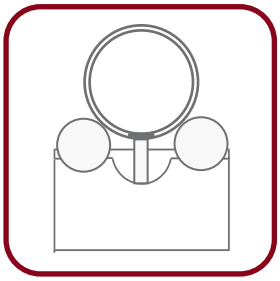
Weld Seam Detection System R4000 SND40

Weld Seam Detector SND40
for Tubes, Cans and Drums



- For positioning applications
- Material diameters from 5 to 500 mm
- Magnetic Leak Flux and Eddy Current measuring principles
- Drive monitoring and control of detection reliability
- Industrial standard interfaces for automation
- Graphical user interface with 10 inch touchscreen
- Data backup via USB or Ethernet

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Declaration of conformity according to EC directives

Manufacturer:	Roland Electronic GmbH Otto-Maurer-Str. 17 75210 Keltern / Germany
Product name:	**SND40**
Product type:	**Weld Seam Detection System R4000**

Roland Electronic GmbH declares that the product listed above complies with the requirements of the directives listed below.

Applied Directives:

2014/35/EU	Low Voltage Directive EN 61010-1:2010	
2014/30/EU:	EMC Directive EN 61000-6-2:2005/AC:2005	EN 61000-6-4:2007/A1-2011

Date of mark's apposition: **10.05.2016**

Keltern, **10.05.2016**		Managing Director
Place, Date	*Signature*	*Function of the signer*

The declaration confirms the compliance with the cited directives. However, it is not any implied warranty of fitness for a particular purpose especially as it may relate to product liability.

The safety instructions and warnings must be observed.

ISO 9001 : 2008
Reg.-no. 5152 QM08

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1 Safety advice

1.1 Safety instructions and warnings for user

This manual contains all information required for the correct operation of the Roland Electronic equipment. It has been written for technically qualified personnel.

Unauthorized tampering with the unit, especially ignoring the warnings in this handbook, can cause malfunction and damage to the unit. Only authorized personnel should be allowed to make changes to the unit and perform cable connections especially the power supply.

Should it be necessary, e.g. in case of service or repair, to make measurements within the unit, then all customary accidents prevention procedures should be observed. Only professional electrical tools should be used.

Note The factory pre-settings – especially the upper / lower limit values – have been chosen such that an optimal machine protection is ensured.

Diverging settings can impair the machine protection.

Safety advice for persons with cardiac pacemakers!

Persons with cardiac pacemakers are to stay away from the sensors!

The strong magnetic / electromagnetic fields of the sensors can cause malfunction of cardiac pacemakers and other such apparatus!

1.2 Declaration of icons

Warning - general dangers!

Reference to imminent hazards, which can result in severe bodily harm or death.

Warning - dangers by high voltage!

Reference to imminent hazards due to electricity, which can result in severe bodily harm or death.

Attention - Damage of construction units!

Reference to a potential imminent situation, which can result in damage to the product or environs.

Note

Useful reference to an application or deepening information.

1.3 Fieldbus terminology

Within this manual the following Fieldbus specific expressions are used:

Term used in the manual	Fieldbus specific expression
Master	Scanner
Slave	Node
Baud rate	Data rate
Bus address	Mac ID / node address

2 System description

2.1 Introduction

Prior to automatic forming or processing of longitudinally welded tubes the long seam detection and positioning to a predetermined position is a preventive measure the motive being a fault free product.

The SND40 is specially designed for this task, and provides:

- High flexibility with regard to material, tube processing condition and machine integration
- Self-monitoring of weld seam detection with superior evaluation methods
- Monitoring of the sensor and of the tubular drive
- Easy positioning with adjustable set angle
- Convenient operation and control interfaces

The highest flexibility of SND40 is achieved using magnetic flux leakage and eddy current methods. In addition, special signal filters and a wide range of sensor models have been developed which lead even in challenging cases to success.

Prior to the implementation of a station for weld seam detection the following steps are required, with which Roland Electronic can provide assistance:

- Feasibility studies on representative samples in the Roland laboratory
- Review of the requirements of cycle time, positioning accuracy and process reliability
- Conception of the weld seam detection station

Once a station is built, Roland Electronic can offer support during commissioning of the SND40. In addition, services for setting up new types of tubes, maintenance inspections, sample tests and training courses for operators, maintenance personnel and plant engineers are offered.

The Weld Seam Detection System SND40 typically consists of:

- the control unit
- a weld seam detection sensor
- the sensor cables
- if required a separate power supply

Fig. 1: Weld Seam Detection System SND40

The control unit and the weld seam sensors are available in different versions. Which version fits the particular weld seam detection is determined in advance by the feasibility study in the laboratory. Only the decision whether I/O or fieldbus interface implemented needs to be taken by the customer.

Note:
Specify the number of the application report when ordering the system and the required settings will be made before shipping. For each required type of tube, i.e. any wall thickness, diameter and type of material a separate data record will be available.

2.2 Station for Weld Seam Detection

For a weld seam detection station following components which are not supplied by Roland Electronic are required in addition to the SND40:

- a loading system to provides tubes from a magazine into a rotating device
- a rotating device, which is able to receive and rotate the tube
- an adjusting device, to turn on and off the weld seam sensor on the tube
- a clamping device which holds the tube, after the positioning process has been completed and before the sensor is retracted
- a sorting device to remove any tubes which are classified as weld seam detection inadequate by the SND40
- an unloading device which takes over the oriented tube from the clamping device and transports without changing the Azimuth (angular position)
- a control system for operation of the components and the linking with the production line

It is useful to obtain the appropriate equipment by an experienced manufacturer of special machines.

2.2.1 Operational sequence of a Weld Seam Detection

Here is a proven 8 step sequence which provides an initial over of the required functions:

1. the system places the tube into the rotational drive.
2. the tube is fixed in the rotating drive for example in a chuck or with cones.
3. the rotation device places the sensor on the tube so that the rollers are in contact.
4. the SND40 is started via the PLC (signal “measurement start”).
   By this, the SND40 activates the drive (signal "motor") and the magnetization.
5. after the settling time has expired, the rated speed is achieved and the magnetic field is in full strength. Internally the recording of the measurements which can be set via the SND40, begins (a measuring cycle lasts at least 3 tube rotations). Is the weld seam detected, the positioning phase begins, which lasts approx. one tube rotation.
6. the positioning phase is completed, if the drive of the SND40 is switched off and has come to standstill. The unloading system now fixes the tube or the container in this position.
7. the sensor is withdrawn and the tube or container is now ready for unloading.
8. if the weld seam cannot be detected, the SND40 stops the drive and releases the signal "reduced detection". Since the tube is not reliably positioned, it must be sorted out by the unloading system.

Important:
When the weld seam of a tube is not recognized immediately, the sorting out might be eventually prevented as it cannot be passed on to the next process. See chapter 2.7 „Measures to improve the Weld Seam Detection“

2.3 Important information for planning and operation

2.3.1 Send tubes before planning

Before conception of weld seam detection send the tubes to the Roland Electronic application laboratory. The purpose is to review the general feasibility.

For each dimension, and each tube type, 3 to 10 examples should be provided, ideally from different production batches.

Important:
Send 3 to 10 test tubes of each dimension and type to our laboratory.

Note:
Sample tubes should have a length greater 150 mm but not exceed 1500 mm. For other lengths please contact the Roland laboratory.

Provide additional necessary information about:

- welding processes, materials and post weld treatment
- maximum cycle time or number of pieces per minute
- positioning accuracy – Set value
- reliability of detection – Set value

- Roland Electronic provides a Questionnaire to enter all available data.

2.3.2 Send tubes during operation

Reason:

- new tube dimension or tube type to be introduced
- changing of the supplier
- the tube specification is changed, concerning welding methods, materials and post weld treatment

- a type of tube shows strong batch dependence and the results are not satisfactory.

Note:
Please inform about the installed type of sensor and unit. The laboratory analysis will be performed with the same equipment.

2.3.3 Tube diameter and wall thickness

For tube diameter and wall thicknesses to be processed, the correct sensor type is determined in the laboratory. Some information for guidance see chapter "Technical Data - Sensors".

2.3.4 Cycle time and Duration of weld seam detection

Die cycle time is the sum of all times in the course of a weld seam detection. See the chapter „Sequence of a Weld Seam Detection“- Steps 1 to 8.

Note:
Typically, the cycle time is initially calculated based on the number of units per minute. If the cycle time is very short, it remains limited time for the individual steps.

The detection time T_D includes the steps 4 to 6 from „ Sequence of a Weld Seam Detection “. The influences are:

- tube diameter
- rotation speed
- wall thickness / settling time
- measuring methods

The following diagram shows the duration of weld seam detection in dependence of the tube diameter and rotation speed. The settling time T_S of 1.5 seconds is considered here.

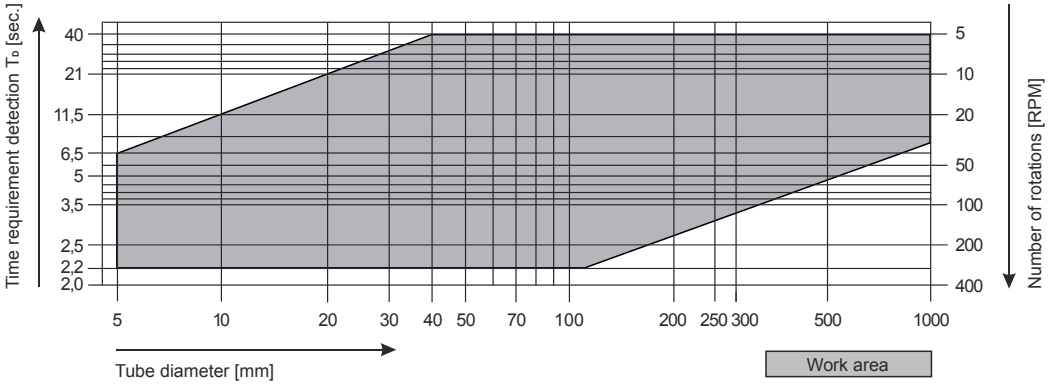

Fig. 2: Duration of weld seam detection in dependency of tube diameter and rotation speed

Note:
Not valid for the type of filter "cross correlation".

To calculate the detection time T_D for another settling time T_S use following formulas:
For drives with clamping chucks or cone points:

$T_D = T_S + \frac{200}{N}$	T_S = Settling time of system
	N = Number of rotations of the tube [rpm] *
	T_D = Detection time [s]

*Conversion of the rotation rate from rpm to rps is not required.

For drives:

$T_D = T_S + \frac{D \cdot 10{,}5}{V}$	T_S = Settling time of system
	T_D = Detection time [s]
	D = Tube Diameter [mm]
	V = Speed [mm/s]

However, the settling time cannot be set arbitrarily small. Following information for orientation:
NS12 sensors: T_S > 0.5 s per 1 mm wall thickness
NS9 sensors: Ts > 0.7s per 1 mm wall thickness

2.3.5 Rotary speed of the tube

The rate of tube turns is mostly determined by the cycle time. See previous chapter „Cycle time and duration of weld seam detection“.

However, it may happen that a very short cycle time requires a very high tube rotation speed N. This can lead to system-related limitations. To check use the formula below:

$\frac{750}{A \cdot D} < N < \frac{K}{A \cdot D}$	**N = Rate of tube turns [rpm]**
	D = Tube Diameter [mm]
	A = Scanning values per cm (item in program parameter 5… 120)
however > 5 rpm and < 300 rpm	**K = 1.000.000**

There are no restrictions if the rate of tube turns N is within the limits.

Important:
During the detecting procedure the rotation rate of the tube must be constant.

2.3.6 Speed

At friction roller drive the speed of the surface / of the periphery is specified.

Whether system related limitations are observed can be checked using the following formula:

$10 < V < \frac{K}{A}$	**V = Speed [mm/sec.]**
	A = Scanning values per cm (item in program parameter 5… 120)
	K = 50.000

There are no restrictions if the velocity V is within the limits.

Important:
During the detecting procedure the speed must be constant.

2.3.7 Weld seam positioning and positioning accuracy

A good positioning accuracy can only be achieved if:

- the response time for the controller is short enough
- the driver rotates the tube with a constant rotation speed / surface velocity and with no slippage
- the drive stops reproducibly
- the weld seam detection is reliable
- for friction rollers the diameter tolerances should be close
- the SND40 is correctly adjusted

Accuracies better than +/- 8° require additionally:

- rotation of the tube with chuck and servo drive
- check for feasibility in the application laboratory
- an optimum setting of the SDN40

Important:
the "blue discoloration" at the seam is for checking of the position roughly suitable! Measurement errors of 10 ° or more may occur.

2.3.8 Reliability of detection

Due to steady progress in the welding technology and in the production processes of tubes, the detection of weld seams is a constantly increasing challenge. Therefore some tubes can be encountered, where the weld seams are not reliably detectable.

Reliable weld seam detection can be affected by a variety of factors, such as grooves, deviations from concentricity, material defects, or hard spots in the tube wall from roll forming.

In the most unfavourable case this can result in false weld seam positioning. Such tubes cannot be processed further and must be sorted out..

Therefore, for such tubes the SND40 supplies the signal "*reduced detection capability*" to the PLC interface. This signal instructs the PLC to initiate the removal of the tube. The decision therefore is done automatically by the SND40.

High detection reliability means:

- no incorrectly positioned tubes (ideal case), but
- depending on tube class, a relatively large number of rejected tubes.

Low detection reliability means:

- relative large number of incorrectly positioned tubes
- few or no rejected tubes

The detection reliability can be adjusted in the SND40 with the parameter "*detection grade*".

The reliability of detection increases with high dB values.

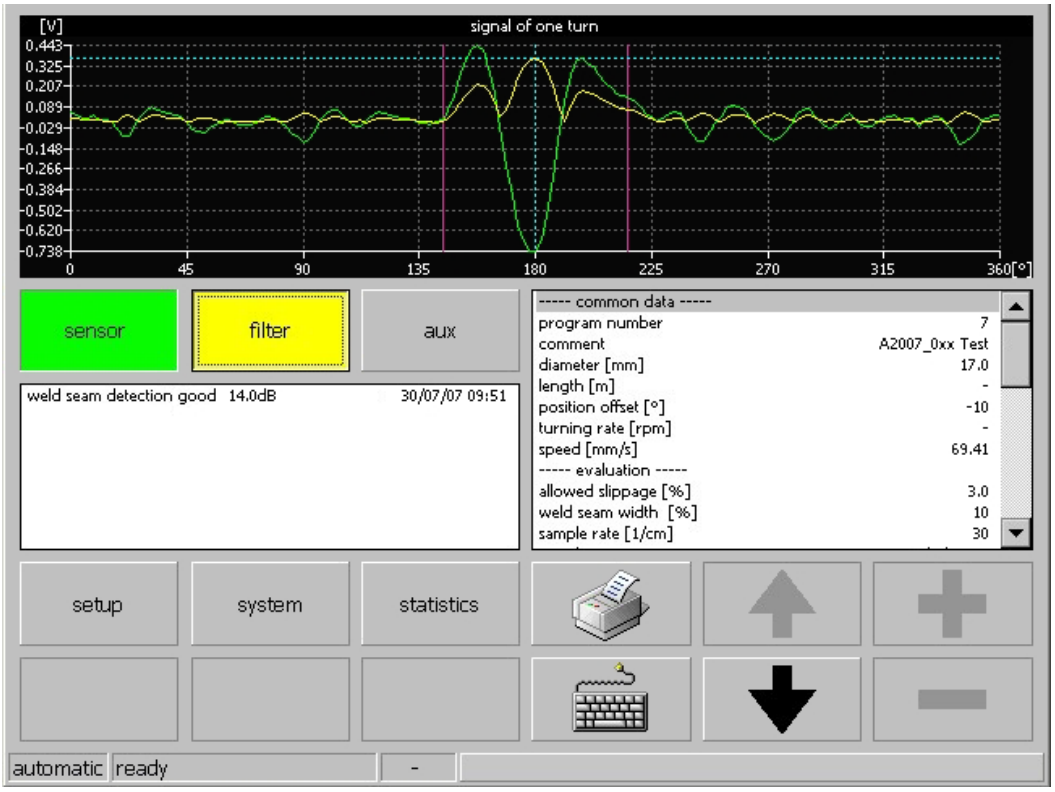

Fig. 3: High reliability at a high dB-value

Important:
The plant must sort out tubes if the dB value is too low!

The thresholds for sorting-out can be set in three / five levels (from software version 10-1.04):

Thresholds for sorting-out	Nominal value of signal/noise ratio
ultra	**larger 18 dB (factor 8:1)**
extra	**larger 12 dB (factor 4:1)**
very good	**larger 6 dB (factor 2:1)**
good	**larger 2.5dB (factor 1,33:1)**
satisfactory	**larger 1.1dB (factor 1,14:1)**

If the measured dB value falls below the value for the selected stage, the message "*critical detection*" is displayed and the signal "*reduced detection capability*" is set to sort out the tube.

Note:
Setting the sort-out threshold to the levels **extra** or **ultra** may lead to an extremely large amount of discarded tubes.

It must therefore be concluded that there are different tube classes. Tubes with clearly detectable weld seams generate high dB values; poorly detectable weld seams generate low dB values.

The following table shows how the number of **discarded tubes** and the number of **wrong positioned tubes** are influenced by the tube class and the chosen sort-out-threshold:

	Risk of critical detection[1)]		Risk of wrong positioning[2)]	
Tube class* / **Sorting-out threshold**	**Good detectable**	**Bad detectable**	**Good detectable**	**Bad detectable**
Ultra				
Good				
Satisfactory				

1) Possibility that the position of the weld seam can not be detected with sufficient certainty. With the signal "reduced detection capability" the discarding starts.

2) Possibility that a tube is stopped at wrong position.

*Tubes with a high dB-value are „good detectable“, tubes with a low dB-value are „bad detectable“.

Note Please also refer to chapter 2.7 „Measures for improvement of Weld Seam Detection“

2.4 Important notes for machine manufacturers

- The following components have decisive influence on the function of the system:
- the rotation device for the tube
- Bending mandrels within the tube
- the positioning device for the sensor
- the clamping device for the tube
- the unloader device for the tube
-

2.4.1.1 Rotation device and drive

The main requirements are:

- stable tube holder
- slip-free drive of the tube
- constant rotation speed on the tube
- low starting time of the drive
- stopping behaviour of the drive or the constant brake

A stable tube holder means a device that takes the tube reproducibility and allows a smooth multiple rotation of the tube.

Here, the weld seam sensor should not be carrying part of this device. Often, the tube drive is designed so that it forms the tube receptacle.

Available drives, possibilities and guidelines for setting the devices:

Clamping chuck	Cone drive	Friction roller drive
• ideal for all tube diameters • also for oily and greasy tubes • **mandatory** for positioning accuracy better than + / - 8 ° • access to at least one end of the tube, a further bearing for support • SND40 is set at drive type to "constant rotation speed"	• reasonably usable from tube diameter > 20 mm • access to both ends of the tube is necessary • **not** for positioning accuracy better than +/-8° • SND40 is set at drive type to "constant rotation speed"	• ends of tubes must not be accessible • tube diameter at least > 15mm • separate clamping device necessary • higher maintenance because cleaning and abrasion of the rollers • **not** suitable for oily and greasy tubes • **not** for positioning accuracy better than +/-8° • SND40 is set at drive type to "constant rotation speed"

When selecting the drive motor follow the rules below:

1. Dimension the torque so that the tube reaches quickly the nominal speed
2. Servo motor is obligatory for positioning accuracy better than + /- 8 °
3. If no servo motor, use speed-controlled motor with precise brake
4. Without speed control: dimension the motor drive larger so that dependence on the speed of the engine and transmission temperature is as low as possible
5. Without any speed or brake control, the positioning error can reach + /- 20 °

▶ **Note:**
The stopping behaviour of the drive or the brake is adjusted with the parameter "Position offset" at the SND40 so that the desired angular position can be achieved. This assumes that the stopping behaviour is always constant because the SND40 has no angle or rotary encoder information.

For drive units without brakes the temperature response of the machine can dramatically affect stopping behaviour because changing of the transmission oil viscosity or lubrication of rolling bearings.

! **Important:**
Keep the rotation speed / speed / braking behaviour constant!

2.4.2 Mandrels inside the tube

Magnetic material, such as mandrels may disturb the measurement inside the tube sustainable so that regular weld seam detection is not possible. In special cases, the usage of a mandrel is possible. However, this is to clarify in the conception of a station for weld seam detection with the application laboratory.

2.4.3 Placement device for the sensor

The decision at which position the sensor should measure along the axis of the weld is very important. Especially for tubes with a length > 50 cm the twist of the weld can affect the weld positioning (weld start and weld end have different circumferential positions). For tubes with small diameter / wall thickness a variation of up to 10° per meter can be observed. on 1m length. In such cases it is advisable to place the sensor either at the centre of the tube or at the place where the weld position is considered to be most important.

Important:
When placing the sensor take into account the twist of the weld seam!

Other requirements are:

- Stable, good reproducibility of placement
- path compensation for different tube diameters
- Soft, shock-and impact-free touchdown on tube surface
- Availability of compensation of mounting tolerances and tube geometry
- Availability of lateral displacement of the axis
- Clear view on sensor

NS9S, mounted with rubber buffers in a tube rotator

Fig. 4: NS9S Application

A stable placement device is considered to be a device which can place the sensor correctly on the tube with a high degree of reproducibility. Proven solutions are:

- a parallel guide that guides the sensor at right angles to the tube surface
- the entire device can be aligned with the tube admission, to compensate for mounting tolerances
- damping elements and air pressure adjuster when using pneumatic cylinders to enable a soft touch down and allow for sideways movement (adaption) during placement and removal of the sensor.
- the adjusting force is approximately the same as the weight of the sensor
- the sensor is mounted using the supplied rubber buffers, so compensation for deviations in the tube geometry is possible. This includes ovality and banana effect
- the rubber buffers are mounted on the two narrow sides
- the placing device is mounted on a separate axis so that it can be placed on another measuring spot providing the length of the tube allows for this

2.4.4 The clamping device for the tube

Important:
Ensure that the tube is not twisted before lifting the sensor

Possible reasons are:

- the tube is mechanically pre-tensioned
- a residual adhesive force which causes the tube to stick to the sensor when it is withdrawn

For drives with a chuck and tapered rollers a brake to stop the tube from turning while the sensor is withdrawn is normally sufficient.

When the tube is placed on friction roller drive, a separate clamping device is only preventable if the unloading device grips the tube safely before the sensor is lifted.

2.4.5 The unloading device for the tube

Special attention should be paid to the twist-safe grip and transport of the tube. Reason: The achieved positioning accuracy at the measuring point is required at the processing station. A poorly designed transporter device causes angular errors of more than 90 °.

Important:
Comply to positioning accuracy over the entire transportation

2.4.6 Notes on applying eddy current sensors

If the results of the specimen analysis stipulate the use of an Eddy current sensor rather than a magnetic flux sensor, please note the following:

- the distance of the eddy current sensor to the tube surface must be kept constant, for example by using a roller support
- the placement for a leakage flux - or combined sensor should be planned in a way to permit easy retrofitting in case of changed tube material
- if measured from the inside, no magnetic material is allowed to be present at the measuring point on the outer skin of the tube - exceptions may be clarified with the application laboratory

2.5 Important notes for software and hardware of the plant control

Note:
The use of the program interface minimizes operator errors.

The correct sequence is critical for the successful integration of weld seam detection. The following points must be considered in the conception:

- Each tube type has its own program. The corresponding data record, called program parameters is stored in SND40. To select the correct program for a specific tube type use the control interface.
- The signal on/off for the drive motor comes directly from the SND40, so long as functions with a higher priority such as emergency off or release allow.
- The signal is "recognized weld seam / motor" for the control of the motor must be processed at correct time and processed in real time by the controller. Always connect to a "Fast" input of the PLC or motor controller.
- 0 ° is the angle when the weld is directly in front of the sensor element. For other positions the parameter position offset can be adjusted in steps of 1°.
- For commissioning and service of the weld seam detection system the control system needs a separate operating mode for set up and calibration. This is to assist with optimizing of programs.
- When setting the operator should have the possibility to load a tube into the turning mechanism, to place the sensor onto the tube and be able to then delegate the control of the motor to the SND40, until the setup process is terminated by the operator or a fault is present which requires shut down.
- The interface signals of the SND40 such as "Ready" and "Error" are to be logically evaluated and indicated to the operator
- The interface signals "critical detection" or "slip" activates the sorting out of the tube
- In order to reduce the rate of sorting out, the measurement cycle can be repeated
- The repetition is done either by selecting another program or method of sensor positioning

The minimum requirements for operation of the SND40 are:

- Setup operation
- Measuring operation
- Program change
- Error handling
- Sorting out

For the best usage of the SND40 the following additions should be made:

- 2nd measurement procedure automatically
- 2nd measurement procedure with program change
- 2nd measurement procedure at alternative measuring position

2.5.1 Notes for placement of the SND40 components

The control unit SND40 is to be installed so that the control and monitoring of the unit is possible under the following conditions:

- easily accessible in accordance with ergonomic principles in all operating modes, especially in normal operation
- ideally, with a view to the sensor, so that the positioning process can be observed
- the back side of the device must be accessible to get access to connections and assemblies
- the ventilation holes must not be obstructed
  - The operation and monitoring is required:
- during commissioning, maintenance and service work
- when new types of tubes have to be set up
- at optimization work regarding reliability of detection
- for occasional assessment of the process, for example via the statistics function
- at occurring faults

Regarding the placement of the sensors to the instructions in chapter 2.4.3 "Placement device for the sensor" are to be considered. In addition, the following points are recommended:

- mounting the sensor from above
- the sensor should be accessible for maintenance
- attach a note that the sensor is working with magnetic fields

Safety advice!

Persons with pacemakers are not permitted to work on the sensor.

2.6 Details of the dB-value

For determining the signal-to-noise ratio the SND40 automatically calculates and displays the dB-value of the signal to noise ratio.

The level of the weld seam signal always serves as reference for the signal level. The value is used to control the automatic sorting out process.

Note: For the SND40 the weld seam always is at the maximum appearing in the signal of a tube turn. In the following example the weld seam level (and thus the signal level) 0.47 V.

In direct vicinity of the weld seam there might be similar strong signals – e.g. the flanks of the weld seam signal. This effect is based on the fact that the weld seam is not infinitely delicate, but has a noticeable size. This is why the signal from one complete turn of a tube is divided into two zones, the zone in immediate proximity to the weld and the rest outside of the weld zone.

For further locating the noise level the weld seam zone becomes suppressed. For doing so, a circumferential area symmetrically left and right of the weld seam is defined, which each has the width of the parameter “*weld seam width*“. The weld seam width (1…20%) can be individually set for every program.

Thus the remaining circumferential area is considered for determining the noise level.

The following example shows a signal level of 0,47V and a noise level of 0,2 V:

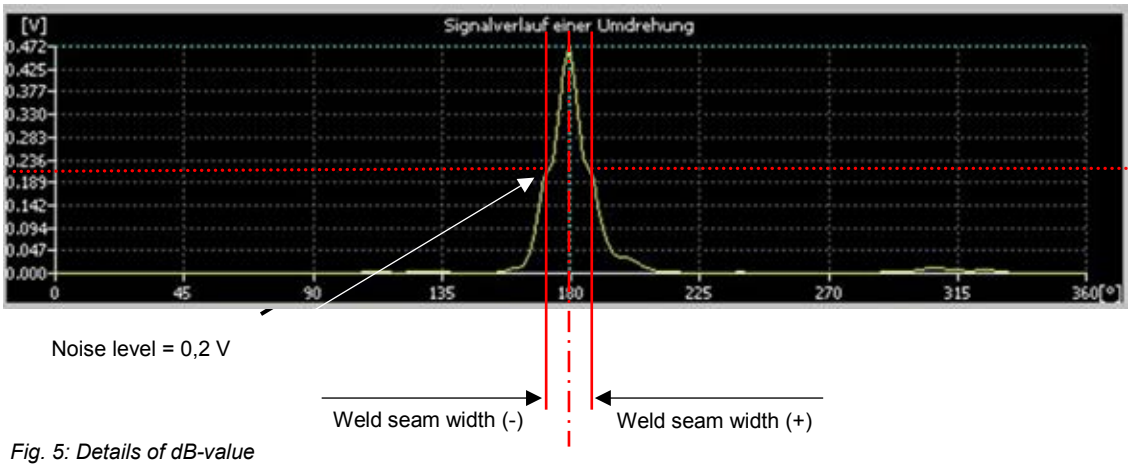

Fig. 5: Details of dB-value

Thus a signal-to-noise ratio of 2.35 (0.47 V/0.2 V) results, which equals 7.4 dB.

So the detection grade threshold for class "*good*" has been reached. This tube will not be sorted out.

2.6.1 Effect of weld seam width on detecting capability

This example makes it easy to understand what would happen if the weld seam width was reduced. With a 50% width the noise level would rise considerably, since the intersective point then rises with the signal.

Here the signal-to-noise ratio would be below 2. Thus the detection grade threshold for class *"good"* could no longer be reached – the tube would be sorted out (when class *"good"* is set).

The smaller the weld seam width is chosen, the harder it is to reach the detection grade threshold for class *"good"*.

But the setting of the weld seam width also affects the positioning accuracy.

Rule: small weld seam – high positioning accuracy.

This coheres with the fact that the likelihood of having similar peaks to those of a weld in this area decreases.

A signal peak being almost as large could very well represent the real weld seam and could thus be undetected as weld seam. But if the weld seam zone becomes decreased, the possibility increases that this signal (which is almost as large) will fall into the noise zone. If this happens, the detection grade threshold will no longer be exceeded – the tube will be sorted-out.

Thus the possibility of incorrect positioning will be reduced.

Summary: High detection reliability when:

- Detection grade threshold "***good***", "***extra***" *or* "***ultra***"
- Weld seam width "***as small as possible***"

2.7 Measures for improvement of Weld Seam Detection

2.7.1.1 Process tubes with constant quality

Tubes from different batches, production lines and suppliers may have different seam characteristics. If problems occur it is advisable to make the decision only to use tubes from one manufacturer who have a proven process stability. See table in chapter 2.7.6.

2.7.1.2 Alternate Program

If a seam cannot be detected with enough certainty, a second test with an alternate program should be possible.

2.7.1.3 Multiple locations

The seam characteristic may change with the position on the tube. An actuator can be used to move the sensor to a 2nd location and to do a second test.

2.7.1.4 Sort out

If a seam cannot be detected with enough certainty, the tube must be sorted out in order to avoid the processing of wrongly positioned seams! (Eventually after a test with an alternative program on 2nd location.)

2.7.1.5 Factors that influence the Weld Seam Characteristic and the Detectability of Weld Seams of tubes

- Tube material
- Tubes forming process, tube coating
- Welding technology and welding process
- Drawing process
- Annealing process
- Tube handling
-

2.7.2 Measures to improve detectability of Weld Seam

Tube forming process	Adjust for uniform curvature. Do not allow edges Reduce roller marks Optimize seam shaving
Welding	Do not change weld additives. Control welding process for steady width of seam and close limit of welding heat.
Drawing process	Avoid unnecessary drawing. Always use same drawing process and same number of drawing processes. Do not use outworn drawing tools.
Annealing process	Control process for stability of heat level, heating-up and cooling phases.
Tube coating	Control process for stability of heat level.
Tube handling	**Avoid scratches and dents during handling and transport.**

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3 Mounting

3.1 Mounting of sensor

Basically, the sensor can be mounted in any orientation. However, an overhead mounting (sensor face looking down) is favourable, since the sensor will be less contaminated.

The sensor must be installed so that the weld seam runs right-angled to the direction of motion. It must be assured, that all rollers of the sensor are contacting the tube and turn when the tube rotates. The provided rubber mounts are intended for the installation of the sensor. Thus the sensor adapts to the tube.

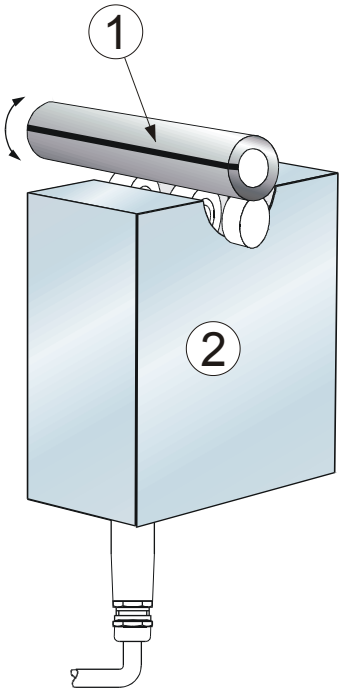


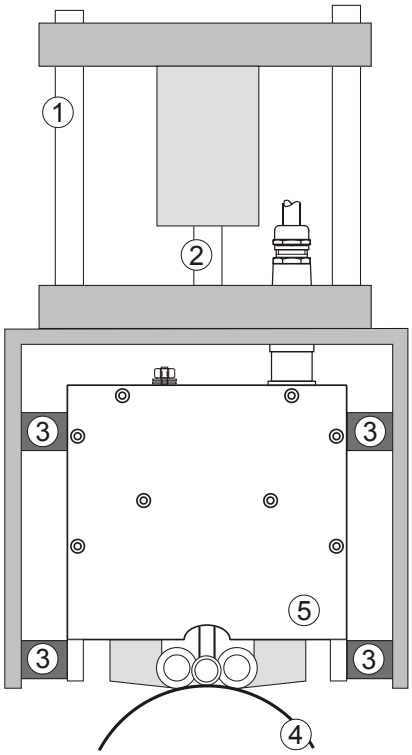
Fig. 6: Mounting of sensor

Description	
For the explanation of principle the sensor is shown here under the tube. In the practical case, the sensor should be preferably set above the tube.	
1:	Weld seam
2:	NS-Sensor

The sensor mounting bracket substantially influences the correct function. If the sensor is mounted in a rigid mounting bracket, it can happen that the sensor contacts the tube only at one side. This will lead to unwanted one-sided pressure distribution on the sensor. In addition, such uneven contact with the tube provokes faulty measurements.

Thus the sensor should be mounted using the provided rubber buffers as well as an air cylinder (see next picture). The sensor does not need to be pressed onto the tube, the own weight of the sensor is sufficient.

Depending on mechanical arrangement, it might be necessary to equip the sensor bracket with springs.



Description	
The rubber mounts are included In the scope of supply.	
1:	Parallel guiding
2:	Air cylinder
3:	Rubber mounts
4:	tube - specimen
5:	NS sensor

Fig. 7: Mounting of rubber mounts

The sensor can only function correctly, if all rollers of the sensor contact the tube continuously during the measurement.

Due to the rollers, the gap between sensor element and tube results automatically.

It has to be considered, that a strong magnetic field is generated while measuring. Magnetic steel must not be present within a distance of 5 cm to the sensor head (guide rollers of the sensor).

The same also meets the rear of the material (inside of tube). It must be free from any metallic matter (especially support rollers, tapered guidance or mandrels*****).

Note * In special cases the usage of a mandrel is allowed.

During detection the sensor must continuously contact the tube. Therefore the sensor bracket must be equipped with rubber mounts, so that the sensor can evenly contact the tube.

As rubber mounts the following can be used (e.g.):

Model: Rubber mounts Type B, (see "*technical data*", rubber mounts D=30mm, H=25mm).

The rubber mounts are included in the scope of supply.

Mounting errors, to be avoided under all circumstances:

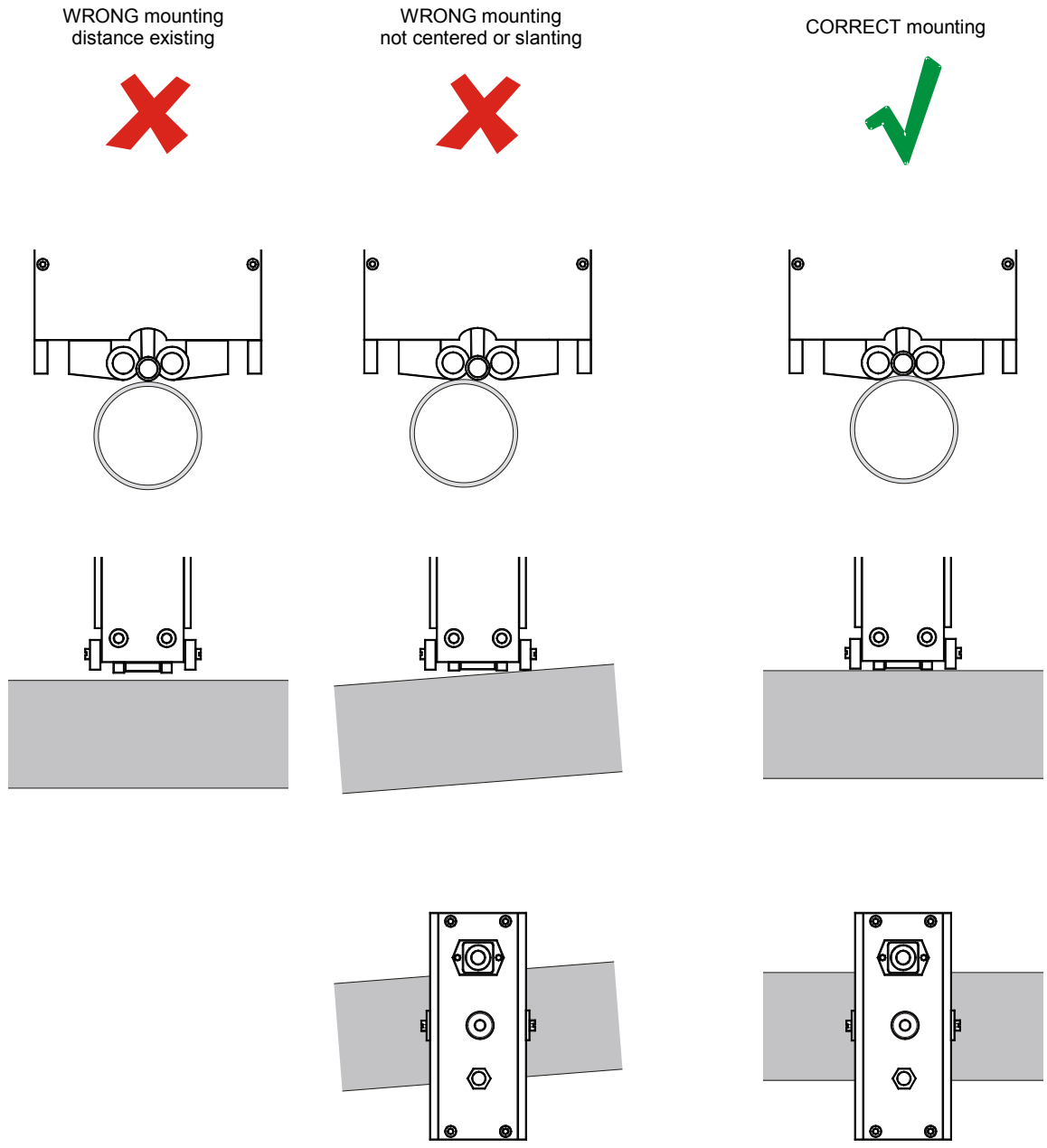


Fig. 8: Wrong and correct mounting of sensors

3.1.1 Rubber mount assembly of the NS9

Four rubber mounts are included in the scope of supply.
In each case two buffers have to be installed diagonally shifted on the narrow sensor sides.

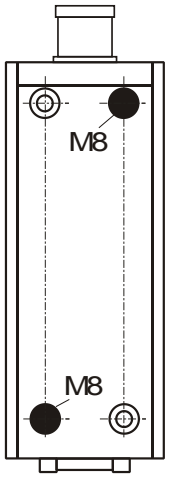


Fig. 9: NS9 Rubber mount

3.1.2 Rubber mount assembly of the NS12 / NS24

Eight rubber mounts are contained in the scope of supply. In each case four buffers are installed on the narrow sensor sides.

Note For the NS24 sensor use only the rubber mounts intended for this sensor!
Refer to chapter 9, section “rubber mounts”

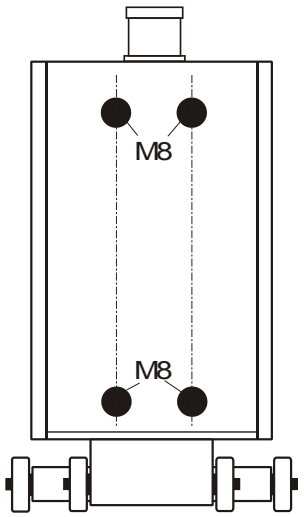


Fig. 10: NS12 rubber mount assembly

3.2 Mounting of Eddy Current probes

Basically, an eddy current probe can be mounted in any orientation. However, an overhead mounting (probe face looking down) is favourable, since the probe will be less contaminated.

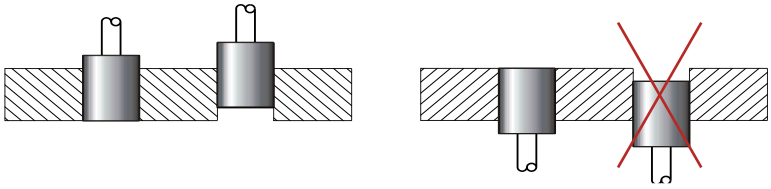
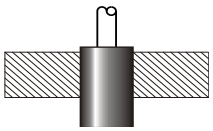


Fig. 11: Mounting of Eddy Current probes

The probe may be mounted flushed or recessed only in rigid plastic, ceramics or other non-conductive materials.

A recessed mounting protects the probe, but increases the air gap between material and probe. Furthermore, particles and scarfs can accumulate in the recess, which also can reduce the measuring capacity. Thus, mount the probe recessed only in overhead orientation.

Has the sensor been mounted in a holder with high electrical connectivity (e.g. Aluminium), then this material will extract energy from the sender in form of eddy current. This reduces the capability of the probe.

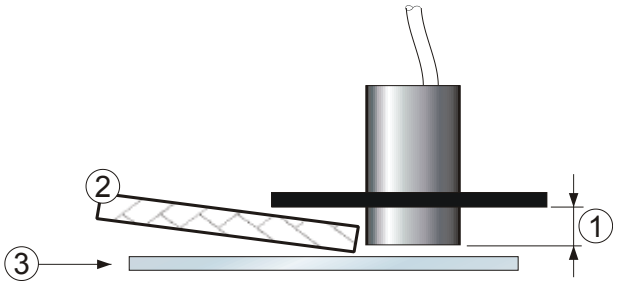


Non-flushed (standing-out) mounting can also be done in metallic holders. Then care for an utmost large distance between the active side of the sensor and the holder.

Fig. 12: Standing-out mounting of EC probes

Note:

When the probe is mounted in a holder made of steel, the probe should look of the holder for at least 10 mm. This can necessitate that the probe must be protected from damage by additional baffles.



Legend	
1:	Steel holders: Let the probe look out of the holder for more than 10mm. Plastic holders: Flushed mounting is practical.
2:	External baffle
3:	Transport direction of material

Fig. 13: Mounting of external baffles

Depending on the kind of probe, the correct distance between probe and material surface is at 0.3 ...1mm.

The smaller the probe is, the smaller the correct distance is.

Since the distance between probe and material must be kept constant, it is essential to guide the probe on the material. Exception: the distance remains constant due to material guidance.

While measuring, the rear side of the material must be free from any metallic matter (especially support rollers, tapered guidance or mandrels), since this influences the measuring.

Structural irregularities (e.g. holes or grooves) will cause very strong interference signals.

Therefore, the probe should only be mounted in positions where the material structure is undisturbed.

Note:
Scratched or coarse surfaces also lead to strong interference signals.

The eddy current probe is defined for a defined direction of material flow. This means, the probe must be mounted according to the technical drawing.

Note:
If a probe is mounted 90° rotated, the measuring signal will be remarkably worse. The stated track width is then no longer correct.

3.3 Mounting the SND40 Control Unit

The control unit must be mounted such it can be monitored and easily operated during production. The place where the unit is mounted is to be safely accessible and clearly arranged. For service purposes it might be required to open the door from the rear. Attention must be paid to this fact when mounting the unit.

Ideally the unit is mounted at a place from which the sensor can be watched.

Note:
The unit must not be mounted within danger zones, otherwise operating and monitoring the unit is no longer possible without endangering.

The unit must not be exposed to extreme temperature, radiation or mechanical load.

The enclosure (Rittal, Type CP 6531.200) is prepared for the support arm system CP-L (round). The connection for the support arm is at the bottom side.

Note:
CAD files are available from Rittal in dxf and dwg format. The files can also be found on the Rittal CD-ROM "RiGeo" (Part No. SZ 2406.100). issue Febr. 2006.

Suitable components such as enclosure couplings, floor mounts, connecting adapters, inclination adapters and support arms are available from the Rittal Company.

Source: Finow
A rather simple solution can be implemented by using a tube with flange plates welded at the ends and thus creating a fixed floor mount.

Fig. 14: Mounting example of the SND40

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4 Electrical installation

4.1 Cables

The sensor cables must not be laid out directly side by side with other unshielded lines potentially emitting strong electromagnetical interference radiation.

Such lines are e.g. servo motor cables or other cables carrying large pulsed currents.

In case of very strong interference sources the same applies also for the SND40 power supply cable and signal cable towards the control unit.

In order to reduce interferences, laying out the SND40 cables within separate EMC cable channels might be required.

All cables must be professionally laid out. Bending radii (see suppliers data sheets) must be kept to. Damages due to wearing / buckling must be avoided by circumspective installing.

Note:
Care for sufficient strain relief!

Damaged cables may never be used, they need to be replaced immediately.

If the cables cannot be used (e.g. due to missing UL/CSA permission), contact Roland Electronic for substitutes.

The provided snap-on cores are designated for a preventive protection from HF-interferences. These can be simply snapped on the connected cables.

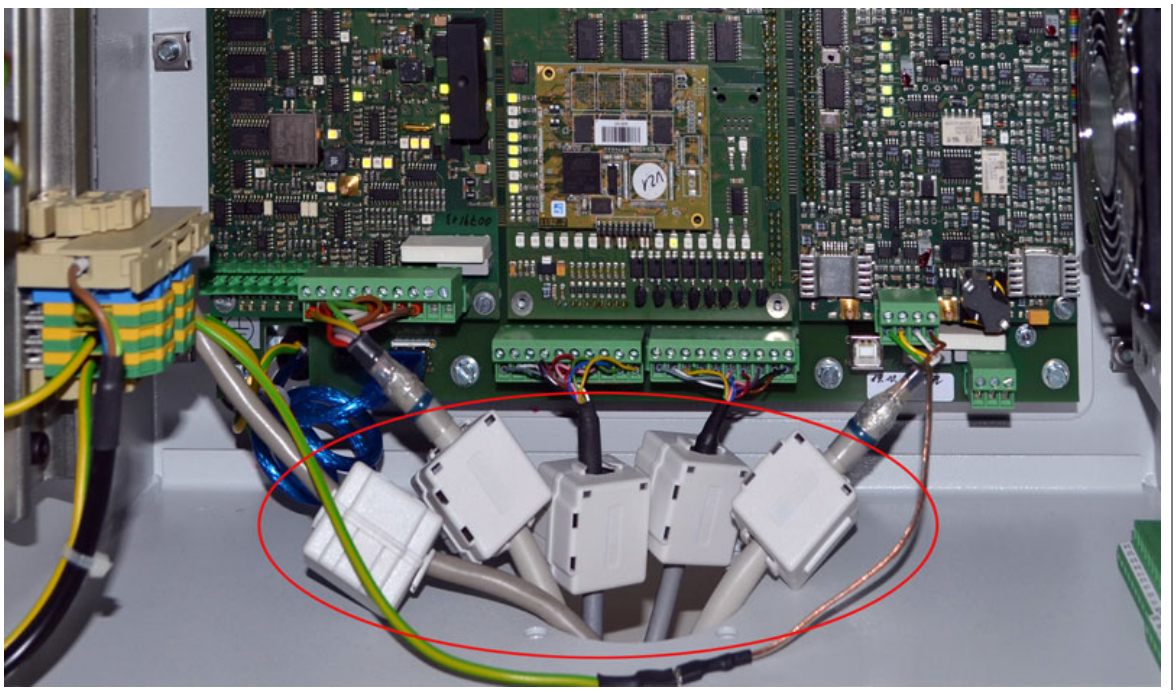


Fig. 15: Snap-on cores on power supply, sensor cables and PLC cables

4.2 Mains connection

The SND40 unit may only be connected to the mains power net by an electrician.

For connecting the wires at the terminal clamps use insulated splice ferrules in any case.

For details on the supply voltage see chapter ”*Technical data*“.

Note:

Always connect the protective conductor (PE) at the mains infeed.

For the connection to the mains net a cable of the type H05VV5-F (Lapp Oilflex® 140) 3x1,0/1,5mm² (or equivalent / better) is suitable.

For usage under severe interferences a shielded mains connection cable must be used, such as one of the type H05VVC4V5-K (Lapp Oilflex® 140CY).

The shielding must then be grounded at the feeding side. The cable needs to led-in via special EMC cable entries or EMC bulkhead screw fitting.

Alternatively, the shielding can also be connected (via metal cable ties) to the EMC base sheet of the enclosure (e.g. system Rittal).

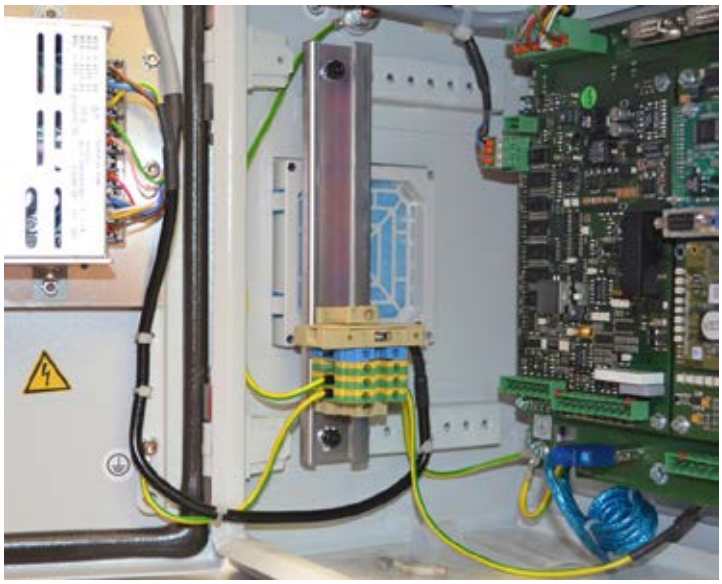


Fig. 16: Mains connection

Terminal diagram - Mains connection		
use insulated splice ferrules in any case!		
Colour of wire	**Info**	**Name**
brown	Fuse 3,15A medium-blow	L
blue		N
green-yellow	PE	
green-yellow		
green-yellow		

4.3 Connection of PLC

4.3.1 Terminal diagram SND40

Terminal	Cable	Colour of wire	Direction	Voltage / current	Function	
6	Roland KNS9S-G or KNS9S-W	yellow	->	0...+/-20 mA R i = 100 Ohm	Leakage Flux signal input 1a	
7		red	->		Leakage Flux signal input 1b	
8		white	<-	+12 V DC / 0,1 A	Supply outputs f. Leakage Flux sensor	
9		brown **(+blue)***	<-	0 V DC (Common)		
10		green	<-	-12 V DC / 0,1 A		
11		grey	<-	0…48V DC	Supply for magnet coil +	
12		pink	<-		Supply for magnet coil –	
13		blank	<->		Shield (internally at protective conductor	
14	PLC		<->	max. 250 V AC / 6A max. 30 V DC / 6A	Motor relay 1 Closing contact (N.O)	
15			<->			
16	PLC		->	$U_{PowerIn}$ 13...30 V DC / 0,1 A	Ext. + 24V supply	
17			->		Ext. – 24V supply (common connection of all inputs); sinking input	
18			->	Low 0…4 V DC High 13...30 V DC I_{in} < 20 mA Sinking input	IN0	Function see chart of inputs
19					IN1	
20					IN2	
21					IN3	
22					IN4	
23					IN5	
24					IN6	
25					IN7	
26	PLC		->	$U_{PowerOut}$ 13...30V DC / 0,5A	Ext. + 24 V supply (common connection of all outputs); sourcing output	
27			->		Ext. – 24 V supply	
28	PLC		<-	Low: U_{out} < 4 V R_{load} > 1,2 kOhm High: U_{out} > $U_{PowerOut}$ - 2 V DC I_{out} < 50 mA Sourcing output	OUT0	Function see chart of outputs
29					OUT1	
30					OUT2	
31					OUT3	
32					OUT4	
33					OUT5	
34					OUT6	
35					OUT7	
36	Roland CECM18S-G	green	<-	max. 20 Vss unloaded	Output/a Eddy current transmitter	
37		yellow	<-		Output/b Eddy current transmitter	
38		white	->	max. 100 mVss	Input/a Eddy current receiver	
39		brown	->		Input/b Eddy current receiver	
Ground		transparent	<->	-	Shield (internal at ground connect)	
40	Reserve					
41						
42						
43						
44	PLC		<->	max. 250 V AC / 6A max. 30 V DC / 6A	Motor relay 2 opening contact (N.C.)	
45			<->		Motor relay 2 common (COM)	
46			<->		Motor relay 2 closing contact (N.O.)	
47	Internal wiring	pink		+24 V DC	Internal power supply (do not use for external applications)	
48		grey		0 VDC (Common)		
49		red		+5 V DC		
50		blue		D GND		
51		yellow-white		A GND		
52		green		–12 V DC		
53		brown		+12 V DC		
54		black		+24 V DC	Fan +	Fan
55		blue		0 V DC	Fan -	
56		brown		PWM	Tacho in	

Note: For cables delivered starting Nov. 2014 following applies:

***** A brown wire might be connected parallel together with a blue wire. This will **not affect** the proper functionality of the cable, the sensor or the control unit.

4.3.2 View at terminals

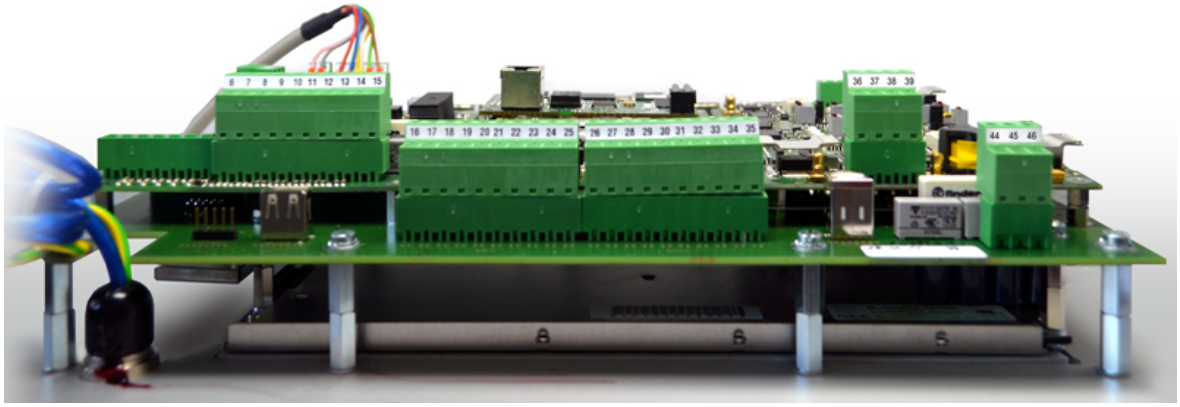


Fig. 17: SND40 View at terminals

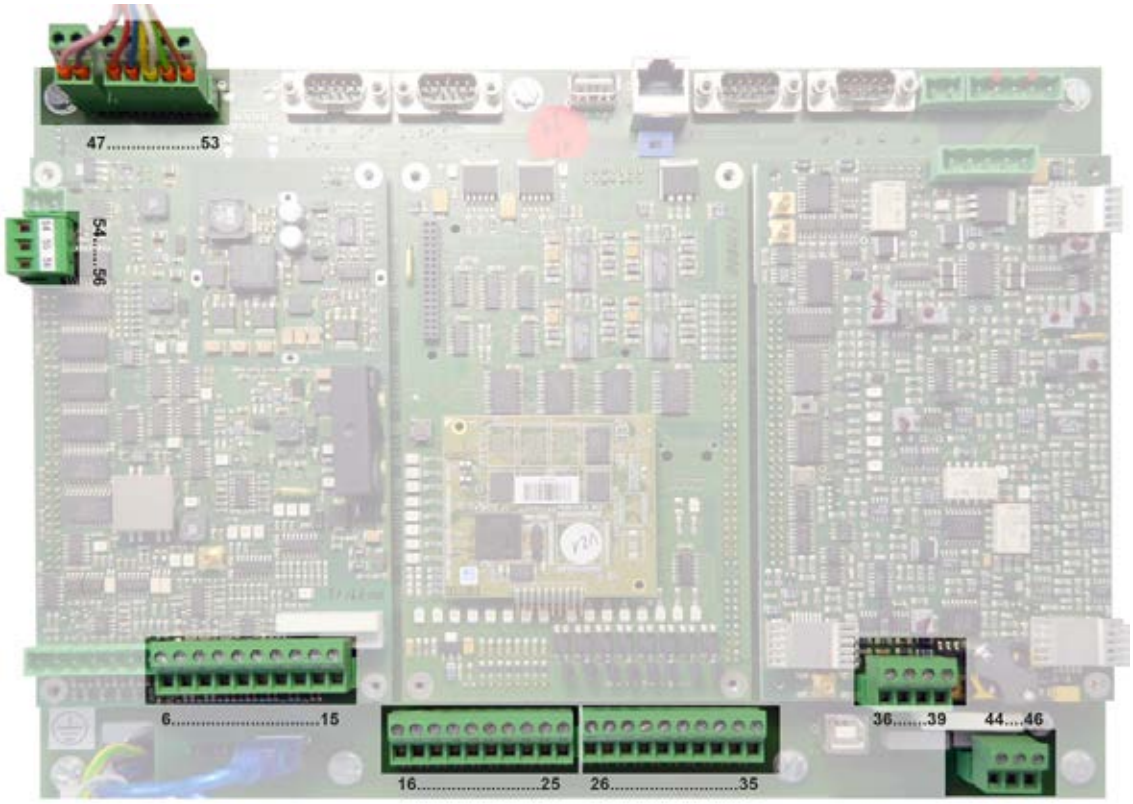


Fig. 18: Numeration of terminals

4.3.3 Operating mode “round specimen“

PLC signals

Inputs (PLC -> SND40)

IN	0	1	2	3	4	5	6	7
Terminal								
Function	Measurement Start/ Test job Start	Program selection	M1	M2	M4	M8	M16	----

The program is addressed binary coded (”M1...M16“). *”Program selection“* serves as strobe.

Program no.	M1	M2	M4	M8	M16
1	1	0	0	0	0
2	0	1	0	0	0
3	1	1	0	0	0
...					
31	1	1	1	1	1

Program 0 does not exist. Selecting this program will cause an error message.

Outputs (SND40 -> PLC)

OUT	0	1	2	3	4	5	6	7
Terminal								
Function	Measurement Start active/ Test job Start active		Ready for operation	Teach-In active	Slippage	Fault general	Reduced detection capability	Motor
Function on Program selection		Program selection active	M1	M2	M4	M8	M16	

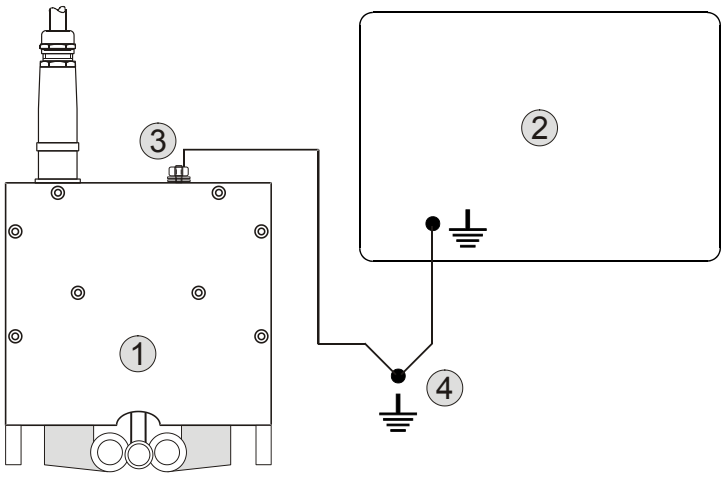
The signals OUT2 … OUT6 have two different functions. On *”Program selection“* they mirror the input signals IN2 … IN6 to the corresponding outputs.

4.4 Connecting of sensor

The sensor should be connected only by an electrician.

Special note:

When connecting the sensors, take care that the cable shields get connected with the provided terminals or flat contacts. If grounding connections are present at the sensors, they must be connected to grounding in every case.



Description	
1:	Sensor
2:	Control unit SND40
3:	Grounding terminal
4:	Central machine grounding

Fig. 19: Grounding

The sensor cable KNS9S-G and CECM18S-G are supplied by ROLAND ELECTRONIC. A different naming of the cable is possible - see „Technical data“. At the sensor side those cables are equipped with a round plug. The other side is prepared with splice ferrules.

The wires need to be connected to the assigned cable terminals. For doing so, the terminal strips can be detached.

4.5 Connecting of probe

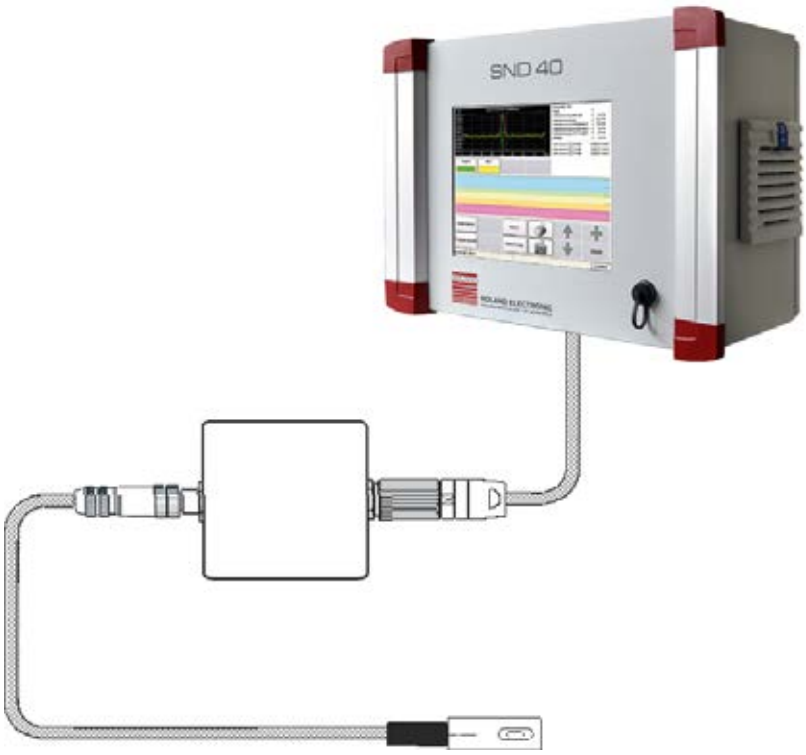
The eddy current probe has a connecting cable of 1 meter length. The cable is connected to the Sensor Interface Box SCB-EC-S with the M12 round plug.

With the sensor cable CECM18S-G the Sensor Interface Box is connected to the SND40. The sensor cable is supplied by ROLAND ELECTRONIC. Different naming of the cable is possible - see „Technical data“.

At the side of the interface box the cable is equipped with a round plug. At the side of the SND40 the cable leads are prepared with splice ferrules.

The wires need to be connected to the assigned connecting terminals. For doing so, the terminal strips can be detached.

4.5.1 Connecting scheme for eddy current probes



Description	
1:	SND40 control unit
2:	Sensor Connection Box SCB-EC-S
3:	Eddy current probe

Fig. 20: Connecting scheme for eddy current probes

4.6 Connection schedule – Leakage flux sensors

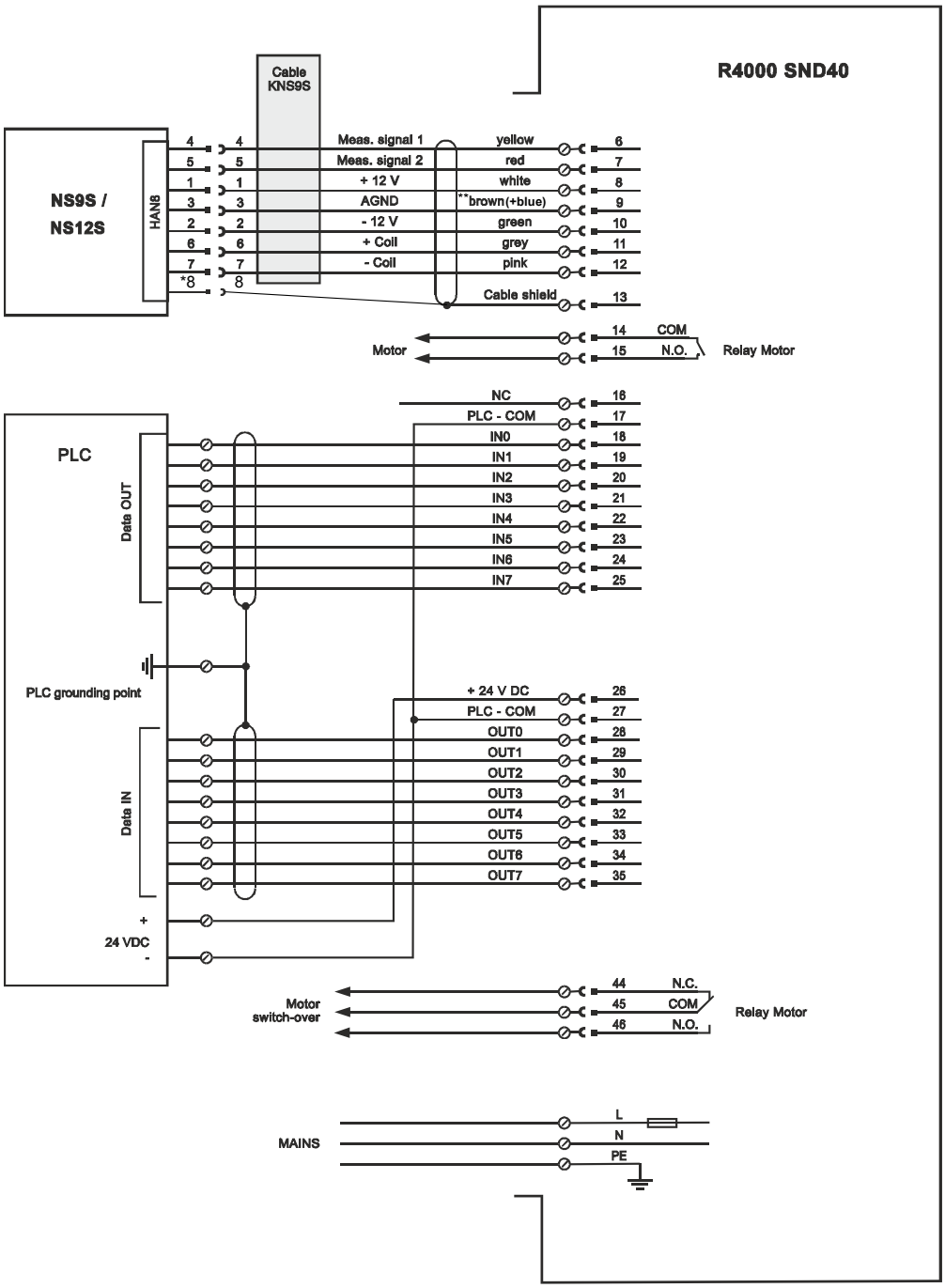


Fig. 21: Connection schedule for Leakage Flux Sensors

Note:

For cables delivered starting Nov. 2014 following applies:
*Contact No. 8 might be connected with the cable shield.
** A brown wire might be connected parallel together with a blue wire. This will **not affect** the proper functionality of the cable, the sensor or the control unit.

4.7 Connection schedule - Combination sensors

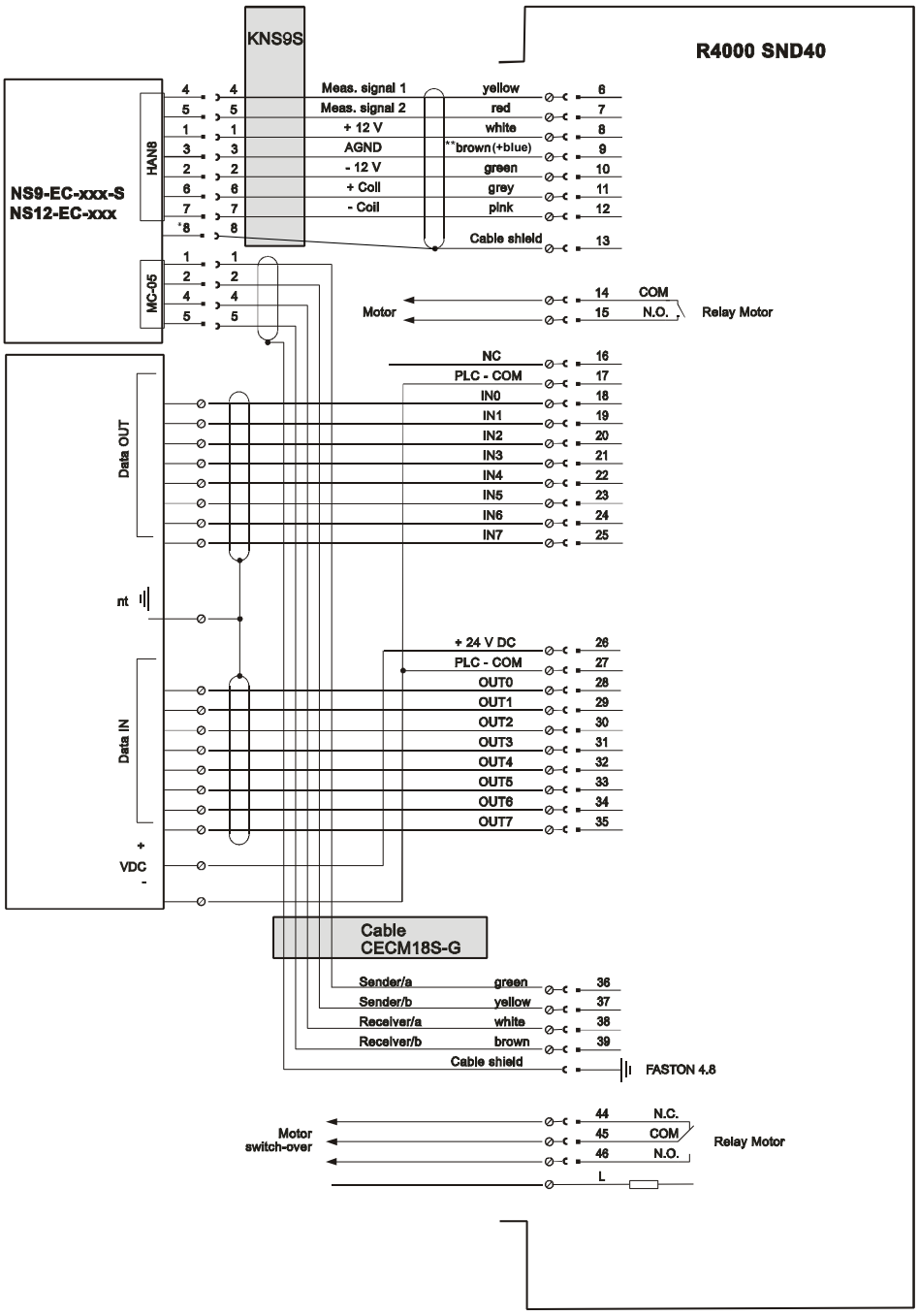


Fig. 22: Connection schedule – Combination sensors

Note:

For cables delivered starting Nov. 2014 following applies:
*Contact Nr. 8 might be connected with the cable shield.
** A brown wire might be connected parallel together with a blue wire. This will **not affect** the proper functionality of the cable, the sensor or the control unit.

4.8 Connection schedule – Eddy current sensors and Encircling coil systems

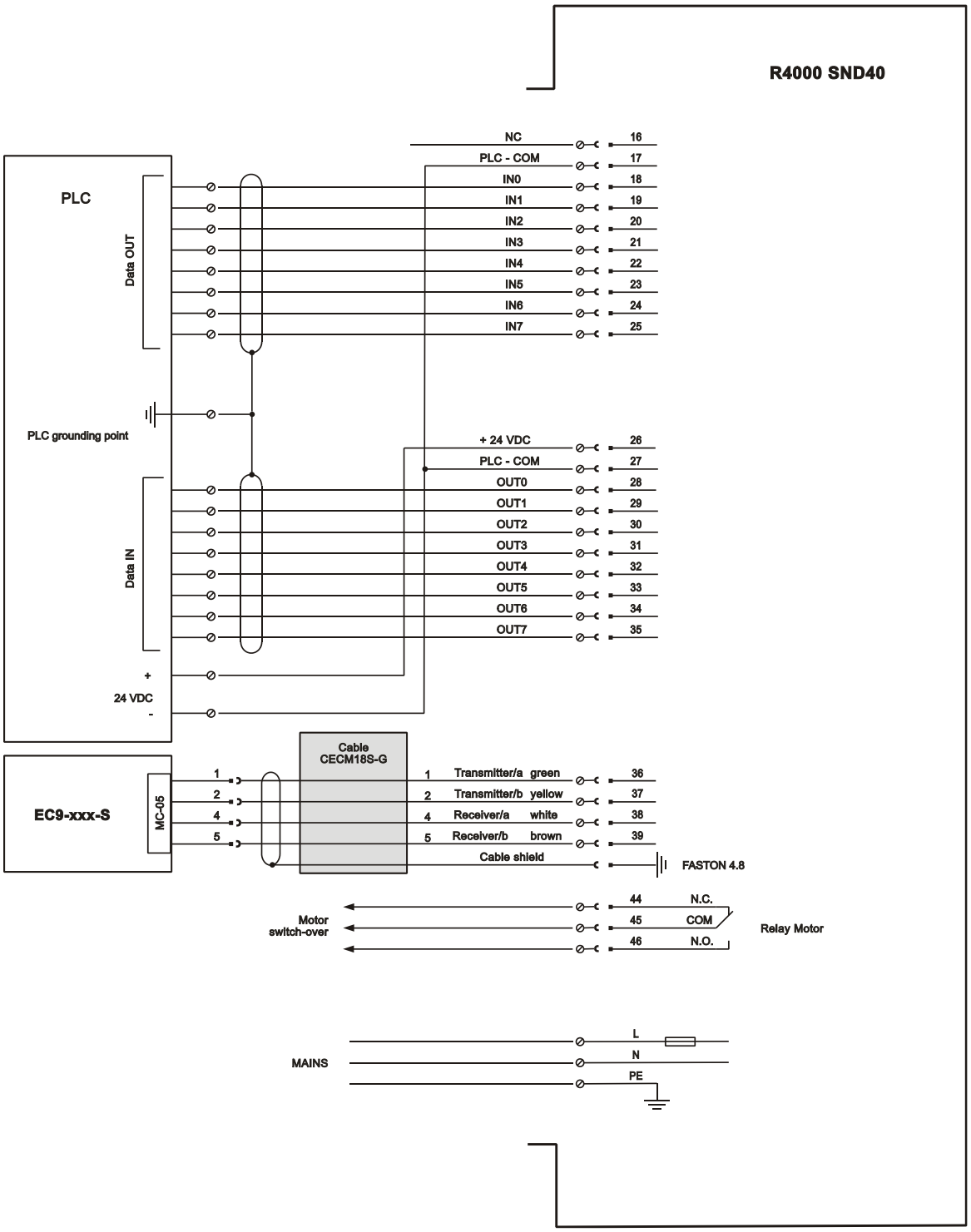


Fig. 23: Connection schedule for eddy current sensors and encircling coil systems

4.9 Connection schedule – Eddy current probes

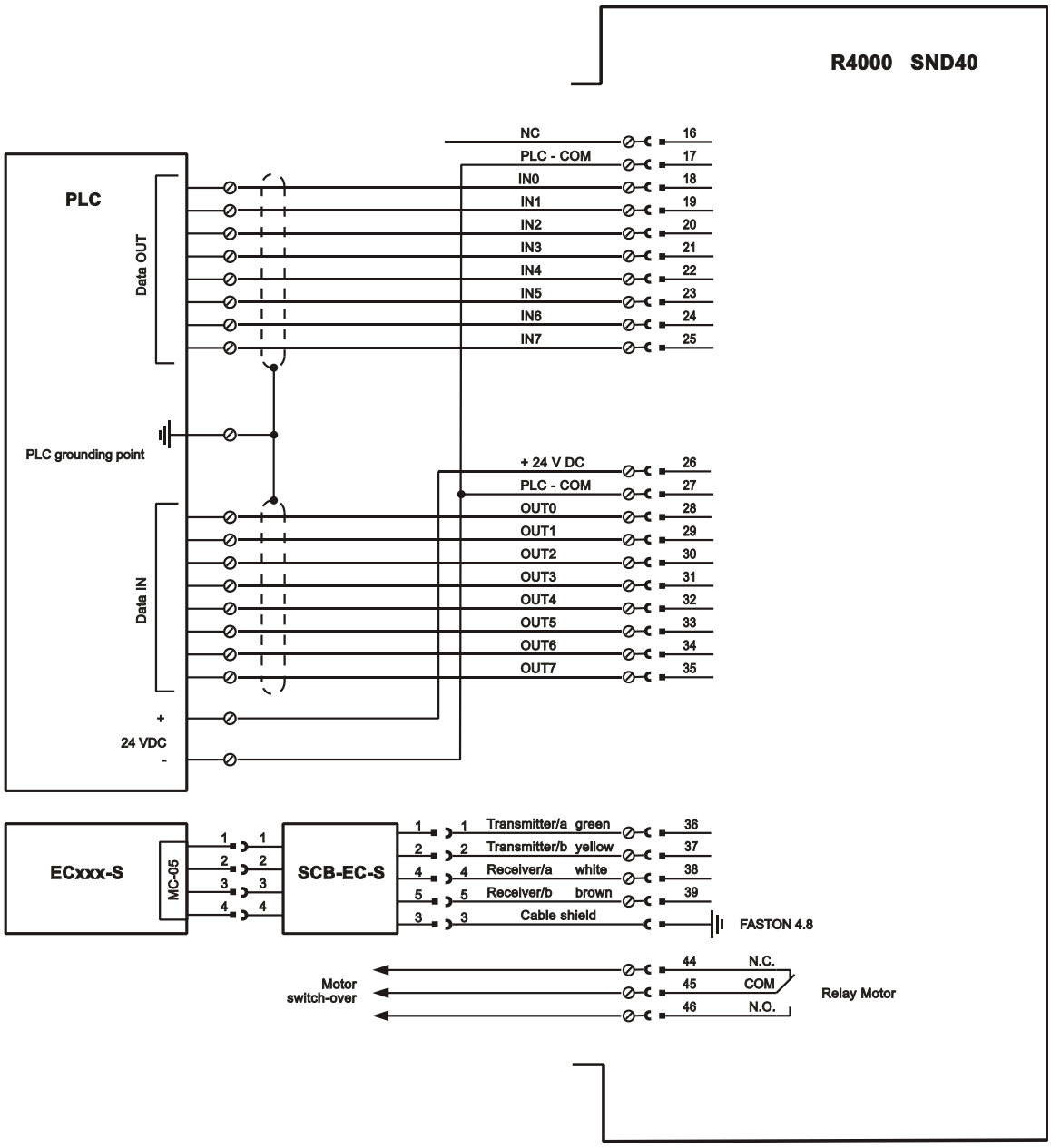
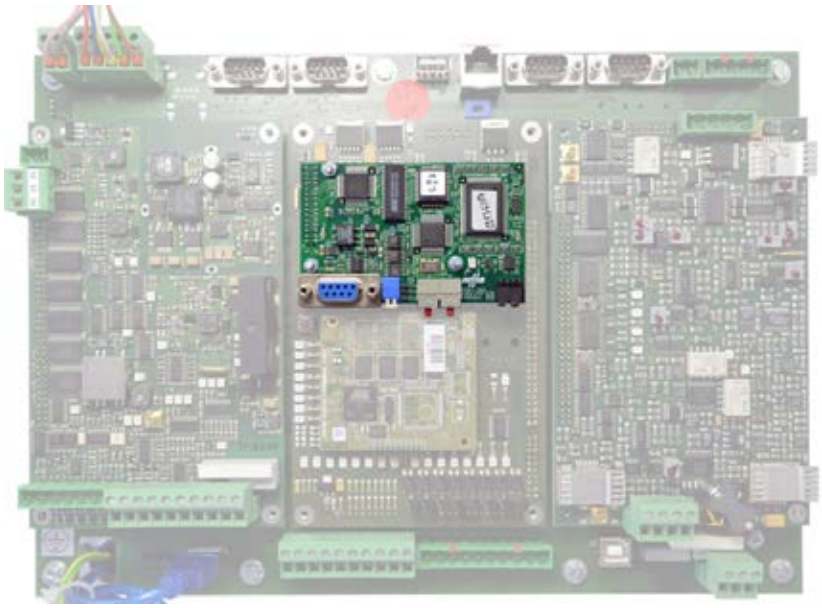


Fig. 24: Connection schedule for eddy current probes

4.9.1 Profibus DP Connection

A Profibus-DP module is installed in units of the type SND40-(EC)-(MF)-PR.



Mainboard SND40
View of the Profibus DP module (type Anybus S, Supplier: HMS Industrial Networks).
For further details about Profibus interface please read chapter "*Technical data*".

Fig. 25: Mainboard Profibus module

Connection to the Profibus may only be done by an electrician.

Note:
For use as Profibus cable, the type "Unitronic® BUS FD P L2/FIP"
(1 x 2 x0.64 mm², supplier: Lapp) or an equivalent / better cable is suitable.
For usage in severely interference loaded environs a separate shielding might be required.

As connection plug standardized shielded SUB D 9 Profibus connectors are suitable.
The use of connection plugs with integrated (switchable) terminating resistors is recommended.
If the SND40 is placed at the bus end / begin, the terminating resistor must be switched on.

Fig. 26: Profibus module cable

View of module with connected cable		
Allocation of the Profibus plug		
Color of wire	D- SUB	Name
red	Pin 3	P (B-Line)
green	Pin 8	N (A-Line)
Shield	Enclosure	-

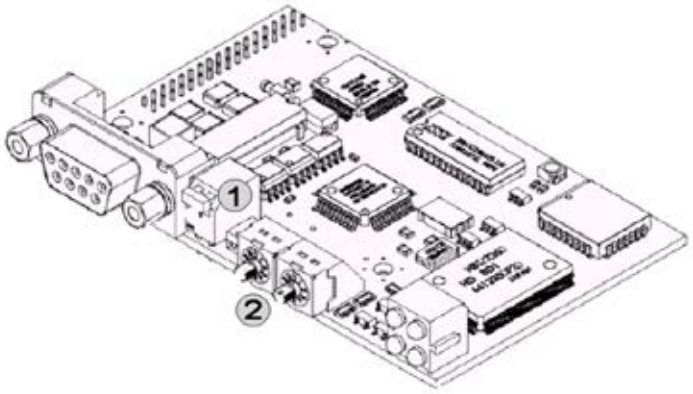


Fig. 27: SND40 Profibus module

Factory setting on Profibus module		
1:	Bus termination	
	downward =	ON
	upward =	OFF
2:	Slave address (00) Both turn switches in pos. 0	
	(00) means, the slave address is determined by the system configuration	

The bus address can also be set in the system configuration of the SND40. To do this, the switches on the module must be set to 00.

4.9.2 ProfiNet IO Connection

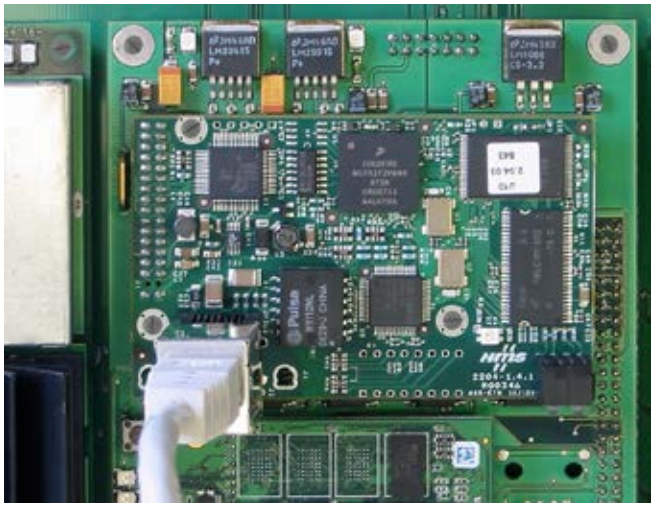
A ProfiNet IO module is installed in control units of the type SND40-(EC)-(MF)-PN.
The module is connected to the bus via RJ45 plug.

Mainboard SND40
View of ProfiNet IO module (Type Anybus S, supplier HMS Industrial Networks).
For further details on ProfiNet IO interface see chapter "*Technical data*".

Fig. 28: SND40 ProfiNet module

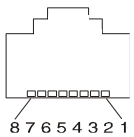
Connection to the ProfiNet bus may only be done by an electrician.

Note:
For use as ProfiNet IO cable a commonly used RJ45 Ethernet cable (Cat 5e) is suitable.
For usage in severely interference loaded environs a separate shielding might be required.



View of module with connected cable

Allocation of ProfiNet IO socket
(RJ45 socket on the p.c.b.)



View:
Plug side

Pin 1	TD +
Pin 2	TD –
Pin 3	RD +
Pin 6	RD –
Pins 4, 5, 7, 8	--

Addressing the ProfiNet module

The MAC-ID is hardware determined and cannot be set.
It will be shown in the Hardware info section of the SND40.

The SND40 can be identified at the machine control via this MAC-ID.

Fig. 29: ProfiNet module cable

4.9.3 CC-Link Connection

A CC-Link module is installed in units type SND40-(EC)-(MF)-CC. The unit supports the protocol version 1 of CC-Link. This module is connected via a pluggable screw connector, which is in scope of delivery.

Mainboard SND40
View of CC-Link module (protocol version 1).
For further details on CC-Link interface see chapter "*Technical data*".

Fig. 30: SND40 CC-Link module

Connection to the CC-Link bus may only be done by an electrician.

View of module with connected cable		
Allocation of CC-Link socket		
	Pin	Signal
	1	Communication line (DA)
	2	Communication line (DB)
	3	Digital GND (DG)
	4	Shield
	5	Frame Ground (FG / PE)

Addressing the CC-Link module

The station number and the baud rate are set in the system parameter of the SND40.

Rotary switches on the module are set to "9" by Roland Electronic and should not be changed.

Fig. 31: SND40 CC-Link module allocation

If the SND40 is the last participant in the bus, then an external termination resistor should be placed into the open connector. The resistor is not included in the scope of supply. A resistor between DA und DB 110 Ohm or 130 Ohm ½ Watt can be used.

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5 Communication with the PLC

The PLC can control the SND40 via a Fieldbus interface[1] or a parallel interface.
The following functions can be activated:

- Starting a measurement
- Selecting a program (1… 31)
- Acknowledging and clearing of weld seams
- Resetting of faults

Note:
When using the fieldbus module, error messages can also be read

5.1.1 Signal overview

Inputs (sinking inputs)

Terminal parallel	Byte.Bit Fieldbus	Name	Comment
IN0	BIN0.0	Measurement start / test job start	-
IN1	BIN0.1	Program selection	-
IN2	-	-/(M1)	(…) only possible via parallel interface. Activate by program selection If the program selection is not set, the function mentioned (without brackets) can be activated
IN3	-	-/(M2)	
IN4	-	-/(M4)	
IN5	-	Reset fault 2 / (M8)	
IN6	BIN0.6	Weld Seam acknowledge / (M16)	
IN7	BIN0.7	-	Not used

Terminal parallel	Byte.Bit Fieldbus	Name	Comment
-	BIN1.0 -1.7	-	Not used

Terminal parallel	Byte.Bit Fieldbus	Name	Comment
-	BIN2.0	M1	Program number
-	BIN2.1	M2	
-	BIN2.2	M4	
-	BIN2.3	M8	
-	BIN2.4	M16	
-	BIN2.5	M32	
-	BIN2.6	M64	
-	BIN2.7	M128	

Terminal parallel	Byte.Bit Fieldbus	Name	Comment
-	BIN3.0 -3.7	-	Not used

[1] Only for control units with integrated fieldbus field bus module
[2] Available starting with software PM version 12

Outputs (sourcing outputs)

Terminal parallel	Byte.Bit Fieldbus	Name	Comment
OUT 0	BOUT0.0	Measurement start active / Test job start active	-
OUT 1	BOUT0.1	Program selection active	-
OUT 2	BOUT0.2	Ready for measuring / (M1)	(…) possible only via parallel interface Active by program selection If the program selection is not set, the function mentioned (without brackets) can be activated
OUT 3	BOUT0.3	Set up active / (M2)	
OUT 4	BOUT0.4	Slippage/weld seam detected (duration) / (M4)	
OUT 5	BOUT0.5	General fault / (M8)	
OUT 6	BOUT0.6	Reduced detection capability / (M16)	
OUT 7	BOUT0.7	Motor / Weld seam detected (pulse)	-

The output OUT4 "Weld seam detected (permanent) is only activated in the system configuration at acknowledge mode.

Terminal parallel	Byte.Bit Fieldbus	Name	Comment
-	BOUT1.0	Ready	-
-	BOUT1.1-1.7	Not used	-

Terminal parallel	Byte.Bit Fieldbus	Name	Comment
-	BOUT2.0	M1	Number of the active program. If no program is active, number 0 will be issued.
-	BOUT2.1	M2	
-	BOUT2.2	M4	
-	BOUT2.2	M8	
-	BOUT2.4	M16	
-	BOUT2.5	M32	
-	BOUT2.6	M64	
-	BOUT2.7	M128	

Terminal parallel	Byte.Bit Fieldbus	Name	Comment
-	BOUT3.0-3.7	Fault identification	See fault reporting table (8-bit)

Note:
For CC-Link assignment see also chapter 4.9.3 "CC-Link Connection".

Fault reporting table

Fault number via bus	Description
10	XY operation interrupted, since the data transfer for display is too slow
11	24 V PLC voltage is missing
12	Flat specimen operation is interrupted, since the data for the display is too slow.
13	Sensor cable broken
14	PLC program number is incorrect e.g. 0
17	Speed measurement not possible
18	Sensor short circuit
19	Leak flux module defect
20	PLC program not implemented
21	Fan defect
80 - 89	Timing problems to the Fieldbus modul (only display no faulty bit)
95	Internal data communication problems RS232
96	Internal problem (incorrect internal instruction)
97	System file not correct
98	Bus module defective

5.1.2 Input "Measurement start / Test job start"

This PLC command causes the SND40 to start a measurement. This function is available via the Fieldbus and the parallel interface. The measurement can be made in the program / operating status **Automatic / Ready** and **Set-up / Edit**.

5.1.3 Input "Program selection"

Via the PLC interface the programs 1 to 31 can be selected binary coded. In addition, the signals M1 to M16 are used.

Pattern for the binary coding		
Program 0	=	Signals M1… M16 not set (this combination is not permitted)
Program 1	=	M1 set
Program 2	=	M2 set
Program 3	=	M1 + M2 set
…	**…**	**…**
Program 31	=	M1 + M2 + M4 + M8 + M16 set (control of 1 + 2 + 4 + 8 + 16 = 31)

The program is taken over with the signal "*program selection*". The program selection fails, if

a) program No.0 is selected

b) the selected program is missing

c) or the selected program contains inadmissible parameters.

Case a) the failure message "*selected program No. is 0 (invalid)*" is shown, the program will not be switched. Via the bus the fault code 14 is set.

Case b) the failure message "*program parameter index 1 invalid*" is shown, or fault code 20 via the bus. The program switch to the desired program is not executed. The currently active program becomes deactivated. The program number via bus is not changed.

Case c) the failure message "*program parameter index xxx*" is displayed or fault code 20 via the bus. The program switch to the desired program is executed.

Note:

The SND40 has 32 programs in the program memory.
Program 32 cannot be selected, but it can be used as backup memory.

5.1.4 Input “Acknowledge of weld seam”

This function is possible only in the “*flat specimen*” mode. For this purpose the “*acknowledge*” mode has to be switched ON in the system configuration.

In the “*flat specimen*” mode two signals can be evaluated by the PLC:

a) Weld seam detected (impulse)

b) Weld seam detected (duration)

Signal a) is active only as long as a weld seam actually is in front of the sensor. The resulting short impulse can be extended by the SND40[3]. If the PLC evaluates the signal only cyclical (e.g. every 100 milliseconds) the signal may not be reliably detected.

Signal b) should be used then. This signal remains set until the weld seam is cleared.

A stored weld seam signal is only reset by setting the signal "*acknowledge weld seam*".

5.1.5 Input "Reset fault"

With this signal the output "*General fault*“ can be reset. If the fault is serious, the output remains set.

Note:

Faults which repair themselves (e.g. by recovering the SPS voltage) are reset automatically.

5.1.6 Output "Measurement start active"

Indicates that a measurement is active. For this purpose the signal "*measurement start*" has to be applied at the input.

An exception is the set-up operation. Two cases have to be distinguished:

1. **Control test job: PLC**
(Therefore the system parameter "*testjob control mode*" must be adjusted to “*PLC*”).
The operator can request the measurement in the set-up routine by pushbutton. Therefore, the keys <*test job start*> or <*drive*> or (in the X/Y function) the key <*start*> can be used.
The status message "Waiting for PLC start" appears on the display of the SND40 and the signals "Ready for measurement" and "Set-up active" are set. The PLC is now preparing a tube for measurement (prepare tube for measuring and put the sensor on the tube).
When the signal "*measurement start*" is applied at the input, the measurement starts and the output is set.

2. **Control test job: KM**
(Therefore the system parameter "*testjob control mode*" is to be set to “*KM*”)
The operator can start the measurement in the set-up routine by pushbutton. Therefore, the keys <*test job start*> or <*drive*> or (in the X/Y function) the key <*start*> can be used. The measurement starts instantly and the output is set.

Note:

The signal "measurement start " does not have to be applied at the input. Before pressing the <Start> button, the PLC has to prepare a tube for measurement rotation and put the sensor on the tube.

[3] The pulse length can be adjusted with the parameter *" off delay "*.

5.1.7 Output "Program selection active"

Indicates that the program selection was activated. This signal is not set, if the program is selected via the control panel.

5.1.8 Output "Ready for measuring"

Indicates that the control unit is ready for a measurement, i.e. that a measurement can be started. This is the case if the program -/operating mode is "***automatic/ready***". In the operating mode "***setup / edit***" the signal is set only if the keys <*test job start*>, <*drive*> or in the X/Y function the key <*start*> were confirmed.

5.1.9 Output "Set-up active"

This output is set only in the "s*etup / edit*" mode as soon as the keys <*test job start*>, <*drive*> (or in the function X/Y the key <*start*>) have been confirmed.

When the SND40 was configured to "Control test job: PLC", a signal is sent to the PLC for preparing a tube for detection.

When the SND40 was configured to "Control test job: KM", a signal is sent to the PLC for set-up operation.

5.1.10 Output "Slippage/weld seam detected (duration)"

The output OUT4 "Weld seam detected (permanent) is only activated in the system configuration at acknowledge mode.

Meaning in the *"round specimen"* mode: *"slippage"*.
During the measurement slippage was detected.

Meaning in the *"flat specimen"* mode: "*weld seam detected (duration)*".
A weld seam was detected, but not yet acknowledged. This takes place via the input "*weld seam acknowledge*".

5.1.11 Output "General fault"

In the *"round specimen"* mode this output is set, if either *"slippage"*, *"critical detection"* or a fault are to be displayed.

In the "*flat specimen*" mode this output is set, if a fault is to be displayed.

5.1.12 Output "Reduced detection capability"

In the "*round specimen*" mode this output is set, if *"critical detection"* is to be displayed.

In the "*flat specimen*" mode this output is not used.

5.1.13 Output "Motor / weld seam detected (impulse)"

In the "*round specimen*" mode this output is used for the control of the rotary drive/motor. The output is set, as long as the tube is to be rotated.

In the "*flat specimen*" mode this output is used for reporting of the weld seam detected. The signal is set as long as a weld seam is detected. This time can be extended via the "switch-off delay" parameter (50 ms and 200 mc only)[4].

5.2 Output „Ready" via Fieldbus

Output via Fieldbus only. Only set when unit started up without faults.

[4] The pulse length can be adjusted with the parameter *"switch-off delay"*.

5.2.1 Fieldbus interface

5.2.2 Data transmission

The SND40 with integrated Fieldbus- interface can communicate with a Fieldbus-master. The data transmission communication takes place in cyclic data exchange mode.

For each transmission direction 4 bytes are reserved.

Master	Data direction	Input		SND40
	→	Byte BIN0	Process channel	
	→	Byte BIN1		
	→	Byte BIN2		
	→	Byte BIN3		

Master	Data direction	Output		SND40
	←	Byte BOUT0	Process channel	
	←	Byte BOUT 1		
	←	Byte BOUT 2		
	←	Byte BOUT 3		

Note:

When configuring the data format, attention must be paid to provide consistent data transmission from the PLC.

Note:

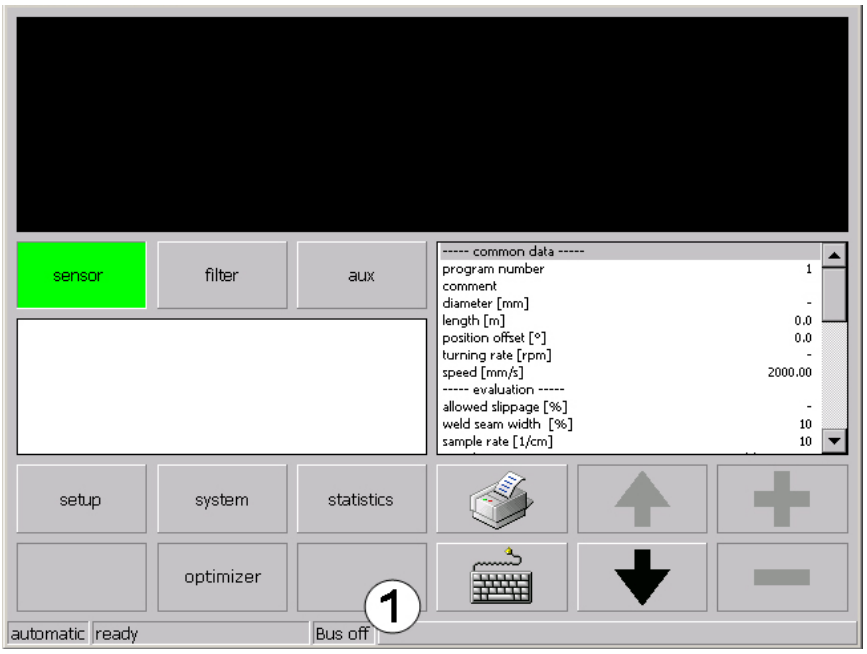
For CC-Link assignment see also chapter 4.9.3 "CC-Link Connection".

The allocation of the control signals is described in the signal overview.

The timing behaviour of the control via the bus corresponds with the information provided in the timing diagrams of the parallel interface.

5.2.3 Fieldbus-specific messages

For control units with fieldbus interfaces, the bus messages are displayed after applying supply power.



Description	
1:	Bus message

Fig. 32: SND40 Bus Offline

Overview of bus messages

Message	Explanation	Boundary condition
--	Without Fieldbus-interface	In the system configuration the parameter *"Fieldbus"* is set to OFF
INIT	Phase during the start-up of the control unit; the interface is prepared for operation.	Parameter *"Fieldbus"* is ON and Slave address is valid.
Bus offline	The Fieldbus-interface is in a fault condition or out of order or no Fieldbus is connected.	Parameter *"Fieldbus"* is ON and slave address is valid and Fieldbus is connected.
Bus online	The Fieldbus-interface is in operation.	Parameter *"Fieldbus* is ON and slave address is valid.

5.2.4 Bus address

The bus address of the SND40 (Slave address) is assigned in the system configuration with the parameters *"field bus address"* and *"baud rate"*.

Depending on the type of fieldbus, the valid range of values is different.

Note:
The range of values is not checked by the SND40 during the input.

Example with Fieldbus interface in the Profibus DP version:

- **Fieldbus address**: 1
- (here the address 1 is entered)

Addressing the ProfiNet module

The MAC-ID is hardware preset and cannot be set / changed. It will be displayed in the hardware info of the SND40.

At the machine control the SND40 can be identified by this MAC-ID.

Settings of bus address and baud rate (depending on fieldbus type):

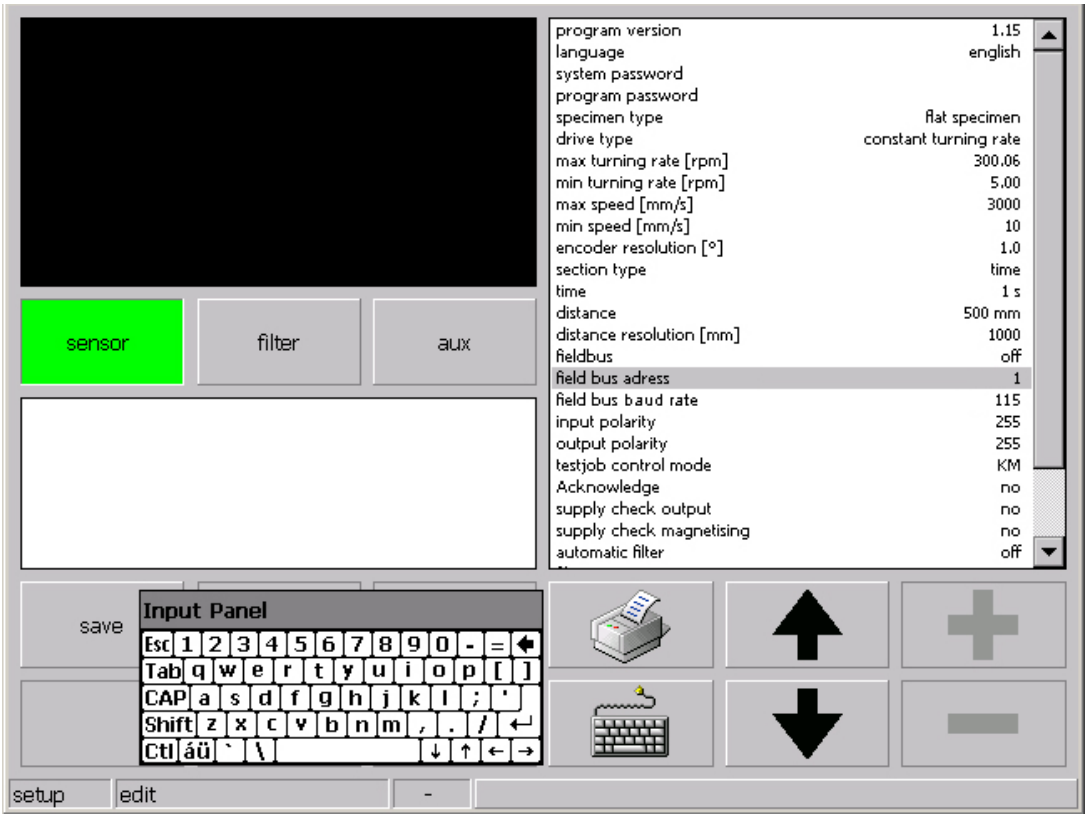


Fig. 33: SND40 Fieldbus address

The fieldbus can be switched off. Then the unit is like an I/O SND40.

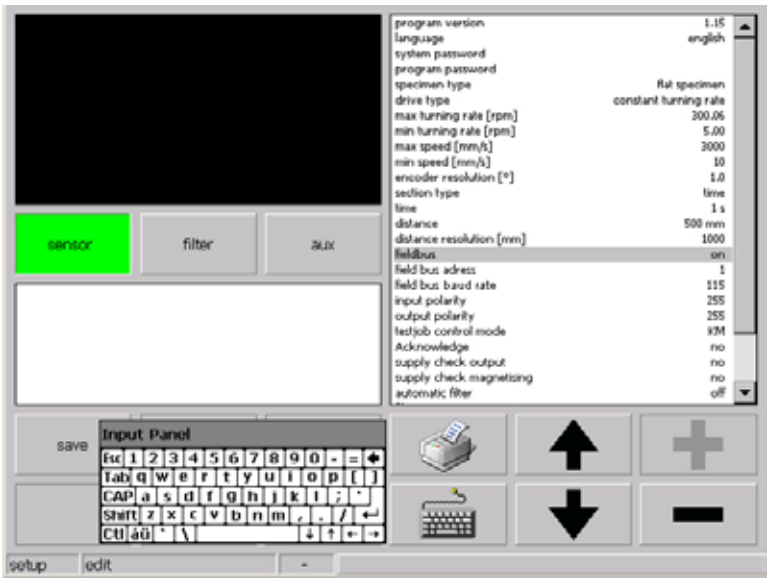


Fig. 34: SND40 Fieldbus On

Description	
1.	Select the parameter *"Fieldbus"* with the ↑ key.
2.	Set the parameter *"Fieldbus"* with the + key to ON
3.	Close the keyboard (input panel) with the < keyboard > key.

5.2.5 GSD file for Profibus

The GSD file contains specific configuration data of the Slaves. The data must be known to the Profibus Master. The manufacturers of the Profibus master supply the tools for integrating the GSD file into the Profibus network. For example, the Siemens “step 7 Tools” are suitable for this. ROLAND ELECTRONIC does not supply such tools, since they must be orientated according to the interface conception of the masters.

The GSD file is supplied on a CD or can be downloaded from the ROLAND ELECTRONIC homepage.

5.2.6 GSD file for ProfiNet IO

The GSD file contains the specific configuration data of the device. The data must be known to the Profibus controller. The manufacturers of the Profibus controller supply the tools for the integration of the GSD file into the Profibus network. Roland Electronic does not supply such tools, because they have to be compatible with the interface design of the controller.

The GSD file is supplied on a CD or can be downloaded from the ROLAND ELECTRONIC homepage.

5.2.7 CSP file for CC-Link

To simplify network configuration, CC-Link devices may be associated with CC-Link System Profile, also known as a CSP-file. This file contains a description of the device and can be used by some CC-Link system utilities to simplify the configuration process. The CSP file is supplied on a CD or can be downloaded from the ROLAND ELECTRONIC homepage.

One „occupied Station“ is used. The station type is “Remote Device”.

2 Byte are Bit Data Area, 2 Byte are System Area and 4 Byte Word Data Area. The meanings of the Bit are explained in chapter 5.1.

Link Input RWrn(Roland R1000 => PLC)

Bit data area: not used

System area: Bit 3 = Remote Ready *1)

*1) Remote Ready: after Roland SND40 is ready for Data exchange the signal Remote READY is set. If Remote READY is off the Data in the user area are not valid.

Word data area 2 Word

Word number	Roland Byte	Function
RWr0	**RWr0.0-7**= BIN1 **RWr0.8-F**= BIN0	Ready / Not used General Control
RWr1	**RWr1.0-7**= BIN3 **RWr1.8-F**= BIN2	Fault identification Active Program number

Link Output RWwn (PLC => Roland R1000)

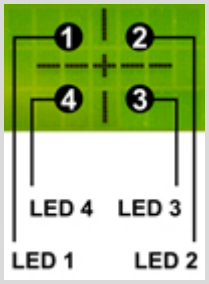
Bit Data area: not used

System area: not used

Word data area 2 Word

Word number	Roland Byte	Function
RWw0	**RWw100.0-7**= BOUT1 **RWw100.8-F**= BOUT0	Not used General Control
RWw1	**RWw101.0-7**= BOUT3 **RWw101.8-F**= BOUT2	Not used Program number

For diagnostics, the LEDs at the fieldbus module may help.

Status Indicators				
	Nr.	LED	State	Description
	LED 1	RUN	Green On	Normal operation
			Green Off	Network non-participating or timeout status No power on the module
	LED 2	ERRL	Red On	CRC Error detected Illegal station number or illegal baud rate detected
			Red Off	Normal Operation No power on the module
	LED 3	RDLED	Green On	Data being received
			Green Off	No data reception No power on the module
	LED 4	SDLED	Green On	Data being transferred
			Green Off	No data transmission No power on the module

5.3 Monitoring the Inputs / Outputs of the Control

On triggering the unit via the PLC-IO-interface, the correct function can be checked by the reaction of the unit.

1) After the measurement has been initiated with the signal "*IN0 Measuring Start*", the output signal "*OUT 7 Motor*" must switch to HIGH within 100 ms. If not, a fault condition exists.

2) After the max. measurement time (depending on tube diameter, rotation rate and program parameter "*Transient Time*") the SND40 must have switched the output "*OUT7 Motor*" to LOW. If not, a fault condition exists.

Sequence plan for measuring:

1. Prepare the tube for measuring
2. Check if signal "*OUT2 Ready for measuring*" is HIGH
   If YES, continue. If NO, the unit is not ready for measuring (e.g. during Teach-In)
3. Switch the signal "*IN0 Measuring Start*" to HIGH and start the tube turn
4. Check if signal "*OUT7 Motor*" is HIGH within 100ms
   If YES, continue. If NO, error condition exists
5. When signal "O*UT7 Motor*" is LOW, stop the tube turn instantly.
   At the same time, monitor whether the signal "*OUT7 Motor*" is not LOW after time xx otherwise a fault condition exists
6. Evaluate the signal "*OUT6 reduced detection capability*" or "*OUT5 Error*"
7. Switch the signal "*IN0 Measurement Start*" to LOW
8. Remove the tube.
   The time xx depends on the tube diameter, the tube rotation rate and the set transient time.

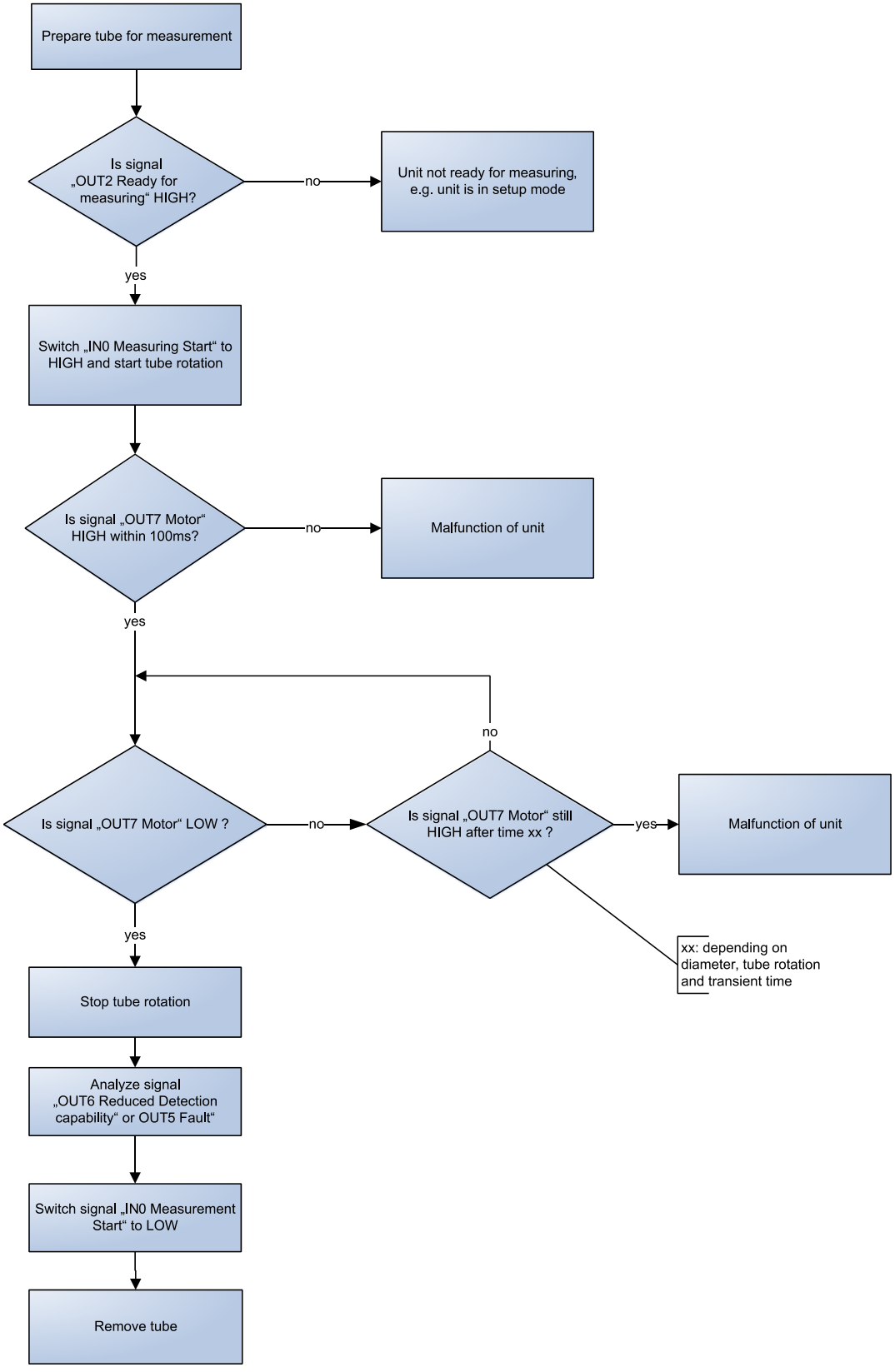


Fig. 35: Flow chart for tube measurement

6 Start-up

6.1 Prerequisites for Start-up

The following form helps to clarify whether the SND40 can be put into operation. This is the case if all items can be checked out with YES.

Item	Yes	No
For sensor type EC9…,NS9…/NS12…:- Sensor with rubber buffers mounted and alignment checked [5]		
All other sensor types: Sensor mounted, alignment and distance checked [6]		
Line-up facility for sensor is functional		
Tube drive and tube feeder is functional		
SND40 is mounted		
Power supply for SND40 is connected and checked for function		
Sensor cable is laid out, connected and checked		
PLC interface is connected and checked for function (LEDs)		
PLC is programmed (Setup and Auto operation) and checked for function		
Tube drive is running slip-free, in Auto mode as well as in Setup mode		
Suitable tubes in sufficient quantity (>10) available for tests		
Machine can be operated in Auto mode as well as in Setup mode at the day of Start-up		
Operator and maintenance staff is ready for training		

[5] When the sensor is contacting the material, all rollers are turning if the tube rotates

[6] Marking for adjusting the sensor aligns with the weld seam. If the tube rotates, the distance remains constant and smaller than the maximum stated in the data sheet

6.2 Menu tree

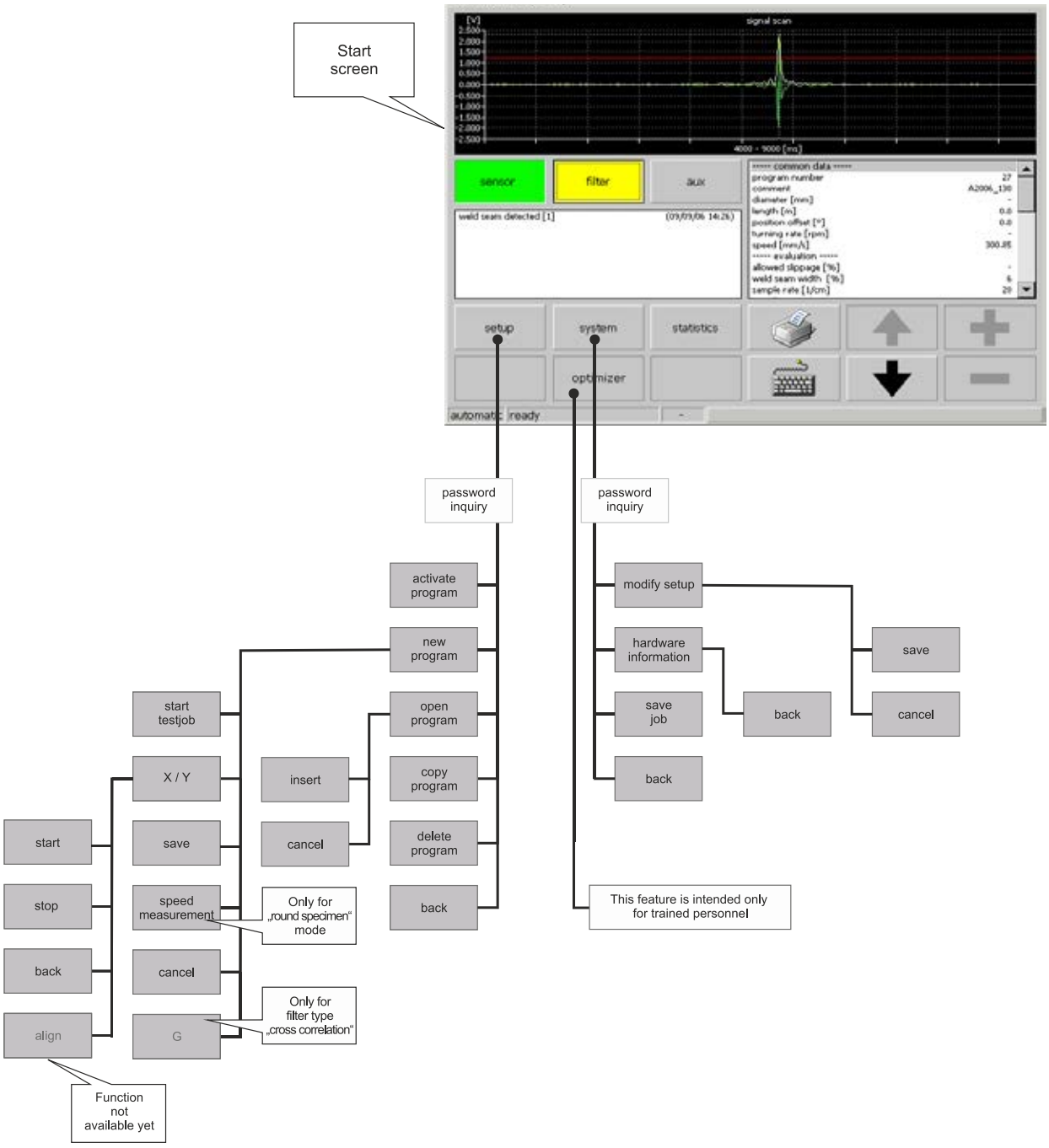


Fig. 36: SND40Menu tree

6.3 Basic settings / Standard values

6.3.1 Program parameters

Standard values – Eddy current

Parameter	**Standard value**	Alternative	Application-specific	Standard
General data				
Program number:	**1**			X
Description			X	
Diameter [mm]:	**30.0**		X	
Length [m]:	**-**			
After-run [°]:	**0**		X	
Rotation rate [rpm]:	**-**			
Speed [mm/s]:	**100**		(X)	(X)
Analysis				
Slip rate [%]	**3.0**		(X)	X
Weld seam width [%]:	**3**		(X)	X
Samples per cm:	**30**			X
Sensor signal:	**Eddy current**			X
Filter type:	**Flank Extreme / SAF**[7]	Absolute	(X)	X
Detection grade:	**good**		(X)	X
Group:	**-**			
Correlation factor:	**-**			
Eddy current parameters				
Low pass [Hz]:	**Auto**			
High pass [Hz]:	**Auto**			
Frequency [kHz]:	**50.0**		(X)	(X)
Phase [°]:	**0**		X	
Signal type:	**Y-component**	Amount		X
Input gain [dB]:	**20**		(X)	
Output AC voltage [V]:	**20**			X
DC voltage offset [mV]:	**-**			X
Y stretch:	**1**			X
Signal parameters				
Signal gain:	**20**			X
Magnetization				
Rel. magnetic flux [%]:	**100**		(X)	X
Transient time [ms]:	**1500**			X
Switch-off delay [ms]:	**0**			X
Indication parameters				
Picture intervals:	**5**			X

[7] not before software version 1.15

Standard values - Leak flux

Parameter	**Standard value**	Alternative	Application-specific	Standard
General data				
Program number:				X
Description:			X	
Diameter:	**30.0**		X	
Length [m]:	**-**			
After-run [°]:	**0**		X	
Rotatio rate [rpm]:	**-**			
Speed [mm/s]:	**100**		(X)	(X)
Analysis				
Slip rate [%]	**3.0**		(X)	X
Weld seam width [%]:	**5**		(X)	X
Samples per cm:	**30**			X
Sensor signal:	**Leak flux**			X
Filter type:	**Flank Extreme /SAF**[8]	Flank Standard	(X)	X
Detection grade:	**good**		(X)	X
Group:	**-**			
Correlation factor:	**-**			
Eddy current parameters				
Low pass [Hz]:	Auto			
High pass [Hz]:	Auto			
Frequency [kHz]:	50.0		(X)	(X)
Phase [°]:	0		(X)	(X)
Signal type:	Y Component	Amount		X
Input gain [dB]:	20		(X)	
Output AC voltage [V]:	20			X
DC voltage offset [mV]:	-			X
Y stretch:	1			X
Signal parameters				
Signal gain:	1			X
Magnetization				
Rel. magnetic flux [%]:	**100**		(X)	X
Transient time [ms]:	**1500**			X
Switch-off delay [ms]:	**0**			X
Indication parameters				
Picture intervals:	**5**			X

[8] not before software version 1.15

6.3.2 System parameters

Standard values – Eddy current / Leak flux

Parameter	Eddy current		Leak flux	
	Standard value	Alternative	**Standard value**	Alternative
Program version:				
Language:				
Product geometry:	**Round material**		**Round material**	
Driving principle:	**Constant speed**	Constant turning rate	**Constant speed**	Constant turning rate
Max. rotation rate [rpm]:	**300.06**		**300.06**	
Min. rotation rate [rpm]:	**5.00**		**5.00**	
Max. speed [mm/s]:	**3000**		**3000**	
Min. speed [mm/s]:	**10**		**10**	
Angular resolution [°]:	**1.0**		**1.0**	
Interval forming:	**Time**		**Time**	
Time interval:	**500 ms**		**500 ms**	
Path interval:	**500 mm**		**500 mm**	
Path resolution [mm]:	**1000**		**1000**	
Fieldbus:	**off**		**off**	
Fieldbus address:	**1**		**1**	
Fieldbus baud rate:	**115**		**115**	
Inputs to logics:	**255**		**255**	
Outputs from logics:	**255**		**255**	
Selection test job:	**KM**	PLC	**KM**	PLC
Confirm mode:	**yes**	no	**yes**	no
Monitoring of outputs:	**yes**	no	**yes**	no
Monitoring of magnetizing current	**yes**	no	**yes**	no
Filter automatics:	**off**	on	**off**	on
Filter parameters:	**5**		**5**	
Effective width of probe [mm]:	**4**		**4**	
Monitoring of slip:	**on**	off	**on**	off
Statistics:	**on**	off	**on**	off

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7 Operation

7.1 Switching on and Powering up

The system will be switched on by applying mains power. The operating software will then automatically be loaded. This procedure can require up to 30 seconds.

While the operating software becomes loaded, the system will check the voltages, cables and sensors. If a fault condition is detected here, the system will show respective messages.

Has the operating software been loaded, the system automatically switches over to the measurement mode and loads the last used measurement program. If another measurement program is to be used, the operator must change over to the program list (with the <SETUP> key) and choose a suitable program.

7.2 Measuring operation

After powering up, the system automatically switches over to the measuring operation.

Screen area	
1:	Visualization of the sensor signal (original signal und digitally filtered signal) and a control signal. Indication of weld seam width according to entry "*weld seam width [%]*".
2:	List of measuring results.
3:	List of parameters of the activated measuring program.
4:	Indication of program status and operation condition, see chapter "*Maintenance and repair*".

Fig. 37: Measuring operation

setup	Changes over to the program selection.
system	Changes over to the system parameter selection.
statistics	Changes over to the statistics function.

	Prints out the signal visualization and a list of the program parameters.
	No key function in this mode.
	Selects the parameters from the list.
	No key function in this mode.

Note:

The result of the weld seam detection is stated in dB (signal amplitude within the weld seam vs. signal amplitude outside the weld seam).

Note:

Starting with firmware version V23 following behaviour has been observed: At a data amount of 5000 values per rotation the signal transmission is suspended. In the display only a horizontal line appears. To avoid this, the parameter "sample rate" can be set to a lower value, for example to 30.

7.3 Setup – Program selection

Administration of the measuring programs.

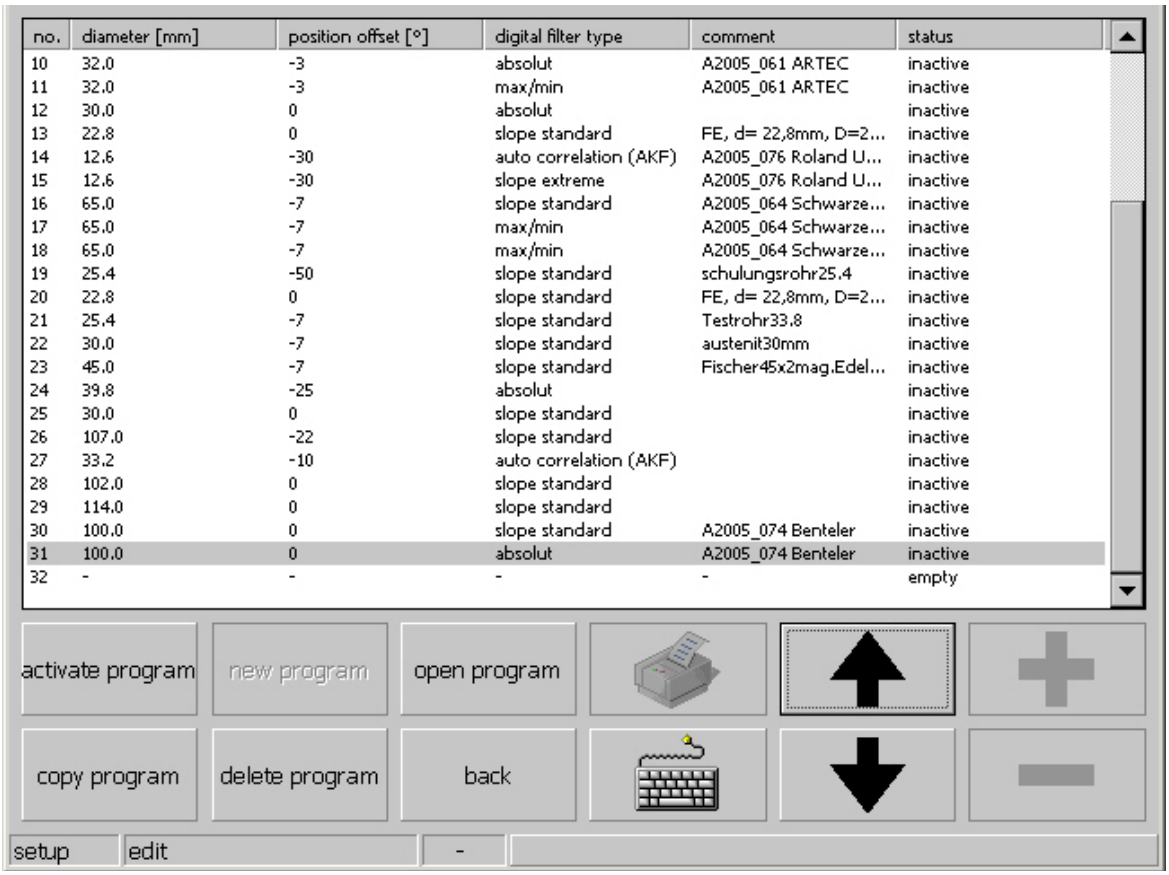


Fig. 38: Setup program selection

activate program	Switches this program active, on which the cursor is just placed. The currently active program will be switched passive.
new program	Sets up a new program at the empty program space, on which the cursor is just placed. Therefor the unit switches over to the mode *"setup operation"*.
open program	The unit switches over to the mode *"setup operation"*.
delete program	Deletes the program, on which the cursor is just placed.
copy program	Copies the program, on which the cursor is just placed on, into the clipboard. For storing this program onto another program place, select an empty program place and press the *"Insert"* key.

	Prints out the program list.
	No key function in this mode.
	Selects the parameters from the list.
	No key function in this mode.

7.4 Setup – Test operation

The screen contains the same functions as shown in the measuring mode. However, the size of the signalling is reduced in favour of the parameter list.

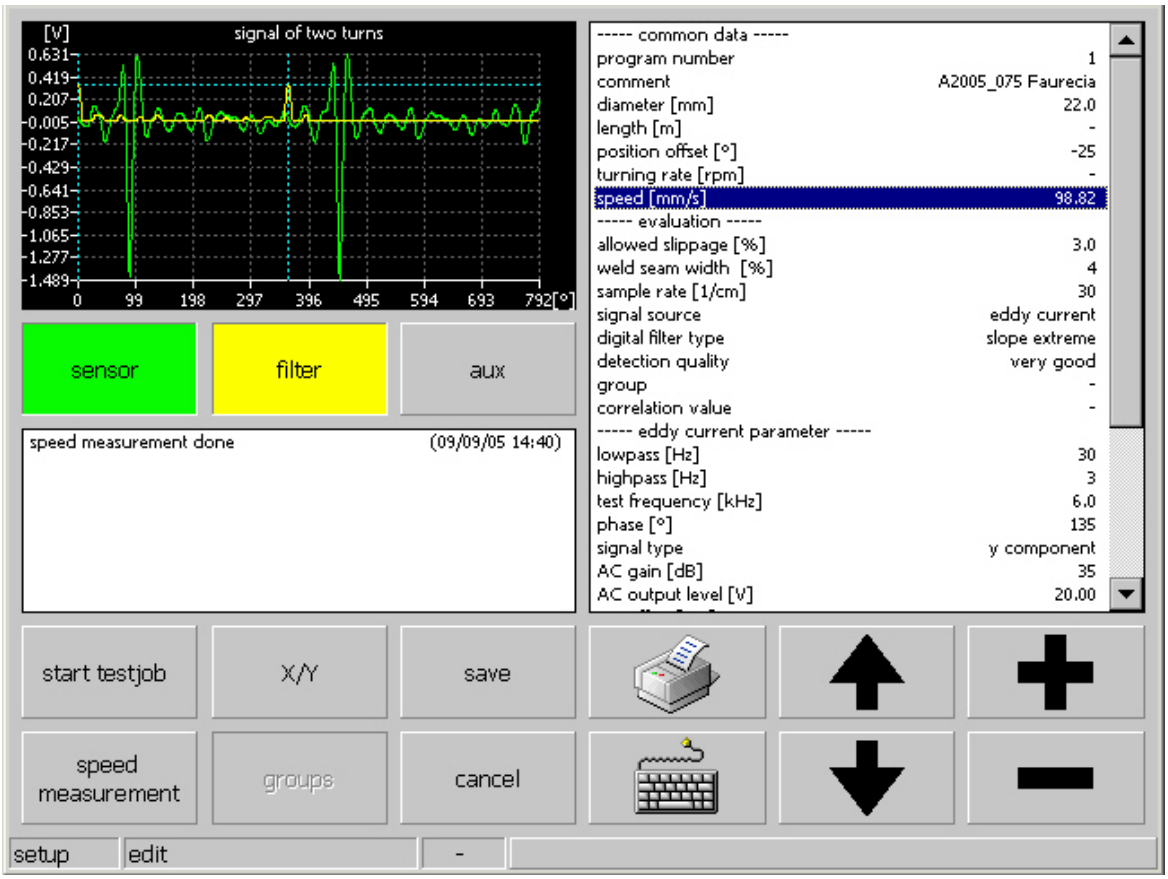
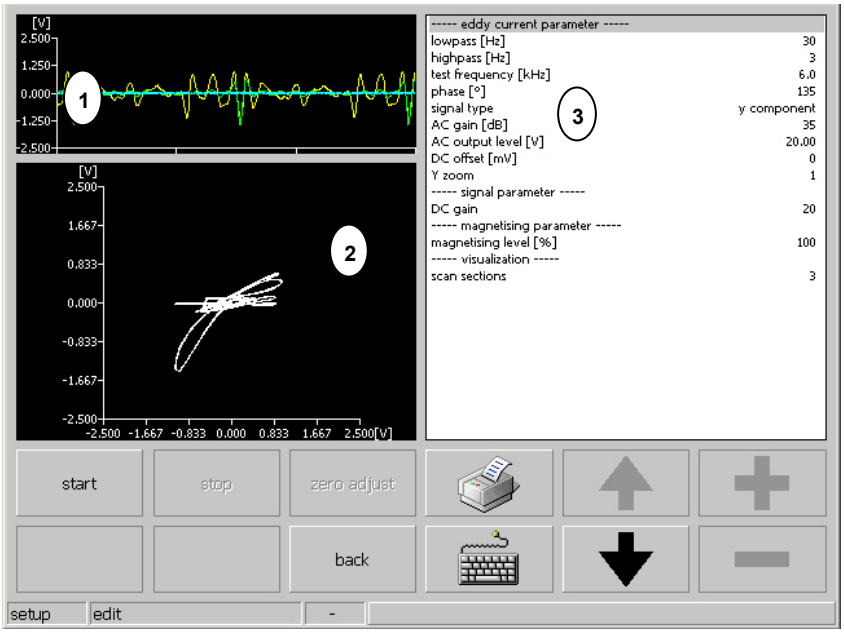


Fig. 39: Setup test operation

start testjob	Starts a positioning. (Signals see chapter 11.1 timing diagram test job with test job PLC or test job KM)		Prints out the signal visualization and the program list.
X/Y	Changes (on signal type “*Eddy current*”) to the mode ”*Setup – X-Y-diagnosis*”.		Inserts the screen keyboard.
save	Stores the settings and returns to the mode ”*Setup – Program selection*”.		Enters the parameter.
speed measurement	Starts measuring the turn speed. (Signals see chapter 11.1 timing diagram speed measurement with test job PLC or test job KM)		Selects the program parameter from the list.
cancel	Returns to the mode ”*Setup – Program selection*” without storing the program parameters.		Changes the program parameter.

7.5 Setup X/Y diagnosis



Screen area	
1:	Indication of the X and Y signals and the control signal vs. time.
2:	2-dimensional indication of the signals of the eddy current sensor.
3:	Indication of all parameters of the eddy current channel and parameters for controlling the X/Y visualization.

Fig. 40: Setup X/Y diagnosis

start	Starts the continuous measuring operation. (Signals see chapter 11.1 timing diagram x/y with test job PLC or test job KM)
stop	Stops the continuous measuring operation.
back	Changes over to the ”setup operation“ mode.

	Prints out the signal visualization and the eddy current parameters.
	No key function in this mode.
	Selects the parameters from the list.
	Changes the program parameters.

X-share of signal: yellow line.
Y- share of signal: green line.

7.6 Statistics function

Evaluation of detection results.

At the left side the events are shown in the rank of appearance, at the right side the accumulation of events since the last reset.

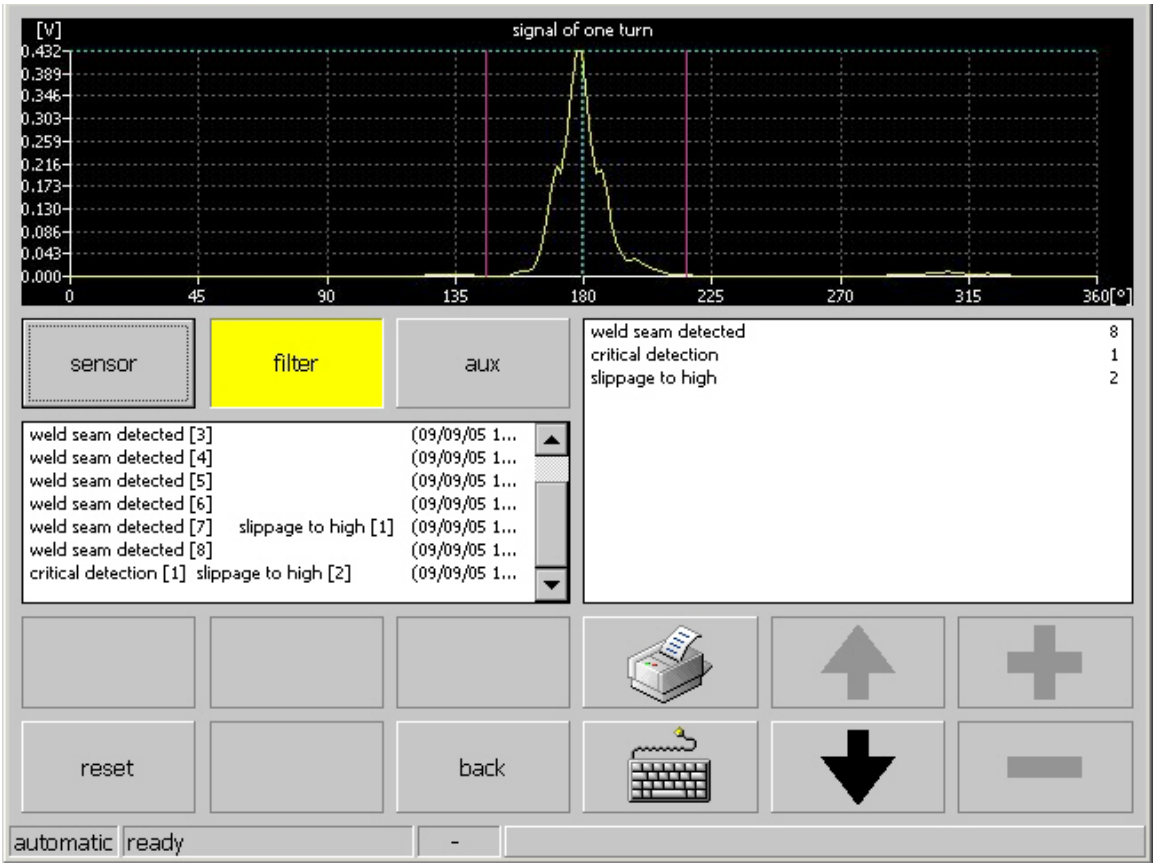


Fig. 41: Statistics function

reset	Resets the event table.		Prints out the signal progression and the parameter list.
back	Exits the statistics function.		No key function in this mode.
			No key function in this mode.
			No key function in this mode.

- Setting the "*Statistics*" system parameter to "*on*" activates the statistics function.
- Setting the "*Create SN file*" system parameter to "*on*" activates storing the statistics values in a log book file.

7.6.1 Generating Log files

The system can generate 3 different Log files:

1. Statistics.log

Generating this file can be switched on with system parameter <*Statistics on/off*>.

Example:

```
[STATISTICS]
GOOD = 148634
BAD = 552
SLIPPAGE = 168
[PROGRAM]
ACTIVE PROGRAM = 2
[ERROR]
CURRENT_POSITION = 17
ERROR1 = 0X00C
ERROR2 = 0X00C
ERROR3 = 0X00C
```

2. SNlog.1234

Generating this file can be switched on with system parameter <*SN file on/off*>

The file extension encrypts the current date (year*365 + month*31 + day). After 14 days the oldest file will automatically be deleted. (Statement of signal-noise-ratio from SND version 1.17)

Here all messages are stored, which are shown in the status bar.

Example:

```
Weld seam detection good  14dB     10/04/07   09:47
Weld seam detection good  12dB     10/04/07   09:48
PM: AC overdrive     10/04/07   09:48
Weld seam detection not possible  0.9dB     10/04/07   09:49
...
```

3. Signal1.log

Shows the digital values of the measured tubes.

The file can be accessed with keys <*System*> <store *Job*>. There will be max. 10 files generated, then the first file will be overwritten.

Example:

```
ProgNo 4, 14/02/07 23:53
Weld seam detection not possible 0.9dB      (inserted from SND version 1.17)
Original, Filter, Check
2503, 382, -83
1722, 180, -47
2424, 358, -61
1448, 127, -67
654, 26, -34
-1646, 165, -49
-1742, 185, -7
```

7.7 System Parameters

Setting the system parameters

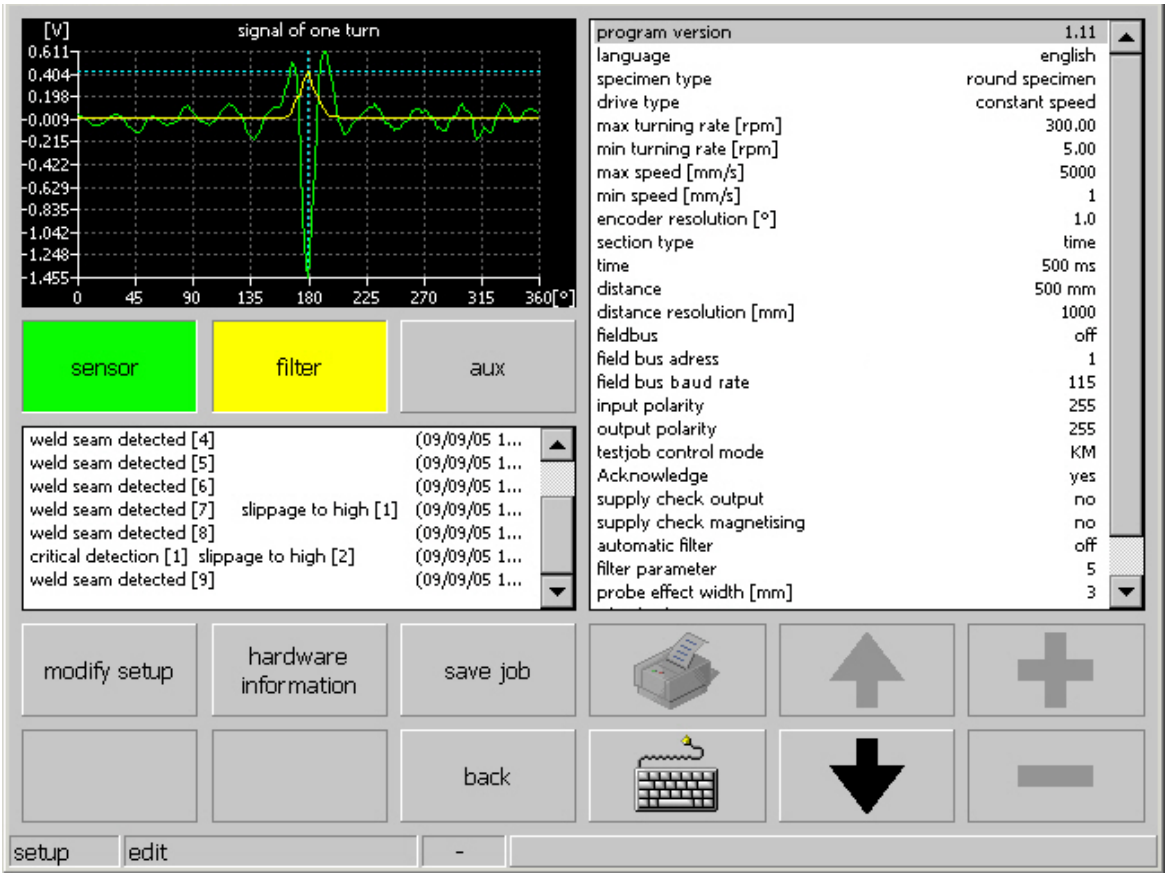


Fig. 42: System parameters

modify setup	Changes the current parameter settings.
hardware information	Shows the hardware parameters.
save job	Stores the data of the last measurements [signal1.log].
back	Returns to the measuring mode.

	Prints out the signal progression and al list of the eddy current parameters.
	No key function in this mode.
	Selects the parameters from the list.
	No key function in this mode.

7.7.1 Modifying of system parameters

If system parameters need to be changed, proceed as follows:

- Press the <*System*> key when being in the measurement mode.
- Press the <*modify setup*> key.
- If a password is existing, the password inquiry appears.
  Then type-in the valid password and confirm with <Enter>. Only then access to the system settings is permitted.
  If no password is existing, the password inquiry will not be called up.
- With the <*arrow*> keys access the entry to be changed from the parameter list to the right and change with the <+> / <-> keys.
- With the <*save*> key store the entry or dismiss with <*cancel*>.
- If a restart is required, the system will perform it automatically (systems following serial number 400059 / SW version 1.16).

It is recommended to note down all changes, in order to enable easy return to the previous settings in case of doubt.

7.8 Creating and editing of measuring programs

In the measuring programs the parameters for detecting and positioning the weld seam are stored.

We recommend to create product specific / tool specific measuring programs, in order to consider all variables (material, wall thickness, width of weld seam, etc.) which are important for optimal detection.

For creating / editing a measuring program first insert a sample tube into the turn drive and with the <*Program*> key change over to the "*Setup – Program selection*" mode. There select an empty program place or the program to be edited.

Note:
Creating of new programs can be simplified by copying of existing programs and modifying them, if they are intended for similar tubes.

1. With the key <*Edit program*> change over to the "*Setup – Test operation*".
2. Enter parameter "*Description*" and "*Diameter*" (only for initial editing).
3. Enter parameter "*Rotation*" or "*Speed*" (coarse value).
4. Enter parameter "*Sensor signal*":
   When using the sensors NS9S, NS12S or the NSL sensors, select "*Leakage flux*";
   when using the sensors NS9-EC…, select "*Leakage flux*" or "*Eddy current*";
   when using the sensors EC…, select "*Eddy current*".
5. Press the <*Speed measurement*> key:
   When measuring the speed, the parameter „*Rotation*" or "*Speed*" should have a plausible value.
   In the visualisation of the signal there should be 2 weld seam signals visible:

Fig. 43: Speed measurement

6. Press the <*Start test job*> key.

7. Find the position of the weld seam and enter the deviation from the nominal position (in parameter ”*position offset*“).
8. Press the <*Start test job*> key.
9. Check the position of the weld seam and correct the parameter “*Position offset*” (if required).
10. If the position of the weld seam matches with the nominal position, turn the sample tube for 180° and repeat the test run. In case of deviation from the nominal position change the parameter “*Position offset*” for half of the deviation.
11. Repeat the test run in both orientations, the same error angle should result.
12. Check the parameter ”*Detection quality*“.
    The default value ”very *good*“ is only practicable for measuring results *“very good detection“* and *“good detection“*. For measuring results “s*atisfactory detection*“ the parameter “*Detection quality*“ should be set to “*good*” or *“satisfactory”*.
13. If the error angle is too large, if no satisfying positioning could be reached or if the unit shows error messages (e.g. *”slippage too high“*), please refer to the chapter “*Optimizing the weld seam positioning*“.
14. Press the <*Save*> key to store the parameters and exit the mode “*Setup – Edit operation*“.
15. With the <*Activate program*> key the created measuring program will be activated.

7.9 Optimizing the positioning of the Weld seam

If no satisfying results can be achieved with the default settings, the changing of certain parameters can often cause improvements.

For more details see section “General parameters” and “Special parameters for sensor signal “Eddy current””.

7.10 Setting-up and changing the system / program password

The passwords for system parameters and program parameters are changed in the same manner.

When entering the password, the system distinguishes between capital letters and regular letters!

1. Press the <*System*> key and then the <*modify setup*> key.
2. If a password is already existing, the password inquiry will appear. Then type-in the current password and confirm with <Enter>. Only then access to the system settings is permitted.
   If no password is existing, the password inquiry will not be called up.
3. Activate the <*Onscreen keyboard*>.
4. With the <*Arrow*> keys select the “*system password*” resp. the “*program password*”.
5. Enter the new password.
6. With the <*Save*> key confirm the entry.
7. If re-starting is required, the system performs it self-acting.

7.11 General parameters

Parameter:	*"Weld seam width"*
Standard value:	3 %
Value range:	1 - …

Signals, which are within the specified circumferential range (referred to the determined weld seam position), will not be used for evaluating the seam detection.

If weld seams are rather wide (e.g. at ERW-welded steel tubes with diameter >50mm), then parts of the weld seam signal can (at standard setting) be detected as interference signal. This effect can be avoided by increasing the value.

With this value the max. positioning deviation is determined.

Parameter:	*"Samples per cm"*
Standard value:	30
Value range:	1 - 120

This value specifies the number of samples (scans) per centimetre of material passing the sensor.

In order to reach a resolution of at least 1°, more than 360 samples must be drawn during one turn of the tube. A proven value is at approx. 600 samples.

From this it can be easily calculated, which sample value is practicable for a tube diameter.

Rough values:

Tube Ø	Samples/cm	samples/circumference.
> 50 mm	30	540
> 100 mm	20	600
> 200 mm	10	600
< 500 mm	5	750

Parameter:	*"Slippage"*
Standard value:	3 %
Value range:	0,1 - …

Determines the max. permissible slip rate (= variation of turn speed). If the unit reports too large slip rates, the turn drive system should be inspected first. If a larger slip rate must be accepted, the resulting worse positioning accuracy must be considered.

Parameter:	*"Filter type"*
Standard value:	Flank extreme / SAF[9]
Value range:	-

In the SND40 the sensor signal becomes digitally filtered. The result serves for seam detection and positioning.

Parameter:	*"Rel. Magnet flux [%]"*
Standard value:	100 %
Value range:	0 - 100 %

Changing the value causes stronger / weaker magnetization of the material being in front of the sensor.

When using the EC-…-sensors, this value should be 0%.

When using the NS9S and NS12S sensors, this value should be 100%.

When using combo sensors, changing the value can result in better signal quality and requires adjustment of the parameter *"Phase"* on use of the signal type *"Y Component"*.

Parameter:	*"Settling time"*
Standard value:	
Value range:	0 - 5000

Time, which the magnetic field requires after being switched on for building up the magnetic flux inside the material.

In most cases, a time of 1500 ms is sufficient.

Parameter:	*"Signal gain"*
Standard value:	20 (eddy current), 1 (leakage flux)
Value range:	1 - 100

Increases the signal amplitude, in order to obtain a better evaluation.

[9] from software version 1.15

7.12 Special parameters for sensor signal „Eddy current“

Parameter:	„Low *pass*“	Reducing the value improves the signal quality under influence of RF interferences (e.g. frequency converters, annealing facilities).	In the standard setting the suitable value (frequency) will be automatically entered. Another individual value can only be entered and used if the system parameter “*Filter automatic*” has been previously set to “*off*” . Formula for determining the main frequency: $f_H = \frac{v[mm/\sec]}{2 \times w_b}$ Example: Tube-Ø = 63,5 mm, Circumference = approx. 200 mm, Rotation rate = 1 turn/second Effective width w_b = 4mm $f_H = \frac{200}{8} = 25Hz$ For Low pass: Lp = $3f_H$ = 75 Hz For High pass: Hp = $1/3f_H$ = 8 Hz
Standard value:	Auto		
Value range:	-		
Parameter:	„*High pass*“	Enlarging the value improves the signal quality under influence of LF interferences (e.g. variations of distance due to insufficient sensor holders or uneven tubes).	
Standard value:	Auto		
Value range:	-		

Parameter:	*“Frequency“*	Enlarging the value improves the detection of weld seam characteristics at the exterior surface of the material (e.g. jutting-out of seam at outside). Reducing the value improves the detection of weld seam characteristics at the interior surface of the material (e.g. jutting-out of seam at inside). Changing the frequency normally requires adaptation of the parameters *”Phase“* and *”Input gain*“. For most applications a value of 25 - 100 kHz is optimal.
Standard value:	50 KHz	
Value range:	1 - 800 kHz	

Parameter:	*“Phase“*	Changing the value turns the eddy current signal at the X/Y level, it is used for optimizing the signal on use of the signal type ”*Y Component*“
Standard value:	none	
Value range:	0 - 359°	

Parameter:	*“Signal type“*	On analysing the amount, the eddy current signals are evaluated independently from their phase position (X/Y indication). This setting should only be used for very pithy weld seam signals with a weld seam detection not affected by noise signals. The usage of the Y Component setting can often improve the signal quality. Therefore, the parameter “*Phase*” must be set accordingly.
Standard value:	Y Component	
Value range:	Amplitude, Y Component	

Parameter:	*“Input gain“*	Increasing the value can result in better signal quality, but also in overdriving the input stage. When changing the frequency, this parameter must be adjusted.
Standard value:	20 dB	
Value range:	20 dB - ...	

Parameter:	“*Output AC voltage*“	This value should only be changed in exceptional cases. Decreasing the value will decrease the sender signal and thus attenuate the sensor signal.
Standard value:	20 V	
Value range:	0 - 20 V	

Parameter:	*“DC Voltage offset [mV]“*	This parameter should not be changed.
Standard value:	0	
Value range:		

7.13 Setup – Test operation X/Y

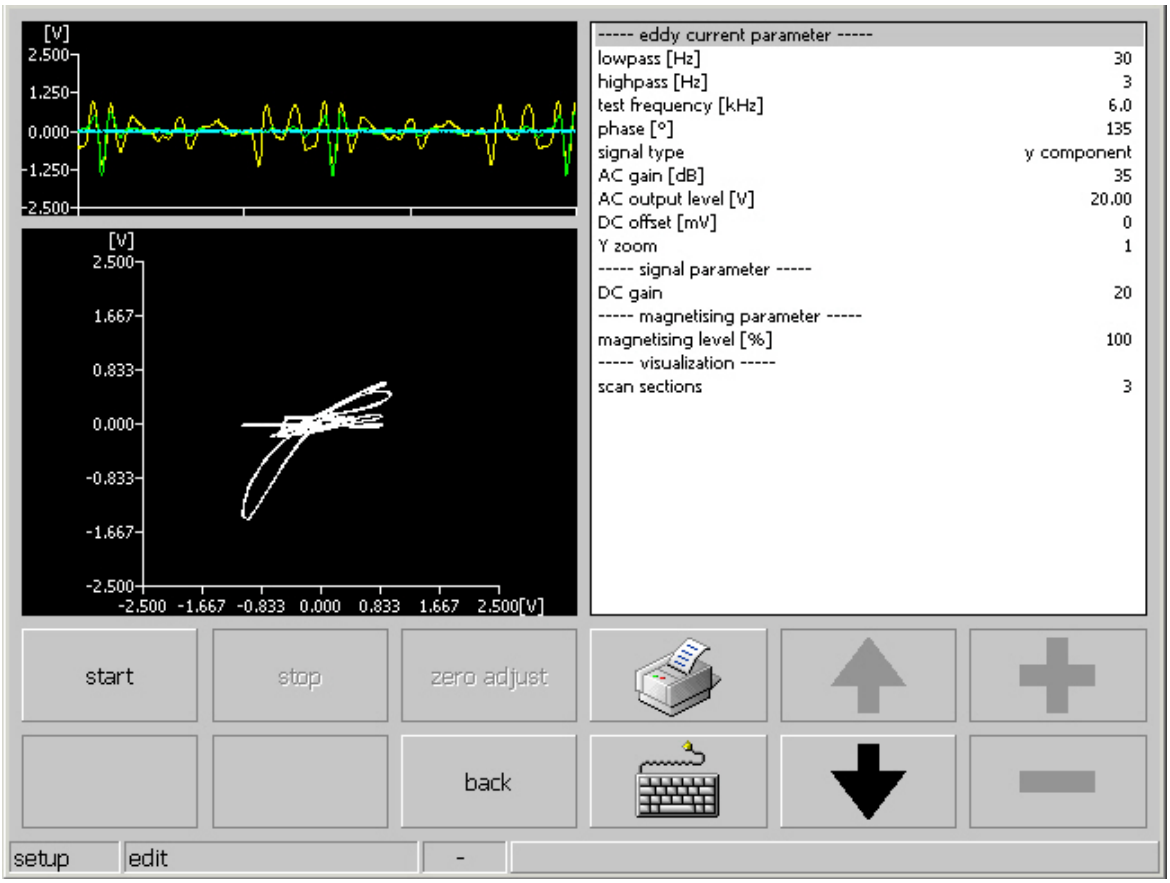


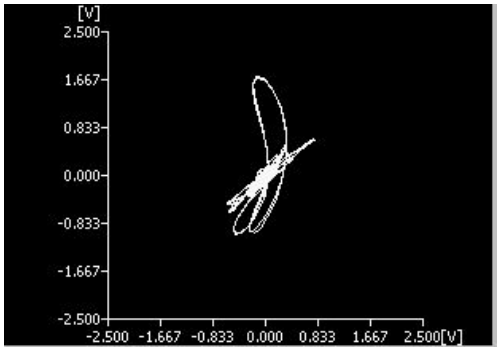
Fig. 44: Setup the test operation

The function “X/Y“ serves for checking and optimizing the program parameter settings (on signal type “*eddy current*“).

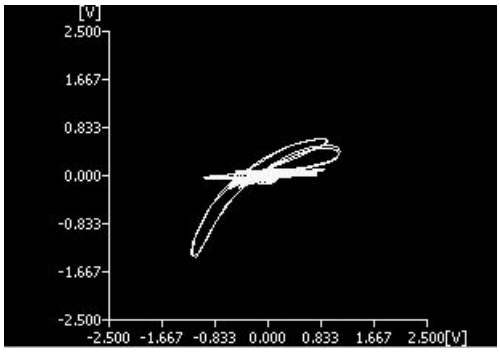
In this mode the signal is shown two-dimensionally. At the signal type “*Y Component*” only the vertical signal share is considered.

X-share of signal: yellow line.
Y- share of signal: green line.

The signal display is in this mode two dimensional. The signal type "Y component" is evaluated only by its vertical signal component.
Therefore the signal of the weld seam regularly is aligned vertically with the parameter “*Phase*”.



In the shown case further improvement can be reached by setting the parameter “*Phase*“ differently. The “noise” signal (which does not belong to the weld seam) becomes horizontally oriented:



Though now not the full amplitude of the weld seam signal becomes evaluated, the signal-to-noise ratio is remarkably better and thus the positioning is more safely.

With the following parameters the X/Y indication and the X/Y gains can be controlled:

Parameter:	“*Scan sections*“	This parameter sets the storage time for the display. The length of the picture intervals is set in the system parameter list.
Standard value:		
Value range:		

Parameter:	“*Y zoom*“	This parameter sets the gain for the vertical signal shares.
Standard value:	1	
Value range:	1 - …	

8 Fault messages, causes and remedies

Text of error message	Error No. via Field bus	Possible cause	Remedy
Error while initialization of WIN sockets.	-	Windows system error	Re-install Windows CE
Unknown error.	-	Unspecific error.	Re-start
Invalid data received.	20	Processor module is sending invalid data. Bus connection or hardware might be defective.	Check RS232 connection between processor module and communication module – change hardware.
System configuration was not converted.	-	Invalid values for system settings or memory error.	Check / re-enter parameters, change hardware if required.
File error.	-	File cannot be read or has a wrong format.	Create the program newly.
Internal error.	-	Unspecific error.	Re-start.
Program initialization failed.	-	Error in the program file.	Re-teach.
Frequency table not loaded.	-	Error in the frequency file.	Re-install.
System configuration was not stored.	-	Error in Flash.	Change KM hardware.
System configuration was not loaded.	-	Error in the system file.	Re-enter system parameters or change KM hardware.
Unable to copy program.	-	File already existing, insufficient memory space or error in Flash.	Delete unused files, check name.
Unable to store program.	-	File already existing, insufficient memory space or error in Flash.	Delete unused files, check name.
No active program.	-	No valid program selected.	Select a valid program.
Invalid program number.	-	No valid program selected.	
Program parameter xxx invalid. xxx = no. of parameter (see rank in program file).	20	Special parameter is invalid.	Re-enter parameter.
System parameter xxx invalid. xxx = no. of parameter (see rank in system file).	-	Special parameter is invalid.	Re-enter parameter.
Parameter xxx in system settings invalid. Please modify and restart system. xxx = designation of parameter, e.g. “Language”.	-	Special parameter is invalid.	Re-enter parameter.
Unable to save job.	-	File already existing, insufficient memory space or error in Flash.	Delete unused files, check name.
Invalid groups.	20	Data quantity of groups (auto correlation) does not match.	Delete program, re-teach.
PM: receive buffer overflow.	95	Too much data to proc. module.	Check RS232 connection / Hardware error.
PM: character not in hex format.		Error at data transmission.	
PM: message error - no STX.		Error at data transmission.	
PM: message – checksum wrong		Error at data transmission.	

Text of error message	Error No. via Field bus	Possible cause	Remedy
Invalid groups.	20	Data quantity of groups (auto correlation) does not match.	Delete program, re-teach.
PM: receive buffer overflow.	95	Too much data towards processor module.	Check RS232 connection / Hardware error.
System error.	95	System error.	Re-start / Hardware error
PM: message error - no STX.	95	Error at data transmission.	Check RS232 connection / Hardware error.
PM: char not received in hex.	95	Error at data transmission.	Check RS232 connection / Hardware error.
PM: message checksum error.			
PM: message ID not in hex.			
PM: message length invalid.			
PM: unknown message ID.			
PM: unexpected message.			
PM: XY data transfer to slow.	10	Data speed too high in x-y operation, or manual entries during measuring.	Possible due to system, Re-start function. Refrain from entering during measuring.
SPS: 24V power supply error.	11	External 24V are not recognized.	Apply 24 V, replace PM hardware.
PM: Sensor cable error.	13	Sensor not connected, sensor cable defective.	Connect sensor.
SPS: Selected program number 0 is invalid.	14	Program no. 0 selected.	Select valid program.
PM: transmit buffer overflow.	95	Communication module does not react or is too slow.	Check RS232 connection / Hardware error.
PM: AC overdrive.	16	AC gain is too large.	Adjust gain. Reduce output voltage if gain is already to minimum.
PM: Data transfer too slow.	17	Manual entries during measuring.	Refrain from entering during measuring.
PM: Speed measurement not possible.	98	No reproducible tube circumference signals. Diameter or speed might be wrongly entered.	Correct diameter / speed, try another tube.
PM: Error bus module.	-	Fieldbus module not detected.	Check Fieldbus module.
PM: Bus transfer fault.	-	Fieldbus communication blocked for short period, due to high processor load.	Seldom possible due to system, problem will be redressed automatically. Check Fieldbus module, if frequently occurring.
PM: Short-circuit at sensor	18	Short-circuit	Check cable or sensor
PM: Flux leakage module defect	19	Fuse defect	Check fuse at flux leakage module
PM: Fan defect	21	Fan no signal	Check fan

Note also important instructions in following chapters:

2.5.6 – Reliability of Detection

2.7 – Measures for improvement of Weld Seam Detection

8.1 Troubleshooting at problems

- No detection of Weld Seam
- Too many „Critical Detections“
- Too many „ Wrong positioned“

are attributed to:

- Faults in machine construction (consult chapter 13.1 „Checklist“)
- Incorrect settings (consult chapter 13.1 „Checklist“)
- Deficiencies in maintenance (consult chapter 10 „Maintenance“ and chapter 13.1 „Checklist“)
- Product effects (consult chapter 2.7.1 „Factors that influence the Weld Seam Characteristic and the Detectability of Weld Seams“ and chapter 13.1 „Checklist“)

8.2 Creation of a sample tube

We recommend creating a sample tube for better delimitation of possible occurring problems:
Archive each type of tube an label it as follows:

Tube Type:	
Program number:	
Detection result (dB):	_____ dB
Date:	

If the detection quality becomes in the course of operation significantly bad, i.e. the number of outputs „*critical detection*“ is rising significantly, please insert the sample tube and check the result.

Detection result:	**Measure:**
The detection result has significantly changed	Make a check as indicated in the appendix check list for fault identification.
The detection result is the same	Use an adapted program; the characteristics of the weld seams have changed.
For further instructions follow previous chapter 7.1	

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9 Technical data

9.1 Control unit SND40

Technical Data	
Mains voltage:	85...264 VAC
Power consumption:	<110 W
Switch-on current:	<15 A/115V, <30 A / 230V
External fuse protection:	3.15 A medium-blow
Weight:	12 kg (26.5 lbs.)
Dimensions of industrial enclosure (L x W x H)* :	approx. 420 x 234 x 305 mm
	*approx. 435 x 234 x 305 mm (starting May 2016)
Protection class of industrial enclosure:	IP54
Ambient temperature:	0 - 40 °C (operation)

Further characteristics:
- Embedded PC with Windows CE operating system for user interface
- Real-time computer (ARM7) for detection and positioning
- Programming and operation via 10" Touchscreen
- 31 programs, selectable via parallel interface / field bus interface
- 8 potential free optocoupler inputs 24 V DC with common ground potential; sinking inputs.
  Specification:
  – min. switching voltage HIGH: 13 V DC
  – max. switching voltage HIGH: 30 V DC
  – min. switching voltage LOW: 0 V DC
  – max. switching voltage LOW: 4 V DC
- 8 potential free optocoupler outputs with common positive foreign supply 13… 30 V DC; sourcing outputs.
  Specification:
  – max. switched voltage: 30 V DC
  – max. switched current: 50 mA (internal current limitation)
  – max. contact rating: 1.5 W (only resistive load)

Note!
For inductive load a coil protection diode is to be used. Otherwise the signal output can be destroyed by the overvoltage when switching the inductive load off.

• 1 relay output (change-over contact)
• 1 relay output (closing contact), additionally only for SND40...MF… units
Specification for Ohmic load:
- max. switched voltage: 30 V DC / 250 V AC
- max. switched current: 50 mA
- max. contact rating: 180 W / 1500 VA

• USB 1.1 interface (front side)
PCL3 compatible for printer, e.g. HP Deskjet HP5650, hp5652, hp6540
(other models must be registered in the operating system)

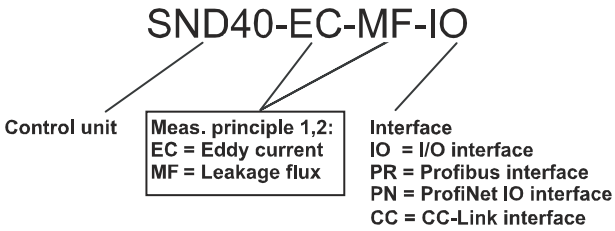
for USB stick for software updating and backup of the program data,
not until distribution with PC assembly NetDCU5.2 (approx. April 2006)

• 10 Mbit Ethernet interface (internal)
for general system access via TCP/IP (telnet)
IP address for Telnet 192.168.100.107, Subnet 255.255.255.000 (on delivery)
IP address for remote host 192.168.100.222 (on delivery)

• Fieldbus interface
- Profibus DP interface, according to EN 50170, protocol v.1.10,
  max. Baud rate 12 Mbit/s
- ProfiNet IO interface
- CC-Link interface

9.1.1 Versions of control unit SND40

The equipment designation is coded as follows:



From this code key the following versions of the control unit result:

SND40-EC-IO	**SND40-EC-PR**	**SND40-EC-PN**	**SND40-EC-CC**
for Eddy current sensors, Eddy current probes, Encircling coil systems			
SND40-MF-IO	**SND40-MF-PR**	**SND40-MF-PN**	**SND40-MF-CC**
for Leakage flux sensors			
SND40-EC-MF-IO	**SND40-EC-MF-PR**	**SND40-EC-MF-PN**	**SND40-EC-MF-CC**
for Eddy current sensors, Eddy current probes, Encircling coil systems, Leakage flux sensors, Combo sensors			

The SND40 control unit is delivered in different versions.

A version property is the measuring principle. Three versions are available:

- The combination unit **„EC-MF“** works with eddy current **and** leakage flux principle
- The eddy current unit „**EC“** works only with the eddy current principle
- The leakage flux unit **„MF“** works only with the magnetic leakage flux principle

The combined unit "EC-MF" represents with its combined sensors the future-proof solution for sophisticated Weld Seam Detection. The combination sensors are designed for both eddy current and magnetic flux leakage. The other two versions "EC" and "MF" are for special cases only. The matching sensors support only the respective principle.

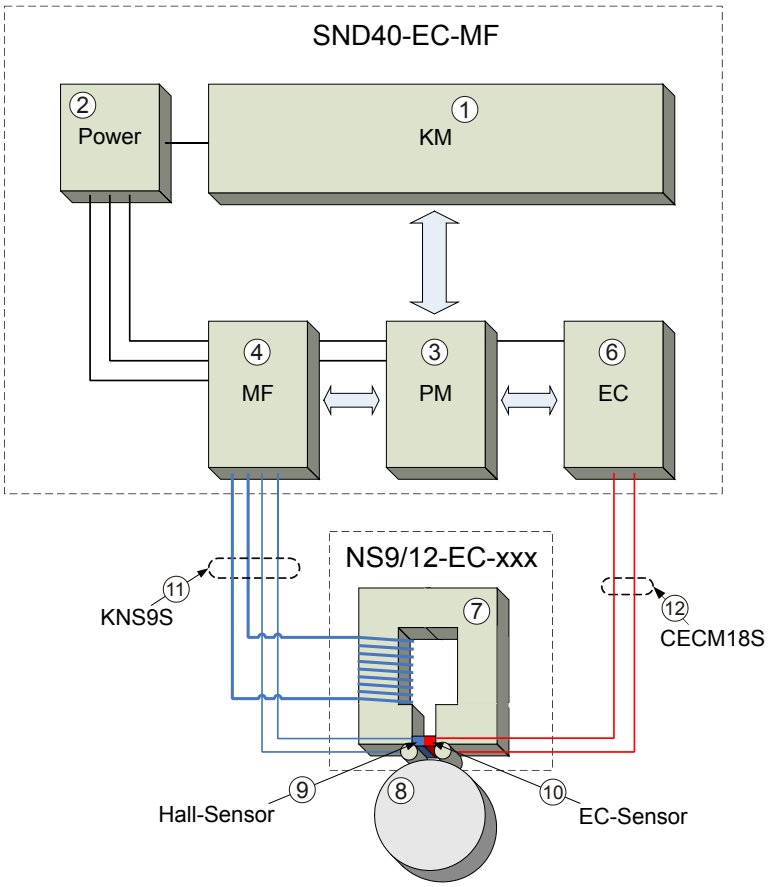
A specimen examination in the application laboratory of Roland Electronic GmbH clarifies which measuring principle is suitable for a process-safe detection. We strongly recommend not to make a selection of one certain measuring principle without a specimen report.

Another important version consists in the interface for control. There is the parallel I/O interface, via which the signal is exchanged. The usage of a fieldbus interface reduces the amount of wiring. Additionally, fault messages can be also read out. At present, Profibus DP and Profibus IO are available.

Note Using the fieldbus interface may require to pass the time-critical signal "weld seam detected" through the I/O interface to ensure accurate positioning. This is a way to avoid unpredictable latencies of the fieldbus communication, which may manifest in visible changes of accuracy positioning.

9.1.2 Block diagram SND40 with combination sensor

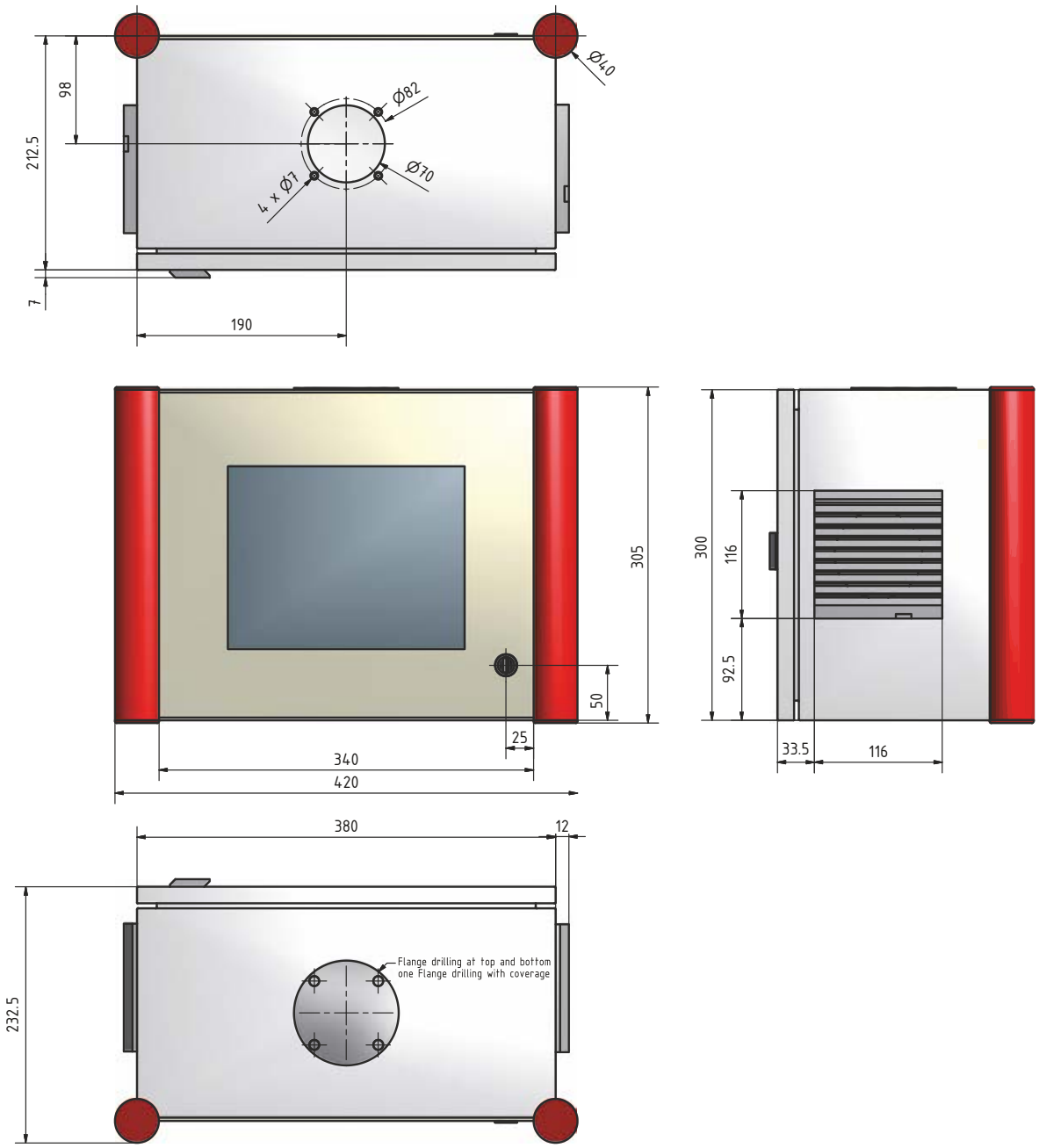
A system consists of a control unit SND40, a sensor and a sensor cable. The block diagram exemplarily shows a system with leakage flux module (4) and eddy current module (6). To it a combination sensor (7) for round materials is attached.



Description of block diagram:	
1:	**KM:** The communication module is the interface to the operator and stores the system and program files.
2:	**Power:** The power supply module supplies all internal modules and the sensors with electrical energy.
3:	**PM:** The processor module takes over the detection and positioning of the welding seam and controls the PLC interface.
4:	**MF:** The leakage flux module is the "front end" electronics to the Hall sensor and supplies the magnetizing current for the leakage flux and combination sensors. In addition a sensor (check signal) with current exit (0… +/-20mA) can be attached. This module is only present with SND40 devices with the numbers… MF… in the designation.
5:	*without representation:* Motherboard, on which the modules are attached.
6:	**EC:** The eddy current module is the "front end" electronics to the eddy current sensor. This module is only present with SND40 devices with the numbers… EC… in the designation.
7:	**NS9/12-EC…:** combination sensor consisting of magnetizing coil, (9) Hall sensor and (10) EC sensor.
8:	Round specimen, e.g. tube.
9:	Hall sensor for measuring the magnetic leakage flux. Unit is integrated in the sensor element of the combination and leakage flux sensors.
10:	EC sensor (eddy current probe) for generating and measuring the alternating field. Integrated in the sensor element of the combination and EC sensors.
11:	**KNS9S:** Sensor cable for combination and leakage flux sensors.
12:	**CECM18S:** Sensor cable for combination and EC sensors / probes.

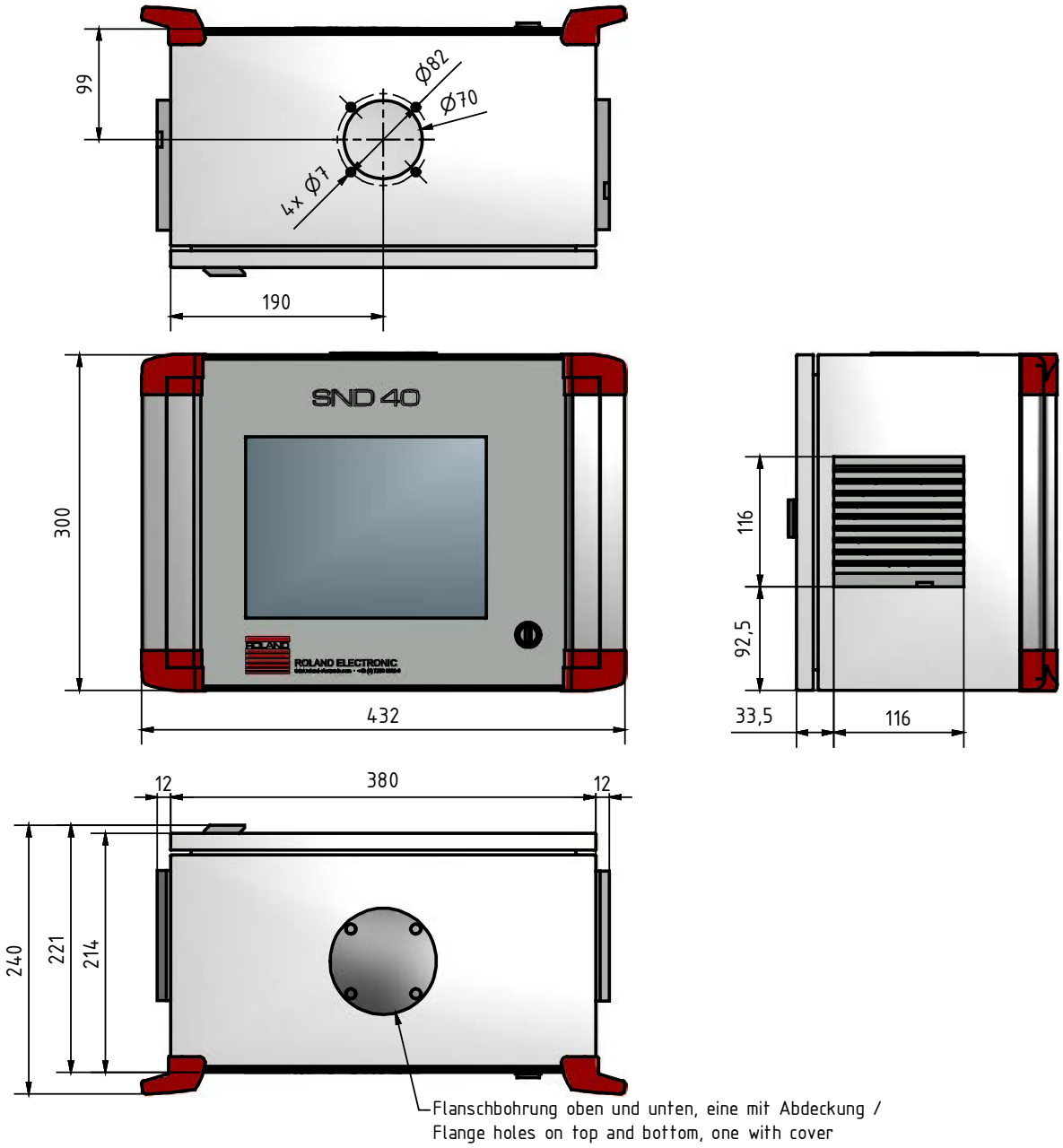
Fig. 45: SND40-EC-MF Block diagram

9.2 Mechanical drawing control unit SND40



All dimensions are in mm.

Fig. 46: SND40 Mechanical drawing of the unit (until 2016, May)



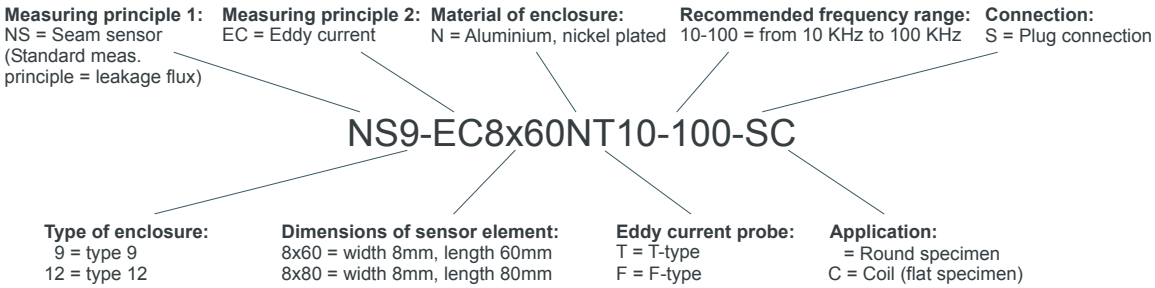
All dimensions are in mm.

Fig. 47: SND40 Mechanical drawing of the unit (from 2016, May)

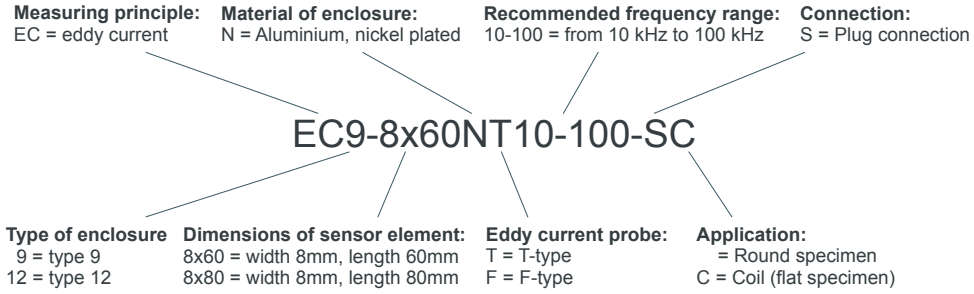
9.3 Designation of sensors

The sensor designations are coded as follows.

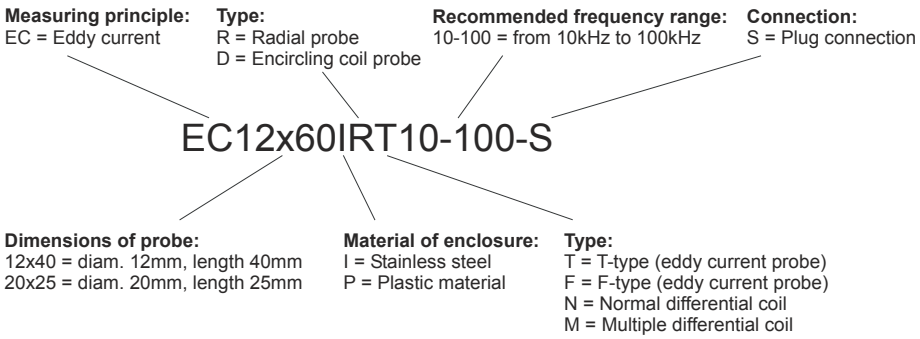
9.3.1 Combination sensors (leakage flux / eddy current)



9.3.2 Eddy current sensors



9.3.3 Eddy current probes / Eddy current coils



9.4 Leak flux sensor NS9S

Technical data		
Application:	Round material (ferrous tubes)	
Diameter of tube:	10 – 250 mm	
Wall thickness:	Up to 3 mm	
Measuring principle:	Magnetical leak flux	
Ambient temperature:	10 - 40 °C (50 – 104°F) (operation)	
Class of protection:	IP53	
Weight:	6.6 kg (14.6 lbs.)	
Material of enclosure:	Aluminum, nickel plated	
Sensor cable:	KNS9S	
Air gap between pole boots and tube surface	0.2 … 0.25 mm in new condition 0.1 … 0.35 mm is permissible range	The air gaps must be within the permissible range. If the value gets – due to wearing - outside the permissible range, the sensor needs to be repaired (see also chapter 10 “Maintenance”).
Air gap between sensor element and tube surface	0.6 … 0.65 mm in new condition 0.3 … 0.75 mm is permissible range	

9.5 Combination sensor NS9-EC8x60NT10-100-S

Technical data		
Application:	Round material (ferrous / non-ferrous tubes)	
Diameter of tube:	10 - 250 mm	
Wall thickness:	Up to 3 mm / depending on material	
Measuring principle:	Magnetical leakage flux / eddy current	
Width of measuring patch:	4 mm	
Ambient temperature:	10 - 40 °C (50 - 104 °F) (operation)	
Class of protection:	IP53	
Weight:	6.6 kg (14.5 lbs.)	
Material of enclosure:	Aluminum, nickel plated	
Sensor cable:	KNS9S (leak flux) CECM18S-G (eddy current)	
Air gap between pole boots and tube surface	0.2 … 0.25 mm in new condition 0.1 … 0.35 mm is permissible range	The air gaps must be within the permissible range. If the value gets – due to wearing - outside the permissible range, the sensor needs to be repaired (see also chapter 10 “Maintenance”).
Air gap between sensor element and tube surface	0.6 … 0.65 mm in new condition 0.3 … 0.75 mm is permissible range	

9.6 Combination sensor NS9-EC8x60NF10-100-S

Technical data		
Application:	Round material (ferrous / non-ferrous tubes)	
Diameter of tube:	10 - 250 mm	
Wall thickness:	Up to 3 mm / depending on material	
Measuring principle:	Magnetical leakage flux Eddy current (high resolution, only for non-ferrous material), relative magnetic Flux = 0%	
Width of measuring patch:	2 mm	
Ambient temperature:	10 - 40 °C (50 – 104 °F) (operation)	
Class of protection:	IP53	
Weight:	6.6 kg (14.5 lbs.)	
Material of enclosure:	Aluminum, nickel plated	
Sensor cable:	KNS9S (leak flux) CECM18S-G (eddy current)	
Air gap between pole boots and tube surface	0.2 … 0.25 mm in new condition 0.1 … 0.35 mm is permissible range	The air gaps must be within the permissible range. If the value gets – due to wearing - outside the permissible range, the sensor needs to be repaired (see also chapter 10 “Maintenance”).
Air gap between sensor element and tube surface	0.6 … 0.65 mm in new condition 0.3 … 0.75 mm is permissible range	

9.7 Leak flux sensor NS9-GMR-S

Special feature: GMR sensor element, high magnetic resolution, for precision steel tubes.

Technical data		
Application:	Round material (ferrous tubes)	
Diameter of tube:	10 - 250 mm	
Wall thickness:	Up to 3 mm	
Measuring principle:	Magnetical leak flux, with GMR element, high resolution	
Ambient temperature:	10 - 40 °C (50 - 104 °F) (operation)	
Class of protection:	IP53	
Weight:	6.6 kg (14.6 lbs.)	
Material of enclosure:	Aluminum, nickel plated	
Sensor cable:	KNS9S	
Air gap between pole boots and tube surface	0.2 … 0.25 mm in new condition 0.1 … 0.35 mm is permissible range	The air gaps must be within the permissible range. If the value gets – due to wearing - outside the permissible range, the sensor needs to be repaired (see also chapter 10 “Maintenance”).
Air gap between sensor element and tube surface	0.6 … 0.65 mm in new condition 0.3 … 0.75 mm is permissible range	

9.7.1 Technical drawing NS9

Note!

When using the supplied rubber mounts, the total width extends (for 50 mm, 25 mm per rubber mount) from 165 mm to 215 mm.

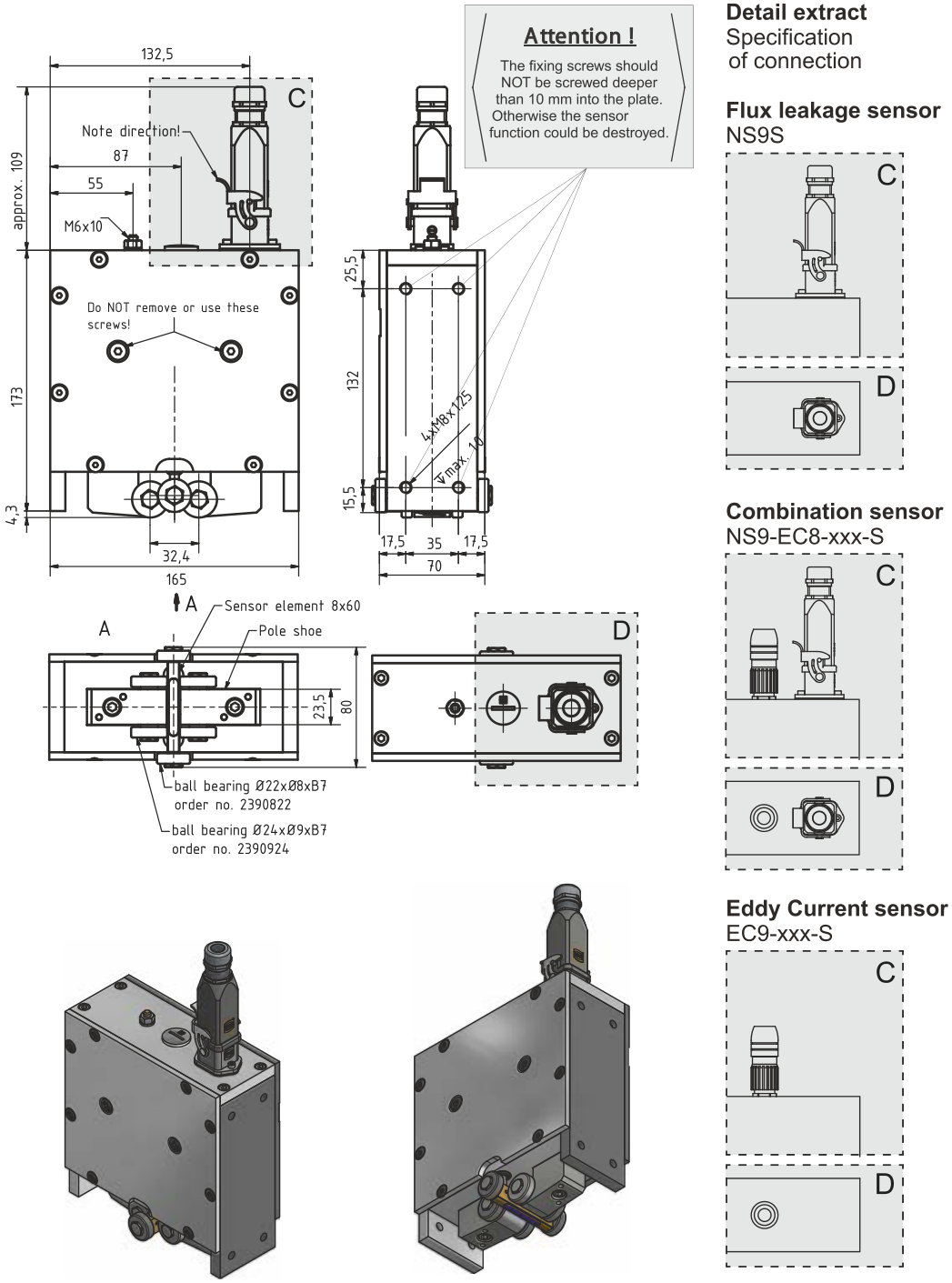


Fig. 48: NS9 technical drawing

9.8 Combination sensor NS9-EC5x30NT10-100-S

Special feature: extra narrow measuring patch, for tubes > 6mm Ø.

Technical data		
Application:	Round material (ferrous / non-ferrous tubes)	
Diameter of tube:	6.5 - 10 mm	
Wall thickness:	Up to 3 mm / depending on material	
Measuring principle:	Magnetical leakage flux Eddy current (high resolution, only for non-ferrous material), relative magnetic Flux = 0%	
Width of measuring patch:	2 mm	
Ambient temperature:	10 - 40 °C (50 – 104 °F) (operation)	
Class of protection:	IP53	
Weight:	6.6 kg (14.5 lbs.)	
Material of enclosure:	Aluminum, nickel plated	
Sensor cable:	KNS9S (leak flux) CECM18S-G (eddy current)	
Air gap between pole boots and tube surface	0.2 … 0.25 mm in new condition 0.1 … 0.35 mm is permissible range	The air gaps must be within the permissible range. If the value gets – due to wearing - outside the permissible range, the sensor needs to be repaired (see also chapter 10 “Maintenance”).
Air gap between sensor element and tube surface	0.6 … 0.65 mm in new condition 0.3 … 0.75 mm is permissible range	

Note When using the supplied rubber mounts, the total width of 165mm increases by 50mm (25mm per mount) to 215mm.

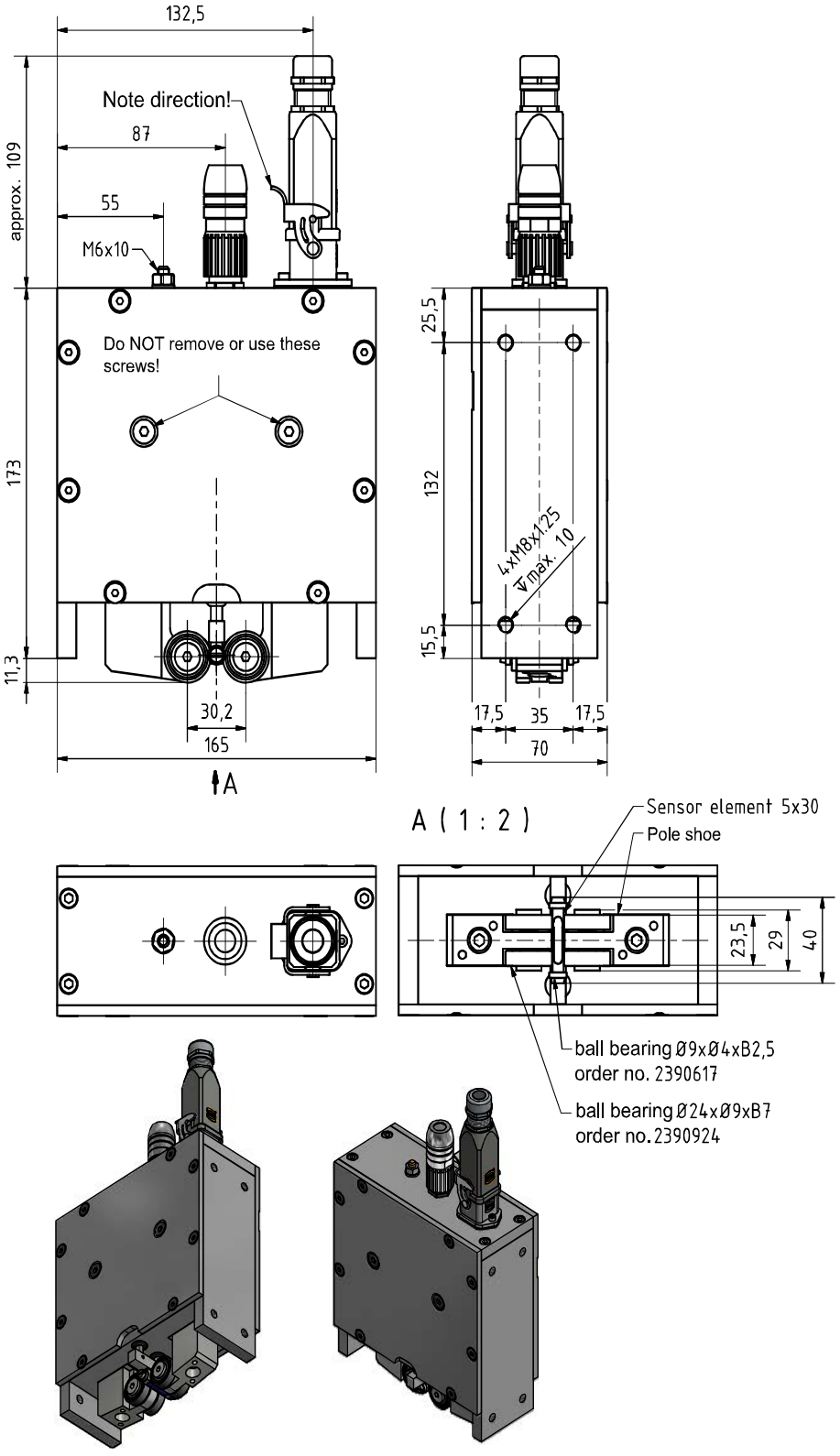


Fig. 49: Dimensional drawing NS9-EC5x30NT10-100-S

9.9 Combination sensor NS9NH-EC8x18NT10-100-S

Special feature: extra narrow sensor element, contact with tube <30 mm, ideal for corrugated tubes.

Technical data		
Application:	Round material (ferrous / non-ferrous tubes)	
Diameter of tube:	10 - 250 mm	
Wall thickness:	Up to 1.5 mm	
Measuring principle:	Eddy current, with pre-magnetization	
Width of measuring patch:	4 mm	
Ambient temperature:	10 - 40 °C (50 - 104 °F) (operation)	
Class of protection:	IP53	
Weight:	6.6 kg (14.5 lbs.)	
Material of enclosure:	Aluminum, nickel plated	
Sensor cable:	KNS9S (electro magnet) CECM18S-G (eddy current)	
Air gap between pole boots and tube surface	0.2 … 0.25 mm in new condition 0.1 … 0.35 mm is permissible range	The air gaps must be within the permissible range. If the value gets – due to wearing - outside the permissible range, the sensor needs to be repaired (also see chapter 10 “Maintenance”).
Air gap between sensor element and tube surface	0.6 … 0.65 mm in new condition 0.3 … 0.75 mm is permissible range	

Note When using the supplied rubber mounts, the total width of 165 mm increases by 50 mm (25 mm per mount) to 215 mm.

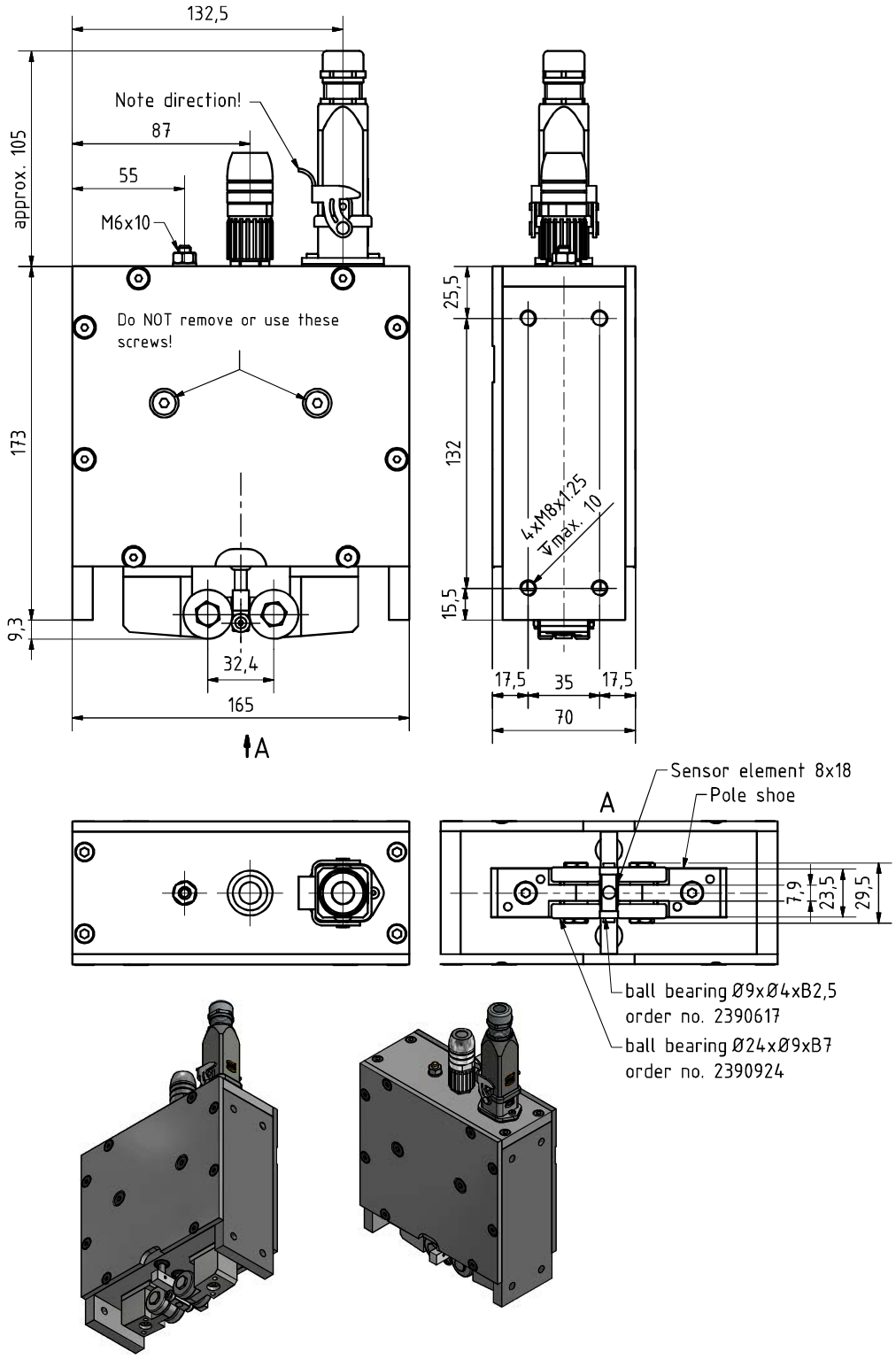


Fig. 50: Dimensional drawing NS9NH-EC8x18NT10-100S

9.10 Eddy current sensor EC9-8x60NT10-100-S

Technical data		
Application:	Round material (non-ferrous tubes)	
Diameter of tube:	10 - 250 mm	
Wall thickness:	Depending on material	
Measuring principle:	Eddy current	
Width of measuring patch:	4 mm	
Ambient temperature:	10 - 40 °C (50 – 104 °F) (operation)	
Class of protection:	IP53	
Weight:	5.6 kg (12.4 lbs)	
Material of enclosure:	Aluminium, nickel plated	
Sensor cable:	CECM18S-G	
Air gap between pole boots and tube surface	0.2 … 0.25 mm in new condition 0.1 … 0.35 mm is permissible range	The air gaps must be within the permissible range. If the value gets – due to wearing - outside the permissible range, the sensor needs to be repaired (see also chapter 10 “Maintenance”).
Air gap between sensor element and tube surface	0.6 … 0.65 mm in new condition 0.3 … 0.75 mm is permissible range	

9.11 Eddy current sensor EC9-8x60NF10-100-S

Technical data		
Application:	Round material (non-ferrous tubes)	
Diameter of tube:	10 - 250 mm	
Wall thickness:	Depending on material	
Measuring principle:	Eddy current (high resolution)	
Width of measuring patch:	2 mm	
Ambient temperature:	10 - 40 °C (50 – 104 °F) (operation)	
Class of protection:	IP53	
Weight:	5.6 kg (12.4 lbs.)	
Material of enclosure:	Aluminum, nickel plated	
Sensor cable:	CECM18S-G	
Air gap between pole boots and tube surface	0.2 … 0.25 mm in new condition 0.1 … 0.35 mm is permissible range	The air gaps must be within the permissible range. If the value gets – due to wearing - outside the permissible range, the sensor needs to be repaired (see also chapter 10 “Maintenance”).
Air gap between sensor element and tube surface	0.6 … 0.65 mm in new condition 0.3 … 0.75 mm is permissible range	

9.12 Leakage flux sensor NS12S

Technical data		
Application:	Round material (ferrous tubes)	
Diameter of tubes:	12 - 250 mm	
Wall thickness:	Up to 4 mm	
Measuring principle:	Magnetical leakage flux	
Ambient temperature:	10 - 40°C (50 – 104°F) (operation)	
Class of protection:	IP53	
Weight:	11 kg (24.3 lbs)	
Material of enclosure:	Aluminum, nickel plated	
Sensor cable:	KNS9S	
Air gap between pole boots and tube surface	0.2 … 0.25 mm in new condition 0.1 … 0.35 mm is permissible range	The air gaps must be within the permissible range. If the value gets – due to wearing - outside the permissible range, the sensor needs to be repaired (see also chapter 10 “Maintenance”).
Air gap between sensor element and tube surface	0.6 … 0.65 mm in new condition 0.3 … 0.75 mm is permissible range	

9.13 Combination sensor NS12-EC8x80NF10-100-S

Technical data		
Application:	Round material (ferrous / non-ferrous tubes)	
Diameter of tube:	12 - 250 mm	
Wall thickness:	Up to 4 mm / depending on material	
Measuring principle:	Magnetical leakage flux / eddy current (high resolution, only for non-ferrous material), relative magnetic flux = 0%	
Width of measuring patch:	2 mm	
Ambient temperature:	10 - 40°C (50 – 104°F) (operation)	
Class of protection:	IP53	
Weight:	11 kg (24.3 lbs.)	
Material of enclosure:	Aluminum, nickel plated	
Sensor cable:	KNS9S (leak flux) CECM18S-G (eddy current)	
Air gap between pole boots and tube surface	0.2 … 0.25 mm in new condition 0.1 … 0.35 mm is permissible range	The air gaps must be within the permissible range. If the value gets – due to wearing - outside the permissible range, the sensor needs to be repaired (see also chapter 10 “Maintenance”).
Air gap between sensor element and tube surface	0.6 … 0.65 mm in new condition 0.3 … 0.75 mm is permissible range	

9.14 Combination sensor NS12-EC8x80NT10-100-S

Technical data		
Application:	Round material (ferrous / non-ferrous tubes)	
Diameter of tube:	12 - 250 mm	
Wall thickness:	Up to 4 mm / depending on material	
Measuring principle:	Magnetical leakage flux / eddy current	
Width of measuring patch:	4 mm	
Ambient temperature:	10 - 40 °C (50 – 104°F) (operation)	
Class of protection:	IP53	
Weight:	11 kg (24.3 lbs)	
Material of enclosure:	Aluminum, nickel plated	
Sensor cable:	KNS9S (leak flux) CECM18S-G (eddy current)	
Air gap between pole boots and tube surface	0.2 … 0.25 mm in new condition 0.1 … 0.35 mm is permissible range	The air gaps must be within the permissible range. If the value gets – due to wearing - outside the permissible range, the sensor needs to be repaired (see also chapter 10 “Maintenance”).
Air gap between sensor element and tube surface	0.6 … 0.65 mm in new condition 0.3 … 0.75 mm is permissible range	

9.15 Combination sensor NS12NH-EC8x80NT10-100-S

Special feature: extra-large width of measuring patch for tubes with rough surface or heterogeneous weld seam.

Technical data		
Application:	Round material (ferrous / non-ferrous tubes)	
Diameter of tube:	12 - 250 mm	
Wall thickness:	Up to 4 mm / depending on material	
Measuring principle:	Eddy current, with pre-magnetization	
Width of measuring patch:	20 mm	
Ambient temperature:	10 - 40 °C (50 – 104°F) (operation)	
Class of protection:	IP53	
Weight:	11 kg (24.3 lbs)	
Material of enclosure:	Aluminum, nickel plated	
Sensor cable:	KNS9S (electro magnet) CECM18S-G (eddy current)	
Air gap between pole boots and tube surface	0.2 … 0.25 mm in new condition 0.1 … 0.35 mm is permissible range	The air gaps must be within the permissible range. If the value gets – due to wearing - outside the permissible range, the sensor needs to be repaired (see also chapter 10 “Maintenance”).
Air gap between sensor element and tube surface	0.6 … 0.65 mm in new condition 0.3 … 0.75 mm is permissible range	

9.15.1 Technical drawing NS12

Note!

When using the supplied rubber mounts, the total width extends (for 50 mm, 25 mm per mount) from 165 mm to 215 mm.

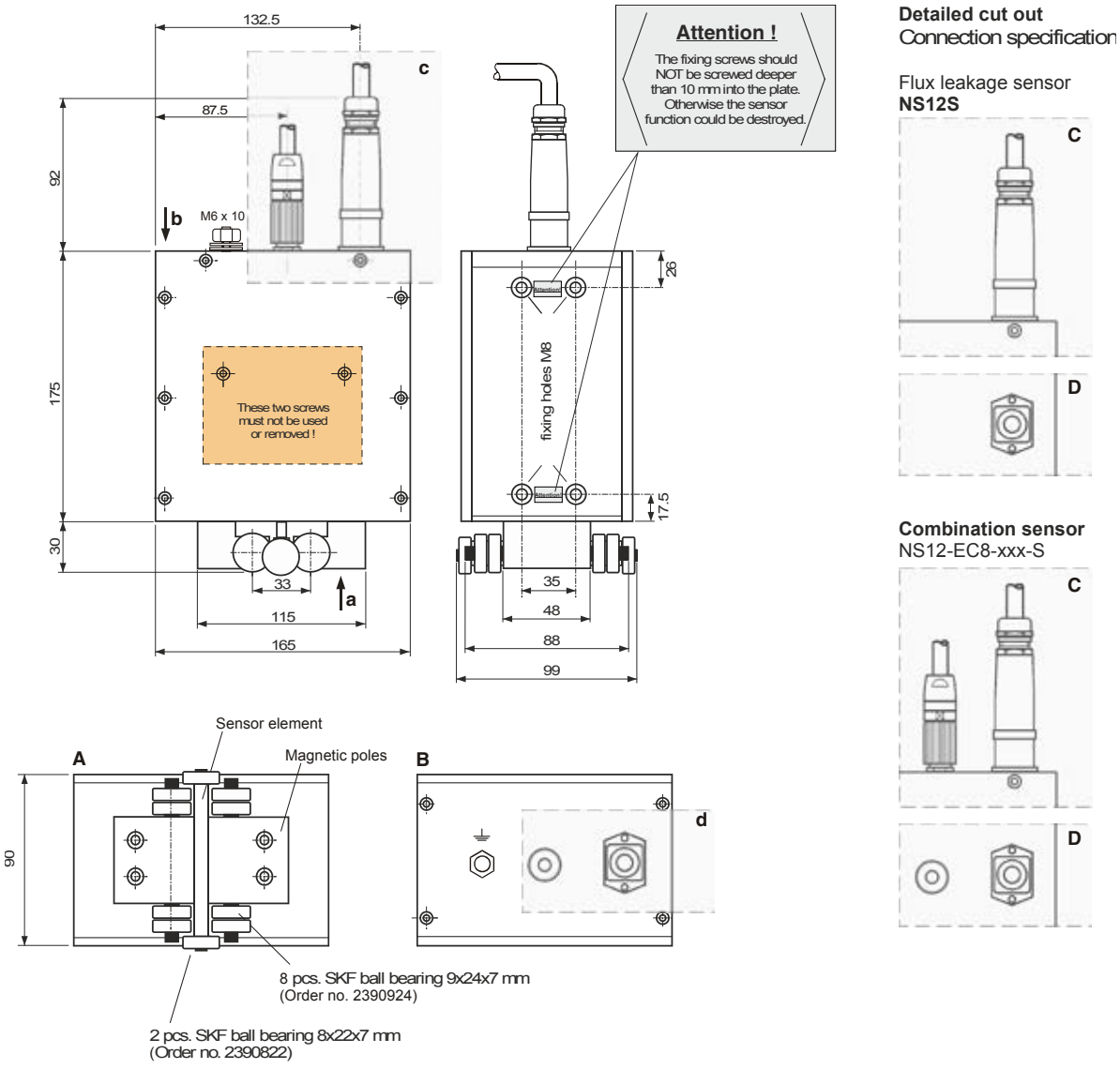


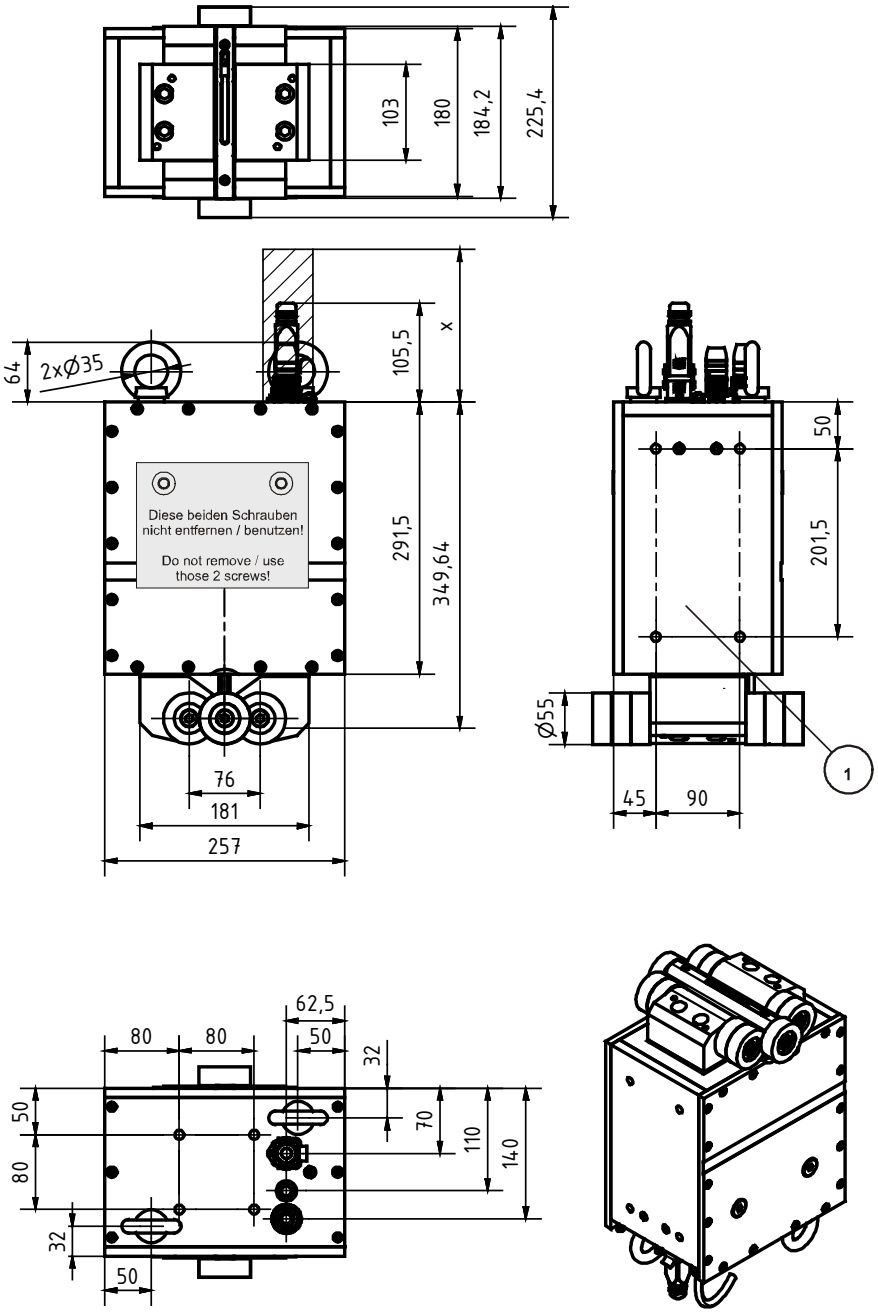
Fig. 51: NS12

9.16 Sensor NS24-EC18x185NT10-100-S

Technical data		
Application:	Round material (ferrous tubes)	
Diameter of tubes:	25 - 500mm (0.98 – 19.7in)	
Wall thickness:	Up to 12.5mm / depending on material	
Measuring principle:	Magnetical leakage flux / Eddy current	
Width of measuring patch:	20mm	
Ambient temperature:	10 - 40°C (50 - 104°F) during operation	
Class of protection:	IP54	
Weight:	63 kg (139 lbs)	
Material of enclosure:	Aluminum, nickel plated	
Sensor cable:	KNS9S and CECM18S-G	
Air gap between pole boots and tube surface	0.5 … 0.55mm in new condition 0.3 … 0.7mm is permissible range	The air gaps must be within the permissible range. If the value gets – due to wearing - outside the permissible range, the sensor needs to be repaired (see also chapter 10 “Maintenance”).
Air gap between sensor element and tube surface	0.5 … 0.55mm in new condition 0.3 … 0.7mm is permissible range	
Number of rubber mounts	8	

9.16.1 NS24-EC18x185 NT10-100-S Technical drawing

Note! When using the supplied rubber mounts, the total width extends (for 90 mm, 45 mm per mount) from 257 mm to 347 mm.



Description
1 Thread holes M12 for mounting the sensor. Do not screw in the mounting screws in for more than 15 mm, since otherwise the internal components will be damaged.

Fig. 52: NS24-EC18x185 NT10-100-S Technical drawing

9.17 Sensor NS24-EC30x185NT10-100-S

Technical data		
Application:	Round material (ferrous tubes)	
Diameter of tubes:	75 - 1500mm (1.57 - 59in)	
Wall thickness:	Depending on material	
Measuring principle:	Magnetical leakage flux / Eddy current	
Width of measuring patch:	20mm	
Ambient temperature:	10 - 40°C (50 - 104°F) during operation	
Class of protection:	IP54	
Weight:	63kg (139lbs)	
Material of enclosure:	Aluminum, nickel plated	
Sensor cable:	KNS9S and CECM18S-G	
Air gap between pole boots and tube surface	2.0 – 2.05mm in new condition 1.0 – 2.5mm is permissible range	The air gaps must be within the permissible range. If the value gets – due to wearing - outside the permissible range, the sensor needs to be repaired (see also chapter 10 “Maintenance”).
Air gap between sensor element and tube surface	2.0 – 2.05mm in new condition 1.0 – 2.5mm is permissible range	
Number of rubber mounts	8	

9.18 Cooling water for NS24-EC30 sensors

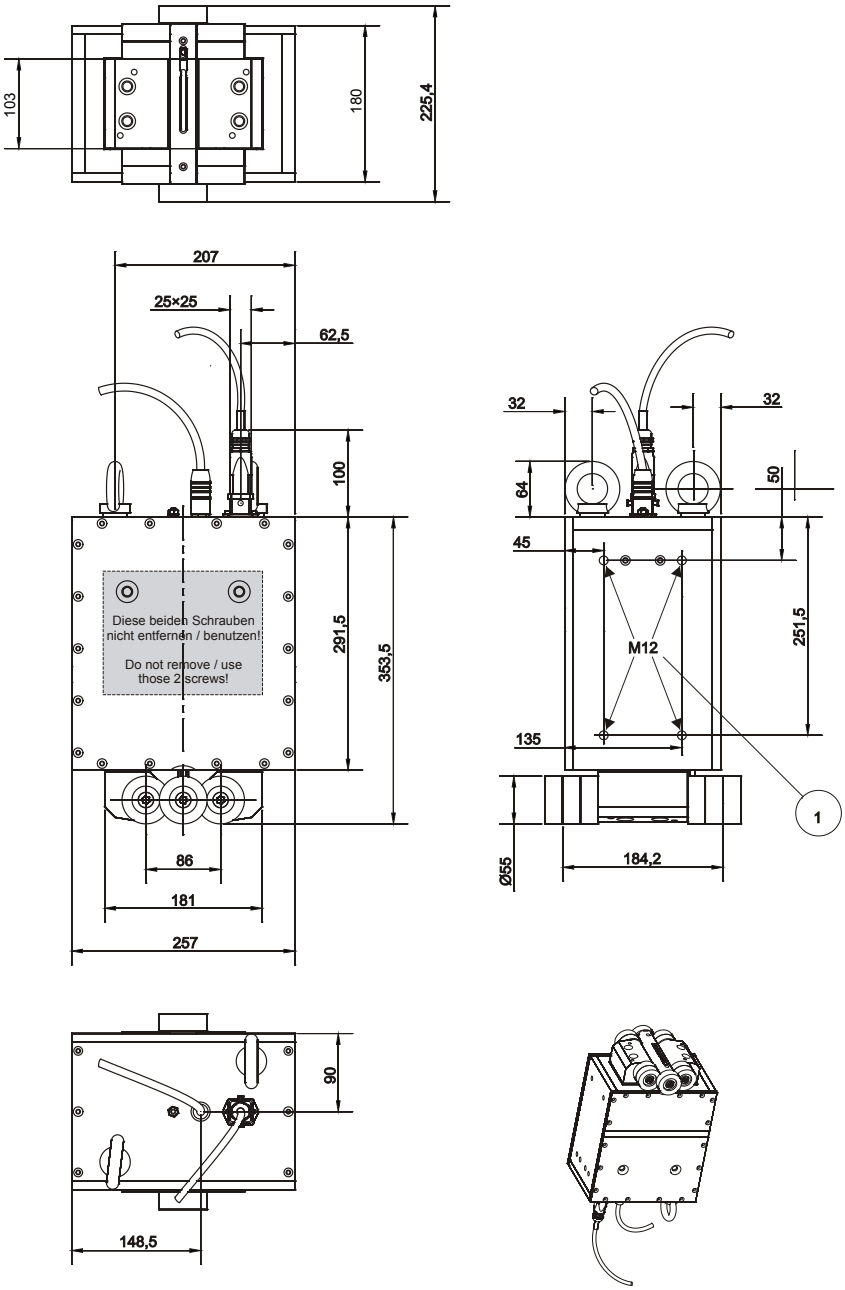
Connections at sensor	
Connecting material	Copper tube
Diameter	10mm outer Ø, 8mm inner Ø

The cooling water for the NS24-EC30 sensors must meet the following specifications:

TEMPERATURE, PRESSURE, THROUGHPUT	
Temperature	min. 5°C, max. 30°C at incoming connection
Pressure	max. 2bar
Throughput	min. 5l/min
HARDNESS, CONDUCTIVITY, pH VALUE	
Total hardness	max. 8°dH
Conductivity	50 – 600µS/cm
pH value	> 7.5 (7.8 at 8° dH / 8.1 at 6° dH / 8.3 at 4° dH)
INGREDIENTS	
Suspended substances	None
Aggressive carbonic acid	must not be detected
Ammonia	must not be detected
Nitrite	< 1mg/l
Iron	< 0.3mg/l
Manganese	< 0.05mg/l
Sulphate	< 250mg/l
Chloride	< 250mg/l
COD (chemical oxygen demand)	< 40mg/l
Microbiologic growth	
- number of colonies	< 1000/ml
- sulfate reducing agents	must not be detected
ADDITIVES	
Copper corrosion inhibitor	Nalco 73199, concentration 3mg/l
Oxidizing biocides	
- Halogens (free halogen)	< 0.15mg/l (as Cl_2), only in combination with copper corrosion inhibitor
- Ozone	none
- Hydrogen peroxide	none
- Peracids	none

9.18.1 NS24-EC30x185 NT10-100-S Technical drawing

Note! When using the supplied rubber mounts, the total width extends (for 90 mm, 45 mm per mount) from 257 mm to 347 mm.



Description	
1	Thread holes M12 for mounting the sensor. Do not screw in the mounting screws for more than 15 mm, since otherwise the internal components will be damaged.

Abb. 53: NS24-EC30x185 NT10-100-S Technical drawing

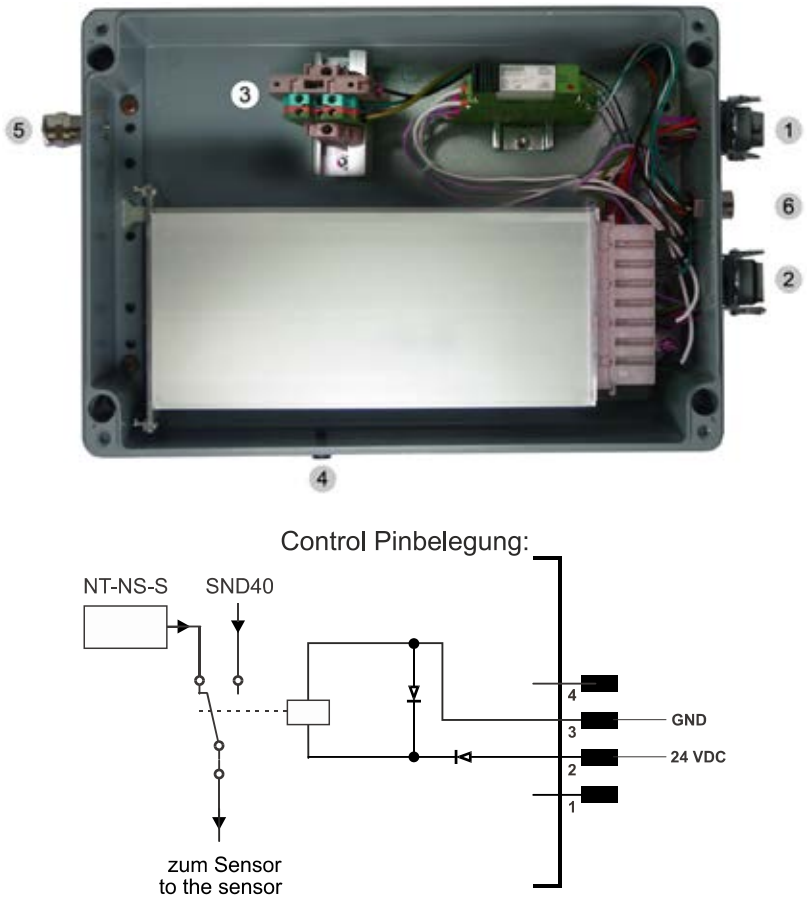
9.18.2 Power supply NT-NS-S

If an increased magnetization power is required at the NS12… sensor, the use of the auxiliary power supply NT-NS-S is advisable.

The power supply takes over the supply of the NS12 sensor with electrical energy, it will be controlled by the SND40 system.

Supply voltage:	90-260V AC 50-60Hz
Output:	60-90 VDC, 240 W (set to 75 V)
Fuse protection:	3.15 A medium-blow, 5×20 mm, in connecting terminal for mains voltage
Startup current:	14 A
Triggering:	Opto coupler input for enabling the output voltage
	Relay input for the selection of magnetizing current (valid from serial number C1211)
Ambient temperature:	0...40°C (during operation)
Connections:	Harting quick connectors
Enclosure:	Wall-mount enclosure, Aluminum
Class of protection:	IP65
Dimensions:	approx. 330×180×110mm (without sockets) approx. 410×180×110mm (with sockets)

Fig. 54: Dimensions of enclosure and mounting holes



	Description
1	Output for supplying the sensor
2	Input for controlling by the SND40
3	Connecting terminals for the supply voltage (mains voltage), with built-in fuse (3.15 A medium-blow) Brown = L blue = N green/yellow = PE (ground) Always connect the safety lead (PE) !
4	Adjuster for output voltage (behind screw)
5	Cable infeed fitting for supply voltage
6	Control connection assignment (valid from serial number C1211) weiss white blau blue ② ① ③ ④

Fig. 55: Connections and components

Connection diagram

Connect the NT-NS-S according to the following scheme, use the stated cables.
This diagram is valid starting from serial number C1211)

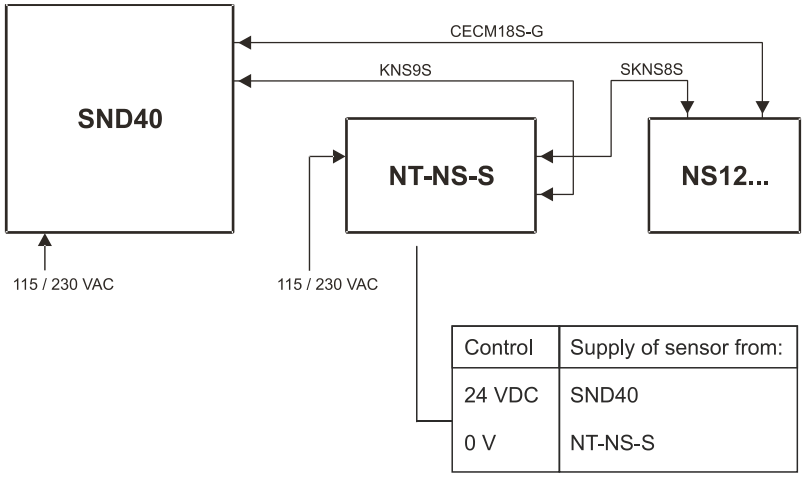


Fig. 56: Connection diagram

Allocation of connections

Connection towards SND40 (HAN8)			Connection towards sensor (HAN8)	
Pin 1	+ 15 V	bridged	Pin 1	+ 15 V
Pin 2	- 15 V	bridged	Pin 2	- 15 V
Pin 3	AGND	bridged	Pin 3	AGND
Pin 4	Measurement signal	bridged	Pin 4	Measurement signal
Pin 5	Measurement signal	bridged	Pin 5	Measurement signal
Pin 6	+ coil (ENABLE Power supply)		Pin 6	+ coil (60 V – 90 V DC)
Pin 7	- coil (ENABLE Power supply)		Pin 7	- coil (60 V – 90 V DC)
Pin 8	Shield for sensor cable		Pin 8	NC

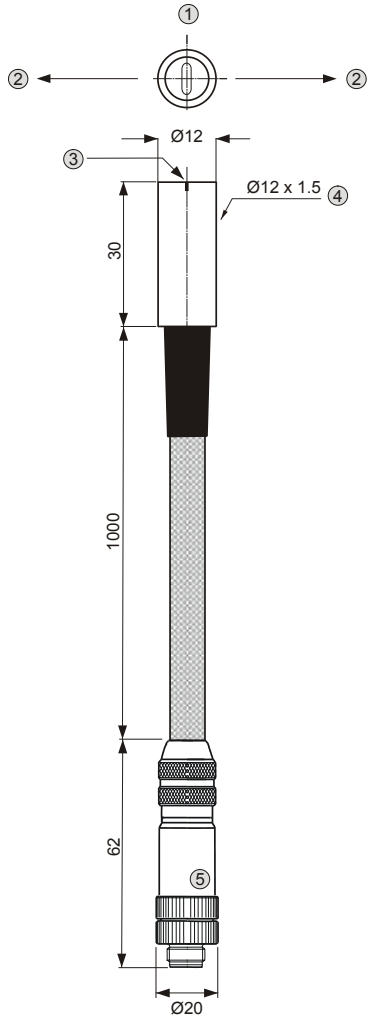
Operation

For operating the power supply with the SND40 is necessary that at the SND40 pins 6 and 7 of the HAN8 plug are wired. Furthermore, a magnetization of at least 29% must be set.

Note For operating the power supply NT-NS-S, the cable breakage monitoring must be switched off at the SND40.

9.19 Eddy current probe EC12x30IT10-100-S

Technical data	
Application:	Round material Flat material
Diameter of tube:	unlimited
Wall thickness:	Depending on material
Measuring principle:	Eddy current
Arrangement:	axial
Width of track:	4 mm
Width of measuring patch:	6 mm
Ambient temperature:	10 - 40°C (50 – 104°F) (operation)
Class of protection:	IP65
Weight:	0.15 kg (0.33 lbs)
Material of enclosure:	Stainless steel
Sensor cable:	CECM18S-G
Sensor Connection Box:	SCB-EC-S



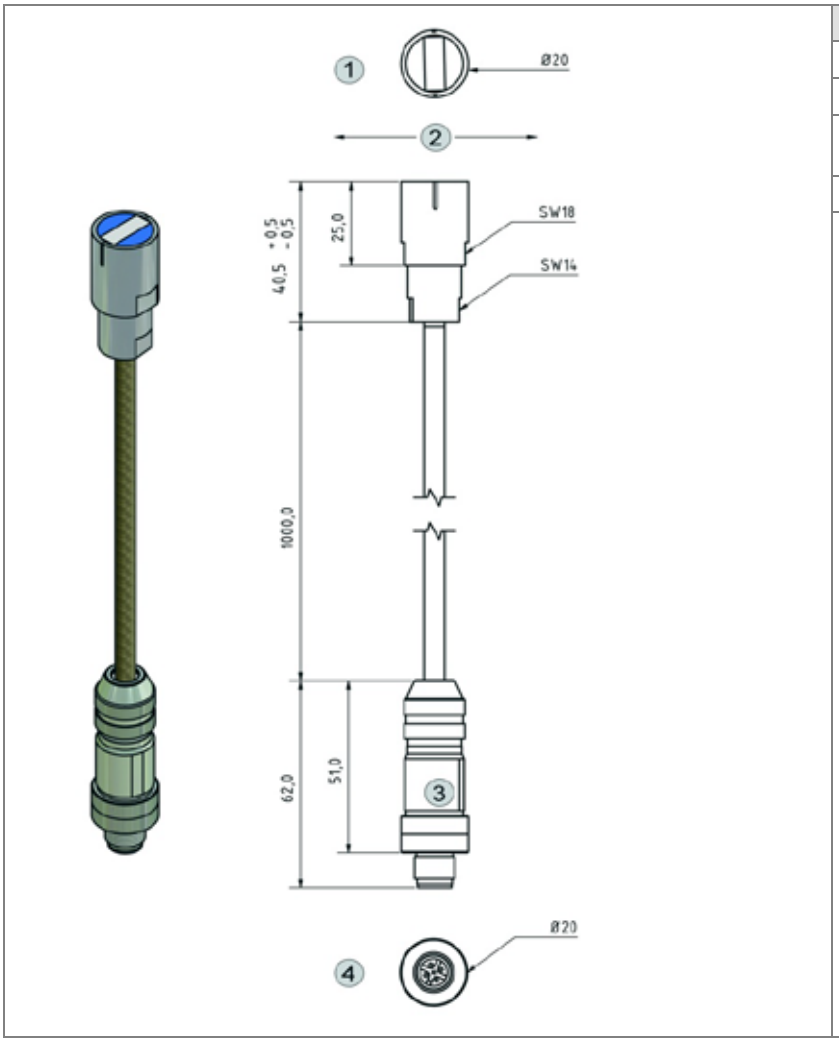
Description		
1:	View – active area	
2:	Direction of material flow	
3:	Marking	
4:	Sleeve Ø12 x 1.5 Stainless steel	
5	Cable order no.: 2277704	plug

All dimensions in mm

Fig. 57: EC12x30IT10-100-S

9.20 Eddy current probe EC20x25IT10-100-S

Technical data	
Applications:	Round material Flat material
Diameter of tube:	unlimited
Wall thickness:	Depending on material
Measuring principle:	Eddy current
Arrangement:	axial
Width of track:	10 mm
Width of measuring patch:	13 mm
Ambient temperature:	10 - 40° C (50 – 104°F) (operation)
Class of protection:	IP65
Weight:	0.2 kg (0.44 lbs)
Material of enclosure:	Stainless steel
Sensor cable:	SM18CECM18S-GG
Sensor Connection Box:	SCB-EC-S



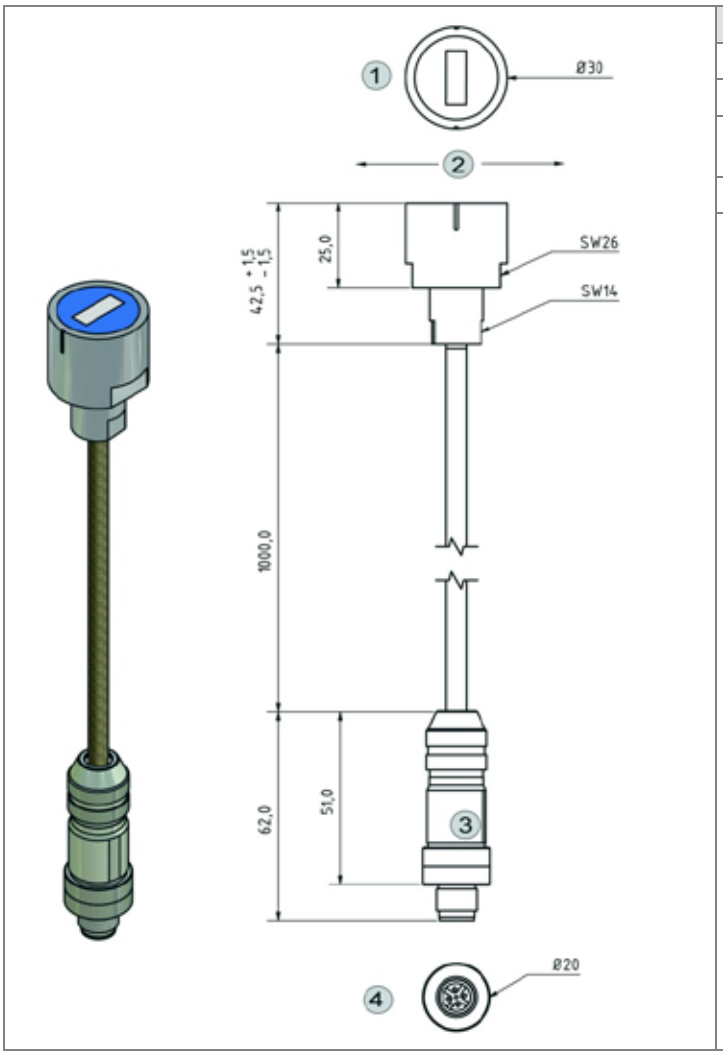
Description	
1:	View – active area
2:	Direction of material flow
3:	Cable plug order no.: 2277704
4:	View – cable plug

All dimensions in mm

Fig. 58: EC20x25IT10-100-S

9.21 Eddy current probe EC30x25IT10-100-S

Technical data	
Application:	Round material Flat material
Diameter of tube:	unlimited
Wall thickness:	Depending on material
Measuring principle:	Eddy current
Arrangement:	axial
Width of track:	16 mm
Width of measuring patch:	20 mm
Ambient temperature:	10 - 40 °C (50 – 104°F) (operation)
Class of protection:	IP65
Weight:	0.3 kg (0.66 lbs)
Material of enclosure:	Stainless steel
Sensor cable:	SM18CECM18S-GG
Sensor Connection Box:	SCB-EC-S



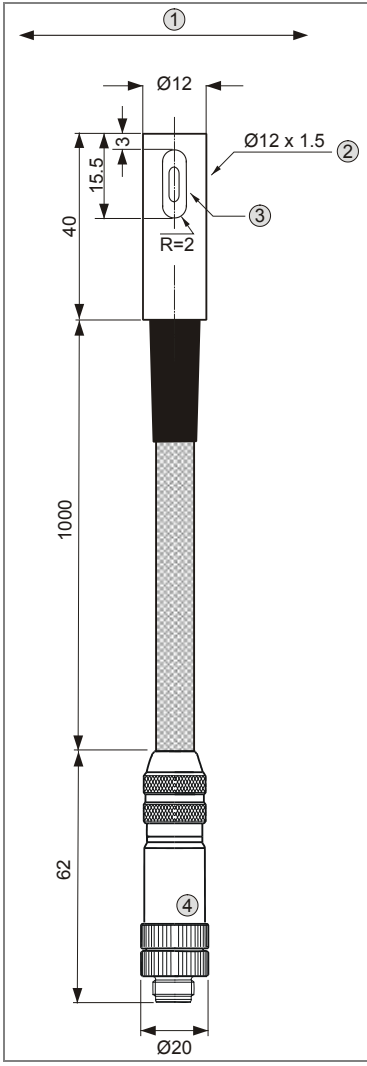
Description	
1:	View – active area
2:	Direction of material flow
3:	Cable plug order no.: 2277704
1:	View – active area

All dimensions in mm

Fig. 59: EC30x25IT10-100-S

9.22 Eddy current probe EC12x40IRT10-100-S

Technical data	
Application:	Round material
Diameter of tube:	unlimited
Wall thickness:	Depending on material
Measuring principle:	Eddy current
Arrangement:	radial
Width of track:	3 mm
Width of measuring patch:	4 mm
Ambient temperature:	10 - 40°C (50 – 104°F) (operation)
Class of protection:	IP65
Weight:	0.15 kg (0.33 lbs)
Material of enclosure:	Stainless steel
Sensor cable:	SM18CECM18S-GG
Sensor Connection Box:	SCB-EC-S



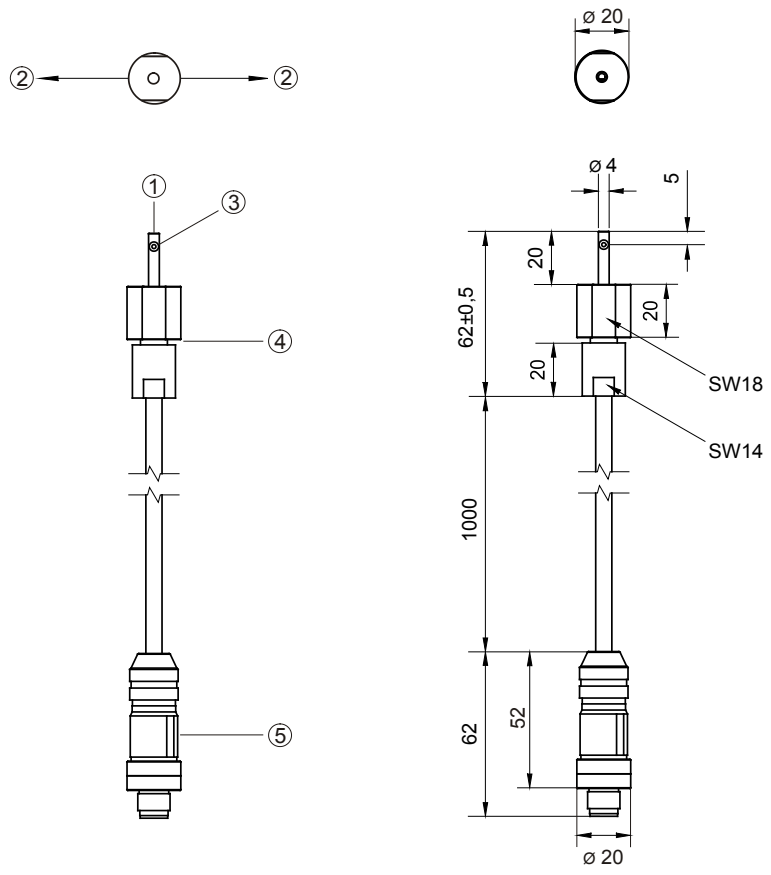
Description	
1:	Direction of material flow
2:	Sleeve Ø 12 x 1.5 made of INOX
3:	View – active area
4:	Cable plug order no.: 2277704

All dimensions are in mm.

Fig. 60: EC12x40IRT10-100-S

9.23 Eddy current probe EC4x40IRF50-400-S

Technical data	
Application:	Round material Flat material
Diameter of tube:	unlimited
Wall thickness:	Depending on material
Measuring principle:	Eddy current (high resolution)
Arrangement:	radial
Width of track:	1 mm
Width of measuring patch:	1.5 mm
Ambient temperature:	10 - 40° C (50 – 104°F) (operation)
Class of protection:	IP65
Weight:	0.15 kg (0.33 lbs.)
Material of enclosure:	Stainless steel
Sensor cable:	CECM18S-G
Sensor Connection Box:	SCB-EC-S



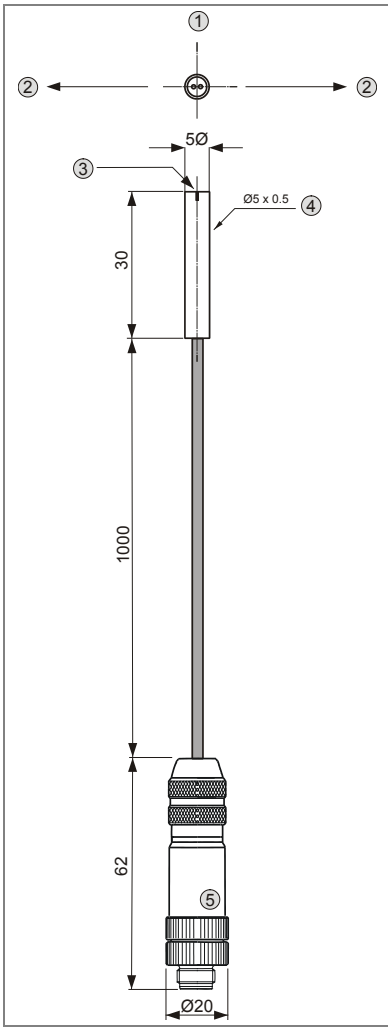
Description	
1:	View – active area
2:	Direction of material flow
3:	Marking
4:	Sleeve Ø 5 x 0.5 made of INOX
5:	Cable plug Order no.: 2277704

All dimensions in mm.

Abb. 61: EC4x40IRF50-400-S

9.24 Eddy current probe EC5x30IF10-100-S

Technical data	
Application:	Round material flat material
Diameter of tube:	unlimited
Wall thickness:	Depending on material
Measuring principle:	Eddy current (high resolution)
Arrangement:	axial
Width of track:	1.5 mm
Width of measuring patch:	2 mm
Ambient temperature:	10 - 40 °C (50 – 104°F) (operation)
Class of protection:	IP65
Weight:	0.15 kg (0.33 lbs)
Material of enclosure:	Stainless steel
Sensor cable:	CECM18S-G
Sensor Connection Box:	SCB-EC-S



Description	
1:	View – active area
2:	Direction of material flow
3:	Marking
4:	Sleeve Ø 5 x 0.5, made of Stainless steel
5:	Cable plug order no.: 2277704

All dimensions are in mm.

Fig. 62: EC5x30IF10-100-S

9.24.1 Connection schedule SND40 (general)

The following illustration shows the connection schedule of a SND40 with one sensor as well as with two sensors via a sensor switch box, together with the names of the required cables.

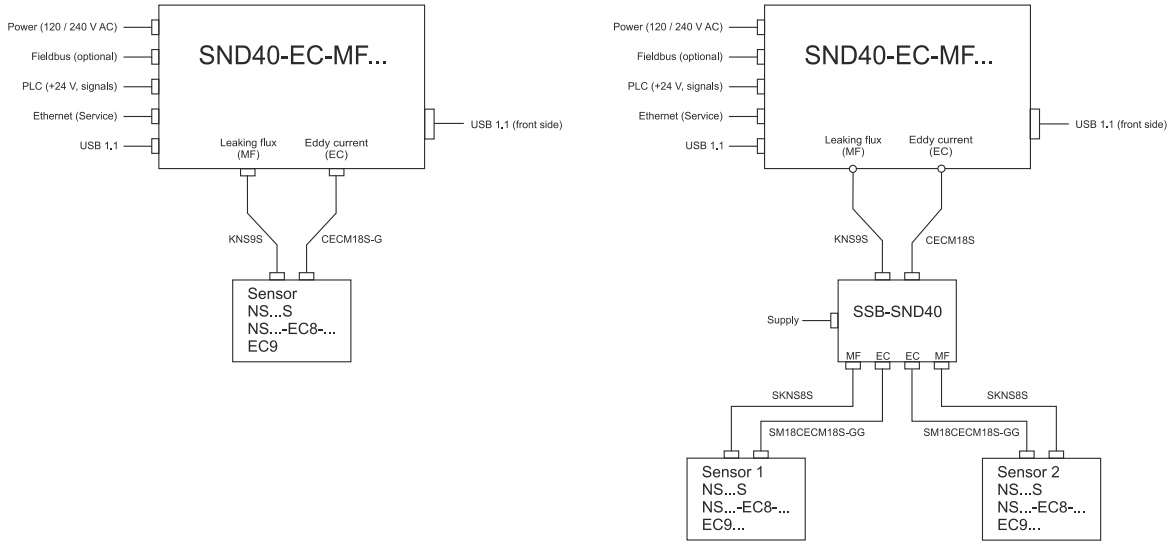


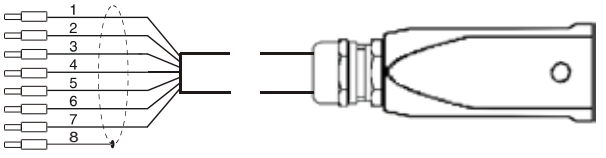
Fig. 63: Connection schedule with 1 sensor and with 2 sensors via sensor switch box

9.25 Sensor cable KNS9S

Usage: Connecting the combo sensors and the leakage flux sensors to the control unit.

The cable has a cable socket at the sensor side, and open end wires with wire-end ferrules at the control unit side.

Versions of cable:	**KNS9S-G:** **straight cable socket at sensor side**	**KNS9S-W:** **angled cable socket at sensor side**



Cable socket at sensor side: Harting HAN8

1:	white	+12 V
2:	green	-12 V
3:	Brown **(+blue)***	AGND
4:	yellow	Meas. signal 1
5:	red	Meas. signal 2
6:	grey	+coil
7:	pink	-coil
**8:	blank	shield

Fig. 64: KNS9S-G

Cable diameter: 8.7 mm
Structure: 8 × 0.5 mm^2, LiYCY
Bending radius: 54 mm: laid fixed, 130 mm: laid flexible

Note For cables delivered starting Nov. 2014 following applies:
*A ***brown*** wire might be connected parallel together with a ***blue*** wire. **Contact Nr. 8 might be connected with the cable shield. This will **not affect** the proper functionality of the cable, the sensor or the control unit.

9.26 Sensor cable SKNS8S

Usage: Connecting the combo sensors and the leakage flux sensors to the sensor switch box.
The cable has a cable socket at the sensor side, and a cable plug at the control unit side.
Standard cable length is 5 meters, other lengths must be specified.

1:	white	+12 V		1:	white	+12 V
2:	green	-12 V		2:	green	-12 V
3:	brown**(+blue)***	AGND		3:	brown **(+blue)***	AGND
4:	yellow	Meas. signal 1		4:	yellow	Meas. signal 1
5:	red	Meas. signal 2		5:	red	Meas. signal 2
6:	grey	+coil		6:	grey	+coil
7:	pink	-coil		7:	pink	-coil
**8:	blank	shield		**8:	blank	shield
Control unit side cable plug (Harting HAN8)				Sensor side cable socket (Harting HAN8)		

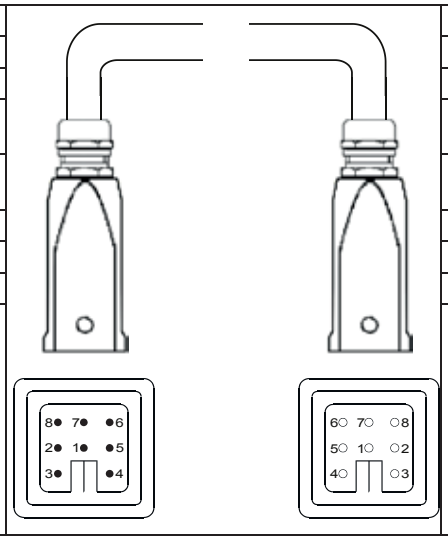


Fig. 65: SKNS8S

Cable diameter: 8.7 mm
Structure: 8 × 0.5 mm^2, LiYCY
Bending radius: 54 mm: laid fixed, 130 mm: laid flexible

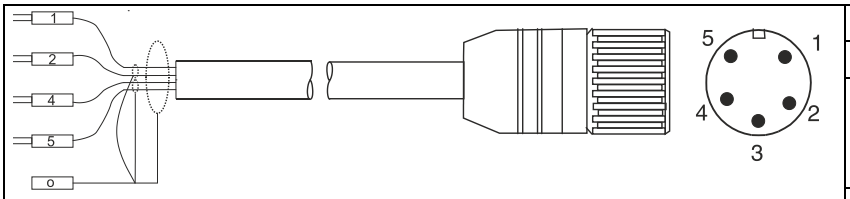
Please observe the notes (*, **) for sensor cable KNS9S. These are identic to the sensor cable SKNS8S!

9.27 Sensor cable CECM18S-G

Usage: Connecting the combo sensors and the eddy current sensors to the control unit.

On using eddy current probes, the sensor connection box SCB-EC-S must be used additionally.

The cable has a cable socket at the sensor side, and open end wires with wire-end ferrules at the control unit side. Standard length is 5 meters, other lengths must be specified.



Cable socket at sensor side: Coninvers M18, Roland 2276010

1:	green	Transmitter / a
2:	yellow	Transmitter / b
3:	Inner stranded cable shields	Ground
4:	white	Meas. signal 1
5:	brown	Meas. signal 2
	External cable shield to socket enclosure	

Fig. 66: CECM18S-G

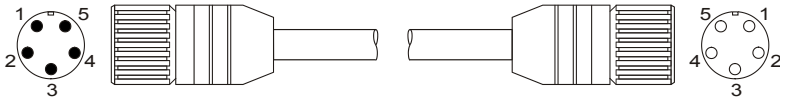
Cable diameter: 9.5 mm
Structure: 2 × 2 × 0.25 mm^2, CY – PIDY(TP)
Bending radius: 57 mm, laid fixed
150 mm, laid flexible

9.28 Sensor cable SM18CECM18S-GG

Usage: Connecting the Eddy current sensors as well as the combosensors and the encircling coils to the sensor switch box.

For using Eddy current probes the Sensor Connection Box SCB-EC-S must be used in addition.

The cable has a cable socket at the sensor side and a cable plug at the switch box side. Standard cable length is 5 meters, other lengths upon request.



Cable plug at Switch box side
Roland 2277010, M18,
supplier: Coninvers

Cable socket at Sensor side
Roland 2276010, M18,
supplier: Coninvers

1:	green	Sender / a
2:	yellow	Sender / b
3:	Inner cable shieldings	Ground
4:	white	Meas. signal 1
5:	brown	Meas. signal 2
External cable shielding connected to enclosure		

Fig. 67: Cable SM18CECM18S-GG

Cable diameter: 9.5 mm
Structure: 2 × 2 × 0.25 mm^2, CY – PIDY(TP)
Bending radius: 57 mm, laid fixed
150 mm, laid flexible

9.29 Sensor Switch Box SSB-SND40

With help of the switch box two eddy current sensors, leakage flux sensors or combination sensors can be connected with the SND40 control unit. Measuring via the switch box is always done by selection resp. sequentially.

Switching over to another sensor is exclusively controlled by the PLC. The SND40 does not receive any information about the selected sensor, thus the switch-over may only happen during the measuring pause. Depending on type of sensor and task, the PLC must perform an additional program switching on the SND40. This must be considered on planning the arrangement.

A 24V input serves for controlling the switch-over function.

The sensor cables are connected at corresponding flange sockets.

The allocated cables SKNS8S and SM18CECM18S-GG need to be ordered separately.

The PLC control cable is connected to a M12 flange socket.

The control cable is a part of the allocated machine and does not belong to the scope of supply.

9.29.1 Technical drawing

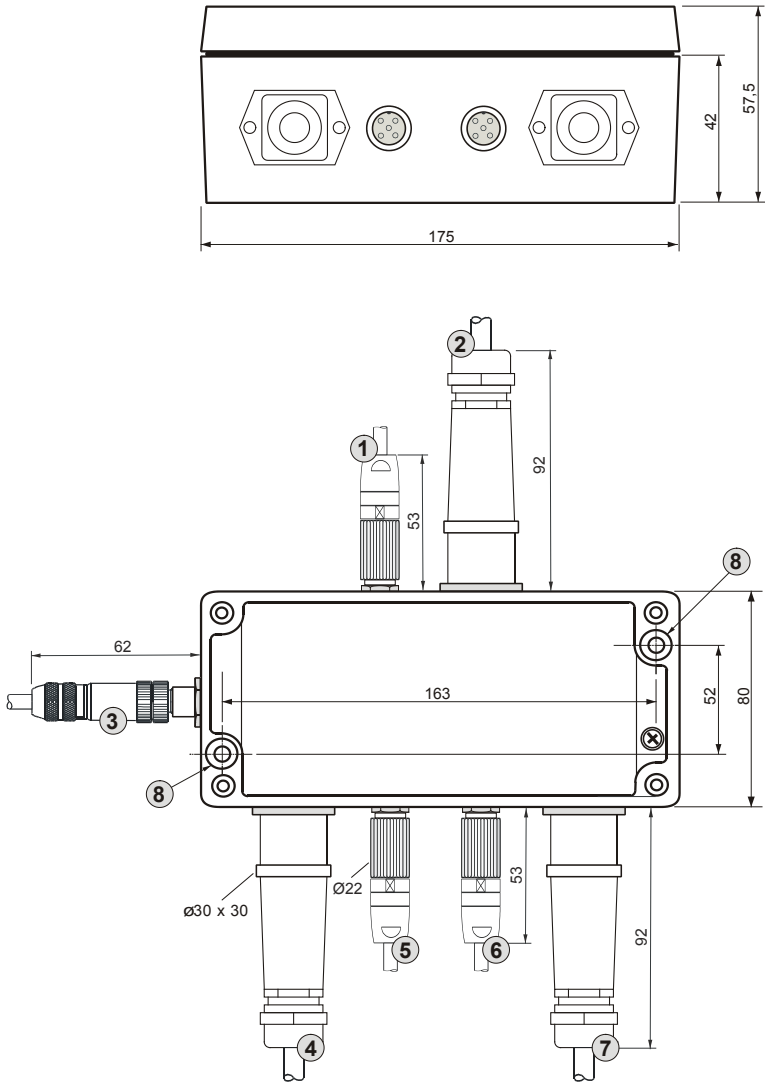
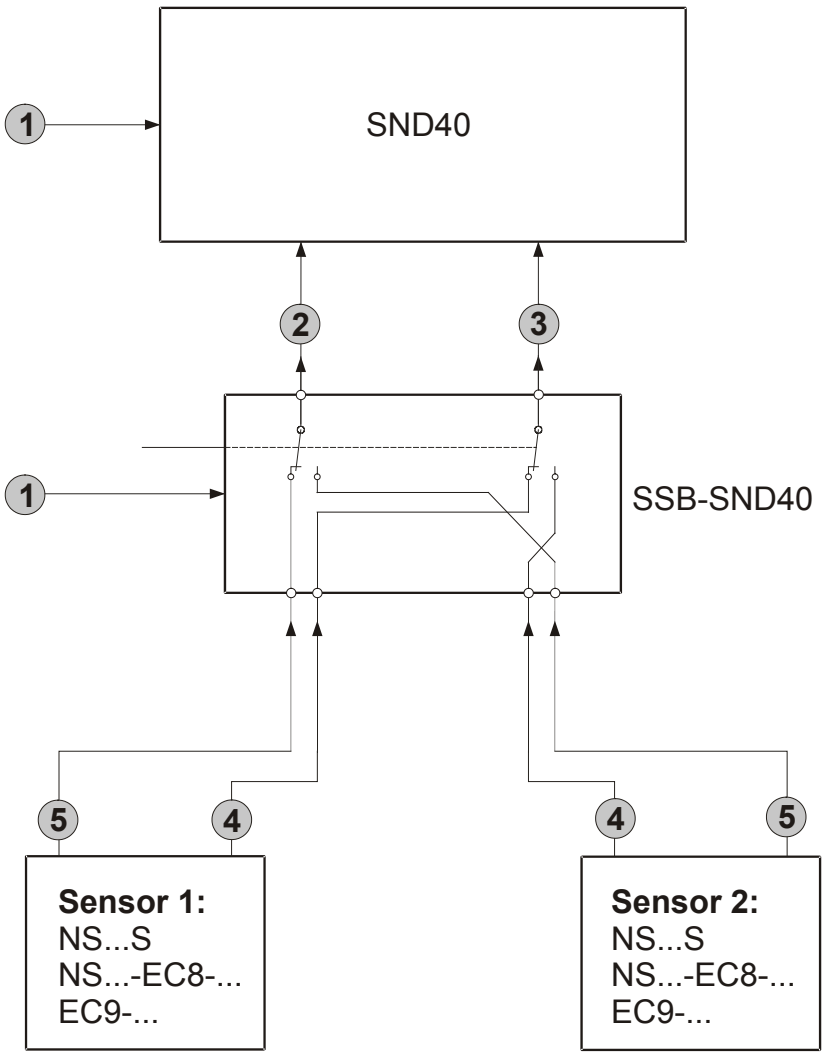


Fig. 68: SSB-SND40 technical drawing

Description	
1:	**SND40** Eddy current connection
2:	**SND40** Leakage flux connection
3:	**SPS** Control connection
4:	**Sensor 1** Leakage flux connection
5:	**Sensor 1** Eddy current connection
6:	**Sensor 2** Eddy current connection
7:	**Sensor 2** Leakage flux connection
8:	Drilling for mounting Ø 5

9.29.2 Connecting scheme



Description	
1:	**SPS** -> SND40 / SSB-SND40 Supply connection
2:	**KNS9S** Cable (leakage flux)
3:	**CECM18S-G** Cable (eddy current)
4:	**SM18CECM18S-GG** Sensor cable (eddy current)
5:	**SKNS8S** Sensor cable (leakage flux)

Fig. 69: SSB-SND40 connecting scheme

9.29.3 PLC supply / control connection scheme

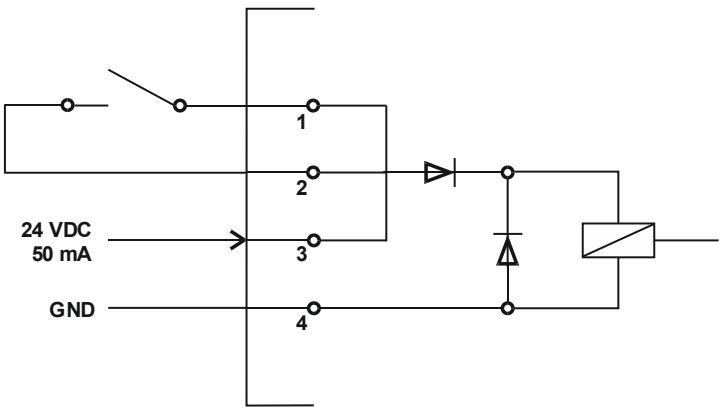


Fig. 70: PLC supply / control connection scheme

9.30 Sensor Connection Box SCB-EC-S

Using eddy current probes requires use of the Sensor Connection Box SCB-EC-S. This box contains the protective resistor for limiting the transmitter current. For the larger combination sensors, eddy current sensors and encircling coil sensors the box is not needed.

The sensor is connected to the box with the cable belonging to the sensor. For connecting the box to the control unit / sensor-switch-box the cable CECM18S-G is required.

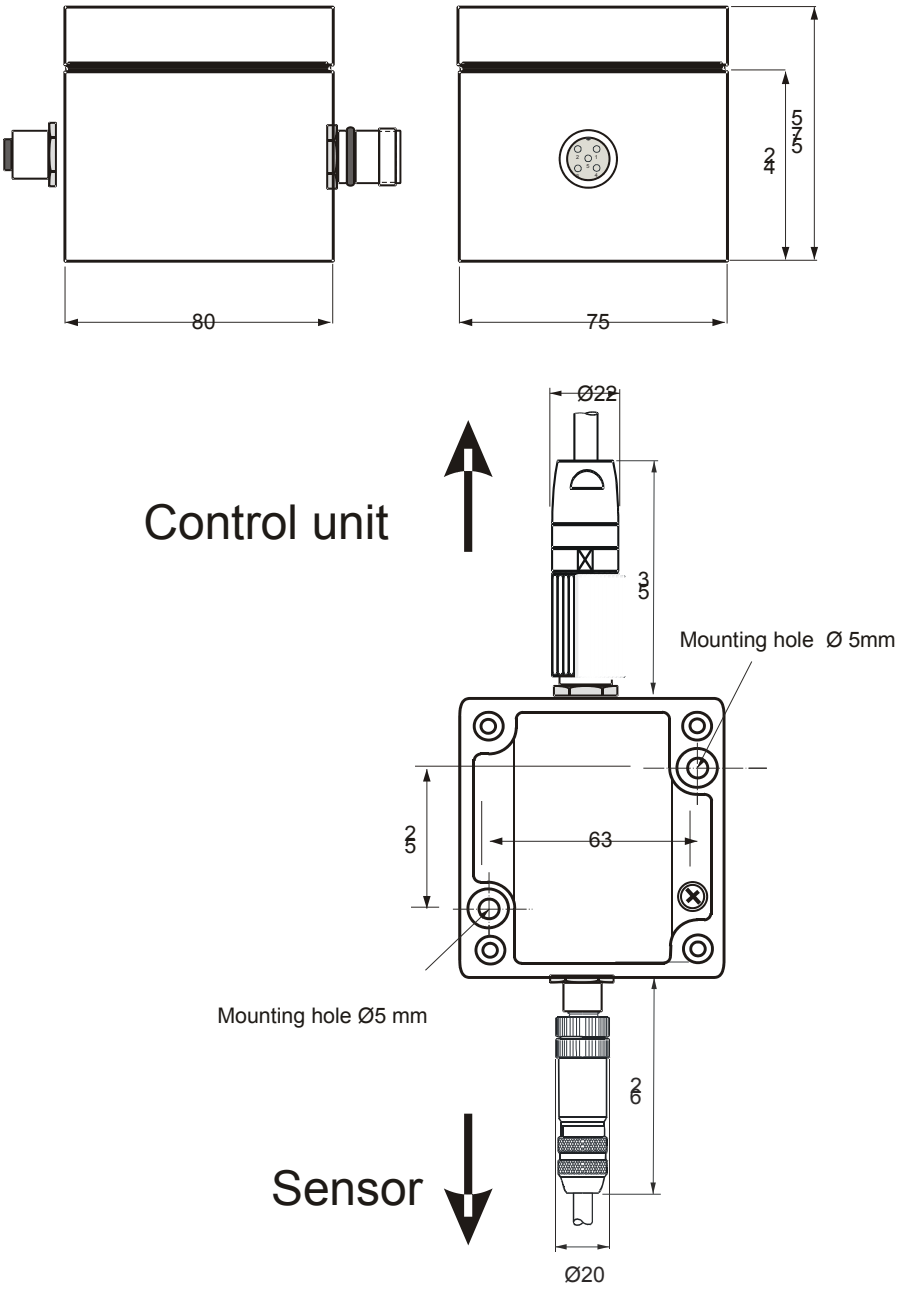
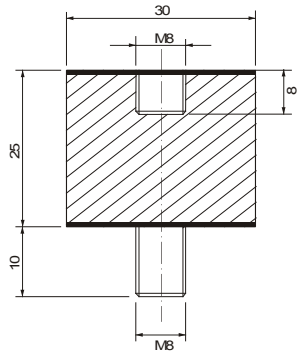


Fig. 71: SCB-EC-S

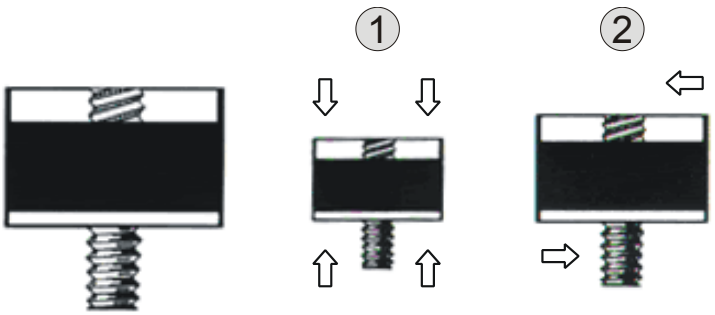
9.31 Rubber mounts for NS9 and NS12



Properties	
Material:	NBR (Acrylnitril-Butadien)
	Metal parts zinc plated and chromated
Hardness:	45+ / -5 Shore A
All dimensions in mm.	

Fig. 72: Rubber mounts

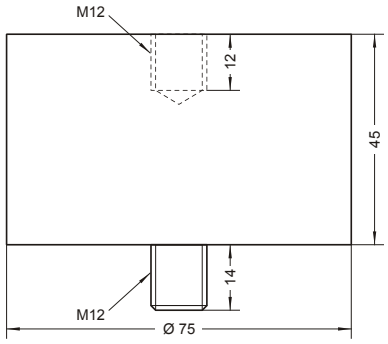
Further properties		
Spring rate (compression):	180 N/mm	1000 lbs/in.
Max. compression travel:	1.5 mm	0.06 in.
Max. compression force:	270 N	60 lbs
Spring rate (shearing):	28 N/mm	160 lbs/in.
Max. shear travel:	3.8 mm	0.15 in.
Max. shear force:	110 N	25 lbs



Description	
1:	Compression
2:	Shearing

Fig. 73: Rubber mounts

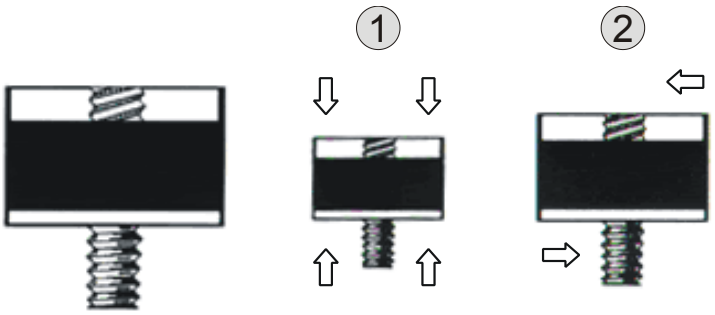
9.32 Rubber mounts for NS24



Properties	
Material:	NBR (Acrylnitril-Butadien)
	Metal parts zinc plated and chromated
Weight:	approx. 0.4 kg (0.88 lbs)
Hardness:	55+ / -5 Shore A
All dimensions in mm.	

Fig. 74: Rubber mounts

Further properties		
Spring rate (compression):	600 N/mm	3500 lbs/in.
Max. compression travel:	4.5 mm	0.18 in.
Max. compression force:	2900 N	600 lbs
Spring rate (shearing):	120 N/mm	700 lbs/in.
Max. shear travel:	10 mm	0.39 in.
Max. shear force:	1200 N	250 lbs



Description	
1:	Compression
2:	Shearing

Fig. 75: Rubber conditions

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10 Maintenance

10.1 Control unit SND40

In order to simplify a possible replacement of the unit, periodical data backup via network (see "*data backup via network*" in chapter "*technical information*") or on USB stick (see "*SND40 Store*") is required.

If new programs are created rarely, data backup can be performed at this moment.

10.2 Sensors

During the progressing of use, the pole shoes and bearings of the sensor may face wearing and damage. Thus, inspection in regular intervals contributes to long-term maintain the functionality of the sensor. Normally a quarterly inspection interval is sufficient.

1. **Inspecting the ball bearings:** In new condition their diameter is 22 or 24 mm. When the diameter has fallen short of 21.8 resp. 23.8 mm, a bearing should be replaced. Care must be taken, that the diameters of the ball bearings do not differ among each other for more than
   ± 0.1mm. If required, all bearings must be replaced.
   Important: Uneven wearing at the bearings indicates a loose mounting or fault in assembling. This results in uneven mechanical load. In any case, worn out bearings need to be replaced.
2. **Inspecting the pole shoes:** Normally the pole shoes do not touch the tube. Anyhow, contact can happen. Possible reasons are worn out bearings, weak mounting or uneven weld seams. If pole shoes show visible wearing marks, the air gap between pole shoe and tube surface can increase to an inadmissible size. Check whether this air gap is within the permissible range. Larger air gaps reduce the magnetic flux and can drastically limit the detecting capability of the sensor. If the air gap exceeds the permissible range, the pole shoes need to be renovated.
   The value ranges for the air gaps can be read from the technical data of the respective sensor.
3. **Inspecting the sensor element:** Normally the sensor element does not touch the tube. If wearing marks are sighted, the air gap needs to be inspected in any case, whether it is within the permissible range. Besides that, the surface of the sensor may not be so deeply grooved that the electronics lays open. In such a case the sensor element must be replaced by the manufacturer.
   The value ranges for the air gaps can be read from the technical data of the respective sensor.
4. **Inspecting the mountings:** If rubber cushions are installed for elastic suspension of the sensor, those must be inspected for damage. Sometimes a broken cushion can be already noticed by skewness of the sensor. In any case, damaged rubber cushions need to be replaced. Furthermore, all screws must be checked for tight seating and be tightened, if required.
5. **Inspecting the electrical components:** Inspect cables, plugs and grounding line for damage, correct layout and tight seating (plugs and screw terminals). Loose cables are endangered to getting jammed or chaffed. Always replace damaged cables.
6. **Inspecting movable parts:** Due to the use of permanent magnets, metal particles can cumulate at the sensor. In this case clean the sensor with compressed air.

10.2.1 Air gaps and wearing limits of the sensors

Due to the wearing of the rollers, the air gaps at the sensor decrease. When the wearing limit has been reached, the rollers need to be exchanged by new ones.

The following chart shows the air gaps of the sensors in new condition as well as the minimal permissible air gaps at the wearing limit.

	EC9… / NS9… / NS12…	NS24-EC18…	NS24-EC30…
Air gap between pole boots and sheet in mm (inch)			
in new condition	0.2 – 0.25 (.008“ - .01“)	0.5 – 0.55 (.02“ - .022“)	2.0 – 2.05 (.079“ - .081“)
at wearing limit	< 0.1 or > 0.35 (.004“ or .014“)	< 0.3 or > 0.7 (.012“ or .028“)	< 1 or > 2.5 (.039“ or .098“)
Air gap between sensor element and sheet in mm (inch)			
in new condition	0.6 – 0.65 (.024“ - .026“)	0.5 – 0.55 (.02“ - .022“)	2.0 – 2.05 (.079“ - .081“)
at wearing limit	< 0.3 or > 0.75 (.012“ or .03“)	< 0.3 or > 0.7 (.012“ or .028“)	< 1 or > 2.5 (.039“ or .098“)

10.3 Regular wearing and increased wearing

During operation, a sensor is subject of a certain regular wear. Thus, the sensors need to be inspected in regular intervals and worn components must be replaced.

If increased wear within a short period is detected, this is a symptom for one or more of the fault conditions shown below. The cause for this should be immediately found and redressed. In the worst case a sensor can be unrepairable damaged.

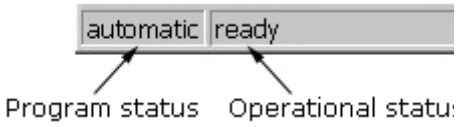
A further symptom for increased wear within a short period is the gradual drift of the measuring values, because they depend on the mechanical conditions.

The case when increased wear is existing depends considerably on the individual conditions of application.

Increased wear	Comment	Reduced wear
Sensor is mounted wrongly or unfavourably. Sensor is not correctly aligned.	The sensor can no longer move suspended in the bracket or runs unevenly on the material. The rubber mounts might break. The rollers do not touch down simultaneously and evenly onto the surface, the sensor runs tilted on the material (the rollers are „rubbing“ over the surface and wear-out unevenly or prematurely).	Take care that the sensor is correctly mounted in the bracket. Align the sensor correctly. **All sensor rollers must be in contact with the surface and rotate!** This applies also for tubes as well as for coils.
Rubber mount is damaged or broken.	Damaged / broken rubber mounts can no longer provide for elastic suspending and correct guidance. Thus a mis-positioning and a wrong alignment of the sensor results.	Replace damaged rubber mounts.
Jacking force too large.	If the sensor is pressed onto the material with too much force, the rollers and the bearings wear-out too fast. The rubber mounts might break. The sensor should be pressed onto the material with a force which equals its own weight.	Reduce the jacking force. If the attached rubber mounts are used, the sensor should comply only for up to 5mm when touching-down.
Touch down motion too vehement.	Vehement touch down motions causes severe impacts on the rollers, their bearings and shafts. The rubber mounts as well as the bearings of the rollers might break.	Cushion the touch down motion.
Very uneven material surface.	The nature of the material surface can considerably influence the wearing of the sensor.	

10.4 Program status / Operational status

Program status	Operational status
Inactive	**System start**
	Program invalid
	Inactive
	System configuration invalid
Automatic	**Ready**
	Active
	Program change
	Program invalid
	Error
	Done
	Inactive
	System configuration invalid
	Section active
Setup	**Edit**
	Active
	Program change
	Error
	Program invalid
	Measurement stopped
	Inactive
	System configuration invalid
	Speed meas. finished
	X/Y active
	X/Y sampling done
	Section active
	Wait for PLC



10.4.1 Operational conditions in program status „Automatic“

Ready: Neither a program change nor a detecting job is active. The unit is ready for the next job or program change via PLC. The operator can use the keys “*Print*”, “*Statistics*”, “*Program*” or “*System*”.

Active: A detecting job was started by the PLC. This operational condition will be automatically terminated, as soon as the positioning procedure has been performed. When no error condition is existing, the condition changes over to “*Ready*”.

Program change: A program change was started by the PLC. This operational condition will be automatically terminated, as soon as the change has been performed by the PLC, also if a change was not possible since a non-existing program number was selected. Then a message is released which will be displayed in the “error message” field.

Note: In this case the unchanged program number will be mirrored back at the PLC interface, since the change was not possible.

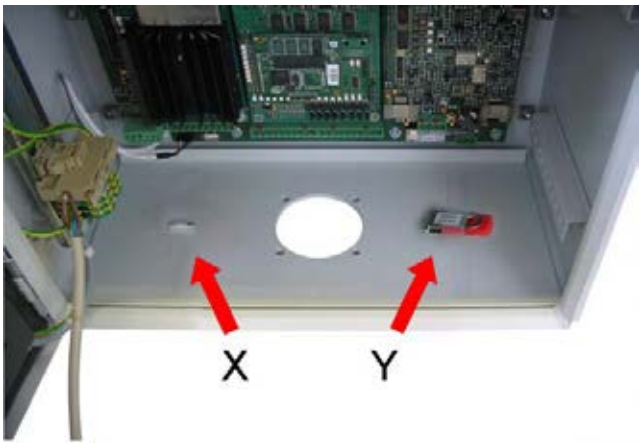
Error: A started detecting job cannot be executed. An operator intervention is required to redress this condition. The cause for this condition may be internal or external disturbances which do not redress themselves. In the field “*error message*” the triggering error message is shown.

10.5 SND40StoreV2

SND40StoreV2 is an easy-to-handle aid for saving / restoring program and system files.

Requirements:

- Hardware version of the SND40, based on processor module NetDCU10
- USB-Stick (attached and located inside the unit)



X	Position of spare fuse
Y	Position of USB stick

Fig. 76: Position of USB stick and spare fuse inside of unit

The program replaces the previous backup program of the SND40 device "SND40_10Store.exe" and its English version "SND40_10StoreENU.exe". The programs mentioned above are among others no longer able to backup and restore advanced system configuration and programs with numbers higher than 31.

10.5.1 Definitions

Term	Explanation
SND40 program directory	Folder on the SND40 device containing all the program, utility, configuration and data files associated with the SND40 application.
Backup root directory	Folder containing one or more backup directories.
Backup directory	This folder contains the backup files of a specific backup operation.

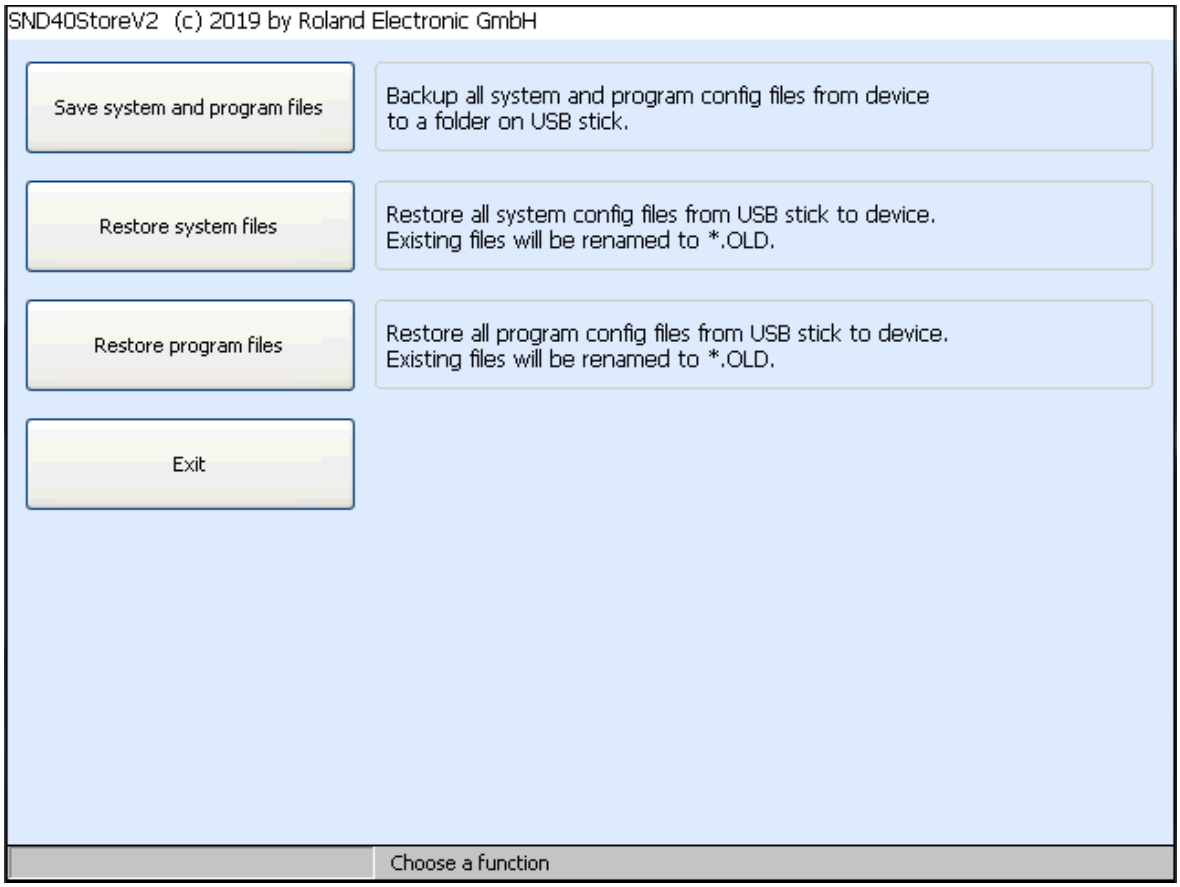


Fig. 77: Program interface of SND40StoreV2.exe

The program interface of SND40StoreV2 contains on the left side the buttons for function selection as well as on the right side a brief description of the function in English.

10.5.2 Function description

The program contains 3 different functionalities, which are described in detail below:

1. Backup of all system and program configuration files. Actually following files are included:
   - System.cfg
   - SystemEx.cfg
   - Program1.cfg - Program255.cfg (if available)
2. Restore the system configuration files
3. Restore the program configuration files

Note The language of the program interface is in English.

10.5.3 Starting the program

SND40StoreV2 is implemented as a stand-alone program, but can be started directly from the SND40 application without the need to exit it (as of version A5-V2.15 of SND40_10.exe).

Note For all functions, the corresponding backup USB stick should already be connected before selecting a function, this facilitates the subsequent functional sequence.

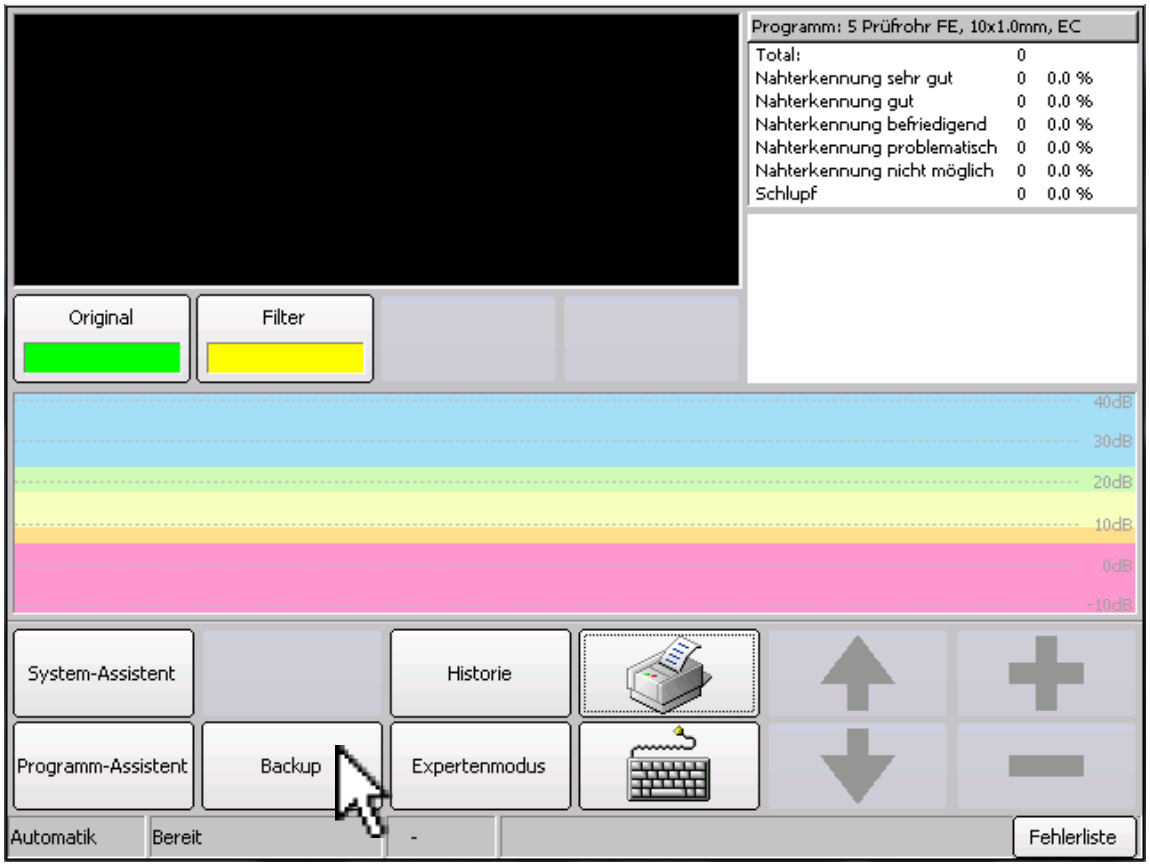
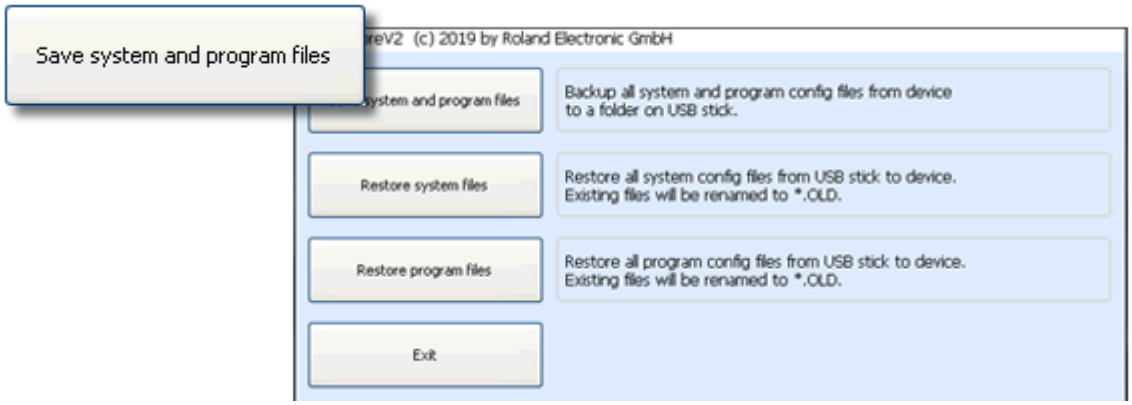
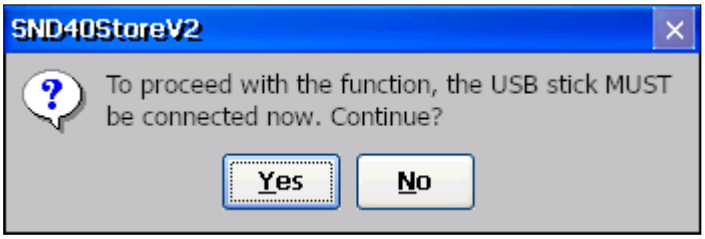


Fig. 78: To start the program press the "Backup" button from the main menu of the SND40 application.

10.5.3.1 Function „Save system and program files”



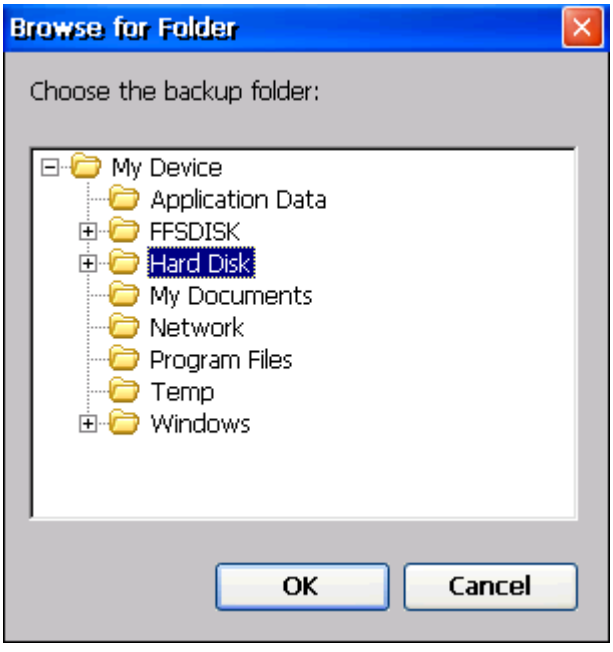
This function saves all system and program configuration files from the SND40 program directory to a freely definable directory on a connected USB stick.



After selecting the function, a dialog window reminds that the USB stick MUST be connected to proceed. Confirm by pressing “*Yes*”.

Note It is also possible to connect the USB stick after starting the function, but then it is necessary to wait a few seconds, so that the operating system can recognize the USB stick properly.

After confirming the message, the program checks if the USB stick is present. If the result is negative, you will receive a corresponding error message and the function will be aborted.



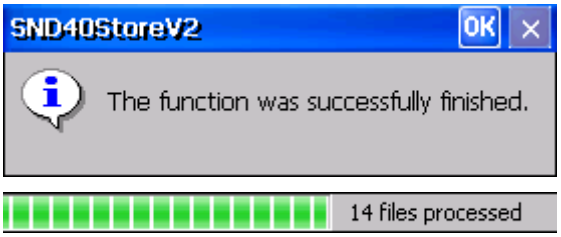
If the USB stick is identified as “*Hard Disk*”, the selection must be done where the backup directory should be created.

This selection defines the so-called backup root directory, in which the actual backup directory with the saved files is saved.

For this, the program displays a dialog window to select the directory; there, the main directory of the USB stick is already selected.

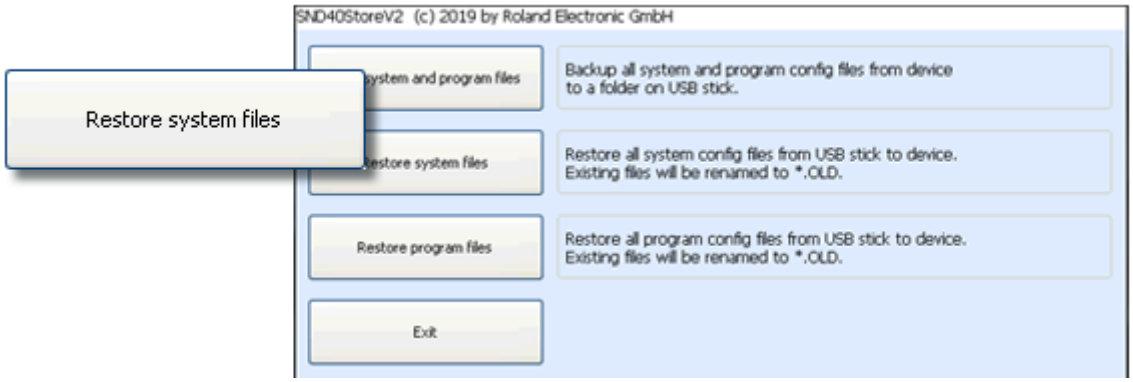
Note In order to use an own directory structure on the USB stick, this must be already present on the USB stick; creating new folders is not possible within this dialog.

After selecting and confirming the dialog, the copy process starts; the progress bar is displayed in the left area of the status bar.
The program uses the following format to name the backup directory:
Year_Month_Day_Time_<Geometry>
According to the parameter "PRODGEOM" in the file "*System.cfg"*, the suffix "Round" is used for <*Geometry*> in measurement mode "Round" or "Flat" in measurement mode "Flat".
This makes it possible to back up from different dates and / or systems on a USB stick.



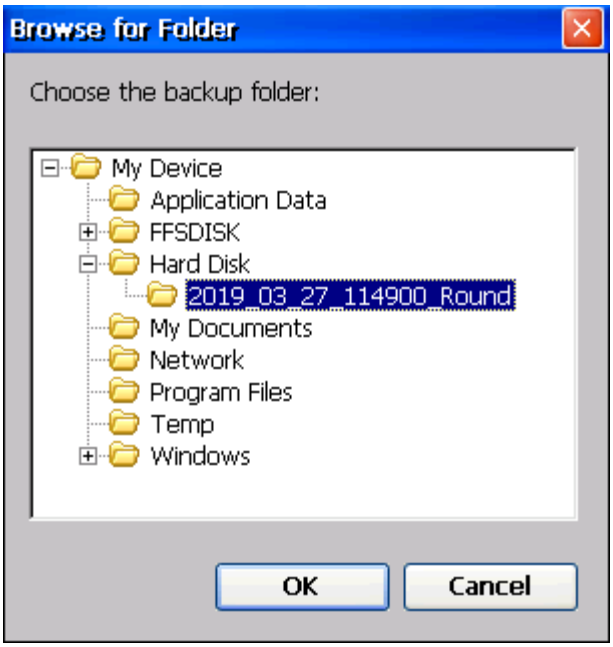
In case the copy procedure has been successful, a message window appears and the numbers of copied files are displayed in the status bar.

10.5.3.2 Function „Restore system files“



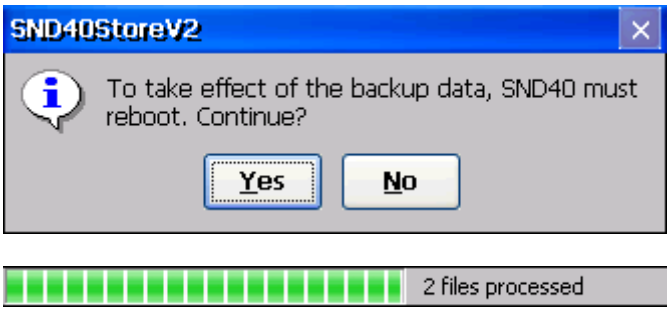
This function copies all system configuration files from the selected backup directory to the SND40 program directory.

The process of this function is in many parts similar to the backup process. First of all, the verification of a connected backup USB stick takes place again; If necessary, observe the instructions in previous chapter “Function Save system and program files”.



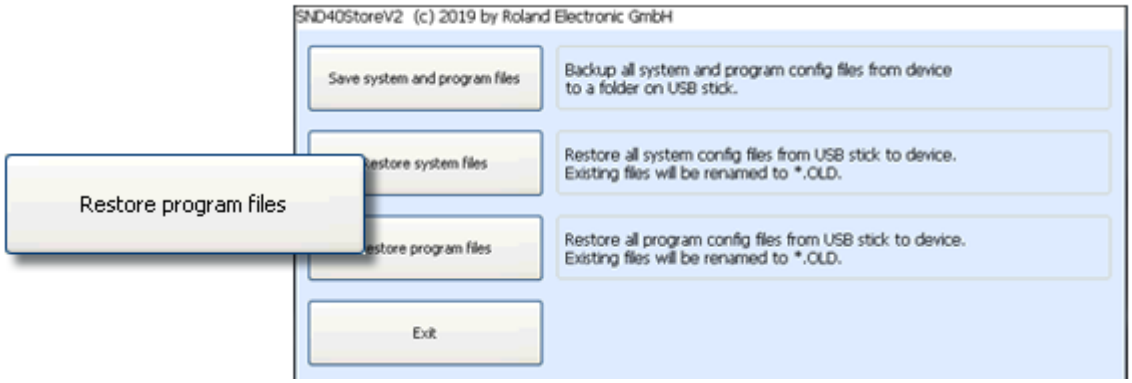
The selection of the backup directory differs somehow from the same process during the backup process: There it has been necessary to specify the backup root directory, now the actual backup directory one level deeper which contains the backed up files.

If the measurement modes of the SND40 device and the "*System.cfg*" file are different in the backup directory, you will receive a warning message before copying; however, recovery may still be possible.
Since the system files usually already exist in the SND40 program directory, they are initially renamed to "*System.cfg.old*" or "*SystemEx.cfg.old*" before being restored from the backup directory.



In case that the copy process has been successful, the SND40 device must be restarted to permit the changed files to become active. A message dialog window pops up and the number of copied files will be displayed in the status bar. After confirming the dialog by pressing "Yes" the restart will be performed automatically.

10.5.3.3 Function „Restore program files“

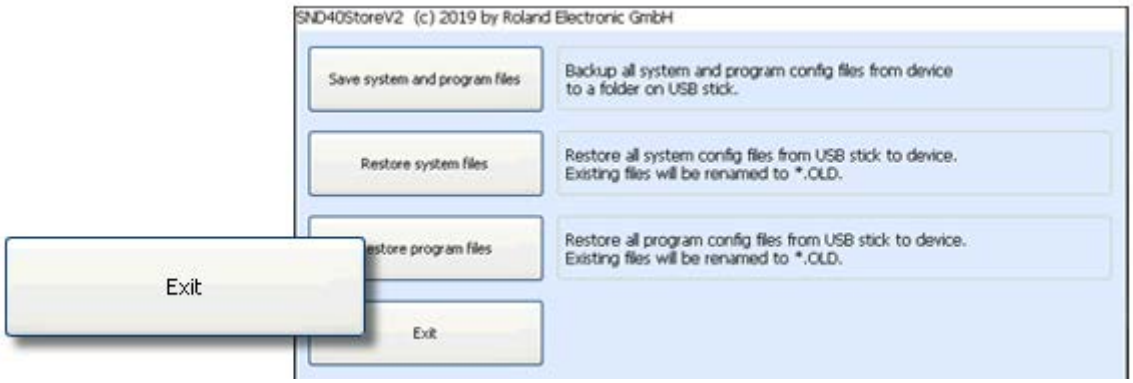


This function copies all program configuration files from the selected backup directory into the SND40 program directory.

The sequence of this function largely corresponds to the function "Restore system files" with reference to the program files.

At this point, also existing files are renamed first to "*ProgramXX.cfg.old*" before the backed up files are copied back. Existing program files which are not contained in the saved data remain unaffected by this process. In contrast to restoring the system files, there is no check of the measurement mode of the SND40 device and saved program files.

10.5.3.4 Button „Exit“



By pressing this button, the backup program is terminated and the main menu of the SND40 application appears without restarting of the SND40 device.

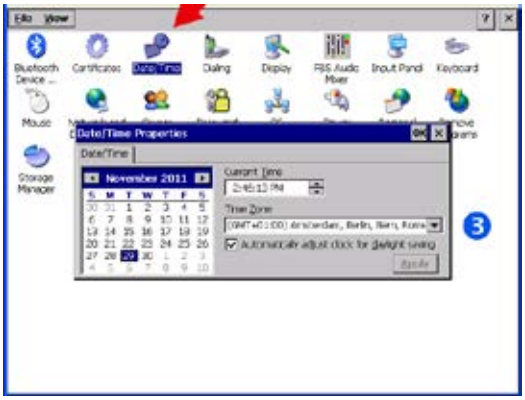
10.6 Setting the System Time / Date

The system time / date is a component of the Windows operating system, it is set in the system control as for every other PC with Windows OS.

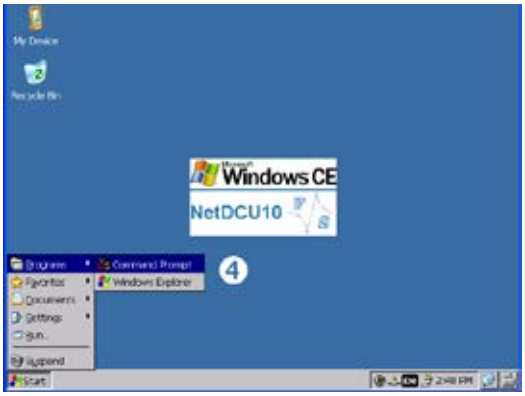
- Connect a USB keyboard (if available), otherwise use the touchscreen.
- Terminate the SND40 program (ESC key on screen keyboard), the Windows desktop then appears.

- Click in the left bottom corner of the screen to make the taskbar visible.

- In the Start menu, choose under „Settings“ the „Control Panel“.



- In the Control Panel press or click on the “Date/Time” icon.
- Change the system time / date (as for any other Windows PC).
- Clicking on the *Apply* key validates the changes.



- Go back to the Windows Desktop and choose in the Start menu under „Programs“ the „Command Prompt“.
- Enter: ndcucfg

- Please type „ > reg save“ und confirm with „Enter“ button.
- Re-start the system by recovering the supply voltage.

10.7 Calibrating the touchscreen

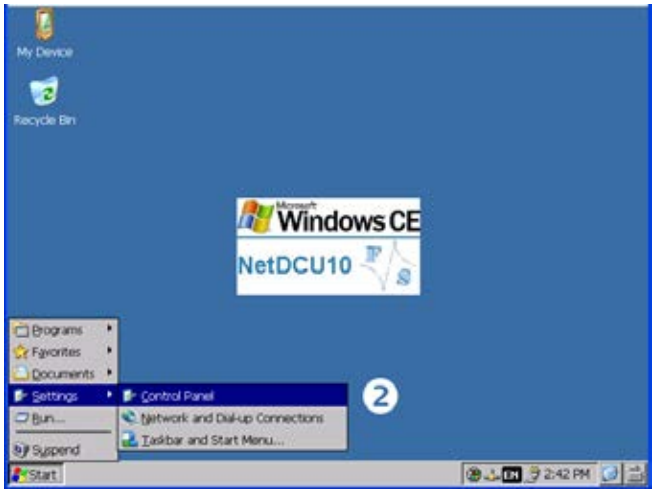
Method 1: Calibration via Remote connection

Note: Establishing a Remote connection is described in this manual, section “Service function Remote Desktop”.

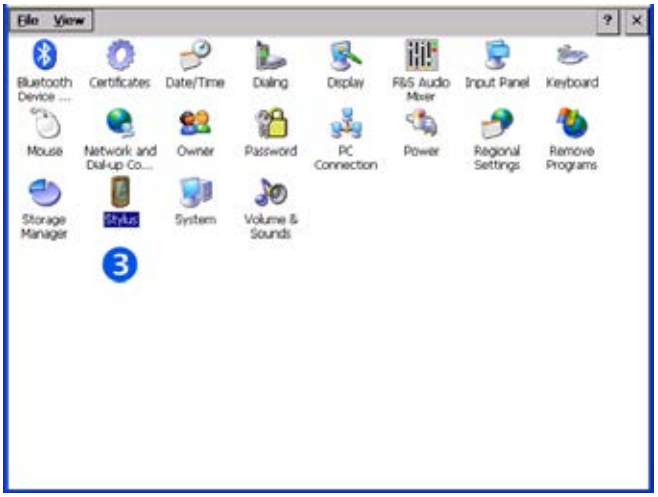
Establishing a Telnet connection is also described in this manual, section “Data backup via network”, item 1 + 2.

- At the PC establish Remote connection with Remote Desktop, so that the SND40 can be remote operated.
- Terminate SND40 program (ESC key).

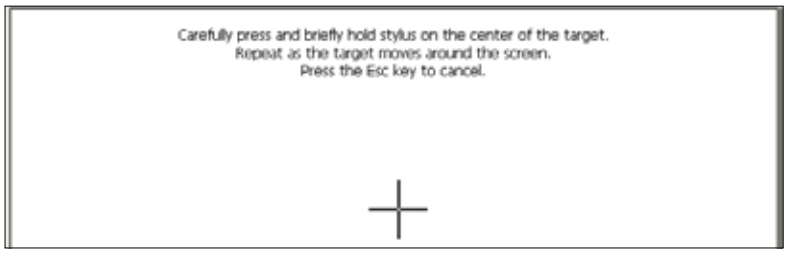
- Click in the left bottom corner to make the taskbar visible.



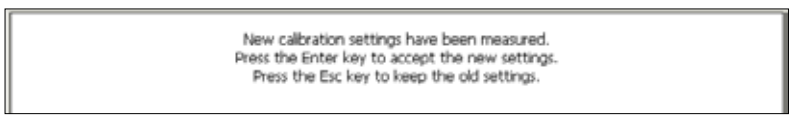
- In the Start menu, under „Settings“ choose the „Control Panel“.



- In the Control Panel press, resp. click on the „Stylus“ icon.
- Click on the “Calibration” tab.
- Operate the “Recalibrate“ key.
- Calibrate the display according to the instructions.

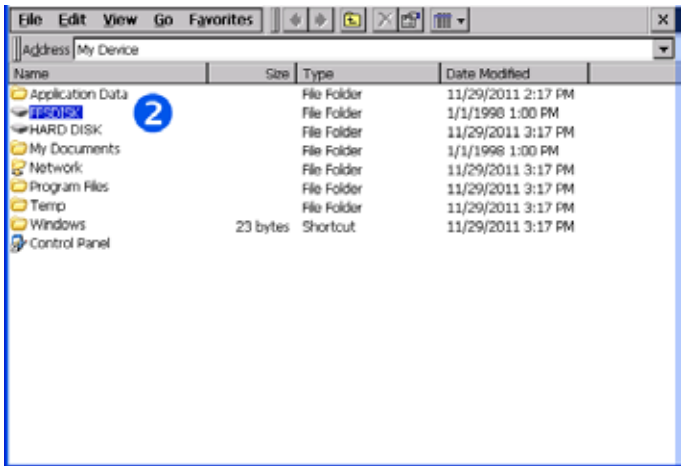


- After the calibration process close the calibration window and return to the start screen.

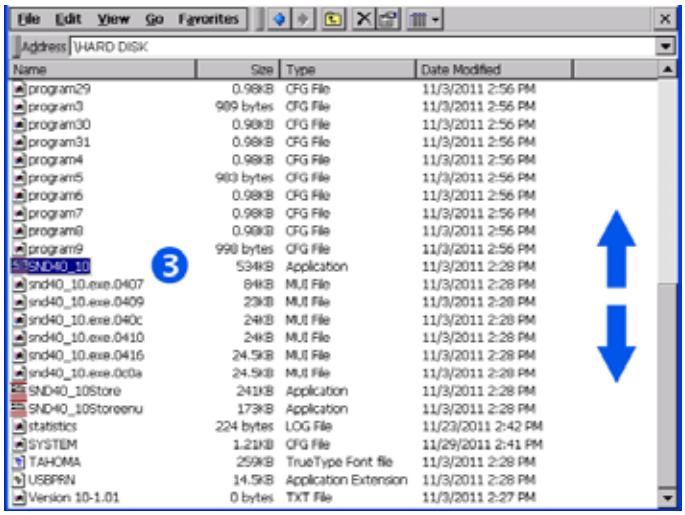


- Establish a Telnet connection.
- Enter: ndcucfg.
- Type the following commands and confirm each by pressing „Enter“:
  reg save
  quit
  The changes are now saved.
- Restart the application:

Start application SND40_10	
1:	Open the Windows Explorer by double click the icon “My Device”.



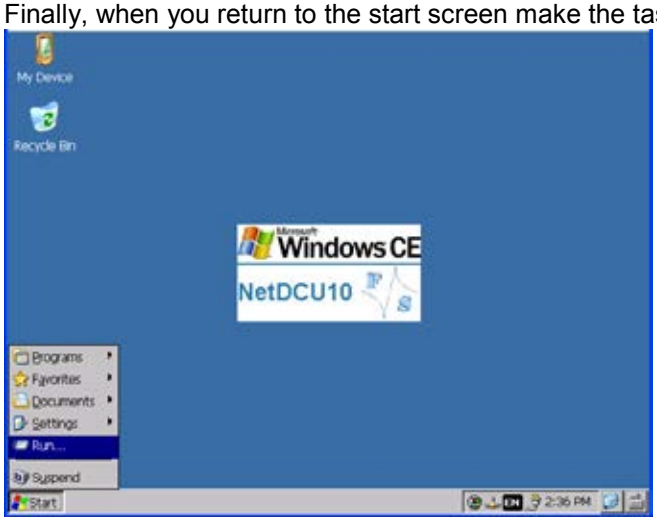
Start application SND40_10	
2:	Please execute “FFSDISK”.



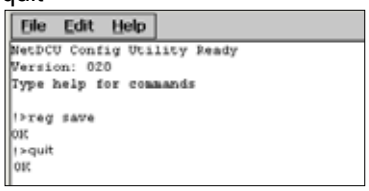
Start application SND40_10	
3:	Scroll until you find “SND40_10” and restart the application.

Method 2: Calibration without PC connection, but with a external USB keyboard

- Connect a USB keyboard.
- Terminate SND40 program (ESC key).
- The procedure in calibration without PC is almost identical.
  No Telnet connection is required. So proceed with the calibration as described in method 1.
- Instead of a USB keyboard you may also use a USB mouse.
- Finally, when you return to the start screen make the taskbar visible.



- Press "Run" and execute "cmd.exe".
- Enter: ndcucfg
- Type the following commands and confirm each by pressing „Enter“::
  reg save
  quit



The changes are now saved.

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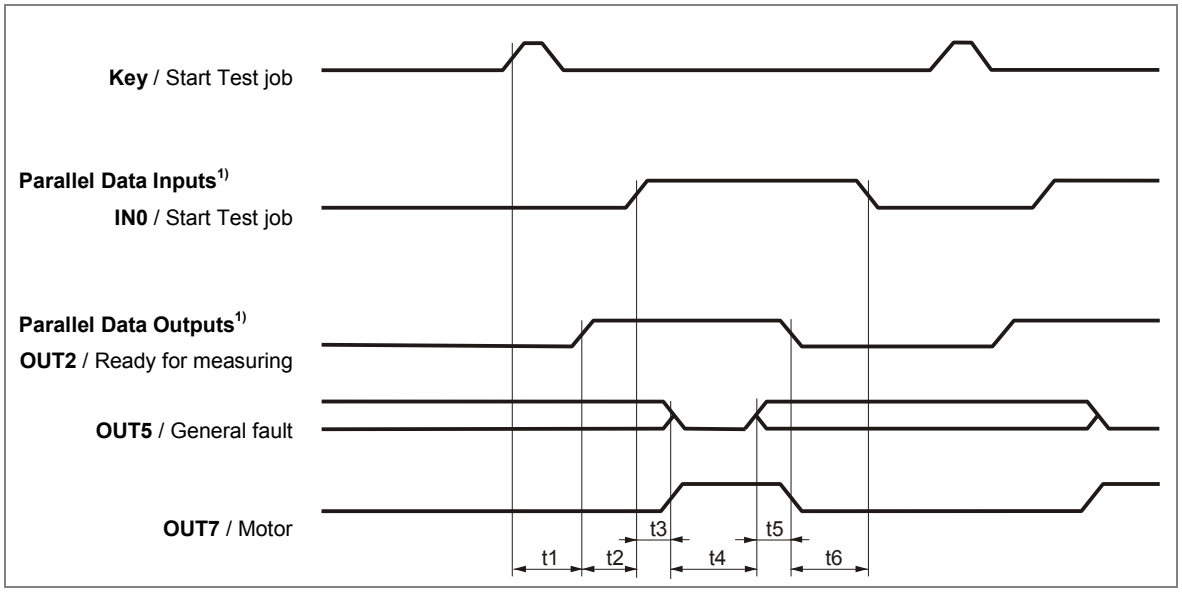
11 Technical records

11.1 Timing Diagrams – Round material application

Minimal wiring of interface
Operational condition: Setup - Edit

Pre-condition:

1. The unit must be in *"Setup - Edit"* condition.
2. System parameter *"Test job control mode: PLC"*
3. Test job or Speed measurement (is started by key operation and automatically terminated).
   By pressing the button the SND40 outputs the signals to the PLC. The status message "Waiting for PLC start" is generated by the SND40. The PLC prepares a tube for detection and gives the signal "start test job" to the SND40.



t1: < 100 ms
t2: Time which the PLC needs to prepare a tube for parameter programming (Putting-on the tube).
t3: < 30 ms
t4: The duration of the test procedure / speed measurement is depending on tube diameter and tube rotation rate.
t5: ≥ 0 ms
t6: At the end of the test procedure / speed measurement the Start signal must be cancelled.

The duration of parameter optimization (test job / speed measurement) depends on tube diameter, tube rotation rate and the time required for entering the parameters.

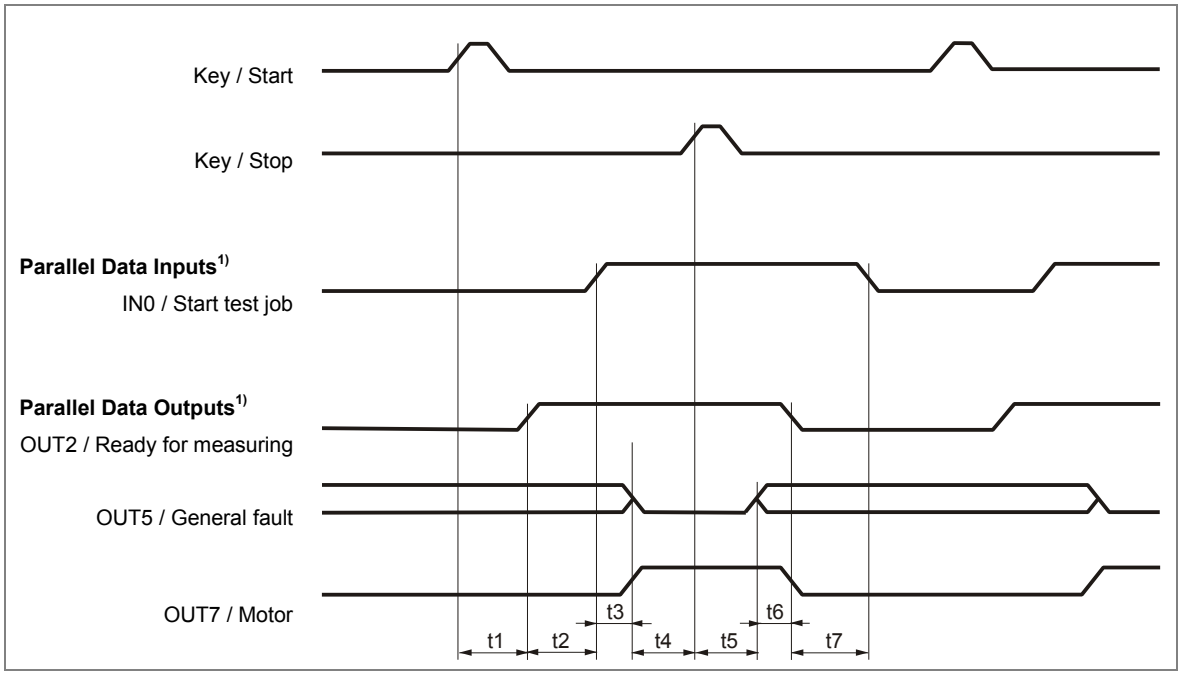
Test job:	Transient time + 3 to 4 tube turns
Speed measurement	approx. 60 s transient time + 5 tube turns

[1)] Not mentioned inputs / outputs of the interface are not required for parameter programming.

Minimal wiring of interface
Operation condition: Setup – Edit (X/Y)

Pre-condition:

1. The unit must be in "*Setup - Edit*" condition.
2. System parameter "*Speed measurement: PLC*"
3. X/Y operation (started / terminated by key operation).
   By pressing the button the SND40 outputs the signals to the PLC. The status message "Waiting for PLC start" is generated by the SND40. The PLC prepares a tube for detection and gives the signal "start test job" to the SND40.



t1: < 100 ms
t2: Time which the PLC needs to prepare a tube for parameter programming (Putting-on the tube).
t3: < 30 ms
t4: The user will terminate the X/Y operation with the <Stop> key.
t5: ≥ 0 ms
t6: At the end of the X/Y operation the Start signal must be cancelled.

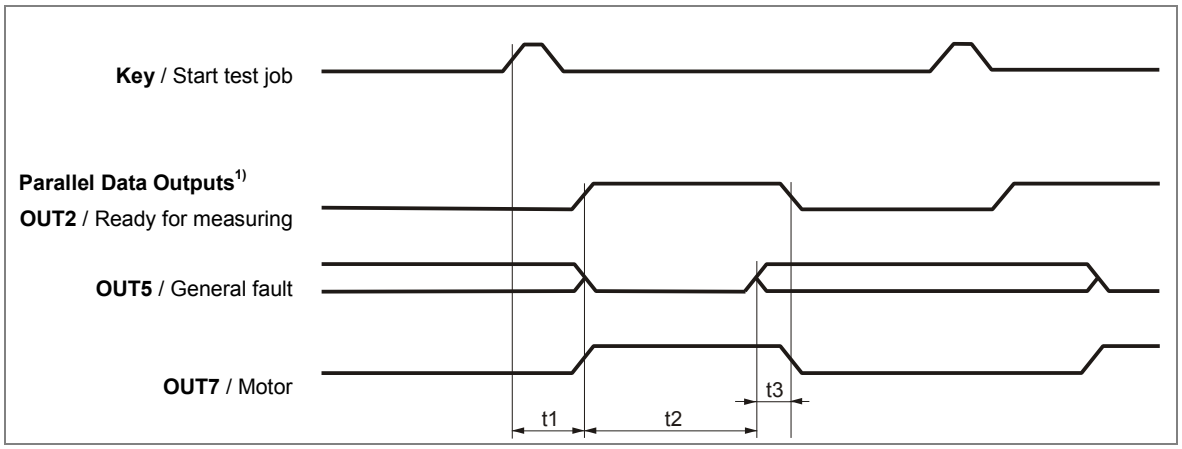
The total duration of the X/Y operation will be determined via key operation by the user.

1) Not mentioned inputs / outputs of the interface are not required for parameter programming.

Minimal wiring of interface
Operational condition: Setup - Edit

Condition!

1. The unit must be in "*Setup - Edit*" condition.
2. System parameter "*Test job control mode: KM*" (by SND40 key)
3. Test job or speed measurement (is started by key operation and automatically terminated).
4. The PLC must already have the tube prepared for rotation. The PLC must then accordingly output the signal "motor" to rotate the tube.



t1: < 100 ms
t2: The duration of the test procedure / speed measurement is depending on tube diameter and tube rotation rate.
t3: ≥ 0 ms

The duration of parameter optimization (test job / speed measurement) depends on tube diameter, tube rotation rate and the time required for entering the parameters.

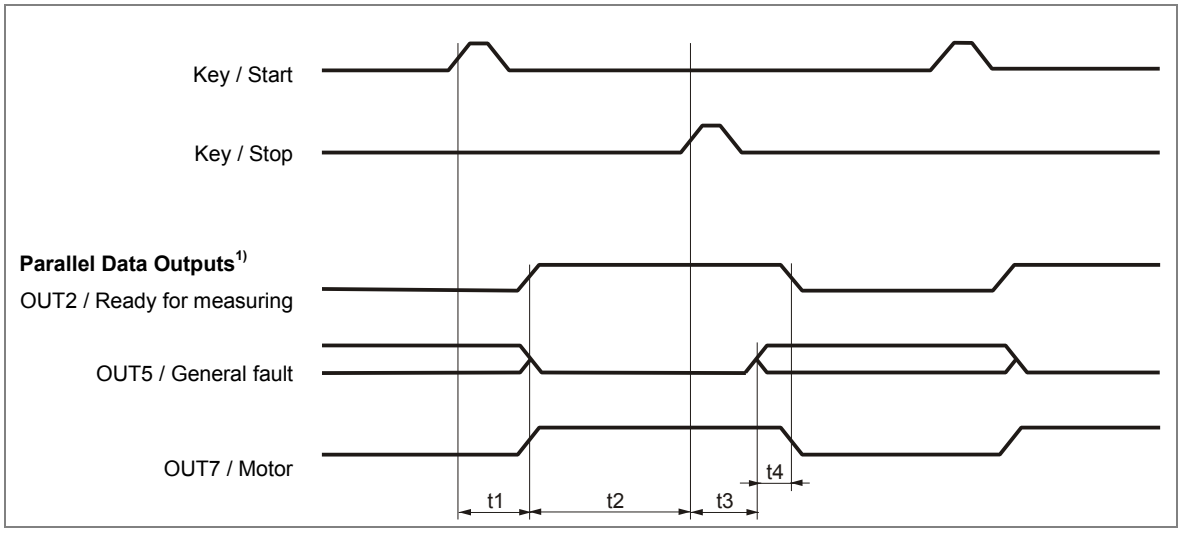
Test job:	Transient time + 3 to 4 tube turns
Speed measurement	approx. 60 s transient time + 5 tube turns

[1)] Not mentioned inputs / outputs of the interface are not required for parameter programming.

Minimal wiring of interface
Operation condition: Setup – Edit (X/Y)

Condition!

1. The unit must be in "*Setup - Edit*" condition.
2. System parameter "*Test job control mode: KM*" (by SND40 key)
3. X/Y operation (started / terminated by key operation).
4. The PLC must already have the tube prepared for rotation. The PLC must then accordingly output the signal "motor" to rotate the tube.



t1: < 100 ms
t2: The user will end the X/Y operation with the <*Stop*> key.
t3: < System parameter "*time*"
t4: ≥ 0 ms

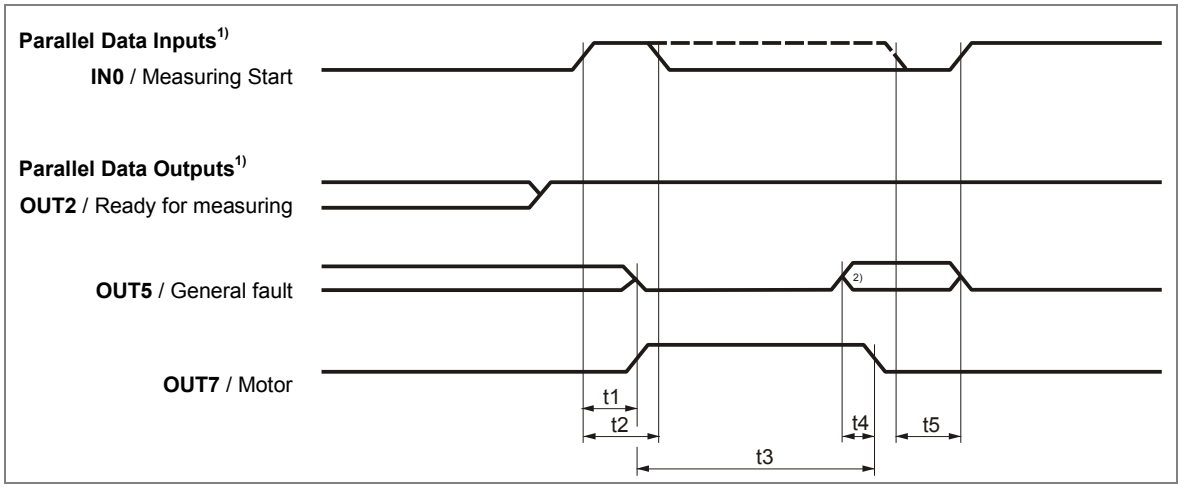
The total duration of the X/Y operation will be determined via key operation by the user.

1) Not mentioned inputs / outputs of the interface are not required for parameter programming.

Minimal wiring of interface
Measuring procedure by external PLC

Note!

For externally triggering a measuring with IN0, a valid program must be selected (externally or via keyboard) and the unit must be in "*Automatic - Ready*" condition.



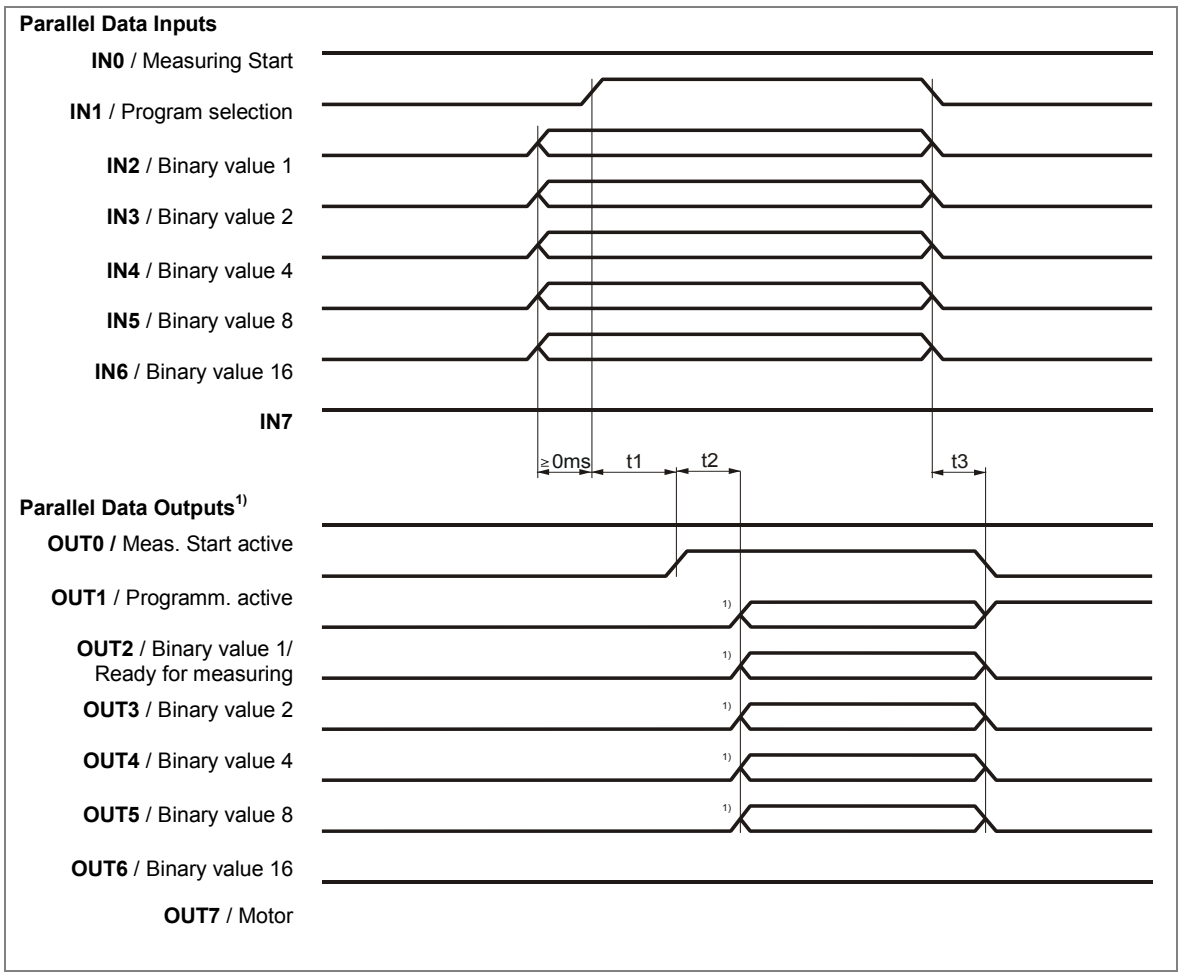
t1: < 20 ms
t2: > 30 ms
t3: Depending on tube diameter
t4: ≥ 0 ms
t5: > 30 ms

1) Not mentioned inputs / outputs of the interface are not required for measuring.
2) A "HIGH" signal at the *"General fault"* output indicates, that the weld seam might not be correctly positioned.

Standard wiring of interface
Program selection by external PLC – Menu address is binary coded

Note!

For external program selection the unit must be in "*Automatic - Ready*" or "*Automatic - Program invalid*" condition. On selecting a measuring program without previous programming, the program will not be enabled and the input data IN2 to IN6 will not be mirrored at the outputs OUT2 to OUT6. A message regarding the missing parameters will be shown.



IN0 and IN1 are flank triggered interrupt inputs. In the standard configuration the positive flank is active. Both inputs must not be activated simultaneously. The min. time between 2 commands must be >20 ms IN1 is the strobe input for the data inputs IN2 to IN6.

t1: < 20 ms
t2: < 4 s for filter type "*cross correlation*", else < 200 ms
t3: < 5 ms

[1] The output signals OUT2 to OUT6 have two different functions.

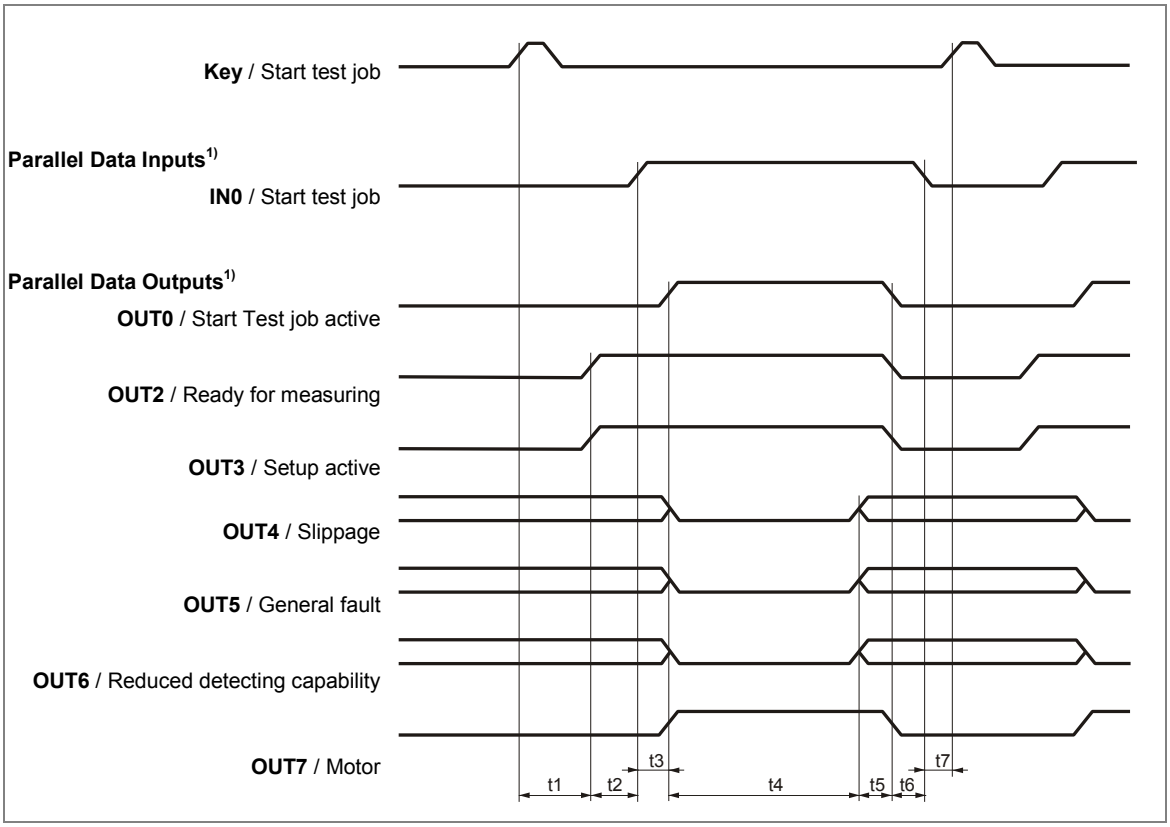
On externally activating the command "*Program selection IN1*" the input data IN2 to IN6 are mirrored at the outputs OUT2 to OUT6, in order to enable transmission monitoring.

On externally activating the command "*Measuring Start IN0*" the measuring result and status messages will be reported. In the standard configuration High Level = active.

Standard wiring of interface
Operational condition: Setup - Edit

Pre-condition:

1. The unit must be in "*Setup - Edit*" condition.
2. System parameter "*Test job control mode: PLC*".
3. Test job or speed measurement (is started by key operation and automatically terminated).
   By pressing the button the SND40 outputs the signals to the PLC. The staus message "Waiting for PLC start" is generated by the SND40. The PLC prepares a tube for detection and gives the signal "start test job" to the SND40.



t1: < 100 ms
t2: Time which the PLC needs to prepare a tube for parameter programming (Putting-on the tube).
t3: < 30 ms
t4: Duration of test procedure / locating of rotation rate is according to tube diameter and tube rotation rate.
t5: ≥ 0 ms
t6: At the end of the test procedure / locating of rotation rate the Start signal must be cancelled.
t7: > 30 ms

The duration of parameter optimization (test job / locating of rotation rate) depends on tube diameter, tube rotation rate and the time required for entering the parameters.

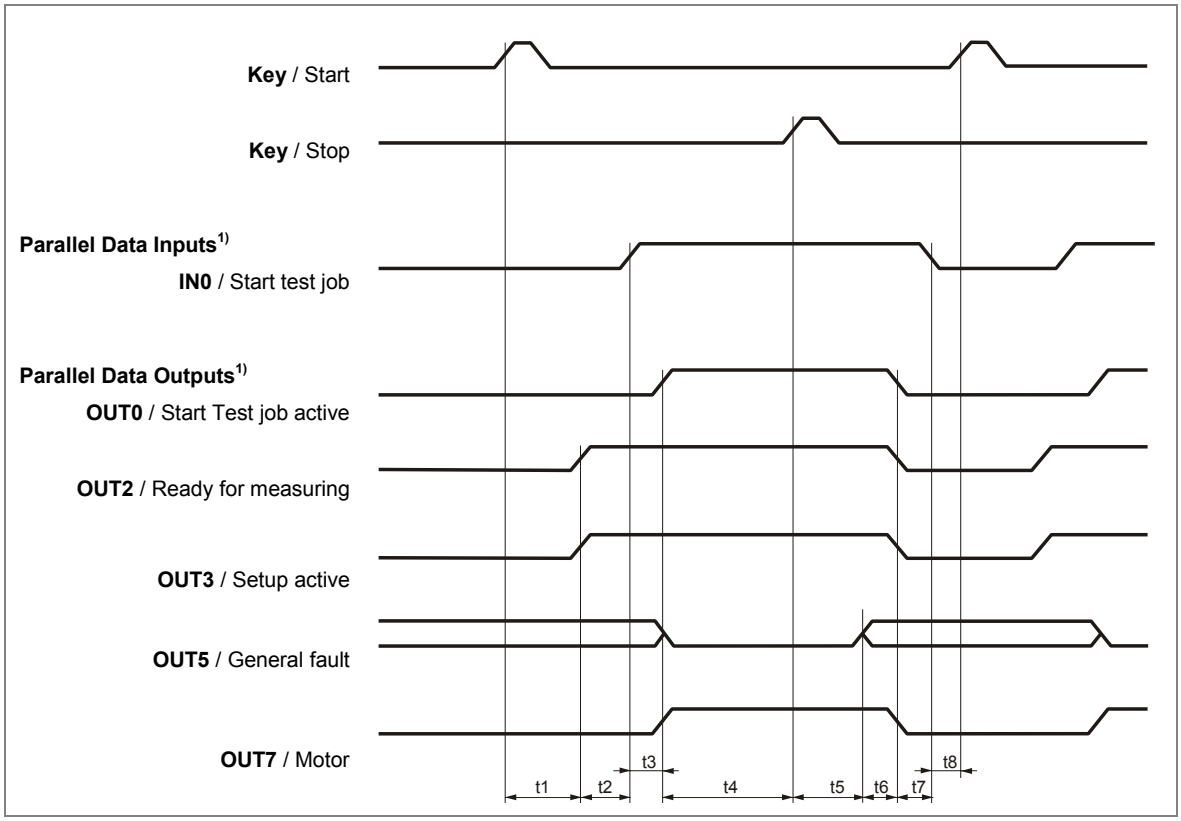
Test job:	Transient time + 3 to 4 tube turns
Speed measurement	approx. 60 s transient time + 5 tube turns

[1)] Not mentioned inputs / outputs of the interface are not required for parameter programming.

Standard wiring of interface
Operational condition: Setup – Edit (X/Y)

Condition!

1. The unit must be in "*Setup - Edit*" condition.
2. System parameter "*Test job control mode: PLC*"
3. X/Y operation (started / terminated by key operation).
   By pressing the button the SND40 outputs the signals to the PLC. The staus message "Waiting for PLC start" is generated by the SND40. The PLC prepares a tube for detection and gives the signal "start test job" to the SND40.



t1: < 100 ms
t2: Time which the PLC needs to prepare a tube for parameter programming (Putting-on the tube).
t3: < 30 ms
t4: The user terminates the X/Y operation with the <*Stop*> key.
t5: < System parameter "*time*"
t6: ≥ 0 ms
t7: At the end of the X/Y operation the Start signal must be cancelled.
t8: > 30 ms

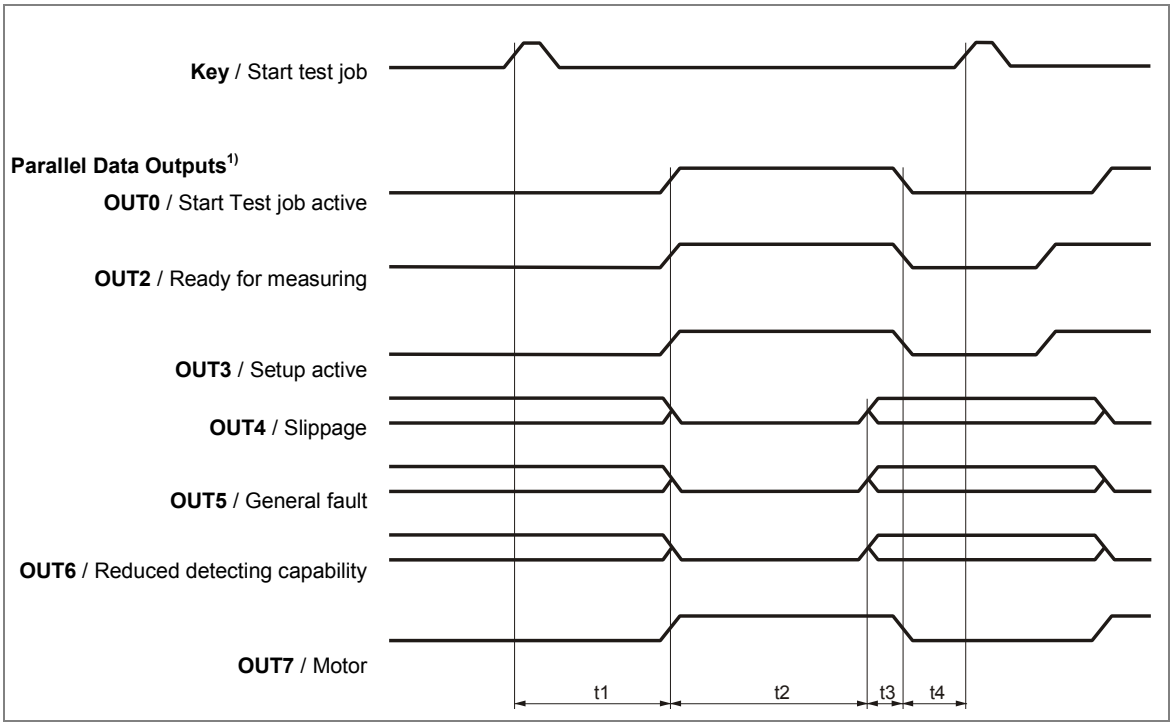
The total duration of the X/Y operation will be determined via key operation by the user.

[1)] Not mentioned inputs / outputs of the interface are not required for parameter programming.

Standard wiring of interface
Operational condition: Setup - Edit

Condition!

1. The unit must be in "*Setup - Edit*" condition.
2. System parameter *"Test job control mode: KM"* (by SND40 key)
3. Test job or speed measurement (is started by key operation and automatically terminated).
4. The PLC must already have the tube prepared for rotation. The PLC must then accordingly output the signal "motor" to rotate the tube.



1: < 100 ms
t2: Duration of test procedure / speed measurement depending on tube diameter and tube rotation rate.
t3: ≥ 0 ms
t4: > 30 ms

The duration of parameter optimization (test job / speed measurement) depends on tube diameter, tube rotation rate and the time required for entering the parameters.

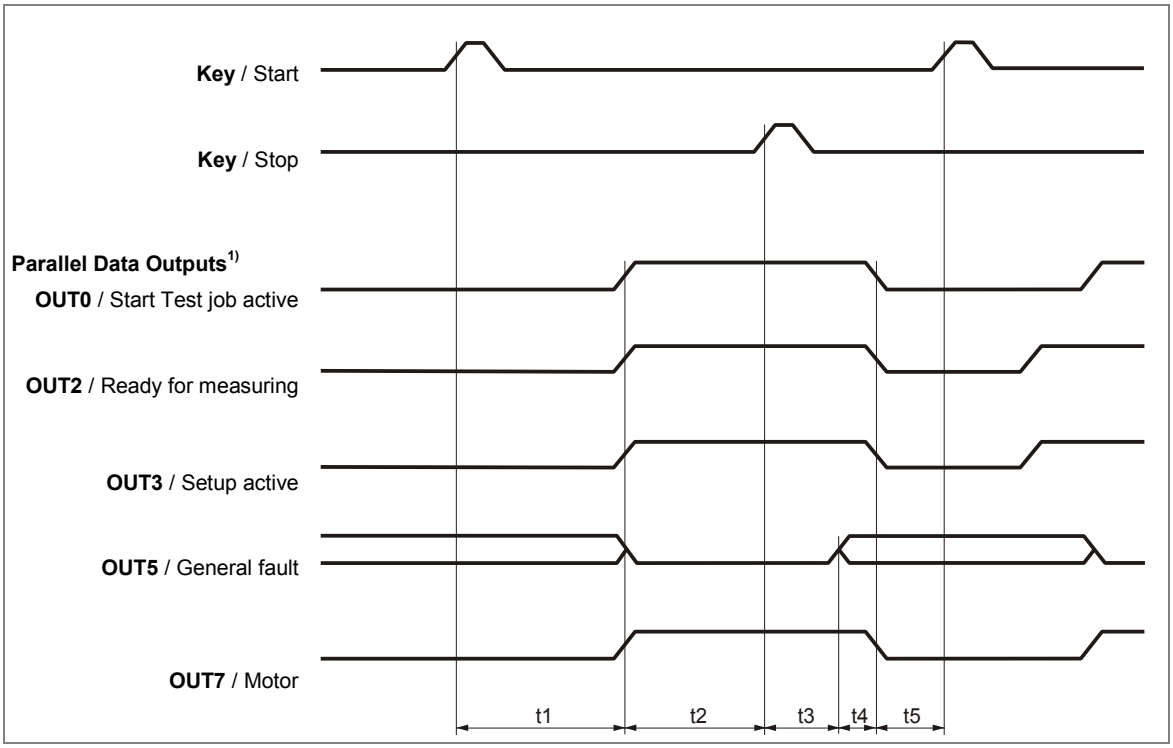
Test job:	Transient time + 3 to 4 tube turns
Speed measurement	approx. 60 s transient time + 5 tube turns

[1)] Not mentioned inputs / outputs of the interface are not required for parameter programming.

Standard wiring of interface
Operational condition: Setup – Edit (X/Y)

Condition!

1. The unit must be in *"Setup - Edit*" condition.
2. System parameter *"Test job control mode: KM*" (by SND40 key)
3. X/Y operation (started / terminated by key operation).
4. The PLC must already have the tube prepared for rotation. The PLC must then accordingly output the signal "motor" to rotate the tube.



t1: < 100 ms
t2: The user will terminate the X/Y operation with the <*Stop*> key.
t3: < System parameter *"time*"
t4: ≥ 0 ms
t5: > 30 ms

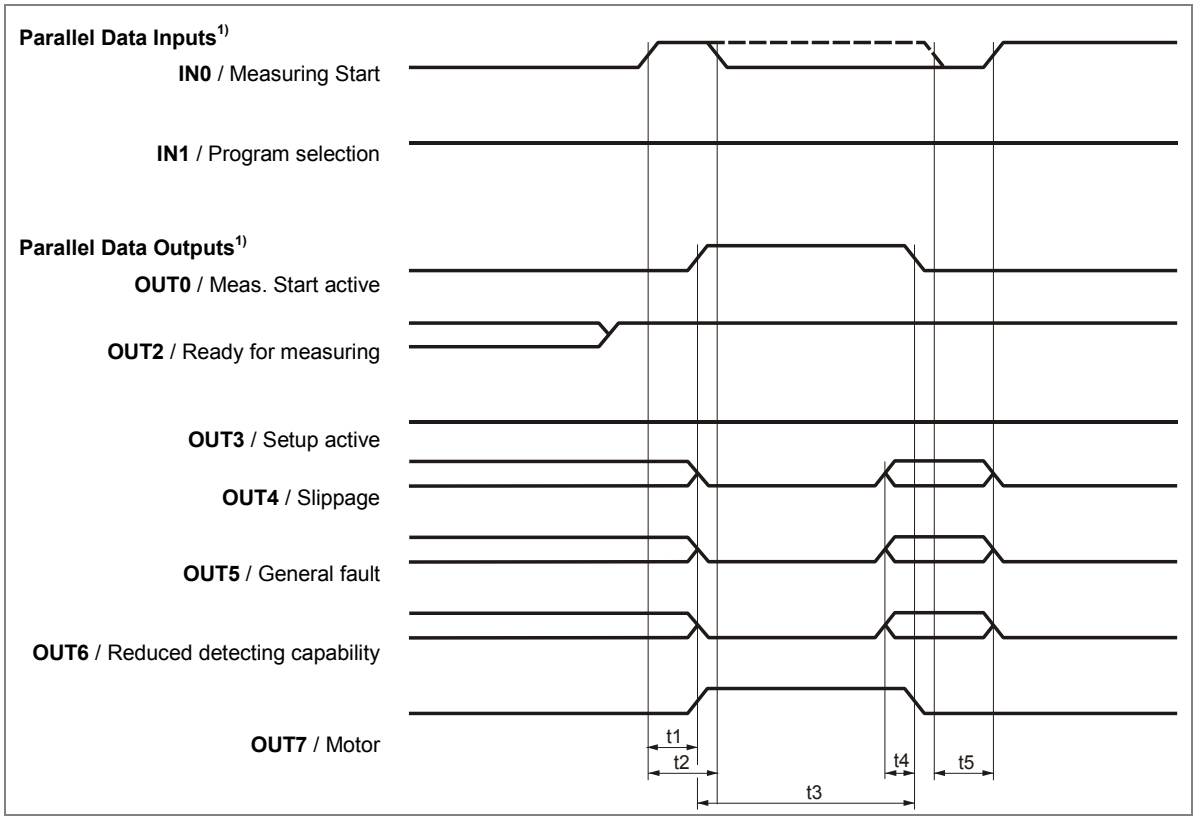
The total duration of the X/Y operation will be determined via key operation by the user.

[1)] Not mentioned inputs / outputs of the interface are not required for parameter programming.

Standard wiring of interface
Measuring procedure by external PLC

Note!

For the external triggering of a measuring with IN0, a valid program must be selected (externally or via keyboard) and the unit must be in *"Automatic - Ready*" condition.



IN0 and IN1 are edge triggered interrupt inputs. In the standard configuration the positive flank is active. Both inputs must not be activated simultaneously. The min. time between 2 commands must be >20 ms. IN1 is the strobe input for the data inputs IN2 to IN6.

The output signals OUT2 to OUT6 have two different functions.

On externally activating the command *"Program selection IN1*" the input data IN2 to IN6 are mirrored at the outputs OUT2 to OUT6, in order to enable transmission monitoring.

On externally activating the command *"Measuring Start IN0*" the measuring result and status messages will be reported. In the standard configuration High Level = active.

t1: < 20 ms
t2: < 30 ms
t3: Depending on tube diameter and turn rate.
t4: ≥ 0 ms
t5: > 30 ms

1) Not mentioned inputs / outputs of the interface are not required for parameter programming.

11.2 Service

11.2.1 Setting-up a tube

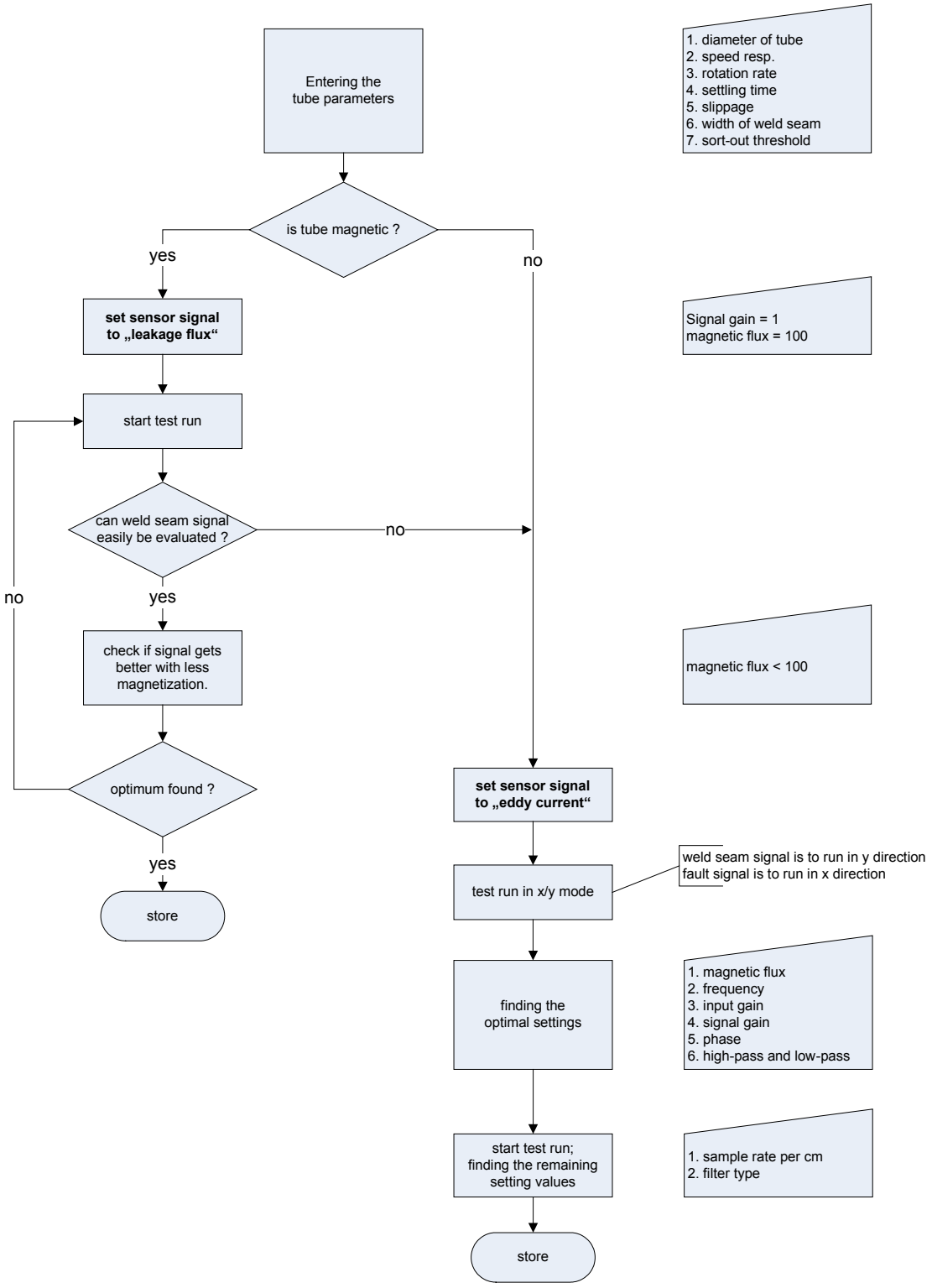


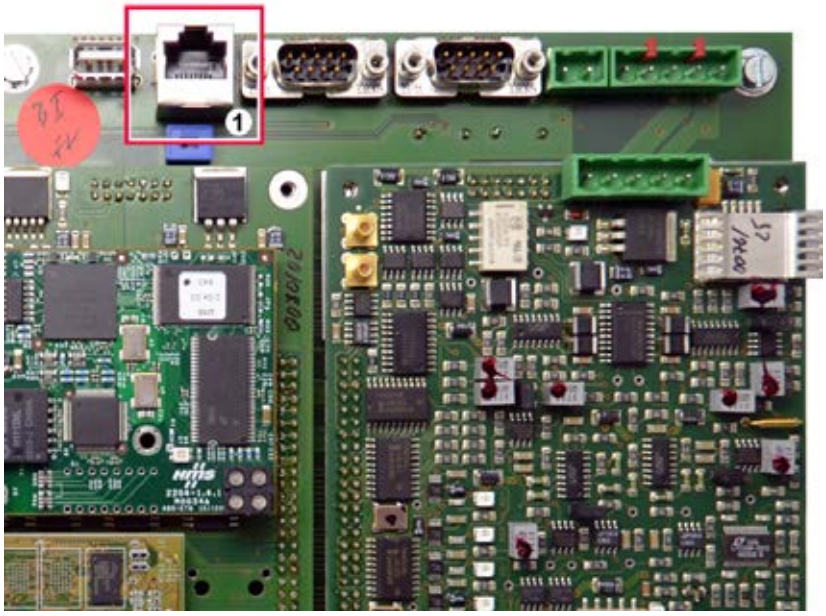
Fig. 79: Setting up a tube

11.2.2 Service function “Remote Desktop”

For monitoring and remote controlling, the operator surface of the SND40 can be visualized on another PC.

Attention! The Remote Desktop connection itself as well as the connection of the network cable claims computing capacity!
This can result in cancelling of the measurement operation (error message “Data transfer too slow”).

For directly connecting the unit to a Laptop or a Host PC a cross-over network cable is required. On practically all the current laptops and PCs, a normal network cable can be used, as these devices Auto MDI-X are capable and accept the crossing of the wires.



The connection is made inside the unit.	
1:	RJ45 socket

Fig. 80: Remote Desktop connection

Further prerequisites:

1. On the Host-PC the permanent IPV4 address 192.168.100.222 with the sub net mask 255.255.255.0 must be allocated. This can also be found in the registry of the SND40. If it should be necessary to set another address in the Host-PC, please contact ROLAND ELECTRONIC.
2. The file ”*rhost.exe*“ must be present on the Host-PC. The program rchost.exe must be approved in the Windows Firewall. See "Allow rhost.exe in Windows Firewall".
3. On the Host-PC the Windows function Telnet Client must be activated. See “Activate Telnet Client” for details.

Settings on delivery:

IP-Address SND40:	192.168.100.107
SubnetMask:	255.255.255.000
IP-Address for Remote desktop:	192.168.100.222

Characters within ” “ must be typed in, within < > the designations of keys or buttons are shown.

How to establish the remote connection:

1. Start ”*rhost.exe*“ on the Host-PC.
2. Start a *Telnet* session on the Host-PC (towards the SND40):
   - Start the windows command shell and enter the command "cmd".
   - Enter the string “`telnet 192.168.100.107`“ and confirm with <*ENTER*>.
   - Enter the string “`cerdisp -c`“ and confirm with *ENTER*.

Now the SND40 display should be visible in the “*rhost*“ window, then the SND 40 software can be remote operated via mouse.

Script for easy establishing a connection:
On the Roland website https://roland-electronic.com/en/service/software there is a script to download, which starts the connection by double click on the unzipped file.

11.2.2.1 Allow rhost.exe in the Windows Firewall

When starting rhost.exe for the first time, this message will appear on new Windows systems:

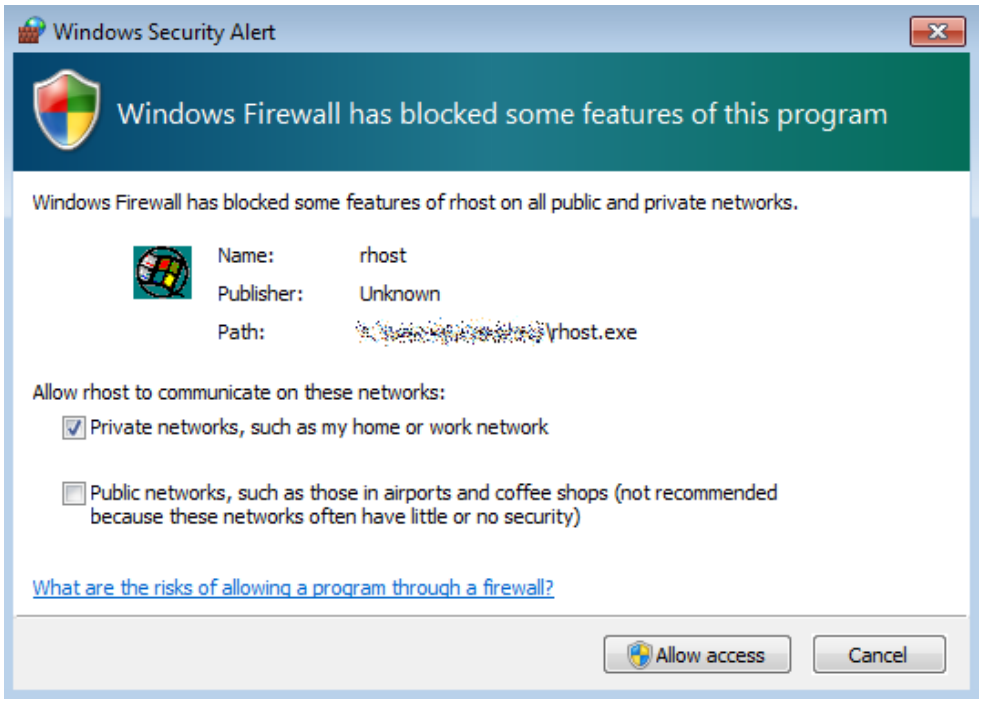


Fig. 81: Allow program rhost.exe in the Windows Firewall

Allow the program in Home and workplace networks at this point.

11.2.2.2 Activate the Telnet Client

If the following message is displayed in the Windows command prompt, the function must be activated in Windows (generally staring from Windows Vista):

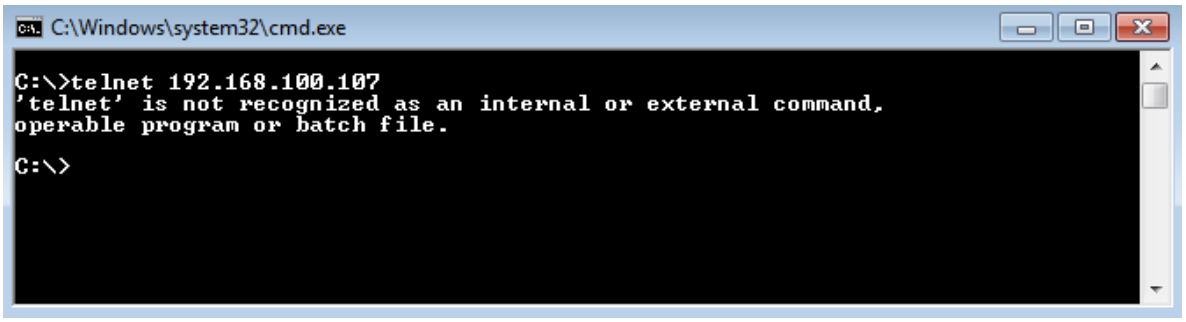


Fig. 82: Activate the Telnet Client

The activation of the Telnet Client must be performed here:

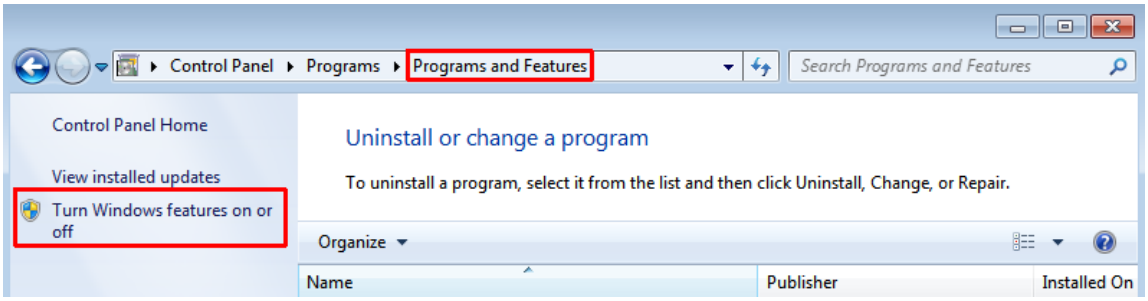


Fig. 83: Activate the Windows function Telnet-Client step1

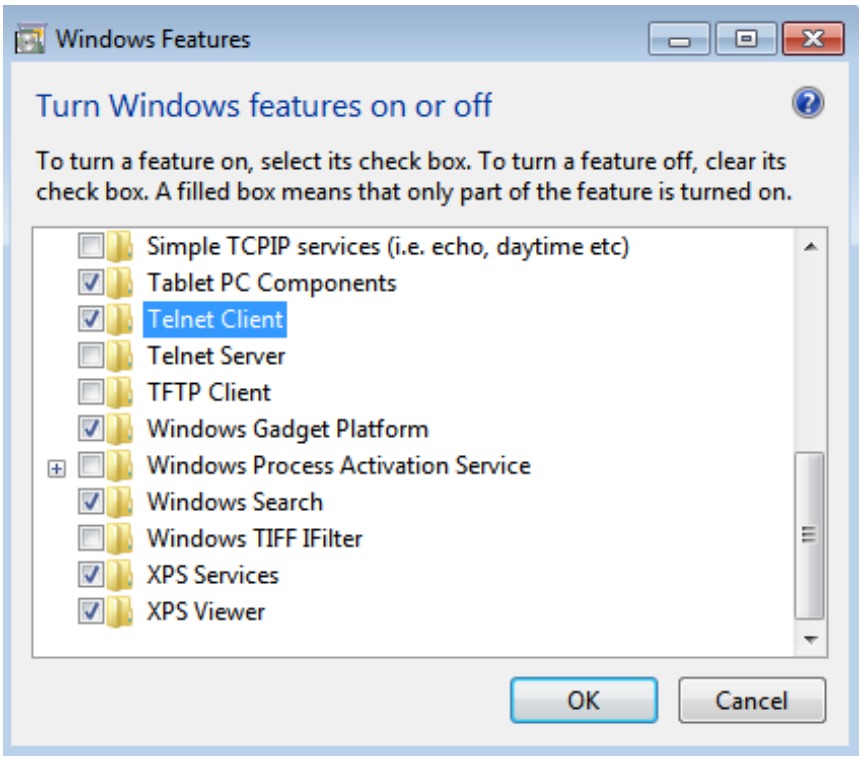


Fig. 84: Activate the Windows function Telnet-Client step 2

11.2.3 Data backup via network

Data backup can be done via Ethernet or by USB interface (for newer hardware).

Data backup via Ethernet is performed within a *Telnet* session.

Note: For the term "*Host-PC-name*" used in this section, the respective Windows name of the PC must be inserted. The PC name can be found via "*my computer*" -> "*properties*" -> "*computer name*".

1. Create a new folder, e.g. „*SND40-backup*" on the Host PC, which permits full access with the access name „*netdcu*".
2. Start a *Telnet* session on the Host PC (towards SND40).

   Therefore:
   - Open the command prompt (Start > Run) and enter "*CMD*" and confirm with <ENTER>.
   - Enter "*telnet 192.168.100.107*" and confirm with <ENTER>.
3. Copy data:

   Generally: Always copy data from / to folder "*ffsdisk*" on the SND40.

   Copy files from the SND40 to the Host PC:
   - Enter "*cd \ffsdisk*" and confirm with <ENTER>.
   - Enter "*copy *.cfg \\Host-PC-name\netdcu*" and confirm with <ENTER> (this will copy the program files and the system settings).
   - Enter "*copy statistics.log \\Host-PC-name\netdcu*" and confirm with <ENTER> (this will copy the Log files).
   - Now all files should be reported as copied.
   - For verification enter "*dir*" and confirm with <ENTER>. All files in the directory will be shown. Verify if all files have been copied.

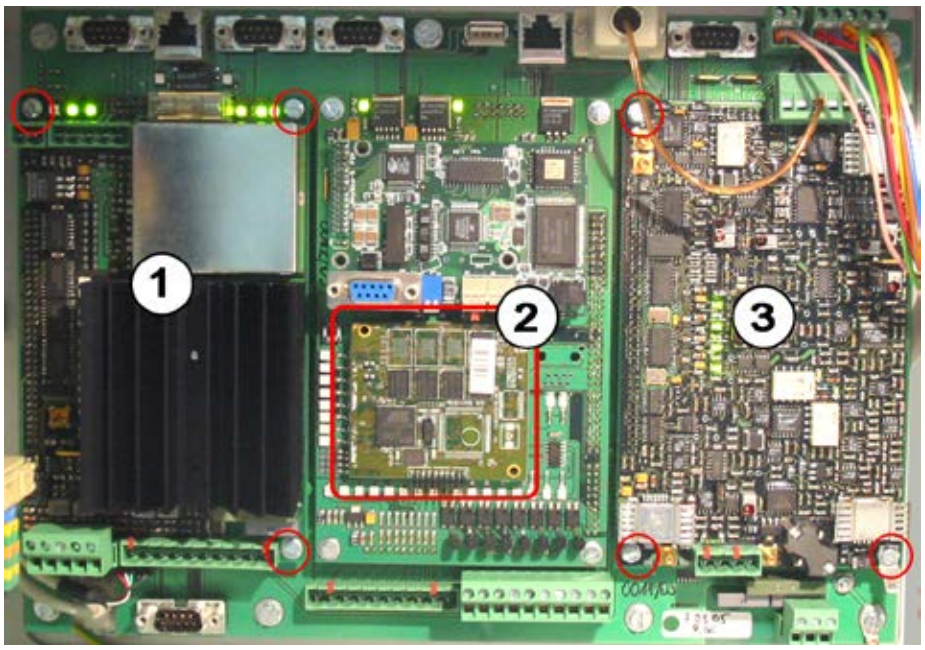
   Copying files from the HOST PC to the SND40:

   Attention! The files on the SND40 will be overwritten without further notice !!!
   - Enter "*cd \ffsdisk*" and confirm with <ENTER>.
   - Enter "*copy \\"Host-PC-name"\netdcu*.**" and confirm with <ENTER>.
   - Now all files should be reported as copied.
   - For verification enter "*dir*" and confirm with <ENTER>. All files in the directory will be shown. Verify if all files have been copied.

Data backup via USB stick is performed by the enclosed software "*SND40Store*". For details read "*SND40 Store*" in chapter "*Maintenance and repair*". When using newer hardware, a backup via USB stick should be preferred.

11.2.4 Exchanging components and retrofitting

- Disconnect the unit from mains net before performing works on the unit.
- Discharge yourself to ground before touching electronic components. Otherwise components could be damaged due to electrostatic charges.



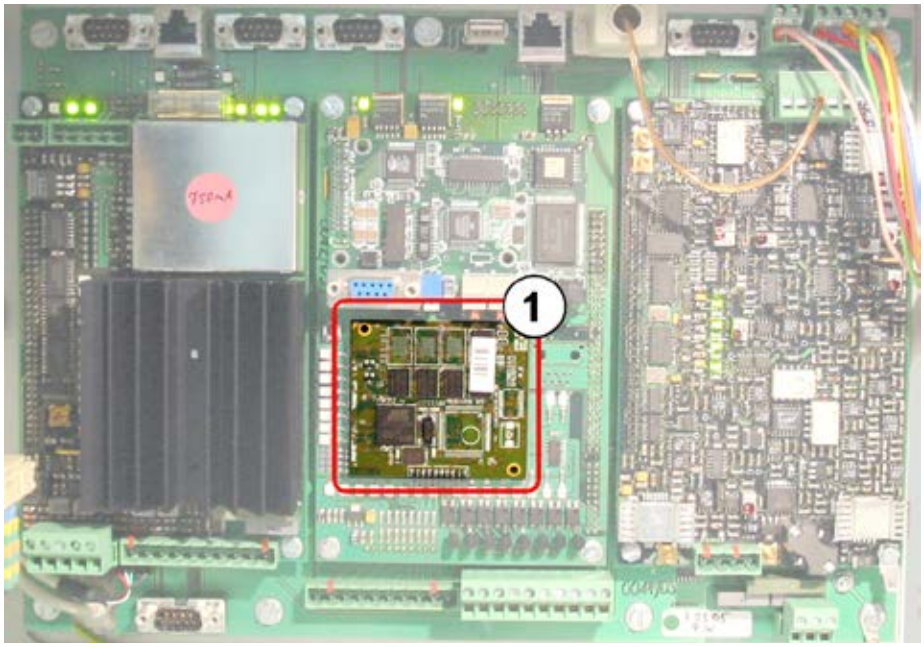
Typical delivery condition of a SND40 combination unit	
1:	Leakage flux module
2:	Processor module
3:	Eddy current module

Fig. 85: Delivery condition

Required tools and material:

- Mid-size screw driver
- Screw driver with hexagon insert, size 5.5 for M3
- 4 spacer bolts M3

11.2.4.1 Exchanging the processor module

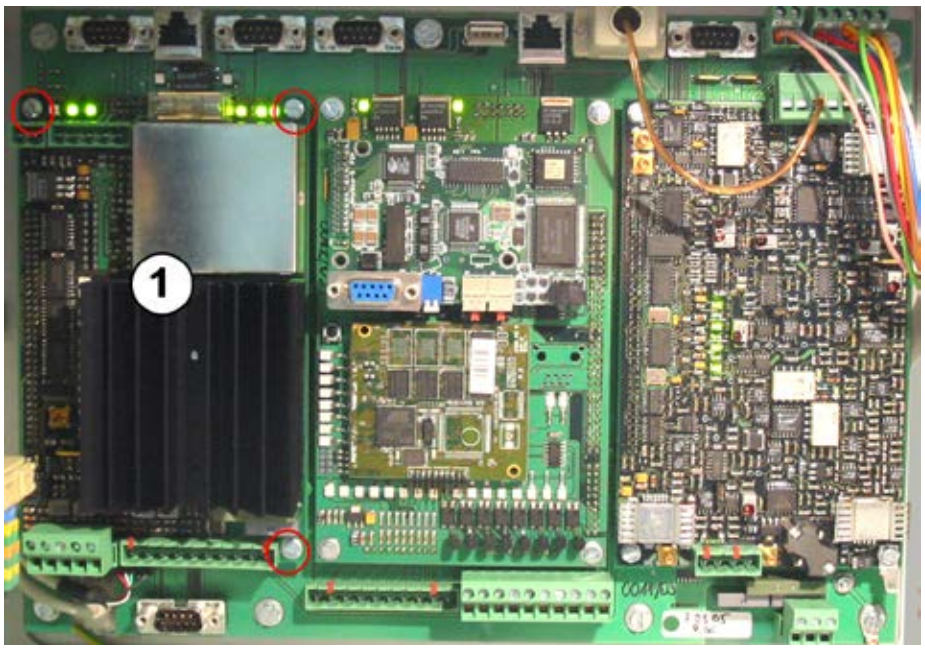


Change of components	
1:	Processor module

Fig. 86: Exchanging the processor module

- Remove the module carefully. Grab the module with both hands (index finger and middle finger) and carefully lift the module off its socket.
- Insert the new module with the same orientation. The pin strip always points towards the unit floor.
- Before inserting the module into the socket, take care that on both sides plugs and sockets match.

11.2.4.2 Exchanging the leakage flux module

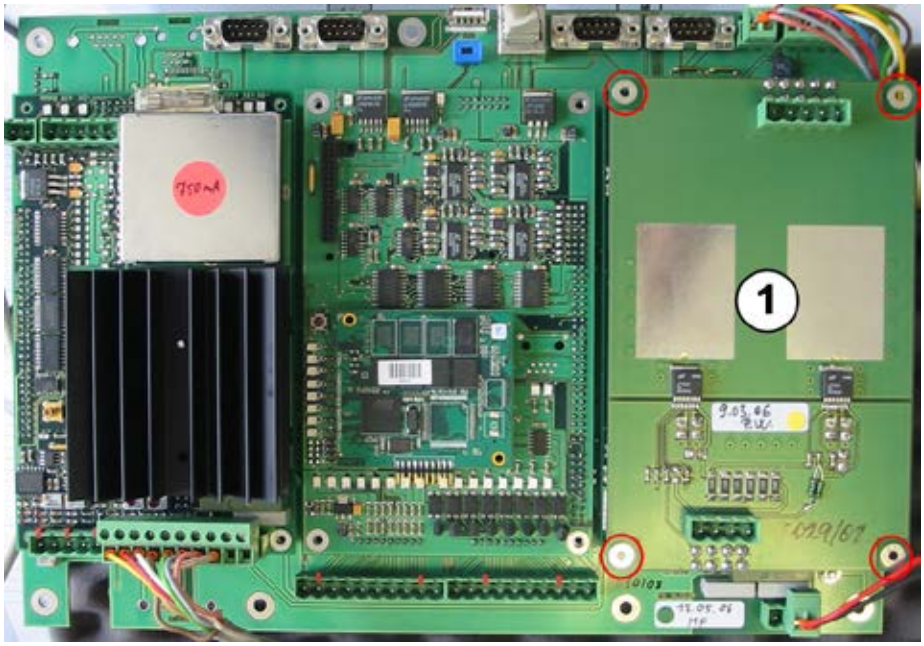


Change of components	
1:	Leakage flux module

Fig. 87: Exchanging the leakage flux module

- Loosen all cable plugs and the 4 fixing screws.
  Every screw connection consists of an M3 screw, a toothed washer and a flat washer.
- Do not lose any parts, danger of short-circuit.
- Carefully pull the module at the upper and lower side, in order to loosen it from its socket.
- Insert the modified leakage flux module with the same orientation into the socket.
- If the module has been correctly inserted, the fixing holes and the holes of the support bolts match.
- Re-fasten the module with the screws and put-on the cable plugs again.

11.2.4.3 Retro-fitting the cable driver module



Retrofit	
1:	Cable driver module

Fig. 88: Retro-fitting the cable driver module

- Loosen all cable plugs and the 4 fixing screws.
  Every screw connection consists of an M3 screw, a toothed washer and a flat washer.
- Do not lose any parts, danger of short-circuit.
- **Note:** Older units are equipped with a flat plug at the lower right screw joint.
  Do not forget this when mounting the driver module.
- Replace every screw by one of the provided spacer bolt.
- Plug-on the cable driver module.
  Take care that every connector at the module gets into the corresponding contact on the eddy current module.
- Fasten the module with the remaining screws.
- For older units: re-attach the flat plug for the shielding connection.
- Re-plug all cables onto the cable driver module.

11.3 Hints on Hardware and Software versions

Index of changes

Communication module	
KM V1.15 04.04.2006	Introduction: Cancelling on entering password is possible Introduction: Printing the system settings without change mode is possible Introduction: Filter „SAF“ “*SAF*” stands for “*Signal Activity Filter*“, representing the filter function more correctly. Introduction: Bus error message (Fieldbus): “*Bus transfer disturbed*” Introduction: Y stretching limited 1…10 *Only in combination with PM V12 or later*
KM V1.16 28.07.2006	Introduction: Automatic restart after changing of settings. (from serial number 400059). *(if restart required)*
KM V1.17 12.04.2007	Introduction: Round specimen: Visualization of weld seam width in graphics. Introduction: Flat specimen: Visualization of both limits at filter „bipolar“. Introduction: Transmission of signal-noise ratio in dB (up to 34 dB) and visualization in log files Change: StartUp fault; „24V voltage fault“ redressed.
KM V1.18 13.07.2007	Change: Signal-noise ratio extended to 40dB resp. >40dB *Only in combination with PM V14 or later*
KM V1.19 30.07.2007	Change: SnlogFile extended to 14 days. Change: Storing fault messages of PM in SNLogFile.
KM V1.20 27.10.2007	Introduction: New language: Portuguese, new MUI file:„SND40.exe.0416.mui“. Introduction: New SND40Store software
KM V1.21 09.01.2008	Introduction: New language: Spanish, new MUI file: „SND40.exe.0c0a.mui“.
KM V2.04 19.09.2008	Introduction: Extension French + Optimizer + 99 Programs.
KM V2.05 25.02.2009	Optimizer locked 31 Prog.
KM V2.06 09.12.2009	Optimizer free 31 Prog. Error: Memory problems existing!!
KM V2.07 07.01.2010	Memory problem fixed
KM V2.08 03.07.2012	On old mainboards also showing message „please restart“
KM V1.21 09.01.2008	Introduction: New language: Spanish new MUI-file: „SND40.exe.0c0a.mui“.
KM V10-1.00 25.04.2010	For SND40 units with NETDCU 10 (Defective version on round objects)
KM V10-1.01 10.10.2010	For SND40 units with NETDCU 10 (Defective version on round objects)
KM V10-1.03 17.01.2012	For SND40 units with NETDCU 10 (Defective version on round objects fixed)
KM V10-1.04 09.07.2012	For SND40 units with NETDCU 10 Added on param. „detection quality“: extra + ultra
KM V10-1.05 01.01.2016	For SND40 units with NETDCU 10 + NETDCU A5: New language Russian
KM V10-1.06 01.01.2016	For SND40 units with NETDCU 10 + NETDCU A5

Processor module	
PM V12 04.04.2006	Change: SAF filter: more firmly specified (old: 8/4/1,5; new:16/8;3) for teach-in. *This filter is preferably used since being introduced. With the old settings the filter showed results "good" to "very good" even with weak seam signals. Thus tubes with unsuitable seam signal were falsely declared practicable. The new settings prevent from such mis-interpretations.* Introduction: Bus interface Profibus Introduction: PLC interface additional input „Reset Fault " *Was introduced in order to permit the PLC to reset a fault condition.*
PM V13 19.03.2007	Change: Digital filter in mode „Flat specimen" extended by „bipolar". ATTENTION! The allocation of the digital output signals for „bipolar" and „Flat" deviates from the standard. Introduction: Signal-noise ratio
PM V14 13.07.2007	Change: Signal-noise ratio extended to 40dB resp. >40dB
PM V15 20.10.2008	Introduction Profinet (errors)
PM V18 01.05.2009	Introduction Profinet (error-free)
PM V19 28.01.2010	Works well with new leakage flux module and with old module; for NETDCU 10 too
PM V20 15.04.2011	Same as V19 + Error magnetic field on start-up fixed
PM V21 08.09.2011	Error message „Fan defect" ,error fixe on old leakage flux module
PM V22 24.04.2012	New Profibus modules utilizable
PM V23 18.02.2014	Detection of speed measurement: Increasing to 2000 values for one tube turn. (previously 500 values for one tube turn) Slippage: Minimum adjustability 0,1 % (previously 1%) Sample rate: maximal 120 (previously 30) Internal signal type calculation: 8 kHz (previously 2 kHz)
PM V24 01.01.2016	Adaptation to NETDCU A5; also suited for NETDCU 10

Delivery only with leak flux module 750mA

In combination units and leak flux units following the serial number 400052 (mid-April 2006) the leak flux module 750 mA will be used.
Exception: Units with / for coil seam sensors NS9…EC.

Note for units with cable driver

Attention!

For units with cable driver module, please consider the following:

- Reduce the output voltage when using the cable driver:
- 0…25KHz = 20 Vss (no reduction)
- 50…100 KHz = 17 Vss
- 400…800 KHz = 5 Vss

11.4 Other informations

Evaluation criteria for round material

Setup mode		
Message	Signal-to-noise ratio	For filter SAF following: PM version V12 KM version 1.15
very good	>18dB (>8:1)	>24dB (>16:1)
good	>12dB (>4:1)	>18dB (>8:1)
satisfactory	>3,5dB (>1,5:1)	>9,5dB (>3:1)
not possible	<=3,5dB (<=1,5:1)	<=9,5dB (<=3:1)

Detection grade for round material

Automatic mode	
Detection grade	Signal-to-noise ratio
ultra	>18dB (> 8:1)
extra	>12dB (> 4:1)
very good	>6dB (> 2:1)
good	>2,5dB (> 1,33:1)
satisfactory	>1,1dB (> 1,14:1)

Typical gain values for NS9/12-EC…NT10-100-S sensors

Frequency	AC gain
6kHz	44dB
12 kHz	38dB
25 kHz	32dB
50 kHz	26dB
100 kHz	20dB
400 kHz	26dB
800 kHz	32dB

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12 Order data

12.1 Control units

Ordering Designation	Comment
SND40-EC-IO	Unit for Eddy current sensors, Eddy current probes, Encircling coil systems. Controlling via I/O interface
SND40-EC-PR	Unit for Eddy current sensors, Eddy current probes, Encircling coil systems. Controlling via Profibus interface
SND40-EC-PN	Unit for Eddy current sensors, Eddy current probes, Encircling coil systems. Controlling via ProfiNet IO interface
SND40-MF-IO	Unit for Leakage flux sensors. Controlling via I/O interface
SND40-MF-PR	Unit for Leakage flux sensors. Controlling via Profibus interface
SND40-MF-PN	Unit for Leakage flux sensors. Controlling via ProfiNet IO interface
SND40-EC-MF-IO	Unit for Eddy current sensors, Eddy current probes, Encircling coil systems, Leakage flux sensors, Combination sensors. Controlling via I/O interface
SND40-EC-MF-PR	Unit for Eddy current sensors, Eddy current probes, Encircling coil systems, Leakage flux sensors, Combination sensors. Controlling via Profibus interface
SND40-EC-MF-PN	Unit for Eddy current sensors, Eddy current probes, Encircling coil systems, Leakage flux sensors, Combination sensors. Controlling via ProfiNet IO interface
SND40-EC-MF-CC	Unit for Eddy current sensors, Eddy current probes, Encircling coil systems, Leakage flux sensors, Combination sensors. Controlling via CC-Link interface

12.2 Sensors

12.2.1 Leakage flux sensors

Order designation	Comment
NS9S	Sensor (incl. 4 pcs. rubber mount) for FE tubes; tube diameter 10 - 250 mm; wall thickness up to 3 mm
NS9-GMR-S	Sensor (incl. 4 pcs. rubber mount) for FE tubes; tube diameter 10 - 250 mm; high resolution due to GMR element, wall thickness up to 3 mm
NS12S	Sensor (incl. 8 pcs. rubber mount) for FE tubes; tube diameter 12 - 250 mm; wall thickness up to 4 mm

12.2.2 Combo sensors

Combo sensors F-Type

Order designation	Comment
NS9xEC8-60NF10-100-S	Sensor (incl. 4 pcs. rubber mount) for FE / NF tubes; tube diameter 10 - 250 mm;
NS12-EC8x80NF10-100-S	Sensor (incl. 8 pcs. rubber mount) for FE / NF tubes; tube diameter 12 - 250 mm;

Combo sensors T-Type

Order designation	Comment
NS9-EC5x30NT10-100-S	Sensor (incl. 4 pcs. rubber mount) for FE / NF tubes; tube diameter 6.5 - 10 mm
NS9-EC8x60NT10-100-S	Sensor (incl. 4 pcs. rubber mount) for FE / NF tubes; tube diameter 10 - 250 mm;
NS9NH-EC8x18NT10-100-S	Sensor (incl. 4 pcs. rubber mount) for FE / NF tubes; tube diameter 10 - 250 mm;
NS12-EC8x80NT10-100-S	Sensor (incl. 8 pcs. rubber mount) for FE / NF tubes; tube diameter 12 - 250 mm;
NS12NH-EC8x80NT10-100-S	Sensor (incl. 8 pcs. rubber mount) for FE / NF tubes; tube diameter 12 - 250 mm;
NS24-EC18x185NT10-100-S	Sensor (incl. 8 pcs. rubber mount) for FE tubes; tube diameter 25 - 500 mm
NS24-EC30x185NT10-100-S	Sensor (incl. 8 pcs. rubber mount) for FE tubes; tube diameter 75 - 1500 mm

12.2.3 Eddy current sensors

Order designation	Comment
EC9-8x60NF10-100-S	Sensor (incl. 4 pcs. rubber mount) for NF tubes; tube diameter 10 - 250 mm;
EC9-8x60NT10-100-S	Sensor (incl. 4 pcs. rubber mount) for NF tubes; tube diameter 10 - 250 mm;

12.2.4 Eddy current probes

Order designation	Comment
EC12x30IT10-100-S	Probe for round and flat material; axial type; track width 3 mm
EC20x25IT10-100-S	Probe for round and flat material; axial type; track width 10 mm
EC30x25IT10-100-S	Probe for round and flat material; axial type; track width 16 mm
EC12x40IRT10-100-S	Probe for round and flat material; radial type; track width 3 mm
EC5x30IF10-100-S	Probe for round and flat material; axial type; track width 1.5 mm

12.2.5 Encircling coil system

Order designation	Comment
EC13x25PDN50-500-S KOMPLETT	Encircling coil system for cables and wires (cross seams); diameter up to max. 12 mm

12.3 Cables / Accessories

Order designation	Comment
KNS9S-G	Cable for connecting the combo and leakage flux sensors to the control unit, with straight cable socket, standard length 5 m, max. 25 m*
KNS9S-W	Cable for connecting the combo and leakage flux sensors to the control unit, with angular cable socket, standard length 5 m, max. 25 m*
CECM18S-G	Cable for connecting the combo and eddy current sensors to the control unit, standard length 5 m, max. 20 m*
SKNS8S	Cable for connecting the combo and leakage flux sensors to the Sensor Switch Box, with straight cable socket and cable plug, standard length 5 m, max. 20 m*
SM18CECM18S-GG	Cable for connecting the combo and eddy current sensors to the Sensor Switch Box, with straight cable socket and cable plug, standard length 5 m, max. 15 m*
SSB-SND40	Sensor Switch Box for connecting 2 sensors
SCB-EC-S	Sensor Connection Box for connecting the Eddy current probes
2299700	1 pcs. Rubber mount, for sensor NS9 / NS12
S0003246	1 pcs. Rubber mount, for sensor NS24
2390924	1 pcs. Ball bearing 9x24x7 mm; for pole shoe NS9 / NS12
2390822	1 pcs. Ball bearing 8x22x7 mm; for sensor element NS9 / NS12

*The total maximum cable length, especially when using the Sensor Switch Box must **not** be exceeded!

13 Appendix

13.1 Checklist for fault identification

Use the following checklist for identifying fault conditions.

Problem Classification	**X**	**Please tick appropriate description**	
		No operation / No start of tube turning device	
		Absolutely no weld seam detection	
		No. of non-detected weld seams too high	
		Wrong weld seam position with constant offset	
		Wrong weld seam position with permanently changing positioning	
		This problem occurs in _____ cases of _____ processed tubes/coils/drums	
Problem detected	**#**	**Possible Reason**	**Checked**
No operation / No start of tube turning device	1	Error found in SND40, see error message displayed, see manual for further information	
	2	Attached PLC does not function correctly	
	3	Cabling to PLC interrupted / disturbed	
	4	Problem of drive	
- Absolutely no weld seam detection - No. of non-detected weld seams too high - Wrong weld seam position with permanently changing positioning	5	Active Program does not match to the tube / coil to be detected.	
	6	Active Program has been modified with parameters not fitting to this tube	
- No. of non-detected weld seams too high - Wrong weld seam position with permanently changing positioning	7	Velocity or rotational speed differs from the settings in the program. Check this with function “Speed Measurement”	
	8	Velocity or rotational speed is not constant due to: - problems with drive control, - bad transmission of power from drive to tube, - reduced friction due to oil or dirt	
	9	Too strong or too weak pressing force of sensor onto tube, e.g. due to incorrect pressure of air cylinder	
	10	Not all rollers at sensor tip touch the tube due to: - incorrect mounting of sensor - Insufficient elasticity in sensor mounting (rubber mounts not used ?)	
	11	Accumulation of dust and dirt (e.g. metal particles) at sensor tip. Clean sensor regularly according to operating conditions. (Check at least every week)	
Problem detected	**#**	**Possible Reason**	**Checked**
- No. of non-detected weld seams too high - Wrong weld seam position with permanently changing positioning	12	Cabling problems: - Plugs loose - Bad grounding - Cable to close to high current cables or other equipment emitting electrical noise	
	13	Wear of ball bearings or pole shoes (see manual)	
	14	Tubes from a different charge or another manufacturer with different tube forming quality or different weld seam quality.	
Wrong weld seam position with permanently changing positioning	15	Drive without brake or with brake function switched off.	
Wrong weld seam position with constant offset	16	Check program parameter “Position Offset”	

If you are still unable to locate the reason of your problem and you need the support of the manufacturer, please send the filled-out checklist together with the information on the next page to Roland Electronic:

From the product label of the control please transfer these fields:
Type: _____ P.N. _____ S.N. _____

From the product label of the sensor:
Type: _____ P.N. _____ S.N. _____

The problem occurs with this tube / coil / drum:

diameter: _____ mm wall thickness: _____ mm material: _____

Company: _____

Address: _____

_____

Zip-code + City: _____

Your name: _____

Your telephone no: _____

Your e-mail: _____

Manufacturer of machine,
where SND40 is integrated: _____

Please add any comment that may help to identify the error: (e.g. since when does error occur, how often, under which situation, new tube / coil material, new tube sizes, new tube / coil supplier etc.)

_____

_____

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_____

---------- **End of Document** ----------