Instruction Manual

Flow Transmitter Type TE67Axxxxxxxxx

IM-TE91K001-EN3
ESE01745EN
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1 General information

1.1 Introduction

The Flow Transmitter is a precision meter for the volumetric measurement of liquids that are electrically conducting.

The rugged construction of the transmitter makes it suitable for installations where solid particulates make up part of the liquid for measurement.

Note: The illustrations and specifications contained in this manual were effective at the date of printing. However, as continuous improvements are our policy, we reserve the right to alter or modify any unit specification on any product without prior notice or any obligation.

1.2 Features

- Sanitary design
- Maintenance-free, no moving parts
- Automatic zero point correction
- High accuracy, even at very low flow rates
- Bi-directional flow
- Volumetric measurement in m^3, litres, U.S. gallons etc.
- Pulse output to an electronic counter, 0-1000 pulses per second
- Pulse output to an electromechanical counter, 0-10 pulses per second
- Current output, 4-20 mA (extended version)
- Batch control function
- Limit switch function
- Flow regulator function (PI controller)
- Practically no loss of pressure
- A Display Unit can be simply connected. The Display Unit can display accumulated volume, set-point for batch control or PI regulator, flow rate, temperature, etc.
- Count stop/clear logic input function.
- Temperature measurement using an external temperature sensor
- Temperature compensated flow measurement
- Continuous Selftest
- EMC approved (DS/EN 61000-6-2) (DS/EN 61000-6-3)
- Vibration approved (IEC 60068-2-6 Test Fc)

1.3 Construction

The Flow Transmitter consists of three parts: The meterhead, the electronic module, and the terminal box. [1]
The electronic module and the terminal box are the same for all sizes of transmitter.

The Meterhead consists of a stainless metering pipe with clamp connections. Two magnet coils are mounted external to the metering pipe. Two stainless electrodes are mounted inside the metering pipe.

The measuring section is designed with a square measurement chamber, which prevents changes in flow profile affecting meter accuracy (see the following sections, *Operating principles*, and *Reducing the influence of varying flow profiles*, for details). Hence the transmitter has a wide range of flow rates within its linear accuracy. Changes from laminar to turbulent flow do not affect the linear accuracy, and changing viscosity has no effect on meter accuracy. The calibration of the meterhead is carried out during manufacture using a computer controlled calibration facility.

The Electronic Module has two pulse output signals and one logic input. The transmitter can also be directly connected to a display unit.

One of the outputs can be configured either for pulse output or analogue current output, 4-20 mA.

The Terminal Box is completely separated from the electronic module. Connections can therefore be changed without disruption to the electronics. All terminals within the terminal box are clearly marked with both number and function.

The box is also equipped with 3 cable glands, type PG 11.

Figure 1: TE67A1xxxxxxxx, TE67A2xxxxxxxx, TE67A3xxxxxxxx, TE67A4xxxxxxxx, TE67A5xxxxxxxx

Figure 2: TE67A6xxxxxxxx

[1] For TE67A6xxxxxxxx: The electronic module is an integrated part of the meterhead.

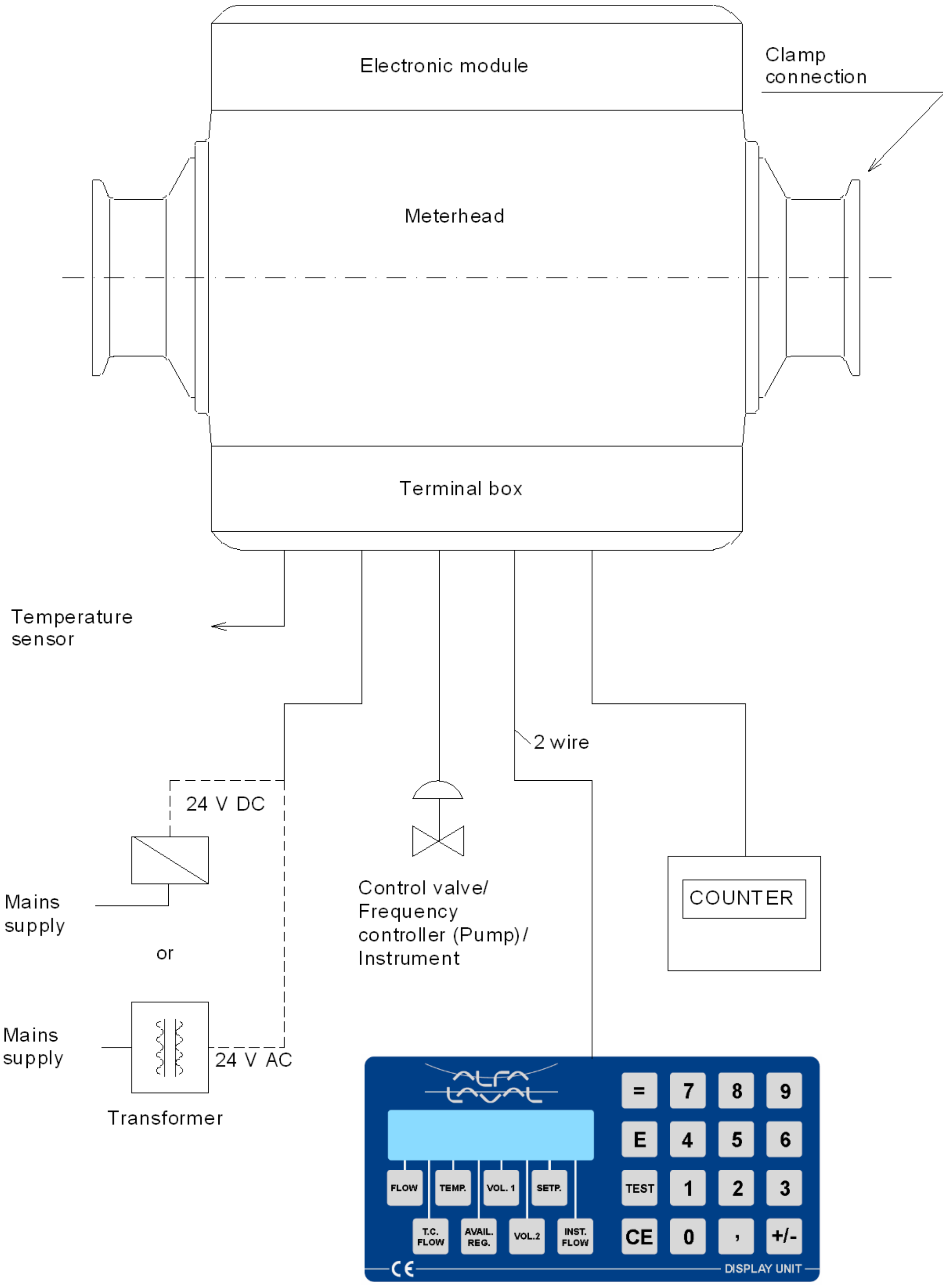


Figure 3: System diagram

1.4 Operating principles

The meterhead consists of a metering pipe and two magnetic coils. When a current is applied to the coils a magnetic field is produced at right angles to the metering pipe.

With a conductive liquid flowing through the metering pipe an electrical voltage is induced and measured by two electrodes mounted in the metering pipe. This voltage is proportional to the average velocity of flow and therefore to the volume flowing.

The Flow Transmitter utilizes a square measurement chamber. The shape of the measurement chamber significantly reduces the influence of viscosity, type of liquid, and flow profiles (see details in the next section, *Reducing the influence of varying flow profiles*).

Practical tests confirm that it is not necessary to recalibrate the meter when changing product, such as from water to milk. This would normally be necessary when using magnetic flowmeters that have traditional round measuring chambers.

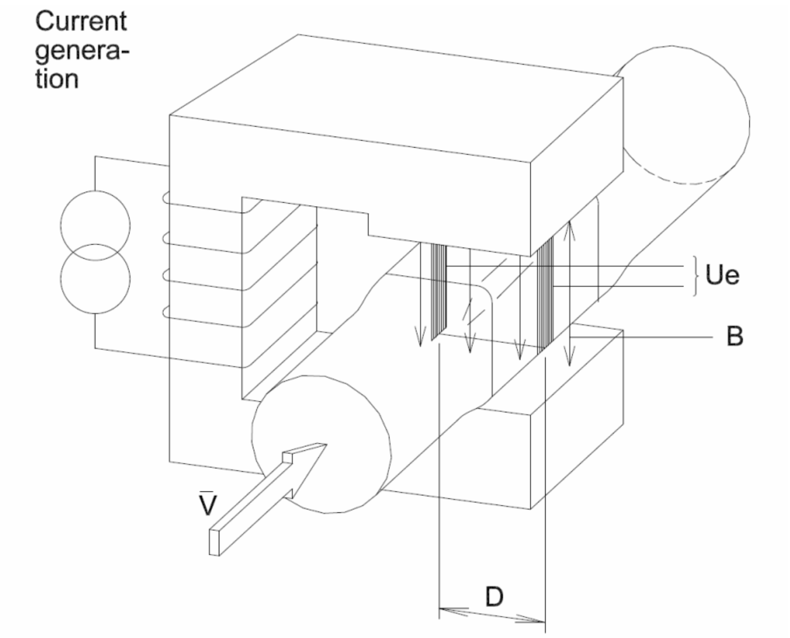


Figure 4: Operating principles

- Ue = K x B x V x D
- Ue = voltage across electrodes
- K = system constant
- B = magnetic field
- V = average velocity
- D = distance between electrodes

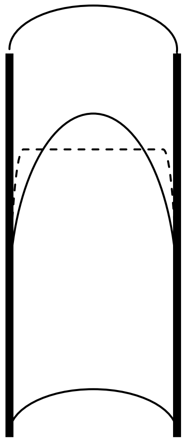
The micro-processor in the transmitter controls the current generator, keeping the magnetic field constant. The voltage across the electrodes is amplified and converted to a digital value from which the micro-processor calculates the liquid flow.

1.5 Reducing the influence of varying flow profiles

When a liquid flows through a pipe, its velocity tends to vary from zero along the pipe wall up to its maximum through the centre of the pipe.

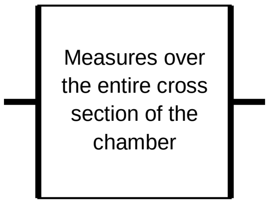
The velocity profile depends on the actual flow velocity together with the viscosity of the liquid.

When the flow rate is low, the velocity profile takes the shape of a parabola. This is called laminar flow. If the flow rate is gradually increased, the flow profile also changes gradually, still maintaining the laminar flow profile, until it reaches the critical velocity. At this flow rate, the flow profile will, via a transition phase, change from laminar to turbulent flow with the formation of eddies and chaotic motion, which do not contribute to the volume flow rate. The two types of flow profile are illustrated on the figure to the right. Precisely when the liquid reaches the critical velocity and changes to turbulent flow, depends on the diameter of the pipe, and on the viscosity and density of the liquid. For cream, for example, the viscosity strongly depend on the temperature and the percentage of fat, and it is therefore not possible to predict the flow profile at any given flow rates.

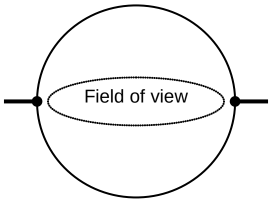


The technique used to avoid an unknown flow profile from affecting the accuracy of a measurement, consists essentially of measuring the average velocity of the liquid throughout the **full cross section of the pipe,** hence registering all the liquid passing through it.

The average measurement is achieved in a FLOW TRANSMITTER by using a square measurement chamber, where each of the two electrodes are designed to measure across the complete cross section of flow.



This is in contrast to flow meters having a circular cross section and point-type electrodes. Here the ‘field of view’ between the electrodes is limited to only involving the liquid passing directly between the electrodes. Its calibration is therefore conditional on a particular known flow profile.

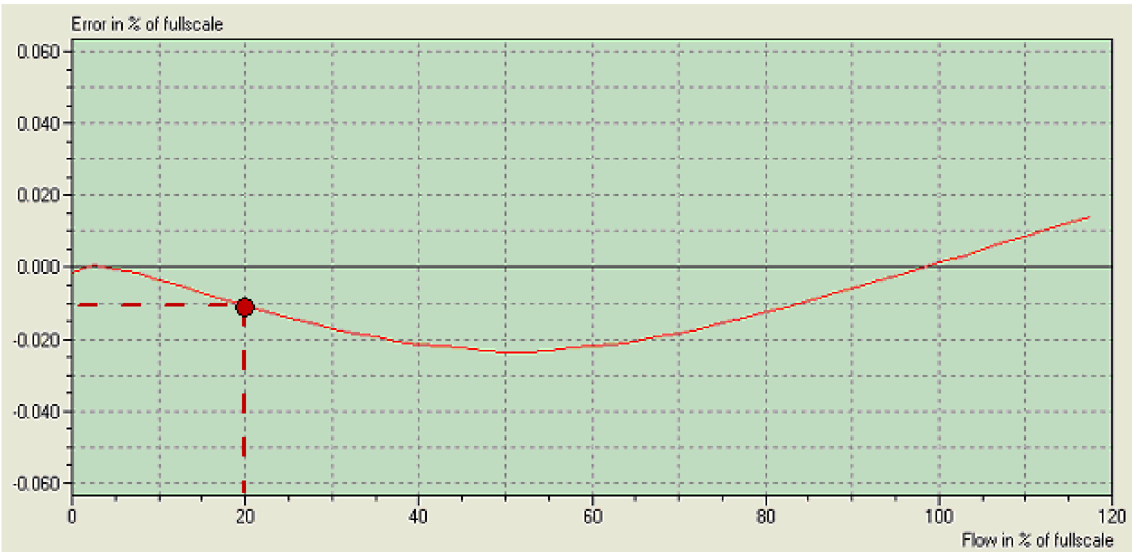


1.6 Linearizing function

Because of its construction as described in the previous section, the Flow Transmitter is, by its very nature linear, even without any electronic compensation.

However, most of our customers prefer not to use anything smaller than 25 mm (1”) as a pipe diameter, even for very low flow rates. Therefore, to further improve linearity, a special compensation function has been developed and implemented and the FLOW TRANSMITTER can now be used even at very low flow rates, but still offering the same well-known high accuracy measurement as normally experienced with higher flow rates.

During the flow calibration at the factory, the linearizing curve is calculated and downloaded to the electronic module. For this reason, all new Flow Transmitters will hold the data needed by the linearizing function, when they are delivered.
The graph below shows the linearizing curve for a specific Flow Transmitter. If this Flow Transmitter measures the flow rate at 20% of full scale, this value will be compensated by –0.01% of full scale.



2 Function description

The Flow Transmitter holds a number of internal functions and connections for external signals. The functions may be selected by keying in a set of configuration parameters. Calibration parameters may also be set. The data may be entered via Alfa Laval display/keyboard unit.

The Flow Transmitter may be scaled to operate in any volumetric units, Litre, m^3, Gallon etc. The flow rate may be selected to be displayed as *volume unit/hour* or */minute*.

2.1 Flow measurement

The flow rate may be filtered to stabilize the readout of an unstable flow. Flow rates below 0.2 % of full scale may be ignored. This may be useful to avoid totalizing the volume during long periods with no flow (see configuration of function selector Code3).

Flow is measured in both directions. Flow in the direction of the arrow on the meter head will be indicated as positive flow. Optionally, negative flow can be ignored and set to zero to prevent downward volumetric totalisation (see configuration of function selector Code3).

To compensate for the expansion of the liquid, the Flow Transmitter may be configured to indicate a flow as if the liquid temperature was at 4 °C (39.2 °F) (see also T.C. Flow).

2.1.1 Test mode

The Flow Transmitter may be switched into test mode. During installation and service, the test mode may be used to simulate that liquid is flowing in the pipe system. All output signals, pulse signals as well as the current signal, will act as if the liquid flow was present. This way, all internal functions, external signals and cable connections may be checked (see configuration of function selector Code2).

2.2 Volume counter

The Flow Transmitter utilizes two independent totalizers, Volume1 and Volume2, which indicate the measured volume since each were cleared. Each volume counter may be independently cleared or preset to a specific value (see further details in the Volume1 description).

2.3 Automatic functions

A number of automatic functions are selectable in the Flow Transmitter. Only one of the functions should be selected (see configuration of function selector Code2 about how to select each function).

2.3.1 Batch Control

The Flow Transmitter has a built-in batch control function, and can therefore easily be used to control the dosing of a specified volume. The required volume is keyed into a setpoint register. A digital input on the Flow Transmitter may be used to start the batch control. A digital output, Output2, opens the dosing valve or starts a pump. When the setpoint volume is reached, the output is switched off and the valve is closed or the pump stops. The Volume2 counter shows the dosed volume (see also the Batch control application example).

2.3.2 Flow control

In systems where it is desirable to have a constant flow, the built-in Flow Control function may be used to control a valve or pump directly. The required flow rate is keyed into a setpoint register and the internal PI controller will control the valve or pump by means of the current output signal (4-20 mA) (see the Flow control).

2.3.3 Limit switch

The Flow Transmitter has a built-in limit switch function. This function may be used to indicate whether a measuring value is below or above the value in the setpoint register. As an example, this may be used to indicate a high/low flow rate. The indication may appear on a digital output, Output2, as ON or OFF (see configuration of function selector Code2 to select this function for Output2).

2.4 Temperature measurement

The Flow Transmitter can measure temperature by connecting an external Pt100 temperature sensor. The temperature may be read in a register as °C or °F (see configuration of function selector Code3). This would be necessary for temperature compensated flow measurement.

2.5 Output1

Output1 is a power supply output, which can be used to supply nom. 24 V DC to an external counter or relay circuit (see further details in section 5.2).

2.6 Output2

Output2 can be selected for one of several functions:

- Pulse signal, 0-10 Hz. The signal may be taken to a counter, electronic or electromechanical, for indication of the total volume, e.g. in litres (see section 5.3.1 Output2).
- Sign for Output3. The signal indicates the flow direction. The output is switched OFF, when the flow is positive. By means of an UP/DOWN-counter, this signal may be used for the totalizing of the volume flowing with a sign.
- Control signal from the Batch control function.
- Control signal from the Limit function.
- Error free measurement signal. The output signal is ON if no error is present.

(See configuration of function selector Code2)

Further details for connecting Output2 can be found in section 5.3.1 Output2.

2.7 Output3

Output3 may be used as a digital signal output **or** as an analogue 4-20 mA current output. When used as a digital signal, it may be used as a fast pulse signal (0 - 1000 Hz) for external counter circuits (see scaling example in chapter 0). Further details for connecting Output3 can be found in section 5.3.2 Output3.

2.8 Input

The transmitter has a logic input, Input1, which can be selected for one of several functions:

- Stop counters. The signal may be derived from an air detector, and is then used to make the transmitter stop counting, when there is air in the liquid.
- Clear Volume2 counter. The input can be used in batch control, to start the Batch function and clear the batch volume counter.
- Manual/Automatic mode for PI controller. The input can be used to set the operation mode for the PI controller.

(See configuration of function selector Code3).

Further details for connecting Input1 are found in chapter 5.4 Input signal.

2.9 Display

A local display unit can be connected directly to the Flow Transmitter. From this unit it is possible to display the flow rate, volume counters, temperature, setpoint etc. Furthermore the Display Unit may be used to change setpoint values and to perform a complete configuration of the Flow Transmitter (see description in section 3).

3 Alfa Laval Display Unit

Various options are available for displaying information from the Flow Transmitter. The Flow Transmitter may be controlled and supervised via a connected Display Unit, as described in the following paragraphs.

3.1 Local or remote Display Unit

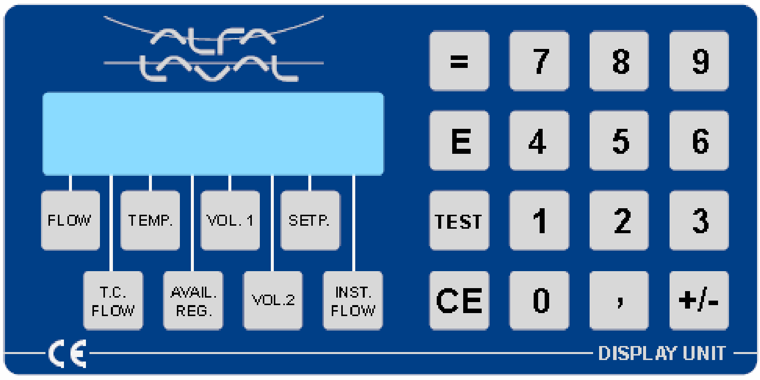
The Display Unit can be directly connected to the transmitter. With the Display Unit connected, it can perform a number of different functions.

- Display of data from the transmitter, e.g. flow or volume.
- Change data in the transmitter, e.g. contents of volume register or SET-point register.
- Configuration and calibration, e.g. setting of the size of the meterhead or the function of the output signals.
- Readout and reset of an internal error code.

The display unit is connected to the Flow Transmitter with a two-wire cable, up to a length of 100 m (328 feet). The display unit is supplied with power via this cable. It also carries the exchange of data between the Flow Transmitter and the display unit.

3.2 Display registers

The contents of 8 different registers in the transmitter can be displayed on the unit. A touch on one of the 8 buttons under the display selects whichever register needs to be read. The display indication is automatically updated about once per sec. Additional details may be found in section 6.1.1.



Reg. No.	Name	Function
1	FLOW	Liquid flow, e.g. in m^3/h or gallons/hour
2	T.C.FLOW	Temperature compensated flow
3	TEMP	Temperature in °C or °F
4	AVAIL. REG.	Available register
5	VOL.1	Volume, result of totalization, e.g. in m^3 or gallons
6	VOL.2	Volume for comparing with Set-point, e.g. in m^3 or gallons
7	SETP.	Set-point, e.g. in m^3 or gallons
8	INST. FLOW	Instant Flow

3.2.1 Changing register contents

If a change in the contents of a register is required, the register must first be displayed. Then the desired contents are entered, followed by a press on the **=** button. This gives a blank display for approx. 1 sec., and then the new contents are displayed in the normal way.

3.2.2 Configuration using the Display Unit

The Flow Transmitter contains 8 configuration registers. See also section 6.1.2 for a detailed explanation and purpose for these registers. If it is required to display the contents of a configuration register, press the **E** button, which will turn the display blank. Then press a numeric key between **1** and **8** to choose the desired configuration register. The number of the configuration register appears in the first digit of the display, and the contents of the register in the rest of the display. Changing the contents of a register are performed by keying in the new contents, and then pressing the **=** button.

3.2.3 Error readout

The user is informed of an error by an "A" for ALARM appearing in the first digit of the display. By pressing the "TEST" button the display will show an error code of two digits, indicating the type of error. The test system ensures that the alarm will not be cancelled before the error code has been displayed by pressing the "TEST" button, even though the error may have disappeared. By pressing the "TEST" button once again, the display will show "00" if the Flow Transmitter is now error free. The error code on the display is **only** updated by re-pressing the "TEST" button. A complete list of error codes is given in section 6.

3.2.4 Construction

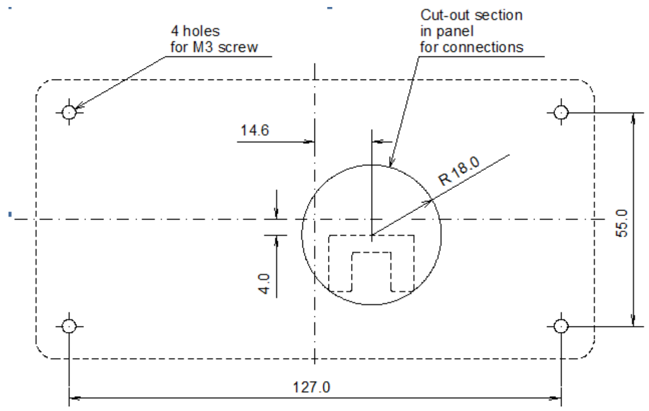
The display unit consists of an LCD display, a keyboard, and electronics for exchange of data with the transmitter and control of the display and the keyboard.

The unit is built into a case of NORYL PPO, sealed to IP 65. The dimensions of the enclosure are LxHxD = 144 x 72 x 8 mm (5.67” x 2.83” x 0.32“).

3.2.5 Assembly drawing for the Display Unit

Note: Please observe that the M3 mounting screw holes are only **4 mm (0.16”)** deep.

Do **NOT** screw down beyond this length. This may damage the display unit.



4 Meter selection and Installation

4.1 Selecting the correct meter size

The complete Flow Transmitter family has a very large measuring range. It is normally recommended that a particular transmitter size is selected so that it will operate in the upper half of its measuring range. This is due to the fact that the influence of zero point error is relatively higher at low flow rates. This applies to any Flow Transmitter on the market. However, it is possible to use the Flow Transmitter even at very low flow rates, whilst still obtaining high accuracy. Flow measurement down to 1 % of maximum flow rate for the Flow Transmitter is now possible (100:1 turndown).
Practical examples from different installations indicate that actual expected operational flow rates do vary. It is therefore recommended that the calculated maximum flow rate should not exceed **90 %** of the specified maximum flow rate for the selected Flow Transmitter. Exceptions may be made if the flow rate is well known and very stable.

As a rule, a Flow Transmitter with a pipe dimension equal to the rest of the piping system should be selected.

The size of the meterhead should be selected according to the maximum flow rate. This maximum flow rate must be the absolute maximum flow rate during operation, cleaning, startup etc. The smallest possible transmitter is then chosen for that maximum flow rate. This will ensure optimum measurement accuracy. If the metering section is smaller than the pipework in the installation, the connecting pieces should be tapered.

A Flow Transmitter should not be installed in a pipe construction where the pipes are smaller than the pipes in the connections.

If two products are mixed before measuring, the mixed product must be a homogenous liquid before entering the Flow Transmitter to ensure maximum accuracy.

The Flow Transmitter is available in 6 different sizes as shown in the table below:

Max. flow rate:

TE67A1xxxxxxxx	TE67A2xxxxxxxx	TE67A3xxxxxxxx	TE67A4xxxxxxxx	TE67A5xxxxxxxx	TE67A6xxxxxxxx
8 m^3/h (2113 GPH)	20 m^3/h (5284 GPH)	40 m^3/h (10568 GPH)	80 m^3/h (21136 GPH)	120 m^3/h (31704 GPH)	200 m^3/h (52840 GPH)

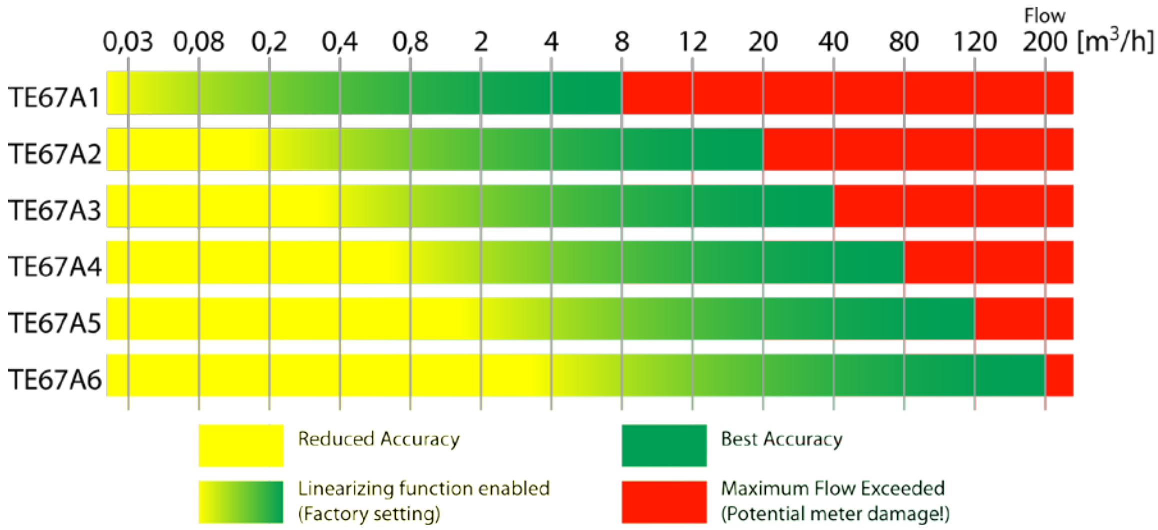
(GPH = US gallons/hour, 1 m^3/h = 264.2 GPH).

Note: The max. flow rate for the Flow Transmitter must NEVER be exceeded, otherwise the meterhead may be damaged.

4.1.1 Quick Selection Guide

Use the following diagram as a guideline for selection of the meter size, and then take the following precautions:

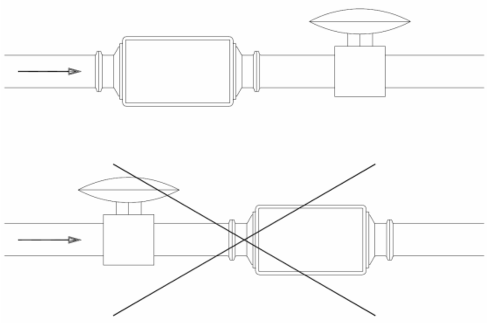
- Never exceed the maximum flow rate of the Flow Transmitter.
- If optimum measurement accuracy is of primary concern, the smallest possible transmitter should be chosen, while still observing that the maximum flow rate must not, under any circumstances, be exceeded.



4.2 Installation and Care of Transmitter

The transmitter should be installed within the pipe work system such that the metering pipe is always filled with liquid, because the transmitter can register some flow, even when the meter is empty.

As the transmitter will measure any air in the liquid as a part of the total volume, the volume of the air must be reduced to an absolute minimum. To help achieve this, the transmitter should be located in the pipe work system at the point of maximum pressure. Here the volume of the air will be at a minimum and thus the influence of air on the measurement will also be at a minimum. It is therefore recommended that control valves, or other restrictions that might create a pressure drop, are mounted after the Flow Transmitter. Even when there is no air in the liquid it is important to ensure that the pressure is sufficiently high, otherwise cavitation may occur in the transmitter. Not only will this influence the accuracy, but it is also destructive to the PFA lining.

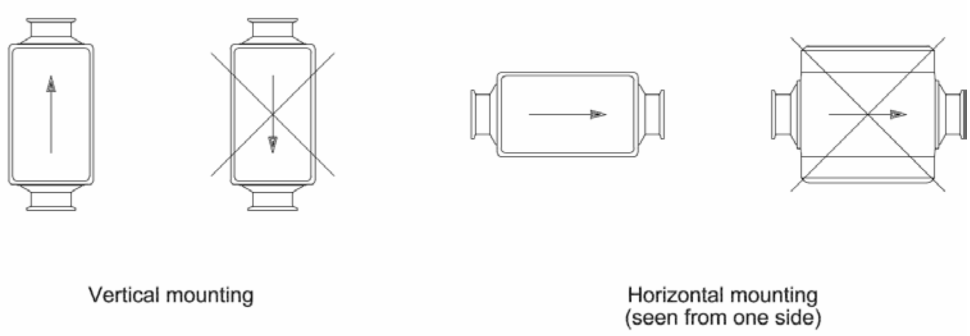


Ensure that the valve is always mounted after the Flow Transmitter (downstream).

If heavy vibrations can occur in the pipe work caused perhaps by resonance from pumps, or a pulsating pressure in connection with, for example, a homogenizer or a positive displacement pump, then vibration damping is required, or the transmitter should be mounted somewhere else where there is less variation in pressure.

If the liquid contains air, an air eliminator should be mounted before the Flow Transmitter.

The transmitter can be mounted both horizontally and vertically. No air must be trapped in the meter head. The positive flow direction is indicated by an arrow on the meterhead.



With vertical mounting, upward flow is recommended. The reason for this is that any air within the liquid will easily follow the liquid in its upward direction, which would not be the case with downward liquid flow. With horizontal mounting, orientation as shown on the left is recommended. Mounting the meter as shown in the figure to the right would mean that one of the electrodes would be positioned at the top of the meter tube, and any air bubbles could cause the electrode to loose contact with the liquid.

To create the best conditions for precise metering, and to maximise the lifetime of the transmitter, a straight pipe run of at least three times the pipe work diameter should be mounted upstream and downstream of the transmitter. This is especially important when running at high temperature and high flow rate, since the risk of cavitation is increased with turbulent flow.

When selecting the location of the transmitter it must be ensured that the ambient temperature is within the specified limits. Finally, the transmitter should be installed such that the electronic module and the terminal box can be fitted and dismantled in situ.

Note: The clamp connections **must** be loosened completely before the transmitter is rotated. Otherwise the meterhead may be fatally damaged.

Precautions must be taken to ensure that neither the electronic module, nor the meterhead, nor the terminal box is exposed to moisture, when the transmitter is dismantled. To prevent moisture, the cables must be mounted correctly in the glands. The electronic module and the terminal box must be carefully mounted with all screws tightened.
The Flow Transmitter supply should always be connected, as heat developed in the electronic module prevents any condensation, which could damage the transmitter. The transmitter should therefore be powered up as soon as possible after mounting.

5 Electrical connections

The figure below shows the terminal board with all the possible electrical connections for the Flow Transmitter. The *program enable* switch, SW1 located in the upper left corner, must be in the ON position when configuring and calibrating the Flow Transmitter. After configuration and calibration, the switch must be set in the OFF position.

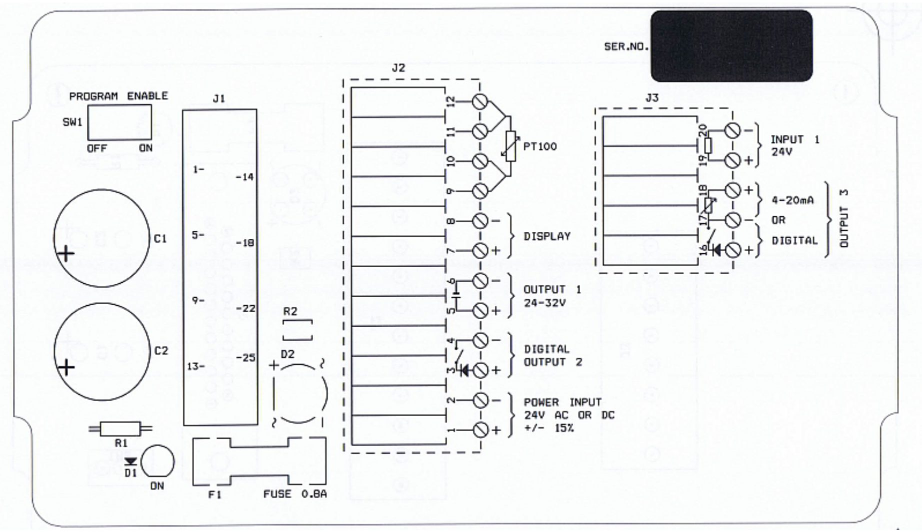


Figure 5: Electrical connections in Terminal Board

5.1 Power supply

The power supply for the Flow Transmitter can be either 24 V DC or 24 V AC.
If the conductivity for the liquid is below the specified 5 µs/cm, it might still be possible to measure the flow. To do this, the Flow Transmitter must be connected to a separate DC power supply with the -24 V DC terminal connected to the piping system.
This will increase the sensitivity, and flow measurement may still be possible.

5.2 Output1

Output1 on the terminal board is a voltage supply, which can be used to supply an external counter circuit, relays or current devices (4-20 mA).

The voltage at the output can vary from 20 to 40 V DC, depending on the power supply voltage (Supply voltage - 2 V as minimum).

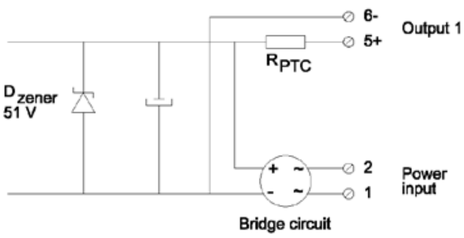


Figure 6: Power supply output electrical

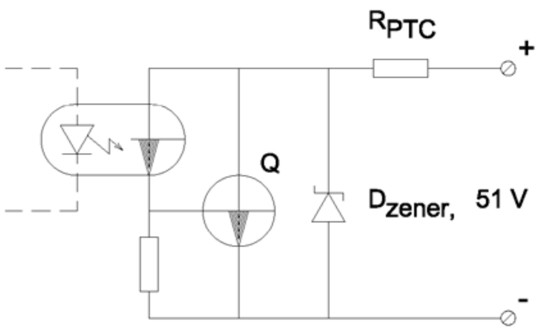
The voltage supply is connected directly to a bridge circuit, which rectifies the power supplied to the transmitter. The output is protected with a zener diode and a current-limiting resistor in the same way as the pulse outputs. Furthermore, the output is isolated from the internal electronics by a transformer. The output is **not** isolated from the power source supplying the transmitter.

5.3 Digital output signals

The Flow Transmitter has two digital output signals, Output2 and Output3. Voltage supplies are required for output signals.

The outputs are isolated from other parts of the electronics by optocouplers. Furthermore, the outputs are protected against overload by a zener diode and a current-limiting resistance, R_{PTC}. R_{PTC} is about 25 Ohms at normal load (max. 100 mA). At overload, the R_{PTC} will rise rapidly thus limiting the current to about 16 mA.

If an output has been overloaded, the current must be completely switched off for some seconds, by switching off the power supply to the Flow Transmitter, before the output can be normally loaded again.

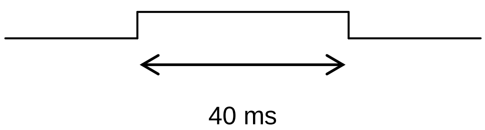


A voltage drop of up to 1.0 V may occur when the output is switched ON. This should be noted when connecting to low voltage external equipment.

In case of wrong polarization of the connection, the signal acts as a constant ON signal.

5.3.1 Output2

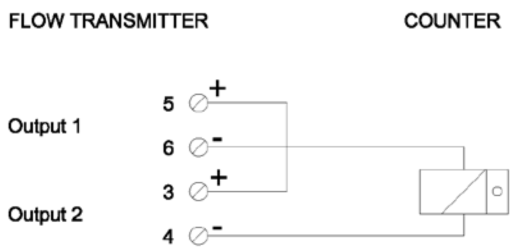
The pulse output signal from Output2 has a pulse width of 40 ms. The frequency is continuously variable from 0-10 Hz.



Pulse signal Output2
Example of electrical connection of electro-mechanical counters.

Counter specification:

Supply voltage:	20-40 V DC
Power consumption:	Max. 2.5 W
Counting frequency:	Min. 10 Hz
ON-time:	Typ. 40 ms
OFF-time:	Min. 60 ms



5.3.2 Output3

The TE67Axxxxx1xxx version of the Flow Transmitter can generate a pulse output signal at Output3. A voltage supply is required for this pulse output signal.

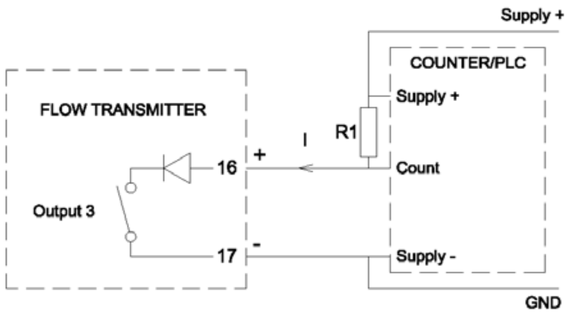
The TE67xxxxx2xxx version of the Flow Transmitter can generate two different output signals at Output3, a pulse output signal **or** an analogue current output signal. Voltage supplies are required for both types of signals.

The pulse output signal from Output3 is symmetrical (50 - 50 % duty cycle), and the frequency is continuously variable from 0-1000 Hz.

Electronic counters and PLC's are normally connected to the pulse output, Output3.

The pulse output in the transmitter consists of a voltage free electronic switch contact. Therefore, it is necessary to equip the count pulse input on the counter/PLC with a pull-up resistance, if the counter/PLC has no internal pull-up.

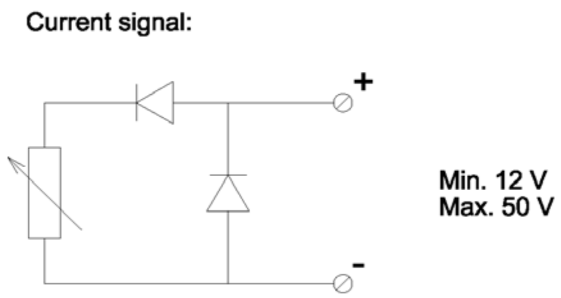
The pull-up resistance R1 should be chosen so that the current I is approx. 5 mA when the contact in the Flow Transmitter is switched on.



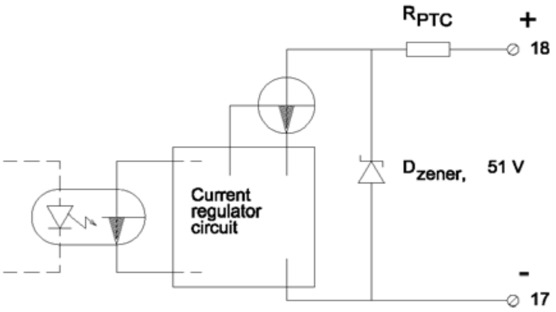
5.3.3 Output3, current output

The current output signal is in the range from 4 - 20 mA. The current output may be taken to a regulator for controlling the liquid flow.

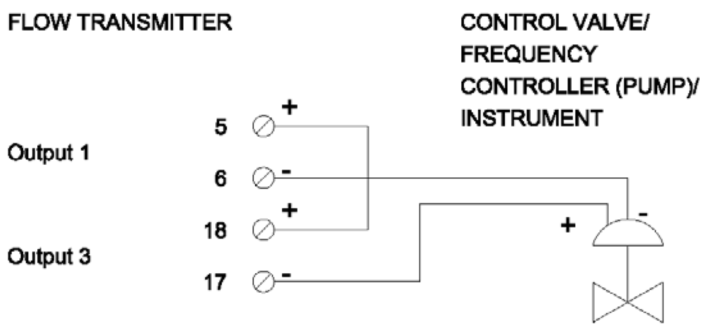
The current output from Output3 works as a variable resistance. It therefore requires an external supply voltage, which can provide min. 12 V at terminals 17 and 18 in the Flow Transmitter plus the voltage drop across the load and cable. The necessary supply voltage must be calculated for max. current, 20 mA.



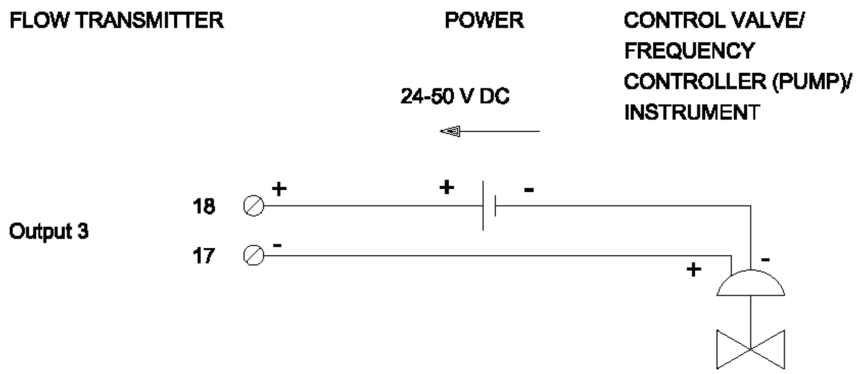
The current output is isolated from other parts of the electronics and protected against overload in the same way as the pulse outputs. However, the current-limiting resistance R_{PTC} is designed so that overload protection comes into force at about 35 mA.



Supplied by internal voltage supply (Output1)

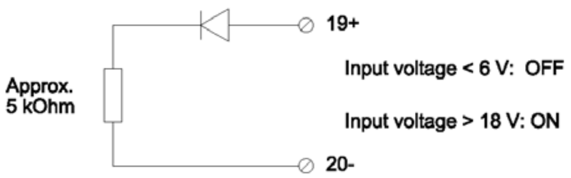


Supplied by an external power supply



5.4 Input signal

The input signal is galvanically isolated. To activate the input, a voltage of minimum 18 V must be connected to the terminals with the right polarization. This voltage may be supplied from either the internal voltage supply or an external power supply.



5.5 Temperature signal, Pt100

A standard Pt100 temperature sensor may be connected to the Flow Transmitter. The temperature sensor must be connected with a 4-wire cable all the way from the sensor to the terminal box. This must be done to avoid errors introduced by the cable length, junctions and connections. The cable that connects the Pt100 temperature sensor to the Flow Transmitter must not exceed 25 m.

Note 1: The sensor wires **must not** be connected to the sensor housing (grounded).

Note 2: If a temperature sensor is not used, the terminals 9-10-11-12 **must** either be connected together **or** left unused in order to avoid errors in the flow measurement. Do not connect any other kind of resistors except Pt100 sensors, as a resistance out of range could influence the results of the measurements without your knowledge. Due to this fact, it must also be ensured that the 4-wire cable connections between the sensor and the terminals are steady and reliable.

5.6 Connecting the Display Unit

The Display Unit is connected to the Flow Transmitter with a two wire twisted cable, up to a length of 100 m. The display unit is supplied with power via this cable. It also carries the exchange of data between the Flow Transmitter and the display unit.

The data readout is updated approx. every second.

To improve the electrical noise immunity with long length cables, a shielded cable is recommended. In this case the shield should be connected to terminal 8 at the terminal box and **not** connected at the Display Unit.

6 Variable description

Flow Transmitter holds a number of variables and functions, which may be accessed via the Display Unit.

6.1 Variable overview

The variables shown in the following table are used to define the size of the meterhead, setpoint for the PI regulator, function of output signals etc.

At delivery, the transmitter is programmed for the functions specified on the order.

Identifier	**SI Unit**
Error3	
Output2	
Output3	
Input1	
BatchStart	
Flow	*1
TcFlow	*1
Temperature	*2
Available	
Volume1	*3
Volume2	*3
SetPoint	*3
InstantFlow	*3
MeterSize	*3
Ti	s
PICode	
MeterNumber	
Scale	*4
Code1	
Code2	
Code3	

NOTES:

1. Flow may be read out as 'unit/min' or 'unit/hour'
2. The unit for Temperature may be °C or °F
3. The unit for Flow depends on the calibration factor inserted in MeterSize.
4. If Output3 is configured as a regulator, the SI unit for Scale must be the same as for Flow.

Error3 Display key: TEST

The Flow Transmitter is equipped with a comprehensive test system, which is able to disclose faults, arising from improper use of the transmitter, or faults arising from the transmitter during use.
When the test system registers a fault, an error code is generated and saved in this register. If more than one error occurs at the same time, only the highest error code will be saved. The error code will

be saved until it has been read out. By reading out the error code twice, one can see if the error has disappeared.
The Display Unit will show the text "P.FAIL" after resetting the transmitter whatever caused the reset.

ERROR CODE	FAULT TYPE
83	Error in program storage (PROM)
82	Error in program execution - watchdog
81	Error in data storage (RAM)
80	Error in program execution
76	Error in EEPROM-storage
75	Error in RAM-storage or EEPROM-storage
64	Improper connection of temperature sensor
63	Improper connection of temperature sensor
62	Temperature sensor disconnected
54	Magnetic coil in meter head disconnected (may also occur from empty metering pipe)
52	Magnetic coil in meter head short-circuited (may also occur from empty metering pipe)
44	Shunt in meter head defective
43	Shunt in meter head defective
42	Shunt in meter head defective
24	Temperature >> max
23	Temperature > 130 °C / 266 °F
08	Overrun, volume counter 2
07	Overrun, volume counter 1
05	Input active
04	Flow >> max / metering pipe empty
03	Flow > max
02	Overflow, Output2
01	Overflow, Output3
00	No error

6.1.1 Process variables

Flow Display key: FLOW

This register can show the current Flow rate for the liquid in the Flow Transmitter. The Flow rate is an averaged value, where the time constant for the digital filter and the flow rate in unit/min. or unit/hour can be selected in the Code3 register. The time constant for the filter can be chosen to be one of four values in the interval between approx. 0.15 sec. and approx. 10 sec. Reverse flow (relative to the arrow on the meter head) can be set to 0, as well as Flow rates smaller than 0.2% of max. flow can be set to 0 (selected in Code3).

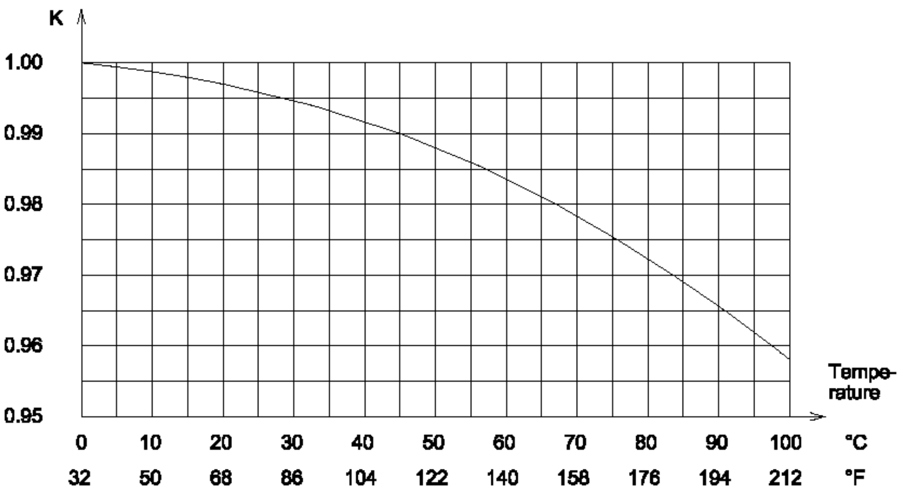
TCFlow **Display key: T.C.FLOW**

In addition to the normal flow measurement, the Flow Transmitter also measures a temperature, which may then be used to calculate a temperature compensated flow.

The calculation of the temperature compensated flow is performed to compensate for the expansion of the liquid as a function of the liquid temperature.

The Flow Transmitter automatically calculates the temperature compensated flow by multiplying the flow rate by a temperature dependent correction factor, K.

The temperature compensated flow, TCFlow, may be read directly in this register.
The relationship between temperature and K is stored in the Flow Transmitter and is shown below.
Implementing an automatic calculation of TCFlow in the entire temperature range requires a Pt100 temperature sensor to be connected to the terminals 9, 10, 11 and 12.



Temperature compensation may be implemented for liquids at fixed temperature without using a Pt100 temperature sensor. This is shown in the following example:

> The liquid is at a fixed temperature of 75 °C (167 °F) during production. No Pt100 sensor is connected, but temperature compensated flow is required for the volume counters.
>
> The value for the correction factor K is read from the above diagram, 0.975. This value should now be multiplied by the value from the E1 register, Metersize, and then stored back in Metersize. The Code2 register, digit 4 should be set to **1** in order to select Flow as data for volume counters.

Note: Using this kind of temperature compensation will only give the correct result when the liquid is at the fixed temperature.

Temperature **Display key: TEMP**

This register can show the temperature, calculated using the Pt100 sensor connected to the Flow Transmitter. If the four terminals for the temperature sensor are short-circuited, the calculated temperature will be approx. -245 °C, equal to -409 °F. The calculation unit for temperature is selected in the Code3 register.

Available **Display key: AVAIL. REG.**

The Available register has several functions depending on the selected options for Output3 and Batch control / Limit switch:

- If the **Output3 function** is set to **current output with PI-regulator**, the Available register contains the output value from the regulator. The output value will be in the range 0 to 100%, corresponding to 4-20 mA or 20-4 mA, depending on the selection in the PICode register. If the PI-regulator is in Manual operation, then a value may be written into the Available register, giving the output value for the current output.

- The Available register may be used as **Data input** for **Batch control** / **Limit switch**.

- If none of the above options are selected, this register may be used as a free register for storing Real values.

Volume1 **Display key: VOL.1**

This register can show one of the two internal volume counters in the transmitter. The counter increments when the flow is positive and decrements when the flow is negative.

The read-out resolution (number of digits after the decimal point) on the Display Unit for the counter is chosen in the Code1 register. This read-out resolution also determines the overflow value for the counter. The counter value uses a total of 6 significant digits including the digits after the decimal point.

When the counter has reached its maximum, error code 07 is generated, and the counter starts from 0 again. The maximum value for the counter is reached when all 6 significant digits show the value 9. The corresponding volume depends on the counter resolution. If the resolution is 3 digits after the decimal point and the meter size is inserted in m^3, maximum will be 999.999 m^3 - even if there is no Display Unit connected to the transmitter.

Volume2 **Display key: VOL.2**

The Volume2 counter is similar to the Volume1 counter, though error code 08 is generated at overflow. Furthermore it is possible to clear Volume2 by means of Input1 or Batchstart.

Setpoint **Display key: SETP.**

The Setpoint register has several functions depending on the selected options for the PI-regulator and Batch control / Limit switch:

- If the Output3 function is set as a regulator, the setpoint for the regulator is inserted here. The setpoint is inserted in the same unit as the amount to be regulated - e.g. m^3/h.

- If the Output2 function is set for Batch control, the setpoint for the batching is inserted here. After batch start (via Input1 or BatchStart) Output2 will be ON until the volume counter has reached the Setpoint. This function works for positive values **only**.

- If the Output2 function is set as Limit switch, the limit is inserted in this register. If data for the limit switch is below the limit, Output2 will be OFF. If data is above the limit, Output2 will be ON.

As Setpoint may be used for Output2 as well as Output3, it is **not** possible to use the regulator function for Output3 **and** either the batch control or limit switch function for Output2 at the same time.

InstantFlow Display key: INST. FLOW

This register shows the flow directly as it is measured in the transmitter.

- The read out is not conditioned through the digital filter
- Reverse flow is shown
- Flowrates lower than 0.2% of maximum flow are shown
- The actual flow is shown - even if the transmitter is in TEST-mode

6.1.2 Configuration and calibration parameters

MeterSize Display address: E1, Size of Meter

The meter size, as shown on the meter head, is normally inserted in this register. On the meter head, the meter size is stated in m^3/h. If another volumetric unit is required to be used for measurement results, the value of MeterSize should first be converted to the equivalent in the new unit and then stored as the calibration factor. This value must always be stated in **volume units per hour** - even if the required Flow read out is to be volume per minute.

Example 1: On the meterhead the meter size is shown as 80 m^3/h. The required volume unit is litres, so insert 80 x 1000 = 80000 in MeterSize.

Example 2: On the meterhead the meter size is shown as 80 m^3/h. The required volume unit is US Gallons, so insert 80 x 264.2 = 21136.0 in MeterSize.

Ti Display address: E2, Integration time Ti

Ti is the integration time constant for the PI-regulator, which is the time it takes for the I-component of the regulator to give the same change in the output signal as that made by the P-component, following a permanent change of the input signal. If Ti is equal to 0, the I-component of the regulator is disabled and set to zero.

See also the application example Flow control.

Please consult the specialist literature on the subject of process control for further information on how to set the regulator parameters for particular purposes.

PICode Display address: E3, PI-regulator function

The content of this register defines the function of the PI-regulator and the current output (where **in** determines the calculation of the input signal and **out** determines control direction for the current output). The register also holds an operation mode selector (Manual/Auto).

The data type for PICode is a LongInteger, which may be considered as 8 digits in hexadecimal readout. The first 6 digits represent and select an optional function. The information must be interpreted as shown below:

Value	Dig. 1	Dig. 2	Dig. 3	Dig. 4	Dig. 5	Dig. 6
					Regulator Function	**Regulator operation mode**
0	0	0	0	0	in=setpoint-data out 0-100%: 4-20mA	Auto
1					in=data-setpoint out 0-100%: 4-20mA	Manual
2					in=setpoint-data out 0-100%: 20-4mA	Input ON => manual operation
3					in=data-setpoint out 0-100%: 20-4mA	

MeterNumber Display address: E4, Meternumber

The meter head serial number may be retrieved from this register. This number is set by the manufacturer and is used for service purposes only. The serial number is printed on the side of the Flow Transmitter meter head.

Scale Display address: E5, Output3 scaling

This register is used for the scaling of Output3 when it is used as a pulse output or current output.

If the Output3 function is for **pulse output**, 0 to 1000 Hz, the number of volume units per pulse is defined in Scale.

Example 1: The meter size (MeterSize is read in E1 at the Display Unit) is 20000 litres per hour. The requirement is for 0.01 litres per pulse on Output3 (equal to 100 pulses per litre). The figure **0.01** is therefore inserted in **Scale** (E5 on Display Unit).

In this example a flow of 20000 litres per hour will give an Output3 frequency of

$$\frac{20000\ l/h}{0.01\ l/pulse\ x\ 3600\ \sec/h} = 555.5\ pulses/\sec$$

Note: Be sure that the frequency on the output does not exceed 1000 Hz

Example 2: The meter size (MeterSize is read in E1 at the Display Unit) is 5284 US GPH. The requirement is for 0.01 US gallons per pulse on Output3 (equal to 100 pulses per US gallon). The figure **0.01** is therefore inserted in **Scale** (E5 on Display Unit).

In this example a flow of 5284 GPH will give an Output3 frequency of

$$\frac{5284\,GPH}{0.01\ gallons/pulse\ x\ 3600\sec/h} = 146.8\ pulses/\sec$$

Note: Be sure that the frequency on the output does not exceed 1000 Hz.

If the Output3 function is for **current output**, 4 - 20 mA, Scale will indicate the full-scale value of the data for the current output.

Example 1: Full scale (20 mA) is required to be the current output at 15000 litres per hour. The number 15000 is inserted in Scale. 4 mA always equals a measured result of 0.

Example 2: Full scale (20 mA) is required to be the current output at 4000 US GPH. The number 4000 is inserted in Scale. 4 mA always equals a measured result of 0.

If the function of Output3 is a **PI-regulator**, Scale will indicate the proportional band of the regulator. The proportional band for a regulator is the change required in the input signal to give a change from 0 to 100% in the output signal (without I). The proportional band is defined in the same unit, as the input signal to the regulator - e.g. m^3/h.

See also the application example Flow control.

Please consult the specialist literature on the subject of process control for further information on how to set the regulator parameters for particular purposes.

Code1 **Display address: E6, Display resolution**

Various measurement results can be read out from the Flow Transmitter using the display unit. Code1 is used to determine how many digits appear after the decimal point when displaying each of these values. The resolution may be in the range from 0 to 6.

Digit 1	Digit 2	Digit 3	Digit 4	Digit 5	Digit 6
Flow	**TCFlow**	**Volume1**	**Volume2**	**Setpoint**	**Instantflow**

For digit 3 - Volume1 and digit 4 - Volume2, the resolution also determines the maximum value for the counters, i.e. the overflow value See also the description for Volume1.

Example 1: The size of the transmitter is 80 m^3/h. Flow is requested on the display with a resolution of 0.01 m^3/h. Set digit 1 in Code1 equal to 2 (2 digits after the decimal point).

Example 2: The size of the transmitter is 21136 US GPH. Flow is requested on the display with a resolution of 0.01 GPH. Set digit 1 in Code1 equal to 2 (2 digits after the decimal point).

When the Output2 function is for pulse output, 0 - 10 Hz, the resolution on Volume1 indicates the resolution on the display read out as well as the pulse output. Output2 will give a pulse each time the least significant digit changes on the display.

Example 1: In MeterSize the size of the transmitter is specified to be 20 m^3/h. On Output2, 1 pulse is required for each 0.01 m^3 (10 litres). Digit 3 in Code1 is set to 2 (2 digits after the decimal point).

At a flow of 20 m^3/h, the frequency on Output2 is:

$$\frac{20\ m^3/h}{0.01\ m^3/pulses\ x\ 3600\sec/h} = 0.55\ Hz$$

Example 2: In MeterSize the size of the transmitter is specified to be 5284 US GPH. On Output2, 1 pulse is required for each US gallon. Digit 3 in Code1 is set to 0 (0 digits after the decimal point).

At a flow of 5284 US GPH, the frequency on Output2 is:

$$\frac{5284\,GPH}{1\ gallon/pulse\ x\ 3600\sec/h} = 1.47\ Hz$$

Note: Resolution should be chosen so that the frequency on Output2 does not exceed 10 Hz.

Code2 Display address: E7

The contents of Code2 define the functions of Output2, the functions and control data for Output3, data for volume counters, data for the batch control / limit switch and the operational mode for the Flow Transmitter.

The information must be interpreted as shown below:

Value	Dig. 1	Dig. 2	Dig. 3	Dig. 4	Dig. 5	Dig. 6
	Function Output3	**Data for Output3**	**Function Output2**	**Data for vol counter**	**Mode**	**Data for batch/limit**
0	No function	No function	No function	No counting	Linearizing function disabled	No batch/limit
1	PI-regulator	Flow	Pulse output 0 - 10 Hz	Flow	Linearizing function enabled	Flow
2	Current output, 4-20 mA	TCFlow	Batch control	TCFlow		TCFlow
3		Temp				Temp
4	Pulse output, 0 - 1000 Hz	Available	Limit switch			Available
5						Volume1
6			Error code=0			Volume2
7						
8		Instantflow	Sign for Output3	Instantflow	TEST	Instantflow

If the PI-regulator is selected for Output3, then it is not possible to select Batch control or Limit switch for Output2 at the same time, because the Setpoint register is used for both functions.
With Output2 function *Sign for Output3,* means Output2 is OFF for positive flow.
During TEST-mode the flow is not calculated by the transmitter, and can thus be inserted in the Flow register, using the display unit.
See also the Flow control application example in the Flow control section for a specific configuration of the Code2 register.

Code3 Display address: E8

The contents of Code3 defines the digital filter for Flow, selects the calculation of flow direction and temperature, defines the function for Input1.

The 6 digits represent and select one of the above-mentioned options. The information must be interpreted as shown below

Value	Dig. 1	Dig. 2	Dig. 3	Dig. 4	Dig. 5	Dig. 6
	Flow unit Time const.	**Calculation of Flow**	**Calculation of Temp.**	**Input1 function**	1	1
0	Unit/min Time = 0.15 s	Unidirectional flow<0.2% =0			1	1
1	Unit/hour Time = 0.15 s				1	1
2	Unit/min Time = 1.0 s	Unidirectional	Unit = °C	Stop counters => no error	1	1
3	Unit/hour Time = 1.0 s		Unit = °F	Stop counters => error = 05	1	1
4	Unit/min Time = 5.0 s	Bidirectional flow<0.2% =0		Clear Volume2 Start Batch	1	1
5	Unit/hour Time = 5.0 s				1	1
6	Unit/min Time = 10.0 s	Bidirectional			1	1
7	Unit/hour Time = 10.0 s				1	1

The positive flow direction is indicated by an arrow on the meterhead. When metering in both directions, flow in the direction of the arrow is registered as positive flow, and flow in the opposite direction of the arrow is registered as negative flow. When set to measure in one direction only, flow in the opposite direction to the arrow is ignored.

See also the Batch control for a specific configuration of the Code3 register.

6.2 Standard settings

If specific functions are not requested at time of order, the transmitter will be delivered with the following standard settings:

Variable name Display address		TE67A1x xxxxxxx	TE67A2x xxxxxxx	TE67A3x xxxxxxx	TE67A4xx xxxxxx	TE67A5xx xxxxxx	TE67A6xx xxxxxx
MeterSize E1		8.0	20.0	40.0	80.0	120.0	200.0
Scale E5	TE67Axxxxx1xxx TE67Axxxxx2xxx	.000010 8.00000	.000010 20.0000	.000100 40.0000	.000100 80.0000	.000100 120.000	.000100 200.000
Code1 E6		333333	333333	222222	222222	222222	222222
Code2 E7	TE67Axxxxx1xxx TE67Axxxxx2xxx	411110 211110	411110 211110	411110 211110	411110 211110	411110 211110	411110 211110
Code3 E8		302411	302411	302411	302411	302411	302411

These standard settings result in the following output configurations:

TE67Axxxxx1xxx (with 2 pulse outputs):

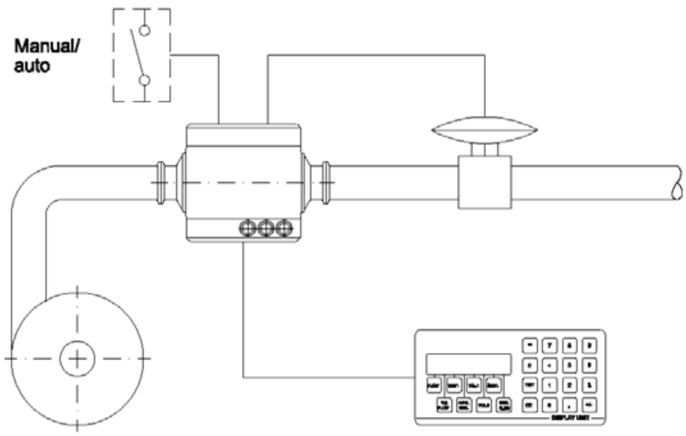
Output2: 1 litre/pulse (TE67A1 and TE67A2)
10 litre/pulse (TE67A3, TE67A4, TE67A5 and TE67A6)
Output3: 0.01 litre/pulse (TE67A1 and TE67A2)
0.1 litre/pulse (TE67A3, TE67A4, TE67A5 and TE67A6)

TE67Axxxxx2xxx (with 4-20 mA output and pulse output):

Output2: 1 litre/pulse (TE67A1 and TE67A2)
10 litre/pulse (TE67A3, TE67A4, TE67A5 and TE67A6)
Output3: 20 mA at max flow rate

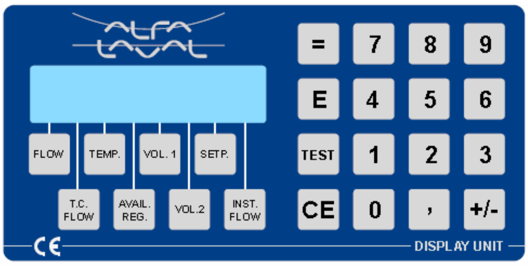
7 Applications

7.1 Flow Control



A centrifugal pump, a Flow Transmitter, and a modulating valve with an I/P converter can form an accurate FLOW CONTROL SYSTEM. Such a system is more accurate, and also normally less expensive than systems using a positive pump with variable speed.

The Flow Transmitter has a built-in PI-REGULATOR, which can be operated in AUTO as well as in MANUAL. Input1 is used for this manual/auto selection.



The requested flow rate is keyed into SETPOINT on the connected Display Unit. The output value can be read in % by pressing the untitled key to the left of VOL.2. If the regulator is in MANUAL, the operator can key the requested output position into the same register.

Programming

To enable the PI REGULATOR function, the Flow Transmitter should be programmed in the following way: The * indicates that these digits are not in use for this function but should be programmed according to the meter size and other working conditions of the Flow Transmitter. The program enable switch must be in position ON during programming.

E1: ******	E5: P-band
E2: --Ti--	E6: ******
E3: 0000AB	E7: 18**1*
E4: ******	E8: ******

The P-band indicates the proportional sensitivity in the same flow units as the "FLOW" register (l/h or gallons/min.). The P-band is equal to the change in flow rate, which will change the output from 0 to 100%. A typical setting of E5 is 25% of max. flow.

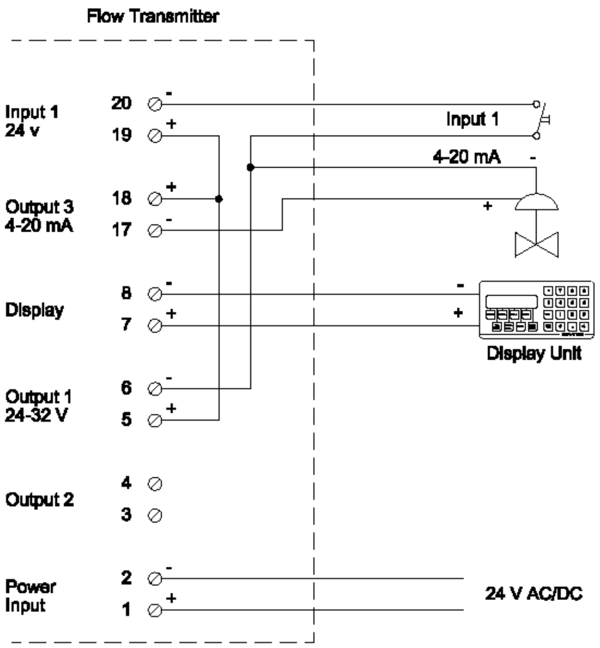
The Ti is the regulator's integration time in seconds. Ti is equal to the time the integrating part of the regulator requires to provide the same change on the output as the proportional part for a step in flow rate. A typical Ti time is 2 sec. The P-band and the Ti can be optimized by experiment, or by following the rules available in specialized literature.

There are two types of valves. Digit 5 in E3 is set to 0 if the valve is normally closed at 4 mA, or set to 2 if the valve is normally open at 4 mA.

Digit 6 in E3 determines the function of the AUTO/MAN. Digit 6 = 0: The regulator is always in auto. Digit 6 = 2: If Input1 is ON, the regulator is in MANUAL, otherwise in AUTO.

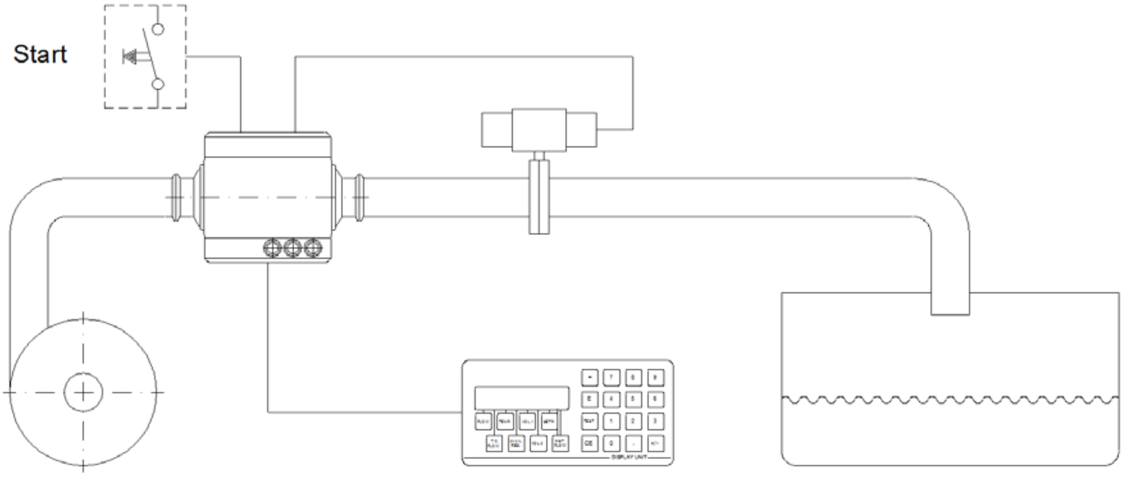
The P-band, Ti and Setpoint can always be changed, because these registers are stored in RAM. The contents will disappear after a power-cut, unless the programme enable switch is in position ON. In this case the contents of P-band, Ti and SETPOINT are stored in EEPROM, and restored in RAM after power-up. The program enable switch must be switched off after programming, to preserve the EEPROM memory.

Electrical connections

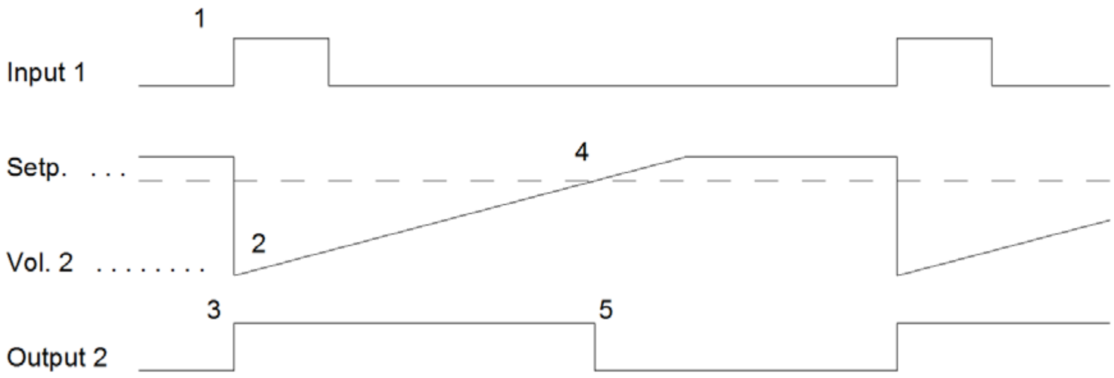


It is very important to select the correct valve size. Which size to choose depends on the following information: The min. and max. flow rate, the flow/pressure curves of the pump, and the pressure drop in the pipe work at the specified flow rate. It is normally recommended to ask the supplier of the modulating valve to select the size.

7.2 Batch control using the Display Unit



The Flow Transmitter has a built-in batch control function, and can therefore be easily used to control the dosing of a specified volume. The requested volume is keyed into "SETPOINT" on the Display Unit. Input1 is used to start the batch control. Output2 controls the dosing valve or pump. The Volume2 counter shows the dosed volume. When the batch control function is used, the built-in flow regulator cannot be used.



The function of the system

First, the requested volume is keyed into "SETPOINT". The dosing will start when Input1 is activated. This will clear the Volume2 counter and Output2 switches on. The valve or pump controlling the flow must be activated by the relay. When the liquid starts to flow, "Volume2" will count up, and when it is equal to the setpoint, Output2 will switch off. Because of the reaction time of the valve or pump, the flow will not stop immediately after Output2 is switched off. Consequently the actual dosed volume is a little higher than the setpoint. This after-flow is fairly constant if the reaction time and the flow rate are constant, and therefore it is possible to compensate for that by reducing the setpoint with the volume of the after-flow. The volume of this after-flow can be calculated as [Volume2 - setpoint].

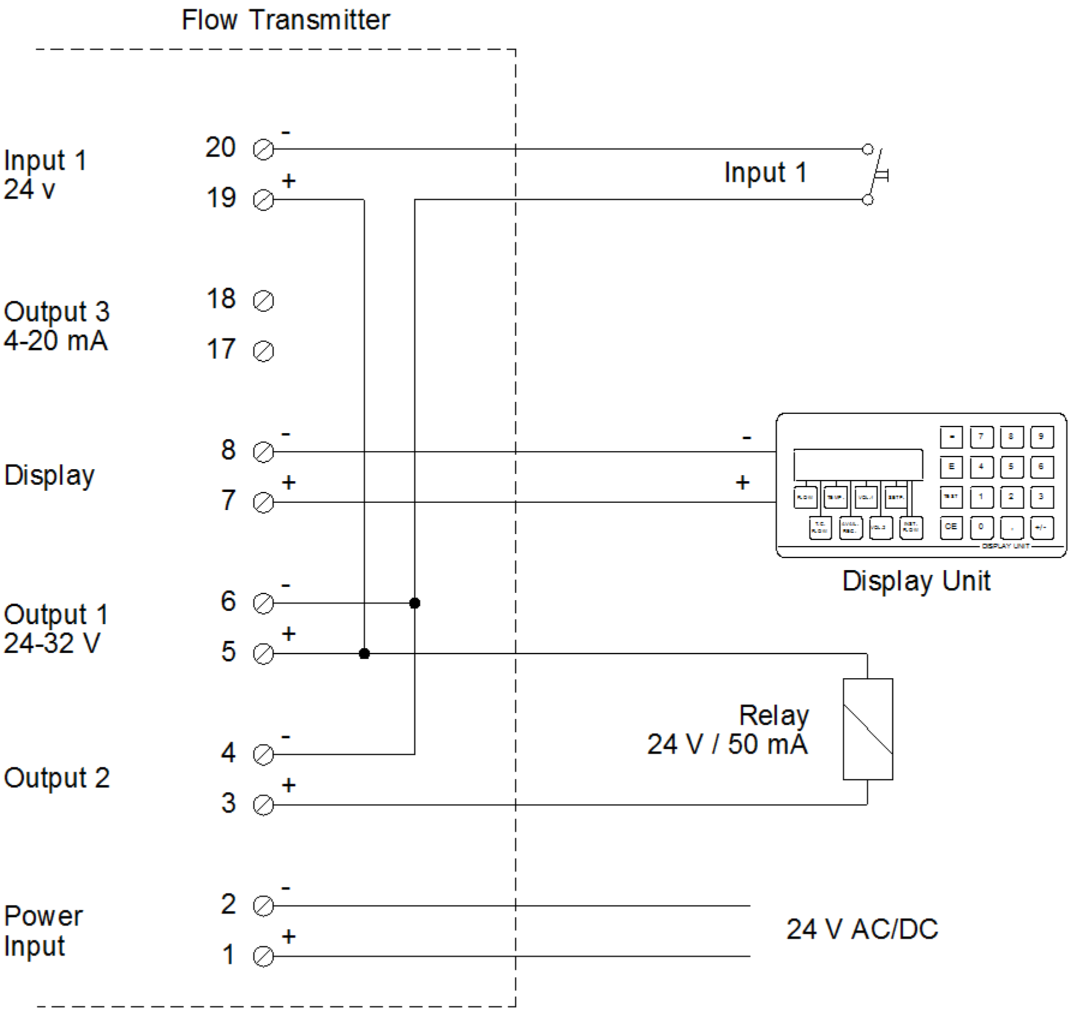
Programming the batch control

To obtain the requested functions the Flow Transmitter must be programmed as shown below. When programming the Flow Transmitter, the Program Enable Switch on the terminal board must be in the ON position. Digits marked with * are not used for the batch control function, but should be programmed according to meter size and other working conditions.

E1: ******	E5: ******
E2: ******	E6: ******
E3: 000000	E7: **2116
E4: ******	E8: 3024**

When programming is complete, the Program Enable Switch should be switched back to the OFF position. The value in the setpoint register before the program enable switch was switched off, will be used as a power-up value following a power-cut.

Electrical connections



8 Fault finding

8.1 Error detection

The Flow Transmitter is equipped with a comprehensive self testing system, which is able to indicate faults arising from improper use of the transmitter, or faults arising whilst the transmitter is in use.

When the internal test system registers a fault, an error code, in the form of a number, is generated within the Flow Transmitter. If several errors in the error checking system should develop at the same time, only the highest numbered error is saved.

The error may be observed by means of the Display Unit.
The user is informed by an "A" for ALARM appearing in the first digit of the display. By pressing the "TEST" button, the display will show an error code of two digits, indicating the type of error. The test system ensures that the alarm will not be cancelled before the error code has been displayed by pressing the "TEST" button, even though the error may have disappeared. By pressing the "TEST" button once again, the display will show "0" if the Flow Transmitter is currently error free. The error code on the display is **only** updated by re-pressing the "TEST" button.

8.2 Typical errors

8.2.1 Flow Transmitter with Display Unit

If neither the transmitter nor the Display Unit functions

- Check that the light-emitting diode in the terminal box is on.
- Check that the transmitter is correctly connected.
- Check that the supply voltage **at the Flow Transmitter** is at least 20 V AC or DC, when the transmitter is powered up (with the terminal box mounted on the transmitter).

If the Display Unit does not function

- Check that the cable between the transmitter and the Display Unit is correctly connected at both ends.
- Check that the cable is not defective.
- Check that the cable is not too long or too thin (max. 100 m / 328 feet, min. 0,75 mm² / AWG 18).

If external equipment, e.g. an electronic counter, does not function, or does not function properly

- Check that the equipment is correctly connected.
- Check that the transmitter data is being displayed correctly (using the Display Unit).
- Check that the required functions for the output signals have been correctly set, and that the meter size is correct using the Display Unit.

If the transmitter does not indicate flow

- Check that there really is flow through the metering pipe.
- Check that the flow direction is correct.

If the transmitter gives a false read-out

- Check if there is any air in the liquid.
- Check that the conductivity of the liquid lies within the specified range.

8.2.2 Flow Transmitter without Display Unit

If the transmitter does not function

- Check that the light-emitting diode in the terminal box is on.
- Check that the transmitter is correctly connected.
- Check that the supply voltage **at the transmitter** is at least 20 V AC or DC, when the transmitter is powered up (with the terminal box mounted on the transmitter).
- Check that there really is flow through the metering pipe.
- Check that the flow direction is correct.

If the transmitter gives a false read-out

- Check if there is any air in the liquid.
- Check that the conductivity of the liquid lies within the specified range.

9 Specifications

All electrical characteristics are valid at an ambient temperature from -10 to +50 °C (+14 to +122 °F), unless otherwise stated.

All specifications apply within approved EMI conditions

9.1 Flow measurement

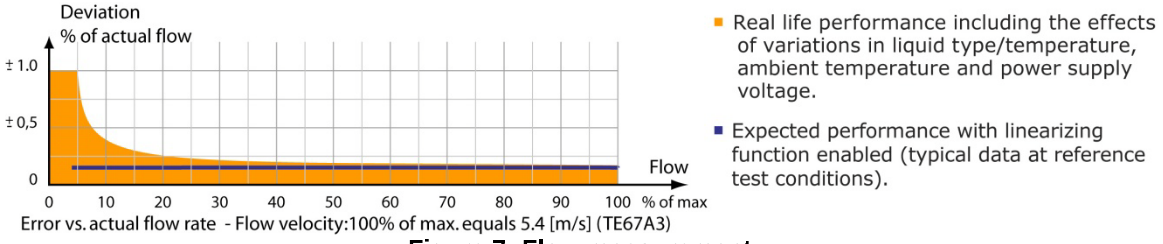


Figure 7: Flow measurement

Flow measurement error:	typ. less than half the value as shown on Figure 7
Current output error:	As Figure 7, plus ±0.3% of current output range
Linearity:	(see the Figure 7)
Repeatability:	max. (0.5 x error), (see Figure 7)
Ambient temperature effect:	max. 0.04%/10 °C
Voltage supply effect:	max. 0.01%/10%
Response time pulse output:	0.2 sec.
Response time current output:	1.0 sec.

9.2 Power Supply

The transmitter should always have the supply connected to prevent condensation in the electronics.

Power supply AC (50/60 Hz) or DC:	nom.	24.0 V
	min.	20.0 V
	max.	28.0 V
Current at power up:	max.	650 mA
Fuse (time lag):		0.8 A
Power consumption:	max.	6 W

9.3 Liquid

Conductivity:	min.	5 µs/cm
Temperature range:		-30 °C to +100 °C
		(-22 °F to +212 °F)
Pressure:	max.	10 bar
	.	(145 psi)
Pressure test:	max.	15 bar
		(218 psi)

9.4 Measurement of temperature

Temperature input with Pt100 sensor (IEC 751, DIN 43760). Specifications exclude the accuracy of the Pt100 sensor.

Range:	-30 °C to +100 °C (-22 °F to +212 °F)
Error:	max. ±0.9 °C ±1.6 °F

9.5 Environment

Ambient temperature:	-10 °C to +50 °C (14 °F to +122 °F)
Protection:	IP 67

9.6 Approvals

Compliance with EMC-directive no.:	89/336/ECC
Generic standards for emission:	
Residential, commercial and light industry	DS/EN 61000-6-3
Industry	DS/EN 61000-6-4
Generic standards for immunity:	
Residential, commercial and light industry	DS/EN 61000-6-1
Industry	DS/EN 61000-6-2

9.7 Dimensions and capacities

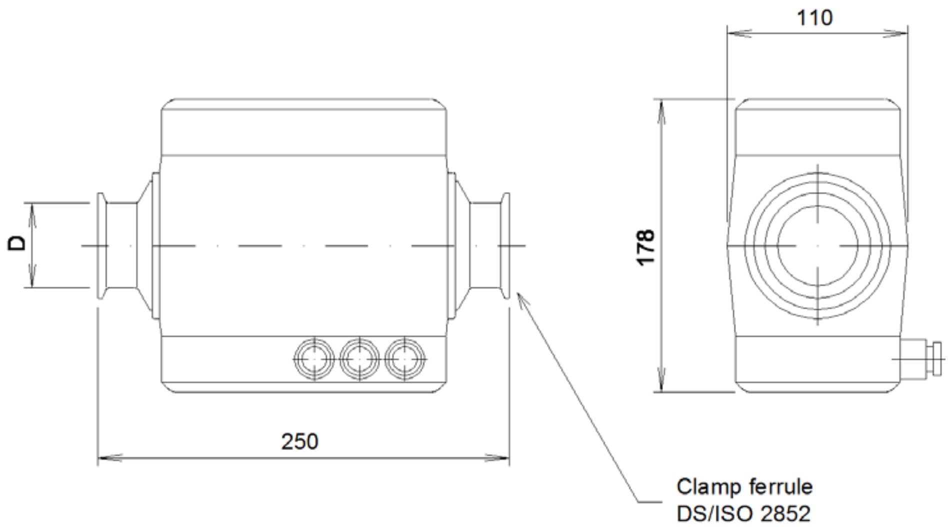


Figure 8: Dimensions in mm (TE67A1 through TE67A5)

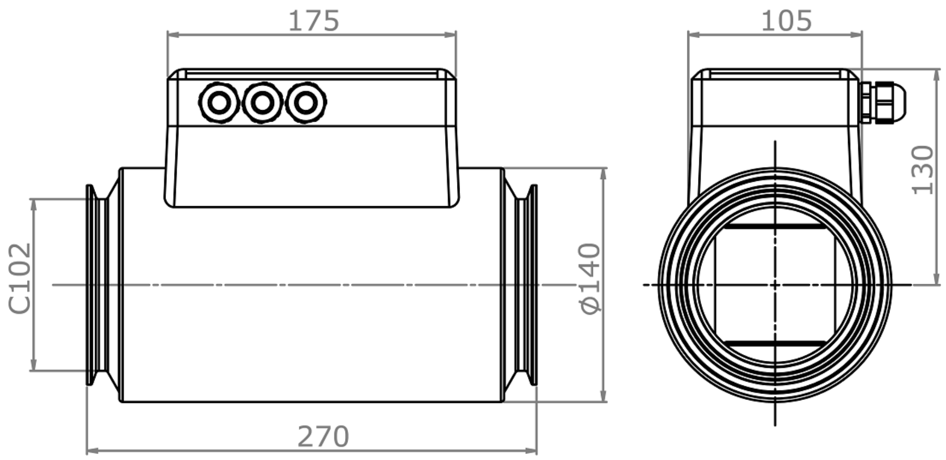


Figure 9: Dimensions in mm (TE67A6)

9.8 Maximum flow rates and weight

Meter type	Nom. Size		Max. flow rate		Weight	
	[mm]	[in.]	[m^3/h]	[GPH]	[kg]	[lbs]
TE67A1xxxxxxxx	25	1	8	2113	5	11
TE67A2xxxxxxxx	38	1.5	20	5284	5	11
TE67A3xxxxxxxx	51	2	40	10568	5	11
TE67A4xxxxxxxx	63.5	2.5	80	21136	5	11
TE67A5xxxxxxxx	76	3	120	31704	5	11
TE67A6xxxxxxxx	102	4	200	52840	10.5	23

(GPH = US gallons/hour, 1 m^3/h = 264.2 GPH).

Note: The max. flow rate for the Flow Transmitter must NEVER be exceeded. Otherwise the meterhead may be damaged.

9.9 Material

Electrodes:	Stainless steel AISI 316.
Metering pipe:	Stainless steel AISI 316.
Coating inside metering pipe:	PTFE/PFA.
Housing:	
TE67A1xxxxxxxx to TE67A5xxxxxxxx:	PPO.
TE67A6xxxxxxxx:	Stainless steel AISI 316/PPO.

9.10 Connections

Clamp pipe coupling:	DS/ISO 2852.

10 How to contact Alfa Laval Tank Equipment A/S

For further information please feel free to contact:

Alfa Laval Tank Equipment A/S
Baldershoej 19
P.O. Box 1149
2635 Ishoej
Denmark

Phone no.: +45 43 55 86 00
Fax no.: +45 43 55 86 01
www.alfalaval.com
www.toftejorg.com

Contact details for all countries are continually updated on our websites.

11 EC Declaration of Conformity

The designated company

Alfa Laval Tank Equipment A/S
Company name

Baldershoej 19, DK-2635 Ishoej, Denmark
Address

+45 43 55 86 00
Phone no.

hereby declare that

Alfa Laval Flow transmitter	TE67Axxxxxxxxx
Denomination	Type

is in conformity with the provisions of the Directive 2004/108/EU and with the national implementing legalization and EC regulation 1935/2004 relating to materials and articles intended to come into contact with food

and furthermore declares that the following (parts/clauses of) applicable directives have been used:

- Directive 2006/95/EC on low voltage
- EMC: EN61000-6-3:2007
- EN61000-6-2:2005

The technical construction file for this instrument is retained at the above address.

R&D Manager	Henrik Falster Hansen	
Title	Name	Signature

January 6, 2011	Alfa Laval Tank Equipment A/S
Date	Company

How to contact Alfa Laval
Contact details for all countries are
continually updated on our website.
Please visit www.alfalaval.com to access the information directly.