

## Features

Piping :	15mm-4000mm
Protection class transmitter:	IP65
Protection class transducer:	IP68
Display:	2x20 digit alphanumeric backlighted
Keypad:	4x4
Displayed data:	instantaneous flowrate, flow totalizer
Housing:	Aluminium
Mounting:	wall
Output::	Sel. 4÷20mA or 0÷20mA
Total accuracy:	± 1%
Repeatability:	±0,2÷0,5%
Linearity:	±0,5%
Basic measurement period:	500ms
Serial port:	RS485
Communication protocol:	MODBUS RTU or ASCII+ (opt.)
Programmable frequency output:	12÷9999HZ
Relay output:	for pulse totalizer or alarm
Medium speed:	±32m/s
Working temperature:	-30÷80°C
Instrument humidity:	non condensing 85% RH (40°C)
Sensor process temperature:	S1/M1/L1 0÷70°C S1H/M1H 0÷160°C; I1/I2 ÷150°C
Sensor humidity:	non condensing 98% RH (40°C)
Power supply:	230Vac / 24Vdc
Dimensions:	251x192x80mm
Weight:	3,1Kg



## General

The **SGM-100F** is composed by a digital converter and two clamp-on or insertion type ultrasonic transducers. It is designed to measure the fluid velocity of a liquid inside a closed conduit. The transducers are a non-contacting, clamp-on type, which provide benefits of non-fouling operation and easy installation. The DSP digital technology (Digital Signal Processing) ensure a low sensibility of the instrument against potential transient factors.

## 0. Working principle

The **SGM-100F** utilizes two transducers which work as ultrasonic transmitters and receivers.

They are clamped on the outside of a closed pipe at a specific distance from each other. They can be mounted in V position (the sound crosses the pipe twice), in W position (the sound crosses the pipe 4 times) or in Z position (mounted on opposite sides of the pipe - the sound crosses the pipe once). The selection of the mounting position depends on pipe and on liquid characteristics.

The **SGM-100F** operates by alternately transmitting and receiving a frequency modulated burst of sound energy between the two transducers and measuring the transit time that takes the sound to travel between them. The difference in measured transit time is directly and exactly related to the velocity of the liquid inside the pipe (fig.1).

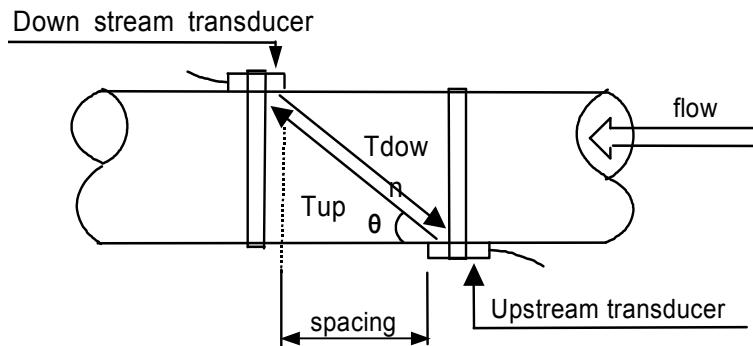


Fig. 1

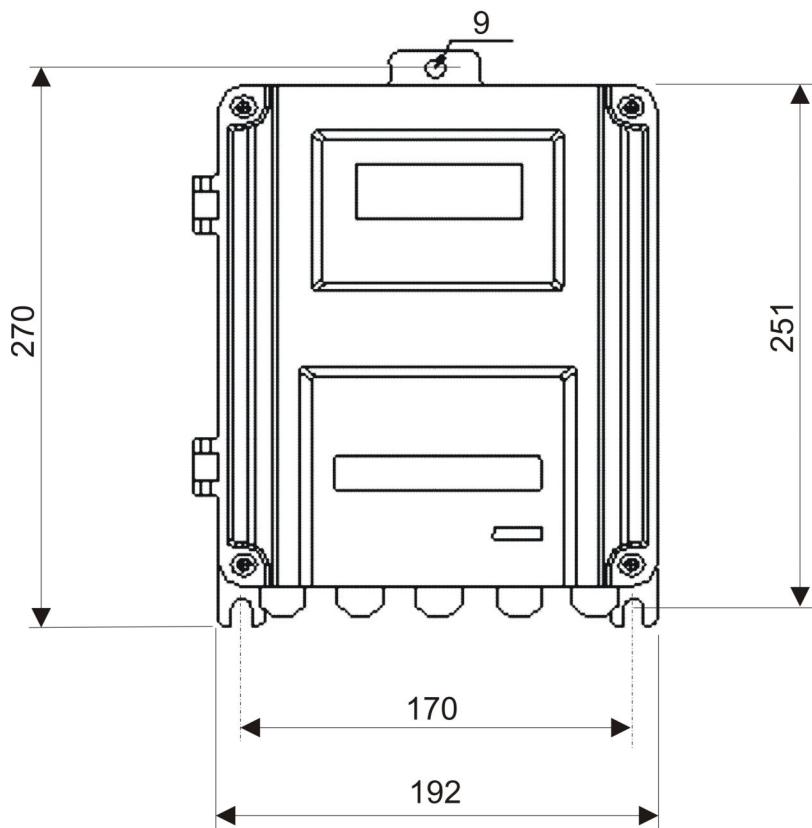
$$V = \frac{MD}{\sin 2\theta} \times \frac{\Delta T}{T_{up} \cdot T_{down}}$$

Where:

$\theta$ =	include angle for the flow direction
M =	transit time of the ultrasonic signal
D=	Internal pipe diameter
T <sub>p</sub> =	Transit time in the forward direction
T <sub>down</sub> =	Transit time in the reverse direction
$\Delta T$ =	T <sub>up</sub> -T <sub>down</sub>

## 1 Features

### 1.1 Mechanical dimensions



### 1.2 Applications

1. water, sewage with low particle content and seawater
2. water supply and drainage water
3. power plants, nuclear power plant, thermal and hydropower plants, heat energy, boiler feed water and energy management system
4. metallurgy and mining application
5. petroleum and chemicals
6. food, beverage and pharmaceutical
7. pulp and paper
8. pipeline leak detection
9. network monitoring system, energy and flow computer management

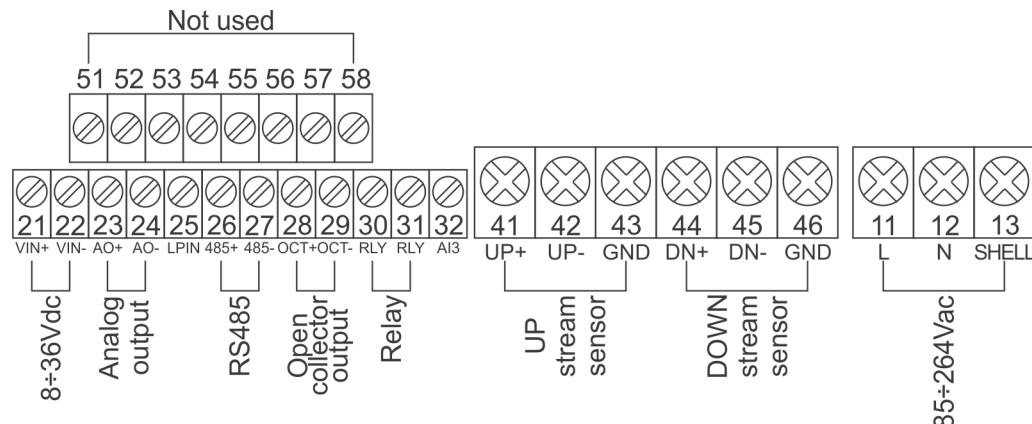
## 1.3 Product Identification

Every instrument has an 8 digit identification number (ESN) which provides the information of version and manufacturing date. It is displayed on menu M61 and can be employed for instrumentation management.

## 1.4 Specifications

Item		Specifications
<b>Main Unit</b>	<b>Principle</b>	Low voltage, multipulse
	<b>Accuracy</b>	1% or better, repeatability of 0.5% measuring period: 500ms
		Backlitghted LCD display shows instantaneous flow and accumulated flow ,flowrate, time etc
	<b>Output</b>	Electric current output of 4-20 Ma or 0-20mA,impedance of 0-1KO precision of 0.1% Open Collector (OCT) output: positive/negative/net flow or integrating flow rate pulse signal (70ms) or instance flow rate frequency signal
<b>Transducers connection cable</b>	2x5 mt - max length: 200m <b>Warning:</b> connection cable must be placed far from high power and switching cable connections	
<b>Piping</b>	Steel, stainless steel, cast iron, current pipe, copper, PVC, aluminum, glass steel	
	20mm-4000mm	
	Installation suggestions: Upstream 10D, downstream 5D, 30D away from the pump	
<b>Fluids</b>	Water, seawater, sewage, oils and other liquids capable of ultrasonic wave propagation	
<b>Operating condition</b>	Temperature	Transmitter -30~80°C Transducers S1/M1/L1 0÷70°C; S1H/M1H 0÷160°C; I1/I2 ÷150°C
	Umidity	Main unit: 85%RH Transducer: can work under water of depth lower than 3m
<b>Power supply</b>		2w, AC230V / DC24V

## 2.1 Connections



## 2.2 Power on

Standard power supply of **SGM-100F** is 230VAC or 24Vdc. Please check power supply voltage before connecting the unit. Once the instrument is switched on, it will run a self diagnostic program. If there's any anomaly the corresponding error message will be displayed. Generally, there should be no display of error messages, and the flow meter will go to the most commonly used Menu Window Number 01 (short for M01) to display the Velocity, Flow Rate, Positive Totalizer, Signal Strength and Signal Quality, based on the pipe parameters configured last time by the user or by the initial program.

The operation on the keypad does not interfere with the measurement because there's the simultaneous processing technology.

When power is on, the user can see on menu window M01 that it is adjusting the gain of the amplifier. Progress S1, S2, S3 and S4 will be displayed on the left upper corner of the display and after the adjustment the flowmeter will go into the normal measurement mode, with "R" displayed on the left upper corner.

If the instrument is running for the first time or it has been installed in a new position, the user needs to enter new pipe parameters. Any parameter will be recorded permanently into the NVRAM of the SGM-100F, until new modification.

## 2.3 Keypad

The **SGM-100F** keypad has 16 keys.

Keys from **0** to **9** and **.** are to enter numbers or menu numbers

Key **▲/+** is for entering the previous menu window. It can be also used to increase a numeric value.

Key **▼/-** is for entering the next menu window. It can be also used to decrease a numeric value.

Key **◀** is for moving left or to delete the left character.

Key **ENT** is for selecting a menu option or for confirming a modification.

Key **MENU** is for the direct menu window jump over

## 2.4 Menu windows

The interface has about 100 different menu windows, numbered from M00 to M94, from M+0 to M+9 and from M-0 to M-1.

There are two methods to enter menu windows:

(1) Directly entering by pressing **MENU** followed by two digit-number keys. For example, to enter M11 menu (pipe external diameter) press in sequence **MENU 1 1**

(2) Research by **▲/+** and **▼/-**, scrolling the windows numbers. By pressing **▲/+** the user will display the previous menu window and by pressing **▼/-** will display the next one.

There are three different types of menu windows:

(1) for number/value entering, like pipe diameter dimensions

(2) for options selection, like pipe material

(3) for values display, like velocity, flow rate etc.

For number entering windows press directly the digit-numbers and **ENT** to confirm. For example, if the outer diameter of the pipe is 219.2345, select the menu window M11 and press in sequence:

**2 1 9 . 2 3 4 5 ENT**

For selecting and modifying the parameters, press **ENT** and select the option by pressing **▲/+** and **▼/-**. Press then **ENT** to confirm.

For example, if the pipe material is SS316, select menu window M14, press **ENT** and select the pipe material by pressing **▲/+** or **▼/-** or by digitizing the number showed before the material (in this case 1).

Press then **ENT** to confirm the choice.

## 2.4 Menu windows types

M00~M09 for values display (flowrate, velocity, date and time, totalizer,  
M10~M29 for entering pipe parameters  
M30~M38 for selecting flow rate unit and totalizer unit  
M40~M49 for response time, zero and calibration setup and password modification  
M50~M53 for data logger setup  
M60~M78 for time-keeper setup, ESN information and alarms  
M82 for totalizer data display  
M90~M94 for diagnostic  
M-1 password setting  
M+0~M+9 additional fucntions, as calculator, and for displaying total working hours, turn-on and turn-off times and date and time of the single operations.

## 2.5 Parameters setting

In order to achieve a proper measurement, proceed with the configuration of the following parameters:

- (1) Pipe outer diameter
- (2) Pipe wall thickness
- (3) Pipe material. In case of non standard materials (not listed) it's necessary to enter also the relevant medium sound speed.
- (4) Liner material, if present, and the relevant medium sound speed and thickness
- (5) Liquid type. In case on non standard liquid (not listed) it's necessary to enter also the relevant medium sound speed.
- (6) Transducers type
- (7) Transducers mounting method
- (8) Transducers mounting distance (showed on menu window M25)

For standard pipe materials and standard liquids refer to the following instructions:

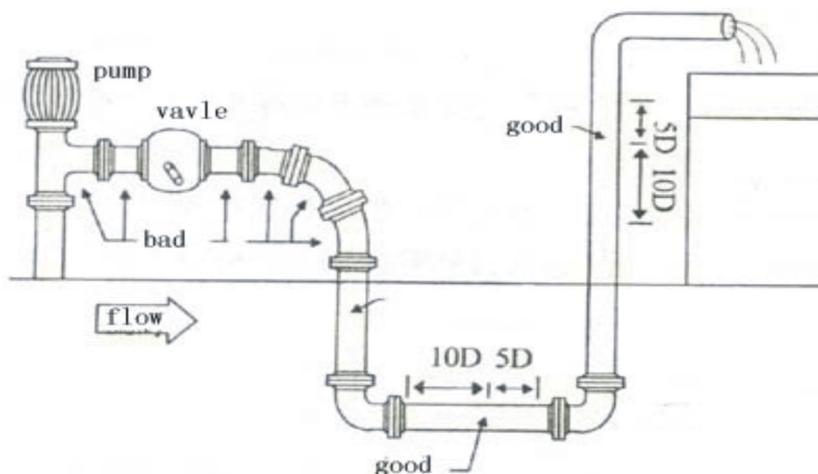
- (1) Press **MENU** **1** **1** to input the pipe outer diameter and press **ENT** to confirm.
- (2) Press **▼/-** to enter menu M12 and input the pipe wall thickness. Press **ENT** to confirm.
- (3) Press **▼/-** to enter menu M14 and press **ENT** to enter selection mode. Use **▲/+** or **▼/-** to select the material and press **ENT** to confirm.
- (4) Press **▼/-** to enter menu M16 and press **ENT** to enter selection mode. Use **▲/+** or **▼/-** to select the lining material and press **ENT** to confirm.
- (5) Press **▼/-** to enter menu M20 and press **ENT** to enter selection mode. Use **▲/+** or **▼/-** to select the liquid and press **ENT** to confirm.
- (6) Press **▼/-** to enter menu M23 and press **ENT** to enter selection mode. Use **▲/+** or **▼/-** to select the transducers and press **ENT** to confirm.
- (7) Press **▼/-** to enter menu M24 and press **ENT** to enter selection mode. Use **▲/+** or **▼/-** to select transducers mounting method and press **ENT** to confirm
- (8) Press **▼/-** to enter menu M24 to install the transducers on the pipe and then press **ENT** to go to menu M01 to check the parameters.

### 3 Installation

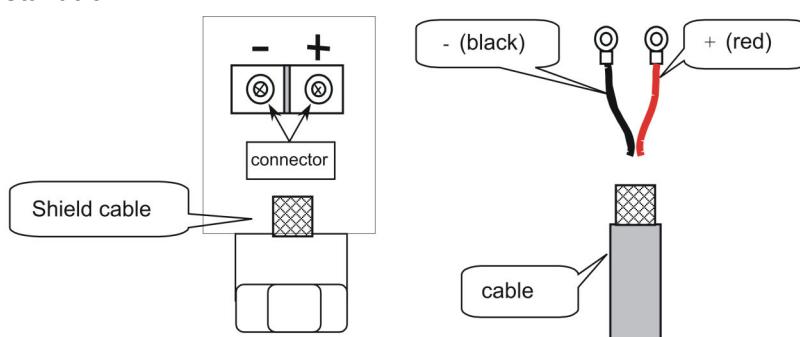
#### 3.1 Measuring location

The first step of the installation process is the selection of an optimum place in order to obtain a more accurate measurement. For this reason it is important to have a basic knowledge of the piping and of its plumbing system. An optimum place would be defined as a straight pipe length full of liquid, horizontally or vertically positioned. Selection principles for an optimum installation:

- (1) Install the transducers on the longer length of the pipe and make sure that the pipe is completely full of liquid.
- (2) Make sure that the temperature on the location does not exceed the temperature range of the transducers. In general the closer to the room temperature the better.
- (3) Take the pipe fouling into consideration. Select a straight length of a relatively newer pipe. If the condition is not satisfying, consider the fouling thickness as part of the liner for a better result.
- (4) Remember that gas phase in the liquids is in the upper part of the pipe. Consequently on horizontal pipe installations avoid to put the transducers in the upper part.



#### 3.2 Transducers installation



The **SGM-100F** transducers are made of piezoelectric crystals, both for transmitting and receiving the ultrasonic signals through the wall of the liquid piping system. The measurement is realized by measuring the traveling time difference of the ultrasonic signals. Since the difference is very small, the spacing and the alignment of the transducers are important factors for the accuracy of the measurement and the performance of the measuring system.

How to proceed with the installation:

- (1) Locate an optimum position on the pipe, which has to be in good condition (no rust)
- (2) Clean and dust the pipe surface.
- (3) Apply adequate coupler on the spot where the transducers have to be installed and leave no gap between the pipe surface and the transducers.

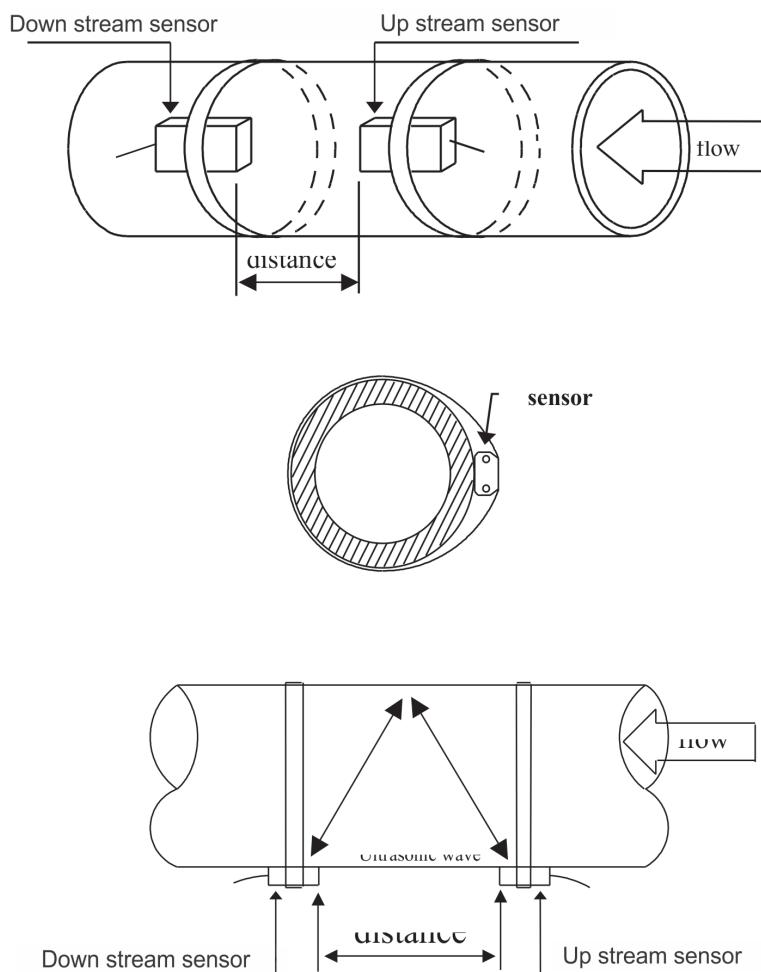
To avoid gas bubbles (gas fase) inside the upper part of the pipe, the transducers should be installed horizontally by the side of the pipe.

## 3.2.1 Transducers spacing

The spacing value shown in menu M25 refers to inner distance between the two transducers. The actual trasducers spacing should be as close as possible to the spacing value. (see figures on next page).

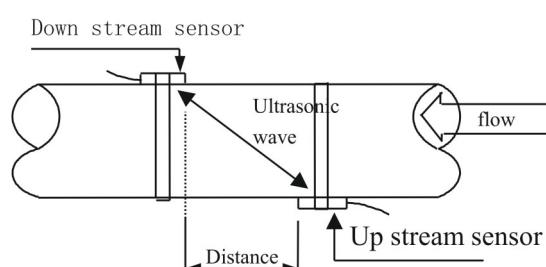
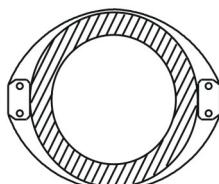
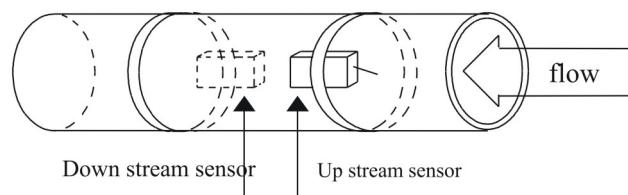
## 3.2.2 V method installation

It is the most common used method for pipe with diameters ranging from 20 to 300 millimeters.



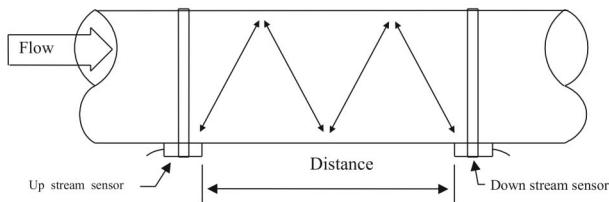
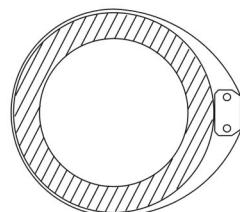
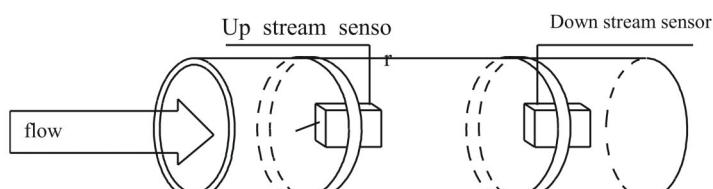
## 3.2.3 Z method installation

It is commonly used when the pipe diameter is between 300 and 500 millimeters.



## 3.2.4 W method installation

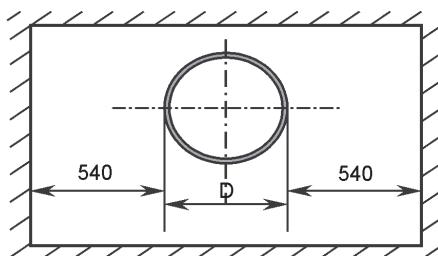
It is usually used on little pipes with a diameter from 10 to 100 millimiters.



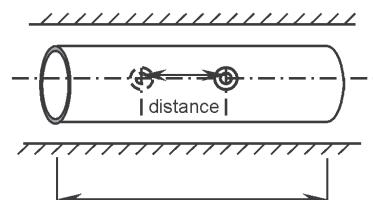
## 3.2.6 Insert sensor installation

Steps for a correct installation:

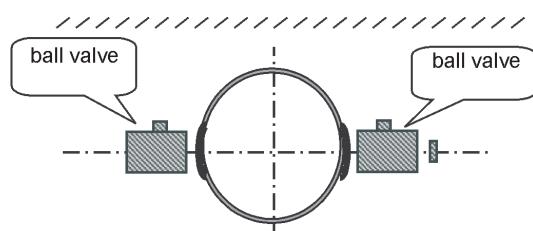
- 1- If the pipe is placed inside the wall, check that there's sufficient space for the mounting of the insertion sensor (min. distance between the wall and the pipe = 540mm)



Pipe length :  $L > (D+100)$  mm

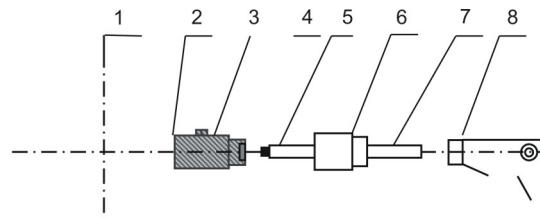


- 2- Procure a drilling tool
- 3- Enter pipe parameter (in menu M23 choose option 5. "insertion B sensor" - in menu M24 choose 1. "Z method" - in menu M25 input installation distance)
- 4- Choose the right position and calculate the distance
- 5- Install the ball valve



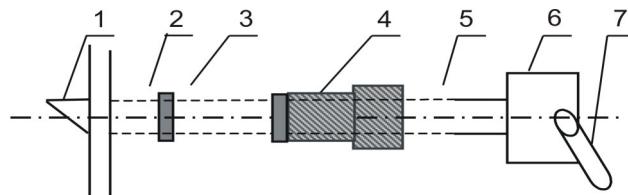
# SGM-100F - Installation

**6- Drill the pipe**

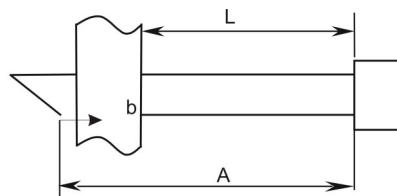


1 sensor      2 bottom of ball valve      3 ball valve      4 screw  
 5 tight screw      6 connection      7 cable

**7- Insert the sensor**



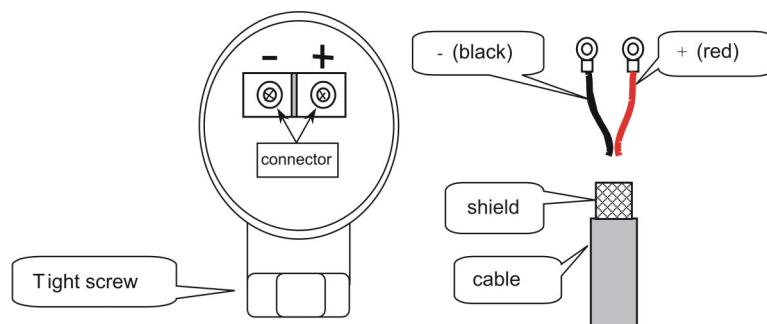
1 sensor      2 bottom of ball valve      3 ball valve      4 screw  
 5 tight screw      6 connection      7 cable



$$L = A - b$$

A = sensor length    b = pipe thickness    L = external sensor length

**8- Proceed with the electrical connection**



### 3.3 Installation check-up

Through the checkup of the installation, one can: check the receiving signal strength, the signal quality Q value, the traveling time difference of the signals, the estimated liquid speed, the measured traveling time of the signals and the calculated traveling time ratio.

#### 3.3.1 Signal strength

Signal strength indicates the amplitude of receiving ultrasonic signals by a 3-digit number. [000] means there is no signal detected, and [999] refers to the maximum signal strength that can be received.

Although the instrument works well if the signal strength ranges from 500 to 999, stronger signal strength should be pursued, because a stronger signal means a better result. The following methods are recommended to obtain stronger signals:

- (1) Relocate a more favorable location, if the current location is not good enough for a stable and reliable flow reading, or if the signal strength is lower than 700.
- (2) Try to polish the outer surface of the pipe, and apply more coupler to increase the signal strength.
- (3) Adjust the transducers both vertically and horizontally while checking the varying signal strength, stop at the highest position, and then check the transducers spacing to make sure the transducers spacing is the same as shown in menu M25 .

#### 3.3.2 Signal quality (Q)

Signal quality is indicated as the Q value on the instrument. A higher Q value would mean a higher Signal and Noise Ratio (short for SNR), and accordingly a higher degree of accuracy would be achieved. Under normal pipe condition, the Q value is in the range of 60-90, the higher the better.

Causes for a lower Q value could be:

- (1) Interference of other instruments and devices such as a powerful transverter working nearby. Try to relocate the flow meter to a new place where the interference can be reduced.
- (2) Bad sonic coupling for the transducers with the pipe. Try to apply more coupler or clean the surface etc
- (3) Pipes are difficult to be measured. Relocation is recommended.

#### 3.3.3 Total transit time and Delta Time

The numbers displayed on menu window M93 are called total transit time and delta time respectively. They are the primitive data for the instrument to calculate the flow rate inside the pipe. So the flow rate indication will vary accordingly with the total time and delta time.

The total transit time should remain stable or vary little.

If the delta time fluctuates higher than 20%, it means there are certain kinds of problems with the transducer installation.

#### 3.3.4 Time ratio between the Measured Total Transit Time and the Calculated Time

This ratio would be used to check the transducer installation. If the pipe parameters are entered correctly and the transducers are installed properly, the value for this ratio should be in the range of  $100\pm3$ . If this range is exceeded, the user should check:

- (1) If the pipe parameters are correctly entered.
- (2) If the actual spacing of the transducers is right and the same as what the window M25 shows.
- (3) If the transducers are installed properly in the right directions.
- (4) If the mounting location is good and if the pipe has changed shape.
- (5) If there is too much fouling inside the pipe.

## 4 Use

### 4.1 How to check if the instrument works properly

When 'R' is displayed in the lowest right corner of LCD display, the instrument is working properly. If an 'H' flashes on that place, there could be poor signal received. Please refer to the chapters on diagnosis. If an 'I' is displayed, it means that there is no signal detected. If a 'J' is displayed, it means that the hardware of this instrument could be out of order. Refer to the chapter on diagnosis.

### 4.2 How to check the liquid flow direction

Make sure that the instrument works properly

Check the flow rate for the indication. If the displayed value is POSITIVE, the direction of the flow will be from the UP transducers to the DOWN transducers; if the displayed value is NEGATIVE, the direction will be from the DOWN transducers to the UP transducers.

### 4.3 How to select unit system

Use menu window M30 for the selection of unit system in English or Metric system.

### 4.4 How to select a required flow rate unit

Use menu window M31 to select the flow unit first and then the timing unit.

### 4.5. How to use the totalizer multiplier

Use window M33 to select a proper totalizer. Make sure that the totalizer pulse is appropriately speeded. It should not be too fast and neither too slow. A speed of producing a pulse in several seconds or minutes is preferable. If the totalizer multiplier is too small, there can be a loss of accumulation pulse because the output device can output only one pulse in a measurement period (500milliseconds)

If the totalizer multiplier is too large, the output pulse will be too fewer for the devices that are connected with the instrument for a quicker response.

### 4.6 How to enable or disable the totalizers

Use M34, M35 and M36 to turn on or turn off the POS, NEG, or NET totalizer respectively.

### 4.7 How to reset the totalizers

Use M37 to reset the proper totalizer.

### 4.8 How to restore the flow meter with default values setted by the producer

Use M37, when the 'selection' message is displayed. Press the dot key first and the message 'Master Erase' will display, then press the backspace key 

The master erase step will erase all the parameters entered by the user and setup the instrument with default values.

### 4.9 How to use the damper

The damper acts as a filter for a stable reading. If '0' is entered in window M40, that means there is no damping. A bigger number brings a more stable effect. But bigger damper numbers will prevent the instrument from acting quickly. Numbers from 0 to 10 are commonly used for the damper value.

### 4.10 How to use the zero-cutoff function

The number displayed in window M41 is called the low-cutoff value. The flow meter will replace these flow rate values that are absolutely less than the low-cutoff value with '0'. This means the flow meter will avoid any invalid accumulation when the actual flow is below the zero-cutoff value.

The low-cutoff value does not affect the flow measurement when the actual flow is absolutely greater than the low-cutoff value.

### 4.11 How to setup a zero point

There exists a 'Zero Point' with certain installation which means the flow meter will display a non-zero value when the flow is absolutely stopped. In this case, setting a zero point with the function in window M42 will bring a more accurate measurement result.

Make sure that the flow is absolutely stopped, then run the function in window M42 by pressing the ENT key.

### 4.12 How to get a range factor for calibration

A range factor is the ratio between the 'actual flow rate' and the indicated value by the flow meter.

The range factor can be determined by calibration with flow calibration equipment.

### 4.13 How to use the operation locker

The system locker provides a means of preventing accidental configuration changes or totalizer resets.

When the system is locked, menu window browsing can be done without affecting any change, but any modifications are prohibited.

The system can be locked without a password or with a one 1 to 4 digit password. With a no-password locking, directly press the ENT key when the password input prompt displays.

If the password is forgotten, please contact the factory

### 4.14 How to use the built-in data logger

Use M50 to turn on the logger and for the selection for the items that is going to be logged.

Use M51 for the times when the logging begins and at how long an interval sustains and how long the data logging will last.

Use M52 for the direction of logging data. The default setting will permit the logging data to be redirected to the RS-485 interface.

### 4.15 How to use the Frequency Output

The frequency output signal, which represents the flow rate, is intended to make connection with other instruments.

The Frequency Output is totally user-configurable. Generally, four parameters should be configured for the setups.

Enter the lower flow rate value in window M68 and the higher flow rate value in window M69.

Enter the frequency range in window M67.

For example, assume that the flow rate varies in a range 0m3/h to 3000m3/h, and an output signal is at a maximum frequency of 1000Hz, the minimum of 200Hz is going to be required for other instrumentation. The user should enter 0 in M68 and 3000 in M69, and enter 200 and 1000 in window M67.

Please note that the user has to make the selection with OCT setups in window M78 by selecting the 13<sup>th</sup> option reading like 'FO output' to direct the frequency output to the OCT OUTPUT hardware device.

### 4.16 How to use the Totalizer Pulse Output

The totalizer output will produce a pulse output with every unit flow of the totalizer.

Refer to point 4.4 and 4.5 for the setups of the totalizer units and multiplier.

The totalizer pulse output can only be realized by mapping the pulse output to the OCT or BUZZER hardware devices.

For example, assume that the POS totalizer pulse output is needed, and every pulse should represent 0.1cubic meter of liquid flow; the pulse output will be mapped to the internal Buzzer, so that with every 0.1 cubic meter of flow the BUZZER will beep for a while.

The following setups should be taken/Performed:

Select the unit Cubic Meter under window M32.

Select the Multiplier as '2. X0.1' under window M33.

Select the output option '9. POS INT Pulse' under window M77. (INT stands for totalized )

### 4.17 How to produce an alarm signal

There are 2 types of hardware alarm signals that are available with this instrument. One is acoustic (the Buzzer), and the other one is the attivation of an Open Collector put (OCT). For both the Buzzer and OCT output the triggering sources of the event include the following:

- (1) no receiving signal
- (2) poor signal received
- (3) flow meter not in normal measurement mode
- (4) reverse flow
- (5) overflow of the Frequency Output
- (6) flow out of the setted range

There are two out-of-normal-range alarms in this instrument. They are called #1 Alarm and #2 Alarm. The flow range can be user-configurable through M73, M74, M75, M76.

For example, assume that the Buzzer should start beeping when the flow rate is less than 300 m3/h and greater than 2000m3/h, the following steps for setups would be recommended:

- (1) Enter 300 under M73 for #1 alarm low flow rate
- (2) Enter 2000 under M74 for #1 alarm high flow rate
- (3) Select the item '6. Alarm #1' under M77.

## 4.18 How to use the acoustic alarms (Buzzer)

The built-in buzzer is user-configurable. It can be used as an alarm. Use M77 for setups.

## 4.19 How to use the OCT output (Open Collector)

The OCT output is user-configurable, which can be performed by selecting the proper input source such as pulse output. Use M78 for the setups. Please make sure that the Frequency Output shares the OCT.

The OCT output terminal are 28 (+) and 29 (-).

## 4.20 How to modify the built-in calendar

Modification will be required only in such cases as when the battery is totally consumed, or when the changing of the battery takes a long time.

Press the ENT key under M61 for Modification. Use the dot key to skip over these digits that need no modification.

## 4.21 How to adjust the LCD contrast

Use M70 to the LCD contrast. The adjusted result will be stored in the EEPROM so that the MASTER ERASE will make no effect on the contrast.

## 4.22 How to use the RS485 serial interface

Use M62 for the setup of the RS-485 serial interface.

## 4.23 How to view the Date Totalizers

Use M82 to view the date totalizers that are comprised of a daily totalizer, a monthly totalizer and a yearly totalizer.

## 4.24 How to use the manual totalizer

Use M38 for the manual totalizer. Press ENT key to start and stop the totalizer.

## 4.25 How to check the ESN and other minor details

Every set of the series flow meter utilizes a unique ESN to identify the meter. The ESN is an 8-digit number that provides the information of version and manufacturing date. The user can also employ the ESN for instrumentation management. The ESN is displayed in window M61.

Other details about the instrument are the total working hours displayed in window M+1, and the total power-on times displayed in window M+4.

## 5 Menu structure

### 5.1 Menu window details

**WARNING!!!! On the menu window from M00 to M09 the display will not show the menu number on the top left corner!**

- M00 Display flow rate, net totalizers
- M01 Display flow rate, flow velocity
- M02 Display POS totalizer, flow rate
- M03 Display NEG totalizer, flow rate
- M04 Display date and time, flow rate
- M05 Display heat and total heat
- M06 Display the T1, T2
- M07 Display the AL3, AL4
- M08 Display the system wrong data
- M09 Display today's net total flow
- M10 Window for entering the outer perimeter of the pipe
- M11 Window for entering the outer diameter of the pipe 0 to 6000mm is the allowed range of the value.
- M12 Window for entering pipe wall thickness
- M13 Window for entering the inner diameter of the pipe
- M14 Window for selecting pipe material Standard pipe materials (that the user need not know the speed ) include:  
(0) carbon steel; (1) stainless steel; (2) cast iron; (3) ductile iron; (4) copper; (5) PVC; (6) aluminum  
(7) asbestos ; (8) fiberglass; (9) other
- M15 Window for entering the pipe material speed only for non-standard pipe materials
- M16 Window for selecting the liner material, select none for pipes without any liner Standard liner materials that the user need not know the speed include:  
(1) Tar Epoxy; (2) Rubber; (3) Mortar; (4) Polypropylene; (5) Polystyrol; (6) Polystyrene; (7) Polyester;  
(8) Polyethylene; (9) Ebonite; (10) Teflon; (11) other
- M17 Window for entering the liner material speed only for non-standard liner materials
- M18 Window for entering the liner thickness, if there is a liner
- M19 Window for entering the ABS thickness of the inside wall of the pipe

## SGM-100F- Menu structure

- M20 Window for selecting fluid type for standard liquids that the user need not know the liquid speed include:  
(0) Water; (1) Sea Water; (2) Kerosene; (3) Gasoline; (4) Fuel oil; (5) Crude Oil; (6) Propane at -45C;  
(7) Butane at 0C; (8) Other liquids; (9) Diesel Oil; (10) Caster Oil; (11) Peanut Oil; (12) #90 Gasoline;  
(13) #93 Gasoline; (14) Alcohol; (15) Hot water at 125C;
- M21 Window for entering the fluid sonic velocity only for non-standard liquids
- M22 Window for entering the viscosity of the non-standard liquids
- M23 Window for selecting the proper transducers. There are 14 different types of transducers for selection.  
If the user-type-transducers are used, 4 user type wedge parameters, which will be prompted by the software, should be entered following. If the  $\Pi$  type transducers are used, 3  $\Pi$  type transducers and pipe parameters should be entered following.
- M24 Window for selecting the transducer mounting methods. Four methods can be selected:  
(0) V-method; (1) Z-method; (2) N-method; (3) W-method
- M25 Displays the transducers mounting spacing
- M26 Default Settings:  
“0”, Use RAM Settings; (recommended setting); automatically keeps in memory the last parameter changes  
“1”, Solidify Setting; when select this option, the system stores the parameters current setting as default values. In the case of turning off and turning on, the system will automatically load the default values stored parameters, canceling any changes.
- M27 Save/Load Parameters: is possible to save up to 9 system parameterizations, and then subsequently retrieve if it were necessary
- M28 Select YES or NO for the instrument to determine whether or not to hold (or to keep) the last correct value when poor signal condition occurs. YES is the default setup
- M29 Empty Pipe Setup
- M30 Window for selecting unit system. Default value is ‘Metric’. The change from English to Metric or vice versa will not affect the unit for totalizers.
- M31 Window for selecting flow rate that will be used by the instrument afterward.  
Flow rate can be in: Cubicmeter short for “m<sup>3</sup>”; Liter “l”; USA gallon “gal”; Imperial Gallon “gl”; Million USA gallon “mgl”  
Cubicfeet “cf”; USA liquid barrel “bal”; Imperial liquid barrel “ib”; The flow unit in terms of time can be per day, per hour, per minute or per second. So there are 36 different flow rate units in total for selection.
- M32 Window for selecting the totalizers working unit
- M33 Select totalizer multiplier. The multiplier ranges from 0.001 to 10000
- M34 Enable/disable the differential flow totalizer (NET)
- M35 Enable/disable the direct flow totalizer (POS)
- M36 Enable/disable the reverse flow totalizer (NEG)
- M37 (1) Totalizer reset (2) Restore default parameter setted by the producer (press  and after the message Maste Erase is displayed, press ).
- M38 Press-a-key-to-run or to stop totalizer for easier calibration
- M39 Language selection
- M40 Flow rate damper for a stable value. The input range is 0 to 999 seconds. 0 means there is no damping.  
Default value is 10 seconds

## SGM-100F - Menu structure

- M41 Lower flow rate cut-off to avoid invalid accumulation
- M42 Zero point setup under the condition when there is no liquid running inside the pipe
- M43 Clear the zero point set by the user, and restore the zero point set by the manufacturer
- M44 Set up a manual flow bias. Generally this value should be 0.
- M45 Range factor for the instrument. The default value is '1'.  
Keep this value as '1', when no user calibration has been made
- M46 Network environment Identification Number. Any integer can be entered except 13(0DH, carriage return), 10 (0AH, line feeding), 42 (2AH), 38, 65535.  
Every set of the instrument in a network environment should have a unique IDN.  
Please refer to the chapter for communication.
- M47 System locker to avoid modification of the parameters.
- M48 Entry to Calib. Data
- M49 Serial Port Traffic
- M50 "Option" selection for the built-in logger. It also functions as the switch of logger.
- M51 Time setup for data logger
- M52 Printing only to RS485
- M53 Display input AL5
- M54 AL5 range
- M55 Electricity circle output selection
- M56 Electricity circle 4mAor 0mAout put
- M57 Electricity circle 20 mAout put
- M58 Electricity circle out put examination
- M59 Electricity circle out put value right now (cl current output)
- M60 Calendar. Press **ENT** to mofify and use **•** to skip the digit that need no adjusting
- M61 Display Version information and Electronic Serial Number (ESN) that are unique for each SGM-100F series flow meter.  
The users can employ the ESN for instrumentation management
- M62 RS485 serial port configuration
- M63 MODBUS communication protocol selection
- M64 Output AL2 Correspond value range
- M65 Output AL3 Correspond value range

## SGM-100F - Menu structure

- M66 Output AL4 Correspond value range
- M67 Input the frequency range for the frequency output. The highest range is 0Hz-9999Hz. Default value is 1-1001 Hz
- M68 Enter a flow rate value that corresponds to lower frequency
- M69 Enter a flow rate value that corresponds to higher frequency
- M70 LCD display backlight control. The entered value indicates how many seconds the backlight will be on with every key pressing.
- M71 LCD contrast control. The LCD will become darker when a small value is entered.
- M72 Working timer. It can be cleared by pressing **ENT** and then selecting YES.
- M73 Enter Lower Flow Rate value that will trigger the #1 Alarm. There are two virtual alarms in the system. By "virtual" we mean that the user must redirect the output of the alarms by setuping the output hardware in M78 and M77.
- M74 Enter higher flow rate value that will trigger the #1 alarm
- M75 Enter lower flow rate value that will trigger the #2 alarm.
- M76 Enter higher flow rate value that will trigger the #2 alarm
- M77 Buzzer setup. If a proper input source is selected, the buzzer will beep when the trigger event occurs
- M78 OCT (Open Collect Transistor Output) setup By selecting a proper input source, the OCT hardware will close when the trigger event occurs.
- M79 Relay output selection
- M80 Flow Batch CTRL
- M81 Flow Batch Controller
- M82 Date Totalizer: day, month and year
- M83 Add flow automatically when power-off
- M84 Select heat unit
- M85 Select temperature signal resources
- M86 Heat capacity
- M87 Heat totalizer
- M88 Heat totalizer multiplier
- M89 Heat totalizer reset

## SGM-100F - Menu structure

- M90 Displays signal strength, signal quality and time ratio on the upper right corner
- M91 Displays the Time Ratio between the measured total transit time and the calculated time. If the pipe parameters are entered correctly and the transducers are installed properly, the value should be in the range of 100±3 %. Otherwise the entered parameters and the transducer installation should be checked.
- M92 Displays the estimated fluid sound velocity. If this value has an obvious difference with the actual fluid sound speed, pipe parameters entered and the transducer installation should be checked again..
- M93 Displays total transit time and delta time (transit time difference)
- M94 Displays the Reynolds number and the pipe factor used by the flow rate program.

~ ~ ~

- M+0 Browse the 64 recorded instrument power-on and power-off date and time with the flow rate at the time of power on and off
- M+1 Displays the total working time of the instrument
- M+2 Display the last power-off date and time
- M+3 Displays the last power-off flow rate
- M+4 Displays the times of instrument powered on (the instrument has been powered on)
- M+5 A scientific calculator for the convenience of field working.  
All the values are in single accuracy.  
The drawback is that the user can't operate it by direct key-pressing
- M+6 Enter sound speed change
- M+7 Monthly totalizer
- M+8 Annual totalizer
- M+9 Unread echo signal time

## 6 Troubleshooting

### 6.1 Circuit hardware error and solutions

The **SGM-100F** has a self-diagnosis system which detects hardware problems. The instrument will show “\*F” in the top left corner of the display and it will be necessary to power on again the SGM-100F in order to see the error message and the solution:

Error message	Cause	Solutions
Memory Checking Error	System ROM illegal or error	Contact the producer
Stored Data Error	Memory parameter data error	Press ENT key and restore default parameters
System Data Memory Error	System stored data block error	Power on again or contact the producer
Circuit Hardware Error	Sub-CPU circuit fatal error	Power on again or contact the producer
Timer Slow/Fast Error	System Clock error	Power on again or contact the producer
Clock Error	Abnormal clock inside the hardware	Check the cell and contact the producer
CPU or IRQ Error	-----	Power on again
Host resetting Repeatedly	-----	Contact the producer
Time or date Error	Date/Time system chip error	Reset date and time
No display	Bad wiring connection	Check wiring connection
Stroke key - No response	Keypad locked - Bad plug connection	Enter the unlock password

table 2

### 6.2 Operating error codes and solutions

When the instrument detects an operating error, a letter will appear on the top left corner of the display. In menu window M08 can be displayed the error message. Refer to the following table for the solution:

Error codes	M08 display message	Cause	Solution
R	System Normal	Normal working status	
I	Signal not detected	1) No signal detected 2) Wrong transducers spacing 3) Transducers installed improperly 4) Lining too thick 5) New pipe liner 6) Transducers cables not properly connected	1) Tight the transducers on the pipe 2) Check the setted parameters 3) Clean the pipe surface and remove any rust 4) Change installing position 5) Wait until the new liner is dry 6) Check the cables.
J	Hardware Error	Hardware defect	Contact the producer
H	PoorSig Detected	1) No signal detected 2) Wrong transducers spacing 3) Transducers installed improperly 4) Lining too thick 5) New pipe liner 6) Transducers cables not properly connected	1) Tight the transducers on the pipe 2) Check the setted parameters 3) Clean the pipe surface and remove any rust 4) Change installing position 5) Wait until the new liner is dry 6) Check the cables
E	Current Loop over 20mA	1) 4+20mA current loop over 100% 2) Improper settings to current loop output	Check the values setted in menu M56 and if the actual flow is too high
Q	Frequ OutputOver	1) Frequency output over 120% 2) Improper setting of frequency output or actual flow too high	Check the values setted in menu M66-M67-M68 and M69 and if the actual flow is too high
F	Refer to table 2	1) Error in self-diagnosis during power-on 2) Permanent hardware error	1) Power on again and follow the i instructions on table 2 2) Contact the producer
G	Adjustig gain S1-S2-S3-S4 (displayed on M00, M01,M02 and M03)	Four steps of the adjusting gain for normal measurement. Sop in S1 or S2 and only switch between S1 and S2 indicate a poor waveform of low signal strength	-----
K	Empty pipe	1) No liquid inside the pipe 2) Setting error in menu M29	Once fluid is detected inside the pipe, set 0 in menu M29

table 3

### 6.3 Other problems and solutions

- 1) The actual flow inside the pipe is not standstill, but the instrument displays 0.0000 for the flow rate, and 'R' displaying signal strength and the signal quality Q (value) has a satisfactory value.  
The problem are likely caused by the user who has used the 'Set Zero' function on this non-standstill flowing pipe. To solve this problem, use the 'Reset Zero' function on menu window M43.
- 2) The displayed flow rate is much lower or much higher than the actual flow rate in the pipe under normal working conditions.
  - a) There is probably an offset value wrongly entered by the user in M44. Enter '0' in M44.
  - b) Check the transducers installation
  - c) There is a 'Zero Point' setted. Try to 'zero' the instrument by using M42 and make sure that the flow inside the pipe should be standstill.
- 3) The battery cannot work as long as the time period indicated in menu M07.
  - a) The battery should be replaced due to the end of the service life
  - b) Newly changed battery does not fit the battery estimating software
  - c) The battery has not been fully recharged or the recharge has been stopped too many times
  - d) The remaining volatge is in the range of 3.70 and 3,90V.

## SGM-100F - Communication Protocol

### 7 Communication Protocol

#### 7.1 General

The SGM-100F has a standard communication interface and a complete set of communication protocol.

#### 7.2 Interface pin-out definition

Pin	1	for battery recharge, positive input
	2	RXD
	3	TXD
	4	not used
	5	GND
	6	OCT output
	7	not used
	8	for battery recharge, negative input
	9	RING input for MODEM connection

#### 7.3 The Protocol

The Protocol is composed by a set of basic commands (string in ASCII format) ending with a carriage return (CR) and line feed (LF). Commonly used commands are listed below:

Command	Function	Data Format
DQD(CR)	Return flow rate per day	$\pm d.dddddE\pm dd(CR) LF$ *
DQH(CR)	Return flow rate per hour	$\pm d.dddddE\pm dd(CR) LF$
DQM(CR)	Return flow rate per minute	$\pm d.dddddE\pm dd(CR) LF$
DQS(CR)	Return flow rate per second	$\pm d.dddddE\pm dd(CR) LF$
DV(CR)	Return flow velocity	$\pm d.dddddE\pm dd(CR) LF$
DI+(CR)	Return POS totalizer	$\pm ddddddE\pm d(CR) LF$ **
DI-(CR)	Return NEG totalizer	$\pm ddddddE\pm d(CR) LF$
DIN(CR)	Return NET totalizer	$\pm ddddddE\pm d(CR) LF$
DID(CR)	Return Identification Number	$dddd(CR) LF$
DL(CR)	Return signal strength and quality	S=ddd,ddd Q=dd (CR)(LF)
DT(CR)	Return date and time	yy-mm-dd hh:mm:ss(CR)(LF)
M@(CR)***	Send a key value as if a key is pressed	
LCD(CR)	Return the current window display	
FOddd(CR)	Force the FO output with a frequency in dddd Hz	
ESN(CR)	Return the ESN for the instrument	Dddddd(CR)(LF)
RING(CR)	Handshaking Request by a MODEM	
OK(CR)	Response from a MODEM	No action
GA	Command for GSM messaging	Please contact factory for detail
GB	Command for GSM messaging	
GC	Command for GSM messaging	
DUMP(CR)	Return the buffer content	In ASCII string format
DUMP0(CR)	Clear the whole buffer	In ASCII string format
DUMP1(CR)	Return the whole buffer content	In ASCII string Format, 24KB in length
W	Prefix before an Identification Number in a network environment. The IDN is a word, ranging 0-65534.	
N	Prefix before an Identification Number in a network environment. The IDN is a single byte value, ranging 00-255.	
P	Prefix before any command	
&	Command connector to make a longer command by combining up to 6 commands	

**Notes** \* CR = Carriage Return e LF= Line Feed.

\*\* 'd' = numeric digit 0-9

\*\*\* @ stands for the key value, e.g., 30H for the '0' key.

## 7.4 Protocol prefix utilisation

### 7.4.1) Prefix P

The prefix P can be added before any command in the above table to have the returning data followed with two bytes of CRC check sum, which is the adding sum of the original character string.

Take the DI+(CR) command as an example. Assume that DI+(CR) would return +1234567E+0m3(CR)(LF) (the string in hexadecimal is 2BH, 31H, 32H, 33H, 34H, 35H, 36H, 37H, 45H, 2BH, 30H, 6DH, 33H, 20H, 0DH, 0AH) , then PDI(CR) would return +1234567E+0m3!F7(CR)(LF). '!' acts as the starter of check sum which is yielded by adding up the string 2BH, 31H, 32H, 33H, 34H, 35H, 36H, 37H, 45H, 2BH, 30H, 6DH, 33H, 20H.

Please note that there will be SPACES (20H) before '!'.

### 7.4.2) Prefix W

The prefix W should be used in the network environment. The usage format is W + digit string which stands for the IDN + basic command.

The digit string should have a value between 0 and 65534 except 13(0DH), 10 (0AH), 42(2AH,\*), 38(26H, &).

For example, if the IDN=12345 instrument is addressed and returning the velocity of that instrument is requested, the command will be W12345DV(CR).

## 7.4.3) N Prefix

The prefix N is a single byte IDN network prefix, not recommended in a new design. It is reserved only for the purpose of the compatibility with the former versions

Command Connector &

The & command connector can connect up to 6 basic commands to form a longer command so that it will make the programming much easier.

For example, assume that the measurement of an instrument with IDN=4321 are going to be returned, and (then) all the following 3 values— (1) flow rate (2) velocity (3)POS totalizer—will be returned simultaneously. The combined command would be W4321DQD&DV&DI+(CR), and the result would be:

+1.234567E+12m3/d(CR)

+3.1235926E+00m/s(CR)

+1234567E+0m3(CR)

## 7.5 Code for keypad

The codes for the keypad should be used when the instrument is connected with other terminals that operate the instrument by transmitting the 'M' command along with the keypad code. By this function, remote operation of this instrument can be realized, even via the Internet.

Key	Hexadecimal key code	Decimal key code	ASCII code		Hexadecimal key code	Decimal key code	ASCII code
0	30H	48	0		38H	56	8
1	31H	49	1		39H	57	9
2	32H	50	2		3AH	58	:

## SGM-100F - Warranty

Products supplied by SGM LEKTRA are guaranteed for a period of 12 (twelve) months from delivery date according to the conditions specified in our sale conditions document. SGM LEKTRA can choose to repair or replace the Product. If the Product is repaired it will maintain the original term of guarantee, whereas if the Product is replaced it will have 12 (twelve) months of guarantee. The warranty will be null if the Client modifies, repairs or uses the Products for other purposes than the normal conditions foreseen by instructions or Contract. In no circumstances shall SGM LEKTRA be liable for direct, indirect or consequential or other loss or damage whether caused by negligence on the part of the company or its employees or otherwise howsoever arising out of defective goods.

## SGM-100F - Factory Test Certificate



In conformity to the company and check procedure I certify that the equipment:

SGM-100F..... part nb. .....

is conform to the technical requirements on Technical Data and it is made in conformity to the SGM-LEKTRA procedure

Quality Control Manager: .....

Production and check date: .....