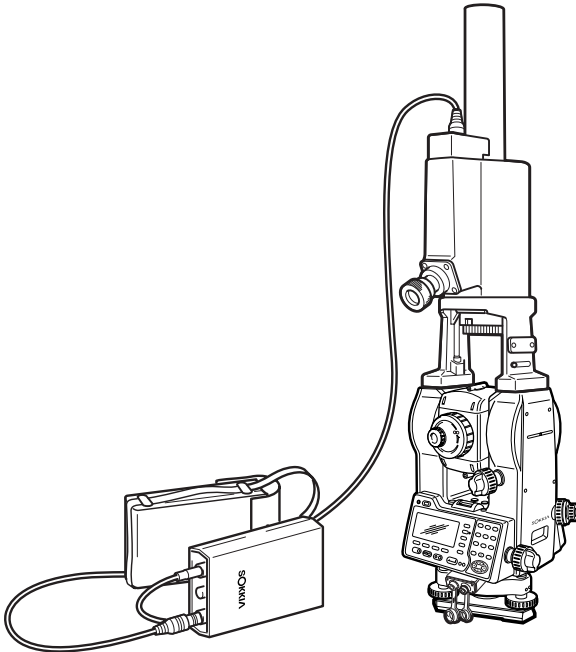


SOKKIA

**GP3130R
GP3130R3**

Gyro Station



GP3130R3:
CLASS 3R Laser Product

GP3130R:
CLASS 2 Laser Product

CLASS 1 LED Product

OPERATOR'S MANUAL



Ni-Cd

- **[English]** CONTAINS NICKEL-CADMIUM BATTERY. MUST BE RECYCLED OR DISPOSED OF PROPERLY.
- **[Deutsch]** MIT NiCd AKKU. EFORBERT RECYCLING ODER FACHGERECHTE ENTSORGUNG.
- **[Français]** CONTIENT UNE BATTERIE AU CADMIUM NICKEL. DOIT ÊTRE RECYCLÉE OU DONNÉE A UN ORGANISME DE RETRAITEMENT.
- **[Italiano]** CONTIENE NiCd BATTERIA. DEVE QUINDI ESSERE RICICLATA O ELIMINATA IN MODO APPROPRIATO.
- **[Nederlands]** BEVAT EEN NiCd BATTERIJ. DIENT GERECYCLEERD TE WORDEN OF OP EEN CORRECTE MANIER VERNIETIGD TE WORDEN.
- **[Español]** CONTIENE UNA NiCd BATERÍA. DEBE RECICLARSE O ELIMINARSE ADECUADAMENTE.
- **[Portugulês]** CONTEM BATERIA DE NÍQUEL CÁDMIO. DEVERÁ SER RECICLADA OU DEPARTADA CONVENIENTEMENTE.
- **[Svensk]** INNEHÅLLER NiCd BATTERI. BÖR ÅTERVINNAS ELLER FÖRSTÖRAS PÅ ETT SÅKERT SÄTT.
- **[Suomi]** SISÄLTÄÄ NIKKELI-KADMIUM AKUN. HÄVITETTÄESSÄ KÄSITELTÄVÄ ONGELMAJÄTTEENÄ.
- **[Norsk]** NiCd BATTERIER MÅ RESIRKULERES ELLER KASTES PÅ EN FORSVARLIG MÅTE.
- **[Dansk]** INDEHOLDER NiCd BATTERI. SKAL GENVINDES ELLER KASSERES PÅ FORSVARLIG MÅDE.
- **[Ελληνικά]** ΠΕΡΙΕΧΕΙ ΜΠΑΤΑΡΙΑ ΝΙΚΕΛΙΟΥ-ΚΑΔΜΙΟΥ. ΠΡΕΠΕΙ ΝΑ ΑΝΑΚΥΚΛΩΝΕΤΑΙ Η ΝΑ ΚΑΤΑΣΤΡΕΦΕΤΑΙ ΜΕ ΤΟΝ ΚΑΤΑΛΛΗΛΟ ΤΡΟΠΟ.

For U.S.A. ATTENTION:

The product that you have purchased contains a rechargeable battery. The battery is recyclable. At the end of its useful life, under various state and local laws, it may be illegal to dispose of this battery into the municipal waste stream. Check with your local solid waste officials for details in your area for recycling options or proper disposal. Use the standard battery charger.

Die Schweiz: Nach Gebrauch der Verkaufsstelle zurückgeben.

La Suisse: Après usage à rapporter au point de vente.

Swizzera: Ritornare la pila usate al negozio.


SET3130R: "Series 130R operator's manual"


:This is the mark of the Japan Surveying Instruments Manufacturers Association.

SOKKIA

GP3130R GP3130R3

Gyro Station

GP3130R3:
CLASS 3R Laser Product

GP3130R:
CLASS 2 Laser Product

CLASS 1 LED Product


OPERATOR'S MANUAL

- Thank you for selecting the GP3130R/3130R3.
- Before using the instrument, please read this operator's manual carefully.
- Verify that all equipment is included.
☞ "16. STANDARD EQUIPMENT"
- The specifications and general appearance of the instrument may be altered at any time and may differ from those appearing in brochures and this manual.
- Some of the diagrams shown in this manual may be simplified for easier understanding.
- This manual does not explain how to operate the SET surveying instrument. Before operating the GP1, please read the operator's manual for the SET instrument to be used.

INTRODUCTION

The gyroscopic total station GP3130R/3130R3 consists of a specially-adapted SET3130R/3130R3 electronic total station fitted with a GP1 gyroscope unit.

Features

- The GP1 gyroscope unit uses a suspended gyromotor which oscillates around the earth's meridian (true north) due to the principle of precession caused by the rotation of the earth.
 For GP1 theory, see "20. APPENDIX : PRINCIPLE OF THE GP1".
- The combination of the GP1 gyroscope and the SET3130R/3130R3 total station with special application software programs allows the true north position to be calculated by the SET instrument.
- Two different measurement methods (follow-up or time measurement) can be used to determine the true north position.
- The true north measurement can be performed regardless of the magnetic conditions to a mean accuracy of $\pm 20''$ (0.006 gon/0.10 mil).
- The calculated true north position can be easily transferred to the SET horizontal circle.

How to read this manual

- Except where stated, "GP3130R" means GP3130R/3130R3, "SET" means SET3130R/3130R3 in this manual.
- The following conventions are used in this manual.



: Indicates precautions and important items which should be read before operations.



: Indicates the chapter title to refer to for additional information.



: Indicates supplementary explanation.



: Indicates an explanation for a particular term or operation.

[DIST] etc. : Indicates softkeys on the display.

{ESCAPE} etc. : Indicates operation keys on the SET or wireless keyboard.

1. PRECAUTIONS FOR SAFE OPERATION	1
2. PRECAUTIONS	5
3. LASER SAFETY INFORMATION	7
4. PARTS OF THE INSTRUMENT	9
5. CONNECTING THE INSTRUMENTS	10
6. BASIC OPERATION	12
6.1 Mode Diagram	12
6.2 Key Functions	13
7. BATTERY CHARGING	16
8. PREPARATION FOR MEASUREMENT	17
8.1 Preparing for Measurement	17
8.2 Finishing Measurement	20
9. EXPLANATION OF MEASUREMENT MODES	21
9.1 Selection of Measurement Mode	21
9.2 Azimuth Display Mode	22
10. FOLLOW-UP MEASUREMENT	23
10.1 Determining the Turning Point	24
10.2 Procedure for Follow-up Measurement	25
11. TIME MEASUREMENT	27
12. INSTRUMENT CONSTANT MEASUREMENT MODE	31
13. ERROR MESSAGES	36
14. TROUBLE SHOOTING	37
14.1 Replacing the Fuse	38
14.2 Replacing the Light Bulb	39
15. CHECKS AND ADJUSTMENTS	40
15.1 Checking the Suspension Tape	41

CONTENTS

15.2 Zero Point Adjustment	42
15.3 Reticle Adjustment	43
16. STANDARD EQUIPMENT	45
17. SPECIFICATIONS	48
18. REGULATIONS	50
19. COMMUNICATION COMMANDS	52
20. APPENDIX : PRINCIPLE OF THE GP1	53

1. PRECAUTIONS FOR SAFE OPERATION

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

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

Definition of Indication



WARNING

Ignoring this indication and making an operation error could possibly result in death or serious injury to the operator.



CAUTION

Ignoring this indication and making an operation error could possibly result in personal injury or property damage.



This symbol indicates items for which caution (hazard warnings inclusive) is urged. Specific details are printed in or near the symbol.



This symbol indicates items which are prohibited. Specific details are printed in or near the symbol.









This symbol indicates items which must always be performed. Specific details are printed in or near the symbol.






1. PRECAUTIONS FOR SAFE OPERATION

General

Warning










-  Do not use the unit in areas exposed to high amounts of dust or ash, in areas where there is inadequate ventilation, or near combustible materials. An explosion could occur.
-  Do not perform disassembly or rebuilding. Fire, electric shock, burns or hazardous radiation exposure could result.
-  Never look at the sun through the telescope. Loss of eyesight could result.
-  Do not look at reflected sunlight from a prism or other reflecting object through the telescope. Loss of eyesight could result.
-  Direct viewing of the sun during sun observation will cause loss of eyesight. Use solar filter (option) for sun observation.
-  When securing the instrument in the carrying case make sure that all catches, including the side catches, are closed. Failure to do so could result in the instrument falling out while being carried, causing injury.

Caution


-  Do not use the carrying case as a footstool. The case is slippery and unstable so a person could slip and fall off it.
-  Do not place the instrument in a case with a damaged catch, belt or handle. The case or instrument could be dropped and cause injury.
-  Do not wield or throw the plumb bob. A person could be injured if struck.
-  Secure handle to main unit with locking screws. Failure to properly secure the handle could result in the unit falling off while being carried, causing injury.
-  Tighten the adjustment tribrach clamp securely. Failure to properly secure the clamp could result in the tribrach falling off while being carried, causing injury.

Power Supply

Warning

-  Do not use voltage other than the specified power supply voltage. Fire or electrical shock could result.
-  Do not use damaged power cords, plugs or loose outlets. Fire or electric shock could result.
-  Do not use power cords other than those designated. Fire could result.
-  Do not place articles such as clothing on the battery charger while charging batteries. Sparks could be induced, leading to fire.
-  Use only the specified battery charger to recharge batteries. Other chargers may be of different voltage rating or polarity, causing sparking which could lead to fire or burns.
-  Do not heat or throw batteries into fire. An explosion could occur, resulting in injury.
-  To prevent shorting of the battery in storage, apply insulating tape or equivalent to the terminals. Otherwise shorting could occur resulting in fire or burns.
-  Do not use batteries or the battery charger if wet. Resultant shorting could lead to fire or burns.
-  Do not connect or disconnect power supply plugs with wet hands. Electric shock could result.






Caution

-  Do not touch liquid leaking from batteries. Harmful chemicals could cause burns or blisters.

1. PRECAUTIONS FOR SAFE OPERATION

Tripod

Caution

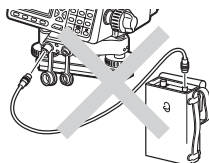
-  When mounting the instrument to the tripod, tighten the centering screw securely. Failure to tighten the screw properly could result in the instrument falling off the tripod, causing injury.
-  Tighten securely the leg fixing screws of the tripod on which the instrument is mounted. Failure to tighten the screws could result in the tripod collapsing, causing injury.
-  Do not carry the tripod with the tripod shoes pointed at other persons. A person could be injured if struck by the tripod shoes.
-  Keep hands and feet away from the tripod shoes when fixing the tripod in the ground. A hand or foot stab wound could result.
-  Tighten the leg fixing screws securely before carrying the tripod. Failure to tighten the screws could lead to the tripod legs extending, causing injury.

2. PRECAUTIONS



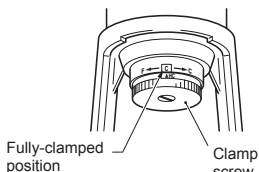
Please ensure that you are fully familiar with the SET3130R/3130R3 instrument and Operator's Manual before using this manual.

- Handle the GP3130R Gyroscopic Total Station with care and avoid heavy shocks or vibration.
- Do not connect the three pin cable connector (12V) to the SET External power source connector (6V) located in the lower part of the SET, as the voltage is different.



The three pin cable should only be used for connection between the Inverter and battery (BDC7).

- As the battery capacity is limited to about 3 hours for continuous measurement, it is advised that all the measurements at the same survey station are performed without switching the power off. (The running-up of the gyro uses a large amount of battery power.)
- Charge the battery after measurements, using the charger CDC7.
- Ensure that the gyromotor is fully clamped before switching on or off the GP1. (The suspension tape seldom breaks when the correct clamping procedure is followed.)



- When removing the battery from the GP1, ensure that the gyromotor has been clamped, and the power switched off.
- When storing the GP1, make sure that the clamping ring has been fully tightened and put the clamp lock over the clamping ring.



2. PRECAUTIONS

Other precautions

- Never place the GP3130R directly on the ground. Sand or dust may cause damage to the screw holes or the centering screw on the base plate.
- Do not aim the telescope at the sun.
- Protect the GP3130R from heavy shocks or vibration.
- Never carry the GP3130R on the tripod to another site.
- Turn the power off before removing the battery.
- When placing the GP3130R in its case, first remove its battery and place it in the case in accordance with the layout plan.

Maintenance

- The gyromotor should be overhauled three years after the purchase date, or after 3000 hours of use, whichever occurs sooner.
- Always clean the instrument before returning it to the case. The lens requires special care. First, dust it off with the lens brush to remove tiny particles. Then, after providing a little condensation by breathing on the lens, wipe it with the wiping cloth.
- If the display is dirty, carefully wipe it with a soft, dry cloth. To clean other parts of the instrument or the carrying case, lightly moisten a soft cloth in a mild detergent solution. Wring out excess water until the cloth is slightly damp, then carefully wipe the surface of the unit. Do not use any organic solvents or alkaline cleaning solutions.
- Store the GP3130R in a dry room where the temperature remains fairly constant.
- Check the tripod for loose fit and loose screws.
- If any trouble is found on the rotatable portion, screws or optical parts (e.g. lens), contact your SOKKIA agent.
- When the instrument is not used for a long time, check it at least once every 3 months.
- When removing the GP3130R from the carrying case, never pull it out by force. The empty carrying case should be closed to protect it from moisture.
- Check the GP3130R for proper adjustment periodically to maintain the instrument accuracy.

3. LASER SAFETY INFORMATION

GP3130R is classified as the following class of Laser Product and LED Product according to IEC Standard Publication 60825-1 Amd. 2: 2001 and United States Government Code of Federal Regulation FDA CDRH 21CFR Part 1040.10 and 1040.11 (Complies with FDA performance standards for laser products except for deviations pursuant to Laser Notice No.50, dated July 26, 2001.)


GP3130R3:

- EDM device in objective lens: Class 3 Laser Product (Class 1 Laser Product when prism or reflective sheet is selected in Config mode as target on the SET.)
- Guide light (optional function): Class 1 LED Product

GP3130R:

- EDM device in objective lens: Class 2 Laser Product (Class 1 Laser Product when prism or reflective sheet is selected in Config mode as target on the SET.)
- Guide light (optional function): Class 1 LED Product




- EDM device is classified as Class 3R Laser Product (GP3130R3)/ Class 2 Laser Product (GP3130R), however the equivalent of class 2 output is emitted only when reflectorless measurement is selected. When the prism and reflective sheet is selected in Config mode as target, the output is equivalent to the safer class 1.
- The guide light is an optional function.
 " Series 130R Operator's manual "

Warning

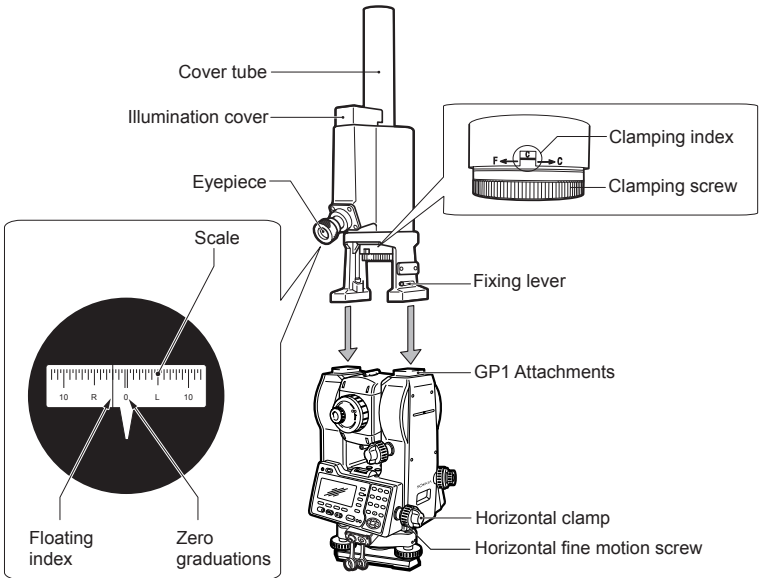
- Use of controls or adjustments or performance of procedures other than those specified herein may result in hazardous radiation exposure.
- Follow the safety instructions on the labels attached to the instrument as well as in this manual to ensure safe use of this laser and LED product. The position of these labels are described in the SET operator's manual. The position of the GP3130R3 labels correspond to those for class 3R products and the labels for the GP3130R correspond to those for class 2 products.
- Never point the laser beam at another person. If the laser beam strikes skin or an eye, it could cause serious injury.
- Do not look directly into the laser beam source. Doing so could cause permanent eye damage.
- Do not stare at the laser beam. Doing so could cause permanent eye damage.
- If an eye injury is caused by exposure to the laser beam, seek immediate medical attention from a licensed ophthalmologist.
- Never look at the laser beam through a telescope, binoculars or other optical instruments. Doing so could cause permanent eye damage. (GP3130R3 only)
- Sight the targets so that laser beam does not stray from them. (GP3130R3 only)

3. LASER SAFETY INFORMATION

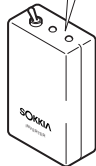
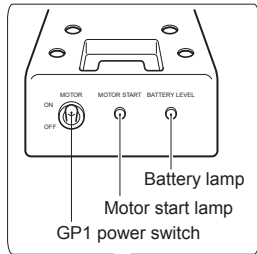
Caution

- Perform checks at start of work and periodic checks and adjustments with the laser beam emitted under normal conditions.
- When the instrument is not being used, turn off the power.
- When disposing of the instrument, destroy the battery connector so that the laser beam cannot be emitted.
- Operate the instrument with due caution to avoid injuries that may be caused by the laser beam unintentionally striking a person in the eye. Avoid setting the instrument at heights at which the path of the laser beam may strike pedestrians or drivers at head height.
- Never point the laser beam at mirrors, windows or surfaces that are highly reflective. The reflected laser beam could cause serious injury.
- When using the Laser-pointer function, be sure to turn OFF the output laser after distance measurement is completed. Even if distance measurement is canceled, the Laser-pointer function is still operating and the laser beam continues to be emitted. (After turning ON the Laser-pointer, the laser beam is emitted for 5 minutes, and then automatically switches OFF. But in the Status screen and when target symbol (ex. ) is not displayed in the Measurement mode, the laser beam is not automatically turned off.)
- Only those who have been received training as per the following items shall use this product. (GP3130R3 only)
 - Read the Operator's manual for usage procedures for this product.
 - Hazardous protection procedures (read this chapter).
 - Requisite protective gear (read this chapter).
 - Accident reporting procedures (stipulate procedures beforehand for transporting the injured and contacting physicians in case there are laser induced injuries).
- Persons working within the range of the laser beam are advised to wear eye protection for Helium Neon radiation. Recommended safety glasses from Yamamoto Optics Co., Ltd. (GP3130R3 only)
- ① Full Absorption type YL-331 (for He-Ne laser radiation) or ② Maintenance type YL-331M (for visible semiconductor laser radiation)
- Areas in which the lasers are used should be posted with laser warning notices. (GP3130R3 only)

4. PARTS OF THE INSTRUMENT

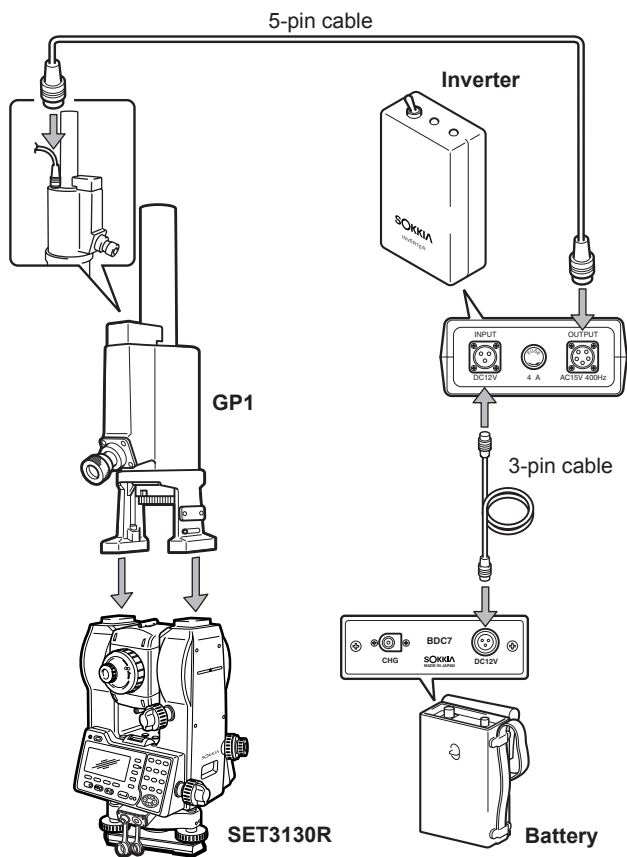


GP3130R



Inverter

5. CONNECTING THE INSTRUMENTS



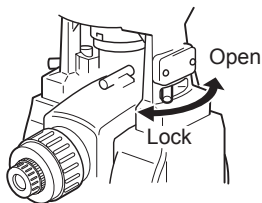
To connect the instruments follow the procedure described below.

► PROCEDURE

1. Set up the tripod over the measurement point and mount the SET on the tripod.

☞ "Series 130R operator's manual"

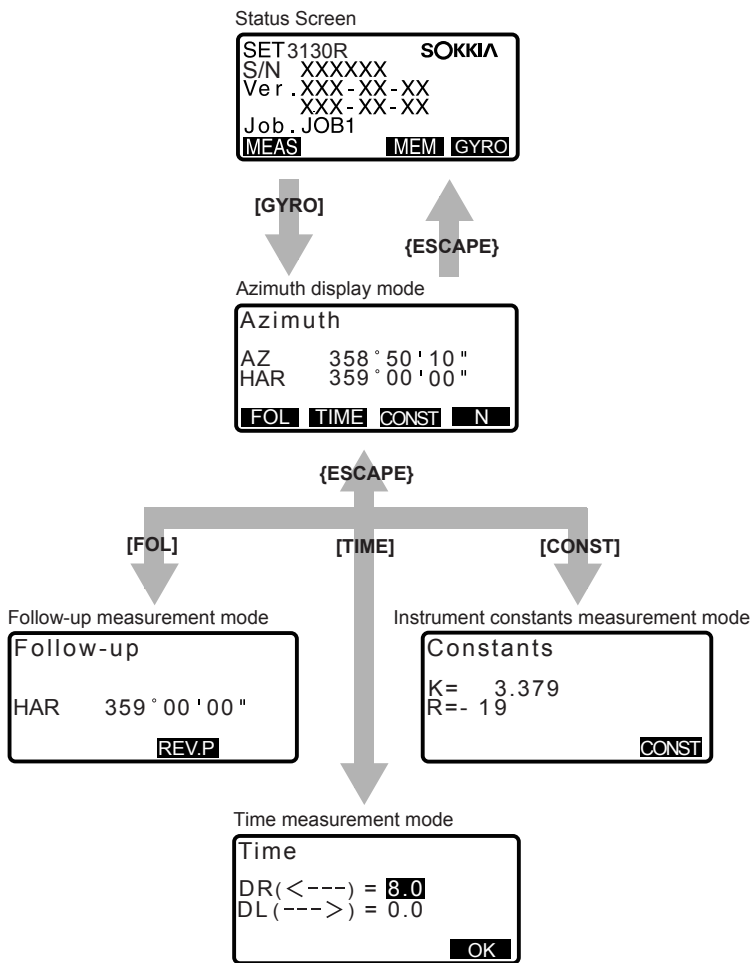
2. Set the GP1 fixing levers to the open position. Lower the GP1 onto the SET and lock the fixing levers.



3. Connect the GP1 connector to the Inverter OUTPUT connector with the 5-pin cable.
4. Connect the Inverter INPUT connector to the battery DC 12V connector with the 3-pin cable.
5. Perform leveling as described in ☞ "Series 130R operator's manual"

6. BASIC OPERATION

6.1 Mode Diagram



6.2 Key Functions

● Azimuth display mode

[N]	Transfer the measured azimuth angle (the angle from calculated true north) to the original horizontal angle value.
{ESCAPE}	Return to the Status screen.

● Follow-up measurement mode

[FOL]	Enter the Follow-up measurement mode.
[REV.P]	Enter the reversing (turning) point position.
[OK]	End the Follow-up measurement, compute the true north position and exit to the Azimuth display mode.
[CE]	Delete the last turning point value.
{ESCAPE}	Cancel the Follow-up measurement. Azimuth angle will not be calculated.

● Time measurement mode

[TIME]	Enter the Time measurement mode.
[EPOCH]	Enter the Time that the floating index mark crosses the zero graduations of the gyro scale.
{▶}	Select L (which side of zero the floating index is).
{◀}	Select R (which side of zero the floating index is).
[AMP]	Enter DR or DL (amplitude of the R and L turning points).
[OK]	End the Time measurement, compute the true north position and exit to the Azimuth display mode.
[CE]	Delete the last input of the [EPOCH] (i.e. if the [EPOCH] has been pressed too early or late), and restart the Time measurement procedure.
{ESCAPE}	Cancel the Time measurement. Azimuth angle will not be calculated.

● Instrument constants measurement mode

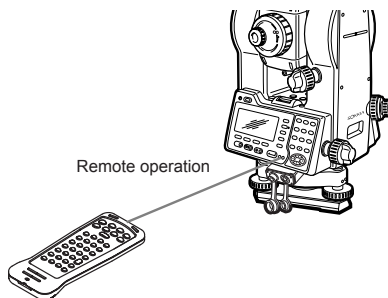
[CONST]	Enter the Instrument constants measurement mode.
[N]	<ul style="list-style-type: none"> • When sighting the known true north position, set the instrument to this true north direction. • Finish measurement in each direction. (After 3rd direction measurement, K and R are calculated and displayed.)
[EPOCH]	Enter the time that the floating index mark crosses the zero graduations of the gyro scale.
{▶}	Select L (which side of zero the floating index is).

6. BASIC OPERATION

{←}	Select R (which side of zero the floating index is).
[AMP]	Enter DR or DL (amplitude of the R and L turning points).
{ESCAPE}	Cancel the Instrument constants measurement. Instrument constants will not be calculated.
[CE]	Delete the last input of the [EPOCH] (i.e. if the [EPOCH] has been pressed too early or late), and restart the Instrument constants measurement procedure.
[REC]	Memorize the constant obtained by the measurement in SET, end the Instrument constant measurement and exit to the Azimuth display mode.

Key operation for Wireless Keyboard (SF14)

The GP3130R is operated from the Wireless Keyboard by pointing the Wireless Keyboard beam at the Beam Detector on the SET and pressing the required operation keys.



- When sunlight shines directly into the Beam Detector on the SET, the Wireless Keyboard may not work correctly.
- If other SETs are turned ON and placed within the operating range of the Wireless Keyboard, they may be unintentionally operated at the same time.
- Do not place the keyboard under heavy objects or in a tight space. A key may be continuously depressed and deplete battery power.
- Ni-Cd batteries are recommended when operating the Wireless Keyboard under low temperatures.
- In temperatures around -20°C , the SET may function erratically if the Wireless Keyboard is operated too close to the SET. Hold the Wireless Keyboard further away from the SET and at various angles to the Beam Detector until normal operation is resumed.

● Inputting letters / figures

{A/N}	Switch between numerals and alphabetic characters
{A} to {Z}	During numeric input, input numeral or symbol (+/- and .) printed above the key During alphabetic input, input the character of the key
{BS}	Delete a character on the left
{ESC}	Cancel the input data
{SFT}	Switch between upper and lower case
{←}	Select / accept input word / value

● Selecting options

{R} / {U} (▲/▼ is printed above the key)	Up and down cursor (numeric input mode)
{V} / {T} (▶/◀ is printed above the key)	Right and left cursor / Select other option (numeric input mode)
{←}	Accept the option


Note

- Other operations (softkey operations and switching modes) are the same for the operation panel on the SET.
- Power On/Off, lighting up the display, Laser-pointer and Guide light (optional function) On/Off cannot be done on the Wireless Keyboard.

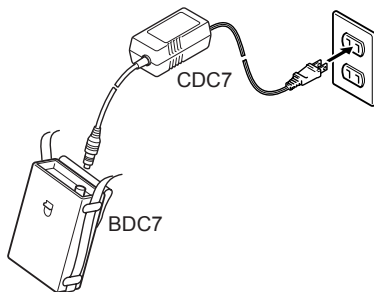
7. BATTERY CHARGING



- Charge the battery at a temperature between 10°C and 40°C. The higher the temperature, the longer the charging time will be.
- The battery charger normally becomes warm while charging.
- Do not use the charger to charge more than two batteries in quick succession.

► PROCEDURE

1. Connect the charger CDC7 power plug to a wall socket.
2. Connect the charger CDC7 cable to the battery BDC7. Make sure the battery lamp is on.
3. About 15 hours are required for charging.
4. When charging is over, unplug the charger from the wall socket and disconnect the CDC7 cable from the BDC7.



8. PREPARATION FOR MEASUREMENT

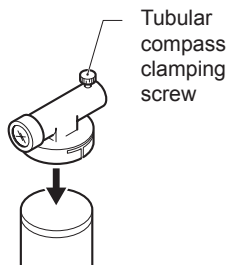
This chapter will describe the preparations necessary for measurement as well explaining how to finish measurement.

8.1 Preparing for Measurement

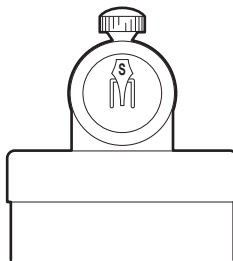
Follow the procedure below to prepare for measurement.

► PROCEDURE

1. Mount the tubular compass on the top of the GP1 and align the compass body with the SET telescope. Loosen the tubular compass clamping screw.



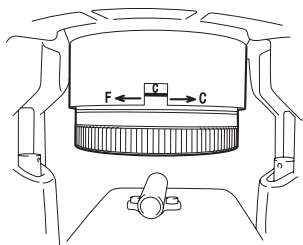
2. Use the horizontal clamp and horizontal fine motion screw to turn the SET until the tubular compass needle is centered between the S index lines. The SET is now pointing towards approximate magnetic north. Where the compass is not usable, use any other available means to point the SET telescope in the north direction; e.g. map, sun, time etc.



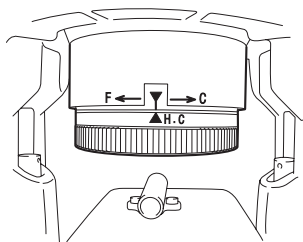
3. Do not turn on the gyromotor - check that the movement of the pendulum is symmetrical around the zero graduations using the following procedure.


8. PREPARATION FOR MEASUREMENT

- a. Turn the clamp screw fully in the C direction until the "C" mark can be seen in the clamping index. The pendulum is now fully clamped - **FULL CLAMP position**.



- b. Turn the clamp screw in the F direction until the "▼" mark can be seen in the clamping index. Continue turning in the F direction until the "▲HC" mark on the clamp screw is aligned with the "▼" mark in the clamping index. The pendulum is now only lightly clamped. This is the **HALF-CLAMP position**.




- c. Wait for approx. 10 seconds at this position to allow the pendulum movement to settle. Check the floating index movement.
- d. Now turn the clamp screw fully in the F direction. When the clamp can be turned no further in the F direction the **FREE position** has been reached. The pendulum is now freely suspended.
- e. Check that the floating index is moving symmetrically around the zero graduations. If the movement is not symmetrical,  see page 42 "15.2 Zero Point Adjustment".

8. PREPARATION FOR MEASUREMENT

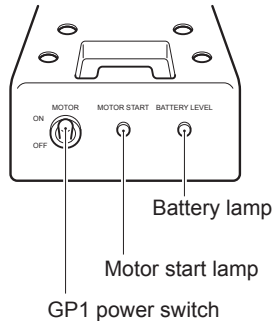
f. Turn the clamp screw back in the C direction until the pendulum is in the FULL CLAMP position once again.

4. Switch on the GP1 power switch located on the inverter.



- When the battery power becomes low the battery lamp is lit red. Recharge the battery. For how to recharge the battery, see  "7. BATTERY CHARGING".

5. Approximately 60 seconds after turning on the power, the motor start lamp is lit green. This indicates that the gyromotor is rotating correctly.



Preparation for measurement with the GP1 is complete.

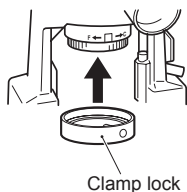
8. PREPARATION FOR MEASUREMENT

8.2 Finishing Measurement

Always follow the procedure below to finish measurement. This procedure should also be performed when moving to a different point.

► PROCEDURE

1. Turn the clamp screw in the C direction until the pendulum is in the FULL CLAMP position.
2. Check that the pendulum is in the FULL CLAMP position then turn off the power to the GP1 using the switch on the inverter.
3. Wait for approx. 10 minutes for the motor to come to a complete standstill. Check that no sound is coming from the motor and put the clamp lock over the clamping screw, then store in the carrying case or move to the next point.



9. EXPLANATION OF MEASUREMENT MODES

This section will explain the Selection of measurement mode and the Azimuth display mode which is displayed before and after the execution of true north measurement.

9.1 Selection of Measurement Mode

Both Follow-up (Turning point) measurement and Time measurement may be used to make a true north measurement.

Follow-up measurement (using 2 turning points) may be used to quickly obtain an approximate true north position. Repeat this measurement when the initial approximate alignment of the SET telescope with true north is not close to true north.

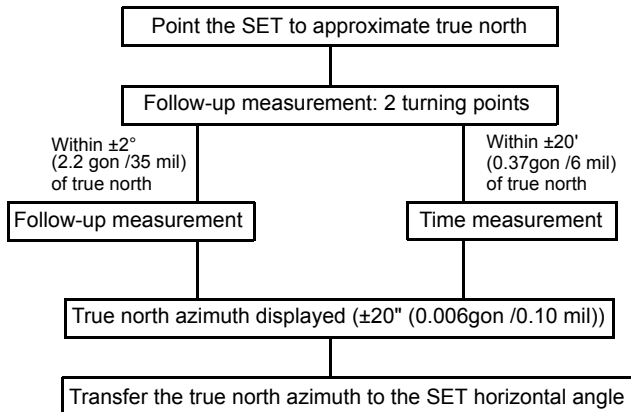
Follow-up measurement (using 3 or more turning points) can be used to determine an accurate true north position within 20" when the telescope can be roughly pointed to within $\pm 2^\circ$ of true north before measurement.

 "10. FOLLOW-UP MEASUREMENT"

Time measurement can be used to determine an accurate true north position within 20" when the telescope can be roughly pointed to within $\pm 20'$ of true north before measurement.

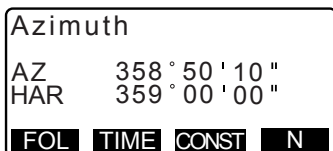
 "11. TIME MEASUREMENT"

Although the accuracy of both Follow-up measurement and Time measurement are the same when determining true north, the procedures are quite different. It is recommended that the results obtained by each mode be compared to check the accuracy of the measurements.



9.2 Azimuth Display Mode

Press **[GYRO]** in the SET status screen to enter the Azimuth display mode.



- The azimuth (angle from the calculated true north position) is displayed in AZ and the horizontal angle is displayed in HAR. The horizontal angle can be displayed as a clockwise/counterclockwise value whereas the azimuth can only be displayed as a clockwise value.
- The true north position determined using Follow-up measurement or Time measurement is recorded in SET and retained even after using the horizontal angle 0 SET and hold functions.
- Press **[N]** to transfer the azimuth angle to the horizontal angle. The azimuth angle is now displayed as a horizontal angle, even in the SET measurement mode.
- To perform true north measurement, rotate the SET until the displayed AZ value (azimuth angle) is 0° 00' 00".
 - ☞ "10. FOLLOW-UP MEASUREMENT"
 - ☞ "11. TIME MEASUREMENT"
- When the instrument constants K and R have been reset in the Instrument constants measurement mode the current azimuth angle settings cease to be in effect and the azimuth angle is no longer displayed. To display the azimuth angle, perform either Follow-up measurement or Time measurement.
 - ☞ "12. INSTRUMENT CONSTANT MEASUREMENT MODE"

10. FOLLOW-UP MEASUREMENT



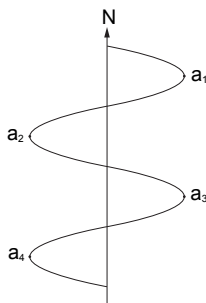
- Follow-up measurement involves rotation of the SET which can cause the pendulum to move. Such vibrations of the pendulum can adversely affect the accuracy of the results. Care must be taken to rotate the SET without disturbing the pendulum movement.

Follow-up measurement involves carefully rotating the SET to follow the movement of the floating index. When the floating index reaches its turning point, press **[REV.P]** to record the horizontal angle. When 2 or more successive turning points have been recorded, the true north direction can be determined. To improve the accuracy of true north determination, the SET telescope should be roughly pointed to within $\pm 2^\circ$ of true north, and 3 or more successive turning points should be measured.

Note

- The turning point is the point at which the movement of the floating index switches $R \rightarrow L$ or $L \rightarrow R$. As the index approaches the turning point it appears to slow down and stop, before changing direction.

Theory of the follow-up measurement:



When the number of turning points is 2 :

$$N = \frac{a_1 + a_2}{2} + R$$

a_1, a_2 = turning points

N = true north

R = alignment constant

When the number of turning points is over 3:

$$N = \left(\frac{a_1 + a_3 + a_2}{2} + \frac{a_2 + a_4 + a_3}{2} \dots \dots + \frac{a_{n-2} + a_n + a_{n-1}}{2} \right) \cdot \frac{1}{n-2} + R$$

10. FOLLOW-UP MEASUREMENT

10.1 Determining the Turning Point

Set the GP1 to the HALF-CLAMP position and wait approx. 10 seconds to allow the movement of the floating index to settle. Then, slowly open to the FREE position. The floating index moves in the R or L direction. By rotating the SET using the horizontal clamp and horizontal fine motion screw, the index can be kept close to zero.

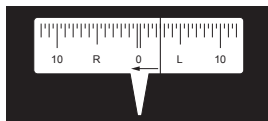


- If the floating index appears to make fine oscillations after turning the clamping screw to the FREE position, turn the clamp back halfway in the C direction. When these irregular movements have ceased release the clamp back to the FREE position.
- If the speed of the floating index appears to be too fast after turning the clamping screw to the FREE position, movements of 5 or 10 graduations may be necessary to follow it.

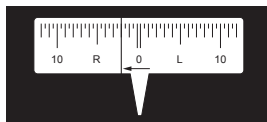
The following is a method for following the floating index.

►PROCEDURE

Example: Assuming that the index is starting from the 2nd graduation on the L side of zero and is moving in the R direction.

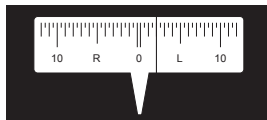


1. Wait until the index comes to the 2nd graduation on the R side of zero.

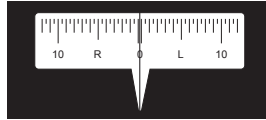


2. Rotate the SET using the horizontal clamp and horizontal fine motion screw until the index is at the opposite 2nd graduation on the L side.

Rotate the SET



3. The index moves in the L → R direction once again. When the index movement slows repeat the procedure described in Steps 1 and 2 rotating the SET at smaller and smaller graduations, first 1 then 0.5 graduations.
4. The turning point has been reached when the index comes to a standstill in the zero graduations.

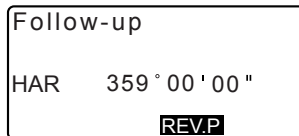


10.2 Procedure for Follow-up Measurement



- If a mistake is made when pressing **[REV.P]** at the turning point, **[CE]** can be used to delete the last input value.
- After deleting the last input value by pressing **[CE]**, continue measurement starting with the next turning point in the same direction (e.g. If **[CE]** is pressed at the turning point on the R side of zero, the next measurement should be the turning point on the R side of zero).

1. Press **[FOL]** to shift to Follow-up measurement from the Azimuth display screen.

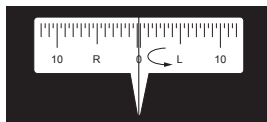


2. To prepare for measurement set the GP1 to the HALF-CLAMP position and wait approx. 10 seconds to allow the movement of the floating index to settle. Then, slowly open to the FREE position.

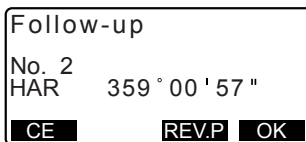
10. FOLLOW-UP MEASUREMENT

3. Enter the turning point.
☞ "10.1 Determining the Turning Point".

Press **[REV.P]** when the turning point is aligned with the zero graduations.



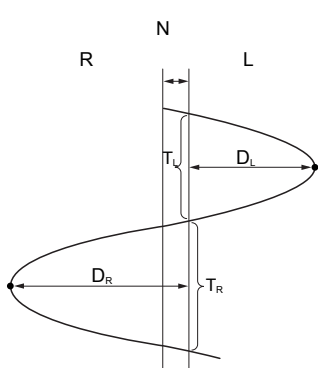
4. Input the turning point values for the turning point measured in Step 3 and the opposite turning point.



5. Continue pressing **[REV.P]** until the required number of turning points have been measured. The minimum number is 2 and the maximum number is 10.
6. Press **[OK]** to end follow-up measurement when input is complete. After one long audio tone, the true north position is calculated and the SET returns to the azimuth display screen. After the 10th turning point has been measured, the true north position is automatically calculated and the SET exits to the azimuth display screen.
7. When switching to a different measurement mode, always set the GP1 to the FULL CLAMP position before starting measurement again.
If all measurements have been completed, set the GP1 to the FULL CLAMP position then turn off the power.
☞ "8.2 Finishing Measurement"

11. TIME MEASUREMENT

When conducting Time measurement, measurement begins once the turning points in both the L and R directions occur on the graduated scale without moving the SET instrument. By inputting the DR/DL values, i.e. the amplitude of the R and L turning points (position of the turning points on the graduated scale), and pressing a key each time the floating index crosses the zero graduations, it is possible to calculate a true north position.



$$\theta = -(K \cdot D \cdot Dt + R)$$

K = Instrument constant

R = Alignment constant

$D = (DR + DL) / 2$: Average of the R and L amplitude values.

$Dt = TR - TL$: Time difference between successive zero crossings.



- Before starting Time measurement point the telescope approximately in the direction of true north to within $\pm 20'$ using Follow-up measurement (2 turning points). ☞ "10. FOLLOW-UP MEASUREMENT"
- If the floating index appears to make fine oscillations after turning the clamping screw to the FREE position, turn the clamp halfway in the C direction. When these irregular movements have ceased release the clamp back to the FREE position.
- For correct measurement, the index should have steady movement, and an R and L amplitude in the range of 8-10 graduations either side of 0. The amplitude of the index can be changed by first re-tightening the clamp to the FULL CLAMP position, then releasing again until the FREE position is reached once again.
- If a mistake is made when pressing **[EPOCH]** at the crossing of the zero graduations, the **[CE]** can be used to delete the last input value.
- After deleting the last input value by pressing **[CE]**, continue measurement starting with the next crossing of the zero graduations.

11. TIME MEASUREMENT

►PROCEDURE

1. Perform Follow-up measurement (2 turning points).

☞ "10. FOLLOW-UP MEASUREMENT".

Determine true north to within $\pm 20'$. Point the telescope to Azimuth $0^\circ 00' 00''$ in the Azimuth display mode.

2. Press **[TIME]** in the Azimuth display mode to enter the Time measurement mode.
3. Set the GP1 to the HALF-CLAMP position and wait approx. 10 seconds to allow the movement of the floating index to settle. Then, slowly open to the FREE position.

4. Read the position of the R-side turning point on the graduated scale to the nearest 0.1 units. Input this DR value (amplitude) and press **[OK]**.



Time
DR(<---) = 8.0
DL(--->) = 0.0
OK

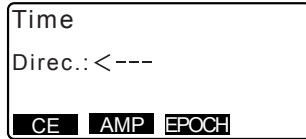
5. Read the position of the L-side turning point on the graduated scale to the nearest 0.1 units. Input this DL value (amplitude) and press **[OK]**.

Time
DR(<---) = 8.0
DL(--->) = 8.2
OK

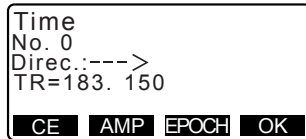
6. At the moment the floating index crosses the zero graduations, press **[EPOCH]**. The <---> symbol flashes.

Time
Take Reading
CE EPOCH

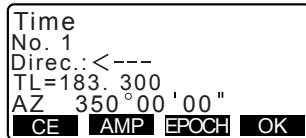
7. After the floating index has crossed the zero graduations input whether it is on the R or L side of the zero graduations. If it is on the R side of zero, press . If it is on the L side of zero, press . After inputting the direction, the relevant arrow symbol will be displayed.
- Press **[AMP]** to change the amplitudes (DR and DL) input in Steps 4 and 5.



8. At the moment the floating index crosses the zero graduations, press **[EPOCH]**. The time (sec.) taken for this half-cycle is displayed in TR/TL.




9. At the moment the floating index crosses the zero graduations, press **[EPOCH]**. The time (sec.) taken for this second half-cycle is displayed in TR/TL. The calculated azimuth angle is displayed in AZ. After the input of the full cycle, an audio warning is given approximately 20 seconds before the floating index is due to cross the zero graduations.



10. Continue to press **[EPOCH]** for the required number of crossings of the zero graduations. The maximum is 255.

11. TIME MEASUREMENT

11. Press **[OK]** to end Time measurement when input is complete. After one long audio tone, the true north position is calculated and the SET returns to the azimuth display mode. After the 255th value has been input, the true north position is automatically calculated and the SET exits to the azimuth display mode.

12. When switching to a different measurement mode, always set the GP1 to the FULL CLAMP position before starting measurement again.
If all measurements have been completed, set the GP1 to the FULL CLAMP position then turn off the power.
 "8.2 Finishing Measurement"

12. INSTRUMENT CONSTANT MEASUREMENT MODE


Instrument constant measurement should be performed after the suspension tape has been replaced or if the measuring location is greatly different in latitude from the previous location.

The instrument constant K and alignment constant R can be obtained using Instrument constant measurement when an accurate true north position is known. Three measurements are taken: $0^{\circ} 00' 00''$ (true north), $0^{\circ} 10' 00''$, $359^{\circ} 50' 00''$. After the instrument constants have been set, the current azimuth angle settings will be lost.



- If the floating index appears to make fine oscillations after turning the clamping screw to the FREE position, turn the clamp halfway in the C direction. When these irregular movements have ceased release the clamp back to the FREE position.
- For correct measurement, the index should have steady movement, and an R and L amplitude in the range of 8-10 graduations either side of 0. The amplitude of the index can be changed by first re-tightening the clamp to the FULL CLAMP position, then releasing again until the FREE position is reached once again.
- If a mistake is made when pressing **[EPOCH]** at the crossing of the zero graduations, the **[CE]** can be used to delete the last input value.
- After deleting the last input value by pressing **[CE]**, continue measurement starting with the next crossing of the zero graduations.

► PROCEDURE

1. Prepare for measurement.
 "8. PREPARATION FOR MEASUREMENT"
Check that the GP1 is in the FULL CLAMP position.

2. Press **[CONST]** in the azimuth display mode to enter the instrument constants measurement mode. The current instrument constants are displayed.

Constants	
K=	3.379
R=-	19
CONST	

3. Press **[CONST]** twice in quick succession. The button blinks on the first press.

12. INSTRUMENT CONSTANT MEASUREMENT MODE

4. Sight true north and press **[OK]**.
The horizontal angle will be set to 0°.

```
Constants
          0 Set
HAR  350° 00' 00"
OK
```

5. Sight the 1st direction and press **[OK]**. The 1st direction should always be true north.

```
Constants
Obs. Direc.:1
HAR  0° 00' 00"
OK
```

►PROCEDURE The first direction measurement

6. Set the GP1 to the HALF-CLAMP position and wait approx. 10 seconds to allow the movement of the floating index to settle. Then, slowly open to the FREE position.

7. Read the position of the R-side turning point on the graduated scale to the nearest 0.1 units. Input this DR value (amplitude) and press **[OK]**.
- Press **{ESCAPE}** to delete the input value.

```
Constants
Obs. Direc.:1
DR(<---) = 9.8
DL(--->) = 0.0
OK
```

8. Read the position of the L-side turning point on the graduated scale to the nearest 0.1 units. Input this DL value (amplitude) and press **[OK]**.
- Press **{ESCAPE}** to delete the input value.

```
Constants
Obs. Direc.:1
DR(<---) = 9.8
DL(--->) = 9.5
OK
```

9. At the moment the floating index crosses the zero graduations, press **[EPOCH]**. The < --- > symbol flashes.

```
Constants
Obs. Direc.:1
Take Reading
CE EPOCH
```

12. INSTRUMENT CONSTANT MEASUREMENT MODE

10. After the floating index has crossed the zero graduations input whether it is on the R or L side of the zero graduations. If it is on the R side of zero, press **[←]**. If it is on the L side of zero, press **[→]**. After inputting the direction, the relevant arrow symbol will be displayed.

- Press **[AMP]** to change the amplitudes (DR and DL) input in Steps 7 and 8.

```
Constants
Obs. Direc.:1
Direc.:<---
CE AMP EPOCH
```

11. At the moment the floating index crosses the zero graduations, press **[EPOCH]**. The time (sec.) taken for this half-cycle is displayed in TR/TL.

```
Constants
Obs. Direc.:1
No. 0
Direc.:--->
TR=183. 300
CE AMP EPOCH
```

12. At the moment the floating index crosses the zero graduations, press **[EPOCH]**. The time (sec.) taken for this second half-cycle is displayed in TR/TL. After the input of the full cycle, an audio warning is given approximately 20 seconds before the floating index is due to cross the zero graduations.

```
Constants
Obs. Direc.:1
No. 1
Direc.:<---
TL=184. 750
CE AMP EPOCH OK
```

13. Continue to press **[EPOCH]** for the required number of crossings of the zero graduations. The maximum is 10. When input is complete press **[OK]** and the 2nd direction measurement starts. After the 10th turning point has been measured, the 2nd direction measurement starts automatically.


12. INSTRUMENT CONSTANT MEASUREMENT MODE

►PROCEDURE Second and third direction measurements

14. Turn the clamping screw in the C direction to the FULL CLAMP position and release to the HALF-CLAMP position.
Then re-tighten to the FULL-CLAMP position.


15. Sight the 2nd direction (either $0^{\circ} 10' 00''$ or $359^{\circ} 50' 00''$ when true north is $0^{\circ} 00' 00''$) and press **[OK]**.

Constants Obs. Direc.:2 HAR 359° 50' 00" OK

16. Perform measurement in the same way as  "PROCEDURE The first direction measurement".

17. Repeat the procedure shown in Step 14.

18. Sight the third direction (either $0^{\circ} 10' 00''$ or $359^{\circ} 50' 00''$ when true north is $0^{\circ} 00' 00''$ - the direction not used for the 2nd direction measurement) and press **[OK]**.

19. Perform measurement in the same way as  "PROCEDURE The first direction measurement".


20. Press **[OK]** at the end of the third measurement and the instrument constants K and R are calculated. To record these results press **[REC]**. To delete, press **{ESCAPE}**.

Constants K= 3.224 R=- 19 REC




- When $R > \pm 30''$, perform "15.3 Reticle Adjustment".

12. INSTRUMENT CONSTANT MEASUREMENT MODE

21. Turn the clamp to the FULL CLAMP position, then turn off the power to the GP1.
 "8.2 Finishing Measurement"

13. ERROR MESSAGES

The following is a list of the error messages displayed by the SET and the meaning of each message. If the same error message is repeated or if any message not shown below appears, the instrument has malfunctioned. Contact your Sokkia agent.


 For error messages not explained here, refer to the "Series130R Operator's manual".

Timeout

TL/TR timeover error

If **[EPOCH]** is not input for a period of 5 minutes during the measurement of TL/TR, the time measurement mode and instrument constants measurement mode are forcibly ended, and the azimuth display mode is set.

In the time measurement mode, set the azimuth angle if it can be calculated.

 For TL/TR, see the illustration in "11. TIME MEASUREMENT".

No solution

When divided by 0 or when the constant calculated exceeds the range in the instrument constants measurement mode, the instrument constants measurement mode is ended and the azimuth display mode is set. The constant/azimuth angle measured before is effective.

Confirm DR/DL input

The DL/DR values for time measurement mode or instrument constant measurement mode have not been input. Input the DL/DR values.

14. TROUBLE SHOOTING

Check the instrument as follows when it does not work normally.

● When the gyromotor does not run:

(The rotation sound cannot be heard.)

- Check if the battery lamp is lit red.

If so, make sure the clamping screw is clamped, switch off the GP1, then remove the battery and recharge. ☞ "7. BATTERY CHARGING"

- Check if the cables are firmly connected.

If not, connect the cables in the correct way.

- Check if the fuse of the Inverter is blown.

If so, replace the fuse (4A) with a new one. ☞ "14.1 Replacing the Fuse"

- Check if any cables are broken.

If so, replace the broken cable.

● When the index mark does not move:

- Check if the SET is levelled correctly.

If not, level the SET by referring to the Series 130R operator's manual. (Measurement cannot start when the SET is badly off level.)

- Check to see if the suspension tape is broken.

If so, replace the tape. ☞ "15.1 Checking the Suspension Tape"

● When the index movement speed increases during observation:

- Check if the red battery low lamp is lit.

If so, make sure the clamp screw is clamped, switch off the GP1, then remove and recharge the battery. ☞ "7. BATTERY CHARGING"

● When the graduations cannot be seen:

- Check if the cables are firmly connected.

- Check if the battery lamp is lit red.

- Check if the bulb has blown.

If so, replace the bulb. ☞ "14.2 Replacing the Light Bulb"

● When the motor start lamp does not light:

- Check if the battery lamp is lit.

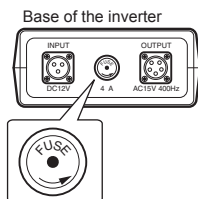
If so, recharge the battery. ☞ "7. BATTERY CHARGING"

14.1 Replacing the Fuse

If the motor does not run even when the power has been turned on, it is possible that the cause is a blown fuse. To replace a blown fuse, follow the procedure below.

► PROCEDURE

1. Turn the fuse screw (located on the base of the inverter) in a counterclockwise direction and pull out. The fuse is located on the inner portion of the fuse screw.
2. Remove the blown fuse and insert a fresh one. The fuse can be inserted in either direction.
3. Check that fuse is fitted properly. Insert the fuse screw back into the slot and turn in a clockwise direction to re-fasten.

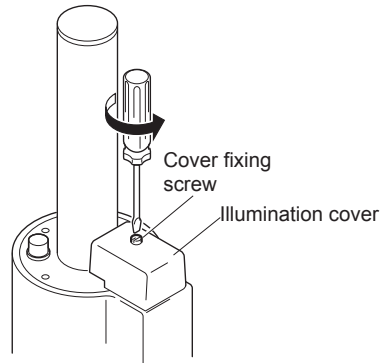


14.2 Replacing the Light Bulb

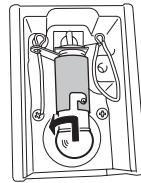
If the graduations cannot be seen when looking into the GP1 eyepiece, it is possible that the cause is a blown bulb. To replace a blown bulb, follow the procedure below.

► PROCEDURE

1. Loosen the cover fixing screw located on the top of the illumination cover. Remove the cover.



2. Push and turn the bulb in a counterclockwise direction. Remove the bulb.

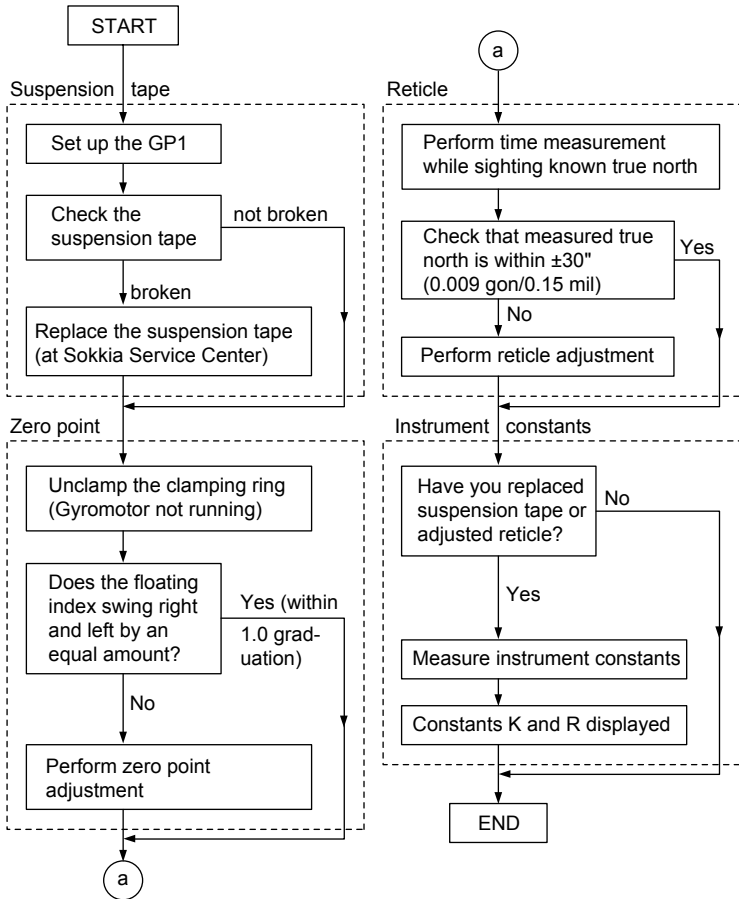


3. Insert the new bulb into the slot, push and turn in a clockwise direction. Make sure that the bulb is fitted securely.
4. Retighten the cover fixing screw to secure the illumination cover back in place.

15. CHECKS AND ADJUSTMENTS

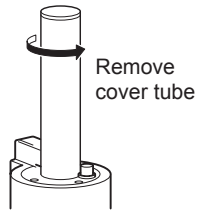
After the suspension tape has been replaced, or if the measuring station is greatly different in latitude from the previous one, perform the following checks and adjustments.

However, as it is necessary to know the true north position before checking (except for the zero point check), and to perform the checks precisely, it is recommended that a Sokkia agent performs these checks.

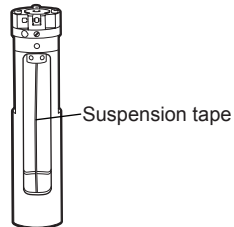


15.1 Checking the Suspension Tape

1. Set up the GP1 on the SET.
2. Unscrew and remove the GP1 cover tube.



3. Check if the tape is broken. If it is broken, contact your Sokkia agent. Replacement of the suspension tape is carried out by Sokkia Service Center.



15. CHECKS AND ADJUSTMENTS

15.2 Zero Point Adjustment

This adjustment is necessary if the oscillation of the floating index is not symmetrical within 1.0 scale division.



Always turn off the power to the GP1 when performing zero point adjustment. If the power is on, adjustment cannot be performed correctly.

► PROCEDURE

1. Set up the GP1 on the SET.
2. Turn the telescope to the approximate true north position.
3. Remove the cover tube.
4. Unclamp the gyroscope pendulum by turning the clamping ring fully in the F direction.

5. Half-loosen the three set screws on the top of the suspension piece.

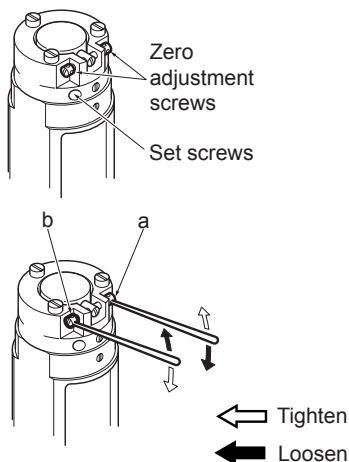
Adjust the zero adjustment screws while watching the floating index as follows:

When the R amplitude is larger than the L amplitude, loosen the right-side adjusting screw slightly and tighten the left-side adjusting screw by the same amount.

The screw adjusting procedure should be reversed if the L amplitude is larger than the R amplitude.



Do not over-tighten the adjusting screws.




6. The adjustment is complete if the oscillation is symmetrical within 1.0 division about the zero point.
7. Tighten the upper three set screws and replace the cover tube.

15.3 Reticle Adjustment

This adjustment is necessary if the alignment constant R is larger than 30" (0.009 gon/0.15 mil) after performing the instrument constant measurement, or if the difference between known and measured true north is greater than 30" (0.009 gon/0.15 mil).



- After this adjustment, the instrument constants measurement procedure should be performed.
 "12. INSTRUMENT CONSTANT MEASUREMENT MODE"

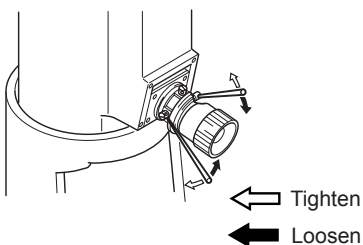
►PROCEDURE Check

1. When the instrument is sighted on the known true north position, perform time measurement several times (input the R constant value as zero) and determine the difference between the measured and known true north positions.
Turn the clamping ring to C to clamp the gyromotor.
2. To adjust, unscrew and remove the eyepiece cover and read the floating index position.

15. CHECKS AND ADJUSTMENTS

- Adjust the reticle adjusting screws, considering that the amount of the shift is 0.1 divisions per 1' (0.02 gon/0.3 mil):
When the measured value is between 30" and 1°00'00" (0.009 and 1.1 gon/0.15 and 18 mil), slightly loosen the adjusting screw on the left side and tighten the one on the right side by the same amount.

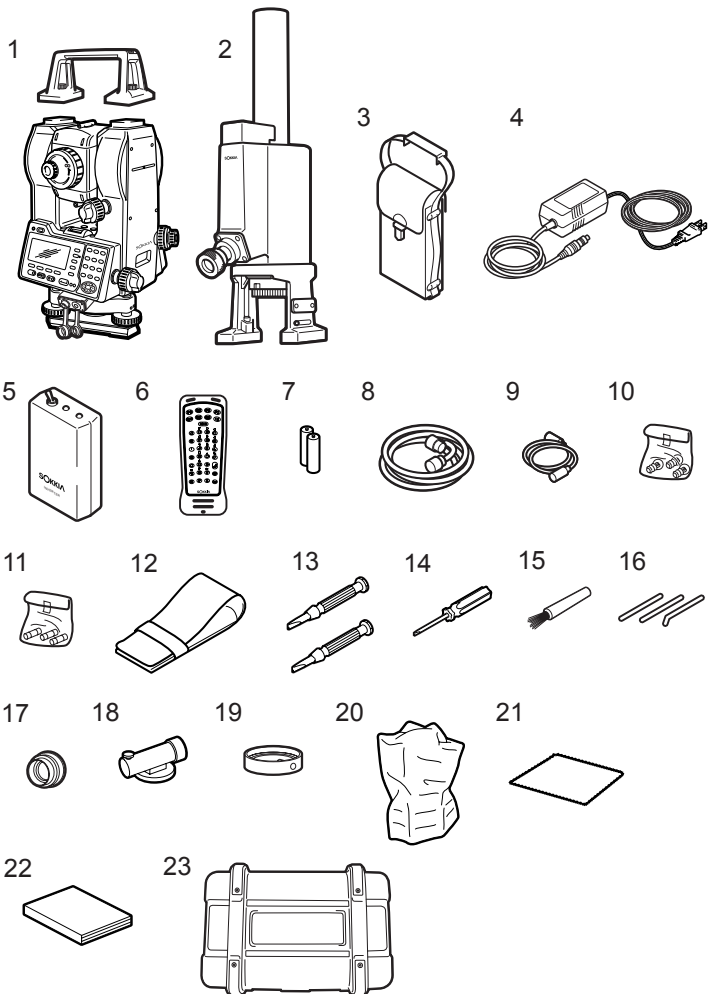
When the measured value is between 359°00'00" and 359°59'30" (398.9 and 399.991 gon/6382 and 6399.85 mil), loosen the adjusting screw on the right side and tighten the one on the left side by the same amount.



- Replace the eyepiece cover.
- Perform zero point adjustment.
See previous page.
- Repeat time measurement three times after the adjustment (with constant $R = 0$) to determine the new measured D true north value. If the new value is greater than $\pm 30''$ (0.009 gon/0.15 mil) repeat the above procedure from step 2).

16. STANDARD EQUIPMENT

Please verify that all equipment is included.



16. STANDARD EQUIPMENT

1	SET main unit	1	11	Fuse	3
	For SET accessories, ☞ "Series 130R Operator's manual"		12	Tool pouch	1
2	Gyroscope unit with bridge (GP1)	1	13	Watch-maker's screwdrivers.	2
3	Battery (BDC7).	1	14	Screwdriver.	1
4	Charger (CDC7).	1	15	Lens brush	1
5	Inverter.	1	16	Adjusting pin.	3
6	Wireless keyboard (SF14)	1	17	Lens hood.	1
7	R03/AAA manganese batteries	2	18	GP1 Tubular compass	1
8	5-pin cable	1	19	Clamp lock	1
9	3-pin cable	1	20	Vinyl cover	1
10	Bulb	3	21	Cleaning cloth.	1
			22	Operator's manual	1
			23	Carrying case	1

● Wireless keyboard (SF14)

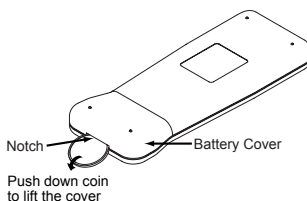
Changing battery cells



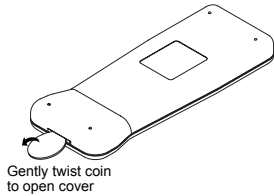
- Be sure to replace all battery cells at the same time.
- Either all alkaline or all manganese batteries should be used.
- Remove the battery cells when the keyboard is not to be used for a long time.

► PROCEDURE

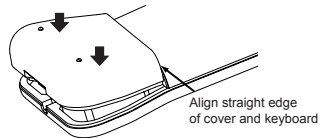
1. Hold the Wireless Keyboard with the Battery Cover facing toward you.
2. Insert the edge of a coin into the Notch on the Battery Cover and push down the coin to lift up the cover.



3. Gently twist the coin to open the cover.



4. Mount two battery cells (R03/AAA). The direction of the batteries is indicated in the battery compartment.
5. Align the straight edge of the cover with the straight edge of the battery compartment. Press down on the areas indicated by the arrows in the illustration below to close the cover.



17. SPECIFICATIONS

GP-1 main unit

Standard deviation of measurements:	±20" (0.006 gon/0.10 mil)
Running-up time:	Approx. 60 sec
Half period (at middle latitudes):	Approx. 3 min
Minimum interval between main divisions:	Approx. 10' (0.185 gon/3 mil)/div.
GP-1 mounting accuracy:	±5" (0.002 gon/0.025 mil)
Operation range:	-20 to 50°C
Size:	Approx. 145(W) x 200(D) x 416(H) mm
Weight:	Approx. 3.8 kg

Wireless keyboard (SF14)

Interface:	Modulated infrared LED
Power source:	R03/AAA x 2 (3V DC)
Operating range:	within 2m (operating range may vary with different operating conditions)
Keyboard:	37 keys
Operating temperature:	-20 to 50°C
Dust and water resistance:	IP44 (IEC60529:1989)
Size:	Approx. 162(W) x 63(D) x 19(H) mm
Weight:	Approx. 120g (with battery cells)

Inverter

Input:	12V DC
Output:	115V AC, 400 Hz
Size:	Approx. 130(W) x 55(D) x 240(H) mm
Weight:	Approx. 1.7 kg

Battery (BDC7)

Voltage:	12V DC
Operating time:	3 hours
Size:	Approx. 140(W) x 50(D) x 250(H) mm
Weight:	Approx. 2.0 kg

Charger (CDC7/7A/7B)

Input:	100/120/220V AC
Output:	14.5V DC
Charging time:	15 hours
Size:	Approx. 60(W) x 50(D) x 120(H) mm
Weight:	Approx. 0.5 kg

Cables

004-D0170 (5 pin):	1.5 m
004-D0171 (3 pin):	1.0 m

18. REGULATIONS

Radio Frequency Interference

WARNING: Changes or modifications to this unit not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

NOTE: This equipment has been tested and found to comply with the limits for a Class A digital device pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

Notice for Canada

This Class A digital apparatus meets all requirements of Canadian Interference-Causing Equipment Regulations.

Cet appareil numérique de la Class A respecte toutes les exigences du Règlement sur le matériel brouilleur du Canada.

CE Conformity Declaration

CE Conformity Declaration
in accordance with EMC Directive 89/336/EEC of the European Community

We herewith declare that the undermentioned instrument, in view of its design and type of construction, fully complies with the relevant basic radio interference requirements of the EMC Directive.

Should the instrument be modified without agreement, this declaration becomes invalid.

Instrument Description: Gyro Station (Surveying Instruments)

Model Name : GP3130R (SET3130R+GP1), GP3130R3 (SET3130R3+GP1)

Relevant EC Directive: EMC Directive (89/336/EEC)
Version: 92/31/EEC, 93/68/EEC (SET3130R, SET3130R3)
91/263/EEC, 92/31/EEC, 93/68/EEC (GP1)

Applied	SET3130R, SET3130R3:
Harmonized Standard:	EMI EN55022 <small>1994+A1:1995+A2:1997</small>
	EN55022 <small>1998+A1:2000</small>
	EMS EN61000-6-2 <small>1999</small>
	EN61000-6-2 <small>2001</small>
GP1:	
	EMI EN55011 <small>1991 Group 1 class B</small>
	EMS EN50082-2 <small>1995</small>

Date: 21-02-2007

Firm: SOKKIA B.V.


Address: Industrieterrein De Vaart, Damsluisweg 1, NL-1332 EA Almere

Representative's Signature: _____

Name of Representative : Jan van der Weijden

Representative's position : Managing Director

19. COMMUNICATION COMMANDS

In Measurement mode and Gyro mode the 00H and 11H commands are different.
 For other commands, refer to "SET Command Explanations".

● Measurement mode

00H (Vertical angle and Horizontal angle data request)

0000000 0895942 1243159 [SUM] CR LF
a b c

- a) Always 0
- b) Vertical angle
- c) Horizontal angle

11H (Slope distance, Horizontal angle and Vertical angle data request)

0456789 0895942 1243159 [SUM] CR LF
a b c

- a) Slope distance
- b) Vertical angle
- c) Horizontal angle

● Gyro mode

00H and 11H (Vertical angle and Azimuth angle data request)

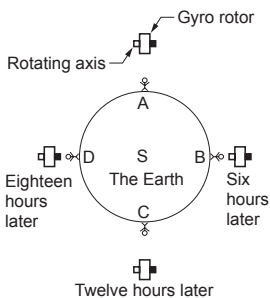
0000000 0895942 1243159 [SUM] CR LF
a b c

- a) Always 0
- b) Vertical angle
- c) Azimuth angle

20. APPENDIX : PRINCIPLE OF THE GP1

The GP3130R pendulum-type gyroscope consists of a gyroscopic motor suspended by a tape and housed in a cylindrical body, which is mounted on the SET3130R/3130R3 electronic total station.

The pendulum oscillates around the earth's meridian. This oscillation (called precession) is observed by the use of a mirror attached to the pendulum and can be followed without applying any torque to the suspension tape by slowly turning the theodolite (follow-up mode). Both turning points of the precessional oscillation can be read on the horizontal circle of the total station and the SET can calculate the centre of the precession (true north). When the optical axis of the theodolite is coincidental with the direction of the centre of precession, the instrument telescope is sighting true north.

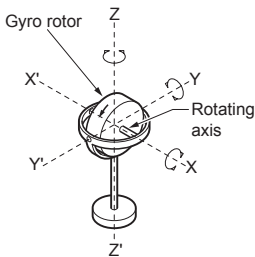


[Theory of the gyroscope]

The gyroscope is really a motor having a large moment of inertia, and spinning rapidly. When the angular momentum of the rotor is high, and the rotor is freely suspended, the direction of the rotating axis is kept unchanged in space.

The Earth is seen from the south.

Suppose a gyroscope started to oscillate over the arbitrary point A on the equator. It is assumed that the gyroscope has freedom in three axes as shown below.



[Degree of freedom in three axes]

The three axes are defined as shown. If the rotating axis of the gyroscope can freely change direction around the XX' , YY' , and ZZ' axes, the gyroscope is said to have freedom in three axes.

20. APPENDIX : PRINCIPLE OF THE GP1

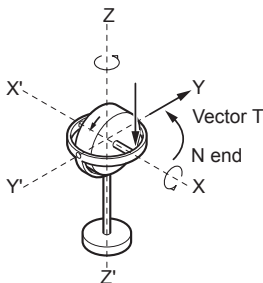
Six hours later, the rotation of the earth will cause point A to reach point B. At that moment, the N end of the rotating axis faces the same direction as it did at point A. Similarly, 12 hours later, at point C and 18 hours later at point D, the direction of the axis will remain unchanged. Although an observer on the axis will perceive the direction of the axis to be changing, it must be remembered that, as described above, a gyroscope maintains its original rotating direction.

Besides the ability to maintain axis direction, the gyroscope has another important characteristic. When torque (twisting moment to change the axis direction) is applied to the rotating axis, the rotating axis starts moving in the direction of the torque vector due to precession.

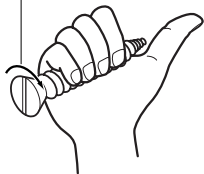
If torque is applied to the rotating axis, lowering the N end of the rotating axis, while the gyro, which has freedom in three axes, is rotating clockwise as viewed from X' , the gyroscope will start rotating counterclockwise on the ZZ' axis as viewed from Z .

The original rotation of the rotor and the torque applied to the rotor which moves the N end downward are expressed as vectors H and T , respectively, based on the right-hand screw law.

The rotating vector H rotates in the direction of torque vector T , and this rotating motion is called precession.



Direction of
screw rotation

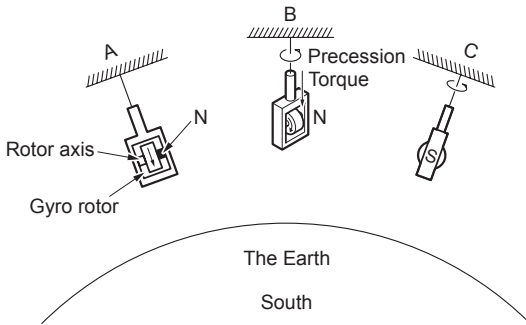


[Right-hand screw law]

The four fingers represent the direction of screw rotation, while the thumb indicates the advancing direction of the screw. Torque vector is defined as the direction of the thumb. The direction and amount of rotation are thus represented by a vector shown by the right-hand screw law.

[Pendulum gyroscope]

If the motor of a pendulum gyroscope is rotated clockwise viewed from end S of the rotating axis with another end N of the rotating axis facing east at an arbitrary point Q, the gyroscope changes its position from A to B, then B to C (see below) and finally the N end faces true north, i.e., the rotating axis aligns itself with the meridian by precession. Here it is assumed that the torque around the suspension tape is nil. Let us consider what causes the northward rotation of the N end.



Even though the axis has a property which allows it to maintain its direction unchanged, end N of the axis must go down because of the rotation of the earth. In other words, when the Earth's gravity applies torque to the pendulum, its vector faces north. Therefore, end N of the axis (vector of rotor) starts a precession toward the north. Until end N precesses to the north, the torque caused by gravity is applied and the precession continues. The speed of precession is greatest in the north direction. After end N passes north, gravity applies torque to lower the new end N (old end S) downward. Therefore, the speed of precession decreases. When the new S end precesses to the same bearing at this end, a movement back to the north starts. Because the rotation of the Earth never stops, the back and forth motion around north will continue as long as the motor continues to rotate. This is the precession of a pendulum gyroscope.

MEMO

SOKKIA Customer Service

SOKKIA CO.,LTD.

<http://www.sokkia.co.jp/english/>

INTERNATIONAL SALES DEPT.

260-63, HASE, ATSUGI, KANAGAWA, 243-0036

PHONE +81-46-248-7984 FAX +81-46-247-1731

SOKKIA CO.,LTD.

<http://www.sokkia.co.jp/english/>

260-63 HASE, ATSUGI, KANAGAWA, 243-0036 JAPAN

PHONE +81-46-248-0068 FAX +81-46-247-6866

1st ed. 01-0404 Printed in Japan

©2004 SOKKIA CO., LTD.