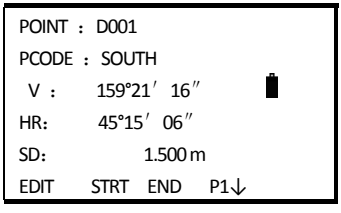
※2) Pcode: When entering numeric code, if there is code corresponding to this number in the Pcode library, then the system will list the code. If not, then the numeric code will be displayed on Pcode column.

※3) The mark “ *” indicates the previous measuring mode.

7.4.1 Searching the recorded data

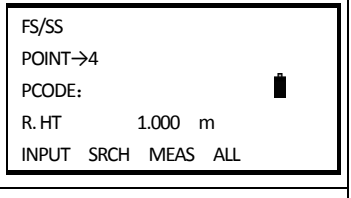
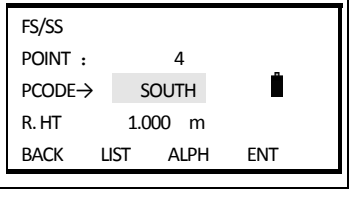
In the Data Collect mode, you can search the recorded data.

Operation procedure	Operation	Display
①In DATA COLLECT→ FS/SS mode, press [F2] (SRCH) to look through recorded data. ※1)	[F2]	FS/SS POINT→4 PCODE：SOUTH R. HT： 1.000 m INPUT SRCH MEAS ALL

②Data in code lib will be shown. Press [▼] t o select the file while press [▶], [◀] to scroll.	[▼]	
③Press [F1] (VIEW), the screen displays measured data of the selected file. Press [F2]/[F3] to check the first /last data. ※2)	[F1]	
※1) It is possible to see the PCODE list when the arrow is located beside PCODE ※2) The operation is same as the "SEARCH" in the MEMORY MGR.mode, For more information, see "11.1.5 Edit Measured Data in Search Mode".		

7.4.2 Entering PCODE/ID

In the DATA COLLECT mode, you can enter PCODE/ID directly.

Operation procedure	Operation	Display
① In DATA COLLECT→ FS/SS mode, press [F1] (INPUT).	[F1]	
②Press [▼] to move → to PCODE column, input PCODE and press [F4] to confirm.	input PCODE [F4]	

7.4.3 Entering PCODE by Using PCODE library

You can enter PCODE/ID from PCODE Library, too.

Operation procedure	Operation	Display
①Move the arrow to the PCODE column, in DATA COLLECT mode, press [F2] (LIST).	[F2]	FS/SS POINT：4 PCODE→ R. HT 1.000 m INPUT LIST MEAS ALL
②System enters into PCODE library, press below keys to refer to PCODE..※1) [▲] / [▼]: Increase or decrease one by one. [▶]/ [◀]: Turn page	[▲]、[▼]	1 2 3 4 VIEW SRCH DEL ADD
③After finding the right PCODE Press [ENT].	[ENT]	FS/SS POINT：3 PCODE→ 2 R. HT： 1.000 m INPUT LIST MEAS ALL
※1) Press corresponding soft keys to edit, delete or create pcode files.		

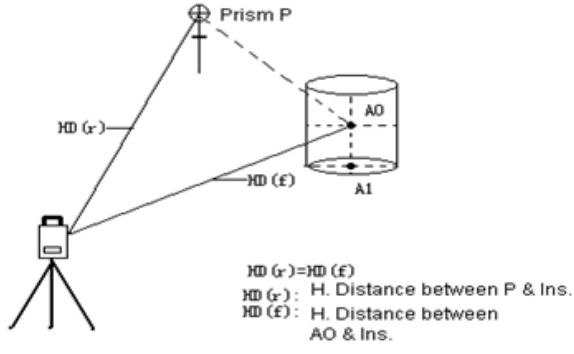
7.5 DATA COLLECT OFFSET MEASUREMENT MODE

This mode is useful when it is difficult to set up the prism directly, for example at the center of a tree.

Data Collect Offset Measurement has four measuring methods:

1. Angle Offset Measurement
2. Distance Offset Measurement
3. Plane Offset Measurement
4. Column Offset Measurement

7.5.1 Angle Offset



Place the prism at the same horizontal distance from the instrument as that of point A0 to measure. To measure the coordinates of the center position, operate the offset measurement after setting the instrument height/prism height.

●When measuring coordinates of ground point A1: Set the instrument height/Prism height

●When measuring coordinates of point Ao: Set the instrument height only (Set the prism height as 0).

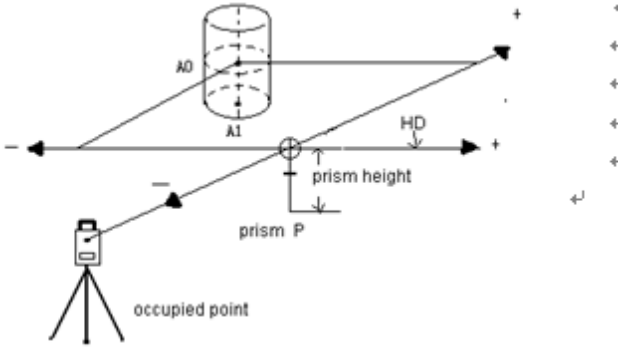
Operation procedure	Operation	Display
①In DATA COLLECT→ FS/SS mode, press [F3] (MEAS), press [F4] (OFFS) in the prompted function menu.	[F3] [F4]	FS/SS POINT：5 PCODE→ SOUTH R. HT： 1.000 m INPUT LIST MEAS ALL ANG. *SD NEZ OFFS
② Press [1] (ANG. OFFSET).	[1]	Offset 1. ANG. OFFSET 2. DIST. OFFSET 3. PLANE OFFSET 4. COLUMN OFFSET

③Collimate the prism center, and press [F1] (MEAS) to measure.	Collimate P [F1]	ANG. OFFSET HR: 90°00′ 05″ SD: HD: VD: MEAS
④ System runs measurement function. To carry on repeating measurement, press [F4] (SET). The result displays when measuring is over, You can press [CORD] to display the coordinates of the target.	[F4]	ANG. OFFSET HR: 90°01′ 13″ SD*: [F.R] <m HD: VD: Measuring..... SET ANG. OFFSET HR: 90°01′ 13″ N: 99.999 m E: 102.328 m Z: 10.543 m >REC.? [NO] [YES]
⑤Rotate horizontal clamp and tangent screw to collimate the target point A0, and display its coordinate.	Sight A0	ANG. OFFSET HR: 159°22′ 55″ N: 98.116 m E: 100.710 m Z: 10.535 m >REC.? [NO] [YES]
⑥If press [DIST], then SD, HD and VD are displayed.	[DIST]	ANG. OFFSET HR: 159°21′ 16″ SD: 2.041 m HD: 2.013 m VD: 0.335 m >REC.? [NO] [YES]

⑦Press [F4](YES)，Data is recorded, and the next target offset is measured. Press [F4] (NEXT) and redefine ANG. OFFSET. Collimate the prism, and press [F1](MEAS). Press [F3] (CONT), then the basic point remains and offset measuring of the next point carries on.	[F4] [F4] [F1]	ANG. OFFSET POINT→6 PCODE：SOUTH R. HT 1.000 m INPUT SRCH CONT NEXT ANG. OFFSET HR： 220°54′ 57″ SD： HD： VD： MEAS

7.5.2 Distance Offset Measurement

The measurement of a place apart from a prism is possible by inputting offset horizontal distance of front and back / right and left.



Operation procedure	Operation	Display

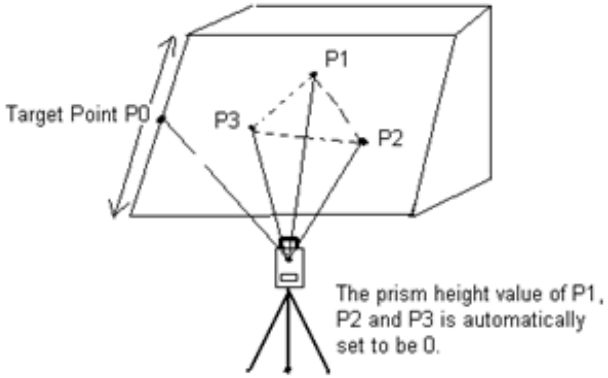
①In the DATA COLLECT →FS/SS mode, press [F3] (MEAS), press [F4] (OFFS) in the prompted function menu.	[F3] [F4]	FS/SS POINT：3 PCODE→ SOUTH R. HT： 1.000 m INPUT LIST MEAS ALL ANG. HD NEZ OFFS
② Press [2] (DIST. OFFSET).	[2]	Offset 1. ANG. OFFSET 2. DIST. OFFSET 3. PLANE OFFSET 4. COLUMN OFFSET
③Input left or right offset value and forward oHD, press [F4] (ENT).	Input offset distance [F4]	DIST. OFFSET INPUT L or R oHD : 0.000 m INPUT FORWARD oHD : 0.000 m BACK ENT
④Collimate the target, press [F1] (MEAS).	Collimate AO [F1]	DIST. OFFSET HR： 128°29′ 47″ SD： HD： VD： MEAS
⑤System runs measurement function. To carry on repeating measurement, press [F4] (SET).	[F4]	DIST. OFFSET HR： 128°29′ 47″ SD* [F.R] <m HD： VD： Measuring..... SET

⑥The result displays when measuring is over, You can press [CORD] to display the coordinates of the target. Press [F4] (YES) to record.	[CORD] [F4]	DIST. OFFSET HR: 147°17′ 47″ N: 96.791 m E: 102.060 m Z: 9.797 m >REC.? [NO] [YES] < Complete >

7.5.3 Plane Offset Measurement

Measuring will be taken for the place where direct measuring cannot be done,

For example distance or coordinate measuring for an edge of a plane.



Three random prism points (P1, P2, P3) on a plane will be measured at first in the plane offset measurement to determine the measured plane. Collimate the measuring target point (P0) then the instrument calculates and displays coordinate and distance value of cross point between collimation axis and of the plane.

To set the coordinate value for the occupied station, refer to Section 6.2 'Setting Coordinate Values of Occupied Point'.

Operation procedure	Operation	Display
①Press [F3] (MEAS), press [F4] (OFFS) in the prompted function menu.	[F3] [F4]	FS/SS POINT：3 PCODE→ SOUTH R. HT 1.000 m INPUT LIST MEAS ALL ANG. *HD NEZ OFFS
② Press [3] (PLANE OFFSET).	[3]	Offset 1．ANG. OFFSET 2．DIST. OFFSET 3．PLANE OFFSET 4．COLUMN OFFSET
③Collimate prism P1, and press [F1] (MEAS).	Collimate P1 [F1]	PLANE OFFSET NO. 01 HR： 129°10′ 36″ SD： HD： MEAS
④System runs measurement function. To carry on repeating measurement, press [F4] (SET).	[F4]	PLANE OFFSET NO. 01 HR： 121°10′ 36″ SD* [F.R] < m HD： Measuring… SET

⑤After measuring, the display indicates measurement to the 2nd point. Measure the 2nd and 3rd point in the same way.	Collimate P2 [F1] Collimate P3 [F1]	PLANE OFFSET NO. 02 HR: 118°08′ 48″ SD: HD: MEAS PLANE OFFSET NO. 03 HR: 120°52′ 35″ SD: HD: MEAS
⑥After measuring, the plane has been defined. Press [F4] (YES) to record. And it displays the points of the plane as right. Collimate plane edge (P0), and press F4 (MEAS.). *3）	Collimate P0 [F4]	PLANE OFFSET POINT→4 PCODE: SOUTH INPUT SRCH MEAS
⑦The result displays when measuring is over		PLANE OFFSET HR: 120°52′ 35″ HD: 12.205 m SD: 5.453 m VD: 2.005 m >REC.? [NO] [YES]
⑧Press [CORD] to display the coordinates of this point.	[CORD]	PLANE OFFSET HR: 120°52′ 35″ N : 25.205 m E : 37.453 m Z : 27.005 m >REC.? [NO] [YES]

⑨Press [F4] (YES), measuring data is recorded, and begin to measure the next target point. Press [ESC] to redefine the plane.		PLANE OFFSET POINT→5 PCODE：SOUTH INPUT SRCH MEAS FS/SS POINT：5 PCODE→ SOUTH R. HT： 1.000 m INPUT LIST MEAS ALL ANG. *HD NEZ OFFS

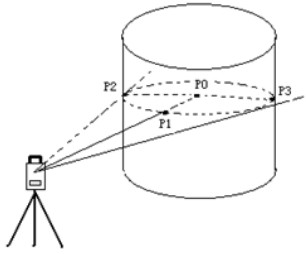
*1）In case the calculation of plane was not successful by the measured three points, error displays. Start measuring over again from the first point.

*2）Data display is the mode beforehand of offset measurement mode.

*3）Error will displayed when collimate to the direction which does not cross with the determined plane.

7.5.4 Column Offset Measurement

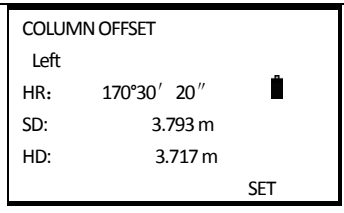
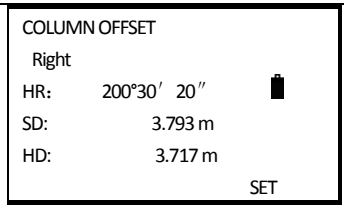
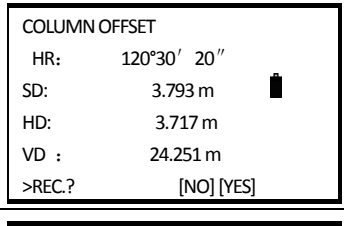
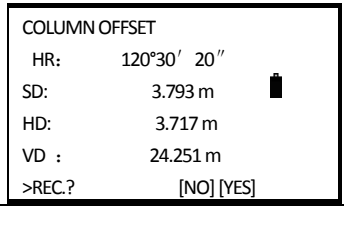
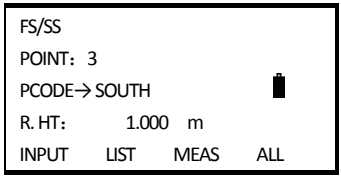
If it is possible to measure circumscription point (P1) of Column directly the distance to the center of the column (P0), coordinate and azimuth can be calculated by measured circumscription points (P2) and (P3). The direction angle of the center of the column is 1⁄2 of total azimuth of circumscription points (P2) and (P3).



When setting the coordinate

value for the occupied station, refer to Section 6.2 'Setting Coordinate Values of Occupied Point'.

Operation procedure	Operation	Display
①Press [F3] (MEAS), press [F4] (OFFS) in the prompted function menu.	[F3] [F4]	FS/SS POINT：3 PCODE→ SOUTH R. HT： 1.000 m INPUT LIST MEAS ALL ANG. *SD NEZ OFFS
② Press [4] (COLUMN OFFSET).	[4]	Offset 1．ANG. OFFSET 2．DIST. OFFSET 3．PLANE OFFSET 4．COLUMN OFFSET
③Collimate the center of the column (P1) and press [F1] (MEAS) to start measuring.	Collimate P1 [F1]	COLUMN OFFSET Center HR： 170°30′ 20″ SD: HD： MEAS COLUMN OFFSET Center HR： 170°30′ 20″ SD* [F.S.] -< m HD: Measuring……

④After the measurement, angle measurement of the left side (P2) will be shown. Collimate the left side of the Column(P2) and press F4(SET)	Collimate P2 [F4]	
⑤After measurement, angle measuring of the right side (P3) will be shown. Collimate the right side of the column(P3) and pressF4(SET).	Collimate P3 [F4]	
⑥After measurement, the coordinates of P0 will be calculated and displayed.		
⑥After measurement, the coordinates of P0 will be calculated and displayed.		
⑧Press F4 (YES), the data is recorded. Press ESC to exit the column offset mode, and return to the previous mode.		

7.6 SETTING CONFIG OF DATA COLLECTION

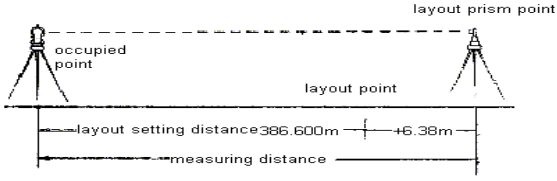
In 1. DATA COLLECT menu, press F4[P ↓] to enter into DATA COLLECT 2/2, and then press 2.[CONFIG]

Menu	Selecting item	Function
1. NEZ AUTO CALC	[1. ON] 2. OFF	During collecting data, choose whether to use the measured data to calculate coordinate data and save into the coordinate file automatically.
2. Collect Seq	1. EDIT→ MEAS. 2. MEAS→ EDIT.	Set the sequence of data collection and edition. EDIT→ MEAS: Set the PT# name, PCODE and target height firstly and then collect data. MEAS→ EDIT: Collect data firstly, and then allow the customer to edit the collected PT# name, PCODE, target height.
3. Data Confirm	1. ON 2. OFF	Switch of recording data after collection. ON: Indicates whether to record.
4. SELECT SD/HD	1. SD &HD 2. HD & VD	Set the displaying sequence of data collection.

●If need to change the setting when collecting data, you should set parameter at first.

8. LAYOUT

LAYOUT mode has two functions that are setting of layout points and setting new points using coordinate data in the internal memory. The coordinate data for layout maybe the points stored in the internal memory, or maybe inputted from keyboard. The coordinate data is loaded from PC to the internal memory via communication cable.



The internal memory of N6 series Total Station is divided into measurement data and coordinate data for layout. The coordinate data is memorized into a COORD.DATA file. For the internal memory, refer to Chapter 11 "MEMORY MANAGEMENT".

8.1 LAYOUT PROCEDURE

There are the following steps：

1. Selecting layout file. You can call up the occupied point coordinate data, backsight coordinate data, and layout point data.
2. Setting occupied point.
3. Setting backsight point and azimuth angle.
4. Input layout point coordinates, and then starts.

8.2 PREPARATION

8.2.1 Setting the GRID FACTOR

Calculation Formula

1）Elevation factor

Elevation factor=R/(R+ELEV)

R：The average radius of the earth

ELEV：The elevation above the mean sea level

2）Scale factor:

Scale factor in the surveying station

3）Grid factor

Grid factor = Elevation factor×Scale factor

Distance calculation

1）Grid distance

HDg=HD×Grid factor

HDg：Grid distance

HD：Ground distance

2）Ground distance

HD= HDg/ Grid factor

How to set Grid Factor?

Operation procedure	Operation	Display
① Press [MENU] to enter to the main menu, press [F4] (P↓) to turn to 2/2 and press [5].	[MENU] [F4] [5]	MENU 2/2 1. ADJUSTMENT 2. INST. CONSTANT 3. Select code file 4. Hardware. 5.Grid Factor P↓
②Input elevation, press [F4](ENT).※1)	Input ELEV [F4]	GRID FACTOR = 1.000000 ELEV. : 2000.0 m SCALE：1.000000 BACK ENT
③Enter Scale Factor in the same way.	Inout Scale Factor [F4]	GRID FACTOR = 0.999686 ELEV. : 2000.000 m SCALE：0.999000 BACK ENT

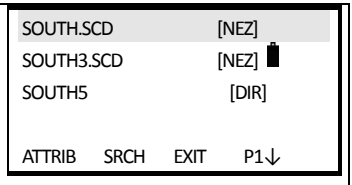
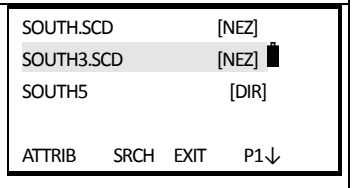
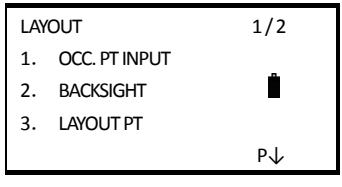
④The system calculates out the Grid factor, press [F4] (ENT), then the display returns to LAYOUTMENU2/2.	[F4]	GRID FACTOR = 0.998687 ELEV. : 2000.000 m SCALE：0.999000 BACK ENT
*1）Refer to Section 3.7 METHOD OF INPUTTING ALPHARNUMERIC CHARACTERS Input Range：Elevation：-9999 to +9999m（-32805 to +32805ft.） Scale factor：0.990000 to 1.010000		

8.2.2 Selecting Coordinate Data File

You can execute a Layout from selected coordinate data file, also you can record New point measured data into the selected coordinate data file.

When LAYOUT MODE begins, a file can be selected in the same way.

Operation procedure	Operation	Display
①In MENU1/2, press [2] (LAYOUT).	[2]	MENU 1/2 1. DATA COLLECT 2. LAYOUT 3. MEMORY MGR. 4. PROGRAMS 5. PARAMETERS P↓
②Press [F2](LIST).※1)	[F2]	SELECT SO. FILE FILE： SOUTH BACK LIST NUM ENT
③Disk list displays. Select the disk which the file is in. Press [F4]or [ENT].※2)	[F4]	Disk:A Disk:B ATTRIB FORMAT ENT

④Display the catalogue of coordinate data file.		
⑤Scroll file list by pressing the [▲] or [▼] and select a file to use.	[▲] or [▼]	
⑥Press [ENT]. The file will be selected	[ENT]	
※1) File name can be input directly. ※2) For Instruction of Disk , please refer to 11.1.1 Check the Memory and Format the Disk		

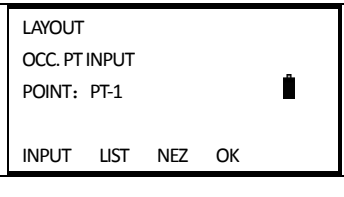
8.2.3 Setting Occupied Point

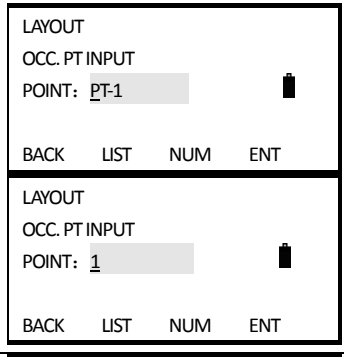
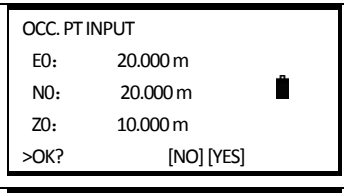
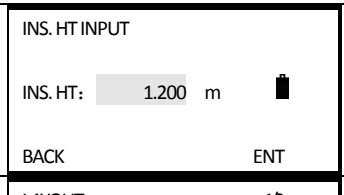
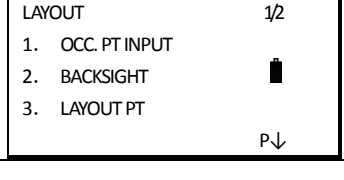
Occupied point can be set by two setting methods as follow:

1) Setting from the coordinate data stored in the internal memory

2) Direct input of coordinate data

Example：Setting the occupied point from the internal coordinate data file.

Operation procedure	Operation	Display
①Press the 1（OCC.PT INPUT）from the Layout menu 1⁄2. The previous data is shown. Press F1（Input）to redefine.	[1] [F1]	

②Input point #, and then press [F4] (ENT).	Input PT# [F4]	
③System searches the input PT#, and displays its coordinate, press [F4] (YES).※1)	[F4]	
④Input instrument height, and press [F4] (ENT).	Input INS. HT [F4]	
⑤The display returns to LAYOUT Menu 1/2.		
※1) Refer to Section 3.7 METHOD OF INPUTTING ALPHARNUMERIC CHARACTERS.		

Setting instrument point coordinates directly

Operation procedure	Operation	Display
①Press [1] (OCC. PT INPUT) in LAYOUT menu 1/2, press [F3] (NEZ) to list the function of inputting coordinate directly.	[1] [F3]	LAYOUT OCC. PT INPUT POINT：PT-1 INPUT LIST NEZ OK
②Input coordinate value, and press [F4](ENT).※1)	Input NEZ [F4]	OCC. PT INPUT E0: 0.000 m N0: 0.000 m Z0: 0.000 m BACK PT# ENT
③Input over, and press F4 (ENT).	[F4]	OCC. PT INPUT N0: 10.000 m E0: 25.000 m Z0: 63.000_ m BACK PT# ENT
④Input instrument height in the same way, and press [F4] (ENT).	Input instrument height [F4]	INS.HT INPUT INS. HT: _ 1.000 m BACK ENT
⑤System returns to layout menu.		LAYOUT 1/2 1. OCC. PT INPUT 2. BACKSIGHT 3. LAYOUT PT P↓
※1) Refer to Section 3.7 METHOD OF INPUTTING ALPHARNUMERIC CHARACTERS.		

8.2.4 Setting Backsight Point

The following three setting methods for Backsight point can be selected:

1）Setting from the coordinate data file stored in the internal memory.

2）Direct input of coordinate data.

3）Direct input of setting angle.

Example: Setting the backsight point from the internal coordinate data file

Operation procedure	Operation	Display
①Press [2] (BACKSIGHT) in LAYOUT menu.	[2]	LAYOUT 1/2 1. OCC. PT INPUT 2. BACKSIGHT 3. LAYOUT PT P↓
②Press [F1](INPUT).※1)	[F1]	LAYOUT BACKSIGHT POINT：1 INPUT LIST NE/AZ ENT
③Input PT#, press [F4] (ENT).	Input PT# [F4]	LAYOUT BACKSIGHT POINT：2 BACK LIST NUM ENT
④Display the coordinate of this point. Press [F4] (YES) and the display shows the azimuth.		BACKSIGHT NBS: 100.000 m EBS: 100.000 m ZBS: 10.000 m >OK? [NO] [YES] BACKSIGHT HR: 45°00′ 00″ [NO] [YES]

⑤Collimate the backsight point, and press [F4] (YES) to show "Set". In two seconds, the display returns to LAYOUTMenu 1/2.	Collimate backsight [F4]	LAYOUT 1/2 1. OCC. PT INPUT 2. BACKSIGHT 3. LAYOUT PT P↓

※1) Refer to Section 3.7 METHOD OF INPUTTING ALPHARNUMERIC CHARACTERS.

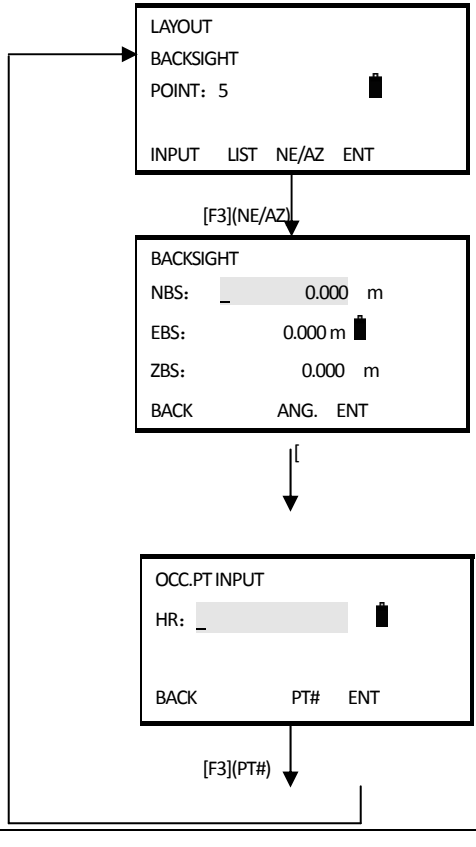
With each pressing of F3, method of inputting backsight directional angle and coordinate data directly is changed in sequence.

1. Use recorded point

2.Input coordinate directly

F3](ANG.)

3 Input angle directly.



Example: Inputting backsight point coordinates directly.

Operation procedure	Operation	Display
①Press 2（BACKSIGHT）from layout menu 1/2 to enter the backsight setting function. Press [F3] (NE/AZ).	[2] [F3]	LAYOUT BACKSIGHT POINT：5 INPUT LIST NE/AZ ENT
②Input coordinate value, and press [F4](ENT).※1)	Input coordinate [F4]	BACKSIGHT NBS: _ 0.000 m EBS: 0.000 m ZBS: 0.000 m BACK ANG. ENT
③System calculates the azimuth according to the coordinates of occupied point and backsight. Show as right figure.	F4	BACKSIGHT HR: 225°00′ 00″ [NO] [YES]
④Collimate backsight point.	Collimate backsight Point.	
⑤Press [F4] (YES). Display The display returns to LAYOUTMENU1/2.	[F4]	LAYOUT 1/2 1. OCC. PT INPUT 2. BACKSIGHT 3. LAYOUT PT P↓
※1) Refer to Section 3.7 METHOD OF INPUTTING ALPHARNUMERIC CHARACTERS.		

8.3 LAUNCHING A LAYOUT

The following methods can be selected to launch a Layout:

1) Obtaining points from internal memory by point number

2) Direct input of coordinates values

Example setting: Obtaining point from internal memory.

Operation procedure	Operation	Display
①Press 3（LAYOUT PT）from layout menu 1/2.	[3]	LAYOUT 1/2 1. OCC. PT INPUT 2. BACKSIGHT 3. LAYOUT PT P↓
②Press [F1] (INPUT).	[F1]	LAYOUT LAYOUT PT POINT：6 INPUT LIST NEZ ENT
③Enter POINT and press [F4] (ENT). ※1)，※2)	Input point [F4]	LAYOUT LAYOUT PT POINT：1 BACK LIST NUM ENT
④System searches this PT#, and the coordinate of this point displays on the screen, press F4 (YES) to accept it.		LAYOUT PT N: 100.000 m E: 100.000 m Z: 10.000 m >OK? [NO] [YES]
⑤Input the height of the target.	Input R. HT [F4]	INPUT R.HT R.HT: 0.000 m BACK ENT

⑥When the layout point is set; the instrument will start layout calculation.	Collimate [F1]	LAYOUT Calculated HR = 45°00′ 00″ HD = 113.286 m DIST NEZ
⑦The system calculates out the angle that the lens should be rotated.		HR : 2°09′ 30″ dHR= 22°39′ 30″ HD: dHD: dZ: MEAS MODE R.HT NEXT
⑧Press [F1] (MEAS). HD：Measuring (Actual) horizontal distance dHD: Horizontal distance to be turned to the layout point = Actual horizontal distance—Calculated horizontal distance. ※2)	[F1]	HR : 2°09′ 30″ dHR= 22°39′ 30″ HD*[F. S.] -< m dHD: dZ: MEAS MODE R.HT NEXT HR : 2°09′ 30″ dHR= 22°39′ 30″ HD: 25.777 m dHD: -5.321 m dZ: 1.278 m MEAS MODE R.HT NEXT
⑨Press [F2] (MODE) to start fine measuring.	[F2]	HR : 2°09′ 30″ dHR= 22°39′ 30″ HD*[F.R] -< m dHD: -5.321 m dZ: 1.278 m MEAS MODE R.HT NEXT HR : 2°09′ 30″ dHR= 22°39′ 30″ HD: 25.777 m dHD: -5.321 m dZ: 1.278 m MEAS MODE R.HT NEXT

⑩When the display value dHR, Dhd and DZ are equal to 0,the layout point is established		HR ： 2°09′ 30″ dHR= 0°00′ 00″ HD: 25.777 m dHD ： 0.000 m dZ ： 0.000 m MEAS MODE R.HT NEXT
⑪Press [ESC] to return to display of LAYOUT calculated value, press [F2] (NEZ), the coordinate data is shown. ※3)	[F2]	LAYOUT Calculated HR = 45°00′ 00″ HD = 113.286 m DIST NEZ HR ： 2°09′ 30″ dHR= 0°00′ 00″ dN : 12.322 m dE ： 34.286 m dZ ： 1.5772 m MEAS MODE R.HT NEXT
⑫Press [F4] (NEXT) set next layout point.	[F4]	LAYOUT LAYOUT PT POINT：2 INPUT LIST NEZ ENT

※1) Refer to Section 3.7 METHOD OF INPUTTING ALPHARNUMERIC CHARACTERS

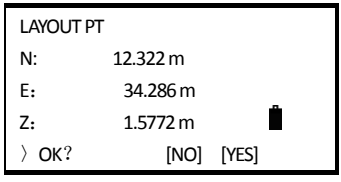
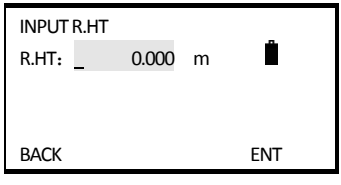
※2) Point number could not be entered when data to comply with the coordinate value does not exist in the file.

※3) Press [F3] (R.HT) to input target height again.

VIEW POINT

In layout mode, you can view the point list and call up the data as point to be layout.

Operation procedure	Operation	Display
①In layout mode, press [F2] (LIST). List of points which exist in memory is shown.	[F2]	LAYOUT LAYOUT PT POINT: 2 BACK LIST ALPH ENT C000 C001 C002 C003 C004 VIEW SRCH DEL. ADD
②Press the following cursors to scroll.※1) [▲] or [▼]: ±1 [▶] or [◀]: turn page	[▲] or [▼]	C005 C006 C007 VIEW SRCH DEL. ADD
③Press [F1] (VIEW) to display data of selected point. Press [▲] or [▼], data of the points in list can be displayed up and down one by one.	[F1]	POINT: C002 PCODE: SOUTH N: 12.322 m E: 34.286 m Z: 1.5772 m EDIT STRT END
④Press [F1] (EDIT) to rectify data of selected point. Press [F1]/ [F3] to view the first and last data of point list.		POINT: C002 PCODE: SOUTH N: 12.322 m E: 34.286 m Z: 1.5772 m BACK ALPH ENT

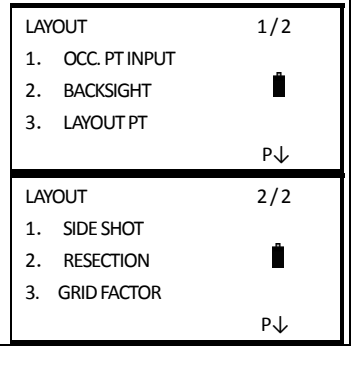
⑤Confirm to select the point by pressing [ENT].	[ENT]	
⑥Display the coordinate of selected point, which is confirmed as layout point. Press [F4] (YES) and the screen indicates to input R.Ht again.		
※1) Press [F2] (DEL) to delete selected data of the point list. Press [F4](ADD) to create a new one.		

8.4 SETTING A NEW POINT

New point is required, for example, when a layout point cannot be sighted from existing occupied points.

8.4.1 Side Shot Method

Set up the instrument at a known point, and measure the coordinate of the new points by this side shot method.

Operation procedure	Operation	Display
①Press [F4] (P↓) in LAYOUT Menu 1/2, to enter LAYOUT Menu 2/2, press [1](SIDE SHOT).	[F4] [1]	

②Press [F2] (LIST) to display SELECT SO. FILE screen. ※1)	[F2]	SELECT SO. FILE FILE: SOUTH BACK LIST NUM ENT
③The screen display Disk list, select the disk which the file is in. Press [F4](ok) or [ENT] key.※2)	[F4]	Disk: A Disk: B ATTRIB FORMAT OK
④Use [▲] or [▼] to scroll the files. Select a file. ※3) If there are more than five files, use [▶] or [◀] to turn page.	[▲] or [▼]	SOUTH.SCD [NEZ] SOUTH3.SCD [NEZ] SOUTH5.SCD [DIR] ATTRIB SRCH EXIT P1↓
⑤Press [ENT] to confirm.	[ENT]	SOUTH.SCD [NEZ] SOUTH3.SCD [NEZ] SOUTH5.SCD [DIR] ATTRIB SRCH EXIT P1↓
⑥You can input new point name, code and R.HT. Press [F4](ENT).※4) to confirm.	Input new point name, code and R.HT. [F4]	SIDE SHOT POINT→ 2 PCODE: SOUTH R.HT: 1.000 m BACK LIST NUM MEAS
⑦Collimate new point and press [F4] (MEAS) to measure.	Collimate [F4]	SIDE SHOT POINT: 2 PCODE: SOUTH R.HT→ 1.356 m INPUT MEAS
⑧ Measure the target		SIDE SHOT HR: 48°53′ 50″ N: m E: m Z: m

⑨After measuring, the coordinate will be shown. Press [F4] (YES) to record. Point # and coordinates will be saved into coordinate data file. The next new point inputting menu displays, point# adding 1 automatically.※5)	[F4]	SIDE SHOT HR：48°53′ 50″ N： 9.169 m E： 7.851 m Z： 12.312 m >REC.? [NO] [YES] < COMPLETE > SIDE SHOT POINT：3 PCODE：SOUTH R.HT→ 1.356 m INPUT MEAS

an be input directly, press [F4] (ENT) to confirm.

※2) For Instruction of Disk , please refer to "11.1.1 Check the Memory and Format the Disk

※3)Press [F2](SRCH)，enter the file name directly to launch the required COORD. FILE.

Press [F3](EXIT)，Display back to LAYOUTMENU.

※4) Refer to Section 3.7 METHOD OF INPUTTING ALPHARNUMERIC CHARACTERS

※5) When the memory room is full, error message will display.

8.4.2 Resection Method

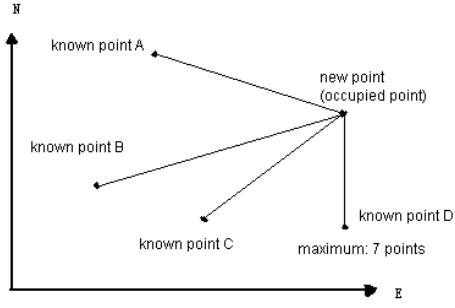
Set up the instrument at a new point, and calculate the coordinate of the new point using the coordinate data for maximum seven known points and the measurement made to these points. By following observation, resection is possible.

*Resection by distance measurement: 2 or more points must be measured.

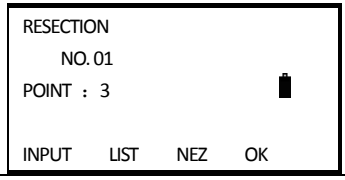
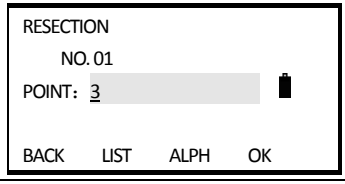
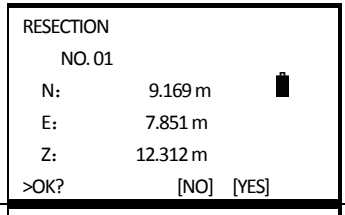
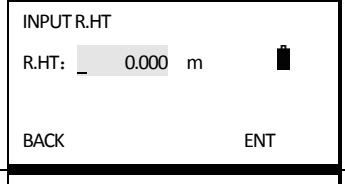
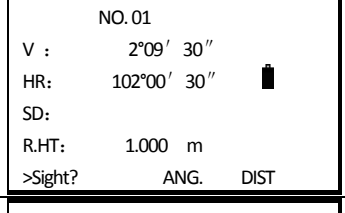
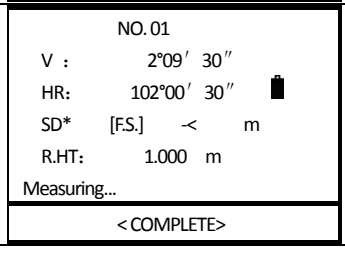
*Resection by angle measurement: 3 or more points must be measured.

* Resection by angle measurement and distance measurement cannot be used together. When using resection by angle measurement, the direction of known points should be clockwise or anti-clockwise, and the angle between two points should not exceed 180.

An occupied point coordinate value will be calculated by the method of least squares. (In case that 3 known points are measured by angle measurement only, the value would not be calculated by the method of least squares).



Operation procedure	Operation	Display
① [F4] (P↓) from LAYOUTMENU1/2 to enter LAYOUT Menu 2/2, press [2] (RESECTION).	[F4] [2]	LAYOUT 1/2 1. OCC. PT INPUT 2. BACKSIGHT 3. LAYOUT PT P↓ LAYOUT 2/2 1. SIDE SHOT 2. RESECTION 3. GRID FACTOR P↓
②Press [F1](INPUT).※1)	[F1]	NEW POINT POINT→3 PCODE: INS. HT 1.2000 m INPUT LIST SKP OK
③Input the new point name, Pcode and instrument height. Press [F4] (ENT). ※2)	Input the new point name, Pcode [F4]	NEW POINT POINT: 3 PCODE: SOUTH INS. HT 1.2000 m BACK LIST ALPH ENT

④ System indicates to enter name of the target point, press [F1] (INPUT).	[F1]	
⑤Enter the point# of point A, and press [F4] (OK). ※3)	Enter PT# [F4]	
⑥ The coordinates of the point display. Press [F4] (YES) to confirm.	[F4]	
⑦The display indicates to enter target height, press [F4] (ENT) after inputting.	Enter R.HT [F4].	
⑧Collimate the known point A and press [F3] (ANG.) or [F4](DIST). E.g. [F4] (DIST).	Collimate [F4]	
⑨Start to measure.		

⑩ The display of entering known Point B shows.		RESECTION No. 02 POINT: 4 BACK LIST ALPH OK
⑪Do the same as step ⑥-⑪ to measure point B, after using "DIST" to measure two known points, the residual error will be calculated..※4)	Collimate [F3]	RESECTION RESIDUAL ERROR dHD = -0.003 m dZ = 0.001 m NEXT CALC
⑫Press [F1](NEXT) to measure other known points. Maximum 7 points.	[F1]	RESECTION No. 03 POINT: 4 BACK LIST NUM OK
⑬From step ⑥-⑪, known point C has been calculated. Press [F4] (Calc) to view results of resection.	[F4]	No. 03 V : 52°09′ 30″ HR: 102°00′ 30″ SD*[F.R] -< m R.HT: 1.000 m Measuring... < COMPLETE>
⑭Display the standard deviation of the coordinate. Unit:(mm)		SD(n) = 4 mm SD(e) = -6 mm SD(z) = 1 mm NEZ
⑮Press [F4] (NEZ) to view coordinate of new points. Press [F4](YES) to record the data.※5)	[F4] [F4]	N: 12.322 m E: 34.286 m Z: 1.5772 m >REC.? [NO] [YES]

⑯Coordinate of new point is saved into coordinate data file and the occupied point data will change to that of the calculated New Point. The system returns to layout menu.		LAYOUT 2/2 1. SIDE SHOT 2. RESECTION 3. GRID FACTOR P↓

※1) If there is no need to save the new point data, press [F3](SKP) and start from step 5.

※2) Refer to Section 3.7 METHOD OF INPUTTING ALPHARNUMERIC CHARACTERS

※3) To enter the known point coordinate data, press [F3](NEZ).

※4)Residual error

dHD(Horizontal distance between two known points)=Measured value – Calculated Value.

dZ(Z coordinate of the new point calculated from known point A) - (Z coordinate of the new point calculated from known point B)

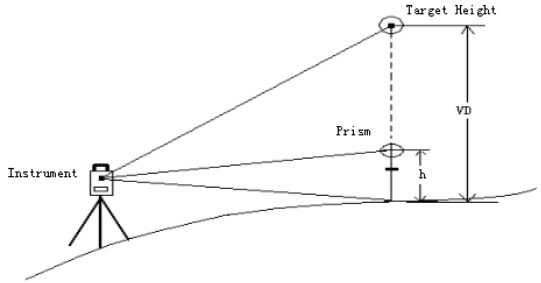
※5) If press [F3](SKP) in step 2, the new point data is not stored into the coordinate data file, only the value of occupied coordinate data is replaced by that of the calculated new point.

9. MEASUREMENT PROGRAM MODE

Press MENU key, and instrument will entry to menu mode. In this mode, you can set and check.

9.1 REMOTE HEIGHT MEASUREMENT (REM)

To obtain the target height in which user can not lay prism, just lay the prism in any point above target on the plumb line, and then start REM.



Known prism height (e.g.: h=1.3m)

Operation procedure	Operation	Display
①Press [MENU] and then [4] to enter into PROGRAMS function.	[MENU] [4]	MENU 1/2 1. DATA COLLECT 2. LAYOUT 3. MEMORY MGR. 4. PROGRAMS 5. PARAMETERS P1↓
② Press [1] (REM).	[1]	1. REM 2. TRAVERSE 3. Z COORDINATE 4. COGO 5. POINT TO LINE 6. Roads

③ Press [1] and select the REM mode that requires inputting prism height.	[1]	REM 1. INPUT R.HT 2. NO R.HT
④Input prism height, and press F4 (ENT).※1)	Input prism height [F4]	INPUT R.HT R.HT: _ 0.000 m BACK ENT
⑤Collimate the prism, and press [F1] (Measure) to start measurement.	Collimate P [F1]	REM-1 V: 94°59′ 57″ HR: 85°44′ 24″ HD: MEAS REM-1 V : 94°59′ 57″ HR: 85°44′ 24″ HD: *[F.S.] -< m Measuring... SET
⑥The position of prism was confirmed, and displayed as right figure.		REM-1 V : 94°59′ 57″ HR : 85°44′ 24″ VD: 1.650 m R.HT HD
⑦Collimate target K, and display the vertical distance (VD) from prism center to target point.※2), ※3)	Collimate K	REM-1 V : 120°59′ 57″ HR : 85°44′ 24″ VD : 24.287 m R.HT HD

※1) Refer to Section 3.7 METHOD OF INPUTTING ALPHANUMERIC CHARACTERS.

※2)Press [F2](R.HT) to return to step ④, and press [F3](HD) to return to step ⑤.

※3) Press [ESC] to return to program menu.

1) When prism height is unknown.

Operation procedure	Operation	Display
① Press [2] to select the REM function which doesn't require inputting prism height.	[2]	REM 1. INPUT R.HT 2. NO R.HT
②Collimate prism center, and press [F1] (MEAS).	Collimate P [F1]	REM-2 <STEP-1> V: 100°59′ 57″ HR: 85°44′ 24″ HD: MEAS
③System starts to measure.		REM-2 <STEP-1> V: 100°59′ 57″ HR: 85°44′ 24″ HD* [F. 3] ≺ m Measuring... SET
④When the measurement is finished, display the horizontal distance between instrument and prism. Press F4 (SET)	[F4]	REM-2 <STEP-2> V: 73°59′ 57″ HR: 85°44′ 24″ HD: 2.2999 m SET
⑤The position of prism is confirmed, press [F4] (SET).	[F4]	REM-2 V: 73°13′ 57″ HR: 44°44′ 24″ VD: 0.000 m V HD

⑥Collimate ground point G,, the position of G is confirmed. .※1)	Collimate G	REM-2 V: 96°13′ 57″ HR: 44°44′ 24″ VD: 0.311 m V HD
⑦Collimate target point K, and display the height difference(VD).※2)	Collimate K	REM-2 V: 96°13′ 57″ HR: 44°44′ 24″ VD: 1.125 m V HD

※1) Press F3（HD）key to return to step ②; and press F2（V） to return to step ⑤.

※2）Press ESC to return to procedure menu.

9.2 TRAVERSE

The traverse is defined by entering start and end points and the intermediate points are determined from foresight observations. The coordinates for the start and end points must be known.

If the coordinates of initial backsight point are known, the software calculates the bearing from the points data.

The foresight option must be used to record observations to the traverse points and the observed end point must have a different point number to the known point.

To adjust angles the end point must be occupied and a known point observed to measure the closing angle. The point number used for this observation must be different from the known point, too

Operation procedure	Operation	Display
① Press Menu and enter 4 for Programs. Then choose 2 for Traverse	[Menu] [4]	1. REM 2. TRAVERSE 3. Z COORDINATE 4. COGO 5. POINT TO LINE 6. Roads

② Then choose 2 for Traverse	[2]	[Traverse] Start Pt: BACK NUM ENT
④ Input a known point for start pt, press F4[ENT] to confirm Eg.pt 11 as a start point	Input the pt name [F4]	[Traverse] Start Pt: 11 BACK NUM ENT
⑤ Input a known point for end point and the other one for fixed pt Eg. Pt 18 and 558 as an example	Input the pt name [F4]	[Traverse] End Pt: 18 Fixed pt: 558 BACK NUM ENT
⑥ Press F4 to confirm the misclose, bearing and error of this traverse calculation	[F4]	[Traverse] Misclose: 138.920m Bearing: 2° 28' 43 Error: 1:0 [NO] [YES]
⑦ Press F4 to adjust the coordinates and level	[F4] [F4]	[Traverse] Adjust Coord? [NO] [YES] [Traverse] Adjust Level? [NO] [YES]

⑧ The traverse is finished. It will shown the before menu of program	Collimate K	1. REM 2. TRAVERSE 3. Z COORDINATE 4. COGO 5. POINT TO LINE 6. Roads

9.3 SETTING Z COORDINATE OF OCCUPIED POINT

Occupied point coordinates data and known point actual measuring data are utilized Z coordinate of occupied point is calculated and reset again.

Coordinate data file can be used as Known point data and coordinate data.

1）Setting Z coordinate of occupied point

[Example setting] Using coordinate data file

Operation procedure	Operation	Display
① Press [3] (Z COORDINATE) in Programs menu.	[3]	1. REM 2. MLM 3. Z COORDINATE 4. AREA 5. POINT TO LINE 6. Roads
② Input the file name directly or choose the file from [F2] LIST. Press [F4]ENT to confirm	[F2] [F4]	SELECT COORD. FILE FILE: BACK LIST NUM ENT
③Input the file name，then press [F4](ENT). Or press [F2] (LIST) to list files in the memory.	Input file name [F4]	SELECT COORD. FILE FILE: SOUTH BACK LIST NUM ENT

④ Press [1] (OCC. PT INPUT).	[1]	Z COORDINATE 1. OCC. PT INPUT 2. REF. MEAS
⑤Press [F1](INPUT) and enter the point#, and then press [F4] (ENT).※1)	[F1] Enter PT # [F4]	Z COORDINATE OCC. PT INPUT POINT: 2 INPUT LIST NEZ ENT
⑥System searches this PT# and displays its coordinate, press [F4] to confirm.	[F4]	OCC. PT INPUT N0: 177.258 m E0: 393.369 m Z0: 25.396 m >OK? [NO] [YES]
⑦Enter the prism heightand press [F4](ENT).	Input Instrument height, [F4]	INS.HT INPUT INS.HT: 0.000 m BACK ENT
⑧Return to the Z COORDINATE menu.		Z COORDINATE 1. OCC. PT INPUT 2. REF. MEAS
※1) Press [F2](LIST) to call up coordinate data from current file as occupied point; Press F3 (NEZ) to input the coordinate data manually.		

2）Setting z coordinate of occupied point

[Example setting] Without coordinate data file

Operation procedure	Operation	Display
① Press [3] (Z COORDINATE) in Programs menu.	[3]	1. REM 2. MLM 3. Z COORDINATE 4. AREA 5. POINT TO LINE 6. Roads
②Input the file name directly or choose the file from [F2] LIST. Press [F4]ENT to confirm	[F2] [F4]	SELECT COORD. FILE FILE: SOUTH BACK LIST NUM ENT
③ Press [2] (REF. MEAS).	[2]	Z COORDINATE 1. OCC. PT INPUT 2. REF. MEAS
④ Press [F3] NEZ to switch to coordinate input interface. Then enter the coordinate of the point to be measured, and press [F4] (ENT).	[F3] Enter coordinates [F4]	Z COORDINATE No. 01 POINT: 11 BACK LIST NEZ OK Z COORDINATE No. 01 N: 0.000 m E: 0.000 m Z: 0.000 m BACK PT# ENT
⑤Input prism height and press [F4] (ENT).	Input R.HT [F4]	INPUT R.HT R.HT: 0.000 m BACK ENT

⑥Collimate the prism at the point to be measured, press [F4](YES) to start measuring.	[F4]	REF. MEAS R.HT: 1.000 m >Sight? [NO] [YES]
⑦System starts to measure and the result is displayed. Press[F4](CALC).※1)	[F4]	REF. MEAS HR: 90°09′ 30″ SD: [F3] -< m HD: VD: >Measuring..... SET REF. MEAS HR: 90°09′ 30″ SD: 8.034 m HD: 12.534 m VD: 23.769 m NEXT CALC
⑧The calculating result is displayed. Press [F4] (SET), Coordinates of occupied point was set.	[F4]	Z COORDINATE Az :45°00′ 00″ Z : 12.534 m dZ: 0.365 m SET
⑨The backsight point measuring screen is displayed. Press [F4](YES) set the horizontal angle.	[F4]	BACKSIGHT HR: 45°00′ 00″ [NO] [YES]
⑩Return to Z COORDINATE menu.		Z COORDINATE 1. OCC. PT INPUT 2. REF. MEAS
※1) Press [F1] (NEXT) to measure other points, using several points to calculate coordinates.		

9.4 COGO

The COGO contains several functions of surveying calculation, including intersection, inverse calculation, MLM, radiation and area measurement.

9.4.1 Intersection

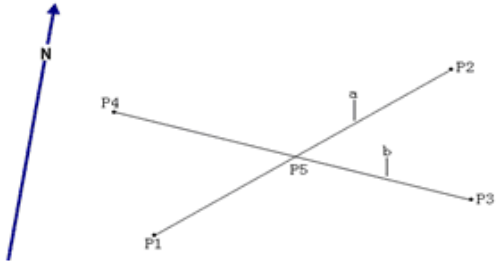
The coordinate for a point can be computed by the intersection of two known bearings.

Operation procedure	Operation	Display
① Enter Menu key, press [4]PROGRAMS, [4] COGO	[MENU] [4] [4]	MENU 1/2 1. DATA COLLECT 2. LAYOUT 3. MEMORY MGR. 4. PROGRAMS 5. PARAMETERS P1↓ 1. REM 2. TRAVERSE 3. Z COORDINATE 4. COGO 5. POINT TO LINE 6. Roads
② Press [1] INTERSECTION	[1]	1. INTERSECTION 2. INTERSECTION 4 3. INVERSE 4. MLM 5. RADIATION 6. AREA MEAS
③ Input the point name and azimuth of PT.1 and PT.2 that applied in intersection.	Input PT name [F4]	SELECT COORD. FILE PT. 1: 1001 AZ: 0° 00'00" BACK NUM ENT

④ If the point name does not exist, you can input the coordinate by manual and click [F4] to enter.	[F4]	POINT: 1001 PCODE: N: 0.000m E: 0.000m Z: 0.000m BACK NUM ENT
⑤If there is no intersection, please re-input the point name to finish calculation.		SELECT COORD. FILE PT. 2: 1002 AZ: 0° 00'00" NO INTERSECTION!
⑥ It will returns to before surveying menu		OCC. PT INPUT N: 1.499m E: 1.499m Z: 0.000m >OK? [NO] [YES]
⑦ It will returns to before surveying menu		1. INTERSECTION 2. INTERSECTION 4 3. INVERSE 4. MLM 5. RADIATION 6. AREA MEAS

9.4.2 INTERSECTION 4

The coordinate for a point can be computed by the intersection of four known points.



Known data:

P1 First known point

P2 Second known point

P3 Third known point

P4 Fourth known point

a Line between P1 and P2

b Line between P3 and P4

Unknown data:

P5 Coordinates of the point

Operation procedure	Operation	Display
① Enter Menu, press [4]PROGRAMS, [4] COGO	[MENU] [4] [4]	MENU 1/2 1. DATA COLLECT 2. LAYOUT 3. MEMORY MGR. 4. PROGRAMS 5. PARAMETERS P1↓ 1. REM 2. TRAVERSE 3. Z COORDINATE 4. COGO 5. POINT TO LINE 6. Roads
② Press [2] for 4-points intersection	[2]	1. INTERSECTION 2. INTERSECTION 4 3. INVERSE 4. MLM 5. RADIATION 6. AREA MEAS
③ Input the four known point into A-1/A-2/B-1/B-2. Press Enter key to calculate, instead of [F4].	Input pt name [ENT]	[4- Intersection] A-1: 1 A-2: 3 B-1: 2 B-2: 4 BACK NUM ENT
④ After calculation, press [F4] to confirm. It will returns to before surveying menu	[F4]	OCC. PT INPUT N: 1.499m E: 1.499m Z: 0.000m >OK? [NO] [YES]

1) If there is no intersection point, the message “No Intersection” will be displayed.

2) If intersection is not in the specified bearing, the software creates the intersection point backward.

3) The intersection point can not be saved, if the coordinates are not in the allowed range.

9.4.3 INVERSE

Operation procedure	Operation	Display
① Enter Menu key, press [4]PROGRAMS, [4] COGO	[MENU] [4] [4]	MENU 1/2 1. DATA COLLECT 2. LAYOUT 3. MEMORY MGR. 4. PROGRAMS 5. PARAMETERS P1↓ 1. REM 2. TRAVERSE 3. Z COORDINATE 4. COGO 5. POINT TO LINE 5. Roads
② Press [3] INVERSE	[3]	1. INTERSECTION 2. INTERSECTION 4 3. INVERSE 4. MLM 5. RADIATION 6. AREA MEAS
③ Input the start point and end point then press [ENT] key to calculation.		[Inverse] FromPT: 1 To Pt: 2 BACK NUM ENT

④The result will show on the screen, press [F3] NEXT to finish this calculation. Press [F4]EXIT to back to the before interface	[F4]	FromPT: 1 To PT: 2 AZ: 90° 00'00" Dist.: 10.000m HtDiff: 0.000m NEXT EXIT

※1) To call coordinate data from project, Click [Load].

※2)From PT：Pt shows start from which point.

To PT：Pt shows finish at which point.

From Pt → To Pt

※3)Azimuth：Azimuth from start point to end point.

HD：Distance between two points.

VD：Height difference between two points. Positive sign means start point is higher than end point while minus means lower.

9.4.4 MLM

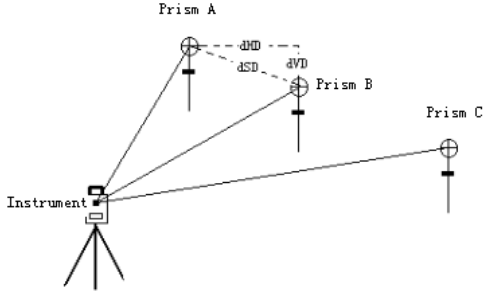
Measure dHD、dSD、dVD and HR between two prisms. Also calculate by inputting coordinate value or list coordinate data file.

There are two options for Tie Distance.

1. MLM-1（A-B，A-C）：Measure A-B，A-C，A-D……

2. MLM-2（A-B，B-C）：Measure A-B，B-C，C-D…

…



[e.g.]MLM-1(A-B，A-C)

The measuring process of MLM-2（A-B，B-C）mode is totally the same as MLM-1 mode.

Operation procedure	Operation	Display
①Press [4] in COGO menu	[4]	1. INTERSECTION 2. INTERSECTION 4 3. INVERSE 4. MLM 5. RADIATION 6. AREA MEAS
② Input the file name directly or choose the file from [F2] LIST. Press [F4]ENT to confirm	[LIST] [ENT]	SELECT COORD. FILE FILE：SOUTH BACK LIST ALPH ENT
③ Press [1] or [2] to select whether to use coordinate grid factor. [e.g.: Press [2]: Don't use]	[2]	GRID FACTOR 1. USE G.F. 2. DON'T USE
④ Press [1] to select MLM function of A-B，A-C.	[1]	MLM 1. MLM-1(A-B A-C) 2. MLM-2 (A-B B-C)
⑤Collimate prism A, and press [F1](MEAS).※1)	Collimate A [F1]	MLM-1(A-B A-C) <STEP-1> V： 106°13′ 57″ HR： 96°40′ 24″ HD： MEAS R.HT NEZ PT#

⑥The HD from instrument to prism A is displayed after measurement.		MLM-1(A-B A-C) <STEP-1> V: 106°13′ 57″ HR: 96°40′ 24″ HD* [F.S.] ≺ m Measuring... SET MLM-1(A-B A-C) <STEP-1> V: 106°13′ 57″ HR: 96°40′ 24″ HD: 287.882 m MEAS R.HT NEZ PT#
⑦Collimate prism B, and press [F1] (MEAS).	Collimate B [F1]	MLM-1 (A-B A-C) <STEP-2> V: 106°13′ 57″ HR: 85°01′ 24″ HD: MEAS R.HT NEZ PT#
⑧The HD from instrument to prism B is displayed after measurement.		MLM-1 (A-B A-C) <STEP-2> V: 106°13′ 57″ HR: 85°01′ 24″ HD*[F.S.] ≺ m Measuring... SET MLM-1 (A-B A-C) <STEP-2> V: 106°13′ 57″ HR: 85°01′ 24″ HD: 223.846 m MEAS R.HT NEZ PT#
⑨System calculates dSD, dHD and dVD between prism A and prism B according to the positions of points A and B.		MLM-1(A-B A-C) dSD: 263.376 m dHD: 21.416 m dVD: 1.256 m HR= 10°09′ 30″ NEXT

⑩Press F1 （NEXT） to measure distance between A-C.※1)	[F1]	MLM-1 (A-B A-C) <STEP-2> V : 106°13′ 57″ HR : 85°01′ 24″ HD: MEAS R.HT NEZ PT#
⑾ Collimate prism C, and press [F1] (MEAS). The HD from instrument to prism C is displayed after measurement.	Collimate prism C [F1]	MLM-1 (A-B A-C) <STEP-2> V : 106°13′ 57″ HR : 85°01′ 24″ HD: MEAS R.HT NEZ PT#
⑿ System calculates dSD, dHD and dVD between prism A and prism C according to the positions of points A and C.		MLM-1 (A-B A-C) dSD: 0.774 m dHD: 3.846 m dVD: 12. 256 m HR = 86°25′ 24″ NEXT
⒀ Measure the distance between A-D, and repeat operation steps ⑾-⑿. ※2)		

※1) If the coordinate of target point is known, you can press F3 (NEZ) to enter manually.
※2) Press [ESC] to return to MLM menu.

USING COORDINATE FILE

It is possible to input coordinate value directly or calculate from coordinate data file.

Operation procedure	Operation	Display

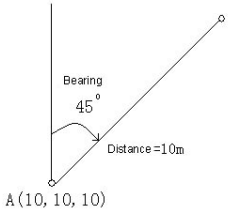
① press [F3] (NEZ) to display the entering screen of NEZ in the right graph.※1),※2)	[F3]	MLM-1 (A-B A-C) <STEP-1> V: 106°13′ 57″ HR: 85°01′ 24″ HD: MEAS R.HT NEZ PT# MLM-1 (A-B A-C) N: _ 0.000 m E: 0.000 m Z: 0.000 m BACK HD ENT
②Press [F4] (PT#), the screen shows as the right graph. Press [F2] (LIST) to read coordinate from coordinate data file.	[F2]	MLM-1 (A-B A-C) READ COORD. DATA POINT : 2 INPUT LIST ALPH ENT
③Press [F4] YES to confirm this point	[F4]	MLM-1 (A-B A-C) N: _ -0.862 m E: 2.491 m Z: 1.651 m >OK ? [NO] [YES]

※1) If the coordinate of target point is known, you can press F3 (NEZ) to enter manually.

※2) Press [F3] (HD) to return to MLM menu.

9.4.5 RADIATION

The coordinate for a point can be computed by entering the Azimuth and Distance.



Example：

Operation procedure	Operation	Display
① Press [5] Radiation in COGO	[5]	1. INTERSECTION 2. INTERSECTION 4 3. INVERSE 4. MLM 5. RADIATION 6. AREA MEAS
② Input From Point name, azimuth and distance, press ENT key to calculate.	[ENT]	[Radiation] FromPt: A1 AZ: 0° 00'00" Dist: 0.000 BACK NUM ENT
③Press [ENT] key to confirm saving this point	[ENT]	POINT: A2 PCODE: N: 9.659m E: 2.588m Z: 1.000m BACK NUM ENT <COMPLETE!>

9.4.6 AREA MEASUREMENT

This mode calculates the area of a closed figure.

There are two area calculation methods as follows:

1) Area calculation from Coordinate data file

2) Area calculation from measured data

Note

Area is not calculated correctly if enclosed lines cross each other.

It is impossible to calculate what a mix of coordinate file data and measured data.

The number of points used to calculate is not limited.

9.4.6.1 Area calculation from Coordinate data file

Operation procedure	Operation	Display
① Press [6] (AREA MEAS) in COGO.	[6]	1. INTERSECTION 2. INTERSECTION 4 3. INVERSE 4. MLM 5. RADIATION 6. AREA MEAS
② Input the file name directly or choose the file from [F2] LIST. Press [F4]ENT to confirm	Input file name [F4]	SELECT COORD. FILE FILE：SOUTH BACK LIST NUM ENT
③ press [1] or [2]，to select whether to coordinate grid factor .[e.g.: press [2], DON'T USE]	[2]	AREA 1. USE G.F. 2. DON'T USE

④ The display of Area calculation is shown※2)		POINTS: 0000 AREA: m^2 GIRTH: NEXT#: DATA-01 MEAS PT# UNIT NEXT
⑤ A: Press [F4] (NEXT), the top of the file data (DATA-01) will be set and the second point number will be shown, while the number of points for calculating the area adds one. B: Or press [F2] (PT#) and input the PT# for area calculating manuallly. C: Press [F2] (LIST) to choose point from current project.	[F4] [F2] [F2]	A: POINTS: 0001 AREA : m^2 GIRTH: NEXT#: DATA-02 MEAS PT# UNIT NEXT B: AREA READ COORD. DATA POINT:DATA-02 INPUT LIST NEZ OK C: C000 C001 C002 VIEW SRCH DEL. ENT
⑥Repeat step ⑤ to set the POINT# for area calculating. When 3 points or more are set, the area surrounded by the points is calculated	[F4]	POINTS: 0003 AREA : 540.000 m^2 GIRTH: 226.637 m NEXT#: DATA-02 MEAS PT# UNIT NEXT
※Press [F3] (UNIT) to change the area unit.		

9.4.6.2 Area Calculation from Measured Data

Operation procedure	Operation	Display
①In area calculation display, sight the prism and press [F1] (MEAS) to start measuring. ※1)	Collimate P [F1]	POINTS: 0000 AREA : m^2 GIRTH: NEXT#: DATA-01 MEAS PT# UNIT NEXT POINTS: 0000 HR: 45°00′ 00″ N* [F3] -< m E: Z: Measuring.....
② Collimate the next point and press [F1] (MEAS). Press [F4] NEXT to measure the other points. When 3 points are set, the area surrounded by the points is calculated and the result will be shown.	Collimate [F1] [F4]	POINTS: 0003 AREA : 0. 478 m^2 GIRTH: 2.317 m NEXT#: DATA-01 MEAS PT# UNIT NEXT

9.4.6.3 to Change the Display Unit

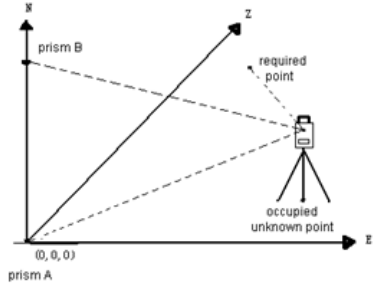
It is possible to change the display area unit.

Operation procedure	Operation	Display
① Press [F3] (UNIT).	[F3]	POINTS: 0000 AREA : m^2 GIRTH: NEXT#: MEAS PT# UNIT NEXT

② Press [F1]-[F4] to select a UNIT. e.g.: Press [F2](ha)	[F2]	POINTS: 0000 AREA: m^2 GIRTH: NEXT#: m^2 ha ft^2 acre
③ The UNIT has been changed.		POINTS: 0000 AREA: ha GIRTH: NEXT#: MEAS PT# UNIT NEXT

9.5 MEASUREMENT FROM POINT TO LINE

This mode is used to obtain the coordinate data with the origin A (0,0,0) and the line AB as N axis. Place the 2 prisms at the A and B on the line, and place the instrument at unknown point C. After measuring the 2 prisms, the coordinate and the azimuth of the instrument will be calculated and recorded.



Operation procedure	Operation	Display
① Press [5] (POINT TO LINE) in 4.Programs MENU	[MENU] [4] [5]	1. REM 2. TRAVERSE 3. Z COORDINATE 4. COGO 5. POINT TO LINE 6. Roads

② Input the file name directly or choose the file from [F2] LIST. Press [F4]ENT to confirm	Input file name [F4]	SELECT COORD. FILE FILE：SOUTH BACK LIST NUM ENT
② Press [F2] R.HT to Input instrument height and prism height and [F4] to enter.	[F2] [F4]	HEIGHT INPUT INS. HT ： 0.000 m R.HT ： 0.000 m BACK ENT
③ Collimate to the prism P1(Origin), and press F1(MEAS) to measure.※1)	Collimate P1 [F1]	POINT TO LINE NO. 01 HR： 225°00′ 00″ SD： HD ： MEAS R.HT NEZ PT# POINT TO LINE NO. 01 HR： 225°00′ 00″ SD* [F. 3] -< m HD： Measuring.....
④ Collimate to B（P2）point, and press [F1]MEAS to measure.※ 1)	Collimate P2 [F1]	POINT TO LINE NO.02 HR： 225°00′ 00″ SD： HD ： MEAS R.HT NEZ PT# POINT TO LINE NO.02 HR： 225°00′ 00″ SD*[F.3] -< m HD： Measuring.....

⑤ After measuring, it displays as right figure on the screen.		POINT TO LINE DIST (P1-P2) dSD 5.071 m dHD: 5.071 m dVD: -1.032 m NEZ OCC.
⑥ Press [F4] (OCC.) to display the new coordinate of the Occupied point. Press [F4] (P1P2↓), Display dSD. Press [F1] (NEZ) to measure other targets.		POINT TO LINE OCC. PT NO: 0.000 m EO: 5.110 m ZO: -11.035 m P1P2 POINT TO LINE HR: 225°00′ 00″ N : E : Z : EXIT R.HT MEAS
⑧ If press [F1] (NEZ) then collimate prism and [F4] (MEAS). ※2)		POINT TO LINE HR: 225°00′ 00″ N: 3.554 m E: 5.254 m Z: 0.000 m EXIT R.HT MEAS

※1) Instrument is in the mode of N times' fine measurement.

9.6 ROAD

This function is used for staking out the designed point according to the chainage and offset that made sure in road design

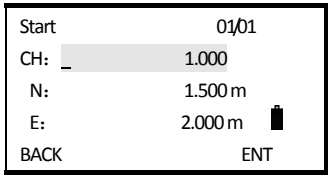
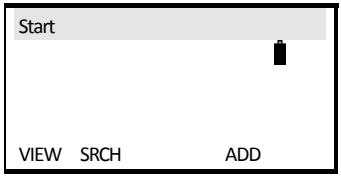
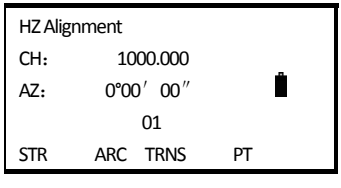
9.6.1 Input Road Parameter

The road design menu includes the function of alignment design.

9.6.1.1 Define Horizontal Alignment (Maximum data quantity of each file: 30)

Horizontal alignment data can be edited manually or encased from computer. Horizontal alignment consisted of following elements: starting point, staight line, circular curve and transition curve.

Operation procedure	Operation	Display
①Press [6] (Roads) in Programs of MENU	[MENU] [4] [6]	1. REM 2. TRAVERSE 3. Z COORDINATE 4. COGO 5. POINT TO LINE 6. Roads
② press [1]: HZ Alignment". Disk list is displayed. Select the disk which the file is in and then press [F4] (OK).	[1] [F4]	Roads 1. HZ Alignment 2. VT Alignment 3. Set-out Roads
③Select a HZAL file, press [ENT]. ※1)	[ENT]	SOUTH [DIR] S0001 [DIR] S0002.SHL [HZAL] ATTRIB SRCH EXIT P1↓

④ Press [F1] (VIEW), the screen displays data of start point. Press [F1](EDIT) to input the particular information of the start point	[F1] [F1] Input CH, N,E coordinate	
⑤After inputting ,press[F4] (ENT) and then [ESC], the display shows as the right figure.※2)	[F4] [ESC]	
⑥Press [F4] (ADD), enter the display of inputting the process of main line.	[F4]	
※1) Press [F4] (P1↓) to display function menu in page 2. Press corresponding softkey to create or edit horizontal alignment file. ※2) Press [F2] to search data by searching the chainage.		

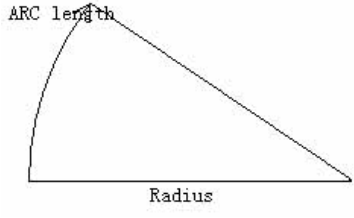
The main line inputting screen displays current chainage and the bearing angle (the tangent line from the chainage) and the function key (For creating new line). System provides four functions: defining straight line, circular curve, point. Select a function key, enter the detail information of the chainage, the alignment elements will be created. Press ENT, the new chainage and bearing angle will be calculates automatically and the main alignment screen will be restored. Now other line style can be defined. Press ESC to exit current screen. To modify the element which entered in advance, you should enter the "Edit Alignment" option; the new element can be added only in the end of the original alignment file.

Straight line

When the start point or other line style is well-defined, it allows you to define straight line. A straight line consists of bearing angle (AZ) and distance; the distance value can not be minus.

Operation procedure	Operation	Display
① Press [F1] (STR) in the screen of inputting process, entering the screen of defining straight line.	[F1]	HZ Alignment CH: 1000.000 AZ: 0°00′ 00″ 01 STR ARC TRNS PT#
②After inputting the azimuth angle, press [F4] (ENT) to get the next inputting item, and after inputting the length of the line, press [F4] (ENT).	Input Azimuth [F4]	STR 02 AZ: 25°00′ 00″ Len.: 48.420 m BACK ENT
③After recording this alignment data, display the bearing angle and the chainage in the end of straight line. Now other alignments can be defined. When the straight line is in the middle of the road, the bearing angle is calculated from the original elements. To change this bearing angle, input a new angle manually.	Input length [F4]	HZ Alignment CH: 1048.420 AZ: 25°00′ 00″ 02 STR ARC TRNS PT

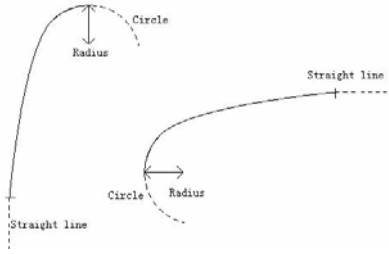
Circular Curve



Press [ARC] in the "Main line Input Screen", the circular curve can be defined. Circular curve consists of Arc length and Radius. The rule of radius value: along the forward direction of the curve.When the curve rotates to right, the radius value is positive. When the curve rotates to left, the radius value is minus. The arc length can not be minus.

Operation procedure	Operation	Display
①Press [F2] (ARC), the screen of defining Arc will be shown.	[F2]	HZ Alignment CH: 1048.420 AZ: 25°00′ 00″ 02 STR ARC TRNS PT
②Input radius and arc length, then press F4] (ENT) to save.	Input radius And arc length [F4]	Arc 03 Rad: 0.0000 m Len.: 0.000 m BACK ENT
③Return to the Input Process Screen.		HZ Alignment CH: 1071.561 AZ: 91°17′ 38″ 03 STR ARC TRNS PT

Transition curve

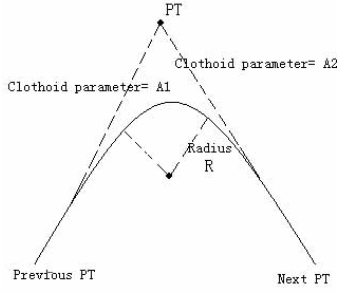


Press F3 (TRNS) in the Main Line Input Screen, the transition curve can be defined. Transition curve consists of the minimum radius and arc length. The rule of radius value: along the forward direction of the curve.When the curve rotates to right, the radius value is positive. When the curve rotates to left, the radius value is minus. The arc length can not be minus.

Operation procedure	Operation	Display
①Press [F3] (TRNS) in the Input Process Screen.	[F3]	HZ Alignment CH: 1071.561 AZ: 91°17′ 38″ 03 STR ARC TRNS PT
②Input the minimum radius and arc length of transition curve then press [F4] (ENT).	Input the minimum radius and arc length + [F4]	Transition 04 Rad.: 0.0000 m Len.: 0.000 m BACK ENT
③Return to the Input Process Screen.		HZ Alignment CH: 1091.561 AZ: 119°56′ 31″ 04 STR ARC TRNS PT

PT (Point)

Press [F4] (PT) in the "Main line input screen", the point can be defined. A point element consists of coordinates, radius and clothoid parameter A1 and A2. Radius, A1 and A2 can not be minus. If radius is entered, an arc is inserted with the specified radius. If clothoid parameter A1 or A2 is entered, a clothoid is inserted between straight and arc with the specified length.



Operation procedure	Operation	Display
①Press [F4] (PT) in the Input Process Screen.	[F4]	HZ Alignment CH: 100.000 AZ: 0°00′ 00″ 04 STR ARC TRNS PT
②Input N, E, radius and A1, A2, press [F4] (ENT).	Input N, E Radius, A1, and A2 [F4]	N : 0.000 m E : 0.000 m Rad.: 0.000 m A1 : 0.000 m A2 : 0.000 m BACK 05 ENT
③Data is saved and return to the main screen.		HZ Alignment CH: 2745.602 AZ: 61°40′ 51″ 05 STR ARC TRNS PT

[NOTE]: When you want to enter A1, A2 from clothoid length L1, L2, the following equations are used:

$$A_1 = \sqrt{L_1 \text{ Radiu}}$$

$$A_2 = \sqrt{L_2 \text{ Radiu}}$$

Any changes to the alignment must be done using the edit alignment option.

9.6.1.2 Edit Alignment

To edit the alignment data il in this menu.

Operation procedure	Operation	Display
① Select the HZAL file to be edited, and then press [F1] (VIEW), the selected HZAL data is displayed.	▲or ▼ [F1]	Start STR Arc Transition PT VIEW SRCH ADD
② Press ▲or ▼ to find the HZAL data which needs to be edited.		Arc 03/05 Rad.: 25.000 m Len.: 10.000 m EDIT STRT END
③ Press [F1](EDIT) to input new data. Press [F4] (ENT) to save.	[F1] [F4]	Arc 03/05 Rad.: 25.000 m Len.a: 10.000 m BACK ENT

▲: Press this key to display the previous point data.

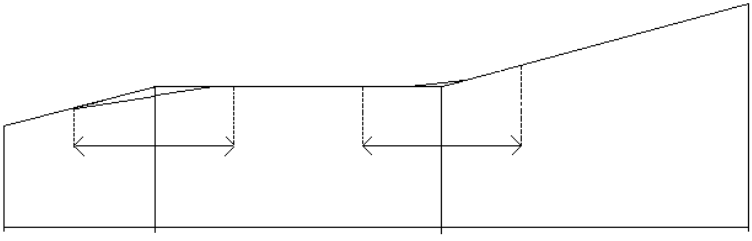
▼: Press this key to display the next point data.

STRT: Press this key to go to the strart of the file.

END: Press this key to go to the end of the file.

PAGE: Press this key to go to page 2.

It is possible to edit data and modify raw data by using above function keys.



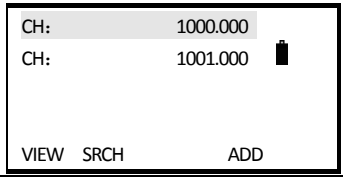
9.6.1.3 Define Vertical Curve (Maximum 30 data)

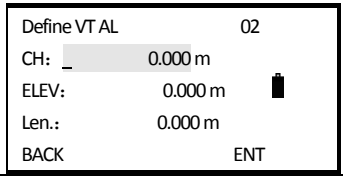
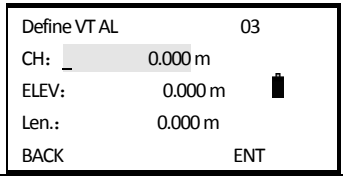
A vertical curve consists of series of intersection points. The intersection point consists of chainage, elevation and curve length.The start and end intersection points must be a zero curve length

Chainage	1000	1300	1800	2300
Elevation	50	70	60	90
Curve length	0	300	300	0

Intersection points can be entered in any order. After entering a point data, press ENT to save it and go to input next one. Press ESC to exit without saving.

Operation procedure	Operation	Display
① Press [2] (VT Alignment) in Roads menu. Display disk list; select the disk which the file is in. Press [F4] or [ENT] to enter. Display file list. Select one VT AL file and press [ENT].※1)	[2] [F4] [ENT] [F4]	Roads 1. HZ Alignment 2. VT Alignment 3. Set-out Roads SOUTH [DIR] S0001 [DIR] S0002.SVL [VTAL] ATTRIB SRCH EXIT P1↓

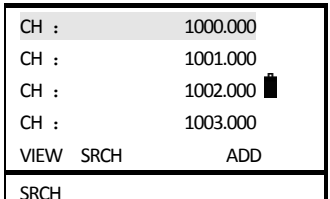
<table>
<tr>
<td>② Press [F4](ADD) to enter into the mainline INPUT PROGRESS SCREEN. As the right figure, input chainage, elevation and length, and press [F4] (ENT).</td>
<td>Input CH, elevation and curve length
[F4]</td>
<td> 

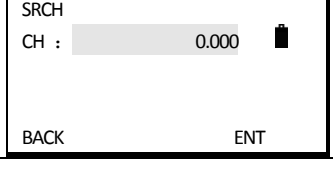

</td>
</tr>
<tr>
<td>③ Record this vertical curve data. Then input the next vertical alignment data.</td>
<td></td>
<td> 
</td>
</tr>
<tr>
<td colspan="3">※1) Press [F4] (P1↓) to display function menu in page 2. Press corresponding softkey to create or edit vertical alignment file.</td>
</tr>
</table>

9.6.1.4 Edit Vertical Curve

To modify the curve data, the procedure is the same with editing alignment data.

<table>
<tr>
<th>Operation procedure</th>
<th>Operation</th>
<th>Display</th>
</tr>
<tr>
<td>① Press ▲ or ▼, or use [F2](SRCH), to find alignment data which needs to be edited. In search menu, input the Chainage and press [F4].</td>
<td>▲ or ▼

[F2]
[F4]</td>
<td> 


</td>
</tr>
</table>

② Press [F1] (VIEW) to view data of selected VTAL, and press [F1] (EDIT).	[F1] [F1]	Define VT AL 03/07 CH: 1003.000 m ELEV: 100.000 m Len.: 100.000 m EDIT STRT END
③Input new data. Press [F4](ENT) to save the rectified data. Press [ESC] to return te previous screen.	[F4]	Define VT AL 03/07 CH: 1003.000 m ELEV: 125.000 m Len.: 120.000 m BACK ENT

9.6.2 Road Layout

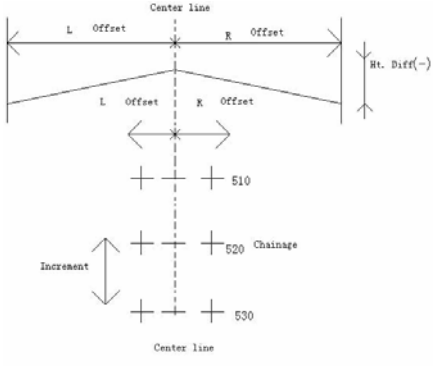
Use the chainage and offset you input in ROADS (Road Design) for layouting.

For Alignment Setout, you must define the line type of the horizontal alignment in the [Define Roads]. The vertical alignment is optional, but is required to compute cut and fill. The defining method is the same as defining horizontal alignment.

Rule：Offset left: the horizontal distance from the left stake point to the center line.

Offset right: the horizontal distance from the right stake point to the center line.

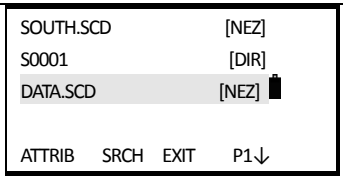
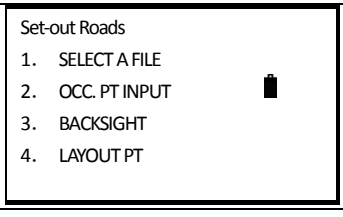
Elevation difference: Left (right) is the elevation difference between left (right) stake and the center line point.



9.6.2.1 Selecting a File

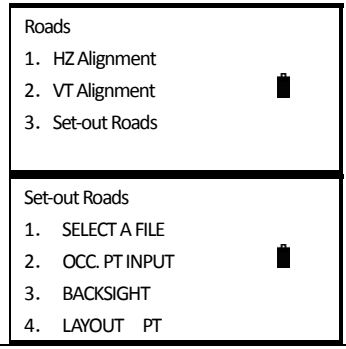
First select a file for listing and recording layout data

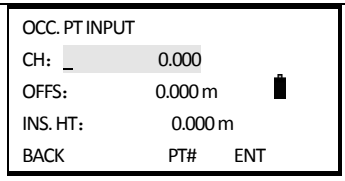
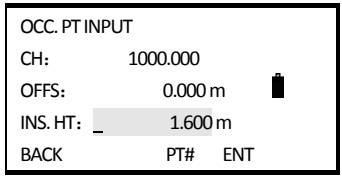
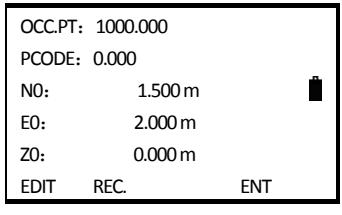
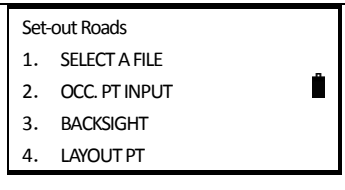
Operation procedure	Operation	Display
①Select [3] (Set-out Roads) in Roads menu, and then select [1] (SELECT A FILE)".	[3] [1]	Roads 1. HZ Alignment 2. VT Alignment 3. Set-out Roads Set-out Roads 1. SELECT A FILE 2. OCC. PT INPUT 3. BACKSIGHT 4. LAYOUT PT
②Select the type of file，e.g.: Press [3] (SELECT SO. FILE).※1)	[3]	SELECT A FILE 1. Select HZAL file 2. Select VTAL file 3. SELECT SO. FILE
③You can input the file name directly or call up files from internal memory.		SELECT SO. FILE FILE：SOUTH BACK LIST NUM ENT
④ Press [F2] (LIST) to display disk list, select the disk which the file is in. Press [F4] or [ENT] to display catalog of the coordinate data file. ※2)，※3)	[F2] [F4]	SOUTH.SCD [NEZ] S0001 [DIR] DATA.SCD [NEZ] ATTRIB SRCH EXIT P1↓

⑤ Press [▲] or [▼] to make the file tabulation to scroll up or down, and then select a file.	[▲] or [▼]	
⑥ Press [F4](ENT) to select the file. Press [ESC] to return to Set-out RoadsMenu.	[F4]	
※1) Press [1] or [2], use the same method to choose HZAL or VTAL file. ※2) Input file name directly. ※3) Press corresponding softkey to create or edit vertical alignment file.		

9.6.2.2 The Setting of the Occupied Point

The setting of the occupied point can be inputted by keyboard or listing in the memory. Inputting by keyboard is in the form of "Chainage, offset", but listing in the memory is in the coordinate form: N, E, Z.

Operation procedure	Operation	Display
①Select [3] (Set-out Roads) in Roads menu, and then [2]: OCC. PT INPUT in Set-out Roads menu.	[3] [2]	

②Enter into OCC. PT INPUT screen.		
③ Input CH, OFFS of the occupied point. Press [F4] (ENT).	Input CH, OFFS and INS.HT [F4]	
④ The instrument calculates the coordinate of this point on the basis of inputted chainage and offset. If there is vertical curve data of this chainage, display the elevation, otherwise, display 0.		
⑤ Press [F4] (ENT) to finish the setting of the occupied point, and then return to Set-out Roads menu.	[F4]	
※1) Press [F1] (EDIT) to edit occupied point and code.		

Use the coordinate data in the memory

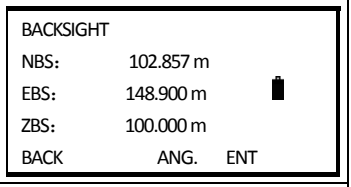
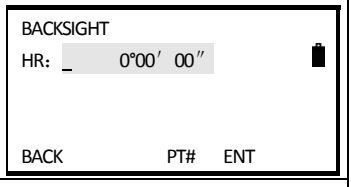
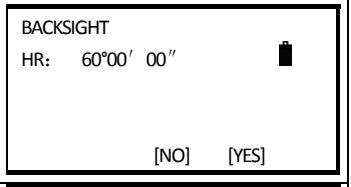
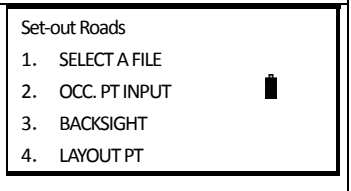
Operation procedure	Operation	Display
① Select [3] (Set-out Roads) in Roads menu, and then [2] OCC. PT INPUT	[3] [2]	Roads 1. HZ Alignment 2. VT Alignment 3. Set-out Roads Set-out Roads 1. SELECT A FILE 2. OCC. PT INPUT 3. BACKSIGHT 4. LAYOUT PT
② Enter the "OCC. PT INPUT".		OCC. PT INPUT CH: _ 0.000 OFFS: 0.000 m INS. HT: 0.000 m BACK PT# ENT
③ Press [F3] (PT#) to list the coordinate data in the memory for the setting the occupied point.	[F3]	Set-out Roads OCC. PT INPUT POINT: SOUTH INPUT LIST NEZ ENT
④ Press [F2](LIST).※1)	[F2]	C000 C001 C002 VIEW SRCH DEL. ADD
⑤Press ▲or▼ to select coordinate point in the memory; press [ENT] to display. Press [F4] (YES) to finish	▲or▼ [ENT] [F4]	OCC. PT INPUT NO: 102.857 m EO: 148.900 m ZO: 100.000 m > OK ? [NO] [YES]

9.6.2.3 The Setting of Backsight

For the setting of the backsight, there are two ways: input backsight angle directly and set backsight angle by coordinate.

1）Use angle to set backsight

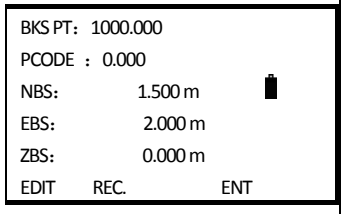
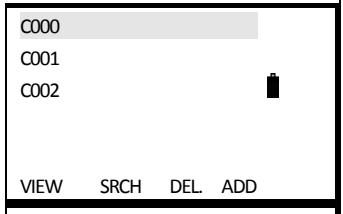
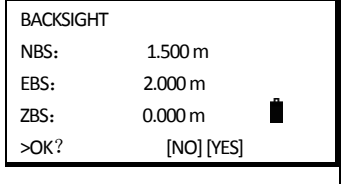
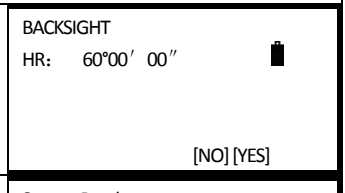
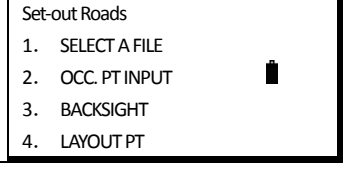
Operation procedure	Operation	Display
① Select [3] (Set-out Roads) in Roads menu and then [3] (BACKSIGHT)".	[3] [3]	Roads 1. HZ Alignment 2. VT Alignment 3. Set-out Roads Set-out Roads 1. SELECT A FILE 2. OCC. PT INPUT 3. BACKSIGHT 4. LAYOUT PT
②Enter the "BACKSIGHT ".		BACKSIGHT CH: 0.000 OFFS: 0.000 m R.HT: 0.000 m BACK PT# ENT
③ Press [F3] (PT#).	[F3]	Set-out Roads BACKSIGHT POINT: 2 INPUT LIST NE/AZ ENT

④ Press [F3] (NE/AZ).	[F3]	
⑤ Press [F3] (ANG.).	[F3]	
⑥Input backsight azimuth, and press [F4](ENT)，system prompts to enter backsight	[F4]	
⑦ Collimate to backsight point, and press [F4] (YES), then the setting of backsight point is finished. So it returns to Set-out Roads MENU.	[F4]	

2）Use coordinate file to set backsight

This setting way of backsight is the same with the occupied point. Could input by keyboard or listing from memory. Inputting by keyboard is in the form of "Chainage, offset", but listing in the memory is in the coordinate form: N, E, Z.

Operation procedure	Operation	Display
①Select [3] (Set-out Roads) in Roads menu, and then "[3] BACKSIGHT".	[3] [3]	Roads 1. HZ Alignment 2. VT Alignment 3. Set-out Roads Set-out Roads 1. SELECT A FILE 2. OCC. PT INPUT 3. BACKSIGHT 4. LAYOUT PT
②Enter the "BACKSIGHT ".		BACKSIGHT CH: _ 0.000 OFFS: 0.000 m R.HT: 0.000 m BACK PT# ENT
③ A: Input chainage, offset and target height of backsight. B: Press [F3] (PT#).		BACKSIGHT CH: 1000.000 OFFS: 0.000 m R.HT: 1.600 m BACK PT# ENT Set-out Roads BACKSIGHT POINT: 2 INPUT LIST NE/AZ ENT

④ A: The instrument calculates the coordinate of this point on the basis of inputted chainage and offset. If there is vertical curve data of this chainage, display the elevation, otherwise, display 0. Press [F2](REC.) to save data into the selected file. Press [F1] (EDIT) to edit data manually. B: Press [F2](LIST), use ▲or ▼to search data in the file, then press [ENT] display its coordinate.		A:  B:  
⑤ There is a prompt: collimate to the backsight, press [F4](YES) to enter backsight point coordinate	[F4]	
⑥ The setting of backsight point is finished, so it returns to Set-out RoadsMenu.		

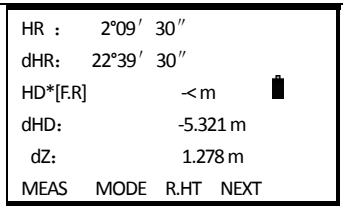
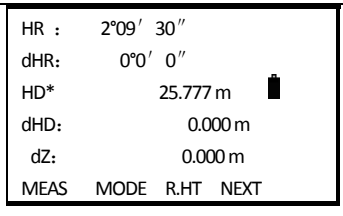
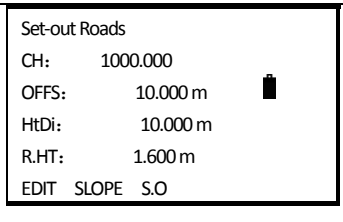
9.6.2.4 Layout

When the setting of occupied point and backsight point is finished, enter into layout.

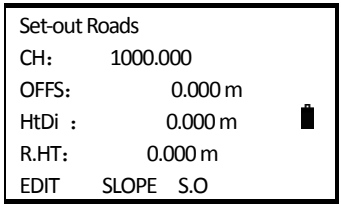
Operation procedure	Operation	Display
①Select [4] LAYOUT PT in"Set-out Roads"Menu.	[4]	Set-out Roads 1. SELECT A FILE 2. OCC. PT INPUT 3. BACKSIGHT 4. LAYOUT PT
②Enter the screen of alignment layout data. Input the start chainage, chainage increment, HD from side stake point to center line, and press [F4](ENT) to enter the next inputting screen. Offs. L: HD from left side stake point to center line (Refer to Figure 9-1 for stipulation of layout data.) ※1),※2)	Input StartC, Incre, and Off.L [F4]	Set-out Roads 1/2 StartC _ 0.000 Incre. 0.000 m Offs. L 0.000 m BACK ENT
③Input the height difference between side stake and center line point, and press [F4] (ENT) . Offs.R: HD from right side stake point to center line HtDi.L: height difference between left side stake point to center line HtDi.R: height difference between right side stake point to center line	Input Offs.R, HtDi.L, HtDi.R [F4]	Set-out Roads 2/2 Offs.R _ 0.000 m HtDi.L 0.000 m HtDi.R 0.000 m BACK ENT

④Display the chainage and offset of the center line on the screen.(refer to the explanation for the main laytout screen behind)		Set-out Roads CH: 1000.000 OFFS: 0.000 m HtDi: 0.000 m R.HT: 0.000 m EDIT SLOPE S.O
⑤ Press ▶(Offs. L) or ◀(Offs.R) to set out left (right) side stake. Corresponded chainage, offset, elevation difference will be displayed on the screen. Press [EDIT], the chainage, offset, HtDi and target height can be entered manually. If the offset is minus, the offset point is at the left side to center line. If the offset is positive, the offset point is at the right side to center line. Press ▲or▼to decrease/increase chainage.		Set-out Roads CH: 1000.000 OFFS: 10.000 m HtDi: 10.000 m R.HT: 1.600 m EDIT SLOPE S.O

⑥When the chainage and offset to be layout are appeared, press [F3] (S.O) to confirm. The coordinate of the point to be layout will be shown on the screen.Here, Press [F2](REC.) to record data in the selected file, Press [F1](EDIT) to edit data manually. Press [F4](ENT) to start layout	[F3]	POINT : 1012 PCODE : 12.000 N : 1599.255 m E : 1599.924 m Z : 0.000 m EDIT REC. ENT
⑦Instrument will calculate the layout elements firstly HR: the calculated value of the layout point's horizontal angle HD: the calculated horizontal distance value from instrument to layout point		Set-out Roads Calculated HR = 122°09′ 30″ HD = 245.777 m DIST NEZ
⑧Collimate prism, and press [F1](DIST) and then [F1](MEAS). HR: measured horizontal angle dHR: the horizontal angle to be turned to the layout point =actual horizontal angle—calculated horizontal angle When dHR=0º00′ 00", it means that the layout direction is right	Collimate [F1] [F1]	HR : 2°09′ 30″ dHR: 22°39′ 30″ HD*[F. S.] -< m dHD: dZ: MEAS MODE R.HT NEXT HR : 2°09′ 30″ dHR: 22°39′ 30″ HD: 25.777 m dHD: -5.321 m dZ: 1.278 m MEAS MODE R.HT NEXT

⑨ Press [F2](MODE) to shift among measuring modes.	[F2]	
⑩When the displayed values of dHR，dHD and dZ are 0, the layout point is established.		
⑪ Press [F4](NEXT) to get the next layout point. If the offset is minus, the offset point is at the left side to center line. If the offset is positive, the offset point is at the right side to center line.	[F4]	
※1) Refer to Section 3.7 METHOD OF INPUTTING ALPHANUMERIC CHARACTERS. ※2) Offs.L, Offs.R are not allowed to input minus.		

Explanation for the main layout screen:



SLOPE: The key is used for slope layout.

▲: **-CHG:**The key is use in decreasing the chainage.

(The deceasing No. =curremt chainage -decrement)

▼: **+CHG:** The key is use in increasing the chainage.

(The increasing No. =current chainage +increment)

◀: **Offs.R:** The key is use in setting out the right side stake. Press it to display the offset and the height difference of the right side stake.

▶: **Offs.L:** The key is use in setting out the left side stake. Press it to display the offset and the height difference of the left side stake.

Press ESC to return to the setting screen of the chainage and offset at anytime, and input new point for the next layout point; on the PT# screen, press ESC key to return to the last screen.

9.6.2.5 Slope layout

Slope setting-out can be performed as part of the Alignment layout option. After defining vertical alignment and horizontal alignment in the

"Define Roads Menu", it is possible to perform slope layout. Press SLOPE , and slope layout will be displayed

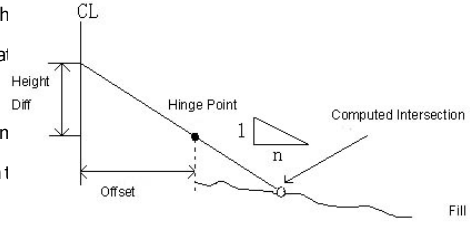
Main layout screen

Press F2 (SLOPE)

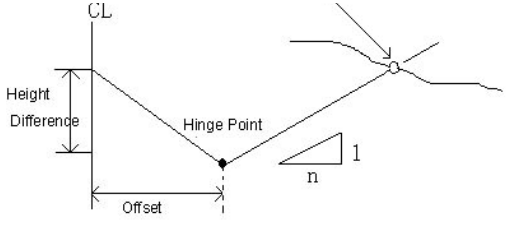
Set-out Roads	
CH:	1000.000
OFFS:	0.000 m
HtDi :	0.000 m
R.HT:	0.000 m
EDIT	SLOPE S.O

SLOPE Set-out (1: N)	
Cut L: _	0.000
Fill L :	0.000
Cut R :	0.000
Fill R :	0.000
BACK	ENT

The left and right slopes may be entered for both cut and fill. Enter the required slopes using positive numbers for both table depending on whether the situat



Cut or fill is determ vel is above the level of the hinge then t



Cut

Operation procedure	Operation	Display
① Press [F2](SLOPE) in the layout screen of alignment chainage and offset	[F2]	Set-out Roads CH: 1000.000 OFFS: 0.000 m HtDi: 0.000 m R.HT: 0.000 m EDIT SLOPE S.O
②Input left/right cut/fill slope, and press [ENT] to save.	[F4]	SLOPE Set-out (1: N) Cut L : 0.000 Fill L : 0.000 Cut R : 0.000 Fill R : 0.000 BACK ENT
③Select [F2] (LEFT) or [F3] (RIGHT).	[F2] or [F3]	Select L or R Cut L: 2.150 Fill L: 0.000 Cut R: 2.150 Fill R: 0.000 LEFT RIGHT
④Enter SLOPE Set-out screen.		SLOPE Set-out HD: HR: 180°13′ 25″ MEAS MODE STOP

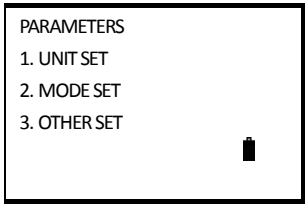
⑤Sight a point near where it is estimated the slope will intercept and press [F1](MEAS) to take the first trial shot. The appropriate slope is selected from the data entered in the preceding step. The appropriate slope is selected from the data entered in the preceding step. The first intercept is computed assuming a horizontal surface at the level of the measured point. The error from measured point to calculated point will be displayed.		SLOPE Set-out ← 3.398 m ↑ 3.321 m HD: 2.546 m HR : 180°13′ 25″ MEAS MODE STOP
⑤Sight a point near		SLOPE Set-out ← 3.398 m ↑ 3.321 m HD: 2.546 m HR : 180°13′ 25″ MEAS MODE STOP
⑥Move prism following the display on the screen, and press [F1](MEAS). Until there are two arrowheads on the two head rows, it means finding the layout point.	Move prism [F1]	SLOPE Set-out ↔ 0.000 m ↕ 0.001 m HD: 1.546 m HR : 140°13′ 25″ MEAS MODE STOP
⑦ Press [ESC] to return to Slope Set-out selecting screen. Start to set out the next point from step 3.		Select L or R Cut L: 2.150 Fill L: 0.000 Cut R: 2.150 Fill R: 0.000 LEFT RIGHT

1) An intersection can not be computed if the ground surface passes through the hinge point.

2) The cut is not displayed because the cut at the computed point is zero.

10. PARAMETERS

You can set 'unit'and measuring mode in the menu of PARAMETERS，inMENU press"5"to enter



1：Unit Set: American Feet: 1m=3.2803333333333ft

Menu	Selections	Contents
FEET	1. INTERNATIONAL 2. USA SURVEY	Select the standard of FEET. International feet: 1m=3.280839895013123ft USA feet: 1m=3.2803333333333ft
ANGLE	1. DEG (360°) 2. GON (400G) 3. MIL (6400M)	Select angle unit. DEG/GON/MIL (degree/gon/mil)
DISTANCE	1. METER 2. FEET 3. FEET·INCH	Select distance unit: m / ft / ft+in (meter/feet/feet·inch)
TEMP. & PRESS.	1. TEMP.：°C/°F 2. PRESS.：h /mmHg/inHg	Select temperature unit：°C/°F Select pressure unit：hPa /mmHg/inHg

2：Mode set

Menu	Selections	Contents
POWER ON MODE	1. Angle Meas 2. Distance Meas 3. Coord. Meas	Choose to enter angle, distance or coordinates measuring mode after power on.

DIST. MODE	1. FINE [S] 2. FINE [N] 3. FINE [R] 4. TRACKING	Choose the distance mode after power on, fine[s], fine[n], fine[r], or tracking.
GRID FACTOR	1. DON'T USE 2. USE G.F.	Choose to use or not to use grid factor.
NEZ/ENZ	1. NEZ 2. ENZ	Choose the coordinates displaying order NE/Z or EN/Z.
V.ANGLE Z0/H0	1. Zenith 0 2. Horizontal 0	Choose the reading of vertical angle, from zenith or horizontal.

3：Other set

Menu	Selections	Contents
Min Angle Read	1. 1 second 2. 5 second 3. 10 second 4. 0.1 second	Set the minimum reading of angle unit.
Min Dist Read	1. 1mm 2. 0.1mm	Set the minimum reading of distance unit.
Face in L or R	1. Differ 2. Equation	Set whether the coordinates are the same as both in Face L and R.
Auto Power Off	1. OFF 2. ON	Set auto power off. ON: If NO key is pressed or no measurement is launched in 30 minutes, the total station will be off automatically.
H-Angle Buzzer	1. OFF 2. ON	When the horizontal angle exceeds 90°, whether the buzzer is activated.
Meas Buzzer	1. OFF 2. ON	When there's refecting signal, whether the buzzer is activated.

W-Correction	1. OFF 2. 0.14 3. 0.2	Settings of atmospheric refraction and curvature correction.
Date&Time	DATE: 2016-07-28 TIME:17:14:5:	Set the date and time.
Buzzer	1. OFF 2. ON	Switch of the buzzer. Press 1. OFF to inactivate all the buzzers.

11. MEMORY MANAGEMENT

You can implement the following applications under Memory Management.

1) File Maintain: modify file name/search for data in the file/delete files/create new files/edit files.

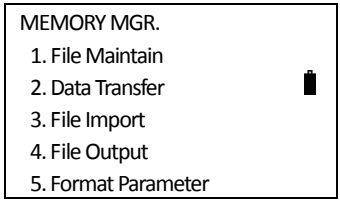
2) Data Transfer: sending measurement data/coordinates data or code-base data/receiving coordinates data or code-base data, or horizontal/vertical alignment, setting communication parameters.

3) File Import: transferring the files stored in SD card to local disks or another SD card.

4) File Output: transferring the files stored in local disks or SD card to another SD card.

5) Format Parameter: initializing the parameter settings (i.e. to resume the measurement Parameters and settings is in default value. It doesn't influence the data and files).

Menu list of Memory Management:



11.1 FILE MAINTAIN

This function can check the memory status, format the memory, and modify file name/search for data in the file/delete files/create new files/edit files.

11.1.1 Check the Memory and Format the Disk

Procedure	Key	Display
① Press [MENU] to enter to 1/2 of main page. Press [3] (MEMORY MGR.) to display the menu of MEMORY MGR.	[MENU] [3]	MEMORY MGR. 1. File Maintain 2. Data Transfer 3. File Import 4. File Output 5. Format Parameter

②Press [1] (File Maintain) to display different types of files. Press [1] to [6] to select a certain type. e.g.: Press [2] (COORD. FILE).	[1] [2]	1. MEAS. FILE 2. COORD. FILE 3. PCODE FILE 4. HZ AL FILE 5. VT AL FILE 6. All Files
③Then you can enter to list of disks.※1) Disk:A Local Disk Disk:B SD card inserted (if the disk of SD card has enough memory to partition, it will also show C/D… Disk.)		Disk:A Disk:B ATTRIB FORMAT OK
④Press [F1] (ATTRIB) to check the memory of the selected disk. Press [F4] (P1↓) to turn to P2, description of the disk.	[F1] [F4]	Disk: B Filer: Type：SD card File Sys: FAT12 Used Spc： 2.01 MB P1↓ Disk: B Free Spc： 119.19 MB Capacity： 121.20 MB P2↓
⑤Press [F2] (Format) to delete all the data in the chosen disk. Press [F4] to confirm. When finishing formatting, return back to list of disks. ※2)	[F2] [F4]	Format Disk：B Format may del data Sure to Format? CE OK FORMAT FORMATING：B PLEASE WAIT……

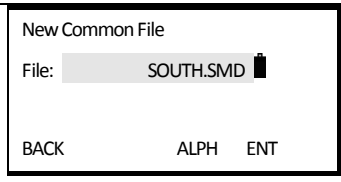
※1) Press [F4] (OK) or [ENT] to open the chosen disk and show the file list.

※2) Press [F1] (CE) to return to list of disks.

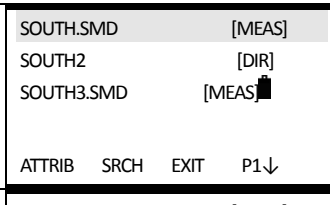
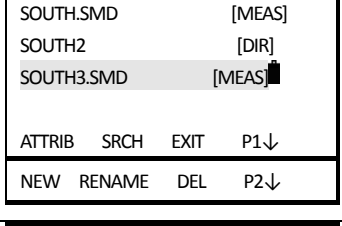
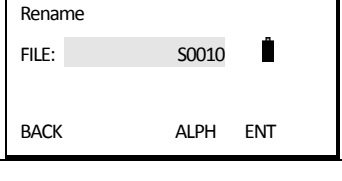
11.1.2 Create a New File

Create a new file in the memory.

Procedure	Key	Display
① Press [F4] (P1↓) in file list, to turn to P2 functions.	[F4]	SOUTH.SMD [MEAS] SOUTH2 [DIR] SOUTH3.SMD [MEAS] ATTRIB SRCH EXIT P1↓
② Press [F1] (NEW).	[F1]	SOUTH.SMD [MEAS] SOUTH2 [DIR] SOUTH3.SMD [MEAS] NEW RENAME DEL P2↓
③Types of new file are displayed. Press [F4] to show menu in the next page. E.g. : Press [7](New Common)	[F4] [7]	NEW 1. New Direct 2. New Meas File 3. New Coord. FIle 4. New Code File P1↓ NEW 5. New HZ AL File 6. New VT AL File 7. New Common File P2↓

④Enter the file name and suffix, Suffix is required to input in New Common File but not in other new files. Press [F4](ENT), New Common File is created, the screen returns to file list. ※1)～※3)	[F4]	
※1) Refer to "3.7 INPUTTING METHOD OF ALPHARNUMERIC CHARACTERS" to learn ho w to input numbers or characters. ※2) Existed file name can't be used again. ※3) Press [ESC], to return to file list.		

11.1.3 Renaming a File

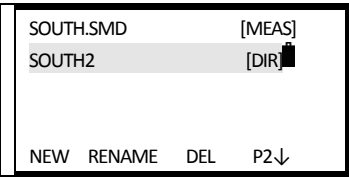
Operation procedure	Operation	Display
①In file list, press [▲] or [▼] to select the file to be renamed. Press [▶], [◀] to turn page.	[▲] or [▼]	
② Press [F4] (P1↓) to display functions in Page2.	[F4]	
③ Press [F2] (RENAME).	[F2]	

④Enter new file name and press [F4] (ENT) to finish. ※1)～※3)	[F4]	SOUTH.SMD [MEAS] SOUTH2 [DIR] S0010.SMD [MEAS] NEW RENAME DEL P2↓
※1) Refer to Section 3.7 INPUTTING METHOD OF ALPHARNUMERIC CHARACTERS. ※2) Existed file name can't be used again. ※3) Press [ESC], to return to file list.		

11.1.4 Delete file

Delete one file in the internal memory and only one file once.

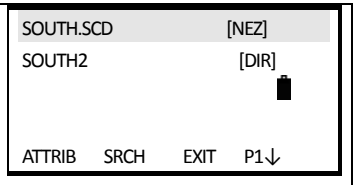
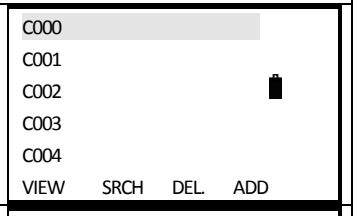
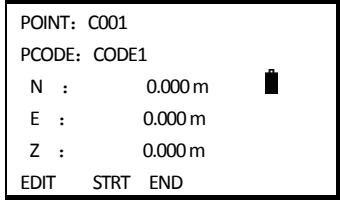
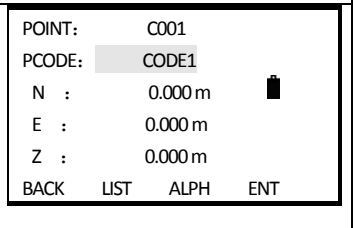
Operation procedure	Operation	Display
①Press [▲] or [▼] to select a file to delete, and press ([►], [◄] to turn page.	[▲] or [▼]	SOUTH.SMD [MEAS] SOUTH2 [DIR] SOUTH3.SMD [MEAS] ATTRIB SRCH EXIT P1↓
② Press [F4] (P1↓) to display functions in page 2.	[F4]	SOUTH.SMD [MEAS] SOUTH2 [DIR] SOUTH3.SMD [MEAS] ATTRIB SRCH EXIT P1↓ NEW RENAME DEL P2↓
③ Press [F3] (DEL).	[F3]	Delete Delete File RD.SCD Sure to Delete? CE OK

④Press [F4] (OK) to delete the file.	[F4]	
※1) Press [F1] (CE) to return to file list.		

11.1.5 Edit Measured Data in Search Mode

In this mode PT#, ID, PCODE, Instrument Height and Prism Height can be modified, but not include ured data

Operation procedure	Operation	Display
① Press [MENU] to enter into MENU 1⁄2, press [3](MEMORY MGR.), DisplayMEMORY MGR.MENU.	[MENU] [3]	MEMORY MGR. 1. File Maintain 2. Data Transfer 3. File Import 4. File Output 5. Format Parameter
② Press [1] (File Maintain), different file types are displayed. Press [1] to [6] to select one. e.g.: Press [2], COORD. FILE.	[1] [2]	1. MEAS File 2. COORD. FILE 3. PCODE FILE 4. HZ AL FILE 5. VT AL FILE 6. All Files
③Enter into disk list. Press [▲] or [▼] to select the disk which the file to be edited is in. Press [F4](OK) or [ENT] to enter into file list.	[F4]	Disk:A Disk:B ATTRIB FORMAT OK

④ Press [▲] or [▼] to select the COORD. FILE to be edited, press [ENT] again.	[ENT]	
⑤Select the coordinate data in the same way. And press [F1](VIEW).※1)	[F1]	
⑥Selected coordinate data is shown, press [F1] (EDIT).	[F1]	
⑦ Enter new Point name, Pcode, and coordinate which needs to be edited. Or press [F2] (LIST) to view pcode in internal memory. After inputting, press [F4](ENT) to finish editing..※3)	[F4]	

※1) Press [F2](SRCH), to search data by inputting point name. Press [F3] (DEL.) to delete selected coord. data.

Press [F4](ADD), t o create a new coord. data.

※2) Press [▲] or [▼] to scroll to next or previous point.

※3) Refer to "3.7 INPUTTING METHOD OF ALPHARNUMERIC CHARACTERS" to learn ho w to input numbers or characters.

11.2 DATA IMPORT

In this mode, this operation can't be done among the files in local disk.

Operation procedure	Operation	Display
①Press [3] (MEMORY MGR.) in main MENU 1/2.	[3]	MEMORY MGR. 1. File Maintain 2. Data Transfer 3. File Import 4. File Output 5. Format Parameter
② Press [3] (File Import), file types to be imported are displayed. e.g.: Press [1] (Coord. File Import)	[3] [1]	File Import 1. Coord. File Import 2. Code File Import 3. HZ AL Import 4. VT AL Import
③ Enter the name of the file which to be imported. Press [F4] (ENT). Press [F2] (LIST) to call up a file.	Enter the name of the file which to be imported. [F4]	File Import FILE: BACK LIST ALPH ENT
④ Press [1] to [3] to select the sending format. e.g.: Press [1] (NTS-300).	[1]	Sending Format 1. NTS-300 2. NTS-660 3. Custom Custom
⑤Input the file directly or press [F2] to call up COORD. FILE in internal memory. Press [F4] (ENT) again.※1)	[F4]	SELECT COORD. FILE FILE: BACK LIST ALPH ENT

⑥The information about the ongoing file imported is displayed. After all data are imported, the screen returns to File Import Display menu automatically. ※2)		Coord. File Import From:B: \ 1000.TXT To : B: \ SOUTH.SCD ＊ 40 EXIT < Complete >

※1) Refer to "3.7 METHOD OF INPUTTING ALPHARNUMERIC CHARACTERS" to learn how to input numbers or characters.

※2) Press [F4] (EXIT) to return to File Import menu. (＊40): Indicates how many groups of data are being imported.

11.2.1 User-defined Receive/Send Format

This setting can only be operated in the mode of sending or receiving coordinate data.Set the display sequence of PT#, coordinate and code of the imported/ output coordinate data. So the 5 items can't be set repetitiously.

Operation procedure	Operation	Display
① From step ④ of "11.2 DATA IMPORT", press [F1] (Custom), then sending format of coordinate data can be customized.	[F1]	Sending Format 1. NTS-300 2. NTS-660 3. Custom Custom
②Display NEZ Send Order menu, press [▲] or [▼] or numeric key [1] to [5] to select the items. Press [▶], [◀], NEZ send order will shift among PT#/N/E/Z/PCODE.		NEZ Send Order 1. PT# 2. PCODE 3. N 4. E 5. Z OK

③ Set other items in the same way. After setting, press [F4] (OK).	[F4]	NEZ Send Order 1. PT# 2. PCODE 3. N 4. E 5. Z OK
④Return to Sending Format menu, press [3](Custom), then coord. data is sent in the order which is set just now.		Sending Format 1. NTS-300 2. NTS-660 3. Custom Custom

11.3 FILE OUTPUT

Operation procedure	Operation	Display
① Press [3] (MEMORY MGR.) in MENU1/2.. Eg. Insert a SD card to output data.	[3]	MEMORY MGR. 1. File Maintain 2. Data Transfer 3. File Import 4. File Output 5. Format Parameter
②Press [4](File Output), types of data out are displayed. e.g.: Press [2](Coord File Export)	[4] [2]	File Output 1. Meas File Export 2. Coord File Export 3. Code File Export
③Input Coord. data file directly or press [F2] to call up coordinate data file in internal memory. Press [F4] (ENT).	[F4]	SELECT COORD. FILE FILE: BACK LIST ALPH ENT

④Press [1] to [3] to select Sending Format.※1) e.g.: Press [2] (NTS-660).	[2]	Sending Format 1. NTS-300 2. NTS-660 3. Custom Custom
⑤ Enter the name of the output file, press [F4] (ENT).	[F4]	File Output FILE: SOUTH BACK LIST ALPH ENT
⑥The screen displays information of the outputting file. After exporting all data, it returns to File Output Menu automatically. ※2)，※3)，※4)		Coord. File Export From: A: \ 1000.SMD To: B: \ SOUTH.TXT ＊ 45 EXIT < Complete >

※1) Press [F1] (Custom) to display the order of sending N/E/Z.

※2) Press [F4](EXIT) to return to File Output Menu (＊ 45): Indicates how many groups of data are being exported.

※3) For all exported file, the suffix of which will be changed intoTXT Format automatically.

※4) All data in SOUTH.TXT will be covered.

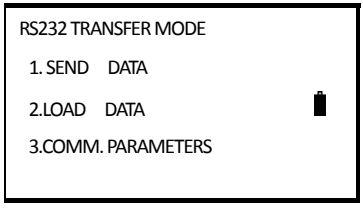
11.4 DATA TRANSFER

You can send a data file stored in the internal memory to a computer directly. Also you can directly load a coordinate data file and PCODE Library data to the internal memory from the computer.

The detailed format of horizontal and vertical alignment, please see Appendix A.

NTS360R series total station provides communication for three kinds of data format, i.e. NTS300 format, NTS660 format and defined format. User can choose according to the requirement. About these data format see AppendixA.

Data Communication Menu：



1：SEND DATA ———— send data

2：LOAD DATA———— introduce data

3：COMM. PARAMETERS ———— communication parameters setting

Note：When communicating the data, you should check whether the cable is connected well and whether the parameter settings in PC and Total Station are consistent. In addition, trasfer data to PC in time after every outside working, so make sure that the memory of the instrument is enough. At the same time the data can not be easy to loss.

11.4.1 Setting Parameter of Data Communication

Example：RS232 TRANSFER MODE: setting Baud rate: 4800

Operation procedure	Operation	Display
①In MEMORY MGR.Menu press [2](Data Transfer).	[2]	MEMORY MGR. 1. File Maintain 2. Data Transfer 3. File Import 4. File Output 5. Format Parameter P↓
②Press [1] (RS232 Mode).	[1]	Data Transfer 1：RS232 Mode 2：USB Mode 3：U Disk Mode

③Press [3](COMM. PARAMETERS).	[3]	RS232 Mode 1. SEND DATA 2. LOAD DATA 3. COMM. PARAMETERS
④ Press [▼], moving the cursor to BAUD item, andpress [◀] or [▶] to select needed parameter. Press [F4] (SET). ※1)，※2)	[▼] [◀] or [▶] [F4]	COMM. PARAMETERS PROTOCOL: Ack/Nak BAUD : 4800 b/s PARITY：8/NON SET
⑤It returns to RS232 Mode menu.		RS232 Mode 1. SEND DATA 2. LOAD DATA 3. COMM. PARAMETERS

※1) Press [◀]： The modulus of parameters decreases gradually. Press [▶]: The modulus of parameters increases gradually. Press [ESC] to cancel the setting.

※2) In this screen, protocol and parity can be set. Press [▼] or [▲] to move to the item which needs to be corrected. And then press [◀] or [▶], to select needed parameter.

E.g.：Under USB mode, set the protocol: None

Operation procedure	Operation	Display
①In Data Transfer Menu press [2] (USB Mode).	[2]	Data Transfer 1：RS232 Mode 2：USB Mode 3：U Disk Mode
②Press [3] (COMM. PARAMETERS).	[3]	USB Mode 1. SEND DATA 2. LOAD DATA 3. COMM. PARAMETERS

③Press [◄] or [►] to select the needed protocol parameter, and press [F4](SET).(e.g.：None)	[◄] or [►] [F4]	COMM. PARAMETERS PROTOCOL：Ack/Nak SET COMM. PARAMETERS PROTOCOL：None SET
④It returns to USB Mode menu.		USB Mode 1. SEND DATA 2. LOAD DATA 3. COMM. PARAMETERS

11.4.2 Send data (RS232 Mode)

Operation procedure	Operation	Display
①In MEMORY MGR. Menu, press [2](Data Transfer)	[2]	MEMORY MGR. 1. File Maintain 2. Data Transfer 3. File Import 4. File Output 5. Format Parameter P↓
②Display three modes of DATA TRANSFER. RS232Mode、USBModeandU Disk Mode. e.g.：Press [1] to select (RS232Mode).	[1]	Data Transfer 1. RS232Mode 2. USBMode 3. U Disk Mode

③Press [1](SEND DATA), types of data sending are shown. e.g.: Press [2] (COORD. DATA)	[1] [2]	RS232Mode 1. SEND DATA 2. LOAD DATA 3. COMM. PARAMETERS SEND DATA 1. MEAS. DATA 2. COORD. DATA 3. PCODE DATA
④Input the name of the file which to be sent, press [F4](ENT). Or press [F2] to call up files from internal memory. .※1)	Input name of the file [F4]	SELECT COORD. FILE FILE: 1 BACK LIST ALPH ENT
⑤ The transferring format has three types: NTS-300, NTS-660 and custom. Users can select among these. e.g.:Press [2](NTS-660) ※2)	[2]	Data Transfer 1. NTS-300 2. NTS-660 3. Custom Custom
⑥After sending data, ,the screen displays "SEND FINISH" and return to SEND DATAmenu.※3)		COORD. DATA < RS232> FILE: A: \ SOUTH.SCD ＊ 123 STOP

※1) Refer to Section 3.7 INPUTTING METHOD OF ALPHARNUMERIC CHARACTERS.

※2) Press [F1] (Custom), referring to"11.2.1 User-defined Receive/Send Format " for the sending format.

※3) Press [F4](STOP) to cancel sending.

11.4.3 Load data

Coord. data file and Code data can be loaded into instrument memory from computer.

E.g.： USB Mode, load coord. Data.

Operation procedure	Operation	Display
①In MEMORY MGR.menu, press [2] (Data Transfer).	[2]	MEMORY MGR. 1. File Maintain 2. Data Transfer 3. File Import 4. File Output 5. Format Parameter P↓
②Display Data Transfer Menu, press [2] (USBMode).	[2]	Data Transfer 1. RS232Mode 2. USBMode 3. U Disk Mode
③Press [2] LOAD DATA and select the type of data to be loaded. e.g.： Press [1] (LOAD COORD.)	[2] [1]	USB Mode 1. SEND DATA 2. LOAD DATA 3. COMM. PARAMETERS LOAD DATA 1. LOAD COORD. 2. LOAD PCODE 3. LOAD HZ AL 4. LOAD VT AL
④Enter the name of the new file to be loaded. Press [F4] (ENT). Or press [F2] (LIST) to call up coord. data in internal memory..※1)	Input FILE [F4]	SELECT COORD. FILE FILE：SOUTH BACK LIST ALPH ENT

⑤The transferring format has three types: NTS-300, NTS-660 and custom. Users can select among these. Press [3] (e.g.: Custom) ※2)	[3]	Receiving Format 1. NTS-300 2. NTS-660 3. Custom Custom
⑥Fisnish loading coordinate data. ※3)		LOAD COORD.[USB] FILE ： A: \ SOUTH.SCD ＊ 102 STOP

※1) Refer to Section 3.7 INPUTTING METHOD OF ALPHARNUMERIC CHARACTERS.

※2) Press [F1] Custom. For setting of receiving format, see“11.2.1 User-defined Receive/Send Format ".

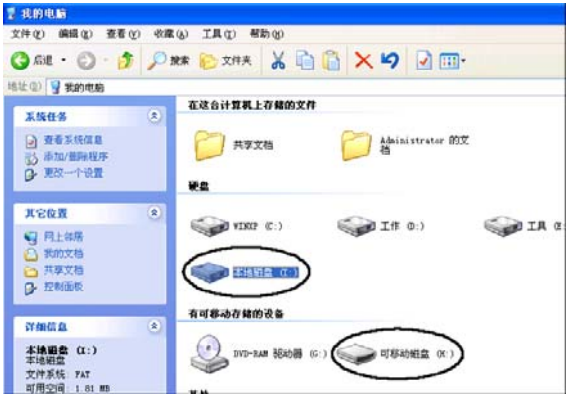
※3) To cancel receiving data, press [F4] (STOP).

11.4.4 U Disk Mode

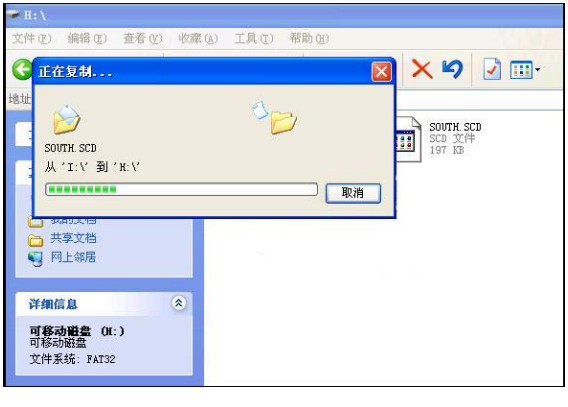
You can do the operation on computer: transfer or edit.

Operation procedure	Operation	Display
①In MEMORY MGR.menu, press [2](Data Transfer).	[2]	MEMORY MGR. 1. File Maintain 2. Data Transfer 3. File Import 4. File Output 5. Format Parameter P↓
②DisplayDataTransfer menu, press [3] (U Disk Mode).	[2]	Data Transfer 1. RS232Mode 2. USBMode 3. U Disk Mode
③”Connected to PC” is shown.		U Disk Mode Connected to PC..... EXIT

④Click “My computer”, as the following graph shows, local disk I (instrument) and removable disk H (SD card) are included.



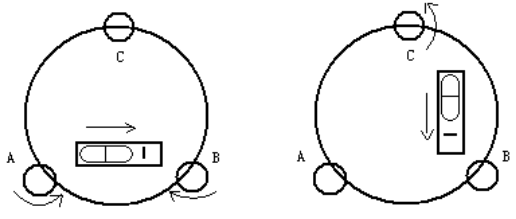
⑤select the file data to be edited. Right click the mouth, select Copy. Paste the file in this disk. You can delete or edit files in this menu. To return to data transfer menu, press [F4] (EXIT) on the instrument, then the connection is cut.



12. CHECK AND ADJUSTMENT

The instrument has been checked and adjusted strictly in the factory and meet the quality requirement. But the long distance transportation and the change of the environment will have great influence on internal structure of the instrument. So before using, the instrument should be checked and adjusted according to the items of this section.

12.1 PLATE VIAL



Inspection

Refer to Section 3.2 "INSTRUMENT SETUP".

Adjustment

1. If the bubble of the plate vial moves from the center, bring it half way back to the center by adjusting the leveling screw, which is parallel to the plate vial. Correct the remaining half by adjusting the screw of plate vial with adjusting pin.

2. Confirm whether the bubble does is in the center by rotating the instrument 180º. If not, repeat Procedure(1).

3. Turn the instrument 90ºand adjust the third screw to center the bubble in the vial.

Repeat inspection and adjustment steps until the bubble remains in center with the vial in any direction.

12.2 CIRCULAR VIAL

Inspection

No adjustment is necessary if the bubble of the circular vial is in the center after inspection and adjustment of the plate vial.

Adjustment

If the bubble of the circular vial is not in the center, bring the bubble to the center by using the adjusting pin or hexagon wrench to adjust the bubble adjusting screw. First loosen the screw opposite to the offset

side, and then tighten the other adjusting screw on the offset side, bringing the bubble to the center. After the bubble stays in the center, keep the tightness of the three screws in uniform.

12.3 INCLINATION OF RETICLE

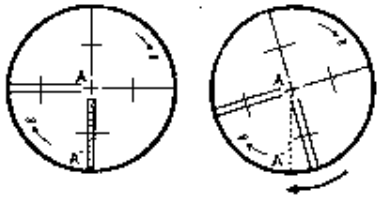
Inspection

1. Sight object A through the telescope and lock the horizontal and vertical clamp screws.

2. Move object A to the edge of the field of view with the vertical tangent screw (point A′)

3. No adjustment is necessary if object A moves along the vertical line of the reticle and point A′ still in the vertical line.

As illustrated，A′ offsets from the center and the cross hair tilts, then need to adjust the reticle.



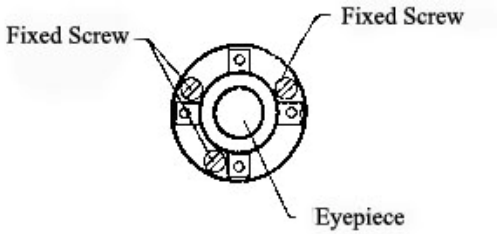
Adjustment

1. If the object A does not move along the vertical line, first remove the eyepiece cover to expose the four reticle adjusting screws.

2. Loosen the four reticle adjusting screws uniformly with an adjusting pin. Rotate the reticle around the sight line and align the vertical line of the reticle with point A′ .

3.Tighten the reticle adjusting screws uniformly，repeat the inspection and adjustment to see if the adjustment is correct.

4. Replace the eyepiece cover.



12.4 PERPENDICULARITY OF LINE OF SIGHT TO HORIZONTAL AXIS (2C)

Inspection

1. Set object A about 100m away from the instrument and make the the target vertical angle in the range of ±3 °, then level and center the instrument and turn on the power.

2. Sight object A in left position and read the horizontal angle value (horizontal angle L= 10°13′ 10″).

3. Loosen the vertical and horizontal clamp screws and rotate the telescope. Sight object A in right position and read the horizontal angle value. (Horizontal angle L= 190°13′ 40″)

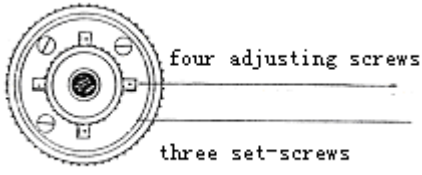
4. 2C=L—(R±180°)= —30″ ≥± 20″ , adjustment is necessary..

Adjustment

A: Electronic Adjustment Operation Steps:

Operation procedure	Operation	Display
①After leveling the instrument, turn on the instrument, press [MENU], and press [F4] (P↓) to enter into page 2 of the menu.	[MENU] [F4]	Menu 2/2 1. Adjustment 2. INST. CONSTANT 3. Select code file 4. Hardware 5. GRID FACTOR P↓
②Press [1] (Adjustment), then Select [2](Collimation)	[1] [2]	ADJUSTMENT 1. V0 Adjustment 2. Collimation 3. Horizontal Axis 4. V0/Axis const.
③Collimate target precisely in left position, and press F4 (OK).	[F4]	Collimation <STEP-1> Front V : 0°34′ 15″ HR : 186°23′ 15″ OK

④Rotate the telescope, and sight the same target A precisely in the right position. Press [F4].	[F4]	Collimation <STEP-2> Reverse V : 179°21′ 35″ HR : 5°23′ 42″ OK
⑤ Setting is finished and the instrument returns to the adjusting menu automatically		ADJUSTMENT 1. VO Adjustment 2. Collimation 3. Horizontal Axis 4. VO/Axis const.



B: Optical adjusting:

1. Use the tangent screw to adjust the horizontal angle reading,

2. Take off the cover of the reticle between the eyepiece and focusing screw. Adjust the two adjusting screws by loosening one and tightening the other. Move the reticle to sight object A exactly.

3. Repeat inspection and adjustment until | 2C | < 20".

4. Replace the cover of reticle.

NOTE: Check the coaxiality of Sighting Axis and Emitting Photoelectric Axis as well as Receiving Axis after adjusting.

12.5 VERTICAL INDEX DIFFERENCE COMPENSATION

Inspection

1. Mount and level the instrument and make the telescope parallel with the line connecting the center of the instrument to any one of the screws. Lock the horizontal clamp screw.

2. After turning on the power, zero the vertical index. Lock the vertical clamp screw and the instrument should display the vertical angle value.

3. Rotate the vertical clamp screw slowly in either direction about 10mm in circumference, and the error message "b" will appear. The vertical axis has increased to more than 3 ´ at this time and exceeds the designated compensation range.

Rotate the above screw to its original position, and the instrument display screen will show the vertical angle again, meaning that the vertical index difference compensation function is working.

Adjustment

If the compensation function is not working, send the instrument back to the factory for repair.

12.6 ADJUSTMENT OF VERTICAL INDEX DIFFERENCE (I ANGLE) AND VERTICAL ANGLE 0 DATUM

Inspect the item after finishing after finishing the inspection and adjustment of Item 12.3 and 12.5.

Inspection

1. Power on after leveling the instrument. Sight object A in left position and read the Verticail an′ gle value L.

2. Rotate the telescope. Sight object B in right position and read the Verticail angle value R.

3.If the vertical angle is 0°in zenith， $i=(L+R-360°)/2$

If the vertical angle is 0°in horizon. $i=(L+R-180°)/2$ or

$i=(L+R-540°)/2$.

4.If $|i|\geq 10''$, the Vertical Angle 0 Datum shall be set again.

Adjustment:

Operation procedure	Operation	Display

①After leveling the instrument，turn on the instrument, and press MENU and [F4] to enter 2/2 menu.	[MENU] [F4]	Menu 2/2 1. Adjustment 2. INST. CONSTANT 3. Select code file 4. Hardware 5. GRID FACTOR P↓
②Press [1] (Adjustment).Select [1]：V0 Adjustment	[1] [1]	ADJUSTMENT 1. VO Adjustment 2. Collimation 3. Horizontal Axis 4. VO/Axis const.
③Collimate target precisely (face left), and press [F4] (OK).	[F4]	VO Adjustment <STEP-1> Front V ： 0°34′ 15″ HR ： 186°23′ 15″ OK
④Rotate the telescope, and sight the same target A precisely (face right). Press F4.	[F4]	VO Adjustment <STEP-2> Reverse V ： 179°21′ 35″ HR ： 5°23′ 42″ OK
⑤ Setting is finished and the instrument returns to the adjusting menu automatically.		ADJUSTMENT 1. VO Adjustment 2. Collimation 3. Horizontal Axis 4. VO/Axis const.

NOTE:

1 Repeat the inspection setps to measure the Index Difference (i angle). If the Index Difference cannot meet the requirement, you should check whether the threee steps of the Adjustment are right, the sight is right and etc. Then set again according to the requirement.

2. If Index Difference still meets the requirement after the repeated operation, the instrument should be returned to factory for inspection and repair.

The vertical angles shown in the Vertical Angle 0 Datum are only for reference.

12.7 TRANSVERSE AXIS ERROR COMPENSATION ADJUSTMENT

As the transverse axis error only affects the angle of sight, it can be only confirmed through observing the target of which height is obviously lower or higher than the instrument.

To avoid the influence of sight axis, user must have an associated adjustment before adjusting sight axis.

It is unnecessary to collimate the prism or the target plane to decide

the transverse axis error. Therefore user is enabled to launch this adjustment at any time. Select a recognizable point which is rather far away from the instrument, and much higher or lower than the instrument, with an aim to precisely collimate the point twice.

Operation procedure	Operation	Display
①After leveling the instrument，turn on the instrument, and press MENU and[F4] (P↓) to enter 2/2 menu.	[MENU] [F4]	Menu 2/2 1. Adjustment 2. INST. CONSTANT 3. Select code file 4. Hardware 5. GRID FACTOR P↓
② Press [1](ADJUSTMENT) and select [3](Horizontal Axis).	[1] [3]	ADJUSTMENT 1. V0 Adjustment 2. Collimation 3. Horizontal Axis 4. VO/Axis const.
③Collimate the target on face I (left position), press [F4] (OK) 10 times. (The obliquity is among ±10°～±45°) The screen shows as the right graph	[F4]	Horizontal Axis <STEP-1> Front ±10°＜Level＜±45° V ： 112°34′ 15″ HR ： 266°23′ 15″ INPUT [00/10] OK

④Rotate the telescope, collimate the same target in face II (right position), press [F4] (OK) 10 times.	[F4]	Horizontal Axis <STEP-2> Reverse ±10°＜Level ＜±45° V ： 247°34′ 15″ HR ： 86°41′ 09″ INPUT [10/10] OK
⑤After setting, the screen returns to ADJUSTMENT menu. After finishing setting, the screen returns to the ADJUSTMENT mode		ADJUSTMENT 1. V0 Adjustment 2. Collimation 3. Horizontal Axis 4. V0/Axis const.

12.8 OPTICAL PLUMMET

Inspection

1. Set the instrument on the tripod and place a piece of white paper with two perpendicular lines, then intersect drawn on it directly under the instrument.

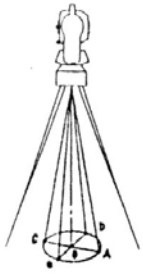
2. Adjust the focus of the optical plummet and move the paper so that the intersection point of the lines on the paper comes to the center of the field of view.

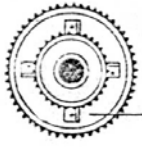
3. Adjust the leveling screws so that the center mark of the optical plummet coincides with the intersection point of the cross on the paper.

4. Rotate the instrument around the vertical axis and at every 90°observe whether the center mark position coincides with the intersection point of the cross.

5. If the center mark always coincides with intersection point, no adjustment is necessary.

Otherwise, the following adjustment is necessary.





Adjusting Screws for plummet
(4 pcs)

Adjustment

1. Take off the protective cover between the optical plummet eyepiece and focusing knob.

2. Fix the paper. Rotate the instrument and mark the point of fall of the center of optical plummet on the paper at every 90°. As illustrated: Point A, B, C, D.

3. Draw lines that attach AC and BD and mark the intersection point of the two lines as O.

4. Adjust the four adjusting screws of the optical plummet with an adjusting pin until the center mark coincides with Point O.

5. Repeat the inspection and adjusting steps to be sure the adjustment is correct.

6. Replace the protective cover.

12.9 INSTRUMENT CONSTANT (K)

Instrument constant has been checked and adjusted in the factor, K=0. It changes seldom and it is suggested to check one or two times every year. The inspection should be made on the base line, also can be made according to the following method.

Inspection

1. Mount and level the instrument on Point A in a plain place. Use the vertical hair to mark Point B and Point C on the same line with the distance of 50m on the same line, and set the reflector accurately.

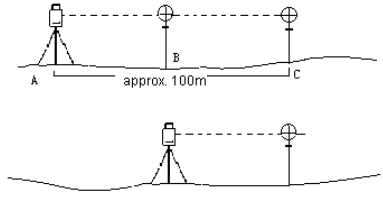
2. After setting temperature and air pressure in the instrument, measure the Horizontal Distance of AB and AC accureately.

3. Set the instrument on Point B and center it accurately, measure the Horizontal Distance of BC accurately.

4. Then you can get the Instrument Constant：

$$K = AC - (AB + BC)$$

K should be closed to 0, If $|K| > 5\,mm$, the instrument should be strictly inspected in the standard baseline site, and adjusted according the inspection value.



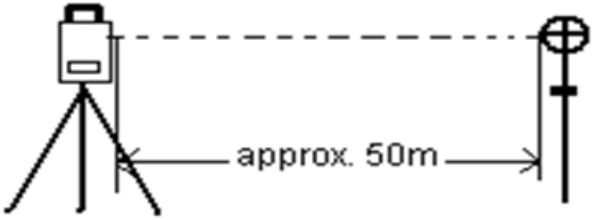
Adjustment

If strict inspection approves that the Instrument Constant K has changed and is not closed to 0. If the operator wants to adjust, should set Stadia Constant according the Constant K (Power On pressing [F1]).

●Set the direction by using the Vertical Hiar to make Point A,B,C on the same line strictly. On Point there must be fixed and clear centering mark.

●Whether the prism center of Point B coincide with the Instrument Center is the Bis the important tache to inspect the accuracy. So on Point B Tripod or tribrach compatible should be used. That will decrease the difference.

12.10 PARALLEL BETWEEN LINE OF SIGHT AND EMITTING PHOTOELECTRIC AXIS



Inspection

1. Set the reflector 50m from the instrument.

2. Sight the center of the reflector prism with reticle.

3. Power on and enter Distance Measurement Mode. Press [MEAS] to measure.

Rotate the Horzontal Tangent Screw and Vertical Tangent Screw, to do electric collimation and make the light route of EDM unblocked. In the bight zone find the center of emiting photoelectric axis.

4. Check whether the center of reticle coincides with the center of emiting photoelectric axis. If so, the instrument is up to grade.

Adjustment

If there is great difference between the center of reticle and the center of emiting photoelectric axis, the instrument need repairing.

12.11 REFLECTORLESS EDM

The red laser beam used for measuring without reflector is arranged coaxially with the line of sight of the telescope, and emerges from the objective port. If the instrument is well adjusted, the red measuring beam will coincide with the visual line of sight. External influences such as shock or large temperature fluctuations can displace the red measuring beam relative to the line of sight.

The direction of the beam should be inspected before precise measurement of distances, because an excessive deviation of the laser beam from the line of sight can result in imprecise distance measurements.

Warning

Looking straight at the laser beam should be always considered as hazardous.

Precautions:

Do not stare at the beam or point it to the other people. Measuring result might also available even the laser pass through body.

Inspection:

A target plate is provided. Set it up between five and 20 meters away with the grey reflective side facing the instrument. Move the telescope to face II. Switch on the red laser beam by activating the laser-point function. Use the reticle to align the instrument with the centre of the target plate, and then inspect the position of the red laser dot on the target plate. Generally speaking the red spot cannot be seen through the telescope, so look at the target plate from just above the telescope or from just to the side of the target plate.

If the spot illuminates the cross, the achievable adjustment precision has been reached; if it lies outside the limits of the cross, the direction of the beam needs to be adjusted.

If the spot on the more reflective side of the plate is too bright (dazzling), use the white side instead to carry out the inspection.

12.12 TRIBRACH LEVELING SCREW

If the leveling screw becomes flexible, adjust the two adjusting screw in the leveling screw to tighten the screw appropriately.

12.13 RELATED PARTS FOR REFLECTOR

1. The Tribrach and Adapter for Reflector

The plate vial and optical plummet in the adapter and tribrach should be checked, refer to Chapter 12.1 and 12.7.

2. Perpendicularity of the prism pole

As illustrated, mark '+' on Point C, place the tine of the prism pole on the Point C and do not move during the inspection. Place the two feet tine of Bipod on Point E and F on the cross lines. Adjust the two legs to make the bubble on the prism pole centered.

Set and level the instrument on Point A near the cross. Sight tine of Point C with the center of reticle, and fix the Horzontal Clamp Screw. Rotate the telescope uptward to make D near the horizotal hair. Flex the prism pole Leg e to make the D in the center of reticle. Then both Point C and D are on the central line of reticle.

Set the instrument on Point B on another cross lines. With the same way flexing the Leg f to make Point C and D are on the central line of reticle.

Through the inspection by the instrument on Point A and B, Prism pole has been perpendicular. If then the bubble offset from the center, adjust the three screws under circularial to make the bubble centered.

Check and adjust again until the bubble is in the center of the vial from both directions.

13. SPECIFICATION

Model			N6 2”	N6 5”
Distance Measurement				
Max. Range	**Single Prism**		5.0km	
	Reflectorless		600m	
*Object in shade, or sky overcast				
Accuracy	**Reflector**	**Fine**	±(2mm＋2x10^{-6}·D)	
		Tracking	±(5mm＋2x10^{-6}·D)	
	Reflectorless	**Fine**	±(5mm＋2x10^{-6}·D)	
		Tracking	±(10mm＋2x10^{-6}·D)	
Reading			Max:99999999.9999 m Min:0.1 mm	
Measuring Time	**Reflector**		Fine<0.3s, Tracking<0.1s	
	Reflectorless		0.3-3s	
Atmosphere Correction			Manual Input, Auto correction	
Atmosphere Refraction and Earth Curvature Correction			Manual Input, Auto correction	
Prism Constant			Manual Input, Auto correction	
Dist.Unit			Meter/ US.Feet/International Feet/ Feet-inch optional	
Angle Measurement				
Measuring Method			Absolute Continuous	
Dia of Encoder Disk			79mm	
Minimum Reading			1”/5”	
Accuracy			2”	5”
Detection Method			Horizontal: Dual, Vertical Dual	
Telescope				
Image			Erect	
Tube Length			154mm	
Effective Aperture			45mm (EDM:50MM)	

Magnification	30x
Field of View	1° 30′
Minimum Focus Distance	1m
Resolving Power	3″
Reticle Illumination	Adjustable
Auto Compensator	
System	Dual axis liquid-electric
Working Range	±3′
Accuracy	1″
Vial	
Plate Vial	30″/2mm
Circular Vial	8′/2mm
Optical Plummet (Optional)	
Image	Erect
Magnification	3 x
Focusing Range	0,5m~∞
Field of View	5°
On-board Battery	
Type	Rechargeable Lithium battery
Voltage	7.4V DC
Continuous Operation Time	8 hrs
Others	
IP Standard	IP65
Keyboard	Alphanvmeric 24 keys
Display	LCD 6 lines, Digital Screen
Data Communication	RS-232. USB. SD card
Temperature	-20~+50 ℃
Dimension and Weight	160 x 150 x 330mm, 5.2kg

14. ACCESSORY

- Carrying Case 1 pc
- Main Body 1 pc
- Backup on-board Battery 1 pc
- Charger 1 pc
- Plummet 1 pc
- Correction Pin 2 pcs
- Fur Brush 1 pc
- Screwdriver 1 pc
- Hexagon Wrench 2 pcs
- Cloth 1 pc
- Dryer 1 pc
- Certificate 1 pc
- Operation Manual 1 pc

【APPENDIX－A】

1. THE RAW DATA FORMAT

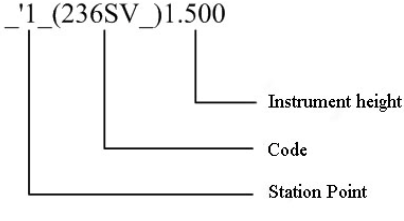
NTS660 Format：

(Identifier)	(Information included in identifier)
JOB	Job name
INST	Version, Serial number of instrument
UNITS	(unit) meter/feet，degree, gon, mil
STN	Point ID，instrument height，occupied station code
XYZ	X(E)，Y(N)， Z(H)
BS	Point number，Target height, code of backsight point
SS	Point number，Target height，code of Point number
HV	HA(Horizontal angle)，VA(Vertical angle)
SD	HA(Horizontal angle)，VA(Vertical angle)，SD(Slanting distance)

NTS300：

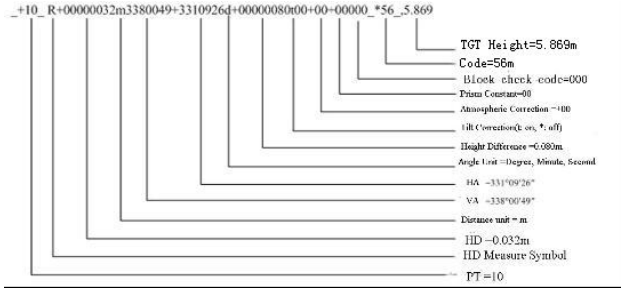
[Example]

1. Data on station point



2. Angle measuring data

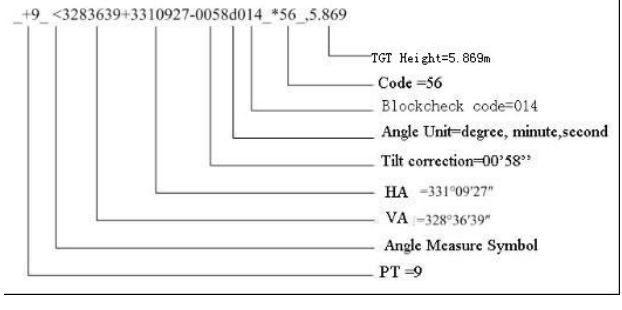
_+9_ <3283639+3310927-0258d014_*56_, 5.869



3. Distance Measuring Data

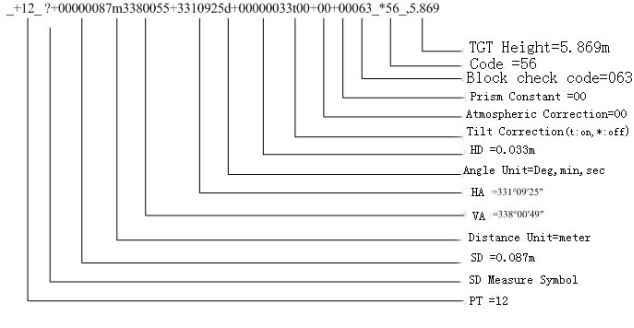
HD Measure:

_+10_ R+00000032m3380049+3310926d+00000080t00+00+00000_*56_,5.869



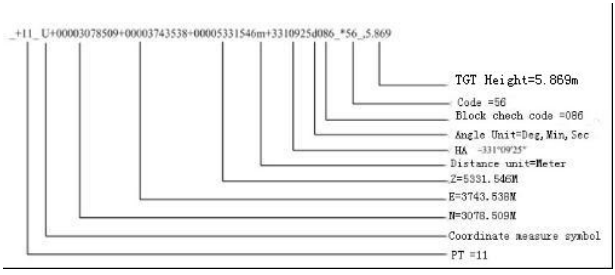
SD Measure

_+12_ ?+00000087m3380055+3310925d+00000033t00+00+00063_*56_,5.869



4. Coordinate Measuring Data

_+11_ U+00003078509+00003743538+00005331546m+3310925d086_*56_,5.869



2. COORDINATE DATA FORMAT

The format of coordinate data transferred to PC is as follows:

NTS660 ：

Pt，E，N，Z ，Code

1, 1000.000,1000.000,1000.000, STN

2, 990.000,1010.000,100.000, STN

101,994.890,1000.964,100.113, STN

102,993.936,1007.799,100.800, STN

103 ,998.515,1009.639,100.426, STN

104,1002.068,1002.568,100.342, STN

1001,1004.729,997.649,100.1153, PT

1002,1003.702,990.838,100.799, PT

1003,7911.990,990.358,100.403, PT

1004,997.311,998.236,100.354, PT

NTS300：

_+1 _ x+01111107396_ y+00000005457_ z+00000003612_+2 _ x+01111107397_ y+00000005457_ z+00000003612_+3 _ x+01111107395_ y+00000005457_ z+00000003612_+4 _x+00000108916_y+00000101580_z+00000100118_

3. POINT CODING FORMAT

The code files enclosed in code library, should assure that there is a code every line, which includes register No.and code, and every entity is ended by carriage return.

Register No.，Code

Example：

1，TREE

2，FENCE

3，CL

4，EP

5，GUTTER

6，PATH

7，DRAIN

8，BM

9，MH

10，GUS

11，WATER

12，LP

13，LIGHTS

14，ROCK

4. HORIZONTAL LINE FORMAT

The horizontal line is transmitted from computer to instrument through line element, including initial definition. It should be included in initial definition the number of the start stake and coordinate of this point. The line elements include point, straight, arc, and transition curve.

Each recorded format is:

KEYWORD nnn,nnn[,nnn]

Here：

START POINT stake number，E，N

STRAIGHT azimuth, distance

ARC radius, arc length

SPIRAL radius, length

PT E，N[，A1，A2]

(A1，A2: LENGTH)

Example 1:

START 1000.000,1050.000,1100.000

STRAIGHT 25.000,48.420

SPIRAL 20.000,20.000

ARC 20.000,23.141

SPIRAL 20.000,20.000

STRAIGHT 148.300,54.679

Example 2：

START 1000.000,1050.000,1100.000

PT 1750.000,1300.000,100.000,80.000,80.000

PT 1400.000,1750.000,200

PT 1800.000,2000.000

5. VERTICAL CURVE FORMAT

Input vertical curve data from computer through typical point and stake number, the vertical curve data should include the height, curve length, and the curve length of start point and terminal point is zero.

Data format is:

Stake number, height, length

For example：

1000.000,50.000,0.000

1300.000,70.000,300.000

1800.000,70.000,300.000

2300.000,90.000,0.000

【APPENDIX-B】CALCULATE ROAD ALIGNMENT

The road alignment stake-out program can stake out the alignment elements including straight, arc and transition curve.

NOTE:

1) Road alignment data can be uploaded from computer or can be entered manually.
2) Road alignment data is managed by chainage.

1. ROAD ALIGNMENT ELEMENTS

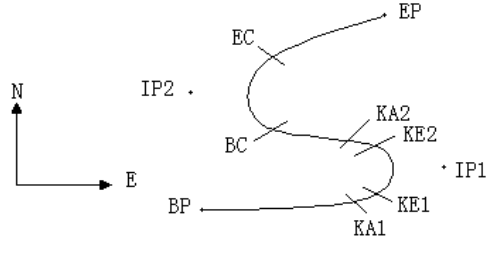
There are two ways to enter the alignment elements:

1) Download from PC.
2) Manually entered on the NTS360R series.

How to enter the alignment data is explained below:

Alignment Element	Parameter
Straight	Bearing, Distance
Transition Curve	Radius, Length of Transition Curve
Arc	Radius, Length of Arc
PT	N, E, radius, A1, A2

NOTE: When downloading from computer or selecting PT option, you do not have to calculate the Parameter.



Pt	North (N)	East (E)	Radius (R)	Transition curve A1	Transition curve A2
BP	1100.000	1050.000			
IP1	1300.000	1750.000	100.000	80.000	80.000
IP2	1750.000	1400.000	200.000	0.000	0.000
EP	2000.000	1800.000			

Example:

To enter the following data select DEF AL of ROADS in PROG menu:

Stake number	0
N	1100.000
E	1050.000

Press [ENT] and then press [F4] (PT), Enter the following data:

N	1300.000
E	1750.000
R	100.000
A1	80.000
A2	80.000

Enter the following data in the above way:

N	1750.000
E	1400.000
R	200.000
A1	0.000
A2	0.000

N	2000.000
E	1800.000
R	0.000

A1	0.000
A2	0.000

The format of the data above transmitted to computer is as follows:

START 0.000，1050.000，1100.000 CRLF

PT 1750.000，1300.000，100.000，80.000，80.000 CRLF

PT 1400.000，1750.000，200.000，0.000，0.000 CRLF

PT 1800.000，1800.000，2000.000 CRLF

2. CALCULATION ROAD ALIGNMENT ELEMENTS

(1) Calculation of the length of transition curve

$$L_{1.2} = \frac{A_{1.2}^2}{R}$$ $L_{1.2}$: Length of transition curve

$A_{1.2}$: Parameter of transition curve

R : Radius

$$L_1 = \frac{A_1^2}{R} = \frac{80^2}{100} = 64 \text{ m} \qquad L_2 = \frac{A_2^2}{R} = \frac{80^2}{100} = 64 \text{ m}$$

(2) Calculation of Deflection Angle

$$\tau = \frac{L^2}{2A^2}$$

$$\tau_1 = \frac{64^2}{2 \cdot 80^2} = 0.32 \text{ rad} \quad = \quad \text{deg} \quad = \quad 0.32 \frac{180}{\pi} = 18°20' \ 06''$$

. $\tau_1 = -\tau_2$

(3) Calculation of transition coordinates

$$N = A \cdot \sqrt{2\tau}\ (1 - \frac{\tau^2}{10} + \frac{\tau^4}{216} - \frac{\tau^6}{9360} \ldots.)$$

$$E = A \cdot \sqrt{2\tau}\ (\frac{\tau}{3} - \frac{\tau^3}{42} + \frac{\tau^5}{1320} - \frac{\tau^7}{7560} \ldots.)$$

$$N = 80 \cdot \sqrt{2 \cdot 0.32}\ (1 - \frac{(0.32)^2}{10} + \frac{(0.32)^4}{216} - \frac{(0.32)^6}{9360} \ldots.)$$

$$= 64(1 - \frac{0.01024}{10} + \frac{0.01048576}{216} - \frac{0.00107341824}{9360})$$

$$= 64(1 - 0.01024 + 0.00004855 - 0.00000011)$$

$$= 64 * 0.98981$$

$$= 63.348$$

Similarly, the value of E is:

$$E = 80 \cdot \sqrt{2 \cdot 0.32}\ (\frac{0.32}{3} - \frac{(0.32)^3}{42} + \frac{(0.32)^5}{1320} - \frac{(0.32)^7}{7560} \ldots.)$$

$$= 64(0.10666667 - 0.00078019 + 0.0000025 - 0)$$

$$= 6.\mathbf{777}$$

This example is symmetry spiral transition N1=N2， E1=E2

(4) Calculation of shift value ΔR

$$\Delta R = E - R(1 - \cos\tau)$$

$$\Delta R = 6.777 - 100(1 - \cos 18°20' 06'')$$

$$= 1.700$$

Symmetry spiral transition $\Delta R_1 = \Delta R_2$

(5) Calculation of Spiral Transition coordinate

$$N_m = N - R\sin\tau = 63.348 - 100\sin 18°20' 06'' = 31.891$$

Symmetry spiral transition $N_{m1} = N_{m2}$

(6) Calculation of Tangent Distance

$$D_1 = R\tan(\frac{LA}{2}) + \Delta R_2 \cos ec(LA) - \Delta R_1 \cot(LA) + N_{m1}$$

$LA = 111°55' 47''$, $\cos ec = \frac{1}{\sin}$, $\cot = \frac{1}{\tan}$

$$D_1 = 100 * \tan(111°55' 47'' / 2) + 1.7(1/\sin 111°55' 47'')$$

$$-1.7(1/\tan 111°55' 47'') + 31.891$$

$$= 148.06015 + 1.8326 + 0.6844 + 31.891$$

$$= 182.468$$

$D_1 = D_2$

(7) Calculation of the coordinate KA1

$$N_{KA1} = N_{IP1} - D_1 \cdot \cos\alpha_1$$

$$E_{KA1} = E_{IP1} - D_1 \cdot \sin\alpha_1$$

Bearing from BP to IP1 = $\alpha_1 = 74°03' 16.6''$

N_{KA1} = 1300 – 182.468 * cos 74°03′ 16.6″ = 1249.872 m

E_{KA1} = 1750 – 182.468 * sin 74°03′ 16.6″ = 1574.553 m

(8) Calculation of Arc Length

$$L = R(LA - \tau_1 + \tau_2)$$

$=R$ (111°55′ 47″ -2 * 18°20′ 06″)

$=100(75°15′\ 35″\ \frac{\pi}{180^\circ})$

=131.353 m

(9) Calculation of the coordinate KA2

$$N_{KA2} = N_{IP1} - D_2 \cdot \cos\alpha_2$$

$$E_{KA2} = E_{IP1} - D_2 \cdot \sin\alpha_2$$

Bearing from IP1 to IP2 = $\alpha_2 = 322°07′\ 30.1″$

N_{KA2} = 1300 –(-182.468) * cos 322°07′ 30.1″ = 1444.032 m

E_{KA2} = 1750 –(-182.468) * sin 322°07′ 30.1″ = 1637.976 m

(10) Calculation of coordinates BC， EC which is ARC (IP1,IP2,EP)

Arc length $CL = R \cdot IA$

IA= 95°52′ 11″

CL=200 * 95°52′ 11″ * $\frac{\pi}{180^\circ}$ =334.648 m

$TL = R \cdot \tan(\frac{IA}{2})$ = 200 * tan(95°52′ 11″ / 2) =221.615 m

Each coordinates are computed ：

$$N_{BC} = N_{IP2} - TL \cdot \cos\alpha_2$$

$$E_{BC} = E_{IP2} - TL \cdot \sin\alpha_2$$

$$N_{EC} = N_{IP2} - TL \cdot \cos\alpha_3$$

$$E_{EC} = E_{IP2} - TL \cdot \sin\alpha_3$$

here:

α_2 (Bearing from IP1 to IP2) = 322°07′ 30.1″

α_3 (Bearing from IP2 to EP) = 57°59′ 40.6″

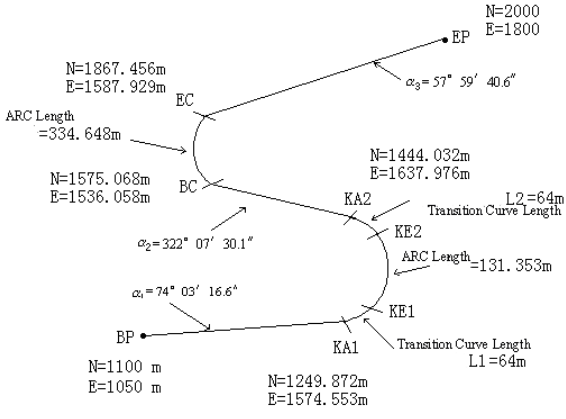
N_{BC} = 1750 - 221.615 * cos322°07′ 30.1″ =1575.068 m

E_{BC} = 1400 - 221.615 * sin322°07′ 30.1″ =1536.058 m

N_{EC} = 1750 –(-221.615) * cos57°59′ 40.6″ =1867.456 m

E_{EC} = 1400 –(-221.615) * sin57°59′ 40.6″ =1587.929 m

The calculated results display as below :



The coordinates and the distance are calculated as below ：

1） Compute the length of straight line

Straight line

BP·KA1= $\sqrt{(1249.872-1100.000)^2+(1574.553-1050)^2}=545.543$ m

straight line

KA2·BC= $\sqrt{(1575.068-1444.032)^2+(1536.058-1637.976)^2}=166.005$ m

straight line

EC·EP= $\sqrt{(2000-1867.456)^2+(1800-1587.929)^2}=250.084$ m

Start point coordinate (BP)

N 1100.000 m

E 1050.000 m

straight line (between BP and KA1)

Bearing 74°03′ 16.6″

Distance 545.543 m

Transition clothoid (between KA1 and KE1)

Radius -100 m ("-"sign is turn left curve toward the end point)

Length 64 m

ARC (between KE1 and KE2)

Radius -100 m ("-" sign is turn left curve toward the end point)

Length 131.354 m

Transition (Between KE2 and KA2)

Radius -100 m ("-" sign is turn left curve toward the end point)

Length 64 m

Straight line (between KA2 and BC)

Bearing 322°07′ 30.1″

Distance 166.004 m

Arc (between BC and EC)

Radius 200 (without sign is turn right curve toward the end point)

Length 334.648 m

Straight line (between EC and EP)

Bearing 57°59′ 40.6″

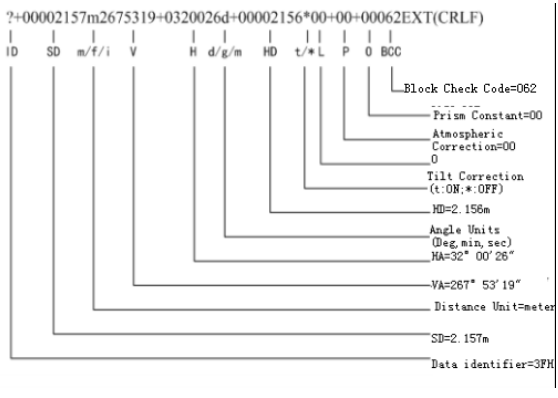
Distance 250.084 m

【APPENDIX—C】

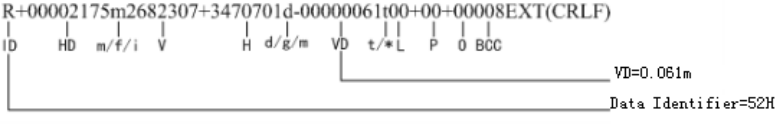
1. DATA OUTPUT FORMAT OF NTS SERIES TOTAL STATION

①Data Format when the distance output mode is 1mm.

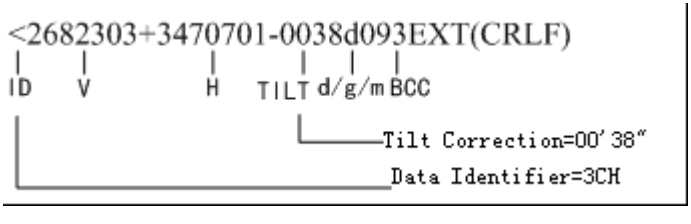
1) SDcode



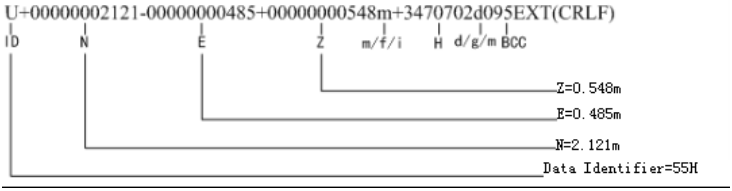
2) HD/VD Mode



3) Angle (H/V Mode)

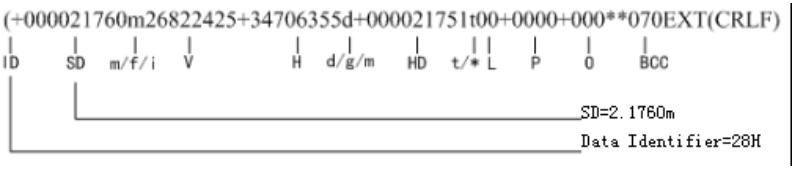


4) Coordinate (N/E/Z) Mode



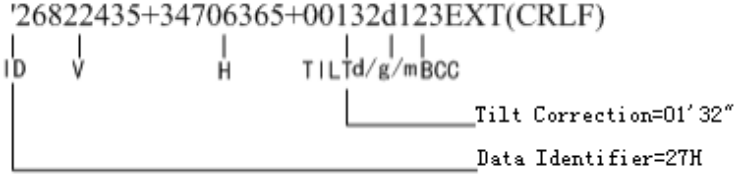
②Data Format when the distance output mode is 0.1mm.

1）Slanting Distance (SD)Mode

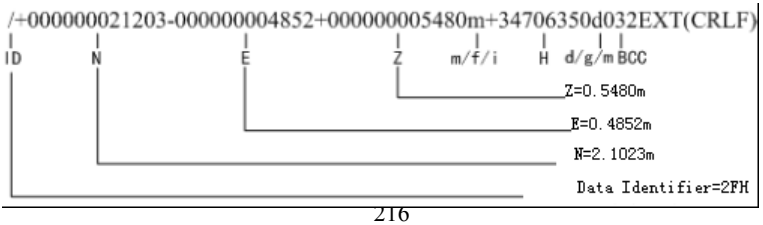


2）HD/VD Mode

3）Angle (H/V)Mode



4）Coordinate (N/E/Z) Mode



2. STEERING INSTRUCTION AND FORMAT

Class 1: Start measurement and send data to computer.

C 067 ETX CRLF

ASCII code: 43H 30H 36H 37H 03H 0DH 0AH

Class 2: Answer whether the receiving data is effective.

ACK 006 ETX CRLF.....Effective

ASCII code: 06H 30H 30H 36H 03H 0DH 0AH

NAK 021 ETX CRLF.....Invalid

ASCII code: 14H 30H 32H 31H 03H 0DH 0AH

Class 3: Change the measurement mode

Instruction	Mode
Z10 091 ETX CRLF	H/V Angle Measurement
ASCII code: 5AH 31H 30H 30H 39H 31H 03H 0DH 0AH	
Z12 089 ETX CRLF	HR Right Angle
ASCII code: 5AH 31H 32H 30H 39H 31H 03H 0DH 0AH	
Z13 088 ETX CRLF	HL Left Angle
ASCII code: 5AH 31H 33H 30H 39H 31H 03H 0DH 0AH	
Z32 091 ETX CRLF	SD Coarse measurement
ASCII code: 5AH 33H 32H 30H 39H 31H 03H 0DH 0AH	
Z34 093 ETX CRLF	SD Fine Measurement
ASCII code: 5AH 33H 34H 30H 39H 33H 03H 0DH 0AH	
Z35 092 ETX CRLF	SD Repeat Measurement
ASCII code: 5AH 33H 35H 30H 39H 32H 03H 0DH 0AH	
Z42 092 ETX CRLF	HD Coarse measurement
ASCII code: 5AH 34H 32H 30H 39H 32H 03H 0DH 0AH	
Z44 090 ETX CRLF	HD Fine Measurement
ASCII code: 5AH 34H 34H 30H 39H 30H 03H 0DH 0AH	
Z45 091 ETX CRLF	HD Repeat Measurement
ASCII code: 5AH 34H 35H 30H 39H 31H 03H 0DH 0AH	

Z62 094 ETX CRLF NEZ Coarse measurement

ASCII code: 5AH 36H 32H 30H 39H 34H 03H 0DH 0AH

Z64 088 ETX CRLF NEZ Fine Measurement

ASCII code: 5AH 36H 34H 30H 38H 38H 03H 0DH 0AH

Z65 089 ETX CRLF NEZ Repeat Measurement

ASCII code: 5AH 36H 35H 30H 38H 39H 03H 0DH 0AH

3. REAL-TIME COMMUNICATION PROCESS BETWEEN SOUTH TOTAL STATION AND COMPUTER

It is the response process communication signal between south total station and computer.

① Process of starting and receiving measurement data in the mode of single measurement and repeated measurement

1） PC sends Class 1 instruction to instrument(Command"C")

2）Instrument checks BBC of command "C", if the received instruction is

right, instrument will send admitting signal "ACK" to computer in 0.05s. Otherwise instrument will not send answering signal to computer.

3）If it doesn't receive the admitting signal "ACK" from instrument in 0.05s, computer must send command "C" again.

4）Step 3）can be repeated 10 times at most, and if it is more than 10 times ,computer will interrupt communication and display error information.

5）When instrumrnt receives the command "C", it starts to measure; then send data after measurement.

6)When it receives the data correctly and checks BBC, computer must send "ACK" to instrument in 0.3s. And communication finishes when instrument receives "ACK".

7）If there is communication error with the received data, computer can't send "ACK". Then, instrument will send the same data to computer again.

8）Step 7）can be repeated 10 times at most, and if it is more than 10 times ,computer will interrupt communication and display error information.

NTS series PC

<---- C 067 ETX

ACK 006 ETX --->

Measuring data

<--- ACK 006 ETX : communication is successful.

<--- C 067 ETX

(no answer) --->

<--- C 067 ETX

(no answer) --->

|

|

10 times at most : communication is unsuccessful.

Measuring data --->

<--- (no answer)

Measuring data --->

<--- (no answer)

|

|

10 times at most : communication is unsuccessful.

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② Communication Process of Changing Measurement Mode

1）Computer sends Class 5 instruction to instrument.

2）Instrument checks BBC of command "C", if the received instruction is right, instrument will send admitting signal "ACK" to computer in 0.05s. Otherwise instrument will not send answering signal to computer.

3）If it doesn't receive the admitting signal "ACK" from instrument in

0.05s, computer must send the same command again.

4）Step 3）can be repeated 10 times at most, and if it is more than 10 times, computer will interrupt communication and display error information.

NTS series PC

<---- Class 5

ACK 006 ETX ---> ： communication is successful.

<--- Class 5

(No answer) --->

<--- Class 5

(No answer) --->

|

|

10 times at most：communication is unsuccessful.

Attachment 1:

Note:

This attachment is only applicable to NTS360R series total station with laser plummet function. For the ordinary NTS360R series total station, this attachment is ignored.

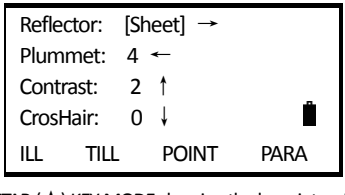
Functions of laser plummet:

SOUTH NTS360R series total station laser plummet applying laser centering method. The laser intensity is adjustable, with quick switch off feature.

Usage of laser plummet

In STAR (★) KEY MODE

Press ★, the screen will show:



The value of plummet in the STAR (★) KEY MODE showing the laser intensity level, 0 is the weakest, 4 is the strongest.

Note: When the laser intensity level is adjusted to 0, the laser plummet function is shut off.