

6000 Servo Tank Gauge

Intelligent tank gauge with high accuracy liquid level, interface level, density & density profile measurements for bulk liquid storage applications

Varec[®]



FuelsManager[®]
Compatibility



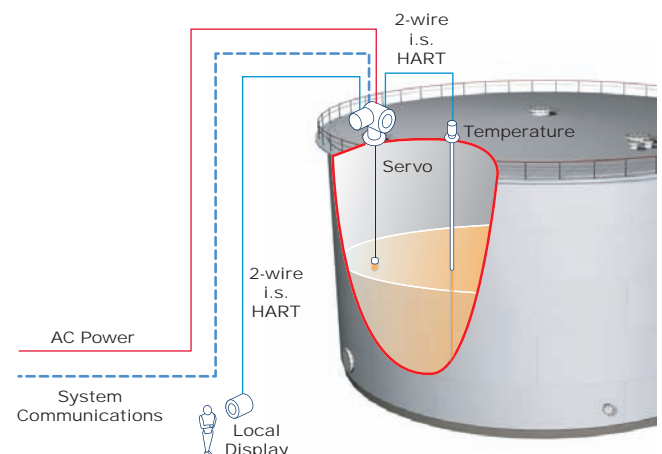
Benefits

- Measures liquid to an accuracy of ± 0.7 mm
- Measures two clear interface levels and specific gravity of up to three liquid phases
- Profiling of liquid density throughout the tank (tank profile) and upper layer (I/F profile)
- Wetted parts are completely separated from the electronic circuit
- Tank top mounting with 3" flange weighing only 12 kg (aluminum version)
- Wide range of output signals, including RS-485 (MODBUS & Rackbus), WM550, Mark Space, Enraf BPM and HART[®] protocol
- Material and pressure rating of the wetted parts can be selected according to the application
- Suitable for atmospheric and high pressure applications up to 25 bar
- Maintenance prediction of the instrument
- Direct connection of spot or average temperature probes
- Built-in calibration window capabilities – daily alarm/event file logged to the hard disk
- FM & CSA approved for use in hazardous areas
- NMI Approved for custody transfer applications

Application

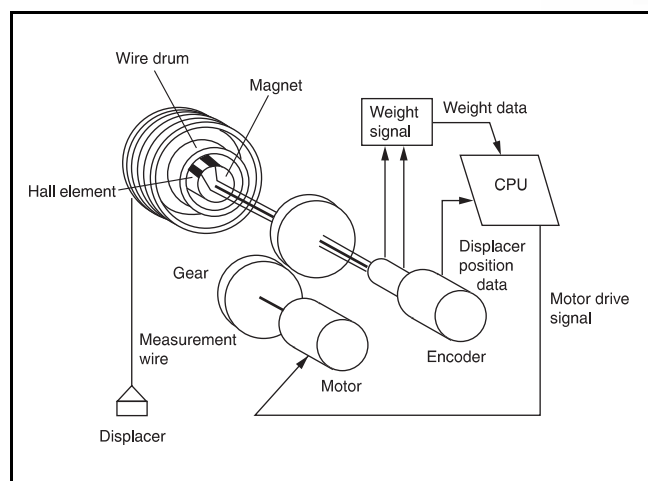
The 6000 Servo Tank Gauge (STG) is designed for high accuracy measurement in bulk liquid storage applications. Typical areas of application include:

- Oil (fuels)
- LPG/LNG
- Chemicals
- Water / chemical interface measurement
- Foods, liquid food.



Function and System Design

The 6000 STG is an intelligent tank gauge for high accuracy liquid level measurement employing the latest microprocessor technology. In addition to level measurement, the 6000 STG can determine the interfaces between three liquids, specific gravity of these liquids and tank bottom. To enable accurate volume calculation the 6000 STG will accept an input from either an average temperature probe 453x ATC series of temperature devices (via twisted pair cables, HART protocol) or via spot temperature element (via 3-wire Pt. 100 RTD signal). Once installed, all calibration and operating functions can be made via the user friendly Matrix program and touch sensitive keypad. Tank side monitoring and operation can be performed by the 4560 SGM.



Direct Torque Detection

Measuring Principle

The 6000 STG tank gauging system is based on the principle of displacement measurement. A small displacer is accurately positioned in the liquid medium using a servo motor. The displacer is suspended on a measuring wire that is wound onto a finely grooved drum housing within the instrument.

The drum is driven via coupling magnets, which are completely separated by the drum housing. Outer magnets are connected to the wire drum whilst the inner magnets are connected to the drive motor. As the magnets turn, the magnetic attraction causes the outer magnets to turn as well, resulting in turning the entire drum assembly. The weight of the displacer on the wire creates a torque on the outer magnets generating the change of magnetic flux. These changes generated between the drum assembly are detected by a unique electromagnetic transducer on the inner magnet. The drive motor is actuated to balance the voltage generated by the variations of magnetic flux to equal the reference voltage defined by the operating command.

When the displacer is lowered and touches the liquid, the weight of the displacer is reduced because of the buoyant force of the liquid. As a result, the torque in the

magnetic coupling is changed and this change is measured by 5 sets of Hall sensor chips (patented) which are temperature compensated. The signal, an indication of the position of the displacer, is sent to the motor control circuit. As the liquid level rises and falls, the position of the displacer is adjusted by the drive motor. The rotation of the wire drum is precisely evaluated to determine the level value, which is accurate to an outstanding ± 0.7 mm.

Maintenance Prediction

6000 STG will provide advance warning of required maintenance, such as replacement of worn wire, etc. The operating life span of electrical and mechanical parts of the 6000 STG are factory set within the instruments memory. This information is checked with the built-in clock and then compared, and registered in the instrument.

Automatic Displacer Weight Compensation

The displacer can be checked for buildup or corrosion by comparing the measured weight of the displacer in the air with the pre-programmed displacer weight. The 6000 STG can be set to perform periodical checks for the displacer weight; any deviations in the weight will then be corrected and an alarm or memo initiated.

Automatic Compensation of Wire Length

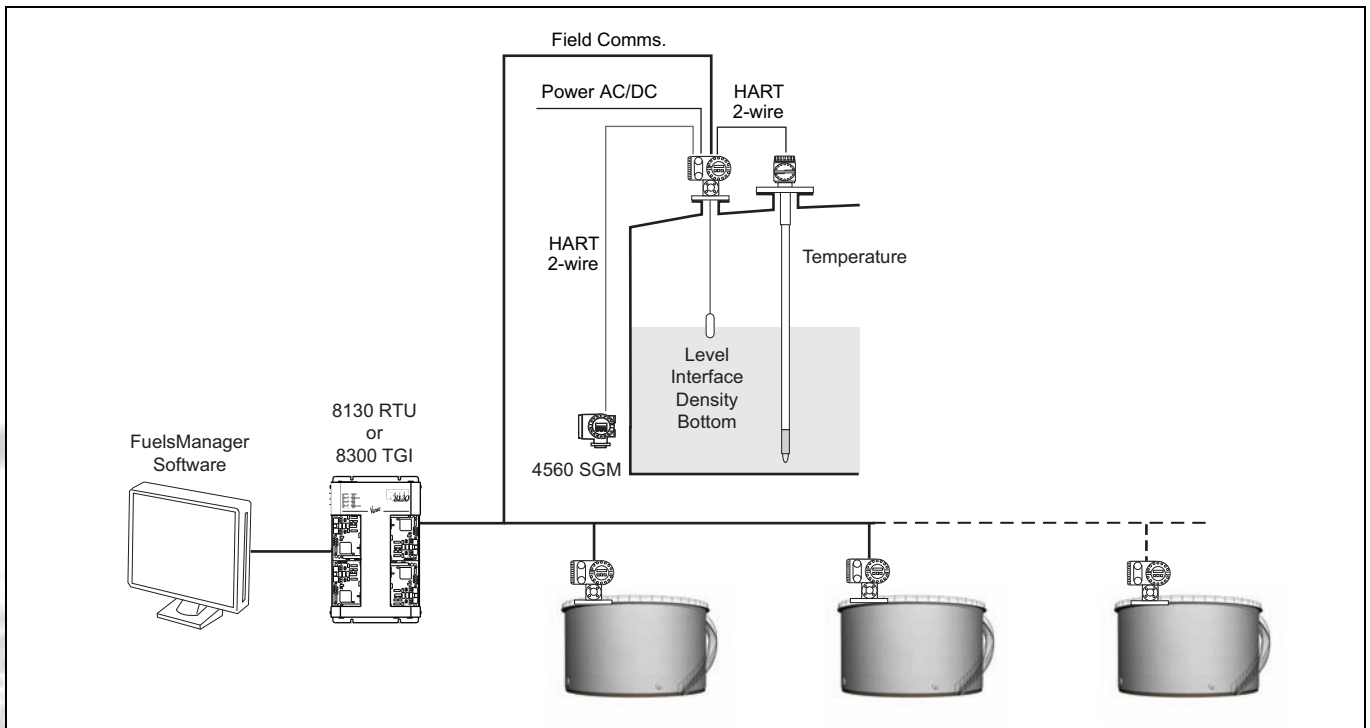
When the displacer is moved from the level position to the reference point (mechanical stop within the instrument), the calibration can be checked. If there is any deviation outside the tolerance, the instrument will emit an alarm. If the deviation is within the tolerance (set by the customer), an automatic recalibration will be done. This function can be working manually or automatically in pre-set time intervals.

Field Communications

The 6000 STG has a variety of communication protocols that enables compatibility and connectability in the following tank gauging systems:

- EIA-485 MODBUS®
- RS-485 Rackbus
- HART
- Varec Mark / Space
- Whessoematic 550 (WM550)
- Enraf BPM

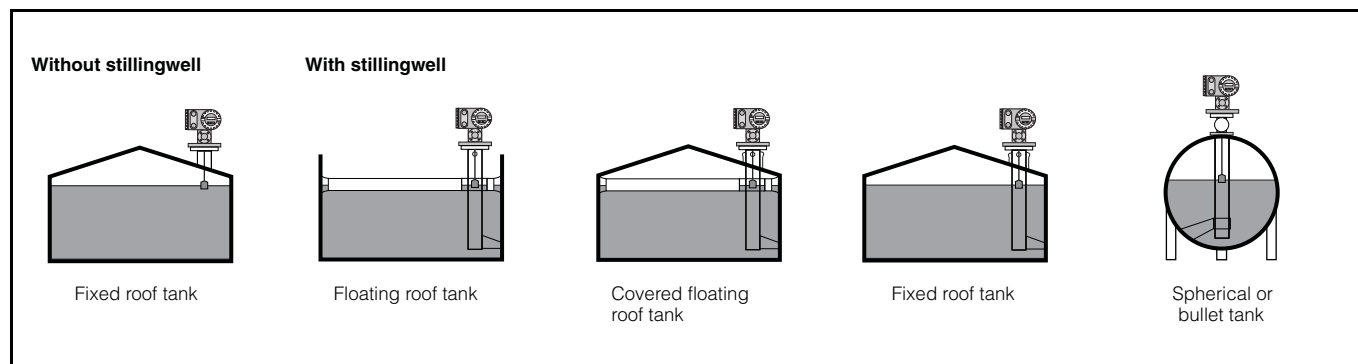
Control room interrogation and operation are facilitated by protocol conversion to various output by the 8130 Remote Terminal Unit (RTU). The 8130 RTU is ideal for large volume tank farms, integrating data from up to 160 tank sensors, transmitting to a FuelsManager host system via 4 separate protocol converter modules.



Example system diagram for Mark/Space and MODBUS communications

Installation Guidelines

The following information should be used as a guide only; please refer to the Operation and Maintenance Manual for complete installation instructions.

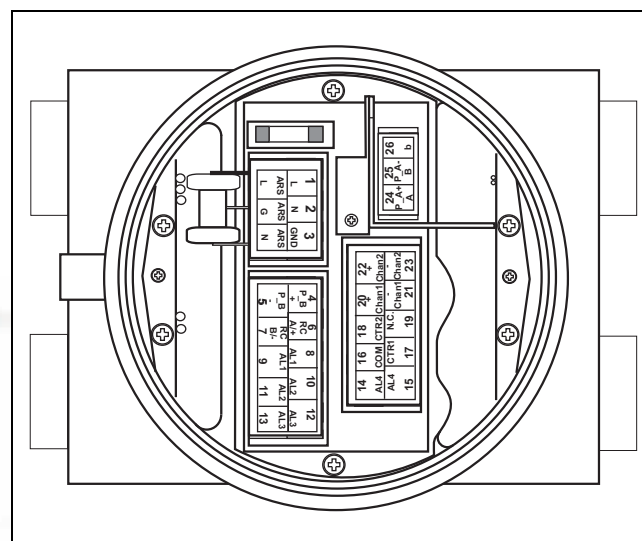


Example Installations

Input and Output

Terminal Connections

#	Function	EIA-485 Modbus Rackbus HART Enraf BPM	Mark/Space	WM 550
1	L	Power Supply AC 85 to 264 V 50/60 Hz or DC 20 to 62 V AC 20 to 55 V		
ARS	L			
2	N			
ARS	N			
3	G			
ARS	G			
4	+	Port B+ & B- Non IS HART (Exd) to the 4560 SGM and other devices		Local HART
5	-			
6	+	Digital Output Rackbus RS- 485 or Remote HART		
7	-			
8	+	Alarm contact		
9	-			
10	+	Alarm contact		
11	-			
12	+	Alarm contact		
13	-			
14	+	Alarm contact		
15	-			
16	Com	Operation contact input		
17	Hoist			
18	Stop			
19				
20	+	4-20 mA Channel 1	Mark/Space	WM 550 Channel 1
21	-			
22	+	4-20 mA Channel 2	Mark	WM 550 Channel 2
23	-		Space	
24	A+	Local (slave) HART (Exd or Ex ia) to 453x ATC or Pt100 3-wire temperature devices)		
25	A-			
26	b			



6000 STG Terminal Enclosure

Input Power

High voltage type: 85 ... 264 VAC 50/60 Hz

Low voltage type: 20 ... 60 VDC / 20 ... 55 VAC 50/60Hz

Note! Allowable voltage supply is specifically stated depending on each Ex approval. Refer to the designated certification.

HART Input for Local Deveices

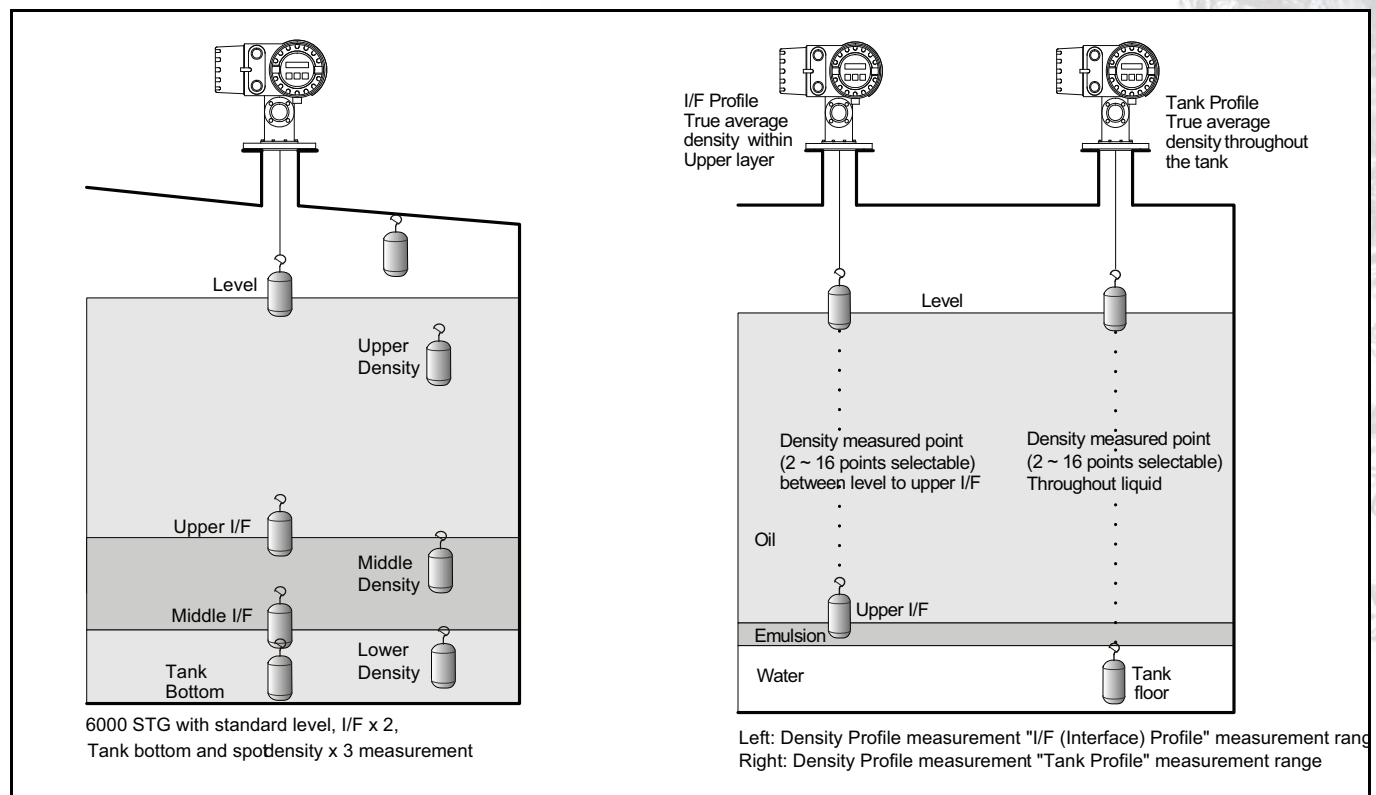
Multi drop local HART® protocol max. 4 devices

Output Parameters

Note! The following are output parameters remarks!

1. Upper I/F output value can be either selected from the 6000 STG's own displacer measurement or Water Bottom measured value via the 4539 ATC.
2. A single point density measurement within the upper layer liquid in the tank. The measurement position is configured to 150mm below the liquid surface at default.
3. A single point density measurement within the middle layer liquid in the tank. The measurement position is configured to 150mm below the upper interface level at default.
4. A single point density measurement within the lower layer liquid in the tank. The measurement position is configured to 150mm below the middle interface at default.
5. The value of this "Average Density" is based on the calculation after performing the Density Profile operation at the 6000 STG.
6. All of the selected number of density measured values from 1 - 16 points can be transmitted.

Parameter	MODBUS	RACKBUS	HART	WM550	ENRAF	M/S
Level	Yes	Yes	Yes	Yes	Yes	Yes
Temperature (product)	Yes	Yes	Yes	Yes	Yes	Yes
Vapor temperature	Yes	Yes	Yes	Yes	–	–
Upper I/F (water level)	Yes	Yes	Yes	Yes	Yes	–
Middle I/F	Yes	Yes	Yes	–	–	–
Upper density *2	Yes	Yes	Yes	Yes	–	–
Middle density *3	Yes	Yes	Yes	–	–	–
Lower density*4	Yes	Yes	Yes	–	–	–
Average density*5	Yes	Yes	–	Yes	–	–
1–16 Points individual density *6	Yes	Yes	–	–	–	–
Multi-element temperature	Yes	Yes	Yes	Yes	–	–
HART device input (device1)	Yes	Yes	Yes	Yes	–	–
HART device input (device2)	Yes	Yes	Yes	Yes	–	–
Alarm/ discrete value	Yes	Yes	Yes	Yes	Yes	–



Measurement terminology

Configuration

The 6000 STG's illuminated liquid crystal display provides all configuration and operation capabilities. Using only three keys, all parameters can be selected and modified. For example, (but not limited to):

- Operation – level; interface; spot and profile density, water dip and tank bottom
- Current output
- Relay output
- Custody transfer
- Maintenance prediction
- Calibration
- Measurement unit and decimal point

Operational Security

A software access code or hardware switch can be enabled to prevent programming changes from the 6000 STG's touch control keypad or a remote system.

Maintenance Record

The maintenance record can be accessed via the instrument and will provide information of alarm data (e.g. date, time, alarm type). A memo function also allows the user/service engineer to enter maintenance data manually.

Accessories

Spare Parts and Maintenance Kits

The 6000 STG is designed and manufactured to provide accurate and reliable operation without an intensive maintenance schedule.

Varec can provide spare parts, maintenance kits, preventive maintenance advice, training and warranties. Please consult your Installation and Maintenance Manual or a representative for more details.

Order Code	Description
C6501-6	24" Cal. Chamber 6" stilling well
C6501-6S	Stainless Steel 24" Calibration Chamber 6" stilling well
C6501-8	24" Cal. Chamber 8" stilling well
C6501-8S	Stainless Steel 24" Calibration Chamber 8" stilling well
C6501-10	24" Cal. Chamber 10" stilling well
C6501-8S	Stainless Steel 24" Calibration Chamber 10" stilling well
F6501-26	Mounting Plate 2" to 6"
F6501-26S	Stainless Steel Flange adapter mounting plate 2" to 6"
F6501-36	Mounting Plate 3" to 6"
F6501-36S	Stainless Steel Flange adapter mounting plate 3" to 6"
F6501-38	Mounting Plate 3" to 8"
F6501-38S	Stainless Steel Flange adapter mounting plate 3" to 8"
F6501-46	Mounting Plate 4" to 6"
F6501-46S	Stainless Steel Flange adapter mounting plate 4" to 6"
F6501-48	Mounting Plate 4" to 8"
F6501-48S	Stainless Steel Flange adapter mounting plate 4" to 8"

4560 Servo Gauge Monitor

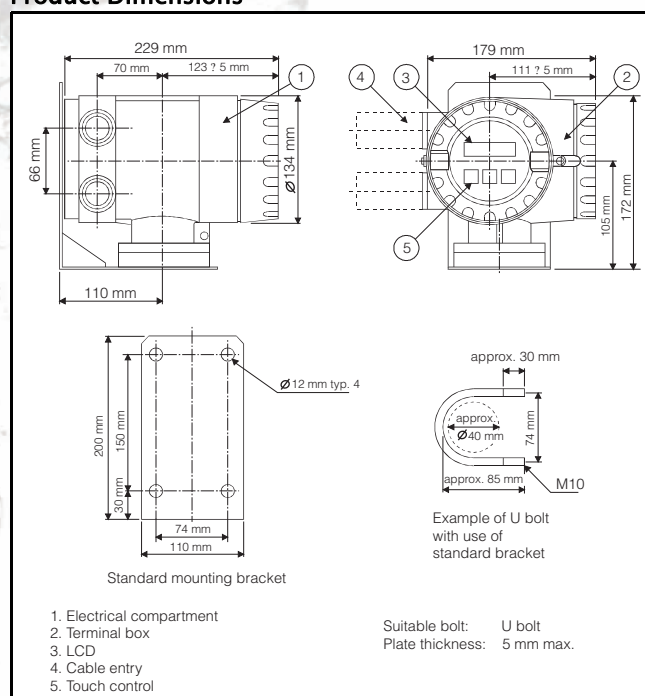
The 4560 Servo Gauge Monitor is a simple, low cost tank side monitor for displaying primary tank gauging data and operating the 6000 STG. Mounted at the tank side or up to 3600 feet (1200 meters) away (local HART connection), it provides indication of measured level, temperature data and operating status, and can send operating commands to the 6000 STG from a convenient location.

A two line, illuminated Liquid Crystal Display (LCD) with touch control is used to operate and select data. Mounted within a flameproof enclosure, touch control ensures safe operation even in hazardous areas.

Two display modes are available for indication of level and temperature*. Operating commands to the 6000 STG include:

- Level measurement
- Displacer host
- Interface level measurement (two interfaces can be measured)
- Specific gravity measurement of each product layer
- Tank Bottom location

Product Dimensions



Note! * The 4560 SGM displays only level and temperature data.

Technical Specifications

Input characteristics	Signal: Local HART protocol
Display	Two lines, 16 digits, illuminated display, language selectable English and Japanese
Programming	3 optical keys for selection of matrix functions (touch control)
Power supply	85 – 264 VAC 50/60 Hz or 20–60 VDC / 20–55 VAC
Power consumption	For AC power supply: 40 VA For DC power supply: 40 W
Ambient temperature protection	–20...+60°C IP67 with closed housing and cable glands of same protection class
Housing: material & weight	aluminumminum, coated with rust inhibitor paint – Approx. 6.5 kg
Electromagnetic compatibility	Immunity and emission to EN 50082-1,2

Order Codes

10	Protection Class	
	0	Protection: Weather proof; IP67,NEMA 4X
	4	Flame proof, XP Cl.I, Div.1, Groups ABCD FM
	5	Flame proof, Cl.I, Div.1, Groups ABCD CSA
	9	Special version
20	Cable Entry	
	B	Two NPT 1/2" thread
	9	Special Version
30	Mounting	
	3	Power supply 85-264 VAC, 50/60Hz,
	4	Power supply 20-62 VDC, 40W/20-55VAC, 50/60 Hz
	9	Special version
40	Mounting	
	0	None
	1	With mounting bracket
	9	Special version
50	Color	
	9	Silver
4560 –		Complete product code

Technical Specifications

The following specifications apply to the 6000 STG over the normal (ambient) operating temperature range.

General Specification

Manufacturer	Varec, Inc.
Designation	6000 STG
Function	Level, interface level, density, tank bottom, water dipping measurement and repeatability testing

Physical

Net weight	6531/4 : 12 kg 6532/5/6/7 : 27 kg
Shipping weight	16 lbs (7.25 kg)
Enclosure materials	Electrical compartment : aluminium Drum chamber: aluminium or stainless steel 316 (depending on model) Rated IP67 with closed housing and cable glands of equal protection type
Flange type	ANSI, JIS, DIN 3" (standard) or equivalent. Refer to order code for full selection

Power

Power requirements	High voltage type: 85 ... 264 VAC 50/60 Hz Low voltage type: 20 ... 60 VDC / 20 ... 55 VAC 50/60Hz
Power consumption	Maximum 50 VA, 50W (cos ϕ =0.5)
Safe electrical isolation	Between power supply and signal output, CPU, RS 485, relay and other electronics

Input Characteristics

Signal	Multi drop local HART® protocol max. 4 devices
Power supply additional units	DC 24V 453x average temperature sensor
	4560 Servo Monitor Others – compatible HART® devices Spot temperature Pt 100 Ohm ISO standard 3-wire connection

Displacer

Diameter	30...50mm (dependent on application), optional 70...110mm
Material (standard)	Stainless steel 316
Material (optional)	Hastelloy C; PTFE
Horizontal movement	1.23 mm /m with standard wire
Speed of movement	0...2500 mm/min.

Measuring Wire

Range	28m (optional 36m)
Material (standard)	Stainless steel 316, 0.15mm (standard)
Material (optional)	Hastelloy C. ϕ 0.2 mm (max. 16m range)
Wire protection	PTFE coated St/St 316L, 0.4mm (max 16m range) Any turbulent conditions: stilling well or guidewire

Compensation

Wire	Compensation of wire expansion due to temperature and wire weight
Displacer	Automatic compensation of displacer weight
Tank roof	Compensation of depression and distortion

Environmental

Operating (Liquid) temperature	-200... +200°C
Ambient temperature	-20... +60°C -40... +60°C (ATEX approval)

Performance

Level accuracy	+/-0.7 mm for L=10 m, D=1 g/cm ³ with 50 mm displacer
Interface level	+/-2.7 mm for L=10m, *D=0.2 g/cm ³ with 50 mm displacer *D: difference between densities of 2 liquids
Spot & profile density	+/-5kg/m ³ or better, (at reference condition)
Tank bottom	+/-2.1 mm (independent from liquid condition)

Field Communications

RS-485 Rackbus

Baud rate	19,200 bits, fixed
Cable	Two (2) wire twisted cable with screening (DGND is connected to the ground cable)
Distance	Maximum 3,600 ft (1,200 m), including limbs or branches (negligible with branches under 3 m)
Topology	Serial bus, electrically isolated, tree structure
Instrument address	Accessed via touch control
Isolation	Bus inputs are electrically isolated from the other electronics

EIA-485 MODBUS

Baud rate	600 / 1,200 / 2,400 / 4,800 / 9,600 / 19,200 bits selectable
Parity	Odd, Even, None, selectable
Cable	Two (2) wire twisted cable with screening (DGND is connected to the ground cable)
Topology	Serial bus, electrically isolated, tree structure
Distance	Maximum 3,600 ft (1,200 m) including limbs or branches (negligible with branches under 3 m)
Instrument address	Accessed via touch control
Isolation	Bus inputs are electrically isolated from the other electronics

HART

No. of units	Maximum 15 instruments per loop
Baud rate	1,200 BPS
Cable	Two wire, twisted pair screened cable Minimum core 0.15 (24AWG)
Distance	Maximum 3,600 ft (1,200 m)
Topology	Serial bus, tree structure
Instrument address	Accessed via touch control
Isolation	Bus input are electrically isolated from the other electronics

Whessmatic 550

No. of units	15 instruments per loop (connected to RTU)
Baud rate	1,200 / 2,400 bit/s
Cable	Two wire, twisted cable with screening
Distance	Depending on specifications
Topology	20 mA current loop
Instrument address	Setting by DIP switches on communication board
Isolation	Current loop circuit isolated from other circuits

Mark/Space

Baud rate	1,200 / 2,400 / 4,800 / 9,600 / 19,200 bits
Cable	Four (4) wire
Distance	Depending on specifications
Topology	Serial bus, tree structure
Instrument address	Setting by DIP switches on communication board
Isolation	Serial communication isolated from other circuits

Enraf Bi Phase Mark

No. of units	Maximum 10 instruments per loop
Baud rate	1,200 / 2,400 bits, selectable
Cable	Two wire, twisted cable with screening
Distance	Maximum 10 km
Topology	Serial bus, electrically isolated, tree structure
Instrument address	Accessed via touch control
Isolation	Serial communication circuit isolated from other circuits

Analog Output

Output	4...20 mA, two channels freely assignable value
On alarm	Switchable +110%, -10% or hold last measured value
Electrical isolation	Analog output isolated from other circuits
Adjustable damping	0 to 99 s
Maximum load	500 Ohm
Load effect	Negligible

Relay

Version	4 relays with potential free change-over contacts, freely assignable to measured value
Hysteresis	Switch points and switching hysteresis freely adjustable, residual current fail-safe mode: minimum or maximum selectable
Switching capacity	AD max. 2 A, max. 250 V, max. 62.5 VA DC max. 2 A, max. 220 V, max. 60 W For FM / CSA: 5A250VAC, 8A250VAC

Display/Programming

Display (LCD)	Two line, 16 digit, illuminated display English, Japanese selectable
Programming	Three optical keys (touch control) for selection of matrix functions
Memo function	Memo of maintenance information

Certifications & Approvals

Weather proof; IP67/NEMA4X/Type 4X (only for stain. steel Drum chamber)

XP Class 1, Division 1, Groups C & D (FM)

Class I, Division 1, Groups C & D (CSA)

Flame proof; EEx d IIB T6 ATEX

Flame proof; EEx d IIB T6 ATEX Zone 0 (only with SS drum N6005-2..., 5..., 6...)

Flame proof; EEx d (ia) IIB T6 ATEX

Flame proof; EEx d (ia) IIB T6 ATEX Zone 0

XP-AIS Class I, Division 1, Groups C & D (FM: EEx d(ia))

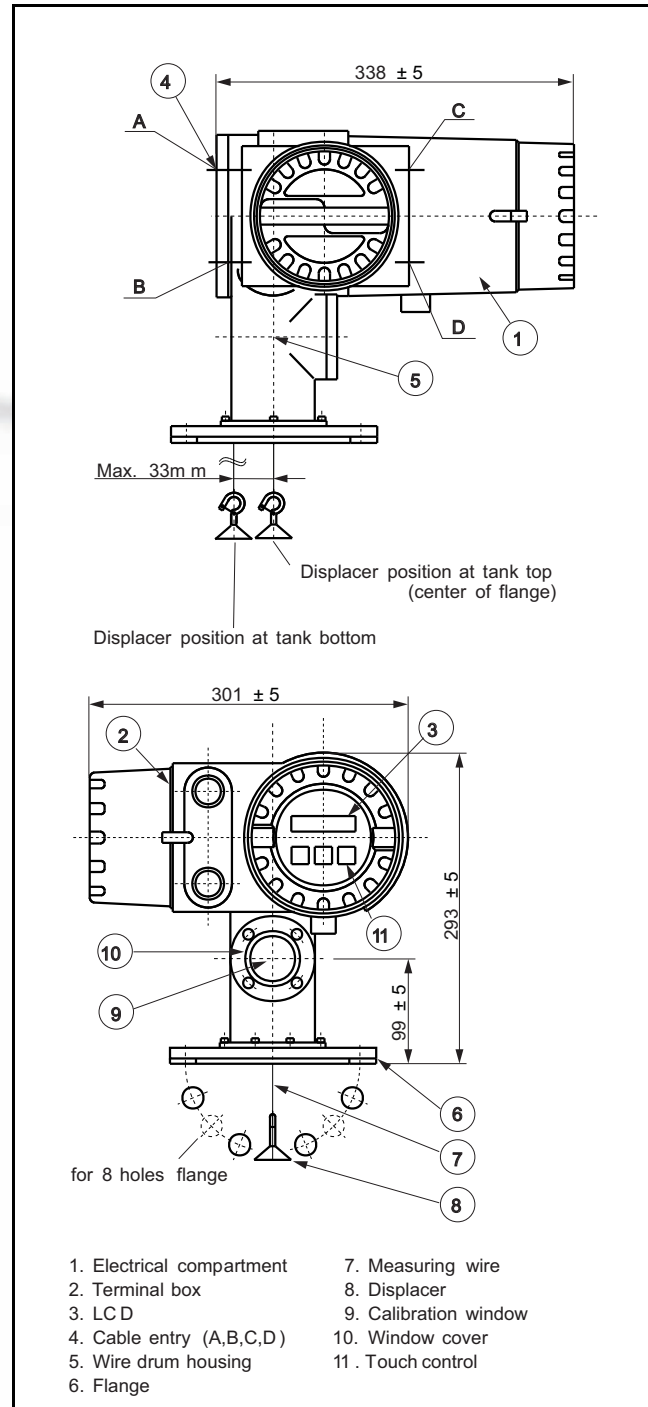
Class I, Division 1, Groups C & D, (CSA: EEx d(ia))

Flame proof; EEx d IIC T6 ATEX

Flame proof; EEx d IIC T6 ATEX Zone 0 (only with SS drum N6005-2..., 5..., 6...)

Note: IS Safety Barrier required for all available options when a 453X Temperature Device is used.

Product Dimensions



Order Codes

6005 Servo Tank Gauge

10						Pressure Rating, Drum Chamber Material
						1 Drum housing: 0.2bar g; aluminum casting
						2 Drum housing: 0.2bar g; stainless steel
						4 Drum housing: 6bar g; aluminum casting
						5 Drum housing: 6bar g; stainless steel
						6 Drum housing: 25bar g; stainless steel
						9 Special Version
20						Protection Class
						0 Weather proof; IP67/NEMA4X/Type 4X (only for stain.steel Drum chamber)
						5 XP Class 1, Division 1, Groups CD (FM)
						6 Class I, Division 1, Groups CD (CSA)
						F Flame proof; EEx d IIB T6 ATEX
						G Flame proof; EEx d IIB T6 ATEX Zone 0 (only with SS drum N6005-2..., 5..., 6...)
						H Flame proof; EEx d (ia) IIB T6 ATEX
						J Flame proof; EEx d (ia) IIB T6 ATEX Zone 0
						N XP-AIS Class I, Division 1, Groups CD (FM: EEx d(ia))
						O Class I, Division 1, Gr. CD, (CSA: EEx d(ia))
						P Flame proof; EEx d IIC T6 ATEX
						Q Flame proof; EEx d IIC T6 ATEX Zone 0 (only with SS drum N6005-2..., 5..., 6...)
						9 Special Version
30						Measuring Function
						A Level
						D Level, I/F level, Bottom, Density, multi measurement
						G Level, I/F level, Bottom, Density, Density Profile Multi-Measurement
						9 Special Version
40						Primary (Digital) Output
						N Enraf BPM
						P RS 485 Modbus
						F Not selected
						E RS 485 Rackbus
						G HART (active)
						H HART (passive)
						M Mark / Space
						9 Special Version
50						Secondary Output
						0 Not selected
						1 Alarm contact, 4x SPST
						2 4 - 20 mA, 2 channels selectable
						3 4 x SPST + 4 - 20 mA, 2 channels
						4 2 x SPST, overspill protection TÜV
						5 4 x SPST, 4 - 20 mA, 1 channel
						9 Special Version
60						Signal Input from Field Units
						0 HART protocol (e.g. NMT, NRF)
						1 HART + Pt100 spot temp.
						2 HART + operation contact, 3digits
						3 HART + Pt100 Spot temp.+ operation contact
						4 HART + 1 x status
						5 HART + Pt100 spot temp. + 1 x status
						6 HART + Pt100 + operation contact +1 x status
						9 Special Version
70						Measuring Range, Wire Material
						C Range: 0...28m, AISI316 wire
						L Range: 0 -36m, AISI316 wire
						H Range: 0 -16m, AISI316 wire PTFE covered wire
						K Range: 0 -16m, Alloy C
						Y Special version

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