

OUTLINE

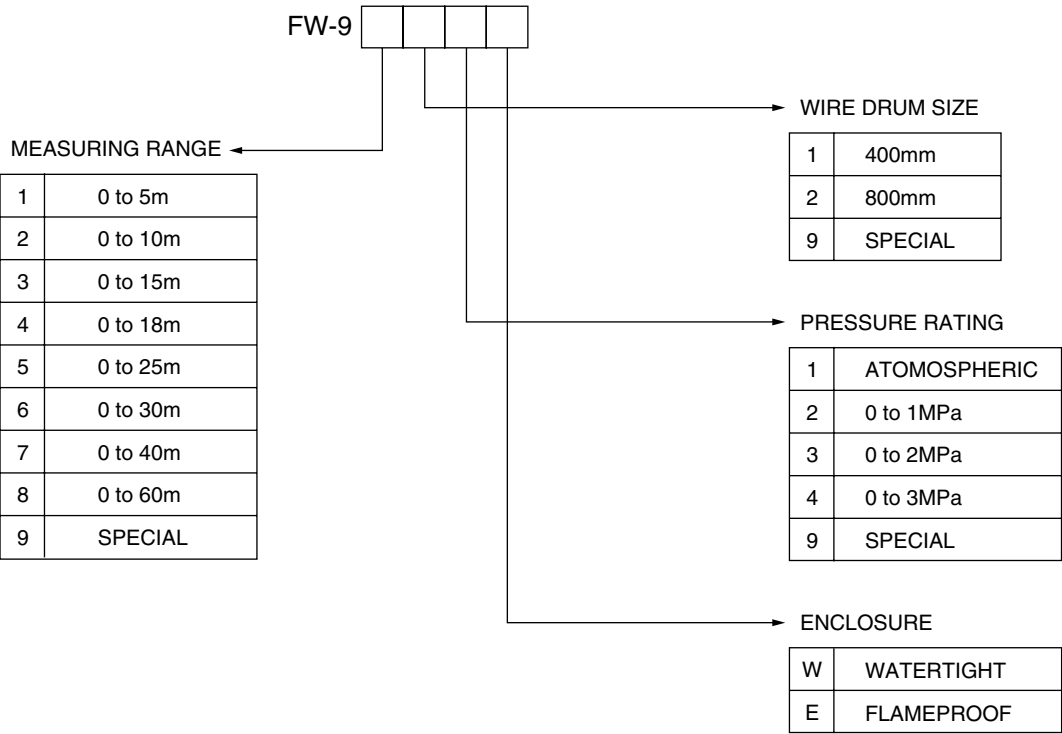
FW-9000 SUPER INTELLIGENT TANK GAUGE has been developed based on the technical and field application know-how obtained through Tokyo Keiso's long time activity in level measurement field. The mounted microprocessor for tank gauge offers high speed control /monitoring and remarkable improvement of function. In addition to normal measurement and transmission of liquid level and temperature, interface of two different liquids (i.e. Oil/Water), sludge height (or tank bottom height) and liquid density are measured and transmitted. Two different sizes of wire winding drum are ready to cover from small process tanks to large storage tanks of max. height of 60m. Thanks to the improved and strengthened data communication function, maximum 8 points 2-way contact transmission from control room to field and vice versa and digitalized data transmission of 1 point of field analog signal (4~20mA). It is possible to offer combined monitoring and control of tank related instruments, i.e. pumps, valves, actuator, etc.



FEATURES

- ❑ 16-bit microprocessor is used for main CPU. Super intelligent function is obtained.
- ❑ Full remote control and operation parameter setting thanks to strengthened data communication function
- ❑ Flameproof built-in keyboard using Hall elements enables operation parameter setting without opening housing cover during electrically active condition in hazardous area. This eliminates difficulties in handling of HHC (Hand Held Communicator).
- ❑ Very high accuracy thanks to high resolution stepping motor controlled by microprocessor.
- ❑ High reliability based on intelligent self-diagnosis function
- ❑ Perfect Non-contact tension detection system without any slipping rings. High durability and long term stability.
- ❑ **FW-9000** can be combined to existing Tokyo Keiso tank monitoring system due to wide variety of signal format adjustment.
- ❑ Optical signal transmitter unit is available.
- ❑ Max. 8 points contact status transmission between field and control room is possible for monitoring and controlling of other field instruments such as pumps, valves, actuators, etc.
- ❑ One point of 4~20 mA signal from field instrument, i.e. pressure transmitter can be connected to FW-9000 for serial coded pulse.
- ❑ 4~20 mA analog level output is additionally available for field control or high speed data sampling by HOST computer.
- ❑ High brightness type 3-line LED indication provides easy recognition in night or dark places with wide visible angle.

MODEL CODE



OPERATION PRINCIPLE

A very thin measuring wire B is wound onto measuring drum C having 400 mm/r or 800 mm/r precisely machined spiral groove.

Measuring drum C is connected to Driving shaft F through magnet coupling D, E and rotates forward and backward according to movement of gear-down unit J, K and stepping motor N. A worm gear J, which is located on the same axis as Driving shaft F, is connected to Driving shaft F through Spring I.

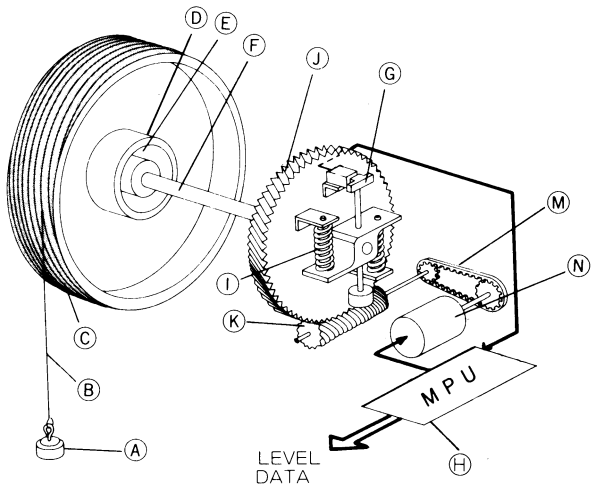
By this arrangement, tension onto Measuring wire B can be precisely detected by measuring distortion of Spring I by Balancer G. A Displacer A, of which density is higher than that of liquid to be measured, is connected to one end of Measuring wire B. The weight of Displacer A always gives downforce tension to Driving shaft F. In normal measurement condition, Stepping motor N is controlled by signal from Balancer G to give Measuring wire B a slightly less and constant tension than the weight of Displacer A. In this way, Displacer A always follows liquid surface with stable draft line.

Thus, rotating angle of Measuring drum C which corresponds to length of unwound Measuring wire B represents height of liquid in tank.

By adjusting the control level of tension T onto measuring wire B, interface of two liquids having different density can also be measured. Also, by sinking displacer into liquid and measuring the tension T onto measuring wire B, the liquid density can be detected and measured.

In FW-9000, signal from Balancer G is fully digitalized. Stepping motor N, having high resolution, is controlled by Microprocessor unit H. This digitalized servo operation system offers high liquid following capability and stability in operation compared to existing analog control method.

The angle of Measuring drum rotation is obtained from the number of steps of Stepping Motor N. This remarkably improves the resolution of liquid level measurement of 0.1 mm.



STANDARD SPECIFICATION

Mechanical specification

- Liquid level detection : Digital controlled electric servo balancing type
(In combination with small size displacer, measuring wire and wire drum)
- Displacer : Dia. $\phi 140$, $\phi 110$, $\phi 90$, $\phi 70$, $\phi 50$, $\phi 30$
Mass 250g (Standard)
Material SUS304, SUS316, SUS316L, Hastelloy, PTFE, others
- Measuring wire : Standard SUS316 ($\phi 0.2$, single)
Option* Hastelloy ($\phi 0.3$, single)
PTFE covered
($\phi 0.6$, stranded core)
- * : Small type wire drum may be unable to be used in case of measuring wires other than standard ($\phi 0.2$) even in short measuring range. Consult factory for details.
- Wire drum size : 400 mm/r (FW-9□1□□)
800 mm/r (FW-9□2□□)
- Tension detection : By perfect Non-contact magnetic field response type Hall element sensor
- Driving motor : High resolution type stepping motor
- Drive shaft sealing : Strong magnet coupling
- Measuring range

0~5m	*	(FW-91□□□)
0~10m	*	(FW-92□□□)
0~15m	*	(FW-93□□□)
0~18m	*	(FW-94□□□)
0~25m	*	(FW-95□□□)
0~30m	*	(FW-96□□□)
0~40m	**	(FW-97□□□)
0~60m	**	(FW-98□□□)
Special	**	(FW-99□□□)
- * : Small size drum (400 mm/r, FW-9□1□□) or Large size drum (800 mm/r, FW-9□2□□) available.
- ** : Large size drum (800 mm/r, FW-9□2□□) only available.
- Temp. range : Liquid -200 ~ +300°C
Ambient -20 ~ +60°C
(Temperature of main body)
- Press. range :

Prees.	Op. press. (MPa)	MODEL	Material of pressurized part
Low press.	ATM	FW-9□□1□	AC2A, SCS13, SCS14
High press.	0 ~ 1	FW-9□□2□	SCS13, SCS14
	0 ~ 2	FW-9□□3□	SCS13, SCS14
	0 ~ 3	FW-9□□4□	SCS13, SCS14

- Liquid following speed : Approx. 2100mm/min.

● Accuracy (Indication and digital output) :

1) Liquid level measurement

$$\text{Standard} \quad \pm(0.1 + \frac{20}{\rho \cdot A} + 0.06L) \text{ mm}$$

$$\text{Fine} \quad \pm(0.1 + \frac{20}{\rho \cdot A} + 0.03L) \text{ mm}$$

ρ : Density of liquid to be measured

A : Cross section area of displacer (cm^2)

L : Measuring range (m)

Example : In case of density (ρ) 0.8g/cm³ and with $\phi 90$ displacer

$$\text{Standard} \quad : \pm(0.5 + 0.06L) \text{ mm}$$

$$\text{Fine} \quad : \pm(0.5 + 0.03L) \text{ mm}$$

2) Interface measurement

In case of density difference of 0.2

$$\text{Standard} \quad \pm(1.7 + 0.06L) \text{ mm}$$

$$\text{Fine} \quad \pm(1.7 + 0.03L) \text{ mm}$$

3) Density measurement

$$\pm 0.01 \text{ g/cm}^3$$

● Process connection : Through flange

Flange size 3", 4", 5", 6" or others

(Horizontal movement of displacer for tank height to be considered for decision of flange size)

Flange reating JIS5K/10K/20K/30KRF,
ANSI #150/300,
JPI #150/300, Others

- Displacer guiding : Standard : By stand pipe
Option : Non guide*
By guide wire*
Special*

* : Specified accuracy not applicable. Consult factory for further details.

● Displacer horizontal movement :

For small size drum

(400 mm/r, FW-9□1□□)

for 1 m liquid level movement

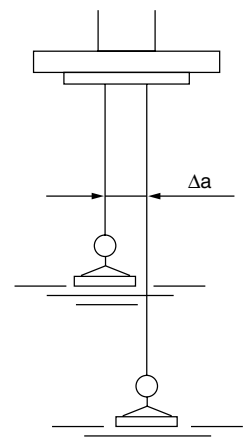
$$\Delta a = 2.5 \text{ mm}, 1.9 \text{ mm}, 1.4 \text{ mm}$$

For large size drum

(800 mm/r, FW-9□2□□)

for 1 m liquid level movement

$$\Delta a = 1.25 \text{ mm}, 0.95 \text{ mm}, 0.7 \text{ mm}$$



- Construction : Watertight (FW-9□□□W) or
Flameproof ExdIICT6
(RIIS certification No. TC14583)

ELECTRONICS AND SOFTWARE SPECIFICATION

● Signal : I/O

1) External input

Besides normal level measurement by FW-9000, the following external devices can be connected to FW-9000. Data from such external instruments are digitalized and transferred to control room through serial data signal:

a. Temperature sensors

(Temperature conversion range :-60 to +350°C)

- 1) Pt100Ω spot temp. sensor (TS type)
- 2) Average temp. sensor (ATM type)
- 3) Multi-spot average temp. sensor (ATS type)

b. Contacts

Dry contacts, max, 8 points

c. Analog signal

4 ~ 20mA, 1 point (Ri250Ω)

2) External output :

a. Serial data output for remote control room receiver (Electric or optical pulse, Refer to ◆ OUTPUT FORMAT for further details.)

b. Serial data coded output for tank side receiver (Electric)

c. Contact output (Open collector, 8 points)

Control signal from remote control room or set alarm parameter can be freely assigned by programming.

d. Analog output (Option)

DC4 ~ 20mA × 2 (Level and Temperature)

● Alarm monitoring :

The following 16 alarm points can be programmed:

- | | |
|---|----------|
| 1) Liquid surface level alarm | 4 points |
| 2) Level alarm other than surface
(i.e.interface) | 4 points |
| 3) Displacer position alarm (Hoisting) | 4 points |
| 4) Liquid temp. | 2 points |
| 5) Externally input analog signal alarm
(4 ~ 20mA) | 2 points |

In case above parameters come into alarm area :

- 1) Specified alarm message is indicated on LED.
- 2) Specified bit of serial output is "ON".
- 3) Assigned open collector output is actuated.

● Operation parameter setting :

All operation parameters can be set by the following procedures:

- 1) Dialogue type setting by Built-in flameproof keyboard
(Setting and control are possible without opening housing cover in hazardous area during operation. Password system is provided for security purposes.)
- 2) Through 2-way data communication from remote control room.
- 3) Dialogue type setting by Built-in flameproof keyboard provided on tank side receiver. (DIR-120)

● Contents of control :

Specification for measurement (Liquid surface, Interface, Density), hoist, stop, etc.

● Contents of parameter setting :

Hoisting (Maximum, Minimum), Adjustment of level indication, Displacer operation PID mode, Alarm set point / Reset span / Alarm action / Relay allotment (Level, Temperature etc. total 16 points), Connection thermometer classification, Point changing of temperature element, Type of external input, etc.

● Self-diagnosis function

Indication of status LED	Diagnosis
E1	AC power supply not in order
E2	Wire under tension
E3	Wire over tension
E4	Balancer signal not in order
E5	—
E6	Temp. element breakage
E7	Temp. detector over ranged
E8	Internal counter error
E9	4 ~ 20mA input over ranged

● Local indication : Red colour, high brightness 3 line LED

Line 1 : 4 digit, 7 segment LED

Temp. indication with 0.1°C resolution

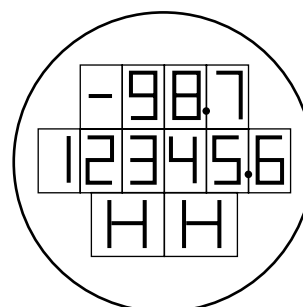
Line 2 : 6 digit, 7 segment LED

Level indication with 0.1mm resolution or

Density indication in 5 digit

Line 3 : 2 digit, 14 segment LED

Operation status, alarm status and /or applicable errorcode



- Cable entry : Standard G(=PF) or NPT female
(Flameproof cable glands available as option)
Size 3 × 3/4 B + 1 × 1B

- Cable termination : Plug type terminal connection

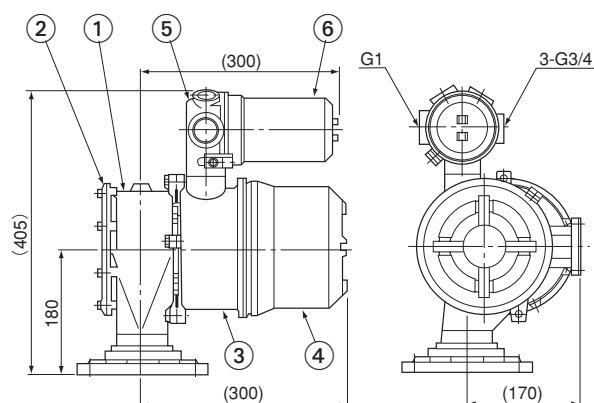
- Power supply : AC100, 110, 115, 120, 200, 220, 230, 240V,
50/60Hz

- Power consumption : Max. 50VA

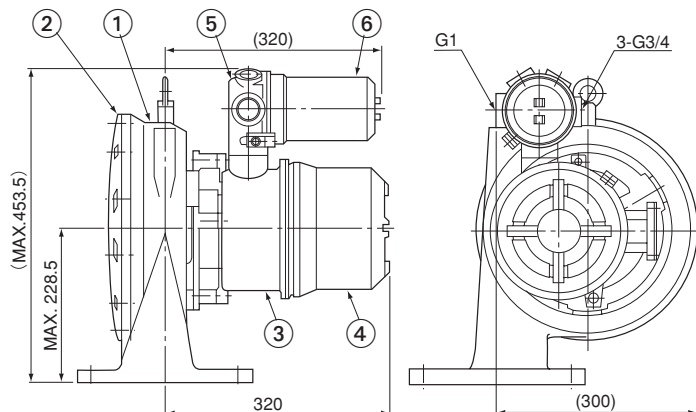
- Arrester : Provided as standard

DIMENSION AND WEIGHT

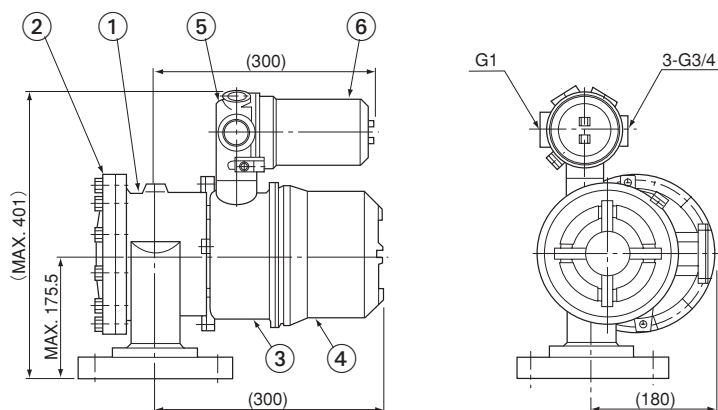
Small size drum, Low pressure type



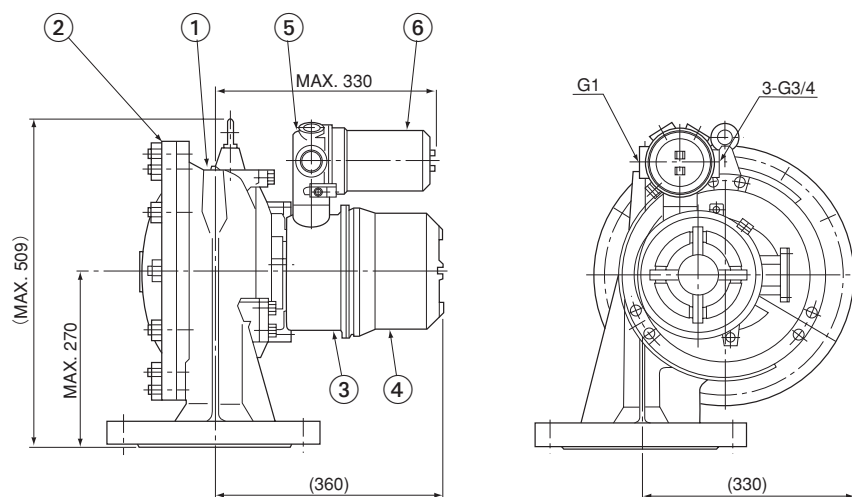
Large size drum, Low pressure type



Small size drum, High pressure type



Large size drum, High pressure type

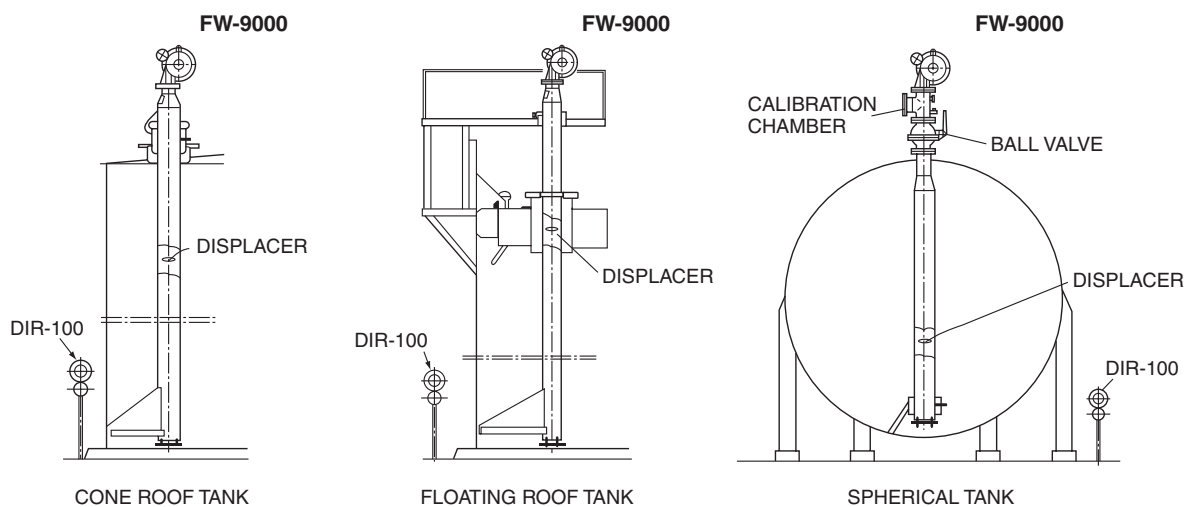


No.	Description
1	Wire drum compartment
2	Drum compartment cover
3	Electric compartment
4	Electric compartment cover
5	Terminal box
6	Terminal box cover

Wire drum compartment material	Wire drum size	
	Small	Large
AC2A	15kg	20kg
SCS13/14	28kg	73kg

INSTALLATION

Standard installation figures onto CRT, FRT and Spherical tanks by using stand pipe are shown below :



OUTPUT FORMAT

The following different output formats for main port are available for FW-9000 SUPER INTELLIGENT TANK GAUGE:

1) HIGH SPEED SERIAL CODED PULSE

Transmission type	2 way-2 wire serial data transmission
Baud rate	2400 bps
Wiring	Bus line wiring (16 tanks/BUS)
Distance	Max.5 km (Subject to 20 /one w ay and inter-core ca- pacitance 0.5 μ F/m)

2) COMPATIBLE FORMATS FOR TOKYO KEISO'S EXISTING TANK DATE TRANSMITTERS

- DM-II type
- DB-M type
- DM type
- FW-7000 series

3) OPTICAL PULSE OUTPUT

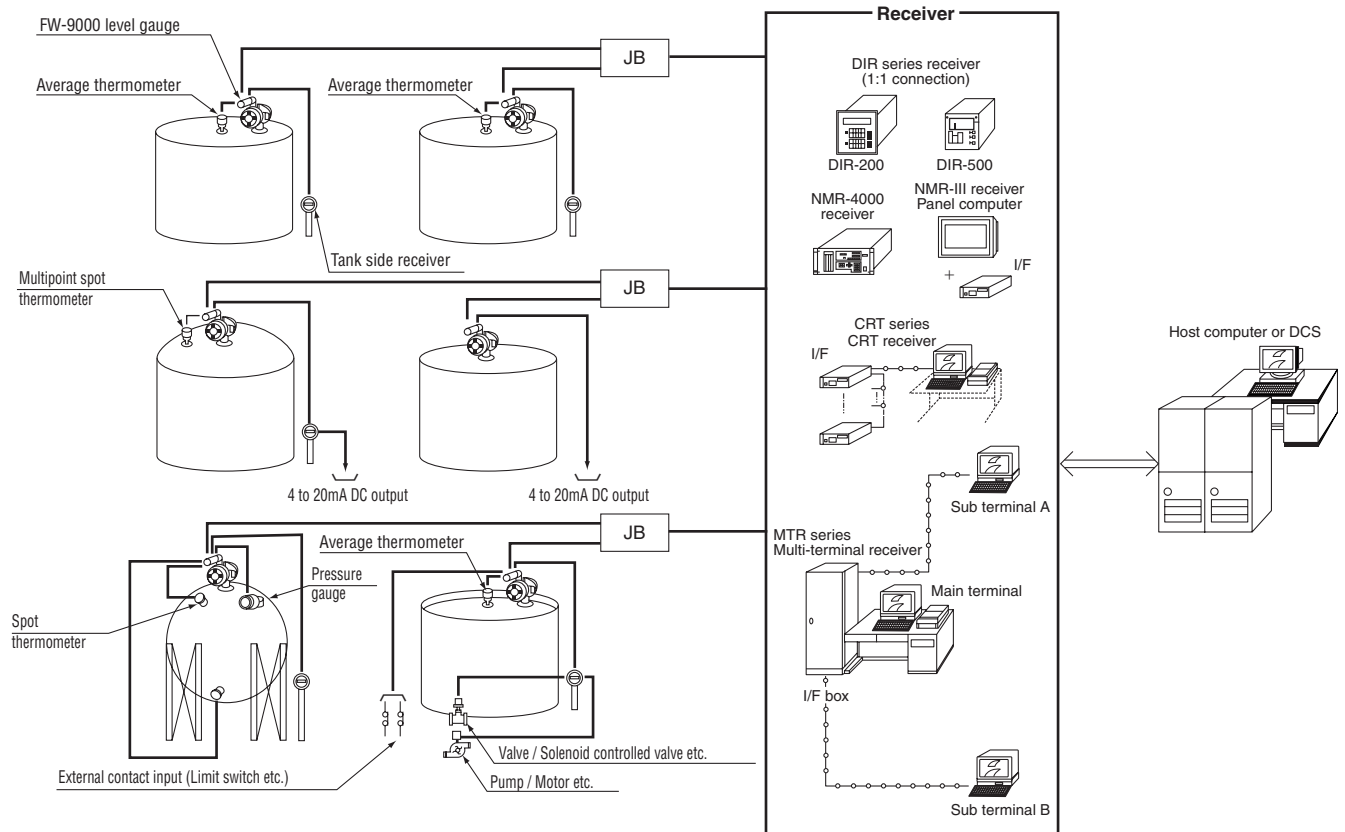
- Optical pulse output for Tokyo Keiso's Ø-CATAMS
- Optical fiber tank gauging system

4) SERIOUS OUTPUT, OTHERS

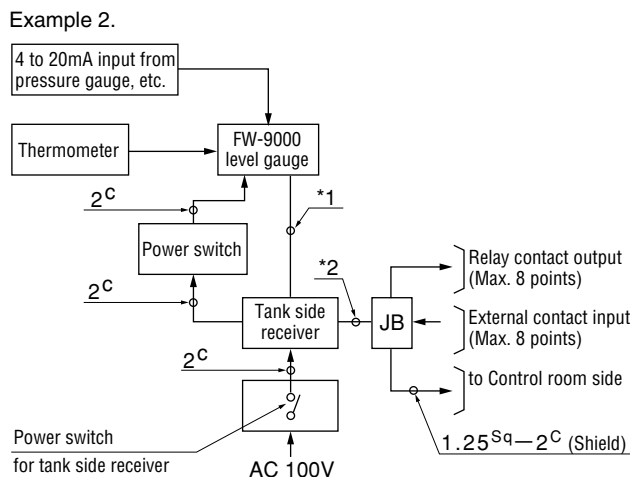
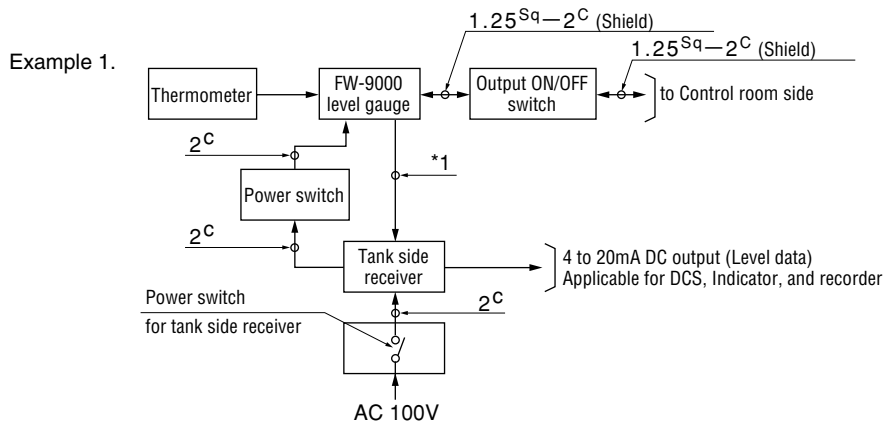
- RS-485 MODBUS
 - Transmission type : RS-485 (2-wire)
 - Baud rate : 2400/4800/9600bps
 - Distance : 1.2km
- TRL/2 compatible
 - *Field bus communication of Saab Rosemount
- V1 compatible
 - *Corresponding to E+H company

EXAMPLE OF CONFIGURATION

1) Example of system configuration instruments



2) Local configuration / Wiring system figure



*1 : 1.25^{Sq}-n^C (Shield)
 n : Total of following
 For signal to control room 2^C
 For signal to tank side receiver 2^C
 For external contact inputs (2+point)^C
 For operation and control of DIR-120 6^C
 (In case of DIR-110, 6^C is unnecessary.)

*2 : 1.25^{Sq}-m^C (Shield)
 m : Total of following
 For signal to control room 2^C
 For relay contact output (2+point)^C
 For external contact inputs (2+point)^C

ORDERING FORM

TANK SPECIFICATION	
LIQUID NAME	
DENSITY	
VISCOSITY	mPa's
LIQUID TEMP.	°C
PRESSURE	MPa
TANK TYPE	☐ CONE ROOF ☐ FLOATING ROOF ☐ SPHERICAL ☐ ()
MEASURING RANGE	mm
MAX. LEVEL CHANGE SPEED	mm/min.
MODEL CODE	FW-9 ☐ ☐ ☐ ☐
PROCESS CONNECTION	
FLANGE SIZE	☐ 150mm (6") ☐ 125mm (5") ☐ 100mm (4") ☐ 80mm (3") ☐ Others ()
FLANGE RATING	☐ JIS 5K RF ☐ JIS 10K RF ☐ JPI #150 ☐ ANSI#150 ☐ JIS 20K RF ☐ ANSI#300 ☐ JIS30KRF ☐ OTHERS ()
DISPLACER GUIDING	☐ NON-GUIDE ☐ STAND PIPE ☐ GUIDE WIRE ☐ SPECIAL ()
MATERIAL	
DRUM COMPARTMENT	☐ AC2A ☐ SCS13 ☐ SCS14 ☐ Others ()
DISPLACER	☐ SUS304 ☐ SUS316 ☐ SUS316L ☐ HASTELLOY ☐ TEFLON ☐ OTHERS ()
MEASURING WIRE	☐ SUS316 ☐ HASTELLOY ☐ TEFLON COVERED ☐ OTHERS ()
OUTPUT AND INPUT	
A. REMOTE OUTPUT*	☐ WITHOUT DIGITAL OUTPUT ☐ FW-9000 (STANDARD) ☐ DM-II ☐ DM ☐ DB-M ☐ FW-7000 ☐ FW-9000 optical pulse (std.) ☐ RS-485 MODBUS ☐ TRL/2 ☐ TV1
B. 4 TO 20mA OUTPUT*	☐ NOT REQUIRED ☐ REQUIRED (☐ LEVEL, ☐ TEMPERATURE) ☐ REQUIRED (HART) (☐ LEVEL, ☐ TEMPERATURE)
C. CONNECTED THERMOMETER*	☐ NOT REQUIRED ☐ SPOT TYPE (TS) ☐ AVERAGE TYPE (ATM or ATS)
EXTERNAL CONTACT INPUT	☐ NOT REQUIRED ☐ REQUIRED (POINTS)
EXTERNAL CONTACT OUTPUT	☐ NOT REQUIRED ☐ REQUIRED (POINTS)
EXTERNAL ANALOG OUTPUT(4 TO 20mA DC)	☐ NOT REQUIRED ☐ REQUIRED
POWER SUPPLY	
VOLTAGE	☐ AC 100V ☐ AC 110V ☐ AC 115V ☐ AC 200V ☐ AC 220V ☐ AC 240V ☐ Others ()
CABLE ENTRY	☐ G (=PF)FEMALE ☐ NPT FEMALE ☐ Others ()
CABLE GLAND	☐ CUSTOMER'S SCOPE ☐ TOKYO KEISO SCOPE
SPECIAL MEASUREMENT FUNCTION	
INTERFACE MEASUREMENT	☐ NOT REQUIRED ☐ REQUIRED (DENSITY : UPPER LOWER)
DENSITY MEASUREMENT	☐ NOT REQUIRED ☐ REQUIRED
APPLICATION	☐ GENERAL ☐ CUSTODY
CONSTRUCTION	☐ GENERAL ☐ SANITARY FINISH ☐ LOW AMB TEMP ☐ SPECIAL ()
ACCESSORIES	
CALIBRATION CHAMBER	☐ NOT REQUIRED ☐ TOKYO KEISO SCOPE ☐ CUSTOMER'S SCORE
ISOLATION BALL VALVE	☐ NOT REQUIRED ☐ TOKYO KEISO SCOPE ☐ CUSTOMER'S SCORE
LOCAL POWER SWITCH	☐ NOT REQUIRED ☐ TOKYO KEISO SCOPE ☐ CUSTOMER'S SCORE

*: Up to two instruments are available.

* Specification is subject to change without notice.


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