SIEMENS

Handbook

SITRANS F US SONOFLO®

Ultrasonic Flowmeter
Type SONOKIT

2-track DN 200 - DN 4000

Order no.: FDK:521H0549

SFIDK.PS.029.S2.02 - A5E00253093

* Q 8 5 R 9 3 7 7 *

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Introduction

The SITRANS F US SONOFLO® ultrasonic flowmeter type SONOKIT mounting set is used for installing two sets of ultrasonic transducers type SONO 3200 in existing pipes made of steel or concrete.

This manual only describes the SONOKIT installation in empty unpressurized pipes. When installing SONOKIT in pressurized pipes (hot tapping), please contact Siemens Flow Instruments for further instructions.

SONOKIT is designed for measuring the flow velocity of liquids in full pipes. Satisfactory function of the ultrasonic flowmeter depends on a low attenuation of the medium and a well-defined and stable flow profile.

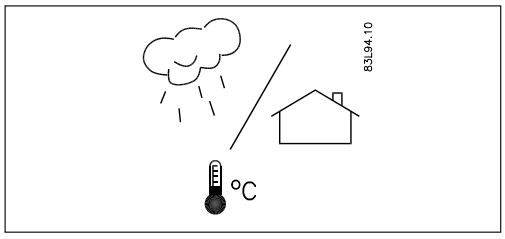
The making of an ultrasonic flowmeter by means of the SONOKIT is divided into 4 steps:

1. Calculating and marking the transducer holder position
2. Installing the transducer holders
3. Marking the sensor geometry
4. Entering the sensor geometry into SONO 3000 (theoretical calibration)

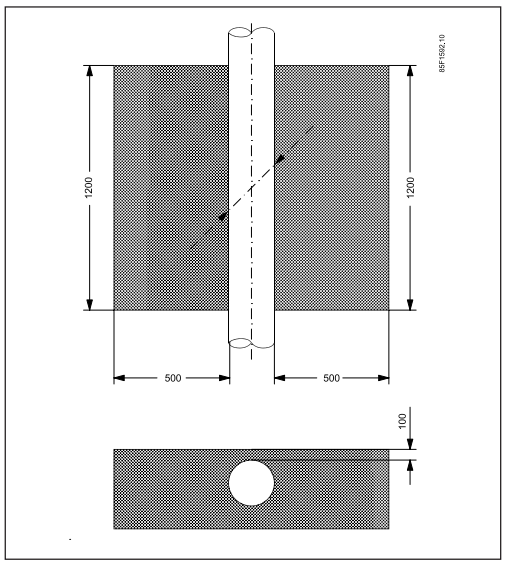
Potential Hazards
The ground wire must always be connected to the ground terminal in accordance with the diagram.

To ensure optimum performance of the measuring equipment it is essential that the following instructions are followed.

Location



The SONO 3200 sensor can be installed both indoors and outdoors, even in exposed surroundings.



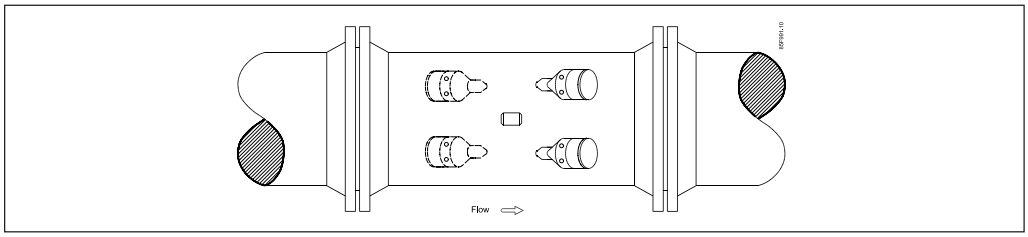
The sensor is suitable for media and ambient temperatures from –50°C to +100°C, the high-temperature version from –40°C to +200°C. The temperature range is stated on the data plate on the transducer. The enclosure rating is IP 67 or better. Optionally, the SONO 3200 is available with IP 68.

In case of large temperature differences between the medium and the environment the sensor must be isolated to avoid 2-phase flow which will result in inaccurate measuring results.

The space requirements around the pipe for retrofitting a SITRANS F US SONOFLO® ultrasonic flowmeter type SONOKIT are given below:

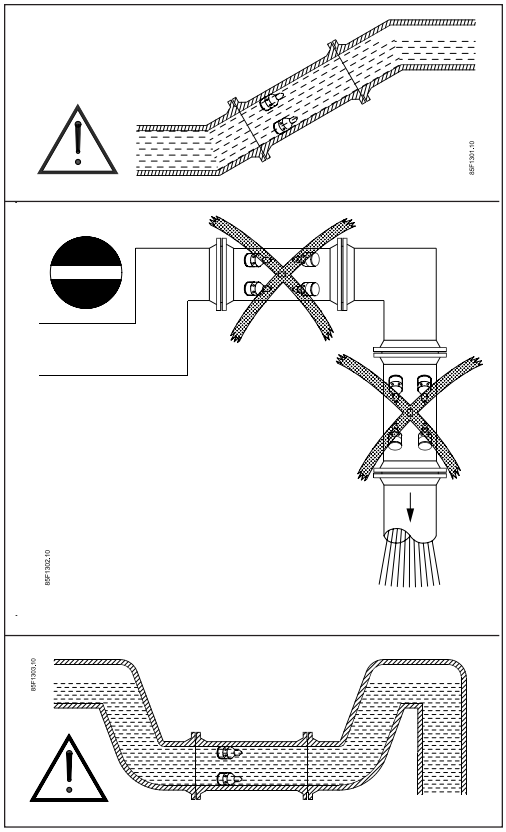
Note
The above dimensions are minimum values.
Different space requirements apply when retrofitting takes place in pressurized pipes or when the transducers are exchanged under pressure.

Direction of flow



Double arrow marked with "+" and "–" on the sensor.
+ indicates direction of flow when the electrical connections correspond to the ones described in the manual.

Full pipes

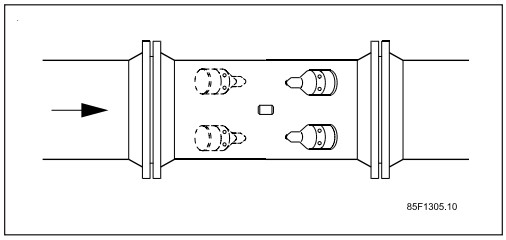


The sensor must always be completely filled with liquid.

The following installations should be avoided:
- Installation at the highest point of the pipe system
- Installation in vertical pipes with free outlet

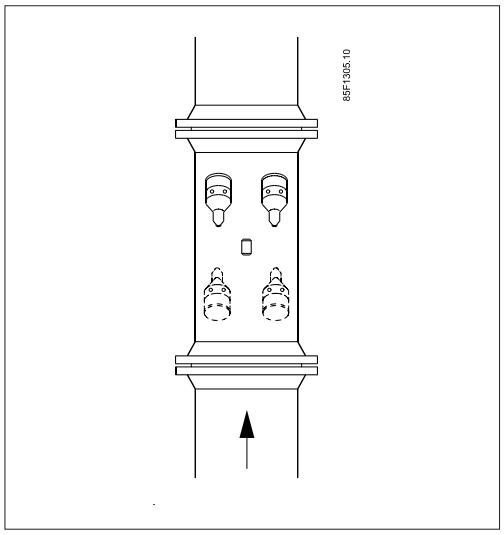
With partially full pipes or pipes with free outlet the flowmeter should be located in a U-shaped tube.

Installation in horizontal pipes



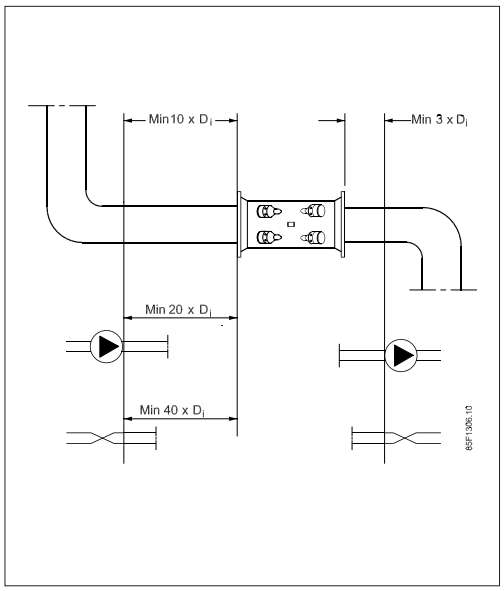
Installing the transducers in horizontal position is recommended.

Measuring liquids containing abrasive or other particles



The sensor should be mounted in vertical or inclined pipe position to minimize wear.

Inlet and outlet conditions



To maximize performance inlet and outlet must be straight. There must be a certain distance between meter and bends, pump and valves. It is also important to centre the flowmeter in relation to pipe flanges and gaskets.

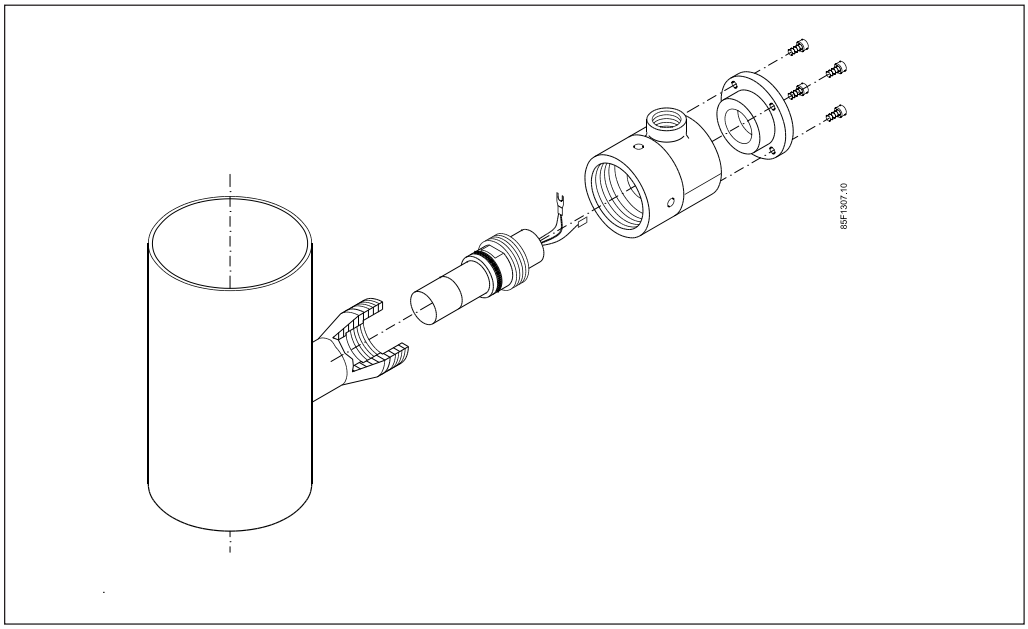
Valves must always be installed after the flowmeter. The only exception is installation of the sensor in a vertical pipe. In this case a valve below the sensor is necessary to allow zero-point adjustment. It is important to select a valve which does not alter the flow when fully open.

Recommended inlet:
Fully open valve, i.e. no flow restriction:
min. 10 × pipe diameter
Partially open valve: min. 40 × pipe diameter
Pumps: min. 20 × pipe diameter
Bends: min. 10 × pipe diameter
Recommended outlet: 3 × pipe diameter.
If more bends than one, please contact Siemens Flow Instruments for advice.

Installation of transducer type SONO 3200

The transducer type SONO 3200 is used together with the mounting kit type SONO 3110.

O-ring type:
The transducer has a screwed union for fitting in a counterflange welded onto the pipe. The union and the pipe are sealed with an O-ring.



The transducer holders are welded directly onto steel pipes or cast into the walls of concrete pipes and must be flush with the inside surface of the pipe.

Tools etc.

- Length of angle iron to be used as a ruler having a length approximately corresponding to the outer diameter of the pipe
- Measuring tape
- Scriber, pencil or the like
- Pocket calculator
- Calipers
- Sliding gauge
- Hammer
- Centre punch
- Spirit level
- Roll of adhesive tape

Tools for installing transducer holders on steel pipe

- Flame cutter or drill with ø 60 mm drill bit for making holes in steel pipes
- Electric or TIG welder for welding the mounting plate and the transducer holder

Tools for installing transducer holders on concrete pipe

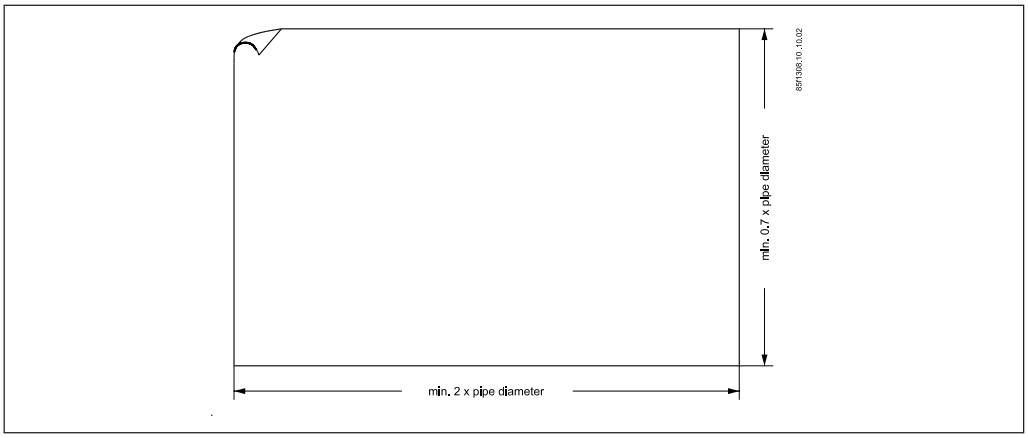
- Special drill unit for drilling ø 46 mm holes in concrete
- Filler

A suitable filler or mortar does not shrink when setting. A comparatively short setting time is preferred.

Calculating the transducer position and drawing it on paper

The transducer position is calculated using the roll of paper supplied with the mounting kit.

Drawing paper



Step 1

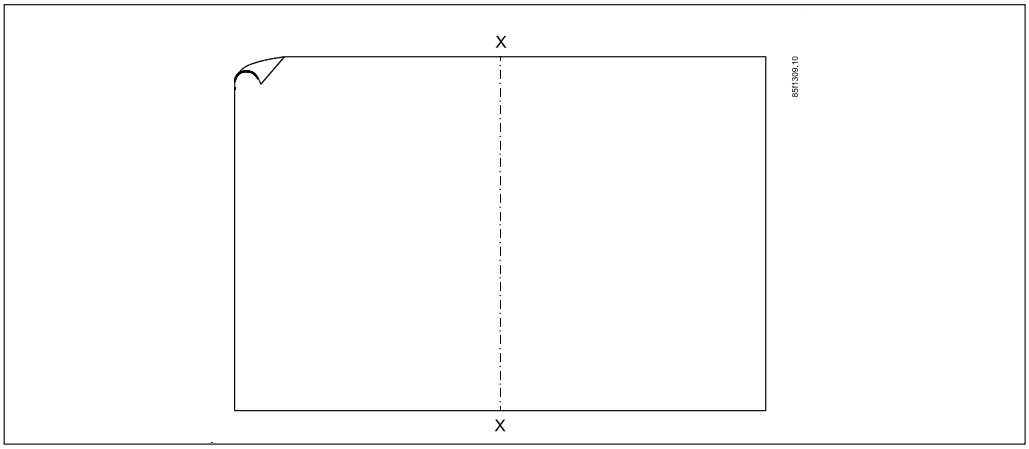
The following pipe dimensions must be known before calculating the transducer position and making the drawing.

1. Circumference (C)
2. Wall thickness (t)

The circumference is determined using the measuring tape. Make sure that the pipe's surface is plane and free of dirt etc. The measuring tape must fit snugly around the pipe. Read the circumference (C). Repeat the measurement several times to avoid inaccuracies.

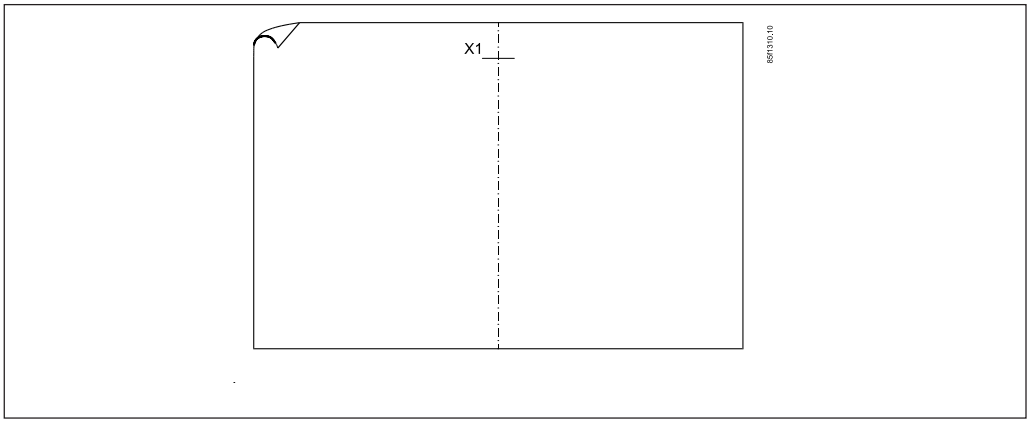
The wall thickness is obtained by measuring a similar pipe whose wall thickness is accessible, or by consulting the relevant standard.

Step 2



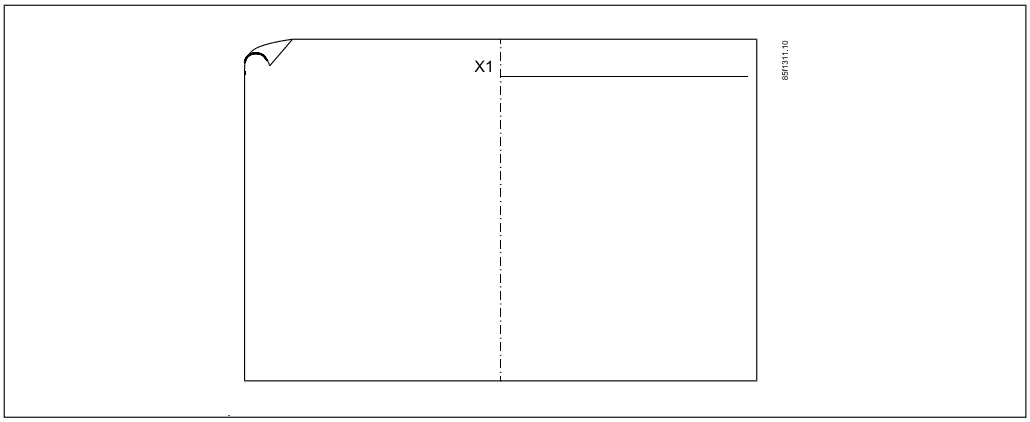
Draw a line x-x through the middle of the paper.
The line x-x should be at right angles to the edge of the paper.

Step 3



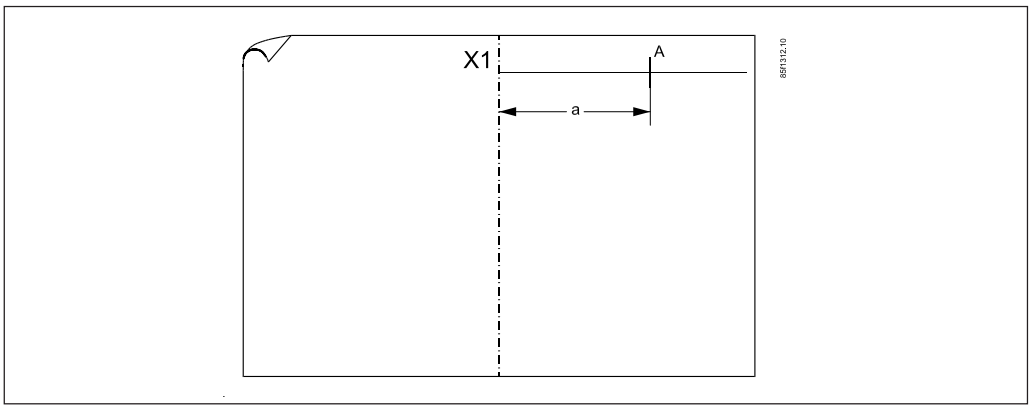
Mark a point X_1 on line x-x. (X_1 should be approx. 5 cm from the edge of the paper).

Step 4



Draw a line X_1 at right angles to x-x.

Step 5

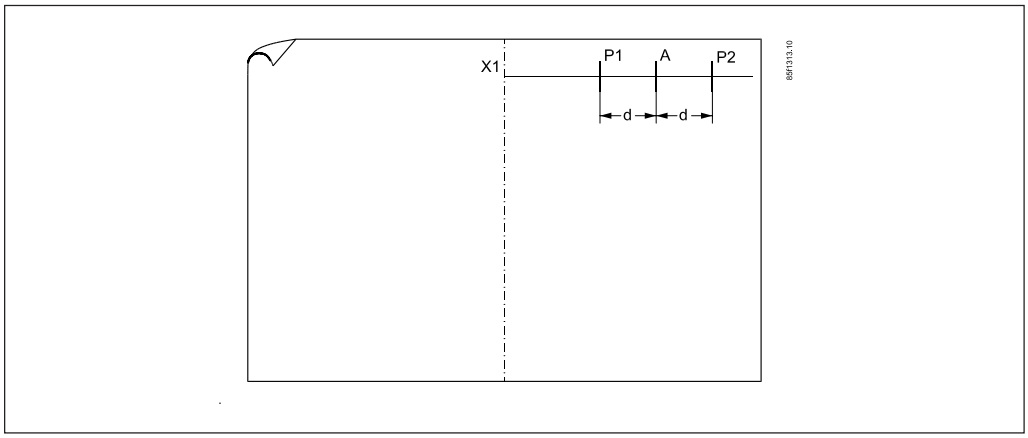


Mark a point A on line X_1.

The distance a from X_1 to A is calculated as follows:

a = 0.25 x C

Step 6

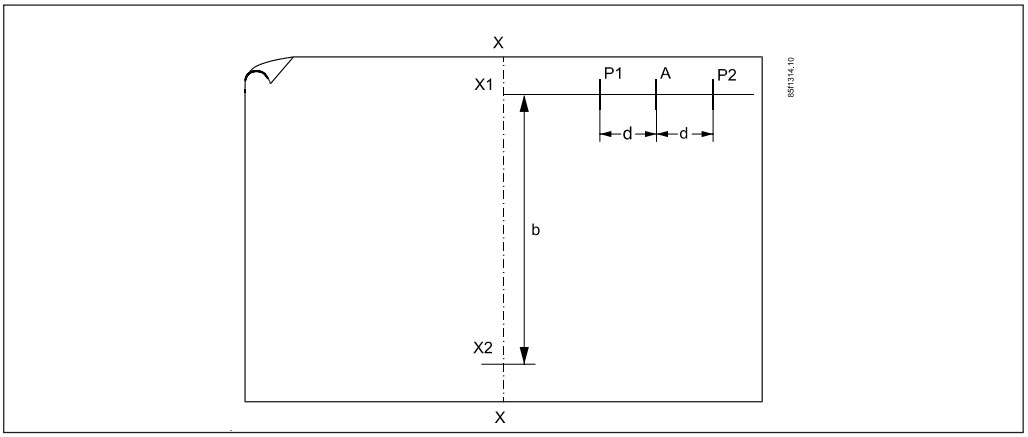


Mark points P_1 and P_2 at a distance d from point A.

d is calculated using the formula: **d = @d x C**

For @d, see table 1.

Step 7

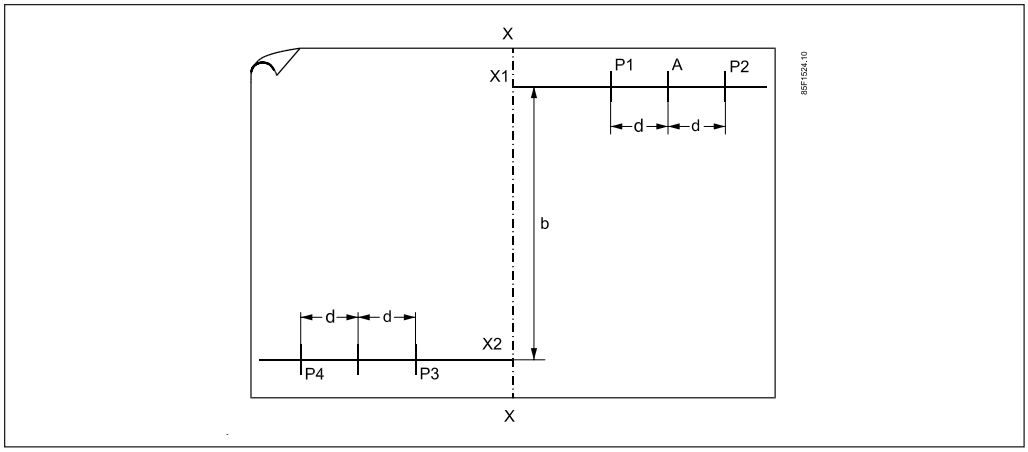


Mark point X_2 on the line x-x at a distance b from point X_1.

b is calculated using the formula: **b = @b x C**

For @b, see table 1.

Step 8



Repeat steps 4 - 6 as shown above.
The drawing on the paper is now finished.

Correction factors (table 1)

Track ratio = 0,49
Angle = 60 °C

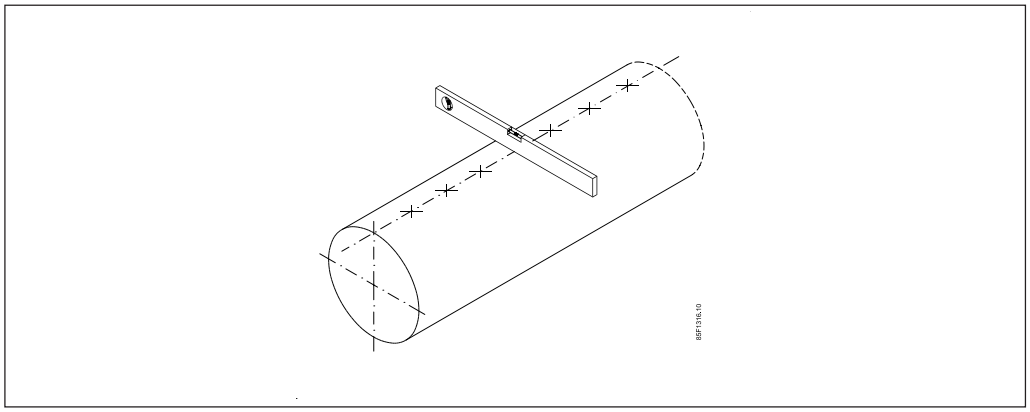
t/Du	@d	@b	t/Du	@d	@b	t/Du	@d	@b	t/Du	@d	@b	t/Du	@d	@b
,00500	,08061	,16070	,01825	,07825	,16201	,02875	,07640	,16300	,04200	,07408	,16422	,05525	,07178	,16540
,00525	,08056	,16073	,01850	,07821	,16203	,02900	,07636	,16303	,04225	,07404	,16425	,05550	,07173	,16542
,00550	,08052	,16075	,01875	,07817	,16205	,02925	,07631	,16305	,04250	,07399	,16427	,05575	,07169	,16545
,00575	,08047	,16078	,01900	,07812	,16208	,02950	,07627	,16307	,04275	,07395	,16429	,05600	,07165	,16547
,00600	,08043	,16080	,01925	,07808	,16210	,02975	,07623	,16310	,04300	,07391	,16432	,05625	,07160	,16549
,00625	,08039	,16083	,01950	,07803	,16213	,03000	,07618	,16312	,04325	,07386	,16434	,05650	,07156	,16551
,00650	,08034	,16085	,01975	,07799	,16215	,03025	,07614	,16314	,04350	,07382	,16436	,05675	,07152	,16553
,00675	,08030	,16088	,02000	,07795	,16217	,03050	,07610	,16317	,04375	,07378	,16438	,05700	,07147	,16555
,00700	,08025	,16090	,01750	,07839	,16193	,03075	,07605	,16319	,04400	,07373	,16441	,05725	,07143	,16558
,00725	,08021	,16093	,01775	,07834	,16196	,03100	,07601	,16321	,04425	,07369	,16443	,05750	,07139	,16560
,00750	,08016	,16095	,01800	,07830	,16198	,03125	,07596	,16324	,04450	,07365	,16445	,05775	,07134	,16562
,00775	,08012	,16098	,01825	,07825	,16201	,03150	,07592	,16326	,04475	,07360	,16447	,05800	,07130	,16564
,00800	,08007	,16100	,01850	,07821	,16203	,03175	,07588	,16328	,04500	,07356	,16450	,05825	,07126	,16566
,00825	,08003	,16103	,01875	,07817	,16205	,03200	,07583	,16331	,04525	,07351	,16452	,05850	,07121	,16568
,00850	,07998	,16105	,01900	,07812	,16208	,03225	,07579	,16333	,04550	,07347	,16454	,05875	,07117	,16571
,00875	,07994	,16108	,01925	,07808	,16210	,03250	,07574	,16335	,04575	,07343	,16456	,05900	,07113	,16573
,00900	,07990	,16110	,01950	,07803	,16213	,03275	,07570	,16338	,04600	,07338	,16458	,05925	,07108	,16575
,00925	,07985	,16113	,01975	,07799	,16215	,03300	,07566	,16340	,04625	,07334	,16461	,05950	,07104	,16577
,00950	,07981	,16115	,02000	,07795	,16217	,03325	,07561	,16342	,04650	,07330	,16463	,05975	,07100	,16579
,00975	,07976	,16118	,02025	,07790	,16220	,03350	,07557	,16345	,04675	,07325	,16465	,06000	,07095	,16581
,01000	,07972	,16120	,02050	,07786	,16222	,03375	,07552	,16347	,04700	,07321	,16467	,06025	,07091	,16583
,01025	,07967	,16123	,02075	,07781	,16225	,03400	,07548	,16349	,04725	,07317	,16470	,06050	,07087	,16586
,01050	,07963	,16125	,02100	,07777	,16227	,03425	,07544	,16352	,04750	,07312	,16472	,06075	,07083	,16588
,01075	,07958	,16127	,02125	,07772	,16229	,03450	,07539	,16354	,04775	,07308	,16474	,06100	,07078	,16590
,01100	,07954	,16130	,02150	,07768	,16232	,03475	,07535	,16356	,04800	,07304	,16476	,06125	,07074	,16592
,01125	,07950	,16132	,02175	,07764	,16234	,03500	,07531	,16359	,04825	,07299	,16479	,06150	,07070	,16594
,01150	,07945	,16135	,02200	,07759	,16237	,03525	,07526	,16361	,04850	,07295	,16481	,06175	,07065	,16596
,01175	,07941	,16137	,02225	,07755	,16239	,03550	,07522	,16363	,04875	,07291	,16483	,06200	,07061	,16599
,01200	,07936	,16140	,02250	,07750	,16241	,03575	,07517	,16365	,04900	,07286	,16485	,06225	,07057	,16601
,01225	,07932	,16142	,02275	,07746	,16244	,03600	,07513	,16368	,04925	,07282	,16487	,06250	,07052	,16603
,01250	,07927	,16145	,02300	,07742	,16246	,03625	,07509	,16370	,04950	,07277	,16490	,06275	,07048	,16605
,01275	,07923	,16147	,02325	,07737	,16248	,03650	,07504	,16372	,04975	,07273	,16492	,06300	,07044	,16607
,01300	,07919	,16150	,02350	,07733	,16251	,03675	,07500	,16375	,05000	,07269	,16494	,06325	,07039	,16609
,01325	,07914	,16152	,02375	,07728	,16253	,03700	,07496	,16377	,05025	,07264	,16496	,06350	,07035	,16611
,01350	,07910	,16154	,02400	,07724	,16256	,03725	,07491	,16379	,05050	,07260	,16498	,06375	,07031	,16613
,01375	,07905	,16157	,02425	,07719	,16258	,03750	,07487	,16382	,05075	,07256	,16501	,06400	,07026	,16616
,01400	,07901	,16159	,02450	,07715	,16260	,03775	,07482	,16384	,05100	,07251	,16503	,06425	,07022	,16618
,01425	,07896	,16162	,02475	,07711	,16263	,03800	,07478	,16386	,05125	,07247	,16505	,06450	,07018	,16620
,01450	,07892	,16164	,02500	,07706	,16265	,03825	,07474	,16388	,05150	,07243	,16507	,06475	,07013	,16622
,01475	,07887	,16167	,02525	,07702	,16267	,03850	,07469	,16391	,05175	,07238	,16510	,06500	,07009	,16624
,01500	,07883	,16169	,02550	,07697	,16270	,03875	,07465	,16393	,05200	,07234	,16512	,06525	,07005	,16626
,01525	,07879	,16172	,02575	,07693	,16272	,03900	,07461	,16395	,05225	,07230	,16514	,06550	,07001	,16628
,01550	,07874	,16174	,02600	,07689	,16275	,03925	,07456	,16398	,05250	,07225	,16516	,06575	,06996	,16630
,01575	,07870	,16176	,02625	,07684	,16277	,03950	,07452	,16400	,05275	,07221	,16518	,06600	,06992	,16633
,01600	,07865	,16179	,02650	,07680	,16279	,03975	,07447	,16402	,05300	,07217	,16520	,06625	,06988	,16635
,01625	,07861	,16181	,02675	,07675	,16282	,04000	,07443	,16404	,05325	,07212	,16523	,06650	,06983	,16637
,01650	,07856	,16184	,02700	,07671	,16284	,04025	,07439	,16407	,05350	,07208	,16525	,06675	,06979	,16639
,01675	,07852	,16186	,02725	,07667	,16286	,04050	,07434	,16409	,05375	,07204	,16527	,06700	,06975	,16641
,01700	,07848	,16188	,02750	,07662	,16289	,04075	,07430	,16411	,05400	,07199	,16529	,06725	,06970	,16643
,01725	,07843	,16191	,02775	,07658	,16291	,04100	,07426	,16413	,05425	,07195	,16531	,06750	,06966	,16645
,01750	,07839	,16193	,02800	,07653	,16293	,04125	,07421	,16416	,05450	,07191	,16534	,06775	,06962	,16647
,01775	,07834	,16196	,02825	,07649	,16296	,04150	,07417	,16418	,05475	,07186	,16536	,06800	,06957	,16649
,01800	,07830	,16198	,02850	,07645	,16298	,04175	,07412	,16420	,05500	,07182	,16538	,06825	,06953	,16652

C = Circumference
t = Wall thickness
D_u = Outer diameter

D_u is calculated as $\frac{C}{\pi}$

Positioning the paper on the pipe

Step 1

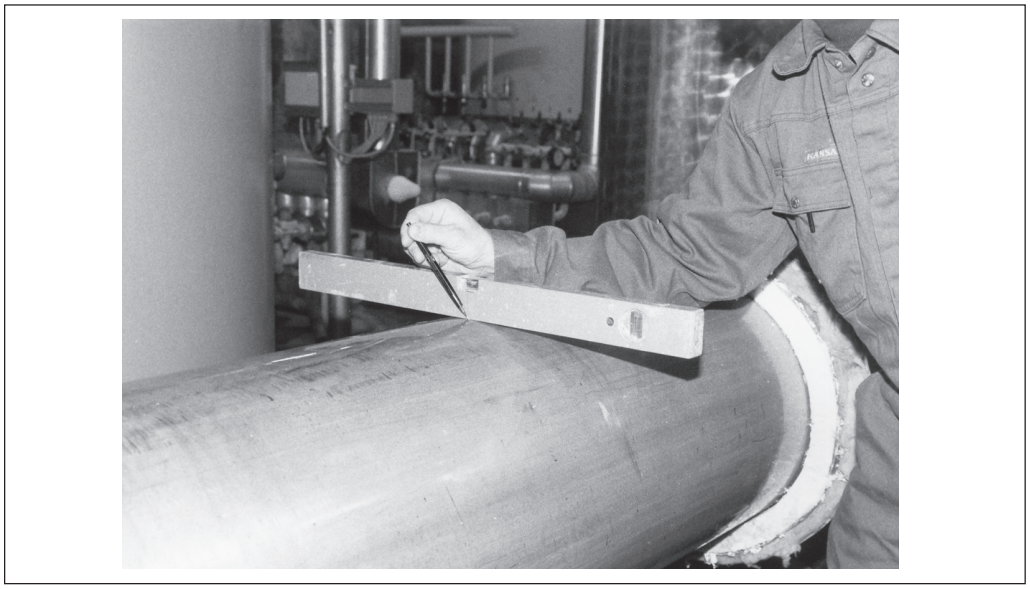


Remove any rust or dirt from the surface of the pipe.

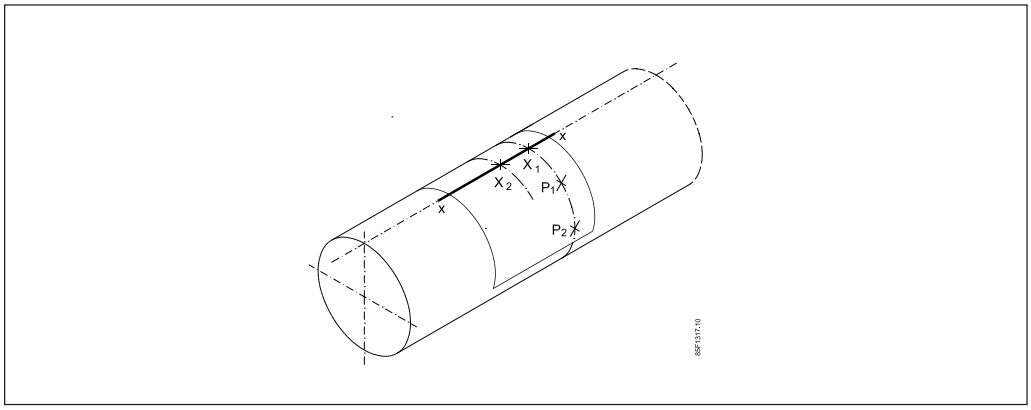
Find the top line X - X using a spirit level. Place the spirit level on top of the pipe. When it is perfectly balanced in horizontal position, it intersects the top line.

Mark 4 -5 points on the pipe's top line using the above method.

Draw a line X - X through the marked top points using the length of angle iron.



Step 2



Place the paper on the pipe in such a way that the line X - X on the paper coincides with the top line X_1 - X_2 on the pipe.
Fix the paper to the pipe with adhesive tape.

Step 3

Punch points P_1, P_2, P_3 and P_4 onto the pipe with the centre punch. Make sure that the lines dissecting the points can be redrawn once the paper is removed.

When preparing a steel pipe, it is useful to draw a circle with a radius of 60 mm around points P, again using the centre punch, as this will facilitate cutting the holes with a flame cutter.

Remove the paper, and start making the holes.

Marking directly on the pipe

With pipes **larger than DN 1000** marking directly on the pipe is recommended.

Marking directly on the pipe is carried out as follows:

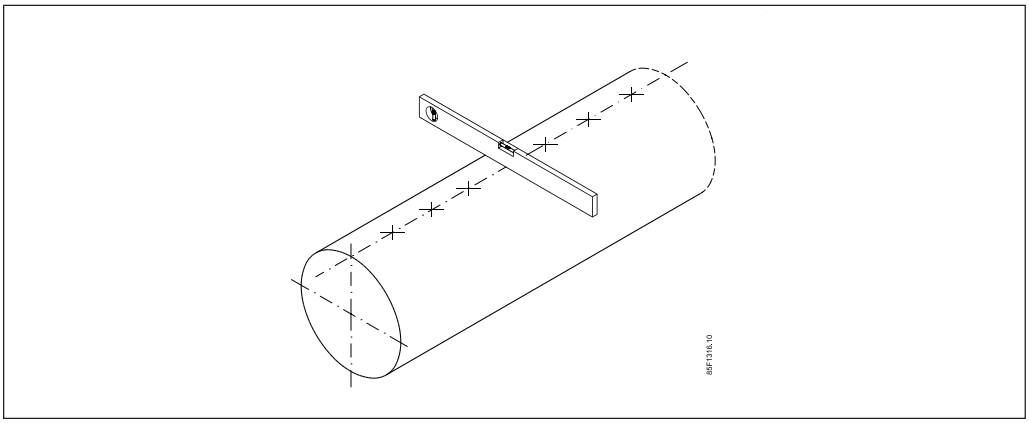
Step 1
The following pipe dimensions must be known before calculating the transducer position and making the drawing.

1. Circumference (C)
2. Wall thickness (t)

The circumference is determined using the measuring tape. Make sure that the pipe's surface is plane and free of dirt etc. The measuring tape must fit snugly around the pipe. Read the circumference (C). Repeat the measurement several times to avoid inaccuracies.

The wall thickness is obtained by measuring a similar pipe whose wall thickness is accessible, or by consulting the relevant standard.

Step 2

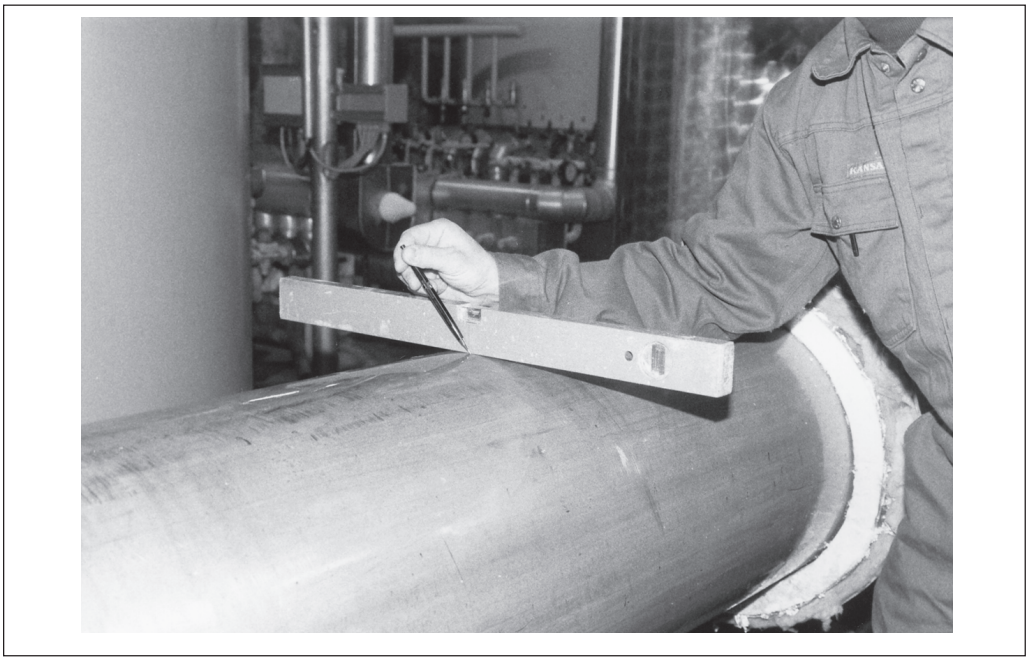


Remove any rust or dirt from the surface of the pipe.

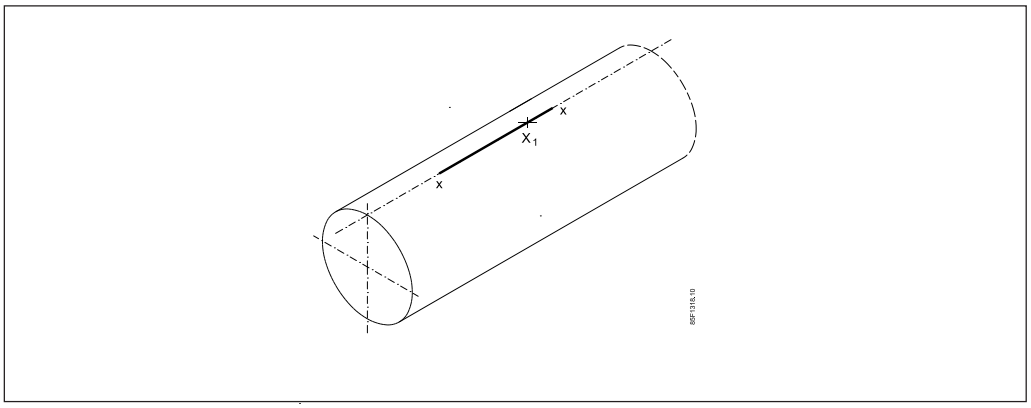
Find the top line X - X using a spirit level. Place the spirit level on top of the pipe. When it is perfectly balanced in horizontal position, it intersects the top line.

Mark 4 -5 points on the pipe's top line using the above method.

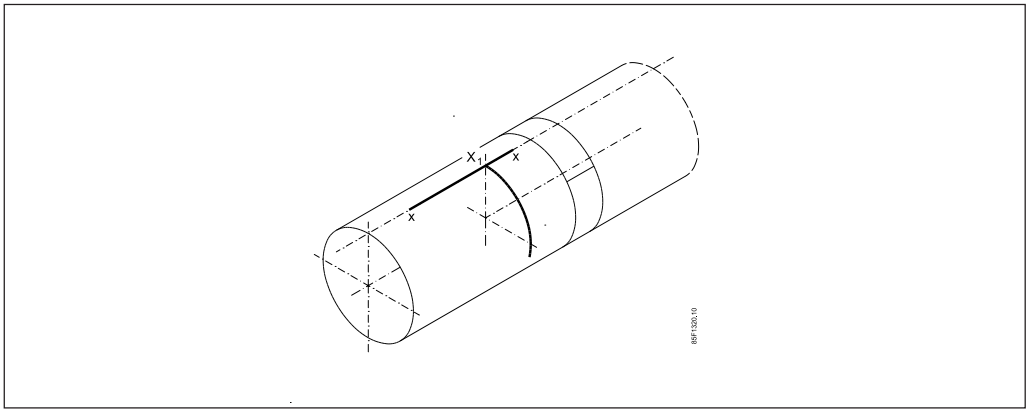
Draw a line X - X through the marked top points using a length of angle iron.



Step 3



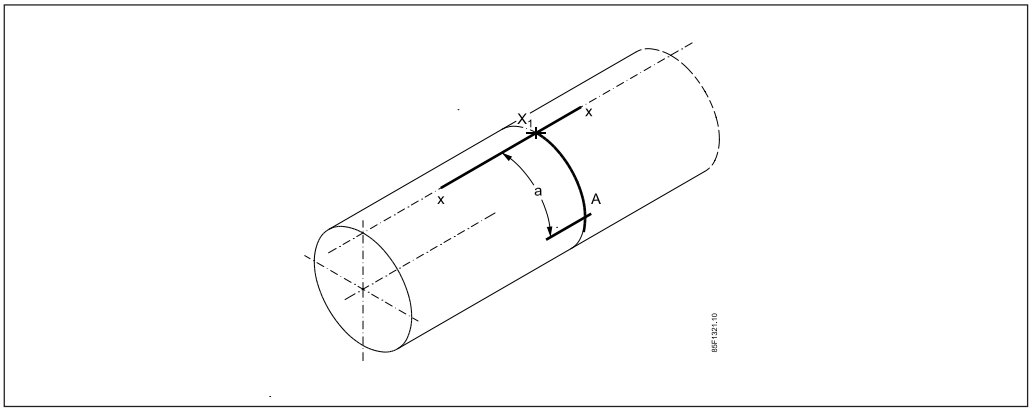
Mark a point X_1 on top line X - X.



Draw a line at right angles to the top line X - X through point X_1.

To construct the line through X_1 place a strip of metal foil around the pipe, thus ensuring that the line is at right angles to the pipe.

Step 4

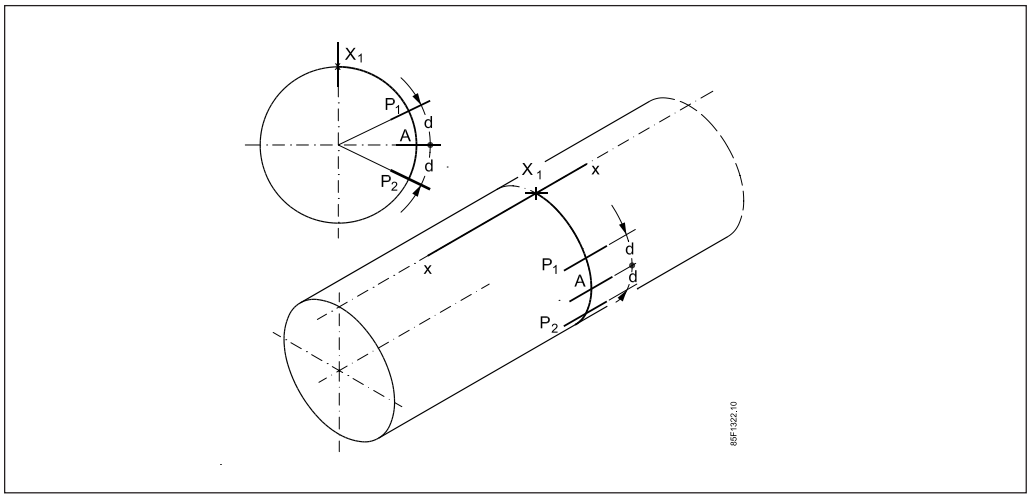


Mark point A on the line at a distance a from X_1.

Point A is on the side of the pipe. Therefore distance a is calculated as follows:

$$a = 0.25 \times C$$

Step 5

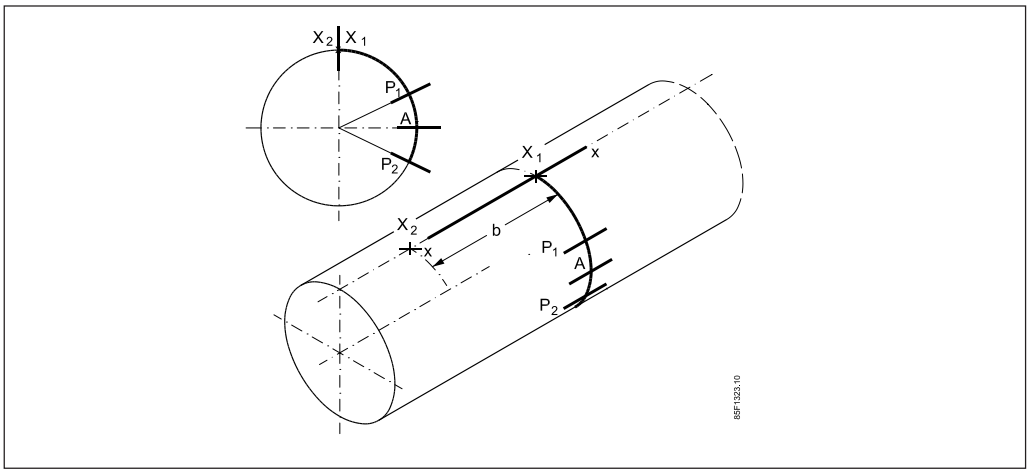


Mark points P_1 and P_2 at a distance d from point A.

d is calculated using the formula: **d = @d x C**

For @d, see table 1.

Step 6

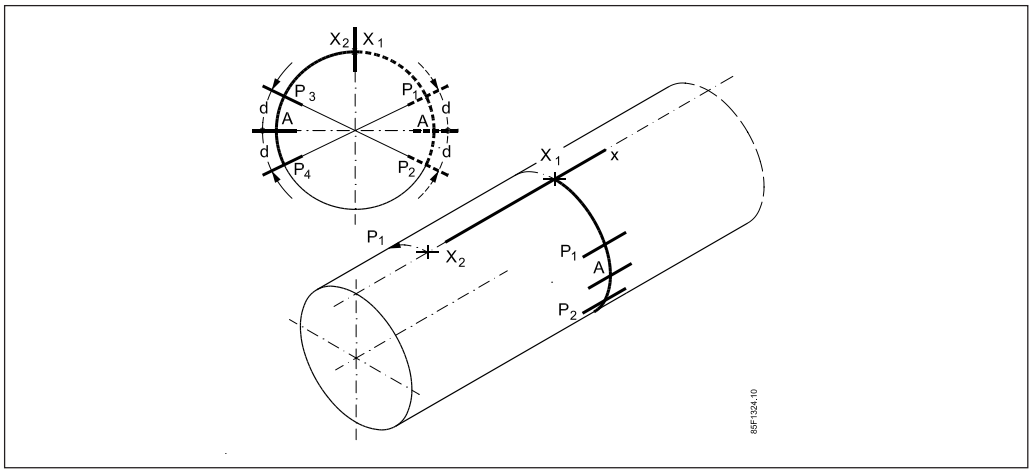


Mark point X_2 on line X-X at a distance b from point X_1.

b is calculated using the formula: **b = @b x C**

For @b, see table 1.

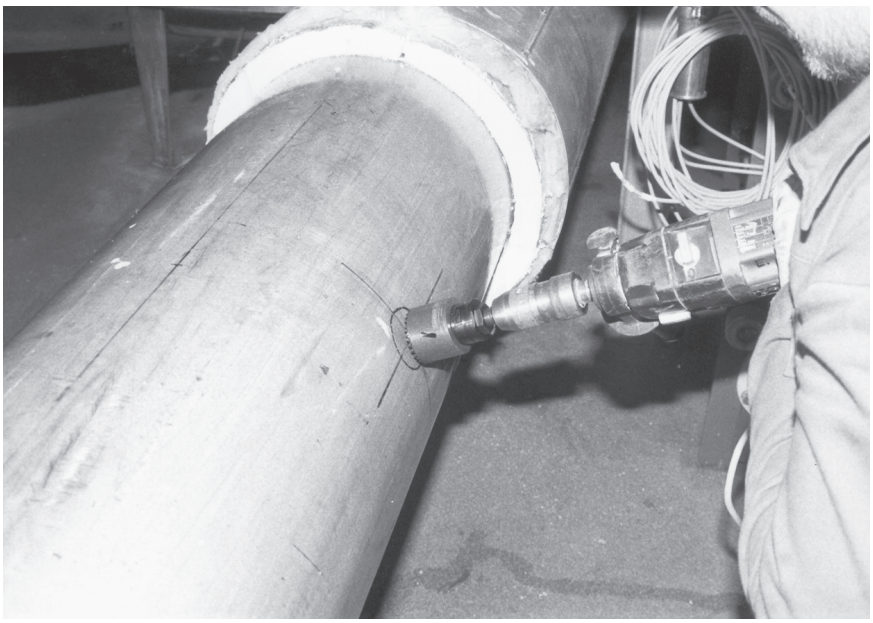
Step 7



Repeat steps 4 - 6 on the opposite side of the pipe.
The drawing is now finished.

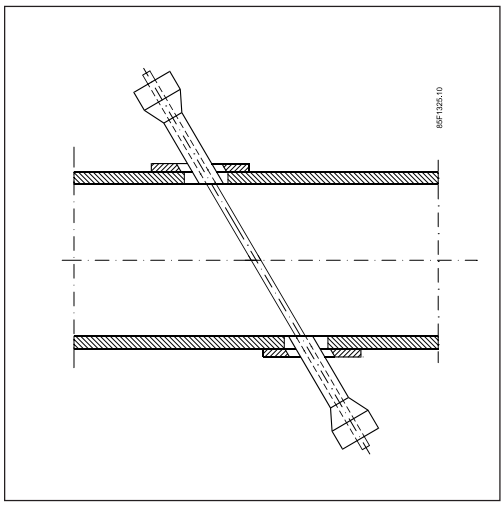
Installation of the transducer holders

Step 1

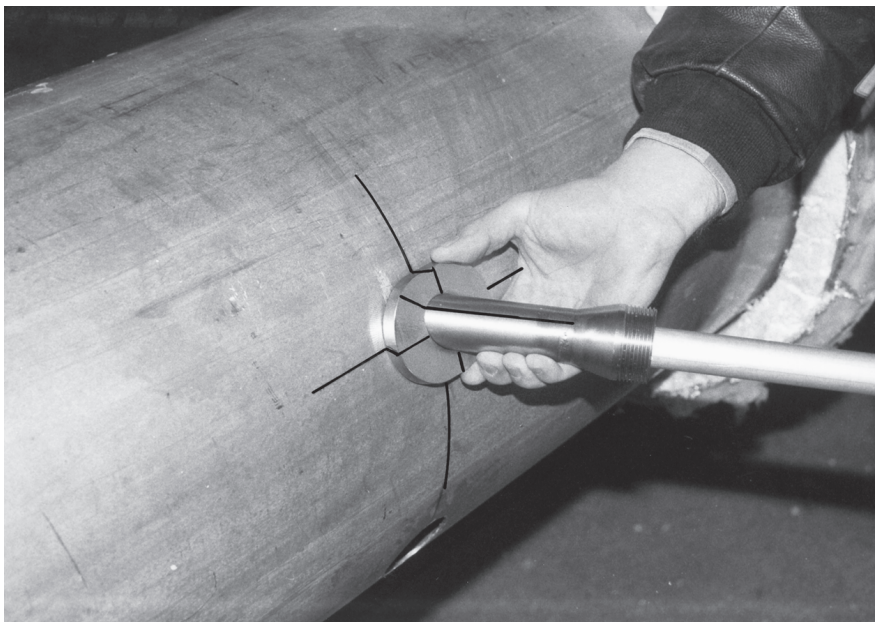


Cut or drill 4 holes centred on P. Dimension of the holes: ø 60 mm +5/-0.

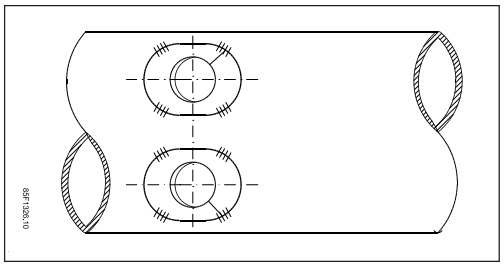
Step 2



Place a set of transducer holders and mounting plates on the mandrel (supplied with the kit) without permanently fixing them.

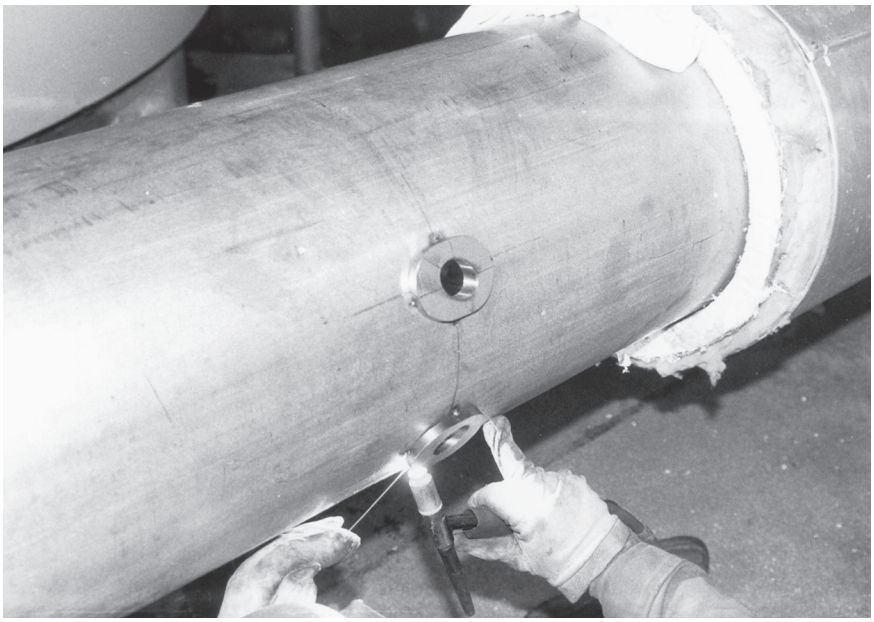


Step 3

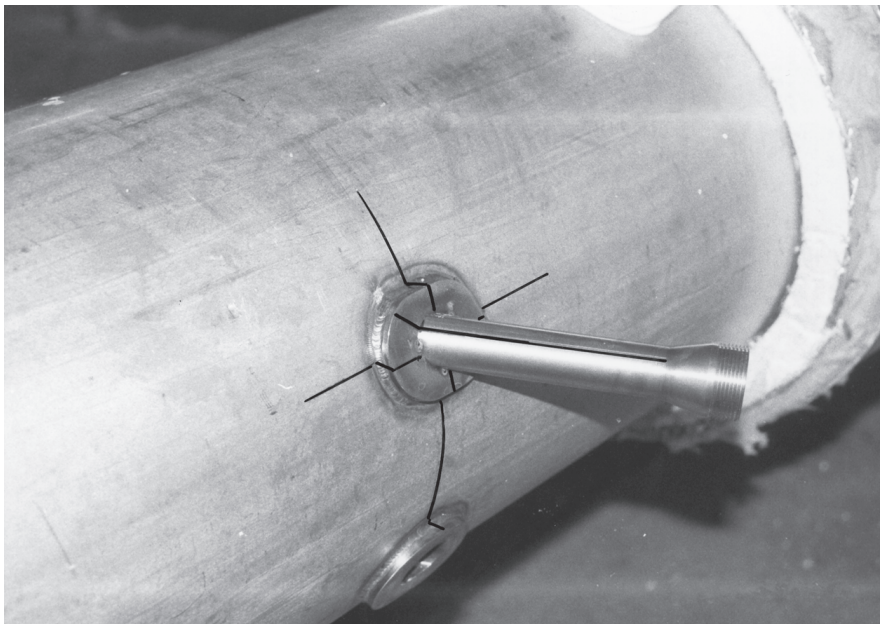


Tack-weld the mounting plates in at least 3 places with transducer holders and mandrels mounted.

Repeat for track 2.

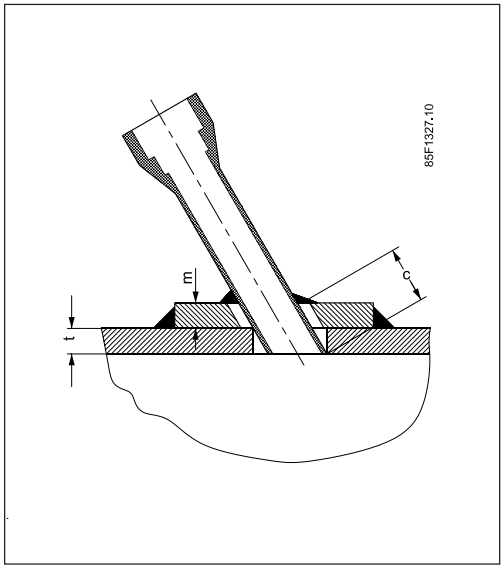


Step 4



Remove transducer holders and mandrel, and weld the mounting plates completely onto the pipe.

Step 5



Mark a point on the transducer holders marking line at a distance c.
c is determined by measuring the wall thickness t and the mounting plate m.

Mount the transducer holders so that they are flush with the inner surface of the pipe.

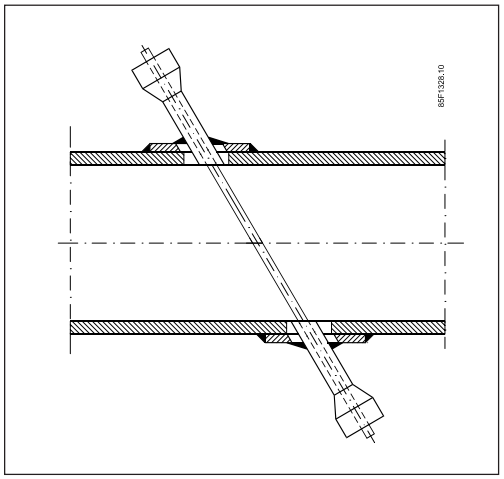
c is calculated using the following formula:

c = (t + m) x 1.15

The correctly positioned transducer holders are tack-welded in at least 3 places with mandrels inserted.

Remove the mandrel and fully weld the transducer holders. **Make sure that the transducer holders are bent as little as possible by the heat generated during welding. Repeat for second track.**

Step 6



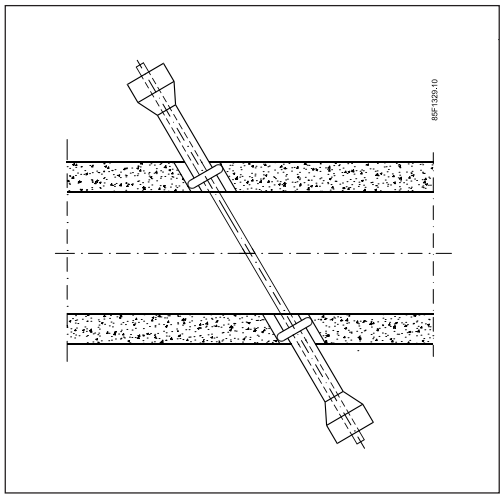
Check whether the mandrel can still pass through the transducer holders. Correct the alignment of the transducer holders if necessary. Use a 1½" protection nut to protect the transducer holders' thread and a hammer.

Installation in concrete pipe

Step 1
Measuring and marking as for steel pipes using the drawing paper supplied with the mounting kit or directly on the pipe, see above.
Once points P_1, P_2, P_3 and P_4 are marked, the holes can be made.

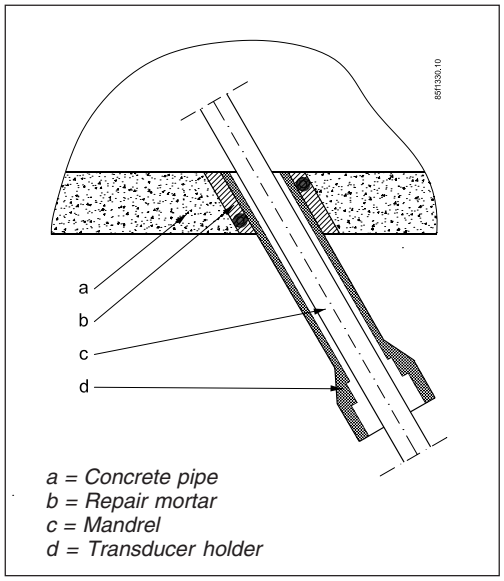
Step 2
Drill 4 holes, ø 46 mm, into the wall of the pipe at an angle of 60°, advantageously using the drill unit shown on the left. The unit is not part of the mounting kit, but can be rented from companies specializing in construction equipment.
The unit contains a core drill bit, an ordinary handheld drill and a device for fastening the unit to the pipe wall.
The unit is fastened to the pipe wall by means of vacuum or clamping band.

Step 3



After having drilled the four holes, mount the transducer holders with mandrel inserted.
Remember to use O-rings to seal the transducer holders.

Step 4



a = Concrete pipe
b = Repair mortar
c = Mandrel
d = Transducer holder

Fix the transducer holder to the pipe by means of mortar.
Make sure that the mandrel is not exposed to the mortar as this might result in the mandrel getting stuck to the transducer holders.
The mandrel keeps the transducer holders in place until the mortar has set.

Measuring the SONOKIT

To allow theoretical calibration by the SONO 3000 signal converter the sensor must be measured.

The following sensor data must be known:

⇒ θ = Angle between sound track and longitudinal axis of the pipe

⇒ L = Distance between transducer windows

⇒ Di = Inner diameter of the pipe

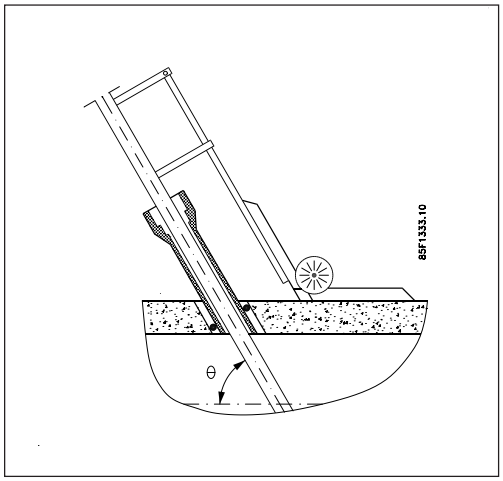
⇒ h = Distance between sound track and centre axis of the pipe

The inaccuracies with which θ, L, Di and h are measured directly influence the measuring accuracy of the finished system during theoretical calibration. Be sure to choose measuring equipment with a suitable measuring accuracy.

Δθ	DN 400-3000	0.1°
ΔL	DN 400-1000	0.8 mm
	DN 1000-2000	2.0 mm
	DN 2000-3000	4.0 mm
ΔDi	DN 400-1000	0.8 mm
	DN 1000-2000	2.0 mm
	DN 2000-3000	4.0 mm
ΔH	DN 400-1000	0.8 mm
	DN 1000-2000	2.0 mm
	DN 2000-3000	4.0 mm

The table shows the required measuring accuracy:

Step 1

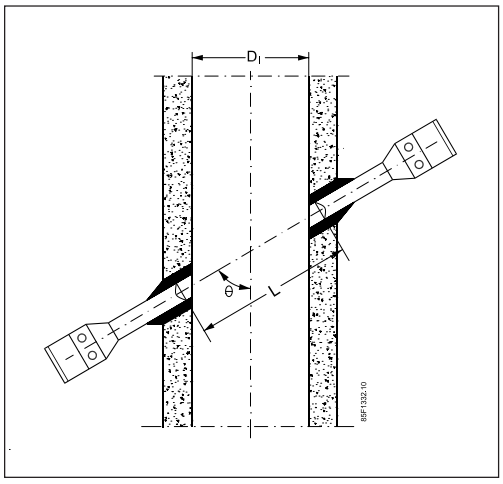


Measuring the angle (θ)

Measure the angle at each transducer holder several times and calculate the average of all measurements at each transducer holder.

Enter angle θ of each transducer holder into the measuring report. Calculate the mean angle of each sound track and enter the value into the measuring report.

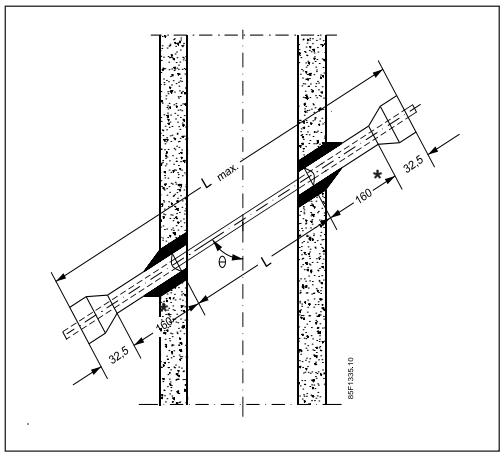
Step 2



Distance between transducers (L)

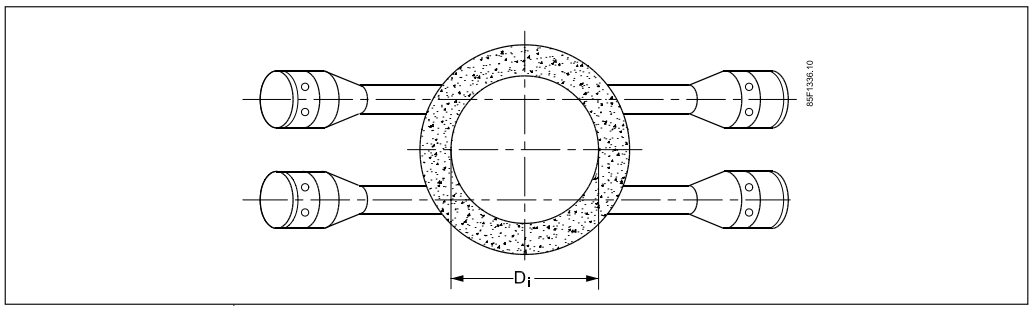
Measure L for each sound track and enter the value into the measuring report.

L may be measured by inserting the mandrel or a similar instrument into the transducer holders, which makes it possible to measure the distance between the thread ends of both transducer holders, see drawing.



* Valid for standard 160 mm transducers. With other transducer lengths, set in dimensions corresponding to these lengths.

Step 3



Measuring the inner diameter (Di)

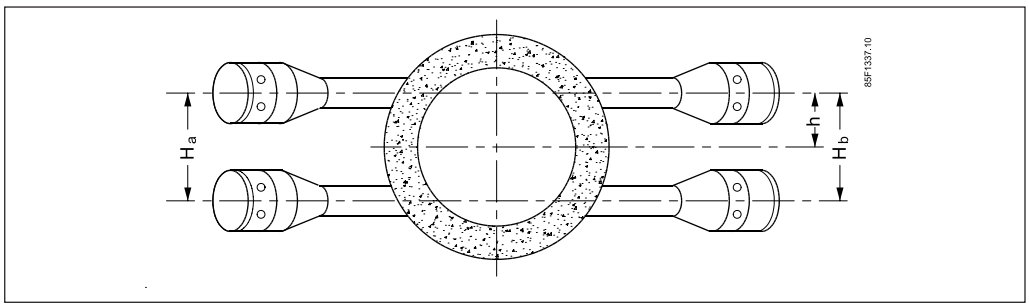
The inner diameter Di can be calculated on the basis of the circumference C according to the following formula:

$$Di = (C / \pi) - (2 \times t)$$

The precise wall thickness t is measured with a sliding gauge after the holes have been made.

Enter Di into the measuring report.

Step 4



Measuring the distance h between sound track and centre axis

To determine h measure Ha and Hb with a measuring tape or a sliding gauge and calculate h using the formula:

$$h = \frac{Ha + Hb}{4}$$

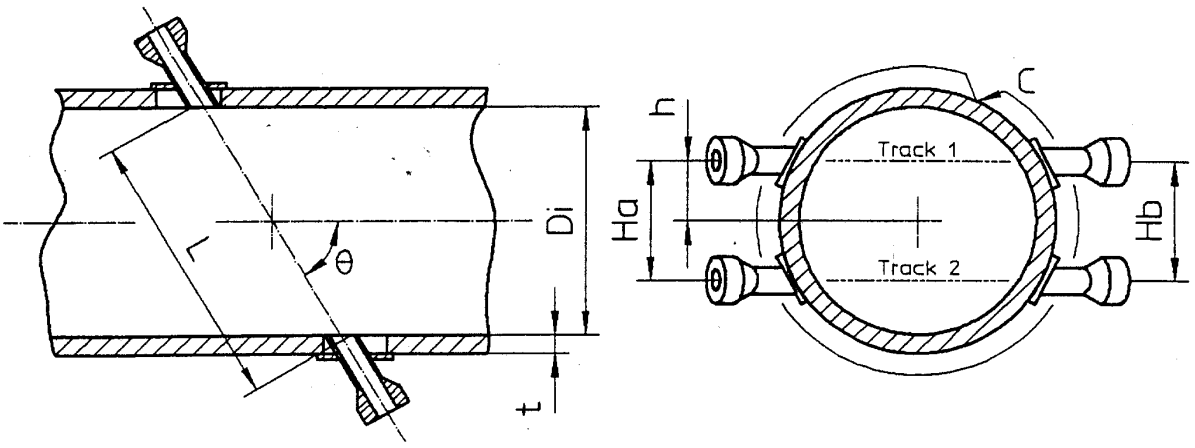
Enter h into the measuring report.

SENSOR GEOMETRI MEASUREMENT REPORT

Sensor type SONOKIT 2-Track

Company	Name	Approved by

Date	Sensor size (DN)	Pressure (PN)	Tag no.:



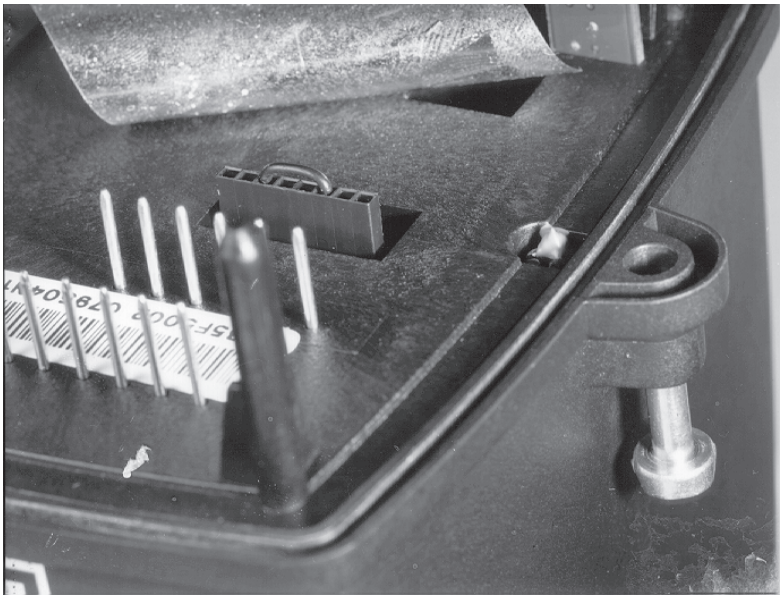
Measure	Calculation	Result
Circumference (C)	C / π = External diameter (Du)	D_u =
Pipe wall thickness (t)	D_u - (2 x t) = Internal diameter (Di)	D_i =

Transducer distance (L) track 1	L =
Transducer distance (L) track 2	L =
Angle θ transducer C	Average angle (track 1) (C+D)/2
Angle θ transducer D	
Angle θ transducer A	Average angle (track 2) (A + B)/2
Angle θ transducer B	
Transducer separation Ha	$h = \frac{Ha + Hb}{4}$
Transducer separation Hb	
Cable length (distance from transducer to converter x 2)	Qmax

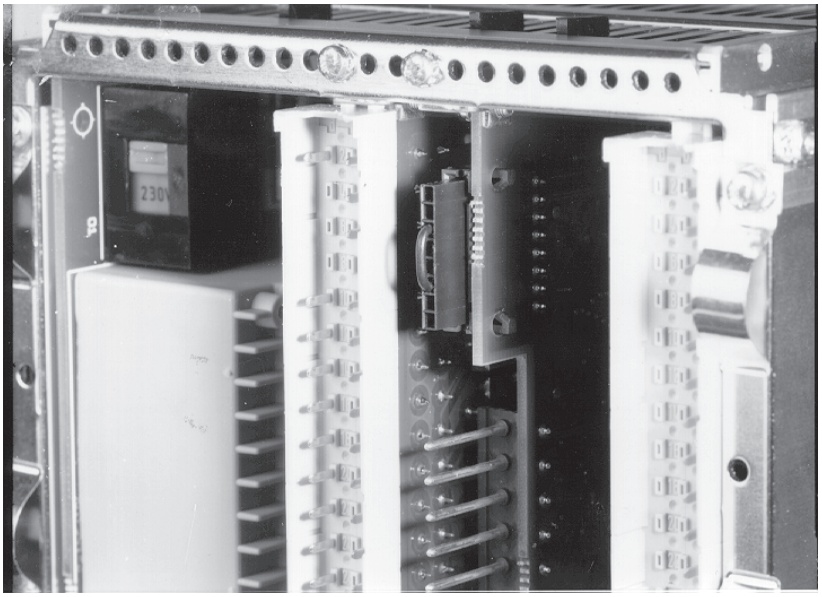
SENSORPROM® memory unit

The SENSORPROM® memory unit is an E^2Prom storing i.a. sensor geometry data. To retain the measured data in the SENSORPROM® unit, install the software lock (SW lock) as shown in the figure.

IP 67 electronic



19" electronic



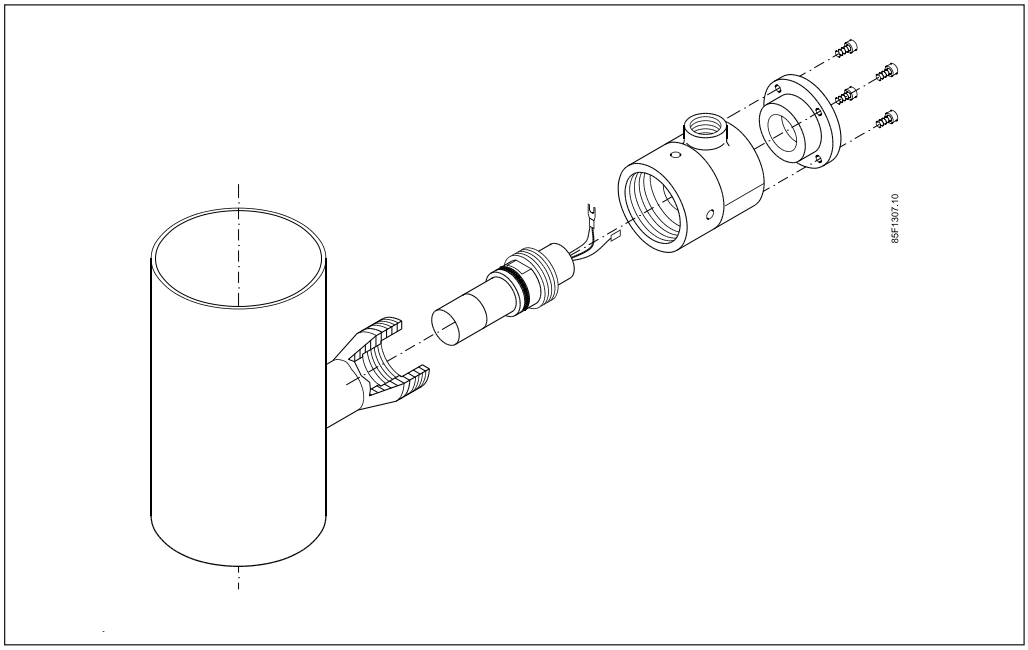
After installation of the SW lock the SENSORPROM® unit is placed on the electronics of the signal converter as described in chapter 6, "Installation of the signal converter". Electronics unit and SENSORPROM® unit are programmed with the sensor geometry data entered into the measuring report, see pipe geometry, chapter 8, "Commissioning".

Important!
Remove the SW lock from the electronics unit to avoid reprogramming.

Installation of the transducer type SONO 3200

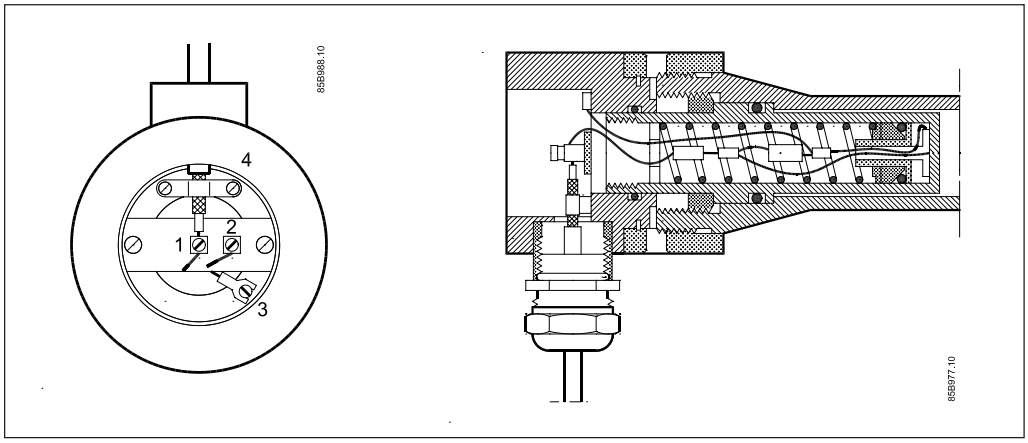
The transducer type SONO 3200 is used together with the sensor type SONO 3100 and the mounting kit type SONO 3110.

O-ring type:
The transducer has a screwed union connection for fitting in a counterflange welded onto the pipe. The union and the pipe are sealed with an O-ring.



The transducer holders are welded directly onto steel pipes or cast into the walls of concrete pipes and flush with the internal walls.

The terminal box is fastened to the transducer holder by means of a union. Stress on the connection wires must be avoided when passing them through the terminal box. The wire without a spade terminal is connected to terminal 2. The wire with a spade terminal is connected to the transducer by means of screw 3. The inner wire is connected to terminal 1 and the transducer cable and screen are fixed to cable clip 4.

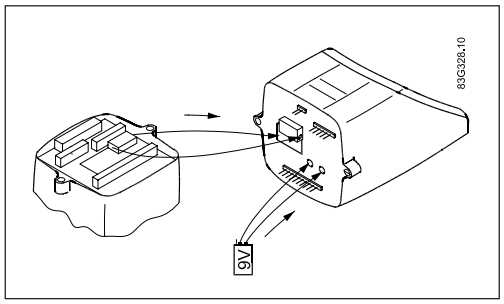


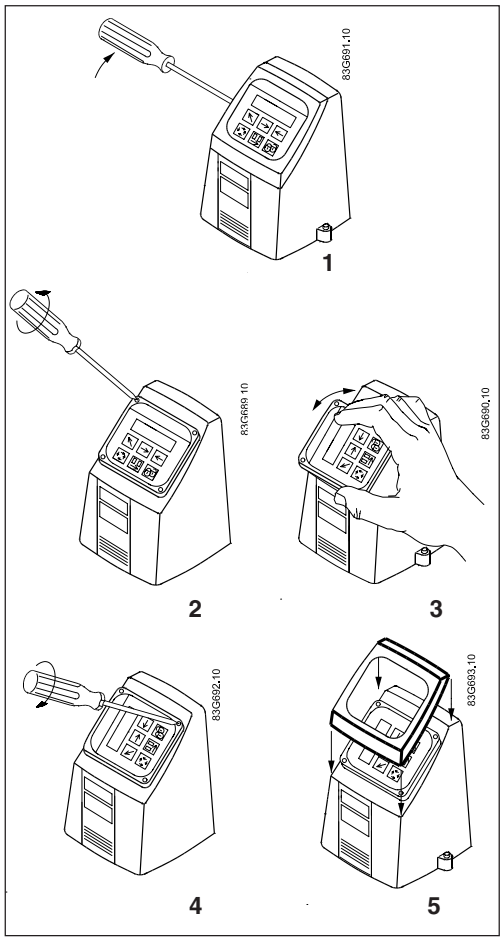
Note:
When disassembling the terminal box the wires must be loosened from the connection board. It is not necessary to remove the transducer cable.

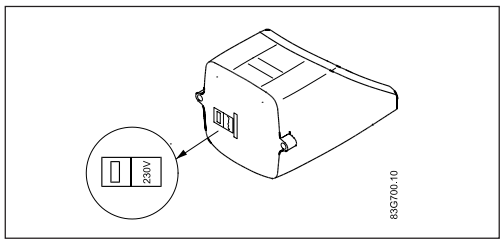
Support the terminal box while loosening the union. Then remove the terminal box from the transducer holder.

Turning the terminal box can damage the wires to the crystals.

Signal converter IP 67 version







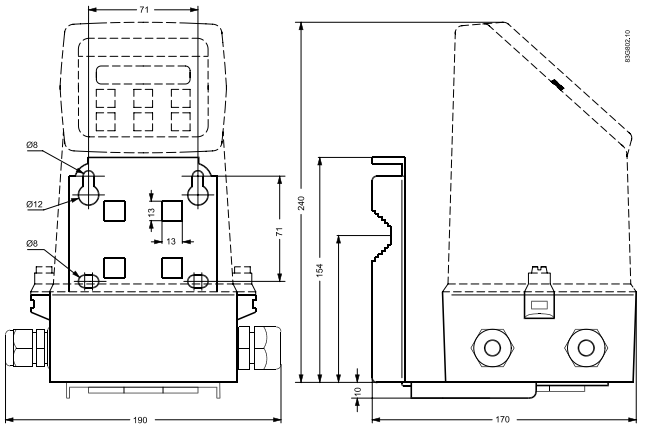
Setting prior to installation
The flowmeter can be set before the final installation using a 9 V alkaline battery. This is especially advantageous if the flowmeter is to be installed before the system is put into operation.

1. Position the SENSORPROM® memory unit supplied in the terminal box at the bottom of signal converter as shown.
2. To protect the pins, place the signal converter in the packaging base supplied.
3. Set the signal converter as described under “Commissioning”.
   The SENSORPROM® unit has now been programmed with the required settings.
4. Remove the battery and replace the SENSORPROM® unit in the terminal box. The flowmeter is now ready for operation.

Turning the control pad
1. Remove the outer frame using a fingernail or a screw driver.
2. Loosen the 4 screws retaining the control pad.
3. Withdraw the control pad and turn it to the required position.
4. Tighten the 4 screws until a mechanical stop is felt in order to obtain IP 67 enclosure rating.
5. Snap-lock the outer frame onto the control pad (click).

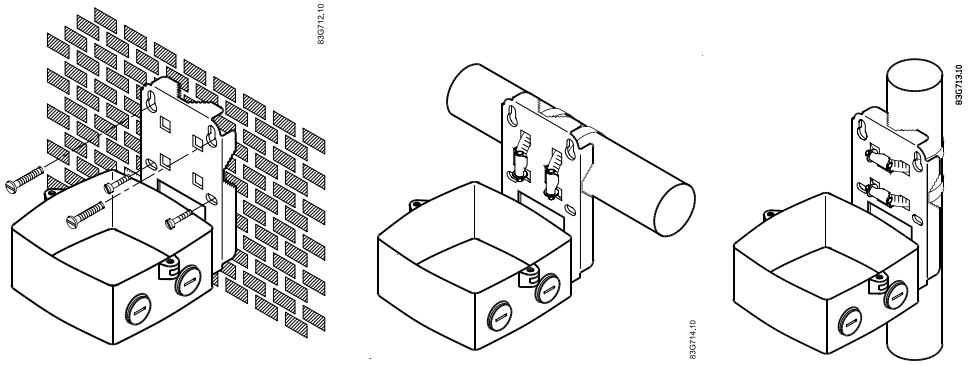
Setting the supply voltage
The mains voltage selector 115/230 V a.c. is located at the bottom of the signal converter.

Remote installation of the signal converter, IP 67 version



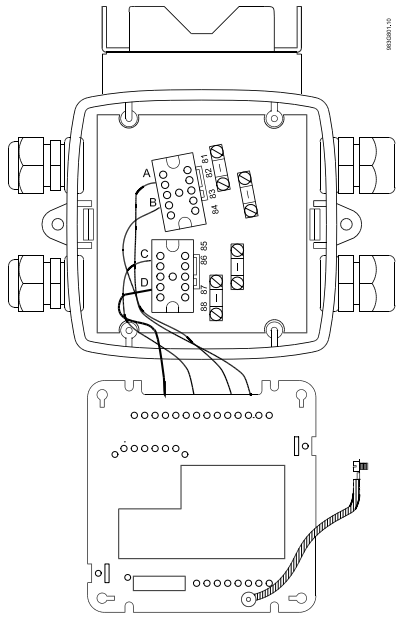
Add approx. 30 mm to each side to allow for cables.

Wall or panel mounting



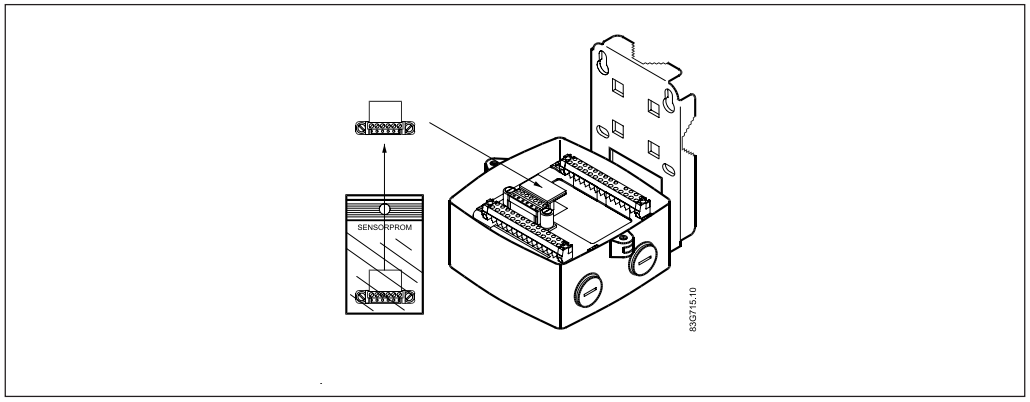
Installation in horizontal pipe

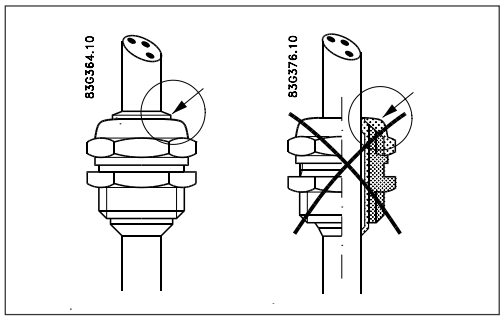
Installation in vertical pipe



1. Use a 75 Ω coaxial cable between feeler and remote signal converter.
2. Mount the wall bracket.
3. Remove the connection board and loosen the earth cable.
4. Connect track 1 transducer to terminals 85...88 and track 2 transducer to terminals 81...84.
   Signal wires to even, screen to odd numbers.
5. Reinstall the earth cable and snap in the connection board.
6. Connect current and signal cables and tighten all cable entries to ensure optimum sealing.
7. Mount the SENSORPROM® unit supplied with the set on the connection board.
8. Place the signal converter in the wall bracket.

Remote installation of the signal converter





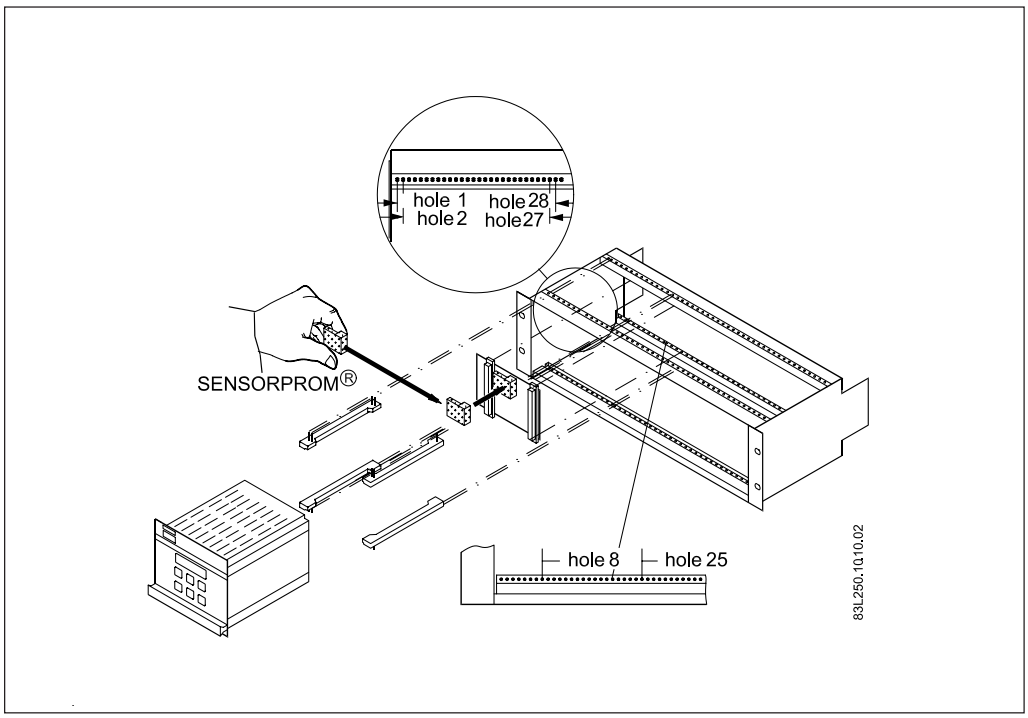
Tighten the cable unions to obtain optimum sealing. The gaskets must be visible above the cable.

19" insert

The 19" insert is designed for a 19" rack system. The insert has a width of 28 TE (142 mm), a height of 3 HE (128 mm) and a module depth of 160 mm.

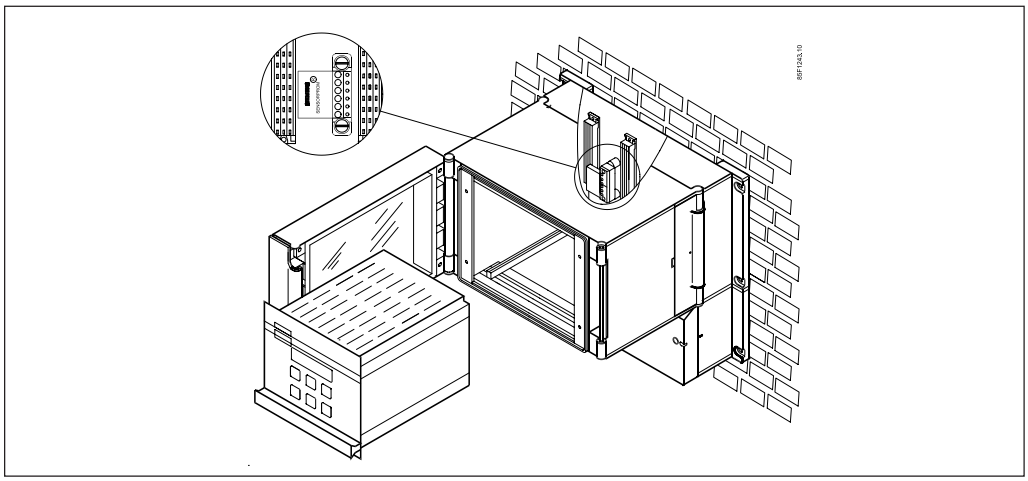
The insert can be mounted directly in a 19" rack system or on a wall (IP 65 version). An optional mounting kit for front of panel mounting or for back of panel mounting is available. The various mounting options are illustrated on the following pages.

Installation in 19" rack



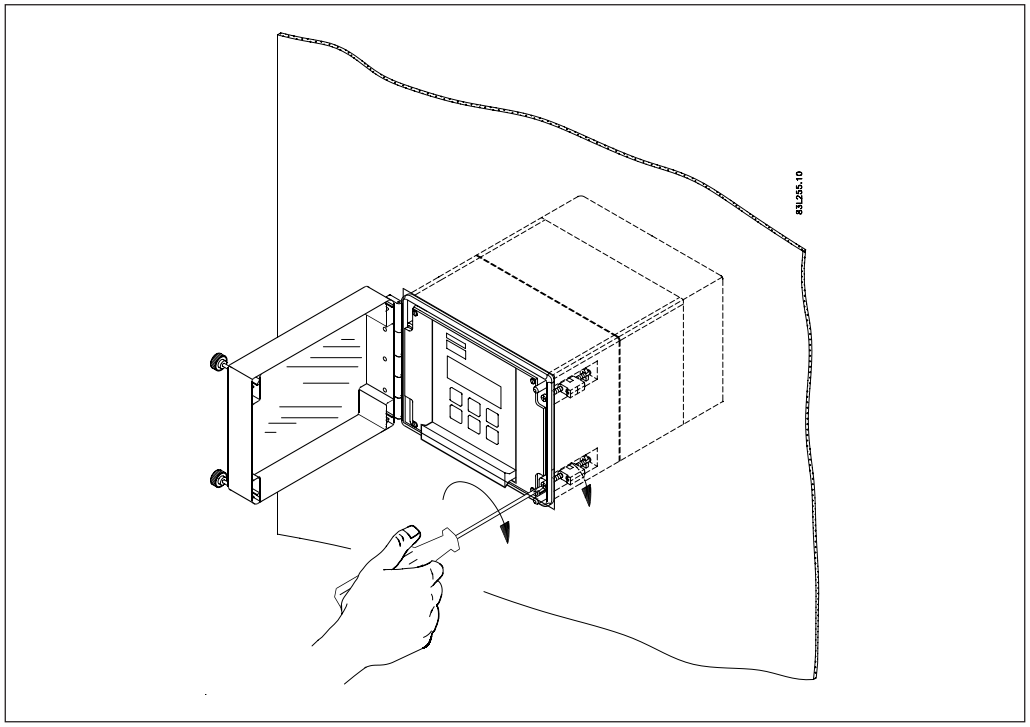
1. Place the SENSORPROM® memory unit on the connection board of the signal converter.
2. Mount the connection board and the guide rails in the rack system as shown.
3. Connect the cables as shown in "Electrical connections".
4. Plug the signal converter into the rack system.

Installation of the signal converter, IP 65 version



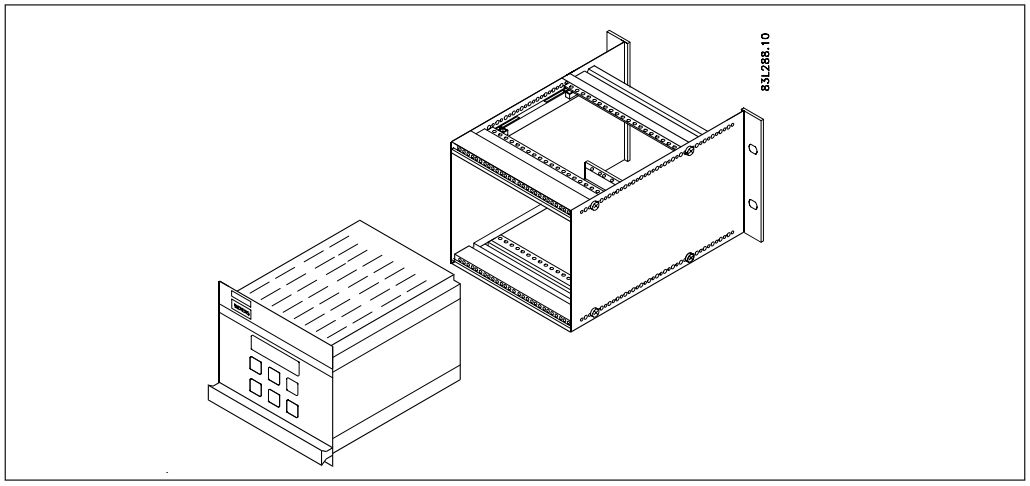
1. Mount the IP 65 enclosure on the wall using four screws.
2. Remove the signal converter from the IP 65 enclosure and mount the SENSORPROM® unit on the signal converter's connection board in the enclosure.
3. Connect the cables to the accessible terminals in the terminal box mounted separately below the enclosure, see "Electrical connections".
4. Plug in the signal converter and close the cover.

Front of panel mounting



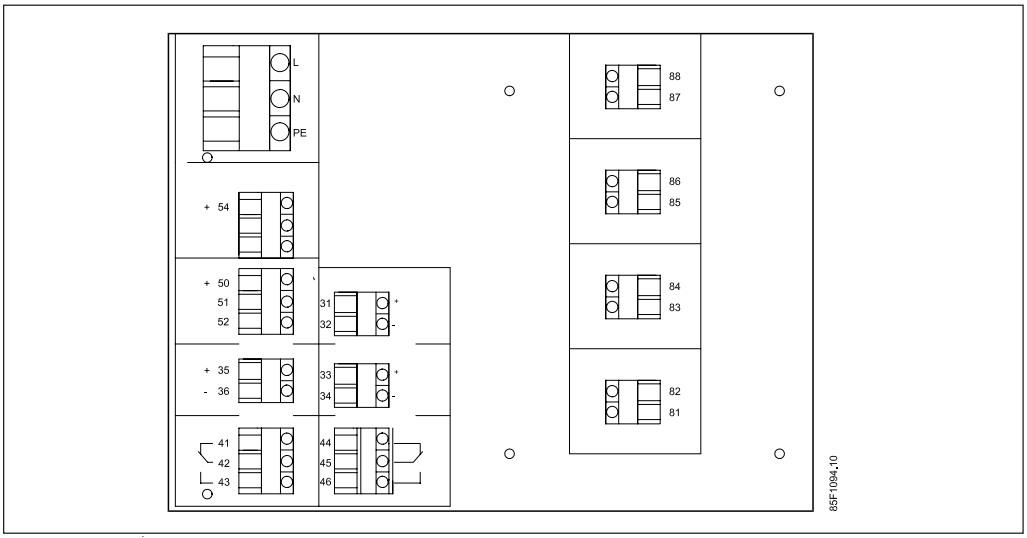
1. Mount the connection board in the housing set using four screws.
2. Mount the housing set as shown in the figure.
3. Place the SENSORPROM® unit on the signal converter's connection board.
4. Insert the signal converter into the frame and fasten with the four screws accessible from the front.
5. Connect the cables as shown in “Electrical connections”.

Back of panel mounting

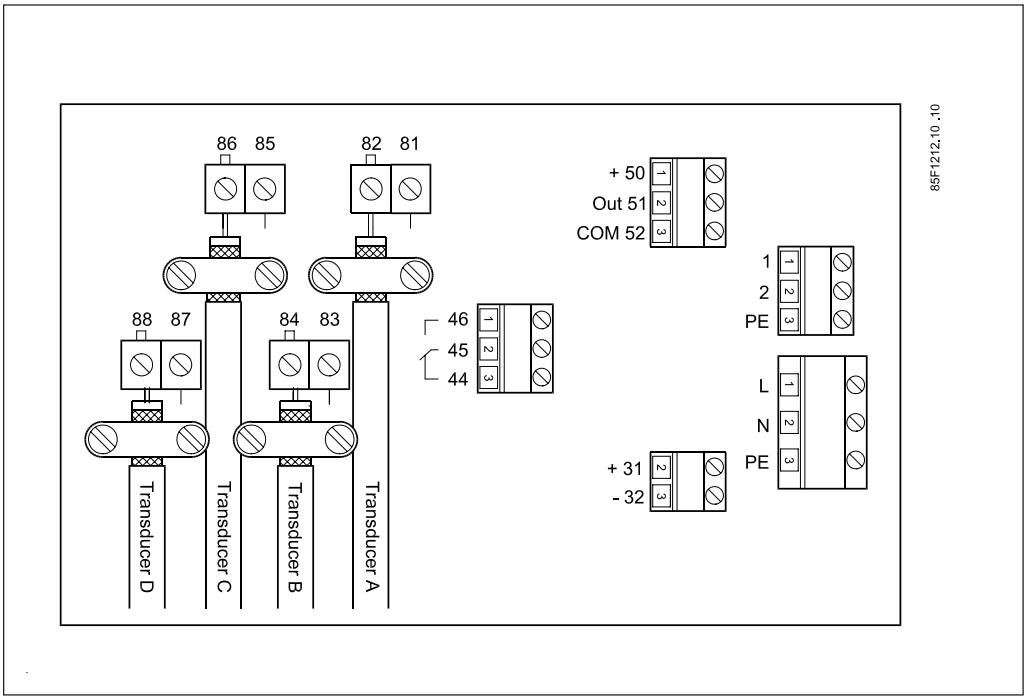


1. Mount the connection board at the back of the panel using four screws.
2. Place the SENSORPROM® unit on the connection board.
3. Connect the cables as shown in “Electrical connections”.
4. Fasten the back of panel housing using four screws.
5. Insert the signal converter into the housing.

Connection board for 19" insert

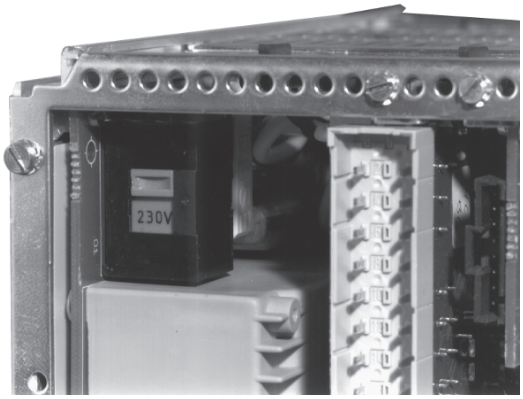


IP 65 wall mounting box connection



The number of connection possibilities depends on the version.

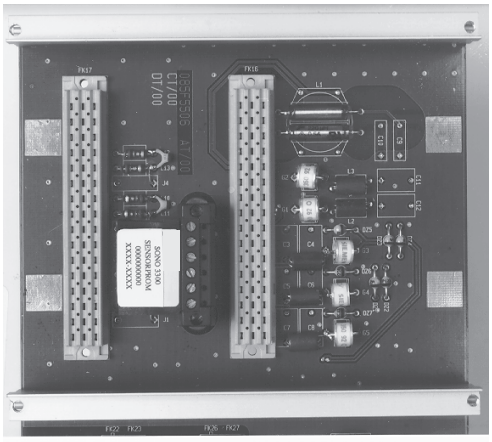
Setting the voltage selector, 19" insert



The voltage selector is located at the back of the signal converter. Settings are 115 or 230 V a.c.

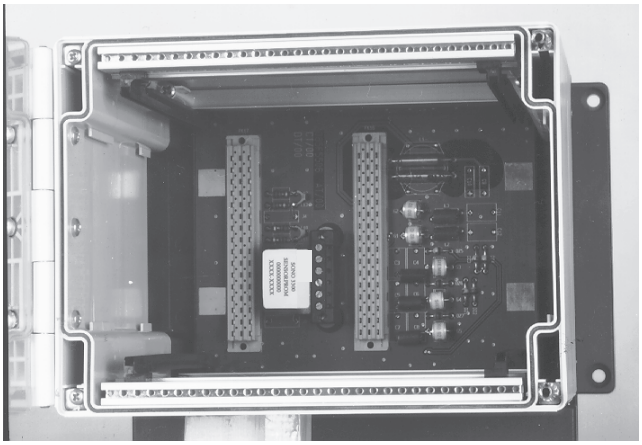
Location of the SENSORPROM® memory unit

19" insert



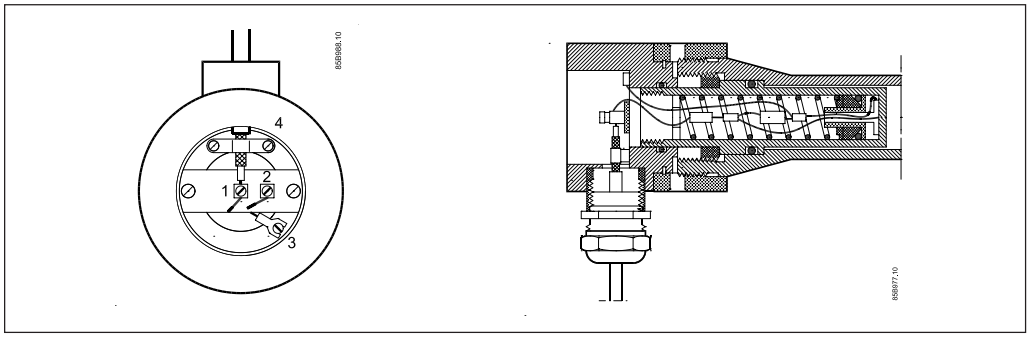
The SENSORPROM® unit is placed on the connection board, see figure.
For identification purposes each SENSORPROM® unit is labelled with the sensor type. On the SONO 3000 the identification can also be read in the menu SENSOR CHARACTERISTICS. During commissioning it should always be checked whether the pipe data settings in the menu correspond to the values in the sensor's measuring report.

19" insert in IP 65 housing



Electrical connection of transducers

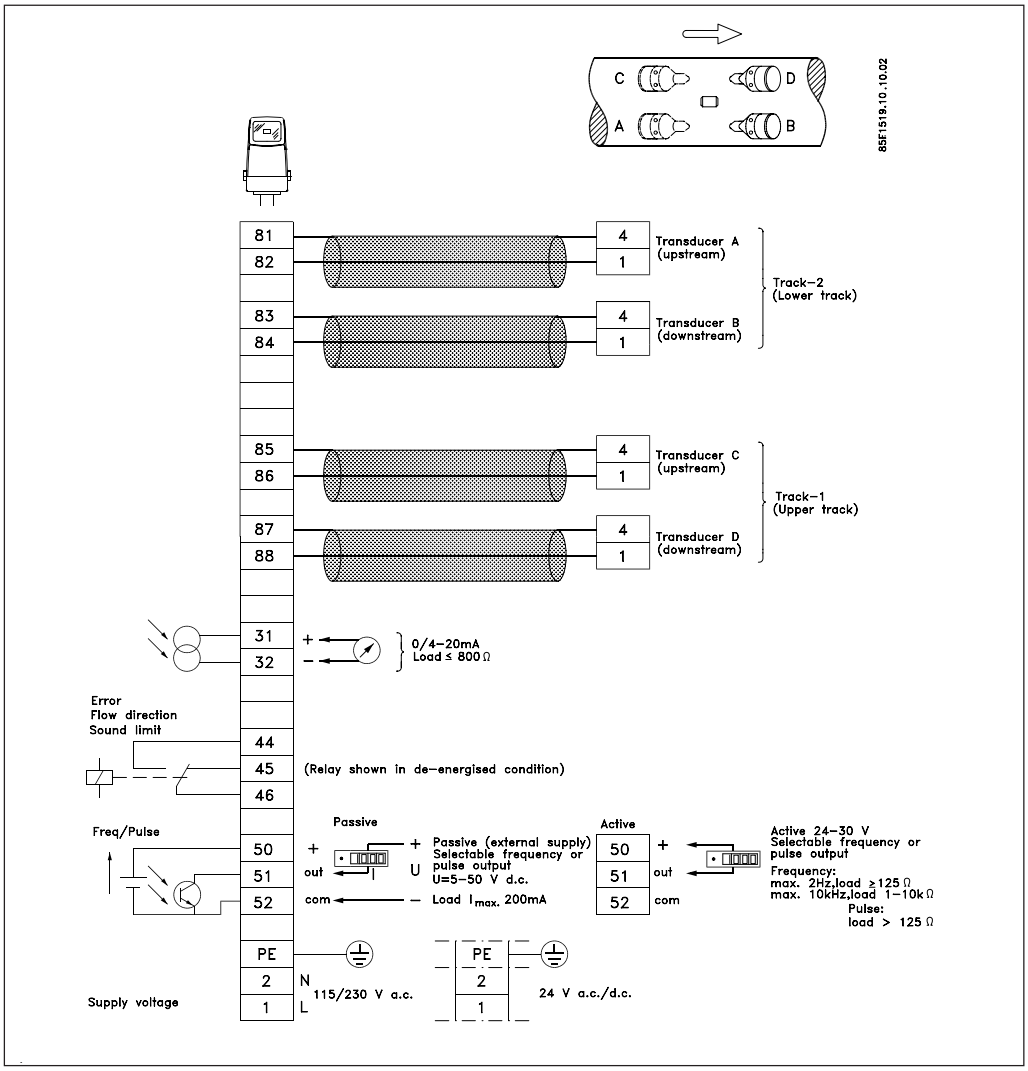
The terminal box is fastened to the transducer holder by means of a union. Stress on the connection wires must be avoided when passing them through the terminal box. The wire without a spade terminal is connected to terminal 2. The wire with a spade terminal is connected to the transducer by means of screw 3. The inner wire is connected to terminal 1, and the transducer cable and screen are fixed to cable clip 4.



Note:
When disassembling the terminal box the wires must be loosened from the connection board. It is not necessary to remove the transducer cable.
Support the terminal box while loosening the union. Then remove the terminal box from the transducer holder.

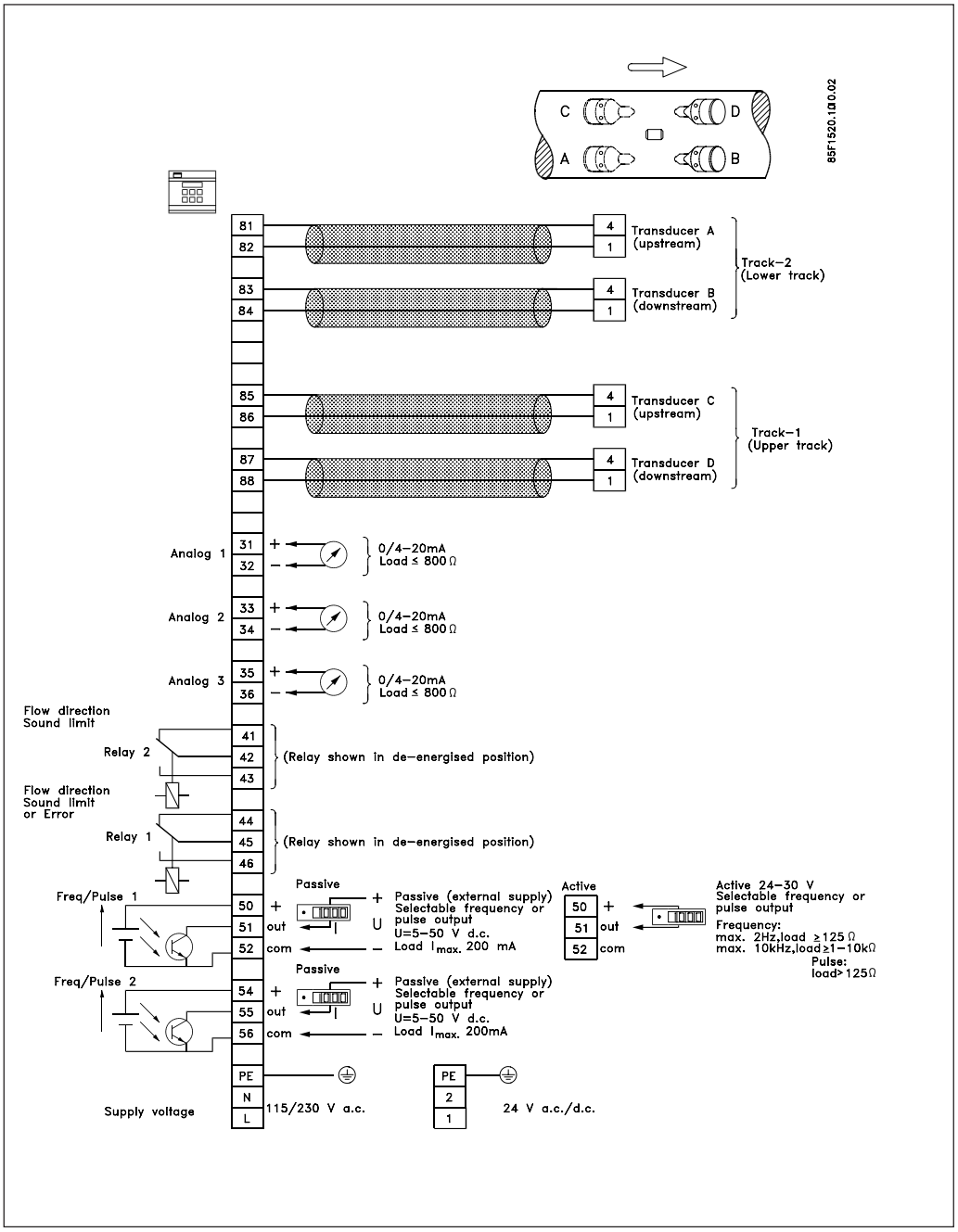
Turning the terminal box can damage the wires to the crystals.

Electrical connection



Connect screen to 81, 83, 85 and 87.

Electrical connection, 19" insert with 3 current outputs, 2 frequency/pulse outputs

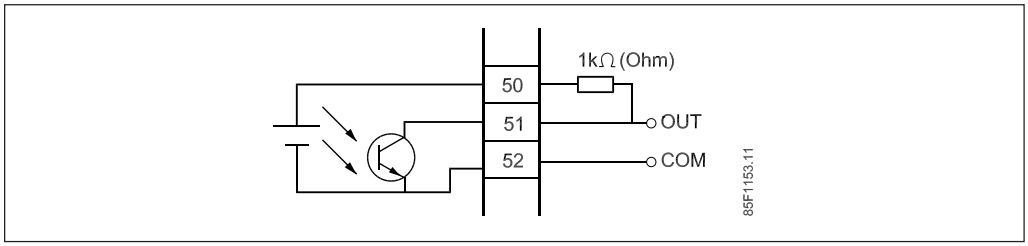


Connect screen to 81, 83, 85 and 87.

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.

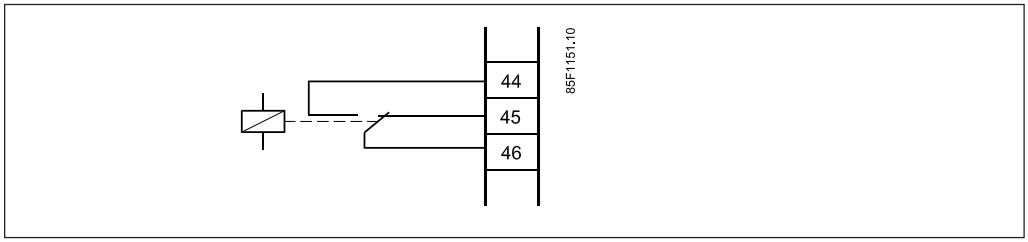
If the ground wire is not connected, personnel can be exposed to 115 V / 230 V.

Frequency output with a load > 10 kΩ



If the load exceeds 10 kΩ it is recommended that a resistor is connected to the frequency output as shown in the figure above.

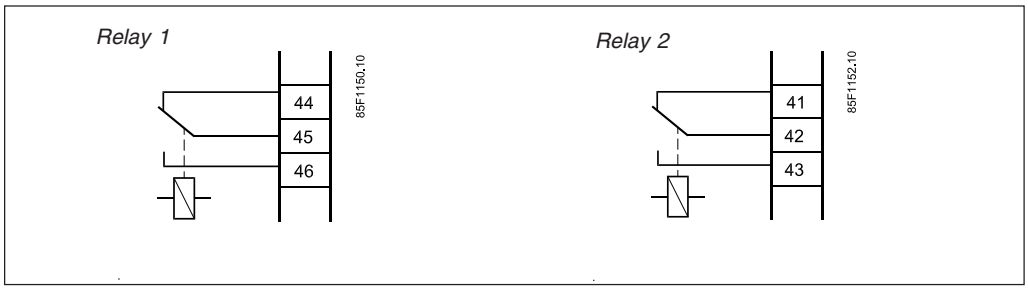
Relay mode signal converter, compact version



Relay shown in de-energized position.

Relay 1 Connection between terminal no.	OFF (De-energized) 45-46	ON (Energized) 44-46
Error	“Error”	"Normal"
Direction	“Forward”	"Reverse"
Sound limit	Inside range	Outside range

Relay mode signal converter, 19" insert



Relays shown in de-energized position.

Relay 1 Connection between terminal no.	OFF (De-energized) 44-45	ON (Energized) 45-46
Error	“Error”	"Normal"
Direction	"Forward"	"Reverse"
Sound limit	Inside range	Outside range

Relay 2 Connection between terminal no.	OFF (De-energized) 41-42	ON (Energized) 42-43
Direction	"Forward"	"Reverse"
Sound limit	Inside range	Outside range

Keypad and display layout

Keypad

The keypad is used to set the flowmeter. The function of the keys are as follows:

TOP UP KEY		This key always returns the display to the OPERATOR MENU showing flow value.
PAGE FORWARD KEY	→	This key is used to step forward through the menus.
PAGE BACKWARD KEY		This key is used to step backward through the menus.
CHANGE KEY		This key changes the settings or numerical values.
SELECT KEY		This key selects the digits to be changed.
LOCK/UNLOCK KEY		This key allows the operator to change settings and gives access to submenus.

Settings are stored automatically in the signal converter and the SENSORPROM® memory unit. The settings remain stored in the event of power failure and when the signal converter is replaced.

Operation of any key illuminates the display. The light automatically turns off 10 minutes after the last key operation.

Display

The display is alphanumerical and indicates flow values and flowmeter settings.
The three fields F, M and L are reserved for the following symbols - see keypad layout:

F: If a fault develops, two flashing triangles appear ◪.

M: The symbols indicate the following:

⧖	RESET MENU
⤫	SERVICE MODE
⌸	LANGUAGE SETUP
⊞	OPERATOR MENU SETUP
⍊	CONVERTER SETUP

L: Indicates the function of the LOCK key 🔓 by the following symbols:

🔓	Ready for change
🔒	Value locked
⍗	Access to submenu
⚲	RESET MODE: Zero setting of totalizers and initialization of settings.

Menu structure

The menu structure of the SONO 3000 signal converter is shown in an overview map and in detail in the description of the layout of the submenus .

The menu is divided in two parts. An OPERATOR MENU and a SETUP MENU. The SETUP MENU is accessed by pressing the TOP UP key for 2 seconds. The SETUP MENU operates in two modes: VIEW and CHANGE. VIEW is a read-only mode and CHANGE is both a read and write mode. The preselected flowmeter settings can only be read in VIEW mode. The access to CHANGE mode is protected with a USER CODE. The user code is factory-set at 1000.

OPERATOR MENU

The signal converter always starts in the basic OPERATOR MENU showing the flow rate.
The PAGE FORWARD and PAGE BACKWARD keys are used to step through the OPERATOR MENU.

SETUP MENU

The SETUP MENU contains the following submenus:

- CONVERTER SETUP MODE
- RESET MODE
- SERVICE MODE
- LANGUAGE SETUP
- OPERATOR MENU SETUP
- USER CODE SETUP

The PAGE FORWARD key is used to step through the main menu. Pressing the LOCK key opens the submenu below. There is no access from the submenu back to the SETUP main menu. To leave the submenu press the TOP UP key , which returns the program to the OPERATOR MENU. To perform further changes in other main menus, press the TOP UP key for 2 seconds, then press the PAGE FORWARD key to select the CHANGE mode. Enter the USER CODE, press the LOCK key and page through the main menu using the PAGE FORWARD key until the required menu is reached. Access the submenu by pressing the LOCK key .

CONVERTER SETUP MODE

CONVERTER SETUP MODE contains 3 submenus:

- BASIC SETTINGS
- OUTPUT SETUP
- SENSOR CHARACTERISTICS

BASIC SETTINGS

In BASIC SETTINGS selection of flow direction, measuring range, measuring units, totalizer units and low flow cut off can be made.

OUTPUT SETUP

In OUTPUT SETUP the required output signals can be selected.

SENSOR CHARACTERISTICS

SENSOR CHARACTERISTICS gives sensor information. This information is uploaded automatically from the SENSORPROM® memory unit.

In the case of remote installation, when the signal converter is connected to the sensor by means of a signal cable, the length of the cable must be entered into APPLICATION PARAMETERS, a submenu of SENSOR CHARACTERISTICS

RESET MODE

In RESET MODE totalizers are reset, zero adjustmen is performed and the menus can be reset to factory settings.
When setting up using a 9 V battery, totalizers are not reset.

NOTE!
USER CODE, CORRECTION FACTOR, LANGUAGE SETUP and AUTO ZERO do not return to the factory setting via RESET MODE.

SERVICE MODE

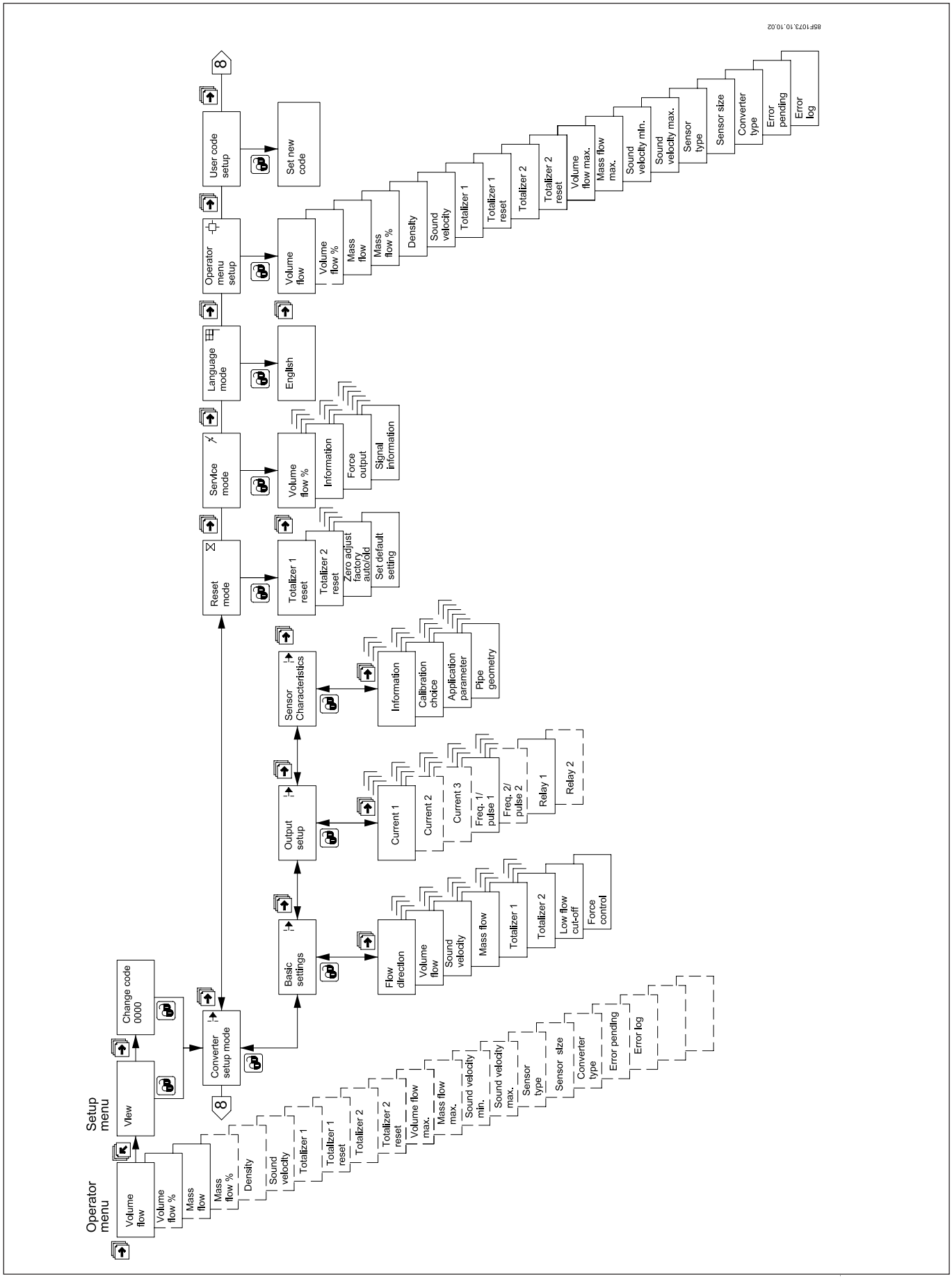
SERVICE MODE provides the facility to set the outputs to fixed values (forced outputs).
On leaving SERVICE MODE, all settings made in SERVICE MODE are cancelled.

LANGUAGE SETUP

The menu language can be selected.

OPERATOR MENU SETUP

The information accessible to the operator can be selected in this menu.


Operator menu
Volume flow
Volume flow %
Mass flow
Mass flow %
Density
Sound velocity
Totalizer 1
Totalizer 1 reset
Totalizer 2
Totalizer 2 reset
Volume flow max.
Mass flow max.
Sound velocity min.
Sound velocity max.
Sensor type
Sensor size
Converter type
Error pending
Error log
Setup menu
View
Change code 0000
Converter setup mode
Basic settings
Flow direction
Volume flow
Sound velocity
Mass flow
Totalizer 1
Totalizer 2
Low flow cut-off
Force control
Output setup
Current 1
Current 2
Current 3
Freq. 1/ pulse 1
Freq. 2/ pulse 2
Relay 1
Relay 2
Sensor Characteristics
Information
Calibration choice
Application parameter
Pipe geometry
Reset mode
Totalizer 1 reset
Totalizer 2 reset
Zero adjust factory auto/old
Set default setting
Service mode
Volume flow %
Information
Force output
Signal information
Language mode
English
Operator menu setup
Volume flow
Volume flow %
Mass flow
Mass flow %
Density
Sound velocity
Totalizer 1
Totalizer 1 reset
Totalizer 2
Totalizer 2 reset
Volume flow max.
Mass flow max.
Sound velocity min.
Sound velocity max.
Sensor type
Sensor size
Converter type
Error pending
Error log
User code setup
Set new code
8
85F-1073.10.10.02

USER CODE SETUP

The user code can be changed in this menu.

The code is factory-set at 1000. If the user code is lost, the factory setting can be re-established as follows: Switch off the supply voltage, press the TOP-UP key and switch on the supply voltage. Release the key after ROM and RAM tests are completed. The user code is now reset to 1000.

Submenus

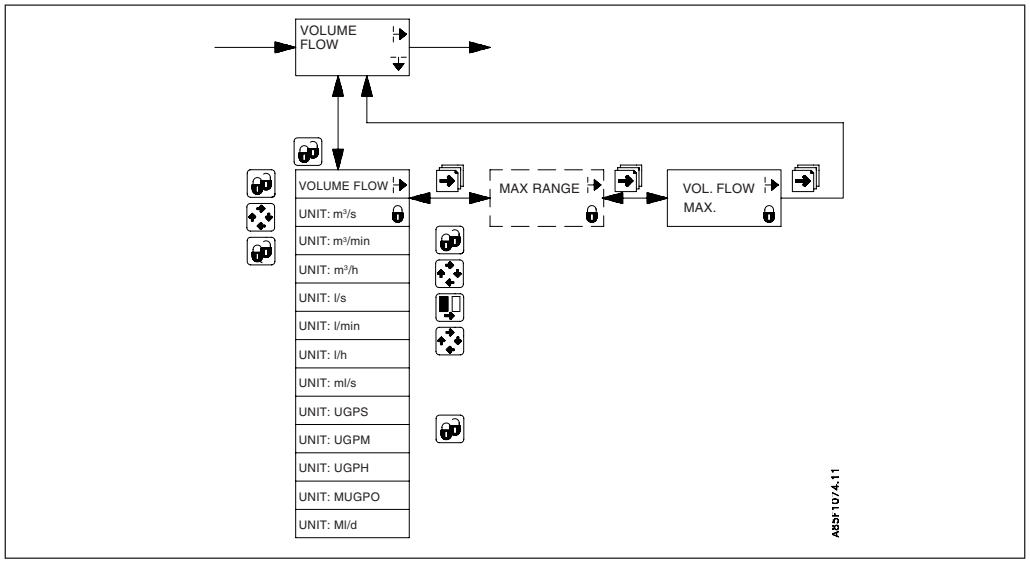
If the signal converter is left in SIGNAL CONVERTER SETUP for more than 10 minutes, the converter automatically reverts to the OPERATOR MENU.
The figure on previous page gives a view of the menu structure. Below is a more detailed description of the submenus. Use the menu block diagram on previous page to step through to required submenu. (See also detailed diagram blocks).

Information regarding the SERVICE MENU is located in the section "Trouble shooting".

FLOW DIRECTION

The flow direction is defined for volume and mass flow simultaneously.

VOLUME FLOW

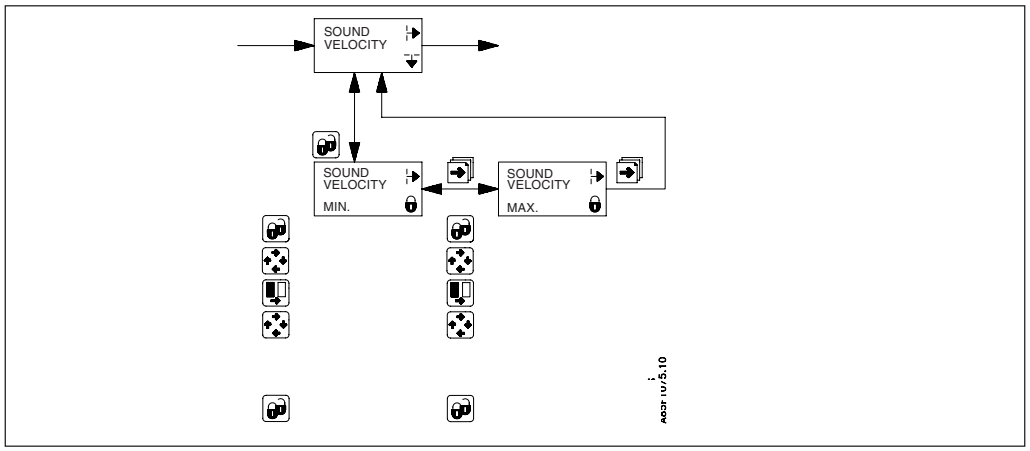


Choose measuring unit and the maximum volume flow.

For SONO 3000 not fitted with a SENSORPROM® memory unit the display indication must be formatted. It is done as follows:

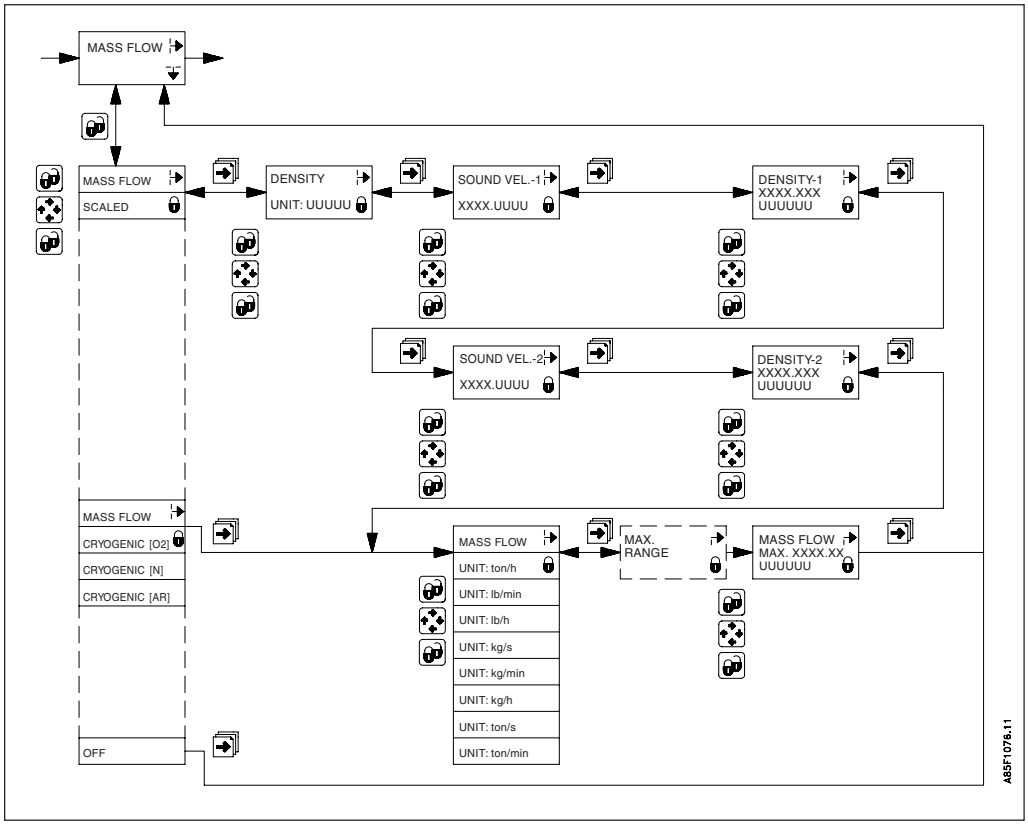
a: Sensor ≤ DN 2000:
In the menu "MAX RANGE" the value 10 x "VOL FLOW MAX" should be entered.
b: Sensor > DN 2000:
In the menu "MAX RANGE" the value 5 x "VOL FLOW MAX" should be entered (Max. 540.000 m³/h).

SOUND VELOCITY



The measuring unit for sound velocity is meters per second. The measuring range is set by entering the minimum and the maximum sound velocity.
Error relay and error indication are activated if the sound speed is outside the limits stated.

MASS FLOW



For SONO 3000 not fitted with a SENSORPROM® memory unit the display indication must be formatted. It is done as follows:

a: Sensor ≤ DN 2000:
In the menu “MAX RANGE” the value 10 × “MASS FLOW MAX” should be entered.
b: Sensor > DN 2000:
In the menu “MAX RANGE” the value 5 × “MASS FLOW MAX” should be entered (Max. 2 x 540.000 t/h).

User-defined relationship between sound velocity and density

In MASS FLOW select SCALED and density measuring unit, enter the two sets of data for sound velocity and density, mass flow measuring units and the maximum mass flow range. If the relay output is set to indicate sound limit, the relay will make if the actual sound velocity is outside the range given by SOUND VELOCITY 1 and SOUND VELOCITY 2, i.e. indicating that the mass flow is calculated with a density outside the defined range.

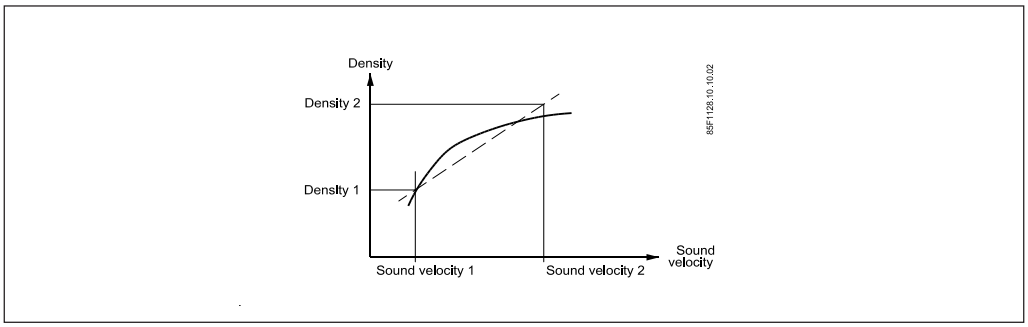
CRYOGENICS

Select cryogenic, mass flow measuring unit and the maximum mass flow range.

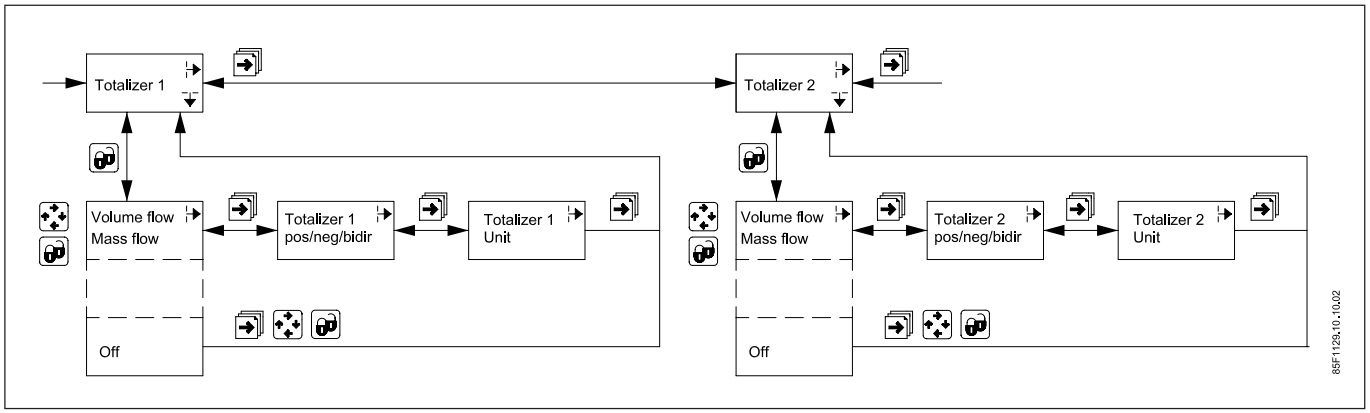
Calculated mass flow

The SONO 3000 is able to measure compensated mass flow, i.e. the mass flow is calculated using volume flow and density derived from sound velocity.

The relation between sound velocity and density is predefined for cryogenics O_2, N_2 and Ar. It is possible to enter a user defined relationship between density and sound velocity. This is achived by entering two sets of data for sound velocity and density, respectively. The meter determines the density by measuring the sound velocity and interpolation of the relation between density and sound velocity.



TOTALIZER, internal



Select flow, direction and measuring units. By selecting bidirectional flow the net flow, i.e. the difference between the positive and the negative flows, will be displayed.

LOW FLOW CUT-OFF

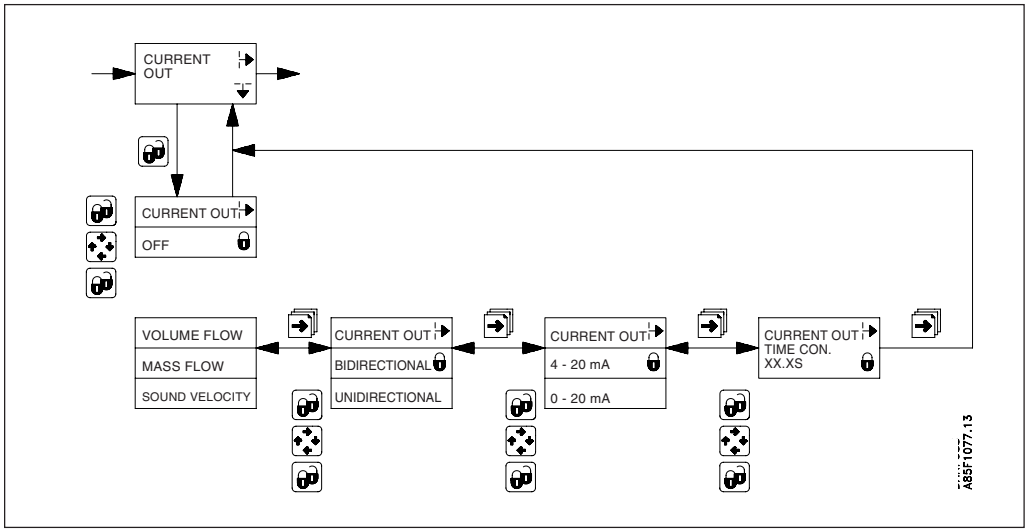
Low flow cut-off can be set within a range of 0-9.9% of the measuring range.

FORCED CONTROL

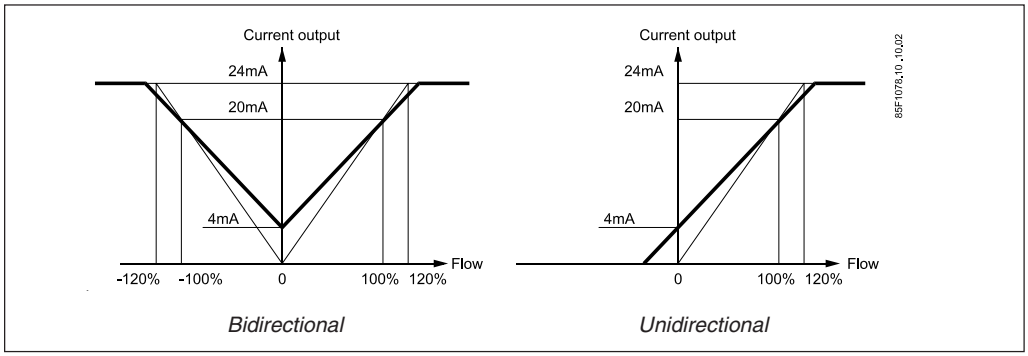
Here it is possible to define the behavior of a current or frequency output in the event of a fatal error.

By selecting:
- "OFF" output remains on the latest valid reading.
- "MIN." forces the output to 0%.
- "MAX." forces the outputs to 100%.

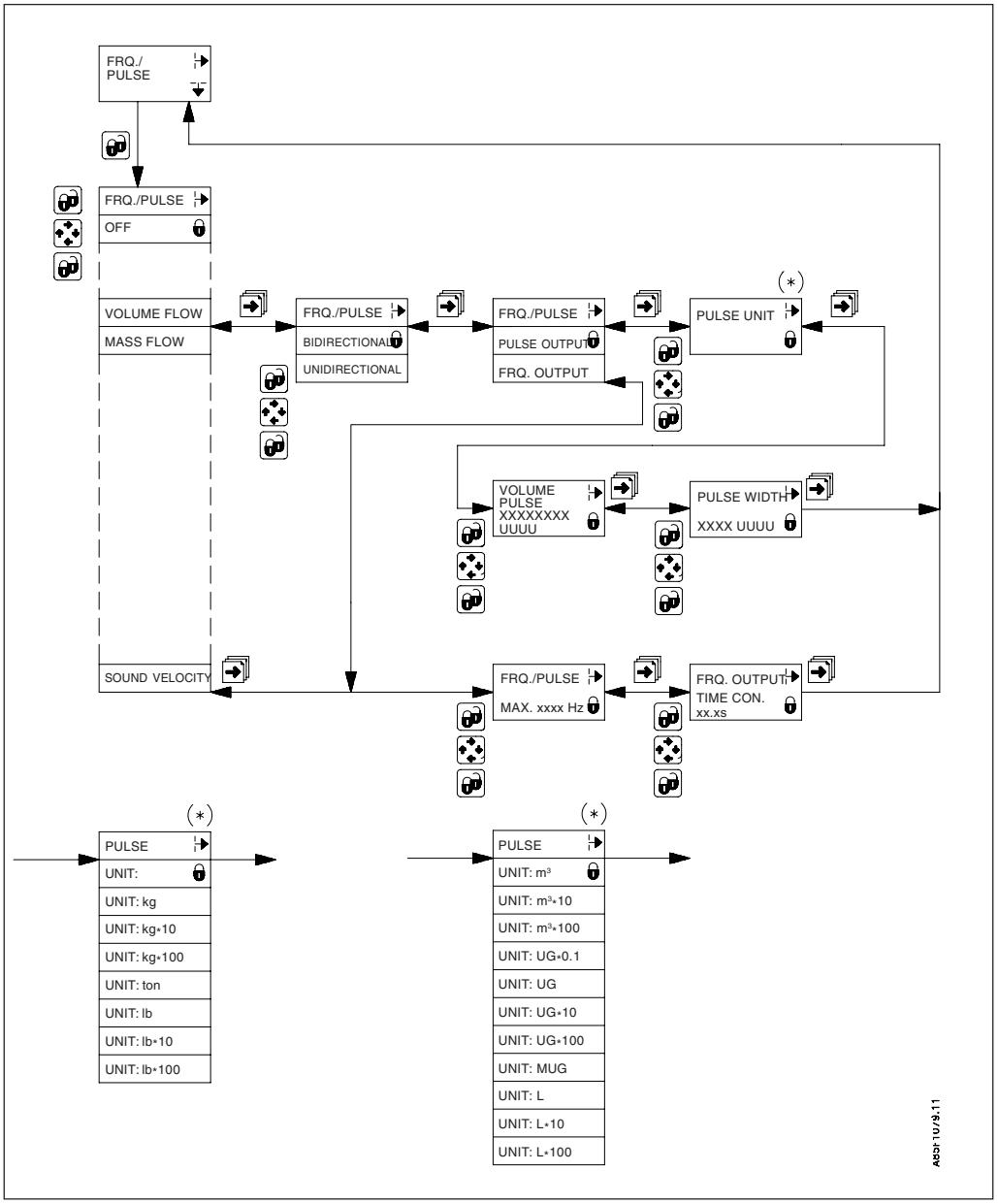
CURRENT OUTPUT



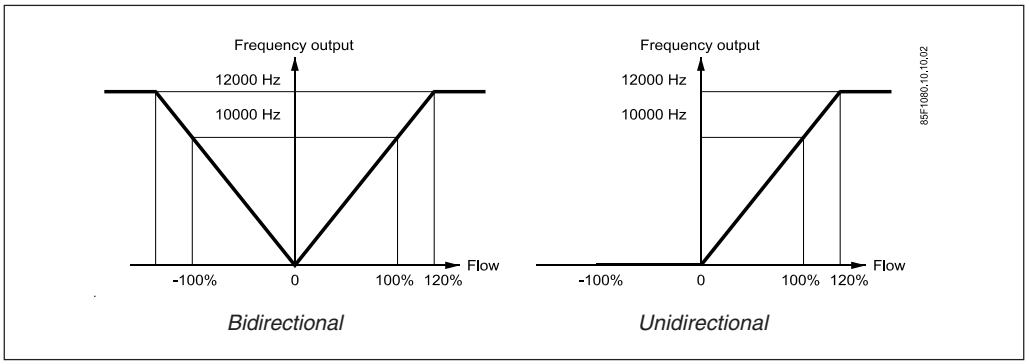
CURRENT OUTPUT CHARACTERISTICS



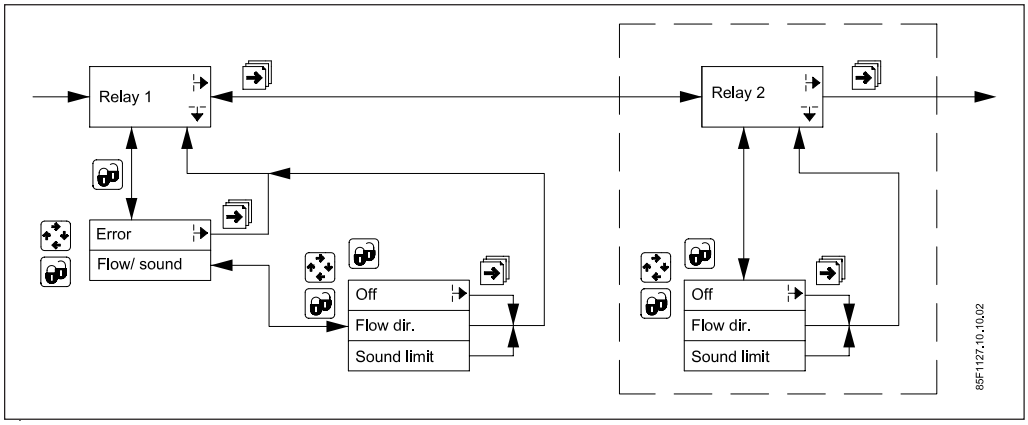
FREQUENCY/PULSE OUTPUT



FREQUENCY OUTPUT CHARACTERISTICS



RELAY

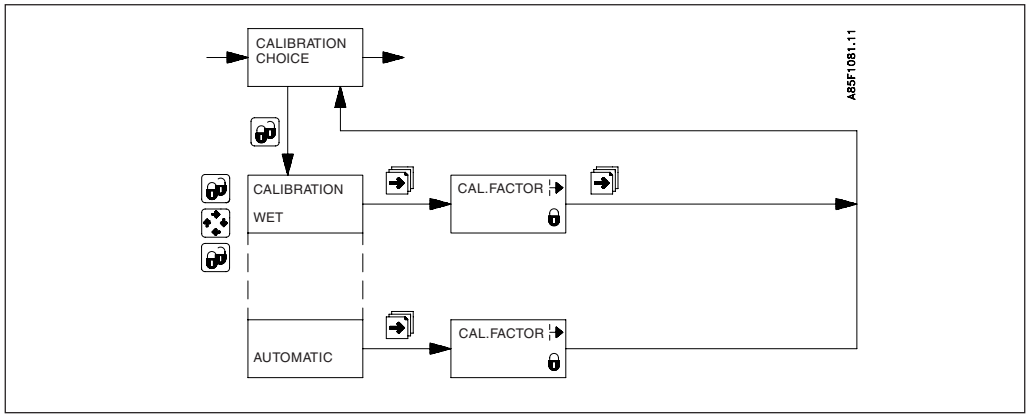


The relay can be set to indicate flow direction, sound limit or error. The error output is only available on relay no. 1.

The sound limit is defined in the MASS FLOW submenu. Select SCALED mass flow and enter SOUND VELOCITY 1 and SOUND VELOCITY 2. The relay will make when the sound velocity exceeds the range defined by SOUND VELOCITY 1 and SOUND VELOCITY 2.

SOUND VELOCITY min. and max. are part of the error message when ERROR has been selected.

CALIBRATION OPTIONS



Wet calibration

The calibration factor can also be changed by inserting the terminal supplied with the set into the bottom of the electronics unit. Remove the terminal after programming if the signal converter is fitted with a SENSORPROM® memory unit. With no SENSORPROM® unit the calibration factor must be set is manually.

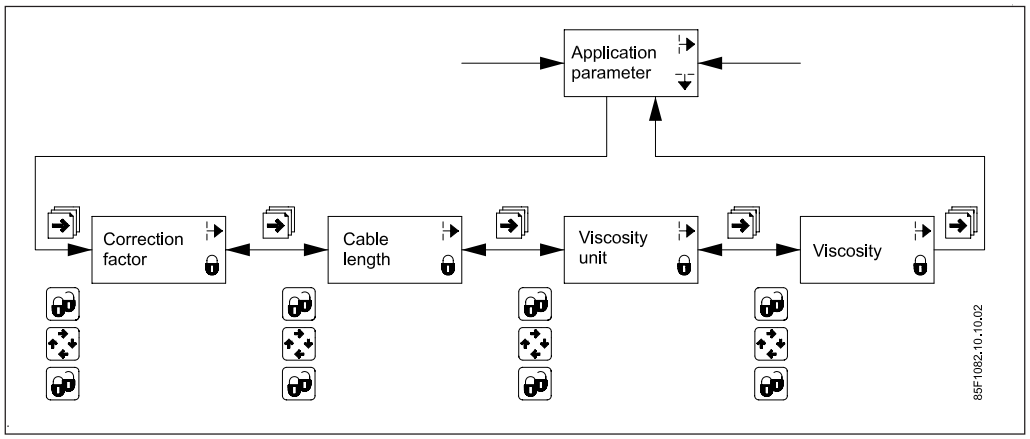
Auto calibration

Selecting AUTOMATIC will allow the converter to calculate a theoretical calibration factor based on the information entered in the APPLICATION PARAMETERS and PIPE GEOMETRY menus.

The theoretical calibration factor is a function of liquid viscosity, inner pipe diameter, roughness, number of tracks, transducer distance, track angle and displacement of each track.

Automatic calibration can be used only with conventional "spool pieces".

APPLICATION PARAMETERS



Correction factor

The correction factor allows the user to adjust the calibration factor by up to ±20% by entering a factor between 0.8 and 1.2. The factory setting is 1.

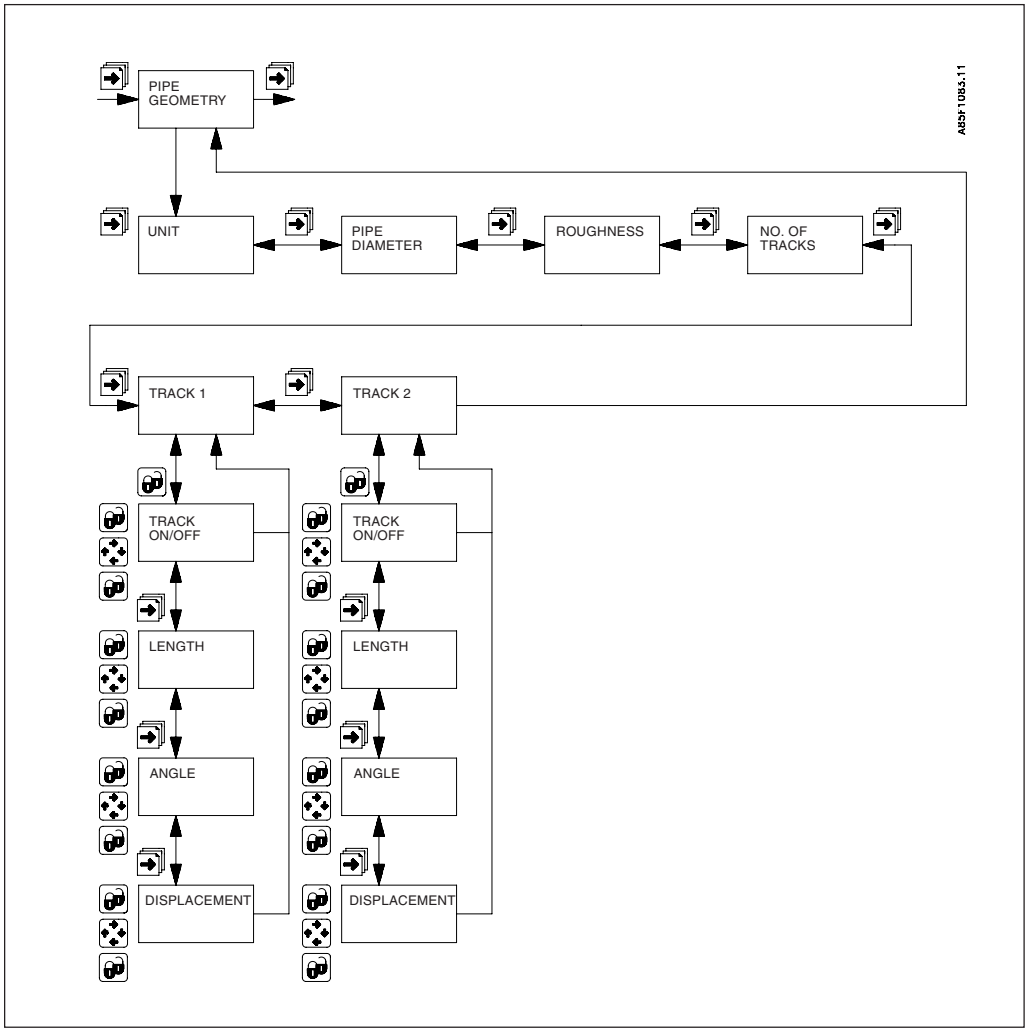
Cable length

If the signal converter is installed in a remote position, entering the length of the sensor cable is necessary to compensate for the time delay occurring in the cables. The cable length is the total length of the signal cable in one sound track. The measuring unit of the cable length is meters. The tolerance is ±0.5 m.

Viscosity

Only required in case of auto calibration.

PIPE GEOMETRY



In the PIPE GEOMETRY menu the number of tracks is defined. Here the signal converter can be set to a 1-4 track system. If the signal converter is connected to a sensor with a SENSORPROM® memory unit the data in the PIPE GEOMETRY menu are read-only. If the signal converter is used with a sensor without a SENSORPROM® memory unit, e.g. with a type SONO 3110 mounting kit the pipe data must be entered here. The standard configuration of a SONO 3000 is a two-track system. It can easily be used as one-track system or in special cases as a three or four track system.

Using the SONO 3000 as a three or four track system is beyond the scope of this manual. Please contact Siemens Flow Instruments for further information.

There is a connection between the number of tracks and which tracks may be set. If installed as a one-track meter, the meter uses only the values set in track 1. Furthermore, it has only electrical connections to transducers C and D. If the meter is installed as a two track meter, one of the tracks can be switched off by moving to the required track and changing the setting to "OFF".

Length

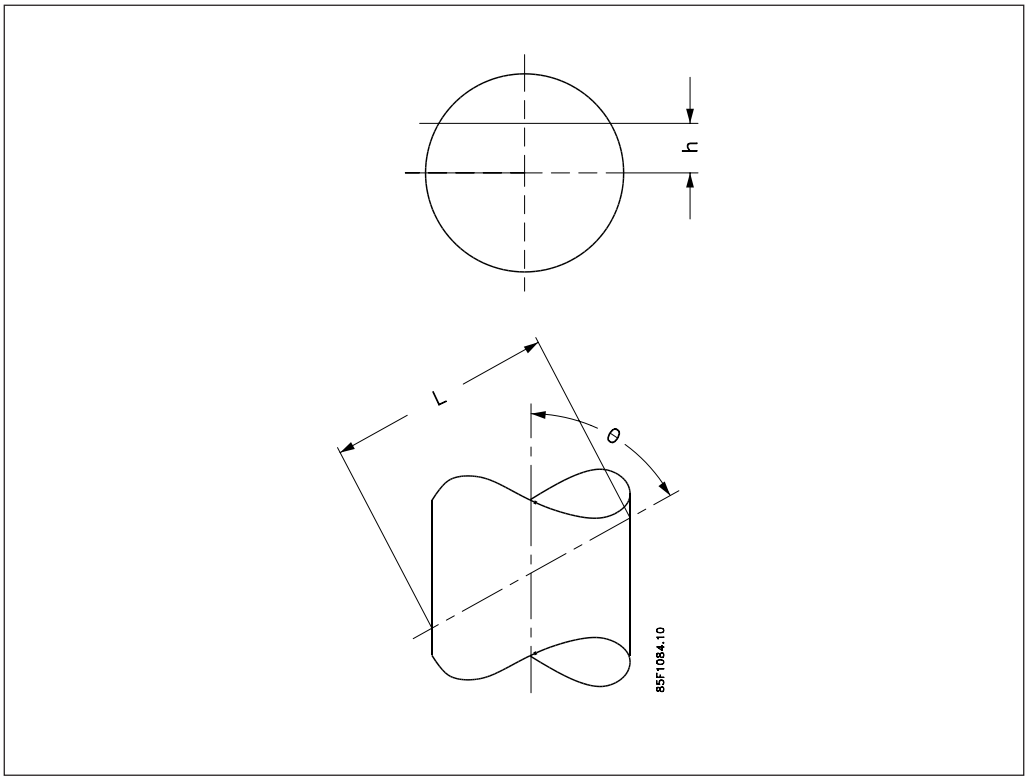
The track length (L) is the distance between the two transducer windows in the same track.

Angle

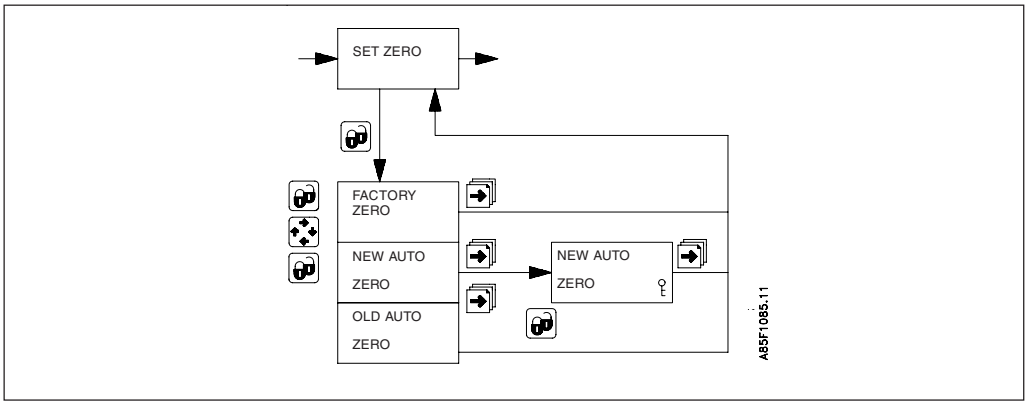
The angle (θ) is the track angle, i.e. the angle between the track and centerline of the pipe. Type SONOKIT will have a default angle close to 60°.

Displacement

The track displacement (h) is the distance between the track and the centre plane of the pipe. In case of a one track system where the track is placed in the centre plane of the pipe the displacement is 0. In a normal two track system where the two tracks are placed symmetrically in the pipe the displacement is equal to half the track distance.



ZERO ADJUSTMENT



The factory setting is applicable in most cases, but if the user requires a very high accuracy at low flow, an application-dependent zero adjustment, NEW AUTO ZERO, is recommended.

Zero adjustment is initiated when the LOCK key is pressed. The zero adjustment will take approx. 60 seconds. During the process the text BUSY and a countdown from 300 is displayed. When the process is finished the value 0.0000 is displayed.

If the meter detects flow in the pipe during the zero adjustment process, the zero adjustment process is interrupted and an error message displayed.

The signal converter stores the result of the previous zero adjustment in the register with the extension "OLD".

Factory settings

On start-up the meter uses the factory default setting in the SENSORPROM® memory unit. The following tables state the factory-set values. The range for each setting is given.

If a setting's range is exceeded, the cursor moves to the first character in the display and flashes to indicate that the setting is invalid. The selected setting cannot be locked with the LOCK key until a valid figure is selected. If the menu is left with cursor flashing, the original value is maintained.

Since a number of factory-set values, e.g. max. volume flow, max. mass flow etc., are dimension-dependent, these are given separately in the table "Dimension-dependent settings".

Table 1

	Factory settings	Settings available
BASIC SETTINGS		
Flow direction definition	Pos	Pos, Neg
Volume flow unit	m^3/h	
Volume flow max.	1300	
Sound velocity, min.	1400	400 - 2000
Sound velocity, max.	1600	400 - 2000
Mass flow	Off	Scaled, O_2, N_2, Ar, Off
Density unit	kg/m^3	g/cm^3, kg/m^3, ton/m^3, lb/ft^3
Sound Velocity 1	1447	400 - 2000
Density 1	997.7	
Sound Velocity 2	1542	400 - 2000
Density 2	998.0	
Mass flow unit	ton/h	xx
Mass flow max.	1300	
Totalizer 1	Off	Volume flow, Mass flow, Off
Totalizer 1 direction	Pos	Pos, Neg, Bidirectional
Totalizer 1 unit	m^3	
Totalizer 2	Off	Volume flow, Mass flow, Off
Totalizer 2 direction	Pos	Pos, Neg, Bidirectional
Totalizer 2 unit	m^3	
Low flow cut-off	1.5%	0 - 9.9%
Force control	Off	Off, Max., Min.
OUTPUT SETUP		
Current 1	Off	Volume flow, Mass flow, Sound Velocity, Off
Current 1 direction	Unidirectional	Unidirectional, Bidirectional
Current 1 range	4 - 20 mA	0 - 20 mA, 4 - 20 mA
Current 1 Time constant	5 s	0.8 - 30 s
Current 2	Off	Volume flow, Mass flow, Sound Velocity, Off
Current 2 direction	Unidirectional	Unidirectional, Bidirectional
Current 2 range	4 - 20 mA	0 - 20 mA, 4 - 20 mA
Current 2 Time constant	5 s	0.8 - 30 s
Current 3	Off	Volume flow, Mass flow, Sound Velocity, Off
Current 3 direction	Unidirectional	Unidirectional, Bidirectional
Current 3 range	4 - 20 mA	0 - 20 mA, 4 - 20 mA
Current 3 Time constant	5 s	0.8 - 30 s
Frq.1/Pulse 1	Off	Volume flow, Mass flow, Sound Velocity, Off
Frq. 1/Pulse 1 direction	Unidirectional	Unidirectional, Bidirectional
Frq. 1/Pulse 1	Pulse	Frequency, Pulse
Pulse 1 unit	m^3	L, L × 10, L × 100, m^3, m^3 × 10, m^3 × 100, UG × 0.1, UG, UG × 10, UG × 100, MUG, kg, kg × 10, kg × 100, ton, lb, lb × 10, lb × 100
Pulse 1 Volume/pulse	1	
Pulse 1 Width	50 ms	50 µs, 500 µs, 50 ms E. Mech., 500 ms, 1 s, 5 s
Frq. 1 frequency	10 kHz	500 Hz, 1 kHz, 5 kHz, 10 kHz
Frq. 1 time constant	5 s	0.8 - 30 s

Table 1 (cont.)

	Factory settings	Settings available
Frq. 2/Pulse 2	Off	Volume flow, Mass flow, Sound Velocity, Off
Frq. 2/Pulse 2 direction	Unidirectional	Unidirectional, Bidirectional
Frq. 2/Pulse 2	Pulse	Frequency, Pulse
Pulse 2 unit	m^3	L, L × 10, L × 100, m^3, m^3 × 10, m^3 × 100, UG × 0.1, UG, UG × 10, UG × 100, MUG, kg, kg × 10, kg × 100, ton, lb, lb × 10, lb × 100
Pulse 2 Volume/pulse	1	
Pulse 2 Width	50 ms	50 µs, 500 µs, 50 ms E. Mech., 500 ms, 1 s, 5 s
Frq. 2 frequency	10 kHz	500 Hz, 1 kHz, 5 kHz, 10 kHz
Frq. 2 time constant	5 s	0.8 - 30 s
Relay 1	Error	Direction, Sound limit, Error, Off
Relay 2	Off	Direction, Sound limit, Off
SENSOR CHARACTERISTICS	Factory settings without SENSORPROM® memory unit	
Calibration choice	Wet	Wet, Auto
Calibration constant	0.392	
Correction factor	1	0.8000 - 1.2000
Cable length	1	
Viscosity unit	mm^2/s	mm^2/s, cSt.
Viscosity	1	
Pipe diameter	0.398	
Pipe geometry unit	m	m, inch
Pipe surface roughness	0.0004	0.0000 - 0.0100
No. of tracks	2	1, 2, 4
Track 1 track	On	On, Off
Track 1 track length	0.46	
Track 1 track angle	60	
Track 1 displacement	0.179	
Track 2 track	On	On, Off
Track 2 track length	0.46	
Track 2 track angle	60	
Track 2 displacement	0.179	
Track 3 track	Off	On. Off
Track 3 track length	0.46	
Track 3 track angle	60	
Track 3 displacement	0.179	
Track 4 track	Off	Off, On
Track 4 track length	0.46	
Track 4 track angle	60	
Track 4 displacement	0.179	
RESET MODE		
Zero adjustment	Factory settings	Factory, new auto, old auto
OPERATOR MENU SETUP	Volume flow Error pending	(Cannot be deselected) Volume flow Volume flow % Mass flow Mass flow % Density Sound Velocity Totalizer 1 Totalizer 1, reset Totalizer 2 Totalizer 2, reset Volume flow, max. Mass flow, max. Sound Velocity, min. Sound Velocity, max. Sensor type Nominal diameter Signal converter type Error log Error pending

Dimension-dependent settings

Table 2

DN		Volume flow							Mass flow						
		Qmax				Volume/ Pulse	Pulse unit	Totalizer unit	Mmax				Mass/ Pulse	Pulse unit	Totalizer unit
[mm]	["]	Factory setting 3 m/s	Min. 0.5 m/s	Max. 10 m/s	Unit				Factory setting 998 kg/m³	Min. 500 kg/m³	Max. 2000 kg/m³	Unit			
10		1.600	140	6.000	l/h	1	l	l∗10	1.600	70	13.000	kg/h	1	kg	kg∗10
15	1/2	2.600	220	10.000	l/h	1	l	l∗10	2.600	110	22.000	kg/h	1	kg	kg∗10
20		4.400	360	16.000	l/h	10	l	l∗10	4.400	180	34.000	kg/h	10	kg	kg∗10
25	1	7.000	600	26.000	l/h	10	l	l∗10	7.000	300	60.000	kg/h	10	kg	kg∗10
32		12	1	46	m³/h	10	l	l∗100	12.000	500	95.000	kg/h	10	kg	kg∗100
40	1 1/2	16	1	60	m³/h	100	l	l∗100	16.000	700	130.000	kg/h	100	kg	kg∗100
50	2	26	2	100	m³/h	100	l	l∗100	26	1.10	220	ton/h	100	kg	kg∗100
65	2 1/2	42	4	160	m³/h	100	l	l∗100	42	1.80	340	ton/h	100	kg	kg∗100
80	3	60	5	220	m³/h	100	l	m³	60	2.60	480	ton/h	100	kg	ton
100	4	100	9	380	m³/h	100	l	m³	100	4.20	800	ton/h	100	kg	ton
125	5	150	13	550	m³/h	100	l	m³	150	6.50	1.200	ton/h	1	t	ton
150	6	220	18	850	m³/h	1	m³	m³	220	9.00	1.800	ton/h	1	t	ton
200	8	380	32	1.400	m³/h	1	m³	m³	380	16	3.000	ton/h	1	t	ton
250	10	600	48	2.200	m³/h	1	m³	m³	600	24	4.800	ton/h	1	t	ton
300	12	850	70	3.200	m³/h	1	m³	m³	850	34	7.000	ton/h	1	t	ton
350	14	1.000	85	3.800	m³/h	1	m³	m³	1.000	42	8.000	ton/h	1	t	ton
400	16	1.300	110	5.000	m³/h	1	m³	m³	1.300	55	11.000	ton/h	1	t	ton
500	20	2.200	180	8.000	m³/h	1	m³	m³	2.200	90	17.000	ton/h	1	t	ton
600	24	3.200	260	12.000	m³/h	1	m³	m³	3.200	130	26.000	ton/h	10	t	ton
700	28	4.200	360	16.000	m³/h	10	m³	m³	4.200	180	34.000	ton/h	10	t	ton
800	32	5.500	460	20.000	m³/h	10	m³	m³	5.500	240	44.000	ton/h	10	t	ton
900	36	7.500	600	28.000	m³/h	10	m³	m³	7.500	300	60.000	ton/h	10	t	ton
1000	40	9.000	750	34.000	m³/h	10	m³	m³∗10	9.000	380	70.000	ton/h	10	t	ton
1200	48	220	17	800	m³/min	10	m³	m³∗10	220	9	1.700	ton/min	10	t	ton
4000	160	2.400	190	9.000	m³/min	100	m³	m³∗100	2.400	95	19.000	ton/min	100	t	ton

Commissioning with the SENSORPROM® memory unit

1. Switch on the signal converter SONO 3000. The meter will automatically run through a self-test routine. During the self-test the display will show the texts ROM TEST, RAM TEST and INITIALIZING. The self-test is completed when the display starts showing the volume flow rate.

2. If the error symbol is displayed, see "Trouble shooting".

3. Zero adjustment is only necessary if the user requires a very high accuracy at low flows.

4. Refer to CONVERTER SETUP MODE, OUTPUT SETUP to set the required output signals.

Commissioning without SENSORPROM® memory unit

1. Switch on the signal converter SONO 3000. The meter will automatically run through a self-test routine. During the self-test the display will show the texts ROM TEST, RAM TEST and INITIALIZING. The self-test is completed when the display shows the volume flow rate.

2. When the signal converter detects no SENSORPROM® memory unit, the sensor is automatically configured st at DN 400 mm . Error 42 is shown for a short while. The signal converter will display the corresponding flow rate.

3. For correct flow measurement the following parameters must be set:

CONVERTER SETUP MODE:
BASIC SETTINGS:
The dimension-dependent settings are listed in table 2.
OUTPUT SETUP:
Set the required output signals.

SENSOR CHARACTERISTICS:

CALIBRATION CHOICE
Options: WET, AUTO

Wet calibration

If WET:
CALIBRATION FACTOR
APPLICATION PARAMETERS
Cable length
PIPE GEOMETRY
PIPE DIAMETER
NO. OF TRACKS
TRACK LENGTH

Automatic calibration

If AUTO:
All PIPE GEOMETRY data and APPLICATION PARAMETERS are required:
UNIT
PIPE DIAMETER (inner)
ROUGHNESS (steel pipes 0.0004 m typically)
NO. OF TRACKS
TRACK ON/OFF
TRACK LENGTH
TRACK ANGLE
TRACK DISPLACEMENT
VISCOSITY UNIT
VISCOSITY

4. To set required measuring ranges, see BASIC SETTINGS.

5. If an error symbol is displayed, see "Trouble shooting".

6. To set the required output signals, see CONVERTER SETUP and OUTPUT SETUP.

The procedure described above is only required when setting up the signal converter for the first time.
The signal converter will retain the settings even in case of a power failure.

ERROR handling

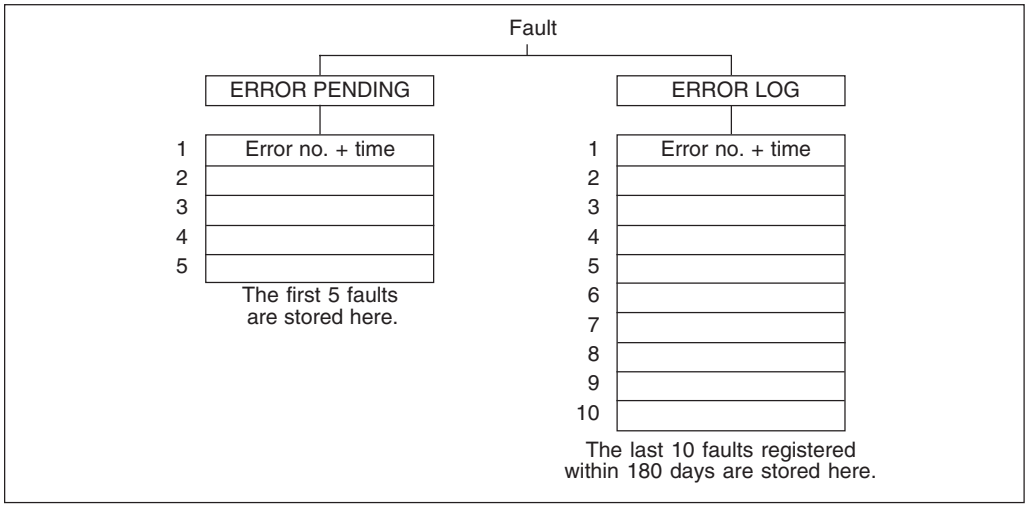
The signal converter is self-monitoring and registers the following faults:

1. Ultrasonic signal errors and application errors.
2. Cable faults in sensor cable and current output loop.
3. Operation and setting errors.
4. Internal faults in the signal converter.

These faults and errors are displayed immediately in the form of two flashing triangles .

The individual faults are stored in two registers. Current faults are stored in ERROR PENDING, and current and past faults are stored in ERROR LOG.

The faults are stored in the form of an error code, with indication of elapsed time since error registration. Power off erases the content of the ERROR LOG.



In SONO 3000, errors can also be indicated by the relay, but only when the relay is set at ERROR in the menu OUTPUT SETUP.

When the converter is being set (user code keyed in), error indication via relay is automatically blocked.

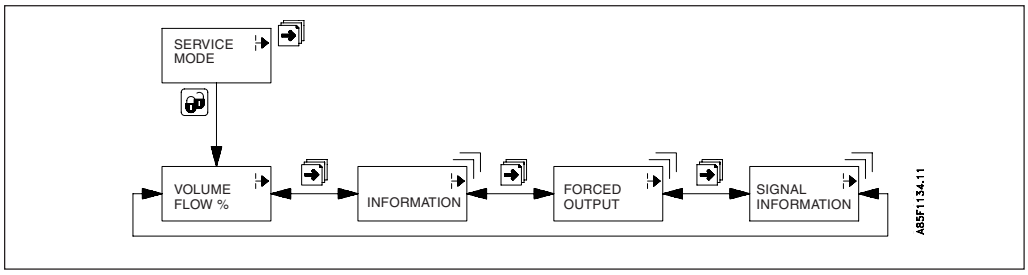
Troubleshooting

Symptom	Error code	Error relay	Cause	Remedy
Empty display	None	ON	1. Supply voltage 2. SONO 3000 defective	1. Check supply voltage and voltage selector 2. Replace SONO 3000
No flow signal		OFF	1. Current output deselected 2. Frequency/pulse output deselected	1. OUTPUT SETUP in the menu 2. OUTPUT SETUP in the menu
	None	OFF	Reverse flow direction	Select direction definition (BASIC SETTINGS)
	1 [1] 2 3 4	ON	The converter rejects the received signals	
	5 [1] [5] 6 7 8		Max. amplification exceeded (> 60 db)	
	9 [1] 10 11 12	ON	1. Sensor cable not connected 2. Mismatch of tranducer and liquid	1. Check cable connections 2. Check transducers manually by means of an oscilloscope. Please contact Siemens Flow Instruments
	13 [1] 14 15 16	ON	1. This error code and a high gain (> 60 dB) indicates a too weak received signal. (Alarm if signal level gets below 500 mV). See SERVICE MENU 2. Unstable flow signal caused by gas bubbles in the liquid.	
	17 18 19 20 51 110 111 121 125 126 68 69 70 84 85	ON	Internal error Function and communication check	Switch off the power supply shortly to reset the signal converter. If the fault is consistent, replace the converter
	21	OFF	Error during zero adjustment. The meter detects flow in the pipe.	Ensure zero flow condition in the pipe
	22	ON	Actual sound velocity outside the measuring range.	Check the setting of track length and min. and max. sound velocity
	23 24 33 34		Hardware fault	SONO 3000 defective Replace the signal converter
	25	ON	1. Defective power supply 2. Supply voltage too low	1. Replace SONO 3000 2. Check supply voltage
No flow signal	26	Force output as defined in FORCED CONTROL	Fatal measuring error	Usually appearing with other codes. Remove the cause of error until the code disappears.
	27		Error due to volume flow exceeding $Q_{max.}$	Increase $Q_{max.}$ in the menu.
	30 31	ON	SENSORPROM® unit defective	Remove the SENSORPROM® unit. Enter settings manually.
	40		Wrong sensor version	
	41	ON	Error in data exchange with SENSORPROM® unit	Restart the converter
	42 [4]	OFF	No SENSORPROM® unit	
	50	ON	Value of internal totalizer not valid (Check sum error)	
	60 [2] 61 62	ON	1. No load or load exceeds specifications of the current output 2. SONO 3000 defective	1. Check cables and connections 2. Replace the signal converter
	64 [2] 65 66	ON	Current output exceeds 24 mA	Check max. settings in BASIC SETTINGS
	80 [2] 81	ON	Frequency output exceeds 12500 Hz	Check max. settings in BASIC SETTINGS
	82 [3] 83	ON	Pulse width on frequency output exceeds 50% of duty cycle	Select a shorter pulse width
	100 [4]	OFF	"Power on" indication. This is not an error.	

[1] Lowest number: track 1
[2] Lowest number: current output no. 1
[3] Lowest number: frequency/pulse output no. 1
[4] No error
[5] Lowest number: transducer A

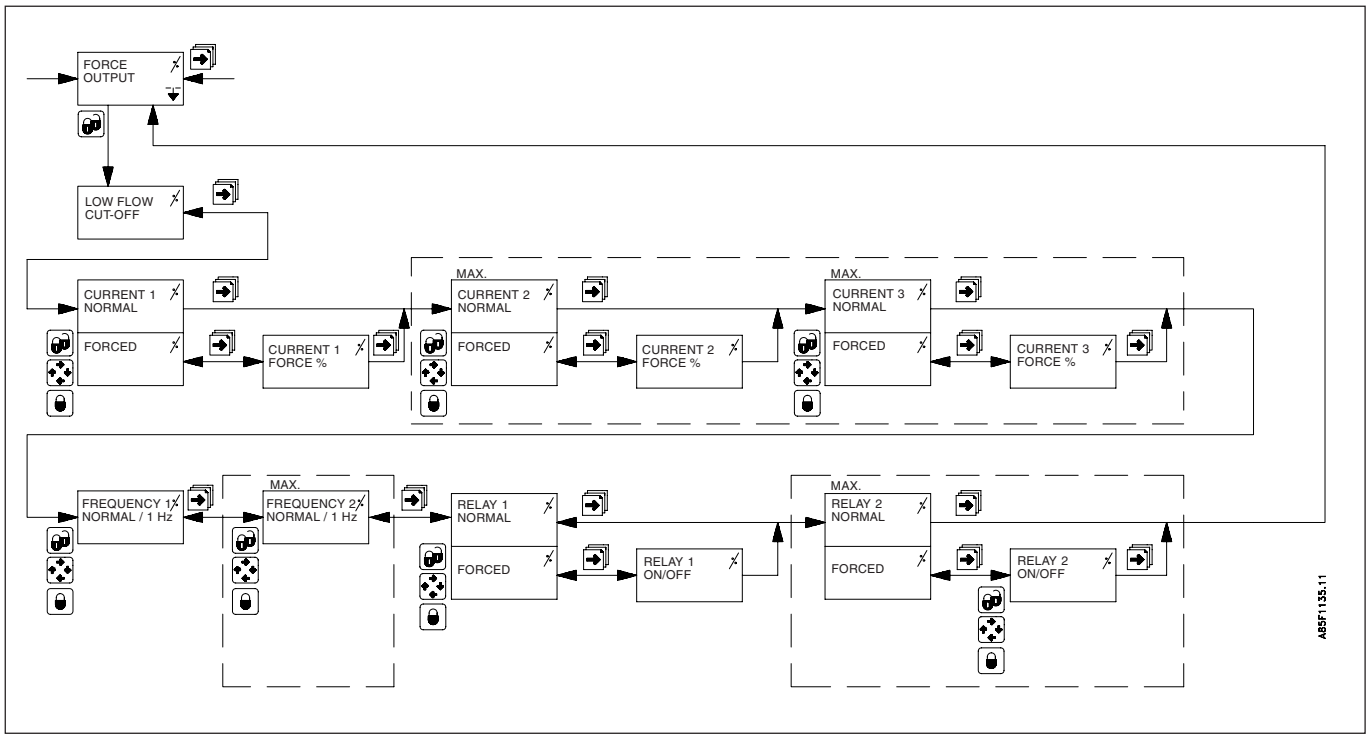
SERVICE MENU

The SERVICE MENU contains three submenues: INFORMATION, FORCE OUTPUT and SIGNAL INFORMATION. INFORMATION contains all identification data of the signal converter and sensor. Note that the meter continues to measure and update the outputs(s) while in the SERVICE MENU. The only exception is when an output is set in the FORCE OUTPUT MENU.



FORCE OUTPUT

In FORCE OUTPUT it is possible to set all outputs to fixed values. The current output can be set to between 0/4-20 mA, the frequency/pulse output can be set to 1 Hz and the relay output can be switched on or off.



SIGNAL INFORMATION

In the SIGNAL INFORMATION menu it is possible to read information regarding the ultrasonic signals, the flow signals and the transducers.

TIME/FLOW

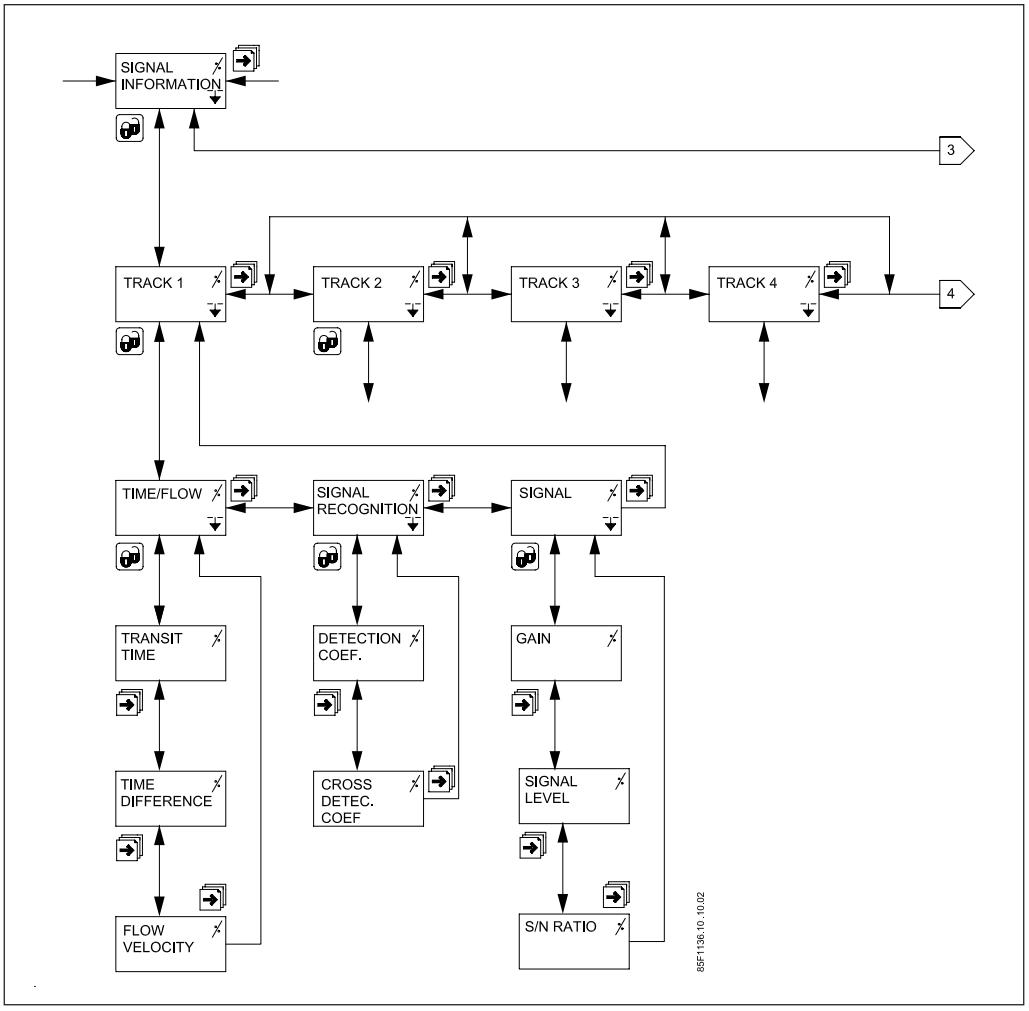
In the TIME/FLOW menu it is possible to read the average transmission time, i.e. the time it takes for the sound to pass between the two transducers at zero flow in the pipe, the time differential and the average flow rate in the track.

SIGNAL RECOGNITION

In the SIGNAL RECOGNITION menu it is possible to read the correlation coefficient of both the transmission time and the difference time. The correlation coefficient is a number between 0 and ±1. A number close to 1 denotes a good correlation between the two signals. The DETECTION COEFFICIENT states the quality of the transmission time analysis. The CROSS DETECTION COEFFICIENT states the quality of the time difference analysis.

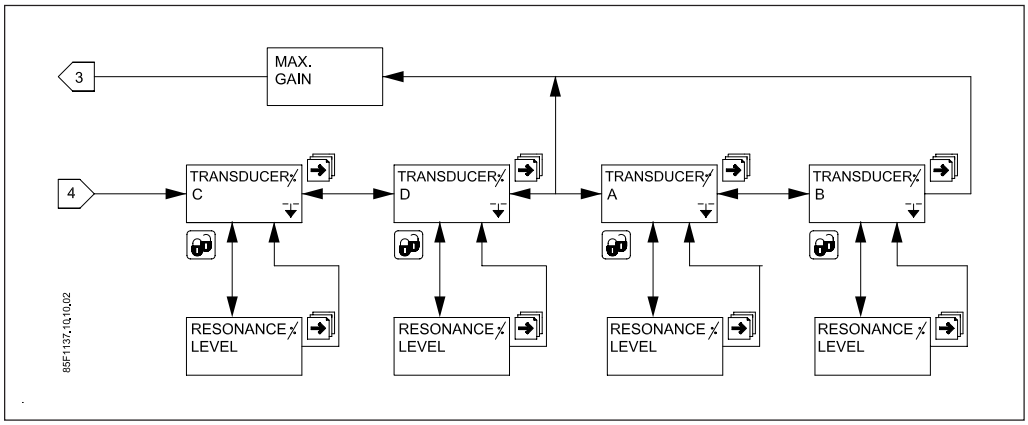
SIGNAL

In the SIGNAL menu, information relating to amplification of the signal, signal amplitude and signal to noise ratio is given as GAIN, SIGNAL LEVEL and S/N RATIO. GAIN can be between 1 and 60, depending on sensor type and size. The typical value for water is between 5 and 30. The SIGNAL LEVEL is between 375 and 800 mV. A value less than 700 mV indicates variation of the signal amplitude caused by variation in the attenuation due to e.g. air bubbles. The S/N RATIO is a number between 1 and 40. The typical value for water is between 20 and 35.



TRANSDUCER

The quality of the transducer and liquid oscillation is indicated by the RESONANCE LEVEL. A number higher than 100 indicates satisfactory operation. A value below 100 indicates mismatch between transducer and liquid. A value below 20 activates an alarm. If the RESONANCE LEVEL is below 20 and the meter is not measuring (error code 5, 6 and 26), check connection cables and check transducers manually. Please contact Siemens Flow Instruments.



We have checked the contents of this manual for agreement with the hardware and software described. Since deviations cannot be precluded entirely, we cannot guarantee full agreement. However, the data in this manual are reviewed regularly and any necessary corrections included in subsequent editions. Suggestions for improvement are always welcomed.

Technical data subject to change without prior notice.

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