SIEMENS

Handbook

SITRANS F US SONOCAL® series 3000

Ultrasonic heat meter and flowmeter

- **District heating applications**
- **Chilled water applications**
- **Combined cooling/heating application**

Order no.: FDK:521H1087

SFIDK.PS.022.I1.02 - A5E00253598

Contents

1. Introduction

Important information about this handbook

The handbook has been divided into 2 parts.

Part 1, chapter 1 to 11 describes SITRANS F US SONOCAL 3000 with SITRANS F US 105 for normal use in district heating applications.

Part 2, chapter 12, contains additional requirements for the use *of SITRANS F US 105 in chilled water applications and in combined cooling/heating applications.*

At delivery the SITRANS F US 105 is programmed to fit into different applications.
The letter combination in the build-up code indicates the different types. The build-up code can be seen on the label located on the front of SITRANS F US 105.

SITRANS F US 105 - XXXXX-**OR**XXX: Standard heat meter for district heating, flowmeter in return

F US 105 - XXXXX-**OF**XXX: Standard heat meter for district heating, flowmeter in forward

F US 105 - XXXXX-**CR**XXX: Chilled water heat meter, flowmeter in return

F US 105 - XXXXX-**CF**XXX: Chilled water heat meter, flowmeter in forward

F US 105 - XXXXX-**SR**XXX: Combined cooling/heating, flowmeter in return (cold pipe in winter)

F US 105 - XXXXX-**SF**XXX: Combined cooling/heating, flowmeter in forward (hot pipe in winter)

Introduction

SITRANS F US SONOCAL® ultrasonic heat meters series 3000 are designed for accurate, high resolution energy measurement in water based district heating plants i.e. local networks, boiler stations or substations with pipe sizes DN 50 - DN 1200.

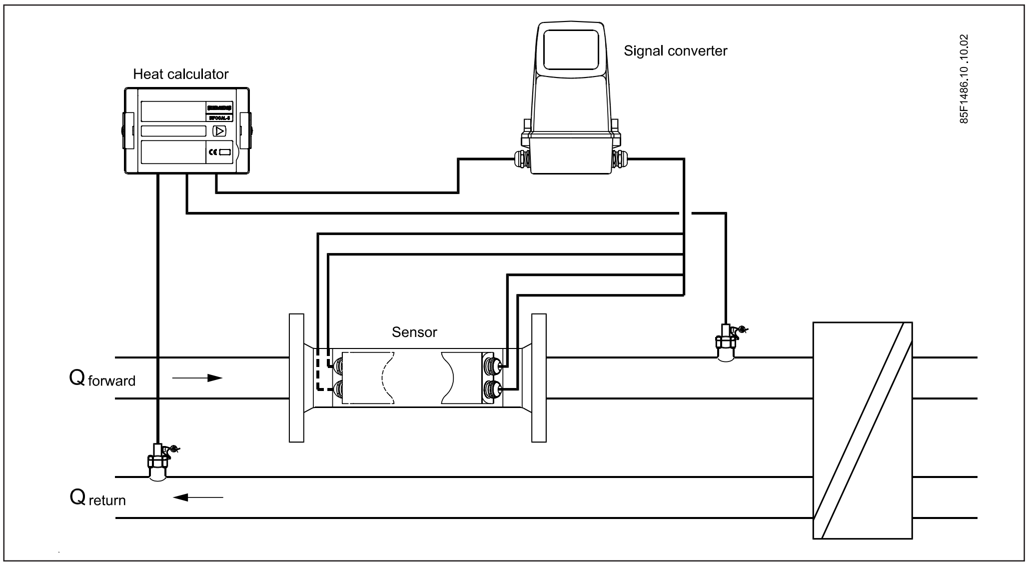
The SITRANS F US SONOCAL® ultrasonic heat meter series 3000 is an ideal combination of a SITRANS F US SONOFLO® ultrasonic flowmeter (which consists of a sensor and a signal converter), an energy calculator type SITRANS F US 105 and a thoroughly matched pair of Pt 500 temperature sensors.

SITRANS F US SONOCAL® ultrasonic heat meters series 3000 are designed and approved for custody transfer.
Energy calculator type SITRANS F US 105 and temperature sensors are approved according to OIML R75 and EN 1434.
The flow part of the SITRANS F US SONOCAL 3000 system, the SITRANS F US SONOFLO® ultrasonic flowmeter, type SONO 3000/3300 CT, is approved according to PTB environment class C and OIML R75 class 4.

The respective temperature sensors are mounted in forward and return pipe. The flowmeter which is mounted in either a forward or a return pipe generates pulses proportional to the water flow.

SITRANS F US 105 carries out an integration, i.e. calculation and accumulation.
The differential temperature is calculated and multiplied by the quantity of water and the K-factor (correction for density and heat contents).

Potential Hazards
The ground wire must always be connected to the ground terminal in accordance with the diagram.



Energy calculation

The energy supplied in the system can be calculated as follows.

$$E = \int_0^t P(t) \times dt = \int_0^t K(T_F) \times Q_F \times (T_F - T_R) \times dt$$

where

E = Energy
$P(t)$ = Power as function of the time
$K(T_F)$ = Enthalpy factor (K-factor)
Q_F = Flowrate forward
T_F = Temperature forward
T_R = Temperature return

Energy calculator type SITRANS F US 105 uses the enthalpy tables issued by PTB in Germany (Dr. Stuck).

Note

To measure correctly, forward and return flow must be equal ($Q_{forward} = Q_{return}$). If there are large losses in the system $Q_{forward} >> Q_{return}$, contact Siemens Flow Instruments for possible solutions.

Every hour accumulated heat and water quantities as well as hour counter are stored in a permanent memory. All the data will be stored in the event of a power failure.

Flowmeter

The flowmeter has a large dynamic flow range.

SITRANS F US SONOFLO® ultrasonic flowmeters are totally obstruction free and thus ensuring reliable and accurate flow measurement with a very small pressure drop and with excellent performance independent of water quality or conductivity. Having no moving parts means no need for maintenance.

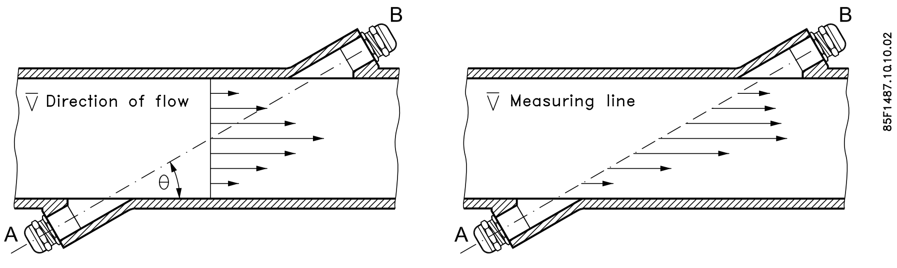
Like all other Siemens Flow Instruments flowmeters, SITRANS F US SONOFLO® ultrasonic flowmeters are calibrated at in-house flow laboratories accredited to the European norm EN 45001, guaranteeing maximum confidence and traceability back to international standards.

Service on the internal parts of the ultrasonic transducers can be done without stopping the water flow and without recalibration of the heat meter.

2. Mode of operation

Function

Measuring with ultrasonics



Physical principle
A sound wave travelling in the same direction as the liquid flow arrives at point B from point A in a shorter time than a sound wave travelling against the direction of flow (from point B to A). The difference in sound transit time indicates the flow velocity in the pipe.

Measuring principle
In SITRANS F US SONOFLO® flowmeters the two ultrasonic transducers are placed at an angle θ in relation to the pipe axis. The transducers function as transmitters and receivers of the ultrasonic signals.
Measurement is performed by determining the time the ultrasonic signal takes to travel with and against the flow. The principle can be expressed as follows:

$$V = K \frac{t_{down} - t_{up}}{t_{up} \times t_{down}} = K \frac{\Delta t}{t^2}$$

t_{down} = $t_{A, B}$
t_{up} = $t_{B, A}$
V = Average flow velocity
t = Transit time
K = Proportional factor

This measuring principle offers the advantage that it is independent of variations in the actual sound velocity of the liquid, i.e. independent of the temperature.
Proportional factor K is determined by wet calibration.

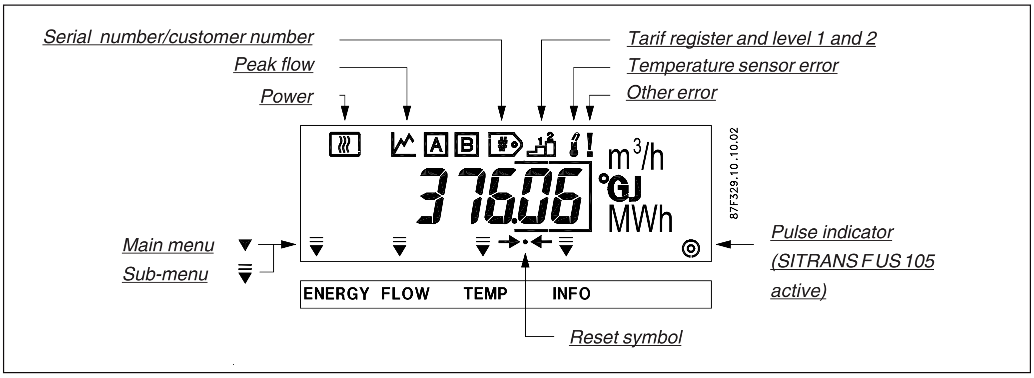
SITRANS F US 105

Operation and reading

The SITRANS F US 105 is supplied with only one control button ▷ .

In the normal state of operation the display will show the cumulative energy.

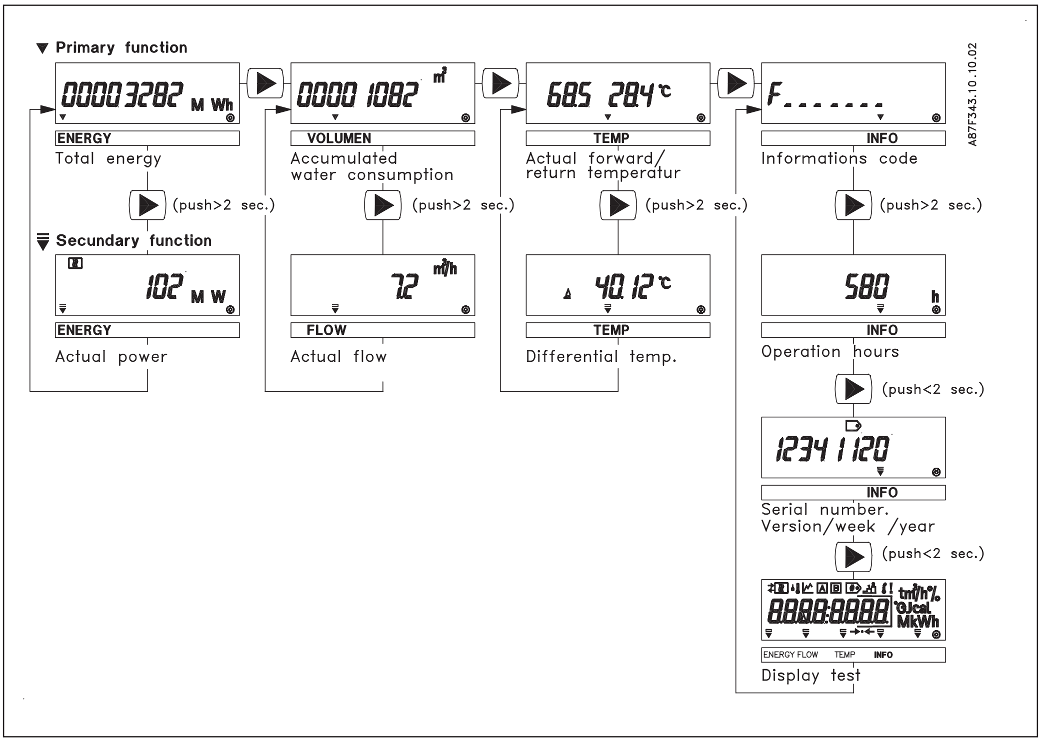
The display will always be configured in accordance with the customer's application and selected settings and consequently there will be fewer or more display options under the individual display menus.



- Pressing the ▷ button *briefly:* the display switches to the next display menu and the indicator arrow shifts to the next position.
- Pressing the ▷ button *for a longer period* of more than 2 sec.: the display switches to the sub-menu for reading secondary parameters. The arrow has 2 bars indicating that you are in a sub-menu.
- *Repeated brief pressing* of the ▷ button: the display switches between the possible display sub-menus.

If the ▷ button is *not pressed* for 1 minute the display returns to the first main menu.

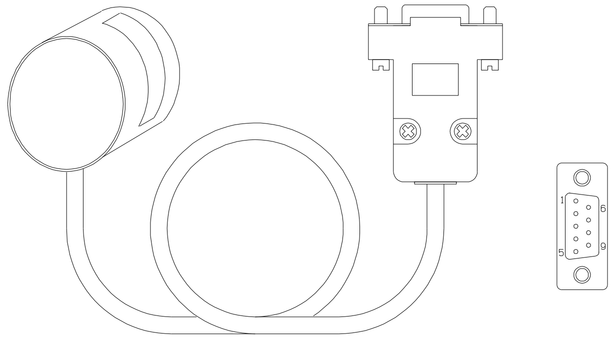
Standard display menu, type OF/OR and CF/CR



Only displays chosen in the programming will be shown are available.

Optical data acquisition via the front panel

An optical, infrared transmitter/receiver is situated in the bottom right corner of the front panel, in accordance with the EN 61107 standard. The data format complies with IEC 870 in start mode and can be subsequently changed to a format specified by the manufacturer. A standard optical head with a permanent magnet is used to read data and configure tariff limits.



2	*RXD*	*Receive Data*
3	*TXD*	*Transmit Data*
4	*DTR*	*Data Terminal Ready*
5	*SG*	*Signal Ground*

Siemens Flow Instruments data acquisition head can be connected to both Siemens Flow Instruments hand-held terminal and a standard IBM-compatible computer with Windows 3.1 or a more recent edition.

For further information on the hand-held terminal or PC-software, please contact Siemens Flow Instruments.

Temperature probes

Sensor element

Pt 500 temperature probes are used with SITRANS F US 105 energy calculator, in accordance with DIN/IEC 751. A Pt 500 temperature probe is a resistance sensor, where the nominal resistance is 500 Ω at 0 °C and 692.5 Ω at 100 °C. All values for the Ohm-resistance are stipulated in the international standard DIN/IEC 751, which applies to Pt 100 temperature probes. The Ohm-resistance values for Pt 500 probes are five times higher and can be seen in the following table [Ω]:

°C	0	1	2	3	4	5	6	7	8	9
0	500.00	501.95	503.91	505.86	507.81	509.76	511.71	513.66	515.61	517.56
10	519.51	521.46	523.41	525.35	527.30	529.24	531.19	533.13	535.08	537.02
20	538.96	540.91	542.85	544.79	546.73	548.67	550.61	552.55	554.48	556.42
30	558.36	560.30	562.23	564.17	566.10	568.03	569.97	571.90	573.83	575.77
40	577.70	579.63	581.56	583.49	585.41	587.34	589.27	591.20	593.12	595.05
50	596.98	598.90	600.82	602.75	604.67	606.59	608.51	610.44	612.36	614.28
60	616.20	618.12	620.03	621.95	623.87	625.78	627.70	629.62	631.53	633.45
70	635.36	637.27	639.18	641.10	643.01	644.92	646.83	648.74	650.65	652.56
80	654.46	65637	658.28	660.18	662.09	663.99	665.90	667.80	669.71	671.61
90	673.51	675.41	677.31	679.21	681.11	683.01	684.91	686.81	688.71	690.60
100	692.50	694.40	696.29	698.19	700.08	701.97	703.87	705.76	707.65	709.54
110	711.43	713.32	715.21	717.10	718.99	720.87	722.76	724.65	726.53	728.42
120	730.30	732.19	734.07	735.95	737.84	739.72	741.60	743.48	745.36	747.24
130	749.12	751.00	752.87	754.75	756.63	758.50	760.38	762.25	764.13	766.00
140	767.88	769.75	771.62	773.49	775.36	777.23	779.10	780.97	782.84	784.71
150	786.57	788.44	790.31	792.17	794.04	795.90	797.77	799.63	801.49	803.35
160	805.22	807.08	808.94	810.80	812.66	814.51	816.37	818.23	820.09	821.94

There are several advantages when using a resistance sensor with a high Ohm value (Pt 500) as opposed to a resistance sensor with a low Ohm value (Pt 100):

- Less cable resistance in the probe cable and change-over resistance in the connections.
- Higher Ohm change per degree centigrade gives better accuracy in the analog/digital converter of the calculator.
- The temperature probes can be matched as a pair with higher accuracy.

Mode of operation

3. Technical data

SITRANS F US SONOFLO® flowmeter type SONO 3000/3300 CT

General technical data

Power supply	115 - 230 V a.c. + 10% - 15 %
Power consumption	< 12 VA
Liquid temperature	–10°C to 200°C***)**
Ambient temperature	–20°C to 55°C / –40°C to 85°C***)**
Storage temperature	–40°C to 85°C
Protection class	IP 67
Electrical connection between sensor and converter	Max. 250 meter, 75Ω coax cable***)** (4 x 10 meter cable delivered with each SITRANS F US SONOCAL®)

***)** Depending on approval and country

Selection guide SITRANS F US SONOCAL® series 3000 (DN 50 - DN 250)

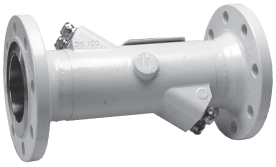
Flowmeter size nominel according to EN 1092-1			DN 50	DN 65	DN 80	DN 100	DN 125	DN 150	DN 200	DN 250
Flow range	Q_{max}	m^3/h	45	72	120	216	300	432	720	1200
	Q_n	m^3/h	36	60	100	180	250	360	600	1000
	$Q_{0,5\%}$*)	m^3/h	3.9	5.6	8.6	15	23	34	60	95
	$Q_{2\%}$*)	m^3/h	1	1.4	2.2	3.7	5.8	8.4	15	24
	$Q_{3\%}$*)	m^3/h	0.7	0.9	1.4	2.5	3.9	5.6	10	16
(starting flow)	Q_{min}	m^3/h	0.31	0.44	0.7	1.2	1.9	2.7	4.8	7.6
Flowrate at 20 mA	Q_{20mA}	m^3/h	36	60	100	180	250	360	600	1000
Thermal power	$Q_{3\%}$	KW	35	45	70	125	195	280	500	800
(ΔT = 50°C)	Q_{max}	MW	2.2	3.6	6.0	10.8	15.0	21.6	36.0	60.0
Pulse output		l / pulse	1	1	2.5	2.5	2.5	10	10	10
Analoge Output			4 - 20 mA (Bidirectional)							
Relay output			Error indication of flowmeter							
Pressure drop			No pressure drop, the sensor is a straight pipe							
Straight inlet pipe			Typically max. 10 * DN straight inlet pipe							
Accuracy			Depending on local approvals							

Selection guide SITRANS F US SONOCAL® series 3000 (DN 300 - DN 1200)

Flowmeter size nominel according to EN 1092-1			DN 300	DN 350	DN 400	DN 500	DN 600	DN 700	DN 800	DN 1000	DN 1200
	Q_{max}	m^3/h	1800	2400	3000	3600	4200	4800	5400	6000	7200
Flow range	Qn	m^3/h	1500	2000	2500	3000	3500	4000	4500	5000	6000
	$Q_{0,5\%}$*)	m^3/h	134	162	209	342	495	679	889	1402	2019
	$Q_{2\%}$*)	m^3/h	34	40	52	86	124	170	222	351	505
	$Q_{3\%}$*)	m^3/h	22	27	35	57	83	113	148	234	336
(starting flow)	Q_{min}	m^3/h	11.0	13.0	17.0	27	40	54	71	112	162
Flowrate at 20 mA	Q_{20mA}	m^3/h	1500	2000	2500	3000	3500	4000	4500	5000	6000
Thermal power	$Q_{3\%}$	MW	1.1	1.4	1.8	2.9	4.2	5.7	7.4	11.7	16.8
(ΔT = 50°C)	Q_{max}	MW	90	120	150	180	210	240	270	300	360
Pulse output		l / pulse	50	50	50	100	100	100	100	100	100
Analoge output			4 - 20 mA (Bidirectional)								
Relay output			Error indication of flowmeter								
Pressure drop			No pressure drop, the sensor is a straight pipe								
Straight inlet pipe			Typically max. 10 * DN straight inlet pipe								
Accuracy			Depending on local approvals								

*) $Q_{x\%}$: For $Q_{x\%} \leq Q \leq Q_{max}$ the accuracy is better than x%

Flow sensor type SONO 3300 CT



Description	2-track sensor with flanges and integrated transducers
Nominal size	DN 50, DN 65, DN 80, DN 100, DN 125, DN 150, DN 200, DN 250, DN 300, DN 350, DN 400, DN 500, DN 600, DN 700, DN 800, DN 900, DN 1000, DN 1200
Liquid temperature	–10 °C to +200 °C***)**
Ambient temperature	–10 °C to +160 °C***)**
	Storage: –40 °C to +85 °C
Enclosure	Standard version IP 67
Process connections PN designated EN 1092-1, type 11, B	PN 16 (DN 50 to DN 1200)
	PN 25 (DN 200 to DN 1000)
	PN 40 (DN 50 to DN 500)
Transducers	Integrated version welded into pipe
Materials: Pipe	DN 50 to DN 150: Steel W1.1131 GS-16Mn5
	DN 200 to DN 1200: Steel EN 1.0345 P235GH
Flange	DN 50 to DN 1200: Steel group 1E1, EN 1.0038 S235JRG2
Transducers	Stainless steel
Certificate	The sensor is supplied as standard with a Siemens Flow Instruments certificate of conformity.
Max. flow velocity	10 m/s

***)** Depending on approval and country

Signal converter type SONO 3000 CT

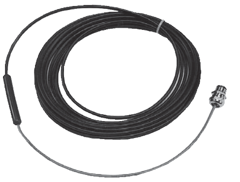
		Terminal connection
Analog output: 1	Individually galvanically isolated, isolation voltage 500 V	31 and 32
Current	4 - 20 mA	
Load	< 800 ohm	
Time constant	5 sec.	
Pulse output: 1	Individually galvanically isolated, isolation voltage 500 V	51 and 52
Measurement of	Volume flow	
Pulse width	5 ms	
Passive: Output mode	3,6 - 30 V d.c.	
	Max. current 200 mA	
Relay 1	Change-over relay for error indication	44, 45 and 46
Load	42 V, 0.5 A	
Time constant/Hysteresis	5 s / 0.5% F.S.O.	
Cut off: Low flow	1% F.S.O.	
Supply voltage and power consumption	115 - 230 V a.c. +10% to –15%, 50-60 Hz, 10-20 VA	PE, N and L
Enclosure compact		
Enclosure	IP 67 to IEC 529	
Material	Fibre glass reinforced polyamide	
Dimension	Width: 148 mm	
	Height: 178 mm/225 mm	
	Depth: 124 mm	
Weight	Approx. 2 kg	
Ambient temperature	Operation: –20 °C to +55 °C	
	Storage: –40 °C to +85 °C	
Electromagnetic compatibility (EMC)	CENELEC Emission Immunity	
	EN 50081-1 EN 50082-2	

SITRANS F US 105 energy calculator

Approved according to		EN 1434
	Temperature range	T: 0 ... 170 °C
	Differential temperature	Δt: 3 ... 150 K
	Accuracy	Max. ± (0.5 + 3 K/Δt) [%]
	Flow range	Qn (qp) ≤ 25000 m^3/h
	Environmental class	A
Temperature input		
	Measuring range	0 ... 170 °C
	Differential temperature	1 ... 170 K
	Sensor type	Pt 500 / Pt 100 (IEC 751)
	Sensor connection	2 wire
	Measurement resolution	0.01 °C
Flow inputs 1 and 2		
	Input impedance	> 100 kW
	Pulse frequency	≤ 400 Hz [1)]
	Pulse ON time	≥ 0.5 ms
	Pulse OFF time	≥ 1.5 ms
	Integration rate	1 ... 600 sec
Pulse inputs A and B		
	Input impedance	> 100 kW
	Pulse frequency	≤ 400 Hz [1)]
	Pulse ON time	≥ 0.5 ms
	Pulse OFF time	≥ 1.5 ms
	Integration rate	1 ... 600 sec.
Bus-output		
	Protocol	EN 60870-5
	Physical connection	Open collector, 2400/300 baud
Optical port		
	Protocol	EN 60870-5
	Physical connection	Optical eye, 600 baud, EN 61107
Pulse output CE and CV/Alarm		
	ON time	> 30 ms
	ON current	≤ 10 mA
	External supply	≤ 24 V d.c.
	OFF time with alarm	Approx. 1 hour
Supply data		
	Internal voltage	3.6 +0.1/-0.4 V d.c.
	Power consumption	Typ. 45 µA
	Battery	3.6 V Lithium D-cell
	Battery lifetime	Typical 6 years
	Mains supply	230 V a.c. +15/-30% 50/60 Hz
	24 V-supply	24 V a.c.
	Back-up	3.0 V cell CR 2032
Environment/safety		
	In general	EN 1434
	Ambient temperature	+5...+55 °C
	Storage temperature	–25...+70 °C
	Enclosure rating	IP 54
	Vibrations	1G, 1... 1000 Hz
	Free fall	IEC 68-2-32
	EMC	EN 1434 (EN 50081-1 / 50082-1)
	Human safety	EN 60730
Materials		
	Top part	PC Lexan 141R Transparent 111
	Pipe/wall bracket	PA 6.6 GF25
	Other plastic parts	ABS Cycolac GPM500
	Gasket	Neoprene
	Rubber bush	EPDM 50 shore
	Packaging	Decomposable cardboard

1) The combined pulserate at, flow 1, flow 2, In A and In B may not exceed 400 Hz – neither when used one at a time or all together.

Coaxial cable



The first 0.5 m of the coaxial cable	
Diameter	∅ 5.3 mm
Length	0.5 m
Material	PTFE
Ambient temperature	–200 °C to +200 °C
Coaxial cable from 0.5 m	
Diameter	∅ 8 mm
Length	Max. 250 m between sensor and signal converter*)
Material	PVC
Ambient temperature	–10 °C to +100 °C

*) If distance between signal converter and sensor is more than 30 m, please contact Siemens Flow Instruments.

Permissible pressure and temperature

Maximum permissible pressure and temperature for Siemens Flow Instruments ultrasonic flowmeters can be seen on the sensor label.

Flanges according to PN
Flanges and joints as well as related pressure/temperature (p/t) classification have been described in EN 1092-1.
For steel group 1E1: Table 15

No flange bolts and gaskets are supplied. Bolts must comply with EN 1515-2 and gaskets with EN 1591-1.

Warning!
Exposing the sensors to pressures/temperatures above the limits stated may cause damage. The sensor construction does not allow any other external action other than what is normal during common mounting in the pipeline. Provide for earthquakes, action of the air etc.

The transducer holders must not be used for any other purpose.

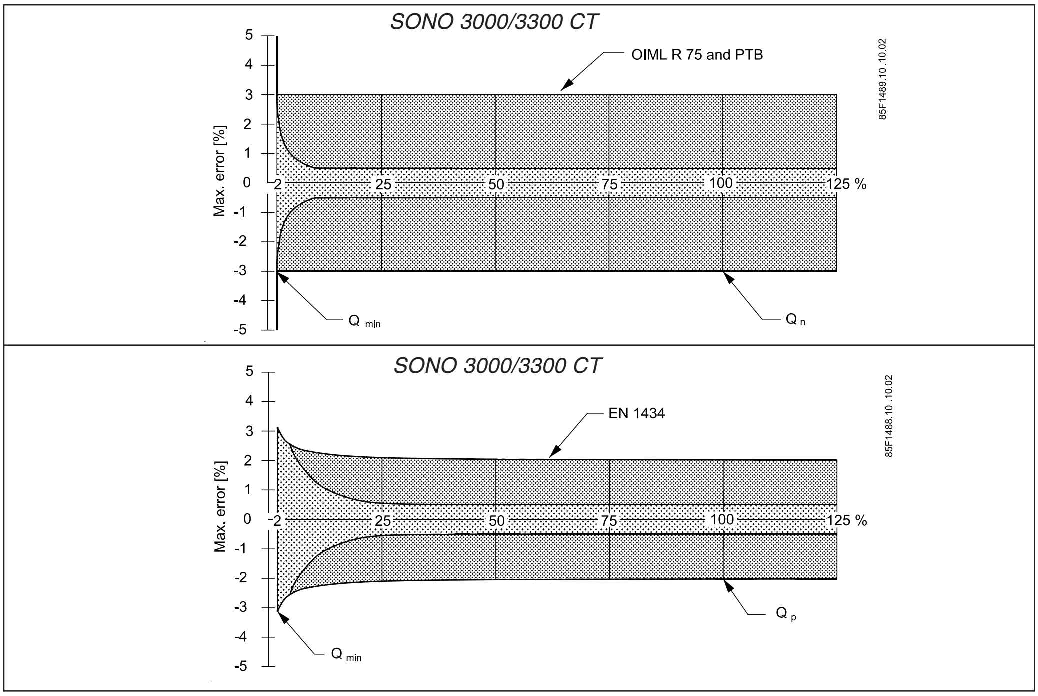
Corrosion

The meters have been designed according to EN 13480 with an additional corrosion layer of approx 1 mm for steel sensors. Stainless steel sensors do not have an additional layer. The customer is responsible for checking that the actual medium can be used with the sensor material chosen.

4. Measuring accuracy

Accuracy

Flowmeter

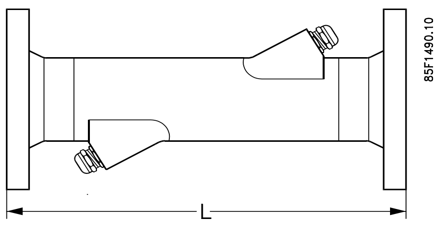


SONO 3000/3300 CT accuracy. DN 50 - DN 1200

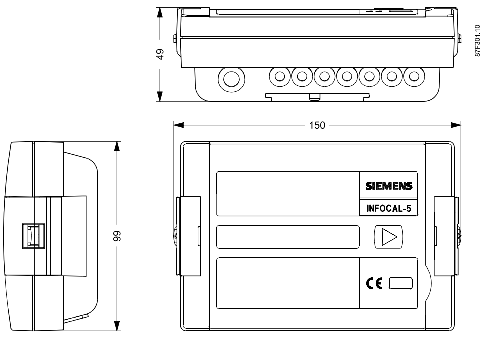
5. Dimensions and weight

Dimensions

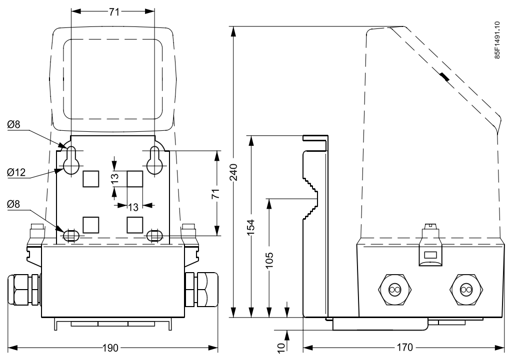
Straight-pipe-sensor. Note 10 x DN straight inlet



SITRANS F US 105 energy calculator



Add app. 30 mm on each side for cabeling.
Flowmeter electronics, 115-230 V a.c. complete with
4 x 30 meter (75 Ohm) transducer cable.



DN Size	Built-in length L between the flanges (mm)			Do Outer diameter	Pipe wall thickness for*) (mm)		
	PN 16	PN 25	PN 40		PN 16	PN 25	PN 40
50	465 ±3	475 ±3	475 ±3	66.6	7.0	7.0	7.0
65	460 ±3	475 ±3	475 ±3	78.0	7.0	7.0	7.0
80	380 ±3	400 ±3	400 ±3	92.0	7.0	7.0	7.0
100	375 ±3	400 ±3	400 ±3	116.4	7.0	7.0	7.0
125	375 ±3	400 ±3	400 ±3	143.2	7.0	7.0	7.0
150	360 ±3	400 ±3	400 ±3	170.4	8.0	8.0	8.0
200	450 ±4	490 ±4	500 ±4	219.1	3.7	4.8	6.5
250	600 ±5	575 ±5	600 ±5	273.0	4.0	5.3	7.3
300	600 ±5	560 ±5	600 ±5	323.9	4.4	5.5	8.1
350	800 ±5	840 ±5	880 ±5	355.6	4.6	6.1	8.6
400	875 ±5	925 ±5	975 ±5	406.4	4.9	6.6	9.7
500	980 ±6	1050 ±6	1080 ±6	508.0	5.6	7.9	11.7
600	1105 ±6	1165 ±6	-	610.0	6.4	9.1	-
700	1140 ±6	1190 ±6	-	711.0	7.2	10.4	-
800	1180 ±6	1240 ±6	-	813.0	8.0	11.7	-
1000	1300 ±6	1370 ±6	-	1016.0	9.7	14.3	-
1200	1360 ±6	-	-	1220.0	11.3	-	-

*) The stated wall thickness for DN 200 - DN 1200 are minimum values according to the EC Directive on the Pressure Equipment 97/23/EC

Weight of flow sensor

DN	Weight (kg) PN 16	PN 25	PN 40
50	13	14	14
65	15	16	16
80	18	19	19
100	32	35	35
125	38	44	44
150	45	52	52
200	58	70	79
250	75	96	117
300	92	114	151
350	113	145	191
400	141	191	274
500	207	284	379
600	276	363	-
700	303	480	-
800	400	650	-
900	475	835	-
1000	594	1078	-
1200	732	-	-

6. Project guidelines

Mounting the flowmeter sensor SONO 3300 CT

To maximise performance it is necessary to have straight inlet and outlet conditions, and a certain distance between meter, bends, pump and valves. It is also important to centre the flowmeter in relation to pipe flanges and gaskets.

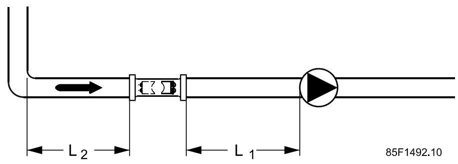
Valves must always be placed after the flowmeter. The only exception is when installing the sensor in a vertical pipe. In this case a valve below the sensor is necessary to allow the zero-point adjustment. It is important to select a valve, which has no impact on the flow profile when fully open.

Find a position on the pipe line where the inlet pipe to the flowmeter has a straight length as specified below.

For "straight-pipe-sensors" DN 50 to DN 1200 a fully developed flow profile requires the minimum straight lengths shown below:

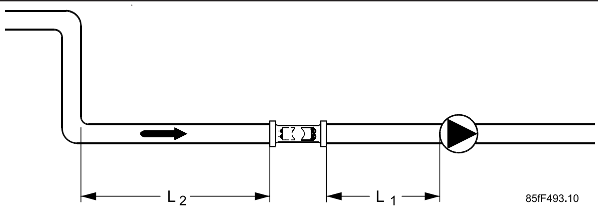
90° bend

L_2	L_1
Min. 10 x D_i	3 x D_i



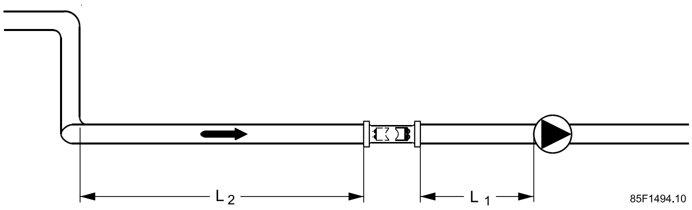
2 x 90° bends in same plane

L_2	L_1
Min. 10 x D_i	3 x D_i



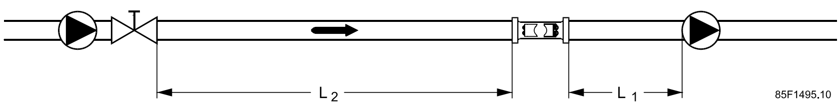
2 x 90° bends in two planes

L_2	L_1
Min 15 x D_i	3 x D_i



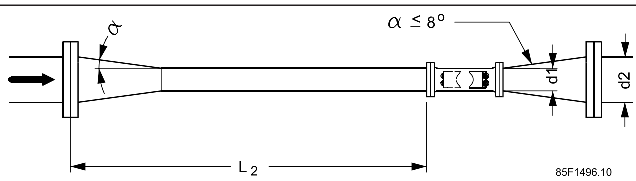
Valve

L_2	L_1
25 x D_i	3 x D_i



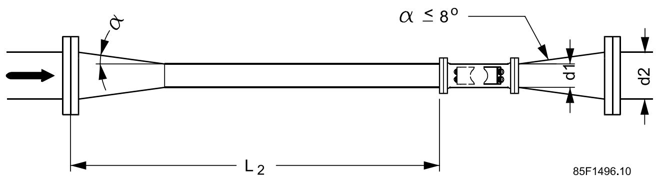
Reduction

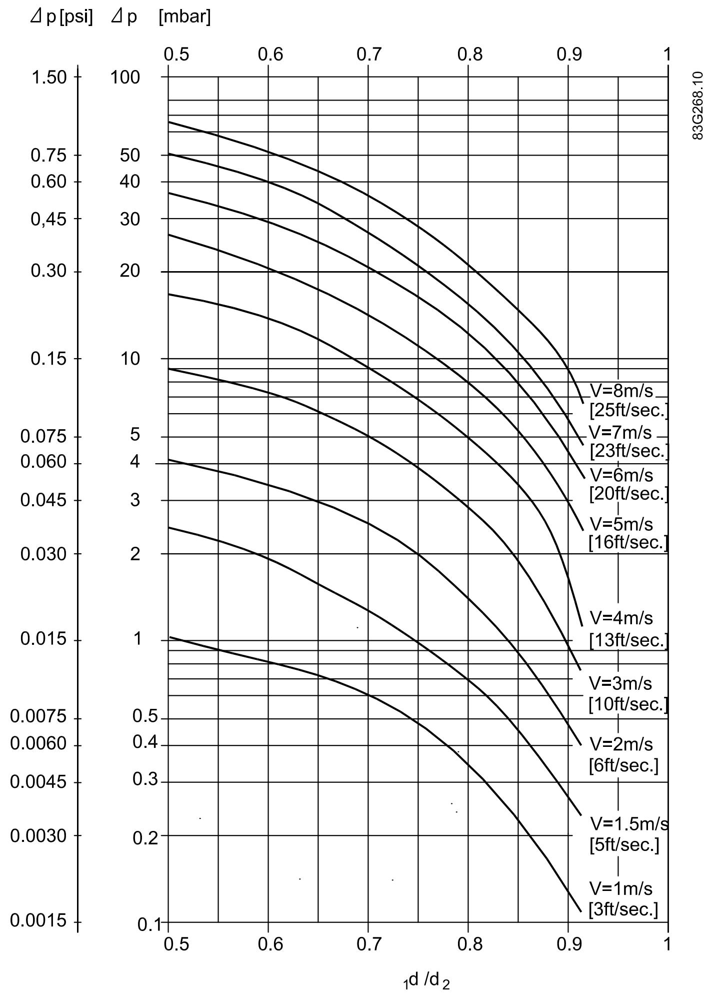
L_2	L_1
10 x D_i	0 x D_i



Mounting the flowmeter sensor SONO 3300 CT *(continued)*

Find a position on the pipe line where the inlet pipe to the flowmeter has a straight length as specified below.



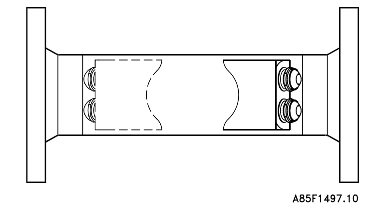


Installation in large pipes
The flowmeter can be installed between two reducers (e.g. DIN 28545) assuming an 8° taper the above pressure drop curve applies.

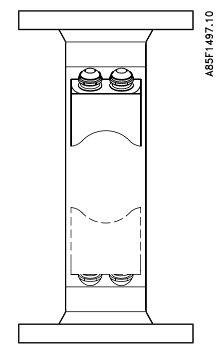
Example:
A flow velocity of 3 m/s (V) in a sensor with a diameter reduction from DN 200 to DN 100 ($d_1/d_2 = 0.5$) gives a pressure drop of 10 mbar.

P.g.

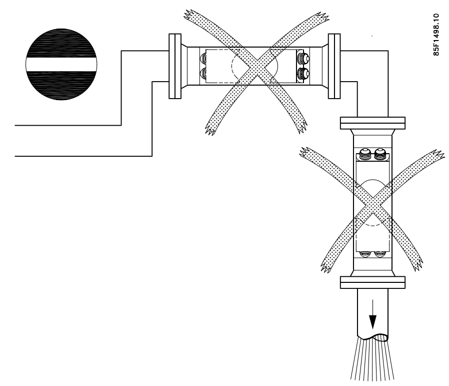
7. Installation



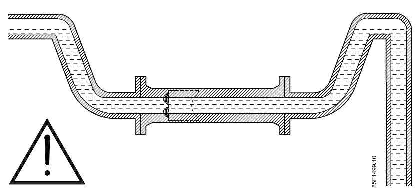
Recommended mounting of sensor.



No restriction when vertically mounted. The sensor, however, must always be completely full of liquid.



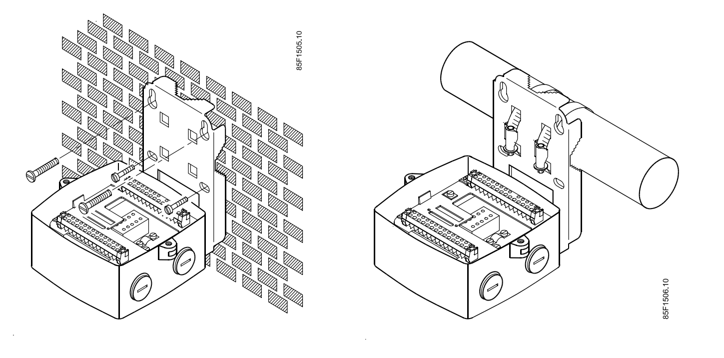
Best installation form is horizontally.
The following installations should be avoided:
- installation at the highest point in the system
- installation in vertical pipes with free outlet



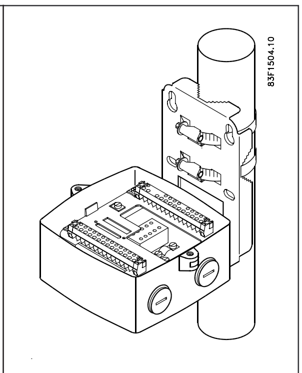
With partially full pipes or pipes with free outlet, the flowmeter should be located in a U-tube.

Instal.

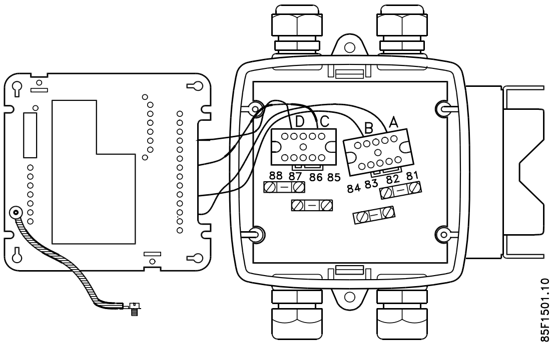
Installation of wall bracket for the SONO 3000 signal converter

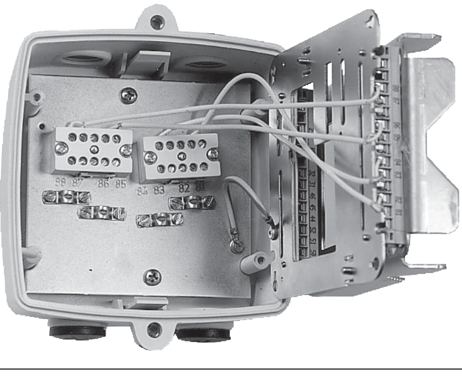


Horizontal pipe mounting



Vertical pipe mounting





1. Use 75 Ω coaxial cable between sensor and remote installed converter.

2. Mount wall bracket.

3. Snap out connection plate, loosen earth connection.

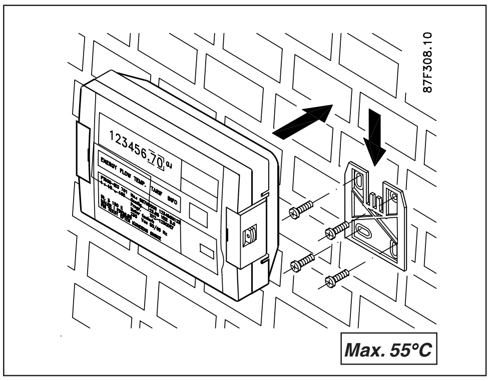
4. Connect track 1 transducers to terminals 85..88 and track 2 transducers to terminals 81...84.
   Signal conductor to even number, screen to odd number.
   (See also chapter 8 "Electrical connections").

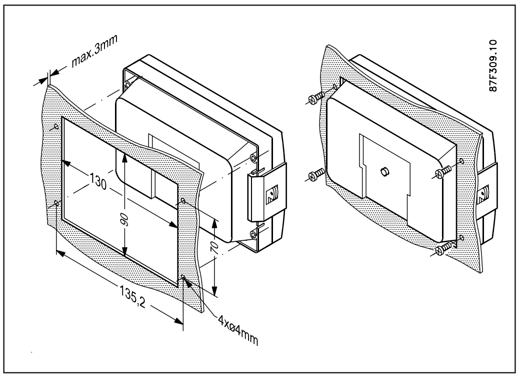
5. Remount earth connection and snap in connection plate.

6. Mount power and signal cables and tighten all cable entries to obtain optimum sealing.

7. Mount the signal converter on the wall bracket.

Installation options, energy calculator type SITRANS F US 105





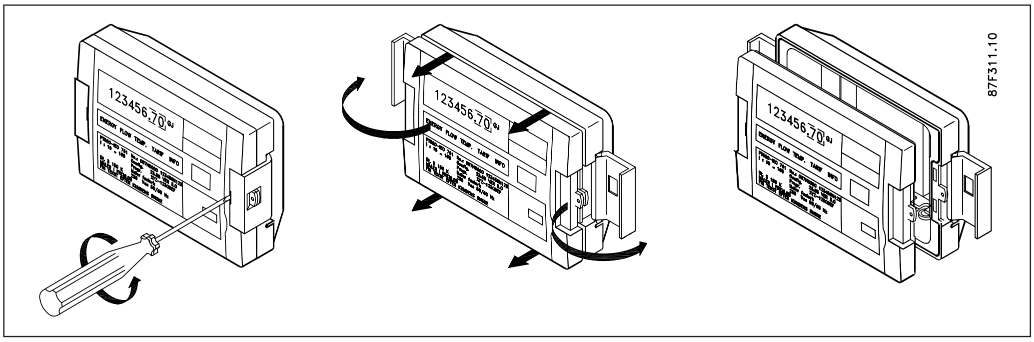
- **On the wall**
  The calculator is mounted using the wall fitting supplied. (Ambient temperature max. 55°C).

- **In panel**
  Mounting hole of 130 x 90 mm.

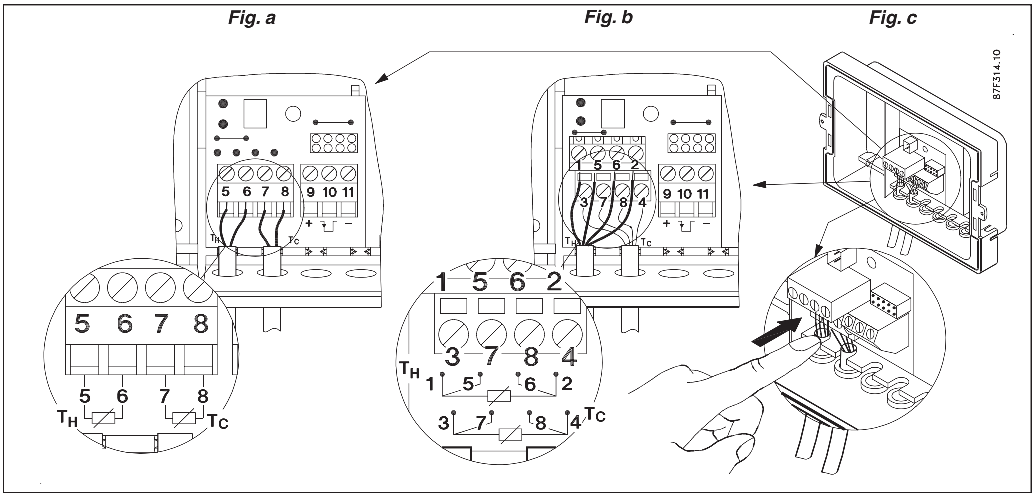
  The calculator is fixed using M3.5 x 12 mm self-tapping screws.

8. Electrical connections

Remove the top of the calculator.



Temperature sensors



If the sensors are already mounted on supply go on to the next section “Connecting the flowmeter”.

1. ***2-wire** temperature sensors (**fig. a**).*
   - The temperature sensors are paired sets and **must never be separated**.
   - The length of the temperature sensor cable must **not** be changed since it affects the accuracy of the meter.
   - Install the *forward flow temperature sensor (red label)* in terminals 5 and 6. (T_{hot}).
   - Mount the forward flow temperature sensor (red label) in the forward run (hot side).
   - Install the return flow temperature sensor (blue label) in terminals 7 and 8. (T_{hot}).
   - Mount the return temperature sensor (blue label) in the return run (cold side).
   - Seal the sensors.

1a. ***4-wire** temperature sensors (**fig. b**).*
   - The polarity **must** be correct for 4-wire measurement.
   - Install the forward flow temperature sensor in terminals 1, 5 and 6, 2. (T_{hot}).
   - Install the return flow temperature sensor in terminals 3, 7 and 8, 4. (T_{cold}).

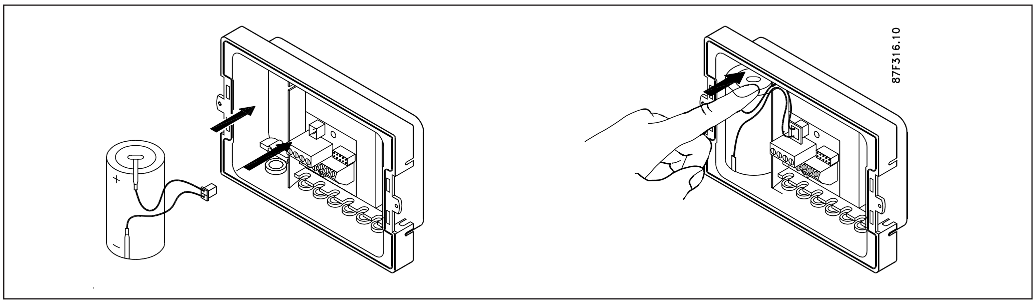
2. Press the sensor cables down into the cable relief rail with your finger (***fig. c***).

E.c.

Electrical connection
(continued)

Battery module

The lifetime of the battery is highly dependent on thermal influences and consequently the period of functioning of the calculator can only be guaranteed if the temperature limits set out in the section "Installation options" are not exceeded.

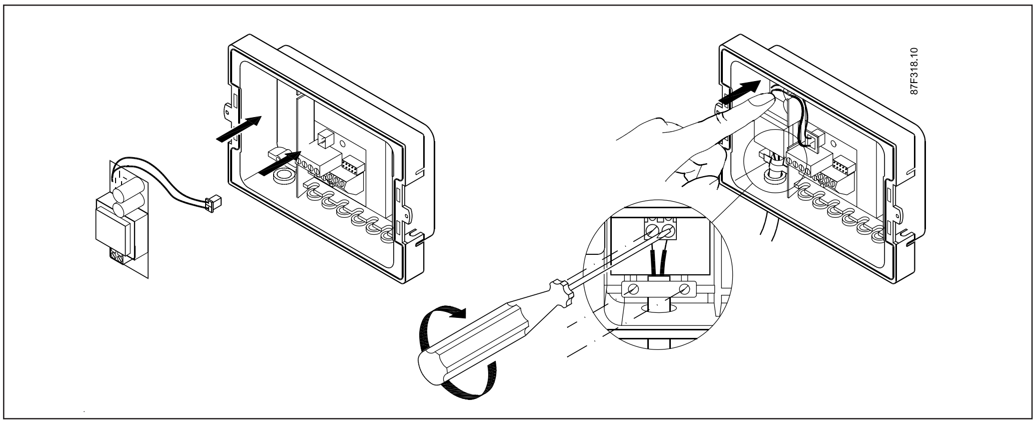


1. Push the battery into place in the bottom section and press the power supply cable into the cutout in the top of the bottom section so that it is not crushed when refitting the top of the calculator.

2. Fit the plug to the connection pin.

3. Refit the top of the calculator.

230 V a.c. module



1. Push the power supply unit into place in the bottom section.

2. Press the power supply cable into the cutout in the top of the bottom section so that it is not crushed when refitting the top of the calculator.

3. Mount the plug on the connection pin.

4. Connect the 230 V a.c. lines to terminals 27 and 28.

5. Refit the top of the calculator.

E.c.

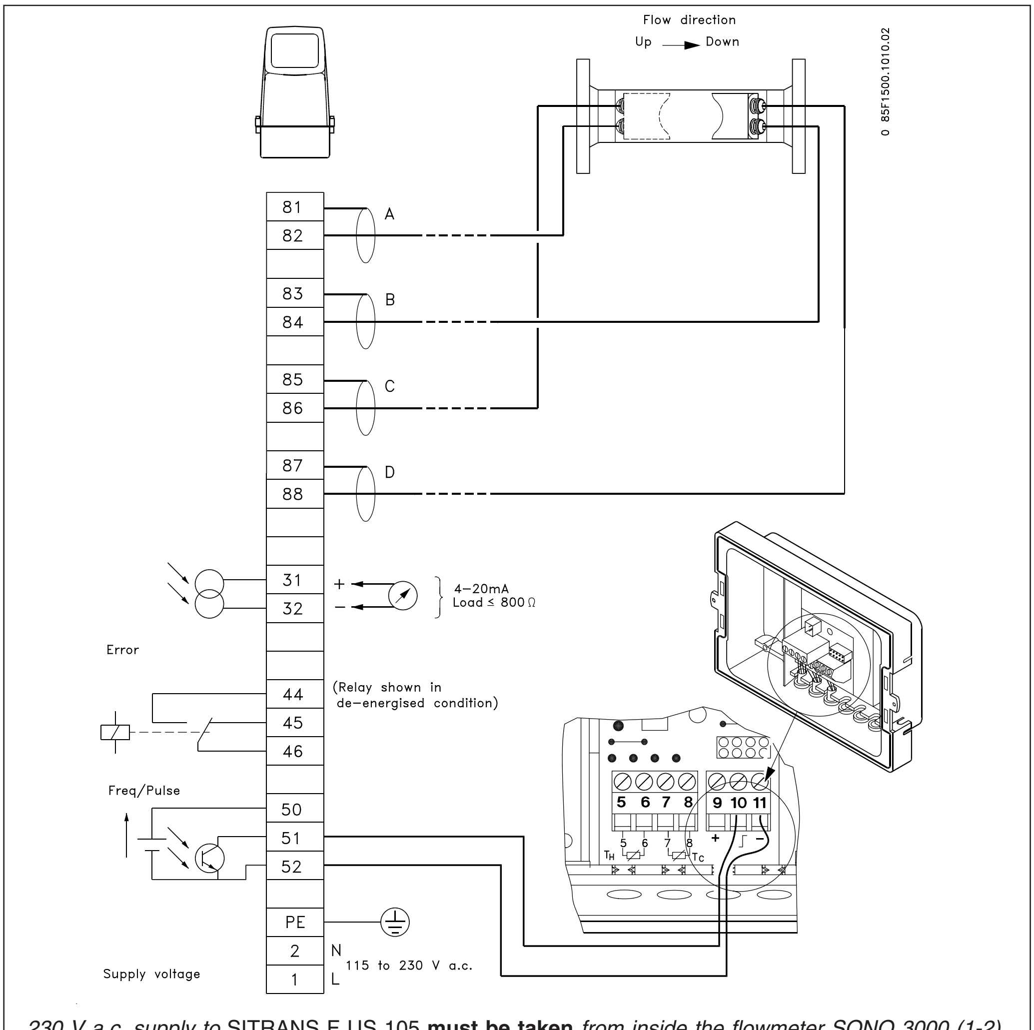
Electrical connection
(continued)

The electrical connections must be made in accordance with the diagram in the bottom of the case. The numbering must correspond to that given in the transducer housing.

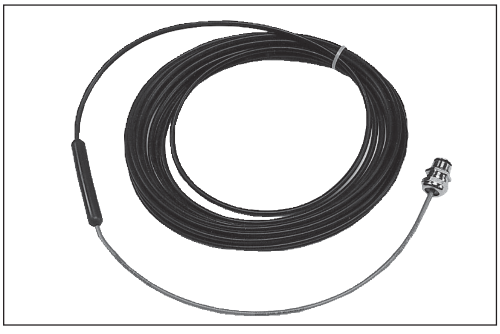
Supply voltage 230 V a.c.:
115 to 230 V a.c. is connected to terminals 1 and 2. The ground wire must be connected to the ground terminal on the terminal plate.

If the ground wire is not connected, personnel can be exposed to 115 V / 230 V.

Extra 4-20 mA flow output:
A current output signal 4-20 mA can be taken from terminals 31 (+ Ve) and 32 (- Ve). Ordinary cable can be used (non-critical lead impedance). Current output load ≤ 800 ohms.
The outputs are galvanically isolated.
When running cables in areas with electrical noise, the signal from the current output of the unit should be conducted in screened cable to avoid electromagnetic interference. The screen must be connected to the earth terminal in the bottom of the case.



230 V a.c. supply to SITRANS F US 105 **must be taken** *from inside the flowmeter SONO 3000 (1-2)*



When using coaxial cables, connect the cable screens to terminals 81, 83, 85 and 87. Connect the four coaxial cables to the sensor with screws and tighten using a wrench. See the cable entry with mounted cable and the contact connection below. Fasten the coupling nut to the cable entry for sealing. Install the cables in the terminal box of the signal converter.

E.c.

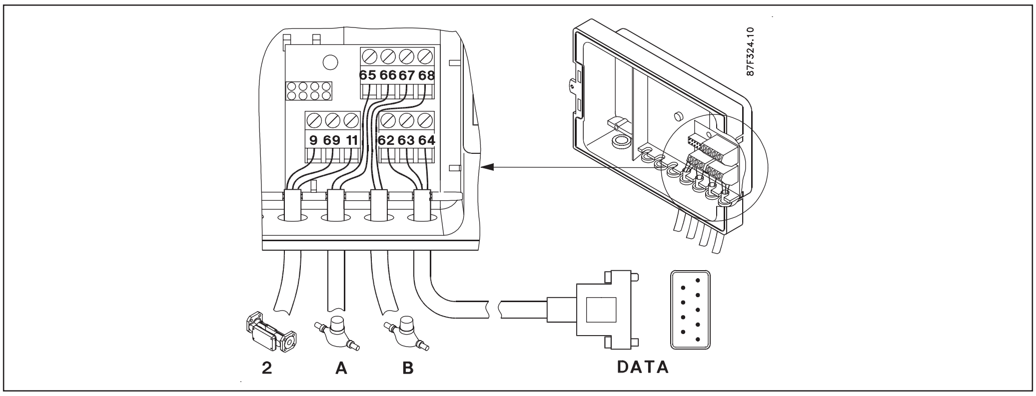
Add-on modules

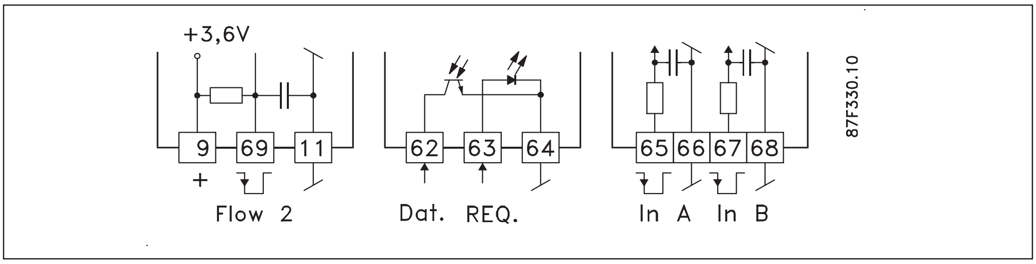
The SITRANS F US 105 can be supplied with one of several types of module.

The module is placed in the right-hand side of the bottom section and screwed tight if this has not already been done on supply.

Input module

(Extra ultrasonic meter signal input, signal input A and B, data output).





1. Terminals for flowmeter.
2. Flow 2 not active.
3. Signal input A; terminals 65, 66.
(Pulse time ≥0.5 ms, pause time ≥1.5 ms).
4. Signal input B; terminals 67, 68.
(Pulse time ≥0.5 ms, pause time ≥1.5 ms).
5. Data; terminal 62 (Data), 63 (Request), 64 (GND).

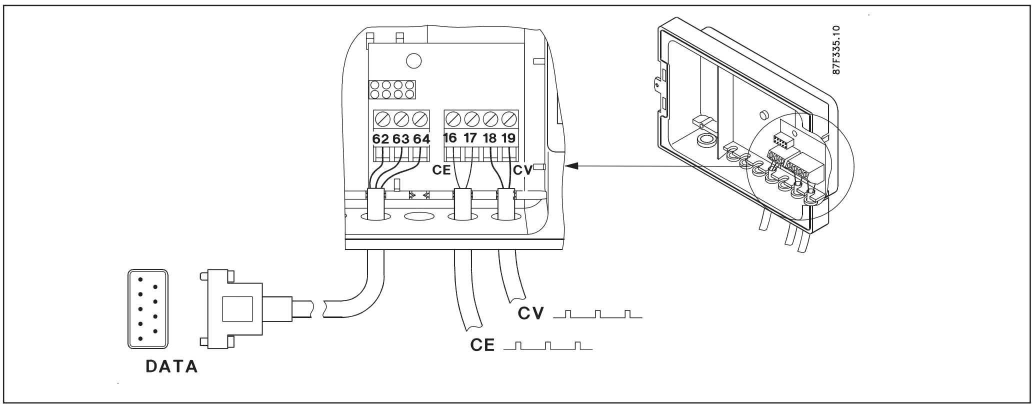
   (An outdoor data plug can be connected to above terminals for data transfer to a handheld terminal).

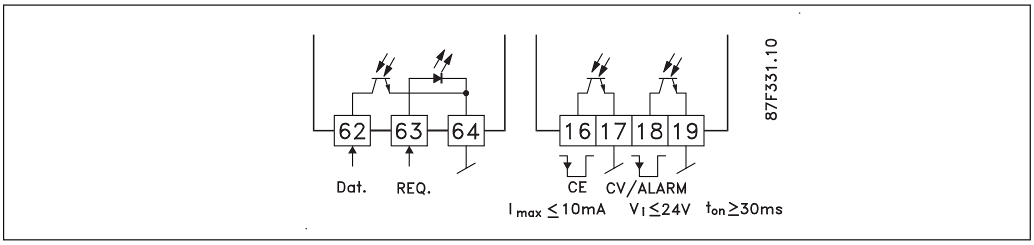
The SITRANS F US 105 requires a special adapter cable for communication with a PC due to signal modification to RS 232 level.

E.c.

Output module

(Pulse output for accumulated energy, accumulated volume/alarm signals, data output).





1. Data; terminal 62 (Data), 63 (Request), 64 (GND).

   (An outdoor data plug can be connected to above terminals for data transfer to a handheld terminal).

   The SITRANS F US 105 requires a special adapter cable for communication with a PC due to signal modification to RS 232 level.

2. CE, terminal 16, energy pulse output. Output active (low) for changing with least significant figure in display. (Accumulated energy).

3. CV, terminal 18, volume pulse. Output active (low) for changing with least significant figure in display. (Accumulated volume).

E.c.

9. Commissioning

SITRANS F US SONOFLO® flowmeter

The flowmeter operates correctly when the actual reading in the SITRANS F US 105 shows value and the error relay is de-energised as shown under electrical connection. If there is no flow indication, check the wiring to make sure that the current output is in use. If the current output is not in use, there should be a short circuit, otherwise please contact Siemens Flow Instruments

Funktion test

Before leaving the unit check the following:

Flowmeter

1. That the flowmeter is fitted correctly in the direction of the water flow.
2. That the flowmeter is placed in the forward or return line section in accordance with the position information printed on the calculator label (forward or return).

SITRANS F US 105

A pulse indicator can be seen in the bottom right-hand corner of the display.

The pulse indicator flashes at a fixed frequency during error-free operation.

1. Check that the pulse indicator is flashing regularly.
2. Check that no error function is indicated by the ! symbol or a broken heat meter symbol.
3. Press the ▷ button briefly to check that all the major functions display feasible values, e.g. cumulative energy, cumulative water quantity, forward and return temperature.
4. Press the ▷ button repeatedly to return the arrow indicator to the top “INFO” and check that all display segments are visible.

The SITRANS F US SONOCAL® is now ready for use.

Error information

If a or error code is displayed this is due to one of the following possible errors:

F1 Forward temperature sensor (hot) is interrupted or short-circuited.
F2 Return temperature sensor (cold) is interrupted or short-circuited.

If a ! error code is displayed this is due to one of the following possible errors:

F3 Internal fault.
F4 Differential temperature, but no flow.
F5 Water quantity exceeds measurement range.

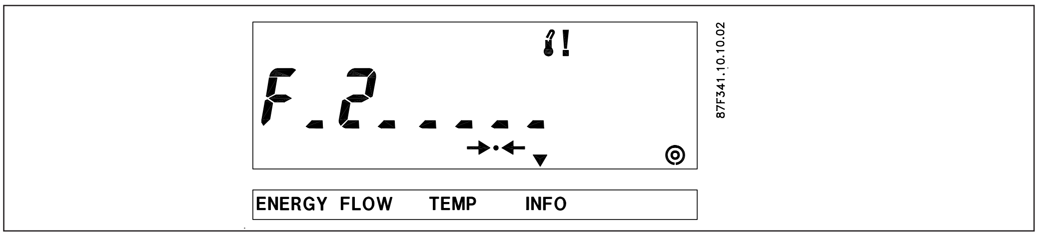
Resetting errors

Error states can be reset either:

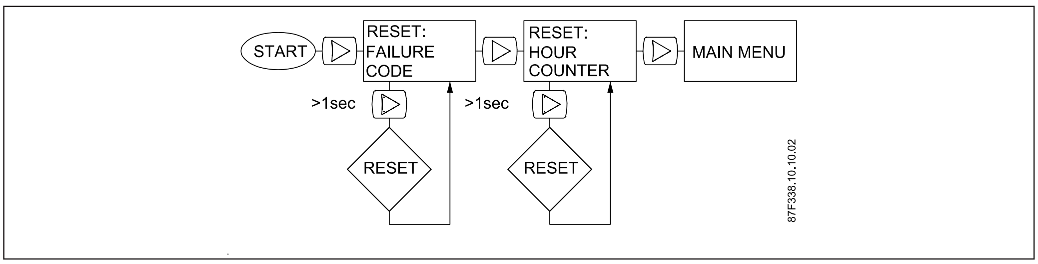
1. Using a handheld terminal (see instructions for use of handheld terminal).
2. Without using a handheld terminal.

Without using handheld terminal

1. Lift the top of the calculator off of the bottom section and wait until the digits in the display disappear (this may take up to 30 seconds).
2. Hold in the button ▷ and keep it pushed, whilst putting the top of the calculator back on the bottom section. The character for reset mode →•← is now shown and the display will show:



3. *Brief press:* jumps through the various reset options.
4. *Long press:* resets the error.
5. After the reset the error number and ! or will disappear from the display.

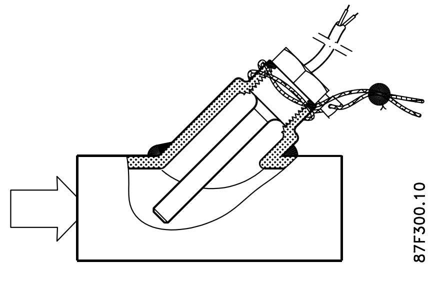


Commis.

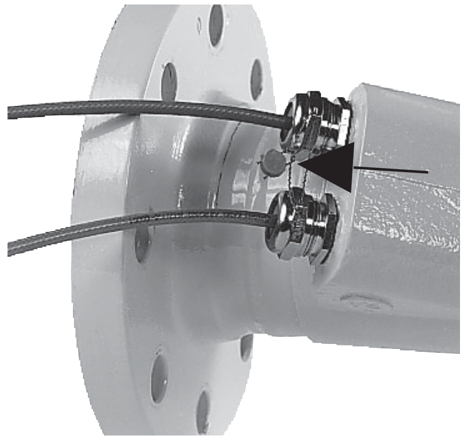
10. Sealing

User sealings of the SITRANS F US SONOCAL® ultrasonic heat meter series 3000

Pockets

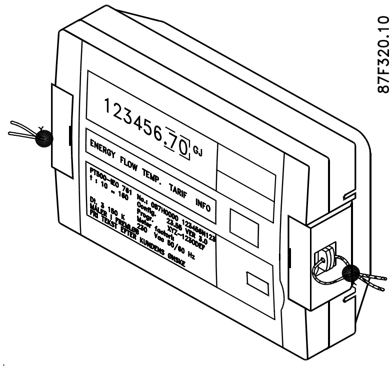


SONO 3300 CT



SONO 3000 CT

SITRANS F US 105

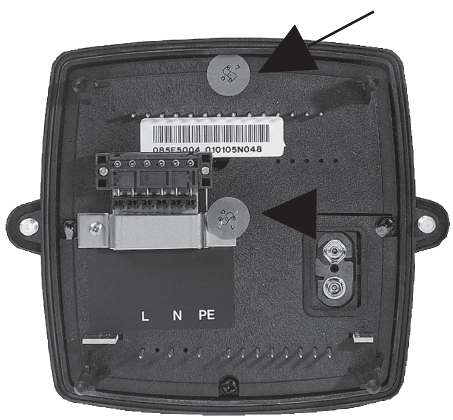


SITRANS F US SONOCAL® ultrasonic heat meters series 3000 are sealed from factory.

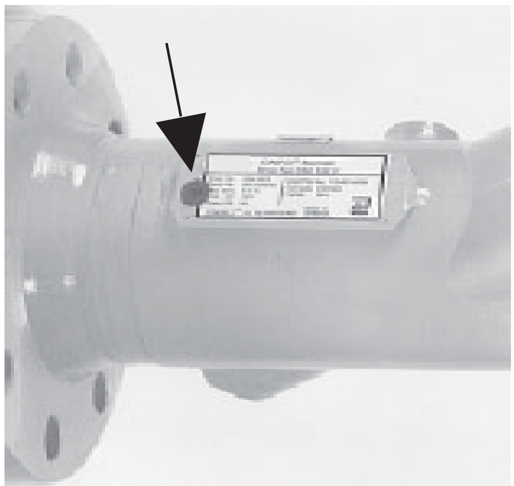
After installation the "user" sealings have to be made by the local authorities.
If due to some reason the user sealings must be broken (e.g. for trouble shooting), the user sealings must be made again by the local aurthorities.

Verification sealing

SONO 3000 CT



SONO 3300 CT



Sealing

11. Trouble shooting

Experience shows that function failure seldom lies in the heatmeter. In most cases, function failure can be traced to:

- Air in the liquid
- Incorrect installation of measuring pipe
- Cables connected incorrectly

If there is doubt about whether SONO 3000 CT is OK, the SONO 3000 CT can be checked by a simulator, contact Siemens Flow Instruments.

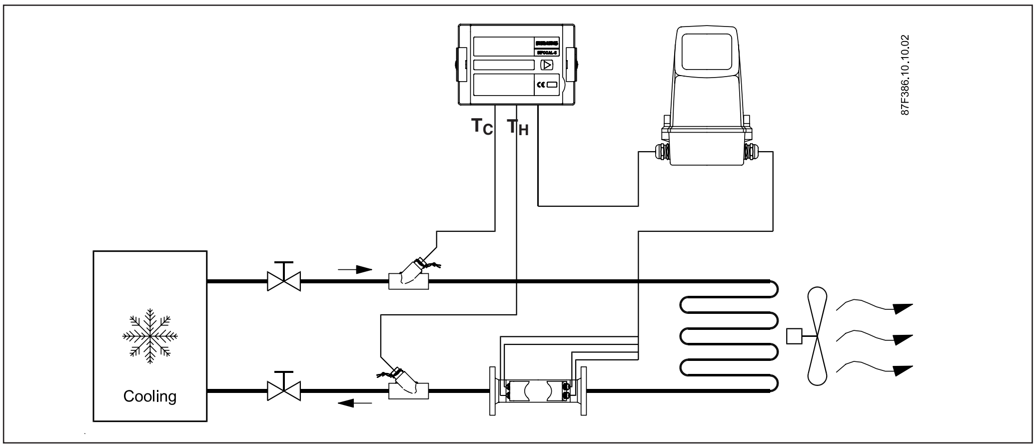
Trouble shooting SITRANS F US 105

Symptom	Possible reason	Proposal for correction
Display not functioning (blank display)	No power supply	Check power supply
No energy accumulation, (e.g. MWh) and m^3	Temperature sensors defect	Check both flowmeter and temperature sensors
	Display show ! 🌡	Check the error indicated by the info code
Accumulation of m^3 but not energy (e.g. MWh)	Forward and return sensors have been inverted either at the installation or at the connection	Mount sensors correctly
No accumulation of m^3	No volume pulses	Check flowmeter connection, Check flowmeter direction
Faulty accumulation of m^3	Error in flowmeter	Send meter for repair
	Flowmeter inverted	Invert flowmeter
	Erroneous programming	Send SITRANS F US 105 for control
Faulty temperature indication	Defective temperature sensor	Replace the pair of sensors
Temperature indication or accumulation of energy (e.g. MWh) slightly too low	Bad thermal sensor contact	Push sensors as far into the sensor pockets as possible
	Heat dissipation Sensor pockets too short	Insulate sensor pockets Replace with longer pockets
No display of flow in m^3 in SITRANS F US 105	Mismatch of transducer cables	Check wiring of transducer cable and power supply

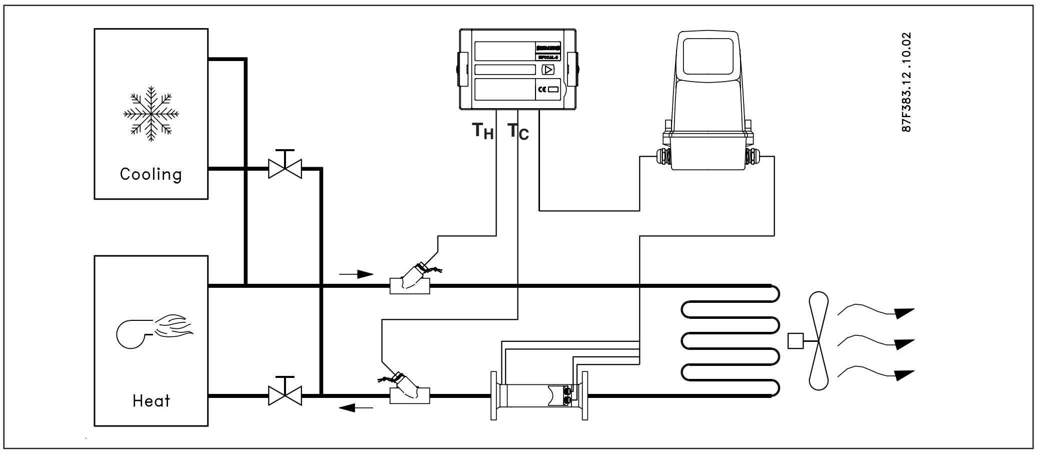
If no possible reason can be found, please contact Siemens Flow Instruments.

12. Special requirements for chilled heatmeter systems and for combined heating/cooling systems

1. SITRANS F US 105 identification



Types designed for chilled water:
SITRANS F US 105-XXXXX-**CF** (**c**hilled **f**orward mounting).
SITRANS F US 105-XXXXX-**CR** (**c**hilled **r**eturn mounting).



Types designed for heating/cooling:
SITRANS F US 105-XXXXX-**SF** (**s**ummer **f**orward mounting).
SITRANS F US 105 -XXXXX-**SR** (**s**ummer **r**eturn mounting).

2. Mounting of the ultrasonic flowmeter

Mounting of the flowmeter must be in accordance with the text stated on the SITRANS F US 105 e.g. “flowmeter in return”, i.e.

for type CF: Flowmeter in flow pipe (cold pipe)

for type CR : Flowmeter in return pipe (warm pipe)

for type SF: Flowmeter in forward pipe (warm pipe in the wintertime, cold pipe in the summertime)

for type SR: Flowmeter in return pipe (cold pipe in the summertime, warm pipe in the wintertime)

3. Mounting of sensors

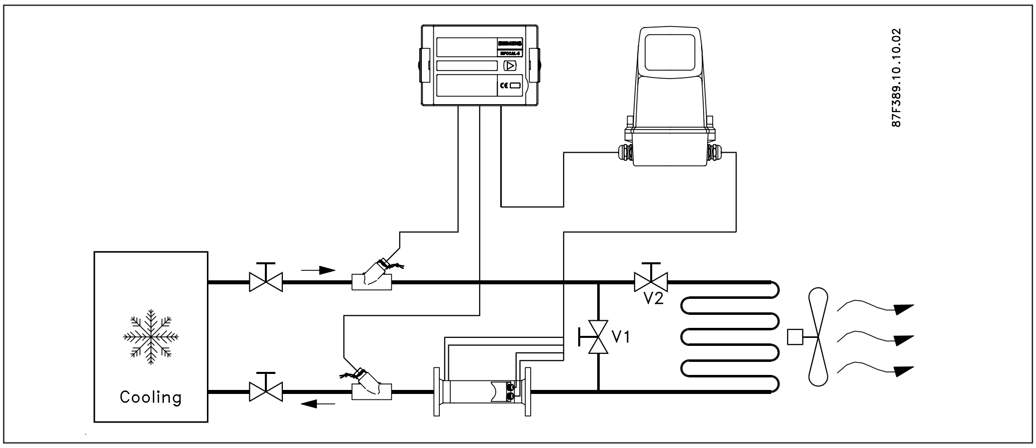
The Pt 500 2-wire cables are marked with a red and blue label.

For pure cooling systems CF/CR:
The temperature cable marked with a “red” label has to be mounted on the “hot side” in the system (return pipe) and connected to heat meter terminal T_H..

For combined systems SF/SR:
The temperature cable marked with a “red” label has to be mounted on the “hot side” (forward) in the system when installing in the heating season (winter), or the cold side when installing in the cooling season (summer) and connected to heat meter terminal T_H.

4. Zero point calibration of differential temperature (only types CF/CR)

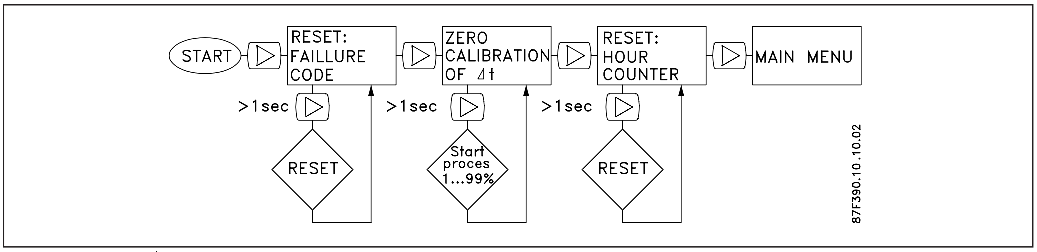
Cooling systems always operate with a small Δt and a relatively high flow rate. For technical reasons no sensor pair provides completely accurate temperature difference measurements when the sensor temperature difference between forward and return flow is close to zero.
SITRANS F US 105 type CF/CR contains a special zero point calibration routine that can be activated in order to minimize the temperature difference measuring failure.
Normally the zero point calibration is not needed, but can be activated out in order to obtain maximum accuracy in the energy calculation.
The zero point calibration function requires a short circuit between forward and return sensor in the cooling system – e.g. by installing a valve V1 (see drawing).



Procedure

1. Open valve V1 and close valve V2 and let the cooling system run at a medium cooling temperature. E.g. 10°C until the absolute temperature in forward and return pipe and the Δt are stable.

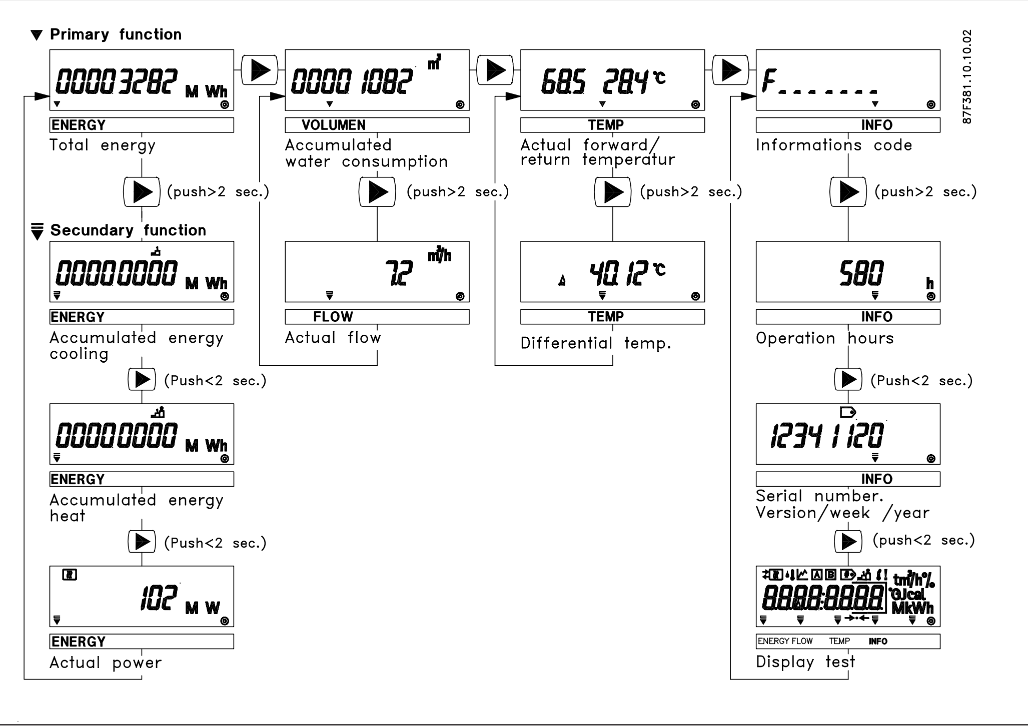
2. Bring the SITRANS F US 105 in the reset routine (see item “Reset routine“) and step forward with a brief press on the push button until the Δt value appears.



3. A long press on the push-button will start the zero point calibration.
   The display now shows a 1…99 % indication. When the indication reaches 99%, the zero point calibration is finished and the display shows the calculated zero displacement value.

4. The SITRANS F US 105 has now been zero adjusted – and the display returns to normal mode within 10 sec. or the push button can be activated again for further reset at hour counter.

5. Standard menu, type SF/SR



Siemens Flow Instruments A/S
Nordborgvej 81
DK-6430 Nordborg

Order no.: FDK:521H1087-01
Printed in: Denmark