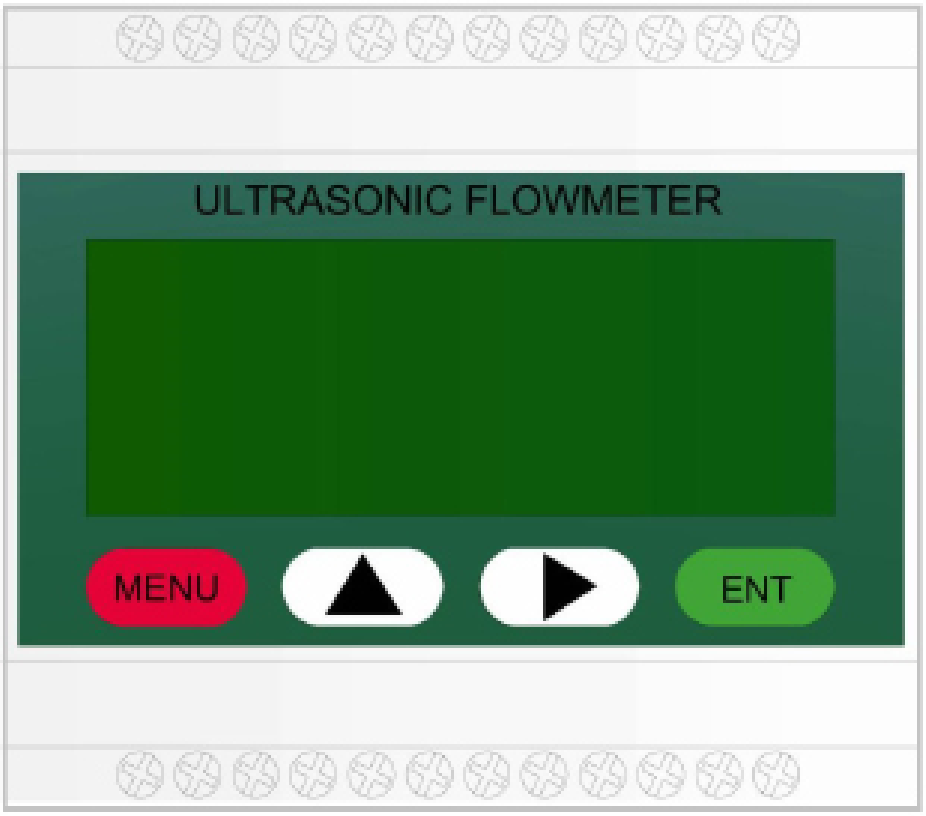
RIELS INSTRUMENTS



Ver. RIF600S.01 year 2020

RIF600S
Clamp-on ultrasonic flow meter
Installation manual

Index

1.0 Manufacturer's data

Company:	Riels Instruments S.r.l.
Company headquarters:	Viale Spagna, 16 - 35020 - Ponte San Nicolò (PD)
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Office phone:	+39 049 8961771
Email:	info@riels.it
Website:	www.riels.it

2.0 Summary

Welcome to use new generation transit-time ultrasonic flow meter, please read the user manual carefully before using. The wall mount ultrasonic flow meter is designed to be installed in a fixed location for long term flow measurement.

2.1 Features

- Linearity: 0.5%, Repeatability: 0.2%, Accuracy: ±1%
- Easy to operate.
- Several type transducers for selection, measuring pipe size is from DN15 mm to DN6000 mm
- Adopt low voltage, multi-pulse technology to improve accuracy, useful life and reliability.
- Powerful Recording Function, record the totalizer data of the last 64 days/64 monthes/5 years.

2.1 Typical application

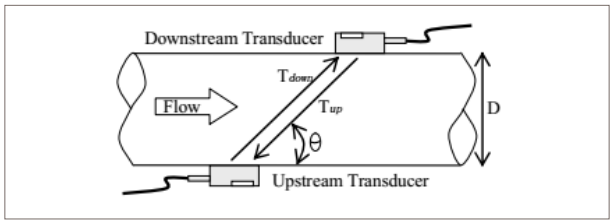
The wall-mounting flow meter can be applied to a wide range of pipe flow measurements. Applicable liquids include pure liquids as well as liquid with small quantity of tiny particles.

Examples are:
- Water (hot water, chilled water, city water, sea water, waste water, etc.)
- Sewage with small particle content
- Oil (crude oil, lubricating oil, diesel oil, fuel oil, etc.)
- Chemicals (alcohol, acids, etc.)
- Plant effluent
- Beverage, liquid food
- Ultra-pure liquids
- Solvents and other liquids

3.0 Working principle

The RIF600S ultrasonic flow meter is designed to measure the fluid velocity of liquid within a closed conduit. The transducers are a non-contacting, clamp-on type, which will provide benefits of non-fouling operation and easy installation.

The RIF600S transit-time flow meter utilizes two transducers that function as both ultrasonic transmitters and receivers. The transducers are clamped on the outside of a closed pipe at a specific distance from each other. The transducers can be mounted in V-method where the sound transverses the pipe twice, or W-method where the sound transverses the pipe four times, or in Z-method where the transducers are mounted on opposite sides of the pipe and the sound crosses the pipe once. This selection of the mounting method depends on pipe and liquid characteristics. The flow meter operates by alternately transmitting and receiving a frequency modulated burst of sound energy between the two transducers and measuring the transit time that it takes for sound to travel between the two transducers. The difference in the transit time measured is directly and exactly related to the velocity of the liquid in the pipe, show as follows:



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

WHERE:

- V: velocity of the liquid
- θ: is the include angle to the flow direction
- M: is the travel times of the ultrasonic beam
- D: is the pipe diameter
- T_{up}: is the time for the beam from upstream transducer to the downstream one
- T_{down}: is the time for the beam from downstream transducer to the upstream one
- ΔT: T_{up}-T_{down}

To measure the temperature, the two Pt1000 sensors are hooked to the outside of the pipe or inserted inside it and detect two temperature values. The energy value is indicated/measured based on the following mathematical model:

$$Q = \int_{V_1}^{V_2} k(t_1 - t_2) dV$$

WHERE:

- Q: Amount of heat released
- V: Volume of the last liquid
- k: Heat coefficient, function of the properties of liquids that transmit heat at a relevant temperature and pressure
- t_1: Liquid inlet temperature
- t_2: Liquid outlet temperature

4.0 Basic parameter

Power supply	85÷264 VAC or 8÷36 VDC
Repeatability	≥ 0.2%
Precision	≥ 1%
Outputs	• RS485 • 4÷20 mA or 0÷20 mA (active) • OCT with programmable pulses 6-1000 ms (default 200 ms) • Relay output for total flow or alarms
Inputs	• Two channel two wire input system with PT100 resistance, for the thermal energy display function • Optional three channel 4÷20 mA input, accuracy: 0.1% • Backlit 2x20 display • 4x4 keyboard • Capacity storage function for up to 10 years • Automatic storage of the switch-off/switch-on date
Protection degree	Mainframe: IP65 Sensors: IP68

5.0 Accessories

Clamp-on sensors	Available in SMALL / MEDIUM / LARGE versions
Temperature sensors	For the calculation of thermal energy Accuracy 100 °C ±0.8 Combined well with the main unit the minimum temperature di erence is ≤0.1°C.
Memory card	For saving the acquired data
Card reader usb	For downloading data purchases on PC
Fastening belts	For installation in cast iron, grp, pvc, etc. that do not support direct connection of transducers
111 Compound	Gel for ultrasound transducers

6.0 Installation of sensors

Warnings!

All devices are tested and set up by the manufacturer before shipment and delivery to the customer.

The preparation operations and how and where to use the product are listed and described below.

RIF600S is designed, manufactured and tested to meet all specific standards (see the declaration of conformity), when used and connected correctly. The installation must be carried out in such a way as to ensure that the instrument can function properly. The environmental characteristics must be those indicated by the manufacturer. Improper use and maintenance will invalidate the warranty terms.

The RIF600S devices use sensors containing piezoelectric crystals that allow the emission and reception of ultrasonic signals, through the walls of the pipe. Although easy to install, for the most accurate measurement possible and optimal device operation, the positioning distance and alignment of the sensors are of crucial importance. The instructions must therefore be followed carefully.

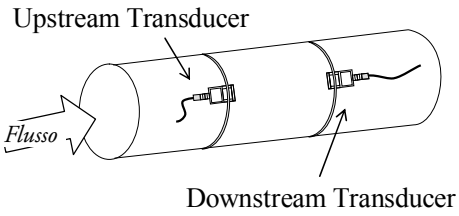
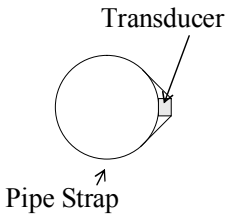
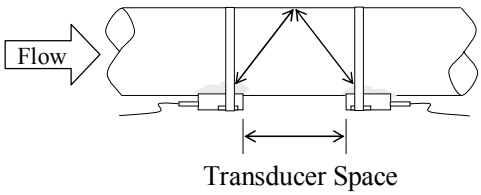
The installation of ultrasonic sensors includes the following steps:
- identification of the optimal position on the pipe;
- entering the required parameters in the device keyboard;
- based on the parameters entered, the instrument will calculate the most suitable distance for transducers positioning;
- pipeline preparation and transducer assembly.

Depending on the type of pipe and the characteristics of the liquid, the sensors can be installed:
- in position V (method V), the generated signal passes through the pipe twice;
- in position Z (method Z), the generated signal passes through the pipe only once;
- in position W (method W), the generated signal passes through the pipe four times.

6.1 V method

The V method is considered the standard method.

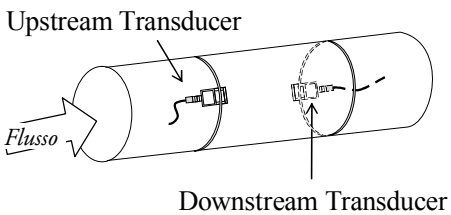
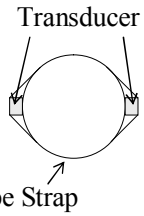
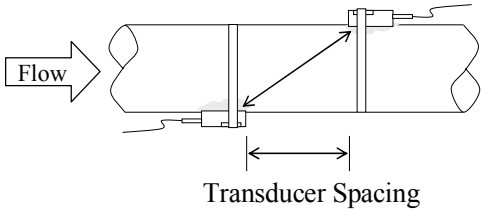
It is usually used on diameters between about 50 mm and about 700 mm.

Vista laterale	Sezione	Vista dall'alto
		

6.2 Z method

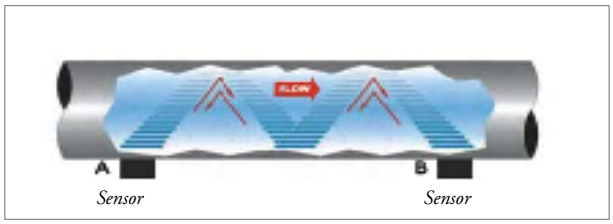
The signal transmitted in an installation with the Z method is subject to less disturbance, compared to the V method seen in the previous paragraph. This is because the signal is transmitted directly (rather than reflected) and flows through the liquid only once.

It is preferable to install the sensors according to the Z method when the pipes are very large, if there are solids suspended in the fluid or if the inner lining of the pipe is too thick. The Z method is able to measure approximately on pipe diameters from 300 mm to 6000 mm.

Vista laterale	Sezione	Vista dall'alto
		

6.3 W method

The W method is used on diameters between about 15 mm and about 100 mm.



7.0 Mounting positions

The first step in the installation process is the selection of an optimum location in order to obtain a more accurate measurement. For this to be completed effectively, a basic knowledge about the piping and its plumbing system would be advisable.

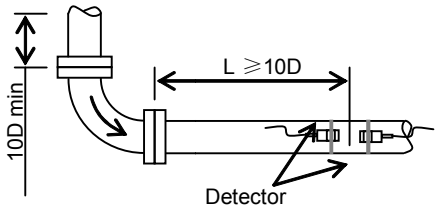
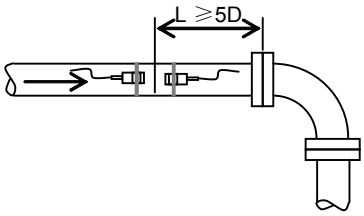
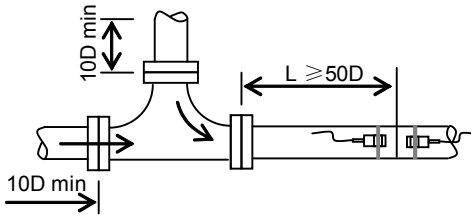
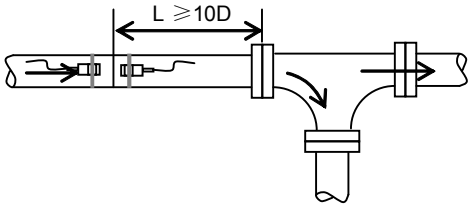
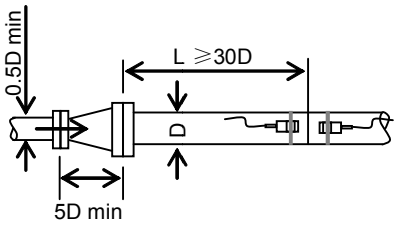
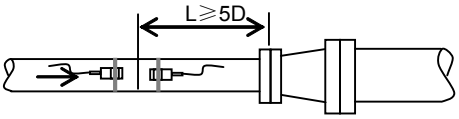
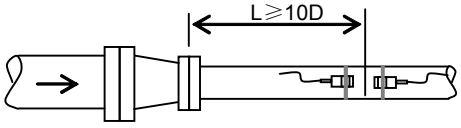
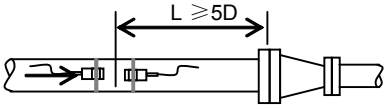
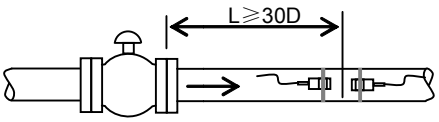
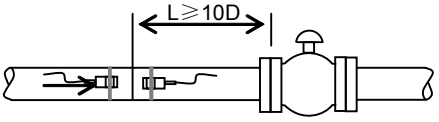
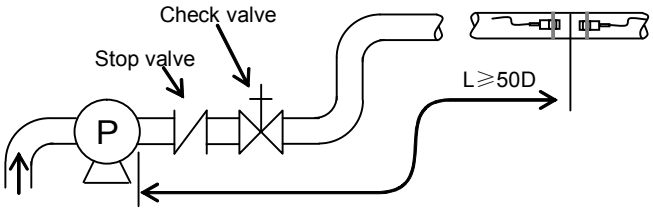
An optimum location would be defined as a straight pipe length full of liquid that is to be measured. The piping can be in vertical or horizontal position. The following table shows

8.0 Choice of assembly point

Warnings!

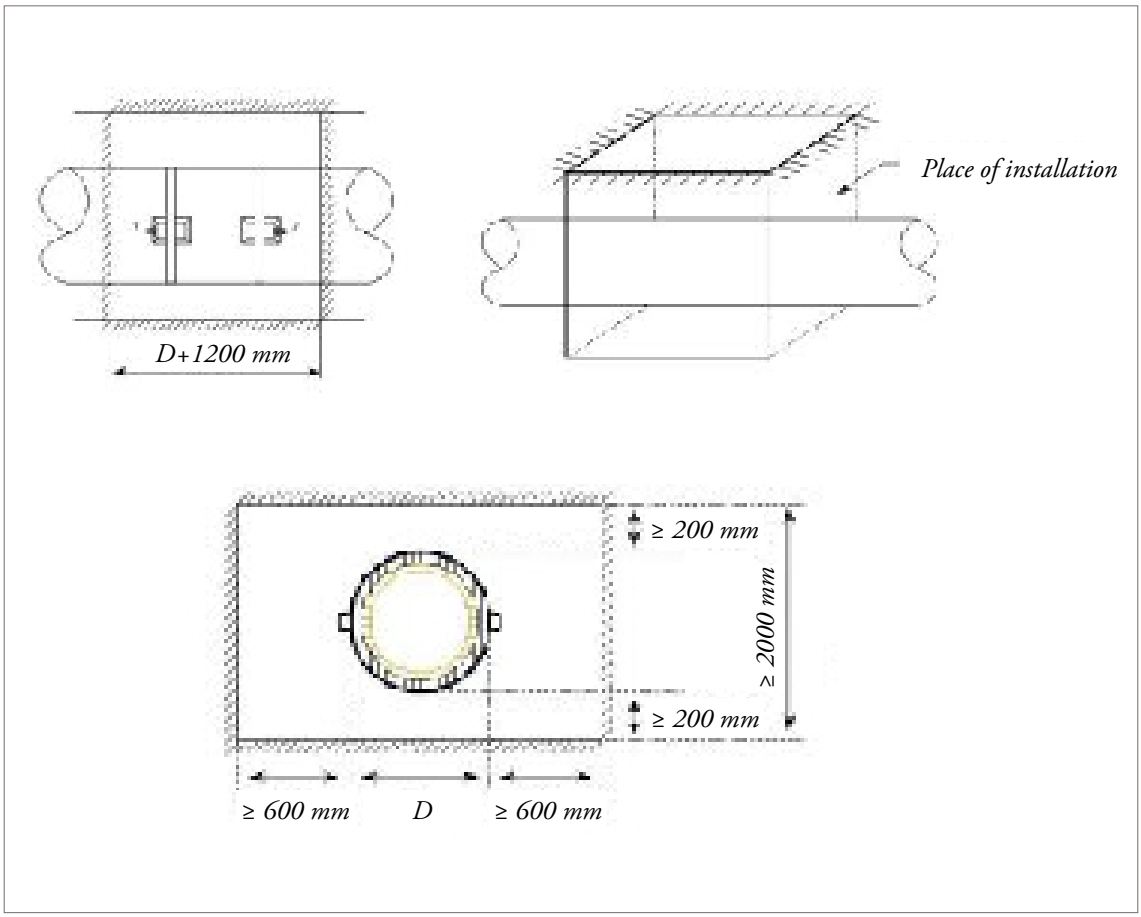
To ensure accuracy and stability of the measurement, the installation point of the sensors should be on the straight pipe filled with well distributed fluid (during installation, the pipe must be filled with liquid).

- The tube must be full of uniformly distributed liquid and suitable to be crossed by the ultrasonic beam (vertical tube or horizontal tube).
- The sensors must be installed in a pipe position that has a straight section of 10D in length before the upstream sensor positioning point and a straight section equal to 5D after the downstream sensor positioning point. D means the outside diameter of the pipe. The portion of pipe must also be away from valves, pumps, high pressure currents, transformers that can be a source of interference.
- Avoid installing the sensors in the highest section of the system, or in a section of pipeline with downward flow with free exit.
- For systems with open or not completely full piping, install the U-tube sensors.
- The temperature and pressure at the point of installation must be compatible with the operating values of the sensors.
- It is advisable to use pipes that do not have too large diameter reductions due to internal coatings.
- The two sensors must be installed in a horizontal direction on the plane of the pipe axis, within ± 45 ° from the axis line, firmly anchored to the pipe in total absence of bubbles / particles between the transducers and the pipe.

Name	Straight sections before the upstream sensor	Straight sections after the downstream sensor
90° curve		
T		
Enlargement		
Shrinking		
Valve	 Flow controlled upstream	 Flow controlled downstream
Pump		

9.0 Assembly room

In order to guarantee an operating environment suitable for the access of an operator, use distances between the pipe and the walls of the room equal to or greater than those indicated in the following figure:



10.0 Installation of clamp-on sensors

	Warnings!
☑	Before installation, clean the installation area of the chosen pipe, removing any rust or paint residue.

We recommend using an angle grinder for polishing, and then wipe a cloth soaked in alcohol or acetone to remove oil and dust.
Once the surface has been cleaned, spread a good quantity of gel 111 and apply the sensors, without any air bubbles or dust particles remaining between the sensor and the pipe.

The available clamp-on sensors are as follows:

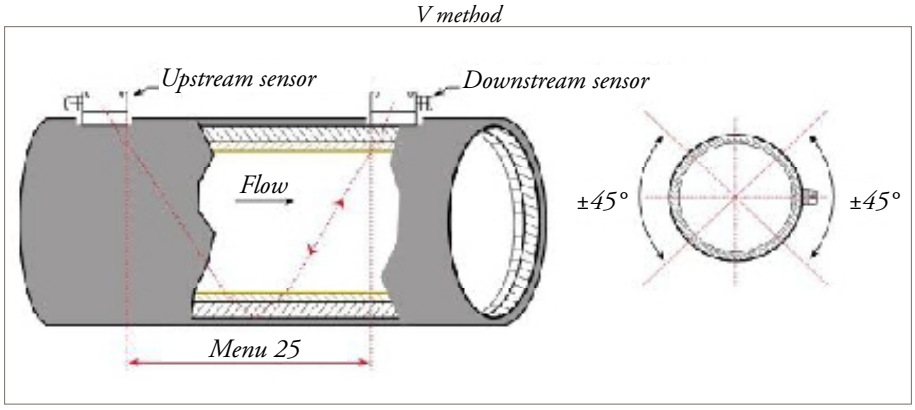
Sensore	S1 (standard)	M1 (standard)	L1 (standard)	S1H (high temperatures)	M1H (high temperatures)	L1H (high temperatures)
Range	DN15÷DN100	DN50÷DN700	DN300÷DN6000	DN15÷DN100	DN50÷DN700	DN300÷DN6000
Temperature of the fluid	0°C÷70°C	0°C÷70°C	0°C÷70°C	0°C÷160°C	0°C÷160°C	0°C÷160°C
Dimensions	45×30×30	60×45×45	80×70×55	90×85×24	90×82×29	80×70×55
Weight	75g	250g	650g	94g	150g	150g

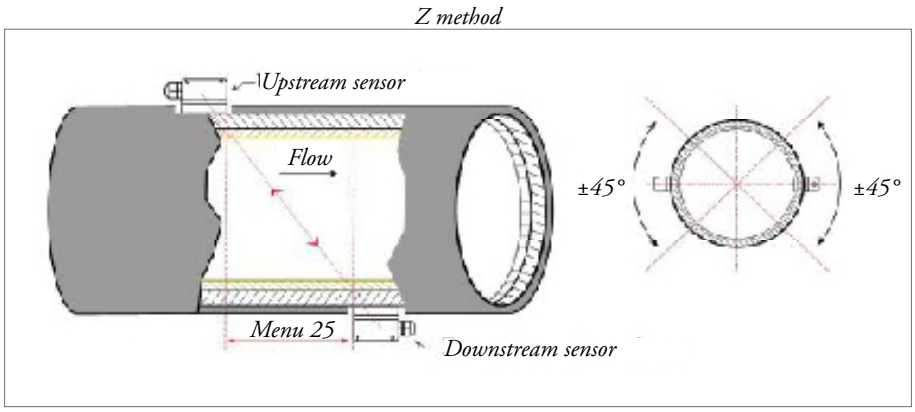
Once you have chosen the type of sensor best suited to the measurement to be carried out, you will need to configure the sensor parameters manually, following the instructions in the following sections of this manual.

The installation spaces between the transducers are indicated in menu 25.

The standard positioning method is the V-shaped method, ideal for pipes with diameters between DN15 and DN40.

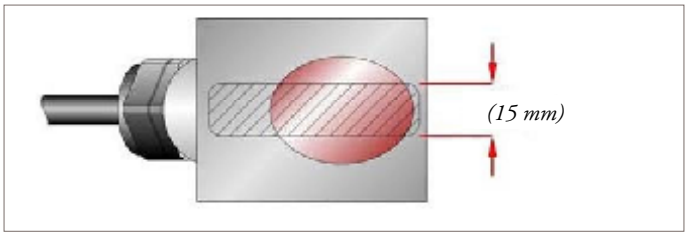
With larger pipes, too thick coatings or the presence of suspended solids in the fluid it is recommended to switch to the Z method.
It is very important that the angle between the position of the sensor and the horizontal axis of the pipe does not exceed ±45°.





10.1 Installation of V method sensors

- Insert a strip of dough, about 15 mm wide, onto the flat surface of the transducer, as shown in the following figure. Generally, silicone grease is used, but any fat-like substance may be used provided it is estimated that it does not melt at the operating temperature of the tube.

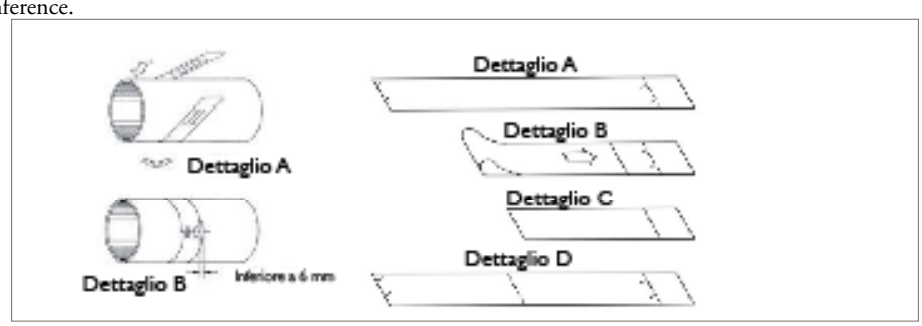


- Position the transducer upstream and secure it with a strap. The belts must be placed in the curved channel of one end of the transducer. A screw allows to fix the belt on the transducer. Check that the transducer is firmly fixed on the tube and adjust it if necessary. Tighten the strap on the transducer to secure it.
- Position the downstream transducer on the pipe at the specified distance. By exerting firm pressure with your hand, slowly move the transducer both in the direction of the upstream transducer and in the opposite direction to it and observe the power signal. Hook the transducer in the position where the highest power signal is present (menu 90); this signal must be between 60 and 95;.
- If, once the transducers are positioned, the power signal does not exceed 60, it is necessary to select another method of installation. If the V-position of the transducers was chosen, configure the device again by selecting the Z position, then reset the device and move the transducer downstream to the new position; then repeat the point described above.

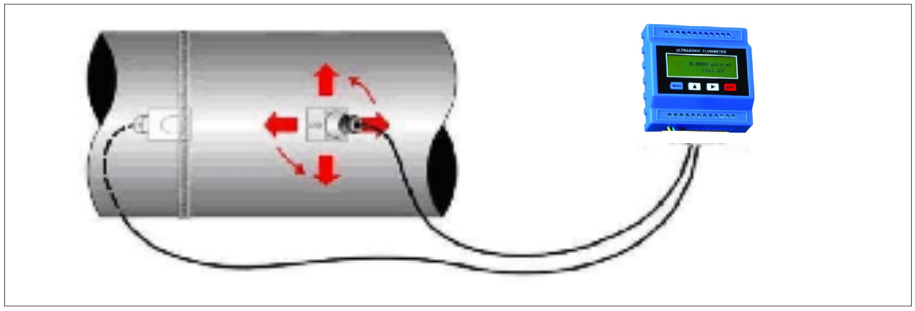
The arrangement and alignment of the transducers is of crucial importance in transit time measuring devices.
Therefore, the user must respect the exact distance indicated on the screen of the menu window 25 on the basis of the parameters that he has entered.
The reference distance is indicated in window 91; a value between 97 and 103% is maintained.

10.2 Installation of Z method sensors

- It requires the use of a roll of resistant paper (for example, wrapping paper and insulating tape) and a marker.
- Wrap the tube as shown in the following figure. Align the ends of the paper up to a maximum of 6mm.
- Mark the intersection of the two edges of the paper to indicate the circumference. Remove the model and spread it on a flat surface. Fold it in half, bisecting the circumference.



- Crack the card on the line. Mark the folding. Mark the tube at the point where one of the transducers will be positioned. Wrap the paper around the tube again, placing the two ends at the demarcation point on the tube. Move to the other side of the tube and mark it in the fold. Measure from the end of the crusher to the opposite side. Mark this point on the tube.
- The two demarcations are now measured and aligned. If it is not possible to wrap the paper around the tube, cut a piece of paper of this size and place it on top of the tube.
  Length = external tube dimension x 1.57.
  Width = the distance entered in the menu 25.
  Mark the opposite sides of the paper on the tube. Place the two transducers in these points.
- Introduce a strip of dough, about 15 mm wide, on the flat surface of the transducer.
- Position the transducer upstream and secure with a steel belt or other. The straps are positioned in the curved channeling of the transducer. A screw is also supplied. Tighten the belt to the transducer. Verify that the transducer is firmly attached to the tube. Adjust it if necessary, then tighten the belt. Larger tubes may require more than one belt. Place the transducer downstream on the tube at the positioning distance indicated in the following figure with firm pressure of the hand, slowly move the transducer both in the direction of the upstream transducer and in the opposite direction to it and observe the signal strength. Engage the transducer at the point where the most powerful signal is observed. This signal must in any case be between 60 and 90. On certain tubes, a slight screwing of the transducer can increase the signal to the acceptable level.
- Fasten the transducer with a steel strap or other.



11.0 Installation of insertion sensors

The new RIF600W insertion sensors combine the advantages of clamp-on and in-line sensors.
These translators can be installed directly in carbon steel pipes, while the use of special belts for installation is required for cast iron, fiberglass reinforced plastic, PVC and cement pipes.
Users in this situation will inform Riels Instruments of the exact outside diameter of the pipeline, in order to avoid leakage.

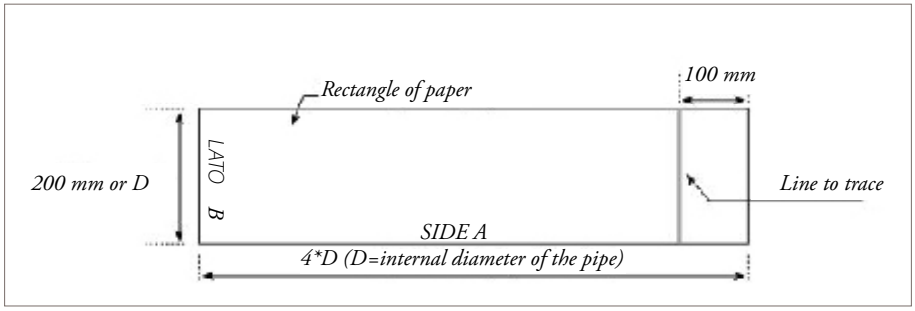
The models available are as follows:

Sensor	Type B entry Direct insertion	Type B entry Cement version
Range	≥ DN80	≥ DN80
Installation spaces	≥ 550 mm	≥ 700 mm
Fluid temperature	-40°C÷160°C	-40°C÷160°C
Material	Stainless steel 316L	Stainless steel 316L

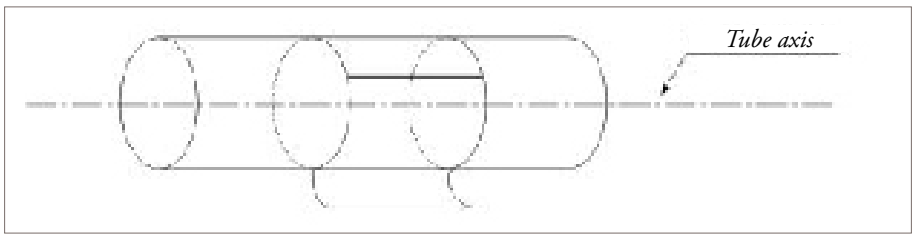
For the installation it is advisable to use a rotary drill of 400W (preferably high speed adjustable), a wrench and a screwdriver.
Insertion sensors can only be installed with the Z method and can be applied to all pipes with a diameter greater than DN80.

Proceed as follows:

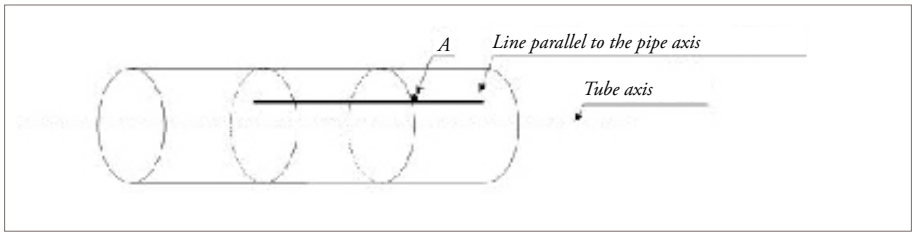
- Access menu 25 to display the installation spaces between the sensors. The spacing of the insertion transducers is calculated based on the distance between the centers of the two transducers along the pipe axis.
- Cut out a rectangle of paper / cardboard that has side A of length 4*D (D is the internal diameter of the piping) and side B of 200mm length (or length D). Once prepared the rectangle, draw a line parallel to the side B at a distance of 100mm.



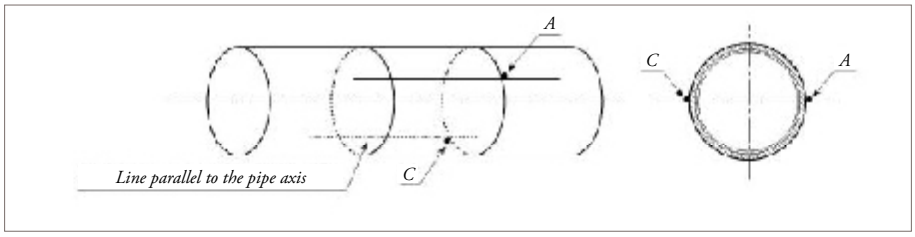
- Wrap the sheet created around the pipe, taking care to keep the line drawn parallel to the tube axis.



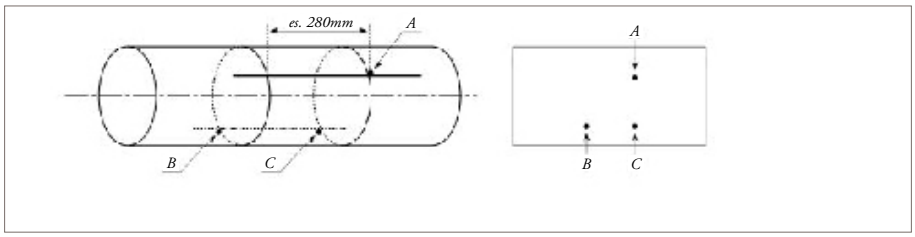
- Extend the drawn line identifying point A as in the following figure:



- Starting from A, cover the side of the sheet measuring half the circumference of the tube, thus identifying point C



- At this point, use the line parallel to the tube axis passing through point C to locate point B, which is the intersection with the side of the sheet of paper. Points A and B indicate the positions in which to install the sensors.



12.0 Transmitter installation

After opening the package, it is advisable to keep the packaging material in case of storage or shipping to the factory.
Check that the carton and the equipment have not been damaged during shipment.
The device must be arranged to facilitate maintenance, calibration, and the screen view.

- Arrange the transmitter for the length of the cable supplied with the device.
  If this is not possible, it is recommended to exchange the supplied cable with a suitable one; cables up to 300 meters are available.
- Install the transmitter in a position where:
  - The oscillations are at a minimum,
  - Be protected from the release of corrosive liquids,
  - The temperature is from -40 to 131 ° F [-40 to 55 ° C],
  - Do not be exposed to sunlight, these could overheat the transmitter.

13.0 Cabling

To access the terminals of the electronic connectors, loosen the two screws and open the door. Thread the transducer cables through the conduit hole at the bottom of the center of the sag. The transmitter terminals are of the plug type, can be detached and hung up.
Attach suitable cables to the corresponding terminals.

- “24V+ & 24V-“ power supply. 10÷36 VAC is also applicable to these two terminal;
- “485+ & 485-” RS485 terminals;
- “AO+ & AO-” analog output, loop powewed;
- “UP+ & UP- & GND” it is used for the upstream transducer (red line);
- “DN+ & DN- & GND” it is used for the downstream transducer (blue line);
- “T1 & GND” connect to signal terminals of the PT100 RTD;
- “T2 & GND” connect to signal terminals of the PT100 RTD;
- “TX1 & GND” connect to the power terminals of the PT100 RTD;
- “TX2 & GND” connect to the power terminals of the PT100 RTD;
- “AI3 & AI4 & AI5” analog inputs, ground connect to GND;
- “OCT+ & OCT-” OCT output terminals, OCT is related to menu 78;
- “RLY+ & RLY-” RLY output terminals, RLY is related to menu 79.

The transducer cable provides a low level of high frequency signals.
Generally, it is not advisable to extend the cable supplied for the transducers.
If this is necessary, contact Riels Instruments to request replacement of the cable with one of the desired length. in fact, cables of different lengths are available, up to 300 meters.

	Warnings!
☑	This instrument requires a noise-free power supply. Do not operate on circuits with interference components (for example, fluorescent lights, relay circuits, compressors, or with a variable frequency hard disk). It is not recommended to use the same wiring for power and signal cables.

14.0 Final verification of the installation

Is the device intact (visual inspection)?	❒
Does the meter comply with the measuring point specifications? • Process temperature • Room temperature • Measuring range • Measured fluid	❒
Did the sensors mount properly?	❒
Are the measurement point identification and labeling correct (visual inspection)?	❒
Is the meter sufficiently protected against precipitation and direct solar radiation?	❒
Have the fixing screws been tightened with the correct tightening torque?	❒

15.0 Commissioning of the meter

After making all the wiring and closing the meter door, it is sufficient to power the instrument to start it.
At this point it is possible to start programming.
In general, no error message should appear and the device menu number 01 will appear on the device, the most common, which displays speed, range, positive totalizer, signal strength and signal quality, the values of which are based on parameters entered first by the user or by the system itself.

15.1 Key functions

The RIF600S keyboard consists of 4 keys, of which 10 are numeric keys from 0 to 9 to enter parameters or menu numbers, while the keys for point, backward, enter, down/-, on/+ have specific functions, indicated in following table:

Tasto	Funzioni
MENU	Enter the edit mode of a menu, confirm the entered data.
DOWN	Go to the previous menu, or as a subtraction key
UP	To go to the next menu, or as an addition button
ENT	Reach a specific menu. Press this key followed by the desired menu es. if you want to display the menu 11 press MENU+1+1

To activate/deactivate the typing beep function, use menu 77.
The parameter settings entered and the measurements are displayed in more than 100 independent windows.
The user can view the menu, the parameter setting windows, change the setting or view the results of the readings.
These windows are indicated by 2 digit serial numbers from 00...95, and then, from .9, etc.
Each window number, so called address code, has a well defined function. for example, window M11 indicates the parameter entered for the outer diameter of the pipe, while window M25 indicates the mounting distance between the transducers, etc. (see the section dedicated to the description of the menu windows).
For normal measurements, the following parameters are entered:

- outer diameter of the tube
- tube thickness
- tube material
- coating material parameters (including sound thickness and speed if necessary)
- type of fluid
- type of transducer
- transducer mounting methods
- for “clamp-on” transducers, follow the transducer positioning distance displayed in M25 and keep the M91 digit around 97...103%.

16.0 List of menus

00	Instant flow rate, net totalizer and operating status. PORT. 0.0000 m3/h *R (R = system/regular operation) NET 0x1 m3
01	Instant flow rate, flow rate and operating status. PORT. 0.0000 m3/h *R (R = system/regular operation) VELOC 0.0000 m/s
02	Instant flow rate, positive totaliser and operating status. PORT. 0.0000 m3/h *R (R = system/regular operation) POS 0x1 m3
03	Instant flow rate, negative totalizer and operating status. PORT. 0.0000 m3/h *R (R = system/regular operation) NEG 0x1 m3
04	Date (YY-MM-DD), time (HH: MM: SS), instantaneous flow rate and operating status. 19-01-01 10:00:00 *R (R = system/regular operation) PORT. 0.0000 m3/h
05	Total energy, instant energy and operating status. EFR 0.0000 kW *R (R = system/regular operation) E. T. 0E+0 kWh
06	Temperature value T1 in °C, °F and temperature value T2 in °C, °F. T1 = xx.xxC, xx.xx T2 = xx.xxC, xx.xx
07	View the AI3 and AI4 inputs.
08	Operating error code and operating status.
09	Total capacity of the day/month/year.
10	Enter the value of the circumference of the pipe in mm.
11	Enter the value of the external diameter of the pipe in mm.
12	Enter the value of the pipe thickness in mm.
13	Enter the value of the internal diameter of the pipe in mm. If the parameters have been set in the MENU windows 11, 12 the value is automatically calculated.
14	Select the piping construction material. 0. Carbon steel 1. Stainless Steel 2. Cast iron 3. Spheroidal cast iron 4. Copper 5. PVC 6. Aluminum 7. Asbestos 8. Glass fiber 9. Others
15	Enter the speed of sound transmission in the construction material of the pipe in m/s. MENU window visible only if you select “9. Other materials ”in the MENU window 14.
16	Select the inner lining of the pipe. 0. No coating. 1.Tar Epoxy 2. Rubber 3. Mortar 4. Polypropylene 5. Polistriolo 6.Polistirolo 7. Polyester. 8. Polyethylene 9. Ebonite 10. Teflon 11. Others

17	Enter the speed of sound transmission in the construction material of the inner lining in m/s. MENU window visible only if you select “11. Other materials ”in the MENU window 16.
18	Enter the thickness value of the inner lining in mm. MENU window visible only if you select “11. Other materials ”in the MENU window 16.
19	Absolute degree of roughness of the inner lining of the pipe. MENU window visible only if you select “11. Other materials ”in the MENU window 16.
20	Select the type of liquid to be measured. 0. Water 1. Sea water 2. Kerosene 3. Gasoline 4. Fuel oil 5. Raw oil 6. Propane at -45 °C 7. Butane at 0 °C 8. Others* 9. Diesel oil 10. Ricino oil 11. Peanut oil 12. #90 Benzine 13. #93 Petrol 14. Alcohol 15. Hot water at 125 °C
21	Enter the speed of sound transmission in the liquid to be measured in m/s. MENU window visible only if you select “8. Other liquids “in the MENU window 20.
22	Enter the viscosity value of the liquid to be measured in cSt. MENU window visible only if you select “8. Other liquids “in the MENU window 20.
23	Select the type of transducers used to make the measurement. 0. Standard-M 1. Type C listing 2. Standard-S 3. Customer sensor 4. Standard-B 5. Listing B (45) 6. Standard-L 7. JH-Polysonics 8. Standard-HS 9. Standard-HM 10. Standard-M1 11. Standard-S1 12. Standard-L1 13. Type-PI 14. Fuji FS410 15. FS510 of Fuji 16. Clamp-on TM-1 17. Inserts TC-1 18. Clamp-on TS-1 19. Clamp-on TS-2 20. Clamp-on TL-1 21. Inserts TLC-2 22. Clamp-on M2 23. Clamp-on L2 For the RIF600W clamp-on ultrasonic flowmeter, choose: 10. Standard-M1 for TM-1-HT sensors suitable for detecting pipes from DN50 to DN700 11. Standard-S1 for TS-1-HT sensors suitable for detecting pipes from DN15 to DN100 12. Standard-L1 for TL-1-HT sensors suitable for detecting pipes from DN300 to DN6000
24	Select the transducer installation method. 0. Suitable V mounting on pipes from DN50 to DN700 1. Suitable Z mounting on pipes from DN300 to DN6000 3. W fitting suitable on pipes from DN15 to DN100
25	Transducer mounting distance calculated automatically based on the parameters entered.
26	Saving set parameters. 1. Save set parameters
27	Save or load the set parameters. Possibility to save the parameters set to multiple positions from 0 to 8, to then be loaded when needed. Useful function if you use the meter to check the flow rate on many different pipes, to quickly recall the parameters set in a previous configuration.

28	Warning weak signal. SI is the default setting. If the weak signal warning appears, the instrument will show the previous survey.
29	Enter the value for the empty tube function. 20 is the default setting.
29A	Enter the value of the maximum capacity.
30	Select the unit of measurement. 0. METRIC is the default setting.
31	Select the unit of measurement for the instantaneous flow rate. 0. Cubic meters (m3) per second (SEC.), per minute (MIN.), per hour (HOUR), per day (DAY) 1. Liters (l) per second (SEC.), per minute (MIN.), per hour (HOUR), per day (DAY) 2. US (Gal) gallons per second (SEC.), per minute (MIN.), per hour (HOUR), per day (DAY) 3. UK Gallons (IGL) per second (SEC.), per minute (MIN.), per hour (HOUR), per day (DAY) 4. Millions of US Gallons (Mg) per second (SEC.), per minute (MIN.), per hour (HOUR), per day (DAY) 5. Cubic feet (CF) per second (SEC.), per minute (MIN.), per hour (HOUR), per day (DAY) 6. US oil barrels (OB) per second (SEC.), per minute (MIN.), per hour (HOUR), per day (DAY) 7. UK oil barrels (IB) per second (SEC.), per minute (MIN.), per hour (HOUR), per day (DAY)
32	Select the unit of measurement for the totalizer. 0. Cubic meters (m3) 1. Liters (l) 2. US Gallons (Gal) 3. Galloni UK (IGL) 4. Millions of US Gallons (Mg) 5. Cubic feet (CF) 6. US oil barrels (OB) 7. UK oil barrels (IB)
33	Select the multiplier factor of the totalizer. 3. x1 is the default setting.
34	Turn on or off the net totalizer. 0. OFF is the default setting, for detections in a single direction 1. ON for two-way surveys
35	Turn the positive totalizer on or off. 0. OFF 1. ON is the default setting
36	Turn the negative totalizer on or off. 0. OFF is the default setting, for detections in a single direction 1. ON for two-way surveys
37	Reset the instrument to the initial parameters. Reset system: press the • and ◀ Take note of the previous parameters before restoring.
38	Manual totalizer. Press "ENTER" to start, "ENTER" to stop. It is used to measure flow, and for manual calibration and calculation.
39	Choice of language.
39A	Scherm. current. 255 is the default setting.
40	Set the value for signal damping in seconds. Flow compensation for stable detection. The input range is from 0 to 999 seconds. The common setting value is between 1 and 10 seconds. 0 Sec = no compensation 10 Sec is the default setting
41	Set the cutoff value for low flow rates in m/s. Function used to avoid the increase of the totalizer, in the presence of vibrations or noises, or to cut the low flow rates not relevant to the total measurement. For example, if a value of 0.1 m/s is set, the instrument will not increase the accumulated total, until the flow velocity does not exceed the set value of 0.1 m/s.
42	Setting the zero point. With completely full piping and zero flow, the value of instantaneous flow detected must be equal to 0. If a flow is detected, it will be necessary to start the zero point calibration procedure, only after having configured all the essential parameters for the measurement detection and having correctly installed the transducers.

43	Delete the reference zero point value. If you cancel, reset the zero point to the MENU window 42 again.
44	Manual setting of the zero point. It is preferable to use automatic sampling in the MENU window 42.
45	Calibration factor. Refer to the issued calibration certificate.
46	Serial address for RS485 ModBus communication.
47	Set the device lock password to avoid parameter changes by non-enabled users. Unlock only with password. If you forget to contact Riels Instruments.
48	Enter the degree of non-linearity.
49	Communication test.
50	Data Logger setting.
51	Set the exit time at the scheduled time. START TIME = **:**:** with the following configuration, obtainable by pressing the POINT key, the registration will be 24h/24h INTR. MEAS = HH:MM:SS set the sampling frequency
52	Internal data recording management: 0. Internal serial bus on SD card 1. Send data via ModBus RS485
53	Display of the AI5 input (if available).
54	Setting OCT totalizer pulse output, interval: 6-1000 ms.
55	Current loop mode.
56	Selection of the data to be transmitted at the output in current 4mA/0mA.
57	Selection of the data to be transmitted at the output in current 20mA.
58	Check current output display.
59	Indicates the presence of the current loop
60	Set the device's date and time. Check again after installing updates.
61	Device Version Information and Serial Number.
62	Setting the serial port parameters.
63	Choice of the communication protocol between MODBUS-RTU binary and MODBUS-ASCII.
64	Analog Input AI3. By entering the measurement range, the flowmeter will transform the current signal into the data range needed by the users, then display the corresponding analogue input corresponding to the physical parameter data.
65	Analog Input AI4. By entering the measurement range, the flowmeter will transform the current signal into the data range needed by the users, then display the corresponding analogue input corresponding to the physical parameter data.
66	Analog Input AI5. By entering the measurement range, the flowmeter will transform the current signal into the data range needed by the users, then display the corresponding analogue input corresponding to the physical parameter data.
67	Sets the frequency range of the frequency output signal (default: 0-1000Hz, maximum range: 0-999 Hz).
68	Minimum flow limit in frequency signal output.
69	Maximum frequency output signal flow limit.
70	LCD backlight option. ‘’Always Log In“,”Always Off“,”Lighting for“ option, enter a second digit, which indicates the backlight seconds.
71	Contrast of the LCD.
72	Chronograph indicating the activation time of the device. Can be reset using the ENTER key, and then YES. The instrument is calibrated and examined before being packaged so the chronograph is not reset.
73	Activation of an alarm for minimum flow limit in frequency signal output.
74	Activation of an alarm for maximum frequency signal output flow limit.

77	Activate or deactivate the typing beep.
78	OCT output settings.
79	RLY relay output settings.
80	Choose the input signal of the batch controller
81	Batch controller
82	Register of the net totalizer. • Net of the day • Net of the month • Net of the year
83	Automatic correction. Automatic increase of the totalizer when it is switched off.
84	Heat flow unit: 0. Gia Joule (GJ) 1. Kilocalorie (Kc) 2. kWh 3. BTU
85	Select origin of the temperature signal.
86	Specific Heat selection
87	Thermal Flow totalizer
88	Thermal Flux multiplier
89	Displays the difference in temperature and allows setting the temperature difference.
8 + .	Installation options of temperature probes in the delivery or return pipe.
90	Signal strength displayed. Signal quality, IMPORTANT: when the transducers are installed, digit Q: at least ≥60 M90 Strenth + Quality S=00.0, 00.0 Q=00
91	Displays the time ratio between total transit time and calculated time. If the pipe parameters are correct and the transducers installed correctly, the ratio should be about 100±3%. Otherwise the transducer parameters must be checked.
92	Displays the speed of the sound of the fluid. Normally this value must be more or less the same as in menu 21 when M20 is set to 'Other'. If this value is obviously different from that of the actual sound velocity, the tube parameters and the installation of the transducers must be checked again. If ''Other'' is not selected in the M20, this window is not used.
93	View total transit time.
94	Shows the Reynolds number and the tube coefficient.
95	Displays the negative and positive totaliser of thermal energy.
+0	Displays the total flow rate and the number of switching on/off the device.
+1	Displays the total operating time of the device.
+2	Displays the time of the last shutdown.
+3	Displays the flow rate measured at the time of the last shutdown.
+4	Displays the total number of starts
+5	Calculator.
+6	Threshold value of the fluid speed.
+7	Net current account month.
+8	Current year net total.
+9	Operating time including also the switch-off time.
. + 2	Store the static zero point.
. + 5	Sets the threshold value of the Q value.
. + 8	Maximum current flow rate for day and month.
. + 9	Serial port test window, with CMM output.
- 0	From here you enter the protected internal menus of the instrument, you need to enter the password to access the subsequent menus.
- 1	4-20mA output calibration

- 2	Calibration of the 4mA value for the analog input AI3.
- 3	Calibration of the 20mA value for the analog input AI3.
- 4	Calibration of the 4mA value for the analog input AI4.
- 5	Calibration of the 20mA value for the analog input AI4.
- 6	Calibration of the 4mA value for the analog input AI5.
- 7	Calibration of the 20mA value for the analog input AI5.
-8	Setup of the zero point of the temperature probes a for temperatures <40 ° C.

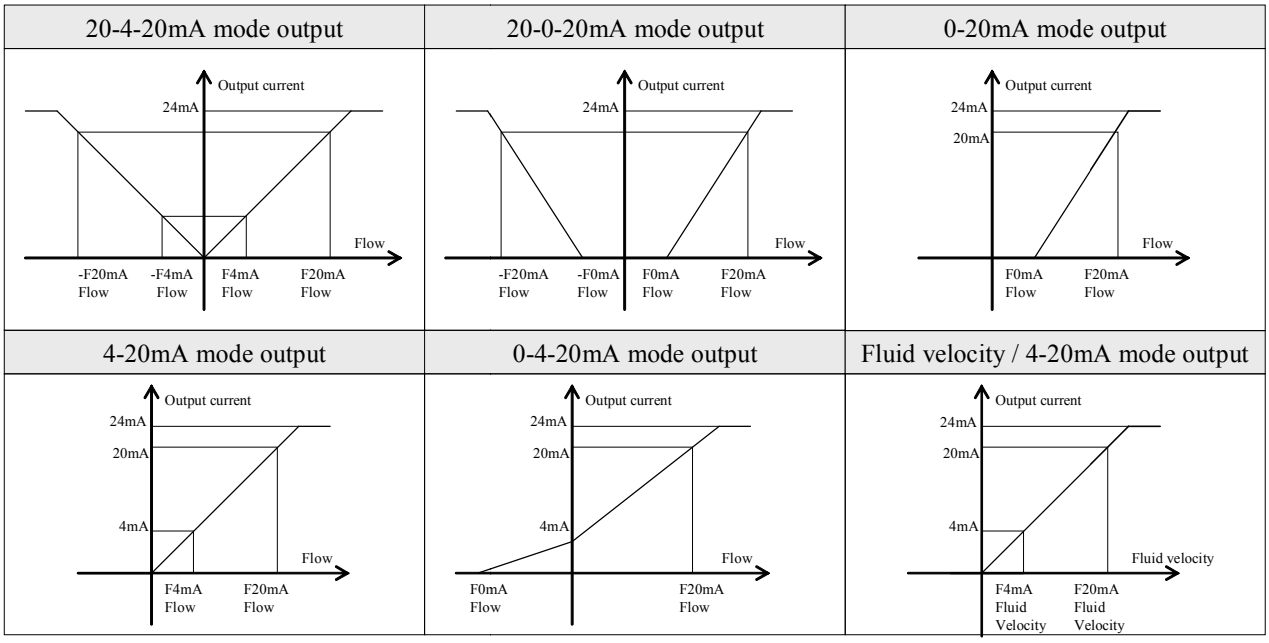
17.0 Configuration of the outputs

17.1 4÷20mA output

Connect to the "AO +" and "AO-" terminals (the 4-20 mA output does not require an external power supply).
The reference menus are 55, 56, 57, 58, 59.
With a more accurate current output of 0.1%, the ultrasonic flow meter RIF600S is programmable with more outputs, for example 4-20 mA or 0-20 mA, selectable from menu 55.

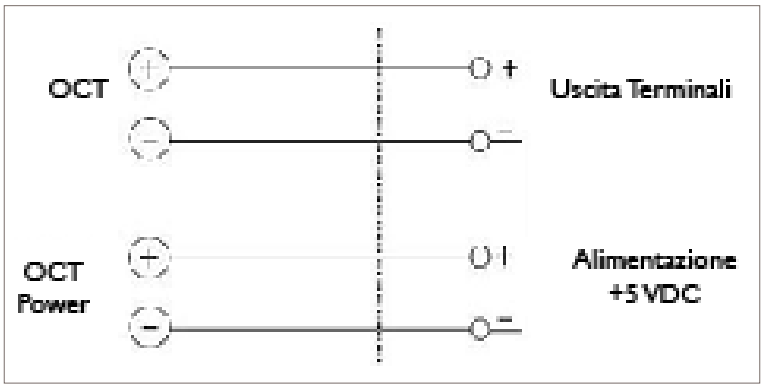
CL Mode Select [55]
0. 4 - 20 mA

1. 4-20 mA — set the 4-20 mA output range.
2. 0-20mA — sets the output range from 0-20mA.
3. 0-20mA via RS232 — configured to be controlled by the serial port.
4. 20-4-20mA — sets the CL output range from 20-4-20 mA.
5. 0-4-20mA — sets the CL output range from 0-4-20mA.
6. 20-0-20 mA — sets the CL output range from 20 to 20 mA.
7. 4-20 mA vs. vel — sets the 4-20 mA CL output range corresponding to the flow rate.
8. 4-20 mA vs. energy — sets the CL output range 4-20 mA corresponding to the thermal energy.



17.2 OCT pulse output

The output wiring is as follows:



When the OCT output for flow is used, the pulse output is used to transmit data to external meters and PID systems through a frequency proportional to the flow rate of the device.
The pulse frequency output is approximately 0-9.999 Hz. The displayed high or low frequency output indicates the maximum and minimum detection. The user can reset both the frequency output and the desired flow rate. For example, if the scope of one tube is about 0~2000 m3/h, the required frequency output is 20~1000Hz and the configuration is as follows: in the M78 Window, select FO ("FO" element-frequency output.); in Window M68 (Minimum allowed frequency output), enter 0; in Window M69 (maximum frequency output allowed), enter 2000; in the M67 window (Select the frequency range), Press ENTER, enter the minimum FO (Frequency Output) 20, Press V, enter 1000.
When the OCT output is used for the total positive flow, select "Positive Int Pulse" in Menu 78 and set minimum increment for the totalizer in Menu 33. Each time the totalizer increases according to the digit entered in the M33, the OCT "+ - "will make a pulse.

17.3 Relay output

Connect to the RLY "+ -" terminals. The relay operates an actuator or triggers an alarm.
The relays are qualified 125VAC/0.5A or 110VDC/0.3A.
Startup time: max. 3.0 ms;
switch-off time: max. 2.0 ms;
conduction resistance 0.1 ohms, I/O;
terminal insulation resistance: 1000 Mohms.
When switched off, the "RLY +, -" output is normally in the open state.
Set "Alarm #1 Low Value" in Menu 73, and set "Alarm #1 High Value" in Menu 74. When the flow is between these values, the relay is in open state, and when the flow is lower than "Low Value" or higher than "High Value", the relay is in the closed state.

18.0 Troubleshooting

18.1 Error handling

The RIF600W ultrasonic flowmeter has advanced self-diagnosis functions and makes every error in the upper right part of the LCD through predefined codes, in order of date/time. Device diagnostics are usually performed on each boot and some errors are detected during normal operation. The undetectable errors due to incorrect settings or incorrect parameters are displayed in the same way. This function detects errors and quickly determines their causes, so that problems can be solved according to the solutions listed in the following tables.

The errors displayed in the RIF600W are divided into two categories:

- Errors during self-diagnosis at startup. You can display "* F" at the top left of the screen after setting the measurement mode. When this happens, you need to restart for a new self-diagnosis. If the problem persists, contact Riels Instruments.
- Errors caused by incorrect settings and during operation, displayed in Window M08.

18.2 Self diagnosis and troubleshooting (on startup)

LCD display	Cause	Solution
ROM Parity Error	System ROM invalid/error	Contact Riels Instruments
Stored Data Error	Error of a data set.	Restart or contact Riels Instruments
SCPU Fatal Error!	SCPU Circuit Error	Restart or contact Riels Instruments
Timer Slow Error / Timer Fast Error	Chronograph error	Contact Riels Instruments
CPU or IRQ Error	CPU or IRQ problem	Restart
System RAM Error	System RAM lock	Restart or contact Riels Instruments
Time or Bat Error	System date and time error	Restart or contact Riels Instruments
No display, wrong operation	Wrong wiring	Check the wiring
Keyboard is not responding	Locked keyboard or incorrect plug connection	Enter Password if the keyboard is locked

18.3 Self diagnosis and troubleshooting (on startup)

Error code	Cause	Solution
* R	1. Normal System	1. No Errors
* J	1. Device defect	1. Contact the factory
* I	1. Signal not detected. 2. Incorrect placement of the transducers or there is not enough coupling paste between the transducer connectors. 3. Transducers not installed correctly. 4. Too thick plate. 5. New coating.	1. Remove any rust, plaque or paint from the surface of the pipe and smooth it. 2. Apply the dough generously to the outside of the tube 3. Position and tighten the transducers well to the tube. 4. Check the initial parameter settings. 5. Normally, it is possible to change location. The instrument could work better in another place with less plaque and rust.
* H	1. Low Signal Power	1. See the solutions above.
* H	1. Low Signal Quality	1. Solutions listed in previous boxes.
* E	1. 4-20mA current above 120%. 2. Wrong settings on the current circuit	1. Check settings (M56) 2. Confirm if actual flow is too high
* Q	1. Frequency output above 120%. 2. Wrong settings or Actual flow too high.	1. Check settings (M67-M69) and confirm whether the actual frequency is too high
* F	1. Error during start-up. 2. Permanent error.	1. Restart If problems persist, contact the factory.

18.4 Common questions and answers

1	Q: New pipe, high quality material, all parameters installed correctly. Why is no signal detected? A: 1. Check the setting of the tube parameters, installation method and wiring connections. 2. Make sure that the coupling paste is well applied, that the tube is filled with liquid, that the spacing of the transducers is as in M25 and that the orientation is correct.
2	Q: Old tube with a lot of plaque inside, no signal detected or weak signal. How to solve? A: 1. Check that the tube is filled with liquid. 2. Try installing the Z method. 3. Carefully select a section of the tube and clean it well, apply a large strip of paste on each surface of the transducers (at the bottom) and install well. Slowly move both transducers into the direction of the other around the installation point so that the maximum signal is taken. 4. Make sure that the inside of the tube is smooth in the new positioning point and that the pipe is not distorted so that the sound waves do not bounce outside the chosen area. 5. For a thick plate inside or outside, clean the plate if possible. Note: This method may not work and wave transmission may not be possible due to the plate layer between the transducers and the tube wall).
3	Q: Why is the CL output wrong? A: 1. Check that the required current output mode is set in the M55 Window. 2. Check whether the minimum and maximum current numbers are set appropriately in the M56 and M57 windows. 3. Recalibrate CL and check in the M58 window.
4	Q: Why is the flow rate 0 when there is fluid in the tube and the “R” symbol is displayed? A: 1. Check if “Set Zero” has been performed while the liquid flows into the pipe (refer to Window M42). 2. If this has been ascertained, restore the default in the M43 window. 3. Make sure that the number in M41 is lower than the actual range.
5	Q: In an inadequate environment with an unstable power supply, can the instrument run 24/7 and last for years? A: 1. The RIF600W is designed to be reliable even under such conditions: 2. It automatically changes the signals through an intelligent internal circuit 3. It holds under strong interference conditions and can adapt to strong or weak waves. 4. It also works with a wide voltage range: 90-240 VAC or 9~28 VDC. In any case, contact Riels Instruments for assessments regarding the conditions of use of the instrument.
6	Q: Why do you get an unstable or incorrect detection even when there is no liquid or flow inside the tube? A: 1. There must be some liquid inside the tube, if not, in Window M29, set EMPTY PIPE VALUE to a level lower than the normal figure of Q (liquid filled tube), the device will make a detection of ZERO.

19.0 Appendix I: characteristics of fluids

19.1 Fluid properties

Fluid	Density (Kg/m3)	Sound speed		Delta-V / Degree °C	Kinematic viscosity	Absolute viscosity
	20 °C	m/s	ft/s	m/s / °C	m2m²/s/s	
Butyl acetate		1270	4163.9			
Ethyl acetate	901	1085	3559.7	-4.4	0.489	0.441
Methyl acetate	934	1211	3973.1		0.407	0.380
n-Propyl acetate		1280	4196.7			
Acetone	790	1174	3851.7	-4.5	0.399	0.316
Alcohol	790	1207	3960.0	-4.0	1.396	1.101
Alcohol, butyl	830	1270	4163.9	-3.3	3.239	2.688
Ethyl alcohol	830	1180	3868.9	-4	1.396	1.159
Alcohol, methyl	791	1120	3672.1	-2.92	0.695	0.550
Alcohol, propyl		1170	3836.1			
Alcohol, propyl	780	1222	4009.2		2.549	1.988
Ammonia	770	1729	5672.6	-6.7	0.292	0.225
Anillina	1020	1639	5377.3	4.0	3.630	3.710
Petrol	880	1330	4363.5	4.7	0.711	0.625
Benzene, ethyl	867	1338	4389.8		0.797	0.691
Bromine	2930	889	2916.7	-3.0	0.323	0.946
n-Butane	600	1085	3559.7	-5.8		
Butirrato, etil		1170	3836.1			
Carbon dioxide	1100	839	2752.6	-7.7	0.137	0.151
Carbon tetrachloride	1600	926	3038.1	-2.5	0.607	0.968
Chlorobenzene	1110	1273	4176.5	-3.6	0.722	0.799
Chloroform	1490	979	3211.9	-3.4	0.550	0.819
Ethic ether	710	985	3231.6	-4.9	0.311	0.222
Diethyl ketone		1310	4295.1			
Dietelinglicole	1120	1586	5203.4	-2.4		
Ethanol	790	1207	3960.0	-4.0	1.390	1.097
Ethyl alcohol	790	1207	3960.0	-4.0	1.396	1.101
Ether	710	985	3231.6	-4.9	0.311	0.222
Ethic ether	710	985	3231.6	-4.9	0.311	0.222
Ethylene glycol	1110	1658	5439.6	-2.1	17.208	19.153
Freon R12		774.2	2540			
Diesel	700	1250	4098.4			
Glycerine	1260	1904	6246.7	-2.2	757.100	953.946
Glycol	1110	1658	5439.6	-2.1		
Isobutanol	810	1212	3976.4			
Iso-butane		1219.8	4002			
Isopentane	620	980	3215.2	-4.8	0.340	0.211
Isopropanol	790	1170	3838.6		2.718	2.134
Isopropyl alcohol	790	1170	3838.6		2.718	2.134
Kerosene	810	1324	4343.8	-3.6		
Linalool		1400	4590.2			
Linseed oil	925-939	1770	5803.3			
Methanol	790	1076	3530.2	-2.92	0.695	0.550
Methylene alcohol	790	1076	3530.2	-2.92	0.695	0.550
Methylene chloride	1330	1070	3510.5	-3.94	0.310	0.411
Methylethyl alcohol		1210	3967.2			

Engine oil (SAE 20/30)	880-935	1487	4875.4			
Octane	700	1172	3845.1	-4.14	0.730	0.513
Oil	970	1477	4845.8	-3.6	0.670	0.649
Castor oil	800	1250	4101			
Diesel		1530	5019.9			
Oil (lubricant X200)	910	1431	4694.9	-2.75	100.000	91.200
Olive oil	940	1458	4783.5			
Pneumatic oil		1420	4655.7			
Pentane	626	1020	3346.5		0.363	0.227
Petroleum	876	1290	4229.5			
1-Propanol	780	1222	4009.2			
Refrigerant 11	1490	828.3	2717.5	-3.56		
Refrigerant 12	1520	774.1	2539.7	-4.24		
Refrigerant 14	1750	875.24	2871.5	-6.61		
Refrigerant 21	1430	891	2923.2	-3.97		
Refrigerant 22	1490	893.9	2932.7	-4.79		
Refrigerant 113	1560	783.7	2571.2	-3.44		
Refrigerant 114	1460	665.3	2182.7	-3.73		
Refrigerant 115		656.4	2153.5	-4.42		
Refrigerant C318	1620	574	1883.2	-3.88		
Silicone (30cp)	990	990	3248		30.000	29.790
Methylbenzene	870	1328	4357	-4.27	0.644	0.558
Transformer oil		1390	4557.4			
Trichlorethylene		1050	3442.6			
1,1,1-Trichloro-Ethane	1330	985	3231.6		0.902	1.200
Turpentine	880	1255	4117.5		1.400	1.232
Distilled water	996	1498	4914.7	-2.4	1.000	0.996
Heavy water	1000	1400	4593			
Sea water	1025	1531	5023	-2.4	1.000	1.025
Wood alcohol	791	1076	3530.2	-2.92	0.695	0.550
m-Xylene	868	1343	4406.2		0.749	0.650
o-Xylene	897	1331.5	4368.4	-4.1	0.903	0.810
p-Xylene		1334	4376.8		0.662	

19.2 Sound speed for water

Temperature °C	Sound speed (m/s)	Temperature °C	Sound speed (m/s)	Temperatue °C	Sound speed (m/s)	Temperature °C	Sound speed (m/s)
0	1402.3	34	1515.7	68	1554.3	75	1555.1
1	1407.3	35	1519.7	69	1554.5	76	1555.0
2	1412.2	36	1521.7	70	1554.7	77	1554.9
3	1416.9	37	1523.5	71	1554.9	78	1554.8
4	1421.6	38	1525.3	72	1555.0	79	1554.6
5	1426.1	39	1527.1	73	1555.0	80	1554.4
6	1430.5	40	1528.8	74	1555.1	81	1554.2
7	1434.8	41	1530.4	75	1555.1	82	1553.9
8	1439.1	42	1532.0	76	1555.0	83	1553.6
9	1443.2	43	1533.5	77	1554.9	84	1553.2
10	1447.2	44	1534.9	78	1554.8	85	1552.8
11	1451.1	45	1536.3	79	1554.6	86	1552.4
12	1454.9	46	1537.7	80	1554.4	87	1552.0
13	1458.7	47	1538.9	81	1554.2	88	1551.5
14	1462.3	48	1540.2	82	1553.9	89	1551.0
15	1465.8	49	1541.3	83	1553.6	90	1550.4
16	1469.3	50	1542.5	84	1553.2	91	1549.8
17	1472.7	51	1543.5	85	1552.8	92	1549.2
18	1476.0	52	1544.6	86	1552.4	93	1548.5
19	1479.1	53	1545.5	87	1552.0	94	1547.5
20	1482.3	54	1546.4	88	1551.5	95	1547.1
21	1485.3	55	1547.3	89	1551.0	96	1546.3
22	1488.2	56	1548.1	90	1550.4	97	1545.6
23	1491.1	57	1548.9	91	1549.8	98	1544.7
24	1493.9	58	1549.6	92	1549.2	99	1543.9
25	1496.6	59	1550.3	93	1548.5		
26	1499.2	60	1550.9	94	1547.5		
27	1501.8	61	1551.5	95	1547.1		
28	1504.3	62	1552.0	96	1546.3		
29	1506.7	63	1552.5	97	1545.6		
30	1509.0	64	1553.0	98	1544.7		
31	1511.3	65	1553.4	99	1543.9		
32	1513.5	66	1553.7				
33	1515.7	67	1554.0				

19.3 Speed of sound by type of pipe material

Tube material	Sound speed (m/s)
Steel	3206
ABS	2286
Aluminum	9048
Brass	2270
Iron	2460
Bronze	2270
Fiber glass	3430
Glass	3276
Polyethylene	1950
PVC	2540

Coating	Sound speed (m/s)
Teflon	1225
Titanio	3150
Cemento	4190
Catrame Epossidico	2540
Porcellana	2540
Vetro	5970
Plastica	2280
Polietileno	1600
PTFE	1450
Gomma	1600

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