

Pipe Jacking Gyro Navigation System

PN-S1

Specifications

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1. Overview

1.1 Introduction

The Gyro Navigation System “PN-S1” provides the operator with useful real time navigational data including exact 3D machine attitude and position information which aids in minimizing deviation from the designed centerline.

1.2 Export regulations

Gyro Unit (TMG-32F) 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.

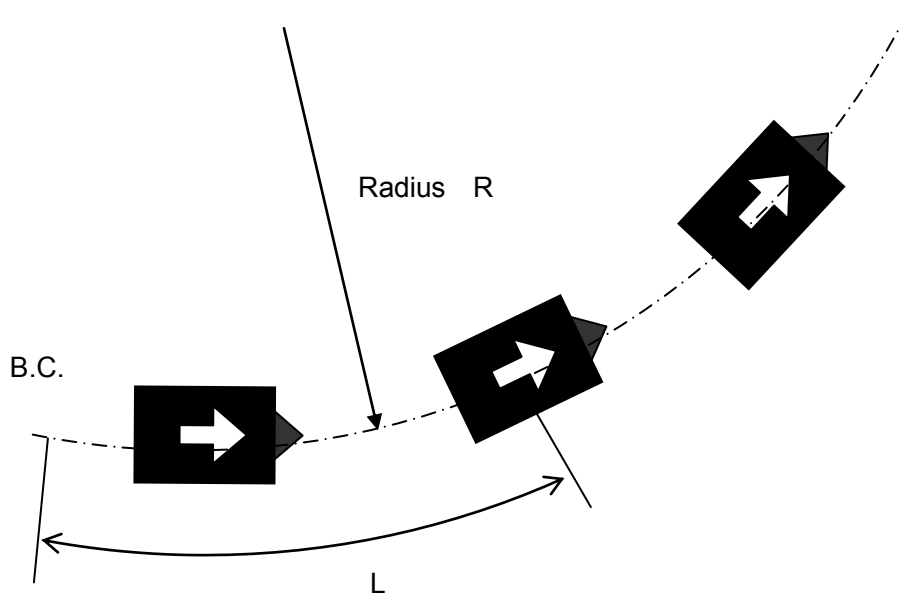
1.3 The theory

(1) Direction control

In order to drive the machine along a curved line, machine direction needs to be changed according to machine position.

The target direction “ θ ” can be calculated from the following formula with radius “R” and distance “L” from the beginning of curve “B.C.”.

$$\theta = L \div (2 \times \pi \times R) \times 360$$



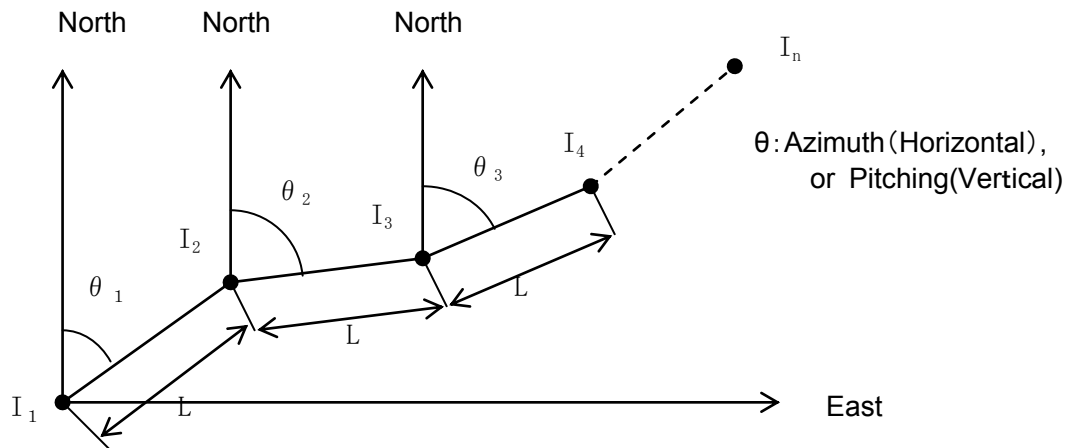
- The gyrocompass mounted on the machine indicates absolute azimuth from the north pole in real time by detecting global rotation.
- Both the machine current azimuth and the target azimuth of the designed alignment are displayed on the screen to facilitate operation of the machine steering jacks.

(2) Method to calculate the last position

Machine position can be calculated from the jacking distance and the attitude angle (azimuth and pitching).

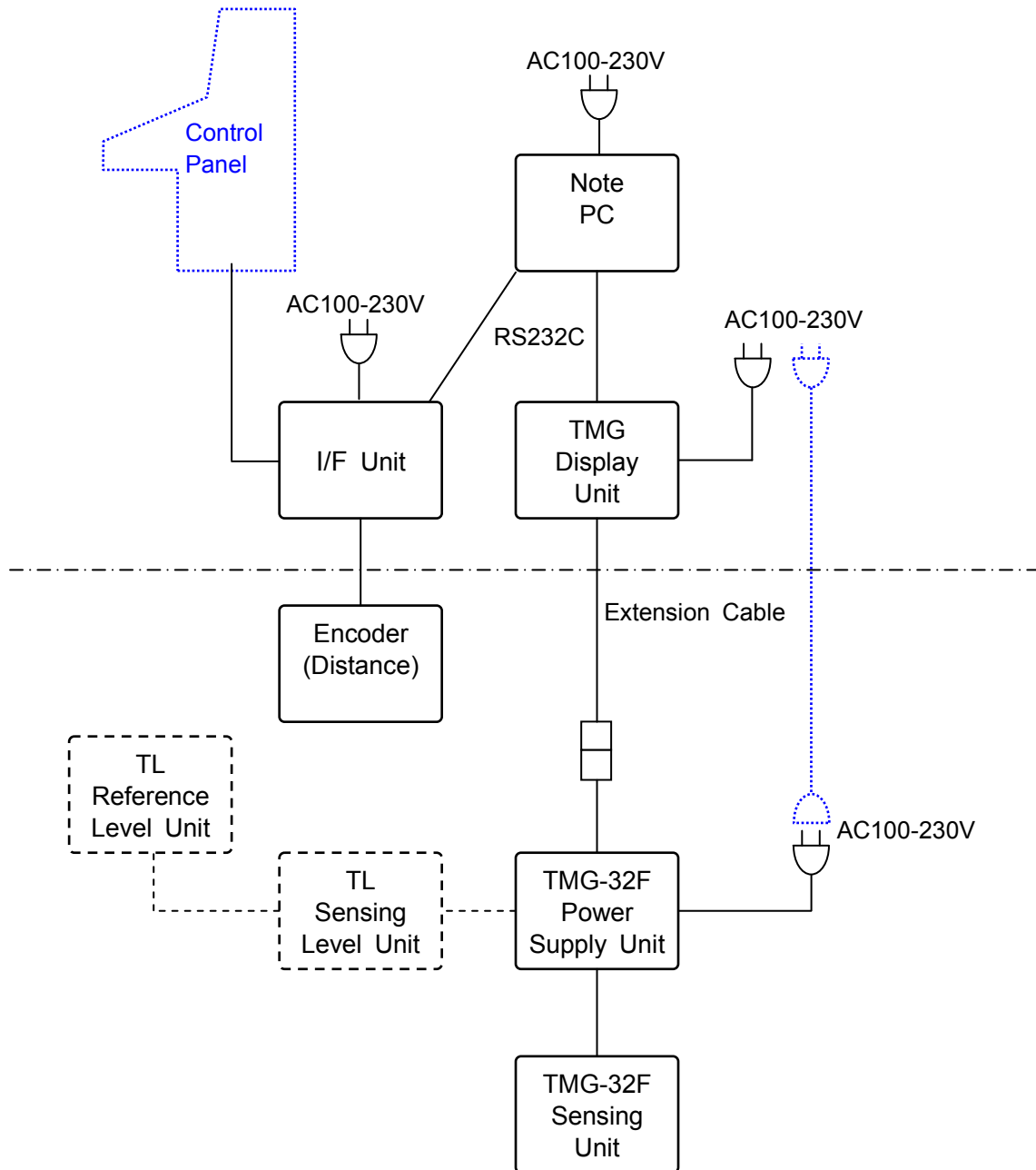
When known point " I_1 " is jacked distance " L " in direction " θ_1 ," I_2 can be obtained by calculation.

Similarly, " I_3 ," " I_4 " " I_n " can be obtained.



- The first known point I_1 must be obtained by surveying.
- In "Auto" mode, present position is automatically sought at every 10cm interval of excavation distance.
- In "Manual" mode, distance " L " intervals can be freely set.

2. System composition



2-1 Above ground unit component equipment (PN-S1)

No	Name	Dimension(mm)			Mass (kg)	Q'ty	Remarks
		W	D	H			
1	Computer	272	233	33.5	1.8	1	Note PC (TOUGHBOOK)
2	USB serial converter				0.1	1	
3	I/F unit	200	250	120	5	1	
4	Encoder	130	225	106	1.8	1	Distance meter
5	Cable				(m)		
	Computer ---- Display unit				5m	1	RS232C Cable
	Computer ---- RS232C Junction cable				5m	1	RS232C Cable
	Computer ---- I/F unit				4m	1	RS232C Cable
	I/F unit --- Central Control panel				5m	1	Signal Cable
	I/F unit --- Encoder				30m	1	
	I/F unit --- Encoder extension				30m		

2-2 Gyro unit component equipment (TMG-32F)

No	Name	Dimension(mm)			Mass (kg)	Q'ty	Remarks
		W	D	H			
1	Sensing unit	182	382	194	15	1	
2	Power supply unit	180	375	170	11	1	
3	Display unit	215	96	190	4	1	
4	RS422 Isolation Box	200	250	120	5	1	Included Cable(3), Cable(4)
5	Cable				(m)		
	Power supply unit ---- Sensing unit				10m	1	Cable(J1)
	Power supply unit ---- Display unit				3m	1	Cable(3)
	Power supply unit ---- AC power supply				3m	1	Cable(4P)
	Display unit ---- AC power supply				3m	1	Cable(4)
	Power supply unit ---- Display unit extension				50m		
	Power supply unit ---- Display unit extension				25m		

2-3 Level measuring unit component equipment (TL-300BP) (Option)

No	Name	Dimension(mm)			Mass (kg)	Q'ty	Remarks
		W	D	H			
1	Reference level unit	120	150	229	2.6	1	With a 3m hose
2	Sensing level unit	182	105	215	3.1	1	
3	Hose				(m)		
	Reference level unit ---- Sensing level unit				6m		
	Reference level unit ---- Sensing level unit				50m		
	Reference level unit ---- Sensing level uni				25m		
4	Pouring set						
	Pouring hose				10m	1	
	Conversion Coupler					1	
	Bucket					1	W478 D359 H220
	Spare Coupler					1set	
5	Cable						
	Sensing level unit ---- Power supply unit				10m	1	Level Cable

3. Hardware specifications

3-1 Gyro Unit (TMG-32F)

Measurable range	Azimuth	0 to 360 deg
	Pitch angle / Roll angle	±15 deg
Accuracy (*)	Azimuth	±0.05 deg secant latitude
	Azimuth settle point error	±0.3 deg secant latitude
	Pitch angle / Roll angle	±0.05 deg
Resolution	Azimuth	0.01 deg
	Pitch angle / Roll angle	0.01 deg
Settling time	Azimuth	Less than 3hours from power ON
	Pitch angle / Roll angle	Immediately after power ON
Output signal	Serial signal (RS-422 / RS-232C)	
Environmental	Housing	Waterproof (IP67 rating) (sensing unit) Splash proof (power supply unit)
	Operating temperature	-15 to 55°C (sensing unit) 0 to 40°C (non-sensing units)
	Humidity	95% RH or less
	Vibration	5~22.5Hz ±1mm 22.5~2000Hz ±10m/s ²
	Shock	100G 6ms
Power supply	100~230VAC, 50/60Hz, 120VA or less	
Battery backup time	90 minutes	

*Note:For accuracy, latitude should be set in 0.1 degree (Example:Tokyo 35.7 degrees latitude) units under condition of negligible vibration and temperature variation and temperature range, 15 to 35°C.

Note1) Install the Sensing unit in 1st frame (or 2nd frame).

Note2) The Sensing unit should be mounted on a strong support pad and fixed in a horizontal position.

Note3) Do not hit any connector or joints on sensor unit.

Note4) Always supply the power supply of a Gyro unit. (Commercial power etc.)

Note5) Please separate from a power line and wire.

Note6) Although an extended distance is usually to about 600m, transmission distance may become short under the influence of a noise.

3-3 Level Measuring Unit (TL-300BP)(Option)

Measurable Range	-50 to -6300mm (down : -) +50 to +6300mm (up : +)	
DP sensor accuracy (*1)	0.18%(F.S.)	
Temperature differential drift	DP sensor	±0.85mm/5°C
	Hose	-2.5mm/+5°C (hose length: 200m)
Roll angle/pitch angle correction (*2)	Correction with the inclinometer and mounting position(mm)	
Output Signal	Serial signal (RS422 / RS232C)	
Environmental resistance	Structure	Drip-proof
	Temperature	5 to 50°C
	Humidity	95% RH or less
Power consumption	1 VA max.	
Display contents	True level	0 to -6350mm (down: -) 0 to +6350mm (up: +)
	Level	±99999mm
Liquid to be water (*3)	Tap water (Supply water pressure more than 196kPa)	
Evaporation of water (*4)	Around 1.5mm/10days	

*1 Some shock to hose cause level error.

*2 Install the sensing level unit in the center of the tunnel excavator as far as possible.

*3 Well water can not be used.

*4 The amount of evaporation varies depending on temperature and humidity.

4. Measurement signal specifications

4-1 Measurement signals

Please prepare the signals following

Signal name	Signal form	Remarks
Main thrust jack stroke (mm)	4~20mA DC	Unnecessary using encoder
Intermediate thrust jack stroke (mm)	4~20mA DC	Unnecessary there is no IJS
Steering jack stroke right (top right) (mm)	4~20mA DC	front side
Steering jack stroke left (bottom right) (mm)	4~20mA DC	front side
Steering jack stroke top (bottom left) (mm)	4~20mA DC	front side, Unnecessary fixed type
Steering jack stroke bottom (top left) (mm)	4~20mA DC	front side, Unnecessary fixed type
cutter rotation	A contact	Necessary using Main / Intermediate thrust jack stroke

Note1) Analog signal (4-20mA DC), let an isolation amplifier go through by all means.

Note2) Contact signal is no voltage contact such as relays.

5. System specifications

5-1 Basic specifications

(1) Personal computer specification

-A setting position is ground.

(2) Data input

-Prepare for plan line data (X,Y,Z coordinate) beforehand.

-First, it is necessary to input position (X,Y,Z coordinate) of a excavator.

(3) Encoder (Distance meter)

-Install it in the upper part of the pipe after a excavating machine was contained in the under ground. (difference in outer diameter)

In addition, when there is unevenness to the pipe, you perform filling or flatten it.

-Please protect it with vinyl tape so that water does not hang in the connector part.

5-2 Screen display specifications



5.2.1 Nomenclature and functions

① Menu panel

- MEASUREMENT : Switches to the measurement screen.
- DATA HISTORY : Switches to the data history list.
- SURVEY INPUT : Displays the survey input screen.
- SETTINGS : Displays the settings screen.
- ALIGNMENT : Displays the alignment management screen.
- COMM. CHECK : Switches to the communication confirmation screen.

② Header panel

This is for performing measurement, displaying communication status and performing manual input operations (* only during manual measurement).

③ HRZ. DEVIATION

Displays the horizontal deviation of the head, articulated joint, tail, and target (front body center point when the gyro is installed on the front body) of the machine from the alignment.

④ AZIMUTH / STEERING ANGLE

Displays azimuth angle information, the deviation meter, the horizontal and vertical corrected azimuths.

⑤ PLANE

Displays the horizontal alignment, machine position and distance up to the next change point.

⑥ DEV TRACK (HRZ/VRT)

Displays the horizontal/vertical deviation history.

⑦ EXC. INFO / PITCHING / ROLLING / MACHINE INFO