

# PROTECHNA

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**Instruction Manual**  
**Digital Needle Sensor Type 4022**  
**with Needle Position Display**

B-E-0620/4.21/E



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**Important information**

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**1. Important information**

**1.1 Working with the operating instructions**

On the following pages you will find all the information on the functioning and operation of the needle sensor 4022. You will discover how you can make all the necessary settings with the input device, the hand-held terminal 8024. If you are working with the needle sensor for the first time, follow the operating instructions step by step.

**If you want to install and set up the needle sensor**

In the chapter “An overview of the needle sensor 4022”, you can find an overview of the important controls and functions. The chapter “Starting up the Needle Sensor” explains how to start up the needle sensor step by step.

**If you only want to make a particular setting**

In the chapter “Operating the needle sensor with the hand-held terminal 8024”, please select the menu item for your setting.

**If you want to know what the control indicators on the device mean**

The chapter “Control unit indicators” describes which control indicators you will find on your control unit, what they mean and what has to be done.

**If a malfunction occurs**

The chapter “Guidance for troubleshooting” provides advice on recognising and correcting malfunctions.

**Important information**

**1.2 Explanation of the symbols**

In these instructions you will find the following symbols:



**Warning**

Danger to health! The purpose of these instructions is to keep you safe. Read these sections carefully and follow the instructions.



**Caution**

The purpose of these instructions is to ensure a reliable and safe operation of the device. Follow the instructions carefully.



**Note**

The purpose of a note is to draw your attention to important matters. For example, your attention will be drawn to possible operating errors, which can impair the function of the needle sensor.



**Tip**

Here you will find information on how to use the needle sensor effectively.

Important information

1.3 Safety instructions

Before using the device for the first time, please read the following information carefully for your own safety and to ensure a reliable and safe operation of the device.



**Warning:** Always pay attention to all warnings and cautions that are attached to the device or displayed on it, as well as those mentioned in these instructions.



**Warning:** Always ensure that the voltage specifications for the device are adhered to for the power supply.



**Warning:** Before opening or cleaning the control unit, always unplug it from the mains or the supply voltage. For cleaning use a damp cloth. Do not use liquid cleaners or cleaning sprays.



**Caution:** Never use the device in locations where there is a danger that water or other liquids could penetrate it.



**Caution:** The site where the device is installed must be stable, as the device can be seriously damaged by sudden jolts, such as being dropped.



**Caution:** Never attempt to insert objects through openings in the device, as short circuits can be caused by the internal voltages.



**Caution:** With the exception of the interventions explicitly stated in the instructions, never try to repair the device yourself.

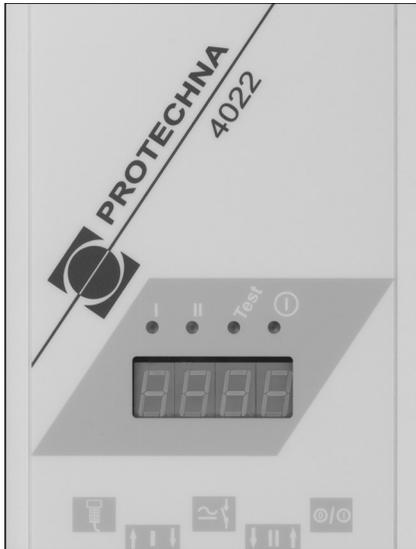


**Caution:** Please handle the fibre-optic cables of the optical heads with due care, as they are unusable once they have been bent. If this happens, the entire optical head must be replaced together with the cable.

An overview of the needle sensor 4022

2. An overview of the needle sensor 4022

2.1 Illustrations of the components



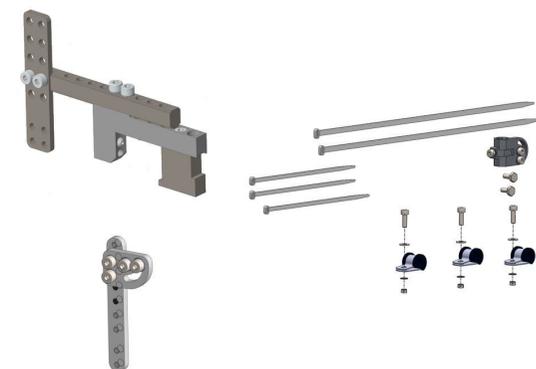
Control unit 4022



Machine cable  
(standard version)



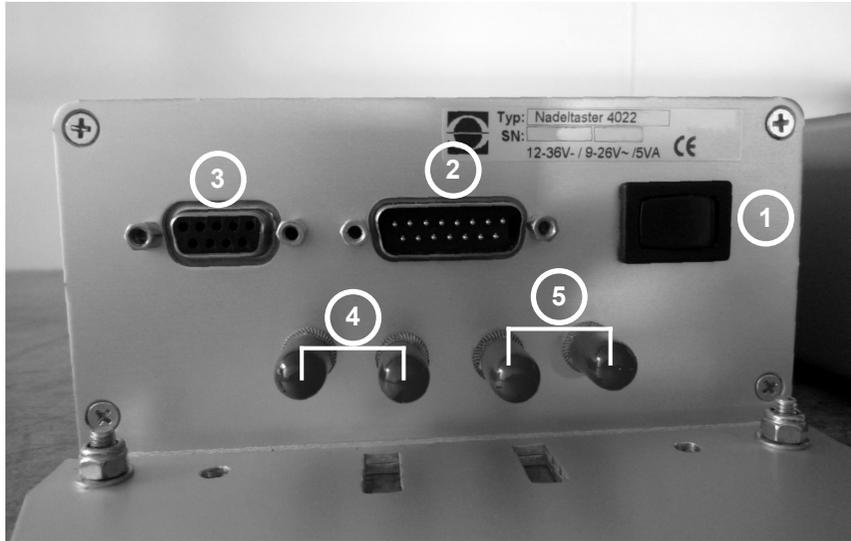
Optical head



Adjustment device  
for optical heads

**An overview of the needle sensor 4022**

**2.2 Connections on the control unit**



**Electrical connections**

- 1 On/Off switch**
- 2 Connector for machine cables**  
standard machine cable or extended machine cable
- 3 Connector for the hand-held terminal 8024**  
(also the connector for the connecting cable during a software update)

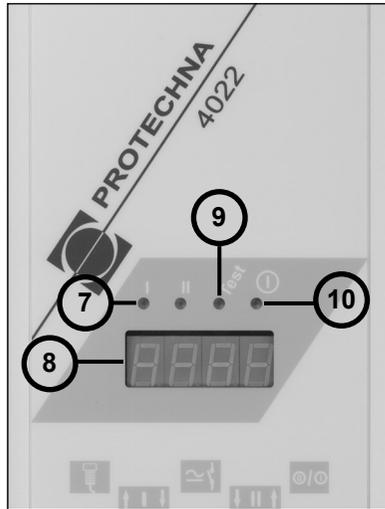
**Connecting the optical heads**

- 4 Ports for optical head channel 1**  
(the transmitter is on the left)
- 5 Ports for optical head channel 2**  
(the transmitter is on the right)

An overview of the needle sensor 4022

**2.3 Control unit indicators**

Control unit 4022 (front)



- 7 Indicators for channel 1 and channel 2**  
Colour-coded status indicator for each monitoring channel
- 8 Needle position display**  
Displays the number of needles by which the machine needs to be turned until the defective needle is exactly below the optical head
- 9 Test indicator**  
Lights up yellow when the device is in test mode
- 10 Power on indicator**  
Lights up green when the control unit is on

**2.4 Functional description**

**2.4.1 General information**

The needle sensor 4022 provides contact-free monitoring of the needle hooks on single jersey, rib, interlock and jacquard circular knitting machines, as well as on single cylinder stocking and bodywear machines. It switches the machine off immediately if a needle hook or butt has broken.

Depending on the type of knitting and machine, the needle sensor consists of up to two optical heads and one control unit 4022. At least one optical head is used for each needle cylinder. Several heads must be attached to one cylinder if not all needles used can be pushed out at a single position. In this case, one optical head is used for each group of identically controlled needles, for sensing these needles. Machines with an individually programmable control of each individual needle and other jacquard machines can be monitored if all of a cylinder's needles are pushed out at a yarn guide (possibly without yarn feeding).

### An overview of the needle sensor 4022

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The monitoring can be cyclically activated, which means that the duration of a monitoring cycle can be limited to a few rounds. This operating mode is particularly suited for stocking and bodywear machines. Here, the needles usually cannot be permanently pushed out so that all needle hooks are caught by the beam of light.

#### 2.4.2 Features

- The machine stops immediately once defective needles have been recognised
- 4-figure digital display for quick localisation of the defective needles
- The sideways bend of the needles is measured and the machine is switched off if the adjustable maximum value is exceeded

- Monitoring of one or more separating rows can be masked out
- The control unit automatically adapts to the gauge of the needles
- The control unit adapts largely automatically to various machine speeds
- Wide operating voltage range
- Optical heads are connected via plastic fibre-optic cables
- Error and stop counters. The time when these counters were last reset is saved and displayed.

#### 2.4.3 Function

The light sources for the optical sensing of the needles are located in the control unit 4022 in the form of red LEDs. Using fibre-optic cables, the light is fed to the monitoring point. The spot of light, however, is much larger than the actual area monitored. The very small area monitored makes it possible to monitor extremely fine gauge needles.

### An overview of the needle sensor 4022

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The quantity of light reflected by the needles is measured. The average light signal of the needles is displayed as the signal height. This display value is used to adjust the optical head accordingly.

A switching threshold is also derived from the signal height, which is used to decide if the needle is damaged (broken needle hook). This is necessary, as damaged needles also reflect a certain part of the light. However, the quantity of light is lower than in the case of undamaged needles. Therefore, if the light signal from a needle remains below the switching threshold, the needle is considered to be defective. The threshold can be set as a percentage of the average needle signal.

Needles that are recognised as being undamaged are counted during one revolution of the machine. Separating rows and their width and position within the needle cylinder are taken into consideration. It is also possible to set a needle pattern of your choice, which is then checked during each revolution of the machine. The machine is stopped if one or more needles are recognised as being defective or they are in an incorrect position in the needle pattern.

The sideways bend of the needles is measured based on the time lag between the needles at the optical head. For this reason the machine speed must remain constant while needle monitoring is active. An adjustable start delay guarantees that the needle monitoring is not activated until the machine has reached its operating speed. If the bend of the needles exceeds an adjustable maximum value, the machine is stopped.

There is an error counter for each individual needle. It is possible to only stop the machine when an error (broken or bent needle hook) is discovered on a needle in two or more consecutive revolutions of the machine. Unnecessary stoppages of the machine can therefore be largely prevented; however the length of the defect in the product increases proportionately to the number of errors.

## Getting started

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### 3. Getting started

#### 3.1 The needle sensor on a single jersey machine

##### 3.1.1 Device components

The device consists of at least:

- Control unit 4022 with holding plate and mounting set
- Standard machine cable
- Optical head, type depending on the cylinder gauge
- Adjustment device for the optical head
- Hand-held terminal 8024 (one hand-held terminal is normally sufficient for a group of machines or a machine hall)

As an extension to the device, a pulse sensor might be required if the machine speed is not constant during the monitoring of the needles.

You will then require:

- A suitable inductive or optical pulse sensor is available from PROTECHNA (required if a rotary sensor pulse is not available from the machine)

##### 3.1.2 Start-up

You will find an exact description of the steps necessary for start-up under "Starting up the Needle Sensor". In the short description below the basic procedure and the special features of single jersey machines are outlined.

To start up the needle sensor device, please proceed as follows:

1. Install the control unit

2. Electrical connection

3. Install and connect the optical head

Select the yarn guide to be monitored so that all needles are detected. Pay attention to the position of the connection cable. The distance between the optical head and the control unit is also limited by the fact that it must be possible to read the hand-held terminal while adjusting the head. Connect the optical head to channel 1 of the control unit.

4. Setting the operating data

First set the machine-related parameters in the Machine menu. In this menu, switch on channel 1; channel 2 must be switched off. Set the activation type to "**with machine**" and set the maximum number of needles according to the cylinder of the machine.

## Getting started

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If there is a separating row, set this in the Channel Settings menu for channel 1.

### 5. Adjusting the optical head

The needle signal (in the Displays menu) should be as high as possible. Change the distance to the needles for the optical head, then the angle.

### 6. Check the functioning

## 3.2 The needle sensor on a double jersey machine

### 3.2.1 Device components

The device consists of at least:

- Control unit 4022 with holding plate and mounting set
- Standard machine cable
- Two optical heads, types depending on the cylinder gauge (different types of heads can be used simultaneously at one control unit)
- An adjustment device for each optical head
- Hand-held terminal 8024 (one hand-held terminal is normally sufficient for a group of machines or a machine hall)

As an extension to the device, a pulse sensor might be required if the machine speed is not constant during the monitoring of the needles.

You will then require:

- A suitable inductive or optical pulse sensor is available from PROTECHNA (required if a rotary sensor pulse is not available from the machine)

## Getting started

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### 3.2.2 Rib (e.g. fine rib) machines

The vertical cylinder needles are usually controlled in several groups. This means that only some of the needles are used for looping at each yarn guide, and so only some of the needles are pushed out. To monitor all the needles it is necessary to

- push out all needles at a special cylinder yarn guide (possibly without yarn feeding);

or

- monitor each group of needles separately. A maximum of two groups can be monitored at different yarn guides with the corresponding number of optical heads.

The dial needles can usually be monitored at a yarn guide with only one optical head.

### 3.2.3 Interlock machines

The same information applies to interlock machines as to rib machines. The vertical as well as the horizontal needles can be controlled in groups. It is necessary to check how many optical heads are needed to cover all the needles for both needle cylinders. In most cases two heads are sufficient, one for the vertical needle cylinder and one for the horizontal needles.

### 3.2.4 Jacquard needle control

Here it is absolutely necessary to push out all needles of a cylinder at a particular yarn guide (possibly without yarn feeding). Extensions to the needle sensor device beyond the minimum configuration under "Device components" are not required.

### 3.2.5 Start-up

You will find an exact description of the steps necessary for start-up under "Starting up the Needle Sensor". In the short description below, the basic procedure and the special features of double jersey machines are outlined.

## Getting started

To start up the needle sensor, please proceed as follows:

1. Install the control unit
2. Electrical connection
3. Install and connect the optical heads  
For these machines the selection of yarn guides at which monitoring is to take place is particularly critical. The restrictions of needle grouping and needle pattern described in the previous sections apply. The limited distance between optical head and control unit restricts the selection further. It is also useful to have a needle gate near the monitoring point to be able to replace defective needles quickly.
4. Setting the operating data  
In the Machine menu, switch on the channels to which optical heads are connected. Switch the other channels off. Monitoring is usually activated for the entire operating time of double jersey machines. In this (normal) case, set the activation type to **“with machine”** for all channels. The maximum number of needles in the cylinder is set for each channel individually, even if several optical heads are monitoring needles of the same cylinder of the machine.

5. Adjusting the optical heads  
(as for single jersey machines)
6. Setting and teaching (programming) the needle pattern  
In the Channel Settings menu, set the separating rows or the number of monitored (used) needles for each channel. If the pattern type **“PATTERN COMPLETE”** is selected, the teaching program must be run after each change in the number of used needles.
7. Checking the functioning.

### 3.3 The needle sensor on a stocking or bodywear machine

#### 3.3.1 Device components

The device consists of at least:

- Control unit 4022 with holding plate and mounting set
- Extended machine cable
- Optical head, type depending on the cylinder gauge
- An adjustment device for the optical head
- Hand-held terminal 8024 (one hand-held terminal is normally sufficient for a group of machines or a machine hall)

## Getting started

In the case of double-knit sock or bodywear machines, a second optical head with an adjustment device is required to monitor the horizontal needles.

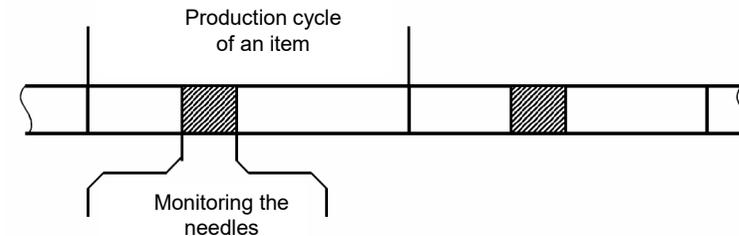
### 3.3.2 Cyclical activation of monitoring

To monitor the needles, a time span is required during the knitting of a stocking or an item in which **all** needles in the cylinder are pushed out at exactly the **same height** at **one** position. The duration of monitoring must last at least three<sup>a)</sup> revolutions of the machine, but can be much longer than that. The needle positions (height) must not change during this time. Within this monitoring time the speed of the machine can be freely selected, but must not change by more than 10%.

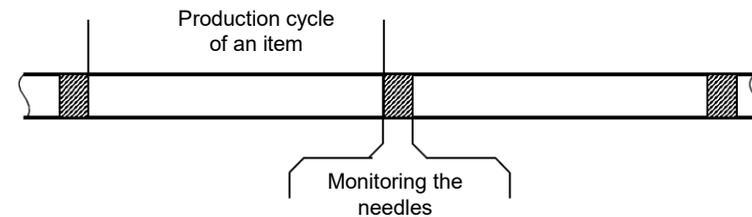
If the conditions described above are not guaranteed during the production of a stocking or an item, monitoring can only take place in the production process between two stockings or items. For this it is necessary to program the machine especially to ensure that before the beginning or at the end of an item, all needles are pushed out in the way described above and do not knit during this time. This "idle phase" can be limited to a few rounds.

a) This minimum length depends on the error counter and the pattern type set, see "Selecting the pattern type".

### Variant 1: Monitoring during production of an item



### Variant 2: Monitoring between items



The time span in which the machine is in the described state is transmitted to the needle sensor 4022 by an electrical signal. Two such switching signals are available; the assignment of switching signal and channel number is adjustable.

## Getting started

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### 3.3.3 Start-up

You will find an exact description of the steps necessary for start-up under "Starting up the Needle Sensor". In the short description below the basic procedure and the special features of stocking knitting machines are outlined.

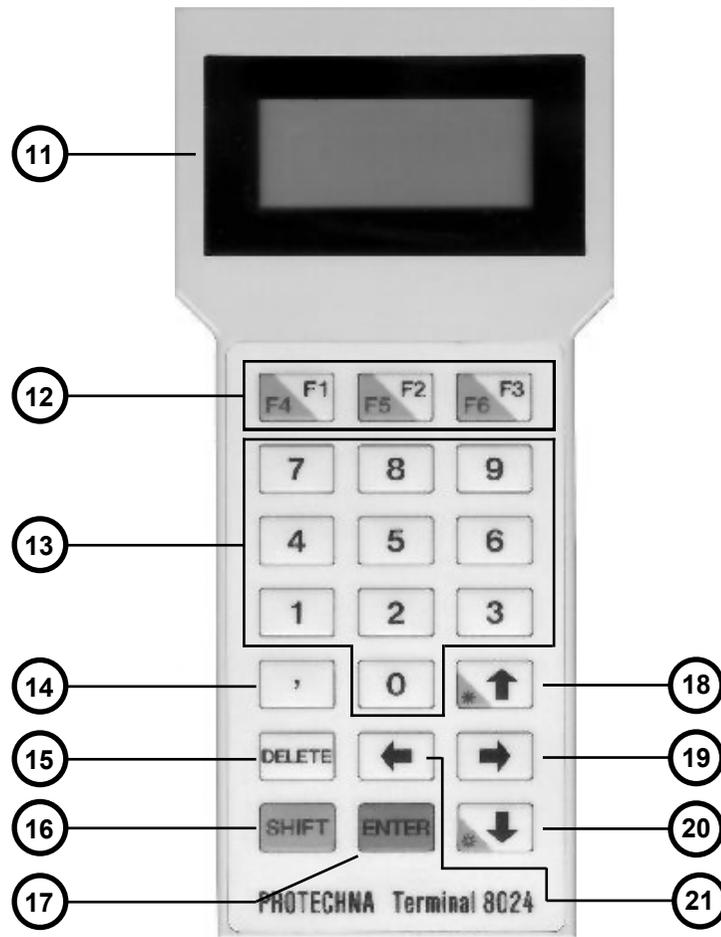
1. Install the control unit
2. Electrical connection  
The connection is always established using the extended machine cable. If there is no suitable connector for the reset input, it can be advantageous to use a rotary transmitter signal.  
The switching signals for the cyclical monitoring activation usually have to be programmed into the machine control. Pay attention to the minimum monitoring cycle length. This applies especially if you want to monitor the needles between items.
3. Install and connect the optical heads  
(as for single jersey machines)
4. Setting the operating data  
First set the machine-related parameters in the Machine menu.  
Switch on the channels to which optical heads are connected.  
Switch the other channels off.  
Set the activation type for each switched on channel according to the switching signal used.

5. Adjusting the optical heads  
Please note that it is only possible to adjust the optical heads if the corresponding channel is activated (by the switching signal). In the case of a short monitoring duration of only a few revolutions of the machine, the machine may have to be switched to a special operating state to retain this monitoring state permanently or at least for a longer time.
6. Checking the functioning  
The function should be checked in normal production, and thereby also with normal monitoring duration.

Operating the needle sensor with the hand-held terminal 8024

4. Operating the needle sensor with the hand-held terminal 8024

4.1 Controls on the hand-held terminal



11 LCD display

12 **Function key field:** Function keys F1, F2 and F3 - together with SHIFT - F4, F5 and F6

13 **Numerical key field:** Input of operational parameter

14 **Comma key** (key not used)

15 **DELETE:** For clearing of false inputs, re-setting the stop counters, re-setting to factory default settings

16 **SHIFT:** For the functions F4, F5, and F6, as well as the setting of the LCD display brightness

17 **ENTER:** Confirmation of inputs and starting of functions

18 **up [▲]:** To move upwards to an input position in a menu. When pressed together with SHIFT, the LCD display will lighten.

19 **right [▶]:** Selection (changing forwards) of setting options and display options

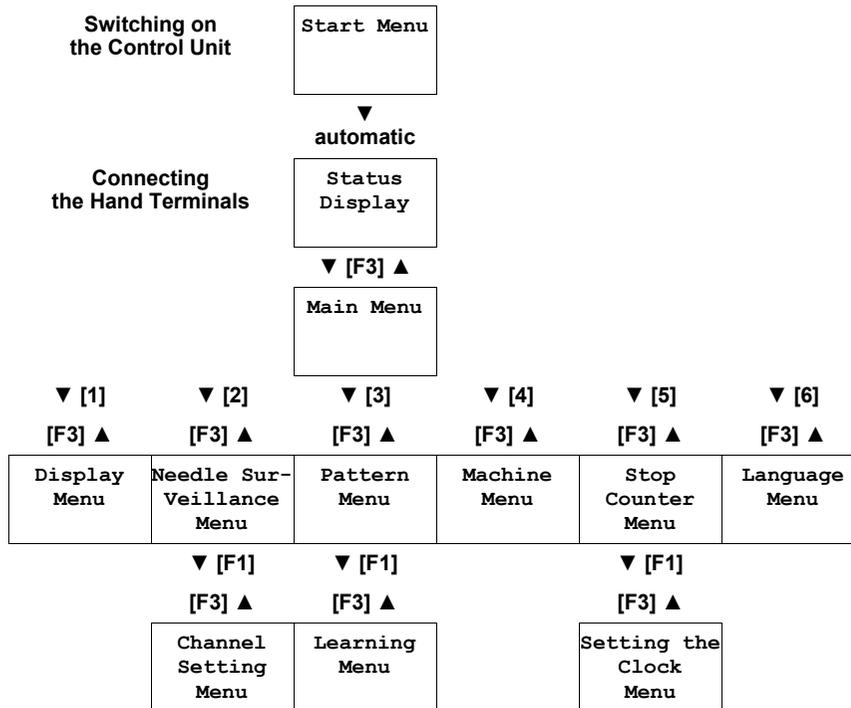
20 **down [▼]:** To move downwards to an input position in a menu. When pressed together with SHIFT, the LCD display will darken.

21 **left [◀]:** Selection (changing backwards) of setting options and display options

Operating the needle sensor with the hand-held terminal 8024

4.2 Using the menu

4.2.1 Menu structure



4.2.2. Menu Navigation

The hand-held terminal 8024 features an LCD display that can display four lines of text. However, some menus have more than 4 lines due to the number and relatedness of setting options. This means that only a part of the menu can be shown on the display. The four lines are always displayed in the immediate vicinity of the input position.

To change the input position, please use the keys [▲] and [▼]. The selected position is marked by a flashing cursor. The menu scrolls through the window of the display.

There are three possibilities of carrying out inputs in a submenu. This is dependent on the selected input position.

Buttons



Buttons can (after pressing and confirming with the [ENTER] key) immediately trigger a certain function, e.g. switching to another menu. These buttons are marked with brackets [xxxx].

Each button is also assigned a particular key, e.g. [F3: xxxx]. Using this key, the switching function within the menu can be triggered without having to move the cursor onto the button before.

**Operating the needle sensor with the hand-held terminal 8024**

**Numerical Input**

Needles: 2345

You can enter a new value using the keypad. If you want to correct the entry, please press the [DELETE] key.

**Input using a selection list**

Pattern type :  
<CUT LINE >

Input positions, which are represented with a selection list, are displayed in brackets <xxxx>. Please press the arrow key [◀] or [▶] to make the required setting.

The altered numerical entries and the setting of a selection list are not automatically saved in the device. Altered entries are marked with an asterisk \*. They are not saved until the [ENTER] key is pressed.



Please note that when switching to another menu, all entries that are not confirmed, i.e. which are marked with an asterisk \*, are discarded. This applies especially when switching back to the main menu.

Needles: =2345

Displays are another feature of the menus. No inputs are possible here. Display fields are distinguished from numerical entries in that they are marked with "=".



Due to the scrolling image it is sometimes possible to position the cursor on a display field. However, it is not possible to carry out any entries.

**Operating the needle sensor with the hand-held terminal 8024**

**4.3 Start menu**

```
<< PROTECHNA >>  
NEEDLE CONTROL  
4022  
VERSION x.xx
```

After switching on the needle sensor with the hand-held terminal connected, this menu appears for approximately 4 seconds. The software version of the program used in the control unit is displayed. In the case of queries regarding the monitoring system, you might be asked for the software version.

There is also the option of resetting all of the control unit's settings to the factory settings. To do this, press the [DELETE] key while this menu is displayed. You will be asked to confirm the action.

```
Do you want to  
clear all  
settings?  
[F1:Yes] [F3:No]
```

This confirmation screen remains on the hand-held terminal for an unlimited period of time. During this time the needle sensor does not function. Press [F1] to reset all of the control unit's settings to the factory settings. Press [F3] to start the needle sensor in the usual way.

**4.4 Status Display**

```
NEEDLE CONTROL  
<< Ready >>  
[F3: Menu ]
```

After you have connected the hand-held terminal or switched on the control unit with the hand-held terminal connected, the status display appears on the LCD screen.

```
NEEDLE CONTROL  
Surveillance is  
in operation  
[F3: Menu ]
```

The device is in monitoring (normal) mode and the machine is running. If the machine is at a standstill, "Ready" is displayed (see above).

```
NEEDLE CONTROL  
Device is in  
test operation  
[F3: Menu ]
```

The device is switched into test mode operation. The machine is not switched off by the monitoring device. Test mode operation enables the adjustment and checking of the monitoring parameters when the machine is running, without stopping the machine.

In test mode it is possible to enter all operating parameters and to view all displays. The optical head can only be adjusted in test mode when the machine is running.

As an additional display, that the device is switched into test mode operation, the yellow LED "Test" is lit on the front of the control unit.



Operating the needle sensor with the hand-held terminal 8024

When the monitoring device has detected a fault, the machine is stopped. You receive the following displays about the fault cause:

- The LED of the channel, which has detected the needle fault, lights red.
- The numerical display on the front of the device shows the number of needles, which the machine must be turned until the defective needle is positioned exactly at the optics head.
- The type of the fault is shown on the hand terminal 8024.

```
NEEDLE CONTROL  
Broken Needle  
Channel 1  
[F3: Menu ]
```

This status display is shown at a needle break once the hand-held terminal is connected.

```
NEEDLE CONTROL  
Pattern Fault  
Channel 1  
[F3: Menu ]
```

A pattern fault occurs immediately after stopping the machine if the actual pattern of the needles does not match the saved pattern.

```
NEEDLE CONTROL  
Bent Needle  
Channel 1  
[F3: Menu ]
```

At this fault, the needle sensor has stopped the machine because the lateral distortion of a needle of the cylinder has exceeded the pre-set tolerance limit.

To move back to the main menu, please press the [F3] key.

#### 4.5 Main Menu

##### 4.5.1 Selecting a Sub Menu

```
---Main Menu---  
F4: Test Mode  
<Test is ON >  
[1: Display ]  
[2: Needle Ctl.]  
[3: Pattern ]  
[4: Machine ]  
[5: Stop count ]  
[6: Language ]  
-----  
[F3: Back ]
```

From the main menu, it is possible to switch to the individual input and display menus of the needle sensor. The main menu is always displayed after terminating these submenus.

Please use the keys [▲] and [▼] to move the cursor to the corresponding entry of the menu. Please use the [ENTER] key to enter the selected submenu. However, selecting a submenu can be carried out faster when using the numeric keys 1 to 6.

To move back from the main menu to the status display, please press the [F3] key. Alternatively, it is possible to move the cursor to the position **F3: Back** and then by pressing the [ENTER] move back to the status display.

Operating the needle sensor with the hand-held terminal 8024

4.5.2 Setting Test Mode Operation

```
F4: Test Mode
<Test is ON >
```

Change with [◀] [▶]. Confirm with [ENTER]

```
<Test is ON >
```

The device is operating in test mode operation. The machine will not be stopped by the monitoring device.

```
<Test is OFF >
```

The device is operating in the monitoring (normal) mode.

For further information about the test mode operation, please refer to "status display."

```
<Test is OFF *>
```

This symbol marks an entry that has been altered but not yet confirmed. The operating mode has not yet been changed.

It is possible to switch (in any menu) between normal and test mode operation at any time using the [F4] key (press [F1/F4] and [SHIFT] at the same time).

4.6 Displays menu

4.6.1 Overview

```
Channel   : <1>
Needles   =2345
Signal    = 321
Minimum   = 54%
Deviation = 12%
-----
[F3:Main Menu ]
```

These displays serve primarily as adjustment aid during the adjustment of the optics heads. Four measurements are displayed for each channel that is switched on.

To return to the main menu, please press the [F3] key.

4.6.2 Selecting the Channel

```
Channel   : <1>
```

Change with [◀] [▶] or numerical keys

In this line the channel for which the measurements are to be displayed is selected. Channels that are switched off cannot be selected.

4.6.3 Display the Number of Needles

```
Needles   =2345
```

Number of needles recognised by the needle sensor during one revolution.



Please note that this display delivers wrong values when the maximum number of needles is not set correctly (see "Setting the Maximum Number of Needles").

Operating the needle sensor with the hand-held terminal 8024

4.6.4 Display of the Signal Level

Signal = 321

The signal level corresponds to the light quantity, which is reflected by the needles. A signal level of 100 is required for a perfect monitoring function. However, during the adjustment of the optics head, the signal level should always be adjusted as high as possible to have sufficient reserve when soiling builds up at the optics head.

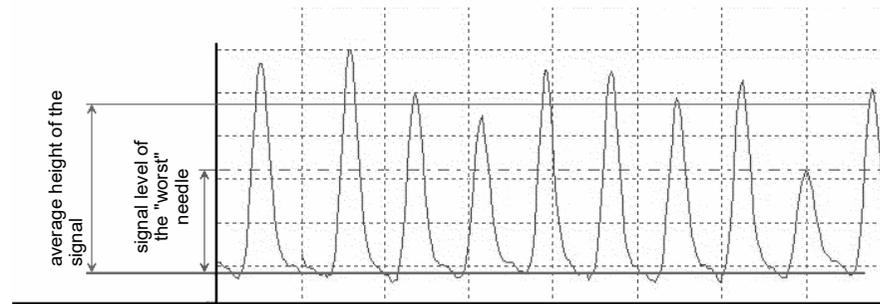
The signal display is logarithmically scaled. A rise of the shown signal value by 100 always means doubling the signal reflected by the needles. The following overview table shows this context.

signal, reflected by the needles (scaled to the minimum height)	displayed signal value
< 0,5-times	< 10
0.7-times	~ 50
1-times (= Minimum height)	100
2-times	200
4-times	300
10-times	~ 420

4.6.5 Display of the Minimum Signal

Minimum = 54%

Height of the signal delivered by the "worst" needle in the cylinder. The display is a percentage value of the average needle signal. This display is an aid for setting the sensitivity threshold (see "Setting the Sensitivity"). The following graphic illustrates the displayed value.



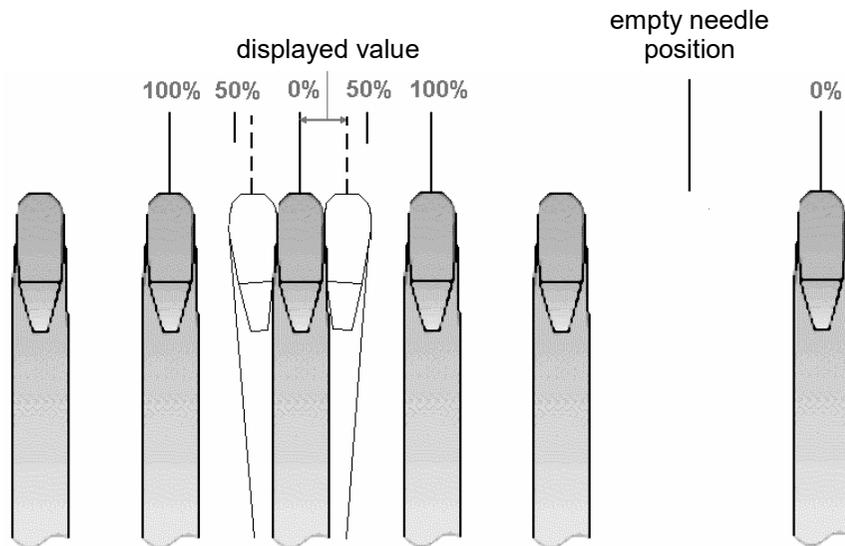
4.6.6 Display of the Tolerance (Deviation)

Deviation = 12%

Deviation of the most bent needle from the ideal position. The display is important for setting the tolerance (see "Setting the Tolerance").

Operating the needle sensor with the hand-held terminal 8024

The indication of the needle deviation is scaled to the normal distance between two needles. The following graphic illustrates the reading.



Needle positions at which no needle is present are not taken into account for the determination of the tolerance value.



Please note that this display can deliver incorrect values if the pattern type and - if applicable - the number of used or missing needles has not been correctly entered. When the pattern type **PATTERN** is selected, the pattern must also be learned (see "Selecting the Type of Pattern").

4.7 Needle Monitoring Menu

```
--Settings-
for channel:<1>
[F1: Settings ]
[F3: Main Menu]
```

If you would like to alter the needle monitoring settings, this menu appears. Here you select the channel for which you want to change the settings.

After selecting the channel, please enter the channel settings menu

```
for channel:<1>
```

Change with [◀] [▶] or numerical keys

with the [F1] key.

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4.8 Channel Settings Menu

4.8.1 Overview

```
- Settings K1 -
Pattern type:
<COMPLETE >

Tolerance [%]
: 50
Fault Counter
: 1
Trigger Level
: 40
-----
[F3: Back ]
[F6: Undo ]
```

This menu contains all the parameters for one channel of the needle sensor. After you have made the required settings, please press [F3] to return to the needle monitoring menu. You can then select another channel or switch back to the main menu by pressing [F3] again.

The key [F6] (keys [F3/F6] and [SHIFT] pressed at the same time) has a special function in this menu. All entries are undone with this key. All input fields then contain exactly the same values as when the menu was opened.

4.8.2 Selecting the Type of Pattern

```
Pattern type:
<COMPLETE >
```

Change with [◀] [▶]. Confirm with [ENTER]

The pattern type **COMPLETE** is selected when the needle cylinder is completely occupied with needles and all needles are driven out so that they are detected by the optics head. In this case, it is not necessary to enter how many needles are currently being used or to learn the pattern.

```
Pattern type:
<CUT LINE >
No. of missing
needles : 2
```

The pattern type **CUT LINE** is selected when (exactly) one separating row has been created by the removal of one or more needles. In addition, all needles must be driven out so that they are detected by the optics head.

The number of needles removed, i.e. the width of the separating row, must also be entered as an additional parameter. In this case learning the pattern is not necessary.

If more than one separating line is present, the pattern type **PATTERN** must be selected.

```
Pattern type:
<Pattern >
Used needles
:2343
```

This pattern type is always selected when the conditions for the other two types are not met. Its main application, besides working with several separating rows, as already mentioned, is to monitor the needle groups of a needle cylinder separately. This becomes necessary if not all needle groups can be driven out at one thread guide.

The input parameter **Used needles** indicates the number of needles, which are detected by the optics head during one revolution of the cylinder.

**Operating the needle sensor with the hand-held terminal 8024**

When the pattern type **PATTERN** is select, the learning programme must be carried out after every change of the number of used needles.

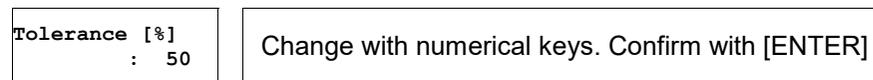
The selection of the pattern type has effects on other operational features of the needle sensor 4022.

	<b>Pattern Type COMPLETE</b>	<b>Pattern Type CUT LINE</b>	<b>Pattern Type PATTERN</b>
Earliest recognition of a needle breakage after monitoring has	after 160 needles + (f - 1) revolution	after (f <sup>a</sup> + 2) revolutions	after (f + 2) revolutions
Minimum length of the monitoring cycle (important for cyclical activation by a switching signal <sup>b</sup> )	(f + 1) revolutions	(f + 3) revolutions	(f + 3) revolutions
Does the pattern have to be learned?	no	no	yes
Restrictions for the pattern	all needles of the cylinder are used	separating row must not exceed a maximum of 10 needles	no more than 10 consecutive needles can be missing
Is the measuring of the needle deviation (tolerance) faded-out at the separating row?	no separating line is present	yes, for the first needle left and right from the separating row	no, all needles are monitored equally for bending

- <sup>a</sup> f refers to the pre-set fault counter (see "Setting the Fault Counter").
- <sup>b</sup> For further information about activating a channel, please refer to "Setting the Activation Type"

**4.8.3 Setting the Tolerance**

The **Tolerance** indicates the permissible deviation of the needle



distance (in per cent) during one revolution for this channel. The value is scaled to the normal distance between two needles. The diagram under "Display of the Tolerance" serves as an illustration. The maximum permissible value is 50%.

The machine is stopped when the deviation of the needle distance at the same needle exceeds this limit in **f** consecutive rounds (**f** stands for the pre-set fault counter; please see next chapter).

Operating the needle sensor with the hand-held terminal 8024

4.8.4 Setting the Fault Counter

Fault Counter : 1	Change with numerical keys. Confirm with [ENTER]
----------------------	--

The value shows how often a fault must be detected successively at the same needle before the machine is stopped.

The setting **1** (machine stops immediately) offers the advantage of the shortest fault length. However, the device becomes more sensitive for false stops caused by e.g. slubs, which get caught by the needles. By increasing the value you can reduce the false stops, however, this might cause a longer fault length

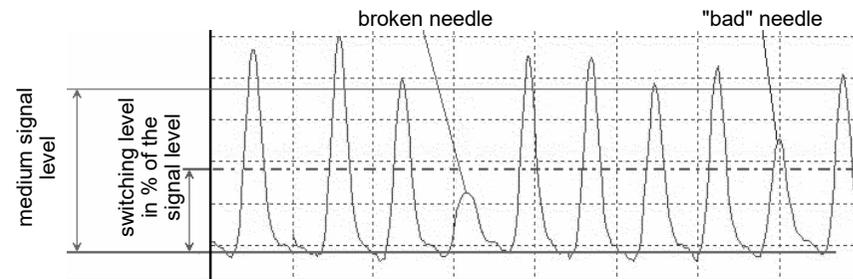
The setting depends very much on the behaviour of the needles at the corresponding optics head. Therefore, the exact setting can only be determined through experience in operating the device.

4.8.5 Setting the Sensitivity

Trigger Level : 40	Change with numerical keys. Confirm with [ENTER]
-----------------------	--

The needle sensor 4022 recognises from the level of the reflected light signal whether the needle hook of the illuminated needle is intact or broken off. However, the reflected light signal is not identical at intact needle hooks at all needles. The causes for this are the oxidation of the needle surface and in small radial distortions of the needles (i.e. distortion to the inside or the outside). On the other hand, a part of the light is reflected also at a faulty needle.

Therefore, a deciding factor is necessary, which distinguishes broken needles from badly reflective needles. The sensitivity is the switching threshold (trigger level) as of which a needle is judged as intact. This threshold is set in per cent of the average needle signal (see the following diagram):



Operating the needle sensor with the hand-held terminal 8024

The machine is stopped when the signal reflected by the same needle stays below this limiting value during **f** consecutive revolutions (**f** represents the pre-set fault counter; see previous chapter).

The display of the minimum signal serves as setting aid for this parameter (see "Display of the Minimum Signal"). Here you can see by how far the light signal of the worst reflecting needle exceeds the threshold.



**Attention:** Reducing this trigger level to a lower value reduces or prevents false stops. However, there is the danger that broken needles are also judged to be intact, which does not ensure the monitoring function as such any more. Therefore, please always check the monitoring function after reducing the trigger level e.g. by placing a broken needle into the needle cylinder.

## 4.9 Pattern Menu

### 4.9.1 Overview

```
-----Pattern-----  
C1:o.k. C2:o.k.  
[F1:Main Menu ]  
-----  
[F3:Main Menu ]
```

The menu shows the state of the internally saved or learnt pattern for all channels of the needle sensor. The example shown on the left refers to the display at a control unit with two channels when the pattern is saved correctly for all channels. In this case, it is not necessary and also not possible to start the learning programme. Both the buttons [F1] and [F3] return you back to the main menu.



When the pattern type **COMPLETE** or **CUT LINE** is selected in the channel menu, the saved pattern is calculated internally for this channel and must not be learned. Learning the pattern is not possible for this channel.

Operating the needle sensor with the hand-held terminal 8024

4.9.2 Status Displays for the Pattern

There are different displays, which show the status of the learnt pattern and the needle monitoring for every channel.

o.k.	The pattern was saved successfully (or calculated internally). When this display is shown for all activated channels, the device can operate in the monitoring mode.
--	The corresponding channel is switched off.
+x	The saved pattern does not correspond to the current status of the device. The setting for the used needles was changed by <b>x</b> needles. Start the learning programme to save the pattern again.
-x	Error display! <b>x</b> needles are not recognised for the corresponding channel. Please check the settings and the adjustment for this channel. Learning the pattern is only possible when this fault was removed.
..	At present, the saved pattern cannot be compared with the current status of the device because the machine is at standstill or the channel has not been activated. Let the machine run for at least 4 revolutions to update the display.

4.9.3 Learning Programme

```
<<LEARNING>>
Please wait...
[F3: Stop    ]
```

After starting the learning programme, this display is shown. For all channels, whose patterns have not yet been saved correctly, the current needle order is saved as a reference. The machine must be started and the channel must be activated. Learning a pattern is usually completed after four revolutions of the machine. It can, however, last longer if individual needles are not recognised during this time. To be able to execute the learning programme without stopping the machine, the device is switched automatically into test mode operation.

```
Please start
the machine!
[F3: Stop    ]
```

If the learning programme is started at a stationary machine, this message appears.

If you have started the learning programme accidentally, please press the [F3] key.

After the learning programme is terminated, the display changes automatically to the pattern menu to show the results of the learning process.

Operating the needle sensor with the hand-held terminal 8024



The needle monitoring can be deactivated at a running machine for one or all activated channels at times (see "Setting the Activation Type"). The learning programme remains active for as long as all channels, which needed to learn the pattern, were active for at least four revolutions once.

#### 4.10 Machine Menu

##### 4.10.1 Overview

```
----Machine----  
M/C is running :  
<SWITCH. LINE>  
Start Delay  
[sec]      : 5  
Stop contact is:  
<norm. CLOSED>  
Channel 1 is  :  
<SWITCHED ON>  
Activation C1 :  
<with Machine >  
max. number of  
needles C1 :2345  
Channel 2 is  :  
<SWITCHED OFF>  
  
Machine speed  
(Needles p. sek)  
<100 .. 5000 >  
-----  
[F3: Main Menu ]  
[F6: Undo      ]
```

The Machine menu contains all the one-time settings that must be made when installing the needle sensor on a particular machine.

The key [F6] (keys [F3/F6] and [SHIFT] pressed at the same time) has a special function in this menu. All settings are undone with this key. All input fields then contain exactly the same values as they contain when the menu was opened.

Operating the needle sensor with the hand-held terminal 8024

4.10.2 Setting the "Machine in Operation" Signal

M/C is running :  
<SWITCH. LINE>

Change with [◀] [▶]. Confirm with [ENTER]

The needle sensor 4022 requires a signal for the operating status of the circular knitting machine. This signalling can be carried out in two different ways:

<SWITCH. LINE>

The reset input at the socket **Maschine** (pin 3 and pin 4) is used. During the normal operation of the machine, a voltage has to be present at this connection. When the machine is standing or during the inching drive operation, no voltage must be present at this connection. No impulse sensor is connected to the control unit.

<RPM SENSOR >

An impulse sensor is connected at the corresponding connections of the **Maschine** socket. The operating status of the machine is recognised from the measured speed (see "Setting the minimum speed"). The reset input is not used and can remain unconnected.

Signalling of the operating status of the circular knitting machine using the speed information is primarily suitable for completely electronically controlled machines. Normally these machines already deliver a signal impulse when the needle cylinder is in the zero position.

This pulse can be used as an impulse sensor signal. On the other hand, at such machines it is often difficult to receive an electrical signal for the normal operation at the machine.

Using an impulse sensor is also recommended, when the working speed of the machine is reduced during certain production cycles. The needle monitoring, which requires a stable speed, can then be interrupted for this time.

4.10.3 Setting the Start Delay

Start Delay  
[sec] : 5

Change with numerical keys. Confirm with [ENTER]

This setting parameter is only used when the "machine in operation signal" is set to **SWITCH. LINE**. Otherwise, these menu lines are not displayed.

The setting of a start delay is important since the needle monitoring must only be activated when the machine has reached its normal operating speed. The start delay has the same effect on all channels. After starting the machine (voltage is present at the reset input), the channels are not active during the start delay time.

Operating the needle sensor with the hand-held terminal 8024

4.10.4 Setting the Minimum Number of Revolutions

minimum RPM  
: 20

Change with numerical keys. Confirm with [ENTER]

This setting parameter is only used when the "machine in operation signal" is set to **RPM SENSOR**. Otherwise, these menu lines are not displayed.

Please enter the speed of the machine at which all channels of the needle sensor are activated. When the machine falls below the pre-set speed the channels are deactivated again.

4.10.5 Stop Contact

Stop contact is:  
<norm. CLOSED>

Change with [◀] [▶]. Confirm with [ENTER]

<norm. CLOSED>  
<norm. OPEN >

This parameter specifies the normal position of the stop relay. Please select the setting required for your application.

4.10.6 Switching a Channel ON and OFF

Channel x is :  
<SWITCHED ON >

Change with [◀] [▶]. Confirm with [ENTER]

<SWITCHED ON >  
<SWITCHED OFF>

At this menu position the individual channels are activated and deactivated.

If you have not connected or designated an optical head to a channel of the control unit, the status **SWITCHED OFF** must be selected for this channel.

This input field and the two following input fields are repeated for all channels of your needle sensor 4022.

Operating the needle sensor with the hand-held terminal 8024

4.10.7 Setting the Activation Type

Activation Cx :  
<with machine >

Change with [◀] [▶]. Confirm with [ENTER]

<with machine >  
<Signal 1(+) >  
<Signal 1(-) >  
<Signal 2(+) >  
<Signal 2(-) >

The needle monitoring can be active during the entire operation of the circular knitting machine, however, it can also be cyclically interrupted. In this case, two additional switching signals (referred to as signal 1 and signal 2) specify the duration of the monitoring cycle.

It is possible to set for every channel separately, how the activation of the needle monitoring shall be carried out, dependent on the operating state of the machine and possibly switching signals 1 or 2. A setting is only possible when the respective channel is **switched on**. Otherwise, these menu lines will not be displayed. The selection options are described in the following:

<with machine >

The needle monitoring is active as long as the machine is in normal operation and has reached its operating speed. Either the connection of the re-set input or the measured speed serves for signalling this operating state of the machine (see Setting the "Machine in Operation" Signal). In this case, the switching signals 1 and 2 are insignificant and are not connected.

<Signal 1(+) >

The needle monitoring is active, for as long as

1. the machine is in normal operation and has reached its operating speed  
and
2. the switching signal 1 is active, i.e. a voltage is present at the contacts 1 and 2 of the "Maschine" socket.

The needle monitoring is interrupted for as long as the switching signal 1 is not active. After switching on the switching signal 1 with the machine running, the needle monitoring is immediately activated for this channel (without start delay).

The switching signal 2 is not used for this channel. It can be used for the control of other channels or is not connected.

<Signal 1(-) > This setting corresponds to the option **Signal 1(+)** with the following difference. The switching signal 1 works as fade-out signal, i.e. the monitoring is interrupted for as long as the signal is active. After turning off the switching signal 1 at a running machine, the needle monitoring is immediately activated for this channel (without start delay).

Operating the needle sensor with the hand-held terminal 8024

<Signal 2(+) >  
<Signal 2(-) >

The function is identical with the **Signal 1(+)** and **Signal 1(-)** settings. However, for the control the switching signal 2 is used. The switching signal 2 uses the contacts 9 and 10 of the "Maschine" socket.

The switching signal 1 is not used for this channel. It can be used to control other channels or is not connected.

To connect the switching signals, you must use the extended machine cable.

**4.10.8 Setting the Maximum Number of Needles**

Please enter the maximum possible number of needles of the

max. number of  
needles Cx:2345

Change with numerical keys. Confirm with [ENTER]

monitored needle cylinder, incl. missing needles, (e.g. for a separating line).

An input is only possible when the corresponding channel is **switched on**. Otherwise, these menu lines are not displayed.

**4.10.9 Setting the Machine Speed**

This setting applies to all channels. Therefore, please

Machine speed  
(Needles p. sek)  
<100 .. 5000 >

Change with [◀] [▶]. Confirm with [ENTER]

enter the range of the needle sequence, which is valid for all channels of the machine. The needle sequence is calculated as follows:

$$(\text{needle positions} \times \text{speed}) / 60$$

The expression **needle positions** is equivalent to the **maximum number of needles** for a certain channel.

< 100 .. 5000 > This standard setting is suitable for most machines.

< 15 .. 750 > In the case of particularly low-speed machines or machines with small needle cylinders with a coarse gauge, it is possible to switch to this range.

Operating the needle sensor with the hand-held terminal 8024

4.11 Stop Counter Menu

4.11.1 Overview

```

--Stops since:--
02/04/11
12:41:37
Channel 1 = 2
Channel 2 = 0
Ext. Stop = 2
Total = 4
[DEL: Reset ]

-----Clock-----
02/04/11
17:33:50
[F1: Set ]

-----
[F3:Main Menu ]
    
```

This menu shows the number of stops for all channels and for all other stops.

The stop counter for external stops contains all stops of the machine which are not triggered by the needle sensor 4022. Besides switching off the machine by the operator also stops by e.g. the machine's thread control are counted. This counter is only activated after a machine runtime of 10 seconds. Machine runtimes of less than 10 seconds are not taken into account.

4.11.2 Re-setting the Stop Counters

```
[DEL: Reset ]
```

When pressing the [DELETE] key, **all** counters are reset to zero. The data previously displayed is lost. The time is set to the current time at the position **Stops since**.

4.11.3 Displaying and Setting the Device Clock

```
[F1: Set ]
```

The current time of the equipment's internal clock is shown in the lower part of the menu. Move the cursor on the button **F1: Set** to display the current time. To set the equipment's clock, please press the [F1] key.

```

---Set Clock---
Year      :2011
Month     : 4
Day       : 2
Hour [24] : 17
Minute    : 33
Second    : 50
-----
[F3:Main Menu ]
    
```

The clock setting menu is now displayed. Please enter the year, month, day etc. in the individual numeric entry fields.

When you confirm the time by pressing [ENTER], the unit clock adopts the values entered. It is not necessary to confirm each numerical value individually. The confirmation applies to the complete time set procedure.

4.12 Language Menu

```

-----Language-----
<ENGLISH >
-----
[F3:Main Menu ]
    
```

Please select the operator language for all menus. The selection list contains all the languages currently available.

The main menu is displayed immediately after the [ENTER] key is pressed to confirm the language change.

Operating the needle sensor with the hand-held terminal 8024

**4.13 Error Messages**

**Notes**

**4.13.1 Invalid Values**

```
Please enter an
integer between
123 and 456
[F3: Back   ]
```

If a set parameter is outside of the valid range, this error message appears as soon as you confirm the entry (the numerical values on the left are examples).

Please press [ENTER] or [F3]. The cursor is then moved to the exact input field that contains the invalid entry.

**4.13.2 Fault Code Display**

```
Internal Error!
Error Number:
  100
[F3: Back   ]
```

During the self-test or during operation an error has been recognised within the device. Please refer to the page for the error code reasons.

```
External Error!
Error Number:
  300
[F3: Back   ]
```

During operation, a fault of the connections has been recognised. Please refer to the page for the error code reasons.

## Starting up the Needle Sensor

### 5. Starting up the Needle Sensor

#### 5.1 General information

The PROTECHNA Needle Sensor 4022 is usually installed and started in the following order:

- Install the control unit
- Electrical connection
- Install and connect the optical head(s)
- Set the operating data
- Adjust the optical head(s)
- Check the function

#### Installation service

We strongly recommend that at least the initial installation of PROTECHNA devices is carried out by our service technicians. This means that the device is professionally installed and set, and provides customers with an introduction to its proper use.

Our installation service is inexpensive and normally available everywhere. Customers from outside Germany should find out about the installation service from PROTECHNA's representatives in their country.

#### Service

Service technicians are available on request to check PROTECHNA devices.

Small problems, however, can often be sorted out by a phone call or by letter, fax or e-mail, without a visit from a technician being required.

#### 5.2 Installation



**Attention:** The position where the device is installed must be stable, as the device can be seriously damaged by sudden jolts, such as being dropped.

The control unit is usually fitted to an easily visible part of the machine. We strongly recommend that you use the holding plate provided because it has integrated supports for connecting the optical heads. Due to the sensitive fibre-optic cable connections, they must be securely attached.

Starting up the Needle Sensor

5.3 Electrical connection



**Warning:** The electrical connection must be carried out by qualified personnel only.



**Warning:** Before electrical connection it must be ensured that there is no danger of coming into contact with live parts.



**Warning:** It is essential to pay attention to the permissible limits for voltages and switching currents under "Electrical data".

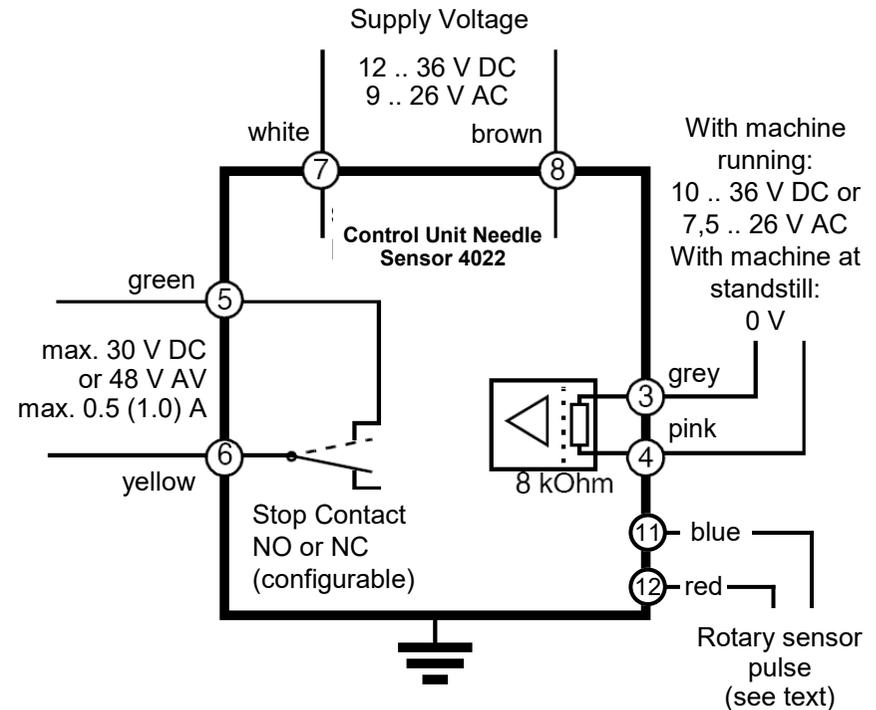
5.3.1 Connection with the standard machine cable

The standard machine cable is a 8-wire cable. It is connected to the control unit by the 15-pin **Machine** plug on the right-hand side of the unit. It has the following functions:

- Voltage connection
- Reset input
- Stop contact
- Pulse sensor

Circuit diagram

Standard machine cable



The control unit is fixed to the machine housing so as to be conductive.

### Starting up the Needle Sensor

---

#### Power connection

The control unit is connected to a nominal supply voltage in the machine of 24 V DC/AC with the white (pin 7) and brown (pin 8) wires. You do not have to pay attention to the polarity of the voltage. Please take the exact connected loads from the technical data under "Electrical data".

#### Reset input

During normal machine operation a nominal voltage of 24 V DC/AC must be applied to the grey (pin 3) and the pink (pin 4) wires. During inching speed mode or standstill, no voltage must be applied to these wires. Please take the exact connected loads from the technical data under "Electrical data".

The reset input is isolated; you do not have to pay attention to the polarity.

#### Stop contact

The green (pin 5) and yellow (pin 6) wires are connected to the machine's stop device. They lead to an isolated relay contact, which is activated when a fault occurs. This contact is set as a **break contact** (NC) at the factory, however, you can change it to a **make contact** (NO) at any time. (see setting "Stop contact"). Please take the exact connected loads from the technical data under "Electrical data".

#### Pulse sensor

Please refer to "5.3.2 Connection with the extended machine cable".

**Attention:** The cable colours for the pulse sensor (rotary sensor pulse) connection are different to the extended machine cable:

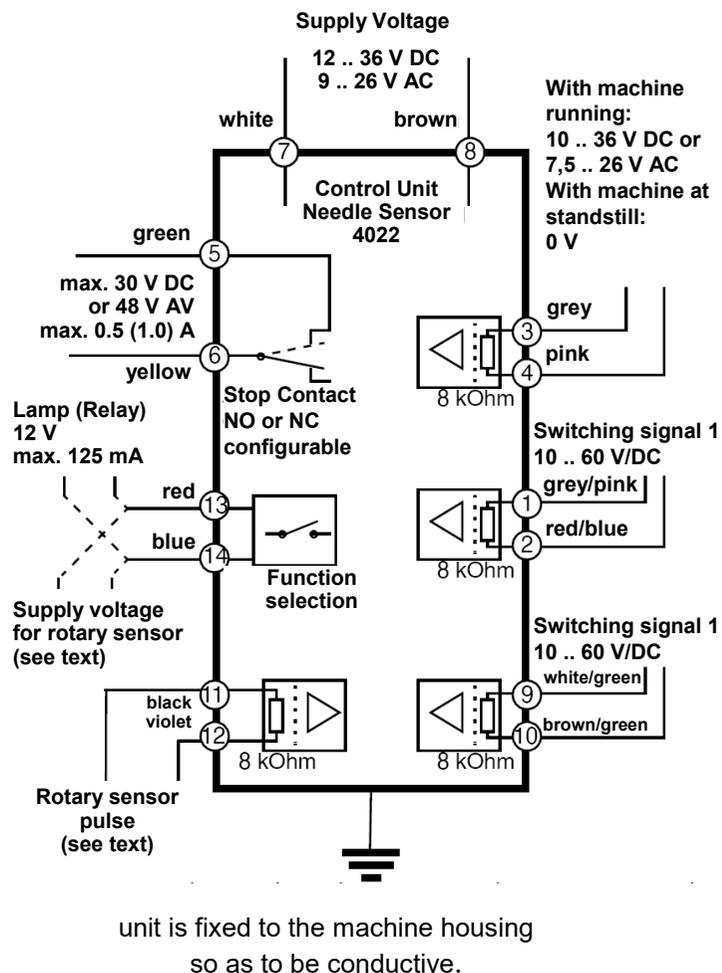
11 (-) pulse: blue

12 (+) pulse: red

Starting up the Needle Sensor

Circuit diagram

Extended machine cable



5.3.2 Connection with the extended machine cable

The extended machine cable is a 14-wire cable. It has the following functions, besides the connections described already:

- Switching signal 1 and switching signal 2
- Pulse sensor
- Lamp output

Switching signal 1 and switching signal 2

The switching signals are for cyclical activation or masking of the monitoring during normal operation of the machine. The functioning of the switching signals can be programmed and is defined in the Machine menu. (see "Setting the activation type")

The electrical connections are isolated. For switching signal 1 that is the grey/pink (pin 1) wire and the red/blue (pin 2) wire; for switching signal 2 that is the white/green (pin 9) wire and the brown/green (pin 10) wire. Please take the exact connected loads from the technical data under "Electrical data".

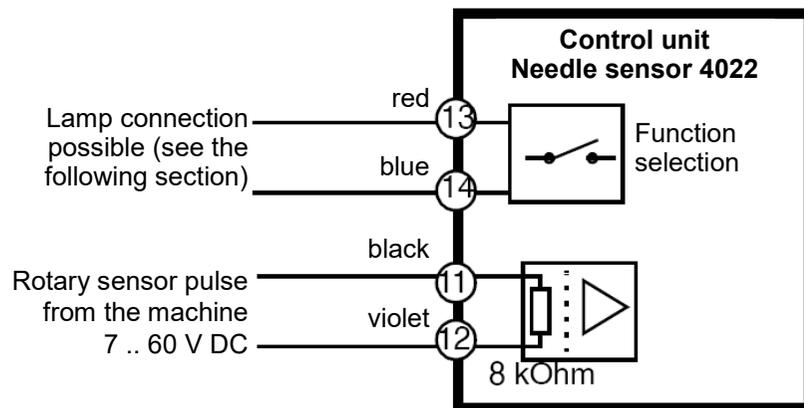
Pulse sensor

It is possible to recognise the operational status of the machine from the machine speed (normal operation, inching speed mode or stopped). This operating mode is particularly suitable for machines that are completely electronically controlled. These machines normally deliver a signal impulse when the needle cylinder is in the home position. This pulse can be used as a rotary sensor signal. On the other hand, it is often difficult in the case of such machines to pick off an electrical signal for normal operation.

Starting up the Needle Sensor

The rotary sensor pulse has to be connected to the black wire (pin 11) and the violet wire (pin 12) of the extended machine cable (see the following circuit diagram).

**First variant**  
Circular knitting machine pulse transmitter can be used

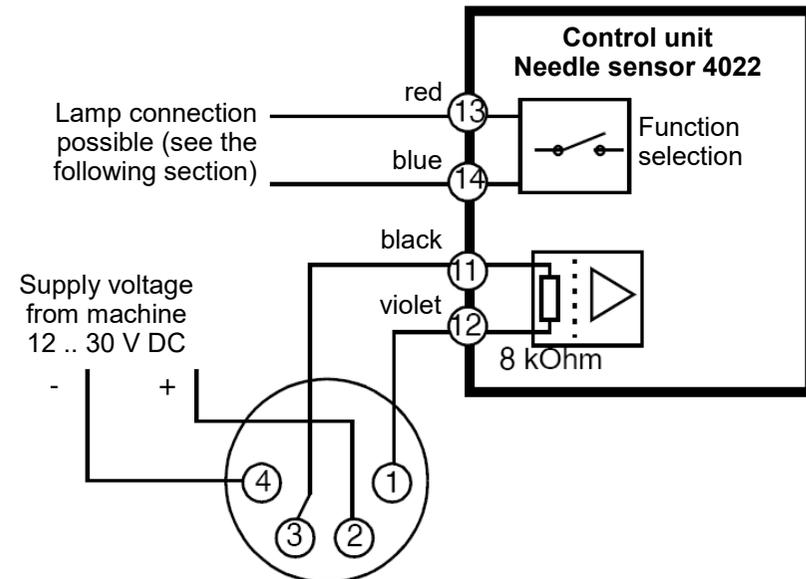


If the circular knitting machine has no suitable rotary sensor pulse, the speed must be measured with a PROTECHNA pulse sensor .

The pulse sensor requires a supply voltage in the region of 12 to 30 V DC. The power consumption is about 30 mA. If the circular knitting machine provides a voltage like this, this voltage can be used directly.

The following configuration then arises:

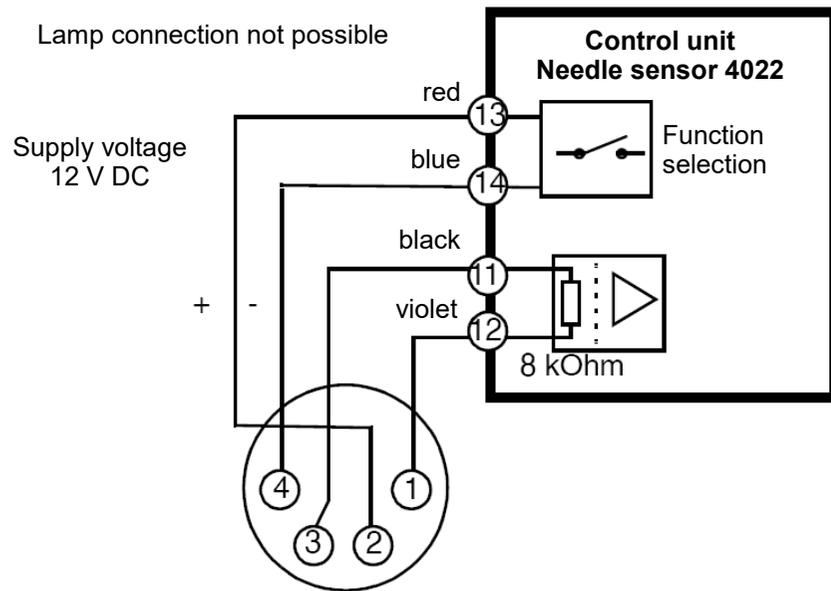
**Second variant**  
Installation of a PROTECHNA pulse sensor  
Supply voltage of the circular knitting machine is used



Starting up the Needle Sensor

The rotary sensor can also be supplied by the control unit 4022 (see the following circuit diagram).

**Third variant  
Installation of a PROTECHNA pulse sensor  
Supply voltage of the control unit 4022 is used**



The supply voltage must be switched on in the control unit 4022 in this case. For this purpose there are three slide switches on the main board of the control unit. To switch on the pulse sensor supply voltage function, please perform the following steps:



**Warning:** Before opening the control unit, always unplug it from the mains or the supply voltage.

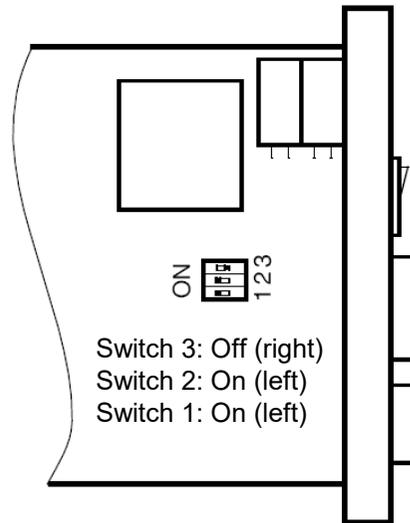
1. Remove the 4 marked screws to open the control unit.



2. Pull the main board from the unit.

### Starting up the Needle Sensor

3. On the main board there are three slide switches. Set the switches in the following way:



4. When sliding the main board back in, please ensure that the connecting cable between the two boards does not come loose.
5. After you have closed the unit, you can reconnect the machine cable and switch on the unit.

The supply voltage of 12 V is now applied to the red wire (pin 13, positive) and the blue wire (pin 14, negative). You can find the exact connected loads in the technical data under "Electrical data".

The pulse sensor supply voltage and lamp output functions cannot be used simultaneously.

### Lamp output

The lamp output must be switched on in the control unit 4022. If this function is switched on, a voltage of 12 V is applied to the red wire (pin 13) and the blue wire (pin 14) in the following way:

- no voltage: Normal operation, the machine is running
- the voltage is applied permanently: Normal operation or test mode, the machine stands still
- flashing: Needle sensor 4022 has detected an error
- flashing: Test mode, the machine is running

You can use this signal as an indicator, for example. To do so, connect a relay to these wires to operate the indicator lamp. Direct connection of the indicator lamp is not recommended due to the low current carrying capacity of the output of 125 mA (1.5 VA).

There are three slide switches on the main board of the control unit for switching on the lamp output function. Proceed as follows:



**Warning:** Before opening the control unit, always unplug it from the mains or the supply voltage.

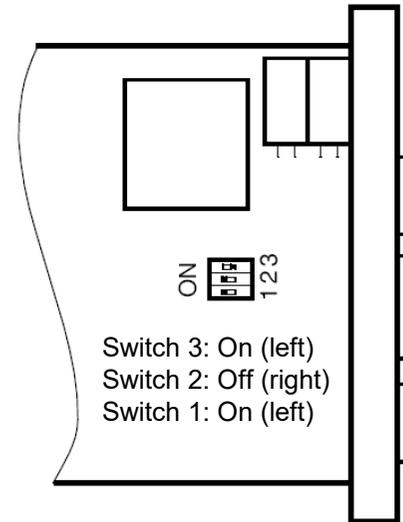
**Starting up the Needle Sensor**

1. Remove the 4 marked screws to open the control unit.



2. Pull the main board from the unit.

3. On the main board there are three slide switches. Set the three switches in the following way:



4. When sliding the main board back in, ensure that the connecting cable between the two boards does not come loose.
5. After you have closed the unit, you can reconnect the machine cable and switch on the unit.

You can find the exact connecting loads in the technical data under "Electrical data".

The lamp output and pulse transmitter supply voltage functions cannot be used simultaneously.

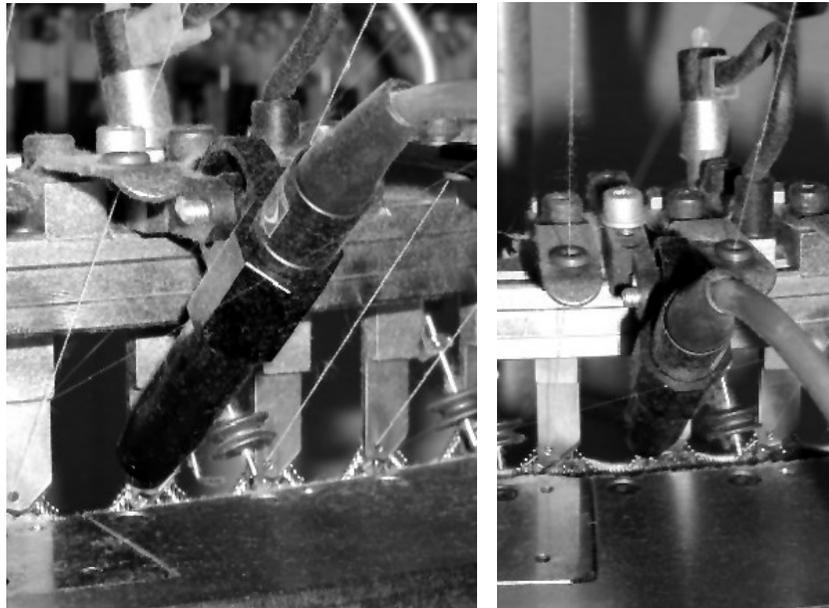
Starting up the Needle Sensor

5.4 Fitting the optical heads

The optical heads are fitted rigidly to the machine with the mounting set supplied. The mounting set is designed according to the modular principle so that different mounting options on different types of machines are possible. The following illustrations provide examples for fitting.

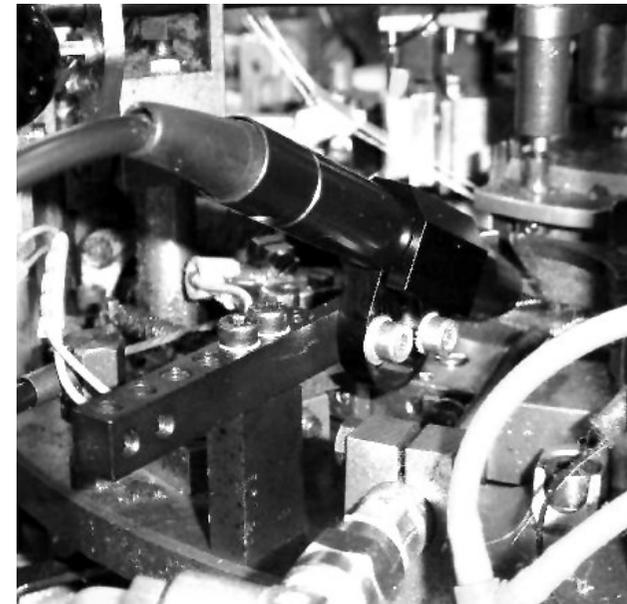
Fitted to the ring of the yarn guide

Example: Optical head on ORIZIO JOHN/C



**Caution:** Please handle the fibre-optic cables with due care, as they are unusable once they have been bent. If this happens, the entire optical head must be replaced together with the cable.

Fitted to the machine base



Example:

head on MERZ RR4-Med

Optical

### Starting up the Needle Sensor

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#### **Clamped to the ring of the yarn guide**

The yarn guide where monitoring is to take place should be selected according to the following criteria:

- All needles of the cylinder or the needle group are detected.
- The distance between the optical head and the control unit is limited. Pay attention to the length of the connection cable. It must also be possible to read the hand-held terminal while adjusting the head.
- It is also useful to have a needle gate near the monitoring point to be able to replace defective needles quickly.

The optical detection of the needles should be carried out in the needles' push-out phase if possible, and as close as possible to the yarn guide. The "angle" to the needles, that is the angle between the axes of the needle and the optical head should be about 45°; it must be between 30° and 60°. Please ensure that the yarn guide, the locking doors and other machine parts do not impair the beam of light.

Connect the fibre-optic cables of the optical heads to the corresponding sockets on the left-hand side of the control unit. Ensure that the cables of an optical head are connected to the sockets for the same channel. It does not matter which of the two fibre-optic cables is connected to the transmitter.

Screw the connector plug of the fibre-optic cables in tight and fix the cables to the optical heads at the holding plate and to the machine along the rest of their length.

Starting up the Needle Sensor

5.5 Settings and adjustments

5.5.1 Basic settings

Before you start adjusting the optical heads, you have to make some basic settings at the control unit. After fitting and connecting the control unit, please proceed as follows when starting up for the first time:

Switch on the control unit. The green indicator light on the front of the unit should now light up.

```
-NEEDLE CONTROL-
Device is in
test operation
[F3: Menu ]
```

Connect the hand-held terminal to the control unit and wait until the Status Display menu appears. If the needle sensor is in normal operation, switch it to test mode by pressing **F4** (see "Status displays").

```
----Machine----
M/C is running :
<SWITCH. LINE>
Start Delay
[sec] : 5
Stop contact is:
<norm. CLOSED>
Channel 1 is :
<SWITCHED ON>
Activation C1 :
<with Machine >
max. number of
needles C1 :2345
Channel 2 is :
<SWITCHED OFF>

Machine speed
(Needles p. sek)
<100 .. 5000 >

-----
[F3: Main Menu ]
[F6: Undo ]
```

Select the Machine menu (keys [F3] and [4]).

Use the [▲] and [▼] keys to move through the menu. The input position is marked by a flashing cursor. The menu "rolls" through the display window.

Check all setting parameters in this menu. You will find a comprehensive description of the individual values under "Machine menu".

Check the stop contact has been set correctly. The needle sensor must not stop the machine (test operation).

Check the "Machine is running" signal is properly set. Depending on the operating mode selected, the channel LEDs should flash - either during the entire start delay or briefly when the minimum speed is reached.

Switch on the channels to which you have connected optical heads. The other channel must be off. Each connected optical head now produces a narrow spot of light.

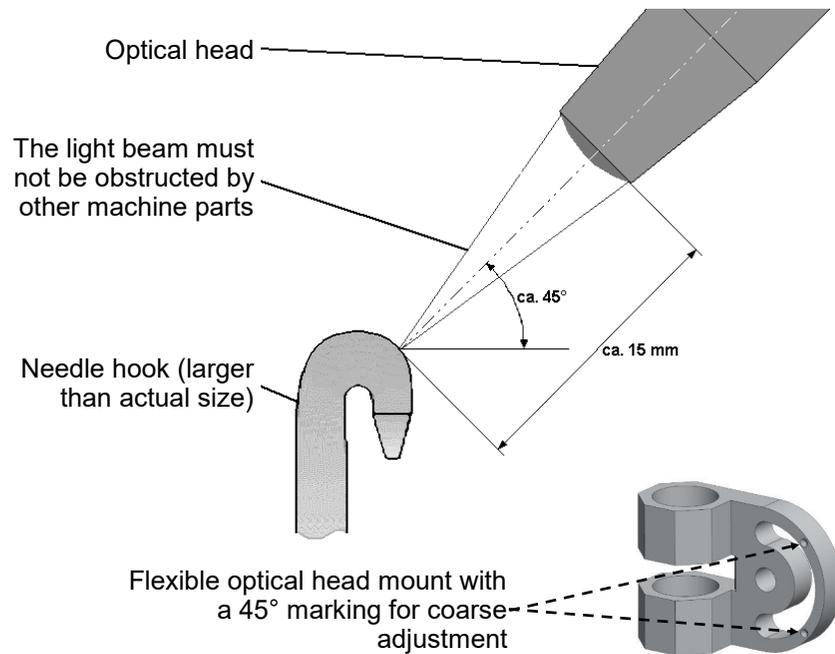
### Starting up the Needle Sensor

Set the activation type and the maximum number of needles for the switched on channels correctly. These settings must be made before the optical heads are adjusted, as otherwise the signal displays will deliver false values.

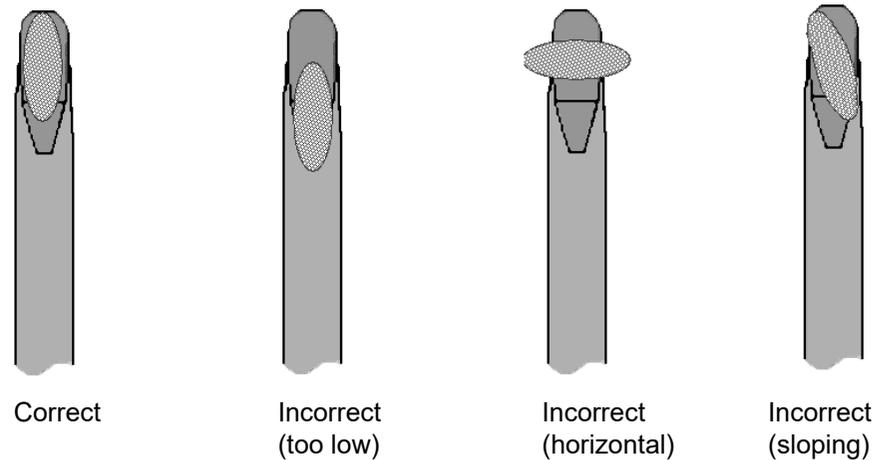
You can now leave the Machine menu by pressing [F3].

#### 5.5.2 Adjusting the optical head

Adjust the optical head roughly in the direction of the needle hooks and adjust the distance from the head's light outlet to the needle hooks to about 15 mm. Two indentations on the mount are used for coarse adjustment and allow to align the light beam to 45°.



The optical head projects a narrow bar of light (approx. 2 mm high and 1 mm wide) onto the needles. Now turn the optical head so that this narrow spot of light is exactly vertical. It should also hit the needle hook exactly (see diagram).



Adjust the distance from the head's light outlet to the needle hooks so that the spot of light is focused, or so that the spot of light appears to be smaller. To do this use a piece of paper as an adjustment aid or switch on the machine and observe the light spot on the moving needles.

### Starting up the Needle Sensor

```
Channel   : <1>
Needles   =2345
Signal    = 321
Minimum   = 32
Deviation = 12
-----
[F3: Main menu ]
```

Now switch to the Displays menu by pressing the key [1] and select the channel whose optical head you want to adjust using the [◀] and [▶] keys or the numerical keys.

Switch on the machine and observe the needle signal display (in the Signal line). Optimise the adjustment of the optical head by moving it carefully so that the needle signal is as high as possible.

First, adjust the distance between optical head and needle hook. To do so, push the optical head from the position with the focused spot of light a little (approx. 0.5 to 1 mm) towards the needles, until the needle signal is optimal. You must not turn the optical head while doing this.

Now swivel the optical head to find the optimum position of the spot of light on the needle hooks in a vertical direction.

Check if the correct number of needles is displayed. If the number is not correct, this can be caused by one of the following:

- There are defective needles in the needle cylinder.
- The optical head has not yet been optimally adjusted (the optimum needle signal has not been reached).
- The beam of light also detects other objects, besides the needles themselves, in front of or behind the needles.
- The maximum number of needles for this channel has not been set correctly.
- One or more needles in the needle cylinder are bent too far inwards or outwards. These needles might need to be replaced if they cannot be adjusted so as to be detected by the optical head.
- The sensitivity has been set too high (higher than the signal of the worst reflecting needle). Please read the information under “Minimum signal display” and “Setting the sensitivity”.
- If only half or fewer of the needles are displayed, stop the machine for a short time and restart it. The same applies if twice as many needles or more are displayed.

### Starting up the Needle Sensor

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**i**

Needle monitoring can also be temporarily deactivated for one or all switched-on channels when the machine is running (see “Setting the activation type”). The needle signal is displayed only in the period of active monitoring. After monitoring has been deactivated, the signal display remains at the last measured value. This means it is only possible to adjust the optical head with monitoring in the activated state.

**i**

For perfect monitoring, a signal height of 100 is required. When adjusting the optical head, the signal level should in any case be set as high as possible. The number of needles is generally only correct at this point, i.e. all needles are properly detected by the beam of light only at this point. In any case, optimum adjustment of the head decreases the number of unnecessary stoppages. When the head has been properly adjusted, the signal can sink to the value of 100 due to dirt before the head has to be cleaned.

**Notes**

Starting up the Needle Sensor

5.5.3 Setting the needle pattern

Before you can operate the needle sensor, you must carry out the following settings for each used (switched on) channel.

Leave the Displays menu by using the [F3] key and select the Needle Monitoring menu (key 2). Then select the channel whose settings you want to change using the [◀] and [▶] keys or the numerical keys.

```

----Settings----
for channel: <1>
[F1: Settings ]
[F3: Main Menu ]
    
```

```

--Settings C1:--
Pattern type :
<COMPLETE >

Tolerance [%]
: 50
Fault Counter
: 1
Trigger Level
: 40
-----
[F3: Back ]
[F6: Undo ]
    
```

Open the Channel Settings menu for this channel by using the [F1] key.

Use the [▲] and [▼] keys to navigate through the menu. The input position is marked by a flashing cursor. The menu “rolls” through the display window.

Set the pattern type and, where applicable, the number of used and missing needles correctly. You will find extensive information on these parameters under “Selecting the pattern type”.

If you have selected the pattern type **PATTERN COMPLETE**, the pattern now has to be taught. For the other pattern types the following lines can be skipped. Leave the Channel Settings menu (2x [F3] key) and select the Pattern menu with the key [3]. Follow the instructions under “Pattern menu” to execute the teaching program.

### Starting up the Needle Sensor



If you set the pattern type correctly for all switched on channels before executing the teaching program, the teaching program only has to be called up once. The patterns for all the channels will then be taught. But you can also start the teaching program individually for each channel. In this case, ignore the status displays of the other channels.

You can now change the permissible deviation of the needle distances (tolerance). The factory setting of 50% is also the maximum value for this deviation. Decrease the value in the Channel Settings menu in order to recognise smaller needle bends as errors.

You will find the deviation of the currently most bent needle in the Displays menu as a setting aid.

#### 5.5.4 Further channel settings

Needle monitoring should now be set up so that:

1. In the Displays menu the correct number of needles is displayed for all switched on channels;
2. In the Pattern menu "O.K." is displayed for all switched on channels.

However, monitoring is still in test mode. Switch off the test mode by pressing **[F4]** [F4/F1] while holding down the [SHIFT] key, thereby setting the device to normal operation.

If false stoppages occur, you can increase the error counter for the respective channel. You will find this parameter in the Channel Settings menu.

**Normal operation of the Needle Sensor**

**6. Normal operation of the Needle Sensor**

**6.1 Displays during normal operation**

For normal operation of the needle sensor it is not necessary to connect the hand-held terminal 8024. The display fields on the front of the control unit provide you with the operating status of the monitoring device.

For all switched on channels the corresponding display field lights up. After the machine has been started, these display fields flash during the start delay or briefly when the set operating speed is reached.

When the start delay is over or the set operating speed is reached, the device begins (depending on the selected activation type) to monitor the needles (see "Setting the activation type").

If a needle error occurs, and monitoring is not yet activated, the machine will not be stopped until monitoring is activated (generally after the start delay). How quickly the machine is then stopped depends on the type of needle pattern (see "Selecting the pattern type").

If the channel indicator changes from green to yellow, the needle signal has sunk too low due to dirt or because the head needs to be readjusted. In this case the optical head will have to be cleaned. The head may also have to be readjusted. Use the hand-held terminal for this and proceed as described under "Adjusting the optical head". Always switch the monitoring device to test mode before making any adjustments.

If the monitoring device has found an error, the machine is stopped. To identify which channel was responsible for the stoppage, the corresponding display field lights up red. At the same time, the needle position display shows the number of needles until the defective needle is detected by the optical head's light beam. Turn the machine by hand or in inching speed until the needle position display shows "0". Now the defective needle is positioned at the optical head.

You can also use the display to determine how far the defective needle is from the next needle gate. To do this, turn the machine not to "0", but to a display corresponding to the position of the needle door.

Normal operation of the Needle Sensor

6.2 Maintenance information



**Warning:** Before starting any cleaning or maintenance, switch the circular knitting machine off at the main switch and safeguard it against unauthorised activation.



**Warning:** With the exception of the procedures explicitly stated in the instructions, never try to repair the unit yourself.



**Warning:** Before opening or cleaning the control unit, always unplug it from the mains or the supply voltage.



**Warning:** For cleaning use a damp cloth; do not use liquid cleaners or cleaning sprays.

6.2.1 Cleaning the optical heads

The signal height decreases during operation due to dirt on the optical head. At first this can be compensated for by the needle sensor and needle monitoring continues to be effective. However, if the needle signal sinks below a certain value (display value 100), unnecessary stoppages must be expected. Therefore the optical head should be regularly cleaned.

The channel indicator serves as an optical indicator of when an optical head should be cleaned (see “Connections on the control unit”). It changes from green to yellow if the needle signal has sunk too low due to dirt or because the head needs to be readjusted.

In this case, first clean the optical head. Use oil-free compressed air (see (4) on page 56) and a dry cloth.

Remove oil droplets, yarn fluff and needle debris from the front (lens) of the heads.

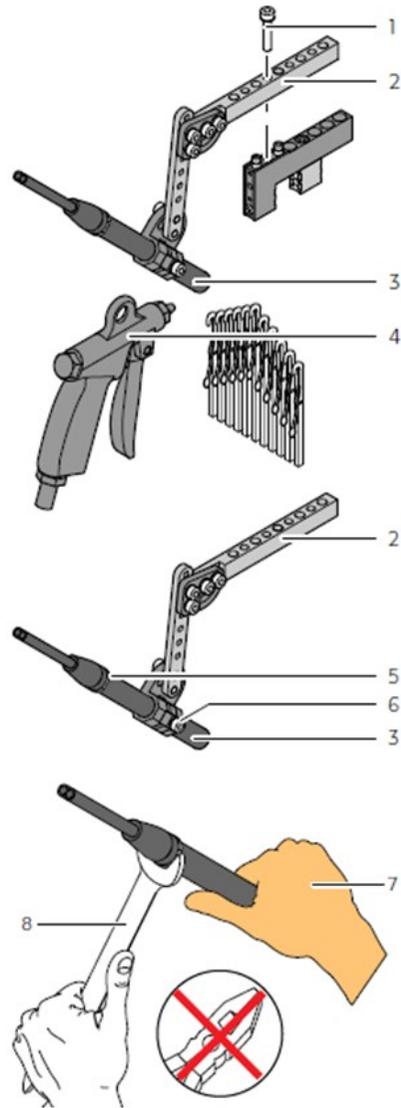
The machine oil must not be removed from the head entirely. A slight film of oil on the optical head reduces the signal height a little, but does not impair monitoring.

We recommend readjusting the head after each cleaning. Use the hand-held terminal 8024 for this and proceed as stated under “Adjusting the optical head”. Always switch the monitoring device to test mode before making any adjustments.

If false stops still occur, despite external cleaning of the optical head, check the optical head lens tube for damage (e.g. Lens scratches) and replace it if necessary (see 6.2.2 Replacing the lens tube).

Normal operation of the Needle Sensor

6.2.2 Replacing the lens tube



You will need the *Protechna 426-S optical head repair kit (part. no.: 14685)*,



an AF 12 open-ended spanner, an AF 12 1.2 Nm torque spanner, a rubberised glove and a soft microfibre cloth.

- > To demount the optical head (3), undo the screw (1) on the adjusting device (2) and remove the mount with the optical head.
- > Undo the screw (6) on the head mount and remove the optical head from the mount.
- > Use the AF 12 open-ended spanner (8) to secure the optical head to the flattened area (5) and unscrew the lens tube using the rubberised surface of the glove (7).
- > Replace the O-ring; it must not be twisted and must lie cleanly against the surface of the thread.
- > Clean the front of the optical head if necessary with a soft, lint-free microfibre cloth.
- > Take the new lens tube from the repair kit and remove the caps.
- > Place the lens tube over the cleaned optical head and screw it by hand on to the thread.
- > Secure the lens tube using the rubberised surface of the glove (7), and use a torque spanner to tighten the thread on the flattened area with a torque of 1.2 Nm.
- > Re-mount the optical head in the adjusting device and set up/adjust in accordance with chapter 5.4/5.5.



Normal operation of the Needle Sensor

6.2.2 Replacing the battery in the control unit

1. Remove the 4 marked screws to open the control unit.

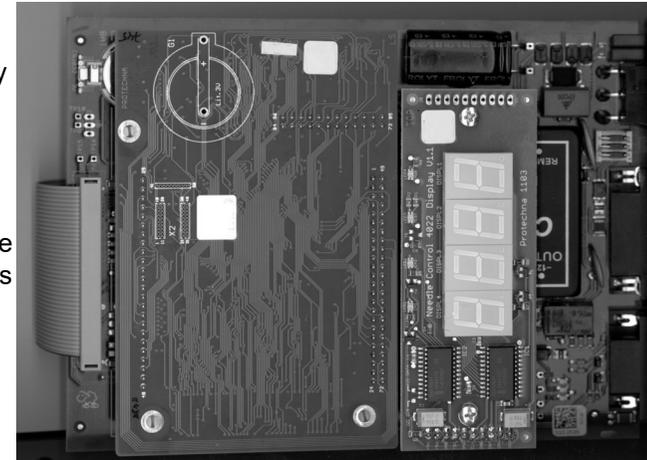


2. Pull the main board from the unit.

3. The battery is located in the upper left corner of the main board:

Battery

Connecting cable  
between the boards



4. When sliding the main board back in, ensure that the connecting cable between the two boards does not come loose.
5. After you have closed the unit, you can reconnect the machine cable and switch it on.

Notes

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Guidance for troubleshooting

7. Guidance for troubleshooting

7.1 Error messages

The following table contains the error codes and the descriptions of those errors detected by the needle sensor 4022 during a self test. This test mainly runs when the control unit is switched on, but some errors are also recognised during operation.

If an error is detected, the channel indicators flash red and the error code is displayed both on the hand-held terminal and on the needle position display.

Errors inside the Control Unit

Error code	Description
101 102	Software error. The software has re-started automatically. If these errors should appear frequently, new software must be loaded.
103	Overload recognised by the software. If possible, reduce the speed of the machine during monitoring.

Error code	Description
200	All of the needle sensor's configuration data has been deleted. Before starting up the needle sensor, all setting parameters have to be checked. If this error recurs several times, the control unit will have to be replaced.
201	The needle pattern has been deleted. The battery may have run down. The pattern will have to be taught again before you can start up the needle sensor.
202	The unit clock is showing the wrong time. The battery may have run down. Please reset the unit clock before you use the stop counter.
203	The battery voltage is low. Please replace the battery soon.
210	The unit clock is defective. The monitoring function is not impaired; however, the stop counters can no longer be evaluated in terms of time. The control unit should be replaced.
211 212 213 215	Internal control unit functions are defective. The control unit must be replaced.
214	Temporary failure of one or more indicators. The monitoring function is not impaired. If this error recurs several times, the control unit will have to be replaced.

Guidance for troubleshooting

**Errors outside the Control Unit**

The following errors are channel-related errors; the **x** in the left-hand column stands for the channel number. If one of these errors occurs the machine is stopped.

Error code	Description
30x	The optical head is not connected or is badly adjusted. Therefore, it is not possible to monitor this channel.
31x	The light signal of this channel is constantly being overridden. Please reduce the irradiation of the surrounding light into the sensor and adjust the head so that light is only reflected by the needle.
32x	The variations in machine speed exceed the permissible tolerance in monitoring mode. If you intend to change the speed in the production, while using needle monitoring at the same time, the needle sensor will have to be provided with a rotary transmitter signal, or a rotary transmitter will have to be installed.
35x	This channel is activated by an external signal (switching signal 1 or 2). However, the channel has not been activated since the machine was switched on because insufficient voltage is being applied to this switching signal. This error message appears about 30 minutes after the machine is switched on.
36x	This channel is activated by an external signal (switching signal 1 or 2). The duration of this switching signal and therefore the length of the monitoring cycle is, however, too short. Needle monitoring is therefore not effective.

**7.2 Troubleshooting**

The following table displays possible causes of errors that are not recognised by the needle sensor 4022 self test.

Error	Possible cause
One or more channel indicators are flashing red.	The needle position display contains the error code corresponding to the previous section. If the needle position display is dark, there is an error in the control unit.
One or more channel indicators are not lit up.	<ul style="list-style-type: none"> <li>• Channel not switched on</li> <li>• Error in the control unit</li> </ul>
One or more channel indicators are lit up yellow.  or  The displayed signal height (Displays menu) is too low.	The needle signal has sunk to below the minimum height of 100. Possible causes: <ul style="list-style-type: none"> <li>• Optical head misadjusted</li> <li>• Optic of the head is dirty</li> <li>• Light beam is obstructed</li> <li>• Optical head feeder cable is defective</li> <li>• Optical head feeder cable is not screwed tightly enough to the control unit</li> <li>• Optic of the head is defective (e.g. scratched)</li> <li>• Fault in the control unit</li> </ul>

Guidance for troubleshooting

Error	Possible cause
"----" is displayed in the menu instead of the signal height and number of needles.	The channel is switched on, but not activated. If this display remains permanently, check the activation type and, if necessary, the switching signals for this channel.
Optical head does not light up in <b>test mode</b> ; there is no narrow spot of light	<ul style="list-style-type: none"> <li>• Feeder cable to the optical head is not connected</li> <li>• Feeder cable to the optical head is wrongly connected</li> <li>• Feeder cable to the optical head is defective</li> <li>• Channel is not switched on</li> <li>• Fault in the control unit</li> </ul>
Optical head does not light up in <b>normal operation</b> ; there is no narrow spot of light	<p>If the machine is switched off, or the channel is currently not activated: <b>no error</b>. In this states the needle sensor switches the channels to dark.</p> <p>If the spot of light remains off even after the channel has been activated, there is an error like in test mode above.</p>
Unnecessary stoppages	<ul style="list-style-type: none"> <li>• Optical head needs to be adjusted</li> <li>• Optic of the head is dirty</li> <li>• Foreign body in the monitoring area</li> <li>• Sensitivity is set too high</li> <li>• Tolerance is set too low.</li> <li>• Feeder cable to the optical head is not screwed tightly enough to the control unit</li> <li>• Fault in the control unit</li> </ul>

Error	Possible cause
Number of needles displayed (Displays menu) is fluctuating despite sufficient signal height (test mode), unnecessary stoppages in normal operation	<ul style="list-style-type: none"> <li>• Optical head needs to be adjusted</li> <li>• Foreign body in the monitoring area</li> <li>• Sensitivity is set too high</li> <li>• Maximum number of needles for this channel is not correctly set</li> <li>• Fault in the control unit</li> </ul>
Machine is not stopped when there is a broken needle.	<ul style="list-style-type: none"> <li>• Device is in test mode</li> <li>• Sensitivity is set too low</li> <li>• Tripping contact is not properly connected</li> <li>• Channel is not switched on</li> </ul>
Machine is not stopped when there is a bent needle.	<ul style="list-style-type: none"> <li>• Device is in test mode</li> <li>• Tolerance is set too high</li> <li>• Tripping contact is not properly connected</li> <li>• Channel is not switched on</li> </ul>
No display on the hand-held terminal 8024	<ul style="list-style-type: none"> <li>• Hand-held terminal is not properly connected</li> <li>• Feeder cable to the hand-held terminal is defective</li> <li>• Hand-held terminal 8024 is defective</li> </ul>
On the hand-held terminal the initialisation screen is displayed instead of a menu	<ul style="list-style-type: none"> <li>• Hand-held terminal is not properly connected</li> <li>• Feeder cable to the hand-held terminal is defective</li> <li>• Hand-held terminal 8024 is defective</li> <li>• Fault in the control unit; you might have to load new software</li> </ul>

Technical data

8. Technical data

8.1 Control unit 4022

8.1.1 Ambient conditions, dimensions

Ambient conditions in operation	
Temperature	0°C - 50°C
Humidity	Max. 85% RH
Ambient conditions in storage	
Temperature	20°C - 70°C
Humidity	Max. 90% RH
Dimensions	
Width / height / depth	135 mm / 300 mm / 65 mm
Weight	1060 g
Safety class	IP 54

8.1.2 Electrical data

Power supply	
Supply voltage	12 V – 36 V DC or 9 V – 26 V AC
Average power consumption	5 VA
Stop contact	
U <sub>max</sub>	55 V AC or 60 V DC
I <sub>max</sub> [U ≤ 30 V]	1A
I <sub>max</sub> [U > 30 V]	0.5 A

Reset input	
U <sub>max</sub>	45 V AC or 50 V DC
U <sub>min</sub> [active]	7 V AC or 8 V DC
U <sub>max</sub> [inactive]	3.5 V AC or 4 V DC
Input resistance: R <sub>min</sub>	7 kOhm
Switching signals 1 and 2	
U <sub>max</sub>	50 V DC
U <sub>min</sub> [active]	8 V DC
U <sub>max</sub> [inactive]	4 V DC
Input resistance: R <sub>min</sub>	7 kOhm
Maximum delay from electrical signal to activation of monitoring	20 ms
Rotary transmitter	
Supply voltage	12 V ± 5%
Maximum load P <sub>max</sub>	1.5 VA
Impulse: U <sub>min</sub> [active]	8 V DC
Input resistance: R <sub>min</sub>	7 kOhm
Lamp output	
U [active]	12 V ± 5%
Maximum load I <sub>max</sub> P <sub>max</sub>	125 mA / 1.5 VA

Technical data

8.1.3 Connections

Machine plug (15-pin, SUB-D, m)	
Pin 1 and pin 2	Switching signal 1 (polarity not important)
Pin 3 and pin 4	Reset input (AC or DC)
Pin 5 and pin 6	Tripping contact (relay contact)
Pin 7 and pin 8	Supply voltage
Pin 9 and pin 10	Switching signal 2 (polarity not important)
Pin 11 and pin 12	Rotary transmitter – switching impulse (polarity not important)
Pin 13	12 V for rotary transmitter or lamp (positive pole)
Pin 14	12 V for rotary transmitter or lamp (negative pole)
Pin 15	Not used

Terminal interface (9-pin, SUB-D, f)	
Pin 1	Not used
Pin 2	Data line RxD
Pin 3	Data line TxD
Pin 4	Not used
Pin 5	Signal - ground
Pin 6	Not used
Pin 7	+ 12 DC supply for the hand-held terminal
Pin 8 and pin 9	Jumper switches on programming function <b>(only for software update!)</b>

8.2 Optical head 426-S

8.2.1 Ambient conditions, dimensions

Ambient conditions (operation and storage)	
Temperature	- 55°C to + 70 °C
Humidity	Max. 90% RH
Dimensions	
Body length	112 mm
Body diameter	11 mm
Length including connection cable	Approx. 2500 mm
<b>Weight</b>	130 g
<b>Safety class</b>	IP 54

8.2.2 Monitoring function

<b>Sensing range</b>	15 mm ± 1 mm
<b>Maximum Gauge (cylinder Gauge)</b>	E50 (50 needles per inch)
Needle sequence	
Minimum needle sequence	15 needles/sec.
Maximum needle sequence	5000 needles/sec.
Needle deviation measurement (tolerance)	
Precision	± 2%
Maximum measurement	50%



Notes

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