

INSTRUCTION MANUAL

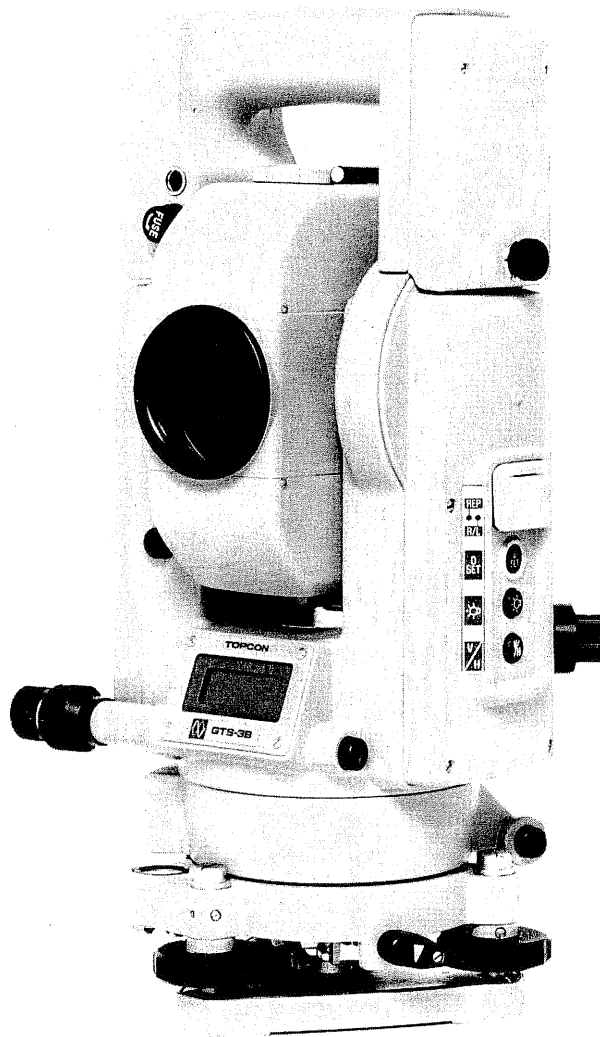
Geodetic
Total
Station

GTS-3B

GTS-3C

FOREWORD

Thank you very much for purchasing a product of TOPCON. This instruction manual is for the TOPCON Geodetic Total Station GTS-3B (GTS-3C). Please read this manual carefully to make the best use of your instrument and keep the manual in a safe place for future reference.



MAIN FEATURES

- GTS-3B (GTS-3C) is a tachometer which is provided with electronic angle reading and distance measuring functions. GTS-3B covers 5 second reading electronic angle measurement up to 2.5 km. GTS-3C is provided with electronic angle reading by 10 seconds and distance measurement up to 1.8 km. The data obtained can be stored electronically through TOPCON's FC-1 Data Collector. The GTS-3B (GTS-3C) has been developed as an electronic total station suitable for use in field surveying as well as a key component in a computerized surveying system.
- The unit of angle measurement is changed by operating option switches; 1 second reading is available with GTS-3B with 5 second divisions. 10 second reading is available with GTS-3C with 5 second divisions.
- Horizontal angles, vertical angles, slope distances, horizontal distance, relative elevation, coordinates of an unknown point and elevation are all available by using the GTS-3B (GTS-3C). The measurements are displayed through a liquid crystal display and can be transmitted and stored in TOPCON's FC-1 Data Collector.
- Angle measurement is obtained by the incremental method. The "O" position of the vertical angle is easily obtained.
- A built-in high-precision tilt sensor (liquid compensator) is used for the vertical axis correction. The "O" position of the vertical angle is easily set and a relative elevation measurement is possible with high accuracy.
- The excellent features of the GTS-3B (GTS-3C) will produce high accuracy and excellent efficiency when used properly during a survey.
- Various points in a detailed survey are immediately available by measuring the angle and distance from an occupied station. The data can be applied effectively, for instance, by transforming it to a graphic expression by use of a computer system or directly used for computation in design.
- The data can be used effectively for peg checking, reference, re-construction and distance measurement in engineering surveys.
- Through TOPCON's technology, we have succeeded in building a compact, light-weight total station (5.2 kg), with our end users being the benefactors.
- It is possible to connect the GTS-3B (GTS-3C) with a computer by using serial signal RS-232C connector.

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1. STANDARD SET COMPOSITION

1-1. Standard Set

1. GTS-3B (GTS-3C) body with lens cap 1 each
2. Handle battery BT-15Q 2 each
3. Charger BC-10B or BC-10C 1 each
4. Atmospheric correction calculator 1 each
5. Tool kit with case (plumb bob hook, rod pins, screwdriver, hexagonal wrench, cleaning brush, silicon cloth, 4 fuses, (4A)) 1 set
6. Sunshade 1 each
7. Plastic rain cover 1 each
8. Plumb bob set 1 set
9. Plastic instrument case 1 each
10. Shoulder strap 1 each
11. Instruction manual 1 each
12. Field chart 1 each

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



Remarks:

1. Battery charger BC-10C is for AC 230V use and BC-10B is for AC 120V use.
2. One handle battery is supplied for certain markets.

1-2 Optional Accessories

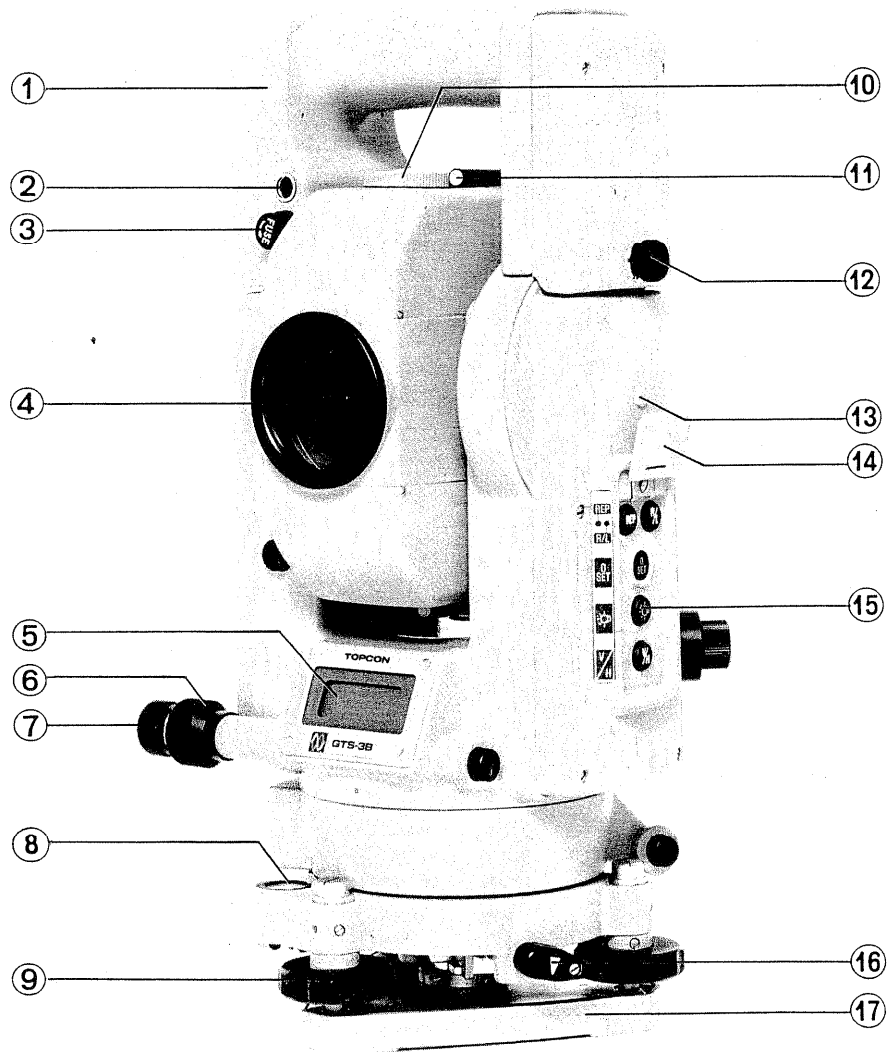
FC-1 Data collector
DK-5 Data entry keyboard
Prism, Model 2 (60 mm dia.; prism constant zero)
Tilting prism holder, Model 2 with target plate
Tilting prism holder, Model 3
Single prism holder, Model 2
Triple prism holder, Model 2
Tilting triple prism holder, Model 1
Nine prism holder, Model 2
Target pole, Model 2
Pole adapter A
Pole adapter F2
Prism unit case, Model 3
Prism unit case, Model 5
Prism unit case, Model 6
Tribrach adapter, Model 2
Tribrach adapter, Model S2
Tribrach (same as TL-D series tribrach)
Optical plummet tribrach
Handle battery BT-15Q (same as supplied with GTS-3B (GTS-3C))
Battery pack BT-3
Battery pack BT-3Q
Large capacity battery pack BT-3L
Power cord PC-3 for BT-3 and AC-3
Power cord PC-5 for BT-3Q
Power cord PC-6 for BT-3L
Auto converter AC-5
Battery charger BC-10B*
Battery charger BC-10C*
Quick battery charger BC-5 for BT-15Q and BT-3Q
Battery charger BC-6 for BT-3L
Cigarette lighter charge BC-9
Aluminum extension leg tripod, Type E
Wide-frame wooden extension leg tripod, Type E
Eyepiece (26X)
Diagonal eyepiece, Model 7
Trough compass, Model 3
Carrying handle, Model 12
Solar reticle, Model 3
Solar filter, Model 3
Back pack
Cadget case, Model 1
Mini Prism

Remarks:

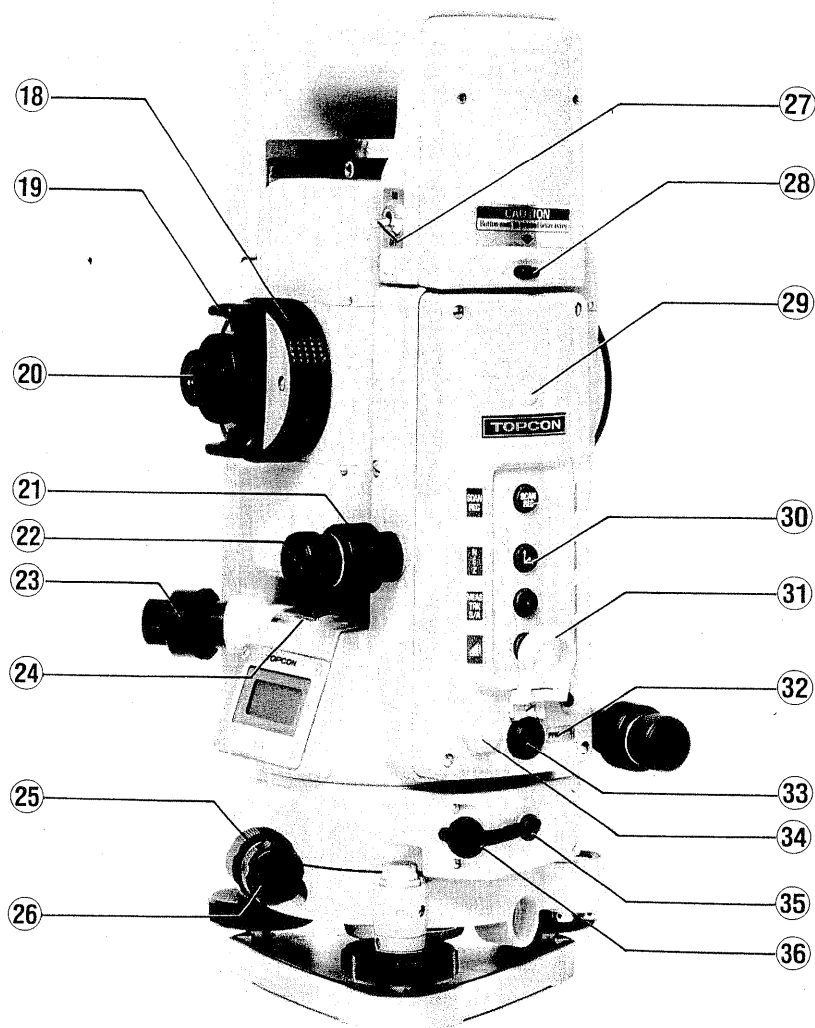
1. The above items are only supplied against specific orders and at extra cost.
2. Items marked with an asterisk (*) are also supplied as standard accessories of the GTS-3B (GTS-3C).

2. NOMENCLATURE AND FUNCTIONS

2-1 Nomenclature

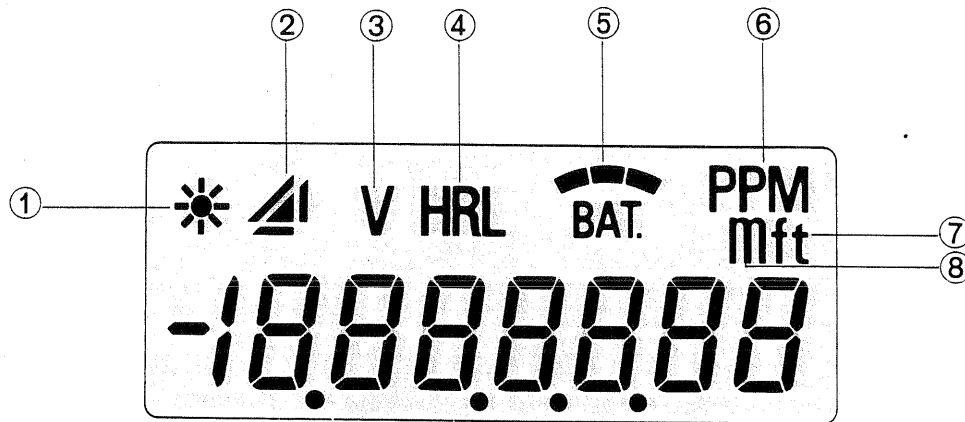


- | | |
|------------------------------------|--|
| ① Handle battery BT-15Q | ⑩ Option switch cover 1 |
| ② Connector A (used when charging) | ⑪ Sighting collimator |
| ③ Fuse holder | ⑫ Battery locking screw |
| ④ Objective lens | ⑬ Instrument center mark |
| ⑤ Display window | ⑭ Protection cover for special function keys |
| ⑥ Upper horizontal motion clamp | ⑮ Operation keys (for angle measurement) |
| ⑦ Upper horizontal tangent screw | ⑯ Tribrach locking lever |
| ⑧ Circular level | ⑰ Base |
| ⑨ Leveling screw | |



- | | |
|----------------------------------|---|
| ⑱ Focussing knob | ⑳ Operation keys (for distance measurement) |
| ⑲ Telescope grip | ㉑ Atmospheric correction knob protection cover |
| ㉒ Telescope eyepiece | ㉒ Meter/Feet selector switch |
| ㉓ Vertical motion clamp | ㉓ Atmospheric correction knob. |
| ㉔ Vertical tangent screw | ㉔ Option switch cover 2 |
| ㉕ Optical plummet telescope | ㉕ Connector B (to be connected to external battery, FC-1, DK-5) |
| ㉖ Plate level | ㉖ Connector C (Serial signal RS-232C connector) |
| ㉗ Lower horizontal motion clamp | |
| ㉘ Lower horizontal tangent screw | |
| ㉙ Power switch | |
| ㉚ Battery locking lever | |
| ㉛ Instrument center mark | |

2-2 Parts Functions



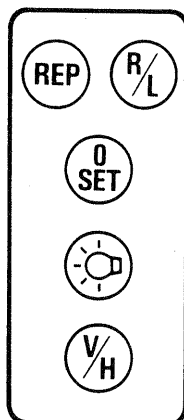
1) Display marks

- ① * EDM working
- ② Horizontal distance
- Relative elevation
- Slope distance
- Northing coordinate
- Easting coordinate
- Z coordinate
- ③ V Vertical angle
- ④ HR Horizontal angle right
- HL Horizontal angle left
- H Repeat angle measurement
- ⑤ Remaining power
- ⑥ PPM Atmospheric correction/PPM applied
- ⑦ ft Feet unit display
- ⑧ m Meter unit display

2) Operating keys

(For detail, see page 20 "8. BASIC KEY OPERATION")

• Angle measurement keys



- Repeat angle measurement: Press when doubling angles. To release, press the key again.

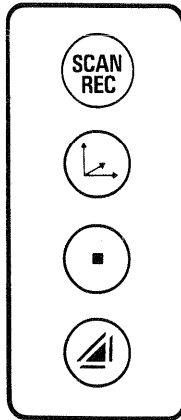
- To select the direction of the horizontal angle measurement. Each time the key is pressed, the direction changes from right to left. To release, press the key again.

- Horizontal angle 0 set: By pressing this key you can set the 0°00'00" position of the horizontal angle.

- Illumination of display and reticle: The display and reticle are illuminated for 30 seconds after the key is pressed.





To change the vertical/horizontal angle: The vertical angle and horizontal angle will alternate when this key is pressed.



- Distance measurement keys



Data scan mode: To scan data press the  key once and the last data measured is retained in memory. Different measurement modes will display the appropriate data every 3 seconds.

Data transmission: To collect data press the  key twice and the last measured data in memory can be transmitted and record in the FC-1 Data Collector.



To change the Northing/Easting and Z coordinate: When the key is pressed the Northing coordinate, Easting coordinate, and Z coordinate are obtained alternately.



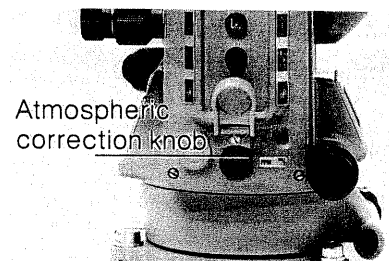
To change the Number of distance (Single), Tracking and Set Audio mode; each time the key is pressed the Number of distance (Single) measurement mode, Tracking mode and Set Audio mode are obtained alternately. If required, you can replace the mode changing order.



To change the Horizontal distance, Relative elevation and Slope distance: Each time the key is pressed, the Horizontal distance measurement, Relative elevation measurement and Slope distance measurement are obtained alternately.

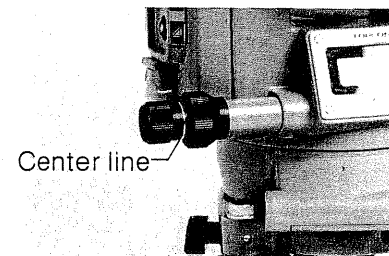
3) Atmospheric correction knob

Calculate the proper atmospheric correction value in ppm by using the atmospheric correction calculator. By turning the atmospheric correction knob, setting the correct value in ppm is possible. (For further information, see page 33 "11. Atmospheric correction".)



4) Coaxial motion screws and clamps

The motion (tangent) screws and clamps are coaxial. The center line is engraved within the working width of the tangent screw.



3. PREPARATIONS FOR MEASUREMENT

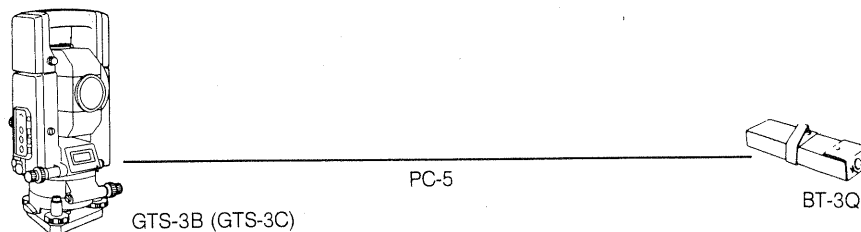
3-1 Power Connection

(unnecessary if handle battery BT-15Q is used.)
See below for connecting the external battery pack.

- Battery pack BT-3Q

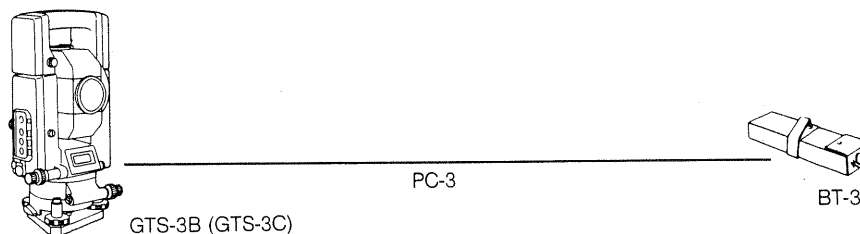
Power cord, PC-5 is used.

(PC-6 can also be used if FC-1 or DK-5 is not connected.)



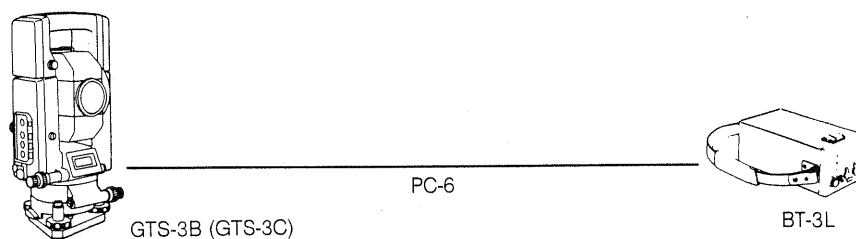
- Battery pack BT-3

Power cord, PC-3 is used. (PC-6 can also be used if FC-1 or DK-5 is not connected)

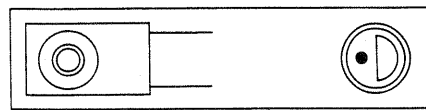


- Large capacity battery pack BT-3L

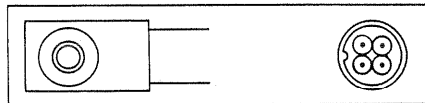
Power cord PC-6 is used.



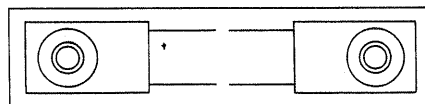
Connector ends of the power cords PC-3, PC-5 and PC-6 are as follows:



PC-3



PC-5



PC-6

Note: Always remove the handle battery or switch it off when any external power supply is used. If used together, battery life may be shortened or a fuse may blow.

3-2 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 aluminum tripod or 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

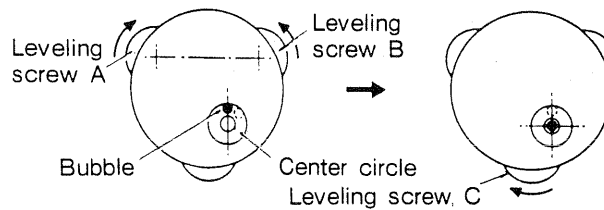
Place the instrument carefully on the tripod head and align the tripod screw with the socket on the base of the instrument. When aligned, screw in the tripod screw until the instrument is fixed securely on top of the tripod head.

3. Leveling the instrument

The circular level is used for initial rough leveling which is then refined with the plate level.

a) 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.

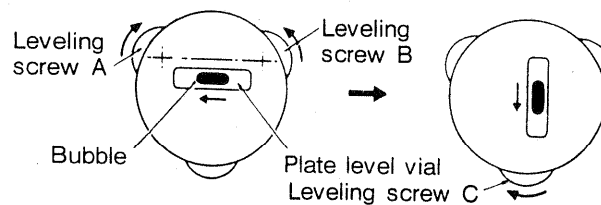
b) Centering the plate level

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

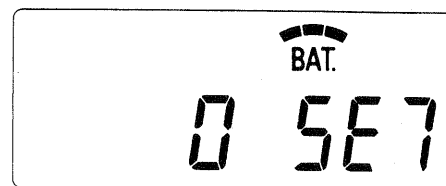
- 1) Adjust the eyepiece of the optical plummet telescope to the user's eyesight.
- 2) Focus the optical plummet telescope on the point.
- 3) Manipulate the leveling screws and coincide the point with the center mark of the optical plummet telescope.
- 4) Center the bubble of the circular level by adjusting 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.

3-3 Power Switch ON

- 1) Turn the power switch on.
All segments of the display will light for about 2 seconds before the vertical angle zero-set command is displayed.



About 2 seconds



If the battery power is insufficient, "BAT." display will flash, or all displays will disappear except "BAT." display. Recharge or replace battery with a charged unit. (See page 38 and page 39)

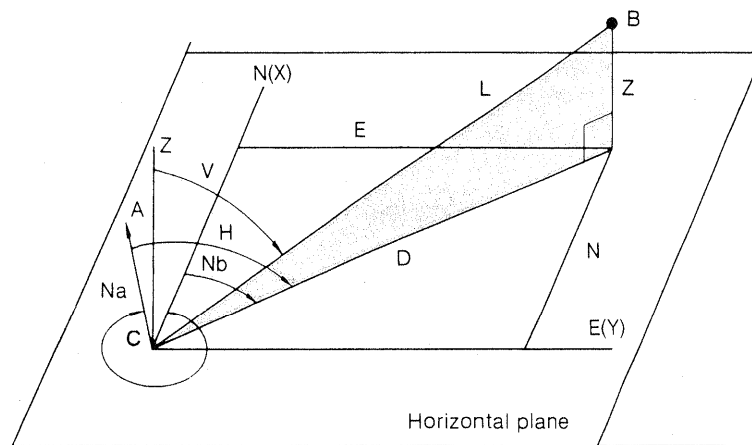
- 2) Rotate the telescope to set the instrument at a vertical angle reading of 0.



Horizontal angle (HR) is then selected for the display.

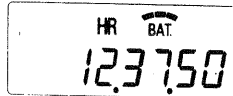

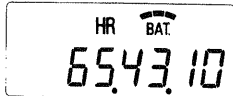
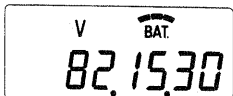
Note: For setting the vertical angle at 0°, a datum 0 is provided on the vertical angle scale circumference. If the telescope is turned and the sensor passes the datum 0, angle measurement begins. The datum 0 is placed near the level position of the telescope, the vertical angle setting of 0 can easily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

- See below for terms and symbols used in the description of measuring methods.
- N(X)—North for square longitudinal and lateral lines and coordinates axis
 E(Y)—East for square longitudinal and lateral lines and coordinates axis
 C —Instrument point (Occupied Station)
 A —Point in datum direction
 B —Unknown point
 H —Horizontal angle
 V —Vertical angle
 L —Slope distance
 D —Horizontal distance
 Z —Relative elevation (Vertical distance)
 E —Longitudinal distance
 N —Latitudinal distance
 Na —Direction angle at Point A
 Nb —Direction angle at Point B



4. ANGLE MEASUREMENT

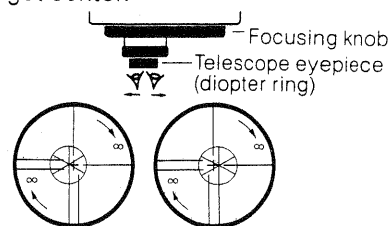
4-1. Measuring a Right Horizontal Angle and Vertical Angle Confirm the horizontal angle (HR) mode.

Key Operation	Operating Procedure	Display
<div>0 SET</div> <div>V/H</div>	① First collimate target A.	
	② Target A is set to read 0°00'00" for the horizontal angle.	
	③ Collimate target B. The horizontal angle of proposed point B is displayed. (65°43'10")	
	④ The vertical angle of proposed point B is displayed. (82°15'30")	
• To return the normal horizontal angle (HR) mode from the vertical angle (V) mode, press the <div>V/H</div> key again.		


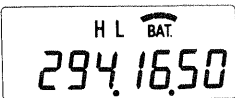

Reference

How to collimate


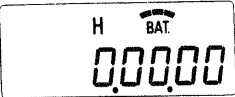

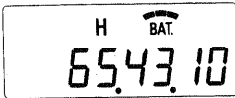

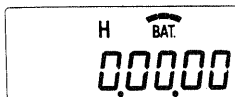
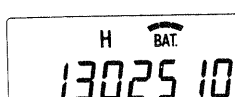
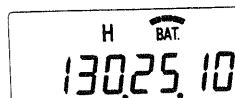
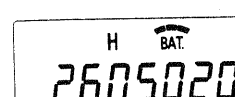
- Point the telescope toward the light. Turn the diopter ring and adjust the diopter so that the reticle is clearly observed. (Turn the ring toward you first and then backward to focus.)
 - Loosen the clamp screws, and observe the target at the peak of the triangle mark of the collimator. Allow a certain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



4-2 Measuring a Left Horizontal Angle

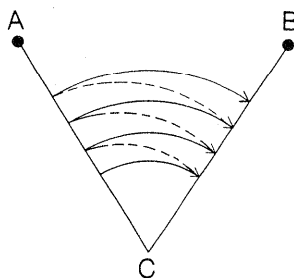
Key Operation	Operating Procedure	Display
	<ol style="list-style-type: none"> 1) The instrument is set in the horizontal angle counter-clockwise (HL) mode from the horizontal angle clockwise mode. (HR) 2) For further operations, follow "4-1 Measuring a right horizontal angle and vertical angle", except the collimating sequence is reversed. 	
	<ul style="list-style-type: none"> • Press the  key once to bring the instrument from horizontal angle counter-clockwise (HL) mode to normal horizontal angle (HR) mode. 	

4-3 Repeat Angle Measurement

Key Operation	Operating Procedure	Display
	<ol style="list-style-type: none"> 1) The instrument is set in the repeat angle measurement mode. 2) Collimate target A. 	
	<ol style="list-style-type: none"> 3) Target A horizontal angle is set at 0°00'00". 	
	<ol style="list-style-type: none"> 4) Use the upper horizontal clamp and tangent screw to collimate target B. 	
	<ol style="list-style-type: none"> 5) Measurement will be stored in the instrument. 	
	<ol style="list-style-type: none"> 6) Use the lower horizontal clamp and tangent screw to recollimate target A. 	
	<ol style="list-style-type: none"> 7) Use the upper horizontal clamp and tangent screw to recollimate target B. 	




- 8) Measurement will be stored in the instrument.
This completes the procedure for doubling an angle.
- 9) Repeat 6) to 8) to measure the desired number of angle turned.



- Horizontal angles can be accumulated up to $(2000^{\circ}00'00''$ —minimum reading) or $-(2000^{\circ}00'00''$ —minimum reading) [counter—clockwise].

In the case of GTS-3B (GTS-3C) with 10 second divisions, horizontal angles can be accumulated up to $1999^{\circ}50'50''$ or $-1999^{\circ}59'50''$ [counter—clockwise].




- 10) The average of angle is displayed.
With the beep sound the “H” mark flashes.
Press the  key, and total angle is displayed.

H BAT
260.50.20
(Doubling an angle)

H BAT
52.140.40
(4 measurements)

H BAT
130.25.10
(Average)

- To begin the repeat angle measurement again, collimate target A first 2).
- Press the  key once to return to normal horizontal angle mode from the repeat angle measurement mode.

5. DISTANCE MEASUREMENT

5-1 Setting the Atmospheric Correction

When setting the atmospheric correction, obtain the correction value by measuring the temperature and pressure. Refer to page 33 to get the correction value and how to set.


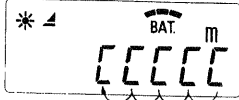
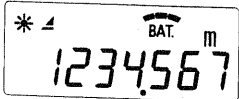


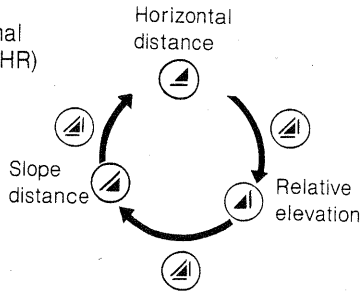
- It is set at 15°C, 760mmHg (0 ppm) when shipped from the factory.

5-2 Setting the Prism Constant





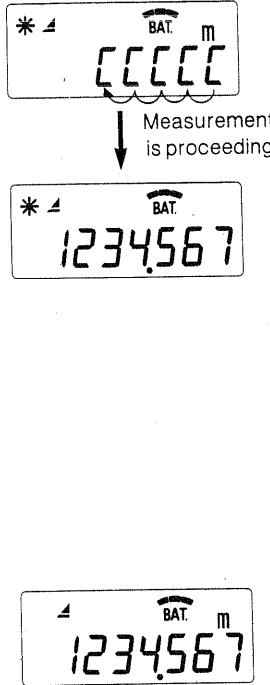



When using prism reflectors other than TOPCON, the offset compensation factor may need to be adjusted. Refer to page 30 to set the offset compensation factor.

- It is set at "0" when shipped from the factory.

5-3 Measuring Distance (Continuous Measurement)

Key operation	Operating procedure	Display
	1) Sight the center of the prism. 2) Set the instrument in the continuous measurement mode to start automatic horizontal distance measuring. <ul style="list-style-type: none"> • When EDM is working, "*" mark appears in the display. <p>Measurement is displayed every 4 seconds.</p> <ul style="list-style-type: none"> • "m" or "ft" mark ON/OFF with buzzer sound is repeated each measurement. 	 <p>↓ Measurement is proceeding</p> 
	<ul style="list-style-type: none"> • The  key to set horizontal distance, relative elevation and slope distance mode in turn. Refer to "8 BASIC KEY OPERATION" on page 20. • When measuring the relative elevation, set the height of the target the same as the height of the instrument. If it is a different height, make the necessary correction. • Press the  key once to return to the normal angle measurement mode (horizontal angle HR) from a distance measurement mode. 	









5-4 Measuring Distance (Number of Distance Measurement)

Key Operation	Operating Procedure	Display
	<p>1) Sight the center of the prism.</p> <p>2) Set the instrument in the number of distance measurement mode to start automatic horizontal distance measuring.</p> <ul style="list-style-type: none"> When EDM is working, "*" mark appears in the display. <p>The number of distance measurement will be displayed.</p> <ul style="list-style-type: none"> Press the  key for measuring a relative elevation () and slope distance (). "m" or "ft" mark ON/OFF with buzzer sound is repeated each measurement. For setting the number of times (N times) in the distance measurement, see page 44. As N, one of 1 to 15 times can be set. In the factory, 1 has been set. <p>3) The average value is displayed followingly with buzzer sound and the "*" mark disappears.</p>	
	<ul style="list-style-type: none"> Press the  key for re-measuring after the measurement is held. Press the  key three times consecutively to return the instrument to the set audio mode and the  key to return to normal measuring distance mode. The instrument is now in the horizontal distance continuous measurement mode. 	

6. TRACKING AND COARSE MEASUREMENT

The tracking mode works in the repeat measuring mode and stake-out operation. The following description is for repeat measuring.

For stake-out operation, see page 27 as it requires the FC-1 Data collector or DK-5 Data entry keyboard.

Key Operation	Operating Procedure	Display
 	1) Sight the center of the prism. 2) The mode changes to tracking and measurement of the horizontal distance starts automatically. <ul style="list-style-type: none"> To measure the relative elevation (▲) and slope distance (▲), press the  key. The results of repeated measurement is shown every 0.6 seconds. The display unit is 1 cm. However, it takes about 1.2 seconds just until the first result of repeat measurement is obtained. 	 Measurement is proceeding  
	<ul style="list-style-type: none"> To return to the normal measuring distance mode from tracking mode, press the  key once to get to set audio mode and the  key. The mode for the horizontal distance continuous measurement will be obtained. At the condition of more than 2,000 m of measuring distance, the displayed value by the tracking mode is: Displayed value = Measured distance - 2,000 m In this case measurement must be done without atmospheric correction and correction for refraction and earth curvature, and the measured value must be calculated as atmospheric correction calculation and correction for refraction and earth curvature way. (see page 35 and page 37) 	

- In tracking mode, only data on the display is transferred.

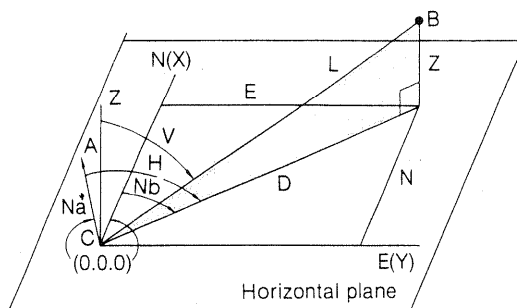
In coarse mode, the same data items as those in continuous measurement mode are transferred as follows:

If horizontal distance or relative elevation is set, V, HR, ▲, and ▲ are transferred. If slope distance is set, V, HR, ▲, and ▲ are transferred. For detail, see page 23.

The same operation is applied with coarse mode as that in tracking mode, except data transfer operation.

7. COORDINATES MEASUREMENT

The following description is for the coordinates measurement with the origin (0, 0, 0) at the instrument station. The coordinates measurement includes measurements for latitude, departure and relative elevation. If any other point than the instrument station is set as the coordinate station, use of FC-1 or DK-5 is required to set the coordinates of the instrument station. See page 28 "9-5 Coordinates Measurement with FC-1" or the DK-5 manual.

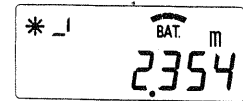



Key operation	Operating procedure	Display
$\odot \frac{V}{H}$	1) If the instrument is set in any other mode than HR (horizontal angle) mode, press the $\odot \frac{V}{H}$ key to enter into HR mode.	<div>HR BAT</div> <div>75.4320</div>
	2) Use the upper horizontal clamp and tangent screw to set the shown horizontal angle in the direction angle of point A and lock.	<div>HR BAT</div> <div>320.2 130</div>
	3) Sight point A and fix it using the lower horizontal clamp and tangent screw.	<div>HR BAT</div> <div>320.2 130</div>
	4) Sight the target point B (prism) using the upper horizontal and vertical clamps and tangent screws.	<div>HR BAT</div> <div>62.09 10</div>
$\odot \angle$	5) The measurement of N coordinates (latitude) of target point B is repeated.	<div>* / BAT m</div> <div>35.678</div>
$\odot \angle$	6) The measurement of E coordinates (departure) of target point B is repeated.	<div>* \ BAT m</div> <div>67.534</div>





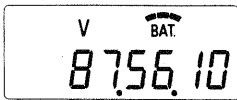
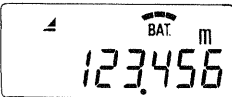
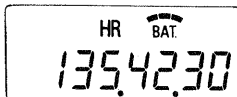





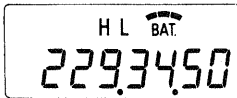
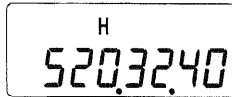

7) The measurement of Z coordinates (relative elevation) of target point B is repeated.


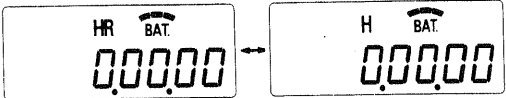




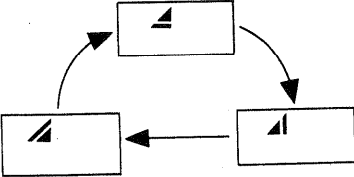

- Z coordinates measured by GTS-3B is the difference in height between the horizontal position of the instrument telescope and target.

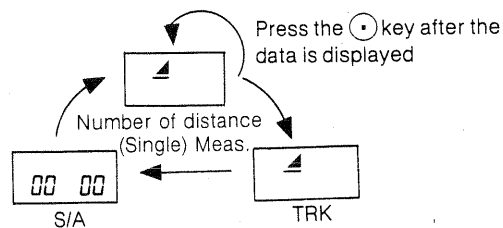


- To return to the normal measuring distance mode from coordinates measurement mode, press the  key once. The mode for the horizontal distance continuous measurement will be obtained.

8. BASIC KEY OPERATION

Key Operation	Description
	<p>1) V/H (vertical angle/horizontal angle) change-over</p> <ul style="list-style-type: none"> Each time the key is pressed, vertical angle and horizontal angle will alternate. <div style="text-align: center;">   </div> <ul style="list-style-type: none"> Press the key to set the instrument at angle measurement mode when it is at distance measurement mode. <div style="text-align: center;">   </div> <ul style="list-style-type: none"> At repeat angle measurement mode, press the key to store the result each time measurement is performed.
	<p>2) Horizontal angle zero set</p> <ul style="list-style-type: none"> Press the key, and the horizontal angle at the position will be 0°00'00". This happens only in the horizontal angle. <div style="text-align: center;">   </div>
	<p>3) Horizontal angle rotation direction setting</p> <ul style="list-style-type: none"> Changes horizontal right angle (HR) to horizontal left angle (HL) readings. Each time the key is pressed, the settings will alternate. <div style="text-align: center;">   </div> <ul style="list-style-type: none"> Press the key, after measuring the required number of double angles, when the instrument is set at repeat angle measurement mode, and the average will be displayed with "H" mark flashes. <div style="text-align: center;">   </div> <p style="text-align: center;">(total angle) (average)</p> <p>Angle measurement, 4 times</p> <p>This is available only in the horizontal angle mode.</p>

	<p>4) Repeat angle measurement mode setting</p> <ul style="list-style-type: none"> Press the key, and the instrument will be set at repeat angle measurement mode. Press once again, and the setting will be released. Changeable only in the horizontal angle mode. <div data-bbox="813 556 1317 653">  </div> <ul style="list-style-type: none"> Use the  and  keys in the repeat angle measurement mode, and the average angle will be displayed. For further information, see page 13 "4-3 Repeat Angle Measurement".
	<p>5) Illumination switch.</p> <ul style="list-style-type: none"> Used for illuminating the telescope reticle scale and display window. Illumination is automatically turned off after 30 seconds. Press again if necessary.
	<p>6) Horizontal distance Relative elevation Slope distance measuring mode setting</p> <ul style="list-style-type: none"> Each time the key is pressed, the mode changes in the following order; the horizontal distance, relative elevation and slope distance. <div data-bbox="927 1129 1279 1304">  </div> <ul style="list-style-type: none"> For measuring the relative elevation, "—" will be displayed if it is lower than the horizontal position of the telescope.
	<p>7) Number of distance (Single) measurement Tracking Set audio mode setting</p> <ol style="list-style-type: none"> Press the key once, and number of distance (single) measurement mode will be selected. At this mode, measurement is performed once, and the displayed data is held. Press the key, after the data is displayed, and another number of distance (single) measuring sequence begins. If the key is pressed twice consecutively, during measurement (before data is displayed), tracking mode will be selected. Press again and the set audio mode will be selected, displaying atmospheric correction and offset values. (see page 36). Press the key once more, and the instrument will return to number of distance (single) measurement.



*Changing to coarse mode measurement is also possible. (see page 44).



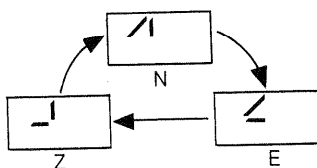
8) Coordinates measurement mode setting

N(x) coordinates

E(y) coordinates


Z coordinates

- Press the key once, and N(x) coordinates (latitudinal distance) will be displayed.
- Press once again, and E(Y) coordinates (longitudinal distance) will be displayed.
- Press once more, and Z coordinates (relative elevation) will be shown. Each time the key is pressed thereafter, N coordinates, E coordinates and Z coordinates will be displayed alternately.
- The instrument will assume coordinates with the instrument point at (0,0,0) as the original point. If the FC-1 or DK-5 is used with the instrument, coordinates (N, E, Z) can be displayed with a different origin point from the instrument point.



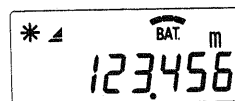
9) Scan

Data output
mode setting

- ① Press the  key once, and the last measured data is retained in memory. Data in memory will be displayed in the different measurement modes approximately every 3 seconds per mode.

Display


Measurement is carried out in
horizontal distance mode.





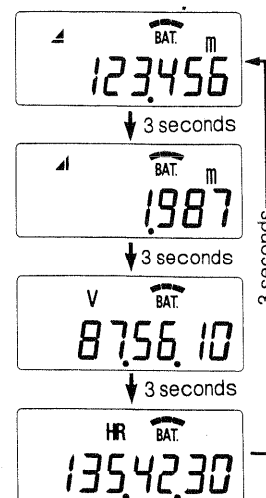
The data obtained right after the above operation is retained and it will be displayed repeatedly.

"*" disappears while the data is retained.

See the following table showing the scan/output data for each mode.

To release the scan mode, press any key, except the  key.

- ② If the scanned data is correct, press the  key a second time and the data will be output to the FC-1 Data collector. The buzzer will sound and all displays except the mode mark will disappear for about 0.5 second. Pressing the  key twice in succession will bypass the scan mode.



- The following data will be scanned/output for at each mode.

Mode	Scan/Output
Vertical angle mode (V) Horizontal angle mode (HR or HL)	V, HR (or HL)
Repeat angle measurement mode (H)	average angle, total angle
Horizontal distance mode (∠)	V, HR, ∠, ∠
Relative elevation mode (∠)	
Slope distance mode (∠)	V, HR, ∠, ∠
N coordinates (∠)	N, E, Z, HR
E coordinates (∠)	
Z coordinates (∠)	

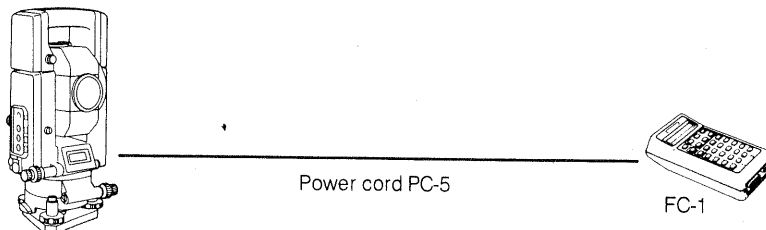
- Suppose that the instrument point is at the original point, N, E and Z will be respectively latitudinal distance, longitudinal distance and relative elevation.
- The display and the output at coarse mode will be same as the contents of above.

9. COMBINED USE OF INSTRUMENT WITH THE FC-1 DATA COLLECTOR

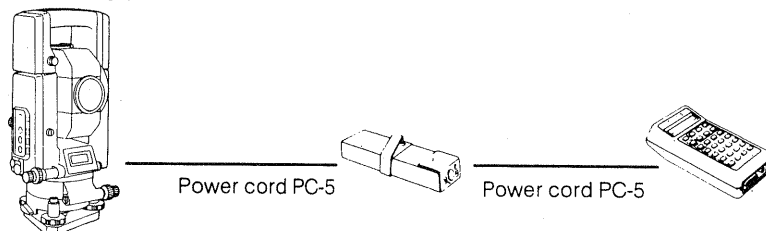
A wider variety of applications is available if the instrument is used with the FC-1 data collector. For further information concerning the FC-1, see "FC-1 Instruction manual".

9-1 Connecting GTS-3B (GTS-3C) to the FC-1

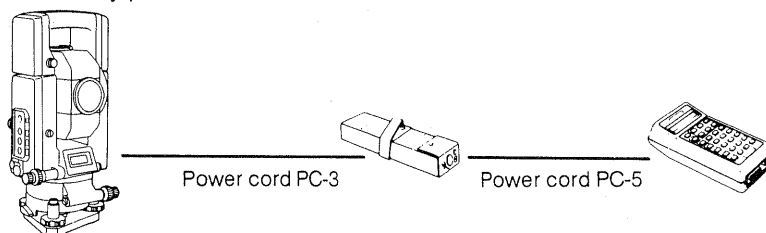
- Handle battery BT-15Q for use:



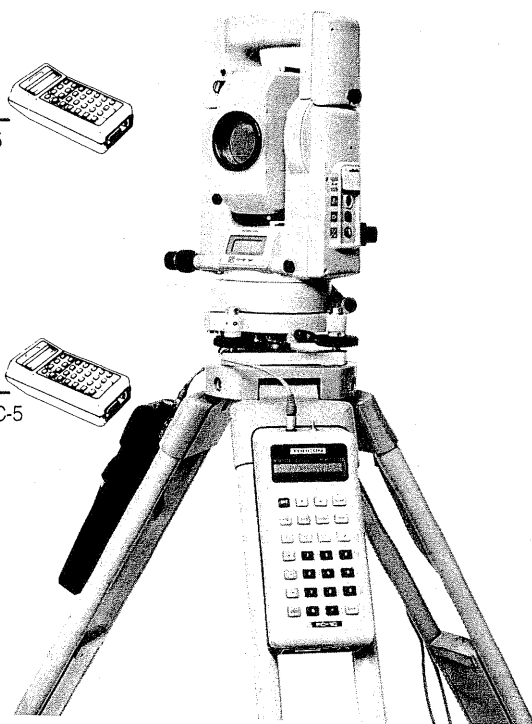
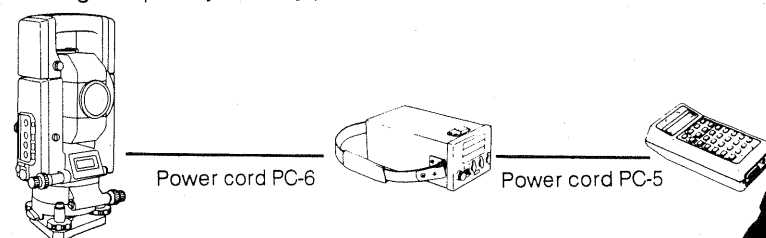
- Battery pack BT-3Q for use:



- Battery pack BT-3 for use:



- Large capacity battery pack BT-3L for use:



9-2 Mode Available with FC-1

1) Data input mode

The FC-1 gives a prompt message to guide the operation in the display window. The operator can enter the data by keyboard operation according to the message.

For further information concerning the FC-1, see "FC-1 instruction manual".

Example:

The sequence to provide the message is programed as follows with the built-in basic program PRG>1 (Ver. 109).

The prompt message for guidance

I.D. CHAR.	STEP NO.	DISPLAY	REMARKS
"SP"	1	GOTO 05 JOB-1?	Instruments used: ET-1, DM-S2/S3, GTS-3B (GTS-3C)
"SP"	2	GOTO 24 JOB-2?	DM-C3/S1/A1/A2, GTS-2/2B/2S
"SP"	3	GOTO 45 JOB-0?	Manual data record
"SP"	4	END	
!	5	JOB-1# XXXXXXXX	Job No. or name
"	6	NAME XXXXXXXX	Name of observer
#	7	INST# XXXXXXXX	Serial No.
\$	8	DATE XX-XX-XX	Date
%	9	TEMP XXXXX ° C/°F	Temperature
&	10	PRES XXXXX Hg/mb	Atmospheric pressure
'	11	OCC.ST# XXXXXXXX	Occupied Station
(12	ID XXXXXXXXXXXXXXXX	Identification of OCC.ST
)	13	INS. HT XXXXX m/f	Instrument height
*	14	PCODE XXXXXXXX	Point code
+	15	PT# XXXXXXXX	Point No.
,	16	R.HT XXXXX m/f	Reflector height
"SP"	17	REC Record?	Record data
"SP"	18	GOTO 14 PCODE?	
"SP"	19	GOTO 09 TEMP?	
"SP"	20	GOTO 05 JOB-1?	
"SP"	21	GOTO 24 JOB-2?	
"SP"	22	GOTO 45 JOB-0?	
"SP"	23	END	

- Input the corresponding data at the steps for desired items, if not, you can move to the next without input by use of [skip] key.
- Mode switching of GTS-3B (GTS-3C) is possible by operating the key of FC-1.



2) GTS-3B control mode

When "READY PRG>1" is shown (state "READY"), press [F2] and the GTS-3B control mode is obtained.



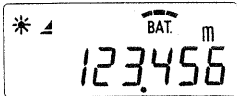
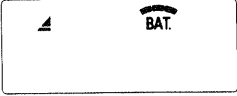

In this mode, setting a standard distance (for stake out), coordinates of instrument point and horizontal angle is possible.

DK-5 also allows for horizontal angle set, coordinate measurement, and stake out work.

9-3 Data Storage

To store the data obtained by GTS-3B (GTS-3C) to FC-1, used the  key of GTS-3B (GTS-3C). Press the  key twice and the data will be output to the FC-1 Data collector.

- Example: In horizontal distance (continuous measurement) mode

Key Operation	Operating Procedure	Display
 	1) Measurement is carried out in horizontal distance mode.	
	2) The data is transferred to the FC-1.	
	<ul style="list-style-type: none"> • At this time, all segments of display except the mode indication disappear for 0.5 seconds with buzzer sounds. • In the horizontal distance mode, the data to be stored in the FC-1 includes horizontal distance (Δ), relative elevation (Δ), vertical angle (V) and horizontal angle (HR). For further information, see page 23. 	<p>↓ 0.5 seconds (Buzzer sounds)</p> 


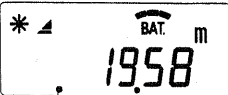
9-4 Stake Out

The difference between the measured distance and the distance preset by FC-1 operation is displayed.

Measured distance – Stake out distance = Displayed value

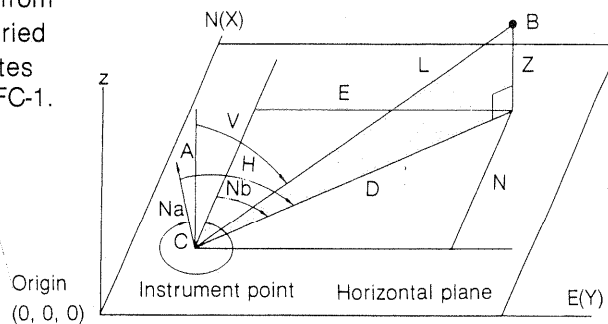
- Stake-out operation can be performed for horizontal distance (Δ), relative elevation (∇) or slope distance (∇).

• Operating Procedure (For Horizontal Distance)

	FC-1 operation	FC-1 display
1) Set the FC-1 at the GTS-3B (GTS-3C) control mode.	[F2]	MODE 1> (m)
2) Set the standard distance for stake out.	[#]	STAKE-OUT DIST- ↓ 1 second D + xxxxxxxx MH
<ul style="list-style-type: none"> Setting the slope distance or relative elevation, press the key as following procedure. Slope distance: [+][7][2][3][4][0][SHIFT][M][S][ENTER] Relative elevation: [+][7][2][3][4][0][SHIFT][M][V][ENTER] 	[+][7][2][3][4][0] [ENTER]	D + 72340xxx MH (Horizontal distance + 72.340m)
3) Set the GTS-3B (GTS-3C) to the horizontal distance mode in tracking. (Sight the prism, if not done yet.) The measurement starts and the difference between the measured distance and the standard distance is displayed. <ul style="list-style-type: none"> With the standard distance preset, the "." (period) lights at the 6th digit from right in the display. 	GTS-3B (GTS-3C) key operation 	GTS-3B (GTS-3C) display  <p>Indicating the standard distance has been preset</p> <p>91.92-72.34 = 19.58 m</p> <p>measured distance</p> <p>stake out distance</p> <p>(horizontal distance) displayed value</p>
<ul style="list-style-type: none"> To return to the normal distance display, set the standard distance to "0". Stake out operation can be carried out in the continuous measurement mode according to the similar operation procedure. 		

9-5 Coordinates Measurement with FC-1

The coordinate measurement from a coordinate origin can be carried out after setting the coordinates of instrument point using the FC-1.



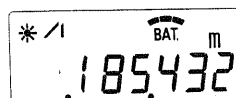
• Operating Procedure

FC-1 operation		FC-1 display
1) Set the FC-1 at the GTS-3B (GTS-3C) control mode.	[F2]	MODE 1> (m)
2) Set the coordinates of instrument point.	[+]	N/E/Z/OFFSET-
		↓ 1 second
○ N coordinate input: (102.345m)	[+][1][0][2][3][4][5]	N + xxxxxxxx N + 102345xx
	[ENTER]	E + xxxxxxxx M
○ E coordinate input: (51.357m)	[+][5][1][3][5][7]	E + 51357xxx M
	[ENTER]	Z + xxxxxxxx MZ
○ Z coordinate input: (23.608m)	[+][2][3][6][0][8]	Z + 23608xxx MZ
	[ENTER]	
3) Sight point A in the standard direction.		
4) Set the direction angle from the FC-1. (330°12'50")	[−]	H-ANG SET-
		↓ 1 second
		H + xxxxxxxx D
	[+][3][3][0][1][2][5][0]	H + 3301250 D
	[ENTER]	
<ul style="list-style-type: none"> Or you can set the horizontal angle by use of the upper and lower horizontal screws according to the same procedure described at 2) and 3) in "7 Coordinates Measurement" at page 18. 		

GTS-3B (GTS-3C) key operation	GTS-3B (GTS-3C) . display
----------------------------------	------------------------------

5) Sight the prism at target point B using the upper horizontal screw.

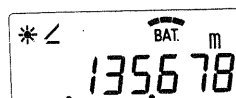
6) The mode changes to the coordinates measurement mode and the measurement starts. N coordinates (N) from the set origin are measured repeatedly.



(185.432m)

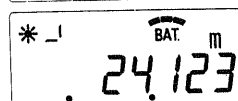
Indicating the coordinates has been preset.

7) E coordinates (E) from the set origin are measured repeatedly.



(135.678m)

8) Z coordinates (Z) from the set origin are measured repeatedly.



(24.123m)

- While the coordinate origin is preset, the "." (period) lights at the 6th digit from right in the display.
- The coordinates measurement can be carried out in a single measurement mode in similar sequence.
- To return to the coordinates measurement with the origin at the instrument point, reset the coordinates of instrument point at (0, 0, 0).

10. DESCRIPTION OF OPTION SWITCH OPERATION

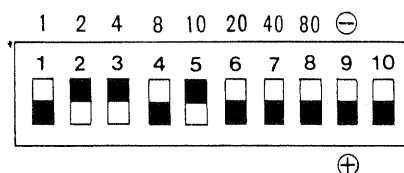
10-1. Offset Switches

Follow the procedure as shown below for adjustment when a prism having any other constant than "0" (See note 4) is used or when the offset value is changed after checking for precision.

- 1) Remove option switch cover 1.
- 2) Offset switches (SW-1) 1~8 are for offsetting, and 9 denotes + and - at offsetting.

Switch 10 is factory test switch. Do not touch.

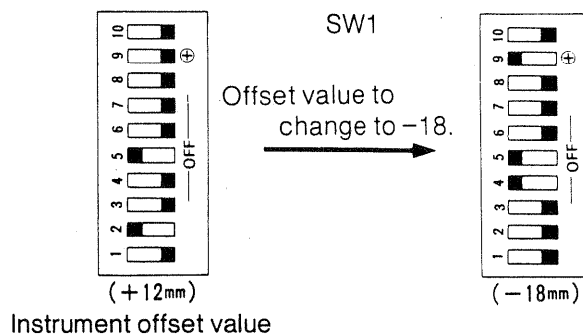
The instrument and prism constants is established offset value.



(Example)

Instrument offset value = + 12mm (variable according to the instrument) and prism constant = + 30mm for use:

$(+12) - (+30) = -18$ offset value (to be set)



(Note 1) Prism constants are expressed by + mm or - mm, but use + values for calculations as above.

(Note 2) The No. 1 to No. 4 switches cannot be used to produce a 10 digit value, as they are used for setting single digit values only. An error code will appear in the display window, if they are used for this purpose.

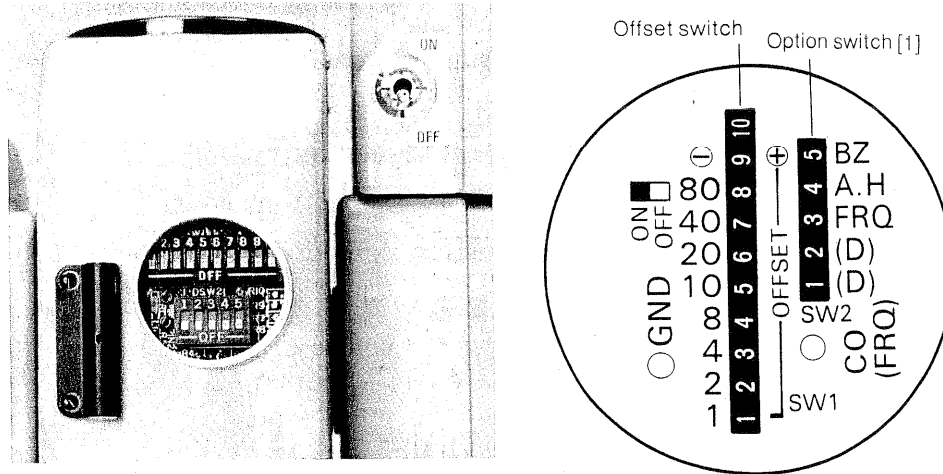
(Note 3) The instrument offset value is found at the back of the option switch cover which was set before shipment. Do not remove it.

(Note 4) Use Topcon prisms. They have a constant of 0.

10-2. Option Switches

Provided are 2 option switches, one on EDM side (Option switch 1) and the other at the lower part of the yoke (Option switch 2.)

1) Option switch [1]



A label is applied to the back of the option switch cover 1.

BZ(SW2-5): Audio buzzer stop switch

To prevent buzzer in set/audio mode when a returned signal is received from the prism set switch to ON position.

OFF position buzzer will sound. It has been set at OFF at the factory.

AH(SW2-4): Return signal control switch

ON: Automatic control function does not operate.

OFF: Return signal control function works. It has been set at OFF at the factory.

(Note) As a general practice, use the instrument with the switch OFF. The measurements will be displayed though they take a little longer than usual even if return signals for measuring a distance are often interrupted.

It has been set at OFF at the factory.

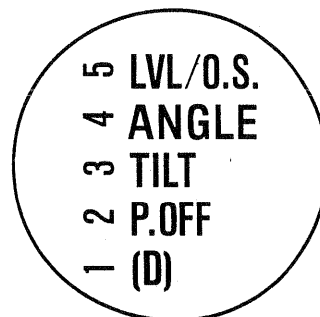
FRQ(SW2-3): Reference frequency measuring switch

With the switch on at set audio mode, signals at the reference frequency 1.5 MHz will be generated between CO and GND. It has been set at OFF at the factory.

(For frequency examination)

(Note) Never use (D) because it has been set at the factory.

2) Option switch [2]



A label is affixed to the back of option switch cover 2.

LVL/O.S. (Switch 5): Return signal level and offset value display ON/OFF switch.

In the set audio mode, if the switch is set at OFF, offset value and atmospheric correction value are displayed. If set at ON the return signal level and atmospheric correction value are shown.

ANGLE (Switch 4): Selecting minimum display unit for angle measurement.

GTS-3B has been set at OFF at the Factory. If the switch is set at ON, it provides 1 second reading. And GTS-3C has been set at ON. If the switch is set at OFF, it provides 10 second reading.

TILT (Switch 3): Stops the function of vertical angle tilt correction.

In case that the instrument is used at an unstable situation, constant indexing of vertical angle may be impossible. In this case, the function of tilt correction can be stopped by changing a switch. If the switch is set at ON, the function stops. It has been set at OFF at the factory.

P.OFF (Switch 2): ON/OFF of automatic power function.

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.

(Note) Never use (D) because it has been set at the factory.

11. 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.

However, an atmospheric correction system is built into the instrument and, therefore, the displayed distance measurements are automatically corrected when the required correction is dialed into the instrument initially with the atmospheric correction dial.

First, find the correction with the atmospheric correction chart or atmospheric correction calculator and set it in the instrument before measuring the distance.

11-1. Use of Atmospheric Correction Chart

The atmospheric correction 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

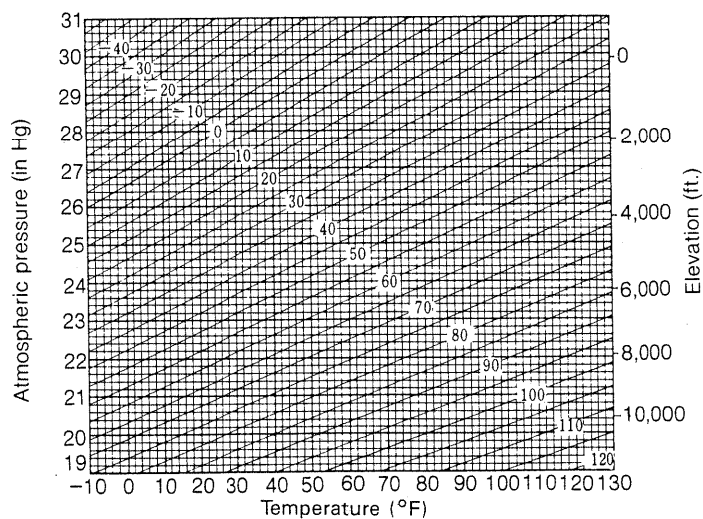
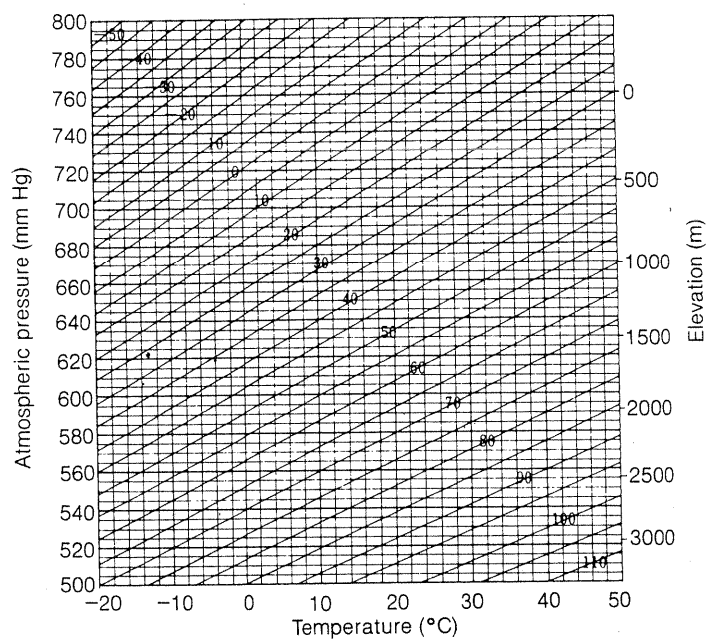
The measured temperature is + 26°C

The measured pressure is 760mm Hg

Therefore,

The correction is + 10ppm

- 5) Dial the correction thus obtained with the atmospheric correction dial. The correction dialed in will be displayed, when the operation mode switch is set to S/A in 2 ppm steps.
- 6) The atmospheric correction can be obtained from the second atmospheric correction chart when the measured temperature is in degrees Fahrenheit and pressure in inches Hg.



11-2. Use of Atmospheric Correction Calculator

The atmospheric correction can also be obtained with the atmospheric correction calculator, in the following manner:

- 1) Measure the ambient temperature and pressure at both instrument and prism reflector positions. Average the results.
- 2) Then, dial in the measured pressure by lining it up with index-line, on the lower half of the calculator.

- 3) Next, read the value lined up with the measured temperature on the upper half of the calculator, which will be the correction.

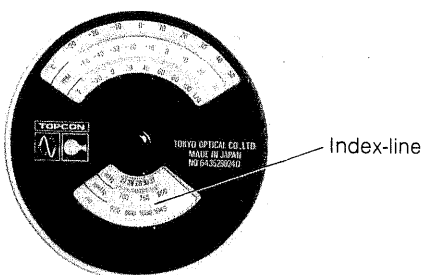
Example

The measured pressure is 760mm Hg

The measured temperature is 15°C

Therefore,

The correction is. 0 ppm



- 4) The calculator can also be used when the measured temperature is in degree Fahrenheit and pressure in inches Hg. and millibar (mbar).

11-3. 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 K_a is obtained from the following formula:

$$K_a = (279.6 - \frac{106.0 \times p}{273.2 + t}) \times 10^{-6}$$

when,

P: Ambient atmospheric pressure (mm Hg)

t: Ambient atmospheric temperature (°C)

Then the distance after correction L is obtained from the following formula:

$$L = \ell(1 + K_a) \text{ (m)},$$

ℓ = Distance measured with the instrument, when $K_a = 0$ (ppm).


Example

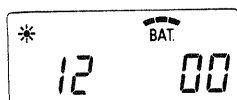
When the atmospheric temperature is 20°C, the atmospheric pressure 635 mmHg and the measured distance 1,000.000 m, the atmospheric correction K_a and the distance after correction L are obtained with the following calculations:

$$\begin{aligned} K_a &= (279.6 - \frac{106.0 \times 635}{273.2 + 20}) \times 10^{-6} \\ &= 50 \times 10^{-6} \\ &= 50 \text{ (ppm)} \end{aligned}$$

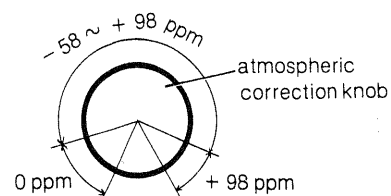
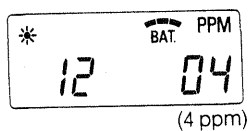
$$\begin{aligned} L &= 1,000.000 \times (1 + 50 \times 10^{-6}) \\ &= 1,000.050 \text{ (m)} \end{aligned}$$

11-4. How to Set the Atmospheric Correction Value

- 1) Press the  key and the set audio mode is displayed. The offset value and the atmospheric correction value are shown.



- 2) Turn the atmospheric correction knob to set ppm value.



- The above ppm value is obtained by the procedure previously described or the correction calculator.
- If the correction value is not 0, the "PPM" mark in the display lights.

12. CORRECTION FOR REFRACTION AND EARTH CURVATURE

GTS-3B (GTS-3C) measures distance, taking into account correction for refraction and earth curvature.

(Note) If the telescope is positioned within $\pm 9^\circ$ from the nadir or zenith, no measurement will result even if the correction function for refraction and earth curvature works.

12-1. 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 $D = \overline{AC}(\alpha)$ or $\overline{BE}(\beta)$

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

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

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

$$\theta = L \cdot \cos\alpha / 2R \dots\dots\dots \text{Earth curvature correcting item}$$

$$\gamma = K \cdot L / 2R \dots\dots\dots \text{Atmospheric refraction correcting item}$$

$$K = 0.14 \text{ (or } 0.2) \dots\dots\dots \text{Coefficient of refraction}$$

$$R = 6372 \text{ Km} \dots\dots\dots \text{Radius of earth}$$

$$\alpha \text{ (or } \beta) \dots\dots\dots \text{Altitude angle}$$

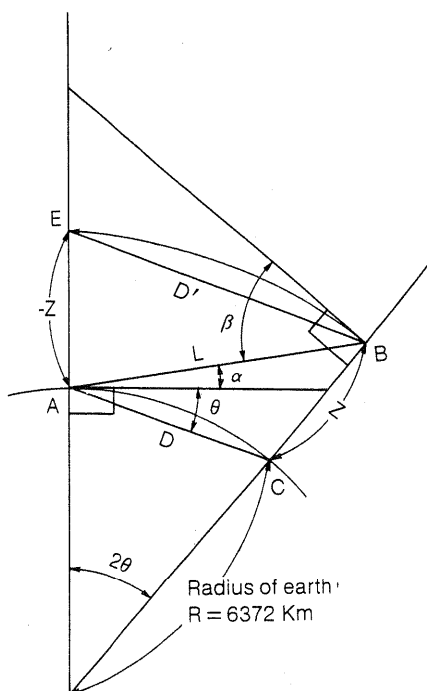
$$L \dots\dots\dots \text{Slope distance}$$

- (Note) The coefficient of GTS-3B (GTS-3C) has been set at 0.14 before shipment ($K = 0.14$). If the "K" value is to be changed, see page 43.

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

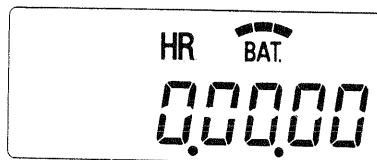
$$D = L \cdot \cos\alpha$$

$$Z = L \cdot \sin\alpha$$



13. BATTERY POWER WARNING

"BAT." mark in the display indicates the power condition.



The power is sufficient.



The power is still sufficient.



"BAT." mark flashes. The battery should be recharged.
Measurement is still possible.



"BAT." mark remains and the other segments of the display disappear. Measurement is impossible.
Need to recharge or replace Battery.

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 recommended 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 "BAT" mark shown while the "0 SET" is displayed at the power-on is for the distance mode, which serves as an easy check before use.

14. POWER SOURCE AND CHARGING

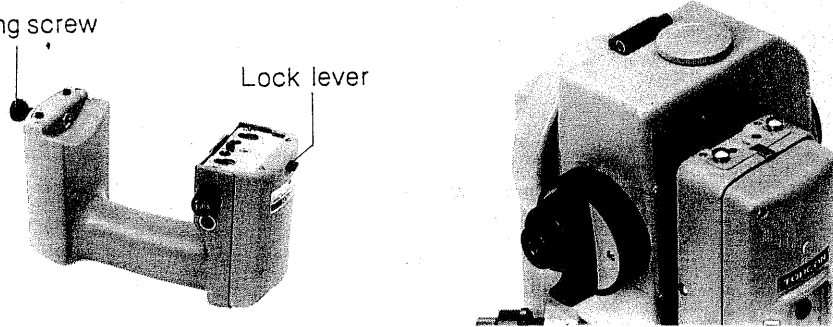
14-1 Handle Battery BT-15Q

- Installation

- 1) Place the mounting fixture of the BT-15Q into the plate opening on top of the standard as shown.
- 2) While pushing the battery locking lever, gently push the handle battery toward the lock lever side till the handle battery comes to the end of the GTS-3B (GTS-3C) and clicks into position.
- 3) Tighten the battery locking screw.

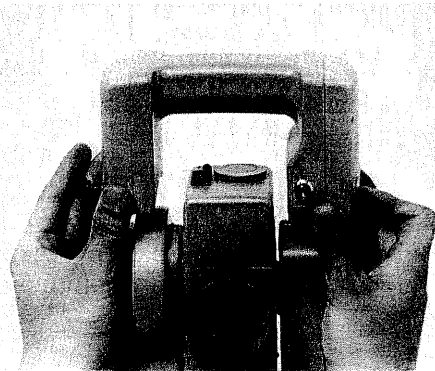
Locking screw

Lock lever



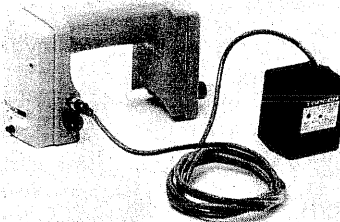
- For removing

- ① Loosen the battery locking screw.
- ② Push the lock lever toward the locking screw side till the handle battery slide.



- For charging

- ① Connect charger connector (BC-10B or BC-10C) to the handle battery at connector(A), the handle battery should be removed from the instrument when recharging.
- ② Plug the charger into an outlet (BC-10B is for AC120V use and BC-10C is for AC230V use).
- ③ Turn the battery source switch to the ON position.
- ④ The red light of the charger will light.
- ⑤ Charging will take approximately 15hours.
Turn the power switch off, and remove the battery source from the charger.



- **Storage of the battery source**

Check to make sure the battery source ON/OFF switch is turned to the off position when storing.

(Note) Recharging should take place in a room with an ambient temperature range of 10°C to 40°C (50°F to 104°F).

(Note) Exceeding the specified charging time may shorten the life of the battery and should be avoided if possible.

(Note) The battery source will discharge when stored and should be checked before using with instrument.

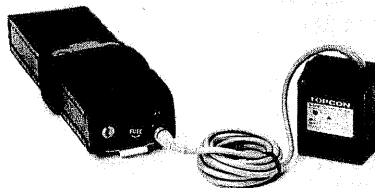
(Note) Be sure to charge the battery source every 3 or 4 months and store in a place at 30°C and below if it will not be used for a long period.

(Note) For further information, see page 70.

14-2 Charging the External Power Source BT-3, BT-3Q, and BT-3L

Charge the external power source in the same way as for the handle battery. About 15 hours are needed for charging. Be sure to turn the power switch off before removing the external power source from the charger.

(If BC-5 charger is used for charging BT-3Q, it takes approximately 1 hour).



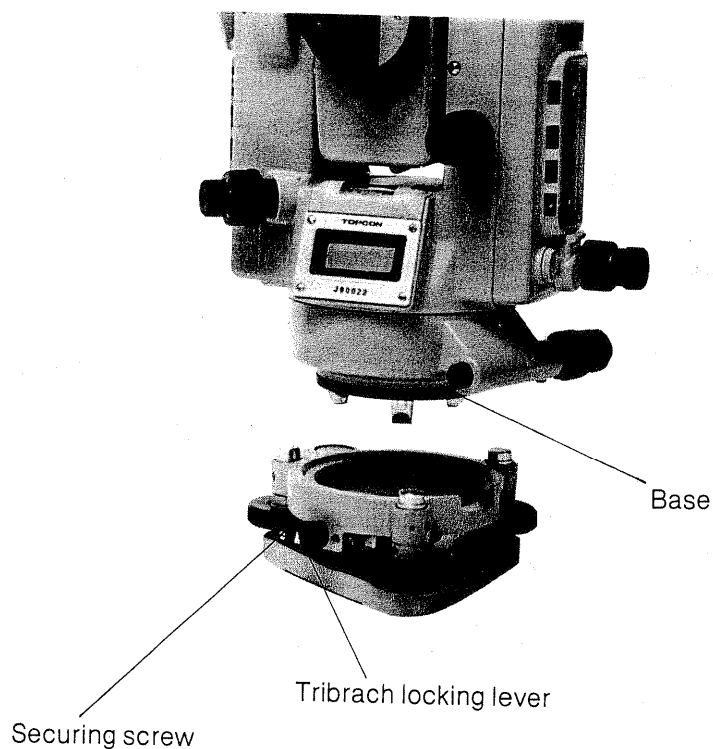
15. ERROR DISPLAYS

Display	Contents
A	Displayed when an internal problem exists partially with the measuring system. An internal problem exists at the very point, for example showing one time error code "A", the measuring can be continued without taking care. But repair is necessary if this code shown frequently.
b	Displayed when it is impossible to read vertical axis tilting index. Check to make sure instrument is leveled properly. Repair is necessary if the "b" remains after checking for level.
E01	Displayed when the alidade portion of the instrument is rotated too fast. To proceed with measurement, press the 0 SET key and take measurement.
E02	Displayed when the telescope is rotated too fast. Press the 0 SET key and "0 SET" appears. Rotate telescope and horizontal angle $0^{\circ}00'00''$ appear.
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.
E04	Displayed in the repeat angle measurement mode when the results differ from each other by more than $\pm 30''$. Press the 0 SET key and repeat the measurement procedure from start.
E51	Unable to correct for earth curvature and refraction while in range of $\pm 9^{\circ}$ —Zenith or Nadir position.
E60	Displayed when the battery power is insufficient for EDM. Charge or replace the battery. Repair is necessary if the error still exists.
E64	Displayed when setting offset value is done incorrectly.
E65	Displayed when any anomaly occurs with EDM. Repair is necessary.
E69	Displayed when data transmission inside the instrument is disabled. Repair is necessary.
E71	Displayed when vertical indexing procedure is done incorrectly.
E72	Displayed when vertical angle "0" point sets extreme wrong position. Level the instrument, then repeat setting of vertical angle "0" position. If E72 continues to display, then repair is necessary.
E73	Displayed when vertical angle "0" position is set without first leveling the instrument. Level the instrument, then repeat setting of vertical angle "0" position. If E73 continues to display, then repair is necessary.
E81	Displayed when the wrong procedure is used for sending data from external equipment, such as FC-1 to GTS-3B (GTS-3C).
E82	Display when the wrong procedure is used for sending data from GTS-3B (GTS-3C) to external equipment, such as FC-1.
E85 E86 E87	Displayed when the GTS-3B (GTS-3C) is unable to send the data. Repair is necessary.
E99	Displayed when any anomaly occurs with GTS-3B (GTS-3C) memory. Repair is necessary.

16. DETACHABLE TRIBRACH

- For detaching
 - 1) Loosen locking lever on the tribrach.
 - 2) Lift the instrument up and remove.
- For attaching
 - 1) Match the instrument base with the correct groove before putting the instrument on the board.
 - 2) Tighten the locking lever.

(Note): Keep the lever tightened at all times.



- **Locking Lever Securing Screw for Use**
Turn the securing screw by using a screwdriver and secure the locking lever when it is unnecessary to remove the instrument. This will help to prevent accidents including an accidental fall. Make sure the screw is tightened well.

17. SELECTING MODE

By operating the keys, the following modes are available.

- (1) $K = 0.14/K = 0.20$ /no correction
Set about correction for refraction and earth curvature; coefficient of refraction $K = 0.14$, $K = 0.20$ or no correction.
- (2) m/ft
Choose meter or feet unit for measuring distance when power is ON.
- (3) Angle/distance
Choose angle measurement (HR) or distance measurement (▲) mode when power is ON.
- (4) Degree/grade/mil
Choose degree, grade or mil unit for measuring angle.
- (5) Zenith/level
Choose the vertical angle reading from zenith or from level.
- (6) The contents and order of \odot key
This \odot key is enable to select the modes and orders which content Set/Audio, Tracking, Number of measurement (Single measurement), Continuous measurement as the program showing in the following table.
And coarse mode can be selected. This mode is effective for quick measuring at distance measurement. (See page 17.).
- (7) The order of \triangleleft key
Select the order of \triangleleft key between (1) horizontal distance (▲), relative elevation (▲), slope distance (▲), and (2) slope distance (▲), horizontal distance (▲), relative elevation (▲) orders.
- (8) Data type for output
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.
- (9) Times of measurement
Use \odot key to set N (number of times) for number of distance measurement.



























The mode changes according to the mode constant setting. The relationship between setting and mode to be obtained is as follows.

① Mode "11"

Constant the tens digit	(1) $K = 0.14/K = 0.20$ /no correction	(2) m/ft	(3) Angle/distance
0	$K = 0.14$	m	angle
1	no correction	m	angle
2	$K = 0.14$	m	distance
3	no correction	m	distance
4	$K = 0.14$	ft	angle
5	no correction	ft	angle
6	$K = 0.14$	ft	distance
7	no correction	ft	distance
8	$K = 0.20$	m	angle
9	no correction	m	angle
A	$K = 0.20$	m	distance
b	no correction	m	distance
C	$K = 0.20$	ft	angle
d	no correction	ft	angle
E	$K = 0.20$	ft	distance
F	no correction	ft	distance

Constant the unit digit	(4)Degree/grade /mil	(5)Zenith /level
0	degree	zenith
1	degree	level
2	grade	zenith
3	grade	level
4	mil	zenith
5	mil	level

② Mode "12"

Constant the tens digit	(6) Contents and order of  key			(7)  key order
0	Number of distance (Single) Meas.	TRK	S/A	  
2				  
4	S/A	TRK	Number of distance (Single) Meas.	  
6				  
8	Number of distance (Single) Meas.	Continuous Meas. (Coarse mode)	S/A	  
A				  
C	S/A	Number of distance (Single) Meas.	Continuous Meas. (Coarse mode).	  
E				  

Setting for the unit digit will be 0.

③ Mode "13"

Constant the tens digit	(8) Data type for output
0	REC A
1	REC B

Constant the unit digit	(9) Times of measurement
0	1 (Single Meas.)
1	1 (Single Meas.)
2	2
3	3
4	4
5	5
6	6
7	7
8	8
9	9
A	10
b	11
c	12
d	13
E	14
F	15

[Example]

Mode 11 → Mode constant is 21.

Mode 12 → Mode constant is 40.

Mode 13 → Mode constant is 11.

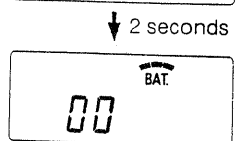
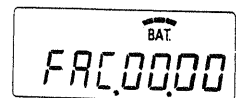
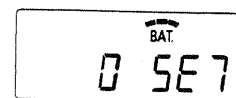
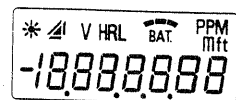
(1) K=0.14 (2) m (3) distance (4) degree (5) level

(6) S/A, TRK, Number of distance (Single) Meas.

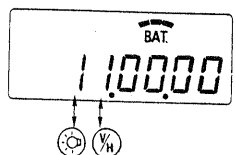
(7) Δ , Δ , Δ (8) REC B (9) Single Meas.

• How to set the selecting mode

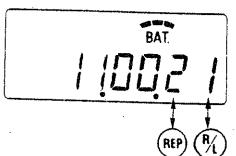
① Pressing the R/L key, turn the power switch ON.
All segments of the display will light for about 2 seconds before the vertical angle zero-set command is displayed.



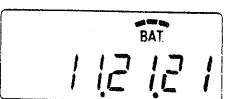
② Rotate the telescope to set the instrument at a vertical angle reading of 0°.



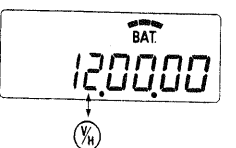
③ Press the \odot key and the V/H key, and mode "11" is displayed.



④ Press the REP key twice and the R/L key once, and constant "21" is displayed.

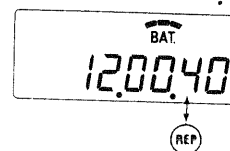


⑤ Press the SET key, and the constant is held.

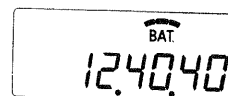


⑥ Press the V/H key, and mode "12" is displayed.

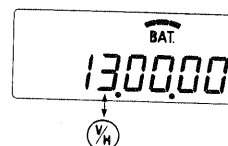
- ⑦ Press the REP key four times and constant "40" is displayed.



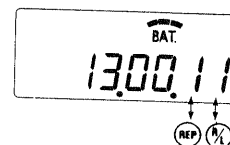
- ⑧ Press the SET key, and the constant is held.



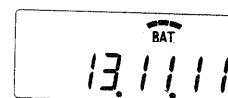
- ⑨ Press the V_H key, and mode "13" is displayed.



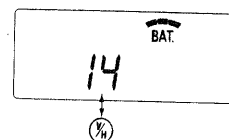
- ⑩ Press the REP key and the R_L key, and constant "11" is displayed.



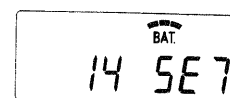
- ⑪ Press the SET key, and the constant is held.



- ⑫ Press the V_H key, and mode "14" is displayed.



- ⑬ Press the SET key, and constant is stored in memory. Setting is completed.



- ⑭ Turn the power switch OFF.

18. PRECAUTIONS

- For transportation, hold by the handle or yoke of the instrument. Never hold by the lens barrel as it can affect the fixing bracket inside and reduce the accuracy of the instrument.
- Never expose the instrument without a filter to direct sunlight. It may damage the components inside the instrument.
- Never leave the instrument unprotected in high temperature. The temperature inside instrument may easily reach up to 70°C or above, and will reduce the service life.
- When a high degree of precision is required for measurement, provide shade against direct sunlight for the instrument and tripod.
- 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.
- When opening the carrying case and taking out the instrument, place the case horizontally, then open the case.
- When returning the instrument to its case, be sure to match the white positioning marks provided with the case and place the instrument with the eyepiece upward.
- For transportation, provide dampening or a cushion appropriately to avoid sudden shock or vibration.
- 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.

19. ADJUSTMENTS

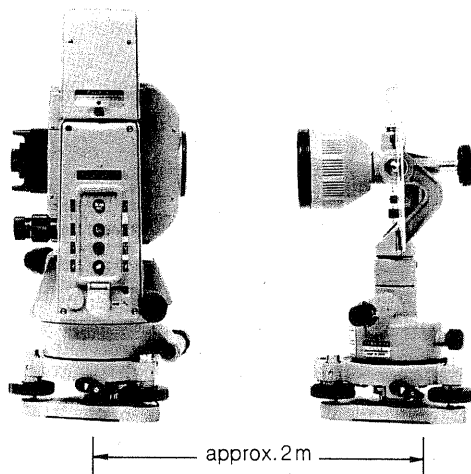
All TOPCON instruments have undergone strict and rigid inspections and should, therefore, arrive properly adjusted, unless subject to excessive rough handling during transportation. The instrument will, of course, lose adjustment when used under the adverse conditions normally prevailing on most sites 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 adjustments 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.

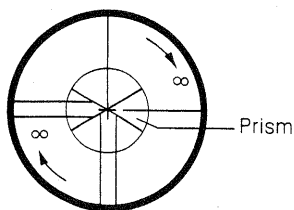
19-1 Adjustment of the Optical Axes



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.

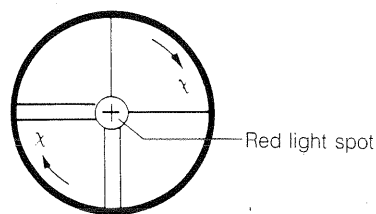
- 1) Position the EDM and prism with 2m between them.



- 2) Turn the power switch ON.
And rotate the telescope to set the instrument at a vertical angle reading of 0° .
- 3) 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.



- 4) Press the  key or the  key to set the instrument in the continuous measurement mode or set audio mode.
- 5) Sight through the eyepiece and focus to the blinking red light spot by turning the focusing knob in the direction of infinity.



- 6) Sight the telescope and turn the focusing knob in the direction of infinity until the round red light spot in the finder is sharply focused. 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.

19-2 Checking Accuracy of the Distance Measurement

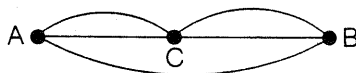
The accuracy of the distance measurements should be checked, at least, once every six months, in order to maintain high accuracy at all times. Use a standard measured distance of known accuracy or an accurately measured distance of more than 20 meters (65.5 ft) for this purpose. The accuracy of the checking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

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. (See page 30 "10-1 Offset Switches".)

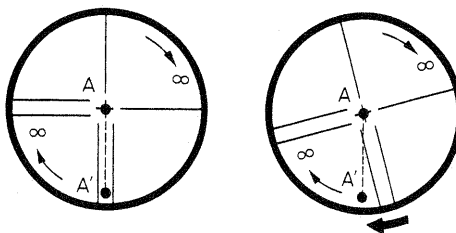
19-3 Pointers on Adjustments

- 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) "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.

19-4 Adjustment of the Vertical Cross-hair

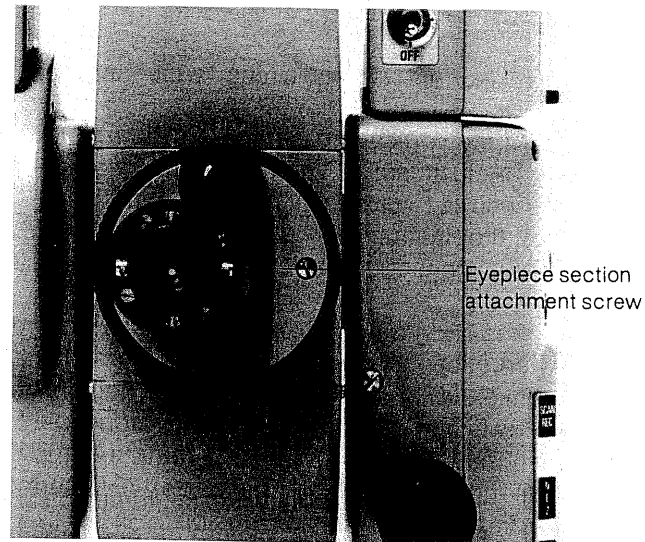
Adjustment is required if the vertical cross-hair is not in a plane perpendicular to the horizontal axis of the telescope (since it must be possible to use any point on the hair for measuring horizontal angles or running lines).

- 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 counter-clockwise direction, and take it off. This will expose four eyepiece section attachment screws, as well as four capstan cross-hair adjustment screws.

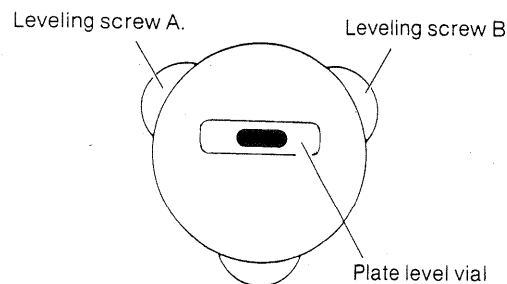


- 7) Loosen all four attachment screws slightly with the accessory screw-driver (while taking note of the number of revolutions). Then, revolve the eyepiece section so that the vertical cross-hair is coincided to Point A'. Finally, re-tighten the four screws by the amount that they were loosened.
- 8)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

19-5 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.



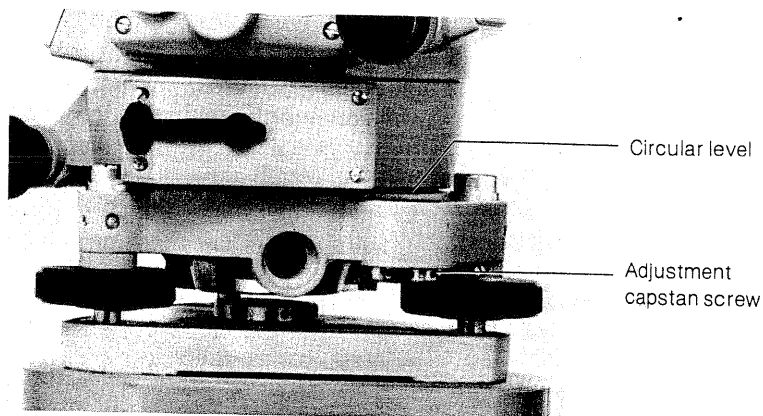
- 2) Next, revolve the instrument 180° or 200 g around the vertical axis and check bubble movement of the plate level.
If the bubble has been displaced, then proceed with the following adjustment.
- 3) Adjust the level adjustment capstan screw, with the accessory adjusting pin and return the bubble towards 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.



19-6 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.

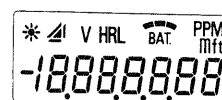
4) Adjustment is completed with the above.

19-7 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.

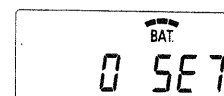
• **Operating Procedure**

1) Level the instrument properly with the plate level.

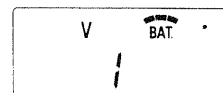


↓ 2 seconds


2) Pressing the 0 SET key, turn the power switch ON.
All segments of the display will light for about 2 seconds before the vertical angle 0-set command is displayed.

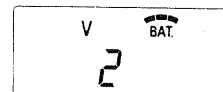


- 3) Turn the telescope for normal telescope setting.




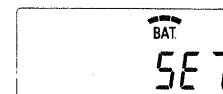
- 4) Sight target A in normal telescope setting.

- 5) Press the  key.

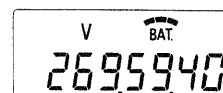


- 6) Turn the telescope and sight target A in reverse telescope setting.

- 7) Press the  key and the correct vertical angle is set as a vertical angle 0 datum. Next, "SET" is displayed for about 2 seconds, then vertical angle (V) is selected for the display.



↓ 2 seconds



- 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°.

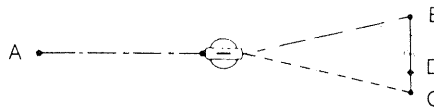
- If there is any misoperation during checking, display for error appears. Then repeat the above procedure from the start. However, if error code "E72" appears, it means it is impossible to adjust the instrument. In such case, request repair.
- After the above adjustment, be sure to carry out procedure 19-1.

19-8 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.

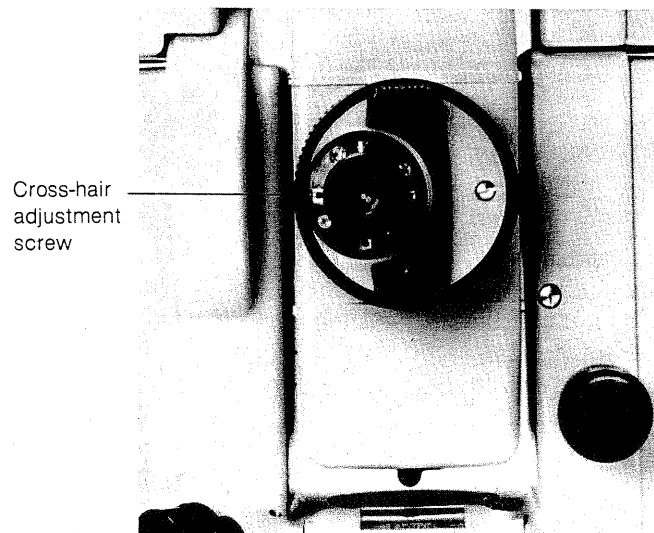
- 4) Loosen the vertical clamp only and plunge the telescope 180° or 200 g around the horizontal axis, so that the telescope is pointed in the opposite direction.
- 5) Sight Point B, at equal distance as Point A, and tighten the vertical clamp.
- 6) Loosen the upper motion clamp and revolve the instrument 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 1/4 th 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:

The left and right capstan adjustment screws are adjusted in the same manner as the top and bottom capstan adjustment screws in "Adjustment Index Error".

- 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.



19-9 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).

The instrument is normally supplied with the optical plummet telescope built into the detachable tribrach. However, for certain markets, this type is replaced with the optical plummet telescope incorporated in the alidade or upper instrument section.

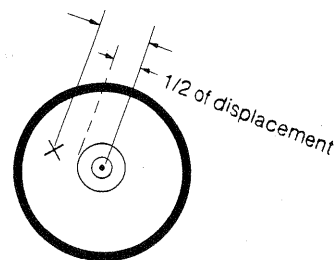
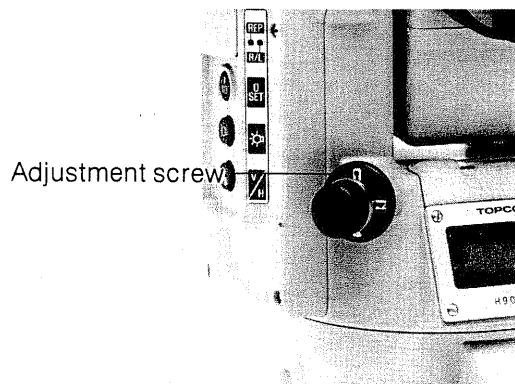
- **Optical Plummet Telescope**

- 1) Coincide the center mark and the point. (See page 9 "4. Optical plumbing".)
- 2) Revolve the instrument 180° or $200g$ 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 "Adjustment Index Error".

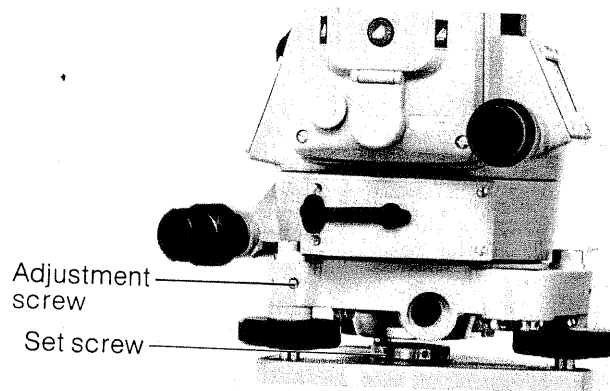
- 4) Next, use the leveling screws and coincide the point and center mark.
- 5) Revolve the instrument 180° or $200g$ around the vertical axis once more and check the center mark. If it is coincided to the point, then further adjustment is not required. Otherwise, repeat the adjustment.



19-10 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.



20. SPECIAL ACCESSORIES



FC-1 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.

-
- | | |
|--|--|
| <ul style="list-style-type: none">• Standard Composition<ul style="list-style-type: none">○ FC-1 body○ Power/signal connecting cable PC-5○ Charger BC-10B or BC-10C (6-hour charging)○ Soft case• Specifications of FC-1<ul style="list-style-type: none">○ Data memory capacity: 60k bytes○ Continuous use with built-in battery: 15 to 25 hours | <ul style="list-style-type: none">○ Data storing time: 2000 hours○ Operating temperature: -20°C to $+50^{\circ}\text{C}$○ Display: 16-characters, LCD○ Keyboard: 28 alphanumeric○ Interface: RS-232C○ Dimensions: 205(L) \times 90(W) \times 58mm(H)○ Weight: 0.7kg <p>(For further information, see FC-1 instruction manual.)</p> |
|--|--|
-



DK-5 Data entry keyboard

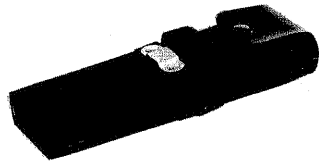
Optional accessory DK-5 has been designed for combined use with GTS-3B (GTS-3C) geodetic station. Through DK-5 keyboard, numeric input to GTS-3B (GTS-3C) is possible, and mode switching of GTS-3B (GTS-3C) is possible by operating the key of DK-5.

DK-5 can be used for

- 1) Numerical input to GTS-3B (GTS-3C):
 - a) setting standard values for stake-out work, such as horizontal and slope distances, and elevations.
 - b) setting values for coordinate origins in northing, easting and Z coordinates measurement.
 - c) setting horizontal angles
- 2) Calculation:
 - a) R.E.M (Remote Elevation Measurement) function
 - b) Missing line measurement

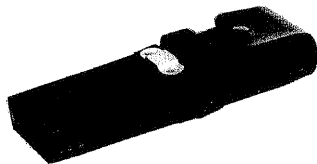
• Specifications

Power source	8.4 V DC(GTS-3B's (GTS-3C's) power source is used)
Power consumption	0.5 W or below
Operating temperature	-20°C to + 50°C
Dimensions	123 × 70 × 25 mm
Weight	0.2 Kg



Battery pack BT-3Q

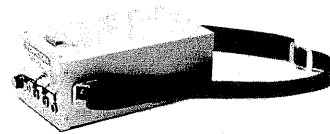
- Output voltage: DC8.4V
- Capacity: 1.8 AH
- Service life per charging: approx. 6 hours under normal use, (however, 2.3 hours for continuous use including measuring distance.)
- External dimensions: 225(L) × 62(W) × 33mm(H)
- Weight: 0.7 kg



Battery pack BT-3

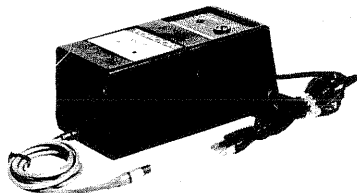
- Output voltage: DC8.4V
- Capacity: 1.8 AH

- 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) × 33mm(H)
- Weight: 0.7 kg



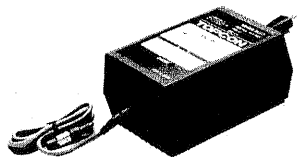
Large capacity battery pack BT-3L

- Output voltage: DC8.4V
- Capacity: 6 AH
- Service life per charging: approx. 20 hours under normal use, (however, approx. 7.5 hours for continuous use including distance measurement.)
- External dimensions: 190(L) × 106(W) × 74mm(H)
- Weight: 2.8 kg



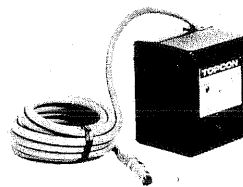
Quick battery charger BC-5

- Input voltage: 100/120/220/240V AC; $\pm 10\%$ 50/60HZ
- Power consumption: 40VA approx.
- Charging time:
 - approx. 1 hour ($+20^{\circ}\text{C}$) to charge BT-15Q
 - approx. 1 hour ($+20^{\circ}\text{C}$) to charge BT-3Q.
- Operation temperature range: $+10$ to $+40^{\circ}\text{C}$
- External dimensions: 181(L) \times 97(W) \times 78mm(H)
- Weight: 1.5 kg



Battery charger BC-6

- Input voltage: 100/120/220/240V AC $\pm 10\%$ 50/60Hz
- Power consumption: 15VA approx.
- Charging time: approx. 15 hours ($+20^{\circ}\text{C}$) to charge BT-3L
- Operation temperature range: $+10$ to $+40^{\circ}\text{C}$
- External dimensions: 142(L) \times 96(W) \times 64mm(H)
- Weight: 1.0kg



Battery charger BC-4 (or BC-2)

- Input voltage: BC-4: 120V AC $\pm 10\%$ 50/60 HZ
BC-2: 230V AC $\pm 10\%$ 50/60HZ
- Power consumption: 5VA
- Charging time: approx. 15 hours ($+20^{\circ}\text{C}$) to charge BT-3
- Operation temperature range: $+10$ to $+40^{\circ}\text{C}$
- External dimensions:
BC-4: 60(L) \times 50(W) \times 43(H)mm
BC-2: 110(L) \times 60(W) \times 50(H)mm
- Weight: BC-4: 0.2kg
BC-2: 0.5kg



Cigarette lighter charge BC-9

- Input voltage: 13.8V to 16V
- Power consumption: 40VA approx.
- Charging time:
 - approx. 2hours ($+20^{\circ}\text{C}$) to charge BT-15Q
 - approx. 2hours ($+20^{\circ}\text{C}$) to charge BT-3Q
- Operation temperature range $+10^{\circ}\text{C}$ to $+40^{\circ}\text{C}$
- External dimensions: 116(L) \times 60(W) \times 50mm(H)
- Weight: 0.3 Kg



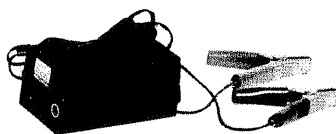
Power cord PC-3 (For BT-3 or AC-3)
 ○ L-shape plug provided
 ○ Cord length: 2m approx.



Power cord PC-5 (For BT-3Q or FC-1)
 ○ L-shape plug provided
 ○ Cord length: 2m approx.



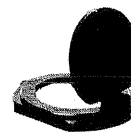
Power cord PC-6 (For BT-3L)
 ○ L-shape plug provided
 ○ Cord length: 2m approx.



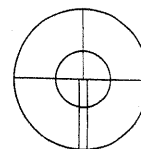
Auto converter AC-5
 ○ Input voltage: 12V DC
 ○ Output voltage: 8.4 V
 ○ Cable length: 3m approx.
 ○ External dimensions:
 100 (L) × 53(W) × 47mm(H)
 ○ Weight: 0.3kg



Diagonal eyepiece, Model 7
 Observation in an easy posture
 will be provided up to the zenith
 position



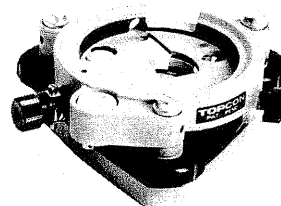
Solar filter, Model 3
 A filter designed exclusively for
 direct collimation of the sun.



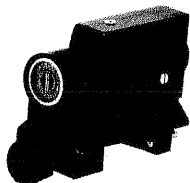
Solar reticle, Model 3
 A reticle designed for collima-
 tion of the sun.
 Can be used together with Solar
 Filter simply by coupling this
 reticle to the eyepiece of GTS-3B
 (GTS-3C).



Eyepiece (26x)



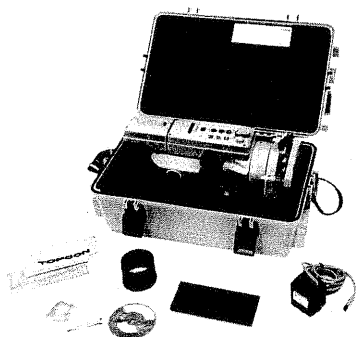
Optical plummet tribrach
 This is detachable tribrach having
 built-in optical plummet telescope.
 (Compatible with Wild.)



Trough compass, Model 3
Shock proof construction.
No clamp is necessary
when carrying the instru-
ment. When using this
compass use the carrying
handle.



Carrying Handle type 12
Use it when carrying the
instrument or when only
external batteries are
used. It is necessary es-
pecially when using the
trough compass 3.

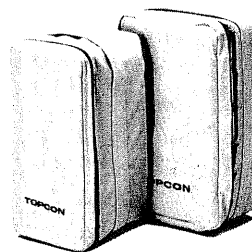


GTS-3B (GTS-3C) carrying case, Model 2
This is small-sized carrying case.
The case covers as follows.
○ GTS-3B (GTS-3C) instrument
with Handle Battery
○ Tool kit with case
○ Sunshade

- Plastic rain cover
- Plumb bob set
- Battery charger BC-10B
- Atmospheric correction
calculator

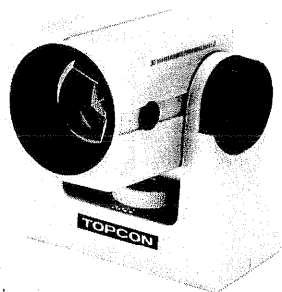


Prism sets
See the description on page 65



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

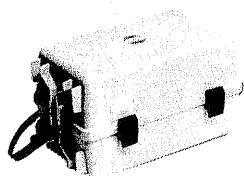
Prism unit case, Model 5
1 prism unit or fixed 3 prisms
unit can be stored in this
case. Especially, this is a very
easy case to carry. Soft
material is used.
○ External dimensions:
200(L)×200(W)×350mm(H)
○ Weight: 0.5kg



Mini prism

The mini prism (25.4mm) 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:

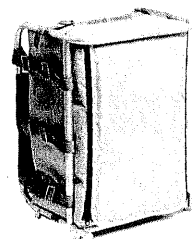
- Tilt single prism set
- Tilt single prism set with a target plate
- Fixed triple prism unit
- Fixed triple prism unit with a target plate
- External dimensions:
427(L) × 254(W) × 242mm(H)
- Weight: 3.1 kg



Cadget case, Model 1

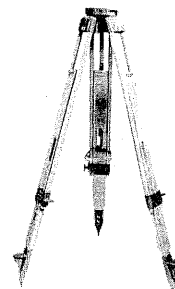
A case to store and carry accessories.

- External dimensions:
300(L) × 145(W) ×
220mm(H)
- Weight: 1.4 kg



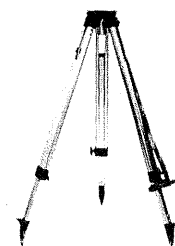
Back Pack

Convenient for use in mountainous terrain.



Wide-frame extension leg tripod, Type E (Wood)

- Flat head 5/8" × 11 threads with adjustable legs.

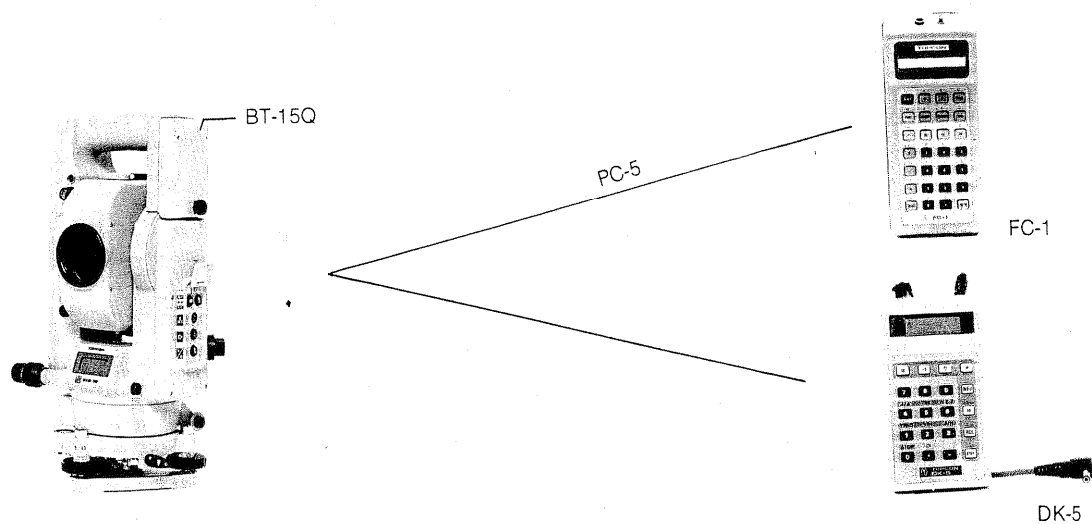


Aluminum extension leg tripod, Type E

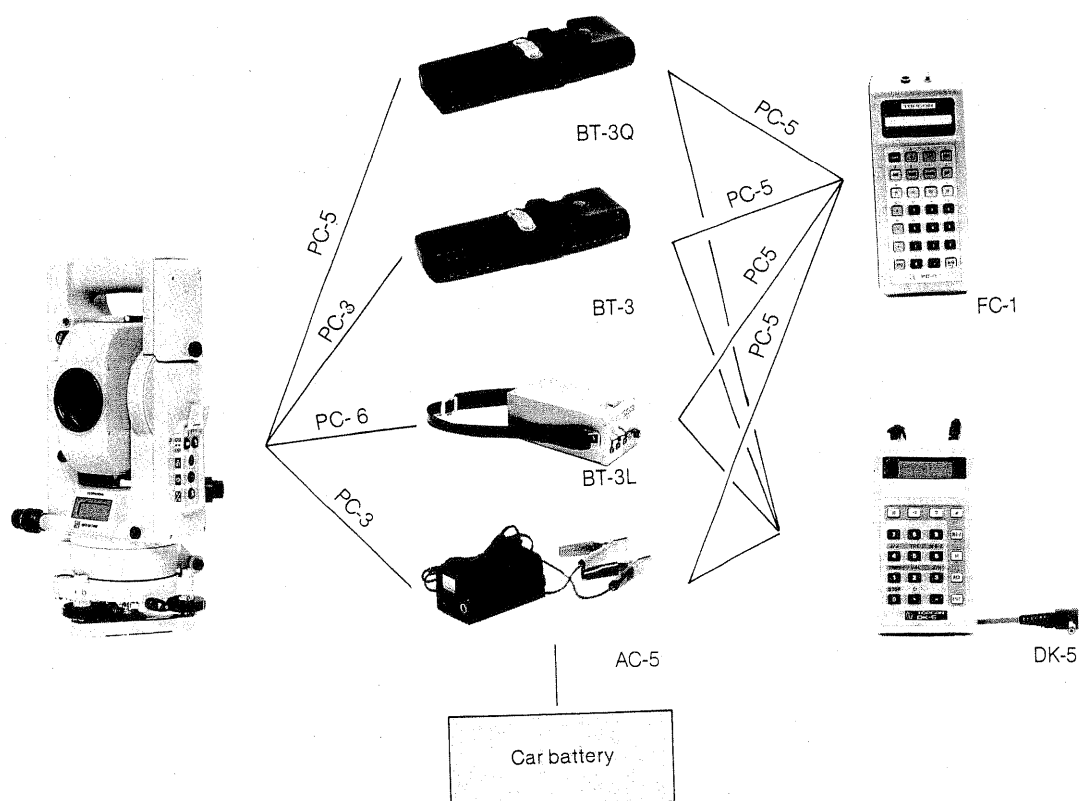
- Flat head 5/8" × 11 threads with adjustable legs.

21. BATTERY SYSTEM

21-1 In Case of Handle Battery BT-15Q

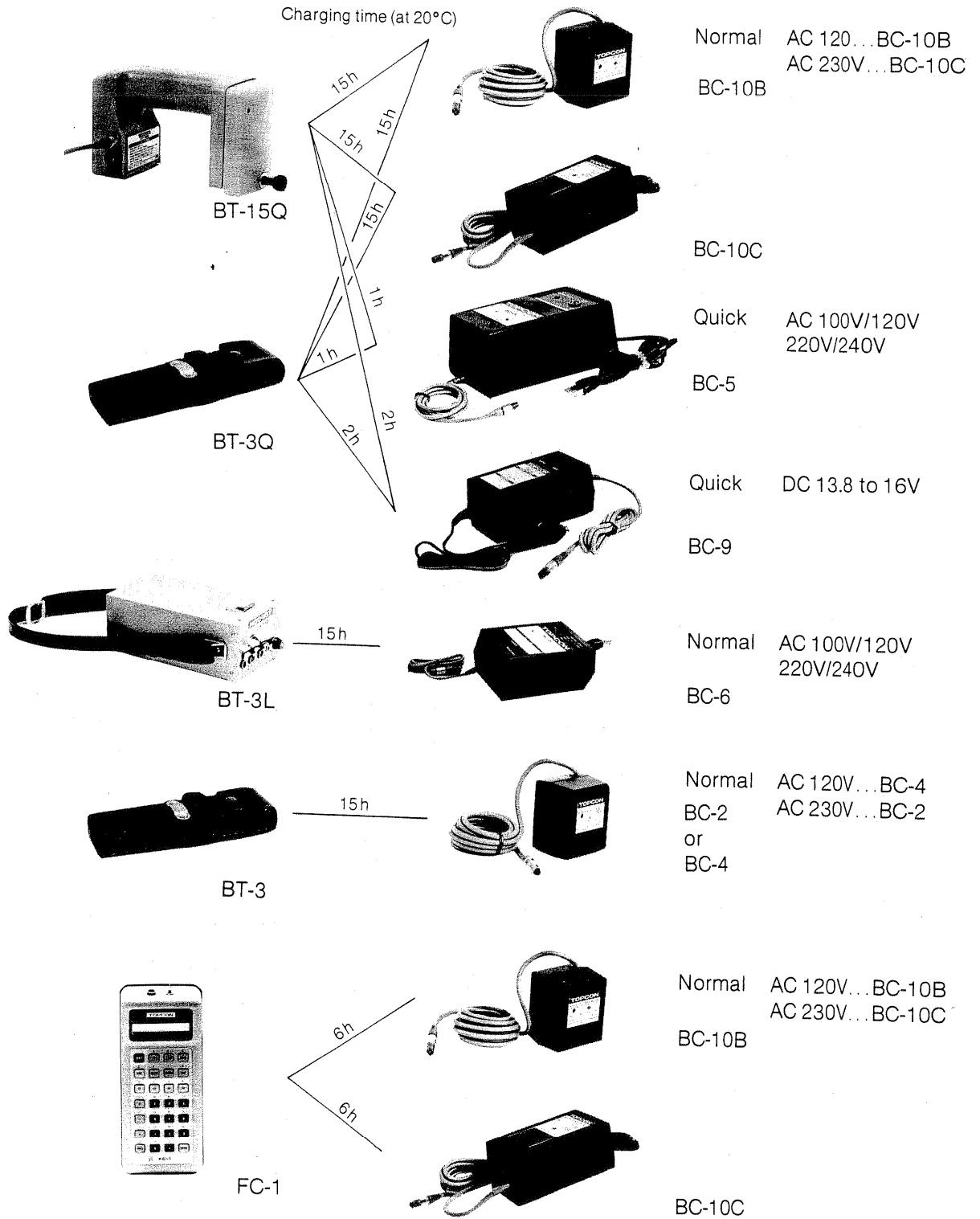


21-2 In case of External Battery Pack



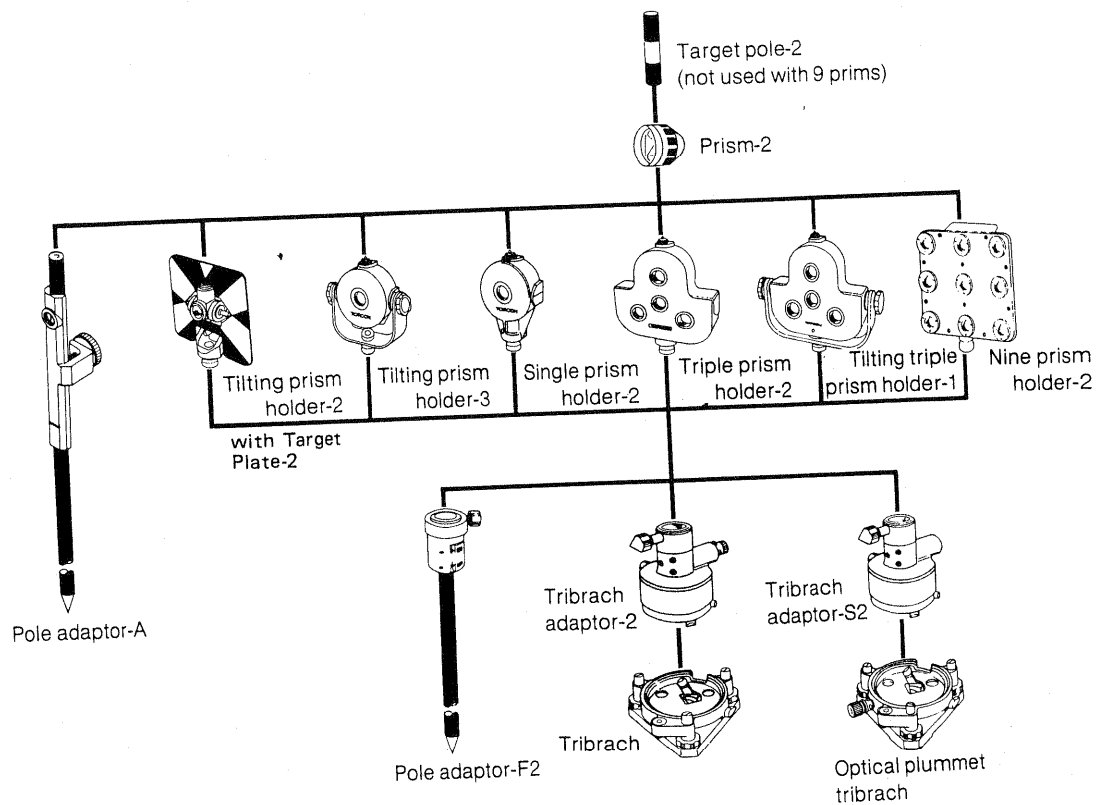
21-3 Charging

Charging time (at 20°C)

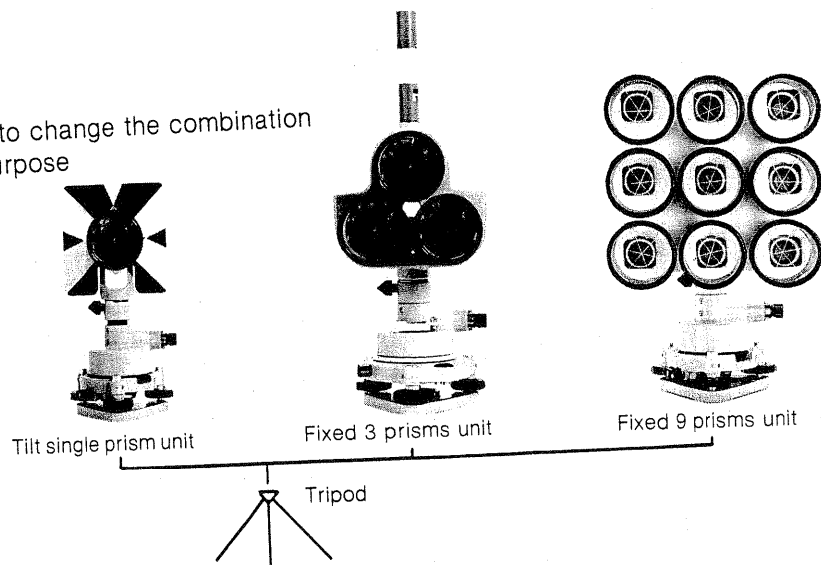


22. PRISM AND REFLECTOR SYSTEM

- Arrangement According to Your Needs is Possible.



- It is possible to change the combination according purpose



23. SPECIFICATIONS

Telescope

Length	152mm
Objective aperture	40mm(EDM: 45mm)
Magnification	30X
Image	Erect
Field of view	1°20'
Resolving power	3"
Minimum focus distance	1.5m

Distance measurement

Measurement range

Type	Prism	Atmospheric conditions	
		Condition 1	Condition 2
GTS-3B	1 Prism	2,000 m (6,600 ft)	2,300 m (7,600 ft)
	3 Prisms	2,700 m (8,700 ft)	3,100 m (10,200 ft)
	9 Prisms	3,600 m (11,800 ft)	4,200 m (13,800 ft)
GTS-3C	1 Prism	1,600 m (5,200 ft)	1,800 m (5,900 ft)
	3 Prisms	2,200 m (7,200 ft)	2,500 m (8,200 ft)
	9 Prisms	2,800 m (9,200 ft)	3,400 m (11,100 ft)

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

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

Measurement accuracy

GTS-3B	± (5mm + 3ppm) m.s.e.
GTS-3C	± (5mm + 3ppm) m.s.e. -10~+40°C ± (5mm + 7ppm) m.s.e. -20~-10°C, +40~+50°C

Accuracy around the far end of measuring distance is enhanced by adding the number of prism; higher accuracy is available with 3 prisms than that with a single prism and with 9 prisms higher accuracy is available than that with 3 prisms.

Display unit

Number of distance (Single)/

Continuous measurement

Tracking/Coarse

1 mm (0.005 ft.)

10mm (0.02 ft.)

Maximum display level	19999.999m
Measuring time	
Number of distance/	
Continuous measurement	4sec.
Tracking/Coarse	0.6sec.
Atmospheric correction	-58ppm~ +98ppm (2ppm-step)
Prism constant correction	-80mm~ +20mm (1mm-step)
Meter/Feet conversion value	1m = 3.280833 ft.
Angle measurement	
Method	Incremental reading
Diameter of circle	71mm
Minimum reading	5"(1")/GTS-3B, 5"(10")/GTS-3C
Accuracy	2"/GTS-3B, 5"/GTS-3C
(standard deviation based on DIN18723)	
Automatic vertical index	
Working range	±3'
Level sensitivity	
Circular level	10'/2mm
Plate level	30"/2mm
Optical plummet telescope	
Image	Erect
Magnification	3 X
Focusing range	0.5m to infinity
Field of view	5°
Instrument height	176mm
(Tilting axis above tribrack dish)	
Ambient temperature range	-20°C to +50°C (-4°F to +122°F)
Dimensions	
Instrument	
without Handle battery or Carrying handle	291mm×190mm×152mm (11.46in×7.28in×5.98in)
with Handle battery or Carrying handle	346mm×190mm×152mm (13.6in×7.28in×5.98in)
Plastic carrying case	536mm×375mm×240mm (21.2in×14.8in×9.45in)
Weight	
Instrument	
without Handle battery or Carrying handle	5.2kg (11.5lb)
with Handle battery	6.2kg (13.7lb)
Plastic carrying case	6.2kg (13.7lb)

Handle battery BT-15Q	
Output voltage	NiCd
Capacity	DC8.4V
	1.8AH
Maximum operating time (when fully recharged) at + 20°C (+ 68°F)	
Including distance measurement	2.5 hours
Angle measurement only	12.5 hours
Weight	1 kg (2.2lb)
Battery pack BT-3Q	
Output voltage	NiCd
Capacity	DC8.4V
	1.8AH
Maximum operating time (when fully recharged) at + 20°C (+ 68°F)	
Including distance measurement	2.3 hours
Angle measurement only	11 hours
Weight	0.7 Kg(1.6lb)
Battery charger BC-10B	
Input voltage	AC120V±10%
Frequency	50/60 HZ
Recharging time (at + 20°C/ + 68°F)	
BT-15Q	15 hours
BT-3Q	15 hours
Operating temperature	10°C to 40°C (50°F to 104°F)
Charging signal	Red lamp illumination
Weight	0.2kg(0.5lb)
Battery charger BC-10C	
Input voltage	AC230V±10%
Frequency	50/60 HZ
Recharging time (at + 20°C/ + 68°F)	
BT-15Q	15 hours
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 (0.9lb)

Precautions when charging 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 the battery's 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.

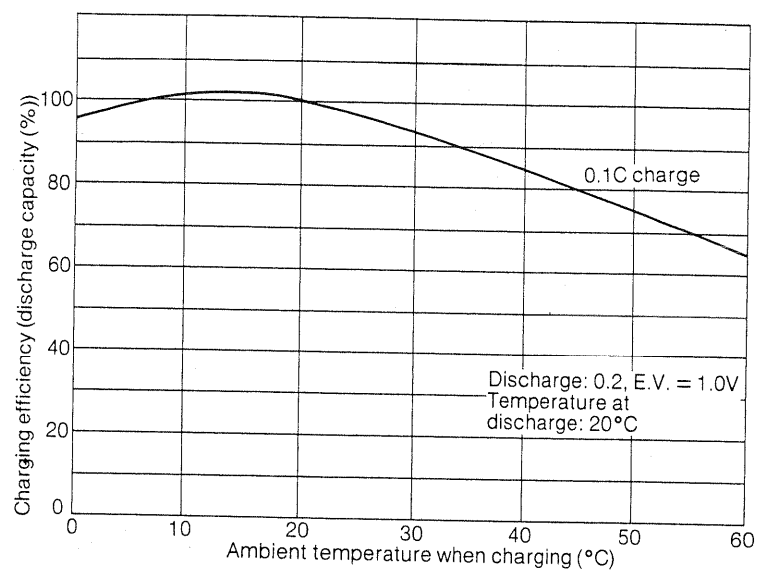


Fig. 1 Recharging

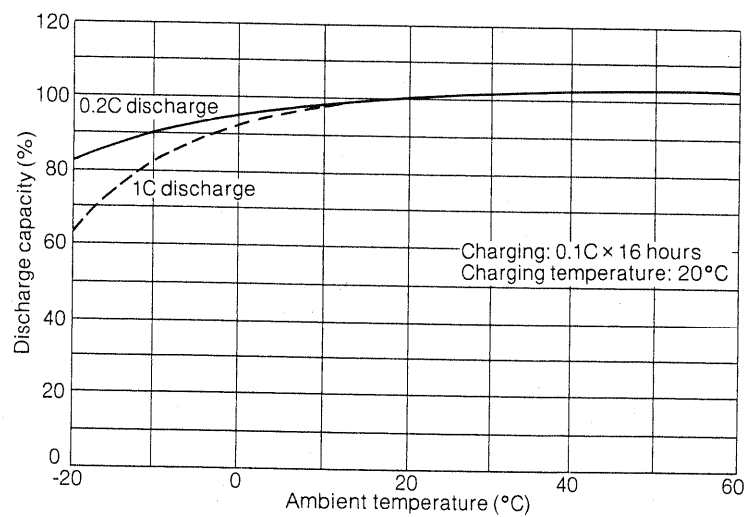


Fig. 2 Discharge

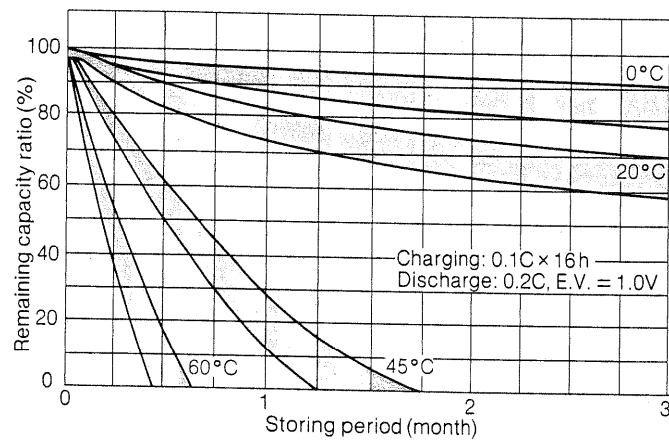


Fig. 3 Storage



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