



Fiber Optic Gyrocompass for Tunnel Excavation

TMG-32F



TOKYO KEIKI INC.

Overview

The TMG-32F precision fiber optic gyrocompass incorporates state-of-the-art inertial navigation device technology. The TMG-32F gyrocompass system displays and outputs azimuth (absolute true north heading) and pitch and roll angles in real-time. The TMG-32F system's solid-state design has no moving parts and as such is strong against vibration and is easy to install. Compact and light weight, the TMG-32F gyrocompass navigation system is suitable for installation in small diameter TBMs and provides improved accuracy in long drive and curved drive tunneling.



Features

Azimuth accuracy: $\pm 0.05^\circ$ SEC latitude

Real-time measurement while tunnel excavation is underway.

Easy to transport and install.

Strong against vibration and shock.

Waterproof (comply with IP 67)

Capable of steep slope (vertical 15°) operation

Options:

Water level sensing system

Pipe jacking navigation system.

Operating Principle

■ Strapdown system

In strapdown systems, a triad of gyroscopes and accelerometers are strapped directly onto the vehicle platform. High speed computers process the output from the sensors based on a virtual software platform and convert the coordinates to determine true north.



Specifications

Measurement range	Azimuth	360°
	Pitch angle, Roll angle	±15°
Accuracy ^{*1}	Azimuth	±0.05° sec λ. ^{*2}
	Azimuth setting point error	±0.3° sec λ. ^{*2}
	Pitch angle, Roll angle	±0.05°
Resolution	Azimuth	0.01°
	Pitch angle, Roll angle	0.01°
Setting time	Azimuth	Within 3 hrs of power on (display 20 minutes)
	Pitch angle, Roll angle	At power on
Output signal	Serial (RS422 or RS232C)	
Environmental	Housing	Water proof (comply with IP67, sensor unit) Splash proof (except sensor unit)
	Operating temperature	-15~55°C (Sensor unit) 0~40°C (except sensor unit)
	Humidity	95%RH or less
	Vibration	5~22.5Hz ±1mm 22.5~2000Hz ±10m/s ²
	Shock	100G 6ms
Power	AC100~230V, 50/60Hz	
Back up time	90 minutes. ^{*3}	

*1 Conditions for operation: negligible vibration, temperature range 15~35°C, small temperature variations.
For accuracy, initial latitude input should be set in 0.1 degree units (ex. Tokyo 35.7 deg. latitude).

*2 $\sec \lambda = 1/\cos \lambda$ λ : latitude

*3 Battery life is about 2 years

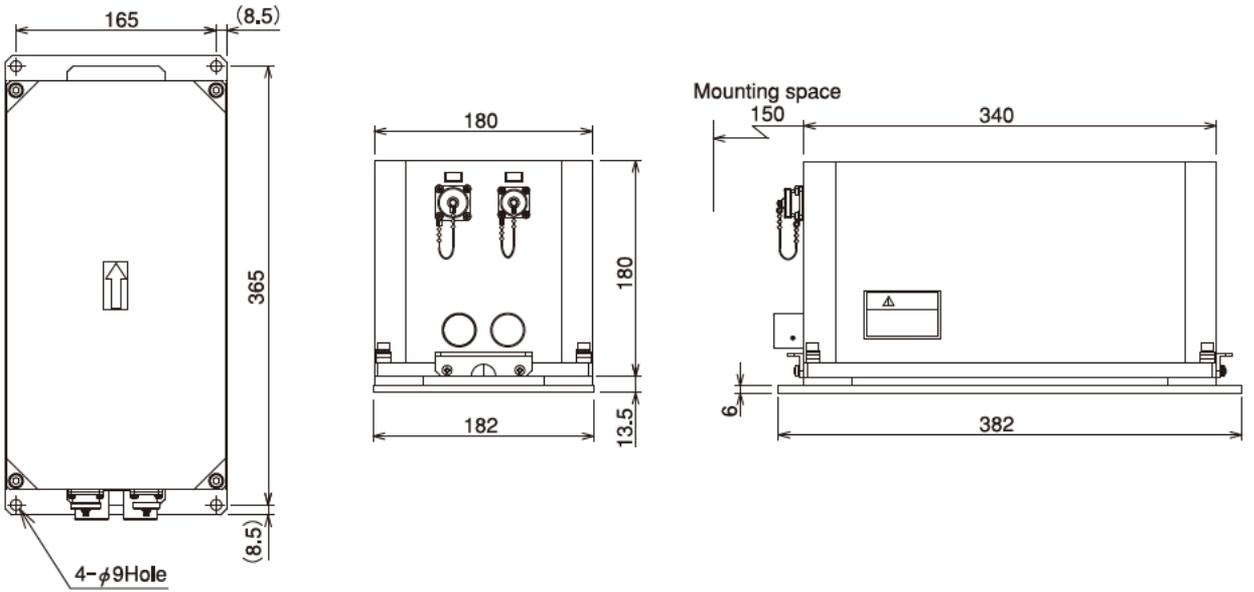
System Components

Component	Dimensions (mm)	Mass (kg)
Sensor unit	182×382×194	10
Power supply unit	180×375×170	11
Display unit	215×96×190	4

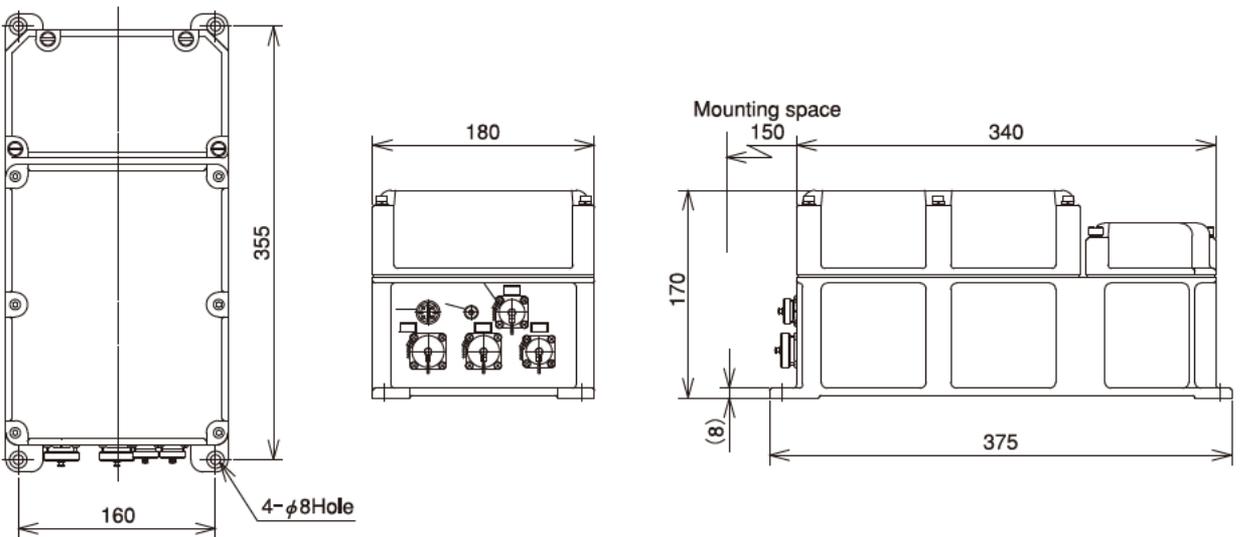
Cables	Length (m)
Power supply unit - sensor unit	10
Power supply unit - display unit	3
Power supply unit - AC plug	3
Display unit - AC plug	3

※Accessories include sets of mounting bolts and storage cases.

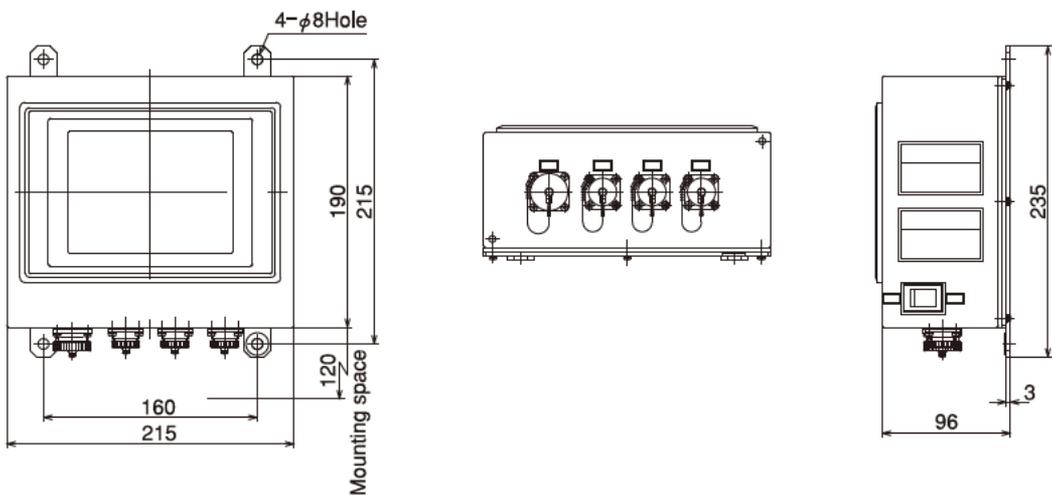
■ Sensor unit



■ Power supply unit



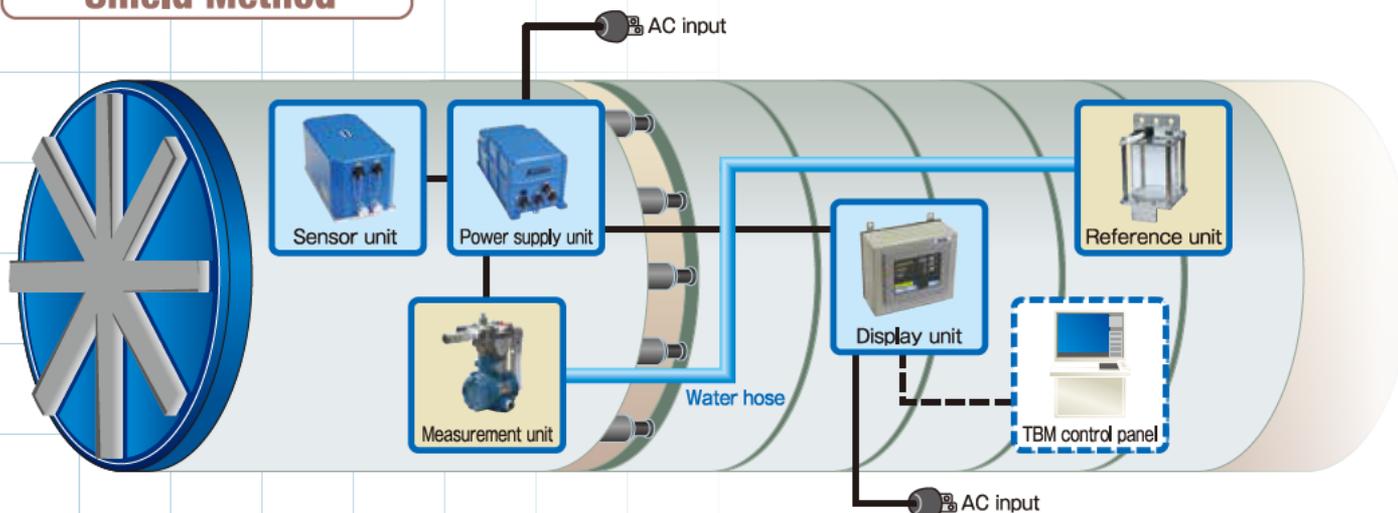
■ Display unit



Tunnel Excavation System Examples

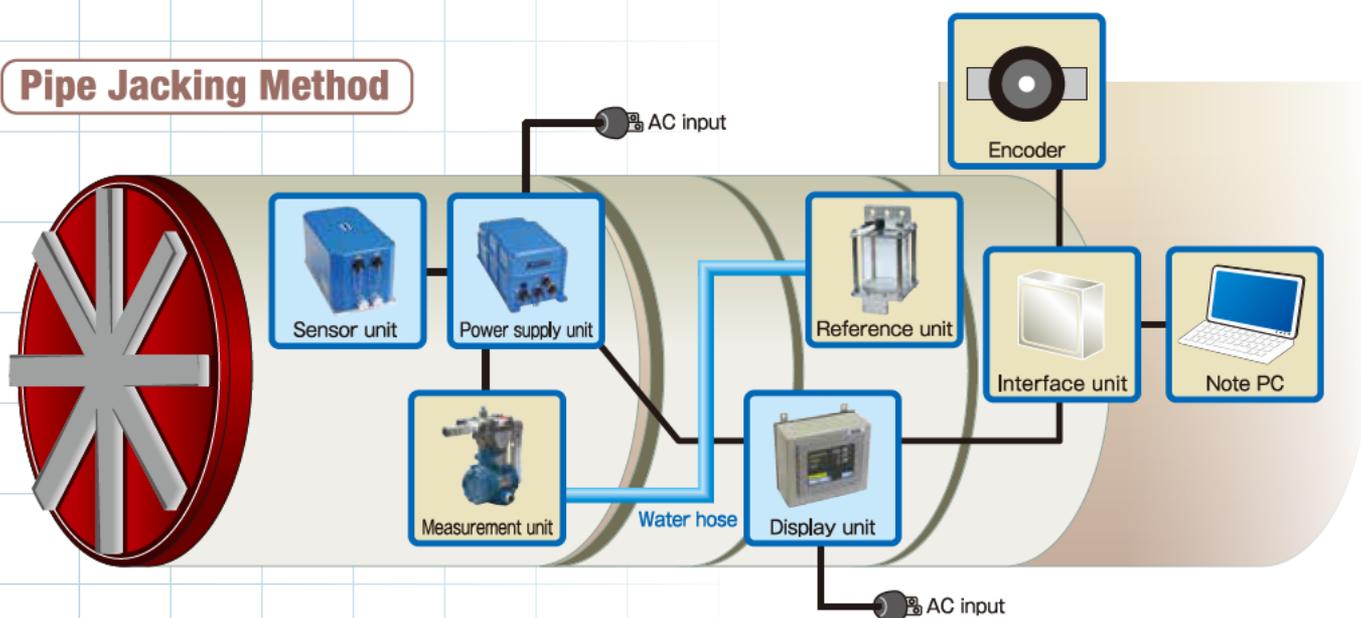
TMG-32F system components
 Options
 Customer scope

Shield Method



- This illustration shows the layout of the various individual system components of the gyrocompass and water level sensing system utilized in shield tunneling.
- The reference unit of the water level sensing system is installed at a high point in the shaft or segment.
- Output signals from the display unit are input to the TBM control panel in the trailing support deck.

Pipe Jacking Method



- This illustration shows the layout of the various individual system components of the gyrocompass and water level sensing system utilized in pipe jacking.
- When the jacking pipe is being placed, the cable connector between the power supply unit and the display unit and the hose coupler of the water level sensing system between the measurement unit and the reference unit are detached. After the jacking pipe is placed, the cable and water hose are reconnected and pipe jacking operation is resumed.
- When the Pipe jacking navigation system is operated, the encoder and interface unit are connected.

※ The cable between the power supply unit of the gyrocompass and display unit can be extended.
 ※ The water hose between the level measurement unit and reference unit can be extended.
 ※ For inquiries regarding operation of these systems, please contact to Tokyo Keiki.

■ Pipe jacking navigation system Gyro-Navi

The pipe jacking navigation system provides data on attitude angle and position that is required for real-time alignment control of the TBM. The system integrates signals from the gyrocompass, water level sensor, as well as measurement values in an easy-to-view graphical screen presentation that contributes to improved accuracy of the tunneling operation.

- Component set

Note PC (software installed)
Interface unit, encoder, cables

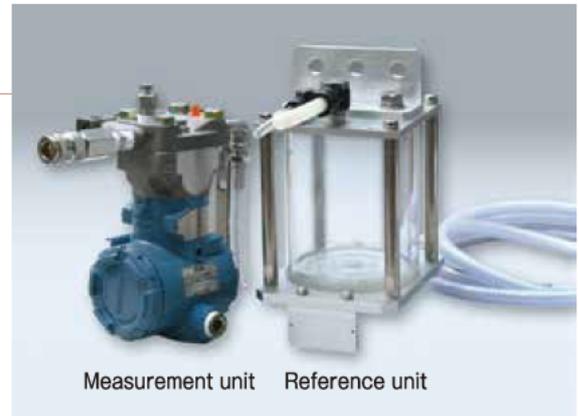


■ Water level sensing system TL-300 Series

The TMG-32F-compatible TL-300 water level sensing system measures changes in relative height of the machine in real-time and is invaluable in projects such as sewage systems where precise control of slope is required. There are no limitations regarding distance or curves.

- Component set

Measurement unit, reference unit, water hose, cables (between measurement unit and power supply unit), accessories.



This product is a controlled item under the Export Trade Control Order of Japan. A license to export this product is required from the Japanese government regardless of the destination. Such export license will require the prospective buyer of the product to submit the appropriate documentation. Design and specifications are subject to change without prior notice, and without any obligation on the part of the manufacturer.



CAUTION

Before operating this equipment, you should first thoroughly read the operator's manual.

**TOKYO
KEIKI**

TOKYO KEIKI INC.

www.tokyo-keiki.co.jp/const/

Communication&Control Systems Company Sensing Control Systems Dept.

Head Office

2-16-46, Minami-Kamata, Ohta-ku, Tokyo 144-8551, JAPAN
TEL.+81-3-3731-2631 FAX.+81-3-3738-8670