TOPCON

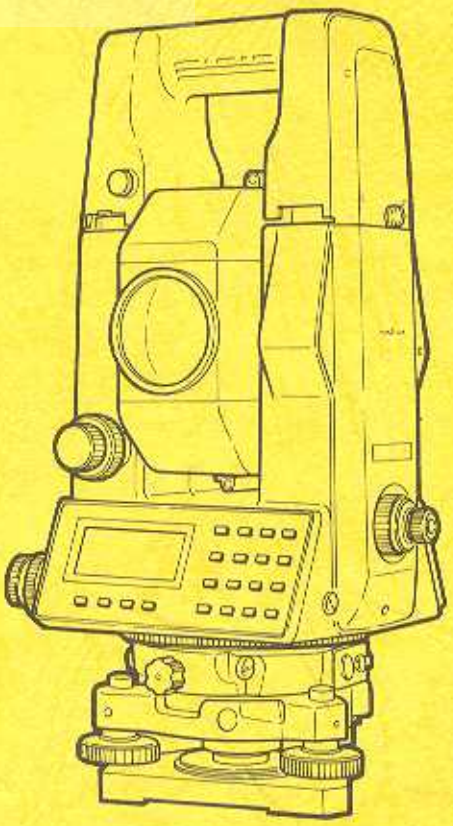
INSTRUCTION MANUAL

Ver.
1.60

ELECTRONIC TOTAL STATION

GTS-4 SERIES

GTS-4
GTS-4A
GTS-4B



FOREWORD

Thank you for purchasing the TOPCON Electronic Total Station GTS-4 series. For the best performance of the instrument, please carefully read these instructions and keep them in a convenient location for future reference.

GENERAL HANDLING PRECAUTIONS

1. Use care to avoid shock to the instrument.
   Always provide some cushioning material to minimize risk of shock during transportation. If exposed to heady shock, the instrument cannot be expected to function properly when measuring.

2. When carrying the instrument.
   Always remove the instrument from its tripod when carrying at the site. Hold the instrument bottom and support in your hands. If it must be carried with the tripod attached, never carry the instrument horizontally over the shoulder. Always keep the instrument in a vertical position when carried.

3. Do not expose the instrument to direct sunlight for long periods.
   Never leave the instrument in extreme heat longer than necessary. It could adversely affect its performance. Never expose the instrument without a filter to direct sunlight. It may damage the components inside the instrument.

4. Any sudden change of temperature to the instrument or prism may result in a reduction of measuring distance range, i.e when taking the instrument out from a heated vehicle.

5. Check the battery indicator.
   Be sure to check the battery for voltage level before using the instrument.

6. Memory back up
   The instrument has a built in battery for memory back up. If the battery power is low, "E" will display. If the battery power is too low to back up the memory, error code "E98" will display. Contact your dealer, to replace the back up battery.

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STANDARD SET COMPOSITION

Standard Set

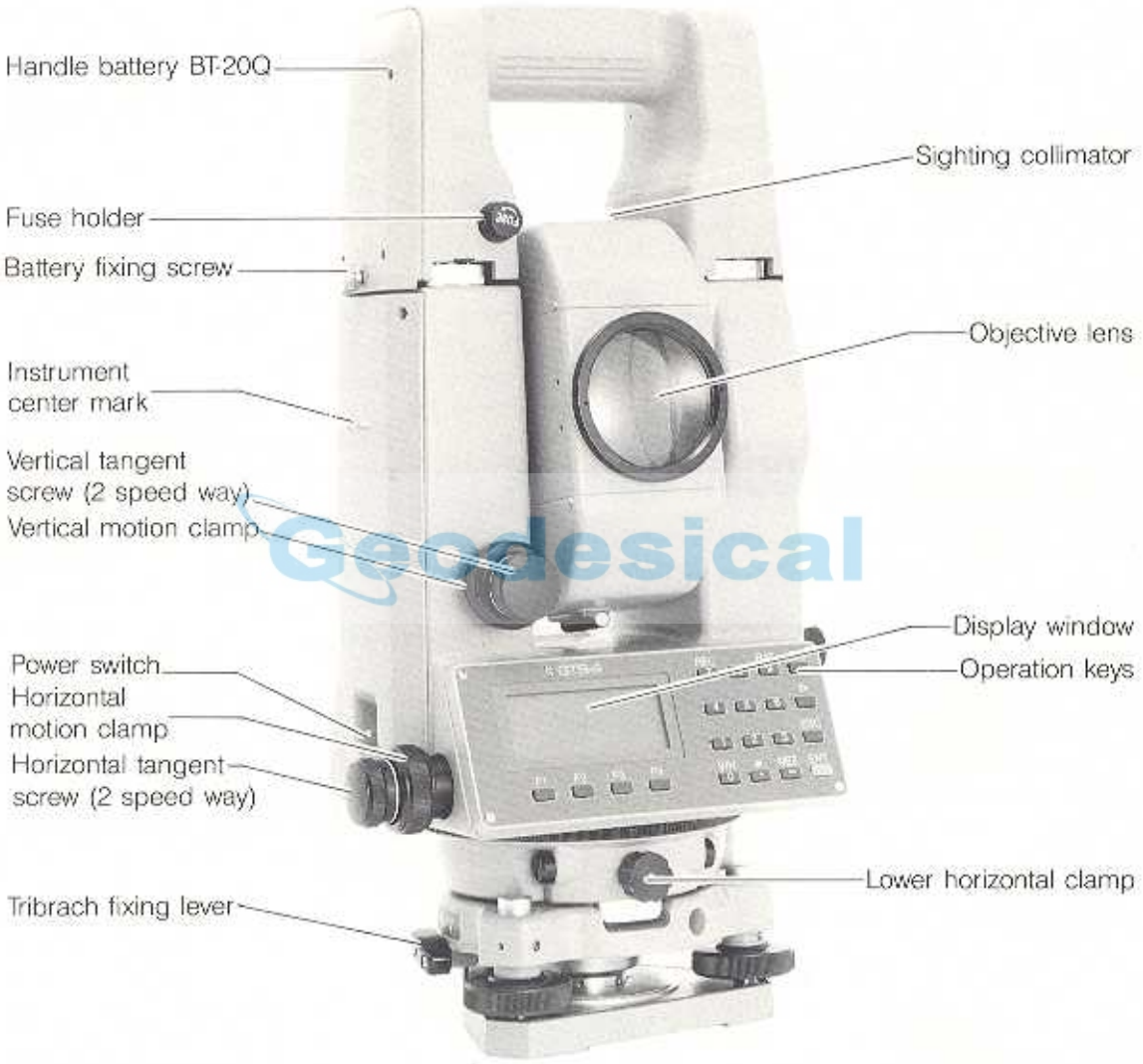
1. GTS-4 series (with lens cap) ..... 1 each
2. Handle battery BT-20Q ..... 1 each
3. Battery charger BC-10B or BC-10C ..... 1 each
4. Tool kit with case [rod pins, screwdriver, hexagonal wrench, cleaning brush, silicon cloth, 2 fuses (4A)] ..... 1 set
5. Plastic carrying case ..... 1 each
6. Sunshade ..... 1 each
7. Plastic rain cover ..... 1 each
8. Shoulder strap ..... 1 each
9. Instruction manual ..... 1 each
10. Field chart ..... 1 each

(Make sure that all of the above items are with the instrument when purchased.)

Remarks:
1. Battery charger BC-10C is for AC 230V use and BC-10B is for AC 120V use.
2. Plumb bob set and plumb bob hook are supplied for certain markets.
3. One handle battery is supplied for certain markets.

1. NOMENCLATURE AND FUNCTIONS

1.1 Nomenclature




Battery locking screw
Instrument center mark
Optical plummet telescope
Connector A (Serial signal RS-232C connector)
Connector B (to be connected to external battery, TOPCON Data Collector)
Connector C (used when charging)
Focusing knob (GTS-4/4A: 2 speed way. GTS-4B: 1 speed)
Telescope grip
Telescope eyepiece
Plate level
Horizontal circle ring
Circular level
Leveling screw
Base

For Certain Markets


Connector C
(used when charging)
Battery locking
screw
Focusing knob
(GTS-4: 2 speed way.
GTS-4B: 1 speed)
Instrument
center mark
Telescope grip
Telescope eyepiece
Vertical tangent
screw (2 speed
way)
Optical plummet
telescope
Vertical motion
clamp
Plate level
Horizontal
circle ring
Connector A (Serial signal
RS-232C connector)
Circular level
Connector B
(to be connected to
external battery,
TOPCON Data Collector)

㉛ Luminance adjusting knob: Adjusting the LCD display luminance.
㉜ Heater ON/OFF switch: ON . . . .The heater of the LCD display will automatically turn it on when ambient temperature is below 0°C (32°F).
OFF. . . .Prohibit the heater of the LCD display.

1.2 Parts Functions

1.2.1 Display marks

Display device is used the dot matrix LCD which has 4 lines and 16 characters per line. The illumination for the LCD is EL back light which is easy reading in the dark.
In the general upper three lines display the measuring data, and the bottom line displays the soft key function which is changed by the measuring mode.


```
 V :   90° 10′ 20″
 HR:  120° 30′ 40″

OSET HLD HSET  1↓
```

Vertical angle: 90°10′20″
Horizontal angle: 120°30′40″

```
 HR:  120° 30′ 40″
 HD*     100.000 m
 VD:       1.000 m
MEAS CRS S/A   1↓
```

Horizontal angle: 120°30′40″
Horizontal distance: 100.000 m
Vertical distance: 1.000 m

```
 V%:       99.99 %
 HL:    6399.990 M

OSET HLD HSET  1↓
```

V% grade: 99.99%
Horizontal angle left: 6399.990 mil

```
 V :   100.0000 G
 HR:   399.9998 G
 SD*  1234.565 f
MEAS TRK S/A   1↓
```

Vertical angle: 100.0000 grad
Horizontal angle: 399.9998 grad
Slope distance: 1234.565 feet

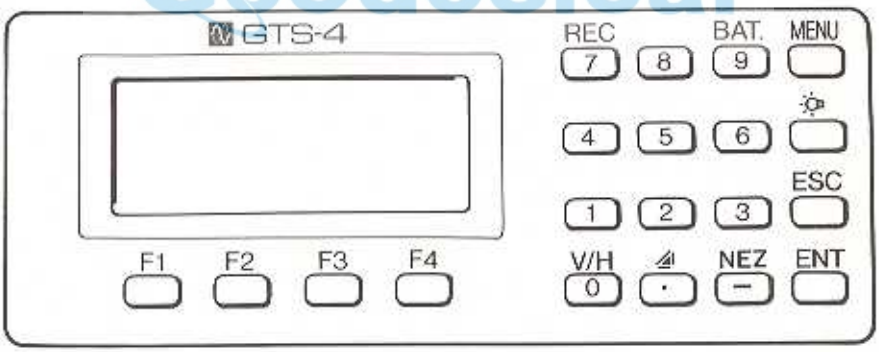
```
 N *  1234.567 m
 E :  2345.678 m
 Z :   123.456 m
MEAS CRS S/A   1↓
```

Northing coordinate: 1234.567 m
Easting coordinate: 2345.678 m
Z coordinate: 123.456m

V : Vertical angle
V% : Percent grade
HR : Horizontal angle right
HL : Horizontal angle left
HD : Horizontal distance
VD : Relative elevation (Vertical distance)
SD : Slope distance
N : Northing coordinate
E : Easting coordinate
Z : Z coordinate

* : EDM working
m : Meter unit
f : Feet unit
G : Grad unit
M : Mil unit

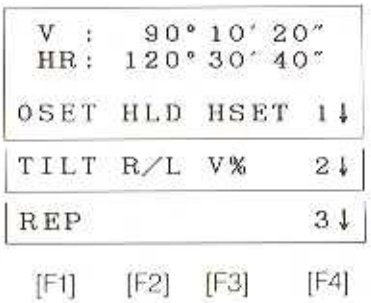
1.2.2 Operating keys

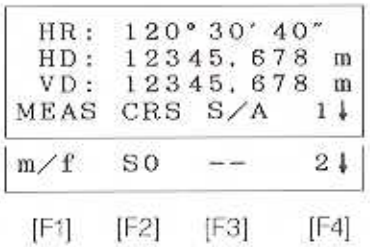


REC: Pressing once, Data hold
Pressing again, Data transmission
BAT.: Remaining battery capacity
MENU: Menu mode
☼: Illumination of display and reticle
ESC: Returning to the measurement mode from setting mode
V/H: Angle measurement mode (V, HR)
◢: Distance measurement mode (HR, HD, VD)
NEZ: Coordinates measurement mode (N, E, Z)
ENT: Enter key
0 ~ 9 : Numeric key value
• , −
F1 ~ F4: Soft key

• Soft keys

Soft keys message is displayed at the bottom line of the display.
This message is changed by the function mode.





(Angle mode page 1)
F1 0SET: Horizontal angle 0° set.
F2 HLD: Holding the horizontal angle.
F3 HSET: Setting the horizontal angle by the numeric keys.
F4 1↓: Changing the soft key function to next page.

(Angle mode page 2)
F1 TILT: Tilting angle of vertical axis. And ON/OFF of the vertical angle tilt correction.
F2 R/L: Changing the Horizontal angle Left/Right.
F3 V%: Changing the Vertical angle and Percent grade.
F4 2↓: Changing the soft key function to next page.

(Angle mode page 3)
F1 REP: Repetition angle measurement mode.
F4 3↓: Changing the soft key function to next (1↓) page.

(Distance mode page 1)
F1 MEAS: Pressing once, N times (Single) measuring distance mode.
Pressing twice, Continuous measuring distance mode.
F2 CRS: Coarse measurement mode.
(TRK: Tracking mode)
F3 S/A: Set/Audio mode

(Distance mode page 2)
F1 m/f: Meter/feet selection
F2 SO: Setting the Stake-out distance.

1.2.3 Battery power warning

Battery mark in the display indicates the power condition.

When the "V-0 SET" is displayed at the power-on, battery mark is displayed at the bottom line in the display window.

```
V-0SET(TURN)

BAT. [■■■]
```

BAT. [■■■] ↓ BAT. [■■・] ↓ BAT. [■・・] — Measurement is possible.

↓

<BATTERY EMPTY!> — Measurement will be impossible soon

↓

<BATTERY EMPTY!> — Measurement is impossible. (All displays disapear except "<BATTERY EMPTY!>" display.) Need to recharge or replace Battery.

```
 HR:  123° 45' 57"
 HD*  12345.678 m
 VD:      1.234 m
MEAS CRS S/A   1↓
```

↕

```
 HR:  123° 45' 57"
 HD*  12345.678 m
 VD:      1.234 m
<BATTERY EMPTY!>
```

While the battery is goes to low, "<BATTERY EMPTY!>" is displayed every few seconds.

The battery operating time will vary depending on the environmental conditions as an ambient temperature, charging time, the number of times of charging and dis-charging etc.
It is recomended for safety to charge the battery beforehand or to prepare spare full-charged batteries to go out with.

The "BAT" mark on the display shows the battery power level regarding to the measurement mode now operating.
The safety condition indicated by the "BAT" mark in the angle measurement mode does not necessarily assure the battery's ability to be used in the distance measurement mode. It may happen that the mode change from the angle mode to the distance mode will stop the operation because of the insufficiency of the battery power for the distance mode which consumes more power than the angle mode.
Note that the EDM unit is working when "V-0 SET" and "BAT" mark shown at the power-on, which shows as an easy battery check before use.

1.2.4 Error displays

Display	Contents
TILT OVER	Displayed when instrument tilts over than 3 minuts. Check to make sure instrument is leveled properly. Repair is necessary if the "TILT OVER" remains after checking for level.
W/C OVER	If measurement to the range from zenith to ±9 degrees nadir is carried out while the earth curvature and refraction correction by instrument operates, this code is displayed.
E	Displayed when back up battery is low. Data in the memory is able to be retained. Back up battery will be dead in the short term.
E01	Displayed when the alidade portion of the instrument is rotated too fast. To proceed with measurement, press the [F1] (0 SET) key and take measurement.
E02	Displayed when the telescope is rotated too fast. To proceed with measurement, press the [F1] (0 SET) key and take measurement.
E03	Displayed when an internal problem exists with the measuring system. Turn the power switch off once, then on, before putting the instrument into operation. Repair is necessary if the listed procedure does not correct the display.
E31	Displayed when the unit of the angle at the recall mode is different from the unit stored at the coordinate setting mode.
E35	If measurement to the range from zenith to ±6 degrees nadir is carried out while REM is operated, this code is displayed.
E36	Displayed when setting the N, E coordinates same as occupied coordinates at the azimuth setting or stake-out setting.
E60 to E69	Displayed if trouble occurs with EDM section. First, check that the offset value is correct, then if the error is shown with correct offset value setting, request service.
E71, E72, E73	Displayed when vertical angle 0 position will be set with incorrect procedure (E71), to wrong position (E72), or without leveling the instrument (E73), at adjustment of vertical angle 0 datum mode. Please confirm the operating procedure. If displayed the same error, then repair is necessary.
E80 to E89	Displayed when the data transmission between GTS-4 series and the instrument (FC series etc.), or GTS-4 series and EDM section impossible. Please confirm the operation and connection of the cable, try again. If displayed the same error, then repair is necessary.
E98	Displayed when back up battery is too low or data in the memory is lost. The setting data is automatically changed as atomospheric correction is 0 ppm (15°C, 760 mmHg) and prism constant is 0 mm. In this state, normal operation for measurement is possible pressing [F4] (CONT) key. But memory back up is impossible.
E99	Displayed when any anomaly occurs with GTS-4 series memory. Repair is necessary.

1.2.5 Data output [REC]

Result of measurement is transfered to TOPCON FC series Data Collector from GTS-4 series.

- Press [REC] key once, and the measuring is started and the new data is held. Press [F3] (YES) key next, and data is transfered to the Data Collector.
- Pressing [REC] key twice continuously, the data transfers immediately.

<Example> In distance measurement mode.
Confirm the distance measurement mode (HR, HD, VD).

Operating Procedure	Key Operation	Display
① Press [REC] key and measuring will be started.	[REC]	HR: 120°30′40″ HD* [r] m VD: m MEAS CRS S/A 1↓
Measured data is held.		HR: 120°30′40″ HD: 100.000 m VD: 1.000 m >REC? [YES] [NO]
② Transfer to the Data Collector. • *In the case of pressing [F4] (NO) key, the holding data is cancelled and the mode will return to the distance measurement mode.*	[F3]	HR: 120°30′40″ HD: 100.000 m VD: 1.000 m <REC!> ↓ 0.5 sec.
The mode will automatically return to the distance measurement mode.		HR: 120°30′40″ HD* 100.000 m VD: 1.000 m MEAS CRS S/A 1↓

The following data will be output at each mode.

Mode	Output
Angle mode (V, HR or HL) (Percent grade mode)	V, HR (or HL)
Horizontal distance mode (HR, HD, VD)	V, HR, HD, VD
Slope distance mode (V, HR, SD)	V, HR, SD, HD
Coordinate mode	N, E, Z, HR

- *The display and the output at coarse mode will be same as the contents of above.*
- *Output in the tracking mode is displayed distance data only (HD, VD or SD).*

Serial signal RS-232C connector

Serial signal connector is used for connecting the GTS-4 series with a computer, which enables the computer to receive measurement data from the GTS-4 series or to send preset data to it. The details necessary for the connection with the GTS-4 series are obtained from its Interface Manual which is optionally available. Please refer to the manual.

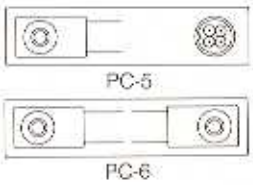
2. PREPARATION FOR MEASUREMENT

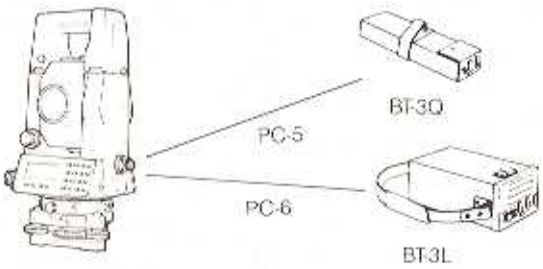
2.1 Power Connection (unnecessary if Handle battery BT-20Q is used.)

See below for connecting the external battery pack.

- Battery pack BT-3Q
  Power cord, PC-5 is used.
  (PC-6 can also be used if FC series is not connected.)
- Large capacity battery pack BT-3L
  Power cord PC-6 is used.

Connector ends of the power cords, PC-5 and PC-6 are as follows:





Note: Always turn the handle battery off when any external battery pack is used. If used together, battery life may be shortened or a fuse may blow.

2.2 Leveling the Instrument

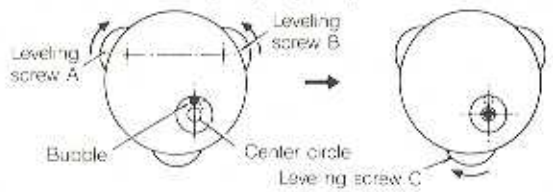
Level and center the instrument correctly to insure the best performance.
Use tripods with a tripod screw of 5/8 in. diameter and 11 threads per inch, such as the Type E TOPCON wide-frame wooden tripod.

Reference

Leveling and centering the instrument

1. Setting Up the Tripod
   First, extend the extension legs to suitable lengths and tighten the screws on their midsections.
2. Attaching the Instrument to the Tripod Head
   Place the instrument carefully on the tripod head and align the tripod screw with the socket on the base of the instrument. When aligned, screw in the tripod screw until the instrument is fixed securely on top of the tripod head.
3. Leveling the Instrument
   The circular level is used for initial rough leveling which is then refined with the plate level.
   - Centering the Circular Level
     1) Use the two furthest leveling screws, or A and B, to move the bubble of the circular level. In other words, rotate the screw in opposite direction as indicated by the arrows which will shift the bubble of the circular level. The bubble is now located on a line perpendicular to a line running through the centers of the two leveling screws being adjusted.
     2) Next, revolve the remaining leveling screw, or C, as noted, to shift the bubble to the center of the circular level.

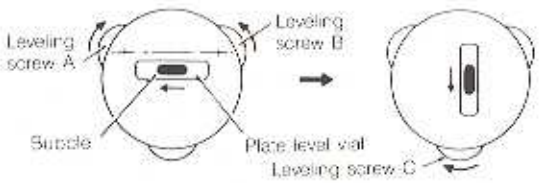
   If the bubble cannot be centered properly, repeat the leveling operations from the beginning.



• Centering the Plate Level

First, place the plate level vial parallel to a line running through the centers of two leveling screws, say A and B.

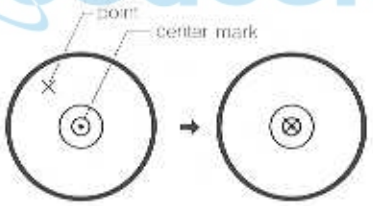
1) Adjust leveling screws A and B only to place the bubble in the center of the level vial.
2) Next, revolve the instrument 90° (100g) around its vertical axis and use the remaining screw, or C, to center the level bubble once more.



Repeat the above procedure for each 90° (100g) revolution of the instrument and check whether the level bubble is correctly centered for all four points.
The bubble of the level will move as indicated by the arrows, when the leveling screws are revolved in the arrow-indicated directions.

4. Optical Plumbing

1) Adjust the eyepiece of the optical plummet telescope to the user's eyesight.
2) Focus the optical plummet telescope on the point.
3) Manipulate the leveling screws and coincide the point with the center mark of the optical plummet telescope.
4) Center the bubble of the circular level by adjusting the lengths of the tripod extension legs.
5) Next, check whether the point is within the center mark of the optical plummet telescope. (If the point is outside the center mark, repeat from 3. once more.)



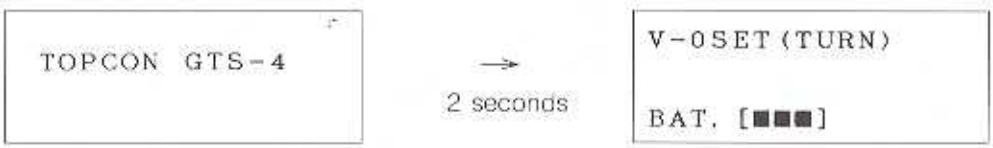
5. Collimate the instrument precisely as in 4.

Turn the instrument, and check to see that the bubble is in the center of the circular level, regardless of telescope direction, then tighten the tripod screw.

2.3 Power Switch ON

① Turn the power switch on.

Right figure of the display will light for about 2 seconds before the vertical angle zero-set command is displayed.



If the battery power is insufficient, "<BATTERY EMPTY!>" display. Recharge or replace battery with a charged unit.

② Rotate the telescope to set the instrument at a vertical angle reading of 0°.

Angle mode (V, HR) is then selected for the display.

```
V  :    90° 10′ 20″
HR:    120° 30′ 40″

OSET HLD HSET 1↓
```

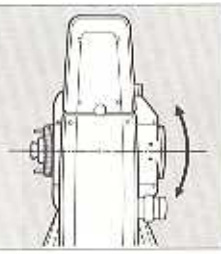
If the instrument is set to the zero detection mode on the horizontal angle, rotate the standard and set zero.

```
V-OSET OK
H-OSET(TURN)

BAT. [■■■]
```

→

```
V  :    90° 10′ 20″
HR:    120° 30′ 40″

OSET HLD HSET 1↓
```

Note: For setting the vertical angle at 0°, a datum 0 is provided on the vertical angle scale circumference. If the telescope is turned and the sensor passes the datum 0, angle measurement begins. The datum 0 is placed near the level position of the telescope, the vertical angle setting of 0 can easily be set by rotating the telescope.



2.4 Vertical and Horizontal Angle Tilt Correction (GTS-4/4B has vertical angle correction only)

Vertical and horizontal angle are corrected automatically by the dual axis tilt sensor.
Level the instrument by seeing the tilt mode display when it is out of the correction range.

```
V  :    80° 10′ 20″
HR:    120° 30′ 40″

OSET HLD HSET 1↓
```

→ Out of the correction range

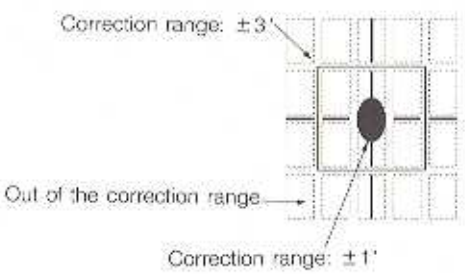
```
TILT [ON]
X: <OVER>
Y: 0° 01′ 40″
[ON] [OFF]
```

Tilting mark

Rotate the leveling screws and adjust the instrument level

When the tilting mark goes into the correction range and the correction value is stable for about 2 seconds, the display is changed to the previous mode.

- When pressing the [F2] (OFF) key, the tilt correction is stopped and the display is changed to previous one. This setting is not memorized after power off.
- Refer to 7.10 Vertical and Horizontal Angle Tilt correction (TILT ON/OFF) to stop the tilt correction at the initial setting (memorized after power off).



3. ANGLE MEASUREMENT

3.1 Measuring a Horizontal Angle Right and Vertical Angle

Confirm the angle measurement mode (V, HR).

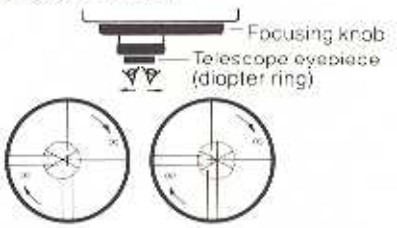
Operating Procedure	Key Operation	Display
① First collimate target A.		V : 90° 10′ 20″ HR: 120° 30′ 40″ OSET HLD HSET 1↓
② Target A is set to read 0° 00′00″ for the horizontal angle.	[F1]	H-OSET >OK? -- --[YES] [NO]
	[F3]	V : 90° 10′ 20″ HR: 0° 00′ 00″ OSET HLD HSET 1↓
② Collimate target B. The horizontal and vertical angle of proposed point B is displayed.		V : 95° 16′ 30″ HR: 128° 20′ 00″ OSET HLD HSET 1↓

Reference

How to collimate

1. Point the telescope toward the light. Turn the diopter ring and adjust the diopter so that the reticle is clearly observed. (Turn the ring toward you first and then backward to focus.)
2. Loosen the clamp screws, and observe the target at the peak of the triangle mark of the collimator. Allow a certain space between the collimator and yourself for collimating.
3. Tighten the clamp screws and focus the target with the focusing knob.
4. Turn the tangent screws to bring the reticle to the target center.

- *If parallax is created between the reticle and target when viewing vertically or horizontally while looking into the telescope, focusing is incorrect or diopter adjustment is poor. This adversely affects precision in measurement or survey. Eliminate the parallax by careful focusing and diopter adjustment.*



3.2 Measuring a Horizontal Angle Left

Confirm the angle measurement mode (V, HR).

Operating Procedure	Key Operation	Display
① Press the [F4] key, and change function of the key.	[F4]	V : 90° 10′ 20″ HR: 120° 30′ 40″ TILT R/L V% 2↓
② Set the instrument in the horizontal angle counter-clockwise (HL) mode from the horizontal angle clockwise mode (HR).	[F2]	V : 90° 10′ 20″ HL: 239° 29′ 20″ TILT R/L V% 2↓
③ For further operations, follow "3-1 Measuring a horizontal angle right and vertical angle", except the collimating sequence is reversed.		

- *Press the* [F2] (R/L) *key once to bring the instrument from horizontal angle counterclockwise* (HL) *mode to normal horizontal angle* (HR) *mode.*

3.3 Repetition Angle Measurement

Confirm the angle measurement mode (V, HR).

Operating Procedure	Key Operation	Display
① Press the [F4] key twice, and change function of the key.	[F4] [F4]	V : 90° 10′ 20″ HR: 120° 30′ 40″ REP -- -- 3↓
② Set the instrument to the repetition angle measurement mode.	[F1]	Repetition Angle >OK? -- --[YES] [NO]
	[F3]	REP-A COUNT[0] Ht: 0° 00′ 00″ Hm: OSET V/H REL HLD
③ Collimate the target A.		REP-A COUNT[0] Ht: 30° 20′ 10″ Hm: OSET V/H REL HLD

④ Set the horizontal angle of target A at 0°00'00''.

[F1]

```
Repetition Mode
   Initialize
OK?
 --   --[YES] [NO]
```

[F3]

```
REP-A   COUNT[ 0]
Ht:      0°00'00"
Hm:
OSET V/H REL HLD
```

⑤ Use the horizontal clamp and tangent screw to collimate the target B.

```
REP-A   COUNT[ 0]
Ht:   130°20'10"
Hm:
OSET V/H REL HLD
```

⑥ Hold and store the horizontal angle in the instrument.

[F4]

```
REP-A   COUNT[ 1]
Ht:   130°20'10"
Hm:   130°20'10"
OSET V/H REL HLD
```

⑦ Recollimate target A using the horizontal clamp and tangent screw.

```
REP-A   COUNT[ 1]
Ht:   130°20'10"
Hm:   130°20'10"
OSET V/H REL HLD
```

Release the horizontal angle.

[F3]

⑧ Recollimate target B, and press the [F4] (HLD) key to hold and store the horizontal angle.
The total of angle (Ht) and the average of angle (Hm) are displayed. This completes the procedure for doubling an angle.

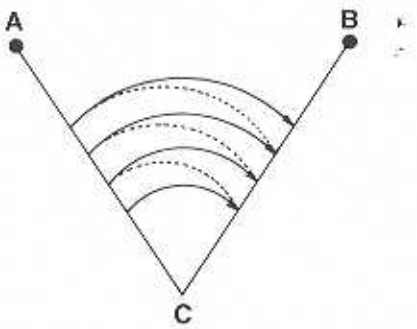
[F4]

```
REP-A   COUNT[ 2]
Ht:   260°50'30"
Hm:   130°25'15"
OSET V/H REL HLD
```

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

```
REP-A   COUNT[ 4]
Ht:   521°40'40"
Hm:   130°25'10"
OSET V/H REL HLD
```

(4 measurements)



- Horizontal angle can be accumulated up to [3600° – minimum reading] or – [3600° – minimum reading] (horizontal angle left). In the case of 5 seconds reading, horizontal angle can be accumulated up to ±3599°59′55″.
- When the results differ from each other by more than ±30″, error is displayed. Press the [F1] (0 SET) key, and start from ③.

- To begin the repetition angle measurement again, start from ③.
- To return to the normal angle mode, press the [F2] (V/H) key and [F3] (YES) key.

3.4 Setting a Required Horizontal Angle

There are two way to set the horizontal angle. One is the horizontal angle holding and the other is numeric input from the keyboard.

3.4.1 Setting by holding the angle

Confirm the angle measurement mode (V, HR).

Operating Procedure	Key Operation	Display
① Set the required horizontal angle, using Horizontal tangent screw.		V : 90° 10′ 20″ HR: 120° 30′ 40″ OSET HLD HSET 1↓
② Hold the horizontal angle.	[F2]	H-HOLD HR= 120° 30′ 40″ >SET? -- --[YES] [NO]
③ Collimate the target.		
④ Finish holding the horizontal angle. The display turns back normal angle measurement mode.	[F3]	V : 90° 10′ 20″ HR: 120° 30′ 40″ OSET HLD HSET 1↓

3.4.2 Setting a horizontal angle from the numeric keys

Confirm the angle measurement mode (V, HR).

Operating Procedure	Key Operation	Display
① Collimate the target.		
② Set a horizontal angle setting mode (HSET).	[F3]	H-SET HR=_ EXIT -- CLR ←
③ Input the required horizontal angle by pressing numeric keys. (120°30′40″) When input the wrong value, push the [F4] (←) key to move the cursor or push the [F3] (CLR) key and input the value again.	[1] [2] [0] [•] [3] [0] [4] [0]	H-SET HR=120.3040_ EXIT -- CLR ←
④ Finish the horizontal angle setting.	[ENT]	H-SET HR= 120° 30′ 40″ <SET!>
The display turns back normal angle measurement mode. When the input value is out of range, it doesn't finish the setting. In this case please retry from ③.		V : 90° 10′ 20″ HR: 120° 30′ 40″ OSET HLD HSET 1↓

4. DISTANCE MEASUREMENT

4.1 Setting of the Atmospheric Correction

When setting the atmospheric correction, obtain the correction value by measuring the temperature and pressure. Refer to page 47 to get the correction value and to set.

- It is set at 15°C, 760 mmHg (0 ppm) when shipped from the factory.

4.2 Setting of the Prism Constant

When using prism reflectors other than TOPCON, the offset compensation factor may need to be adjusted. Refer to page 51 to set the offset compensation factor.

4.3 Distance Measurement (continuous measurement)

Confirm the angle measurement mode.

Operating Procedure	Key Operation	Display
① Sight the center of prism.		
② Set the instrument in the distance measurement mode to start automatic distance measuring. • *When EDM is working, "*" mark appears in the display.* Results of repeated measurement are shown (Horizontal distance, Relative elevation) The results are shown after every 3.5 seconds. • *"m" or "f" mark ON/OFF with buzzer sound is repeated each measurement.* • *To measure the slope distance (SD), press the [◢] key.*	[◢]	HR: 0° 10′ 20″ HD*[r] <<<<< m VD: m MEAS CRS S/A 1↓ ↓ HR: 0° 10′ 20″ HD* 100.000 m VD: 1.000 m MEAS CRS S/A 1↓

- *Measurement may repeat automatically if the result is affected by shimmer, etc.*
- *To return to the normal measuring angle mode from a distance measurement mode, press the [V/H] key.*

4.4 Distance Measurement (N times measurement)

When presetting the number of times, GTS-4 series measures the distance as the setting times and displays the average distance.
When presetting the number of times as 1, it is not displayed the average distance, because of single measurement. It has been set at single measurement at the factory.
For setting the number of times (N times) in the distance measurement, see page 54.
Confirm the angle measurement mode.

Operating Procedure	Key Operation	Display
① Sight the center of prism.		
② Set the instrument in the number of distance measurement mode to start automatic distance measuring.	[◢◤] [F1]	HR: 0°10′20″ HD*[n] <<<<< m VD: m MEAS CRS S/A 1↓
Results of N times measurement are shown. (The displays are the same continuous measurement mode.)		HR: 0°10′20″ HD* 100.000 m VD: 1.000 m MEAS CRS S/A 1↓
The average value is displayed followingly with buzzer sound and the "*" mark disappears.		HR: 0°10′20″ HD: 100.000 m VD: 1.000 m MEAS CRS S/A 1↓

- *Press the* [F1] *key for re-measuring after the measurement in held.*
- *To return to the normal measuring angle mode from N times measurement, press the* [V/H] *key.*
- *To return to the normal measuring distance mode from N times measurement mode, press the* [F1] *key twice.*

4.5 Stake Out (SO)

The difference between the measured distance and the distance preset by numeric key operation is displayed.

Measured distance – Standard (Preset) distance = Displayed value

- Stake-out operation can be performed for horizontal distance (HD), relative elevation (VD) or slope distance (SD).

Confirm the angle measurement mode.

Operating Procedure	Key Operation	Display
① Set the Instrument in the distance measurement mode.	[◢]	HR: 120° 30′ 40″ HD* < m VD: m MEAS CRS S/A 1↓
② Set the Instrument in the stake out mode.	[F4] [F2]	SO HD= 0.000_m VD= 0.000 m EXIT -- CLR ←-
③ Input the standard distance for stake out. • *When input the wrong value, push the [F4] (←-) key to move the cursor or push the [F3] (CLR) key and input the value again.*	[7][2][•] [3][4][0]	SO HD= 72.340_ m VD= 0.000 m EXIT -- CLR ←-
④ Finish the horizontal standard distance presetting. (Sight the prism, if not done yet.) The measurement will start.	[ENT] [ENT]	HR: 110° 35′ 40″ dHD*[r] <<<< m VD: m MEAS CRS S/A 1↓ ↓ HR: 110° 35′ 40″ dHD* 19.580 m VD: 5.678 m MEAS CRS S/A 1↓
The difference between the measured distance and the standard distance is displayed.		
• *In the case of coarse measurement, press [F2] (CRS) key twice.* • *When the standard distance preset, the "d" lights on the top of mode mark.*		91.920 – 72.340 = 19.580 m ↑ mesured distance ↑ preset distance ↑ displayed value

- *In the case of presetting the relative elevation or slope distance, press the key as following procedure of ①, ③, ④.*
  - *Relative elevation:* ③ [ENT] [7][2][•][3][4][0] ④ [ENT]
  - *Slope distance:* ① [◢] [◢] ④ [ENT]
- *To return to the normal distance measurement mode, reset the standard distance to "0" or turn the power switch off once.*

5. TRACKING AND COARSE MEASUREMENT

Tracking measurement is shorter time than normal measurement. Results of repeated measurement are shown every 0.5 seconds. The minimum display is 1 cm (0.02 ft).
The tracking mode is very useful when tailing the moving object or carrying out stake out work. Function of coarse mode is the same as that of tracking mode except displaying and output items. Regarding switching from tracking to coarse mode, or vice versa. (See "14. SELECTING MODE" on page 54.)

5.1 Tracking

Confirm the angle measurement mode.

Operating Procedure	Key Operation	Display
① Sight the center of the prism. ② The mode changes to tracking and measurement of the horizontal distance starts automatically. The results are shown after every 0.5 seconds. • *To measure the relative elevation (VD) and slope distance (SD) press the [◢I] key.*	[◢I] [F2]	V : 90°10′20″ HR: 120°30′40″ HD* [t] <<< m MEAS TRK S/A 1↓ ↓ V : 90°10′20″ HR: 120°30′40″ HD* 12345.67 m MEAS TRK S/A 1↓

• *To return to the normal measuring distance mode from tracking mode, press the* [F1] *key.*
• *To return to the normal measuring angle mode from tracking mode, press the* [V/H] *key.*

5.2 Coarse Measurement

Confirm the angle measurement mode.

Operating Procedure	Key Operation	Display
① Sight the center of the prism. ② The mode changes to coarse and measurement of the distance starts automatically. • *In the case of single (Ntimes) measurement, press* [◢I] [F2]. Results of repeated measurement are shown (Horizontal distance, Relative elevation). The results are shown after every 0.5 seconds. • *To measure the slope distance (SD), press the* [◢] *key.*	[◢I] [F2] [F2]	HR: 120°30′40″ HD* [r] <<< m VD: m MEAS CRS S/A 1↓ ↓ HR: 120°30′40″ HD* 12345.67 m VD: 1.23 m MEAS CRS S/A 1↓

• *To return to the normal measuring distance mode from coarse mode, press the* [F1] *key.*
• *To return to the normal measuring angle mode from coarse mode, press the* [V/H] *key.*

6. 3-DIMENSIONAL COORDINATE MEASUREMENT

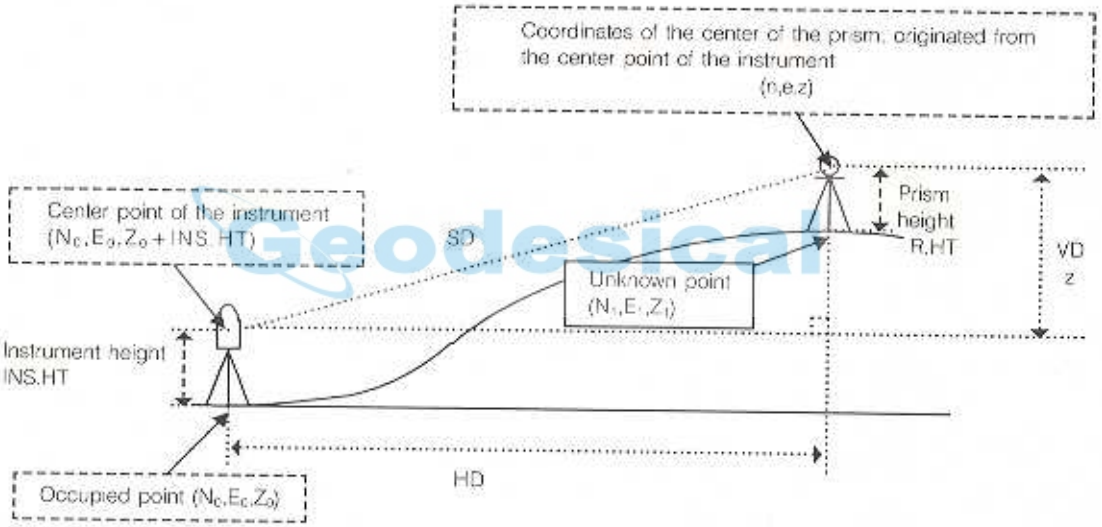
(Measured by entering instrument height/prism height)

Measure the coordinates by entering the instrument height/prism height, coordinates of unknown point will be measured directly.

- When setting coordinate values of occupied point, see "7.8 Setting Instrument Point Coordinates (OCC. STATION)".
- The coordinates of unknown point are calculated as shown below and displayed:

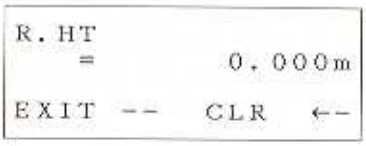
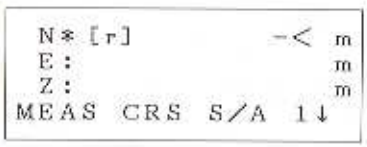
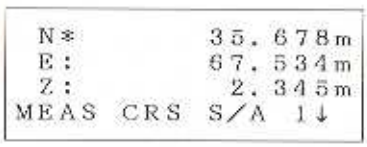
Coordinates of occupied point : (N_0, E_0, Z_0)
Instrument height : INS.HT
Prism height : R.HT
Vertical distance (Relative elevation) : z
Coordinates of the center of the prism, originated from the center point of the instrument: (n, e, z)
Coordinates of unknown point : (N_1, E_1, Z_1)

$N_1 = N_0 + n$
$E_1 = E_0 + e$
$Z_1 = Z_0 + INS.HT + z - R.HT$



Confirm the angle measurement mode.

Operating Procedure	Key Operation	Display
① Sight the target point A.		
② Set the direction angle.	[F3]	H-SET HR=_ EXIT -- CLR ←
Input the direction angle.	[3][2][0][•] [1][3][5][0]	H-SET HR=320.1350_ EXIT -- CLR ←
	[ENT]	V : 90° 10′ 20″ HR: 320° 13′ 50″ OSET HLD HSET 1↓
③ Sight the target point B (prism).		V : 91° 45′ 20″ HR: 62° 09′ 40″ OSET HLD HSET 1↓
④ Set the Instrument in the coordinate measurement mode to start automatic measuring.	[NEZ]	N* [r] -< m E: m Z: m MEAS CRS S/A 1↓
⑤ Press the [F4] (1 ↓) key.	[F4]	m/f HT -- 2↓
⑥ Press the [F2] (HT) key.	[F2]	INS.HT 0.000m R.HT 0.000m EXIT -- -- INP
⑦ Press the [F4] (INP) key.	[F4]	INS.HT = 0.000m EXIT -- CLR ←
⑧ Enter the instrument height. (Example: 1.3m)	[1][•][3]	INS.HT = 1.300m EXIT -- CLR ←

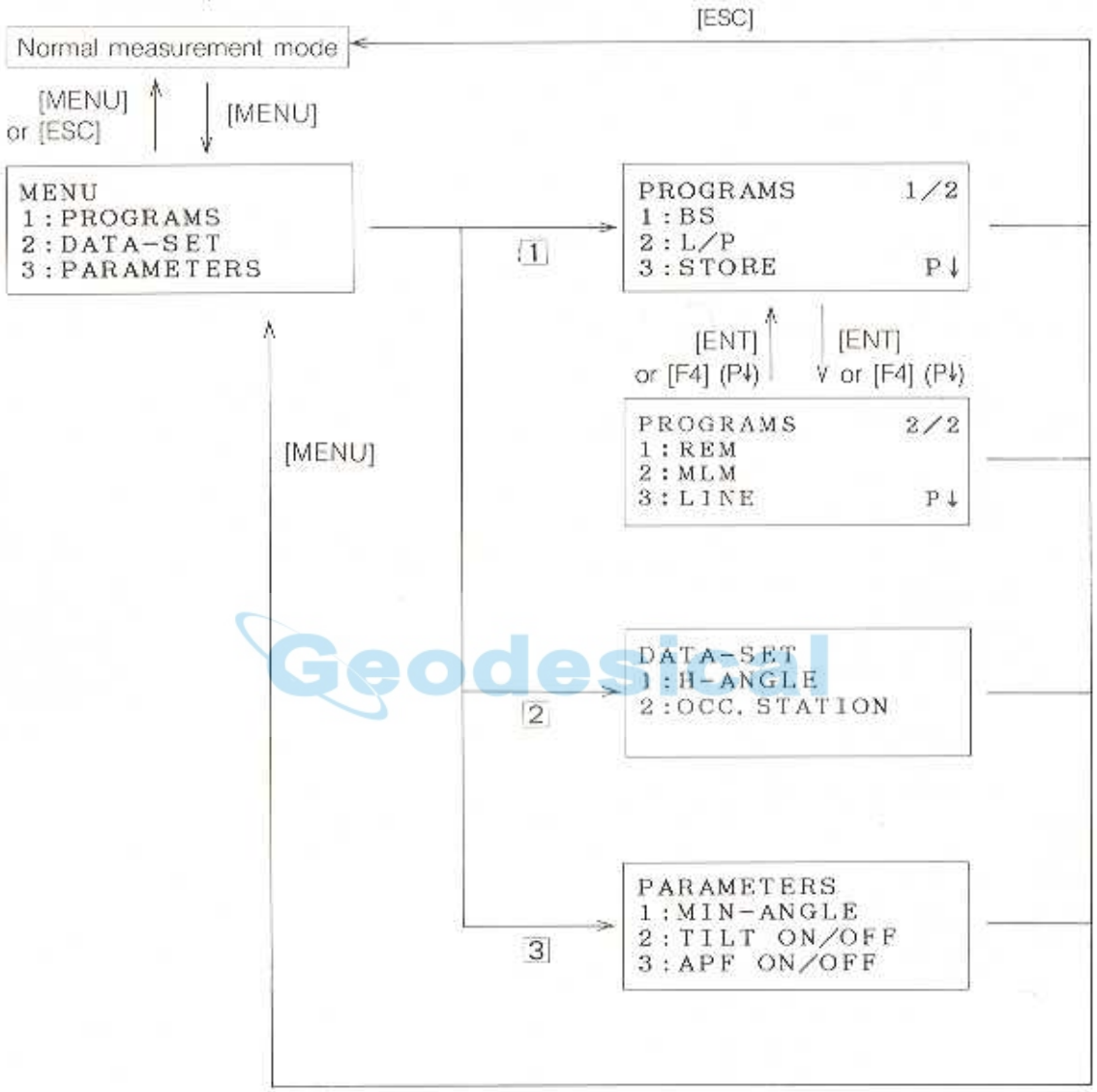
	[ENT]	
⑨ Enter the prism height. (Example: 1.1 m)	[1] [•] [1]	
⑩ Instrument height and prism height are decided by pressing the [ENT] key and coordinate measurement will be started.	[ENT]	 

- *To return to the normal angle measurement mode, press the [V/H] key.*
- *Coordinate measurement is also possible in N times measurement mode.*

7. SPECIAL MODE (MENU key operation)

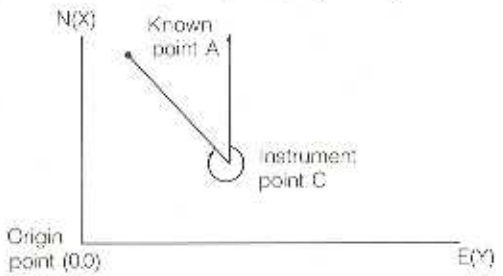
By pressing the [MENU] key, the Instrument will be MENU mode.
In the MENU mode, special measuring and setting are possible.

• MENU mode operation



7.1 Setting Direction Angle (BS)

Use the instrument point and known point coordinates, and the direction angle from the instrument point to the known point can be set. The angle, once set, will remain stored in the memory even after power is turned off.(See page 54.)

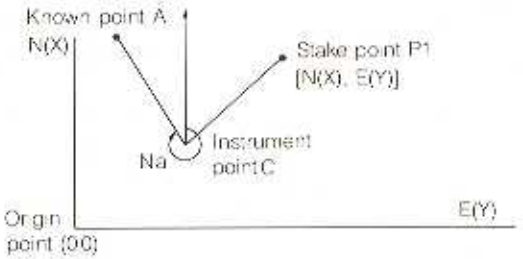


How to set (instrument point C N(X) coordinate 12.345 m E(Y) 54.321 m, and known point A N(X) coordinate 54.321 m E(Y) 12.345 m)

Operating Procedure	Key Operation	Display
① Set instrument point C N(X) coordinate and E(Y) coordinate. For setting, see 7.8 Setting instrument point coordinates on Page 40.		
② Press the [MENU] key, and the instrument will be set at measuring menu mode.	[MENU]	MENU 1:PROGRAMS 2:DATA-SET 3:PARAMETERS
③ Select the PROGRAMS mode.	[1]	PROGRAMS 1/2 1:BS 2:L/P 3:STORE P↓
④ Select the BS mode. Instrument point C coordinate (N.E) is displayed. If resetting the coordinate of C, press [F4] (INP) and input a new value.	[1]	BS:M-POINT N = 12.345 m E = 54.321 m SKIP -- -- INP
⑤ Set known point A N(X) coordinate.	[F1] [5][4][·][3][2][1] [ENT]	
⑥ Set known point A E(Y) coordinate.	[1][2][·][3][4][5] [ENT]	BS:T-POINT N = 54.321 m E = 12.345 m EXIT -- CLR ←-
• *Direction angle is displayed.* • *Collimate the known point A.*		BS HR= 315°00'00" >SET OK? -- --[YES] [NO]
⑦ Press the [F3] (YES) key, and the direction angle will be memorized in the instrument.	[F3]	BS <SET!>
The mode will automatically return to normal measurement mode.		V : 90°10'20" HR: 315°00'00" OSET HLD HSET 1↓

7.2 Setting a lay-out point (L/P)

Set standard coordinates and follow displayed horizontal distance and horizontal angle for setting the stake, and stake points will be set.



- Providing a setting point (N(X) coordinate 123.456 m, E(Y) coordinate 145.678 m)

Operating Procedure	Key Operation	Display
① Set the direction angle from instrument point C toward known point A. See 3.4 Setting a Required Horizontal Angle, 7.7 Setting a Horizontal Angle (H-ANGLE) (if the direction angle is known) or 7.1 Setting Direction Angle.		
② Press the [MENU] key, and the instrument will be set at measuring menu mode.	[MENU]	MENU 1:PROGRAMS 2:DATA-SET 3:PARAMETERS
③ Select the PROGRAMS mode.	1	PROGRAMS 1/2 1:BS 2:L/P 3:STORE P↓
④ Select the L/P (setting a lay-out point) mode.	2	L/P:M-POINT N = 12345.678 m E = 12345.678 m SKIP -- -- INP
⑤ Set coordinate value of instrument point C. If the coordinate value of C was already input at operation ①, just push the [F1] (SKIP) key after confirming the display.	[F4] 1 2 • 3 4 5 [ENT] 5 4 • 3 2 1 [ENT]	L/P:M-POINT N = 12.345 m E = 54.321 m SKIP -- CLR ←- ↓ L/P:T-POINT N =_ m E = m EXIT -- CLR ←-

⑥ Set coordinate value of layout point P1.

1 2 3 • 4 5 6 [ENT]

1 4 5 • 6 7 8 [ENT]

```
L/P:T-POINT
 N=    123.456   m
 E=    145.678   m
EXIT --   CLR   ←-
```

The standard horizontal angle (dHR) of the standard layout point P1 and the horizontal distance (dHD) are calculated and displayed.

```
L/P
dHR=   39°25'40"
dHD=    143.846 m
DIST ANG -- NEXT
```

⑦ Sight the point P1, and press the [F2] (ANG) key.
The measuring horizontal angle is displayed in the upper position and the horizontal angle to the layout point is displayed in the lower position.

[F2]

```
L/P
 HR:   29°05'00"
dHR:  -10°20'40"
DIST ANG NE NEXT
```

⑧ Press the [F1] (DIST) key to set the instrument at distance measurement mode.

The mode changes to the coarse mode and the measurement starts.

The measuring horizontal distance is displayed in the upper position and the horizontal distance to the layout point is displayed in the lower position.

Press the [F1] (F/C) key, the unit of mm will be used for measuring.

[F1]

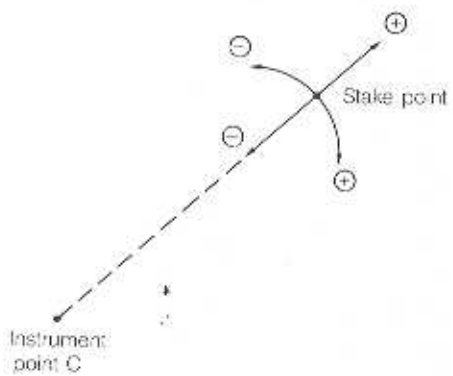
```
L/P
 HD*          <<< m
dHD:             m
F/C  ANG NE NEXT
```

```
L/P
 HD*    100.01   m
dHD:    -43.84   m
F/C  ANG NE NEXT
```

```
L/P
 HD*    143.850 m
dHD:     0.004 m
F/C  ANG NE NEXT
```

⑨ When the lower display value dHR and dHD are equal to 0, it can get the layout point P1.

• ± of that measured on the bottom (+ sign does not display) will be as follows:

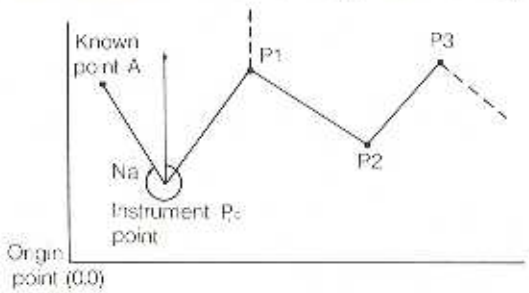


Horizontal angle toward setting point (dHR)
=Actual horizontal angle − Standard horizontal angle
Horizontal distance toward setting point (dHD)
=Actual horizontal distance − Standard horizontal distance

• *Press the* [F4] *key, and repeat the procedure* ⑥ ~ ⑨ *for the setting point.*
• *To return to the normal measuring mode, press the* [ESC] *key.*

7.3 Retaining a Coordinate (STORE-NEZ)

Suppose the instrument point Po moves to P1, P2, P3, etc. and the coordinates at P1, P2, P3 etc., last point will be retained in the memory, after moving, as from the origin point.

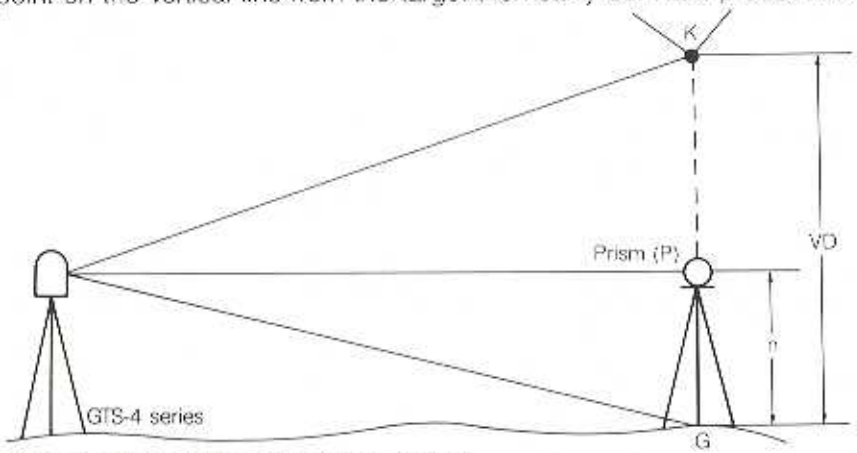


Operating Procedure	Key Operation	Display
① Set the direction angle from instrument point Po toward known point A. See 3.4 Setting a Required Horizontal angle, 7.7 Setting a Horizontal Angle (H-ANGLE) (if the direction angle is known) or 7.1 Setting Direction Angle.		
② Press the [MENU] key, and the instrument will be set at measuring menu mode.	[MENU]	MENU 1:PROGRAMS 2:DATA-SET 3:PARAMETERS
③ Select the PROGRAMS mode.	1	PROGRAMS 1/2 1:BS 2:L/P 3:STORE P↓
④ Select the STORE (retaining a coordinate) mode.	3	STORE 1:STORE-NEZ 2:RECALL-NEZ
⑤ Select the STORE-NEZ mode.	1	STORE-NEZ HR: 100° 10′ 20″ HD: m MEAS -- HT SET
⑥ Collimate target P1 prism to which the instrument moves. Press the [F1] (MEAS) key, and distance measuring will start. Horizontal distance and horizontal angle are shown.	[F1]	STORE-NEZ HR: 120° 30′ 40″ HD* 123.456 m MEAS -- HT SET
⑦ Press the [F4] (SET) key, and coordinate of P1 will be decided.	[F4]	N : 37.321 m E : 156.361 m Z : 1.234 m >STR? [YES] [NO]

⑧ Press the [F3] (YES) key, and the coordinate will be memorized in the instrument.	[F3]	STORE-NEZ <STORE!>
The mode will automatically return to normal measurement mode.		V : 90° 10′ 20″ HR: 120° 30′ 40″ OSET HLD HSET 1↓
⑨ Turn power off and move instrument to P1. (Prism of P1 move to Po.)		
⑩ After the instrument is set up at P1, turn power on and be measurement possible.		
⑪ Repeat the procedure ② ~ ④ to set the STORE mode.	[MENU] 1 3	STORE-NEZ 1:STORE-NEZ 2:RECALL-NEZ
⑫ Collimate Po, the former instrument point.		
⑬ Select the RECALL mode.	2	RECALL HR= 300° 30′ 40″ >SET OK? -- --[YES] [NO]
⑭ The coordinates at P1 and direction angle toward Po are set.	[F3]	RECALL <SET!>
The mode will automatically return to normal measurement mode.		V : 90° 10′ 20″ HR: 300° 30′ 40″ OSET HLD HSET 1↓
⑮ Repeat the procedure ② ~ ⑭ as much as you wish.		

7.4 Remote Elevation Measurement (REM)

To obtain elevation of the point at which setting the target prism is impossible, place the prism at any point on the vertical line from the target then carry out REM procedure as follows.



(1) Input of prism height (h) (for example h=1.5 m)

Operating Procedure	Key Operation	Display
①Press the [MENU] key, and the instrument will be set at measuring menu mode.	[MENU]	MENU 1:PROGRAMS 2:DATA-SET 3:PARAMETERS
②Select the PROGRAMS mode (2/2).	1 [ENT]	PROGRAMS 2/2 1:REM 2:MLM 3:LINE P↓
③Select the REM-1 (INPUT P.h) mode.	1 1	REM-1 <STEP-1> P.h=_ m EXIT -- CLR ←
④Input of prism height.	1 • 5 [ENT]	REM-1 <STEP-1> P.h= 1.500 m EXIT -- CLR ←
Sight prism (P). Press the [F1] (MEAS) key, and distance measuring will start.	[F1]	REM-1 <STEP-2> HD* <<<< m MEAS -- -- SET
Horizontal distance is displayed.		REM-1 <STEP-2> HD* 123.456 m MEAS -- -- SET
⑤Press the [F4] (SET) key, and horizontal distance will be decided.	[F4]	

⑥ Sight point K. Vertical distance (VD) is displayed.		REM-1 VD: 12.345 m EXIT (1) (2) --

- *To return to the normal measurement mode, press the* [F1] (EXIT) *key.*
- *To return to the <STEP-1>, press* [F2] (1) *key.*
- *To return to the <STEP-2>, press* [F3] (2) *key.*

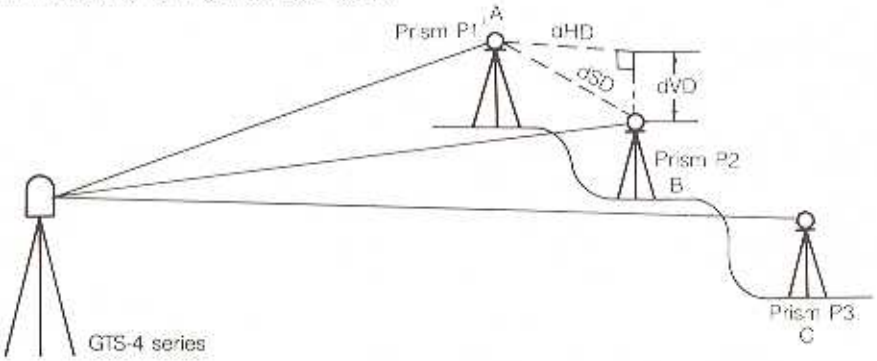
(2) Prism height is not entered

Operating Procedure	Key Operation	Display
① Press the [MENU] key, and the instrument will be set at measuring menu mode.	[MENU]	MENU 1:PROGRAMS 2:DATA-SET 3:PARAMETERS
② Select the PROGRAMS mode (2/2).	1 [ENT]	PROGRAMS 2/2 1:REM 2:MLM 3:LINE P↓
③ Select the REM-2 (No P.h) mode.	1 2	REM-2 <STEP-1> HD: m MEAS -- -- SET
④ Sight prism (P). Press the [F1] (MEAS) key, and distance measuring will start. Horizontal distance is displayed.	[F1]	REM-2 <STEP-1> HD* 123.456 m MEAS -- -- SET
⑤ Press the [F4] (SET) key, and horizontal distance will be decided.	[F4]	
⑥ Sight point G.		REM-2 <STEP-2> V : 90°30'40" -- -- -- SET
⑦ Press the [F4] (SET) key, and vertical angle of point G will be decided.	[F4]	
⑧ Sight point K. Vertical distance (VD) is displayed.		REM-2 VD: 12.345 m EXIT (1) (2) --

- *To return to the normal measurement mode, press* [F1] (EXIT) *key.*
- *To return to the <STEP-1>, press* [F2] (1) *key.*
- *To return to the <STEP-2>, press* [F3] (2) *key.*

7.5 Missing Line Measurement (MLM)

Measurement for horizontal distance (dHD), slope distance (dSD) and elevation (dVD) between two target prisms.
MLM mode have two modes.
MLM-1: measurement is AB, AC, AD....
MLM-2: measurement is AB, BC, CD....



<Example> MLM-1 mode

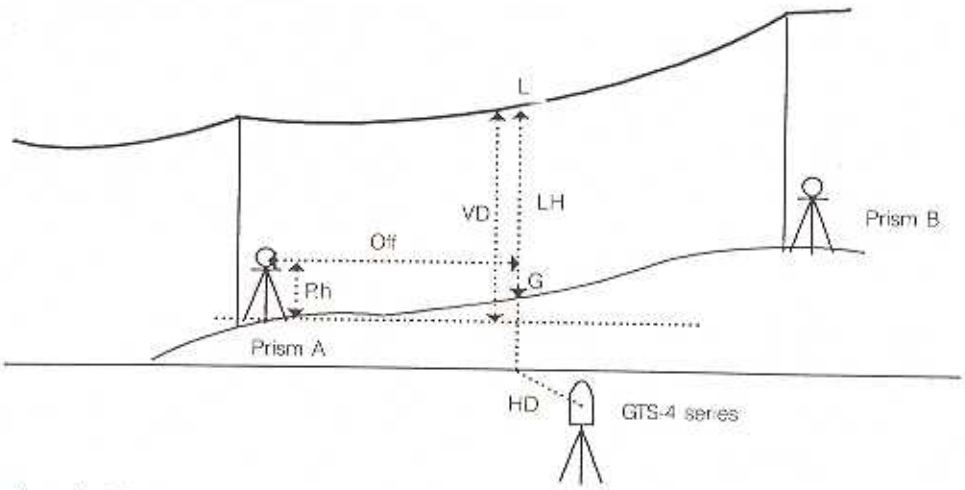
Operating Procedure	Key Operation	Display
① Press the [MENU] key, and the instrument will be set at measuring menu mode.	[MENU]	MENU 1:PROGRAMS 2:DATA-SET 3:PARAMETERS
② Select the PROGRAMS mode (2/2).	1 [ENT]	PROGRAMS 2/2 1:REM 2:MLM 3:LINE P↓
③ Select the MLM mode.	2	MLM 1:MLM-1 (A-B, A-C) 2:MLM-2 (A-B, B-C)
④ Select the MLM-1 mode.	1	MLM-1 <STEP-1> HD: m MEAS -- -- SET
Sight prism P1. Press the [F1] (MEAS) key, and distance measuring will start. Horizontal distance is displayed.	[F1]	MLM-1 <STEP-1> HD* 123.456 m MEAS -- -- SET
⑤ Press the [F4] (SET) key, and horizontal distance will be decided.	[F4]	MLM-1 <STEP-2> HD: m MEAS -- -- SET

Sight prism P2. Press the [F1] (MEAS) key, and distance measuring will start. Horizontal distance is displayed.	[F1]	MLM-1 <STEP-2> HD* 246.912 m MEAS -- -- SET
⑥ Press the [F4] (SET) key, and horizontal distance will be decided. Horizontal distance (dHD) and elevation (dVD) between A and B are displayed. To display the slope distance (dSD) press the [F4] (SLCT) key.	[F4]	MLM-1 dHD: 123.456 m dVD: 12.345 m EXIT (2) -- SLCT
⑦ To measure the distance between A and C, press the [F2] (2) key. The mode return to the <STEP-2>.	[F2]	
Sight prism P3 at C. Press the [F1] (MEAS) key, and distance measuring will start. Horizontal distance is displayed.	[F1]	MLM-1 <STEP-2> HD* 358.023 m MEAS -- -- SET
⑧ Press the [F4] (SET) key, and horizontal distance will be decided. Horizontal distance and elevation between A and C are displayed.	[F4]	MLM-1 dHD: 234.567 m dVD: 24.690 m EXIT (2) -- SLCT
• *To return to the normal measurement mode, press* [F1] (EXIT) *key.*		

Procedure of MLM-2 mode is completely same as MLM-1 mode.

7.6 Line Measurement Mode (LINE)

This mode is useful to obtain the line height.



Input of prism height (P.h)

Operating Procedure	Key Operation	Display
① Press [MENU] key.	[MENU]	MENU 1 : PROGRAMS 2 : DATA. SET 3 : PARAMETERS
② Select the PROGRAMS mode (2/2).	[1] [ENT]	PROGRAMS 2/2 1 : REM 2 : MLM 3 : LINE P↓
③ Select "3:LINE". The title display of "LINE" will be shown approximately 1 second after selecting "LINE".	[3]	LINE 1 : INPUT P. h 2 : No P. h
④ Select "1:INPUT P.h".	[1]	LINE P. h=_ m EXIT -- CLR --
⑤ Input the prism height.	[1] [.] [5] [ENT]	LINE <STEP-1>PT A HD: m MEAS -- -- SET
⑥ Sight prism A. Press [F1] (MEAS) key, and distance measuring will start.	[F1]	LINE <STEP-1>PT A HD* << m MEAS -- -- SET

Horizontal distance is displayed.

```
LINE
<STEP-1>PT A
 HD:      50.234 m
MEAS --   --   SET
```

⑦ Press [F4] (SET) key, and horizontal distance will be recorded. [F4]

```
LINE
<STEP-2>PT B
 HD:              m
MEAS --   --   SET
```

⑧ Sight prism B.
Press [F1] (MEAS) key, and distance measuring will start. [F1]

```
LINE
<STEP-1>PT B
 HD*           << m
MEAS --   --   SET
```

↓

Horizontal distance is displayed.

```
LINE
<STEP-1>PT B
 HD:      67.543 m
MEAS --   --   SET
```

⑨ Press [F4] (SET) key, and horizontal distance will be recorded. [F4]

```
LINE
 VD:      20.123 m
Off:      74.123 m
EXIT LH   HD   --
```

⑩ Sight line point L.
Measured data to the line point L is displayed.
VD: Vertical distance.
Off: Horizontal distance from A to L.
- Pressing [F3] (HD) key, horizontal distance will be displayed.

```
LINE
 VD:      38.987 m
Off:      27.521 m
EXIT LH   HD   --
```

⑪ Press [F2] (LH) key. [F2]
This function is used when measuring the line height from the ground. The procedure is as follows:
- Sight the point on the line before pressing this key.
- Don't move the horizontal tangent screw by setting ground point G.

```
LINE
 G-POINT
 V :  90° 40' 20"
EXIT          SET
```

⑫ Rotate the vertical tangent screw, and sight ground point G.

⑬ Press [F4] (SET) key, line height (LH) and horizontal distance (Off) are displayed. [F4]

```
LINE
 LH:      33.765 m
Off:      27.521 m
EXIT  VD --  NEXT
```

- *To return the normal measurement mode, press the [F1] (EXIT) key.*
- *To return to operation procedure ⑩, press the [F2] (VD) key.*
- *To return to operation procedure ⑫, press the [F4] (NEXT) key.*
  The NEXT key is used when the ground point G is not clear and you would like to check another ground point G on the same vertical line.

7.7 Setting a Horizontal Angle (H-ANGLE)

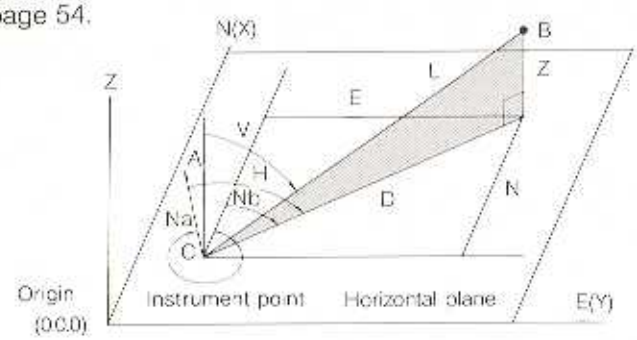
It is possible to set a required horizontal angle by numeric keys same as 3.4.2 Setting a horizontal angle from the numeric key.

Operating Procedure	Key Operation	Display
①Set the MENU mode.	[MENU]	MENU 1:PROGRAMS 2:DATA-SET 3:PARAMETERS
②Select the DATA-SET mode.	[2]	DATA-SET 1:H-ANGLE 2:OCC. STATION
③Select the H-ANGLE mode.	[1]	H-SET HR=_ EXIT -- CLR ←
④Collimate the target.		
⑤Input the required horizontal angle by pressing numeric keys. (120°30′40″)	[1][2][0][.] [3][0][4][0]	H-SET HR=120.3040_ EXIT -- CLR ←
⑥Finish the horizontal angle setting.	[ENT]	H-SET HR= 120°30′40″ <SET!>
The display turns back normal measurement mode.		V : 90°10′20″ HR: 120°30′40″ OSET HLD HSET 1↓

7.8 Setting Instrument Point Coordinates (OCC. STATION)

Set the coordinates of GTS-4 series according to coordinate original point, and GTS-4 series automatically convert and display the unknown point (prism point) coordinates following the original point.

It is possible to retain the coordinate of Instrument point after turning power switch off. For setting, see page 54.



(1) Setting [N(X) coordinate 12.345m, E(Y) coordinate 54.321m, Z coordinate 2.345m].

Operating Procedure	Key Operation	Display
① Press the [MENU] key, and the instrument will be set at measuring menu mode.	[MENU]	MENU 1 : PROGRAMS 2 : DATA-SET 3 : PARAMETERS
② Select the DATA-SET mode.	2	DATA-SET 1 : H-ANGLE 2 : OCC. STATION
③ Select the OP-STATION mode.	2	OCC. STATION 1/2 N = 0.000_m E = 0.000 m EXIT -- CLR ←
④ Set N(X) coordinate.	1 2 • 3 4 5 [ENT]	OCC. STATION 1/2 N = 12.345 m E = 0.000_m EXIT -- CLR ←
⑤ Set E(Y) coordinate.	5 4 • 3 2 1 [ENT]	OCC. STATION 1/2 N = 12.345 m E = 54.321 m EXIT -- CLR ← ↓ OCC. STATION 2/2 Z = 0.000_m EXIT -- CLR ←

⑥Set Z coordinate. The display turns back normal measurement mode.	2 • 3 4 5 [ENT]	OCC. STATION 2/2 Z = 2.345 m EXIT -- CLR ←- ↓ V : 90° 10′ 20″ HR: 120° 30′ 45″ OSET HLD HSET 1↓

7.9 Setting Minimum Angle Reading (MIN-ANGLE)

Select minimum display unit for angle measurement. It is possible to select 1" or 5" (0.1 mgon or 1 mgon): GTS-4/4A, 5" or 10" (1 mgon or 2 mgon): GTS-4B. Setting of degree, gon or mil unit for angle measurement, see page 54 "14. SELECTING MODE".

Operating Procedure	Key Operation	Display
①Set the MENU mode.	[MENU]	MENU 1 : PROGRAMS 2 : DATA-SET 3 : PARAMETERS
②Select the PARAMETERS mode.	3	PARAMETERS 1 : MIN-ANGLE 2 : TILT ON/OFF 3 : APF ON/OFF
③Select the MIN-ANGLE mode.	1	MIN-ANGLE READING: [1] sec. EXIT -- 1 / 5
④Select the minimum reading unit. (ex. select 5 sec. reading) The display turns back normal measurement mode.	[F4]	MIN-ANGLE READING: [5] sec. EXIT -- 1 / 5 ↓ V : 90° 10′ 20″ HR: 150° 30′ 40″ OSET HLD HSET 1↓

7.10 Vertical and Horizontal Angle Tilt Correction (TILT ON/OFF)

(GTS-4/4B has vertical angle correction only)

In case the instrument is used in an unstable situation, constant indexing of vertical and horizontal angle may be impossible. In this case, the function of tilt correction can be stopped by selecting TILT OFF. It has been set to V/H TILT ON at the factory.

Operating Procedure	Key Operation	Display
① Set the MENU mode.	[MENU]	MENU 1:PROGRAMS 2:DATA-SET 3:PARAMETERS
② Select the PARAMETERS mode.	3	PARAMETERS 1:MIN-ANGLE 2:TILT ON/OFF 3:APF ON/OFF
③ Select the TILT ON/OFF mode.	2	1:V TILT ON [2:V/H TILT ON] 3:OFF [1] [2] [OFF] --
④ Select the tilt mode.	[F1] to [F3]	V : 80°10'20" HR: 120°30'40" OSET HLD HSET ↓
The display turns back normal measurement mode.		

7.11 Auto Power Off (APF ON/OFF)

If no key operation is given or no process of measurement is performed for more than 30 minutes (No change exceeding 30" has occurred during horizontal angle or vertical angle measurement.), the power turns off automatically.

Or, if the instrument is set at distance measurement mode (No change in distance exceeding 10 cm has occurred during distance measurement), the mode changes to angle measurement automatically in case that the instrument does not operate for approximately 10 minutes, and the power turns off more than approximately 20 minutes after that.

Operating Procedure	Key Operation	Display
① Set the MENU mode.	[MENU]	
② Select the PARAMETERS mode.	3	PARAMETERS 1:MIN-ANGLE 2:TILT ON/OFF 3:APF ON/OFF
③ Select the APF ON/OFF mode.	3	APF:[ON] <Auto Power Off Function> EXIT --[ON] [OFF]
④ Select ON or OFF of Auto power off. (ex. Select OFF).	[F4]	APF:[OFF] <Auto Power Off Function> EXIT --[ON] [OFF]
The display turns back normal measurement mode.		V : 90°10'20" HR: 150°30'40" 0SET HLD HSET 1↓

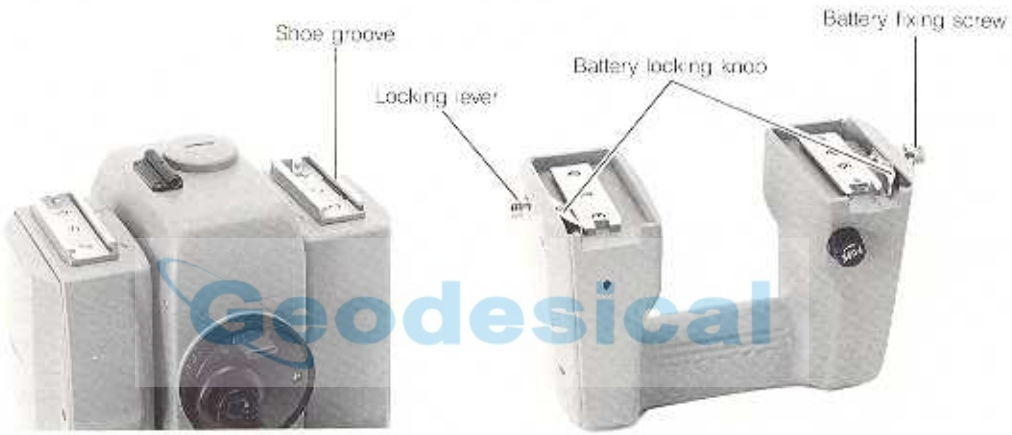
8. POWER SOURCE AND CHARGING

8.1 Handle battery BT-20Q

The handle battery BT-20Q is normally supplied with the instrument and, when attached on the twin attachment shoes on top of instrument standards, becomes an integral part of the instrument, as well as doubling as a very convenient carrying handle.

1) Attachment of the handle battery BT-20Q

a. First, loosen the battery fixing screw, by turning it in the counterclockwise direction.
b. Insert the attachment mounts, on the bottom of the handle battery, into corresponding twin shoes on top of the instrument standards.
c. Push the handle battery gently in, all the way, until there is an audible click which will indicate that the handle battery has been securely engaged.
d. Tighten the battery fixing screw, by turning clockwise.



2) Detachment of the Handle Battery BT-20Q

a. First, loosen the battery fixing screw.
b. Then, pull the handle battery out while pushing both battery locking knob and battery fixing screw down, as illustrated.

8.2 Recharging the Battery Pack

Both the handle battery BT-20Q and external battery pack BT-3Q are rechargeable nickel-cadmium battery packs which can be recharged with Battery Chargers BC-10B or BC-10C. BC-10C is for AC 230V use and BC-10B is for AC 120V use, with both having allowances of plus/minus 10 percent of the rated voltage.

1) Detach the handle battery BT-20Q, if it is to be recharged. If the external battery pack BT-3Q is being recharged, disconnect the battery connector cord.
2) Connect the battery charger and the battery pack being recharged, as illustrated.
3) Connect the plug on the power cord of the battery charger to an electrical receptacle of matching voltage. In case of BT-3Q, turn the power switch on of the Battery Pack.
4) Confirm that a red-colored lamp lights up on the battery charger to indicate that charging is taking place.
5) The handle battery BT-20Q and the external battery pack BT-3Q will require 15 hours for a full recharge.
   When charging BT-20Q and BT-3Q using the special accessory, Quick Battery Charger BC-5, it takes 1 hour to charge.
6) After recharging is completed, then, disconnect the battery pack. In case of BT-3Q, turn the power switch off before disconnect.

Note:
1. Recharging should take place in a room with an ambient temperature range of 10°C to 40°C (50°F to 104°F).
2. Exceeding the specified charging time may shorten the life of the battery and should be avoided if possible.
3. The battery source will discharge when stored and should be checked before using with instrument.
4. Be sure to charge the battery source every 3 or 4 months and store in a place at 30°C and below when it will not be used for a long period.
5. For further information, see page 74.

9. DETACHABLE TRIBRACH

The instrument is easily detached from or attached to the tribrach, with a single fixing lever loosened or tightened for this purpose.

- Detachment
  1) Loosen the tribrach fixing lever, by revolving it 180° or 200g in the counterclockwise direction (which will point the triangle mark upwards).
  2) Grip the handle battery firmly with one hand while holding the tribrach firmly with the other. Then, lift the instrument straight upwards and off.

- Attachment
  1) Hold the instrument by the handle battery, with one hand, and carefully lower it on top of the tribrach while, at the same time, coinciding the alignment piece with the tribrach alignment groove on the instrument and tribrach respectively.
  2) When fully seated, revolve the tribrach fixing lever 180° or 200g clockwise (which will point the triangle mark downwards again).

- Locking the Tribrach Fixing Lever
  The tribrach fixing lever can be locked from being moved accidentally, especially if the upper instrument section is not being detached very often. Simply tighten the securing screw on the fixing lever with the accessory screwdriver, in this case.

10. ATMOSPHERIC CORRECTION

The velocity of light through air is not constant but depends on the atmospheric temperature and pressure, which makes it necessary to correct for the ambient atmospheric temperature and pressure in order to obtain distance measurements of high accuracy.
An atmospheric correction system is built into the instrument and, therefore, the displayed distance measurements are automatically corrected when the required correction is stored into the memory of the instrument from the keyboard.
There are two ways for the setting of the atmospheric correction. One is setting the atmospheric correction value (ppm), the other is direct setting of the temperature and pressure.
The values are kept in the memory even after power is shut off.

10.1 Use of Atmospheric Correction Chart

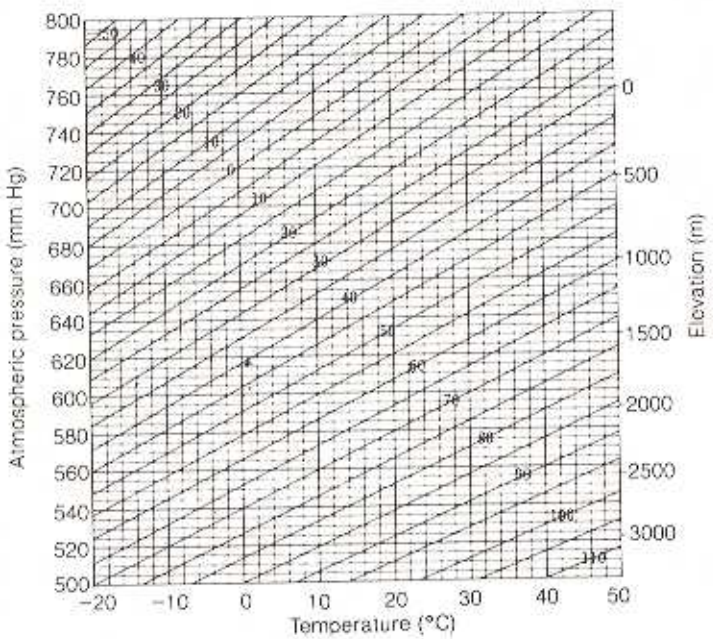
The atmospheric correction value is obtained with the atmospheric correction chart, in the following manner:

1) Measure the ambient temperature and pressure at both instrument position and prism reflector position. Average the results.

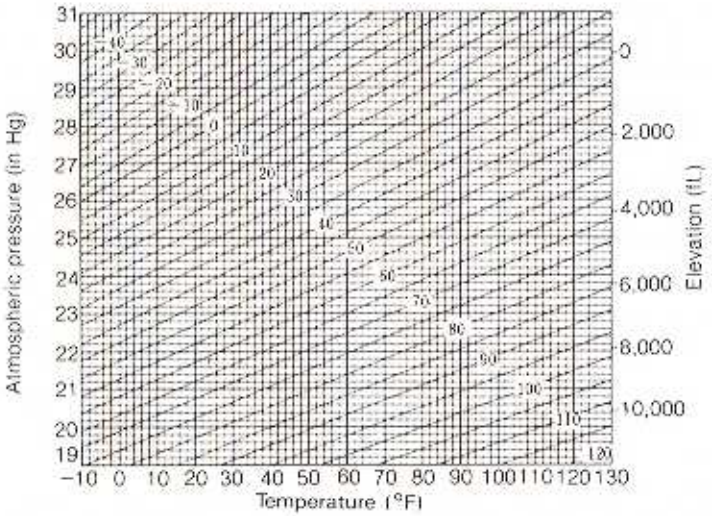
> **CAUTION:** The thermometer and barometer should not be exposed directly to the sunlight.

2) Locate the measured temperature on the horizontal scale of the atmospheric correction chart.
3) Locate the measured pressure on the vertical scale of the atmospheric correction chart.
4) Find the intersection of the measured temperature and pressure on the chart and read the PPM (parts per million) value from the diagonal line, which will be the required atmospheric correction.

Example
The measured temperature is ..... +26°C
The measured pressure is 760mmHg
Therefore,
The correction value is ..... +10ppm



Atmospheric correction chart



Atmospheric correction chart

10.2 Atmospheric Correction Calculation

The atmospheric correction K_a and the distance after correction L can also be obtained in the following manner. First, the atmospheric correction value K_a is obtained from the following formula:

$$K_a = \left(279.66 - \frac{106.036 \times p}{273.16 + t}\right) \times 10^{-6}$$

when,
P: Ambient atmospheric pressure (mm Hg)
t: Ambient atmospheric temperature (°C)
Then the distance after correction L is obtained from the following formula:
$L = \ell\ (1 + K_a)$ (m),
ℓ = Distance measured with the instrument, when $K_a = 0$ (ppm).

(Example)
When the atmospheric temperature is 20°C, the atmospheric pressure 635mmHg and the measured distance 1,000.000m, the atmospheric correction value K_a and the distance after correction L are obtained with the following calculations:

$$K_a = \left(279.66 - \frac{106.036 \times 635}{273.16 + 20}\right) \times 10^{-6}$$
$$= 50 \times 10^{-6}$$
$$= 50 \text{ (ppm)}$$

$$L = 1{,}000.000 \times (1 + 50 \times 10^{-6})$$
$$= 1{,}000.050 \text{ (m)}$$

10.3 How to Set the Atmospheric Correction

• Setting directly temperature and atmospheric pressure (ex: 20°C, 760 mmHg)

Operating Procedure	Key Operation	Display
① Measure the temperature and atmospheric pressure around GTS-4 series. • *Do not expose the thermometer or barometer to direct sunlight.*		
② Set the instrument in the measuring distance mode.	[◢I]	HR: 0° 10′ 20″ HD* [r] < m VD: m MEAS CRS S/A 1↓
③ Press the [F3] key to set the instrument at set audio mode (S/A).	[F3]	S/A PSM:-30 SIG:30 PPM:-99 EXIT PSM PPM T-P
④ Press the [F4] key, and it will become ready for setting a PPM value according to the temperature and atmospheric pressure. (T-P)	[F4]	T-P SET Temp=_ °C Pres= mmHg EXIT -- CLR ←-
⑤ Set temperature. • *Input range −30°C to +60°C (−22°F to +140°F)* • *If the set temperature is the same as displayed, press the* [ENT] *key, and it will be set.*	[2][0] [ENT]	T-P SET Temp= 20 °C Pres=_ mmHg EXIT -- CLR ←-
⑥ Set atmospheric pressure. • *Input range 420mmHg to 800mmHg (16.5inHg to 31.5inHg)* • *If the set atmospheric pressure is the same as displayed, press the* [ENT] *key for setting it.* The instrument is automatically returned to the set-audio mode after approx. 2 seconds.	[7][6][0] [ENT]	T-P SET Temp= 20 °C Pres= 760 mmHg EXIT -- CLR ←- ↓ S/A PSM:-30 SIG:30 PPM: 5 EXIT PSM PPM T-P

• *If temperature and atmospheric pressure exceeding the input range are set, the buzzer will sound to tell you that you made a mistake in setting. You can input a new value.*

• Setting an atmospheric correction value (ppm)

Use the atmospheric correction chart to find a proper correction value (ppm) or find it through calculation, and set it, an automatic correction will be carried out. The setting will be stored even after power is turned off.

Operating Procedure	Key Operation	Display
① Measure the temperature and atmospheric pressure around GTS-4 series. • *Do not expose the thermometer or barometer to direct sunlight.*		
② Use the atmospheric correction chart to find a proper correction constant (ppm) or find it through calculation.		
③ Set the instrument in the measuring distance mode.	[◢I]	HR: 0°10′20″ HD* [r] < m VD: m MEAS CRS S/A 1↓
④ Press the [F3] key to set the instrument at set audio mode (S/A).	[F3]	S/A PSM:-30 SIG:30 PPM: 4 EXIT PSM PPM T-P
⑤ Press the [F3] (PPM) key, and it will be ready for ppm setting.	[F3]	PPM SET PPM=4_ PPM EXIT -- CLR ←
⑥ Set PPM. • *Input range: ±99 ppm in 1 ppm step.*	[−][1][0] [ENT]	PPM SET PPM=-10 PPM EXIT -- CLR ←
The instrument is automatically returned to the set-audio mode after approx. 2 seconds.		S/A PSM:-30 SIG:30 PPM:-10 EXIT PSM PPM T-P

11. SETTING A PRISM CONSTANT

The prism constant for TOPCON prisms is 0. If the prism of other manufacturers than TOPCON is used, the appropriate constant shall be set beforehand.
The constant is kept in the memory even after power is shut off.

• For example to set a prism constant of −30mm:

Operating Procedure	Key Operation	Display
① Press the [F3] key to set the instrument at set audio mode when it is at distance measurement mode.	[F3]	S/A PSM: 0 SIG:30 PPM:-99 EXIT PSM PPM T-P
② Press the [F2] key, and the instrument will be set at prism constant setting mode.	[F2]	PSM SET PSM= 0_mm EXIT -- CLR ←
③ Enter the prism constant: • *The input range is −99mm to 99mm in 1mm steps.*	[−] [3] [0]	PSM SET PSM=-30 mm EXIT -- CLR ←
Press the [ENT] key, and the instrument is automatically returned to the set-audio mode after approx. 2 seconds.	[ENT]	S/A PSM:-30 SIG:30 PPM:-99 EXIT PSM PPM T-P

12. HOW TO SET THE S/A BUZZER AND THE INSTRUMENT CONSTANT

[Example] In the case of the S/A buzzer is OFF, the instrument constant is 1.2 mm.

Operating Procedure	Key Operation	Display
① Pressing the [F3] key, turn the power switch ON.	[F3]+[POWER]	EDM 1:S/A Buzzer 2:Offset
② Select the "1:S/A Buzzer" mode. The data previously set is shown.	[F1]	S/A Buzzer 1:ON 2:OFF 1
③ Set the S/A Buzzer to OFF.	[F2]	2 ↓ about 1.0 SEC. EDM 1:S/A Buzzer 2:Offset
④ Select the "2:Offset" mode.	[F2]	EDM OFFSET 0.0mm >MODIFY? YES NO
⑤ After pressing the [F3] (YES) key, enter the instrument constant.	[F3] [1][•][2]	EDM OFFSET 1.2mm EXIT -- CLR ←-
Press the [ENT] key.	[ENT]	<SET1> ↓ about 1.0 SEC.
⑥ Turn the power switch OFF.	[POWER]	EDM 1:S/A Buzzer 2:Offset

- *The input range of the instrument constant is −99mm to 99mm in 1mm steps.*
- *The instrument constant is found at the back of the rubber on EDM.*

13. CORRECTION FOR REFRACTION AND EARTH CURVATURE

GTS-4 series measures distance, taking into account correction for refraction and earth curvature.

Note: If the telescope is positioned within ±9° from the nadir or zenith, no measurement will result even if the correction function for refraction and earth curvature works.

13.1 Distance Calculation Formula

Distance Calculation Formula; with correction for refraction and earth curvature taken into account Follow the formula below for the converting horizontal and vertical distances.

Horizontal distance $D=AC(\alpha)$ or $BE(\beta)$

Vertical distance $Z=BC(\alpha)$ or $EA(\beta)$

$D=L\ [\cos\alpha-(2\theta-\gamma)\sin\alpha]$

$Z=L\ [\sin\alpha+(\theta-\gamma)\cos\alpha]$

$\theta=L\cdot\cos\alpha/2R$ ..... Earth curvature correcting item

$\gamma=K\cdot L/2R$ ..... Atmospheric refraction correcting item

$K=0.14$ (or 0.2) ..... Coefficient of refraction

$R=6372Km$ ..... Radius of earth

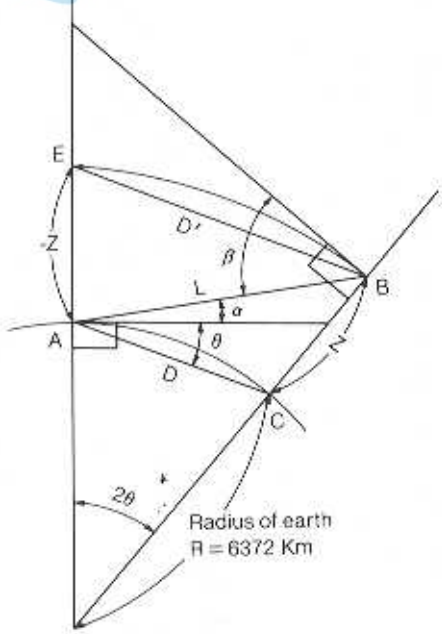
α (or β) ..... Altitude angle

L ..... Slope distance

- The conversion formula for horizontal and vertical distances is as follows when correction for refraction and earth curvature is not applied.

  $D=L\cdot\cos\alpha$

  $Z=L\cdot\sin\alpha$



Note: The coefficient of GTS-4 series has been set at 0.14 before shipment (K=0.14). If the "K" value is to be changed, see page 54.

14. SELECTING MODE

14.1 Items of the Selecting Mode

By operating the keys, the following mode are available.

Menu	Items	Selecting Items	Contents
1. ANGLE	UNIT	DEG GON MIL	Choose degree, gon, or mil unit for measuring angle.
	V	ZENITH-0 LEVEL-0	Choose the vertical angle reading from zenith or from level.
	HA-0-INDEX	OFF ON MEMORY:ON	Horizontal angle can have zero position same as vertical angle (ON). In this case, it is able to retain presetting angle after turning switch off (MEMORY:ON).
2. DIST	UNIT	METER FEET	Choose meter or feet unit for measuring distance when power is ON.
	HD/SD	HD SD	Choose horizontal distance mode (HR, HD, VD) or slope distance mode (V, HR, SD) for initial measuring distance mode.
	N/REPEAT	N REPEAT	Choose N times measurement or repeat (continuous) measurement for initial measuring distance mode.
	W-CORR.	OFF K=0.14 K=0.20	Set about correction for refraction and earth curvature, coefficient of refraction K=0.14, K=0.20 or no correction.
	TRK/CRS	TRK CRS	Choose Tracking or Coarse measurement for measuring distance. The output of Tracking mode is displayed distance data only. The output of Coarse mode is full data, same as continuous distance measurement mode.
	NE-MEMORY	OFF ON	It is possible to retain the coordinate of Instrument point after turning switch off.
	REC-TYPE	REC-A REC-B	Select REC-A or REC-B for data output. If REC-A is selected, the measurement is started and new data is outputted. If REC-B is selected, the data being displayed is outputted.
	TIMES OF MEAS.	1~15	Set N (number of times) for times of distance measurement. When setting number of times as 1, it is single measurement.
	Coordinate displaying order	NEZ ENZ	Select a coordinate displaying order either NEZ or ENZ.
	UNIT (Temperature)	°C °F	Select a temperature unit either °C or °F.
	UNIT (Pressure)	mmHg inHg HPa	Select a pressure unit one of mmHg, inHg and HPa.
3. DATA-OUT	CR,LF	OFF ON	It is possible to output the data with cursor return and line feed.
	ECHO BACK	OFF ON	It is possible to output the data of echo back type.
	NEZ-digits	8 9	Select to record coordinates in 8 digits or 9 digits.

14.2 How to Set the Selecting Mode

<Example>

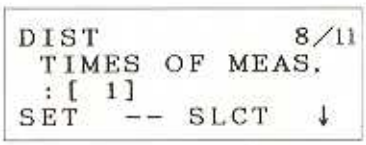
In the case of angle unit is GRAD, initial distance unit is Feet and times of meas. is 5.

- Confirm power switch off of the Instrument.

Operating Procedure	Key Operation	Display
① Pressing the [F2] key, turn the power switch ON.	[F2]	[PARAMETERS SET]
PARAMETERS menu mode is displayed.		PARAMETERS 1:ANGLE 2:DIST 3:DATA-OUT
② Select the "1: ANGLE" mode.	1	ANGLE 1/3 UNIT:DEG SET -- SLCT ↓
③ Set the angle unit to GRAD.	[F4]	ANGLE 1/3 UNIT:GRAD SET -- SLCT ↓
④ Finish the "1: ANGLE" setting.	[F1]	ANGLE >SET OK? -- --[YES] [NO]
	[F3]	ANGLE <SET!>
The mode will return to the PARAMETERS menu mode.		PARAMETERS 1:ANGLE 2:DIST 3:DATA-OUT
⑤ Select the "2: DIST" mode.	2	DIST 1/11 UNIT:METER SET -- SLCT ↓
⑥ Set the distance unit to Feet.	[F4]	DIST 1/11 UNIT:FEET SET -- SLCT ↓

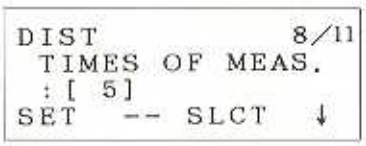
⑦ Change the item to times of meas. mode by pressing [F3] (SLCT) key 7 times.

[F3] · · ·



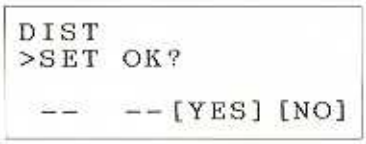
⑧ Set the Times of meas. to 5 times.

[F4] · · ·



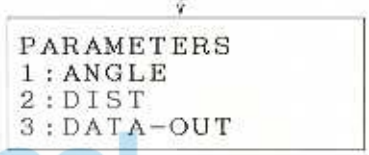
⑨ Finish the "2: DIST" setting.

[F1]



[F3]

The mode will return to the PARAMETERS menu mode.



⑩ Turn the power switch OFF.

15. ADJUSTMENTS

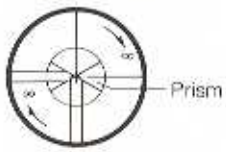
All TOPCON instruments have undergone strict and rigid inspections and should, therefore, arrive properly adjusted, unless subject to excessive rough handling during transportation. The instrument will, of course, lose adjustment when used under the adverse conditions normally prevailing on most sites and in the field, thus requiring adjustment.
Check the instrument from time to time, but especially before important surveying operations in the field, as it may prove expensive to duplicate the operation once more. Be absolutely certain that adjustments are required before making such adjustment but, on the other hand, try to carry out the required adjustments before the instrument gets badly out of adjustment, as the adjustments may have to be repeated several times then.

15.1 Adjustment of the Optical Axes

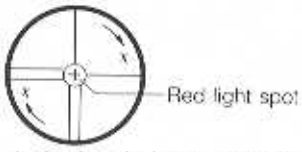
To check if the optical axes of EDM and theodolite are matched, follow the procedure below. It is especially required after adjustment of the eyepiece reticle is carried out.

1) Position the EDM and prism with 2 m between them.

2) Sight through the eyepiece and focus to the prism by turning the focusing knob. Then, align the center of prism with the center of the target.



3) Turn the power ON. Then set the instrument S/A mode or continuous distance measurement mode.
4) Sight through the eyepiece and focus to the blinking red light spot by turning the focusing knob in the direction of infinity.



5) If displacement of the reticule cross-hairs is within one-fifth of the diameter of the round red spot, both vertically and horizontally adjustment will not be required.

Note: If displacement is more than one-fifth, in the above case, and still remains so after rechecking the original line of sight, the instrument must be adjusted by competent technicians.
Please request your authorized Topcon dealer, to adjust the instrument.

15.2 Checking Accuracy of the Distance Measurement

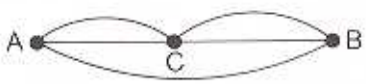
The accuracy of the distance measurements should be checked, at least, once every six months, in order to maintain high accuracy at all times. Use a standard measured distance of known accuracy of an accurately measured distance of more than 20 meters (65.5 ft) for this purpose. The accuracy of the checking procedure will depend entirely on the accuracy of the measured distance, in this case.

Any discrepancy from the true distance will be the additional offset compensation factor (in millimeters) which must be added or subtracted from the offset compensation factor set to the instrument by the factory. Thus, it will become the new offset compensation factor which should be set to the instrument by offset switch.

For comparative measuring when no authorized standard primary length is obtained:

Provide an arbitrary point C on an almost horizontal straight line that is about 100 m long and connects Point A with B and measure the straight lines AB, AC, BC.

$$\text{Instrument constant} = AC + BC - AB$$



Note: Any Errors in installing the instrument and prisms or incorrect slope reduction and sighting will affect checking accuracy. Use care to avoid errors when the instrument constant is changed.

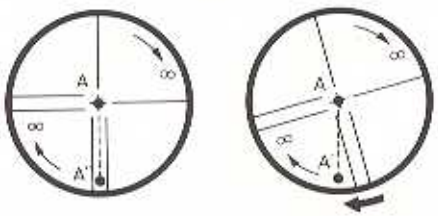
15.3 Pointers on Adjustment

1) Adjust the eyepiece of the telescope properly prior to any checking operation which involves sighting through the telescope. Remember to focus properly, with parallax completely eliminated.
2) Carry out the adjustments in the order listed, as the adjustments are dependent one upon another. Adjustments carried out in the wrong sequence may even nullify previous adjustments.
3) If "Adjustment of the Vertical Cross-Hair" only is required, this adjustment should be followed by "Adjustment of Vertical Angle 0 datum" and "Collimation of the Instrument", as well as "Adjustment of the Optical Axes".
4) If "Collimation of the Instrument" only is required, this adjustment should be followed by "Adjustment of the Optical Axes" and "Adjustment of Vertical Angle 0 datum".
5) If the instrument is badly out of adjustment, make rough adjustments initially and then repeat them once more, as this procedure will usually prove more efficient than trying to make the final adjustment from the beginning.
6) Always conclude adjustments by tightening the adjustment screws securely (but do not tighten them more than necessary, as you may strip the threads, twist off the screw or place undue stress on the parts). Furthermore, always tighten by revolving in the direction of tightening tension.
7) The attachment screws must also be tightened sufficiently, upon completion of adjustments.
8) Always repeat checking operations after adjustments are made, in order to verify results.

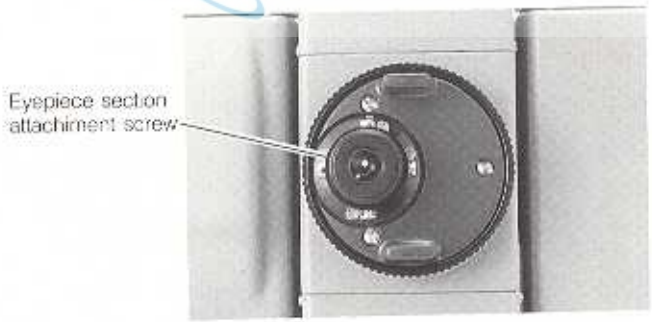
15.4 Adjustment of the Vertical Cross-Hair

Adjustment is required if the vertical cross-hair is not in a plane perpendicular to the horizontal axis of the telescope (since it must be possible to use any point on the hair for measuring horizontal angles or running lines).

1) Set the instrument up on the tripod and carefully-level it.
2) Sight the cross-hairs on a well-defined Point A at a distance of, at least, 50 meters (160 ft.) and clamp all horizontal motions.
3) Next, swing the telescope vertically with the vertical screw, and check whether the point travels along the length of the vertical cross-hair.



4) If the point appears to move continuously on the hair, the vertical cross-hair lies in a plane perpendicular to the horizontal axis (and adjustment is not required).
5) However, if the point appears to be displaced from the vertical cross-hair as the telescope is swung vertically, adjustment is required in the reticule plate.
6) Unscrew the cross-hair adjustment section cover, by revolving it in the counterclockwise direction, and take it off. This will expose four eyepiece section attachment screws, as well as four capstan cross-hair adjustment screws.

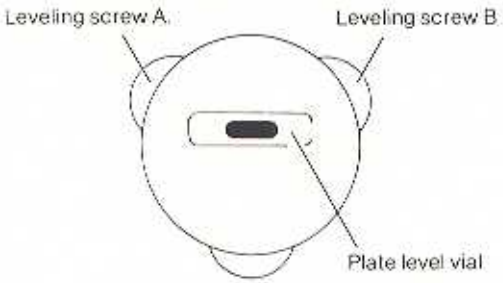


7) Loosen all four attachment screws slightly with the accessory screw-drive (while taking note of the number of revolutions).
   Then, revolve the eyepiece section so that the vertical cross-hair is coincided to Point A.
   Finally, re-tighten the four screws by the amount that they were loosened.
8) Check once more and if the point travels the entire length of the vertical cross-hair, further adjustment is not required.

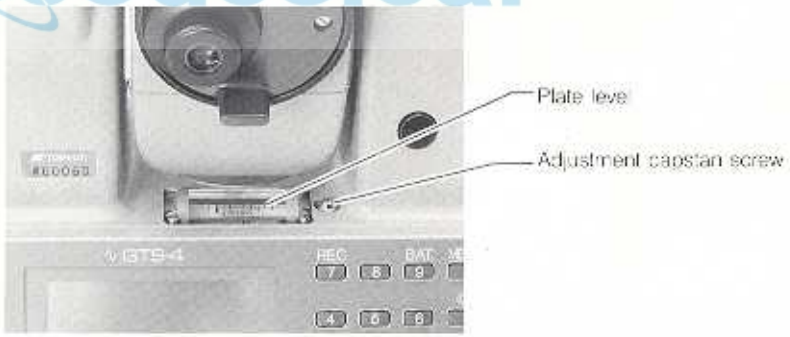
15.5 Adjustment of the Plate Level

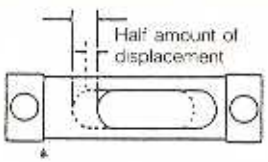
Adjustment is required if the axis of the plate level is not perpendicular to the vertical axis.

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



2) Next, revolve the instrument 180° or 200 g around the vertical axis and check bubble movement of the plate level.
   If the bubble has been displaced, then proceed with the following adjustment.
3) Adjust the level adjustment capstan screw, with the accessory adjusting pin and return the bubble towards the center of the plate level vial. However, correct only one-half of the displacement by this method.
4) Correct the remaining amount of the bubble displacement with the leveling screws.
5) Revolve the instrument 180° or 200 g around the vertical axis once more and check bubble movement. If the bubble is still displaced, then repeat the adjustment.

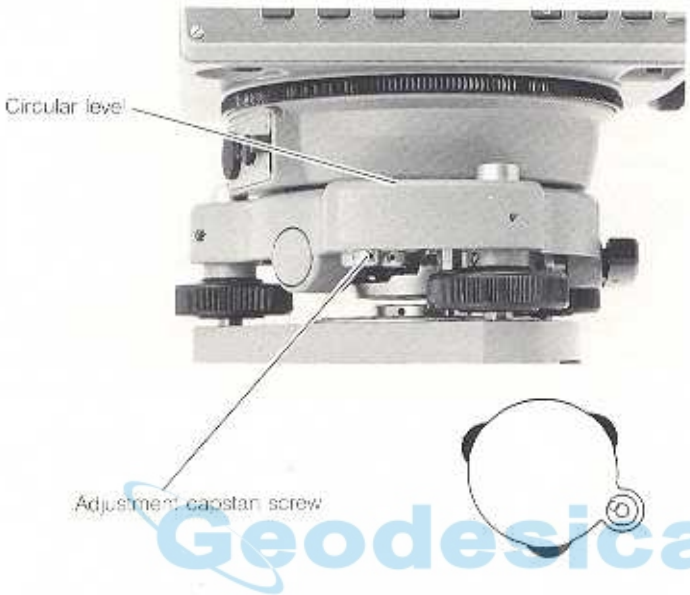




15.6 Adjustment of the Circular level

Adjustment is required if the axis of the circular level is also not perpendicular to the vertical axis.

1) Carefully level the instrument with the plate level only.
2) If the bubble of the circular level is also centered properly, at this time, adjustment is not required. Otherwise, proceed with the following adjustment.
3) Shift the bubble to the center of the level, by adjusting three capstan adjustment screws on the bottom surface of the circular level, with the accessory adjusting pin.



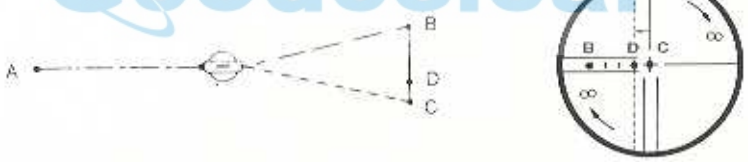
Note: First, loosen the adjustment screw towards which the bubble should be shifted. Then, tighten the adjustment screw on the side towards which the bubble is displaced. Loosen the adjustment screw or screws slightly and take note of the number of revolutions. Then, tighten the second adjustment screws or screw by an equal amount. Clockwise revolution will loosen the screw and counter-clockwise revolution will tighten the screw.

4) Adjustment is completed with the above.

15.7 Collimation of the Instrument

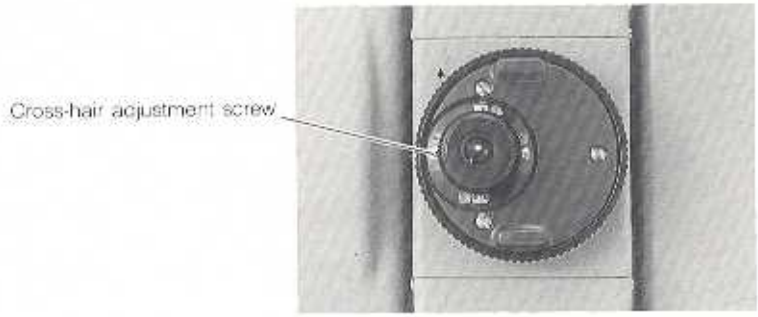
Collimation is required to make the line of sight of the telescope perpendicular to the horizontal axis of the instrument, as otherwise, it will not be possible to extend a straight line by direct means.

1) Set the instrument up with clear sights of about 50 to 60 meters (160 ~ 200 ft.) on both sides of the instrument.
2) Level the instrument properly with the plate level.
3) Sight Point A at approximately 50 meter (160 ft.) distance and tighten all clamps.
4) Loosen the vertical clamp only and plunge the telescope 180° or 200 g around the horizontal axis, so that the telescope is pointed in the opposite direction.
5) Sight Point B, at equal distance as Point A, and tighten the vertical clamp.
6) Loosen the upper motion clamp and revolve the instrument 180° or 200 g around the vertical axis. Fix a sight on Point A once more and tighten the upper motion clamp.
7) Loosen the vertical clamp only. Plunge the telescope 180° or 200 g around the horizontal axis once more and fix a sight on Point C, which should coincide with the previous Point B. Tighten the vertical clamp.
8) If Points B and C do not coincide, adjust in the following manner.
9) Unscrew the cross-hair adjustment section cover.
10) Find Point D at a point between Points C and B, which should be equal to 1/4th the distance between Points B and C and measured from Point C. This is because the apparent error between Points B and C is four times the actual error since the telescope has been reversed twice during the checking operation.
11) Shift the vertical cross-hair line and coincide it with Point D, by revolving the left and right capstan adjustment screws with the adjusting pin.



> **Note:** First, loosen the capstan adjustment screw on the side to which the vertical cross-hair line must be moved. Then, tighten the adjustment screw on the opposite side by an equal amount which will leave the tension of the adjustment screws unchanged. Revolve in the counter-clockwise direction to loosen and in the clockwise direction to tighten, but revolve as little as possible.

12) Upon completing the adjustment, repeat the checking operation once more. If Points B and C coincide, further adjustment is not required. Otherwise, repeat the adjustment.



15.8 Adjustment of the Optical Plummet Telescope

Adjustment is required to make the line of sight of the optical plummet telescope coincide with the vertical axis (as otherwise the vertical axis will not be in the true vertical when the instrument is optically plumbed).

• Optical Plummet Telescope

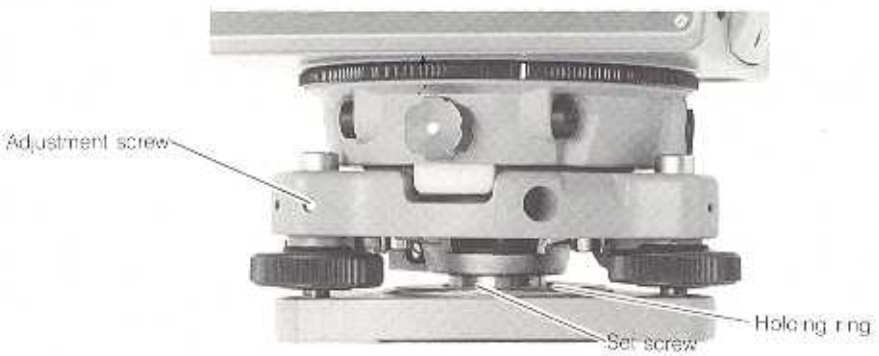
1) Coincide the center mark and the point. (See page 13 "4. optical plumbing".)
2) Revolve the instrument 180° or 200 g around the vertical axis and check the center mark. If the point is properly centered in the center mark, adjustment is not required. Otherwise, adjust in the following manner.
3) Unscrew the adjustment section cover of the optical plummet telescope eyepiece, by revolving it in the counter-clockwise direction, and take it off. This will expose four capstan adjustment screws which should be adjusted with the accessory adjusting pin to shift the center mark to the point. However, correct only one-half of the displacement in this manner.

Note: Adjust in the same manner as for "Collimation of the Instrument".

4) Next, use the leveling screws and coincide the point and center mark.
5) Revolve the instrument 180° or 200 g around the vertical axis once more and check the center mark. If it is coincided to the point, then further adjustment is not required. Otherwise, repeat the adjustment.

15.9 Other Adjustments

1) If the leveling screws become loose and slack, tighten the two adjustment screws on top of each of the leveling screws for obtaining proper tension.
2) Should there be any slack between the leveling screws and the base, loosen the setscrew of the holding ring and tighten the holding ring with the adjusting pin, until it is properly adjusted. Re-tighten the setscrew on completing the adjustment.



15.10 Adjustment of Vertical Angle 0 Datum

If, when measuring vertical angle of target A at telescope normal and reverse settings, the amount of normal and reverse measurements is other than 360°, half of the difference from 360° is the error amount from corrected 0 setting. Carry out adjustment. As adjustment for vertical angle 0 setting is the criteria for determining instrument coordinate origin, use special care for adjustment.

- Operating Procedure

Operating Procedure	Display
① Level the instrument properly with the plate level.	
② Pressing the [F1] key, turn the power switch ON. Right figure of the display will light for about 2 seconds before "V-0 SET (TURN)" is displayed.	[VO-ADJUST]
If the Instrument is set to the zero detection mode on the H angle, it displays "H-0 SET (TURN)". In this case rotate the standard and set zero.	V-OSET(TURN) BAT. [■■■]
③ Turn the telescope for normal telescope setting. (Vertical angle zero-set)	
④ Sight target A in normal telescope setting.	VO-ADJUST <STEP-1> FRONT V : 80° 10′ 20″ -- -- --[SET]
⑤ Press the [F4] (SET) key.	
⑥ Turn the telescope and sight target A in reverse telescope setting.	VO-ADJUST <STEP-2> REVERS V : 279° 50′ 40″ -- -- --[SET]
⑦ Press the [F4] (SET) key and the correct vertical angle is set as a vertical angle 0 datum, and "SET" is displayed.	VO-ADJUST <SET!>
Then the instrument will be set at angle measurement mode.	V : 279° 50′ 10″ HR: 0° 00′ 00″ OSET HLD HSET 1↓
⑧ Check that the instrument works properly by sighting a target at normal and reverse telescope settings and check if the amount of normal and reverse setting is 360°.	

- *If there is any misoperation during checking, display for error appears. Then repeat the above procedure from the start.*

16. STORING PRECAUTIONS

- When storing this instrument in the case, always align the white indication marks on the instrument, and set the telescope at the normal setting position.
- For cleaning the instrument after use, remove dust using a cleaning brush, then wipe off with a cloth.
- For cleaning the lens surface, use a cleaning brush to remove the dust, then use a clean lintless cotton cloth. Moisten it with alcohol (or mixture with ether) to wipe gently in a rotational motion from the center out.
- Even if any abnormality occurs, never attempt to disassemble or lubricate the instrument yourself. Always consult with TOPCON or your dealer.
- To remove the dust on the case, never use thinner or benzine. Use a clean cloth moistened with neutral detergent.

17. SPECIAL ACCESSORIES

TOPCON FC series Data collector
Suitable for systematization of measuring instruments. Measuring data will be automatically stored and transferred to a computer system, making measuring operations more efficient and saving time and effort in such operation.

Battery Pack BT-3Q
- Output voltage: DC8.4V
- Capacity: 1.8 AH
- Service life per charging:
  approx. 6 hours under normal use,
  (however, 2.3 hours for continuous use including measuring distance.)
- External dimensions:
  225(L) × 62(W) × 33 mm(H)
- Weight: 0.7 kg

Quick battery charger BC-5
- Input voltage: 100, 120, 220, 240V
  AC: ±10% 50/60 Hz
- Power consumption: 40VA approx.
- Charging time:
  - approx. 1 hour (+20°C) to charge BT-20Q or BT-3Q
- Operation temperature range:
  +10°C to +40°C (+50 ~ +104°F)
- External dimensions:
  181(L) × 97(W) × 78 mm(H)
- Weight: 1.5 kg

Large capacity battery pack BT-3L
- Output voltage: DC8.4V
- Capacity: 6 AH
- Service life per charging:
  approx. 18 hours under normal use,
  (however, approx. 7.5 hours for continuous use including measuring distance.)
- External dimensions:
  190(L) × 106(W) × 74 mm(H)
- Weight: 2.8 kg

Battery charger BC-6
- Input voltage: 100/120/220/240V
  AC ±10% 50/60 Hz
- Power consumption: 15VA approx.
- Charging time: approx. 15 hours (in +20°C ambient temperature) to charge BT-3L
- Operation temperature range:
  +10 ~ +40°C
- External dimensions:
  142(L) × 96(W) × 64 mm(H)
- Weight: 1.0 kg

Power cord PC-3 (For AC-5)
- L-shape plug provided
- Cord length: 2 m approx.

Power cord PC-5
(For BT-3Q and TOPCON FC series Data collector)
- L-shape plug provided
- Cord length: 2 m approx.

Power cord PC-6 (For BT-3L)
- L-shape plug provided
- Cord length: 2 m approx.

Auto converter AC-5
- Input voltage: 12V DC
- Output voltage: 8.4V
- Cable length: 3 m approx.
- External dimensions:
  100(L) × 53(W) × 47 mm(H)
- Weight: 0.3 kg

Cigarette lighter charge: BC-9
- Input voltage: 13.8V to 16V
- Power consumption: 40VA approx.
- Charging time:
  - approx. 2 hour
    (20°C) to charge BT-20Q or BT-3Q
- Operation temperature range:
  +10°C ~ +40°C
- External dimensions:
  116(L) × 60(W) × 50 mm(H)
- Weight: 0.3 kg

Diagonal eyepiece, Model 10
Observation in an easy posture will be provided up to the zenith position

Solar filter, Model 6
A filter designed exclusively for direct collimation of the sun.
Solar filter of flap-up type.

Solar reticle, Model 6
A reticle designed for collimation of the sun. Can be used together with Solar Filter.

Optical plummet tribrach
This is detachable tribrach having built-in optical plumment telescope (Compatible with Wild)

Trough compass Model 6
Shock proof construction. No clamp is necessary when carrying the instrument. When using this compass use the handle battery BT-20Q.

Prism sets
See the description on page 71.

Prism unit case, Model 6
Fixed 9 prisms unit or tilting 3 prisms unit can be stored in this case. Especially, this is a very easy case to carry. Soft material is used.
○ External dimensions:
250(L)×120(W)×400mm(H)
○ Weight: 0.5kg

Prism unit case, Model 5
1 prism unit or fixed 3 prisms unit can be stored in this case. Especially, this is a very easy case to carry. Soft material is used.
○ External dimensions:
200(L)×200(W)×350mm(H)
○ Weight: 0.5kg

Mini prism
The mini prism (25.4 mm) is made from precision ground glass and mounted in high impact plastic housings.
The mini has the unique capability of being positioned either at a "0" or "−30" with the same prism.

Prism unit case, Model 3
This is the plastic case to store and carry various sets of prisms.
The case covers one of the following prism sets:
- Tilt single prism set
- Tilt single prism set with a target plate
- Fixed triple prism unit
- Fixed triple prism unit with a target plate
- External dimensions: 427(L) × 254(W) × 242 mm(H)
- Weight: 3.1 kg

Gadget case, Model 1
A case to store and carry accessories.
- External dimensions: 300(L) × 145(W) × 220 mm(H)
- Weight: 1.4 kg

Back Pack, Model 2
Convenient for use in mountainous terrain.

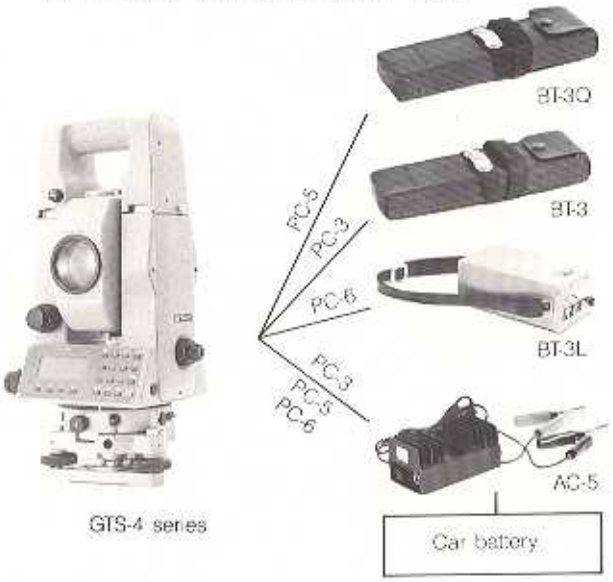
Wide-frame extension leg tripod, Type E (Wood)
- Flat head 5/8" × 11 threads with adjustable legs.

Aluminum extension leg tripod, Type E
- Flat head 5/8" × 11 threads with adjustable legs.

18. BATTERY SYSTEM

In case of Handle Battery BT-20Q

In case of External Battery Pack



Charging

Normal AC 120. . .BC-10B
AC 230V. . .BC-10C

BC-10B

BC-10C

Quick AC 100V/120V
220V/240V

BC-5

Quick DC 13.8 to 16V

BC-9

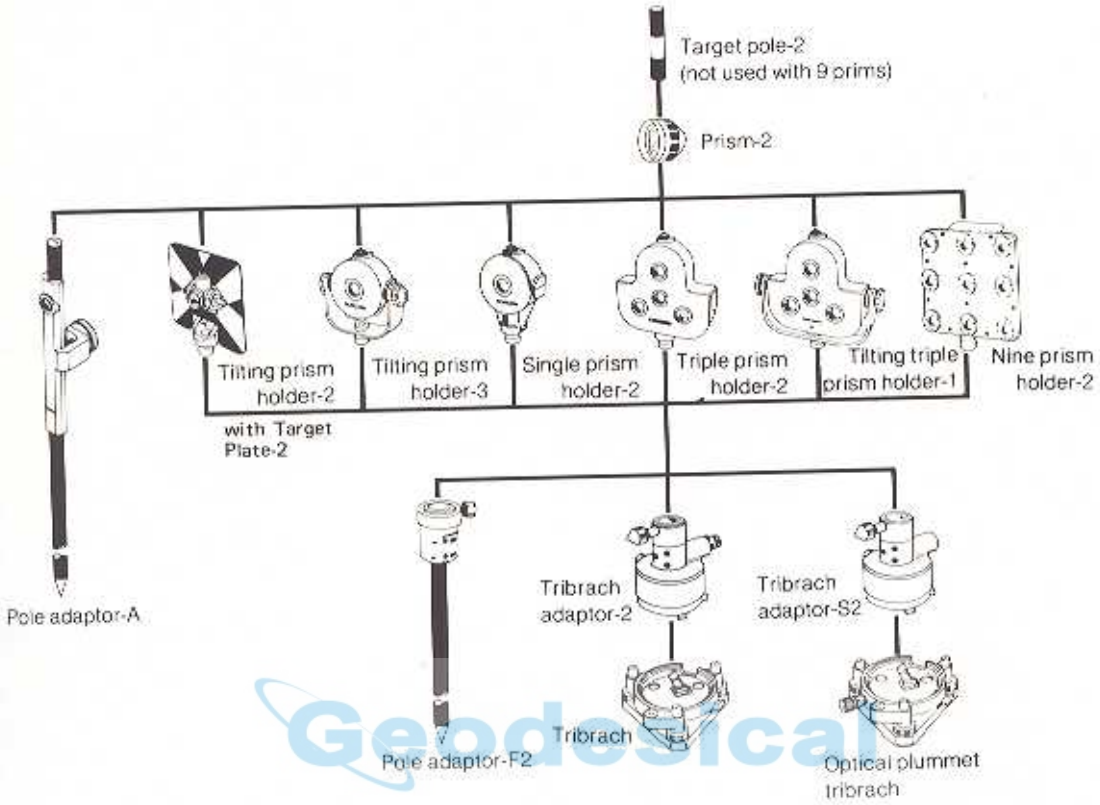
Normal AC 100V/120V
220V/240V

BC-6

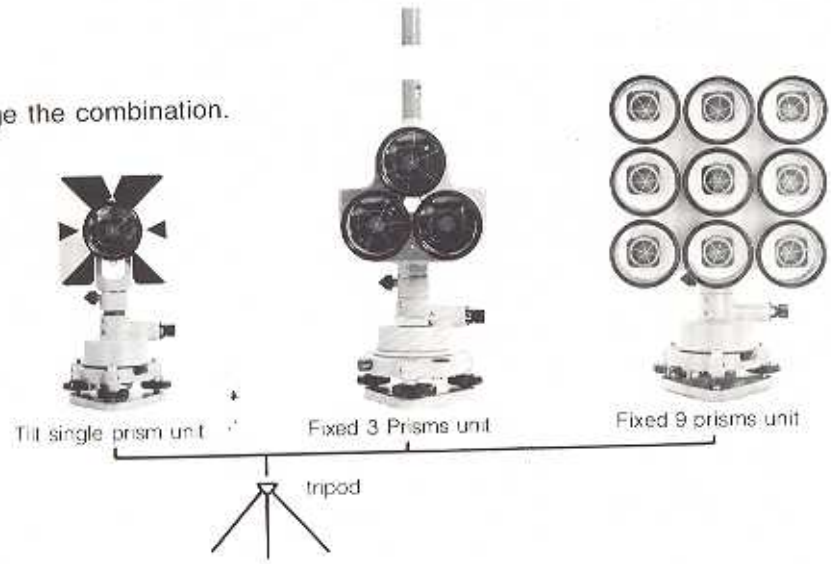
Normal AC 120V. . .BC-4
AC 230V. . .BC-2

19. PRISM AND REFLECTOR SYSTEM

Arrangement according to your needs is possible.



It is possible to change the combination. according purpose



Use the above prisms after setting them at the same height as the instruments. To adjust the height of prism set, change the position of 4 fixing screws.

20. SPECIFICATIONS

Telescope

Length	: 150 mm
Objective lens	: 45 mm (EDM: 50 mm)
Magnification	: 30X
Image	: Erect
Field of view	: 1°30′
Resolving power	: 2.5″
Minimum focus	: 1.3 m

Distance Measurements

Measurement range

		Atmospheric conditions	
		Condition 1	Condition 2
GTS-4/4A	1 prism	2,400 m (7,900 ft)	2,700 m (8,900 ft)
	3 prisms	3,100 m (10,200 ft)	3,600 m (11,800 ft)
	9 prisms	3,700 m (12,100 ft)	4,400 m (14,400 ft)
GTS-4B	1 prism	2,000 m (6,600 ft)	2,300 m (7,600 ft)
	3 prisms	2,700 m (8,900 ft)	3,100 m (10,200 ft)
	9 prisms	3,400 m (11,100 ft)	4,000 m (13,100 ft)

Condition 1: Slight haze with visibility about 20 km (12.5 miles) moderate sunlight with light heat shimmer.

Condition 2: No haze with visibility over 40 km (25 miles), overcast with no heat shimmer.

Measurement Accuracy	: ± (2 mm+2 ppm) m.s.e.
Least Count in Measurements	
Ntimes/Repeat measurement	: 1 mm (0.005 ft.)
Tracking/Coarse measurement	: 10 mm (0.02 ft.)
Measurement Display	: 8 digits; max. display 99999.999 m
Measurement Time	
N times measurement mode	: 2.5 sec.
Continuous measurement mode	: 2.5 sec.
Tracking mode	: 0.5 sec.
Atmospheric Correction Range	: −99 ppm to +99 ppm, in 1 ppm increments.
Prism Constant Correction Range	: −99 mm to +99 mm, in 1 mm increments.
Coefficient Factor	: Meter/Feet 1 meter=3.280833 ft.
Ambient Temperature Range	: −20°C to +50°C (−4°F to +122°F)

Electronic Angle Measurement

Method	: Incremental reading
Detecting	
Horizontal	: 2 sides
Vertical GTS-4/4A	: 2 sides
GTS-4B	: 1 side
Minimum reading GTS-4/4A	: 5″/1″ (1 mgon/0.1 mgon)
GTS-4B	: 10″/5″ (2 mgon/1 mgon)
Accuracy (standard deviation based on DIN 18723)	
GTS-4/4A	: 2″ (0.6 mgon)
GTS-4B	: 5″ (1.5 mgon)
Diameter of circle	: 71 mm

Tilt sensor GTS-4A	: Automatic vertical and horizontal compensator
GTS-4/4B	: Automatic vertical compensator
Method	: Liquid type
Compensating Range	: ±3′
Minimum Reading	: 1″ (0.1 mgon)
Instrument height	: 182 mm (0.597 ft.)
(Tilting axis above tribrack dish)	

Level Sensitivity

Circular level	: 10′/2 mm
Plate level	: 30″/2 mm

Optical Plummet Telescope

Image	: Erect
Magnification	: 3X
Focusing range	: 0.5 m to infinity
Field of view	: 5°

Size

Instrument	
with Handle battery	: 372(H) × 212(W) × 159 mm(L) (14.6(H) × 8.35(W) × 6.26 in(L)
without Handle battery	: 297(H) × 212(W) × 159 mm(L) (11.7(H) × 8.35(W) × 6.26 in(L)
Weight	
Instrument (without Handle Battery)	: 5.8 kgs (12.8 lbs)
Plastic carrying case	: 6.2 kgs (13.7 lbs)

Handle Battery BT-20Q

Output voltage	: 8.4V
Capacity	: 1.8 AH
Maximum operating time (when fully recharged) at +20°C (+68°F)	
Including distance measurement	: 3 hours
Angle measurement only	: 10 hours
Normal use	: 7 hours
Weight	: 1.1 kgs (2.4 lbs)

Battery Charger BC-10B

Input voltage	: AC 120V ±10%
Frequency	: 50/60 Hz
Recharging time (at +20°C/+68°F)	
Handle battery BT-20Q	: 15 hours
Battery pack BT-3Q	: 15 hours
Operating temperature	: 10°C to 40°C (50°F to 104°F)
Charging signal	: Red lamp illumination
Weight	: 0.3 kgs (0.71 lbs)

Battery charger BC-10C

Input voltage	: AC230V ±10%
Frequency	: 50/60 Hz
Recharging time (at +20°C/+68°F)	
Handle battery BT-20Q	: 15 hours
Battery pack BT-3Q	: 15 hours
Operating temperature	: 10°C to 40°C (50°F to 104°F)
Charging signal	: Red lamp illumination
Weight	: 0.4 kg (0.9 lb)

**Battery time will vary depending on environmental conditions and operations done with GTS-4 series.*
Connection of external devices, i.e. Data collector, will also reduce the length of battery use.

• PRECAUTIONS WHEN CHANGING OR STORING BATTERIES

The capacity of battery will be affected and its service life shortened in any of the following cases while it is recharged, discharged or stored.

1. Recharging

Fig. 1 shows how ambient temperature at recharging is related to charging efficiency or as affecting discharge capacity. As seen from the figure, charging at normal temperature is best, and the efficiency decreases as the temperature rises. It is best, therefore, to always recharge the battery at normal temperature to obtain full use of battery capacity and enjoy maximum operation per charge. And the service life of your battery will be shortened if it is frequently overcharged or recharged at high temperature.

Note: 0.1C charge means that the battery is recharged with 0.1 -time current as against its capacity.

2. Discharge

Fig. 2 shows discharge temperature characteristics. Discharge characteristics at high temperature are the same as those at normal temperatures. The battery is likely to have reduced discharge capacity as well as lower discharge voltage when discharged at low temperature. And the service life of your battery will be shortened if it is greatly overcharged.

Note: 1C discharge means one with 1 -time current over battery capacity.

3. Storage

See Fig. 3 for how storing period at different temperature levels is related to the remaining capacity. The battery will lose its capacity as storage temperature rises and the storage period increases. This does not mean, however, that the battery performance is damaged when the battery is stored. The battery, reduced in capacity, will be restored once it is recharged. Always recharge your battery before use. And recharge and discharge the battery 3 or 4 times to restore its capacity if it has been stored for a long period or at high temperature. Storing at high temperature can adversely affect the service life of your battery.

Your battery has been fully charged before leaving the factory, but its capacity may be affected considerably when it takes several months to reach you, if it is stored at high temperature area or passes through a high-temperature region. Then, the battery must be recharged and discharged 3 ~ 4 times to fully restore its capacity.

And the battery should always be stored at normal temperature or lower if it will not be used for any long period. This helps your battery have a longer service life.

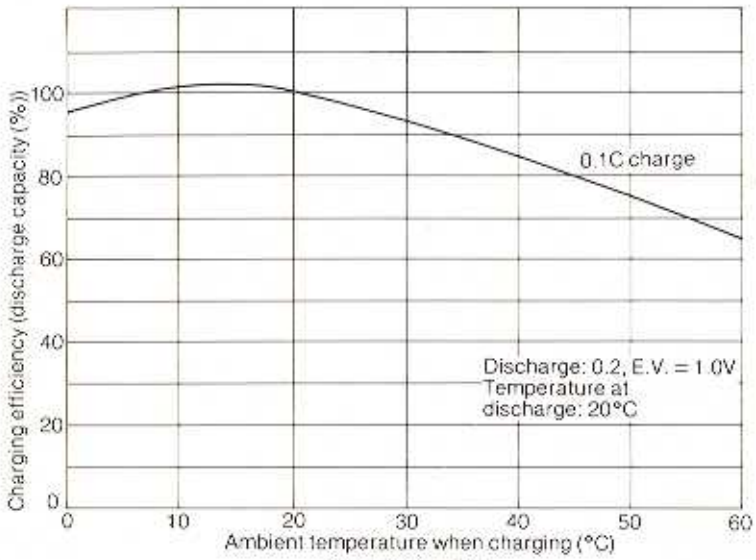


Fig. 1 Recharging

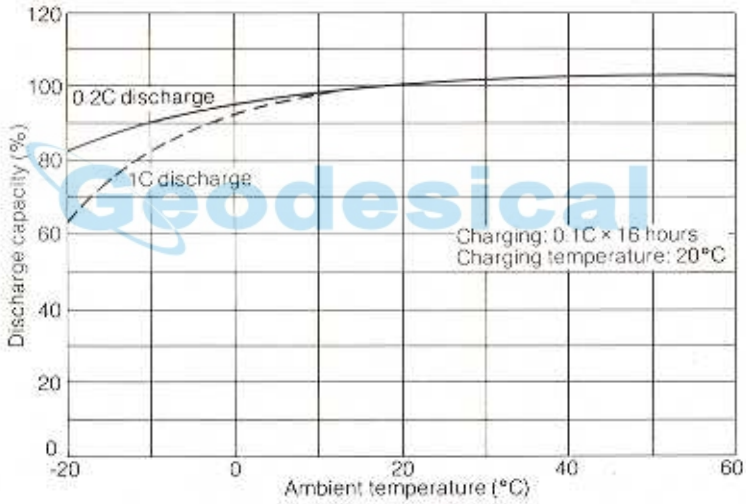


Fig. 2 Discharge

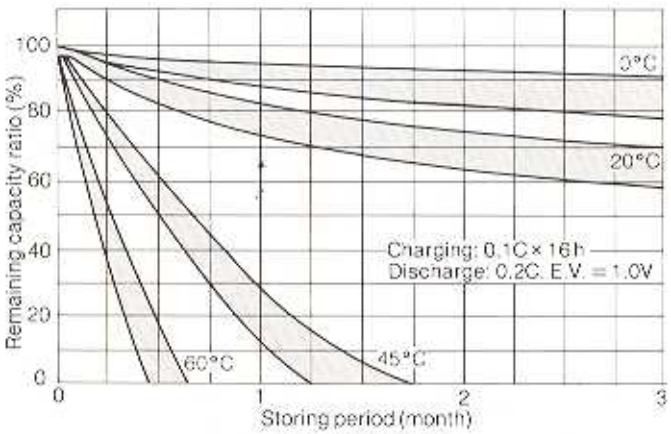


Fig. 3 Storage

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