

Preparation

In this chapter:

- Unpacking and Packing the Instrument
- Charging the Battery Pack
- Detaching and Re-Attaching the Battery Pack
- Setting Up the Tripod
- Centering
- Leveling
- Sighting
- Setting the Measurement Mode and Preparing the Target
- Measurement in Reflectorless mode
- Preparing the Reflector Sheet
- Setting Up the Prism Reflector

Unpacking and Packing the Instrument

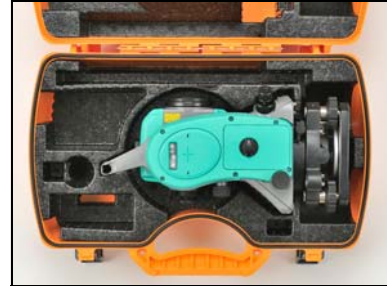
Note – Handle the Nivo series instrument gently to protect it from shocks and excessive vibration.

Unpacking

To unpack the instrument, grip the carrying handle and gently remove the instrument from the carrying case.

Packing

To pack the instrument back into the carrying case, please refer to the figure on the right.



Charging the Battery Pack

Before charging the battery pack, read the warnings (also listed in the Safety section at the front of this manual) and the following notes.



WARNING – Do not damage the rechargeable Lithium-ion battery. A damaged battery can cause an explosion or fire, and can result in personal injury and/or property damage.

To prevent injury or damage:

- Do not use or charge the battery if it appears to be damaged. Signs of damage include, but are not limited to, discoloration, warping, and leaking battery fluid.
 - Do not expose the battery to fire, high temperature, or direct sunlight.
 - Do not immerse the battery in water.
 - Do not use or store the battery inside a vehicle during hot weather.
 - Do not drop or puncture the battery.
 - Do not open the battery or short-circuit its contacts.
-



WARNING – Avoid contact with the rechargeable Lithium-ion battery if it appears to be leaking. Battery fluid is corrosive, and contact with it can result in personal injury and/or property damage.

To prevent injury or damage:

- If the battery leaks, avoid contact with the battery fluid.
 - If battery fluid gets into your eyes, immediately rinse your eyes with clean water and seek medical attention. Do not rub your eyes!
 - If battery fluid gets onto your skin or clothing, immediately use clean water to wash off the battery fluid.
-



WARNING – Charge and use the rechargeable Lithium-ion battery only in strict accordance with the instructions. Charging or using the battery in unauthorized equipment can cause an explosion or fire, and can result in personal injury and/or equipment damage.

To prevent injury or damage:

- Do not charge or use the battery if it appears to be damaged or leaking.
 - Charge the Lithium-ion battery only in a product that is specified to charge it. Be sure to follow all instructions that are provided with the battery charger.
 - Discontinue charging a battery that gives off extreme heat or a burning odor.
 - Use the battery only in equipment that is specified to use it.
 - Use the battery only for its intended use and according to the instructions in the product documentation.
-



WARNING – To charge the battery pack, use only the battery charger and AC adapter that are supplied with the instrument. Do NOT use any other charger or you may cause the battery pack to catch fire or rupture. The enclosed battery pack cannot be used with other chargers.



WARNING – Do not cover the battery charger and AC adapter while the battery pack is being recharged. The charger must be able to dissipate heat adequately. Coverings such as blankets or clothing can cause the charger to overheat.



WARNING – Avoid recharging the battery pack in humid or dusty places, in direct sunlight, or near heat sources. Do not recharge the battery pack when it is wet. If you do, you may receive electric shocks or burns, or the battery pack may overheat or catch fire.



WARNING – Although the battery pack has an auto-reset circuit breaker, you should take care not to short circuit the contacts. Short circuits can cause the battery pack to catch fire or burn you.



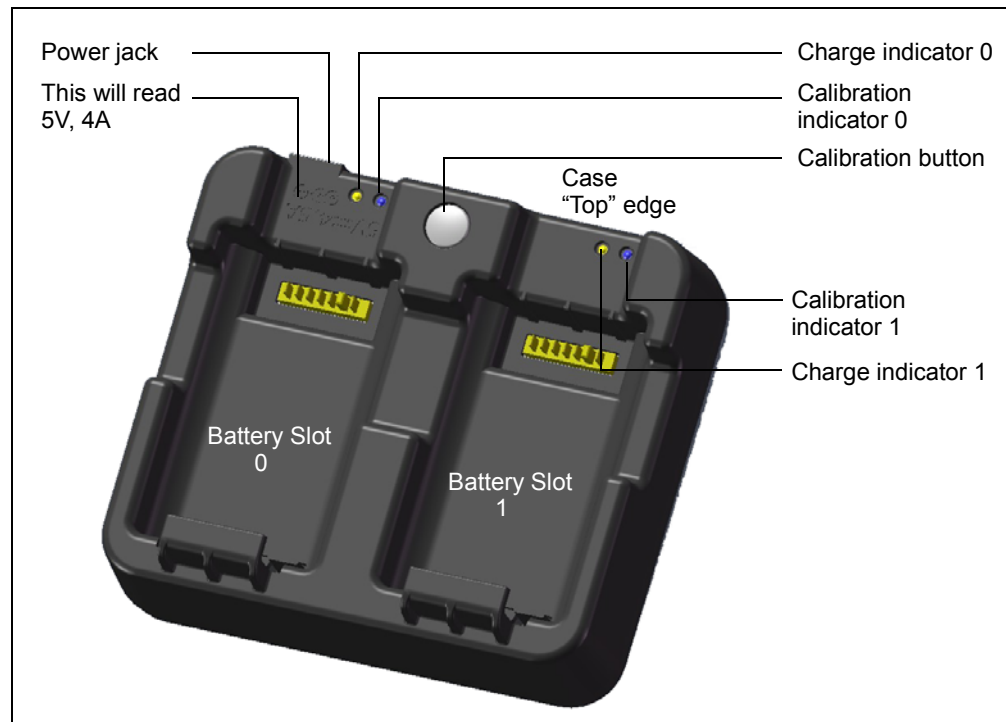
WARNING – Never burn or heat the battery. Doing so may cause the battery to leak or rupture. A leaking or ruptured battery can cause serious injury.



WARNING – Before storing the battery pack or battery charger, cover the contact points with insulation tape. If you do not cover the contact points, the battery pack or charger may short circuit, causing fire, burns, or damage to the instrument.



WARNING – The battery is not itself waterproof. Do not get the battery wet when it is removed from the instrument. If water seeps into the battery, it may cause a fire or burns.



Applying Power

- Plug in the charger to the supplied AC adapter to turn the unit on. The power input must be 5 V with at least 4 A of current capability. Each battery may take up to 2 A while charging.

Charging a battery

- Simply slide a battery into either battery slot to begin charging. The adjacent charge indicator will illuminate yellow when charging is in progress. The charge indicator will change to green when charging is complete.
- Charger slots are completely independent so a battery may be inserted regardless of the state of the other battery slot.
- Charging may take 2-4 hours if the battery was normally discharged.
- Charging may take up to 5 hours with a completely drained battery which has been stored for several months without use.

Conditioning / calibrating a battery

- Battery calibration is necessary about once every 6 months or more often if desired. Calibration insures the reported battery charge remaining is accurate.
- Hold down the calibration button on the unit and then insert a battery while holding the calibration button to begin a battery calibration. Only the battery which was inserted while the button was depressed will begin calibration. During a battery calibration the battery will be charged, discharged completely, and then recharged before finishing. Calibration should complete in roughly 17 hours and the charger vents should not be covered during a calibration cycle.
- The blue calibration indicator light(s) will blink slowly (on 1.5 sec, off 2 sec) while a calibration is in progress and the charge light(s) may be on or off during the calibration cycle.
- When a calibration cycle is completed, the calibration light will stop blinking remain on until the corresponding battery is removed.
- If the case temperature begins to get too warm while discharging a battery, the calibration light blink will blink on for 0.5 sec then off for 3 seconds and the battery load will be cut in half to prevent further overheating. Battery calibration will take longer to finish if this occurs. When the case temperature drops to a safer level battery discharging will return to normal.
- If the case temperature continues to get too hot internally, blinking will become more rapid and eventually the calibration will be aborted. If an abort occurs, the calibration light(s) will blink rapidly and battery charging will be re-enabled.

Detaching and Re-Attaching the Battery Pack

Detaching the battery pack

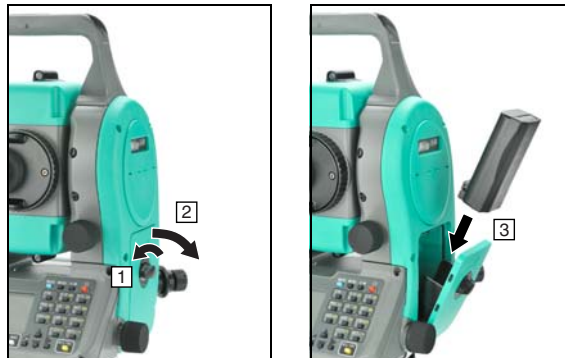


CAUTION – Avoid touching the contacts on the battery pack.

1. If the instrument is turned on, press **[PWR]** to turn it off.
2. Turn the battery box release knob counterclockwise, open the battery box cover and remove the battery pack from the battery box.

Inserting the battery pack

Before inserting the battery pack, clear any dust or other foreign particles from the battery contacts.



1. Turn the battery box release knob counterclockwise and open the battery box cover.
2. Put the battery pack into the battery box. Insert the battery pack with the connectors bottom first, facing inside.
3. Close the battery box cover and turn the knob clockwise until the secure click sound is heard.



CAUTION – If the battery box cover is not closed, this could adversely affect the watertightness of the instrument.

Setting Up the Tripod



CAUTION – The tops of the tripod ferrules are very sharp. When handling or carrying the tripod, take care to avoid injuring yourself on the ferrules.

1. Open the tripod legs enough to for the instrument to be stable.
2. Locate the tripod directly over the station point. To check the tripod's position, look through the center hole in the tripod head.
3. Firmly press the tripod ferrules into the ground.
4. Level the top surface of the tripod head.
5. Securely fasten the thumb screws on the tripod legs.
6. Place the instrument on the tripod head.
7. Insert the tripod mounting screw into the center hole of the base plate of the instrument.
8. Tighten the tripod mounting screw.

Note – Do not carry the instrument while it is attached to a tripod.


Centering

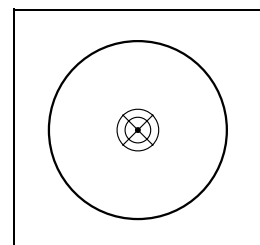
When you center the instrument, you align its central axis precisely over the station point. To center the instrument, you can either use the optical plummet or a plumb bob.

Centering using the optical plummet

Note – If you require high accuracy, check and adjust the optical plummet before you center the instrument. For detailed instructions, see [Checking and Adjusting the Optical/Laser Plummet, page 136](#).

To center the instrument using the optical plummet:

1. Set up the instrument on the tripod. For detailed instructions, see [Setting Up the Tripod, page 13](#).
2. While looking through the optical plummet, align the reticle with the station point. To do this, turn the leveling screws until the center mark  of the reticle is directly over the image of the station point.
3. While supporting the tripod head with one hand, loosen the tripod leg clamps and adjust the lengths of the legs until the air bubble is in the center of the circular level.
4. Tighten the tripod leg clamps.



5. Use the electronic level to level the instrument. For detailed instructions, see [Leveling, page 15](#).
6. Look through the optical plummet to check that the image of the station point is still in the center of the reticle mark.
7. If the station point is off center, do one of the following:
 - If the station point is slightly off center, loosen the tripod mounting screw and then center the instrument on the tripod. Use only direct movement to center the instrument. Do not rotate it.

When the instrument is centered, tighten the mounting screw.
 - If the displacement of the station point is major, repeat this procedure from Step 2.

Centering using the laser plummet

Note – Do NOT look into the laser directly.

Note – If you require high accuracy, check and adjust the laser plummet before you center the instrument. For detailed instructions, see [Checking and Adjusting the Optical/Laser Plummet, page 136](#).

1. Set up the instrument on the tripod. For detailed instructions, see [Setting Up the Tripod, page 13](#).
2. Turn on the laser plummet. See [Laser plummet ON/OFF, page 36](#).
3. Align the laser pointer to the station point. To do this, turn the leveling screws until the laser pointer is over the station point.
4. While supporting the tripod head with one hand, loosen the tripod leg clamps and adjust the lengths of the legs until the air bubble is the center of the circular level.
5. Tighten the tripod leg clamps.
6. Use the electronic level to level the instrument. For detailed instructions, see [Leveling, page 15](#).
7. Check the laser pointer is over the station point.
8. If the station point is off center, do one of the following:
 - If the station point is slightly off center, loosen the tripod mounting screw and then center the instrument on the tripod. Use only direct movement to center the instrument. Do not rotate it.
 - When the instrument is centered, tighten the mounting screw.
 - If the displacement of the station point is major, repeat this procedure from Step 2

Centering using a plumb bob

1. Set up the instrument on the tripod. For detailed instructions, see [Setting Up the Tripod, page 13](#).
2. Hang the plumb line on the hook of the tripod mounting screw.
3. Adjust the length of the plumb line so that the tip of the plumb bob is at the height of the station point.
4. Loosen the tripod mounting screw slightly.
5. Using both hands to support the outer side of the tribrach, carefully slide the instrument about on the tripod head until the tip of the plumb bob is positioned over the exact center of the station point.

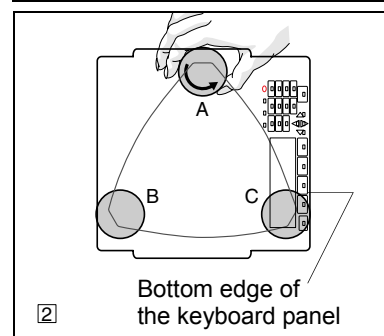
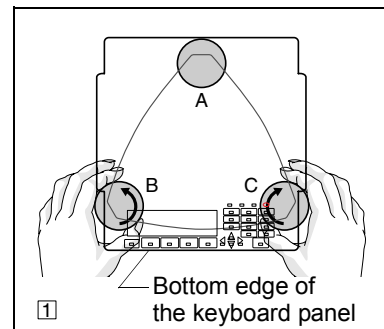
Note – To confirm that the instrument is precisely aligned, check its position from two directions at right angles to each other.

Leveling

When you level the instrument, you make the vertical axis of the instrument exactly vertical. To level the instrument, use the electronic level. In the leveling work, always set the instrument in face 1 direction (please refer to the Fig.1.1 in page 3).

To level the instrument:

1. Move the bubble into the circle drawn on the circular level and then turn on the power.
2. Rotate the alidade until the bottom edge of the keyboard panel is parallel to the two of the leveling screws (B and C).
3. Use leveling screws B and C to move the bubble into the center of the electronic level.
4. Rotate the alidade approximately 90°.
5. Use leveling screw A to move the bubble into the center of the electronic level.
6. Repeat Step 1 through Step 5 to center the bubble in both positions.
7. Rotate the alidade 180°.
8. If the bubble in the electronic level remains centered, the instrument is level. If the bubble moves off center, adjust the electronic level. For detailed instructions, see [Adjusting the Electronic Level, page 136](#).

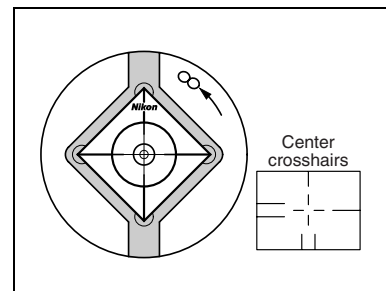


Sighting

When you sight the instrument, you aim the telescope at the target, bring the target image into focus, and align the image with the center crosshairs of the reticle.

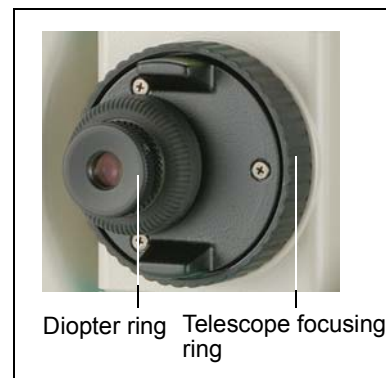
To sight the instrument:

1. Adjust the diopter:
 - a. Aim the telescope at a blank area, such as the sky or a piece of paper.



WARNING – Never look at the sun through the telescope. If you do, you may damage or lose your eyesight.

- b. Looking through the eyepiece, rotate the diopter ring until the reticle crosshairs are in sharp focus.
2. Eliminate parallax:
 - a. Aim the telescope at the target image.
 - b. Rotate the focusing ring until the target image is in sharp focus on the reticle crosshairs.
 - c. Move your eye vertically and laterally to check whether the target image moves relative to the reticle crosshairs.



If the target image does not move, there is no parallax.

- d. If the target image does move, rotate the telescope focusing ring. Then repeat from Step c.
3. Rotate the tangent screw:
 - The final turn of the tangent screw should be in a **clockwise** directions, to align the target accurately on the center crosshairs.

Setting the Measurement Mode and Preparing the Target

The Nivo series has two measurement modes: Prism mode (Prism) and Reflectorless mode (N-Prism). These modes can be changed at any time by holding down the **[MSR1]** or **[MSR2]** key for one second. For more information, see [Measurement settings, page 48](#).

To set the measurement mode depending on the target you want to measure, see the following table.

Target	Target setting
Prism, reflector sheet	Prism (Prism mode)
Other (reflective materials)	N-Prism (Reflectorless mode)

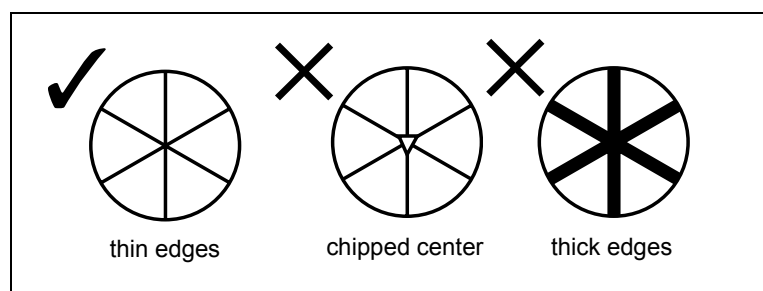
In some cases, you can measure another target that is not appropriate to the set measurement mode.

Note – The Nivo series is Laser Class 1 in the measurement function, and Laser Class 2 in the Laser pointer function.

Don't sight the Prism when the Laser Pointer is on.

Measurement with a prism

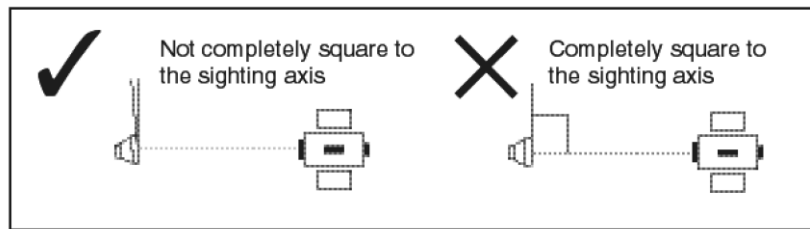
Do not use a prism with scratches, a dirty surface, or a chipped center. Prisms with thin edges are recommended.



As the Nivo series is extremely sensitive, multiple reflections on the prism surface can sometimes cause a significant loss in accuracy.

To maintain the accuracy of your measurements:

- When measuring a short distance, incline the prism slightly so that the EDM can ignore unnecessary reflections on the prism surface, as shown below.



Hold the prism securely in place and do not move while taking measurements.

In Prism mode, in order to avoid false measurements on objects other than the prism or reflector-sheet, targets that are less reflective than the prism or reflector sheet are not measured. Even if you start a measurement, measured values are not displayed. To measure less reflective objects, use the N-prism (reflectorless) mode

Measurement in Reflectorless mode

The intensity of the reflection from the target determines the distance the Nivo series can measure in this mode. The color and condition of the target surface also affect the measurable distance, even if the targeted objects are the same. Some less-reflective targets may not be measured.

The following table describes some examples of targets and approximate measurable distances.

Target	You can measure approximately...
Traffic signs, reflectors	500 meters (1640 feet)
Paper (white), veneer (new)	300 meters (990 feet)
wall (brightly painted), brick	100 to 200 meters (330 to 660 feet)

Measurable distances may be shorter or measurement intervals may be longer in the following cases:

- the angle of the laser against the target is small
- the surface of the target is wet

In direct sunlight, the measurable distance may be shorter. In this case, try to throw a shadow on the target.

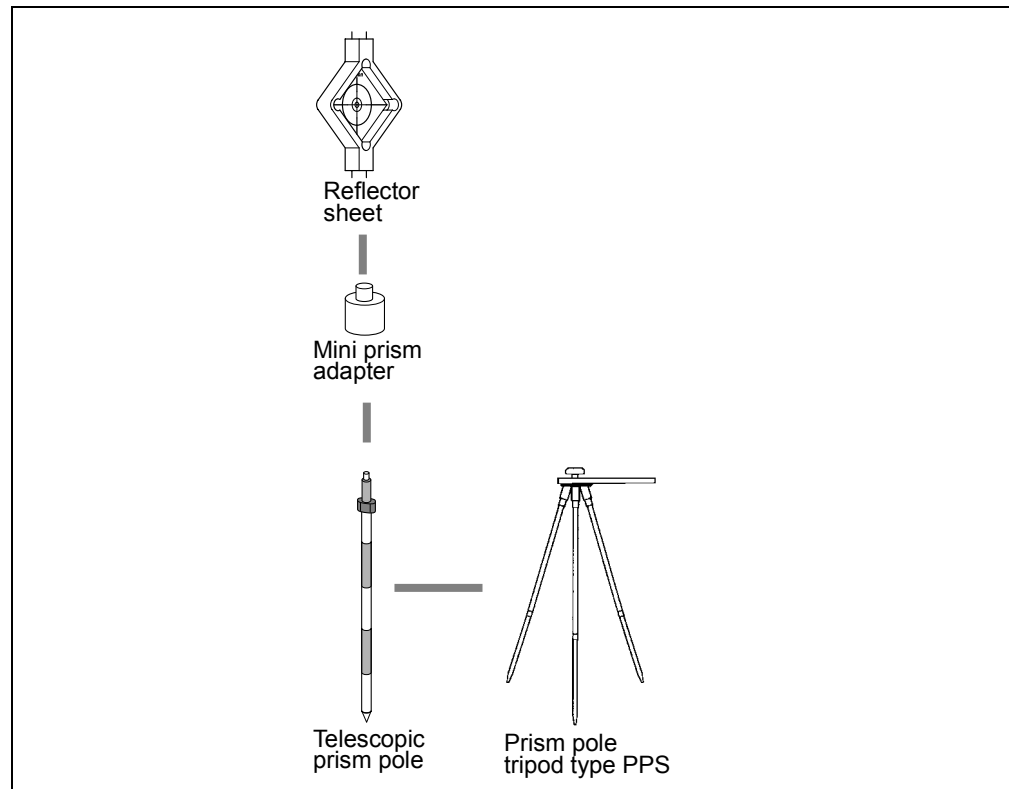
Targets with completely flat surfaces, such as mirrors, cannot be measured unless the beam and the target are perpendicular to each other.

Make sure there are no obstacles between the instrument and the target when taking measurements.

When you need to take measurements across a road or a place where vehicles or other objects are frequently moving, take several measurements to a target for the best result.

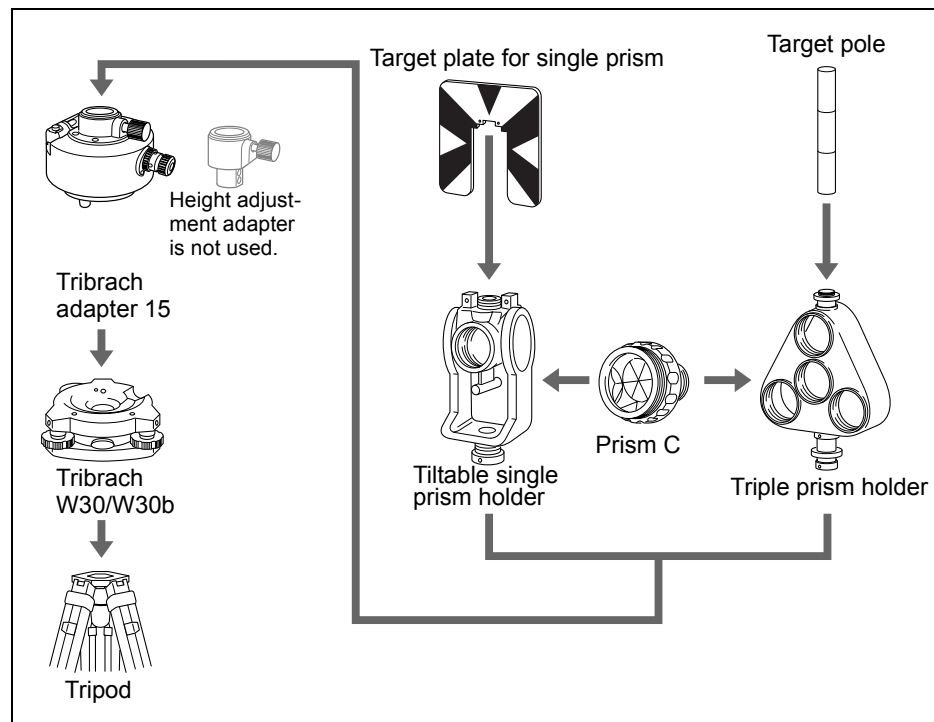
Preparing the Reflector Sheet

The reflector sheet can be used for measurements in Prism mode. Assemble the reflector sheet as shown below.



Setting Up the Prism Reflector

1. Assemble the prism reflector as shown below.



2. Adjust the height of the tribrach adaptor (see [page 21](#)).
3. If necessary, change the direction of the prism (see [page 21](#)).
4. Set the prism constant (see [page 21](#)).
5. If you are using a single prism holder, set the position of the target plate (see [page 22](#)).

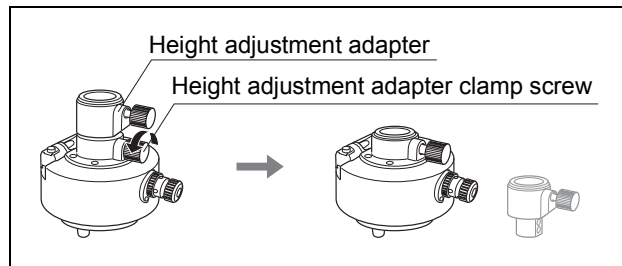
Detailed instructions for Step 2 through Step 5 are provided on the following pages.

Note – *Nivo series must be used with the Tribrach W30 or W30b.*

Adjusting the height of the tribrach adapter

The tribrach adapter has a height adjustment adapter. To use the prism reflector with a Nivo series instrument, remove the height adjustment adapter as shown in the Figure below.

The height adjustment adapter will be used with other Nikon Total Stations.

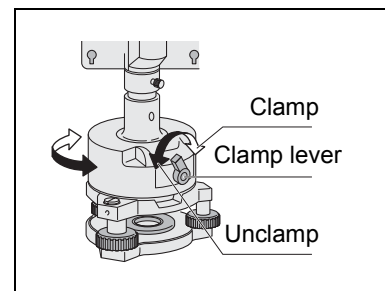


Changing the direction of the prism

The prism mounted on the tribrach adapter can be rotated to face in any direction.

To change the direction of the prism:

1. Release the rotation clamp. To do this, turn the clamp lever counterclockwise.
2. Turn the upper plate of the tribrach adapter until the prism is facing in the required direction.
3. Fasten the rotation clamp. To do this, turn the clamp lever clockwise.



Setting the prism constant

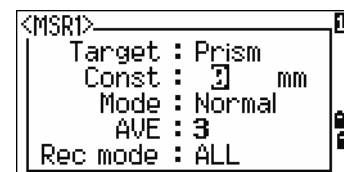
1. Attach the prism to the single prism holder or triple prism holder.



Tip – To use a triple prism holder as a single prism holder, attach the prism to the center thread of the prism holder.

2. Set the prism constant. To do this, hold down **[MSR1]** or **[MSR2]** for one second. For more information, see [Measurement settings, page 48](#).

Note – The prism constant of a Nikon prism is always 0, whether it is attached to a single prism holder or a triple prism holder.



If your prism constant is not 0 mm, then directly enter the prism constant value in the *Const* field. For example, if your prism constant is 30 mm, enter 30mm in the *Const* field on the instrument.



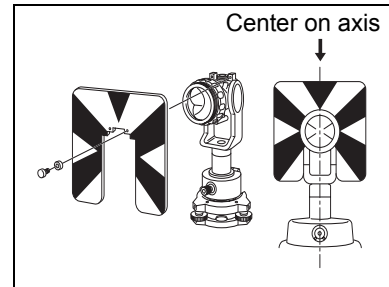
Tip – When you use the prism at a short distance, set the prism at a slight angle to the sighting axis, rather than completely square.

Setting the position of the target plate

If using a single prism, make sure that the target plate is aligned with the tribrach adapter and the prism.

To set the position of the target plate:

1. Use the two set screws supplied to attach the target plate to the single prism holder.
2. Move the target plate within the screw holes until the apex of the wedge pattern is aligned with the vertical axis of the prism and the tribrach adapter.



Getting Started

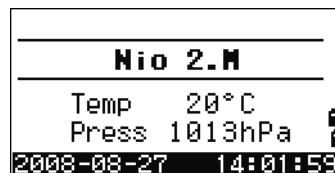
In this chapter:

- [Turning the Instrument On and Off](#)
- [Changing Regional Configuration Pre-sets](#)
- [Display and Key Functions](#)
- [List Display](#)
- [Inputting Data](#)
- [Jobs](#)
- [Measuring Distances](#)

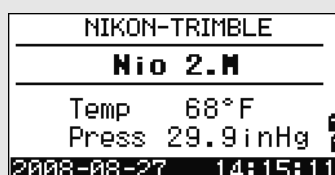
Turning the Instrument On and Off

Turning on the instrument

- To turn on the instrument, press **[PWR]**. The start-up screen appears. It shows the model name, current temperature, pressure, date, and time. The display automatically changes to the electronic level after 2 seconds.

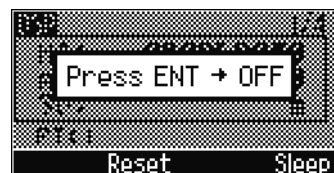


If you have entered your name or your company's name in the Owner's detail field, the text from this field appears on the start-up screen. To set the Owner's detail field, go to **MENU > Settings > Others**. For more information, see [page 113](#).



Turning off the instrument

To enter the power-off process, press **[PWR]** and **[ENT]**.



Then do one of the following:

Press ...	To ...
[ENT] again	turn off the instrument
the Reset softkey	reboot the program and re-start the instrument
the Sleep softkey	put the instrument into power-saving mode
[ESC]	cancel the power-off process and return to the previous screen

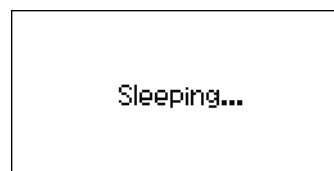
If you press the **Reset** softkey, the software is rebooted and the Basic Measurement Screen (BMS) appears without an open job.

Sleep mode

If you press the **Sleep** softkey in the Press **[ENT]** → OFF screen, or enable the Power Save setting (see [Power saving, page 110](#)), the instrument goes into sleep mode.

When the instrument is in sleep mode, it wakes up if any of the following occurs:

- You press a key
- The instrument receives a remote control command



- You rotate the alidade
- You tilt the telescope

Changing Regional Configuration Pre-sets

To provide easier configuration for common regional settings, you can quickly configure the Nikon total station to a pre-set combination of default regional settings. The Regional Configuration screen appears only after the language configuration is complete, the instrument has rebooted.

1. Follow the steps in [Language, page 113](#).

Once the instrument rebooted, the Regional Configuration screen appears.



2. Press **▲** or **▼** to highlight the required regional settings and then press **ENT**.
3. If you do not want to change the current settings, press **ESC** and quit. The instrument will continue to use the last configured settings that were configured.

The settings affected by the Regional Configuration screen are:

Category	Setting	Europe	International	United States
Angle	VA zero	Zenith	Zenith	Zenith
	Resolution	1"(See note)	1"(See note)	1"(See note)
Distance	HA	Azimuth	Azimuth	Azimuth
	Scale	1.000000	1.000000	1.000000
	T-P corr.	On	On	On
	Sea Level	Off	Off	Off
	C&R corr.	0.132	0.132	0.132
Coordinates	Order	ENZ	ENZ	NEZ
	Label	ENZ	ENZ	NEZ
Power Save	AZ zero	North	North	North
	Main Unit	Off	Off	Off
	EDM Unit	Off	Off	Off
Communication	Sleep	5 minutes	5 minutes	5 minutes
	Ext. Comm	Nikon	Nikon	Nikon
	Baud	4800	4800	4800
	Length	8	8	8
	Parity	None	None	None
Stakeout	Stop bit	1	1	1
	Add PT	1000	1000	1000
Units	Angle	GON	DEG	DEG
	Distance	meters	meters	US-ft

Category	Setting	Europe	International	United States
	Temp	°C	°C	°F
	Press	mm Hg	mm Hg	In Hg
Rec	Store DB	RAW&XYZ	RAW&XYZ	RAW&XYZ
	Data Rec	Internal	Internal	Internal
Others	XYZ disp	Fast	Fast	Fast
	2nd Unit	None	None	None
	Split ST	No	No	No
	CD Input	<ABC>	<ABC>	<ABC>
	Owner's Detail	Blank	Blank	Blank

The default regional configuration pre-set is “United States” settings. For more information, see [Settings, page 108](#).








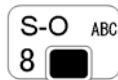




Display and Key Functions






The following figure shows the keys on the Nivo series instrument keyboard and the LCD display.



The functions of the Nivo keys are as follows.

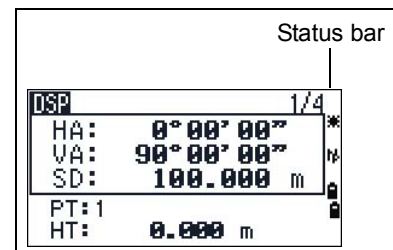
Key	Function	Details
	Turns the instrument on or off.	page 24
	(Illumination key) Provides access to the switch window.	page 30
	Turns on/off the LCD backlight if held down for one second. Displays the MENU screen.	page 91
	Changes the key input mode between alphanumeric and numeric if pressed when you are in a PT or CD field. Activates Qcode mode if pressed when you are in the Basic Measurement Screen (BMS).	page 32

Key	Function	Details
	Records measured data, moves on to the next screen, or confirms and accepts the entered data in input mode. You have the option to record the measurement as a CP record instead of an SS record, if you hold this key down for one second in the Basic Measurement Screen (BMS). The instrument outputs the current measurement data (PT, HA, VA, and SD) on the COM port if you press this key in the BMS or in a Stakeout observation screen. (The Data Rec settings must be set to COM.)	page 81
	Returns to the previous screen. In numeric or alphanumeric mode, deletes input.	
	Starts distance measurement, using the measure mode settings for the MSR1 key. Displays measurement mode settings, if held down for one second.	page 47
	Starts distance measurement, using the measure mode settings for the MSR2 key. Displays measurement mode settings, if held down for one second.	page 47
	Moves to the next available display screen. Changes the fields that appear on the DSP1, DSP2, and DSP3 screens, if held down for one second.	page 49
	Displays the Angle menu.	page 52
	Displays the Station Setup menu. In numeric mode, enters 7. In alphanumeric mode, enters 7.	page 53
	Displays the Stakeout menu. Shows stakeout settings, if held down for one second. In numeric mode, enters 8. In alphanumeric mode, enters A, B, C, or 8.	page 64
	Displays the Offset Point Measurement menu. In numeric mode, enters 9. In alphanumeric mode, enters D, E, F, or 9.	page 83
	Displays the Programs menu, which contains additional measuring programs. In numeric mode, enters 4. In alphanumeric mode, enters G, H, I, or 4.	page 71
	In numeric mode, enters 5. In alphanumeric mode, enters J, K, L, or 5.	
	Displays RAW, XYZ, or STN data, depending on your setting. In numeric mode, enters 6. In alphanumeric mode, enters M, N, O, or 6.	page 38

Key	Function	Details
	Executes the function that is assigned to the [USR1] key. In numeric mode, enters 1. In alphanumeric mode, enters P, Q, R, S, or 1.	page 37
	Executes the function that is assigned to the [USR2] key. In numeric mode, enters 2. In alphanumeric mode, enters T, U, V, or 2.	
	Opens a window where you can enter a code. The default code value is the last code entered. In numeric mode, enters 3. In alphanumeric mode, enters W, X, Y, Z, or 3.	page 33
	Displays the (HOT) menu, which includes Height of Target, Temp-Press, Target, Note recording, and Default PT settings. In numeric mode, enters – (minus). In alphanumeric mode, enters . (period), – (minus), or + (plus).	page 34
	Displays the Bubble indicator. In numeric mode, enters 0. In alphanumeric mode, enters *, /, =, (a space), or 0.	page 36



Status bar

The status bar appears on the right side of every screen. It contains icons that indicate the status of various system functions.




Input mode indicator

The Input mode indicator only appears when you are entering points or coordinates. It shows the data input mode:

-  Input mode is numeric. Press a key on the number pad to enter the number printed on the key.
-  Input mode is alphabetic. Press a key on the number pad to enter the first letter printed beside the key. Press the key repeatedly to cycle through all the letters assigned to that key.
For example, to enter the letter O in alphabetic mode, press **[5]** three times.

Laser pointer indicator


The icon appears while turning on the laser pointer. When the icon is displayed on the screen, the emitting power is laser class 2.

-  Laser pointer ON.
- (None) Laser pointer OFF.

EDM measurement status


When you are taking measurements, the EDM measurement status shows the mode that is being used.

When you display observation data, the EDM measurement status shows the mode that was used when the data was collected.

 Reflectorless mode



Communication port status

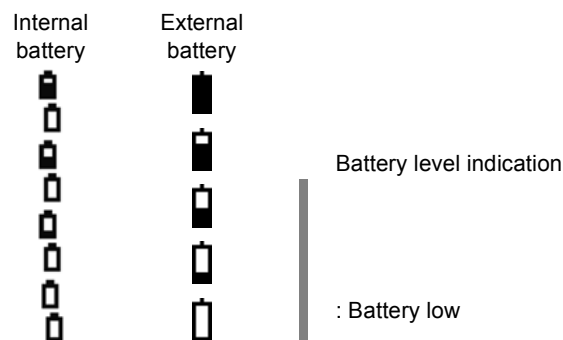
(This is only available when the optional Bluetooth is installed. See [Optional Bluetooth function, page 129](#).)

 Bluetooth enabled

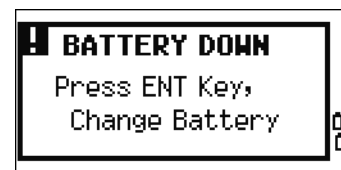
Battery indicator

Shows each voltage level of the right and left internal batteries individually. When the external battery is connected with the instrument, its voltage is shown.

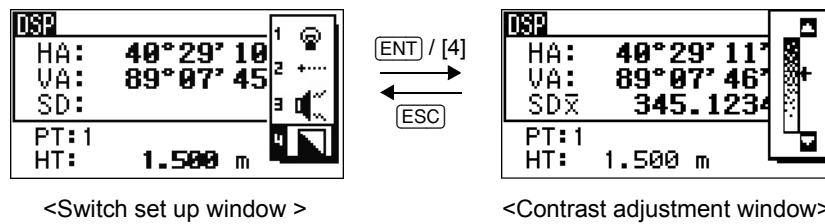
 Internal batteries (above: Left battery, below: Right battery)
 External battery



If the battery level becomes critically low, the message on the right appears:



LCD backlight, Laser pointer, Beep sound and Contrast adjustment




To turn on/off the 1. LCD backlight, 2. laser pointer or 3. beep sound, and to do the 4. contrast adjustment, press the illumination key and open the switch set up window shown above.


Holding down the illumination key for one second also turns on/off the LCD backlight.

- To turn on/off each function, press **[ENT]** when the option 1, 2, 3 or 4 is selected or directly press **[1]**, **[2]**, **[3]** or **[4]** numeric key.
- Press **[↑]** or **[↓]** to move the cursor up and down.
- In the contrast adjustment window, use **[↑]** or **[↓]** to adjust the contrast.


To close the window, press **[ESC]**.


1. LCD backlight

 LCD backlight is OFF


 LCD backlight is ON


2. Laser pointer

 Laser pointer is OFF

 Laser pointer is ON

3. Sound

 Sound is OFF

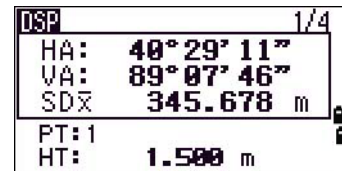
 Sound is ON

DSP key

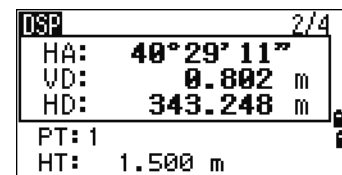
Use the key to change the current display screen or to change display settings.

Switching between display screens

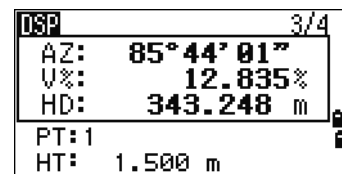
When several display screens are available, the DSP indicator appears at the top left of the screen, and the screen indicator (for example, 1/4) appears at the top right.



To move to the next available screen, press **DSP**.

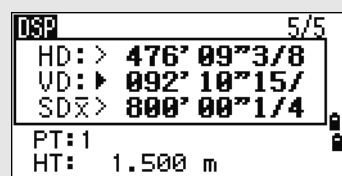


For example, if the DSP2 screen is currently displayed, press **DSP** to move to the DSP3 screen. The screen indicator changes from 2/4 to 3/4.



When the secondary distance unit is set, an additional screen is available. It shows the HD, VD, and SD values. For information on setting the secondary distance unit, see [page 112](#).

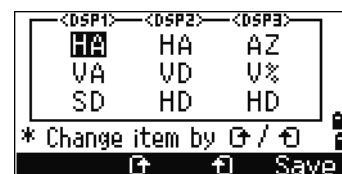
The smallest unit of display for distances measured in feet-and-inches is 1/16 in. Smaller units are impractical in the field. When the actual value is greater than 9999'11"15/16, the ">" symbol is shown. If the actual distance is less than -9999'11"15/16, the "▶" (solid triangle) symbol is shown. This does not affect calculations. The precise value is used internally in all cases.

**Customizing items in the Basic Measurement Screen (BMS)**

To customize the items that are displayed on the DSP1, DSP2, and DSP3 screens:

1. Hold down **DSP** for one second.
2. Use the arrow keys **↑**, **↓**, **←**, and **→** to highlight the item that you want to change.
3. Use the **↵** and **↶** softkeys to scroll through the list of items that can be displayed for this item.

The items that you can choose from are HA, AZ, HL, VA, V%, SD, VD, HD, Z, and (none).



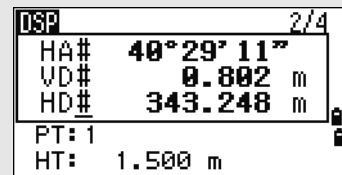
4. To save your changes, press the **Save** softkey. Alternatively, highlight the last item for DSP3 and press **ENT**. The DSP screens show the items you have selected.

Except for the (none) item, you cannot display the same item on more than one line of the same screen. The items displayed in the DSP1, DSP2, DSP3, and DSP4 screens are also used in the corresponding Stakeout screens (SO2, SO3, SO4, and SO5). You can also customize the displayed items in Stakeout.

Header characters

The following header characters can be used in DSP screens:

- A colon (:) indicates that tilt correction is applied to the value.
- A hash symbol (#) indicates that tilt correction is off.
- An underscore () under the tilt correction character indicates that Sea Level Correction or Scale factor is applied.

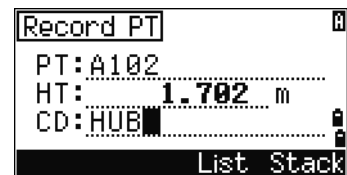


MODE key

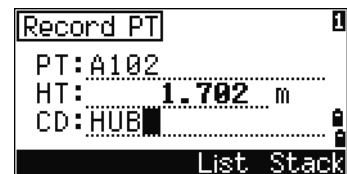
Use the **MODE** key to change the keyboard mode for the current screen.

Changing input mode while entering points or codes

When the cursor is in a point (PT) or code (CD) field, press **MODE** to change the input mode between alphanumeric (A) and numeric (1).



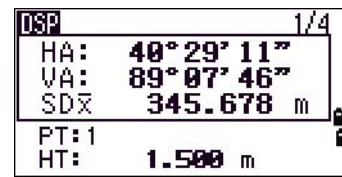
The input mode indicator in the status bar changes to show the current input mode.



When the cursor is in a height (HT) field, only numeric input mode is available. Pressing **MODE** has no effect when the cursor is in a HT field.

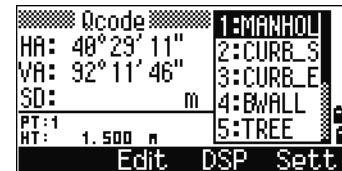
Quick code measurement mode

1. To activate Quick code measurement mode, press **[MODE]** in the BMS.



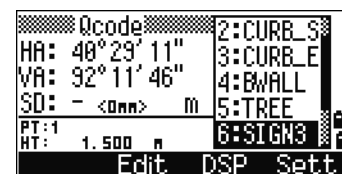
The PT field shows the default point name.

2. Press any numeric key (**[0]** through **[9]**) to start measuring and recording points.



A list of the numeric keys and their assigned feature codes appears on the right side of the screen.

For example, when you press **[6]**, the code assigned to 6 is selected, and the instrument starts a measurement.



3. If you have set the record mode to Confirm (see [Measurement settings, page 48](#)), the Record PT screen appears after each measurement.



Do one of the following:

- To record the point, press **[ENT]**.
- To return to the BMS, press **[ESC]**.

To assign a new feature code to a numeric key, press **[^]** or **[v]** to highlight the code that you want to change. Then press the **Edit** softkey.

You can use the **DSP** softkey to change the values shown in the measurement box, in the same way as you use the **[DSP]** key in the Basic Measurement Screen (BMS).

4. To return to the BMS from the Qcode screen, press **[MODE]** or **[ESC]**.

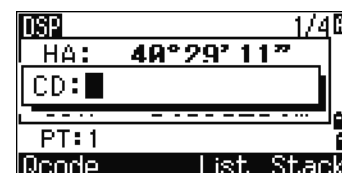
[COD] key

In the BMS, press **[COD]** to change the default feature code that will appear in the CD field when you record a point.

Setting the default code

When you press **[COD]** in the BMS, a window for entering the feature code appears.

You can use the **List** and **Stack** softkeys to enter the code.

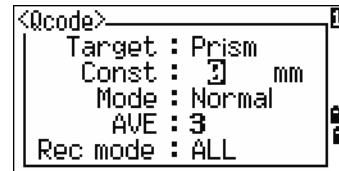
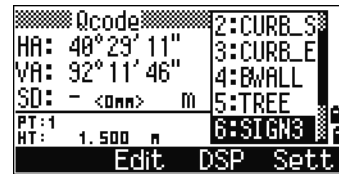


Qcode observations

To enter the Quick code observation routine, press the **Qcode** softkey.

In this function, you can use the ten numeric keys to both select a feature code and shoot a point.

To change the measurement mode for the Quick code observation, press the **Sett** softkey.



In Quick code measurement, the Rec mode can only be set to Confirm or ALL.

HOT key

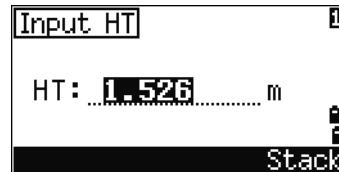
The HOT key menu is available on any observation screen. To display the HOT key menu, press **HOT**.



Changing the height of the target

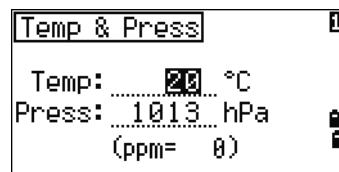
To change the height of the target, press **HOT** to display the HOT menu. Then either press **1** or select HT and press **ENT**.

Enter the height of the target, or press the **Stack** softkey to display the HT stack. The HT stack stores the last 20 HT values entered.



Setting the temperature and pressure

To set the current temperature and pressure, press **HOT** to display the HOT menu. Then either press **2** or select **Temp-Press** and press **ENT**. Enter the ambient temperature and pressure. The ppm value is updated automatically.



Selecting the target set

A target set specifies settings for the target type, the prism constant, and height of target. When you change the selected target set, all three settings are changed. You can use this function to quickly switch between two types of target, such as a reflector sheet and a prism. You can prepare up to five target sets.

1. Prism	0	-
2. N-Pri	0	-
3. Prism	30	4.208
4. Prism	-18	1.250
5. N-Pri	0	1.010
Edit		Set

Press **[HOT]** to display the HOT menu. Then either press **[3]**, or select **Target** and press **[ENT]**. A list of the five target sets appears. To select a target set, either press the corresponding numeric key (**[1]** through **[5]**), or use **[^]** or **[v]** to highlight the target set in the list and press **[ENT]**.

To change the settings defined in a target set, highlight the target set in the list. Then press the **Edit** softkey.

Type	Prism/N-Prism
Const	-999 to 999 mm
HT	-9.990 to 99.990 m

<TGT1>

Type: Prism

Const: 0 mm

HT:m

HT can be left blank in the target set. If you leave it blank, the current HT value is always applied to the measurement.

When a target set is selected, the Type and Const values are copied to both **[MSR1]** and **[MSR2]** settings, and to the measurements in Qcode. If you have specified a value for HT, this value is also copied to the current HT.

Entering a field note

To enter a field note, press **[HOT]** to display the HOT menu. Then either press **[4]**, or select **Note** and press **[ENT]**.

This function can be used at any time on any observation screen.

Each note can be up to 50 characters.

The note is stored as a CO record in the raw data.

To display a list of previously used notes, press the **Stack** softkey. The stack stores the last 20 notes.

Use **[^]** or **[v]** to highlight a note in the list. Then press **[ENT]** to select the note.

Input Note

FINISHED.....

Stack

Input Note

FINISHED.....

Stack

IN TOLERANCE

OUT OF TOLERANCE

GO NEXT SITE

CONTINUE TOMORROW

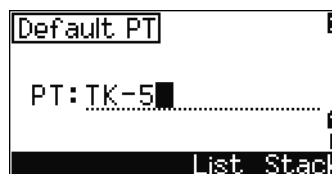
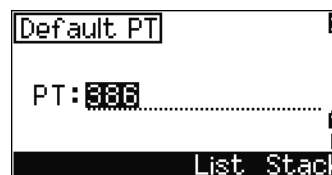
Setting the default point name

To change the default point name, press **[HOT]** to display the HOT menu. Then press **[5]**, or select **Default PT** and press **[ENT]**.

This function is available from any observation screen.

Modify the default point name for the next record.

Press **[ENT]** to confirm the new default point name. The new point name is appears as the default PT name on the input screen.

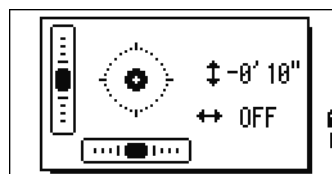


Bubble indicator

The bubble indicator is automatically displayed if the instrument goes out of level while the compensators are turned on, and also appears after the start up screen.

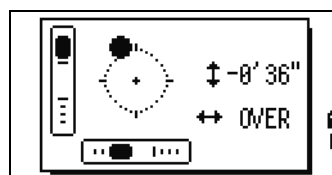
To display the bubble indicator in an observation screen, press **[Envelope]**.

The Nivo series has two-axis level compensation. To turn the leveling compensators on or off, press **[<]** or **[>]**. When the leveling compensators are turned off, the text **OFF** appears on the screen.



If the instrument is more than $\pm 3'30''$ out of level, the text **OVER** appears on the screen.

To return to the observation screen, press **[ESC]** or **[ENT]**.

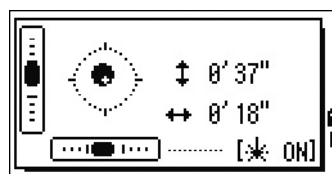


Laser plummet

Laser plummet ON/OFF

Press **[* ON]** to enable the laser plummet.

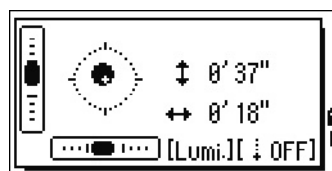
Press **[ESC]** to close the bubble indicator window.



Press **[↓ OFF]** to disable the laser plummet.

Press **[Lumi.]** to open the luminance adjustment window.

Press **[ESC]** to disable the laser plummet and close the bubble indicator window.



(Laser plummet is on.)

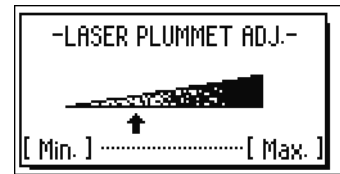
Laser luminance adjustment

Laser luminance can be set to 4 levels.

Press [Max.] to increase the luminance of the laser plummet.

Press [Min.] to decrease the luminance of the laser plummet.

Press **[ESC]** / **[ENT]** to return to the bubble indicator window.



The current setting of leveling compensators is indicated by header characters (:, #, ., and #) after field labels (such as HA, VA, SD, and HD) in observation screens. For more information, see [Header characters, page 32](#).

[USR] keys

If you use a function frequently in the field, you can assign it to the **[USR1]** or **[USR2]** key. Whenever you press a **[USR]** key, the function that is assigned to that key is activated directly.

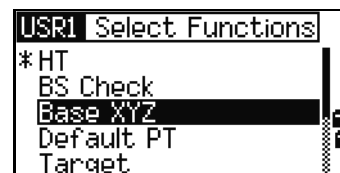
The following functions can be assigned to the **[USR]** keys:

- Input HT
- BS Check
- Base XYZ
- Default PT
- Select Target
- Input Temp-Press
- Input Note
- The following menus, or a single function from one of these menus:
 - Cogo
 - O/S
 - PRG

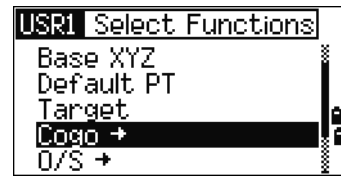
By default, Input HT is assigned to **[USR1]**, and no function is assigned to **[USR2]**.

Hold down the **[USR]** key for one second to display the list of functions that can be assigned to the key. The currently assigned function is indicated by an asterisk (*) beside the function name.

To change the function that assigned to the key, press **[▲]** or **[▼]** to highlight the function. Then press **[ENT]**.



If an item on the list has an arrow (→) beside it, this item is a menu. If you highlight a menu item and then press **[ENT]**, a sub-menu appears.

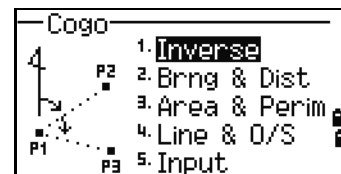
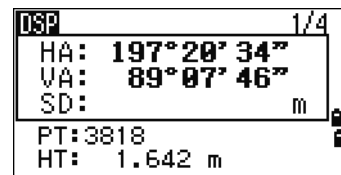


The first item on the sub-menu ends with the text **[MENU]**. If you select this item, the whole menu is assigned to the **[USR]** key.



To assign a specific function from the sub-menu, press **[^]** or **[v]** to highlight the function. Then press **[ENT]**.

Once you have assigned a function to a **[USR]** key, it is called directly whenever you press that **[USR]** key in the BMS.



To change the type of data that is assigned to the **[USR]** keys in **MENU > 1sec-Keys > [USR]**. For more information, see [\[USR\] key settings](#), page 132.



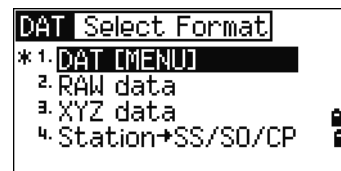
[DAT] key

Use the **[DAT]** key to quickly access data in the current job from observation screens.

When you press **[DAT]** in the BMS or in observation screens in functions such as Stakeout, 2Pt RefLine, and Arc RefLine, the assigned data in the current job appears.



Hold down **[DAT]** for one second in the BMS or an observation screen to display the Select Format screen. Use this screen to change the type of data that is assigned to **[DAT]**. Press **[T]** or select **DAT [MENU]** to display the Data menu whenever you press **[DAT]**.

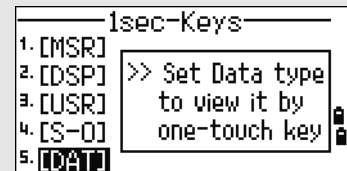


When you select an option from this screen, the change is applied immediately, and the selected data type appears.

Press **[ESC]** to return to the previous observation screen.



To change the type of data that is assigned to **[DAT]**, go to **MENU > 1sec-Keys > [DAT]**. For more information, see [\[DAT\] key settings](#), page 133.




List Display


Available jobs or data appear in a list display when you do any of the following:

- view or edit data (**MENU > Data**)
- open the code list, point list, or Job Manager (**MENU > Job**)
- search for points or codes

In the list, the current cursor position is shown in reverse video (it appears as white text on a black background).

Press **[^]** or **[v]** move the cursor one line up or down.

If the Page Up icon  appears, there are more pages before the current page. Press **[<]** to move up one page.

If the Page Down icon  appears, there are more pages after the current page. Press **[>]** to move down one page.

To select an item from the list, move the cursor onto the item and press **[ENT]**.



Inputting Data

Entering a point name or number

You can use numeric or alphanumeric names up to 16 characters long to identify points.

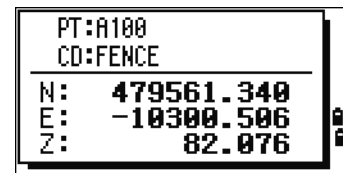
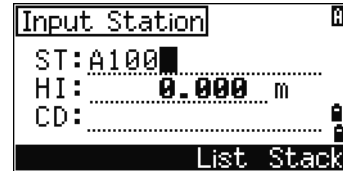
The default name for a new point is the last point name entered, with the last digit incremented. For example, if the last point name was A100, the default name for the next point is A101.

If the last character of the previous point name is alphabetic, the default point name is the last point name.

When the cursor is in a PT (point) field, there are several ways to specify a point, or input coordinates.

Entering an existing point

When you enter a known point name or number, the coordinates of that point are displayed briefly. A short beep sounds before the next screen appears or the next field is selected.

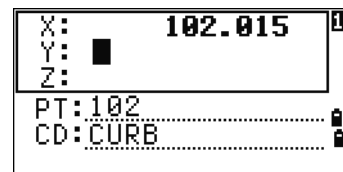


To adjust the duration of the coordinate window display, go to MENU > Settings > Others. To leave the window open until you press **ENT**, set the XYZ disp field to +ENT. For more information, see [page 112](#).

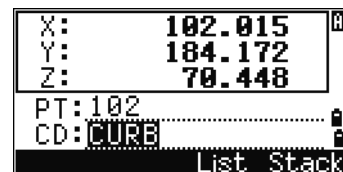


Entering a new point

When you input a new point name or number, a coordinate input screen appears. Enter the point's coordinates in NE, NEZ, or elevation-only (Z) format.

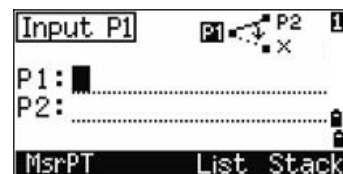


Press **ENT** on the last line (the CD field) to store the point in the current job.



Pressing **ENT** without a point name

To use a point without recording the coordinates, press **ENT** in a PT field, without entering a point name.

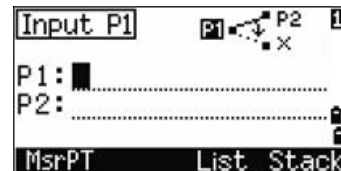


The input coordinates are used in the calculation. They are not saved in the database.

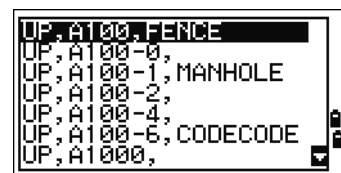


Specifying a wildcard (*)

If you include an asterisk (*) when you enter a point or code name, a list of points that match the entered text appears.

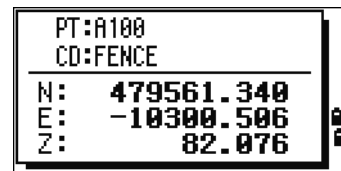


Use \uparrow or \downarrow to move the cursor to the point that you want to use. Then press ENT .



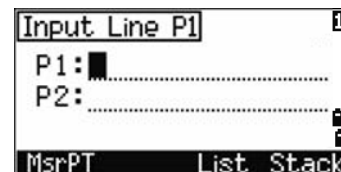
If the Page Up \uparrow or Page Down \downarrow icons are displayed, use \leftarrow or \rightarrow to page up or page down the list.

When you select a point from the list, its coordinates are displayed and a beep sounds.



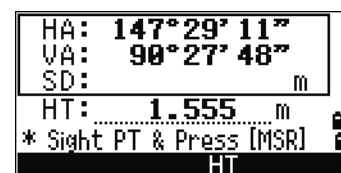
Recording an instant measurement

You can also input a point by recording an instant measurement. To do this, press the MSR softkey.



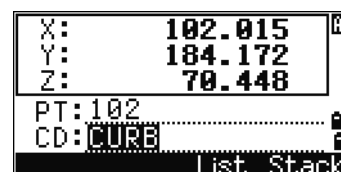
An observing screen appears.

Press MSR1 or MSR2 to start a measurement. To change the height of the target, press the HT softkey.

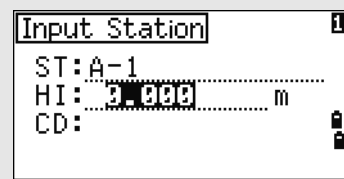


To go to the point recording screen when you have finished the measurement, press ENT .

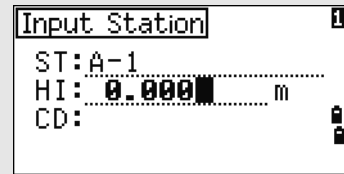
Enter the point or code name. Press ENT .



When you move the cursor to a field, the current or default value appears in inverted text (this is the default “Replace All” input mode).

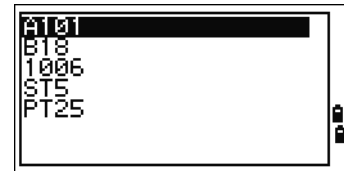


Press \rightarrow to change the input mode to Overwrite mode and highlight the first character. Press \leftarrow to move the cursor the end of the string.



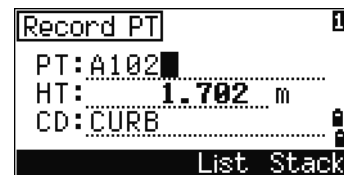
Entering a point from the stack

The point stack is a list of recently used points. To display the stack, press the **Stack** softkey when the cursor is in the PT field.



Use \uparrow or \downarrow to move the cursor to the point that you want to use. Then press **ENT**.

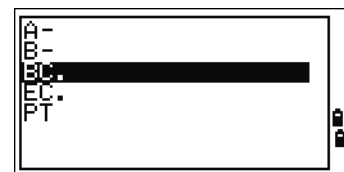
When you return to the point input screen, the selected point name is entered in the PT field, incremented by one. For example, if you selected the A101 point, A102 appears in the PT field.



The stack shows the last 20 point names used, in chronological order from last used to first used.

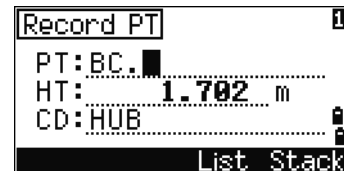
Entering a point from the point list

To display a list of existing points, press the **List** softkey when the cursor is in the PT field.



Use \uparrow or \downarrow to move the cursor to the point that you want to use. Then press **ENT**.

When you return to the point input screen, the selected point name is entered in the PT field. You can add digits or alphabetic characters if required.



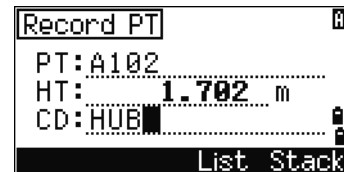
Entering a code

The CD (Code) field always defaults to the last code used. You can change the selected code on the input point screen, or you can press **[COD]** in the BMS. For more information, see [\[COD\] key, page 33](#).

You can use numeric or alphanumeric names up to 16 characters long to identify codes.

Entering a code directly

To enter a code directly, press **[MODE]** to change the input mode to alphanumeric or numeric mode. Then use the keypad to enter the code.



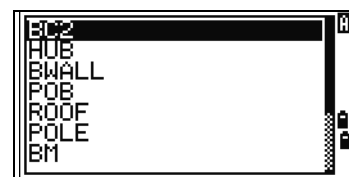
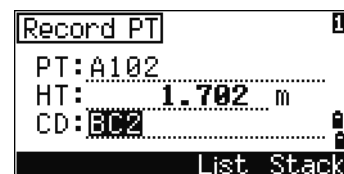
Entering a code from the stack

The code stack is a list of recently used codes. The stack may contain up to 20 codes.

To display the stack, press the **Stack** softkey when the cursor is in the CD field.

Use **[^]** or **[v]** to move the cursor to the code that you want to use. Then press **[ENT]**.

The selected code is copied to the CD field.



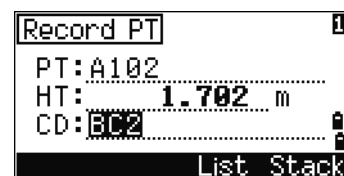
When the instrument is rebooted, the code stack is cleared.

Entering a code from the code list

To display a list of existing codes, press the **List** softkey when the cursor is in the CD field.

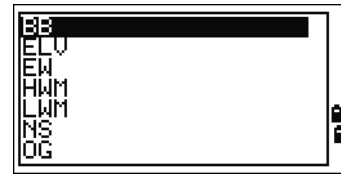
To edit the code list, go to **MENU > Data > Code List**. For more information, see [Editing an item in the point list or code list, page 126](#).

Use **[^]** or **[v]** to highlight the feature code that you want to use. Then press **[ENT]**.



A layer has an arrow at the end of the code label. If you highlight a layer in the list and then press **ENT**, the codes and layers in that layer are displayed.

When you return to the input screen, the selected code is entered in the CD field.



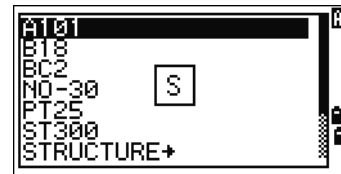
Items are shown in alphabetic order.

You can also use the first character search to quickly find a code. For more information, see [Advanced feature: Searching for a code by using the first character, page 44](#).

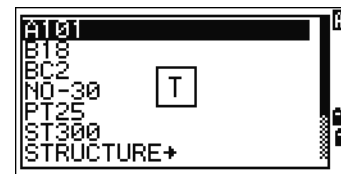
Advanced feature: Searching for a code by using the first character

To find a code quickly when the code list appears, use the first-character search.

For example, to see feature codes that begin with T, use the keypad to enter the letter T. To do this, press **T** twice.

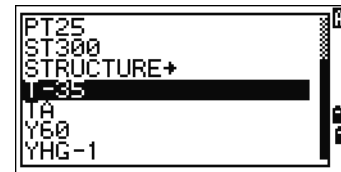


After each press of the key, the input mode field displays the selected letter. For example, if you press **T**, **S** appears. If you quickly press **T** again, **T** appears. If you do not press the **T** key again, the letter T is selected.



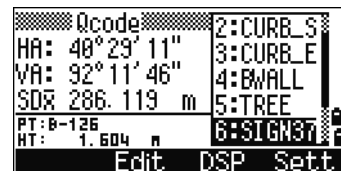
Once you have selected a letter, the cursor moves to the feature code beginning with that letter.

If there is no code beginning with that letter, the cursor moves to the next available letter.



Qcodes

Quick codes (Qcodes) let you shoot and record many points with feature codes in the field. You can register up to ten Quick codes. To register Qcodes, press the **Edit** softkey. For more information, see [Quick code measurement mode, page 33](#).



Press **MODE** to switch Qcodes on or off.

Press the **Edit** softkey to change the Qcode. You can edit the entire code, or just the number at the end of the code.

You can still use **DSP** to change the background displays.

Entering values in feet and inches

When either US Survey Feet (US-Ft) or International Feet (I-Ft) is selected as the distance unit, you can enter and display distances, HIs, HTs, and coordinate values either in decimal feet, or in feet and inches. For more information, see [Unit](#), page 111, and [Others settings](#), page 112.

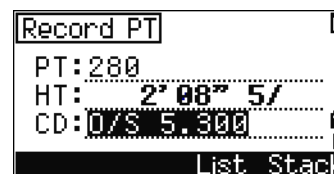
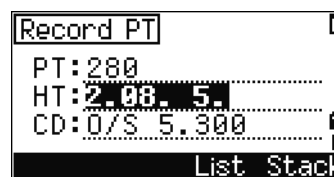
To enter values in feet and inches in an input screen, enter the elements, separated by periods (.), in the following format:

<Feet> [] <Inches> [] <Numerator> [] <Denominator> [] [ENT]
 (0–11) (0–15) (0–99)

The default denominator is 16. If the denominator is 16, you do not have to enter it, and it is not displayed on the screen.

For example, if you enter

[2][0][8].[5][] [ENT], it appears as 2' 08" 5/ (2 feet, 8 and 5/16ths inches).



The following examples show how various values are entered:

To enter ...	Type ...
65' 5 3/8"	[6][5][.][5][.][3][.][8] [ENT]
65'	[6][5] [ENT]
65' 5"	[6][5][.][5] [ENT]
65' 5 3/8"	[6][5][.][5][.][6] [ENT]
5 3/8"	[0][.][5][.][3][.][8] [ENT] or [0][.][5][.][6] [ENT]

The numerator and denominator that you enter are automatically converted to the closest value from the following list: 0, 1/8, 1/4, 3/8, 1/2, 5/8, 3/4, 7/8, 1/16, 3/16, 5/16, 7/16, 9/16, 11/16, 13/16, 15/16. If the denominator is 16, it is not shown on the screen.

Jobs

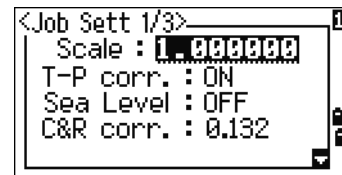
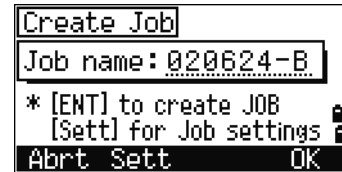
To record data on the instrument, you must create or open a job.



Tip – Before you use the instrument for the first time, check the job settings.

Creating a new job

1. Press **[MENU]** to open the MENU screen.
2. Press **[1]** to open the Job Manager.
3. Press the **Cre at** softkey to open the Create Job screen.
4. Enter the job name.
5. Press the **Set t** softkey to check the job settings. You cannot change a job's settings once you have created the job.
6. Press **[ENT]** in the last field of the Job Sett screen to create the new job.



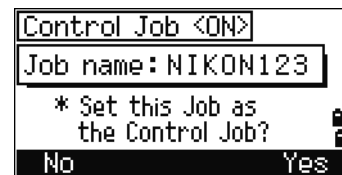
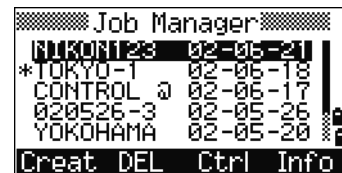
If either of the messages MAX 32JOBS or Data Full appears, delete at least one existing job to free space. You cannot free space by deleting records in an existing job.

Creating a control job

A control job, or common file, stores coordinate data that is used by several field jobs. You can create a control job in the office.

1. Press **[MENU]** to open the MENU screen.
2. Press **[1]** or select **J ob** to open the Job Manager.
3. Move the cursor to the job that you want to use as the control job.
4. Press the **Ctrl** softkey.
5. Press the **Yes** softkey.

For more information, see [Creating a control job](#), page 46.



When you enter a point name or number, the system searches in the current job first. If the point is not found in the current job, the search is automatically extended to the control job. If the point is found in the control job, the selected point is copied to the current job as a UP record.

Measuring Distances

Sighting a prism reflector



WARNING – Never look at the sun through the telescope. If you do, you may damage or lose your eyesight.



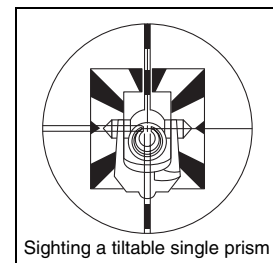
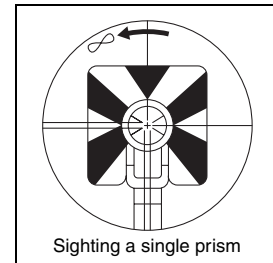
WARNING – Precautions should be taken to ensure that persons do not look directly, with or without an optical instrument, into the beam.



WARNING – Laser beam path should be located well above or below eye level wherever practicable.

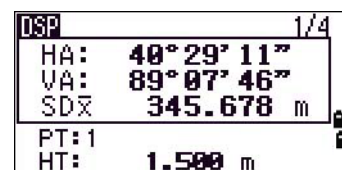
For information on how to assemble the prism reflector, see [Setting Up the Prism Reflector](#), page 20.

Sight the telescope to see crosshairs at the center of the prism reflector.

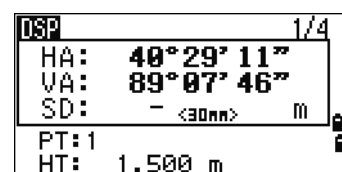


Measuring distances

To take a distance measurement, press **(MSR1)** or **(MSR2)** in the Basic Measurement Screen (BMS) or in any observation screen.

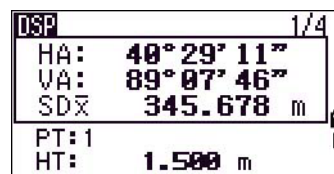


While the instrument is taking a measurement, the prism constant appears in a small font.

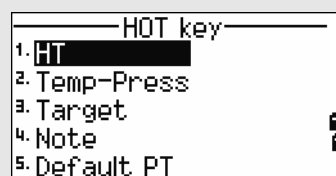


If the average count is set to 0, measurements are taken continuously until you press **[MSR1]**, **[MSR2]**, or **[ESC]**. Each time a measurement is taken, the distance is updated.

If the average count is set to a value from 1 to 99, the averaged distance appears after the last shot. The field name SD changes to $SD\bar{x}$ to indicate the averaged data.



To change the height of target (HT), temperature, or pressure, press **[HOT]**. For more information, see [\[HOT\] key, page 34](#).



Settings that relate to corrections

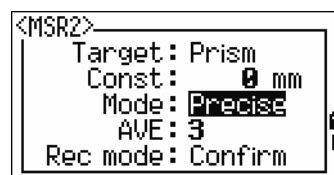
(T-P corr, Sea Level, C&R corr., and Map projection) are included in the job settings. These settings are job-specific. If you need to change any of these settings, you must create a new job. For more information, see [Job settings, page 93](#), and [Settings, page 108](#).



Measurement settings

To view the measurement settings, hold down **[MSR1]** or **[MSR2]** for one second.

Use **[↑]** or **[↓]** to move the cursor between the fields. Use **[←]** or **[→]** to change the value in the selected field.

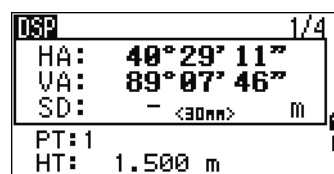


Field	Values
Target	<ul style="list-style-type: none"> Prism N-prism
Const (prism constant)	-999 mm through 999 mm
Mode	<ul style="list-style-type: none"> Precise Normal
AVE (Average count)	0 (Continuous) through 99
Rec mode	One of the following: <ul style="list-style-type: none"> MSR only Confirm ALL


Target field

If the measurement is started with the Target field set to **Prism**, there is a dash “-” in front of the prism constant.

If the measurement is started with the Target field set to **N-prism**, there is a square bracket “[” in front of the prism constant.



The symbol then constantly runs from left to right over the prism constant in the display.

When an N-prism measurement is taken, the  icon appears in the status bar (above the battery icon).

DSP	1/4	*
HA:	40°29'11"	*
VA:	89°07'46"	*
SD:] <0mm>	m
PT:	1	
HT:	1.500	m

Incorrect Target settings may result in measurements outside the precision and intervals specified for the instrument.

If a prism target is aimed in the N-prism mode, the warning message "Signal High! → Try Prism Mode" will be displayed because of the excessive light reflection.

A measurement made immediately after changing the target setting may take a longer time than usual. The Target setting is used to apply better cyclic-error adjustment in distance measurement. It efficiently eliminates multipath reflection.

Rec mode field

The Rec mode setting controls how the **MSR1** and **MSR2** keys operate in the BMS.

The **MSR only** setting is the default measurement mode. After a measurement, the instrument stops in the BMS and waits for you to press **ENT** before recording the point.

The **Confirm** setting displays the Record PT screen before data is recorded.

The **ALL** setting is a quick shooting and recording mode. The instrument automatically records the point using the default PT/CD. The instrument then returns to the BMS for the next measurement.

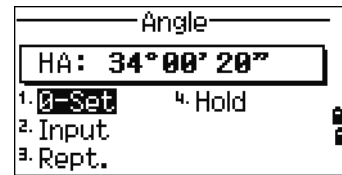
Applications

In this chapter:

- HA Reset and Angle Operations
- Station Setup
- Stakeout
- Program Key
- Recording Measurement Data
- Measuring Offsets

HA Reset and Angle Operations

To open the Angle menu, press **[ANG]** in the BMS. To select a command from this menu, either press the corresponding number key, or press **[←]** or **[→]** to highlight the command and then press **[ENT]**.

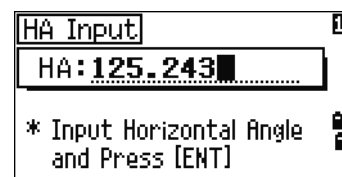


Setting the horizontal angle to 0

To reset the horizontal angle to 0, press **[0]** or select **0-Set** in the Angle menu. The display returns to the Basic Measurement Screen (BMS).

Entering the horizontal angle

To display the HA Input screen, press **[2]** or select **Input** in the Angle menu. Use the numeric keys to enter the horizontal angle. Then press **[ENT]**.

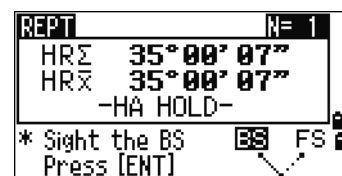
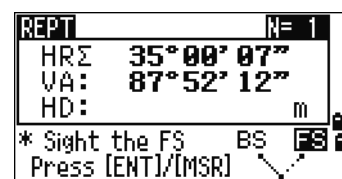
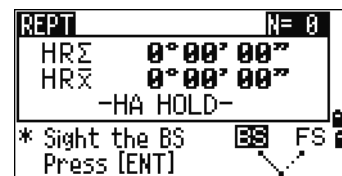


To enter 123°45'50", type **[1][2][3][.][4][5][5][0]**.

The displayed value is rounded to the minimum angle increment.

Recording a foresight point after repeat angle measurement

- To activate repeat angle measurement, press **[3]** or select **Rept.** in the Angle menu.
HR=0 appears.
- Sight the backsight and press **[ENT]**.
- Sight the foresight and press **[ENT]**.
The horizontal angle is accumulated and the value is held again.
- To end repeat angle measurement, press **[ESC]**.
- When you have accumulated enough horizontal angle between the backsight and the foresight, press **[MSR1]** or **[MSR2]** to take a measurement to the foresight.



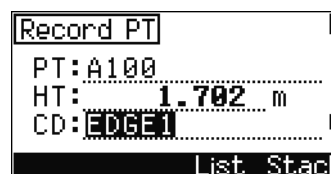
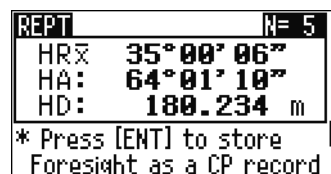
The averaged horizontal angle appears. This value is fixed until the process is finished or cancelled.

$$HR\bar{x} = HR \rightarrow N$$

$$HA = BSAz + HR\bar{x} \text{ (normalized)}$$

$HR\bar{x}$ is not updated even if the instrument is moved.

- Press **[ENT]** to store the foresight as a CP record. Check the PT, HT, and CD values. Then press **[ENT]** to record.



In repeat angle measurement, the HA is replaced by $HR\bar{x}$. The number of repeat angles appears at the top of the screen (for example, N= 5).

Horizontal angles can be measured up to 1999°59'59".

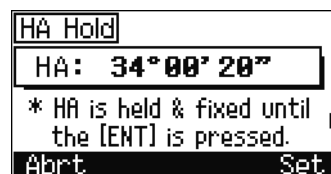
This function stores both raw and XYZ data as CP records, regardless of the Store DB setting.

Horizontal angle hold

To hold the horizontal angle to the current value, press **[5]** or select **Hold** in the Angle menu.

To set the horizontal angle to the displayed value, press **[ENT]** or the **Set** softkey.

To cancel the process and return to the Basic Measurement Screen (BMS), press **[ESC]** or the **Abort** softkey.

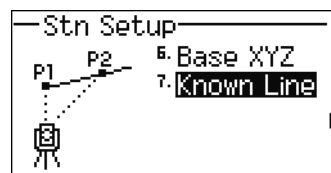
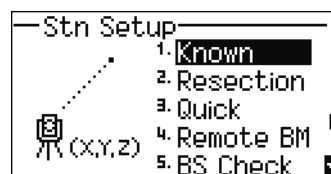


Station Setup

To open the Stn Setup menu, press **[STN]** in the BMS.

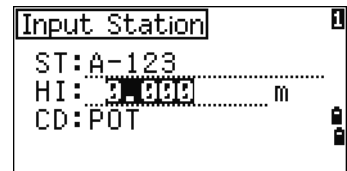
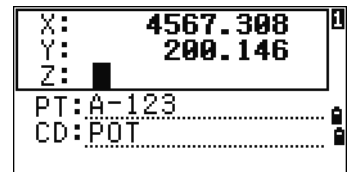
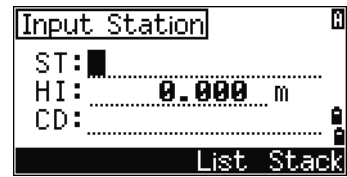
To select a command from this menu, press the corresponding number key. Alternatively, press **[←]** or **[→]** to highlight the command and then press **[ENT]**. Press **[↑]** or **[↓]** to move up or down one page.

The last function used is highlighted.



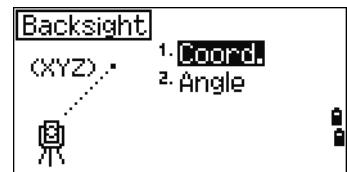
Setting up a station with known coordinates or azimuth

1. Press **[1]** or select **Known** in the Stn Setup menu.
2. Enter a point name or number in the ST field.
 - If the input point number or name is an existing point, its coordinates are displayed and the cursor moves to the HI (Height of instrument) field.
 - If the point is new, a coordinate input screen appears. Enter the coordinates for the point. Press **[ENT]** after each field. When you press **[ENT]** in the CD field, the new point is stored.
 - If the specified point has a code, the code appears in the CD field.
3. Enter the instrument height in the HI field and then press **[ENT]**.

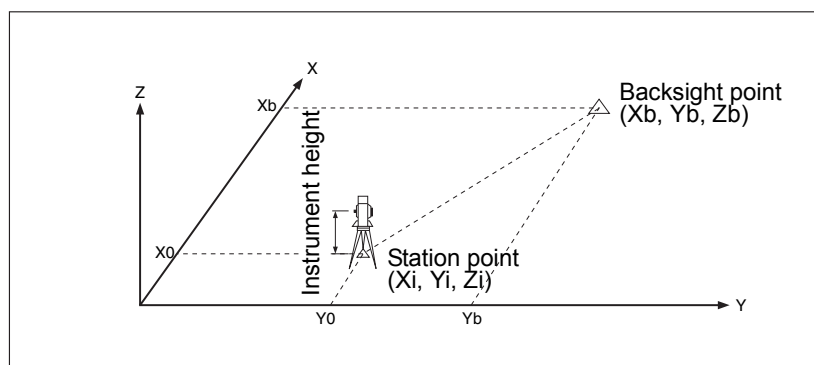


The Backsight screen appears.

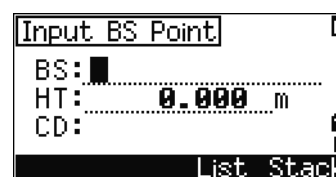
4. Select an input method for defining the backsight point.
 - To sight the backsight by entering coordinates, see below.
 - To sight the backsight by entering the azimuth and angle, see [page 56](#).



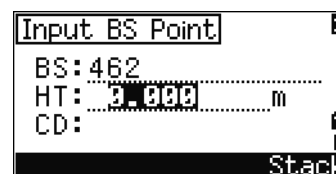
Sighting the backsight by entering coordinates



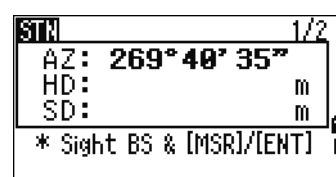
1. To enter coordinates for the backsight point (BS), press **[1]** or select **Coord** in the Backsight screen.
2. Enter the point name. If the point exists in the job, its coordinates are shown.
3. If you intend to take a distance measurement to the BS, enter the height of target in the HT field.



3. If you intend to take a distance measurement to the BS, enter the height of target in the HT field.

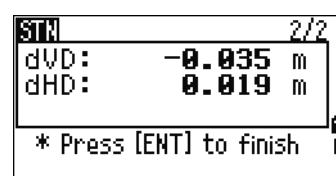


4. Sight the BS. Press **[ENT]** to complete the setup.
 - To record a full shot (with HA, VA, and SD values) to the BS, press **[MSR1]** or **[MSR2]**.

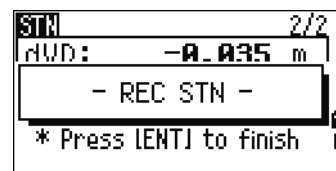


AZ Azimuth calculated by coordinates

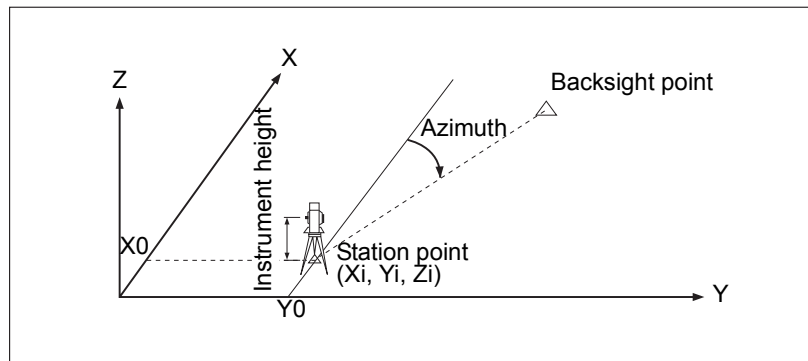
- If you are measuring to a known coordinate BS, press **[DSP]** to display a QA screen. The QA screen shows the dHD and dVD values, which indicate the difference between the measured distance and the distance calculated from the known coordinates.



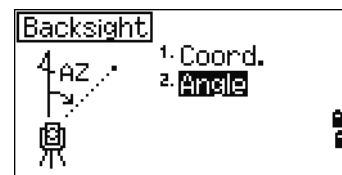
5. To record the station, press **[ENT]**.
6. To finish the station setup after taking a distance measurement, press **[ENT]**. ST and F1 records are stored to the current job.



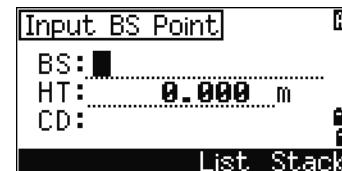
Sighting the backsight by entering the azimuth angle



1. To enter the azimuth angle to the backsight point, press **[2]** or select **Angle** in the Backsight screen.

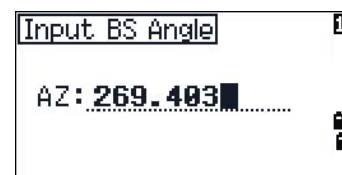


2. If there is no point name for the BS, press **[ENT]** on the BS field.

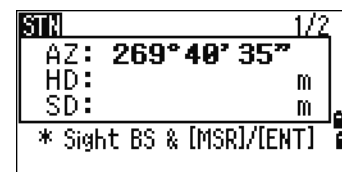


3. In the AZ field, enter the azimuth angle to the BS point.

If you press **[ENT]** without entering a value in the AZ field, the azimuth is automatically set to 0°00'00".

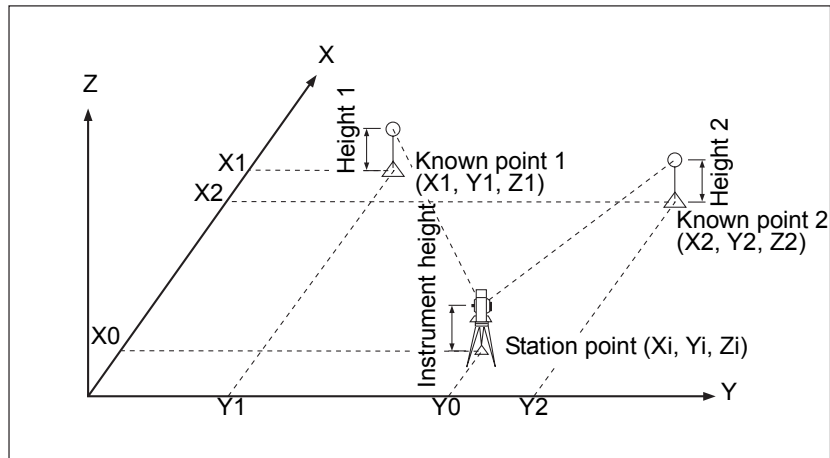


4. Sight the BS point and press **[ENT]**. ST and F1 records are stored in the job.



Setting up a station using multiple point resection

A resection sets up the station using angle/distance measurements to known points.

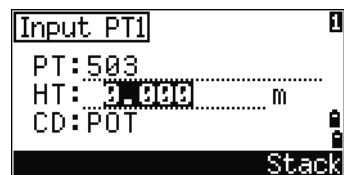
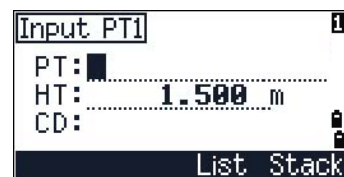
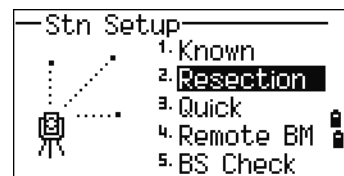


You can use a maximum of 10 points in a resection. Measurements can be distance and angle, or angle only. Calculation starts automatically when enough measurements are taken.

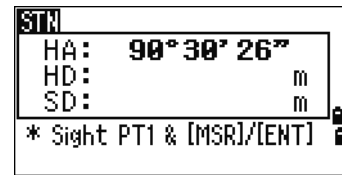
You can delete poor observations and recalculate if necessary. You can also select the BS point.

If the angle between known point 1 and known point 2 (measured from the station point) is extremely acute or extremely oblique, the resulting solution will be less reliable geometrically. For geometric reliability, select known point locations (or station point locations) that are widely spaced.

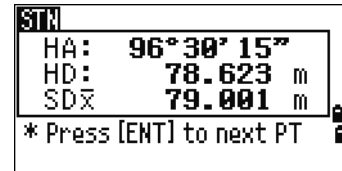
- To start the resection, press **[2]** or select **Resection** in the **Stn Setup** menu.
- Enter the point name for the first observation point (PT1).
- Enter the target height and press **[ENT]**.



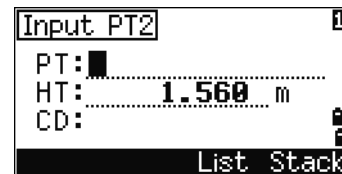
4. Sight PT1 and press **[MSR1]** or **[MSR2]**.



5. To proceed to the next point, press **[ENT]**.

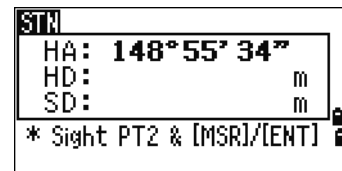


6. Enter the second point (PT2) and its height of target.

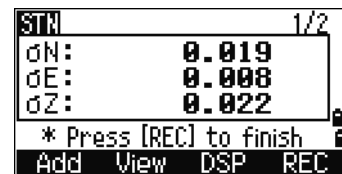


7. Measure to PT2 and press **[ENT]**.

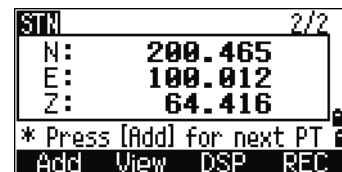
When the instrument has enough data, it calculates the station (STN) coordinates.



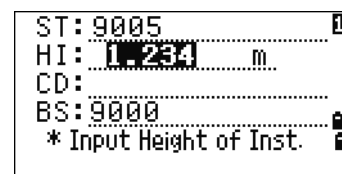
- If more than the minimum required data is available, a standard deviation screen appears.
- To take measurements to strengthen geometry of the resection, press the **Add** softkey. For information about the **View** softkey, see [Advanced feature: Viewing and deleting a measurement in resection, page 59](#).



8. When the results are satisfactory, record the station. To do this, press **[ENT]** or the **REC** softkey.



9. Enter the height of instrument, if required. Press **[ENT]**. The ST field defaults to the last recorded PT + 1.



10. To change the station name, move to the ST field and edit or replace the text.

If you have set Split ST to Yes, the ST field defaults to the last recorded ST value + 1. For more information, see [Others settings, page 112](#).

- BS defaults to the first observed point.
11. To change the BS, press the **Change** softkey.
 12. Select the BS point that you want to use and press **ENT**.
 13. To finish the resection setup, move the cursor to the BS field and press **ENT**.

```

ST: 9005 .....
HI: 1.234 m .....
CD: MANHOLE-7 .....
BS: 9000 .....
* Select Backsight PT
Change

```

```

Select BS point
9000,
200, MANHOLE
30-A, N-POLE
201,

```

```

ST: 9005 .....
HI: 1.234 m .....
- REC STN - .....
* Select Backsight PT

```

The minimum data required for a resection is either three angle shots, or one angle shot and one distance shot. If you use a distance shot, the distance between the target points must be greater than the measured distance. Stn-Z is calculated from distance-measured data. If no distances are measured, then Stn-Z is calculated using angle-only measurements to points with 3D coordinates.

Advanced feature: Viewing and deleting a measurement in resection

To check the measurements to each known point, press the **View** softkey on the calculated STN (sigma or coordinate) screen.

```

View Shots
K-65, ROAD
200, MANHOLE
30-A, N-POLE
201,
202,
Add DEL

```

- dHA Distributed HA errors in each direction
- dVD VD errors between measured distance and calculated distance
- dHD HD errors between measured distance and calculated distance

```

dHA: -4°19'02"
dVD: 0.026 m
dHD: 0.081 m
PT: K-65
HT: 1.852 m
Add DEL DSP

```

To delete a measurement (because of large sigma values, for example), highlight the measurement data or display the detail screen for the measurement. Then press the **DEL** softkey. The STN coordinates are automatically recalculated.

To continue resection observations, press the **Add** softkey. The input screen for the next PT appears.

```

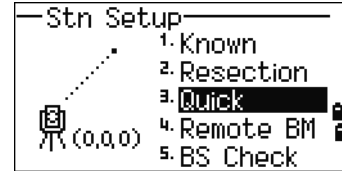
Input PTS
PT:
HT: 0.000 m
CD:
List Stack

```

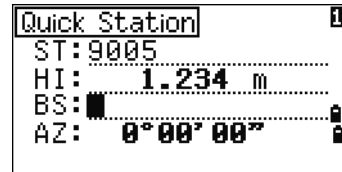
Setting up the station quickly without coordinates

The station point (ST) in this function defaults to a new point number. For the new point, MP (0, 0, 0) is stored as the coordinates. When the ST is manually changed to a known point name, the station is set up on the coordinates of the known point.

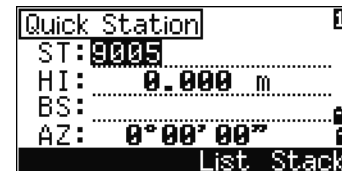
1. To enter Quick Station setup, press **[3]** or select **Quick** in the Stn Setup menu.



- | | |
|----|--|
| ST | Station point (defaults to the last recorded PT + 1, or ST + 1, depending on the Split ST setting) |
| HI | Height of instrument |
| BS | Backsight point (blank) |
| AZ | Backsight azimuth (defaults to zero) |



2. No default PT is assigned to the BS. Leave this field blank, or enter a BS point name.
3. The backsight azimuth (AZ) defaults to zero, but you can change this.
4. To complete the station setup, sight the BS and press **[ENT]**.

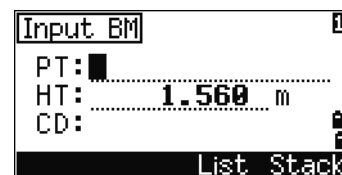
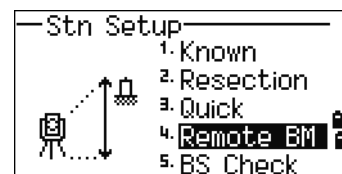


When you press **[ENT]** in the AZ field, both HA and AZ are reset to the value you have entered.

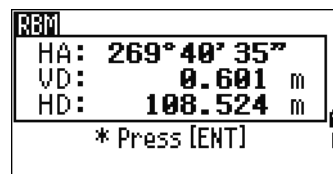
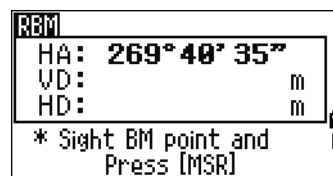
Even if both ST and BS are known points, this function does not calculate the backsight angle (AZ) automatically. To calculate the AZ between two known points (ST and BS), use **Station Setup > Known**. For more information, see [Setting up a station with known coordinates or azimuth, page 54](#).

Determining station elevation

1. Press **[4]** or select **Remote BM** in the Stn Setup menu.
2. Enter the BM point and press **[ENT]**. When the point is found, it appears briefly. The cursor then moves to the HT field.
3. Enter the HT and press **[ENT]**.

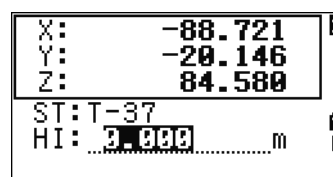


4. Sight the BM point and press **[MSR1]** or **[MSR2]**.



The updated station coordinates are displayed.
You can change the HI in this screen.

5. To record the updated STN, press **[ENT]**.

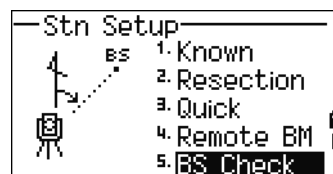


When the HI is changed, the Z coordinate is updated before the station is recorded.
You must complete a station setup before you use the Remote Benchmark function.

Checking and resetting the backsight direction

You must complete a station setup before you use the BS check function.
This function always refers to the backsight point from the last ST record stored in the current open job.

1. To enter the backsight (BS) check function, press **[F5]** or select **BS Check** in the Stn Setup menu.



- HA Current HA reading
BS The HA to the BS in the last station setup. Enter station coordinates for observations without recording data.



2. Do one of the following:
- To reset the horizontal angle to the HA set in the last station setup sight the BS and press the **Reset** softkey or press **[ENT]**.
 - To cancel the process and return to the BMS, press the **Abrt** softkey or press **[ESC]**.

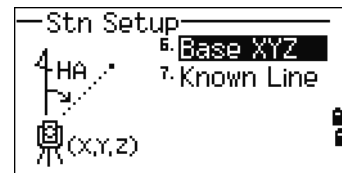
Base XYZ function:

Base XYZ does not store a ST record, so the BS Check cannot check the backsight when you enter a station using Base XYZ.

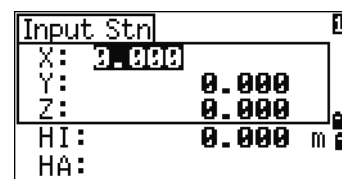
To store raw data, use one of the other functions in the Stn Setup menu. This function does not store an ST record in the job.

You can use this function without an open job. If there is an open job when you use this function, a CO record is stored to indicate that the instrument's base coordinates have changed.

1. To enter the Base XYZ function, press **[6]** or select **Base XYZ** in the Stn Setup menu.

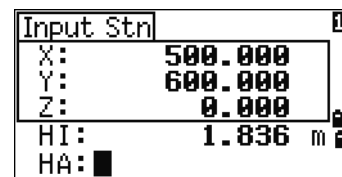


The current instrument XYZ values are shown as the default.

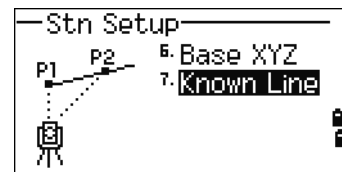


2. Enter the new instrument XYZ values and press **[ENT]**.
3. Do one of the following:
 - To reset the horizontal angle, enter a value in the HA field and press **[ENT]**.
 - If you do not need to reset the HA, leave the HA field blank and press **[ENT]**.

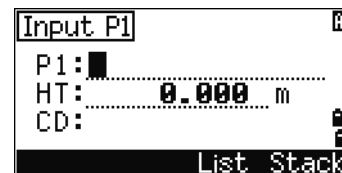
The display returns to the BMS.

**Two-point resection along a known line**

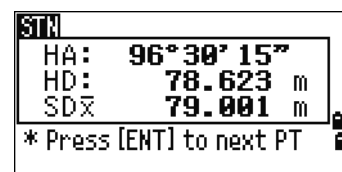
1. To enter the Known Line function, press **[7]** or select **Known Line** in the Stn Setup menu.



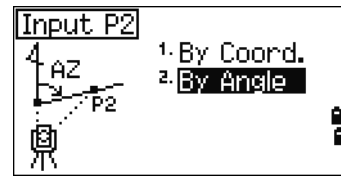
2. Enter a known point as P1.
If you enter a new point name, a coordinate input screen appears.



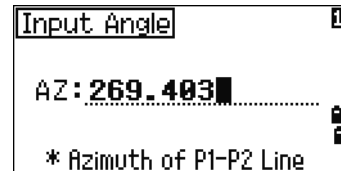
Sight P1 and press **[MSR1]** or **[MSR2]** to take a measurement. Press **[ENT]**.



3. Choose how you want to define a known line:
 - To define the line by entering P2 coordinates, press **[1]** or select **By Coord.**
 - To define the line by entering the azimuth, press **[2]** or select **By Angle.**

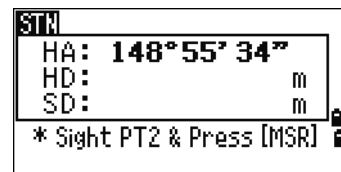


4. If you select **By Angle**, the azimuth input screen appears. Enter the angle value and press **[ENT]**.



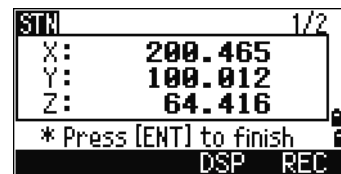
A measurement screen appears.

5. Sight P2 and press **[MSR1]** or **[MSR2]** to take a measurement. Press **[ENT]**.

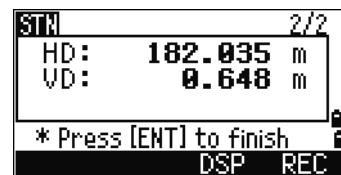


After the measurement to P2 is completed, the coordinates of the station are calculated.

6. To record the station, press **[ENT]** or the **REC** softkey.

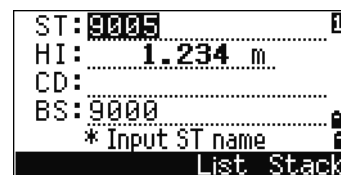


7. To check your measurement, press the **DSP** softkey. If you defined the line by entering its azimuth, HD and VD between P1 and P2 are displayed.

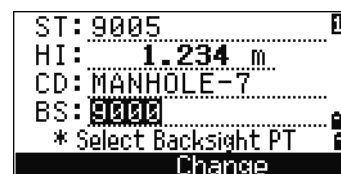


If you defined the line by entering the P2 coordinates, the difference of HD (dHD) and VD (dZ) between your measurement data and input coordinate data are displayed.

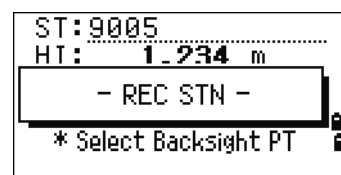
8. Enter the station name, the height of instrument (HI), and a feature code (CD) if required. The station name defaults to the last recorded PT + 1, or last recorded ST + 1, depending on the Split ST setting.



9. Backsight (BS) defaults to the first point (P1). To change it, highlight the BS field and then press the **Change** softkey.



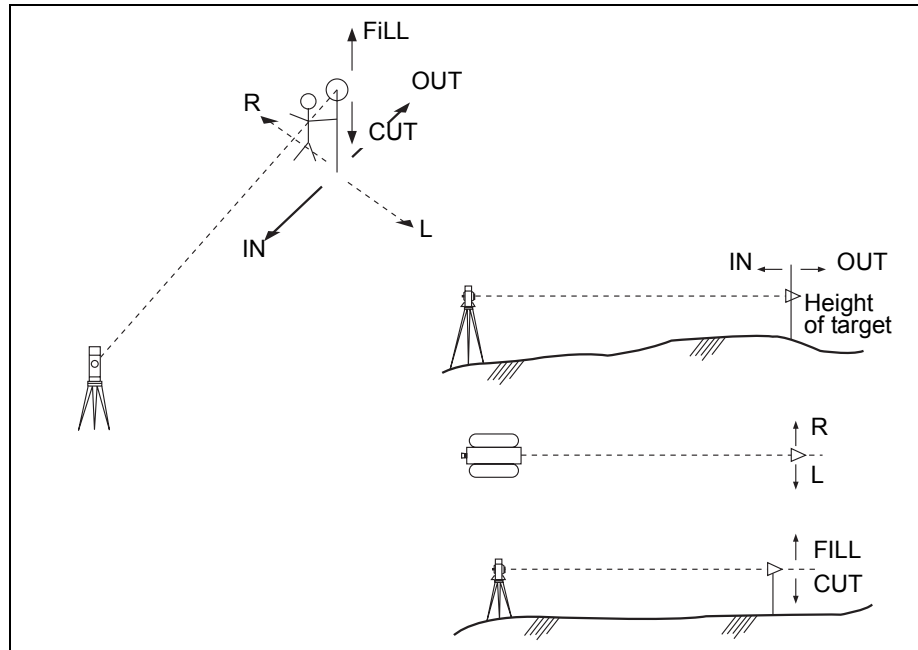
10. To finish the setup and record the station, press **[ENT]** in the BS field.



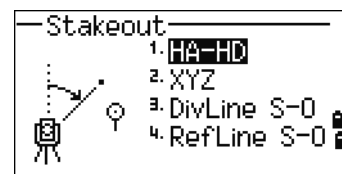
Sample records

CO, Temperature:20C Pressure:1013hPa Prism:0 ...
 ST,9005, ,265, ,1.2350,150.40300,150.40300
 F1,265,1.6040,79.0010,90.30150,89.35260,
 F1,200,1.4590,50.2300,269.4035,93.50110,
 CO, P1-P2 HD=122.0350 VD=0.5600

Stakeout



To display the Stakeout menu, press **[S-O]**.



Specifying the stakeout point by angle and distance

1. To display the input screen for the distance and angle to the target, press **[1]** or select **HA-HD** in the Stakeout menu.
2. Enter the values and press **[ENT]**.

HD	Horizontal distance from station point to stakeout point
dVD	Vertical distance from station point to stakeout point
HA	Horizontal angle to stakeout point

If you press **[ENT]** without entering HA, the current HA is used.

3. Rotate the instrument until the dHA is close to $0^{\circ}00'00''$.
4. Sight the target and press **[MSR1]** or **[MSR2]**.

When the measurement is completed, the differences between the target position and the stakeout point are displayed.

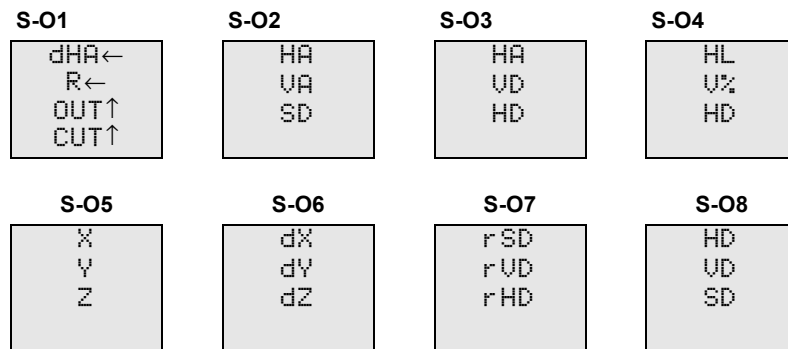
dHA	Difference in horizontal angle to the target point
R/L	Right/Left (Lateral error)
IN/OUT	In/Out (Longitudinal error)
CUT/FILL	Cut/Fill

Once a measurement is taken, the Cut/Fill value and Z coordinate are updated as the VA is changed.

If you press **[HOT]** in any observation screen, the HOT key menu appears. You can use this menu at any time to change HT and T-P.

Using **[DSP]** to switch between display screens

Press **[DSP]** to switch between the Stakeout display screens. The following screens are available:



The S-O8 screen is only available if the secondary distance unit is set. For more information, see [Others settings, page 112](#).

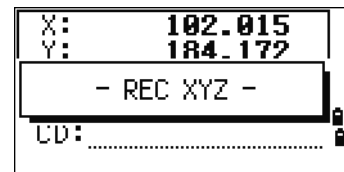
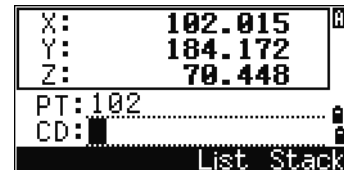
Every time you press **[DSP]**, the next screen appears. If you press **[DSP]** in the last screen (S-O7, or S-O8 if the secondary distance unit is set), the S-O1 screen appears.

To customize the S-O2, S-O3, and S-O4 screens, hold down **[DSP]** for one second. For more information, see [Customizing items in the Basic Measurement Screen \(BMS\), page 31](#).

To record the stakeout point, press **[ENT]**. PT defaults to the last recorded PT+1.

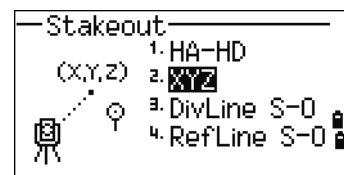
Press **[ENT]** to record the point.

After recording the point, it returns to the observation screen. You can continue observation, or press **[ESC]** to input another angle and distance for stakeout.



Specifying the stakeout point by coordinates

- To start a stakeout by coordinates, press **[2]** or select XYZ in the Stakeout menu.



- Enter the point name that you want to stake and press **[ENT]**.

You can also specify the point by code or radius from the instrument.



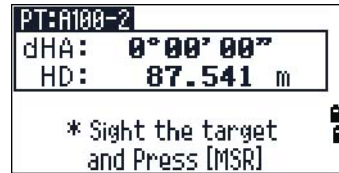
If several points are found, they are displayed in a list. Use \uparrow or \downarrow to move up and down the list. Use \leftarrow or \rightarrow to move up or down one page.

- Highlight a point in the list and press [ENT] .



The delta angle and the distance to the target are shown.

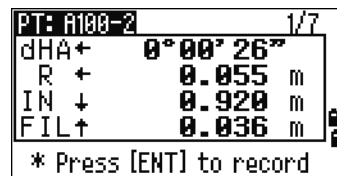
- Rotate the instrument until the dHA is close to $0^{\circ}00'00''$. Press [MSR1] or [MSR2] .



dHA Difference in horizontal angle to the target point
 HD Distance to the target point

- Ask the rodman to adjust the target position. When the target is on the intended position, the displayed errors become 0.000 m (or 0.000 ft).

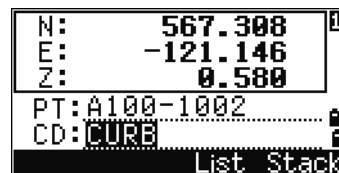
dHA Difference in horizontal angle to the target point
 R/L Right/Left (Lateral error)
 IN/OUT In/Out (Longitudinal error)
 CUT/FILL Cut/Fill



To switch between display screens, press [DSP] . This function works as in the angle-distance stakeout, except that the screen counter (for example, S-O1/8) is not displayed. For more information, see [Using \[DSP\] to switch between display screens, page 66](#).

Once a measurement is taken, the Cut/Fill value and Z coordinate are updated as the VA is changed.

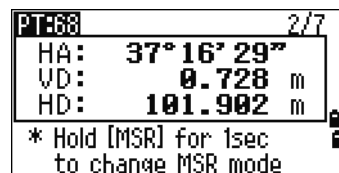
- To record the point, press [ENT] . PT defaults to the specified PT + 1000.



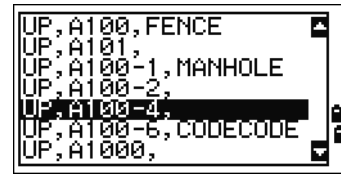
Use the Add Constant field in $\text{MENU} > \text{Settings} > \text{Stakeout}$ to specify an integer that is added to the point number being staked to generate a new number for recording the staked point. The default value is 1000. For example, when you stake out PT3 with an Add Constant of 1000, the default number for SO record is 1003. For more information, see [Stakeout, page 111](#).



After recording the point, the display returns to the observation screen. When you press [ESC] , the display returns to the PT/CD/R input screen. If you entered the stakeout point using a single point name, the PT defaults to the last PT + 1.

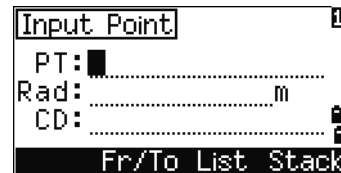


If you selected a point from the list, the display returns to the list, unless all points have been selected. Press **[ESC]** to return to the point input screen.

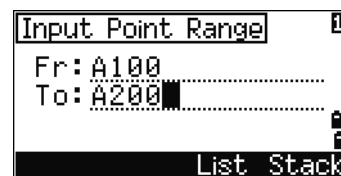


Advanced feature: Specifying a stakeout list by range input

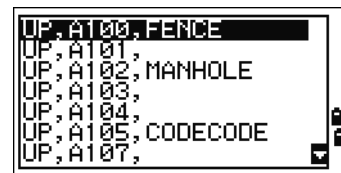
1. To input points by range, press the **Fr/To** softkey in the PT field.



2. Enter the start point (Fr) and the end point (To). The range between Fr and To must be less than 1001 points.

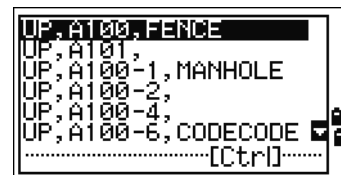


If existing points are found between Fr and To, a point list appears.



To highlight a point, press **[↑]** or **[↓]**. To go to the stakeout observation screen, press **[ENT]**.

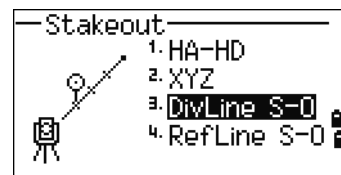
If you have assigned a control job, and additional points are found in the control job, the **Ctrl** softkey appears under the list.



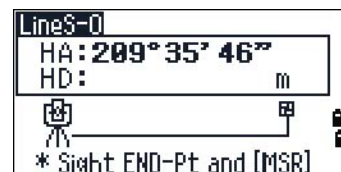
DivLine S-0

This function divides the line between the instrument and the first target by an input span number. It then guides you to stake out the points, one by one.

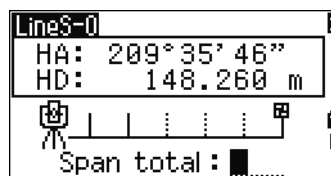
1. Press **[3]** or select **DivLine S-0** in the Stakeout menu.



2. Set up the baseline. To do this, sight the target on the line (the end point) and press **[MSR1]** or **[MSR2]**.

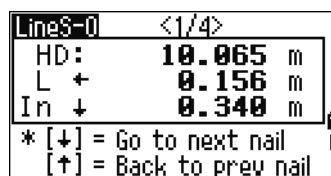


3. Enter the total stake number in the Span total field.

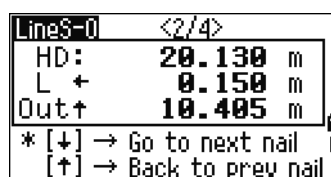


The observation screen for the first stake (from the instrument) appears.

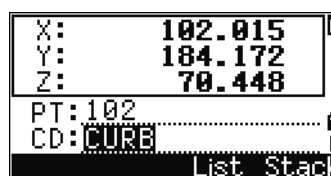
4. Sight the prism and press **[MSR1]** or **[MSR2]**.



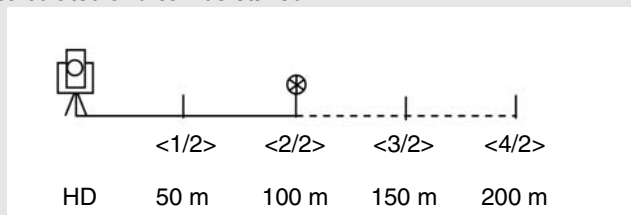
5. Use **[↑]** or **[↓]** to change the guide point. You can calculate and guide up to double the number of the stakes.



6. To record the point as an SO record, press **[ENT]**.



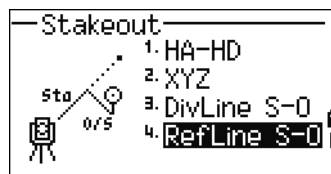
For example, if you measure to the end point at 100 m from the instrument and set the span total to 2, the following four points are calculated and can be staked:



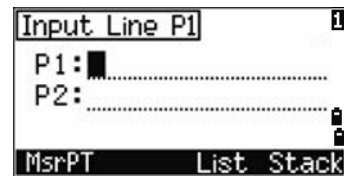
RefLine S-O

This function allows you to stake out a point based on the Sta, O/S, and dZ to a specified line.

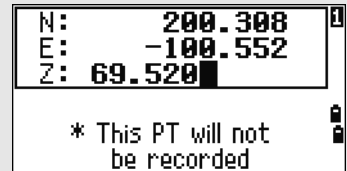
1. Press **[4]** or select **RefLine S-O** in the Stakeout menu.



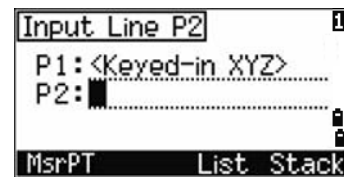
- Enter the first point (P1) of the line.



If you press [ENT] without entering a PT name, you can enter temporary coordinates which are not recorded in the job.
Alternatively, press the MSR softkey to measure a point.

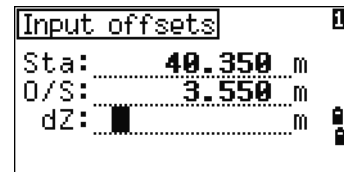


- Enter the second point (P2) of the line.



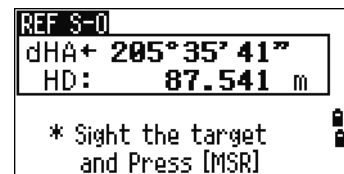
- Enter offsets to the line.

Press [ENT] in a blank field to enter the value 0.0000.



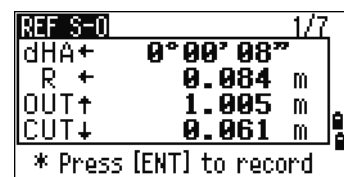
- Sta Distance from P1 along the line
- O/S Distance perpendicular to the line
- (+) Right side of the P1-P2 line
- (-) Left side of the P1-P2 line
- dZ Difference in height from the line

- Rotate the instrument until the dHA is close to 0°00'00".
- Sight the target and press [MSR1] or [MSR2].



When a distance measurement is taken, the difference from the design point appears.

- To record the point as an SO record, press [ENT].



Using [DSP] to switch between display screens

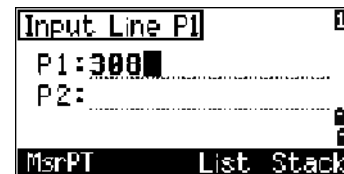
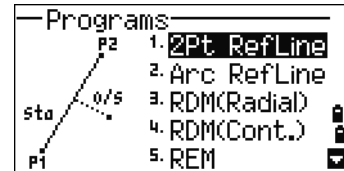
You can use [DSP] to switch between display screens. This function works as in the angle-distance stakeout. For more information, see [Using \[DSP\] to switch between display screens, page 66](#).

Program Key

To display the Programs menu, press **[PRG]**.

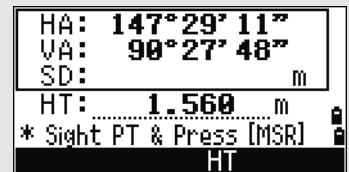
Measuring distance and offset values along a specified line

1. Press **[F1]** or select 2Pt RefLine in the Programs menu.
2. Enter the first point for the reference line. Alternatively (to enter the point by measuring), press the **MsrPT** softkey.

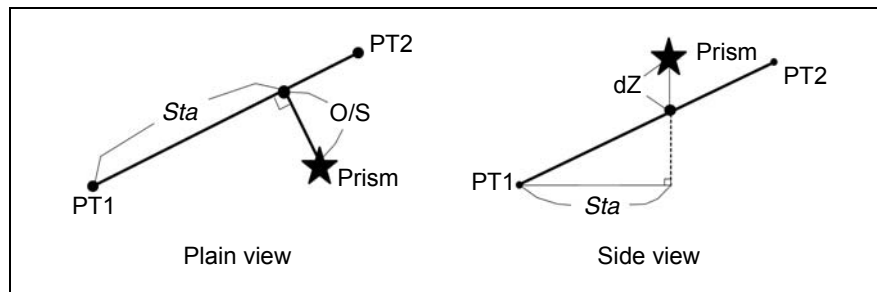
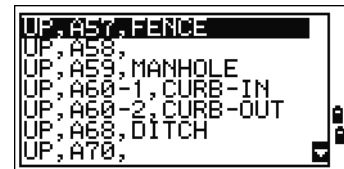
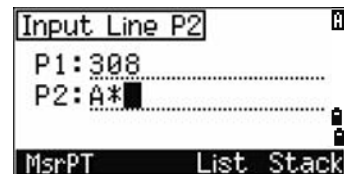


Direct Measurement screen

Press the **MsrPT** softkey to display a direct measurement screen. Sight the target and press **[MSR1]** or **[MSR2]**. The Record PT screen appears. If you press **[ESC]** in the Record PT screen, the measured point is used but not recorded in the job.

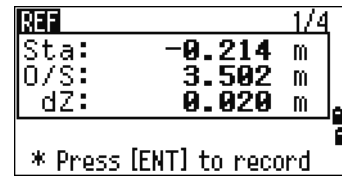


3. Enter the second point for the reference line.
4. Enter an asterisk (*) in the PT field to perform a wildcard search. A list of matching points appears. Highlight a point in the list and then press **[ENT]**.



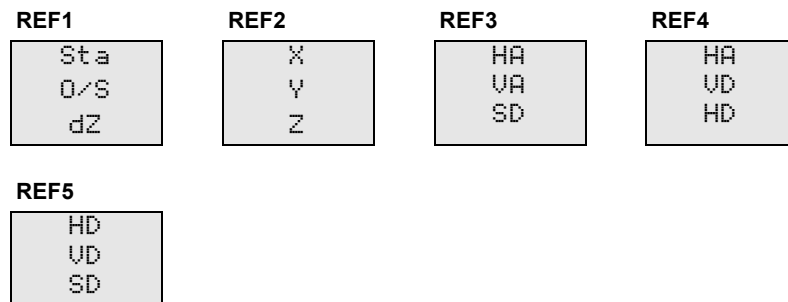
5. Sight the prism or reflective sheet and press **[MSR1]** or **[MSR2]**.

- Sta Horizontal distance from P1 to the measure point along the P1-P2 line
 O/S Horizontal offset from the P1-P2 line to the measured point
 dZ Vertical offset from the P1-P2 line to the measured point



Using [DSP] to switch between display screens

Press **[DSP]** to switch between the Stakeout display screens. The following screens are available:



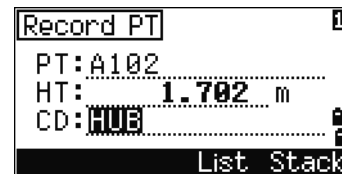
The REF5 screen is only available if the secondary distance unit is set. For more information, see [Others settings, page 112](#).

Every time you press **[DSP]**, the next screen appears. If you press **[DSP]** in the last screen (REF4 or REF5), the REF1 screen appears.

To store the point and its offset distance information, press **[ENT]**.

Enter the point name and feature code.

You can also use this screen to change the HT value.

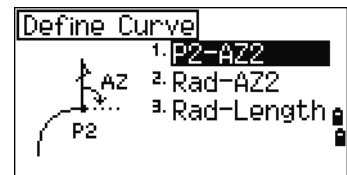
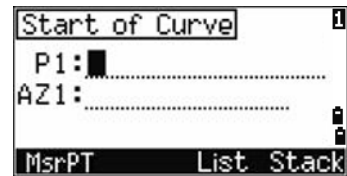
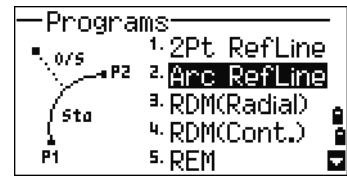


Sample records

CO, 2pt-Ref Pt:16 & Pt:13 Az:311.2932
 CO, Sta= -12.6876 Offset= 1.3721 dZ= 0.0971
 SS,17,1.0000,6.9202,18.4700,80.3120,15:48:48,2REF-LINE

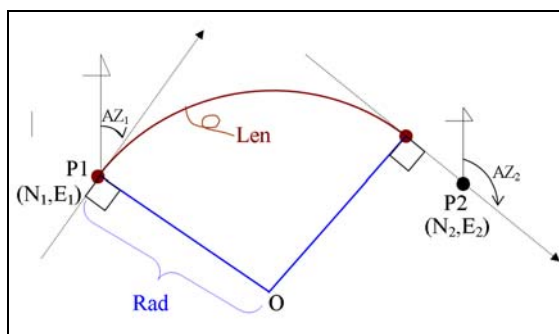
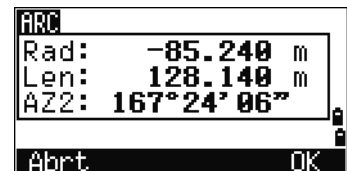
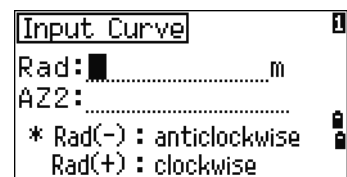
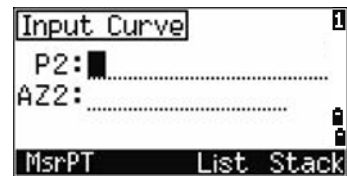
Measuring distance and offset values on the arc-curve

1. Press \square or select Arc RefLine in the Programs menu.
2. Enter the start of the curve point (P1) and the azimuth of its tangent line (AZ1).
3. To enter P1 by direct measurement, press the MSR softkey.
4. Choose a method to define the arc.



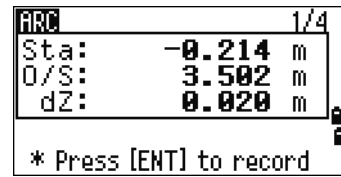
P2 can be any point on the tangent line that is to exit the curve.

5. In the radius (Rad) field, enter a positive value for a clockwise curve. Enter a negative value for a counterclockwise curve.



When all factors have been entered, the instrument calculates the curve.

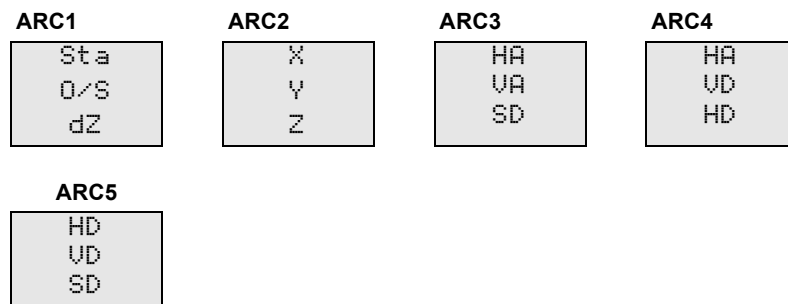
If the curve length (Len) is too large for a circle of the given radius, it is shortened.



To ...	Press ...
switch between display screens	[DSP]
change HT	[HOT]
record points	[ENT]

Using [DSP] to switch between display screens

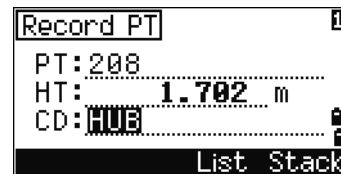
Press [DSP] to switch between the Stakeout display screens. The following screens are available:



The ARC5 screen is only available if the secondary distance unit is set. For more information, see [Others settings, page 112](#).

Every time you press [DSP], the next screen appears. If you press [DSP] in the last screen (ARC4 or ARC5), the ARC1 screen appears.

To record the point, press [ENT] on any observation screen. The arc is stored in comment records.

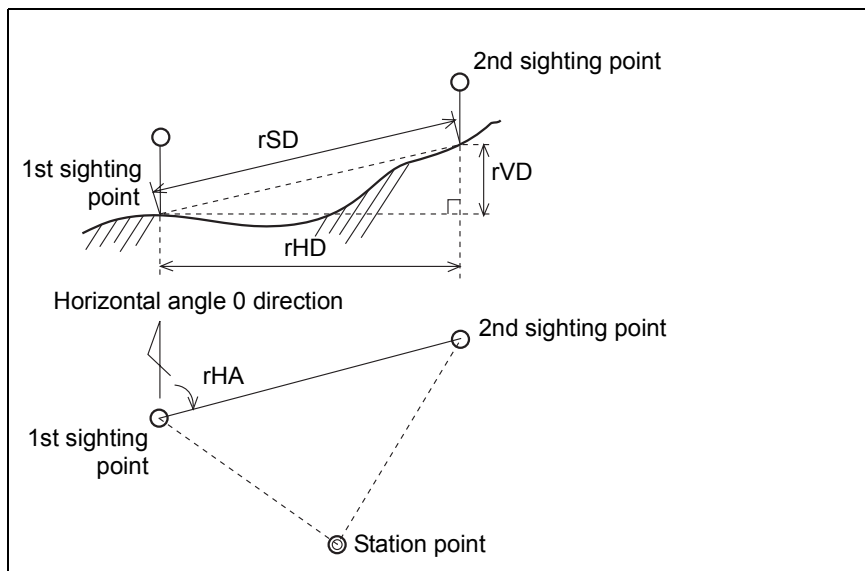


Sample records

CO,Arc P1:583 AZ1=0.0000 P2:102
 CO, AZ2=311.2932 Radius=50.0000 Length=125.6637
 CO, Sta= -12.6876 Offset= 1.3721 dZ= 0.0971
 SS,17,1.0000,6.9202,18.4700,80.3120,15:48:48,2REF-LINE

Remote distance measurement

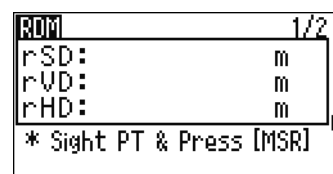
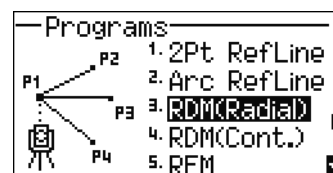
This function measures the horizontal distance, vertical distance, and slope distance between two points.



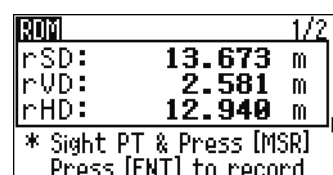
rSD	Slope distance between two points
rHD	Horizontal distance between two points
rVD	Vertical distance between two points
rV%	Percentage of grade $(rVD/rHD) \times 100\%$
rGD	Vertical grade $(rHD/rVD) :1$
rAZ	Azimuth from first point to second point

Measuring between the current and the first point measured

- To enter the RDM (Radial) function, press **[3]** or select RDM(Radial) in the Programs menu.
- Sight the first point and press **[MSR1]** or **[MSR2]**.



The distance from the station point to the first point appears.



- Sight the second point and press **[MSR1]** or **[MSR2]**.
The distances between the first and second point are displayed.

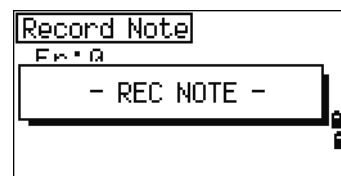
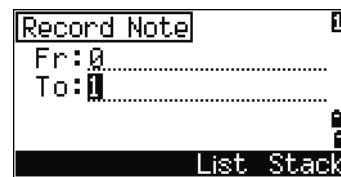
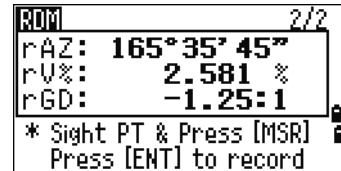
rSD Slope distance between two points
 rVD Vertical distance between two points
 rHD Horizontal distance between two points

- To change display screens, press **[DSP]**.

rAZ Azimuth from first point to second point
 rV% Percentage of grade (rVD/rHD) × 100%
 rGD Vertical grade (rHD/rVD) :1

- To record the distance and angle information as a comment record, press **[ENT]** in the 1/2 or 2/2 observation screen.

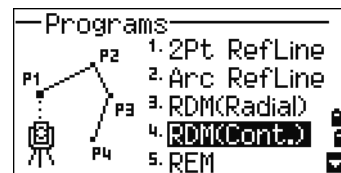
Default point numbers are displayed. You can change these point numbers. To record a note, press **[ENT]** in the To field.

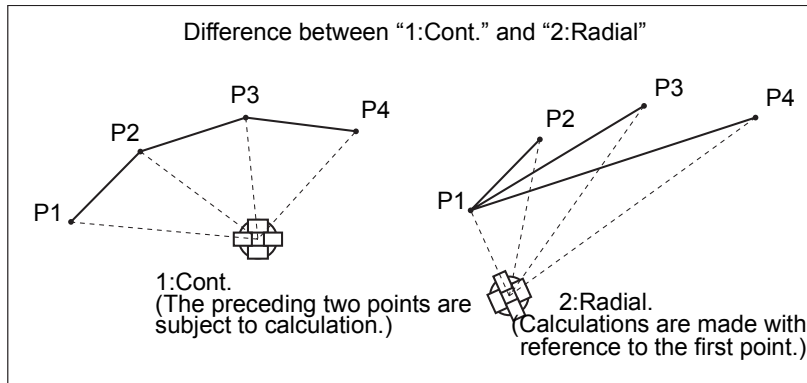


Data that you save in RDM functions is stored in RM records. For more information, see [RM records, page 116](#). When you download data in Nikon RAW format, they are output as comment (CO) records.

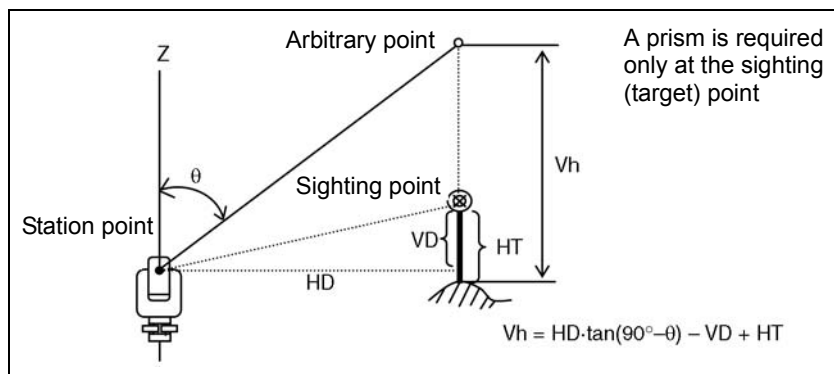
Measuring between the current point and the immediately preceding point

- To enter the RDM (Continuous) function, press **[4]** or select **RDM(Cont.)** in the Programs menu.
- Follow the procedure as for a radial RDM measurement. For more information, see [Measuring between the current and the first point measured, page 75](#).

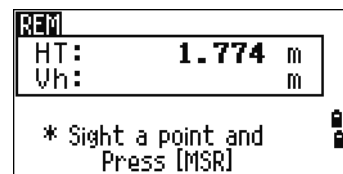
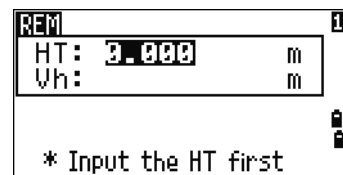
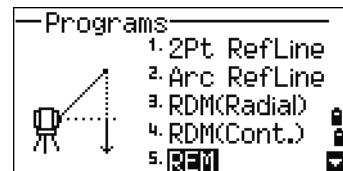




Measuring remote elevation

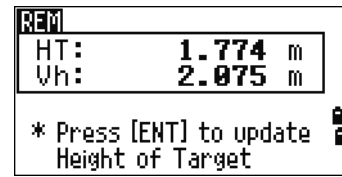


1. To enter the Remote Elevation Measurement function, press **[5]** or select REM in the Programs menu.
2. Enter the height of target.
3. Sight the target point and press **[MSR1]** or **[MSR2]**.



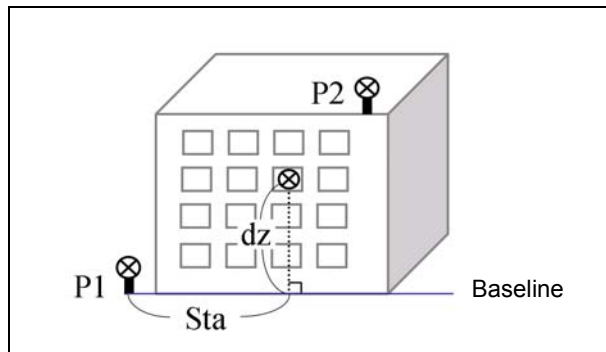
- Loosen the vertical clamp, and turn the telescope to aim at an arbitrary point.

The difference in elevation (Vh) appears.

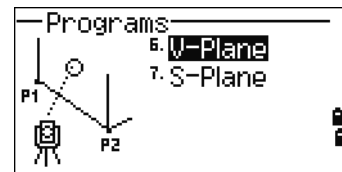


You can use an REM measurement to update the height of target. Take a measurement to the prism, sight the bottom of the prism pole, and press **[ENT]**.

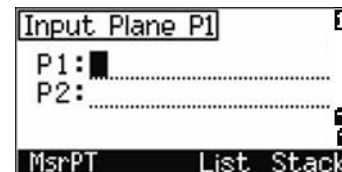
Measuring distance and offset values on the vertical plane



- To enter the 2-Pt Reference Plane function, press **[6]** or select U-Plane in the Programs menu.

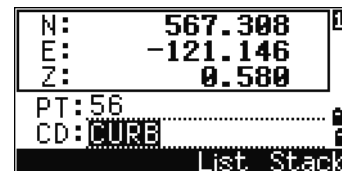
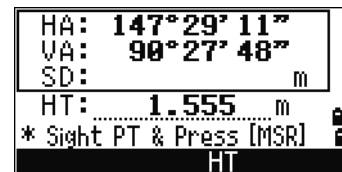


- Enter two points to define the plane.
To enter the point by direct measurement, press the **MSR PT** softkey.

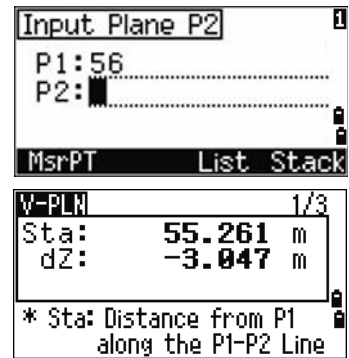


When you press the **MSR** softkey, a temporary observation screen appears.

- Press **[MSR1]** or **[MSR2]**. The Record PT screen appears.
- Enter a value in the PT and CD fields. Press **[ENT]**.



5. Enter the second point on the vertical plane.
Press **[ENT]**.

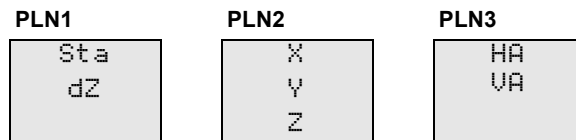


Once the plane is defined, the calculated Sta and dZ values are updated as you move the telescope. No distance measurement is required.

Sta Horizontal distance from P1 to the target point along the baseline
dZ Vertical distance from P1 to the target point

Using **[DSP]** to switch between display screens

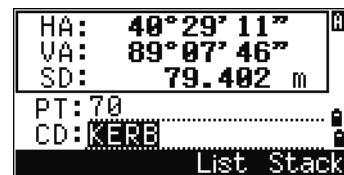
Press **[DSP]** to switch between the plane display screens. The following screens are available:



Every time you press **[DSP]**, the next screen appears. If you press **[DSP]** in the last screen (PLN3), the PLN1 screen appears.

To record the point, press **[ENT]** on any screen (V-PLN1/3 to V-PLN3/3).

Enter PT and CD. Then press **[ENT]**.



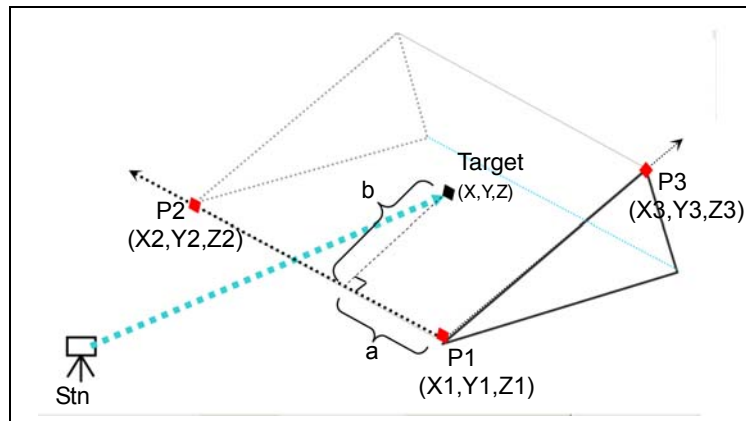
Sample records

CO,Vertical Ref Plane Pt1:516-A1 Pt2:530

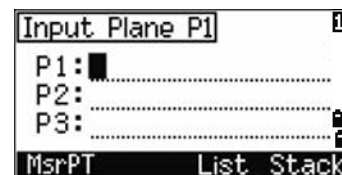
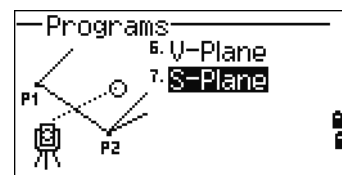
CO,Sta=68.021 dz=17.459

SS,30123-A48,1.5480,16.4020,40.4720,89.0730,14:22:47,

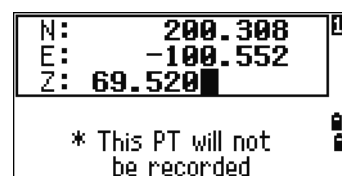
Measuring distance and offset values on the slope



- To enter the 3-Pt Reference Plane function, press **[7]** or select **S-Plane** in the Programs menu.
- Enter three points to define the slope plane. To enter the point by direct measurement, press the **MSR** softkey.



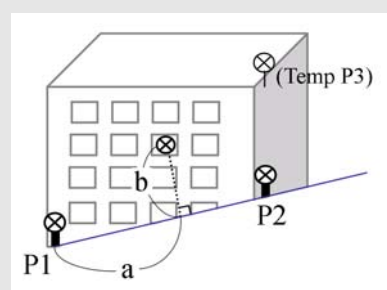
If you press **[ENT]** in a blank field, an input screen for temporary coordinates appears. These coordinates will not be stored.



When you have entered the temporary coordinates, **<Keyed-in XYZ>** appears instead of the PT name.

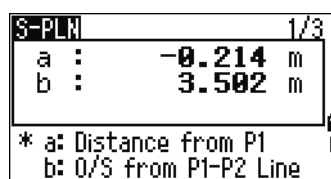


If the plane is defined by two points (by selecting **2Pt**), the vertical plane is the same as the plane used in the **V-Pln** function, but the indicating factors are **Sta** and **dZ**, not **a** and **b**. For more information, see [Measuring distance and offset values on the vertical plane, page 78](#).



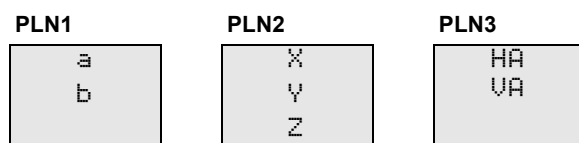
Once the plane is defined, the calculated a and b values are updated as you move the telescope. No distance measurement is required.

- a Distance between P1 and the point that is perpendicular to the target point along the P1-P2 line
- b Length of the perpendicular line from the target point to the P1-P2 line



Using **[DSP]** to switch between display screens

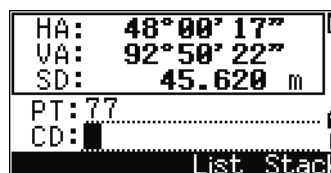
Press **[DSP]** to switch between the plane display screens. The following screens are available:



Every time you press **[DSP]**, the next screen appears. If you press **[DSP]** in the last screen (PLN3), the PLN1 screen appears.

To record the point, press **[ENT]** on any screen (S-PLN1/3 to S-PLN3/3).

Enter PT and CD. Then press **[ENT]**.



Sample records

CO,3ptPlane P1:1062 P2:2902 P3:1547
CO,a=31.497 b=14.239
SS,30123-A49,1.6110,0.0000,234.3210,86.0955,16:07:18,

Recording Measurement Data

Recording data from any observation screen

To record points on observation screens, press **[ENT]**.

PT defaults to the last recorded PT + 1.

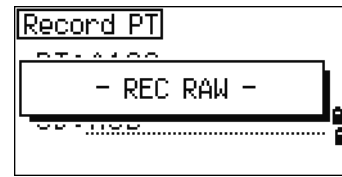
You can enter the PT name from the point list or the point stack. For more information, see [Entering a point from the point list, page 42](#), and [Entering a point from the stack, page 42](#).

You can also use the code list or the code stack. For more information, see [Entering a code from the code list, page 43](#), and [Entering a code from the stack, page 43](#).



To record the point, press **[ENT]** on the last field.

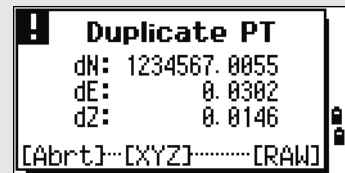
When recording sideshots, stakeout records and control shots from the Rept function, you can choose to store raw data only, XYZ data only, or both. For more information, see [Recording, page 112](#).



If HA or VA is moved after you take a measurement but before you press **[ENT]**, the angle recorded is the angle shown when **[ENT]** is pressed.

In an angle-only record, SD is always recorded as 0.0000.

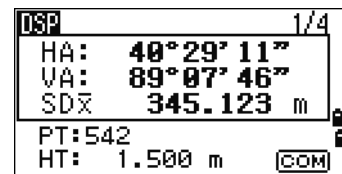
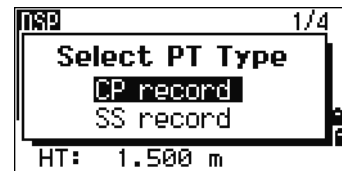
If the point name that you want to record already exists in the job, an error message appears. Depending on the type of existing record, you can overwrite the old record with the new data. For more information, see [Recording Data, page 173](#).



Hold down **[ENT]** for one second to record the measurement as a CP record.

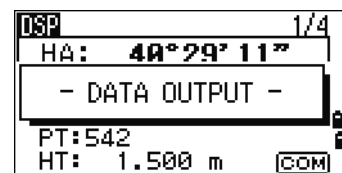
Outputting data to the COM port

If you press **[ENT]** while the **[COM]** icon appears in an observation screen, a line of data is output to the COM port.

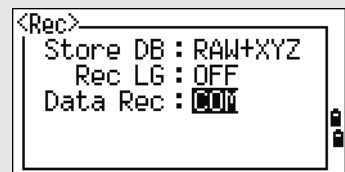


Note – If **[COM]** appears, data is **not** stored to the job when you press **[ENT]**.

The format of the output data is defined by the setting of the Ext.Comm field in **MENU > Settings > Comm**. For more information, see [Communications, page 111](#).



To output data on the COM port when you press **[ENT]**, set the Data Rec field in **MENU > Settings > Rec to COM**. For more information, see [Recording, page 112](#).



Sample output records through COM port

When the Ext.Comm field is set to NIKON:

TR PN: PT8 SD:000066626 HA:003856010 VA:008048500 HT:0000061757
(TR PN: point name SD HA VA HT; when ACK is returned, PN is incremented.)

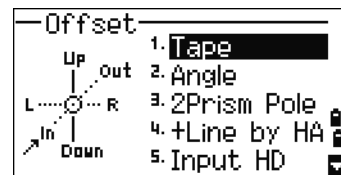
When the Ext.Comm field is set to SET:

0006662 0804806 0394324 97
(SD VA HA Chk-SUM)

Measuring Offsets

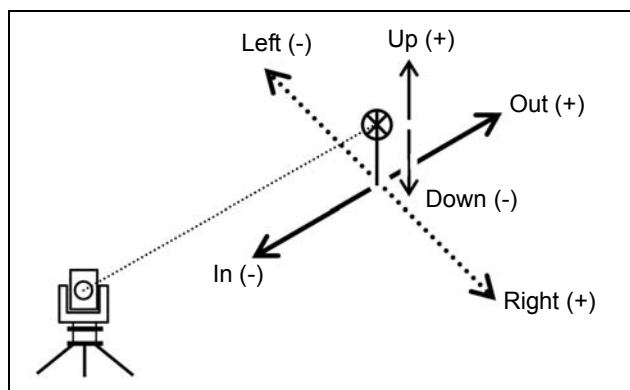
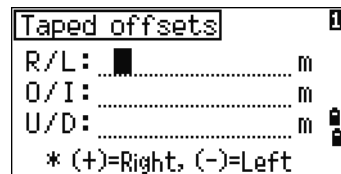
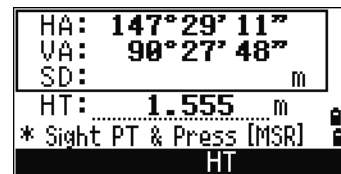
Measuring taped offsets

- To enter the taped offset function, press **[1]** or select **Tape** in the Offset menu.



If you have not taken a distance measurement before entering this function, a temporary measurement screen appears.

- Sight the target and press **[MSR1]** or **[MSR2]**.
- Enter offset distances from the measured point. Use **[↑]** or **[↓]** to move to the appropriate offset field.



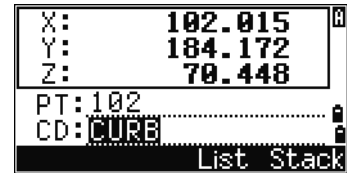
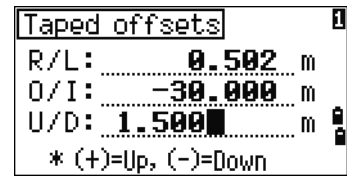
You can enter any combination of taped offset distances to specify the point.

- To go to the recording PT screen, press **[ENT]** in the last field.

The calculated coordinates are shown.

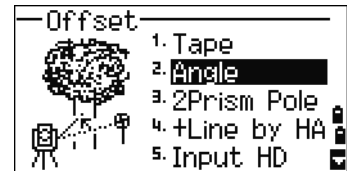
- Enter a PT (and CD) value.
- Press **[ENT]** to record the point.

Raw data is also recalculated, based on the taped offset value.



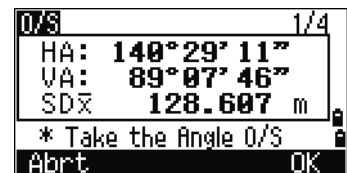
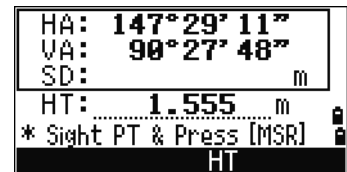
Measuring angle offsets

- To enter the angle offset function, press **[2]** or select **Angle** in the Offset menu.



If you have not taken a distance measurement before entering this function, a temporary measurement screen appears.

- Sight the target and press **[MSR1]** or **[MSR2]**.
- To take the angle offset, rotate the alidade and telescope. The measured distance (HD) remains unchanged.
- To record the offset point, press **[ENT]** or the **OK** softkey.

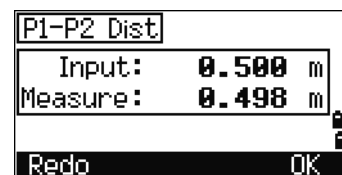
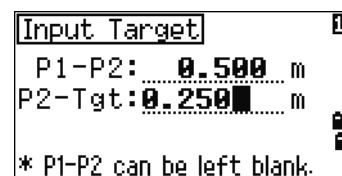
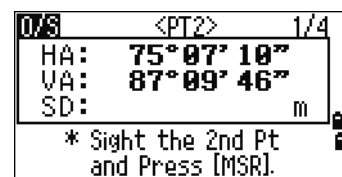
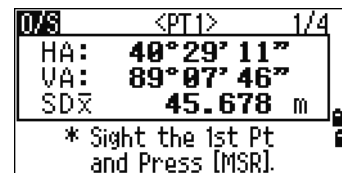
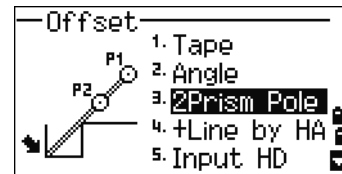


The XYZ data is also recalculated, based on the new angle.

You can record an angle offset in the Basic Measurement Screen (BMS). After taking a distance measurement, rotate the alidade and/or telescope. Then press **[ENT]** to record the measured distance with the updated angle value. If you use this method, the dimension of the angle offset is not stored as a CO record. To store the CO record, use the O/S function.

Two-prism pole

- To enter the two-prism pole function, press **[3]** or select **2Prism Pole** in the Offset menu.
- Sight the first prism and press **[MSR1]** or **[MSR2]**.
- Sight the second prism and press **[MSR1]** or **[MSR2]**.
- Enter the distance between the second prism and the target point. Alternatively, if you do not need QA information, you can leave the distance between the first and the second prism blank.
- If you do enter a P1-P2 distance, the QA screen appears. Compare the entered value and the measured distance to check the accuracy of the observation.
- To record the point, press **[ENT]** or the **OK** softkey.



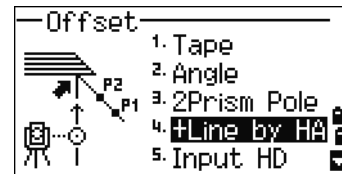
Sample records

SS,14,0.0000,38.9200,271.0350,89.2630,11:04:15,DITCH
 CO,2Prism O/S: P1-P2= 0.5090(0.5060) P2-Tgt= 0.5020

Note – In this sample data, 0.5090 is the measured value. 0.5060 is the entered value.

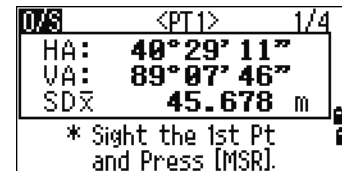
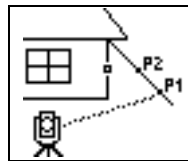
Extending a line by horizontal angle offset

1. To enter the line extension (by HA) function, press **[4]** or select **+Line by HA** in the Offset menu.

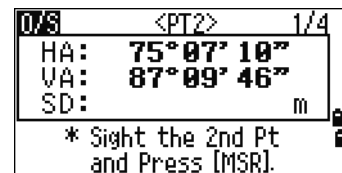
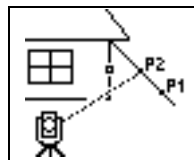


2. Sight the first prism (or target) and press **[MSR1]** or **[MSR2]**.

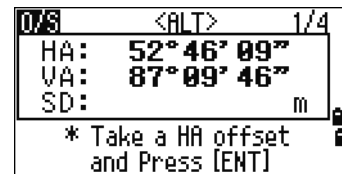
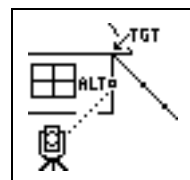
The display moves to the next screen.



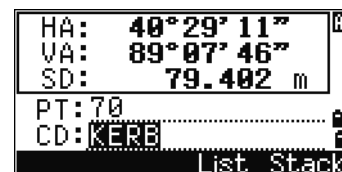
3. Sight the second prism (or target) and press **[MSR1]** or **[MSR2]**.



4. Sight the alternative place on the same vertical line as the required target point.



5. To calculate the coordinates and the raw data of the target point, press **[ENT]**.
6. To record the point, enter a PT (and CD) value and press **[ENT]**. The height of target is fixed to 0.0000 for the offset point.



Sample records

SS, 40, 0.0000, 48.3304, 169.20370, 82.02470, 10:52:37
 CO, PT1, 0.0000, 48.3020, 169.19165, 83.58565
 CO, PT2, 0.0000, 48.3155, 168.54250, 85.42440
 CO, O/S MSR:40 0.0000 0.0000 169.20370 87.02340

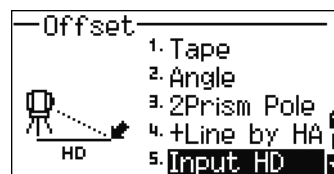
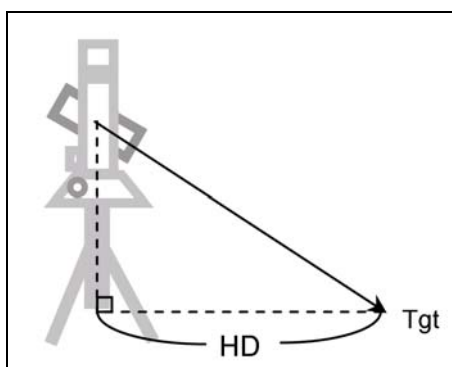
The calculated point (TGT) is stored as a SS record.

Measurements to the first and second target (P1 and P2) are stored as comment records (PT1 and PT2). The last record records the angle measurement to the ALT (vertically offset point from the actual target point).

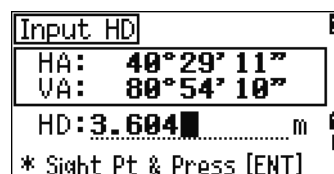
Entering a horizontal distance after an angle-only shot

This function is useful when the instrument is very close to the point and it is difficult to take a measurement using the EDM.

1. To enter the Input HD function, press **[5]** or select **Input HD** in the Offset menu.



2. Turn the telescope in the direction of the point that you want to store.
3. Enter the HD. Usually this is the taped distance from the instrument point.
4. Enter a PT (and CD) value and press **[ENT]**.
The target point is calculated and recorded as an SS record.

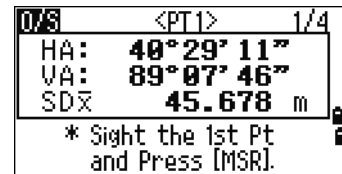
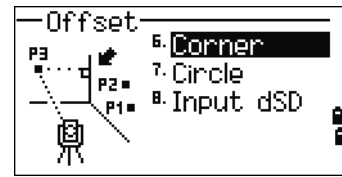
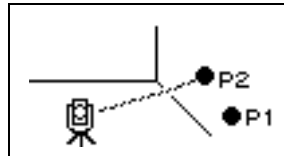


Sample records

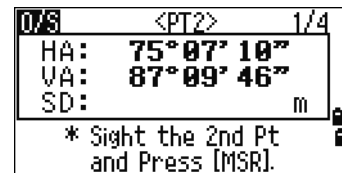
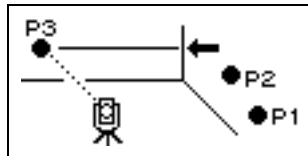
SS,158,0.0000,77.0518,62.08380,108.06510,11:51:48,
CO, Input HD:76.1243

Calculating a corner point

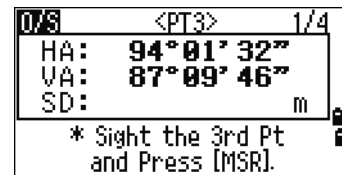
1. To enter the corner point function, press **6** or select **Corner** in the Offset menu.
2. Take a distance measurement to the first prism (or target) on the wall. Press **[MSR1]** or **[MSR2]**.
3. Sight a second point on the same wall with the first point measurement. Press **[MSR1]** or **[MSR2]**.



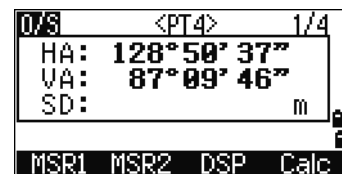
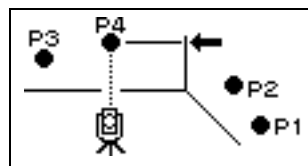
4. Sight the first point on the second wall. Press **[MSR1]** or **[MSR2]**.



5. If the two walls are at right angles, press the **Calc** softkey to calculate the corner point by three points.



6. If you take a measurement to a fourth point, the corner point can be calculated as the intersection of two walls (P1-P2 and P3-P4). The default elevation is given by P4.



7. Enter a PT (and CD) value. The height of target (HT) defaults to the value used in the last measurement.
8. To record the corner point, press **[ENT]**.



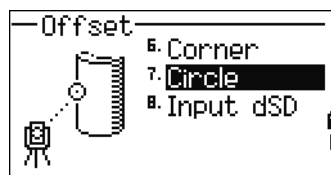
Sample records

SS, 58, 0.0000, 48.3304, 169.19165, 82.02470, 10:52:37, FLOOR2
 CO, PT1, 1.0080, 48.3020, 169.19165, 83.58565
 CO, PT2, 1.0080, 48.3155, 128.54250, 85.42440
 CO, O/S MSR:40 0.0000 0.0000 169.20370 87.02340

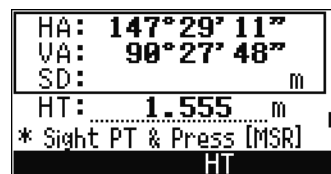
The calculated corner point is stored as an SS record.
 The next three or four comment records are measured points. For example:
 CO, Point name (fixed to PT1, PT2 etc.), HT, SD, HA, VA.

Measuring circle offsets

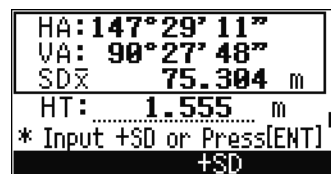
1. To enter the circle center calculation function, press **[7]** or select **Circle** in the Offset menu.



If you have not taken a measurement to the circle before entering this function, a temporary measurement screen appears.

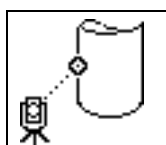


2. Sight any point on the surface of the circle and press **[MSR1]** or **[MSR2]**.



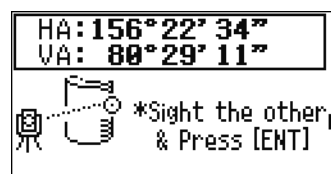
If you use a prism attached to the surface of the circle for the distance measurement, press the **+SD** softkey to eliminate the offset error (from the attached point to the measured surface of the prism) before you press **[ENT]**.

3. Sight one edge of the circle and press **[ENT]**.

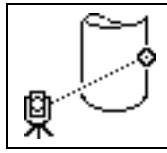


If you have taken a distance measurement to the center of the circle, press the **Calc** softkey to calculate the offset using one edge angle observation.

4. Sight the other edge of the circle and press **[ENT]**.



The instrument calculates and records the center of the circle.

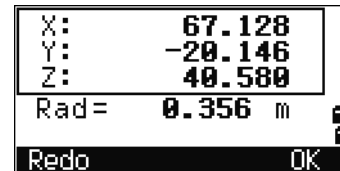


It also calculates the coordinates of the center point and the radius of the circle.

- To record the point, press **ENT** or the OK softkey.

Sample records

SS,71,1.5000,37.0518,32.08380,81.06510,11:51:48,
 CO, PT1, 0.0000, 0.0000,47.05350, 83.58560
 CO, PT2, 0.0000, 0.0000, 29.53010, 83.58560
 CO,O/S MSR:71 1.5555 36.5418 38.28360 81.06510
 CO,Radius of circle 0.356
 CO,Input +SD:0.0020



The calculated point (center of the circle) is stored as an SS record.

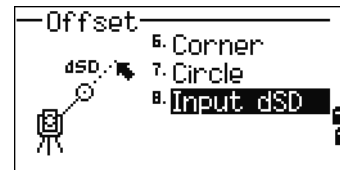
The following one or two comment records are angle-measured points. For example:

CO, Point name (fixed to PT1/ PT2), HT(0.0000), SD(0.0000), HA, VA.

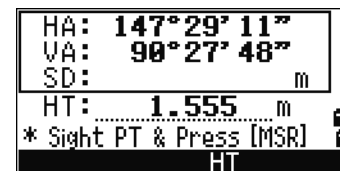
If you press the **+SD** softkey before you sight Edge1, the input value is recorded at the end.

Extending the slope distance

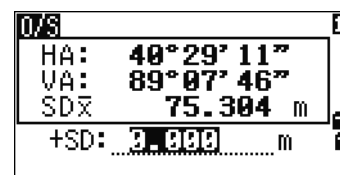
- To enter the function for extending the slope distance, press **Ⓢ** or select **Input dSD** in the Offset menu.



If you have not taken a distance measurement before entering this function, a temporary measurement screen appears.



- Enter the slope distance that you need to add or subtract. You can enter any value from -99.990 through +99.990 m (-328.000 through +328.000 ft).
- To record the point, press **ENT**.



Sample records

SS,83,1.5000,77.0518,62.08380,81.06510,11:51:48,
 CO,O/S MSR:83 1.5555 76.5518 62.08380 81.06510