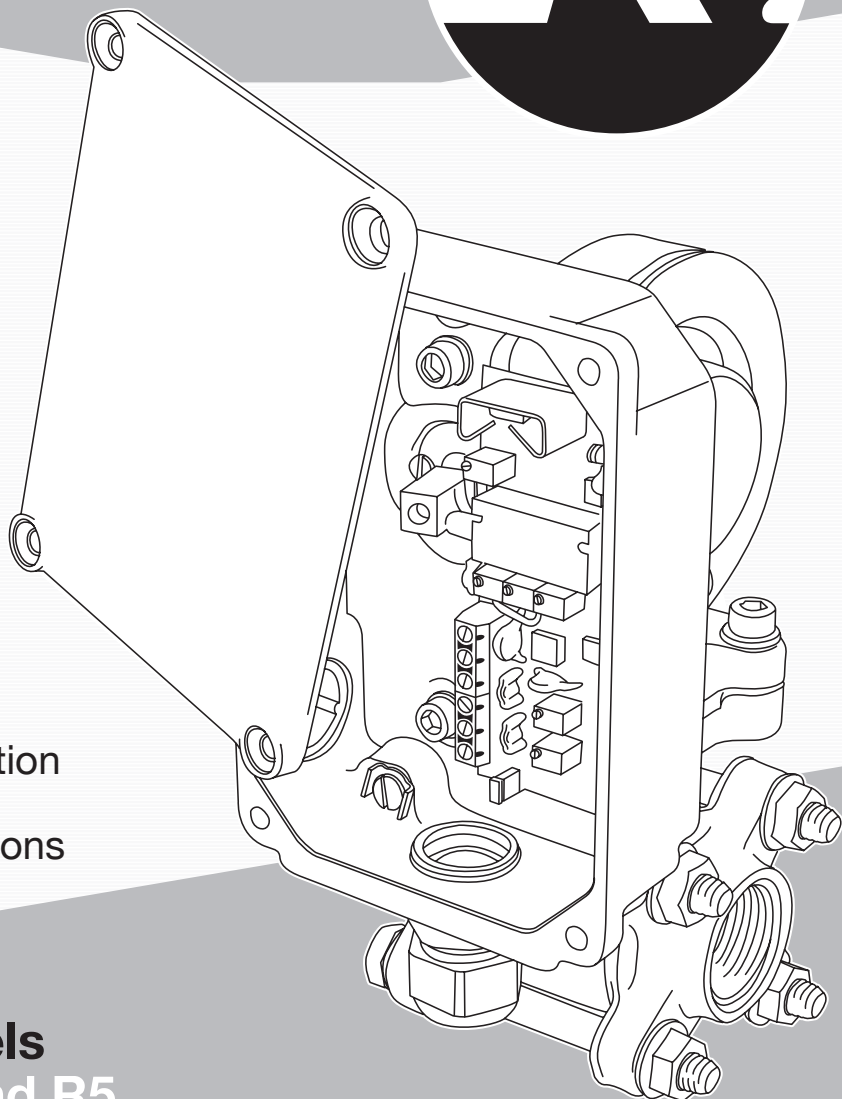


Eletta Flow Monitor



Installation
and
Operations
Manual

Models
R2 and R5



— FLOW MONITORS —

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Even if we have tried to write this manual as carefully and comprehensive as possible from the beginning, we understand that you can run into problems which are not clearly described in this manual. In the unlikely event of such an incident, we kindly ask you to make sure that you go through the manual carefully, before contacting our Distributors or Eletta Flow AB in Sweden. This is to save valuable time for any of us involved in the Eletta Products, as it is sometimes easy to overlook a specific section in the manual. If you after doing this, still not are able to solve the problem our Customer Service staff, at the below numbers and addresses, are more than happy to help you.

You will also find useful information about our Products and organization on our comprehensive homepage, which you can find at the address below.

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General Information

1.1 Description

The Eletta Flow Monitor is used to control and measure flow of liquids and gases in pipes from size 15 mm to 500 mm (larger sizes as an option). The monitors have been manufactured for over 65 years and are well known for its reliability. They are used where operational safety demands, efficient supervision and rugged installation is needed, all over the world. Eletta Flow AB in Sweden is certified according to ISO 9001 and ISO 14001.

The Eletta Flow Monitor is based on the proven and dependable differential pressure principle, using interchangeable orifice plates for different measuring ranges. The Flow Monitors are working with two different differential pressure ranges, i.e. 50 - 200 mbar for the R2 and 22 - 550 mbar for the R5, depending on the desired and ordered flow range. The same goes for our models; V1 and V15, S2 and S25 and D2 and D5. Due to the working principle of the instrument, it is of utmost importance that the installation instructions (chapter 2.3) are followed carefully in order to get the proper function of the instrument. The Eletta Flow Monitor models R2 and R5 will give you an accuracy of $\pm 3\%$ F.S. (Full Scale) if installed in the right way. (See chapter 1.2 "Specifications", for complete information.)

The Instrument consists of two parts mainly i.e. the Pipe Section and the Control Unit. The Pipe Section is the part that is to be mounted in the process pipe and the Control Unit is mounted directly (standard) or remote on/to the Pipe Section. The Control Unit contains the electrical circuit board which is giving you flow information through the dual outputs, 4 - 20 mA and/or 200 - 1000Hz. The Pipe Sections are available with different process connections in the following standards;

Threaded connections in BSP or NPT from 15 mm ($\frac{1}{2}$ ") to 40 mm ($1 \frac{1}{2}$ ") depending on the chosen material of construction.


Flanged (wafer) connection from DN15 /PN16 (ANSI 1/2"/150 lbs) to DN 500/PN16 (ANSI 20"/150lbs) depending on the chosen material of construction. The DIN-standard flangedunits are colored *blue*, the ANSI-standard units are colored *green* (>50 mm < 100 mm) for easy recognition in the field.

The Control Units R2 and R5 have no local readout but gives you the flow information through one analog current 4 - 20 mA/1000 ohm output and/or a frequency 200-1000 Hz 0-10 VDC or open collector 24 VDC max.

The mechanical movement on the diaphragm lever created by the differential pressure in the pipe is acting on the rubber diaphragm in the same way as our other mechanical Flow Monitors. The diaphragm lever connected to the diaphragm is acting on a linear potentiometer placed on the circuit board in the Control Unit. As our Monitors have a linear function between the differential pressure and the flow, the circuit board will give you a linear flow output, described above. The difference to our mechanical series, V- and S- , is that in the R-model there is no mechanical linkage acting on micro switches, as the unit lacks them, only the potentiometer giving information to the circuit board. Since there are fewer moving parts and less mechanical linkage in the Control Unit, the R-series will give you a higher accuracy than V- and S-series.

Product label

Each of our flow monitors wear a product label, see picture below with description.

 Phone +46 (0)8 6030770 www.eletta.com	
Type:	Temp:
Range:	Max Pressure:
Liquid:	Protection Class:
Model:	Std:
No:	CE

- Type: Model type of the flow monitor. For example V15-GL15. Reference to section 1.2 Specifications for a thorough description of available types.
- Temp: The maximum operation temperature allowed for the control unit. Reference to section 1.2 Specifications for a thorough description of available types.
- Range: The flow range for which the flow monitor have been manufactured.
- Max Pressure: The maximum operation pressure allowed for the flow monitor.
- Liquid: The media which the flow monitor have been designated for. Examples: Water, oil etc.

- Protection class: IP -classification (International protection rating), of the control unit.
- Model: The article number of the flow monitor.
- Std: Pipe standard for which the flow monitor is designated. For example: DIN PN16, Dimensions according to DIN and pressure classification according to PN16.
- No: Serial number of the flow monitor. Each of our flow monitor have their own unique id number, which is used for traceability.
- Year of manufacturing.

1.2 Specifications

The *only* difference between the R2 and R5 is the turn down of the flow range i.e. the R2 has a 1:2 turn down (for example; 50 -100 l/min) and the R5 has a turn down of 1:5 (for example; 40 - 200 l/min).

Accuracy: <+/- 3 % F.S (full scale)

The accuracy stated is achievable if the installation instruction given in this manual is followed. It is recommended that you always chose the Flow Range of the Flow Monitor so that the normal process flow is in the middle of the Monitor Flow Range. For example: If you have a flow of 110 l/min maximum and the normal Flow is at 90 l/min, chose the Eletta Flow Monitor R2 with a Flow Range of 60 - 120 l/min. This will give you the highest accuracy since your flow is in the middle of the Monitor Flow Range and also give you a lower pressure loss.

Repeatability: < 2 % on actual value

Pressure: Max: 16 bar (232 PSI), higher test pressure as an option.
Min: A line pressure of appr. 0,7 - 1,0 bar is required for proper operation.

Temperature: **Control Unit**

0°C to 65°C (-4°F to 150°)

Higher process temperature possible with remote installation of Control Unit (separate mounting, see section 2.4).

Pipe Section: The FA- Pipe Sections are equipped with spacers (holding the orifice plate) made of Polyamide plastic (PA) and they can handle liquid/gas temperature up to 120°C (248°F). For higher process temperature, we recommend to use the stainless steel Pipe Section, which has no spacers.

Process connection: DN15 - 40 (1/2" - 1 1/2") for GL-models
 DN15 - 25 (1/2" - 1") for GSS -models
 DN15 - 400 (1/2" - 16") for FA-models
 DN15 - 500 (1/2" - 20") for FSS-models

Control Unit: IP65 (NEMA 4), standard
 Aluminum alloy, alodine and epoxy polyester coated
 Cable gland of plastic included

Power supply: 24 VDC +/- 10%

Output signals: Isolated Analog current 4 - 20 mA, 1000 ohm max (including cables), zero- based as a standard calibration (non-zero based optional). See chapter 2.7 for explanation. Isolated Frequency 200-1000 Hz. Amplitude 0-10 VDC or open collector max. 24 VDC (jumper position described in chapter 2.7). Zero-based as a standard calibration (non-zero based optional). See chapter 2.7 for explanation. The two output signals can be used together or individually at your choice. Connections at the terminal block:

- 1-2 Power supply 24 VDC +/- 10%
- 3-4 Analog output
- 5-6 Frequency output
- 2,4,6 GND (zero) galvanic separated from power ground

Recommended cable: Shielded twisted pair, min. 0,2 mm² (0,0031 inch²)

Current consumption: Max. 50 mA

Material; Diaphragm housing and pipe section:

Type GL: De-zincificated brass, CW602N, EN12420

Type GSS: Seaworthy stainless steel 1.4527

Type FA: Housing: De-zincificated brass, CW602N, EN12420
 Pipe section: <DN50 (ANSI 2") Bronze CC491K / EN1982
 >DN50 (ANSI 2") Painted cast iron, GG25 / DIN1691

Type FSS: Housing: Seaworthy stainless steel 1.4527 / EN10283
 Pipe section: Stainless steel 1.4435

Material

diaphragm: Textile reinforced Hydrated Nitrile rubber (HNBR), standard except stainless steel.
 Textile reinforced EPDM rubber, optional all models
 Textile reinforced Fluorinated rubber, FPM, standard in stainless steel models, optional for all others.

Material, O-rings and sealings:

Follows the Diaphragm materials

Spacer: (FA and GL)

The spacer holds the orifice plate inside the pipe section and are made of Polyamide plastic (PA) as a standard. Max.liquid/gas temperature is 120°C (248°F)

Intrinsically Safe (Ex i):

The R-series Flow Monitors are **not approved** for Ex-hazardous areas.

Explosion Proof: The R-series Flow Monitors are **not approved** for Ex-hazardous areas.

CE-approvals:

The Eletta Flow Monitors conforms with the EU directive for low voltage no: 72/23/EEC (EN 60 204-1, Part 1.) We refer to the certificates issued, which will be sent to you upon request. They can also be found on www.eletta.com.

**PED-
Directive:**

Complies with applicable parts in Pressure Equipment Directive 97/23/EC. Conformity assessment has been performed according to module A. Internal production control combined with module A1. Internal manufacturing checks with monitoring of the final assessment, for category 2. Performed by Inspecta AB, Notified body No. 0409. PED Declaration of conformity will be sent to you upon request and are also available on www.eletta.com.

Installation

2.1 Unpacking

We appreciate that you have decided to purchase our Product and we would like to ask you to begin the installation by checking your delivery against the Packing List. Please make sure to check the delivery box for external damages before opening. If you find external damages, which have also led to damages to the Flow Monitor inside, you should contact the forwarder/shipper to claim replacement (or the cost of replacement). Check the Monitors' identification tag against your purchase order to make sure you have got the right articles with the right specifications.

All Monitors are individually packed in plastic bags and put into the box either two by two or individually in each box. The plastic bag is to prevent foreign particles to get inside the Pipe Section, which could prevent proper function of the Flow Monitor after the installation.

The box is made out of recycled environmental friendly material and we kindly ask you to deal with the waste material in a way that will have as little impact to the environment as possible.

2.2 Procedures before Installation

Note!!! Before any installation or maintenance work, disconnect all electrical power!

Please check that you are going to mount the Monitor in the lowest point in the piping system if you are measuring liquids and at the highest point if you are measuring gases. Also check if the planned flow direction in the system matches the one indicated on the Monitor. There is a red flow direction arrow on the outside of the Pipe Section (not the Stainless Steel models which have a marking engraved on the side). If you find this to mismatch, we refer to section 3.3 "Change of Flow Direction", to adjust the internal flow selector in order to match the desired flow direction. Change of flow direction on our Stainless Steel Pipe Sections (FSS/GSS) is **not** possible in the field without ordering a new Pipe Section and we kindly ask you to contact your local representative or Eletta Flow AB, Sweden for help.

Check that the Pipe Section has the right threads or the right flange standard to match your piping and counter flange.

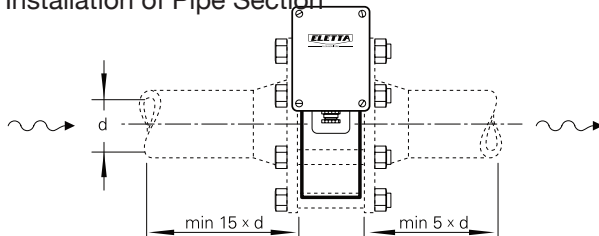
If you are using the separate/remote execution i.e. Pipe Section and Control Unit installed in different locations, please check the plastic hoses supplied with the Monitor for any damages or holes that can prevent proper function. The plastic hoses should not be used in temperatures over 90°C/16 bar (194°F/232 PSI). If your application temperature exceeds this temperature/pressure, we recommend to use copper or stainless steel tubing, depending on the compatibility to the measured gas or liquid (see section 2.4).

2.3 Installation of the Pipe Section

Note!!! Before starting to install the Pipe Section, please make sure that the piping is not under pressure from flow of liquid/gas!

The Pipe Section can be installed in any desired direction, vertical, angled or horizontal and the direction arrow on the Pipe Section denote the direction of the flow. It is very important that the Pipe Section is mounted with the correct direction, as the function of the Flow Monitor otherwise will be prevented. The piping shall be rigid and free from vibrations and hoses connected directly into the Monitor should be avoided as much as possible. If you have weak piping we advise you to use the M6 mounting holes (only on GL-series) on the back-side of the Pipe Section, to fasten the Pipe Section to a wall or a rigid bracket. The straight runs before and after the Monitor should not be to short, in order to avoid disturbances, which can cause the Monitor to show incorrect values. We recommend giving at least 10 -15 diameters upstream and 5 diameters downstream. Please see Fig.1.

Fig.1 Installation of Pipe Section



The reason for this procedure is to achieve a stable flow profile inside the pipe and by doing so, get a true reading. Please be aware of the fact that it is practically impossible to theoretically predict when the flow is stable after disturbances in the piping, so this must serve as a guideline only. The Monitor can give you a reading which is off from the calibration, if the straight runs are not within specifications.

The straight runs must be free from valves, bends or in/decreasing diameters. Any of such disturbances must be placed **before** and **after** you start counting the straight runs.

If you are installing the threaded versions, GL and GSS-versions, please make sure that you are not using “tube fittings”. We have often seen them to have a much smaller inside diameter than the Pipe Section, even though the size of the thread is alright. This can create a jet stream of the fluid or gas through the orifice plate, which will cause the differential pressure to be too low and you will not get a good or accurate reading.

The following inside diameters apply for the threaded Pipe Sections:

GL-and GSS-15 = **16 mm**

GL-and GSS-20 = **21 mm**

GL-and GSS-25 = **26 mm**

GL-and GSS-40 = **41 mm**

Make sure that the Control unit, if mounted directly on the Pipe Section, is placed on top of the Pipe Section and not under to prevent particles in the fluid to collect in the diaphragm housing. Please use a filter in the pipeline if you suspect the fluid to contain particles.

The flanged models, FA- and FSS-versions, must be properly aligned with the counter flange and not placed under stress by tightening the bolts uneven. The flanged models come with a gasket and we recommend using this, as it is dimensioned to suit the installation. Please see to that the gasket is properly aligned with the inner diameter and not disturbing the flow. It is also of utmost importance that the connecting pipe and flange is of the same diameter (inside) and standard as the Pipe Section. A mismatch can cause an erratic or incorrect reading of the flow. If needed, please support the Flow Monitors with rigid brackets. There is no problem in attaching them directly to the Flow Monitor, but we recommend mounting them in the pipeline downstream and upstream to avoid unnecessary stress in the installation area.

2.4 Separate mounting of the Pipe Section and the Control Unit

Sometimes separate mounting of the Pipe Section and the Control unit is requested due to vibrations, high temperature or lack of space. As the Eletta Flow Monitor is using the differential pressure caused by the orifice plate mounted in the pipeline and directs these two pressures via two

individual ports up to the Control unit, it is also possible to separate the Monitor into two parts. The pressure is then lead through either plastic hoses or metallic tubing depending on the liquid, pressure and temperature. As a standard, we supply 2x1,75 meter (5.74 feet) of PA plastic, Ø 6 mm (0,23 inch) hoses capable of handling 90°C (194 °F) and 16 bar (232 PSI), together with two specially made adapters to be mounted on the Pipe Section and Control Unit respectively. If your application requires metallic tubing (copper or stainless steel) it has to be provided locally. If you are measuring a chemical, check with the supplier which material you should use in your tubing. Please make sure to use 6 mm tubing in order to suit the tube fittings included in the delivery. There is no actual limitation in the length of the hoses or tubing, but we recommend to place the units as close as possible to each other, as this will help in trouble shooting and on-site calibration. If you mount valves (not included in delivery) in the pressure hoses/tubing, it will help you to easily shut them off and remove/exchange the Control Unit at full process pressure. The Mounting of three-way/five-way standard valve (not included in delivery) will allow you to discharge any entrapped air/gas or condense and also provide the possibility to even out the pressure between the plus and minus leg.

Please follow the “Installation of the Pipe Section” after you have mounted the adapter to the Pipe Section. As you will use hoses/tubing to lead the pressure up to the Control Unit, it is possible to mount the Pipe Section in any direction, vertically or horizontally and with the pressure ports pointing up, down or to the side (pls. refer to section 2.3).

Fig.2 Separate mounting of Pipe Section –GL/FA

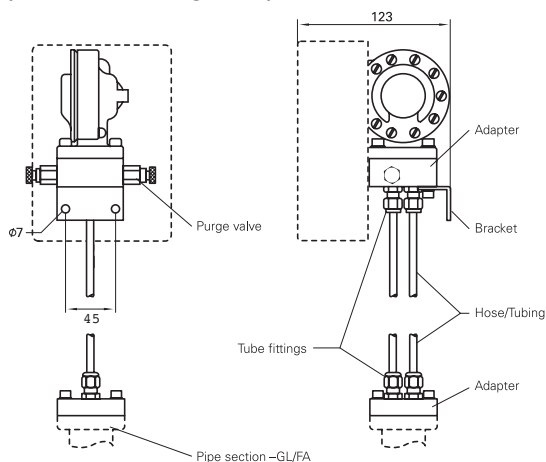
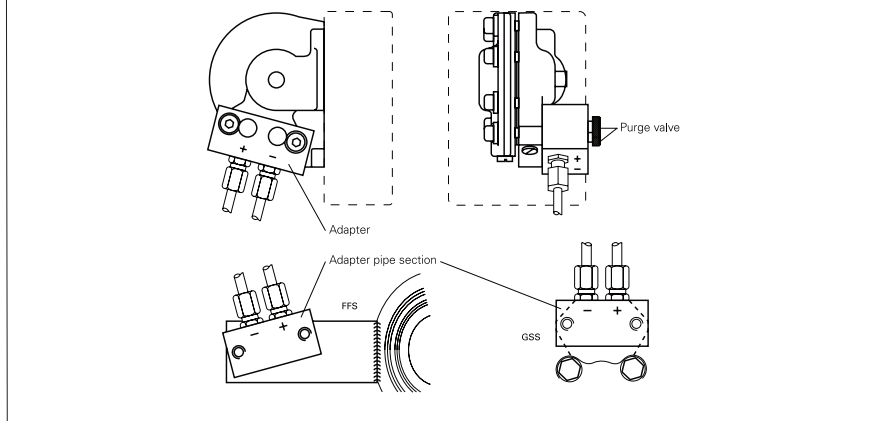


Fig.3 Separate mounting of Pipe Section –GSS/FSS



Find a suitable place for the Control Unit to be mounted. Use the supplied bracket to mount it to a wall, pipe or another steady and rigid support. Please plan this with respect to later mounted piping or other obstacles.

Install the hoses/tubing, commencing with the Pipe Section. Check that you have enough length to cover the distance between the Pipe Section and Control Unit. The Pipe Section adapter has a (+) and (-) marking engraved and the adapter on the Control unit also. Please make sure to match (+) to (+) and (-) to (-) on the adapters. Press the hose/tube end into the coupling and tighten with care. Proceed to the Control Unit and repeat the above.

When you fill up the system for the first time with liquid, please make sure that all entrapped air in the piping between the Pipe Section and Control Unit is removed. The air can otherwise, as it is a compressible media, cause faulty Flow readings.

2.5 Installation and changing of the Control Unit

As all Eletta Flow Monitors are designed in sections to achieve a modular and versatile instrument, there is a possibility to upgrade/rebuild them and adding other features to your already installed Monitor, by changing the Control Unit or Pipe Section. If you, for example, would like to upgrade a **V-series** (V1, V15), without local indication and one micro switch, to an **R-series** (R2, R5) including an analog or/and frequency output or the other way around, this is easily done. You simply order a Control Unit with the flow range you need, to get the right calibrations for the outputs.

You will get the Control Unit with the diaphragm housing included. Make sure you order the right material in the diaphragm housing and the soft rubber parts (diaphragm, o-rings and lever) and you will get the Control Unit already tested and calibrated and ready to fit onto the Pipe Section, without any on-site adjustments or re-calibration. All Eletta DP Flow Monitors work with the same differential pressure within their specific range (pls. see section 1.1).

If you have a Pipe Section designated; **-GL or -GSS (-FSS), start with making sure that there is no pressure in the system**, as these Pipe Sections do not have any shut-off valves for isolating them from process pressure. **Turn the electric power supply off** and then disconnect the cables from the terminal block. If you have a Pipe Section designated; **-FA** you will find the included shut-off valves under the brass elbow, which connects the Control Unit to the Pipe Section. Turn them counter-wise until you feel the end position and this shuts off the pressure up to the Control Unit and you can easily remove this. If you have a Pipe Section designated; **-FSS**, there is an option to buy this with a shut-off manifold, but it will not come as a standard.

On the -GL Pipe Section; loosen the four (4) hexagon screws that holds the diaphragm housing (do not remove the blue housing at any time) to the Pipe Section, and replace the four O-rings in the flow direction selector to the right material if necessary. Install the new Control Unit and tighten the four (4) hexagon screws firmly again.

On the -GSS Pipe Section; loosen the two (2) hexagon screws that holds the diaphragm housing and replace the O-rings to the right material, if necessary. Install the new Control Unit and tighten the two (2) screws firmly again.

On the -FA Pipe Section: shut off the two (2) included valves as per above and then untighten the four (4) screws which hold the diaphragm housing. Remove the housing and replace the O-rings to the right material, if necessary. Install the new Control Unit and tighten the four (4) screws firmly again. Do not forget to open the two (2) shut-off valves again, in order to get a proper function!

On the -FSS Pipe Section: If you have a Monitor that has a shut-off manifold, you can close the two (2) valves to get the diaphragm housing non-pressurized. Otherwise, start with checking that there is no pressure in the pipe system and up to the diaphragm housing. Loosen the two screws that hold the diaphragm housing and replace the O-rings to the right material, if necessary. Install the new Control Unit and tighten the two (2) screws firmly again.

If shut-off manifold is installed; do not forget to open up the two (2) shut-off valves again, in order to get a proper function of the Flow Monitor.

Connect the electrical cables according to your new Control Unit's possibilities and for detailed information regarding wiring, please see section 2.7 "Electrical installation".

2.6 Pressure Drop

The Eletta Flow Monitor is a differential pressure measuring device and therefore it creates a certain pressure drop when in function. There are two different types of Pressure Drop's involved, **actual pressure drop** and **permanent pressure drop**. Below we will explain the difference between these two: When the orifice plate mounted in the Eletta Flow Monitor reduces the flow area inside the pipe system, a pressure drop over the orifice is created. This is what we call **actual pressure drop**. Please refer to chapter 1.1 "Description" for actual pressure drop description (differential pressure). The calculation of the flow is using this pressure drop to calculate the actual flow value (see calculation below). This **actual pressure drop** is a temporary pressure state and the Eletta Flow Monitors are working within this differential pressure created, within the Flow range of the Monitor. When the flow has passed the Monitor, the pressure is then trying to get back to its original pressure and normally after 10 – 15 times the inner diameter of the pipe, the flow becomes linear and fully developed. This is a normalized flow but due to pressure losses over our Flow Monitor, the pressure will not be able to reclaim all the energy (pressure). This is what we call permanent pressure loss. The **permanent pressure drop** can be calculated approximately by $\Delta p (1-\beta^2)$, where the symbols represent:

Δp = differential pressure at measured flow and $\beta = d/D$ ratio (ratio between bore and inner diameter of the pipe)

This means that for the normal β range (0.2 – 0.7) a typical permanent pressure loss ranges from **0.96 Δp** and **0.51 Δp** can be expected.

Example: for the Eletta Flow Monitor R2-GL15 and a flow range of 10 – 20 l/min, the following calculation can be used as an example;

d (bore) = 10.20 mm

D (inner diameter) = 16 mm

gives $\beta = 10.20/16.00$ which results in $(1-\beta^2) = 0.594 * \Delta p$.

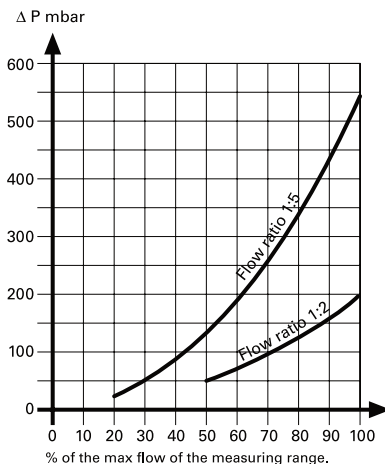
Actual pressure drop (Differential pressure) at a flow of 15 l/min in the above example = 112,5 mbar (see calculation under the fig.4).

Taken the above into consideration, at flow of 15 l/min, the mentioned Flow Monitor will have an approximate **permanent pressure loss** of; $0.594 * 112,5 \text{ mbar} = \mathbf{66,82 \text{ mbar}}$.

The pressure loss curves in the graph (fig.4) must serve as a guideline.

The following formula can be used to calculate the **actual pressure drop** at a given flow if you have another flow than in the above example:

Fig.4 Actual pressure drop graph



$$\Delta p = (Q/Q_{\max})^2 * 200$$

for turn down ratio of 1:2

and

$$\Delta p = (Q/Q_{\max})^2 * 550$$

for turn down ratio of 1:5

Where **Q** = actual flow in l/min and

Q_{max} = maximum flow of the Flow Monitor in l/min (installed orifice plate)

Δp = actual pressure drop in mbar

2.7 Electrical Installation

Note!!! An authorized professional person should make all electrical installations.

Before you connect any cables, please make sure that you have the right power supply and that it is within the specifications (see section 1.2 "Specifications"). Our recommendations for the output signal cable is shielded twisted pair with an area of minimum 0,2 mm² (0,0031 inch²). Only connect the shielding in one end (instrument) to avoid ground loops.

The instrument will drive the analog output (and the frequency output if desired) and you must not connect a two-wire circuit into these terminals.

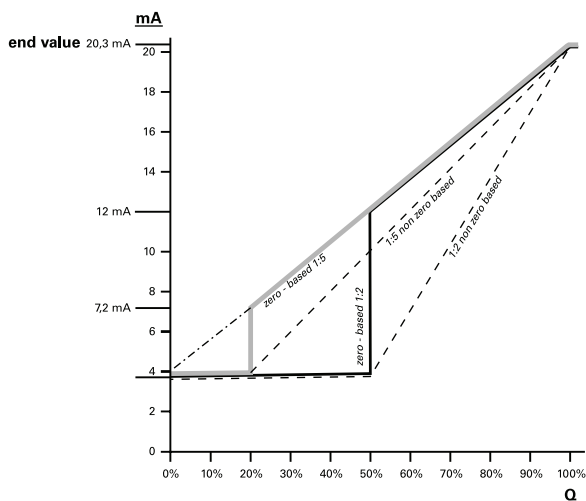
As the frequency output can be set for either 0-10 VDC amplitude or open collector (max. 24 VDC+/-10%) you will find a jumper on the circuit board under the terminal block. When the jumper is placed in the lower position, it will give you 0-10VDC and an open collector possibility in the upper position.

The analogue output signal is pre-calibrated in our flow rig to give you a zero-based signal. This means that you will get a 4 mA reading when the flow is between zero (0) and up to the minimum possible reading of the Flow Monitor and when the flow hits the minimum flow, the signal will jump to the linear part of the signal. For example: a R2 Flow Monitor with a turn down of 1:2 in flow will have the output signal showing 4 mA between 0 and 50% of the maximum flow and the jump up to 12 mA when it hits 50% of the possible flow range and then be linear up to 100% flow. This means that the used millampere signal within the flow range, goes from 12 mA to 20 mA.

The R5 Flow Monitor will then go from 7,2 mA to 20 mA within the possible flow range (20% - 100% flow) and the frequency signal follows the same pattern, a R2 Flow Monitor goes from 600 - 1000Hz with in possible flow range of the Monitor and the R5 gives you 360 - 1000Hz respectively.

A non-zero based output signal/s can be ordered as an option (see Fig.5).

Fig.5 Zero/Non-zero based calibration



All terminal block connections are to be made through the included cable gland (PG11) and please note that you have two alternative mountings of the cable gland depending on what side you want to enter with the cables. We recommend the entry of the cables into the enclosure to be placed in a downward or sideways direction, to avoid moisture/water to collect in the enclosure.

It is not allowed to install the R-series Flow Monitor in an Ex-hazardous area. The terminal block connections are described in the fig.6. A grounding screw is to be found at the side of the terminal block.

Fig.6 Wiring diagram

Input		Output		Output	
24 VDC		4–20 mA		200–1000 Hz	
+	-	+	-	+	-
1	2	3	4	5	6

Operation

3.1 Principle of operation, DP-Flow Measurement

The Eletta Flow Monitor's function is based on the proven and dependable differential pressure principle, using interchangeable sharp-edge orifice plates for different measuring ranges. This is perhaps the oldest and most widely used principle for flow metering, mainly because of its simplicity, its relatively low cost and high volume of research data available for predicting the Flow Monitors behavior. In the Pipe Section, a fixed area flow restriction (the orifice plate) causes a pressure drop, which varies with the flow rate. This pressure drop has a high and a low pressure, which is lead through two channels from each side of the orifice plate, to the Control Unit. By measure the pressure drop allows flow rate measurement by means of a mathematical formula. A short form of the calculation can be described as $Q = \sqrt{\Delta p}$.

In most Eletta Flow Monitors, the differential pressure is sensed and measured mechanically via a rubber diaphragm and linked to the outside of the process liquid/gas, mechanism. This mechanism transforms the movement into a Flow rate value given through the output signal/s in the A- and R-series. All the Eletta Flow Monitors are tested and approved according to the European CE-mark regulations. (Pls. contact your rep.company or Eletta Sweden for copy of certificate.)

The R-series Flow Monitors have zero-based output signals as a standard with the possibility to order non zero-based as an option. Please refer to section 2.7 "Electrical Installation" for details of the output signals. Do not try to adjust or change the output signal/s in the field, as this has to be done in a flow rig against a calibrated reference meter.

3.2 Change of Flow Range

The Eletta Flow Monitor features an orifice construction that does not require recalibration after replacement and can easily be rebuilt in the field to change the flow range to another from the flow rate ordered. This is valid for all Pipe Sections except the GSS/FSS-models where you have to order a completely new Pipe Section, as the orifice plate is an integrated part of the Pipe Section, if you need another flow range than ordered originally. The orifice plate inside the Pipe Section is the only part in the liquid/gas that has to be changed. You can order and change any flow range that suits your specific application, as long as the new flow rate falls within the total possible span for the actual Flow Monitor (see Flow Rate table in section 5.1.).

In each case of rebuilding the flow Monitor in the field, we kindly ask you to consult Eletta or your local Distributor for advice of the right orifice plate before ordering.

Note!!! First empty the piping system so it is un-pressurized and has no flow!

For threaded model -GL:

Untighten the bolts that hold the Pipe Section between the flanges in the piping. (Do not remove the threaded parts from the piping.) Remove only the number of bolts necessary to pull the Monitor from the piping, normally it takes only one bolt from the highest position, to get the Monitor out. Take out one of the spacers that holds the orifice plate. Change the orifice plate to the new ordered orifice plate and remember that you can install it in any direction. Reinstall the spacer that holds the orifice in place inside the Pipe Section. Install the Monitor in the piping system and tighten the bolts firmly to avoid leakage.

For threaded stainless steel model -GSS:

In this model there is no loose replaceable orifice plate and therefore it is necessary to change the complete orifice section with holder, to achieve a new flow range.

Please follow the above instructions for the -GL model for dismantling the whole orifice plate with holder. Remove the Control Unit from the old Pipe Section (orifice section) and install this to the new Pipe Section. Remount the Flow Monitor into the piping system and tighten the bolts firmly.

For flanged model -FA:

Follow the procedure above to loosen the Pipe Section from the counter flanges in the piping system, but note that the spacer ring is hold in place with two screws, which has to be removed before removal of the spacer.

For flanged stainless steel model -FSS:

In this model there is no loose replaceable orifice plate and therefore it is necessary to change the complete pipe unit to achieve a new flow range. Follow the procedure above to loosen the Pipe Section from the counter flanges in the piping system. Remove the Control Unit from the old Pipe Section (orifice section) and install this to the new Pipe Section. Remount the Flow Monitor into the piping system and tighten the bolts firmly.

Always check that no gaskets will interfere, by misaligning, with the flow when installing our Flow Monitors.

When you change the orifice plate in order to get a new flow range, it is necessary to change the identification label to a label with the new range marked. This identification plate comes together with the orifice plate when you order an orifice plate separately. Please make sure that your output signals in the receiving end PLC, display, computer etc., are matched for the new flow range. That is, if you have the receiving device set up to measure engineering units i.e. l/min, m3/h USGPM etc. If you have it set up in percentage, 20-100% for example, you do not need to make any adjustment after installing the new orifice plate. Remember that there is no need to make any adjustment to the circuit board in the Flow Monitor as the Control Unit comes fully calibrated to your specifications and must only be installed according to the above instructions.

3.3 Change of Flow Direction

At the time of ordering, you must specify in which direction the Flow Monitor shall be mounted i.e. from which side the flow is entering the Pipe Section. If, for some reason, the Flow Monitor is ordered with the wrong flow direction, it is possible to change this in the field. For the -GL and -FA models, the flow direction selector, which determines the direction, is placed between the diaphragm housing and the Pipe Section.

3.3.1 Flow direction Selector (from January 2013)

GL- and FA-models are delivered with a flow direction selector that can be used for both directions.

To change the direction, loosen the four (4) hexagon screw, which hold the diaphragm housing to the Pipe Section. Remove the diaphragm housing and you will see the flow direction selector (it might have attached itself to the bottom side of the diaphragm housing). Replace the flow direction selector in the configuration for your system (see fig. 6).

Please also remember to turn the red arrow mounted on the Pipe Section (-GL and -FA models), to align with the new flow direction.

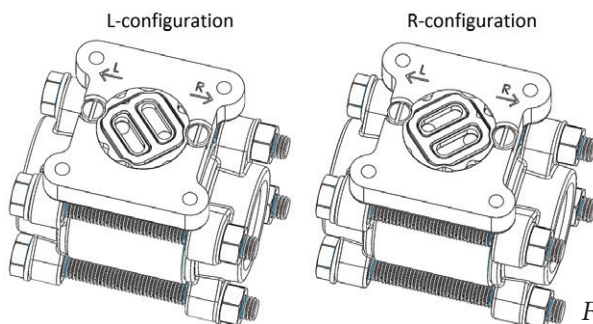


Figure 6

3.3.2 Flow Direction Selector (until December 2012)

For GL and FA models there are two flow direction selectors to choose from, the "R" and the "L" selector.

For flow according to symbol R, use the R Flow Direction selector and the opposite for L.

To change the selector, loosen the four (4) hexagon screws, which hold the diaphragm housing to the Pipe Section. Remove the diaphragm housing and you will see the flow direction selector, which is held in place by two screws. Remove the screws and change the selector. Make sure that the four o-rings are mounted correctly to avoid leakage. Mount the diaphragm housing to the Pipe Section and tighten the four hexagon screws firmly.

Please also remember to turn the red arrow mounted on the Pipe Section (-GL and -FA models), to align with the new flow direction.

For -GSS and -FSS models we refer to section 2.2.

Flow direction alternative

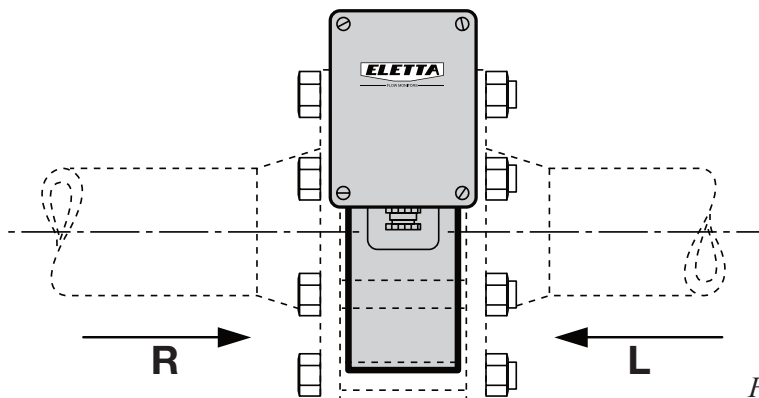


Figure 8

Trouble shooting

4.1 Verification of flow

We would like to stress the fact that all the Elettta Flow Monitors are calibrated and adjusted individually on water in a specially purpose built calibrated flow rig in our workshop. This means that we have calibrated/adjusted the Monitors under reference conditions with enough straight runs before and after, always the same liquid, temperature, flows and pressure. If you find our Monitors to show another value compared to a reference meter on site, it can well be due to the fact that the reference meter has been calibrated under other reference conditions and that our Monitor has other conditions on site in the actual application, than we used under the calibration prior to shipping. We calibrate all Monitors against flow and not pressure.

The meter is not showing any or the wrong value:

-Is the Monitor mounted correctly with respect to the flow direction? Please check the arrow on the outside of the Pipe Section with the actual (true) flow direction. For GL- and FA-models, check the flow direction selector inside the monitor. Lift the control unit and check the arrow on this part. Make sure that it is corresponding to the true flow.

-Is there any flow in the pipe? And is it enough to create the needed ΔP ?

-Do you have the right orifice plate for the application? Check the stamped values on the orifice plate (Pipe Section, model number and flow).

-If you are using tube fittings into the Monitor inlet, check that the inside diameter is enough to avoid the "nozzle" effect described in section 2.3 and also check the table for the minimum correct inner diameter in the same section.

-Are there enough straight runs upstream and downstream the Monitor? (15 diameters upstream and 5 downstream.)

Do you have valves or bends in more than one plane within the above straight runs? If so, move the Monitor further away to achieve enough straight runs.

Under section 3.1 it is described how the Monitor creates the differential pressure. Eletta Flow Monitors work with two different ΔP 's

i.e. on the R2 units the ΔP is always maximum 200 mbar and for the R5 units, the ΔP is always maximum 550 mbar. This means that at maximum ΔP the flow is always 100% in any Flow Monitor mounted on any Pipe Section. This makes it very easy to move one control unit from one pipe to another Pipe Section on another pipe in order to check the function. It does not matter what size/diameter the Pipe Section has, as we always work with the same ΔP on every pipe size.

To check if the Monitor is showing the right desired and ordered value, it is easy to remove the Flow Monitors from the pipe system and block the orifice plate and apply the correct maximum pressure at the inlet. If you apply for example **200 mbar** on the high-pressure side (P1) on R2 series with a blocked orifice, the selected output signal should reach the end value i.e 20 mA or 1000 Hz.

The same goes for a R5 model, which should reach the end value on the output signal, if you apply a pressure of **550 mbar**.

You can of course also verify the flow in the Eletta Flow Monitor versus another flow meter in the system or take the Monitor out and put in a flow test rig, if you have the possibility.

If the above is not the case there is a need to send the Monitor to the Distributor or directly to The Eletta Service department for control.

If you find process liquid/gas coming out of the Control Unit:

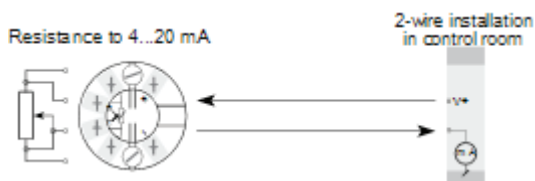
- Most probably you will find a broken diaphragm lever, the small stainless steel shaft going through a rubber sealing and it is attached to the diaphragm in the end. If you have exposed the Monitor to excessive pressure (over 16 bar/232PSI standard) or if the process liquid/gas is too aggressive to the rubber in the sealing, it can cause the sealing to break. When this happens, it nearly always causes a broken circuit board and therefore replace the whole Control Unit as this is a from the manufacturer calibrated replacement part. Do not replace the diaphragm lever only, as it is in most cases impossible to re-calibrate the R-series Monitor in the field to the right settings. Please check the identification plate/tag on the Monitor and write down the serial number, flow range and liquid before ordering a new Control Unit from your representative or us. You can then easily replace the broken Control Unit in minutes without any field calibration necessary (please section 2.5 for details on how to replace a Control Unit). If you originally ordered a specially designed Flow Monitor i.e. if it does not follow our standard execution, it must be checked what kind of soft parts (diaphragm and seals) you have installed in the Flow Monitor. There are three different kinds of rubbers to order (see section 1.2 for details) and we kindly ask you to provide us with the above information in order to help us ship you the right material.

4.2 Electrical connections

Please always see to that you are using the right voltage and current (see Specification chapter 1.2) and that you have connected all the leads in a proper way (see chapter 2.7). If you open the cover on the Control Unit of the Monitors it is normally very easy to see, if a component is broken/burned. If so, please do not try to repair the circuit board yourself. Check the identification plate/tag and write down the serial number, flow range and liquid and order a new control Unit from us. It is not advisable to order only the circuit board as the calibration of a new board must be done together with the Control Unit. We will ship you the complete Control Unit with diaphragm housing and you can easily fit the new Control Unit to your existing Pipe Section with only four (4) screws, please see section 2.5 for details.

4.3 HART® Communication

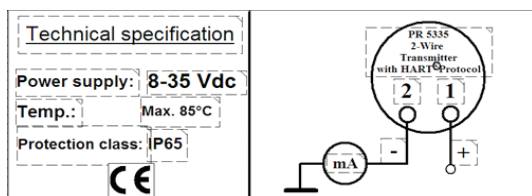
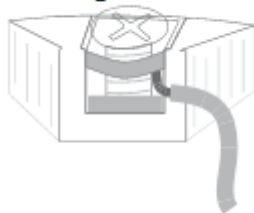
The R-series Flow Monitor can also be equipped with a HART® module instead of the standard analog electronic circuit board. When this option is chosen, the standard circuit board is replaced by an R/I-module and hence, the functions which are in the standard circuit board execution are no longer available. This module is programmed according to customer specifications before leaving the factory. It is not advisable to try to recalibrate these units on site as you need a calibration experience from Eletta Flow Monitors and to use the right tools. This HART® module works as an I/R transmitter where the movement from the lever in the Flow Monitor is transformed through the potentiometer into a HART® protocol communication. It gives a linearized flow output through the 2-wire connection. The output is galvanically isolated with a high measurement accuracy.



Schematics of the HART® module in R-series Flow Monitor

For the electrical connection, please see drawing below. There is a sticker with this connection information placed inside the cover of the blue housing

Mounting of sensor wires



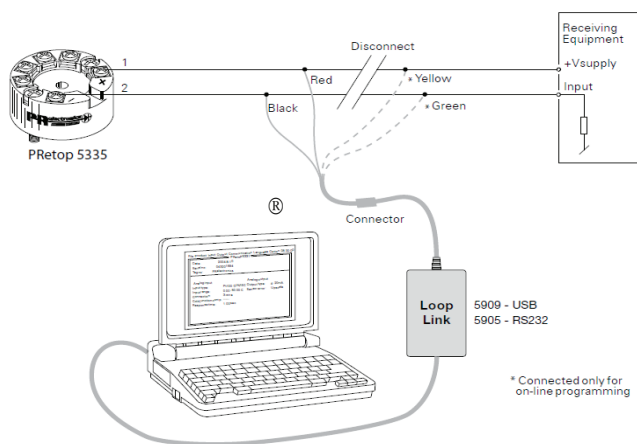
4.4 Programming of the R-series with HART® protocol

The module can be configured in the following 3 ways:

1. With the communications interface Loop Link and the PReset PC configuration software
2. With a HART® modem and Preset PC configuration software
3. With a HART® communicator and a PR DDL driver.

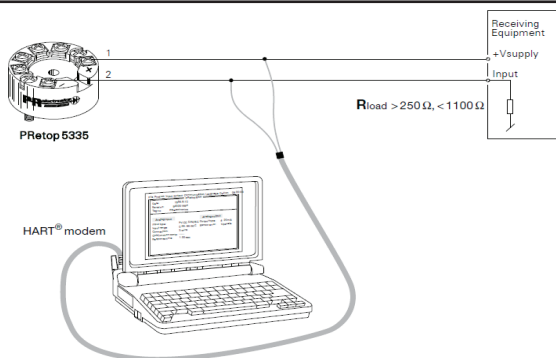
1. Loop Link

For programming, please refer to the drawing below and the help functions in PReset. Loop Link is not approved for communication with modules installed in hazardous (Ex) areas.



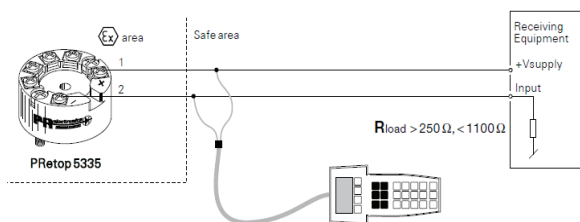
2. HART® modem

For programming, please refer to the drawing below and the help functions in PReset.



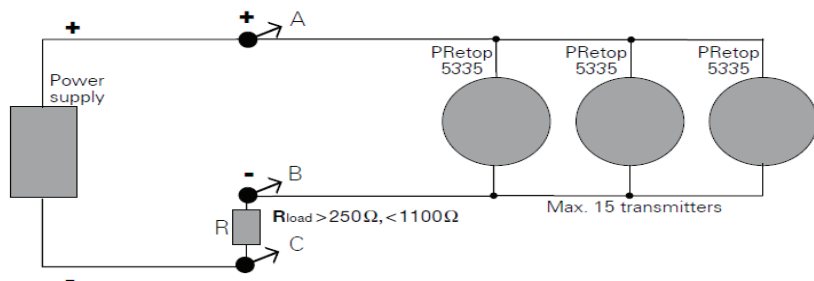
3. HART® communicator

For programming, please refer to the drawing below. To gain access to product specific commands, the HART communicator must be loaded with the PR DDL driver. This can be ordered either at the HART® Communication Foundation or at Eletta Flow AB, Sweden.



4.5 Connection of transmitters in a multidrop mode

The HART® communicator or a PC modem can be connected across AB or BC



The outputs of max. 15 Flow Monitors (transmitters) can be connected in parallel for a digital HART® communication on 2-wires.

Before it is connected, each Flow Monitors (transmitter) must be configured with a unique number from 1 to 15. If 2 Flow Monitors (transmitters) are configured with the same number, both will be excluded. The Flow Monitors (transmitters) must be programmed for multidrop mode (with a fixed output signal of 4 mA). Maximum current in the loop is therefore 60 mA. The communication is either by means of a HART communicator or a HART® modem. The Preset PC configurator software can configure the individual Flow Monitor (transmitter) for multidrop mode and provide it with a unique polling address.

4.6 Spares

We are proud to say that our Flow Monitors are well known for their long life-time and robust construction but inevitable, it is sometimes needed to order spare parts. We refer to section 7 where you can find an exploded drawing showing all replaceable components included in the Flow Monitor.

Distributors

Eletta has appointed distributors around the world. You find more information about which distributor to contact on our website www.eletta.com or call our customer service.

Phone: +46 8 603 07 80

Fax: +46 8 646 10 40

Tables

6.1 Measuring ranges

R2			
Dim. DN		lit/min	MC×(S2)
1/2" DN 15	GL,GSS FA, FSS	0,4 – 0,8	0,1
		0,6 – 1,2	0,15
		1 – 2	0,25
		1,6 – 3,2	0,4
		2 – 4	0,5
		2,4 – 4,8	0,6
		3,2 – 6,4	0,8
		4 – 8	1
		6 – 12	1,5
		8 – 16	2
		10 – 20	2,5
		12 – 24	3
3/4" DN 20	GL,GSS FA, FSS	4 – 8	1
		6 – 12	1,5
		8 – 16	2
		10 – 20	2,5
		12 – 24	3
		16 – 32	4
1" DN 25	GL,GSS FA, FSS	8 – 16	2
		10 – 20	2,5
		12 – 24	3
		16 – 32	4
		20 – 48	6
		36 – 72	9
		40 – 80	10
		50 – 100	12,5
		20 – 40	5
		28 – 56	7
1 1/4" DN 32	FA, FSS	40 – 80	10
		60 – 120	15
		80 – 160	20
		100 – 200	25
1 1/2" DN 40	GL, FA, FSS	20 – 40	5
		28 – 56	7
		40 – 80	10
		60 – 120	15
		80 – 160	20
		100 – 200	25
2" DN 50	FA, FSS	40 – 80	10
		60 – 120	15
		80 – 160	20
		120 – 240	30
		160 – 320	40
		280 – 560	70
2 1/2" DN 65	FA, FSS	60 – 120	15
		80 – 160	20
		120 – 240	30
		160 – 320	40
		240 – 480	60
		280 – 560	70
3" DN 80	FA, FSS	120 – 240	30
		160 – 320	40
		240 – 480	60
		320 – 640	80
		400 – 800	100
		600 – 1200	150
4" DN 100	FA, FSS	160 – 320	40
		280 – 560	70
		400 – 800	100
		600 – 1200	150
		700 – 1400	175
		1000 – 2000	250
5" DN 125	FA, FSS	400 – 800	100
		600 – 1200	150
		800 – 1600	200
		1000 – 2000	250
		1200 – 2400	300
		1400 – 2800	350
6" DN 150	FA, FSS	1500 – 3000	375
		800 – 1600	200
		1200 – 2400	300
		1600 – 3200	400
		2400 – 4800	600
		2500 – 5000	625
8" DN 200	FA, FSS	1600 – 3200	400
		2000 – 4000	500
		3200 – 6400	800
		4000 – 8000	1000
		2000 – 4000	500
		3200 – 6400	800
10" DN 250	FA, FSS	4000 – 8000	1000
		1600 – 3200	400
		2000 – 4000	500
		3200 – 6400	800
		4000 – 8000	1000
		2000 – 4000	500

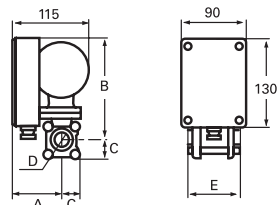
R5			
Dim. DN		lit/min	MC×(S25)
1/2" DN 15	GL,GSS FA, FSS	0,4 – 2	0,4
		1 – 5	1
		2 – 10	2
		4 – 20	4
		6 – 30	6
		8 – 40	8
3/4" DN 20	GL, GSS FA, FSS	4 – 20	4
		6 – 30	6
		8 – 40	8
		15 – 75	15
1" DN 25	GL, GSS FA, FSS	6 – 30	6
		12 – 60	12
		16 – 80	16
		24 – 120	24
	FA, FSS	30 – 150	30
1 1/4" DN 32	FA, FSS	8 – 40	8
		20 – 100	20
		40 – 200	40
		50 – 250	50
1 1/2" DN 40	GL, FA, FSS	8 – 40	8
		20 – 100	20
		40 – 200	40
		60 – 300	60
2" DN 50	FA, FSS	20 – 100	20
		40 – 200	40
		70 – 350	70
		100 – 500	100
2 1/2" DN 65	FA, FSS	20 – 100	20
		50 – 250	50
		100 – 500	100
		160 – 800	160
3" DN 80	FA, FSS	40 – 200	40
		80 – 400	80
		160 – 800	160
		240 – 1200	240
4" DN 100	FA, FSS	80 – 400	80
		160 – 800	160
		250 – 1250	250
		400 – 2000	400
5" DN 125	FA, FSS	100 – 500	100
		200 – 1000	200
		400 – 2000	400
		600 – 3000	600
6" DN 150	FA, FSS	200 – 1000	200
		400 – 2000	400
		600 – 3000	600
		900 – 4500	900
8" DN 200	FA, FSS	400 – 2000	400
		600 – 3000	600
		1000 – 5000	1000
		1500 – 7500	1500
10" DN 250	FA, FSS	600 – 3000	600
		1000 – 5000	1000
		1600 – 8000	1600
		2400 – 12000	2400

The above tables show the maximum flow range achievable in each pipe size. However, it is possible to order a lower flow range indicated above.

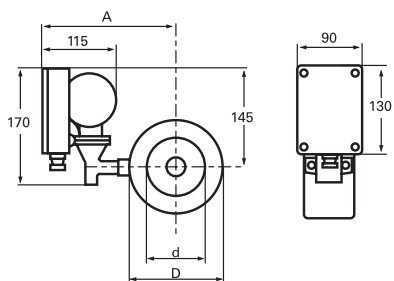
MC=Measuring constant

6.2 Weight and Dimensions

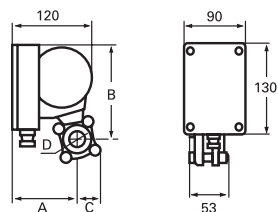
R...GL...GL						
Type	D	A mm	B mm	C mm	E mm	Weight kg*
-GL15	R 1/2"	75	150	30	80	3,0
-GL20	R 3/4	75	150	30	80	3,0
-GL25	R 1"	75	150	30	80	3,0
-GL40	R 1 1/2"	55	160	40	90	4,0



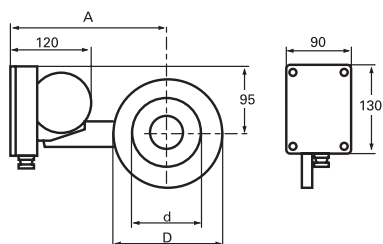
R...FA...FA					
Type	d mm	D mm	A mm	Width mm	Weight kg*
-FA15	16 (1/2")	53	150	70	4,0
-FA20	22 (3/4")	63	154	70	4,5
-FA25	30 (1")	73	161	70	4,5
-FA32	39 (1 1/4")	84	167	70	5,0
-FA40	43 (1 1/2")	94	172	70	6,0
-FA50	55 (2")	109	180	70	6,0
-FA65	70 (2 1/2")	129	190	70	7,0
-FA80	82 (3")	144	197	70	8,0
-FA100	107 (4")	164	207	70	8,0
-FA125	132 (5")	194	222	70	10,0
-FA150	159 (6")	219	235	70	11,0
-FA200	207 (8")	274	263	70	15,0
-FA250	260 (10")	330	290	70	19,0
-FA300	310 (12")	385	320	70	21,0
-FA350	340 (14")	445	345	70	35,0
-FA400	390 (16")	498	375	70	40,5



R...GSS...GSS					
Type	D	A mm	B mm	C mm	Weight kg*
-GSS15	R 1/2"	100	130	35	3,0
-GSS20	R 3/4"	100	130	35	3,0
-GSS25	R 1"	100	130	35	3,0



R...FSS...FSS					
Type	d mm	D mm	A mm	Width mm	Weight kg*
-FSS15	16 (1/2")	53	169	15	3,0
-FSS20	22 (3/4")	63	175	15	3,0
-FSS25	30 (1")	73	183	15	3,0
-FSS32	39 (1 1/4")	84	185	15	3,0
-FSS40	43 (1 1/2")	94	190	15	3,0
-FSS50	55 (2")	109	210	15	3,0
-FSS65	70 (2 1/2")	129	220	15	3,5
-FSS80	82 (3")	144	228	15	3,5
-FSS100	107 (4")	164	238	15	4,0
-FSS125	132 (5")	194	253	15	4,5
-FSS150	159 (6")	219	266	15	5,0
-FSS200	207 (8")	274	293	15	6,5
-FSS250	260 (10")	330	320	15	8,0
-FSS300	310 (12")	385	350	15	9,5
-FSS350	340 (14")	445	375	18	14,5
-FSS400	390 (16")	498	405	18	16,5

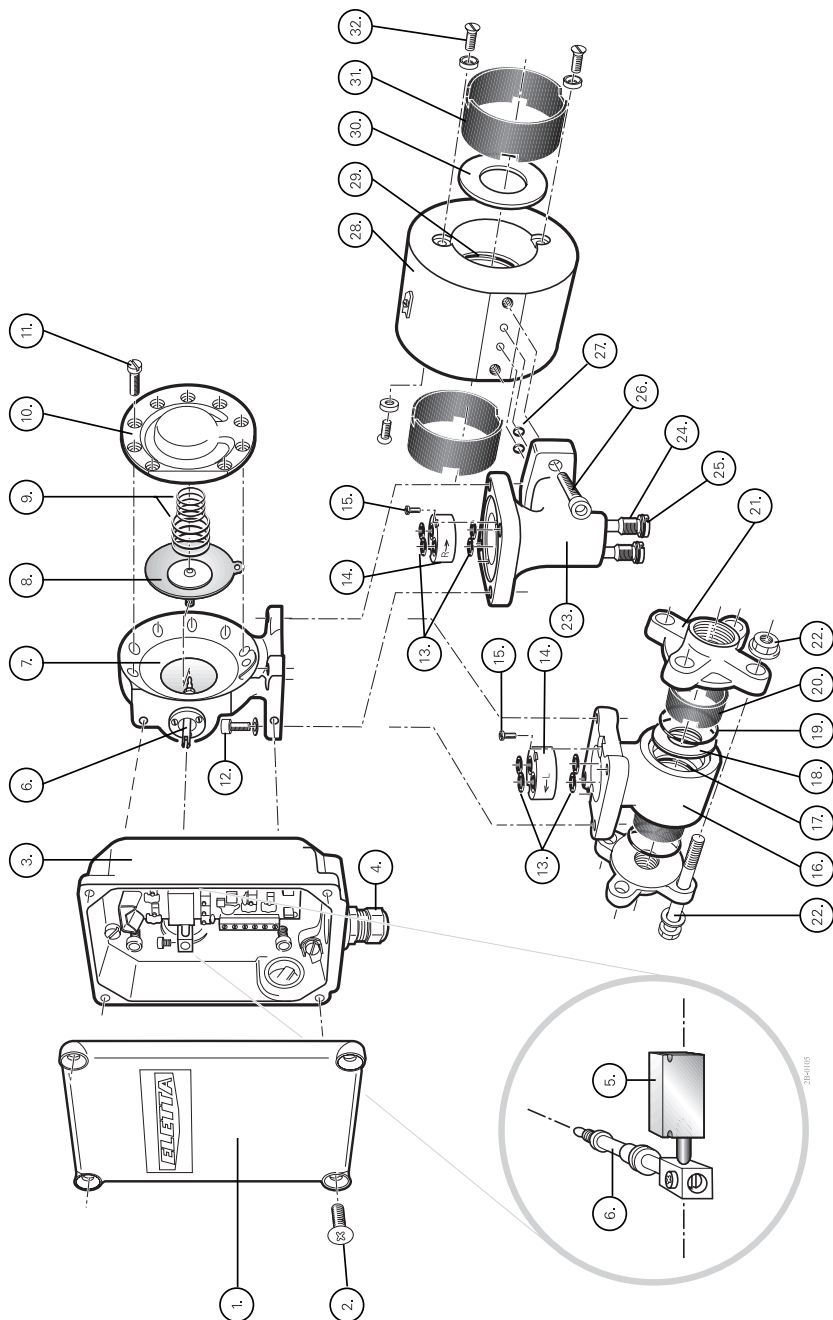


* Approximate weight

Exploded drawing

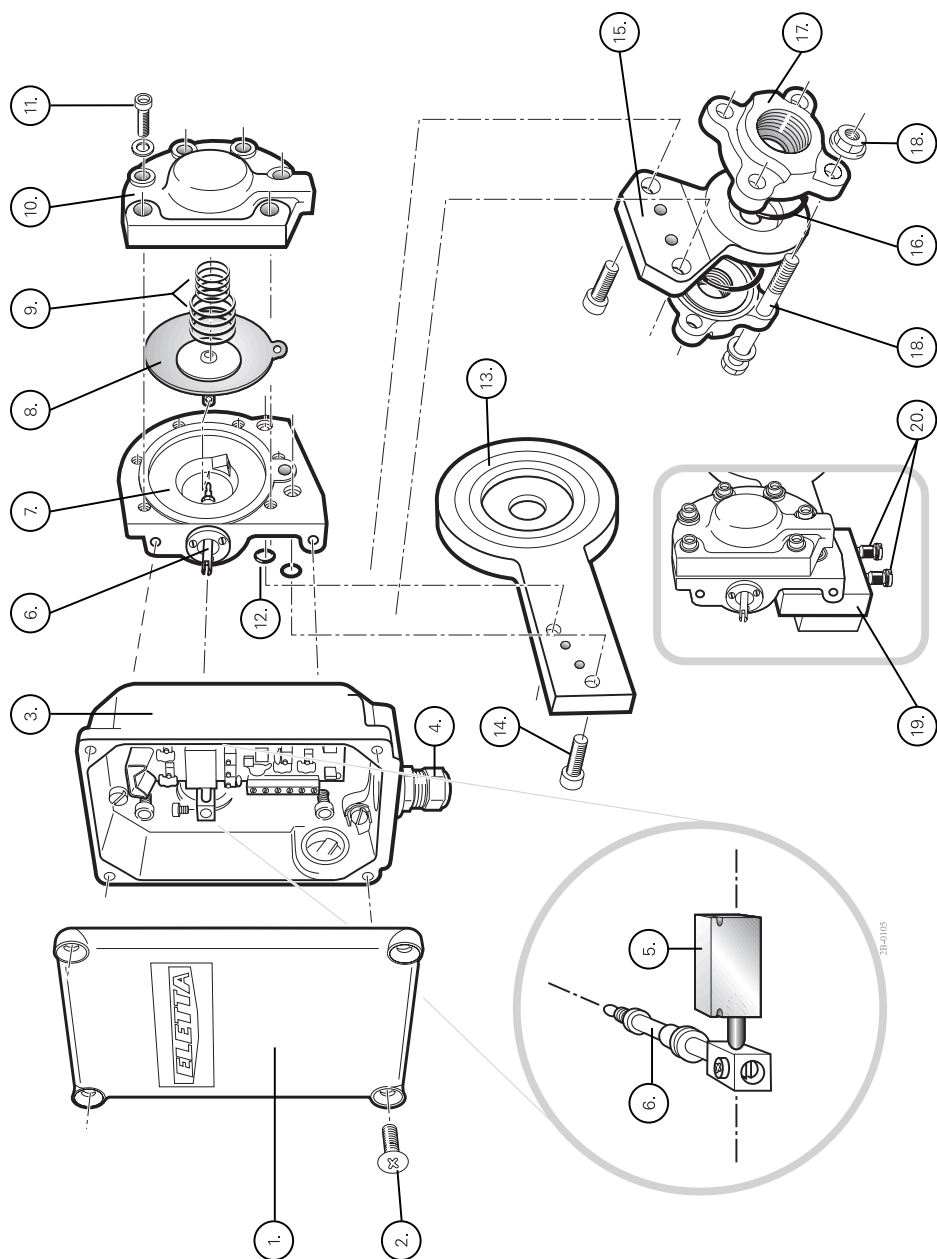
7.1 R...-GL/FA

Item	Description	Nos	Item	Description	Nos
1	Cover	1	17	O-ring	1
2	Screw	4	18	Orifice plate	1
3	Casing	1	19	O-ring	2
4	Cable gland	1	20	Spacer	2
5	Potentiometer	1	21	Threaded flange GL	2
6	Lever	1	22	Screw, washer, nut	4
7	Diaphragm housing	1	23	Connecting unit	1
8	Diaphragm	1	24	Shut-off valve	2
9	Diaphragm spring	1	25	O-ring	2
10	Diaphragm housing cover	1	26	Screw	2
11	Screw	9	27	O-ring	2
12	Screw with washer	4	28	Pipe body FA	1
13	O-ring	4	29	O-ring	1
14	Flow direction selector	1	30	Orifice plate	1
15	Screw	2	31	Spacer	2
16	Pipe body GL	1	32	Screw, washer	4



7.2 R..-GSS/FSS

Item	Description	Nos
1	Cover	1
2	Screw4	
3	Casing	1
4	Cable gland	1
5	Potentiometer	1
6	Lever	1
7	Diaphragm housing	1
8	Diaphragm	1
9	Diaphragm spring	1
10	Diaphragm housing cover	1
11	Screw with washer	6
12	O-ring	2
13	Orifice plate/Pipe unit FSS	1
14	Screw2	
15	Orifice plate/Pipe unit GSS	1
16	O-ring	2
17	Threaded flange GSS	2
18	Screw, washer, nut	4
19.	Manifolder	(option)
20.	Shut off valves	(option)



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